10th Biennial World Society for Simulation Surgery Meeting (WSSS Chicago)

In Conjunction with 96th American Society of Plastic Surgery (PSTM 2018)

President Elect: Arun Gosain MD. (Chief & Professor of Surgery, Northwestern University, USA)

Secretary General: Akira Yamada MD. (Professor of Surgery, Northwestern University, USA)

Board of Directors: Jong Woo Choi MD (South Korea), Gaby Doumit MD (Canada), Tomohisa Nagasao MD (Japan), Howard Levinson MD (USA), John VanAalst MD (USA)

Founder: Toyomi Fujino MD, FACS

Date: September 30 (Sun), 2018

Place: McCormick Place West W 180, Chicago, Illinois, USA
Inaugural Congress of the International Society for Simulation Surgery
Date: December 9-11, 1992 / Venue: Tokyo, Japan / President: Toyomi Fujino

2nd Congress of International Society for Computer Aided Surgery (CAS’95)
Date: June 21-24, 1993 / Venue: Berlin, Germany / President: Jeffrey L. Marsh and Toyomi Fujino

3rd Congress of International Society for Computer Aided Surgery (CAS’96)
Date: June 26-29, 1996 / Venue: Paris, France / President: J Th Lambrech

4th Congress of the International Society for Simulation Surgery
Date: November 6, 2004 / Venue: Tokyo, Japan / President: Yu Maruyama

5th Congress of the International Society for Simulation Surgery
Date: October 15-18, 2006 / Venue: Chiang Mai, Thailand / President: Charan Mahatumurat

6th Congress of the International Society for Simulation Surgery
Date: October 27-29, 2008 / Venue: Taipei, Taiwan / President: Lun-Jou Lo

7th Congress of the International Society for Simulation Surgery
Date: January 12, 2010 / Venue: Waikiki, Hawaii, USA / President: F Donald Parsa

8th Congress of the International Society for Simulation Surgery
Date: June 14-15, 2012 / Venue: Seoul, South Korea / President: Yong-Oock Kim

9th Congress of the International Society for Simulation Surgery
Date: December 3, 2016 / Venue: Nara Centennial Hall, Nara city, Japan / President: Keisuke Imai
**Welcome message of WSSS President Elect**

Dear Colleagues and Friends,

It is a great honor for us to host the 10th congress of the Society for Simulation Surgery. There are several exciting developments for our organization. First and foremost, we have renamed the society from the International Society for Simulation Surgery (ISSIS) to the World Society for Simulation Surgery (WSSS). We feel this will help us to serve our mission to advance simulation surgery without being sidetracked by the implications of our previous initials. The next exciting development is that the congress will be held outside of Asia for the first time in its history, as we will join the 88th Annual Meeting of the American Society of Plastic Surgeons/Plastic Surgery Foundation (ASPS/PSF). The meeting is to be held in Chicago, Illinois from Sept. 29 through October 1. The WSSS meetings will be held on Sep. 30. When registering for the ASPS, please indicate that you are a WSSS member so that we may track the registration process. You will find that the ASPS meeting offers a plethora of educational offerings that will excite and inspire all WSSS members. Participants are welcome to join the instructional courses of the ASPS at no extra charge. You will also find a host of activities to welcome international guests to the ASPS, including an International Reception to be held in the Museum of Science and Industry, hosted by the Plastic Surgery Foundation (PSF). We would encourage all of you to consider joining the ASPS as International members so that you may enjoy their many educational offerings and member benefits on an ongoing basis. The benefits of membership are outlined in the Membership section of the ASPS website:

[https://www.plasticsurgery.org/for-medical-professionals/join-asps](https://www.plasticsurgery.org/for-medical-professionals/join-asps)

The WSSS congress provides a forum in which international leading experts from all over the Asian Pacific region and the world can present and discuss the latest topics regarding simulation surgery, giving a great opportunity for them to share their knowledge and experience. The scientific arena of this congress is of fundamental importance to foster innovation in simulation surgery and move these concepts from the planning and design phase to implementation in clinical practice. By holding this event in conjunction with the annual meeting of the American Society of Plastic Surgeons, we feel it will further stimulate a mutual exchange of ideas well beyond the Asian Pacific region.

Not only is Chicago one of the most popular attractions for tourism in the United States, it is also one of the best-recognized locations for hosting professional conferences. Venues for the meeting will include Navy Pier, the Museum of Science and Industry, with host hotels located on or near Chicago’s famous Miracle Mile. The commute from Chicago O’Hare International Airport to the hotels in downtown Chicago is a 30 minute cab ride, but could take longer depending on the traffic conditions. There are also trains that travel directly from the O’Hare airport to downtown (CTA Blue Line) if one wishes to avoid heavy traffic conditions.

We encourage colleagues from all over the Asian Pacific region and the world to attend and make this an unforgettable important and enjoyable meeting. We look forward to gathering with you to enjoy a pleasant autumn in the beautiful city of Chicago, located on the shore of Lake Michigan.

With Regards,

Arun K. Gosain MD, President-Elect
Akira Yamada MD, Secretary

World Society for Simulation Surgery
Program Overview

8:00 AM  WSSS Welcome & Introductions

8:15 AM  "Recent Advances in Simulation Surgery: Current and Future
Applications." - Howard Levinson, MD, John Van Aalst, MD, Sue Jordan, MD, Jong-Woo (JW) Choi, MD, Derek Steinbacher MD
This Panel will feature current pioneers in surgical simulation and explore all aspects of the field to
include bioprinting, virtual surgical planning for craniofacial surgery, and the use of surgical
simulation in training surgeons

9:45 AM  Break

10:00 AM  Keynote Lecture: "Prediction of Body Shape with
Biomechanical Techniques" - Tomohisa Nagasao, MD
Dr. Nagasao comes from Japan, and is an expert in the field of surgical simulation.

11:00 AM  WSSS Panel 2 -  "Pioneering Craniofacial Surgery and the
Role of Simulation Surgery" - Arun Gosain, MD, Kenneth E.
Salyer, MD, Joseph McCarthy, MD
This is a special feature of the meeting in which two giants of craniofacial surgery, Drs. Salyer and
McCarthy, will present the evolution of surgical simulation through their personal cases. The panel
will end with a discussion of how they anticipate such cases will be handled in the future given the
increasing application of surgical simulation.

12:00 PM  WSSS Business Meeting
4:00 PM  Free Paper Session 1
This session will feature scientific papers on surgical simulation. Each paper will be presented by the author and be followed by two minutes of discussion. The first session will be co-moderated by John VanAalst, MD & Akira Yamada, MD.

5:10 PM  Free Paper Session 2
This session will feature scientific papers on surgical simulation. Each paper will be presented by the author and be followed by two minutes of discussion. The second session will be co-moderated by Howard Levinson, MD & Akira Yamada, MD.

6:13 PM  Closing Comments
WSSS Chicago Program : 9/30/2018 (McCormick Place West W 180)

8:00 – 9:45am:  
WSSS Panel 1 | “Recent Advances in Simulation Surgery: Current and Future Applications.”  
Moderator: Howard Levinson, MD | Panelists: John Van Aalst, MD, Sue Jordan, MD, Jong-Woo (JW) Choi, MD, Derek Steinbacher, DMD, MD

9:45 – 10:00am:  
Break

10:00 – 11:00am:  
Keynote Lecture | “Prediction of Body Shape with Biomechanical Techniques”  
Tomohisa Nagasao, MD

11:00am – 12:00pm:  
WSSS Panel 2 | “Pioneering Craniofacial Surgery and the Role of Simulation Surgery”  
Moderator: Arun Gosain, MD | Panelists: Kenneth E. Salyer, MD, Joseph G. McCarthy, MD

12:00 – 1:30pm:  
WSSS Business Meeting (Invitation Only)  
Lunch Break (Exhibit Hall)

1:30 – 3:00pm:  
PSF President’s Panel | “The Role of Plastic Surgeons in the Delivery of Global Health Care: Assessing the needs and finding the optimal model to meet these needs.”  
Moderator: Arun Gosain, MD | Panelists: Christopher (Alex) Campbell, MD, James Chang, MD, Scott Corlew, MD, Goran Jovic, MD

3:00 – 4:00pm:  
Afternoon Break/Exhibits
Free Paper Session 1: 4:00 – 5:10 pm | Co-Moderators: John VanAalst, MD & Akira Yamada, MD

4:00PM-4:07 PM  Development and evaluation of high fidelity surgical simulators | Dale Podolsky, MD

4:07 PM-4:14 PM  Photoacoustic Imaging for the Planning of Lymphaticovenular Anastomosis: A Case Report | Anna Oh, MD

4:14 PM-4:21 PM  Development of a novel template for the planning and facilitation of fronto-orbital remodeling | Eisuke Watanabe, MD

4:21 PM-4:28 PM  Airway volume Simulation in Virtual Surgical Mandibular Distraction: A Cohort Study | Laura Humphries, MD

4:28 PM-4:35 PM  Touch Surgery: A 21st century platform for surgical training | Ari Mandler, MD

4:35 PM-4:42 PM  Analysis of cranial morphology of Japanese healthy infants using homologous modeling | Makoto Hikosaka, MD

4:42 PM-4:49 PM  Microsoft Kinect V2 as an alternative grading system for facial paralysis | Yohei Sotsuka, MD

4:49 PM-4:56 PM  The use of Computer-Aided Design and Manufacturing in Acute Mandibular Trauma Reconstruction | Thomas Xu

4:56 PM-5:03 PM  Conformity of the Actual to Planning Result in Orthognathic Surgery | Kyle Gabrick, MD

5:03 PM-5:10 PM  Virtual Surgical Planning in Craniofacial Reconstruction: an Evidence-based Update and Workflow Analysis | Kristopher Day MD

Session 2: 5:10 – 6:20pm | Co-Moderators: Sue Jordan MD & Akira Yamada, MD

5:10 PM-5:17 PM  Virtual Surgical Planning for Correction of Delayed Presentation Scaphocephaly Using a Modified Melbourne Technique | Thomas Xu
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<td>5:17 PM-5:24 PM</td>
<td>A New Colored Solid Model for Simulation Surgery: It is made of salt</td>
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<td>5:24 PM-5:31 PM</td>
<td>Is the sphenosquamosal suture related to the cranial deformity in Plagiocephaly?</td>
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<td>Teaching Breast Aesthetics Using A Sculpture-Based Simulation Workshop</td>
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<td>5:45 PM-5:52 PM</td>
<td>Virtual Reality and Augmented Reality Technology in Neurosurgery Tomohisa Miyagi, MD</td>
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<td>Increasing Opportunities for Active Experimentation in Residency Using Simulation: A revised cleft lip education curriculum</td>
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<td>Reconstruction of a Hemirhinectomy Defect Using a 3D Printed Custom Soft Tissue Cutting Guide</td>
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WSSS Panel 1 Abstract

WSSS Panel 1 | “Recent Advances in Simulation Surgery: Current and Future Applications.”

Moderator: Howard Levinson, MD | Panelists: John Van Aalst, MD, Sue Jordan, MD, Jong-Woo (JW) Choi, MD, Derek Steinbacher, DMD, MD

Title: Finite Element Modeling to Guide Stem Cell-Scaffold Craniofacial Constructs

John Van Aalst, MD
Professor, University of Cincinnati Department of Surgery
Director, Division of Plastic Surgery
Surgical Director, Craniofacial Center

We have created a juvenile swine alveolar cleft model and treated the defect with several scaffold types, including both nanoscaffolds and 3D printed polycaprolactone scaffolds. Embedded within these scaffolds are primed mesenchymal stem cells. The goal of this work is to determine best practice for bone formation within the cleft defect. In order to better understand the forces exerted on the stem cell-scaffold constructs, we have additionally developed finite element models to study the sets of scaffold characteristics that lead to best bone formation. This talk will focus on the capacity of FEM to create simulations that improve our ability to treat craniofacial defects with stem cell-scaffold constructs.
WSSS Panel 1 Abstract

WSSS Panel 1 | “Recent Advances in Simulation Surgery: Current and Future Applications.”
Moderator: Howard Levinson, MD | Panelists: John Van Aalst, MD, Sue Jordan, MD, Jong-Woo (JW) Choi, MD, Derek Steinbacher DMD, MD

Title: The next generation of 3D printed implants

Sumanas W. Jordan, MD, PhD
Assistant Professor of Surgery
Northwestern University Feinberg School of Medicine

Plastic surgeons have developed significant expertise in virtual 3D planning and have long used stereolithography to develop surgical models and guides. As 3D imaging and additive manufacturing have advanced side-by-side, customized patient-specific implants are making an impact on craniofacial reconstruction with increasing accessibility and popularity. This talk will look to the next generation of 3D printed implants, beyond inert metals and polymers, to bioactive materials with complex 3D structures. Hyperelastic bone, decellularized tissue inks, and electroconductive material inks will be introduced. The potential for future point-of-care 3D printing will be briefly discussed.
Title: Clinical applications of 3D computer simulation & 3D printing technology in Craniofacial surgery

Jong-Woo Choi, MD, PhD, MMM
Professor, Department of Plastic surgery, Asan Medical Center, Seoul, South Korea

Recent advances in 3D computer simulation allows the surgeons to simulate the surgery preoperatively. In addition, as the brand new 3D printing technology becomes popular, the clinical applications onto the various aspects became a reality. Craniofacial surgery would be the one of the best special areas for these new technologies because it mostly deals with the skeletal tissues which would be good candidate for simulation based on CT dicom data.

Moreover, the recent advances in 3D photogrammetry enable the craniofacial surgeons not only to evaluate the surgical outcomes but also to simulate the soft tissue changes as well as the hard tissue.

This presentation will discuss my clinical applications in terms of the craniofacial surgery such as orthognathic surgery, craniosynostosis and rhinoplasty.
Title: 3D Applications in Orthognathic and CranioMaxillofacial Surgery. (D. Steinbacher, DMD, MD, FACS)

Derek M. Steinbacher DMD, MD, FACS
Yale University School of Medicine
Associate Professor Plastic Surgery, Cranio-Maxillofacial Surgery

PURPOSE: Three-dimensional (3D) analysis and planning are powerful tools in craniofacial, orthognathic, and reconstructive surgery. The elements include 1) analysis, 2) planning, 3) virtual surgery, 4) 3D printouts of guides or implants, and 5) verification of actual to planned results. The purpose of this presentation is to review applications of 3D planning in cranio-maxillofacial and orthognathic surgery.

MATERIALS AND METHODS: Case examples involving 3D analysis and planning were reviewed. Work-flow and optimization for orthognathic surgery is highlighted. Future potential is addressed with unique aspects specific to new applications in cranio-maxillofacial surgery.

RESULTS: Examples of 3D planning are described, with focus on work-flow, planning pearls, and aesthetic optimization in orthognathic surgery.

CONCLUSIONS: Planning in cranio-maxillofacial and orthognathic surgery is useful and has applicability across different procedures and reconstructions. Three-dimensional planning and virtual surgery enhance efficiency, accuracy, creativity, and reproducibility in cranio-maxillofacial surgery.
Prediction of Body Shape by Biomechanical Calculation

Chair and Professor
Department of Plastic and Aesthetic Surgery
Kagawa National University, Takamatsu, Japan
Tomohisa NAGASAO MD.

Many treatments in plastic surgery aim to transform patients’ body shapes. In order to achieve optimal results in such treatments, we need to predict how body shapes transform in response to external forces. A biomechanical technique called “structural analysis” enables the prediction. The basic principles of structural analysis is divided the object into small elements, evaluate the dynamic behavior of each element by dynamic calculation, and accumulate the results with each element to predict the deformity of the whole entity of the object.

By using structural analysis, we clarified the following clinical problems.

(1) Development of prediction system of postoperative shape of the thorax in the treatment of chest deformities
(2) Mechanisms of orbital floor fractures
(3) Appropriate fixation methods of zygoma fracture
(4) Why keloids tend to present so-called “crab-like shapes”
(5) Effective way to perform scar revisions for interrupted scars
(6) How to perform Le Fort 3 Osteotomy safely
(7) How to achieve optimal results if the correction of protruding ears

This presentation introduces the usefulness of structural analysis for the practices in plastic surgery.
WSSS Panel 2: 11:00 AM-12:00 PM

“Pioneering Craniofacial Surgery and the Role of Simulation Surgery”

Moderator: Arun Gosain MD
WSSS President Elect

Panelist:

Kenneth E. Salyer MD
Founder and Chairman
World Craniofacial Foundation, Dallas, Texas, USA

Joseph G. McCarthy MD
Clinical Professor, Hansjorg Wyss Department of Plastic Surgery
Professor Emeritus of Plastic Surgery, Hansjorg Wyss Department of Plastic Surgery, NYU Langone Health, New York, USA

This is a special feature of the meeting in which two giants of craniofacial surgery, Drs. Salyer and McCarthy, will present the evolution of surgical simulation through their personal cases. The panel will end with a discussion of how they anticipate such cases will be handled in the future given the increasing application of surgical simulation.
Free Paper Session 1. 4:00 PM- 5:10 PM(Chairs: VanAalst MD, Yamada MD)

4:00PM-4:07PM

Title: Development and evaluation of high fidelity surgical simulators

Dale J Podolsky, David M Fisher, Karen W Wong Riffler, James M Drake, Christopher R Forrest

1:Division of Plastic & Reconstructive Surgery, University of Toronto, Toronto, Ontario, Canada 2:Center for Image Guided Innovation and Therapeutic Intervention (CIGITI), Toronto, Ontario, Canada 3:Division of Plastic & Reconstructive Surgery, The Hospital for Sick Children, Toronto, Ontario, Canada 4:Division of Neurosurgery, The Hospital for Sick Children, Toronto, Ontario, Canada

Introduction: Surgical simulators provide a platform to gain experience before operating on real patients.

Methods: Using patient imaging, 3D printing, adhesive, polymer and material techniques a high-fidelity physical cleft palate (Figure 1), cleft lip (Figure 2) and adult rhinoplasty (Figure 3) simulator were developed. The cleft palate simulator was evaluated using electromagnetic sensors to test economy of hand motion, a confidence scale, assessment of realism and perceived value using questionnaires as well as knowledge tests. A newly developed technical assessment scale was used to assess whether performance improves with repeated use. The cleft lip simulator was assessed for realism and perceived value. The rhinoplasty simulator was assessed qualitatively for realism and anatomic accuracy.

Results: The cleft palate simulator was shown to improve confidence as well as knowledge of cleft palate anatomy and repair procedures. The cleft palate simulator distinguished between skill level using economy of hand motion, the technical assessment scale, confidence scale, and was shown to improve performance through repeated use. The cleft lip simulator was found to be highly realistic and anatomically accurate allowing performance of all steps of a cleft lip repair and primary cleft rhinoplasty procedure. The adult rhinoplasty simulator allowed performance of critical steps of rhinoplasty in a highly realistic and anatomically accurate physical environment.

Conclusions: High-fidelity physical surgical simulators for cleft and rhinoplasty procedures were successfully developed and evaluated. The simulators provide an effective platform to gain hands-on experience of complex procedures prior to operating on real patients.
Left) Perspective view of the cleft palate simulator. Right) Plastic surgery fellow performing a cleft palate repair on the simulator during a comprehensive cleft palate training workshop.
Perspective view of the cleft lip simulator removing marginal lip tissue demonstrating the multilayered tissues including muscle, subcutaneous fat as well as dissection planes.
Left) High-fidelity rhinoplasty simulator. Right) Performance of grafting technique demonstrating some of the internal components of the simulator.
Background: Photoacoustic imaging (PAI) technique can visualize the distribution of light absorbing molecules, such as hemoglobin or indocyanine green (ICG), with high spatial resolution. After ICG administration, PAI can provide the three-dimensional images of superficial lymphatic vessels as well as venules. Recently, we planned lymphaticovenular anastomosis (LVA) surgery based on PAI, and achieved good outcome.

Methods: The patient is a woman in her 60s with the surgical history of cervical cancer and had left lower extremity lymphedema over 10 years. With ICG fluorescence lymphography, a linear pattern below the knee and diffuse-pattern dermal backflow was observed in the affected limb. Before the surgery, PAI lymphangiography was performed using the PAI-05 system, made by Canon Inc. (Japan), Hitachi, Ltd. (Japan), and Japan Probe Co, Ltd.(Japan). With the PAI images (Fig.1), we determined an incision site where lymphatic vessels were adjacent to venules just below the knee.

Results: During the surgery, we found the lymphatic vessels and venules at the place shown by PAI (Fig.2). After the surgery, the circumferences were reduced at all sites proximal to the anastomosis site.

Conclusion: PAI showed the actual anatomical course of each lymphatic vessel and venule, which was useful in finding them during the surgery. Next, we are planning a clinical trial of the PAI-based LVA surgery to compare the duration of the surgery, number of anastomoses, and the clinical outcomes.

Acknowledgement: This work was funded by ImPACT Program of the Council for Science, Technology, and Innovation (Cabinet Office, Government of Japan).
Fig. 1
In recent years, the use of preoperative templates employing three-dimensional [3-D] preoperative planning software has been reported in cranial remodeling for patients with craniosynostosis. We have created 3-D solid templates for operative simulation to facilitate fronto-orbital remodeling. A 3-D template of the fronto-orbital bar would be expected to enhance the accuracy, shorten the duration of surgery, and improve the outcome of fronto-orbital remodeling. Therefore, we have constructed preoperative templates using a combination of 3-D planning software for craniofacial surgery (ProPlan CMF, Materialise, Leuven, Belgium). A 3-D printer was used to verify the accuracy of the predictive template with the postoperative models of the actual clinical fronto-orbital remodeling carried out.

Subjects and methods

The study subjects were patients with trigonocephaly (n = 5) and unicoronal plagiocephaly (n = 1.). These cases met the following criteria; Firstly fronto-orbital remodeling had been completed. Secondly post-operative computed tomography (CT) data that could be used to create postoperative 3-D material models was also available. Thirdly, preoperative data that could be used to construct a predictive model was available. With this data a comparison between the predictive model and the actual clinical postoperative model could be made. We used the ProPlan’ software to construct the template preoperatively. The templates were created from normative data of the crania that we generally encounter intraoperatively (Eur. J. Plast. Surg.14: 80, 1991). Subsequently, we created 3-D solid models based on the preoperative simulation data and compared them to postoperative CT data of the actual fronto-orbital bars constructed during surgery.

Results
In all six cases, the shapes of the fronto-orbital remodeling created operatively correlated well with the predictive solid models. The 3-D material models created based on the data from the software closely corresponded to those based on the actual postoperative CT data. We believe that the templates created in this study could be applicable and useful for reshaping of the fronto-supra-orbital bar clinically.

Conclusion

This study demonstrated the validity of template models constructed from appropriate software. We have concluded that the combination of 3-D planning software for craniofacial surgery with a 3-D material template to be a potentially useful clinical application.
Title: Airway volume Simulation in Virtual Surgical Mandibular Distraction: A Cohort Study

Laura S. Humphries, MD 1 Essie K. Yates, MD 5
Julie M. Mhlaba, MD 4 John M. Collins, MD, PhD 2 Fuad M. Baroody, MD 3 Russell R. Reid MD, PhD 1

1 Department of Surgery, Section of Plastic Surgery, University of Chicago Medical Center
2 Department of Radiology, University of Chicago Medical Center
3 Department of Surgery, Section of Otolaryngology-Head and Neck Surgery, University of Chicago Medical Center
4 University of Chicago Pritzker School of Medicine
5 Atlantic Center of Aesthetic and Reconstructive Surgery

Background: We investigated the accuracy of virtual surgical planning (VSP) in predicting airway volume (AV) changes after mandibular distraction in patients with Pierre Robin Sequence (PRS) and associated tongue-based airway obstruction (TBAO).

Methods: We completed a retrospective review of patients for whom VSP was used during MDO for treatment of TBAO at a single institution. Pre-operative AV, VSP-predicted AV, and post-operative AV were calculated from 3-D CT scans using industry software. A blinded institutional radiologist also calculated pre- and post-operative AVs using one of two software programs. Pre- and post-operative polysomnography (PSG) was used to titrate end-point of mandibular lengthening.

Results: Data were available for 11 patients, who were included in the study. Mean apnea-hypopnea index (AHI) (5.42 ± 4.53 vs 44.96 ± 20.57, p<0.001) and mean nadir oxygen saturation (70.3% ± 9.72 vs 82.9% ± 9.62, p=0.003) improved with mandibular distraction. There was moderate correlation between VSP-predicted and actual mandibular distraction lengths (R²=0.65, p=0.003). There was a strong correlation between VSP-predicted and industry-calculated actual post-MDO AV (R²=0.99, p<0.001). There was no significant correlation between actual mandibular distraction length and industry-calculated actual post-MDO airway volume for the entire cohort (R²=0.05, p=0.49), but correlation approached significance by institutional calculations. No significant correlation existed between industry and institutional-calculated percent change in post-MDO AV (R²=0.06, p=0.57).

Conclusions: Predictive airway volume calculation may be an effective adjunct to determine anatomic end-point of mandibular distraction but small sample size, operator and software variability, and patient airway morphology may confound firm conclusions. Further studies are warranted.
Figure. Patient 4 Clinical Outcomes and Airway Volume Calculation. Patient 4 was a full-term African-American male with Pierre Robin Sequence who underwent MDO at age 3.8 weeks, weight 4.225kg. He was born with a Veau Type 2 cleft palate. The patient demonstrated obstructive sleep apnea on PSG, with an AHI of 43.8. Flexible laryngoscopy revealed base of tongue prolapse into the pharynx, resulting in retroflexed epiglottis. He underwent placement of a 30mm radius internal curvilinear distractor. Post-operative AHI was 3.6, reflecting a 91.78% reduction in AHI. The patient’s course was complicated by superficial infection of the left cheek requiring incision and drainage and wound VAC placement at about 2 weeks into the consolidation phase. Industry-calculated airway volumes (top): Pre-MDO 1199 mm$^3$; Simulated Post-MDO 1303 mm$^3$ with planned mandibular distraction of 10.47mm on the right and 9.69mm on the left; Actual Post-MDO 1303 mm$^3$. Institutional-calculated airway volumes (bottom), with actual mandibular distraction of 11.5mm; Pre-MDO 488.13 mm$^3$ and Post-MDO 722.29 mm$^3$. In this case, pre- and post-operative AV increased with mandibular distraction with both industry and institutional calculations.
Title: Touch Surgery: A 21st century platform for surgical training

Ari G. Mandler MD
The George Washington School of Medicine and Health Science

TouchSurgery is a novel online platform (iOS, Google Play) that is geared towards innovating professional training for surgical procedures. In other industries, such as aviation, simulation has already been shown to reduce costs and improve outcomes in crisis. Studies involving simulation-based learning in healthcare similarly indicate the potential for reducing errors through skill acquisition and cognitive retention. Cohort studies have shown improved performance among simulator-trained medical students in comparison to those with traditional ward training. With this front in mind, TouchSurgery is paving its way for implementation within the surgical realm. Operations can be completed in one of two settings: learn or test. The learning feature provides step wise instruction, prompting the user to complete tasks like debridement and incising with the drag of a finger. The test feature, on the other hand, allows one to complete operations without guided instructions. Currently, the simulations within the application are numerous and cover over 14 different specialties, providing use for more than 100 residency programs across the United States. Given the revolutionary shift to simulation-based learning, platforms like TouchSurgery will need to meet the demands of surgical training in the 21st century.
Objective: There are many reports analyzing the cranial morphology of healthy children in the past. But most of them are limited to two-dimensional analysis, and there are only a few reports which focused on Japanese healthy infants. We report a novel method that enables comprehensive analysis of cranial morphology in 3D using homologous modeling, and our achievements so far.

Methods: Craniofacial CT data of 20 healthy infants (9 males, 11 females) ranging in age from 1 to 11 months were collected. We created 20 homologous models of cranium using software specifically designed to support homologous modeling. We averaged vertex coordinates of the homologous models to create an average model. We further performed principal component analysis to elucidate the elements that characterize the morphological variety of the cranium, and created virtual models based on each principal component. The contribution rate was calculated, and the features described by each principal component were interpreted.

Results: We created the average cranial model of 20 Japanese healthy infants. Seven principal components (cumulative contribution rate: 89.218%) were interpreted as to which part of the cranial shape each component was related to. The elements were extracted that may characterize the cranial morphology of some of the clinical conditions such as dolico/brachycephaly and deformational plagiocephaly. Some of these elements have not been mentioned in the past literature.

Conclusion: Homologous modeling was considered to be a valid and strong tool for comprehensive analysis of cranial morphology. We are currently working on the project to increase the number of cases.
Title: Microsoft Kinect V2 as an alternative grading system for facial paralysis

Yohei Sotsuka MD, Kenichiro Kawai MD, Hisako Ishise MD, Soh Nishimoto MD, and Masao Kakibuchi MD
Hyogo College of Medicine Department of Plastic Surgery

Introduction and Objective

Grading system for evaluating facial movements in facial paralysis can be classified into traditional and computer-based grading systems. Computer-grading system provided quantitative repeatable results, they required significant time for manually using software and required high cost which limited their widespread clinical use. Recently, three-dimensional depth cameras in commercial gaming systems have been common, and reduced their cost. A few studies have used depth sensors for face detection. One of the three-dimensional depth cameras in commercial gaming systems is Microsoft Kinect V2 sensor. We present the results of using Microsoft Kinect V2 sensor for grading facial paralysis.

Methods

The facial grading system software was implemented using Kinect for Windows SDK 2.0, and was written by the author in Visual C#. The software can display the 17 animation units automatically in real time once the face has been tracked. First, facial emotions of two healthy subjects were captured by Kinect V2 and were graded by the software described. Second, facial emotions of one facial paralysis patient were captured by Kinect V2 and were graded by the software before and after the botulinum toxin injections for treatment of synkinesis.

Results

Facial emotions of two healthy subjects were able to grade by Kinect V2. For facial paralysis patient with synkinesis, after botulinum toxin injections, the synkinesis eye closure movements improved both clinically and also in our facial grading system software.

Conclusion

Microsoft Kinect V2 can be an alternating grading system for facial paralysis.
Title: The Use of Computer-Aided Design and Manufacturing in Acute Mandibular Trauma Reconstruction

George Kokosis MD, Edward H. Davisdon MA(Cantab), MBBS 2, Rachel Pedreira BS 3, Alexandra Macmillan MA(Cantab) MBBS 3, Amir H. Dorafshar MBChB 4

1. Department of Plastic and Reconstructive Surgery, Johns Hopkins Hospital, Baltimore
2. Division of Plastic and Reconstructive Surgery, Albert Einstein College of Medicine, Montefiore Medical Center, Bronx, NY
3. Johns Hopkins School of Medicine, Baltimore
4. Division of Plastic and Reconstructive Surgery, Rush University Medical Center, Chicago, IL

Purpose: Virtual surgical planning (VSP) with subsequent computer-aided design and manufacturing have proved efficacious in improving the efficiency and outcomes of a plethora of surgical modalities, including mandibular reconstruction and orthognathic surgery.

Patients and Methods: Five patients underwent complex mandibular reconstruction after traumatic injury using VSP from July 2016 to August 2017 at our institution. The Johns Hopkins University Hospital institutional review board approved the present study. The patient’s occlusion was restored virtually, and a milled 2.0-mm plate was created that would bridge the defect with the patient in occlusion.

Results: Appropriate occlusion was confirmed using postoperative computed tomography. No patient developed any adverse outcomes, except for a minor dehiscence of the intraoral incision in 1 patient that was treated with local wound care. The average interval from the injury to custom plate availability was approximately 7 days.

Conclusions: The utility of this technology in acute complex mandibular trauma can overcome the challenges of traditional treatment. Custom patient-specific prebent and milled plates permit the use of a lower profile and therefore less palpable hardware, can guide reduction, avoid the need for plate bending, and obviate the need for an extraoral incision.
FIGURE 1. A, Clinical and intraoperative photographs of a 13-year-old male who sustained a blast injury to the right maxilla. Note the extensive soft tissue damage and exposure of the nasal cavity. B, Initial surgical planning used to analyze the nature of the injury to be undertaken. (Fig 1 continued on next page.)

C

D

FIGURE 1. (cont.) C, Intraoperative photograph showing the soft tissue defect used to recreate occlusion. D, Postoperative CT scan (left) and clinical photography (right) confirmed the occlusion.
Title: Conformity of the Actual to Planned Result in Orthognathic Surgery

Kyle Gabrick MD (1); Alexander Wilson BS (1); Rajendra Sawh-Martinez MD (1) Derek Steinbacher MD, DMD (1)

(1) Yale School of Medicine Section of Plastic and Reconstructive Surgery

Abstract

Purpose: Virtual surgical planning (VSP) has facilitated pre-operative planning, splint accuracy, and intra-operative efficiency in orthognathic surgery. The translation of the VSP to the actual result has not been adequately examined. Our chief aim was to examine the conformity of VSP to the post-operative result. We hypothesize the greatest conformity exists in the anteroposterior dimensions.

Methods:

We examined patients who underwent Le Fort I maxillary advancement, bilateral sagittal split osteotomies, and genioplasty. The pre-operative VSP file and post-operative cone beam CT were registered in Mimics utilizing unchanged landmarks. We quantified the conformity to the VSP utilizing linear and angular measurements between bone surface landmarks. Results were compared utilizing t-tests with p < 0.05 considered statistically significant.

Results: 100 patients who underwent Le Fort I, bilateral sagittal split osteotomies, and genioplasty were included. Three-dimensional analysis showed significant differences between the plan and outcome for the following landmarks: A point (y, p=0.04; z, p=0.04), B point (y, p=0.02; z, p=0.02), Pg (y, p=0.04), Me (x, p=0.02; y, p=0.01; z, p=0.03), and ANS (x, p=0.04; y, p=0.04; z, p=0.01). Angular measurements SNA, SNB, and ANB were not statistically different.

Conclusion:

There is a high degree of conformity comparing orthognathic VSP to the actual post-operative result. However, some incongruency is seen: vertically (maxilla), and sagittally (mandible, chin). Departures of the actual position compared to the plan could be the result of: condylar position changes, osteotomy locations, aesthetic intraoperative decisions, and/or play in the system.
Title: VIRTUAL SURGICAL PLANNING IN CRANIOFACIAL RECONSTRUCTION: AN EVIDENCE-BASED UPDATE AND WORKFLOW ANALYSIS

Day KM,1 Kelley PK,1 Dorafshar AH,2 Combs PD,1 Casmedes HP, Henry SL,1 George TM,1 Harshbarger RJ1

1 University of Texas Medical Branch-Austin; Dell Seton Medical Center; Seton Medical Center at the University of Texas
2 Rush University; Rush University Medical Center

Background: The value of Virtual Surgical Planning (VSP) is increasingly cited in craniofacial (CF) surgery articles. Controversy persists regarding the level of evidence for VSP, calling for a quality assessment of existing literature. We summarize the evidence-basis for VSP in CF surgery with cases highlighting established clinical workflow protocols.

Methods: A Medical Subject Headings (MeSH®) keyword search for all MEDLINE® publications on VSP in CF surgery was conducted. Trend lines were tested for best fit to the rate of change in the number of CF VSP publications per year. Articles’ conclusions were tabulated for common data points. Key steps in the VSP workflow are described and illustrated with case examples.

Results: Clinical workflow analysis is provided based on experience with 564 CF cases employing VSP. Publications on VSP in CF surgery have increased exponentially (y = 16.84e^{0.12x}, R^2 = 0.97) over the last two decades, totaling 1728 articles. Common sub-topics include: image analysis, surgical planning, surgical simulation, custom guides or implants, and verification of results. Clinical settings include: acute, elective, acquired, and congenital conditions. Authors suggest that VSP may improve results, increase safety, enhance efficiency, augment surgical education, and aid surgeons’ ability to execute complex CF operations. The majority of VSP publications in CF surgery are level four or five evidence.

Conclusion: While the literature suggests that VSP may improve many aspects of CF surgical care, the level of evidence is low. Higher quality studies are needed to advance beyond proof of concept for VSP in CF surgery.
Figure 1. MEDLINE® Trend of Virtual Surgical Planning Publications Over Time

VSP PUBLICATIONS PER YEAR (Medline)

\[ y = 16.844e^{0.1235x} \]

\[ R^2 = 0.9689 \]

Figure 2. Acute Mandibular Trauma Reconstruction Using Virtual Surgical Planning and Pre-Bent Custom Implant
Figure 3. Elective Cranioplasty in Late-Presentation Craniosynostosis Patient Undergoing Cranial Vault Remodeling with Virtual Surgical Planning
Free Paper Session 2 5:10 PM- 6:13 PM (Chairs: Sue Jordan MD, Yamada MD)

5:10 PM- 5:17 PM

Title: Virtual Surgical Planning for Correction of Delayed Presentation Scaphocephaly Using a Modified Melbourne Technique

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4. Division of Plastic and Reconstructive Surgery, Rush University Medical Center, Chicago, IL

Background: Late treatment of scaphocephaly presents challenges including need for more complex surgery to achieve desired head shape. Virtual surgical planning for total vault reconstruction may mitigate some of these challenges, but has not been studied in this unique and complex clinical setting.

Methods: A retrospective chart review was conducted for patients with scaphocephaly who presented to our institution between 2000 and 2014. Patients presenting aged 12 months or older who underwent virtual surgical planning-assisted cranial vault reconstruction were included. Patient demographic, intraoperative data, and postoperative outcomes were recorded. Pre- and postoperative anthropometric measurements were obtained to document the fronto-occipital (FO) and biparietal (BP) distance and calculate cephalic index (CI). Virtual surgical planning predicted, and actual postoperative anthropometric measurements were compared.

Results: Five patients were identified who fulfilled inclusion criteria. The mean age was 50.6 months. One patient demonstrated signs of elevated intracranial pressure preoperatively. Postoperatively, all but one needed no revisional surgery (Whitaker score of 1). No patient demonstrated postoperative evidence of bony defects, bossing, or suture restenosis. The mean preoperative, simulated, and actual postoperative FO length was 190.3, 182, and 184.3 mm, respectively. The mean preoperative, simulated, and actual postoperative BP length was 129, 130.7, and 131 mm, respectively. The mean preoperative, simulated, and actual postoperative CI was 66, 72, and 71.3, respectively.

Conclusions: Based on our early experience, virtual surgical planning using a modified Melbourne technique for total vault remodeling achieves good results in the management of late presenting scaphocephaly.
FIGURE 1. Preoperative (A–C) and postoperative (D–F) positioning of segments A, B, C, and F is shown from lateral and superior views. The posterior ridge of the cranial base is buried intraoperatively, although this is not shown on the surgical plan.
FIGURE 2. (A, B) Child with nonsyndromic sagittal craniosynostosis who presented at 12 years of age. A subtotal cranial vault reconstruction was performed at 14 years of age. (C) Cranial ostomy splint markings at time of operation. (D) Final construct of cranial vault reconstruction on table. (E) Follow-up at 3 weeks postoperatively. (F) Follow-up at 15 months postoperatively demonstrating good results.
FIGURE 3.  (A, B) Child with nonsyndromic sagittal craniosynostosis who presented at 5 years of age. A subtotal cranial vault reconstruction was performed at 6 years of age. (C) Final cranial construct at time of operation on table. (D) Final cranial vault reconstruction. (E) Follow-up at 3 months postoperatively. (F) Follow-up at 1 year postoperatively demonstrating good results.
Title: A new colored solid model for simulation surgery: it is made of salt

Yoshiaki Sakamoto 1, Hisao Ogata 1, Teruo Sakamoto, D.D.S 2, Takenori Ishii, D.D.S. 2 Kazuo Kishi 1

1 Department of Plastic and Reconstructive Surgery, Keio University School of Medicine  
2 Department of Orthodontics, Tokyo Dental College, 1-2-2 Masago, Mihama-ward, Chiba 261-8502, Japan

Background: Simulated craniomaxillofacial surgery is critical for planning the procedure, shortening operative time, and practicing the procedure. However, typical models are expensive, given their solid materials, and the surgical sensations do not accurately reflect the procedure performed using human bone. To solve these problems, a new solid salt model has been developed.

Method: Stereolithography data was generated using computed tomography data, and a salt model created using a 3D inkjet printer. By extracting specific data for elements such as the teeth and mandibular canal, these elements were highlighted in the solid model using different colored material. As well, we compared the maximum load and plastic deformation of the salt model, a stereolithographic resin model, and a pig limb.

Result: The salt model had similar tenacity to bone, and the risk of damage to the teeth and inferior alveolar nerve was easily confirmed.

Conclusion: The material cost of the salt model is extremely low, and the salt model may provide a more accurate sensation of cutting human bone. Thus, this model is useful for both simulated operation and practice for inexperienced surgeons.
Title: Is the sphenosquamosal suture related to the cranial deformity in Plagiocephaly?

Masashi Takemaru 1, Yoshiaki Sakamoto 1, Junpei Miyamoto 2, Tomohisa Nagasao 3, Kazuo Kishi 1

1 Department of Plastic and Reconstructive Surgery, Keio University School of Medicine
2 Miyamoto Plastic & Reconstructive Surgery Hospital.
3 Department of Plastic and Reconstructive Surgery, Kagawa University School of Medicine

【Purpose】The coronal ring of patients with unilateral coronal synostosis (UCS) presents premature fusion. This study aims to elucidate the causes of the symptom of UCS including asymmetry of the frontal region of the skull and deformity of the orbital region.

【Method】On the basis of computed tomography data of neonatal dry skull, computer-aided design models; involving only frontoparietal suture (FP), involving frontoparietal and frontosphenoid sutures (FP+FS), and involving frontoparietal, frontosphenoid and sphenosquamosal sutures (FP+FS+SS) were produced. Pressure of 15 mm Hg was applied to the neurocranium of each skull model to simulate ICP. Using the finite element method, the displacements presented by each model's orbits were calculated.

【Results】In FP model, high stress was generated at only the frontal region. In contrast, FP+FS and FP+FS+SS models which involves skull base generated high stress not only frontal, but also orbital region. In addition, the high stress also generated at skull base in FP+FS+SS model. The simulated deformation in FP+FS+SS models is similar to UCS.

【Conclusion】Despite the progress of molecular biology and genetics, many things are still not understood about the suture biology and the exact causative pathways remain yet to be completely understood in craniosynostosis. Biomechanical study is useful to reveal the cranial deformation in craniosynostosis.
Title: Teaching Breast Aesthetics Using A Sculpture-based Simulation Workshop

Lauren Nigro MD, Morgan Yacoe MD, Jennifer L. Rhodes MD

Virginia Commonwealth University

Background: With over 106,000 patients undergoing breast reconstruction each year and a growing interest in aesthetic outcomes, it is critical trainees develop an eye for breast aesthetics. To enhance learning, we developed a simulation-based approach to teaching breast aesthetics, including form, symmetry, perspective, and observational skills.

Methods: With the collaborative efforts of a sculptor, we designed a workshop using resin casts of a female torso after unilateral mastectomy. Subjects included plastic surgery residents and students. Using clay and sculpting tools, each subject was tasked with re-creating the absent breast, requiring careful observational critical examination, and translating the conception into a multidimensional creation. The torso was designed to allow subjects to look over the clavicles to understand the patient’s perception of the reconstructed breast. Subjects were surveyed to evaluate the experience.

Results: Twelve subjects participated in the workshop; seven completed the survey. Subjects honed observational and analytical skills to understand and recreate symmetry, volume contour, and texture of the breast from clay. On a scale of 0-10 (10 being the most useful), subjects ranked the effectiveness of the workshop at 9.4 (Table 1). They strongly felt the workshop improved their understanding of breast aesthetics (9.4/10). Subjects reported a greater appreciation of the breast’s complex, nuanced shape, pitfalls of light and shadow’s effect on perspective, and different vantage points of observation.

Conclusion: Using sculpture as a hands-on medium, the simulation workshop provided subjects a greater understanding of three-dimensional breast aesthetics. Subjects sharpened skills crucial for surgical practice.
Table 1.

Survey Results

1. Do you think the exercise was useful?

2. Do you feel this exercise has improved your understanding of breast aesthetics?

3. Was the class material (model and clay) easy to work?
Excessive mechanical tension following flap advancement and transposition has been associated with complications including hypertrophic scarring and delayed healing. Yet, there is still a lack of tools to measure tissue stress in the operating room and anticipating stress distributions in complicated tissue rearrangement cases remains challenging. A patient-specific three-dimensional (3D) geometry of the skin and skull of a 7 year-old patient was built with computer tomography (CT) scan data and multi-view stereo (MVS). The patient was treated to correct a cranial contour deformity and resect two large areas of scalp scarring. The surgery was simulated on the 3D models using finite element analysis (FEA) to compute the mechanical stress contours. Overall stress was highest at specific areas near the suture lines. For the temporal scar, the stress concentration occurred at the distal end of the flap. The occipital scar excision was Y-shaped and showed peak tension along one limb up to the T-junction of the sutures. This region of high stress identified in the simulation did show partial flap tip necrosis and delayed healing one month after surgery. In conclusion, MVS and FEA allow prediction of mechanical stress contours on patient-specific models that can help during preoperative planning to minimize skin tension, as well as help anticipate regions at risk of wound healing complications.
Fig. 1. 7-year-old female with a history of scalp and calvarium resection, with unstable scar and residual pigmented nevus after completing tissue expansion (left); Patient at the 3-day follow up, a small region of partial flap necrosis and delayed healing developed at the T junction of the occipital scar (right).

Fig. 2. The 3D model of the skull with the calvarial defect from the CT scan was corrected to simulate the cranioplasty procedure and merged with the multi-view stereo (MVS) model of the skin after tissue expansion. The two scars were removed from the skin model according to the MVS geometries obtained intraoperatively.
Fig. 3. von Mises stress distribution at the end of the virtual surgery simulation: A region of high stress in the occipital suture extended over a large area including the T junction of the flaps.
OBJECTIVE: We are to report on representative clinical cases using virtual reality and augmented reality technology in our department of neurosurgery.

METHODS: We created three-dimensional computer graphics (3DCG) by SYNAPASE VINCENT of FUJIFILM and iPlan of Brainlab with using DICOM data of 3T MRI and 320 slice CT. Hand and head motion tracking system was used for Virtual reality. The motion tracking was performed using Oculus Rift and Touch of Oculus VR. Real-time physical deformation virtual reality system was built by Unity of Unity Technologies which is a software application to computer programmers for software development. The virtual reality system is used to training of neurosurgeons and medical students.

RESULTS: It was beneficial for the confirmation of the approach to use 3DCG augmented reality (blood vessel, tumor, language area, association fiber and so on) projection to the surgical microscope field. The virtual reality technology was effective for neurosurgical training of neurosurgeons and medical students.

CONCLUSION: The virtual reality and augmented reality technology were useful for the selection of the neurosurgical approach and neurosurgical training.
Title: Increasing opportunities for Active Experimentation in residency using simulation: a revised cleft lip education curriculum.

Francesca Y. L. Saldanha 1, Carolyn R. Rogers-Vizena 1,2

1. Department of Plastic and Oral Surgery, Boston Children's Hospital, Boston, MA.

2. Harvard Medical School, Boston, MA, USA.

Increasing healthcare safety and quality mandates, coupled with duty-hour restrictions and diminishing opportunities for resident operative autonomy, have prompted recruitment of advances in simulation to cater to the hands-on learning preferences of surgical residents.

Revisiting the principles of Kolb’s Learning Cycle (Figure 1), the authors created a revised cleft lip educational program that sought to 1) maximize educational impact by traversing the full learning cycle in a single educational encounter and 2) pilot a high-fidelity procedural skills trainer that captured the importance of submillimeter detail whilst permitting resident operative autonomy.

Eleven residents participated in small group-educational sessions comprising a standard cleft didactic lecture, augmented by an instructional video. Participants immediately processed knowledge from the lecture/video by “operating” on the simulator allowing opportunities for questions and self-reflection, completing the learning cycle (Figure 2). A self-assessment survey (Figure 3) was taken prior to and after each component of the session, including a self-confidence survey to conclude the session.

Preliminary analysis using the Wilcoxon signed-ranked test indicates a statistically significant increase in learning across all aspects of the self-assessment by the end of the session (p<0.02). In particular, simulation contributed a significant increase in understanding of cleft rhinoplasty post-simulation compared to post-lecture (p<0.014 versus p<0.2, respectively). 100% (n=11) of the cohort strongly agreed that simulation helped them actively engage in learning and should be a required aspect of training, whilst 91% (n=10) thought simulation was a highly effective adjunct, granting trainees the Active Experimentation required to efficiently process knowledge less-experienced stages of training.
Figure 1. The Kolb Experiential learning cycle describes the process of taking in and consolidating new experience into retained knowledge as a cycle of four distinct phases: Concrete Experience (CE), and Reflective Observation (RO), Active Experimentation (AE), Abstract Conceptualization (AC). (Adapted from Kolb DA, Kolb A. The Kolb Learning Style Inventory—Version 3.1 2005 Technical Specifications. Boston, MA: Hay-group; 2005.)
### SELF-ASSESSMENT

On a scale of 1 to 4, please rate your confidence for the following statements.

<table>
<thead>
<tr>
<th>I understand the anatomy of the unilateral cleft lip/nasal deformity</th>
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<tr>
<td>1</td>
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<tr>
<td>Not at all Confident</td>
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<table>
<thead>
<tr>
<th>I can independently formulate a treatment plan for a patient with unilateral cleft lip</th>
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<tr>
<td>Not at all Confident</td>
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<table>
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<tr>
<th>I can independently mark a unilateral cleft lip repair</th>
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<tr>
<td>1</td>
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<td>Not at all Confident</td>
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<th>I can independently perform a unilateral cleft lip repair</th>
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<tr>
<th>I can independently perform primary cleft rhinoplasty</th>
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<tr>
<th>I can troubleshoot intra-operative problems (e.g. short medial lip) during cleft lip repair</th>
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<td>1</td>
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<tr>
<td>Not at all Confident</td>
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**Figure 3.** The self-assessment survey for the pilot curriculum was used to gauge learning with respect to important aspects and principles of the unilateral cleft lip repair. It was filled out three times by residents throughout the session (pre-lecture, post-lecture and post-simulation.)
Figure 2. The unilateral cleft lip pilot curriculum is an example of how training in residency can be developed to better target the full experiential learning cycle, promoting early autonomous trainee operative experience without risking patient safety.
Reconstruction of a Hemirhinectomy Defect Using a 3D Printed Custom Soft Tissue Cutting Guide

Jonathan Brower MD, Joseph Crozier MA, Damon McIntire BA, Michael Boyajian BA, Albert S Woo MD, FACS
The Department of Plastic Surgery, Rhode Island Hospital and The Warren Alpert Medical School of Brown University, Providence, RI

Introduction
The forehead flap serves as a workhorse flap for subtotal nasal defects. A three-stage technique is commonly employed for these full-thickness wounds in which reconstruction of skin, support, and nasal lining is required. An optimal aesthetic result, however, depends on surgeon artistry to craft the detailed three-dimensional topography of the nose from a two-dimensional flap. Results are therefore inconsistent and unpredictable. To address this reconstructive challenge, we sought to use 3D printing technology for the creation of a customized soft tissue cutting guide for reconstruction of a hemirhinectomy defect with a forehead flap.

Methods
The Canfield VECTRA® M5 3D imaging system was used to capture a 3D photo of the patient with the hemirhinectomy defect. Blender® software was used to create a mirror image of the unaffected side. The guide was printed using the Stratasys® J750 with "Tango" Polyjet Material.

The guide was sterilized for use in the first stage of reconstruction. It was placed on the defect intraoperatively to confirm the desired result. The guide was manually flattened and a 2D representation was traced onto the forehead, incorporating it into the flap design. The forehead flap was then elevated and inset with a skin graft for nasal lining. The patient subsequently returned to the operating room for cartilage grafting and pedicle division.

Results
Please see attached photos.

Conclusion
A 3D printed cutting guide for soft tissue can be used to provide customized reconstruction of a hemirhinectomy defect with a forehead flap.

Figure 1: Creation of mirror image from unaffected anatomy obtained from 3D camera. The mirror image was then 3D printed as the cutting guide.

Figure 2: The cutting guide is laid over the hemirhinecotomy defect to confirm size and shape.

Figure 3: Immediate post op results of forehead flap fabricated with assistance of cutting guide for symmetry.
Title: **Advanced Microsurgical Trainer for Breast Reconstruction**

Authors: Morgan Yacoe, BFA, Santosh Kale, MD, Jennifer Rhodes, MD, Peter Pidcoe, D.P.T., Ph.D,
Institution: Virginia Commonwealth University

Abstract:
Current options for microsurgical training models are oversimplified, inaccurate, and not reusable. With the collaborative efforts of an artist and engineer, we created a reusable surgical simulation model with accurate human anatomy and physiology. This model gives trainees the skill-set they need to be better prepared for microsurgery, specifically for the training of DIEP flap breast reconstruction.

The model is composed of specialized materials that simulate human tissue and the three-dimensional constraints of the anastomotic environment. Furthermore, the model has a built-in pump which simulates a live vascular system. We regulate the parameters of the pump using an interactive Android application that exposes the trainees to different technical challenges. Additionally, the fabrication principles of the model can be applied to different parts of the body to simulate various microsurgical locations.

Utilizing the model, a training session was held for plastic surgery residents to practice anastomosis. After the training session, the participants filled out a survey evaluating the model. The survey had multiple questions asking the participants to provide a ranking from 1 to 10 on the effectiveness of the model. The model was given a score of 8 for accurately simulating the three-dimensional constraints of the anastomotic environment and a score of 6.7 for increased understanding of the procedure.

Overall, results showed the class had a better understanding of the procedure after using the training model. We believe that trainees who are better prepared with more technical practice will directly benefit with improved surgical technique in the operating room.