



The 16th Congress of International Society of Craniofacial Surgery (ISCFS), 2015



Official Program

Date

14th–18th
September, 2015

Venue

Hilton Tokyo Bay
Hotel, Maihama,
Japan

President

Kaneshige Satoh, M.D.

Professor of Department of Plastic,
Reconstructive and Aesthetic Surgery,
Chiba University

Website <http://iscfs2015.umin.jp/>





The 16th International Congress

INTERNATIONAL SOCIETY OF CRANIOFACIAL SURGERY
September 14th-18th, 2015
Tokyo Bay, Chiba, Japan

OFFICIAL PROGRAM GUIDE

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Welcome Message



Welcome to the ISCFS 2015 in Tokyo

It is with great pleasure that I welcome all of you to the 16th Biennial Congress of the International Society of Craniofacial Surgery (ISCFS) to be held at Tokyo Bay from September 14th to 18th, 2015. I felt highly privileged to host the first ever Congress in Japan.

Topics for the congress were expanded to include craniosynostosis, craniofacial rare cleft, craniofacial trauma and tumors, craniofacial research, cleft lip and palate surgery, craniofacial microsomia and microtia, craniofacial imaging, skull base reconstruction, craniofacial aesthetic surgery, orthognathic surgery, and several others. Although we were extremely pleased with the new record of outstanding 725 abstracts submitted for the general sessions, it is with much regret that we are not able to present them all. A rigid review and evaluation process was conducted by the scientific committee members and we finalized 359 oral presentations and 160 posters due to space limitations of the congress hall.

Craniofacial surgery was started in the 1960s by Dr. Paul Tessier, and has been popularized by his pioneering founding members, who have maintained their techniques for over two decades. The new technology of distraction osteogenesis developed by Dr. Joseph McCarthy in 1992 evoked the innovative potential of craniofacial surgeons. Since then, this technology has expanded to encompass the whole craniofacial bone, giving the younger generation a chance to figure, and now incorporate this as a standard technique in craniofacial and maxillofacial surgery. From this aspect, he has contributed much towards progress within the field. It is with great honor that The Tessier Medal Award dedicated to him will be presented at the Tokyo congress. We have planned several special lectures in relation to this. Tessier Medal Award Memorial lecture by Dr. McCarthy, followed by the Ortis Monasterio lecture, initiated at Jackson Hole during the previous congress. Dr. David David has established the Asian Pacific Craniofacial Association in 1998, and has contributed tremendously as a mentor in the craniofacial surgery field amongst the Asian countries, rightly deserving the Ortis Monasterio lecture. Surgery thrives on basic sciences. Dr. Michael Longaker a craniofacial surgeon, has become a world leader of basic science research over many years. We have high expectations on the advancement and application of laboratory data during his lecture. Dr. Kitaro Ohmori and Dr. Hiroshi Kamiishi, both Japanese founding members of craniofacial surgery, shall also be presenting their lectures. Last but not least, Dr. Takuya Onizuka, my mentor of Plastic and Reconstructive Surgery who has a surgical history of nearly 10,000 cases of primary cleft lip and palate cases. He has several pupils around the world. We are anticipating a brilliant presentation on Cleft surgery and his philosophy on the beauty of Cleft as the Mentor lecture.

We have prepared two topics, Craniosynostosis Treatment and Craniofacial Microsomia with or without Distraction, for the Pre-congress Symposium. The main theme for both is—"Continuing-Controversy and Consensus in the treatment of Craniofacial Surgery". —The craniofacial team includes neurosurgeons, orthodontists, and maxillofacial surgeons who play a very crucial and important part in patients' care; they will gather for the debate.

Currently, major hypertelorism surgery is becoming rarer as a result of rare births. On the contrary, craniosynostosis has taken over as a major sector of craniofacial surgery, less frequent however, within the Oriental versus western population. On the contrary, presentation of Cleft lip and palate patients amongst Asians is more avid. Management of Microtia and related craniofacial malformations shall also be highly featured during this congress. Skull base reconstruction and Craniofacial Aesthetic surgery are often performed in Orientals. Several interesting panel discussions have been organized. Much discussion is expanded on Genuine Craniofacial surgery, such as Hypertelorism and Craniofacial rare malformations, Trauma and Tumors. It is our Japanese colleagues' earnest wish to provide a memorable event and we will surely make every effort to achieve a successful ISCFs congress in September, 2015.

We invite you to come and join us. Tokyo is one of the world's largest cities. The congress site, Maihama Tokyo Bay, located between Tokyo and Chiba is where Chiba University is located. Autumn begins in September, mid-September has recently remained hot in Tokyo. You can perhaps still enjoy the end of summer. The venue is a sunny coastal area. From Tokyo station, it takes approximately 20 minutes by train. There are several sights in Japan—some of world heritage recognition close to Tokyo, so do take the time to plan a short trip, before or after the congress, some of which include Yokohama, Kamakura, Nikko, Mt. Fuji, and even Kyoto. We are prepared reasonably priced trips on one free-day during the congress. We are sure you will enjoy our beautiful country and are proud of the hospitality shown to foreigners by our people. You will certainly enjoy this Asian paradise, in particular the blend of traditional and modern Far East Asian Japanese culture, so different for most of you.

Welcome to Tokyo, Japan in September, 2015.

A handwritten signature in black ink, appearing to read 'Kaneshige Satoh'.

Kaneshige Satoh, MD, PhD

President of ISCFs

Professor of Department of Plastic, Reconstructive, and Aesthetic Surgery

Chiba University, Chiba, Japan

ISCFS Vice President's Message



Dear Colleagues

It is a pleasure to welcome you to the ISCFS 2015 in Tokio. As you will experience, this very rich cultural city has much to offer: centuries-old buildings, ancient temples full of mysticism and respect, vibrant markets full of odors, colors and food, traditionally culinary offering, streets plenty of people walking, the latest trends in electronic and the traditional tea. I hope you will take the time to explore and enjoy the city.

In Japan, our group will honor a significant milestone: almost 50 years of Craniofacial Surgery, since in 1967, in Rome, Paul Tessier established the subspeciality. Also during these days in Tokio, we will discuss our surgical techniques and results, where our approaches are different now and what they may be in the future.

I anticipate that this will be a superb meeting, both scientifically and socially. I should congratulate Dr. Kaneshige Satoh and his team for the splendid organization of the meeting and his generous hospitality to greet us all in Japan.

Mexico, City. July 14th, 2015.

A handwritten signature in black ink, appearing to read 'Fernando Molina'.

Fernando Molina, MD.

Professor of Plastic Surgery

Craniofacial Anomalies Foundation, Hospital Angeles del Pedregal and Postgraduate Division,
School of Medicine, Universidad la Salle.

Mexico City, Mexico.

ISCFS Officers 2013-2015

ISCFS 2015 Organizing Committee

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Yasushi Sugawara, MD-Japan

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Steven Wall, MD-United Kingdom

Andrew Wilkie, MD-United Kingdom

Vincent Yeow, MD-Singapore

ISCFS 2015 Local Organizing Committee (Japan)

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Yoshio Tanaka, MD-Japan
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Koichi Ueda, MD-Japan
Yuhei Yamamoto, MD-Japan
Shinya Yoshimoto, MD-Japan
Kohtaro Yoshimura, MD-Japan
Yohko Yoshimura, MD-Japan
Takatoshi Yotsuyanagi, MD-Japan

Japanese Members of ISCFS

1. Active Members

Tanetaka Akizuki
Akiyoshi Hirano
Keisuke Imai
Yuzo Komuro
Shigeo Kyutoku
Kitaro Ohmori
Kaneshige Satoh
Yorikatsu Watanabe

Seiichiro Kobayashi
Nobuyuki Mitsukawa
Masaaki Miyata
Takeshi Miyawaki
Akihiko Oyama
Yasushi Sugawara
Ikkei Tamada
Kohichi Ueda
Akira Yamada
Masanobu Yamashita

2. Associate Members

Takayuki Honda
Yoshimichi Imai
Kohichi Kadomatsu

3. Craniofacial Orthodontist

Yuki Satoh

ISCFS Founding Members

Ernest P. Caronni, MD-Italy
 David J. David, MD-Australia
 Milton T. Edgerton, MD-USA
 Ian T. Jackson, MD-USA
 Bengt Johanson, MD-Sweden
 Henry K. Kawamoto, MD-USA
 Daniel Marchac, MD-France
 Joseph G. McCarthy, MD-USA
 Ian R. Munro, MD-USA

Joseph E. Murray, MD-USA
 Fernando Ortiz-Monasterio, MD-Mexico
 Jorge Psillakis, MD-Mexico
 Kenneth E. Salyer, MD-USA
 Michael Striker, MD-France
 Paul L. Tessier, MD-France
 Jacques van der Meulen, MD-The Netherlands
 Linton A. Whitaker, MD-USA
 S. Anthony Wolfe, MD-USA

Past Presidents and Congress Meeting Sites

- 1985 Paul Tessier, La Napoule, France
- 1987 Paul Tessier, New Delhi, India
- 1989 Ian R. Munro, Florence, Italy
- 1991 Joseph G. McCarthy, Santiago de Compostela, Spain
- 1993 Fernando Ortiz-Monasterio, Oaxaca, Mexico
- 1995 Daniel Marchac, St. Tropez, France
- 1997 Linton A. Whitaker, Santa Fe, New Mexico, USA
- 1999 Yu-Ray Chen, Teipei, Taiwan
- 2001 Claes Lauritzen, Visby Gotland, Sweden
- 2003 Kenneth E. Salyer, Monterey, California, USA
- 2005 David J. David, Queensland, Australia
- 2007 S. Anthony Wolfe, Bahia, Brazil
- 2009 Steven Wall, Oxford, UK
- 2011 Anil Madaree, Livingstone, Zambia
- 2013 Scott Bartlett, Jackson Hole, USA
- 2015 Kaneshige Satoh, Maihama Tokyo Bay, Japan

Tessier Medal Recipients

- 2005 Fernando Ortis-Monasterio (Mexico)
- 2009 Linton Whitaker (USA)
- 2013 Daniel Marchac (France)
- 2015 Joseph McCarthy (USA)

GENERAL INFORMATION

General Information/ISCFS2015

Registration

The congress registration desk hours are:

Monday, 14 September 2015	7:00 am-5:00 pm
Tuesday, 15 September 2015	7:00 am-5:00 pm
Wednesday, 16 September 2015	7:00 am-12:00 pm
Thursday, 17 September 2015	7:00 am-5:00 pm
Friday, 18 September 2015	7:00 am-12:00 pm

Registration Entitlements

- Entry all the scientific sessions and exhibit hall
- Daily Lunch <except Wednesday 16 Sept/Friday 18 Sept>
- Morning and Afternoon Refreshments
- Congress Bag
- Copy of Program/Abstract Book
- Welcome Reception <included in Category A and Pre-Symposium Registration>

Exhibit Hall Hours

All registrants are invited to visit the exhibits located in the room "S".

The exhibits will be open:

Tuesday, 15 September 2015	8:00 am-5:00 pm
Thursday, 17 September 2015	8:00 am-6:00 pm
Friday, 18 September 2015	8:00 am-12:00 pm

Banks

Automatic Teller Machines are open 24 hours and are located at the airport and in town.

Facilities for exchange of currency are also available at the airport.

We recommend changing funds at a major airport while you are in transit or before leaving Home.

Electricity

Electricity in Japan is uniformly 100 volts, AC, throughout Japan.

Leading hotels in major city have two outlets of 100 and 220 volts, but their sockets usually accept a two-leg plug only.

Travel and Program Disclaimers

In the event of any travel disruptions, Congress Organizer will not be held responsible for any losses incurred by registrants en route to or from the Congress. The program is correct at the time of printing.

Congress Organizers reserve the right to alter the program as necessary.

Liability

Congress Organizers are not liable for personal accidents, losses or damage to the private property of registered attendees or any accompanying persons during the Congress. Please make your own arrangements with respect to personal insurance.

Congress Attire

Congress Sessions: Casual

Welcome Reception: Casual

Gala Dinner: Formal

Mobile Phones and Pagers

As the courtesy to speakers or other registrants, we request that all mobile phones and pagers are switched off or muted before entering sessions.

No Smoking Policy

Registrants and guests should be aware that smoking is not permitted in public buildings and hotels and restaurants including the Congress venue. Smoking is prohibited in the meeting and exhibit rooms at all times.

Program Content Disclaimer

The content of this program is presented solely for educational purposes for use by medical practitioners.

This material is intended to express the opinions, techniques or approaches of the presenters.

Sponsorship of this program and/or advertising any company or organization are not to be construed, in any fashion as an endorsement of the materials or products.

Topic and Abstract Disclaimer

All presentation titles and abstracts are printed as submitted by the speakers. ISCFS cannot be responsible for errors in spelling or content.

Recording Policy

Recording <photographic, video and audio> of the sessions, entertainers and exhibit hall during the ISCFS Congress is **strictly prohibited**.

Wi-Fi

Wi-Fi is available in the lounge of the venue <Hilton Tokyo Bay>, please ask at the Hotel reception for the detail.

PROGRAM AT-A-GLANCE

Program at a glance

	Mon. Sept. 14	Tue. Sept. 15	Wed. Sept. 16		Thu. Sept. 17	
	Room A (2F Soara I/II)	Room A (2F Soara I/II)	Room A (2F Soara I/II)	Room B (2F Soara III)	Room A (2F Soara I/II)	Room C (B1F Ambio I)
8:00	8:00-10:00 112p Pre-Congress Symposium Controversy and Consensus in Craniosynostosis Treatment I; Defining the criteria of failure and success: How to evaluate our results? SY-1-9	8:00-10:30 106p Special Lectures SP-1-6	8:00-8:30 170p Concurrent Session 1 Craniosynostosis 6 48-51	8:00-9:10 182p Concurrent Session 4 Hypertelorism Rare Cleft Trauma Tumor 1 72-83	8:00-9:00 194p Concurrent Session 6 Craniosynostosis 9 97-105	8:00-9:00 215p Concurrent Session 12 Craniofacial Microsomia 1 140-148
9:00	10:00-10:23 Coffee Break	10:30-10:50 Coffee Break	8:30-9:30 172p Concurrent Session 2 Craniosynostosis 7 52-61	9:10-10:30 188p Concurrent Session 5 Hypertelorism Rare Cleft Trauma Tumor 2 84-96	9:00-10:00 199p Concurrent Session 7 Craniosynostosis 10 106-115	9:00-10:00 219p Concurrent Session 13 Craniofacial Microsomia 2 149-158
10:00	10:23-12:00 117p Pre-Congress Symposium Controversy and Consensus in Craniosynostosis Treatment II; Defining the criteria of failure and success: How to evaluate our results? SY-10-17	10:50-12:00 146p General Session 1 Craniosynostosis 1 1-11	10:30-12:30 Business Meeting of ISCSF members		10:00-10:30 204p Concurrent Session 8 Craniosynostosis 11 116-120	10:00-10:30 224p Concurrent Session 14 Craniofacial Microsomia 3 159-163
11:00	12:00-13:00 Lunch	12:00-13:00 Lunch			10:30-11:00 Coffee Break	10:30-11:00 Coffee Break
12:00					11:00-12:00 129p Panel Discussion 1 Distraction for Micrognathia PD1-1-5	11:00-12:00 136p Panel Discussion 4 Microtia Reconstruction PD4-1-4
13:00	13:00-14:40 122p Pre-Congress Symposium Controversy and Consensus in Craniofacial Distraction in the treatment of Craniofacial Microsomia and Associated Deformity I; Defining the criteria of failure and success: How to evaluate our results? SY-18-25	13:00-14:00 151p General Session 2 Craniosynostosis 2 12-21			12:00-13:00 Lunch	12:00-13:00 Lunch
14:00	14:40-15:10 Coffee Break	14:00-15:00 156p General Session 3 Craniosynostosis 3 22-31			13:00-14:00 131p Panel Discussion 2 Craniofacial Orthodontics PD2-1-5	13:00-14:00 227p Concurrent Session 15 CFM 164-173
15:00	15:10-16:46 125p Pre-Congress Symposium Controversy and Consensus in Craniofacial Distraction in the treatment of Craniofacial Microsomia and Associated Deformity II; Defining the criteria of failure and success: How to evaluate our results? SY-26-32	15:00-15:30 Coffee Break			14:00-15:00 134p Panel Discussion 3 Skull Base Reconstruction PD3-1-5	14:00-15:00 138p Panel Discussion 5 Virtual Orthognathic Surgery PD5-1-4
16:00		15:30-16:30 161p General Session 4 Craniosynostosis 4 32-40			15:00-15:30 Coffee Break	15:00-15:30 Coffee Break
17:00		16:30-17:20 166p General Session 5 Craniosynostosis 5 41-47			15:30-16:00 206p Concurrent Session 9 Craniosynostosis 12 121-125	15:30-16:00 232p Concurrent Session 16 Craniofacial Microsomia 4 174-178
18:00		17:30-18:30 Sponsored Seminar Cosponsored by KLS Martin Group			16:00-17:00 208p Concurrent Session 10 Craniosynostosis 13 126-135	16:00-17:10 234p Concurrent Session 17 Craniofacial Microsomia 5 179-191
19:00	18:00-20:00 Welcome Reception [Soara III or Garden Pool]				17:00-17:30 213p Hypertelorism Rare Cleft Trauma Tumor 3 136-139	17:10-17:55 241p Concurrent Session 18 CLCP 1 192-198
20:00	20:00-22:00 Council Meeting [Ami]	19:00-21:30 Officers Dinner [SALA]			Concurrent Session 11	
					19:00-21:00 Gala Dinner [Soara II + III]	

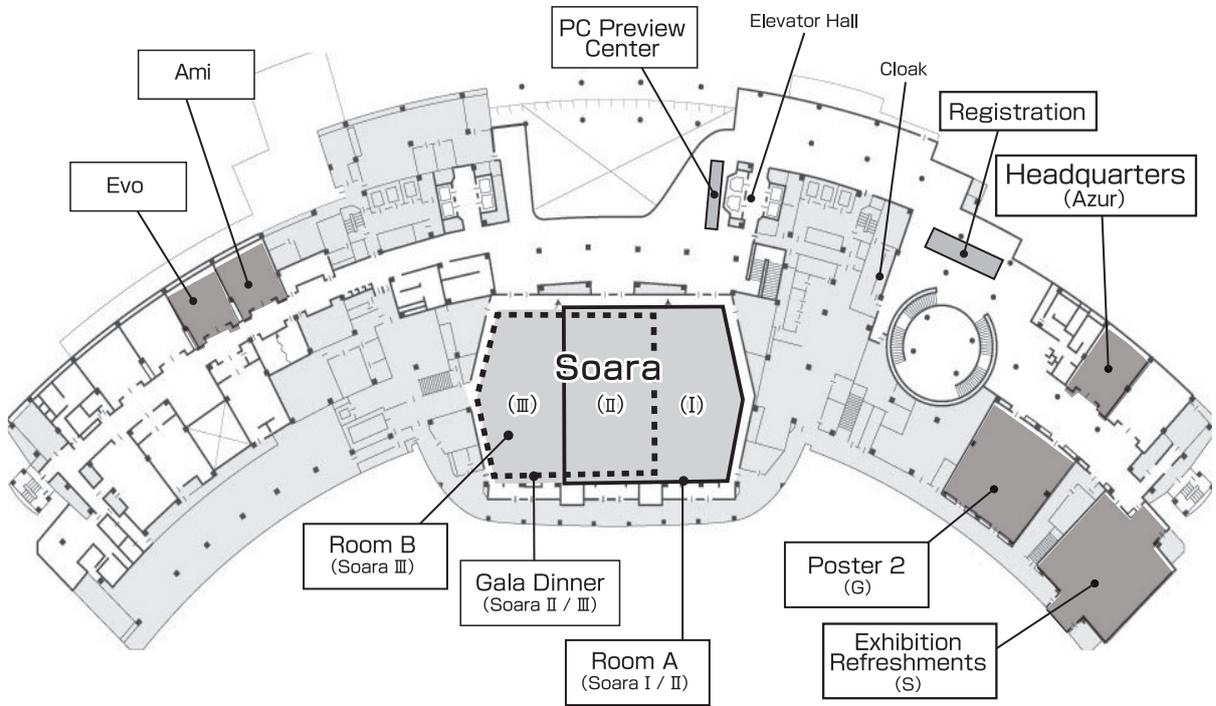
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Concurrent Sessions are included in General Session

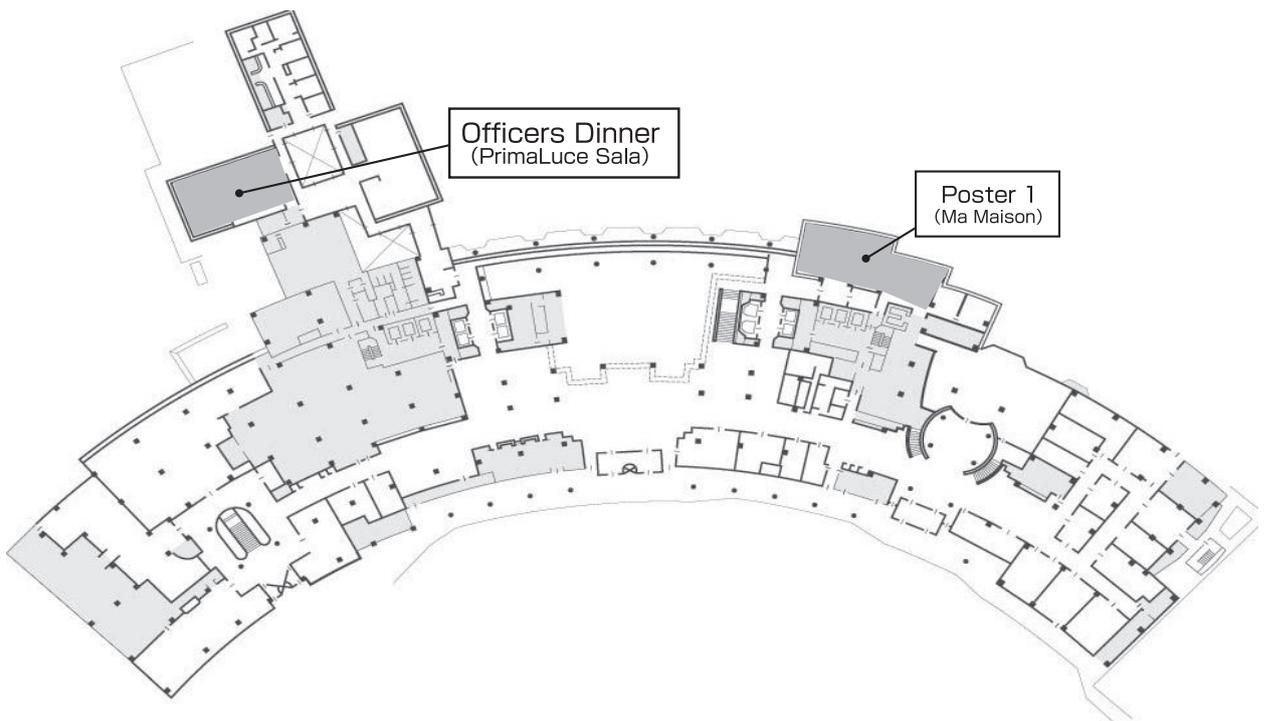
Thu. Sept. 17			Fri. Sept. 18			
Room D (B1F Ambio II)	Poster 1 (1F Ma Maison)	Poster 2 (2F G)	Room A (2F Soara I/II)	Room C (B1F Ambio I)	Room D (B1F Ambio II)	
8:00-9:00 244p Concurrent Session 19 Craniofacial Research 1 199-208			8:00-9:00 271p Concurrent Session 26 Craniosynostosis 14 253-261	8:00-9:15 288p Concurrent Session 31 Cleft Lip and Palate 1 287-297	8:00-9:05 307p Concurrent Session 35 Head Skull Base, Aesthetic 2 326-335	8:00
9:00-10:00 249p Concurrent Session 20 Craniofacial Research 2 209-218			9:00-10:00 275p Concurrent Session 27 Craniosynostosis 15 262-269	9:15-10:30 294p Concurrent Session 32 Cleft Lip and Palate 2 298-309	9:05-9:40 312p Concurrent Session 36 Head Skull Base, Aesthetic 3 337-340	9:00
10:00-10:30 254p Concurrent Session 21 Craniofacial Research 3 219-222			10:00-10:30 279p Concurrent Session 28 Craniosynostosis 16 270-273		9:40-10:30 314p Concurrent Session 37 Craniofacial Imaging 1 341-348	10:00
10:30-11:00 Coffee Break			10:30-11:00 Coffee Break	10:30-11:00 Coffee Break	10:30-11:00 Coffee Break	
11:00-12:00 140p Panel Discussion 6 Cleft Lip and Palate Surgery PD6-1-5			11:00-11:30 281p Concurrent Session 29 Craniosynostosis 17 274-276	11:00-11:45 299p Concurrent Session 33 Others 1 310-317	11:00-12:10 318p Concurrent Session 38 Craniofacial Imaging 2 349-358	11:00
12:00-13:00 Lunch	12:00-13:30 Put up Posters	12:00-13:30 Put up Posters	11:30-12:45 283p Concurrent Session 30 Head Skull Base, Aesthetic 1 277-286	11:45-12:30 303p Concurrent Session 34 Others 2 318-325		12:00
13:00-13:30 256p Concurrent Session 22 Craniofacial Research 4 223-227						13:00
13:30-14:00 258p Concurrent Session 23 CLCP 2 228-231	13:30-15:00	13:30-15:00				14:00
14:00-15:00 143p Panel Discussion 7 Aesthetic Facial Bone Contouring PD7-1-5	Poster Exhibition	Poster Exhibition				14:00
15:00-15:30 Coffee Break						15:00
15:30-16:30 260p Concurrent Session 24 Orthognathic Surgery 232-241	15:30-16:30 324p Poster Session 1 p-1-75	15:30-16:30 361p Poster Session 2 p-76-160				16:00
16:30-17:30 265p Concurrent Session 25 Orthognathic Surgery 242-252	16:30-18:00 Take down Posters	16:30-18:00 Take down Posters				17:00
						18:00
						19:00
						20:00

Floor Map

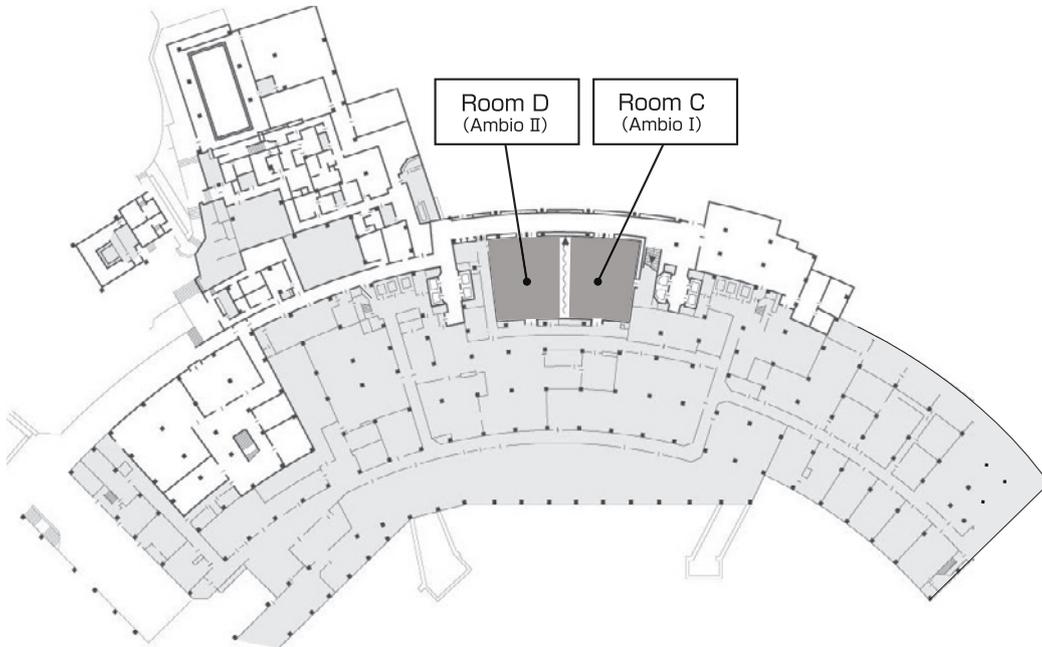
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CONGRESS PROGRAM

Program Schedule (Oral)

The scientific program is correct at the time of printing; however, the Program Committee reserves the right to alter the schedule as necessary.

Monday, 14 September

Pre-Congress Symposium

Room A (2F Soara I/II)

Controversy and Consensus in Craniosynostosis Treatment I; Defining the criteria of failure and success: How to evaluate our results? 1. Evaluate results in Single Suture Craniosynostosis ?

Chairs: *Scott P. Bartlett (USA) & James Goodrich (USA)*

8:00 - 8:16

Introduction from Chairs:

Presenter: Scott P. Bartlett (USA), James Goodrich (USA)

Controversy and consensus in the craniosynostosis treatment is continuous theme, and chairs are expected to present their perspectives from the standpoint of plastic surgery and neurosurgery respectively.

8:16 - 8:32

1-1. How is the developmental and mental prognosis?—focusing on Scaphocephaly and Trigenocephaly

Speakers will discuss on the updated data of developmental delay and mental delay related with scaphocephaly and trigonocephaly focused on. Even if early surgery for these craniosynostosis is conducted, are developmental delay and/or mental delay noticed or not? For what does it happen?

SY-1

MENTAL OUTCOME IN CRANIOSYNOSTOSIS SURGERY: Functional or esthetics?

Presenter: Eric Arnaud (France)

SY-2

Neurodevelopmental Outcomes in Single Suture Craniosynostosis: Emphasis on Sagittal and Metopic Synostosis

Presenter: Kathleen Kapp-Simon (USA)

8:32 - 8:40

Discussion

8:40 - 9:04

1-2. Scaphocephaly surgery: Proper age and proper procedure—Pi procedure, H procedure, Spring-mediated cranioplasty, Cranioplasty using by distraction, or one-staged total calvarial reshaping

This session will be debated on several operative procedures. Different procedures and different timing for the surgery are described. Controversial discussion is expected as for respective surgeons. If possible, some consensus will be welcomed concerning on the proper age and proper procedure.

SY-3

Long-term neuropsychological outcomes in sagittal craniosynostosis

Presenter: John Persing (USA)

SY-4

Proper timing and extent of surgery for sagittal synostosis: are springs the solution?

Presenter: Marie-Lise C. Van Veelen (Netherlands)

SY-5

TOTAL CRANIAL VAULT RECONSTRUCTION FOR SCAPHOCEPHALY: THE MELBOURNE TECHNIQUE

Presenter: Anthony D. Holmes (Australia)

9:04 - 9:12

Discussion

9:12 - 9:28

1-3. Endoscopic surgery and helmet therapy, Evaluate long term results based on optimal age and proper indication

We have alternative procedure of endoscopic removal of premature fused suture and helmet therapy for craniosynostosis patients. Long-term results will be expected. Can this procedure achieve much better results than other operative procedures. Much debate will be expected.

SY-6**Minimally-invasive treatment of craniosynostosis: evidence**

Presenter: Gary Rogers (USA)

SY-7**Endoscopic-Assisted Craniosynostosis Surgery—A decade of experience at a single institution**

Presenter: Mark R. Proctor (USA)

9:28 - 9:36

Discussion

9:36 - 9:52

1-4. Reducing the risks of blood transfusion in craniosynostosis surgery

In craniosynostosis surgery, blood transfusion is often necessary. To reduce the risks of transfusion is very important issue in this surgery. Speakers are expected to present their tactic and technique to reduce blood transfusion.

SY-8**Blood Conservation during Craniosynostosis Corrections**

Presenter: Jeffrey A. Fearon (USA)

SY-9**Classic Open Craniofacial Surgery Without Transfusion: A Novel Multi-Modal Approach.**

Presenter: Robert J. Wood (USA)

9:52 - 10:00

Discussion

10:00 - 10:23

Coffee Break

Pre-Congress Symposium

Room A (2F Soara I/II)

**Controversy and Consensus in Craniosynostosis Treatment II;
Defining the criteria of failure and success: How to evaluate our results?
2. How to evaluate results in Syndromic Craniosynostosis**

Chairs: *Henry Kawamoto (USA) & S. Anthony Wolfe (USA)*

10:23 - 10:28

Introduction from Chairs:

Presenter: Henry Kawamoto (USA), S. Anthony Wolfe (USA)

Two very experienced craniofacial surgeons are expected to make the discussion much interesting as commentators.

10:28 - 10:44

2-1. Proper timing for shunting and cranial expansion in early age. In which age is shunting definitely required and how is decided?

In ICH in syndromic craniosynostosis, shunting and/or posterior expansion to decrease ICH is required in early and very young child. Definite criteria would be reached by craniofacial neurosurgeons.

SY-10

Treatment of hydrocephalus—what

Presenter: Jayaratnam JayaMohan (UK)

SY-11

Proper timing for shunting and cranial expansion in infants

Presenter: Irene M. J. Mathijssen (Netherlands)

10:44 - 10:52

Discussion

10:52 - 11:16

2-2. Evaluate our results-middle and long term: Mono bloc distraction versus FOA followed by Le Fort III distraction

Since paradigm shift was noticed by early posterior expansion, monobloc distraction has been the champion widely. However, FOA followed by Le Fort III distraction is much safer procedure and hard to neglect, Are there any space for FOA followed by Le Fort III distraction in syndromic craniosynostosis?

SY-12

Frontofacial monobloc advancement with internal quadruple distraction in 105 children

Presenter: Eric Arnaud (France)

SY-13

Monobloc distraction vs Le Fort III with Subsequent Le Fort III

Presenter: James P. Bradley (USA)

SY-14

Separation of FOA and following Le Fort III Midface Distraction to avoid retrograde infection

Presenter: Kaneshige Satoh (Japan)

11:16 - 11:24

Discussion

11:24 - 11:40

2-3. Surgical protocol in Pfeiffer type II, III to obtain better result of growth and development—Surgical timing, how is first and where is assessed the final goal of surgery for this kind of severe Syndromic Craniosynostosis

In severe syndromic craniosynostosis, even if rigid surgical protocol is maintained in early and very young child, mental and developmental delay and the prognosis of future QOL is hardly promising. Speakers would be very expected to discuss the surgical timing of protocol, the assessment of the result, and final goal of the surgical treatment.

SY-15

The evolving surgical treatment algorithm for Pfeiffer Syndrome

Presenter: Richard A. Hopper (USA)

SY-16

Treatment Pathways for the Management of Severe Craniofacial Dysostosis Syndromes

Presenter: Steven Wall (UK)

11:40 - 11:48

Discussion

11:48 - 11:56 **2-4. Facial Bipartition Distraction: What is the proper indication for FBD? Proper age for better result**

Facial bipartition distraction is particular surgery for specified syndromic craniosynostosis. The speaker is expected to present the proper indication and proper age to get better result.

SY-17

Bipartition Distraction for the treatment of Apert Syndrome

Presenter: David Dunaway (UK)

11:56 - 12:00 Discussion

12:00 - 13:00 Lunch

Pre-Congress Symposium

Room A (2F Soara I/II)

Controversy and Consensus in Craniofacial Distraction in the treatment of Craniofacial Microsomia and Associated Deformity I;

Defining the criteria of failure and success: How to evaluate our results?

1. Improved Clasification of hemifacial microsomia for Pruzansky and Kaban System

2. Distraction in CFM children

Chairs: *Joseph McCarthy (USA) & John Polley (USA)*

13:00 - 13:08 **1-1. Improved Clasification of hemifacial microsomia for Pruzansky and Kaban System**

Pruzansky and Kaban-Murray have established grading and typing system more than two or three decades ago. Current imaging technology has much advanced, and new clasification based on the treatment protocol is necessitated. The speaker is expected to present refined current clasification for craniofacial misrosomia.

SY-18

Classification of the Mandibular Deformity in Craniofacial Microsomia using 3-dimensional CT

Presenter: Scott P. Bartlett (USA)

13:08 - 13:11 Discussion

13:11 - 13:41 **2-1. Distraction is routinely done, when is the best timing, and how is done? and Long-term Results**

Dr. McCarthy reported the clinical application of the distraction osteogenesis for the hypoplastic mandible in craniofacial microsomia in 1992. Since then, the technique has been popularized world wide including Japan. However, current reports do not support the application of distraction osteogenesis for craniofacial microsoia children. Here the pioneer surgeon and his followers are expected to present their treatment protocol and long term results using distraction osteogenesis for craniofacial microsomia.

SY-19

Mandibular Distraction in Craniofacial Microsomia: Indications, Timing, Methodology and Long-Term Follow-up

Presenter: Joseph G. McCarthy (USA)

SY-20

Presenter: Fernando Molina (Mexico)

SY-21

Presenter: Dae Hyun Lew (Korea)

13:41 - 13:51 Discussion

13:51 - 14:07

2-2. Preoperative, during, and postoperative orthodontic treatment, how are you doing?

In order to obtain excellent results using distraction osteogenesis, collaborating orthodontist takes a very important role. The co-workers with the speakers above are expected to present their protocol and long term results for the orthodontic management.

SY-22

Long-term Stability and Growth Following Unilateral Mandibular Distraction in Growing Children with Craniofacial Microsomia

Presenter: Pradip R. Shetye (USA)

SY-23

Orthopedic and Orthodontic Management for Patients Undergoing a Distraction Osteogenesis Surgical Procedure

Presenter: Pedro E. Santiago (USA)

14:07 - 14:15

Discussion

14:15 - 14:33

2-3. Distraction done, not routinely and Long-term results by internal devices

In managing the craniofacial microsomia patients, distraction technique is not always advantageous depending on the type of the deformity and the age of patients. The speaker has reported and utilized his original internal device for over two decades. The surgeon uses distraction osteogenesis, but not routinely. He and his co-working orthodontist are expected to report the long term results of French series.

SY-24

CRANIOFACIAL MICROSOMIA IN CHILDREN DISTRACTION DONE NOT ROUTINELY—LONG TERM RESULT BY INTERNAL DEVICES

Presenter: Patrick A. Diner (France)

SY-25

CRANIOFACIAL MICROSOMIA IN CHILDREN DISTRACTION DONE NOT ROUTINELY—LONG TERM RESULT BY INTERNAL DEVICES

Presenter: Catherine Tomat (France)

14:33 - 14:40

Discussion

14:40 - 15:10

Coffee Break

Pre-Congress Symposium

Room A (2F Soara I/II)

**Controversy and Consensus in Craniofacial Distraction in the treatment of Craniofacial Microsomia and Associated Deformity II;
Defining the criteria of failure and success: How to evaluate our results?****3. Opponent of Distraction in CFM children****4. Treatment Protocol for Type III CFM****5. Microtia surgery in CFM children****6. Orthognathic surgery for CFM in adults**Chairs: *Yu-Ray Chen (Taiwan) & Kaneshige Satoh (Japan)*

15:10 - 15:30

3-1. Opponent reason : surgeon and orthodontist respectively

Some surgeons have reported unsatisfactory results using distraction osteogenesis for craniofacial microsomia children. Some of them disagree the application, in particular for children. The surgeon and his co-working orthodontist are expected to report their clinical series and opponent reason for the distraction technique.

SY-26**Mandibular Distraction Osteogenesis: What is Appropriate Timing in Hemifacial Microsomia?**

Presenter: John W. Polley (USA)

SY-27**Hemifacial Microsomia: Treatment in Adolescence vs. Infancy and Childhood: Orthodontic Perspective**

Presenter: Alvaro A. Figueroa (USA)

15:30 - 15:40

Discussion

15:40 - 15:48

4-1. Treatment Protocol for Type III CFM

The treatment of severe craniofacial microsomia Kaban-Murray Type III is very particular. Distraction alone can't obtain satisfactory results because of absolute deficiency of hard tissue. The speaker has treated severe deformity using microvascular bone transfer to craniofacial microsomia children for long. He is expected to report his treatment protocol and results for Type III children.

SY-28

Presenter: Eric Santamaria (Mexico)

15:48 - 15:52

Discussion

5. Microtia surgery in CFM children

Microtia reconstruction is one of the specific surgeries, and often associated with the craniofacial microsomia patients. The current surgical technique for microtia has been reported and dispersed by Dr. Nagata. The speakers are expected to present the surgical timing and installment of the auricle to the proper position for craniofacial microsomia children.

15:52 - 16:02

5-1. How do you define the timing and procedure?

Microtia reconstruction is one of the specific surgeries, and often associated with the craniofacial microsomia patients. The current surgical technique for microtia has been reported and dispersed by Dr. Nagata. The speakers are expected to present the surgical timing and installment of the auricle to the proper position for hemifacial microsomia children.

SY-29**Our policy for auriculoplasty to treat patients with microtia who have hemifacial microsomia**

Presenter: Takatoshi Yotsuyanagi (Japan)

16:02 - 16:12 **5-2. Where and How do you put the new auricle?**

SY-30

Systematic approach to the two-stage auricular reconstruction

Presenter: Satoru Nagata (Japan)

16:12 - 16:22 Discussion

16:22 - 16:38 **6-1. Orthognathic surgery for CFM in adults**

The maxillo-mandibular deformity is still the definite problem for craniofacial microsomia. The final orthognathic surgery is mandatory. The speakers who are talented with maxillofacial surgery are expected to report thier excellent technique by CAD/CAM and results of orthognathic surgery.

SY-31

CRANIOFACIAL MICROSOMIA AFTER PUBERTY DISTRACTION OSTEOGENESIS STILL AN OPTION?

Presenter: Patrick A. Diner (France)

SY-32

Orthognathic Surgery for Hemifacial Microsomia in Adults

Presenter: Lim K. Cheung (Hong Kong)

16:38 - 16:46 Discussion

Tuesday, 15 September

8:00 - 10:30

Special Lectures

Room A (2F Soara I/II)

Chair: *Kaneshige Satoh (Japan)*

Opening Remarks

Presenter: Kaneshige Satoh

Affiliation: Department of Plastic and Reconstructive Surgery, Chiba University, Japan

Japanese Founder's Speech

SP-1

CFS, My Experiences

Presenter: Kitaro Ohmori

Affiliation: Ohmori Clinic, Japan

Author: Ohmori K

SP-2

An information of study on craniofacial surgery with the experience for the past half century

Presenter: Hiroshi Kamiishi

Author: Kamiishi H

Memorial Lecture

Tessier Medal Award

SP-3

THE SPIRIT OF CRANIOFACIAL SURGERY

Presenter: Joseph McCarthy

Affiliation: Plastic Surgery, NYU School of Medicine, USA

Author: McCarthy JG

Ortis Monasterio Lecture

SP-4

Progress over 40 years in craniofacial surgery as seen in the management of Apert Syndrome

Presenter: David J. David

Affiliation: The Australian Craniofacial Unit, Australia

Author: David DJ

Guest Lecture

SP-5

Skin and Bone: Scar Wars and Stem Cells

Presenter: Michael T. Longaker

Affiliation: Children's Surgical Research, Hagey Laboratory for Pediatric Regenerative Medicine, USA

Author: Longaker MT

Tokyo Memorial Lecture

SP-6

The way to Onizuka's cleft lip method

Presenter: Takuya Onizuka

Affiliation: Department of Plastic and Reconstructive Surgery, School of Medicine, Showa University, Japan

Author: Onizuka T

10:30 - 10:50

Coffee Break

10:50 - 12:00	General Session 1 Craniosynostosis 1 Chairs: <i>Irene Mathijssen (Netherlands) & Jayantram JayaMohan (UK)</i>	Room A (2F Soara I/II)
10:50 - 10:55 (5min.)	1 Efficacy of early language assessment in single suture synostosis & impact on MDT care pathways Presenter: R Susanna Carter Affiliation: Birmingham Children's Hospital Craniofacial Unit, UK Authors: Carter RS, Evans M, Dover S, Nishikawa H, Rodrigues D, Sharp M, White N, Scobie E	
10:55 - 11:00 (5min.)	2 Psychosocial factors and coping strategies of parents following a diagnosis of craniosynostosis. Presenter: Katia Poliheszko Affiliation: Hôpital Necker-Enfants Malades, France Authors: Poliheszko K, Di Rocco F, Colinet S, Arnaud E, Pamphile L	
11:00 - 11:03 (3min.)	3 Sequencing the Whole Genome; a revolution for craniofacial genetics? Presenter: Jacqueline AC Goos Affiliation: Department of Plastic and Reconstructive Surgery and Hand Surgery, Erasmus MC, University Medical Center, the Netherlands Authors: Goos JAC, Swagemakers SMA, Hoogeboom AJM, van den Ouweland AMW, van Dooren MF, van der Spek PJ, Mathijssen IMJ	
11:03 - 11:06 (3min.)	4 Population-based Prevalence for craniosynostosis in Finland 1993-2010 Presenter: Pia M. B. Vuola Affiliation: Craniofacial Centre, Department of Plastic Surgery, Helsinki University Hospital, Finland/Finnish Register of Congenital Malformations, The Institute for Health and Welfare, Finland Authors: Vuola PMB, Ritvanen A, Hukki JJ	
11:06 - 11:11 (5min.)	5 The variation of minimally invasive approaches to sagittal craniosynostosis: a systematic review of the literature Presenter: Liliana Camison Affiliation: University of Pittsburgh Medical Center, USA Authors: Camison L, Mai R, Naran S, Garland CB, Grunwaldt LJ, Davit AJ, Losee JE, Goldstein JA	
11:11 - 11:14 (3min.)	6 Craniosynostosis Associated with Prenatal Methotrexate Exposure Presenter: Gary F. Rogers Affiliation: CNMC Plastic Surgery, USA Authors: Rogers GF, Zarella CS, Oluigbo CN, Magge SN, Myseros JS, Keating RF, Wood BC, Oh AK	
11:14 - 11:19 (5min.)	7 Reduction Cranioplasty Aided by CAD/CAM Achieves Normal Morphology in Hydrocephalic Macrocephaly Presenter: Tuan Truong Affiliation: Craniofacial & Pediatric Plastic Surgery, Dell Children's Medical Center, University Medical Center Brackenridge, Austin, USA Authors: Truong T, Myers R, Kelley P, Harshbarger R	

11:19 - 11:24 (5min.)	<p>8</p> <p>Scaphocephaly Part III: Cranial Perimeter and Secondary Coronal Synostosis</p> <p>Presenter: Joseph Michienzi</p> <p>Affiliation: Miami Children's Hospital, USA</p> <p>Authors: Michienzi J, Arnaud E, Di Rocco F, Renier D, Marchac D, Lloredo A</p>
11:24 - 11:29 (5min.)	<p>9</p> <p>Extensive cranioplasty for sagittal synostosis by preserving cranial bone flaps adhered to the dura mater</p> <p>Presenter: Yunhe Lu</p> <p>Affiliation: Plastic surgery department, Huashan Hospital Fudan University, China</p> <p>Authors: Lu Y, Wu Y, Bao N</p>
11:29 - 11:34 (5min.)	<p>10</p> <p>Spring-assisted surgery in the treatment of sagittal synostosis: a systematic review</p> <p>Presenter: Lars Kölby</p> <p>Affiliation: Göteborg University, Department of Plastic Surgery, Sahlgrenska University Hospital, Sweden</p> <p>Authors: Kölby L, Fischer S, Strandell A, Tarnow P, Maltese G</p>
11:34 - 11:39 (5min.)	<p>11</p> <p>Treating Muenke syndrome for intracranial hypertension</p> <p>Presenter: Irene Mathijssen</p> <p>Affiliation: ErasmusMC, The Netherlands</p> <p>Authors: Mathijssen IMJ, den Ottelander BK, Spruijt B, Rijken BF, Van Veelen MC</p>
11:39 - 12:00	Discussion
12:00 - 13:00	Lunch

13:00 - 14:00	<p>General Session 2</p> <p>Craniosynostosis 2</p> <p>Chairs: <i>John Persing (USA) & Kaneshige Satoh (Japan)</i></p>	Room A (2F Soara I/II)
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13:00 - 13:03 (3min.)	<p>12</p> <p>National Trends in Inpatient Admission and Treatment of Patients with Craniosynostosis in the United States</p> <p>Presenter: Joseph Shin</p> <p>Affiliation: Montefiore Medical Center, USA</p> <p>Authors: Shin J, Jacobson J, Familusi O, Persing JA</p>
13:03 - 13:08 (5min.)	<p>13</p> <p>Developmental outcome in metopic synostosis: syndromic is different from non-syndromic.</p> <p>Presenter: Matthieu Vinchon</p> <p>Affiliation: Lille university hospital, France</p> <p>Authors: Vinchon M, Stella I, Wolber A, Guerreschi P, Boute O, Touzet S, Pellerin P</p>
13:08 - 13:13 (5min.)	<p>14</p> <p>Brain Growth Normalization After Surgery in Sagittal Craniosynostosis</p> <p>Presenter: Eric D. Brooks</p> <p>Affiliation: Section of Plastic and Reconstructive Surgery, Yale School of Medicine, USA</p> <p>Authors: Brooks ED, Yang J, Beckett JS, Lacadie C, Duncan CC, Constable TR, Pelphrey KA, Persing JA</p>

- 13:13 - 13:18
(5min.)
- 15**
Speech and Language Delays in Patients with Non-Syndromic Craniosynostosis
Presenter: Sanjay Naran
Affiliation: University of Pittsburgh Department of Plastic Surgery, USA
Authors: Naran S, Miller M, Ware B, Camison L, Goldstein JA, Losee JE
- 13:18 - 13:23
(5min.)
- 16**
Pre & Postoperative Developmental Attainment in Patients with Craniosynostosis 5 & 10 Year Follow-up
Presenter: Maggie Bellew
Affiliation: Leeds Teaching Hospitals, UK
Authors: Bellew M, Chumas P, Liddington M, Russell J
- 13:23 - 13:28
(5min.)
- 17**
Does cranioplasty improve neurocognition in patients with sagittal synostosis?
Presenter: Jenny F. Yang
Affiliation: Yale University Plastic Surgery, USA
Authors: Yang JF, Brooks ED, Hashim PW, Travieso R, Terner J, Reuman HS, Persing SM, Zellner EG, Sawh-Martinez R, Levy EJ, Law K, Landi N, Mayes LC, McPartland JC, Persing JA
- 13:28 - 13:33
(5min.)
- 18**
Patient Reported Outcome Measure (PROM) for evaluation of sagittal synostosis surgery
Presenter: Marie-Lise C. Van Veelen
Affiliation: Erasmus University Medical Center Rotterdam, Pediatric Neurosurgery, the Netherlands/University Medical Center Rotterdam, Department of Public Health, the Netherlands
Authors: Van Veelen MC, Kamst NW, Lingsma HF, Mathijssen IMJ
- 13:33 - 13:36
(3min.)
- 19**
Speech and Language Difficulties in Children with A Metopic Ridge
Presenter: Stephen Dover
Affiliation: Birmingham Children's Hospital, Supra-Regional Craniofacial Unit, UK
Authors: Dover S, Scobie EE, Carter RS, Evans M, Nishikawa H, White N, Desiderio R, Sharp M, Jagadeesan J
- 13:36 - 13:41
(5min.)
- 20**
Comparison of Euryon Location in Patients with Sagittal Craniosynostosis to Normal Population
Presenter: Kamlesh Patel
Affiliation: Washington University School of Medicine inn St. Louis, USA
Authors: Patel K, Skolnick G, Nguyen D, Naidoo S, Smyth M, Woo A, Dvoracek L
- 13:41 - 13:46
(5min.)
- 21**
Long-term neuropsychological outcomes of children with sagittal synostosis
Presenter: Annette C. Da Costa
Affiliation: The Royal Children's Hospital, Australia/Murdoch Children's Research Institute, Australia
Authors: Da Costa AC, Chong DK, Wray A, Burge J, Holmes AD
- 13:46 - 14:00
Discussion

14:00 - 15:00	General Session 3 Craniosynostosis 3 Chairs: <i>David David (Australia) & Matthieu Vichon (France)</i>	Room A (2F Soara I/II)
14:00 - 14:05 (5min.)	22 Improvement of Canthal Slant in Aperts undergoing Le Fort 3 with Bipartition and External distraction. Presenter: Vaneshri Chetty Affiliation: Centre de Reference des Malformations Crânio-Faciales Hôpital Necker-Enfants Malades, France Authors: Chetty V, Arnaud E	
14:05 - 14:08 (3min.)	23 HYDROCEPHALUS IN CRANIOSYNOSTOSIS—TREATING THE CAUSE AND NOT THE SEQUELAE Presenter: Jagajeevan Jagadeesan Affiliation: Department of Craniofacial Surgery, Birmingham Children’s Hospital, UK Authors: Jagadeesan J, Noons P, Sharp M, White N, Evans M, Nishikawa H, Dover S, Rodrigues D	
14:08 - 14:13 (5min.)	24 Lumbar puncture pressure vs. intracranial bolt pressure: which is more reliable? Presenter: Gregory w. Hornig Affiliation: Children’s Mercy Hospital, USA Authors: Hornig GW, Cartwright C, Igbaseimokumo U, Kaufman CB, Goldstein JA, Lypka MA	
14:13 - 14:18 (5min.)	25 A Morphable Profile Model of the Human Head as an Outcome Tool for Craniosynostosis Surgery Presenter: Christian Duncan Affiliation: Supra-regional Craniofacial Surgery Unit, UK Authors: Duncan C, Armstrong R, Pears NE	
14:18 - 14:21 (3min.)	26 Raised Intracranial Pressure (in Synostosis & Non-Synostosis) and Correlation with Papilloedema Presenter: Joseph Abbott Affiliation: Consultant Paediatric Ophthalmologist, Department of Ophthalmology, Birmingham Children’s Hospital, UK Authors: Abbott J, Weli I, Rodrigues D, Sharp M, White N, Evans M, Nishikawa H, Dover S, Shafi F	
14:21 - 14:26 (5min.)	27 “GULL WINGING”—AN UNUSUAL COMPLICATION FOLLOWING POSTERIOR CALVARIAL DISTRACTION OSTEOGENESIS Presenter: Hiroshi Nishikawa Authors: Nishikawa H, Jagadeesan J, Noons P, Sharp M, Rodrigues D, White N, Evans M, Dover S	
14:26 - 14:31 (5min.)	28 POSTERIOR CRANIAL VAULT DISTRACTION IN PATIENT WITH SYNDROMIC CRANIOSYNOSTOSIS. Presenter: Leonid Satanin Affiliation: Nikolay Nilovich Burdenko Neurosurgery Institute, Russia Authors: Satanin L, Ivanov A, Roginsky V, Sakharov A, Evteev A, Solonichenko V, Lemeneva N, Sorokin V	
14:31 - 14:36 (5min.)	29 Intra-operative dural tears impact in craniofacial procedures: analysis of 320 consecutive cases. Presenter: Ajay Sinha Affiliation: Alder Hey Supra-regional Craniofacial Surgery Unit, UK Authors: Sinha A, Paternoster G, Robertson B, Duncan C, Parks C, Burn S, Richardson D	

14:36 - 14:41
(5min.) **30**
Designing a protocol for Fronto-facial surgery—a service improvement priority
Presenter: Andrea R. White
Affiliation: The Hospital for Sick Children Great Ormond Street London England, UK
Authors: White AR, Truscott K, Ponniah AJT, Shanmuganathan M, O’Hara JL, Hartley J, Hayward RD, Jeelani NUO, Dunaway DJ

14:41 - 14:46
(5min.) **31**
The evolution of posterior cranial vault distraction in Oxford
Presenter: David Johnson
Affiliation: Oxford Craniofacial Unit, UK
Authors: Johnson D, Thomas G, Magdum S, JayaMohan J, Richards P, Wall S

14:46 - 15:00 Discussion

15:00 - 15:30 Coffee Break

15:30 - 16:30 **General Session 4** Room A (2F Soara I/II)
Craniosynostosis 4
Chairs: *Richard A. Hopper (USA) & Dov Goldenberg (Brazil)*

15:30 - 15:35
(5min.) **32**
PERIORBITAL CHANGES IN APERT PATIENTS FOLLOWING DIFFERENTIAL SEGMENTAL ADVANCEMENT
Presenter: Jevon Brown
Affiliation: Seattle Children’s Craniofacial Center, USA/University of Washington, USA
Authors: Brown J, Hopper RA, Kapadia H, Munding S

15:35 - 15:40
(5min.) **33**
A new tool to measure the aesthetic outcome of craniofacial surgery
Presenter: Allan JT Ponniah
Affiliation: Great Ormond Street Hospital for Children, UK
Authors: Ponniah AJT, Booth JA, Roussos A, Zafeiriou S, Dunaway DJ

15:40 - 15:45
(5min.) **34**
Intracranial Volume Changes in Spring Assisted Posterior Vault Expansion Surgery
Presenter: William Breakey
Affiliation: Great Ormond Street Hospital, UK
Authors: Breakey W, Borghi A, Syme Grant J, Bowman R, Liasis A, Thompson D, Hayward RD, Dunaway DJ, Jeelani NUO

15:45 - 15:48
(3min.) **35**
ROTATION DISTRACTION FOR THE TREATMENT OF SEVERE OBSTRUCTIVE SLEEP APNEA IN SYNDROMIC CHILDREN
Presenter: Richard A. Hopper
Affiliation: Seattle Children’s Craniofacial Center, USA/University of Washington Division of Plastic Surgery, USA
Authors: Hopper RA, Kapadia H

15:48 - 15:53
(5min.) **36**
Crouzon syndrome+acanthosis nigricans: an important identifiable cause of craniosynostosis prior to derm changes
Presenter: Donna M. McDonald-McGinn
Affiliation: The Children’s Hospital of Philadelphia and Univeristy of Pennsylvania, USA
Authors: McDonald-McGinn DM, Skraban C, Whitaker LA, Zackai E, Bartlett SP

- 15:53 - 15:58
(5min.) **37**
Comparison of Bipartition distraction with Le Fort II and zygomatic repositioning in Apert Syndrome
Presenter: David Dunaway
Affiliation: Great Ormond Street Hospital for Children, UK
Authors: Dunaway DJ, Hukki JJ, Vuola PMB, Ponniah AJT, Angullia F, Verdoorn M, Crombag G, Ruff CF, Britto JA, Booth JA, Zafeiriou S, Koudstaal MJ, Jeelani NUO
- 15:58 - 16:03
(5min.) **38**
Anatomic study of the pathophysiology of carotid-cavernous sinus fistula associated with the Le Fort osteotomy
Presenter: Yuuki Uchida
Affiliation: Chiba University Hospital, Japan
Authors: Uchida Y, Mitsukawa N, Akita S, Hasegawa M, Sasahara Y, Kubota Y, Satoh K
- 16:03 - 16:08
(5min.) **39**
A Randomized Controlled Trial of Oral vs. I.V. Non-narcotic Protocols Post Craniosynostosis Repairs
Presenter: Kanlaya Ditthakasem
Affiliation: The Department of Research, Medical City Dallas Hospital, USA
Authors: Ditthakasem K, Dimas V, Fearon JA, Herbert M
- 16:08 - 16:13
(5min.) **40**
An Evidence-Based Algorithm for Managing Syndromic Craniosynostosis in the Era of Posterior Vault Distraction
Presenter: Jesse A. Taylor
Affiliation: University of Pennsylvania, USA/Children’s Hospital of Philadelphia, USA
Authors: Taylor JA, Swanson JW, Samra F, Mitchell BT, Bauder AR, Wes A, Goldstein JA, Whitaker LA, Bartlett SP
- 16:13 - 16:30 Discussion

16:30 - 17:20 **General Session 5** Room A (2F Soara I/II)
Craniosynostosis 5
Chairs: *Eric Arnaud (France) & James Goodrich (USA)*

- 16:30 - 16:35
(5min.) **41**
“A bandeau abandoned”, an alternative fronto-orbital remodelling technique: report of 328 cases
Presenter: Greg James
Affiliation: Craniofacial Department, Great Ormond Street Hospital for Children, UK
Authors: James G, O’Hara JL, Jeelani NUO, Dunaway DJ, Hayward RD
- 16:35 - 16:40
(5min.) **42**
Intracranial volume and cephalic index in sagittal synostosis operated with craniotomy and springs or pi-plasty
Presenter: Sara Fischer
Affiliation: Göteborg University, Department of Plastic Surgery, Sahlgrenska University Hospital, Sweden
Authors: Fischer S, Maltese G, Tarnow P, Wikberg E, Bernhardt P, Kölby L
- 16:40 - 16:45
(5min.) **43**
Age at time of surgery and maintenance of head size in nonsyndromic sagittal craniosynostosis
Presenter: Anna A. Kuang
Affiliation: Craniofacial Surgery, Division of Pediatric Surgery, Department of Surgery, Oregon Health & Science University, USA
Authors: Kuang AA, Bergquist CS, Nauta AC, Selden NR

16:45 - 16:48
(3min.)

44

Management of Non-Syndromic Sagittal Synostosis: A Head-to-Head Meta-Analysis Comparing Three Techniques

Presenter: Patrick A. Gerety

Affiliation: Perelman School of Medicine at the University of Pennsylvania, USA

Authors: Gerety PA, Basta MN, Fischer JP, Taylor JA

16:48 - 16:53
(5min.)

45

SUBARACHNOID CSF COLLECTION AND FINAL MORPHOLOGY AFTER SURGICAL TREATMENT OF SCAPHOCEPHALY: A POTENTIAL ROLE?

Presenter: Eric Arnaud

Affiliation: Centre de Reference des Malformations CranioFaciales Hopital Necker-Enfants Malades Paris, France

Authors: Arnaud E, Usami K, Di Rocco F, Nicolini F

16:53 - 16:58
(5min.)

46

The benefits and limitations of the use of springs in the correction of scaphocephaly: A contemporaneous audit

Presenter: Will P. Rodgers

Affiliation: Department of Craniofacial Surgery, Great Ormond Street Hospital for Children, UK/Institute of Child Health, University College London, UK/Department of Maxillofacial Surgery, St George's Hospital, UK

Authors: Rodgers WP, Glass G, Dunaway DJ, Tahim A, Ponniah AJT, Schievano S, Borghi A, Angullia F, Jeelani N

16:58 - 17:01
(3min.)

47

Two-Stage Correction of Asymmetric Multisutural Craniosynostosis: An Approach to the Child with Cranial Scoliosis

Presenter: Michael R. Bykowski

Affiliation: University of Pittsburgh, USA

Authors: Bykowski MR, Shakir S, Naran S, Maricevich R, Goldstein JA, Losee JE

17:01 - 17:20

Discussion

17:30 - 18:30

Sponsored Seminar

Room A (2F Soara I/II)

Chair: *Nobuyuki Mitsukawa (Japan)*

SS

Successful use of Sonic Welding in pediatric craniofacial surgery: More than 700 cases with a 9 years follow-up

Presenter: Eric Arnaud

Affiliation: Hôpital Necker Enfants Malades Dept. of Craniofacial and Pediatric Surgery, Paris, France

Author: Arnaud E

Cosponsored by KLS Martin Group

Wednesday, 16 September

8:00 - 8:30 **Concurrent Session 1** Room A (2F Soara I/II)
Craniosynostosis 6
 Chairs: *Jesse A. Taylor (USA) & Marie-Lise Van Veelen (Netherlands)*

8:00 - 8:05
 (5min.) **48**
A Treatment Protocol for Atypical Presenting Sagittal Craniosynostosis
 Presenter: Edward J. Ruane
 Affiliation: University of Pittsburgh Medical Center, USA
 Authors: Ruane EJ, Camison L, Fenton R, Pollack IF, Tamber MS, Davit AJ, Grunwaldt LJ, Losee JE, Goldstein JA

8:05 - 8:08
 (3min.) **49**
Combined sagittal and unicoronal synostosis: preoperative assessment and outcomes after spring-assisted surgery
 Presenter: Giovanni Maltese
 Affiliation: Department of Plastic Surgery, Institute of Clinical Science, University of Göteborg, Sahlgrenska University Hospital, Göteborg, Sweden
 Authors: Maltese G, Tarnow P, Wikberg E, Bernhardt P, Kölby L

8:08 - 8:13
 (5min.) **50**
Decreased Craniosynostosis Deformity Relapse Following Removal of Compensations
 Presenter: James P. Bradley
 Affiliation: Division of Plastic and Reconstructive Surgery, Temple University School of Medicine, USA
 Authors: Bradley JP, Lee JC, Hindin DI, Kawamoto HK

8:13 - 8:18
 (5min.) **51**
Power-Assisted Particulate Bone Harvesting Minimizes Osseous Defects After Cranial Vault Reconstruction
 Presenter: Brad M. Gandolfi
 Affiliation: Duke University Medical Center, Division of Plastic, Maxillofacial, and Oral Surgery, USA
 Authors: Gandolfi BM, Hirji SA, Sobol DL, Allori AC, Marcus JR

8:18 - 8:30 Discussion

8:30 - 9:30 **Concurrent Session 2** Room A (2F Soara I/II)
Craniosynostosis 7
 Chairs: *Charles Davis (New Zealand) & Mark Proctor (USA)*

8:30 - 8:35
 (5min.) **52**
Evaluation of long-term sensory outcomes following cranial vault reconstruction
 Presenter: Jana Dengler
 Affiliation: University of Toronto, Canada
 Authors: Dengler J, Ho E, Klar E, Forrest CR

8:35 - 8:38
 (3min.) **53**
Sagittal Synostosis More Than Aesthetics
 Presenter: Kamilah A. Dowling
 Affiliation: Montefiore Medical Center, USA
 Authors: Dowling KA, Tepper O, Goodrich JT

- 8:38 - 8:41
(3min.)
- 54**
Sagittal suture synostosis without scaphocephalic deformation.
Presenter: Kazuaki Shimoji
Affiliation: Department of Neurosurgery Juntendo University School of Medicine, Tokyo, JAPAN
Authors: Shimoji K, Akiyama O, Kimura T, Shimoji T, Komuro Y, Miyajima M, Arai H
- 8:41 - 8:46
(5min.)
- 55**
Less is More? Quantitative Comparison of Endoscopic-Assisted Techniques in the Management of Sagittal Synostosis
Presenter: Suresh N. Magge
Affiliation: Pediatric Neurosurgery, Children’s National Medical Center, USA
Authors: Magge SN, Wood BC, Ahn ES, Wang JY, Keating RF, Rogers GF
- 8:46 - 8:51
(5min.)
- 56**
10 Year Long Term Outcome of Endoscopic Sagittal Craniosynostosis Repair
Presenter: Eric Stelnicki
Affiliation: Cleveland Clinic Florida, USA
Authors: Stelnicki E, Hertzler D, Eberle N, Rodriguez L
- 8:51 - 8:56
(5min.)
- 57**
Endoscope-assisted craniectomy with post-operative helmet for treatment of craniosynostosis in Japan
Presenter: Makoto Hikosaka
Affiliation: Department of Plastic Surgery, National Center for Child Health and Development, Japan
Authors: Hikosaka M, Kaneko T, Morota N, Ogiwara H, Takamatsu A, Kajita H, Nagashima H, Ohara H, Tokuyama E, Yamaguchi K
- 8:56 - 9:01
(5min.)
- 58**
Bilateral Endoscopic Suturectomy and Helmet Therapy for Bilateral Coronal Craniosynostosis
Presenter: Mark R. Proctor
Affiliation: Department of Neurosurgery, Boston Children’s Hospital, Harvard Medical School, USA
Authors: Proctor MR, Rottgers SA, Syed H, Jeelani Y, Yang E, Meara JG
- 9:01 - 9:06
(5min.)
- 59**
Aesthetic outcomes of molding helmet therapy with spring-mediated cranioplasty for sagittal craniosynostosis
Presenter: Jackie Haas
Affiliation: University of Pennsylvania, USA/Children’s Hospital of Philadelphia, USA
Authors: Haas J, Swanson JW, Mitchell BT, Storm JP, Bartlett SP, Heuer G, Taylor JA
- 9:06 - 9:11
(5min.)
- 60**
The Effect of Preoperative Molding Helmet in Patients with Sagittal Synostosis—Follow Up Study
Presenter: Asra Hashmi
Affiliation: Department of Plastic and Reconstructive Surgery Wayne State University/Detroit Medical Center, USA
Authors: Hashmi A, Sood S, Rozzelle A
- 9:11 - 9:14
(3min.)
- 61**
Where does the “volcano sign” come from in sagittal synostosis surgery?
Presenter: Ruth E. Bristol
Affiliation: Phoenix Children’s Hospital, USA/Barrow Neurological Institute, USA/Barrow Cleft and Craniofacial Center, USA
Authors: Bristol RE, Mahaney K, Singh DJ, Beals SP
- 9:14 - 9:30
- Discussion

9:30 - 10:30

Concurrent Session 3

Room A (2F Soara I/II)

Craniosynostosis 8Chairs: *Scott P. Bartlett (USA) & Takuya Akai (Japan)*9:30 - 9:33
(3min.)**62****Fronto-orbital Expansion: Reversing the paradigm of sagittal synostosis correction for late presentation**

Presenter: David Staffenberg

Affiliation: New York University Medical Center, USA

Authors: Staffenberg D, Golinko MS, Nardini G, Alperovich M, Harter D, Weiner H, Wisoff J, Goodrich JT

9:33 - 9:38
(5min.)**63****Application of Distraction Osteogenesis for elderly Scaphocephaly Children**

Presenter: Shinsuke Akita

Affiliation: Department of Plastic and Reconstructive Surgery, Chiba University, Japan

Authors: Akita S, Mitsukawa N, Hasegawa M, Ogata H, Kosaka K, Satoh K

9:38 - 9:43
(5min.)**64****Comparison of two techniques for nonsyndromic sagittal craniosynostosis: morphological outcomes**

Presenter: Christopher R. Forrest

Affiliation: Division of Plastic and Reconstructive Surgery, The Hospital for Sick Children, Canada

Authors: Forrest CR, Smith DM, Clausen A, Shen C, Phillips JH, Nguyen PD

9:43 - 9:46
(3min.)**65****Computer Aided Design and Manufacturing in Cranial Vault Remodeling for Non-syndromic Sagittal Suture Synostosis**

Presenter: Gerhard S. Munding

Affiliation: Johns Hopkins Hospital, Department of Plastic & Reconstructive Surgery, USA

Authors: Munding GS, Medina MA, Major M, Lopez J, Ahn ES, Dorafshar AH

9:46 - 9:49
(3min.)**66****One-piece bone flap osteotomy using thread wire saw for fronto-orbital advancement in craniosynostosis**

Presenter: Takuya Akai

Affiliation: Department of Neurosurgery, Kanazawa Medical University, Japan

Authors: Akai T, Yamashita M, Shojima T, Sasagawa Y, Shiraga S, Iizuka H, Kawakami S

9:49 - 9:54
(5min.)**67****Distraction osteogenesis vs. conventional fronto-orbital advancement for the treatment of Unicoronal Synostosis**

Presenter: Youssef Tahiri

Affiliation: Riley Hospital for Children, USA

Authors: Tahiri Y, Swanson JW, Taylor JA

9:54 - 9:59
(5min.)**68****Springs in Craniofacial surgery-Selection of appropriate cases**

Presenter: Charles Davis

Affiliation: Central and Southern Craniofacial Program, New Zealand

Author: Davis C

9:59 - 10:04
(5min.)**69****Squamosal suture synostosis: incidence, associations and impact in a craniofacial population**

Presenter: Greg Thomas

Affiliation: Oxford Craniofacial Unit, UK

Authors: Thomas G, Eley K, Sheerin F, Cilliers D, Wall S, Johnson D

10:04 - 10:09
(5min.) **70**
Use of Acellular Dermal Matrix in Craniofacial Reconstruction
Presenter: Anil Madaree
Affiliation: Nelson R Mandela School of Medicine, University of Kwazulu Natal, South Africa
Author: Madaree A

10:09 - 10:14
(5min.) **71**
Molding helmet therapy for the infants with deformational plagiocephaly: our experience of 200cases
Presenter: Ako Takamatsu
Affiliation: Plastic Surgery, National Center for Child Health and Development, Japan
Authors: Takamatsu A, Kaneko T, Hikosaka M, Ogiwara H, Morota N, Kaneko A

10:14 - 10:30 Discussion

8:00 - 9:10 **Concurrent Session 4** Room B (2F Soara III)
Hypertelorism Rare Cleft Trauma Tumor 1
Chairs: *Michael Dover (UK) & Anil Madaree (South Africa)*

8:00 - 8:05
(5min.) **72**
Surgical strategies for soft tissue reconstruction in hypertelorbitism.
Presenter: Cassio Eduardo Raposo Amaral
Affiliation: SOBRAPAR, Brazil
Authors: Raposo Amaral CE, Denadai R, Ghizoni E, Buzzo C, Raposo Amaral CA

8:05 - 8:10
(5min.) **73**
Improving Results in Orbital Hypertelorism Correction by Applying Nasoethmoid Fracture Techniques
Presenter: Larry A. Sargent
Affiliation: University of Tennessee College of Medicine Chattanooga, USA
Author: Sargent LA

8:10 - 8:15
(5min.) **74**
The origins & presentation of patients with midline Tessier 0, 14 & 0-14 clefts managed at a single craniofacial unit
Presenter: Thomas E. Pidgeon
Affiliation: University Hospital Coventry and Warwickshire, UK
Authors: Pidgeon TE, Flapper WJ, Anderson PJ, David DJ

8:15 - 8:20
(5min.) **75**
Rare Tessier's Cleft N° 6, about 5 cases.
Presenter: Philippe Pellerin
Affiliation: French National reference center for rare cranio maxillo facial malformations, Lille University Hospital, France/Department of cranio maxillo facial surgery, Plastic surgery hospital of the Chinese Academy of Medical sciences, China/Cleft and cranio facial center, Jeyasekharan hospital, India
Authors: Pellerin P, Zhang ZY, Yin L, Tang XJ, Richardson S

8:20 - 8:25
(5min.) **76**
Intralesional Nd-YAG laser and intratumoral ligation as a cure for craniofacial arteriovenous malformations
Presenter: Nond Rojvachiranonda
Affiliation: Department of Surgery, Faculty of Medicine, Chulalongkorn University, Thailand
Authors: Rojvachiranonda N, Lerdlum S, Mahatumarat C

- 8:25 - 8:28
(3min.)
- 77**
Pediatric Maxillofacial Trauma and Its Impact On Developing Dentition: A Retrospective Review of 117 Patients
Presenter: Sanjay Naran
Affiliation: University of Pittsburgh Department of Plastic Surgery, USA
Authors: Naran S, Camison L, Lam B, Basri O, Schuster L, Martin B, Losee JE
- 8:28 - 8:33
(5min.)
- 78**
COMPUTER PLANNING AND NAVIGATION FOR CRANIOMAXILLOFACIAL TUMORS AND RECONSTRUCTION WITH FIBULA FREE FLAPS
Presenter: Francisco Alamillos
Affiliation: Oral and Maxillofacial Surgery Service, University Hospital Reina Sofía, Spain
Authors: Alamillos F, Dean A, Heredero S, García B, Ruiz MASERA JJ, Solivera J
- 8:33 - 8:36
(3min.)
- 79**
Early intermaxillary traction and delayed reduction for LeFort fracture
Presenter: Akimitsu Sato
Affiliation: Department of Plastic and Reconstructive Surgery, Tohoku University, Japan
Authors: Sato A, Imai Y, Tachi M
- 8:36 - 8:41
(5min.)
- 80**
Island superficial temporal artery flap for reconstruction of complex facial defects: A new algorithm
Presenter: Tarek M. Elbanoby
Affiliation: Plastic Surgery Department, Alazhar University, Egypt/craniofacial unit, Naser institute, Egypt.
Author: Elbanoby TM
- 8:41 - 8:46
(5min.)
- 81**
An Outcomes Comparison Between Autologous and Alloplastic Cranioplasty in the Pediatric Population
Presenter: Mathew Greives
Affiliation: University of Texas Health Sciences Center at Houston, USA/Division of Pediatric Plastic Surgery, USA/Department of Pediatric Surgery, USA
Authors: Greives M, Fu KJ, Barr RM, Kerr ML, Shah MN, Fletcher SA, Sandberg DI, Teichgraeber JF
- 8:46 - 8:51
(5min.)
- 82**
Single Stage Cranioplasty Following Skull Neoplasm Resection Using Customized Craniofacial Implants
Presenter: Jens U. Berli
Affiliation: The Johns Hopkins University School of Medicine, USA/The Johns Hopkins Hospital Department of Plastic and Reconstructive Surgery, USA
Authors: Berli JU, Thomaier L, Zhong S, Quinones A, Huang J, Lim M, Weingart J, Brem H, Gordon CR
- 8:51 - 8:56
(5min.)
- 83**
u-HA/PLLA composite sheet in orbital wall reconstruction
Presenter: Takeshi Miyawaki
Affiliation: Department of Plastic and Reconstructive Surgery, The Jikei University School of Medicine, Japan
Authors: Miyawaki T, Umeda G, Tomita S, Nishimura R, Sakai S, Ninomiya K
- 8:56 - 9:10
- Discussion

9:10 - 10:30

Concurrent Session 5
Hypertelorism Rare Cleft Trauma Tumor 2

Room B (2F Soara III)

Chairs: *Anthony Wolfe (USA) & Cassio Eduardo Raposo Amara (Brazil)*

9:10 - 9:15
(5min.)

84

Incidence of lower eyelid complications after a transconjunctival approach: influence of repeated incisions.

Presenter: Masanobu Yamashita

Affiliation: Kanazawa Medical University, Japan

Authors: Yamashita M, Yamashita A, Kishibe M, Shimada K, Kawakami S

9:15 - 9:20
(5min.)

85

FACIAL INFILTRATING LIPOMATOSIS (FIL): THE VALUE OF SURGICAL RESECTION BASED ON TIMING AND OUTCOMES.

Presenter: Dov C. Goldenberg

Affiliation: Division of Plastic Surgery, Hospital das Clinicas, University of Sao Paulo School of Medicine, Brazil/Hospital Municipal Infantil Menino Jesus, Sao Paulo, Brazil

Authors: Goldenberg DC, Smaniotto PH, Fioravanti AB, Hiraki PY, Fernandes TR, Koga A

9:20 - 9:23
(3min.)

86

The subcranial/transglabellar approach: Our experience with 50 cases.

Presenter: Juan Solivera

Affiliation: Department of Neurosurgery, Hospital Universitario Reina Sofia, Spain

Authors: Solivera J, Heredero S, Blanco C, Lozano JE

9:23 - 9:26
(3min.)

87

Elucidation of Genetic Basis of Craniofacial Hyperostoses

Presenter: Yoshitaka Kubota

Affiliation: Department of Plastic Surgery, Chiba University, Japan

Authors: Kubota Y, Mitsukawa N, Uchida M, Uchida Y, Akita S, Hasegawa M, Satoh K

9:26 - 9:31
(5min.)

88

Craniofacial approach to en plaque cranio-orbital meningiomas: Strategies and lessons learned.

Presenter: Rachna S. Ram

Affiliation: Craniomaxillofacial, Plastic And Burns Unit, Hutt Hospital DHB, New Zealand

Authors: Ram RS, Wickremesekera A, Davis C

9:31 - 9:34
(3min.)

89

Application of a mini-preauricular incision, trans-parotid approach for surgical management of condylar fracture

Presenter: Po-Fang Wang

Affiliation: Department of Plastic and Reconstructive surgery, Chang Gung Memorial Hospital, Taiwan

Authors: Wang P, Liao H, Chen CT

9:34 - 9:39
(5min.)

90

Risk factors analysis for outcome of indirect traumatic optic neuropathy (TON) with steroid pulse therapy

Presenter: I-Li Lai

Authors: Lai I, Liao H

9:39 - 9:44
(5min.)

91

Fibrous Dysplasia: Opinions on the Indications for the Unroofing of Circumferentially Encased Optic Nerves

Presenter: Craig Rowin

Affiliation: Miami Children's Hospital, USA

Authors: Rowin C, Wolfe SA, Satterwhite TS

- 9:44 - 9:49
(5min.)
- 92**
Combining Navigation and Endoscopy for Orbital Reconstruction
Presenter: Chien-Tzung Chen
Affiliation: Chang Gung Memorial Hospital, Taiwan
Author: Chen CT
- 9:49 - 9:54
(5min.)
- 93**
Sphenoid dysplasia in neurofibromatosis: Patterns of presentation and outcomes of treatment
Presenter: Scott P. Bartlett
Affiliation: University of Pennsylvania, USA/Children's Hospital of Philadelphia, USA
Authors: Bartlett SP, Swanson JW, Ligh CA, Shubinetz V, Mitchell BT, Whitaker LA, Taylor JA
- 9:54 - 9:57
(3min.)
- 94**
Comparison of custom CAD/CAM PEEK, HTR, and titanium implants for craniofacial reconstruction in children
Presenter: Phuong D. Nguyen
Affiliation: Division of Plastic and Reconstructive Surgery, The Hospital for Sick Children, Canada
Authors: Nguyen PD, Smith DM, Forrest CR, Phillips JH
- 9:57 - 10:02
(5min.)
- 95**
Surgery of Craniofacial Venous Malformations—New Strategies
Presenter: Nguyen Hong Ha
Affiliation: Viet Duc Hospital, Vietnam
Authors: Ha NH, McKinnon M
- 10:02 - 10:07
(5min.)
- 96**
Navigation assisted standardized Osteotomies as intracranial and extracranial approaches to the skull base
Presenter: Robert A. Mischkowski
Affiliation: Department of Oral, Maxillofacial and Facial Plastic Surgery, Medical Center Ludwigshafen, Germany
Authors: Mischkowski RA, Thiele OC
- 10:07 - 10:30
- Discussion

Thursday, 17 September

8:00 - 9:00 **Concurrent Session 6** Room A (2F Soara I/II)
Craniosynostosis 9
Chairs: *Stephen Beals (USA) & Yuzo Komuro (Japan)*

- 8:00 - 8:03
(3min.) **97**
Prenatal ultrasound screening for single suture craniosynostosis.
Presenter: Martijn J. Cornelissen
Affiliation: Dept. of Plastic and Reconstructive Surgery and Handsurgery, Erasmus Medical Center/Sophia Children's Hospital, The Netherlands
Authors: Cornelissen MJ, Apon I, van der Meulen JJNM, Groenenberg IAL, Kraan-van der Est M, Bonsel GJ, Mathijssen IMJ, Cohen-Overbeek TE
- 8:03 - 8:06
(3min.) **98**
Fronto-orbital distraction to treat metopic synostosis
Presenter: Brianne T. Mitchell
Affiliation: University of Pennsylvania, USA/Children's Hospital of Philadelphia, USA
Authors: Mitchell BT, Swanson JW, Heuer G, Taylor JA
- 8:06 - 8:11
(5min.) **99**
The metopic synostotic correction with distraction.
Presenter: Fernando Molina
Affiliation: Craniofacial Anomalies Foundation, Hospital Angeles del Pedregal and Postgraduate Division, School of Medicine, Universidad la Salle Mexico
Author: Molina F
- 8:11 - 8:16
(5min.) **100**
Surgery for premature suture synostosis may hamper growth and result in reduced intracranial volume
Presenter: Peter Tarnow
Affiliation: Department of Plastic Surgery, Institute for Clinical Sciences, Sahlgrenska Academy, Göteborg University, Sahlgrenska University Hospital, Sweden
Authors: Tarnow P, Maltese G, Wikberg E, Bernhardt P, Tovetjärn R, Fischer S, Kölby L
- 8:16 - 8:21
(5min.) **101**
Sagittal Synostosis; A Review of 213 Consecutive Cases
Presenter: Walter J. Flapper
Affiliation: The Australian Craniofacial Unit, Australia
Authors: Flapper WJ, David DJ
- 8:21 - 8:26
(5min.) **102**
Calvarial Vault Distraction for the Late Treatment of Cephalocranial Disproportion
Presenter: Jordan Deschamps-Braly
Affiliation: California Pacific Medical Center, UCSF Benioff Children's Hospital Oakland, Clinical Instructor-Plastic Surgery University of Oklahoma College of Medicine, USA
Authors: Deschamps-Braly J, Black JS, Denny AD
- 8:26 - 8:31
(5min.) **103**
One-piece frontoorbital advancement with distraction but without bandeau for coronal craniosynostosis
Presenter: Jong-Woo Choi
Affiliation: Seoul Asan Medical Center, Korea/University of Ulsan, College of Medicine, Korea
Authors: Choi J, Rah Y

- 8:31 - 8:36
(5min.) **104**
Long-term Follow-up over 10 years after fronto-orbital advancement for plagiocephaly
Presenter: Keisuke Imai
Affiliation: Department of Plastic & Reconstructive Surgery, Osaka City General Hospital, Japan/Department of Pediatric Neurosurgery, Osaka City General Hospital, Japan
Authors: Imai K, Masuoka T, Takahashi M, Yamaguchi K, Deguchi A, Matsusaka Y, Kunihiro N
- 8:36 - 8:41
(5min.) **105**
Evaluation of fronto-orbital advancement on orbital morphology in unicoronal synostosis
Presenter: Jason W. Yu
Affiliation: Children's Hospital of Philadelphia, USA
Authors: Yu JW, Zhu M, Wes A, Swanson JW, Mitchell BT, Bartlett SP, Taylor JA
- 8:41 - 9:00 Discussion

9:00 - 10:00 **Concurrent Session 7** Room A (2F Soara I/II)
Craniosynostosis 10
Chairs: *David Dunaway (UK) & Nobuhito Morota (Japan)*

- 9:00 - 9:05
(5min.) **106**
Perioperative complications in children with Pfeiffer syndrome: a review of 206 anesthetics in Oxford, UK
Presenter: Sumit Das
Affiliation: Nuffield Department of Anesthesia, Oxford Craniofacial Unit, UK
Authors: Das S, Campbell S
- 9:05 - 9:08
(3min.) **107**
Cost of Care for Children with for Apert Syndrome in the United States
Presenter: Ruth Trivelpiece
Affiliation: Virginia Commonwealth University, USA
Authors: Trivelpiece R, Youn R, Rhodes J
- 9:08 - 9:13
(5min.) **108**
Intelligence and behavior versus neuroimaging in patients with syndromic craniosynostosis
Presenter: Joyce Florisson
Affiliation: Erasmus Medical Center, The Netherlands
Authors: Florisson J, Maliepaard M, Rijken BF, Okkerse J, Lequin MH, Mathijssen IMJ
- 9:13 - 9:18
(5min.) **109**
Changes in the treatment algorithm for craniosynostosis by the introduction of a posterior cranial distraction
Presenter: Yuzo Komuro
Affiliation: Department of Plastic Surgery, Juntendo University Urayasu Hospital, Japan
Authors: Komuro Y, Shimizu A, Shimoji K, Miyajima M, Arai H
- 9:18 - 9:23
(5min.) **110**
Computer-assisted craniofacial surgery-experiences of the Berlin Centre for Craniofacial Surgery
Presenter: Nicolai Adolphs
Affiliation: Department of Craniomaxillofacial Surgery, Campus Virchow, Charité Berlin, Germany
Authors: Adolphs N, Schulz M, Haberl H, Hoffmeister B

- 9:23 - 9:28
(5min.) **111**
Craniosynostosis syndromes: Foramen magnum and ventriculomegaly and Chiari I malformation.
Presenter: Bianca F. Rijken
Affiliation: Dept. of Plastic and Reconstructive Surgery, Erasmus University Medical Center/Sophia Children's Hospital, the Netherlands
Authors: Rijken BF, Lequin MH, van Veelen-Vincent MC, de Rooi JJ, Doerga PN, Mathijssen IMJ
- 9:28 - 9:33
(5min.) **112**
Osteogenesis And Bone Remodeling In A Murine Model Of Crouzon Syndrome
Presenter: Derek M. Steinbacher
Affiliation: Yale University, USA
Authors: Steinbacher DM, Gomillion C, Alcon A, Le A
- 9:33 - 9:38
(5min.) **113**
Clinical Protocol and 15 Year Safety Experience Caring for Postoperative Craniosynostosis Patients on the Ward
Presenter: Steven R. Cohen
Affiliation: Rady Childrens Hospital, USA
Authors: Cohen SR, McIntyre JK, Gosman AA, Levy ML, Meltzer HS
- 9:38 - 9:43
(5min.) **114**
Posterior Vault Distraction Osteogenesis conveys anterior benefit in Apert Syndrome
Presenter: Fares Samra
Affiliation: University of Pennsylvania, USA/Children's Hospital of Philadelphia, USA
Authors: Samra F, Swanson JW, Mitchell BT, Bauder AR, Taylor JA, Bartlett SP
- 9:43 - 9:46
(3min.) **115**
Minimally Invasive Posterior Vault Distraction in Craniosynostosis and Epidermolysis Bullosa Simplex
Presenter: Craig Gendron
Affiliation: Cincinnati Children's Hospital Medical Center, USA
Authors: Gendron C, Runyan CM, Vogel TW, Gordon CB
- 9:46 - 10:00 Discussion

10:00 - 10:30 **Concurrent Session 8** Room A (2F Soara I/II)
Craniosynostosis 11
Chairs: *Hiroshi Nishikawa (UK) & Jeffrey A. Fearon (USA)*

- 10:00 - 10:05
(5min.) **116**
CHIARI I MALFORMATION: RESULTS OF NEUROLOGICAL EXAMINATION VERSUS MRI.
Presenter: Hansje Bredero
Affiliation: Department of Plastic, Reconstructive and Hand Surgery, ErasmusMC Rotterdam The Netherlands
Authors: Bredero H, Rijken BF, Lequin MH, Neuteboom RF, Mathijssen IMJ, Van Veelen MC
- 10:05 - 10:08
(3min.) **117**
Posterior Vault Expansion and Chiari Decompression in Mercedes Benz Synostosis: The Best or Nothing?
Presenter: Michael A. Lypka
Affiliation: Children's Mercy Hospital999, USA
Authors: Lypka MA, Igbaseimokumo U

10:08 - 10:13 (5min.)	118 Lambdoid Synostosis: the Association with Chiari Deformations and an Evaluation of Surgical Outcomes Presenter: Jeffrey Fearon Affiliation: The Craniofacial Center, USA Authors: Fearon JA, Dimas V, Ditthakasem K, Herbert M
	119 withdrawn
10:13 - 10:18 (5min.)	120 Results of very early distraction osteogenesis for the treatment of syndromic craniosynostosis Presenter: John Kestle Affiliation: University of Utah, USA Authors: Kestle J, Anstadt EE, Sands N, Riva-Cambrin J, Siddiqi F, Gociman B
10:18 - 10:30	Discussion
10:30 - 11:00	Coffee Break

11:00 - 12:00	Panel Discussion 1 Distraction for Micrognathia Chairs: <i>Robert Havlik (USA) & Kaneshige Satoh (Japan)</i>	Room A (2F Soara I/II)
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PD1-1**Distraction for Micrognathia in Infancy: Pierre Robin Sequence**

Presenter: Robert Havlik
Affiliation: Department of Plastic Surgery, Medical College of Wisconsin, USA
Authors: Havlik R, Korkos GJ

PD1-2**Mandible Distraction Osteogenesis for Craniofacial Microsomia**

Presenter: Davinder Singh
Affiliation: Mayo School of Medicine, Barrow Cleft and Craniofacial Center, Department of Surgery, Phoenix Children's Hospital, USA
Author: Singh DJ

PD1-3**A protocol for evaluation and treatment of Micrognathia in Infants**

Presenter: Richard A. Hopper
Affiliation: Seattle Children's Craniofacial Center, USA
Authors: Hopper RA, Losee JE, Musgrave RH

PD1-4**Mandibular Growth after Distraction Osteogenesis: Cases of Pierre Robin Sequence in Early Childhood**

Presenter: Nobuyuki Mitsukawa
Affiliation: Department of Plastic, Reconstructive and Aesthetic Surgery, Chiba University, Faculty of Medicine, Japan
Authors: Mitsukawa N, Morishita T, Saiga A, Uchida Y, Akita S, Kubota Y, Satoh K

PD1-5**Early mandibular DO versus a palatal extended plate to reduce glossoptosis in severe Pierre-Robin-Sequence**

Presenter: Martina Wilbrand
Affiliation: University Hospital Giessen, Germany
Authors: Wilbrand M, Howaldt H, Wilbrand J

Discussion

12:00 - 13:00

Lunch

13:00 - 14:00

Panel Discussion 2
Craniofacial Orthodontics

Room A (2F Soara I/II)

Chairs: *Alvaro Figueroa (USA) & Pedro Santiago (USA)*

PD2-1

Longitudinal growth analysis of mandibular asymmetry in unoperated patients with unilateral craniofacial microsomia (UCFM)

Presenter: Pradip R. Shetye

Affiliation: NYU Langone Medical Center, Institute of Reconstructive Plastic Surgery, USA

Author: Shetye PR

PD2-2

The Validity of Current Outcomes Assessment Among Heterogeneous Populations.

Presenter: Patricia Glick

Affiliation: DMD, Craniofacial Orthodontist, Co-Medical Director, The Barrow Cleft and Craniofacial Center, USA

Author: Glick PH

PD2-3

Is the NAM effective or ineffective? The need for orthodontic diagnosis in management of infants with facial cleft, cleft lip and palate.

Presenter: Yuki Satoh

Affiliation: Department of Orthodontics, School of Dentistry Showa University, Japan

Author: Satoh Y

PD2-4

Definitive Facial Skeletal Correction of Craniofacial Microsomia: Orthodontic Treatment Consideration

Presenter: Ellen Wen-Ching Ko

Affiliation: Chang Gung University, Taiwan

Author: Ko EW

PD2-5

Experiences with Cleft and Craniofacial Outcome Studies: A Dialogue for Sharing and Exploring Future Directions

Presenter: Ronaldo Hathaway

Affiliation: Cincinnati Children's Hospital Medical Center, USA

Author: Hathaway R

Discussion

14:00 - 15:00

Panel Discussion 3
Skull Base Reconstruction

Room A (2F Soara I/II)

Chairs: *Stephen P. Beals (USA) & Yuhei Yamamoto (Japan)***PD3-1**

ENDOSCOPIC APPROACH TO SKULL BASE TUMORS AND RECONSTRUCTION WITH THE NASOSEPTAL FLAP

Presenter: Stephen P. Beals
 Affiliation: Barrow Neurological Institute, USA
 Author: Beals SP

PD3-2

Postoperative Complications after Skull Base Reconstruction

Presenter: Kentaro Tanaka
 Affiliation: Department of Plastic and Reconstructive Surgery, Graduate School of Medical Sciences, Tokyo Medical and Dental University, Japan
 Authors: Tanaka K, Okazaki M, Yano T, Suesada N

PD3-3

Our strategy of skull base reconstruction after tumor resection: A 10-year, single institute experience

Presenter: Yuzuru Kamei
 Affiliation: Dept. of Plastic and Reconstructive Surgery, Nagoya University Graduate School of Medicine, Japan
 Authors: Kamei Y, Takanari K, Toriyama K, Yagi S, Fujii M, Saito K, Wakabayashi T, Fujimoto Y, Nishio N

PD3-4

The usefulness of the musculo-pericranial flap in reconstruction of the skull base

Presenter: Kensuke Kiyokawa
 Affiliation: Department of Plastic and Reconstructive Surgery and Maxillofacial Surgery, Kurume University School of Medicine, Japan
 Authors: Kiyokawa K, Koga N, Rikimaru H

PD3-5

Analysis of Risk Factors for Flap Loss and Salvage in Free Flap Head and Neck Reconstruction

Presenter: Edward I. Chang
 Affiliation: MD Anderson Cancer Center, USA
 Authors: Chang EI, Zhang H, Liu J, Skoracki RJ, Yu P, Hanasono MM

Discussion

15:00 - 15:30

Coffee Break

15:30 - 16:00

Concurrent Session 9
Craniosynostosis 12

Room A (2F Soara I/II)

Chairs: *Walter Flapper (Australia) & Jong-Woo Choi (South Korea)*15:30 - 15:33
(3min.)**121**

Hybrid In Situ Cranioplasty Osteotomies for Kleeblattschadel and other High Risk Skull Deformities

Presenter: Joyce K. McIntyre
 Affiliation: University of California San Diego, USA/Rady Childrens Hospital, USA
 Authors: McIntyre JK, Meltzer HS, Cohen SR

- 15:33 - 15:38
(5min.) **122**
An Analysis of Posterior Vault Distraction and its Effects on the Posterior Fossa and Cranial Base
Presenter: Jason D. Wink
Affiliation: University of Pennsylvania, USA
Authors: Wink JD, Bauder AR, Swanson JW, Derderian CA, Bartlett SP, Taylor JA
- 15:38 - 15:43
(5min.) **123**
Occipitofrontal circumference predicts intracranial volume in craniosynostosis syndromes.
Presenter: Priya N. Doerga
Affiliation: Plastic and Reconstructive Surgery, Erasmus University Medical Center/Sophia Children's Hospital, the Netherlands
Authors: Doerga PN, Rijken BF, den Ottelander BK, van Veelen-Vincent MC, Lequin MH, Mathijssen IMJ
- 15:43 - 15:48
(5min.) **124**
The Effect of Cranial Base Surgery on Congenital Craniofacial Deformities
Presenter: Manlio Galie'
Affiliation: Unit of Cranio Maxillo Facial Surgery-"St. Anna" Hospital and University, Italy
Authors: Galie' M, Elia G, Clauser LC
- 15:48 - 15:51
(3min.) **125**
A Risk-Benefit Analysis of Frontofacial Distraction
Presenter: Justine L. O'Hara
Affiliation: Department of Craniofacial Surgery, Great Ormond Street Hospital for Children, UK
Authors: O'Hara JL, Rodgers WP, Tahim A, Abela C, Bagkeris M, Britto JA, Evans RE, Hayward RD, Jeelani NUO, Dunaway DJ
- 15:51 - 16:00 Discussion

16:00 - 17:00 **Concurrent Session 10** Room A (2F Soara I/II)
Craniosynostosis 13
Chairs: *Juan Martin Chavanne (Argentina) & Keisuke Imai (Japan)*

- 16:00 - 16:05
(5min.) **126**
Management of obstructive sleep apnoea in syndromic craniosynostosis: the role of the palatal split
Presenter: Fateh Ahmad
Affiliation: The Australian Craniofacial Unit, Australia
Authors: Ahmad F, Flapper WJ, Thomas G, Anderson PJ, David DJ
- 16:05 - 16:10
(5min.) **127**
Monobloc Distraction in Crouzon-Pfeiffer Syndrome: a Geometric Morphometrics based Evaluation
Presenter: Richard Visser
Affiliation: Great Ormond Street Hospital for Children NHS Foundation Trust, UK/Erasmus Medical Centre, the Netherlands
Authors: Visser R, Ruff CF, Angullia F, Ponniah AJT, Jeelani NUO, Britto JA, Koudstaal MJ, Dunaway DJ
- 16:10 - 16:15
(5min.) **128**
Monobloc frontofacial advancements: do they require distraction?
Presenter: Blake Murphy
Affiliation: Plastic Surgery, Miami Children's Hospital, USA
Authors: Murphy B, Nathan NR, MacArthur IR, Burke R, Wolfe SA

- 16:15 - 16:20
(5min.)
- 129**
Craniosynostoses associated with osteopetrosis: the role of expansion cranioplasty
Presenter: Irene Stella
Affiliation: Pediatric Neurosurgery-University Regional Hospital of Lille France, France
Authors: Stella I, Vinchon M, Guerreschi P, Wolber A, Pellerin P
- 16:20 - 16:23
(3min.)
- 130**
Eight year follow up of identical twins with craniosynostotic variations of Crouzon's syndrome
Presenter: Edward P. Buchanan
Affiliation: Texas Children's Hospital, Baylor College of Medicine, USA
Authors: Buchanan EP, Lloyd MS, Mohrbacher N, Khechoyan DY, Hollier L, Monson LA
- 16:23 - 16:28
(5min.)
- 131**
Value of Three-Dimensional Craniofacial Models for Midfacial Distraction
Presenter: Carolyn R. Rogers-Vizena
Affiliation: Department of Plastic and Oral Surgery, Boston Children's Hospital, USA/Harvard Medical School, Boston, USA
Authors: Rogers-Vizena CR, Flath Sporn S, Daniels KM, Padwa BL, Weinstock P
- 16:28 - 16:33
(5min.)
- 132**
Combined internal and external device for Le Fort III minus I and I Distraction: Secondary Report
Presenter: Kaneshige Satoh
Affiliation: Department of Plastic and Reconstructive Surgery, Chiba University, Japan
Authors: Satoh K, Mitsukawa N, Kubota Y, Hasegawa M, Sasahara Y
- 16:33 - 16:38
(5min.)
- 133**
A Cephalometric Analysis after Le Fort III Osteotomy for Syndromic Craniosynostosis Patients
Presenter: Takeshi Masuoka
Affiliation: Department of Plastic and Reconstructive Surgery, Osaka City General Hospital, Japan
Authors: Masuoka T, Imai K, Takahashi M, Yamaguchi K, Deguchi A, Kawamoto K
- 16:38 - 16:41
(3min.)
- 134**
The adult syndromic craniosynostosis: the final midface retrusion correction.
Presenter: José Cortés-Arreguin
Affiliation: Craniofacial Anomalies Foundation, Hospital Angeles del Pedregal and Postgraduate Division, School of Medicine, Universidad la Salle Mexico
Authors: Cortés-Arreguin J, Molina F, Lorenzana C
- 16:41 - 16:46
(5min.)
- 135**
Conventional Le Fort III advancement versus Le Fort III distraction: an economic analysis.
Presenter: Mark Fisher
Affiliation: The University of Iowa Hospitals and Clinics, USA
Authors: Fisher M, Phillips JH, Forrest CR
- 16:46 - 17:00
- Discussion

17:00 - 17:30

Concurrent Session 11
Hypertelorism Rare Cleft Trauma Tumor 3

Room A (2F Soara I/II)

Chairs: *Jonathan A. Britto (UK) & Takeshi Miyawaki (Japan)*

17:00 - 17:05
(5min.)

136
ZIFENS+/-: To minimize risk and optimise outcome in Orbital Box Translocation for Hypertelorism

Presenter: Jonathan A. Britto
Affiliation: Great Ormond Street Hospital NHS Trust, UK
Authors: Britto JA, Glass GE, O'Hara JL, Hon K, Evans RE, Jeelani NUO, Dunaway DJ

17:05 - 17:10
(5min.)

137
FREE FIBULA FLAP CONTOURING METHOD FOR MANDIBULAR RECONSTRUCTION IN CIPTO MANGUNKUSUMO HOSPITAL

Presenter: Elrica Sapphira Wiraatmadja
Affiliation: Cleft and Craniofacial Center Cipto Mangunkusumo Hospital-University of Indonesia, Indonesia
Authors: Sapphira Wiraatmadja E, Kreshanti P, Handayani S

17:10 - 17:15
(5min.)

138
Outcomes of conservative and operative management of orbital fractures in an Australian trauma centre

Presenter: Olivia M. Perotti
Affiliation: Alfred Trauma Hospital, Australia
Authors: Perotti OM, Morgan D

17:15 - 17:20
(5min.)

139
Surgery of Orbital Neurofibromatosis (NF)

Presenter: McKay McKinnon
Affiliation: Lurie Children's Hospital, USA
Authors: McKinnon M, Ha NH

17:20 - 17:30

Discussion

8:00 - 9:00

Concurrent Session 12
Craniofacial Microsomia 1

Room C (B1F Ambio I)

Chairs: *Robert Havlik (USA) & Takafumi Susami (Japan)*

8:00 - 8:05
(5min.)

140
Reduced 3-dimensional airway volume is a function of skeletal dysmorphology in Treacher Collins Syndrome

Presenter: Xiaoyang Ma
Affiliation: Yale University School of Medicine, USA/Peking Union Medical College Hospital, China
Authors: Ma X, Forte AJ, Persing JA, Alonso N, Berlin NL, Steinbacher DM

8:05 - 8:10
(5min.)

141
Recommendations for treatment of Treacher Collins Syndrome (TCS)

Presenter: Sarah L. Versnel
Affiliation: Erasmus Medical Center, the Netherlands
Authors: Versnel SL, Plomp RG, van Lieshout MJS, Wolvius EB, van der Schroeff MP, van der Meulen JJNM, Bredero-Boelhouwer HH, Poublon RML, Hoeve HLJ, Joosten KFM, Mathijssen IMJ

8:10 - 8:15
(5min.)

142
A Morphological Classification Scheme for the Mandibular Hypoplasia in Treacher Collins Syndrome

Presenter: Cassandra A. Ligh
Affiliation: Division of Plastic Surgery, University of Pennsylvania, USA
Authors: Ligh CA, Swanson JW, Yu JW, Samra F, Bartlett SP, Taylor JA

8:15 - 8:20 (5min.)	<p>143 Application of a new navigation guided distraction device in mandibular distraction osteogenesis Presenter: Ming Cai Affiliation: Dept. of oral & craniomaxillofacial science, Shanghai Ninth people's hospital, China Authors: Cai M, Shen G</p>
	<p>144 withdrawn</p>
8:20 - 8:25 (5min.)	<p>145 Implications of Syndromic Diagnoses in Pierre Robin Sequence: A Case Control Study Presenter: Wendy Chen Affiliation: University of Pittsburgh Department of Plastic and Reconstructive Surgery, USA Authors: Chen W, Lee W, Camison L, Davidson EH, Bykowski MR, Garland CB, Naran S, Grunwaldt LJ, Losee JE, Davit AJ, Goldstein JA</p>
8:25 - 8:30 (5min.)	<p>146 Predictors of Failure in Mandibular Distraction for Robin Sequence Presenter: Sunil S. Tholopady Affiliation: Indiana University School of Medicine, Division of Plastic Surgery, USA Authors: Tholopady SS, Greathouse ST, Fernandez S, Costa M, Tahiri Y, Soleimani T, Flores RL</p>
	<p>147 withdrawn</p>
8:30 - 8:33 (3min.)	<p>148 A clinical review of mandibular distraction osteogenesis in neonates with Pierre Robin sequence Presenter: Ji Yi Affiliation: Department of Plastic Surgery, Nanjing Children's Hospital, affiliated with Nanjing Medical University, China Authors: Yi J, Shen W, Cui J, Chen J</p>
8:33 - 9:00	Discussion

9:00 - 10:00 **Concurrent Session 13** Room C (B1F Ambio I)
Craniofacial Microsomia 2
 Chairs: *Arlene Rozzelle (USA) & Akira Yamada (USA)*

9:00 - 9:05 (5min.)	<p>149 Treated Pierre Robin sequence with placed allogenic acellular bone matrix and mandibular distraction osteogenesis Presenter: Weimin Shen Affiliation: Department of Plastic Surgery, Nanjing Children's Hospital, affiliated with Nanjing Medical University, China Authors: Shen W, Cui J, Chen J</p>
9:05 - 9:08 (3min.)	<p>150 Neonatal Mandibular Distraction Osteogenesis: Virtual Surgical Planning Becomes Operative Reality Presenter: Matthew Doscher Affiliation: Division of Plastic and Reconstructive Surgery, Montefiore Medical Center, USA Authors: Doscher M, Schreiber J, Stern C, Garfein E, Goodrich JT, Tepper O</p>

- 9:08 - 9:13
(5min.)
- 151**
Long-Term Dental and Nerve-Related Complications of Infant Distraction for Robin Sequence
Presenter: Jordan P. Steinberg
Affiliation: Children's Healthcare of Atlanta at Scottish Rite, USA
Authors: Steinberg JP, Brady C, Waters BR, Soldanska M, Burstein FD, Thomas JE, Williams JK
- 9:13 - 9:18
(5min.)
- 152**
Hemifacial Microsomia: Treatment in Childhood
Presenter: Xiaojun Tang
Affiliation: Department of Maxillofacial Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Science, Peking Union Medical College, China
Authors: Tang XJ, Zhang ZY, Shi L, Yin L, Liu W, Yin H
- 9:18 - 9:23
(5min.)
- 153**
Orthopedically induced orbital-maxillary-condylar growth in a patient with hemifacial microsomia
Presenter: Reiko Shibazaki-Yorozuya
Affiliation: Department of Orthodontics, Showa University School of Dentistry, Japan
Authors: Shibazaki-Yorozuya R, Yamada A, Nagata S, Maki K
- 9:23 - 9:28
(5min.)
- 154**
Treatment for patients with hemifacial microsomia in the University of Tokyo Hospital
Presenter: Takafumi Susami
Affiliation: Department of Oral-Maxillofacial Surgery, Dentistry and Orthodontics, University of Tokyo Hospital, Japan
Authors: Susami T, Takahashi N, Ohkubo K, Inokuchi T, Okayasu M, Uchino N, Uwatoko K, Matsubayashi Y, Saijo H, Hoshi K, Takato T
- 9:28 - 9:31
(3min.)
- 155**
Restoration of Facial Symmetry in Hemifacial Microsomia with Mandibular Outer Cortex Grafting and Gonioplasty
Presenter: YuanR You
Affiliation: Department of Craniomaxillofacial Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Science, Peking Union Medical College, China
Authors: You Y, Gui L
- 9:31 - 9:36
(5min.)
- 156**
Evaluation of Obstructive Sleep Apnea and Feeding Difficulties in Craniofacial Microsomia
Presenter: Cornelia J.J.M. Caron
Affiliation: Erasmus Medical Center-Sophia's Children's Hospital, the Netherlands
Authors: Caron CJJM, Pluijmers BI, Joosten KFM, van der Schroeff MP, Mathijssen IMJ, Dunaway DJ, Padwa BL, Wolvius EB, Koudstaal MJ
- 9:36 - 9:41
(5min.)
- 157**
Surgical care in craniofacial microsomia: a Boston-London-Rotterdam collaboration
Presenter: Britt I. Pluijmers
Affiliation: Erasmus Medical Center-Sophia's Children's Hospital, the Netherlands
Authors: Pluijmers BI, Caron LJJM, Padwa BL, Wolvius EB, Dunaway DJ, Koudstaal MJ
- 9:41 - 9:46
(5min.)
- 158**
A Case-Control Study of Cranial Base Deviation in Hemifacial Microsomia by Craniometric Analysis
Presenter: J Thomas Paliga
Affiliation: The Children's Hospital of Philadelphia, USA/Hospital of the University of Pennsylvania, USA/The Perelman School of Medicine at the University of Pennsylvania, USA
Authors: Paliga JT, Tahiri Y, Wink JD, Bartlett SP, Taylor JA
- 9:46 - 10:00
- Discussion

10:00 - 10:30	Concurrent Session 14 Craniofacial Microsomia 3 Chairs: <i>Fernando Molina F (Mexico) & Yorikatsu Watanabe (Japan)</i>	Room C (B1F Ambio I)
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10:00 - 10:05 (5min.)	159 Simultaneous Maxillo-Mandibular Distraction in preadolescent Hemifacial Microsomia patients Presenter: Ting-Chen Lu Affiliation: Chang Gung Craniofacial Center, Taiwan Authors: Lu T, Yao C, Chen PK	
10:05 - 10:10 (5min.)	160 Long term Outcomes of Craniofacial Microsomia Treatment: Mandibular Reconstruction Presenter: Deborah Martins Affiliation: Division of Plastic and Reconstructive Surgery, University of California Los Angeles, USA Authors: Martins D, Mandelbaum R, Willson T, Dubina E, Park S, Bradley JP, Lee JC	
10:10 - 10:15 (5min.)	161 Simulation-Guided Navigation for Vector Control in Mandibular Distraction Osteogenesis Presenter: Alberto Bianchi Affiliation: Oral and Maxillofacial Surgery Unit, S.Orsola-Malpighi University Hospital, University of Bologna, Italy Authors: Bianchi A, Badiali G, Cutolo F, Roncari A, Marchetti C	
10:15 - 10:20 (5min.)	162 Simultaneous orthognathic surgery and free flap in hemifacial microsomia—long term results Presenter: Mark H. Moore Affiliation: Australian Craniofacial Unit, Australia Authors: Moore MH, David DJ, Tan E	
10:20 - 10:23 (3min.)	163 Using dense surface correspondence to evaluate facial asymmetry Presenter: Ali Jafar Affiliation: Great Ormond Street Hospital, UK Authors: Jafar A, Ponniah AJT, Booth JA, Roussos A, Zafeiriou S, Dunaway DJ	
10:23 - 10:30	Discussion	
10:30 - 11:00	Coffee Break	

11:00 - 12:00	Panel Discussion 4 Microtia Reconstruction Chairs: <i>John F. Reinisch (USA) & Akihiko Oyama (Japan)</i>	Room C (B1F Ambio I)
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PD4-1**Constricted Ear-Featured Microtia and Lobule-Remnant Microtia: My Recent Reconstructive Methods**

Presenter: Chul Park

Affiliation: Department of plastic and Reconstructive Surgery, Korea University Anam Hospital, Korea

Author: Park C

PD4-2**Two-stage reconstruction of the auricle with- or without canal plasty**

Presenter: Hirotaka Asato

Affiliation: Dokkyo Medical University, Department of Plastic and Reconstructive Surgery, Japan

Author: Asato H

PD4-3

Ear Reconstruction with a pHDPPE Implant—a 23 year experience—

Presenter: John F. Reinisch

Affiliation: Keck School of Medicine, University of Southern California, USA

Author: Reinisch JF

PD4-4

20-Year Experience of Total Auricular Reconstruction Using Tissue Expander

Presenter: Tsuyoshi Kaneko

Affiliation: Division of Plastic Surgery, National Center for Child Health and Development, Japan

Authors: Kaneko T, Hikosaka M, Kajita H, Ohara H, Tokuyama E

Discussion

12:00 - 13:00

Lunch

13:00 - 14:00

Concurrent Session 15

Room C (B1F Ambio I)

CFM

Chairs: *Silvio Podda (USA) & Hirotaka Asato (Japan)*

13:00 - 13:05
(5min.)

164

Auricular Reconstruction in Treacher Collins-Franceschetti Syndrome: Firmin's Series of 82 patients

Presenter: Joseph R. Dusseldorp

Affiliation: Royal Australasian College of Surgeons, Australia

Authors: Dusseldorp JR, Firmin F

13:05 - 13:10
(5min.)

165

What is the Ideal Ear Position? Measurements and Aesthetic Outcome in Otoplasty Patients

Presenter: Jesse A. Goldstein

Affiliation: UPMC, USA

Authors: Goldstein JA, MacIsaac ZM, Zammerilla L, Naran S, Camison L, Garland CB, Losee JE, Grunwaldt LJ

13:10 - 13:13
(3min.)

166

An investigation of the fixation materials for cartilage frames in microtia and study on mechanism of the fixation

Presenter: Aritaka Sakamoto

Affiliation: Department of Plastic and Reconstructive Surgery and Maxillofacial Surgery, Kurume University School of Medicine, Japan

Authors: Sakamoto A, Kiyokawa K, Rikimaru H, Rikimaru Y

13:13 - 13:18
(5min.)

167

Our recent operative procedure for microtia—To acquire further real appearance of the ear—

Presenter: Takatoshi Yotsuyanagi

Affiliation: Department of Plastic and Reconstructive Surgery, Sapporo Medical University School of Medicine, Japan

Author: Yotsuyanagi T

13:18 - 13:23
(5min.)

168

A new design for microtiaplasty with tissue expansion

Presenter: Yumeji Takeichi

Affiliation: Daiyukai Diichi Hospital, Dept. of Plastic and Reconstructive Surgery, Japan

Authors: Takeichi Y, Motai H, Iguchi H, Tada H, Kato M, Asai A, Ito Y

- 13:23 - 13:28
(5min.)
- 169**
Use of ADM (Acellular Dermal Matrix) as scaffold enhancement in autologous costochondral ear reconstruction
Presenter: Silvio Podda
Affiliation: St. Joseph's Children's Hospital, USA
Authors: Podda S, Gargano F
- 13:28 - 13:33
(5min.)
- 170**
Precision of 3dMDTM in Anthropometry of the Auricle and its Application in Microtia Reconstruction
Presenter: Shih-Hsuan Mao
Affiliation: Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital at Linkou, Chang Gung University, College of Medicine, Taiwan
Authors: Mao S, Chen ZC
- 13:33 - 13:38
(5min.)
- 171**
Sensory Recovery Following Microtia Ear Reconstruction
Presenter: Akihiko Oyama
Affiliation: Department of Plastic and Reconstructive Surgery, Hokkaido University, Japan
Authors: Oyama A, Funayama E, Furukawa H, Hayashi T, Murao N, Yamamoto Y
- 13:38 - 13:43
(5min.)
- 172**
Precision of Three Dimensional Stereo-Photogrammetry (3dMD™) and its Application in Microtia Reconstruction
Presenter: Zung-chung Chen
Affiliation: Chang Gung Memorial Hospital, Taiwan
Authors: Chen ZC, Chen YR, Hsiao JC, Lizardo II JA, Nayef Albdour M
- 13:43 - 13:46
(3min.)
- 173**
Application of Computer-Assisted Design and Manufacture in Unilateral Alloplastic Microtia Reconstruction
Presenter: Hsin-Yu Chen
Affiliation: Craniofacial Research Center, Division of Craniofacial Surgery, Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital, Chang Gung Medical College and University, Taiwan
Authors: Chen H, Chen ZC
- 13:46 - 14:00
- Discussion

14:00 - 15:00

Panel Discussion 5 Room C (B1F Ambio I)
Virtual Orthognathic Surgery
Chairs: *Joseph McCarthy (USA) & Juan Martin Chavanne (Argentina)*

PD5-1

Three-Dimensional Computer-Assisted Orthognathic Surgery: Chang Gung Experience

Presenter: Lun-Jou Lo
Affiliation: Plastic & Reconstructive Surgery, and Craniofacial Research Center, Chang Gung Memorial Hospital, Chang Gung University, Taiwan
Authors: Lo LJ, Lin H, Chang H, Wang C, Kim SG

PD5-2

The Virtual Transformation. Virtual Surgical Planning (VPS) and Occlusal Positioning Systems (OPS) and Beyond!

Presenter: John W. Polley

Affiliation: Helen Devos Children's Hospital, Oral Cleft and Craniofacial Program Pediatric Plastic Surgery, Grand Rapids, USA

Author: Polley JW

PD5-3

CAD CAM TECHNOLOGY: ITS APPLICATION IN COMPLEX TWO JAW SURGERY FOR THE CORRECTION OF FACIAL ASYMMETRY

Presenter: Joseph McCarthy

Affiliation: Plastic & reconstructive surgery, Department of Pediatrics NYU Langone Medical Center, USA

Author: McCarthy JG

PD5-4

Virtual Surgical Planning Optimizes Surgical Outcomes in Osteocutaneous Free Flap Mandible Reconstruction

Presenter: Eric I. Chang

Affiliation: Fox Chase Cancer Center, USA

Author: Chang EI

Discussion

15:00 - 15:30

Coffee Break

15:30 - 16:00

Concurrent Session 16

Room C (B1F Ambio I)

Craniofacial Microsomia 4

Chairs: *Patrick A. Diner (France) & Mark Moore (Australia)*

15:30 - 15:35
(5min.)

174

Long-term growth of costochondral rib grafts in mandibular reconstruction for craniofacial microsomia

Presenter: Andrew R. Bauder

Affiliation: Division of Plastic Surgery, Perelman School of Medicine at the University of Pennsylvania, Children's Hospital of Philadelphia, USA

Authors: Bauder AR, Mitchell BT, Swanson J, Taylor JA, Bartlett SP

15:35 - 15:38
(3min.)

175

A Multicenter Assessment of the Surgical Burden for Patients with Craniofacial Microsomia

Presenter: Craig B. Birgfeld

Affiliation: Seattle Children's Hospital, University of Washington, USA

Authors: Birgfeld CB, Saltzman B, Bartlett SP, Urata M, Pimenta L, Drake A

15:38 - 15:43
(5min.)

176

Evaluation of the Zygoma and Temporomandibular Joint in Hemifacial Microsomia

Presenter: Lin Lin Gao

Affiliation: Children's Hospital of Philadelphia, USA

Authors: Gao LL, Yu JW, Wink JD, Taylor JA, Bartlett SP

- 15:43 - 15:48
(5min.) **177**
Foundation research of the Sandwich method for treatment of mandibular hypoplasia caused by hemifacial microsomia
Presenter: Jia Xu
Affiliation: Department of Cranio-maxillo-facial surgery, Plastic surgery hospital, Peking union medical college, China
Authors: Xu J, Gui L
- 15:48 - 15:51
(3min.) **178**
Radical Bi-Maxillary Distraction in Severe Mandibulofacial Dysostosis
Presenter: Christopher B. Gordon
Affiliation: Cincinnati Children's Hospital Medical Center, USA
Authors: Gordon CB, Runyan CM
- 15:51 - 16:00 Discussion

16:00 - 17:10 **Concurrent Session 17** Room C (B1F Ambio I)
Craniofacial Microsomia 5
Chairs: *Jeffrey L. Marsh (USA) & Koichi Kadomatsu (Japan)*

- 16:00 - 16:05
(5min.) **179**
Staged bony framework reconstruction and lipo-filling for Adult Severe Parry-Romberg Syndrome
Presenter: Zhiyong Zhang
Affiliation: Maxillofacial Surgery Center, Plastic Surgery Hospital, Chinese Academy of Medical Sciences, China
Authors: Zhang ZY, Tang XJ, Yin L, Shi L
- 16:05 - 16:10
(5min.) **180**
The Effects of Tongue Reduction for Macroglossia of Beckwith-Wiedemann Syndrome
Presenter: Jeffrey L. Marsh
Affiliation: Mercy Children's Hospital, USA
Author: Marsh JL
- 16:10 - 16:15
(5min.) **181**
Mandibular Distraction Combined with Orthognathic Techniques for Severe Adult Mandibular Hypoplasia
Presenter: Lin Yin
Affiliation: Department of maxillofacial Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Sciences (CAMS) & Peking Union Medical College (PUMC), Beijing, China
Author: Yin L
- 16:15 - 16:20
(5min.) **182**
MANDIBULAR SYMPHYSEAL DISTRACTION IN THE SILVER RUSSELL SYNDROME
Presenter: Eva Galliani
Affiliation: Department of Maxillo-facial et Plastic Surgery, Hôpital Necker-Enfants malades, France/Centre de Référence Malformations Rares de la Face et de la Cavité Buccale, France
Authors: Galliani E, Diner PA, Tomat C, Kadlub N, Vazquez M, Picard A
- 16:20 - 16:23
(3min.) **183**
Long-term outcomes & treatment strategies in Otocephaly-Dysgnathia Complex
Presenter: Michael S. Golinko
Affiliation: New York University, Institute of Reconstructive Plastic Surgery, USA
Authors: Golinko MS, Staffenberg D, Flores RL, Shetye PR, McCarthy JG

- 16:23 - 16:28
(5min.)
- 184**
The role of ethnicity as a risk factor in the development of Parry Romberg Syndrome
Presenter: Damian Palafox
Affiliation: Plastic and Reconstructive Surgery Department. Hospital General Gea Gonzalez, Mexico
Authors: Palafox D, Gutierrez C, Granados J, Barquera R, Hernandez-Zaragoza DI, Pacheco-Ubaldo HR, Lona-Sanchez A, Ortega-Hernandez EJ, Guerrero A, Perez-Dosal M
- 16:28 - 16:31
(3min.)
- 185**
Treating Romberg Syndrome Using 3D Scanning and Printing and the Anterolateral Thigh Dermal Adipofascial Flap
Presenter: Haisong Xu
Affiliation: Shanghai Ninth people's hospital, Shanghai Jiao Tong University School of Medicine, China
Authors: Xu H, Tan A, Zhan Y, Chai G
- 16:31 - 16:34
(3min.)
- 186**
Indication for Early Mandibular Distraction Osteogenesis in Hemifacial Microsomia: A long-term follow-up study
Presenter: Yorikatsu Watanabe
Affiliation: Tokyo Metropolitan Police Hospital, Japan
Authors: Watanabe Y, Akizuki T, Kurakata M, Ohmori K
- 16:34 - 16:37
(3min.)
- 187**
APPLYING COMPUTER TECHNIQUES IN RECONSTRUCTING SKELETAL AND SOFT TISSUE FOR PARRY-ROMBERG SYNDROME
Presenter: Jia Qiao
Affiliation: the Department of Maxillofacial Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Science, Peking Union Medical College, China.
Authors: Qiao J, Gui L
- 16:37 - 16:42
(5min.)
- 188**
Evolution of surgical methods to increase volume in hemifacial microsomia (154 cases)
Presenter: Xiongzhen Mu
Affiliation: Shanghai Ninth People's Hospital, China
Author: Mu X
- 16:42 - 16:45
(3min.)
- 189**
Using principal components analysis to assess mandibular anatomy in craniofacial microsomia
Presenter: Kohmal A. Solanki
Affiliation: Department of Craniofacial Surgery, Great Ormond Street Hospital for Children, UK/Department of Medical Physics, University College London Hospital, UK
Authors: Solanki KA, Ponniah AJT, Ruff CF, Koudstaal MJ, Dunaway DJ
- 16:45 - 16:50
(5min.)
- 190**
Simultaneous Biplanar Maxillomandibular Distraction Osteogenesis using Single Distractor
Presenter: Hüseyin Karagöz
Affiliation: Gulhane Military Medical Academy, Haydarpasa Training Hospital, Turkey
Authors: Karagöz H, Erkan M, Öksüz S, Eren F, Cesur C, Ülkür F, Ülkür E
- 16:50 - 16:55
(5min.)
- 191**
Predictive Soft tissue Airway Volume Analysis in Mandibular Distraction for Obstructive Sleep Apnea
Presenter: Russell R. Reid
Affiliation: University of Chicago, Department of Surgery, Section of Plastic and Reconstructive Surgery, USA
Authors: Reid RR, Mhlaba BS JM, Lemelman BT, Silva AK, Chen M
- 16:55 - 17:10
- Discussion

17:10 - 17:55	Concurrent Session 18 CLCP 1 Chairs: <i>Koichi Ueda (Japan) & Kreshanti Prasetyanugraheni (Indonesia)</i>	Room C (B1F Ambio I)
17:10 - 17:15 (5min.)	<p>192 Social Services Offered by Cleft and Craniofacial Teams: A National Survey and Institutional Experience Presenter: Gregory E. Lakin Affiliation: Plastic Surgery, Craniofacial Center, UH Rainbow Babies & Children's Hospital, Department of Plastic Surgery, Case Western Reserve University School of Medicine, USA Authors: Lakin GE, Ascha M, McDaniel J, Link I, Becker D, Rowe D, Soltanian H</p>	
17:15 - 17:20 (5min.)	<p>193 ANALYSIS OF NASOLABIAL AESTHETICS IN PATIENTS WITH CUCLP TREATED BY ONE-STAGE SURGERY VS. NAM AND TWO-STAGE SURGERY Presenter: Supakit Peanchitlertkajorn Affiliation: Hayward Braces, USA Authors: Peanchitlertkajorn S, Yokoo KM, Menard RM, Worasakwuttiiphong S, Brudnicki A, Fudalej PS</p>	
17:20 - 17:25 (5min.)	<p>194 MODIFIED ANATOMICAL SUBUNIT APPROXIMATION TECHNIQUE WITH SIMPLIFIED NASAL FLOOR CLOSURE IN WIDE CLEFT LIP Presenter: Siti Handayani Affiliation: Cleft and Craniofacial Center Cipto Mangunkusumo Hospital-University of Indonesia, Indonesia Authors: Handayani S, Kreshanti P</p>	
17:25 - 17:28 (3min.)	<p>195 The proposal to preserve the lesser palatine nerve in palatoplasty Presenter: Hideaki Kishimoto Affiliation: Department of Plastic Surgery, Kyoto University Graduate School of Medicine, Japan Authors: Kishimoto H, Yamada S, Katsube M, Masuoka H, Kawai K, Suzuki S</p>	
17:28 - 17:33 (5min.)	<p>196 Optimising the Delivery of Surgical Aid Work: a 15-year experience Presenter: Priya Nandoskar Affiliation: Royal Adelaide Hospital, Australia Authors: Nandoskar P, Coghlan P, Moore MH</p> <p>197 withdrawn</p>	
17:33 - 17:38 (5min.)	<p>198 Single Stage Primary Cheilo-Naso-Alveoloplasty in Complete BCLP Without Nasoalveolar Molding Presenter: Amir S. Elbarbary Affiliation: Plastic Surgery Department, Ain-Shams University, Egypt Author: Elbarbary AS</p>	
17:38 - 17:55	Discussion	

8:00 - 9:00

Concurrent Session 19
Craniofacial Research 1

Room D (B1F Ambio II)

Chairs: *Hiroshi Mizuno (Japan) & Steven R. Cohen (USA)*

8:00 - 8:03
(3min.)

199

Multidisciplinary Algorithm for Implant-based Cranioplasty Reconstruction in Previously Infected Sites

Presenter: Shuting Zhong

Affiliation: University of Illinois College of Medicine, USA/The Johns Hopkins Hospital Department of Plastic and Reconstructive Surgery, USA

Authors: Zhong S, Lopez J, Sankey EW, Torres IJ, Swanson EW, Liauw J, Huang J, Auwaerter PG, Gordon CR

8:03 - 8:06
(3min.)

200

The effect of bone regeneration using adipose-derived stem cells and platelet-rich plasma

Presenter: Satoshi Tajima

Affiliation: Department of Plastic and Reconstructive Surgery, Juntendo University School of Medicine, Japan

Authors: Tajima S, Tobita M, Mizuno H

8:06 - 8:11
(5min.)

201

BMPR-IA+ Adipose-Derived Stromal Cells: A Promising Candidate for Soft Tissue Reconstruction

Presenter: Elizabeth R. Zielins

Affiliation: Hagey Laboratory for Pediatric Regenerative Medicine, Division of Plastic Surgery, Stanford University, USA

Authors: Zielins ER, Paik KJ, Luan A, Brett EA, Senarath-Yapa K, Atashroo DA, Walmsley GG, Maan ZN, Marecic O, Wearda T, Longaker MT, Wan DC

8:11 - 8:16
(5min.)

202

Upper airway endoscopy in children with syndromic craniosynostosis

Presenter: Marc van der Schroeff

Affiliation: Dutch Craniofacial Center, ErasmusMC, The Netherlands

Authors: Schroeff MVD, Doerga PN, Spruijt B, Wolvius EB, Mathijssen IMJ, Joosten KFM

8:16 - 8:21
(5min.)

203

Comparative study of the orbital shape in Crouzon and Apert syndromes: a quantitative assessment of surgical results

Presenter: Roman Hossein Khonsari

Affiliation: AP-HP, Service de chirurgie maxillo-faciale, Hôpital de la Pitié-Salpêtrière, Paris, F-75013, France and UPMC Université Paris 06, F-75005, Paris, France

Authors: Khonsari RH, Nysjö J, Way B, Odri G, Olszewski R, Nyström I, Dunaway DJ, Evans RE, Britto JA

8:21 - 8:24
(3min.)

204

Modulation of BMP2-induced Calvarial Defect Healing Using Adipose, Bone Marrow, and Muscle-derived Stromal Cells

Presenter: Michael R. Bykowski

Affiliation: University of Pittsburgh, Department of Plastic Surgery, USA

Authors: Bykowski MR, Shakir S, Wang D, Shaw MA, Smith DM, Naran S, MacIsaac ZM, Losee JE, Cooper GM

8:24 - 8:29
(5min.)

205

Ectopic Osteogenesis of Allogeneic Bone Mesenchymal Stem Cells Loading on β -TCP in Canines

Presenter: Fang Xie

Affiliation: Plastic Surgery Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College, China

Authors: Xie F, Teng L, Cai L, Xiao R, Wang Q, Cao Y

- 8:29 - 8:34
(5min.) **206**
Endothelial Cells from Capillary Malformations are Enriched for Somatic GNAQ Mutations
Presenter: Arin K. Greene
Affiliation: Department of Plastic and Maxillofacial Surgery, Hospital Necker University Paris 5, France
Authors: Greene AK, Couto JA, Huang L, Vivero MP, Kamitaki N, Maclellan RA, Mulliken JB, Bischoff J, Warman ML
- 8:34 - 8:39
(5min.) **207**
Facial Lipostructure in Craniofacial Congenital Deformities
Presenter: Manlio Galie'
Affiliation: Unit of Cranio Maxillo Facial Surgery-“St. Anna” Hospital and University, Italy
Authors: Galie' M, Clauser LC, Elia G
- 8:39 - 8:44
(5min.) **208**
A patient specific computational model to predict outcomes of spring cranioplasty
Presenter: Silvia Schievano
Affiliation: UCL Institute of Child Health & Great Ormond Street Hospital for Children, UK
Authors: Schievano S, Borghi A, Hayward RD, Dunaway DJ, Jeelani NUO
- 8:44 - 9:00 Discussion

9:00 - 10:00 **Concurrent Session 20** Room D (B1F Ambio II)
Craniofacial Research 2
Chairs: *Peter Anderson (Australia) & Soh Nishimoto (Japan)*

- 9:00 - 9:05
(5min.) **209**
Autotransplantation of monkey ear perichondrium-derived progenitor cells for cartilage reconstruction
Presenter: Shintaro Kagimoto
Affiliation: Department of Plastic and Reconstructive Surgery, Yokohama City University Hospital, Japan
Authors: Kagimoto S, Takebe T, Kobayashi S, Yabuki Y, Toi A, Hirotohi K, Mikami T, Uemura T, Maegawa J, Taniguchi H
- 9:05 - 9:10
(5min.) **210**
TWIST1 Silencing Enhances in vitro and in vivo Osteogenic differentiation of human Adipose Derived Stem Cells.
Presenter: Kshemendra Senarath-Yapa
Affiliation: Stanford University, USA/Department of Craniofacial Development and Stem Cell Biology, Kings College London, UK
Authors: Senarath-Yapa K, Quarto N, Renda A, Longaker MT
- 9:10 - 9:15
(5min.) **211**
Craniofacial features of GPC1 & GPC3 compund knockout mice
Presenter: Peter J. Anderson
Affiliation: Australian Craniofacial Unit, Australia
Author: Anderson PJ
- 9:15 - 9:20
(5min.) **212**
Glypican3 induces proliferation in hFOB cells
Presenter: Ronghu Ke
Affiliation: Department of Plastic and Reconstructive Surgery, Huashan Hospital, Fudan University School of Medicine, China
Authors: Ke R, Cai T, Mu X

- 9:20 - 9:25
(5min.) **213**
Does prolonged reconstruction of disarticulation defect with bone plate affect the EMG of masticatory muscles?
Presenter: Emad T. Daif
Affiliation: Oral & Maxillofacial Surgery, Cairo University, Egypt
Author: Daif ET
- 9:25 - 9:30
(5min.) **214**
THE EFFECT OF hPTPB INHIBITOR ON MICROCIRCULATION FOLLOWING ISCHEMIA-REPERFUSION INJURY OF MUSCLE
Presenter: Fatih Zor
Affiliation: Gulhane Military Medical Academy, Dept. of Plastic Surgery, Turkey
Authors: Zor F, Meric C, Karagöz H, Siemionow M
- 9:30 - 9:35
(5min.) **215**
Exogenous Growth Factor Independent Osteogenesis on Nanoparticulate Mineralized Collagen Scaffolds
Presenter: Justine C. Lee
Affiliation: Division of Plastic and Reconstructive Surgery, University of California Los Angeles, USA/Greater Los Angeles VA Healthcare System, USA
Authors: Lee JC, Ren X, Bischoff D, Weisgerber DW, Lewis MS, Yamaguchi DT, Miller TA
- 9:35 - 9:40
(5min.) **216**
Biopatterned rhBMP2 Does Not Induce Pansynostosis or Growth Restriction in the Immature Craniofacial Skeleton
Presenter: Sameer Shakir
Affiliation: University of Pittsburgh, Department of Plastic Surgery, USA
Authors: Shakir S, Basri O, Cray JJ, Naran S, Smith DM, MacIsaac ZM, Katzel EB, Schuster LA, Weinberg SM, Mooney MP, Losee JE, Cooper GM
- 9:40 - 9:45
(5min.) **217**
Identification and Isolation of a Dermal Lineage with Intrinsic Fibrogenic Potential
Presenter: Graham G. Walmsley
Affiliation: Stanford University, USA
Authors: Walmsley GG, Hu MS, Maan ZN, Rinkevich Y, Januszyk M, Gurtner GC, Weissman IL, Lorenz HP, Longaker MT
- 9:45 - 9:50
(5min.) **218**
Activation of HIF by small molecule inhibitors of PHD2 accelerates wound healing in vivo
Presenter: Michael S. Hu
Affiliation: Stanford University, USA/University of Hawaii, USA
Authors: Hu MS, Hong WX, Xie M, Tang S, Maan ZN, Gurtner GC, Giaccia AJ, Lorenz HP, Ding S, Longaker MT
- 9:50 - 10:00 Discussion

10:00 - 10:30

Concurrent Session 21

Room D (B1F Ambio II)

Craniofacial Research 3

Chairs: *James P. Bradley (USA) & Takayuki Honda (Japan)*

10:00 - 10:03
(3min.)

219

SPRING BEHAVIOUR IN SURGICAL TREATMENT OF SAGITTAL CRANIOSYNOSTOSIS

Presenter: Alessandro Borghi

Affiliation: Institute of Child Health-University College London, UK

Authors: Borghi A, Schievano S, Ponniah AJT, Rodgers WP, Angullia F, Dunaway DJ, Jeelani NUO

10:03 - 10:08 (5min.)	<p>220 Biopatterned Reconstruction of Subtotal Calvarial Defects: Addition of AMD3100 is potentiated by BMP-2 Presenter: Catharine B. Garland Affiliation: University of Pittsburgh, USA Authors: Garland CB, MacIsaac ZM, Shakir S, Naran S, Grunwaldt LJ, Goldstein JA, Camison L, Smith D, Cooper GM, Losee JE</p>
10:08 - 10:13 (5min.)	<p>221 Biopatterned Reconstruction of Subtotal Calvarial Defects: Inhibition of Bony Regeneration with Addition of VEGF Presenter: Catharine B. Garland Affiliation: University of Pittsburgh, USA Authors: Garland CB, MacIsaac ZM, Shakir S, Naran S, Grunwaldt LJ, Goldstein JA, Camison L, Smith D, Cooper GM, Losee JE</p>
10:13 - 10:18 (5min.)	<p>222 Prefabricated, Ear-shaped Cartilage Tissue Engineering by Scaffold-free Porcine Chondrocytes Membrane Presenter: Han-Tsung Liao Affiliation: Department of Plastic and Reconstructive surgery, Chang Gung Memorial Hospital, Taiwan Author: Liao H</p>
10:18 - 10:30	Discussion
10:30 - 11:00	Coffee Break

11:00 - 12:00	<p>Panel Discussion 6 Cleft Lip and Palate Surgery Chairs: <i>Anthony Wolfe (USA) & Keisuke Imai (Japan)</i></p>	Room D (B1F Ambio II)
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PD6-1

Cleft care at Seoul National University Children’s Hospital during the last 30 years

Presenter: Sukwha Kim
 Affiliation: Department of Plastic Surgery, Seoul National University College of Medicine, Korea
 Authors: Kim S, Chung JH, Choi TH, Baek SH, Kim JC, Yang IH

PD6-2

An integrated approach for primary nasal reconstruction in unilateral cleft lips

Presenter: Philip Kuo-Ting Chen
 Affiliation: Craniofacial Center, Chang Gung Memorial Hospital, Taiwan
 Author: Chen PK

PD6-3

Cleft Palate Repair Using the Buccal Flap

Presenter: Robert J. Mann
 Affiliation: Helen DeVos Children’s Hospital Grand Rapids, USA
 Author: Mann RJ

PD6-4

Importance of correcting the alar base position in patients with cleft lip during primary lip repair

Presenter: Yohko Yoshimura
 Affiliation: Dept. of Plastic and Reconstructive Surgery, School of Medicine, Cleft Lip/Palate Center, Fujita Health University, Japan
 Authors: Yoshimura Y, Okumoto T, Inoue Y, Onishi S

PD6-5

Presurgical Maxillary Orthopedics is Associated with Normal Mid-Face Growth in Unilateral Cleft Patients

Presenter: S. Anthony Wolfe

Affiliation: Miami Children's Hospital, USA

Authors: Wolfe SA, Mejia M

Discussion

12:00 - 13:00

Lunch

13:00 - 13:30

Concurrent Session 22

Room D (B1F Ambio II)

Craniofacial Research 4

Chairs: *Peter Anderson (Australia) & Akira Takeda (Japan)*

13:00 - 13:05
(5min.)

223

Long-term survival of composite midface allograft and development of multi-lineage chimerism

Presenter: Yalcin Kulahci

Affiliation: Gulhane Military Medical Academy, Dept. of Hand Surgery, Turkey

Authors: Kulahci Y, Karagöz H, Zor F, Bozkurt M, Cwykel J, Siemionow M

13:05 - 13:10
(5min.)

224

Mutations of Hedgehog and Wnt signaling pathway genes suggest a role in craniosynostosis

Presenter: Martin Rachwalski

Affiliation: Department of Craniomaxillofacial Plastic Surgery, University Hospital of Cologne, Germany/
Institute of Human Genetics, University Hospital of Cologne, Germany/Center for Molecular
Medicine Cologne (CMMC), University of Cologne, Germany

Authors: Rachwalski M, Li Y, Beleggia F, Vargel I, Mavli E, Nürnberg P, Akarsu N, Wollnik B

13:10 - 13:13
(3min.)

225

Outcomes Analysis of Mandibular Distraction: Treacher Collins versus Robin Sequence

Presenter: Christopher M. Runyan

Affiliation: NYU Langone medical center plastic surgery department, USA

Authors: Runyan CM, Nardini G, Hosseinian B, Seo L, Shetye PR, Staffenberg D, Golinko M, Flores RL

13:13 - 13:18
(5min.)

226

Connective Tissue Growth Factor (CTGF/CCN2) is Essential for Secondary Palatogenesis

Presenter: Alex G. Lambi

Affiliation: Temple University School of Medicine, USA

Authors: Lambi AG, Tarr JT, Hindin DI, Popoff SN, Bradley JP

13:18 - 13:23
(5min.)

227

A NOVEL PROTOCOL FOR ASCs ISOLATION USING NEUTRAL PROTEASE IN VITRO AND IN A MOUSE CALVARIAL DEFECT MODEL.

Presenter: David Leshem

Affiliation: Department of Plastic & Reconstructive Surgery, Tel Aviv Sourasky Medical Center, Israel

Authors: Leshem D, Aronovich A, Manheim S, Gur E, Shani N

13:23 - 13:30

Discussion

13:30 - 14:00 **Concurrent Session 23** Room D (B1F Ambio II)
CLCP 2
 Chairs: *Robert M. Menard R (USA) & Suk Wha Kim (Korea)*

13:30 - 13:35 (5min.) **228**
A Study of the Effects of Paranasal Augmentation in Secondary Unilateral Cleft Lip Nasal Deformity
 Presenter: Seungmin Nam
 Affiliation: Soonchunhyang University, College of Medicine, Department of Plastic and Reconstructive Surgery, Korea
 Authors: Nam S, Kim Y, Park E, Shin H, Choi C

13:35 - 13:38 (3min.) **229**
Fixation of Regenerative Tissue Matrix with Bioabsorbable Bone Anchors in Cleft Palate Repair
 Presenter: Chad Perlyn
 Affiliation: Miami Children's Hospital, FIU College of Medicine, USA
 Authors: Perlyn C, Wolfe SA, MacArthur IR, Nathan NR

13:38 - 13:43 (5min.) **230**
Evaluating the Need for Routine Admission Following Primary Cleft Palate Repair: Analysis of 100 Consecutive Cases
 Presenter: Albert K. Oh
 Affiliation: Plastic & Reconstructive Surgery, Children's National Medical Center, USA
 Authors: Oh AK, Wood BC, Magge KT, Sauerhammer TM, Boyajian MJ, Zurakowski D, Rogers GF

13:43 - 13:48 (5min.) **231**
Improved results in cleft lip rhinoplasty-the modified Vissarionov technique-a 55 patient series
 Presenter: Robert M. Menard
 Affiliation: Northern California Kaiser Permanente Craniofacial Clinic, USA/Stanford University School of Medicine, Division of Plastic Surgery, USA
 Authors: Menard RM, Friduss M

13:48 - 14:00 Discussion

14:00 - 15:00 **Panel Discussion 7** Room D (B1F Ambio II)
Aesthetic Facial Bone Contouring
 Chairs: *Michael Yaremchuk (USA) & Xhingzheng Mu (China)*

PD7-1

Alloplastic Augmentation of the Facial Skeleton—An Adjunct or Alternative to Orthognathic Surgery

Presenter: Michael J. Yaremchuk
 Affiliation: Harvard Medical School, Massachusetts General Hospital, Harvard Plastic Surgery Training Program, USA
 Author: Yaremchuk MJ

PD7-2

L-Type Osteotomy for Reduction Malarplasty: 18 years Review

Presenter: Gui Lai
 Affiliation: Department of Craniofacial Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College, China
 Author: Lai G

PD7-3

Goals and Techniques of Mandible and Zygoma Reduction in Korea

Presenter: Minbum Kang

Affiliation: Romian plastic surgery clinic, Korea/Clinical Faculty of Plastic & Reconstructive Surgery, Ajou University, Korea

Author: Kang M

PD7-4

Presenter: Rong Min Baek

Affiliation: Seoul National University, Korea

Author: Baek RM

PD7-5

Aesthetic orthognathic, facial contouring, and adjunctive surgery.

Presenter: Derek M. Steinbacher

Affiliation: Craniomaxillofacial Surgery, Yale Plastic Surgery, USA

Author: Steinbacher DM

Discussion

15:00 - 15:30

Coffee Break

15:30 - 16:30

Concurrent Session 24

Room D (B1F Ambio II)

Orthognathic Surgery

Chairs: *Yoshimichi Imai (Japan) & Pradip R. Shetye (USA)*

15:30 - 15:35
(5min.)

232

Soft-tissue profile changes through anterior maxillary distraction in patients with cleft palate

Presenter: Yoshimichi Imai

Affiliation: Department of Plastic and Reconstructive Surgery, Tohoku University Graduate School of Medicine, Japan

Authors: Imai Y, Kanzaki H, Daimaruya T, Igarashi K, Sato A, Sibuya N, Nakajou T, Kochi S, Tachi M

15:35 - 15:40
(5min.)

233

Face or Occlusion?

Presenter: Dr CHRISTODOULOS Laspos

Affiliation: Cyprus Center for Clefts and Facial Deformities "MEDICLEFT", Greece

Author: Laspos DC

15:40 - 15:45
(5min.)

234

Mapping the Mandibular Lingula in Pierre Robin Sequence: A Guide to the Inverted-L Osteotomy

Presenter: Wendy Chen

Affiliation: University of Pittsburgh Department of Plastic and Reconstructive Surgery, USA

Authors: Chen W, Davidson EH, MacIsaac ZM, Kumar AR

15:45 - 15:48
(3min.)

235

Does the GOSLON Yardstick predict future requirement for Orthognathic surgery?

Presenter: Kirstin G. Miteff

Affiliation: Princess Margaret Hospital, Western Australia

Authors: Miteff KG, Zaman R, Singer S, Nicholls W, Gillett D, Walters M

- 15:48 - 15:53
(5min.)
- 236**
The Safety of the LeFort I Osteotomy: A Review of 202 Cases Over 36 Years
Presenter: Ian R. MacArthur
Affiliation: Miami Children's Hospital, USA
Authors: MacArthur IR, Nathan NR, Hajirawala L, Wolfe SA
- 15:53 - 15:56
(3min.)
- 237**
Evaluation of the mandibular split patterns in sagittal split ramus osteotomy
Presenter: Min Hou
Affiliation: Oral and Maxillofacial Surgery Professor, Department of orthognathic surgery, Tianjin Stomatological Hospital of Nankai University, China/Master of tianjin medical university, China
Authors: Hou M, Tian-Ping Y, Jian-Guo W
- 15:56 - 16:01
(5min.)
- 238**
Maxillomandibular Rotational Advancement for Adult Obstructive Sleep Apneics
Presenter: Cheng-Hui Lin
Affiliation: Craniofacial Center, Chang Gung Memorial Hospital, Taiwan/Sleep Center, Chang Gung Memorial Hospital, Taiwan
Authors: Lin C, Sasaki R, Chen YR
- 16:01 - 16:06
(5min.)
- 239**
Cosmetic OGS (orthognathic surgery without change of occlusal relationship): applications and result
Presenter: Yu-Ray Chen
Affiliation: Chang Gung Craniofacial Center, Chang Gung Memorial Hospital, Taiwan
Authors: Chen YR, Liao Y, Huang CS
- 16:06 - 16:11
(5min.)
- 240**
Correction of Facial Asymmetry using CAD CAM Technology: An Evaluation of Post-Surgical Results
Presenter: Pradip R. Shetye
Affiliation: NYU Langone Medical Center, USA
Authors: Shetye PR, Grayson B, McCarthy JG
- 16:11 - 16:16
(5min.)
- 241**
Bilateral Medial Femoral Condyle Flaps for Management of Secondary Robin Deformity
Presenter: Raymond Harshbarger
Affiliation: University of Texas, USA
Authors: Harshbarger R, Myers R, Kelley P, Henry S
- 16:16 - 16:30
Discussion

16:30 - 17:30

Concurrent Session 25

Room D (B1F Ambio II)

Orthognathic SurgeryChairs: *Yu Ray Chen (Taiwan) & Kenji Kusumoto (Japan)*16:30 - 16:33
(3min.)**242****The Midface in Muenke Syndrome: Is it Hypoplastic?**

Presenter: Fares Samra

Affiliation: University of Pennsylvania, USA/Children's Hospital of Philadelphia, USA

Authors: Samra F, Swanson JW, Whitaker LA, Bartlett SP, Taylor JA

- 16:33 - 16:36
(3min.)
- 243**
Preventing relapse of mandibular midline shifts in sagittal split ramus osteotomy
Presenter: Sinan Öksüz
Affiliation: Gulhane Military Medical Academy Haydarpasa Training Hospital, Department of Plastic Reconstructive and Aesthetic Surgery, Turkey
Authors: Öksüz S, Ülkür F, Eren F, Karagöz H, Ülkür E
- 16:36 - 16:39
(3min.)
- 244**
A Wearable System Based On Augmented Reality For Maxillofacial Bone Surgery
Presenter: Giovanni Badiali
Affiliation: PhD School in Surgical Sciences, University of Bologna, Italy
Authors: Badiali G, Ferrari V, Cutolo F, Freschi C, Caramella D, Bianchi A, Marchetti C
- 16:39 - 16:44
(5min.)
- 245**
Internal Distraction Resulted in Improved Patient Reported Outcomes for Midface Hypoplasia
Presenter: David I. Hindin
Affiliation: Division of Plastic and Reconstructive Surgery, Temple University School of Medicine, USA
Authors: Hindin DI, Lee JC, Kumar A, Kawamoto HK, Bradley JP
- 16:44 - 16:49
(5min.)
- 246**
A 3D Study of Midfacial Changes Following Segmental LeFort II/III Distraction in Syndromic Patients
Presenter: James M. Smartt
Affiliation: University of Texas Southwestern, Department of Plastic Surgery, USA
Authors: Smartt JM, Campbell C, Hallac R, Derderian CA, Vieira P
- 16:49 - 16:54
(5min.)
- 247**
Two-pin External MDO for Neonatal Airway Obstruction from Pierre Robin Sequence: Long Term Outcomes
Presenter: Christopher M. Runyan
Affiliation: Cincinnati Children's Hospital Medical Center, USA
Authors: Runyan CM, Gendron C, Billmire DA, Pan BS, Gordon CB
- 16:54 - 16:59
(5min.)
- 248**
Improved Outcomes Following Orthognathic Surgery Are Associated with High-volume Centers
Presenter: Charles T. Tuggle
Affiliation: Yale University School of Medicine, USA
Authors: Tuggle CT, Berlin NL, Steinbacher DM
- 16:59 - 17:04
(5min.)
- 249**
STAGED ORTHOGNATHIC TREATMENT OF SEVERE SLEEP APNEA IN ACHONDROPLASIA
Presenter: Hitesh Kapadia
Affiliation: Seattle Children's Craniofacial Center, USA
Authors: Kapadia H, Hopper RA, Dorafshar AH, Lopez J, Roberts S, Medina MA, Soni A
- 17:04 - 17:09
(5min.)
- 250**
Mandibular distraction osteogenesis on condylar load & stress distribution: A finite element analysis model
Presenter: Scott Rapp
Affiliation: Stanford University Medical Center, USA/Cincinnati Children's Hospital Medical Center, USA
Authors: Rapp S, Hunter D, Singh G, Ryan R, Gordon CB, Pan BS, Wan DC
- 17:09 - 17:12
(3min.)
- 251**
Mandibular Distraction via Cranial Traction in Syndromic Micrognathia
Presenter: Scott Rapp
Affiliation: Cincinnati Children's Hospital Medical Center, USA
Authors: Rapp S, Runyan CM, Gendron C, Billmire DA, Pan BS, van Aalst JA, Gordon CB

17:12 - 17:17
(5min.)

252

Single Vs Segmental Maxillary Osteotomies & Long-Term Stability in Unilateral Cleft Lip and Palate Malocclusion

Presenter: Guy D. Watts

Affiliation: The Hospital for Sick Children, Canada/Princess Margaret Hospital, Canada

Authors: Watts GD, Antonarakis GS, Forrest CR, Tompson BD, Phillips JH

17:17 - 17:30

Discussion

Friday, 18 September

8:00 - 9:00 **Concurrent Session 26** Room A (2F Soara I/II)
Craniosynostosis 14
 Chairs: *Steven Wall (UK) & Xiongzheng Mu (China)*

8:00 - 8:03
 (3min.) **253**
Post-operative evolution of pericerebral effusion in scaphocephaly
 Presenter: Kenichi Usami
 Affiliation: Craniofacial Unit, Department of Pediatric Neurosurgery, Hôpital Necker-Enfants Malades, France
 Authors: Usami K, Nicolini F, Arnaud E, Di Rocco F

8:03 - 8:08
 (5min.) **254**
Effectiveness of the Multidirectional Craniaofacial Distraction Osteogenesis (MCDO) in older children
 Presenter: Mihoko Kato
 Affiliation: Department of Neurosurgery, Aichi Children's Health and Medical Center, Japan
 Authors: Kato M, Kato S, Nagakura M, Osawa H, Kuwata K, Morishita T

8:08 - 8:13
 (5min.) **255**
Complications in the surgical treatment of craniosynostosis: a 5 years retrospective study
 Presenter: Giovanna Paternoster
 Affiliation: Alder Hey Supra-regional Craniofacial Surgery Unit, UK
 Authors: Paternoster G, Robertson B, Richardson D, Parks C, Duncan C, Burn S, Sinha A

8:13 - 8:18
 (5min.) **256**
The State Of Outcomes Research in Non-Syndromic Craniosynostosis: Systematic Review of the Literature Over 20 Years
 Presenter: Liliana Camison
 Affiliation: University of Pittsburgh Medical Center, USA
 Authors: Camison L, Morse JC, Naran S, Maricevich R, Garland CB, Grunwaldt LJ, Davit AJ, Losee JE, Wong KW, Goldstein JA

8:18 - 8:23
 (5min.) **257**
Effect of Fronto-orbital Advancement on Ophthalmologic Outcomes in Patients with Unilateral Coronal Synostosis
 Presenter: Amanda M. Murphy
 Affiliation: Dalhousie University, Canada
 Authors: Murphy AM, Gencarelli J, Bezuhly M

8:23 - 8:26
 (3min.) **258**
Optimization of Cranio-Orbital Reshaping: Application of a Mathematical Model
 Presenter: Kathryn V. Isaac
 Affiliation: Division of Plastic and Reconstructive Surgery, University of Toronto, Canada
 Authors: Isaac KV, Koenemann J, Fukasawa R, Qian D, Linhares A, Saber NR, Drake J, Forrest CR, Phillips JH

8:26 - 8:31
 (5min.) **259**
An audit of post-operative analgesia and pain assessment in major paediatric craniofacial surgery
 Presenter: Katharine J. Francis
 Affiliation: Oxford University Hospitals NHS Trust, UK
 Authors: Francis KJ, Evans R, Das S

- 8:31 - 8:36
(5min.) **260**
Efficacy of Tranexamic Acid to Reduce Blood Loss in Open Calvarial Vault Remodeling Surgery for Craniosynostosis
Presenter: Nicole Hooft
Affiliation: Surgical Resident St Josephs Hospital, USA
Authors: Hooft N, Singh DJ, Bristol RE, Serrone R, Beals SP, Joganic E
- 8:36 - 8:41
(5min.) **261**
Enzyme replacement therapy for congenital hypophosphatasia allows for surgical treatment of craniosynostosis
Presenter: Timothy W. Vogel
Affiliation: Division of Pediatric Neurosurgery Cincinnati Children's Hospital, USA
Authors: Vogel TW, Infinger LK, Gendron C, Gordon CB, Pan BS, van Aalst JA
- 8:41 - 9:00 Discussion

9:00 - 10:00 **Concurrent Session 27** Room A (2F Soara I/II)
Craniosynostosis 15
Chairs: *Joseph Losee (USA) & Susumu Ito (Japan)*

- 9:00 - 9:03
(3min.) **262**
Craniosynostosis in Hypophosphatemic Rickets:
Presenter: Jennifer L. Rhodes
Affiliation: Children's Hospital of Richmond at Virginia Commonwealth University, USA
Authors: Rhodes JL, Collins JJ, Fearon JA, Harshbarger R, Vega R, Ritter AM, Opalak C
- 9:03 - 9:08
(5min.) **263**
Craniosynostosis Surgery: Impact of Timing of Intra-Operative Blood Transfusion on Post Operative Course
Presenter: Davinder Singh
Affiliation: Division of Plastic Surgery, Phoenix Children's Hospital, USA/Department of Surgery, Phoenix Children's Hospital, USA/Mayo School of Medicine, USA
Authors: Singh DJ, Hooft N, Bristol RE, Joganic E, Beals SP
- 9:08 - 9:13
(5min.) **264**
Biomechanical properties of calvarial bones in normal and craniosynostotic skulls
Presenter: Mehran Moazen
Affiliation: University of Hull, UK
Authors: Moazen M, Peskett E, Babbs C, Pauws E, Fagan MJ
- 9:13 - 9:16
(3min.) **265**
Improving aesthetic outcome in scaphocephaly correction: Hairline lowering during vault remodeling
Presenter: David Richardson
Affiliation: Supraregional Craniofacial Unit, Alder Hey Children's Hospital, UK
Authors: Richardson D, Robertson B, Sinha A, Burn S, Wittig J, Parks C, Duncan C
- 9:16 - 9:21
(5min.) **266**
FRONTAL WIDENING FOR SCAPHOCEPHALY IN OLDER CHILDREN
Presenter: Eric J. Arnaud
Affiliation: Craniofacial Unit Hôpital Necker, France
Authors: Arnaud E, James S, Di Rocco F, Renier D, Legros C, Sainte-Rose C

- 9:21 - 9:26
(5min.) **267**
CRANIO-ORBITAL MORPHOLOGY DUE TO CORONAL RING SUTURE SYNOSTOSIS
Presenter: Guy D. Watts
Affiliation: The Hospital for Sick Children, Canada/Princess Margaret Hospital, Canada
Authors: Watts GD, Forrest CR, Phillips JH
- 9:26 - 9:29
(3min.) **268**
Osteogenic Distraction and Digital osteotomies for skull remodeling in Coronal Craniosynostosis
Presenter: Adriana Guerrero
Affiliation: Hospital Dr. Manuel Gea Gonzalez, Mexico
Authors: Guerrero A, Guerrero R, Palafox D
- 9:29 - 9:34
(5min.) **269**
An Aesthetic Outcome Scoring System for Scaphocephaly Correction: A Pilot Study
Presenter: Chris Parks
Affiliation: Alder Hey Supra-regional Craniofacial Surgery Unit, UK
Authors: Parks C, Chawla R, Bordbar P, Hartley F, Vaiude P, Quirke D, Burn S, Sinha A, Richardson D, Duncan C
- 9:34 - 10:00 Discussion

10:00 - 10:30 **Concurrent Session 28** Room A (2F Soara I/II)
Craniosynostosis 16
Chairs: *Fernando Molina (Mexico) & Davinder Singh (USA)*

- 10:00 - 10:05
(5min.) **270**
Predicting skull growth in normal and craniosynostosis mice
Presenter: Arsalan Marghoub
Affiliation: University of Hull, UK
Authors: Marghoub A, Libby JW, Babbs C, Wilkie AOM, Fagan MJ, Moazen M
- 10:05 - 10:10
(5min.) **271**
Long-term results of frontal and bilateral cranial distraction osteogenesis for multi-suture craniosynostosis
Presenter: Susumu Ito
Affiliation: Neurosurgery, Kanagawa Children's Medical Center, Japan/Plastic surgery, Kanagawa Children's Medical Center, Japan/Neurosurgery, Kanagawa Rehabilitation Hospital, Japan/Neurosurgery, Sekido Neurosurgery Clinic, Japan
Authors: Ito S, Kobayashi S, Sato H, Sekido K
- 10:10 - 10:15
(5min.) **272**
Does early fusion of the spheno-occipital synchondrosis explain OSA in Crouzon syndrome?
Presenter: Caroline Driessen
Affiliation: ErasmusMC, The Netherlands
Authors: Driessen C, Rijken BF, Mathijssen IMJ
- 10:15 - 10:20
(5min.) **273**
Quantitative analysis of change in intracranial volume after posterior cranial vault distraction
Presenter: Azusa Shimizu
Affiliation: Juntendo University, Japan
Authors: Shimizu A, Akiyama O, Shimoji K, Miyajima M, Arai H, Komuro Y
- 10:20 - 10:30 Discussion
- 10:30 - 11:00 Coffee Break

11:00 - 11:30 **Concurrent Session 29** Room A (2F Soara I/II)
Craniosynostosis 17
 Chairs: *Lun J. Lo (Taiwan) & Tanetaka Akizuki (Japan)*

11:00 - 11:05 (5min.) **274**
Promoting of ossification of Calvarial Defects in Craniosynostosis Surgery by Using Demineralized Bone Plate

Presenter: Mikko Juhani Savolainen

Affiliation: Department of Plastic Surgery, Helsinki University Central Hospital, Finland

Authors: Savolainen MJ, Ritvanen AG, Hukki JJ, Telkkä J, Leikola JP, Vuola PMB

11:05 - 11:10 (5min.) **275**
It is strictly necessary a Hemifacial Rotacion for Apert Syndrome correction?

Presenter: Cuauhtémoc Lorenzana

Affiliation: Craniofacial Anomalies Foundation, Hospital Angeles del Pedregal and Postgraduate Division, School of Medicine, Universidad la Salle Mexico

Authors: Lorenzana C, Molina F, Cortés-Arreguin J

11:10 - 11:15 (5min.) **276**
TIMING OF CLOSURE OF THE ANTERIOR SKULL BASE IN SYNDROMIC INFANTS: IMPLICATIONS FOR EARLY MONOBLOC

Presenter: Sol Mundinger

Affiliation: Seattle Childrens Hospital Craniofacial Center, USA/University of Washington, USA

Authors: Mundinger S, Hopper RA, Lee A, Guo M, Birgfeld CB

11:15 - 11:30 Discussion

11:30 - 12:45 **Concurrent Session 30** Room A (2F Soara I/II)
Head Skull Base, Aesthetic 1
 Chairs: *Robert J. Wood (USA) & Xiongzhen Mu (China)*

11:30 - 11:35 (5min.) **277**
Craniosculpt, A Second Generation Hydroxyapatite Cement; 42 Consecutive Cases in Craniofacial Reconstruction.

Presenter: Robert J. Wood

Affiliation: Gillette Children's Specialty Healthcare, USA/University of Minnesota Medical School, USA

Authors: Wood RJ, Liljeberg KM

11:35 - 11:38 (3min.) **278**
Correction of Severe Short Nose Using Distraction Osteogenesis

Presenter: Hideaki Rikimaru

Affiliation: Department of Plastic and Reconstructive Surgery and Maxillofacial Surgery, Kurume University School of Medicine, Japan

Authors: Rikimaru H, Kiyokawa K

11:38 - 11:43 (5min.) **279**
Endoscopic-assisted intraoral three-dimensional reduction mandibuloplasty

Presenter: Guoping Wu

Affiliation: Nanjing Medical University Friendship Plastic Surgery Hospital, China

Authors: Wu G, Zhou B, Chen X, He X

- 11:43 - 11:48
(5min.) **280**
The application of the digital ostectomy template in the mandibular angle ostectomy
Presenter: Li Teng
Affiliation: Craniofacial Department, Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, China
Authors: Teng L, Zhang C, Jin X, Lu J, Xu J
- 11:48 - 11:53
(5min.) **281**
A Modified Reduction Malarplasty Utilizing 2 Oblique Osteotomies for Prominent Zygomatic Body and Arch
Presenter: Zhanwei Gao
Affiliation: China-Japan Friendship Hospital, China
Author: Gao Z
- 11:53 - 11:58
(5min.) **282**
CAD/CAM planned Lefort 1 DO for early treatment of severe maxillary hypoplasia in cleft lip and palate
Presenter: Catherine S. Chang
Affiliation: Children's Hospital of Pennsylvania, USA
Authors: Chang CS, Yu JW, Tahiri Y, Swanson JW, Paliga JT, Bartlett SP, Taylor JA
- 11:58 - 12:03
(5min.) **283**
Surgical technique vs. aesthetic evaluation in Asian contouring surgery (354 cases)
Presenter: Xiongzheng Mu
Affiliation: Dept Plastic Surgery, Huashan Hospital, Fudan University, China
Authors: Mu X, Yang J
- 12:03 - 12:08
(5min.) **284**
A Modified Reduction Malarplasty for Prominent Zygomatic Body and Arch
Presenter: Lu Yang
Affiliation: The second Department of CranioMaxilloFacial Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College
Authors: Yang L, Teng L, Lu J, Xu J, Zhang C
- 12:08 - 12:13
(5min.) **284-a**
Orthognathic Surgery combining with Facial Bone Contouring Surgery
Presenter: D.B. Yang
Affiliation: D.B. Yang Plastic Surgical Clinic, Korea
Authors: Yang DB, Yang JH
- 12:13 - 12:18
(5min.) **285**
Clockwise and counterclockwise Le Fort I movements influence nasolabial morphology differently.
Presenter: Rajendra Sawh-Martinez
Affiliation: Yale University-Plastic and Reconstructive Surgery, USA
Authors: Sawh-Martinez R, DesSesa C, Wu R, Steinbacher DM
- 12:18 - 12:23
(5min.) **286**
Multiple-wall orbital decompression to reduce exopthalmos in Graves' disease
Presenter: Hans-Peter Howaldt
Affiliation: University Hospital Giessen, Germany
Authors: Howaldt H, Wilbrand M, Streckbein P, Wilbrand J
- 12:23 - 12:45
Discussion

8:00 - 9:15

Concurrent Session 31

Room C (B1F Ambio I)

Cleft Lip and Palate 1Chairs: *Yasuyoshi Tosa (Japan) & Philip Kuo-Ting Chen (Taiwan)*8:00 - 8:03
(3min.)**287****Antibiotic Use in Palatoplasty: A Survey of Practice Patterns, Assessment of Efficacy, and Proposed Guidelines**

Presenter: Joseph E. Losee

Affiliation: Children's Hospital of Pittsburgh of UPMC, USA/Department of Plastic and Reconstructive Surgery, University of Pittsburgh Medical Center, USA

Authors: Losee JE, Rottgers SA, Camison L, Mai R, Shakir S, Grunwaldt LJ, Nowalk A

8:03 - 8:08
(5min.)**288****Treacher Collins Syndrome: Clinical outcomes of cleft palate repair**

Presenter: Etoile LeBlanc

Affiliation: New York University; Institute of Reconstructive Plastic Surgery, USA

Authors: LeBlanc E, Golinko MS, Hallett A, Flores RL

8:08 - 8:13
(5min.)**289****Intrinsic and Extrinsic Dental Predictors for Maxillary Hypoplasia and Le Fort I Advancement in Cleft Patients**

Presenter: Han Hoang

Affiliation: Division of Plastic and Reconstructive Surgery, University of California Los Angeles, USA

Authors: Hoang H, Willson T, Pfaff M, Martz MG, Bradley JP, Lee JC

8:13 - 8:18
(5min.)**290****UCLP POST-NASAL MOLDING TREATMENT NOSTRIL SIZE: COMPARISON BETWEEN TREATED & UNTREATED PATIENTS**

Presenter: Patricia H. Glick

Affiliation: Barrow Cleft and Craniofacial Center, USA

Authors: Glick PH, Icely J, Muller C, Kothari H, Singh DJ, Beals SP

8:18 - 8:23
(5min.)**291****SPEECH OUTCOMES FOLLOWING CLINICALLY INDICATED POSTERIOR PHARYNGEAL FLAP TAKEDOWN**

Presenter: Joseph Losee

Affiliation: University of Pittsburgh Medical Center, USA

Authors: Losee JE, Katzel EB, Sameer S, Sanjay N, Camison L, Mac Z, Goldstein JA, Grunwaldt LJ, Ford M

8:23 - 8:28
(5min.)**292****Modified two-flap palatoplasty for cleft palate in Japanese.**

Presenter: Yasuyoshi Tosa

Affiliation: Department of Plastic Surgery, Showa University School of Medicine, Japan

Authors: Tosa Y, Kuroki T, Sato N, Kusano T, Morioka D, Shimizu Y, Yoshimoto S

8:28 - 8:33
(5min.)**293****Post-operative Hypertrophic Scarring after Primary Lip Repair, Could Race be a Single Predictor?**

Presenter: Solomon Obiri-Yeboah

Affiliation: Children's of Alabama, USA/Komfo Anokye Teaching Hospital, Ghana

Authors: Obiri-Yeboah S, Catignani C, Grant JH

- 8:33 - 8:38
(5min.) **294**
Measuring Quality of Life in Adolescents with Cleft Lip and Cleft Palate
Presenter: Laura A. Monson
Affiliation: Texas Children's Hospital, Baylor College of Medicine, USA
Authors: Monson LA, Lloyd MS, Hernandez C, Pickerel B, Buchanan EP, Khechoyan DY, Hollier L, Wilson K
- 8:38 - 8:43
(5min.) **295**
Secondary Speech Surgery in Older Children and Adolescents—Outcomes and a Decision-Making Algorithm
Presenter: Laura A. Monson
Affiliation: Texas Childrens Hospital, USA
Authors: Monson LA, Wilson K, Hernandez C, Khechoyan DY, Buchanan EP, Lee E, Moore E
- 8:43 - 8:48
(5min.) **296**
Extensive Gingivoperiosteoplasty—an Alternative to Alveolar Bone Grafting in Patients with Difficult Cleft
Presenter: Lu Ting-Chen
Affiliation: Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital inat Linkuo, Craniofacial center inat Taoyuan, Taiwan
Authors: Ting-Chen L, Ho SY, Chen PK
- 8:48 - 8:53
(5min.) **297**
Pre-Surgical Nasoalveolar Molding for Cleft Lip and Palate: The Application of Digitally Designed Molds
Presenter: Gang Chai
Affiliation: Shanghai 9th People's Hospital, Shanghai Jiao Tong University School of Medicine, China
Authors: Chai G, Xu H, Zhang Y, Yao CA, Magee W
- 8:53 - 9:15 Discussion

9:15 - 10:30 **Concurrent Session 32** Room C (B1F Ambio I)
Cleft Lip and Palate 2
Chairs: *Shunsuke Yuzuriha (Japan) & Robert Mann (USA)*

- 9:15 - 9:20
(5min.) **298**
Edge locked stitching with a mucochondrial Z-plasty in correction of unilateral cleft nasal deformity
Presenter: Yingzhi Wu
Affiliation: Fudan University Huashan Hospital, China
Author: Wu Y
- 9:20 - 9:23
(3min.) **299**
Nasal Airway Patency Following BMP-2 Alveolar Cleft Repair
Presenter: Alexander Y. Lin
Affiliation: Division of Plastic Surgery, Saint Louis University School of Medicine, USA/St. Louis Cleft-Craniofacial Center in SSM Cardinal Glennon Children's Medical Center at SLU, USA
Authors: Lin AY, Goss JA, Hunter MS, Armbrrecht ES
- 9:23 - 9:28
(5min.) **300**
INCIDENCE AND SEVERITY OF OBSTRUCTIVE SLEEP APNEA IN 1,020 CHILDREN WITH CLEFT-CRANIOFACIAL CONDITIONS
Presenter: Alexander Y. Lin
Affiliation: Saint Louis University School of Medicine, USA/SSM Cardinal Glennon Children's Medical Center at SLU, USA
Authors: Lin AY, McGauley J, Goss JA, Boakye EA, Hunter MS, Buchanan P, Paruthi S

- 9:28 - 9:33
(5min.)
- 301**
POSTOPERATIVE CLEFT POLYSOMNOGRAMS DO NOT SHOW SIGNIFICANTLY IMPROVED SLEEP PARAMETERS AFTER ADENOTONSILLECTOMY
Presenter: Alexander Y. Lin
Affiliation: Saint Louis University School of Medicine, USA/SSM Cardinal Glennon Children's Medical Center at SLU, USA
Authors: Lin AY, McGauley J, Goss JA, Boakye EA, Hunter MS, Buchanan P, Paruthi S
- 9:33 - 9:38
(5min.)
- 302**
The Application of Surgical Robotics in Craniofacial and Cleft Care
Presenter: Dale J. Podolsky
Affiliation: University of Toronto, Canada/The Hospital for Sick Children, Canada/Centre for Image Guided Innovation & Therapeutic Intervention, Canada
Authors: Podolsky DJ, Fisher DM, Wong KW, Drake JM, Forrest CR
- 9:38 - 9:43
(5min.)
- 303**
Practical Repair Method for Unilateral Cleft Lips: Straight-Line Advanced Release Technique
Presenter: Hobin Lee
Affiliation: Seoul National University Bundang Hospital, Korea
Authors: Lee H, Baek RM, Kim B
- 9:43 - 9:48
(5min.)
- 304**
Changes of the face after primary repair without repositioning the premaxilla in bilateral cleft lip
Presenter: Shunsuke Yuzuriha
Affiliation: Department of Plastic and Reconstructive Surgery, Shinshu University School of Medicine, Japan
Authors: Yuzuriha S, Fujita K, Nagai F, Noguchi M, Matsuo K
- 305**
withdrawn
- 9:48 - 9:51
(3min.)
- 306**
Cleft Patients Profile in the Cleft and Craniofacial Center Cipto Mangunkusumo Hospital, Indonesia
Presenter: Prasetyanugraheni Kreshanti
Affiliation: Cleft and Craniofacial Center Cipto Mangunkusumo Hospital-University of Indonesia, Indonesia
Authors: Kreshanti P, Handayani S
- 9:51 - 9:56
(5min.)
- 307**
Global Online Training for Cleft Care—Analysis of International Utilization
Presenter: Roberto L. Flores
Affiliation: NYU Langone Medical Center, USA
Authors: Flores RL, Culnan D, Olikier A, Cutting C
- 9:56 - 10:01
(5min.)
- 308**
Surgical Options in Adult Age Cleft Patients Who Have Been Operated In Childhood
Presenter: Fikret Eren
Affiliation: Gulhane Military Medicine Academy, Haydarpasa Training Hospital, Turkey
Authors: Eren F, Aysal BK, Melikoglu C, Öksüz S, Sahin C
- 10:01 - 10:06
(5min.)
- 309**
Integral Treatment of primary cleft palate: Anatomical Nasal Floor Closure and Modified Millard II Cheiloplasty.
Presenter: Rogelio Martinez-Wagner
Affiliation: Plastic and Reconstructive Surgery Department. Hospital General Gea Gonzalez, Mexico
Authors: Martinez-Wagner R, Pérez-González A, Gutiérrez-Valdez DH, Garcia-Garcia F
- 10:06 - 10:30
- Discussion

10:30 - 11:00 Coffee Break

11:00 - 11:45

Concurrent Session 33

Room C (B1F Ambio I)

Others 1

Chairs: *Michael Golinko (USA) & Yoshitaka Kubota (Japan)*

11:00 - 11:05
(5min.)

310

Facial Infiltrating Lipomatosis Contains Somatic PIK3CA Mutations in Multiple Tissues

Presenter: Javier A. Couto

Affiliation: Dept. of Plastic and Oral Surgery, Boston Children's Hospital, Harvard Medical School, USA

Authors: Couto JA, Vivero MP, Maclellan RA, Upton J, Padwa BL, Warman ML, Mulliken JB, Greene AK

11:05 - 11:10
(5min.)

311

Complication rate and bone regenerative effects from using calcium phosphate-based implants in cranial repair

Presenter: Thomas Engstrand

Affiliation: Stockholm Craniofacial Centre, Department of Molecular Medicine and Surgery, Plastic Surgery Section, Karolinska University Hospital and Karolinska Institute, Sweden

Authors: Engstrand T, Kihlström L, Lundgren K, Trobos M, Engqvist H, Thomsen P

11:10 - 11:15
(5min.)

312

Voice Disturbance and Dysphonia in Craniofacial Population

Presenter: Scott Rickert

Affiliation: New York University Langone Medical Center, USA

Author: Rickert S

11:15 - 11:20
(5min.)

313

THE TREATMENT OF ARRHINEA

Presenter: José Rolando Prada

Affiliation: Plastic Surgery Hospital Infantil Universitario de San Jose

Authors: Prada JR, Mendoza MB

11:20 - 11:25
(5min.)

314

Successful Reconstruction of Agnathia

Presenter: Kunihiro Ishida

Affiliation: Department of Plastic and Reconstructive Surgery, Okinawa Chubu Hospital, Japan

Authors: Ishida K, Imaizumi A, Hiratsuka M, Kadota H

11:25 - 11:28
(3min.)

315

CSF leaks for the craniofacial surgeon: a review and management algorithm

Presenter: David Harter

Affiliation: New York University, Department of Neurosurgery, USA

Authors: Harter D, Golinko MS, Staffenberg D

11:28 - 11:31
(3min.)

316

Midline and Non-midline Craniofacial Dermoids: The Liverpool Experience

Presenter: Ben Robertson

Affiliation: Alder Hey Supra-regional Craniofacial Surgery Unit, UK

Authors: Robertson B, Scrimshire A, Vaiude P, Nelson K, Cleator A, Brannigan K, Duncan C

11:31 - 11:36
(5min.) **317**
Cell-Assisted Lipotransfer Enhances Fat Graft Retention in Irradiated Tissue
Presenter: Anna Luan
Affiliation: Hagey Laboratory for Pediatric Regenerative Medicine, Department of Surgery, Plastic and Reconstructive Surgery Division, Stanford University School of Medicine, USA
Authors: Luan A, Duscher D, Paik KJ, Zielins ER, Whittam AJ, Brett EA, Atashroo DA, Hu MS, Wearda T, Senarath-Yapa K, Menon S, Shailendra S, Gurtner GC, Longaker MT, Wan DC

11:36 - 11:45 Discussion

11:45 - 12:30 **Concurrent Session 34** Room C (B1F Ambio I)
Others 2
Chairs: *Kunihiro Ishida (Japan) & Thomas Engstrand (Sweden)*

11:45 - 11:50
(5min.) **318**
Twins and Craniofacial Anomalies—a single centre study
Presenter: Deborah Chua
Affiliation: Great Ormond Street Hospital for Children, UK
Authors: Chua D, Dunaway DJ, O'Hara JL

11:50 - 11:53
(3min.) **319**
Transverse Slicing the 6th-7th Costal Cartilaginous Junction To Prevent Warping In Nasal Surgery.
Presenter: Tara Lynn Teshima
Affiliation: Division of Plastic Surgery, Sunnybrook Health Sciences Centre, University of Toronto, Canada
Authors: Teshima TL, Cheng H, Pakdel A, Kiss A, Fialkov JA

11:53 - 11:58
(5min.) **320**
Medial Sub-Coronoid Bone Graft Technique: A Novel Source of Bone Grafts in Craniomaxillofacial Surgery
Presenter: Chuan-Fong Yao
Affiliation: Chang Gung Craniofacial Center, Taiwan
Authors: Yao C, Rivera-Serrano CM, Chen Y, Lu J, Chen Y, Chen YR

11:58 - 12:01
(3min.) **321**
An Internet-Based Surgical Simulator for Craniofacial Surgery
Presenter: Roberto Flores
Affiliation: NYU Langone Medical Center, USA
Authors: Flores RL, Olikier A, McCarthy JG

12:01 - 12:06
(5min.) **322**
Midfacial and Dental Changes Associated with Positive Airway Pressure in Children with Sleep-Disordered Breathing
Presenter: Soleil Roberts
Affiliation: Craniofacial Center, Seattle Children's Hospital, USA
Authors: Roberts S, Kapadia H, Chen M

12:06 - 12:11
(5min.) **323**
Biomechanics of normal human skull growth
Presenter: Joseph W. Libby
Affiliation: University of Hull, UK
Authors: Libby JW, Marghoub A, Johnson D, Fagan MJ, Moazen M

12:11 - 12:16
(5min.)

324

Using 10000 faces to identify the perceptual boundaries of normal variation

Presenter: Justine L. O'Hara

Affiliation: Great Ormond Street Hospital for Children, UK

Authors: O'Hara JL, Ponniah AJT, Booth JA, Solanki K, Dunaway DJ

12:16 - 12:21
(5min.)

325

Our experience of robotic follicular unit extraction for hair transplantation

Presenter: Katsumi Ebisawa

Affiliation: Renaissance Clinic, Japan/Department of Plastic & Reconstructive Surgery, Nagoya University Graduate School of Medicine, Japan

Authors: Ebisawa K, Nagai M, Saitou K, Hayashi T, Kamei Y, Kasai K

12:21 - 12:30

Discussion

8:00 - 9:05

Concurrent Session 35

Room D (B1F Ambio II)

Head Skull Base, Aesthetic 2

Chairs: *Andrew A. Heggie (Australia) & Tomoyuki Yano (Japan)*

8:00 - 8:05
(5min.)

326

Indication for and aesthetical results of the facial dismasking flap approach in skull base surgery

Presenter: Tomoyuki Yano

Affiliation: Department of Plastic and Reconstructive Surgery, Yokohama City Minato Red Cross Hospital, Japan /Department of Plastic and Reconstructive Surgery, Tokyo Medical and Dental University, Japan

Authors: Yano T, Okazaki M, Tanaka K, Honma T, Hamanaga M, Tsunoda A, Aoyagi M, Kishimoto S

8:05 - 8:10
(5min.)

327

Reconstruction of complex maxillary defects with bone transport

Presenter: Alberto R. Pereira

Affiliation: Portuguese Armed Forces Hospital, Portugal

Authors: Pereira AR, Neves P, Montezuma N, Pires J, Matos I, Duarte JM, Rosa J

8:10 - 8:15
(5min.)

328

Mandibular tumours in the paediatric patient: a review of management and reconstruction

Presenter: Andrew A. Heggie

Affiliation: Royal Children's Hospital of Melbourne, Australia

Author: Heggie AA

8:15 - 8:20
(5min.)

329

A strategy of cranioplasty combined with artificial bone and free flap

Presenter: Norio Fukuda

Affiliation: Dept. of Plast. Surg., Dokkyo Medical Univ., Japan

Authors: Fukuda N, Asato H, Umekawa K, Kurabayashi T, Imanishi M, Takada G, Masaoka K, Kan T

8:20 - 8:25
(5min.)

330

Surgical Care Burden in 54 cases of Orbito-Temporal Neurofibromatosis

Presenter: Laurent Lantieri

Affiliation: Department of plastic Surgery Hôpital Européen Georges Pompidou Paris Descartes University, France

Authors: Lantieri L, Hivelin M, Pessis R, Leguerinel C

- 8:25 - 8:30
(5min.) **331**
Skull base reconstruction for children with basal encephaloceles
Presenter: Nobuhito Morota
Affiliation: Division of Neurosurgery, Tokyo Metropolitan Children's Medical Center, Japan
Authors: Morota N, Ihara S, Ogiwara H, Kaneko T
- 8:30 - 8:35
(5min.) **332**
Evaluation on Mandibular Reconstruction with Vascularized Fibular Flap with or without Computer-assisted Surgery
Presenter: Xudong Wang
Affiliation: Department of Oral and Craniomaxillofacial Surgery, Ninth People's Hospital, School of Medicine, Shanghai Jiao Tong University, China
Authors: Wang X, Zhang L, Li B, Shen G, Yu H
- 8:35 - 8:38
(3min.) **333**
Review of our reconstructive procedures for a trigeminal nerve sheath tumor
Presenter: Mayuko Hamanaga
Affiliation: Department of Plastic and Reconstructive surgery, Tokyo Medical and Dental University, Japan
Authors: Hamanaga M, Yano T, Tanaka K, Suesada N, Honnma T, Okazaki M
- 8:38 - 8:41
(3min.) **334**
Management of cranial bone defect cases caused by infection.
Presenter: Hiroko Ochiai
Affiliation: National Hospital Organization Tokyo Medical Center Department of Plastic and Reconstructive Surgery, Japan
Authors: Ochiai H, Mizutani T, Yagi N, Oka A, Hirata E, Kuroshima Y
- 8:41 - 8:46
(5min.) **335**
A rare case of 14 consecutive surgeries, including 4 free flap reconstructions performed on the same patient.
Presenter: Tsutomu Homma
Affiliation: Department of Plastic and Reconstructive surgery, Tokyo Medical and Dental University, Japan
Authors: Homma T, Yano T, Tanaka K, Hamanaga M, Okazaki M
- 8:46 - 9:05 Discussion

9:05 - 9:40 **Concurrent Session 36** Room D (B1F Ambio II)
Head Skull Base, Aesthetic 3
Chairs: *Takashi Nakatsuka (Japan) & Edward Chang (USA)*

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withdrawn

- 9:05 - 9:08
(3min.) **337**
Successful Immediate Reimplantation of Cranial Bone Flaps in the setting of Infection
Presenter: Christopher S. Zarella
Affiliation: Children's National Medical Center, USA
Authors: Zarella CS, Yi S, Oh AK, Magge SN, Myseros JS, K RF, Rogers GF

- 9:08 - 9:13
(5min.) **338**
Prospective Analysis of Double Skin Paddle Fibula Flap for Composite Mandibulectomy Reconstruction
Presenter: Edward I. Chang
Affiliation: MD Anderson Cancer Center, USA
Authors: Chang EI, Yu P

9:13 - 9:18
(5min.)

339

Refinements in planning and execution of TMJ ankylosis surgery: One surgeon's experience

Presenter: Michael A. Lypka
Affiliation: Children's Mercy Hospital, USA
Author: Lypka MA

9:18 - 9:21
(3min.)

340

Middle skull base reconstruction including the facial nerve reconstruction by the free omental flap

Presenter: Miki Kambe
Affiliation: Department of plastic and reconstructive surgery, Nagoya University School of Medicine, Japan
Authors: Kambe M, Kamei Y, Takanari K, Ebisawa K, Sawamura H, Yutaka N

9:21 - 9:40

Discussion

9:40 - 10:30

Concurrent Session 37

Room D (B1F Ambio II)

Craniofacial Imaging 1

Chairs: *Nivaldo Alonso (Brazil) & Masanobu Yamashita (Japan)*

9:40 - 9:45
(5min.)

341

CRANIOFACIAL GROWTH FAILURE AFTER MIDFACE ADVANCEMENT—growth sites damage or pure growth impairment?

Presenter: Nivaldo Alonso
Affiliation: Department of Plastic Surgery-University of São Paulo, Brazil
Authors: Alonso N, Ruellas AC, Cevidanes LH, Tonello C

9:45 - 9:50
(5min.)

342

Defining Normal: Quantifying craniofacial asymmetry assessment in the pediatric population

Presenter: Alex A. Kane
Affiliation: University of Texas Southwestern School of Medicine, USA
Authors: Kane AA, Cho M, Ramesh J, Darvann T, Hermann N, Seaward J, Hallac R, Lipira A

9:50 - 9:55
(5min.)

343

Quantitative Assessment in Craniofacial Surgery: An Objective Metric of Global Shape Change

Presenter: Darren M. Smith
Affiliation: The Hospital for Sick Children, Canada
Authors: Smith DM, Nguyen PD, Forrest CR, Phillips JH

9:55 - 10:00
(5min.)

344

Defining the optimum correction of the periorbital abnormality in CFND patients

Presenter: Allan Ponniah
Affiliation: Plastic surgery Registrar at Great Ormond Street Hospital, London, UK
Authors: Ponniah AJT, Bystrzonowski N, Booth JA, Zafeiriou S, Dunaway DJ

10:00 - 10:05
(5min.)

345

Describing Crouzon and Pfeiffer syndrome based on principal component analysis

Presenter: Femke CR Staal
Affiliation: Craniofacial Unit, Great Ormond Street Hospital, UK/Oral and Maxillofacial Surgery, Erasmus Medical Center, the Netherlands
Authors: Staal FCR, Ponniah AJT, Angullia F, Ruff CF, Dunaway DJ, Koudstaal MJ

- 10:05 - 10:10
(5min.) **346**
A Virtual Reality Atlas of Craniofacial Pathology
Presenter: John H. Phillips
Affiliation: Division of Plastic Surgery at the Hospital for Sick Children, Canada
Authors: Phillips JH, Smith DM, Nguyen PD, Clausen A, Forrest CR
- 10:10 - 10:15
(5min.) **347**
Evaluation of Fronto-Orbital Advancement for Coronal Synostosis using a 3D Statistical Shape Model
Presenter: Benjamin C. Wood
Affiliation: Children's National Medical Center, USA/George Washington University School of Medicine and Health Sciences, USA
Authors: Wood BC, Zukic D, Qi J, Meyer C, Ortiz R, Enquobahrie A, Mendoza CS, Linguraru MG, Rogers GF
- 10:15 - 10:20
(5min.) **348**
Automatic construction and landmarking of 3D facial models to define population means and variation
Presenter: James A. Booth
Affiliation: Imperial College London, UK/Great Ormond Street Hospital, UK
Authors: Booth JA, Zafeiriou S, Roussos A, Ponniah AJT, Dunaway DJ
- 10:20 - 10:30 Discussion
- 10:30 - 11:00 Coffee Break

11:00 - 12:10 **Concurrent Session 38** Room D (B1F Ambio II)
Craniofacial Imaging 2
Chairs: *David Dunaway (UK) & Tsuyoshi Kaneko (Japan)*

- 11:00 - 11:05
(5min.) **349**
Digital Image Correlation: A Novel 3-D Technology for Precise Dynamic Facial Analysis
Presenter: Anthony J. Wilson
Affiliation: The Children's Hospital of Philadelphia, USA
Authors: Wilson AJ, Samra F, Chang B, Chin BC, Friedman C, Taglienti AJ, Percec I, Jackson O
- 11:05 - 11:10
(5min.) **350**
Optical coherence tomography can detect intracranial hypertension in young children with craniosynostosis
Presenter: Jordan W. Swanson
Affiliation: University of Pennsylvania, USA/Children's Hospital of Philadelphia, USA
Authors: Swanson JW, Aleman T, Mitchell BT, Wes A, Chen S, Bender L, Heuer G, Katowitz W, Bartlett SP, Taylor JA
- 11:10 - 11:15
(5min.) **351**
3D planning in orthognathic surgery: Addressing the lower third of the facial asymmetry patient
Presenter: Daniel Lonic
Affiliation: Plastic & Reconstructive Surgery and Craniofacial Research Center, Chang Gung Memorial Hospital, Chang Gung University, Taiwan
Authors: Lonic D, Hsin-Wen C, Lun-Jou L
- 11:15 - 11:18
(3min.) **352**
The Use of Multi-surface 3D model in the Field of Craniofacial Surgery—Diagnosis, Surgical Planning and Assistance
Presenter: Thomas Mon-Hsian Hsieh
Affiliation: Division of Plastic Surgery, Department of Surgery, National Taiwan University Hospital, Taiwan/Institute of Biomedical Engineering, National Taiwan University, Taiwan
Authors: Hsieh TM, Liu TJ, Ko A, Chen M, Wong J

- 11:18 - 11:23
(5min.)
- 353**
The Turricephaly Index—A Quantifiable Measure of Turricephaly by a Validated Radiological System
Presenter: Benjamin Way
Affiliation: Great Ormond Street Hospital for Children, UK
Authors: Way B, O'Hara JL, Hayward RD
- 11:23 - 11:26
(3min.)
- 354**
3D modelling. It's role in the assessment of deformity and planning reconstruction.
Presenter: David Dunaway
Affiliation: Great Ormond Street Hospital for Children, UK/Institute of Child Health, UCL London, UK
Authors: Dunaway DJ, Ponniah AJT, Koudstaal MJ, Borghi A, Booth JA, Evans RE, Ruff CF, Angullia F, Schievano S, Zefariou S, Jeelani NUO
- 11:26 - 11:29
(3min.)
- 355**
A Comparison of Mandibular Distraction Vector Effect on Airway and Mandibular Volumes in Pierre Robin Sequence
Presenter: Elizabeth G. Zellner
Affiliation: Yale University School of Medicine, USA
Authors: Zellner EG, Mhlaba BS JM, Reid RR, Steinbacher DM
- 11:29 - 11:32
(3min.)
- 356**
3D CBCT Volumetric Outcomes of rhBMP-2/MS vs Iliac Crest Bone Graft for Alveolar Cleft Reconstruction
Presenter: Fan Liang
Affiliation: University of Southern California, USA
Authors: Liang F, Yen S, Sanborn L, Yen L, Florendo E, Urata M, Hammoudeh J
- 357**
withdrawn
- 11:32 - 11:37
(5min.)
- 358**
Evolution of facial shape change during frontofacial distraction surgery
Presenter: Freida Angullia
Affiliation: Great Ormond Street Hospital for Children, UK
Authors: Angullia F, Borghi A, Schievano S, Jeelani NUO, Dunaway DJ
- 359**
withdrawn
- 11:37 - 12:10
- Discussion

Program Schedule (Poster)

The scientific program is correct at the time of printing; however, the Program Committee reserves the right to alter the schedule as necessary.

Thursday, 17 September

15:30 - 16:30

Poster Session 1

Poster 1 (1F Ma Maison)

p-1

Surgical treatment for craniosynostoses in infants

Presenter: German V. Letyagin

Affiliation: Pediatric Neurosurgery Department, Federal Center of Neurosurgery Novosibirsk, Russia/Radiology Department, Federal Center of Neurosurgery Novosibirsk, Russia/Federal Center of Neurosurgery Novosibirsk, Russia

Authors: Letyagin GV, Amelin M, Danilin V, Kim S, Sysoeva A, Rzaev D

p-2

Ophthalmologic Outcomes following Fronto-orbital Advancement for Unicoronal Synostosis: A Review

Presenter: Michael Bezuhly

Affiliation: Division of Plastic Surgery, IWK Health Centre, Canada

Authors: Bezuhly M, Gencarelli J, Murphy AM

p-3

Use of the predictive formula for cranial distraction osteogenesis in craniosynostosis

Presenter: Kazuaki Yamaguchi

Affiliation: Osaka City General Hospital Plastic and Reconstructive Surgery, Japan

Authors: Yamaguchi K, Imai K, Deguchi A, Okada A, Ishise H, Takahashi M, Masuoka T, Matsusaka Y, Kunihiro N

p-4

Isolated sphenosphenoidal craniosynostosis-first case report and comparison with other craniosynostoses

Presenter: Robert M. Menard

Affiliation: The Northern California Kaiser Permanente Craniofacial Clinic, USA/Stanford University School of Medicine, Division of Plastic Surgery, USA

Author: Menard RM

p-5

Tracheal Cartilaginous Sleeve in Syndromic Craniosynostosis

Presenter: Edward P. Buchanan

Affiliation: Texas Childrens Hospital, USA

Authors: Buchanan EP, Pickrell BB

p-6

CALVARIAL VAULT RECONSTRUCTION: TECHNICAL MODIFICATIONS IN AN INDIAN CONTEXT

Presenter: Derick Mendonca

Affiliation: Consultant Craniofacial Plastic Surgeon, Sakra World Hospital, Bangalore, UK

Authors: Mendonca D, Gopal S, Rudrappa S

p-7

The Long Term Perioperative Review of Our Fronto-orbital Advancement and Reshaping for Trigenocephaly

Presenter: Ayaka Deguchi

Affiliation: Osaka City General Hospital Plastic and Reconstructive Surgery, Japan

Authors: Deguchi A, Imai K, Yamaguchi K, Okada A, Ishise H, Takahashi M, Masuoka T

p-8

Refinement of the osteotomy for a distraction osteogenesis for the dolicocephalic deformities

Presenter: Hiroyuki Iwanaga

Affiliation: Department of Plastic and Reconstructive surgery, Osaka Medical College, Japan

Authors: Iwanaga H, Kyutoku S, Otani K, Kajimoto Y, Nakai T, Ueda K

p-9

Total reduction cranioplasty for the treatment of scaphocephaly accompanying cranial expansion

Presenter: Shinichiro Hashiguchi

Affiliation: Department of Plastic and Reconstructive Surgery and Maxillofacial Surgery, Kurume University School of Medicine, Japan

Authors: Hashiguchi S, Ohmaru Y, Rikimaru H, Kiyokawa K

p-10

Metopic synostosis: The evolution of surgical management in a single unit's 20-year experience.

Presenter: Tomas O'Neill

Affiliation: Leeds General Infirmary, UK

Authors: O'Neill T, Bellew M, Chumas P, Russell J, Liddington M

p-11

A novel osteogenesis distraction system enabling control of distance and vector for syndromic craniosynostosis

Presenter: Shinji Kobayashi

Affiliation: Department of plastic and reconstructive surgery, Kanagawa Children's Medical Center, Japan

Authors: Kobayashi S, Fukawa T, Hirakawa T, Maegawa J

p-12

Endoscopic Strip Craniectomy Yields Better Results than Pi Craniectomy for Treatment of Sagittal Craniosynostosis

Presenter: Suresh N. Magge

Affiliation: Division of Neurosurgery, Children's National Medical Center, USA

Authors: Magge SN, Bartolozzi AR, DeFreitas T, Mysers JS, Oluigbo C, Rogers GF, Keating RF

p-13

Strategic Cranial Reformation with Distraction Osteogenesis in Sagittal Craniosynostosis

Presenter: Kyuwon Shim

Affiliation: Pediatric Neurosurgery, Severance Children's Hospital, Yonsei University College of Medicine, Korea

Authors: Shim K, Lee MC, Park EK, Kim DS, Kim YO

p-14

Correction of Sagittal Craniosynostosis with Distraction Osteogenesis Using Expansion and Compression Procedure

Presenter: Myung Chul Lee

Affiliation: Department of Plastic and Reconstructive Surgery, Konkuk University School of Medicine, Seoul, Korea

Authors: Lee MC, Kim YO, Kim YJ

p-15

Stability of cranioplasty using multi-split osteotomy and rigid fixation with absorbable plates

Presenter: Jae Woo Lee

Affiliation: Department of Plastic and Reconstructive Surgery, School of Medicine, Pusan National University, Korea

Authors: Lee JW, Nam SB, Song KH, Nam KW, Bae YC

p-16

Diffusion tensor imaging and fiber tractography in children with craniosynostosis syndromes.

Presenter: Bianca F. Rijken

Affiliation: Plastic and Reconstructive Surgery, Erasmus Medical Center/Sophia Children's Hospital, the Netherlands

Authors: Rijken BF, Leemans A, Lucas Y, van Montfort K, Mathijssen IMJ, Doerga PN, Lequin MH

p-17

Our experience of treating craniofacial anomalies with distraction osteogenesis

Presenter: Katsuyuki Torikai

Affiliation: Department of Esthetic and Plastic Surgery, Fureai Yokohama Hospital, Japan

Authors: Torikai K, Fukawa T, Yasumura K, Naganishi H, Kijima T, Nagaoka R, Murashima M

p-18

A Clinical Model to Predict Which Patients Are at Higher Risk for Adverse Events Post Open Craniosynostosis Surgery.

Presenter: Susan Goobie

Affiliation: Boston Childrens Hospital, Harvard Medical School, USA

Authors: Goobie S, Proctor MR, Meara J, Zurakowski D, Rogers GF

p-19

Successful posterior honeycomb cranial distraction for a 4-month-old infant with Pfeiffer syndrome

Presenter: Mayu Takahashi

Affiliation: Department of Neurosurgery, University of Occupational and Environmental Health, Japan

Authors: Takahashi M, Watanabe Y, Akizuki T, Nishizawa S

p-20

Multidirectional Cranial Distraction Osteogenesis for the Treatment of Craniosynostosis

Presenter: Tsuyoshi Morishita

Affiliation: Department of Plastic and Reconstructive Surgery, Aichi Children's Health and Medical Center, Japan

Authors: Morishita T, Kuwata K, Kato S, Nagakura M, Osawa H, Kato M

p-21

Some designs for posterior cranial expansion avoiding minor complications

Presenter: Kazuhiro Otani

Affiliation: Reconstructive Plastic Surgery, Nara City Hospital, Japan

Authors: Otani K, Kyutoku S, Kajimoto Y, Iwanaga H, Ueda K

p-22

The treatment strategy for Apert's syndrome

Presenter: Shoichi Tomita

Affiliation: Department of Plastic and Reconstructive surgery, Jikei University School of Medicine, Japan

Authors: Tomita S, Miyawaki T, Nonaka Y, Sakai S, Nishimura R, Umeda G

p-23

Treatment for hydrocephalus in syndromic craniosynostosis children

Presenter: Ryo Ando

Affiliation: Department of Neurosurgery, Chiba Children's Hospital, Japan

Authors: Ando R, Numata O, Ito C, Date H, Suzuki H, Udagawa A, Satoh K

p-24

Complex craniosynostosis with frontal bossing in very low birth weight baby who has microdeletion in 14q32.2.

Presenter: Shunsuke Ichi

Affiliation: Japanese Red Cross Medical Center, Department of Neurosurgery, Japan

Authors: Ichi S, Aoki K, Suzuki I, Hirota A, Takeda T, Kawakami T, Nakao A

p-25

Versatility of the Alice band onlay graft in remodeling of the orbital bandeau

Presenter: Fateh Ahmad

Affiliation: The Australian Craniofacial Unit, Australia

Authors: Ahmad F, Flapper WJ, Anderson PJ, David DJ

p-26

Possible timing of late cranial surgery for syndromic craniosynostosis considering ICP and DQ

Presenter: Yuichiro Nonaka

Affiliation: Division of pediatric neurosurgery, Department of neurosurgery, the Jikei university, Japan

Authors: Nonaka Y, Miyawaki T, Masumoto A, Tomita S, Nishimura R, Murayama Y

p-27

Limitation of cranial distraction and comparison with a conventional method for frontal plagiocephaly

Presenter: Nobuyuki Mitsukawa

Affiliation: Department of Plastic, Reconstructive and Aesthetic Surgery, Chiba University, Faculty of Medicine, Japan

Authors: Mitsukawa N, Saiga A, Muramatsu H, Yamaji Y, Akita S, Kubota Y, Satoh K

p-28

Passive contraction of frontal bone using mini-plates in DOG for scaphocephaly

Presenter: Tanetaka Akizuki

Affiliation: PRAS, Tokyo Metropolitan Police Hospital, Japan

Authors: Akizuki T, Watanabe Y

p-29

importance of thorough clinical documentation of craniosynostosis, in establishing molecular genetics diagnosis

Presenter: Konstantinos Alexandrou

Affiliation: Hellenic Craniofacial Center, Greece

Authors: Alexandrou K, Panagopoulos K, Apostolopoulou D, Stratoudakis A

p-30

Distinct Cranial Features of Lambdoid Synostosis and Positional Posterior Plagiocephaly by 3D-CT-Imaging

Presenter: Junnu Petter Leikola

Affiliation: Cleft Palate and Craniofacial Centre, Department of Plastic Surgery, Helsinki University Central Hospital, Finland

Authors: Leikola JP, Hurmerinta K, Kiukkonen A, Hukki JJ, Saarikko A

p-31

Craniometric evaluation of nasal morphology in patients with unicoronal craniosynostosis

Presenter: Jason W. Yu

Affiliation: Children's Hospital of Philadelphia, USA

Authors: Yu JW, Zhu M, Wink JD, Ligh CA, Swanson JW, Mitchell BT, Bartlett SP, Taylor JA

p-32

Effect of Molding Helmet on Intracranial Pressure in Patients with Sagittal Synostosis

Presenter: Asra Hashmi

Affiliation: Department of Plastic and Reconstructive Surgery, USA/Wayne State University/Detroit Medical Center, USA

Authors: Hashmi A, Rozzelle A, Marupudi N, Sood S

p-33

Intraoperative Intracranial Pressure Monitoring Prior to Calvairal Reshaping in Craniosynostosis Patients

Presenter: Neena Maripudi

Affiliation: Department of Neurosurgery, USA/Wayne State University/Detroit Medical Center, USA

Authors: Maripudi N, Rozzelle A, Hashmi A, Sood S

p-34

The orthodontic character of the dentition of Apert syndrome

Presenter: Tadashi Morishita

Affiliation: St.Mary's Hospital Orthodontic Department, Japan

Author: Morishita T

p-35

Combination of Tessier's clefts nos. 3 and 4-case of a rare anomaly with 12 years follow-up

Presenter: Taku Maeda

Affiliation: Asahikawa Kosei General Hospital, Japan

Authors: Maeda T, Oyama A, Okamoto T, Funayama E, Furukawa H, Yamamoto Y

p-36

Geometric morphometry for evaluation of the results of patients with anterior and basal encephalocele

Presenter: Alexander Sakharov

Affiliation: Child department, Moscow Burdenko Neurosurgery Institute, Russia

Authors: Sakharov A, Satanin L, Kapitanov D, Roginsky V, Ivanov A, Evteev A, Lemeneva N

p-37

A multidisciplinary management philosophy for the midline craniofacial anomalies.

Presenter: Walter J. Flapper

Affiliation: Australian Craniofacial Unit, Australia

Authors: Flapper WJ, Ahmad F, Pidgeon T, Anderson PJ, David DJ

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Enophthalmos following Facial Bipartition and Box Osteotomy Correction of Hypertelorism

Presenter: William Breakey

Affiliation: Great Ormond Street Hospital, UK

Authors: Breakey W, Abela C, Evans RE, Britto JA, Hayward RD, Jeelani NUO, Dunaway DJ

p-39

LONG-TERM FOLLOWUP OF ONLAY DORSAL NASAL CRANIAL BONE GRAFTS IN CRANIOFACIAL RECONSTRUCTION

Presenter: Jeffrey A. Goldstein

Affiliation: Children's Mercy Hospital, USA

Author: Goldstein JA

p-40

EFNB1 MUTATION IN JAPANESE PATIENTS WITH CRANIOFRONTONASAL SYNDROME.

Presenter: Hideteru Kato

Affiliation: Department of Plastic and Reconstructive Surgery, Fujita Health University School of Medicine, Japan

Authors: Kato H, Okumoto T, Yoshimura Y, Taguchi Y, Sugimoto M, Kurahashi H

p-41

Clinical Characteristic and Treatment Consideration in Managing Hemangioma

Presenter: Tasya Anggrahita

Affiliation: Division of Plastic, Reconstructive and Aesthetic Surgery, Department of Surgery, University of Indonesia-Cipto Mangunkusumo Hospital, Indonesia

Authors: Anggrahita T, Kreshanti P

p-42

Endoscopic Transmaxillary Repair of Orbital Floor Fractures; a Minimally Invasive Treatment

Presenter: Kazutaka Soejima

Affiliation: Department of Plastic and Reconstructive Surgery, Nihon University School of Medicine, Japan

Authors: Soejima K, Kashimura T, Yakata Y, Yoshida K, Nakazawa H

p-43

Water as an Excellent Contact Medium For Ultrasonography

Presenter: Yuka Shigemura

Affiliation: Osaka medical college Department of Plastic & Reconstructive Surgery, Japan

Authors: Shigemura Y, Ueda K, Akamatu J, Sugita N

p-44

Neurofibromatosis Type 1 Clinical Profile in RSCM: A 5-years Retrospective Evaluation

Presenter: Cherry G. Kalangi

Affiliation: Division of Plastic Surgery, Department of Surgery, Cipto Mangunkusumo Hospital, Faculty of Medicine, University of Indonesia, Indonesia

Authors: Kalangi CG, Handayani S

p-45

Surgical treatment of facial fracture by using unsintered hydroxyapatite and poly L-lactide composite device.

Presenter: Minoru Hayashi

Affiliation: Red Cross Maebashi Hospital, Japan

Authors: Hayashi M, Muramatsu H, Yoshimoto S

p-46

Malignant transformation of small facial epidermal cyst with distant metastasis

Presenter: Do Hoon Kwak

Affiliation: Department of Plastic and Reconstructive Surgery, Chung-Ang University Hospital, Korea

Authors: Kwak DH, Kim WS, Tae Hui TH, Kim HK, Kim MK

p-47

ACCURACY IN ORBITAL ROOF RECONSTRUCTION USING PREMOLDED TITANIUM MESHES

Presenter: Susana Heredero

Affiliation: Maxillofacial Surgery, Hospital Universitario Reina Sofia, Spain

Authors: Heredero S, Solivera J, Dean A, Alamillos F, Lozano JE

p-48

Juvenile Psammomatoid Ossifying Fibroma of the Maxillary Sinus: A Case Report

Presenter: Ikkei Tamada

Affiliation: Plastic and Reconstructive Surgery, Tokyo Metropolitan Children's Medical Center, Japan

Authors: Tamada I, Shimizu K

p-49

Fracture fragment removal and bone regeneration of endoscopic transmaxillary repair and balloon technique

Presenter: Tsutomu Kashimura

Affiliation: Nihon University School of Medicine Plastic and Reconstructive Surgery, Japan

Authors: Kashimura T, Soejima K, Shimoda K, Yamamoto A, Yakata Y, Yoshida K, Honnma K, Nakazawa H

p-50

INDICATIONS OF VIRTUAL PLANNING AND INTRAOPERATIVE NAVIGATION IN FRONTAL SINUS FRACTURES

Presenter: Alicia Dean

Affiliation: Oral and Maxillofacial Surgery Department, University Hospital Reina Sofía, Spain

Authors: Dean A, Solivera J, Alamillos F, Heredero S, García B, Sanjuan A

p-51

Restoring Pre-injury Occlusion in Mandible and Maxilla Fracture Treatment: Dental Splint Application

Presenter: Sinan Öksüz

Affiliation: Gulhane Military Medical Academy Haydarpasa Training Hospital Department of Plastic Surgery, Turkey

Authors: Öksüz S, Karagöz H, Eren F, Erkan M, Ülkür E

p-52

Multidisciplinary Treatment for Correction of Malocclusion due to Maxillofacial Deformity from Fractures

Presenter: Yasuharu Yamazaki

Affiliation: Dept. of Plast. & Aesthetic. Surg. School of Medicine, Kitasato University, Japan

Authors: Yamazaki Y, Sugimoto T, Takeda A

p-53

Patterns of intracranial hemorrhage in pediatric patients with facial fractures

Presenter: Jordan N. Halsey

Affiliation: Rutgers, New Jersey Medical School, Division of Plastic Surgery, USA

Authors: Halsey JN, Hoppe IC, Marano AA, Lee ES, Granick MS

p-54

Surgical treatment of zygomatic fracture by using biogradable plate system (Superfixorb MX®) on 33 cases

Presenter: Shinsuke Sakai

Affiliation: Department of Plastic and Reconstructive Surgery, JCHO Tokyo-Shinjuku Medical Center, Japan

Authors: Sakai S, Miyawaki T

p-55

Ethanol sclerotherapy for treating venous malformations of the palatal region.

Presenter: Munetomo Nagao

Affiliation: Department of Plastic and Reconstructive Surgery, Iwate medical University, Japan

Authors: Nagao M, Kato K, Nakasato T, Kashiwaya G, Kashiwa K, Kobayashi S

p-56

Modified Facial dismasking flap approach for excision of orbital hemangioma: A case report

Presenter: Tomoaki Kuroki

Affiliation: Showa University School of Medicine, Japan/Ankara Diskapi Yildirim Beyazit Training and Research Hospital, Turkey

Authors: Kuroki T, Tosa Y, Horoz U, Shimizu Y, Muramatsu H, Kusano T, Sato N, Yoshimoto S

p-57

Arachnoid cyst and dysplasia of the greater wing of the sphenoid in neurofibromatosis. Surgical management

Presenter: Damian Palafox

Affiliation: Plastic and Reconstructive Surgery Department. Hospital General Dr. Manuel Gea Gonzalez. Postgraduate Division. Universidad Nacional Autónoma de México, Mexico

Authors: Palafox D, Cortés-Arreguin J

p-58

The Surgical Approaches To Intraorbital Tumors Applying Orbitotomy

Presenter: Toshihito Mitsui

Affiliation: Department of Plasticsurgery, Kansai Medical University, Hirakata Hospital, Japan

Authors: Mitsui T, Yamauchi T, Hihara M, Morimoto N, Kusumoto K

p-59

Usefulness of pre-bent titanium mesh plates for the precise repair of orbital wall fractures

Presenter: Takahiro Yamamoto

Affiliation: Jichi Medical University, Japan

Authors: Yamamoto T, Kamochi H, Abe S, Uda H, Sugawara Y

p-60

Solitary Fibrous Tumor as an Orbit Lesion: Report of Three Cases.

Presenter: Hiroki Yano

Affiliation: Department of Plastic & Reconstructive Surgery, Nagasaki University School of Medicine, Japan

Authors: Yano H, Tanaka K, Kashiyama K, Suzuki S, Hirano A

p-61

Efficacy and complication of resorbable plate for reconstruction of orbital wall fractures

Presenter: Kazuhide Mineda

Affiliation: Department of Plastic surgery, Tokushima University, School of Medicine, Japan

Authors: Mineda K, Matsuo S, Seike T, Ishida S, Takaku M, Abe Y, Toda A, Yamasaki H, Hashimoto I

p-62

Maxillofacial fractures associated with laryngeal injury; red flag signs and symptoms that should not be overlooked

Presenter: Chih-Hao Chen

Affiliation: Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital, Chang Gung University, College of Medicine, Taiwan

Authors: Chen CH, Shyu VB

p-63

Prevalence of Vascular Malformation Patients in Cipto Mangunkusumo Hospital, Jakarta from 2010 to 2014

Presenter: Prasetyanugraheni Kreshanti

Affiliation: Cipto Mangunkusumo Hospital, Indonesia

Author: Kreshanti P

p-64

Comparison between two different flap for reconstruction in tongue—A quality of life analysis

Presenter: Yisen Shao

Affiliation: The oral and plastic department of the affiliated hospital of jiangxi university of traditional chinese medicine, China

Authors: Shao Y, Zhu Y, Xi W, Wang W

p-65

Correction of Late Post-traumatic Enophthalmos using an Antral Balloon

Presenter: Akihiko Sakagami

Affiliation: Kanazawa Medical University, Japan

Authors: Sakagami A, Yamashita M, Daizo H, Shimada K, Kawakami S

p-66

Percutaneous sclerotherapy for intramuscular venous malformations of the masticatory muscles

Presenter: Kosuke Ishikawa

Affiliation: Center for Vascular Anomalies, KKR Sapporo Medical Center Tonan Hospital, Japan

Authors: Ishikawa K, Sasaki S, Furukawa H, Saito N, Nagao M, Ishiyama S, Iwasaki D, Fujita M, Sugii M, Takahashi H, Nozaki A, Yamatsu Y, Omote C, Funayama E, Oyama A, Yamamoto Y

p-67

Custom-made cranioplasty by hydroxy-apatite prostheses: the report of 3 cases

Presenter: Masami Saito

Affiliation: Plastic and Reconstructive Surgery, Fukushima medical University, Japan

Authors: Saito M, Kimura N, Ueda K

p-68

Closed Reduction of nasal fracture using ultrasonography

Presenter: Ayako Syouka

Affiliation: Department of plastic and reconstructive surgery, The JIKEI University KASIWA hospital, Japan

Authors: Syouka A, Sakai S, Miyawaki T

p-69

Pediatric facial fractures: interpersonal violence as a mechanism of injury

Presenter: Ian C. Hoppe

Affiliation: Rutgers, New Jersey Medical School, Division of Plastic Surgery, USA

Authors: Hoppe IC, Kordahi AM, Lee ES, Granick MS

p-70

MODIFIED LE FORT III OSTEOTOMY-MINIMAL INCISIONS

Presenter: Jose Rolando Prada

Affiliation: Plastic Surgery Hospital Infantil Universitario de San Jose/Hospital Infantil Universitario de San Jose, Colombia/FISULAB (Rehabilitation Center for Children with Cleft Lip and Palate), Colombia

Authors: Prada JR, Mendoza MB, Torres TF

p-71

Therapeutic strategy of Mandibular condylar fractures

Presenter: Arito Kurazono

Affiliation: Tokyo Metropolitan Police Hospital Plastic, Reconstructive and Aesthetic Surgery, Japan

Authors: Kurazono A, Watanabe Y, Mashiko T, Akizuki T

p-72

Comparative study of anthropometry of the face between normal Japanese and Caucasoid subjects

Presenter: Fumio Nagai

Affiliation: Department of Plastic and Reconstructive Surgery, Shinshu University School of Medicine, Japan

Authors: Nagai F, Yuzuriha S, Noguchi M, Fujita K, Matsuo K

p-73

Possibility of using standard plates for orbital fracture.

Presenter: Michiko Fukuba

Affiliation: Teikyo University School of Medicine Department of Plastic, Oral and Maxillofacial Surgery, Japan

Authors: Fukuba M, Okada M, Mochizuki M, Aoi N, Yamaoka H, Gonda K, Hirabayashi S

p-74

The Effects of Desferroxamine on Bone and Bone Graft Healing in Critical-size Bone Defects

Presenter: Serbulent Guzey

Affiliation: Kasimpasa Military Hospital, Department of Plastic Surgery, Turkey

Authors: Guzey S, Aykan A, Ozturk S, Avsever H, Kararlioglu Y, Ertan A

p-75

Effect of allogeneic platelet lysate and cyanoacrylate glue on the fibrovascularization of the Medpor implant

Presenter: Hüseyin Karagöz

Affiliation: Gulhane Military Medical Academy Haydarpasa Training Hospital, Turkey

Authors: Karagöz H, Ozturk S, Sahin C, Caputcu A, Muftuoğlu T

15:30 - 16:30

Poster Session 2

Poster 2 (2F G)

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Z-Plasty Technique Using a Large C-Flap to Maximize Symmetry of Cupid's Bow in Unilateral Cleft Lip Repair

Presenter: Sanjay Naran

Affiliation: University of Pittsburgh Department of Plastic Surgery, USA

Authors: Naran S, Maricevich R, Garland CB, Grunwaldt LJ

p-77

NASAL OSTEOTOMY AS A DEFINITIVE PROCEDURE FOR CLEFT LIP NASAL DEFORMITIES

Presenter: Katsuya Tanaka

Affiliation: Department of Plastic and Reconstructive Surgery, Nagasaki University School of Medicine, Japan

Authors: Tanaka K, Yano H, Hirano A

p-78

Final correction of cleft nose emphasized on the nasal base and septum restoration

Presenter: Chun MING Liu

Affiliation: 301 Hospital in Beijing (The General Hospital of PLA), China

Author: Liu CM

p-79

Stem cell therapy for reconstruction of alveolar cleft in adults: A randomized controlled clinical trial (RCT)

Presenter: Mona Bajestan

Affiliation: State University of New York at Buffalo, Department of Orthodontics, School of Dental Medicine, USA/University of Michigan, Department of Orthodontics, School of Dentistry, USA

Authors: Bajestan M, Rajan A, Cevidanes LH, Edwards S, Aronovich S, Kaigler D

p-80

Secondary rhinoplasty for cleft lip nasal deformity by using rib cartilage graft

Presenter: Masayuki Miyata

Affiliation: Department of Plastic and Reconstructive Surgery, Niigata University Graduate School of Medical and Dental Sciences, Japan

Author: Miyata M

p-81

Computer analysis of cleft lip surgery

Presenter: Masataka Akimoto

Affiliation: Nippon Medical School Chiba-hokusoh Hospital, Japan

Authors: Akimoto M, Ishii N

p-82

Post surgical Nasal Molding in Cleft Lip Patients

Presenter: Alexander L. Ivanov

Affiliation: Central Research Institute of Somatology and Maxillofacial Surgery, Russia

Author: Ivanov AL

p-83

A case report: Cheiloplasty for the median cleft lip deformity in holoprosencephaly

Presenter: Satoshi Takagi

Affiliation: Dep. of Plastic, Reconstructive, and Aesthetic Surgery, School of Medicine, Fukuoka University, Japan

Authors: Takagi S, Tsukamaoto A, Ohjimi H

p-84

Experiences of secondary Furlow's palatoplasty after velar adhesion in cleft lip and palate patients

Presenter: Rui Suzuki

Affiliation: Hyogo Children's hospital, Japan

Authors: Suzuki R, Oyama T, Ikemura K

p-85

Experience and discussion of block anesthesia in surgery for cleft lip and cleft palate.

Presenter: Nobuhiro Sato

Affiliation: Department of Plastic and Reconstructive Surgery, Showa University Hospital, Japan

Authors: Sato N, Yoshimoto S, Yoshikawa A, Kusano T, Muramatsu H, Morioka D, Kuroki T, Tosa Y, Shimizu Y, Ohkubo F, Serada K, Fuke N

p-86

Application of interdental distraction osteogenesis (IDO) in CLP treatment

Presenter: Teruo Sakamoto

Affiliation: Tokyo Dental College, Department of Orthodontics, Japan

Authors: Sakamoto T, Ariizumi D, Yasumura T, Ishii T, Sueishi K

p-87

Comparison of two techniques for nasal floor closure in patients with unilateral primary palate cleft

Presenter: Araceli Perez-GONZALEZ

Affiliation: Plastic and Reconstructive Surgery Department. Hospital General Gea Gonzalez, Mexico

Authors: Perez-GONZALEZ A, Shinji-PEREZ KA, Martinez-Wagner R, Gutiérrez-Valdez DH

p-88

Growth trends in micrognathic infants treated with mandibular distraction with respect to a non-distracted cohort

Presenter: Brianne T. Mitchell

Affiliation: University of Pennsylvania, USA

Authors: Mitchell BT, Swanson JW, Taylor JA

p-89

Distraction by the RED system with consideration for the external nose shape form and control of the occlusal plane

Presenter: Suguru Kondo

Affiliation: Department of Orthodontics and Pedodontics, Cleft Lip and Palate Center, Fujita Health University School of Medicine, Japan

Authors: Kondo S, Okumoto T, Imamura M, Yoshimura Y

p-90

Measurement of distraction force in maxillary distraction osteogenesis for cleft lip and palate

Presenter: Takuya Ogawa

Affiliation: Maxillofacial Orthognathics, Graduate School, Tokyo Medical and Dental University, Japan

Authors: Ogawa T, Sawada H, Kataoka K, Baba Y, Moriyama K

p-91

Finally Scalping forehead flap: An outcome of multiple seugery on cleft lip nose

Presenter: Yohko Yoshimura

Affiliation: Dept. Plast. Reconstr. Surge. Fujita Health University School of Medicine, Japan

Authors: Yoshimura Y, Okumoto T, Inoue Y, Onishi S, Koike G, Kato H

p-92

Endoscopic surgery for cleft palate

Presenter: Osamu Ito

Affiliation: Yokohama City Minato Red Cross Hospital, Japan

Authors: Ito O, Yano T, Kawazoe T, Park S

p-93

Internal Carotid Artery Variations in Velocardiofacial Syndrome Patients and Its Implications for Surgery

Presenter: Yung Ki Lee

Affiliation: The Departments of Plastic Surgery, Seoul National University Bundang Hospital, Korea

Authors: Lee YK, Baek RM, Kim B

p-94

A COMPARATIVE STUDY OF 3D NASAL SHAPE in UCLP NOSES IN ROTATION-ADVANCEMENT AND NAM- CUTTING PRIMARY NASAL REPAIR

Presenter: Banafsheh Hosseinian

Affiliation: NYU Langone medical center plastic surgery department, USA

Authors: Hosseinian B, Almaidhan A, Shetye PR, Cutting C, Grayson B

p-95

A thin vermilion flap augmentation of upper lip for a cleft lip patient—A case report

Presenter: Ichiro Shiokawa

Affiliation: Department of plastic surgery, Saitama Medical Center, Japan

Authors: Shiokawa I, Minabe T, Ohnishi F, Yamakawa T, Shidoh H

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withdrawn

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Simonart's band indicates narrow cleft and mild tissue deficiency in unilateral cleft lip and palate

Presenter: Kenya Fujita

Affiliation: Department of Plastic and Reconstructive Surgery, Nagano Children's Hospital, Japan

Authors: Fujita K, Yuzuriha S, Noguchi M, Nagai F, Matsuo K

p-98

The evaluation of sequence surgical treatments of adult hemifacial microsomia

Presenter: Wei Liu

Affiliation: Department of Maxillofacial Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Science, Peking Union Medical College, China

Authors: Liu W, Tang XJ, Shi L, Yin L, Yin H, Zhang ZY

p-99

Long term Outcomes of Craniofacial Microsomia Treatment: Microtia and Atresia Reconstruction

Presenter: Rachel Mandelbaum

Affiliation: Division of Plastic and Reconstructive Surgery, University of California Los Angeles, USA

Authors: Mandelbaum R, Martins D, Farias-Eisner G, Park S, Dubina E, Ishiyama A, Bradley JP, Lee JC

p-100

The Study of Atrophy in the Reconstructed Ear

Presenter: Makoto Takahashi

Affiliation: Osaka city general hospital, Japan

Authors: Takahashi M, Imai K, Masuoka T, Yamaguchi K, Ishise H, Okada A, Deguchi A, Kawamoto K

p-101

Transverse auricular muscle shortening as an adjunct to Mustarde otoplasty

Presenter: Daichi Morioka

Affiliation: Department of Plastic Surgery, Showa University, Japan

Authors: Morioka D, Ohkubo F, Utsunomiya H, Kusano T, Muramatsu H

p-102

Our therapeutic experience of craniofacial asymmetry with digitization treatment

Presenter: Liang Xu

Affiliation: Department of Plastic and Reconstructive Surgery, Shanghai 9th People's Hospital, Shanghai Jiao Tong University School of Medicine, China

Authors: Xu L, Wei M

p-103

Pierre Robin sequence: challenges in the evaluation, the role of early distraction osteogenesis

Presenter: Jie Cui

Affiliation: Department of Plastic Surgery, Nanjing Children's Hospital, affiliated with Nanjing Medical University, China

Authors: Cui J, Shen W, Chen J

p-104

Application of CAD software for the assessment of facial asymmetry: Zebra mapping & environment mapping

Presenter: Yumeji Takeichi

Affiliation: Daiyukai Diichi Hospital, Dept. of Plastic and Reconstructive Surgery, Japan

Authors: Takeichi Y, Motai H, Iguchi H, Tada H, Kato M, Asai A, Ito Y

p-105

A TPF pocket method in elevation of reconstructed auricle

Presenter: Takashi Kurabayashi

Affiliation: Ashikaga Red Cross Hospital, Japan

Authors: Kurabayashi T, Asato H, Kaji N, Mitoma Y, Suzuki Y

p-106

Stability of Surgical Correction for Facial Asymmetry

Presenter: Takayuki Honda

Affiliation: Department of Plastic and Reconstructive Surgery, School of Medicine, Iwate Medical University, Japan

Authors: Honda T, Kashiwa K, Kobayashi S, Kinnno Y, Seino Y, Miura H

p-107

Three Step Training Method Of Creating Auricular Cartilage Framework In Microtia

Presenter: Akira Yamada

Affiliation: Northwestern University Lurie Children's Hospital of Chicago, USA

Authors: Yamada A, Corcoran J, Gosain A

p-108

Intraoperative repositioning assessment using navigation system in facial bone fracture

Presenter: Akihiro Ogino

Affiliation: Department of Plastic and Reconstructive Surgery, Toho University Omori Medical Center, Japan/
Department of Plastic and Reconstructive Surgery, Toho University Ohashi Medical Center, Japan/
Department of Plastic and Reconstructive Surgery, Toho University Sakura Medical Center, Japan

Authors: Ogino A, Onishi K, Okada E, Yamada T, Hayashi A

p-109

Reconstruction of Orbital Floor Defects With Using 3D Model

Presenter: Hideyuki Muramatsu

Affiliation: Department of Plastic Surgery, Showa University School of Medicine, Japan

Authors: Muramatsu H, Hayashi M, Tokunaka R, Umezawa K, Hamazima A, Araki N, Yoshimoto S

p-110

Experience of Cone-Beam CT for Diagnosis of Malar Bone Fracture

Presenter: Masaru Horikiri

Affiliation: Fukushima Medical University Plastic and Reconstructive Surgery, Japan

Authors: Horikiri M, Ueda K, Okochi M, Saito M, Mochizuki Y, Asai E, Okochi H, Sakaba T, Momiyama M, Sakano I, Furukawa A

p-111

Pre-operative surgical planning of craniosynostosis with a personal 3D printer

Presenter: Natsue Kishida

Affiliation: Shizuoka Children's Hospital, Japan

Authors: Kishida N, Kitagawa M, Ishizaki R, Tashiro Y, Wataya T

p-112

A New Salt Material 3D Model for Pre-Surgical Simulation of Cranio-Maxillofacial Surgery

Presenter: Takayuki Okumoto

Affiliation: Department of Plastic and Reconstructive Surgery, Fujita Health University School of Medicine, Japan

Authors: Okumoto T, Yoshimura Y, Imamura M, Kondo S

p-113

CT-guided sclerotherapy for venous malformation

Presenter: Satoko Yamawaki

Affiliation: Department of Plastic and Reconstructive Surgery, Graduate School of Medicine, Kyoto University, Japan/Department of Plastic and Reconstructive Surgery, Takeda General Hospital, Japan

Authors: Yamawaki S, Aya R, Enoshiri T, Yoshikawa K, Naitoh M, Suzuki S

p-114

Three-Dimensional Computed Tomography Venography as a Guide for Cranioplasty in Parietal Cephalocele

Presenter: Akiko Yamashita

Affiliation: Kanazawa Medical University, Japan

Authors: Yamashita A, Yamashita M, Akai T, Sakagami A, Daizo H, Shimada K, Kawakami S

p-115

Exophthalmometry by computed tomography

Presenter: María Bibiana Mendoza

Affiliation: Plastic & craniofacial surgeon in Plastic Surgery Department, Hospital Infantil Universitario de San Jose, Colombia/Hospital Infantil Universitario de San Jose, Colombia

Authors: Mendoza MB, Prada JR, Abreu JA, Triana GA

p-116

Prenatal Identification of Pierre Robin Sequence: A Review of the Literature and Look Towards the Future

Presenter: Matthew G. Kaufman

Affiliation: Division of Plastic Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine, USA

Authors: Kaufman MG, Cassady CI, Hyman CH, Lee W, Watcha MF, Hippard HK, Olutoye OA, Khechoyan DY, Monson LA, Buchanan EP

p-117

Scoring for the Qualitative Evaluation of Smiles in Patients with Facial Paralysis

Presenter: Akiteru Hayashi

Affiliation: Department of Plastic and Reconstructive Surgery, Toho University Sakura Medical Center, Japan

Authors: Hayashi A, Nawata M, Okaneyama T, Nakamichi M, Okada E, Onishi K, Shinya M, Shiraishi M

p-118

Quantitative determination of zygoma with 3D images in an Asian population

Presenter: Hsuan-Keng Yeh

Affiliation: Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital, Chang Gung University, College of Medicine, Taiwan

Authors: Yeh H, Chen CH

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3D Image Analysis of Facial Skeletal and Soft Tissue Changes after Monobloc Distraction

Presenter: Halil I. Canter

Affiliation: Acibadem University School of Medicine, Department of Plastic Reconstructive and Aesthetic Surgery, Turkey

Authors: Canter HI, Ozek M, Germec-Cakan D, Alanay Y, Yildiz E, Yildiz K

p-120

Zygomaticomaxillary reconstruction with vascularized bone graft aiming to the esthetical result

Presenter: Masaki Fujioka

Affiliation: National Hospital Organization Nagasaki Medical Center, Japan

Authors: Fujioka M, Hayashida KH, Saijo HS

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OSTEOMYOCUTANEOUS PERONEAL ARTERY PERFORATOR FLAP FOR SKULL BASE RECONSTRUCTION

Presenter: Juan Solivera

Affiliation: UGC de Neurocirugía, Hospital Universitario Reina Sofía, Spain

Authors: Solivera J, Heredero S, Blas G, Alamillos F, Dean A

p-122

Multiple delayed cranial reconstruction for complicated cranial defects

Presenter: Yoshiaki Sakamoto

Affiliation: Department of Plastic and Reconstructive Surgery, Keio University School of Medicine, Japan

Authors: Sakamoto Y, Arnaud E

p-123

Secondary skull bone reconstruction using thickened artificial bone designed to reduce the dead space

Presenter: Mine Ozaki

Affiliation: Department of Plastic Surgery, Kyorin University School of Medicine, Japan

Authors: Ozaki M, Narita K, Kita Y, Sato T, Eto H, Takushima A, Harii K

p-124

Facial nerve reconstruction using vascularized nerve grafts

Presenter: Katsuhiko Kashiwa

Affiliation: Department of Plastic, Reconstructive and Aesthetic Surgery, Iwate Medical University, Faculty of Medicine, Japan

Authors: Kashiwa K, Kobayashi S, Honda T, Nagao M

p-125

Modified Lengthening Temporalis Myoplasty with Intraoral approach

Presenter: Ayato Hayashi

Affiliation: Department of plastic and reconstructive surgery, Juntendo University School of Medicine, Japan

Authors: Hayashi A, Yoshizawa H, Senda D, Mizuno H

p-126

An innovative method for reconstruction of the alveolar and palatal midline defect

Presenter: Fumio Ohnishi

Affiliation: Department of plastic, reconstructive and aesthetic surgery, Saitama medical center, Saitama medical university, Japan

Authors: Ohnishi F, Minabe T, Nakatani H, Enomoto Y

p-127

Algorithm for reconstruction of composite cranial defects using the free anterolateral thigh flaps

Presenter: Fumiaki Shimizu

Affiliation: Department of Plastic Surgery, Oita University Hospital, Japan

Authors: Shimizu F, Uehara M, Oatari M, Kusatsu M

p-128

Team approach to Achieve Better Outcome in Mandible Reconstruction with Free Fibular Flap

Presenter: Kristaninta Bangun

Affiliation: Cleft Craniofacial Center RSM Hospita, University of Indonesia, Indonesia

Authors: Bangun K, Atmodiwirjo P, Handayani S, Kreshanti P

p-129

Three-dimensional analysis of zygomatic malunion in patients with cheek ptosis caused by reduction malarplasty

Presenter: Baek-kyu Kim

Affiliation: The Departments of Plastic Surgery, Seoul National University Bundang Hospital, Korea

Authors: Kim B, Baek RM

p-130

The Novel technique in sculpting nasal implant using Chinese ancient architectural technology.

Presenter: Andy Tan

Affiliation: Shanghai Ninth People's Hospital, China

Authors: Tan A, Gang C, Zhang Y

p-131

Massive zygomatic reduction through bone graft of zygomatic arch

Presenter: Daniel Seungyoul Han

Affiliation: DH Plastic Surgery Clinic, Korea

Author: Han DS

p-132

Surgical Orthodontic Treatment of maxillary setback movement

Presenter: Shugo Haga

Affiliation: Department of Orthodontics, School of Dentistry, Showa University, Japan

Authors: Haga S, Yamaguchi T, Furuya R, Tsuneoka M, Futaki K, Ichikawa Y, Kurihara Y, Kondo S, Shirota T, Maki K

p-133

Application of computer-aided design in BSSRO combined with simultaneous osseous genioplasty

Presenter: Xi Li

Affiliation: the Department of Maxillofacial Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Science, Peking Union Medical College, China/General Surgery Dept, Chengdu Intergrated TCM& Western Medicine Hospital, China

Authors: Li X, Gui L, Niu F, Chen Y, Xu J

p-134

Piezosurgery in orthognathic surgery

Presenter: Kazuhiro Toriyama

Affiliation: Plastic and Reconstructive Surgery, Nagoya City University Medical School, Japan

Authors: Toriyama K, Takanari K, Ebisawa K, Sawamura H, Kanbe M, Nakamura Y, Hattori H, Yamanouchi T, Kamei Y

p-135

Modified Bilateral Sagittal Split Ramus Osteotomy Fixation to Correct Mandibular Asymmetry

Presenter: Xudong Wang

Affiliation: Department of Oral and Craniomaxillofacial Surgery, Ninth People's Hospital, School of Medicine, Shanghai Jiao Tong University, China

Author: Wang X

p-136

Changes in chewing efficiency before and after orthognathic surgery

Presenter: Misato Tsuneoka

Affiliation: Department of Orthodontics, School of Dentistry, Showa University, Japan

Authors: Tsuneoka M, Nakamura T, Shirota T, Yamaguchi T, Maki K

p-137

Skeleton first in surgical treatment of facial disharmony

Presenter: Junyi Yang

Affiliation: Shanghai Ninth People's Hospital, China

Author: Yang J

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Tow Jaw Clockwise Rotation Surgery as a tool for lower face reduction

Presenter: Tadashi Akamatsu

Affiliation: Tokai University School of Medicine, Japan

Authors: Akamatsu T, Hanai U, Kuroki T, Miyasaka M

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A case of Apert syndrome treated by bimaxillary orthognathic surgery after Le Fort III distraction

Presenter: Michiko Tsuji

Affiliation: Maxillofacial Orthognathics, Graduate School, Tokyo Medical and Dental University, Japan

Authors: Tsuji M, Naganishi H, Torikai K, Moriyama K

p-140

Indications for Computer Assisted Design and Manufacturing in Congenital Craniofacial Reconstruction

Presenter: Amir Dorafshar

Affiliation: Department of Plastic and Reconstructive Surgery, Johns Hopkins University School of Medicine, USA

Authors: Dorafshar AH, Fisher M, Medina MA, Bojovic B, Ahn ES

p-141

A Novel Method of Human Adipose-derived Stem Cell Isolation with Increased Yield and Viability

Presenter: Elizabeth R. Zielins

Affiliation: Hagey Laboratory for Pediatric Regenerative Medicine, Division of Plastic Surgery, Stanford University, USA

Authors: Zielins ER, Tevlin R, McArdle A, Seo E, Chung MT, Paik KJ, Senarath-Yapa K, Atashroo DA, Hu MS, Walmsley GG, Vistnes S, Li S, Chan CK, Wan DC, Longaker MT

p-142

Computer-assisted laser bone crafting.

Presenter: Soh Nishimoto

Affiliation: Hyogo College of Medicine, Japan

Authors: Nishimoto S, Sotsuka Y, Tsumano T, Shimokita R, Yamauchi T, Kawai K, Kakibuchi M

p-143

Classification of Deformational Plagiocephaly: A Clinician's Tool

Presenter: Kathryn V. Isaac

Affiliation: Division of Plastic and Reconstructive Surgery, University of Toronto, Canada

Authors: Isaac KV, Clausen A, Moghaddam MB, Da Silva T, Forrest CR

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withdrawn

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Repair of nasal alar contracture using autologous dermis graft and secondary full-thickness skin graft overlay

Presenter: Yoshihiro Takami

Affiliation: Department of Plastic Surgery, Tokyo Rosai Hospital, Japan

Authors: Takami Y, Ono S, Kim Y, Osawa S, Ogawa R, Hyakusoku H

p-146

Skeletal Analysys of the Twist +/- heterozygous mice, a Genetic Model for the Sathre-Chotzen syndrome.

Presenter: Takashi Nuri

Affiliation: Plastic and Reconstructive surgery, Osaka Medical College, Japan

Authors: Nuri T, Ueda K, Iseki S, Ota M

p-147

Conjoined Twin Separation: Integration of Three-Dimensional Modeling for Optimization of Surgical Planning

Presenter: Benjamin C. Wood

Affiliation: Children's National Medical Center, USA/George Washington University School of Medicine and Health Sciences, USA

Authors: Wood BC, Sher S, Oh AK, Sauerhammer TM, Cochenour C, Rogers GF, Boyajian MJ

p-148

A novel causative gene for permanent tooth agenesis

Presenter: Tetsutaro Yamaguchi

Affiliation: Department of Orthodontics, School of Dentistry, Showa University, Japan

Authors: Yamaguchi T, Hosomichi K, Kim Y, Yano K, Haga S, Katayama K, Takahashi M, Park S, Inoue I, Maki K

p-149

ANTENATAL CLEFT COUNSELING IN SINGAPORE, KK WOMEN'S AND CHILDREN'S HOSPITAL, CLEFT AND CRANIOFACIAL CENTRE.

Presenter: Josephine C.H Tan

Affiliation: KK Women's and Children's Hospital, Singapore

Authors: Tan JCH, Cheng JSH, Yeo PPY, Hussein HL

p-150

Efficacy of the Intermaxillary Traction Therapy with the Skeletal Anchorage Plate after Le Fort III Bone Distraction

Presenter: Masahiko Noguchi

Affiliation: Nagano Children's Hospital/Matsumoto Dental University

Authors: Noguchi M, Kurata K, Fujita K

p-151

A troublesome case of chronic infection in frontal sinus caused by an unpredictable artificial material.

Presenter: Yoshie Endo

Affiliation: Department of Plastic Surgery Kitakyusyu general hospital, Japan

Authors: Endo Y, Mukae N, Yoshimuta K, So M

p-152

The usefulness of stereolithography models for craniofacial reconstruction at Cipto Mangunkusumo Hospital

Presenter: Siti Handayani

Affiliation: Cleft Craniofacial Center Cipto Mangunkusumo Hospital-University of Indonesia, Indonesia

Authors: Handayani S, Kreshanti P, Ariani N

p-153

Comparison of US national databases for perioperative complications in craniosynostosis surgery

Presenter: Sandi Lam

Affiliation: Texas Children's Hospital, Baylor College of Medicine, USA

Authors: Lam S, Khechoyan DY, Buchanan EP, Monson LA, Luerssen T, Pan I

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Vascularization of Tissue Engineered Bone Using a Macrovascular Flow Channel

Presenter: Derek M. Steinbacher

Affiliation: Yale University, USA

Authors: Steinbacher DM, Le A

p-155

Quality Improvement From Implementation Of A Multidisciplinary Care Pathway For Craniosynostosis Surgery

Presenter: Sandi Lam

Affiliation: Texas Children's Hospital, Baylor College of Medicine, USA

Authors: Lam S, Luerssen T, Pan I, Khechoyan DY, Buchanan EP, Monson LA

p-156

The effect of tailored craiofacial reconstruction using Artificial bone.

Presenter: Tadaaki Morotomi

Affiliation: Department of Plastic and Reconstruction Surgery, Kinki University Faculty of Medicine, Japan

Authors: Morotomi T, Hashimoto T, Iuchi T, Isogai N

p-157

Augmentation for Maxillofacial Deformities using Porous Hydroxyapatite Blocks

Presenter: Motoki Katsube

Affiliation: Department of Plastic and Reconstructive Surgery, Kyoto University, Japan/Department of Plastic and Reconstructive Surgery, Kansai Medical University, Japan

Authors: Katsube M, Kusumoto K, Nakano M, Iguchi Y, Tanaka Y, Suzuki S

p-158

Using Mobile Devices For Surgical Education

Presenter: Peter J. Anderson

Affiliation: Australian Craniofacial Unit, Australia

Author: Anderson PJ

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Botulinum toxin type A as an alternative to surgery for the treatment of persistent congenital muscular torticollis

Presenter: Brian Boland

Affiliation: Cleveland Clinic Florida, USA

Authors: Boland B, Stelnicki E

p-160

Genetic background for third molar agenesis

Presenter: Masahiro Takahashi

Affiliation: Department of Orthodontics, School of Dentistry, Showa University, Japan

Authors: Takahashi M, Yamaguchi T, Haga S, Furuya R, Tsuneoka M, Maruyama N, Nakawaki T, Maki K

ABSTRACTS

SP-1

CFS, My Experiences

Presenter: Kitaro Ohmori

Author: Ohmori K

Ohmori Clinic, Japan



Almost 40 years have passed since we started Craniofacial Surgery in 1976 at Department of Plastic and Reconstructive Surgery, Tokyo Metropolitan Police Hospital.

This could not have happened without a great leadership of late Prof. Seiichi Ohmori as well as deep kindness of Prof. Converse at NYU.

After my coming back to Japan from NYU, a case of Crouzon's Disease and a case of orbital hyperterorisum were set up as operative schedules under my name. This was something like a test or gift from my father. These experiences enabled us to establish a Craniofacial surgical team. Since that time, most of the anomalies or deformities related to these subjects have been operated by craniofacial surgery.

In this presentation I would like to introduce some of my experiences.

SP-2

An information of study on craniofacial surgery with the experience for the past half century

Presenter: Hiroshi Kamiishi

Author: Kamiishi H



Purpose: The craniofacial surgery was a most developed field of Plastic Surgery in the past half century. I have fortunately studied on craniofacial surgery at the same time and experienced many interest clinical cases. Purpose of this study is to inform the knowledge learned from experience for the past half century.

Materials and Method: Clinical experience will be presented by chronological order from 1965 to 2015. These include experience of dental practice and Oral Surgery (1965), Le Fort 1 osteotomy (1973), Orbital decompression for malignant exophthalmos (1973), intracranial correction of OHT (1975), correction of myopathic face by using LeFort1+SSRO (1975), forehead advancement (1978), shortening reduction of facial width (1981), lower to upper transfer of teeth (1990), midface degloving procedure (1994), self impacted fixation of SSRO (1994), osteotomy of orbital apex with intracranial approach (1994), new surgical approach for TMJ fracture (1999), and the application for cosmetic purposes (2015~)

Results and Discussion: The experience of dental practice and Oral Surgery for 2 years was a great advantage for the initiation of craniofacial surgery. I have learned the basic technique for the maxillofacial surgery such as the principle and method of IMF, multiple loop dental wiring and another methods of tooth ligation, usefulness of single edged chisels and manner of mallet striking, extraction of wisdom tooth by bone cutting. In addition, use of air drill and saw for cutting bone were not troublesome by the experience of air turbine for the dental use.

Le Fort 1 osteotomy was performed in 1973. The blood supply of the separated maxilla still remained the unsolved problems to be discussed at that time. The orbital decompression for malignant exophthalmos was accomplished by using the pterional approach. There were interested history of various methods have been developed. An intracranial approach for the correction of OHT was performed by the preservation of cribriform plate in 1975. The remodeling of the orbits were clearly demonstrated by the CT that was rapidly developed at that time. The shortening reduction of the facial height was indicated to the patient with myopathy. In order to maintain the closure of mouth the shortening reduction of the facial height was indicated by using Le Fort 1 osteotomy and SSRO. The resetting of the occlusal plane was the key of this procedure. The initial application of the forehead advancement was indicated to the patient with brachycephaly. We have developed the pantograph technic for the early solution of intracranial space. This method allowed us to perform one stage reconstruction of the cranial reshaping.

Reduction of facial width in 1981, intermaxillary transfer of the teeth in 1990, a midface degloving technic in 1994, a self impacted fixation method of SSRO in 1994 and a new surgical approach for TMJ fracture in 1999 were the new application obtained from the problem based learning. Now, I have interested to the refinement of the procedure and the application of cosmetic purpose.

Conclusion: An information of study on craniofacial surgery was briefly documented touching upon the clinical cases for the past half century. The study of craniofacial surgery was a form of problem based learning of the clinical experience.

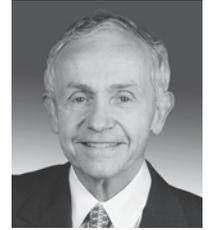
SP-3

THE SPIRIT OF CRANIOFACIAL SURGERY

Presenter: Joseph McCarthy

Author: McCarthy JG

Plastic Surgery, NYU School of Medicine, USA



There is a unique spirit of craniofacial surgery. As one looks at its history, several principles stand out:

1. The patient always comes first, and clinical solutions must be found.
2. Persistence and determination are the hallmarks of the craniofacial surgeon.
3. Clinical problem-solving is imperative.
4. Creativity and innovation are critical.
5. Research is usually what drives innovation.

The role of key figures (Tessier, Obwegeser, Converse among others) in craniofacial surgery will be presented, and some of their historic cases will be demonstrated.

Craniofacial surgeons were also involved in some of the research projects, including transplantation biology, that propelled the field forward.

Craniofacial surgery has also had a wonderful camaraderie, built on mentorships, fellowships, books and scientific meetings.

SP-4**Progress over 40 years in craniofacial surgery as seen in the management of Apert Syndrome**

Presenter: David J. David

Author: David DJ

The Australian Craniofacial Unit, Australia



The establishment of the discipline of craniofacial surgery depended on the presence of a few outstanding multi faceted individuals. Fernando Ortis-Monasterio was one such person and a man for his time. His influence is everywhere to be seen in the progress that has been made in the management of Craniosynostosis syndromes and in particular Apert syndrome which is the subject of this presentation.

Tessier's earliest operations on adult Apert patients are well documented and his early disciples shared the problems he faced not only with caring for these patients, but in knowing the plight they suffered without hope of a meaningful future. In the beginning we all shared the experience of being presented with a cohort of damaged individuals.

During the last 40 years the Australian Craniofacial Unit has managed 174 patients with Apert syndrome. We have developed protocols for treatment and endeavoured to enunciate principles for the delivery of this type of health care that will stand up under social, scientific and political scrutiny. Our Unit has published over thirty papers pertaining to Apert syndrome and its attendant problems.

Twenty nine of our patients have been followed through the whole management programme. The results presented reflect the advances in surgical techniques, the controversies that arise from these innovations. The need to attend to the wider needs of the individual patients such as airway, speech, hearing, and socialisation has been reinforced.

The advances in gene identification, variety within both the genotype and phenotype are reflected in this cohort of patients.

Controversies still persist about the intra cranial pathology and its management. What to do when and what about the hands and feet? The advent of the twenty week ultrasound diagnosis has raise new and difficult issues.

The analysis of 174 patients with Apert Syndrome over 40 years has reinforced the view that multidisciplinary care in major centres is a must. This cohort contains a majority of patients who lead a normal or near normal life. Notwithstanding that we are still confronted with a flow of patients who have been damaged by inappropriate surgery.

SP-5

Skin and Bone: Scar Wars and Stem Cells

Presenter: Michael T. Longaker

Author: Longaker MT

Children's Surgical Research, Hagey Laboratory for Pediatric Regenerative Medicine, USA



Craniofacial surgeons face a number of challenges during reconstructive procedures. The first challenge is scarring. For post-traumatic cases, fibrosis is already present and complicates the ultimate result. For 25 years, I have been studying scarring and in this lecture will describe a new device that significantly minimizes skin scarring post-operatively. In addition, my laboratory recently identified the cellular culprit for scarring following wounding and radiation therapy and this finding will be described in my talk. The second challenge is having adequate bone available to perform the skeletal reconstruction. My laboratory recently identified the skeletal stem cell and I will describe the finding as well as potential clinical implications.

SP-6**The way to Onizuka's cleft lip method**

Presenter: Takuya Onizuka

Author: Onizuka T

Department of Plastic and Reconstructive Surgery, School of Medicine, Showa University, Japan



The first literature about the cleft lip repair may be Yperman method in 16 century. Thereafter many methods have been reported that means not to find the good methods.

When I have begun the cleft lip surgery as a plastic surgeon, Lemedurier quadri-angular method, Tension triangular method and Millard method were famous. Among them I loved Millard method but soon found the several pit-falls of this technique.

The most disappointment point of Millard method is the upward deformity of the Cupid' bow. I have tried to improve this week point and solved by the insertion of the small triangular flap into the median incision line and reported in 1966 as Millard plus small triangular method (old Onizuka's method), but continued to try to get more ideal method. So, I have found the best technique which used the contour lines of the lip such as philtral column, horizontal groove, vermilion border, nasal-labial triangular area, and nasal shape (new Onizuka's method).

Since April 1962 to February 2015, I have operated 7430 cases of cleft lip and palate. By their experience, the following results are obtained,

- ① The incision lines should be incised along the contour line of the lips.
- ② Small triangular flap is inserted along the upper lip horizontal groove.
- ③ Subcutaneous undermining is done to the philtral contour line,
- ④ Orbicularis muscle is anatomically lined and fixed to the nasal spine,
- ⑤ Filtrum and nasolabial triangular area is made symmetrically,
- ⑥ Open rhinoplasty should not be done, because about 30% of my cases are not necessary to do the secondary rhinoplasty empirically.
- ⑦ Nostril rim is done symmetrically by W-plasty if necessary.

I would like to explain about the above points at the congress.

Introduction from Chairs:

Craniofacial perspective from plastic surgical view

Presenter: Scott P. Bartlett

Author: Bartlett SP

University of Pennsylvania, USA

The treatment of single suture non-syndromic synostosis remains controversial. Historically, it has evolved from simple, open strip craniectomy through extended open remodeling, and now is returning towards a more limited approach utilizing endoscopes, helmets, springs and even distractors. Despite this multiplicity of approaches, opinions remain divided not only as to the type of interventions, but also the timing of surgery. Advocates for the early approach argue that early release may be beneficial from a cognitive and developmental perspective, while those in favor of a delayed open approach feel that not only are the cognitive functions preserved, but that the clinical /aesthetic/appearance results are superior. To date, there had been no randomized prospective study to examine these various approaches, nor is there likely to be such. In this symposium we shall examine not only the data from the various centers who employ different strategies, but try to reach a consensus as to a reasonable course of action for our patients moving forward.

Introduction from Chairs:

Single Suture synostosis: A neurosurgeon's viewpoint and perspective

Presenter: James T. Goodrich

Author: Goodrich JT

Children's Hospital at Montefiore Albert Einstein College of Medicine, USA

The origins of single suture synostosis surgery dates to the 1880s with the introduction of suturectomy for mostly in children with microcephalus. Due to a very high morbidity and mortality these early technique were abandoned. Single suture synostectomy was re-introduced just at the end of World War II with some additional modifications and remained popular until the introduction of the now standard techniques of Tessier, Marchac and others in the 1970s. By the mid-1990s the vast majority of craniofacial centers around the world had adopted these recent craniofacial surgical techniques. Some neurosurgeons (not plastic surgeons) have recently gone back to the single suture resection and added modifications such as the endoscope and helmets. A recent review of the literature has clearly demonstrated many differing views on what works and which surgery generates the best long term results. This presentation will be a perspective from a craniofacial neurosurgeon trained in both techniques.

SY-1**MENTAL OUTCOME IN CRANIOSYNOSTOSIS****SURGERY: Functional or esthetics?**

Presenter: Eric Arnaud

Authors: Arnaud E, Brunet F, Mathijssen IMJ, Bottero L, Pamphile L, Di Rocco F, Renier D, Sainte-Rose C

Craniofacial Unit Hôpital Necker, France

Surgery for craniosynostosis is performed for both functional and morphological reasons, but differences exist in the outcomes according to the type of craniosynostosis and protocol of treatments.

Patients and Methods: Out of a cohort of 4500 operated craniosynostosis a subgroup of 650 patients has been retrospectively analyzed. Mental outcome defined by developmental quotient (DQ) or an intellectual quotient (IQ) had been prospectively recorded. Standard tests (Brunet Lezine scale or Wechsler intelligence scale for children-WISC) were carried out by the the same team of psychologists during the selected period of 22 years. The group was split according to pathology 1-Sagittal synostosis (n=396), 2-metopic synostosis (n=76), 3-unicoronal synostosis (n=220), 4-bicoronal synostosis (n=99) and 5-Apert syndrome (n=70).

Each pathology group was split according to age at treatment (before of after one year of age). The final outcome was also analyzed according to genetics findings (FGFR2 or 3 mutations) whenever present.

Surgical technique was classical. There was a minimal followup of 1 year between the initial and secondary mental evaluation.

Results: For all groups except unicoronal synostosis, there was clear benefit of surgery before one year of age on the mental outcome. This was particularly true for the most severe syndromes (Apert) in which there was no patient obtaining a normal score whenever operated after one year of age ($p < 0.05$). Conversely unicoronal synostosis present with a good mental outcome whenever operated or not. In Bicoronal synostosis the mental outcome was worse if in addition to a late operation after 1 year of age, a genetic mutation was present. For sagittal synostosis, the difference was not so obvious but psychological disturbances were found in non operated patients. However, the presence of a good psychosocial environment for the child is clearly a factor of major importance in the outcome.

Discussion: As unicoronal synostosis may clearly appear as a pure esthetic operation, the result is opposite as soon as two or more sutures are involved, functional issues being predominant. For the other craniosynostosis, an increasing problem is the augmentation of moderate forms of metopic synostoses for which we cannot qualify the threshold to indicate surgery for functional reasons. In any case, the quality of the psycho social environment remains critical. In non operated patients, psychologic complications may occur even if the IQ does not seem affected.

SY-2**Neurodevelopmental Outcomes in Single Suture Craniosynostosis: Emphasis on Sagittal and Metopic Synostosis**

Presenter: Kathleen Kapp-Simon

Author: Kapp-Simon K

Northwestern University, Shriners Hospitals for Children, USA

Background: Most neurodevelopmental research on children with single suture craniosynostosis (SSC) has focused on very young children. Our group has studied a cohort of children with and without SSC including four assessment ages (7, 18, and 36 months and 7 years). This presentation will discuss age 7 neuropsychological outcomes for children with SSC (Cases) in comparison to unaffected children (Controls) and among suture groups.

Method: Cases (N=182) and Controls (N=183), representing 70% of the originally enrolled cohort, participated in a comprehensive neuropsychological evaluation including measures of intelligence, language skills, fine motor, visual-motor and executive functioning at age 7. Linear regression analysis with robust standard error, controlling for demographic variables, age, and maternal IQ was used to compare groups.

Results: In this relatively high SES group, 80% of children with SSC compared to 90% of Control children obtained a FSIQ at or above the average range. 42% of Cases compared to 31% of Controls displayed problems with academic achievement with Cases more likely to have achievement problems in three or more areas than Controls (42% vs 28% of those displaying problems). Males and children in SSC groups other than sagittal were most likely to demonstrate problems with achievement. Cases demonstrated more language deficits than Controls, particularly verbal learning (44% vs 26%), fluency (22% vs 12%), and memory (23% vs 12%). Suture groups did not differ in language functioning. Few differences were found between Cases and Controls in fine motor, visual motor skills or executive functioning. Case males performed less well, regardless of suture group.

Conclusions: Most children with SSC achieve average intelligence, though fewer than demographically matched controls. Language problems persist to school entry in a subgroup of children and these problems may be related to academic achievement deficits for that subgroup.

SY-3

Long-term neuropsychological outcomes in sagittal craniosynostosis

Presenter: John Persing
Author: Persing JA
Yale Plastic Surgery, USA

Background: The optimal management of patients with non syndromic sagittal synostosis has been controversial. Components of the strip craniectomy approach using post-operative helmet therapy cite, shorter operating times, smaller scars and a potentially lower morbidity. Those who favor whole vault cranioplasty indicate more complete correction, occurring more rapidly and possibly have improved neurological outcome. These assertions have yet to be objectively analyzed.

Methods: A total of 70 patients were enrolled in a multicenter study where a battery of neurodevelopmental tests were used to evaluate domains of neuropsychological function.

Results: In group comparisons related to IQ, achievement, and behavior, patients who had undergone whole vault cranioplasty had an improved overall profile when compared to the more limited craniectomy approach.

Conclusions: The improved neurologic profile of patients undergoing whole vault cranioplasty is evident when compared to a more limited strip craniectomy approach. This should be information used in the pre-operative planning for patients undergoing craniosynostosis surgery.

SY-4

Proper timing and extent of surgery for sagittal synostosis: are springs the solution?

Presenter: Marie-Lise C. Van Veelen
Authors: Van Veelen MC, Mathijssen IMJ
Department of Neurosurgery, Erasmus University Medical Center Rotterdam, The Netherlands

The trend towards minimally invasive procedures has revived the issue of timing and extend of surgery. Minimally invasive strip craniotomy needs to be assisted by helmet therapy or by distraction with springs to achieve good cosmetic results. The theoretical basis for late complete remodeling is that sagittal synostosis will not regain normal growth potential and needs a definitive intervention for cosmetic correction and sufficient volume. The argument for early extended strip correction is that relief of restriction at the level of the synostotic suture will allow the growing brain and remaining sutures to induce physiological growth with good cosmetic results and sufficient volume.

We followed three cohorts of patients who underwent surgery for sagittal synostosis; complete remodeling performed at 9-12 months, extended strip at 4-6 months and minimally invasive spring distraction at 4-6 months. Late complete remodeling was associated with a lower incidence of postoperative papil edema and a larger postoperative cranial volume when compared to early extended strip. These findings suggest that early and less extensive procedures do not create sufficient volume to prevent the occurrence of raised ICP. However complete remodeling showed a higher incidence of preoperative papilledema (9% vs 2%), indicating that ICP already starts to rise before the end of the first year. Also studies on cognitive development have shown that earlier surgery may be beneficial. These findings suggest that surgery should be performed at an early age, but in such a way that the skull is either enlarged sufficiently or regains the possibility to grow normally.

Complete remodeling at an early age is not advisable because the bone is too thin and the accompanying blood loss relatively large. This brings us to the minimally invasive procedures. Endoscopic strip seems to have the best results at the age of 3 months, however a helmet is needed to achieve a cosmetically normal skull shape. Springs are an alternative to the helmet. They generate active expansion and can be placed through a minimally invasive procedure. In our cohort springs achieved a CI comparable to the two other cohorts. Head circumference initially increased but decreased to the same level as the extended strip cohort. The incidence of papil edema was lower than in the two other cohorts but follow-up is too short to define a good risk percentage yet.

SY-5**TOTAL CRANIAL VAULT RECONSTRUCTION FOR SCAPHOCEPHALY: THE MELBOURNE TECHNIQUE**

Presenter: Anthony D. Holmes

Author: Holmes AD

University of Melbourne, Royal Children's Hospital, Australia

Unhappy with the plethora of techniques available for treating sagittal synostosis, in 1999 we embarked on a program of total vault reconstruction. The Melbourne Method was designed with the goal of correcting all the phenotypic features of scaphocephaly whilst, at the same time, increasing the intracranial volume and allowing subsequent normal growth. We were enthused by the initial results and have completed 255 cases between 2000-2014. Our initial follow up data included post-operative C.T. scans, ophthalmological examinations, paediatric development and routine interval photography. Realising that all craniosynostosis conditions are characterised by high rates of neurocognitive, learning and behavioural difficulties, from 2004 neuropsychological data was also collected from all patients, both before and after surgery. 3D photography was utilised and by 2008, after noting a linear relationship between 3D and scan measurements, routine post-operative C.T. scans were eliminated.

In general, major complications have been rare and the long term functional and aesthetic results most acceptable. Developmental gains are consistently noted post-operatively. Only three patients have had further cranial vault surgery for the late development of raised intracranial pressure. Our long term studies continue. The first of these addressed post operative suture patency of the previously unfused sutures. The lambdoid sutures fused in 74% and the coronals, 40%. Interestingly, this made no appreciable difference in head shape or size. The head circumferences tended to return toward the normal range. An independent neurosurgical study of the same cohort showed no signs of raised intracranial pressure.

An overview will be presented. Total cranial vault correction is still our main stay operation. This would change if a less invasive procedure could demonstrate the same or better long-term scaphocephaly results.

SY-6**Minimally-invasive treatment of craniosynostosis: evidence**

Presenter: Gary Rogers

Author: Rogers GF

CNMC Plastic Surgery, USA

Minimally invasive procedures are now commonplace in all surgical specialties. The benefits of limited incisions include lower morbidity and complication rates, faster recovery, and decreased cost. While the field of craniofacial surgery has followed this trend for certain conditions, there remains much resistance to the use of certain methods used to treatment of craniosynostosis. One technique in particular, endoscopically-assisted suturectomy and post-operative helmet therapy (ES+HT), has received mixed reviews from the craniofacial community in spite of a growing body of research supporting its clinical and cost effectiveness. Reports from numerous centers document comparable and, in some conditions, superior results using ES+HT compared to larger open cranial remodeling procedures (CR). Advantages include: smaller incisions and lower morbidity; shorter operating time, anesthetic exposure, and hospitalization; correction of some associated ophthalmologic conditions (UCS); better facial symmetry (UCS); neosuture formation; and normalization of functional laterality. Moreover, at least two reports have found ES+HT to be significantly less costly than CR for the treatment of sagittal synostosis. There are, however, several reports that question the reliability and adequacy of ES+HT, and others that imply this method leads to lower cognitive outcomes than more traditional open approaches. The evidence for and against ES+HT will be reviewed in detail.

SY-7

Endoscopic-Assisted Craniosynostosis Surgery—A decade of experience at a single institution

Presenter: Mark R. Proctor

Authors: Proctor MR¹, Abd-El-Barr MM¹, Goobie SM², Meier PM², Rogers GF³, Meara JG⁴

¹Department of Neurosurgery, Boston Children's Hospital, Harvard Medical School, USA, ²Department of Anesthesiology, Perioperative, and Pain Medicine, Boston Children's Hospital, Harvard Medical School, USA, ³Department of Pediatric Plastic Surgery, Children's National Medical Center, USA, ⁴Department of Plastic and Oral Surgery, Boston Children's Hospital, Harvard Medical School, USA

Introduction: Endoscopic-Assisted craniosynostosis surgery offers several benefits to select patients with single or multi-suture craniosynostosis. It allows intervention at an earlier age, with a more limited surgery and smaller incisions, as compared to traditional open techniques. In this abstract, we review our experience with endoscopic-assisted craniosynostosis with an emphasis on safety, feasibility and durability.

Methods: A retrospective review of patients' medical charts that underwent endoscopic-assisted craniosynostosis surgery at Boston Children's Hospital by the senior author was undertaken.

Results: Between the years of 2004 and 2014, there were a total of 331 patients that underwent endoscopic assisted suture release. The average age of patients treated was 107 days. 179 (54%) patients underwent correction of sagittal synostosis, 59 patients (18%) underwent correction of metopic synostosis, 57 (17%) patients underwent correction unilateral coronal synostosis, 25 (8%) underwent correction of bilateral coronal synostosis and 11 (3%) underwent correction of unilateral lamboid synostosis. Cosmetic results, as assessed by various methods, has been good to excellent. For non-syndromic single suture craniosynostosis the reoperation rate for sutural re-union was virtually zero. For children with a genetic diagnosis or multi-suture synostosis, the need for subsequent craniofacial surgery ranged from 20-30%. Transfusion rates dropped under 5% over the course of the series. As our experience with the procedure has grown, annual surgical numbers have steadily increased, from 4 procedures in 2004 to 46 procedures in 2014.

Conclusions: Endoscopic-assisted craniosynostosis surgery appears to be a safe and feasible option for the correction of single and select multi-suture craniosynostoses. In our experience, cosmetic results are comparable to open techniques. Our specialty needs to next focus on developmental assessment in children treated by both techniques to further advance the field.

SY-8

Blood Conservation during Craniosynostosis Corrections

Presenter: Jeffrey A. Fearon

Author: Fearon JA

The Craniofacial Center, USA

Craniosynostosis corrections are often performed in children with small blood volumes. Reported blood transfusion rates vary from 7%-26% for endoscopic and 15%-100% for remodeling procedures. Risks of allogeneic transfusions include: transfusion reactions, TRALI, viruses, and higher infection rates. An analysis of mortalities following craniosynostosis corrections (Dallas, Seattle and an Internet survey) suggested that blood loss was most often the underlying etiology. Numerous blood conservation strategies exist:

1. Preoperative increases in red blood cell mass.
2. Use of drugs to alter coagulation factors.
3. Anesthetic manipulations (hemodilution, hypotension).
4. Intraoperative cell salvage.
5. Reduction in transfusion triggers.

In Dallas, we utilize a combination of strategies during craniosynostosis corrections: for children <18-months of age, erythropoietin is given preoperatively (600 U/kg dosed: -21 days, -14 days and -7 days). Erythropoietin increases RBC mass; but may also increase thrombogenesis, further reducing loss. Reassuring safety data has been shown in a 3-center study (U of Pittsburgh, UCLA and Dallas). For children >18-months, we administer the antifibrinolytic tranexamic acid (5 mg./kg./h.). With NIR monitoring, we noted significant cerebral hypoxemia with hypotensive anesthesia; therefore, we prospectively randomized children to normotension or hypotension. We found no differences in transfusion rates, so now all corrections are done with normotension. We also routinely utilize a cell saver, which has reduced allogeneic transfusions rates (currently, 15%). This technology also provides a more accurate ongoing estimation of EBL. Finally, we have lowered our transfusion trigger to <7 g/dl. for the 1st 12 hours, and <6 g/dl afterwards, depending on symptoms. In summary, the use of multiple blood conservation strategies during craniosynostosis corrections can reduce transfusions rates, and may even impact perioperative mortality rates.

SY-9**Classic Open Craniofacial Surgery Without Transfusion: A Novel Multi-Modal Approach.**

Presenter: Robert J. Wood

Authors: Wood RJ^{1,2}, Graupman PC¹, Kim PD¹,
Liljeberg KM¹¹*Gillette Children's Specialty Healthcare, USA*, ²*University of Minnesota Medical School, USA*

Background: Primary open repair of craniosynostosis has reported transfusion rates approaching 100%. We have developed a multi-modal approach to blood conservation in an attempt to decrease rates of transfusion.

Method: Children aged one year or under undergoing primary repair of craniosynostosis from 10/1/13 to 1/12/15 received a multi-modal approach to blood conservation including: pre-operative erythropoietin and oral ferrous sulfate, tumescent infiltration of the scalp incision, plasma blade incision and dissection, modest hemodilution, and I.V. tranexamic acid. All children with an HgB less than 7 g/dL or symptomatic of anemia were transfused. Surgical technique remained unchanged with classic fronto-orbital advancement and anterior cranial vault remodeling for anterior craniosynostosis, posterior calvarial remodeling for lambdoid and sagittal craniosynostosis including barrel stave type osteotomies, out fracture of the cranial base and interposition bone grafts.

Result: 48 children underwent repair with a mean age of 0.50 years. 27 (56%) did not require transfusion. Posterior repairs (n=25) averaged 7.5 mL/kg blood loss and 40% transfusion rate. Anterior repairs (n=23) averaged 10.49 mL/kg blood loss and a 52.2% transfusion rate. Operative time averaged 56 minutes for posterior repairs and 84 minutes for anterior repairs.

Conclusion: We feel this is a significant advance in blood conservation. Transfusion rates have dropped 60% for our posterior repairs. As experience is gained we expect further decreases in rates of transfusion.

Introduction from Chairs:**From their 40 year each experience with craniofacial surgery for syndromic craniofacial dysostoses, the Session Chairs can give the following advice:**

Presenter: S. Anthony Wolfe

Authors: Wolfe SA¹, Kawamoto H²¹*Department of Plastic Surgery Nicklaus Children's Hospital, USA*, ²*Miami Children's Hospital, USA*

1. Do not operate too early: tarsorrhaphies and tracheostomies may be preferable to major osteotomies in infancy
2. Do not be afraid of the intracranial approach: the monobloc advancement generally provides superior aesthetic outcomes to Le Fort 3 advancement. Coupled with a facial bipartition and facial bending, it is the only procedure that can adequately "deApertize". One Chair believes that most monoblocs should be done by distraction, the other Chair believes that most can be done by traditional advancement.
3. We feel that the ideal age for definitive correction is 5-8 years.
4. Subsequent maxillary advancement at the Le Fort 1 level will be need in the early teens for most patients.
5. Pfeiffers have a disproportionate share of complications.

SY-10

Treatment of hydrocephalus—what

Presenter: Jayaratnam JayaMohan

Author: JayaMohan J

Department of Neurosurgery, Joan Radcliffe Hospital, UK

There is a recognised underlying propensity for particularly patients with syndromic craniosynostosis to develop both hydrocephalus, and craniocerebral disproportion, both of which may caused raised intracranial pressure. The ventricular anatomy of such patients may be very abnormal, and may not change in the usual manner with regards to size. The issues to be addressed is

1) Whether there is underlying intracranial pressure issues in a child.

2) Once that is clearly confirmed (whether clinically, radiologically or via investigation) what should the treatment for this be. The issues of vault expansion versus CSF diversion need to be considered, to establish the correct order. This entails considering not only the immediate effectiveness of the proposed treatment (and how urgent this needs to be), but also the likelihood of a more long term efficacy. There then needs to be a consideration of how this first treatment may impact on subsequent plans. This becomes especially important when the complications of shunts, in particular infection, are borne in mind.

3) If hydrocephalus is to be the treated condition, then ETV (endoscopic third ventriculostomy) versus shunt insertion is the first step. If a shunt, where is it to be placed, and where tunnelled to? If an ETV is performed, what anatomical considerations may make it a different procedure to the 'standard' one.

The outlined pros and cons of the decision making tree will be outlined in my talk, with clinical examples of good and bad (!) decisions.

SY-11

Proper timing for shunting and cranial expansion in infants

Presenter: Irene M. J. Mathijssen

Authors: Mathijssen IMJ, Van Veelen MC

Department of Plastic and Reconstructive Surgery, University Medical Center Rotterdam, the Netherlands

Skull growth in the infant is driven by the expanding brain. The insertion of a shunt can reduce this intrinsic push for the skull to grow and may cause secondary craniosynostosis. For the same reason the insertion of a shunt in the very young child with craniosynostosis is counterproductive, as it will reduce skull growth. A shunt also hampers dural expansion once a vault expansion is performed. This can thus result in dead space with a risk of infection and bone loss. In addition, differentiation between ventriculomegaly, distorted ventricles due to aberrant skull shape and genuine progressive hydrocephalus is difficult and may need some time to follow-up. Often the origin for hydrocephalus is not clear: decreased resorption due to venous hypertension or blockage of the fourth ventricle apertures due to Chiari and insufficient cranial volume. Both origins will profit from skull expansion. For all these reasons, we prefer a vault expansion as first choice of treatment in syndromic craniosynostosis, even in the presence of large ventricles. A shunt is useful if after a vault expansion raised ICP either remains or reoccurs quickly and a second vault expansion is inappropriate because of adequate skull shape or large cranial volume.

Given the high risk on raised ICP in particularly Crouzon and Apert syndrome we perform an occipital expansion with spring distraction at 6-9 months of age. An occipital expansion result in a higher gain of intracranial volume compared to a fronto-orbital expansion, especially with the use of springs. For Saethre-Chotzen syndrome the risk on raised ICP is somewhat less, and our first choice is a fronto-orbital expansion at 6-9 months. Muenke syndrome has a rather low incidence of raised ICP, so their fronto-orbital advancement is delayed until the age of 12 months.

A significant percentage of children with Crouzon and Apert syndrome develop raised ICP following an early skull expansion, most commonly between the age of 2 to 6. This has been shown to be particularly related to a deflecting skull growth curve and to lesser degree to OSA, while hydrocephalus was rare. Follow-up of these patients should therefore include repeated skull circumference measurement, screening for OSA and repeat MRI to check for hydrocephalus. Type of treatment can thus be adapted to the main cause of the raised ICP.

SY-12**Frontofacial monobloc advancement with internal quadruple distraction in 105 children**

Presenter: Eric Arnaud

Authors: Arnaud E, Rocco FD

Craniofacial Unit Hôpital Necker, France

Monobloc frontofacial advancement is the most powerful procedure to correct exorbitism.

Even reduced by distraction, some various risks still exist for monobloc advancement.

Patients and Methods: This study prospectively evaluated the complications encountered in a cohort of 105 faciocraniosynostotic children treated with a frontofacial monobloc advancement with internal distraction at the craniofacial unit of Necker Enfants Malades in Paris. The mean age at surgery was 3.8 years. There were 65 Crouzon, 21 Apert, 18 Pfeiffer and 1 Sprintzen-Goldberg syndrome. Mean follow-up was 7 years (12y-6months)

Results:

- Exorbitism was corrected in 95% of the cases
- Respiration was improved in most cases in whom the tonsils and adenoids had been removed previously. But A better improvement was obtained 6 months after removal of distractors.
- Class I occlusion was obtained in 70% of all cases.

Complications:

- At the beginning of the experience, one patient died a few hours after an uneventful surgery from a misdiagnosed tonsillar herniation decompensating because of an acute brain oedema. Since that, all patients were operated on of FM decompression and/or posterior expansion in case of Chiari malformation. No further lethal complications was encountered.
- Suspicion of CSF leakage through the nose was evoked in 37/104 patients but was confirmed in only half of the cases after lumbar puncture during 3 days was proved unsuccessful. Transient lumbar drains were implanted to stop the leakage. In two patients (in the group without periosteal flaps) a persistent long term leakage in the posterior rhinopharynx was treated endoscopically.
- The infection of at least one distractor was found frequently (15 cases) but only 8/104 necessitated some kind of reoperation for removal of one distractor.
- The osteonecrosis of the frontal bone was found in 4 patients, three of them being secondary cases, one of them being a patient in which traction had been simultaneously applied with a rapid distraction and traction.
- One partial frontal brain atrophy in one of the patient who lost the forehead and in whom the cranioplasty repair was delayed after one year.
- Two transient reduction of vision on one eye during the course of distraction, recovered after contraction (partial reverse distraction).
- A tendency to trismus occurred during the course of distraction and necessitated active reeducation in order to prevent permanent jaws contraction.

Discussion: Chiari malformation should be screened and treated with posterior surgery prior to monobloc. The reduction of morbidity was confirmed in terms of reduction of infection but secondary patients and rapid distraction were risk factors of osteonecrosis. Vision problems were transient if immediately detected.

SY-13**Monobloc distraction vs Le Fort III with Subsequent Le Fort III**

Presenter: James P. Bradley

Authors: Bradley JP, Kawamoto HK

Division of Plastic and Reconstructive Surgery, Temple University School of Medicine, USA

Background: After the initial Monobloc (Frontofacial advancement) procedures were performed by Fernando Ortiz-Monasterio and then Paul Tessier, subsequent Monobloc procedures by other Craniofacial Surgeons resulted in complications too severe to continue to offer this procedure for correction of hypoplastic forehead and midface. Years later, when distraction was used after the Monobloc osteotomy, the infectious complications were found to be dramatically decreased to acceptable levels. Presently, when offering frontofacial correction of hypoplasia, options include: 1) Monobloc Distraction or 2) staged Fronto-orbital Advancement followed by subsequent Le Fort III advancement (FOA+Le Fort III). However, evidence based superiority has not been determined between these options.

Methods: Patients with Craniofacial Dysotosis and frontofacial hypoplasia who underwent correction were divided into 1) Monobloc distraction or 2) FOA+Le Fort III (n =52). Perioperative complications; relapse (based on lateral cephalograms and CT scans); need for subsequent procedures were recorded. Functional correction (airway/eye exposure), Whitaker score; Patient Reported Outcomes; and long-term psychosocial data were also looked at.

Results: There was no significant difference in bleeding, meningitis, CSF leak, frontal bone loss, or other perioperative complications between the groups. Monobloc Distraction had decrease number of procedures (2.2 ± 0.3 vs 3.4 ± 0.5); total operative time (4.8 ± 0.4 vs 8.4 ± 0.8); and EBL (290 ± 9.2 vs 510 ± 12). Mean advancement/relapse was as follows: (Monobloc vs FOA+Le Fort III): Forehead $+16\text{mm}/-2\text{mm}$ vs $+12\text{mm}/-5\text{mm}$; Midface $+14\text{mm}/-1\text{mm}$ vs $+12\text{mm}/-2\text{mm}$; Maxilla $13\text{mm}/-1\text{mm}$ vs $+12\text{mm}/-1\text{mm}$. Subsequent Le Fort I and/or Le Fort III advancement (87% vs 90%) were needed in the 38/110 of patients that reached skeletal maturity. Improvement in sleep apnea or tracheostomy removal (84% vs 72%) and eyelid exposure problems (38% vs 27%) were seen. Monobloc Distraction had superior Whitaker scores (2.0 ± 0.3 vs 3.5 ± 0.5); and PROM with regard to aesthetic considerations, and self-esteem. Long term psychosocial data showed similar educational advancement, ability to work, independent activity, and marital status.

Conclusions: Staged FOA+Le Fort III should have less of a role in the correction of Frontofacial hypoplasia in patients with Craniofacial Dysotosis since Monobloc Distraction offers superior functional and aesthetic correction with a similar complication profile. However, there are limitations with our retrospective study including sample size and patient selection.

SY-14

Separation of FOA and following Le Fort III Midface Distraction to avoid retrograde infection

Presenter: Kaneshige Satoh

Author: Satoh K

Department of Plastic and Reconstructive Surgery, Chiba University, Japan

Background: In patients with syndromic craniosynostosis, fronto-orbital advancement and following Le Fort III advancement has been required for long. However, the evolution of distraction osteogenesis has changed the direction of routine protocol for those patients. Current early posterior expansion by distraction has shifted to the late mono bloc advancement by distraction for many craniofacial surgeons widely. In spite of the efficacy of mono bloc distraction, there are small risks for retrograde infection or air leak into the cranial cavity. Herein definitive safe protocol of separated FOA and Le Fort III distraction is mentioned in our series.

Method: In our series of around 80 cases of syndromic craniosynostosis, mono bloc distraction has conducted for small number of cases. Mostly separation of FOA by distraction or conventional technique followed by Le Fort III distraction has been conducted routinely.

Results: Even if small number of cases of mono bloc distraction, retrograde infection has occurred in one case. Conversely, no particular major complications have encountered in our more than 60 cases of Le Fort III distraction following FOA.

Conclusion: In spite of the apparent paradigm shift from posterior expansion by distraction firstly done and substantial period of time for advancement of frontal surgery sustained, separation of FOA followed by Le Fort III distraction instead of mono bloc distraction is safer protocol.

SY-15

The evolving surgical treatment algorithm for Pfeiffer Syndrome

Presenter: Richard A. Hopper

Author: Hopper RA

Seattle Childrens Hospital, University of Washington, USA

In its extreme presentation, Pfeiffer syndrome (PS) represents one of the greatest challenges in craniofacial surgery. It has higher complication rates, more surgeries, and poorer final outcomes than many other diagnoses we treat. The optimum timing and nature of cranial and facial surgeries for PS remains unclear and continue to change over time. We reviewed the surgical treatment of 18 patients with PS at our institution and will describe the evolving algorithm over 15 years based on our past outcomes and challenges. Our earlier algorithms were based on conventional frontal cranial expansion in infancy with subcranial advancement in adolescence, but were prone to relapse and repeat surgeries. Over the past decade our algorithm has evolved to include neonatal strip cranial release, posterior vault DO, infant monobloc DO, and segmental LF2 DO based on the patients specific needs. The timing and coordination of these interventions is crucial to achieving a satisfactory outcome. We will present quantitative outcome analysis to support our current approach.

SY-16

Treatment Pathways for the Management of Severe Craniofacial Dysostosis Syndromes

Presenter: Steven Wall

Author: Wall S

Oxford Craniofacial Unit, UK

Severe craniofacial dysostosis syndromes as typified by patients presenting with Clover-leaf deformities (most frequently associated with severe Pfeiffer phenotype) present a significant challenge.

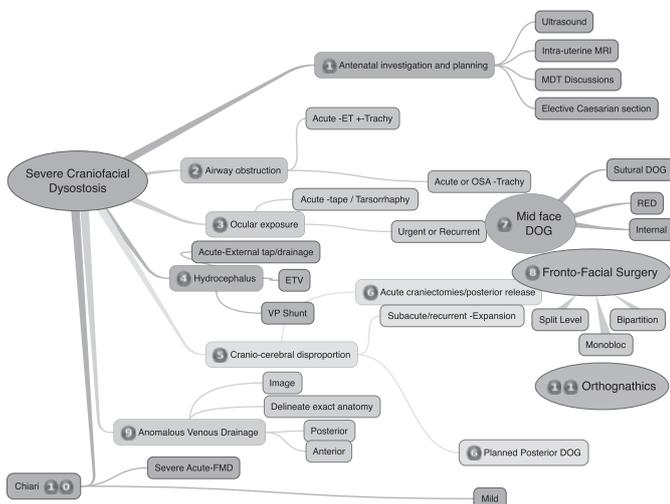
A co-ordinated inter-disciplinary approach is essential with emphasis on staged planning for a life long treatment programme required in all these patients

Management can be classified as ante-natal preparation, emergency neo-natal intervention, planned neo-natal procedures and long-term staged intervention.

Approaches to elements such as hydrocephalus, cranio-cerebral disproportion, ocular exposure and airway obstruction will be presented, in lines with current practice in the Oxford Craniofacial Unit.

Alternative treatment options not necessarily frequently used in our practice will also be discussed.

The accompanying flow diagram outlining intervention options will be explained in greater detail with clinical case examples.



SY-17

Bipartition Distraction for the treatment of Apert Syndrome

Presenter: David Dunaway

Author: Dunaway DJ

Great Ormond Street Hospital for Children, UK

Introduction: Apert syndrome is characterized by hypertelorism, with a negative canthal axis and counter-rotated orbits. Central midface hypoplasia results in a biconcave face in both midsagittal and axial planes. Bipartition distraction partially corrects these facial anomalies.

This study investigates limitations of bipartition distraction using a combination of conventional and geometric morphometric analysis.

Materials and Methods: Pre and postoperative three-dimensional computed tomography (3DCT) scans of 10 patients with Apert syndrome (aged 12 to 21 years) were annotated with 98 landmarks. 13 age matched normal skulls were used as controls. Principal component analysis (PCA) was used to analyze and compare shape characteristics within and between the groups and describe the changes occurring with surgery. The statistical results were graphically displayed using thin plate spline movies and difference colour maps. Conventional point based measurements documented midfacial width, height and asymmetry.

Results: PCA confirms that midface hypoplasia and central biconcavity is corrected by bipartition distraction. Interorbital distance was reduced from a mean of 29 mm to 23mm compared to a mean of 20mm in the control group indicating mild under correction.

Apert skulls were more asymmetrical than controls. Bipartition distraction improved upper midfacial symmetry and worsened lower midfacial asymmetry. Overall, surgery made asymmetry more severe.

Apert skulls were wider than controls and bipartition distraction partially corrected this.

Mean midfacial height was 61.3 mm in controls and 60.3mm in unoperated Apert skulls, which reduced to 58mm postoperatively.

Conclusions: Bipartition distraction corrects midfacial retrusion, exorbitism, midline recession, upper midface asymmetry and hypertelorism. It does not treat midfacial height disproportion or correct orbital shape. It leaves the face too wide at the zygomatic level and increases asymmetry in the lower midface.

Although an improvement on the unmodified monobloc advancement further refinements are needed to fully correct the Apert deformity.

SY-18

Classification of the Mandibular Deformity in Craniofacial Microsomia using 3-dimensional CT

Presenter: Scott P. Bartlett

Authors: Bartlett SP^{1,2}, Swanson JW^{1,2}, Mitchell BT^{1,2}, Wink JD^{1,2}, Taylor JA^{1,2}

¹University of Pennsylvania, USA, ²Children's Hospital of Philadelphia, USA

Background: Three-dimensional computed tomography (3dCT) has created a new paradigm for diagnosing the mandibular deformity in craniofacial microsomia (CFM). Grading systems based on previous radiographic modalities, such as the Kaban modification of the Pruzansky classification, have shown low inter-rater reproducibility among craniofacial surgeons. We sought to design and validate a classification based on 3dCT that correlates features of the deformity with surgical treatment.

Methods: CFM mandibular deformities were classified as Normal (T0), Mild (hypoplastic mandible, likely treated with orthodontics or orthognathic surgery; T1), Moderate (vertically deficient ramus, likely treated with distraction osteogenesis; T2), or severe (ramus rudimentary or absent, with either adequate or inadequate mandibular body bone stock; T3 and T4, likely treated with costochondral graft or free fibular flap, respectively). 3dCT face scans of CFM patients were randomized then classified by craniofacial surgeons using an online platform. Fleiss' kappa was used to assess inter-rater reliability.

Results: 3dCT images of 43 patients with CFM were assembled representing patients aged 2-20 years with a spectrum of mandibular deformities. 3dCT images were reviewed by 15 craniofacial surgeons, representing a mean 15.2 years of experience and who each estimate seeing an average of 27 patients with CFM annually. Reviewers demonstrated fair inter-rater reliability with average pairwise agreement of 50.4%±9.9% (Fleiss' k=0.34.) On average, reviewers classified 7% of patients as normal (T0), 54% mild (T1) or moderate (T2), and 39% severe (T3 and T4; this last group indicating need for graft or flap mandibular reconstruction.) Reviewers demonstrated substantial inter-rater reliability with average pairwise agreement of 83.0%±7.6% (k=0.64) distinguishing deformities requiring graft or flap reconstruction (T3 and T4) from others.

Conclusion: An ideal classification system is simple to use, reliably deployed, facilitates communication among physicians, and links diagnosis with treatment. The proposed classification has been designed for the era of 3dCT, and demonstrates considerably improved consensus with respect to stratifying the severity of mandibular deformity and type of operative management.

SY-19

Mandibular Distraction in Craniofacial Microsomia: Indications, Timing, Methodology and Long-Term Follow-up

Presenter: Joseph G. McCarthy

Author: McCarthy JG

Lawrence D. Bell Professor of Plastic Surgery, NYU Langone Medical Center, USA

There are ABSOLUTE and RELATIVE indications for mandibular distraction (MDO) in craniofacial microsomia (CFM). ABSOLUTE indications include patients with obstructive sleep apnea or OSA (can occur in unilateral CFM) and severe dysmorphism. RELATIVE indications include patients without OSA but with mild-moderate dysmorphism (Pruzansky-Kaban I-IIa). There is no indication in the patient with P-K III until after the ramus-condyle has been reconstructed with rib-iliac bone graft or composite bone flap. With evidence of OSA the timing is ASAP but in the child with severe dysmorphism MDO can be deferred until at least age 3 when there is adequate patient/family cooperation. In the patient with mild-moderate dysmorphism MDO can be delayed until the period of mixed dentition. Treatment methodology is critical and must include a daily relationship between the surgeon and orthodontist. A vertical vector is preferred and overcorrection is critical in the growing child. Endpoints for discontinuing activation must be achieved. Perioperative orthodontic therapy should include bite block therapy and cross-tongue elastics. Long-term follow-up with periodic clinical, photographic and cephalometric documentation is indicated through attainment of craniofacial skeletal maturity, at which time secondary MDO, orthognathic surgery, fat grafting or microvascular free flap may be indicated.

SY-20

Presenter: Fernando Molina
Author: Molina F
Asociados, S.C. Mexico

SY-21

Presenter: Dae Hyun Lew
Author: Hyun Lew D
*Dept of Plastic & Reconstructive Surgery, Yonsei University
College of Medicine, Korea*

SY-22

Long-term Stability and Growth Following Unilateral Mandibular Distraction in Growing Children with Craniofacial Microsomia

Presenter: Pradip R. Shetye

Author: Shetye PR

NYU Langone Medical Center, Institute of Reconstructive Plastic Surgery, USA

Purpose: To study long term mandibular skeletal stability and growth following unilateral mandibular distraction in growing children.

Methods: This retrospective longitudinal study of 12 consecutive patients (N=9 Males, N=3 Females) with unilateral craniofacial microsomia, who underwent mandibular distraction, had a range of 5 to 10 years of post distraction follow-up. Records included clinical photographs, dental study models, lateral and posteroanterior (PA) cephalograms and panoramic radiographs, obtained before distraction, at the time of device removal and 1, 5 and 10 years post distraction. The mean age of patients at the time of distraction was 48 months. The device was activated an average of 21.7 mm at the rate of 1 mm per day. The mean latency period was 6.1 days and consolidation period was 60.6 days. Post-distraction all patients underwent orthodontic treatment with bite block therapy to close posterior open bite. Fifty-two parameters were examined at each of the five-time intervals.

Results: On average, the ramal length (Co-Go) increased 13.04 mm in the distracted rami. At one year following distraction this dimension decreased by 3.46 mm. At 5 and 10 years following distraction, the average Co-Go dimension increased by 3.83 and 3.10 mm respectively with an average growth rate of 0.77 mm per year; during the same period the unaffected ramus grew 1.3 mm per year.

Conclusion: Mandibular distraction in growing children with unilateral craniofacial microsomia, on average, increased ramal length by 13.04 mm, which was reduced by 3.46 mm during the first year following distraction. The distracted rami grew between postoperative years 1, 5 and 10, although at a lower rate, when compared to the contralateral rami. The distraction technique does not eliminate the inherent growth potential of the affected mandibular side. The facial asymmetry is significantly improved following distraction and, despite mild relapse observed during the first year, the surgical correction is stable in the later years of follow-up.

SY-23

Orthopedic and Orthodontic Management for Patients Undergoing a Distraction Osteogenesis Surgical Procedure

Presenter: Pedro E. Santiago

Author: Santiago PE

Associate Consulting Professor of Surgery (Craniofacial Orthodontics), Division of Plastic Surgery, Duke University, USA

The practice of orthodontics not only involves moving teeth through bone, but also some control or influence on skeletal growth and development. Historically, these changes have been measured in small increments; usually less than 10mm, gained over months or years of treatment. Distraction Osteogenesis has provided the means to increase the amount of bone lengthening possible (10-30mms) in a matter of days or weeks. A significant advantage of distraction osteogenesis over a conventional orthognathic surgical procedure is the gradual lengthening of soft the tissues and surrounding functional spaces. As in traditional combined surgical and orthodontic procedures, the orthodontist has a role in the planning and orthodontic support of patients undergoing distraction osteogenesis. This role includes pre-distraction assessment of the craniofacial skeleton and occlusal function in addition to planning both the predistraction and postdistraction orthodontic care. Based on a careful clinical evaluation and radiographic/dental records analysis, the orthodontist, in collaboration with the surgeon, plans distraction device placement and the predicted vectors of distraction. Both surgeon and orthodontist closely monitor the patient during the active distraction phase using intermaxillary elastic traction, sometimes combined with guide planes, bite plates, and stabilization arches, to mold the newly formed bone (regenerate) while optimizing the developing occlusion. Growth after mandibular distraction is variable and appears to be dependent on the genetic program of the native bone and surrounding soft tissue matrix. Distraction osteogenesis can be applied at an earlier age than traditional orthognathic surgery because the technique is relatively simple and bone grafts are not required for augmentation of the hypoplastic craniofacial skeleton. The clinical practice of distraction osteogenesis has strengthened the collaboration between surgeon and orthodontist to gradually alter the magnitude and direction of craniofacial growth.

SY-24, SY-25**CRANIOFACIAL MICROSOMIA IN CHILDREN
DISTRACTION DONE NOT ROUTINELY—LONG
TERM RESULT BY INTERNAL DEVICES****SY-24**

Presenter: Patrick A. Diner
 Authors: Diner PA, Tomat C, Kadlub N, Picard A
*Department of Plastic and Maxillofacial Surgery, Hospital
 Necker University Paris 5, France*

SY-25

Presenter: Catherine Tomat
 Author: Tomat C
*Department of Plastic and Maxillofacial Surgery, Hospital
 Necker University Paris 5, France*

Over the last 18 years our definition of how use Distraction procedures has evolved on different points: Choice of devices e.g using resorbable components. New applications e.g. chin advancement. Use of 3D planning. Deciding the best age in craniofacial microsomia for D.O remains a debate, because of some return to the original asymmetry during subsequent growth. Today we have two opportune ages to propose interceptive DO, the first is as soon as possible if you are confronted with sleep apnea syndrome, essentially observed in bilateral cases. The second is around 8 or 9 for severe cases of unilateral mandibular hypoplasia where there is a strong request from the patient and/or which present severe malocclusion for which we cannot postpone treatment, and for which orthodontics cannot be helpful. We can be faced with two types of scissor bite malocclusion one the affected side, or the other one the non-affected side. Scissor bite on the affected side needs a specific placement of the device helped by the 3D planning and stereolithography. Long term follow up has also shown that D-O has not solved the soft tissue hypoplasia thus requiring early or delayed lipoprostructure.

SY-26**Mandibular Distraction Osteogenesis: What is Appropriate
Timing in Hemifacial Microsomia?**

Presenter: John W. Polley
 Authors: Polley JW^{1,2,3}, Giroto J¹
*¹Helen Devos Children's Hospital Oral Cleft and Craniofacial
 Program Pediatric Plastic Surgery, Grand Rapids, USA,
²Munson Oral Cleft Clinic, Traverse City, USA, ³JP Center for
 Plastic Surgery Pediatric & Adult, USA*

In the early 1990s the lead author began utilizing mandibular distraction osteogenesis (MDO) in the treatment plans for young children (ages 5-10 years) with grade II and select grade III hemifacial microsomia (HFM). Initial aesthetic results were often remarkable. As these children matured however most patients anesthetic improvements gradually diminished, many to the point that it was difficult to determine whether they had had prior treatment or not. In the treatment plans for these HFM patients, at the time of their definitive reconstructive jaw surgery in the teenage years, there was no significant advantage in the patient's that had undergone early distraction. Following final growth and development many patients with hemifacial microsomia seem to revert to their original disproportions and facial asymmetries. These patients in their teenage years may have slightly improved bone stock of the mandible (and the maxilla if bimaxillary distraction was performed) but it did not significantly alter the definitive treatment plan and did not alter whether the final reconstruction required additional bone grafting or not. Early distraction can also cause complications including unwanted scarring and in some unfortunate cases TMJ ankyloses.

MDO is a very important technique for the management of grade II and select grade III HFM patient's. Its most appropriate utilization is as outlined: 1) Early MDO, prior to age 10 years, should be reserved for patients who require, for psycho-social reasons, early but temporary improvements in facial balance and aesthetics. 2) Early MDO should not be utilized under the pretext that it will "make future reconstructions easier or more successful". 3) MDO should be utilized in patient's 12 years or greater in conjunction with a staged treatment plan which includes final definitive reconstructive surgery. This might include serial distraction procedures and/or bimaxillary distraction procedures.

SY-27

Hemifacial Microsomia: Treatment in Adolescence vs. Infancy and Childhood: Orthodontic Perspective

Presenter: Alvaro A. Figueroa

Author: Figueroa AA

Rush Craniofacial Center, Rush University Medical Center, USA

Background: The orthodontic and surgical management of Hemifacial Microsomia (HFM) should be based on an understanding of its original presentation, the impact on critical function, as well as its natural growth progression. If the infant with HFM presents with respiratory and feeding impairments, urgent care may need to be provided (tracheostomy, distraction, NG or G tube feeding). However, if the infant is stable should the reconstructive team wait until most of the facial growth is complete before embarking on the surgical reconstructive process?

Objective: This presentation will address facial growth observations in the un-operated and operated condition. The objective is to assist the reconstructive team in the decision making process during long-term planning, operative timing and selection of the various available surgical/orthodontic approaches to treat patients with Hemifacial Microsomia.

Discussion: It is hoped that key questions will be raised that will allow the reconstructive team to reach a consensus concerning timing and which surgical and orthodontic procedures should be carried out to better treat patients with HFM.

SY-28

Presenter: Eric Santamaria

Author: Santamaria E

Universidad Nacional Autonoma de Mexico, Department of Plastic and Reconstructive Surgery, Mexico

SY-29**Our policy for auriculoplasty to treat patients with microtia who have hemifacial microsomia**

Presenter: Takatoshi Yotsuyanagi

Author: Yotsuyanagi T

Department of Plastic and Reconstructive Surgery, Sapporo Medical University School of Medicine, Japan

Microtia with hemifacial microsomia (HFM) is the most difficult disorder to treat among all types of microtia because the disorder is accompanied by many abnormalities such as asymmetrical balance of the face, low hairline, absence of a sideburn, depression of the temporomandibular joint (TMJ), and low set ear. We introduce here our policy for resolving all of these problems.

The timing of the operation should be 11 years of age or older in Asian patients for all types of microtia. For HFM patients, the operation should be performed at a more advanced age because the created ear tends to be pulled downward with the patient's growth.

The operative procedure is basically in accordance with our reports (PRS 133: 111-120, 2014 and PRS Glob Open 7: 2; e 208, 2014). For a low hairline, the total area of hair-bearing skin is removed and is covered by a skin graft and TPF. The first choice of skin is the contralateral postauricular full-thickness skin. If this cannot be used, the removed skin is shaved and hair follicles are excised, and it is used as a split-thickness skin. If the sideburn is absent, it is constructed using a part of the hair-bearing skin as a local flap. Depression of the TMJ can be treated by dermal fat grafting simultaneously when harvesting the graft skin. The remnant ear in the lower position should be used for an earlobe or concha to the extent that is possible. If it is difficult to arrange in the first stage of costal cartilage grafting, it can be rearranged in the second stage of ear elevation. By these procedures, the results of total treatment for HFM can be remarkably improved. However, it is still a problem that the tissue mound below the constructed ear is not sufficient to support the height of the ear because the mandibular bone is hypoplastic and the area is constructed by only soft tissue.

SY-30**Systematic approach to the two-stage auricular reconstruction**

Presenter: Satoru Nagata

Author: Nagata S

Nagata Microtia and Reconstructive Plastic Surgery Clinic, Japan

Congenital auricular defects can be classified into: (1)lobule type microtia; (2)small concha type microtia; (3)concha type microtia; (4)anotia and (5-8)those with low hairline. The first stage operation is the fabrication and grafting of the three-dimensional costal cartilage framework (3-D frame). The second stage operation is the projection of the reconstructed auricle, symmetrically to the contralateral auricle. In both stages, chest wall deformity must be avoided.

Recent advancements in auricular reconstruction enabled us to treat complicated cases such as secondary auricular reconstruction, anotia (including traumatic amputation), low hairline cases, hemifacial microsomia and post-ENT surgery with consistent and more than satisfactory results. The key is to apply the systematic approach of using temporoparietal fascia flap (TPF), deep temporal flap (DTF) and ultra-delicate split-thickness scalp skin (UDSTS). The approach can be applied to all microtia cases.

TPF with UDSTS cover or DTF with UDSTS cover will both function like a skin flap with full vascularity. Thus, there is no postoperative contracture of the skin cover that leads to resorption of the grafted costal cartilage framework. The conventional method of skin grafting alone is contraindicated because it fails to maintain the contour of the auricle, due to vascular compromise, contracture and resorption.

I would like to present the successful and safe operative method.

SY-31

**CRANIOFACIAL MICROSOMIA AFTER PUBERTY
DISTRACTION OSTEOGENESIS STILL AN OPTION?**

Presenter: Patrick A. Diner

Authors: Diner PA, Tomat C, Kadlub N, Picard A

*Department of Plastic and Maxillofacial Surgery, Hospital
Necker University Paris 5, France*

In some selected cases that are beyond the scope of mandibular conventional surgery, we have extended, a new concept: the Dynamic Orthognathic Surgical Procedure (= DOSP). This new evolution is called the Extended Bone Floating Concept, coming from the idea promoted by B.Hoffmeister in the early years of DO to solve the problem we are faced with after observing anterior open bite following Mandibular body lengthening by DO.

After an earlier device removal, it was possible by using intermaxillary elastics to mold the callus to achieve a good occlusion, and by maintaining a sufficient consolidation time, it was possible to achieve total stability of the results.

This is due to a slow bone regeneration induced by DO, which permits a slow remodelling during the first few weeks. In this way, Mitsugi has proposed treating anterior open bite by molding the callus in two steps.

The criteria to select the patients are strict:

1. Because a mandibular distraction has already been performed.
2. Because a vertical branch reconstruction has already been done and to avoid a new costochondral graft because the good function of the Temporo-Mandibular-Joint and the buccal aperture are perfect.
3. Moreover because conventional surgery cannot be performed because of the loss of the bone contact after mobilisation of the pieces of mandibular bone in 3D. (3D virtual simulation)
4. Because there doesn't exist any possibility to find a stable préop occlusion (Lack of temporo-mandibular-joint) and to anticipate the postoperative occlusion.

In extreme asymmetrical cases, especially in hemi facial microsomia, the horizontal maxillary cant, by using a classical Leforeone osteotomy is first corrected then a bicortical mandibular osteotomy and a distractor on the affected side and a classical sagittal osteotomy on the contro lateral side using a not too tight wire to allow some movement are performed.

The open bite is closed slowly by elongating one side of the mandible with the device and lifting up the opposite side by using elastics to achieve a satisfactory occlusion.

To easily allow the Device mobilisation only one screw or pin can be used to attach the Device to the bone. Or the Device can be removed very early (4 weeks).

SY-32

Orthognathic Surgery for Hemifacial Microsomia in Adults

Presenter: Lim K. Cheung

Author: Cheung LK

*CLK Center for Cranio-maxillofacial & Dental Implants,
Hong Kong*

Orthognathic surgery is a well-established method for the definitive correction of the dentofacial deformities for hemifacial microsomia in adults. The treatment objectives are to correct the maxillary canting with Le Fort I osteotomy with or without segmentalization followed by mandibular rotation in 3-dimensions. The choice of mandibular techniques depends on the complexity of the affected mandibular ramus. In Pruzansky type 1 and 2a, sagittal split osteotomy is commonly deployed for advancement of the hypoplastic side whereas the contralateral relative normal side, vertical ramus osteotomy is used for de-rotation and correction of canting. In Pruzansky type 2b, costochondral graft is commonly used to reconstruct the height the mandibular ramus to reach the rudimentary condylar fossa. In Pruzansky type 3 with missing variable extent of the condyle, ramus or even the posterior mandibular body, an extensive reconstruction will be required by either costochondral graft or microvascular bone, such as fibula flap. Scapula flap is considered particularly useful in adult hemifacial microsomia because of the possibility of transfer not only a long piece of bone for ramus reconstruction but also a sizable soft tissue pedicle for the soft tissue reconstruction. Tissue expansion is a useful technique for severely hypoplastic case in expanding the overlying skin for accommodating the future de-epithelialized micro-vascular flap. Micro-fat injection technique is increasing used to perfect the residual facial asymmetry in hemifacial microsomia.

PD1-1**Distraction for Micrognathia in Infancy: Pierre Robin Sequence**

Presenter: Robert Havlik

Authors: Havlik R, Korkos GJ

Department of Plastic Surgery, Medical College of Wisconsin, USA

Pierre Robin Sequence has been associated with significant morbidity and mortality since the time of its initial description. Distraction osteogenesis of the mandible provides a powerful tool for the treatment of this disorder. However, less than fifty percent of children with Pierre Robin sequence require surgical intervention. This presentation will review the role of polysomnography and the indications for mandibular distraction osteogenesis in infancy. It will review a preferred surgical technique for distraction osteogenesis in infancy. In addition, the surgical outcomes and the complications of distraction in a cohort of over fifty patients will be reviewed. Furthermore, these results obtained with distraction osteogenesis will be compared with those of lip-tongue adhesion performed by the same surgeon. Lip-tongue adhesion is no longer utilized in our practice.

PD1-2**Mandible Distraction Osteogenesis for Craniofacial Microsomia**

Presenter: Davinder Singh

Author: Singh DJ

Mayo School of Medicine, Barrow Cleft and Craniofacial Center, Department of Surgery, Phoenix Children's Hospital, USA

Craniofacial microsomia is quite variable in its presentation and we see children who are severely affected, which necessitates surgery in the neonatal period. The majority of children do not need urgent surgery and timing is at the discretion of the surgeon and family. The real controversy and challenge is in addressing the skeletal deformity: when and how. Treatment needs to be individualized as the mandible deficiency is unique in each patient. The aim of this discussion is to present indications for mandible distraction in patients with craniofacial microsomia, and to review techniques, devices, and outcomes. Distraction is preferable in the Pruzansky Type IIa and IIb mandible at five to six years of age. Enucleation of the second molar at the angle of the affected hemi-mandible is done followed by three months of healing time for the bone. A semi buried, uni-vector device is used to lengthen the ramus. An oblique corticotomy is performed at the angle with device placement at a right angle or slight obtuse angle in order to get ramal lengthening without increasing body length or AP projection of the mandible. Elastics are used during the latter part of activation, during consolidation, and post removal of device if indicated. A controlled up righting of the maxillary occlusal plane is accomplished. Follow up x-rays show increased height of the affected maxilla as well as dentoalveolar remodeling in leveling of the maxillary occlusal plane.

In reviewing outcomes over the past 15 years since the initiation of craniofacial distraction, we are now aware that one mandible distraction is likely insufficient, and that these patients will require further distraction and/or orthognathic surgery upon skeletal maturity.

PD1-3

A protocol for evaluation and treatment of Micrognathia in Infants

Presenter: Richard A. Hopper
Authors: Hopper RA, Losee JE, Musgrave RH
Seattle Children's Craniofacial Center, USA

The presenter will review a protocol for the evaluation and treatment of micrognathia in infants with Pierre Robin Sequence. The discussion will include the work-up and pre-surgical testing, the technique for surgical approach and ostetomoy, the placement and subsequent removal of distractor device, and post-operative care.

PD1-4

Mandibular Growth after Distraction Osteogenesis: Cases of Pierre Robin Sequence in Early Childhood

Presenter: Nobuyuki Mitsukawa
Authors: Mitsukawa N¹, Morishita T², Saiga A³,
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Objective: We performed mandibular distraction osteogenesis in infants and toddlers with obstructive sleep apnea (OSA) caused by micrognathia. In the present study, we examined pre - and postoperative mandibular growth in 9 such patients with Pierre Robin Sequence.

Subjects and Methods: The subjects were 9 patients with Pierre Robin Sequence who were 1 month to 3 years old and who had OSA since birth due to micrognathia. All patients underwent bilateral mandibular distraction osteogenesis using internal fixation devices. Cephalograms were used to measure the lengths of mandibles over time to examine their postoperative growth. Then the mandibular lengths were compared with data of standard mandible growth. The postoperative follow-up period ranged from 6 years to 11 years 6 months.

Results: The mandibles were clearly small and underdeveloped preoperatively. In most patients, the mandibular lengths increased after distraction osteogenesis and thereafter the mandibles continued to grow without falling greatly below the standard growth data of mandibles. However, mild OSA recurred in some patients accompanying mandibular underdevelopment, and two of these patients underwent mandibular distraction osteogenesis again.

Discussion: There are very few reports examining the bone growth of mandibles after distraction osteogenesis. In the present study, we examined over time the mandibular lengths of 9 infant and toddler patients with Pierre Robin Sequence after they underwent mandibular distraction osteogenesis. Our results showed that the mandibular growth was not inhibited after the surgery, and the mandibles grew at rates close to normal. That is, it was speculated that some type of catch up growth was in effect due to mandibular distraction osteogenesis. However, there have been clearly more cases with underdevelopment of the mandibles compared to maxillary growth, and mild OSA has recurred postoperatively for patients who had underdeveloped mandibles. Thus, it is important to overcorrect in distraction osteogenesis.

PD1-5**Early mandibular DO versus a palatal extended plate to reduce glossoptosis in severe Pierre-Robin-Sequence**

Presenter: Martina Wilbrand

Authors: Wilbrand M, Howaldt H, Wilbrand J

University Hospital Giessen, Germany

Objective: The typical clinical signs of Pierre-Robin-Sequence are mandibular hypoplasia, u-shaped cleft palate and glossoptosis. Obstruction of the upper airway can potentially lead to life-threatening conditions. Various procedures were suggested such as lip-to tongue-adhesion, early distraction osteogenesis, tracheostomy and others. We present our experience with early distraction osteogenesis of the mandible versus a palatal extended plate.

Material and Methods: Clinical cases of severe Pierre-Robin-Sequence are presented and different approaches to prevent glossoptosis are shown. Aggressive early distraction osteogenesis is performed during the first two months of life with external distractors. The palatal plate is extended along the tongue-base down towards the supraepiglottical area. It can be applied during the first days after birth. The positioning of the plate is controlled initially by endoscopy in sedation. Care-givers then are closely trained in handling the plate.

Results: Both early distraction osteogenesis and the individual manufactured palatal extended plate lead to disappearance of oxygen desaturation events. The plate led to surprisingly quick and efficient resolution of oxygen desaturation. In contrast to early distraction osteogenesis, the palatal plate does not bear operational risks of anaesthesia and osteotomy procedures. After introduction of the plate, the affected child becomes accustomed to wearing the plate within the first couple of days.

Discussion: To our elation, the palatal extended plate holds potential to reduce glossoptosis and oxygen desaturation in children with Pierre-Robin-Sequence immediately after birth and could make potentially risky early operative interventions unnecessary. It is now our first choice for the immediate treatment of severe Pierre-Robin-Sequence.

PD2-1**Longitudinal growth analysis of mandibular asymmetry in unoperated patients with unilateral craniofacial microsomia (UCFM)**

Presenter: Pradip R. Shetye

Author: Shetye PR

NYU Langone Medical Center, Institute of Reconstructive Plastic Surgery, USA

Purpose: To examine the longitudinal growth changes in facial asymmetry in unoperated children with UCFM and to determine the rate of growth of the ramus height on the affected and on the unaffected side of the mandible

Methods: This is a serial retrospective longitudinal growth study of 30 untreated patients (21 males and 9 females) with unilateral craniofacial microsomia (age range from 5 years to 14 years). The inclusion criteria were that patients had to have a lateral and posteroanterior (PA) cephalograms at 2 time points separated by at least a 2 year interval without any surgical intervention. The mean age of patients was 8.5 years and the mean follow-up records were 3.7 years. There were 13 patients in group I with a Pruzansky Type I mandible and 17 patients in group II with a Pruzansky Type II mandible. Fourteen patients had the right side of the mandible affected and sixteen patients had the left side of the mandible affected. The unaffected side of the mandible served as a control. Eighteen parameters were examined at each of the two time intervals.

Results: In patients with Pruzansky Type I mandible the affected ramus grew on average 1.41 mm per year; during the same period the unaffected ramus grew 1.66 mm per year. In patients with Pruzansky Type II mandible the affected ramus grew on average 0.84 mm per year; during the same period unaffected ramus grew 1.79 per year. When the growth rate of the ramus height on the affected side was compared to unaffected side, there was no statistical significant difference in Pruzansky Type I mandible ($p>0.05$), and there was statistical significant difference in Pruzansky Type II mandible ($p<0.05$).

Conclusion: The growth rate discrepancy of the affected ramus height was more severe in Pruzansky Type II mandible when compared to Type I mandible. Unoperated patients with unilateral craniofacial microsomia and Pruzansky Type II mandible had progressive facial asymmetry. These findings must be considered in treatment decisions in growing patients with UCFM.

PD2-2

The Validity of Current Outcomes Assessment Among Heterogeneous Populations.

Presenter: Patricia Glick

Author: Glick PH

DMD, Craniofacial Orthodontist, Co-Medical Director, The Barrow Cleft and Craniofacial Center, USA

Epidemiological data has documented that the incidence of cleft lip and palate is variable worldwide. One application of clinical epidemiology, the study of the distribution of disease in human populations is healthcare outcomes assessment (OA). Outcomes assessments are being mandated in the US and elsewhere and can play a major role in medical decision making for patients, providers, administrators, and insurance companies.

When properly executed, OA can distinguish between treatment modalities. When heterogeneity is present, either within the experimental group or between the experimental group and the comparison group, conclusions of the OA can be flawed or misleading. One such variable is the underlying characteristics of the patient population. Characteristics of the experimental patient population can affect the interpretation of the OA (Donabedian). Variables in patient characteristics create a “risk” when conducting outcomes assessments. Adjustment for such risk is essential when comparing outcomes.

This paper will:

- 1). Discuss the known relationships between maxillary growth deficiency, the incidence of cleft lip and palate worldwide, and the complexities encountered when conducting outcomes assessments utilizing current instruments and known protocols.
- 2). Assess the validity of outcomes assessment that do not adjust for the “risk” that occurs when the facial and growth characteristics of the study population are different from the facial and growth characteristics of control population.
- 3). Assess the validity of the use of the Goslon Yardstick in an international setting.

PD2-3

Is the NAM effective or ineffective? The need for orthodontic diagnosis in management of infants with facial cleft, cleft lip and palate.

Presenter: Yuki Satoh

Author: Satoh Y

Department of Orthodontics, School of Dentistry Showa University, Japan

There are many types of malocclusion in every patient. We, as orthodontists, select the appliances after a process of diagnosis and identifying the cause of malocclusion. There is no doubt that this process is crucial in establishing an effective treatment plan. However, these obvious steps are not always followed in presurgical stages of infant orthodontic treatment. Hotz plate, Latham, McNeil and NAM appliances are some of the presurgical infant orthodontic appliances. In reality, these appliances are chosen not by after a thorough diagnosis, but often by the institution or the practitioner’s preference and experience level. Of course, some institutions may have a well-established treatment routine to have omitted the diagnosis, but fundamental reasons why the diagnosis process is missing is as follows;

1. The number of cases and treatment institutions are limited.
2. Limited number of infant orthodontists and their clinical skill levels are not the same due to unestablished education system.
3. Unable to identify the effectiveness of one therapy because multiple therapies are applied to one patient, and treatment purposes and goals are different depending on the operator. Treatment goals are different
4. Unable to obtain sufficient records and make a diagnosis due to the gravity of urgency

There has been an astonishing progress in cleft palate surgery in the recent years. It is important to establish an effective and efficient medical team structure, rather than the performance of treatment result itself.

Since 2004, Showa University cleft palate team has been routinely using NAM treatment on over 300 infant patients with cleft lip and palate and facial cleft. However we have temporarily stopped for the past 3 years. This is because successful infant orthodontic treatment, including NAM treatment, needs individualized comprehensive treatment planning and appropriate appliance selection.

In recent years, mid-term results of pros and cons of the NAM treatment have been reported in each facility. I truly wonder the validity of these evidence data, while cause of the specific symptom is unidentified, and without standard treatment protocol. The appliance is just an appliance. It is neither less than and more than. Is NAM effective or ineffective? I believe the answer is dependent on our diagnosis. In this session, I would like to present and review our current situation and points of improvement for infant orthodontics. I will also like to discuss the future approach of infant orthodontics.

PD2-4**Definitive Facial Skeletal Correction of Craniofacial Microsomia: Orthodontic Treatment Consideration**

Presenter: Ellen Wen-Ching Ko

Author: Ko EW

Chang Gung University, Taiwan

Background: Craniofacial microsomia (CFM) is a common congenital craniofacial anomaly, which manifests a range of craniofacial findings involving hypoplasia of tissues arising from the first and second brachial arches. Mandibular hypoplasia has been considered as an important feature of CFM. The methods of correction vary from camouflage orthodontic treatment to different surgical approaches, including distraction osteogenesis (DO), costochondral graft (CCG) and comprehensive orthognathic surgery (OGS). The role of orthodontist in CFM is to document the craniofacial growth and characteristics, preparation of the dentition before surgery, surgical plan and wafer fabrication, post-surgical management of dental occlusion as well as monitor the long-term outcome after surgery.

Objective: To access the treatment outcome and evaluate the process of surgical-orthodontic management of CFM in long term.

Method: A series of 19 patients (7 male and 12 female) with CFM were documented for the treatment history and surgical outcome. The surgical changes and stability were evaluated via 3D craniofacial superimposition. The accuracy of surgical outcomes were accessed in patients with 3D surgical simulation.

Result: The diagnoses of the patients were mainly Pruzansky Grade II mandibular hypoplasia, one patient was Pruzansky Grade III, 2 patients also had cleft lip and palate deformity. The age of these patients to have definitive surgical treatment ranged from 19 to 29 years old. Among these patients, 5 patients had mandible DO at childhood; the patient with Grade III deformity had CCG, which overgrowth tremendously during teenage. The choice of definitive correction included 17 OGS, 2 re-DO. The 3D surgical simulation was applied on 11 patients with OGS.

Conclusion: The choice of treatment methods should base on the severity of the asymmetric defect, the amount of bony deficiency, facial proportion, the age of and the expectation of the patients. The 3D surgical simulation improved quality of OGS in CFM. The long-term growth of patients' faces that underwent DO in childhood indicated the inherent growth pattern could not be altered via early surgery.

PD2-5**Experiences with Cleft and Craniofacial Outcome Studies: A Dialogue for Sharing and Exploring Future Directions**

Presenter: Ronaldo Hathaway

Author: Hathaway R

Cincinnati Children's Hospital Medical Center, USA

The purpose of this talk is to stimulate conversation and provide a platform for the sharing of ideas, discoveries and common ground for future collaboration. The following points will be addressed.

The state of cleft palate and craniofacial outcome studies globally. What have been some key experiences for initiating and for continuing these studies? What were the successes, challenges, lessons learned and future opportunities?

How can we have greater impact? Does it require doing more or perhaps a more focused and shared vision? Where is there opportunity for international colleagues to collaborate in these studies?

Methods that can be utilized to put people in contact, to network and further develop the collegial culture that many of us have experienced and found to be valuable in our own studies.

Developing the young leadership so necessary for the growth and continuation of our work. Could we develop a visiting scholar exchange program specifically for young researchers interested in outcome studies?

Craniofacial orthodontists and surgeons: there a need and opportunity for a shared strategic plan in our efforts.

PD3-1
ENDOSCOPIC APPROACH TO SKULL BASE TUMORS AND RECONSTRUCTION WITH THE NASOSEPTAL FLAP

Presenter: Stephen P. Beals
Author: Beals SP
Barrow Neurological Institute, USA

Transfacial approaches, developed over the past 2 decades, offer safe avenues of skull base exposure, often allowing single-stage resection, which decreases operating time and reduces morbidity. The simultaneous advancement of medical technology in neurosurgery, radiographic techniques, endoscopic approaches, anesthesia, and intraoperative and postoperative monitoring has further aided in the success of transfacial techniques.

The use of endoscopic approaches to skull base tumors has resulted in less need for facial disassembly for exposure of midline skull base and sino-nasal tumors. The use of the nasoseptal flap for skull base reconstruction following endoscopic tumor removal has greatly reduced the incidence of CSF leak.

This presentation focuses on:

1. The integration of the endoscopic approach into strategies for skull base exposure.
2. The nasoseptal flap in the reconstruction of the skull base after the endoscopic approach to skull base tumor resection.

PD3-2
Postoperative Complications after Skull Base Reconstruction

Presenter: Kentaro Tanaka
Authors: Tanaka K¹, Okazaki M¹, Yano T², Suesada N¹
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Introduction: In skull base reconstruction, reliable separation between the cranial and nasal cavities is the most important performance goal of the reconstructive surgical procedure. Postoperative complications could result in critical outcomes, such as cerebral meningitis. Consideration about early postoperative complications will be reported in this presentation.

Patients and Methods: We examined the medical records of skull base reconstructive cases between April 2007 and March 2014 in the Department of Plastic and Reconstructive Surgery at Tokyo Medical and Dental University. One hundred and eight patients (67 males and 41 females) were included. The age of the patients ranged from 8 to 77 (mean age 42). Retrospective analysis was performed on primary disease, ablative and reconstructive surgical procedures, and postoperative complications and their treatments.

Results: Primary diseases were 102 neoplastic lesions (50 malignant tumors and 52 benign tumors) and 6 non-neoplastic lesions. Defect areas included the anterior skull base in 41 cases, middle skull base in 55 cases, and anterior-middle skull base in 12 cases. Reconstructive procedures included free tissue transfer in 68 cases and locoregional flap in 40 cases. Complications and their treatments were as follows: cerebrospinal fluid leakage in 5 cases (3 cases required re-operation), flap necrosis in 2 cases (both required removal of necrotic tissue), disturbance of consciousness by brain compression in one case (required reduction of flap volume), and visual impairment in one case (required optic nerve decompression).

Discussion: Cerebrospinal fluid leakage was the most frequent complication. Characteristic symptoms include pressure in the brain and central nervous system and should be noted in skull base reconstruction. Early detection and rapid treatment of these complications are essential to prevent serious outcomes. We should also take measures to decrease the frequency of complications. Intraoperative assessment, such as indocyanine green fluorescent angiography, is aggressively performed, especially in locoregional flap reconstruction.

PD3-3

Our strategy of skull base reconstruction after tumor resection: A 10-year, single institute experience

Presenter: Yuzuru Kamei

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Background: Skull base reconstructions after tumor resection remain great challenge for reconstructive surgeon. A large and anatomically complex defect after tumor resection that involves soft tissue and bony defect requires large and composite tissue compensation. To avoid postoperative complication and to achieve functional and aesthetic outcome to a maximum extent, reconstruction method has to be carefully considered. In this study, we reviewed our experience of skull base reconstruction.

Methods: Sixty-seven patients who underwent skull base reconstruction from 2004 to 2014 in our institute were reviewed and analyzed.

Results: Reconstructions were performed for 10 region I (anterior skull base) defects, 16 region II (middle skull base) defects, and 41 region I + II defects. Among 67 cases, the defect involved orbit in 39 cases (58.2%), hard palate in 36 cases (53.7%) and facial skin in 18 cases (26.9%). Twelve local or regional pedicled flap reconstructions and 58 free flap reconstructions were performed. The selection of free flaps included rectus abdominis (42), omentum (10), forearm (4), anterolateral thigh (1), and Latissimus dorsi (1) flaps. Complications occurred in 34.3% of patients that included local infection (17.9%), cerebrospinal fluid leakage (11.9%), cutaneous fistula (26.8%), hard palate fistula (16.7%), total (3%) and regional (6%) flap loss, and re-operation (17.9%).

Comments: Region I defects were reconstructed usually with pedicled flap or forearm flap, region II defects were reconstructed with pedicled flap or omental flap, and region I + II defects were reconstructed mainly with free RA flap. The reconstructive methods were decided based on the volume, complexity of the defect and adjacent region that involved in the defect.

PD3-4

The usefulness of the musculo-pericranial flap in reconstruction of the skull base

Presenter: Kensuke Kiyokawa

Authors: Kiyokawa K, Koga N, Rikimaru H
Department of Plastic and Reconstructive Surgery and Maxillofacial Surgery, Kurume University School of Medicine, Japan

Purpose: In reconstruction of the skull base, repair and reconstruction of the dura mater, and isolation of the cranial and nasal cavity are particularly important. We have formed a team with neurosurgeons, otorhinolaryngologists and radiologists to provide medical treatment for trauma and tumors in the anterior skull base. In this paper, we study the methods and treatment results of that team, and consider its effectiveness and problems.

Case and Method: We verified the postoperative course for 81 cases of skull base surgery performed from 1984 to 2014. Regarding the reconstruction method, a temporal musculo-pericranial flap was mainly used for the repair of the dura mater, and for isolating the cranial and the nasal cavity, a frontal musculo-pericranial flap was mainly used. However, in cases where these were inadequate, a free flap was used.

Result: Among the 81 cases, 69 cases (85%) recovered with no problems. Postoperative complications were observed in 12 cases (15%). The breakdown of these is 10 cases of localized infection, 1 case of aspiration pneumonia and 1 case of internal carotid artery rupture. The localized infection cases were all treated by procedures such as drainage, debridement, etc.

Discussion: The methods we used had such benefits as being able to elevate with the reconstruction materials in the same surgical field, being able to definitively perform water tight reconstruction of the dura mater by reconstructing the dura mater using a temporal musculo-pericranial flap with a blood flow, and the fact that even if a localized infection should arise, the musculo-pericranial flap would form a strong barrier against the spread of infection within the dura mater, etc. Compared to the temporal musculo-pericranial flap, the frontal musculo-pericranial flap has a rich blood flow and thickness, and is extremely effective in the isolation of the cranial cavity and nasal cavity.

PD3-5

Analysis of Risk Factors for Flap Loss and Salvage in Free Flap Head and Neck Reconstruction

Presenter: Edward I. Chang
Authors: Chang EI, Zhang H, Liu J, Skoracki RJ, Yu P,
Hanasono MM

MD Anderson Cancer Center, USA

Introduction: Loss of a free flap for head and neck reconstruction can be fatal and devastating, however, the risk factors and techniques for salvaging a failing head and neck flap are poorly described.

Methods: Retrospective review of all head and neck free flaps performed from 2000-2010.

Results: Overall, 2296 head and neck free flaps were performed with 151 flaps (6.6%) suffering microvascular complications. Patient age (mean: 58.4 years), BMI (mean: 26.6kg/m²), and comorbidities had no impact on flap survival. Radiation had no impact on flap survival; however, prior chemotherapy was significantly associated with loss of a free flap (OR: 2.58, CI: 1.21-5.48; p=0.013). Flap type (ALT/AMT: 61, fibula: 33, radial forearm: 24, ulnar forearm: 5, latissimus dorsi: 10, VRAM/TRAM: 7, jejunum: 2, other: 9) had no impact on flap salvage rates; however, muscle flaps had significantly lower salvage rates than other flaps (p=0.002). Surgeon experience also did not affect salvage rates (p=0.88). Vein grafts were used in 23 arterial anastomoses and 26 venous anastomoses and did not affect flap survival; however, venous anastomosis performed with a Coupler had significantly fewer flap complications compared to hand-sewn anastomoses (p=0.03). While venous thromboses were the most common, supercharging a flap did not decrease flap loss rates (p=0.45). Flaps that were found to have an arterial and venous thrombosis had significantly lower salvage rates compared to complications with either the vein (n=59) or the artery (n=26; p<0.0001). The use of aspirin, Fogarty catheter thrombectomy, thrombolytics, and heparin did not improve salvage rates. Flaps requiring multiple takebacks (one takeback: 55.6% vs. 2 takebacks: 3.3% vs. 3 takebacks 1.3%; p=0.003) and late takebacks (>3 days) had significantly worse outcomes (p=0.003). Overall successful salvage rate was 60.3% with 60 total flap losses (2.6%).

Conclusions: Microvascular complications in head and neck free flaps are relatively rare occurrences, and salvage techniques do not decrease flap loss rates. While an attempt should be made to salvage a failing flap, multiple attempts are not recommended especially for muscle flaps. Thromboses of the artery and the vein and late thromboses also have an overall dismal prognosis for flap survival.

PD4-1

Constricted Ear-Featured Microtia and Lobule-Remnant Microtia: My Recent Reconstructive Methods

Presenter: Chul Park
Author: Park C

Department of plastic and Reconstructive Surgery, Korea University Anam Hospital, Korea

We have reconstructed 767 microtias of various types at our Center between April 1991 and February 2014. For each type of auricular deformity, various reconstructive methods have been attempted and subsequently introduced in the literature: some were acceptable, and others were found to be less acceptable in follow-up studies. The latter were discontinued. In this presentation, I will discuss our recent refined techniques, especially for reconstruction of constricted ear-featured microtia and lobule-type microtia.

I. Constricted ear-featured microtia

Among our reconstructed microtias, a series of cases showed features of constricted ear (172 ears in 167 patients). Three different types were observed: Type I, showing shortage of auricular margin near the superior otobasion (n=62); Type II, showing shortage of the entire auricular margin (n=92); Type III, showing low-set cup shape (n=18). The criteria for choosing reconstructive methods can be summed up as follows: Two-stage projection methods were preferred over one-stage projection methods; for framework construction, the deformed cartilage was completely removed and replaced with costal cartilage(n=127); skin that enveloped the deformed vestige cartilage was maximally used; local flap rotation techniques were used in the majority of recent cases. A total of 146 ears (85%) were followed up between 1 month and 13 years (an average of 27 months).

II. Lobule-remnant microtia

We have reconstructed lobule-remnant microtia with two methods: the expanded two-flap method (587 cases between 1995 and 2010), and the embedding and elevation method (180 cases between 2006 and 2014). We compared the two methods by analyzing patients, operated since 2006 (105 reconstructed with the expanded two-flap method, and 180 reconstructed with the embedding and elevation method). Postoperative outcomes, advantages, and disadvantages for each method are presented. Our recently refined techniques of embedding and elevation method are presented.

PD4-2**Two-stage reconstruction of the auricle with- or without canal plasty**

Presenter: Hirotaka Asato

Author: Asato H

Dokkyo Medical University, Department of Plastic and Reconstructive Surgery, Japan

Two stage otoplasty has been common procedure for microtia patients: rib cartilage graft in the first stage, and ear elevation in the second stage operation. If the patient hope ear canal plasty with tympanoplasty, multiple stages of surgery is required by plastic surgeon and otologists. When canal plasty is performed prior to ear reconstruction, it is very difficult to make esthetically good results due to the scar tissue by preceding operation, and the position of the auricle is restricted by the canal. On the contrary, in the case auricle reconstruction performed regardless of canal plasty, sometimes the auricle is constructed above the temporomandibular joint, so the position of constructed ear is not suitable for canal plasty. To overcome this problem we have developed combined surgery in the 2nd stage operation, simultaneous ear elevation and canal plasty. The possibility of getting hearing ability is estimated utilizing Jahrsdoerfer's score from the temporal bone CT scan. When the patient's middle ear is well developed and the patient and family desire to do canal plasty, we plan combined ear elevation with canal plasty for the second stage operation. For patients who is not candidate for ear canal plasty, we have developed a simple procedure for ear elevation making a TPF pocket to cover the cartilage buttress.

The details of our surgical techniques and the results of this procedure are presented.

PD4-3**Ear Reconstruction with a pHDPE Implant—a 23 year experience—**

Presenter: John F. Reinisch

Author: Reinisch JF

Keck School of Medicine, University of Southern California, USA

Porous high-density polyethylene (pHDPE) ear reconstruction produces a realistic-looking ear. Although popular among parents of children with microtia, it has not gained widespread acceptance among reconstructive surgeons. We present the world's largest series of ear reconstructions with a pHDPE implant.

We conducted a retrospective review of all patients who had undergone pHDPE ear reconstruction, between 1991 and 2013. We recorded the history, gender, age at surgery, hospital stay and rates of infections, exposure and fracture.

A total of 1042 PHDPE ear reconstructions were performed. There were 978 primary ear reconstructions for microtia. Of these cases, 301 were done with or after an ear canal reconstruction. An additional 59 were performed as a salvage procedure, following a failed or unsatisfactory ear reconstruction and 5 were performed after trauma. The median age at the time of primary surgery was 4 years and 7 months, ranging from 2.5 to 59 years.

An early series (1993-1995) demonstrated high fracture and exposure rates of 25% and 44% respectively. With refinements of both the surgical technique and implant, the fracture rate has dropped to 1.5%. With implant modification, no fractures have occurred in the last 3.5 years. The current early exposure rate is 4%, with late exposure rate, (>one year post-surgery), less than 1%. Infection and hematoma rates are negligible. Since 1995, all but two surgeries have been performed as an outpatient. In the last four years, no post-operative drains have been used. Salvage of 76 unsatisfactory prior ear reconstructions have been successful in all cases.

This single-stage technique gives a realistic looking ear and can be performed as an outpatient, before kindergarten without a chest or scalp scar. The ability to perform simultaneous atresia and microtia repair is a further advantage. As a salvage procedure, it is often the only acceptable reconstructive option, particularly in bilateral patients, who have had failed or esthetically unacceptable cartilage reconstruction.

PD4-4

20-Year Experience of Total Auricular Reconstruction Using Tissue Expander

Presenter: Tsuyoshi Kaneko

Authors: Kaneko T¹, Hikosaka M¹, Kajita H¹, Ohara H², Tokuyama E³

¹Division of Plastic Surgery, National Center for Child Health and Development, Japan, ²Division of Plastic Surgery, NHO Saitama National Hospital, Japan, ³Department of Plastic Surgery, Okayama University, Japan

Total auricular reconstruction for microtia still remains one of the most challenging surgeries in our specialty. Since 1991, we have introduced computer-assisted techniques in order to help surgeons to operate with more confidence and to obtain better results. These include a life-sized mirror image wax model of the contra-lateral ear which was made using computer-controlled milling machine from the data obtained with laser scanner. This wax model was used as a three-dimensional template in assembling cartilage framework during operation. The second one is a life-sized silicone model of the patient's costal cartilage made from ultrasonography data. This silicone cartilage model is a precise replica of the patient's costal cartilage to be harvested and this model enables realistic simulation surgery. This simulation surgery was effective in minimizing the amount of cartilage to be harvested and seemed promising in performing less invasive surgery. However, these computer-assisted techniques have been conducted on research basis and have not been applied on daily basis due to time and cost required.

From 1991 to 2014 more than 150 ears have been operated using tissue expanders with slight modifications. Our recent operation consists of three stages. At the first stage, the remnant cartilage is extracted and a tissue expander is inserted beneath the temporal skin. Maximum expansion is less than 50 ml in recent cases. At the second stage, the costal cartilage is harvested and precise assembling of three-dimensional framework is done. We try to harvest least amount of cartilage in order to minimize chest wall deformity. At the third stage, the remnant lobule is transposed and full thickness skin grafting is done in most cases in order to create more distinct auriculotemporal sulcus.

Complications, advantages and disadvantages will be discussed and representative cases will be presented.

PD5-1

Three-Dimensional Computer-Assisted Orthognathic Surgery: Chang Gung Experience

Presenter: Lun-Jou Lo

Authors: Lo LJ, Lin H, Chang H, Wang C, Kim SG
Plastic & Reconstructive Surgery, and Craniofacial Research Center, Chang Gung Memorial Hospital, Chang Gung University, Taiwan

Purpose: Three-dimensional computer-assisted orthognathic surgery has been applied to improve planning and outcome. This study presented our experience with this promising modality for simulation of surgery, prefabrication of positioning guides, and navigation of the surgery.

Methods: 37 patients who received the surgical simulation and intraoperative navigation for 2-jaw orthognathic surgery were recruited. Preoperative 3-dimensional cone-beam computed tomography images were used for surgical simulation, and design of intraoperative guidance. An initial surgical plan was developed and transferred for 3-dimensional virtual surgery. Modification of the surgical plan was made if facial symmetry and skeletal harmony or collision of ramus segments were concerned. The result of virtual surgery was used to design and manufacture positioning guides, and perform preoperative navigation planning. During the operation, the positioning guides were used to transfer the virtual planning to actual surgery, and a real-time navigation system was used to confirm the pre-determined position of the maxillomandibular complex. For assessment of the computer-assisted surgical system, the simulation image was superimposed to the postoperative image for comparison.

Results: The computer-assisted orthognathic surgery was successfully carried out in all patients. The initial surgical plan was modified in 17 patients in whom the position of maxillomandibular complex was changed. The positioning guides were helpful to control the spatial position of the maxillomandibular complex. The BrainLab^{TR} navigation system was useful to further confirm the position of the facial bone. Superimposition of the simulation and postoperative images revealed satisfactory result with acceptable errors. The difference ranged from 0.05 to 1.46 mm with a mean value of 0.66 mm for patients using the positioning guides, and the difference ranged from 0.07 to 2.30 mm with a mean value of 1.20 mm for patients using the navigation system. Overall patient and doctor satisfaction was high.

Conclusion: This computer-assisted orthognathic surgery system helps to improve surgical planning, to reduce surgical difficulty, to facilitate positioning and fixation of the maxillomandibular complex, and to improve outcome.

PD5-2**The Virtual Transformation. Virtual Surgical Planning (VPS) and Occlusal Positioning Systems (OPS) and Beyond!**

Presenter: John W. Polley

Author: Polley JW

Helen Devos Children's Hospital, Oral Cleft and Craniofacial Program Pediatric Plastic Surgery, Grand Rapids, USA

The application of computer-aided design and modeling has revolutionized pre-operative treatment planning for orthognathic surgery. VSP technologies have increased the accuracy of pre-operative treatment planning in OGS, eliminating traditional techniques of indirect measurements, 2-dimensional cephalometry, face bow transfer, and articulated model surgery and exposure to laboratory chemicals. To complement these advancements, we have developed a virtually derived OPS based on intraoperative surgical positioning guides. OPS translate the power and accuracy of virtual technology to the operating room, allowing the surgeon to perform exacting repositioning of the maxilla and mandible. The use of intra-operative guides eliminate difficult steps during OGS such as; the need for intermediate splints for 2-jaw surgery; the need for intraoperative intermaxillary fixation; auto-rotation of the maxillary and mandibular complex; guessing intra-operative condylar centric relation; intra-operative guessing of final vertical, horizontal and transverse positioning of osteotomized skeletal segments; and peripheral reference site determination and use.

The purpose of this presentation is to review current techniques of VSP in OGS and present the utilization of OPS in appropriate cases. The authors have extensive experience using VSP and OPS with various diagnosis, including isolated dentofacial deformities, maxillo/mandibular asymmetries, clefts, and hemifacial microsomia. Applications in cranio-orbital surgery will also be presented. Techniques, triumphs, and limitations of these techniques will be illustrated through multiple case presentations.

PD5-3**CAD CAM TECHNOLOGY: ITS APPLICATION IN COMPLEX TWO JAW SURGERY FOR THE CORRECTION OF FACIAL ASYMMETRY**

Presenter: Joseph McCarthy

Author: McCarthy JG

Plastic & reconstructive surgery, Department of Pediatrics NYU Langone Medical Center, USA

CT scans were obtained in 10 patients requiring two jaw surgery with unilateral craniofacial microsomia and severe facial asymmetry. Five patients required the insertion of autogenous bone grafts in the affected ramus. There was 4 mm advancement at the maxillary craniofacial midline with yaw correction of 4.96 mm to the unaffected side and 2.74 mm impaction on the unaffected side. The mandibular movements were as follows: advancement of point B of 10.5 mm, yaw correction to the unaffected side of 6.58mm, genioplasty segment advancement of 8.43mm and mean transverse correction of 6.33mm. CAD CAM technology was employed to construct the intermediate and definitive interocclusal splints, bone graft template and osteotomy cutting guides. Postop CBCT scans were obtained at least six months postoperatively and 3D color coded displacement maps were generated to assess the visual and quantitative outcomes. There was only a mean error of 0.88mm from planned maxillary projection and the anterior mandibular error was 0.96mm. For planning and executing complex, three dimensional maxillomandibular movements, CAD CAM technology represents a major clinical advancement and an essential tool in achieving optimal surgical outcomes.

PD5-4

Virtual Surgical Planning Optimizes Surgical Outcomes in Osteocutaneous Free Flap Mandible Reconstruction

Presenter: Eric I. Chang

Author: Chang EI

Fox Chase Cancer Center, USA

Purpose: Osteocutaneous free flaps have become the primary reconstructive modality for segmental mandibulectomy defects. The advent of preoperative virtual surgical planning (VSP) with models and templates has led to significant refinements in operative technique. Here, we examine the value of CT-guided preoperative VSP on outcomes and operative efficiency after mandibular reconstruction with osteocutaneous free flaps.

Methods: A retrospective review was performed from 2002-2013 of all patients undergoing free flap mandible reconstruction at a single cancer center. Surgical technique and operative time were assessed and cost analysis was performed. Patient demographics, complications, and overall outcomes were also examined. A review of postoperative CT scans was also performed to assess accuracy of the osteotomies and bone healing.

Results: Ninety-three patients underwent osteocutaneous free flap reconstruction of the mandible during the study period. In 10 patients, the shaping of the neo-mandible was performed without VSP while 27 patients underwent shaping of the bone based upon the prefabricated stereolithic models. The remaining 56 patients underwent preoperative CT-imaging to design patient-specific, cutting templates for the native mandible as well as the fibula and scapula. The use of preoperative CT-guided planning resulted in less osteotomies, burring, and bone grafting. VSP also significantly decreased operative time (707 min vs. 534 min, $p < 0.0003$) which translated into increased cost savings. Review of postoperative CT scans demonstrated higher rates of bony nonunion/malunion without VSP but this was not clinically significant. There were no significant differences in overall outcomes or complications between the groups.

Conclusion: Preoperative VSP has refined mandible reconstruction with osteocutaneous free flaps. The use of patient-specific, CT-guided modeling with fabrication of osteotomy guides outweigh the costs associated with this adjunctive technology. Patient-specific, computer-guided surgical planning improves operative efficiency without jeopardizing overall outcomes or increasing complications.

PD6-1

Cleft care at Seoul National University Children's Hospital during the last 30 years

Presenter: Sukwha Kim

Authors: Kim S¹, Chung JH¹, Choi TH¹, Baek SH², Kim JC², Yang IH²

¹Department of Plastic Surgery, Seoul National University College of Medicine, Korea, ²Department of Orthodontics, School of Dentistry, Seoul National University, Korea

Multidisciplinary care is essential for the best management of the cleft lip and palate. As the surgeons repair the clefts, the most of the cleft centers provides team approach.

Prenatal diagnosis needs medical counseling and the supportive care of the obstetricians, cleft surgeon and the psychiatrists. Immediately after the birth, the patients with wide cleft in the palate suffer from the feeding problem which needs the help from the lactation nurse or the nutritionist. In the bilateral cleft lip with the protruding premaxilla, the presurgical orthodontic treatment permits the simultaneous and easy repair of the both sides of the cleft in the lip. One of the goals in the cleft palate repair is the normal speech and the appropriate management of the otitis media by the otologists with postoperative speech evaluation and speech therapy is provided. The cleft lip and palate is associated with various syndromes and the care by the pediatrician is needed with the genetic consultations. In the Pierre-Robin syndrome the retruded mandible provokes the problems in intubation which can be solved by the anesthesiologic care.

Since 1989 when the orthodontist join the cleft care team in Seoul National University Children's Hospital, 1111 primary cleft lip repairs and 1432 primary palatoplasty was done by 2014.

After the repair of the cleft lip and palate, the secondary deformities in the lip and nose are resulted with the skeletal deformities. The alveolar bone grafting is done after the expansion of the maxillary arch. By the time of the growth, continuous orthodontic and dental care must be provided. Predictors for the future need of jaw surgery are proposed and the effect of secondary alveolar bone grafting on the maxillary growth in comparison of the unilateral and bilateral cleft lip and palate is investigated.

Multidisciplinary care should be continued for the normal facial growth and the appearance with the normal speech in the cleft lip and palate. Based on the experiences of cleft care at SNUCH.

PD6-2**An integrated approach for primary nasal reconstruction in unilateral cleft lips**

Presenter: Philip Kuo-Ting Chen

Author: Chen PK

Craniofacial Center, Chang Gung Memorial Hospital, Taiwan

An integrated approach for primary nasal reconstruction in patients with unilateral cleft lips has been used in Chang Gung Craniofacial Center for more than 15 years. The approach consists of (1) presurgical nasolabial molding, (2) surgical modifications and (3) postoperative maintenance.

Two types of nasolabial molding, the Figueroa and the Grayson technique, have been used in our center since the late 1990's. A recent prospective randomized study showed both techniques could produce similar nasal outcomes.

Surgical modification consists of (1) using various mucosal flaps for nasal floor reconstruction, (2) complete mobilization of alar base with extensive muscle dissection, (3) good repositioning of the alar base in its vertical, sagittal and horizontal directions, (4) semiopen rhinoplasty with Tajima incision on the cleft side and rim incision on the non-cleft side; medial rotation of both lower lateral cartilages, and (5) over-correction of the cleft side nostril in its sagittal and horizontal dimensions.

A modified silicone conformer is used after operation for maintenance of the over-corrected nostril. The conformer is used as long as possible, usually 6 to 9 months.

This integrated approach can give more consistent better results than their peers before mid-90's. The author didn't have any preschool nasal revision in recent 10 years.

PD6-3**Cleft Palate Repair Using the Buccal Flap**

Presenter: Robert J. Mann

Author: Mann RJ

Helen DeVos Children's Hospital Grand Rapids, USA

This presentation will demonstrate how to incorporate the versatile Buccinator Myomucosal Flap into your cleft palate program.

1. Primary Cleft Repair

Review the result of more than 500 cleft cases using the Double Z-plasty plus or minus Buccal Flap approach over 28 years. This review will:

- A. Demonstrate how you can reduce your overall fistula rates and improve your success rate closing those fistulas that do occur
- B. Improve your speech results no matter how wide the cleft without sacrificing midface projection.
- C. Simplify your orthodontic treatment.
- D. Reduce your required orthognathic surgery while simplifying those cases that are required.

2. Secondary Cleft Surgery

Discuss the double opposing Buccal Flap palate lengthening procedure and how it can add to your treatment algorithm for velopharyngeal incompetence.

3. Pre-surgical Orthodontics

Discuss how the Buccal Flap can work well in programs that do not use pre-surgical orthodontics as well as those that do.

PD6-4

Importance of correcting the alar base position in patients with cleft lip during primary lip repair

Presenter: Yohko Yoshimura

Authors: Yoshimura Y, Okumoto T, Inoue Y, Onishi S

Dept. of Plastic and Reconstructive Surgery, School of Medicine, Cleft Lip/Palate Center, Fujita Health University, Japan

Background: Until 1999, we had performed primary nose repair for cleft lip concurrently with primary lip repair. However, as the patients grew older, we experienced many challenging cases, in which it was difficult to perform the final nose repair because of previous surgical scars. Therefore, in 2000, we stopped performing primary nose repair. However, nose repair is performed after the completion of growth of the patient. We believe that a symmetrical nose when viewed from the front is critical for achieving an acceptable nose shape without primary surgery. Therefore, the position of the alar base and nostril floor must be corrected to positions symmetrical with the contralateral side. The lateral wall of the nasal vestibule should be undermined and sufficiently raised from the piriform aperture with the lining flap of the nasal floor sutured in a position as cranial as possible at the piriformis margin.

Methods: In this study, we evaluated the outcomes of patients who underwent primary nasal repair after 2005, when we had an adequate experience with this technique, and those who underwent primary nasal repair before 2000.

Results: A statistically significant difference was observed in the alar base position symmetry between the two groups ($p=0.03$).

Conclusions: This result indicates the efficacy of our currently used technique for achieving nasal symmetry.

PD6-5

Presurgical Maxillary Orthopedics is Associated with Normal Mid-Face Growth in Unilateral Cleft Patients

Presenter: S. Anthony Wolfe

Authors: Wolfe SA, Mejia M

Miami Children's Hospital, USA

Introduction: The purpose of this paper is to present our technique, which differs from Grayson and Cutting's in a number of respects and present our preliminary treatment results in complete unilateral cleft lip and palate patients, looking at both facial and maxillary development in primary and mixed dentition.

Methods: Pre-surgical orthopedic treatment was begun at 7 days after birth. The duration of the treatment was 35 weeks, using a Pre-Surgical Orthopedic Appliance (POA). No retention is placed into the cleft to allow normal physiologic development. We should also consider if there will need to be any descent of the occlusal plane and what the maxilla will look like when it is in complete physiologic position. We describe different adjustments according to the treatment plan. We have used our current protocol including gingivoperiosteoplasty in more than 150 complete unilateral cleft lip and palate patients. We will show the results in the first 10 patients treated with this protocol, in primary and mixed dentition, with cephalometric analysis to appreciate mid-face development.

Conclusion: With the correct presurgical orthopedic treatments, complete unilateral cleft lip and palate patients, can develop a good and physiological maxillary arch before surgery. For this reason, they're going to have a better chance to develop their faces in a correct way.

PD7-1

Alloplastic Augmentation of the Facial Skeleton—An Adjunct or Alternative to Orthognathic Surgery

Presenter: Michael J. Yaremchuk

Author: Yaremchuk MJ

Harvard Medical School, Massachusetts General Hospital, Harvard Plastic Surgery Training Program, USA

Alloplastic implants can enhance areas of the facial skeleton not amenable to osteotomy. They can simulate the visual effect of osteotomies in patients with skeletal deficiencies when occlusion is normal or has been corrected. Implants can also be adjunctive to orthognathic surgery by correcting contour irregularities or disharmonies after skeletal movements.

Technique: Implant surgery is usually performed under general anesthesia performed through remote incisions. Porous polyethylene implants which limit capsule formation and underlying bone erosion are preferred. Implants are immobilized with titanium screws.

Implant Design and Applications: *In patients who have undergone orthognathic surgery*, alloplastic implants specifically designed to augment the infraorbital rim can correct the residual upper midface deficiency remaining after LeFort I maxillary advancement. Mandible and extended chin implants can correct skeletal irregularities and deficiencies after sagittal and horizontal osteotomies. *In patients whose occlusion is satisfactory*, infraorbital rim implants, sometimes in combination with malar implants can correct the negative vector of midface hypoplasia. When used with paranasal and malar implants they can simulate the visual effect of the LeFort III osteotomy with advancement. Paranasal implants alone can simulate the appearance after LeFort I advancement. Chin and mandible implants reliably augment the lower jaw. The use of computer aided design and manufacture (CAD/CAM) has increased the level of sophistication of implant surgery.

Results: The application of these concepts has been effective with low morbidity. No implants have extruded or migrated. The infection rate is less than 3%.

Conclusion: Alloplastic augmentation of the facial skeleton is safe and predictable. It can be a useful adjunct or an alternative to orthognathic surgical procedures in situations when the occlusion is normal or has been corrected.

PD7-2

L-Type Osteotomy for Reduction Malarplasty: 18 years Review

Presenter: Gui Lai

Author: Lai G

Department of Craniofacial Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College, China

Malar reduction has been quickly becoming one of the most popular aesthetic procedures in China over the past 20 years. Nevertheless, there are different methods of the osteotomy that can be used for the reduction of the prominent malar. Our patients do not satisfy some of these procedures, because they produce asymmetry and vertical droop of the malar region after vertical osteotomy of the malar body. To avoid these shortcomings, we use a new method for the reduction of the prominent malar eminence through an intraoral approach, by which the malar complex is reduced naturally after an L-type osteotomy of the malar body and the greenstick fracture at the root of the zygomatic arch.

To date, at our department of Cranio-Maxillo-facial Surgery of the Plastic Surgery Hospital in Beijing, a total of 619 patients suffering from the prominent malar eminence have been operated on by this method from October 1996 to October 2014. These patients consist of 578 women and 41 men ranging in age from 15 to 38 years. The mean age was 23 years. Their indication for the surgery was purely cosmetic. The principal complications of these patients were 12 cases of infraorbital hypoesthesia related to nerve contusion by wound retractors, that was recovered 6 months postoperatively, and 21 case of slight asymmetry which needed no second surgery. No significance bleeding had been noted. No disorder of temporomandibular joint was observed. These patients have been followed up routinely with a minimum of three months and a maximum of ten years. A postoperative basal skull x-ray view and photograph were taken generally for comparing with the preoperative status. All the patients were satisfied with the results.

The satisfied result lead us to make the following conclusion: This procedure (1) has precise osteotomy volume, (2) keeps the anatomy and structures of the zygoma and zygomatic arch intact, (3) ensures the comprehensive lowering of the body and arch of the zygoma, thus best facial aesthetic result is achieved, (4) leaves no skin scar through an intraoral incision, (5) is performed under the bone membrane, lessening the chance of damaging facial soft tissue and facial nerve, (6) is simple, with good results and few complications. In a word, it is an ideal method for the malar reduction.

PD7-3

Goals and Techniques of Mandible and Zygoma Reduction in Korea

Presenter: Minbum Kang

Author: Kang M^{1,2}

¹Romian plastic surgery clinic, Korea, ²Clinical Faculty of Plastic & Reconstructive Surgery, Ajou University, Korea

In East Asian countries, the mesocephalic with wide and short face prefer to have a slender face. A number of surgical techniques have been developed to reduce the malar bone volume and reshape the mandibular area. For mandible reduction, various techniques can be applied such as long curved ostectomy, corticectomy, tubercle excision, and T-osteotome. For zygoma reduction, there are two main techniques: fixation technique and non-fixation technique. Mandible reduction is very effective in reducing the volume of lower face and making a face look slender. Depending on a patient's needs and his or her facial shape, it is necessary to perform not only long curved ostectomy but also corticectomy and tubercle excision. If genioplasty is needed, reduction genioplasty or bone grafting for lengthening have been carried out simultaneously. As surgical techniques have advanced, some patients prefer simpler procedures, having ostectomy without general anesthesia. To meet the needs of patients, the author invented an endoscopic instrument to approach from postauricular area. In zygoma reduction, The author approached the bone with the intraoral and preauricular incision and removed the bone in body area with small L-shaped osteotome and arch area bone cutting. As zygoma moved forward, inward and upward, it was fixed by miniplates and screws. The author performed ancillary procedures including neck liposuction, buccal fat removal, and autologous bone graft. Based on 10 year experience in surgery, the author would present and introduce each technique and the results of mandible and zygoma surgeries.

PD7-4

Presenter: Rong Min Baek

Author: Baek RM

Seoul National University, Korea

PD7-5

Aesthetic orthognathic, facial contouring, and adjunctive surgery.

Presenter: Derek M. Steinbacher

Author: Steinbacher DM

Craniomaxillofacial Surgery, Yale Plastic Surgery, USA

Facial skeletal surgery can be used to improve balance, shape, and aesthetics. The cosmetic impact of orthognathic surgery is maximized when the overall dimensions are appropriately altered. In addition, there are a multitude of adjunctive procedures that can be performed in the context of jaw surgery, to further enhance the result. These may include contouring, soft and hard tissue augmentation, genioplasty, rhinoplasty, and others. The purpose of this presentation is to highlight the aesthetic perspective of orthognathic, facial contouring, and adjunctive surgery.

1

Efficacy of early language assessment in single suture synostosis & impact on MDT care pathways

Presenter: R Susanna Carter

Authors: Carter RS, Evans M, Dover S, Nishikawa H, Rodrigues D, Sharp M, White N, Scobie E

Birmingham Children's Hospital Craniofacial Unit, UK

Purpose: At Birmingham Children's Hospital all children who present with single suture synostosis undergo speech and language assessment at 18 months, 3, 5, 7 and 10 years. Based on assessment findings and clinical judgement at these key ages, children are referred on to community speech and language therapy (SLT) services as required.

An increase in referrals to the Birmingham Craniofacial Unit, and the subsequent increased demand on Speech and Language resources, highlighted the need to review the assessment care pathway, focusing on language assessment at 18 months and 3 years of age.

Methodology: A retrospective audit was carried out of the SLT notes of 82 children with single suture synostosis who had undergone language assessment at both 18 months and 3 years of age.

The outcomes at both key ages were compared for each child and their performance categorised using a three point scale.

Data on the nature of intervention offered at 18 months was also analysed.

Results: The results showed that language assessment outcomes at 18 months are predictive of outcomes at 3 years in 93% of the cohort.

The results showed that 55% of the children assessed at 18 months presented with normally developing language. 91% of these children were continuing along the same trajectory at age 3.

Of the 45% who showed language delay at 18 months, 95% were given advice and 51% were also referred onto the community SLT Service. By 3 years of age, 46% of the delayed children had improved and 49% had carried on along the same trajectory.

Conclusions: These results suggest that detailed language assessment at 18 months by a trained SLT clinician can help to determine the multi-disciplinary team (MDT) care pathway for children with craniosynostosis. It also allows for early intervention in the form of advice or referral to community SLT.

2

Psychosocial factors and coping strategies of parents following a diagnosis of craniosynostosis.

Presenter: Katia Poliheszko

Authors: Poliheszko K¹, Di Rocco F¹, Colinet S², Arnaud E¹, Pamphile L¹

¹Hôpital Necker-Enfants Malades, France, ²Université de Cergy Pontoise, France

Background: The researchers studied the family context of a child with a chronic illness (Walker et al., 1987) but not concerning craniosynostosis. The diagnosis of craniosynostosis require fundamental changes in the structure and family functioning. Furthermore, the management of a child with a craniofacial malformation forced parents to implement various strategies to adapt to the announcement of the disease but also the lifestyle that it imposes. In this context, it seemed interesting to be concerned with the experiences of parents facing this situation.

Method: The objective of this research is to highlight the different variables that can influence the adjustment of parents of children with a craniosynostosis and their impact on their quality of life. We based this study on Psychology of Health Bruchon Schweitzer model (2002). It integrates the various factors affecting health: environmental and socio-demographic history, the individual history, psychosocial and biological and the transactions and coping strategies. The total sample consists of 24 parents of children with craniosynostosis (including 25% of syndromic forms). Family functioning, perceived anxiety and stress, social support perceived, coping strategies and quality of life were assessed through questionnaires and an interview of parents' reactions facing the announcement of craniosynostosis diagnosis was also conducted.

Results: At this stage, analyzes reveale that very few variables seem to be significantly correlated with coping strategies. Anxiety of parents seem to be linked with the quality of life score. Similarly, a relationship between perceived stress and quality of life score could be established. Coping strategies seem generally more effective for mothers than fathers. In addition, the quality of life of parents of children with a craniosynostosis does not seem correlated with the severity of the disease.

3

Sequencing the Whole Genome; a revolution for craniofacial genetics?

Presenter: Jacqueline AC Goos

Authors: Goos JAC¹, Swagemakers SMA²,
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Introduction: Craniofacial malformations can have a genetic cause. Until now, diagnostic testing on these genetic causes have been performed predominantly by testing single genes. The number of known causative genes, however, is growing rapidly, making single-gene testing more complex and more costly. Currently, techniques are developed that can test all genes in parallel. Whole Genome Sequencing (WGS; Complete Genomics, a BGI company, Mountain View, CA, USA) is one of those techniques; sequencing the complete human genome in one test. We have studied the merit of this technique for identifying genetic causes of craniofacial malformations in a pilot-study of a Dutch cohort.

Methods: DNA samples were collected of thirteen families and of eight individuals with craniofacial malformations and negative single-gene tests. Whole Genome sequencing was performed according to the protocol of Complete Genomics. The data were checked for mutations in known craniofacial genes first. If mutations were not found, further analysis was performed to identify new genetic causes. This analysis included filtering based on the expected inheritance pattern, coverage, and characteristics of the mutations and of the affected genes.

Results: In total, fifty-two samples were whole-genome sequenced. In twenty-four samples a mutation was identified. Mutations were identified in known craniofacial genes in six families (3 *TCF12*, 2 *IL11RA*, 1 *MSX2*) and one individual sample (*IDS*). In two families, new craniofacial genes were identified (*TXNL4A* and *ZIC1*).

Conclusion: By WGS of a Dutch cohort, causative mutations were identified in eight out of thirteen families and one out of eight individual samples. Previously, mutations were not found by standard single-gene testing in these samples, showing the power of sequencing the whole genome. Hence, WGS is a revolutionary development that can facilitate craniofacial genetics.

4

Population-based Prevalence for craniosynostosis in Finland 1993-2010

Presenter: Pia M. B. Vuola

Authors: Vuola PMB^{1,2}, Ritvanen A², Hukki JJ¹

¹Craniofacial Centre, Department of Plastic Surgery, Helsinki University Hospital, Finland, ²Finnish Register of Congenital Malformations, The Institute for Health and Welfare, Finland

Background: Isolated single suture craniosynostosis is a common cranial malformation estimated to occur in 4-5/10 000 births. Syndromic synostoses are rare, with the prevalence for Crouzon's and Apert's syndromes estimated to be 1.5/100 000 births. Population-based epidemiological studies are few. The aim of this study was to estimate the total and birth prevalence for single suture craniosynostosis and syndromic craniosynostosis in Finland 1993-2010.

Methods: Births and selective terminations of pregnancy with craniosynostosis between 1993-2010 were collected from the nation-wide registers maintained by the National Institute for Health and Welfare: the Register of Congenital Malformations, the Medical Birth Register, the Hospital Care Register (hospital discharges and outpatient registers of all hospitals in Finland) and from the Cause of Death Statistics, Statistics Finland. Cases from the patient and surgical registers of Helsinki University Hospital and Helsinki Regional Hospital were also included. The register data for all cases, including medical records and autopsy records in stillbirths and infant deaths, were reviewed by a craniofacial surgeon and a clinical geneticist to confirm and give an accurate diagnosis.

Results: The preliminary total prevalence for craniosynostosis was 6.1/10 000 births, for Crouzon syndrome: 1.7/100 000 and for Apert syndrome: 1.3/100 000. The most frequent error in the reporting of cases to the Register of Congenital Malformations was when clinicians registered the suspicion of craniosynostosis as a confirmed diagnosis but which later proved to be a normal variation of skull form.

Discussion: The data has been collected from several sources and covers almost twenty years and includes not only live births but also stillbirths and selective terminations of pregnancy. This population-based nationwide study reveals a higher prevalence for craniosynostosis than previously reported internationally. In the future, this unique confirmed data will be used to study the risk factors, inheritance, associated anomalies and syndromes, as well as treatment of craniosynostosis. It will also be used to study the impact of craniosynostosis on social coping.

5

The variation of minimally invasive approaches to sagittal craniosynostosis: a systematic review of the literature

Presenter: Liliana Camison
Authors: Camison L¹, Mai R², Naran S¹, Garland CB¹,
Grunwaldt LJ¹, Davit AJ¹, Losee JE¹,
Goldstein JA¹

¹University of Pittsburgh Medical Center, USA, ²Allegheny General Hospital, USA

Background: Scaphocephaly is the most common form of single suture craniosynostosis, and recent attention has focused on minimally invasive approaches for surgical correction. However, variations in these *minimally invasive* techniques are evident across centers, and have the potential to hinder clear reporting of surgical outcomes.

Methods: A systematic review was performed all English publications from 1950-2014 on all minimally invasive techniques for correction of sagittal craniosynostosis. Following database search, articles were selected based on predetermined inclusion and exclusion criteria. Detailed data on operative technique and postoperative management was extracted. Three reviewers analyzed each article, with final discrepancies resolved until a consensus was reached.

Results: 115 articles were identified; 19 met inclusion/exclusion criteria. These 19 papers were attributed to 15 groups per authorship and institution. Regarding technique, access to the cranium ranged from bicoronal (n=2) and “lazy S” incisions (n=1), to anterior and posterior scalp incisions (n=10). 4 groups (31%) employed a single strip osteotomy (ranging in width from 1-5 cm), while 6 groups (46%) described additional wedge osteotomies. 5 groups (38%) employed parietal barrel stave osteotomies as well (2-6 on each side). In terms of force, 15% used springs (n=3), while 75% (n=15) used a postoperative helmet. Despite this heterogeneity, 69% of articles (n=8) labeled their technique as “*endoscopic assisted*” craniectomy or suturectomy. Of these, > 50% used the endoscope only for brief visualization after blind dissection was performed. 15% (n=2) described their technique as “*minimally invasive*”; however, only one employed the endoscope.

Conclusion: This review reveals the significant variation in minimally invasive approaches for correction of sagittal craniosynostosis. Although surgical techniques differ considerably in every aspect, the label of the procedure is largely unchanged in the literature. This discrepancy presents challenges for reporting and interpreting outcomes research on this topic. We recommend a standard nomenclature system in order to streamline outcomes reporting for this technique.

6

Craniosynostosis Associated with Prenatal Methotrexate Exposure

Presenter: Gary F. Rogers
Authors: Rogers GF, Zarella CS, Oluigbo CN,
Magge SN, Myseros JS, Keating RF, Wood BC,
Oh AK

CNMC Plastic Surgery, USA

Background: Methotrexate (MTX) is a folic acid antagonist that is a known teratogen and is used as an abortifacient. Newborns affected with MTX embryopathy demonstrate intrauterine growth retardation, and cardiac, craniofacial, and skeletal abnormalities. Four cases of MTX-associated, or MTX analog-associated craniosynostosis (CS) have been reported in the literature since 1956. We report an additional four patients with MTX-associated CS.

Methods: A retrospective, IRB approved chart review was performed. Characteristics of each patient were recorded as was pertinent medical and prenatal history.

Results: All patients were exposed to MTX early in the first trimester (<9 weeks gestation) to induce abortion. In two instances, the mother did not finish the course of medication. All patients were born in the third trimester (33-40 weeks). Two patients had unilateral coronal synostosis, one had fusion of both coronal and the sagittal suture, and one had bilateral lambdoid and sagittal synostosis. All patients had upper limb anomalies, varying from mild to severe, including: clinodactyly of the small digits (n=3), absent distal phalanges of the index finger (n=2), thumb hypoplasia (n=1), radial hypoplasia (n=1), and humeral hypoplasia (n=1). Lower extremity anomalies included shortened femur, club foot, and oligodactyly, (two patients having a single-toed foot bilaterally).

Discussion: MTX toxicity is associated with multiple developmental anomalies, including craniosynostosis. This is the largest series of MTX-associated CS in the literature.

7

Reduction Cranioplasty Aided by CAD/CAM Achieves Normal Morphology in Hydrocephalic Macrocephaly

Presenter: Tuan Truong

Authors: Truong T¹, Myers R², Kelley P², Harshbarger R²

¹*Craniofacial & Pediatric Plastic Surgery, Dell Children's Medical Center, University Medical Center Brackenridge, Austin, USA*, ²*Dell Children's Hospital, USA*

Background: Hydrocephalus, the most common cause of macrocephaly, is usually treated with VP shunting. Despite shunting, changes to the overlying cranial bones cause calvarial expansion and distortion. Reduction cranioplasty can be performed to approach proper cranial size, shape, and cephalocranial proportion, with optimal results being difficult to achieve. Virtual surgical planning and creation of intraoperative templates allows for systematic control of both volume and morphology.

Methods: Two patients presented with severe hydrocephalic macrocephaly (HM). Both had undergone VP shunting to control ventriculomegaly as an infant. We performed 3D CT scans and utilized virtual surgical planning to obtain a post-operative cranial size/shape using age-based anatomical norms. Cutting guides and intraoperative templates were generated. Reduction cranioplasty was performed using VSP guides and brain monitoring with open VP shunt.

Results: Both patients recovered well after surgery. One patient had a small seroma of the scalp related to drain removal that was aspirated. Both had stable reconstruction and excellent post-operative cranial morphology. Through use of cutting guides and templating, intraoperative guesswork was minimized, reducing surgical time, and increasing accuracy.

Conclusions: Reduction cranioplasty can be performed on patients with HM. While the concept is straightforward, achieving proper cranial morphology while respecting brain volume can be difficult. Traditionally, this procedure was performed with little advanced planning. Use of VSP allows for optimization of osteotomy design while translating this plan to the final result through cutting guides and reconfiguration templates. A final cranial size and shape can be predicted to a normative cohort, allowing for precision and reliability when actuating this plan. To our knowledge, this is the first documented use of VSP and cutting/plating templates for reduction cranioplasty in HM.

8

Scaphocephaly Part III: Cranial Perimeter and Secondary Coronal Synostosis

Presenter: Joseph Michienzi

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Purpose: Scaphocephaly and secondary coronal synostosis (SCS) were retrospectively analyzed. 10% of secondary coronal synostosis after craniectomies not involving the removal of the coronal suture. 1% requiring surgical decompression due to increased intracranial pressure. In a retrospective review, a decreased cranial perimeter in scaphocephaly was correlated with increased intracranial pressure and approximately 1% required surgical decompression.

Method: Observation of SCS, and clinical signs of raised intracranial pressure in scaphocephaly. Division into 4 surgical groups. Group 1: 'H' craniectomy[193]; Group 2: craniectomies with removal of the coronal suture [24]; Group 3: 'H' craniectomies without removal of the coronal suture [36]; and Group 4: nonsurgical [253]. Group I, 20 patients or 10.4% where found to have SCS, group II and III, 6 patients or 10% were found to have SCS.

All SCS cases after craniectomy for scaphocephaly were evaluated for circumferential perimeter.

Results: In group I, 4 had a decrease in PC (circumferential head perimeter), 2 of the 193 had a decrease in PC and had increased ICP which required surgical decompression. 1.04% had a decrease in PC and also required surgical decompression for increased ICP.

In groups II and III, 1 had a decrease in PC only, and another 1 had a decrease in PC and required surgical decompression for increased ICP. 1 of the 60 or 1.6% required surgical decompression.

Conclusion: In scaphocephaly, 10% develop SCS after craniectomy. In group I, 1.04% and groups II and III, 1.6% required surgical decompression related to increased ICP and decreased PC. Thus approximately 1% of scaphocephalic patients with SCS, had increased ICP that needed surgical decompression and decreased PC. In Conclusion long term follow up is needed in scaphocephaly to observe for possible secondary coronal synostosis, and vigilance for decreased PC which may be associated with increased intracranial pressure and possible surgical decompression.

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Extensive cranioplasty for sagittal synostosis by preserving cranial bone flaps adhered to the dura mater

Presenter: Yunhe Lu

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This study aimed to evaluate extensive cranioplasty involving the frontal, parietal, occipital, and temporal bones without removing the floating bone flaps in the treatment of sagittal synostosis. Sixty-three children with sagittal synostosis, aged 5 months to 3 years, were included in the study. The frontal bone flap was removed using an air drill. The occipital and bilateral temporal bone flaps were cut open but not detached from the dura mater or fixed to produce floating bone flaps. The skull bone was cut into palisade-like structures. Brain compression from both sides and the base of the skull was released and the brain expanded bilaterally through the enlarged space. Only a long strip-shaped bone bridge remained in the central parietal bone. Subsequently, the frontal bone flaps and occipital bone flap were pushed towards the midline and fixed with the parietal bone bridge to shorten the anteroposterior diameter of the cranial cavity and allow the brain to expand bilaterally to correct scaphocephaly. Patients were followed up 1-5 years. Skull growth was excellent in all patients, the anteroposterior diameter was shortened, the transverse diameter was increased, the prominent forehead was corrected, and scaphocephaly improved significantly. There were no complications such as death and skull necrosis. Surgery without removing bone flaps is less traumatic and results in no massive bleeding. It can effectively relieve brain compression and promotes transversal expansion of the brain during surgery and subsequent normal brain development. The skull of young children is relatively thin and early surgery can easily achieve satisfactory bone reshaping. Our surgical technique is not only safe and effective, but also can avoid subsequent psychological disorders caused by skull deformity.

Key Words: craniostenosis, surgery, young children

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Spring-assisted surgery in the treatment of sagittal synostosis: a systematic review

Presenter: Lars Kölby

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Background: Premature sagittal synostosis (SS) can be surgically corrected using extensive cranioplasties or using less invasive methods, e.g. spring-assisted surgery (SAS). The aim of the present study was to perform a proper systematic review of springs in the treatment of SS.

Method: A literature search was performed with the assistance of a professional librarian in the databases PubMed, EMBASE and The Cochrane Library between 1997 and September 2013. Studies that fulfilled the PICO (patients, interventions, controls, outcome) criteria were included. All studies were graded for methodological quality according to MINORS and all retrospective studies were assessed according to a scale developed for retrospective studies in pediatric surgery. The quality of evidence was rated according to GRADE.

Result: A total of 241 abstracts were extracted in the literature search. Five studies met the PICO criteria. Two of these five were considered as preliminary reports and excluded. Assessment according to MINORS showed a mean score of 21, i.e. fair quality. The clinical outcome regarding cephalic index did not differ between the surgical techniques but the quality of evidence, according to GRADE, that SAS was equally efficient, was very low. Clinical outcome regarding operation time, blood loss, ICU stay and hospital stay was in favor for SAS but the quality of evidence was low.

Conclusion: This systematic review has revealed that the level of evidence for SAS being an equally efficient surgical method as more extensive cranioplasties for SS is low or very low. The results point out the need for well-designed prospective studies within craniofacial surgery.

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Treating Muenke syndrome for intracranial hypertension

Presenter: Irene Mathijssen

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Background: Patients with Crouzon, Apert, and Saethre-Chotzen syndrome, are at risk to develop raised intracranial pressure (ICP). Despite early vault expansion, raised ICP may develop within the first 6 years of life, requiring a second vault expansion. Whether or not Muenke syndrome has a similar risk for raised ICP is unknown.

Method: Since 2007, a prospective study is ongoing with inclusion of all syndromic craniosynostosis. This involves CT and MRI at intake and at age 4, and at least annual recording of skull circumference, fundoscopy, and polysomnography, and formal psychological assessment.

Result: Eighteen patients with a P250R mutation in FGF3 were included. According to our protocol, all had a fronto-orbital advancement at a mean age of 9 months (range 7 to 13). Prior to this intervention, 2 patient had mild papilledema, which resolved after surgery.

During follow-up only one patient had (a recurrence of) papilledema, without clinical symptoms of raised ICP, a normal skull growth curve, no sleep apnea, and tonsillar herniation with normal sized ventricles on the MRI. An ICP measurement showed an initial mean ICP of 10 mmHg, 5 REM-sleep plateaus shortly above 20 mmHg, but a gradual increase of baseline ICP during the night up to 14 mmHg.

Of the remaining 17 patients, 1 had a deflecting skull growth curve, 6 had OSA (5 mild, 1 moderate; resolved with adenotonsillectomy). The MRI demonstrated ventriculomegaly in 11 and none had hydrocephalus, tonsillar herniation in 4 and Chiari I in 1. This last patient with Chiari also had the deflecting growth curve.

Conclusion and Discussion: Signs of raised ICP after a single frontoorbital advancement in Muenke syndrome occurred in 11%, which is remarkably low, compared to Apert and Crouzon syndrome. A single fronto-orbital expansion appears to be sufficient treatment for Muenke syndrome.

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National Trends in Inpatient Admission and Treatment of Patients with Craniosynostosis in the United States

Presenter: Joseph Shin

Authors: Shin J¹, Jacobson J¹, Familusi O², Persing JA³¹Montefiore Medical Center, USA, ²Albert Einstein College of Medicine, USA, ³Yale University, USA

Purpose: No study to date has evaluated the inpatient hospitalization and resource utilization of children with craniosynostosis. The purpose of this study is to investigate US national trends in hospitalization and surgical repair in these patients.

Methods: The Kid's Inpatient Database (KID), a federal database of inpatient hospital stays for patients younger than 21 years, from 1997 to 2009 was searched using ICD-9 code 756.0 to identify all inpatient stays with a diagnosis of craniosynostosis. Demographic information, length of stay (LOS), procedures (by ICD-9 procedure code), and hospital charges were extracted and analyzed.

Results: On average, 58.3% of patients were male. Craniosynostosis was most prevalent in Caucasians (59.7%), followed by Hispanics (20.9%) and African Americans (10.7%) ($p < 0.001$). 65.2% of repairs were performed within the first year of life with 52.9% of those before 6 months of age. Average LOS for operative repair decreased from 4.55 days in 1997 to 4.18 days in 2009 ($p = 0.015$). Average daily hospital charge increased from \$7778.72 in 1997 to \$19948.54 in 2009 (adjusted for inflation: Equivalent to 2013 dollar value) ($p < 0.001$). On average 33.4% of cases were Medicaid covered and 60% were covered by private insurance. The proportion of Medicaid patients has increased yearly ($p < 0.001$).

Conclusions: Consistent with prior epidemiologic data, craniosynostosis is most prevalent in Caucasians, males, and children born in Southern states. Majority of repairs occur within the first year of life, with an average LOS of 4.18 days, and a mean daily hospitalization cost of \$7778.72. Cost of care has risen dramatically over the past decade.

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Developmental outcome in metopic synostosis: syndromic is different from non-syndromic.

Presenter: Matthieu Vinchon
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Introduction: Metopic synostosis (MS) is common, and not infrequently associated with other malformative defects, chromosomal imbalance or a more hazily defined “syndromic context”. The prevalence of syndromic MS (SMS) is poorly documented, and the impact of this syndromic context on outcome has rarely been studied

Material and Methods: In order to document the impact of SMS on outcome, we reviewed retrospectively cases of MS referred to our institution during the last three decades, in order to identify associated conditions, the results of genetic investigations, and compare clinical outcome in syndromic versus non-syndromic MS (NSMS).

Results: Between 1986 and 2014, we followed 250 children with MS. A syndromic context was identified in 87 (35%). Genetic (12) and chromosomal disorders (4) were rare. Teratogenic agents, such as Valproate (7) and ethanol (3), were identified in 12. Familial cases were present in 8 cases. Other “syndromic markers”, including malformations of the heart, spine, brain, eye, face and extremities, were identified in 27. Moreover, obstetrical conditions, including diabetes mellitus (12), in-vitro fertilization (2) and multiple pregnancy (11) were identified in 26. Developmental outcome was impaired in 26% of SMS VS 2% of NSMS ($p < 0.001$), and schooling was normal in 54% of cases of SMS, VS 87% of NSMS ($p < 0.001$)

Conclusion: SMS are common, often caused by environmental stresses, and associated with a poorer developmental outcome. The presence of a syndromic context is an important confusion factor when studying the developmental impact of MS.

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Brain Growth Normalization After Surgery in Sagittal Craniosynostosis

Presenter: Eric D. Brooks
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Background: Nonsyndromic craniosynostosis (NSC) is associated with significant learning disability later in life. Surgical reconstruction is performed before 1 year of age to correct the cranial vault dysmorphology, and to allow for normalized brain growth, with the goal of improving cognitive function. Yet, no studies have assessed to what extent surgery in infancy leads to a final more normalized brain growth in later adolescence, and whether this primary endpoint is actually achieved. Recent advances in magnetic resonance imaging (MR) have allowed for automated methods of objectively assessing subtle and pronounced brain morphology differences. We aim to use one such technique, Deformation-based morphometry (DBM) Jacobian mapping, to determine how the brains of previously treated sagittal NSC (sNSC) adolescents differ significantly in anatomy compared to healthy matched controls.

Methods: 8 adolescent patients with sNSC, previously treated via whole vault cranioplasty at a mean age of 7 months, and 8 control subjects, underwent functional MR imaging (mean age both groups 12.3 years). Significant changes in tissue volume differences between the two groups were analyzed using DBM; a whole brain technique that estimates morphologic differences between two groups at each voxel ($p < 0.05$, $k \geq 150$).

Results: There were no significant areas of volume reduction or expansion in any brain area(s) in sNSC adolescents compared to controls ($p < 0.05$). Only at the non-significant threshold $p = 0.20$ did areas of localized brain expansion appear in sNSC compared to controls and this was localized to the posterior brainstem.

Conclusion: Morphometry analysis reveals previously treated sNSC children achieve complete, or near-complete, brain shape normalization by adolescence, when comprehensive cranioplasty is performed at an early age. It appears this primary goal of surgery is achieved. Larger samples correlating degree of normalization with cognitive performance in NSC is warranted.

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Speech and Language Delays in Patients with Non-Syndromic Craniosynostosis

Presenter: Sanjay Naran

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Children with non-syndromic craniosynostosis (NSCS) are considered to be at high risk of adverse neurodevelopmental outcomes. While many metrics for such neurodevelopmental delays have been analyzed, few have directly examined early language acquisition and speech development. Our purpose was to determine whether infants with NSCS have normal language acquisition and speech development.

Our institutional database was queried for patients with a diagnosis of NSCS from 2000-2014. Patients with a syndrome, or diagnosis of a sub-mucous cleft palate, were excluded. Specific data elements included; age, gender, Pittsburgh Weighted Speech Score (PWSS), evaluation for anatomic motor delay, language/speech delay, articulation/phoneme deficiency, hypernasality, velopharyngeal insufficiency (VPI) or borderline competency, and whether speech therapy was recommended. All patients were evaluated by a certified speech and language pathologist.

65 patients met our inclusion criteria, 58.5% of which were male. Average age at time of most recent speech evaluation was 6.24 years (Range: 2.31-17.95). The majority of patients (53.85%) had normal speech/language metrics. The remainder (43.85%) had one or more abnormalities, including anatomic motor delay (1.54%), speech/language delay (24.62%), articulation/phoneme deficiency (10.77%), hypernasality (3.08%), and VPI or borderline competency (15.38%). In all, 27.69% (n=18) of patients were recommended to have speech therapy. Of those, the average PWSS was 2.7 (Range 0-5). Two patients were documented to have global cognitive delay.

Many neurodevelopmental studies indicate that children with NSCS are at increased risk for difficulties in cognitive, language, and motor domains during infancy and childhood. Looking at 7 objective speech metrics, we found that defective speech and language development occurred in 1 in 4 patients with NSCS; a prevalence 2-3 times higher compared to the general population.

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Pre & Postoperative Developmental Attainment in Patients with Craniosynostosis 5 & 10 Year Follow-up

Presenter: Maggie Bellew

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Background: There is controversy in the literature regarding risk of developmental delay in simple craniosynostosis and whether surgery has an impact. We present 2 studies which aim to clarify this.

Study 1 (Bellew et al, 2011):

Method: 32 children with Sagittal Synostosis (SS) underwent surgery (mean age: 8.5m). Their development was assessed pre-op, 7 months post-op and at 5 years of age. A control group of 23 children with SS had developmental assessment on 2 or more occasions, without surgery.

Results: Prior to surgery, children with SS had poorer Gross Locomotor function than other areas of development, but following surgery the deficit resolved. This was further improved upon by 5 years of age. The same was true for overall GQ. Lesser improvements were shown for other skill areas. The control group did not show any improvement in development, and in fact a deterioration in fine Locomotor control was identified.

Conclusions: Surgery offers more than a cosmetic improvement.

Study 2:

Method: 91 children with synostosis attended their 10 years of age IQ assessment.

Results: The mean FSIQ score for all types of synostosis combined fell within the Average range. There was some variation across the different types of synostosis: the SS group showed the highest FSIQ and a normal distribution of bandings; the other types had a higher proportion of FSIQs in the lower bandings. There was a discrepancy of VIQ>PIQ: a difference of 5.0 for all types of synostosis combined (p=0.001), of 7.6 for the SS group (p=0.001) and of 6.9 for the unicoronal group (p=0.029). The VIQ>PIQ effect was not found with multi-suture synostosis. The VIQ>PIQ effect occurred regardless of surgery but occurred more in males than females. In the SS and bicoronal groups, there was evidence that FSIQ and PIQ (though not VIQ) are higher when surgery is performed early.

Conclusions: Children with synostosis have normal IQ, but data is indicative of more subtle difficulties in achievement.

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Does cranioplasty improve neurocognition in patients with sagittal synostosis?

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Background: Isolated sagittal synostosis (SS) is associated with neurological deficits in areas of learning, language development, and behavior. Surgery is performed to relieve restrictive forces on the underlying brain. This is thought to attenuate the neural deficit in SS, however the degree to which it may do so is unknown. Language processing in infants, as revealed by event related potentials (ERPs), can objectively predict language function and risk of learning disability at school age. This longitudinal study compares infant language processing in SS before and 6 months after surgery to evaluate the role of surgery in correcting neurological disabilities.

Methods: This prospective cohort study includes 6 infants with SS and 14 controls. SS patients received the first ERP assessment before surgery (mean age 6.4 months), and a follow-up assessment 6 months after surgery (mean age 12.1 months). All controls similarly underwent two assessments. ERPs to verbal phonemes were recorded in the frontal and temporal-parietal scalp regions. P150 and N450 components of auditory processing were analyzed.

Results: Untreated SS patients had a trend toward attenuated N450 components in the left temporal-parietal region compared to controls (p=0.06). Pre-surgery patients also had exaggerated P150 components compared to controls with trending toward significance (p=0.06) in this region. No difference was found between the two groups after treatment in this region of the brain (p=0.47 and p=0.13 for N450 and P150, respectively). Auditory processing in the frontal region was not significantly different between SS and controls before or after surgery.

Conclusion: Infants with untreated SS are trending towards abnormal language processing relative to control subjects. However, SS patients may have more normalized cortical processing as early as 6 months following surgery.

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Patient Reported Outcome Measure (PROM) for evaluation of sagittal synostosis surgery

Presenter: Marie-Lise C. Van Veelen
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Background: Good outcome measures for sagittal synostosis surgery are lacking. Cosmetic results are difficult to objectify, while cephalic indices seem insufficiently representative. Patient Related Outcome Measurements (PROMs) reflect the patient's own satisfaction regarding the outcome and may be the most valuable type of outcome parameter. This study evaluated a PROM specifically designed for sagittal synostosis surgery.

Method: The questionnaire consists of 9 questions on cosmetic and functional issues. Answers are rated along a five point Likert scale. 145 questionnaires were sent out to patients aged six and older who were operated for sagittal synostosis. This study evaluated the PROM by looking at the effect of age (at completion of the questionnaire) and type of surgery, and the correlation with the more objective parameter cranial index (CI), with spearman correlation coefficients and chi-square tests.

Result: 94 questionnaires were returned (75 males, 19 females, mean age 11,6±4,1 years). Patients underwent an extended strip craniotomy (n=50, 53%) at a mean age of 4,5±2,0 months or a complete remodelling (n=44, 47%) at a mean age of 11,9±6,1 months.

Most respondents (84%) considered the shape of their head as being similar or slightly different from others, 95% never or very rarely received remarks about the shape of their head. Headache was reported by a remarkably large proportion of patients, 79%.

The PROM was not significantly correlated to age, except the question on scars, which were considered more noticeable in older children (p=0.012). The PROM showed a trend but was not significantly correlated to CI. Dissatisfaction was more likely to consider the forehead after complete remodelling (11% vs. 2%, p=0.064) and the occiput after extended strip craniotomy (28% vs. 2%, p=0.001). Headache was more prevalent after strip craniotomy (88% vs. 68%, p=0.014).

Conclusion: This first evaluation of the PROM shows that the majority of patients is satisfied with the outcome of their intervention. The PROM is mostly robust to the age of completion, has additional value as it is independent of cranial index, and shows to discriminate between different techniques. The PROM is a valuable outcome parameter for evaluating sagittal synostosis surgery and may influence technique or extent of remodelling.

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Speech and Language Difficulties in Children with A Metopic Ridge

Presenter: Stephen Dover

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Purpose: An audit carried out at Birmingham Children's Hospital in 2007 suggested that there is an increased risk of speech and language difficulties in children with metopic craniosynostosis, with 48% of the cohort presenting with difficulties. The aim of this study is to determine whether this risk can also be ascribed to children presenting with a metopic ridge.

Methodology: A retrospective audit was carried out using the Speech and Language Therapy notes of 62 children presenting with a metopic ridge, in the absence of trigonocephaly and hypotelorism. All of these children had undergone at least one assessment of their speech and language skills between the ages of 18 months and 7 years. The notes were examined to determine the number of children who had speech and language difficulties that warranted on-going support from community Speech and Language Therapy Services.

Results: The current results showed that around 37% of the cohort had a speech, language or communication deficit requiring intervention.

Conclusions: The results indicate that children with metopic ridge are at an increased risk of speech and language difficulties compared to the general (UK) population (6%), but at a lesser risk than those with metopic craniosynostosis. This also highlights that, in order to ensure that timely intervention is provided, regular definitive assessment of these children by a Speech and Language Therapist is essential.

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Comparison of Euryon Location in Patients with Sagittal Craniosynostosis to Normal Population

Presenter: Kamlesh Patel

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Purpose: Preoperative severity and postoperative success in cranial remodeling for patients with sagittal craniosynostosis is measured by cephalic index (CI). While this metric offers some understanding of overall width of the calvarium relative to its length, it does little to describe the appropriateness of euryon location relative to the rest of the cranium, a crucial consideration for aesthetic outcome. In this study we describe the location of euryon in both anteroposterior and cephalocaudal dimensions in normal infants and in patients with sagittal craniosynostosis before and after surgical correction. We then compare traditional CI to CI measured in the normal euryon location in patients with sagittal craniosynostosis.

Methods: Pre and one-year postoperative computed tomography scans of children with sagittal craniosynostosis, treated at 6 months of age or younger by either open calvarial reconstruction (Open Group, n=10) or endoscopic-assisted craniectomy and custom molding helmet therapy (Endoscopic Group, n=10) were reviewed. The average location of euryon in age and gender matched controls as a fraction of both the glabella-opisthocranium (Horizontal Point of Maximum Width, H-PMW) and nasion-vertex (Vertical Point of Maximum Width, V-PMW) distances was determined. The CI at this ideal euryon location (normative CI) as well as traditional CI was determined in all pre and postoperative patients.

Results: The mean H-PMW and V-PMW of preoperative-aged controls were both significantly different from preoperative patients with sagittal craniosynostosis (Controls: H-PMW 56%, VPMW 56%; Open: 51% and 36%; Endoscopic: 51% and 41%; $p \leq 0.008$ from controls for both metrics). These lower values reflect a more antero-caudal location of the euryon than in unaffected controls.

Preoperatively, normative CI was less than CI in both Open (60% vs. 66%) and Endoscopic Groups (63% vs. 68%, $p \leq 0.001$) and remained smaller than measured CI postoperatively for both Open (68% vs. 73%, $p < 0.001$) and Endoscopic Groups (71% vs. 76%, both $p < 0.001$).

Conclusions: Antero-caudal displacement of euryon over the temporal bone in patients with sagittal synostosis influences cephalic index. Normative CI, assessed at ideal euryon location, is a more accurate measure of preoperative severity and postoperative outcome.

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Long-term neuropsychological outcomes of children with sagittal synostosis

Presenter: Annette C. Da Costa
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Background: Children with isolated craniosynostosis display a higher incidence of neurocognitive deficits and learning difficulties than their non-afflicted peers. This study examined the long-term cognitive and behavioural outcomes of children with sagittal craniosynostosis.

Methods: The study cohort formed part of a consecutive patient series who underwent sagittal synostosis repair (total vault remodeling) between 2004 and 2008. The final sample comprised 30 children, aged 6 to 11 years at the time of testing. Children were assessed on a comprehensive, age-standardised neuropsychological test battery. The main outcome measures included intelligence, attention and executive cognitive function, and behaviour.

Results: As a group, the mean intellectual skills of this sample fell significantly below general population averages ($p=.001$), although placed within the normal range overall ($M=88.2$, $SD=17.3$). These children displayed deficits in attention and executive cognitive skills. Hyperactivity was also a commonly ascribed problem in this group.

Conclusions: These findings suggest an increased risk of cognitive and behavioural difficulties in children with sagittal synostosis. Findings support the need for long-term developmental monitoring of these children as part of standard clinical care.

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Improvement of Canthal Slant in Aperts undergoing Le Fort 3 with Bipartition and External distraction.

Presenter: Vaneshri Chetty
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Patients and Methods: Fifteen Apert syndrome patients were operated on to correct midface deficiency associated with sleep apnoea. They were operated on by the Necker-Enfant Malades craniofacial group, between the dates January 2009 and April 2014. Thirteen of these children had undergone an initial Fronto-Orbital advancement procedure in infancy, and the other two had undergone a posterior decompression first.

The sex ratio: 10 males and 5 females.

The mean age at surgery: 9.96 years.

The surgical procedure standardized, by the same surgeon (EA): Le Fort 3, with bipartition and external distraction by RED in children presenting with Midface retrusion, and obstructive sleep apnoea. Analysis was performed on the outcomes of canthal position and inner:outer canthal ratios. Results were compared to similar pre-operative photos. Data analysis: standard Student t-test

Study 1: Obliquity of the Apert's orbital canthal slant analysed. The inner, and outer, canthal angle was measured to the horizontal.

Study 2: The ratio of the inner:outer canthus was also measured pre and post operatively

Results: The mean pre operative inner canthal angle before was, right =10.598 and left=12.632. Respective post operative angles were, right =7.21 and left=8.672

1) Paired *t* test results: Medial canthus
 The two-tailed P value equals 0.0021
 this difference: statistically significant.

Data:

Group

Group One

Group Two

Mean 10.5980 6.9529 SD 2.7283 3.0559 SEM 0.7045 0.8167 N 15 14

2) *t* test results: Lateral Canthus

P value and statistical significance:

The two-tailed P value equals 0.0110
 This difference: statistically significant.

Review Data:

Group

Group One

Group Two

Mean 12.3687 8.2564 SD 3.9527 3.9351 SEM 1.0206 1.0517 N 15 14

3) Paired *t* test results Ratio, Inner Canthus versus Outer

P value and statistical significance:

The two-tailed P value equals 0.8012
 This difference: not statistically significant.

Discussion: There was an improvement of canthal slant postoperatively in Aperts after Lefort3 with bipartition. The relative improvement of the teleorbitism was not significant. A secondary combined lateral canthopexy associated with a medial canthopexy was necessary after one year to fulfill the complete improvement.

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HYDROCEPHALUS IN CRANIOSYNOSTOSIS— TREATING THE CAUSE AND NOT THE SEQUELAE

Presenter: Jagajeevan Jagadeesan

Authors: Jagadeesan J, Noons P, Sharp M, White N,
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Introduction: Hydrocephalus with craniosynostosis is well recognised, especially in syndromic multisuture craniosynostosis. The aetiology is multifactorial. While diversion procedures are reliable in treating non-synostotic hydrocephalus, they are less so in craniosynostosis is variable and can be damaging. We present our experience in the management of hydrocephalus in the presence of craniosynostosis.

Materials and Methods: Of the 1169 craniosynostosis patients treated in our unit over the last 12 years, 169 (14%) had syndromic craniosynostosis; 21 of these had hydrocephalus (N=21). We divided them into two groups, and compared their outcomes.

Group A - patients who underwent a Cerebro Spinal Fluid (CSF) diversion procedure ie a shunt or endoscopic third ventriculostomy (ETV) prior to calvarial expansion procedures (N=8).

Group B - patients who underwent calvarial expansion procedures with or without subsequent CSF diversion (N=13).

Results: Group A were associated with increased complications compared to Group B (87% vs 8%). These complications were a consequence of CSF diversion procedure and resulted in a delay in definitive treatment or required multiple calvarial remodeling interventions.

Conclusion: Hydrocephalus in craniosynostosis is a different entity to non-synostotic hydrocephalus. Primary treatment should address the craniosynostosis with calvarial expansion surgery. The intracranial CSF maintains brain drive and promotes expansion of the released calvarium. Further monitoring should be undertaken to evaluate the need for further calvarial surgery or a CSF diversion. This may avoid the need for any CSF diversion procedure and their associated side effects.

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Lumbar puncture pressure vs. intracranial bolt pressure: which is more reliable?

Presenter: Gregory w. Hornig

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Lumbar puncture (LP) has traditionally been used to measure intracranial pressure (ICP). In this study of 12 pediatric patients, six had a history of craniosynostosis with previous calvarial vault remodeling, one had pseudotumor cerebri, five had hydrocephalus. Surgery was anticipated in all twelve. Tissue expanders were placed in two children with craniosynostosis. All the children with craniosynostosis had abnormally elevated cerebrospinal fluid (CSF) pressures greater than 25 cm water.

Intracranial pressure monitoring for at least 24 hours was done in the 12 patients, with a mean ICP recorded overall, capturing parenchymal pressures every minute.

The cumulative LP pressures were significantly higher than the fiberoptic (Camino) ICP pressures. The mean LP pressure was 22.4 mm Hg vs. a mean bolt pressure of 7.8 mm Hg. (P <.0001) Lumbar pressures were done in a lateral decubitus position with either sedation or general anesthesia.

Lumbar pressures were thought to reflect transient CSF elevations due to the traumatic nature of the intervention and/or sedation.

The intracranial pressure milieu was considered to be best evaluated with intracranial monitoring of at least 24 hours. No problems resulted from bolt placement. No surgeries occurred in the 12 patients. Two had tissue expanders removed.

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A Morphable Profile Model of the Human Head as an Outcome Tool for Craniosynostosis Surgery

Presenter: Christian Duncan

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Introduction: Outcome analysis in craniosynostosis surgery is difficult and often relies on limited anthropometric measurement, qualitative analysis of photography or patient reported outcome. Quantifiable morphable models of the human face have been described but, to date, a similar model of the head has not been available because of specific challenges in constructing such a tool. We present a morphable profile model of the human head, which includes an average, and demonstrate proposals for its use in outcomes analysis following craniosynostosis surgery.

Method: The 'Headspace Project' was a public partnership data gathering exercise which deployed a 5pod 3dMD camera system to a permanent site in Liverpool between September 2013 and January 2014. Specific photographic protocols were adhered to and consent was obtained from public volunteers so that their images could be compiled into a searchable database. Appropriate 3D images were imported into Matlab, automatically aligned, and compiled to produce a cross-sectional model of head shape, comprising of a mean profile and the profile's modes of variation. The extracted profile's of craniosynostosis patients were then compared with this model.

Results: Images of 1523 individuals were collected, consisting of 752 males, 770 females and 1 transgender. Age ranges were categorised according to 10 year brackets with 111 below 10 years, 196 10-20 year olds, and the remainder above the age of 20. Details of facial or head trauma or surgery were collected. A preliminary profile model was constructed from a demographically matched subset and this was used to develop preliminary postoperative outcomes in scaphocephaly patients.

Conclusion: There were logistic and technical challenges which will be discussed, but we developed a morphable profile model of the head. Aesthetic outcomes derived by comparison of pre-operative and post-operative 3dMD photos of scaphocephaly patients with the defined norm can be produced.

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Raised Intracranial Pressure (in Synostosis & Non-Synostosis) and Correlation with Papilloedema

Presenter: Joseph Abbott

Authors: Abbott J, Weli I, Rodrigues D, Sharp M, White N, Evans M, Nishikawa H, Dover S, Shafi F

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Aims: Patients with craniosynostosis are at risk of developing raised intracranial pressure (ICP). Papilloedema can be graded using the Frisén scale. The aim of this study was to determine whether there is a direct correlation between degree of raised ICP and degree of papilloedema in cases undergoing ICP monitoring by the craniofacial team at Birmingham Children's Hospital

Methods: Retrospective review of all patients undergoing intraparenchymal ICP monitoring under the care of Birmingham Children's Hospital Craniofacial Unit between April 2009 and June 2013. Diagnosis, date of surgery, highest recorded ICP and degree of papilloedema (determined by ophthalmologist) if present, was recorded.

Results: Intraparenchymal ICP monitoring was performed in 38 children following a standard unit protocol. 20 cases had an underlying diagnosis of synostosis and the remaining 18 were non-synostosis patients. ICP was stratified into normal (<10 mmHg), high (10-15 mmHg) and very high (>15mmHg). Raised ICP was found in 77.8% of all patients with no significant difference in incidence between the two groups (16/20 synostosis vs. 14/18 non-synostosis). Mean age at time of surgery was significantly lower in the synostosis group (5±3 years vs. 13±4 years). Papilloedema was detected in 15.8% of all patients (4/20 synostosis vs. 2/18 non-synostosis). There was no direct correlation between degree of raised ICP and presence of papilloedema in either group. The sensitivity for papilloedema in raised ICP was 14.3% and the specificity was 100%.

Discussion: Fundoscopy should be performed on all patients with suspected raised ICP to assess for the presence of papilloedema to i) detect those rare cases (in our practice) where papilloedema is severe enough to lead to visual compromise and ii) support or otherwise ICP readings though the sensitivity of papilloedema for raised ICP is not high. In our series, the degree of raised ICP did not appear to directly correlate with the presence of papilloedema.

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“GULL WINGING”—AN UNUSUAL COMPLICATION FOLLOWING POSTERIOR CALVARIAL DISTRACTION OSTEOGENESIS

Presenter: Hiroshi Nishikawa

Authors: Nishikawa H, Jagadeesan J, Noons P, Sharp M, Rodrigues D, White N, Evans M, Dover S

Introduction: Calvarial vault expansion using distraction osteogenesis is a safe and effective method of increasing intracranial volume in patients with craniosynostosis. The commonly documented complications include distractor site wound problems, distractor loosening and asymmetrical expansion. We present an unusual complication of “gull winging” of the transport fragment, which reduces the expansion achieved. This is a process where the occipital fragment of the posterior distraction segment lags behind the bilateral temporal segment giving the appearance of a sea gull with its wings open.

Materials and Methods: A retrospective review of all patients who underwent posterior calvarial distraction (PCD) in our unit was carried out and the complications analysed.

Results: We identified four cases (4/48=8%) of the patients with gull winging of the posterior distraction fragment. All of these patients had bicoronal craniosynostosis. Their mean follow up was 48 months.

We believe the winging is because of the opposing forces acting through the posterior vault fragment—the two anterior to posterior vector forces along the temporo parietal bones caused by the distractors and the posterior to anterior forces on the occiput caused by the weight of the head when the patient lying on the occiput resulting in hinging of the fragments at the lambdoid suture or the wormian bones. This phenomenon is worse in patients with bicoronal synostosis because of the rigidity of the anterior skull. This results in failure to achieve the desired expansion. This complication was avoided by strengthening the sutures using plates as demonstrated in one of our cases.

Conclusion: Gul winging should be anticipated in cases where there is diastasis of the lambdoid sutures, multiple wormion bones and bicoronal synostosis. It can be prevented by the simple maneuver of strengthening the sutures with plates.

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POSTERIOR CRANIAL VAULT DISTRACTION IN PATIENT WITH SYNDROMIC CRANIOSYNOSTOSIS.

Presenter: Leonid Satanin

Authors: Satanin L, Ivanov A, Roginsky V, Sakharov A, Evtcev A, Solonichenko V, Lemeneva N, Sorokin V

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Patients with complex syndromic craniosynostosis have a severe craniocerebral disproportion. The deformation of the skull is accompanied with hypoplasia of anterior and posterior parts of the skull. Fronto-orbital advancement (FOA) cannot achieve an adequate increase of the intracranial volume.

Material and Methods: In Moscow Burdenko Neurosurgery Institute from 2009 to 2014 45 patients have had posterior cranial vault expansion using distraction osteogenesis. The mean age was 19 months (6-96 months). Patients have Kleeblattschadel anomaly (6 cases), Pfeiffer (7), Apert (10), Saethre-Chotzen (5), Craniofrontonasal syndrome (2), and unspecified syndrome (15) were operated. Arnaud type distractors (KLS Martin) were used in 25 patients and internal distractors (Conmet, Russia) in 20 cases. In 19 cases 4 distractors were used, in 10 cases -3, and in 16 cases only 2 devices. The latency period was 5 days and distraction rate was 0,5 mm/day. The average advancement was 23,7 mm (range 17,4-30 mm). There was no complication during distraction. Satisfactory callus formation was found on postoperative CT. Distractors were removed after consolidation period (6 mths). After 6 months FOA were performed as a second stage of the treatment.

Results: Measures of volumetric changes of intracranial volume after posterior cranial vault expansion revealed significant increase of intracranial volume (mean+250 ml). That differs significantly from changes in intracranial volume after FOA (mean+175 ml). As a result of surgery there were changes in anterior part of skull morphology, with reduction of bulging in anterior fontanelle region, temporal protrusion. Comparison of the morphology of the cranial vault before and after surgery by geometric morphometrics was performed.

Conclusion: Expansion of the posterior cranial vault using distraction osteogenesis is effective method of treatment of complex syndromic deformities of the skull accompanied by hypoplasia of parietal-occipital region.

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Intra-operative dural tears impact in craniofacial procedures: analysis of 320 consecutive cases.

Presenter: Ajay Sinha

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Objective: to calculate the incidence of dural tears in craniofacial surgical procedures realised between 2010 and 2014 and to evaluate their impact in the post-operative course and medium-term follow-up.

Methods: We retrospectively review 305 patients operated on between 2010 and 2014 at Alder Hey Hospital. We analyse a surgical series consist 320 procedures: 50 (15.6%) in syndromic or with multi-suture craniosynostosis and 270 (84.4%) in non-syndromic single-suture craniosynostosis-NSSS; 16 were re-operations.

We assess the incidence of intraoperative dural tear considering the surgical operation notes: we reported all cases when a suture has been applied to repair a CSF leaking.

Results: Sixty-seven dural tears (20.9% of all procedures) have been reported: 23 in syndromic patients (34.3%) and 44 in NSSS cases (65.7%).

We observed 46 dural tears in FOAR surgery (68.7%), 12 in the subtotal vault remodelling (17.9%), 4 in the posterior vault remodelling (6%), 3 in total vault procedures (4.4%) and 2 in the strip craniectomy (3%).

A dural tear has been reported in 7 out of 16 re-operations (43.7%).

In 55 patients (82% of all dural tears), no post-operative or long-term consequences have been detected.

In only 13 cases (4.1% of all procedures), we noticed surgical complications related to dural tear: 3 intra-operative bleeding; 1 requiring duroplasty and a subsequent surgical wash out for wound infection; 1 CSF leakage requiring lumbar drainage; 1 supra-orbital pus collection; 1 orbital pseudo-meningocele; 1 opened frontal sinus; 5 wound infection requiring surgical debridement (one with bone exposure and one with deep tissue infection).

Only 2 patients are on anti-epileptic treatment at 3 years follow-up.

Discussion: Intra-operative dural tears are not so rare complications in craniofacial surgery (20% of procedures), but in only 4% of cases are responsible of real post-operative complications.

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Designing a protocol for Fronto-facial surgery—a service improvement priority

Presenter: Andrea R. White

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Introduction: Fronto-facial surgery has been shown to have a significant complication rate including infection +/- CSF leaks. The objective of this study was to determine the value of a formally standardized protocol in reducing the incidence of these complications.

Methodology: A review of our current practice and complications was undertaken in July 2014. Based on this, we designed a protocol for pre-op, intra-op and post-op phases of treatment. This addressed the key question of what should be done when, where and by whom, and provided a framework to improve conformity and compliance. Adherence to the protocol was assessed by a contemporaneously completed pro forma attached to the patient record.

Compliance with the protocol and the incidence of complications related to infection (+/- CSF leak) were over nine months (16 cases). Complications were compared with a control group of 18 patients prior to the introduction of the protocol

Results: Protocol compliance was 98%. Areas of non-compliance took place over weekend periods when postoperative documentation of the protocol was incomplete.

Prior to the protocol 4 consecutive cases suffered significant infections that resulted in re-admission, return to theatre and prolonged intravenous antibiotic therapy. This group of patients had no permanent sequelae. Post protocol there were 0 infections and one CSF leak.

Conclusion: No specific aetiology of the complications was identified. Evidence based changes in protocol, reducing variations in the treatment and improving compliance resulted in an improvement of quality of care. Through leadership and staff engagement the protocol has been a powerful stimulus on the MDT to deliver improved outcomes being delivered reliably to every patient, every time. Compliance with the protocol provides consistent presentation of data, and the basis for further development and audit.

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The evolution of posterior cranial vault distraction in Oxford

Presenter: David Johnson
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Introduction: Posterior distraction (PD) is rapidly emerging as an important technique to increase the intracranial volume and correct calvarial morphology in patients with severe brachycephaly or turribrachycephaly.

Methods: A retrospective review was performed of all 31 patients who underwent PD at the Oxford Craniofacial Unit between 2007 and 2012.

Results: Twenty three patients (74.2%) underwent PD as a primary procedure at a median age of 8 months. Eight patients (25.8%) had PD as a secondary transcranial procedure at a median age of 48 months. Full distraction to 20mm was achieved in 28 (90.3%) of patients. Of these, all but one demonstrated a significant improvement in morphology, with a resolution of the symptoms and signs of raised ICP in all proven to have it preoperatively. Unanticipated events occurred in 61.3% of patients with 19.4% undergoing one or more unplanned procedures. Wound infection (29.0%) and tissue necrosis (22.6%) were the commonest. CSF leaks were rarer (6.5%) but prevented full distraction. Nine patients (29.0%) had a consolidation period of less than 30 days without experiencing relapse. In 11 patients who had a later fronto-orbital advancement and remodelling, wound closure was tight, resulting in dehiscence in 3 (27.3%) of cases.

Conclusion: PD is an effective procedure in the management of severe brachycephaly or turribrachycephaly but has associated risks. Our protocol has evolved with experience to favour a reduced latency period and consolidation phase and the use of two distractor devices.

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PERIORBITAL CHANGES IN APERT PATIENTS FOLLOWING DIFFERENTIAL SEGMENTAL ADVANCEMENT

Presenter: Jevon Brown
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Differential segmental advancement (DSA) of the Apert skeleton normalizes axial and coronal facial ratios compared to Lefort 3 advancement alone. The technique involves simultaneous Lefort 2 distraction, zygomatic repositioning, and frontal alloplastic augmentation. This results in subjective favorable periorbital changes on frontal view that are not observed following traditional techniques. The purpose of this study was to objectively quantify the periorbital changes that occur following segmental advancement to better understand Apert dysmorphology and refine surgical correction.

Method: Eleven Apert patients who had undergone differential segmental advancement were included in the study. Quantitative analysis of periorbital changes was performed on 2D photographs, 3D surface scans, and CT scans using Osirix, Dolphin and Slicer software. Measurements were standardized to the skullbase for comparison and compared to normal controls.

Results: Average age at surgery was 9 yrs (range 7-14yrs). Surface quantitative analysis demonstrated leveling of the palpebral fissure, a decrease in interpupillary distance, increased superior supratarsal height with decreased brow ptosis, improved limbus/scleral ratio, and sagittal uprighting of the inferior lid. Intercanthal distance was static. Intraorbital changes included medicalization of the globes with inferior and anterior displacement of the lacrimal fossa, medial canthus and inferior oblique pulley. Compared to pre-operative measures these changes approached normal controls. Similar changes were not seen in a second control group of patients who underwent Lefort 3 surgery.

Conclusions: DSA surgery normalizes multiple periorbital measures in Apert patients to improve frontal view esthetics. These changes have not been observed in other subcranial approaches. Refinement of the technique should focus on decreasing intercanthal distance while maintaining the other favorable changes.

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A new tool to measure the aesthetic outcome of craniofacial surgery

Presenter: Allan JT Ponniah

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Introduction: A universally accepted aesthetic outcome measure in craniofacial surgery would allow the assessment of outcomes following different procedures and in different units. This is essential in facilitating the evolution of craniofacial surgery. An objective tool is preferable as it can be more consistent than subjective tools. Subjective measures are useful to calibrate and validate the final tool.

Method: 10 000 subjects unaffected by a craniofacial disorder underwent 3D photography with metadata collection. These data were analysed using a fully automated landmarking system and N-ICP to create very accurate dense correspondence between all the meshes. The meshes then underwent principal component analysis to create a mathematical model of normal variation in the form of a point distribution model. This allowed the creation of a tool where the degree to which a surgical correction has taken the face shape as a whole towards the unaffected population could be measured. Before and after 3D images of patients with Apert Syndrome, Crouzon syndrome, hemifacial microsomia and hypertelorism were analysed using this tool.

Results: The principal component analysis of the 10 000 meshes demonstrated that over 98% of this population could be described by 120 components. Bearing in mind the diversity within this population, it is likely that the number of components to describe any unaffected face that has ever existed or could ever exist would be of the same relatively low magnitude. Introducing pre and post op 3D photos of patients with facial deformity allowed the software to give a score of how far the surgery had taken then towards the unaffected population.

Conclusion: This paper has demonstrated a new tool for objective analysis of aesthetic outcomes following craniofacial surgery. It needs to be tested at different units around the world to see if it can become a universally accepted outcome measurement tool.

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Intracranial Volume Changes in Spring Assisted Posterior Vault Expansion Surgery

Presenter: William Breakey

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Objective: Children with multisuture craniosynostosis require cranial vault expansion to ameliorate the effects of raised intracranial pressure. Of the techniques described, it is thought that posterior vault expansion offers the greatest volume increase. Our unit moved from rigid posterior vault expansion to spring mediated expansion in 2008 and has since undertaken over 100 cases. The purpose of this study is to demonstrate the volumetric changes achieved in a series of 20 cases of posterior vault expansion using spring distraction and correlating this with their ophthalmological findings.

Methods: Pre and postoperative CT imaging was analysed using OsiriX Medical Image software. 20 cases with complete imaging were randomly selected. Diagnoses included nonsyndromic and syndromic craniosynostosis (Saethre-Chotzen, Muenke, Apert, Cruzons and Pfeiffer). Segmentation of the entire cranial vault was performed and volume calculated. Post operative volumes were compared to published normative data.

Preoperative and serial postoperative ophthalmological assessments were collated and used as a surrogate measure for procedural efficacy. Fundoscopy and Electrodiagnostic studies were employed.

Results: In all cases, indication for surgery was raised intracranial pressure. The mean preoperative intracranial volume was 1000.1cm³. The mean postoperative intracranial volume was 1273.7cm³. The mean change in volume was 272.8cm³. (27% increase) Mean age at insertion of springs was 574 days. Springs remained in situ for an average of 260 days.

All cases showed a resolution in their ophthalmological signs over a 3 month period post operatively.

Conclusion: Spring assisted posterior vault expansion significantly increases intracranial volume, resulting in improvement on ophthalmological assessment. It is the preferred method of calvarial volume expansion for raised intracranial pressure within our unit.

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ROTATION DISTRACTION FOR THE TREATMENT OF SEVERE OBSTRUCTIVE SLEEP APNEA IN SYNDROMIC CHILDREN

Presenter: Richard A. Hopper

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Background: Craniofacial Microsomia (CFM) and Treacher Collins Syndrome (TCS) have variable presentations, but severe forms can present with symmetric sub-cranial clockwise rotation hypoplasia deformity. Despite an acceptable occlusal relationship the abnormal centric relation compresses the posterior facial height and causes severe obstructive sleep apnea (OSA). Isolated mandible distraction has been unsuccessful in achieving stable advancement resulting in tracheostomy dependence. We propose subcranial facial rotation advancement as a more effective way to treat these patients.

Purpose: To evaluate the success of bilateral mandible distraction lengthening driven off simultaneous subcranial facial rotation advancement in treating severe OSA.

Method: Two children with CFM and one with TCS were included with AHI of 84 and 38 (TCS patient was tracheostomy dependent). Superimposition skullbase analysis was performed on CT scans pre- and post-treatment. OSA was measured using polysomnography. Patients were treated with simultaneous bilateral mandible distraction lengthening and subcranial facial advancement that was hinged at the nasion. MMF was maintained during activation, and an external halo based device and mandible distraction devices were used.

Results: The MM plane rotated 20, 12 and 25 degrees respectively, and SNA increased 10, 8 and 11 degrees. AHI decreased from 84 to 1 and 38 to 3, with resolution of the need for tracheostomy. The airway increase was multi-level and exceeded traditional mandible distraction by a factor of two to three.

Conclusions: Simultaneous clockwise rotation of the entire subcranial facial skeleton in primary dentition is possible. The differential advancement and the posterior lengthening of the maxilla and mandible had a dramatic effect on multi-level severe OSA and should be considered an option to isolated mandible lengthening in these severe cases.

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Crouzon syndrome+acanthosis nigricans: an important identifiable cause of craniosynostosis prior to derm changes

Presenter: Donna M. McDonald-McGinn

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Crouzon syndrome with acanthosis nigricans (CAN), a distinct entity from Crouzon syndrome is a rare disorder caused by a mutation (p.Ala391Glu) in FGFR3 that leads to constitutive activation of the tyrosine kinase receptor and is characterized by craniosynostosis and acanthosis nigricans, choanal stenosis, hydrocephalus with posterior fossa abnormalities, renal involvement, diffuse hypopigmentation, skin thickening, prominent scars, short stature, spinal stenosis, scoliosis, and cementomas/psammomas desmo-osteoblastomas of the jaw. Here we report two children with CAN confirmed by FGFR3 mutational analysis including one infant identified prior to the onset of dermatologic manifestations. Patient 1 is a now 4 year old male who presented in infancy with Crouzonoid features without evidence of craniosynostosis on 3D CT scan. At 5 months of age he developed hydrocephalus requiring a VP shunt. At 7 months he underwent posterior vault expansion, cranial distractors, and bilateral orbital advancement. At 2 years he was noted to have seizures, developmental delay and OSA requiring CPAP at night. At 4 years he developed pigmentary changes, thick scarring and prognathism leading to identification of an FGFR3 mutation and mandibular biopsy revealing a cemento-ossifying fibroma resulting in mandibular tumor resection. Patient 2, a 12 day old female with unicoronal craniosynostosis and choanal stenosis had mutational analysis as part of a craniosynostosis panel which identified a mutation in FGFR3 consistent with CAN prior to the onset of dermatologic findings. At 5 months she has a Chiari 1 malformation, ventriculomegaly, horizontal pendular nystagmus, is ventilator dependent and requires G-tube feedings. The experience with these patients highlights the importance of molecular diagnostic panels in identifying rare conditions, even prior to the emergence of hallmark features, in order to provide appropriate long term anticipatory care guidance for both families and providers.

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Comparison of Bipartition distraction with Le Fort II and zygomatic repositioning in Apert Syndrome

Presenter: David Dunaway

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Introduction: Midfacial retrusion, hypertelorism, counter-rotated orbits and a biconcave facial profile in axial and sagittal planes characterize Apert syndrome. Both Bipartition distraction and Le Fort II osteotomy with zygomatic repositioning partially correct these anomalies.

This study investigates the effectiveness of these techniques using conventional and geometric morphometric analysis.

Materials and Methods: Pre and postoperative 3D computed tomography scans of 13 patients with Apert syndrome (aged 12 to 21 years) were annotated with 98 landmarks. 13 age matched normal skulls acted as controls. 10 patients underwent bipartition distraction and 3 underwent Le Fort II osteotomies with zygomatic repositioning. Principal component analysis was used to describe deformity and changes occurring with surgery. Results were graphically displayed using colour difference maps. Point based measurements documented midfacial width, height and asymmetry.

Results: Midfacial hypoplasia and central biconcavity is corrected by both procedures.

Interorbital distance was reduced from a mean of 29 to 23mm by bipartition. No hypertelorism correction occurred with Le Fort II.

Neither procedure corrected asymmetry.

Apert skulls were wider in the zygomatic region than controls. Bipartition distraction partially corrected this, but no correction occurred in the Le Fort II group.

Mean midfacial height was 61.3 mm in controls and 60.3mm in preop Apert skulls. Midfacial height was reduced by bipartition and increased by Le Fort II osteotomy.

Conclusions: Bipartition and Le Fort II and zygomatic repositioning correct midfacial retrusion and exorbitism, seen in Apert syndrome.

Bipartition corrects hypertelorism and addresses midfacial width anomalies.

Le fort II with zygomatic repositioning is more effective at addressing midfacial height disproportion.

Neither procedure is ideal. The choice of procedure should be governed by a morphometric analysis of individual patterns of deformity.

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Anatomic study of the pathophysiology of carotid-cavernous sinus fistula associated with the Le Fort osteotomy

Presenter: Yuuki Uchida

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Purpose: Carotid-cavernous sinus fistula (CCF) is a very rare but severe complication after the Le Fort osteotomy; however, its pathophysiology is unknown. The purpose of this study was to elucidate the cause of CCF in the Le Fort osteotomy using fresh cadaver models.

Materials and Methods: Eleven fresh cadavers were used in this study. After craniotomy, the cerebellum were removed, sparing the cranial nerves and arteries of the cavernous sinus. A Le Fort III bipartition osteotomy was then performed. On the left side, both the lateral wall of the maxilla and the pterygomaxillary junction (PMJ) were divided completely, in addition to the conventional osteotomy line. On the right side, the lateral wall of the maxilla and the PMJ were kept intact. After the osteotomy, a tensiometer was fixed to the skull base. The tensiometer sensor was linked with the wall of the carotid artery at the cavernous sinus. A downfracture was then performed initially from the left side, followed by the right. Tensile force data of the carotid wall from both sides were recorded. In addition, pre-fracture and post-fracture computed tomography was performed in all cadavers.

Results: Normal pterygomaxillary dysjunction was observed in 9 of 11 cases of left-sided complete osteotomy. The remaining 2 cases displayed a low-level transverse fracture of the pterygoid process. In the 11 intact right-sided osteotomies, 2 skull base fractures were observed, and 8 high-level malfractures of the pterygoid process were identified. In all 11 cases, a higher arterial wall tensile load was observed on the right side compared to the left. In 2 of the cases with a skull base fracture, the tensile load was extremely high.

Conclusion: While performing downfracture of the Le Fort osteotomy, the wall of the carotid artery in the cavernous sinus experiences significant tensile load. If the Le Fort osteotomy is not adequately performed, the tensile load of the carotid arterial wall increases, particularly in cases of skull base malfracture. The penetrating part of carotid artery of the cavernous sinus is tightly fixed by the dural ring, whereas the carotid artery of the intracavernous portion is relatively loose. As such, the tensile load on the arterial wall during downfracture may collapse the fine arterioles of carotid artery in the intra-cavernous portion.

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A Randomized Controlled Trial of Oral vs. I.V. Non-narcotic Protocols Post Craniosynostosis Repairs

Presenter: Kanlaya Ditthakasem

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Purpose: Our center utilizes a non-narcotic postoperative regimen following craniosynostosis corrections; yet in spite of opioid avoidance, we noted some children experienced postoperative nausea and vomiting (PONV) shortly following the oral administration of either acetaminophen or ibuprofen. Based on these observations, we sought to evaluate whether or not the intravenous administration of these non-narcotics might lower the incidence of PONV.

Methods: 50 children undergoing craniosynostosis corrections were prospectively randomized to into one of two groups: a control group given only *oral* ibuprofen (10mg/kg) and acetaminophen (15mg/kg), or a treatment group given only *intravenous* ketorolac (0.5mg/kg) and acetaminophen (15mg/kg). All patients were assessed for postoperative nausea and vomiting by a blinded research nurse.

Results: 28 patients randomized to the *oral* control group, 22 to the *intravenous* treatment group. There were no statistically significant differences identified between groups with respect to: age, BMI, gender, prior history of severe postoperative nausea and vomiting, or procedure. With similar anesthesia times there was significantly more PONV episodes in the *oral* group (71% versus 41%). Using a multivariate logistic regression, controlling for age, BMI and procedure, the odds ratio for vomiting in the *oral* control versus *intravenous* experimental groups was 3.61 (95% CI 1.11-11.76; $p=0.033$), and for postoperative nausea was 14.0 (95% CI 1.40-71.69, $p=0.010$).

Conclusions: We found a significant reduction in PONV episodes for those children randomized to receive intravenous medications. In addition, treating postoperative children with intravenous medication has the theoretical benefit of insuring that the full dose is effectively delivered. Based on these findings, our current standard process is to preferentially manage all children following craniosynostosis corrections with intravenous non-narcotics.

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An Evidence-Based Algorithm for Managing Syndromic Craniosynostosis in the Era of Posterior Vault Distraction

Presenter: Jesse A. Taylor

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Background : Treatment approaches to syndromic craniosynostosis are variable and lack evidence. Early posterior vault distraction osteogenesis (PVDO) confers considerable cranial vault expansion and may also cause anterior vault morphologic changes that enable fronto-orbital advancement (FOA) to be delayed to a later age, with improved outcomes.

Methods: We compared treatment patterns and craniometric changes of children presenting with syndromic craniosynostosis before (2003-2008) and after (2009-2014) implementation of PVDO.

Results: 64 children with syndromic craniosynostosis presented during the study period. 40 met inclusion criteria with complete medical records and care continuity since birth: 22 prior to and 18 after implementation of PVDO. Patients with computed tomographic studies before and after PVDO demonstrate significant reduction in frontal bossing (FNS angle decreased 125.4 to 118.8, $p=0.005$.) Cranial volume increased after PVDO by a mean 21.5%, and by 28.4% in the subset of patients under 1 year of age, compared to 8.6% in patients undergoing FOA with or without posterior cranial vault remodeling ($p=0.041$). Only 10 (56%) of patients who underwent initial PVDO required frontal advancement, at a mean follow-up of 4.0 years of age (range 1.5-7.5 years,) compared to 22 (100%) prior to implementation of PVDO, at a mean initial age of 1.3 years. Kaplan-Meier survival analysis indicates significant delay in need for subsequent FOA in patients who underwent early PVDO compared to early FOA or monobloc ($p=0.011$).

Conclusions: Early PVDO confers improved frontal morphologic changes in children with syndromic craniosynostosis, and increased cranial volume expansion compared with those treated initially with FOA and/or posterior cranial vault remodeling. Consequently, these children are less likely to undergo FOA early in life. We have developed an evidence-based algorithm for syndromic synostosis based on these results that employs early PVDO.

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“A bandeau abandoned”, an alternative fronto-orbital remodelling technique: report of 328 cases

Presenter: Greg James

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Background: In 1982, Marchac & Renier described the standard operation for unicoronal and metopic synostosis, based around remodelling of the supra-orbital ridge (SOR) bandeau. In severe deformity, this technique can require multiple osteotomies, onlays and implants, increasing the complexity of the procedure.

Method: We describe a procedure in which, after the initial craniotomy, the SOR is discarded. From the posterior edge of the frontal bone block (“D” flap), areas with a favourable contour for a new SOR are selected. The block is divided in the midline, the halves turned through 180°, reverse-sided and trimmed as necessary to create the new SORs and forehead construct. The halves are connected and secured to the skull base with steel wire. Prolongations that connect to the upper lateral orbital walls and anterior temporal contouring are achieved by a combination of bone trimming and greenstick fracturing. The new frontal region can be divided into segments and reassembled armadillo-fashion as required using absorbable sutures to produce optimal contour.

We performed a retrospective review of fronto-orbital remodelling procedures using this technique since its adoption in our unit in 1995, using our electronic operative and craniofacial patient database systems.

Results: We identified 328 consecutive operations in 322 patients (167 metopic and 155 unicoronal). The median age at surgery was 1 year 5 months (range 4 months to 25 years), with 169 males and 153 females. 13 complications occurred in the 284 cases since introduction of prospective recording of such in 1999, predominantly infections (no deaths). 6/322 patients required revision for unsatisfactory cosmetic result (4 unicoronals, 2 metopics).

Discussion: In our experience, this operation offers a safe and reliable technique for fronto-orbital remodelling in unicoronal and metopic synostosis, with a low rate of complications and a predictable and satisfactory aesthetic result.

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Intracranial volume and cephalic index in sagittal synostosis operated with craniotomy and springs or pi-plasty

Presenter: Sara Fischer

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Background: The aim of the present study was to evaluate the intra cranial volume (ICV) and cephalic index (CI) in patients operated for sagittal synostosis and to compare the outcome of two different surgical techniques; the craniotomy combined with springs and the modified pi-plasty.

Method: All patients operated for isolated sagittal synostosis and registered in the Göteborg Craniofacial Registry until the end of 2012 with a pre- and/or postoperative (at three years of age) CT examination was extracted. Sex and age matched controls were identified from children who had undergone CT for other reasons.

Result: Craniotomy combined with springs increased the ICV and CI from 802±13 ml (mean±SEM) and 70.1±0.4 to 1300±20 ml and 73.1±0.4, respectively. The corresponding values for controls were 796±14 ml and 83.6±0.7 preoperatively and 1334±17 ml and 80.0±0.6 at three years of age.

Pi-plasty increased the ICV and CI from 1014±18 ml (mean±SEM) and 69.7±0.5 to 1286±20 ml and 74.1±0.4 respectively. The corresponding values for controls were 1043±23 ml and 83.4±1.1 preoperatively and 1362±20 ml and 79.6±0.6 at three years of age.

Conclusion: Craniotomy combined with springs in children younger than 6 months and Pi-plasty in older children were equally efficient in improving ICV and CI. However, none of the surgical techniques fully normalized the head shape.

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Age at time of surgery and maintenance of head size in nonsyndromic sagittal craniosynostosis

Presenter: Anna A. Kuang

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Background: Surgical repair of non-syndromic sagittal synostosis is directed at creating and maintaining increased intracranial volume and improving the cranial index. There is no consensus as to optimal timing of surgery. We previously reported a possible relationship between age <6 months at operation and the occurrence of reoperation. Here, we retrospectively review the effect of age at the time of primary sagittal craniosynostosis repair on head circumference, intracranial volume, and cranial index.

Methods: We retrospectively reviewed our patients from 2005 to 2012 who underwent primary cranial reconstruction for non-syndromic sagittal craniosynostosis at age <6 months versus age 6-12 months. Head circumference (HC) was recorded preoperatively, 3 months post-operatively, and yearly until age 6. Preoperative, and immediate- and 2 year-postoperative CT imaging was used to determine cranial index (CI) and intracranial volume.

Results: Thirty-six patients were included. Thirteen patients (36%) were >than 6 months old at the time of operation. HC percentile was increased immediately after surgery but decreased at 1 and 2 years post surgery, significantly more so in patients undergoing surgery at age <6 months (Figure 1, $p < 0.011$, $p = 0.004$ for 1 and 2 years). Cranial index (CI) was increased from a mean of 77 before surgery to 87 two years post surgery ($p < 0.05$), with no significant difference between the groups (Figure 2). Intracranial volume measured by CT imaging increased in all patients from pre-operatively to 2 years post-operatively (Figure 3). Volume was higher in the >6 months old group at the time of surgery, as expected, but this difference was also maintained at 2 years post-operatively ($p < 0.05$).

Conclusions: Cranial reconstruction for non-syndromic sagittal synostosis improved cranial index in all patients regardless of the timing of surgery. HC and intracranial volume two years after surgery were significantly higher in patients who underwent surgical reconstruction at age >than 6 months compared to those operated before age 6 months. By contrast, cranial index was improved equally in all patients. Timing primary surgical reconstruction for sagittal synostosis after age 6 months may result in sustained larger intracranial volumes without sacrificing optimal resulting head shape.

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Management of Non-Syndromic Sagittal Synostosis: A Head-to-Head Meta-Analysis Comparing Three Techniques

Presenter: Patrick A. Gerety

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Background: The timing and surgical technique for the treatment of sagittal synostosis remains controversial. Calvarial vault remodeling (CVR), strip craniectomy (SC), and spring-mediated cranioplasty (SMC) are all currently in use though the recent trend has been towards less invasive techniques. The purpose of this study was to compare outcomes for these techniques via systematic review of literature and head-to-head meta-analysis.

Methods: A literature search identified all articles involving operative management of non-syndromic sagittal synostosis. Studies were included if at least two operative techniques were compared, and methodology was assessed via ASPS Levels of Evidence. Three techniques were considered: CVR, SC, and SMC. Head-to-head meta-analysis was conducted for the primary outcome, change in cephalic index (CI), reported as weighted mean difference (WMD). Pooled subgroup analyses were performed for secondary outcomes including operative time, length of stay, estimated blood loss, and total cost.

Results: Twelve studies providing level 2 or 3 evidence were included. All studies involved CVR (n=187), 8 involved SC (n=299), and 7 involved SMC (n=158). Head-to-head comparison of change in CI demonstrated a greater, yet statistically insignificant change for CVR versus SMC, WMD=0.94 [-0.23-2.11] ($p=0.12$, $I^2=55\%$). CVR showed a small but statistically greater change in CI versus SC, WMD=1.47 [0.47-2.48] ($p=0.004$, $I^2=66\%$). Post-operative cephalic index was correlated with reported study follow-up for each technique. As follow-up time increased, cephalic index increased in the suturectomy and spring cranioplasty groups and decreased in TVR studies. Compared to SMC/SC, CVR had longer operative length (170 vs. 97 min), higher blood loss (238 vs. 47 mL), longer length of stay (5.1 vs. 2.9 days), and higher costs (\$35,280 vs. \$13,147), all with $p < 0.0001$.

Conclusions: This study, the first meta-analysis comparing three primary operations for correcting non-syndromic sagittal synostosis, demonstrates no difference in CI for CVR versus SMC and a small but statistically greater improvement in CI favoring CVR over SC. Secondary outcomes favored SC/SMC procedures over CVR. However, long-term studies are still needed to adequately assess the risk/benefit ratios.

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SUBARACHNOID CSF COLLECTION AND FINAL MORPHOLOGY AFTER SURGICAL TREATMENT OF SCAPHOCEPHALY: A POTENTIAL ROLE?

Presenter: Eric Arnaud

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Background: A physiological dilatation of subarachnoid spaces is present in infants within 2 years of age; but children with sagittal suture synostosis often present an increased subarachnoid spaces enlargement. The role of this condition on the morphological outcome of forehead was analyzed.

Patients and Methods: 159 children (72.3% male) under 6 months of age who underwent a surgical correction of the scaphocephaly with Renier's H technique between 2003 and 2008 were included in the study. In these patients preoperative and postoperative fronto-occipital diameter (FOD), Biparietal Diameter (BPD), Temporal Width (TW), and naso-frontal angle (NFA) were measured. Cranial Index (CI) and difference between preoperative and postoperative CI (Δ CI) were calculated. Preoperative Cranio-Cortical Width (CCW) was measured to analyze subarachnoid spaces enlargement and children were divided in two groups: group 1 with CCW smaller than estimated value corrected for age; and group 2 with CCW larger than estimated value.

Results: An increased enlargement of subarachnoid spaces was found in 59.7% of the children (group 1: n=64, group 2: n=95). The frontal morphology was different in the two groups. Preoperatively, the mean BPD, TW, CI and NFA were significantly in group 2 ($p \leq 0.01$). The range of follow-up period was 19-129 months. Mean age at postoperative examination (RX or CT-scan) was 53.4 months in group 1 and 51.8 months in group 2. Postoperative analysis showed that the Δ CI was statistically different between the two groups ($p < 0.04$).

Discussion: In infants with scaphocephaly, the morphology of the forehead differs when a pathologic subarachnoid spaces enlargement is present preoperatively. Moreover, its presence affects also the post-operative evolution. Such observation highlights the importance of assessing the subarachnoid spaces when planning a surgical correction in isolated sagittal suture synostosis.

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The benefits and limitations of the use of springs in the correction of scaphocephaly: A contemporaneous audit

Presenter: Will P. Rodgers

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Background: Spring assisted correction of sagittal synostosis is a novel alternative to formal calvarial remodelling. Benefits include technical simplicity, favourable morbidity profile and reduced hospital stay however assymetric results, incomplete correction, need for a second operation and lack of long term results are potential drawbacks. We present the results of a single institution's experience over 4 years using a novel spring design. We assess the outcome and discuss the benefits and limitations of the use of spring assisted correction of scaphocephaly secondary to sagittal synostosis.

Methods: All patients treated at a single unit between April 2010 and Oct 2014 were evaluated using retrospective review of our contemporaneous database. Patients with multisutural synostosis and those operated over 7 months of age were analysed separately. Data were collected for operative time, anaesthetic time, hospital stay, transfusion requirements and complications.

Results: 81 patients were included. Cephalic index was 68 pre-operatively, 71 at 1 day post-operatively and 73 at 3 weeks and 6 months post-operatively. Seven patients required transfusion, 5 patients had post operative infection requiring early spring removal, 5 patients required traditional calvarial remodelling surgery for incomplete correction and 9 patients required burring down of ridges, 1 patient sustained a venous infarct.

Conclusion: Our modified spring design and protocol represented an effective strategy in the management of sagittal synostosis in children under 6 months old. Improvement in scaphocephaly was achieved in all patients although some required further procedures. The morbidity and mortality profile is favourably comparable to more traditional techniques. In patients referred within the first 6 months of birth, this technique has become our procedure of choice. In phenotypically severe cases and the older age group the correction may require further remodelling surgery.

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Two-Stage Correction of Asymmetric Multisutural Craniosynostosis: An Approach to the Child with Cranial Scoliosis

Presenter: Michael R. Bykowski

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Background: Asymmetric multisutural craniosynostosis (AMC) is a complex and rare problem. Despite the potential high morbidity of a one-stage surgical repair, many craniofacial surgeons correct AMC with in a single stage. In this study, we share our institutional experience with two-stage correction of AMC.

Methods: We conducted a retrospective review of all craniosynostotic patients who presented to our Pediatric Tertiary Referral Center and underwent surgical correction between January 2004 to December 2013. From these patients, we focused on those who had AMC and underwent two-stage repair. More specifically, the first stage included sagittal strip craniectomy, followed by a period of helmet therapy, and then fronto-orbital advancement. A minimum of 1 year follow-up was required from the second stage for inclusion in this study. We evaluated functional and aesthetic outcomes.

Results: Four patients met our inclusion criteria. All had unilateral coronal and sagittal synostosis, of which one patient additionally had bilateral lambdoid synostosis. On average, patients underwent their first and second stages of surgery at 0.24 and 0.96 years of age, respectively. No patients were syndromic or had a known genetic mutation. The average follow-up period was 3.7 years. At follow-up, three patients were considered to have developmentally normal vocabulary development; whereas one patient was noted to have fair vocabulary development, as evaluated by a Speech and Language Pathologist. No patients developed blindness, learning disabilities, or signs of elevated intracranial pressure.

Conclusions: AMC is a rare clinical entity. Early two-stage repair of AMC resulted in resolution or prevention of typical craniosynostotic sequelae (i.e., learning disability, delayed speech development). Performing the correction in two-stages afforded two shorter, relatively low morbidity procedures while allowing “touch-up” modifications during the second procedure. Our protocol for two-stage correction resulted in good functional and aesthetic outcomes.

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A Treatment Protocol for Atypical Presenting Sagittal Craniosynostosis

Presenter: Edward J. Ruane

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Background: Sagittal craniosynostosis is the most prevalent single-suture craniosynostosis and is typically diagnosed and treated within the first year of life. Herein the authors highlight their experience with a challenging and previously unreported patient population: those with phenotypically mild, missed, or late-presenting sagittal craniosynostosis.

Methods: A retrospective chart review was conducted for all cases of sagittal craniosynostosis in our institution's Cleft-Craniofacial Center Database presenting between July 2013 and October 2014. Patients older than 1 year of age with isolated sagittal craniosynostosis were selected. Our protocol takes into account the increased challenges of cranial vault surgery in older children. All children are evaluated by craniofacial surgery, neurosurgery, and ophthalmology who perform dilated fundus examinations and visual evoked potential (VEP) testing.

Results: Thirty-five patients were identified who met inclusion criteria. Of these, only two patients had obvious scaphocephaly which was addressed surgically. Four patients had clear signs/symptoms of intracranial hypertension (ICH) and were offered cranial vault remodeling. Seven patients presented either with mild scaphocephaly, with signs/symptoms of ICH in the setting of other potential causes, or with inconclusive ophthalmologic evaluation. These patients were admitted for intracranial pressure monitoring, of which two were found to be elevated (28.6 percent) and therefore underwent cranial vault surgery. The other twenty-two patients presented with isolated sagittal craniosynostosis in the setting of either overall normal head shape or a lack of any signs/symptoms concerning for ICH. These patients continue to undergo serial ophthalmologic evaluation every six months with normal optic disc appearance and VEPs to date.

Conclusions: The optimal treatment of patients presenting with atypical sagittal craniosynostosis is not well defined. A new treatment protocol based upon the authors' experience with this cohort of patients is therefore described.

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Combined sagittal and unicoronal synostosis: preoperative assessment and outcomes after spring-assisted surgery

Presenter: Giovanni Maltese

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Background: Nonsyndromic multiple suture synostosis compose a rare subset of craniosynostosis. A relatively frequent combination is sagittal and unicoronal synostosis, which results in scaphocephaly with a pronounced frontal asymmetry. The aim of this study was to evaluate the preoperative status as well as the surgical outcomes after spring assisted surgery (SAS) in patients presenting the combination sagittal and unicoronal synostosis.

Method: The Gothenburg Craniofacial registry was searched for patients with sagittal AND unicoronal synostosis AND operated on with SAS. Pre- and postoperative intracranial volume (ICV) was estimated on CT scans with a MATLAB tool and compared to that of an adequate control group. Symmetry along the sagittal plane was evaluated by measuring the angle between the intersection of the line along the nasal septum and a line along the long axis of the foramen magnum (NS-FM angle). The preoperative values were then compared to the postoperative ones.

Results: Four patients were identified. All four were male. Genetic testing for FGFR and TWIST resulted negative; one patient had a 10.q22.3-q23.1 deletion. Two patients presented with more extensive cranial deformations and concurrent cardiac malformations that needed surgical correction prior to the cranioplasty. Surgery consisted in craniotomy of the synostosed sutures followed by the implantation of two springs across each craniotomy line. The mean preoperative ICV was not significantly smaller than the control group (655 vs 756 ml, p=0.148), while both at one year and three years follow up ICV in significantly reduced (1008 vs 1143, p=0.01 and 1053 vs 1319, p=0.04). The mean NS-FM angle improved from 9° to 2.7°.

Conclusions: We could conclude that SAS improves sagittal symmetry in patients with sagittal and unilateral craniosynostosis, while the postoperative ICV is significantly reduced. Children with combined sagittal and unicoronal synostosis are at high risk for cardiac malformations and should be adequately examined.

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Decreased Craniosynostosis Deformity Relapse Following Removal of Compensations

Presenter: James P. Bradley

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Background: The goal of Craniofacial surgeons in craniosynostotic corrective surgery should be to maximize aesthetic and functional outcome while minimizing the extent and number of procedures. In an attempt to minimize relapse after craniosynostotic procedures, we modified our operative technique to remove cranial vault compensations while addressing pathologic cranial vault restriction deformities. In particular, we studied both unilateral (UCS) and bilateral coronal synostosis (BCS) procedure modifications with regard to relapse and need for additional procedures.

Methods: In the first part of our study, CT scans of patients with UCS and BCS were compared to age-matched controls for regional volumetric differences (n=72). In the second part of our study, we compared groups of patients before and after operative technique adjustment aimed at correcting compensation deformities based on volumetric information from the first part of our study (n=53). For the UCS patients, in addition to frontoorbital advancement, adjustments were aimed at reducing temporal and posterior parietal volume. For the BCS patients, in addition to the frontoorbital advancement, adjustments were aimed at reducing the temporal volumes and parietal height. CT volumetric differences (Preop vs. Postop) were compared for the 2 groups of patients. In addition, clinical evaluations (Whitaker score) and need for additional procedures were recorded.

Results: For UCS, volumetric deficiencies consistently existed in the supraorbital (8±1cc) and frontal (19±1cc) regions; volumetric excess existed in the temporal (12±1cc), ipsilateral posterior parietal (17±1cc), and contralateral frontal (9±1cc) regions. For BCS, deficiencies consistently existed in the supraorbital (19±1cc), and frontal (33±1cc) regions; volumetric excess existed in the bilateral anterior and posterior parietal (42±1cc), and bilateral temporal (17±1cc) regions. Comparing the 2 groups of patients before and after technique modification, we found closer regional volumetric similarities after 6 months in both the UCS (97% vs. 78%) and BCS (105% vs. 82%) patients.

Conclusions: When compensations are addressed at the time of corrective craniosynostotic surgery, decreases are seen in both cranial vault deformity relapse and the need for additional surgery.

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Power-Assisted Particulate Bone Harvesting Minimizes Osseous Defects After Cranial Vault Reconstruction

Presenter: Brad M. Gandolfi

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Background: A limited supply of calvarial autograft exists following expansion of cranial dimensions during cranial vault remodeling (CVR). Greene successfully decreased the rate of osseous defects following CVR by utilizing a hand-driven Hudson brace to harvest particulate bone graft (PBG), but these results have not been reproduced outside of their institution. Utilizing a low-speed pneumatic craniotome, we have expedited the harvest of PBG. The hypothesis of this study is that particulate bone graft harvested with a pneumatic-powered craniotome decreases full thickness calvarial defects after CVR.

Methods: The records of patients that underwent CVR between 2005 and 2013 at Duke Medical Center were analyzed. Data was collected pertaining to diagnosis, procedures, operative techniques, complications, and follow up. Patients without a diagnosis of craniosynostosis, without adequate follow up, with prior operations, or those that underwent CVR utilizing minimally invasive techniques were excluded.

Results: A total of 135 patients underwent CVR between 2005 and 2013 and met our inclusion criteria. 95 of these patients underwent a standard CVR, while 40 had their CVR augmented with PBG. PBG was harvested using a hand driven Hudson brace in one patient. In the remaining 39 patients, PBG was harvested using a perforator bit on a pneumatic craniotome at low speed. The average follow up period was 37 months (range 5.9-103). 19 (19.7%) patients that did not receive PBG had residual full thickness calvarial defects, of which 6 (6.25%) required a reoperation. In the population that received PBG, 1 (2.5%) had a full thickness calvarial defect, not requiring reoperation.

Conclusions: Particulate bone harvested using a low speed pneumatic-powered craniotome decreases full thickness defects after CVR (p=0.0074). This data further validates prior studies on particulate grafting, and establishes the safety and efficacy of low-speed pneumatic craniotome harvests.

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Evaluation of long-term sensory outcomes following cranial vault reconstruction

Presenter: Jana Dengler

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An inherent step during fronto-orbital advancement (FOA) for correction of metopic and unicoronal synostosis is exposure of the bony orbits to allow for orbital rim advancement. This risks injury to several terminal branches of the trigeminal nerve, namely the supraorbital (SO), supratrochlear (ST), zygomaticotemporal (ZT) and zygomaticofacial (ZF). Despite numerous studies demonstrating successful esthetic outcome after FOA, the functional sequelae of transecting these nerves is not well understood. A cross-sectional case control research design was used to evaluate facial sensory threshold of the SO, ST, ZT and ZF nerve distributions after cranial vault reconstruction in children with isolated, non syndromic metopic and unicoronal craniosynostosis, compared to those with sagittal craniosynostosis (where operative management only risks injury to the ZT, ZF or ST nerves) and age-matched controls. Study participants were recruited from the Hospital for Sick Children between the ages of 6 and 18 years of age who had previously undergone surgery. Sensory outcome was determined using the Weinstein Enhanced Sensory Test (WEST)-D, Ten Test and self-reported facial sensibility functional questionnaire. To date, 8 patients who underwent FOA for metopic and unicoronal synostosis have been evaluated and compared to 6 patients who underwent correction for sagittal synostosis, and 6 age-matched controls. Preliminary results suggest there is no statistical significance in sensory outcome between these groups. Qualitative reports of facial sensibility function measured by the questionnaire indicated no difference in subjective sensation, no decrease in protective sensation and no altered motor behaviour. These results suggest that nerve transection during FOA does not result in a quantifiable nor clinically significant long-term sensory deficit threshold. Additional study participants are actively being enrolled and evaluated.

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Sagittal Synostosis More Than Aesthetics

Presenter: Kamilah A. Dowling

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Early studies of the epidemiology of single suture craniosynostosis noted a predominance of premature fusion of the sagittal suture, accounting for more than half of all reported cases. Historically the management of sagittal synostosis has been based on the premise that this is primarily an aesthetic issue with no effect on the development of the brain. We will present seven children from our practice who range in age from twenty-three months to eight-years of age. All of these children had been diagnosed with sagittal synostosis based on both radiographic and clinical examination. In this group of patients all had an initial consultation in infancy (done less than 8 months of age). In this group the families all declined any surgical intervention. The patients have now later returned for further consultation to discuss surgical correction due to psychosocial issues such as bullying and low self-esteem and in several cases early onset of severe headaches. It is now recognized that untreated (i.e., surgical intervention) sagittal craniosynostosis can, in some cases, lead to inhibition of brain growth, and an increase in intracranial pressure due to the premature synostosis. These children also commonly present with severe headaches. From our experience and others sagittal synostosis is clearly not always an "aesthetic" problem. There is a subset of untreated children that suffered from bullying and low self esteem and a significant proportion also present with associated signs of increased intracranial pressure. The management of these children by our craniofacial center will be reviewed. Our craniofacial team no longer considers sagittal synostosis to be just an "aesthetic" problem. Left untreated there is a group of children that will re-present in later childhood with psychosocial issues from peer taunting and also issues with premature skull fusion and increased intracranial pressures.

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Sagittal suture synostosis without scaphocephalic deformation.

Presenter: Kazuaki Shimoji

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Objective: The classification of craniosynostoses depends on a combination of several criteria. The vast majority of craniosynostoses is possible to classify because there is a distinct morphological change in each affected suture. In our cases of sagittal suture synostosis, we found that there are cases which does not show a typical scaphocephaly. To determine these cases we conducted a retrospective analysis.

Materials and Methods: During 2000 to 2014, 25 cases of sagittal suture synostosis were treated. 10 cases obtained a Cephalic Index (CI) over 75. The other 15 obtained CI under 75 which had a typical scaphocephalic deformation. Also we added 9 cases which had CI over 75 from our affiliated hospital and defined these 19 cases as group A (Non scaphocephalic deformation). The other typical scaphocephaly cases were defined as group B. They underwent CT scans and Skull X-rays to CI and to obtain characteristic imaging in these cases. Also extra dural intracranial pressure (ICP) monitoring was measured before surgery.

Results: The mean age of diagnosis was later in group A (A: 5.7±3.9, B:1.5±1.2years old). Parietal foramina was visible in 61.1% in group A, 6.7% in group B, Digital marking were seen in the frontal area in 88.8% of group A and 6.7% of group B, Group A also had a higher incident of developmental delay and increased ICP respectively.

Discussion: There are several hypotheses of the theory of the deformation of the skull in craniosynostosis. In our cohort we found that there is an existence of sagittal suture synostosis without scaphocephalic deformity. These cases, which have more lateral extension so that the CI tends to be normal, tend to show increased intracranial pressure and developmental delay. There might be a risk that these cases may not be diagnosed because of its non-characteristic deformity. Further collection of cases is necessary.

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Less is More? Quantitative Comparison of Endoscopic-Assisted Techniques in the Management of Sagittal Synostosis

Presenter: Suresh N. Magge

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Purpose: Endoscopic-assisted techniques are well described as a valid option for the early release of patients with sagittal synostosis. However, there exists a wide variation in the operative approaches that have been employed, ranging from simple suturectomy (SS) to more extensive variations that include osteotomies and barrel-staving (BS). The morbidity inherent to increasingly invasive procedures calls into question the relative efficacy of these techniques. The purpose of this study was to compare the quantitative outcomes of patients undergoing two different endoscopically-assisted techniques in the treatment of sagittal synostosis.

Methods: A retrospective review was conducted of a consecutive series of patients undergoing endoscopically-assisted treatment of sagittal synostosis at two different institutions from March 2008 to August 2014. Demographic and operative data were collected, and postoperative outcomes were analyzed using quantitative imaging data acquired from the orthotic manufacturer treating patients from both institutions. Final cephalic index (CI) and follow-up period were defined by the last scan obtained by the orthotic manufacturer.

Results: A total of 73 patients underwent endoscopically-assisted treatment of sagittal synostosis. There were 34 patients in whom SS alone was performed, and 39 patients that had suturectomy with BS. The average age at operation was 3.2 months and 2.7 months for SS and BS, respectively. Patients undergoing SS had a mean anesthetic duration of 177.2 minutes and operative time of 77.6 minutes, compared to 195.1 minutes and 111.7 minutes for BS. The average postoperative length of stay was 1.2 days for SS and 1.4 days for BS. In SS, preoperative CI was 72.6 and immediate postoperative CI was 73.8, compared to 71.0 and 73.6 for BS. The CI at 12 months postoperatively was 80.6 for SS and 80.3 for BS. Final CI was 80.4 for SS and 79.6 for BS, with a mean follow-up period of 13.2 months for SS and 19.4 months for BS patients.

Conclusions : Both endoscopically-assisted simple suturectomy and suturectomy with barrel-staving produce good outcomes. However, the addition of barrel staves does not seem to improve the results, and therefore may not be warranted in the treatment of sagittal synostosis.

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10 Year Long Term Outcome of Endoscopic Sagittal Craniosynostosis Repair

Presenter: Eric Stelnicki

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Objective: This is a 10 year, long term outcome study on the results of endoscopic sagittal craniosynostosis repair. It exams the long term efficacy, risks, benefits, reoperation rates, etc. of this minimally invasive procedure.

Methods: A 10 year, retrospective review of 250 consecutive cases of newly diagnosed sagittal craniosynostosis treated with the endoscopic repair. All patients underwent post-operative treatment with a Star Band cranial molding orthosis. Skull shape correction was verified by 3-D laser surface scanning using the Star Scanner and direct caliper measurements. All potential morbidities and mortalities were assessed.

Results: The cranial anthropomorphic measurements all patients were normalized (100%) according to the standard cranial measurements. There was 0% mortality. The transfusion rate was 36%. 87% of patients requires only one Star Band for the post-operative cranial molding. 97% of families were happy with the resulting head shape from endoscopic repair. 6% of patients required reoperation via an open repair due to areas of non-ossification. However, 100% of patients were satisfied with the scar and had no post-operative symptomology. 0.8% of patients had relapse and required reoperation for elevated intracranial pressure or recurrent sagittal craniosynostosis.

Conclusion: This is one of the few long term outcome studies on endoscopic repair of sagittal craniosynostosis. It demonstrates that the endoscopic repair is as safe and effective. The 10 year follow up shows that the result of this surgery are long lasting with a lower reoperation rate. The morbidity and mortality of this treatment is low and this modality is effective in the young patient with sagittal craniosynostosis.

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Endoscope-assisted craniectomy with post-operative helmet for treatment of craniosynostosis in Japan

Presenter: Makoto Hikosaka

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Background: Endoscope-assisted craniectomy with post-operative helmet therapy has been recently reported for the treatment of craniosynostosis as a less-invasive modality. In an attempt to gain insights about this method, our past cases and the reports from the other institutions were reviewed.

Methods: The craniosynostotic cases treated with endoscope-assisted craniectomy at our institution since 2002 were retrospectively assessed. Past reports on the procedure were also reviewed.

Results: Eight cases of craniosynostosis were treated by the procedure. Three of the 8 cases were treated with post-operative molding helmets. Out of the 2 patients who completed the molding phase, only 1 case of anterior plagiocephaly achieved a good cranial shape. Two cases with multiple-suture synostosis responded poorly to the treatment, and required early re-operation.

Discussion: Past reports conclude that any types of single-suture synostosis and bi-coronal cases are good candidates for the procedure, but this could not be confirmed through our experience because of the small number of cases. The operation should be performed before the age of 3-6 months to gain adequate force for cranial expansion driven by the enlargement of the brain. Post-operative molding helmet is mandatory for good outcome. For the helmet for anterior plagiocephaly, simple de-compression of the flattened region by creating space for growth is sufficient. For scaphocephaly, both mild compression to inhibit growth on portions of the cranium where bone is removed as well as de-compression on both sides to actively alter the direction of the cranial growth is necessary, and more meticulous design and adjustment of the helmet is required for these cases. The need for early operation and frequent and time-consuming visits for adjustment of the helmet post-operatively are thought to be the obstacles of this procedure before it can be widely accepted in Japan.

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Bilateral Endoscopic Suturectomy and Helmet Therapy for Bilateral Coronal Craniosynostosis

Presenter: Mark R. Proctor

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Introduction: The best treatment for turricephaly associated with bilateral coronal synostosis (BCS) is early intervention to halt its development. Our center employs bilateral endoscopic coronal suturectomy with helmeting (BES) as a first treatment of BCS. We report a craniometric evaluation of our surgical outcomes compared to controls.

Methods: A retrospective study was completed of patients who underwent BES with pre- and postop CTs. Sagittal and axial views were measured by three examiners. Measurements included: anterior cranial base length (ACBL; sella-nasion), anterior bossing angle (ABA; sella-nasion-anterior frontal bone), cranial length (CL), and cranial width (CW). Cranial heights were measured perpendicular to ACBL at nasion (anterior), sella (middle), and basion (posterior). Cranial heights were normalized to ACBL (cranial height/ACBL). Ventricular widths were measured and frontal-occipital horn ratio (FOHR) was calculated.

Results: Twelve BCS patients had preop and postop CTs performed at 1.1mo (0.03-2.6) and 19.6mo (10.8-37.5). Thirteen trauma patients (mean age 1.3mo) and another 14 patients (mean age 18.5mo) served as controls. Turricephaly was greatest anteriorly. Preop anterior cranial heights (ACH) were significantly greater than controls (67.9 vs 40.7; $p < 0.00001$). ACH increased only 2.8mm ($p = 0.196$) while the ACBL increased 17.3mm ($p < 0.00001$). The ACH/ACBL ratio improved significantly (1.92 to 1.63; $p = 0.00149$) but remained higher than controls (1.36; $p = 0.0058$). Frontal bossing resolved. Preoperative ABAs were significantly greater than controls (115.0 vs 105.6; $p = 0.0014$). Postop values normalized (108.6 vs 109.3; $p = 0.792$). The cephalic indices improved from 92.5 to 85.3 ($p = 0.0002$). The mean FOHR was 0.3 for all groups.

Conclusion: Early BES is a rational alternative to posterior distraction in ameliorating the deformity of BCS. This procedure reduces anterior turricephaly, corrects frontal bossing, and improves the cephalic index.

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Aesthetic outcomes of molding helmet therapy with spring-mediated cranioplasty for sagittal craniosynostosis

Presenter: Jackie Haas

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Background: Many therapies have been employed to affect cranial vault changes in infants with sagittal craniosynostosis, and there is no clear consensus as to the optimal treatment. Recent studies suggest that neurocognitive outcomes may be improved when surgical intervention imparts active cranial expansion or remodeling and is performed before six months of age. We consider spring-mediated cranioplasty (SMC) to optimally address these imperatives, and this is an investigation of how helmet orthoses before or after SMC affect aesthetic outcomes.

Methods: We retrospectively evaluated patients treated with SMC for sagittal synostosis. Based on our observation that the severity of scaphocephaly often worsened between the time of initial presentation and surgery, all patients were referred for helmet orthosis at initial presentation. Post-operative helmet orthoses were prescribed selectively depending on the resulting contour three weeks after surgery. Patients were stratified into four cohorts based on helmet usage: pre-op, post-op, both, and neither. 3dCT scans, laser head scans, radiographs, and clinical photographs were abstracted to assess changes in cephalic index (CI).

Results: 27 patients met inclusion criteria: 6 (22%) had pre-op, 9 (33%) had post-op, 4 (15%) had pre-op and post-op, and 8 (30%) had no helmeting. Mean age at surgery was 4.0 months, and did not vary significantly between groups. Overall, CI improved from a mean 69.6 to 77.1 during an average 7 month course of care. CI on presentation did not differ between those who underwent pre-op helmet (69.8) or not (70.0) ($p = 0.88$). Mean preoperative change in CI showed greater improvement with pre-op helmet (1.3) versus not (0.0), ($p = 0.029$). Mean postoperative change in CI showed a trend toward improvement in patients who wore a helmet post-op (8.3) versus not (5.9), ($p = 0.074$). Patients who had pre- and post-op helmeting showed a trend toward increased CI (9.7) versus those who had no helmet (6.1), ($p = 0.11$).

Conclusion: Early spring-mediated cranioplasty with adjunct use of preoperative helmet orthosis significantly improved cephalic index by the time of surgery compared to no preoperative helmet. Further work is needed to more fully understand both the aesthetic and neurocognitive effects of SMC and helmet orthoses in treating sagittal synostosis.

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The Effect of Preoperative Molding Helmet in Patients with Sagittal Synostosis—Follow Up Study

Presenter: Asra Hashmi

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Background: Sagittal synostosis is the most common form of craniosynostosis with patients requiring correction by strip craniectomy and cranial vault remodeling to facilitate neurologic development and normal cranial shape. We used molding helmet in a group of patients before definitive surgery for sagittal synostosis with the hypothesis that it would improve the final cephalic index of these patients and give a better surgical result. To our knowledge there is no prospective study investigating the use of preoperative molding helmet in patients with sagittal synostosis. This a follow up of the preliminary findings presented in ICSFS meeting 2011.

Methods: A prospective cohort study was performed on 48 patients undergoing surgical correction of sagittal synostosis from January 2009 through December 2014 at Children’s Hospital of Michigan. Patient’s were categorized into two groups; group A only had surgical correction and group B had preoperative molding helmet in addition to surgical correction. CI was measured on the first visit, immediately preoperatively and postoperatively for both groups. Statistical analysis was performed using t-test.

Results: There were 30 patients in group A(no helmet) and 18 patients in group B(with helmet). In group A mean CI at presentation was 0.70 (±0.047), preoperatively it was 0.71 (±0.02) and postoperative CI was 0.79 (±0.028). In group B mean CI at presentation was 0.69 (±0.023), after helmet use preoperative CI was 0.73 (±0.036) and postoperatively it was 0.83 (±0.036). First, preoperative CI for the two groups was compared using t-test which did not show any statistical significance (p value=0.70). We then compared CI of the two groups after surgery which showed a statistically significant difference between the groups (p value=0.002). There was statistically significant improvement in CI for group B patients after helmet use(p value=0.0004).

Conclusion: Our results suggest that preoperative molding helmet may be used as a valuable adjunct in the management of patients with sagittal synostosis.

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Where does the “volcano sign” come from in sagittal synostosis surgery?

Presenter: Ruth E. Bristol

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Background: Craniosynostosis of the sagittal suture can be treated with either open calvarial vault procedures, or with an endoscopic/minimally invasive procedure. When the less invasive procedure is performed, there are two methods for accessing the epidural space: dissection of the anterior fontanel, or burr hole craniostomy.

Methods: An IRB-approved retrospective review of patients who underwent minimally invasive sagittal synostosis surgery between 2009 and 2012 revealed 17 patients. The surgical team had employed the anterior fontanel approach from April 2009 to May 2011. The same surgeons switched to a burr hole approach in May 2011. Clinic notes and photographs were reviewed to assess for the development of the “volcano sign” in which boney overgrowth is noted at the site of the anterior fontanel.

Results: In 6 patients, the fontanel was dissected (AF group); 11 underwent burr holes (BH group) to access the epidural space. Mean follow up was 27 months for the AF group and 19 months for BH group. Four of the 6 AF patients (67%) developed the 747 hump in comparison to 2 of the BH group (18%) (p=0.109). Cephalic index at last follow up was not significantly different (77.8% vs. 75.3%, p=0.360). There was no significant difference in occipital-frontal circumference percentile (72% vs. 83%, p=0.947). Although no invasive pressure monitoring was carried out, there were no other signs of increased intracranial pressure.

Conclusion: It appears that the method used initially by this team to dissect the anterior fontanel resulted in a higher incidence of excessive boney growth at the site of the anterior fontanel. This result trended toward but did not reach statistical significance in our small sample. As a result of this observation, the team now routinely uses the burr hole approach to access the epidural space. Although this finding has been correlated with increased intracranial pressure in other reports, we do not see signs of that in this cohort. This finding implies a role for dural signaling in the development of bone at suture sites.

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Fronto-orbital Expansion: Reversing the paradigm of sagittal synostosis correction for late presentation

Presenter: David Staffenberg

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Background: There are options for the treatment of scaphocephaly in infancy. They should eliminate the scaphocephaly and resolve the frontal bossing and temporal narrowing. When the synostosis is inadequately treated, or not treated until a later age, these anterior changes worsen. By this time it is these anterior changes that are more visible and cause the most concern. Patients and their parents find these anterior deformities difficult to hide under hair while the original primary changes posteriorly, are more easily hidden.

Method: Patients with uncorrected sagittal synostosis, or inadequately corrected sagittal synostosis were evaluated by the interdisciplinary craniofacial team at the Institute of Reconstructive Plastic Surgery of New York University Medical Center. Significant complaints of parents and/or patients did not involve the posterior calvarium; they were directed at the frontal bossing and temporal narrowing. To directly address these concerns, Fronto-Orbital *Expansion* and Calvarial Vault Remodeling (FOE/CVR) was performed.

Result: When sagittal synostosis is left untreated, or inadequate correction with incomplete elimination of the sagittal suture is performed, the objectionable deformity is anterior, not posterior. Temporal narrowing and frontal bossing are reliably corrected with this simple technique.

Conclusion: The treatment of primary scaphocephaly generally involves posterior approaches to the calvarium (CVR, strip craniectomies with or without molding helmets, or springs). When the correction is inadequate, or the patient presents after infancy, the secondary anterior changes are those that cause the most concern. These findings consist of forehead bossing and temporal narrowing. Therefore, the the successful treatment plan will be directed to these anterior deformities in this less common patient population. The FOE/CVR, in our experience, has been a simple, reliable and successful technique for the treatment of children with previously untreated scaphocephaly, or for those with incomplete correction of scaphocephaly. A review of the philosophy, technique, and consecutive cases will be presented.

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Application of Distraction Osteogenesis for elderly Scaphocephaly Children

Presenter: Shinsuke Akita

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Background: The surgical treatment for scaphocephaly is considerably variable. General consensus is recognized as early surgery before 6 months of age. Pi procedure, spring mediated expansion, total calvarial remodeling, and others are recognized. Application of distraction technique was reported as a different concept of the treatment for craniosynostosis in Asian countries. Although distraction technique requires two surgeries of in and out of devices, distraction has the advantage of early coverage of the bone defect much expected. Herein our concept of treatment for scaphocephaly using by distraction is discussed, in particular for elderly consulted patients in our country.

Method: Among the scaphocephaly treated, distraction was applied to 15 patients. Age of the surgery ranged 15 to 38 months. Surgical procedure includes frontal total osteotomy, wide bilateral parietal osteotomy with 2-4 distraction devices attached, and immediate correction of temporal hollow. Antero-posterior shortening did not dare to be conducted.

Result: As the lateral expansion proceeds by distraction, protruding forehead is likely to move backward. Unilaterally around 15 mm (bilaterally around 30 mm) distraction was achieved. After the consolidation of 3-4 months, all the devices were removed. No particular complications were encountered. Device exposure was noticed in several cases in distraction and retention phase, but no particular infections were found. Bony defect was covered considerably in less than a year by neo-generated bone even for elder children. Postoperative follow-up ranged 8 months to 7 years uneventfully.

Conclusion: There are several operative procedures, depending on the age of the surgery for scaphocephaly. In our country, the distraction technique is often used for craniosynostosis. Among them, scaphocephaly in elder patients is thought to be one of the proper indications for distraction. Although two surgeries are required, early coverage of bony defect by neo-generated bone is attractive and the technique is still useful.

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Comparison of two techniques for nonsyndromic sagittal craniosynostosis: morphological outcomes

Presenter: Christopher R. Forrest

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Purpose: Sagittal craniosynostosis is the most prevalent form of isolated fused cranial suture fusion. Multiple surgical techniques have been described for its correction. These are largely grouped in two categories based on the physiology and malleability of the cranial bone: Extended strip craniectomy (ESC) with postoperative helmet molding versus total cranial vault remodeling (TCVR). Postoperative morphological outcome data is scarce.

Methods: A retrospective review of patients with nonsyndromic isolated sagittal craniosynostosis who underwent surgical intervention from 2008-2013 were identified. Cranial index, head circumference, and cranial volume were pre- and post-operatively using 3D photogrammetry.

Results: 33 patients met criteria with 25 patients undergoing ESC and 8 patients undergoing TCVR. The average age at time of surgery for ESC patients was 5.5±1.0 mos and TCVR patients was 12.3±2.9 mos (p<0.005). The average follow up time was 27.2 mos (16-61 mos). Preoperative cephalic index (CI) was 0.70±0.03 for the ESC group and 0.69±0.03 in the TCVR group. Postoperative CI was 0.77±0.04 and 0.77±0.03, (p<0.005, respectively). Absolute postoperative head circumference change was significantly different between the two groups (61.7±11.9 mm vs. 43.9±13.1 mm, p<0.01), though percentile change difference was not (-3.4±18.6% vs. -3.4±6.0%). There was no difference in postoperative volume change (765.3±187.1 mm³ vs. 656.3±192.4 mm³).

Conclusion: Both extended strip craniectomy and total cranial vault remodeling procedures adequately address scaphocephaly with comparable corrections in cranial index and increase in cranial volume. The head circumference percentile does not significantly decrease postoperatively with either technique in this series, suggesting that these interventions do not constrict immediate future cranial growth.

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Computer Aided Design and Manufacturing in Cranial Vault Remodeling for Non-syndromic Sagittal Suture Synostosis

Presenter: Gerhard S. Munding

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Purpose: The purpose of this study was to investigate the utility of virtual computer aided design/computer aided manufacturing (CAD/CAM) surgical planning for subtotal calvarial vault remodeling in patients with non-syndromic isolated sagittal suture synostosis.

Methods: Consecutive cases of single suture sagittal synostosis presenting to the senior authors (AHD and ESA) with scaphocephaly undergoing virtual surgical planning for subtotal vault remodeling were reviewed. All patients underwent preoperative CT evaluation prior to operative repair. Imaging was used to virtually design osteotomies according to a modified Melbourne subtotal cranial vault remodeling technique in a preoperative virtual planning session, with respect to the dural venous sinuses. Cutting and positioning guides were generated in accordance with the preoperative plan for intraoperative guidance along with stereo-lithographic models. Patients were assessed clinically and radiographically for degree of scaphocephaly as determined by cranial index both pre- and postoperatively. Cases were additionally reviewed for blood loss, transfusion requirements, and postoperative complications.

Results: Between August 2012 to May 2014, 11 children with moderate to severe scaphocephaly underwent cranial vault remodeling operations assisted with CAD/CAM technology. 7 were boys and 4 were girls. Mean age at surgery was 32 months (range 7 to 168 months). All patients received an intraoperative blood transfusion, with a mean operative blood loss of 789ml (range: 225-2500ml). Mean hemoglobin level immediately post-procedure was 9.1±1.6 gm/dL, and hemoglobin levels immediately prior to discharge averaged 10.3±1.3 gm/dL. Average hospital stay was 3.1 days (range 2-6). Mean preoperative cranial index was 66.7±2.3%. Average postoperative cranial index improved to 75.5±2.3% (p=0.0001). No patients required further scaphocephaly correction.

Conclusions: In a series of patients with advanced presentation of isolated non-syndromic sagittal craniosynostosis, virtual CAD/CAM modeling allows for efficient utilization of time in the operating room, ability to correct more challenging deformities, and provide improved predicted quantification of postoperative positioning of mobilized vault segments.

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One-piece bone flap osteotomy using thread wire saw for fronto-orbital advancement in craniosynostosis

Presenter: Takuya Akai

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Background: One of the advantages of distraction osteogenesis for fronto-orbital advancement is a minimal dissection of dura mater from the skull resulting in less bleeding and better new bone formation. For this purpose, we perform one-piece bone flap osteotomy incorporating the frontal bone and orbital rim. We previously did the orbital osteotomy by chisel, but it needed expert skill and we experienced incomplete osteotomy. We therefore introduced a thin, flexible thread wire saw (the T-saw) for the orbital osteotomy.

Purpose: In this study, we compared the results using the T-saw with those of conventional osteotomy.

Methods: To make a one-piece bone flap, four burr holes located on nasion, middle vault and pterions were made. The frontal bone osteotomy was completed by osteotome, and then the outer sphenoid wing and lateral orbital rim were separated using a reciprocating saw. Limited dura dissection through burr holes at nasion and pterion was performed for the orbital osteotomy. The T-saw was inserted into the supra orbital epidural space through the lateral orbital rim and nasion burr hole, and the osteotomy was performed with gentle reciprocating strokes.

Results: Five patients underwent one-piece fronto-orbital bone flap osteotomies using the T-saw. The median age of patients was 26 months (7-132 months), median operation time was 275 min (183-303 min), and median estimated blood loss was 65 ml (20-250 ml). These values did not differ from those of control cases treated by conventional methods. No complications, including incomplete osteotomy or dura damage, occurred.

Conclusions: Orbital osteotomy using the T-saw was safe and easy, and would give more advantages for fronto-orbital one-piece advancement with distraction osteogenesis. This technique could also be available for other skull base surgeries that have a narrow working space.

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Distraction osteogenesis vs. conventional fronto-orbital advancement for the treatment of Unicoronal Synostosis

Presenter: Youssef Tahiri

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Background: Fronto-orbital advancement and remodeling (FOAR) remains the most widely practiced treatment for unicoronal craniosynostosis (UCS) despite recent reports of ocular dysfunction and aesthetic shortcomings in the long-term. The aim of the study is to compare perioperative morbidity and short-term outcomes of a recently developed, non-devascularizing, distraction-based treatment of UCS to conventional FOAR.

Methods: We compared the first six patients who were treated with a new osteotomy/distraction approach to the last six patients who underwent traditional FOAR for the treatment of UCS with regards to demographics, operative details, perioperative morbidity and short-term outcomes.

Results: Between July 2012 and June 2014, six patients underwent each procedure. Duration of surgery and length of hospital stay in the distraction group were on average 2 hours 7 min and 3.4 days, respectively, significantly less than in the traditional FOAR group (p=0.039, p=0.032, respectively). Peri-operative blood loss averaged 169cc, which trended toward less than in the traditional group (mean of 400cc, p=0.065). Patients undergoing conventional compared to DO mediated FOAR were significantly more likely to develop new onset strabismus postoperatively (odds ratio 15.4; p=0.0384). All 12 patients completed therapy without complications and with Whitaker grade I results at latest follow-up.

Conclusion: In the peri-operative period, distraction-mediated cranial vault remodeling provides similar correction of the aesthetic deformity associated with UCS and an improved morbidity profile. Longer follow-up is needed to determine how distraction compares to FOAR with respect to neuropsychological and long-term aesthetic outcomes.

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Springs in Craniofacial surgery-Selection of appropriate cases

Presenter: Charles Davis

Author: Davis C

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Introduction: Cranial springs transmit sufficient force to cause ongoing shape change for several weeks after surgery. The appropriate indications for their use continue to evolve. The author has been using springs for the past 10 years as part of the armamentarium of available craniofacial techniques. This paper reviews this experience with a view to rationalizing the types of conditions for which springs are most appropriate.

Method: A retrospective review of all transcranial procedures performed by the author over the first 10 years of practice was performed. Those cases utilizing springs were specifically reviewed with respect to the original indications and the success of the result achieved.

Results: During the 10-year period 2005-2014, 365 transcranial cases were performed. Of these 66 (18%) utilized springs. Cases included sagittal synostosis (54), occipital decompression for Apert, Crouzon and Pfeiffer syndromes(8) and miscellaneous (4). Three early sagittal cases had a second procedure because of insufficient biparietal widening. 4 sagittal synostosis cases continued to have moderate frontal bossing at one year follow up that became minor at the two-year follow up. 5 sets of springs were removed earlier than planned due to impending exposure but in all cases the desired expansion was maintained.

Discussion: The use of springs has been shown to be associated lower rates and volumes of transfusion, faster recovery, shorter hospital stays and lower cost than more extensive reshaping techniques. However they are not appropriate for all cases.

In our unit, the primary indication is sagittal synostosis. Cases are excluded if the initial frontal bossing is severe however minor frontal bossing resolves without a foreheadplasty. If bone is too thin, springs cannot be used. Single springs widen insufficiently for very extreme biparietal narrowing. The age limitation has been extended up to a year for cases with a more minor morphology and minimal frontal bossing.

Springs have been invaluable for occipital decompression and cases of ventricular shunt associated cranial collapse. We do not use springs for trigonocephaly or unicoronal synostosis because of the limitations of controlling the morphological outcome. in our hands.

Various technical tips and tricks will be discussed in further detail.

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Squamosal suture synostosis: incidence, associations and impact in a craniofacial population

Presenter: Greg Thomas

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Background: Squamosal suture synostosis (SS) has been implicated in atypical cranial deformation and, if combined with synostosis of a major calvarial suture, progressive cranial distortion. However, SS is rarely reported. The suture is often poorly rendered in 3D-CT reconstructions and is liable to be overlooked. Thus its true incidence and associations are unknown. This study aimed to address this deficit in our knowledge.

Method: The CT images of all new paediatric patients referred to the Oxford Craniofacial Unit between 2008 and 2013 were reviewed.

Results: Of 432 patient datasets examined, 367 had craniosynostosis. SS was present in conjunction with major suture synostosis in 33 cases (9%) and in isolation in 5 (1%); 38 in total. Its incidence increased with age. It was more common in patients with syndromic craniosynostosis (20%) than in those with synostosis but no syndromic disorder or genetic abnormality (7.2%). Children with Crouzon syndrome were most frequently affected (58%), more than Pfeiffer and Apert syndromes. It was rare in Saethre-Chotzen (1 in 13) and absent in all 10 cases with Muenke syndrome.

SS showed marked variation in its association with major suture synostosis patterns. It was most common in pansynostosis (60%), followed by multisuture (26%), bicoronal (12%), sagittal (8%) and unicoronal (7%). None of the 82 patients with metopic synostosis had SS.

SS was not associated with a consistent calvarial deformity. When combined with a major suture synostosis, the deformity reflected that typical for the major suture involved and was not more severe than anticipated. Of the 5 patients with isolated SS, 2 had a normal head shape, 2 had scaphocephaly and one left posterior plagiocephaly. None required corrective surgery for an aesthetic indication.

Conclusion: Contrary to previous reports, SS is a relatively frequent finding in children presenting to a typical craniofacial unit. In isolated SS, we could identify no indication for surgical intervention.

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Use of Acellular Dermal Matrix in Craniofacial Reconstruction

Presenter: Anil Madaree

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Introduction: In a large proportion of craniofacial the cases, the frontal bone is removed and replaced in the original or remodelled state. One of the common late sequelae following craniofacial surgery is contour irregularities of the frontal region. They are invariably palpable and often visible. Surgeons have attempted various methods to improve the contour irregularities. Despite this irregularities can still ensue. Acellular dermal matrices (ADM) has been used in plastic surgery over the last two decades mainly for burns, breast and abdominal wall reconstruction. We have used ADM's in an attempt to diminish the contour irregularities in the frontal region following craniofacial reconstruction.

Material and Methods: Since 2011 we used ADMs in a total of 34 cases -28 cranial vault remodelling for craniosynostosis, 3 post traumatic cranioplasty, 2 following tumour removal and 1 following hypertelorism correction. Age ranged from 6 months to 42 years. 20 males and 14 females. Bone fixation was obtained with a combination of wires, resorbable plates and titanium hardware. After bone reconstruction, the pericranial flaps were draped and sutured to obtain as much cover of the bone as possible. The ADM was then placed on the pericranium in the frontal region and sutured into position. The galeal skin flap was then draped over the ADM. A 3 mm suction drain was used and removed on day 3. We used 3 types of ADMs. AlloDerm in 5 cases, Strattice in 3 cases and XCM Biologic Tissue Matrix in 26 cases.

Results: Follow up ranged from 3-42 months. There were no episodes of infection, seroma or any need to remove the ADM. None of the patients required any reoperation related to the use of ADMs. As compared to patients prior to the use of ADMs, the patients with ADM had a significantly improved appearance of the fronto orbital region. There was a smoother contour with diminished irregularities. The appearance was more uniform.

Conclusion: The use of ADMs has diminished the extent of the frontal contour irregularities that are commonly found following craniofacial surgery and may obviate the need for secondary surgery to correct these. In our unit, it has now become a routine to use ADMs following fronto-orbital remodelling.

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Molding helmet therapy for the infants with deformational plagiocephaly: our experience of 200cases

Presenter: Ako Takamatsu

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Background: Since the infants had been traditionally put to sleep supine in Japan, there was a higher rate of deformational plagiocephaly and less attention was paid to it, compared to Western countries. But the recent rise in maternal age at first childbirth and decline in birth rate prompted higher attention to the baby's head shape, and more parents are consulting plastic or neurosurgeons. Based on these changes, "Clinic for Baby's Head Shape" was founded in National Center for Child Health and Development in November 2011.

About the Clinic: The purpose of the clinic is the diagnosis and treatment of deformational plagiocephaly. It is open on Wednesdays and run by 4 plastic surgeons and 1 orthotist. At the first visit, baby is evaluated by grading based on visual assessment and measurement using craniometer. When suspected, CT scan is performed for the differential diagnosis of craniosynostosis and other conditions. For a child less than or equal to 3 months of age, a physiotherapy program is introduced. For whom older than 3 months of age or with deformity severer than Grade I, molding helmet therapy is considered. When indicated, Michigan Cranial Reshaping Orthosis is produced using laser or LED scanner and carving software system (Ohio Willow Wood, Ohio, USA).

Result: During 3 years and 3 months, 470 new patients visited the clinic. Average age at first visit was 4.6 months (range: 1-13 months), and average grade was 3.1. Of the 450 infants diagnosed as deformational plagiocephaly, 200 infants were provided with molding helmet therapy. The average duration of helmet application was 21.1 weeks, and average improvement was 1.7 in grade. Seven patients with craniosynostosis and 1 with atlantoaxial subluxation were diagnosed.

Discussion: We confirmed that the molding helmet therapy executed overseas can be safely conducted in Japan as well with reasonable efficacy. The clinic is also helpful in detecting babies with craniosynostosis at earlier age.

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Surgical strategies for soft tissue reconstruction in hypertelorbitism.

Presenter: Cassio Eduardo Raposo Amaral
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Introduction: After correction of hypertelorbitism with facial bipartition, orbital box osteotomy or monobloc advancement with facial bipartition facial soft tissues should be addressed. The purpose of this study was to review our surgical strategies for soft tissue reconstruction in hypertelorbitism correction.

Methods: A retrospective study was performed of 15 consecutive patients with hypertelorbitism undergoing facial soft tissue reconstruction after hypertelorbitism correction between 2007 and 2014. All aspects related to the facial soft tissue surgical procedures (number and type of procedures, outcomes, and complications) were verified through the medical records, clinical photographs, and interviews with all patients.

Results: The present study included 15 patients (11 female and 4 male) diagnosed with Tessier number 0-14 type (n=3), Tessier number 10 type (n=1), frontonasal dysplasia (n=1), craniofrontonasal dysplasia (n=6), encephalocele (n=1), Crouzon syndrome (n=2), and Apert syndrome (n=1), between 4 and 34 years old (13.38 ± 10.23 years) in the preoperative period. Local flaps (e.g., z-plasty), Converse flap, paramedian forehead flap, and/or K stitch technique were used for facial soft tissue reconstruction; the number of surgeries performed varied according to the facial soft tissue deformities of each patient. The mean length of hospital stay was 7.08 ± 3.75 days. The mean blood unit transfusions were 595.08 ± 261.39 ml. There were no procedure-related complications. At a median follow-up of 5.15 ± 2.51 years (1 to 8 years), all patients/parents reported satisfaction. All patients are still being followed up at our center.

Conclusions: As hypertelorbitism has been associated with a variety of congenital deformities, plastic surgeons who deal with these patients should have a broad surgical armamentarium for reconstruction of soft tissue deformities after transcranial box osteotomy or facial bipartition approaches.

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Improving Results in Orbital Hypertelorism Correction by Applying Nasoethmoid Fracture Techniques

Presenter: Larry A. Sargent
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Purpose: Management of the medial canthi and adjacent soft tissue deformities associated with orbital hypertelorism often pose greater technical difficulties than treatment of the exaggerated interorbital distance. Secondary canthopexies are frequently required and results are often disappointing. The purpose of this paper is to describe modifications in standard techniques applying the principles used in multi-segment nasoethmoid fracture treatment in an effort to improve results in orbital hypertelorism management.

Method: The author's experience in the treatment of over 450 complex nasoethmoid orbital fractures has been applied to modify standard orbital osteotomies and soft tissue management in orbital hypertelorism. Segmental osteotomies and bony recontouring of the medial orbital walls has been added to the standard osteotomies. The medial canthi are routinely detached facilitating both bony and soft tissue contouring. Nasoethmoid fracture techniques are then used to facilitate restructuring bone and soft tissue in the interorbital region. Simple canthopexies have been replaced by multiple areas of soft tissue fixation to bone combined with canthi fixation and soft tissue stabilization/compression bolsters.

Results: Fifty-four patients with varying degrees of interorbital separation were operated on with the techniques described allowing restructuring of the shape and angulation of the bone in the nasoethmoid region with thinning and contouring of the soft tissue in the medial canthal area. The combination of wiring techniques, plate and screw fixation, cantilever calvarial bone grafts for the nose and soft tissue stabilization with compression bolsters were used. No repeat bony osteotomies were required and only 4 of 54 (7%) needed secondary medial canthopexies.

Conclusion: Successful management of orbital hypertelorism must address the differential shape of the medial orbital wall bone and the technically challenging soft tissue contouring of the medial canthal area. These goals are facilitated by applying techniques used in nasoethmoid management to create medial wall osteotomies combined with the key step of meticulous soft tissue management in the medial canthal area.

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The origins & presentation of patients with midline Tessier 0, 14 & 0-14 clefts managed at a single craniofacial unit

Presenter: Thomas E. Pidgeon

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Introduction: The rare craniofacial clefts remain an understudied aspect of craniofacial surgery. To date, no large series of patients affected by a single type of cleft has been examined. We present and describe the largest reported case series of midline Tessier 0, 14 and 0-14 cleft patients, who attended our centre from 1973-2012.

Methods: A database search was performed at our centre to identify applicable patients. A retrospective case note review was carried out to document patients' presenting anatomy, origins, demographics, neurodevelopment, speech, vision, and antenatal and family histories.

Results: Sixty-two patients were examined by this review; 14 (22.6%) with Tessier 0 clefts, 4 (6.5%) with Tessier 14 clefts, 28 (45.2%) with Tessier 0-14 clefts, and 16 patients (25.8%) with "other" diagnoses. Twenty-eight (45.2%) were male and 34 (54.8%) female.

Nineteen patients (30.6%) had complicated antenatal histories, with 19 (30.6%) having complications at birth. Fourteen patients (22.6%) had a family history of clefting. Visual function was poor; 26 patients (41.9%) had an acuity defect and 30 (48.3%) had strabismus. The most common anatomic defects were; hypertelorism (87.1%), bifid nose (64.5%) and maxillary hypoplasia (51.6%).

Conclusions: The anatomic features described in this case series will assist other centres in the diagnosis of new patients, and in surgical planning. The midline clefts can be difficult to diagnose and there is a high degree of variance in their presenting phenotype. Clinicians who encounter these patients should be wary of respiratory compromise at birth and a need for early ophthalmological input.

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Rare Tessier's Cleft N° 6, about 5 cases.

Presenter: Philippe Pellerin

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In 1976 Paul Tessier has published his well known classification for rare craniofacial cleft,. Out of his series he has observed all the described varieties but the Cleft N°6.

Even if he has suspected and given a description of it he did not met an isolated form and considered that it was at any time a part of Treacher Collins syndrome.

We now have a better understanding of Treacher Collins whose genetic determination is well known and would not be longer confused with rare clefts syndromes. Medical imaging has too improved the knowledge of precise anatomical details of cleft deformities.

In our personal series we have operated on three cases in France, one case in India and given an advice for one case whom data were submitted from the department of cranio maxillo facial surgery at the Plastic Surgery Hospital of the Chinese Medical Science Academy.

Thank to these observations we confirm the Tessier's hypothesis and make some proposal for treatment. We have found in the literature some misdiagnosis cases of cleft N°6 published as cleft N° 5.

The accuracy of CT scan allows a precise anatomical description; we emphasize the differential diagnostic with clefts 5 and 7.

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Intralesional Nd-YAG laser and intratumoral ligation as a cure for craniofacial arteriovenous malformations

Presenter: Nond Rojvachiranonda
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Arteriovenous malformation (AVM) of the craniofacial region, although very rare, has been a very difficult problem to treat especially when it is large and involves important structures. Surgical resection often results in unacceptable complications but still not curative. At our institution treatment by combined intralesional Nd-YAG laser and intratumoral ligation has been successful in venous malformation. This study was to prove this minimally invasive technique for its efficacy in managing the more challenging AVM cases.

AVM on the head and neck region considered unresectable without major complications were included. Disease control was studied using clinical parameters and magnetic resonance imaging.

Four patients with moderate-to-severe, unresectable craniofacial AVM were treated by this technique from 2001 to 2011. Patient age ranges from 2-51 years (mean=25). After 2-9 treatments and follow-up period of 1,456 days, three were clinically and radiologically cured. The other had residual periorbital lesion which was intentionally left untreated so as to avoid triggering intraorbital spreading. One of the three patients with cure was infant with huge mass and secondary pulmonary hypertension and clinical cure was achieved only after 3 treatments, without residual cardiovascular compromise.

High rate of complete resolution, which is normally considered impossible, becomes expectable by this technique. Laser energy setting, ablative technique and skin cooling are the main factors determining the success. Individualized laser settings and properly set endpoints can increase treatment effectiveness while shortening the whole process.

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Pediatric Maxillofacial Trauma and Its Impact On Developing Dentition: A Retrospective Review of 117 Patients

Presenter: Sanjay Naran
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No study has looked comprehensively at dental sequelae following pediatric facial fractures. Our goal was to explore adverse dental complications in the pediatric population following facial trauma, and to identify those at risk.

We identified children with facial fractures of the tooth supporting regions from 2000-2014. Data elements included; age, date of injury, treatment mode, gender, and dental outcome measures including dental avulsion, subluxation, cross bite, open bite, occlusal cant, and disruption/dysgenesis of developing dentition.

117 patients met our criteria. Average age at injury was 10.41 yrs (range: 1.03-18.68), and average follow-up was 2.9 yrs (range: 0.03-13.27). Fractures were grouped as mandibular (62.39%), maxillary (22.22%), or combination (15.39%). Dental development at the time of injury was classified as primary (17.95%), mixed (38.46%), or permanent (43.59%). Conservative management was employed in 41.88%, open reduction and internal fixation (ORIF) in 49.57%, and closed reduction and external fixation in 8.55% patients. The majority (n=79, 67.52%) did not experience any dental trauma or sequele. Dental avulsion was noted in 10.26%, subluxation in 10.26%, cross bite in 5.13%, open bite in 3.42%, occlusal cant in 0.85%, and disruption or dysgenesis of developing dentition in 5.13%. Dental avulsion was more likely to occur in patients whose fractures required ORIF (p<0.05). The development of an open bite, cross bite, or occlusal cant was more likely to occur in patients whose fracture severity required ORIF, or had a combination fracture (p<0.05). Patients in primary or mixed dentition were more likely to require follow-up dental intervention (p<0.05).

Dentition is an important consideration in pediatric facial fractures. Fracture severity, mode of treatment, and dental age are all strong predictors for adverse dental complications. Craniofacial surgeons should be cognizant of the increase in risk of complication in these patients.

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COMPUTER PLANNING AND NAVIGATION FOR CRANIOMAXILLOFACIAL TUMORS AND RECONSTRUCTION WITH FIBULA FREE FLAPS

Presenter: Francisco Alamillos

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Background: Both delimitation of surgical resection margins during ablative surgery and tailoring of a fibular flap for adequate shape reconstruction may be difficult after ablation in head and neck tumors involving bone. Computer-assisted planning (CAP) and surgical navigation (SN) may be helpful in determining these margins and in enhancing the accuracy of the reconstruction in these cases.

Objective: To report our experience using computer preoperative planning (CAP) and surgical navigation (SN) in the management of patients with head and neck cancer and fibula free flap reconstruction.

Patients and Methods: This is a retrospective study of 5 oncologic patients: two squamous cell carcinoma affecting mandible, two maxillary squamous cell carcinoma and one frontal sinus melanoma. In all cases tumor resection and primary reconstruction with fibula free flap was performed. Planning software iPlan of BrainLab has been used for preoperative planning of resection margins and fibular flap tailoring, and the Vector Vision of BrainLab for surgical navigation.

Results: In all patients we were able to assist the ablative surgery with navigation determining the adequacy of resection margins and the amount of bone that was necessary to accomplish the reconstruction. In the mandibular cases we could also determine the proper premolded reconstruction plate before surgery. Navigation also helped in checking the adequacy of the position of the fibular bone segments used for the reconstruction: lower jaw (2 cases), maxilla (2 cases), and supraorbital rim (one case).

Conclusions: Preoperative computer planning (CAP) and surgical navigation (SN) are useful tools to get accuracy in ablation and reconstruction of tumors of the head and neck affecting bone.

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Early intermaxillary traction and delayed reduction for LeFort fracture

Presenter: Akimitsu Sato

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Purpose: Le Fort fractures are usually caused by high energy trauma, and are frequently associated with other potentially fatal injuries, such as intracranial injury and cardiovascular injury. In most cases, treatments for these take priority over those for maxillofacial fractures. Even if maxillofacial surgery is performed in the early period, it is difficult to re-establish premorbid dental occlusion and it is very invasive for the patient. To improve this situation, we employed gradual closed reductions for the treatment of Le Fort fractures. Here, we present our protocol and evaluate our treatment.

Method: We start with an attempt at closed reduction using an arch-bar and elastic bands in parallel with other major injury treatment.

As the patient's general condition becomes stable and a habitual occlusal position is re-established, we perform open reduction if needed. We investigated patients with Le Fort fractures that were admitted to Tohoku University Hospital between 2007 and 2013 and treated by our protocol. Data extracted from patient records included types of fractures, treatment modality, duration from injury to operation, operation time, and operative hemorrhage.

Results: We treated 30 patients between 2007 and 2013. There were 98 Le Fort fractures (Le Fort I: 43%, Le Fort II: 35%, LeFort III: 16%, Sagittal fx: 6%). We performed preoperative intermaxillary elastic traction in 22 patients (73%) and delayed open reduction in 14 patients (47%). The average duration from injury to achieving intermaxillary elastic traction was 2.5 days, and the average duration from injury to open reduction was 14 days. Average operation time was 184 min. Average intraoperative hemorrhage was 68 ml.

Discussion/Conclusions: Our treatment protocol for Le Fort fractures successfully re-established facial appearance and premorbid dental occlusion.

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Island superficial temporal artery flap for reconstruction of complex facial defects: A new algorithm

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Background: a variety of island flaps can be based on superficial temporal artery with variable tissue composition. These can be used for defects reconstruction, cavity resurfacing or facial hair restoration

Aim: to describe our experience in using superficial temporal artery island flaps in facial reconstruction

Patients and Methods: fifty-eight patients underwent facial reconstruction using superficial temporal artery island flap either pedicled or free in the period from October 2010 and October 2013. Patients, demographic data, defects characteristics, operative procedures, postoperative results and complications were prospectively documented.

Results: 21 females and 37 males were included in this study. The flaps were used for defects reconstruction in 30cases, for cavity resurfacing in 10 cases and for facial hair restoration in 18 cases.

Conclusion: we presented a series of 58 consecutive composite superficial temporal artery flaps. They were versatile in reconstruction of a wide variety of facial defects.

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An Outcomes Comparison Between Autologous and Alloplastic Cranioplasty in the Pediatric Population

Presenter: Mathew Greives

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Background: The use of alloplastic material in cranial reconstruction has been well described in the adult population, especially when a paucity of autologous tissue exists. However, in children it is unknown how long-term growth may be affected by the implantation of non-expandable alloplastic material. Therefore, we sought to compare the outcomes of pediatric patients undergoing alloplastic versus autologous cranial reconstruction.

Methods: To assess the safety and long-term outcomes of alloplastic cranioplasty in children, an IRB-approved, retrospective, single institution review of pediatric patients undergoing cranioplasty was performed from 2000 to 2014. The age at surgery, cause of the cranial defect, defect size, time since initial surgery to reconstruction, implant type, and complications were assessed. Post-reconstruction imaging was reviewed if available.

Results: A reconstructive cranioplasty was performed in 41 pediatric patients (ages 1-19 yrs, average 7.35 yrs). Thirty patients underwent alloplastic reconstruction (age 4.67±5.54 yrs), and 11 underwent autologous reconstruction (age 2.00±3.68 yrs). The size of the cranial defects was 143.92±393.07 cm² for autologous and 405.78±572.64 cm² for alloplastic reconstructions (p=0.068). Follow up for all patients was an average of 2.10±2.62 yrs (0.1-9yrs). No patients in either group showed evidence of recurrence or elevated intracranial pressure, though one patient noted persistent headaches. One patient in the autologous cohort failed to ossify, requiring a repeat cranioplasty. In the alloplastic group, one patient required a wound revision. In long-term follow up none of the implants were exposed or lost due to infection. CT and physical exam demonstrated that there was no skull growth restriction in either group.

Conclusion: Our data show that alloplastic cranioplasty in the pediatric population is a safe alternative when autologous cranial bone is not available.

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Single Stage Cranioplasty Following Skull Neoplasm Resection Using Customized Craniofacial Implants

Presenter: Jens U. Berli

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Background: Craniectomy defects following resection of calvarial neoplasms are most often reconstructed with on-table manufacturing. With the advent of computer-aided design/manufacturing (CAD/CAM) and customized craniofacial implants (CCIs), there seems to be more suited alternatives. In this study we report our experience and outcomes using single-stage, CCI-based reconstruction for benign and malignant skull neoplasm defects.

Methods: A retrospective review of all implant cranioplasties performed between 2011 and 2014 by a single craniofacial surgeon was performed. Pre- and post-operative CT scans with 3D reconstruction were performed to assess adequate resection and final outcomes. Primary endpoints included length of surgery, predicted defect-versus-post-operative implant surface area, contour irregularities and complications.

Results: Of the 108 cranioplasty patients identified, 7 patients underwent immediate CCI-based reconstruction for calvarial neoplasms. Four patients (4/7, 57%) presented with malignant pathology. All defects were >5 centimeters squared. As compared to their original delivery size, all implants were modified intra-operatively (between 0.2-40.8%) with a mean of 13.8%. Follow-up ranged between 1 to 16 months. There were no implant-related complications identified. Aesthetic results and patient satisfaction were both ideal.

Conclusion: With this preliminary experience, we have successfully demonstrated that immediate customized implant reconstructive techniques, by way of intraoperative modification, are both safe and feasible for benign and malignant skull neoplasms. We believe that with wider acceptance of this multidisciplinary approach and increased surgeon familiarity, this technique will soon become the reconstructive standard of care.

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u-HA/PLLA composite sheet in orbital wall reconstruction

Presenter: Takeshi Miyawaki

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Many materials have been described to reconstruct the orbital walls in order to support the contents and restore orbital volume. u-HA/PLLA composite sheet was released in market in late 2013, we introduced it in reconstructing orbital walls. It is a resorbable material made of u-HA and PLLA, and designed to keep its strength for more than 6 months, and then be replaced by bone ingrowth within 4 years post-operatively. This study is to report tentative result in the use of u-HA/PLLA composite sheet in orbital fractures.

Materials and Methods: SuperFIXORB/MX^R (u-HA/PLLA composite sheet: Takiron, JAPAN), available in size of 30×50 mm, 0.5mm in thick was used in orbital wall reconstruction in 18 cases. Patients consisted of 8 males and 9 females, 2 cases were malunion, one case was impure orbital fracture with concomitant malar bone and Le Fort I fracture, one case was orbital enlargement caused by neurofibromatosis, and remaining 13 cases were pure orbital fractures. Age at surgery ranged from 6 to 53 years (mean: 28.6). Site of orbital defect, size of implant, access to the fracture site, and complication were evaluated.

Results: The site of orbital defect was orbital floor (9 cases), medial wall (2 cases), and combination of medial wall and floor of orbit (6 cases). Size of implanted material ranged from 15×20 to 43×38 mm. Transconjunctival, transcaruncular or the combination of the two were used to access the fracture site(s). Follow-up period ranged from 1 month to 14 months with a mean of 7 months. There was neither post-operative diplopia nor enophthalmos in our series.

Conclusion: Successful use of u-HA/PLLA composite sheet in the reconstruction of orbital wall defects of up to 43×38 mm following trauma is demonstrated. It can be cut and bent manually to fit the shape of orbital wall defect. This material is especially useful in orbital floor and medial wall blow-out fractures and is a valuable additional material for use in cranio-maxillo-facial reconstruction.

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Incidence of lower eyelid complications after a transconjunctival approach: influence of repeated incisions.

Presenter: Masanobu Yamashita
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Background: Although many authors have described advantages of the transconjunctival approach, few reports describe risks of postoperative lower eyelid complications with repeated incisions. The objective of this study was to investigate whether the incidence of postoperative lower eyelid complication using the transconjunctival approach was different, depending on the time of incision.

Methods: Patients who underwent orbital bony surgery at the Kanazawa Medical University Hospital between 1996 and 2012 were reviewed. Patients were divided into a group that underwent single transconjunctival incision and a group that underwent repeated incisions. Intraoperative and postoperative complications, including eyelid ectropion, entropion, and scleral show, were compared between the groups.

Results: A total of 154 transconjunctival incisions were made in 145 patients (mean age, 35.6 y; 99 men and 46 women), who were observed for a mean of 14 months (range, 6-97 mo). Two patients had eyelid lacerations with inferior lacrimal canaliculus injuries. Lower eyelid malposition requiring operative correction occurred in 3 of the 140 patients in group A (2.1%) and in 3 of the 14 patients in group B (21.4%) (P=0.01). The total postoperative complication rate in patients with a single incision was 5.0% (n=7), and that for repeated incisions (2-5 times) was 35.7% (n=5) (P=0.001).

Conclusions: The total complication rate of transconjunctival incision was slightly high. Although repeated incision cases were significantly more frequent, the eyelid could be corrected without visible scarring although eyelid complications occurred.

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FACIAL INFILTRATING LIPOMATOSIS (FIL): THE VALUE OF SURGICAL RESECTION BASED ON TIMING AND OUTCOMES.

Presenter: Dov C. Goldenberg
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Background: Congenital facial infiltrating lipomatosis (FIL) is a rare congenital disease in which mature adipocytes infiltrates all facial layers. Patients present facial asymmetry at birth that evolves as the patient grows. Associated skeletal deformities, macrodonthia and tongue nodular lesions are frequent. Differential diagnoses include lymphatic malformation, hemangioma, angioliipoma, neurofibromatosis, parotid tumor and other fat-infiltrating tumors, such as lipoblastoma and liposarcoma. Surgical treatment of FIL is controversial. Liposuction, partial or aggressive soft tissue resection are the available options. Timing is crucial for effective results.

Objective: The aim of this study was to assess operated patients, as well as discuss surgical techniques and the ideal moment for resection.

Method: A retrospective study was performed including 6 patients diagnosed with FIL and surgically treated between 2001 and 2013. Data was assessed according to age at first procedure, facial involvement, skeletal deformities, method of surgical resection and reconstruction and outcome.

Result: Mean age of patients was 9.5 years at evaluation. There was no predominance regarding the affected side of the face. In terms of surgical procedures, 05 superficial resections and 14 deep resections were performed (including liposuction in 4), totalizing 19 procedures, 3 per patient on average. The mean follow-up time was 5 years. Some degree of improvement was observed in all cases. Younger patients needed more additional procedures since facial growth overcome the obtained resection.

Discussion: Therapeutic modalities available for FIL are resection and liposuction. Complete surgical excision is technically challenging and prone to many side effects. Partial surgical resection, however, results in a high recurrence rate. There still is no consensus about the best moment for surgical treatment. We suggest postponing excision and definitive reconstruction until the end of the patients' adolescence since a better molecular understanding is expected to obtain an effective control of this pathology.

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The subcranial/translabellar approach: Our experience with 50 cases.

Presenter: Juan Solivera

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Background: The subcranial approach was developed by Raveh in 1978 for the management of severe frontobasal fractures and it was later adapted for the resection of anterior skull base tumors. Our objective is to describe a retrospective case series of 50 consecutive patients managed surgically with this approach at our institution since 2007.

Method: The mean age was 38 years (1-71), with a mean follow-up of 17 months. A standard zig-zag bicoronal approach was used in all cases. The osteotomies were planned with iPlan software (BrainLab, since 2012) and were performed using a high speed drill or a piezoelectric device. The frontal sinus was reconstructed if its posterior wall and drainage pathway were intact. If only the posterior wall of the sinus was intact, but not the drainage pathway, it was obliterated. Otherwise, the sinus was cranialized. This approach was used in 23 trauma cases with craniofacial fractures, 10 patients with late sequelae of trauma, 5 benign frontal sinus tumors, 4 anterior skull base or paranasal sinuses malignant tumors, 1 epidermoid of the third ventricle, 3 complicated sinusitis, 2 spontaneous CSF leaks and 2 congenital encephaloceles.

Result: None of the patients died. Short term complications related to approach were: three postoperative CSF leaks (one was later diagnosed of intracranial hypertension) and one meningitis with full recovery.

Conclusion: This approach allows wide access to the anterior cranial base and clival-sphenoid region for the treatment of a variety of pathologies. Also, it makes possible an adequate water and airtight reconstruction with minimal frontal lobe retraction. Craniofacial and anterior skull base osteotomies can be performed with great safety and precision with the aid of preoperative planning, navigation and piezosurgery.

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Elucidation of Genetic Basis of Craniofacial Hyperostoses

Presenter: Yoshitaka Kubota

Authors: Kubota Y, Mitsukawa N, Uchida M, Uchida Y, Akita S, Hasegawa M, Satoh K

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Craniofacial and cervical spinal hyperostoses are rarely seen in the absence of other abnormalities. Only seven patients with isolated cranial hyperostoses have been reported, and only a single patient with both calvarial and cervical vertebral hyperostoses.

We report on an adult with late-onset right-sided asymmetrical hyperostoses of the cranium, mandible, and cervical vertebrae in the absence of an AKT1 mutation. At presentation the patient displayed neither generalized overgrowth nor dysregulated adipose tissue. Standard polymerase chain reaction and Sanger sequencing of DNA extracted from formalin-fixed paraffin-embedded frontal bone and mandibular angular bone was negative for an AKT1 mutation. Though the patient's clinical manifestations did not fulfill the consensus diagnostic criteria of Proteus syndrome, the mosaic distribution of lesions, the sporadic occurrence, and the patient's progressive course were consistent with a somatic mosaicism similar to that syndrome.

Hence, the patient's phenotype may have been caused by a very late mesodermal somatic mutation during embryogenesis.

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Craniofacial approach to en plaque cranio-orbital meningiomas: Strategies and lessons learned.

Presenter: Rachna S. Ram

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Background: En plaque sphenoid wing meningiomas involve the orbit, dura and at times cavernous sinus. Bony infiltration causes hyperostosis and bony resection is indicated. Optimal reconstruction restores craniofacial anatomy, preserves ocular function and prevents enophthalmos. Dural involvement requires dural reconstruction whereas orbital involvement causes neurological compromise.

Cavernous sinus and superior orbital fissure involvement is frequent and some consider these to be at the surgical limit of resection. Radiotherapy then plays an important role in limiting recurrence.

Method: Patients with en plaque sphenoid wing meningiomas to the Wellington Craniofacial team between 2008 to 2013 were retrospectively reviewed.

Results: Eleven patients underwent combined craniofacial resection and reconstruction. Six patients had newly diagnosed disease and five patients were referred for recurrence.

A combination of anterolateral orbitotomy was performed in 8 patients, orbital roof orbitotomy in 5 patients and a supraorbital bar in 2 patients. The zygomatic arch was removed in 7 patients. The superior orbital fissure was decompressed in 9 patients via deroofting of superior orbital fissure in 3, laterally in 3 patients and inferiorly in 2 patients. Dural reconstruction was done using duramatrix, fascia or vascularised pericranium.

The lateral orbit was reconstructed with split calvarial bone, titanium mesh, free bone graft and preserved roof of orbit.

Subtotal resections achieved Simson grade II clearance for most patients. Radiotherapy was offered to 5 patients. At 1 year, three patients had recurrence needing further debulking surgery. Two had declined post operative radiation but accepted after further debulking surgery while one patient recurred despite radiotherapy for malignant meningioma. At five years, there was one death from malignant meningioma. Nine patients were disease free and asymptomatic at up to 5 year follow up.

Conclusion: Recurrent disease can be safely excised with a combined multi disciplinary team approach using craniofacial principles. Cavernous sinus and supra-orbital fissure involvement is complex with high risk of recurrence. We present techniques to safely decompress the superior orbital fissure and access tumors involving cavernous sinus.

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Application of a mini-preauricular incision, trans-parotid approach for surgical management of condylar fracture

Presenter: Po-Fang Wang

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Background: The optimal surgical approach for condylar process fracture is still debated. The aim of this study was to introduce a mini-preauricular transparotid approach for direct reduction and plating the condylar fracture. It was also compared to other approach methods for the complications and functional restoration.

Methods: A retrospective study was conducted on 58 patients from 2009 to 2011 with 69 high subcondylar and condylar neck fractures in Chang Gung Memorial Hospital. The fractures were treated surgically with a 2-cm mini-preauricular and transparotid approach using miniplates and screws for fixation in 29 patients with 36 fractures. The control group consisted of 29 patients with 33 fractures. Among this group, 13 patients underwent intraoral approach with endoscopic assistance, 2 facelift approaches, and 17 retromandibular approaches. The post-operative hospital stay, occlusion status, mouth opening and facial nerve and parotid gland related complications were compared between two groups.

Result: The operation time and post-operative hospital stay had no significant difference between two groups. Both groups showed 90% patients had good restoration of preinjury occlusion. Postoperative mouth opening was 39.8 mm and 39.9mm in preauricular approach and in other approaches respectively. Facial symmetry was achieved in all of the patients. No facial nerve palsy, infection or hemorrhage in the mini-preauricular group. One patient of control group had a persisted weakness of the frontal nerve palsy. There were no cases suffering from Frey syndrome, salivary fistula or sialocele on both groups.

Conclusion: Based on the results, the mini-preauricular approach can be an alternative, safe and effective method to manage the condylar neck and high subcondylar fracture. It provides the advantage of the smaller incision with direct exposure to the fracture site which make reduction and fixation of the condylar neck and high subcondylar fracture easier.

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Risk factors analysis for outcome of indirect traumatic optic neuropathy (TON) with steroid pulse therapy

Presenter: I-Li Lai

Authors: Lai I, Liao H

Background: Although recent evidence suggests a controversy effect of steroids in management of indirect traumatic optic neuropathy (TON), steroid pulse therapy remains one of reasonable treatments for patients with indirect TON. It is thought that microcirculatory spasm, edema, and nerve cell necrosis can be prevented or reduced by large doses of corticosteroids. The aim of this study is to analyze the predisposing factor for the recovery of the patients with indirect TON who were treated with steroid pulse therapy.

Material and Methods: Tracing the data of trauma center of Chang-Gung Memorial Hospital from 2008 to 2014, 20 consecutive cases of indirect TON were identified retrospectively. The 20 cases all showed NLP (no light perception) under initial ophthalmologic examination. They all received steroid pulse therapy with Methylprednisolone in IV form after examined by ophthalmologists, and they did not receive optic nerve decompression. General data, fracture pattern from images, hospital courses, trauma-related data from ER record, initial and final visual data from ophthalmologic record are reviewed. Relative risk (RR) and 95% confidence intervals (CI) are calculated. Fisher-exact test is used for two variables to test differences between proportions.

Result: Female gender (RR=3.400, 95% CI 1.628 to 7.101, p=0.049), administration of Methylprednisolone less than 24 hours from injury (RR=3.429), lateral force fracture pattern (RR=3.500), age \leq 40 (RR=2.333), and pure facial trauma (RR=3.667) are predisposing factors for improvement of visual acuity. While orbital blow-out fracture (RR=9.800, 95% CI 0.899 to 106.845, p=0.070), initial free extra-ocular movement (EOM) (RR=6.667, 0.809 to 54.597, p=0.145), initial intra-optic pressure (IOP) $>$ 25mmHg (RR=8.000, 0.598 to 106.936), and higher triage grade (RR=3.000) are at risk of no improvement.

Conclusions: From this study, we might suggest to apply steroid pulse therapy on those patients without contraindication, incurring injury less than 24 hours. Factors like female gender, young age, lateral force fracture pattern, and pure facial trauma revealed better outcome of improvement of visual acuity. Orbital blow-out fracture, initial free EOM, initial IOP $>$ 25mmHg, and higher triage grade suggest poor improvement of visual acuity.

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Fibrous Dysplasia: Opinions on the Indications for the Unroofing of Circumferentially Encased Optic Nerves

Presenter: Craig Rowin

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Introduction: Fibrous dysplasia is an abnormal growth of bone that can lead to disfiguring facial growth as well as functional craniofacial deficits. One of the dreaded outcomes of fibrous dysplasia is the compression of the optic nerve, leading to blindness. Controversy has surrounded the role of optic nerve unroofing (ONU) in the presence of fibrous dysplasia. At present, standard practice is to decompress the nerve in a therapeutic fashion when there is progressive visual compromise.

Methods: From 1975 to 2013, all patients with fibrous dysplasia were investigated. Their age at operation, demographics, operative procedure, optic nerve involvement (radiologically and clinically), and long term outcomes and complications were recorded.

Results: Over the course of 37 years, the senior author had operated on 33 patients with fibrous dysplasia. Average follow-up was 10 years. Nine patients had circumferential involvement of the optic nerve. Whenever possible, all fibrous dysplastic bone was removed and replaced with autogenous bone.

Therapeutic decompression was performed on 2 patients-they had polyostotic fibrous dysplasia, and both underwent decompression for deteriorating vision, one rapidly so. One lost vision bilaterally in spite of adequate unroofing of both nerves at one sitting; the other had ONU of one nerve when visual deterioration was noted, and then the other nerve unroofed when dysfunction arose there; he went on to blindness in one eye.

Conclusion: This data indicates that compressive optic neuropathy can lead to blindness. When ONU is delayed for chronic compressive optic neuropathy until objective signs of optic nerve dysfunction arise, nerve function may be so significantly impaired that function fails to improve, or even goes on to visual loss. In cases in which both optic canals are involved, then decompression should occur in a staged fashion, operating on one orbit at a time. In regards to prophylactic optic nerve unroofing, we believe it is safe when performed by an experienced neurosurgeon, and it should be performed not necessarily as a primary surgical procedure, but as a procedure secondary to excision of fibrous dysplasia in the anterior skull base during the same operation.

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Combining Navigation and Endoscopy for Orbital Reconstruction

Presenter: Chien-Tzung Chen

Author: Chen CT

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Background: Sequelae of inadequate orbital reconstruction include enophthalmos, hypoglobus, and diplopia. Accuracy of orbital reconstruction is largely subjective and even more difficult to achieve due to anatomic distortion in secondary or late reconstruction and in extensive injury. We report our experience combining computer navigation and endoscopy to perform accurate, aesthetic, and safe minimal-access primary and secondary orbital reconstruction.

Methods: From March 2012 to March 2014, 24 patients underwent unilateral primary and secondary or late minimally-invasive orbital reconstruction with mainly Medpor and/or titanium mesh via navigation and endoscopic assistance through transantral, transconjunctival or upper blepharoplasty approaches. Mean follow-up was 13.8 months (range, 6.2 months to 2.8 years).

Results: All orbital fractures were successfully reduced. Average enophthalmos among patients who underwent early reconstruction, late reconstruction, and repair of two or more orbital walls improved after surgery from 1.6 mm to 0.2 mm, 2.6 mm to 0.2 mm, and 2.6 mm to 0.2 mm, respectively. One four-wall orbital fracture had 7 mm enophthalmos that resolved after another secondary orbital augmentation. Hypoglobus was corrected in all affected patients. There were no major complications during follow-up and all were satisfied with their final appearance and function.

Conclusion: Navigation increases reconstructive accuracy and avoids injury to vital structures. When combined with endoscopic assistance for minimal-access reconstruction of wide-ranging orbital defects from primary to secondary or late cases and to extensive multi-wall fractures, navigation facilitates minimal cosmetic incision and synergistic endoscope use, and clearly improves aesthetic and functional outcomes all with enhanced safety and unparalleled intraoperative visualization.

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Sphenoid dysplasia in neurofibromatosis: Patterns of presentation and outcomes of treatment

Presenter: Scott P. Bartlett

Authors: Bartlett SP^{1,2}, Swanson JW^{1,2}, Ligh CA^{1,2}, Shubinets V^{1,2}, Mitchell BT^{1,2}, Whitaker LA^{1,2}, Taylor JA^{1,2}

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Background: Although it is one of the major criteria for neurofibromatosis (NF) type 1, patterns of sphenoid dysplasia are poorly understood. Marchac's landmark 1984 study summarized his results as "far from being satisfactory," yet no subsequent report has advanced our treatment algorithm. We sought to determine the patterns of sphenoid dysplasia and the outcomes of different surgical treatment.

Methods: A multi-institutional, retrospective study was performed at tertiary pediatric and adult hospitals. A radiographic search algorithm at each institution identified patients with findings of sphenoid dysplasia; they were compared to an institutional NF registry. Clinical, photographic, radiographic, and surgical records were reviewed with emphasis on NF disease, vision, and outcomes of treatment.

Results: Sixty patients with sphenoid dysplasia were included; 59 (99%) were diagnosed with NF-1. Cross sectional data yielded a sphenoid dysplasia prevalence of 7.1% among patients with NF-1. Initially, a normal sphenoid was seen in 28 (46%) patients, abnormal sphenoid contour in 18 (30%), sphenoid thinning in 4 (7%), and sphenoid defect in 10 (17%). On subsequent imaging, 31 patients initially presenting with a normal, dysplastic, or thin sphenoid progressed to dysplasia (24), thinning (2), or a defect (5). Patients with serially-imaged defects demonstrated mean defect growth of 2.6cm²/yr. Eye enucleation occurred in 10 (17%) patients, at a mean age of 4.4 years, and was more common in patients with a sphenoid defect (p<0.0001). Among 15 patients (25%) with a defect, 4 were managed with orbitosphenoid reconstruction with titanium mesh and cranial bone graft and 5 were treated with soft tissue debulking/canthopexy only. In both patients with intact vision in whom this was performed, vision was preserved (mean followup 4.0 years). Soft tissue debulking only had no impact on progression to vision loss compared to those that were not debulked (44% vs 50%, p=0.87).

Conclusion: Sphenoid changes in neurofibromatosis patients appear to be progressive, from dysplasia and thinning to a complete defect. Early orbitosphenoid reconstruction of a sphenoid defect with titanium mesh and cranial bone graft may spare vision compared to soft tissue debulking in our limited surgical experience. Further analysis is forthcoming.

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Comparison of custom CAD/CAM PEEK, HTR, and titanium implants for craniofacial reconstruction in children

Presenter: Phuong D. Nguyen

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Background: Children pose unique challenges for craniofacial defects incurred by trauma, tumor extirpation, congenital anomalies, or residual defects from previous surgery. CAD/CAM patient specific implants offer cerebral protection and improved facial harmony without the disadvantages of autologous bone. Titanium implants and polymethylmethacrylate (PMMA) hard tissue replacement (HTR) implants have been used but are limited by high cost and reduced long-term incorporation. Polyetheretherketone (PEEK) is a synthetic material with advantages including strength, durability, inertness, and volume. We review our experience with these three patient-specific implants.

Methods: A retrospective review was performed of all pediatric patients undergoing inlay or onlay implant reconstruction using CAD/CAM PEEK, HTR, or titanium implants at a single institution. Preoperative CT scans were obtained for each patient for implant design. Demographics, cost, operative time, complications, and outcomes were assessed.

Results: Between 2003 and 2014, 136 patients had custom patient-specific craniofacial reconstruction with 72 patients using PEEK implants, 42 patients with HTR implants, and 22 patients with titanium implants. There were 69 male (51%) and 67 female (49%), with an average follow up of 30 months. Average age for PEEK patients was 13.7 years, HTR patients 10.8 years, and titanium patients 10.1 years ($p < 0.05$). Indications included post-cranial vault remodeling defects (26.5%), decompressive craniectomies (25.0%), craniofacial syndromes (25.7%), tumor defects (14.0%), and trauma (6.6%). There was a significant difference in material cost between PEEK (\$7,703) and HTR (\$8,328) vs. titanium (\$11,980) ($p < 0.0005$). Operative time was no different (140 min vs. 170 min vs. 168 min, $p = 0.12$). Major complications included 5 infections in the PEEK group (6.9%) with 4 requiring removal (5.7%) and 1 wound dehiscence (4.6%) requiring removal in the titanium group. There were 93 inlay and 43 onlay cases. All patients with intact implants reported satisfaction with the ultimate aesthetic result on follow up evaluation.

Conclusions: Custom designed PEEK and HTR implants are safe and versatile with excellent long-term results in the pediatric population with less cost than titanium implants.

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Surgery of Craniofacial Venous Malformations—New Strategies

Presenter: Nguyen Hong Ha

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Purpose: Controversies persist regarding correct treatment of venous malformation (VM), including time and type of intervention. The morbidity and mortality of VMs remain a serious threat to patients, even when observation is the default strategy. Treatment of VM by a variety of specialists including surgeons, dermatologists, and interventional radiologists has led to conflicting opinions and, we suggest, increased morbidity. There is a clear need for consensus based upon evidence of superior treatment outcomes. This study examines the postulation that surgery represents the most effective treatment for permanent control and/or cure of VM.

Material and Methods: This study represents the surgical experience of one plastic surgeon and colleagues with 20 craniofacial venous malformations, including the largest facial VM reported. Pre-operative physical examinations, MRI and CT findings, photographs, photomicrographs and Doppler examinations are presented as are long-term post-operative results, recurrences and complications.

Results: All patients were followed after surgery for at least one year. There were no deaths from surgery or other treatments. All patients in the study underwent at least one surgical procedure. Half of patients had undergone prior treatment with a combination of laser, sclerotherapy, chemotherapy (systemic or intra-lesional), partial surgery and observation. Successful treatment (no residual tumor or no significant residual tumor) was achieved by surgery in 19 of 20 patients. One patient with giant VM required 3 procedures.

Conclusions: (1) Radical excisional surgery can be a primary curative therapy with minimal functional or aesthetic morbidity for VM; (2) Sclerotherapy, including alcohol percutaneous injection, embolisation and laser therapy should not be the primary mode of therapy for large, high flow VMs; (3) Vascular plus plastic surgical techniques can render large VMs manageable and insignificant; and (4) Our results support the consideration by other teams of primary surgical therapy for VM.

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Navigation assisted standardized Osteotomies as intracranial and extracranial approaches to the skull base

Presenter: Robert A. Mischkowski

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The surgical therapy of pathologies at the skull base is associated with the challenge to find an optimal approach which allows not only for a sufficient overview of the surgical site but at the same time results in the least functional problems and aesthetic impairment for the patient. As intracranial approaches to the anterior, middle and lateral skull base we introduced standardized fronto-orbital, fronto-orbitonasal and fronto-orbitozygomatic osteotomies. As extracranial approaches, mostly to the infratemporal fossa, zygomatic and lateral mandibular osteotomies have been used.

Since 01.01.2005 97 surgeries have been performed using the techniques described above. The most frequent pathologies were tumors in 92 cases (94.8%), hereby especially meningiomas in 36 cases (37.1%). The most frequent approach was the unilateral fronto-orbitozygomatic osteotomy in 29 cases (29.9%) followed by the fronto-orbital osteotomy in 23 cases (23.7%). The osteotomized bone segments were transiently removed and re-inserted after the treatment of the pathology using internal fixation. All procedures were conducted using computer assisted intraoperative navigation.

In all cases the chosen osteotomy technique allowed for a sufficient surgical overview for a navigation assisted treatment of the pathology. In 10 cases (10.3%) complications have been encountered, mostly a liquor leakage (4 cases). In 3 patients a partial necrosis of the reinserted bone segments occurred. In one patient the transiently osteotomized bone segments were completely lost.

The presented standardized osteotomy techniques allow for a safe approach to the entire skull base including the orbits. Computer assisted planning and intraoperative navigation based on 3D imaging data improve significantly the safety margin of the procedures and should be considered as standard in this type of operations.

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Prenatal ultrasound screening for single suture craniosynostosis.

Presenter: Martijn J. Cornelissen

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Objectives: Although single suture craniosynostosis is diagnosed only sporadically during pregnancy, timely referral is critical to its treatment. In the Netherlands, 95% of pregnant women receive a standard ultrasound at around twenty weeks of gestation, potentially an ideal setting for detecting craniosynostosis prenatally. To enhance prenatal detection of trigonocephaly and scaphocephaly, we wished to identify new screening parameters.

Methods: We retrospectively analyzed data of the 20 week anomaly scan in trigonocephaly patients (n=40), scaphocephaly patients (n=27) and matched controls. We measured six different cranial dimensions, including head circumference, biparietal diameter and occipito-frontal diameter, defining the ratio between biparietal and occipito-frontal diameter as the cephalic index.

Results: Prenatal biometric measurements did not differ significantly between trigonocephaly patients and controls. The cephalic index was significantly lower in scaphocephaly patients than in controls (0.76 vs 0.79; p=0.003). A ROC curve was constructed and a CI value of 0.73 is proposed as cut-off value for screening purposes.

Conclusions: Prenatal biometric measurements do not differ significantly between trigonocephaly patients and controls. The cephalic index is lower in scaphocephaly patients and could be a useful tool for identifying scaphocephaly at around 20 weeks of gestation.

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Fronto-orbital distraction to treat metopic synostosis

Presenter: Brianne T. Mitchell

Authors: Mitchell BT^{1,2}, Swanson JW^{1,2}, Heuer G^{1,2}, Taylor JA^{1,2}¹University of Pennsylvania, USA, ²Children's Hospital of Philadelphia, USA

Background: Fronto-orbital advancement (FOA) remains the standard treatment for metopic craniosynostosis despite fairly high rates of frontal retrusion requiring revision or cranioplasty in the long-term. Further, some recent literature suggests that neurocognitive risks are better mitigated with earlier surgical intervention in craniosynostosis. We introduce an alternative non-devascularizing FOA technique that is performed at an earlier age and utilizes distraction osteogenesis.

Methods: The surgical technique employs a 7mm metopic strip craniectomy, followed by standard FOA osteotomies. These are performed via limited dural dissection technique, but include bilateral sphenoid wing release, and leave the frontal bandeau attached to the bilateral frontal bones. An interpositional midline frontal bone graft is placed, followed by bilateral internal distractors with their baseplates "spring-loaded" to provide additional widening to the frontal region. We review peri-operative morbidity and early outcomes, and performed craniometric analysis of cranial volume change compared to conventional FOA.

Results: Four patients with metopic synostosis underwent treatment, at a median age of 6.5 months. Median procedure length was 3.2 hours, with 465cc of blood transfused. Distractor activation commenced two days postoperatively at a rate of 1.5 mm/day for 16 days. Distractors were removed after 8 weeks of consolidation with a median 100cc blood loss and overnight hospital stay. There were no apparent perioperative complications. Craniometric analysis indicates a median 14.7% increase in anterior cranial volume, compared to median 9% that we observe in conventional FOA. At early followup (median 7 months,) patients uniformly showed robust frontal advancement with good symmetry and contour.

Conclusion: Distraction-mediated FOA can safely achieve early, robust cranial expansion in a non-devascularizing manner for metopic synostosis.

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The metopic synostotic correction with distraction.

Presenter: Fernando Molina

Author: Molina F

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The metopic suture is very important role in the development the frontal bone, responsible for the shape of the forehead. Its early closure produce bone prominence triangular shape and flattening of the lateral regions. Also is cause of hypotelorism. A Trigenocephaly traditionally is treated osteotomies in the skull, reshaping the frontal bone and increasing the orbital distance. This procedure produce with blood loss requiring transfusion and miniplates to fix bone segments. To minimize procedures and morbidity, a trigonocephaly can be corrected resecting the affected suture and springs. We present a clinical series, 8 patients, 3 male, 5 female, aged 3-6 months. A Tri-Di CT Scan was obtained confirming suture closure. Surgical correction was made 6-8 months old. Through a bicoronal incision, frontal bone exposure, the metopic suture is resected reaching until the middle portion of sagittal suture. A bone gap wide 1.5 cm diameter is left. Then 3 to 5 springs are inserted, omega shape, along the open suture. With a fine chisel we produce a "green stick" interorbital fracture inserting one spring near. To avoid wires are far apart the skull, absorbable sutures are used, adapting springs to cranial curvature. Immediately springs starts acting, separating the bone gap edges. Its strength and capacity to separate bone segments concluded 4 and 6 weeks later. By this time, radiological controls show an early area of bone regeneration. The springs are left for 5-6 months. Then x-ray controls show the presence of healthy cortical bone, and we remove the devices. With this surgical technique frontal bone deformity is corrected very satisfactorily. Also the lateral flattening is corrected, with better final configuration of the entire skull. Distance between orbits increases with hypotelorism correction. In serie we have not observed complications such as bone infection, hematoma, intracranial dead space, intracranial hypertension, seizures or other neurological problems. The technique is very benign and well tolerated for the children. Its main disadvantage in to include a second surgical procedure for springs removal. Our longest clinical follow-up is four years.

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Surgery for premature suture synostosis may hamper growth and result in reduced intracranial volume

Presenter: Peter Tarnow

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Background: Cranioplasty for premature suture synostosis is indicated for correction of the skull deformity and enable normal growth of the skull as well as to sometimes relieve increased intracranial pressure. Even though the benefits of cranial surgery are widely accepted, surgical intervention might also restrict skeletal growth.

Methods: All patients operated for metopic synostosis (2002-2008) and sagittal synostosis (2002-2012) that had undergone a CT examination before surgery and/or at three years of age were included. The intracranial volume (ICV) was measured with a MATLAB application. Controls were age and sex matched children that had undergone CT for trauma or neurological indications.

Results: Preoperatively, 185 patients were identified (sagittal synostosis n=143, metopic synostosis n=42). Postoperatively 160 patients were identified (sagittal synostosis n=103, metopic synostosis=57). A total of 414 controls were measured. Preoperatively the ICV was identical both for sagittal synostosis and metopic synostosis vs controls within the span from 4 to 10 months of age.

At three years of age the ICV was significantly reduced vs controls for both types of cranioplasties performed for metopic synostosis: after frontal cranioplasty and bone transplant the ICV was 1,270±0.101 ml (mean±SEM) vs 1356±0.103, p=0.002, and after frontal cranioplasty complemented with a spring the ICV was 1,263±0.123 vs 1,346±0.115 ml, p=0.001.

The ICV was also significantly reduced vs controls after cranioplasty for sagittal synostosis 1,286±20 ml vs 1,362±20 ml, p=0.004. After craniotomy and springs for sagittal synostosis the ICV was 1,300±20 ml vs 1334±17 ml, p=0.223.

Conclusion: These measurements of ICV have revealed that extensive cranioplasties for premature craniosynostosis can be suspected to produce growth retardation and reduced ICV at long-term follow-up.

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Sagittal Synostosis; A Review of 213 Consecutive Cases

Presenter: Walter J. Flapper

Authors: Flapper WJ, David DJ

The Australian Craniofacial Unit, Australia

Sagittal synostosis remains the most common form of single suture craniosynostosis. This study reviews the management of 213 consecutive cases presenting to a single centre over a 38 year period.

Methods: A retrospective review of all cases of sagittal synostosis presenting to the Australian Craniofacial Unit was carried out. Data was obtained from the unit database, case files and hospital notes. This was entered onto an Excel Spreadsheet and analysed.

Results: 261 cases were reviewed. Of these, there were 213 cases of sagittal synostosis with scaphocephaly identified. The majority of patients were male and presented with primary synostosis of the sagittal suture. A significant number of patients had an abnormal labour with 31 patients requiring a Caesarean section.

The surgical technique used has changed over the period of the audit from linear strip craniectomy in the early cases to a more extensive craniectomy, reshaping of the frontal bone and lateral barrel staving. The latter technique has been used almost exclusively since 2002.

A number of cases in the series have presented with complications of surgery carried out elsewhere prior to presentation at our unit.

The complication rate in our series has decreased over time and with the changes in our technique. Similarly, the rate of reoperation for raised intracranial pressure has decreased.

Discussion: The management of sagittal synostosis continues to vary between units. This study reviews the outcomes of a single unit's experience in managing sagittal synostosis. We believe that our technique is safe and effective in managing this condition.

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Calvarial Vault Distraction for the Late Treatment of Cephalocranial Disproportion

Presenter: Jordan Deschamps-Braly

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Background: Cephalocranial disproportion is a symptomatic condition related to a volume discrepancy between the calvarial vault and the brain. Traditional expansion techniques are unfavorable in children beyond 12 months due to their inadequate dural ossification, lack of bone pliability, and limited future growth potential. We review our experience using distraction to achieve expansion in this setting

Methods: A retrospective analysis was performed of all patients treated using distraction in this setting by a single surgeon. Demographic and outcomes data were collected. The efficacy of ossification of bone defects after expansion by distraction was measured using volume analysis of 3D CT scans. This required a CT scan at the completion of device activation and a followup CT scan six months or more beyond activation.

Results: 16 patients (17 distractions) met the imaging-based inclusion criteria. The average age at surgery was 3.97 (2.14-6.89) years. The mean initial bone defect volume after asymmetric transverse distraction was 7.26 (5.45-13.73) mL. The mean final defect volume was 2.18 (0.00-5.90) mL with a mean change of 5.08 (1.21-12.79) mL and mean interval time of 27.85 (7.13-56.39) months. This represents a mean percent defect closure of 72.30 (20.38-100.00). All patients had evidence of elevated intracranial pressure with elevated direct pressure measurement, papilledema, or both. All had resolution following treatment.

Conclusion: Distraction osteogenesis is a very effective tool in treating the older child with cephalocranial disproportion. The ability to ossify the bone defects incurred by the expansion process provides a considerable advantage in those patients unable to spontaneously ossify.

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One-piece frontoorbital advancement with distraction but without bandeau for coronal craniosynostosis

Presenter: Jong-Woo Choi

Authors: Choi J^{1,2}, Rah Y¹*¹Seoul Asan Medical Center, Korea, ²University of Ulsan, College of Medicine, Korea*

Traditional frontoorbital advancement with a supraorbital bar is the standard technique for correcting coronal craniosynostosis. However, several reports indicate that cranioplasty using distraction osteogenesis can be an alternative. To maximize the advantages of distraction, preservation of the dura attachment to the frontal bone appears to be important. Therefore, we designed a novel procedure for coronal craniosynostosis involving a one-piece frontoorbital advancement with distraction but without a supraorbital bar using only a small temporal burr hole.

The novel one-piece frontoorbital advancement technique was used in 32 coronal craniosynostotic patients. Follow-up ranged from 9~78 months (mean 36.2 months). Osteotomy on the fronto-parietal area was performed using a saw, and a burr hole of <1.0 cm was made at the 'pterion'. While referring to a rapid prototype model, osteotomies in the orbital roof, zygomatico-frontal, nasion areas and pterion were performed using a guarded osteotome to protect the dura mater. Distraction devices were applied without detachment of the bone flap from the dura (standard cranial distraction protocols were used).

The present technique resulted in minimal bleeding, shorter surgery time and minimization of the bony defect with preservation of the dural attachment. The 1.0 cm burr hole allowed visualization of the greater and lesser sphenoid bone wings, which is necessary for a safe osteotomy. The average length of distractions was 19 mm. This approach was less invasive than the traditional approach and resulted in satisfactory correction. Transfusions were not required for 20 patients. The average cranial index decreased from 98 to 84. There were no complications other than a case of meningitis which resolved following intravenous antibiotic administration.

I conclude that the one-piece fronto-orbital advancement without bandeau can be possible and a good alternative for the non-complex form of coronal craniosynostosis.

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Long-term Follow-up over 10 years after fronto-orbital advancement for plagiocephaly

Presenter: Keisuke Imai

Authors: Imai K^{1,2}, Masuoka T¹, Takahashi M¹, Yamaguchi K¹, Deguchi A¹, Matsusaka Y², Kunihiro N²¹Department of Plastic & Reconstructive Surgery, Osaka City General Hospital, Japan, ²Department of Pediatric Neurosurgery, Osaka City General Hospital, Japan

Background: Fronto-orbital advancement (=FOA) is a standard procedure for craniosynostosis. Because FOA is usually performed during infancy, changes with future growth must be carefully considered. However, long-term follow-up over 10 years after FOA has seldom been reported. We therefore report on long-term follow-up in cases who underwent FOA for plagiocephaly.

Cases and Methods: Among the 231 cases who underwent surgery for craniosynostosis between January 1994 and December 2014, this study included cases who underwent FOA for plagiocephaly, were followed postoperatively over 10 years, and for whom Computer Tomography (=CT) and pre- and postoperative photographs were available. Cases without these criteria were excluded. CT was performed with 1- to 3-mm slices parallel to the orbito-meatal line.

Results: Ten cases were evaluated. Age at surgery ranged from 5 to 19 months, and follow-up ranged from 10 to 18 years. FOA was performed by a traditional method in 5 patients, and by cranial distraction (=CD) in 5 cases. Almost no relapses occurred after surgery in any patient, but 6 patients experienced hollowing of the temporal region. This finding tended to be prominent after over 8 years follow-up postoperatively. However, 4 of the cases who underwent CD did not exhibit prominent hollowing. On the other hand, dystrophic ossification was observed at the calvaria in 3 CD cases. In addition, 1 patient showed dystrophic ossification of the orbit. Nasal deviation improved during postoperative follow-up in 6 patients.

Conclusion: This study included patients who underwent surgery for plagiocephaly and were followed after surgery over 10 years. Hollowing of the temporal region was more prominent as these children grew, but this process was milder in patients who underwent CD compared to those who underwent traditional FOA. Dystrophic_ossification of the calvaria became more pronounced over time, and it is suggested to be attributed to ossification of hematoma.

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Evaluation of fronto-orbital advancement on orbital morphology in unicoronal synostosis

Presenter: Jason W. Yu

Authors: Yu JW, Zhu M, Wes A, Swanson JW, Mitchell BT, Bartlett SP, Taylor JA

Children's Hospital of Philadelphia, USA

Background: Recent literature has demonstrated the bilateral nature of orbital dysmorphology in unicoronal craniosynostosis (UCS). The purpose of this study is to craniometrically evaluate anatomical differences between the ipsilateral and contralateral orbit in UCS patients undergoing fronto-orbital advancement and remodeling (FOAR) and compare them to unaffected controls.

Method: We performed a craniometric evaluation of orbital morphology, including orbital volume, horizontal and vertical orbital cone angle, orbital depth, corneal projection, height and width of orbital rim, and modified orbital index (MOI) in UCS patients pre- and post-FOAR, as well as unaffected controls. Univariate comparisons were performed between groups.

Result: 146 orbits were analyzed from 25 UCS patients and 23 age-matched controls. The ipsilateral UCS orbits were 14.7% smaller volumetrically ($p=0.049$) with larger vertical angle ($p<0.001$), smaller horizontal angle ($p<0.001$), increased orbital protrusion ($p<0.001$), and 7.8% smaller MOI ($p<0.001$), compared to controls. When comparing the contralateral UCS orbits to controls pre-operatively, the vertical cone angle was larger ($p=0.030$), corneal projection was greater ($p=0.011$), and MOI was smaller ($p=0.025$). After FOAR, comparison between ipsilateral orbits and controls revealed an improvement in the horizontal angle difference ($p=0.007$), the vertical angle difference ($p<0.001$), and a trend towards improvement in orbital width. The volume deficiency had been corrected to become similar to controls ($p>0.05$). In comparing contralateral orbits to controls, differences in horizontal and vertical orbital angle increased. However, corneal projection improved ($p=0.008$), as did the bilateral symmetry of corneal projection ($p=0.043$).

Conclusion: FOAR addresses only some aspects of orbital dysmorphology in UCS while not correcting others. This may explain the continued pathophysiology of eye muscle imbalances in these patients.

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Perioperative complications in children with Pfeiffer syndrome: a review of 206 anesthetics in Oxford, UK

Presenter: Sumit Das

Authors: Das S, Campbell S

*Nuffield Department of Anesthesia, Oxford Craniofacial Unit, UK***Objectives:** To perform a retrospective, anesthesia case note review in children with Pfeiffer Syndrome.**Aim:** To identify perioperative complications in this group of patients.**Background:** Pfeiffer syndrome is a rare autosomal dominant disorder characterized by craniosynostosis, craniofacial anomalies, broad and deviated thumbs and big toes, and partial syndactyly (cutaneous and bony fusion) of the hands and feet. Children with this syndrome require general anesthetics for a number of different operations and procedures. Our institution has records of 15 children with Pfeiffer syndrome. Analysis of their general anesthetic records was undertaken, and the incidence of perioperative complications was investigated.**Methods:** A retrospective case note review was performed on 15 children with Pfeiffer syndrome over a 30-year period. There were a total of 206 general anesthetics administered to these children during this period of time.**Results:** There were a total of 39 perioperative respiratory complications (18.9% of the total cases). Eight of these complications were difficult intubations (3.8% of total cases) and seven of these complications were supraglottic airway obstruction (3.3% of total cases). Eight of these complications included intraoperative desaturation (3.8% of total cases). A further twelve complications included postoperative respiratory distress (5.8% of total cases). There were two critical events including major blood loss and cardiac arrest secondary to a suspected air embolus.**Conclusions:** We found there to be a high incidence of perioperative complications in this group of patients, including difficult intubation. A significant proportion of these children have obstructive sleep apnea and may develop supraglottic airway obstruction on induction and emergence from anesthesia due to the associated mid-face anatomical abnormalities.

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Cost of Care for Children with for Apert Syndrome in the United States

Presenter: Ruth Trivelpiece

Authors: Trivelpiece R, Youn R, Rhodes J

*Virginia Commonwealth University, USA***Background:** Patients with Apert syndrome have significant malformations of the skull, face, and extremities requiring multiple complex reconstructive procedures. There are no available reports on the costs of treating and managing Apert syndrome in the United States to date. The need for current national data on treatment costs and the identification of recent trends exists.**Methods:** The authors analyzed the HCUP Kids' Inpatient Database (KID) to obtain national information on pediatric Apert syndrome discharges from five distinct periods (3-year intervals) from 1997 to 2009. The authors utilized patient and hospital data to identify trends in hospital charges based on the type of hospital, location, and other variables among various groups. A detailed investigation searching for significant trends during the 12-year study period was also conducted.**Results:** Trends identified from 1997 to 2009 included (1) average overall charges increased from nearly \$21,000 in 1997 to over \$77,000 in 2009; (2) an increase in mean overall charges (272.04% increase) and a rate of rise over double that of total healthcare expenditure (122.58%) during the same period; (3) patient race and discharge status contributed to significant differences in overall charges in at least 3 of the 5 periods examined; as did (4) hospital control (private, public, etc.), location (rural vs. urban), teaching status, and region.**Conclusions:** The authors' data show that there are significant costs associated with the treatment of Apert syndrome as well as considerable variability in overall charges depending upon patient and hospital characteristics. An understanding of such trends and differences in resource use is important for physicians and policy makers.

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Intelligence and behavior versus neuroimaging in patients with syndromic craniosynostosis

Presenter: Joyce Florisson
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Erasmus Medical Center, The Netherlands

Background: The aim of this study was to examine whether intellectual, behavioral and emotional functioning of syndromic craniosynostosis patients correlates with white matter abnormalities.

Methods: We used a prospective study in patients with syndromic craniosynostosis at the Erasmus MC Rotterdam, The Netherlands. From 2008 to 2013 a consecutive sample of all children aged 6 to 14 years were included. Eight Apert, 14 Crouzon, 8 Muenke, 8 Saethre-Chotzen and 7 complex patients were enrolled. All patients were assessed by a child psychologist and intellectual behavioral functioning was determined, using Wechsler Intelligence Scales for Children (WISC III). Memory was measured using WISC III Digit Span. Time reproduction which loads heavily on attention and inhibition processes, was assessed, using the Time Test. Regions of interest (ROIs) were placed in the following structures: limbic system, corticospinal tract, medial cerebral peduncle, white matter, corpus callosum. Eigenvalues were measured and fractional anisotropy (FA) was calculated. We were interested in the regions of the limbic system which is closely linked to memory. Corpus callosum is related to inattention.

Results: The IQ varies between all patient groups were our Apert patients have the lowest mean score (63) and the Saethre-Chotzen patients have the highest score (106). Generally, a good correlation was found between the FA values of the limbic system (fornix and left gyrus cingulate) with the patient's intelligence ($P < 0,05$ and memory ($P = < 0,02$), which is considered to be an important contributor to intelligence. When comparing patients with Apert syndrome to others, we found that the FA value of the limbic system (fornix) indeed is different ($P = 0.04$). Moreover, in patients with Apert syndrome the genu ($P = 0.02$) and splenium ($P = 0.04$) of the corpus callosum were significantly different from patients with other syndrome diagnoses.

ADHD was diagnosed in 9% (4/43) of the patients. The FA values of the corpus callosum, and no other region of interests, were significantly correlated to ADHD diagnosis ($P = 0.01$). The group was too small however to test for distribution of ADHD among syndrome diagnoses.

Conclusion: We can describe a correlation between IQ, mainly memory and the limbic system. Attention problems show correlations with corpus callosum.

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Changes in the treatment algorithm for craniosynostosis by the introduction of a posterior cranial distraction

Presenter: Yuzo Komuro
 Authors: Komuro Y¹, Shimizu A², Shimoji K³, Miyajima M³, Arai H³

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Background: We have reported that distraction osteogenesis is useful in posterior cranial vault expansion. The purpose of this study was to review our series of patients treated with posterior cranial distraction and consider a change in the treatment algorithm for craniosynostosis.

Methods: Fourteen patients (6 males, 8 females) aged between 3 months and 7 years (mean age, 1 year and 10 months) were included in this report. These included 6 patients with syndromic craniosynostosis, 2 with multiple-suture synostosis, 3 with single-suture synostosis, 1 with pancraniosynostosis, 1 with frontonasal dysplasia, and 1 with a cranial cleft.

Results: One patient with Crouzon syndrome died from postoperative respiratory dysfunction that had no causal relationship to the surgery. Sufficient posterior cranial expansion was achieved in the remaining 13 cases. The extent of expansion ranged from 23 to 35 mm. Subarachnoid spaces were expanded and the stricture of the occipital lobe and cerebellum was improved, as shown by MRI. In two cases of Pfeiffer syndrome and multiple-suture synostosis, preoperative MRI revealed a Chiari malformation. In both cases, the ascent of the cerebellar tonsil was noticed on MRI following expansion of the occipital bone.

Conclusions: Our procedures included performing a posterior cranial vault distraction osteogenesis as the initial treatment for craniosynostosis with posterior flattening, such as in multiple suture synostosis, bicoronal synostosis, and syndromic craniosynostosis. For cases with raised intracranial pressure, the surgery should be carried out when patients are less than one year old. If the patient shows exorbitism, fronto-orbital advancement should be continued by distraction osteogenesis. In the absence of exorbitism, the patient should only undergo follow-up examinations. Alternatively, frontal or fronto-orbital remodeling may be carried out to improve the forehead shape. Some cases with single-suture synostosis may show indications for posterior cranial distraction.

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Computer-assisted craniofacial surgery-experiences of the Berlin Centre for Craniofacial Surgery

Presenter: Nicolai Adolphs

Authors: Adolphs N¹, Schulz M², Haberl H², Hoffmeister B¹¹*Department of Cranimaxillofacial Surgery, Campus Virchow, Charité Berlin, Germany,* ²*Pediatric Neurosurgery-University Regional Hospital of Lille France, France*

Background: Computer assisted technologies are well established in all fields of contemporary surgery. With respect to complex craniofacial corrections computer assisted surgery is also able to support planning, surgical transfer and documentation of operative results. Possibilities and limits of these technologies are demonstrated based on the experiences of the Berlin Centre for Craniofacial Surgery.

M&M: Since 2006 computer assisted technologies have been used for the planning of different craniofacial corrections in selected patient cases (n=15). DICOM datasets were used for individual 3d-model fabrication and virtual simulation of different skeletal displacements in the first patient cases. Subsequently surgical cutting guides (DePuy Synthes Trumatch[®]) as well as patient specific implants (KLS Martin Uniqos[®]) were used in order to improve the transfer of the final surgical plan. Superimposition of pre- and postoperative skeletal situations was performed in order to evaluate the effective surgical result.

Results: Preoperative workflows have been improved since the first application in 2006. Virtual simulation of different surgical options was helpful in determining the individual treatment plan especially in distraction procedures. Intraoperative transfer can be supported by cutting guides that are created according to the virtual surgical planning. A promising approach is the use of patient specific implants in challenging skeletal situations. Superimposition of pre- and postop skeletal situations offered additional options with respect to assessment, evaluation and documentation of skeletal changes with respect to quality control and surgical teaching.

Conclusion: Computer assisted technologies are usable for surgical corrections of the craniofacial framework. They support planning, transfer and evaluation of complex corrections. Although preoperative workflows have improved additional efforts of cost and time limit the application of these technologies to selected patient cases for the moment.

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Craniosynostosis syndromes: Foramen magnum and ventriculomegaly and Chiari I malformation.

Presenter: Bianca F. Rijken

Authors: Rijken BF¹, Lequin MH¹, van Veelen-Vincent MC¹, de Rooi JJ², Doerga PN¹, Mathijssen IMJ¹¹*Dept. of Plastic and Reconstructive Surgery, Erasmus University Medical Center/Sophia Children's Hospital, the Netherlands,* ²*Dept. of Biostatistics, Erasmus University Medical Center, the Netherlands*

Object: Craniosynostosis syndromes are characterized by prematurely fused skull sutures, however less is known about skull base synchondroses. This study evaluates how foramen magnum (FM) size and closure of its intra-occipital synchondroses (IOS) differ between different craniosynostosis syndromes and control subjects, and whether this correlates to ventriculomegaly and/or Chiari malformation type I (CMI), intracranial disturbances often described in these patients.

Methods: Surface area and anterior-posterior diameter were measured in 175 3D-CT scans of 113 craniosynostosis patients, and in 53 controls (0-10 years old). Scans were aligned in a 3D multiplane-platform. Frontal occipital horn ratio was used as indicator of ventricular volume, and the occurrence of CMI was recorded. Synchondroses were studied in scans with ≤ 1.25 mm slice-thickness. Generalized linear mixed-model and repeated measures ordinal logistic regression model were used to study differences.

Results: Patients with craniosynostosis syndromes have a smaller FM size than controls ($p < 0.05$), already at birth. This is not related to the presence of CMI ($p = 0.36$). In Crouzon-Pfeiffer patients anterior and posterior IOS fused prematurely ($p < 0.01$), in Apert patients only posterior IOS ($p = 0.028$).

Conclusion: FM is smaller in craniosynostosis syndromes than in controls, already at birth. Other factors than timing of IOS closure might influence FM size as well.

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Osteogenesis And Bone Remodeling In A Murine Model Of Crouzon Syndrome

Presenter: Derek M. Steinbacher

Authors: Steinbacher DM, Gomillion C, Alcon A, Le A
Yale University, USA

Purpose: Crouzon syndrome is the most common craniosynostosis condition, resulting from a mutation in the functional domain of the fibroblast growth factor receptor 2 gene. In this study, we aimed to evaluate the wound healing and osteogenic potential associated with Crouzon Syndrome, using the FGFR2C342Y/+Crouzon mouse model. We sought to assess in vivo bone formation, and to also determine the osteogenic potential of a bioactive scaffold and/or adipose derived mesenchymal cells when applied at the defect site.

Methods: Osteogenic differentiation of ADSCs from FGFR2C 342Y/+mice and wild-type CD-1 mice was evaluated in vitro using cells isolated from subcutaneous adipose tissue samples from each mouse strain, which were treated with osteogenic differentiation and assessed after 7, 14, and 21 days with a quantitative assay for alkaline phosphatase, Alizarin Red S staining for calcium-based mineral, and gene expression analysis for osteogenic-specific markers. To evaluate bone healing in vivo, critical size defects were created in the right parietal bone of WT and Crouzon mice then fibrin scaffolds with or without ADSCs, were pipetted into the defect. Bone regeneration was assessed after 8 and 16 weeks using micro-CT and histological staining to assess tissue composition and bone mineralization.

Results: ALP activity in Crouzon mouse ADSCs was significantly higher than the WT cells at Day 7, 14, and 21, however, when stained with ARS, no significant difference was observed between the WT and Crouzon cells. Osteogenic gene expression showed no difference in Col1a or Runx-2 gene expression in WT or Crouzon cells, however, there was significantly more ALP and OPN expressed by Crouzon cells at Day 7. After 8 and 16 weeks, no significant differences in bone architecture, mineralization, or osteoblast activity were observed between WT and Crouzon mice, however, fusion of multiple cranial sutures was observed in the reconstructions of Crouzon skulls.

Conclusion: In vitro findings suggest that ADSCs from Crouzon mice may undergo increased osteogenic differentiation than similar cells from WT mice. Qualitatively, the fusion of cranial sutures for the in vivo model suggests that bone healing is enhanced in Crouzon mice when the critical-size defect heals.

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Clinical Protocol and 15 Year Safety Experience Caring for Postoperative Craniosynostosis Patients on the Ward

Presenter: Steven R. Cohen

Authors: Cohen SR¹, McIntyre JK^{1,2}, Gosman AA^{1,2}, Levy ML^{1,2}, Meltzer HS^{1,2}

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Background: At Rady Children’s Hospital in San Diego, we routinely care for postoperative craniosynostosis patients in the regular ward. This is a departure from international norms; in most craniofacial centers these children are cared for postoperatively in Intensive Care Units (ICUs). In the context of increasingly value driven healthcare, where each dollar spent is scrutinized for effectiveness, our experience shows that a less resource expensive postop setting for appropriately selected craniosynostosis patients is safe and effective.

Purpose: As part of our ongoing commitment to the highest quality of care in craniofacial surgery, we recently reviewed our protocol for postoperative care of craniosynostosis patients. We present safety outcomes for 63 patients here and report our experience with a clinical protocol for postoperative surgical care of craniosynostosis patients (open and endoscopic) in the regular ward.

Methods and Materials: Retrospective chart review identified 63 patients undergoing intracranial surgery for a craniosynostosis diagnosis in the last 18 months at Rady Childrens Hospital (open intracranial surgery=44 and endoscopic=19.) Patients undergoing onlay cranioplasty or minor procedures were excluded.

Results: 63 patients total were identified; 52 patients were managed postoperatively in the ward and 11 patients were planned admissions to the ICU, because of concomitant medical comorbidities (including significant heart disease, apnea or neuroendocrine disorders) or magnitude of intervention (including facial bipartition, Lefort 3 osteotomies, monobloc advancement or macrocephaly reduction for congenital hydrocephalus). No patients initially managed on the floor required transfer to the ICU. No adverse events or deaths occurred. Our specific protocol for managing craniosynostosis patients in the ward (including telemetry and timing of postoperative hematocrit checks) will be reviewed in the presentation.

Conclusions: Postoperative surgical care of appropriately selected craniosynostosis patients in the regular ward is safe and effective, as indicated by our review of 63 patients. Because escalation of care is rarely required, we are performing a complete review of our 15 year experience with 700 patients using this unique clinical protocol.

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Posterior Vault Distraction Osteogenesis conveys anterior benefit in Apert Syndrome

Presenter: Fares Samra

Authors: Samra F^{1,2}, Swanson JW^{1,2}, Mitchell BT^{1,2}, Bauder AR^{1,2}, Taylor JA^{1,2}, Bartlett SP^{1,2}¹University of Pennsylvania, USA, ²Children's Hospital of Philadelphia, USA

Background: The volumetric advantages of posterior vault distraction osteogenesis (PVDO) are well established. Our clinical experience further suggests that PVDO may confer morphologic changes to the anterior cranium that may delay or defer the need for fronto-orbital advancement (FOA). We sought to evaluate the effects of PVDO on anterior cranial morphology and timing of FOA in patients with Apert syndrome.

Methods: Craniometric analysis was performed on patients with Apert syndrome who underwent PVDO with emphasis on morphologic changes to the anterior calvarium. Treatment patterns of Apert syndrome treated with early PVDO (2006-2014) were compared to those initially treated with FOA (1998-2006) at our institution.

Results: 14 Apert patients were studied: 7 treated with early PVDO and 7 treated with early FOA, with an average follow-up of 6.7 years (± 4.7 years). Craniometric analysis demonstrated that after PVDO, frontal bossing angle normalized by an average of 7.6%. In the PVDO group, surgery was performed at a mean age of 6 months (± 2 months). Although this cohort is young (mean age 3.3 years), only 3 patients (43%) have undergone FOA at an average age of 20 months (± 6 months,) and none has required revision. In contrast, early FOA patients underwent initial frontal treatment at a mean age of 12 months (± 3 months); each of these subsequently required repeat FOA (4, 57%) at an average age of 6.0 years or monobloc advancement (3, 43%) at an average age of 5.8 years. Kaplan-Meier survival analysis indicates significant delay in need for subsequent FOA in patients who underwent early PVDO compared to early FOA ($p=0.02$).

Conclusions: In addition to its volumetric benefits, PVDO results in anterior morphological changes that may allow for a delay or deferral of frontal advancement. This delay may have significant advantages in reducing number of intracranial surgical procedures and durability of fronto-facial advancement.

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Minimally Invasive Posterior Vault Distraction in Craniosynostosis and Epidermolysis Bullosa Simplex

Presenter: Craig Gendron

Authors: Gendron C, Runyan CM, Vogel TW, Gordon CB

Cincinnati Children's Hospital Medical Center, USA

Background: The current approach to multi suture synostosis is a posterior vault distraction to increase the AP dimension of the skull and relieve elevated intracranial pressure (ICP). This is followed by secondary surgeries as required including fronto-orbital advancement (FOA).

Posterior vault distraction first is a smaller operation and can increase the skull volume more than a FOA. However, this procedure is still done with a bicoronal skin incision and elevation of a large posterior scalp flap.

Patients with epidermolysis bullosa simplex (EB) have significant healing difficulties and undergoing a posterior vault distraction poses a significant risk of wound breakdown and exposure of the dura, sagittal or sigmoid sinuses.

A minimally invasive approach utilizing small incisions, an endoscope and an ultrasonic osteotome maximizes the potential for healing while being an effective and safe alternative.

Case: A 2 1/2 year old male with EB, laryngomalacia, tracheostomy and restrictive lung disease was found to have papilledema and referred to our center for workup of his craniosynostosis. Head CT showed sagittal, bilateral coronal, and squamosal craniosynostosis.

Following his workup, a posterior vault distraction utilizing an endoscopic assisted minimally invasive technique with two 4 cm coronal and a 4cm long midline sagittal incision for the osteotomy and distractor placement was undertaken. The procedure was completed without complication. His incisions healed well and he is consolidating post distraction phase without any healing issues.

Conclusion: Our minimally invasive technique with endoscopic assistance minimizes incisions and maximizes healing potential while remaining a safe and effective option for posterior vault distraction particularly for cases where healing potential is a concern.

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CHIARI I MALFORMATION: RESULTS OF NEUROLOGICAL EXAMINATION VERSUS MRI.

Presenter: Hansje Bredero
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Background: Children with craniosynostosis syndrome, in particular those with Crouzon syndrome are at risk for tonsillar herniation (TH) and Chiari I malformation (CMI). CMI may present with a variety of symptoms related to the compression of the brainstem and cranial nerves. The aim of this study is to routinely screen patients for symptoms, and to relate the occurrence of these symptoms to the position of the cerebellar tonsils.

Method: Neurological assessment was performed in syndromic craniosynostosis patients, who had undergone a MRI according to protocol. The examiner was blinded for the MRI results. The following categories were assessed; mental state, cranial nerves, motor function, sensory function, cerebellar function and reflexes. These results were matched with the results of their MRI, using a chi-square test. CMI was defined as a descendance of the cerebellar tonsils of more than 5 mm below the foramen magnum. If the position of the tonsils was between 1 to 5 mm below the foramen magnum, it was referred to as TH.

Results: 68 children (mean age: 8.6 years, range: 2-18 years) underwent both neurological assessment and MRI, including 9 Apert, 25 Crouzon, 9 Muenke, 6 Saethre-Chotzen and 19 complex craniosynostosis patients. In 47/68 patients one or more abnormalities were found on neurological examination. MRI showed TH in 10 patients and CMI in 16 patients including 1 patient with Crouzon syndrome who also had a syrinx. Most of the symptoms on neurological examination were not correlated to the position of the tonsils. However asymmetry of the pharyngeal arch was present in 4/26 patients with TH/CMI and high reflexes (+2) at the arms were found in the patient with syrinx. Nystagmus was found twice as much in patients with TH/CMI compared to those without (38% vs 20%).

Conclusion: Neurological symptoms are remarkably frequent in patients with syndromic and complex craniosynostosis, but occur almost all equally frequent in patients with and without TH/CMI. Nystagmus was seen more often, but not exclusively, in patients with TH/CMI. Only asymmetry of the pharyngeal arch and high reflexes occurred specifically in patients with TH/CMI and syrinx.

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Posterior Vault Expansion and Chiari Decompression in Mercedes Benz Synostosis: The Best or Nothing?

Presenter: Michael A. Lypka
Authors: Lypka MA, Igbaseimokumo U
Children's Mercy Hospital999, USA

Background/Purpose: Mercedes Benz type Craniosynostosis is a rare form of skull suture fusion involving the posterior sagittal and lambdoidal sutures. There is a high incidence of Chiari malformation. The numbers of these patients treated at most institutions is low and widely accepted surgical protocols are absent. The purpose of this report is to describe our early approach to the surgical management of the patient with Mercedes Benz Craniosynostosis.

Methods: Two patients, one male and one female, were treated with posterior vault expansion and direct Chiari release from a coronal approach. Shunting was performed in one case before posterior vault expansion, based on neurosurgeon preference, and not in the other. Patient outcomes at 1 year were evaluated.

Results: Both patients underwent effective posterior cranial vault expansion with successful decompression of the Chiari malformation. The patient who did not receive a shunt had resolution of hydrocephalus after posterior vault expansion and Chiari release.

Conclusion: Posterior vault expansion with simultaneous Chiari release is an effective treatment for patients with Mercedes Benz Craniosynostosis and may preclude the need for shunting.

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Lambdoid Synostosis: the Association with Chiari Deformations and an Evaluation of Surgical Outcomes

Presenter: Jeffrey Fearon

Authors: Fearon JA¹, Dimas V², Ditthakasem K³, Herbert M³

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Background : A relationship between lambdoid craniosynostosis and Chiari deformations has been suggested but the true extent of this association remains uncertain. We sought to review our center's experience treating lambdoid synostosis to further elucidate this relationship, examine surgical outcomes, and identify associations that might guide future treatments.

Methods: The authors performed a retrospective chart review of all patients treated for lambdoid craniosynostosis, excluding the syndromic craniosynostoses. Operative data, scans, hospitalization, and subsequent surgical procedures were tracked. The described surgical approach varied with the presence or absence of an associated Chiari.

Results: Over 22 years, 1006 non-syndromic craniosynostosis patients were treated, 45 of these (4.5%) presented with lambdoid involvement: 25 single sutural and 20 multi-sutural (complex craniosynostosis). MR imaging revealed 60 percent of children with unilateral synostosis, and 70.6 percent with a complex synostosis, had associated Chiari deformations. The mean surgical age was 12-months, hospital stay <2.4 days, and no major morbidities or mortalities were noted. The average follow up was 5.7 years: two patients developed syringomyelia, requiring decompressions; two had planned secondary remodeling procedures (complex synostoses) and one isolated synostosis underwent secondary remodeling during a subsequent Chiari decompression.

Conclusions: The treatment of lambdoid craniosynostosis with cranial remodeling procedures, and with incontinuity suboccipital decompressions when Chiari deformations were present, was associated with no significant complications. 96 percent of those with isolated fusions were managed with a single procedure. We found a high correlation between lambdoid synostoses and Chiari deformations, suggesting the need for routine pre- and postoperative screening MR imaging.

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Results of very early distraction osteogenesis for the treatment of syndromic craniosynostosis

Presenter: John Kestle

Authors: Kestle J, Anstadt EE, Sands N, Riva-Cambrin J, Siddiqi F, Gociman B

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Introduction: Posterior cranial vault distraction (PCVD) is an important modality in the management of complex craniosynostosis. We reviewed its use at a very young age in multisuture synostosis.

Methods: We searched our 10 year operative database of 809 cranial procedures for synostosis for very young children with multisuture synostosis treated with PCVD.

Results: 9 children were treated at a mean age of 21 weeks. 2/9 with cloverleaf deformities had prior suturectomies. Average latency period was 3 days, activation period 22 days and consolidation 97 days. All patients had significant increase in cranial volume with subjective improvement of the calvarial shape. The average preoperative OFC increased from 40 cm to 45 cm at the end of the distraction. Distraction distance was 2.1-3.0 cm (mean 2.6). Two postoperative complications: one patient's hardware became infected and had operative washout and IV antibiotics for the duration of the consolidation period. One patient had CSF leak prompting premature termination of activation and placement of a lumbar drain.

Conclusions: PCVD is an option for multisuture craniosynostosis and can be initiated very early in life.

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Hybrid In Situ Cranioplasty Osteotomies for Kleeblattschadel and other High Risk Skull Deformities

Presenter: Joyce K. McIntyre

Authors: McIntyre JK^{1,2}, Meltzer HS^{1,2}, Cohen SR²

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Background: Kleeblattschadel skull deformities are notoriously difficult to correct, with high morbidity and poor outcomes, especially in patients with difficult concomitant medical diagnosis.

Purpose: To describe an innovative operative approach for patients with complex multi suture craniosynostosis that allows for safe and effective correction of skull deformities with excellent aesthetic outcomes. This hybrid approach uses techniques from open cranial vault reconstruction, endoscopic approaches to craniosynostosis and postoperative helmet therapy/banding, and is useful in patients with Kleeblattschadel skull deformities and patients with confounding medical or social diagnosis that make classic operative approaches to craniosynostosis less desirable.

Methods and Materials: The operative approaches to 4 patients are reviewed, 3 with multiple complex craniosynostosis and 1 whose parents are Jehova’s Witness and objected to blood transfusion on religious grounds. Unique approaches of the hybrid in situ technique include freeing stenosed sutures in their entirety and leaving surrounding cranial bones (or pieces of cranial bones) “floating” on underlying dura with their blood supply intact, liberal use of excisional osteotomies and out-fracturing to improve overall cranial volume, precise intraoperative suturing techniques and placement of resorbable plates and mesh, and postoperative cranial banding to retain and improve head shape during skull growth.

Results: No adverse events occurred. All patients had excellent correction of their complex craniosynostosis. CT scans with 3D reconstruction, intraop video and postop photos (with up to 1 year follow up) demonstrating the operative techniques and outcomes will be reviewed.

Conclusions: The hybrid in situ cranioplasty technique for making osteotomies for Kleeblattschadel and other high risk skull deformities allows for safe, rapid and effective correction of skull deformities with excellent aesthetic outcomes.

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An Analysis of Posterior Vault Distraction and its Effects on the Posterior Fossa and Cranial Base

Presenter: Jason D. Wink

Authors: Wink JD¹, Bauder AR¹, Swanson JW¹, Derderian CA², Bartlett SP¹, Taylor JA¹

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Introduction: Posterior vault distraction osteogenesis(PVDO) is used to manage severe turribrachycephaly and elevated intracranial pressure. PVDO allows for greater expansion of the cranial vault(CV) when compared to more conventional modalities. However, little is known about how PVDO directly affects the cranial base. The goal of our study was to use 3D craniometric analysis to better elucidate these relationships.

Methods: We identified children with syndromic craniosynostosis(SC) who underwent PVDO at our institution between 2009-2012 who had no previous intracranial surgery and underwent pre/post-operative 3DCT of adequate resolution. 3D volumes of the CV and posterior fossa(PF) were generated. Craniometric analysis of the cranial base included measurement of the dimensions and surface area of the foramen magnum(FM), cranial base angle(CBA: FM-Sella-Nasion), and posterior vault inflection angle(PIA: Sella-FM-Occipital protuberance). Statistical analysis was performed comparing pre- and post-operative measurements using the Wilcoxon matched pairs sign rank test(significance: p<0.05).

Results: A total of 10 children (5M, 5F) were identified who met inclusion criteria for this study. Each patient carried a diagnosis of SC: 2 Apert, 2 Crouzon, 3 Saithre-Choutzen, 1 Pfeiffer, 1 Muenke and 1 undefined syndrome. The mean age of intervention was 13.0 +/-12.2 months. We found a mean total increase in CV volume of 299.8+/-154.6cm³(p=0.007). On average, the ratio of PF volume to CV volume increased by 9.8%(p=0.005). The CBA and PIA increased by a mean of -1.3+/-8.4 deg(p=0.08) and 7.3+/-13.4 deg(p=0.6) respectively as the result of PVDO. The dimensions of the FM increased by 0.22+/-0.33cm(p=0.074) and 0.18+/-0.2cm(p=0.0284) resulting in increased total surface area of 0.7+/-0.9cm²(p=0.03,18.4%).

Conclusions: The results of our study suggest that PVDO results in a large relative increase in the PF component of CV volume. The surface area of the FM is similarly expanded. These data potentially have important implications for cerebellar tonsillar herniation and regional cerebral blood flow, which will be the focus of future studies.

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Occipitofrontal circumference predicts intracranial volume in craniosynostosis syndromes.

Presenter: Priya N. Doerga

Authors: Doerga PN¹, Rijken BF¹, den Ottelander BK¹, van Veelen-Vincent MC², Lequin MH³, Mathijssen IMJ¹¹Plastic and Reconstructive Surgery, Erasmus University Medical Center/Sophia Children's Hospital, the Netherlands, ²Pediatric Radiology, Erasmus University Medical Center/Sophia Children's Hospital, the Netherlands, ³Neurosurgery, Erasmus University Medical Center/Sophia Children's Hospital, the Netherlands**Object:** Patients with craniosynostosis syndromes at risk for developing elevated intracranial pressure (ICP). In clinical practice, the occipitofrontal circumference (OFC) is used as an indirect measure for intracranial volume (ICV), to evaluate skull growth. However, it remains unknown whether OFC is a reliable predictor of ICV in patients with a severe skull deformity. Therefore, in this study we evaluated the relation between ICV and OFC.**Methods:** Eighty-four CT-scans of 69 patients with syndromic and complex craniosynostosis treated at the Dutch craniofacial center were enrolled. ICV was calculated based on CT-scans using auto-segmentation with a Hounsfield Units threshold (HU<150). OFC was collected from electronic patient files. CT-scans and OFC measurements were matched based on a maximum amount of the time that was allowed between these examinations, which was dependent of age. A Pearson correlation coefficient was calculated to evaluate the correlations between OFC and ICV. The predictive value of OFC, age and sex on ICV was then further evaluated using a univariate linear mixed model. The significant factors in the univariate analysis were subsequently entered in a multivariable mixed model.**Results:** The correlations found between OFC and ICV were $r = 0.908$ for the total group ($p < 0.001$), $r = 0.981$ for Apert ($p < 0.001$), $r = 0.867$ for Crouzon-Pfeiffer ($p < 0.001$), $r = 0.989$ for Muenke ($p < 0.001$), $r = 0.858$ for Saethre-Chotzen syndrome ($p = 0.001$) and $r = 0.917$ for complex craniosynostosis ($p < 0.001$). Age and OFC were significant predictors of ICV in the univariate linear mixed model (p *Conclusion:* OFC is a significant predictor of ICV in patients with syndromic and complex craniosynostosis. Therefore measuring the OFC during clinical practice is very useful in determining which patients are at risk for impaired skull growth.

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The Effect of Cranial Base Surgery on Congenital Craniofacial Deformities

Presenter: Manlio Galie'

Authors: Galie' M, Elia G, Clauser LC

*Unit of Cranio Maxillo Facial Surgery-"St. Anna" Hospital and University, Italy***Background:** Craniofacial surgery and syndromology during the last two decades have undergone a tremendous evolution by different approaches, assessments and also surgical techniques. The cranial base is a "constructional template" for facial development, normal or abnormal. Craniofacial synostosis involves abnormalities of the sutures of the cranium, the face, and the growth centers of the skull base.**Method:** A retrospective review (1998-2014) of non syndromic (Trigono, Scapho, Plagio, Brachy) and syndromic craniofacial dysostosis (Apert, Crouzon, Saethre-Chotzen, Pfeiffer), as well as BETS-type syndrome (with Brachycephaly, Euryprosopia, Telorbitism, Scaphomaxilla) (Paul Tessier-Cannes-La Napoule 1985) and the effect of surgery on anterior cranial base development is reported. This review is based on clinical, surgical and CT scan data.**Result:** In non syndromic craniosynostosis early skeletal release with total fronto orbital remodelling at 6-8 months, as an unique procedure, usually expands the cranial base. Techniques depend on the synostosis. More complex is the approach and the results in syndromic cases where a severe misshapen cranium and face are almost always present. In Apert and Crouzon the anterior cranial base is foreshortened and the middle cranial fossae rotated in a more vertical position. In Saethre-Chotzen the asymmetric involvement of coronal sutures produces bandeau retrusion and facial asymmetry.**Conclusion:** Surgical management of syndromic cases is complex. Orbito-maxillo-mandibular surgery must be considered (traditional vs DO). In craniosynostosis molecular pathogenesis is still poorly understood. Known genes account for less than 40%. Further identification of genes involved in suture patterning is necessary especially in syndromic forms. As the study of cranial suture biology has evolved from morphologic descriptions to molecular analysis, the opportunity for treatment of craniofacial deformities to progress in a similar fashion does exist.

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A Risk-Benefit Analysis of Frontofacial Distraction

Presenter: Justine L. O'Hara
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Background: Frontofacial distraction produces functional benefits in the treatment of syndromic craniosynostosis, but is associated with a significant complication rate. This study aims to identify the patients who benefit from surgery and quantify the associated risk.

Method: A systematic review of 82 consecutive patients undergoing frontofacial distraction over an eleven-year period was undertaken. Prospectively collected information from a standardized assessment was augmented with a retrospective case note review.

Assessments were undertaken preoperatively, at distractor removal, and at 6 and 12 months postoperatively.

Functional outcomes were assessed with a multifactorial Craniofacial Outcome Score (GCOS).

Complications were classified as major, moderate, intermediate or minor.

Results: Frontofacial advancement produced significant functional benefits. Tracheostomy decannulation was achieved in 14 of 21 patients. All 15 patients with ocular exposure achieved globe protection. Raised intracranial pressure was treated in 13 of 14 patients.

Multi/univariate linear regression showed a negative correlation of age with functional score. Sex, underlying disease, surgical complications and history of previous surgery were not associated.

There was one postoperative death. 65 patients suffered one or more complications (81%). There were 13 major complications (16%). Major perioperative complications included haemorrhage (9%), CSF leaks (11.9%) and infections (6.3%). Complication risk factors included increasing age, length of surgical procedure, previous craniofacial surgery, presence of a VP shunt.

Conclusions: Infants and young children are more likely to benefit from frontofacial surgery and less likely to suffer complications than older patients. Frontofacial distraction can be regarded as a procedure of choice for young children with severe functional compromise. Alternative strategies should be considered in older patients with previous frontal surgery.

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Management of obstructive sleep apnoea in syndromic craniosynostosis: the role of the palatal split

Presenter: Fateh Ahmad
 Authors: Ahmad F, Flapper WJ, Thomas G,
 Anderson PJ, David DJ

The Australian Craniofacial Unit, Australia

Introduction: The aetiology of obstructive sleep apnoea (OSA) in syndromic craniosynostosis is multifactorial, with contributory factors located along the entire respiratory tract. The management protocol at the Australian Craniofacial Unit (ACFU) involves utilising temporary measures to alleviate OSA until such time that it is safer to perform midface advancement procedures. The palatal split with uvulopalatoplasty aims to increase the nasopharyngeal space.

Methods: Retrospective review of all patients with syndromic craniosynostosis who have undergone palatal split using the ACFU database.

Results: 44 patients (Aperts n=19; Pfeiffers n=11; Crouzons n=10; Antley Bixler n=3; other n=1) underwent palatal split after evidence of severe OSA following sleep studies between 1987 and 2014. Median age of surgery was at 8 months. Mean follow up is 14.4 years (range 7 months to 17 years). Post-operatively, 40 patients (93%) demonstrated improvement in OSA. 4 patients (9%) required midfacial procedures in the first decade to further alleviate OSA, whereas 31 midface procedures were performed or will be performed in teenage years. Velopharyngeal insufficiency (VPI) was demonstrated in 6 (13%) patients when speech could be assessed although only 4 (9%) ultimately required VPI surgery to help normalise speech.

Conclusions: The ACFU management philosophy dictates that following calvarial expansion procedures in the first year of life, any midface procedure is delayed until completion of skeletal maturity, unless a pressing need arises. The palatal split is a useful, quick and effective procedure with acceptable morbidity that can defer midface advancement for airway improvement.

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Monobloc Distraction in Crouzon-Pfeiffer Syndrome: a Geometric Morphometrics based Evaluation

Presenter: Richard Visser

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Introduction: Crouzon and Pfeiffer syndrome are characterised by midfacial hypoplasia. Monobloc distraction aims to correct the resultant functional and aesthetic disharmony. This study evaluates the effectiveness of monobloc distraction in Crouzon-Pfeiffer patients.

Methods: Preoperative and postoperative scans were collected from 20 Crouzon and 2 Pfeiffer patients aged 7-20 years. 56 normal skulls were used as a control group. Geometric morphometrics using 52 frontofacial landmarks were used to analyse the normal skull and pre- and postoperative patient skulls. The average Crouzon-vector was applied to a normal skull to create the average normal and pre- and postoperative Crouzon-Pfeiffer patient. Colourmaps were created to visualize differences between the average normal, pre- and postoperative patients.

Results: In the studied patient population, monobloc distraction with the use of an external distractor advanced the upper half of the midface more than the lower half of the midface. There was an antero-inferior rotation in the monobloc segment. The zygomatic arch length improved on average to 89% of normal whereas globe protrusion was corrected from 132% to 86% of normal in the studied patient population. Compared with a normal skull, the maxillary region remains retruded.

Conclusions: Frontofacial distraction with the RED external distractor tends to preferentially advance the upper midface. This needs to be taken into account when placing the distractor and planning vectors. The Crouzon facial skeleton is an abnormal shape and cannot be fully treated by simply advancing the face. Intrinsic changes in bony form are required to fully correct bony anatomy.

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Monobloc frontofacial advancements: do they require distraction?

Presenter: Blake Murphy

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Background: Paul Tessier felt that monobloc frontofacial advancement is the definitive procedure for simultaneous correction of midface hypoplasia and forehead retrusion in syndromic patients. Unfortunately, its use has been limited by complications such as CSF rhinorrhea, epidural abscess, and frontal bone loss. Distraction osteogenesis has been advocated by some as a way to reduce complications. The purpose of this study is to compare outcomes of conventional monobloc advancement with distraction.

Methods: Our retrospective review encompasses the cases (n=84) performed by the senior author over a 33 year period (1981-2014). Group 1 (conventional monobloc; n=47) represented patients who received conventional monobloc advancement with bone grafting. Group 2 (monobloc distraction; n=24) represented patients who underwent monobloc advancement using distraction osteogenesis. Group 3 (conventional monobloc, international; n=13) consisted of patients who underwent conventional monobloc advancement in an international setting. Complication and reoperation rates were recorded.

Results: The complication rates between groups 1 and 2 were similar (36.2% versus 41.7%). The rates of reoperation between groups 1 and 2 were also similar (59.5% versus 62.5%). The differences between groups 1 and 2 were not statistically significant. Notably, there were two deaths in group 3. One death was due to intraoperative blood loss, and the other was due to an arrhythmia from a pre-existing cardiac condition. The incidence of death in group 3 was statistically significant when compared to the other two groups (15.4% versus 0%; p=0.0224).

Conclusions: Our review did not show a statistically significant difference between the surgical outcomes of monobloc frontofacial advancement and distraction. Our indications for monobloc distraction are as follows: 1) patients with severe respiratory compromise in which a large amount of alveolar advancement is needed and 2) reoperative cases where significant scarring is present. More often, however, monobloc advancement is performed to correct morphological deformities. In these straightforward cases, we believe that conventional monobloc advancement produces morphological results that are better than distraction, with equivalent complication rates.

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Craniosynostoses associated with osteopetrosis: the role of expansion cranioplasty

Presenter: Irene Stella

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Osteopetrosis (OP) is a rare skeletal disease, affecting the skull base and calvaria, and can cause blindness on account of intracranial hypertension as well stenosis of the optic canal. Few observations have been published, and the optimal management of OP is not established

Report of Case: We report a case of an infant with OP diagnosed aged 5 months, who presented signs of intracranial hypertension associated with unilateral blindness. Bone marrow allograft was performed at six month of age.

At clinical examination aged 11 months, the child was hypotonic, with severe amblyopia; characteristic features of bicoronal synostosis were appreciated, with tense anterior fontanel bulging mimicking typical synostotic oxycephaly. Head circumference had stagnated from +3 SD initially to +1 SD at presentation.

Cerebral CT scan showed marked reduction of intracranial volume, caused by bicoronal suture closure, associated with considerable inward thickening of the calvaria, as well as bilateral stenosis of optic canal; ventricular dilatation and enlargement of the arachnoid spaces, associated with Chiari malformation, were also found.

We considered that severe amblyopia was caused by intracranial hypertension as well as optic canal narrowing. We elected to perform cranial vault expansion with frontal advancement and bi parietal decompression. Surgery was performed age 11 months; drilling of inner table of the bone flaps and anterior advancement allowed comfortable volume expansion; optic canal decompression under microscopic control was performed during the same session.

Results: Postoperative course was uneventful, and the patient was discharged on day 8. Vision was yet unchanged but rapid improvement of axial tonus was noted. The CT scan showed satisfactory calvarial expansion with regression of Chiari malformation.

Conclusions: Cranial vault remodelling with expansion should be considered in patients with osteopetrosis and sign of intracranial hypertension. Craniofacial techniques can be adapted to allow optimal preservation of vision and development in rare skeletal diseases.

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Eight year follow up of identical twins with craniosynostotic variations of Crouzon’s syndrome

Presenter: Edward P. Buchanan

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Background: The opportunity to study and identical monozygotic (MZ) twins with syndromic craniosynostosis as they grow is interesting and a worthy endeavor because it allows us to evaluate the effect of genetic and non-genetic influences on their clinical course. The effects of these factors on development, cognitive function and need for surgical intervention has rarely been reported in the literature due to the rarity of syndromic craniosynostosis combined with the rarity of twinning (3 per 10,000,000 births).

Method: We provide an 8 year follow up for two monozygotic twins born with Crouzon’s Syndrome. Despite having the identical FGFR 2 mutations, each twin had discordant craniosynostosis presentations.

Results: Twin A was found to have a right uni-coronal craniosynostosis and twin B had bi-coronal craniosynostosis with the inferior portions of the sutures fused resulting in severe brachycephaly. Both twins underwent fronto-orbital advancement and remodeling in 2006. This successfully treated their exorbitism with a clear improvement in the supraorbital and forehead regions. Twin A’s surgery was complicated by infection resulting in resorption of the remodeled frontal bone. A titanium cranioplasty was performed to reconstruct the defect in 2009. She went onto have an uneventful post-operative course. By 8 years of age, both twins were found to have significant forehead and mid-face retrusion with exorbitism. There was no clinical, ophthalmological or radiological findings consistent with elevated ICP. They both exhibited Angle class III malocclusion with obstructive sleep apnea. Both patients underwent PEEK cranioplasty and Le Fort III distraction to correct their deformity. Neither twin suffered CSF leaks, bone flap loss or other serious complications. Six month follow-up evaluation demonstrated an improvement in craniofacial form and resolution of their obstructive sleep apnea and class III malocclusion.

Conclusion: Non-genetic factors may play a role in craniosynostotic variations between twins early in development. However, as age progresses, the timing of when non-genetic factors cease being the pre-dominant driving force for phenotype and are then overtaken by genetic factors cannot still be established due to the rarity of monozygotic 17 syndromic twin sets.

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Value of Three-Dimensional Craniofacial Models for Midfacial Distraction

Presenter: Carolyn R. Rogers-Vizena

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Background: Patient-specific 3D models are increasingly utilized for planning and execution of uncommon surgical procedures. These models facilitate better understanding of unique anatomy and allow for pre-contouring or pre-fabrication of surgical hardware and implants. These attributes are particularly valuable in craniofacial surgery. The purpose of this study was to determine if pre-operative use of 3D models reduces operative time and increases patient safety. Midfacial distraction with a rigid external device was studied as a representative craniofacial operation that is performed in a standardized fashion.

Methods: A retrospective review of patients undergoing midfacial distraction with a rigid external device was conducted over a ten-year period. When an adequate CT was available, a 3D model was fabricated. The model was used to study patient-specific anatomy and pre-contour osteosynthesis hardware for use during the operation. Total surgical time, estimated blood loss, and complications were assessed. Cost of the operation was estimated based on total surgical time.

Results: Twenty-eight patients underwent midfacial distraction, 20 without and 8 with preoperative use of 3D models. Controlling for surgeon variation, there was a 34.9 minute reduction in operative time when models were utilized pre-operatively. There was no difference in estimated blood loss. Seven complications occurred in six patients without model use, including CSF leak (2), hardware failure (2), and premature consolidation of the midface (3). No complications occurred with model use. Time-based cost savings was estimated to be \$1,158.00 with model use, excluding the cost of the model.

Conclusions: 3D models are a valuable tool in craniofacial surgery. Their preoperative use for surgical planning and hardware pre-contouring decreases operative time and may reduce the risk of complications for midfacial distraction with a rigid external device. These benefits can be extrapolated to other craniofacial operations, particularly the rare and highly customized procedures that are the most time-consuming and have the highest potential risk.

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Combined internal and external device for Le Fort III minus I and I Distraction: Secondary Report

Presenter: Kaneshige Satoh

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Background: In Syndromic Craniosynostosis, midfacial hypoplasia is always encountered, and Le Fort III distraction following Fronto-orbital advancement or mono-bloc advancement by distraction is routinely conducted in children. However, As the patient grows, midfacial hypoplasia differs in upper and lower portion of the midface, and when Le Fort III distraction is planned for elder children and adults, occlusion consideration is indispensable as well as the upper midface. Dual distraction of the midface separating Le Fort III and Le Fort I portion makes sense and valuable for these patients. This procedure was firstly applied to the adults in 2004 and then extended to the early adolescence, and obtained good results.

Method: 14 of 9 male and 5 female patients are included. Age of the surgery ranged 10-34 years. In all of them, dual distraction separating Le Fort III minus I and Le Fort I portion was conducted. In the Le Fort I osteotomy after Le Fort III, tooth germs are very much taken care to avoid the injury, in particular for young adolescence. In the upper portion of the midface, distraction using an internal distraction device and in the lower portion, Halo device were used. Halo device was totally removed early in around 3 weeks and fixed with osteosynthetic materials and internal device was retained for substantial period of time for consolidation.

Results: Less morbidity using Halo device of short duration was noticed and postoperative results were excellent in the aesthetic and occlusal views. Internal distraction device and osteosynthetic materials for Le Fort I site were removed in a year postoperatively. Follow-up ranged 3 to 15 years. The young adolescence ranged 10-12 years of age, and no postoperative teeth problems were noticed at all. No particular complications were found.

Conclusion: In early adolescence and adults in syndromic craniosynostosis, dual distraction separating Le Fort III minus I and Le fort I portion is an ideal procedure, and rigid fixation of the upper portion using the internal device and early removal of Halo device for Le Fort I portion with osteosynthetic materials induced less morbidity and stable results to the patients. Early adolescence can be well indicated for this procedure of dual distraction of Le Fort III minus I and Le Fort I in syndromic craniosynostosis.

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A Cephalometric Analysis after Le Fort III Osteotomy for Syndromic Craniosynostosis Patients

Presenter: Takeshi Masuoka

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Background: Syndromic craniosynostosis shows not only the premature fusion of the cranial sutures, but also the undergrowth of the midface, which often results in airway narrowing, occlusal disharmony, along with aesthetic issues. Le Fort III osteotomy is usually indicated to treat these problems; however, during the postoperative follow-up, proportional changes of these faces are observed. To evaluate these changes, cephalograms after the operation of these patients were retrospectively investigated.

Method: Patients with syndromic craniosynostosis who underwent Le Fort III osteotomy and were followed more than 1 year, were retrospectively investigated. Setting Sella-Nasion plane as X-axis of coordinate, perpendicular line to X-axis as Y-axis, and Sella as the origin, translocations of Orbitale and point A were measured. The distances from Sella to point B were also measured.

Results: Ten syndromic patients were included: Crouzon (n=6), Apert (n=3), Pfeiffer (n=1). The ages at the time of the operation were ranged from 6 years to 20 years old. The distraction method was applied on 8 patients, and the traditional method was applied on 2 patients.

As to Orbitale, no significant translocation was detected. Point A had tendency to translocate posteriorly on X-axis, although no significant translocation was detected on Y-axis. The distance from Sella to point B had tendency to be increased.

Discussion: The proportional changes of the face observed during the postoperative follow-up after the osteotomy are mainly due to the subsequent growth of the mandible and translocations of the maxilla also seem to affect them to some extent. These tendencies should be taken into consideration for the preoperative planning.

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The adult syndromic craniosynostosis: the final midface retrusion correction.

Presenter: José Cortés-Arreguin

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Apert syndrome, Crouzon disease, Pfeiffer, etc, have in common a wide variation of midface retrusion. A common fact in syndromic craniosynostosis is that early in life fronto-orbital and monobloc advancements are performed. In the first scenario, routinely the midface is treated subsequently. With the monobloc during the first years of life, maxillary relapse is very common. The lack of a stable occlusal relationship and other associated problems are the most common cause of midface retrusion. We present a series of 21 adult patients with syndromic craniosynostosis and midface retrusion, 13 male, 8 female, aged between 16 and 29 years. In 14 of these patients was associated exorbitism related with hypoplastic inferior orbital rim and floor. All patients received preoperative orthodontic treatment, highlighting: the transverse expansion, shaping the dental arch and correction of dental compensations. The surgical techniques used were: High Lefort I in 7 patients and Lefort III in 14 patients. Maxillary advancement varied between 9 and 22 mm. In all bone advancement over 14 mm, bone distraction techniques were used. In all of the cases a stable and effective occlusal relationship was obtained. Functional results showed that blood oxygen measurement after maxillary advancement reported normal levels. Sleep apnea was corrected successfully in patients presenting this problem. Also we noted some speech improvement, after obtaining a better relationship between maxillae and tongue, dyslalias were corrected which allowed for a more intelligible language. From the aesthetic point of view, all patients had excellent results. The classic facial concavity, shift into a pleasant facial convexity. Midface relationship with the upper and lower thirds changed dramatically, especially in the group of patients with retrusion above 14 mm. The exorbitism and the corneal exposure also has been corrected satisfactorily. The clinical follow-up varies from 2 up to 8 years. We will present radiological documentation, clinical pictures and occlusal photographs from the patients.

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Conventional Le Fort III advancement versus Le Fort III distraction: an economic analysis.

Presenter: Mark Fisher

Authors: Fisher M¹, Phillips JH², Forrest CR²¹The University of Iowa Hospitals and Clinics, USA, ²The Hospital for Sick Children, Canada

Background: The two senior authors of the present study routinely perform Le Fort III advancements, representing a large experience. Of interest, one routinely uses distraction whereas the other performs direct advancement. Since 2008, prospective economic data has been collected at our institution. We therefore sought to compare these two protocols in an economic and clinical analysis.

Methods: An IRB-approved retrospective chart review was performed comparing all children who underwent Le Fort III advancement at the Hospital for Sick Children, Toronto from 2000 to 2014 with economic analysis on all cases since 2008.

Results: Between 2000-2014, a total of 18 Le Fort III advancements were performed. Economic data was collected on 8 patients. 44% were performed by distraction.

Contrary to our expectations, the total cost of Le Fort III via distraction was the less expensive treatment strategy. Whereas the index operation was slightly more expensive for distraction (\$10.2k versus \$9.7k), lower total hospital costs for the distraction group resulted in an overall cost savings (\$36.9k versus \$23.3k).

This stemmed from the fact that patients who underwent distraction had fewer days on the ventilator (mean 1.9 days versus 4.5 days), resulting in shorter stays in the ICU (mean 3.2 days versus 5.5 days), and had shorter total lengths of stay (mean 9.4 days versus 12.2 days). Complications and overall risk profile including blood loss, and duration of hardware were also substantially different.

Conclusion: Le Fort III advancement via distraction and direct advancement are both powerful and effective tools in our experience. Contrary to our expectations, we have demonstrated substantial cost-savings with a distraction-based approach due to a shorter post-operative course. Additional distinctives exist for each approach including duration of hardware and risk profile. As such, individualized care should take these differences into consideration.

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ZIFENS+/-: To minimize risk and optimise outcome in Orbital Box Translocation for Hypertelorism

Presenter: Jonathan A. Britto

Authors: Britto JA, Glass GE, O'Hara JL, Hon K, Evans RE, Jeelani NUO, Dunaway DJ

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Introduction: The correction of hypertelorism (HPT) requires translocation of the effective orbit for appearance change at functional risk. Our report to ISCFs 2013 described the differential movement of hard/soft tissue correlates. We now report a risk analysis of operative morbidity in HPT surgery, and offer the ZIFENS+/-, a technical classification of the box osteotomy designed to improve operative outcome and technical planning in orbital translocation.

Methods: Complete clinical records were reviewed 21 HPT patients (CFND 11, FND 6, others 4) to include complete specialist orthoptic evaluations pre- and postoperatively, and post-surgical morbidities. Pre-operative facial shape was classified into 4 groups independent of diagnostic category.

Results: Visual risk and graded surgical adversity (Oxford classification I-IV) correlate to pre-operative facial shape, trajectory of orbital translocation, and severity of HPT (Tessier classification). The ZIFENS+/- classification was therefore derived to improve planning, documentation, and outcome in orbital box translocation.

Discussion: Favourable outcome in HPT surgery is determined by patient reported appearance benefit. The potential for adverse operative event is significant and reward must therefore be predictable. ZIFENS+/- provides a reliable, reportable surgical planning tool to achieve this and mitigate operative risk.

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FREE FIBULA FLAP CONTOURING METHOD FOR MANDIBULAR RECONSTRUCTION IN CIPTO MANGUNKUSUMO HOSPITAL

Presenter: Elrica Sapphira Wiraatmadja
Authors: Sapphira Wiraatmadja E, Kreshanti P, Handayani S

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Introduction: The reconstruction of complex mandibular defects with free fibula flap requires precise flap contouring and inset. This remains highly challenging since it is operator dependent and time consuming. Many methods have been described in the literature, from the most conservative gross intraoperative measurements to the most sophisticated technology involving computer-aided manufacturing and rapid prototyping procedures. We are trying to adopt the most suitable methods to be used in our institution.

Methods: This is a retrospective study of the free fibula flap used for mandibular reconstruction in our institution since we began in 2010, emphasizing on the flap contouring method. A questionnaire regarding the quality of life will also be collected.

Results: Thirty-four consecutive free fibula flap were performed between August 2010 and February 2015. Patient median age was 27.5 years (range, 5 years to 55 years). Seventy-eight percent were primary reconstructions. The most common tissue diagnoses were ameloblastoma (66,6%), and the remainder cases were malignancy, fibrous dysplasia and ossifying fibroma. Twenty-four percent were lateral defects and the remainder had combined defects. Fifty-four point five percent defects included the condyle. The bone gap averaged 15 cm (range, 8 cm to 28 cm). In the earlier cases, flap contouring was assisted by measurements from the CT scans using OsiriX[®]. Since the imprecise contouring resulted from this method, we tried to use other methods to assist the flap contouring, i.e surgical wafers, Essix surgical guide, mandibular model, plate from the previous surgery, resected specimens, and 3D printing. The summary of the quality of life from the questionnaire will be reported.

Conclusions: Although a variety of tools had been used to assist our flap contouring, we feel the need to find a more precise yet affordable tools.

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Outcomes of conservative and operative management of orbital fractures in an Australian trauma centre

Presenter: Olivia M. Perotti
Authors: Perotti OM, Morgan D
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Background: Orbital fractures make up a significant proportion of Faciomaxillary trauma managed at the Alfred Hospital in Melbourne. Many of these are relatively minor fractures, perhaps only diagnosed as a result of higher quality CT imaging, and the more routine scanning of trauma patients, although there remains a range of injury severity. The decision to treat can be based on clinical or radiological grounds.

Aim: The purpose of this study is to determine which patients proceed to operative management of their orbital fractures and the functional and cosmetic long term outcomes of both operative and non-operative cohorts. A secondary aim of this audit is to predict which patients are most likely to have postoperative complications and whether this was attributable to the treatment method.

Methods: A retrospective audit of more than 1,500 patients who were referred for orbital fracture management in a 10-year period from July 2004-June 2014 to a major Australian trauma centre. Descriptive statistics will be used to assess patient's demographics, nature of management, and radiological and clinical features of the injury. Comparative analysis will be performed on patients who received early or delayed operative and non-operative management.

Results/Conclusion: Data collection is currently underway. However, based on previous unit audits, we would expect an overall of rate of conservative management to greater than 60%, with that proportion to have increased during the 10-year period.

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Surgery of Orbital Neurofibromatosis (NF)

Presenter: McKay McKinnon

Authors: McKinnon M¹, Ha NH²¹Lurie Children's Hospital, USA, ²Viet Duc Hospital, Vietnam

Purpose: The purpose of this study is to reconsider the pathophysiology and surgery of orbital neurofibromatosis. There remains a preponderant attitude to defer surgery in the child despite an almost certain progression of bone, soft tissue and visual pathology. Plastic surgery reports of the past 30 years perpetuate surgical dogma, but without clear justification or improvement of results. This study also presents the authors' use of rational principles to determine surgical timing and treatment of orbital NF.

Method: A review of the pertinent anatomy and surgical literature is made. Analysis of 48 cases of orbital NF operated by the authors is presented, including pre and post-op photographs, CT scans, ophthalmologic exams, and long term results of more than 2 years.

Results: Adult patients (35/48) demonstrated no recurrence of resected NF. Patients with bony and soft tissue deformity required an average of 3 procedures. No patients had demonstrable visual loss following surgery, although several patients suffered eventual visual deterioration. There were no deaths, brain injuries, CSF leaks or infections. All patients experienced significant improvement of orbito-facial appearance by patient/parent reporting.

Conclusions: Surgery for significant orbital NF should be offered to young patients. Radical surgical excision can achieve non-recurrence of tumor in most cases. Resection and reconstructive procedures should be derived by analysis of the patient's individual pathology(ies). The craniofacial surgeon should accept primary responsibility for resection, reconstruction and surveillance with other specialists. Our results exceed those of recent reports and support the above conclusions.

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Reduced 3-dimensional airway volume is a function of skeletal dysmorphology in Treacher Collins Syndrome

Presenter: Xiaoyang Ma

Authors: Ma X^{1,2}, Forte AJ¹, Persing JA¹, Alonso N³, Berlin NL¹, Steinbacher DM¹¹Yale University School of Medicine, USA, ²Peking Union Medical College Hospital, China, ³University of Sao Paulo, Brazil

Background: Children with Treacher-Collins syndrome (TCS) frequently present with obstructive sleep apnea and respiratory insufficiency. Previous studies have focused on the tongue-base airway alone using 2-dimensional radiographs. The purpose of this study is to 3-dimensionally calculate upper airway volume in TCS patients. Additionally, we sought to assess the correlation between bony craniofacial morphology and spatial position with airway volume.

Methods: Thirty non-operated TCS patients were compared to a sample of thirty-five age- and gender-matched unaffected controls. Upper airway volume was stratified into retropalatal and retroglossal aspects. 3-dimensional craniometric findings were compared between TCS patients and controls. Among TCS patients, we assessed the relationship of craniofacial morphology and spatial positioning to airway volume. Statistical analyses included independent sample T-tests and Pearson correlation coefficient analyses.

Results: Decreased total upper airway volume ($P=.034$) was found in the TCS group and due primarily to a decrease in retroglossal airway volume ($P=.009$). Regarding 3-dimensional craniometric variables, maxillary and mandibular length ($r=0.76$, $P<.001$ and $r=0.68$, $P<.001$), as well as the anterior and posterior cranial base ($r=0.61$, $P<.001$ and $r=0.77$, $P<.001$) were positively correlated with airway volume in TCS patients. Transverse internal diameters of the upper airway were also positively correlated with airway volume ($r=0.635$, $P=.001$ and $r=0.511$, $P=.006$), however no correlation was shown for the anteroposterior airway diameters.

Conclusions: 3-dimensional analysis revealed diminished upper airway volume in TCS, with the retroglossal region being most severely constricted. Maxillomandibular dysmorphologies, and their relationship to the cranial base, correlated significantly with airway findings.

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Recommendations for treatment of Treacher Collins Syndrome (TCS)

Presenter: Sarah L. Versnel
 Authors: Versnel SL, Plomp RG, van Lieshout MJS, Wolvius EB, van der Schroeff MP, van der Meulen JJNM, Bredero-Boelhouwer HH, Poublon RML, Hoeve HLJ, Joosten KFM, Mathijssen IMJ

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Background: In the treatment of TCS various aesthetic problems and functional deficits have to be addressed. Due to the rarity of the disorder and the varying range in severity of phenotypic presentation, clinical scientific evidence has been limited. With this study we analyze clinical implications of TCS, and give recommendations to improve the multidisciplinary treatment.

Method: In a cross-sectional cohort of 35 TCS patients several topics were analyzed, using clinical examinations, clinical tests, validated questionnaires, standardized photographs, and retrospective data. In addition a systematic review was performed to summarize the current best-quality evidence for treatment of TCS.

Result: The overall prevalence of Obstructive Sleep Apnoea (OSA) in TCS was 46% (54% in children; 41% in adults). The Brouillette score and the Epworth Sleepiness Scale appear not suitable for screening for OSA in TCS. Examination of the upper airway revealed obstruction on various anatomical levels, with the most significant obstruction at the level of the oro/hypopharynx. The nose was frequently deformed (hump 73%, tip 55%), and in 82% a septal deviation was found. Patients were least satisfied with the appearance of the ears, facial profile and eyelids, and the functions hearing and nasal patency. Residual deformities after surgery remained mainly a problem in the periorbital area. The review demonstrated the necessity for further research.

Conclusion: All referred TCS patients should be screened for OSA with a polysomnography, and in case of OSA, additional endoscopy of the upper airway is advised for determining the level(s) of obstruction. A structured nasal ENT examination with nasal endoscopy should be included, and speech, hearing, and feeding difficulties should be detected early, and routinely checked. An ophthalmologist should be consulted for (intra-) ocular deformities. Ear deformities and midface hypoplasia should be addressed adequately in treatment.

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A Morphological Classification Scheme for the Mandibular Hypoplasia in Treacher Collins Syndrome

Presenter: Cassandra A. Ligh
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Background: Mandibular hypoplasia is a hallmark of Treacher Collins syndrome (TCS), and its severity accounts for the main functional morbidity. There is scant literature quantifying and characterizing the mandibular deformity in TCS, and the purpose of this study is to develop a morphological classification scheme of the TCS mandible.

Methods: We identified 20 patients with TCS, ages 1 month to 20 years, with at least one 3D-CT prior to mandibular surgery. We examined 28 3D-CT scans from 20 patients and ordered them from least to most severe phenotype. We then performed a rigorous morphological analysis of the mandible and its relation to the face and skull base. The mandibles were then categorized based on morphology of the condyle, Co-Go-Me angle, and SNB.

Results: TCS mandibles demonstrated three consistent characteristics: a large antegonial notch, a steep mandibular plane angle, and retrogenia. TCS mandibles were graded from I to IV based on degree of condylar hypoplasia (I=normal, II=morphologically normal but small, III=condylar remnant that may not translate to the glenoid fossa, IV=No condyle), the Co-Go-Me angle in degrees (I=<150, II=151-160, III=161-170, IV=>170 degrees), and SNB in degrees (I=>67, II=62-67, III=56-61, IV=<55). The overall mandible classification was determined by the median value among the three characteristics. Among the twenty-eight 3D CT exams studied, 12 (43%) were class 1 (least severe), 10 (36%) were class 2, 4 (14%) were class 3 and 2 (7%) were class 4 (most severe). Three patients had at least 3 longitudinal scans encompassing 5 to 11 years of growth. Despite increasing age, mandibular severity remained stable in those patients.

Conclusion: This provides a classification scheme of the TCS mandible in the era of 3D-CT. It takes into account three key morphological features of the TCS mandible-degree of condylar hypoplasia, Co-Go-Me angle, and SNB-that each appear to correlate with overall phenotype. While there is a natural progression of the mandible with age, we believe the mandibular deformities seen in longitudinal scans may also be inherent to the primary pathology of TCS. Further work is needed to determine the classification scheme's validity, generalizability, and overall utility.

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Application of a new navigation guided distraction device in mandibular distraction osteogenesis

Presenter: Ming Cai

Authors: Cai M, Shen G

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Purpose: The purpose of this study is to evaluate the accuracy of mandibular distraction osteogenesis by using a new designed navigation guided distraction device.

Materials and Methods: Five adult goats were included in this study. Computed tomography and 3D simulation distraction osteogenesis were carried out in TBNavis-CMFS navigation system (Multifunctional Surgical Navigation System, Shanghai, China). A specific designed mandibular distraction device with the detachable digital reference frame for navigation surgery was used for animal study. Image-guided distraction osteogenesis was performed on the goat hemi-mandible by using a new designed navigation guided distraction device. The 3-D skeletal measurements of presurgical plan and postsurgical outcome was compared statistically.

Results: Navigation assisted distraction osteogenesis was successfully performed in and the new designed distraction devices worked uneventful. The accuracy of intra-operative registration was within 1 mm. The hemi-mandible was lengthened a mean of 10.04 mm (range, 9.78 to 10.09 mm). There were no significant differences between simulation distraction and post-operative 3-D measurements ($p>0.05$).

Conclusions: A new designed navigation guided distraction device can be used in mandibular distraction osteogenesis with high accuracy by using the TBNavis-CMFS navigation system.

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withdrawn

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Implications of Syndromic Diagnoses in Pierre Robin Sequence: A Case Control Study

Presenter: Wendy Chen

Authors: Chen W¹, Lee W², Camison L³, Davidson EH¹, Bykowski MR¹, Garland CB³, Naran S¹, Grunwaldt LJ^{1,3}, Losee JE^{1,3}, Davit AJ^{1,3}, Goldstein JA^{1,3}

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Background: Syndromic diagnoses occur in 7-70% of Pierre Robin Sequence (PRS) patients and are associated with greater respiratory compromise and worse treatment outcomes. However, few studies stratify syndromes that do or do not play an important role in pathology. Our aim is to characterize morbidity in syndromes associated with PRS.

Method: A retrospective case control study was performed for patients in the Pittsburgh PRS registry (2002-2014). "Syndromic" was defined as patients deemed by formal genetics evaluation to have known syndrome or chromosome deletion. Controls were isolated PRS patients not referred to genetics. Variables compared included demographics, birth, neonatal, clinical, diagnostic, and surgical data. Outcomes measured included avoidance of tracheostomy, successful decannulation after initial tracheostomy, and severity of apnea per polysomnogram.

Results: Of 250 PRS patients in the registry, 81 had formal genetics workup, 51 had known syndromes, 7 had unspecified syndromes, and 16 were nonsyndromic. Of the 81 patients, 39 avoided surgery; 23 underwent tracheostomy, 22 underwent MDO, 10 required tracheostomy prior to MDO. One of the 32 MDO patients failed distraction and required tracheostomy and supraglottoplasty. Of 51 syndromic patients, 80% had syndromes associated with micrognathia. These patients had a greater Total and Obstructive Apnea/Hypopnea Indices at first PSG. Compared to controls, Stickler syndrome was associated with increased obstruction and tracheostomy as index procedure ($p=0.015$). CHARGE ($p=0.014$), 22q11 ($p=0.039$), and other chromosomal deletion ($p=0.00$) patients were more likely to have MDO and airway procedures than controls. Syndromic patients had higher rates of Nissen fundoplication ($p=0.017$), but no significant difference ($p>0.05$) in gastrostomy rates or any demographic or clinical variables (race, sex, birth history (prenatal hx, prematurity, APGAR, birth wt), median income). Worse outcome was correlated with syndromes with central nervous system, cardiac, and airway comorbidities.

Conclusion: Syndromic PRS patients are a very diverse group with variable clinical outcome. Our cohort shows Stickler, CHARGE, and 22q11 patients to have worse airway status and may warrant special consideration.

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Predictors of Failure in Mandibular Distraction for Robin Sequence

Presenter: Sunil S. Tholopady

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Introduction: Robin Sequence is defined as the triad of micrognathia, glossoptosis and airway obstruction. Treatment options include conservative and surgical measures. Of the surgical measures, tongue-lip adhesion and mandibular distraction are two popular options. Variables associated with failure of MDO have previously been reported. In this study, it is demonstrated that the associated variables change dependent on the manner in which failure is defined. These multiple failure outcomes are used to construct a scoring system to predict MDO failure.

Methods: A 10 year retrospective database of neonatal MDO patients was constructed. Patient demographics and comorbidities were collected. Failure outcomes studied included tracheostomy, decrease in AHI but AHI >20, and death. A combination of bivariate and regression analysis was used to produce significantly associated variables. A scoring system was produced from this data.

Results: Statistical analysis demonstrated the association of GERD, age >30 days, neurologic anomaly, airway anomalies other than laryngomalacia, intact palate, and pre-operative intubation on the outcome variables studied. Multiple scoring systems were produced with reasonable sensitivity, specificity, positive and negative predictive value.

Conclusions: When reporting surgical outcomes of MDO in the setting of RS, it is important to consider AHI as well as avoidance of tracheostomy as an outcome variable. Incompletely ameliorated AHI accounts for half of patients with a problem after MDO and requires further study. The predictive scores presented will be utilized and validated on a larger prospectively collected dataset.

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A clinical review of mandibular distraction osteogenesis in neonates with Pierre Robin sequence

Presenter: Ji Yi

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Introduction: Neonatal upper airway obstruction secondary to micrognathia can be managed with conservative or surgical interventions. Traditionally, severe upper airway obstruction was managed with a tracheostomy and endotracheal intubation. Although tracheostomy and endotracheal intubation may be life saving, it is associated with high rates of complications and can lead to developmental problems. More recently, mandibular distraction osteogenesis has been utilized to relieve micrognathia associated airway obstruction.

Methods: A clinical review of 44 cases was performed to evaluate the efficacy of mandibular distraction osteogenesis in neonates with Pierre Robin sequence.

Objectives: (1) To evaluate whether mandibular distraction osteogenesis can relieve the upper airway obstruction in micrognathic neonates and (2) to discuss and increase the awareness of various issues surrounding neonatal mandibular distraction procedures including preoperative workup, distraction protocols, and complications.

Results: Mandibular distraction osteogenesis can be a safe and effective intervention in neonates diagnosed with Pierre Robin sequence with severe micrognathia and airway obstruction. Interestingly, in patients with additional complex syndromes, the airway obstruction was not consistently alleviated.

Conclusion: When conservative measures fail, mandibular distraction osteogenesis should be considered to obviate the need for a tracheostomy in newborns with micrognathia associated upper airway obstruction.

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Treated Pierre Robin sequence with placed allogenic acellular bone matrix and mandibular distraction osteogenesis

Presenter: Weimin Shen

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Pierre Robin sequence (PRS) is classically described as a triad of micrognathia, glossoptosis, and airway obstruction. Infants frequently present at birth with a hypoplastic mandible and difficulty breathing. The smaller mandible displaces the tongue posteriorly, resulting in obstruction of the airway. Typically, a wide U-shaped cleft palate is also associated with this phenomenon. Early intervention with bilateral mandibular distraction osteogenesis avoids the need for tracheostomy, along with its complications, and it targets the primary etiologic factor of the problem—the anomalous anatomy of the mandible. However distracting the mandible can not ease dyspnea immediately, the symptom of difficulty in breathing will be relieved after 5 to 6 days, then we can remove endotracheal intubation in order to immediately ease breathing difficulties after the surgery, we placed allogenic acellular bone matrix before bilateral mandibular distraction osteogenesis. We report 27 neonates with severe Pierre Robin sequence managed with placed allogenic acellular bone and bilateral mandibular distraction osteogenesis. Length of placed allogenic acellular bone is 6 mm. This can relieve the difficulty in breathing instantly. Although the surgical techniques, distraction and consolidation periods were similar, the allogenic acellular bone matrix we placed is quite different from the traditional distraction devices. With the technology we used, tracheal intubation can be removed immediately after the surgery and start feeding. The jaw extending can begin in the fifth day. Total mandibular distraction was 15 mm and 20 mm. The procedures were successful with early extubation (day 5 and day 7), oral feeding tolerance (day 11 and day 13) and hospital discharge (day 19 and day 18). No major complications were reported. Medium to long-term results were good. Bilateral mandibular distraction osteogenesis and placed allogenic acellular bone in the neonate is a safe and accurate procedure and is the primary option in cases of selected severe Pierre Robin sequence.

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Neonatal Mandibular Distraction Osteogenesis: Virtual Surgical Planning Becomes Operative Reality

Presenter: Matthew Doscher
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Purpose: Mandibular distraction osteogenesis (DO) has become an accepted method to manage severe cases of micrognathia-induced airway obstruction in neonates. Current imaging offers only a rough guide for operative planning. This leaves a significant obstacle to translating the surgical plan. To our knowledge, we offer the first description of computerized virtual surgical planning used to help guide pre- and intra-operative steps for neonatal mandibular DO.

Methods: A virtual surgical plan was created and tested using three-dimensional reconstructions of the patients' CT scans, custom guides and distraction devices. The plan simulated the positioning of the osteotomy, device and distraction vector. In the operating room the virtual plan served as a step-by-step guide for the execution of the procedure.

Results: This unique approach to surgical planning of distraction osteogenesis was used for 5 neonates. As predicted from testing, each mandible was unique such that the customized guide would only "snap-on" if appropriately placed in the planned position. After securing the guide with K wires the osteotomy was performed. The guide and distraction device were exchanged by sliding over the K wires using the preplanned holes. The device was then secured. An average advancement of 18.5 mm was performed bilaterally. Hardware was removed 3 months post-operatively. At follow-up the children have excellent cosmetic results and have successfully avoided tracheotomy. Additionally, similar planning methods were used with 2 patients for Le Fort III distractions with successful results.

Conclusions: The custom guides created through 3D printing allowed for seamless transfer from virtual plan to operative steps. This provides objective guidance in device selection, vector planning and operative guide positioning both for mandible and midface distraction.

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Long-Term Dental and Nerve-Related Complications of Infant Distraction for Robin Sequence

Presenter: Jordan P. Steinberg
 Authors: Steinberg JP, Brady C, Waters BR, Soldanska M, Burstein FD, Thomas JE, Williams JK

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Background: Mandibular distraction has become increasingly common for infants with Robin sequence. Dental and nerve-related complications have not been studied.

Methods: Records were reviewed for patients ≥age 5 who underwent a single distraction in the first year of life with internal devices placed extraorally. Children with craniofacial syndromes were excluded. Patients were invited back for: (1) follow-up dental examination including radiography and cold sensitivity testing for inferior alveolar function, and (2) photographic assessment of marginal mandibular function.

Results: 71 patients met inclusion criteria, 44 of which are followed regularly in dental clinic. Adult first molars showed damage in 40/84 (48%) half-mouths: 9/84 (11%) required extraction while 31/84 (37%) required restoration. Ankylosis of a primary second molar was seen unilaterally in 1 patient (1/86 half-mouths=1%). An absent second premolar with distalized first premolar was seen in 12 patients, 6 bilaterally and 6 unilaterally (18 half-mouths). Of the 13 patients who have returned for cold testing, 1 showed complete absence of sensitivity in a half-mouth (1/26=4%). Of 12 patients assessed for marginal mandibular function, 2 were noted to have unilateral absence of depressor function while 1 showed weakness/partial function (total=3/24 half-mouths=12.5%).

Conclusions: Although internal mandibular distraction is highly effective for relieving obstruction and averting tracheostomy, dental and nerve-related complications are not insignificant and have received little attention to date. Injury to adult first molars, ankylosed primary second molars, and absent second premolars appear to be the predominant patterns of dental injury. Most can be managed simply and combined with treatment for caries. Diagnosis and treatment may be optimized with routine radiography obtained before age 5. Knowledge of the frequency and etiology of nerve injury will also help minimize future complications.

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Hemifacial Microsomia: Treatment in Childhood

Presenter: Xiaojun Tang

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Background: Hemifacial microsomia (HFM) is the second most common facial birth defect after clefts. The major clinical manifestation of it is the facial asymmetry that mainly caused by the mandible dysplasia. There is always some controversy among craniofacial surgeons and craniofacial surgery teams as to what is the best treatment for children on earth. Some surgeons assume that surgical correction should begin at an earlier age, and others believe it is best to wait after adolescence. Meanwhile, what is the exactly optimal time for the early surgery. Some surgeons prefer to use distraction osteogenesis and others believe that this technique does not make sense. Though it is very difficult to answer those questions, we still reviewed our 73 clinical cases and made some analyses on the treatment methods and clinical results microsomia. Our aim was to get some useful advice from our jobs.

Methods: 73 children were performed by distraction osteogenesis to correct the deformities of the mandible from September 2009 to December 2014, who were suffered from hemifacial microsomia with Pruzansky Type II. The lengthened distance varied from 25mm to 40mm. The digital technology and surgical simulation as well as cutting guide were applied before the operations. Orthodontic treatment was also used for reducing the relapse. The results were evaluated by clinical appearances and image analyses.

Results: The distractors dropped off in 4 cases, they had to be removed finally and the process halted, Affection happened in 2 cases, but the bone generation process went well, intrusion of the distractor into the middle crania fossa in 4 cases, limitation of open mouth in 3 cases. The other cases went well and the prolonged bone was excellent. The surgical effects were relatively stable, and the relapse rate is nearly 30%.

Conclusions: 1. According to our experience, the appropriate age for treatment in children is between 6 to 14 years at age. 2. Due to the data of relapse we got, the length of the affected mandible should be better to overcorrected up to 30%. 3. A long follow up period is still necessary to study the growth and development of the prolonged bone. 4. Orthodontic treatment was recommended to maintain the surgical outcomes and reduce the relapse.

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Orthopedically induced orbital-maxillary-condylar growth in a patient with hemifacial microsomia

Presenter: Reiko Shibazaki-Yorozuya

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Hemifacial microsomia (HFM) displays skeletal growth on the less affected side further accentuates the resultant asymmetrical retrognathia and occlusal canting. Other features of HFM include orbit/maxilla/zygomatic hypoplasia and ear malformations. A 7-year-old boy with HFM; Pruzansky/Kaban classification type IIA, OMENS classification O₂M_{2B}E₃N₀S₁; was treated orthodontically/orthopedically in early stage by means of expansion of narrow maxillary dental arch and functional appliance to guide and promote skeletal growth with stimulation of the affected areas. Three-dimensional (3D) changes were compared between before and after treatment (growth) by using cone-beam computed tomography (CBCT) images. The effect of this therapy was an excessive change not only in condylar growth but also orbital and maxillary growth particularly in vertical dimension, and facial symmetry was observed in 3D. Initially, maxillofacial reconstructive surgery was planned at the time of maturation, but was avoided. It was, however, lack of patient compliance may be the primary cause of the variable results obtained with functional appliance in HFM.

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Treatment for patients with hemifacial microsomia in the University of Tokyo Hospital

Presenter: Takafumi Susami

Authors: Susami T, Takahashi N, Ohkubo K, Inokuchi T, Okayasu M, Uchino N, Uwatoko K, Matsubayashi Y, Saijo H, Hoshi K, Takato T

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Introduction: For patients with hemifacial microsomia (HFM), various surgical and/or orthodontic treatments are applied. Some recommend early surgical intervention with facial bone distraction to correct facial asymmetry and others prefer treatment after pubertal growth spurt expecting predictable outcome. In this study, surgical and/or orthodontic treatments for patients with HFM in the University of Tokyo for 22 years were surveyed.

Methods: Seventy-five patients with HFM who received orthodontic examination from 1991 to 2013 (male: 40, female: 35; unilateral:64 and bilateral: 11) were included in this survey. Clinical charts and orthodontic records (photos, radiographs and dental models) were used.

Results: Orthodontic treatment had been performed in about a half of patients (37 of 75). Most of other patients were before treatment observing facial growth. Sixteen patients started orthodontic treatment in the mixed dentition for the correction of anterior occlusion or skeletal growth modification and 21 patients started in the permanent dentition. Orthognathic surgeries were performed in 23 patients (61% of the patients who received treatment) and 11 patients underwent mandibular distraction. Conventional surgeries were; two-jaw surgery: 9, mandibular surgery: 2, genioplasty: 9, mandibular angle plasty: 5. Maxillary advancement was performed in 2 patients with clefts. Functional appliance treatment and mandibular distraction in small children were performed in 1990s. However, these treatment were not performed recently and orthognathic surgery after pubertal growth spurt was popular to correct skeletal asymmetry. In some patients, orthodontic treatment and soft-tissue transplantation were performed independently.

Conclusion: Large variations of the treatment were confirmed. Functional appliance treatment and mandibular distraction in small children were not performed recently, and treatments in the permanent dentition was popular to minimize the burden on patients.

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Restoration of Facial Symmetry in Hemifacial Microsomia with Mandibular Outer Cortex Grafting and Gonioplasty

Presenter: YuanR You

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Background: Using contralateral mandibular outer cortex bone graft to augment the affected mandible effectively augments the thickness of the affected mandible and reduces the thickness of the normal side in patients with hemifacial microsomia, but the ramus on the affected side is still shorter than the contralateral side. The authors used mandibular outer cortex bone grafting and reduction gonioplasty on the normal side to restore the facial symmetry in 'mild' hemifacial microsomia.

Methods: From March of 2007 to July of 2014,15 patients with hemifacial microsomia underwent mandibular outer cortex bone graft to augment the affected mandible and reduction gonioplasty on the normal side. Seven patients were classified with Pruzansky type I, eight patients with Pruzansky type II mandibular deformity. The operations were performed at a mean age of 18.87 years (range, 14to 25 years). Facial symmetry was evaluated by photography and radiography with a minimum of 7-month follow-up.

Results: Mandibular ramus height was reduced on the normal side after reduction gonioplasty. Lower facial width was increased on the affected side and reduced on the normal side after bone grafting. The lower face symmetry was significantly improved in all patients. The majority of the patients were satisfied with the reconstructive outcome.

Conclusion: The combination of mandibular outer cortex bone grafting and reduction gonioplasty effectively improved the lower facial symmetry in 'Mild' hemifacial microsomia.

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Evaluation of Obstructive Sleep Apnea and Feeding Difficulties in Craniofacial Microsomia

Presenter: Cornelia J.J.M. Caron

Authors: Caron CJJM¹, Pluijmers BI¹, Joosten KFM¹, van der Schroeff MP¹, Mathijssen IMJ¹, Dunaway DJ², Padwa BL³, Wolvius EB¹, Koudstaal MJ^{1,2}

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Background: Due to underdevelopment of the mandible, children with craniofacial microsomia (CFM) are at risk for obstructive sleep apnea (OSA) and feeding difficulties. However, the exact prevalence of these features in children with CFM is unclear and no treatment consensus is available.

Patients and Methods: All medical files of patients with CFM from 3 major craniofacial units were screened for the presence of OSA and feeding difficulties and the respective treatments. Patient characteristics were recorded. Results were compared with a systematic literature review, which was performed by the authors to provide an overview of the literature on OSA and feeding difficulties in CFM.

Results: In total over a 1000 patients were diagnosed with CFM. A pilot at Erasmus Medical Center showed OSA was noticed in six out of 89 patients (5.6%). Polysomnographs of these six patients showed mild to severe OSA in five patients. Treatment consisted of prone positioning, tracheostomy or distraction osteogenesis. Unfortunately, nothing was mentioned on feeding difficulties. The prevalence of OSA in our cohort was low compared with the literature (7-67%). A prevalence of feeding difficulties of 42-83% was found in the literature.

Conclusion: OSA and feeding difficulties are thought to be related to CFM. In part due to the retrospective nature of our and most other studies, large variations in prevalence and severity are found. We started a collaboration with the Great Ormond Street Hospital in London and the Boston children's hospital to retrospectively and prospectively study the prevalence of OSA and feeding difficulties in children with CFM. The results of the retrospective study to the prevalence of OSA and feeding difficulties in this cohort of over a 1000 patients will be presented.

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Surgical care in craniofacial microsomia: a Boston-London-Rotterdam collaboration

Presenter: Britt I. Pluijmers

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Background: Craniofacial microsomia is best described in its embryologic origin: a developmental defect of the first and second branchial arch leading to asymmetric hypoplasia of their derivatives. The aim of this study was to present the retrospective data concerning craniofacial microsomia (CFM) from 3 major Craniofacial Units: Boston Children's Hospital, Boston, Great Ormond Street Hospital, London and the Erasmus Medical Center-Sophia's Children's Hospital, Rotterdam and to compare this data to our recent systematic review regarding surgical corrections for children with craniofacial microsomia.

Methods: All patients diagnosed with craniofacial microsomia with both clinical and radiographic images available were included. All surgical notes were reviewed. Literature databases were searched for studies on surgical correction of the deformity performed in the growing patient, and its long-term outcome and stability.

Results: Over a 1000 patients with craniofacial microsomia were evaluated in this study. Most patients were treated for their ear anomaly followed by mandibular correction, mid-face correction. The more severe cases, often with a Pruzansky-Kaban type III mandible, proved to be the most challenging to correct often in need of multiple surgeries until the patient satisfaction was sufficient.

Conclusions: Concurrent with the results from the literature studies the most challenging patients in terms of correction of asymmetry have the Pruzansky-Kaban III mandible. Postponing the surgical correction until mid-puberty or even skeletal maturity seems to be beneficial for the decrease of amount of surgical procedures.

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A Case-Control Study of Cranial Base Deviation in Hemifacial Microsomia by Craniometric Analysis

Presenter: J Thomas Paliga

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Background: While facial asymmetry in hemifacial microsomia (HFM) is well documented in the literature, no studies have concentrated on the morphology of the cranial base. This study aims to evaluate the endocranial morphology in patients with HFM.

Methods: Consecutive patients with unilateral HFM treated at a craniofacial center from 2000 to 2012 were included. Patients were grouped according to severity based on the Kaban-Pruzansky classification: Mild(0-1), Moderate(2a), Severe(2b-3). Skull base angulation and transverse craniometric measures were recorded and then compared to age-matched controls.

Results: A total of 30 patients(14 males,16 females) averaging 7.5 years of age(range: 1.1-15.7) were included. 4 patients were classified as mild, 12 as moderate, and 14 as severe. The mean cranial base angle was found to be between 179 and 181 degrees with no significant difference between severity groups (p=0.57). Mean cranial base angle did not differ significantly in cases compared to controls(179.6 vs. 180.0, p=0.51) No significant differences between the affected and unaffected sides in cases were found in distances from midline to hypoglossal canal, IAM, lateral carotid canal, medial carotid canal, foramen ovale and rotundum. There were no significant differences in transverse measurements between the severity classes using the same landmarks (p=0.46, p=0.30, p=0.40, p=0.25, p=0.57, p=0.76, respectively).

Conclusions: The cranial base axis is not deviated in HFM compared to age-matched controls, and there exists little difference in endocranial morphological measurements with increasing severity of HFM. This data is interesting given the role of the cranial base in facial growth and the varying hypotheses regarding mechanism of disease in HFM.

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Simultaneous Maxillo-Mandibular Distraction in Preadolescent Hemifacial Microsomia patients

Presenter: Ting-Chen Lu

Authors: Lu T, Yao C, Chen PK

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Introduction: The timing of intervention in the hemifacial microsomia patients is a long-running controversy. Early distraction had become widely accepted technique in the past 20 years, however, gradually relapse of asymmetry was found. We used simultaneous maxilla-mandibular distraction in preadolescent hemifacial microsomia patients who were classified as Pruzansky type IIA and IIB since 2007. The symmetry was maintained after long-term follow up.

Materials and Methods: From 2007 to 2012, there were totally 8 patients with hemifacial microsomia, which were classified as Pruzansky type IIA (2 patients) and Type IIB (6 patients) received simultaneous maxilla-mandibular distraction in their preadolescent and adolescent age (Age 12 to Age 16). The oral commissure cant was measured in the front view pictures in all patients.

Results: There were 4 female and 2 male patients. The average age of distraction was 15.4 y/o. 2 patients had Pruzansky type IIA and 6 patients had Pruzansky type IIB. The Average pre-distraction occlusion cant was 5.7 degree, and after distraction, the average final occlusion cant was 2.3 degree. 4 patients had posoperative transient facial nerve palsy and no permanent complication encountered. Follow up time ranged from 3 to 8 years.

Conclusion: Simultaneous maxillary and mandible distraction at preadolescent age has relatively stable outcome. It is suitable for those hemifacial microsomia patients who have short mandible ramus (Pruzansky type IIA to II B), which can't be easily solve by orthognathic surgery. It also has the advantages of preventing occlusal disaster due to no over-correction needed.

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Long term Outcomes of Craniofacial Microsomia Treatment: Mandibular Reconstruction

Presenter: Deborah Martins

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Background: Mandibular hypoplasia is a defining characteristic of craniofacial microsomia. In this work, we review a single institution experience of the treatment and outcomes of mandibular reconstruction.

Methods: Craniofacial microsomia patients actively treated at the UCLA Craniofacial Clinic (n=151) between 2008-2014 were reviewed for mandibular treatment and outcomes. Patients greater than 14 years of age at the time of study initiation were included (n=42, average age of 18.3 years).

Results: 83.3% of patients had mandibular hypoplasia, of which 22.9% were bilateral, 40.0% were on the right, and 37.1% were on the left. 58.1% of mandibles were Pruzansky I, 20.9% Pruzansky IIA, 7.0% Pruzansky IIB, and 14.0% Pruzansky III. Facial nerve dysfunction was normal to mild in greater than 80% of the patients. 22.9% of patients required tracheostomy or early distraction for airway compromise. 38.9% of patients underwent an average of 4.14 mandibular surgeries with the initial surgery at a mean age of 8.3 years. 31.1% of patients required distraction, 7.1% required rib graft, and 19.0% underwent orthognathic surgery. In a linear regression model, age, higher Pruzansky score, airway compromise, or simultaneous microtia reconstruction did not predict increased number of mandibular surgeries, reoperation, or relapse. Facial nerve involvement was significantly associated with a greater number of surgeries performed ($p = .039$). In terms of psychosocial development, 27.3% had psychosocial problems such as poor academic performance, depression, and insecurities in comparison to the 14.3% of patients who received mandibular reconstructive surgery.

Conclusions: Mandibular reconstruction in craniofacial microsomia patients is a multi-stage procedure. Increased operations but not risk of complications were associated to the severity of the constellation of clinical presentation in craniofacial microsomia.

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Simulation-Guided Navigation for Vector Control in Mandibular Distraction Osteogenesis

Presenter: Alberto Bianchi

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Distraction osteogenesis is a primary choice for pediatric cranio-maxillofacial malformations, especially for unilateral or bilateral mandibular hypoplasia, and distraction vector control still remains one of the main issues of this technique. Navigation technology has given surgeons the capacity to know precisely where their instruments are during surgery and simulation-guided navigation is a surgical method which is based on the use of navigation technology linked to 3D virtual surgery simulation. The aim of the present study was to describe and analyze our experience with a new method for distraction vector control through simulation-guided navigation in cranio-maxillofacial distraction osteogenesis.

We retrospectively evaluated seven patients affected by unilateral and bilateral mandibular hypoplasia and treated with this method between 2012 and 2014 at the Maxillofacial Surgery Unit of the University of Bologna, Italy. All patients underwent mandibular distraction using internal unidirectional devices (total: 11 devices). Patients were studied through a 3D reconstruction of the facial bones, based on CT datasets. The distraction device positioning was simulated using a specific experimental software. The surgical planning was loaded on the navigation system and the distraction device was tracked and placed following the virtual plan.

We compared the 3D coordinates of the real device and the planned one. Among the eleven distractors, we found a mean angular error of $3,74^{\circ} \pm 3,30^{\circ}$ on the axial axis and of $6,27^{\circ} \pm 5,32^{\circ}$ on the sagittal axis, while median angular error are $3,72^{\circ}$ on the axial axis and $4,08^{\circ}$ on the sagittal axis.

Our preliminary experience seems to support that simulation-guided navigation in mandibular distraction osteogenesis could be a useful procedure to reproduce the virtually planned outcome. Nevertheless, our results cannot be considered completely satisfactory and more tests should be conducted to investigate factors that still limit accuracy.

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Simultaneous orthognathic surgery and free flap in hemifacial microsomia—long term results

Presenter: Mark H. Moore

Authors: Moore MH, David DJ, Tan E

Australian Craniofacial Unit, Australia

Background: For more than 35 years, patients with severe hemifacial microsomia have been managed in a protocol based fashion, culminating in a combined bimaxillary osteotomy and microvascular free tissue transfer to restore facial symmetry and occlusal function.

Method: A series of hemifacial microsomia patients who underwent such simultaneous complex reconstruction, and who have had long term review more than 10 years after final surgical treatment is presented.

Results: In those most severe hemifacial microsomia patients, release and restoration of the soft tissue environment by free tissue transfer, in concert with skeletal and occlusal levelling and centralisation is possible with simultaneous surgery. Long term followup suggests that some recurrence can be expected, in concert with ongoing changes of aging.

Conclusion: With the potential for the ongoing expression of the disease of hemifacial microsomia beyond the time of completion of facial growth should encourage specialist craniofacial units to maintain followup long term, and raises the spectre of the need for ongoing surgical intervention.

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Using dense surface correspondence to evaluate facial asymmetry

Presenter: Ali Jafar

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Introduction: Facial asymmetry can be caused by a number of conditions including hemifacial microsomia, Parry-Romberg syndrome, tumours and trauma. In planning surgery for these patients, it is important to understand where the priorities in reconstruction lie. To understand pathological asymmetries, we first evaluated asymmetries that occur in an unaffected population.

Method: 10 000 unaffected volunteers underwent 3D photography. The data was analysed using an automated landmarking system followed by creating a dense surface correspondence model. The dense surface model contained 60 000 vertices which corresponded across the whole population. This allowed division of the face into 2 parts each with 30 000 vertices, so that each vertex could be tested against its equivalent on the opposite side of the face. Having evaluated the boundaries of asymmetry in the unaffected population, pathological asymmetries such as hemifacial microsomia were tested. The dense surface correspondence allowed division of the pathological faces into 2 halves despite not having a definable midline plane.

Results: Using the dense surface correspondence, a global asymmetry score was created for the unaffected population. This allowed the calculation of a statistical model which demonstrated the boundaries of asymmetry in the unaffected population. The pathological scans were tested against this model. This allowed a global asymmetry score for pathological asymmetries. Using colour maps it was possible to see exactly where asymmetries were present and to what degree.

Conclusion: This tool allows a global score for facial asymmetry and also highly accurate regional data which is useful for planning reconstructive surgery.

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Auricular Reconstruction in Treacher Collins-Franceschetti Syndrome: Firmin's Series of 82 patients

Presenter: Joseph R. Dusseldorp

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Background: The patient born with Treacher Collins-Franceschetti Syndrome has unique maxillo-facial concerns and a treatment paradigm that is usually highly individualized. Auricular reconstruction can be more challenging due in part to anatomical features of the auricular region in this condition including thickness of the local skin and low position of the hairline.

Methods: We retrospectively reviewed a personal series of 82 consecutive cases.

Results: Bilaterality, lobular type and a correlation between the extent of upper third facial dysmorphology and severity of auricular dysplasia were discovered. The course of the superficial temporal artery was also found to be ectopic in over 65% of cases. Teenage patients were more likely to desire auricular reconstruction as their first major reconstructive procedure.

Conclusions: Though possible to achieve excellent results, there can be a tendency towards low positioning of the ears and a lack of definition of the auricular features. This series will demonstrate our approach and outline the challenges faced in combining facial, bi-maxillary and auricular reconstruction in this difficult patient group.

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What is the Ideal Ear Position? Measurements and Aesthetic Outcome in Otoplasty Patients

Presenter: Jesse A. Goldstein

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Background: Candidates for otoplasty have variable anatomy that may result in an aesthetically suboptimal appearance. This study is a retrospective review of patients undergoing otoplasty, where a standard algorithm was employed to obtain ideal aesthetic position of the ear without the use of intra-operative measurements. using a standardized suturing only technique.

Methods: A review of one surgeon from 2010-13 was conducted at a major children's hospital. Pre- and postoperative distance from the mastoid to the posterior lateral helical rim were measured at three consistent points (upper helix, mid helix, and lobule). Cosmetic outcomes were determined by Visual Analog Cosmetic Scores (VACS), assigned by 3 independent reviewers. Statistical analysis was performed using SPSS 21.

Results: 26 patients underwent otoplasty for prominent ear. average of 8.2 years (5.2-17.3 years). Duration of follow-up was an average of 32 weeks postoperatively.

Pre- and postoperative VACS were determined for all patients (100%): overall-appearance, 25.8 vs 71.3; overall-ear appearance, 25.7 vs 70.0, shape 24.4 vs 72.6, and projection 23.7 vs 73.9 (p<0.05 for all). There was no inter-rater difference between scores. There was greater symmetry postoperatively, (p<0.05).

Measurements were significantly changed pre- versus postoperatively. Upper-helix 2.04 cm versus 1.20 cm, mid-helix 2.22 versus 1.18 cm, and lobule 1.85 versus 1.49 cm (p< 0.05.) Postoperative measurements are in accordance with established norms for ideal ear position (1.0-1.2 cm upper third of the ear).

2 patients experienced recurrence, and 1 experienced a spitting suture (11.5%).

Conclusion: Aesthetic ideal was established on the operating table based on the appearance of the ear. Postoperative measurements taken at least 6 weeks after surgery fell within aesthetic ideal for a normal ear; this suggests that the use of intra-operative measurements are not needed to obtain an aesthetically acceptable outcome.

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An investigation of the fixation materials for cartilage frames in microtia and study on mechanism of the fixation

Presenter: Aritaka Sakamoto

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Purpose: In auriculoplasty for microtia, wires are usually used for fixing costal cartilage frames. However, the exposure of the wire might be admitted during long-term follow-up. We had investigated past operations in our facility, and reported that absorbable sutures are believed to be the most suitable material for the fixation of cartilage (JPRAS 2012). In next, we studied to make clear the mechanism of the fixation with the absorbable sutures.

Object and Result: Objects are 122 examples that performed auriculoplasty by costal cartilage graft from 1984 to 2007. We investigated the fixation material for cartilage frames and postoperative course. Wire was used in 84 cases and absorbable suture was used in 33 cases. The result was that an exposure of the wire was observed in 19 cases. In cases that absorbable sutures were used, neither any deformities nor exposure of the fixation materials was observed. In next, we studied to make clear the reason why the cartilage form was maintained even if we used the absorbable sutures for the fixation. We used 24 rats and harvest costal cartilages to make three pattern of transplantation models. One was the cartilage bent and fixed by only absorbable sutures, one was fixed with another cartilage as small base frame, and one was fixed with two cartilages as large base frame. We transplanted them at the back of the rat during 8 weeks and took them out to assess them about the moving back of cartilage form. As a result, in the group of the cartilage fixed by absorbable suture, the form moved back to almost the original form. In the group of the cartilage fixed with another two cartilages, the moving back of the bent cartilage was a little. Then we observed that cartilages with a microscope. The around of contact area between bent cartilage and basal cartilage was surrounded by fibrous connective tissue and fixed by them.

Discussion: The wire had the risk of exposure and the absorbable sutures didn't caused the transformation of the cartilage frame. The reason is that each cartilages were fixed by the fibrous connective tissue in the contact area and keep it's form. So absorbable sutures are believed to be the most suitable material for the fixation of cartilage and it is considered that we have to take enough contact area between bent cartilage and basal cartilage when making a cartilage frame.

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Our recent operative procedure for microtia—To acquire further real appearance of the ear—

Presenter: Takatoshi Yotsuyanagi

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We already reported our operative procedure for lobule-type microtia (PRS 133: 111-120, 2014 and PRS Glob Open 7: 2; e 208, 2014). Here we introduce the details of our recent operative technique for microtia to acquire further real appearance of the ear.

In the first stage of costal cartilage grafting, the base frame is fabricated by two cartilage blocks partly overlapped on the area of the antihelix. The thickness in the overlapping area can create a rigid structure of the frame and also emphasizes the contour between the antihelix and the helical crus by its thickness. The completed frame contains all structures of the ear including the helical crus and the tragus. For concha-type microtia, the base frame and the antihelical part of the costal cartilage are trimmed adequately to fit the remnant conchal curve, with some areas overlapping. It is recommendable to connect the antihelical part of the costal cartilage with the remnant cartilage at the antitragus. The helical crus is immobilized on the conchal cartilage.

In the second stage of ear elevation, the upper part of the ear is elevated with temporoparietal fascia underlying the cartilage frame. The scalp and neck skin behind the ear is undermined subcutaneously. Then the mastoid fascial flap is elevated. The banded cartilage is grafted on the posterior side of the lower part of the ear and is covered by the mastoid fascial flap. Undermined skin in the neck is lifted up cranially. This makes it possible for all of the grafted skin in the temporal area to be hidden behind the ear. The postauricular surface is covered by full-thickness skin from the lower abdomen.

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A new design for microtiaoplasty with tissue expansion

Presenter: Yumeji Takeichi

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The color and texture of the skin is very close and sacrificed area is minimum as it is mainly obtained local skin. On the other hand, re-shrinkage of the expanded skin is its problem.

We developed several methods to avoid this problem. We used PMT's 152cc double chambered tissue expander, and expanded to up to 200cc. The cartilage frameworks are were manufactured using 3-dimensional design.

We elevated two triangle flaps on the expanded tissue. The front side of the reconstructed ear is was placed by the front triangle flap and the back side of the ear is was covered by the posterior triangle flap. The temporal region of the donor site was closed directly to prevent shrinking of the expanded skin.

We removed the capsule of the expanded skin to obtain clear contour. But we remain didn't remove the capsule of the triangle flap region to keep blood supply.

We have reconstructed more than hundred cases using this method.

The most severe problem of this method is the perforation of the skin covering the expander. In this series, the perforation rate was around 5%. To reduce this complication, we leave the expander without filling for a month. After that, we begin started filling saline. At first we injected smaller volume such as 2-3 ml at one time then it was gradually increased up to 12 ml. And around the end of the expansion, we reduced the adding volume again.

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Use of ADM (Acellular Dermal Matrix) as scaffold enhancement in autologous costochondral ear reconstruction

Presenter: Silvio Podda

Authors: Podda S, Gargano F
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Objectives: Second stage autologous costochondral ear reconstruction is often challenging for lack of soft tissues coverage over the cartilaginous framework and unpredictable skin graft take. To achieve complete cartilage cover, local fascial flap (TPF) are often used. Aim of our work is to present an innovative technique to give enhancement of soft tissue coverage to ease second stage ear projection and skin graft take.

Materials and Methods: This innovative technique has been used in three patients with lobular type microtia from 2014 to 2015. Mean age was 12 and male to female ratio is 2:1. Appropriate consent was obtained before surgery. During the first stage ear reconstruction, Allomax^R Acellular Dermal Matrix was sutured over the cartilaginous construct on the posterior surface of the reconstructed framework and then banked with the incision closure. At the time of the second stage, the ADM represents an adequate choice of soft tissue coverage for the cartilage construct. The newly generated soft tissue layer will allow to create a safe pocket for the cartilage graft used to project the lobule and at the same time represent a well-vascularized bed for the impending skin graft closure. Projection and mastoid-auricular angle were measured preoperative and during follow up.

Results: Mean follow up has been less than a year. No complications occurred. All skin grafts adhered and healed. Projection and mastoid-auricular angle did not show significant changes over time.

Conclusions: The use of ADM can be considered an adjunct as a safe technique in staged autologous ear reconstruction. It spares the use of a TPF during the second stage leaving the TPF as an option in case of failure. The technique is reproducible and allows a safe and reliable mean to augment soft tissue coverage over the cartilaginous construct.

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Precision of 3dMDTM in Anthropometry of the Auricle and its Application in Microtia Reconstruction

Presenter: Shih-Hsuan Mao

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Background: The advent of three-dimensional stereophotogrammetry in recent years has vastly helped the craniomaxillofacial field improve in terms of preoperative and intraoperative decision-making. With regard to the auricle though, there is paucity of research as to the application of this promising technology.

Methods: A total of 20 normal adult ears were included in this study. Thirteen anthropometric measurements were taken, twice by two plastic surgeons using Direct Measurement (DM) and through images captured via 3dMDTM. The purpose was to compare the reliability of measurements involving the two instruments.

Results: The overall Mean Absolute Differences (MAD) of all ear anthropometries of DM and 3dMDTM were 0.52 mm (range: 0.28-0.72 mm) and 0.27 mm (range: 0.15-0.53mm) respectively; and the grand mean Relative Error Magnitudes (REM) were 2.85% (range: 1.01%-5.99%) and 1.57% (range: 0.48%-3.62%), respectively, across observers. Thus, the precisions of all ear anthropometries across observers were high in both methods, but the precision of 3dMD was better than DM irrespective of observers. In addition, the MADs were less than a millimeter across all measurements.

Conclusion: The application of three-dimensional technology in microtia surgery for both template production and soft tissue analysis leads to improved planning and satisfactory results with fewer complications. We, believe, that with further refinement and enhancement, the use of this innovation will pave the way for prefabricated, individualized autologous or biocompatible alloplastic implantable frameworks based on an accurate mirror image of each patient's normal ear in unilateral cases and in bilateral cases, appropriately sized.

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Sensory Recovery Following Microtia Ear Reconstruction

Presenter: Akihiko Oyama

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Background: In microtia ear reconstruction, loss and restoration of sensation in the reconstructed ear observed following surgery.

Sensory recovery is important to protect the ear from harm and for patients' quality of life along with its aesthetic outcome. However, there is no reports on the recovery of sensation after ear reconstruction.

Patients and Methods: In this study, we tested return of sensation in a series of 6 patients including 3 lobule type microtia cases and 3 concha type microtia cases, by using the Semmes-Weinstein monofilament test (S-W test) for 6 months after costal cartilage framework grafting and ear elevation, respectively.

Results: In all cases of lobule type microtia which have a subcutaneous pedicle, the area of normal sensation appeared first on lower part of anti helix which locates just on the subcutaneous pedicle, and it expanded toward superior area. Furthermore, red area (loss of protective sensation) disappeared 5 months after first stage operation (costal framework grafting).

In concha type microtia, red area disappeared slightly earlier than in lobule type. However, in 2 cases without subcutaneous pedicle, sensory recovery started from anterior area and expanded toward posterior area. Delayed expansion of normal sensation area compared with the cases with subcutaneous pedicle was observed.

After ear elevation, red area appears on the helix. However, the sensation on the anterior part of the ear (concha and helix crus) didn't change.

Conclusion: Subcutaneous pedicle plays the important role not only in support of blood circulation but also in enhancement of sensory recovery.

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Precision of Three Dimensional Stereo-Photogrammetry (3dMD™) and its Application in Microtia Reconstruction

Presenter: Zung-chung Chen

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Background: The advent of three-dimensional stereo-photogrammetry in recent years has vastly helped the craniomaxillofacial field improve in terms of preoperative and intraoperative decision-making. With regard to the auricle though, there is paucity of research as to the application of this promising technology.

Methods: A total of 20 normal adult ears were included in this study. Thirteen anthropometric measurements were taken, twice by two plastic surgeons using Direct Measurement (DM) and through images captured via 3dMD™. The purpose was to compare the reliability of measurements involving the two instruments.

Results: The overall Mean Absolute Differences (MAD) of all ear anthropometries of DM and 3dMD™ were 0.52 mm (range: 0.28-0.72 mm) and 0.27 mm (range: 0.15-0.53mm) respectively; and the grand mean Relative Error Magnitudes (REM) were 2.85% (range: 1.01%-5.99%) and 1.57% (range: 0.48%-3.62%), respectively, across observers. Thus, the precisions of all ear anthropometries across observers were high in both methods, but the precision of 3dMD was better than DM irrespective of observers. In addition, the MADs were less than a millimeter across all measurements.

Conclusion: The application of three-dimensional technology in microtia surgery for both template production and soft tissue analysis leads to improved planning and satisfactory results with fewer complications. We, believe, that with further refinement and enhancement, the use of this innovation will pave the way for prefabricated, individualized autologous or biocompatible alloplastic implantable frameworks based on an accurate mirror image of each patient's normal ear in unilateral cases and in bilateral cases, appropriately sized.

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Application of Computer-Assisted Design and Manufacture in Unilateral Alloplastic Microtia Reconstruction

Presenter: Hsin-Yu Chen

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Background: The advances in 3D scanning, computer-assisted design and computer-assisted manufacture (CAD/CAM), and rapid-prototyping technology make customizing a symmetric auricular framework feasible for unilateral microtia patients.

In this study, we used the stereo-photogrammetry system to acquire the 3D geometric data of the patient's normal ear for template design and presented our algorithm of producing a customized template using CAD/CAM technology.

Methods: Three-dimensional photographs of the patient's head were captured using 3dMDCranial™ system. Eight sets of 3D geometric data were obtained for each patient. The resulting 3D surface images were visualized on 3dMDvultus™ software, in which we selected the set of data displaying the most detailed structures of the normal ear. The normal ear segment was converted into a virtual solid as the basis for framework construction. Geomagic® OFreeform® software and Touch™ X Haptic device were used for virtual sculpture of the template. The definitions of the virtual template were tailored to each patient's unique auricular morphology. The final 3D model was mirrored to the defect side and the template was printed out of biocompatible acrylic.

Results: Five patients with unilateral microtia were enrolled in the study with mean age of 11 years old. Three patients had hemifacial microsomia on the same side. Single stage total ear reconstructions were performed. The customized template served as a guide for positioning and sculpture of Medpor framework. In addition, the templates were used to simulate the appearance after skin draping and helped the surgeon to determine the appropriateness of soft tissue coverage. Four patients received single stage total auricular reconstruction with Medpor. One patient received staged procedure with insertion of Medpor framework without projection because the temporoparietal fascia was insufficient to cover the entire implant.

Conclusion: The stereo-photogrammetry is reliable in acquiring the 3D model of the normal ear. The customized 3D template can be obtained with the assistance of the stereo-photogrammetry system for accurate 3D model acquisition and the CAD/CAM technology for precise and symmetric design.

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Long-term growth of costochondral rib grafts in mandibular reconstruction for craniofacial microsomia

Presenter: Andrew R. Bauder

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Introduction: Costochondral rib grafting is the most common surgical technique for reconstructing the Pruzansky-Kaban 2b/3a mandibular deformity in craniofacial microsomia (CFM). However, graft growth is thought to be unpredictable, with possible over- or undergrowth with time. Secondary procedures, including mandibular distraction osteogenesis (DO), may be utilized to augment graft growth. We seek to understand the intrinsic growth properties of costochondral grafts in CFM and the role of mandibular distraction to refine symmetry of the grafted mandible.

Methods: We identified children with Pruzansky-Kaban 2b/3a CFM who underwent mandibular reconstruction with costochondral rib grafting (2005-2012; >2 yrs follow-up). Changes in graft length/volume were calculated using 3D volumetric analysis. Graft growth was compared within the individual, using the contralateral side as a control, and between distracted and non-distracted patients. The Wilcoxon matched pairs sign rank test was used for comparisons within individuals, and Wilcoxon rank sum for comparisons between groups.

Results: Eleven children (6M, 5F) received 12 rib grafts for CFM. The average age at intervention was 6.58+/-1.36 years, and all grafts achieved stable graft integration with the native mandible, at a mean follow up of 5.71+/-2.74 years. Eight grafts (67%), which did not undergo subsequent DO, achieved growth in length [6.86+/-8.15mm (16.1+/-19.6%)] and volume [287.0613+/-2404.98mm³ (14.3+/-55.3%)] that was not significantly different from the contralateral side (L: $p=0.796$; V: $p=0.519$). Four grafts (33%) went on to require DO. All distracted grafts achieved long-term length increases [15.34+/-2.51mm (46.8+/-9.7%)], accompanied by volume decreases [-1570.05+/-1079.70mm³ (-39.3+/-24.5%)], both of which were significantly different from changes in the contralateral side (L: $p=0.043$; V: $p=0.021$), attributed to remodeling of the reconstructed native mandible/graft. Compared to non-distracted grafts, DO resulted in greater increases in mandibular length ($p=0.017$).

Conclusions: Costochondral grafts grow in length and volume commensurately with the unaffected side in the majority of patients with CFM. Distraction osteogenesis achieves consistent graft lengthening, but is associated with graft remodeling.

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A Multicenter Assessment of the Surgical Burden for Patients with Craniofacial Microsomia

Presenter: Craig B. Birgfeld

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Background: Craniofacial Microsomia (CFM) is the second most prevalent condition treated by craniofacial teams. The complexity of CFM requires multidisciplinary care and coordination with growth. Disagreement exists regarding optimal timing and type of procedures offered. We describe the surgical burden of CFM and the current approaches to timing of intervention.

Methods: FACIAL is a multicenter research network whose aim is to improve care for patients with CFM. Patients diagnosed with CFM at 4 participating centers were enrolled. Surgical interventions, phenotype and age of surgery were assessed by chart review and parent recall and were grouped into the following categories: Airway, Dental, External Ear, Middle Ear, Eye, Facial Palsy, Orofacial cleft, Facial Skeleton, Soft Tissue and Other.

Results: 100 patients enrolled (CHLA-20, CHOP-12, SCH-56, UNC-12). 21 had not undergone surgery while 79 underwent a total of 280 procedures related to CFM (avg=3.5 per patient) in the following categories; Airway: 23, Dental: 15, External Ear: 96, Middle Ear: 27, Eye: 21, Facial nerve: 2, Orofacial cleft: 16, Facial Skeletal: 18, Soft Tissue: 17, Other: 45. Operative anesthetics per year of life ranged from 0.26 to 0.76. Kids with microtia and facial asymmetry had the highest average number of surgeries at 0.47/year. Those with isolated microtia had the lowest average number of surgeries/yr (0.21), likely because 25% had no history of surgery. Average surgeries per year were lower among older kids, suggesting an early, intense period of intervention.

Conclusion: Patients with CFM undergo numerous surgeries during childhood, most frequently pertaining to ear and airway followed by facial skeletal and soft tissue. These interventions tend to appear early in childhood. Other surgeries are also frequently performed in this cohort, illuminating the need for multidisciplinary coordination of care for these patients.

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Evaluation of the Zygoma and Temporomandibular Joint in Hemifacial Microsomia

Presenter: Lin Lin Gao

Authors: Gao LL, Yu JW, Wink JD, Taylor JA, Bartlett SP

Children's Hospital of Philadelphia, USA

Background: The facial asymmetry of hemifacial microsomia patients (HFM) is result of the unilateral skeletal hypoplasia of the mandible, orbit, zygoma and temporal bone. Although HFM mandibular hypoplasia has been categorized and studied, a detailed examination of the anatomic bony morphology of the temporal bone is lacking.

Method: We identified forty-four HFM patients at Children's Hospital of Philadelphia with computed tomography scans including three-dimensional image reformatting. We assessed and rated, from mild to severe, the morphologic abnormalities of the zygomatic process, glenoid fossa and mandibular condyle. Kaban-Puzansky classification was used to evaluate the mandible.

Results: The degree of zygomatic deformity was graded according to severity: 0=no deformity, 1=mild hypoplasia, 2=severe hypoplasia resulting in disjointed arch. The degree of glenoid fossa deformity was categorized: 0=no deformity, 1=mild effacement, 2=complete flattening. Thirty-six percent (36%) of patients did not have a zygomatic process of the temporal bone. Twenty percent (20.4%) of patients had a discontinuous zygomatic process. There was no statistically significant relationship between the degree of zygomatic process deformity with mandibular deformity. There was no statistically significant relationship between the degree of glenoid fossa deformity and mandibular condyle deformity.

Conclusion: This is first study to examine the spectrum of abnormality of the temporal bone in hemifacial microsomia patients and to notes its relationship with mandibular morphology. These abnormalities are variable and are independent of severity of mandibular deformity.

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Foundation research of the Sandwich method for treatment of mandibular hypoplasia caused by hemifacial microsomia

Presenter: Jia Xu

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Purpose: To evaluate the effect of the osteogenesis of the compound of CHA+VEGF+FS as composite scaffold materials and study the effect of this new method. Using osteotomy of the outer mandibular cortex combined with the compound of CHA+VEGF+FS in miniature pigs to treat mandibular hypoplasia caused by hemifacial microsomia, provide the necessary theoretical basis for clinical application in the future.

Method: 10 miniature pigs at age 9-12months were selected as the experimental animals which were divided into 2 groups randomly: group A and group B. In group A, the outer cortex of mandibular body and angle was split in one side and the compound of CHA+VEGF+FS was implanted into the gap between the outer and inner cortex of mandible, with the other side as control. In group B, two kinds of compounds (leftside: the compound of CHA+VEGF+FS:the compound of CHA+FS) was implanted into the gaps with the same methods separately. The osteogenesis and effect of this method by morphological, histological, radiological observation and biomechanical testing.

Result: Both of the compound of CHA+VEGF+FS and the compound of CHA+FS after implantation could increase the width of the mandible effectively. But the compound of CHA+VEGF+FS was higher than the compound of CHA+FS in the degree of vascularization in the early time, and achieved bone mature much earlier after implantation by histological observation. On the bone resorption rate of the test, the compound of CHA+VEGF+FS was lower than the compound of CHA+FS. After 6 months, the two implant materials showed that there was no evident difference with normal bone tissue by the histomorphology, scanning electron microscopy of ultrastructure observation and the implant had no obvious effect on maximum stress.

Conclusion: The results of this pilot study indicate that the osteotomy of the outer mandibular cortex combined with the compound of CHA+VEGF+FS may be useful for the augmentation of width of mandible. This study provided a theoretical basis for clinical use of this new method.

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Radical Bi-Maxillary Distraction in Severe Mandibulofacial Dysostosis

Presenter: Christopher B. Gordon

Authors: Gordon CB, Runyan CM

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Introduction: Patients with severe Nager and Treacher Collins (TCS) syndromes present a distinct challenge to craniofacial surgeons due to micrognathia and airway obstruction that frequently recur or persist despite mandible distraction osteogenesis (MDO). In our experience the massive mandibular movements required to clear the airway using a two-pin transfacial approach requires forces that often result in hardware failure or patient discomfort. More recently we found that by performing bi-maxillary distraction using a rigid external device (RED) we were able to achieve greater and more stable advancements.

Methods & Results: Consecutive cases (8) of children with severe TCS or Nager syndrome treated with Lefort III/BSSO distraction osteogenesis were examined. Six (75%) had a prior MDO operation and 6 had a tracheostomy. Prior to Lefort III, malar and periorbital augmentation were performed using BMP2-soaked particulate allograft bone, to establish greater continuity between the midface and cranial base. This was performed serially (up to 4 times) as necessary to produce adequate bone. Using an ultrasonic osteotome, concomitant transconjunctival Lefort III and BSSO were then performed and distracted to a RED device at both levels at 1mm/day. We overdistracted to promote airway clearance and utilized a consolidation period and/or intermaxillary fixation following distraction. Significant midface soft tissue advancement often required subsequent canthoplasty (6), midface bony contouring (7) or nasal dorsum augmentation with rib graft (3). Three patients required a second bimaxillary advancement. Of the patients with tracheostomy half (3) are decannulated and another two are receiving capping trials.

Conclusion: Based upon our experience, aggressive bimaxillary distraction with stable counterclockwise maxillary movement has greater success than isolated/serial MDO for treatment of upper airway obstruction in patients with severe mandibulofacial dysostosis.

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Staged bony framework reconstruction and lipo-filling for Adult Severe Parry-Romberg Syndrome

Presenter: Zhiyong Zhang

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Background: Parry-Romberg Syndrome (PRS) is an acquired facial deformity that manifests as progressive hemifacial atrophy that has unknown etiology. For severe case, except for large-scale soft tissue atrophy, the osseous framework is often involved, rendering their management difficult. Many surgical techniques focused on soft tissue restoration, especially microvascular free tissue transfer have been reported, but the result is not always optimal due to the bulking and sag of the transferred flap and the leaving deformities of the underlying hard tissue. From 2009, we have changed our protocol, the skeletal deformities were firstly reconstructed and the soft tissue was restored with serial lipo-filling.

Methods: The occlusal canting and chin deviation were corrected with mandibular lengthening plus second stage Le Fort I osteotomy and genioplasty. Polyethylene implants or autologous bone graft was used to increase the malar projection and the width of the atrophied mandible simultaneously. The soft tissue deficits were corrected with serial autologous fat injection.

Results: From September 2009 to July 2014, 8 patients with severe Parry-Romberg Syndrome were treated with the techniques mentioned above, the tilted occlusal plane and mal-occlusal relationship were corrected and facial asymmetry was improved significantly.

Conclusion : The underlying osseous framework reconstruction is crucial for the management of severe Parry-Romberg Syndrome. With staged skeletal and soft tissue reconstruction, the facial asymmetry and occlusal relationship, as well as facial expression can be improved significantly compare with the technique of microsurgical flap transplantation alone.

Keywords: Parry-Romberg Syndrome, Bony framework reconstruction. Lipo-filling

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The Effects of Tongue Reduction for Macroglossia of Beckwith-Wiedemann Syndrome

Presenter: Jeffrey L. Marsh

Author: Marsh JL

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Background: Macroglossia is one of the initial defining manifestations of Beckwith-Wiedemann syndrome (BWS). However, the dentoskeletal deformities of BWS were only recognized more recently. It has not been known whether the anterior malocclusions (anterior crossbite and/or anterior openbite) seen in BWS are primary due to the overgrowth syndrome, secondary to the macroglossia, or a combination of both.

Method: A retrospective record review was conducted of 504 individuals with a clinical and/or DNA diagnosis of BWS. Of these, 375 underwent the same TR operation, an anteriorly based "W" wedge resection, performed by one CF surgeon between 1986 and 2014. All patients were evaluated pre and postTR by the same surgeon in conjunction with an interdisciplinary CF team. A retrospective review of 108 of these patients, with sufficient time and data for follow-up, was conducted to determine whether surgical TR affects the anterior malocclusion of BWS as well as breathing and speech.

Results: The **dentoskeletal** natural history of 504 of individuals with BWS without TR surgery is: 81% anterior crossbite and/or anterior openbite; 13% edge-to-edge; 6% normal occlusion. Of these, 375 patients underwent a single TR by one surgeon using one technique at a median age of 13 months. The median postTR follow-up was 9 months (range 3-277 months) with anterior occlusion distribution: 30% anterior crossbite and/or anterior openbite; 11% edge-to-edge; 59% normal occlusion.

Perinatal **breathing** issues were recorded for 18% of the BWS individuals who had TR. Perioperative respiratory morbidity occurred in 4% of individuals following TR. Of the individuals with documented obstructive sleep apnea, OSA was resolved or improved for 5 and worse for 1 after palatoplasty but then improved with T&A.

Pre and post-TR **speech** evaluations were available for 41 patients with a mean age of preTR of 25 months and a mean speech follow-up 16 months after TR at 41 months of age. Articulation was abnormal in a majority of patients preTR. Following TR, 66% of the patients had no articulation problems while the remainder had documented improvement in articulation.

Conclusion: Surgical tongue reduction for BWS macroglossia within the first 2 years of life dramatically improves anterior malocclusion, decreases the severity of OSA and improves articulation.

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Mandibular Distraction Combined with Orthognathic Techniques for Severe Adult Mandibular Hypoplasia

Presenter: Lin Yin

Author: Yin L

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Background: Deficiencies in the growth of the mandible can not only cause various degrees of facial deformity but also affect breathing and occlusal function. Here we report our experiences with mandibular distraction combined with orthognathic surgical techniques for the treatment of severe adult mandibular hypoplasia.

Methods: Cephalometric analysis was conducted in all patients for quantitative evaluation. A computer-assisted surgical simulation was prepared before distraction. According to the simulation data, an operative osteotomy guide plate was designed and three-dimensionally printed with photosensitive resin. With the help of the guide plate, the osteotomy line was precisely placed. An internal distractor was then placed through an extraoral incision created under general anesthesia. Distraction began after 7 days of latency at the rate of 1 mm/day. After a 6- to 8-month consolidation period, the distractor was removed. At the same time, genioplasty and/or subapical osteotomy was performed to correct the patient's cross-bite and improve the facial contour for bilateral mandibular hypoplasia. For unilateral mandibular hypoplasia, a Le Fort I osteotomy was performed to correct the open bite on the affected side, while a mandibular outer cortex excision was performed on the unaffected side to improve lower facial symmetry.

Results: Facial appearance and occlusal function were improved greatly in all 36 patients (mean age, 20.3 years). No facial nerve palsy was reported, nor were there complaints about postoperative facial scarring. The postoperative infection rate was 2.8%. The distance of lengthening was 26.2 ± 2.8 mm. The increased ramus length on the affected side was 18.9 ± 9.3 mm. At the end of the consolidation period, the affected mandibular ramus length increased by $49.1\% \pm 44.8\%$. For bilateral mandibular hypoplasia, the increased chin projection was $21.0\% \pm 16.5\%$. For unilateral mandibular hypoplasia, the chin deviation was corrected by $60.1\% \pm 21.9\%$. However, 6-8 months after distractor removal, the length of the mandibular ramus decreased by $16.6\% \pm 20.8\%$.

Conclusion: Complicated mandibular hypoplasia can be well corrected with mandibular distraction combined with orthognathic surgery.

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MANDIBULAR SYMPHYSEAL DISTRACTION IN THE SILVER RUSSELL SYNDROME

Presenter: Eva Galliani

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Introduction: The purpose of the study was to examine the typical triangular face with mandibular micrognathia of patients with Silver Russell Syndrome (SRS) in order to explore the treatment options. A transversal and sagittal lack of mandibular growth creating an anterior lower dental crowding treated usually with two bicuspid extractions, but this worsens the skeletal class II malocclusion. The orthodontic treatment consists of an inferior expansion width but often is inefficiency. When the skeletal mandibular transvers deficiency is upper 1 tooth (7 mm), a symphyseal mandibular distraction is indicated.

Materials and Methods: Twenty-six patients were included in the study, ranging in age from 5.0 to 20.0 years at the initiation of treatment (mean, 9.4 years). Of this group, 16 were male and 10 female. Of this group 15 had Delaire and Tweed radiological analysis of profile, and 13 had Ricketts radiological frontal analysis.

Results: Clinically 90% of the patients presented deep bite and hypodivergency. In the vertical analysis 75% have lack of vertical height. In the transversal analysis, 60% have lack of transversal growth of the maxilla and mandible. The therapeutic options for transversal mandibular deficiency is orthodontic or surgery. The orthodontic possibilities are: stripping, bicuspid extraction and orthodontic widening, but in the SRS often it is inefficiency and relapse. The surgical treatment is a symphysis osteotomy with a cutting guide after a 3-dimensional planning and followed by a gradual osteodistraction.

Conclusion: In the severe cases of mandibular micrognathia in the SRS results indicate the mandibular symphyseal distraction creates the space of the alignment of lower incisors. This surgery could be programmed from 8-9 years old when the permanent lower incisors have erupted in the dental inferior dental arch. This therapeutic protocol is an efficient and stable treatment method in the skeletal transverse deficiency of the mandibular arch in Silver Russell Syndrome.

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Long-term outcomes & treatment strategies in Otocephaly-Dysgnathia Complex

Presenter: Michael S. Golinko

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Background: Otocephaly-dysgnathia complex (ODC) is characterized by mandibular hypo- or aplasia, ear abnormalities, microstomia, and microglossia. The spectrum of this rare syndrome extends from patients born without any mandible whatsoever, agnathia-- to patients with varying degrees of micrognathia. The literature reports only a handful of patients whom have survived past infancy. We report our long-term follow-up on 3 patients, present our reconstructive experience and suggest a management strategy.

Methods: A retrospective, single institution review of all patients with ODC treated over a 30 year period was reviewed. Two males with a symphyseal mandibular remnant only, i.e. *nanognathia* and one female with agnathia were included.

Results: All patients had a normal nasopharynx but no tongue. Mean age at last visit was 12.1 years (5-16), and mean follow-up was 11.1 years (5-13). All three patients underwent immediate tracheostomy and gastrostomy-tube placement shortly thereafter. Commissuroplasties were typically performed before 3 years of age and repeated as necessary to allow for oral hygiene and improved oral access for surgery. Mandibular reconstruction was performed with rib between ages 3 and 8, after which time, free fibula transfer was utilized. Due to resorption or extrusion, all patients underwent repeat bone grafting. Tissue expansion of the neck was commonly used to augment deficient soft tissue of the lower third of the face, but was more successful in the teenage years. Although all patients retained tracheostomy and gastrostomy-tube dependent, they were able to communicate, make friends and attend school. An algorithm based on our experience will be presented.

Conclusions: ODC need not be a fatal nor untreatable condition; a reasonable quality of life can be achieved as we have shown in these three patients. Although the lower-facial contour may be restored, and stoma created, the inherent lack of musculature make deglutition virtually impossible with current therapies. Transplantation may become an option in the future for such congenital deformities.

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The role of ethnicity as a risk factor in the development of Parry Romberg Syndrome

Presenter: Damian Palafox

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Background: Major Histocompatibility Complex encodes the Human Leucocyte Antigen systems. HLA discriminating ability may also be used to single out populations. Parry Romberg Syndrome (PRS) is characterized by progressive facial hemiatrophy with variable tissue involvement. To our knowledge, the association between HLA and PRS has not been studied before but in isolated individual cases.

The aim of our research was to explore the potential association between PRS and an the HLA system, to comprehend the physiopathological mechanism and the possible role of ethnicity in the development of PRS in Mexican mestizo individuals.

Methodology: We studied 24 patients with PRS from our Department obtaining the gene and haplotypic HLA frequency in 24 patients (48 haplotypes), which included loci from the HLA systems: HLA-A, HLA-B, HLA-DR and HLA-DQ. Results were further compared with the frequencies in a group of 99 mexican mestizo controls without background of any disease. The differences in the gene frequencies were analyzed with non-parametric statistics, which included Chi-square test and Fisher's exact test, as well as de odds ratio determination (OR), with a 95% Confidence Interval (CI).

In PRS patients, we found significant rise (gene frequency: 14% in PRS versus 1% in controls) of the allele HLA-DRB1*16, as well as significant low prevalence of the allele HLA-DR*7 (2% in PRS versus 11% in controls). We also encountered that HLA-DR*16 is part of the haplotypes: HLA-DRB1*16, DQB1*0301, in combination with the alleles HLA-B*39, B*15 and HLA-B*35, while in control normal population, the DQ allele is DQB*0502.

Conclusion: This results suggest that the risk haplotype for PRS is HLA-DRB1*16-DQB1*0301. Given the fact that the origin of this haplotype is indigenous, it suggests that the Mexican mestizo affected with the disease is influenced by the Amerindian genetic background, and due to the fact that the risk alleles (DR11, DR1 and DR3) for other diseases often associated or compared with PRS, such as Scleroderma, CREST Syndrome and Morphea were absent in this study, we can infer that Parry Romberg Syndrome is a separate, unique and extraordinary disease.

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Treating Romberg Syndrome Using 3D Scanning and Printing and the Anterolateral Thigh Dermal Adipofascial Flap

Presenter: Haisong Xu

Authors: Xu H, Tan A, Zhan Y, Chai G

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Background: As 3D technology becomes more ubiquitous, many plastic surgical applications have emerged. We investigate a 3D scanning and printing system for facial soft tissue reconstruction in conjunction with an anterolateral thigh dermal adipofascial flap for the treatment of Romberg Syndrome.

Methods: Seven patients with facial atrophy of the zygomatic, buccal and mandibular areas were included. 3D scanning of each patient's face in conjunction was analyzed with computer -aided design to quantify areas of facial asymmetry. Models were then created using 3D printing to map areas of soft tissue deficiency. Free anterolateral thigh (ALT) dermal adipofascial flaps were designed based on the 3D models of soft tissue deficiency.

Results: All flaps survived. One case had a postoperative hematoma. 6 patients had restored facial symmetry. One patient required fat injections to obtain symmetry. No patients required revision surgery of their healed flaps for contouring.

Conclusion: 3D laser scanning and 3D printing in combination with a free ALT dermal adipofascial flap offer surgeons a precise means to reconstruct facial contour deformities.

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Indication for Early Mandibular Distraction Osteogenesis in Hemifacial Microsomia: A long-term follow-up study

Presenter: Yorikatsu Watanabe

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Background: More than 20 years have passed since the introduction of distraction osteogenesis (DO) in hemifacial microsomia (HFM). Recently the long-term studies about the early mandibular DO before completion of facial skeleton have been published. The aim of this study was to evaluate our patients with HFM who were treated with mandibular DO and followed up till the completion of craniofacial growth.

Methods: Twenty patients with HFM (Pruzansky-Kaban type I:1, type IIA:15, type IIB:4) were operated at an average age of 8.5 years with an average degree of distraction of 16.6 mm and an average consolidation period of 118 days. Follow-up years till the growth completion varied between 6 and 14 years, with a mean follow-up of 8 years. Mandibular vertical changes were measured on cephalograms taken at preoperation and at the end of distraction, 1, 5, and 10 years after DO. Ratios between affected and non-affected ram heights were evaluated. Patient with mandibular ratio below 80%, whose facial asymmetry was clinically conspicuous, was indicated for early DO in our clinical cases.

Result: The mean ratio was 76.6% preoperatively (n=20), increased 87% at the end of distraction (n=20), and showed a gradual return to 80.4% at 1 year (n=20), 83.2% at 5 years (n=17), and 80% at 10 years of distraction (n=7) respectively. Long-term result suggested the mean ratio between preoperation and the growth completion had no significant differences (p>0.05). Seven patients (35%) underwent bimaxillary surgery for correction of facial asymmetry and mal occlusion as a major orthognathic surgery. Minor touch-up procedures like a genioplasty and fat injection were underwent for most patients.

Conclusion: In conclusion, patient with the ratio above 80% was suggested to wait for orthognathic surgery till the completion of skeletal growth. Patient with the ratio below 80% is carefully recommended to accept the early mandibular DO offering aesthetic and psychosocial improvements for several years of adolescence, but reoperation will be needed at the growth completion to correct facial asymmetry.

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APPLYING COMPUTER TECHNIQUES IN RECONSTRUCTING SKELETAL AND SOFT TISSUE FOR PARRY-ROMBERG SYNDROME

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Background: Parry-Romberg syndrome involves progressive atrophy of facial bony structures as well as changes in skin and subcutaneous tissue. This study focused on the application of computer aided design in restoring facial bony alignment and soft tissue volume to improve the accuracy of reconstruction.

Methods: Medical three-dimensional image reconstruction and mirror technique were applied to design and evaluate the skeletal and soft tissue(include masseter and facial fat) deficiency before operation. A surgical procedure was performed in 7 patients with Parry-Romberg syndrome according to the preoperative planning. Using computer software, the ideal region to take mandibular outer cortex bone was located according to the size and surface curvature of the preoperative design. Surgical accuracy was evaluated by comparing the preoperative and postoperative 3D reconstructed images.

Conclusion and Discussion: All 7 patients had ideal clinical outcome with few complications during long term follow-up. Symmetrical appearance improved significantly. Basing on clinical, this study applied computer-aided technology to the treatment of Parry-Romberg syndrome and solved the difficult problem that lack of accuracy of bone's reparation and soft tissue's restoration. The depth of excavation advantage of computer-aided technology has been used to assess the amount of bone deficiency and morphology, provides a new means to optimize mandibular outer cortex and atrophy bone curvature. The three dimensional images of preoperative design using computer techniques and postoperative were superimposed onto each other and fit well. Computer technique is a more reliable quantitative evaluation method than the eyes, which simplifies the operative procedure, shortens the operating time, and improves the accuracy of the operation.

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Evolution of surgical methods to increase volume in hemifacial microsomia (154 cases)

Presenter: Xiongzhen Mu

Author: Mu X

*Shanghai Ninth People's Hospital, China***Purpose:** To analyses the results of volume increasing in correction of hemifacial microsomia.**Method:** Data include 154 cases in last 20 years with both maxillofacial surgery and soft tissue augmentation. We focused on evolution of surgical methods by each 5 years.**Results:** The methods of maxillofacial surgery for skeleton correction have no change in last 20 years. It included traditional orthognathics surgery, bone graft, and distraction osteogenesis. Free fascial or muscle flaps were increased in first 10 years but decreased in recent 5 years. Pedical fascial flap or Sandwish pedical flap have been used for fourth of all cases with supplementary consideration. Autologous free fat graft were used a little in first 5 years but increasingly used with a large amount in recent 5 years.**Conclusion:** The change of treatment have happened in volume augmentation in soft tissue in hemifacial microsomia in last 20 year.

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Using principal components analysis to assess mandibular anatomy in craniofacial microsomia

Presenter: Kohmal A. Solanki

Authors: Solanki KA^{1,2}, Ponniah AJT¹, Ruff CF², Koudstaal MJ^{1,3}, Dunaway DJ¹*¹Department of Craniofacial Surgery, Great Ormond Street Hospital for Children, UK, ²Department of Medical Physics, University College London Hospital, UK, ³Department of Oral and Maxillofacial Surgery, Erasmus University Medical Center, The Netherlands***Background:** Craniofacial microsomia (CFM) is the second commonest facial deformity after cleft lip/palate. Mandibular hypoplasia is a defining clinical feature, yet the changes occurring on both the affected and unaffected sides are poorly understood. Principal components analysis (PCA) is a mathematical technique that characterises shape variation within a population. We aimed to determine use PCA to evaluate mandibular anatomy in craniofacial microsomia.**Methods:** Using CT data, 3D normal and CFM mandibles were reconstructed and isolated from the rest of the craniofacial skeleton. Two age-matched groups: 2.5-10 years (n=11 [normal]; n=9 [CFM]) and 11-19 years (n=8 [normal]; n=9 [CFM]) were investigated. 48 homologous points were used as landmarks for the study. Using PCA, the first 3 modes of variation were calculated and thin-plate spline warps created to visualise the changes from -2SD to +2SD from the mean for each mode.**Results:** Intra-observer variability showed >95% of landmarks were within 2SD of the mean. The 1st mode of variation demonstrated mostly allometric growth changes for both populations. The 2nd mode showed that with increasing condylar hypoplasia, there was a corresponding increase in contralateral alveolar length. The 3rd mode demonstrated condylar hypoplasia caused midline rotation towards the affected side but without significant contralateral alveolus hyperplasia. These changes appeared more pronounced in younger patients.**Discussion:** The results of this study suggest that there are multiple changes in shape and position of all parts of the mandible on both the affected and "normal" side. It is therefore not surprising that current reconstructive techniques that concentrate of one or two areas fail to fully address the overall deformity. The compensatory changes occurring to the "normal" side and midline need to be considered in surgical and orthodontic treatment planning.

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Simultaneous Biplanar Maxillomandibular Distraction Osteogenesis using Single Distractor

Presenter: Hüseyin Karagöz
 Authors: Karagöz H¹, Erkan M¹, Öksüz S¹, Eren F¹, Cesur C¹, Ülkür F², Ülkür E¹

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Background: Progressive hemifacial atrophy is a pathologic process characterized by unilateral facial atrophy involving skin, subcutaneous tissue, fat, muscle, and bones. The maxilla and mandible are most often involved, and these bones are fail to develop in both sagittal and vertical plane. Although bony deformity is profound, malocclusion which required orthognathic surgery is not common in the cases of simultaneous maxilla and mandible hypoplasia.

We performed simultaneous maxillomandibular distraction in sagittal and vertical plane with single bi-directional internal distractor for treatment of progressive hemifacial atrophy patients, and we want to share our results.

Method: We have operated three progressive hemifacial atrophy patients for 3D reconstruction of their hemiface. All the patients have had unilateral maxillary and mandibular hypoplasia without malocclusion. Following a short term pre-surgical orthodontic treatment, unilateral mandibular osteotomies and Le Fort I osteotomy were performed, however pterygomaxillary junction of the unaffected side was left intact to avoid total maxillary separation. Bidirectional internal mandibular distractor was placed on the mandible in a suitable fashion, and maxillomandibular fixation was performed. Following 5 days of latency period, distraction was performed in both sagittal and vertical plane until the desired correction was achieved. The distractor was removed and maxillomandibular fixation was released following 2 months of consolidation period.

Result: All the surgical procedures and distraction osteogenesis were successful. The patients were evaluated in postoperative 2 years and it was determined that long-term results were successful and relapse or malocclusion didn't occur.

Conclusion: Distraction osteogenesis is the common treatment method to lengthen the hypoplastic mandible and/or maxilla for 3D reconstruction, however it may cause malocclusion if the patient has normal maxillary and mandibular dental relationship previously. We could achieved simultaneous correction in both sagittal and vertical plane for maxilla and mandible without disturbing the occlusion using single internal distractor.

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Predictive Soft tissue Airway Volume Analysis in Mandibular Distraction for Obstructive Sleep Apnea

Presenter: Russell R. Reid
 Authors: Reid RR¹, Mhlaba BS JM¹, Lemelman BT¹, Silva AK¹, Chen M²

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Background: 3D-Computed Tomography (CT) has been used in both the preoperative planning of mandibular distraction osteogenesis (MDO)¹, as well as in the evaluation of post-operative outcomes²⁻⁴. We present a case report of the use of predictive software to derive a planned post-distraction airway volume during virtual surgical planning in a 7 year-old boy undergoing MDO for obstructive sleep apnea.

Methods & Results: A simulated post-distraction, model of the craniofacial skeleton was rendered and airway volume was calculated (Materialise, Inc.). The increase in airway volume after 3D simulated advancement of the mandible was 33.57% (1716 mm³ preoperatively to 2292 mm³ post virtual distraction). Based on 3D virtual planning, the patient's airway volume increased to 2211 mm³ post-operatively, a 28.85% increase in airway volume. This post-operative airway volume is 3.5% less than the predicted airway volume.

Discussion: This case demonstrates not only the relationship of mandibular distraction and airway volume improvement, but also that this relationship can be predicted using sophisticated, virtual planning. The implications of this technology are far-reaching. First, the ability to predict airway volume increase allows for planning to center on the functional outcome, not on the position of the jaw as current practice dictates. In addition, we should be able to use these predictive models to compare with normative airway volume values for all ages. This would enable us to follow the progress of patients post-distraction and to better evaluate the effects of mandibular regression and bone growth velocity over time as compared to normal controls. We plan to include this preoperative virtual planning and predictive analysis on all patients with mandibular hypoplasia going forward.

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Social Services Offered by Cleft and Craniofacial Teams: A National Survey and Institutional Experience

Presenter: Gregory E. Lakin

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Background: A multidisciplinary approach to patients with craniofacial abnormalities is the standard of care by the American Cleft Palate-Craniofacial Association (ACPA). However, the standards of team care do not require provision of social support services beyond access to a social worker. The purpose of this investigation is to study 1) social support services provided by ACPA teams, 2) funding sources for services, and 3) family interest in services.

Methods: A survey was submitted to ACPA cleft and craniofacial team leaders (N=161) which evaluated the provision of potentially beneficial social support services, and their funding sources. A second survey administered to patient families at our institution gauged their level of interest in these services. Statistical analysis examined the level of interest amongst services.

Results: Seventy-five out of 161 (47%) teams and 39 out of 54 (72%) families responded to the surveys. Services provided included scholarships (4%), summer camp (25%), social media (32%), patient support groups (36%), parties (42%), parent support groups (46%), other opportunities (56%), and social workers (97%). The majority of funding for social workers was by the institution (61%) while funding for ancillary services varied (institution, team, fundraisers, grants, and other sources). Families indicated an average interest of 2.4 ± 1.41 for support groups, 2.5 ± 1.63 for summer camps, 2.92 ± 1.66 for parties, 3.16 ± 1.65 for social media, and 3.95 ± 1.60 for scholarships (p-value < 0.05).

Conclusion: The ACPA standards of team care do not require teams to provide social support services beyond access to a social worker. Amongst our survey respondents we found that in addition to a social worker, teams offered social support services which were not required. The social worker position is usually institutionally funded, while funding sources for additional services varied. Respondents at our center desired additional social support services.

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ANALYSIS OF NASOLABIAL AESTHETICS IN PATIENTS WITH CUCLP TREATED BY ONE-STAGE SURGERY VS. NAM AND TWO-STAGE SURGERY

Presenter: Supakit Peanchitlertkajorn

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Background & Purpose: This study compared nasolabial aesthetics in patients with non-syndromic complete unilateral cleft lip and palate (CUCLP), treated by 2 protocols. The 1-stage Repair group performed a single repair at 9 months, combining lip, hard and soft palate without using pre-surgical orthopedics. Alveolar bone grafting was done between 2-4 years. The NAM group performed pre-surgical nasoalveolar molding, lip repair at 3-5 months, and one or two-stage palate repair. The one-stage palate repair was performed at 12 months. For the two-stage palate repair, soft palate and lip were repaired at the same time while hard palate was repaired at 18 months. Alveolar bone grafting and surgical revision were not performed in this group.

Methods: Pre-orthodontic photos were cropped to show only nasolabial area for ratings. They were rated twice using Asher-Mcdade scale and Reference Picture method by 3 craniofacial surgeons, blinded to origins of photos. For Asher-Mcdade scale, a lower score indicates a more aesthetic outcome. For Reference Picture method, a higher score depicts a better outcome. The 1-stage Repair group (N=43) had a mean age of 10.2 years compared to 7.75 years for the NAM group (N=32). Weighted Kappa statistics and Interclass Correlation Coefficients were calculated to demonstrate intra-rater and inter-rater reliability respectively. Independent *t* tests were used to detect differences between rating scores from the 2 groups.

Results: Intra and inter-rater reliability tests showed moderate to very good agreements (k=0.657-0.969; ICC=0.401-0.5135). The rating scores for nasal deviation were highly statistically different between the 2 groups (mean=2.45, 121.78, NAM group; mean=2.99, 99.87, 1-stage Repair group; P<0.01) in both rating methods. Nasolabial profile (mean=2.56, 115.58, NAM group; mean=2.85, 106.32, 1-stage Repair group; P<0.05) and combined aesthetics scores (mean=2.26, 112.57, NAM group; mean=2.93, 102.60, 1-stage Repair group; P<0.05) are statistically different between 2 groups when Asher-Mcdade rating was performed.

Conclusion: NAM group showed more favorable overall nasolabial aesthetics especially nasal deviation and nasolabial profile. These differences could be attributed to NAM, skills, alveolar bone grafting, surgical technics and timing, or age difference.

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MODIFIED ANATOMICAL SUBUNIT APPROXIMATION TECHNIQUE WITH SIMPLIFIED NASAL FLOOR CLOSURE IN WIDE CLEFT LIP

Presenter: Siti Handayani

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Introduction: The cleft lip repair technique has evolved to achieve better result in the recent years. In 2005 Fisher propose novel technique focused on anatomical subunit approximation. This technique is quite challenging for patients with wide gap and without presurgical molding.

Methods: We are adapting modified Fisher anatomical subunit approximation technique for lip repair and we modify the lateral and medial flap for nasal floor closure. The posterior nasal floor closure was approximated with these flaps without using the turbinate flap. The tension is decreasing with this technique. This is preliminary report of our complete cleft lip repairs from April 2014 to February 2015.

Results: Twenty-five patients with alveolar gap >5mm and nasal floor distance >10mm were operated using our modified technique. The median age was 5 months (range, 10 weeks to 7 years), male to female distribution was 14 to 11. Of the 25 patients, 16 patients were unilateral complete cleft lip, 6 patient with bilateral complete cleft lip, 2 patients were facial cleft, and 1 patient was amniotic band sequence. Long term follow up of 3 months to 1 year revealed satisfactory restoration of the nasal floor and aesthetically acceptable lip repair.

Conclusion: The anatomical subunit approximation for cleft lip repair with simplified nasal floor closure is a feasible and safe technique, which is applicable in wide complete cleft lip repair. Further studies are needed to evaluate and improve this technique.

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The proposal to preserve the lesser palatine nerve in palatoplasty

Presenter: Hideaki Kishimoto

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Some patients with cleft palate after palatoplasty persist velopharyngeal dysfunction in speech, although they acquire good velopharyngeal function on deglutition. The velopharyngeal function is owed to the movement of the soft palate, that is, palatal muscles. Of the palatal muscles, the levator veli palatini muscle is inevitable for the velopharyngeal function, but the innervation of the levator veli palatini muscle is still controversial. We used the human samples in Kyoto collection, one of the most famous human embryo and fetus collections in the world, and observed that the anlage of the levator veli palatini muscle appears below the auditory tube, deriving from the first branchial groove between the first branchial arch and the second branchial arch. It is supposed that the muscle relates with the facial nerve, deriving from the second branchial arch. In addition, the observation of the fetus samples suggests that the facial nerve innervates the muscle through the lesser palatine nerve besides the pharyngeal plexus which is conventionally supposed to the dominant nerve of the levator veli palatine muscle. We think the difference between speech and deglutition mentioned at the beginning is caused by the double innervation of the muscle. Preserving the lesser palatine nerve from the facial nerve may be a key to relieve some patients with the speech impediment.

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Optimising the Delivery of Surgical Aid Work: a 15-year experience

Presenter: Priya Nandoskar

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Background: The disparity in access to good health care between first world and developing countries remains an issue of concern, and most recognisably, it is an issue of affordability. Surgical care is often thought to be an expensive and impractical service to deliver on a mission basis, however we outline here the clear economic benefits that can be obtained through delivery of specialty service of cleft care to a resource-poor setting over a sustained period of 15 years.

Methods: The demographics of all patients undergoing cleft lip and cleft palate (CLP) repair by a single team of Plastic Surgeons in Timor Leste were recorded in a comprehensive database, with more than 3000 surgeries performed over 40 visits. This data was analysed retrospectively using a disability-adjusted life year (DALY) framework to calculate the individual and total economic value gained by the provision of these surgeries. The cost of each DALY averted, both with and without age weighting, and with and without discounting, was calculated using the disability weights as determined by the Disease Control Priority (DCP) life tables. These were converted to pecuniary gains using the GNI per capita approach and also the Value of a Statistical Life (VSL) approach.

Results: The team undertook more than 700 primary cleft procedures over 15 years, of which almost 200 were cleft palate repairs and almost 600 were cleft lip repairs. The total number of DALYs averted were substantial, even after age weighting and discounting. In monetary terms, the total value of all CLP cases repaired in this time period ranged from AUD \$10 million via the human capital approach (GNI per capita) to AUD\$3 billion using the value of a statistical life approach (VSL), far beyond the costs incurred to provide the missions themselves.

Conclusions: This 15-year experience clearly demonstrates that the delivery of surgical specialist aid in a low-middle income country can be of great economic benefit to its people, if it is carried out in an effective manner as we have outlined. We have shown through the use of a DALY framework, with both VSL and GNI approaches, that the continued delivery of these services is in fact sustainable and cost-effective.

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Single Stage Primary Cheilo-Naso-Alveoloplasty in Complete BCLP Without Nasoalveolar Molding

Presenter: Amir S. Elbarbary

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Background: The surgical management of bilateral cleft nasal deformity is characterized by huge diversity in treatment protocols. The development of presurgical orthopedics/nasoalveolar molding facilitated lip closure & improved nasal projection. Unfortunately, in the developing countries, it is not widely available to serve all BCLP patients. A number of techniques have been developed to reposition lower lateral cartilage domes at the time of lip repair & recruit columellar skin from nasal tip skin instead of prolabium. Among these is the Trott & Mohan's one-stage open rhinoplasty at the time of lip repair, which allows for the best possible exposure to the displaced dome cartilages and avoids scars at both nasal tip & lip-columella junction despite claims of poor prolabial supply.

Materials & Results: Primary cheiloalveoloplasty has been our standard of care for cleft patients. In this study, we report successful combination of cheiloalveoloplasty & a modified primary open tip-plasty at six months of age in 27 infants suffering bilateral complete cleft lip & palate followed up to five years. All patients postoperative period passed uneventful without any vascular compromise of the nasal tips, columello-prolabial flaps, or premaxillae. Anthropometric assessment of nasal tip projection and columellar length for these patients were comparable to age matched controls at one year postoperatively.

Conclusions: Despite the lack of nasoalveolar molding, a well-implemented primary lip, alveolar & open tip-plasty is cost effective in limiting the number of surgical interventions & combining the advantages of both cheiloalveoloplasty & open tip-plasty. It stabilizes the alveolar segments and eliminates the occurrence of anterior palatal & alveolar fistulae by providing a two-layer closure. Furthermore, this approach provides optimally oriented nasal tip anatomy while reducing the social stigma of the bilateral cleft lip nose appearance early during the child's growth.

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Multidisciplinary Algorithm for Implant-based Cranioplasty Reconstruction in Previously Infected Sites

Presenter: Shuting Zhong

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Purpose: Bone-flap infection is a frequently encountered complication (1-59%) following cranial reconstruction and carries significant morbidity including recurrence rate approaching 40%. Currently, the timing of secondary cranioplasty following bone-flap infection is controversial. Most advocate for late/delayed reconstruction ranging from 6 to 12 months following complete debridement of infected bone and surrounding devitalized tissue. However, delayed secondary cranial reconstruction is associated with scalp contracture and tissue deficiency, prolonged use of protective helmets, acquired asymmetry/deformity, and potential for syndrome of trephined. Therefore, our goal was to investigate an optimal time to secondary cranioplasty by evaluating outcomes following early (3-6 months) and delayed (6 months or more) time intervals.

Methods: The study is a retrospective cohort review of 108 consecutive cranioplasty cases performed at a single, multidisciplinary center. Of these cases, 25 patients fulfilled our inclusion/exclusion criteria. Logistic regression was performed comparing variables between two groups: "early" cranioplasty (between 90-180 days) and "late/delayed" cranioplasty (≥ 180 days).

Results: No significant difference was found in primary and secondary outcomes in patients who underwent early (mean=4 months) vs late (mean=8 months) secondary cranioplasty ($p=0.285$). The overall post-secondary cranioplasty complication rate including major and minor complications was 16% (4/25). In fact, there was a trend towards more complications in the later cranioplasty cohort than the early cohort (27% (3/11) vs. 7% (1/14), $p=0.29$, respectively). In both time categories, the most common complication was post-operative subgaleal fluid collection (12%, 3/25, $p=0.2831$). No occurrence of re-infection occurred in the early group (0% (0/14) $p=0.44$).

Conclusion: Our results suggest that early secondary cranioplasty (3-6 months; mean 3.77 months) is a viable strategy vs. delayed secondary cranioplasty (>6 months; mean 8 months) for reducing perioperative morbidity. With further analysis and long-term follow up, a reduced time interval could signal a paradigm shift in calvarial bone-flap osteomyelitis management and subsequent cranioplasty reconstruction.

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The effect of bone regeneration using adipose-derived stem cells and platelet-rich plasma

Presenter: Satoshi Tajima

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The goal of bone regeneration is to bridge a bone defect over healing procedures stable and durable. Adipose-derived stem cells (ASCs) with/without several scaffolds can differentiate into osteogenic cells. Meanwhile, platelet-rich plasma (PRP) is an interesting biological means to repair tissue by inducing chemotactic, proliferative, and anabolic cellular responses. The purpose of this study was to evaluate the ability of bone regeneration with the combination of ASCs and PRP. ASCs were isolated from inguinal fat pads of F344 inbred rats, while PRP was prepared from these rats. ASCs were cultured in control medium supplemented with 10% fetal bovine serum or 5% PRP in vitro. After 1 week, levels of growth factors including insulin-like growth factor-1, transforming growth factor- β 1, hepatocyte growth factor, and vascular endothelial growth factor in the culture supernatant were measured by enzyme-linked immunosorbent assays. Moreover, the ASC/PRP admixture was transplanted into the rat calvarial defect. Micro-computed tomography, histological, and immunohistochemical analyses were performed at 4 and 8 weeks after transplantation. The in vitro study showed that the levels of growth factors secreted by ASCs were significantly increased by the addition of PRP. Transplantation of the ASC/PRP admixture had dramatic effects on bone regeneration overtime in comparison with rats that received other transplants. Furthermore, some ASCs directly differentiated into osteogenic cells in vivo. These findings suggest that implantation of ASCs/PRP admixture may have cooperative effects for bone regeneration. This may be a promising method for the clinical treatment of cranial defects.

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BMPR-IA+ Adipose-Derived Stromal Cells: A Promising Candidate for Soft Tissue Reconstruction

Presenter: Elizabeth R. Zielins

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Background: Reconstruction of soft tissue defects has traditionally relied on the use of grafts and flaps, which may be associated with variable resorption and/or significant donor site morbidity. Cell-based strategies employing adipose-derived stromal cells (ASCs), found within the stromal vascular fraction (SVF), may offer an alternative strategy for soft tissue reconstruction. In this study, we investigated the potential for a bone morphogenetic protein receptor (BMPR)-IA+subpopulation of ASCs to undergo enhanced *de novo* adipogenesis.

Methods: Human lipoaspirate was enzymatically digested to isolate the SVF and magnetic-activated cell separation (MACS) was utilized to obtain BMPR-IA+and BMPR-IA-cells. These cells, along with unsorted cells, were evaluated for adipogenic gene expression and *in vitro* differentiation. Cells from each group were also labeled with a GFP lentivirus and transplanted into the inguinal fat pads of immunocompromised mice to determine ability for *de novo* adipogenesis within a fat niche. Confocal microscopy along with HCS Lipidtox staining was performed to evaluate formation of mature adipocytes by transplanted cells.

Results: Adipogenic gene expression (AP2, LPL, PPAR γ) was significantly higher in BMPR-IA+cells compared to BMPR-IA- and unsorted cells, as was staining with Oil-Red-O. Within an adipogenic niche, BMPR-IA+cells formed significantly more adipocytes *in vivo*, as demonstrated by quantification of GFP+adipocytes and ImageJ analysis. Minimal formation of mature adipocytes was appreciated by BMPR-IA-cells.

Conclusions: BMPR-IA+ASCs show an enhanced ability for adipogenesis *in vitro*, as shown by gene expression and histological staining. Furthermore, within an adipogenic niche, BMPR-IA+cells possessed an increased capacity to generate *de novo* fat compared to BMPR-IA- and unsorted cells. This suggests utility for this subpopulation in cell-based strategies for soft tissue reconstruction.

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Upper airway endoscopy in children with syndromic craniosynostosis

Presenter: Marc van der Schroeff

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Background: Two-thirds of the patients with syndromic craniosynostosis develop obstructive sleep apnea (OSA), often due to midface hypoplasia, but also e.g. nasal obstruction, enlarged adenoids and tonsils and increased pharyngeal collapse. OSA may result in major neuropsychological and cognitive impairment, failure to thrive, feeding difficulties, recurrent infections and behavioral deficits. Moreover, OSA has been associated to causing increased intracranial pressure.

Method: A prospective observational cohort study was performed at the Dutch Craniofacial Center, Sophia Children's Hospital-Erasmus University Medical Center, Rotterdam, the Netherlands. Children with syndromic or complex craniosynostosis who underwent upper airway endoscopy between January 2006 and February 2015 were included in the study. Endoscopy findings were graded according to the severity index by Bachar et al. and the VOTE index. All patients underwent at least one level 1 polysomnography in the hospital. The Ethics Committee of the Erasmus MC (MEC-2005-273) approved the study.

Result: We included 24 patients (12 boys, 50%) who received upper airway endoscopy, including cases of Apert (n=10), Crouzon-Pfeiffer (n=12), Saethre-Chotzen (n=1) and complex craniosynostosis (n=1). Mean age at time of endoscopy was 6.8 years.

There was a positive correlation between the severity index by Bachar et al. and the severity of OSA (R=0.450, P=0.04). The correlation between the VOTE index and the severity of OSA was not significant (R=0.161, P=0.49).

Conclusion: OSA in patients with syndromic craniosynostosis is often a multi-level problem. A clinical classification tool, such as the severity index by Bachar, correlates nicely with severity of OSA. Upper airway endoscopy is a crude method of assessment on levels of anatomic obstruction whereas PSG is a very precise method of functional assessment of breathing difficulties.

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Comparative study of the orbital shape in Crouzon and Apert syndromes: a quantitative assessment of surgical results

Presenter: Roman Hossein Khonsari
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Aims and Scope: A major clinical concern in Crouzon-Pfeiffer (CPS) and Apert (AS) syndrome patients is oculo-orbital disproportion, eventually leading to functional visual impairment. Monobloc osteotomy followed by distraction osteogenesis aims to correct midfacial growth deficiencies in CPS patients. Bipartition distraction followed by distraction osteogenesis is the standard procedure in AS patients for a similar purpose. Little is known about the 3D shape of the orbit in these syndromes, about how this shape is modified by surgery and about the rationale guiding the choice of a specific procedure for CPS or AS.

Materials and Methods: Here we included 28 patients with CPS, 13 patients with AS and age-matched control patients. CT-scans were performed before and after surgical procedure, as well as 6 months after surgery (late post-operative scans). Orbital morphology was investigated using 3D cephalometry and shape analysis after semi-automatic mesh-based segmentation of the orbital contents. We generated mean size and shape models from the segmented orbits and assessed size and shape similarity by calculating and visualizing the volume overlap and surface distance between superimposed orbits.

Results: We characterized the 3D morphology of the CPS and AS orbits and showed that orbital shape is significantly modified by monobloc surgery in CPS and bipartition distraction in AS. We quantified for the first time shape normalization after surgery in 3D and provide quantitative arguments supporting the use of monobloc for CPS and bipartition for AS.

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Modulation of BMP2-induced Calvarial Defect Healing Using Adipose, Bone Marrow, and Muscle-derived Stromal Cells

Presenter: Michael R. Bykowski
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Purpose: Current methods of tissue engineering for craniofacial reconstruction focus on implantation of bioresorbable scaffolds seeded with proteins and/or osteogenic progenitor cells. It remains unclear whether specific stromal cell types are better suited for use in craniofacial reconstruction. This study aims to determine the healing capacity of adipose (ADSC), bone marrow (BMDSC), and muscle-derived (MDSC) stromal cell populations augmented with bone morphogenetic protein 2 (BMP2) in a calvarial defect model.

Materials and Methods: ADSCs, BMDSCs, and MDSCs were harvested from 10-week old wildtype mice. Cells were seeded overnight onto 5mm acellular dermal matrix (ADM) discs (1×10^5 cells/disc) and were osteoinduced with 150ng BMP2. Unseeded ADM discs treated with either BMP2 or vehicle served as controls. Discs were placed into 5mm circular calvarial defects. Mice were euthanized 4 weeks postoperatively. Regenerate tissue was analyzed by 3D microCT and histology.

Results: Differences in percent healing (mean \pm SE) were observed between vehicle (31.5% \pm 8.8), BMP2 control (71.9% \pm 7.0), ADSC+BMP2 (31.4% \pm 1.8), MDSC+BMP2 (21.9% \pm 4.9), and BMDSC+BMP2 (38.5% \pm 20.2) groups. One-way ANOVA revealed a statistically significant main group effect ($F=3.988$, $p<0.02$). Percent healing was significantly decreased in osteoinduced stromal cell constructs when compared to unseeded, BMP2 therapy. BMP2 treated defects regenerated vascularized, thick woven bone with large marrow spaces. Osteoinduced stromal cell-treated defects regenerated less bone that was also thinner than BMP2-regenerated bone.

Conclusions: Low-dose BMP2 potentially stimulates local osteoprogenitors to heal calvarial bony defects. We observed significant modulation of BMP2-induced osteogenesis with the addition of stromal cells; unlike BMP2 therapy alone, osteoinduced stromal cell therapies do not improve defect healing beyond that of vehicle in this model. This calls into question the role of progenitor cells in tissue engineering strategies for calvarial repair, and suggest that engrafted cells may negatively affect bony regeneration. We suggest that the heterogeneous population of cells within the stroma of adipose, bone marrow, and muscle tissues may restrict BMP2-induced calvarial defect healing.

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Ectopic Osteogenesis of Allogeneic Bone Mesenchymal Stem Cells Loading on β -TCP in Canines

Presenter: Fang Xie

Authors: Xie F, Teng L, Cai L, Xiao R, Wang Q, Cao Y
*Plastic Surgery Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College, China***Background:** To evaluate the use of osteo-induced allogeneic BMSCs with β -tricalcium phosphate (β -TCP) scaffold in the treatment of critical-sized bone defect in canines without immunosuppressive therapy.**Methods:** The animal model of full-thickness critical skull defect (diameter: 2 cm) was built in Beagle dogs bilaterally. Allogeneic or autologous BMSCs-TCP complex was constructed to repair the above bone defect. Scaffold alone group was served as control. 4, 12, 24 and 36 weeks postoperatively, the repair effect of skull defect among the three groups was compared quantitatively by 3D-CT. 36 weeks postoperatively, the quality of the bone repaired among the three groups was evaluated by gross observation, micro-CT, biomechanical detect and histological observation respectively.**Results:** 3D-CT reconstruction and measurement analysis showed that bone mineral density of allogeneic and autologous bone tissue engineering bone gradually reduced at 4, 12 weeks, but remained stable from 24 to 36 weeks. There is no significant difference in bone mineral density between the two groups ($P>0.05$). Bone mineral density of the control group gradually reduced as time goes by, which is significantly lower than the above two groups at 12, 24 and 36 weeks ($P<0.001$). At 36 weeks, gross observation showed allogeneic and autologous tissue engineering bone still can maintain the integrity of the skull. Micro-CT and biomechanic examination showed no significant difference between the two groups ($P>0.05$). Histology showed that there was osteoblast and osteocyte in allogeneic and autologous groups, and osseous connection was formed. However in the control group, β -TCP degraded mostly and the defect was composed of fibrous tissue.**Conclusions:** Osteo-induced allogeneic BMSCs loaded on β -TCP scaffold implants enhanced the repair of a critical-sized bone defect in the canines without the use of immunosuppressive therapy.

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Endothelial Cells from Capillary Malformations are Enriched for Somatic GNAQ Mutations

Presenter: Arin K. Greene

Authors: Greene AK¹, Couto JA², Huang L², Vivero MP², Kamitaki N³, Maclellan RA², Mulliken JB², Bischoff J², Warman ML²¹*Department of Plastic and Maxillofacial Surgery, Hospital Necker University Paris 5, France,* ²*Boston Childrens Hospital, Harvard Medical School, USA,* ³*Harvard Medical School, Boston, USA***Background:** A somatic mutation in GNAQ (c.548G>A;p.R183Q), encoding $G\alpha_q$, has been found in syndromic and sporadic capillary malformation tissue. However, the specific cell type(s) containing the mutation is unknown. The purpose of this study was to determine which cell(s) in capillary malformations have the GNAQ mutation.**Methods:** Human capillary malformation tissue was obtained from 13 patients during a clinically-indicated procedure. Droplet digital PCR (ddPCR), capable of detecting mutant allelic frequencies as low as 0.1%, was used to quantify the abundance of GNAQ mutant cells in capillary malformation tissue. Six specimens were fractionated by fluorescence activated cell sorting (FACS) into hematopoietic, endothelial, perivascular, and stromal cells. The frequency of GNAQ mutant cells in these populations was quantified by ddPCR.**Results:** Eight capillary malformations contained GNAQ p.R183Q mutant cells, 2 lesions had novel GNAQ mutations (p.R183L; p.R183G), and 3 capillary malformations did not have a detectable GNAQ p.R183 mutation. Mutant allelic frequencies ranged from 2% to 11%. Following FACS, the GNAQ mutation was found in the endothelial but not the platelet-derived growth factor receptor- β -positive (PDGFR β) cell population; mutant allelic frequencies were 3% to 43%.**Conclusions:** Endothelial cells in capillary malformations are enriched for GNAQ mutations and are likely responsible for the pathophysiology underlying capillary malformation.

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Facial Lipostructure in Craniofacial Congenital Deformities

Presenter: Manlio Galie'

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Background: The use of adipose tissue transfer for the correction of maxillofacial defects was reported for the first time at the end of the 19th century and has been the subject of numerous studies. Focusing attention on the face, in 1988 Sydney R. Coleman systematized the technique. This was based on the belief that fat was the ideal filler, since it was natural, stable, and without the complications of earlier fillers. Structural Fat Grafting (SFG) differs from other fat grafting techniques, given its delicate aspiration to protect the fragile adipocytes, purification of the material, and its reinsertion using microinjections to redefine facial contours and create more harmonious and esthetically appealing proportions of the face.

Method: A retrospective review (2006-2014) on patients (cleft lip sequelae, complex craniofacial deformities, Treacher-Collins and Pfeiffer syndromes, anophthalmia, facial palsy, Parry-Romberg and scleroderma) is reported.

Result: Clinical long-term follow-up is reported after single or multiple procedures of facial lipostructure. In craniofacial malformations all tissue layers can be affected in various degrees. Growth potential is altered and adipocytes must be injected in many stages because of a higher degree of resorption.

Conclusion: Human adipose tissue represents a rich source of mesenchymal stem cells because they exhibit multilineage potential and secrete angiogenic and antiapoptotic factors. The main indications for SFG are the restoration and reconstruction of facial soft tissues after trauma, tumor resection, in congenital deformities and clefts, Parry-Romberg and scleroderma, orbital and periorbital surgery, facial palsy, burns, and scars. SFG can be considered a safe procedure with a low rate of complications, and as a soft tissue filler alone or in combination with other surgical procedures has tremendous potential. However additional studies are necessary to confirm the clinical outcomes.

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A patient specific computational model to predict outcomes of spring cranioplasty

Presenter: Silvia Schievano

Authors: Schievano S, Borghi A, Hayward RD, Dunaway DJ, Jeelani NUO

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Background: The implantation of spring-like distractors in the treatment of sagittal craniosynostosis is an alternative to traditional total calvarial remodeling, allowing for shorter operative time and lower blood loss. This procedure has proven functionally and aesthetically effective in correcting skull deformities, but final outcomes remain sometimes unpredictable due to an incomplete understanding of craniofacial biomechanics and skull/device interaction. In this work, we present and validate a patient specific computational model of spring cranioplasty that could be used to predict procedural outcomes.

Methods: A 5-month-old boy diagnosed with scaphocephaly was surgically treated with springs at our Institution. During surgery, local skull thickness, position and dimension of the osteotomies, and spring models (1 anterior and 1 posterior) were recorded. Pre-procedural CT images were processed in order to create a realistic 3D model of the patient skull, where the surgical osteotomy was recreated. Based on follow-up x-ray images and measurements at removal, the cranioplasty spring loading curve for this patient was retrieved using an analytical method previously developed. Spring loading conditions were simulated to expand the skull model.

Results: The opening of the anterior and posterior springs were calculated and compared with theatre measurements: 35 vs 30mm (16% difference), and 36 vs 35mm (3% difference), respectively. The change in the skull antero-posterior dimension was compared between the model and the measurement taken on the operating table, showing good agreement (5.8mm vs 6mm).

Conclusions: The model accurately predicted the amount of spring expansion experienced in theatre and overall variation of skull dimensions. Further refinement of this model, including viscoelastic material properties, could help evaluate the time-dependent changes in skull dimensions, aid surgical planning and provide an important tool for designing new distractors.

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Autotransplantation of monkey ear perichondrium-derived progenitor cells for cartilage reconstruction

Presenter: Shintaro Kagimoto

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Background: We recently identified a promising regenerative method based on the xenotransplantation of human cartilage progenitor cells in immunodeficient animals to reconstruct self-renewing elastic cartilage, which may potentially be applied to patients with craniofacial injuries and abnormalities. However, whether the autotransplantation of immunocompetent individuals may fundamentally work in a similar manner as our previous reports have documented remains unknown. We here used a monkey model to assess our regenerative approach using autotransplantation as a pre-clinical study.

Methods: Three monkeys (*Macaca fascicularis*) were used. First, we identified the progenitor population from the monkey ear perichondrium. Progenitor cells were expanded and differentiated extensively into chondrocytes *in vitro*. Then, this differentiated progenitor cells were xenotransplanted into immunodeficient mice and autotransplanted into monkeys craniofacial lesions. This autotransplanted tissue regeneration was monitored using non-invasive magnetic resonance imaging (MRI). The transplanted cells were retrieved three months later. Histological assessment and glycosaminoglycan (GAG) levels of reconstructed tissue were assessed. The experimental animal protocols were approved by the Animal Welfare and Animal Care Committee of the National Institute of Biomedical Innovation (Osaka, Japan) (approval ID: DS25-32).

Results: The *in vivo* cartilage regenerative capacity of the differentiated progenitor cells was demonstrated via both xeno- and autotransplantation. A remarkable density difference was detected in the MRI T1/T2 images. The maximum size of reconstructed tissue was 42×28×2.5mm. An elastic cartilage reconstructed was detected by histological staining. GAG levels were nearby original auricular cartilage. No complication such as inflammation and tumorigenesis were observed in any of the experiments.

Conclusion: The autotransplantation of immunocompetent individuals fundamentally work in a similar manner this time. We conclude that the use of autologous cartilage progenitor cells will be a highly promising to treat craniofacial deformities.

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TWIST1 Silencing Enhances *in vitro* and *in vivo* Osteogenic differentiation of human Adipose Derived Stem Cells.

Presenter: Kshemendra Senarath-Yapa

Authors: Senarath-Yapa K^{1,2}, Quarto N^{1,3}, Renda A³, Longaker MT¹

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Background: Human adipose-derived stem cells (hASCs), found abundantly in lipoaspirate are an attractive source of cells for regenerative medicine. Optimizing their osteogenic capacity through modulation of signaling pathways is a key translational objective. TWIST1, associated with Saethre-Chotzen syndrome, is in fact a transcription factor that controls lineage commitment and differentiation. Our study shows that TWIST1 shRNA silencing increased the osteogenic potential of hASCs *in vitro* and their regenerative ability *in vivo* in a calvarial defect model. We demonstrate that the increased osteogenic capacity with TWIST1 knockdown is mediated through activation of BMP and ERK/FGF signaling leading to upregulation of TAZ, a transcriptional modulator of MSC differentiation.

Methods: Human ASCs were obtained from lipoaspirates following approved guidelines. Knockdown of TWIST1 and TAZ in hASCs was achieved with shRNA lentiviral particles. Osteogenic differentiation assays were performed on shTWIST1 hASCs, shTAZ hASCs and control hASCs and qRT PCR performed for osteogenic markers. The different cell groups were then seeded on (PLGA) scaffolds and placed in 4 mm calvarial defects in nude mice. Calvarial healing was assessed using mCT and histology.

Results: qRT PCR and immunoblots revealed that: Twist expression was effectively knocked down using shRNA; Downregulation of TWIST1 increased *in-vitro* osteogenic potential and expression of osteogenic markers RUNX and OSX; Downregulation of TWIST1 enhanced BMP and ERK/FGF signaling and upregulation of TAZ. Importantly, shTWIST1 hASCs potentiated bone repair *in vivo* relative to control ASCs (P<0.05).

Conclusions: We demonstrate that the increased osteogenic capacity with TWIST1 knockdown in hASCs is mediated through activation of BMP and ERK/FGF signaling leading to upregulation of TAZ. Inhibition of BMP or ERK/FGF signaling suppressed TAZ upregulation and the enhanced osteogenesis in shTWIST1 hASCs. Co-silencing of TWIST1 and TAZ abrogated the effect elicited by TWIST1 knockdown alone, identifying TAZ as a key downstream mediator. Our study provides insights into the molecular mechanisms governing osteogenic ability of hASCs, and identifies TWIST1 as a target to facilitate *in vivo* bone healing.

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Craniofacial features of GPC1 & GPC3 compound knockout mice

Presenter: Peter J. Anderson

Author: Anderson PJ

Australian Craniofacial Unit, Australia

Background: From birth the cranial vault grows rapidly and there is accelerated activity in the osteoblastic cells with the cranial sutures. Bone morphogenetic proteins are potent growth factors of this cranial bone growth. Previously, we have found that glypican1 and glypican 3 are expressed in cranial sutures but expression is decreased during craniosynostosis. We have also shown that glypican 1 and glypican 3 act both independently and synergistically to inhibit BMP's 2, 4 and 7, in cultured human suture cells. We wished to investigate what would be the effects on the development of the tissues with regard to craniofacial morphology and the sutures if both genes were absent.

Method: Murine models of GPC1 Knockout and GPC3 Knockout were sourced and bred onto a common wildtype background. The two strains were then cross-bred to produce "double knockout" mice.

Results: The resulting offspring were viable and the effect on the craniofacial morphology and dimensions compared to the same wild-type background, was of a similar effect of a Crouzon mutant gene compared to wild type.

Conclusion: Glypicans 1 & 3 are potent inhibitors of BMP's and have potential to be used as therapeutic agents as an adjunct in the treatment of syndromic craniosynostosis.

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Glypican3 induces proliferation in hFOB cells

Presenter: Ronghu Ke

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Mutations in glypican-3 (GPC3), one of the six mammalian glypicans, causes the Simpson-Golabi-Behmel overgrowth syndrome (SGBS) and GPC3-deficient mice display skeletal defects. However, the biologic and molecular effects of GPC3 in osteoblasts remain largely unknown. In this present study, we have employed lentiviral constructs to upregulate endogenous GPC3 expression in human fetal osteoblastic cell line hFOB1.19 (hFOBs) and successfully selected stable cell line by puromycin. CCK8 results revealed that GPC3 overexpression significantly induced cell proliferation. Furthermore, flow cytometer analysis showed GPC3 overexpression promoted G1 into S phase. However, GPC3 had no effect on the percentage of apoptotic hFOBs. In contrast, silence of GPC3 by short hairpin RNA (shRNA) hindered proliferation together with cell cycle arrest at the G1 phase. In conclusion, our study demonstrates that GPC3 play important role during osteoblast proliferation.

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Does prolonged reconstruction of disarticulation defect with bone plate affect the EMG of masticatory muscles?

Presenter: Emad T. Daif

Author: Daif ET

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Objectives: For medical or socioeconomic reasons, the primary reconstruction of disarticulation defects with bone plates stays for many years. This study was performed to assess the effect of this delay on EMG records of masticatory muscles.

Materials and Methods: 25 patients treated by insertion of reconstruction plates in disarticulation defects were prospectively participated in this study. EMG records for masticatory muscles were obtained before surgery and three months, six months, one year, two years and three years afterwards. Paired t-test was used to determine whether there was significant difference between the EMG values or not.

Results: At three years after surgery, the amplitude values of masseter and temporalis muscles, on the resected side, have decreased by 39% and 60% respectively while; on the non-operated side they have increased by 35% and 29%. The peak decrease, on the resected sides, has occurred at three months for temporalis and two years for masseter. On the non-operated side, the peak increase has occurred at six months for both temporalis and masseter.

Conclusions: A prolonged use of bone plates to reconstruct disarticulation defects leads to alterations in EMG values of masticatory muscles. These alterations present clinically as muscle atrophy on the operated side and hypertrophy on the non-operated side.

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THE EFFECT OF hPTP β INHIBITOR ON MICROCIRCULATION FOLLOWING ISCHEMIA-REPERFUSION INJURY OF MUSCLE

Presenter: Fatih Zor

Authors: Zor F¹, Meric C², Karagöz H³, Siemionow M⁴

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Activation of receptor tyrosine kinases is negatively regulated by protein tyrosine phosphatases (PTP). Inhibition of PTPs enhances endothelial receptor tyrosine kinases activation and may have beneficial effects on vessel growth and improve blood flow to ischemic tissue. Human PTP beta (hPTP β) is expressed by endothelial cells and may play important role in response to injury. The purpose of this study is to determine influence of hPTP β inhibitors on ischemia-reperfusion injury in muscle flap.

Following the cremaster muscle flap dissection, sixty male Lewis rats divided into 10 experimental groups (control, placebo and treatment groups at different time points). In all groups, following the group-specific treatment, microcirculatory hemodynamics (vessel diameters, functional capillary index, vascular permeability index) and leukocyte-endothelial activation (number of rolling, sticking and transmigrating leukocytes) were recorded for 4 hours in 1 hour intervals after a 2h period of reperfusion.

The results of subcutaneous administration of the hPTP β inhibitor following different periods of muscle ischemia showed preservation of capillary perfusion in group subjected to 2 hours of ischemia when compared with placebo. Treated ischemic groups (1h, 2h and 3h) showed decreased activation of rolling, sticking and transmigrating leukocytes compared to the respective placebo groups at all time points. The differences were significant for transmigrating leukocytes after 2h and 3h of ischemia. There was also a significant reduction in the endothelial edema index in the 2h ischemia group.

Administration of hPTP inhibitors after submission of tissue to sub-critical ischemic conditions (1-2 hours) improved functional capillary perfusion and decreased leukocytes-endothelial activation during 4 hours. These results indicate that hPTP inhibitor has potential as a post-conditioning therapy applied after tissue ischemia just before the reperfusion injury.

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Exogenous Growth Factor Independent Osteogenesis on Nanoparticulate Mineralized Collagen Scaffolds

Presenter: Justine C. Lee

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Background: Skeletal regenerative medicine frequently incorporates deliverable growth factors to stimulate osteogenesis. However, the cost and side effects secondary to supraphysiologic dosages of growth factors warrant investigation of alternative methods of stimulating osteogenesis for clinical utilization. In this work, we describe growth factor independent osteogenic induction of human mesenchymal stem cells (hMSCs) on a novel nanoparticulate mineralized collagen glycosaminoglycan scaffold (MC-GAG).

Methods: Primary bone marrow derived hMSCs were induced to undergo osteogenic differentiation on non-mineralized (Col-GAG) and nanoparticulate mineralized collagen glycosaminoglycan scaffolds (MC-GAG). Quantitative osteogenic gene expression, micro computed tomographic scanning, Western blot analyses, and immunohistochemistry were performed.

Results: hMSCs demonstrated elevated osteogenic gene expression and mineralization on MC-GAG with minimal to no effect upon addition of BMP-2 when compared to Col-GAG. To investigate the intracellular pathways responsible for the increase in osteogenesis, we examined the canonical and non-canonical pathways downstream from BMP receptor activation. Constitutive Smad1/5 phosphorylation with nuclear translocation occurred on MC-GAG independent of BMP-2, whereas Smad 1/5 phosphorylation depended on BMP-2 stimulation on Col-GAG. When non-canonical BMPR signaling molecules were examined, ERK1/2 phosphorylation was found to be decreased in MC-GAG but elevated in Col-GAG. No differences in Smad2/3 or p38 activation were detected.

Conclusions: Collectively, these results demonstrated that MC-GAG scaffolds induce osteogenesis without exogenous BMP-2 addition via endogenous activation of the canonical BMP receptor signaling pathway.

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Biopatterned rhBMP2 Does Not Induce Pansynostosis or Growth Restriction in the Immature Craniofacial Skeleton

Presenter: Sameer Shakir

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Purpose: When other therapeutic options have failed, rhBMP2 may help to heal problematic calvarial defects. Current off-label applications far supersede physiologic concentrations and may contribute to side effects including ectopic bone formation, inflammation, and cancer. The efficacy of rhBMP-2 therapy in the skeletally immature patient remains unknown. The study aimed to compare the effects of rhBMP-2 dose on cranial growth with the hypothesis that higher dose rhBMP2 will negatively affect cranial growth.

Methods: Twenty juvenile New Zealand White rabbits underwent bicoronal strip suturectomies treated with 0.4-mg/mL rhBMP-2, 100-ug/mL biopatterned rhBMP-2, or left empty. Amalgam markers were placed at suture confluences to track suture separation and cranial growth at 10, 25, and 42 days of age. Means and standard deviations for growth variables were calculated and compared using two-way ANOVA analysis. Cranial sutures were qualitatively assessed using micro-computed tomographic (uCT) scanning at 42 days postoperatively.

Results: Treatment with 0.4mg/mL rhBMP-2 resulted in significant growth changes and fusion of the coronal sutures bilaterally, anterior sagittal suture, and frontonasal suture by cephalometric analyses ($p < 0.05$). Growth changes appeared greatest in the nasal region and less in the bicoronal and anterior sagittal regions. No significant differences in cranial growth were noted with use of 100-ug/mL biopatterned rhBMP-2 when compared to control. MicroCT analysis revealed comparable bony healing between rhBMP2 groups. Application of high-dose, 0.4mg/mL rhBMP-2 resulted in pansynostosis upon uCT analysis. Low-dose, 100-ug/mL biopatterned rhBMP-2 regenerated bone within the surgical defect margin without evidence of extra-sutural invasion.

Conclusions: Use of rhBMP-2 results in unwanted craniofacial changes in a dose-dependent manner. Local effects of high dose rhBMP-2 include pansynostosis and growth restriction that may limit its potential translation into the clinical setting. Low dose biopatterned rhBMP-2 regenerates bone within a target defect without causing these undesirable effects. This low-dose, spatially controlled methodology of growth factor delivery may improve the efficacy of rhBMP2 in the immature craniofacial skeleton.

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Identification and Isolation of a Dermal Lineage with Intrinsic Fibrogenic Potential

Presenter: Graham G. Walmsley

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Dermal fibroblasts represent a heterogeneous population of cells with diverse features that remain largely undefined. We reveal the presence of at least two fibroblast lineages in murine dorsal skin. Lineage tracing and transplantation assays demonstrate a single fibroblast lineage is responsible for the bulk of connective tissue deposition during embryonic development, cutaneous wound healing, radiation fibrosis, and cancer stroma formation. Lineage-specific cell ablation led to diminished connective tissue deposition in wounds and reduced melanoma growth. Using flow cytometry, we identify CD26/DPP4 as a surface marker that allows isolation of this lineage. Small molecule-based inhibition of CD26/DPP4 enzymatic activity during wound healing results in diminished cutaneous scarring. Identification and isolation of these lineages holds promise for translational medicine aimed at *in vivo* modulation of fibrogenic behavior.

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Activation of HIF by small molecule inhibitors of PHD2 accelerates wound healing in vivo

Presenter: Michael S. Hu

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Introduction: Impaired wound healing, particularly in diabetic and vasculopathic patients, represents a significant clinical challenge. Prior studies have revealed that an important prognostic determinant of wound repair is the presence of hypoxia. Hypoxia-inducible factor (HIF), master regulator of cellular response to hypoxia, is critical for enhancing the appropriate inflammatory and angiogenic responses that promote wound healing. Herein, we examine the effect of small molecule activators of the HIF pathway on wound healing.

Methods: We generated 25 small molecule analogue inhibitors of PHD2, designated GPHD-1 through GPHD-25. A high throughput HRE-luciferase assay was performed on NIH 3T3 fibroblasts on 96-well plates to identify GPHD compounds that would achieve the greatest increase in the HIF pathway. The best three compounds were tested *in vivo* using a murine model of wound healing with splinted 6 mm full thickness excisional wounds. The compound was delivered every other day at a concentration of 10 uM. Photographs were taken every other day and the rate of wound healing was analyzed.

Results: Using the HRE-luciferase assay, we identified compounds GPHD-11, -14, and -15 for upregulating HIF activity 4.01-, 4.38-, and 4.08-fold, respectively (*p<0.05). Full thickness excisional wounds treated with GPHD-11, -14, and -15 completely healed on days 11.5, 11.4, and 11.8, respectively. Wounds treated with saline control healed on day 13.4 (*p<0.05).

Conclusions: Our results validate the ability of small molecule analogue inhibitors of PHD2 to activate the HIF pathway *in vitro*. *In vivo*, we demonstrate accelerated wound healing with topical application of our compounds. With further studies, the small molecule activators of HIF may prove to be a novel therapeutic to stimulate wound healing.

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SPRING BEHAVIOUR IN SURGICAL TREATMENT OF SAGITTAL CRANIOSYNOSTOSIS

Presenter: Alessandro Borghi

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Spring cranioplasty for the treatment of sagittal craniosynostosis offers a novel, less invasive alternative to conventional treatment. The technique has proven successful in widening the skull, shortening operating time and lowering blood loss; however, concerns remain with regards to unpredictable spring behavior and variable outcomes. In this work, the relationship between the spring biomechanics and their effect on the paediatric calvarium is analysed, considering the current devices used at Great Ormond Street Hospital for Children, London for this procedure (three springs varying in wire diameter).

Data from 26 patients (age 3-6 months, 2 springs per patient) who underwent implantation of spring distractors for treatment of sagittal craniosynostosis were retrospectively analysed. Spring opening was measured *in situ* at the time of insertion and removal and via planar x-ray during follow up post-implantation. Spring behavior in terms of opening vs force exerted in the interaction with the skull was derived by applying an exponential model to force decay.

Springs were in place for 123.2±44.8 days (range: 35÷205). Spring opening varied from 3.0±0.6 cm (force=26.83±10.61N) at implantation to 5.4±0.5 cm (force=5.05±4.71N) at time of removal. The force decay time constant τ was found equal to 1.13±0.41 days.

This study suggests that the force exerted by the current springs decays by 90% within the first 10 days of implantation and a residual force equal to 18% of the insertion force is present at removal time. This mathematical analysis will be performed on a larger number of patients to better understand the spring/skull interaction, potentially adapt the spring implantation follow up protocol, and drive design a more effective spring distractors.

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Biopatterned Reconstruction of Subtotal Calvarial Defects: Addition of AMD3100 is potentiated by BMP-2

Presenter: Catharine B. Garland

Authors: Garland CB, MacIsaac ZM, Shakir S, Naran S,
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Background: While bone morphogenetic protein-2 (BMP-2) demonstrates promise as a therapy for calvarial bone regeneration, its application remains controversial due to concern for side effects such as heterotopic ossification or malignant transformation. Addition of other treatment modalities may reduce the dose of BMP-2, while maintaining its efficacy. The aim of this study was to determine the ability of BMP-2 to potentiate the efficacy of bone regeneration through application of the stem cell mobilizing agent, AMD 3100.

Methods: Subtotal calvariectomy defects measuring 7.5×7.5 mm² were created in 12-week old New Zealand White rabbits. Defects were reconstructed in one of three groups: Group 1, ADM with AMD3100 [ADM/AMD3100 n=3]; and Group 2, ADM with AMD3100 and 1.78 µg of BMP-2 applied by ink-jet based biopatterning [ADM/AMD3100/BMP-2 n=3]. Animals underwent serial CT imaging at 0, 2, 4 and 6 weeks postoperatively, followed by euthanization and histological analysis. CTs were reconstructed utilizing Amira software (Visage Imaging, San Francisco, CA, USA), and areas of translucency were calculated using ImageJ (NIH) to determine change in defect area relative to time zero (baseline value).

Results: At 6 weeks compared to time zero, ADM/AMD3100 resulted in 18.7% healing (standard deviation 15.8%), and ADM/BMP-2/AMD3100 resulted in 74.2% healing (standard deviation 13.1%). There was no significant difference between groups. Histologically, bone in each group was similar, consisting of islands of compact, cellular bone.

Conclusions: Compared to treatment with ADM/AMD3100 only, addition of BMP-2 for reconstruction of an acute calvarial defect greatly potentiated results. Combination therapy may enable application of lower doses, for successful bony regeneration for large calvarial defect reconstruction.

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Biopatterned Reconstruction of Subtotal Calvarial Defects: Inhibition of Bony Regeneration with Addition of VEGF

Presenter: Catharine B. Garland

Authors: Garland CB, MacIsaac ZM, Shakir S, Naran S, Grunwaldt LJ, Goldstein JA, Camison L, Smith D, Cooper GM, Losee JE

University of Pittsburgh, USA

Background: While growth factor therapy for calvarial regeneration hold great promise, higher doses create concern for untoward effects such as malignant transformation. Combination of growth factors may result in synergistic effects. The aim of this study was to augment the efficacy of bone regeneration through application of VEGF to a low dose of BMP-2

Methods: Subtotal calvariectomy defects measuring 7.5×7.5 mm² were created in 12-week old New Zealand White rabbits. Defects were reconstructed in one of three groups: Group 1, acellular dermal matrix (ADM) soaked in PBS overnight [ADM/PBS, n=3]; and Group 2, ADM with 1.78 µg of BMP-2 and VEGF applied by ink-jet based biopatterning [ADM/BMP-2/VEGF n=3], and Group 3, ADM with VEGF only applied by ink-jet based biopatterning [ADM/VEG-F n=3]. Animals underwent serial CT imaging at 0, 2, 4 and 6 weeks postoperatively, followed by euthanization and histological analysis. CTs were reconstructed utilizing Amira software (Visage Imaging, San Francisco, CA, USA), and areas of translucency were calculated using ImageJ (NIH) to determine change in defect area relative to time zero (baseline value).

Results: At 6 weeks compared to time zero, ADM/PBS resulted in 54.9% healing (standard deviation 46.1%), and ADM/BMP-2/VEGF resulted in 48.2% healing (standard deviation 13.4%). Treatment with ADM/VEGF resulted in 25.3% healing (standard deviation 34.7%); there was no significant difference between groups. Histologically, bone in each group was similar, consisting of islands of compact, cellular bone.

Conclusions: Compared to treatment with ADM/PBS only, addition of VEGF for reconstruction of an acute calvarial defect inhibited bony regeneration. Addition of VEGF to BMP-2 diminished bony regeneration compared to biopatterned BMP-2 only in a historical control. While combination growth factor therapy may enable successful reconstruction of calvarial defects without side effects related to higher dose, VEGF inhibits potential in this scenario.

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Prefabricated, Ear-shaped Cartilage Tissue Engineering by Scaffold-free Porcine Chondrocytes Membrane

Presenter: Han-Tsung Liao

Author: Liao H

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Background: Ear defect due to traumatic injury, tumor ablation and congenital deficiency is still a challenging problem to plastic and reconstructive surgeon. In this study, we developed a scaffold-free, ear-shaped cartilage by tailoring multi-layered chondrocytes membrane on an ear-shaped titanium alloy model and investigated the possibility of long-term ear-shaped maintenance in nude mice.

Materials and Methods: High density chondrocytes (around 30×10⁶ cells) were seeded to produce chondrocytes membrane after cultivation under chondrogenic medium for 2 weeks. Then three-layered chondrocytes membranes were tailored on the ear-shaped titanium mold and fixed by 6-0 nylon. The construct were implant on dorsal pocket of nude mice for 8 and 24 weeks. The chondrocytes membrane, 8- and 24-week implant were analyzed by Safranin O, Toluidine blue, ElasticaVan Gieson and Collagen type II immunohistochemistry stain and quantitative measurement of glycosaminoglycan and total collagen compared to native cartilage. The mechanical strength was compared by compressive Young's modulus.

Results: The result showed the chondrocytes membrane was durable and non-fragile and easily manipulated by forceps. The composite of chondrocyte membrane and titanium alloy maintained the stable ear-like shape after 8- and 24-week subcutaneous implantation. The histological examination verified the newly formed tissue at implant construct was elastic cartilage at both 8- and 24-week by Safranin O, Toluidine blue, ElasticaVan Gieson and Collagen type II immunohistochemistry stain. The Young's modulus was only half of and similar to normal cartilage in 8- and 24wk-implant, respectively.

Conclusion: This study demonstrated an ear-shaped elastic cartilage could be regenerated by scaffold-free chondrocytes membrane shaped by prefabricated, three-dimensional ear-shaped titanium mold.

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Long-term survival of composite midface allograft and development of multi-lineage chimerism

Presenter: Yalcin Kulahci

Authors: Kulahci Y¹, Karagöz H², Zor F³, Bozkurt M⁵, Cwykel J⁴, Siemionow M⁴

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Aim: Reconstruction of composite midface defects is challenging and vascularized composite allotransplantation (VCA) provides the only successful one-stage reconstructive option. Up to date, most of the facial VCA operations included midface region. The only functional midface allotransplantation model is previously described by our team. By using this one of the most clinically relevant model, this study aimed to investigate the long-term allograft survival in correlation with induction and maintenance of donor-specific chimerism.

Methods: Eighteen composite functional midface allotransplantations were performed in three groups: Group 1 (n=6)-isotransplantations between Lewis (LEW) rats (RT¹)-served as controls. Group 2 (n=6)-allograft rejection controls-performed across major histocompatibility complex (MHC) barrier between semiallogeneic LEW-Brown-Norway (RT¹) donors and LEW (RT¹) recipients without immunosuppression. Allografts in Group 3 (n=6) received tapered CsA monotherapy. Assessments included monitoring of rejection, flow cytometry for donor-specific chimerism of major histocompatibility complex class I (RT¹) antigen, immunohistochemistry for engraftment of donor cells, and histology for midface architecture.

Results: Isograft controls survived indefinitely; in allografts without treatment, rejection started within 5 to 7 days. Treated functional midface allografts survived up to 170 days, without signs of rejection or graft loss. Flap angiography confirmed intact vascularity, and computer tomography scan and histology confirmed bone viability. Donor-specific chimerism at day 125 was present for T cells (2.3% CD4/RT1, 0.9% CD8/RT1) and B cells (3.4% CD45RA/RT1). Engraftment of donor-origin cells was confirmed into BM compartment and lymphoid organs of recipients.

Conclusions: Of the described facial VCA models, functional midface allotransplantation model is one of the most clinically relevant models, which not only includes nose, maxilla and perioral tissues but motor and sensory nerves and units also. In this study, we showed long-term survival of composite midface allotransplantation and development of multi-lineage chimerism development following functional midface allotransplantation.

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Mutations of Hedgehog and Wnt signaling pathway genes suggest a role in craniosynostosis

Presenter: Martin Rachwalski

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Introduction: Heterozygous gain-of-function mutations frequently found in FGFR2 have been attributed to various forms of syndromic craniosynostosis. However, a relatively large subset of these patients remains FGFR2 mutation negative, strongly suggesting genetic heterogeneity. We therefore aimed to elucidate the underlying molecular basis of craniosynostosis in mutation negative patients.

Methods: We performed whole exome sequencing in three patients clinically diagnosed with various forms of craniosynostosis in which mutations in known causative genes have been previously excluded. Since consanguinity was suspected, variants in regions of homozygosity were prioritized. Shortlisted, causative mutations were re-sequenced and further checked for annotation in over 6000 exomes of the Exome Variant Server (EVS). Direct sequencing of all coding regions of the newly identified candidate genes were then conducted in additional syndromic cases.

Results: We detected a total of three different mutations in the low-density lipoprotein-related protein 2, encoded by LRP2, a gene known to be implicated in Donnai-Barrow syndrome but which hitherto has not been associated with the development of craniosynostosis. One homozygous splice-site mutation (c.8452+1 G/T) in a patient with Crouzon syndrome and a homozygous and heterozygous missense substitution (p.R3236 Q and p.4019K) in two cases with unclassified syndromic forms of craniosynostosis were detected. Additionally, we were able to identify a homozygous mutation (p.G169A) in WNT9A in a patient with trigonocephaly and cleft lip and palate. Previous studies showed that Wnt signaling plays a prominent role in craniofacial development.

Conclusion: In this study, we were able to identify LRP2 and WNT9A as a new molecular cause underlying various forms of craniosynostosis. Additional functional studies of these genes and their downstream molecules will further enhance our understanding regarding the regulation of cranial suture morphogenesis and fusion.

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Outcomes Analysis of Mandibular Distraction: Treacher Collins versus Robin Sequence

Presenter: Christopher M. Runyan

Authors: Runyan CM, Nardini G, Hosseinian B, Seo L, Shetye PR, Staffenberg D, Golinko M, Flores RL

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Background: Research on mandibular distraction (MDO) as a treatment for Robin Sequence (RS) related airway obstruction commonly includes Treacher Collins (TC) within the RS study population. Although RS and TC both present with retrognathia, glossoptosis and airway obstruction, there are distinct anatomic differences between the RS and TC mandible which may affect surgical outcomes. We present our center's clinical outcomes of TC patients treated with MDO in comparison to historic data on RS.

Methods: A single center, twenty-year retrospective review was conducted on all patients with TC treated with MDO. Recorded variables included: age of MDO, number of distraction procedures, type of device, presence of tracheostomy and complications. Literature review of clinical outcomes of MDO in the RS population demonstrated age of distraction under one year, average of one distraction per patient and avoidance of tracheostomy in over 90% of patients.

Results: 24 patients with TC who underwent MDO were included in our analysis. The follow up time was 9.2 years (range 1.7-17 years). The mean age of the first MDO was 4.97 years and the mean number of distractions was 1.42. Distraction devices were external in 67% and internal in 33%. 19 patients (79%) had a tracheostomy prior to MDO and only 9 (47%) patients were decannulated within one year of distraction. An additional 5 patients were decannulated several years later after further jaw reconstruction. Complications were divided into major, such as ankylosis, device failure and minor such as pin infection, hypertrophic scar. Ankylosis was noticed in 20% of patients without relationship to the vector of distraction or device type, one patient had parotid cutaneous fistula and 16% had device failure.

Conclusions: Compared to the RS population, TC patients undergo MDO at a later age, require more distraction and have less successful decannulation. Further surgery is required to effectively treat airway obstruction. The incidence of major complications is higher. When assessing clinical outcomes in RS, TC should be assessed as a separate category due to the complexity of surgical care in this patient population.

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Connective Tissue Growth Factor (CTGF/CCN2) is Essential for Secondary Palatogenesis

Presenter: Alex G. Lambi

Authors: Lambi AG¹, Tarr JT¹, Hindin DJ², Popoff SN¹, Bradley JP²*¹Temple University School of Medicine, USA, ²Plastic and Reconstructive Surgery, Temple University School of Medicine, USA*

Background: Previous studies have used TGF-beta 3 and IRF-6 Knockout (KO) models to study the pathogenesis of facial clefting. Connective tissue growth factor (CTGF/CCN2) is known to act as a necessary downstream mediator of TGF-β-dependent mesenchymal stem cell proliferation in palatogenesis. In our laboratory, we developed a CTGF knockout mouse to be studied as a novel cleft model which shows consistent failure of secondary palate formation. We investigated this novel cleft (CTGF KO) model's anatomy, histology, and cellular function compared to the wild-type (WT).

Methods: In the first part of our study, we used microCT analysis and routine histology to compare anatomic changes at various pre and postnatal time points. Next, pre-osteoblasts were isolated from CTGF KO mice and compared to WT pre-osteoblasts for cellular organization, functioning, proliferation, and migration. Finally, CTGF KO palatal tissue explant cultures were compared to WT explants harvested from a time point prior to normal palate closure.

Results: Micro CT and histological analyses showed that CTGF KO mice had complete absence in midline convergence of mesenchymal tissue compared to wild-type (WT) mice which demonstrated closure by timepoint E17. Pre-osteoblasts isolated from CTGF KO mice exhibited decreased ability to adhere to extracellular matrices, reduced spreading, altered cytoskeletal organization, and reduced levels of total and activated Rac1 compared to WT cells compared to wild-type (WT) mice. Proliferation of CTGF KO cells was also decreased and migration of CTGF KO cells was abnormal. WT explants were brought through cleft closure, while CTGF KO palates stayed viable and clefted.

Conclusions: Cellular functions that were abnormal in our CTGF KO cells are necessary for proper formation of the secondary palate during craniofacial development. It is likely that similar defects in the mesenchyme of the developing palate account for failure of the palatal shelves to form and fuse. Our explant model is being used for rescue experimentation and elucidating the mechanism(s) responsible for secondary cleft palate in CTGF KO mice. These investigations will help with our understanding of cleft etiology, and may lead to the development of novel therapeutic approaches for the clinical management of this birth defect.

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A NOVEL PROTOCOL FOR ASCs ISOLATION USING NEUTRAL PROTEASE IN VITRO AND IN A MOUSE CALVARIAL DEFECT MODEL.

Presenter: David Leshem
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Current surgical methods for repair of skeletal defects utilize either alloplastic materials or autologous bone grafts the first restores only basic mechanical protection while the second promotes true bone regeneration. Although autologous bone may provide good regenerative outcome it is a tedious process with donor site morbidity and not applicable to young children. Mesenchymal stem cells (MSCs) have been shown to promote bone regeneration and may therefore provide a feasible alternative solution.

Adipose tissue is being widely used as a source for MSCs for bone regeneration. To date extraction of cells from adipose tissue is achieved by collagenase digestion. Although efficient, this procedure is expensive when considered for clinical therapy purposes. We developed an alternative method for the isolation of adipose derived MSCs (ASCs) with an alternative cheaper regulatory accepted digestive enzymes termed Neutral Protease [t1]

Viability of freshly isolated cells assessed by flow cytometry, revealed $1.9\pm 0.3\%$ (n=5) dead cells and $6.3\pm 0.9\%$ in collagenase and NP isolated cells respectively.

Despite their initial lower viability, NP isolated ASCs displayed in vitro propagation and proliferation rates similar to collagenase isolated cells. NP isolated cells further met MSCs characterization criteria when they demonstrated efficient differentiation potential to adipocytes and osteoblasts and the expected surface marker expression.

The bone regeneration capability of NP isolated and collagenase isolated ASCs were compared in a critical-sized (4 mm) calvarial bone defect adult mice. Regeneration was induced either by an alginate scaffold combined with ASCs, and a alginate scaffold control group.

Clinical examination and Micro-CT imaging of retrieved implants 6 weeks post transplantation revealed new bone like deposition in alginate ASCs grafts but not in the scaffold control group.

Our results demonstrate that NP isolation provide a valuable alternative to collagenase preparations *in vitro* and *in vivo* settings. Therefore achieving complete calvarial bone regeneration using ASCs and a scaffold. [t1].

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A Study of the Effects of Paranasal Augmentation in Secondary Unilateral Cleft Lip Nasal Deformity

Presenter: Seungmin Nam
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Background: In unilateral cleft lip and palate patients, the alar base is displaced inferoposterolaterally due to the depression of the pyriform aperture in the cleft side and the drooping of the nostril rim is provoked by displacement of the alar base.

Methods: This study was conducted between May 1998 and December 2012. In total, 82 patients with secondary unilateral cleft lip nasal deformities were treated using paranasal augmentation. Patients with alar base asymmetry <3 mm were treated with a soft tissue augmentation and >3 mm and <6 mm were treated with a bony augmentation.

Results: Soft tissue augmentation was conducted in 42 patients and bony augmentation was conducted in 40 patients. The degree of alar base asymmetry was improved from 2.42 ± 0.38 mm preoperatively to 0.45 ± 0.21 mm postoperatively in the soft tissue augmentation group, from 4.27 ± 0.50 mm to 0.85 ± 0.14 mm in the hydroxyapatite graft group and from 4.37 ± 0.52 mm to 0.78 ± 0.23 mm in the onlay iliac bone graft group. The amount of paranasal augmentation was 1.97 ± 0.32 mm in the soft tissue augmentation group, 3.42 ± 0.42 mm in the hydroxyapatite group and 3.58 ± 0.48 mm in the onlay iliac bone graft group.

Conclusion: This clinical study shows that secondary cleft lip nasal deformities can be corrected with paranasal augmentation using soft tissue and bony augmentation and that these procedures can provide reliable, satisfactory, and safe clinical outcomes.

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Fixation of Regenerative Tissue Matrix with Bioabsorbable Bone Anchors in Cleft Palate Repair

Presenter: Chad Perlyn

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Background: The use of regenerative tissue matrix such as Alloderm® (Lifecell) has become a well-accepted complement to the traditional repairs used to close a cleft palate or cleft fistula. One of the challenges with this technique is fixation, particularly over the bony palate. Numerous methods including suture stabilization or use of tissue glues have been described. We have found that using bio-absorbable bone anchors (Arthrex) allows for secure, lasting fixation at any site along the hard palate. In turn, the tissue matrix can be positioned and set at the desired tension with ease, thereby providing for excellent soft tissue reinforcement.

Methods: Alloderm fixation with micro-bioabsorbable bone anchors was used in eight consecutive patients with complete cleft palate. A standard Bardach two-flap palatoplasty with intravelar veloplasty was performed. After closure of the nasal lining, two micro-sized bone anchors were placed at the anterior, medial aspect of each bony shelf. The Alloderm was then secured to these anchors with the attached suture. Posteriorly, the Alloderm was stretched to tightness and secured to the posterior palate with 4-0 vicryl suture. The muscle layer was then closed over the tissue matrix, followed by closure of the oral layer.

Results: All 8 patients were seen for follow-up. There was complete palatal closure with no fistula formation in 7/8. One patient had a slight posterior dehiscence, though the Alloderm remained secured. Long term results for up to one-year show intact palates, with no extrusion of the screws or other complications.

Discussion: Augmentation of palatal repairs with tissue matrix has become an accepted, and at some centers routine, part of cleft palate repair. Use of bioabsorbable bone anchors, similar to those used in tendon surgery, now allows for a stable, long term fixation method which solves some of the difficulties associated with use of these products. To date, this has facilitated intact palatal repairs without any adverse results.

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Evaluating the Need for Routine Admission Following Primary Cleft Palate Repair: Analysis of 100 Consecutive Cases

Presenter: Albert K. Oh

Authors: Oh AK¹, Wood BC^{2,3}, Magge KT²,
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Background: Routine admission following primary cleft palate repair (PCPR) is the standard of care at most institutions. The postoperative length of stay (LOS) is typically determined by the need for intravenous (IV) fluids, pain medication, and supplemental oxygen. Insurance companies have demonstrated increasing resistance to hospitalization longer than a 'short stay' (23 hour) observation period following PCPR. The purpose of this study was to identify the factors related to LOS following PCPR.

Methods: Retrospective chart review was conducted for 100 consecutive patients undergoing PCPR from May 2009 to February 2013. Demographic and perioperative data were collected and two-sample t-test, univariate and multivariate linear regression models were performed to assess for correlation.

Results: The male to female ratio was 49:51 and mean age at time of surgery was 12.6 months. The mean duration of surgery and general anesthesia was 1.8 hours and 2.8 hours, respectively. Mean LOS was 47.5 hours; 73% of patients required IV fluids greater than 23 hours after admission. Postoperative IV narcotics were required in 92% of patients after transfer to the post-surgical floor, and the last dose was given on average 19.8 hours after the completion of surgery. Of the 17 infants requiring postoperative supplemental oxygen, 13 (77%) patients required oxygen for greater than 23 hours following admission. A significant correlation was identified between increased LOS and older age at time of surgery, female gender, syndromic diagnosis, longer operative and anesthetic duration, longer time to postoperative *per os* (PO) intake, and lower dose of postoperative IV narcotic.

Conclusions: The majority of infants in this study required IV fluids greater than 23 hours until adequate PO intake could be established, and nearly all patients required IV narcotics after transfer to the post-surgical floor. When postoperative supplemental oxygen was required, it was necessary for greater than 23 hours in most infants. Factors identified in association with increased LOS may guide opportunities for reducing postoperative hospitalization; however, these findings would oppose the safety of routine ambulatory surgery or short-stay observation following PCPR.

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Improved results in cleft lip rhinoplasty-the modified Vissarionov technique-a 55 patient series

Presenter: Robert M. Menard

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Purpose: Despite the development of primary rhinoplasty techniques at the time of cleft lip repair and improvements in cleft lip surgical techniques, dynamic midfacial growth from infancy to adulthood often results in the need for secondary cleft lip rhinoplasty. The unilateral cleft lip secondary nasal deformity involves a retrodisplaced dome on the side of the cleft, hooding of the alar rim with an alar-columellar web, and deficient nasal lining in the vestibular dome. In 1989, Vladimir Vissarionov published his technique for addressing these deformities through a sliding flap cheilorhinoplasty; this was later modified to an open rhinoplasty technique including a septoplasty, columellar strut, and shield graft. The laterally based chondrocutaneous flap of the cleft side lower lateral cartilage, vestibular skin, and lip scar tissue allows for precise, anatomic repositioning of the lower lateral cartilage complex, providing a stable, symmetrical result due to the adequate restoration of the nasal lining defect on the cleft side.

Materials and Methods: 55 patients, ranging in age from 16 to 58 years presented with the unilateral cleft lip secondary nasal deformity for correction from 2004 to 2014. They had completed all orthodontic and orthognathic procedures prior to definitive secondary cleft lip rhinoplasty.

Results: In all patients a modified Vissarionov repair was performed, with unilateral cleft lip scar revision and in some cases complete cleft lip revision with muscle repair, open septorhinoplasty with columellar strut graft and repositioning of the cleft side lower lateral cartilage to equal the non-cleft side, and tip shield graft. Improvements in nasal symmetry and aesthetics as well as the nasal airway were noted in all patients, and examples which will be presented.

Conclusions: The modified Vissarionov secondary cleft lip rhinoplasty combines many cleft lip rhinoplasty concepts into one elegant technique that provides a stable, long term result.

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Soft-tissue profile changes through anterior maxillary distraction in patients with cleft palate

Presenter: Yoshimichi Imai

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Objective: AMDO is novel technique that expands maxilla sagittally and provides alveolar spaces, where orthodontists arrange crowded teeth subsequently. We have reported advantages of AMDO in velopharyngeal function and skeletal stabilities. The objective of this study is to compare anterior maxillary distraction osteogenesis (AMDO) with conventional LeFort I or Distraction LeFort I about effects on soft-tissue profile in patients with cleft palate.

Design: Retrospective.

Materials and Methods: Eight adult patients with cleft palate who underwent AMDO were examined (AMDO group). Changes in the positions of soft and hard tissue landmarks were calculated from lateral cephalograms taken before distraction, at the end of distraction, and 1 year after surgery. They were compared with those in 7 other patients with cleft palate who underwent conventional Le Fort I osteotomy (LFI group) and 6 other patients with cleft palate who underwent distraction LeFort I with halo device (LF1DO group).

Results: The mean soft-tissue changes in the AMDO group as percentage of skeletal changes 1 year postoperatively were 50.3% at pronasale, 99.2% at subnasale and 91.5% at labrale superior. They were significantly larger than in the LFI group, while there were no significant difference in soft-tissue change between AMDO and LE1DO group.

Conclusions: AMDO is an effective approach for hypoplastic maxilla in patients with cleft palate because of not only low impact on velopharyngeal function but also effect on soft-tissue improvement.

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Face or Occlusion?

Presenter: Dr CHRISTODOULOS Laspos

Author: Laspos DC

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Orthodontists around the globe are trained to treat every individual to an ideal Class I occlusion. The use of new biomaterials combined with advanced technology offer a considerable armamentarium to facilitate almost every case in the desired occlusion.

Individuals with skeletal discrepancies, however, constitute cases requiring good judgment, critical evaluation, as well as an individualized treatment plan from both the orthodontist and the oral and maxillofacial surgeon in order to achieve good results.

We will present several cases, which in spite of the fact that they were orthodontically treated in a nice class I occlusion, the face and the skeletal discrepancy were overlooked by the orthodontist. These four patients were referred to our clinic after the completion of the orthodontic treatment complaining about the esthetic outcome.

This presentation illustrates very clearly:

- a) The failure of the orthodontist to understand the real major complaint of the patient or
- b) The inability of the orthodontist to present the option of surgical correction to the patient, either because of lack of experience or due to inadequate knowledge or personal beliefs regarding surgical orthodontic approaches.

A second treatment was necessary in all four cases. The extra cost and the extra time involved are issues which illustrate the lack of good judgment initially. The new treatment approach that focuses equally on the occlusion and the face, as well as the results, will be presented with emphasis on the cooperation between the orthodontist and the oral and maxillofacial surgeon.

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Mapping the Mandibular Lingula in Pierre Robin Sequence: A Guide to the Inverted-L Osteotomy

Presenter: Wendy Chen

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Background: The inverted L osteotomy for treatment of symptomatic Pierre Robin Sequence (PRS) is a useful technique for avoiding injury to the tooth root and inferior alveolar nerve. Position of the lingula relative to adjacent mandibular anatomic points is understudied and may decrease iatrogenic complications. This study aims to map and compare the position of the lingula in the micrognathic mandible (PRS) compared to normal mandible (controls).

Method: This is a retrospective cohort of symptomatic PRS patients treated over 36 mos. We compare 3D CT data of relative lingula position between PRS vs controls using standard cephalometric data. Mann-Whitney U testing was performed using SPSS 21 for statistical analysis between groups.

Result: From 2008-2011, 11 PRS patients were identified (5 male, 6 female, 2 syndromic, ave age at surgery 0.94mos, ave age at CT scan 0.50mos). From 2010-2011, 4 control patients were identified (4 male, 0 female, 0 syndromic, ave age at surgery 7.08mos, ave age at CT scan 5.78mos).

The average cephalometric measurements were: overjet 9.99 mm vs 4.28(p=0.001), vertical ramus height (condylion to gonion) 16.05mm vs 23.04mm(p=0.003), ave vertical ramus width 15.16mm vs 20.67mm(p=0.003), ave horizontal ramus length (gonion to pogonion) 26.58mm vs 40.62mm(p=0.001), and gonial angle 132.64° vs 123.5°(p=0.018) for PRS vs control, respectively.

The ave horizontal lingula position (lingula to anterior vertical ramus, Li-AVR) was 7.25mm(PRS) vs 10.75mm(control)(p=0.001). The ratio along the x-axis (vertical ramus width), defined as [Li-AVR]/[AVR-PVR] was 0.44(PRS) vs 0.52 (control)(p=0.138). The ave vertical lingula position (lingula-gonion, Li-Go) was 9.02mm(PRS) vs 11.34mm(control)(p=0.026). The ratio along the y-axis, defined as [Li-Go]/[Co-Go] was 0.57(PRS) vs 0.49(control)(p=0.078).

Conclusion: As expected, in PRS patients, overjet is greater, vertical ramus height and width are lesser, horizontal ramus length is lesser, and the gonial angle is greater. However, relative proportions along the height and width of the vertical ramus show no statistical difference (p>0.05) in lingula position between PRS patients and normal controls. For both normal and micrognathic mandibles, the position of the lingula was approximated at 0.5 width and 0.5 height of the vertical ramus.

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Does the GOSLON Yardstick predict future requirement for Orthognathic surgery?

Presenter: Kirstin G. Miteff
Authors: Miteff KG, Zaman R, Singer S, Nicholls W, Gillett D, Walters M

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Background: A retrospective review was performed of all non-syndromic Unilateral Complete Cleft Lip and Palate patients (UCLP) at Princess Margaret Children's Hospital (PMH) Multidisciplinary Cleft Centre from 1982-1995 to assess whether the GOSLON yardstick is predictive of the requirement for Orthognathic surgery.

Method: Included were all patients with complete dental models at 9 years and medical records through to facial maturity. Patients who had orthodontic intervention prior to 9-year-old models were excluded. GOSLON scoring was performed by 2 independent examiners on patients 9-year-old dental models to assess the intermaxillary dentoalveolar relationship. This was performed on 2 occasions, 2 weeks apart to assess intra-rater and inter-rater reliability.

Results: There were 73 consecutive UCLP patients; 42 males and 31 females. Patients were found to have GOSLON 2: 45.2%, GOSLON 3: 26.1%, GOSLON 4: 21.9% and GOSLON 5: 6.8%. Overall GOSLON score was 2.9. Intra-rater reliability and inter-rater reliability weighted kappa of 0.78 and 0.73 respectively, indicate good strength of agreement. Orthognathic surgery referral occurred for all GOSLON 5 patients, 14 of 17 GOSLON 4 patients, 7 of 19 GOSLON 3 patients and 3 of 33 GOSLON 2 patients. Positive predictive value 86%, negative predictive value 91% (sensitivity 86% and specificity 91%).

Conclusion: The GOSLON yardstick is a good predictor of the future requirement for orthognathic surgery. However, other patient and anatomical factors need to be considered before selecting suitable surgical candidates.

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The Safety of the LeFort I Osteotomy: A Review of 202 Cases Over 36 Years

Presenter: Ian R. MacArthur
Authors: MacArthur IR, Nathan NR, Hajirawala L, Wolfe SA

Miami Children's Hospital, USA

Background: The LeFort 1 osteotomy is a versatile procedure that is beneficial to a wide variety of craniofacial patients. Despite its well-documented advantages, this operation has previously been associated with several dangerous complications. Chief among these are the possibility of life-threatening hemorrhage, blindness, and necrosis of the maxilla. The purpose of this study was to review a single surgeon's complication rate with the LeFort I osteotomy over a 36 year time period.

Methods: A retrospective chart review was carried out on all patients who received a LeFort 1 osteotomy by the senior author over a 36 year time period. Patient demographics, diagnosis and surgical treatment details were recorded, as well as any potential complications that occurred.

Results: 202 patients underwent a LeFort 1 osteotomy during the specified time period. Mean age at surgery was 19.5 years, with an average follow-up of 18.3 months. Cleft patients made up 46% of the study population. Class I occlusion was obtained in 89% of patients. Many patients underwent other simultaneous osteotomies at the time of their LeFort I. These included sagittal split mandibular osteotomies (32 patients), genioplasties (80 patients) and LeFort III advancements (6 patients). Distraction was used in 13 patients. A repeat LeFort I was required in 18 patients (9%) and was offered for another 6 patients. One patient experienced a dental injury at surgery, 1 patient developed a late tooth loss and 5 patients had tooth root exposure. Mucosal slough occurred in one patient. Blood transfusions were required in 30% of all study patients. There were no cases of blindness, uncontrollable hemorrhage or the requirement for ligation of the carotid artery, as well as no cases of bone necrosis or osteomyelitis.

Conclusion: The LeFort 1 osteotomy is a safe, reliable operation associated with a low complication rate.

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Evaluation of the mandibular split patterns in sagittal split ramus osteotomy

Presenter: Min Hou

Authors: Hou M^{1,2}, Tian-Ping Y², Jian-Guo W³

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Purpose: To evaluate the split patterns of the mandibular ramus in sagittal split ramus osteotomy (SSRO) using cone-beam computed tomography (CBCT), and examine the related anatomical features that may be associated with the split patterns.

Methods: A total of 130 consecutive patients (62 males and 68 females) with different maxillofacial deformities who underwent a SSRO between July 2011 and October 2012 at the Department of Orthognathic Surgery at the *Tianjin Stomatological Hospital of Nankai University* were included in retrospective study. The split patterns on each side were evaluated as the outcome variable, one month post-operation by CBCT. The predictor variable was composed of a set of heterogeneous anatomical variables that could be associated with the split patterns.

Results: Two types of split patterns of the mandibular ramus were observed in an SSRO: split at the lingual side nearby the mylohyoid sulcus, which occurred in 75.38% of the patients, and split at the posterior border region of the mandibular ramus, which occurred in 24.62% of the patients. No fracture lines were observed through the mandibular canal. The thickness of the lingual cortical bone between the mandibular canal and the posterior border of the ramus was significantly associated with split patterns ($P < 0.05$). The thickness of the cortical bone in the posterior border of the ramus, the degree of the mandibular angle and the shapes of the mandibular ramus in the axial plane were also found to influence these split patterns.

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Maxillomandibular Rotational Advancement for Adult Obstructive Sleep Apneics

Presenter: Cheng-Hui Lin

Authors: Lin C^{1,2}, Sasaki R^{1,3}, Chen YR¹

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Background: Obstructive sleep apnea (OSA) holds high incidence in population of Far East Asia. Among versatile surgical treatment, using maxillomandibular advancement (MMA) as the primary treatment has been found as the most effective one in terms of apnea-hypopnea index (AHI) reduction. Yet, MMA is not the workhorse of surgical treatment for OSA in Asia, where majority of patients show maxillofacial retrusion.

Method: In craniofacial center, Chang Gung Memorial Hospital, maxillomandibular rotational advancement (MMRA) has been used as the primary treatment option for patients with OSA. A retrospective review was conducted.

Result: Seventy-five consecutive patients were collected. AHI was reduced from 35.9/sec \pm 18.0 to 4.6/sec \pm 4.1. Patients with younger age, lower body weight, and lower AHI were found to have better improvement after surgery. Aesthetic outcome was found pleasing by majority of the patients.

Conclusion: MMRA is an effective surgical option for Asian patients with OSA. This treatment modality could be recommended as the first consideration for patients with maxillomandibular retrognathism.

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Cosmetic OGS (orthognathic surgery without change of occlusal relationship): applications and result

Presenter: Yu-Ray Chen

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Background: Patients want to improve their facial proportion, symmetry and profile without having orthodontic appliance or without change of their occlusion. We define this two jaw surgery as cosmetic OGS.

Method: Patients with acceptable occlusion with 1) post-compensatory orthodontic treatment for skeletal class III, 2) mild occlusal cant with facial asymmetry or 3) bimaxillary protrusion were selected for OGS without changing the occlusion relationship. Two jaw surgery including maxillary Lefort I and Bilateral sagittal split of the mandible rami with/without genioplasty are performed with maxillomandibular complex(MMC) fixed in the presurgical occlusion status. New or improved aesthetic facial symmetry, profile or proportion is achieved by clockwise or counterclockwise rotation, roll or set-back of MMC.

Result: Among the annual 600 OGS patients done in Chang Gung Craniofacial Center, around dozen cases were cosmetic OGS. The orthodontic appliance can be totally avoided in half of them and partially applied for a period of a few months in the rest half. The occlusion remained similar and the cosmetic improvement was achieved.

Conclusion: It is possible to improve facial profile, proportion and symmetry by cosmetic OGS without changing the occlusion relationship.

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Correction of Facial Asymmetry using CAD CAM Technology: An Evaluation of Post-Surgical Results

Presenter: Pradip R. Shetye

Authors: Shetye PR, Grayson B, McCarthy JG

NYU Langone Medical Center, USA

Reconstruction in patients with unilateral Craniofacial Microsomia (UCFM) presents challenges to restoring 3-dimensional symmetry and optimizing functional outcomes. We report our experience using virtual surgical planning for mandibular reconstruction in patients with UCFM.

CT scans were obtained for surgical planning on 10 patients with the diagnosis of UCFM. For surgical planning, a CT scan, dental study models and photographs were obtained. A 3D virtual patient was constructed by integrating patient's CT data and dental study models. The craniofacial surgeon and the orthodontist completed the virtual surgical treatment plan with the help of engineer via a web meeting. All patients underwent 2 jaw surgery with genioplasty. Five patients needed iliac crest bone graft to reconstruct the mandible. The planned mean advancement at maxillary dental midline was 4mm, yaw correction to the unaffected side was 4.96 mm and impaction was 2.74 mm. Mean mandibular advancement at Point B was 10.5mm and yaw correction towards unaffected side was 6.58 mm. Mean genioplasty advancement was 8.43 mm and mean transverse correction was 6.33 mm. The surgeon executed the surgical treatment plan using intermediate and final surgical splints, bone graft templates and cutting guides that were constructed with CAD/CAM technology.

Post-surgical CBCT's were obtained for superimposition and cranial base was used as a reference for superimposition. 3D color coded displacement maps were generated to visually and quantitatively assess the surgical outcome. Maxillary anatomical structures showed a mean error from the planned position of 0.88 mm (± 0.30). The anterior mandible showed a 0.96 mm (± 0.26) error from the planned position. (Include error in Yaw and in vertical)

The 3D presurgical planning technology is invaluable to the surgeon performing complex craniofacial surgeries, allowing for three-dimensional control over the osteotomized segments with greater precision.

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Bilateral Medial Femoral Condyle Flaps for Management of Secondary Robin Deformity

Presenter: Raymond Harshbarger

Authors: Harshbarger R¹, Myers R², Kelley P², Henry S²¹University of Texas, USA, ²Dell Children's Hospital, USA

Background: The medial femoral condyle (MFC) free flap provides reliable osseous tissue based on the descending geniculate artery. The MFC flap has been mainly described for wrist reconstruction, with one report on use for a unilateral segmental mandible defect. We present the first-ever case of bilateral MFC flaps coupled with orthognathic surgery for reconstruction of teenage Robin sequence with severe class II malocclusion and limited donor sites.

Methods: A fifteen year-old girl presented with Robin sequence and severe class II malocclusion. There was a history of 3 failed attempts at mandibular distraction osteogenesis, and subsequent placement of condylar prostheses. Due to severe amniotic banding syndrome the patient was missing hands, and lower extremities distal to the proximal tibia. Given restricted donor availability, bilateral MFC flaps were chosen for reconstruction. Virtual surgical planning (VSP) was utilized. Reconstruction involved a Le Fort I repositioning, removal of prostheses, soft tissue release, and MMF in class I occlusion. Bilateral mandibular body, ramus, and condylar reconstruction were achieved with MFC flaps.

Results: The patient healed well from surgery with viability of both MFC flaps. Post-operative CT scan revealed marked improvement of her dentofacial deformity. Post-operative plain films of her bilateral femurs at 5 months show formation of new cortical bone.

Conclusions: Traditionally, large defects of the mandible are addressed with the free fibular osteoseptocutaneous flap. Our patient presented with severe amniotic band syndrome, and lack of a fibula donor site. During VSP the MFC flaps were found to possess good bone stock and ideal shaping to reconstruct this patient's defects. The use of bilateral MFC flaps combined with orthognathic surgery allowed for an efficient and successful reconstruction of a complex dentofacial deformity. This is the first-ever use of bilateral MFC flaps for mandibular reconstruction.

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The Midface in Muenke Syndrome: Is it Hypoplastic?

Presenter: Fares Samra

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Background: Max Muenke included midface hypoplasia as part of the clinical syndrome caused by the Pro250Arg FGFR3 mutation that now bears his name. Our knockout mouse model of Muenke syndrome demonstrates midface hypoplasia in homozygous recessive mice *only*, with heterozygotes having normal or mildly deficient midfaces; as the majority of humans with the syndrome are heterozygotes, we set about to investigate the incidence of midface hypoplasia in our institution's clinical cohort.

Methods: We retrospectively reviewed all patients with a genetic and clinical diagnosis of Muenke syndrome from 1990 to 2014. Review of clinical records and photographs included skeletal Angle Class, dental occlusion, and incidence of orthognathic intervention. Cephalometric evaluation of our patients was compared to the Eastman Standard Values with the appropriate statistical tests.

Results: 23 patients with Muenke syndrome presented for evaluation and 18 met inclusion criteria with complete data-7 females and 11 males. Average age of presentation was 0.8 years (0.0-9.4), and patients were followed to an average age of 11.2 years (1.0-23.1). Average age at the time of imaging was 9.5 years (0.5-22.0). Clinical records revealed a skeletal Class I appearance in all but one patient. Cephalometric analysis revealed an average SNA of 82.5 (67.8-88.8) and an average SNB of 77.9 (59.6-84.1), and there were each equivalent to controls ($p < 0.05$). 12 patients were noted to be in Class I occlusion, 4 in Class II malocclusion, and 2 in Class III malocclusion. Only one patient (6%) underwent orthognathic surgery for Class III malocclusion. Subgroup analysis by dentition-primary, mixed, permanent-revealed consistency of the maxillomandibular relationships.

Conclusions: While a part of the original description of Muenke syndrome, clinically significant midface hypoplasia is not a common feature. This data is important, as it allows more accurate counseling of patients and families.

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Preventing relapse of mandibular midline shifts in sagittal split ramus osteotomy

Presenter: Sinan Öksüz

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Background: Sagittal split ramus osteotomy (SSRO) as a component of orthognatic surgery is the standard of treatment for certain mandibular discrepancies including midline shifts of the y axis such as laterognathia.

The osteotomized distal segments of the mandible are rotated towards the contralateral side of the shift on the y axis for treatment. In conventional procedure axial triangular gaps are created between the proximal and distal segments of osteotomies due to rotation. Large area of bony interface between osteotomized segments and rigid fixation are the advantages for the technique. However undesired contact of the osteotomy segments or failure in preserving the rotation of distal segments result in relapse of mandibular shift or alterations in the condylar position and axis due to excessive load to the temporomandibular joint.

We cut the undesired contact surfaces of the ostotomized segments to prevent relapse of mandibular midline shift. Excess load on the proximal segments and condyle arising from undesired contact is also avoided with this modification.

Method: Patients with mandibular occlusion discrepancies and laterognathia problems were addressed with SSRO following the preoperative orthognatic treatment. Undesired contact surfaces on the distal segment of osteotomies are cut to prevent the excess load on the proximal segments and to avoid relapse of the midline shift in long term.

Result: The rigid internal fixation of the ostotomies could be done without any problem, and with ideal occlusion. The relapse of the midline shift on the y axis was not encountered in long term follow up.

Conclusion: Cutting the undesired contact surfaces of the distal segments is an efficient method to prevent the relapse of latherognathia and to avoid excess load on the condylar segments.

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A Wearable System Based On Augmented Reality For Maxillofacial Bone Surgery

Presenter: Giovanni Badiali

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Augmented reality is an innovative technology allowing merger of data from the real environment with virtual information. Augmented reality provides a surgeon with direct perception of how virtual content, generally obtained via medical imaging, is located within an actual scene. The aim of this study is to present a newly designed localizer-free head-mounted wearable system based on augmented reality for maxillofacial bone surgery.

The system was developed as a stand-alone video-see-through device and designed to show the virtual planning overlaying the real patient. Alignment between the real and virtual world is achieved in the absence of an external tracking system.

A method to perform wafer-less augmented-reality assisted bone repositioning was implemented. Then, in vitro test was conducted on a physical replica of a human skull, where the augmented reality system was used to perform LeFort1 maxillary repositioning.

Three maxillofacial surgeons, three trainees in maxillofacial surgery and three engineers were involved in the testing; we evaluated interobserver variability. To evaluate the accuracy of our system, we used a traditional navigation platform featuring an active infrared localiser.

We determined the linear and angular errors between the real positions and the expected positions. The mean error was 1.70 ± 0.51 mm. The axial errors were 0.89 ± 0.54 mm on the sagittal axis, 0.60 ± 0.20 mm on the frontal axis and 1.06 ± 0.40 mm on the cranio-caudal axis. Overall mean pitch was $3.13^\circ \pm 1.89^\circ$, mean roll was $1.99^\circ \pm 0.95^\circ$ and mean yaw was $3.25^\circ \pm 2.26^\circ$.

Our results suggest that wearable augmented reality is both comfortable and functional, permitting a surgeon to maintain their natural operative posture during surgery performed from different angles, without losing the three-dimensional relationship between the real scene and the virtual planning. In terms of validation, our results suggest that the device affords a satisfactory level of accuracy.

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Internal Distraction Resulted in Improved Patient Reported Outcomes for Midface Hypoplasia

Presenter: David I. Hindin

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Background: Both internal and external distraction devices have been used successfully in correcting midface hypoplasia. Although the indication for surgery and the osteotomy techniques for a Le Fort I and Le Fort III may be similar, deciding when to use an internal vs. external device has not been well evaluated. We studied patient reported outcomes (PROM) for internal and external (RED) devices using a survey and clinical outcomes of internal devices for both Le Fort I and Le Fort III patients.

Methods: Using information obtained from a pilot group of patients with maxillary and midface hypoplasia who underwent internal vs. external distraction procedures, a PROM survey was created and then vetted by 3 surgeons and 3 different institutions. The survey was validated to record patient satisfaction with the surgical procedure, postoperative care, and final results. It was then given to patients treated for midface hypoplasia with either internal or external devices (n=50). In addition, panel assessment using the Asher McDade Aesthetic Index was used. For long-term clinical outcomes, patients who underwent internal device Le Fort I and Le Fort III distraction were studied during preoperative, postoperative, and follow-up (>1 year) periods. Lateral cephalogram measurements were compared, including angular (SNA and SNB) and linear (Deltax=horizontal and Deltay=vertical) changes (n=61).

Results: PROM showed that scores were higher in self-perception (92% vs. 71%) and social functioning (89% vs. 61%), while lower in dental anxiety (2% vs. 27%) in the internal group with respect to the external group. Females but not males had significantly higher scores when rating appearance: Improved (96% vs. 78%), Uncertain (4% vs. 10%), Different but not improved (0% vs. 12%). No correlation was seen with panel assessment and PROM. With clinical outcomes, patients with Le Fort I internal distraction had a mean SNA change from preoperatively (74.1) to postoperatively (84.9) and a horizontal change of 16.5 mm, with 15 percent relapse (follow-up 6.7 years).

Conclusions: For correction of midface hypoplasia, patient outcome measures were superior with internal distraction devices in comparison to external devices. Internal distraction after Le Fort I and Le Fort III resulted in long-standing correction of midface hypoplasia.

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A 3D Study of Midfacial Changes Following Segmental LeFort II/III Distraction in Syndromic Patients

Presenter: James M. Smartt

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Introduction: The recent introduction of LeFort II/III distraction introduced the ability to restore vertical midfacial height and convexity independent of changes in orbital morphology. This study analyzes three-dimensional changes in midfacial and orbital morphology before and after LeFort II/III distraction.

Methods: The study included all patients that underwent segmental midfacial advancement between 2013 and 2015. Two and three-dimensional measurements were made using 3 dMD Vultus software (3DMD, Atlanta, GA, USA). From these images the following measurements were compiled: canthal tilt, nasolabial angle, ratio of midfacial height to lower facial height, and absolute change in nasal length. The presence or absence of an open bite and the Angle classification of occlusion were assessed before and after surgery. Pertinent demographic data was compiled.

Results: Four patients underwent segmental midface advancement using the LeFort II/III distraction. Associated diagnoses included Apert and Goldenhar syndrome, and achondroplasia. The average age at the time of surgery was 14.8 years. Changes in facial dimensions included: a 3.19 degree improvement in canthal tilt (range -4.7 to 8.4 degrees), 9 degree change in nasolabial angle (range -1.0 to 19 degrees), and 0.69 cm increase in absolute nasal length (range 0.2 to 0.94 cm). The mean ratio of midfacial to lower facial height was 0.79 preoperatively and 0.89 postoperatively. Before surgery, all patients demonstrated Angle class III occlusion with three of four patients also demonstrating an anterior open bite. All patients achieved closure of their open bite and demonstrated class I or II occlusion. No major complications were observed in the treatment group.

Conclusions: Segmental midface advancement resulted in normalization of midfacial soft tissue landmarks. This form of midfacial advancement demonstrates the ability to selectively improve midfacial height and canthal tilt while restoring normal occlusion.

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Two-pin External MDO for Neonatal Airway Obstruction from Pierre Robin Sequence: Long Term Outcomes

Presenter: Christopher M. Runyan

Authors: Runyan CM, Gendron C, Billmire DA, Pan BS, Gordon CB

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Introduction: Mandibular distraction osteogenesis (MDO) has become an accepted treatment for severe airway obstruction in neonates with Pierre Robin Sequence (PRS). We hypothesized that a minimally invasive transfacial two-pin technique for MDO would minimize scars and complications but remain efficacious in correction of severe airway obstruction. We have utilized this technique for the past 11 years and now report our long-term outcomes.

Methods: Two 2-mm transfacial Steinman pins are placed: one through bilateral coronoid processes and velum, and a second through the lower mandibular border at the midpoint of the body. Using an ultrasonic osteotome, mandibular angle corticotomies are performed through 1.5 cm buccal mucosal incisions. Uni-vector distractors are placed and activated on POD#1, distracting at 2 mm/day. No consolidation is performed, and closed remodeling of the callus is used to close the open bite at the time of distractor removal. A retrospective review was performed for consecutive neonates (<1 yo) treated with this technique as a primary surgical intervention from 1994-2014.

Results: Sixty-eight patients were treated with current mean age of 5.6 years. The mean obstructive indices on sleep study improved from 43.3 to 9.2. Only 22.1% required G-tube feeds whereas all others were fed temporarily by nasogastric tube. Six patients had persistent airway obstruction necessitating tracheostomy (8.8%). These patients had significantly higher rates of syndromic status, neurologic impairment, and low birth weight. There were 10 complications (14.7%) requiring surgical intervention, including hardware failure (4), early consolidation (3) or molar anomalies (3). There were no facial nerve injuries, incisor anomalies, TMJ ankylosis or need for scar revision.

Conclusion: The two-pin transfacial technique for external MDO is an effective tool for correction of severe airway obstruction in neonates with PRS, with favorable long-term outcomes and complication profile.

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Improved Outcomes Following Orthognathic Surgery Are Associated with High-volume Centers

Presenter: Charles T. Tuggle

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Background: Previous studies assessing outcomes following orthognathic surgery primarily rely upon single-center/surgeon experience. These studies are limited in evaluating the effect of operative volume on outcomes.

Methods: Orthognathic procedures were identified in the 1999-2011 HCUP Nationwide Inpatient Sample. Outcomes included in-hospital procedure-related complications, systemic complications, any complications, and length of stay (LOS). High-volume hospitals were defined as 90th percentile of case volume or higher (>31 cases/year). Univariate and multivariate analyses were performed to identify independent predictors of outcomes.

Results: Of the 101,693 patients identified, mean age was 24.7 years, 77.9% were white, 19.6% underwent ancillary procedures (genioplasty/rhinoplasty/septoplasty), and 37.6% underwent double jaw surgery. The total complication rate was 5.4%, and the procedure-related complication rate was 1.2%. Mean LOS was 2.4 days. There were 2,999 hospitals. 53% of cases were performed at high-volume institutions; 50% of hospital performed <6 cases annually. Patients at high-volume hospitals more often received ancillary procedures (21.4% vs. 17.4%, $P<.001$) and double jaw surgery (41.3% vs. 33.4%, $P<.001$) compared to low-volume hospitals. On unadjusted analysis, total complication rates of 4.8% vs. 6.0% were observed for high-volume compared to low-volume hospitals ($P<.001$). After adjusting for case-mix, high-volume hospitals were associated with a decreased likelihood of suffering a procedure-related complication (OR 0.75, $P<.001$), systemic complication (OR 0.82, $P<.001$) and general complication (OR 0.80, $P<.001$). Surgery at a high-volume center also was associated with a shorter LOS (2.2 ± 5.5 vs. 2.7 ± 7.1 days, $P<.001$).

Conclusions: The majority of orthognathic cases nationwide are performed at a small number of high-volume hospitals. These hospitals appear to discharge patients earlier, perform more complex procedures, and have fewer complications.

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STAGED ORTHOGNATHIC TREATMENT OF SEVERE SLEEP APNEA IN ACHONDROPLASIA

Presenter: Hitesh Kapadia

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Background: The reported incidence of obstructive sleep apnea (OSA) in patients with Achondroplasia or Dwarfism is 10 to 30%. Many can be treated with tonsillectomy, nasal surgery or positive pressure mask (CPAP), but there are severe presentations that require tracheostomy if orthognathic options are not successful. Orthognathic treatment planning is a challenge because of the variable skull base shortening, nasopharyngeal constriction, vertical facial ratio compression, and complex maxillo-mandibular disproportion. Sub-cranial advancements have been used with mixed results. It remains unclear which Lefort (LF) level gives the optimum improvement in treating severe OSA.

Purpose: To review the airway changes that occur following LF3 distraction compared to LF2 distraction treatment plans.

Method: Patients were reviewed from our two institutions that had 1) Achondroplasia 2) documented OSA 3) failed non-orthognathic treatment of OSA. These patients represented a severe subgroup of Achondroplasia. The cases were analyzed for the treatment provided and the airway outcome. Digital analysis was performed as well as pre- and post-polysomnography (PSG).

Results: Two patients underwent LF3 distraction parallel to Frankfort, and two underwent LF2 distraction with a more vertical vector. Point A movement was comparable in both groups (mean 17mm), but SNA increased three times greater in the LF2 group than the LF3 with corresponding increased airway volumes. The OSA did not improve in the two LF3 cases, but decreased from 54 to 5 after LF2 in one patient, and relieved symptoms in the second with PSG pending.

Conclusions: In this limited series, LF2 distraction resulted in greater SNA changes and improvement in OSA compared to LF3. The technical and orthognathic considerations of segmental LF2 in Achondroplasia patients will be discussed.

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Mandibular distraction osteogenesis on condylar load & stress distribution: A finite element analysis model

Presenter: Scott Rapp

Authors: Rapp S^{1,2}, Hunter D¹, Singh G¹, Ryan R¹, Gordon CB², Pan BS², Wan DC¹¹Stanford University Medical Center, USA, ²Cincinnati Children's Hospital Medical Center, USA

Background: Mandibular distraction osteogenesis effects the vectors and magnitude of force applied by opposing soft tissues and muscles in proximity to the mandible. The resultant stress and strain on the condyles is unclear with conventional distraction techniques. Clinical manifestations from excessive TMJ joint loading may include joint or disk erosion, remodeling, derangement or possibly ankylosis. A predictive biomechanical model is presented on patient-specific conditions to observe resultant mechanical effects.

Methods: 3-D finite element analysis (FEA) models were performed on 6 patients. N=4 had 30 mm internal Zurich distractors placed and n=2 had 43 mm Molina external distractors (KLS Martin). N=5 pts underwent bilateral distraction for mandibular hypoplasia and n=1 pts underwent unilateral distraction for microsomia (n=11 distractors). Ages ranged from 2 weeks to 13 years of age. CT scans were performed pre-operatively and post-operatively after 3 months consolidation. Multiphysics, material properties and nominal masticatory loads were applied to each tissue domain. Muscles were modeled as force vectors at mandibular attachment sites. Stresses at each element were calculated and visualized in a heatmap. Distraction vector relative to occlusal planes and internal vs. external distraction placement on condyle strain load were evaluated.

Results: CT scans of the pts skull were segmented into 3 solid tissue domains: the mandible, condylar cartilage, and mandibular fossa. Domains were concatenated into 3D volumes of tetrahedral elements, totaling 476,852 individual pieces, then algorithmically refined to a max error of 10 μ m. The avg pre-op infant (<1 yo) condylar surface area stress load >14 MPa was 12.33%. Post distraction, the % S.A. stress load >14 MPa increased to 20.22%. The avg baseline condylar stress load in pts >1 yo was 7.84% and post-op 38.95%. Preliminary data suggests external distraction results in a lower stress load on the condyle vs. internal distraction.

Conclusion: Stress loads after distraction is difficult to measure experimentally. FEA may be useful to test various distraction techniques to optimize bone generation and limit concomitant morbidities. External distraction with anterior pin placement near the coronoid may offload the condyle and reduce TMJ impact.

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Mandibular Distraction via Cranial Traction in Syndromic Micrognathia

Presenter: Scott Rapp
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Introduction: Mandibular distraction osteogenesis (MDO) is an accepted technique for the treatment of nonsyndromic congenital micrognathia. In syndromic micrognathia, distraction is less reliable and many centers prefer to postpone or avoid distraction. We present a cranially-borne MDO technique for airway correction with limitation of technical issues hindering conventional approaches.

Methods: A minimal incision exposes the retromolar area of the mandible. The molar bud is exposed depending on pt age. An ultrasonic osteotome creates an "inside out" osteotomy from within the substance of the mandible, with a limited sagittal or oblique vector. Minimal periosteal degloving maximizes distraction callus quality and permits rapid distraction. A transmental tunnel is drilled within the vestibular of the menton to the submenton area. A T-shaped attachment anchor is passed through and fixed to the alveolar process with transmucosal unicortical screws and bent around the menton anteriorly. A halo-type distractor base is affixed to the cranium in the Frankfort plane. Initial tension permits mild distraction of the condyles from the fossae. Distraction begins POD1, 2-3 mm/day, and empirically finishing when airway stripe is increased by at least 200%. 1 week of consolidation is performed, and in select cases, remodeling of the callus is used to close the open bite at time of distractor removal.

Results: From 2012-2015, a retrospective review of 16 syndromic pts with severe OSA who underwent cranial-borne MDO was performed. The mean age was 4.4 yrs. Decannulation or airway correction documented by MLB or PSG was successful in 11/16 (69%). 3 pts had persistent airway obstruction and could not be decannulated. Mean distraction at point B was 41 mm. Menton to hyoid distance was increased by a mean of 55%. There were 4 complications (25%) requiring surgical intervention, excluding hardware adjustment. These included need for reintubation ($n=3$) and dentoalveolar displacement ($n=1$). There were no facial nerve injuries, TMJ ankylosis or scar revisions.

Conclusion: MDO can be used in previously poor syndromic candidates by utilizing the cranial-borne submental traction approach. Advantages of this technique include: condyle unloading, minimal submental scar, reduced facial nerve risk, and improved airway outcomes.

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Single Vs Segmental Maxillary Osteotomies & Long-Term Stability in Unilateral Cleft Lip and Palate Malocclusion

Presenter: Guy D. Watts
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Purpose: To investigate the stability of single-piece versus segmental (2-piece) maxillary advancement in patients with unilateral cleft lip and palate (UCLP) treated using conventional Le Fort I orthognathic surgery.

Patients and Methods: A retrospective study was undertaken in 30 patients with nonsyndromic UCLP treated with the same surgical and orthodontic protocol from 2002 through 2011. Standard lateral cephalometric radiographs were taken preoperatively, immediately postoperatively, and at least 1 year postoperatively. Patients were divided into single-piece and segmental Le Fort I groups based on planned surgical movement. Postoperative movements were compared between groups using repeated measures analysis of variance.

Results: The mean skeletal horizontal advancement was 7.3 and 7.5 mm in the single-piece and segmental groups, respectively. The skeletal horizontal relapse was 1.3 mm (18%) for the single-piece group and 1.9 mm (25%) for the segmental group. The skeletal surgical extrusion was 2.7 mm for the 2 groups. The skeletal vertical relapse was 0.6 mm (22%) and 1.5 mm (56%) for the single-piece and segmental groups, respectively. The mean dental horizontal postoperative movement was an advancement of 0.4 mm for the single-piece group and a relapse of 0.2 mm (3%) for the segmental group. The mean dental vertical relapse was 0.1 mm (4%) for the single-piece group and 0.3 mm (11%) for the segmental group. There was no statistically significant difference in relapse between the single-piece and segmental groups for all movements ($P>.05$).

Conclusion: Skeletal and dental relapses were similar between single-piece and segmental maxillary advancements using conventional Le Fort I orthognathic surgery in patients with UCLP.

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Post-operative evolution of pericerebral effusion in scaphocephaly

Presenter: Kenichi Usami

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Objective: Some patients with scaphocephaly can present with a pericerebral effusion (PE) in frontal region, but its etiology and development are still unknown. We analyzed the evolution of PE in scaphocephaly and discuss its property and influence of surgery on hydrodynamics of cerebrospinal fluid (CSF).

Method: The subjects were 51 patients with scaphocephaly who underwent craniotomy with decompression of superior sagittal sinus (SSS) between 2008 and 2014. PE was measured before and after surgery, and compared to expected value of normal control. Evans index (EI) and 3rd Ventricle index (3VI) were calculated. A correlation between PE and EI, and PE and 3VI were analyzed.

Result: Twenty-two of 51 patients (43%) had larger PE than the average of estimated value corrected for age (pathological PE) preoperatively. PE improved more than natural course in 49 of 51 patients (96%) postoperatively. Patients with pathological PE had significantly high EI ($p=0.025$) and high 3VI ($p=0.005$).

Conclusion: Surgery for scaphocephaly with decompression of the SSS reduced PE faster than the expected natural course. PE correlated with EI and 3VI in the preoperative period. These may indicate that the decompression of SSS is important to hydrodynamics of CSF in scaphocephaly.

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Effectiveness of the Multidirectional Craniaofacial Distraction Osteogenesis (MCDO) in older children

Presenter: Mihoko Kato

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Distraction cranioplasty for Craniosynostosis has become a standard procedure. Compared to conventional cranioplasty, the distraction procedure has advantages for bone movement and osteogenesis. However, a satisfactory outcome does not always obtained in morphological correction especially among older children who have poor ability of osteogenesis and remodeling. Multidirectional Craniaofacial Distraction Osteogenesis (MCDO) has been developed to solve this problem. We tried to apply MCDO method for older children. We retrospectively analyzed the results of the patients after the MCDO method.

Material and Methods: Twenty three patients with craniosynostosis have been treated with MCDO method in our institution since 2005. We focused on 4 patients who were over 5 years old at the operation and tried to evaluate the osteogenesis after the MCDO operation in older children.

Results: Case1) 5y7m male with Crouzon disease, maximum bone defect was 1.3×1.1cm 95 month after operation. Case2) 5y8m female with Metopic synostosis. maximum bone defect was 3.3×0.4cm 70 month after operation. Case3) 6y2m male with Multisuture synostosis. maximum bone defect was 2.7×0.8cm 26 month after operation. Case4) 7y6m male with Crouzon disease, maximum bone defect was 2.7×0.8cm 26 month after operation.

Discussion: In case1, the maximum bone defect was very small at 95 months after operation. Case 2, 3 and 4 had linear bone defects (width: 0.4-0.8 cm) that were correspond to osteotomies. Considering the patients age, the osteogenesis of the patients seemed to be good enough. The MCDO method could be an effective procedure for older children.

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Complications in the surgical treatment of craniosynostosis: a 5 years retrospective study

Presenter: Giovanna Paternoster
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Objective: to review the incidence of surgical complications in 320 consecutive craniofacial procedures at Alder Hey Hospital, Liverpool, UK.

Methods: Surgical series consist of 320 procedures performed on 305 patients operated on between 2010-2014 at Alder Hey Hospital: 50 (15.6%) in syndromic or with multi-suture craniosynostosis and 270 (84.4%) in non-syndromic single-suture craniosynostosis; 16 were re-operations.

Analysis Revealed: 141 FOAR (fronto-orbital advancement and remodelling); 66 strip craniectomy; 54 subtotal vault remodelling; 30 total vault remodelling; 26 posterior vault remodelling +/- extension to sub-occipital craniectomy.

Results: There was no mortality and all complications resolved without permanent deficit.

We reported 27 major surgical complications (8.4%), 9 in syndromic patients (33.3%) and 18 in non syndromic cases. 26% in the re-operation group (7/27).

An additionally surgical procedure has been required in 24 cases.

The most frequent complication was dural tear (n=67 [20.9%]). 13 cases (4.1% of procedures) were associated to: 5 intra-operative bleeding (1 requiring duroplasty and a subsequent surgical wash out for wound infection; one resulting in CSF leakage requiring lumbar drainage; one associated with a subdural haematoma; one associated with air embolism; one resulting in abandonment of the procedure); 1 case of supra-orbital pus collection; 1 of orbital pseudomeningocele; 1 opened frontal sinus; 5 wound debridement.

We reported 7 intra-operative bleeds (in 1 case with sequent abandoned procedure, in 1 requiring surgical evacuation of infected collection and plates removal); 5 wound debridement (in 2 patients with deep tissue infection); 2 broken distractors; 1 CSF leakage treated after lumbar drain insertion; 1 removal of screws and plates for local pain.

Discussion: The overall complication rate is low (8%) and no evidence of increase risk has been demonstrate in the syndromic patients group (33%) or in the reoperation group (26%).

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The State Of Outcomes Research in Non-Syndromic Craniosynostosis: Systematic Review of the Literature Over 20 Years

Presenter: Liliana Camison
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Purpose: The field of craniofacial surgery has been slow in embracing the outcomes research movement. In this era of result-driven health care, rigorous evaluation of surgical outcomes is paramount for patient care. We sought to examine the state of outcomes research in the non-syndromic craniosynostosis (NSCS) literature to identify strategies for improvement.

Methods: A systematic review was conducted of English articles evaluating outcomes in non-syndromic craniosynostosis from 1993 to present. After pre-determined inclusion/exclusion criteria, articles were analyzed for design, demographics, level of evidence, and details of outcomes metrics employed. Four researchers independently reviewed each article, with final discrepancies resolved.

Results: 840 articles were identified; 132 met inclusion criteria. There was a significant trend toward increasing annual rate of publications ($R^2=0.43$, $p<0.01$). Only 3.7% of studies were multicenter; 6% prospective. 85.6% were retrospective series. 91.6% and 88.6% were graded with the lowest evidence scores in ASPS and Oxford scales, respectively. 60% of studies (n=79) came from the US/Canada. When available, average follow-up was 46.5 months (SD=36); however 32.5% of studies (n=43) did not mention length of follow-up. Mean number of patients was 68 (SD=63.5). Outcomes measures varied significantly across studies; only 15.1% (n=20) used any validated outcome measure, and all were established neurodevelopment scales. In contrast, 40.9% (n=54) of studies employed *ad hoc* measures for analysis. 16.6% of studies (n=22) considered a patient/family-reported outcomes mechanism. Aesthetic results were evaluated in 44.7% of studies (n=59); 35.6% of them used the Whitaker scale. However, 22% did not state any criteria for assessment. Other commonly reported outcome measures were also accounted for. Notably, only 2.3% (n=3) of articles included a cost analysis.

Conclusion: Most literature on NSCS remains classified as low level of evidence, calling for more rigorously designed research in the field. Multicenter efforts are key, as variation in outcome reporting hinders combination of evidence across studies. Field-specific validated measures are needed; the Whitaker classification could be a candidate based on clarity and wide use by craniofacial surgeons.

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Effect of Fronto-orbital Advancement on Ophthalmologic Outcomes in Patients with Unilateral Coronal Synostosis

Presenter: Amanda M. Murphy

Authors: Murphy AM, Gencarelli J, Bezuhly M

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Background: Patients with unilateral coronal synostosis (UCS) have an increased incidence of significant refractive error, oculomotor abnormalities and amblyopic visual impairment. Although fronto-orbital advancement is the gold standard for UCS repair, its effect on ophthalmologic function is unknown. This review examines the effect of fronto-orbital advancement on ophthalmic outcomes in patients with UCS.

Methods: Computerized database searches were performed. Studies reporting ophthalmologic outcomes in children with UCS in whom the surgical intervention was frontal orbital advancement were included.

Results: A systematic search revealed 12 studies that satisfied inclusion criteria, 11 of which were retrospective case series. Five studies reported on pre and post-operative strabismus rates. Six studies reported on the incidence of post-operative amblyopia. In general, strabismus persisted in patients post frontal-orbital advancement. Three studies reported on the development of new onset strabismus following surgical repair. It is unclear, however, whether or not these patients developed amblyopic visual impairment related to persistent oculomotor dysfunction. Additionally, patients with UCS demonstrated higher rates of refractive errors and amblyopia, but the temporal relationship to frontal orbital advancement was reported in only one study.

Conclusions: Patients with UCS demonstrate higher rates of strabismus, refractive errors and amblyopia than the general population following frontal orbital advancement. This review emphasizes the need for prospective studies and long-term ophthalmologic surveillance in these patients to better define the effect of frontal-orbital advancement on ophthalmologic outcomes.

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Optimization of Cranio-Orbital Reshaping: Application of a Mathematical Model

Presenter: Kathryn V. Isaac

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Background: Cranio-orbital remodelling aims to correct the dysmorphic skull associated with craniosynostosis. Traditionally, the skull is reconstructed into a shape that is subjectively normal according to the surgeon's perception. We present a novel technique using a mathematical algorithm to define the optimal location for bony osteotomies and to objectively reshape the fronto-orbital bar into an ideal normal skull.

Methodology: Using pre-operative CT images, the abnormal skull contour at the frontal-orbital region was obtained for infants planned to undergo cranio-orbital remodelling. The ideal skull shape was derived from an age and gender-matched normative skull library. For each patient, the mathematical technique of Dynamic Programming (DP) was applied to compare the abnormal and ideal skull shapes. The DP algorithm identifies the optimal location of osteotomy sites and calculates the objective difference in surface area remaining between the normative and dysmorphic skull shape for each solution applied. By selecting the optimal solution with minimal objective difference, the surgeon is guided to reproducibly recreate the normal skull contour with defined osteotomies.

Results: The Dynamic Contouring algorithm was applied in 13 cases of cranio-orbital remodelling. Five female and eight male infants with a mean age of 11 months were treated for craniosynostosis classified as metopic (n=7), unicoronal (n=4) or bicoronal (n=2). The mean OR time was 190.2 minutes (SD 33.6), mean estimated blood loss 244 cc (SD 147.6) and 10 infants required blood transfusions. Compared to a historical crania-orbital remodelling group treated without application of the algorithm, there was no significant difference in OR time, estimated blood loss or transfusion rate.

Conclusion: This novel technique enables the craniofacial surgeon to objectively reshape the frontal-orbital bar and reproducibly reconstruct a skull shape resembling that of normal infants.

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An audit of post-operative analgesia and pain assessment in major paediatric craniofacial surgery

Presenter: Katharine J. Francis

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Introduction and Aims: Oxford University Hospital carries out 60 to 80 major paediatric craniofacial operations per year.¹ Patients are admitted to Paediatric Intensive Care Unit (PICU) postoperatively before returning to the ward for ongoing care. Guidelines are used to ensure appropriate analgesia and assessment is provided on the ward.² Since the withdrawal of codeine for children our unit changed to a regime of paracetamol, ibuprofen and Oramorph.

The aims of this audit were to establish adherence to the guidelines. Documentation of pain scores, sedation and nausea and vomiting scores were also assessed.

Methods: The notes of 24 patients undergoing major craniofacial surgery between May and September 2014 were reviewed. Observation charts, prescription charts and anaesthetic charts were analysed.

Results: 23 patients were included, 1 patient was excluded due to a prolonged PICU admission. The mean age was 18 months (8-54), and mean weight was 11.3kg (8.6-15). Patients stayed a mean of 40 hours on the PICU before discharge to the ward (24-72).

100% of patients had analgesia prescribed as per the guidelines. 75% were prescribed NSAIDS appropriately. Patients received an average of 2 doses of Oramorph (range 0-8) on the ward.

19% had a pain score of 2 in the first 48 hours, and 1 patient had a pain score of 2 subsequently. These were all responded to with extra analgesia within 30 minutes.

70% of patients did not have documented nausea and vomiting score, and 43% of patients had no sedation score documented daily.

Discussion and Conclusion: All patients' analgesic prescriptions adhered to the guidelines and all patients had pain scores documented. The majority of patients appear to be comfortable (pain scores of 0/1) and those who scored higher received appropriate analgesia. Sedation and nausea assessment was poor. We conclude that postoperative analgesia guidelines are useful to ensure high quality care however further training is needed to improve assessment of side effects.

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Efficacy of Tranexamic Acid to Reduce Blood Loss in Open Calvarial Vault Remodeling Surgery for Craniosynostosis

Presenter: Nicole Hooft

Authors: Hooft N¹, Singh DJ^{2,3,4,5}, Bristol RE^{5,6,7}, Serrone R¹, Beals SP^{2,5}, Joganic E^{2,5}

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Introduction: It is well known that craniosynostosis surgery is associated with significant blood loss. Recently, tranexamic acid (TXA) has been used in attempts to reduce blood loss and transfusion requirements in patients undergoing calvarial vault remodeling. This has been well studied in pediatric orthopedic and cardiovascular surgery. However, in craniosynostosis surgery these studies have provided mixed results and the efficacy of tranexamic acid in open calvarial vault remodeling for craniosynostosis still needs to be further investigated.

Methods: We retrospectively reviewed 81 patients with craniosynostosis who underwent either bifrontal or biparietal-occipital calvarial vault remodeling before institution of a TXA administration protocol(non-TXA group) and 36 patients after institution of the TXA protocol (TXA group). Variables tracked included: total intraoperative blood transfused, post-operative blood transfused and estimated blood loss (EBL).

Results: Patients who received TXA required significantly less total blood transfusion during their operation; 258cc TXA group vs 390 cc non-TXA (p=0.009). Patients who received TXA required no blood transfusions postoperatively, compared to the non-TXA group who received an average of 78cc postoperatively (p=1.25E-05). EBL was also lower in the patients receiving TXA, 260cc in the TXA group vs 410cc non-TXA (p=0.26). All patients underwent transfusion intraoperatively, as per our institutional preference to transfuse early for open calvarial vault surgery.

Conclusions: Intraoperative TXA administration reduced blood transfusion requirements, as well as EBL, in patients undergoing open calvarial vault remodeling. There were no adverse events related to TXA administration. Incorporation of TXA with other blood preservation protocols may further reduce transfusion rates.

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Enzyme replacement therapy for congenital hypophosphatasia allows for surgical treatment of craniosynostosis

Presenter: Timothy W. Vogel

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Background: Hypophosphatasia (HPP) is a rare inherited disorder of bone metabolism that results in the loss of function of the gene coding for tissue non-specific alkaline phosphatase (TNSALP). Patients with HPP have defective bone mineralization as well as craniosynostosis that can be seen in the infantile and childhood forms of this disease. Traditionally HPP has had a poor prognosis, with few children surviving to exhibit the phenotype of clinical craniosynostosis that requires surgical intervention.

Method: Here we report on new advancements in enzyme replacement therapy for children affected by HPP, allowing these patients to survive and undergo surgery to address complex craniosynostosis. We discuss our case series of four HPP patients treated at our institution with enzyme replacement therapy that have had successful surgical intervention for craniosynostosis.

Results/Discussion: These children had no complications related to their surgeries and exhibited decreased neurological symptoms following cranial vault remodeling. Our study reveals enzyme replacement therapy administered either pre- or post-operatively paired with cranial vault remodeling strategies can yield improved neurological outcomes in children affected by HPP.

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Craniosynostosis in Hypophosphatemic Rickets:

Presenter: Jennifer L. Rhodes

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Objective: This study examines a series of patients with hypophosphatemic rickets and craniosynostosis to characterize the clinical course and associated craniofacial anomalies.

Methods: A 20 year retrospective review identified patients with hypophosphatemic rickets and secondary craniosynostosis at three major craniofacial centers. Parameters examined included: Sex, age at diagnosis, affected sutures, etiology of rickets, presenting symptoms, number and type of surgical interventions, and associated diagnoses.

Results: 10 patients were identified (8 males, 2 females). Age at presentation varied between 1 and 5 years of age. The most commonly affected suture was the sagittal in 60%. Etiologies included antacid-induced rickets, autosomal dominant hypophosphatemic rickets, and X-linked hypophosphatemic rickets. 90% of patients have undergone at least one cranial remodeling surgery. 3 patients underwent subsequent surgeries in later years. 3 patients underwent formal intracranial pressure monitoring, 2 of which revealed elevated intracranial pressure. 3 patients were diagnosed with a Chiari 1 malformation.

Conclusions: Secondary craniosynostosis develops postnatally due to metabolic or mechanical factors. The most common metabolic cause is hypophosphatemic rickets which has a variety of etiologies and displays a heterogeneous phenotype. Cranial vault remodeling may be required to prevent or relieve elevated intracranial pressure and abnormalities of the cranial vault.

Children with hypophosphatemic rickets who develop head shape abnormalities should be promptly referred to a craniofacial specialist.

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Craniosynostosis Surgery: Impact of Timing of Intra-Operative Blood Transfusion on Post Operative Course

Presenter: Davinder Singh
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Background: Correction of craniosynostosis is known to result in blood loss, leading to poor perfusion potential multi organ dysfunction. The aim of this study is to determine which patient population may benefit from early blood transfusion, the impact of timing of blood transfusion on metabolic disturbances, and post-operative course.

Methods: Following IRB approval, a retrospective review of 71 patients who underwent open calvarial vault remodeling for correction of craniosynostosis was performed. Patients were separated into two groups: those who received blood transfusions within the first 30 minutes of surgery and those that received blood transfusions after the first 30 minutes of surgery. Patients were then further divided into cohorts; non-syndromic, syndromic and secondary transcranial surgery. Variables tracked included: hemoglobin (hgb), arterial blood gas values, lactate level, length of stay, estimated blood loss and amount of blood transfused in the operating room, post-operatively and total blood transfused.

Results: In the non-syndromic cohort 30 patients underwent early transfusion and 25 received late transfusion. There was no significant difference in outcomes between groups. The syndromic cohort had 8 patients in the early transfusion group and 8 in the late transfusion group. The early transfusion group had significantly less EBL (266cc vs 381cc) and higher hgb nadir (8.96 vs 7.2). Early transfusion group also trended towards lower lactate, shorter length of stay and less post-op blood transfused.

In the secondary transcranial surgery cohort 4 patients underwent early transfusion and 10 received late transfusion. The early transfusion group trended towards significance with higher hgb nadir, lower lactate level, shorter length of stay and less post-op blood transfused.

Discussion: In patients undergoing open calvarial vault remodeling transfusion within the first 30 minutes of surgery is correlated with lower transfusion rates, higher hgb nadir and lower lactate level in syndromic patients and in those patients undergoing secondary transcranial surgery. In these cohorts early transfusion should be considered.

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Biomechanical properties of calvarial bones in normal and craniosynostotic skulls

Presenter: Mehran Moazen
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Introduction: Calvarial reconstruction is used in the management of various forms of craniosynostosis. From a biomechanical point of view mixing bones with different mechanical properties, i.e. elastic modulus, may free or over-constrain the natural growth of the brain and affect subsequent remodelling of the skull. The aim of this study was to investigate whether there are differences between the mechanical properties of calvarial bones in wild type (WT) and Crouzon type (MT-Fgfr2^{C342Y/+}) mice displaying early coronal suture fusion.

Methods: A total of 21 WT and MT mice, all bred from the same genetic background, were collected at ten (P10) and twenty (P20) days postnatal development age. Specimens were kept frozen until preparation for indentation. Frontal and parietal bones were indented in the coronal plane. Following optimisation of the indentation parameters and positions, the mean of five indentations in each level and sample was reported. Statistical differences were calculated using paired t-test (p<0.05).

Results: In the WT group the elastic modulus of the frontal bone was higher than parietal bone for both P10 (5.32±0.68 vs. 4.33±0.18 GPa; p<0.05) and P20 (7.14±0.79 vs. 6.30±0.47 GPa; p<0.05). By contrast, in the MT group the elastic modulus of frontal bone was lower than parietal bone at both P10 (1.39±0.30 vs. 4.40±0.92 GPa; p<0.05) and P20 (5.57±0.33 vs. 6.04±1.49 GPa). Furthermore, elastic modulus of the frontal bone was significantly lower in the MT group comparing to the WT group, and showed less trabecular bone and larger lacunae, at P10.

Conclusions: This is the first study to show that the mechanical properties of calvarial bones can vary significantly across craniosynostotic skulls and differ to those of normal skulls. The clinical significance of these results remain uncertain and require further investigations, however they suggest that caution may be required during calvarial remodelling when considering bone properties.

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Improving aesthetic outcome in scaphocephaly correction: Hairline lowering during vault remodeling

Presenter: David Richardson

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Introduction: The bossed forehead in patients with scaphocephaly is often associated with a high hairline which is a hitherto unrecognised feature of the condition. A new technique to improve the aesthetic outcome of patients undergoing scaphocephaly correction is described.

Methods: Sixteen patients with scaphocephaly and having a high hairline due to frontal bossing who underwent scaphocephaly correction by subtotal or total vault remodeling were analyzed. The median age at surgery was 18 months. The mean distance between the nasofrontal suture and the hairline (NF-HL) was preoperatively 70mm (range 58 to 91mm). As control group for the preoperative values the hairlines of 14 patients who were seen in clinic for positional plagiocephaly were measured. As control group for the postoperative values the hairlines of 14 patients after scaphocephaly correction who did not have hairline lowering were measured.

Results: An obvious lowering of the hairline could be achieved in all 16 patients with a mean postoperative NF-HL of 59mm (range 50mm to 73mm) and was significant when compared with preoperative measurements ($p < 0.05$). The pre-op hairline heights were also significantly higher ($p < 0.001$) than a series of patients without craniosynostosis who had a mean NF-HL of 55mm (range 45 to 65mm). Post hairline lowering patients also had lower hairlines than a historical series of scaphocephaly patients corrected without hairline lowering who had a mean NF-HL of 66mm (range 50 to 75 mm) ($p < 0.05$).

Conclusion: Hairline lowering is a useful addition to vault remodeling techniques for scaphocephaly and can help to avoid the strong forehead appearance which is often a feature of the post scaphocephaly correction patient.

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FRONTAL WIDENING FOR SCAPHOCEPHALY IN OLDER CHILDREN

Presenter: Eric J. Arnaud

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Surgical correction for scaphocephaly in infants before 6 months of age may provide a spontaneous remodeling of the whole skull with a subtotal procedure. After 1 year of age, transverse frontal narrowing and anterior bulge need to be addressed specifically in this subgroup of older children.

Patients and Methods: Fourteen children aged between 15 months and 6 years were operated on during the last 6 years for a sagittal synostosis. Those children had not operated before because of late presentation or initial parental reluctance.

All patients presented with a transversal narrowing of the forehead and an anterior bulge. Mean age at surgery was 38 months.

The procedures were carried out under general anesthesia. A zigzag posterior coronal incision, as described by Renier, allowed elevation of the scalp flap. The forehead was harvested in situ 5mm above the upper orbital line. Adjacent pieces of bone were removed between squamosal sutures including the midline. Special care was given not to damage the sagittal sinus. A coronal strip at least 1 cm wide was harvested and then inserted in the middle of the forehead after it was splitted sagittally in two symmetrical halves. In order to adapt the inferior base of the neo-forehead, the lateral aspects of the base were splitted and anteriorly maintained by a wedge of bone. The forehead was maintained in a posterior tilted position with resorbable osteosynthesis (sonic weld). This posterior tilt was allowed by shortening of the sagittal distance and widening of the skull. The whole skull was reconstructed with splitted bonegrafts. Mean time of the procedure was 3 hours. Mean follow-up after surgery was 3 years.

Results: In all patients but one a transverse widening and a posterior tilting of the forehead were obtained. In one patient, the midline sagittal strip of the forehead consolidated with a setback creating a midline ridge. In the one patient presenting with some indirect sign of raised intracranial pressure, the thumbprinting appearance disappeared within one year.

Discussion: It is recommended to address sagittal synostosis correction before 6 months of age because after 12 months of age, some forehead remodeling needs to be performed in order to achieve better results.

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CRANIO-ORBITAL MORPHOLOGY DUE TO CORONAL RING SUTURE SYNOSTOSIS

Presenter: Guy D. Watts

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Background: Minor cranial sutural synostosis is currently regarded as a rare diagnosis. As clinical awareness grows there are a greater number of cases being documented in the literature. This study was aimed at describing the variants of unicoronal synostosis in regards to major and minor sutural involvement and secondary effects on cranial and orbital morphology.

Methods: A retrospective study was conducted at the Hospital for Sick Children between 2002 and 2012. The pre-operative CT scans of 65 patients diagnosed with unicoronal synostosis and listed for surgical interventions were identified from the craniofacial database. Eighteen scans of normal paediatric skulls (trauma) were used for a normal control group. Using Aquarius Intuition[®] software CT scans were analyzed for sutural involvement, cranial base deflection, ipsilateral and contralateral orbital height and width. All statistical analyses were carried out using SAS/STAT[®] software version 9.2. One-way analysis of variance was utilized to detect differences between variants.

Results: Four variants of unicoronal synostosis were identified. These include isolated frontoparietal (FP), isolated frontosphenoidal (FS), FP+FS and FS+FP. The last two variants differ in their temporal involvement in sutural synostosis and cranial and orbital morphology. There were 26 cases of isolated FP synostosis (45.6%), 26 cases of FP+FS synostosis (45.6%) four cases of isolated FS synostosis (7%) and one case of FS+FP (1.8%). The ratio of the ipsilateral-to-contralateral vertical orbital dimension averaged: normal 1.0, FP 1.13, FS 0.9, FP+FS 1.05 FS+FP 0.95 comparative p values < 0.05. The cranial base deflection for the FP and FP+FS variants averaged 15.53 and 16.32 degrees (p > 0.05) and the FS and FS+FP variants -12.82 and -12.7 degrees (p > 0.05). These two subgroups differed statistically from normal and one another p < 0.05.

Conclusion: Cranio-orbital morphology is distinctly different between the four variants of unicoronal synostosis and changes as the synostosis progresses. Three of these have been previously identified but the fourth is presented for the first time. Failure to recognize the variations in morphology of the subtypes of unicoronal synostosis can result in a poor postoperative correction and potential exaggeration of pathological features.

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Osteogenic Distraction and Digital osteotomies for skull remodeling in Coronal Craniosynostosis

Presenter: Adriana Guerrero

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In patients with coronal craneosynostosis, the structural deformation, the brain activity and the muscle action will result in a deformation of the cranial vault characterized by a shortening AP skull dimension that mainly affects the anterior skull base leading to a insufficient orbit volume incapable of containing the eye ball. The turricephaly produced by the brain mass positive pressure in the synostotic suture prohibits the skull to extend in a AP way leading to a extended growth through the sagittal suture.

The traditional surgical procedures such as fronto orbital advancement or monoblock where successful in achieving a three dimensional remodeling, however they have a high morbidity and mortality rate. The mobilization and extraction of big skull segment with dura detachment affects the bone vascularity, such bones will act as bone grafts which makes them susceptible for reabsorption and diminish the integration capacity.

In our technique we perform a lineal craniotomy in the sinostotic suture, with osteotomies without the subjacent dura dissection maintaining the bone attached to the dura. A circumferencial osteotomy in the anterior half orbit walls is performed, and a naso glabellar osteotomy to detach de nasal pyramid. The fronto orbital advancement is performed through gradual distraction. The distractors are collocated in the temporal fossa. Digital osteotomies in the fronto-parietal bone are performed, maintaining the internal dura table attached to the bone. When using digital osteotomies perpendicular to the previously synostotic suture it gives the cranial bone the chance to be remodel in a three dimensional way by the forces of the negative hydraulic forces implied by the brain mass, reshaping the cranial bone in a more aesthetic way.

The treatment with osteogenic distraction and digital osteotomies is successful in three dimensional remodeling, lowering the morbidity and mortality, reshaping the skull in a more harmonic way.

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An Aesthetic Outcome Scoring System for Scaphocephaly Correction: A Pilot Study

Presenter: Chris Parks

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Introduction : Scaphocephaly is the commonest craniosynostosis. Cephalic index as an outcome measure is suboptimal because 2-D measures express 3-D deformities poorly and don't evaluate the other morphological components of the condition. We piloted a Red/Amber/Green (RAG) scoring system to judge aesthetic outcome following surgery using photographs and experienced observers.

Method: Standard photographic views of 20 patients were scored by 5 assessors, using RAG scoring before and after scaphocephaly correction according to 6 morphological characteristics. The RAG scores were added to give a composite score. These were averaged between the 5 assessors.

Results: There was a highly significant difference between both pre-operative composite scores and post-operative scores. There was also a significant difference between the composite scores when assessing pre-operative photographs twice with all assessors scoring the photographs as worse at the second view ($P < 0.05$, Wilcoxon rank sign test). This significance wasn't maintained when non-parametric tests were used (Mann Whitney).

Discussion: The RAG scoring system can be used to assess aesthetic change following scaphocephaly correction and provides both a visual analogue and numerical indicator of aesthetic change. The inconsistency of scoring of pre-operative views may result from study design and will be discussed along with propositions for validation of the scoring system.

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Predicting skull growth in normal and craniosynostosis mice

Presenter: Arsalan Marghoub

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Introduction: There are various treatment options for different forms of craniosynostosis with most cases involving surgical intervention. Hence, there is a need to find optimum treatment methods. Computational models have great potential in optimisation of skull reconstruction. However, such models first need to be validated against *in vivo* models. The aim of this study was to develop and validate a series of computational models to predict the skull growth in wild type (WT) and mutant type (MT-*Fgfr2*^{C342Y/+}) mice displaying coronal suture fusion.

Methods: Two ontogenetic series of WT and MT mice were scanned using micro-computed tomography. A 3D model of a WT mouse skull at day 3 postnatal development age (P3) was created, including the bones, sutures and brain. The model was used to predict the WT and MT skull growth at P10, when the overall skull shape has largely formed in mouse, using finite element analysis. Input parameters to the model were estimated based on a series of parallel experimental studies. Nevertheless, several sensitivity analyses to the input parameters were performed and outputs were compared in terms of overall shape to *ex vivo* specimens.

Results: As expected, sensitivity analyses highlighted that model predictions were sensitive to the choice of input parameters. However, using the experimental data, it was demonstrated that the P3 model could predict the subsequent overall shape of the WT skull at P10. Further, it predicted the shape of the P10 MT skull, which has a slightly wider and shorter profile compared to the equivalent P10 WT skull.

Conclusions: The models developed in this study are the first validated models of skull growth. The close match between the predicted shape of the models and *ex vivo* data build confidence in a modelling approach. However, further studies are required to test the validity of the assumptions used in this study before they can be applied to patient-specific models of craniosynostosis.

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Long-term results of frontal and bilateral cranial distraction osteogenesis for multi-suture craniosynostosis

Presenter: Susumu Ito

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Object: The authors retrospectively analyzed effectiveness of frontal and bilateral cranial distraction osteogenesis for oxycephalic multi-suture craniosynostosis, especially in the cases with long-term follow-up.

Methods: Between October 2000 and January 2009, 10 patients with multi-suture craniosynostosis (Crouzon: 6, Other: 4) underwent cranial distraction osteogenesis, expanding skull both anteriorly and bilaterally. The age at the surgery ranged from 1 year and 6 months to 7 years and 11 months (median: 4 years and 6 months). The osteotomies were made in fronto-orbital area including anterior skull base and in biparietal area. After the osteotomies, two or four distraction devices (Keisei Ika Kogyo, Japan) were attached at bicoronal area for frontal expansion. In addition, one or two devices were applied each side at parietal bones for bilateral dilatation. The final cranial expansion ranged from 10 to 25mm (median: 21mm) anteriorly; from 6 to 25 mm (median: 17mm) bilaterally. The median duration of follow-up was 12 years and 4 months (ranged from 6 years and one month to 14 years and 4 months).

Results: After the treatment, copper beaten appearances of the skulls disappeared in all patients. In addition, CT scans showed good visualization of cortical sulci in all cases. One patient had CSF leakage around the distraction device and underwent removal of the device. However, neither serious infection nor other complication occurred. No recurrence of cranial stenosis was evident during the follow-up periods.

Conclusion: In the view point of long-term follow-up, frontal and bilateral cranial distraction osteogenesis is useful treatment for oxycephalic multi-suture craniosynostosis.

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Does early fusion of the spheno-occipital synchondrosis explain OSA in Crouzon syndrome?

Presenter: Caroline Driessen

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Background: OSA is a challenging problem in patients with Crouzon syndrome. It was recently shown that premature fusion of the spheno-occipital synchondrosis is associated with midface hypoplasia. Our aim was to evaluate if premature fusion of the spheno-occipital synchondrosis is causally related to obstructive sleep apnea (OSA). We postulate that patients with Crouzon syndrome with OSA have an earlier fusion of the spheno-occipital synchondrosis as compared to patients with Crouzon syndrome without OSA.

Method: Fifty-three patients with Crouzon syndrome were evaluated by 91 CT scans and multiple sleep studies. Spheno-occipital synchondrosis was graded from being open to totally closed (grade 1-5). OSA was defined as a need for treatment and/or a obstructive apnea hypopnea index >5. A Kaplan Meier analyses was used to compare almost and total closure (grade 4-5) over time in patients with or without OSA.

Result: Median closure occurred at the age of 11,7 years old. 38/53 (72%) of all Crouzon patients had OSA. Median closure was at 11.4 years old in OSA patients and 13.4 years old in non OSA patients. Kaplan Meier analyses demonstrates a non significant earlier closure of synchondrosis (grade 4-5) in patients with OSA (Log Rank comparison Chi square 0.64; p=0.42). In 3/29 (11%) patients with Crouzon syndrome first signs of fusion of the synchondrosis occurred before the age of 1 year old. All 3 had OSA too. In 6/29 (21%) patients younger than six years old the synchondrosis was closed. The distribution of open versus closed synchondrosis was similar in patients with versus without OSA aged younger than six (Pearson Chi square 0.23; p=0.63).

Conclusion: Premature fusion of the spheno-occipital synchondrosis is not a significant factor that contributes to OSA in patients with Crouzon syndrome.

Discussion: Based on previous studies, early fusion of the spheno-occipital synchondrosis may be related to midface hypoplasia but according to our conclusion the clinical relevance of this finding does not lie in obstructive breathing.

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Quantitative analysis of change in intracranial volume after posterior cranial vault distraction

Presenter: Azusa Shimizu

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Background: Posterior cranial vault expansion is regarded to be more effective for increasing intracranial volume than fronto-orbital advancement (FOA) or anterior cranial vault expansion. We investigated the changes in intracranial volume in cases of premature craniosynostosis treated by posterior cranial vault expansion using the distraction osteogenesis technique.

Methods: Six patients, 2 boys and 4 girls aged from 5 months to 3 years 3 months (mean, 21 months) at operation, with craniosynostosis underwent posterior cranial vault distraction at Juntendo University Hospital from 2011 to 2014. Patient characteristics, length of distraction, and pre- and postoperative computed tomography (CT) scans were reviewed. Total intracranial volume, including the supratentorial space and posterior cranial fossa, was measured using the workstation functions on three-dimensional CT scans obtained the day before and the day after operation, and the day before removal of the cranial distractor.

Results: Posterior distraction was performed without severe complications in all 6 patients. The distraction length was 22.5-35 mm (mean 29.5 mm), the intracranial volume change was 144-281 ml (mean 197 ml), and the enlargement ratio of intracranial volume was 113-128% (mean 119.3%).

Discussion: The present quantitative analysis of intracranial volume change after posterior distraction showed that posterior cranial vault distraction achieved similar increases in intracranial volume compared to FOA or conventional anterior distraction. Posterior distraction is reported to achieve 35% greater intracranial volume expansion compared to anterior cranial vault advancement, and anterior skull morphology was improved spontaneously by expansion of the occipital region. Posterior cranial vault distraction is very effective for cranial volume increase, so may be the first choice of treatment in cases of craniosynostosis.

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Promoting of ossification of Calvarial Defects in Craniosynostosis Surgery by Using Demineralized Bone Plate

Presenter: Mikko Juhani Savolainen

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Background: Correction of bony defects after calvarial vault reconstruction (CVR) is challenging in craniosynostosis patients after infancy. Demineralized bone matrix (DBM) is an alternative material for autologous bone. Despite its long and reliable clinical use and commercial availability. However, its use has not been extended to correct calvarial defects.

Patients and Methods: 13 non-syndromic and 5 syndromic craniosynostosis patients operated during 2008-2010 with bilateral, comparable defects were reviewed retrospectively; mean age 6.9 years. Mean follow-up time was 5.6 years. Each patient received both interventions; each side (right or left) was chosen to receive the DBM plate (DBX strip, Synthes USA, West Chester, Pa.) intervention on one side and the control intervention on the mirrored side. The study comprised 26 DBM covered defects and 26 control defects. The Fusion Degree of all defects were measured from one week and one year postoperative from 3D-CT images with OsiriX[®] method. Medical records were reviewed for DBM-related complications.

Results: Twenty-six defects were covered with DBM plate (mean area 11.1 cm²) and 26 controls were identified (mean area 7.7 cm²). The mean fusion degree of the DBM defects was 76% and 56% for the controls ($p < 0.001$). The difference between the DBM defects and the controls were statistically significant for patients older than 2.3 years ($p < 0.002$). No DBM-related complications were recognized.

In 15 of the patients, the DBM defects were larger (mean 11.08 cm² (SD 7.07)), compared with the control defects (mean 7.75 cm² (SD 4.45)). The fusion was 100% in five DBM defects while only two control defects fused 100%. There was no difference between the patients with syndromic or non-syndromic craniosynostosis in fusion degree.

Conclusions: DBM plate is a safe and effective material to promote ossification in calvarial defects for CVR patients after infancy.

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It is strictly necessary a Hemifacial Rotacion for Apert Syndrome correction?

Presenter: Cuauhtémoc Lorenzana
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Apert syndrome is one of the syndromic craniosynostosis with more difficulties during treatment. Contemporary treatment include occipital expansion in the first months of life and then a hemifacial rotation with monobloc advancement. Respiratory functional changes together with the correction of the frontal and midface deformity, the exorbitismo and the inter-orbital distance are corrected. An important number of major complications has been reported already for different groups with non-satisfactory final results. We present a serie of 12 Apert patients, 7 female and 5 male, ages between 6 months to 4 years of age and treated with a combine occipital expansion and monoblock. After the occipital expansion with springs, a monobloc distraction advancement was performed emphasizing the supraorbital deformity correction with its classical depression. The use of proper distraction vectors to advance the midface and the frontal bone, together with an extra bone weakening on the posterior cortex at the interorbital area, will change the classical concavity into a very nice convexity of the supraorbital region. The frontal flattening simultaneously is corrected with an efective fronto-orbital-maxillary advancement ranged from 20 to 32 mm at the orbital level. This combined treatment produce a highly satisfactory result with a nice reshaping of the posterior skull and and surprisingly, the interorbital and supraorbital hollowing reshaping produce a nice curvature that follows the new orbital position. Postoperative interorbital measurements shows normal distances between the lacrimal crests, correcting the apparent hiperteleorbitism from Apert syndrome. The final aesthetic appearance is very pleasant together with the correction sleep apnea and corneal exposure. Maximun clinical follow up is 5 years. Surgical technique details, pre and post CT-Scan, intracranial views will be present.

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TIMING OF CLOSURE OF THE ANTERIOR SKULL BASE IN SYNDROMIC INFANTS: IMPLICATIONS FOR EARLY MONOBLOC

Presenter: Sol Mundinger
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Background: Early monobloc distraction advancement has been proposed as a treatment option for infants born with complex craniosynostosis. We have observed abnormal dural adhesion to the anterior skull base in young children undergoing this procedure that we have not observed in older children. Our hypothesis is that this anterior skull base defect persists in syndromic craniofacial patients in the first few years of life but then closes before the time of traditional monobloc treatment. This abnormal adhesion may explain the high rate of dura violation experienced during infant monobloc surgery and we propose a modification to allow improved visualization.

Purpose: To determine the presence and timing of closure of anterior skull base defects in syndromic craniofacial patients.

Method: All syndromic patients who underwent intracranial surgery from 2000-2013 were included. Pre-operative CT scans were examined for the presence of an anterior skull base defect which was measured based on defined coronal and sagittal planes. The sizes of the defects were plotted relative to age of patient to estimate timing of closure in this population.

Results: 22 syndromic patients were included with age at CT scan ranging from 1 to 62 months. All patients less than age 10 months had a defect present, with a coronal size range of 6-14 mm. There was a progressive decrease in defect size with age, with all patients after 24 months age not demonstrating a defect.

Conclusions: The anterior skull base defect in syndromic infants has not been well described. Any surgery requiring dissection in this area before two years of age, such as early monobloc, is at risk of tearing the dural adhesion. We have successfully performed six monobloc osteotomies in patients with anterior skull defects without a dural tear and without pericranial flap by using an anterior window approach to directly visualize this area during dissection.

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Craniosculpt, A Second Generation Hydroxyapatite Cement; 42 Consecutive Cases in Craniofacial Reconstruction.

Presenter: Robert J. Wood

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Background: Hydroxyapatite (HA) cements are typically used to repair cranial defects and as an onlay to improve bone contour. Craniosculpt (KLS-MARTIN L.P.) is a new HA moldable cement with a putty like consistency. A calcium phosphate starting powder is reacted with diluted silicate liquid, and undergoes a non-exothermic chemical reaction to form low crystalline hydroxyapatite, which is very similar to the mineral phase of human bone. Studies indicate that Craniosculpt has superior tension, flexion, and fracture toughness, as compared to existing HA cements and thus makes it more suitable for cranio-maxillo-frontal applications. We present our experience with Craniosculpt in craniofacial surgery.

Method: 42 children received Craniosculpt as part of their reconstruction during the period 9/9/13 to 1/25/15. Seven cases were secondary fronto-orbital advancements for anterior craniosynostosis, 32 cranioplasties were performed for cranial defects or contour deformities. Two patients underwent secondary posterior calvarial remodeling. Mean age was 8.18 years (range 1.14 to 33.25).

Result: No infections, extrusions, or other complications were noted. Blood loss averaged 97.23mL. No children have required re-operation to date for inadequate restoration of skull form or relapse. All children have returned for follow up as scheduled.

Conclusion: These results are favorable relative to other series of HA cements where complication rates as high as 15% were reported. Our experience suggests resistance to infection in addition to the superior tensile strength the silicate crystalline structure is reported to yield. We feel this is an important new option in repair of cranial defects and contour deformity of the face and skull.

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Correction of Severe Short Nose Using Distraction Osteogenesis

Presenter: Hideaki Rikimaru

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Background: Correction of severe short nose is a distressing problem for plastic surgeons. It is difficult to simultaneously lengthen the 3 components of the nose, which are the outer skin envelope, the framework, and the mucosal lining. We developed a new method to lengthen the nose more than 10 mm definitively and safely, which was performed using the technique of distraction osteogenesis.

Methods: The procedure involves a 2-stage operation. At the first stage, boat-shaped iliac bone is grafted on the dorsum. More than 6 months later, the second-stage operation is performed. The grafted bone is cut horizontally in the center, and the distraction device is applied to it. Distraction osteogenesis is started after a latency period of 14 days and performed at a rate of 0.6 mm once daily. The distraction device is replaced by a special attachment during over the 6-month consolidation period.

Results: Our method was applied for 5 patients with congenitally or acquired severe short nose, respectively. The total amount of distraction osteogenesis was 12.6, 13.8, 21.7, 17.5, 22.4 mm respectively. The profiles of both of the patients improved, and they were satisfied with the results. However some retrogression of the nose length were observed.

Conclusions: The method we developed is an entirely new approach to the correction of severe short nose. This method made it possible to simply, safely and definitively obtain more than 10 mm length of the nose. Furthermore, it was determined that nonvascularized grafted iliac bone could be lengthened by distraction osteogenesis. We are convinced this method will be the first choice to correct severe short nose.

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Endoscopic-assisted intraoral three-dimensional reduction mandibuloplasty

Presenter: Guoping Wu

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Background: Oriental people have a square face with a prominent mandibular angle means masculine and coarse and that is considered to be an unappealing feature. Reduction mandibuloplasty has become popular in the orient in the past two decades, the operation was frequently performed through the intraoral approach. But an invisible mandibular angle forces the surgeon to perform blind ostectomy which leads to difficult to perform an accurate ostectomy as planned, leaves unnatural mandibular contours and sever complications.

Methods: From January 2010 to January 2013, a total of 112 patients with prominent mandibular angles underwent one stage long-curved ostectomy combined with splitting corticectomy through an intraoral approach with endoscopic-assisted for reduction of the lower face. A retractor with an adjustable endoscope provide a clear operative field, the ostectomy line was marked. The one stage long-curved ostectomy and corticectomy were performed following the marked ostectomy line using an oscillating saw with angles of various degrees and length under direct vision.

Results: Mandibular contouring was three-dimensionally refined; the width of the lower face was reduced in the frontal view and the mandibular angle appeared natural and inconspicuous in the lateral view. The majority of patients were satisfied with both their frontal and lateral appearances. The gonial angle and the mandibular plane angle were increased effectively. No major complications such as fracture or facial nerve nerve injury occurred.

Conclusions: Intraoral approach long-curved ostectomy combined with splitting corticectomy with endoscopic-assisted allows surgeons to perform accurate, safe and reproducible ostectomies and to recontour mandible three-dimensionally, can make the face look thinner from the frontal view and, in the lateral view, keep more natural looking ones with smooth ostectomised borders.

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The application of the digital ostectomy template in the mandibular angle ostectomy

Presenter: Li Teng

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Objective: This research applied digital techniques such as 3D imaging design, RP technology to the pre-operative design of ostectomy lines, to the design of the digital ostectomy template along the ostectomy lines that can match perfectly the 3D model of the mandibular angle region. The templates were afterwards 3D printed and able to provide a guide to the operation, increase the precision and symmetry of the ostectomy, shorten the time span of operation as well as reduce the rate of operative complication.

Methods: Part One: Ensure the possibility of the implantation of templates into operation area: The variation in each mandibular measurement point was measured preoperatively. Then the surgeon molded the mandibular angle along the ostectomy line with self-curing tooth acrylic mixed with base resin, which is called the 'ostectomy template'. Inserting the ostectomy template into the operation area verified the feasibility of the insertion of templates of different shapes into operation area.

Part Two: Design ostectomy lines on digital 3D theoretical model with ProPlan, import the statistics of the ostectomy into GeoMagic in the form of STL file to design the 3D ostectomy template, fabricate the ostectomy template with FDA certificated PLA through RP machine, and insert the template into operation area to finalize the clinical application of this technique.

Results: The templates can fit perfectly and stably with the mandibular angle. And the removed bone proved to be highly matched with the template. All the post-operative effects of the ten cased in the first part and five cases in the second part were satisfactory.

Conclusion: The research found that pre-operative design were able to be precisely duplicated into the mandibular angle through digital ostectomy templates, with the guidance of which the surgeon could conduct the ostectomy in an accurate way, thus greatly increase the level of precision and symmetry of the operation.

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A Modified Reduction Malarplasty Utilizing 2 Oblique Osteotomies for Prominent Zygomatic Body and Arch

Presenter: Zhanwei Gao

Author: Gao Z

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Background: The shape of the zygomatic body and arch have great influences to the facial contour of Orientals. The prominent zygoma makes the appearance look more fierce. Nowadays in China, the number of patients who underwent reduction malarplasty is increasing rapidly. Therefore, it is important to develop a reliable surgical procedure with small wound and good effects.

Method: Included in this report were 46 patients with prominent zygomatic body and arch treated between October 2007 and November 2010. Combined intraoral and extraoral approaches were used, and 2 oblique osteotomies were performed to anterior and posterior part of malar complex, respectively. The isolated zygoma segment was then internalized utilizing z-plasty for the posterior end and inward sliding and internal fixation for the anterior end. The extraoral approach was made through a small temple incision.

Result: All patients were subjectively satisfied with the postoperative appearance. Their face contours were effectively improved by the modified procedure. One patient had short-term numbness of the medial zygomatic region skin; no other complications were observed during the follow-up period.

Conclusion: This surgical procedure was carried out using combined intraoral and extraoral approaches. No visible scars left on the face. After 2 oblique osteotomies were made, the anterior inward sliding and posterior z-plasty could be easily performed to the isolated zygomatic bone. No segmental bone removal was required. The natural curve of the face contour was maintained while the malar complex was reshaped. We concluded that it is an effective and safe reduction malarplasty technique for Orientals.

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CAD/CAM planned Lefort 1 DO for early treatment of severe maxillary hypoplasia in cleft lip and palate

Presenter: Catherine S. Chang

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Background: Traditionally, maxillary hypoplasia in the setting of cleft lip and palate is treated via orthognathic surgery at skeletal maturity, which condemns these patients to abnormal facial proportions during adolescence. For larger advancements, Le Fort I distraction is advantageous in its expansion of soft tissues and potentially lower relapse. The purpose of this study is to determine the safety profile of CAD/CAM planned Lefort I distraction osteogenesis with internal distractors in select patients presenting at a young age with severe maxillary retrusion.

Methods: We retrospectively reviewed the early Le Fort I distraction osteogenesis experience-cases performed for severe maxillary retrusion (≥ 15 mm underjet), after canine eruption but prior to age 17-at a single institution. Patient demographics, cleft characteristics, CAD/CAM plans, surgical complications, post-operative 3-D CT scans, and occlusal outcomes were analyzed.

Results: 4 patients were reviewed, with a median age of 12.8 years at surgery (range 8.6-16.1 years). Mean surgical duration was 110.5 minutes and estimated blood loss 200mL. All patients were admitted for 2-3 days. Distractor activation began after a 5 day latency phase and progressed at a rate of 1 mm/day until slight overcorrection into Class II malocclusion was achieved; all patients then underwent a 2 month consolidation phase after which the distractors were removed. Overall mean advancement was 14.4 mm (range 13.1-15.7 mm), with SNA advancement from 85.8 ± 5.7 degrees to 98.5 ± 5.6 degrees postoperatively. The preoperative mean SNA-SNB difference was -6.8 ± 3.6 degrees; this improved to 8.1 ± 2.9 degrees postoperatively, demonstrating intentional mild overcorrection. Compared to pre-operative CAD/CAM planning, patients clinically achieved 72.7% ($\pm 12.6\%$) of the intended distraction length. In short-term follow up (mean 50 weeks; range 7-97 weeks) the advancements have remained stable with no evidence of relapse by physical exam or lateral cephalogram.

Conclusion: Lefort I distraction osteogenesis with internal distractors is a safe procedure to treat severe maxillary hypoplasia in young children, which would be expected to worsen over this time period in untreated patients. Short-term follow-up demonstrates stability of the advancement.

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Surgical technique vs. aesthetic evaluation in Asian contouring surgery (354 cases)

Presenter: Xiongzhen Mu

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Purpose: To indicate the importance between surgery technique and aesthetic evaluation in Asian contouring surgery.

Method: Data include 354 cases and we analyses the difference between surgical technique and pre-surgical purpose from patient. We listed surgical technique as simple technique (bur-shaving) and complicate technique (osteotomy with/without bur-shaving). Also we suppose to classify aesthetic evaluation as usual “oval face (OF)” and exceeding “melon seed face (MSF)”.

Result: There were 115 cases (32.5%) have been operated by simple technique which reached OF in general, while all MSF (20%/71 cases) have been operated by complicate technique which involving zygoma arch reduction and mandibular body reduction. Complication was noted increasingly in complicate technique such as mental nerve damage, condyle fracture, masseter weakness/rigidity, rough edge of facial contouring, and so on.

Conclusion: It is necessary to take care of using complicate technique esp. for MSF.

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A Modified Reduction Malarplasty for Prominent Zygomatic Body and Arch

Presenter: Lu Yang

Authors: Yang L, Teng L, Lu J, Xu J, Zhang C

The second Department of CranioMaxilloFacial Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College

Background: Prominent zygomatic body and arch is considered and perceived aesthetically unfavorable and unattractive by Orientals. Nowadays, to improve the aesthetics of prominent zygoma, the number of patients who underwent reduction malarplasty is increasing rapidly. The purpose of the study is to provide a modified surgical procedure with small wound and good effects for malar reduction.

Methods: Records in this report included 72 patients with prominent zygomatic body and arch treated between September 2013 and February 2015 in our center. The surgical procedure was combined with intraoral and extraoral approaches. An intraoral mucosa incision and a minor preauricular incision were made, and 2 oblique osteotomies were performed to the anterior and posterior part of the malar complex respectively. The zygomatic arch segment was drawn upward and internal fixed to prevent cheek drooping. The anterior end of the isolated zygoma segment was then pushed and slid to the target position and internal fixed.

Results: All patients' mid-face appearance were effectively improved by the modified procedure. All patients were basically satisfied with the postoperative appearance. No visible scars left on the preauricular area. One patient had infection, one had nonunion, and one had zygomatic asymmetry. No other serious complications were observed during the follow-up period. The internal fixation was suggested to be removed in more the 9 months.

Conclusion: The modified surgical procedure utilizing 2 oblique osteotomies had no segmental bone removal and the isolated zygoma segment was easily reshaped and fixed. A favourable face contour could be maintained. Therefore, it is an effective and safe surgical procedure for reduction malarplasty.

284-^a**Orthognathic Surgery combining with Facial Bone Contouring Surgery**

Presenter: D.B. Yang

Authors: Yang DB¹, Yang JH²¹D.B. Yang Plastic Surgical Clinic, Korea, ²Jelim Plastic Surgical Clinic, Korea

Aesthetic orthognathic surgery, by definition, excludes congenital and syndromal condition that affect the maxillo-mandibular complex that is facial clefting, hemifacial microsomia and secondary traumatic deformities (Rogen. Mathes).

North East Asians are relatively common in brachycephalic type compared to Caucasians. To reduce facial width, we should control bizygomatic width, bigonial width, state of the mentum and maxillary height. To control maxillary height for the cases of short face, long face and asymmetrical face without orthodontic treatment, we should do rotation of the maxillomandibular complex to correct facial bony proportions aesthetically. Rotation of the maxillo-mandibular complex includes clockwise rotation, counter-clockwise rotation, rotation on the horizontal plane and their combination type.

We will present these items including surgical techniques, problems, photographs, radiographs, 3DCT and soft tissue changes.

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Clockwise and counterclockwise Le Fort I movements influence nasolabial morphology differently.

Presenter: Rajendra Sawh-Martinez

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Purpose: Le Fort I advancement impacts nasal appearance. However, no data exists assessing 3D nasal change following anterior (counterclockwise, CCW) or posterior maxillary impaction (clockwise, CW) during Le Fort I osteotomy. The purpose of this study was to analyze nasolabial changes comparing CW to CCW maxillary movements.

Materials and Methods: This was a retrospective cohort study of patients undergoing single-piece Le Fort I advancements. Patients were split into two groups: CCW and CW. Pre- and postoperative 3D photographs (Canfield, Fairfield, NJ) were captured and anthropometric measurements were performed (>6mo postoperative). Two observers verified each landmark. Statistical analysis involved paired *t* test for comparison of numerous pre- and postoperative nasolabial measurements for each patient in each group.

Results: Thirty patients were evaluated, 15 per group. CCW had statistically significant increases in alar width (3.6mm, $P < 0.001$), alar base width (1.6mm, $p = 0.009$), oral width (3.1mm, $P = 0.02$), and lip projection (+3.3mm, $P = 0.04$). The subnasion projection (2.3mm, $p = 0.08$) and columella width (0.58mm, $P = 0.9$) demonstrated trends toward significant increases. There were decreases in the nasofrontal angle (-3.05mm, $p = 0.10$), nasolabial angle (-3.2mm, $p = 0.5$), nostril height (-0.68mm, $p = 0.24$), columella height (-0.11mm, $p = 0.88$), philtrum height (-0.08, $p = 0.94$) but these did not achieve statistical significance. CW changes were not statistically significant. However, the largest changes in positions were noted in alar width (2.7mm, $p = 0.07$) and alar base width (1.7mm, $p = 0.09$). Decreases in the nasofrontal angle (-2.36, $p = 0.37$), nostril height (-0.9mm, $p = 0.09$), and columella height (-0.8mm, $p = 0.31$) were noted.

Conclusion: 3D nasolabial changes are more marked for CCW movements. This study suggests that soft-tissue nasolabial changes following Le Fort I are more complex than previously thought, and occlusal plane alteration significantly influences nasal form.

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Multiple-wall orbital decompression to reduce exophthalmos in Graves' disease

Presenter: Hans-Peter Howaldt
 Authors: Howaldt H, Wilbrand M, Streckbein P, Wilbrand J

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Objective: Graves' disease can lead to severe exorbitism with significant aesthetic and functional impairment to the affected individuals. Next to medication and radiation, the surgical decompression of the orbit with fat reduction still remains highly effective in reducing exophthalmos.

Material and Methods: 44 Patients were orbitally decompressed as described by Matton in 1991 for exophthalmos in Graves' disease. Pre- and postoperative Naugle-measurements were taken. Diplopia was evaluated pre- and postoperatively and finally Patients were asked to provide a questionnaire regarding the perioperative course and Quality of life.

Results: In all Patients, exophthalmos was clearly improved by surgical orbital decompression of two or three orbital walls and limited reduction of orbital fat. Indication for orbital decompression was seen in 90% for aesthetic reasons and only in 15% for degradation of vision. Diplopia resolved in 26% of cases. 45% of Patients had no diplopia pre- and postoperatively. Patient's satisfaction was as high as 88% after surgical reduction of exophthalmos.

Discussion: Surgical decompression of two or three orbital walls should be performed before radiation. Bearing limited surgical effort and risk, a high number of Patients with Graves' disease can benefit from the Matton-Operation.

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Antibiotic Use in Palatoplasty: A Survey of Practice Patterns, Assessment of Efficacy, and Proposed Guidelines

Presenter: Joseph E. Losee
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Background: The literature provide no guidelines for antibiotic use in primary palatoplasties. This study group sought to ascertain current practice patterns, review a large, single-surgeon experience, and propose guidelines for the thoughtful antibiotic use in primary palatoplasty.

Methods: A six-question survey was emailed to all surgeon members of the ACPA. A retrospective study was conducted of the senior author's 10-year primary palatoplasty series. Two groups were studied. Group 1: received no antibiotics. Group 2: received preop and/or postop antibiotics.

Results: 312 of the 1115 surgeons (28%) responded to the survey. 85% of respondents administer prophylactic antibiotics. 26% use a single preoperative dose. 23% give 24 hours of postoperative therapy; 12% use 25-72 hours; 16% use 4-5 days; and 12% use 6-10 days. 5% of surgeons give penicillin, 64% give a first generation cephalosporin, 13% give ampicillin/sulbactam, and 8% give clindamycin.

Of 311 patients, 173 received antibiotics and 138 did not. Delayed healing and fistula rates did not differ between groups: 13.3% vs 10.9% (p=0.71) and 2.3% vs 1.4% (p=0.47). One patient received no preop antibiotic, and developed postop Group A streptococcal bacteremia. The case did not meet the CDC definition of a surgical site infection, but the patient developed a palatal fistula.

Conclusion: Antibiotic use in primary palatoplasty varies widely. Our data supports a clinician's choice to forego prophylactic antibiotic use; however, given the significance of palatal fistulae, and our case of postoperative streptococcal bacteremia, the study group recommends a single preop dose of ampicillin/sulbactam. Protracted antibiotic regimens are not justified.

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Treacher Collins Syndrome: Clinical outcomes of cleft palate repair

Presenter: Etoile LeBlanc

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Background: Clinical outcomes of palatoplasty have been well described in non-syndromic patients. In patients with Treacher Collins Syndrome (TCS), outcomes are more difficult to predict. We present clinical outcomes in the surgical management of cleft palate in TCS.

Methods: A 30 year, single institution retrospective review was undertaken of all patients with TCS and cleft palate. Patient demographics and outcome variables included: length of stay, perioperative complications, unplanned readmissions, presence of a tracheostomy after repair and need of distraction. Speech variables included velopharyngeal insufficiency (VPI), articulatory and resonance quality.

Results: 58 total patients were identified: 25 (43%) had a cleft palate; 9 (15.5%) underwent palatoplasty at our institution. The mean age of repair was 24.4 months (13-80), follow-up time, 7.6 years (1-16) and average length of stay, 2.2 days (1-5). Pruzansky mandible types were: IIA 1/9; IIB 6/9; III 2/9. Three patients' underwent bilateral mandibular distraction *prior* to palate repair, one patient required repeat distraction and one required bone grafting. There were no peri-operative complications or unplanned re-admissions. A third of patients were eventually de-cannulated. After palate repair, all nine patients presented with sound errors consistent with the anatomical anomalies and a combination of mixed resonance. Five patients (55%), presented with hypernasality. One of the five patients with hypernasality had structurally based VPI requiring a pharyngeal flap, while the remaining 4 patients had articulatory based VPI which did not require surgical intervention.

Conclusions: Patients with TCS and cleft palate are typified by late palatoplasty, and higher incidence of sound and resonance disorders than the isolated cleft palate population. The incidence of VPI is higher than the isolated cleft population; however the majority of VPI is articulatory based and not amenable to more surgery.

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Intrinsic and Extrinsic Dental Predictors for Maxillary Hypoplasia and Le Fort I Advancement in Cleft Patients

Presenter: Han Hoang

Authors: Hoang H¹, Willson T¹, Pfaff M¹, Martz MG², Bradley JP³, Lee JC¹

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Background: Severe maxillary hypoplasia in cleft patients is caused by a combination of pathogenic and iatrogenic factors. In this work, we evaluated the anatomic deficiencies and manipulation of dentition for predicting Le Fort I maxillary advancement surgery for severe maxillary hypoplasia in cleft patients.

Methods: Cleft lip/palate and cleft palate patients older than 14 years of age were reviewed for demographics, dental anomalies, orthodontic canine substitution, and Le Fort I advancement. Chi square tests, t tests, and multivariate logistic regression analyses were performed to delineate the contribution of quantity and position of dental agenesis to maxillary advancement surgery.

Results: In the 114 patients reviewed (mean age 19.2 years), 64.0% were male, 71.9% had dental agenesis, and 59.6% required Le Fort I advancement. In patients who did not exhibit dental agenesis, 18.8% required Le Fort I advancement versus 74.4% of patients with dental agenesis ($p < 0.0001$). Le Fort I advancement surgery was increased to 76.3% when dental agenesis was at the lateral incisor position ($p < 0.0001$) and 86.4% when patients were missing two or more teeth ($p < 0.0001$). Both SNA ($p = 0.003$) and ANB ($p = 0.04$) measurements were decreased in patients missing dentition at the lateral incisor position. Multivariate logistic regression analyses demonstrated that both lateral incisor agenesis and orthodontic canine substitution are an independent predictors for Le Fort I advancement surgery (OR 4.4, CI 1.42-13.64, $p = 0.01$; OR 5.6, CI 1.64-19.18, $p = 0.006$).

Conclusions: Dental contributions to maxillary hypoplasia in cleft children stem from both intrinsic and extrinsic factors. Lateral incisor agenesis correlated to maxillary hypoplasia and independently predicted the need for Le Fort I advancement in cleft patients, potentially as an anatomic readout of intrinsic growth deficiency. In addition, orthodontic cleft closure using canine substitution was strongly associated with maxillary hypoplasia and subsequent Le Fort I advancement. We suggest systematic criteria for management of cleft related dental agenesis.

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UCLP POST-NASAL MOLDING TREATMENT NOSTRIL SIZE: COMPARISON BETWEEN TREATED & UNTREATED PATIENTS

Presenter: Patricia H. Glick

Authors: Glick PH¹, Icely J², Muller C¹, Kothari H¹,
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The purpose of this study was to evaluate the change in the nostril length post-nasal molding, in a sample of infants with unilateral cleft lip and palate (UCLP). The authors aimed to assess the post-nasal molding differences in nostril size and contrast it to the results of their pre-treatment study that determined that the cleft side nostril is 37% longer than the non-cleft side nostril in an untreated sample. The goal of nasal molding treatment in infants with a UCLP is to affect a conformational change without increasing the nostril size. Opponents of nasal molding claim that molding can create a “mega-nostril”. This data will be useful to better inform families consenting to treatment and to help establish realistic treatment expectations.

The participants in the study were selected from a retrospective chart review of nasal molding treated, photographed infants with UCLP. Nasal molding treatment consisted of custom nasal molding devices, secured vertically to the forehead, along with taping of the lip. Photographs of the inferior view of the nose were utilized, as they provide the maximum amount of information about the cleft nose deformity, the level of the alar domes, the slope of the alar borders, and the length of the nostrils. Using the ImageJ software (available from the NIH), measurements of the perimeter of the nostril on the cleft side and the non-cleft side were compared. Three researchers measured each photograph twice, at least twenty-four hours apart. Statistical analyses between cleft side and non-cleft side nostril size was performed using a mixed effects linear model.

The perimeter of the cleft side nostril was on average 30% greater than the non-cleft side. The pre-treatment study noted that the cleft side nostril was on average 37% greater, indicating a post molding decrease of 7%. This data shows that careful molding does not lengthen the cleft side molded nostril. Symmetry can be improved without the negative consequences of lengthening.

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SPEECH OUTCOMES FOLLOWING CLINICALLY INDICATED POSTERIOR PHARYNGEAL FLAP TAKEDOWN

Presenter: Joseph Losee

Authors: Losee JE, Katzel EB, Sameer S, Sanjay N,
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Background: Velopharyngeal insufficiency (VPI) affects as many as 1/3 of patients following cleft palate repair. Correction using a posterior pharyngeal flap (PPF) has been shown to improve clinical speech symptomatology; however, PPFs can be complicated by hyponasality and obstructive sleep apnea (OSA). The goal of this study was to assess if speech outcomes revert following clinically indicated PPF takedown.

Methods: Our database was retrospectively queried to identify patients with a diagnosis of VPI treated with a PPF who ultimately required takedown. Using the Pittsburgh Weighted Speech Score (PWSS), pre-operative scores were compared to those following PPF takedown. Outcomes following two different methods of PPF takedown (PPF takedown alone or PPF takedown with conversion to Furlow Palatoplasty), were stratified & cross compared.

Results: 64 patients underwent takedown of their PPF. 18 underwent PPF takedown alone, and 46 underwent PPF takedown with conversion to Furlow Palatoplasty. Patients averaged 12.4(SD: 3.9) years of age at the time of PPF takedown. Demographics between groups were not statistically different. The mean duration of follow up after surgery was 38.1(SD: 27.8) months. For patients undergoing PPF takedown alone, the mean pre-operative and post-operative PWSS was 3.8 (SD: 6.1) and 4.1(SD: 5.3) respectively (p=0.89). The mean change in PWSS was 0.3(SD: 4.3). For patients undergoing take down of PPF with conversion to Furlow Palatoplasty, the mean pre-operative and post-operative PWSS was 6.2(SD: 6.7) and 3.1(SD: 4.1) respectively (p<0.01). The mean change in PWSS was -3.3 (SD: 4.3). For all patients, the mean pre-operative PWSS was 5.7 (SD: 6.6) and 3.4 (SD: 4.5) respectively (p<0.05). The mean change in PWSS was -2.3 (SD: 5.7). There was no statistically significant regression in PWSS for either surgical intervention.

Conclusions: This study presents a quaternary care institution’s 20 year experience in critically analyzing speech changes after clinically indicated PPF takedown. Not only does the study quantify speech changes using the validated PWSS, but it also demonstrates the efficacy of performing PPF takedown procedures in the treatment of PPF-related OSA. Neither PPF takedown alone nor PPF takedown with conversion to Furlow palatoplasty negatively affects speech outcomes.

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Modified two-flap palatoplasty for cleft palate in Japanese.

Presenter: Yasuyoshi Tosa

Authors: Tosa Y, Kuroki T, Sato N, Kusano T,
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Background: The objectives of the palatoplasty for the treatment of cleft palate are to prevent maxillary retrognathia and maintain normal occlusion enabling normal speech. We reported a modified Veau-Wardill-Kilner method palatoplasty applying the artificial dermis with the mucoperiosteal flap in 2006. For cleft palates extending to the anterior part of the hard palate, however, pushback palatoplasty results in fragile portion of only one layer in the mucoperiosteum of the anterior hard palate. Therefore, we applied two-flap palatoplasty covering the fragile portion with the self-tissue together with intravelar veloplasty detaching and mobilizing muscle sling and z-plasty in the nasal mucosa.

Methods and Results: A modified two-flap palatoplasty has been applied for patients with cleft of the soft and hard palates. In this surgical procedure, the anterior portion of the hard palate is covered with the mucoperiosteal flap of the hard palate and the cleft is closed with the z-plasty in the nasal mucosa.

Discussion: Palatoplasty technique has been developed and improved by forming nearly normal anatomical structure to obtain normal speech capability, maxillomandibular relation, occlusion and dentition. Regarding language evaluation following palatoplasty, the initial group of this method of palatoplasty has reached the age of four. In the future, I think that evaluation is needed at the stage when the follow-up period and the number of cases have increased. Regarding the growth of maxilla, I will show a cephalogram of the initial patient who is age 5 years and 10 months. The maxilla and occlusion have followed a favorable course. Long-term follow up as well as selection of appropriate procedure based on the size of the cleft is crucial to achieve favorite prognosis. We report a modified two-flap palatoplasty strengthening the fragile portion of the anterior hard palate resulted from Veau-Wardill-Kilner palatoplasty method. The modified two-flap method was introduced in earnest in 2010.

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Post-operative Hypertrophic Scarring after Primary Lip Repair, Could Race be a Single Predictor?

Presenter: Solomon Obiri-Yeboah

Authors: Obiri-Yeboah S^{1,2}, Catignani C¹, Grant JH¹
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Background: Following cleft lip repair, Hypertrophic scarring (HTS) is a relatively common late post-operative complication ranging from 1% to 50% often requiring a surgical revision. According to the literature, Blacks and African Americans have a higher risk of HTS followed by Asians, Hispanics and Caucasians. In this review we sought to test the hypothesis that race alone was a predictive factor for HTS formation and hence, a need for revision cheiloplasty.

Method: An IRB approved, retrospective chart review of a single surgeon's experience over a period of eight years was conducted. The charts of 262 patients with cleft lip with or without cleft palate who underwent primary cheiloplasty, using a single technique, between January 2005 to December 2012 were reviewed. Those who had revision surgery due to hypertrophic scarring were noted. Race and other demographic indices were also recorded. A correlation between race and the need for revision was analyzed using the SAS system.

Results: 262 patients with cleft lip +/- palate who underwent primary cheiloplasty were identified over a period of 8 years. The over all revision rate due to hypertrophic scar was 6.87%. The racial breakdown of our population was: Black N=38, Asian N=20, Hispanic N=16 and Caucasian N=176. The revision rates were: Black 7.89%, Asian 10%, Hispanic 12.5% and Caucasian 6.25%. The p-value for the correlation between Race and need for surgery was 0.63.

Conclusion: Our incidence of HTS scar formation of 6.87%, reflects the published range of 1% to 50%. While Caucasians had a lower propensity of hypertrophic scar formation, the difference by race in our study were far less than what is reported in literature. We were unable to demonstrate that ethnicity/race alone could be a statistically significant predictive factor. We suspect there is more to the individual genetic makeup than race alone contributing to adverse scar formation.

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Measuring Quality of Life in Adolescents with Cleft Lip and Cleft Palate

Presenter: Laura A. Monson
Authors: Monson LA, Lloyd MS, Hernandez C, Pickrel B, Buchanan EP, Khechoyan DY, Hollier L, Wilson K

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Background: The aim of this study was to objectively quantify the quality of life of adolescent patients with cleft deformity in relation to the severity of the initial cleft, their age, gender, socioeconomic status, ethnicity and presence of velopharyngeal insufficiency (VPI) of speech.

Methods: Children between 11 to 18 years of age with cleft lip or cleft lip and palate (but not cleft palate only) participated in answering two administered questionnaires-PROMIS (Patient Reported Outcome Measure Instrument System) and YQOL-FD (Youth Quality of Life with Facial Difference). PROMIS scored anxiety, depression and peer-relationships. YQOL-FD scored patients' perception of the quality of their peer relationships, the negative and positive consequences of facial deformity, presence of negative self image, social stigma and their ability to cope. Demographic data included age, gender, socioeconomic status based on zip code, type of cleft, ethnicity and presence of VPI. Statistical analysis was performed using the Kruskal-Wallis and Wilcoxin tests.

Results: A total of 106 children (52 female, 50 male) enrolled with 4 children having a unilateral cleft lip only, 28 children having bilateral cleft lip and palate and 74 having unilateral cleft lip and palate. The average age was 14.4 years (SD 2.4 years) with 58 Hispanic, 35 White, 7 Asian, 5 African American and 1 who declined reporting their ethnicity.

Females had a significantly higher scores than males in the following-Anxiety Score ($p=0.0004$), Depression Score ($p=0.0007$), Negative Consequences from having facial deformity ($p=0.0003$), Positive Consequences from having facial deformity ($p=0.0109$), negative self image ($p=0.0062$) and Stigma ($p=0.0008$).

Those with unilateral cleft lip only also had significantly higher scores in Negative Consequences from facial deformity ($p=0.0424$).

Conclusions: Females with cleft lip and palate have higher Anxiety and Depression scores as measured by this study with weaker evidence suggesting they also have a higher negative self-image, and associated social stigma.

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Secondary Speech Surgery in Older Children and Adolescents—Outcomes and a Decision-Making Algorithm

Presenter: Laura A. Monson
Authors: Monson LA, Wilson K, Hernandez C, Khechoyan DY, Buchanan EP, Lee E, Moore E
Texas Childrens Hospital, USA

Background: Secondary speech surgery in the cleft population can be a challenging surgical dilemma. Published reports of success rates after secondary speech surgery vary widely. The diagnostic workup and management of these patients has been little reported upon. The published literature is typically a single surgeon experience with a single technique, typically a pharyngeal flap.

Methods: One hundred and thirty children, aged 5-20 were evaluated by pre-operative speech assessment, nasoendoscopy, videoflouroscopy and/or nasometry. Children with and without associated syndromes were included. The children underwent either Furlow palatoplasty, posterior pharyngeal flap, sphincter pharyngoplasty or fat grafting of the pharyngeal wall by one of four surgeons. Technique of choice was decided upon based on pre-operative assessment in conjunction with our speech pathologist. Post-operative speech assessment was performed at least three months after surgery. Results were stratified based on underlying diagnosis, age at surgery, type of procedure and surgeon.

Results: The vast majority of children (95%) experienced improvement in VP function regardless of surgical technique, with 20% still remaining moderately to severely hypernasal. Older age, original diagnosis of cleft palate only and surgeon were all predictive of final outcome.

Discussion: Secondary speech surgery remains a difficult diagnostic and surgical problem in the cleft population. Careful pre-operative assessment is critical to success. We suggest a decision-making algorithm to guide the choice of surgical technique that factors in age and underlying diagnosis of the child.

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Extensive Gingivoperiosteoplasty—an Alternative to Alveolar Bone Grafting in Patients with Difficult Cleft

Presenter: Lu Ting-Chen

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Secondary ABG has been recognized as a standard operative method for cleft and palate reconstruction. If gingivoperiosteoplasty without cancellous bone chip can achieve a satisfactory bone formation, and with the potential benefit of decreasing donor site morbidity, can GPP replace secondary ABG in patients with unilateral complete cleft lip and palate? The aim of present study is to compare surgical outcome between secondary alveolar bone grafting (ABG) and gingivoperiosteoplasty (GPP).

The patients with cleft lip and palate at mixed dentition age from single surgeon were retrospectively reviewed, and **the mean follow up time was 49.44 months**. These patients accepted either secondary ABG or GPP. Forty-three patients accepted ABG(bilateral cleft: 16; unilateral: 27) while the rest twenty-four ones underwent secondary GPP(bilateral: 14; unilateral:10). We divided into three groups, group I was between ABG and GPP regardless unilateral or bilateral cleft. We compared bilateral cleft between ABG and GPP in group II while solely patients with unilateral cleft in group III. With pre-operative radiographic studies, including panoramic radiographs and medical CT; combined with complete preoperative orthodontic treatment, we evaluate the post-operative results by subjective response from the patients and objective radiographic data(including radiographic grading and bone thickness estimation). All patients will have medical CT taken before surgery and 6 month after surgery.

From 2001 to 2012, Sixty-seven cleft lip and palate patients were included, the mean age was 10.12 ± 0.98. The comparison of grading of alveolar bridging showed no significant difference between ABG and GPP in group I and II.(P value of group I:0.278;group II:1.0) (Fisher exact test for categorical variables).There's slightly much better bone formation of GPP in unilateral cleft patients(group III, P value: 0.036) No type IV ossification was found. The bone thickness estimation from medical CT also showed similar results between two operative methods.

Extensive gingivoperiosteoplasty can achieve similar effects as alveolar bone grafting with the potential benefits of less risk of bone graft infection and donor site morbidity and it's the major and profound benefit of this study.

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Pre-Surgical Nasoalveolar Molding for Cleft Lip and Palate: The Application of Digitally Designed Molds

Presenter: Gang Chai

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Background: We present a novel nasoalveolar molding (NAM) protocol by prefabricating sets of NAM appliances using three-dimensional (3D) technology.

Methods: Prospectively, 17 infants with unilateral complete cleft lip and palate underwent our protocol before primary cheiloplasty. An initial NAM appliance was created based on the patient's first and only in-person maxillary cast, produced from a traditional intraoral dental impression. Thereafter, each patient's NAM course was simulated using computer software that aimed to narrow the alveolar gap by 1mm each week by rotating the greater alveolar segment. A maxillary cast of each predicted NAM stage was created using 3D printing. Subsequent NAM appliances were constructed in advance, based on the series of computer generated casts. Each patient had a total 3 clinic visits spaced one month apart. Anthropometric measurements and bony segment volumes were recorded before and after each patient's treatment.

Results: Alveolar cleft widths narrowed significantly ($p < 0.01$), soft tissue volume of each segment expanded ($p < 0.01$) and the arc of the alveolus became more contiguous across the cleft ($p < 0.01$). One patient required a new appliance at visit two because of bleeding and discomfort. Eleven patients had mucosal irritation and two experienced minor mucosal ulceration.

Conclusions: 3D technology can precisely represent anatomic structures in pediatric clefts. Results from our algorithm are equivalent to traditional NAM therapies; however, the number of required clinic visits and appliance adjustments decreased. As 3D technology costs decrease, multidisciplinary teams may design customized NAM treatment with improved efficiency and less burden to medical staff, patients and families.

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Edge locked stitching with a mucochondrial Z-plasty in correction of unilateral cleft nasal deformity

Presenter: Yingzhi Wu

Author: Wu Y

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Background: Ala and nostril collapse are most raised complaints in secondary deformity of unilateral cleft patients. While a lot of techniques have been introduced so far, the purpose of this study was to evaluate the effectiveness of edge locked stitching between nostril ala and lateral cartilages with mucochondrial Z plasty to correct the collapse in lower lateral cartilage in the ala and nostril shaping.

Methods: 57 patients with unilateral cleft nasal deformities were recruited. They all had primary surgery before and were left with nasal deformities. Based on the anatomic understanding, we operated on all the patients using edge locked stitching between nostril ala and lateral cartilages with a mucochondrial Z-plasty to correct the abnormal lateral collapse of nostril deformities.

Results: All the patients had an improvement in the shape of the ala and nostril immediately after the surgery. Follow-up at six months (or later) showed no severe relapse.

Conclusion: The edge locked stitching between nostril ala and lateral cartilages with mucochondrial Z-plasty is effective to correct the ala and nostril deformities in unilateral cleft.

Key Words: edge locked stitching between nostril ala and lateral cartilages, secondary rhinoplasty; unilateral cleft; nasal deformity; Z-plasty

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Nasal Airway Patency Following BMP-2 Alveolar Cleft Repair

Presenter: Alexander Y. Lin

Authors: Lin AY^{1,4}, Goss JA², Hunter MS^{2,4}, Armbrrecht ES³

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Introduction: A former surgeon at our institution preferentially used bone morphogenetic protein 2 (BMP-2) when repairing alveolar clefts. Clinically, his patients appeared to have higher rates of postoperative nasal stenosis. Content analysis was undertaken on this cohort to determine if there is a causal relationship between BMP-2 use and postoperative nasal stenosis.

Methods: Patients were prospectively enrolled in our IRB-approved study to assess their clinical outcomes following cleft-craniofacial repair with BMP-2 by a former surgeon at our institution. Each of the patients' alveolar cleft surgeries was examined for postoperative outcomes by content analysis of our cleft team members' notes related to the immediately preceding surgery. Only patients with typical cleft lip-nose-palates and alveolar involvement were included. Nasal stenosis was defined as any mention of clinical signs of stenosis and all indeterminate responses were counted as no stenosis. Patients with nasal stenosis prior to their primary alveolar repairs were excluded.

Results: 60 consecutively enrolled patients underwent 115 surgeries that met our criteria: surgeries involving BMP-2 (BY) 48%, those without BMP-2 (BN) 52%. The average patient age at surgery in years was: BY 3.53, BN 3.43, P=0.890. The incidence of postoperative nasal stenosis was: BY 62%, BN 30%, *** P<0.001. Some surgeries involved a concurrent nasal repair with a frequency of: BY 69%, BN 32%, *** P<0.001. A logistic regression was run and indicated that BMP-2 status was a statistically significant predictor of postoperative nasal stenosis with an odds ratio of 3.49 (CI= 1.061, 11.459; *P=0.040. Neither concurrent nasal repair nor the interaction of BMP-2 and concurrent nasal repair were statistically significant predictors of postoperative nasal stenosis.

Conclusion: In patients for whom BMP-2 was used for alveolar cleft repairs, higher rates of postoperative nasal stenosis were observed. While, a greater proportion of these repairs also involved a concurrent nasal repair, a logistic regression showed that only the effect of BMP-2 status was a significant predictor of postoperative nasal stenosis. Given these findings, postoperative nasal stenosis should be discussed as a potential complication of BMP-2 alveolar reconstruction.

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INCIDENCE AND SEVERITY OF OBSTRUCTIVE SLEEP APNEA IN 1,020 CHILDREN WITH CLEFT-CRANIOFACIAL CONDITIONS

Presenter: Alexander Y. Lin

Authors: Lin AY^{1,2}, McGauley J¹, Goss JA¹, Boakye EA³, Hunter MS^{1,2}, Buchanan P³, Paruthi S^{1,2}

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Background: We characterized the degree and severity of obstructive sleep apnea (OSA) among our patients with cleft-craniofacial conditions.

Methods: Retrospective review of records from 2009-2014. Patients with polysomnograms (PSG) were included for analysis with descriptive statistics.

Results: Of 1,020 cleft patient records examined, 92 patients (51.1% male) had clinical symptoms warranting 115 postoperative PSGs. Average PSG age 6.3 years (SD 4.7). 105/115 (91.3%) had OSA defined by obstructive apnea-hypopnea index (OAH) >1. OAH histogram performed; ≤1: 10/115 (8.7%); >1, <5: 46/115 (40.0%); ≥5, <10: 30/115 (26.1%); ≥10, <15: 9/115 (7.8%); ≥15, <20: 4/115 (2.5%); ≥20, <25: 6/115 (5.2%); ≥25, <30: 4/115 (3.5%); ≥30: 6/115 (5.2%).

Syndromic association was 27/92 (29.4%). Robin sequence in 18/92 (19.6%). Procedures performed before each PSG: primary palatoplasty 11.3% (13/115), secondary speech surgery 31.3% (36/115), tonsillectomy or adenoidectomy 25.2% (29/115), takedown procedures 2.6% (3/115), and other procedures 40.0% (46/115). Median time until postoperative PSG 11.5 months (IQR 6.2-32.2).

Conclusions: Obstructive sleep apnea is a common finding in our patient population, with an incidence near 10%, compared to the published rate of 1-5% in the general pediatric population. The majority of these patients (40%) present with OAH between 1 and 5. Signs and symptoms of OSA should be elicited and further evaluated in children with cleft-craniofacial conditions.

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POSTOPERATIVE CLEFT POLYSOMNOGRAMS DO NOT SHOW SIGNIFICANTLY IMPROVED SLEEP PARAMETERS AFTER ADENOTONSILLECTOMY

Presenter: Alexander Y. Lin

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Background: The most common etiology for pediatric obstructive sleep apnea (OSA) is tonsillar or adenoidal hypertrophy. Children with cleft-craniofacial conditions have additional factors that lead to OSA. Postoperative cleft polysomnograms (PSG) were compared in adenotonsillectomy (AT) procedures versus non-AT procedures.

Methods: IRB-approved retrospective review from 2009-2014 for PSGs. Data was analyzed per procedure, with postoperative PSGs (before the next surgery if there was an additional surgery), and preoperative PSG if one existed. Continuous outcomes were compared with Mann Whitney U-tests, and categorical by chi-square or Fisher exact tests.

Results: 92 patients had a postoperative PSG after surgery, for a total of 115 postoperative PSGs. Of these postoperative PSGs, the procedure distribution was tonsillectomy (T) 5/115 (4.4%), adenoidectomy (A) 5/115 (4.4%), adenotonsillectomy (AT) 19/115 (16.5%). Postoperative OSA as defined by apnea-hypopnea index (AHI) >1: T 4/5 (80%), A 4/5 (80%), AT 18/19 (95%), P=0.2668. Total AHI median (IQR) was T: 4.1 (1.5-5.0), A: 4.2 (3.1-7.3), AT: 6.3 (3.6-12.9), P=0.4130. Obstructive AHI median (IQR) was T: 3.5 (1.3-4.5), A: 2.3 (1.9-6.9), AT: 6.0 (2.0-9.1), P=0.3677. Arousal index median (IQR) was T: 22.0 (13.4-22.2), A: 16.5 (11.0-23.0), AT: 14.9 (9.6-24.9), P=0.7449.

We then compared change between preoperative and postoperative PSGs. 30 patient procedures were associated with pre- and post-operative PSGs. 16 procedures were T, A or AT (TAAT), versus 14 non-TAAT procedures. Changes were measured as post-PSG minus pre-PSG. Median (IQR) AHI change was: TAAT 0.45 (-5.8-5.05), non-TAAT 0.6 (-13.0-1.9), P=0.5160. Median (IQR) obstructive AHI change was: TAAT 1.7 (-4.2-4.95), non-TAAT -0.5 (-11.3-2.5), P=0.2550. Median arousal index change was: TAAT -1.6 (-12.25-4.75), non-TAAT -1.85 (-12.9-1.2), P=0.6362.

Conclusions: TAAT procedures, hypothesized to improve airway patency in patients with cleft palates, were not associated with significant improvement in OSA when compared to other cleft procedures. We tentatively caution that TAAT procedures may not have a strong effect as we would expect, and in that scenario, teams may want to avoid adenoidectomy to avoid its risks of velopharyngeal insufficiency.

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The Application of Surgical Robotics in Craniofacial and Cleft Care

Presenter: Dale J. Podolsky
 Authors: Podolsky DJ^{1,2,3}, Fisher DM^{1,2}, Wong KW^{1,2},
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Background: The application of robotics in craniofacial and cleft care offers the potential for more minimally invasive techniques and improved access and visualization in confined spaces. Cleft palate repair is a challenging procedure due to the confines of the infant oral cavity and is therefore an ideal environment for robotic application. We propose developing a robotic approach to cleft palate repair using a phantom model.

Method: A cleft palate phantom was developed from an infant computed tomography (CT) scan. A computer model of a cleft palate, and oral cavity with palatal anatomy was produced using modeling software. A physical model was developed using 3D printing and silicone casting. The model was tested by staff plastic surgeons and fellows to assess validity. A workspace analysis was performed in MATLAB[®] using an anthropometric manipulator. The phantom was pilot tested using a da Vinci[®] Surgical System with 5 mm EndoWrist[®] instruments.

Result: A high-fidelity cleft palate phantom has been developed that simulates performing a cleft palate repair. Staff surgeons and fellows were successful in incising and elevating mucosal flaps, releasing the musculature and suturing the muscles and mucosa together. Workspace analysis demonstrated that a joint location proximal to the oral aperture would result in fewer robotic arm collisions. Pilot testing using the da Vinci[®] demonstrated successful elevation of the mucosa from the hard palate and musculature and suturing the muscles and mucosa together. However, frequent collisions between the patient-side-manipulators (PSM's) and between the EndoWrist[®] instruments and oral aperture made the procedure challenging.

Conclusion: Utilization of the da Vinci[®] Surgical System for cleft palate repair is feasible. However, modifications to the EndoWrist[®] instruments and optimization of the PSM positioning method will improve the safety and efficiency of the procedure.

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Practical Repair Method for Unilateral Cleft Lips: Straight-Line Advanced Release Technique

Presenter: Hobin Lee
 Authors: Lee H, Baek RM, Kim B
 Seoul National University Bundang Hospital, Korea

Background: Straight-line closure repair of unilateral cleft lips was first introduced in the 1840s, and since then, many different techniques have been attempted for cleft repair. However, these methods have several disadvantages and are difficult to adopt. In this study, we describe our novel technique, known as Straight-Line Advanced Release Technique (StART), and its application in treating several cases of unilateral cleft lip.

Methods: The preoperative design of the surgical method is drawn on the skin, the vermilion, and the oral mucosa. A total of 13 points are marked (points 0-12). The A flap, B flap, triangular flap, M (medial mucosal) flap, and L (lateral mucosal) flap are designed. After completion of the preoperative marking, the wide dissection is performed to separate the orbicularis oris muscle completely from the abnormally inserted bony structure and the enveloped skin-mucosal flap. The freed orbicularis oris muscle is then reconstructed with full width. After all planes of the lip wound are closed, a straight vertical skin suture line is achieved without any unnecessary transverse scar.

Results: Unilateral cleft lip repair using StART was conducted in 145 patients between 1993 and 2012. Cases of microform cleft lip were excluded. A total of 21 patients (14%) required a secondary operation on the lip after the first unilateral cheiloplasty. In all patients, satisfactory surgical outcomes were obtained with an indistinct straight-lined scar and a well-aligned lip contour.

Conclusions: To acquire a natural and balanced shape in unilateral cleft lip repair, we recommend the novel StART.

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Changes of the face after primary repair without repositioning the premaxilla in bilateral cleft lip

Presenter: Shunsuke Yuzuriha

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Purpose: It is a difficult and controversial issue how to treat protruding premaxilla in patients with bilateral complete cleft lip and palate. This study was performed to determine how facial appearance changes with age after primary synchronous bilateral nasolabial repair without repositioning the protruding premaxilla by presurgical nasoalveolar molding or vomer osteotomy.

Methods: Twenty-eight cases of bilateral complete cleft lip and palate and two cases of bilateral complete cleft lip and alveola were evaluated. Primary nasolabial repair was performed before 4 months of age in all cases. Cleft palate was repaired with modified two-flap palatoplasty at the age of one year several months. The length of the nasal dorsum (n-prn), height of the nose (n-sn), vertical length of the face (n-gn), vertical length of the upper lip (sn-ls), and columellar labial angle (nla) were measured on profile photographs of all patients at 5, 12, and 18 years old.

Results: The lengths of n-prn, n-sn, and n-gn increased with age. The sn-ls did not change with age. The nla became smaller with age.

Discussion: The protruding premaxilla causes a tip-up nose and long upper lip. These images of nasolabial appearances improved with age. The growth of the upper lip and maxilla including premaxilla was arrested in comparison with the mid-face, nasal dorsum, nasal septum, and mandibula. Premaxilla protrusion can gradually improve with age because of this facial growth pattern and the effects of therapies, such as orthodontic treatment and alveolar bone grafting.

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Cleft Patients Profile in the Cleft and Craniofacial Center Cipto Mangunkusumo Hospital, Indonesia

Presenter: Prasetyanugraheni Kreshanti

Authors: Kreshanti P, Handayani S

Cleft and Craniofacial Center Cipto Mangunkusumo Hospital-University of Indonesia, Indonesia

Introduction: The Cleft and Craniofacial Center at Cipto Mangunkusumo Hospital (Jakarta, Indonesia) was established in June 2011. It is a multidisciplinary service focusing on the management of patients with cleft and craniofacial deformities (congenital, trauma, tumor, vascular anomalies) of all ages. The services consist of outpatient clinics, dental clinics, and operating theaters. Cipto Mangunkusumo Hospital itself is the national referral hospital, serving patients from all over Indonesia.

Methods: This is a retrospective data analysis of all cleft patients presenting to the Cleft and Craniofacial Center who underwent cleft and cleft related surgery from January 2012 to December 2014.

Results: Of 658 cleft and cleft related surgery patients found in the database, 506 were primary surgeries, 136 were secondary surgeries, and 16 were facial cleft surgeries. Among the primary surgeries, lip repair had the highest numbers (53.2%), followed by palate repair (44.1%), and alveolar bone grafting (2.7%). The median age for the lip repair patients was 4 months (range, 10 weeks to 32 years), with almost equal gender distribution (male 135, female 134). Only 188 cleft lip patients (70.4%) were clearly described for the affected site in the database (left 45.7%, right 26.1%, bilateral 28.2%). Of all the 214 unilateral cleft lip patients, only 72.9% were clearly described for the extent of the cleft (complete 51.3%, incomplete 48.7%). Seventeen cleft lip patients (41% bilateral, 59% unilateral) underwent nasoalveolar molding prior to the lip repair. The median age for the palate repair patients was 16 months (range, 9 months to 40 years), with almost equal gender distribution (male 112, female 111). Among the secondary surgeries, rhinoplasty had the highest numbers (34.5%), followed by palate fistula repair (33%), scar revision (23.5%), and VPI surgery (3.7%).

Conclusions: Patients clinical characteristics in the Cleft and Craniofacial Center need to be recorded in a better database system. The cleft patients presenting to the Cleft and Craniofacial center were at the proper time for primary lip or palate repair.

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Global Online Training for Cleft Care—Analysis of International Utilization

Presenter: Roberto L. Flores

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Background: We present a first year report on the international utilization of a freely available, web-based surgical simulator which demonstrates the cardinal procedures in cleft lip and palate reconstruction. The purpose of this simulator is for delivery to underserved countries and use by local surgeons treating their cleft populations.

Methods: The Simulator (www.cleftsim.com) demonstrates six cleft surgery procedures in a multimedia fashion including voice-over, text and high definition (HD) intraoperative video. The unique Internet Protocol (IP) of each country accessing the Simulator was identified over a one year period. All users accessing the Simulator for less than 5 minutes were eliminated. The countries were analyzed based upon economic factors such as Gross Domestic Product (GDP) and per capita income (PCI).

Results: There were 849 novel users of the Simulator from 78 countries over the one-year study period, representing 6.28 billion persons or 88.5% of the global population. 54 countries were classified as developing economies, representing 5.3 billion people. The poorest developing countries accessing the Simulator in terms of PCI were Congo (\$400), Ethiopia (\$1,200), and Nepal (\$1,300). In terms of percent population living below the poverty line, Haiti (80%), Congo (71%) and Nigeria (70%) were the poorest nations. In developing countries, the health expenditures as a percentage of GDP averaged 6.1%. The Simulator was used in 21 countries with active armed conflicts and 28 where the US State Department advises against travel including Ukraine, Egypt, Yemen, Iraq and Nigeria.

Conclusion: The presented Simulator is accessible globally and is used in 78 countries representing 88% of the global population. Over 2/3rds of the countries accessing the simulator are developing nations and include regions experiencing severe poverty. International education of cleft care in the developing world should consider the use of web-based digital technology.

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Surgical Options in Adult Age Cleft Patients Who Have Been Operated In Childhood

Presenter: Fikret Eren

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Treatment of patients with cleft lip and palate is highly challenging and depend on many variables. Even with modern and the best treatment modalities, various kind of clinical sequel may exist in a different range when those patients grow up and reach adult age population. Additional negative parameters such as low socioeconomic level, lack of surgical and institutional experience, health system drawbacks may influence the success of treatment modalities and may increase the severity of problems in the adulthood.

Existing deformities in the adult age may be classified into three major groups: nose deformities, maxillary bone hypoplasia and upper lip deformities. Inevitable scar tissue contraction and fibrosis may alleviate the preexisting deformities.

Many patients with clefts may need surgical maxillary correction due to class III malocclusion. Problematic hypoplastic maxilla may cause deformities in the adulthood due to bone growth even if they are surgically corrected in childhood. Anyway, in the adulthood period of cleft patients, surgical interventions such as orthognatic surgery or maxillary distraction osteogenesis may be performed.

Adult cleft patients with various deformities may lose chance of corrections regarding to lack of surgeon's or institution's experience, high costs or long-lasting therapies such as orthodontics. This clinical case series was designed to bring an easier, effective and relatively inexpensive way of surgical options. Using the basic approaches of plastic surgery, many important corrections can be achieved in case of unavailability of a qualified maxillofacial surgery center or a patient's will about having an easier operation.

In ten patients, a combined correction and revision surgeries in the same session were performed including a septorhinoplasty with a columellar lengthening by a V-Y advancement flap, dermofat graft to increase the projection of cutaneous segment of upper lip and Abbe flap to increase the defective vermilion.

In conclusion, when the facts are not appropriate for conventional surgical approaches, there still exist some procedures to be performed not for functional correction, but for aesthetic improvement.

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Integral Treatment of primary cleft palate: Anatomical Nasal Floor Closure and Modified Millard II Cheiloplasty.

Presenter: Rogelio Martínez-Wagner

Authors: Martínez-Wagner R, Pérez-González A, Gutiérrez-Valdez DH, García-García F

*Plastic and Reconstructive Surgery Department. Hospital General Gea González, Mexico***Introduction:** This congenital malformation represents a critical situation because of the high incidence, the clinic diversification and the amount of Interdisciplinary Treatments.**Objective:** Present functional (reduction of vestibular fistula) and aesthetic outcomes (lip and nose symmetry), in the integral treatment of the primary cleft palate obtained with the Anatomical Nasal Floor Closure Technique and Modified Millard 2 Cheiloplasty.**Methods:** During 5 years, 320 procedures were made. All the patients with Unilateral Cleft Lip diagnosis admitted at the Hospital General "Dr. Manuel Gea González", Brimex Clinic of the ABC Medical Center and in the Outdoor Surgery Programs were included. The age ranges from 3 months to 3 years. The Modified Millard 2 Cheiloplasty and Anatomical Nasal Floor Closure Technique was made in the same surgery. The medical follow up consisted in clinic and photographic evaluation, it was made at 3 and 6 months and annually.**Results:** 320 patients were included. The surgery consisted in Rotational and advancement flap cheiloplasty, Anatomical nasal floor closure technique as a continuation of the "C" flap described by Millard, release of columnella's orbicularis oris muscle anomalous insertions and alar cartilage in the cleft side and columella elongation. The average follow up was 3 years. We observed a decrease in the sequelae rate, including vestibular fistula, and an improvement in the aesthetic results.**Conclusions:** Using the Anatomical Nasal Floor Closure Technique we didn't find oronasal fistula and the aesthetic results improved, including nasal base and tip symmetry and minimal nostril asymmetry; therefore decreasing revision surgeries.

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Facial Infiltrating Lipomatosis Contains Somatic PIK3CA Mutations in Multiple Tissues

Presenter: Javier A. Couto

Authors: Couto JA, Vivero MP, Maclellan RA, Upton J, Padwa BL, Warman ML, Mulliken JB, Greene AK

*Dept. of Plastic and Oral Surgery, Boston Children's Hospital, Harvard Medical School, USA***Background:** Facial infiltrating lipomatosis (FIL) is a rare congenital disorder that causes overgrowth of one side of the face, that can include premature dental eruption, hemimacroglossia, macrodontia, and mucosal neuromas. We recently reported that affected subcutaneous adipose tissue in patients with FIL contains mutant cells with somatic gain-of-function mutations in *PIK3CA*. The purpose of this study was to determine whether other affected tissues in FIL also contain mutant cells.**Methods:** We obtained FIL tissue from 2 patients during a clinically-indicated procedure. We isolated skin, subcutaneous fat, muscle, buccal fat, and mucosal neuroma tissues, and cultured CD31⁺ endothelial cells. We then performed droplet digital PCR (ddPCR) on DNA from each tissue and the cultured endothelial cells to determine the frequencies of *PIK3CA* mutant alleles in the different tissues.**Results:** In one FIL specimen we identified a p.H1047R mutation that was present at allele frequencies of 5.5% in skin, 17.6% in subcutis, 23.2% in buccal fat, 12.5% in mucosal neuroma, and 1.2% in endothelial cells. In a second FIL specimen, we identified a p.H1047L mutation that was present at allele frequencies of 5.6% in muscle, 16.2% in subcutis, and 1.5% in endothelial cells.**Conclusions:** Cells containing *PIK3CA* mutations are present in several different tissues that are affected in FIL. These data are consistent with the mutation arising in an early pluripotent cell gives rise to several different tissue types in the face, rather than the mutation arising in only one cell type and causing overgrowth of surrounding tissues via paracrine signaling.

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Complication rate and bone regenerative effects from using calcium phosphate-based implants in cranial repair

Presenter: Thomas Engstrand
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Background: Autologous bone or inert alloplastic materials are today utilized in cranial reconstructions. These methods are associated with resorption, infection and extrusion, which may limit their use in difficult cases. As alternative, a bioactive scaffold with unique calcium phosphate composition has been developed for the repair of large cranial defects. The primary objective of the study was to determine complication rate, as defined as number of explantation due to infection and/or extrusion (N=75). The secondary objective was to uncover comprehensive evidence of bone formation induced by the implant in two patients.

Method: Seventy-five patients with various cranial defects were treated and recorded in a register. The follow-up time was 1-60 months. In two patients the implants were either replaced due to aesthetical concerns or surgically exposed for the removal of fixating titanium plates, respectively. Biopsies were taken 9 and 50 months after surgery for gene expression analyses and histological examinations. Informed consent was obtained with signed approval to take perioperative biopsies.

Result: The explantation rate was 7% in a cohort where approximately 40% of treated patients had a history of previously failed autologous bone flaps or conventional implants (PMMA, titanium, polyethylene). Early failures with postoperative infection occurred in 5 cases whereas beyond 3 months of surgery there has been no incidence of complication necessitating explantation. In one patient, 9 months postoperatively, gene expression analyses revealed expression of osteocalcin, collagen type I, osteopontin, calcitonin receptor, and cathepsin K within the reconstructed area whereas runx2 expression was low. In another patient, 50 months postoperatively, the reconstructed area appeared with bleeding bone. Histological examination confirmed vascularized compact bone.

Conclusion: Seven percent explantation rate of ceramic cranial implants was recorded in this study, all of them due to early postoperative infections. We hypothesize that the process of new bone formation induced in situ by the ceramic implant may contribute to reducing the number of postoperative complications, especially late-onset weakening of covering soft tissue leading to extrusion.

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Voice Disturbance and Dysphonia in Craniofacial Population

Presenter: Scott Rickert
 Author: Rickert S
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The heterogeneous nature of craniofacial anatomy yields a wide range of airway/vocal tract anatomy compared with norms. When craniofacial patients are noted to have voice disturbance, it is routinely diagnosed as dysphonia and assumed to be hypernasality or hyponasality. True dysphonia (vocal fold pathology) is not thoroughly evaluated.

Most craniofacial patients have multiple surgeries--craniofacial, cardiac or cervical/thoracic. Given the number of surgical procedures, there is a high chance for iatrogenic causes of dysphonia.

This study hypothesizes is that dysphonia is generally underreported in the craniofacial population and that many craniofacial dysphonic issues may be iatrogenic. Furthermore, QOL studies can help guide investigation of dysphonia.

This study followed all craniofacial patients evaluated over a 4 year period at a tertiary center (2010-2014). All patients were evaluated for airway/voice issues to determine the nature of the voice disturbance (hypernasality, hyponasality, dysphonia). The true percentage of dysphonia was then evaluated for cause and compared to subgroups and general norms (using the pediatric Voice Handicap Index).

366 consecutive non-trached craniofacial patients were evaluated by one surgeon (SMR). 280 were referred for airway/voice issues. 68 had no voice complaints (craniofacial normals) and 212 were referred specifically for dysphonia. All were evaluated with pVHI and videostroboscopy. The mean age was 6.4 (M/F=47/53).

The prevalence of dysphonia in CF patients: 41/366=11.2% which is higher than the 6-9% in normals. pVHI is higher in craniofacial patients than normative data (3.95 +/- 1.39 vs. 1.85). pVHI greatly depended on cause of voice disturbance: Dysphonia: 26.30 +/- 4.77, Hypernasality: 11.34 +/-2.42, Hyponasality: 10.21 +/- 2.21. There was noted statistically significant difference between: Craniofacial Dysphonia, Craniofacial Hyponasality, Craniofacial Hypernasality, and Craniofacial 'normal voice' vs. normal voice. The potential Iatrogenic causes of dysphonia was noted to be 49%.

The prevalence of craniofacial dysphonia is underreported and iatrogenic causes are most likely a significant factor secondary to multiple surgical interventions. QOL studies (pVHI) can be helpful to evaluate causes and potential treatment options.

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THE TREATMENT OF ARRHINEA

Presenter: José Rolando Prada

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The arrhinea is a very rare pathology with an incidence of 1 in 20,000 to 40,000. We classify it as Hemiarrhinea, Arrhinea and Total or complete Arrhinea. Although this disease requires multiple surgical procedures; the gold standard reconstruction consists of a Le Fort III osteotomy and nasal reconstruction. The variable expression of this pathology and the referral to a physician in different periods of life, requires the treatment to be adjust to each patient. In general we have two lines of treatment:

The first one, is when patients arrive in an early age. In these patients we perform a nasal reconstruction with a pre expanded forehead flap preserving the contralateral pedicle for a second reconstruction. A distraction of a LeFort III osteotomy including a distraction of the nasal bones or the area around the nasal dorsum. We finished the treatment with the second nasal reconstruction when the craniofacial growth has been completed.

The second line of treatment applies to patients who arrive in later childhood or during adolescence. In these patients we perform a LeFort III osteotomy with distraction including the nasal area; and the final nasal reconstruction is done when their growth has been completed.

The Hemiarrhinea in most of the cases requires only the nasal reconstruction. When the craniofacial complex is compromised we treat these patients as we treat an arrhinea following one of the two lines of treatments previously explained according to the age of the patients.

In this presentation we show you clinical cases of these pathology.

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Successful Reconstruction of Agnathia

Presenter: Kunihiro Ishida

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Background: Agnathia is an often lethal, very rare congenital malformation characterized by absence of the mandible and the tongue. Although long term survival cases have been rarely reported, no successful surgical reconstruction has been described yet. The world first successful surgical reconstruction case of a 9-year-old boy with agnathia will be presented.

Case Presentation: A 9-year-old mentally retarded boy with agnathia who is tracheostomy and gastrostomy dependent has been successfully reconstructed by tissue expansion of the oral lining and the submandibular skin followed by free vascularized fibula flap reconstruction. After the reconstruction his mother said that he can show his feeling with facial expression, which he was never able to use before surgery.

Discussion: To reconstruct the agnathia defect, in addition to reconstruct the bony structure, the oral lining and the overlying soft tissue need to be reconstructed. Ideally the overlying soft tissue should be in good color and texture match with the surrounding facial skin and the utilization of tissue expansion technique is preferable. However, because of significant tissue deficiency, subcutaneous insertion of a tissue expander between the overlying skin and the oral lining is very difficult and prone to exposure. To solve this problem, a tissue expander was inserted intra-orally and the simultaneous expansion of the oral lining and the overlying skin became possible. After the successful tissue expansion, the bony structure was reconstructed by free vascularized fibula flap with the skin paddle placed in the submandibular area, which was later de-epithelialized and buried in front of the newly reconstructed symphysis simulating a chin projection.

Result: He is now 13 years old, two and a half years after surgery. In Okinawa they celebrate 13-year-old-celebration with a traditional Okinawan clothes and a hat with a chin strap. His mother was very happy showing a photograph of her son wearing a traditional Okinawan hat with a chin strap under his chin.

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CSF leaks for the craniofacial surgeon: a review and management algorithm

Presenter: David Harter

Authors: Harter D¹, Golinko MS², Staffenberg D²

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Craniofacial surgeons routinely perform operations that involve exposure of the dura. Typical procedures include cranial vault remodeling (CVR), fronto-orbital advancement (FOA), Le Fort III, monobloc, and bipartition advancement. Cerebrospinal fluid (CSF) leaks of some kind remain on one of the most common complications craniofacial surgeons encounter, occurring in up to 30% of patients. CSF leaks can be encountered in the intra-operative setting, acute or late post-operative period. Traditional management has been well described in the neurosurgical and trauma literature. While several good studies of the complications of the aforementioned procedures exist, there is lack of a focused treatment of CSF leaks written for craniofacial surgeons. We will review current literature and use illustrative case studies to describe a useful management algorithm for the craniofacial surgeon to consider in clinical practice.

We review the last 30 years of experience at our institution and review the current literature. Nine articles were selected and findings summarized. The mean rate of CSF leak was 11.2% (1.1%-30%); leak rates tended to be lower for FOA/CVR, mean of 5.5%.

We use three case reports to highlight our management algorithm for CSF leaks. While the majority of leaks resolved spontaneously, those persisting for more than 48 hours or in symptomatic patients, prompted placement of a lumbar drain. Failure of the leak to resolve with extra-dural drains within 72 hours, prompted exploration and treatment which could include fibrin glue, an acellular dura patch, pericranial flaps, pericranial grafts, and/or endo-nasal repair with septal flaps.

CSF leaks remain one of most common complications craniofacial surgeons encounter. This may lead to more significant morbidity or mortality. Although neurosurgery is often part of the treatment team, craniofacial surgeons should be comfortable with all aspects in the treatment algorithm. Prompt diagnosis and appropriate management of CSF leaks is necessary to minimize the risks associated with such leaks.

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Midline and Non-midline Craniofacial Dermoids: The Liverpool Experience

Presenter: Ben Robertson

Authors: Robertson B, Scrimshire A, Vaiude P, Nelson K, Cleator A, Brannigan K, Duncan C

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Aims: To review imaging, surgical findings and complications of craniofacial dermoids based on our experience in a supra-regional craniofacial centre.

Methods: Retrospective review of all patients undergoing craniofacial dermoid excision between 2006-2012.

Results: 95 patients with mean age of 29.6 months were reviewed. 32 were midline, 63 non-midline.

In the non-midline cohort 52 were external angular, 9 temporal and 2 occipital.

On imaging 3 temporal dermoids were found to have intracranial extension, requiring transcranial excision.

In the midline cohort 16 were nasal, 12 glabellar, 3 anterior fontanelle and 1 occipital. 11 had intracranial extension needing transcranial excision; all were identified using CT, MRI or both.

Sensitivity and specificity for MRI to identify intracranial extension were 80% and 94% respectively with positive and negative predictive values of 89% and 88%. For CT sensitivity and specificity were 100% and 83% with positive and negative predictive values of 80% and 100%.

2 of 11 developed CSF leaks requiring lumbar drainage and washout following a fall and plate fracture 2 weeks post op.

There was 1 death from a brain abscess following excision of a midline extracranial dermoid.

Conclusions: The salient findings of this study included the significant number of transcranial extensions of non-midline, temporal dermoids, that multiple imaging modalities may be required to identify intracranial extension and the lack of clinical usefulness of a punctum to predict intracranial extension. Finally, we discuss the usefulness of lumbar drains in association with transcranial excision of dermoids.

The mortality is a reminder of the risk profile in any midline pathology, irrespective of transcranial extension.

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Cell-Assisted Lipotransfer Enhances Fat Graft Retention in Irradiated Tissue

Presenter: Anna Luan

Authors: Luan A¹, Duscher D¹, Paik KJ¹, Zielins ER¹, Whittam AJ¹, Brett EA¹, Atashroo DA¹, Hu MS¹, Wearda T¹, Senarath-Yapa K¹, Menon S¹, Shailendra S¹, Gurtner GC¹, Longaker MT^{1,2}, Wan DC¹¹*Hagey Laboratory for Pediatric Regenerative Medicine, Department of Surgery, Plastic and Reconstructive Surgery Division, Stanford University School of Medicine, USA,*²*Institute for Stem Cell Biology and Regenerative Medicine, Stanford University, USA*

Background: Radiation therapy results in obliteration of microvasculature and collateral fibrosis. While fat grafting hypovascular irradiated recipient sites remains challenging, coincident improvement in skin quality has been noted. Cell-assisted lipotransfer (CAL), the enrichment of fat with additional stromal vascular fraction (SVF) cells, has been shown to improve retention, and enhanced outcomes may be achieved with CAL at irradiated sites. Supplementing fat grafts with additional SVF may also augment the regenerative effects on surrounding skin.

Methods: The scalps of immunocompromised mice were treated with 30 Gy external beam radiation, delivered as six fractionated doses. Human fat grafts, with or without SVF supplementation, were placed beneath the scalp. Non-irradiated mice also received fat grafts with or without SVF supplementation for comparison. Volume retention was then followed over eight weeks by micro-CT. Skin samples were obtained at multiple time points to evaluate histological and mechanical changes in response to fat grafting. Finally, grafts were harvested after eight weeks for histological analysis.

Results: Volume analysis showed significant improvement in graft retention with CAL compared to unsupplemented fat placed beneath the irradiated scalp, with normalization of retention compared to non-irradiated controls. This was associated with increased vascularity, decreased disordered collagen, and decreased mechanical stiffness of the overlying irradiated skin in skin grafted with CAL. Compared to unsupplemented fat, CAL in irradiated sites also demonstrated improved graft structural qualities, as well as greater vascularity as measured by CD31 staining.

Conclusions: Radiation therapy results in deleterious soft tissue changes which can diminish fat graft outcomes. CAL improves volume retention at irradiated recipient sites while simultaneously augmenting the regenerative effects of fat grafts on the overlying skin. CAL therefore shows promise for reconstructing soft tissue deficits following radiation treatment.

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Twins and Craniofacial Anomalies—a single centre study

Presenter: Deborah Chua

Authors: Chua D, Dunaway DJ, O'Hara JL
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Introduction: Twin studies are widely established to qualify and quantify genetic involvement in diseases. Reported data of twin studies in Craniofacial Anomalies (CFA) is limited. This report considers the prevalence of twinning in CFA observed in a single institution.

Methods: A retrospective study examined the association between CFA and zygosity in 66 twin sets and 1 group of triplets. Review of unit database, letters and genetics recorded zygosity, gender and diagnoses. Twin sets were categorized into single sutural craniosynostosis, multisutural synostosis, syndromic synostosis and other CFA.

Results: Higher concordance in monozygotic twin sets (26.7%) as compared with dizygotic twin sets (5.71%) was observed. Gender was represented by 52.9% affected males and 47.1% of affected females. Four pairs of monozygotic concordant twins were described. Concordance of hypertelorism, metopic, and sagittal synostosis is reported. All 29 twins with syndromic or multisutural pathology were dizygotic with an unaffected twin.

Conclusions: Increased concordance rates in monozygotic twin sets compared with dizygotic twin sets confirm the contribution genetics in specific CFA. A multifactorial contribution to craniofacial morphology is supported by a less than 100% concordance rate in monozygotic twins, discordant dizygotic twin sets in complex craniosynostosis and discordant monozygotic twin sets in hypertelorism. This cohort describes the largest twinning study to contribute new directions for research in the aetiology of CFA.

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Transverse Slicing the 6th-7th Costal Cartilaginous Junction To Prevent Warping In Nasal Surgery.

Presenter: Tara Lynn Teshima

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Background: Costal cartilage is an important reconstructive tissue for correcting nasal deformities. Warping of costal cartilage, a recognized complication, can lead to significant functional and aesthetic problems. We present a technique to prevent warping that involves transverse slicing of the sixth-seventh costal cartilaginous junction, a unique anatomic site, that when sliced perpendicular to the long axis of the rib junction, provides long, narrow, clinically useful grafts with balanced cross-sections. Our aim is to measure differences in cartilage warp between this technique (TJS) and traditional carving techniques.

Method: With ethics approval and patient consent, all costal cartilage samples were obtained from human subjects and standardly cut/sliced to standardized clinically relevant dimensions using a custom cutting jig. The sixth-seventh costal cartilaginous junction was sliced transversely leaving the outer surface in tact, yielding multiple narrow samples. The adjacent sixth rib cartilage was carved concentrically and eccentrically yielding one concentric and one eccentric sample per patient. The samples were incubated and standardized serial photography was performed at set time points up to and including four weeks. Warp was quantified by measuring non-linearity using least-squares regression and compared between carving techniques within and across patients.

Result: Thirteen transverse cartilage grafts were obtained for analysis with an average length of 3.12cm (range 4.6 to 2.3 cm). TJS resulted in significantly less warp than both eccentric and concentric carving (p<0.0001). As expected, warp was significantly higher with eccentric carving compared to concentric carving (p<0.0001). Warp increased significantly with time for both eccentric (p=0.0002) and concentric (p=0.0007) techniques while TJS warp did not (p=0.56).

Conclusion: The technique of transverse slicing costal cartilage from the sixth-seventh junction minimizes warp compared to traditional carving methods providing ample grafts of adequate length, and versatility for reconstructive requirements.

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Medial Sub-Coronoid Bone Graft Technique: A Novel Source of Bone Grafts in Craniomaxillofacial Surgery

Presenter: Chuan-Fong Yao

Authors: Yao C, Rivera-Serrano CM, Chen Y, Lu J, Chen Y, Chen YR

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Objectives: Bone grafts are frequently needed in maxillofacial surgery to fill bone gaps and stabilize bone segments. Since 2011 we started harvesting medial sub-coronoid process bone grafts during bilateral sagittal split osteotomy of the mandible. This article describes the harvesting technique of medial sub-coronoid process bone grafts, its clinical applications, the dimensions of the grafts, and the advantages & disadvantages of this method compared with other techniques of bone grafting.

Materials and Methods: Bone grafts were harvested in 50 patients using the medial sub-coronoid process bone grafting technique, and used as interposition grafts after Le Fort I-type maxillary osteotomy and elongation genioplasty. The size of the grafts was recorded prospectively.

Results: The average size of the bone grafts harvested was 19.4x12.3x5.1 mm. Grafts were used in 31 patients to stabilize a Le Fort I-type osteotomy, and in 13 patients to stabilize an osseous genioplasty. Harvesting time was less than 5 minutes per site. Postoperative morbidity was similar to mandibular sagittal split osteotomy without bone harvesting.

Conclusion: Medial sub-coronoid bone grafts can be harvested from bone that otherwise would be discarded during standard sagittal split osteotomy of the mandible. Medial sub-coronoid process bone grafts are easy to harvest and can be used in a versatile way in maxillofacial surgery. Other advantages of this technique include the good size of the grafts, the lack of extra-morbidity, and the enhanced visualization of the mandibular inferior alveolar nerve if sagittal split osteotomy of the mandible is to be performed.

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An Internet-Based Surgical Simulator for Craniofacial Surgery

Presenter: Roberto Flores

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Background: Craniofacial surgery remains a challenging field to learn and master. We present a freely-available internet-based multimedia simulator for craniofacial surgery designed as a resource of surgeons in craniofacial fellowship training.

Methods: Previously constructed digital animations of craniofacial surgery were upgraded in Maya 10 (Autodesk, San Raphael, CA) in preparation for web-based simulation. These animations were exported into an internet cloud-based, surgical simulator produced by BioDigital Systems Inc. (New York, NY). High-definition intra-operative video recordings of all procedures were edited in Adobe Premiere CS5.5 (Adobe, San Jose, CA) and exported into the simulator with the addition of voiceover. Test questions were produced for each surgical module.

Results: Nine craniofacial surgery procedures are demonstrated in this interactive surgical simulator. Through a customized digital interface the user can manipulate the 3D simulations in real-time including the ability to alter perspective, pace and order of the virtual operation. High-definition intra-operative video footage compliments the critical steps of each procedure demonstrated in the simulation. A voiceover and text guides the user through each tutorial. A test is included at the end of each simulation. As the simulator is internet-based, there is no need for specialized software or downloads and simulator upgrades are immediately available to all users. Access is zero cost and the tutorial can be viewed on a modern laptop or desktop computer with a current web-browser.

Conclusion: We present the first internet-based surgical simulator of craniofacial surgery. This freely available resource capitalizes on recent improvements in internet capability to produce an interactive virtual surgical environment for students and teachers of craniofacial surgery. This free simulator is designed as an educational resource for the next generation of craniofacial surgeons.

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Midfacial and Dental Changes Associated with Positive Airway Pressure in Children with Sleep-Disordered Breathing

Presenter: Soleil Roberts

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Background: Positive Airway Pressure (PAP) for treatment of pediatric Sleep Disordered Breathing (SDB) is a widespread therapy that currently lacks longitudinal data describing how mask pressure impacts the developing facial skeleton. This retrospective cohort study compared midfacial growth in pediatric craniofacial subjects diagnosed with SDB that were compliant vs. non-compliant with PAP therapy, and explored correlations between demographic, medical, and sleep variables with rate of annual facial change.

Methods: Review of Craniofacial Center and Sleep Disorders Center records was performed to identify patients prescribed PAP for SDB with serial cephalographic images obtained as part of routine clinical care for concomitant craniofacial diagnosis. Lateral cephalometric analysis was used to determine mean annual change in midfacial structures from T1 to T2 in compliant vs. noncompliant subjects. Compliance was indicated by PAP usage of Results: Overall compliance of 45.2% was observed in the initial subject population. After applying exclusion criteria, 50 subjects were compliant with PAP therapy (28 male, 22 female; mean age 10.42) for an average of 2.57 years and 50 subjects were noncompliant (29 male, 21 female; mean age 8.53). Compliant subjects experienced negative mean annual change (retrusion) of the midface compared to forward growth seen in non-compliant subjects (SNA: -0.57° vs. 0.56°), counterclockwise rotation of palatal plane (SN-PP: -1.15° vs. 0.09°) and upper incisor flaring (U1-SN: 2.41° vs. -0.51°).

Conclusions: Pressure to the midface from compliant PAP use may alter normal facial growth, resulting in maxillary retrusion, counterclockwise tipping of the palatal plane, and flaring of the maxillary incisors. These findings indicate a greater need for collaboration between sleep medicine physicians, orthodontists, and surgeons to monitor midfacial growth during PAP treatment.

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Biomechanics of normal human skull growth

Presenter: Joseph W. Libby

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Introduction: Understanding the complex relationships between the biomechanical forces from the growing brain, calvarial bone, cranial suture geometry and properties, during normal human skull growth would be extremely valuable. The aim of this study was to develop a combined laboratory and computational model of human calvarial growth to explore these relationships.

Methods: A 3D printed physical model and an equivalent finite element (FE) computer model were developed from a computerised tomography (CT) scan of a newborn infant skull. Both models were created to simulate skull growth from birth by expanding the brain volumes. The resultant overall skull shapes of the experimental and computational models were compared to *in vivo* head measurements. Parameters considered included skull width, length and circumference.

Results: Cranial measurements of the experimental and FE skulls gradually increased during the first 2 months after birth, in line with the *in vivo* measurements. For example the experimental model showed an increase of 11.7%, 9.2% in cranial length and width respectively from birth to 2 months, which was comparable to 15.5%, 10.8% reported in the literature.

Conclusions: Considering the limitations of the experimental model, and the corroboration between the experimental and computational models, the computational model will be used to predict the skull growth throughout the first year of life. Once the computational models are validated against the *in vivo* data (throughout the first year of life); the same modelling approach will be used to predict the skull growth in patient-specific models of conditions such as craniosynostosis.

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Using 10000 faces to identify the perceptual boundaries of normal variation

Presenter: Justine L. O'Hara

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Introduction: In order to plan craniofacial surgery it is important to understand what represents a normal face geometrically. Previously, normal mean values have been utilised to assess proportions. A new approach is described which employs principal component analysis to assess global face shape. Warping along principal variation components away from the mean allows identification of the point where the global face shape stops being normal.

Methods: 10 000 normal 3D photographs were taken of volunteers at the London Science Museum. Using an automated landmarking system a mathematical model was created from this population. This population covered a wide age range (from 1-90 years) and included all ethnic groups. Movies were then created which represented deviation from the mean face shape in subgroups. Fifty craniofacial unit members from across the United Kingdom and fifty non-clinical staff were surveyed with these movies and requested to determine the point at which the face appeared different.

Results: There was degree of variation in the point at which individuals perceive the transition beyond normal. This means there is a range along a principal component where all agree the face is normal, and then there is disagreement and a range beyond this where all agree the face is not normal. The magnitude of the range differs with different principal components. There was marked disagreement between the perceptual concept of normal and the statistical model of normal showing the importance of a perception.

Conclusion: Understanding the perceptual boundaries of normal variation is possible and an essential concept in assessing and planning craniofacial surgery.

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Our experience of robotic follicular unit extraction for hair transplantation

Presenter: Katsumi Ebisawa

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Background: Hair loss causes distress to patients and deteriorates their quality of life. For patients who have a scarred scalp caused by a congenital anomaly, trauma, or other surgical scars, therapeutic option is limited to surgical intervention such as hair transplantation. The “strip method” is regarded as a golden standard for harvesting hair follicles. However, the possibility of post-surgical pain and scarring can be problem.

Follicular unit extraction (FUE) method is one solution. A small diameter biopsy punch is used to harvest hair follicles, resulting in non-linear, diffused tiny scars. But, FUE still has some disadvantages such as non-human ergonomics and a long learning curve, which make it difficult to become popular. To help these problems, powered punch device for FUE is developed, improving harvest speed and follicle transection rate. Since then, it has become one of the most discussed topics, and the ratio of patients using this method is increasing.

In 2011, the FDA approved a new robotic FUE device (ARTAS system, Restoration Robotics, Inc.). The robotic arm with its four CCD cameras and one powered punch automatically identifies and dissects follicular units from the donor area. There are few medical facilities that use ARTAS system. In this presentation, we introduce our procedure using ARTAS system.

Methods: Once patients are in a sitting position with their face down, a skin tensioner is set to the donor area. The image-guided robotic system analyzes hair follicle density, distribution and hair angle. Hair follicles are dissected using a robotic powered punch with a two-step method.

Result: This system helps to harvest healthy, intact grafts by approaching appropriate angle and eliminates human error such as uneven donor site distribution.

Conclusion: This robotic system assists surgeons with repetitive and precise movements to achieve better outcomes by reducing manual variability.

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Indication for and aesthetical results of the facial dismasking flap approach in skull base surgery

Presenter: Tomoyuki Yano

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Background: The facial dismasking flap (FDF) approach consists of a coronal incision and a hemi or bilateral palpebral incision. This approach provides a wide surgical field for extirpation of deep extended craniofacial tumors without leaving any undesirable scar on the face. Therefore a FDF approach could provide satisfactory aesthetical and functional results. Meanwhile, in some cases especially patients with a history of surgery or orbital extension, satisfactory results are not obtained even when the FDF approach is used. In this study, we evaluated the indication and aesthetical results of the FDF approach.

Patients: We reviewed 26 patients who underwent the FDF approach for skull base surgery. The patients were 16 males and 10 females, ranging in age from 12 to 76 years (average 37 years). Of these patients, 21 underwent a hemi-FDF approach and the remaining 5 a bilateral-FDF approach. Follow-up period averaged 62 months. Patients were divided into two groups in this study, Group A (11 patients); patients with no history of skull base surgery and orbital extension, and Group B (15 patients); patients with such history. Aesthetical evaluation has performed by three board certified plastic surgeons.

Result: There was no facial dismasking flap loss, eyelid opening disorder or facial palsy in both Groups A and B. In addition, in Group A, there was no eyelid closing disorder or scar contracture of the eyelid. But there was one case of ptosis (9%) and one of ectropion (9%). In Group B, there was one case of ptosis (6%), five of ectropions (33%), five of eyelid closing disorders (33%) and seven of eyelid scar contracture (46%). As for aesthetical evaluation, in Group A, 14 patients scored Excellent (42%), 12 Good (36%), 4 Average (12%), 2 Fair (6%) and 1 Poor (3%). In Group B, 1 patient scored Excellent (0.7%), 8 Good (17%), 14 Average (30%), 13 Fair (28%) and 9 Poor (20%).

Conclusion: The FDF approach could be a good option for skull base surgery. In particular, patients without a history of skull base surgery and orbital extension could obtain satisfactory aesthetical and functional outcomes. The procedure was however limited for patients with a history of skull base surgery or orbital extension as aesthetical and functional outcomes rather became inevitably worse. Surgeons should know these facts and the indication of this technique.

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Reconstruction of complex maxillary defects with bone transport

Presenter: Alberto R. Pereira

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Presentation of authors clinical experience with a 6 patients group, all presenting anterior maxillary complex defects resulting from mixed etiology, both congenital and acquired, all treated with trifocal distraction osteogenesis.

Ages ranging from 16 to 47, 5 males and 1 female, they all present a complex defect, missing bone, mucosa and teeth, conditioning a wide oro-nasal communication and collapse of de superior lip and nasal tip with a class III like appearance. Missing bone ranges from 22 mm to 35 mm (transverse dimension) and all were full thickness 3D segmental defects, 4 sequel of FLAP, 1 trauma sequel and the other 1 resulting from tumor excision, a mixoma of the anterior maxilla. This patient was the only one treated immediately with placement of the distractor devices at the same surgical time of excision.

All patients were operated 3 times. First time, segmental inverted L osteotomies bilateral and marginal to the defect and application of two monofocal distractors were performed. When both bone transport discs contact in the middle, patients went for second procedure, for debridement of interposed soft tissues. Final procedure, was performed after consolidation period in 3 cases for removal of the devices and in 3 cases, prior consolidation, for removal of devices, manipulation of the segments and fixation in ideal position.

Orthodontic treatment starts as soon as possible for final alignment of dental arch and closure of residual central teeth gap. Dental rehabilitation ends with dental implants in the distraction segments and modification of the crows of transported canines/premolars to incisors.

All patients were successfully treated with this approach, regarding reconstruction of the defect with closure of oro-nasal fistula. Clinical and radiographic evidence of bone stability was achieved, as shown by smooth mucosa lining and central teeth contact resulting in superior intraoral aesthetic outcome. Reconstructed bone, show good quality and enough quantity to permit dental implants application and integral dental rehabilitation.

All patients improve facial aesthetics, with adequate projections of superior lip and nasal tip.

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Mandibular tumours in the paediatric patient: a review of management and reconstruction

Presenter: Andrew A. Heggie

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Background: The spectrum of pathology affecting the cranio-maxillofacial skeleton in the young patient differs from the adult in that malignant craniofacial lesions in the paediatric patient are usually sarcomas of hard and soft tissues yet are relatively rare. There is also a range of benign, aggressive pathological entities that require resection with an adequate margin to reduce the risk of recurrence. The purpose of this paper is to review a series of patients who underwent the management and reconstruction of mandibular tumours

Patients & Methods: A retrospective review of 8 patients undergoing resection of mandibular tumours was undertaken. Five patients had ameloblastomas, 2 patients osteosarcomas and in one patient, a Ewing's sarcoma. All lesions were resected intraorally and reconstructed with a DCIA bone flap. Six of the patients had occlusal reconstruction with implants.

Results: All patients assessed the aesthetic result as satisfactory and were able to function normally. Morbidity from the donor site was minimal. Two patients described local discomfort for several months but there were no hernias nor on-going gait disturbances.

Discussion: Iliac non-vascularized grafts or rib may readily reconstruct "short-span" mandibular segmental resections. For larger mandibular segments including tooth-bearing segments free vascularized grafts provide the most reliable reconstruction (fibula/ilium).

Where possible, facial skin incisions are best minimized in young patients to avoid unnecessary aesthetic compromise from potentially poor scarring. Surgical access for resection can often be achieved intraorally with access to recipient vessels gained by limited incisions in a skin crease.

The "neo-alveolus" needs optimal orientation and sufficient prosthetic space with the opposing dentition for future implant-supported bridges. Hemi-mandibular reconstructions are often too laterally-placed making rehabilitation difficult or impossible.

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A strategy of cranioplasty combined with artificial bone and free flap

Presenter: Norio Fukuda

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Background: In cranial reconstruction using a bone translation, we sometimes experience complication such as the dead space under the bone-flap, or difficultness of skin coverage over the bone. When we use the artificial bone, such complications are more mortal problems. We have been actively used free flaps if they are suspected preoperatively. We reported a strategy of cranioplasty combined with artificial bone and free flap.

Method: Between April 2008 and March 2015, we treated 13 patients (10 men and 3 women) who required cranioplasty combined with artificial bone and free flap. Patients age at first surgery was 18-62 (mean 45.6) years old. We analyze the surgical procedure, flap choice and complications.

Result: The free flap used were 10 Latissimus Dorsi(LD) flaps, 1 rectus abdominis musculocutaneous flap, and 1 superficial temporal fascia(TPF) flap. In ten cases we inserted artificial bone over free flap secondary, and in three cases we translated a free flap over the artificial bone at one time.

During the observation periods, in six cases infection or exposure of artificial bone were appeared, so we took need of removal surgery. Of these three cases was rebuilt again with an artificial bone. No cases caused brain damage that might be due to transplanted the free flap. We carried out in combination with extension of tissue expander in eight cases.

Discussion: In chronic cases the brain sometimes does not expand and the dead spaces under the bone-flap are not filled after surgery. To prevent of infection future, it appeared useful to keep filled by vascularized free flaps in such cases. Free LD flap was very usefull because we could harvest it with long vascular pedicles and with broad muscle tissue under same position during operation. We also recommend that translation of flap over the artificial bone is as thick as possible to prevent the expose of bone.

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Surgical Care Burden in 54 cases of Orbito-Temporal Neurofibromatosis

Presenter: Laurent Lantieri

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Background: Patients with orbito-temporal neurofibromatosis (OTNF) bear a heavy burden of care, where disease progression is unfavorable to surgical outcome. We assessed the factors associated with higher risks of repeated surgical procedures in this patient group.

Patients and Methods: Fifty four consecutive patients with OTNF from the French Neurofibromatosis 1 Referral Center cohort (n>900), operated over a 20-year period were analyzed to determine the clinical features most likely to predict repeat surgery and longer duration of surgical care.

Results: Fifty four patients (5.2% of the NF1 patients' cohort) underwent 87 procedures with a 4.8 years average follow-up. Soft-tissue surgery had a high revision rate (23/47 patients), skeletal surgery did not (3/17 patients). Of the range of soft tissue procedures, transosseous wire canthopexy and facial aesthetic unit remodeling were associated with stable outcome. Ptosis repair carried an unfavorable outcome, particularly in the presence of sphenoid dysplasia. Stable skeletal remodeling was achieved with polyethylene implants and/or cementoplasty. Multiple procedures were undertaken in 70% of patients and were predicted by the NF volume, canthopexy, skeletal dysplasia, or a Jackson's classification 2 and/or 3; but not by declining visual acuity.

Conclusion: Analysis of this series of OTNF suggests a classification based upon predictive risk of repeated procedures as follows: Group 1: Isolated soft tissue infiltration not requiring levator palpebrae or canthal surgery; Group 2: Soft tissue involvement requiring ptosis repair or canthopexy, or NF great axis over 4,5 cm; Group 3: Presence of sphenoid dysplasia with pulsatile proptosis, regardless of visual acuity.

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Skull base reconstruction for children with basal encephaloceles

Presenter: Nobuhito Morota

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Introduction: Surgery for the basal encephalocele (BEC) still remains a challenge. Reconstruction of the skull base bone defect is the key for successful repair of BEC.

Subjects and Methods: The authors repaired 13 consecutive BECs between March 2004 and July 2014, and they were subjected for the study. The material used for the skull base reconstruction and the outcome were retrospectively analyzed.

Results: Age at initial surgery ranged from 25 days to 7 years old (median: 4 months old). Autograft bone (mainly, from the parietal bone) was sufficient to reconstruct the skull base in 3 of 4 children with the sphenoidal BEC and 2 elder children with the speno-ethmoidal BEC. On the other hand, autograft bone materials failed by drop or absorption in 2 infants of the speno-ethmoidal BEC and the reconstruction was finally achieved by using a titanium mesh. The skull base was successfully reconstructed at a single surgery using a titanium mesh/plate combined with autograft bone for the remaining 6 infants (1 sphenoidal, 4 speno-ethmoidal, and 1 fronto-ethmoidal BECs).

Discussion: In our early experience, use of the autograft bone alone for the skull base reconstruction in two infants with speno-ethmoidal BECs failed and led to multiple surgeries. Indication of the autograft bone material alone is limited for those with the sphenoidal BEC or the speno-ethmoidal BEC in elder children. Use of the titanium mesh/plate showed excellent results with no drop or absorption in younger children with speno-ethmoidal BECs. The titanium mesh/plate was safely supported by surrounding skull base even in the neonatal cases.

Conclusion: The titanium mesh/plate seems the best choice for the reconstruction material for the relatively large skull base bone defect in case of the BEC.

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Evaluation on Mandibular Reconstruction with Vascularized Fibular Flap with or without Computer-assisted Surgery

Presenter: Xudong Wang

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Background: Mandibular defects usually affect the esthetic value of the face and functions such as mastication, respiration, phonation, and deglutition. Microvascular free fibular transfer is the most popular method of mandible reconstruction. To purpose of this study is to evaluate the accuracy of computer-assisted mandibular reconstruction with a vascularized fibular flap and compare it to conventional surgery.

Methods: Between December 2008 and June 2012, eight patients underwent accurate mandibular reconstruction with preoperative virtual computer planning, stereomodel and prefabricated surgical templates, and 14 patients underwent conventional surgery. The follow-up period was 9.5-14.4 months. The accuracy of virtual surgical planning was determined and the outcomes were compared between the two groups using Surgicase 5.0 and Geomagic Studio 2013.

Results: Flap survival was 100%. All the patients achieved good occlusion and a symmetric mandibular contour. In the computer-assisted group, the mean length deviation of the actual fibula segments compared with the virtual ones was 1.34±1.09 mm; mean angular deviation, 2.29°±1.19°; maximum 3D deviation, 1.62±0.19 mm; mean 3D deviation, 0.53±0.06 mm. The maximum 3D deviation of the mandibular remnants was 3.91±0.33 mm and the mean 3D deviation was 0.53±0.14 mm.

The mean ischemia time was 52.53±13.14 min in the computer-assisted group and 94.18±24.75 min in the conventional group. The mean difference between the planned and actual inter-condylar distance in the computer-assisted and conventional surgery group was 2.97±1.71 mm and 4.12±3.80 mm respectively; mean difference in the inter-gonial angle distance, 2.96±1.85 mm and 4.45±3.06 mm respectively; mean difference in the anterior-posterior distance, 4.27±3.62 mm and 5.07±5.47 mm respectively; mean difference in the gonial angle, 3.22±3.14 mm and 4.81±4.70 mm respectively.

Conclusion : Computer-assisted surgery including preoperative virtual surgical planning, intraoperative cutting and reconstructive guides, and postoperative analysis is highly accurate for fibular flap mandibular reconstruction.

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Review of our reconstructive procedures for a trigeminal nerve sheath tumor

Presenter: Mayuko Hamanaga

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Purpose: The total complete resection rate of trigeminal nerve sheath tumors by using skull base surgery is reportedly higher than 90%. Therefore, skull base surgical reconstruction after trigeminal nerve sheath tumor extirpation should yield reliable and aesthetic results. This study aimed to review reconstructive procedures after trigeminal nerve sheath tumor extirpation

Methods: Between June 2009 and September 2013, seven patients underwent trigeminal nerve sheath tumor resection and primary skull base reconstruction. Of the patients, three were male and four were female. Their ages ranged from 32 to 59 years (mean, 49 years). Local flaps from the temporal region were used in the reconstruction.

Results: Temporal muscle flaps were used in two patients; temporalis musculopericranial flaps, in four; and a temporoparietal musculopericranial flap, in one. No severe perioperative complications such as intracranial infection or cerebrospinal fluid leakage occurred. However, six patients later showed temporal hollowing. The two patients for whom temporal muscle flaps were used showed severe temporal hollowing, requiring additional surgery with thoracodorsal artery perforator free flaps.

Conclusion: According to our case series, using local flaps from the temporal region is a good option for a safe and reliable skull base reconstruction after trigeminal nerve sheath tumor extirpation. However, it can result in temporal hollowing. Trigeminal nerve sheath tumors are benign and have a high complete resection rate. Aesthetic aspects should also be considered in these cases. Use of muscle-sparing flaps from the temporal region, such as a temporoparietal musculopericranial flap, is recommended. However, using local flaps from the temporal region remains controversial. Thus, more cases should be accumulated in order to obtain conclusive findings. If aesthetic results are unsatisfactory, a secondary surgery should be positively planned.

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Management of cranial bone defect cases caused by infection.

Presenter: Hiroko Ochiai

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Background: Infections that develop after craniotomy can be very difficult to treat. The treatment courses of 9 patients who developed infections after craniotomy are reported.

Patients: Nine patients (3 men; 6 women) developed infections after craniotomy during the period between January 2012 and August 2014. They ranged in age from 38 to 80 years. The primary disease was subarachnoid hemorrhage, acute subdural hematoma, acute epidural hematoma, cerebral arteriovenous malformation, brain tumor, and meningioma. Artificial materials that were used included artificial dura mater in 6 patients, titanium plates in 2, and artificial bone in 6 (including duplication).

Results: During surgery, artificial materials to which the infection had spread were removed, and contaminated soft tissues were debrided. The artificial dura mater was removed from 5 of the 6 patients in whom it had been used, and then dura reconstruction was performed by autologous free fascia lata grafting. In 5 patients, autologous bone was removed, and two-stage cranial reconstruction of the defect was performed. The reconstruction material was custom-made artificial bone in 4 cases and a titanium mesh plate in 1. Skin defects were reconstructed by temporary plication in 8 patients and use of a local skin flap in 1. In one reconstructed case, the artificial bone again became exposed, so it was removed, and a free latissimus dorsi flap was used for reconstruction. That graft was performed so that the dermis side of the flap was in contact with the dura mater, which had the advantage that synchotomy would be easy at the time of additional cranial reconstruction surgery. That additional cranial reconstruction was later performed using artificial bone, and recurrent infection was successfully avoided.

Discussion: If an infection develops after craniotomy, it is essential to perform adequate debridement and immediately remove all artificial materials that had been used. At that time, for the dural defect at the infected wound and as backing for the scalp, free fascia lata grafting should be performed. We found that this leads to rapid wound healing without any recurrence of infection and facilitates wound closure. Free flap grafting was also effective in patients who experienced recurrent infection and/or a skin defect even after fascia lata grafting.

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A rare case of 14 consecutive surgeries, including 4 free flap reconstructions performed on the same patient.

Presenter: Tsutomu Homma
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Background: We experienced a rare and extraordinary case of multiple consecutive surgeries performed on the same patient, who also needed multiple reconstructive procedures. The primary disease was a hemangiopericytoma located in the anterior skull base, for which the patient had already undergone 12 surgeries in the craniofacial area. Surgical planning was faced with many difficulties and problems. We report our effort to solve these difficulties and problems.

Patient: The patient was a 60-year-old female diagnosed with recurrence of a hemangiopericytoma in the anterior skull base. At the previous hospital she had already been operated upon 12 times for multiple recurrence. Surgical planning was faced with many problems as a right latissimus dorsi flap and a left rectus abdominis flap had already been used on the patient and moreover, she had surgical scars on the right abdomen due to an appendectomy and the right thigh due to a hip joint surgery. Therefore only a left latissimus dorsi free flap and a left anterolateral thigh free flap were bulky enough to use on the large defect. Furthermore there were scars in the right temporal and the right neck region. Finally, we planned to use the left vastus lateralis muscle free flap and recipient vessels in the left temporal area. All reconstructive procedures were performed successfully as planned. But unfortunately, the patient had another recurrence and need to undergo additional surgery. Although there was scar formation in the right thigh, we decided to use a right vastus lateralis muscle free flap using the left facial artery and vein as recipient vessels in order to avoid changing the position of the skull base during the surgery.

Result: There was no flap loss, intracranial infection and cerebrospinal fluid leakage perioperatively.

Discussion: A hemangiopericytoma is a rare tumor of the central nervous system with a high risk of recurrence. We actually experienced 4 skull base reconstructions with free flaps for this patient with a hemangiopericytoma. Therefore reconstructive surgeons should keep in mind the possibility of multiple reconstructive procedures. In other words, to avoid making unnecessary scars or incisions on potential candidates for other free flaps, and to pay attention in preserving recipient vessels for further surgery if faced with this disease.

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Successful Immediate Reimplantation of Cranial Bone Flaps in the setting of Infection

Presenter: Christopher S. Zarella
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Background: Treatment of intracranial abscess requires removal of large segments of cranial bone to access the infection. These bone grafts are obligatorily contaminated and, at times, grossly infected with bacteria. While reimplantation of these devitalized bone segments violates common surgical precepts, the practice is not uncommon in the field of pediatric neurosurgery. We report a large series of patients with intracranial abscesses that were successfully managed with replacement of the bone grafts in the setting of infection.

Methods: A retrospective chart review was performed on all pediatric patients undergoing surgical management of intracranial abscess between 1997 and 2014. Patient characteristics, presentation, operative details, and ultimate outcomes were recorded.

Results: There were 38 bone grafts in 28 patients. 32 grafts in 24 patients were returned immediately following the abscess drainage. Of these, 30 grafts (22 patients) healed uneventfully and required no further procedures. Two grafts (2 patients) required removal at a later operation for infection. Six grafts (5 patients) were banked frozen. Four healed and had no further procedure. Two became infected and were removed. When known, the source was sinusitis (n=20), periorbital cellulitis (n=1), tooth abscess (n=1), meningitis (n=1), and otitis (n=1).

Discussion: Our series demonstrates that contaminated or infected cranial bone grafts can be successfully replaced either immediately or after being banked with good clinical results. Nearly 90% of flaps removed in the setting of infection were successfully replaced without complication.

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Prospective Analysis of Double Skin Paddle Fibula Flap for Composite Mandibulectomy Reconstruction

Presenter: Edward I. Chang

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Background: A double skin island free fibula flap can be used successfully for reconstruction of through-and-through composite mandibulectomy defects, but prospective studies are lacking regarding patient outcomes.

Methods: Prospective analysis of all double island fibula flaps (DIFF) performed by the authors from 2010-2014.

Results: Thirteen patients underwent a DIFF based on our P-A-B-C perforator mapping system, and one patient needed a second DIFF. Defects included through-and-through mandibulectomy defects due to osteoradionecrosis (n=5) or following tumor extirpation (n=7). One patient required two sequential DIFF for osteoradionecrosis, and another patient underwent reconstruction of a composite mandibulectomy and hemiglossectomy defect. One skin paddle was used for the intraoral mucosal defect, but the P perforator perfusing the proximal skin paddle did not join the peroneal vessels and was harvested as free proximal peroneal artery perforator (PPAP) flap for hemiglossectomy reconstruction. All other DIFF only required a signal anastomosis as all perforators arose from the peroneal vessels. There were no fibula flap losses, but the external skin paddle was lost in one patient and reconstructed with a pedicle pectoralis myocutaneous flap. There were no donor site complications. All patients were tolerating an oral diet, one patient is alive with disease, and one patient passed away secondary to recurrent disease.

Conclusions: The double island free fibula flap is a reliable flap that can reconstruct complex mandibulectomy defects often obviating the need for a second free flap thereby decreasing operating time, added donor site morbidity, and the need for additional recipient vessels.

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Refinements in planning and execution of TMJ ankylosis surgery: One surgeon's experience

Presenter: Michael A. Lypka

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Purpose: Treatment of temporomandibular joint ankylosis can be a frustrating endeavor with potential intraoperative hazards and high rates of reankylosis. Gap arthroplasty with postoperative physical therapy is the mainstay of ankylosis surgery, with ramus condylar unit (RCU) reconstruction achievable by various means. It is the purpose of this presentation to describe a treatment strategy including preoperative medical modeling, navigation, ultrasonic scalpel, and distraction osteogenesis.

Methods: Four patients with TMJ ankylosis were treated with wide gap arthroplasty, lining of base of skull with temporalis muscle/fascial flap, RCU reconstruction with distraction osteogenesis, and aggressive postoperative physical therapy. Resection was planned virtually and transferred to navigation software to duplicate resection intraoperatively. The planned vector of ramus distraction to create a new condyle was simulated virtually. At surgery, with the aid of navigation, bony resection was performed with an ultrasonic bone cutting device to safely avoid important vasculature medial to the bony resection. With surgical guides to duplicate the preoperative plan, ramus osteotomy was performed and distractor applied. Physical therapy was started on day one and distraction was initiated at 1 mm/day on day 7. Distraction continued until desired RCU length was achieved.

Results: All patients achieved greater than 25 mm of mouth opening with functional RCU reconstruction. One patient had transient facial nerve weakness.

Conclusion: The described protocol has consistently resulted in safe surgery with excellent functional outcomes.

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Middle skull base reconstruction including the facial nerve reconstruction by the free omental flap

Presenter: Miki Kambe
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Background: After the subtotal temporal bone resection, reconstructive surgery for defect of middle skull base is necessary to fill the dead space and sometimes for facial nerve. It is difficult to fill the deep and complex space surrounding facial nerve by usual musculocutaneous flap. In usual, facial nerve is reconstructed by long nerve graft running at the floor of the defect and covered by musculocutaneous flap. In our cases, we used free omental flap to cover defect of middle skull base without dead space. We report our experiences in middle skull base reconstruction with free omental flap and facial nerve reconstruction.

Method: Between July 2005 and July 2014, we applied this procedure to 11 patients for middle skull base reconstruction. 5 were female and 6 were male; mean age was 57.4 years. 6 patients received postoperative radiotherapy with mean dose 53.6 Gy.

Result: All flaps took. Although local infection and minor spiral leakage were occurred in 2 patients, they were treated with conservative management. 9 patients had facial nerve reconstruction. 7 patients used sural nerve, 1 patient used direct suture, and 1 patient used hypoglossal-facial nerve bypass for facial nerve reconstruction. In all cases, reconstructed facial nerve was covered by free omental flap. In 8 patients, facial nerve functions were evaluated more than 12 months after operation by Yanagihara score and Postoperative House-Brackmann (H-B) grading system, which showed 24.2 and 2.67 in mean score.

Conclusion: The advantage of our procedure is that facial nerve can be reconstructed by the shortest distance. Although facial nerve function after reconstruction is influenced by multi-factors, such as level of resection, postoperative radiation and etc., it is believed that shorter length in facial nerve reconstruction is mostly better for the functional recovery. In any ways of facial nerve reconstruction, the flexibility of omental flap allows us to reconstruct deep and complex space around the facial nerve without dead space. It is recommend for middle skull base reconstruction with facial nerve reconstruction.

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CRANIOFACIAL GROWTH FAILURE AFTER MIDFACE ADVANCEMENT—growth sites damage or pure growth impairment?

Presenter: Nivaldo Alonso
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Background: It is frequent the affirmation that the growth rate of the midface is severely reduced after midface advancement because damage is caused to the maxillary growth sites.

On the other hand, disturbed cranial base and midface growth have been correlated to earlier closure of important sites of growth like the Spheno-Occipital Synchondrosis.

Additionally, premature findings could be observed that the circummaxillary sutures maturation behaves differently in Syndromic Craniosynostosis.

Method: Retrospective study. Computed Tomographic scans of seventy four patients were assessed.

Scans of 20 patients undered to Monobloc advancement and Le Fort III midface distraction were evaluated previous and posteriorly the procedure. Tomographic scan superimposition and colormaps evaluation were compared to control group with at least 2 scans and 1 year of interval between its.

Scans of 27 patients with Apert Syndrome and 25 patients with Crouzon Apert and age of mixed dentition were assessed to classify the maturation status of the Spheno-Occipital Synchondrosis and compared with control group according to the literature.

Evaluation of Zygomaticomaxillary suture was made following the protocol in process of validation.

Results: The advancement is stable in both groups. No significant relapse and growth is observed in the treated patients as well as no representative growth is observed in untreated individuals when compared with control group.

While all of individuals of control group presented open synchondrosis, 18,5% of Apert Syndrome patients and 28% Crouzon Syndrome patients presented open. The mean age of closure was 7 years old for this patients.

The Zygomaticomaxillary apparently follows the same pattern but more observer concordance is needed.

Conclusions: Syndromic Craniosynostosis courses with growth impairment indendently of surgery. The impairment already is determinated in the surgical moment because the important growth sites are affected earlier.

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Defining Normal: Quantifying craniofacial asymmetry assessment in the pediatric population

Presenter: Alex A. Kane

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Background: Patients with craniofacial deformity often undergo reconstructive surgery to improve symmetry. However, defining normal craniofacial symmetry can be controversial and has not been well established. In this study, we used 3D non-radiologic images to quantify the craniofacial asymmetry of a large sample of normal healthy children.

Methods: Stereophotogrammetric images (3dMD, Georgia, USA) of normal children (n=252) with no known cranial or facial abnormality were recruited at well-child visits following IRB approval. The children ages ranged from 0 to 16 years old (median 8 years). A symmetric 3D scan with left and right point correspondences was used as a template to calculate the asymmetry in the 3D subject data. The template was registered and scaled to each individual scan using 25 manually placed landmarks. An additional 40 landmarks were automatically placed on the head surface and the template scan was deformed to each subject's 3D surface scan using a thin-plate spline algorithm and iterative closet point matching. A distance map was generated between the left and right surface anatomy to the center of the head (midpoint of the left and right tragus points), which in turn was used to calculate the asymmetry for each subject. Group characteristics were calculated.

Results: The mean cranial asymmetry was $1.60 \pm 0.8\%$ ranging from 0.6% to 4.5%. The mean asymmetry was similar between younger children (Conclusion: This study shows the feasibility of quantifying normal cranial asymmetry using 3D surface scans. We are currently expanding our study to include more normal subject scans in our image repository and we plan to share these results gathered from this work in the this presentation. An understanding of the "normal" distribution of craniofacial asymmetry is an important prerequisite in considering interventions and diagnosis of patients presenting with concerns about asymmetry.

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Quantitative Assessment in Craniofacial Surgery: An Objective Metric of Global Shape Change

Presenter: Darren M. Smith

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Background: A robust metric of head shape normality has yet to be widely adopted in craniofacial surgery. Present techniques rely primarily on over-simplified 2D measures to describe complex 3D shapes. Here, we describe a method to quantitatively describe the difference between two head shapes on the basis of global 3D morphological similarity as opposed to in terms of predefined 2D angles, distances and ratios. The resulting metric can be used not only to quantify head shape normality, but also to describe the efficacy of a given surgical procedure.

Method: To determine head shape normality, a CT scan of the patient's cranium and an age-matched normative skull are imported into Maya (Autodesk, California, United States). The meshes are then scaled to a uniform volume and aligned. The Hausdorff distance of the two meshes is then calculated in Meshlab (Visual Computing Lab, CNR-ISTI, Pisa, Italy). In addition to providing a quantitative metric of the difference between the two head shapes, this algorithm color-maps the meshes according to their degree of difference. Skull morphology before and after an intervention or over time can be assessed with an analogous approach. Surface scan data can be substituted for CT scan data when desired.

Result: The workflow is broadly generalizable (reliably generates an objective measure of morphological similarity between any two head shape meshes) and universally accessible (all software used is straightforward and free of charge for academic purposes). In addition to providing a global description of head shape, regional assessments can be performed by applying the methods described to user-defined regions of interest.

Conclusion: We introduce a workflow that effectively generates a metric to describe the similarity between any two head shapes based on overall 3D morphology instead of potentially misleading individual 2D measures. This strategy may find utility in quantifying phenotypic severity and surgical efficacy.

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Defining the optimum correction of the periorbital abnormality in CFND patients

Presenter: Allan Ponniah

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Introduction: Craniofrontonasal dysplasia (CFND) is an X-linked genetic syndrome, caused by mutations on the EFN1 gene and is characterized by hypertelorism, asymmetry, abnormal orbits and craniosynostosis. The deformity is complex and difficult to characterize using traditional measurement techniques.

Aims: To create a geometric morphometric (GM) model using principle component analysis (PCA) to describe the variation of soft tissue facial form within and between affected and unaffected populations. The mathematical model created will be used to guide surgical planning and assess outcomes.

Methods: Twenty-two CT scans of patients with CFND treated at Great Ormond Street Hospital were used to create STL files containing facial soft tissue surface data. Age, sex and ethnicity control data was provided from the London Science museum project (MEIN3D). Surface images were automatically landmarked and dense surface correspondence models were created based on the Basal face mask. The resultant models were analysed using PCA and thin plate spline movies and distance colour maps were created to display the results.

Results: The CFND group demonstrate significant hypertelorism and both the shape and orientation of the periorbital soft tissues differ markedly from the control group. Nasal width is increased and nasal length decreased. Neither box osteotomy or bipartition are able to fully correct the intrinsic soft tissue facial anomalies.

Conclusion: GM facial models using dense surface correspondence models and PCA demonstrate and quantify the intrinsic soft tissue anomalies in CFND. They provide a valuable surgical planning tool and facilitate assessment of outcome.

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Describing Crouzon and Pfeiffer syndrome based on principal component analysis

Presenter: Femke CR Staal

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Introduction: Crouzon and Pfeiffer syndrome are characterised by midfacial hypoplasia. Patients share the characteristics of a tall, flattened forehead, exorbitism, hypertelorism, maxillary hypoplasia and mandibular prognathism. Geometric morphometrics allows the identification of the global shape changes within and between the normal and syndromic population.

Methods: Data from 27 Crouzon-Pfeiffer and 33 normal subjects were landmarked in order to compare both populations. With principal component analysis (PCA) the variation within both groups was visualized and the vector of change was calculated. This model normalized a Crouzon-Pfeiffer skull and was compared to age-matched normative control data.

Results: PCA defined a vector that describes the shape changes between both populations. Movies showed how the normal skull transformed into a Crouzon-Pfeiffer phenotype and vice versa. Comparing these results to established age-matched normal control data confirmed that our model could normalize a Crouzon-Pfeiffer skull.

Conclusions: PCA was able to describe deformities associated with Crouzon-Pfeiffer syndrome and is a promising method to analyze variability in syndromic craniosynostosis. The virtual normalization of a Crouzon-Pfeiffer skull is useful to delineate the phenotypic changes required for correction, can help surgeons plan reconstructive surgery and is a potentially promising surgical outcome measure.

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A Virtual Reality Atlas of Craniofacial Pathology

Presenter: John H. Phillips

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Background: Craniofacial pathology is three-dimensionally complex. Education in craniofacial surgery outside of the operating room largely relies on 2D resources. Virtual and physical 3D resources for education and planning that do exist tend to be prohibitively expensive. Here, we present a freely accessible online library of 3D craniofacial pathology detailing all major conditions likely to be encountered. These models can be used for any educational purpose in their virtual form, or 3D printed for physical manipulation.

Methods: The Hospital for Sick Children's extensive CT scan library of pathological skull anatomy was surveyed, and scans representative of all the craniosynostoses and major syndromes were selected. The DICOM data for each scan was used to construct a polygonal skull model in Amira (FEI, Oregon, USA). The polygonal models were then optimized in Mudbox and Maya (both from Autodesk, California, USA) and uploaded to create an online library of craniofacial pathoanatomy.

Results: A virtual reality library of all major craniofacial pathological conditions was designed. This library is available for *gratis* access on the internet. The user can interact with the models in 3D in real-time online. Additionally, the models can be downloaded at no charge. Once downloaded, the models can be used for virtual surgical simulations or printed in 3D for use as physical references or to illustrate, practice, or develop novel techniques in craniofacial surgery.

Conclusion: This paper presents the first open-source repository of 3D craniofacial pathoanatomy. These models can be used as online educational aids, downloaded for use in virtual surgical applications, or 3D printed for use as physical references. By making these models a freely available online resource, we hope to encourage a global exchange of ideas as craniofacial surgery continues to evolve.

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Evaluation of Fronto-Orbital Advancement for Coronal Synostosis using a 3D Statistical Shape Model

Presenter: Benjamin C. Wood

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Purpose: Current surgical approaches for cranial vault reconstruction (CVR) are based on qualitative measures. We aim to develop a method that enables the precise, quantitative comparison of cranial shape before and after CVR in order to determine the efficacy and durability of specific reconstructive techniques.

Methods: Computational analysis was performed of craniosynostosis subjects using a previously validated proprietary software platform. Statistical shape models were constructed using principal component analysis from a normative multi-atlas of 92 patients with CT scans acquired from an institutional imaging repository. Patients who underwent front-orbital advancement (FOA) for the treatment of coronal synostosis were compared to the mean shape (MS) and closest normal (CN) shape in the multi-atlas. The mean and standard deviation of the deformation fields (point-wise distances) were obtained for each of the cranial bones to provide quantitative assessment of postoperative shape normalization.

Results: A total of 16 CT scans for 6 patients with coronal synostosis who underwent FOA were analyzed using the automated system. Mean age at surgery was 5.6 months and mean postoperative follow-up CT scan was 30.9 months. Calculated point-wise distances and deformation fields demonstrated greater postoperative reduction in mean cranial malformation in relation to the MS compared to CN shape. The degree of improvement at the point of maximal deformation correlated directly with the severity and laterality of coronal synostosis. Variable degrees of cranial asymmetry resolution were noted long-term.

Conclusion: The results of this study validate the use of automated statistical shape analysis for the quantitative evaluation of the postoperative outcomes after FOA. In the absence of quantitative shape analysis for surgical planning, the surgeon aims to achieve a mean normal shape of the cranium rather than the closest normal shape. Utilization of these metrics would facilitate planning that achieves the closest normal shape rather than the population average. Additionally, valuable insight regarding relative efficacy and durability of specific techniques in CVR would shorten operative time and anesthetic duration, while optimizing long-term outcomes.

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Automatic construction and landmarking of 3D facial models to define population means and variation

Presenter: James A. Booth

Authors: Booth JA^{1,2}, Zafeiriou S¹, Roussos A¹, Ponniah AJT², Dunaway DJ²¹Imperial College London, UK, ²Great Ormond Street Hospital, UK

Introduction: Quantitative analysis of facial form is essential to describing variation in populations and for craniofacial surgical planning and outcome assessment. Manual morphometric measurements although accurate are time consuming making large population studies impractical.

We present the first fully automated accurate system for bringing large databases of raw 3D facial scan into dense correspondence.

Method: 12,000 high definition stereophotogrammetric facial images acquired from the general population at the London science museum (MEIN3D) were analyzed.

For each facial mesh, a set of landmarks are reliably localized using facial point localization algorithms on synthetic images of the 3D surface taken from virtual cameras positioned around the subject. These landmarks are projected to the 3D surface via a depth map, and used to initialize a non-rigid Iterative Closest Point (N-ICP) algorithm, which registers each facial mesh with a pre-defined template. Iterative re-fitting of the dense correspondences from an initial pass-through of the algorithm refines the correspondence to high degree of accuracy.

Landmark precision was assessed by comparison with a manually landmarked subset of the data.

The correspondences produced were used to construct a dense facial model by applying Principal Component Analysis (PCA) to the registered surfaces. Standard anthropometric measurements (Farkas) were automatically calculated and along with PCA were used to describe the variation within and between subsets of the studied population.

Results: High levels of agreement were seen between automated and manual landmarking. Ethnicity, age and sex all significantly affected morphometric mean values and variation.

Discussion: The ability to automatically create detailed accurate facial models from large study samples allows subpopulation facial characteristics to be accurately described. The information derived enables the construction of personalized surgical plans and outcome measures.

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Digital Image Correlation: A Novel 3-D Technology for Precise Dynamic Facial Analysis

Presenter: Anthony J. Wilson

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Background: Facial reanimation provides patients with facial palsy the ability to generate facial movement and therefore communicate emotions; however, results are often criticized as incomplete or unnatural. There is little reliable objective data for outcomes analysis of facial reanimation. This is largely secondary to a lack of proper means to objectively and quantitatively evaluate the dynamic face. This pilot study introduces Digital Image Correlation (DIC) and speckle tracking as a novel technology for precisely quantifying the re-animated face during dynamic activity.

Methods: A prospective pilot study of children aged 4-20 years with and without facial motion pathology was conducted at a tertiary referral children's hospital. After complete facial coverage with speckle make-up, patients were asked to make an "open-mouthed" smile for 5 seconds. Average major (vertical) and minor (horizontal) strain was calculated for each side of the face using DIC. Each hemiface was then compared with the contralateral side and a precise percentage of facial asymmetry between sides was determined.

Results: A total of 10 patients were recruited into the pilot phase of this study, 6 cases and 4 controls. In the affected group there was a 45.9% minor (horizontal) strain asymmetry and 45.94% major (vertical) strain asymmetry. In control patients there was an 8.78% minor (horizontal) strain asymmetry and 8.56% (vertical) asymmetry. The difference between affected group and controls were strongly statistically significant between the minor strain ($p < 0.01$) and the major strain ($p < 0.01$) during smiling.

Conclusions: We present DIC with speckle tracking as a novel mechanism of objectively and precisely quantifying facial motion of the animated face. As our surgical and medical approaches towards facial palsy expand, it is essential we have a means to compare results and improve patient outcomes.

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Optical coherence tomography can detect intracranial hypertension in young children with craniosynostosis

Presenter: Jordan W. Swanson

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Background: Detecting intracranial hypertension (ICH) in children with craniosynostosis may enable timely intervention to prevent neurocognitive impairment, but is invasive and often equivocal with conventional methods. Optical coherence tomography (OCT) can noninvasively quantify retinal thickness using high-resolution ultrasound. We study whether OCT can reliably measure retinal thickness in children with craniosynostosis, and whether findings correlate with intracranial hypertension.

Methods: Children with craniosynostosis were prospectively evaluated with OCT immediately before cranial vault expansion and again at any later operative procedures. Negative control (without cranial pathology) and positive control patients (with known ICH) were similarly evaluated. When indicated by the neurosurgical team, patients underwent direct intracranial pressure (ICP) measurement.

Results: Sixty-six retinas in 33 children with craniosynostosis underwent OCT prior to cranial vault remodeling, at a median age of 9.6 months (range 3 months-13 years.) ICP was directly measured in 12 patients. An additional 16 retinas were evaluated in 6 negative and 2 positive control patients. We determined that anterior retinal deviation and retinal nerve fiber layer (RNFL) thickness were both significantly associated with elevated ICP (each $p < 0.001$). Increasing RNFL thickness was also associated with increasing patient age ($p = 0.003$), although when controlling for age in a multivariate analysis, increasing RNFL thickness was still independently associated with increasing ICP ($p < 0.001$). All patients treated under 1 year of age exhibited ICP below 15mmHg, which we considered the upper limit of normal, whereas 63% of older patients had elevated ICP ($p = 0.04$.) After craniectomy, ICP decreased by a mean 9.9mmHg ($p < 0.0001$). Patients without ICH had maximum RNFL thickness of 80 μ ; setting this as the high normal cutoff point yielded 77% sensitivity and 100% specificity. When this test was applied to our craniosynostosis cohort, 6 (18%) showed evidence of ICH. Preoperative diagnosis of papilledema was only 50% sensitive for retinal thickening on OCT.

Conclusion: Optical coherence tomography can objectively identify retinal thickening in young children with craniosynostosis, and may enable earlier detection of ICH.

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3D planning in orthognathic surgery: Addressing the lower third of the facial asymmetry patient

Presenter: Daniel Lonic

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Background: No face is completely symmetric. However, facial asymmetry is most evident in the lower third of the face. In contrast to conventional 2D methods, 3D planning offers great possibilities for addressing especially the ramus and chin areas of the mandible.

Patients and Methods: 30 facial asymmetry patients were planned using 2D methods by orthodontists for double-jaw orthognathic surgery. 3D simulation of the surgery was performed and modifications of the plan were made. The final plans were evaluated and approved by the treatment team regarding maxillo-mandibular complex position as well as overall facial harmony, especially in the lower third of the face.

Results: The large majority of patients had an altered treatment plan in accordance with the orthodontic department. Bony collisions of the proximal and distal mandibular segments as well as asymmetry issues could be addressed effectively before the surgery. Surgical procedures could therefore be formulated.

Conclusion: 3D planning shows superior possibilities over 2D methods when dealing with facial asymmetry of the lower third of the face.

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The Use of Multi-surface 3D model in the Field of Craniofacial Surgery—Diagnosis, Surgical Planning and Assistance

Presenter: Thomas Mon-Hsian Hsieh
 Authors: Hsieh TM^{1,2}, Liu TJ¹, Ko A¹, Chen M¹, Wong J²
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Background: With the advance of medical imaging instruments and computer hardware, the role of medical imaging study has now expanded beyond the scope of diagnosis, and into the domain of surgical planning and assistance.

In this presentation, we will introduce how we use the new generation 3-D image visualization technique, the multi-surface image model, in craniofacial surgery. This technique can generate semi-transparent surface over our 3D craniofacial model, and demonstrate the outline of the craniofacial area and visualize the inner detail as well.

Method: In the past 8 years, more than 80 image series over the craniofacial area were generated for study.

At first, this model was only for demonstrating the relation between the bone and related soft tissue. The emergence of the surgical navigation system had made the best of this modeling technique, and provide intra-surgical guidance in craniofacial surgery.

A special group, most of them MRI images of the craniofacial soft tissue tumor, went through complicated image analysis procedure, before render in to the 3D model. Because the margin of these tumors usually cannot be readily demonstrate by traditional 3D imaging, and need to be pre-processed before clinical use.

Result: We found the multi-surface 3D model is efficient in documenting the pre-op diagnosis and post-op follow-up. The use of navigation system based on this model provides more precise positioning in craniofacial surgical reconstruction. The resection of craniofacial diffuse soft tissue tumor benefit from this model as well, as it provide more clear tumor margin, and in 3D fashion, thus facilitate more precise tumor resection, and avoid damaging to surrounding important structures.

Conclusion: We think the advanced medical imaging technique, like the multi-surface 3D model we presented here, is effective in diagnosis and surgical assistance in the field of craniofacial surgery. This technique could readily be combined with other new technologies, like 3D-printing, and the potential of future development is promising.

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The Turricephaly Index—A Quantifiable Measure of Turricephaly by a Validated Radiological System

Presenter: Benjamin Way
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Introduction : Syndromic causes of multisutural craniosynostosis frequently result in a turricephalic head shape. We present a Turricephaly Index (TI) to aide in surgical planning, monitoring and communication, similar to the widely used cranial index.

Materials and Methods: This single centre radiological study utilized images from the 3D computerized tomography (CT) scans of 42 Apert Syndrome patients and 42 matched normal controls. Data were exported in DICOM format to both the Centricity operating system (used to analyse the scout image alone) and Osirix (for validation by full analysis of all scan data). Four measurements were recorded from CT scans: the maximal antero-posterior (AP) distance, the vertical height from sellae turcica to the highest bony point on the calvarium (Hi), the AP/Hi angle of intersection, and the vertex position in the AP plane. The TI was recorded as the ratio of AP:Hi.

In addition, 21 Apert patient TIs were tracked at multiple timepoints following posterior vault expansion.

Results: TI calculated from the Centricity scout image for normal controls averaged 1.73 (range 1.46-1.98), while Apert patients averaged 1.41 (range 1.14-1.78). The same measurements repeated in Osirix (on 3D MPR reconstructions with heads orientated in neutral position) showed excellent relative Pearson correlation to the scout and no statistically significant differences in means (p<0.05). Expectedly, the control vs. TI groups were statistically different (p<0.0001). Following posterior vault expansion Apert patients demonstrated an increase in TI trending towards normal.

Conclusions: The Turricephaly Index provides a method to quantify subjective clinical assessment of head shape in craniofacial patients. Simple measurements made on a scout image (as validated in this study) can be easily carried out in a clinic setting. The progress of the TI over time guides treatment, surgical planning, and communication amongst colleagues.

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3D modelling. It's role in the assessment of deformity and planning reconstruction.

Presenter: David Dunaway

Authors: Dunaway DJ^{1,2}, Ponniah AJT¹, Koudstaal MJ⁴, Borghi A², Booth JA³, Evans RE¹, Ruff CF⁵, Angullia F¹, Schievano S², Zefariou S³, Jeelani NUO^{1,2}¹Great Ormond Street Hospital for Children, UK, ²Institute of Child Health, UCL London, UK, ³Imperial College London, UK, ⁴Erasmus Medical Centre, the Netherlands, ⁵University College London Hospital, UK**Introduction:** Measuring distances, and angles between homologous points on the face or skeleton can partially describe facial form. It defines how specific aspects of a subject differ from population averages. It does not provide a global description of shape and thus has limited value in planning correction of complex deformities.

Three-dimensional (3D) detail of the face and skull is provided by CT and stereophotogrammetry. This information can describe anatomical variation using a combination of point based geometric morphometrics and principle component analysis (PCA). The resultant statistical models define the limits of variation within populations and can be used to plan surgery and assess outcome.

Method: A statistical model of facial variation in the general population was constructed from 10,000 3D facial images (MEIN3 D).

Normal skull data was analysed from CT scans of patients without craniofacial anomalies and skulls in historical collections.

CTs from 100 patients with syndromic facial anomalies were analysed.

A combination of manual and automatic landmarking registered the large datasets. A procrustes superimposition aligned the data, which was then analysed. Population means were defined and variations from the mean defined by PCA.

The resultant models quantify variation in craniofacial form within and between populations. The models were used to construct best possible shape changes for individual patients and constrained so that only surgically possible changes were permitted.

Results: Geometric morphometrics and PCA quantify abnormalities in craniofacial form. The technique is most effective in single gene anomalies (eg. Apert and Treacher Collins syndrome).

The PCA driven process planned best-fit surgical solutions taking into account areas of the facial skeleton that cannot be changed (eg. Skull base)

Discussion: Accurate quantification of 3D changes needed to correct deformity refines surgical technique and provides an effective outcome measurement.

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A Comparison of Mandibular Distraction Vector Effect on Airway and Mandibular Volumes in Pierre Robin Sequence

Presenter: Elizabeth G. Zellner

Authors: Zellner EG¹, Mhlaba BS JM², Reid RR², Steinbacher DM¹¹Yale University School of Medicine, USA, ²University of Chicago School of Medicine, USA**Background:** The goal of mandibular distraction in Pierre Robin Sequence is to maximally expand the oropharyngeal airway. It has been hypothesized that a steep oblique distraction vector may allow greater airway enlargement. This study compares sagittal versus oblique vectors to assess vector correlation with eventual airway volume.**Methods:** IRB approval was obtained from two institutions. Micrognathic infants who underwent mandibular distraction with pre- and post-op CT scans were included. Demographic, diagnostic, perioperative data and distraction protocol, including vector relative to the mandibular border, were recorded. Airway and mandibular volumes were measured using Mimics (Leuven, Belgium). Statistics involved two-tailed t-test and Pearson correlation.**Results:** 40 CT scans were analyzed. Mean distraction age was 41 days with devices maintained 82 days on average. Vector axis from the inferior mandibular border was ≤ 10 degrees in group 1 (n=10), and >10 degrees in group 2 (n=10). Airway and mandibular volumes, minimal airway area, and PAS distance were all significantly increased following distraction. Inter-group analysis showed no difference in airway measurements (no vector correlation to airway). However, mandibular volume was increased in the oblique group, approaching significance (p=0.07), attributable to greater ramus volume (p=0.03), with similar body volumes between groups. Clinically, patients had improved sleep studies post-distraction.**Conclusions:** Significant airway enlargement occurs following mandibular distraction. An oblique vector does not result in a greater volumetric airway increase compared to sagittal elongation, but does confer modest increase in ramus volume. Successful clinical outcomes are achieved using both trajectories. Further work will assess vector influence on overall mandibular morphology and presence/persistence of open bite.

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3D CBCT Volumetric Outcomes of rhBMP-2/MS vs Iliac Crest Bone Graft for Alveolar Cleft Reconstruction

Presenter: Fan Liang

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Background: Recent studies suggest that recombinant human bone morphogenic protein (rhBMP)-2 encased in a demineralized bone matrix scaffold (MS) is a comparable alternative to iliac crest bone grafting for secondary alveolar cleft repair. Post reconstruction occlusal radiographs are used to measure bone reconstitution but cannot evaluate bony growth in three dimensions. In this study, we use Cone Beam Computed Tomography (CBCT) to provide the first volumetric comparison of bone fill between rhBMP-2/MS and iliac crest grafts.

Methods: A prospective study was performed to include 55 patients undergoing secondary alveolar cleft repair over a 2 year period. 38 patients received rhBMP-2/MS and 17 patients underwent iliac bone grafting. Postoperatively, occlusal radiographs were obtained at 3 months and CBCT at 6-9 months. Bone stock was evaluated on occlusal radiographs using the Bergland rating scale and AMIRA[®] software was used to obtain volumetric data on CBCT images.

Results: At 3 months, post-operative occlusal radiographs demonstrate that 67% of patients receiving rhBMP-2/MS had complete bone fill vs 56% of patients in the iliac bone graft group. In contrast, 3D volumetric analysis using CBCT data at 6 to 9 months showed that patients in the rhBMP-2/MS group had on average 31.6% (95% CI: 24.2-38.5%) bone fill compared with 32.5% (95% CI: 22.1-42.9%) in the iliac bone population.

Conclusions: These data demonstrate comparable bony regrowth in alveolar cleft defects using rhBMP-2/MS vs. iliac bone graft. This study, which is the first to perform 3D volumetric analysis of alveolar cleft repair between two treatment modalities, demonstrates that complete fill on occlusal radiographs does not indicate full bony reconstitution as seen on CBCT images. We believe that CBCT will provide a more nuanced understanding of temporal and spatial events in bone regeneration in alveolar cleft repair as well as in other geometrically complex problems in craniofacial reconstruction.

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Evolution of facial shape change during frontofacial distraction surgery

Presenter: Freida Angullia

Authors: Angullia F, Borghi A, Schievano S, Jeelani NUO, Dunaway DJ

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Introduction: Frontofacial distraction surgery corrects mid-face retrusion associated with syndromic craniosynostosis. Unpredictable shape changes to facial anatomy during distraction challenge judging outcomes of surgery. Correlation of facial surface change to distance of distraction quantifies shape changes observed during the distraction process.

Method: Serial 3D facial surface scans (Rodin4D) were performed on 7 patients undergoing frontofacial surgery followed by RED frame facial distraction. Scans were performed pre-operatively, before frame, during distraction and after frame removal. Mean differences of surfaces were measured between time points and correlated with bony distraction distance. Whole face, forehead-brow, malar, nasal and lower-facial regions were assessed.

Results: There was significant on-table advancement of 11mm for the forehead-brow region. Fronto-orbital level distraction yielded 1mm malar and nasal advancement, with 1-2mm relative reduction in exorbitism. Maxillary level distraction produced 4-5mm of malar and nasal advancement, with 0.5-1 mm of exorbitism correction. A reduction in facial advancement occurred between the end of distraction to frame removal. The soft tissue to bony movement ratio is approximately 0.01 for forehead-brow, 0.06 for orbits, 0.24 for malar, 0.29 for nasal, and 0.03 for lower-facial regions.

Discussion : This study quantifies fronto-maxillary advancement and exorbitism correction in frontofacial distraction surgery for multisutural craniosynostosis. Most fronto-orbital advancement occurs at osteotomy release whilst maxillary advancement occurs more at post-operative distraction. The overlying soft tissues move differentially from underlying bone making distraction difficult to predict probably due to device strain and skin elasticity.

Conclusion: The ratios provide a guide to quantify soft tissue outcome from bony distraction. The process, however, remains unpredictable and at this stage still requires iterative judgement for optimal surgical outcome. Over-distraction may be required to compensate for post-distraction retraction of tissues.

POSTERS

p-1

Surgical treatment for craniosynostoses in infants

Presenter: German V. Letyagin

Authors: Letyagin GV^{1,2,3}, Amelin M², Danilin V¹, Kim S¹, Sysoeva A¹, Rzaev D³

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Purpose: To estimate results of different surgical approaches to craniosynostoses treatment.

Materials and Methods: In the period of 2013-2014 year. 30 patients with craniosynostoses underwent operation at the age 3 to 12 months. Scaphocephaly was in most cases (12 cases), methopic synostosis was in 10 cases, left-sided anterior plagiocephaly in 1 case, combination of scaphocephaly and double-sided in 2 cases, other complex combinations of craniosynostoses 1 case per each, also there was 2 cases of complex syndromal craniosynostoses (Pfeiffer and Aperta).

MDCT was performed in all patients with 3D volume rendering, which allowed to see in details type of craniosynostosis and to plan operation tactics. Anterior plagiocephaly In all patients open cranial reconstruction was performed. In case of methopic craniosynostosis in 11 patients reconstruction of orbital complexes was performed. In 2 cases (Pfeiffer's syndrome and anterior plagioscapocephaly) reconstruction was performed in two steps with 3 month interval. Taking into attention that the blood loss took place in all cases there was blood and plasma during operation and after it. No complications were in early post-operative period.

Results: in all cases cosmetic problem of skull was reconstructed, normal ratio of skull bones and orbital complexes were formed. In all patients subarachnoid spaces could be easily traced, intra-cranial volume was not differ from typical volume in normal infants.

Conclusion: Surgical treatment of craniosynostoses require individual approach depending on age type and manifestation of pathology. Use of 3D volume rendering in different cases of craniosynostosis allows to estimate intracranial volume before and after operation, and to estimate results of operation.

p-2

Ophthalmologic Outcomes following Fronto-orbital Advancement for Unicoronal Synostosis: A Review

Presenter: Michael Bezuhly

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Background: Patients with unilateral coronal synostosis (UCS) have an increased incidence of significant refractive error, oculomotor abnormalities and amblyopic visual impairment. Although fronto-orbital advancement is frequently performed for treatment of UCS, its effects on ophthalmologic function are unclear. This systematic review examines the effect of fronto-orbital advancement on ophthalmic outcomes in patients with UCS.

Methods: Computerized database searches were performed of Pubmed, EMBASE, CINAHL, Cochrane databases. Studies reporting ophthalmologic outcomes in children with UCS in whom the surgical intervention was fronto-orbital advancement were included.

Results: A systematic search revealed 12 studies that satisfied inclusion criteria, 11 of which were retrospective case series. Five studies reported on pre and post-operative strabismus rates. Six studies reported on the incidence of post-operative amblyopia. In general, strabismus persisted in patients post fronto-orbital advancement. Three studies reported on the development of new onset strabismus following surgical repair. It is unclear, however, whether or not these patients developed amblyopic visual impairment related to persistent oculomotor dysfunction. Additionally, patients with UCS demonstrated higher rates of refractive errors and amblyopia, but the temporal relationship to fronto-orbital advancement was reported in only one study.

Conclusions: Patients with UCS demonstrate higher rates of strabismus, refractive errors and amblyopia than the general population following fronto-orbital advancement. This review emphasizes the need for prospective studies and long-term ophthalmologic surveillance in these patients to better define the effect of frontal-orbital advancement on ophthalmologic outcomes.

p-3

Use of the predictive formula for cranial distraction osteogenesis in craniosynostosis

Presenter: Kazuaki Yamaguchi

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Background: Compared to conventional Fronto-orbital advancement (FOA), cranial distraction osteogenesis (CDO) allows gradual bone tissue regeneration in the distracted area, indicating that all bones are totally vascularized from the attached dura. We have reported the original formula to predict a postoperative cranial expansion and following cranial growth. To show the effectiveness of CDO and the formula, we conducted the present study on infants with syndromic craniosynostosis.

Materials and Methods: The study included infants who underwent primary cranial distraction for bicoronal craniosynostosis between March, 2013 and Jun, 2014. Distraction was initiated after a 7-day latency period. The distraction rate was routinely 0.5-1 mm/day. The amount of distraction was determined by the following formula. After achieving the target length, residual shafts over the skin were resected, and the distractors were maintained for 12 weeks after the procedure.

Target volume (ml)=Abbott formula+(-66.66 ln (operative age in months+1) +257.42)

These CT data were analyzed using Mimics[®] software to calculate cranial volumes. We defined the close space surrounding by the bony structure as an intracranial volume, and plotted the each volume on the Abbot standard cranial growth curve.

Results: CDO was performed in 4 infants. The infants' mean operative age was 9.2 months (range, 5.7-12.5 months). One infant with Crouzon syndrome, one with Saethre-Chotzen syndrome, and two with atypical syndrome were included. Two cases achieved the target volume calculated by the formula, and showed gradual growth curve compatible with the formula curve. However, the other two cases which did not complete distraction for technical problems showed gradual inclining curves compared to target volume formula.

Conclusion: Use of the predictive formula for cranial distraction osteogenesis was applicable and effective to set the target cranial volume at each operative age.

p-4

Isolated sphenosphenoidal craniosynostosis-first case report and comparison with other craniosynostoses

Presenter: Robert M. Menard

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Purpose: The involvement of the basilar coronal ring has been well described in the deformity associated with unilateral coronal synostosis. Previous studies have documented the involvement of the frontosphenoidal suture in the development of frontal plagiocephaly, both in concert with the coronal suture as well as in isolation, and have described secondary growth restriction along patent sutures collinear with it. Presented is a 3 month old infant with isolated sphenosphenoidal craniosynostosis and the clinical, radiographic, and surgical findings associated with it; its similarities and differences with unicoronal and frontosphenoidal craniosynostosis are highlighted.

Case Report: The patient presented as a 3 month old infant with significant left supraorbital rim retrusion and left temporal bulging. He was a 2.7 kg twin product of a 37 week gestation to a 31 year old G1P1 mother; the other twin was unaffected, and there was no family history of craniofacial disorders. Genetic testing of exon 10 of the FGFR1 gene, exons 8 & 10 of the FGFR2 gene, exons 7 & 10 of the FGFR3 gene and TWIST1 was negative for detectable mutations. 2D and 3D CT analysis revealed patent sagittal, coronal, lambdoid, and frontosphenoidal sutures, with isolated fusion of the greater and lesser wings of the sphenoid on the left, seen both intraorbitally as well as between the anterior and middle cranial fossae. A 0.5 degree deviation of the endocranial base angle to the left, affected side was observed. The orbital angle of 30 degrees on the affected side was similar to that seen in isolated frontosphenoidal synostosis in previous studies.

Treatment: The infant was treated for 3 months pre-operatively with a cranial orthosis, resulting in a significant improvement of the cranial vault asymmetry. At 6 months of age he underwent frontoorbital advancement and calvarial vault remodeling.

Conclusion: Presented is the first case of isolated, intraorbital sphenosphenoidal craniosynostosis. Clinical findings differ from unicoronal and unicoronal + frontosphenoidal craniosynostosis, with transverse elongation of the affected orbit and inferolateral displacement of the zygoma with pronounced temporal bulging. Early use of pre-operative orthoses can help address some of the cranial asymmetry seen with the condition.

p-5

Tracheal Cartilaginous Sleeve in Syndromic Craniosynostosis

Presenter: Edward P. Buchanan

Authors: Buchanan EP¹, Pickrell BB²

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Background: The tracheal cartilaginous sleeve (TCS) is an airway malformation in which individual tracheal arches are not formed. TCS has been associated with craniosynostosis syndromes such as Crouzon disease, Apert syndrome, and Pfeiffer syndrome. Previously, TCS has been incidentally discovered via nasal endoscopy to assess respiratory difficulties in these patients but true incidence of this airway malformation remains uncertain in the context of our syndromic craniosynostosis patients.

Methods: Retrospective chart review was performed using our prospectively maintained TCH craniofacial database on patients diagnosed with syndromic craniosynostosis. Patients with nasal endoscopy reports were specifically selected and said reports were evaluated to assess for the presence or absence of tracheal sleeve. Information was also gathered regarding: type of craniosynostosis, age at diagnosis, presence /absence of respiratory distress at time of nasal endoscopy, associated comorbidities /anomalies, and subsequent intervention (e.g. tracheostomy).

Results: 26 patients were found to have a diagnosis of syndromic craniosynostosis in our TCH database. 35% (9 patients) were found to have previous endoscopy reports (2 Crouzon, 3 Pfeiffer, 3 Apert, 1 Muenke). Of those evaluated with endoscopy, ~1/3 were found to have some evidence of tracheal sleeve. The vast majority (89%) of endoscopy reports were ordered and analyzed in the past 2 years.

Conclusion: Many patients with a diagnosis of syndromic craniosynostosis present with signs of airway obstruction. It is important for clinicians to be cognizant of associated upper and lower airways congenital anomalies (eg TCS) in these patients and to diagnose these anomalies early. Early detection with appropriate intervention is essential to improve the survival of patients with syndromic craniosynostosis who also have TCS. Understanding the incidence of TCS in this patient population will improve early detection and intervention.

p-6

CALVARIAL VAULT RECONSTRUCTION: TECHNICAL MODIFICATIONS IN AN INDIAN CONTEXT

Presenter: Derick Mendonca

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Introduction: Craniosynostosis is a premature fusion of the growing cranial suture resulting in head deformities. Anterior craniosynostosis (metopic/uni/bicoronal) is more common in India, as compared to sagittal suture. Calvarial Vault Reconstruction(CVR) is the standard surgical treatment. The aim of this paper is to investigate and document outcomes of craniosynostosis treatment in a new craniofacial unit in Bangalore, South India.

Methods: A prospective study of all craniosynostosis patients treated from Jan 2014 to Jan 2015 was conducted. Pre and post-operative data were collected and analysed.

Results: A total of 10 patients were diagnosed with craniosynostosis. Four patients presented late, while 6/10 patients underwent surgery(CVR). The mean age at surgery was 12 months. One patient had isolated metopic, 3 patients had metopic and coronal, 1 patient bicoronal and 1 patient had sagittal synostosis. The mean length of stay in PICU was 1 day. Mean blood loss during surgery was 250ml. Head circumference increased by 2.5cm. One patient developed a CSF leak which settled conservatively. Technical variations in an Indian context are presented and discussed. Strategies to create awareness and education of craniosynostosis are offered.

Conclusion: Calvarial vault reconstruction can be offered to Indian patients in a safe, reliable and cost effective manner.

p-7

The Long Term Perioperative Review of Our Fronto-orbital Advancement and Reshaping for Trigenocephaly

Presenter: Ayaka Deguchi

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Background: Trigenocephaly is a type of craniosynostosis, which results from the premature fusion of the metopic suture that leads to forehead deformity and hypotelorism. By applying our standard frontal configuration data, we have been performing fronto-orbital advancement and reshaping as a surgical treatment for trigenocephaly since 1997. Upon evaluation of the improvement of the forehead configuration, it was found that the long term postoperative review of the periodic change in the measurement of the forehead and eyeball position had never been reported. Using several parameters, we report the perioperative change in the measurement of the forehead configuration of trigenocephaly treated by fronto-orbital advancement and reshaping.

Methods: Applying the standard frontal configuration data reported in 1991, we performed fronto-orbital advancement and reshaping to the patients with trigenocephaly from 1997 to 2014, and periodically analyzed the forehead configuration using helical CT scan. Using Mimics software, we measured the preoperative, postoperative, and the most recent data of endocranial bifrontal angle (ECA), interzygomaticofrontal suture distance (ZF), and interdacyon distance (ID). The periodic change in the shape of the forehead and eyeball position was then analyzed through the comparison of the data in the controlled groups for each parameter.

Results: There were 4males and 2 females, and the range of age at the time of the operation was from 7months to 68 months with a mean of 28 months. There was no significant difference when comparing the controlled data to the postoperative and the most recent measured data of ECA, and ZF. Therefore, it can be concluded that the frontal configuration improved by surgery with no long term regression. There was no significant change in the preoperative and postoperative data of ID, but a gradual increase in ID was evident long term, concluding that the operation was not invasive for the eyeball distance.

Conclusion: Our method for fronto-orbital advancement and reshaping led to the improvement of the frontal configuration in all cases, which indicates the efficacy of this surgical treatment for trigenocephaly.

p-8

Refinement of the osteotomy for a distraction osteogenesis for the dolicocephalic deformities

Presenter: Hiroyuki Iwanaga

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Scaphocephaly is the most common simple craniosynostosis, but morphological condition of its distortion is too varied to choose standard-type of osteotomy, compared to the other type of craniosynostosis.

Philosophy of the surgery for the cranial expansion and morphological repair is summarized as follows; 1)to correct shorten the anterior-posterior length, 2)to widen the lateral narrowness, 3)and to improve CI with above procedures. According to a severity of the deformity may require those osteotomy -or ostectomy-design and length and direction.

In the last decade, 11 cases of surgical correction of dolicocephalic deformities-8 scaphocephalies and 3 oxycephalies-were underwent in our unit. Basic procedure is mentioned with representative case illustrations; bi-coronal strip bandectomy is done variably by its tightness and concaveness and CI, then bi-lateral square shaped pantonematic osteotomies and set a couple of distractors symmetrically. And wedged ostectomy is done on metopic keel region, because of its narrowed and convex frontal bone.

The distraction is started usually on three days post-operatively, and an extent of elongation is decided with a distortion and an estimation of extradural space during lengthening. AP distance is being gradually improved compensatory during the widening distraction. Two frontal bone flaps slightly attached medial supraorbital area is also being flattened smoothly day by day. If the deformity is not too saddle-shaped and projected frontal bossing and downwarded inion, an extensive maneuver should be avoided. The procedure detailed above effectively leads the better results.

No case out of 11 surgeries has been needed another or further operation in approximately 4years follow-up.

p-9

Total reduction cranioplasty for the treatment of scaphocephaly accompanying cranial expansion

Presenter: Shinichiro Hashiguchi
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Objectives: In cases of craniosynostosis, the greatest problem is to be increased intracranial pressure, which leads to pressing the brain. However, another significant problem is the reduced QOL arising from lack of cosmetic form. In this case, we performed total reduction cranioplasty to treat scaphocephaly accompanying cranial expansion resulting from hydrocephalus, achieving an almost completely satisfactory form. The purpose of this study is to consider the possibility or otherwise of reducing the size of the cranium in this type of case.

Case: The subject was a young boy aged 2 years and 10 months, who was fitted with a V-P shunt to treat hydracephalus 20 days after birth. His mental development was normal, but at 2 years 4 months, scaphocephaly was noted. Cranioplasty was scheduled, mainly for cosmetic formation reasons. The procedure preserved the shunt, and reconfigured the cranium bone, shortening the height and anteroposterior diameter, while lengthening the left-right diameter. Overall, the operation reduced the volume of the cranium and post-surgical cerebral hernia was a concern. However, the patient made good progress. The patient and his parents are extremely satisfied with the improvement to the cranial form.

Observations: There are few reports of cases such as this one, in which the procedure was conducted to reduce the volume of the cranium, and in such cases, it is considered that there could be various complications such as an increase of intracranial pressure. In this operation, the volume of the cranium was reduced to approximately 90% of what it had been prior to the procedure. The fact that this level of reduction did not lead to complications is thought due to the V-P shunt. Even if the cranium size is reduced, provided cerebrospinal fluid can be emitted from the V-P shunt, it is possible to avoid rising intracranial pressure. However, we need to consider the extent of reducing the size of the cranium.

p-10

Metopic synostosis: The evolution of surgical management in a single unit's 20-year experience.

Presenter: Tomas O'Neill
Authors: O'Neill T, Bellew M, Chumas P, Russell J, Liddington M

Leeds General Infirmary, UK

Metopic synostosis is the third most common form of craniosynostosis but the most frequent single suture synostosis associated with adverse neurodevelopmental sequelae (Meulen, 2009). Surgical correction is generally advocated within the first year of life in order to mitigate this (Shilito 1968).

We present a review of the surgical management of 132 cases of single sutural non-syndromic Metopic Synostosis in our unit. We describe a gradual evolution from Marchac's technique (Marchac 1978), to that of David's technique, detailing some modifications of our own, over a 20-year period.

We examine the developmental and behavioural outcomes following both techniques. Surgical results are illustrated with radiographs and photographs and evaluated using the Whitaker classification and compared (Whitaker 1987). We further characterize outcomes based on parental and surgeon satisfaction scores.

p-11**A novel osteogenesis distraction system enabling control of distance and vector for syndromic craniosynostosis**

Presenter: Shinji Kobayashi

Authors: Kobayashi S¹, Fukawa T², Hirakawa T³,
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Distraction osteogenesis is now an important clinical tool in craniofacial surgery. However, controlling the distance and vector of distraction in infants with syndromic craniosynostosis with good repeatability is a task that still proves difficult today.

We have developed a new hybrid facial osteogenesis distraction system that combines the advantages of external and internal distraction devices to enable control of both the distraction distance and vector.

We describe the method and short-term results of this system.

Our distraction system uses both a conventional external distraction device and a newly developed internal distraction device. Postoperative control of the distraction vector is performed using the external device, while control of distraction distance is done with the adjustable-angle internal device.

This system was used for 11 patients with syndromic craniosynostosis (Crouzon 7, Apert 3, Pfeiffer 1 cases).

The system enabled control of lengthening distance and vector, and no major complications occurred during the procedures.

We developed a facial distraction system leveraging the advantages of external and internal distraction devices, which we then used to successfully control both lengthening distance and vector. The system would be particularly indicated in patients with severe scarring due to multiple follow-up surgeries and in patients requiring distraction of 25 mm or more.

p-12**Endoscopic Strip Craniectomy Yields Better Results than Pi Craniectomy for Treatment of Sagittal Craniosynostosis**

Presenter: Suresh N. Magge

Authors: Magge SN¹, Bartolozzi AR³, DeFreitas T¹,
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Background: There remains much controversy regarding the best treatment for sagittal craniosynostosis. We compared the open "Pi" craniectomy versus minimally-invasive endoscopic strip-craniectomy followed by helmet therapy. Our aim was to compare surgeries for sagittal craniosynostosis that are normally done at relatively young ages, and this is the first ongoing study to our knowledge that compares these two techniques. We compared the resulting cranial indices (CI) and examined effects of timing of surgery.

Methods: This IRB-approved, retrospective study included 52 patients diagnosed with non-syndromic, single-suture sagittal craniosynostosis who were treated between 2009-2014 at Children's National Medical Center with Pi-craniectomy (n=22) or endoscopic strip-craniectomy followed by helmet therapy (n=30). Patients included in the study had follow-up appointments more than 3 months after surgery.

Results: Average age at surgery was slightly younger for endoscopic patients (3.07 months) compared to Pi patients (4.93 months). Both groups started with statistically similar cranial index measurements, but endoscopic patients experienced a 13.3% increase in CI (CI=0.683 to CI=0.774) with average f/u of 1.5 years compared to Pi patients' 5.4% increase (CI=0.685 to CI=0.722) with average f/u of 2.5 years (p<0.001). Hospital stay (1.17 days vs. 1.91 days) and operation duration (69.2 minutes vs. 91.6 minutes) were shorter for endoscopic patients (p<0.05). Estimated blood loss (35.3 ml vs 47.95 ml) was less for endoscopic patients, resulting in a decreased intraoperative blood transfusion rate for endoscopic (16%) versus Pi (32%) patients. The results of endoscopic patients were better when their surgeries were done at younger ages (endoscopic+1.43%CI/month younger; Pi+0.39%CI/month younger), but their results were still better in absolute terms compared to Pi patients even when the endoscopic surgeries were done at older ages.

Conclusion: While both techniques were effective at treating sagittal craniosynostosis, endoscopic strip craniectomy showed superior results compared to Pi craniectomy. Younger age at surgery was more important for endoscopic cases for improved results, but endoscopic patients who had surgery at older ages still had better results compared to Pi patients.

p-13

Strategic Cranial Reformation with Distraction Osteogenesis in Sagittal Craniosynostosis

Presenter: Kyuwon Shim

Authors: Shim K¹, Lee MC^{2,3}, Park EK¹, Kim DS¹, Kim YO²

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Background: Distraction osteogenesis (DO) has been well known as a less morbid procedure than extensive cranial vault remodeling surgery. Authors applied different approach of the surgical design and distraction procedures according to types of cranial shape.

Methods: From June 2002 to 2013, forty-five patients of non-syndromic symmetric sagittal synostosis are enrolled. Patients were divided into three groups according to the type of surgical methods, Expansion-Compression (EC) group, Bitemporal Expansion (BE) group, and Expansion-Expansion (EE) group. In all groups, surgical procedures were accomplished by circumferential baseline osteotomy, mid-sagittal and bicoronal osteotomies, and then created 4 quadrant bone flaps were moved by distraction devices with dural attachment. Preoperative and postoperative CI, intracranial volume (ICV) and head circumference (HC) are analyzed for the shape and growth.

Results: For all patients there were no major complications. Preoperatively, CI showed significant discrepancy between EC (68.85±3.61) and other two groups (BE, 76.75±2.4; EE, 85.63±4.31). Postoperatively, CI showed significant alteration in EC (78.28±3.74, $p<0.05$) and BE (81±1.9, $p<0.05$) groups. Postoperative CI in all groups converged to the value of mesocephalic CI. For ICV, 85.2% (n=23) of EC were within normal range (±1 standard deviation; SD) and 66.7% (n=6) in BE were within normal range preoperatively, however, 77.8% (n=7) of EE were below -1SD preoperatively. Postoperatively, 92.6% (n=25) of EC and 77.8% (n=7) of BE showed values within normal range. Two patients in EE group (22.2%) showed ICV below -1SD postoperatively, and age adjusted ICV ratio changed from 0.83±0.14 to 0.98±0.12 with statistical significance. All patients in EC and BE groups exhibited HC within range from -1SD to 2SD. However, 66.7% (n=6) in EE group exhibited values lower than normal limit preoperatively, then 77.8% (n=7) was included in normal range on postoperative analysis.

Conclusion: The symmetrical sagittal synostosis can be treated effectively with strategic approach by the categorization of shape and circumferential cranial reforming by DO.

p-14

Correction of Sagittal Craniosynostosis with Distraction Osteogenesis Using Expansion and Compression**Procedure**

Presenter: Myung Chul Lee

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Background: Distraction osteogenesis is a surgical option and its effectiveness has been validated in sagittal craniosynostosis. We have conducted distraction osteogenesis utilizing expansion in combination with compression procedure, based on cranial index (CI) as well as intracranial volume (ICV), and report analytic results.

Methods: Between June 2002 and June 2013, 45 patients (>5 months) with non-syndromic sagittal synostosis were recruited, each patient was assigned to one of three therapeutic groups, according to the operative technique with regard to CI and ICV. Patients of group 1 (n=27) presented ICV below normal range or normal ICV with CI values <75; underwent antero-posterior compression with bitemporal expansion procedures. Group 2 (n=9) presented normal ICV with 75≤CI<80; and underwent bitemporal expansion. Group 3 (n=9) presented ICV above normal range or normal ICV with CI values ≥80; and underwent antero-posterior expansion with bitemporal expansion. Pre- and post-operative CI, ICV and neurodevelopmental index were utilized for evaluation.

Results: Group 1 and 2 demonstrated improvement in CI, and group 3 exhibited significant enlargement in ICV. As for the neurodevelopmental state, group 3 showed delayed development preoperatively, and group 1 resulted in significant improvement postoperatively. Furthermore, patients who underwent surgical correction before the age of one year demonstrated significant advancement in terms of neurodevelopmental function.

Conclusion: Distraction osteogenesis utilizing antero-posterior compression in combination with bitemporal expansion validated effectiveness in morphological, volumetric and developmental improvement. Expansion in both antero-posterior and bitemporal direction should be considered for non-dolichocephalic sagittal craniosynostosis patients.

p-15

Stability of cranioplasty using multi-split osteotomy and rigid fixation with absorbable plates

Presenter: Jae Woo Lee

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Purpose: In order to increase the intracranial volume sufficiently, multiple osteotomies based on rigid fixation would be more helpful. Authors have conducted multi-split osteotomy within the limits of the possible, substantial interosseous fixation with variable types of absorbable plates to patients with diverse craniosynostosis, and follow-up studies including postoperative complications with long term stability were done.

Methods: We surveyed in this research 7 cases receiving 'multi-split osteotomy with rigid fixation'. Five were plagiocephaly and others were trigonocephaly. Through the coronal incision placed from ear to ear, periosteum was carefully elevated. Burr holes were drilled on expected osteotomy line and cranial vault was splitted into as many pieces as possible. The extent of 'multi-split osteotomy' depends on the degree of dysmorphology, expectative volume increment after surgery and probable dead space caused by bony gap between bone segments. Rigid interosseous fixation was performed with variable types of absorbable plate and screw including straight type, double-Y type, 5*5 square type and 5*10 rectangular type plates. Immediate postoperative complications regarding hemorrhage, wound infection, meningitis and wound dehiscence were examined. Long term results were checked including any occurrence of morphologic changes, incomplete ossification and growth disturbances.

Results: The medical record review under this research has found no single case of severe hemorrhage, wound infection or meningitis. One patient showed wound dehiscence requiring simple revision operation and recovered without a special problem. Morphologic changes or growth disturbances were not found and satisfactory cranial vault remodeling with increased intracranial volume was maintained after the limited duration of 3 years, but longer periods of follow-up would be needed for future research.

Conclusion: Cranial vault remodeling surgery with multi-split osteotomy and rigid fixation with absorbable plates showed potential advantages with sufficient cranial expansion, better morphologic outcome without increasing any complications during limited duration of follow-up period.

p-16

Diffusion tensor imaging and fiber tractography in children with craniosynostosis syndromes.

Presenter: Bianca F. Rijken

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Patients with craniosynostosis syndromes caused by mutations in *Fibroblast Growth Factor Receptor-2,3* and *TWIST1*-genes are characterized by prematurely fused skull sutures and skull base synchondroses, which results in a skull deformity and is accompanied by brain anomalies, including altered white matter micro-architecture. In this study, the reliability and reproducibility of DTI fiber tractography (FT) is investigated in these patients. The outcomes are compared to those of controls.

Methods: DTI datasets were acquired with a 1.5-Tesla MRI system with 25 diffusion gradient orientations (voxel size=1.8 × 1.8 × 3.0 mm³, b-value=1000 s/mm²). White matter tracts that were studied included: corpus callosum, cingulate gyrus, fornix, corticospinal tracts, and medial cerebellar peduncle. Tract pathways were reconstructed with *ExploreDTI* in 58 surgically treated craniosynostosis patients and 7 controls (age ranges: 6-18 years).

Results: Because of the brain deformity and abnormal ventricular shape and size, DTI-FT was challenging to perform in craniosynostosis patients. To provide reliable tracts, standard tracking protocols were adapted. Fractional anisotropy was equal to controls (0.44 vs 0.45 ± 0.02, $p=0.54$), whereas mean, axial and radial diffusivity parameters of the mean white matter were increased in craniosynostosis patients ($p<0.0011$). No craniosynostosis syndrome-specific difference in DTI properties was seen for any of the fiber tracts studied in this work.

Conclusion: Performing DTI-FT in craniosynostosis patients was difficult due to partial volume effects caused by an anisotropic voxel size together with deformed brain structures. Although these patients *have a normal fiber organisation*, increased diffusivity parameters suggest abnormal microstructural tissue properties of the investigated white matter tracts.

p-17

Our experience of treating craniofacial anomalies with distraction osteogenesis

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Background: Distraction osteogenesis (DO) for craniofacial anomalies has become a standard of care. However, craniofacial anomalies vary from one case to another, which can hardly be treated by one type of DO alone. So we have developed combined DO of Le Fort (LF) I, II and III using transpalatal approach.

Methods: Between 1996 and 2014, we performed 33 combined LF III and/or II and/or I DO using transpalatal approach; 22 LF III, 3 LF II and 4 LF III/II, 2 LF I/II 1 LF I/III and 1 LF I/II/III DO, comprising 14 Crouzon, 10 Apert, 2 Pfeiffer syndrome and 7 others. Our transpalatal approach is as follows. The palatine bone is removed and the lateral wall of the nasal cavity is peeled off to expose the posterior margin of the inferior conchal base. The medial wall of maxillary sinus is fenestrated from medial to lateral aspect from the side of inferior nasal meatus, and osteotomy of posterior wall of maxillary sinus is performed with direct vision, then pterygomaxillary disjunction are performed.

Results: Proptosis was lessened and facial proportions were significantly improved in all patients without major complications.

Discussion: Transpalatal approach has several advantages; one of them is that it can preserve maxillary molar tooth germ, which is very important in young patients.

Le Fort II DO is indicated for the cases with maxillary hypoplasia and short nose deformity who have no or slight exophthalmos. In addition, Le Fort II DO can be performed together with Le Fort III when there is a big difference between (i) the distraction vector of orbital rim for improving exophthalmos and (ii) that of occlusal plane for improving anterior cross bite and/or open bite. When there is a big difference between (ii) and (iii) the distraction vector for improving the nasal deformity of short nose or saddle nose, LF DO can be performed together.

Conclusion: Combined LF I, II and III DO using transpalatal approach is safe and beneficial in the treatment of craniofacial anomalies.

p-18

A Clinical Model to Predict Which Patients Are at Higher Risk for Adverse Events Post Open Craniosynostosis Surgery.

Presenter: Susan Goobie
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Background: Mortality rates post open craniosynostosis surgery are less than 0.1% and morbidity rates are quoted from 4.6% to 14% for adverse events such as cardiorespiratory and hematological. Most craniofacial centers routinely admit patients to the ICU after major cranial vault procedures, but this step may be unnecessary for many patients. **The authors investigate specific variables, which might influence the risk for postoperative adverse events, and thereby make recommendations regarding the need for ICU admission.**

Methods: With local institutional board approval, a retrospective review of 225 children undergoing open craniosynostosis repair at a single center during a 10-year period, from 2002 to 2012 is reported. **The primary outcome measure was the incidence of predefined clinically relevant postoperative cardiorespiratory and hematological events requiring ICU admission.**

Results: The incidence of postoperative cardiorespiratory and hematological events requiring ICU care were 14.7% (95% CI: 10.5-20.1%) and 29.7% (95% CI:24.0-36.3%), respectively. Independent predictors were body weight <10 kg, American Society of Anesthesiologists (ASA) status 3 or 4, intraoperative transfusion of >60 ml/kg packed erythrocytes, transfusion of hemostatic products (fresh frozen plasma, platelets and/or cryoprecipitate), occurrence of an intraoperative complication and tranexamic acid not administered.

Conclusions: Children undergoing craniosynostosis surgery are at increased risk for clinically significant postoperative events requiring ICU if they are <10 kg body weight, ASA 3 or 4, require intraoperative transfusion of >60 ml/kg of **packed erythrocytes**, receive hemostatic blood products or if they develop a significant intraoperative complication. Tranexamic acid administration was associated with fewer postoperative events. A predictive clinical algorithm for pediatric patients having major craniosynostosis surgery was developed and validated to risk stratify these patients.

p-19

Successful posterior honeycomb cranial distraction for a 4-month-old infant with Pfeiffer syndrome

Presenter: Mayu Takahashi

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Posterior cranial expansion using distraction osteogenesis has gained popularity in syndromic craniosynostosis to enlarge intracranial volume compared with the anterior region. However there are some difficulties to distract posterior cranial vault with severe honeycomb appearance. Here we present a 4-month-old infant with Pfeiffer syndrome effectively treated using posterior cranial distraction method. The patient showed a marked brachycephaly and fronto-facial hypoplasia. The anterior fontanel was largely opened and bulged. She had a sagittal and lambdoid synostoses and a marked honeycomb appearance in the parieto-occipital lesion on cranial computed tomography (CT). Ventriculomegaly was also detected. Posterior cranial distraction was planned for the initial treatment to reduce the intracranial pressure in the occipital region. Strip craniectomy was carefully performed in the rigid part of the cranium to install the 4 distractors (Keisei Ika Kogyo, Japan). The distraction was started 4 days after the surgery. Each part was distracted for 1 mm per day in the beginning and then for 0.5mm in the latter period. It took 61 days to obtain posterior distraction at 35 mm. No complication was occurred during the distraction except for the minor skin infection around the distractors. Cranial CT showed the cranium was well enlarged and the honeycomb lesion was remarkably diminished. Intracranial pressure was well controlled though the ventricular size was not changed. The distractors were removed 119 days after the completion of the distraction. Our surgical strategy for this patient indicates that anterior cranioplasty prior to posterior distraction is not always necessary to improve the honeycomb skull of the occipital region.

Careful placement of the distractors and gradual distraction are the key points for the successful treatment of the posterior honeycomb cranial distraction in infants.

p-20

Multidirectional Cranial Distraction Osteogenesis for the Treatment of Craniosynostosis

Presenter: Tsuyoshi Morishita

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Background: The distraction osteogenesis is the one of the most common surgical procedures for patients with craniosynostosis in Japan. We have used the MCDO system.

Methods: From 2006 to 2013, a selected group of 10 patients (primary surgery) with syndromic and nonsyndromic craniosynostosis were treated using the MCDO system. The mean patient age was 78 month (31 to 251 months). The nonsyndromic group consisted of a total of 8 patients: 3 with sagittal and bi coronal synostosis 2 with pansynostosis, 2 with sagittal synostosis m and 1 with metopic synostosis, 1. The syndromic group consisted of a total of 2 patients: 1 with Crouzon syndrome and trisomy 9p syndrome.

Results: Only one patient of chronic subdural hematoma was treated with surgical drainage. There were no cases of meningitis, liquid fistula. 9 patients were performed a blood transfusion. The planned distraction program was completed in all cases. The mean duration of fitting was 58.2 days (42 to 91 days).

Morphologically satisfactory results could be obtained in all patients.

Conclusion: Distraction osteogenesis with the multidirectional cranial distraction osteogenesis method is safe and effective. It is sufficiently for older children.

p-21

Some designs for posterior cranial expansion avoiding minor complications

Presenter: Kazuhiro Otani

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Posterior cranial expansion has taken place to fronto-orbital advancement for the purpose of enlargement of intracranial volume, nowadays especially for a syndromic craniosynostosis or an oxycephaly as a first choice after Nishikawa's report (2009).

In the past 5 years, 5 cases of posterior cranial distraction have been applied in our team; two syndromic cases (1 Apert, 1 Seathre-Chotzen) and 3 Oxycephalies, 1 female, 4 males, aged at operation in 1 to 5 years, with 1 to 3 years follow-up.

Inion (posterior-inferior) horizontal osteotomy should be lower, if easily possible. Since the lower osteotomy is performed, the more bone flap could move so as to gain more volume. And to avoid intraoperative complications, 3D model may show intra cranial structural variation such as bony spicula due to increased ICP around transverse sinuses.

Posterior osteotomy can be bi-cortically -to move bone flap posteriorly parallel to osteotomy line, or hinged to move bone hemi-pantograph fashion. Two devices are applied on parasagittal area on either procedure. The former could get more expansion, but has some limitation of post-operative supine sleeping position. In the case of some amount of distraction with this method, stretched inferior lambdoidal sutures widening is found.

The latter hinge distraction requires more anterior to vertex osteotomy or some band osteotomy on the top of the vault, otherwise distraction vector goes gradually to touch on the frontal bone and restrict to distract and stuck. The procedure may have some limit.

Representative cases underwent those distraction, are mentioned, illustrating minor complication such as device migration to the bone, bony step formation on osteotomy lines.

The alternative for the previous method may need four devices is applied para-median area and bi-laterally with posterior freed bone flap and speed of distraction is varied-fast on top, slow on lateral portion.

p-22

The treatment strategy for Apert's syndrome

Presenter: Shoichi Tomita

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Background: Since various surgical techniques and concepts for craniosynostosis have been described, the indications for and timing of surgery still remain controversial because of their functional and cosmetic problems. As we reported, we classified the treatment strategy, especially for syndromic craniosynostosis, into three categories: infantile calvarial normalization, toddler calvarial reconstruction and elder child calvarial reconstruction. However, because of the cosmetic problems, we revised this treatment strategy for syndromic craniosynostosis since 2011. This report shows the long-term follow up of Apert's syndrome and shows the reason we changed our treatment strategy.

Material and Methods: From January 2002 to December 2011, 57 patients with craniosynostosis were operated on. Twenty-two patients were syndromic craniosynostosis, including 14 Apert's syndrome, and 35 patients were non-syndromic craniosynostosis. Focused on Apert's syndrome, those who cannot follow more than five years were excluded. We evaluated the pre- and post-operative developmental quotient (DQ) and cosmetic change retrospectively.

Results: Thirteen patients were able to follow up more than five years. The primary surgery was performed between the age of 3 months and 20 months (mean age 8.1 months). The mean DQ at age 5 was 81.3. However, based on follow up CT, we found it difficult to maintain the cranial appearance.

Conclusion: For the syndromic craniosynostosis, treatment must consider about development and cosmetic problem. Since infantile calvarial normalization was performed, we consider that DQ score was within an allowance. However, it was difficult to maintain the appearance because of the vulnerability of the cranium. Therefore, since 2012, posterior vault distraction for a primary surgery was performed on 3 patients. Long-term follow up is required for further evaluation of durability and growth potential of the distracted cranial bone.

p-23

Treatment for hydrocephalus in syndromic craniosynostosis children

Presenter: Ryo Ando

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Introduction: Our aim was to assess the appropriateness of ventriculo-peritoneal (VP) shunt treatment for hydrocephalus in syndromic craniosynostosis. Progressive hydrocephalus develops in about 10% of syndromic craniosynostosis cases. Controlling ICP is complicated in such cases.

Methods: We reviewed our clinical experience of craniosynostosis between 1988 to 2014. During these periods, we have twenty-seven syndromic craniosynostosis patients including Cruzon, Apert, Pfeiffer, cloverleaf skull, Antley-Bixler and Beare-Stevenson cutis gyrate syndrome. Among them, six patients required CSF diversion by VP shunt. The treatments of VP shunt were examined with respect to its timing of surgery, final form of ventricle and shunt complications.

Results: Three patients underwent VP shunt after skull operation, and two did it before. The rest of one was performed simultaneously. Final form of lateral ventricle was narrow or slit in five of six patients. One patient was required to undergo revision surgery because of symptomatic slit ventricle. The follow-up period ranged from 20 months to 14 years.

Conclusion: The hydrocephalus occurred in syndromic craniosynostosis children is possibly caused by the outlet obstruction of intracranial venous flow due to jugular foramen stenosis and Chiari type 1 malformation with narrow posterior fossa. Thus, shunt procedure would be recommended rather than endoscopic third ventriculostomy for anatomical and physiological characteristics. However, VP shunt contains two critical matters on treatment of hydrocephalus in craniosynostosis. First, VP shunt decreases cranial expansive force. Second, VP shunt develops its dependency, so once patients undergo CSF diversion, they need its maintenance for whole life. To manage these problems, adjustable shunt valve and antishiphon devices could be preferable for treatment of hydrocephalus in syndromic craniosynostosis children.

p-24

Complex craniosynostosis with frontal bossing in very low birth weight baby who has microdeletion in 14q32.2.

Presenter: Shunsuke Ichi

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Maternal uniparental disomy 14 (upd(14)mat) is reported to be characterized by pre- and postnatal growth retardation, neonatal hypotonia, small hands and feet, feeding difficulty, and precocious puberty. Paternal one (upd(14)pat) shows much more severe phenotype characterized by facial abnormality, bell-shaped thorax, and abdominal wall defect. Chromosome 14q32.2 contains several imprinted genes, which loss of expression is believed to be responsible for characteristic phenotype on upd(14)mat and upd(14)pat. We report a case of severe skull deformity who had serious gene-related frontal bossing with multiple synostosis. Her chromosomal test revealed microdeletion affecting the 14q32.2 imprinted region which had been reported to have upd(14)-like phenotype. Only few number of cases were reported so far.

Case: At 36 weeks of gestation, ultrasound examination revealed intrauterine growth retardation (IUGR) with small head circumference. Therefore the C-section was hurried at 37 weeks and 0 day of gestation. A baby girl weighing 1302g was born with an Apgar score of 3/4 at 1/5 minute respectively and needed immediate respiratory care with intubation. Her somatic feature included severe frontal bossing, microstomia, micrognathia, and blepharophimosis. No abnormality was detected on her chest and abdomen and external genitalia was female. Chromosomal test revealed microdeletion of 14q32.2 (46,XX,del(14)(q32.2)). Along with severe frontal bossing, scaphocephalic deformity due to bicoronal and sagittal synostosis was gradually exacerbated which resulted in severe intracranial hypertension. On 134 days-old with 3520g of body weight, Π suturectomy with barrel shaped osteotomy and frontal remodeling were performed. Even though effective decrease of high intracranial pressure with dramatic correction of deformity was achieved, another craniostenosis due to oxycephalic deformity has been appeared since four month after surgery. We now plan to do the second surgery to enlarge her cranial vault.

To our knowledge, no report could be found about upd(14) and its related chromosomal abnormality accompanied with craniosynostosis which needed surgical correction. Characteristic frontal bossing seems to be independent phenotypic feature by del(14)(q32.2) from synostosis deformity.

p-25

Versatility of the Alice band onlay graft in remodeling of the orbital bandeau

Presenter: Fateh Ahmad

Authors: Ahmad F, Flapper WJ, Anderson PJ, David DJ
The Australian Craniofacial Unit, Australia

Frontoorbital advancement: Mainstay of managing established or impending raised intracranial pressure in craniosynostosis, as well as correction of deformity. Many techniques described, mostly for children over 12 months of age when bone is stronger.

Orbital bandeau, once removed is 'remodeled' to varying degrees. Complete correction of the deformity frequently requires weakening of the bandeau which may compromise inherent strength and appearance.

At the Australian Craniofacial Unit, FOAR is performed within the first 6 months when bone is malleable and re-ossification occurs very quickly. Release of the synostotic sutures at an early age (<6 months) reduces the incidence and severity of secondary facial deformities.

Harvesting an Alice band from the posterior edge of the calvarium provides a versatile, curved and reasonably symmetrical bone graft that may be secured onto the bandeau as an onlay graft.

We describe the operative technique, its use in single and multi-suture synostosis and outcomes.

p-26

Possible timing of late cranial surgery for syndromic craniosynostosis considering ICP and DQ

Presenter: Yuichiro Nonaka

Authors: Nonaka Y¹, Miyawaki T², Masumoto A¹, Tomita S², Nishimura R², Murayama Y³

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Cranial surgery for syndromic craniosynostosis is usually understood to be performed in early stage of life for brain development. However, surgery in late can reduce the rate of reoperation from the standpoint of aesthetic assessment. The purpose of this study is to identify possible timing of late surgery considering intracranial pressure (ICP) and patient's developmental quotient (DQ).

Among the 10 patients with syndromic craniosynostosis who underwent cranial and/or LeFort surgery at the Jikei university hospital in 2014, four patients who examined ICP and DQ were enrolled. ICP examination was performed together with syndactyly surgery in advance of cranial surgery. Distracion osteogenesis (DQ) was applied to all cranial surgery.

Three patients with Apert syndrome and 1 Pfeiffer syndrome were examined. Mean age of ICP monitoring was 11 mos (from 8 to 14 mos) and median ICP was 10.1 mmHg (5.2 to 14 mmHg). Frontoorbital advancement (FOA) in one patients and posterior vault advancement (PVA) in three was performed at the mean age of 24.8 mos (14 to 32 mos). One patient with Apert syndrome who indicated moderate elevated ICP at the age of 14 mos was compelled to delay the operation until the age of 2 years 8 months due to social reasons. Surgery for 3 patients was intervened when DQ indicated deterioration. The entire patient's DQ were improved and pleasing morphological conditions were maintained after surgery.

Standardization of surgical strategy for syndromic craniosynostosis is complicated due to their variety of pathological state, so that surgical intervention is decided along with each condition. From the analysis of this study, the timing of surgery could be stood until 3 years of age even the ICP revealed moderate high, however morphological and developmental changes in long term follow-up should be required for determining precise decision.

p-27

Limitation of cranial distraction and comparison with a conventional method for frontal plagiocephaly

Presenter: Nobuyuki Mitsukawa

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Objective: Frontal plagiocephaly is the condition that requires the most careful consideration for morphological improvement. We discuss limitations of cranial distraction osteogenesis based on applied cases. We also compare this surgical method with the conventional method, which has been used commonly worldwide, and report our remedy concept.

Method: We have experienced 17 cases of frontal plagiocephaly since 1987. At first, we performed the conventional surgical method, and then cranial distraction was applied to 5 cases since 1998. After that, the conventional method has become the main procedure. Their ages at surgery were 10 months to 18 months of age for 16 cases, and 5 years of age for 1 case. Postoperative recovery was observed for 6 months at the shortest and for 27 years at the longest.

Results: The conventional surgery required 1 treatment, but cranial distraction required 2 surgeries including removal of the bone extension device. Among the cases of conventional surgery, most obtained fairly good improvement of morphology during the observation period but some cases showed a small area of unevenness at the bone junction of the forehead. Regarding the cases of cranial distraction, 4 out of 5 cases obtained fairly good improvement of morphology. One case underwent a modification surgery with bone shaving and transplant of artificial bone for asymmetry of the forehead.

Discussions: Cranial deformation with frontal plagiocephaly is mostly caused by premature fusion of the unilateral coronal suture, but the deformation area also involves the cranial base. In the affected side, the supraorbital margin is lifted and inclines, twisting towards the back. Upward flattening of the forehead is also observed. In addition, the non-affected side of the forehead protrudes forward to compensate, which results in an extremely peculiar deformation. Although the severity of deformation varies with cases, the reasonable treatment concept is a surgical procedure aiming at correcting the deformation mentioned above. Therefore, treatment with cranial distraction osteogenesis has a limitation. Active locational correction of the orbital bar under direct vision would be an easier method. When cranial distraction is applied, combination with the conventional method would be reasonable.

p-28

Passive contraction of frontal bone using mini-plates in DOG for scaphocephaly

Presenter: Tanetaka Akizuki

Authors: Akizuki T, Watanabe Y

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Background: DOG (distraction osteogenesis) is widely applied for treatment of scaphocephaly. In this method, the cranial width is enlarged by DOG of the temporal bone laterally. Moreover scaphocephaly needs shortening (contraction) of the cranial length. For this sake, the frontal bone should be moved backward. We devised a simple method.

Methods: The cranium is osteotomised in conventional pi osteotomy. Two to four internal type distraction devices are set for temporal bone widening. The supraorbital bar of the frontal bone is osteotomised. Two miniplates are loosely fixed between the frontal and the temporal bone. As the temporal bone is distracted laterally, the frontal bone hinged on the supraorbital bar is passively moved backward by traction of two miniplates. To widen the narrowed frontal bone, the center line (metopic suture line) of the frontal bone would be osteotomised.

Discussion: Since a contraction device for active movement is already reported, breakdown of the device or infection due to the exposed device are often encountered. On the other hand, our simple passive movement method could avoid those drawbacks.

p-29

importance of thorough clinical documentation of craniosynostosis, in establishing molecular genetics diagnosis

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Establishment of firm diagnosis in various cases of syndromic and non syndromic craniosynostosis is important in relation with prognosis, family counseling and treatment. Documentation of diagnosis of different cases of syndromic and even non syndromic craniosynostosis by means of molecular genetics, although crucial, remains demanding. This is due to the necessity of broad range genomic search, making it economically expensive and time consuming. So clinical documentation helps the molecular search by narrowing the range of interest. In return the molecular diagnosis confirms or rejects the final diagnosis.

We report to examples from our experience. In the first case and due to incorrect clinical guidance towards Crouzon or Sheathre-Chotzen syndrome, the molecular genetics search ended inconclusive. By correcting the clinical documentation towards Shpritzen-Goldgerg syndrome, the gene SKI (1p36) was tested. Its heterozygous mutations can guide to the above syndrome. That was confirmed by the molecular genetics investigation. In our second case, a patient with CFNS was at first the clinically diagnosed as Sheathre-Chotzen syndrome or non syndromic plagiocephaly. However firm final diagnosis was achieved when the clinical documentation was corrected. In this interesting case we have reported a heterozigus de novel mutation, which was detected in EFNB1 gene, mutations of which are known to be responsible for CFNS.

In conclusion, molecular genetics search which confirms or rejects diagnosis in cases of craniosynostosis, has to be specifically targeted. This is achieved by guidance of well documented clinical information.

p-30

Distinct Cranial Features of Lambdoid Synostosis and Positional Posterior Plagiocephaly by 3D-CT-Imaging

Presenter: Junnu Petter Leikola
Authors: Leikola JP, Hurmerinta K, Kiukkonen A,
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Introduction: There is a considerable overlap in the clinical features of positional posterior plagiocephaly and unilateral lambdoid synostosis resulting in diagnostic misjudgments. In this study, we aimed to compare skull base, the shape of calvarium and antero-posterior and vertical auricular position in children with unilateral lambdoid synostosis and positional posterior plagiocephaly by 3D-CT imaging.

Patients and Methods: 3D-CT images of 9 children (mean age 2.9 years) with unilateral lambdoid synostosis were compared with gender and age matched children with positional posterior plagiocephaly to quantitatively compare the characteristics of endocranial skull base and ectocranial calvarium.

Results: The skull bases in the lambdoid synostosis were posteriorly shorter and more twisted than in positional posterior plagiocephaly. Anterior twisting was moderate in both skull types. Prominent ipsilateral mastoidal bossing downward and laterally was present in all lambdoid skulls. In positional posterior plagiocephaly, the bossing was typically not detected. Interestingly, there was a great variation in the position of the ipsilateral ear and external auditory meatus in both patient groups

Conclusions: This descriptive 3D-CT study showed structural differences in the skulls between the patients with lambdoid synostosis and posterior positional plagiocephaly. These distinct features are easily recognizable and thus helpful in the difficult diagnostics. We suggest the definite diagnosis to be based on 3D tomographic scans.

p-31

Craniometric evaluation of nasal morphology in patients with unicoronal craniosynostosis

Presenter: Jason W. Yu

Authors: Yu JW, Zhu M, Wink JD, Ligh CA, Swanson JW, Mitchell BT, Bartlett SP, Taylor JA

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Background: Literature has descriptively characterized nasal anatomy of unicoronal craniosynostosis (UCS) patients, with nasal tip deviated contralaterally. The purpose of this study is to craniometrically evaluate the nasal morphology in UCS with an emphasis on the effects of nasal root deviation on the distal nasal portion in UCS patients.

Methods: Craniometric evaluation of nasal morphology was performed in UCS and unaffected controls, including the distance from the most superior point of nasomaxillary suture (SNM) to the midline reference plane (MID). The midline plane was created using landmarks basion, sella and nasion (Na). We also included the distance from the most inferior point of the nasomaxillary suture (INM) to the midline plane (INM-MID), the angle formed by the SNM to the Na to the contralateral SNM (SNM-Na-SNM), the angle formed by the INM to nasal bone tip (NT) to contralateral INM (INM-NT-INM), and the nasal deviation angle (Na-NT), formed between the line from nasal tip to nasion and MID. Univariate analysis was performed between the groups.

Results: 47 nares were analyzed, including 28 UCS patients and 38 age-matched controls. When comparing the ipsilateral portion of the nares to the controls, the ipsilateral INM-MID distance was 14.2% shorter ($p:0.002$). Contralaterally, the SNM-MID and INM-MID distances were 371.4% and 20.4% greater respectively when compared to controls. The INM-NT-INM angle in UCS were more obtuse when compared to controls ($p:0.042$). All UCS Na-NT angles deviated away from the ipsilateral side at an average of 7.11 degrees. This was 4.97 degrees more than the absolute values of the controls ($p<0.001$).

When comparing ipsilateral to contralateral side, SNM-MID and INM-MID distances were significantly shorter on the ipsilateral side, 62.2% ($p<0.001$) and 28.7% respectively.

Conclusions: Craniometric analysis confirms that nasal tip deviation away from the ipsilateral side. The nasal root deviation towards the ipsilateral side suggests possible etiology for tip deviation.

p-32

Effect of Molding Helmet on Intracranial Pressure in Patients with Sagittal Synostosis

Presenter: Asra Hashmi

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Background: Goals of cranial vault expansion in pediatric patients with craniosynostosis include improved aesthetic appearance and a potential reduction in harmful effects associated with elevated intracranial pressure (ICP). Alternatively, molding helmets can be used to improve cranial index in patients with sagittal synostosis prior to surgery. We investigated the effect of molding helmet to assure no adverse affect on ICP.

Methods: This prospective cohort study included 25 pediatric patients with sagittal synostosis (Age range: 4 months-3 years, Median: 7 months) planned for total cranial reconstruction for craniosynostosis from 2011-2014 at Children's Hospital of Michigan. Preoperative molding helmet was used in 13 patients and no molding helmet used in 12 patients. ICP reading was performed just prior to performing craniotomy intraoperatively. End-tidal carbon dioxide, patient positioning, level of sedation, type of anesthesia and the monitoring site at the time of intraoperative recording were regulated and standardized to establish accuracy of ICP readings. The pressure sensor was placed through a burr hole in intraparenchymal or subdural space.

Results: Mean duration of preoperative use of molding helmet was 18 weeks (Range 8-22 weeks). Under controlled settings, average intraoperative ICP was 7.6 mm Hg (Range 2-18 mm Hg) in patients treated with preoperative molding helmet. ICP was not significantly different between the two groups, suggesting that use of molding helmets in this population is safe.

Conclusion: Intracranial pressures were not significantly different with the use of preoperative molding helmet, refuting the prevailing thought that molding helmets would be detrimental in children who have craniosynostosis. The use of molding helmets in this population of patients does not adversely affect ICP.

p-33

Intraoperative Intracranial Pressure Monitoring Prior to Calvairal Reshaping in Craniosynostosis Patients

Presenter: Neena Maripudi

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Introduction: Intracranial pressure (ICP) and skull volume are intricately related. To our knowledge, no study has definitively investigated the incidence of elevated ICP under controlled settings in craniosynostosis patients.

Methods: This prospective cohort study includes 50 patients (median age 8 months; range 3 months-8.6 years) undergoing total cranial reconstruction for craniosynostosis from 2011-2014 at the Children's Hospital of Michigan. ICP reading was recorded prior to performing craniotomy intraoperatively. End-tidal carbon dioxide, patient positioning, level of sedation and the monitoring site at the time of intraoperative recording were regulated and standardized to establish accuracy of ICP reading. The pressure sensor was placed through a burr hole under general anesthesia in intraparenchymal or subdural space.

Results : Patient diagnosis included single-suture craniosynostosis and craniofacial dysostosis. The mean preoperative ICP was 9.76 mm Hg. 29 patients had ICP less than 10 mm Hg and 17 patients had ICP ranging between 11 and 20 mm Hg. 4 patients had ICP of 22, 23, 28 and 34 mmHg, respectively associated with sagittal, coronal and multiple suture craniosynostosis. No correlation with elevated ICP and type of craniosynostosis could be statistically established.

Conclusion: Utilizing invasive ICP monitoring, under controlled settings, our study demonstrated that up to 10% patients selected for craniofacial reconstruction procedures may demonstrate ICP>15 mmHg in a controlled intraoperative setting. Complex forms of craniosynostosis were not at higher risk of elevated ICP compared to single-suture synostosis.

p-34

The orthodontic character of the dentition of Apert syndrome

Presenter: Tadashi Morishita

Author: Morishita T

St.Mary's Hospital Orthodontic Department, Japan

Background: An orthodontist meets a child of Apert syndrome for the first time by reference from a plastic surgeon. Apert syndrome is a rare autosomal dominant disorder characterized by craniosynostosis, craniofacial anomalies, and severe symmetrical syndactyly of the hands and feet. The oral situation is quite different from other diseases. So the treatment strategy peculiar to Apert syndrome is inevitable. I examined past cases and considered about the treatment strategy.

Method: Materials were dental casts and oral photographs of 8 Apert syndrome patients who hoped for reconstruction of occlusion, were introduced and visited our orthodontic dentistry. Their dental age were permanent dentition. The size of the teeth, the degree of the discrepancy and the shape of the alveolar bone were measured.

Result: The crown mesio-distal width of the teeth it were possible to measure were large compare with Japanese standard. The perimeter of dentition were also large. Though there were space, abnormality were seen in the direction of tooth germs eruption. The timing of eruption tended to be delayed to a calendar age. The thickness of the alveolar bone were wide. There were some cases which undergoes dental influence of distraction osteogenesis of maxilla or mandibular in the past. They had low tongue function and the lip seal functions were also incomplete by the mouth breathing.

Discussion: Their abnormality of oral condition was very severe compared with Crouzon syndrome. The orthodontic strategy would be very difficult. There were also slight mental retardation, and it was difficult for understanding to goal of treatment to be obtained. Miofunctional therapy were also difficult. Their orthodontic treatments depend on the family's cooperation and one's own effort to conquer such bad condition.

p-35

Combination of Tessier's clefts nos. 3 and 4-case of a rare anomaly with 12 years follow-up

Presenter: Taku Maeda

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Tessier cleft types 3 and 4 are both rare craniofacial anomalies. Here we present the first case of a girl born with a combined anomaly of Tessier clefts 3 and 4 with severe bilateral cleft lip, a displaced premaxilla, and three-dimensional underdevelopment of hard and soft tissues of the maxilla and zygoma. This type of rare facial cleft poses a major operative challenge. Over a period of years, presurgical alveolar molding with an active appliance was followed by seven operations. A satisfactory esthetic outcome was obtained. A multidisciplinary approach to treatment with a plastic surgeon in charge of the operation and an orthodontist in charge of the cleft deformity is essential.

p-36

Geometric morphometry for evaluation of the results of patients with anterior and basal encephalocele

Presenter: Alexander Sakharov

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Objectives: anterior and basal encephalocele are rare pathology accompanied by rough cosmetic defect. In addition to the pathological manifestations of the masses in the glabella and the root of the nose may appear liquorrhea, recurrent episodes of meningitis. Modern surgical treatment requires simultaneous removal of the hernia and reconstruction of bone structures and plastic of soft tissues. Aim of this work was to evaluate the results after surgical treatment.

Material and Methods: We report 65 cases of anterior and basal encephaloceles who underwent surgery by the different approaches and were followed up in our clinic. 33 were male and 22 were female; ages ranged from 2 month to 8 years (mean 18 months). 41 patients had anterior, 15 basal encephaloceles and 7 had cleft of skull. All of them had been diagnosed with CT, MRI and nasal endoscopy. The goal of surgery was the resection of the encephalocele at early stage, through a transcranial or combined transcranial and transnasal endoscopic approaches, and achieving closure of the defect in the dura and bone and immediate reconstruction of cranio-naso-orbital region. Follow up ranged from 3 months to 15 years. No postoperative complications were observed. Results of surgical treatments of 31 patients were evaluated by geometric morphometrics.

Results: Methods of the geometric morphometry confirmed the effectiveness of reconstructive surgery at the anterior and basal encephalocele. The results will be presented in the report.

Summary: Using a combination of neurosurgical approaches as well as endoscopic transnasal technology is optimal for the treatment of patients with anterior and basal encephalocele.

p-37

A multidisciplinary management philosophy for the midline craniofacial anomalies.

Presenter: Walter J. Flapper

Authors: Flapper WJ, Ahmad F, Pidgeon T, Anderson PJ, David DJ

Australian Craniofacial Unit, Australia

Introduction: Patients with midline craniofacial anomalies may exhibit a highly varied spectrum of deformity. Despite differences in pathophysiology, the presenting features of midline craniofacial deformity in these patients lend themselves to a unifying management philosophy that we intend to describe.

Methods: A database search was performed at our centre to identify patients with midline craniofacial deformity including the 0-14 Tessier clefts, the midline and para-midline encephaloceles, and craniofrontonasal dysplasia. A retrospective case note review was carried out to document patients' presentation, management and results.

Results: Patients were classified clinically and radiologically. Despite the differences between midline craniofacial clefting (dysrhapias), craniofrontonasal dysplasia and the encephaloceles, these conditions can be, and often are, managed in a similar manner. As previously described in our cohort of midline craniofacial pathology, emphasis is placed on first correcting any encephaloceles as early as safely possible after diagnosis. Airway, feeding, sight and hearing are all prioritised immediately. The aim is to address hypertelorism by age 8 years. Orthodontic therapy is encouraged until skeletal maturity. After the completion of growth, the midface is advanced and the nose reconstructed. This process is transferable between patients with midline clefts and with frontonasal dysplasia.

Conclusion: The birth to maturity protocol management is described. This work serves to highlight the multidisciplinary driven management of these patients, assessment of their physical deformity and also aids in the formation of a diagnosis.

p-38

Enophthalmos following Facial Bipartition and Box Osteotomy Correction of Hypertelorism

Presenter: William Breakey

Authors: Breakey W, Abela C, Evans RE, Britto JA, Hayward RD, Jeelani NUO, Dunaway DJ

Great Ormond Street Hospital, UK

Objective: Enophthalmos is a recognised complication of orbital advancement and translocation. The purpose of this study is to review the degree of pre and post operative globe protrusion in a series of 22 hypertelorism correction cases.

Methods: Pre and post operative computerised tomography scans were analysed from 22 patients undergoing facial-bipartition (n=9), or box-osteotomy (n=13) between 2001 and 2014. Diagnoses included; craniofrontonasal dysplasia (n=17), fronto-facio-nasal syndrome (n=1), frontonasal dysplasia (n=1), bilateral Prozanski Type 1 hemifacial microsomia (n=1), facial cleft (n=2). Globe protrusion was measured for each globe. A normal globe protrusion was taken as 14-21mm.

Results: The mean preoperative globe protrusion was 16.8 mm, the mean post operative globe protrusion was 13.2mm. A net reduction in globe protrusion was seen in 19 patients (bipartition n=7, box n=12). 9 patients became enophthalmic from euophthalmia (bipartition n=2, box n=7). 6 patients began euophthalmic and remained euophthalmic, however all 6 experienced a reduction in their globe protrusion towards enophthalmia. In the bipartition group 1 patient became enophthalmic from exophthalmia, 1 patient returned to euophthalmia from enophthalmia. The mean change in globe protrusion was a reduction of 7.1mm

Discussion: The position of the globe within the orbit depends on the volume of the orbit and contents, along with orbital shape. Medialising the anterior orbit to correct hypertelorism can have unintended effects on globe position within the orbit. Adverse changes in globe protrusion are more likely to occur in box osteotomy than facial bipartition. Maintaining euophthalmia is an important part of hypertelorism correction.

p-39

LONG-TERM FOLLOWUP OF ONLAY DORSAL NASAL CRANIAL BONE GRAFTS IN CRANIOFACIAL RECONSTRUCTION

Presenter: Jeffrey A. Goldstein

Author: Goldstein JA

Children's Mercy Hospital, USA

Cranial bone grafts are commonly used to reconstruct the nasal dorsum in many congenital and acquired craniofacial conditions. The purpose of this study is to assess the longer-term outcome of onlay cranial bone grafts to the nasal dorsum as a component of craniofacial reconstruction.

Methods: The records of 34 patients who were reconstructed with onlay cranial bone grafts to the nasal dorsum were reviewed. Patient diagnoses included encephalocele, hypertelorism, facial cleft, craniosynostosis, trauma, and tumor. 32 of the grafts were harvested full-thickness; the remaining 2 were harvested partial thickness. All grafts were rigidly fixed cephalically with metallic or resorbable fixation to the frontal bone, or fixed by lag screws to the underlying nasal foundation. All patients were followed for a minimum of 1 year and evaluated clinically, radiographically, and with photographs.

Results: With a minimum of one year follow-up, the onlay dorsal nasal grafts narrowed transversely to a minor extent. The grafts shortened longitudinally, more so in those that extended to the nasal tip. Grafts that were overprojected and created some tip tension led to the best aesthetic result after expected resorption. When the skin envelope was deficient or tight, dorsal nasal and tip projection decreased over time. Later patients in the study with a tighter skin envelope benefitted from a concomitant columellar strut at the time of dorsal bone grafting to enhance and maintain nasal dorsal and nasal tip projection.

Conclusions: When employed in craniofacial reconstruction, dorsal nasal onlay cranial bone grafts undergo some resorption when followed for a minimum of one year. Overcorrection is advised. Columellar support with strut placement enhances nasal dorsal and tip projection in patients with a less compliant skin envelope.

p-40

EFNB1 MUTATION IN JAPANESE PATIENTS WITH CRANIOFRONTONASAL SYNDROME.

Presenter: Hideteru Kato

Authors: Kato H¹, Okumoto T¹, Yoshimura Y¹, Taguchi Y¹, Sugimoto M², Kurahashi H²

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Craniofrontonasal syndrome (CFNS) is a subgroup of frontonasal dysplasia characterized by females with hypertelorism, coronal craniosynostosis, broad bifid nose, frontal bossing, downslanting palpebral fissures, low posterior hairline, cleft lip and palate, grooved nails and other digital anomalies. CFNS is an X-linked disorder caused by loss of function mutations of EFNB1 gene. Only three cases have been reported in Japan. We report a family with multiple CFNS cases confirmed by DNA sequencing of the EFNB1 gene. Case 1 is a 27-year-old female. She was referred to our hospital for treatment of hypertelorism after repair of bilateral cleft lip at the other hospital. At the age of 16, hypertelorism was surgically corrected. Then, she was married and gave birth to two daughters and one son. Case 2 is a 6-year-old-girl and the first child of the case 1. Her facial features included hypertelorism, broad nose and bilateral cleft lip and palate. We performed surgery for cleft lip at the age of 4 month. Case 3 is 1-year-old-girl and second daughter of case 1. She had facial characteristics similar to her sister and underwent an operation for cleft lip at the age of 1 month. In cases 2 and 3, we wait for their growth and are going to operate on for hypertelorism. None of these features were observed in son. Mutation analyses of the EFNB1 gene using Sanger method of DNA sequencing demonstrated a novel insertional mutation (c.296_297delTCinsGGTGCTCG (p.V99GCS)) in exon 2. CFNS symptoms are often similar to other diseases, so sometimes accurate diagnosis is difficult. Genetic test can make an accurate diagnosis possible, and we can give adequate advice about treatment. Therefore, when we examine a patient with these characteristic disorders, the genetic screening of the EFNB1 gene is recommended.

p-41

Clinical Characteristic and Treatment Consideration in Managing Hemangioma

Presenter: Tasya Anggrahita

Authors: Anggrahita T, Kreshanti P

Division of Plastic, Reconstructive and Aesthetic Surgery, Department of Surgery, University of Indonesia-Cipto Mangunkusumo Hospital, Indonesia

Background: Hemangioma is a benign vascular tumor with predictable course of growth that will regress spontaneously without any further complication. Historically hemangioma was managed under direct close observation over the phase of the lesion. In the present time, apparently there were shift in management trends over the different specialisation. Many consideration to choose mode of therapy then applied, included clinical characteristic and complication. This study was done to gain a better understanding of clinical course and treatment preferred for managing hemangioma over the different field of specialisation.

Methods: A retrospective data analysis was done to all patients presenting to Ciptomangunkusumo Hospital from 1 January 2009 to Mei 2014 with diagnosis of hemangioma. Data collected including demographic, clinical characteristic, and referral information. Diagnosis and treatment information was also recorded; include working diagnosis, diagnostic modalities, and treatment options. Possible risk factors include premature birth and low birth weight was also recorded.

Result: Of 127 patients recorded, hemangioma was commonly found in female (70.1%) and most commonly located on the face (38.3%). The median time for onset and age presented at the hospital was 0 and 7 months. Most treatment was done in the proliferative phase (74.1%) with the majority was small-sized lesion (48%). Surgery was the preferred treatment, accounted 36.2% of all patients. Larger size of the lesion and involuted phase of the lesion were found to be determinant factors when to choose surgery as a treatment. Apparently, most patients came without any complication (66.9%), just chief complain of anatomically disfigured. The most frequent regimen used for medication was propranolol with dose of 2-3 mg/kgBW/day, followed by intralesional and oral corticosteroid.

Conclusion: Hemangioma was the most common benign vascular tumors. Most hemangiomas were uncomplicated and can be managed by observation alone. However, parental discomfort and anxiety of their anatomically disfigured child was found to be the main indication for treatment and for surgery, despite there was no complication happened. Larger size and involuted phase of the lesion also become consideration for surgery.

p-42

Endoscopic Transmaxillary Repair of Orbital Floor Fractures; a Minimally Invasive Treatment

Presenter: Kazutaka Soejima

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Although endoscopic transmaxillary repair of orbital floor fractures is a minimally invasive treatment, controversy remains regarding the method for supporting the orbital floor after elevation of the orbital contents. To date, a urethral balloon catheter has been widely used. However, it can be difficult to leave the catheter in place for a long time period due to the inconvenience, and prolapse of the orbital contents may recur in the case of its premature removal. The authors describe their techniques for endoscopic reduction and use of a balloon for orbital floor fractures.

From September 2010 through April 2014, 29 of 58 patients (50.0 percent) with an isolated orbital floor fracture underwent endoscopic transmaxillary repair. A maxillary sinus balloon (# 3007, Koken Co., Japan) was inserted into the maxillary sinus to support the orbital floor following endoscopic transmaxillary reduction, and the connecting tube of the balloon was pulled into the nasal cavity through the maxillary ostium. After confirmation of accurate reduction by postoperative CT, the connecting tube was shortened and hidden in the nasal cavity. The balloon was left in place for 4 to 8 weeks, and then removed via the maxillary ostium on an outpatient basis.

Complete resolution of preoperative diplopia was achieved in 93 percent, and no late-developing enophthalmos was seen in 97 percent of our patients. There were no significant complications.

This technique is safe and permits prolonged retention of the balloon, without interfering with daily life.

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Water as an Excellent Contact Medium For Ultrasonography

Presenter: Yuka Shigemura

Authors: Shigemura Y¹, Ueda K¹, Akamatu J², Sugita N²

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Ultrasonography is now a very popular noninvasive imaging technique with a broad range of indications. It has been reported to be useful in the diagnosis and assessment of reduction in nasal bone fractures. However, it is difficult to see the whole nasal bone and the neighboring facial bones because the probe cannot be applied to such a complicated 3D structure of the nose.

Ultrasound signals are attenuated by passing through the medium. The attenuation rate can be calculated by the following relationship: Attenuation volume (dB)=Attenuation index (dB/cm/MHz)×Depth (cm)×Frequency (MHz). The larger the attenuation index of the medium, the more signals are absorbed as they pass through the medium. The attenuation index of water is the lowest among various media. Therefore, a clear ultrasonographic image can be obtained if water can be utilized as the medium.

We used saline as the coupling medium for ultrasonography in nasal bone fractures. The ultrasound probe could be applied through the pool of saline without adding pressure to the nasal bone fracture site. To keep saline on the face, we made a plastic outer frame according to the shape of the face in every case and fixed the environment by film material. To prevent saline from entering the nasal cavity, the nostrils were sealed with medical tape.

The ethical committees of Chikamori Hospital and Osaka Medical College approved this method before it was performed. A Venue 40, 12-MHz linear array probe (GE healthcare) was used. All cases were performed under the general anesthesia. Clearer ultrasonographic images were obtained and demonstrated successful reductions during operation.

Water has a better attenuation index than a gel pad and does not add pressure on the fracture site during probe scanning; and clearer images can be obtained.

It is believed that this method is very useful in evaluating reduction of nasal bone fractures. This can be further refined and become a simpler and better procedure.

p-44

Neurofibromatosis Type 1 Clinical Profile in RSCM: A 5-years Retrospective Evaluation

Presenter: Cherry G. Kalangi

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Background: Neurofibromatosis type 1 (NF Type 1) is a common genetic nerve tissue disorder with obvious clinical manifestation. Apart from its benignity, its presentation has quite an impact on the patients' quality of life, by often causing discomfort and furthermore lowering patients' self esteem. Since no epidemiological data of Neurofibromatosis Type 1 is found in our country, this paper's objectives are to provide initial database of the disease obtained from the authors' institution, which expectantly will be useful to develop further research in the near future.

Methods: We did a retrospective study of patients diagnosed with Neurofibromatosis Type I that came to our institution, Rumah Sakit Cipto Mangunkusumo (RSCM) from July 2009-June 2014. Datas collected are of demographic, clinical manifestations, consultation preference and treatment options.

Results: Over 5 years time, 139 patients were diagnosed with Neurofibromatosis Type 1 in our institution. The ratio between male and female are almost even, 70 patients were male and 69 female. Patients mostly come to seek consultation at productive age group (50% at the age of 16-30, 20% at 31-45 years old group). Predominantly, patients came with neurofibroma (111 out of 139) followed by cafe-au-lait skin lesion (39.56%). Hereditary factor was not clearly proven in our data, for there were only 15 patients have first degree family with the same condition. Larger part of our samples (53%) attended Dermatology clinic for treatment. Eighty eight patients did not go under surgery, while in the surgery group, lesion excision became the most procedure been done (17.8%)

Conclusion: In the end, this paper provide quite an adequate profile of Neurofibromatosis Type 1 in RSCM. Neurofibromatosis Type 1 is proven to be disturbing to the patients' quality of life, which lead them to seek for treatment at their productive years. This fact should challenge us as surgeons and researchers to explore and develop the better treatment options for our Neurofibromatosis Type 1 patients.

Key Words: Neurofibromatosis Type 1, Clinical manifestation, Treatment Option

p-45

Surgical treatment of facial fracture by using unsintered hydroxyapatite and poly L-lactide composite device.

Presenter: Minoru Hayashi

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Background: In Japan we use absorption properties for facial fracture these days. OSTEOTRANS MX[®] (Takiron co., Ltd, Japan) is one of absorption devices. But these are called Super FIXSORB MX[®] in Japan. This absorbable osteosynthesis device constitutes unsintered hydroxyapatite particles/poly L-lactide(uHA/PLLA) composites. The aim of this study is to report clinical cases of using OSTEOTRANS MX[®].

Material and Method: 17 patients(16 men and a woman) aged 10 to 80 years (mean: 39.9 years, SD: ±20.7) with 86 fracture sites were treated. We used 1.0mm plates and 5mm or 7mm screw in all cases. The postoperative progress observation period was 6 to 45 months (mean: 21.0 months, SD: ±12.4).

Result: The fracture line had recovered with all the cases. Complications were bone excess on the forehead in one patient and foreign body reaction on the frontozygomatic suture in one patient. But these two fracture site were recovered and had no problem. In one case which progress observation time was the longest 45 month, the plate was almost absorbed. However another cases were not absorbed because of short observation time.

Conclusion: OSTEOTRANS MX[®] is useful device, because of suitable intensity, thin, radiopaque and few complications. More time is required until a plate is absorbed completely. We are going to perform further progress observation.

p-46

Malignant transformation of small facial epidermal cyst with distant metastasis

Presenter: Do Hoon Kwak

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Background: There are some reports of squamous cell carcinoma originated from a longstanding epidermal cyst. However, malignant transformation of an epidermal cyst into squamous cell carcinoma with distant metastasis is fairly rare. We present a rare case of malignant transformation of facial epidermal cyst with distant metastasis.

Methods: A 79-year-old man presented with a one year history of a cystic nodule on the left cheek. He had received occasional puncture at local clinics. The clinical diagnosis was epidermal cyst. However the initial small nodule gradually increased in size and the lesion grew rapidly 3 months before visit. Physical examination revealed a fistulated lesion with swelling and erythema measuring 2.6×1.7cm on left cheek. We performed total excision and biopsy revealed squamous cell carcinoma. A CT scan revealed poorly defined well enhancing lesion in skin and superficial soft tissue and enhancement in left masseter, temporalis and left zygomaticus muscle. The patient subsequently underwent wide excision of the lesion with clear margin and local flap was done over the defect. And PET-CT demonstrated FDG-avid lesions in both lung field and multiple mediastinal lymph nodes.

Results: Excised tissue was sent for histopathology which finally confirmed squamous cell carcinoma. Microscopically, neoplastic cells were noticed next to the epidermal inclusion cyst with the transitional zone from benign to malignant changes. The neoplastic squamous cells contain hyperchromatic nuclei with distinctive nucleoli and abundant cytoplasm. In addition, these lesions demonstrate frequent mitosis, keratin pearls, dyskeratotic cells, and intercellular bridges, indicating a well-differentiated squamous cell carcinoma.

Conclusion: There is general agreement that despite of rarity of malignancy in an epidermoid cyst, malignant transformation should be suspected in cases of skin lesions that are large, rapidly changing in size, inflamed, ulceration, fistulas and do not respond to medical treatment. In addition to this, we recommend that even in short term arising and small sized lesion, histopathological investigation of entire lesion should be performed. And surgeon should keep in mind that relation with distant metastasis.

p-47

ACCURACY IN ORBITAL ROOF RECONSTRUCTION USING PREMOLDED TITANIUM MESHES

Presenter: Susana Heredero

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Background: Orbital roof defects may require reconstruction to avoid complications. Fan shape titanium meshes are a good choice because they are malleable and have no donor site morbidity. However orbital volume symmetry may be difficult to achieve.

Objectives: To present our method for orbital roof reconstruction with premolded titanium meshes using a skull model. To assess the effect of presurgical planning and intraoperative navigation increasing accuracy in orbital reconstruction.

Patients and Method: This is a retrospective study performed on 9 patients (10 orbits): 3 meningiomas, 1 sarcoma, 1 melanoma and 4 fractures or post-traumatic sequelae. 7 reconstructions were planned using iPlan 3.0 (BrainLab): the adequate position of these meshes was designed mirroring the healthy orbit. Intraoperative navigation helped to check the adequate final position.

The difference between healthy and reconstructed orbits (VD) was compared in navigated and non-navigated cases and analyzed with R v3.1.1 (CRAN, Vienna). Other clinical outcome variables as postoperative enophthalmos, proptosis, distopia and diplopia were also assessed.

Results: Good functional and cosmetic results with no intraoperative complications were achieved. Enophthalmos, distopia and diplopia were not observed. Mild proptosis was observed in 2 patients reconstructed without navigation. Statistically significant difference in VD was found between the group reconstructed using navigation (0.067 ± 0.03 cc) and the group reconstructed without it (1.49 ± 0.3 cc), $p < 0.05$.

Conclusions: Mesh plates molded in a standard skull enable a convenient and rapid reconstruction, and they are a cheaper option compared to CAD-CAM implants. Preoperative planning and surgical navigation increases accuracy in orbital roof reconstruction.

p-48

Juvenile Psammomatoid Ossifying Fibroma of the Maxillary Sinus: A Case Report

Presenter: Ikkei Tamada

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Case Report: An 11-year-old boy was referred to our emergency department by a local pediatrician for detailed examination of a mass on his right cheek. His parents noticed swelling of his cheek 10 days before the visit. On physical examination, the mass was bony-hard, without skin redness or tenderness.

On ultrasound examination, a diagnosis of bony tumor was suggested. Hence, computed tomography and magnetic resonance imaging were performed. The imaging diagnosis was either intraosseous vascular malformation or angiofibroma of the maxillary sinus.

At 1 month after his first visit to our hospital, the patient was referred for treatment to the plastic and reconstructive surgery department. The tumor was resected 1 month later.

The maxillary antrum was intraoperatively removed via an intraoral mucosal incision to expose the tumor. The white tumor was elastic-hard and adhered to the inner surface of the maxillary sinus. Macroscopic total resection was possible by using the piecemeal technique via the bone window of the maxillary antrum. A silicone drain was inserted intranasally. On histological examination, the tumor contained small bones resembling psammoma bodies in the cellular stroma. The final diagnosis was juvenile psammomatoid ossifying fibroma (JPOF).

Discussion: JPOF is a rare fibro-osseous tumor involving the craniofacial skeleton of the young population. It is essentially benign but progresses locally.

Details of the clinical features and postoperative course of the present case, along with a literature review, will be discussed in this presentation.

p-49

Fracture fragment removal and bone regeneration of endoscopic transmaxillary repair and balloon technique

Presenter: Tsutomu Kashimura

Authors: Kashimura T, Soejima K, Shimoda K, Yamamoto A, Yakata Y, Yoshida K, Honnma K, Nakazawa H

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Background: We performed endoscopic transmaxillary repair and balloon technique for the treatment of orbital floor fractures as a minimally invasive method. In cases in which balloon inflation carries a risk of deviation of fractures into the eye socket, we removed the fracture while preserving the periosteum under endoscopic guidance before repairing and fixing the area. However, reports investigating orbital floor fixation in fracture removal cases are not enough. Some reports have also demonstrated postoperative orbital floor bone regeneration even in fracture removal cases. We hereby report the results of our investigation of orbital floor support and bone regeneration in fracture fragment removal cases.

Methods and Subjects: Subjects comprised 14 patients who underwent orbital floor fracture fragment removal and maxillary sinus balloon placement between November 2011 and May 2014. We investigated the presence or absence of orbital floor enophthalmos/bone regeneration and the timing for bone regeneration from computed tomography (CT) findings until 6 months postoperatively. Orbital floor repeat enophthalmos was analyzed using postoperative CT images with three-dimensional analysis software (Zio Station, ZioSoft), and maxillary sinus volume was measured after balloon removal from 3 months postoperatively onward. Post-balloon removal maxillary sinus volume ratios (maxillary sinus volume 3 months after surgery/maxillary sinus volume upon removal \times 100) were calculated and compared.

Results: Mean maxillary sinus volume ratio was $96.8\% \pm 4.8\%$. Thus, good support was achieved with repeat enophthalmos of the orbital floor and no decreased maxillary sinus volume postoperatively. Orbital floor bone regeneration was observed in 12 of the 14 cases (85.7%). The timing for confirmation of bone regeneration was 2 months postoperatively in three cases, 4 months postoperatively in eight cases, and 6 months postoperatively in one case. The two cases with delayed bone regeneration exhibited extensive orbital floor comminuted fracture but no repeat enophthalmos was observed.

Conclusions: It appears that appropriate balloon fixation in an appropriate position preserving the periosteum can make orbital floor reconstruction by bone regeneration possible even if fracture fragments are removed.

p-50

INDICATIONS OF VIRTUAL PLANNING AND INTRAOPERATIVE NAVIGATION IN FRONTAL SINUS FRACTURES

Presenter: Alicia Dean

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Background: Surgical treatment of frontal sinus fractures requires to achieve several objectives: contour repair of the anterior frontal sinus wall and the supraorbital rim, repair of the orbital roof, identification of the drainage system of the frontal sinus and complete removal of the mucous membrane of the frontal sinus. Thus, computer assisted planning (CAP), and surgical navigation (SN) can be useful tools for the management of the frontal sinus fractures

Objective: To analyze the applications of CAP and SN in the management of frontal sinus fractures.

Patients and Methods: We have applied CAP and SN for the treatment of 8 frontal sinus fractures. One of them was a primary fracture, and the remaining 7 were postraumatic sequelae. CAP was done with the iPlan planning software that allows planning the adequate contour of the anterior wall of the frontal sinus and the orbital roof by means of auto-segmentation and symmetrization tools. SN was carried out with the Vector Vision of BrainLab.

Results: The SN was used to draw the osteotomy approach to the anterior wall of the frontal sinus, to identify the drainage system of the frontal sinus, to verify the appropriateness of the removal of the sinus mucosa checking recesses, to assess the accurate reduction of the anterior wall, and to confirm the proper placement of an orbital mesh for the roof of the orbit when indicated. In all the patients CAP and SN was useful to achieve the goals of treatment.

Conclusions: In the management of frontal sinus fractures we consider three moments of navigation. With the first navigation we draw the osteotomy of the anterior wall of the frontal sinus. The second navigation we use for the identification of the drainage system of the frontal sinus or verification of its recesses. The third navigation is used to check that the goals of treatment, such as an adequate contour of the anterior wall of the frontal sinus or of the roof of the orbit, have been achieved.

p-51

Restoring Pre-injury Occlusion in Mandible and Maxilla Fracture Treatment: Dental Splint Application

Presenter: Sinan Öksüz

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Background: Maxilla and mandible fractures disorganize teeth alignment and cause orthognathic problems. Arch-bar bimaxillar fixation is the conventional method to restore teeth alignment. However arch-bar fixation method is far from ideal to accomplish pre-injury occlusion. Occlusion splints can be prepared preoperatively on the jaw model of patients and these splints can ensure correct restoration of teeth occlusion in jaw fractures. We present our experience about using occlusion splints in treatment of maxilla-mandible fractures.

Method: Patients with maxilla and mandible fractures were treated with dental occlusion splints and open reduction rigid internal fixation method. Jaw models of the patients were prepared prior to surgery in the department of Othodontics. The acrylic dental occlusion splints were prepared following the model surgery. The fractures were surgically exposed and the splints were placed before the bimaxillary fixation. Rigid internal fixation was accomplished right after providing anatomic reduction and pre-injury occlusion.

Result: The correct pre-injury occlusion planes of the patients were determined by means of jaw model surgery, and occlusion splints were prepared before the live surgery. Using dental occlusion splints provided correct alignment of teeth and ideal occlusion restoration without a delay during live surgery. Fractures healed without complications. Dental occlusions were restored to pre-injury status.

Conclusion: The drawback of the method is preparing the jaw model, requirement of model surgery and preparing the occlusion splints prior to surgery. These steps require extra effort and time. However the final ideal fracture reduction and occlusion restoration obtained by means of splints, eliminates the drawback of the method. Using dental occlusion splints ensure restoring the pre-injury occlusion with correct fracture reduction in jaw fractures associated with occlusion misalignment.

p-52

Multidisciplinary Treatment for Correction of Malocclusion due to Maxillofacial Deformity from Fractures

Presenter: Yasuharu Yamazaki

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Background: The prime therapeutic principle in the treatment of maxillofacial bone fractures is reintegration to the original condition. However, in the event of neurosurgical complications, treatment of these complications takes precedence over correction of maxillofacial fractures. Therefore, a multidisciplinary approach is indispensable for such patients. To achieve optimal results during secondary correction, it is essential to adopt a 'profile approach' for improvement of face contour and a 'function approach' for improvement of masticatory function. *We will present the importance of multidisciplinary treatment in achieving optimal results for secondary correction of malocclusion.*

Object: Twelve patients of malunion after facial bone fracture (August, 1999-March, 2013) Man: 8 patients, Woman: 4 patients.

Evaluated Items: 1. A cause of malunion, 2. A presence of jaw bone osteotomy and bone graft, 3. Soft tissue correction, 4. Orthodontic treatment, 5. Final dental prosthesis method.

Results: 1. Causes: Brain contusion-5 patients, Treatment in other hospitals-5 patients, Alveolar bone loss-2 patients, 2. Skeletal correction: Jaw bone osteotomy surgery alone-4 patients, Jaw bone osteotomy surgery and bone graft-7 patients (Donor: mental bone-2 cases, iliac bone-one case, Body of mandible-4 cases), Vascularized bone graft from the rib-one patient, 3. Soft tissue correction: Augmentation-one patient, Labial scar or facial revision 3 patients, 4. Orthodontic treatment: 8 patients, 5. Final dental prosthesis method: Dental Implant-9 patients.

Conclusion: Multidisciplinary treatment is successfully used to achieve cosmetic reconstruction and recovery of maxillomandibular function and occlusion for patients.

p-53

Patterns of intracranial hemorrhage in pediatric patients with facial fractures

Presenter: Jordan N. Halsey

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Purpose: Intracranial hemorrhage (ICH) in the presence of a facial fracture requires intervention or close monitoring. This often takes priority in management when compared to the fracture of the facial skeleton. Recognition and appropriate management of ICH is paramount prior to intervening surgically with the fracture of the facial skeleton. The goal of this study was to examine all pediatric patients with facial fractures that sustained an intracranial hemorrhage to determine aspects of patient presentation, concomitant injuries, and fracture patterns.

Methods: Following institutional review board approval, a retrospective review from 2000-2012 of all facial fractures for patients 18 years or younger at a level 1 trauma center was performed. Patient demographics, location of fractures and the presence of an ICH were collected. In addition, management of the ICH was analyzed.

Results: During this time period 285 patients met inclusion criteria. ICH was noted in 67 patients with intraparenchymal and subdural hemorrhages the most common finding. Midline shift was noted in 8 patients, an intracranial pressure monitor was placed in 14 patients, an external ventricular drain (EVD) was placed in 6 patients, 10 patients were taken to the operating room (OR) for craniotomy, and 11 patients showed worsening of the hemorrhage on repeat imaging. Of patients sustaining an ICH, 6 expired. The presence of a mandible fracture was negatively correlated with the presence of an ICH. Patients requiring an advanced airway were more likely to undergo placement of an EVD. Glasgow Coma Scale on presentation was noted to be significantly lower in patients who expired, underwent placement of an ICP monitor or EVD, underwent evacuation in the OR, or showed worsening of hemorrhage on repeat imaging.

Conclusion: The initial presentation of the patient and need for airway protection appears to correlate with the severity of an ICH. ICH is less likely to be observed with mandible fractures compared with other fractures of the facial skeleton. It is important to recognize and manage ICH appropriately prior to fracture treatment. Delay in treatment of the fracture can lead to unavoidable suboptimal results.

p-54

Surgical treatment of zygomatic fracture by using biodegradable plate system (Superfixorb MX®) on 33 cases

Presenter: Shinsuke Sakai

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Zygomatic fracture is relatively common in facial trauma. The operation method is almost established. Recently open reduction procedures are improved to less invasive and particular one plate fixation technique seems to be recommended.

We considered that using biodegradable plate system in open reduction procedures was minimally invasive to the patient.

We had performed open reduction procedures on 33 patients with zygomatic fracture (21 males and 12 females, Average age of the patients was 42.) by the use of hydroxyapatite particles/poly L-lactide composite device (Superfixorb MX[®] Takiron Co., Ltd.: Japan) since 2010 to 2013. The fracture site recovered in all cases and there was no dislocation in the post-operational period. However, minor complication occurred in 3 cases, the plate exposed in maxillary vestibular region in 2 cases and abscess formed in oral cavity in 1 case.

As this system is more fragile than titanium plate, we must manipulate this system very care fully. Once we have master the system, it would be very effective.

p-55

Ethanol sclerotherapy for treating venous malformations of the palatal region.

Presenter: Munetomo Nagao

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Introduction: Treatment of deeply located venous malformations (VMs) are challenging problems for plastic surgeon, especially when it is located in the head and neck region. Recently, sclerotherapy has been a useful alternative to traditional surgical excision.

We herein describe the clinical experience of using ethanol injection sclerotherapy to treat the VMs with dyspnea of the palatal region.

Case Reports: Case 1: A 63-year-old male presented with swelling, dark-bluish discoloration of the palatal region and dyspnea in the supine position. MR imaging was performed and VMs were thus diagnosed to be present in the palatal region.

The patient underwent sclerotherapy using absolute ethanol. One year after the treatment, the dyspnea in the supine position was improved without any complications.

Case 2: A 56-year-old female presented with swelling, dark-bluish discoloration of the palatal region and dyspnea in the supine position. MR imaging revealed multiple VMs in the head and neck region including the palatal region. The patient underwent sclerotherapy using absolute ethanol for the palatal region. After two courses of treatment, the dyspnea in the supine position was improved. We plan to continue treatment for the other lesions in near future.

Discussion: VMs are one of the most common benign vascular lesions, with approximately 40% of all cases appearing in the head and neck region. They can affect a patient's appearance, functionality and even result in life-threatening bleeding or air way obstruction.

We treated the VMs in the palatal region using sclerotherapy, and the patients responded well to this treatment. A single treatment may be adequate for small lesions, however, this procedure may also be safely repeated until a satisfactory result is obtained.

Conclusion: Injection sclerotherapy using ethanol offers an effective treatment option for minimum invasion in the patients presenting with VMs in the oral and pharyngeal regions.

p-56

Modified Facial dismasking flap approach for excision of orbital hemangioma: A case report

Presenter: Tomoaki Kuroki

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Introduction: We designed a new surgical approach which is consisting of a combination of either Facial dismasking flap approach and *Transconjunctival approach* for orbital lesion, and which succeeded the excision of deep orbital cavernous hemangiomas.

Case: 42 years old man who had plural hemangioma on both sides of optic nerve on the right eye. He was not able to close right eye because of severe exophthalmos, and complained of lacrimation with pain.

Method: We made dismasking flap incision, whole circumferential outer eyelids incision except from lachrymal punctum, and *conjunctival* incision at lateral caruncle.

Then we made zygomaticotomy and lateral orbitotomy, and moved orbital contents laterally, and excised hemangiomas surrounding optic nerve through outer eye muscles.

Result: We had performed this operation twice at Sept. 2 2010 and Oct. 30, 2011. After two operations, his right eye ball moved 17mm backward eventually. Then he became able to close right eye. There was no lacrimal apparatus damage. His subjective symptoms and facial appearance had been improved dramatically.

Discussion/Conclusion: Our technique has the advantage to approach the medial side optic nerve lesion without craniotomy. Since our technique can avoid some risks of craniotomy, that approach is an effective option for treatment of orbital tumors.

p-57

Arachnoid cyst and dysplasia of the greater wing of the sphenoid in neurofibromatosis. Surgical management

Presenter: Damian Palafox

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Arachnoid cysts represent less than 1% of brain tumors. There are few reports of subarachnoid cysts of the temporal lobe with subsequent remodeling of the orbit, however there are no reports regarding the reconstructive management of the orbital cavity in this pathology. We report the case of a man of 44 years who presented progressive increase in volume of the left eye of 40 years of evolution, with intermittent retro-ocular pain. A temporal lobe arachnoid cyst was diagnosed invading the orbital cavity and dysplasia of the greater wing of the sphenoid. Drainage and cystocisternostomy of arachnoid cyst with orbital wall reconstruction with titanium mesh and covered with a flap of pericranium was performed as well as the lifting and repositioning of the eyeball by canthopexies and orbital osteotomy to decrease the volume of the cavity.

p-58

The Surgical Approaches To Intraorbital Tumors Applying Orbitotomy

Presenter: Toshihito Mitsui

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Aim: In the intraorbital space, many important constructive and functional organs are located. So it is necessary to take attention at surgical removal of intraorbital tumors to avoid the surrounding tissue damages. Especially against retrobulbar tumors, the approaching route should be carefully considered. Various methods of intraorbital tumor resection have been performed in our department, for example transcranial orbitotomy, lateral orbitotomy, etc. The aim of this study is to introduce our surgical approaches to intraorbital tumors.

Material and Methods: Four cases with intraorbital tumors that needed orbitotomy approaches between 2006 and 2015 were reviewed retrospectively. All cases underwent magnetic resonance or computed tomography before surgical resection. The approach was chosen referring to the tumor localization.

Results: The first case showed an intraorbital osteoma that located at cranial side of orbit. Then transcranial orbitotomy was indicated to approach there safely. The second had a malignant lymphoma that located at retrobulbar area. The transsine approach that removed the central part of the infraorbital bony floor via subciliary incision was chosen. The third had an adenocystic carcinoma that located at the lateral area out of muscle cone in orbit. In this case, lateral orbitotomy was needed for biopsy. The fourth showed a schwannoma along the inferior rectal muscle and retrobulbar area. Transsine approach was indicated similar to the second case.

Conclusion: The approach and the resection of intraorbital tumor is originally difficult, however it is more safe to indicate the adequate approach depending on the tumor location. It could remain good visual ability, smooth eye movement and less abnormal senses.

p-59

Usefulness of pre-bent titanium mesh plates for the precise repair of orbital wall fractures

Presenter: Takahiro Yamamoto

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Objectives: The three-dimensional (3D) virtual models using 3D-printer technology as a simulation tool have been used widely and inexpensively in craniofacial surgery, and the usefulness of pre-bent titanium mesh plates have been reported for the reconstruction of orbital wall fractures; however, few have mentioned operation lengths in detail. This is worthy of notice as the more operative time it takes, the more difficult it is to perform the operation due to the swelling of soft tissues. The objective of this study is to compare and determine the effectiveness of pre-bent plates over intraoperative-bent plates.

Methods: 15 consecutive patients affected by an orbital wall fracture were included in this retrospective study. The first 6 were treated by intraoperative-bent titanium mesh plates, and the others, by pre-bent titanium mesh plates. In the group which received the pre-bent treatment, 3D-models were created as templates to form the pre-bent plates. These plates were then used intraoperatively as guides to further increase the accuracy of the implant placement in the orbit. They were bent carefully to fit snugly onto the specific shape of orbital rim, which led to an accurate reconstruction in the orbital wall and cavity. Fifteen patients' clinical data and operative time were analyzed. We used a transconjunctival approach for the exposure of fractures.

Results: All the patients had good results including significant improvement in enophthalmos and diplopia. There were no severe permanent complications. The mean operation length of the pre-bent group (38.5±16.3 min) was significantly shorter than that of the intraoperative-bent group (83.6±24.1 min) ($p < 0.01$, Student's t-test).

Conclusions: The method of using pre-bent titanium mesh plates is not technique-dependent but is a more precise and less time consuming approach compared to the conventional intraoperative-bent plate. Furthermore, in Japan, this method would be applicable for all patients with orbital fractures as it is financially feasible to build an anatomical model for ¥20,000 (160US\$).

p-60

Solitary Fibrous Tumor as an Orbit Lesion: Report of Three Cases.

Presenter: Hiroki Yano

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Background: Although solitary fibrous tumor is familiar with the pleural lesion, it has been rarely described at several extraserosal sites, such as liver, upper respiratory tract, kidney, adrenal gland, and other soft tissues. Since Westra et al first reported two cases of orbital solitary fibrous tumor in 1994, it has been gradually recognized as a spindle cell neoplasm arising in the orbit. In fact, solitary fibrous tumor is rarer than lymphoma, lacrimal gland tumors, but it should be known as one of the orbital lesions for craniofacial surgeons treating facial tumors.

Objectives: The authors describe three cases of solitary fibrous tumor arising from the orbit, and discuss about its management including the diagnosis and treatment with reviewing literatures.

Patients & Methods: Two male (59 years-old and 42 years-old) and one female (74 years-old) patients with orbital solitary fibrous tumor were observed. Two lesions occupied the upper lateral orbit and one captured the upper medial orbit. The upper lateral lesions were completely extracted with lateral orbitotomy from Stallard-Wright incision, and medial one was resected with frontal craniotomy. The specimens of the tumors showed positive staining in immunohistochemistry, such as vimentin, CD34 and BCL2, which reached solitary fibrous tumor in definitive diagnosis. Their follow-ups are from 12 to 101 months, and these results please all three in their esthetic and functional conditions.

Conclusion: Principle of treatment for orbital solitary fibrous tumor is complete resection because the prognosis is based on the control of the tumor progression, which was not enough to control with chemotherapy and radiotherapy. Furthermore periodic follow-up is important because orbital tumors in low malignancy result in the marginal resection.

p-61

Efficacy and complication of resorbable plate for reconstruction of orbital wall fractures

Presenter: Kazuhide Mineda

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Purpose: We had used resorbable plate for orbital wall fracture since 2009. We examined the outcomes about efficacy and complications in our facilities.

Patients and Methods: Between November 2009 and June 2014, 27 patients with traumatic orbital fracture were treated in our facilities. We used resorbable plate (LactoSorb[®]; mesh or non-porous type) for reconstruction of orbital wall fracture in all patients. Retrospectively, we investigated patient demographic, sites of the fracture, and postoperative complications including infraorbital nerve paralysis, ocular motility, enophthalmus and wound infection.

Result: Patient's age ranged from 11 to 62 (mean 40 years old). The follow-up duration was 9.3±7.6 months. The sites of the fracture included orbital floor in 18 patients, medial wall in 4 patients, and floor and medial wall in 5 patients. One patient without infraorbital nerve paralysis had the paralysis postoperatively. The ocular motility was improved postoperatively on 19 patients who had diplopia preoperatively. However, 7 of these 19 patients (39%) still had slight diplopia after surgery. Preoperatively, five of these 7 patients had large herniation of orbital contents caused by both floor and medial wall fracture. The postoperative enophthalmus (>2mm) remained in 3 patients (11%). One patient had plate removed because of abnormal displacement of the plate. Allergic reactions and infections were not observed in all patients.

Conclusions: We considered that postoperative diplopia and enophthalmus was caused by large punched out fracture. This study represented that the resorbable plate was a safe and effective materials for reconstruction of orbital wall fracture.

p-62

Maxillofacial fractures associated with laryngeal injury; red flag signs and symptoms that should not be overlooked

Presenter: Chih-Hao Chen

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Background: Maxillofacial fractures with associated laryngeal injuries put both the quality and maintenance of life in jeopardy. Their symptoms vary widely from distinct airway obstruction to minor or subtle symptoms that often go unnoticed. Overlooking these signs or symptoms, however, may result in fatal outcomes. In this study, we review the incidence, management and outcome of maxillofacial fracture patients with associated laryngeal traumas in order to determine common red flag signs and symptoms, which will help raise the suspicion index of such injuries when evaluating trauma victims in the emergency department.

Methods: Between 2008 and 2013, seven patients suffering from maxillofacial fractures with associated laryngeal injuries were included in this study. The various signs and symptoms of each patient upon presentation were identified. Their courses of treatment were analyzed along with their length of hospital stay, complications and individual outcomes.

Results: Seven patients, all male, with a mean age of 36.4 years-old were evaluated. Motor vehicle accidents were the prominent (71.4%) cause of injury, while blunt trauma represented the majority (85.7%) of the mechanism of trauma. Based on the collected data, subcutaneous emphysema and cervical pain were the prominent signs and symptoms, each presenting in six out of the seven (85.7%) patients. In addition, hoarseness and dyspnea both appeared in four out of the seven patients (57.1%). The mean hospital stay was 18 days. Grade III and IV patients (5/7 patients) had poor outcomes as three required permanent tracheostomies and three were dysphonic upon follow up.

Conclusions: Our results suggest that laryngeal injuries should be highly suspected in maxillofacial fracture trauma victims presented in the emergency department with subcutaneous emphysema, cervical pain, hoarseness, dyspnea or neck swelling. An increased clinical awareness may lead to prompt examinations such as physical inspection of the neck, a neck CT or a fiberoptic endoscopy to confirm the diagnosis and initiate proper treatment. As a result, we will be able to identify an easily overlooked, yet potentially life-threatening injury, while giving the patient their best chance of survival and long term quality of life.

p-63

Prevalence of Vascular Malformation Patients in Cipto Mangunkusumo Hospital, Jakarta from 2010 to 2014

Presenter: Prasetyanugraheni Kreshanti

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Background: Vascular malformation (VM) is a common disease that can be seen in daily practice at Cipto Mangunkusumo Hospital, Jakarta and treated by several divisions. But, there is no data that has been published to show the prevalence of VM patient and their characteristic in our hospital.

Methods: This is a descriptive-cross sectional study. The data of VM patients has been collected from medical records in our hospital's ward start from 2010 to 2014. Data will be excluded if the patient profile or the diagnosis is not complete or the lesion appear in the location of the body other than face, head and neck, and extremity.

Results: From 94 patients that has been diagnosed having VM, 53 patients (56,4%) have arteriovenous malformation, 15 patients (16%) have venous malformation, and 26 patients (27,7%) have lymph malformation. From 94 subjects, 45 (47,9%) are male and 49 (52,1%) are female. There are 45 patients (47,9%) that has the VM been recognized since they were born, 11 patients (11,7%) before 2 YO, and 38 patients (40,4%) after 2 YO. The division that treat the patient with VM are plastic surgery (27 patients, 28,7%), vascular surgery (42 patients, 44,7%), pediatric surgery (19 patients, 20,2%), and other division (6 patients, 6,4%). From 94 subjects in this study, 33 patients (35,1%) have no referral history of referral from any doctor, 16 patients (17%) came with referral from general practitioner, and 45 subjects (47,9%) came with referral from specialist. The most common location of VM are in the face with 39 patients (41,5%), followed by head and neck with 32 patients (34%), and extremity with 23 patients (24,5%). The imaging used are CT angiography (39 patients, 41,5%), MRI (5 patients, 5,3%), and ultrasound (11 patients, 11,7%). The treatment modalities are non-operative (17 patients, 18,1%), operative only with resection (41 patients, 43,6%), and combination (36 patients, 38,3%). The regiment used in non-operative and combination treatment are oral corticosteroid (1 patient, 1,1%), propranolol (1 patient, 1,1%), bleomycin (10 patients, 18,9%), and ethanol 96% (41 patients, 77,4%).

Conclusions: This study show the prevalence of VM patient and their profile in Cipto Mangunkusumo Hospital from 2010 to 2014.

p-64

Comparison between two different flap for reconstruction in tongue—A quality of life analysis

Presenter: Yisen Shao

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Background: To compare the quality of life (QOL) between anterolateral thigh perforator free flaps (ALTF) and pectoralis major myocutaneous flap (PMMF) for reconstruction the tongue.

Method: Collect the date from tongue squamous cell carcinoma patients who underwent surgery using anterolateral thigh perforator free flaps or pectoralis major myocutaneous flap during 2008-2014, quality of life were assessed by the 36-item short form health survey(SF-36) in 89 patients after 1 year of surgery, SPSS 19.0 were used for statistical analysis.

Results: To compare the anterolateral thigh perforator free flaps and pectoralis major myocutaneous flap, there was significant differences in the gender,age and treatment (P< 0.005); Statistically significant difference was also found in six scales of quality of life including role limitations due to physical health(RP), role limitations due to emotional problems (RE), bodily pain (BP), vitality (VT), mental health (MH) and general health perceptions (GH)(P<0.005).

Conclusion: The quality of life who received anterolateral thigh perforator free flaps is better than that of pectoralis major myocutaneous flap. This study provide useful information for physicians during their discussion of reconstruction modalities for tongue.

p-65

Correction of Late Post-traumatic Enophthalmos using an Antral Balloon

Presenter: Akihiko Sakagami
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Background: Enophthalmos is the posterior displacement of the ocular globe within the bony orbit. Correction of late post-traumatic enophthalmos is one of the most challenging surgical procedures. We have performed a corrective procedure for late enophthalmos using an antral balloon, with or without minimal bone grafting.

Method: All orbital contents were separated from the bone fragments, infraorbital nerve, and mucosa of the maxillary antrum. The remaining orbital floor was fractured by the surgeon's digital pressure from the maxillary antrum. The antral balloon was placed in the maxillary antrum and inflated under direct vision from inside the orbit. After a consolidation period, the patient underwent antral balloon removal.

Result: A total of 5 patients underwent repair of late enophthalmos using this antral balloon technique. The median time from initial injury was 14 months (range, 6 to 90 months). The median antral balloon placement duration was 76 days (range, 53 to 106 days). Satisfactory symmetries were achieved in 4 patients. Mild residual enophthalmos remained in 1 case, who had an orbital framework deformity and was missing the entire orbital bony floor preoperatively and who required simultaneous bone grafting.

Conclusion: The ideal indication for our technique was the need for orbital floor reconstruction, without an orbital framework deformity. This technique could avoid autogenous bone grafting or permanent alloplastic implantation, which may cause a foreign body reaction, chronic inflammation, and migration. We believe that our new technique is one of the least invasive corrective procedures for late post-traumatic enophthalmos.

p-66

Percutaneous sclerotherapy for intramuscular venous malformations of the masticatory muscles

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Background: Venous malformations (VMs) are the most common congenital vascular malformations. They present in a wide spectrum, from isolated cutaneous or intramuscular varicosities to more complex anomalies involving several tissue planes. The purpose of this study was to retrospectively evaluate the outcomes of sclerotherapy for VMs involving masticatory muscles.

Method: Between 1992 and 2013, a total of 24 consecutive patients with VMs involving masticatory muscles who underwent percutaneous sclerotherapy were enrolled in this study. Of the 24 patients, 13 were female and 11 were male, with a mean age of 26.0 years (range, 4 to 58 years) at the beginning of treatment. Clinical symptoms were swelling on the affected side in all the patients, pain in 13, exophthalmos in 1, and malocclusion in 1. Areas of involvement included the localized lesion of the masseter muscle in 7, the localized lesion of the temporalis muscle in 2, the localized lesions of the multiple masticatory muscles in 3, and the extensive lesions of the masticatory muscles involving the oral cavity and/or the orbit in 12. The sclerosants used were absolute ethanol and polidocanol.

Result: The mean number of sclerotherapy sessions was 6.6 times (range, 1 to 32 times) per patient. The mean follow-up period after the first sclerotherapy was 60.6 months (range, 6 to 178 months). Of the 24 patients, the clinical outcome was excellent in 8, good in 11, and fair in 5. Better results were obtained in patients with the localized type of lesion. The complications were incomplete facial paralysis in 6, intraoral ulceration in 2, and acute tubular necrosis in 1.

Conclusion: Percutaneous sclerotherapy is effective treatment for craniofacial intramuscular VMs, especially in the localized lesion of the masseter muscle.

p-67

Custom-made cranioplasty by hydroxy-apatite prostheses: the report of 3 cases

Presenter: Masami Saito

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Several materials, such as titanium, resin, silicon, acrylic mesh and different types of bioceramics, have been proposed to reconstruct the skull defect. Among others hydroxy-apatite seems to be good for biocompatibility. We present 3 cases of the cranioplasty performed with a bioceramic hydroxy-apatite prosthesis. Two patients were posttraumatic cranial bone defects and another had suffered from a loss of skull resulting from bone-involving tumor. In each case, an exact prosthesis of the bone defect was made based on three-dimensional (3-D) reconstructed computerized tomography data. All patients showed a satisfactory functional outcome with good cosmetic appearance. Customised hydroxy-apatite prosthesis is an important variant of the cranioplasty with artificial bone.

p-68

Closed Reduction of nasal fracture using ultrasonography

Presenter: Ayako Syouka

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Nasal fracture is common in facial trauma. The operation method is quite simple, but obtaining exact reposition has been thought difficult. Recently, closed reduction using ultrasonography is likely to be recommended.

Our closed reduction procedure is composed of 3 steps. At first, we perform manual reduction and confirm reposition by ultrasonography. Secondary, we prick 23 gauge needle percutaneously using ultrasonography and restore bone fragment. Finally, we make 3 size of roll gauze and insert nasal cavity in ascending order.

We had performed closed reduction procedures on 19 patients nasal fracture (13 males and 6 females, 9 cases in general anesthesia and 10 cases in local anesthesia, 3 cases classified as saddle nose type and 16 cases as deviated nose type) since October 2013 to March 2015.

Post operative CT images were taken 2 weeks after the surgery and results were evaluated as good (12 cases), fair (5 cases), poor (2 cases).

We concluded our technique of nasal operation using ultrasonography was useful. Especially, we recommend to pile up three gauzes on the nasal cavity, since compression between gauzes and splint is necessary for fixation of nasal bone.

p-69

Pediatric facial fractures: interpersonal violence as a mechanism of injury

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Purpose: Several of the most common causes of pediatric facial fractures are interpersonal violence and motor vehicle accidents. The presentation of fractures as a result of different etiologies varies dramatically and can have a direct impact on management. This study compares facial fractures in a pediatric population as a result of interpersonal violence to other mechanisms of injury.

Methods: A retrospective review of all facial fractures at a level 1 trauma center in an urban environment was performed for the years 2000 to 2012. Patients 18 years of age or younger were included. Patient demographics were collected, as well as location of fractures, concomitant injuries, services consulted, and surgical management strategies. Patients were placed into 2 groups, those sustaining an injury as a result of interpersonal violence and all others.

Results: During this time period, there were 3,147 facial fractures treated at our institution, 285 of which were in pediatric patients. There were 124 (43.5%) patients identified as sustaining a fracture as a result of interpersonal violence. Those sustaining a fracture as a result of interpersonal violence were statistically ($p < 0.05$) more likely to be male and to have sustained a fracture of the mandible. This group of patients was statistically ($p < 0.05$) more likely to be admitted specifically for management of a facial fracture and statistically ($p < 0.05$) more likely to be treated operatively with rigid internal fixation. Those sustaining a fracture as a result of interpersonal violence were significantly less likely to have other systemic injuries such as spinal fractures, intracranial fractures, long bone fractures, and pelvic/thoracic fractures. In addition a significantly higher Glasgow Coma Scale (14.7 vs. 12.8) and age (16.0 vs. 12.8 years) and a significantly lower hospital length of stay (2.9 vs. 7.9 days) was observed in the group subjected to interpersonal violence.

Conclusion: Pediatric patients suffering facial fracture as a result of interpersonal violence show a very distinctive pattern of presentation. The energy associated with the injury is likely directed directly at the craniofacial skeleton and therefore other organ systems are spared. This allows more directed fracture management resulting in a shorter hospital stay when necessitating admission.

p-70

MODIFIED LE FORT III OSTEOTOMY-MINIMAL INCISIONS

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Objective: The aim of this study is to evaluate functional results of a modified LeFort III osteotomy technique.

Design: This is a descriptive, case series study. The patients included were diagnosed with Crouzon syndrome, arrhinia, or Binder. Surgical indication was mid face retrusion, exorbitism or Obstructive Sleep Apnea (OSA). All patients were treated at Hospital Infantil Universitario de San Jose (Bogotá Colombia)

Patients: The Surgical Technique was done in 23 patients.

Interventions: In this technique coronal incision is avoided, the incisions are performed at the nasofrontal junction, subciliary and vestibular areas. Also there is a modification in the zygomatic osteotomy which is not over the arc but right through the body of the zygoma.

Main Outcome Measure: We used measurements of central tendency, and frequencies.

Results: In all cases we used an external distractor, age at the time of surgery was between 4 to 16 years old, the time of surgery was about 150 to 240 minutes, distracted length achieved was 11 to 20 mm average. All patients showed improvement in the anteroposterior projection associated to decrease in exorbitism measurements and breathing symptoms, with no obvious scars.

Conclusions: This technique can reduce bleeding by avoiding coronal incision, and time of surgery, and allows good aesthetic and functional results.

Key Words: Lefort III osteotomy, Crouzon, midface, distraction.

p-71

Therapeutic strategy of Mandibular condylar fractures

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Purpose: Although condyle is one of the frequent site of fracture in the mandible, anatomical and functional complexity of the temporomandibular joint (TMJ) make the treatment policy of mandibular condyle fracture controversial. Watanabe et al. reported a novel treatment for mandibular condylar fractures: a dynamic distraction treatment (PRS 2008). This application of a dynamic internal distraction device is an effective and minimally invasive treatment; however, in our substantial experience on dynamic distraction treatment, we occasionally encounter rare cases in which resulted insufficient reduction of the fractured bony fragments. The purpose of this study is to investigate our clinical cases retrospectively, and establish a novel therapeutic strategy of mandibular condyle fracture.

Methods: The subjects were 55 cases who underwent condylar fracture treatment in 2006-2014. In reference to the Spiessl classification, cases were classified depend on the site of fracture and the location of the fractured fragment. Clinical outcomes were evaluated with regard to TMJ function and occlusion.

Result: Ten cases were treated by means of ORIF, 31 cases by dynamic distraction treatment, 2 cases by combination of ORIF and dynamic distraction treatment, and 12 cases by conservative therapy. The mean operative duration of ORIF was over six hours, and in some cases of intra-articular fracture, completion of surgery was impossible and discontinued. Dynamic distraction treatment worked well in most cases, however, in some cases with displacement of large bony fragments, only modest reduction was obtained and long period was needed to recovery of the TMJ. In such cases, combination of ORIF and dynamic distraction treatment achieved better outcomes. Conservative therapy was performed only when location of the fractured fragment was not changed.

Discussion: Dynamic distraction treatment is very effective when fractured fragment is not large (intra-articular fracture; Type VI) or the bone fragment remains within dislocation (Type IV, V). For extra-articular fracture with displacement of bony fragment (Type II, III), ORIF can be the choice, however, combination of ORIF and dynamic distraction treatment which can avoid plate fixing and thus be less-invasive may be more preferred by many surgeons.

p-72

Comparative study of anthropometry of the face between normal Japanese and Caucasoid subjects

Presenter: Fumio Nagai

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Purpose: Faces show significant differences in morphology according to age, sex, and race. Data on craniofacial norms from birth to adulthood are useful in clinical medicine, especially plastic surgery. Farkas provided normal facial growth curves in North American Caucasians in 1994. Unfortunately, there have been few reports regarding anthropometry of the Asian face, including Japanese. In this study, we directly measured the faces of normal Japanese children to obtain data on the facial norms for Japanese in each age group, and compared them with published data for Caucasians.

Methods: This study included 185 individuals (101 males and 84 females) with an average age of 75 months. None of the individuals had any craniofacial conditions and received surgery under general anesthetic. We obtained the following 19 anthropometric measurements: intercanthal distance (en-en), binocular width (ex-ex), eye fissure length (en-ex), orbital height (or-os), nasal height (n-sn), nasal dorsum length (n-prn), nasal tip protrusion (sn-prn), nasal width (al-al), columellar length (sn-c), columellar width (c-c), philtral height (sn-ls), lateral upper-lip height (sbal-ls'), total labial height (sn-sto), philtrum width (cphi-cphi), mouth width (ch-ch), lower face height (sn-gn), lower vermilion height (sto-li), lower lip height (sto-sl), nasolabial angle (NLA). All data were compared with Farkas' normal Caucasian values.

Results: At all ages, the following horizontal distances of Japanese were larger than those of Caucasians: en-en, ex-ex, en-ex, al-al, and cphi-cphi. However, sn-c and NLA of Japanese were smaller than those of Caucasians. The other 9 distances, including 7 vertical distances, were the same between the two races.

Conclusions: The horizontal distances of eyes, nose, and philtrum of Japanese are wide at all ages. Almost all vertical distances are similar to those of Caucasoids. It is important for surgeons to recognize these tendencies of Asians, including Japanese.

p-73

Possibility of using standard plates for orbital fracture.

Presenter: Michiko Fukuba

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Absorbable plates are sometimes grafted for treating orbital fractures. These plates cannot be readily processed to fit the shape of the fracture site, particularly when the fracture encompasses a broad area from the medial toward the inferior wall. Preparing the plates in a standard shape beforehand will be useful. We conducted experiments in patients aged ≥ 18 to determine whether orbital fracture can be reduced using a standard plate such that enophthalmos does not occur. The standard plate was shaped using a dry skull of unknown race, sex, and age and placed on CT images of 14 orbital fracture patients. After positioning the plate, volumes of the orbit and contralateral orbit were measured. We also measured the orbital wall distances of healthy orbits in 40 male and 40 females to determine the mean size of the orbit. The difference in volume between the orbit and contralateral orbit after the standard plate was placed was up to -1.81 ml. In healthy orbits, the medial, inferior, and medial+inferior wall distances were markedly longer in males than in females. Although the orbit length was markedly different between males and females, it was possible to reduce orbital fractures such that enophthalmos does not occur through the placement of a standard plate. These results suggest that the standard plate is an appropriate graft material for orbital fractures.

p-74

The Effects of Desferroxamine on Bone and Bone Graft Healing in Critical-size Bone Defects

Presenter: Serbulent Guzey

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Background: Autogenous bone grafts are still the gold standard treatment option in critical-size bone defect reconstructions and many therapies can affect its incorporation. In this study it was aimed to research the effects of Desferroxamine application on bone and bone graft healing due to the effects of osteoblast and osteoclast regulation, and stimulation of angiogenesis.

Method: Rat zygomatic arch critical-size bone defect model (5 mm) was used as the experimental model. Thirty-two Sprague-Dawley rats (64 zygomatic arches) were divided into four groups. In Group 1 and 2, defects were reconstructed with the bone grafts harvested from the other side and right arc was named as Group 1 and the left was Group 2. At Group 1, 200 microM/300microL dosage of DFO was injected at the zygomatic arch region starting at 7th day preoperatively and lasting 45th day postoperatively. Group 2 animals were defined as the control group of Group 1 and 0.9%NaCl injection was applied. In Group 3 and 4 there was no repair after the formation of defects and the right arc region was treated with DFO and left was treated with 0.9%NaCl for postoperative 45 days, respectively. Radiological (CT), histological (H&E), and biomechanical (3 point bending test) tests were used for the evaluation.

Results: In radiological evaluation, there was a statistically significant decrease ($p < 0.05$) in bone defect size at Group 3 animals at 4th, 8th and 12th weeks and bone graft volume showed a statistical difference at all weeks ($p < 0.05$). In histological evaluation it was observed that there was an increase in osteoblast number and vascularity rates ($p < 0.05$) at DFO treated groups at all weeks. Biomechanical evaluation of the subjects showed that the increase in bone strength in Group 1 animals at 12-weeks.

Conclusion: In this study, it was shown that DFO treatment increased bone graft incorporation and healing in critical-size bone defects. In this aspect, we suggest that DFO can be used to increase graft incorporation in risky areas and reduce the defect size in patients who are not suitable for vascularized bone graft transfer.

p-75

Effect of allogeneic platelet lysate and cyanoacrylate glue on the fibrovascularization of the Medpor implant

Presenter: Hüseyin Karagöz

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Background: Because of limited autogenous tissue sources, donor site morbidity, and difficulty of shaping the autologous tissue, surgeons often need to use alloplastic frameworks in reconstruction of three dimensional tissue defects. Medpor (Porex Surgical, College Park, CA, USA) a synthetic porous polyethylene (PP) implant is widely used in plastic surgery for three-dimensional reconstruction of the lost or highly deformed tissues. One of the main factors of PP implant exposure is delayed fibrovascular ingrowth.

Method: In the present study, we investigated the effect of allogeneic platelet lysate (PL) and Glubran2-(2-octyl cyanoacrylate)(CTG) on the fibrovascularization of the PP implant. Twenty 10 weeks-old adult female Wistar rats were divided into 4 groups equally, according to the different surgical techniques and implanted materials used. Group 1 was only implanted with PP, Group 2 was implanted with PP with CTG, Group 3 was implanted with PP with PL, and Group 4 was implanted with PP with CTG and PL. All of the implants in each group were histologically assessed at postoperative week 2. Determination of the collagen density in the tissues, inflammation, necrosis and vascularization status was assessed semi quantitatively.

Result: At the gross examination of the implants, we saw that all the implants in the PL groups (Groups 3 and 4) were totally covered with the soft tissue. On the other hand, some implants in the control and CTG only groups (Groups 1 and 2) showed partial external soft tissue coverage. A denser collagen structure, low inflammation and necrosis were found in PL groups.

Conclusion: PL can be easily and rapidly produced and used in bio integration of PP safely.

p-76

Z-Plasty Technique Using a Large C-Flap to Maximize Symmetry of Cupid's Bow in Unilateral Cleft Lip Repair

Presenter: Sanjay Naran

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Gaining symmetry of Cupid's bow can be challenging in cleft lip repair; this is especially true when the difference between the distance from the peak of Cupid's bow on the non-clefted side to the collumellar labial junction and the new peak of Cupid's bow on the clefted side to the collumellar labial junction is great. A technique is described which uses a rotation type flap with a modification to gain maximum length and minimal scar.

A retrospective review of all unilateral cleft lip repairs performed by a single surgeon from 2010-2014 was performed. Only patients with at least 6 months of post-operative follow up were included. Pre-operative, intra-operative, and post-operative photographs were reviewed. Patients included were those who had undergone unilateral cleft lip repair using a Z-Plasty type rotation flap with a very large C-flap. Post-operative photographs were analyzed for symmetry of Cupid's bow and scar appearance.

30 patients were evaluated (13 complete, 17 incomplete clefts); 18 male and 12 female; 11 right-sided clefts and 19 left-sided clefts. All patients were repaired using the aforementioned technique. 7 patients were excluded because they did not have at least 6 months of post-operative follow-up. 23 patients were analyzed. 86% had excellent symmetry of Cupid's bow (level). 1 patient had a slightly long Cupid's bow, and 2 patients had a slightly short Cupid's bow. 78% had an excellent scar (nearly imperceptible) and 22% had a good scar (slightly visible).

Z-Plasty with a very large C-flap used as the method for the rotation flap in unilateral cleft lip repair is a useful technique for leveling Cupid's bow and for attaining excellent scars that are nearly imperceptible. Further work will look at the severity of the pre-operative cleft as measured by visual analogue scale (VAS) and will compare this to post-operative appearance of the lip (symmetry of Cupid's bow and scar) as measured by VAS.

p-77

NASAL OSTEOTOMY AS A DEFINITIVE PROCEDURE FOR CLEFT LIP NASAL DEFORMITIES

Presenter: Katsuya Tanaka

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Background: Some approaches for correction of the nasal tip and nasal ala (lower third of the nose) have been reported, including the reverse U technique and open rhinoplasty. However approaches of the upper nose and bony deformity have not been often reported. A wide nasal root in bilateral cleft-lip or bony deviation in unilateral one bother some cleft patients.

Objectives: The authors describe nasal osteotomy for cleft lip nasal deformity as a definitive surgery, and discuss about its availability and advantage.

Patients & Methods: In 21 cases (15 males, 6 females) with left lip nasal deformities, the nasal osteotomy was performed as a definitive surgery from 1993 to 2012. The mean patient age was 21.2 years. The lateral osteotomy was approached from the piriform margin of the nasal cavity or oral vestibula, and the medial osteotomy was from an intercartilaginous incision. After correction, the bone was percutaneously pinned to the maxilla.

Results: At the same operation, eighteen cases required correction of the lower nose, 12 cases needed a septal cartilage or auricular cartilage graft, 2 cases needed a cantilever calvarial bone graft, 2 cases needed a cross lip, 1 case needed a Le Fort I osteotomy, and 1 case needed genioplasty. No complication was observed in the perioperative period. The corrections were stable and satisfying to all patients.

Discussion: Nasal osteotomy is a successful correction of bony deformity. It can provide a coordinated face to Cleft-lip patients, especially in after puberty, and may benefit them with this approach.

p-78

Final correction of cleft nose emphasized on the nasal base and septum restoration

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Alveolar bone defect and retrusion of maxillary segment at cleft side, makes one of the two nasal bases collapse. Imbalance traction of facial muscle give rise to the deflection of the anterior nasal jujube and attached tissue and structure. All these led to the whole triangle structure tilt. Septum deviation also play an important role in left nose deformation. In a group of cleft lip and palate patients with nose deformity, a new technique was used. The septal cartilage was harvested for correction of septum deviation and later use in nasal correction. L-shaped osteotomy was done under the anterior nasal jujube and fixed at the central line. Iliac bone graft was performed to restore the nasal base. The harvested septal cartilage was trim and sutured to the caudal reserved septal cartilage, make the septal cartilage extend toward caudal and higher. Dissect cartilago alaris major and fix it to the refined septal cartilage. After 6 month follow-up, good results was seen in this group of patients. The optimal age for this technique was also discussed.

p-79

Stem cell therapy for reconstruction of alveolar cleft in adults: A randomized controlled clinical trial (RCT)

Presenter: Mona Bajestan

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Introduction: Autogenous alveolar bone grafting prior to oral implant therapy is considered standard-of-care for patients with severe alveolar defects. Though routine, these grafting procedures are often associated with significant morbidity of the donor site. More novel, less invasive techniques are needed to circumvent these limitations.

Objective: To determine if an autologous stem cell-based therapy is safe and efficacious in the regeneration of large alveolar defects.

Methods and Materials: In this RCT, 18 adults were enrolled with alveolar defects secondary to either a history of cleft palate or traumatic injuries to the face. Patients were randomized to receive either autogenous block bone grafts (control) or an autologous stem cell therapy (SCT). SCT consisted of CD90+mesenchymal stem cells contained within mixed populations of stem and progenitor cells (ixmyelocel-t, Aastrom Biosciences Inc.). Volumetric changes in bone were evaluated with CT scans and 4 months post-treatment, bone biopsies were harvested and analyzed radiographically and histologically. Following treatment, oral implants were placed and restored with functional dental restorations.

Results: In the control group, treatment yielded sufficient bone to place oral implants in all patients while in the SCT group, half of the patients required additional bone grafting to place implants. For patients in the SCT group, there was a significantly ($p < 0.05$) higher increase in bone gain in those with a history of trauma compared to those with a history of cleft palate. All patients who received oral implants had fixture stability at the six month post-loading follow up. No serious, study-related adverse events were reported.

Conclusion: This was the first RCT evaluating SCT in large alveolar defects secondary to trauma or congenital defects and provides important insight into factors critical to the success of bone regeneration with SCT. Though less invasive than traditional treatment, further development of this approach is needed to optimize treatment outcomes to meet those of the standard-of-care.

p-80

Secondary rhinoplasty for cleft lip nasal deformity by using rib cartilage graft

Presenter: Masayuki Miyata

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Purpose: The acquisition of a normally shaped nose in cleft lip and palate patients is still a major challenge. We investigated the treatment performed by our hospital for final rhinoplasty involving the cartilage. The purpose of this study was to identify effective methods for controlling the position of the nasal tip and the shape of the nose by conducting anthropometric measurements.

Methodology: The study population consisted of 10 male and 10 female patients who underwent rhinoplasty using autologous costal cartilage between April 2004 and March 2011.

Twelve patients with hypoplastic septal cartilage underwent septal extension graft and 8 patients with saddle nose or crooked nose underwent L-shaped graft reconstructions of the nasal tip and dorsum.

Result: Comparative anthropometric measurements before and after surgery showed improvement of the nasal tip angle, the nasolabial angle, and nasal tilting. However, there were cases wherein the grafted cartilage was warped or the nasal tip was directed upward.

Conclusion: The use of autologous costal cartilage in rhinoplasty may be associated with good aesthetic outcomes, because this method enabled us to reconstruct a nose as an integrated whole.

p-81

Computer analysis of cleft lip surgery

Presenter: Masataka Akimoto

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Introduction: Basic principle of all the cleft-lip surgery is to elongate the shortened white lip on non-cleft side with a horizontal cut. Then put a tissue of the same sized white lip from the suffered cleft side. Major two designs are well known. One is the small triangular method such as Randall's method. Another is the rotation-advancement method such as Millard's design. Each of the designs differs in regions of the elongation. Then it affects in the results.

We analyzed each designs using computational method and examined the mechanical stress.

Method: Two designs of the cleft-lip surgery were analyzed with finite element method. Photographs taken from the patients were digitized and put into the computer. Each cut designs were made into the FEM model using CAD. Two-dimensional hyper elastic model was employed for analysis. The computer program was ADINA v9.1 (Adina R&D inc. Massachusetts)

Result: Post-operative shape, mechanical stress and strain were evaluated in both designs.

In post-operative shape, elongation was observed in all through the suture line in the Millard's method, whereas in small triangular method elongation was obtained mainly around the triangular flap. In Millard's design, stress was scattered along the suture line. In small triangular method stress was relatively concentrated around the triangular flap. In Millard's large strains were observed around the tip of the upper flap and junction of the red and white lip. In small triangular method, strains were mainly in the tip of the triangular flap.

Conclusion: Historical two major designs of the cleft lip surgery were analyzed with the computational method. The fact that had been known only by an experienced surgeon was visualized. Such computational analysis will leads to more rational method.

p-82

Post surgical Nasal Molding in Cleft Lip Patients

Presenter: Alexander L. Ivanov

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Background: After the cleft lip primary surgery is performed there is no appropriate technique to maintain lower alar cartilage in correct position during the fast nostril growth in the 1st year of age. This can lead to relapse of nostril position and disappointing results.

Method: The newly designed nostril retainers have standardized shape received by using reverse 3D modeling of healthy nostrils (data taken from 3D-CT) made of soft silicone. There are 14 progressively increasing dimensions, which allow to quickly switch to the bigger one following the fast growth of the nose during the healing and scarring period (6-8 months after surgery).

Result: The anatomically shaped retainers were used since 2010 for more than 100 patients with cleft lip. Average three changes of nostril retainers were required after the surgery before achieving stable results. Insertion and positioning of the retainers is facilitated by their design. Due to the shape, they do not require external fixation and are well tolerated by patients. When in position the device is fully inserted in the nasal cavities and is practically invisible. The average period of use was 6-8 months after surgery.

Conclusion: The first results have shown the positive effect of progressive increase of nostril stents. The effect is comparable with NAM. The use of postsurgical molding permits to completely avoid complications which can occur with NAM, assure the early nasal breathing, maintaining of correct alae and septum position, activate the development of the alar cartilage, favour scarring and prevent nostril stenosis. The technique can be used in combination with presurgical orthopedics and after secondary surgeries. Long-term results are to be evaluated with statistical evidence.

p-83

A case report: Cheiloplasty for the median cleft lip deformity in holoprosencephaly

Presenter: Satoshi Takagi

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Background: Holoprosencephaly is a structural anomaly of the brain resulting from failure of the embryonic forebrain to differentiate into the cerebral hemisphere and lateral ventricles early in gestation. Depending on the degree of the midline cleavage of the telencephalon, holoprosencephaly is classified into three types: alobar, semilobar, and lobar. In general severe brain malformations in alobar type cause spontaneous intrauterine death or only several days to live and only less severely affected infants in the lobar type may survive to childhood or puberty. Holoprosencephaly is accompanied by a spectrum of characteristic craniofacial anomalies which include closely spaced eyes, hypoplastic nasal structure, or median cleft lip and palate.

Method: A lobar-type-holoprosencephaly girl was referred to us about her median cleft lip in the first week of life. Her premaxilla and columellar was completely deficient. After 12 months application of presurgical nasoalveolar molding, we performed cleft lip surgery for her median cleft lip at her age of 18 months. In the surgery we gave importance to the reconstruction of the cupid bow shape and skin graft was administered on the philtrum.

Result: Nearly normal shape of the cupid bow was reconstructed and her parents were pleased at the outcome.

Conclusion: In the holoprosencephaly related median cleft lip, the structural defects are more complicated than the usual cleft lip in that necessary midline structures, such as the columella, septum and philtrum are deficient, and this makes the cheiloplasty more complicated and challenging. In spite of the generally poor life expectancy of the holoprosencephaly, we plastic surgeons should work with utmost effort for his/her median lip deformity for the family caregivers as well as patient him/herself.

p-84

Experiences of secondary Furlow's palatoplasty after velar adhesion in cleft lip and palate patients

Presenter: Rui Suzuki

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Various methods of palatoplasty in cleft lip and palate cases have been developed. In 1986, Furlow reported double opposed Z-palatoplasty which enabled both soft palate lengthening and palatal muscle reorientation, and the raw surface of the hard palate which occurred after Furlow's procedure could be smaller than the Push Back procedure. Whereas, the Z-plasty is likely to be tensional in wide cleft cases.

We have been employing the velar adhesion procedure during cheiloplasty to decrease the cleft width of the hard palate since 2000. This time, we investigated the 130 cases having undergone the velar adhesion procedure.

Method: Hotz plate was used soon after birth and cheiloplasty was performed at 3 months of age to the cleft lip and palate cases. Prior to the cheiloplasty, the marginal membrane of the soft palate was incised with an arc shape, and the mucosal flaps were turned over above the muscle. Tuned-over flaps were approximated with the single-layered fashion. Furlow's palatoplasty was scheduled at approximately 1 to 1.5 year of age.

Results: After the velar adhesion, the residual cleft width of the hard palate decreased dramatically. We could perform the Furlow's palatoplasty procedure with less raw surface of the hard palate than our previous palatoplasties. Dehiscence of the mucosal adhesion area was occurred in 10 cases, and they underwent push back palatoplasties.

We estimated speech results and dental occlusal relationships (5-Year-Old Index) in some cases. They could obtain both good speech results and better dental arch relationships than the reported cases undergoing the push back procedure.

Conclusion: Our velar adhesion procedure at the time of cheiloplasty is easy to perform and requires a short time. Simultaneous performance with cheiloplasty requires no additional operations. Decreasing cleft width of the palate enables tension-free Furlow's palatoplasty.

p-85

Experience and discussion of block anesthesia in surgery for cleft lip and cleft palate.

Presenter: Nobuhiro Sato

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Background: Many surgeries for cheilorhinoplasty and palatoplasty are performed under general anesthesia because patients are in their infancy and intraoral bleeding accompanies these surgeries. Surgical modification of a very small area may be performed under local anesthesia. Infiltration anesthesia of the operation area is usually the choice of local anesthesia and block anesthesia has been performed infrequently. We experienced block anesthesia to control pain during our medical services in Nepal. Suprazygomatic maxillary nerve block or infraorbital nerve block was conducted in combination with general anesthesia in surgeries for cheilorhinoplasty and palatoplasty, or block anesthesia was conducted alone for patients who were in their adolescence or older. We report findings from our experiences, with bibliographical discussions.

Method: We conducted surgeries of cheilorhinoplasty and palatoplasty in Nepal for about 2 weeks from late November 2014. Among all surgeries, 31 cases were performed under block anesthesia of the maxillary or infraorbital nerve in combination with general anesthesia. Six patients, who were 14 to 35 years old, underwent cheilorhinoplasty or palatoplasty with block anesthesia alone.

Results: Patients with combination of general and block anesthesia showed no problems during and after surgeries. Patients with block anesthesia alone also underwent surgeries safely.

Discussion: In patients with combination of general and block anesthesia, there were no abnormalities during and after surgeries. This method was very effective for pain control even after surgeries. Although patients with block anesthesia alone mainly underwent surgical modification of lip and nose deformity, or surgical closure of palatal fistula, a relatively larger area of anesthesia was achieved. This method would be effective for safe surgery if we consider proper treatment for bleeding and airway management.

p-86

Application of interdental distraction osteogenesis (IDO) in CLP treatment

Presenter: Teruo Sakamoto

Authors: Sakamoto T, Ariizumi D, Yasumura T, Ishii T, Sueishi K

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Introduction: Success rate of alveolar bone graft in the case with wide alveolar cleft is low. So I applied interdental distraction osteogenesis (IDO) with orthodontic treatment in CLP (Cleft lip and palate) patients to reduce or close alveolar cleft and obtained the good results. Its procedure and therapeutic effects are reported.

Method: Distractor was fabricated by soldering of expansion screw or Zurich type ramus distractor to the orthodontic bands. The protocol of IDO is as follows: duration of latency was 1 week, rate and rhythm was 0.5mm per day, consolidation period was 1 month.

Result & Discussion: By application of IDO, alveolar cleft closed or narrowed and maxillary midline was corrected. The advantage of IDO is as followed, 1) Narrowing and/or close of the width of alveolar cleft 2) Correction of deviation of maxillary dental midline 3) Relief of arch length discrepancy 4) Improvement of the result of secondary bone graft 5) No need and/or simplification of prosthodontics of missing teeth.

p-87

Comparison of two techniques for nasal floor closure in patients with unilateral primary palate cleft

Presenter: Araceli Perez-GONZALEZ

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Objective: To compare the esthetic (nasal base asymmetries) and functional (nasovestibular fistula) postsurgical complications of two techniques: the vomerian flap technique vs. the anatomical closure technique of the nasal floor in patients with unilateral primary cleft lip and palate.

Methods: Sixty four patients with unilateral primary cleft lip palate, three months of age or older were included in a clinical trial. All patients have hemoglobin higher than 10g and needed to be 3 months and older, and informed consent signed by the parents prior to the surgery in order to participate in the study. The group A (31 patients) was treated with vomerian flap technique and group B (33 patients) with anatomical closure technique of the nasal floor. Two certified plastic surgeons with previous standardization carried on the surgery and the evaluation of postoperative complications was made by a Dentist Surgeon in a blind manner to 12 months postoperative. T the Student or X^2 were used accordingly with the type of variables as needed to compare the presence of nasal asymmetries and fistula.

Results: 65.6% of the patients were males. The mean age was 5.78 ± 2.2 months.

In the group A after of surgery, all patients' present nasovestibular fistula and nasal base asymmetry (2.4 ± 0.56 mm) and in the group B none of the patients presented nasovestibular fistula and 7 patients (21%) presented asymmetries (0.21 ± 0.41 mm). There was significant statistical difference between both groups ($p < 0.05$).

Conclusion: The anatomical closure technique of the nasal floor offer better esthetic and functional results, lowering the number of postoperative complications.

p-88

Growth trends in micrognathic infants treated with mandibular distraction with respect to a non-distracted cohort

Presenter: Brianne T. Mitchell

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Background: Mandibular distraction osteogenesis (MDO) is increasingly used to advance the jaw of micrognathic infants with tongue-based upper airway obstruction. Often, these children have feeding limitations resulting in poor nutritional intake and development. To determine the impact of MDO on the overall growth of micrognathic infants with cleft palate, we compared trends in growth for these patients to a similar cohort managed with tongue lip adhesion (TLA) and palatoplasty.

Methods: We retrospectively collected anthropometric data for infants who underwent MDO between 2010 and 2014 and those who underwent TLA between 2005 and 2009. Data was stratified into three time periods for both groups: Pre-Precedural (time to distractor placement versus TLA), Intra-Precedural (distraction versus TLA takedown), and Post-Precedural (distractor removal versus palatoplasty). Growth measurements were age and sex adjusted according to the WHO international growth standards and converted to z-scores of weight, length, and body mass index (BMI) using a growth model for analysis.

Results: Growth data was obtained for infants with cleft palate; 42 were treated with MDO and 15 with TLA, all followed by palatoplasty. Mean patient age at DO application and removal were 2.4 and 6.0 months respectively, while mean age at TLA and TLA takedown were 1.2 and 8.4 months respectively. Overall, average z-scores for length and BMI appeared to stabilize earlier in DO patients, marked by significantly improved Pre-Precedural to Post-Precedural weight maintenance (DO: -2.0 to -2.3, TLA: 0.7 to -2.9, $p = 0.039$). Palatoplasty was performed at a younger age in patients who underwent DO compared to those who underwent TLA (13.0 versus 14.7 months, $p = 0.021$).

Conclusions: Growth patterns tend to stabilize earlier in patients who underwent MDO compared to those who underwent TLA. Palatoplasty was performed at a significantly younger age in patients who underwent MDO compared to TLA. These findings raise questions about the benefits accrued with early growth maintenance and palatoplasty at closer to optimal age, both achieved with MDO.

p-89

Distraction by the RED system with consideration for the external nose shape form and control of the occlusal plane

Presenter: Suguru Kondo

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Objective: The RED system is usually applied to treat patients with severe maxillary hypoplasia. However, when applied to Le Fort I osteotomy, anterior shift of the external nose, especially the nasal tip, is relatively less compared to that of the maxillary distraction, which often results in unwanted disfigurement of the nose. In addition, it is often difficult to make fine adjustments of the occlusal plane during the elongation process and the anterior open bite might result from the counter clockwise rotation of the maxillary molar. Consequently, in such cases, mandibular osteotomy might be inevitably needed. We have been able to overcome these problems and have obtained satisfactory results.

Case and Methods: The patient is a 19 year-old girl with left unilateral cleft lip and palate and severe maxillary hypoplasia. Both maxilla and mandible were severely retrusion with SNA 65.0, and SNB 73.0 and therefore, improvement of occlusion by mandibular osteotomy alone was not deemed sufficient. Consequently, the improvement of occlusion using RED system was planned. It was planned 1) to perform High Le Fort I osteotomy to improve the deformity of the midface, 2) to carry out rear-end septotomy in order to shift the nasal tip anteriorly along with the maxilla, and 3) to apply facebow and elastics to tract upper molars upward to prevent counter-clockwise rotation of the maxilla. These plans were strictly followed to avoid above mentioned problems.

Results: After elongation of about 14mm, occlusal plane was well controlled. The nasal tip was satisfactorily shifted anteriorly and midface deformity also improved was kept to minimal. Three months postoperatively, SNA was 72.5° and SNB was 72.0°. After one year, SNA and SNB were 71.0° and 71.0° respectively and slight relapse was noted but the occlusion remained stable.

Conclusions: Not only the length elongated but also the direction of the elongation is critical and should be well-planned. By tracting upper molars upward, counter clockwise rotation of the maxilla is prevented thereby allowing elongation of the maxilla without shifting the occlusal plane. In addition, simultaneous anterior elongation of both the maxilla and the external nose effectively minimized the disfigurement of the nasal tip.

p-90

Measurement of distraction force in maxillary distraction osteogenesis for cleft lip and palate

Presenter: Takuya Ogawa

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Background: Maxillary distraction osteogenesis (DO) is one of a mainstream surgical technique for patients who have severe maxillary hypoplasia associated with craniofacial syndromes and cleft-related deformities. However, little information about the mechanical and biological features of maxillary DO is available to improve the procedure. The objective of this study was to investigate changes in force and the relationship between maxillary movement and distraction force during Le Fort I maxillary DO using a rigid external distraction (RED) system.

Methods: Micro tension gauges were integrated into the distraction wires on each side of the RED system. Six patients with cleft lip and palate aged 12.8-23.5 years underwent strain gauge measurement. Lateral cephalograms were taken to estimate maxillary movement during DO.

Results: The average linear maxillary movement was 11.2 mm (range, 8.5-15.9 mm). Maximum force ranged from 13.4 to 26.8 N in the six patients. The distance of maxillary movement was proportional to the distraction force.

Conclusions: The measurement of distraction forces during DO provides important data in establishing an appropriate protocol. Data on distraction forces could help in the management of DO in individual cases.

p-91

Finally Scalping forehead flap: An outcome of multiple surgery on cleft lip nose

Presenter: Yohko Yoshimura

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Background: Primary nose correction at the time of the first lip repair has become like a trend. But we had experienced many cases of short nose resulting from the early surgical intervention on cleft lip nose. Here we present a case of severe growth disturbance of the affected ala ultimately required a scalping forehead flap to reconstruct the ala. The original cleft lip of this patient was incomplete. The primary nasal repair was done at the same time lip repair. He suffered suture abscess on the repaired ala after the first operation and showed an asymmetry of the nose. Then he got threetimes of nasal repair during school age. As his nose became very short as he grew, Iliac bone graft was done to elongate his nose. However, it worked a little. He visited us again as 23-year-old young man, searching for correction of his deformed nose. Our final choice was the scalping forehead flap to make outer layer of the ala, combined with rib cartilage to the nasal dorsum.

Result: He was satisfied with the result.

Discussion: Although we have been hesitating to make additional scar on the face to repair the deformed ala, which originally was not a defect. Scalping forehead flap is a classical method with few experience these days. But it can be used with minimal visible scar. Most of all, it was not a case to require such an operation if we did not touch his nose at the first time.

Conclusion: This is certainly a rare case, but we strongly recommend not to do the cleft lip nose repair on patients of growing age.

p-92

Endoscopic surgery for cleft palate

Presenter: Osamu Ito

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Background: For cleft palate, endoscopy has been used for evaluating the postoperative function of the soft palate, but there have been only a few studies on its application in cleft palate surgery. In cleft palate surgery, the operation area is small and deep, and accurate incision and suturing is difficult. In addition, blind manipulations on the nasal cavity base side are inadequately performed. At the operating theater, we used endoscopes for the acquisition of the visual field in 4 cleft palate patients and for postoperative observation in 2 patients.

Method: Video nasopharyngoscopes (PENTAX VNL-1330, 1530T Japan) were connected to a video processor and used. Both endoscopes were soft electron scopes, and the VNL-1330 has a diameter of 4 mm and no forceps pores while the VNL-1530T has a diameter of 5 mm and has one forceps pore. In principle, the VNL-1330 was nasally inserted for monitoring during operation. When necessary, the VNL-1530T was inserted into the oral cavity and used for observation and aid for manipulations in deep areas. The endoscopes were manipulated by an assistant surgeon. When the endoscope was inserted to a site that provided a good space, it was fixed at the gag with tape. At secondary repair of cleft lip, a VNL-1330 was nasally inserted, and findings after cleft palate surgery were observed from the nasal cavity side.

Result and Conclusion: The VNL-1330 was slightly large for the nasal cavity of the babies aged 1.5 years but could be inserted into the nasal cavity in all patients. The VNL-1530T could be used in the oral cavity. The endoscope in the oral cavity was useful for observing dead angle areas and retaining the suture thread at the tip of the palatine uvula. In a male with left cleft lip and palate, secondary repair of cleft lip was performed 4 years after primary repair of cleft palate. This patient did not require speech therapy and showed a favorable course. In the nasal cavity, the endoscope showed accurate closure of the cleft but slight posterior protrusion of the palatine uvula, suggesting slight contracture on the nasal cavity side. The 4 patients who underwent primary repair of cleft palate have shown a favorable course without problems for 1 year or more after operation. The 2 patients who underwent secondary repair of cleft lip showed no special findings except slight protrusion of the palatine uvula.

p-93

Internal Carotid Artery Variations in Velocardiofacial Syndrome Patients and Its Implications for Surgery

Presenter: Yung Ki Lee

Authors: Lee YK, Baek RM, Kim B

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Background: Medially displaced internal carotid arteries in velocardiofacial syndrome carry a risk during pharyngeal flap surgery. This study was designed to evaluate the frequency of medially deviated internal carotid arteries in both velocardiofacial syndrome patients and the general pediatric population and to assess the minimum distance to the pharyngeal walls to define the potential risk of internal carotid artery injury during pharyngeal surgery.

Methods : Twenty-three consecutive patients with velocardiofacial syndrome who underwent posterior pharyngeal flap surgery and 21 control subjects who did not have velocardiofacial syndrome but who underwent oropharynx magnetic resonance imaging were reviewed.

Results: Medial deviation of at least one internal carotid artery was documented in 10 velocardiofacial syndrome patients (43.5 percent), compared with three patients (14.3 percent) in the control group ($p=0.034$). The mean \pm SD minimum distance to the posterior pharyngeal wall was 3.78 ± 1.86 mm in velocardiofacial syndrome patients and 9.17 ± 2.94 mm in the control group ($p=0.014$). Only one patient had significant medial dislocation of the internal carotid artery, and the closest distance from the pharyngeal wall was 0.86 mm.

Conclusions: In velocardiofacial syndrome patients, medial dislocation of the internal carotid artery was common, and the minimum distance to the pharyngeal wall was short compared with the control group. However, in most of the authors' patients, the course of the cervical portion of the internal carotid artery is irrelevant to pharyngeal flap surgery. The authors conclude that preoperative vascular imaging study is not cost-effective in velocardiofacial syndrome patients but that intraoperative use of ultrasound imaging is still valuable for the purpose of planning pharyngeal flap surgery.

p-94

A COMPARATIVE STUDY OF 3D NASAL SHAPE in UCLP NOSES IN ROTATION-ADVANCEMENT AND NAM- CUTTING PRIMARY NASAL REPAIR

Presenter: Banafsheh Hosseinian

Authors: Hosseinian B, Almaidhan A, Shetye PR, Cutting C, Grayson B

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The aim of this study was to compare 3D symmetry of the nose in patients with UCLP, subsequent to rotation advancement and the NAM/Cutting technique.

Methods: Nasal casts were made for 12 patients with UCLP. Group 1 patients had a Millard repair without primary nasal repair while Group 2 patients had NAM and primary nasal repair. Patients were 6 to 18 years of age. Surgery was performed at the mean age of 3.8 months. None of patients in Group 1 had primary nasal surgery. Models were scaled to the same size prior to evaluation. Procrustes analysis of 3D symmetry was performed using 3dMD Vultus software. Columellar height, nasal dome height, alar base and nasal projection measurements were performed on cleft and non-cleft side in both groups. For 3D analysis, student's t-test was used to determine asymmetry. For linear analysis, student's T test was utilized to compare the differences. SPSS was used to perform a descriptive analysis.

Results: The mean asymmetry index in the Millard rotation advancement repair was 4.41 and the NAM plus primary nasal repair was 2.45. The difference was statistically significant ($P=0.006$). In linear measurements, columellar length and alar base were significantly different when cleft side was compared to non-cleft side in Millard group ($P=0.04$ and 0.005). There was no significant difference in columellar length, nasal dome height, alar base and nasal projection in cleft versus non-cleft side in NAM group. Inter-group analysis showed that alar base in cleft and non-cleft side is significantly different in Millard versus NAM group ($P=0.02$).

Conclusions: To our knowledge this is the first long-term, quantitative 3D study to analyze the asymmetry of the nose in the Millard rotation advancement versus NAM plus primary nasal repair in patients with complete UCLP. This study shows that the NAM plus primary nasal repair results in significantly less asymmetry of the nose compared to the Millard rotation advancement without nasal correction.

p-95

A thin vermilion flap augmentation of upper lip for a cleft lip patient—A case report

Presenter: Ichiro Shiokawa

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Objective: Problems of cleft lip and palate patients include impaired growth of palatal hard and soft tissue and following imbalance of upper and lower lip. We herein designed a novel thin vermilion flap in the lower lip of the patient and applied to the upper lip augmentation.

Case Report: A 22-year old man suffering postoperative upper lip deformity was presented to our hospital. As an operose worker, His growing imbalance of the lip made him desire small invasive esthetic improvement rather than radical orthognatic surgery. Thin vermilion flap augmentation of upper lip under local anesthesia was indicated.

Two long and thin vermilion flaps were elevated from the wet lip border of the lower lip, with lateral commissure pedicles. Lower labial artery was remained in the lower lip.

Another incision was made in the wet-lip border of the upper lip above the muscle layer, and the flaps were settled in the incision via submucosal tunnel of the commissure. Donor site was closed by direct suture. Congestion was observed in distal flap area, and was gradually recovered. Postoperative shape and balance of the lip was highly improved and gratified the patient.

Discussion: Definitive treatment for maxillary deformity remains time-consuming and somewhat invasive. We considered this method under local anesthesia as one of the valuable treatment option with minimally invasive, single-staged, and highly effective for adjusting the volume of the lip.

p-96

withdrawn

p-97

Simonart's band indicates narrow cleft and mild tissue deficiency in unilateral cleft lip and palate

Presenter: Kenya Fujita

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Purpose: To assess whether the presence of Simonart's band is correlated with initial width of the cleft, the shape and the tissue amount of the maxilla in unilateral complete cleft lip and palate (UCLP) patients, and discuss the relationship between cleft severity and the presence of Simonart's band.

Design: Retrospective, cross-sectional study.

Patients and Methods: Thirty-five nonsyndromic UCLP patients were selected to participate in this study. The infant maxillary dental casts were obtained just before cheiloplasty. In the presurgical period, the patients were not indicated for intraoral plates (e.g., Hotz Plate), nasoalveolar molding, presurgical orthopedics, lip adhesion, or taping. Six designated landmarks were identified and five linear dimensions were measured directly on each dental cast. Differences between the two groups were analyzed by Student's t test.

Results: The anterior cleft widths were significantly smaller in the UCLP group with than without Simonart's band. The posterior cleft widths were also smaller in the former group. There were no significant differences in intertuberosity width or palate depth between the two groups. The widths of palatal shelves were significantly increased in the former group.

Discussion: The results of the present study indicated that UCLP patients with Simonart's band have a narrow cleft in the posterior part, the level of the intertuberosity, and not only in the anterior part, the alveolar cleft. In addition, our data suggested that the narrow posterior cleft was not caused by collapse of the arch or its high arched palate, but was due to the larger palatal shelves

Conclusions: This study indicated that UCLP patients with Simonart's band also have a narrow cleft in the posterior part and larger palatal shelves. We hypothesized that the presence of Simonart's band may indicate narrow cleft width and mild tissue deficiency of the maxilla in UCLP patients.

p-98

The evaluation of sequence surgical treatments of adult hemifacial microsomia

Presenter: Wei Liu

Authors: Liu W, Tang XJ, Shi L, Yin L, Yin H, Zhang ZY
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Objective: Sequence surgical treatments were performed in adult hemifacial microsomia patients. The aim of this study was to evaluate the surgical effect.

Methods: Eighteen adult HFM patients were treated from September 2009 to March 2014. In the first stage, a mandibular distractor was implanted and maintained for 6 months after distraction. In the second stage, the mandibular distractor was removed and Le Fort I osteotomy was performed. In the third stage, autologous fat injection was performed for the facial contour reconstruction.

Results: Both the facial symmetry and occlusal relation of the 18 adult hemifacial microsomia patients were significantly improved after the sequence surgical treatments.

Conclusion: Sequence surgical treatments of mandibular distraction osteogenesis, orthognathic surgery and autologous fat injection were the effective option for the treatment of adult HFM patients.

p-99

Long term Outcomes of Craniofacial Microsomia**Treatment: Microtia and Atresia Reconstruction**

Presenter: Rachel Mandelbaum

Authors: Mandelbaum R¹, Martins D¹, Farias-Eisner G¹, Park S¹, Dubina E¹, Ishiyama A², Bradley JP³, Lee JC¹¹Division of Plastic and Reconstructive Surgery, University of California Los Angeles, USA, ²Department of Head and Neck Surgery, University of California Los Angeles, USA, ³Division of Plastic and Reconstructive Surgery, Temple University, USA**Background:** One of the defining characteristics of craniofacial microsomia is microtia and canal atresia. In this work, we review a single institution experience of the treatment and outcomes of ear reconstruction.**Methods:** Craniofacial microsomia patients actively treated at the UCLA Craniofacial Clinic (n=151) between 2008-2014 were reviewed for microtia treatment and outcomes. Patients greater than 14 years of age at the time of study initiation were included (n=42, average age of 18.3 years).**Results:** 92.9% of patients presented with ear malformations (81.6% with grade III lobular-type microtia). 44.7% of patients were affected on the right, 28.9% on the left, and 26.3% bilaterally. 92.3% of patients underwent autologous ear reconstruction using a modified Nagata/Firmin technique, with the initial surgery starting at a mean age of 8.3 years. Age, type of incision, and size of cartilage framework did not predict total number of surgeries or complication incidence via a linear regression analysis. Severity of ear anomalies correlated to an increased number of surgeries (p=.001) but did not correlate to higher rates of post-operative complications (p=.548). Hearing deficits were addressed in 71.4% of patients. 19.0% of patients opted to only use external hearing aids, 31.0% had a bone-anchored hearing aid (BAHA), and 21.4% underwent formal atresia reconstruction with a canaloplasty. 30.7% of patients who received a BAHA procedure and 33.3% of the patients who had canaloplasty required additional revisional surgeries.**Conclusions:** Treatment of microtia and atresia in patients with craniofacial microsomia requires multiple stages of reconstruction for both the external ear and canal atresia.

p-100

The Study of Atrophy in the Reconstructed Ear

Presenter: Makoto Takahashi

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*Osaka city general hospital, Japan***Background:** Maintaining upon the form of the reconstructed ear after the operation of microtia is the most important issue. The evidence upon the cause of the atrophy in the reconstructed ear has not yet been established.**Patient and Method:** Subjects were patient who underwent microtia surgery at our hospital between March 1997 to December 2013. The retrospective study on the form of reconstructed ear, the type of, and the patient background.

We evaluated the form of reconstructed ear using the clinical photos in which was performed at least 12 months had passed in all cases after the second stage operation. Atrophy was classified into three categories: Grade1 with no atrophy, grade 2 with moderate atrophy, grade3 with severe atrophy.

Result: Microtia surgery was performed in 29 cases, in which 20 cases were men, and 9 cases were women). Preoperative form with lobule type was 14 cases, small concha type has 9 cases, concha type was 3 cases and there were 3 cases which were unable to classify into any of those three types.Three costal cartilages (6th, 7th, 8th) were used for 22 cases and four costal cartilages (6th, 7th, 8th, 9th) were used for 7 cases. Regarding to the method of second stage operation, there were 18 cases using TPF with graft, 8 cases using skin flap with graft and 3 cases using retroauricular fascia.

The age range was 7.9 years old to 15.9 years old with the means of 11.2 years old.

The follow-up time ranged from 12.5 months to 151.6months with the mean of 64.2 months.

There were 20 cases of Grade 1, 3cases of Grade2, and 6 cases of Grade3.

All of the cases of Grade3 were lobule type.

Conclusions: By observing the long-term morphological changes after the microtia surgery, we had found that there was a high rate of atrophy in the reconstructed ear of lobule type.

p-101

Transverse auricular muscle shortening as an adjunct to Mustarde otoplasty

Presenter: Daichi Morioka

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Background: Prominent ear is one of the most common deformities of the external ear. Many surgeons have performed a Mustarde mattress suture technique to create a new antihelical fold and have attempted an additional modification to avoid recurrence, which includes anterior or posterior cartilage scoring, cartilage thinning, or a perichondrial flap.

Method: For patients with antihelix hyperplasia-type prominent ear, we have performed transverse auricular muscle shortening as an adjunct to a Mustarde mattress suture. This muscle is located between the helical and conchal cartilages. The shortening was performed using 4-0 nylon sutures followed by cartilage-sparing Mustarde sutures for patients younger than 10 years old, and Mustarde sutures in combination with posterior scoring for older patients.

Results: Since 2012, more than 30 young patients with prominent ears underwent this technique. There were no early postoperative complications, and almost all of them were satisfied with the results. Late complications included keloids in three patients and a recurrence in one auricle of one patient with bilateral prominent ears.

Conclusion: Our adjunctive procedure is anatomically appropriate, easy to perform, and can reduce the recurrence rate of prominent ear.

p-102

Our therapeutic experience of craniofacial asymmetry with digitization treatment

Presenter: Liang Xu

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Craniofacial asymmetry is a physical finding in many craniofacial anomalies, including hemifacial microsomia, Romberg syndrome, etc. The purpose of the treatment is to correct the deformities and recover a normal ratio of the two sides of the face. Using digitization treatment for craniofacial asymmetry could effectively improve the contour of the and receive an accurate and controllable result in the therapeutic process.

60 cases of craniofacial asymmetry got digitization treatment in the craniofacial Unit in Shanghai 9th hospital between 2010 and 2014(33 cases with hemifacial microsomia, 21 cases with Romberg syndrome, 5 cases with other disease). All the patients received the digital 3-dimensional CT scan and cephalometric radiograph examination to evaluate the deformity of the head before operation. Based on these data, we contrasted between the right and left side of the face, and evaluated the difference between two sides of the face (asymmetric index). Also, we performed an individual surgical plan with computer aided design technology according pre-operation. The area and volume of the removing/filling material were accurately designed. After this, we just followed the plan step by step during the operation. With 1~2 years' follow-up, we recorded the improvement of the facial contour and evaluated the effect of the digitization treatment by CT and X-ray. We found that most of the patients got a good appearance of the face and the ratio of two sides of the face was equal to the plan designed pre-operation.

p-103

Pierre Robin sequence: challenges in the evaluation, the role of early distraction osteogenesis

Presenter: Jie Cui

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Introduction: The challenges for the management of Pierre Robin Sequence (PRS) are the evaluation and management of airway and feeding difficulty from glossoptosis and associated cleft palate.

Objective: To present the clinical findings, management, outcome and the role of early distraction osteogenesis in patients with PRS.

Method: The medical records were reviewed of 265 patients with PRS seen and managed by the authors at Nanjing children's Hospital, Nanjing medical University between 2010 and 2014.

Results: 376 patients with PRS were seen and managed. The female-to male ratio was 2.0 to 1 (179 girls, 86 boys). All of the patients presented with a small mandible, retrodisplaced tongue and upper airway difficulty. Patients were primarily from the china. Conservative management was successful in 62 patients while the 1 with tracheostomy required distraction osteogenesis, the tracheostomy was subsequently successfully plugged and removed intubation. 202 patients required mandibular distraction osteogenesis. At the last follow-up, most of the patients had proper catch-up and mandibular growth.

Conclusion: The present study confirmed that proper conservative management can be used to manage most of the patients with PRS. However, the following situation should be considered of using early mandibular distraction: (a) patients with respiratory insufficiency to avoid tracheostomies (b) PRS which can not be obviously improved by using prone position and nasopharyngeal airway (c) patients which suffering feeding issue for a long time.

p-104

Application of CAD software for the assessment of facial asymmetry: Zebra mapping & environment mapping

Presenter: Yumeji Takeichi

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Purpose: In conditions with facial asymmetry such as hemifacial microsomia and hemifacial atrophy, the problems are not only bone deformities but also soft part tissue deformities. So even complete symmetry of the bone was obtained the treatment is still incomplete. In treatment of old nasal bone fracture requires high symmetry too.

Method: For the examination of the surface symmetry, we have created surface model of the skin then local curvature was compared. This method is called zebra mapping. The surface is assumed to be a mirror and reflection of black and white stripes is calculated using ray-tracing method. It was originated to sheet metal engineers used light array to examine their finishing.

CAT scan DICOM data are not always smooth we have used wrapping procedure to obtain smooth curvature.

Result: Zebra mapping is very useful to analyze the result of facial osteotomy.

We can easily determine symmetric center.

Conclusion: Facial asymmetry such as hemifacial microsomia and hemifacial atrophy is difficult to analyze. We use two methods to analyze such asymmetry, zebra mapping and environmental mapping. Environmental mapping is similar to zebra mapping. Instead of the stripes natural view were used. Using both mapping method, we have examined our cases with optimal reputation of the stripes. It was also useful to find out symmetric center line.

p-105

A TPF pocket method in elevation of reconstructed auricle

Presenter: Takashi Kurabayashi

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Introduction: In the two-stage procedures for the reconstruction of microtia, the axial flap of temporoparietal fascia (TPF) is widely used for covering the costal cartilage blocks placed behind the framework. Although TPF flap is undoubtedly reliable, utilization of the flap has certain morbidity and comes at the expense of the mighty option for the salvage surgery.

Materials and Methods: The authors devised a simplified procedure for covering the cartilage blocks with creating a pocket in the postauricular TPF. In the new procedure, the constructed auricle is elevated from the head superficially to the TPF, and a pocket for the blocks is created under the TPF and the capsule of the auricle framework.

A total of 38 reconstructed ears in 38 patients with microtia ranging from 9 to 19 years old were elevated using the authors' method from 2002 to 2014 and followed up for at least 6 months.

Results: Great projection of the auricles and creation of well defined sulci were achieved. Furthermore, the postauricular sulci have a tendency to hold their steep profile over a long period of time.

Conclusion: The TPF pocket method is simple but produces preferred results. Moreover it is less invasive and has a benefit in a sense of sparing TPF flap elevation.

p-106

Stability of Surgical Correction for Facial Asymmetry

Presenter: Takayuki Honda

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Purpose: We investigated postoperative stability following surgical correction for facial asymmetry.

Materials and Methods: Two male patients and two female patients (aged 16-18 years) were included in this study. Three patients presented with craniofacial microsomia and one patient had non-syndromic facial asymmetry. The follow-up period was 22-93 months.

Le Fort I osteotomy and bilateral sagittal splitting of ramus osteotomy was applied. After maxillary osteotomy, the maxilla was positioned in accordance with the distance between the lower eyelid and the tip of the maxillary canine, and with the occlusal cant set horizontally or slightly over-corrected in the frontal view. After maxillary fixation, the mandible was osteotomized and fixed in accordance with the maxilla-mandibular fixation.

Clinical photos and PA cephalograms (pre-op, 1 year post-surgery and current) were evaluated, using OSM-OSM' as a horizontal reference line. Bony tilting (the angle between OSM-OSM' and CAW-CAW') and soft tissue tilting (the angle between the line across both lateral canthi and the line across both oral commissures) were evaluated.

Results: Bony tilting was 1.4-8.4° in the pre-op cephalogram. It improved to 0.7-5.2° at 1 year post-op and was 1.2-7.1° in the final evaluation. Soft tissue tilting was 2.8-10.0° in the pre-op photograph. It improved to 0.9-6.6° at 1 year post-op and was 1.5-4.8° in the final evaluation.

Discussion: The initial degree of asymmetry was less severe and postoperative stability was better in the non-syndromic patient compared with the microsomia patients. The cephalograms of the craniofacial microsomia patients were difficult to compare because the external meatus was absent or malpositioned. The clinical photographs showed relatively stable data compared with the cephalograms. Tilting of the oral commissure gradually improved in some of the craniofacial microsomia patients.

p-107

Three Step Training Method Of Creating Auricular Cartilage Framework In Microtia

Presenter: Akira Yamada

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Purpose: Results of microtia reconstruction using autologous cartilage is highly variable. The outcome of ear reconstruction can be improved by providing a uniform method to teach the technique. We present a step by step training method for the ear framework carving/fabrication/assembly process.

Methods: Both 2D ear framework templates and life-size framework model are used through all steps.

1) Carve an ear framework out of potato. This allows one to understand, feel, and sculpt the three dimensional anatomy of the ear framework.

2) Create five parts of the framework from carrots, then assemble them. The purpose of this step is to understand the anatomy of each part of the framework, practice the assembly process, and master the fixation techniques.

3) Create an auricular framework from precise copy of rib cartilages 6-9.

Results: The author organized ear framework workshop in five different occasions. The workshop was unanimously well-accepted by the participants. Frameworks of each step, created by the residents were documented, analyzed, compared with 2 D templates and the life-sized model.

Conclusions: The three-step training method outlined is a very effective way to train residents to obtain skills for ear framework creation. Autologous ear reconstruction remains the standard of care for microtia, and a defined means for teaching this skill is essential to maintaining the outcomes of microtia reconstruction.

p-108

Intraoperative repositioning assessment using navigation system in facial bone fracture

Presenter: Akihiro Ogino

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Background: Intraoperative repositioning assessment in the facial bone fracture operation is very important in achieving adequate facial symmetry. A navigation system that has been developed in neurosurgery has recently been applied in the otolaryngol surgery, orthopaedic surgery and maxillofacial surgery. We employed a navigation system (Stealth Station TRIA plus, Medtronic) in facial bone fracture operation, and found it useful in performing accurate reduction and confirming the symmetry.

Methods: We applied a navigation system in 6 patients with zygomatic bone fracture and in 2 patients with zygomatic malunited fracture, in 4 patients with orbital blowout fracture. Navigation aided reduction of the bone fracture was evaluated by comparing the image of the affected side with the mirror image of the nonaffected side. The placement angle of the grafted bone could be verified during surgery, confirming lateral symmetry of the orbital form in the patients with orbital blowout fracture.

Results: Accurate reduction and symmetry, the placement angle of the grafted bone were confirmed during the operation in all cases. In the patients with zygomatic malunited fracture, we were able to performed safely bone osteotomy through a small incision. On postoperative CT, good symmetry was confirmed, and the grafted bone was retained at a favorable placement site.

Conclusion: Navigation systems enable real-time and 3-dimensional intra-operative imaging, allowing operator to view the procedure in progress; therefore, we were able to performing accurate reduction of the fractures and confirming the exactly osteotomy position and the symmetry of the face, confirming the positional relationship between the bone fragment and orbital tissue and bone graft fixation position.

p-109

Reconstruction of Orbital Floor Defects With Using 3D Model

Presenter: Hideyuki Muramatsu
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Introduction: Orbital floor fractures are common facial fractures. No consensus have been existed for the ideal reconstruction material. The authors' aim was to investigate the efficiency of the 3D model with absorbable plate (super FIXSORBMX: TAKIRON) for reconstruction the orbital floor defects.

Materials and Methods: Ten patients who had defective orbital wall fractures who were treated with absorbable plates with 3D model between 2013 and 2014. The subjects were detected either preoperative and postoperative periods with computed tomographic scans. The absorbable plate harvested with using the 3D model and grafted to the defect area.

Results: All cases have satisfactory results. Diplopia, enophthalmos or restriction of eye movement did not note in our patients. As noted no volume increase is regarded the most ideal reconstruction material which we had with our experiences.

Conclusions: 3D model with absorbable plate is useful method for repairing orbital floor fractures. It has the advantage of being adequate before the operation, decreased operation time, easy to adaptation without any donor area from the body. The 3D model is cost effective and is expected to be used in new clinical studies in the future.

p-110

Experience of Cone-Beam CT for Diagnosis of Malar Bone Fracture

Presenter: Masaru Horikiri
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Cone beam computed tomography (CBCT) was developed in the 1990s, and is increasingly being used for head and neck or dento-maxillofacial imaging. In the present study, we used CBCT for diagnosis of malar bone fracture in 15 cases, and compared the images with those obtained using multi-detector row computed tomography (MDCT) in the same cases. For objective evaluation of the images, we used two free software packages, DiffImg and ImageFileComparerS. In all cases, the rate of agreement between the images was over 98%. The quality of the CBCT images were not at all inferior to those of MDCT. In addition, the price of the CBCT system is much more inexpensive than that of MDCT, and the CBCT effective radiation dose is less than half than that required of MDCT. CBCT is not considered to be suitable for the examination of internal organs, but may be very useful for examination of bones. We conclude that CBCT should be utilized more frequently for the assessment of facial fracture.

p-111

Pre-operative surgical planning of craniosynostosis with a personal 3D printer

Presenter: Natsue Kishida

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Recently, price of three-dimensional (3D) printer become low, and most of the hospitals can afford it. There are some reports of surgical planning using 3D models made by 3D printers in otolaryngology and orthopedic fields. In our institution, patients' 3D skull models made by a personal 3D printer are utilized for surgical planning of spine or craniofacial surgery. Illustrative craniosynostosis cases are reported, and its merit and limitation is discussed.

Full size or half size bone models of 5 craniosynostosis are made by 3D printer (UP! mini, PP3DP). STL files for 3D printing are made from DICOM files with a open-source software, Osirix. Acrylonitrile butadiene styrene (ABS) was used as material. Models are cut with nippers and re-assembled in advance of surgeries as surgical planning.

1 multisuture synostosis (clover-leaf skull), 2 uni-coronal synostosis, and 2 trigonocephaly skull were made. Approximate average time for 3D construction of half size models were 2.5 hours, and 12 hours for actual size. For patients of gradual distraction, appropriate plane to attach distractors were able to find easily with appropriate vectors by using real-size models and actual distractors. For trigonocephaly and plagiocephaly with unicoronal synostosis cases, angles of orbital bandeau could be planned with DICOM images. However, contour of frontal bones were able to be designed only with 3D models.

Surgical planning of craniofacial surgeries for craniosynostosis cannot be made uniformly, because each patient has different size and morphology. Angles and measurements can be assessed by computer software, but 3D models has advantage on assessment of countour. Functions of personal 3D printers are good enough for surgical planning, and there were no need of professional printers which cost more than 10 times as much as personal ones.

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A New Salt Material 3D Model for Pre-Surgical Simulation of Cranio-Maxillofacial Surgery

Presenter: Takayuki Okumoto

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Background: The advantage of the three-dimensional life-sized model is the reality of taking it in our hand. However, the conventional models made of UV-curable resin or plasters are very expensive and have difference of touch with the real bone, and also the difficulty of cutting work. Therefore, development of a new model which is cheaper and easier to handle has been expected.

Method: The new model was developed with salt as a material. The saline solution added with an absorbent and binding material was sprayed by a printer and laminated to form a model, and finished with impregnant for solidification. Pre-surgical simulation for cranio-maxillofacial surgery was performed with this new model in our institute. Besides, an experimental study was conducted to compare the maximum load and the presence of the plastic deformation required for fracture between the salt model, pig sparerib, and conventional UV-curable resin model.

Result: The new model could be cut easily using an ultrasonic cutter for hobby. Especially the sagittal splitting of the mandibular ramus was done without any difficulty. We succeeded in giving the model toughness near the living bone by changing the kind of impregnant for solidification. We were able to accomplish the simulation in case of distraction that was difficult with the conventional model without any cracks by entering pins of the device. In the experiment, both the sparerib and the salt model showed the plastic deformation in which the load and the displacement were not proportional, while the UV-curable resin model did not. The former two have toughness and the latter brittleness.

Conclusion: The salt model costs extremely cheap, having the advantage of fine feeling of cutting work. In addition, we can control hardness and viscosity of the model to bring it close to the living bone by changing the impregnant.

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CT-guided sclerotherapy for venous malformation

Presenter: Satoko Yamawaki

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The sclerotherapy is one of the most effective treatments for the venous malformation. Ultrasonography(US) is used for the guidance during the treatment commonly. US is convenient but it is difficult to reproduce the same image and to detect the deeper lesion especially behind the bone.

The venous malformations often occur in head and neck regions and some of them expand the maxilla which is difficult to detect by US. We treated a venous malformation around the maxilla using the CT-guided sclerotherapy.

Case: A 10-year-old girl had the venous malformation in the right cheek that extended underneath of the cheek skin to the posterior wall of the maxilla. The lesion had a few cysts which show effectiveness of the sclerotherapy. At first, CT image was obtained in the operative theater to decide the lesion to treat and an insertion point. A length from the skin to the lesion was calculated on the simulation system. We injected the foam of polidocanol into the lesion according to the CT guidance. The injection was performed exactly as planned.

Discussion: The sclerotherapy is useful and effective treatment for the venous malformations. We performed CT-guided sclerotherapy to the venous malformation of the cheek. Our system could guide the insertion point, the insertion angle and the depth from the insertion point to the lesion correctly during the procedure. Although US is a convenient and minimally invasive tool for not only the diagnosis but also the guidance for the treatment, US is not able to detect the lesion behind the bone. Moreover, the lesion sealed by the sclerosant cannot be detected by US. Therefore, CT-guidance sclerotherapy seems to be more effective especially in deeper lesion.

p-114

Three-Dimensional Computed Tomography Venography as a Guide for Cranioplasty in Parietal Cephalocele

Presenter: Akiko Yamashita

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Background: Cephalocele is a rare condition of congenital malformation of the brain, characterized by the protrusion of intracranial contents through a congenital defect in the dura and skull. Treatment includes the removal of non-functional cerebral tissue and closure of the dura and scalp during infancy. Cranioplasty with autogenous bone is an option for later reconstruction. For a safe procedure, preoperative examination including both bone and underlying tissue evaluation should be conducted.

Method: An eight-year-old girl presented with a skull defect. The patient was born with a parietal encephalocele, and had undergone excision and repair of the encephalocele with a fascia graft and skin rotation flap without bone grafting two days after birth. Subsequent ventriculo-peritoneal shunting was performed for hydrocephalus. We planned staged cranioplasty using an autogenous calvarial bone graft. Computed tomography venography was performed on a multi-slice computed tomography scanner with a three-dimensional workstation to evaluate both the skull defect and underlying superior sagittal sinus preoperatively.

Result: Computed tomography venography showed the skull defect of 4.0 cm in diameter at the posterior fontanella. Three-dimensional translucent images showed the superior sagittal sinus running on the right side of the skull defect. Therefore, the midline of the skull and intracranial contents existed at different locations. We performed cranioplasty using a calvarial bone graft. A full-thickness calvarial bone graft was harvested from the patient's left parietal region, in which no superior sagittal sinus ran through. The harvested graft was split, and the inner cortex was used to reconstruct the defect, with the outer cortex returned to the donor site.

Conclusion: Using computed tomography venography images as a guide, we could safely harvest full-thickness calvarial bone from the contralateral side of the superior sagittal sinus.

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Exophthalmometry by computed tomography

Presenter: María Bibiana Mendoza

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Objective: Although different methods have been described for measuring sagittal relationships between the cornea and the orbit, most of these measurements are operator dependent and difficult to take in children. It has been shown that computed tomography (CT) allows accurate and reproducible measurements in Craniofacial region. The aim of this paper is to describe four measurements to objectively establish the relationship of the eyeball with the orbital walls, taking as reference the eyeball.

Design: Descriptive study.

Patients: Patients between 0 to 18 years who have taken a simple sinus tomography in Fundación Santa Fé de Bogotá in the period between June 2008 and March 31, 2014. Diagnosis to take the study: Sinusitis, headache, fever, irritability, or apnea.

Results: IMPAX software tools were established to take tomography measures, the bony landmarks were identified in the superior and inferior orbital rim using the sagittal plane, and the reference points: nasion and lateral orbital wall in the axial plane.

Conclusions: Computed tomography is performed in a standardized way and offers the possibility of addressing the ophthalmometer measurements with better accuracy and less variability.

Key Words: Exophthalmometry, computed tomography, dimensions

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Prenatal Identification of Pierre Robin Sequence: A Review of the Literature and Look Towards the Future

Presenter: Matthew G. Kaufman

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Background: Pierre Robin Sequence (PRS) is a rare congenital deformation characterized by micrognathia, glossoptosis, and airway obstruction. PRS can present as a perinatal emergency when the retro-positioned tongue obstructs the airway leading to respiratory compromise. Currently, no screening algorithm exists for consistent and reproducible prenatal diagnosis. More predictable and reliable diagnostic studies could help the treating medical team as well as families prepare for these early airway emergencies.

Methods: The medical literature was reviewed for different techniques and metrics previously described to prenatally identify features of PRS with ultrasound and magnetic resonance imaging (MRI).

Results: After reviewing the literature, we identified Inferior Facial Angle (IFA) as the most reliable metric to identify micrognathia on ultrasound, with an IFA<50° corresponding to a mandible with micrognathia. The literature also demonstrated findings of glossoptosis, whether seen on ultrasound or MRI, are also a very strong predictor of PRS. By incorporating these two findings specific to PRS into the standard prenatal ultrasound schedule all gravid women undergo, we propose a novel prenatal screening algorithm.

Conclusions: Prenatal diagnosis of PRS would be an advance in current clinical practice by allowing for appropriate prenatal consultation as well as intra-partum and post-partum care. Although the medical literature has identified several important measurements to assist with diagnosis, these need to be tailored into a clinically applicable screening tool and validated with prospective clinical trials. By developing a reliable screening protocol, early risk stratification can be achieved with the hopes of decreasing perinatal morbidity. In the setting and spirit of multidisciplinary care and patient centered outcomes, the goal of prenatal diagnosis of Pierre Robin Sequence can be achieved.

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Scoring for the Qualitative Evaluation of Smiles in Patients with Facial Paralysis

Presenter: Akiteru Hayashi

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Background: The goals of reconstruction of the paralyzed mid-face are achieving symmetry at rest, symmetry in smile, and spontaneity.

Method: To evaluate quality of smile, we devised a method of smile evaluation employing scoring in which five parameters were focused; (1) symmetry of facial tone at rest, (2) symmetry of the corner of the mouth on voluntary smile, and (3) on spontaneous smile, (4) symmetry of the lower lip on spontaneous smile, and (5) on mouth opening. Each item was rated 4 (excellent) to 1 (poor/no improvement), and the scores of items (1), (2), and (3) were weighted by multiplying by 2. Total score of these five parameters were categorized into 5 steps as grade 5 (excellent) to Grade 1 (poor) for final evaluation.

Result and Discussion: Ten patients were submitted to a single stage reanimation of the face with free short head of biceps femoris transfer (group 1; 5 patients, 4 male and 1 female, 42 to 69 years old) or temporalis myoplasty (group 2; 5 patients, 2 male and 3 female, 12 to 85 years old). Postoperative follow-up period were more than 3 years in all patients. Patients in group 1 showed high score in item (3), whereas patients in group 2 showed high score in items (1) and (2). Overall evaluation of quality of smile was Grade 4 (good) in both groups. We are currently developing software to semi-automatically evaluate smiles using PCs or tablet-type terminal devices. In this system, you initially select an image targeted for evaluation, and click the checkbox to display reference lines. Subsequently, you adjust these reference lines and points to the landmarks on the screen manually, and indicate points of evaluation for each item. Scores will be sequentially presented in the screen, with the results of comprehensive judgment. A method presented here employing scoring of 5 items would be a simple, easy and reproducible option to evaluate smile after surgical reanimation for facial paralysis.

p-118

Quantitative determination of zygoma with 3D images in an Asian population

Presenter: Hsuan-Keng Yeh

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Zygomatic complex is the most prominent part of mid face. It is also one of the most vulnerable sites of craniofacial fracture. When fractured, it produces not only functional deficit, also appearance asymmetry is usually complained. An objective, quantitative post-operative measurement is crucial in determine outcome of surgical result.

We propose a method using craniofacial anthropometry technique on 3D computer tomography (CT) to evaluate both skeletal and soft tissue structure precisely. Distance between zygion and nasion and maxillozygion and nasion were measured for determining lateral position of zygomatic complex in x plane. Heights in y plane were measured from maxillozygion to vertex and orbitale to vertex. Distance between maxillozygion and opisthocranion defined the projection of zygomatic complex in z plane. All the measurement was performed after 3D image was reconstructed and placed in Frankfurt horizontal position. The measurements were repeated by three investigators independently.

The results show constant between each measurement performed by different investigators. The difference between each measurement was within 1 mm. When comparing distance difference on each side of same face, the result shows the face appears to be symmetrical.

Our anthropometric method with 3D facial CT images provides constant, accurate, and reliable assessment of zygomatic complex. The results offer us an objective tool to evaluate both skeletal and soft tissue landmark in future craniofacial structure study.

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3D Image Analysis of Facial Skeletal and Soft Tissue Changes after Monobloc Distraction

Presenter: Halil I. Canter

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Both monobloc and Le Fort III distraction are important tools for correcting functional and aesthetic problems in patients with syndromic craniosynostosis. Three-dimensional computed tomographic reconstructions have become increasingly useful in planning and analyzing surgical results. This powerful tool, however, exposes patients to radiation. Tridimensional photography is recently developing technology for volumetric documentation of craniofacial structures.

This study measured the differential deformation of the facial skeleton with both Three-dimensional computed tomographic and tridimensional photographic measurements following distraction osteogenesis with the rigid external distractor frame.

Four children with syndromic craniosynostosis were studied. They underwent monobloc distraction using the rigid external distractor frame. The advancement of the facial skeletons was compared by land marking three-dimensional computed tomographic reconstructions using the sella turcica as the fixed point. To compare the shape of the monobloc segment from the preoperative to postoperative scans, a color map was generated. Same measurements were repeated with preoperative and postoperative tridimensional photographs of the patients and same color map was generated to demonstrate the effect of distraction on soft tissue structures of the different parts of their faces.

Although this study demonstrated that the tridimensional photographic measurements have comparable results with computed tomographic measurements and have advantage of not exposing patients to any radiation, number of patients evaluated with both techniques need to be increase to have more conclusive results.

p-120

Zygomaticomaxillary reconstruction with vascularized bone graft aiming to the esthetical result

Presenter: Masaki Fujioka

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Introduction: Maxillary and zygomatic bones are responsible to a large extent for the facial contour esthetically. Defects after palatotomy usually require vascularized bone-containing flaps. We present our considerations of their operative indication based on our two types of surgical experiences.

Patients and Methods: Two patients of zygomaticomaxillary bone defect after the resection of a maxillary carcinoma, underwent reconstruction using a rectus abdominis myocutaneous (RAM) flap combined with vascularized costal cartilages. The zygomaticomaxillary buttress was reconstructed using vascularized costal cartilages.

A patient with radiation-induced ulcer and sequestering of a bone of the cheek due to maxillary squamous cell carcinoma underwent reconstruction using a temporalis osteomuscular flap.

Result: In all cases, computed tomography after surgery showed favorable alignment of the inserted bone and cartilage segment, and favorable contours of the zygomatic prominence were evident.

Discussion: Bony reconstruction is important to achieve a symmetric appearance. Most palatomaxillary defects require flap transfer combined with a vascularized bone-segments. Because vascularized bone for reconstruction is hard to absorb, and it maintains the post-surgical form for a long period.

Filling of the maxillary sinus and orbital cavity requires a sufficient soft tissue transfer volume. Therefore, a free RAM flap is a reasonable option to compensate for the midfacial tissue defect. The costal cartilages are the only vascularized hard tissue able to be harvested with this myocutaneous flap.

Temporo-parietal bone myocutaneous flap may be useful, if the reconstruction does not require maxillary sinus and orbital cavity occupation.

Conclusion: The shape and size of the both harvested costal cartilages and temporo-parietal bone fit the zygomaticomaxillary bone defect, thus, they are favorable cosmetically.

p-121

OSTEOMYOCUTANEOUS PERONEAL ARTERY PERFORATOR FLAP FOR SKULL BASE RECONSTRUCTION

Presenter: Juan Solivera

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Background: Complex cranial base defects are better reconstructed with microvascularized free flaps. The rectus abdominis muscle has been the workhorse for skull base (SB) microvascular reconstruction, however some groups have replaced it for the anterolateral (ALT) free flap. The fibula free flap has been described to be useful when the frontal skeletal buttress must be restored. The osteomyocutaneous peroneal artery perforator (PAP) flap is a refinement of the fibula flap originally described for reconstruction of composite maxillary defects.

Objective: To describe the use of the PAP flap as a novel indication for SB reconstruction.

Patient and Method: We present the clinical case of a 63 year-old female patient with a T4N0M0 melanoma of the frontal sinus. Radical en bloc resection included right orbital exenteration, anterior SB craniectomy and resection of the infiltrated dura. A right suprafascial PAP flap was harvested. Two segments of vascularized bone were used to reconstruct the horizontal frontal buttress. A thinned and depithelized 9x5 cm cutaneous paddle was used to seal the anterior SB from the upper aerodigestive tract. The soleus muscle was used to obliterate dead space in the orbit and SB. Anastomosis were performed to the temporal vessels.

Results: Good functional and cosmetic results with no intraoperative or postoperative complications were achieved.

Conclusions: The PAP flap is a composite flap providing several different tissue components from one donor site. It makes this flap adequate for complex SB defects when bone, muscle and skin are needed in order to restore cosmetic appearance and provide a good isolation from the upper aerodigestive tract.

p-122

Multiple delayed cranial reconstruction for complicated cranial defects

Presenter: Yoshiaki Sakamoto

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In cases of skull trauma, emergency surgery for cranial decompression typically involves the shortest approach, with the incision lying directly on or immediately near the bony defect. Subsequent skull reconstruction by plastic surgery in such cases is difficult, since incisions taken on the previous scar overlying the bony defect are prone to dehiscence and infection. We describe here our technique for creating a well-vascularized skin flap via multiple-stage operations prior to the actual skull reconstruction. We prepared 4 patients (age range, 10-25 years) for skull reconstruction using our technique, with the skin in this area becoming a delayed flap. Flap elevation was performed in 3 operations, with adequate time intervals (4 weeks between each stage) to allow for adequate vascularization. Dissection under the galea aponeurotica was performed only after initial flap elevation and allowing for adequate vascularization. Skull reconstruction was then performed using custom-made implants. We followed up the patients for 6-12 months, and no complications, including infections, exposure of artificial bone, or necrosis of the flap, were observed. All the patients were satisfied with the cosmetic results. Despite the multiple operations required, we consider that our technique of using a delayed, well-vascularized bipedicled skin flap can be successfully used in the skull reconstruction of patients in whom the initial scar lies close to the bone defect.

p-123

Secondary skull bone reconstruction using thickened artificial bone designed to reduce the dead space

Presenter: Mine Ozaki

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Customized artificial bone is often employed for the treatment of skull bone defect as sequelae of neurosurgery. Although artificial bone offers tough and cosmetically acceptable reconstructive options, removal of the implant is sometimes necessary because of intractable infection. Several other treatment options such as autologous bone graft or free flap are likely to be considered for the secondary reconstruction in order to avoid re-infection, however, re-implantation of artificial bone is beneficial for the patients, being not concerned with donor site morbidity. We consider one of risk factors of infection of artificial bone as dead space between the implant and dura and skin tension. In order to attain reduction of the dead space, we have employed thickened artificial bone.

Between 2010 and 2014, 5 patients (all males with a mean age of 45.8 years; range 33 to 63 years) underwent implantation of thickened artificial bone for the secondary skull bone reconstruction. All patients were suffered from intractable infection with fistulae of previously implanted artificial bone.

Firstly, the infected artificial bone was removed with proper debridement. More than 3 months after the closure of the infected wound, tissue expander was inserted beneath the surrounding healthy scalp to ensure the coverage of subsequently implanted artificial bone without skin tension. The thickened artificial bone was designed from the CT findings so as not to leave any dead space between the implant and dura. After optimal expansion of the scalp, the artificial bone was implanted with suspension of dura.

Postoperative course was uneventful in all cases (follow up period of 6-months to 4-years). The figure of the cranial vault was also satisfactory in all cases.

Usually, the dead space between the implant and dura is likely to be neglected, however, the dead space frequently induces infection. Thickened artificial bone, by reducing the dead space, may be useful for reconstruction for the patients who experienced intractable infectious episodes.

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Facial nerve reconstruction using vascularized nerve grafts

Presenter: Katsuhiko Kashiwa

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Purpose: Vascularized nerve grafts are one of options for nerve reconstructions, especially in the cases with the poorly vascularized recipient bed or some extent of soft tissue defect. We demonstrate our experiences of facial nerve reconstruction using some types of flaps composed with vascularized nerve grafts.

Patients and Methods: We treated 35 patients (13 females and 22 males aged from 28- to 79-year-old, 59.1-year-old on average). The defects were caused by the parotid tumor in 32 patients, the external auditory canal cancer in 1, and the skin or mucosal cancer in 2. The extent of sacrificed facial nerve branches was from 1 to total. A lateral gastrocnemius perforating artery flap with the sural nerve (SN), a posterior calf fasciocutaneous flap with the sural nerve, an anterolateral thigh flap with the lateral femoral cutaneous nerve (LFCN), a vastus lateralis musculocutaneous flap with the branch of femoral nerve (FN), a soleus perforator flap with SN, a groin flap with LFCN, and a kimera type of combination of an anteromedial thigh flap and the vascularized LFCN based on the superficial circumflex iliac artery were used respectively in 13, 9, 7, 3, 1, 1 and 1 patients. The flaps combined were used to cover or fill the soft tissue defects.

Results: Although postoperative courses were uneventful in 33 patients, partial necrosis and/or surgical site infection were observed in 2 patients. We evaluated the results using Yanagihara's 40-points grading system in 22 patients, who could be followed up over twelve months. Although animation recovery was not confirmed in 1 patient, other 21 patients obtained 12 and 36 points (23.5 in average). 19 patients with total branches defects obtained 12 and 28 points (22.4 in average).

Discussions and Conclusions: We believe that free flaps combined with vascularized nerve grafts are preferable for a reliable result, although further studies and experiences are necessary.

p-125

Modified Lengthening Temporalis Myoplasty with Intraoral approach

Presenter: Ayato Hayashi

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Background: Lengthening temporalis myoplasty (LTM) is a unique and definite facial reanimation procedure that involves moving the whole temporal muscle anteroinferiorly and inserting its tendon directly into the nasolabial fold. However, to advance temporal muscle tendon toward nasolabial fold, it requires nasolabial fold incision, which is one of the biggest problem of this procedure especially for young or female patients.

In this presentation, we report our experience of performing modified LTM under intraoral approach to manipulate temporal muscle tendon toward nasolabial fold and avoiding incision at nasolabial fold.

Method: We performed modified LTM under intraoral approach in 3 female patients with permanent facial paralysis. To put key-sutures creating nasolabial fold at proper points, we used propeller needle for epidural anesthesia. To avoid infection to the advanced tendon, we switched the thread to fix tendon from polyfilament to monofilament, and tried to reduce time of intraoral exposure of the tendon as less as possible. We also performed several additional static reconstructions for other remaining deformities with our original modifications.

Results: We were successful at achieving considerable static improvement at rest, immediately after the surgery, and we could achieve smile reconstruction without obvious scar on the face. There was no infection or other major complications after the surgery; however, one patient developed slight dimple which required revision subsequently. All the patient could get good facial movement within 3 months.

Discussion: We could perform modified LTM under intraoral incision and obtained fairly good results. Understanding detail anatomy toward coronoid process, we could advance temporal tendon toward nasolabial fold firmly; however, obtaining good traction points at nasolabial fold was more difficult than conventional method.

Establishing modified LTM without nasolabial fold incision, we could expand the indication of LTM more widely, and it could be more familiar procedure for smile reconstruction in all generation.

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An innovative method for reconstruction of the alveolar and palatal midline defect

Presenter: Fumio Ohnishi

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Background: The reconstruction of alveolar and palatal midline defect is challenging because it anatomically consists of thin three layers, palatal mucosa, alveolar and palatal bone and nasal mucosa.

The free osteomuscular latissimus dorsi scapula flap combined with serratus fascia is very useful for the reconstruction of such a defect.

Method & Result: An 80-year-old man with hard palate cancer underwent ablative surgery, which resulted in full thickness midline defect of alveolus and hard palate. The free osteomuscular latissimus dorsi scapula flap combined with serratus fascia was elevated on thoracodorsal vessels as single pedicle. The flap was transferred to the defect and fixed in layer to layer fashion; the scapular bone flap was fixed in the alveolar and palate bone defect, the defect of palatal and nasal mucosa were covered with latissimus dorsi muscle flap and serratus fascial flap respectively. The latissimus dorsi muscle flap was transferred as bare muscle and was bulky in his oral cavity immediately after the surgery. The nasal side of the defect was covered with the raw surface of serratus fascial flap. Postoperative course was successful; the raw surface of bare muscle and fascial flap in the oral and nasal cavities epithelialized with atrophy of bulkiness of the muscle flap. At third month after surgery, the form of reconstructed alveolus and hard palate was similar to the normal anatomy, and it could allow the dental prosthesis to fit the site very well. The patient recovered to be able to masticate and speak as he could have done before surgery.

Conclusion: Thin reconstruction of midline defect in the alveolus and palate was successfully achieved with the free osteomuscular latissimus dorsi scapula flap combined with serratus fascia.

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Algorithm for reconstruction of composite cranial defects using the free anterolateral thigh flaps

Presenter: Fumiaki Shimizu

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Background: In case of composite cranial defect including dura mater, cranial bone and scalp, the fascial component of the anterolateral thigh flap can be used for dural reconstruction. However, the advantages and applications of the fascial component depending on the type of defect have not been thoroughly discussed. We made the algorithm for reconstruction of composite cranial defects using the fascial component of free anterolateral thigh flaps.

Patients and Methods: Six cases of composite cranial defects were reconstructed using free anterolateral thigh flaps with the fascial component. The type of method used was classified into three types. Type I involves separating the fascia from the flap completely and using it as a nonvascularized component. In type II, the fascia is not separated from the flap and is instead used as a vascularized component. Type III involves separating the vascularized adipofascial component from the skin paddle and using it as a chimeric pattern flap. The algorithm for determining the type of fascial component is applied depending on the condition of the defect.

Results: All flaps were transferred successfully in every case. In four cases, the type I method was used. The type II and III methods were used in one case each. Cranial bone reconstruction was performed in three cases. There were no major complications after the procedures.

Conclusions: The fascial component is useful for dural reconstruction. The type of fascial component used is selected depending on the condition of the defect.

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Team approach to Achieve Better Outcome in Mandible Reconstruction with Free Fibular Flap

Presenter: Kristaninta Bangun

Authors: Bangun K, Atmodiwirjo P, Handayani S, Kreshanti P

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Background: Free fibular flap currently is the best choice in mandibular defect reconstruction, in our center we performed more than 25 cases of mandible reconstruction every year. The cases varies from segmental, hemi mandibulectomy to total mandibulectomy.

Methods: The process begin with pre-surgical fibular planning, we used osirix software and for some patients we also used stereolithography model. To achieve better outcome we use team approach method, the team consists of oncology surgeon/ENT surgeon/oral surgeon to remove the mass, Micro surgeon to harvest fibular graft and performed vascular anastomosis, Craniofacial surgeon to mold and plating the fibular bone and Prosthodontist to attach dentures/osseointegrated dental implants.

Result: With this method, we obtain satisfactory outcome, not only for the patients but also for the team.

Conclusions: In our center, team approach method gives better outcome in mandible reconstruction with free fibular flap.

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Three-dimensional analysis of zygomatic malunion in patients with cheek ptosis caused by reduction malarplasty

Presenter: Baek-kyu Kim

Authors: Kim B, Baek RM

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Background: Reduction malarplasty is one of the most popular aesthetic surgical procedures for reshaping facial contour in oriental people. Especially for those who have a wide midface and a prominent zygoma. Although malunion and cheek ptosis are known as major complications in reduction malarplasty, but there have been few reports about their causes and patterns. The authors experienced many revision reduction malarplasty using the coronal approach to correct cheek ptosis with malunion and were able to categorize the types of malunion by analyzing 3-dimensional CT imaging prior to revision surgery.

Methods: A total of 24 patients underwent revision reduction malarplasty with the coronal approach to correct the unfavorable result after primary malarplasty. Most patients complained of various degrees of cheek ptosis associated with malunion. In all cases, the status of zygomatic malunion was evaluated through 3D CT imaging. The operative procedures during revision surgery including repositioning of the inferolaterally displaced malar complex to the appropriate position and obtaining bone-to-bone contact with rigid fixation. If bony absorption at non-union margin was found during the operation, bivalved calvarial bone was grafted into the bony gap. Midface and forehead lifts were also performed when indicated.

Results: The types of zygomatic malunion could be categorized into four patterns according to the shape of displacement. The degree of displacement was relevant to the condition of the fixation in all cases. The higher the grade of malunion was evaluated in 3D CT imaging, the more difficult procedures it required during revision surgery. The postoperative results in all cases were satisfactory without any complications.

Conclusions: In reduction malarplasty, inappropriate fixation and the ignorance of repositioning vector can lead to cheek ptosis and malunion by the action of masseter muscle. The malunion types apprehended by the preoperative 3D CT scanning enabled precise operative planning before revision surgery. In all grades of zygomatic malunion with cheek ptosis, revision reduction malarplasty with coronal approach was a very useful solution because it offers a wide surgical field, enables accurate repositioning along with firm fixation and easily allows simultaneous midface lift.

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The Novel technique in sculpting nasal implant using Chinese ancient architectural technology.

Presenter: Andy Tan

Authors: Tan A, Gang C, Zhang Y

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Rhinoplasty is one of the most delicate procedure in plastic and reconstructive surgery. The preciseness of every single millimeter is counted in order to achieve better quality of the surgical results. Many methods had been developed as a result of this requirement. Implant was applied, whether it was autogenous implant or artificial implant. Application of artificial implant created numerous of surgical complications, such as body rejection to implants' material, infection, and rigid sensation of nasal tip especially. The application of autogenous implants itself were widely applied, from septum cartilage, concha cartilage, and rib cartilage. We developed new technique of rhinoplasty using osseuschondral rib as autogenous implants based on the ancient Chinese architectural technology. This technique is called dougong formula. The unique of this implants is located on the joint between nasal dorsum and columella strut, which is fixated without any screw, stiches, or K-wire. This joint is proved to be very useful to minimize application of any fixation technique. We achieved the better nasofrontal angle, nasolabial angle and columella length. These data were provided by using Mimics software, which is gathered by data of preoperative and postoperative three dimensional CT scan.

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Massive zygomatic reduction through bone graft of zygomatic arch

Presenter: Daniel Seungyoul Han

Author: Han DS

DH Plastic Surgery Clinic, Korea

Background: It is not uncommon to find wide facial type due to widely open zygomatic arch in Asians. In such case, it is inevitable that the quantity of reduction for the stabilized bone contact following the surgery is limited even if a reduction of zygoma is executed. Therefore, the results are also limited if the patient has a very wide face. Accordingly, I am reporting my experience of having achieved outstanding results through massive zygomatic reduction by using bone graft.

Method: This Study is conducted on 14 patients who needed greater reduction than the general quantity of reduction of zygoma over a period from February 2014 to February 2015. After having made an incision inside the mouth, approximately 3mm of bones on the long straight section were excised by fracturing the zygomatic body into an L-shaped form. Then, it was possible to perform the reduction of the zygomatic arch that has been fractured to up to 10mm on each side by using the excised bone fragment for the purpose of bone contact on the zygomatic arch that has been fractured.

Results: The level of satisfaction of the patients was very high, with no patient complaining of complications during the period of progress observation.

Conclusion: It is deemed that massive zygomatic reduction through bone graft of zygomatic arch would be an effective surgical procedure for patients with very wide face.

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Surgical Orthodontic Treatment of maxillary setback movement

Presenter: Shugo Haga

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Objective: Le Fort I osteotomy has been widely used for maxillary advancement in patients with jaw deformity. Although there are cases of skeletal maxillary protrusion with maxillary overgrowth and jaw deformity with vertical overgrowth of the maxilla in which maxillary posterior repositioning is expected, few reports are available on maxillary posterior repositioning. The present study reports 4 cases of posterior repositioning of the maxilla.

Materials and Methods: Subjects underwent preoperative orthognathic treatment in the Department of Orthodontics, Showa University Dental Hospital, followed by orthognathic surgery in the Department of Oral Surgery. Subjects were female patients aged between 15-38 years (average age: 24 years) at the first visit. The same surgeon performed maxillary osteotomy under general anesthesia in the Department of Oral Surgery to setback the maxilla. Pre- and postoperative lateral cephalograms were superimposed to compare the displacement.

Results: Predicted and surgical displacements were compared using preoperative model measurement and lateral cephalograms. The result showed an improvement of maxillary protrusion in all 4 cases. The amount of displacement was different in each case.

Discussion: We consider that the limit of the amount of maxillary setback is approximately 5.0 mm on considering the position of the pterygoid process and descending palatine artery. Diagnostic imaging is carefully performed for safe orthognathic surgery. In the present study, Le Fort I osteotomy that preserves the descending palatine artery and fractures the pterygoid process was performed to improve the chief complaint. The postoperative stability of bone fragments was simultaneously clarified.

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Application of computer-aided design in BSSRO combined with simultaneous osseous genioplasty

Presenter: Xi Li

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Background: Some patients suffer from mandibular protrusion and microgenia in China. In the past, since lack of accurate preoperative design, the clinical outcome were always far from ideal with bilateral sagittal split ramus osteotomy (BSSRO).

Objective: This study was aiming to improve the accuracy of BSSRO and genioplasty by the computer-aided design(CAD) preoperatively and to explore the necessity and feasibility of BRSSO with genioplasty at the same stage.

Methods: 7 patients with mandibular protrusion and microgenia undergoing BSSRO and genioplasty were collected. 3D reconstruction models were applied to design and prefabricate the individualized surgical splint. To estimate the precision of CAD, we compared the CAD's three-dimensional cephalometry with postoperative ones. And to assess the stability of clinical outcome by comparing the postoperative three-dimensional cephalometry and follow-up's.

Results: All 7 patients got perfect clinical situation, with few complications. The statistical analysis demonstrated that: 1) there were statistically significant differences between preoperative three-dimensional cephalometry and postoperative ones, 2)there were no statistically significant differences between preoperative design and postoperative ones, 3)excepting for SNB and Pog-NB, there were no statistically significant differences between postoperative ones and follow-up's.

Conclusion: Computer aided design can help surgeons obtain the accurate individual surgery plan for patients with mandibular protrusion companying microgenia. CAD can play a great role to improve the surgery accuracy.

Key Words: computer-assisted design (CAD), bilateral sagittal split ramus osteotomy(BSSRO), osseous genioplasty, 3D Reconstruction

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Piezosurgery in orthognathic surgery

Presenter: Kazuhiro Toriyama

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Purpose: Piezoelectric surgery is based on the use of ultrasound for the cutting of bones. Piezosurgery feasibility as a substitute for the conventional saw in orthognathic surgery was evaluated regarding blood loss, time requirement and complications.

Patient and Methods: Three patients had orthognathic surgery procedures using piezosurgical osteotomy: Le Fort I osteotomies and sagittal split osteotomies, between April 2014 and October 2014. Controls were 5 patients with conventional saw and chisel osteotomies. The patients present four mandibular protrusion and four maxillary retrusion. The average age was 25.3 years old.

Results : Piezosurgical bone osteotomy permitted individualized cut designs. Auxiliary chisels were required for the nasal septum and lateral nasal walls as pterygoid processes. After downfracture, the dorsal maxillary sinus wall and pterygoid processes were easily reduced. Hemorrhage was successfully avoided with average blood loss of 179 ml versus 276 ml for a conventional bimaxillary procedure. Sagittal mandibular osteotomy required considerable time; the lingual dorsal osteotomy was mostly performed tactile. Time requirement got shorter: 320 minutes per bimaxillary standard osteotomy versus 297 minutes. No type of laceration of vascular elements or laceration of palatal tissue was observed. Clinical courses and reossification were unobtrusive.

Conclusions: Piezoelectric osteotomy reduced blood loss and time requirement. Single cases required auxiliary chiseling or sawing.

p-135

Modified Bilateral Sagittal Split Ramus Osteotomy Fixation to Correct Mandibular Asymmetry

Presenter: Xudong Wang

Author: Wang X

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Background: There lies an ever-present issue in the inability of orthognathic surgery to perfectly correct facial asymmetry. As such there was a need to develop and modify new techniques to treat this issue. The purpose of this study was to introduce and validate a new method based on 3D cephalometric analysis as a modified BSSRO fixation method to treat facial asymmetry.

Methods: This prospective study evaluated and treated mandibular excess patients with facial asymmetry using 3D computer aided cephalometric analysis. BSSRO was then carried out on these patients. After the operation, the proximal segment was overlapped the distal segment of the hypoplastic side of the mandible and fixed with bicortical lag screws. The hyperplastic side was then routinely fixed with a four-hole mini titanium plate. Facial symmetry was evaluated 6 months post-surgery using Computer tomographic (CT) scanning. Additionally, Magnetic resonance imaging (MRI) was used to show temporomandibular joint (TMJ) morphology.

Results: The facial asymmetric deformity in all 11 patients was corrected without complications. The mean difference in the distance between the left gonion-sagittal plane (SP) and the right gonion-SP pre-surgery was 8.14 mm, and 3.77 mm ($P=0.01$) post-surgery. The mean difference between the angles formed by MeGoLGoR (the angle was formed by menton, left Gonion and right Gonion) and MeGoRGoL (the angle was formed by menton, right Gonion and left Gonion) was 25.98 mm pre-surgery and 17.00 mm post-surgery. ($P=0.031$).

Conclusion: Facial asymmetry can be effectively, simply and safely corrected with this modified fixation method.

p-136

Changes in chewing efficiency before and after orthognathic surgery

Presenter: Misato Tsuneoka

Authors: Tsuneoka M¹, Nakamura T², Shirota T³, Yamaguchi T¹, Maki K¹*¹Department of Orthodontics, School of Dentistry, Showa University, Japan, ²Takahashi Orthodontic office, Japan,**³Department of Oral and Maxillofacial Surgery, School of Dentistry, Showa University, Japan*

Purpose: Functional changes in masticatory performance that occur after orthognathic surgery are known to recover over time, but the mechanisms underlying this recovery are unknown. A better understanding of this would be useful to establish treatment goals for surgical orthodontics. Therefore, we observed patients who received maxillofacial surgery at Showa University Dental Hospital to investigate the primary factors responsible for observed changes in chewing ability.

Materials and Methods: Twenty-two patients (10 males and 12 females) were examined preoperatively, and at 3 and 6 months and 1 year after surgery for their ability to chew small pieces of wax or chewing gum. We also measured their silicone bite force, used the Dental Prescale Occluzer System to determine occlusal parameters, and performed electromyography of their masticatory muscles.

Results: The chewing ability, occlusal contact point, occlusal contact area, occlusal force, and performance of masticatory muscles were slightly decreased between the preoperative and 3-month postoperative time points, as well as between the 3- and 6-month postoperative time points. However, the masticatory efficiency increased slightly between the preoperative and 3-month time points.

Conclusion: To fully understand the mechanisms that contribute to functional recovery, it will be necessary to quantitatively measure changes in masticatory efficiency in a larger sample size.

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Skeleton first in surgical treatment of facial disharmony

Presenter: Junyi Yang

Author: Yang J

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Purpose: The aim of this study was to correct facial disharmony with or without occlusal dysfunction.

Methods: Based on computed tomography and presurgical design restoration of normal skeleton relationship is a priority for selected facial deformities. Combination of different osteotomies for facial skeleton was chosen in 1-stage operation such as orthognathic surgery zygomatic reduction, and mandibular angle reduction. Supplementary surgeries was considered in some cases as substitute implantation or autologous fat graft

Results: All the 50 patients (hemifacial microsomia, Romberg syndrome, mandibular condyle hyperplasia, secondary cleft palate, and Crouzon syndrome) received surgeries, and their facial appearance improved significantly. Yearly follow-up shows that the symmetry and balance of the facial proportion approach normal, whereas most of their occlusal relationship has been significantly improved after the first stage of surgery.

Conclusions: For most facial disharmony with or without occlusal dysfunction, skeleton-first surgery is a feasible strategy.

p-138

Tow Jaw Clockwise Rotation Surgery as a tool for lower face reduction

Presenter: Tadashi Akamatsu

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Background: In recent orthognathic surgery, it is essential not only to obtain a good occlusion but also to create a beautiful and well balanced facial bony framework. Most of Japanese Class III patients present flat and long faces due to the insufficient facial depth associated with the short frontal skull base length (S-N length). Thus the single jaw surgery provides flat and long facial impression even if the patient achieve beautiful class I occlusion. In these cases, patients need two jaw surgery in order to achieve good balance between facial depth and facial height.

Method: We reviewed 6 cases of Two Jaw Clockwise Rotation surgery performed from 2011to 2012 in Tokai University Hospital. Measurement and analysis of Cephalogram and the airway space change.

Result: It was necessary to elevate the posterior part of maxilla and rotate maxilla-mandible component to clockwise direction. Two Jaw clockwise rotation provided reduction of lower facial volume which balanced well to the short frontal skull base length. Mean SNB was 76.8 degree, Mean Sn V-line to Pog was -5.0mm. Airway space in Cephalogram were reduced to 81.5% at the level of PNS, to 82% at the level of Uvula, and to 92% at the level of lingual root.

Discussssion: The followings are controversial points of Two Jaw Clockwise Rotation Surgery. 1. Reduction of the air way space. 2. The volume reduction of the oral floor and tongue space. 3. damaged and lost beautiful shape of mandibular angle. 4. Only narrow and slim face can achieve well balanced face in the frontal view by Two Jaw Clockwise Rotation. surgery.

Conclusion: Most of Japanese Class III patients present flat and long faces due to the insufficient facial depth associated with the short frontal skull base length (S-N length). Two Jaw clockwise rotation provided reduction of lower facial volume which balanced well to the short frontal skull base length.

p-139

A case of Apert syndrome treated by bimaxillary orthognathic surgery after Le Fort III distraction

Presenter: Michiko Tsuji

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Background: Apert syndrome is a rare congenital disorder characterized by craniosynostosis associated with dentofacial anomalies and syndactyly of the hands and feet. Patients with Apert syndrome often require orthodontic and orthopedic treatment, because of their esthetic and functional problems, such as a Class III malocclusion and midfacial hypoplasia. We aimed to use combined comprehensive orthodontic-surgical treatment for an Apert patient: surgical correction using bimaxillary orthognathic surgery after Le Fort III distraction for improving midfacial hypoplasia.

Case: A 8-year-old Japanese boy with Apert syndrome visited our orthodontic clinic with a chief complaint of anterior open bite. He had a turricephaly, syndactyly, narrow airway and mild mental retardation. An anterior open bite; the overbite and overjet being -8.0mm and +2.0mm, respectively, Byzantine arch palate with soft cleft palate, and congenital missing of upper second premolars were observed. The patient was diagnosed as having skeletal Class III jaw-base relationship caused by midfacial hypoplasia. Combined orthodontic-surgical treatment using multibracket appliances was planned. Following presurgical treatment, a LeFort III osteotomy was performed at the age of 11 years. After a 7-day latency period, activation was performed at the rate of 1mm per day for 21 days by using a rigid internal distraction system: the amount of distraction of the Or and ANS were 21.0 mm and 22.0 mm, respectively. The maxilla was shifted 5.0mm to the right side and the mandible was shifted 2.0mm to the left side caused by maxillary distraction and mandibular growth, respectively, so that a Le Fort I osteotomy and mandibular setback osteotomy were performed at the age of 19 years. Superimposition showed that the amount of ANS advancement and upward movement were 3.0mm and 5.0mm, respectively, and the mandible rotated 6.0 degrees counterclockwise. The multibracket appliances were removed at the age of 21 years and an acceptable facial profile and occlusion had been maintained 2 years after orthodontic active treatment.

Conclusion: Not only did malocclusion, but the patient's profile also improved, and intermaxillary disharmonies were corrected by means of orthodontic treatment combined with orthognathic surgery.

p-140

Indications for Computer Assisted Design and Manufacturing in Congenital Craniofacial Reconstruction

Presenter: Amir Dorafshar

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Background: Like any new technology, computer-aided design and manufacturing (CAD/CAM) has been propelled into practice by its potential to revolutionize the field. As a tool with broad applications, it has been used from head to toe, however, there is a paucity of data demonstrating the benefit of its use and legitimizing the cost. As this technology continues to mature, acceptable indications for its use must be established.

Methods: Congenital craniofacial reconstruction is uniquely suited for the use of CAD/CAM. The complex three-dimensional relationship, in conjunction with the growing craniofacial skeleton, makes the ability to accurately plan and model the result indispensable. We believe that any reconstruction involving a large number of osteotomies, manipulation of multiple segments, severe facial asymmetry, vertical dystopia and hypertelorism, manipulation of occlusion, and historical dependence on time-consuming intra-operative decisions is especially suited for the planning and precision offered by CAD/CAM. Pre-operative appearance, computerized plan, intraoperative course, and final outcome for a selection of reconstructive cases were analyzed and assessed.

Results: A selection of patients that underwent craniofacial reconstruction using CAD/CAM for congenital malformations were analyzed. Pre-operative planning enabled efficient execution of the operative plan with predictable results. Risk factors that made these patients ideal candidates for CAD/CAM were identified and compiled.

Conclusion: We illustrate the use of CAD/CAM for these indications and describe the decision-making process both before and during surgery. We explore that the indications for using CAD/CAM in congenital craniofacial reconstruction as well as the disadvantages and risks.

p-141

A Novel Method of Human Adipose-derived Stem Cell Isolation with Increased Yield and Viability

Presenter: Elizabeth R. Zielins

Authors: Zielins ER, Tevlin R, McArdle A, Seo E, Chung MT, Paik KJ, Senarath-Yapa K, Atashroo DA, Hu MS, Walmsley GG, Vistnes S, Li S, Chan CK, Wan DC, Longaker MT

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Background: Adipose tissue represents an abundant and easily accessible source of multipotent cells which may serve as excellent building blocks for tissue engineering. We have developed a new protocol for isolating adipose-derived stromal cells from human lipoaspirate and compare our new method for ASC isolation to our standard protocol.

Methods: Gravity sedimentation was performed to allow separation of blood from fat. Processed human lipoaspirate was then digested with type I collagenase and centrifuged to isolate the SVF pellet. Density gradient separation was performed on the resuspended pellet using Histopaque to isolate the cloudy interface containing SVF cells. This process was compared to the conventional method using type I collagenase digestion and centrifugation only. FACS analysis was employed to determine cell yield and viability, and proliferation capacity was assessed. Osteogenic and adipogenic potential of ASCs from each method was also evaluated *in vitro*, and relative ability to generate bone *in vivo* was determined in critical-sized mouse calvarial defects.

Results: The novel protocol resulted in a 10-fold increased yield of ASCs compared to our conventional technique. ASCs from our new protocol also demonstrated significantly increased viability and proliferation capacity ($p < 0.05$). Additionally, ASCs isolated using our new protocol demonstrated significantly enhanced osteogenic and adipogenic differentiation capacity *in vitro* ($p < 0.05$). However, equal ability for *in vivo* bone regeneration was noted from ASCs harvested by either protocol.

Conclusion: We have developed a protocol that maximizes the yield, viability, and proliferation capacity of ASCs derived from human lipoaspirate. We demonstrate that ASCs harvested using this new method have an increased osteogenic and adipogenic potential *in vitro* and are similarly capable of regenerating critical-sized mouse calvarial defects with ASCs isolated using the conventional protocol.

p-142

Computer-assisted laser bone crafting.

Presenter: Soh Nishimoto

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Laser crafting became an indispensable technology in industries for precision machining. And also in medical field, laser radiation has been used routinely. Though, no laser systems, with advantages over conventional chisels and saws, have been established and applied in clinical bone surgery. A computer-assisted robotic system with Ytterbium-doped fiber laser, at a wave length of 1070 nm, was assembled and experimentally used.

The laser with a continuous wave was guided thorough an optic fiber and focused with a lens. Irradiation apparatus was controlled by a computer-aided design/computer-aided manufacturing (CAD/CAM) system. Pressured nitrogen gas was sprayed for cooling.

Radial bones of rabbits were cut by the system with a sweeping speed of 20 mm/sec. Immediately and three weeks after the surgery, bone specimens were taken and microscopically compared with those cut with an electric driven saw.

With the system, sharp cut with approximately 500 μ m bone gap was observed. A thin surface of thermal damage was observed. Whereas, the saw made 400 μ m gap. Three weeks after the surgery, solid plug of mineralized bone was observed in both laser treated and saw treated specimens. No evidence of thermal damage, impairing bone healing was observed.

It is not well-known how laser with 1070 nm can ablate bone. Because bone composite materials, hydroxyapatite, collagen and water, absorb very little of this wave length. It is speculated that very tightly focused laser with very high energy density can induce plasma-cutting process. The other advantage of this laser, is the low thermal damage to soft tissue, because of the low absorption by water and collagen. The results of this study show that the robotic system with Yb-doped fiber laser can be a good candidate for future bone surgery.

p-143

Classification of Deformational Plagiocephaly: A Clinician's Tool

Presenter: Kathryn V. Isaac

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Background: The incidence of Deformational Plagiocephaly (DP) is estimated to be 1 in 7. There is no standardized classification system to guide management decisions and monitor progress. The aim of this study is to create a severity classification scale for DP and to develop a simple measurement device for non-expert clinicians to evaluate the severity of DP.

Methods: All infants presenting with DP from 2007-2012 were retrospectively reviewed. 3D stereophotographic images and anthropometric measurements were obtained using the 3 dMD system. A survey was created with 3D photographs of 20 infants selected to represent the spectrum of severity (5 normocephalic, 15 plagiocephalic). Based on 3 standard views, experts rated the severity of asymmetry and rated the importance of 7 diagnostic criteria for defining the severity of DP. Subsequently, non-experts rated the severity of asymmetry of the same infants. Correlation was calculated using Pearson's coefficient and the utility of severity characteristics was analyzed with Receiver Operating Characteristic (ROC) curves.

Results: A group of 13 experts completed the survey. The expert clinical impression of severity was significantly correlated with the degree of ear displacement ($r=0.657$, $p<0.002$). Expert respondents judged occipital flattening and ear displacement as the most important criteria for the diagnosis of DP severity. The non-expert rating of severity did not correlate with the expert opinion. Infants with normal or low asymmetry are distinguishable from infants with moderate or high asymmetry based on an ear displacement of 3.9mm (sensitivity 0.90, specificity 0.70).

Conclusion: The experts' clinical impression of DP severity strongly correlates with ear displacement and the vertex view is most valuable for defining severity of DP. Based on these principles, a simple measurement device has been developed as a tool for the non-expert clinician to identify infants with a moderate or high degree of asymmetry.

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Repair of nasal alar contracture using autologous dermis graft and secondary full-thickness skin graft overlay

Presenter: Yoshihiro Takami

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Contractures of nasal ala are generally repaired with local skin flaps using the surrounding facial skin. However, when the contracture is due to an extensive facial burn, it is difficult to obtain an appropriate donor skin for the local skin flaps. For such a case, full-thickness skin graft is considered as a major therapeutic option. Even if the thicker full-thickness skin graft is transplanted, some amount of graft shrinkage must be inevitable. In order to minimize the postoperative graft shrinkage, more thicker dermal component is needed. For this purpose, we have tried to use free autologous dermal grafts, which were placed prior to full-thickness skin graft to the secondary defects after releasing nasal alar contractures of 3 cases of extensive facial burn scarring. Two or 3 weeks after the dermal grafting, full-thickness skin graft was carried out onto the vascularized grafted dermis. With these procedures, much thicker dermal component was able to be transplanted than ordinary full-thickness skin grafts. The minimized graft shrinkage was observed in all cases. It is suggested that our method is useful for the repair of nasal alar contracture due to extensive burn injuries.

p-146

Skeletal Analysis of the *Twist* +/- heterozygous mice, a Genetic Model for the Sathre-Chotzen syndrome.

Presenter: Takashi Nuri

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Objective: In the patient with craniosynostosis, the abnormal skull growth may result in raised intracranial pressure. The osteoplasty is performed to release raised intracranial pressure, but after the operation asymmetry of the face and skull remain. Sometimes these deformities require additional surgery. One reason for this, there is few reports about analysis of skull development in the craniosynostosis. One goal of our study is therefore to validate the mouse model as an appropriate tool for understanding the skull development of patients with craniosynostosis. We have analyzed the development of the skull in the *Twist*^{+/-} heterozygous mouse using 3D micro CT.

Methods: Micro CT scans and skeletal preparation were obtained on previously described *Twist*^{+/-} heterozygous mice and wild-type mice at 2, 4, 6 and 8 weeks of the age. Three-dimensional coordinate data from biologically relevant landmarks on the skull were collected. We compare the distances of each landmark between *Twist*^{+/-} heterozygous mice and wild-type mice.

Results: In the *Twist*^{+/-} heterozygous mouse, premature fusion of the coronal suture was identified by 6 week old, then development of the lengthwise of the skull was stopped and the heights was increased. The 3D analysis of 8 week old shows that *Twist*^{+/-} heterozygous mice has short face and wider skull. However, the size of orbit are almost same between wild type and *Twist*^{+/-} heterozygous mouse.

Conclusion: These findings and 3D micro CT data are necessary for future work such as the development of new surgical techniques. Further investigation into the molecular mechanisms is currently under way.

p-147

Conjoined Twin Separation: Integration of Three-Dimensional Modeling for Optimization of Surgical Planning

Presenter: Benjamin C. Wood

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Background: Conjoined twins represent a rare anomaly of monozygotic twinning with an incidence of approximately 1 in 100,000 births. Although there is a high rate of perinatal mortality, conjoined twins who survive to surgical candidacy pose complex reconstructive challenges, unique to the location and extent of the union. While the diagnostic role of prenatal imaging has been established, there is a paucity of literature regarding the use of advanced imaging applications in planning the surgical approach, as has been well described for other fields, such as orthognathic surgery. We describe our ten-year experience with conjoined twin separation, and the evolution of medical modeling and three-dimensional (3D) imaging as a critical tool for pre-surgical planning.

Methods: We performed a retrospective review of all consecutive cases of conjoined twin separation at a single institution from January 2004 to December 2013. Data were collected related to patient demographics, co-morbidities, surgical details, perioperative complications, survival, long term outcomes, and type of medical modeling system used for preoperative planning.

Results: Five sets of conjoined twins underwent separation during the ten year study period. There were three sets of thoraco-omphalopagus twins, one set of pyopagus twins, and one set of ischiopagus tetrapus twins. The mean age of separation was 70 days, with a mean of 3.5 surgical procedures performed per patient during the first year of life. One set of twins experienced post-separation complications, which warranted immediate return to the operating room. The overall survival rate after separation was 80%. The imaging methods used were computed tomography with 3D reconstruction, plaster molds, 3D modeling with composite printing, and virtual surgical planning.

Conclusion: Our series of conjoined twin separation represents the highest survival rate reported in the literature. The use of medical modeling in pre-surgical planning has proven to be a key element in optimizing the outcomes for patients with this rare anomaly. Recent advances in three-dimensional imaging have further extended those capabilities to facilitate virtual interactive modeling and surgical simulation to predict outcomes of specific techniques including tissue expansion and local tissue transfer.

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A novel causative gene for permanent tooth agenesis

Presenter: Tetsutaro Yamaguchi

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Non-syndromic permanent tooth agenesis is one of the most frequently observed diseases in the stomatognathic area. *MXS1*, *PAX9*, *AXIN2*, and *LTBP3* mutations are known to be causative in families with multiple missing teeth. However, the cause of a few missing teeth such as mandibular anterior tooth agenesis, which is common in Japan, is unknown. Recent studies have reported rare familial diseases in which the causative gene was identified using whole exome sequencing. This study therefore aimed to use this technique to identify the mutation causing non-syndromic mandibular anterior tooth agenesis in one family from Japan, one from Korea, and 32 sporadic patients with agenesis of 1-2 mandibular anterior teeth, excluding the third molar. Mandibular anterior tooth agenesis was diagnosed using panoramic radiography, and patients with other congenital anomalies were excluded. Whole exome sequencing was performed in the 32 sporadic patients and the Japanese family containing three patients with agenesis as a dominant trait. SIFT and Polyphen-2 programs were used to predict the influences of amino acid changes on protein function. The presence or absence of mutations in candidate genes known to induce permanent tooth agenesis was determined. Of 32 samples, five harbored *AXIN2* mutations. Mutations in a novel gene encoding a calcium-dependent cell adhesion molecule not previously shown to be involved in non-syndromic permanent tooth agenesis were identified in six samples. This mutation could partly explain the observed number of congenitally missing teeth and variety of affected areas in mandibular anterior tooth agenesis.

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ANTENATAL CLEFT COUNSELING IN SINGAPORE, KK WOMEN'S AND CHILDREN'S HOSPITAL, CLEFT AND CRANIOFACIAL CENTRE.

Presenter: Josephine C.H Tan

Authors: Tan JCH, Cheng JSH, Yeo PPY, Hussein HL
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The Cleft and Craniofacial centre was set up in KK Women's and Children's Hospital in 2005. The centre provides multi-disciplinary team care for children seeking one-stop treatment for all cleft anomalies. The centre is committed to providing integrated care, compassion and competence to assure quality and continuity of patient care and longitudinal follow-up.

Each year, the center sees an estimated average of 40 antenatal cleft counseling cases. The centre workflow for antenatal cleft counseling starts when the newly antenatal diagnosed family is referred, by activation of centre's coordinator. She coordinates and facilitates the cleft surgeon's appointment and the coordinator's counseling session.

The goal of the counseling is to provide sufficient information and support to the newly diagnosed parents by the surgeon and coordinator. The information shared during coordinator cleft counseling includes: Stages of treatment, management by the team, feeding method used in the centre, estimated cost of treatment, the family support group and the management workflow after the child is born.

The antenatal counseling educates, reassures, support and bridge the communication between the family and the team. It introduces treatment coordination early before the child is born and it ensures each patient is treated holistically through integrated collaboration within the multi-disciplinary team.

p-150

Efficacy of the Intermaxillary Traction Therapy with the Skeletal Anchorage Plate after Le Fort III Bone Distraction

Distraction

Presenter: Masahiko Noguchi

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Background: In Le Fort III—a midface distraction for treatment of premature craniofacial dysostosis—determining the direction of the distraction is difficult; and, it may lead to the malocclusion such as an anterior open bite. Especially, in most syndromic craniofacial dysostosis, several osteotomies to expand intracranial volume must be done before Le Fort III midface distraction. Moreover, given the degree of their mental retardation, patients or their parents seldom want the conclusive reconstructive surgery with mandibulomaxillary osteotomy. In these matters, we attempt an intermaxillary traction therapy with the skeletal maximum anchorage plate (SMAP) for the patients with anterior open bite after Le Fort III bone distraction.

Patients and Methods: We treated 3 Crouzon syndrome cases with this procedure. In all cases, Le Fort III bone distraction was performed at the age of 7 or 8 with an internal device. Intermaxillary traction therapy with SMAP was initiated immediately after the distraction in one case and was initiated after several months of bone consolidation in the rest of the cases. Using the cephalometric analysis, we examined pre- and postoperative changes of overbite, overjet, ANB, point A, point B, angle of NF-SN and MP-SN. We separated each data into x and y components and measured changes to project postoperative images over preoperative Frankfort plane.

Results: An anterior open bite after the midface distraction were improved with intermaxillary traction therapy with SMAP in all cases. The cephalometric analysis revealed that this improvement was not due to the rotation of the maxillary or mandibular bone(average rate of changes: angle of NF-SN: 0.17, MP-SN: -2.0) but the changes of the y component of the alveolar bone itself(average degree of change. anterior maxillary alveolar: 5.8, anterior mandibular alveolar: 3.7).

Conclusion: The effect of this device is not a kind of torque to maxilla or mandible; it is neither the extrusion of the teeth, but it is the alteration of the alveolar bone.

We believe this orthodontic technique is useful for the improvement of the dental occlusion with fewer invasions than other techniques.

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A troublesome case of chronic infection in frontal sinus caused by an unpredictable artificial material.

Presenter: Yoshie Endo

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We report a case of chronic infection in frontal sinus.

A patient was 65-years-old woman, who had craniotomy and clipping for brain aneurysm in the other hospital. A neurosurgeon stuffed artificial material into sinus and 4 years later her forehead skin was perforated from frontal sinus infection. We first removed sequestrum and artificial material in sinus, and performed reconstruction with anterolateral thigh flap. After operation pus flowed continuously, so we applied VAC system. But pus was not stopped. We finally performed complete debridement and reconstructed with latissimus dorsi flap in order to reach a complete remission.

The artificial material was not able to be detected by CT and MRI before surgery. It was not discovered until operation.

It is well-known that artificial material sometimes cause infection. Neurosurgeon often use it while operation. We have to expect existence of artificial material when patients have chronic wound of forehead, and inquire an operation record of previous surgery.

p-152

The usefulness of stereolithography models for craniofacial reconstruction at Cipto Mangunkusumo Hospital

Presenter: Siti Handayani

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Introduction: Craniofacial reconstruction are among the most challenging for the plastic surgeon because of the intimate relationship between form and function in this anatomical area. The aims of reconstruction within this area is to facilitate a satisfactory facial appearance and to provide suitable condition for functional rehabilitation, needs details and accuracy presurgical planning helped with 3D surgical models. However, in Indonesia this technique mostly provide by imported technology resulting total high cost of craniofacial reconstruction procedure.

Methods: we developed a presurgical planning program, that can be performed on a common computer workstation using CT Scan. The surgeon customized the CT Scans and transferred into rapid prototyping using stereolithography to obtain 3D surgical planning model. 3D surgical models used as template for customizing the implants and presurgical planning.

Results: This method adapted for 2 patients with Ameloblastoma reconstructed with free fibula tissue transfer. The accuracy and anatomical positioning evaluated intraoperatively, using this technique the molding time decreased from 150min to 45min. The 3D model (vs imported 3D model) printing time 16-20hour (vs 3-4weeks) and total cost 100-130USD (vs 2000-3000USD).

Conclusions: Presurgical planning and 3D CT-modeling outweigh the costs associated with the additional technology. These methods can allow for reduction in the learning curve associated with contouring, enhanced levels of accuracy, and acceleration of a time-consuming intraoperative step. There is room for further improvement of the outcome in complex craniofacial reconstruction cases.

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Comparison of US national databases for perioperative complications in craniosynostosis surgery

Presenter: Sandi Lam

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Introduction: The American College of Surgeons' and the American Pediatric Surgical Association sponsor the Pediatric NSQIP program, which is recognized as having high quality clinical outcomes data abstracted by trained reviewers. The Kids' Inpatient Database (KID) is a population-based database developed by the US Agency for Healthcare Reporting and Quality (AHRQ) to track national discharge data. We aim to compare perioperative complications in craniosynostosis surgery recorded in both databases in 2012 to analyze potential differences in the two databases.

Methods: Craniosynostosis surgeries were identified by CPT codes (61550, 61552, 61556, 61557, 61558, 61559, 21175, 21179, 21180) in the Pediatric NSQIP database for one year (2012). Craniosynostosis surgeries were identified by ICD-9 codes (procedure: 02.01, 02.03, 02.04, 02.06, diagnosis: 756.0) in the KID database. Perioperative complications were identified in the NSQIP database by pre-defined event variables, and in the KID database by ICD-9 code.

Results: A total of 572 estimated cases of craniosynostosis surgery were found in NSQIP in 2012 and 1827 estimated case in KID. Rates of complications were generally similar between the two databases. Rates of wound disruption (0.5% NSQIP, 0.3% KID), ischemic/hemorrhagic stroke (0.2% NSQIP, 0.3% KID), convulsions/seizures (0.4% NSQIP, 0.7% KID), cardiac events (0.4% NSQIP, 0.4% KID), pulmonary events (0.5% NSQIP, 0.3% KID), infection (0.9% NSQIP, 0.2% KID) and sepsis (0.2% NSQIP, 1.6% KID) were low and similar between the two databases. The rate of transfusion/hemorrhage was much higher in NSQIP (68%) than in KID (36%). Rates of transfusion in craniosynostosis surgery in the literature vary depending on the procedure.

Conclusion: Perioperative complication rates in Pediatric NSQIP and KID associated with craniosynostosis surgery in children were similar, with notable variation in transfusion rates. This discrepancy may be due to underlying differences in the population studied or likely under-reporting in the KID discharge database due to limitations in the structure of administrative data sets. Further studies into reliability of coding and actions to enhance clinical representation in large datasets are warranted.

p-154

Vascularization of Tissue Engineered Bone Using a Macrovascular Flow Channel

Presenter: Derek M. Steinbacher
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Purpose: Currently, no off-the-shelf vascularized bone tissue replacement exists for clinical use. The ideal solution for osseous craniomaxillofacial reconstruction would be creation of a tissue engineered construct, seeded with host bone-forming cells, and a mature vasculature network that would permit blood flow and nutrient delivery, to facilitate immediate integration and reconstitution of the defect. A construct of this nature could allow for nutrient perfusion within all regions of the scaffold, increasing the viability of larger-scale grafts, and ultimately facilitating development of a fully sustainable implant with anastomosis to host vessels. In this study, we aimed to evaluate the ability of a rat aorta to establish vessel ingrowth and provide perfusion to a porous bone scaffold. We sought to access microvessel growth and determine the effect on bone formation in a tissue engineered construct.

Methods: Using aortas from fully transgenic GFP expressing rats, which allows for easy identification of vessel growth with fluorescent microscopy, angiogenic growth was monitored over 7 days. Thoracic aortas from adult GFP rats of age 8-12 weeks were dissected out and cleaned of any attached adipose and connective tissue. The aortas were then coated in an FDA approved fibrin matrix and cultured for a period of 7 days and observed for microvessel sprouting from the adventitial surface using fluorescent microscopy.

Results: The GFP rat aortas displayed robust microvascular spouts stemming centripetally from the periphery of the aorta. The vessels that grew out from the aorta are anatomically similar to neovessels in vivo in that they recruit smooth muscle cells and pericytes to associate with the endothelial cell tube.

Conclusion: In our studies, the use of an existing vascular conduit may prove promising for bone tissue engineering as explanted rat aortas have the ability to grow microvessels when cultured in vitro. The use of a large macrovessel in the middle of an engineered bony construct will improve mass transport of oxygen and nutrients, thus increase cell survival and proliferation of osteoblasts on engineered bony scaffolds.

p-155

Quality Improvement From Implementation Of A Multidisciplinary Care Pathway For Craniosynostosis Surgery

Presenter: Sandi Lam
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Introduction: Craniosynostosis is a complex condition treated with one or more elective surgeries on young infants. We implemented a multidisciplinary care pathway at our institution that was driven by best practice guidelines. The focus was on streamlining preoperative workup, minimizing surgical and anesthetic time, and improving perioperative communication.

Methods: Metrics pre- and post-implementation of the multidisciplinary care pathway were examined with review of institutional medical records and cross-referencing with the American Pediatric Health Information System (PHIS) database. 25 consecutive cases from the pre-intervention year (2013) and 25 consecutive cases from the post-intervention year (2014) from the first 6 months of each calendar year were retrospectively reviewed.

Results: We demonstrate measurable improvements after implementation of the multidisciplinary care pathway. The rate of blood transfusion was lowered by 30%. Length of hospital stay decreased by 25%. Corresponding median and average charges per craniosynostosis surgery hospitalization at our institution decreased by 31%. We compare our program to national benchmarks in PHIS from the first 6 months of 2013 and 2014. Adjusting for case mix, our patients' average length of stay post-intervention is reduced to 47thile among the national multicenter group (68thile prior). Complication rates have remained among the lowest in the country, less than 3% overall.

Conclusion: Implementation of a multidisciplinary care pathway for our craniosynostosis surgery program has led to increased value of care, with measurable decrease in rates of blood transfusion, length of stay, and overall hospital charges.

p-156

The effect of tailored craiofacial reconstruction using Artificial bone.

Presenter: Tadaaki Morotomi

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Craniofacial reconstruction with artificial bone was performed for 20 patients with craniofacial deformity. Implant of hydroxyapatite bone involves taking computed tomographic images with a 0.625 mm slice width of the facial bone. According to the CT data, reconstruction model was simulated on mirror image. 3-D shaped implants were fabricated as the standard model for us, and then operation was performed utilizing the customized artificial bone to repair deformities and defects of the skeletal. As a result, satisfactory results were obtained in all cases, but there is one case that need to be removed its artificial bone due to infection. In conclusion, long-term follow-up is necessary, and artificial bone is thought to be useful for distorted craniofacial deformities. Improvements of manufacturing process will continue to be made to address some of the disadvantage in anatomic structure of this implants.

p-157

Augmentation for Maxillofacial Deformities using Porous Hydroxyapatite Blocks

Presenter: Motoki Katsube

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Background: In maxillofacial fields, concave deformity often requires hard tissue augmentation. Various types of materials have been used for facial augmentation. Among them hydroxyapatite is the most ideal material because of its remarkable biocompatibility and ability to maintain the desired form for a long period. We present a simple surgical procedure to augment facial concavity with porous hydroxyapatite block (Apaceram[®], PENTAX Co., Ltd., Japan) (pHA-B), and its clinical applications and potential complications.

Method: In this retrospective study, we reviewed 24 patients with facial concave deformity and who underwent surgery using the pHA-B for facial augmentation, from July 1992 to January 2014. These patients underwent 30 pHA-B procedures for facial augmentation and were evaluated for complications and malposition. The study group consisted of 12 male and 12 female patients (age ranged, 15-52 years; mean, 26.7 years). The follow-up periods ranged from 6 to 80 months, with a mean period of 27.3 months.

Results: The primary diagnoses of facial concave deformity consisted of 13 congenital craniofacial deformity cases; 8 aesthetic contouring; and 3, posttraumatic facial deformity. The augmented sites included the malar and parapiriformis areas and the mandible. There was no malpositioning nor any obvious infection for which removal of the pHA-B was needed.

Conclusions: Our surgical treatment for facial concave deformity using pHA-B is simple, minimally invasive, provides the desired result in form, and is safe for the long term.

p-158

Using Mobile Devices For Surgical Education

Presenter: Peter J. Anderson

Author: Anderson PJ

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Background: The reduction in the time available for surgical training in most programs world-wide as a result of the implementation of competency based training programs combined with a reduction in the working week for junior doctors has resulted in a review of the methods underlying medical education. One such approach was developed at Harvard University where the concept of spaced education has been studied and has been shown to improve long-term knowledge retention of medical trainees. This theory of repeated questioning led to the development of the e-learning Q-Stream[®] system which has been tested and applied widely to the educational programs for Physician and Pediatric trainees.

Method: The creation of an educational program for post-graduate surgeons at the Women's and Children's Hospital, Adelaide who had not yet entered Higher training was complicated by the limited time available for formal teaching, so it was decided to supplement their face-to-face time with a Q-Stream program[®]. A bank of 25 questions, all with multi-stem formats was developed (examples shown in figure 3). Trainees simply log onto the system and each day two questions are sent to the trainee via their mobile phone or laptop. The questions are repeated after a few days until the trainee has the correct. There are explanations available for a question that is incorrectly answered highlighting references for the trainee to guide learning.

Results: Evaluation of the program by the trainees anonymously identified that all the trainees who completed the program thought that it was a valuable supplement to their largely informal educational program.

Conclusion: This program has been found to be a useful adjunct to the educational programs of junior surgical trainees, and this suggests that it could be adapted for educational purposes in Craniofacial Surgery.

p-159

Botulinum toxin type A as an alternative to surgery for the treatment of persistent congenital muscular torticollis

Presenter: Brian Boland

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Background: Congenital muscular torticollis (CMT) is caused by shortening of the sternocleidomastoid (SCM) muscle and may lead to limitation of neck movement, head tilt, and craniofacial deformity. This condition is recognized in infancy and can be successfully treated by conservative management with physical therapy and a soft cervical collar. Patients who fail conservative management are often offered surgical lengthening of the SCM. In this study, we propose that the use of Botulinum toxin type A injections for patients with persistent torticollis refractory to conservative therapy may lead to resolution of symptoms and avoidance of surgery.

Methods: A six-year retrospective chart review of pediatric patients treated for congenital muscular torticollis by a single surgeon was performed. Patients were identified by diagnosis and procedure codes. Data collected included age, gender, type of treatment, number of treatments, laterality, time to follow-up, success of treatment, and complications. Treatment success was defined as resolving head tilt, a flaccid SCM, and family satisfaction.

Results: During the study period, 161 patients received Botox treatments (100 units IM into the affected SCM) for persistent torticollis not responsive to conservative management. Of these patients, 91 were male and 70 were female, with an average age of 2 years. 97 injections were performed on the left and 64 were performed on the right. Average follow-up was 9.6 months.

107 patients (66.5%) with persistent torticollis refractory to conservative management were successfully treated with Botox treatment alone, therefore avoiding surgical intervention. The remaining 54 patients (33.5%) underwent surgical SCM lengthening at around 2 years of age.

Conclusion: Our results demonstrate that 66.5% of pediatric patients with persistent torticollis refractory to conservative management were successfully treated with the use of Botulinum toxin type A injections alone, therefore avoiding surgical intervention. The use of Botox affords trial of multiple treatments, minimal complications, and avoidance of scarring and other issues associated with more invasive surgical approaches.

p-160**Genetic background for third molar agenesis**

Presenter: Masahiro Takahashi

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Objective: Jaw deformity patients targeted for surgical orthodontic treatment require extraction of the third molar before orthognathic surgery. In contrast, third molar agenesis is most frequently observed in the permanent teeth of all species. The purpose of the present study was to investigate the genetic background of third molar agenesis.

Method: 1) Patients were diagnosed with third molar agenesis based on history-taking regarding tooth extraction and panoramic X-ray. The characteristics of third molar agenesis among 5 sets of identical twins were investigated. 2) The relationships among third molar agenesis and 5 single nucleotide polymorphisms (SNPs) in the paired domain box 9 (PAX 9) were evaluated in 223 Korean patients. 3) A genome-wide association study (GWAS) was performed in 503 Japanese and Korean patients to search for susceptibility genes involved in third molar agenesis. 4) The relationship between third molar agenesis and the mesio-distal width of teeth was investigated in 247 Japanese and Korean patients. 5) The eruptive position of the canine was confirmed based on an intraoral image and panoramic X-ray at the first visit in a third molar agenesis case.

Results: 1) There were young pairs among the 5 pairs of identical twins. There was no disagreement in the confirmed pairs. 2) There were no relationships among the 5 SNPs in PAX 9 and third molar agenesis. 3) The GWAS result identified several SNPs that seemed to be related to third molar agenesis. 4) The remaining permanent teeth of the patients with third molar agenesis were slightly small. 5) Although there is a report suggesting that genetic factors may affect the relationship between third molar agenesis and the eruptive positions of canines, no cases of abnormal positioning were observed based on the present materials.

Discussion: It is suggested that there is a genetic contribution in third molar agenesis, and susceptibility genes can be identified. Although it is considered that there are factors other than genetic factors, the opinions are different in each report. Genetic factors may be intricately intertwined with non-genetic factors. Further studies involving larger groups are needed in the future.

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