



# The Midwestern Association of Plastic Surgeons

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## The Midwestern Association of Plastic Surgeons

In Conjunction with Unity Point Health Trinity



Presents

### 53<sup>rd</sup> Annual Scientific Meeting

Saturday - May 10<sup>th</sup>, 2014

7:00 A.M.

Northwestern Memorial Hospital  
Feinberg Pavilion – 3<sup>rd</sup> Floor Conference Center  
251 East Huron Street  
Chicago, Illinois

### **Educational Purpose and Intended Audience**

- To provide new information on various topics in Plastic Surgery which will help its members provide better care for their patients
- The target audience includes practicing plastic surgeons and plastic surgeons in training (residents and students)
- The scope of professional practice includes wound healing and remodeling plastic surgery, breast plastic surgery, hand plastic surgery, microsurgery plastic surgery, maxillofacial plastic surgery, reconstructive plastic surgery, craniofacial plastic surgery, plastic surgery technology and cosmetic plastic surgery

### **Educational Strategies**

The MAPS 2014 program will specifically address advanced approaches to soft tissue and breast reconstruction after cancer resections, ADSC transplantation, use of synthetic and natural regenerative matrix scaffolds and others.

The specific take away messages will be:

- The best algorithms for selecting the optimum synthetic tissue scaffold for breast and soft tissue reconstruction
- The most effective strategies for harvesting adipose cells to optimize cell survival and quality of tissue reconstruction
- The benefits of lymphatic reconstruction for treatment of lymphedema
- Comprehensive review of the risk factors and the mitigation strategies for adverse outcomes in office plastic surgery procedures.

Based on the practice gap, the following strategies will be used to change competence and performance:

- Provide a more precise understanding of methods to successfully auto-transplant viable ADSC's for to improve wound healing after cancer or radiation treatment
- Provide a more precise understanding of adipose auto-transplantation methods for soft tissue reconstruction. This would include information about time of surgery, tissue transfer volume limitations, pre- and postoperative management and patient selection
- Provide an expert panel discussion between very experienced and successful plastic surgeons regarding steps to reduce complication rate, improve outcome and enhance patient safety.

## Midwestern Association of Plastic Surgeon Officers

<u>President</u>	Reuben A. Bueno, MD
<u>President Elect</u>	John Hijjawi, MD
<u>Vice President, Program Chair</u>	Raphael Lee, MD
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Trinity Medical Center designates this live activity for a maximum of **8.5 AMA PRA Category 1 Credit(s)**<sup>™</sup>. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

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*The following MAPS CME planning members, panelist and presenters involved with this activity have no significant financial relationships to disclose:*

Reuben A. Bueno, MD  
Wei Chen, MD

Mohammed Alghoul, MD  
Samuel Poore, MD, PhD

John Hijawi, MD has a Royalty Agreement with McGraw Hill Publishing

David Shifrin, MD is a paid consultant with LifeCell

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**SATURDAY May 10, 2014**

**CONFERENCE PROGRAM AGENDA**

**6:15 am** REGISTRATION

**6:55 – 7:05 am** Welcoming Remarks  
Reuben A. Bueno, Jr. MD, *MAPS President*

**SCIENTIFIC ABSTRACT PRESENTATIONS**

**TRACK I**

**WOUND HEALING AND REMODELING**

Moderator: W. Thomas Lawrence, MPH, MD, FACS,

**7:05** **Identification of twist Expression Patterns and Localized Manipulation of fgfr1 Expression in Zebrafish Cranial Sutures**  
Michael Gart; Tomaszewski J.P., Topczewska J.M., Gosain A.K.  
Northwestern University, Division of Plastic Surgery

**7:10** **Burn Injury Promotes Cholinergic Dysregulation in Human Epidermis**  
Casey Holmes; Tina Griffin, Jennifer Plichta, Richard Gamelli,  
Katherine A. Radek  
Loyola University Chicago

**7:15** **Chyrsin Accelerates Wound Closure in Splinted Cutaneous Excisional Wounds in Mice**  
Marielle Brenner; A. Thompson, T. J. Jaraczewski, P. R. Pathak, M. Roy,  
T. W. King  
University of Wisconsin, Division of Plastic Surgery

**7:20** **Reduction Of Post-Surgical Scarring With The Use Of Ablative Fractional CO2 Lasers: A Pilot Study Using A Porcine Model**  
Marissa Baca; Keith Neaman, M.D; Derek Rapp, M.D.; Michael Burton,  
M.D.; John Renucci, M.D.; Robert Mann, M.D  
Grand Rapids Medical Education Partners/MSU

**7:25** **The impact of Fibroblast Growth Factor Receptor- 1 (FGFR1) expression on regulation of premature suture fusion**  
Joanna Tomaszewski; Michael Gart, Ramy Shoela, Jacek Topczewski,  
Arun Gosain, Jolanta Topczewska  
Northwestern University

**7:30 – 7:45** **Discussion**

## **HAND**

Moderator: Sai Ramasastry, MD

- 7:45**                    **An Evidence-Based Approach to Proximal Interphalangeal Joint Arthroplasty**  
Timothy Ade; Michael W. Neumeister MD, FRCSC, FACS – Professor  
Southern Illinois University School of Medicine
- 7:50**                    **A 28-day Prospective, Randomized, Double-Blind, Placebo Controlled Clinical Trial of Botulinum Toxin Type A for Raynaud's Phenomenon**  
Kelli Nicole Belangee Webb; Bueno, Neumeister  
SIU School of Medicine
- 7:55**                    **Application of 3D Printing in Hand Surgery: Innovations in Technology**  
Sam Fuller; D Butz, C Vevang, MV Makhlof  
University of Chicago
- 8:00**                    **Thirty-Year Follow-Up of Total Hand Replantation: A Case Report** Jacqueline Israel; Samuel O. Poore MD, PhD, Venkat K. Rao MD  
University of Wisconsin Division of Plastic Surgery
- 8:05**                    **The Treatment of Metacarpal Fractures: Conservative Management May Be Better**  
Chelsea Snider; Kate McKenna, Mary Burns, Michael Neumeister  
SIU School of Medicine
- 8:10 – 8:25**           **Discussion**

## MICROSURGERY

Moderator: Larry Gottlieb, MD, FACS

- 8:25**                    **Defining the salvage time window for the use of ischemic post-conditioning in skeletal muscle ischemia reperfusion injury**  
Ryan Schmucker; Mei Yang, Shaun Mendenhall, Nathan Wetter, Joel Reichensperger, Brian Derby, Michael Neumeister  
SIU School of Medicine
- 8:30**                    **Perineal and Abdominal Wound Failure After Rectus Abdominis Muscle Flap Reconstruction in Radical Pelvic Surgery – A Metanalysis**  
David A Mateo de Acosta; Marrero M.,<sup>δ</sup> Schmidt J.,<sup>δ</sup> Gurria JP.,<sup>δ</sup> Elwood Eric T. €  
UICOMP Department of Surgery
- 8:35**                    **Clinical Outcomes after a Modified End-to-Side Nerve Transfer Using the Phrenic Nerve as a Donor for Treatment of Brachial Plexus Injury**  
Jacques Machol IV; Ji-Geng Yan, MD, PhD; Robert Fang, MD; Lin-Ling Zhang, MD; James R. Sanger, MD; Hani S. Matloub, MD  
Medical College of Wisconsin
- 8:40**                    **Dynamic Operational Mapping: Tracking Key Decision Points in Microvascular Breast Reconstruction and Their Impact on Surgical Teamwork**  
Emily Stockert; Julie E. Park, MD; David H. Song, MD, MBA; Alexander Langerman, MD  
University of Chicago
- 8:45**                    **Microsurgical and Supermicrosurgical Interventions in Lymphedema Treatment: Current Perspectives**  
Kubat Rahatbek; Wei F. Chen<sup>1</sup>, M.D.  
University of Iowa
- 8:50 – 9:05**           **Discussion**
- 9:05**                    **BREAK**



## RECONSTRUCTIVE

Moderator: David A. Shifrin, MD

- 9:30**                    **Repair of recurrent hernia after biologic mesh failure in abdominal wall reconstruction**  
Chad Purnell; Jason M Souza, Eugene Park, Gregory A Dumanian  
Northwestern Feinberg School of Medicine
- 9:35**                    **The Venous Anastomotic Flow-Coupler for Free Flap Monitoring: A Prospective Analysis of 85 Microsurgical Breast Reconstruction Cases**  
Jenny Chen; Steve Kempton MD, Ahmed Afifi MD, Samuel Poore  
MDUniversity of Wisconsin
- 9:40**                    **Denying the Obvious: Four Extreme Cases of Neglected Tumors**  
Lisa Block; Jee, Young M., BS, MB; Bentz, Michael L., MD;Poore, Samuel O., MD, PhD  
University of Wisconsin
- 9:45**                    **Dynamic Operational Mapping: Tracking Key Decision Points in Microvascular Breast Reconstruction and Their Impact on Surgical Teamwork**  
Jason Souza; Gregory A Dumanian,  
Northwestern University, Division of Plastic Surgery
- 9:50**                    **A Novel Supermicrosurgery Training Model: The Chicken Thigh**  
Anas Eid; Wei Chen, MD; Jerrod Keith, MD; Grace Nimmons, MD;  
Thomas Lawrence, MD  
University of Iowa Hospitals and Clinics
- 9:55 – 10:10**        **Discussion**

## **PLASTIC SURGERY TECHNOLOGY**

Moderator: Greg Dumanian, MD

- 10:10**                    **Indocyanine Green: An Update on Current Usage in Reconstructive Surgery and Novel Applications**  
Ryan Jacobs; Katherine A. Rodby, MD, Anuja K. Antony, MD, MPH  
University of Illinois Chicago
- 10:15**                    **Shared-Decision Making in Pediatric Plastic Surgery**  
James McCarthy  
University of Wisconsin- Madison
- 10:20**                    **Simple Modifications to Improve Reliability and Accuracy of Indocyanine Green Lymphography**  
Karen Lai; Wei F Chen, M.D.2  
University of Iowa
- 10:25**                    **Hybrid Electrical-Optical Functional Stimulation System**  
Sahil Kapur; Thomas Richner, Sarah Brodnick, Justin Williams, Samuel Poore.  
University of Wisconsin, Madison
- 10:30**                    **Development and Early Implementation of an Endoscopic Carpal Tunnel Release Simulator**  
Steve Kempton; Benjamin Mandel, MD; A Neil Salyapongse, MD  
University of Wisconsin
- 10:35 – 10:50**        **Discussion**

## TRACK II

### BREAST

Moderator: William Dzwierzynski, M.D. FACS

- 7:05**            **The BREASTrial: Breast Reconstruction Evaluation of Acellular Dermal Matrix as a Sling Trial, A Prospective Randomized Trial Comparing AlloDerm to DermaMatrix**  
Shaun Mendenhall; Layla Anderson, Jian Ying, Kenneth Boucher, Leigh Neumayer, Jayant Agarwal  
SIU School of Medicine
- 7:10**            **Breast implant reconstruction with acellular dermal matrix after mastectomy: outcomes with adjuvant rediation treatment in one-stage and two-stage reconstruction**  
Anupama Mehta; Mendez, Fabian, Brandy, Reder, Vandevender, Angelats, Cimino  
Loyola University Chicago
- 7:15**            **A Proposed Scale for Severity of Mastectomy Skin Necrosis Correlates with Need for Intervention**  
Ziyad S. Hammoudeh, Degnim, Amy; Hoskin, Tanya; Farley, David; Grant, Clive; Boughey, Judy; Jacobson, Steven; Torstenson, Tiffany Reusche, Ryan; Lemaine, Valerie  
Mayo Clinic
- 7:20**            **Adipose-Derived Stem Cell Transplantation Decreases Capsule Formation during Tissue Expansion with Radiotherapy**  
Abigail Maciolek Cochran, Mei Yang, MD, PhD; Joel Reichensperger, Nicole Cosenza, Lisa Cox, Carrie Harrison, Michael W. Neumeister, MD  
SIU School of Medicine
- 7:25**            **Results from a Quality Improvement Initiative to Reduce Breast Skin Necrosis After Mastectomy with Breast Reconstruction**  
Sebastian Winocour; Degnim A, Hoskin T, Farley D, Grant C, Boughey J, Jacobson S, Jakub J, Torstenson T, Reusche R, Lemaine V  
Mayo Clinic
- 7:30 – 7:45**    **Discussion**

## BREAST II

Moderator: Julie Park, MD

- 7:45**                    **Volumetric analysis of the chest wall deformity in Breast Reconstruction: The Sagitta Defect**  
Karina Quinn; Ramasamy Kalimuthu  
University of Illinois at Chicago
- 7:50**                    **Large volume direct-to-implant immediate breast reconstruction: outcomes and complications**  
Neil Dalal  
Loyola University Chicago
- 7:55**                    **The Role of the Plastic Surgeon in Sentinel Lymph Node Biopsy of Internal Mammary Nodes: A Case Report and Review of the Literature**  
Justin Hellman; Allison M Shore, MD, Julie E. Park, MD  
University of Chicago
- 8:00**                    **Trends in Breast Reconstruction by Ethnicity: An Institutional Review Centered on the Treatment of an Urban Population**  
Katherine Rodby; Emilie Robinson, BS; Kristie Danielson, PhD; Anuja K. Antony, MD, MPH  
University of Illinois at Chicago
- 8:05**                    **Age-Dependent Characteristics in Women with Breast Cancer: Mastectomy and Reconstructive Trends by Decade**  
Emilie C Robinson; Katherine Rodby, MD; Kristie Danielson, PhD; Karina P. Quinn, MD; Anuja K. Antony, MD, MPH  
University of Illinois at Chicago
- 8:10 – 8:25**           **Discussion**

## MAXILLOFACIAL

Moderator: Pravin Patel, MD

- 8:25**                    **Quantitative CT-Based Assessment of Nasal Change Following Le Fort I Osteotomy: Volumetric Analysis and Curvature Interpolation**  
Belinda Daniel; David Morris, MD; Linping Zhao, PhD  
University of Illinois College of Medicine
- 8:30**                    **Three-dimensional soft tissue change of the malar region with high LeFort-1 advancement: Implications for aesthetic malar contouring**  
Brian Rosett; D. Morris, L. Zhao, P. Patel  
University of Illinois at Chicago
- 8:35**                    **Joint flap: A novel local flap for reconstructing defects that cross the alar crease.**  
Matthew Ranzer, R Kalimuthu  
University of Illinois at Chicago
- 8:40**                    **Non-Surgical Cleft Rhinoplasty**  
Christina Tragos  
Rush University Medical Center
- 8:45**                    **Orthognathic Positioning System (OPS): Optimizing Results in Severe Facial Asymmetries**  
Amit Patel  
Rush University Medical Center
- 8:50 – 9:05**           **Discussion**
- 9:05**                    **BREAK**

## **CRANIOFACIAL**

Moderator: Ahmed M. Afifi, MD

- 9:30**                    **Use of Integra Biologic in Complicated Craniotomy Wounds with Exposed Dura – a Review of a Series**  
Jacob A Thayer  
Medical College of Wisconsin
- 9:35**                    **Introducing Zebrafish as a Model to Study Cranial Suture Biology**  
Ramy Shoela; Joanna P. Tomaszewski, Jolanta M. Topczewska, Arun K. Gosain.  
Northwestern University, Feinberg School of Medicine
- 9:40**                    **Development of a Radiographic Classification Scheme for Nasolacrimal System Fractures**  
Ravi Garg; Michael J. Hartman, Mark J. Lucarelli, Glen Levenson, Ahmed M. Afifi, Lindell R. Gentry  
University of Wisconsin
- 9:45**                    **The State of Global Health Training in Plastic Surgery Residency: Pragmatic Considerations and Future Directions**  
Harry Nayar; Delora L. Mount, MD; Michael L. Bentz, MD  
University of Wisconsin
- 9:50**                    **Bioresorbable Fixation Devices for Craniosynostosis: A Single Surgeon Experience**  
Stephanie Cohen; David Morris, MD; Pravin K. Patel, MD  
University of Illinois at Chicago
- 9:55 – 10:10**        **Discussion**

## COSMETIC

Moderator: Mimis Cohen, MD, FACS

- 10:10**                    **No-Drain Lipoabdominoplasty: An Analysis of 100 Consecutive Patients**  
Michael Epstein; Karol A. Gutowski, M.D., F.A.C.S.; Sarah A. Epstein, M.D.,  
MAE Plastic Surgery
- 10:15**                    **Aesthetic Mesh Repair of Severe Rectus Diastasis**  
Jennifer E Cheesborough; Cayce Spencer Workman, BS, Gregory A. Dumanian, MD  
Northwestern, Feinberg School of Medicine
- 10:20**                    **Enhanced Recovery Protocol After Microsurgical Breast Reconstruction: A Cohort Study**  
Jorys Martinez-Jorge; Niles J. Batdorf, M.D., Jenna K. Lovely, Pharm. D., Karla Ballman, P.H.D, Samuel G. Sarmiento Fernandez, M.D., Ronnie Mubang, M.D., Pamela L. Grubbs, R.N., C.N.S., Lisa D. Bungum, R.N., Andria L. Booth-Kowalczyk, C.N.P., Alex Senchenkov, M.D., Brian T. Carlsen, M.D., Michel Saint-Cyr, M.D, Valerie Lemaine, M.D.  
Mayo Clinic
- 10:25**                    **Evaluating Autologous Lipofilling of Parry-Romberg Syndrome Associated Defects: Prospective 3-Dimensional Image Evaluation and Systematic Review of the Literature**  
Yvonne Kaptein; Katherine A. Rodby, MD; Anuja K. Antony, MD, MPH  
University of Illinois at Chicago
- 10:30**                    **Reducing Unplanned Reoperations for Mastectomy Skin Flap Necrosis- A Multidisciplinary Approach**  
Charalam bos k Rammos; Hoskin, Boughey, Farley, Grant, Jacobson, Jacub, Tortenson, Reusche, Degnum, Lemaine  
Mayo Clinic
- 10:35 – 10:50**        **Discussion**

## **PLENARY PROGRAM**

- 11:00 - 12:00**      **KEYNOTE LECTURE: “Breast Reduction and Mastopexy Using the Vertical Sculpted Pillar Approach”**  
James C. Grotting, MD, FACS  
Moderator: Reuben A. Bueno, MD
- 12:00 - 1:00 pm**      **Lunch & Talk: “How to Successfully Develop Your Career in Plastic Surgery”**  
Michael Neumeister, MD  
Conference Room A
- 1:00 - 1:50**      **PANEL: ADVANCES IN LYMPHATIC RECONSTRUCTION**  
David Chang, MD, Section of Plastic Surgery, The University of Chicago  
Wei F. Chen, MD Division of Plastic Surgery, University of Iowa  
Moderator: Victor Lewis, MD
- 2:00 - 3:00**      **KEYNOTE LECTURE: “Cosmetic and Reconstructive High-Volume Fat Grafting”**  
Daniel A. Del Vecchio, MD, MBA  
Moderator: W. Thomas Lawrence, MPH, MD, FACS
- 3:10 - 4:00**      **PANEL: FAT AUTOGRAFTING - TECHNICAL VARIATIONS AND FUTURE TECHNOLOGY**  
Anuja K Antony, MD, MPH, Division of Plastic Surgery, University of Illinois, Chicago  
Daniel A. Del Vecchio, MD - Back Bay Plastic Surgery, Boston, Massachusetts  
Eric Brey, PhD, Biomedical Engineering, Illinois Institute of Technology, Chicago  
Moderator: John Hijjawi, MD
- 4:00 - 4:15**      **Break**
- 4:15 - 5:15**      **PANEL: OUTPATIENT SURGERY SAFETY CONSIDERATIONS PANEL**  
James C. Grotting, MD - University of Alabama, Birmingham  
Samuel O. Poore MD, PhD - Division of Plastic Surgery, University of Wisconsin  
Moderator: Victor Cimino, MD
- 5:15 - 5:30**      **PRESIDENT’S COMMENTS & CLOSING REMARKS:**  
Reuben A. Bueno, Jr. MD, *MAPS President*  
Michael Neumeister, MD, *American Society of Plastic Surgeons*
- 5:30 - 7:30**      **Cocktails & Awards**  
Raphael Lee, MD, *MAPS Program Chair & Vice President*



**NOTES**

Lined area for writing notes, consisting of multiple horizontal lines.

**2014 MIDWESTERN ASSOCIATION OF PLASTIC  
SURGEONS SCIENTIFIC ABSTRACTS**

**Track I**

# **Wound Healing and Remodeling**

## Identification of *twist* Expression Patterns and Localized Manipulation of *fgfr1* Expression in Zebrafish Cranial Sutures

Gart M.S., Tomaszewski J.P., Topczewska J.M., Gosain A.K.

Northwestern University Feinberg School of Medicine

Presenter: Gart M.S., M.D. – Resident Submission

**PURPOSE:** The TWIST and FGFR gene families have been implicated in the pathogenesis of human craniosynostosis. However, their essential role in mesenchymal cell proliferation and differentiation throughout development makes it difficult to study these mutations in isolation. The present study was undertaken to: (1) determine if genes implicated in the development of human craniosynostosis are expressed in the zebrafish cranial vault; and (2) determine if we can locally manipulate expression of these genes, thereby avoiding broader developmental consequences.

**METHODS:** (1) Digoxigenin (DIG)-labeled RNA antisense probes were designed for *twist1a*, *twist1b*, *twist2*, and *twist3*. Wild-type fish calvaria were microdissected after fixation with paraformaldehyde. After hybridization, calvaria were imaged using light microscopy.

(2) The transgenic zebrafish line *Tg(dnFGFR1:EGFP)* was used to develop a protocol for localized heat shock using a modified soldering iron. Tricaine-anesthetized fish were immobilized, and constant energy was applied to the cranial sutures for three-minute intervals. Transgene expression was detected by GFP reporter expression using confocal microscopy.

**RESULTS:** (1) RNA in-situ hybridization revealed that *twist1a* was not expressed in the sutures of the developing zebrafish; however, *twist1b*, *twist2*, and *twist3* all localized to different suture regions in the developing calvaria.

(2) The localized heat shock approach successfully induced expression of the dominant-negative Fgfr1 mutant protein in the coronal sutures of *Tg(dnFGFR1:EGFP)* juvenile fish.

**CONCLUSIONS:** (1) TWIST genes are highly conserved across species, and encode regulatory proteins essential to embryonic development, specifically in the cranial vault. Here, we characterize the differential expression patterns of the zebrafish TWIST gene homologs—*twist1a*, *twist1b*, *twist2*, and *twist3*—in the developing cranial sutures.

(2) Through the application of localized heat shock, we have locally induced expression of an engineered transgene to tissues of interest, thereby establishing this method for future manipulations. This technology allows the study of gene function in specific tissues without impairing global development.

## **Burn Injury Promotes Cholinergic Dysregulation in Human Epidermis**

Casey Holmes, Tina Griffin, Jennifer Plichta, Richard Gamelli, Katherine A. Radek

Loyola University Medical Center

Presenter: Casey Holmes, MD – Resident Submission

**Introduction:** In severely burned patients, grafts from unburned skin exhibit functional deficiencies. These defects' mechanisms are unknown. Keratinocytes comprise a non-neuronal cholinergic system that regulates inflammation and stimulates wound repair through the  $\alpha 7$  nicotinic acetylcholine receptor (nAChR). The secreted mammalian Ly-6/ urokinase-type plasminogen activator receptor-related proteins (SLURPs) are endogenous ligands that selectively facilitate ACh-dependent keratinocyte functions via nAChRs to modulate wound healing and cytokine production. No studies have evaluated cholinergic dysregulation in the burn margin or donor sites as a mechanism for graft failure.

**Methods:** Split-thickness skin samples were obtained from human burn wounds, burn margins, and distal unburned sites during grafting. Control skin was collected from tissue discarded following elective surgical procedures. Gene expression and protein abundance were evaluated by qPCR and Western Blot.

**Results:** Greater  $\alpha 7$  nAChR and cytokine gene expression was observed for burn margin vs. control skin, but no changes were observed at the protein level. Greater SLURP1, SLURP2 expression was observed in donor skin, whereas High Mobility Group Box Protein 1 (HMGB1), IL-6 and IL-8 cytokine gene expression was elevated only in burn margin. HMGB1 and SLURP1 protein levels were also significantly elevated in donor skin and burn margin vs. control. We observed an inverse relationship between  $\alpha 7$  nAChR and HMGB1 protein levels in burn margin and donor skin.

**Conclusions:** Increase in SLURP ligands suggest that activation of  $\alpha 7$  and other nAChRs is enhanced in donor skin, which may influence apoptosis and re-epithelialization of potential grafts. Defects in the keratinocyte non-neuronal cholinergic system also play a role in pro-inflammatory cytokine production at both the burn site and donor skin. HMGB1 is passively secreted from necrotic cells or actively secreted from infiltrating immune cells. The increase in HMGB1 in donor skin, which should be devoid of immune cells, suggests that that burn injury promotes tissue necrosis in presumably normal skin.

## Chrysin Accelerates Wound Closure in Splinted Cutaneous Excisional Wounds in Mice

Marielle A. Brenner; A. Thompson; T.J. Jaraczewski; P.R. Pathak; M. Roy; T.W. King

University of Wisconsin

Presenter: Marielle A. Brenner – Student Submission

**Introduction:** Management of impaired wound healing cost the US \$20B/yr. We are interested in increasing the efficiency of wound healing by investigating the mechanisms of this process. Previously, we have shown that chrysin enhances keratinocyte differentiation and wound healing *in vitro*. Here, we tested the effects of chrysin on re-epithelialization in a murine stented wound model. We hypothesized that the application of chrysin would improve wound healing.

**Methods:** 6 week old male mice (n=19) were anesthetized & 2 full-thickness wounds were placed through the skin of their backs. A 12 mm dia. silicone stent was secured around each wound with cyanoacrylate glue & interrupted 6-0 nylon sutures and covered with transparent sterile dressing. On day 7, mice were treated with chrysin (10  $\mu$ M) or vehicle (0.01% DMSO). Dressings were changed, treated, and photographed other day every. Wound images were analyzed using ImageJ software & expressed as a ratio of wound area to stent area. Results were analyzed using students paired ttest ( $p < 0.05$ ). After sacrifice, wounds were harvested for histological analysis.

**Results:** Wound closure was significantly accelerated with chrysin treatment compared to control within 48 hours (n=6,  $p < 0.05$ ). The wound sizes were similar in both groups (% open,  $68 \pm 5$  vs  $68 \pm 8$ ) before treatment began. Chrysin (10  $\mu$ M) increased wound closure compared to control on day 9 (% open,  $17 \pm 3$  vs  $43 \pm 12$ ,  $p = 0.02$ ) and day 11 (% open,  $5 \pm 1$  vs  $23 \pm 8$ ,  $p = 0.04$ ). Re-epithelialization was confirmed by histology. A higher number of fibroblasts and myofibroblasts were present in the wound bed in the chrysin group compared to the ipsilateral control.

No local side effects were noted in the mice.

**Conclusions:** Chrysin accelerates cutaneous wound closure in the *in vivo*. Based upon our findings, further study of chrysin in wound healing is warranted, to lead to better therapeutics for the wound healing in patients.

## **Reduction Of Post-Surgical Scarring With The Use Of Ablative Fractional CO2 Lasers: A Pilot Study Using A Porcine Model**

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Robert Mann, M.D.

Grand Rapids Medical Education Partners/MSU Plastic Surgery Residency

Presenter: Marissa Baca, M.D, - Resident

**Introduction:** Wound healing inevitably leads to scarring, which leads to functional and cosmetic defects. Ablative fractional CO2 lasers create microscopic columns of thermal injury surrounded by viable tissue, enhancing re-epithelialization. It is the goal of this study to investigate the use of ablative fractional CO2 lasers to reduce post-operative scarring secondary to surgical wounds.

**Methods:** In this prospective controlled study, 3 pigs each received 20 surgical incisions. Fifteen incisions were treated with an ablative fractional CO2 laser in one of three laser settings. Five incisions served as a control. Two punch biopsies were taken from an incisional scar in each treatment group and the control group over six months post-operatively. The biopsies were analyzed with light microscopy by a blinded evaluator and given a score ranging from 0-32. Lower scores correspond to better healing.

**Results:** A total of 120 biopsies were evaluated. There was no statistically significant difference between average histological scores for pig A (11.47), B (11.50), and C (10.98),  $p=0.758$ . There was also no significant difference between the average histological scores of each individual laser setting from all pigs over all time periods,  $p=0.603$ . However, at six months the average histological score of all biopsies treated with the laser (12.17) was statistically better than that of the control group (13.33),  $p=0.023$ .

**Conclusion:** In the limited setting of this pilot study, treatment of surgical incisions with ablative fractional CO2 lasers does not significantly improve wound healing. This is true for all levels of laser settings individually. However, the average histological score for each laser setting consistently trended better than that of the control group. When looking at all incisions treated by the laser as a group, the histological score demonstrates improved healing. Future studies will need a larger sample size to better answer whether a significant difference may exist among individual laser settings.



## The impact of Fibroblast Growth Factor Receptor- 1 (FGFR1) expression on regulation of premature suture fusion

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Presenter: Joanna P. Tomaszewski - Student paper

**INTRODUCTION:** Human genomic studies and research on animal models suggest that various loci and genetic mechanisms, notably mutations in fibroblast growth factor receptor 1 (FGFR1), are involved in craniosynostosis (CS), or premature suture obliteration. In order to better understand the etiology of CS, we aim to mimic the mutation observed in Pfeiffer syndrome by generating a stable transgenic zebrafish line that allows for inducible expression of the mutated *fgfr1b*<sup>(Pro252Arg)</sup> gene.

**METHODS:** *fgfr1b* was cloned and mutagenized with a single Pro252Arg base pair substitution. Gateway Recombineering and the Tol2 system were used to create the transgenic construct, which includes an *hsp70* promoter for inducible expression of the mutated gene and an IRES-driven GFP reporter for monitoring ectopic expression. To analyze the impact of the mutation on embryonic development, single cell stage embryos were injected with mutated *fgfr1b* mRNA. Expression of FGF signaling target genes was assessed using whole mount in situ hybridization. Once a final form of the *hsp70:CA-fgfr1:IRES:GFP* transgenic cassette is confirmed, it will be injected into embryos to create a stable line.

**RESULTS:** Preliminary results of RNA in situ hybridization revealed that the expression domain of *krox20* within the presumptive 3<sup>rd</sup> and 5<sup>th</sup> rhombomeres is expanded in injected embryos, supporting the hypothesis that Pro252Arg has an activating character in zebrafish. Furthermore, embryos injected with *fgfr1b*<sup>(Pro252Arg)</sup> mRNA phenotypically reveal decreased head size, consistent with *fgfr1* upregulation.

**CONCLUSION:** The activating character of the *fgfr1b*<sup>(Pro252Arg)</sup> mutation in zebrafish indicates a conserved role of *fgfr1* in cranial suture development among vertebrates. The effects of genetic manipulation will be assessed in our transgenic embryos by observing cell proliferation and adult suture phenotype will be analyzed using histology and skeletal morphology studies. This zebrafish model of CS will advance our understanding of the role of *Fgfr1* in cranial suture morphogenesis and the etiology of the disorder.

**Hand**

## **An Evidence-Based Approach to Proximal Interphalangeal Joint Arthroplasty**

Timothy A. Ade MD; Michael W. Neumeister MD, FRCSC, FACS

Southern Illinois University School of Medicine – Division of Plastic Surgery

Presenter: Timothy A. Ade MD – Resident Submission

**Background:** Proximal Interphalangeal (PIP) joint arthroplasty is used to treat patients with rheumatoid arthritis, primary osteoarthritis, and posttraumatic arthritis. There appears to be consensus that arthroplasty of the proximal interphalangeal (PIP) joint leads to successful outcomes. Arthroplasty can be performed with a variety of implants, including use of a silicone spacer and pyrocarbon arthroplasty. A complete review was performed to summarize the published evidence on silicone and pyrocarbon PIP joint arthroplasty to identify an evidence-based approach to this treatment method.

**Methods:** A review of the PubMed and Cochrane Library databases were performed to find all reports of silicone and pyrocarbon PIP joint arthroplasty. Outcomes were evaluated based on range of motion, pain relief, grip strength, quality of life measures, cost, and complications. A level of evidence was given to each study in accordance with the American Society of Plastic Surgeons' Rating Levels of Evidence.

**Results:** Of the initial 223 reports, 26 studies were identified (5 comparative studies, 8 pyrocarbon case series, and 13 silicone case series) and represented a total of 1403 joints. After evidence review, 1 study represented level II evidence, 4 studies were level III evidence, and the remaining 21 studies represented level IV evidence. Both types of joint replacements provided similar post-operative measure of grip strength, range of motion, pain relief, and quality of life measures. Generally, pyrocarbon arthroplasty had a higher frequency complications, surgical revisions, and salvage procedures over silicone arthroplasty.

**Conclusions:** From the limited collection of higher level evidence, PIP joint arthroplasty provides adequate relief of arthritis symptoms. The evidence does not indicate a superior joint replacement method between silicone and pyrocarbon joint replacement. However, there is concern for pyrocarbon arthroplasty because of higher rates of complication and surgical revision over silicone arthroplasty. Future high level evidence studies are needed to guide treatment modalities and should focus on standardized outcome measures

## A 28-Day Prospective, Randomized, Double-Blind, Placebo Controlled Clinical Trial of Botulinum Toxin Type A for Raynaud's Phenomenon

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Southern Illinois University

Presenter: Webb KN, MD - Resident Submission

**Background:** Raynaud's phenomenon affects an estimated 28 million Americans and is a common cause of ischemic digits, severe pain, and nonhealing ulcers. Current treatment options can be ineffective, invasive, addictive, or have systemic side effects. Botulinum toxin type A (Btx-A) may be a novel therapeutic treatment option.

**Methods:** A prospective, randomized, placebo-controlled clinical trial was designed to describe the efficacy of injected Btx-A in alleviating pain due to Raynaud's disease. Our secondary goal was to describe this minimally invasive therapy's effects and impact on quality-of-life by measuring subjective pain scores, pain-free intervals, ulcer healing, changes in hand function, finger survival, and subsequent treatment choices. Study participants were randomized to receive injection with either placebo (normal saline) or 100 units of Btx-A into the palm around involved digital neurovascular bundles. Data collection included subjective evaluation of pain relief, serial photography of wound healing, and objective data on tissue perfusion using a Doppler perfusion imager and Periscan image analysis software.

**Results:** Currently, a total of 35 patients are actively participating in the study, which represents 88% of our total enrollment target (n=40). Twenty primary Raynaud's patients and fifteen secondary Raynaud's patients are enrolled. Seventeen of these subjects received placebo at the first study visit, and eighteen received the study agent, BOTOX®. At presentation, twenty-three patients reported pain as their primary complaint. At one month, one out of ten (10%) placebo patients compared with eight out of thirteen (62%) Btx-A patients reported pain relief (p=.0288). At the follow-up visit on day 28, the patients were unblinded and placebo patients were offered injection with Btx-A. We completed a follow-up retrospective survey, with average follow-up of 239 days. 22 of 35 patients (63%) report symptom relief after injection with Btx-A. Average duration of symptom relief is 127 days. 6 of 10 patients (60%) with fingertip ulceration healed after Btx-A injection.

**Conclusions:** Btx-A injection may be an effective, localized, nonsurgical treatment option without addictive properties or systemic side effects for treatment of ischemic digits. Preliminary results show a statistically significant number of Raynaud's patients injected with Btx-A report pain relief compared with placebo at 1 month follow-up and 60% of patients with fingertip ulcerations healed their wounds. The second part of this study is to follow these patients for 5 years to determine the long-term efficacy of Btx-A injection for Raynaud's Phenomenon.

## **Application of 3D Printing in Hand Surgery: Innovations in Technology**

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Presenter: Sam Fuller, MD – Resident Submission

**Introduction:** 3D printing is being rapidly incorporated in the medical field to produce external prosthetics for improved cosmesis and fabricated molds to aid in pre-surgical planning. While at first expensive and conceptually difficult to construct, 3D printing is now becoming more affordable and widely accessible. In fact, once the design data is available, many 3D printing companies are able to deliver products within 48 hours. In hand surgery, many surgeons desire customized surgical instruments for specific procedures or challenging cases. We are presenting our step by step experience in creating a bone reduction clamp.

**Methods and Materials:** Using free, downloadable software programs, the Author (C.V.) created a 3D model of a bone reduction clamp for hand fractures based on the senior author's (M.V.M.) previous experience and preference of fracture fixation. The computer files were sent to a local company for production of the prototype.

**Results:** The printing company successfully produced the surgical clamp prototype directly from the 3D model represented in the computer files. The prototype afforded a fast, low cost working model of the proposed clamp providing insight into a myriad of improvements. The improvements were incorporated into the 3D model by (C.V) under the direction of (M.V.M.) and resubmitted to the printing company. Within a couple of weeks a viable prototype was ready for transformation into a useable operative product. The cost of printing each prototype was \$75.00.

**Conclusions:** 3D printing is affordable and offers the benefits of reducing production time and nurturing innovation in hand surgery. We present a step by step description of our design process using online software programs and printing services. As medical technology advances, it is important that hand surgeons remain aware of available resources and be equipped with the knowledge of how the processes work.

## Thirty-Year Follow-Up of Total Hand Replantation: A Case Report

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Presenter: Jacqueline S. Israel MD – Resident Submission

**Introduction:** Traumatic hand injuries occasionally result in amputation, and the decision to replant the affected extremity must be one that is carefully considered. We present a case of a total hand replantation performed 30 years ago, as well as a review of the significance of long-term follow-up in patients undergoing reconstruction of an amputated upper extremity.

**Method:** Our patient, a 21-year-old male, sustained a work-related circular saw amputation of the left, non-dominant hand in the early 1980s [Fig1]. He underwent emergent replantation at the level of the carpus, and experienced a satisfactory postoperative course. He participated in regular outpatient therapy, and at 12 months following the initial operation, he subjectively denied pain, and demonstrated wrist active range of motion (aROM) of the injured hand that was approximately 50% that of the non-injured hand. Grip strength in the affected hand was 19% that of the opposite hand.

**Results:** The patient returned to our clinic almost 30 years after his initial operation [Fig2]. Subjectively, the patient expressed satisfaction with his replanted hand, with no impairments in activities of daily living. Combined total Michigan Hand Outcomes Questionnaire (MHQ) score in the injured hand was 85/100, compared to 99 in the contralateral side.<sup>1</sup> Total aROM of the left, injured wrist was approximately 65% that of the right, and both grip strength and lateral pinch in the left hand were 58% that of the right. Two-point sensation of each fingertip on the affected hand was an average of 10mm, compared to 5mm on the opposite side. Overall hand function was found to be significantly improved compared to 12-month follow-up.

**Conclusion:** This case exemplifies how upper extremity replantation is successful in the purposefully selected patient. The outcomes observed in this patient illustrate the importance of long-term follow-up in all postoperative patients, including those undergoing replantation and hand transplant both now and in the future.

## The Treatment of Metacarpal Fractures: Conservative Management May Be Better

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Southern Illinois University

Presenter: Chelsea C. Snider, MD – Resident Submission

**Introduction:** Metacarpal fractures account for twenty percent of all upper extremity fractures. Treatment of these common fractures varies widely and is often based on surgeon experience and preference. The purpose of this study is to develop evidence-based recommendations for best practices in the treatment of metacarpal fractures.

**Methods:** We conducted an IRB approved retrospective review and [prospective](#) clinical follow-up study of patients treated for metacarpal fractures at Southern Illinois University School of Medicine over the last [five](#) years. Physical exam, hand therapy measurements, and a [validated](#) patient questionnaire were [utilized](#) for critical analysis of non-operative and operative intervention for metacarpal fractures to assess complication rates, re-intervention rates, patient-centered outcomes (pain, stiffness, days off work, and cost), and functional outcomes (measured range of motion and grip strength).

**Results:** There were 902 patients identified as having received treatment for metacarpal fractures between years 2007 and 2012. Sixty-four patients returned for the clinical follow-up study. Of these, 52 patients received non-operative management and 12 underwent operative intervention, [with a total of 60](#) fractures treated non-operatively and 17 treated operatively. Overall complication rate was 10.39%. [The complication rate](#) in the non-operative group was significantly lower: [3.33%](#) compared to 35.29% in the operative group ( $p=0.0011$ ). Decreased range of motion was seen in 5.0% of patients in the non-operative group and 35.3% of patients in the operative group ( $p=0.0018$ ). Subjective pain and stiffness were reported similarly in both groups; however, average days off work were 36.14 in the non-operative group and 213 in the operative group ( $p=0.0088$ ). Higher out-of-pocket cost for the patient was appreciated in the operative group relative to [the non-operative group](#), \$3179.00 and \$1037.50, respectively. Patients treated conservatively regained nearly full grip strength and metacarpophalangeal (MCP) joint flexion. There were no significant differences in flexion or extension of the injured digits compared to the uninjured digits. MCP joint flexion of all injured digits treated conservatively ranged from 82.91 to 86.46 degrees.

**Conclusion:** This retrospective review and [prospective](#) follow-up clinical study demonstrate that conservative treatment of metacarpal fractures may result in satisfactory outcomes that are comparable to operative management. Improved patient satisfaction, earlier return to work, and decreased out-of-pocket cost were also appreciated among those patients who received conservative management. [Our current practice is](#) to offer non-operative management, including splinting and early range of motion [therapy](#), as first-line treatment for patients with uncomplicated metacarpal fractures. Surgical intervention is reserved for second-line intervention or for the more complicated patient. [The results of this study support this practice.](#)

# Microsurgery



## **Defining the Salvage Time Window for the use of Ischemic Postconditioning in Skeletal Muscle Ischemia Reperfusion Injury**

Ryan Schmucker, MD; Mei Yang, MD, PhD; Shaun Mendenhall, MD; Nathan Wetter, BS; Joel Reichensperger, MD; Brian Derby, MD; Michael Neumeister, MD

Southern Illinois University

Presenter: Ryan Schmucker, MD – Resident Submission

**Introduction:** Ischemic postconditioning (Post-con) has been shown to ameliorate ischemia/reperfusion (I/R) injury in skeletal muscle and skin flaps. However, recent studies suggest that the benefits (and potential risks) of post-con may be dependent on the duration of ischemia. The purpose of this study was to define the optimal ischemic salvage time window for which post-con reduces I/R injury in a skeletal muscle flap.

**Methods:** Utilizing a gracilis pedicled muscle flap model, 48 SD rats were divided into 2 groups: I/R only (control) and I/R with IPOC. These groups were then further divided by duration of ischemia (2,4,6,& 8 hours). The post-con protocol used for the IPOC group consisted of 6 cycles of 15 seconds of reperfusion followed by 15 seconds of re-clamping (total time = 3 minutes). Muscles were harvested 24 hrs after I/R injury to examine tissue viability (NBT staining), histology, and MPO activity. Protective gene expression related to mitochondrial metabolism (complex I, II, III), endothelial cell function (eNOS, iNOS), and apoptosis (Bcl-2, TNF-alpha, Caspase 3) were also measured.

**Results:** NBT assay showed similar muscle flap viability between control and post-con groups after 2 hours of ischemia ( $p>0.05$ ). Improved flap viability was detected in post-con groups after 4 and 6 hours of ischemia time compared to controls ( $p<0.05$ ). After 8 hours of ischemia, tissue from both groups showed low viability. Histological examination corroborated with NBT results. Higher expression of complex I, II, III, eNOS, iNOS, and Bcl-2 were observed in the post-con group after 4 and 6 hours of ischemia, with the highest values occurring in the 4 hour group ( $p<0.05$ ). Lower expression of TNF-alpha and Caspase 3 was observed in the post-con group within the 6 hour group. MPO activity was similar in both groups at all time points except 8 hours ischemia in which the control group had higher activity ( $p<0.05$ ).

**Conclusion:** Protection by post-con occurred after 4 & 6 hours ischemia, with the most protection conferred after 4 hours. Post-con offered minimal protection from I/R injury following 2 hours of ischemia and had a slightly detrimental effect after 8 hours of ischemia. Post-con used within this salvage time window was accompanied by improved mitochondrial and vascular function and decreased cell death. The loss of protective effect by post-con with prolonged ischemia may be from an exhaustion of endogenous mitochondrial enzymes and NOS. Post-con may prove clinically useful as a post-injury salvage technique to attenuate I/R injury.

## PERINEAL AND ABDOMINAL WOUND FAILURE AFTER RECTUS ABDOMINIS MUSCLE FLAP RECONSTRUCTION IN RADICAL PELVIC SURGERY - A METANALYSIS

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Presenter: David A. Mateo de Acosta Andino MD – Resident Submission

**Introduction:** Perineal healing complications after primary closure (PC) in radical pelvic surgery have been reported to approach up to 77%. Rectus abdominis myocutaneous flap (RAM) closure of these wounds decreases complication rates. There is one prospective study comparing perineal and abdominal wound failure in PC vs RAM in this setting. This study evaluates the evidence on RAM closure of these difficult to manage perineal wounds.

**Methods:** A Pubmed search including the keywords abdominal perineal resection, pelvic exenteration, primary closure and rectus abdominis myocutaneous flap resulted 27 studies (857 patients). Case series and reports were excluded, 4 studies (263 patients) were included. The primary outcomes studied were perineal complications, abdominal wall failure, abdominal wall dehiscence and abdominal hernia. Statistical analysis was performed using RevMan ® 5.1.

**Results:** Perineal complications developed in 77.3% of patients in PC vs 29.5% in RAM (I2 41%, P 0.17 CI 0.55 (0.32, 0.95). Abdominal wall failure resulted in 25.4% in PC vs 74.3% in RAM (2 0%, P 0.02, CI 0.81 (0.34-1.92) without statistical difference. In PC, 8.2% of patients had abdominal wall dehiscence and 21.6 % abdominal hernia vs 30.76% and 43.2% in RAM, not reaching statistical significance.

**Discussion:** Our analysis showed that primary closure after radical pelvic surgery results in a 77.3% rate of perineal wound complications compared to a lower rate of 29.5% with RAM reconstruction. RAM had a trend of higher abdominal morbidity (30.7% dehiscence and 43.2% hernia). In additional case series and reports, abdominal wall morbidity is higher for PC (34% in PC vs 12.6% RAM), although this data is not statistically significant.

**Conclusions:** RAM flap closure of perineal defects after pelvic surgery decreases perineal morbidity in radical pelvic surgery with a trend of increased abdominal wall complications.

## **Clinical Outcomes after a Modified End-to-Side Nerve Transfer Using the Phrenic Nerve as a Donor for Treatment of Brachial Plexus Injury**

Jacques Machol IV, MD; Ji-Geng Yan, MD, PhD; Robert Fang, MD; Lin-Ling Zhang, MD; James R. Sanger, MD; Hani S. Matloub, MD

Medical College of Wisconsin

Presenter: Jacques Machol IV, MD - Resident Submission

**Introduction:** End-to-side neurorrhaphy has not been widely utilized due to its potentially low sprouting capability. The phrenic nerve has a continuous firing rhythm that likely enhances side sprouting. Suitable clinical outcomes were obtained after end-to-side neurorrhaphy with the phrenic nerve as a donor for treatment of brachial plexus injury.

**Methods:** A total of 86 patients (27 adults, 59 children) from 1999 to 2010 with brachial plexus injury underwent modified end-to-side phrenic neurorrhaphy by the senior author (H.S.M). For this, the phrenic side was widely opened; one or two nerve grafts were interpositioned and sutured between the phrenic nerve side and the recipient nerve end. These transfers included various recipient nerve ends targeting at least one end muscle with grade 1 strength. Postoperative muscle strength was then scored using the Medical Research Council (MRC) scale, and the greatest target end muscle score was utilized. The pediatric cohort was followed for major complications such as those requiring immediate operative management or respiratory distress.

**Results:** The patients were followed postoperatively for a mean 25.5 months (3 to 69 months). Sixty-seven had adequate clinical records for evaluation. 23/67 (34%) patients had MRC muscle grade 4; 26/67 (39%) patients had muscle grade 3; 10/67 (15%) patients had muscle grade 2; 8/67 (12%) patients had muscle grade 1. The total effective functional recovery ( $\geq$  MRC grade 3) has reached 73%. No major complications were noted during the postoperative period in the pediatric cohort.

**Conclusions:** The phrenic nerve has strong side sprouting capability suitable for end-to-side nerve repair. This is likely due to its continuous firing rhythm. Satisfactory functional results may be obtained if the phrenic nerve side is widely opened to allow nerve grafting via an oblique end-to-side repair method for brachial plexus injury treatment. This technique should be considered in severe cases with limited donor options.

# **Dynamic Operational Mapping: Tracking Key Decision Points in Microvascular Breast Reconstruction and Their Impact on Surgical Teamwork.**

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The University of Chicago

Presenter: Emily Walker Stockert - Student Submission

**Objective:** Create a novel multimedia tool—the Dynamic Operational Map (DOM)—through translation of a complex series of steps, interactions, and variability of microvascular breast reconstruction. The DOM highlights processes, responsibilities, decision points, and potential outcomes from the perspective of the surgical team, anesthesia, the scrub, and the circulator. The DOM facilitates transparent communication and more efficient coordination in the operating room.

**Study Design and Methods:** A single-site, observational study of microvascular breast reconstruction procedures was performed at an academic medical center. Case progression and decision points for participants were recorded through in-person observation. Interviews with OR team members augmented our understanding of intra-operative decision-making and identified reasons for non-ideal case progression.

**Results:** A complete DOM for microvascular breast reconstruction was created [Figure 1]. Decision nodes for the surgical team include patient positioning, DIEP vs. SIEA flap, number of perforators harvested, recipient vasculature quality, number and type of venous anastomoses, volume of flap, initial flap perfusion and appearance, and wound closure. Anesthesia nodes include the location and number of venous access, need for arterial line, response to blood pressure changes, and plans for intubation/extubation. The circulator and scrub nodes include room readiness, instruments readiness, microscope calibrated and draped.

**Conclusions:** The Dynamic Operational Map has applications for directing flow in the operating room, assessing supply chain needs, educating staff and trainees, and informing patient discussion. The visibility and integrated nature of the DOM enhances OR efficiency, improves team coordination and communication, decreases procedure variability, and reduces unnecessary cost

# **Microsurgical and Supermicrosurgical Interventions in Lymphedema Treatment: Current Perspectives**

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Presenter: Kubat Rahatbek – Student Submission

**Background:** Lymphedema is a progressive condition that devastatingly compromises the patient's quality of life. Being known as an incurable condition, lymphedema patients are frequently placed on life-long decongestive therapy despite sometimes having no response or deterioration. In the recent years, the development and refinements of microsurgical lymph node transfer (LNT) and lymphaticovenular anastomoses (LVA) have rekindled the effort to tackle this challenging clinical entity. This study aims to review the current concepts of lymphedema diagnosis, workup, and treatment, with highlights on the development of the advanced microsurgical and supermicrosurgical techniques.

**Methods:** PubMed independent searches using key words of "lymph node transfer and lymphedema" and "lymphaticovenular anastomosis and lymphedema" with time limit between January 1990 and November 2013 were performed and yielded 28 and 42 publications, respectively. All of the seventy publications were reviewed. Relevant information were analyzed and organized.

**Results:** Indocyanine green lymphangiography is emerging as a diagnostic imaging modality that is as accurate, but more versatile than the conventional lymphoscintigraphy. Clinical as well as radiographic staging systems have been developed to facilitate severity stratification and delineate surgical indication. Important technical refinements of both microsurgical LNT and supermicrosurgical LVA have been made over the past two decades and the results of these procedures are generally highly favorable. The performance of these procedures are becoming more widespread.

**Conclusion:** Breakthroughs in reconstructive microsurgery in the past two decades have made surgical management of lymphedema a clinical reality. While results of the reconstructive interventions are encouraging, many controversies and unknowns remain and deserve further investigation.

**Reconstructive**

## **Repair of recurrent hernia after biologic mesh failure in abdominal wall reconstruction**

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Northwestern Plastic Surgery

Presenter: Chad A. Purnell, MD – Resident Submission

**Background:** Biologic mesh has become commonly used in both clean and contaminated abdominal wall reconstruction. However, hernia recurrence rates appear higher than that of conventional mesh. The aim of this study is to describe the repair of these recurrent hernias.

**Methods:** We conducted a retrospective chart review of 24 patients presenting to a single surgeon for abdominal wall reconstruction. 24 consecutive recurrent hernias after biologic mesh reconstruction were selected for further review. In 11 of 24 cases, the biologic mesh was placed at an outside institution.

**Results:** Mean age was  $47.4 \pm 8.9$  years and BMI was  $31.2 \pm 7.4$ . Mean transverse hernia defect size was  $14.5 \pm 6.4$  cm, and patients had a history of  $6.1 \pm 4.3$  prior abdominal surgeries. 14 patients had previous porcine-based mesh, 7 had cadaveric dermis-based mesh, and 2 had unknown biologic mesh. 13 of 24 recurrences were originally repaired with spanning biologic mesh by the senior author. Upon further review, 100% of all of the senior author's spanning biologic mesh repairs since 2010 had failed. 17 patients underwent open hernia repair, including revision of component separation in 10 patients. Soft polypropylene mesh was utilized in 11 patients and fenestrated condensed PTFE (Motif) mesh in 3 patients. In 2 patients, spanning porcine biologic mesh was utilized due to contamination. Both of these porcine repairs have since recurred. There were no other recurrences. Complications occurred in 5 patients (29.4%), including one return to the operating room for hematoma.

**Conclusions:** Prior components release can be repeated if the previous release seems incomplete by CT scan. Recurrence rates appear to be particularly high after spanning biologic mesh repair. Definitive repair can be achieved safely in recurrent abdominal hernia after biologic mesh failure with conventional mesh.

## **The Venous Anastomotic Flow-Coupler for Free Flap Monitoring: A Prospective Analysis of 85 Microsurgical Breast Reconstruction Cases**

Jenny Chen MD, Steve Kempton MD, Ahmed Afifi MD, Samuel Poore MD

University of Wisconsin School of Medicine and Public Health

Presenter: Jenny Chen, PGY3 - Resident Submission

**Purpose:** The venous anastomotic flow-coupler is used as an adjunct to clinical monitoring of free flaps. No data exists on the use of the flow coupler in the setting of abdominal based free flaps for breast reconstruction. The authors present a prospective analysis of the venous anastomotic flow coupler in 85 microsurgical breast reconstruction cases.

**Methods:** Prospective data was collected on patients undergoing post-mastectomy free flap breast reconstruction from May 2012 to May 2013. Data obtained included patient age, BMI, flap type, incidence of intraoperative and postoperative signal loss, anastomotic problems, coupler problems, flap take back, and flap failure. Proportion data was compiled and analyzed.

**Results:** Eighty-five consecutive abdominal based free flaps for breast reconstruction were performed from May 2012 to May 2013 by two co-surgeons at the University of Wisconsin Hospital. The average patient age was 49.3 years and average BMI was 28.4. There were 53 MS-TRAM, 31 DIEP, and 1 SIEA flaps performed. Overall flap failure rate was 4.7% and flap take back rate was 7.1%. The flow-coupler was analyzed in both intraoperative and postoperative settings as seen in Figure 1 and Figure 2 respectively. The intraoperative and postoperative sensitivity of the flow-coupler was found to be 100%. However, intraoperatively, the flow-coupler had a false positive rate of 75% and a positive predictive value of 0.25. Postoperatively, the flow-coupler had a 36% false positive rate and a positive predictive value of 0.64.

**Conclusions:** If the flow-coupler Doppler signal is audible, it easily confirms patency of a microsurgical anastomosis. However, there is a high false positive rate. This led to a high incidence of intraoperative maneuvers to diagnose and amend the cause of signal loss. In 13% of cases, the flow-coupler Doppler signal was completely ignored and flaps were monitored more traditionally with external doppler or clinical exam.



## **Denying the Obvious: Four Extreme Cases of Neglected Tumors**

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University of Wisconsin Hospital and Clinics

Presenter: Block, Lisa M., MD – Resident Submission

**Abstract:** It is a known phenomenon that patients often neglect tumors or other signs of cancer as part of a denial coping mechanism. As a result of this neglect, disease progression continues unchecked, resulting in excessive tumor growth, invasion of nearby structures, metastatic spread, and significant disfigurement. In this case series, we present four extreme cases of neglected tumors that posed significant reconstructive challenges, and explore the bio-psycho-social components of tumor neglect. We furthermore present the multidisciplinary effort involved in tumor resection, and describe the complex reconstruction required after extensive resection. The tumor neglect phenomenon is of broad interest to the field of Plastic Surgery given the complex patient factors that contribute to the extreme state of disease progression as well as the extensive reconstructive challenges that arise after tumor resection. While challenges still lie ahead in understanding the various and interrelated factors that lead to delay in medical care by these patients, a better biologic understanding of the apparent immunoprotective effect of these large and longstanding tumors could provide significant new strategies for the treatment of all malignant neoplasms.

## **In Vivo Evaluation of a Novel Suture Design for Abdominal Wall Closure**

Jason M. Souza, MD; Gregory A. Dumanian, MD, FACS

Northwestern University, Feinberg School of Medicine

Presenter: Jason Souza, MD – Resident Paper

We present a novel suture design aimed at minimizing the early laparotomy dehiscence that drives ventral hernia formation.

**Methods:** Incisional hernias were produced in 30 rats according to an established hernia model. The rat hernias were randomized to repair with either two 5-0 polypropylene sutures (Group 1) or two mid-weight polypropylene mesh sutures (Group 2) placed in similar fashion. Standardized photographs were taken prior to repair and 1 month after repair, with an intra-abdominal sheet of 2mm grid graph paper serving as a calibration reference for all photographs. Edge-detection software was used to define the border of the hernia defect and calculate the defect area. Histology was performed on all mesh suture specimens, with in-growth graded according to the ASTM 4-point scale.

**Results:** Seventeen hernias were repaired with mesh sutures; 13 hernias were repaired with conventional sutures. Despite randomization, the defects repaired with mesh suture were significantly larger than those undergoing conventional suture repair ( $391.9 \pm 33.4 \text{ mm}^2$  vs.  $255.4 \pm 23.3 \text{ mm}^2$ ;  $P < .0025$ ). The mean area of the recurrent defects following repair with mesh suture was  $177.8 \pm 27.1 \text{ mm}^2$ , compared to  $267.3 \pm 34.1 \text{ mm}^2$  following conventional suture repair. This correlated to a 57.4% reduction in defect area after mesh suture repair, compared to a 10.1% increase in defect area following conventional suture repair ( $p < .0007$ ). None (0/34) of the mesh sutures pulled-through the surrounding tissue, while 65% (17/26) of the conventional sutures demonstrated complete pull-through. Excellent (ASTM3) fibrocollagenous in-growth was observed in 13/17 mesh suture specimens; 4 specimens demonstrated Good (ASTM2) in-growth.

**Conclusions:** The mesh sutures better resisted suture pull-through than conventional polypropylene sutures. By more evenly distributing distracting forces and permitting tissue integration into the substance of the suture, a suture incorporating these design elements may prevent the early laparotomy dehiscence that leads to incisional hernia formation.

## **Physiologic Changes in the Recipient Arm after Autologous Groin Lymph Node Transfer for Secondary Arm Lymphedema**

Anas Eid, M.D. , Kubat Rahatbek, Wei F. Chen, M.D.

University of Iowa Hospitals and Clinics

Presenter: Anas Eid, M.D. - Resident/Fellow

**PURPOSE:** Vascularized lymph node transfer has shown promising results in the treatment of arm lymphedema refractory to non-operative decongestive therapy. The exact physiologic mechanism of how the transferred lymph nodes help to clear the excess lymph and reduce the limb edema remains unclear. Popular theories include the "pump" mechanism via Venturi effect and the transferred lymph nodes stimulating lymphangiogenesis. None of these, however, has been objectively demonstrated. We report a case of autologous lymph node transfer for secondary arm lymphedema in which radiographic down-staging of the disease severity was observed and that unequivocal lymphangiogenesis was demonstrated in sequential indocyanine green (ICG) lymphangiography.

**METHODS & RESULTS:** We performed a groin lymph node flap transfer in a 53-year-old female who previously underwent bilateral mastectomies, chemoradiation, and delayed reconstruction with DIEP flaps who suffered from therapy-refractory left arm lymphedema. Two weeks following the surgery, the ICG lymphangiography demonstrated signal uptake in the lymph node flap (Fig.1), reflecting the formation of a physiologic conduit between the recipient site and the flap. At two months after surgery the ICG lymphangiography demonstrated down staging of the lymphedema severity from the dermal backflow stage V to stage IV due to the disappearance of the "diffuse" pathologic pattern (Figure 2). On her 5-month postoperative evaluation, she achieved a 64% swelling reduction. ICG lymphography now demonstrated a clear linear lymphatic channel extending from the wrist into the lymph node flap.

**CONCLUSION:** This case demonstrated following novel findings: 1) Reversal of lymphatic pathology is possible after autologous lymph node. 2) A physiologic lymphatic conduit between the flap and the recipient limb may form, as early as the second postoperative week, and that evidence of lymphangiogenesis may be demonstrable by the second postoperative month. These findings are important in the future investigation of the physiologic mechanism of the lymph node transfer.

# **Plastic Surgery Technology**

# **Indocyanine Green: An Update on Current Usage in Reconstructive Surgery and Novel Applications**

Ryan J. Jacobs, BS, Katherine A. Rodby, MD, Anuja K. Antony, MD, MPH  
Department of Surgery, Division of Plastic, Reconstructive, and Cosmetic Surgery,

University of Illinois at Chicago

Presenter: Ryan J. Jacobs, BS – Student Submission

**Background:** Poor tissue perfusion and microvascular flap failure can cause significant postoperative complications, resulting in a prolonged and often frustrating recovery period for patients and surgeons. The introduction of laser-assisted indocyanine green (LAICG) angiography into the surgical armamentarium facilitates real-time evaluation of tissue perfusion status, however, its indications and benefits in reconstructive surgeries may not be widely known.

**Methods:** A systematic review of the literature was conducted utilizing three separate search schemes via PubMed and yielded 36 articles after application of inclusion and exclusion criteria. The remaining articles were evaluated for cohort size and demographics, surgical indications, ICG dosage, flap donor site and survival, degree of use, accuracy, and reported benefits.

**Results:** Our review yielded 850 cases with indications for surgery comprising: breast reconstruction/reduction(40%), general tissue reconstruction(32%), head and neck reconstruction(9%), burn/wound healing(9%), upper gastrointestinal tract reconstruction(6%), kidney and liver transplantation(3%), abdominal wall reconstruction(0.7%), and small bowel and colorectal resection(0.3%). Benefits reported included assessment of tissue perfusion, flap viability, quality perforators, and vessel anastomosis in 60%, 64%, 35%, and 44% of cases respectively. 19% of cases correlated quantitative ICG fluorescence with tissue viability, giving levels of 30% relative fluorescence and 3.7-25 units absolute fluorescence for tissue healing. Of 116 cases reporting sensitivity and specificity, aggregate sensitivity and specificity of LAICG fluorescence was determined to be 92.24% and 90.35% respectively.

**Conclusion:** LAICG provides another resource for intraoperative tissue evaluation that can reliably yield excellent surgical outcomes. Increased implementation of the technology into surgical cases allows for the ability to accurately visualize a tissue's vascular supply and drainage, determine anastomotic patency, and supplement clinical judgment by quantitatively establishing a tissue's potential for post-operative viability. Previously only used in neurosurgical or ophthalmologic procedures, LAICG has branched into other surgical fields such as reconstructive, transplant, and vascular surgery to strengthen intraoperative decision-making and improve patient outcomes.

## Shared-Decision Making in Pediatric Plastic Surgery

James E. McCarthy, MD

University of Wisconsin-Madison

Presenter: James E. McCarthy, MD; - Resident Paper

**Background:** Shared decision making entails a partnership between patient and clinician to use evidence-based medicine, patient values and preferences to reach an optimal decision. While shared-decision making has been studied extensively in adults over the last decade, very little research has occurred in the pediatric and adolescent population. The goals of this work are to explore shared-decision making in the adolescent population presenting for elective plastic surgery by examining (1) decisional conflict, (2) decisional values, and (3) self-efficacy using a validated surveys (Ottawa Decision Support Framework).

**Methods:** Adolescents presenting to the plastic surgery clinic at a tertiary care center for any elective surgical procedure were invited to complete three validated surveys; the age, gender, and type of procedure were recorded. The results of each survey were then analyzed. A student's t-test was used to analyze differences between gender and age groups.

**Results:** 15 participants to date have participated with a mean age of 14.5 years and 53% female gender. The mean decisional conflict score was 47.8 (SD 15.4), indicating feelings uncertainty; the most important values in making decisions were the (1) personal characteristics of the surgeon, (2) risk of infection and (3) benefits of improved appearance; the mean self-efficacy score was 82.1 (14.8), indicating high self-efficacy.

**Conclusion:** Adolescents presenting for elective plastic surgery demonstrate overall uncertainty in decision making despite reporting high confidence in their decisions. Surgeon personal characteristics, risk of infection, and benefit of improved appearance are of highest import in decision making. Accordingly, the latter two should be discussed thoroughly.

# Simple Modifications to Improve Reliability and Accuracy of Indocyanine Green Lymphography

Karen Lai, B.A.<sup>1</sup>, Wei F Chen, M.D.<sup>2</sup>

Department of Surgery, University of Iowa Hospitals and Clinics

Presenter: Karen Lai, B.A.<sup>1</sup>, - Student Submission

**Background:** Indocyanine green (ICG) lymphography has emerged as a safe and effective imaging modality for lymphedema diagnosis, staging, as well as for pre-operative planning and intraoperative guidance in the cutting-edge supermicrosurgery procedures such as lymphaticovenular anastomosis (LVA). However, specifics of ICG lymphography methodology are not described in the literature, and there are no established standards for dosage, location and number of injection sites, and timing of imaging. We share our approach and experience of this novel, evolving imaging modality.

**Methods:** Twenty-two patients with arm or leg lymphedema were imaged using ICG lymphography (83 videos). 0.1 to 0.2 cc of 0.25% ICG were injected in second and third web spaces of the hand or foot. For lower extremity evaluation, an additional Achilles tendon injection was selectively added. Immediately after injection, the injection sites were treated with either rigorous massage or normal activity. Serial imaging was obtained at 0, 2 and 24 hours post-injection.

**Results:** Post-injection massage was found to be crucial in demonstrating linear, healthy lymphatics. With the massage, all of the healthy upper limbs demonstrated an injection site-to-axilla transit time of < 2 minutes. Implications of these results support usage of ICG lymphography for quantitative assessment of pump function. The 2-hour delayed scan was found to be unnecessary as it consistently showed a preliminary, evolving pattern, and thus provided no additional information. The Achilles tendon injection for lower extremity evaluation was found to be unnecessary and may risk causing the "quenching effect".

**Conclusion:** ICG lymphography is a powerful and useful imaging modality in the lymphedema treatment. Our findings will help reconstructive lymphedema surgeons in increasing the reliability and reproducibility of this novel tool.

## Hybrid Electrical-Optical Functional Stimulation System

Sahil Kapur, Thomas Richner, Sarah Brodnick, Justin Williams, Samuel Poore.

University of Wisconsin Madison

Presenter: Sahil Kapur, MD – Resident Submission

**Objective:** Conventional neuroprostheses using functional electrical stimulation lead to high levels of muscle fatigue and tissue damage due to extended periods of electrical stimulation. Newer modalities, such as the use of optogenetic nerve stimulation, are limited by the levels of light sensitive ion channel expression within peripheral nerves. Our objective is to combine both electrical and optical stimulation modalities to develop a hybrid stimulation interface that has the capability of producing both less fatigue as well as a high magnitude of muscle EMG response.

**Method:** Transgenic mice expressing blue light sensitive channelrhodopsin ion channels were anesthetized and their sciatic nerve and gastrocnemius muscles were exposed in accordance with IACUC guidelines. Simultaneous electrical and optical stimulation of the sciatic nerve was carried out using a concentric needle electrode and a blue light emitting diode. Compound muscle action potentials were measured using needle electrodes placed in the gastrocnemius muscle.

**Results:** Isolated electrical stimulation generated a significantly higher EMG response in the muscle and more fatigue than isolated optical stimulation. Combined electrical-optical stimulation was able to generate a comparable magnitude of EMG response with less electrical and optical stimulus than when both modalities were used in isolation. Sub-twitch threshold electrical stimulation was amplified in the presence of simultaneous optical exposure of the nerve to generate EMG response in the gastrocnemius muscle. Combined electrical-optical stimulation did not produce similar effects in control mice.

**Conclusion:** Combined electrical-optical stimulation allows one to use the advantages of both modalities to develop an interface that has the capability of producing less fatigue as well as a high magnitude of muscle response. This hybrid model can be integrated into existing control algorithms to improve performance and longevity of functional electrical stimulation devices.



## Development and Early Implementation of an Endoscopic Carpal Tunnel Release Simulator

Steve J. Kempton, MD; Benjamin Mandel, MD; A Neil Salyapongse, MD

University of Wisconsin Hospital and Clinics

Presenter: Steve J Kempton, M.D. - Resident Submission,

**Background:** Carpal tunnel release surgery includes both open and endoscopic techniques (ECTR). Despite similar long-term outcomes, ECTR has been shown to have a significant learning curve in training residents and in the first 6 months of clinical practice. We have developed and initiated testing of an endoscopic carpal tunnel release simulator to evaluate its usefulness in surgical education and training.

**Methods:** An endoscopic carpal tunnel release simulator was developed at the University of Wisconsin. Plastic surgery, orthopedic surgery, and neurosurgery residents were randomized to simulation and non-simulation groups for comparison. A pre and post-test was administered before and after simulation or independent preparation depending on study group. Residents were evaluated in an ECTR case by the senior author (NS) who was blinded to the participant's study group. Residents were evaluated by a 100-point objective scoring system. A student T test was used to determine differences between study groups.

**Results:** Twelve subjects were evaluated (6 simulation and 6 non-simulation). There was no difference between the groups in their pre-test scores ( $p=0.275$ ). Post-test scores following use of the simulator were significantly higher compared to the non-simulation group ( $p<0.001$ ). The average objective operation scoring for the simulation group and non-simulation group was 95% and 78% respectively ( $p=0.0399$ ). When divided into operative steps, the simulation group performed significantly better on set-up ( $p=0.0028$ ), where there was no difference in anesthesia ( $p=0.062$ ), tourniquet placement ( $p=0.0752$ ), Procedure ( $p=0.0772$ ), or dressing ( $p=0.0870$ ).

**Conclusions:** Early data on the endoscopic carpal tunnel release simulator suggests its usefulness as a clinical training tool. Despite a limited number on participants, trainees with limited experience (<3 cases) performed at the same level as a non-simulation trainee who had done 26 prior ECTR cases. Further testing will allow for maximizing the educational benefit based on level of training and number of prior ECTR operations.

## **Track II**

**Breast**

## **The BREASTrial: Breast Reconstruction Evaluation of Acellular Dermal Matrix as a Sling Trial, A Prospective Randomized Trial Comparing AlloDerm to DermaMatrix**

Shaun D. Mendenhall MD, Layla A. Anderson BA, Jian Ying PhD, Kenneth M. Boucher PhD, Leigh A. Neumayer MD MS, Jayant P. Agarwal MD

Institute for Plastic Surgery, Southern Illinois University School of Medicine and the Division of Plastic Surgery, University of Utah School of Medicine

Presenter: Shaun D. Mendenhall MD, - Resident Submission

**Background:** Use of acellular dermal matrix (ADM) in tissue expander (TE) breast reconstruction has become a popular alternative to the total submuscular technique. Recent meta-analyses have demonstrated increased complication rates when ADM is used in breast reconstruction, however this data is retrospective and based predominantly on one type of ADM.

**Methods:** After IRB approval, a randomized trial was conducted to compare outcomes of immediate TE breast reconstruction using either AlloDerm (Lifecell) or DermaMatrix (Synthes). The impact of obesity, radiation, chemotherapy, mastectomy type, expander dynamics, and drain time on complications and bio-integration of ADM was analyzed. The trial was divided into three different time periods/stages with the first stage results reported here. Logistic regression was utilized to determine predictors of complications.

**Results:** 128 patients (199 breasts) were equally randomized over 2.5-years. Most patients were healthy, non-smoker Caucasians. There was no difference in complication rate (33.6% vs. 38.8%,  $p=0.50$ ), infections (13.9% vs. 16.3%,  $p=0.29$ ), seromas (6.1% vs. 3.1%,  $p=0.34$ ), hematomas (0% vs. 2%,  $p=na$ ), skin necrosis (17.8% vs. 21.4%,  $p=0.66$ ), or expander loss (5.0% vs. 11.2%,  $p=0.11$ ) between the AlloDerm and DermaMatrix groups respectively. The AlloDerm group required less time to reach full expansion (42 vs. 70 days,  $p=0.001$ ). Obesity was a predictor of poor ADM bio-integration (OR 7.0,  $p=0.001$ ) on multivariable logistic regression. Poor ADM bio-integration was associated with tissue expander loss ( $p<0.001$ ).

**Conclusions:** The BREASTrial emphasizes the importance of careful patient and allograft selection in ADM breast reconstruction. Different types of ADM may impact outcomes such as expander dynamics and should be studied further. Obesity predicted a 7-fold increase in poor ADM bio-integration indicating that ADM should not be used in obese patients. Results from this trial will assist plastic surgeons in making evidence-based decisions regarding ADM-assisted breast reconstruction.

## **Breast implant reconstruction with acellular dermal matrix after mastectomy: outcomes with adjuvant radiation treatment in one-stage and two-stage reconstruction**

Anupama Mehta MD, Bernardino Mendez MD, Noelle Fabian BA, Whitney Brandt BA, Nicholas Reder BA, Darl Vandevender MD FACS, Juan Angelats MD FACS, Victor Cimino MD FACS

Department of Surgery, Loyola University Chicago

Presenter: Anumpama Mehta, MD – Resident Submission

**Background:** The use of acellular dermal matrix in recreating the inferior pole during breast implant reconstruction after mastectomy has led to many technical and cosmetic benefits. However, there is limited data comparing complication outcomes for one-stage and two-stage reconstruction in the setting of radiation therapy.

**Methods:** This study was designed as a retrospective review of one-stage and two-stage breast implant reconstructions with acellular dermal matrix in the setting of adjuvant radiation therapy. Breast reconstruction was performed by three surgeons between April 2007 and December 2012 at a single institution. Data collected included patient demographics, comorbidities, surgical materials, technique, length of follow-up, breast cancer stage, and post-operative treatment. Outcomes analyzed included wound infections, dehiscence, hematoma, seroma, flap necrosis, implant revision, and explantation. Statistical analyses were conducted using Chi-square, Fisher's or Whitney Mann tests, with statistical significance being  $p \leq 0.05$ .

**Results:** 158 patients met inclusion criteria with a mean age of 51.4 years. 67 (42%) underwent one-stage reconstruction and 91 (58%) underwent two-stage reconstruction. The overall complication rate was 33.8%, though the two groups did not differ in overall complications or in any subclass of complications.

**Conclusion:** Post-mastectomy patients that underwent breast implant reconstruction with acellular dermal matrix in the setting of adjuvant radiation therapy did not differ in complication rate when comparing one-stage and two-stage reconstruction.

## **A Proposed Scale for Severity of Mastectomy Skin Necrosis Correlates with Need for Intervention**

Hammoudeh, Ziyad S.<sup>1</sup>; Degnim, Amy C.<sup>1</sup>; Hoskin, Tanya<sup>2</sup>; Farley, David R.<sup>1</sup>; Grant, Clive S.<sup>1</sup>; Boughey, Judy C.<sup>1</sup>; Jacobson, Steven<sup>1</sup>; Torstenson, Tiffany A.<sup>1</sup>; Reusche, Ryan D.<sup>1</sup>; Lemaine, Valerie.<sup>1</sup>

Mayo Clinic

Presenter: Hammoudeh, Ziyad, M.D. - Resident

**Introduction:** With increasing use of immediate breast reconstruction after mastectomy, skin flap necrosis is a problem that deserves further study. We propose a new scale to describe and discriminate severity and extent of mastectomy skin necrosis.

**Methods:** Women who underwent skin-sparing mastectomy (SSM) or nipple-sparing mastectomy (NSM) with immediate breast reconstruction from Nov 2009 to Oct 2010 were studied retrospectively. Surgeons screened all patient records to find cases with any concern of skin ischemia/necrosis within 90 days of operation. These cases were reviewed (records and available photographs) by a workgroup of breast surgeons and plastic surgeons. Photographs were scored for necrosis severity, assigning a letter score on a four-point scale for depth of necrosis and a numerical score on a four-point scale for the area. Necrosis severity scores were evaluated for correlation with need for surgical intervention.

**Results:** 177 patients underwent 299 procedures (204 SSM, 95 NSM); 69% underwent bilateral procedures. Postoperatively, 233 breasts (77.9%) had no ischemic problems and 47 (15.7%) had mild ischemia/necrosis not needing intervention. Overall, 17 (9.6%) of patients and 19 (6.4%) of breasts had necrosis requiring reoperation. Of 238 breasts with a postoperative photograph within 60 days of surgery, 15 (6.3%) breasts required intervention (3.8% of SSM, 11.4% of NSM). Reoperations for necrosis occurred from 4 – 62 days (median 28) after mastectomy. Both the letter score (depth) and numerical score (area) correlated with a need for additional surgical intervention per breast (see Table). The combined letter and numerical score demonstrated a c-statistic of 0.97 for SSM and 0.94 for NSM, for predicting need for additional intervention.

**Conclusion:** A simple scoring system for the severity of mastectomy skin necrosis is proposed, incorporating the depth and area of skin necrosis. Scores obtained with this severity scale correlate strongly with the need for additional surgical intervention to treat mastectomy skin necrosis.

## **Adipose-Derived Stem Cell Transplantation Decreases Capsule Formation during Tissue Expansion with Radiotherapy**

Abigail Maciolek Cochran, MD; Mei Yang, MD, PhD; Joel Reichensperger; Nicole Cosenza; Lisa Cox; Carrie Harrison; Michael W. Neumeister, MD

Southern Illinois University - School of Medicine

Presenter: Abigail M. Cochran, MD - Resident Submission

**Background:** Fat grafting, commonly used to correct breast contour deformities also seems to improve skin elasticity, scarring and sclerosis; the effects of which have been attributed to Adipose Derived Stem Cells (ADSCs) within the transplant. ADSCs have also been shown to improve healing and treat side effects of radiotherapy. However, their effect on expansion of irradiated skin remains unclear. We hypothesize that ADSC transplantation promotes tissue expansion of irradiated skin by minimizing capsule formation.

**Methods:** A female Sprague Dawley (SD) tissue expansion model was used. Tissue expanders were placed subcutaneously on the dorsum of the rat, and weekly expansion ensued. Media: DMEM (Dulbecco's Modified Eagle Medium) or ADSC from male SD rats was injected at 0, 14, 28 and 42 days. Three groups of animals (n=16) were examined: sham (no radiation, DMEM injection), control (radiation, DMEM injection) and treatment (radiation, ADSC injection). Four rats from each group were sacrificed at 7, 14 and 28 days. Four rats were expanded to 60cc before undergoing flap surgery; 14 days later they were sacrificed. The expanded tissue surface area was measured and skin was taken for histological analysis. Hemotoxyn & Eosin and Trichrome staining were used to measure the amount of collagen present. ADSC migration was observed via immunohistochemistry CM-Dii staining and y-chromosome fluorescence *in situ* hybridization.

**Results:** Subcutaneous ADSC injection with tissue expanders resulted in thicker, more cellular epidermis compared to control. Decreased fibrosis and inflammation was also observed in the ADSC group. Furthermore, at the time of expander explantation, a larger surface area of expanded skin was harvested.

Male ADSCs injected into the female rat were found to appear in epidermis, hair follicles, sweat and sebaceous glands by Y chromosome *in situ* hybridization.

**Conclusion:** Subcutaneous ADSC injection promotes tissue expansion by decreasing capsule formation and by directly differentiating into dermal components

## Results from a Quality Improvement Initiative to Reduce Breast Skin Necrosis After Mastectomy with Breast Reconstruction

Winocour S, Degnim A, Hoskin T, Farley D, Grant C, Boughey J, Jacobson S, Jakub J, Torstenson T, Reusche R, Lemaine V

Mayo Clinic

Presenter: Sebastian Winocour – Resident Submission

**Purpose:** Necrosis of breast skin and/or the nipple areolar complex (NAC) following skin-sparing mastectomy (SSM) or nipple-sparing mastectomy (NSM) and immediate breast reconstruction (IBR) may lead to poor outcomes. A quality improvement (QI) project was undertaken using the DMAIC (Define, Measure, Analyze, Improve, Control) framework to improve surgical outcomes.

**Method:** Consecutive cases of SSM or NSM followed by IBR were reviewed. Breast and plastic surgeons retrospectively scored breast skin necrosis in postoperative photographs using the validated Mastectomy SKIN Score. Breast SKIN scores were assessed in both SSM and NSM, and in NSM cases the nipple areolar complex (NAC) was scored separately. SKIN scores were compared for time periods BEFORE initiating the QI project (Nov 2009-Oct 2010) and AFTER (Nov 2010-Dec 2011).

**Results:** 334 patients underwent 567 breast procedures (378 SSM and 189 NSM). Cases with any partial or full thickness necrosis of the NAC decreased significantly from the BEFORE group (42/76= 55.3%) to the AFTER group (15/86= 17.4%,  $p<0.0001$ ). The frequency of breast skin necrosis of SSM cases did not change significantly in the BEFORE and AFTER groups (17/110=15.5% and 18/145=12.4% respectively,  $p=0.49$ ). NSM cases with partial or full thickness breast skin necrosis decreased but was not statistically significant (11/76=14.5% BEFORE vs 5/86=5.8% AFTER,  $p=0.06$ ). Cochran-Armitage test for trend evaluating the combined score for depth and area confirmed a significant reduction in combined SKIN score severity for the NAC ( $p<0.0001$ ) and for breast skin in NSM ( $p=0.03$ ), but not for breast skin in SSM ( $p=0.41$ ).

**Conclusions:** After this QI initiative to improve outcomes after SSM and NSM with IBR, significant reductions in necrosis were achieved in NSM. Further work is ongoing to enumerate factors associated with improved outcomes.



## **Breast II**

# **Volumetric analysis of the chest wall deformity in Breast Reconstruction: The Sagitta Defect**

Karina Paulius Quinn, Ramasamy Kalimuthu, MD

University of Illinois at Chicago

Presenter: Karina Paulius Quinn, MD- Resident submission

**PURPOSE:** Numerous reports have documented tissue expansion of the breast can be complicated by significant chest wall deformity. Yet, to date none have quantified the volume of the concavity in the chest wall. The resulting volume loss can affect the size of permanent implant needed to fill the soft tissue envelope, and may partly account for the need to upsize implants at the time of exchange and after breast augmentation. Using basic intra-operative measurements of the depth of the depression (sagitta) and diameter of the depression (chord), we have developed a method of calculating the volume loss resulting from the chest wall deformity associated with tissue expansion.

**METHODS:** 43 consecutive patients undergoing second stage breast reconstruction by a single surgeon were prospectively assessed for chest wall deformity at the time of expander exchange for permanent implant. First stage breast reconstructions had been performed with ADM and partial submuscular tissue expanders filled to soft tissue capacity. Dimensions of the rib deformity (sagitta, chord), patient characteristics (XRT, chemotherapy comorbidities, smoking status), tissue expander volume and final implant volume were recorded. Subgroup analysis was then performed with regards to smoking status, XRT history, and patient comorbidities.

**RESULTS:** All patients were noted to have some degree of chest deformity related to tissue expansion, mean 96.25ccm range 57-150cc. Defect volume correlated with expander volume, with larger expanders filled to larger volumes causing greater depression of the ribcage. A trend toward greater deformity was present in those patients with pre-operative radiation. Similar chest wall deformity of 120cc was noted in a patient with previous breast augmentation with 325 cc silicone implants.

**CONCLUSION:** Using the sagitta method allows the plastic surgeon to easily quantify the volume of chest wall deformity at the time of second stage reconstruction. The sagitta and chord are easily measured intra-operatively, allowing for on table calculation of the volume of depression. Taking into account the volume of chest wall concavity resulting from tissue expansion can refine appropriate sizing of the permanent implant, especially in the setting of larger volumes or overfilled expanders.

# Large volume direct-to-implant immediate breast reconstruction: outcomes and complications

Neil D. Dalal

Loyola University Medical Center

Presenter: Neil D. Dalal, MD – Resident Submission

**Background:** An increasing number of patients are undergoing skin-sparing mastectomy and immediate breast reconstruction with permanent implants and acellular dermal matrix to provide lower pole coverage. Large implant sizes in breast surgery are associated with higher complication rates. The purpose of this study is to demonstrate the feasibility of utilizing larger implants at the time of immediate breast reconstruction.

**Methods:** All patients from 2008-2013 undergoing immediate breast reconstruction with silicone implants greater than or equal to 400 ml were included in this study. Patient charts were reviewed retrospectively for implant size, complications, radiation therapy, and need for revision surgeries.

**Results:** A total of 89 breasts (59 patients) were reconstructed. Implant size ranged from 400-800 ml. Revision surgery was required in 15 breasts (17%). Eleven breasts (9 patients) required explantation (12%); five of these breasts were radiated post-operatively. Overall, radiation was associated with a three-fold increase in complications. Skin flap necrosis was noted in 14 breasts (16%), there were a total of 8 breast infections (9%), and seroma was noted in 4 breasts (5%). Average body mass index (BMI) was 28.2 +/- 4.2. There was no statistical difference in BMI for patients with complications.

**Conclusions:** This study demonstrates that large implants may be utilized for direct-to-implant breast reconstruction. Overall, 88% of patients had a successful reconstruction, and 71% of patients underwent breast reconstruction in a single-stage. The increased rate of implant loss is consistent with the literature for patients undergoing direct-to-implant reconstruction. Seroma and infection rates were similar to reports in the literature for acellular dermal matrix reconstruction. Other methods of breast reconstruction should be considered in patients expected to receive radiation. Further studies to demonstrate patient satisfaction would be of benefit.

# **The Role of the Plastic Surgeon in Sentinel Lymph Node Biopsy of Internal Mammary Nodes: A Case Report and Review of the Literature**

Justin Hellman, BA, Allison M Shore, MD, Julie E. Park, MD

The University of Chicago Medicine and Biological Sciences

Presenter: Justin Hellman, BA – Student Submission

**Abstract:** Sentinel lymph node (SLN) biopsy is the primary method of detecting metastases to the axillary lymph nodes in patients with early stage clinically node negative breast cancer, yet it is not routinely performed on sentinel nodes in the internal mammary chain (IMC) due to uncertainty over its clinical significance and safety concerns. The aims of this study are to explain the significance of the procedure and to describe how a plastic surgeon can safely and effectively perform it using breast reconstruction and mastopexy techniques. We present the case of a 47 year-old woman with triple negative invasive ductal carcinoma and drainage to the internal mammary chain on lymphoscintigraphy. Following mastectomy a plastic surgeon (JEP) removed a section of costal cartilage in order to access the sentinel lymph node, which was negative for metastatic disease. Though some argue against routine IMC SLN biopsy, evidence shows that it can lead to significant changes in adjuvant care that improve mortality rates. Most plastic surgeons are comfortable performing IMC sentinel node biopsies through a variety of techniques that they routinely use which are unfamiliar to many breast oncologic surgeons. Biopsy of IMC SLNs allows for more accurate staging and appropriate assignment of adjuvant therapy in select patients.

## **Trends in Breast Reconstruction by Ethnicity: An Institutional Review Centered on the Treatment of an Urban Population**

Katherine Rodby, MD; Emilie Robinson, BS; Kristie Danielson, PhD; Anuja K. Antony, MD,  
MPH

Division of Plastic and Reconstructive Surgery, University of Illinois at Chicago

Presenter: Katherine Rodby, MD – Resident Submission

**Background:** A paucity of data is available on breast reconstruction trends in ethnic minority patient populations. While trends for the Caucasian population have been elaborated, limited studies describe African-American preference for autologous tissue reconstruction, while preferences for Hispanic women are largely unknown. This institutional review provides a unique evaluation of an understudied urban population, highlighting reconstruction trends to garner a current understanding of minority patient preferences. Such understanding holds potential to guide efforts toward eliminating ethnic disparities in breast reconstruction.

**Methods:** Patients undergoing breast reconstruction were entered into a prospectively maintained database at the University of Illinois at Chicago hospitals by a single surgeon between 5/2010 and 10/2013. Demographic and co-morbidity data, tumor staging, and BRCA testing were reviewed. Reconstructive trends assessed by racial group included type of reconstructive procedure, mastectomy volume, and implant characteristics. Statistical analysis was performed using SAS (Cary, NC).

**Results:** During the study period, 165 breast reconstructions were performed in 108 women (42% African-American (AA), 24% Hispanic (Hisp), 22% Caucasian(Cau) , and 2% Asian (As)). Mean age and BMI were similar across all groups. Obesity, HTN, and DM were higher in AA and Hisp cohorts. Despite comparable positive BRCA testing rates, 68% of AAs, 46% of Cau, and 34% of Hisp patients underwent bilateral mastectomies ( $p=0.005$ ). AA were more likely to undergo tissue expander reconstruction, while Hispanics predominantly underwent flap based reconstruction; Caucasian patients were equally likely to pursue either type of reconstruction. Implant sizes demonstrated a bell-shape curve of usage for Caucasian patients with a peak volume of 550cc. Mastectomy volumes were increased in AA and Hisp with least one-third of each of these minority cohorts requiring permanent implants using the maximum volume available of 800cc.

**Conclusion:** Current reconstructive trends of ethnic minority patients at an urban hospital demonstrate increased rates of bilateral implant-based reconstruction in AA women and unilateral flap-based reconstructions in Hispanic patients. Higher mastectomy volumes were seen in both AA and Hisp cohorts despite similar BMIs with concordantly increased final implant volumes. One-third of each of these cohorts required the maximum implant volume available, indicating a potential unmet need for larger implant sizes.

## **Age-Dependent Characteristics in Women with Breast Cancer: Mastectomy and Reconstructive Trends by Decade**

Emilie Robinson, BS; Katherine Rodby, MD; Kristie Danielson, PhD; Karina P. Quinn, MD;  
Anuja K. Antony, MD, MPH

Division of Plastic and Reconstructive Surgery, University of Illinois at Chicago

Presenter: Emilie Robinson, BS – Student Submission

**Background:** Breast reconstruction is an important aspect of treatment following breast cancer, as post-mastectomy reconstruction bears a significant impact on a woman's post-surgical confidence, sexuality, and overall well-being. Identifying age-dependent trends will assist with counseling women on mastectomy and reconstruction.

**Methods:** 100 consecutive women were sampled from a prospectively enrolled breast reconstruction database at the University of Illinois at Chicago from 6/2010 through 6/2013 to identify trends in younger versus older women. Patients were placed into two cohorts ( $\leq 40$  yrs and  $> 40$  yrs) to compare co-morbidities, tumor staging, oncologic treatment, and BRCA testing. To evaluate reconstructive trends, patients were evaluated by decade (20-29, 30-39, 40-49, and 50+ yrs) to assess trends and risk for complications. Statistical analysis was performed using SAS software (Cary, NC).

**Results:** 150 reconstructions were performed in 100 patients; mean age was 42yrs (range 23-72) and mean BMI was 30.5 (range 18-48). As anticipated, younger patients were more likely to undergo BRCA testing ( $p < 0.001$ ), while older patients were more likely to have one or more comorbidities ( $p = 0.02$ ). Younger patients were significantly more likely to receive neoadjuvant chemotherapy ( $p = 0.02$ ) and radiation ( $p = 0.049$ ). When assessing mastectomy and reconstructive trends by decade, younger women in their 20s, 30s, and 40s were more likely to undergo bilateral mastectomies ( $> 60\%$ ), while women 50+ were more likely to undergo unilateral mastectomy (65%). Similarly, the number of prophylactic mastectomies decreased by decade to less than 25% of all mastectomies in women 50+. With regards to reconstruction, women in the youngest decade (20s) were most likely to undergo tissue expander/implant reconstruction (100%) while older decades (30s, 40s) were 2/3<sup>rd</sup> as likely to choose TE/I (68%, 66%) and the oldest decade (50s) equally likely to choose TE/I versus autologous flap reconstruction (50%). All decades were equally likely to experience one or more complications.

**Conclusion:** Age-related factors may influence patient priorities when deciding upon breast cancer treatment and reconstruction. Younger women typically require more aggressive oncologic treatment including chemotherapy and radiation. Reconstructive choices are influenced by a patient's age at presentation. Women in younger decades appear to be more likely to pursue risk-reduction procedures and pursue implant-based strategies for reconstruction. Age-related preferences, age-dependent body habitus and tissue availability, and lifetime risk reduction may play a factor in choices pursued for mastectomy and reconstruction.

# **Maxillofacial**

## Quantitative CT-Based Assessment of Nasal Change Following Le Fort I Osteotomy: Volumetric Analysis and Curvature Interpolation

Belinda Daniel<sup>1</sup>; Linping Zhao, PhD<sup>2, 3,4</sup>; David Morris, MD<sup>2,3,4</sup>

University of Illinois College of Medicine at Rockford

Presenter: Belinda Daniel – Student Submission

**Background:** Repositioning of the maxilla with LeFort 1 maxillary osteotomy is often accompanied by morphologic change of the nose, as the maxilla is the skeletal foundation for the lower portion of the nose. As such, subsequent rhinoplasty is sometimes required to restore the original nasal appearance. Previous studies have attempted to quantify this change in nasal morphology through the use of anthropometric landmarks and linear measurements.

**Purpose:** We aimed to use three-dimensional cone beam CT (3D CBCT) technology for quantitatively describing the nasal morphologic changes and to explore the full potential of 3D medical image analysis.

**Methods:** A series of patients in whom the maxilla was repositioned with LeFort 1 osteotomy was selected and their archived CBCT scans were collected. For each, preoperative hard and soft tissue 3D forms were superimposed with 1-year postoperative 3D forms. Simplant Pro 2011 and MIMICS v 15 software (Materialise NV, Leuven, Belgium) was used to analyze the images. Three-dimensional skeletal maxillary movement was quantified in millimeters by direction and by degrees of rotation. Local curvature of the nose was fitted using a cubic spline technique and principal component analysis (PCA). Volumetric analysis was performed on the soft tissue of the nose and corresponding airways.

**Results:** Alteration in nasal morphology was quantified with the proposed technique and splines smoothly fit the curvature of the nose. Quantitative results of our newly developed 3D quantification parameters are in agreement with qualitative clinical observations.

**Conclusion:** We have demonstrated how Simplant Pro and MIMICS software can be used to measure nasal morphologic change as it relates to underlying surgical skeletal change. Data obtained through this methodology supplements the existing literature and provides a broad 3D-based data set. This approach is feasible for future outcome studies.



## **Three-dimensional soft tissue change of the malar region with high LeFort-1 advancement: Implications for aesthetic malar contouring**

D. Morris, B. Rosett, L. Zhao, P. Patel

University of Illinois at Chicago

Presenter: Brian Rosett, MD – Resident Submission

**Purpose**-A fundamental goal of orthognathic surgery is to reposition the facial skeletal components. For patients with malar hypoplasia, modification of the traditional Le-Fort-1 osteotomy allows one to carry the osteotomy superolaterally to advance the zygoma, and simultaneously augment the malar region. Moreover, using current technology one can preoperatively plan such three-dimensional skeletal movements and then accurately execute these movements intraoperatively. The goal of this study is to quantify the relationship between underlying skeletal change and overlying soft tissue change in the zygoma region for a series of patients who underwent high LeFort-1 osteotomy.

**Methods**-For 5 consecutive patients who underwent high LeFort-1 osteotomy with zygomaticomaxillary advancement, preoperative and late postoperative cone-beam CT studies were compared using MIMICS (Materialise NV, Leuven, Belgium) and Simplant Pro (Materialise Dental NV, Leuven, Belgium) software. Quantitative change was measured using three different parameters: volumetric change, contour change, and landmark spatial position change. Soft tissue change overlying the zygoma was quantified along the underlying osteotomy line.

**Results**-Soft tissue change in the cheek paralleled the direction of zygomatic skeletal movement. At the level of the osteotomy and directly inferior to the infraorbital foramen, the ratio of soft tissue to skeletal advancement was between 0.4 and 0.5. At this same level, for a skeletal advancement of 7 mm., a 3 mm decrease in thickness of the overlying soft tissue envelope was noted.

**Conclusion**-For this group of patients, soft tissue change in the upper face was quantitatively related to underlying zygomatic advancement using multiple 3D parameters. With this there was some attenuation of the soft tissue layer. This study provides outcome data that our group now considers in tailoring the high Le-Fort 1 osteotomy in subsequent patients based on their preoperative clinical findings. Finally this data may be useful for those surgeons performing malar augmentation with alloplastic implants.

**Joint flap: A novel local flap for reconstructing defects that cross the alar crease.**

Matthew J Ranzer, Ramasamy Kalimuthu

University of Illinois at Chicago

Presenter: Matthew J Ranzer – Resident Submission

We share our experience with a local flap technique for nasal defect reconstruction of lesions that cross or abut the alar crease. There are many local flaps that are used for reconstruction of nasal defects in this region including V-Y advancement flaps, Banner flaps, nasolabial advancement flaps and bilobed flaps. These flaps are commonly used for lesions of the nasal sidewall, however when the defect abuts or crosses the alar crease, these commonly used flaps often create a resultant deformity at the nasolabial fold or alar rim. We describe our experience with the "Joint flap," a local flap that is well suited to reconstruct lesions at the alar crease without creating a resultant deformity at the nasolabial fold or alar rim. We present our experience with over 50 of these cases and describe the indications where this flap is useful. The design of the joint flap is ideal for these lesions as it has a narrower base and is able to rotate a full 90 degrees, as opposed to the bilobed flap which has a wider base and covers a 90 degree arc with 2 separate 45 degree turns. In our experience we have had no complications or need for revisional surgery and all of our reconstructions have maintained a normal contour of the alar rim and nasolabial fold which would not have been possible with other conventional local flaps.

## **Non-Surgical Cleft Rhinoplasty**

Christina Tragos, James Kong, Amit Patel, Michael Tran, John Polley

Rush University Medical Center

Presenter: Christina Tragos, MD – Resident Presenter

**Background & Purpose:** Perfection in nasal morphology continues to be a challenging aspect of cleft care. Many cleft patients require surgical revisions in an attempt to achieve this often elusive goal. Results from surgical revision cleft rhinoplasty can often be disappointing, as working with scarred anatomy in this delicate area is difficult. We present a unique non-surgical technique utilizing hyaluronic acid for the secondary reconstruction of cleft nasal deformities and asymmetries. Outstanding immediate results are obtainable. Nonsurgical hyaluronic acid cleft rhinoplasty requires no general or sedative anesthesia and is readily performed in an office setting. There is no postoperative period, no incisions, no sutures, no splints, no dressings, and no donor sites.

### **Methods:**

A series of ten consecutive patients with clefts have been treated using non-surgical hyaluronic acid rhinoplasty. Based upon established cosmetic principles, under minimal local anesthesia, hyaluronic acid is utilized for dorsal, supratip, alar, columellar, tip, and dome support depending on each patient's requirements.

**Results:** All of our patients were successfully treated. There were no complications. Our patients and their families noted immediate improvement in the appearance of the nose following the procedure. They were thrilled that such a drastic change occurred without undergoing a surgical procedure. Techniques and results of hyaluronic acid non-surgical rhinoplasty will be illustrated with multiple cases.

**Conclusion:** Non-surgical cleft rhinoplasty with hyaluronic acid offers the craniofacial surgeon an additional minimally invasive tool for secondary treatment of cleft nasal deformities.

**Main Objectives of Presentation:** This study presents a powerful alternative to surgery for obtaining optimal results in secondary cleft rhinoplasty.

## **Orthognathic Positioning System (OPS): Optimizing Results in Severe Facial Asymmetries**

Amit M. Patel, MD; John Polley, MD

Rush University Medical Center

Presenter: Amit Patel – Fellow Submission

**Background:** Correction of severe facial asymmetry is one of the most challenging aspects in maxillofacial surgery. The traditional treatment planning in these cases is prone to errors due to bony hypoplasia, soft tissue deficiencies, and centric relation (CR) and centric occlusion (CO) mismatches. Virtual surgical planning (VSP) has enabled surgeons to design a detailed plan for both skeletal and soft tissue rehabilitation preoperatively. Orthognathic positioning system (OPS) is an occlusal-based surgical planning system that uses drilling and final positioning guides allowing the virtual surgical planning to be translated intra-operatively. It guides precise intraoperative repositioning of the osteotomized maxillofacial segments to achieve a final facial balance.

**Methods:** Both syndromic and nonsyndromic patients with severe facial asymmetry underwent treatment with virtual surgical planning and orthognathic positioning system. The indirect method of planning using cephalometric analysis, mock surgery on dental models, and use of multiple intermediate splints was replaced by VSP and OPS. The application and technique of OPS is presented in detail.

**Results:** Our patients with severe facial asymmetry were successfully treated with virtual surgical planning and orthognathic positioning system. This technique eliminated the need for extensive lab time and chemical exposure, and treatment planning time was reduced. Patients had no complications. Excellent functional and aesthetic outcomes were achieved with a single surgery.

**Conclusion:** Orthognathic positioning system in conjunction with virtual surgical planning allows successful execution of the intended preoperative plan and has resulted in superior clinical outcomes. This new innovative technique has enhanced our ability to treat patients with severe facial asymmetry with precision, accuracy, and efficiency.

# **Craniofacial**

# Use of Integra Biologic in Complicated Craniotomy Wounds with Exposed Dura – a Review of a Series

Jacob Thayer, BSN

Medical College of Wisconsin

Presenter: Jacob Thayer, BSN – Student Submission

**Background:** Coverage of craniotomy wounds for brain tumors or trauma may be difficult to achieve in the presence of infection, prior radiation, or scarring from prior surgery. Published single case reports have described use of dermal regeneration templates in such craniotomy wounds. We present an expanded perspective and report a case series detailing treatment of neurosurgical patients with full thickness scalp wound complications from craniotomy that underwent closure with Integra® (Integra Life Sciences Corporation, Plainsborough, NJ) as definitive coverage, or as a bridge to definitive flap coverage.

**Methods:** A case series of 6 patients who underwent Integra placement for dehiscence or infected craniotomy incisions between 2010 and 2013 at Froedtert Hospital was conducted. Data was collected on patient demographics, wound characteristics, surgical and healing timeline, and postoperative complications. Healing was defined as removal of sutures and donor site drains with complete epithelialization of grafts and incisions at 30 days.

**Results:** Craniotomy indications included brain tumor (n=4) and trauma (n=2). There was an average of 5.5 prior intracranial operations (range = 4-8). Wound beds needing closure had exposed dura (n=6), were complicated by infection (n=5) or sterile dehiscence (n=1), and had an average size of 105.5 cm<sup>2</sup> (range= 8-180 cm<sup>2</sup>) at the time of Integra placement. Integra served as a bridge to free flap transfer for an average of 45 days (range= 4-168) in 5 of 6 patients, and as definitive closure in 1 patient. No complications arose throughout this period and all 5 flap donor/recipient sites healed within 30 days.

**Conclusions:** Integra was successful in serving as a bridge or definitive closure in complicated craniotomy wounds in our case series of patients. This provides a reasonable option for neurosurgeons to treat such wounds, independent of plastic surgical consultation availability or in patients not medically optimized to undergo long reconstructive procedures.

## **Introducing Zebrafish as a Model to Study Cranial Suture Biology**

Ramy A. Shoela, Joanna P. Tomaszewski, Jolanta M. Topczewska, Arun K. Gosain.

Northwestern University Feinberg School of Medicine

Presenter: Ramy A. Shoela – Resident Submission

**Introduction:** Craniosynostosis is a congenital condition characterized by premature fusion of cranial sutures leading to skull growth abnormalities. Animal models have been used to understand the pathology of craniosynostosis. In this study we characterize the normal development of zebrafish cranial vault and provide novel experimental procedures for assessing zebrafish cranial vault for future studies. By establishing developmental norms and showing homology to accepted models, we introduce zebrafish as a tool for the study of craniosynostosis.

**Methods:** Zebrafish between 3 weeks and 2 years of age were stained with alizarin red and alcian blue for bone and cartilage (n=72), and the cranial vault was evaluated. The projected area of each cranial bone and suture was measured for morphometric analysis. Histologically stained sections of cranial sutures were analyzed and immunofluorescence was performed on SP7:EGFP transgenic lines to detect active osteoblasts. Cranial growth patterns were also assessed using sequential live staining with two calcium stains, alizarin red and calcein green with a period of washout in between.

**Results:** We observed the following bones and sutures of the zebrafish cranial vault: paired frontals and parietals, and an unpaired supraoccipital bone, and the corresponding cranial sutures: interfrontal, sagittal, coronal and lambdoid. Frontal and parietal bones develop through intramembranous ossification similar to higher vertebrates. Histological analysis revealed overlapping, as well as U shaped and end-to-end contact patterns of bones at the suture sites, resembling cranial sutures in mice. We demonstrated that early frontal bone growth is mainly directed towards the presumed interfrontal and coronal suture, while the parietal bone grows circumferentially.

**Conclusion:** We introduce zebrafish as a new model to explore cranial suture biology and to model craniosynostosis. Our data shows that zebrafish cranial vault development parallels currently accepted models and demonstrates homology to mammalian development. We describe the standard for normal development in-depth and introduce novel staining techniques to study bone growth patterns.

## Development of a Radiographic Classification Scheme for Nasolacrimal System Fractures

Authors: Ravi K. Garg, Michael J. Hartman, Mark J. Lucarelli, Glen Levenson, Ahmed M. Afifi, Lindell R. Gentry

University of Wisconsin

Presenter: Ravi Garg, MD – Resident Submission

**Background:** Fractures of the nasolacrimal system (NLS), including the lacrimal fossa and duct, have not been comprehensively described in patients with facial trauma. Characterization of these injuries may help facial trauma surgeons better predict which patients will develop lacrimal outflow obstruction symptoms including epiphora and dacryocystitis and who may eventually need lacrimal surgery.

**Methods:** CT images for all patients seen at the University of Wisconsin Hospital and Clinics for craniofacial trauma were reviewed from January 2001 to December 2005. Patients were included if they had a NLS fracture and at least 1 year of follow-up. Fracture patterns were described and correlated with clinical outcomes documented in the medical record. Outcomes, including the development of epiphora or dacryocystitis, and the need for lacrimal surgery were analyzed using Fisher's exact test.

**Results:** We identified 104 patients with NLS fractures among 1,980 patients with craniofacial trauma who had at least 1 year of follow-up. Eleven patients (10.6 percent) developed epiphora or dacryocystitis, and 2 patients (1.9 percent) required external dacryocystorhinostomy (DCR). Ten radiographic injury patterns were characterized. Avulsion of the lacrimal crest, bone fragment in the lacrimal fossa or duct, duct compression greater than 50 percent, and nasomaxillary buttress displacement were significantly associated with the development of epiphora or dacryocystitis ( $p < 0.05$ ). Nasomaxillary buttress displacement was significantly associated with the eventual need for external DCR ( $p = 0.03$ ).

**Conclusions:** Patients with radiographic evidence of a NLS fracture have an approximately 10% risk of developing epiphora or dacryocystitis. We describe 5 NLS fracture patterns that are significantly associated with the development of lacrimal outflow obstruction. The presence of nasomaxillary buttress fracture and displacement suggests a significantly higher risk of eventually needing lacrimal surgery.



# **The State of Global Health Training in Plastic Surgery Residency: Pragmatic Considerations and Future Directions**

Harry S. Nayar, MD, MBE; Delora L. Mount, MD; Michael L. Bentz, MD

University of Wisconsin

Presenter: Harry S. Nayar, MD, MBE – Resident Submission

**Background:** We sought to describe the current state of global health training in plastic surgery residency programs.

**Methods:** An electronic survey was distributed to RRC/AAMC certified residency programs. Programs having a formal global health curriculum were asked to describe the experience with regards to classification, collaboration details, regions travelled, conditions/procedures encountered, expense support, accreditation, and personal sentiment. Programs without a formal curriculum were asked to select barriers to implementation.

**Results:** Sixty-four questionnaires were returned from eighty-one residency programs (response rate: 79%). Programs identified as independent (n=16; 25%), integrated (n=25; 39%), or both (n=23; 36%). Twenty-six programs (40%) reported a formal global health curriculum; thirty-seven did not (60%). Most classified their curriculum as a clinical care experience (n=24; 92%) followed by an educational experience (n=19; 73%). Personal reference was the most common means to establish the international collaboration (n=19, 73%). The three most commonly encountered conditions were: cleft lip/palate (n=26; 100%), thermal injury (n=17; 65%), and post-traumatic reconstruction (n=15; 57%). Regarding dominant funding sources, 53% (n=14) selected non-profit organizations, 46% (n=12) chose faculty personal expenditures, and 38% (n=10) report section/division/department support. Although the majority of programs had not applied for PSOL/RRC recognition (n=23; 88%), many were considering applying (n=16; 62%). Overall, 96% of programs (n=25) reported being supportive of their global health curriculum, choosing exposure to different health systems (n=22, 84%) and surgical education (n=17; 65%) as reasons. For programs without a global health experience, the most commonly reported reasons were a lack of PSOL/RRC recognition of cases performed abroad (n=27; 73%), lack of funding for trip expenses (n=25; 67%) and salary support (n=24; 65%).

**Conclusion:** Programs endorsing global health training describe the experience positively, emphasizing clinical variety, exposure to different health systems, and importance in surgical education. Issues related to funding and case accreditation are major obstacles to incorporating a global health curriculum.

## **Bioresorbable Fixation Devices for Craniosynostosis: A Single Surgeon Experience**

Stephanie M. Cohen, MD, MS, David Morris, MD, Pravin K. Patel, MD

University of Illinois at Chicago

Presenter: Stephanie M. Cohen, MD, MS, - Resident Submission

**Introduction:** Over the past 25 years, cranial vault fixation for craniosynostosis has evolved from wire osteosynthesis to rigid fixation of the skull with titanium plates. With time it became evident that ectocranial fixation came to be translocated endocranially with the potential for complications. The advent of bioresorbable fixation system alleviated the concern for many surgeons. This study examines the long term outcomes of a consecutive series of bioresorbable fixation in single suture craniosynostosis patients.

**Methods:** A single surgeon (PKP) prospective study of 100 patients with single suture craniosynostosis to evaluate the length of time to dissolution of the plate with a minimum follow-up time was 36 months. All patients were photographed at the time of closure. A standardized form was completed to prospectively monitor the patients. Relevant variables related to the fixation system included plate prominence over time and complications, which included failure of resorption and exposure.

**Results:** 100% of plates were palpable prior to 6 months of age, 34% palpable at 12 months, 0% palpable by 24 months. This was dependent upon the specific chemical make-up of the plate composition. 4 patients (4%) required second operation for resorbable screw/plate protrusion or to clean out residual plate (14 mo, 15 mo, 18 mo, 19 mo). Remaining patients had no identifiable complications.

**Conclusion:** Although bioresorbable plates do not suffer from the translocation issues of their titanium predecessors, they are not without complications. The main identifiable cause of complication in our experience is failure of plate and screw resorption with the formation of a foreign body reaction and plate exposure when they crossed incisional lines. While this is an acceptably low complication rate, it is important to emphasize to parents the prominence of the plates, the failure for resorption and the need for reoperation in a small percentage of patients.

**Cosmetic**

## **No-Drain Lipoabdominoplasty: An Analysis of 100 Consecutive Patients**

Sarah Epstein; Karol A. Gutowski, M.D., F.A.C.S.; Michael A. Epstein, M.D., F.A.C.S.

MAE Plastic Surgery

Presenter: Sarah Epstein; - Student Submission

**BACKGROUND:** Subcutaneous surgical drains are commonly used in abdominoplasties to prevent seromas but are not tolerated well by patients and add additional discomfort after the procedure as well as patient anxiety and risk of infection. The lipoabdominoplasty modification may create a more favorable surgical field to eliminate the need for surgical drains without increasing seroma formation.

**OBJECTIVE:** To determine if surgical drains can be completely eliminated in lipoabdominoplasty procedures without an increased risk of seromas.

**METHODS:** A retrospective chart review of 100 consecutive standard, extended and circumferential lipoabdominoplasty patients done by a single surgeon with at least a 3 month follow up period.

**RESULTS:** Without using drains, seroma was identified in 5% of patients, which falls within the range of published seroma rates when drains are used. Other outcomes include: Hematoma and abscess each in 2% of patients, and granuloma, cellulitis and delayed wound healing each in 1% of patients.

**CONCLUSIONS:** The use of discontinuous undermining with liposuction, limited direct undermining in the midline, preservation of a thin layer of fibrofatty tissue on the superficial abdominal wall fascia and targeted surgical site compression can eliminate the need for surgical drains in lipoabdominoplasty without increasing seroma rates.

## **Aesthetic Mesh Repair of Severe Rectus Diastasis**

Jennifer E. Cheesborough, MD; Cayce Spencer Workman, BS, Gregory A. Dumanian, MD

Northwestern University, Feinberg School of Medicine

Presenter: Jennifer E. Cheesborough, MD; - Resident Submission

**Introduction:** Standard abdominoplasty rectus plication techniques may not suffice for the most severe cases of rectus diastasis. In our experience, prosthetic mesh facilitates the repair of severe female pattern rectus diastasis and male pattern epigastric rectus diastasis with or without concomitant ventral hernias.

**Technique:** After skin elevation and exposure of the anterior rectus fascia, the retrorectus space is developed just lateral to the linea alba. Soft polypropylene uncoated mesh, 7 cm in transverse dimension, is anchored with transrectus polypropylene sutures with bites taken 4 cm from the incised edge of fascia. The rectus muscles are then approximated in the midline with interrupted permanent suture. Skin tailoring via horizontal or vertical pattern abdominoplasty can be safely performed simultaneously.

**Methods:** A retrospective review of all abdominal wall surgery patients treated in the last four years by the senior author was performed. Those patients with either an isolated rectus diastasis repair with mesh or a combined ventral hernia repair with abdominoplasty were analyzed.

**Results:** Five patients, four female and one male, underwent mesh reinforced midline repair with horizontal or vertical abdominoplasty. Patient characteristics include: average age 41 years, average BMI 25.9, all nonsmokers, average width of diastasis 7.1 cm, and average surgery time 166 minutes. After an average of 20 months of follow up, none of the patients had recurrence of either a bulge or a hernia by physical examination.

**Conclusions:** For male and female patients with significant rectus diastasis, with or without concomitant hernias, the described mesh repair is both safe and durable. Although this is a larger operation than plication alone, it may be safely combined with standard horizontal or vertical abdominoplasty skin excision techniques to provide an aesthetically pleasing overall result.

## Enhanced Recovery Protocol After Microsurgical Breast Reconstruction: A Cohort Study

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Mayo Clinic

Presenter: Jorys Martinez-Jorge, M.D.,

**Objective:** Enhanced Recovery After Surgery (ERAS) pathways are designed to achieve early recovery for patients undergoing major surgery. To date, no data is available on the use of ERAS protocols in plastic surgery. The aim of this investigation was to evaluate the feasibility and safety of a procedure-specific ERAS pathway designed for women undergoing microsurgical breast reconstruction.

**Methods:** An ERAS protocol was instituted in November 2012 and was used for all inpatients undergoing microsurgical breast reconstruction using the abdominal donor site. 103 consecutive women were reviewed. In this retrospective cohort study, women under the ERAS pathway were compared with consecutive historical controls matched by procedure before ERAS was implemented. The primary outcome was a reduction in hospital length of stay (LOS). Thirty-day surgical outcomes were assessed to evaluate safety (readmissions, reoperations, and flap loss rates). Continuous variables were compared with a Wilcoxon rank sum test and categorical variables were compared with a chi-squared test.

**Results:** A total of 51 women were included in the ERAS group and were compared to 52 women in the control group. In the ERAS group, frequency of patient-controlled anesthesia (PCA) use decreased from 94.0% to 19.6% (p-value <0.0001). Length of PCA use decreased from an average of 59.6 hours in controls to 21.4 hours in the ERAS group (p-value < 0.0001). ERAS resulted in a 2.1-day reduction in LOS (p-value <0.0001) with stable unplanned readmission rates at 30 days (19.6% in the ERAS group versus 11.3% in the control group). No difference was observed in rate of any postoperative complication at 30 days (29.4% in the ERAS group versus 22.6% in the control group).

**Conclusion:** ERAS in women undergoing microsurgical breast reconstruction promotes successful early recovery and was associated with reduced LOS, reduced opioid intake with no increase in surgical morbidity and unplanned readmission rates.

## **Evaluating Autologous Lipofilling of Parry-Romberg Syndrome Associated Defects: Prospective 3-Dimensional Image Evaluation and Systematic Review of the Literature**

Yvonne Kaptein, BS; Katherine A. Rodby, MD; Anuja K. Antony, MD, MPH

Department of Plastic Surgery, University of Illinois at Chicago

Presenter: Yvonne Kaptein, BS – Student Submission

**Background:** Parry-Romberg syndrome (PRS) is a disfiguring craniofacial disease, causing progressive hemifacial atrophy of the soft tissue, and occasionally osseous framework, before spontaneously entering remission. Correction of severe defects has traditionally involved flaps to dramatically increase tissue bulk; however, the increasing utility of autologous lipofilling provides an alternative, less invasive strategy to address these patients results with minimal complications. Treatment characteristics and potential benefits have not been methodologically evaluated prior to this study.

**Methods:** Prospective evaluation with 3-dimensional imaging was completed in a patient treated with repeat lipofilling for PRS with quantitative volumetric analysis carried out using the 3D-MD system. For the systematic review of the literature, two search schemes in PubMed were conducted to which inclusion and exclusion criteria were applied. Articles were evaluated for cohort demographics, disease characteristics, donor site and aspirate processing, number of treatments, amount and location of fat injections, complications, imaging modalities and assessments, and qualitative outcome assessments.

**Results:** Our review yielded 127 cases describing autologous lipofilling to correct PRS soft tissue defects. Patients underwent 1-5 procedures(average 2.3), receiving a total of 5-400cc of grafted fat(average 75cc). Disease severity ranged between mild, moderate, and severe in 36%, 44%, and 20% of patients respectively. Analysis demonstrated that as disease severity increases, patients proportionally required increasing amounts of lipofilling and additional sessions to achieve adequate outcomes. When compared to flap-based reconstructions, reported benefits included decreased cost(31%), decreased operative time(22%), decreased donor site morbidity(44%), and decreased complications(22%). Aesthetic benefits of improved skin quality, more natural contours, and natural facial expressions were reported in 58%, 2%, and 11% of cases respectively.

**Conclusion:** Lipofilling is an alternative technique to achieve aesthetic corrections of soft tissue defects. Generally, increasing disease severity requires a proportionally increased number of procedures and lipofilling volume. Autologous fat grafting may serve as a monotherapy modality to correct a wide severity range of Parry-Romberg associated soft tissue atrophy.

## **Reducing Unplanned Reoperations for Mastectomy Skin Flap Necrosis- A Multidisciplinary Approach**

Charalambos K. Rammos, MD; Tanya L. Hoskin, MS; Judy C. Boughey, MD; David R. Farley, MD; Clive S. Grant, MD; Steven R. Jacobson, MD; James W. Jacub, MD; Tiffany T. Torstenson, DO; Ryan D. Reusche, MD; Amy C. Degnim, MD; Valerie Lemaine, MD, MPH

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**Purpose:** Necrosis of breast skin and/or nipple areolar complex (NAC) following skin-sparing mastectomy (SSM) or nipple-sparing mastectomy (NSM) and immediate breast reconstruction (IBR) can result in delayed adjuvant therapy, prosthetic infection and reconstruction failure. A multidisciplinary quality improvement (QI) project was undertaken using the DMAIC (Define, Measure, Analyze, Improve, Control) framework in attempt to reduce mastectomy skin flap necrosis. This study's goal was to assess the impact of the QI initiative in improving surgical outcomes by reducing unplanned reoperations for mastectomy skin flap necrosis in patients undergoing IBR.

**Method:** Consecutive cases of SSM or NSM followed by IBR were reviewed retrospectively for skin flap necrosis and unplanned reoperation for necrosis. Plastic and breast surgeons reviewed medical records and postoperative photographs for details of mastectomy skin flap necrosis and its management. Reoperations specifically performed for management of mastectomy skin flap necrosis were recorded. Reoperation rates were compared for time periods BEFORE initiating the QI project (Nov 2009-Oct 2010) and AFTER (Nov 2010-Dec 2011).

**Results:** 344 patients underwent 594 breast procedures (397 SSM and 197 NSM). 296 procedures were performed BEFORE the QI project was initiated (201 SSM and 95 NSM). AFTER the QI project began, 298 procedures were performed (196 SSM and 102 NSM). Overall, reoperation rates decreased significantly from the BEFORE group ( $22/296 = 7.43\%$ ) to AFTER group ( $10/298=3.36\%$ ,  $p=0.026$ ). The rate of reoperation of SSM cases decreased in the BEFORE vs AFTER group, but was not statistically significant ( $4.98\%$  vs  $3.06\%$ , respectively;  $p=0.330$ ). For NSM cases, reoperations decreased significantly from the BEFORE group ( $12/95=12.63\%$ ) vs AFTER group ( $4/102=3.92\%$ ,  $p=0.023$ ).

**Conclusions:** This multidisciplinary QI initiative to improve outcomes after SSM and NSM resulted in substantial reductions in unplanned reoperations for mastectomy skin flap and/or NAC necrosis in NSM. Further work is ongoing to identify factors that contributed to the reduction.