Aesthetic Abstract

Mapping a Danger Zone of the Dorsal Nerve of the Clitoris: Implications in Female Cosmetic Genital Surgery

Presenter:	Victoria Gordon, BS
Co-Authors:	Joanna Rowe, BS, Lauren Grubb, BS, Larry Segars, PharmD, DrPH, BCPS, FACE, FCCP, RPh, Christopher C. Surek, DO, Travis McCumber, PhD, Gilbert Willett, PT, PhD, OCS, CSCS, Anthony Olinger, PhD
Affiliation:	Kansas City University of Medicine and Biosciences, Kansas City, MO

OBJECTIVE: Complications following labiaplasty procedures are understudied and underreported[1] and could possibly include loss of sensation in the female pudendum[2]. As the number of procedures each year increase[3], it is important to continue to explore ways to ensure positive outcomes for patients. The aim of this study was to determine variability in the course and branching of the dorsal nerve of the clitoris (DNC) and to generate a surgical safe zone.

METHODS: Ninety-seven Cadavers from the University of Nebraska Medical Center, Creighton University, and Kansas City University anatomy labs were examined for this study. A shallow vertical incision was made from the pudendal cleft superiorly through the mons pubis. The glans clitoris was identified and used as a landmark while the fascia surrounding the body of the clitoris was carefully removed. The DNC was located where it pierces the perineal membrane and traced distally. The following measurements were taken: 1. from the point where the DNC pierces the perineal membrane to the urethra, 2. from the point where the DNC pierces the perineal membrane to the pubic bone, 3. from the angle of the clitoris to where the nerve branches on the dorsum of the body of the clitoris and 4. from that branch point to the distal most portion of the glans clitoris.

A subset of the population (n=72) cadavers were examined for abnormal branching patterns, which were noted and characterized. All statistical data analyses were conducted through IBM SPSS.

RESULTS: Thirty-five DNCs were characterized as anomalous in the branching pattern analysis. Type 1 was the typical DNC branching pattern (splits once into two terminal branches). Type 2 was distinguished by the presence of an early branch near where the DNC pierces the perineal membrane. Types 3-6 corresponded to the number of branches the DNC had (type 3 had 3 branches etc.). Finally, the measurements that were taken were used to generate a surgical safe zone which can be used to avoid injury to the DNC during procedures involving the female pudendum.

CONCLUSIONS: The findings of this study allowed the investigators to map out a surgical safe zone for procedures involving the female pudendum to avoid injury to the DNC and identify and classify anomalous branching patterns. This information should be useful to physicians performing procedures near the DNC to increase patient satisfaction and safety. Further research should be done into the DNC and outcomes of labiaplasties and other surgeries that could impact this nerve.

REFERENCES:

1. Goodman MP. Outcomes. In: Goodman MP, ed. *Female Genital Plastic and Cosmetic Surgery*. First. John Wiley & Sons, Ltd.; 2016:206-211.

2. Runacres SA, Wood PL. Cosmetic Labiaplasty in an Adolescent Population. *J Pediatr Adolesc Gynecol*. 2016;29(3):218-222. doi:10.1016/j.jpag.2015.09.010

3. Vieira-Baptista, Pedro; Almeida, Gutemberg; Bogliatto, Fabrizio; Bohl, Tanja Gizela; Burger, Matthe; Cohen-Sacher, Bina; Gibbon, Karen; Goldstein, Andrew; Heller, Debra; Likes, Wendy; Longo da Silva, Celene; Marchite K. International Society for the Study of Vulvovaginal Disease Recommendations Regarding Female Cosmetic Genital Surgery. *J Low Genit Tract Dis*. 2018;22(4):415-434. http://ovidsp.dc2.ovid.com/sp-4.02.1a/ovidweb.cgi?&S=CLNOFPCKBOEBMGLAJPCKBGBFBDGFAA00&Link+Set=S.sh.22%7C1%7Csl_10&Counter5=CRS_full_text%7C00128360-201810000-00028%7Covft%7Covftdb%7Covftt.

Aesthetic Abstract

The Role of Tranexamic Acid (TXA) in Rhinoplasty

Presenter: Stav Brown, BS
Co-Authors: Tal Brown, Ariel Tessone, MD
Affiliation: Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel

GOALS/PURPOSE: Prevention of blood loss is a chief consideration in plastic and reconstructive surgery. Tranexamic acid (TXA) has emerged as a lifesaving antifibrinolytic agent for treating traumatic hemorrhage, reducing intraoperative blood loss and transfusion requirements. Despite its high efficacy, favorable safety profile and large volume of existing literature in other surgical specialties, published reports on TXA use in plastic surgery, especially in aesthetic surgery, are limited and an optimal dosing regimen has not been yet described. The aim of this study was to evaluate the efficacy and safety profile of TXA in rhinoplasty.

METHODS/TECHNIQUE: All patients underwent rhinoplasty by a single surgeon using an intravenous bolus dose of 1 g TXA before skin incision. TXA was also added to local anesthesia (0.5 mg TXA in 5-ml saline 0.9% and 0.5 mg epinephrine in 10-ml lidocaine and 10-ml Marcaine) and injected locally before skin incision in the TXA group. Saline 0.9% IV bolus and standard local anesthesia (0.5 mg epinephrine in 5 ml saline 0.9%, 10 ml lidocaine and 10 ml Marcaine) were used for the control group. The authors' TXA administration protocols and techniques in rhinoplasty will be illustrated and presented in detail.

RESULTS/COMPLICATIONS: 100 elective primary rhinoplasties were included in the study. Hospital records were reviewed for patient demographics, operative times, postoperative periorbital ecchymoses and edema, return to social activity and secondary revision rates. Neither thrombotic events nor other TXA related complications were recorded.

CONCLUSION: This is the largest study to date on the use of TXA in rhinoplasty. Intravenous and local administration of TXA have a substantial effect in decreasing pain, periorbital edema, and ecchymosis and achieving a faster return to social activity in rhinoplasty patients. In addition, TXA has a potential advantage in reducing rhinoplasty revision rates. These findings highlight the importance of TXA's anti-inflammatory properties alongside its antifibrinolytic effects, cardinal in its role in aesthetic surgery procedures. These properties may be enormously beneficial in rhinoplasty where postoperative edema may mask results and influence patient and surgeon perception of surgical outcome for several months after surgery.

Aesthetic Abstract

Submandibular Gland Aesthetic Elimination with Neurotoxin

Presenter: Kristy L Hamilton, MD
Co-Authors: Roy Kim, MD, Rod J. Rohrich, MD, FACS
Affiliation: Baylor College of Medicine, Houston, TX

PURPOSE: Submandibular glands can be noticeable in some facelift and necklift patients. The current standard is to surgically remove them. The senior author has treated them with neuromodulators during necklift operative procedures and occasionally post-operatively with follow-up injections. We present a novel way to eliminate submandibular glands without the need for excision, achieving a smooth jawline contour post necklift surgery.

METHODS AND MATERIALS: Before any lower facelift and necklift, assessment is done by visual inspection and palpation of the submandibular glands to determine if they require neuromodulator injection.

During necklift, if the gland is prominent, then 50 units of Dysport (Galderma) is injected into each gland. 2 injections are placed into each gland. Care is taken to inject with a 25-gauge needle under direct visualization.

6 weeks after necklift, a post-operative visit with visual inspection and palpation of the submandibular gland is performed. If necessary, a repeat injection of 50 units of Dysport (Galderma) per gland is given.

EXPERIENCE/DATA: A total of 12 patients underwent initial necklift with Dysport injection from 2016-2020. Out of these patients, a total of 1 patient/ 8 % of patients required a second injection 6 weeks post surgery. No patient required a third injection.

A post-surgical survey was performed with interpretation by 3 independent plastic surgeons as well as a patient satisfaction survey.

Independent plastic surgeons who did not perform the actual necklift procedure were asked to grade the submandibular gland appearance from before and after photographs. Out of 12 patients, a total of 11 patients/ 92 % were deemed “Total Correction", 1 patients/ 8 % was deemed “Incomplete Correction” and a total of 0 patients / 0 % were deemed “No Correction”.

All 12 patients were asked similar questions. A total of 11 patients/ 92 % self reported “Total Correction, 1 patients/ 8% self reported “Incomplete Correction” and a total of 0 patients / 0% self reported “No Correction”.

1 patient required a 2nd injection due to continued palpability of the gland after surgery. She developed the sensation of "dry mouth" which resolved 2 months after the 2nd injection No other sequelae were noted by the patient or Plastic Surgeon.

No other sequelae were noted in any other patient, including excessive bleeding, pain at the submandibular gland size, irregular contour deformity, skin necrosis, or seroma formation.

SUMMARY: Dysport (Galderm) injection directly into the submandibular gland, whether through an open technique or by palpation, resulted in substantially less prominent gland and a more aesthetically pleasing jawline.

CONCLUSIONS: Direct submandibular gland excision has a risk of difficult to control bleeding due to the unique and random arterial supply of the gland. Having smaller exposure due to a necklift incision lateral to the gland does not aid in visualization of the gland and the blood supply.

Direct neuromodulator injection into the gland is a safe and effective way to decrease the visibility and palpability of the gland on a long term basis. We feel it is a useful alternative to surgical excision of the submandibular gland.

Aesthetic Abstract

Long-Term Functional Outcomes Following Septal Extension Grafting in Open Rhinoplasty

Presenter: Navid Pourtaheri, MD, PhD
Co-Authors: Kitae Eric Park, BA, Omar Allam, BS, Ludmila Chandler, BS, Derek M Steinbacher, MD, DMD
Affiliation: Yale School of Medicine, New Haven, CT

BACKGROUND: Septal extension grafts in rhinoplasty can successfully support tip projection/position, tension the lower lateral cartilages, and thereby open the nasal airway. Since long cartilage grafts under tension may warp or collapse over time, long-term outcomes must be evaluated in these patients. We aimed to assess long-term functional outcomes in a large series of patients who underwent septal extension grafting.

METHODS: Retrospective chart review was performed on all patients that underwent an open rhinoplasty approach that included use of a septal extension graft performed by a single surgeon from February 2013 through December 2018. Patients with a minimum 12 months post-operative follow up were included. Pre and post-operative functional outcomes including history of nasal obstruction, snoring, sleep apnea, sinus congestion, and sinus headaches were recorded. Patient demographics, types of grafts used, patient complaints, readmission, and reoperation rates were recorded. Statistical analysis was performed using McNemar's test.

RESULTS: Of the 385 patients who underwent open rhinoplasty with septal extension grafting during the study period, 127 with adequate follow-up were included; 72% females, 28% males, mean age 28 (range: 5 to 72) years. 83.5% primary rhinoplasty, 16.5% secondary rhinoplasty. Mean follow-up was 24.2 (range: 11.2 to 74.0) months. 10.2% had history of cleft lip, 49.6% had history of nasal trauma. Other graft types used included tip/infratip (92.9%), dorsal onlay (90.6%), spreader graft/flap (92.1%), and columellar strut/onlay (7.9%). 85.0% underwent a turbinate outfracture/coblation. Patients reported an improvement in (pre- vs. post-operative): nasal airway obstruction (89.8% vs 11.8%, $p<0.001$), snoring (55.1% vs 1.6%, $p<0.001$), sleep apnea (5.5% vs 0.0%, $p=0.016$), sinus congestion (45.7% vs 15.7%, $p<0.001$), and sinus headaches (6.3% vs 0.0%, $p=0.008$). All patients reported an improvement in aesthetic appearance, with 7.9% undergoing touch-up procedures such as filler or fat injection to smooth a minor contour deformity. 6.5% of patients in this cohort required reoperation; the most common reasons for reoperation were for nasal deformity/deviation (72.0%), persistent airway obstruction (20.0%), and scar revision/dermabrasion (8.0%). Only 3.1% of non-cleft, non-trauma patients required revision. No patients reported worsening of nasal airway patency.

CONCLUSIONS: Septal extension grafts, when applied in open rhinoplasty patients, can reliably and significantly improve functional outcomes in addition to the aesthetic benefits to tip projection and rotation. Quantitative analysis of nasal airway changes following septal extension grafting will be presented.

Breast Abstract

Factors Influencing Symptomatic and Non-Symptomatic Bulge Rates in the Abdominal Donor Site of Autologous Breast Reconstruction

Presenter: Armin Edalatpour, MD
Co-Authors: Ellen Shaffrey, MD, Pradeep K Attaluri, MD, Samuel O. Poore, MD, PhD, Ahmed M Afifi, MD
Affiliation: University of Wisconsin School of Medicine and Public Health, Madison, WI

INTRODUCTION: With continued demand for abdominal based breast reconstruction, it is important to understand all the factors influencing donor site morbidity. Previous studies mostly focus on type of flap and its associated donor site complications. However, we aim to assess other factors, including history of prior abdominal surgery, BMI, and specific operative details such as the total area of muscle harvested, portion of the rectus muscle harvested, status of the anterior fascia after abdominal closure, use of mesh, as well as the status of abdominal wall nerves.

METHODS: A retrospective chart review of patients undergoing autologous breast reconstruction from May 2012 to October of 2017 by two surgeons at a single institution was performed. Only patients with abdominal based breast reconstruction were included in the study. Demographics, prior medical and surgical history, intraoperative data, and postoperative course were collected. Primary outcomes of interest were non-symptomatic bulge found on physical exam and symptomatic bulge requiring surgical correction.

RESULTS: One-hundred and twenty women were identified with 39 undergoing unilateral and 81 undergoing bilateral breast reconstruction. Within the unilateral patient group, 30 patients underwent ms-TRAM and nine patients underwent DIEP reconstruction. The breakdown in the bilateral group is as follows: 39 bilateral ms-TRAM, 5 bilateral DIEP, 37 a combination of ms-TRAM and DIEP. The average follow-up was 2.01 years (range 0.04 to 7.52 years). Thirteen (10.8%) patients developed non-symptomatic bulge and 14 (11.7%) patients developed symptomatic bulge requiring surgical correction. Patient with BMI $\geq$ 30 were 3 times more likely to develop a symptomatic bulge (p=0.029). Similarly, patients with prior abdominal surgery were 7.2 times more likely to develop a symptomatic bulge (p=0.047). Patients with bilateral ms-TRAM reconstruction had higher rate of non-symptomatic and symptomatic bulge compared to any other reconstruction type (p=0.050). Size of muscle harvested did not have an effect on bulge development (p=0.674). Higher percentage of patients with muscle harvested from the central portion of the rectus muscle developed non-symptomatic bulge (p=0.008). In contrast, patients with muscle harvested from the medial or lateral portion of the rectus muscle had a 15% increased risk of developing symptomatic bulge (p=0.023 and p=0.021, respectively). The use of mesh, type of mesh, and location of mesh placement during abdominal wall reconstruction did not affect bulge development (p=0.236, p=0.285, p=0.195, respectively). Whether the anterior rectus fascia was closed or left open at the end of the case did not influence the bulge rate (p=0.122). Similarly, number of nerves severed did not influence the bulge rate (p=0.575).

CONCLUSION: High BMI and previous abdominal surgery significantly increase the risk of symptomatic bulge development. Location of muscle harvest from the rectus muscle influenced the rates of non-symptomatic and symptomatic bulge development, with muscle from the central portion of the rectus muscle resulting in significantly higher rate of non-symptomatic bulge, and muscle from medial or lateral portion of the rectus muscle resulting in higher rate of symptomatic bulge. Total muscle area harvested, use of mesh in abdominal reconstruction, or nerve preservation did not affect the rate of bulge development.

Breast Abstract

Immediate Targeted Nipple-Areolar Complex Re-Innervation: Improving Outcomes in Immediate Autologous Breast Reconstruction

Presenter: Ruth Tevlin, MD
Co-Authors: Philip S Brazio, MD, Nhung Tran, Dung H Nguyen, MD, PharmD
Affiliation: Stanford University, Stanford, CA

INTRODUCTION: Breast reconstruction often renders the chest skin and nipple areolar complex (NAC) insensate. As we continue to push the envelope in breast reconstructive surgery, patient expectations have evolved from the creation of a breast mound to the restoration of breast functionality. The nipple areolar complex (NAC) is the signature element of the breast and NAC preservation is associated with superior psychological outcomes in breast reconstruction. The rates of nipple sensation following NSM is extremely varied in the literature, ranging from 15 to 75% of patients, with unpredictable quality of sensibility. Recovery of sensation has been associated with improved quality of life in the breast reconstruction patient.

METHODS: We propose a new technique of preserving the intercostal nerves during mastectomy and using them to reinnervate the NAC following mastectomy and immediate autologous tissue reconstruction. A cdaveric nerve graft was then coapted to the proximal nerve stump using interrupted 7-0 prolene sutures. The nerve graft was tunneled through the flap using a passer and neurorrhaphy was performed at the base of the NAC with simple interrupted 7-0 prolene sutures, anchoring the perineurium of the nerve allograft to the nerve stump when available or dermis of the NAC. We performed a prospective analysis of 14 breasts that underwent nipple reinnervation during immediate autologous breast reconstruction. Mean age was 49 years (range: 32 to 61 years). Sensory outcomes, as tested with Semmes-Weinstein monofilaments, were compared to a cohort of breasts that underwent nipple sparing mastectomy and autologous reconstruction without neurotization.

RESULTS: Compared to control breasts, treated breasts had significant improvement in whole breast sensation (treatment 4.8+/-1.5; control 5.4 +/-1, p=0.0001). In addition, treated breasts had no significant difference in nipple sensation compared to pre-operative findings (treatment pre-op 3.2+/- 0.52; treatment post-op 3.9 +/- 1.1, p=0.096) for those patients followed for greater than 8 months, compared to control post-operative breasts who had significantly less nipple sensation (control pre-op 2.83; control post-op 4.9 +/ 1.5, p=0.0001) at median follow-up time of 36 months. Treated breasts also had significantly increased areolar sensation (control 5.68 +/- 0/9; treated-4.84 +/- 1.4; p=0.0001) and non-significant improvement of peripheral breast skin (control 4.9 +/- 1.1; treated 4.60 +/- 1.5; p=0.1321) versus control breasts.

CONCLUSION: Here, we report a technique of targeted NAC reinnervation that enhances NAC sensation following NSM with autologous reconstruction with re-innervation versus NSM with autologous reconstruction alone. In contrast to prior studies, we employ a control group to objectively quantify the extent of sensory restoration in the reinnervated group. All patients had sensory recovery at the nipple, in contrast to fractions of patients in prior studies.

Breast Abstract

Topical Tranexamic Acid (TXA) Safely Reduces Seroma and Time to Drain Removal Following Implant-Based Breast Reconstruction

Presenter:	Jason M. Weissler, MD
Co-Authors:	Joseph Banuelos, MD, Ahmed Alsayed, MD, Nho Van Tran, MD, Jorys Martinez-Jorge, MD, Oscar J Manrique, MD, Minh-Doan T. Nguyen, MD, PhD, Christin A Harless, MD
Affiliation:	Mayo Clinic, Rochester, MN

BACKGROUND: Tranexamic acid (TXA) has been demonstrated to be a valuable pharmacologic adjunct capable of decreasing intraoperative blood loss, hematoma, seroma, and bruising amongst various plastic surgery procedures. Despite its proven efficacy, safety, and acceptable cost profile in both the intravenous and topical form, the use of TXA in breast reconstruction remains understudied. As such, the purpose of this study is to investigate whether the topical administration of TXA reduces the risk of postoperative seroma and time until drain removal following immediate implant-based breast reconstruction (IBR).

METHODS: A single-center retrospective cohort study was performed to analyze all consecutive patients undergoing immediate first stage IBR following mastectomy between 2018-2020. Demographics, comorbidities, radiation history, and surgical characteristics were collected for all patients. The authors reviewed the incidence of postoperative seromas, days until drain removal, and hematomas amongst all patients who either did, or who did not receive topical TXA at the time of surgery. A minimum of one month of follow-up was required for inclusion. The patients in the intervention group received 75mL of TXA (3g in NaCl 0.9%), which was applied topically into the breast pocket prior to closure. Postoperatively, all drains were maintained to bulb suction, and outputs recorded. Drains were removed upon meeting removal criteria (<30cc for 2 consecutive 24-hour periods). Adverse events, such as thromboembolic occurrences were captured. Univariate analyses of demographic variables and postoperative outcomes were performed using Fisher's exact test for categorical variables and Mann-Whitney-Wilcoxon test for continuous variables.

RESULTS: A total of 364 patients were included in this study. Overall, 208 patients (374 breasts) received topical TXA, whereas 156 patients (280 breasts) did not. Patient characteristics and comorbidities were similar amongst the groups. The location of tissue expander placement (pre-pectoral vs. sub-pectoral), mastectomy specimen weight, and use of acellular dermal matrix were also similar amongst the cohorts. Patients who received TXA were more likely to undergo nipple-sparing mastectomy (n=232, 62%) than the patients who did not receive TXA (n=125, 44.6%) [$p<0.0001$]. Patients who received topical TXA were significantly less likely to develop postoperative seromas (n=28, 7.5%) than patients who did not receive TXA (n=35, 12.5%) [$p=0.032$]. Furthermore, patients who received TXA also had their surgical drains removed significantly earlier (12.3± 4.3 days) than the patients who had not received topical TXA (13.1± 4.9 days) [$p=0.024$]. Rate of hematoma amongst patients who received TXA (n=3, 0.8%) was not significantly different than the patients who did not (n=5, 1.8%) [$p=0.256$]. Adverse effects of TXA were not observed. Average follow-up amongst the TXA group and patients who did not receive TXA was 6.1± 3.9 months and 5.9± 2.8 months, respectively ($p=0.675$).

CONCLUSION: In the first reported use of topical TXA during IBR, the authors conclude that the use of topical tranexamic acid is associated with both a decreased risk of postoperative seroma and decreased drain duration, with an acceptable safety profile. Larger cohort analyses and prospective randomized controlled studies are warranted to further support these findings.

Breast Abstract

A Cost-Utility Analysis Comparing Immediate Oncoplastic Surgery to Delayed Oncoplastic Surgery in Smoking Breast Cancer Patients

Presenter:	Joshua A Bloom, MD
Co-Authors:	Ammar A Asban, MD MAS, Tina Tian, MD, Yurie Sekigami, MD, Albert Losken, MD, Abhishek Chatterjee, MD, MBA, FACS
Affiliation:	Tufts Medical Center, Boston, MA

PURPOSE: Oncoplastic surgery (OPS) allows for lower positive margin rates and improved aesthetic outcomes compared to traditional breast conservation surgery.[1] A Level 2 volume displacement oncoplastic surgery (LVOS) (also known as an oncoplastic reduction) allows for a large partial mastectomy through a reduction mammoplasty incision and is ideal for breast cancer patients with macromastia. Typically, a concurrent ipsilateral reduction mammoplasty is also performed.[2-3] However, if the patient is a smoker, the decision to perform a concurrent reconstruction is challenging. It can be argued that in order to allow sufficient time for the patient to stop smoking, reconstruction should be delayed until after adjuvant radiation. However, radiation can also cause poor wound healing and can increase the risk of a wound-related complication. LVOS with immediate and delayed reconstruction are associated with different clinical outcomes and costs. Our aim was to examine the cost-utility of immediate versus delayed reconstruction in LVOS when operating on a smoking patient with macromastia and a long-term commitment to smoking cessation.

METHODS: A literature review was performed to determine the probabilities and outcomes related to the treatment of unilateral breast cancer with immediate or delayed reconstruction with LVOS.[1-3] Reported utility scores were used to estimate the quality adjusted life years (QALYs) associated with a successful procedure as well as post-operative complications. A decision analysis tree was constructed with rollback analysis to highlight the more cost-effective strategy. An Incremental Cost-Utility Ratio (ICUR) was calculated. Single variable and probabilistic sensitivity analyses were performed to validate the robustness of the results.

RESULTS: Immediate LVOS is associated with a higher clinical effectiveness (QALY) of 33.3 compared to delayed (33.26), with a higher increment of clinical effectiveness of 0.07 and relative cost reduction of $3,458.11. This resulted in a negative ICUR of -50194, which was in favor of immediate reconstruction, indicating a dominant strategy. In one-way sensitivity analyses, delayed reconstruction was the more cost-effective strategy if the probability of successful immediate reconstruction falls below 29% or its cost exceeds $29,611. Monte Carlo analysis showed a confidence of 99% that immediate oncoplastic surgery costs less and is the more effective strategy.

CONCLUSIONS: Despite the known risk of post-operative complications associated with smoking, immediate LVOS is more cost-effective compared to delayed LVOS. The risks of post-operative complications are higher when operating on a radiated breast in the delayed setting, thus favoring immediate LVOS.

REFERENCES:

1. Munhoz AM et al. Outcome Analysis of Immediate and Delayed Conservative Breast Surgery Reconstruction with Mastopexy and Reduction Mammaplasty Techniques. *Annals of Plastic Surgery*. **2011**, Volume 67, Number 3, 220-225.
2. Asban A et al. A cost-utility analysis comparing large volume displacement oncoplastic surgery to mastectomy with single stage implant reconstruction in the treatment of breast cancer. *The Breast*. **2018**, 41, 159-164.

3. Chatterjee A et al. A Cost-Utility Analysis Comparing Oncoplastic Breast Surgery to Standard Lumpectomy in Large Breasted Women. *Advances in Breast Cancer Research*. **2018**, 7, 187-200.

Breast Abstract

Immediate Implant-Based Reconstruction of the Contralateral or Bilateral Prophylactic Mastectomies: Risk Factor Analysis for Index and Prophylactic Breast

Presenter: Utku Can Dolen, MD
Co-Authors: Megan Quan, BS, Marissa M Tenenbaum, MD, Terry Myckatyn, MD
Affiliation: Washington University School of Medicine in St. Louis, St. Louis, MO

PURPOSE: The number of bilateral mastectomies has dramatically increased over the past two decades. While it is reported that bilateral surgery substantially increases the risk of major complications, data is limited in identifying whether these are more likely to occur on the therapeutic versus prophylactic side.

METHODS: A retrospective chart review was conducted of 385 patients who underwent contralateral prophylactic mastectomies (CPM) and 131 patients who underwent bilateral prophylactic mastectomies (BPM) with immediate tissue expander or direct implant-based breast reconstruction (IBR). Patient characteristics, clinical information, and major surgical complications were evaluated. Multivariate analyses identified factors contributing to major complications, which were defined as events necessitating an unplanned subsequent surgery. The risk factors of interest included BMI, comorbidities, smoking status, history of previous breast conservation therapy, expander volume, radiotherapy, and chemotherapy. These were analyzed at both the patient level and at the breast level for the CPM/IBR groups.

RESULTS: 19.7% of patients in the CPM/IBR group and 19.8% in the BPM/IBR group had at least one major complication requiring extra surgery. Patients in the BPM/IBR group were generally younger than those of the CPM/IBR group ($p<0.001$). Nipple-sparing mastectomies ($p<0.001$) and direct implant reconstructions ($p<0.001$) were more common in the BPM/IBR group. Logistic regression analyses showed that smoking ($p<0.001$) and BMI above 25 kg/m^2 ($p=0.002$) corresponded with a greater number of major complications in the BPM/IBR group. Smoking ($p=0.003$) and BMI above 30 kg/m^2 ($p=0.027$) correlated with major complications in CPM/IBR group as well.

In the CPM/IBR cohort, the rate of major complications in the prophylactic breast was only 5.2%. Complications in the index breast occurred in 8.6% of cases, and bilaterally in 5.9%, of cases. Multinomial logistic regression analyses showed that a BMI above 30 kg/m^2 ($p=0.025$) and adjuvant chemotherapy ($p=0.019$) were related to major complications in both breasts. Smoking ($p=0.013$) and adjuvant radiotherapy ($p=0.02$) were factors significantly associated with complications in the index breast. Smoking ($p=0.039$), BMI above 25 kg/m^2 ($p=0.036$), and a history of radiotherapy ($p=0.004$) corresponded to complications in the prophylactic breast. In both the CPM/IBR and BPM/IBR cohorts, the number of additional surgeries following tissue expander placement was one; if a major complication happened, patients underwent at least three more surgeries ($p < 0.001$).

CONCLUSIONS: The decision to pursue a prophylactic mastectomy is usually made between the breast surgeon and the patient. Patients may be under the impression that a prophylactic mastectomy with reconstruction carries a reduced risk due to the absence of cancer, eliminates future risk of cancer – which it

does not, and may be worthwhile to improve symmetry. However, our study demonstrates that in the CPM/IBR cohort, almost half of the patients who had a major complication may not have required any unplanned surgery had they not elected for bilateral mastectomy. Undergoing an extra surgery due to a complication in a healthy breast can be more difficult to accept for both the patient and the surgeon. This study will aid plastic surgeons in conducting an evidence-based discussion with their patients.

Breast Abstract

Alternatives to Acellular Dermal Matrix in Breast Reconstruction: Outcomes from Dermal Autograft Assisted Tissue Expander Breast Reconstruction in 104 Consecutive Patients

Presenter: Brian D Rinker, MD
Affiliation: Mayo Clinic, Jacksonville, FL

PURPOSE: Acellular dermal matrices (ADMs) have many benefits when used in implant-based breast reconstruction, but they add cost to the procedure and may increase complications. In addition, many patients prefer to avoid human-based products if there is an autologous option. For this reason surgeons have sought viable alternatives to ADM in breast reconstruction. Dermal autografts can be harvested at the time of mastectomy and represent a useful, autologous alternative to ADMs.

METHODS: 104 consecutive patients (171 breasts) underwent breast reconstruction using tissue expanders and dermal autograft over a 7 year period. Age ranged from 32 to 73 years (median 53 years). Autografts were harvested from either the lower abdomen (n=86) or the inferior breast (n=18). Dermal autografts were used to cover the inferior pole of the tissue expander at the time of expander placement. Demographic data, clinical history, and harvest time were recorded. The initial fill volume, number of expansions, cost, and complications were compared to ADM-assisted reconstruction. Breast-Q surveys were mailed to all patients, and satisfaction ratings were compared to historical values of patients of patients undergoing ADM-assisted breast reconstruction. A cost analysis was performed of dermal autograft assisted reconstruction, and this was compared to historical values for ADM-assisted reconstruction.

RESULTS: Follow up ranged from 9 months to 7 years (mean 31 months). 25 patients were smokers. Mean BMI was 30.5 (range 19.1 to 48.8). 36 patients received chemotherapy between reconstructive stages, 7 required radiation. The mean time of autograft harvest was 27 minutes, however there was no difference in mean operative times between the ADM and autograft groups. The mean initial fill was 151cc, and the average number of expansions was 4.2. There were 3 infections resulting in implant loss (3%). There were 14 minor complications (13%). Mild capsular contracture was observed in 3 patients, and no patients underwent reoperation for capsular contracture. Initial expander fill, number of expansions, and complication rate were equivalent to historical values for ADM-assisted breast reconstruction. The mean per patient cost savings for dermal autograft versus ADM-assisted reconstruction was 3600 USD for unilateral and 7639 USD for bilateral reconstructions. Survey data (response 30%) showed no statistically significant difference in any Breast-Q category between the ADM and the dermal autograft groups.

CONCLUSIONS: The use of dermal autograft in tissue expander breast reconstruction offers the advantages of ADM at a lower cost. Dermal autograft-assisted breast reconstruction did not differ significantly from historical values for ADM regarding operative time, complication profile, capsular contracture, or patient-reported outcomes. However, cost was significantly lower in the dermal autograft group. Dermal autograft assisted implant reconstruction should be considered in patients undergoing breast reconstruction, especially in patients who wish to avoid human-based products.

Breast Abstract

Human Acellular Dermal Matrices Fabricated By Various Processes Elicit Diverse Host Responses in a Primate Model

Presenter: Hani Sbitany, MD
Co-Authors: Jared Lombardi, Amardeep Hoonjan, Joselito Ferrer, Hui Xu, Maryellen Sandor

PURPOSE: An assortment of human acellular dermal matrices (HADMs), manufactured using a variety of decellularization and antiseptic protocols, are commercially available and used for various surgical applications. While several studies in the literature have made direct comparison among multiple HADMs, few have linked in vivo biologic host response to tissue manufacturing method or resulting out-of-package biochemical and biomechanical attributes of the matrix. Here, we aim to evaluate 5 distinctly processed and disinfected HADMs in a non-human primate.

MATERIALS AND METHODS: African Green monkeys were implanted either subcutaneously on the back with two, 1x1 cm pieces each of electron-beam irradiated HADM (AlloDerm/e-HADM) and gamma-irradiated HADM (DermACELL/g-HADM) for 1 month, or in the dynamically-loaded site of the ventral abdominal wall with one, larger 3x7cm piece of either electron-beam irradiated HADM (AlloDerm/e-HADM), freeze-dried gamma-irradiated HADM (AlloMax/g-HADM-FD), ethanol-stored aseptically-processed HADM (Flex HD/EtOH-HADM), or freeze-dried aseptically-processed HADM (DermaMatrix/HADM-FD) for either 1, 3, or 6 months. All HADM samples were harvested at the specified time points and evaluated histologically for cellular ingrowth, vascularity, and inflammatory response, while dynamically-loaded HADM samples were additionally evaluated for regenerative response as judged by HADM-host interface integration and neo-collagen alignment. Host response established in these NHP models was compared to out-of-package in vitro mechanical properties as well as in vitro attributes established in previous studies.

RESULTS: Out-of-package, e-HADM had significantly higher tensile strength (379.4 ± 26.2N), than g-HADM, EtOH-HADM, HADM-FD, and g-HADM-FD (233.2 ± 33.1N, 233.1 ± 126.2N, 211.6 ± 18.6N, and 104.0 ± 17.8N, respectively). In previous benchtop studies, e-HADM had also been found to have ultrastructural characteristics, acid-soluble collagen content, and degree of susceptibility to digestion by collagenase more similar to native tissues than either g-HADM, EtOH-HADM, or g-HADM-FD. [1]

Subcutaneously implanted g-HADM samples demonstrated substantially greater inflammatory host response than e-HADM as determined through hematoxylin & eosin histologic analysis and immunohistochemically via anti-CD-68 antigen presence at 1-month implantation. In the dynamically-loaded model, a greater inflammatory infiltrate was evident histologically and immunohistochemically (CD-68/CD-3/CD-20) for g-HADM-FD, EtOH-HADM, and HADM-FD, as compared to e-HADM. Subsequently, degree of HADMs to resist in vivo contraction and extent of incorporation was greater grossly for e-HADM than other HADMs and was supported by histologic fibroblast cell infiltration at the HADM-primate tissue interface. Likewise, collagen fibers could be observed to align linearly in the direction of dynamic forces for e-HADM, while other HADMs in the study tended to demonstrate a scar-like morphology histologically. Vascularization/integration was shown to increase in terms of vessel number and relative size for e-HADM and was generally not inflammation-associated, while g-HADM-FD, EtOH-HADM, and HADM-FD vessels were either less evident or associated with areas predominated by inflammatory cell infiltration.

CONCLUSIONS: The data presented here appear to demonstrate a relationship between in vivo host response to HADMs in a non-human primate and benchtop attributes of these differently processed HADMs.

Maintenance of structural, biochemical, and mechanical attributes of HADM products appears to be crucial for positive host response in terms of cellular infiltration and vascularization, leading to improved incorporation with low inflammatory characteristics.

Breast Abstract

Acellular Dermal Matrix, Smooth Tissue Expanders, and Betadine: Histologic Assessment in a Primate Model

Presenter:	Maurice Y. Nahabedian, MD, FACS
Co-Authors:	Nimesh Kabaria, Jared Lombardi, Amardeep Hoonjan, Eric Stec, Braden Leung, Maryellen Sandor
Affiliation:	National Center for Plastic Surgery, McLean, VA

INTRODUCTION: It is known that an overabundance of pathogens in the setting of prosthetic breast devices can lead to infection, prolonged inflammation, and capsular contracture. As such, there has been increasing emphasis on the use of aseptic techniques that include antimicrobial irrigation solutions such as Betadine. The increasing use of human acellular dermal matrices (HADM) and prosthetic devices have raised questions as to whether exposure of the implant or tissue expander to Betadine may lead to deleterious effects related to HADM incorporation. The aim of this study was to determine if exposure of HADM to a Betadine-saturated tissue expander would affect the corresponding biological response.

METHODS: Samples (1.5x1.5cm) cut from custom-made smooth silicone tissue expanders (TE) (Allergan plc) were soaked in 100% Betadine for 2 minutes, without a subsequent saline rinse, or soaked in control saline alone, and then sutured to equivalently-sized HADM samples (AlloDerm, Allergan plc) to form an HADM:TE construct. Eighteen (18) African Green monkeys were each implanted subcutaneously with a pair of Betadine and saline-treated HADM:TE constructs and evaluated for overall biologic response to Betadine treatment following implantation at 2- or 4-weeks as demonstrated by hematoxylin & eosin histologic staining and using a subjective scoring scale (0 to 9) inclusive of recellularization, neovascularization, and inflammatory responses. The presence of individual cell types involved in inflammation (eosinophils, lymphocytes, neutrophils, histiocytes, foreign body giant cells) and HADM remodeling (fibroblasts) was also evaluated based on hematoxylin and eosin histologic staining (0-3 scoring scale) and in some cases corroborated by immunohistochemical staining (CD-3, CD-20, CD-68). Betadine-treated constructs were compared at 2-weeks (n=9) and 4-weeks (n=9) implantation to saline control-treated constructs with no exposure to Betadine also at 2-weeks (n=9) and 4-weeks (n=9) implantation.

RESULTS: Overall biologic response to the HADM in the presence of Betadine or saline control was similar at 2 weeks implantation, scoring 5.6 ± 0.5 and 5.3 ± 0.9, respectively (P = 0.41) and remained similar at 4 weeks, scoring 4.6 ± 1.0 and 4.2 ± 0.8, respectively (P = 0.46). Although the presence of individual inflammatory cell types appeared to trend higher in the saline control group than the betadine-treated group at 2 weeks, the difference was not statistically significant, and the trend did not persist at 4 weeks. Likewise, differences in HADM fibroblast infiltration were not significant between Betadine-treated and control groups. However, the presence of fibroblasts within the implanted HADM did increase over time between 2 and 4 weeks, for both the Betadine-treated (increase from 1.0 ± 0.9 to 1.8 ± 1.0) and saline control groups (increase from 1.4 ± 0.9 to 1.8 ± 0.8), indicative of ongoing HADM incorporation.

CONCLUSIONS: The data suggest that exposure of the HADM to a Betadine-treated TE did not negatively impact the host response to the implanted HADM in terms of inflammation, vascularization, recellularization, or overall HADM incorporation.

Breast Abstract

Abdominal Wall Thickness Vs. BMI As a Predictor of Complications after Abdominally-Based Free Flaps to Treat Mastectomy Defects

Presenter: Adee Heiman, MD
Co-Authors: Makai Dunne, BS, Megan Gray, MD, Ashit Patel, MBChB, FACS, Joseph A. Ricci, MD
Affiliation: Albany Medical College, Albany, NY

INTRODUCTION: Although BMI > 30 kg/m^2 is often considered a relative or absolute contraindication for abdominally-based free flaps, there is very little evidence in the literature that BMI correlates with complication rate. The purpose of this study was to determine whether BMI or abdominal wall thickness correlated with post-operative complication rate.

METHODS: A retrospective chart review was conducted on 151 patients who underwent abdominally-based free flap reconstruction after mastectomy at our institution. Pre-operative axial computed tomography scans were used to measure the distance from the skin surface to the abdominal wall at the umbilicus and at the lower abdomen (8 cm inferior to the umbilicus). The medical records of all 151 patients were then scanned for demographic data, medical history, BMI, surgical records, and post-operative complications. Mean BMI, mean Abdominal Wall Thickness at the Umbilicus (AWTU), and mean Lower Abdominal Wall Thickness (LAWT) were then compared between patients who did and did not develop overall, abdominal donor site, and breast recipient site complications. The mean LAWT was also compared between patients who had and had not experienced different subtypes of abdominal and breast complications (unpaired t test). Patients were then stratified into four groups based on LAWT, and complication rates were then compared between all four groups (Chi-squared).

RESULTS: Average BMI did not differ significantly between patients who did or did not experience any complication, abdominal complications, or breast complications. Mean AWTU was significantly higher in patients with overall complications ($p = 0.005$) and abdominal complications ($p = 0.003$) but did not differ significantly between those who did and did not experience breast complications. Average LAWT was significantly higher in patients who experienced all three types of complications ($p = 0.001$, 0.0001, 0.02, respectively), and so this point was chosen as the major comparison point. Patients with abdominal complications requiring re-operation ($p = 0.001$), abdominal wound healing complications ($p < 0.0001$), and breast wound healing complications (0.004) had a higher average LAWT compared to those without these respective complications, but no there was no significant difference between those who did and did not experience abdominal infectious complications, breast complications requiring re-operation, breast fat necrosis, or breast infectious complications. After stratification of complication rates based on LAWT groups, the rates of overall abdominal complications and abdominal wound healing complications significantly increased as LAWT increased ($p = 0.01$, 0.03, respectively). Breast wound healing complications were also higher in the high LAWT groups, although this did not reach statistical significance ($p = 0.2$).

CONCLUSIONS: Abdominal wall thickness is a much better predictor of complications after abdominally-based free flaps compared to BMI.

Breast Abstract

Breast Implants and Immune Modulation: Does Foreign Body-Induced Inflammation Promote Immunosurveillance of Breast Tumor Antigen?

Presenter:	Megan Fracol, MD
Co-Authors:	Nikita Shah, BS, David Dolivo, PhD, Seok-Jong Hong, PhD, Lexa Giragosian, BS, Robert D. Galiano, MD, Thomas A. Mustoe, MD, FACS, John Y.S. YS Kim, MD
Affiliation:	Northwestern University Feinberg School of Medicine, Chicago, IL

BACKGROUND: Women with cosmetic breast implants have significantly lower rates of subsequent breast cancer than the general population.[1] We hypothesize breast implant-induced local inflammation stimulates immunosurveillance recognition of breast tumor antigen.

METHODS: Women with breast-related complaints were recruited from the plastic surgery clinic. Sera was collected and tested via ELISA assay for antibody responses to common breast tumor antigens: BRCA2, CEA, HER-2, mammaglobin-A and MUC-1, as well as tetanus. A cohort of patients had sera collected prospectively to allow comparison of pre- and post-implant placement. Antibody response levels between long term breast implant (LTBI) and implant-naïve (IN) groups were compared with unpaired t-test. Antibody responses pre- and post-implant placement were compared with paired t-test. Statistical analysis was performed with Graphpad Prism v8.0.2.

RESULTS: One-hundred and four women were recruited. Thirty-six (34.6%) had LTBI while 68 (65.4%) were IN. Women with LTBI had higher antibody responses than IN to mammaglobin-A (OD450 0.33 versus 0.22, p=0.003) and MUC-1 (OD450 0.42 versus 0.34, p=0.02). There was no difference in antibody responses to BRCA2, CEA, HER-2 or tetanus. In the sample of patients with longitudinal sera samples pre- and post-op, antibody responses post-implant placement were significantly increased to mammaglobin-A (mean difference 0.13, p=0.0002) and MUC-1 (mean difference 0.08, p=0.02). There was no difference in post-implant responses to BRCA2, CEA, HER-2 or tetanus. There was no difference in antibody responses between women with or without capsular contracture, with or without rupture, with or without surface texture or with sub-glandular versus sub-muscular placement.

CONCLUSION: Women with LTBI have higher antibody recognition of breast tumor associated antigens mammaglobin-A and MUC1. This study provides the first evidence of implant-related immune responses to breast cancer antigens.

REFERENCES:

1. Noels EC, Lapid O, Lindeman JHN and Bastiaannet E. Breast implants and the risk of breast cancer: a meta-analysis of cohort studies. Aesthetic Surgery Journal. 2015;35(1):55-62.

Breast Abstract

A National Survey to Assess the Population's Perception of Breast Implant Associated Anaplastic Large Cell Lymphoma and Breast Implant Illness

Presenter: Alain J. Azzi, MD

Co-Authors: Yasser Almadani, MD, Peter Davison, MD

Affiliation: McGill University, Montreal, QC, Canada

INTRODUCTION: The goal of this study was to gauge the public's general perception of breast implants, levels of concern, spontaneous word associations and misperceptions that might need to be addressed by plastic surgeons regarding *Breast Implant-Associated Anaplastic Large Cell Lymphoma*(BIA-ALCL) and *Breast Implant Illness*(BII).

METHODS: An anonymous survey was completed by a total of 979 female participants in the US by means of MTurk.

RESULTS: Over 91% of participants indicated that they have never heard the term*BIA-ALCL*.Of the respondents who were aware of the term, 37.21% report being "moderately" or "extremely" concerned about BIA-ALCL and 85.4% were less likely to recommend breast implants to a friend. Awareness of BII was significantly higher at 50.9% while almost 40% of participants report being either "moderately" or "extremely" concerned about BII. Over 78% of participants were less likely to recommend breast implants to a friend because of BII. The most common word association with BII was "pain". The terms "cancer" and "scary" were the two most common word associations with BIA-ALCL. A significant overlap in word associations was observed between BIA-ALCL and BII, potentially representing a lack of distinction between the two terms. The survey demonstrated a paucity of important knowledge within the general population, notably 71% of respondents who were not aware that, to date, only textured implants/expanders were associated with BIA-ALCL.

CONCLUSION: These findings support the need for further targeted awareness to remedy existing misperceptions and fill the knowledge gaps relating to BII and BIA-ALCL.

Breast Abstract

Air v. Saline: The Effect of Tissue Expander Fill Prepectoral Breast Reconstruction Postoperative Complications

Presenter: Pooja Yesantharao, MS

Co-Authors: Nada Rizk, MS, Shanique A Martin, BS, Ruth Tevlin, MD, Gordon K. Lee, MD, Rahim Nazerali, MD, MHS

Affiliation: Johns Hopkins University School of Medicine, Baltimore, MD

BACKGROUND: A common practice in breast reconstruction is two-stage implant reconstruction with initial tissue expander placement. Traditionally, saline is added to the tissue expander intraoperatively, followed by continued expansion with saline postoperatively. Recently, intraoperative expansion with air rather than saline has been proposed to reduce the pressure applied to the mastectomy skin flap and incisions in the immediate postoperative setting. The aim of our study was to determine if tissue expansion fill (air versus saline) affects postoperative complications in the setting of pre-pectoral delayed immediate reconstruction.

METHODS: A retrospective cohort study of 144 breasts (86 patients) who underwent immediate prepectoral breast reconstruction with full anterior coverage with ADM over a 2-year period was performed. Patient demographics, intraoperative tissue expander fill medium, and the occurrence of postsurgical complications were analyzed. Crude and multivariable-adjusted logistic regression estimated odds ratios were used to identify predictors of postsurgical complications. To account for the potential clustering of 144 breast interventions from 86 women, regressions used robust variances. Statistical analyses were performed using SAS software v9.4.

RESULTS: The demographic and clinical data were well matched between study cohorts. The mean follow-up time is 196 days (range: 85 to 633 days) and the average age is 46.7 years old. Initial tissue expander fill volume was similar (p=0.2). ASA III+, BMI, diabetes, and smoking status were added in a step-wise fashion as potential confounding variables in the model. The crude association between air versus saline fill on overall complication suggests a protective effect when the tissue expander is filled with air, OR=0.5 (p=0.04) and the suggested protective effect is maintained as potential confounding variables are added to the model OR=0.4 (p=0.05). Fewer complications requiring salvage reoperation were observed when tissue expanders were filled with air, OR=0.3 (p=0.02). Additionally, there is a suggested protective effect regarding skin flap necrosis if the tissue expander is air-filled, OR=0.7 (p=0.6).

CONCLUSION: The medium used in immediate intra-operative tissue expansion affects post-operative outcomes of patients undergoing delayed immediate pre-pectoral breast reconstruction. Here, we demonstrate that air-filled tissue expanders were associated with significantly less post-operative complications following breast reconstruction relative to saline-filled tissue expanders.

Breast Abstract

A Comparative Quantitative Study of Silicone Particles and Foreign Body Reaction in En Bloc Capsulectomy Specimens: An Underestimated Phenomenon and a Critical Difference between Implant Surfaces.

Presenter:	Michel Alain M Danino, MD, PhD, FRCSC
Co-Authors:	Arij El Khatib, MD, Jean-Philippe Giot, MD, PhD, Laurence Paek, MD, Andrei Odobescu, MD, Monica Iliescu Nelea, PhD, Louis Gaboury, MD, PhD, Rejean Couture, Joseph Bou-Merhi, MD
Affiliation:	Montreal University, Montreal, QC, Canada

PURPOSE: In recent years, several controversies have arisen concerning breast implants, including late seromas, double capsules, BIA ALCL or BII. All have in common the premise of chronic inflammation surrounding the breast implant as a causative factor. We believe that this inflammation may be linked to micro-silicone particles in the capsule surrounding breast implants. We propose for the first time to quantitatively assess silicone particle bleeding into the breast capsule as well as the resulting inflammation surrounding these silicone particles.

MATERIALS AND METHODS: Patients undergoing an en bloc capsulectomy after breast reconstruction or augmentation using silicone breast implants without any active pathology were included in this study after institutional review board study approval and informed patient consent. These patients were divided into 3 groups of 3 individuals each by the type of their implant surface: Smooth (Mentor), Siltex (Mentor), and BioCell (Allergan). During surgery, 2 capsule samples, each measuring 1x1cm were harvested at the following levels: expander implant dome (anteriorly, centrally), the rib cage (laterally), and the posterior side of the capsule. One capsule sample from each location was then sent for Scanning Electron Microscopy (SEM), while the other was sent for histological studies.

A meticulous count of the number and size of silicone particles imbedded in the capsule specimens, as well as a measurement of the magnitude and type of the inflammatory reaction around these silicone particles was performed over the entire thickness of these 1x1cm capsule tissue blocks. This allowed us to extrapolate to a number of particles per implant and to estimate the extent of the inflammatory reaction surrounding each type of breast implant.

RESULTS: The silicone particle density and foreign body reaction markers were significantly higher on the lateral sides of the capsule specimens and there was a significantly higher particle density in the BioCell implants when compared to smooth and Siltex implants. With a number of particles ranging from 12000 to 1,2 million particles in the capsules (Wilcoxon p=0.004 and p=0.008 respectively).

CONCLUSION: Our results confirm our initial hypothesis that there is chronic inflammation in patients with breast implants linked to the presence of micro-silicone particles in breast capsules. This chronic inflammation exists at an unexpectedly high level, and could be the causative factor for a systemic reaction and pathological stimulation of the immune system, eliciting breast-implant associated pathologies.

Breast Abstract

Prepectoral Breast Reconstruction Is Safe in the Setting of Adjuvant Radiation Therapy

Presenter:	Chao Long, MD
Co-Authors:	Franca Kraenzlin, MD, George Kokosis, MD, Pathik Aravind, MBBS, Justin M. Sacks, MD MBA, Gedge D. Rosson, MD
Affiliation:	Johns Hopkins University, Baltimore, MD

PURPOSE: Prepectoral breast reconstruction has been shown to be similar in clinical outcomes to the subpectoral approach, while eliminating animation deformity and decreasing postoperative pain, loss of strength, operating times, and hospital stays. Although many of these patients undergo adjuvant radiation therapy (XRT), which is well-known to increase the risk of all complications following reconstruction, there is limited data on outcomes and safety of prepectoral breast reconstruction in this setting. The purpose of this study was to compare the clinical outcomes of prepectoral versus subpectoral two-stage implant-based breast reconstruction in patients undergoing adjuvant XRT.

METHODS: We conducted a retrospective review of all consecutive two-stage implant-based breast reconstructions performed at our institution during a 22-month period from September 2016 to July 2018, with a minimum follow-up of 10 months. Patients who received adjuvant XRT were identified, and two cohorts were created: those who underwent prepectoral versus subpectoral breast reconstruction. We collected data including

patient demographics, operative variables, and clinical outcomes. Univariate analyses and multivariate logistic regression were conducted, with statistical significance set as $p < 0.05$.

RESULTS: We captured 313 patients, or 492 breasts, that had undergone two-stage reconstruction. Of those, 69 breasts received adjuvant XRT. 28 were reconstructed prepectorally, and 41 breasts subpectorally. The two cohorts were well matched, with no differences in age, body mass index, smoking, mastectomy location, need for lymph node biopsy, mastectomy specimen weight, or use of incisional wound vacuum ($p>0.05$). The prepectoral cohort had a higher rate of diabetes (14.3% vs. 0.0%, $p=0.02$).

We detected no differences in clinical outcomes between the two groups (prepectoral vs. subpectoral, $p>0.05$), including rate of return to the operating room (OR), capsular contracture, explantation, necrosis of the nipple or skin, infection, hematoma, seroma, dehiscence, or readmission. There however were differences in certain perioperative variables. Prepectoral reconstruction was associated with a shorter time in the OR (257.0 vs. 325.6 minutes, $p=0.006$), shorter length of stay (LOS) (1.0 vs. 1.4 days, $p=0.02$), higher cost ($28,391.7 vs. $23,316.7, $p=0.03$), and shorter time to final reconstruction (320.2 vs. 422.7 days, $p=0.04$). Multivariate logistic regression demonstrated that prepectoral reconstruction does not predict likelihood of developing a complication (OR 0.63, CI 0.21-1.83, $p>0.05$).

CONCLUSIONS: We found that prepectoral reconstruction is safe in the setting of adjuvant XRT, with similar rates of all complications as compared to subpectoral reconstruction. To our knowledge, this is the largest cohort of radiated prepectoral two-stage breast reconstructions to be studied. Although radiation is a known risk factor for all complications following breast reconstruction, we did not find device location to influence complication rate in this high-risk population. Importantly, although rate of capsular contracture is reported to be higher in the general prepectoral population, we did not find this to be true in our radiated population. Prepectoral reconstruction is associated with higher OR cost, however this cost may be recuperated with the overall shorter LOS. Aesthetic outcomes were not considered but will be studied prospectively in future studies.

Breast Abstract

A Quantitative Analysis of Inframammary Fold Position Changes with Radiation after Tissue Expander Placement and Exchange

Presenter:	Nirbhay S Jain, MD
Co-Authors:	Ginger C Slack, MD, Nance Yuan, MD, Jason Roostaeian, MD, Jaco Festekjian, MD, Andrew L. Da Lio, MD, Christopher Crisera, MD
Affiliation:	David Geffen School of Medicine at University of California, Los Angeles, Los Angeles, CA

BACKGROUND: Postmastectomy radiation therapy (PMRT) has well-defined ill effects on the character of the skin envelope of the breast, most directly causing contraction and elevation of the breast, especially at the inframammary fold (IMF). These effects negatively impact breast symmetry, overall aesthetic outcomes, and patient satisfaction. Though radiation-induced skin changes have been qualitatively described, quantitative changes to the position of the IMF due to radiation have not yet been described. Despite maneuvers to lower the fold when PMRT is expected, the reoperation rates have been reported as high as 28%. Delineating numerical values may allow more specific intraoperative adjustments to better approximate the IMF to the pretreatment level. Herein we discuss our analysis of the effect of radiation on IMF position in patients who underwent expander placement and subsequent radiation.

METHODS: Patients who underwent breast reconstruction with Tissue Expanders from January 2015 to October 2019 at UCLA by four attending surgeons were reviewed. Operative reports were reviewed and indicated disruption of the IMF in all patients during mastectomies, requiring resetting of the IMF with suture. Patient inclusion criteria required that patients have corresponding sets of pictures at three timepoints: (1) preoperative (before mastectomy), (2) postoperative (after tissue expander placement and before radiation), and (3) post radiation (before exchange to permanent implant). Photographs were retrospectively analyzed by a single surgeon. In the lateral view, the distance from the acromion to IMF was measured, and compared to acromion to elbow, and recorded as a ratio to allow for variation of photographic focal length differences. Changes in IMF from pre to post-radiation were measured as a percentage change.

RESULTS: Fifteen patients with appropriate photos over the past year were analyzed of which ten had pictures at all three timepoints, and five had only the last two timepoints and were excluded. All operative reports were reviewed verifying that the IMF was disrupted after mastectomy in all group. Fourteen had unilateral radiation and one had bilateral radiation, thus sixteen breasts were reviewed separately. For the ten patients with preoperative photos, the IMF ratio from timepoints 1 to 3 (preoperative to post-radiation) was -12.5+5.2%, indicating a significant elevation of the IMF following radiation.

CONCLUSIONS: Inframammary position after tissue expander placement and radiation reliably elevates approximately 12% above the position of the preoperative fold. This study is the first of its kind to quantitatively measure radiation change elevation on the inframammary fold in tissue expander reconstructions. This finding may be a useful guide for setting the inframmary fold at the time of tissue expander placement, and avoid need for second stage fold lowering at the time of implant exchange.

Breast Abstract

Improvement in Quality of Life Following Breast Reconstruction in Patients with Stage IV Metastatic Breast Cancer

Presenter:	Geoffrey E Hespe, MD
Co-Authors:	Niki Matusko, BS, Jennifer B. Hamill, MPH, Jeffrey Kozlow, MD, MS, Edwin G. Wilkins, MD, MS
Affiliation:	University of Michigan, Ann Arbor, MI

PURPOSE: Metastatic breast cancer makes up approximately 6% of all newly diagnosed breast cancer, but with enhancements in treatment options, more patients with advanced disease are living longer. While more advanced staged patients are undergoing breast reconstruction, there are few published reports on the benefits and risks of reconstruction in the setting of metastatic breast cancer. Such investigations are important in light of the potential impact of adjuvant cancer therapies on surgical complications and post-reconstruction quality of life. In this study, we assessed patient-reported outcomes (PROs) and risks of mastectomy reconstruction in patients with Stage IV breast cancer.

METHODS AND MATERIALS: This study utilized the Mastectomy Reconstruction Outcomes Consortium (MROC) data set, which prospectively collected data from 11 institutions from 2012 to 2015. Patient characteristics by groups and complications were analyzed using Chi-square tests and/or independent t-tests as appropriate. Single factor linear mixed models were used to account for hospital level clustering and to compare

groups for satisfaction with breast, psychosocial well-being and sexual well-being using the Breast-Q at baseline (pre-reconstruction) and 2 years post reconstruction.

RESULTS: There were 26 MROC patients with Stage IV breast cancer and 2613 with Stage I-III disease (controls). There were no differences between the cohorts for mean age (control 50.1±9.9 versus 48.8±10.4 in the metastatic group), BMI, smoking status, race, ethnicity, income, marital status, or employment. There was no significant difference in radiation between groups, but there were significant differences in receipt of chemotherapy and in surgical evaluation of lymph node status. We evaluated PROs at baseline and 2 years. We found that metastatic patients had significantly lower baseline scores for satisfaction with breast (46.39 vs. 58.50; $p<0.005$), psychosocial well-being (61.28 vs. 68.27; $p<0.05$) and sexual well-being (38.16 vs. 53.08; $P<0.001$). Interestingly, at 2 years' post-reconstruction, there were no significant differences in scores between Stage IV and Stage I-III patients. Finally, evaluation of any (all), and major (requiring reoperation or re-hospitalization) complications demonstrated no difference between the control and metastatic cohort.

CONCLUSIONS: With improvements in treatment, patients with metastatic breast cancer are living longer, and more of them are undergoing breast reconstruction. We found that patients with Stage IV disease reported significant improvements in satisfaction with breast, psychosocial well-being and sexual well-being, with two-year PRO scores comparable to those of women with non-metastatic disease. Furthermore, disease stage had no significant effects on risks of complications. Although this study has some limitations (i.e. small sample size, possibility of confounding), we believe these data support the important role of breast reconstruction women with metastatic breast cancer.

Breast Abstract

Randomized Control Trial of the Utility of Preoperative CT-Angiography in DIEP Flap Breast Reconstruction

Presenter:	Ariel Johnson, B.S.
Co-Authors:	Salih Colakoglu, MD, Jonathan David Freedman, Md, PhD, Tae Chong, MD, David W. Mathes, MD
Affiliation:	University of Colorado, Aurora, CO

BACKGROUND: CT-Angiogram has become the preferred method for the planning of abdominal based microsurgical breast reconstruction to gather information about location, number, caliber and trajectory of the abdominal perforators and to decrease overall flap dissection and operating room time. However, the high-level evidence to support its utility has been limited to non-randomized retrospective and prospective studies.

METHODS: Patients undergoing deep inferior epigastric artery perforator (DIEP) flap breast reconstruction were prospectively randomized to preoperative CT-Angiogram and no imaging groups. Patient demographics, operative times, selected row and number of perforators for flap harvest, agreement in perforator selection between radiologist and surgeon and clinical outcomes data were collected. Two-way ANOVA, Fischer's exact and Student t- tests were used for statistical analysis.

RESULTS: Overall, 37 patients with 63 flaps were included in this study. Seventeen patients had CT scan prior to surgery. Mean age was 50.5 ± 9.64 years. Flap dissection time was significantly shorter in the CT group (150.82 ± 17,866 vs 184.74 ± 25.125 min, $p< 0.001$). Although overall OR time was also shorter in CT group, this only reached to a statistical significance in bilateral surgeries (575.91 ± 70.10 vs 641.87 ± 79.55, $p= 0.038$).

Hemiabdomen side, selected DIEA row and number of dissected perforators did not effect the overall dissection time. Complication rates were similar between the two groups.

CONCLUSION: This prospective, randomized study demonstrates that preoperative CT- Angiogram analysis of perforators decreases flap harvest and overall OR time with equivalent post-operative outcomes.

Breast Abstract

Assessing Complication Profile of Perioperative Versus Prophylactic Postoperative Antibiotics for Pre-Pectoral Tissue Expanders in Immediate Breast Reconstruction: A Pilot Study

Presenter: Danielle L. Sobol, MD
Co-Authors: Jenny Yu, MD, Rebecca Desanti, MD, Shannon M Colohan, MD

PURPOSE: Tissue expanders are frequently placed after mastectomy to preserve the native breast skin envelope; however, one notable risk associated with tissue expanders is implant-associated infection. Within plastic surgery literature, there remains debate regarding the appropriate duration of antibiotics for tissue expander-based immediate breast reconstruction (TE-IBR). Based on prospective studies reporting no significant difference between perioperative antibiotics (POA) versus prophylactic postoperative antibiotics (PPA)[1], our plastic surgery division transitioned from PPA until surgical drain removal to POA alone for patients after TE-IBR. This study evaluated POA effectiveness compared to PPA with particular interest in postoperative complications at 30 and 90 days.

METHODS: A retrospective chart review was undertaken to analyze patients 18 years of age or older undergoing pre-pectoral TE-IBR at a single, large-volume institution by five oncologic breast surgeons and five plastic surgeons. All patients who met inclusion criteria over a six-month total time period (February to August 2019) were evaluated. Three months of which included the pilot cohort with POA alone and the preceding three months when patients received PPA until drain removal. Preoperative patient characteristics, intraoperative details, and postoperative complications were recorded.

RESULTS: 40 patients underwent immediate, pre-pectoral TE-IBR for total placement of 60 tissue expanders (TE) when considering bilateral cases. 12 patients (16 TE) received POA and 28 patients (44 TE) received PPA. 8 (66.6%) POA patients developed complications of any type within 30 days, compared to 8 (28.6%) PPA patients ($p = 0.04$). These 30-day complications included surgical site infection (SSI) (25% POA vs. 0% PPA), flap skin necrosis with implant exposure (8.3% POA vs. 0% PPA), seroma requiring aspiration (25% POA vs. 25% PPA), and superficial wound dehiscence (8.3% POA vs. 3.6% PPA). In reviewing the 90-day complications, the POA group did not have a higher complication profile ($p = 0.17$). Of the 5 POA patients who experienced a SSI post-operatively, all received additional antibiotics, Ultimately, 33.3% of POA patients required TE explant compared to 3.6% explant rate in the PPA group ($p = 0.02$). There was no difference in number of emergency department visits ($p = 1.00$) or unplanned hospital admissions ($p= 0.07$).

CONCLUSIONS: During a trial period of perioperative-only antibiotics, we noticed an increase in surgical site infections in patients undergoing immediate pre-pectoral TE-IBR compared to patients who received antibiotic prophylaxis until drain removal. The patients in the POA group required additional antibiotic prescriptions and underwent increased expander explant rates. The data suggests that immediate tissue expander placement into a pre-pectoral tissue plane may have a different risk profile than defined in prior studies which involved submuscular or dual plane expander placement. Future work at our institution will focus on conducting a

prospective randomized control trial to further analyze whether prophylactic antibiotics until drain removal is needed in this patient population.

REFERENCES:

1. Brett et al. Are Prophylactic Postoperative Antibiotics Necessary for Immediate Breast Reconstruction? Results of a Prospective Randomized Clinical Trial. J Am Coll Surg. 2013;22:1116-1124.

Breast Abstract

A Critical Appraisal of Late Complications of Prepectoral Vs. Subpectoral Breast Reconstruction Following Nipple-Sparing Mastectomy

Presenter:	Caroline A. King, MS
Co-Authors:	Alex J. Bartholomew, MD, Michael Sosin, MD, Azalia Avila, MD, Amber L. Famiglietti, MD, Idanis M. Perez-Alvarez, BS, Caroline A. Schreeder, MD, FACS, Ian T. Greenwalt, MD, Kenneth L. Fan, MD, David H. Song, MD, MBA, FACS, Eleni A. Tousimis, MD, MBA, FACS
Affiliation:	Georgetown University School of Medicine, Washington, DC

PURPOSE: Nipple-sparing mastectomy (NSM) offers improved aesthetics without compromising oncologic safety. Subpectoral (SP) breast reconstruction has long been standard practice, though prepectoral (PP) reconstruction has recently resurged in popularity. Due to this recent paradigm shift, studies comparing long-term outcomes by reconstructive plane are lacking.

METHODS: A retrospective review was conducted on consecutive NSMs with implant-based reconstruction in either the PP or SP plane from 2014 to 2018. Patient demographics and operative details were collected to evaluate primary outcomes of prosthetic failure (PF) and unplanned reoperations by reconstructive plane. Secondary outcomes included animation deformity, capsular contracture, rippling, plane change, and minor revisions including fat grafting. Univariate and multivariate analyses were performed to assess outcomes.

RESULTS: 405 NSMs were performed on 228 women (SP=202, PP=203) with mean follow-up of 2.1 (1.1) years. PP reconstructions were more often direct-to-implant (DTI) compared to SP (73.9% vs. 33.2%, $p<0.001$). PP reconstruction demonstrated significantly reduced PF (OR 0.37, 95% CI 0.18-0.76) and unplanned reoperations (0.58, 0.34-0.98) compared to SP. PP patients experienced decreased animation deformity (AD) overall (19.7% vs. 0.0%, $p<0.001$), with plane changes seen in 10.6% of SP reconstructions for AD correction. PP patients experienced an increase in rippling (15.3% vs. 6.1%, $p=0.003$) without a significant increase in fat grafting (SP=11.6% vs. PP=12.3%, $p=0.829$).

CONCLUSIONS: This single-institution experience compares late complications of PP and SP implant-based reconstruction following NSM. PP reconstruction is associated with reduced rates of PF and unplanned reoperations and more readily affords DTI reconstruction and reduces AD at the expense of rippling.

Breast Abstract

Impact of Preoperative Immunonutrition on Outcomes of Immediate Breast Reconstruction

Presenter: Carol E Soteropulos, MD
Co-Authors: Kylie M Edinger, MD, Kishan M Thadikonda, MD, Katherine M Gast, MD, MS
Affiliation: University of Wisconsin School of Medicine and Public Health, Madison, WI

BACKGROUND: Recent literature in various surgical specialties has shown the use of enteral immunonutrition prior to major surgery to reduce infectious complications, length of stay and overall morbidity[1,2]. To date, no studies have examined the use of immunonutrition within plastic and reconstructive surgery. The purpose of this study is to evaluate the impact of preoperative immunonutrition supplementation on the outcomes of immediate breast reconstruction.

METHODS: All patients undergoing immediate autologous or alloplastic breast reconstruction at the University of Wisconsin, Madison beginning February 2018 were contacted and offered enrollment in this study. All patients who consumed Impact Advanced Recovery for 5 days prior to surgery were reviewed (n=59, 36 autologous, 23 alloplastic). This group was compared with a retrospective control group (n=106, 40 autologous, 66 alloplastic) of patients who underwent surgery prior to February 2018. No other major changes in perioperative care or operative technique were made within the timeframe of the retrospective or prospective collection period. Chart review was performed on all patients in a 30-day (autologous, direct-to-implant) or 90-day (expander) postoperative window. The rates of surgical site infection, wound dehiscence, seroma, and mastectomy skin flap necrosis were analyzed individually and combined to form an aggregate "wound complication rate".

RESULTS: Aggregate wound complication rate was reduced from 49.06% to 32.20% after intervention (p=0.0361). Specifically, the rate of mastectomy skin flap necrosis was reduced from 24.53% to 8.47% (p=0.0114), and the rate of wound dehiscence was reduced from 15.09% to 1.69% (p=0.0067) in the cohort who received preoperative immunonutrition supplementation. The rates of infection, unplanned return to the operating room, and aborted reconstruction were not significantly different between the control and interventional cohorts.

CONCLUSIONS: Based on the initial results of this ongoing trial, preoperative immunonutrition supplementation with Impact Advanced Recovery may significantly improve wound complication rate in patients undergoing immediate autologous and alloplastic breast reconstruction.

REFERENCES:

1. Hegazi RA, Hustead DS, Evans DC. Preoperative standard oral nutrition supplements vs immunonutrition: results of a systematic review and meta-analysis. *Journal of the American College of Surgeons.* 2014;219(5):1078-1087.
2. Xu J, Sun X, Xin Q, et al. Effect of immunonutrition on colorectal cancer patients undergoing surgery: a meta-analysis. *International journal of colorectal disease.* 2018;33(3):273-283.

Breast Abstract

The Impact of Pre- Versus Post-Mastectomy Radiation Therapy on Outcomes in Prepectoral Implant-Based Breast Reconstruction

Presenter: Catherine J. Sinnott, MD
Co-Authors: Mary Pronovost, MD, Christine Hodyl, D.O., Anke Ott Young, M.D., Ph.D.
Affiliation: Long Island Plastic Surgical Group, Garden City, NY

PURPOSE: Prepectoral implant-based breast reconstruction is being increasingly performed over subpectoral post-mastectomy reconstruction because of the reduced invasiveness of the procedure, postoperative pain and risk of animation deformity. Radiation therapy is a well-known risk factor for complications in implant-based breast reconstruction. However, the effect of pre-mastectomy versus post-mastectomy radiation therapy on outcomes after prepectoral breast reconstruction has not been well-defined. The purpose of this study was to compare the impact of pre- versus post-mastectomy radiation therapy on outcomes after prepectoral implant-based breast reconstruction.

METHODS: A retrospective chart review was performed of all patients who underwent prepectoral implant-based breast reconstruction with inferior dermal flap and acellular dermal matrix (ADM) performed by a single surgeon from 2010 to 2019. Demographic, clinical and operative data were reviewed and recorded. Outcomes were assessed by comparing rates of capsular contracture, infection, seroma, hematoma, dehiscence, mastectomy skin flap necrosis, rippling, implant loss, local recurrence and metastatic disease, between patients receiving pre- and post-mastectomy radiation therapy and patients not receiving radiation therapy.

RESULTS: During the study period, 369 patients (592 breasts) underwent prepectoral implant-based breast reconstruction. 26 patients (28 breasts) received pre-mastectomy radiation, 45 patients (71 breasts) received post-mastectomy radiation, and 305 patients (493 breasts) did not receive either pre- or post-mastectomy radiation therapy. Patients with pre-mastectomy radiation had higher rates of seroma (14.3% vs. 0.2%; $p<0.001$), minor infection (10.7% vs. 1.2%; $p=0.009$), implant loss (21.4% vs. 3.4%; $p=0.001$) and local recurrence (7.1% vs. 1.0%; $p=0.049$), when compared to those without radiation. Patients receiving pre-mastectomy radiation also had a capsular contracture rate three times that of non-radiated patients (10.7% vs. 3.2%; $p=0.075$), although the difference was not significant. Patients with post-mastectomy radiation had higher rates of major infection (8.4% vs. 2.4%; $p=0.017$), capsular contracture (19.7% vs. 3.2%; $p<0.001$), implant loss (9.9% vs. 3.4%; $p=0.022$) and local recurrence (5.6% vs. 1.0%; $p=0.018$), when compared to patients without radiation. Outcomes after prepectoral implant-based breast reconstruction were comparable between pre- and post-mastectomy radiation therapy groups, respectively, with regard to major infection (7.1% vs. 8.4%; $p=1.000$), dehiscence (3.6% vs. 1.4%; $p=0.488$), major mastectomy skin flap necrosis (7.1% vs. 2.8%; $p=0.317$), capsular contracture (10.7% vs. 19.7%; $p=0.382$), implant loss (21.4% vs. 9.9%; $p=0.184$) and local recurrence (7.1% vs. 5.6%; $p=1.000$). However, patients with pre-mastectomy radiation had a higher rate of seroma compared to those receiving post-mastectomy radiation therapy (14.3% vs. 0%; $p=0.005$).

CONCLUSIONS: In prepectoral implant-based breast reconstruction, both pre- and post-mastectomy radiation therapy were associated with higher rates of infection and implant loss compared to non-radiated patients. However, pre-mastectomy radiation was associated with a higher rate of seroma compared to non-radiated and post-mastectomy radiation therapy groups. Post-mastectomy radiation was associated with a higher rate of capsular contracture when compared to non-radiated patients, and a comparable rate of capsular contracture when compared to pre-mastectomy radiation therapy patients.

Breast Abstract

Outpatient Microsurgical Breast Reconstruction

Presenter:	Sean G Boutros, MD
Co-Authors:	
Affiliation:	Houston Plastic and Craniofacial Surgery, Houston, TX

BACKGROUND: The extensive nature of perforator-based breast reconstructions, combined with the need for postoperative flap monitoring, often leads to long hospitalizations. We presented an early report demonstrated the feasibility and advantages of a modified operative technique and recovery protocol, allowing us to perform outpatient breast reconstructions with the DIEP flap[1]. This follow-up comprises the experience gained, expanded to other perforator-based flaps and not limited to DIEP breast reconstructions.

PATIENTS AND METHODS: Patients and methods. We have implemented a general protocol in patients undergoing breast reconstruction with autologous flaps, promoting early mobilization and discharge by improving postoperative pain and decreasing opioid requirements. This protocol includes intraoperative local anesthesia, a microfascial incision for DIEP harvest with rib preservation, along with prophylactic anticoagulation.

RESULTS: 92 consecutive patients underwent autologous tissue-based breast reconstruction with DIEP, IGAP, SGAP and PAP flaps. No intraoperative complications were reported. All patients were discharged within 23 hours, without evidence of flap compromise. One patient required operative takeback for evacuation of a hematoma on postoperative day 4. No partial or total flap losses were documented.

DISCUSSION: The aim of any procedure should be to get to the patient back to the preoperative status as quickly as possible, as prolonged hospitalizations are associated with higher incidences of infection, deep venous thrombosis, overall dissatisfaction and higher overall costs of care. By using a modified operative technique, multimodal pain control and postoperative anticoagulant therapy, outpatient perforator flap-based breast reconstructions can be performed with high success and low complication rates.

REFERENCES:

1. Martinez CA, Reis SM, Rednam R, Boutros SG. The Outpatient DIEP: Safety and Viability following a Modified Recovery Protocol. Plast Reconstr Surg Glob Open. 2018;6(9):e1898.

Breast Abstract

Breast Reconstruction in Inflammatory Breast Cancer: An Analysis of Predictors, Trends, and Survival from the National Cancer Database

Presenter:	Murad J Karadsheh, MD
Co-Authors:	Jacob Katsnelson, MD, Eric S Weiss, MD, James C Krupp, MD, Elin R Sigurdson, MD, PhD, Richard J Bleicher, MD, FACS, Karen Ruth, MS, Marilyn Ng, MD, M Shuja Shafqat, MD, Sameer A Patel, MD, FACS
Affiliation:	Einstein Healthcare Network, Philadelphia, PA

PURPOSE: Survival for women having inflammatory breast cancer (IBC) improved with advances in multimodal therapy. Standard treatment includes chemotherapy, modified radical mastectomy, and radiation,[1] with the order dependent upon response to systemic therapy. The benefits of breast reconstruction following mastectomy in the non-inflammatory setting are well-established. IBC is traditionally a contraindication to immediate breast reconstruction (IBR) out of concern for treatment delays, giving preference to delayed reconstruction.[2] This study was performed to evaluate trends, predictors, and survival for reconstruction in IBC in the United States over time.

METHODS: Women diagnosed with non-metastatic inflammatory breast cancer between 2004 and 2016 who underwent mastectomy were reviewed from the National Cancer Database (NCDB) for those having and not having reconstruction. Chi-square and multivariable logistic regression were used to determine associations and predictors of reconstruction. Kaplan Meier methods and Cox proportional hazards regressions were used for adjusted association between reconstruction and overall survival.

EXPERIENCE: Among 12,544 patients with IBC who underwent mastectomy, 1,307 underwent reconstruction. Within the reconstruction group, 1,019 patients underwent chemotherapy and radiation ($p<0.01$). 9,738 remained in the survival dataset after excluding those with <1 year potential follow-up, or missing time to treatment.

RESULTS: Patients having reconstruction were younger (50.8±11.2 vs. 57.6±13.2, $p<0.01$), and predictors of reconstruction use included younger age, private insurance, higher income, performance of contralateral prophylactic mastectomy, and those located in large metropolitan areas ($p<0.01$). The proportion of women having breast reconstruction for IBC increased from 7.3% in 2004 to 12.3% in 2016. In the survival cohort, there was 4,781 deaths, generating a median survival of 70.2 months (95% CI 67.0-73.8). The reconstructive group had better median survival (93.7 months, 95% CI 75.2-117.5) than the non-reconstructive group (68.1 months, 95% CI 65.5-71.7, $p<0.01$). Unadjusted overall mortality hazard ratio (HR) for reconstruction versus no reconstruction was 0.79 (95% CI 0.72-0.88, $p<0.01$). After adjustment for age, race, and comorbidity, the HR was 0.91 (95% CI 0.82-1.02, $p=0.08$). With further adjustment for insurance, cancer history, diagnosis year, stage, and treatment, the HR was 0.95 (95%CI 0.85-1.06, $p=0.37$).

CONCLUSION: Reconstruction rates for IBC are increasing, suggesting clinicians increasingly feel that reconstruction in this setting is safe. Since women with IBC who undergo reconstruction tend to be younger, this option is likely to be valued in those whose lives may have the greatest disruption from this diagnosis and who may be focused on secondary benefits of enhanced body image, self-esteem, and quality of life. However, the NCDB database does not differentiate immediate from delayed reconstruction, resulting in possible selection bias. Further evaluation of simultaneous reconstruction in this setting should be performed to determine whether reconstruction remains safe enough to change current guidelines.

REFERENCES:

1. Dawood, Shaheenah, et al. "Survival of women with inflammatory breast cancer: a large population-based study." Annals of oncology 25.6 (2014): 1143-1151.
2. Patel, Sameer A., et al. "Immediate breast reconstruction for women having inflammatory breast cancer in the United States." Cancer medicine 7.7 (2018): 2887-2902.

Craniomaxillofacial Abstracts

Changes in Intracranial Pressure with Craniosynostosis Based on Age at Intervention, Syndromic Status, and Multiple Suture Involvement

Presenter:	Christopher L. Kalmar, MD MBA
Co-Authors:	Laura S. Humphries, MD, Duncan Mackay, MD MBA, Giap H. Vu, BA, Carrie E. Zimmerman, BS, Shih-Shan Chen, MD, Greg Heuer, MD, PhD, Philip B Storm, MD, Scott Paul P Bartlett, MD, Jesse A. Taylor, MD, Jordan W. Swanson, MD, MSc
Affiliation:	Children's Hospital of Philadelphia, Philadelphia, PA

BACKGROUND: Craniosynostosis may lead to elevated intracranial pressure due to disproportion between a growing brain and constricted skull. We hypothesize that syndromic patients may seek intervention earlier given more obvious craniofacial asymmetry and developmental delay, but we remain uncertain about whether this possible earlier age at intervention offsets the effects of greater dysmorphology upon intracranial pressure. The purpose of this study is to elucidate the effect of syndromic status, number of prematurely fused cranial sutures, and age at intervention on elevated intracranial pressure.

METHODS: Patients were enrolled in our prospective craniofacial database and queried for those undergoing initial craniosynostosis procedure. Intracranial pressure was obtained by the attending neurosurgeon based on clinical judgement. The attending neurosurgeon was blinded to the design of this study as this query of the database is being retrospectively performed. Syndromic status, age at procedure, and opening intracranial pressure were analyzed using appropriate statistics.

RESULTS: Patients undergoing initial craniosynostosis procedure (n=167) had a median age of 12.6 months and were comprised of 24.0% (n=40) syndromic and 76.0% (n=127) nonsyndromic patients. Sixty-two patients had intracranial pressure recorded intraoperatively at the beginning of the procedure. Age was significantly correlated to intracranial pressure in nonsyndromic patients (p=.002, B=.084 mmHg/month, 95%CI .067-.108), and nonsyndromic patients are operated on significantly earlier than syndromic patients (p=.018, 11.1 months vs. 23.35 months). Single suture craniosynostosis has significantly lower intracranial pressure than multiple suture craniosynostosis at the time of operative intervention (p=.005, 13.5 mmHg vs. 19.0 mmHg), yet this could be confounded by the fact that patients with single suture craniosynostosis were operated on significantly earlier than those with multiple suture involvement (p<.001, 9.1 months vs. 21.5 months). Multivariate linear regression was conducted to eliminate these confounders and elucidate the impact of these variables on intracranial pressure, which demonstrated that multiple suture craniosynostosis is significantly implicated in increased intracranial pressure (p=.021) when controlling for age at operative intervention and syndromic status.

CONCLUSIONS: Multiple suture craniosynostosis is significantly associated with increased intracranial pressure when controlling for syndromic status and age at intervention. Syndromic patients and those with multiple suture involvement are operated on significantly later in life. Further research is needed to understand the reason behind such significant differences in age at intervention, and whether significantly delaying surgical intervention in some of these patients remains clinically justified to optimize other medical comorbidities and ensure overall better outcomes.

Craniomaxillofacial Abstracts

Is Cortical Complexity Development Affected By Syndromic Craniosynostosis?

Presenter: Alexander T. Wilson, BS
Co-Authors: Henri A. Vrooman, PhD, Irene M.J. Mathijssen, MD, PhD
Affiliation: Erasmus Medical Center, New Haven, CT

INTRODUCTION: In order to fully understand mechanisms of brain development in craniosynostosis, structural relationships must be identified over time. The relationship between cortical surface area and volume allometrically scales with age and is an indicator of neurocognitive ability. The aim of this study was to evaluate cerebral cortical complexity development in syndromic craniosynostosis patients compared with controls.

METHODS: Records of all syndromic craniosynostosis patients were reviewed at a single national craniofacial center to include patients with adequate clinical and imaging data for analysis. Age matched controls with appropriate imaging were also identified. 209 total MRIs were included in this study, 171 of which were of syndromic patients (38 Apert, 68 Crouzon, 25 Muenke, 18 Pfeiffer, 22 Saethre-Chotzen) and 38 of which were of controls. All imaging data was processed via FreeSurfer software analysis to determine pial surface area and cortical volumes by lobe. The ratio of surface area to volume was calculated and compared with control data by lobe via linear mixed effect model to account for multiple measurements, syndrome, sex, and age at the time of imaging. Age was observed to vary logarithmically with this ratio and was subsequently log transformed for all analyses. Bonferroni correction was used for multiple comparisons.

RESULTS: Average age at the time of MRI was 8.97 yrs (SD 5.26 yrs) and was significantly associated with an increase in surface area to volume ratio in all lobes ($p < 0.001$). Mean frontal complexity ratio was 0.29 (SD 0.02) and did not significantly vary among syndromic status ($p = 0.493$). Similarly, temporal (0.26, SD 0.02, $p = 0.322$) and parietal (0.33, SD 0.03, $p = 0.124$) complexity ratios were found to be uninfluenced by syndromic status. Mean complexity ratio for the occipital lobe was 0.38 (SD 0.05) for all patients but was significantly reduced in Apert syndrome ($p = 0.002$). Further analysis of isolated cortical volumes demonstrated Apert syndrome patients to have larger volumes in each lobe among all groups ($p < 0.001$).

CONCLUSION: Occipital lobe cortical complexity development is significantly impeded in Apert syndrome, despite adequate gains in brain volume. This is suggestive of cortical folding impairment and may provide an anatomical explanation for neurodevelopmental delay observed in Apert syndrome.

Craniomaxillofacial Abstracts

Ultrasonographic Evidence of Trapezius Fascia Thickening in Patients Undergoing Trigger Site Deactivation Surgery Compared to Healthy Control

Presenter: Christian Chartier, DEC
Co-Authors: Lisa Gfrerer, MD, William Gerald G Austen, Jr., MD
Affiliation: Massachusetts General Hospital, Harvard Medical School, Boston, MA

PURPOSE: Trigger site deactivation surgery at the occipital site involves release of the greater occipital nerve (GON) from surrounding structures such as muscle, fascia, and occipital vessels. Recent intra-operative anatomic data at this site found that the trapezius fascia was macroscopically thickened in the majority of patients (94%) undergoing surgery (1). This structural anomaly has resemblance to the thickened transverse carpal ligament (TCL) seen in carpal tunnel syndrome (CTS). Ultrasonographic examination has been used to show TLC thickening as part of the screening and diagnosis of CTS. We hypothesized that similar to CTS, trapezius fascia would be significantly thicker in patients with migraine/ headache/ occipital neuralgia than in healthy controls when measured with ultrasound.

METHODS: Ten patients undergoing screening for trigger site deactivation surgery at the occipital site were enrolled in this study prospectively. Ten subjects with no history of migraine, headache, occipital/ trigeminal neuralgia, or trauma to the head and neck region were matched by gender/ age/ BMI and included as controls. All participants underwent an ultrasound examination of the occipital region by the same examiner using standardized settings (frequency 10.0MHz, depth 2.5cm) and standardized pressure. Trapezius fascia thickness was measured bilaterally 3cm inferior and 1.5cm lateral to the occiput, at the exit point of the GON from the semispinalis capitis muscle. The resulting data were analyzed by unpaired t-test.

RESULTS: 20 participants were enrolled in the study with equal gender distribution between groups (12 females and 8 males). There was no statistically significant difference in age (49.1 vs. 47.3, p= 0.09) or BMI (27.5 vs. 26.8, p=0.21) between groups. Trapezius fascia was significantly thicker in patients presenting with migraine (mean 2.0mm +/- SD 0.88mm) than control (0.9mm +/- SD 0.23mm) ($p<0.01$). Maximum thicknesses among migraineurs was 4.1mm versus 1.2mm in healthy controls.

CONCLUSION: As previously seen in observational intraoperative studies, trapezius fascia appears grossly abnormal and thickened in patients undergoing trigger site deactivation surgery at the occipital site. This is the first study to quantify trapezius fascia thickness at the exit site of the GON from the semispinalis capitis muscle using ultrasound. It is also the first evidence that trapezius fascia is thickened in occipital migraine/ headache/ neuralgia patients versus control. As we continue to analyze the pathomechanism of headaches, it is critical to understand the origin of pain. We hypothesize that the structural anomalies seen at this site could be related to microtrauma/ overuse or actual trauma in the head and neck region. Understanding the pathomechanism could lead to better diagnostic and screening methods for headaches, accelerated diagnosis and more effective treatment.

REFERENCES:

1. Gfrerer L, Hansdorfer MA, Ortiz R, Nealon KP, Austen Jr. WG. Occipital neuralgia/ migraine: Intra-operative evidence for extracranial pathology. American Society for Reconstructive Microsurgery Meeting 2019, Palm Desert, CA, USA.

Craniomaxillofacial Abstracts

Immediate Extubation Following Placement of Mandibular Distractors: Feasibility and Safety Profile

Presenter:	Samuel H Payne, MD
Co-Authors:	Oblaise A Mercury, BA, Magdalena Soldanska, MD, Stefanie Hush, PA, Joseph K. Williams, MD, Colin Brady, MD
Affiliation:	Emory University, Atlanta, GA

BACKGROUND AND PURPOSE: Mandibular distraction osteogenesis is the preferred treatment at many centers for micrognathic patients with recalcitrant upper airway obstruction. Timing of extubation after placement of mandibular distractors is the subject of ongoing debate. Maintaining intubation allows for the airway size to be increased through gradual mandibular distraction, thus decreasing the impact of airway edema which may occur after extubation. However, prolonged intubation has risks including subglottic stenosis, ventilator-associated pneumonia, and accidental extubation. In this retrospective chart review, our experience with mandibular distraction followed by immediate extubation is examined.

METHODS: A four-year retrospective review of patients diagnosed with Pierre Robin Sequence who underwent mandibular distraction within the first three months of life was performed. All patients were treated at a tertiary children's hospital and had failed preoperative positioning and airway adjuncts. Patients who were intubated preoperatively were excluded. Analytic endpoints included patient demographics, comorbidities, preoperative and postoperative respiratory support, rates of immediate extubation, need for reintubation, progression to tracheostomy, correlative polysomnography, direct laryngoscopic grade view, and functional nasoendoscopy.

RESULTS: A total of 52 (29 males, 23 females) patients met inclusion criteria. The mean follow-up interval was 18 months. Six patients (12%) progressed to tracheostomy in long-term follow-up. There was one mortality (2%) which was remote from surgical intervention. Seventy-three percent of patients undergoing distraction were extubated immediately in the operating room. In those who remained intubated (27%), the mean intubation interval was 7.2 days (range 1-14 days). No significant differences were found in associated comorbidities, syndromic status, cleft pathology, preoperative respiratory support, or grade of view on direct laryngoscopy between the extubated and intubated groups. Case duration >120 minutes and the subjective designation of a difficult airway by the anesthesiologist were associated with maintaining intubation ($p<0.05$). Twenty-one percent of patients in the extubated group experienced a respiratory event before discharge, and eleven percent (4 patients) required reintubation. Respiratory events were significantly more likely in patients with other congenital anomalies, a syndromic diagnosis, cardiac anomalies, gastroesophageal reflux disease, and in those who required respiratory support greater than low-flow nasal cannula before distraction ($p<0.05$). Secondary airway anomalies and cleft palate were not associated with respiratory events or reintubation.

CONCLUSION: Our data suggests that immediate extubation after placement of mandibular distractors is feasible in patients who are not intubated preoperatively. Extra caution should be exercised in patients who required significant respiratory support before distraction and in those with certain comorbidities, as these patients were more likely to experience respiratory events and reintubation.

Craniomaxillofacial Abstracts

Impact of Prior Oncologic Treatment on Complications and Functional Outcomes in 1751 Head and Neck Free Flap Reconstruction Patients: An Institutional Analysis Using American College of Surgeons National Surgical Quality Improvement Program Methodology

Presenter:	Paschalia M. Mountziaris, MD, PhD
Co-Authors:	Fang-Yu Lin, PhD, Matthew M. Hanasono, MD, Patrick B. Garvey, MD, FACS, Kimberley L. Kiong, MBBS, Randal S. Weber, MD, Carrie Kai-Cheng Chu, MD, Carol M. Lewis, MD, MPH
Affiliation:	The University of Texas MD Anderson Cancer Center, Houston, TX

PURPOSE: Patients with head and neck squamous cell carcinoma (HN-SCC) frequently present with locally advanced disease, and many develop locoregional recurrence. Treatment of locally advanced or recurrent HN-SCC often involves neoadjuvant chemotherapy and/or radiation. However, a knowledge gap exists regarding the interplay of toxicities from prior oncologic treatments on successful reconstruction. The aim of this study was to evaluate the effect of prior oncologic treatment, including chemotherapy, radiation, and/or surgery, on long-term outcomes and functional status after head and neck free flap reconstruction utilizing a prospectively maintained database modeled on the American College of Surgeons National Surgical Quality Improvement Program (NSQIP).

METHODS AND MATERIALS: This is a retrospective review of all head and neck free flap reconstructions at our institution from 2012-2019. Data were retrieved from our database, which utilizes NSQIP methodology modified to track major head and neck oncologic reconstructive outcomes. In contrast to the NSQIP, which limits prior treatment to 3 months before the index procedure, our database includes any prior oncologic treatment.

RESULTS: 1751 patients were identified, 1093 of whom received prior oncologic treatment before the principal operative procedure for tumor extirpation and immediate free flap reconstruction. Patients without prior treatment were more likely to be active smokers (25% vs. 18%, $p < 0.0001$), and have: BMI ≥ 25 (67% vs. 53%, $p < 0.0001$), hypertension (55% vs. 47%, $p < 0.0001$), and diabetes (18% vs. 12%, $p < 0.001$). Patients receiving prior treatment had higher rates of steroid use (8% vs. 5%, $p = 0.019$) and preoperative G-tube placement (15% vs. 3%, $p < 0.0001$). On multivariate analysis, prior treatment did not increase the risk of postoperative complications including: flap loss, fistula, infection, hematoma, seroma, reoperation, or readmission ($p > 0.05$). However, there was a significant increase in the risk of transfusion (OR 2.01, 95% CI: 1.60-2.53), death within 12 months (OR 1.43, 95% CI: 1.05-1.95), G-tube dependency at 3 months postoperative (OR 1.42, 95% CI: 1.11-1.81), and poor speech scores (OR 1.40, 95% CI: 1.01-1.95). When comparing prior surgery vs. chemotherapy vs. radiation, multivariate analysis indicated that chemotherapy was associated with the highest risk of: transfusion (OR 2.51, 95% CI: 1.96-3.22), death within 12 months (OR 1.67, 95% CI: 1.20-2.33), and G-tube dependency at 3 months postoperative (OR 1.78, 95% CI: 1.37-2.32). Prior radiation as associated with the highest risk of poor postoperative speech scores at 3 months (OR 1.82, 95% CI: 1.27-2.61).

CONCLUSIONS: The goals of HN-SCC treatment and reconstruction include disease stabilization, prolonging survival, and improving quality of life. This study demonstrates prior oncologic treatment is not associated with flap loss or postoperative wound-healing complications, after controlling for confounding factors. It is associated with higher mortality and worse functional outcomes, which may reflect disease burden. Our results demonstrate that free flap head and neck reconstruction is a reasonable choice for well-selected patients with advanced and recurrent HN-SCC, even in the setting of multiple prior treatments, and has the potential to improve quality of life and reduce functional deficits.

Craniomaxillofacial Abstracts

Retinal Changes with Craniosynostosis: How Long Does It Take for Microscopic Retinal Thickening to Resolve after Surgery?

Presenter:	Christopher L. Kalmar, MD MBA
Co-Authors:	Laura S. Humphries, MD, Duncan Mackay, MD MBA, Carrie E. Zimmerman, BS, Giap H. Vu, BA, Scott Paul P Bartlett, MD, Jesse A. Taylor, MD, Jordan W. Swanson, MD, MSc
Affiliation:	Children's Hospital of Philadelphia, Philadelphia, PA

BACKGROUND: Papilledema has been traditionally used as a surrogate for increased intracranial pressure, but its sensitivity remains poor. Optical coherence tomography (OCT) is emerging as a useful adjunct for quantitative assessment of thickened retinal nerve fiber layers. It is unclear how long it takes for elevated intracranial pressure to elicit these morphologic changes, and similarly it is unclear how long it takes for these changes to resolve after achieving restoration of normal intracranial pressure with surgical expansion of the cranial vault. Pediatric patients with craniosynostosis undergoing distraction osteogenesis returning to the operating room for distractor hardware removal provide an opportunity for repeat assessment of the retina under anesthesia. The purpose of this study is to determine how these retinal parameters change after surgery for craniosynostosis.

METHODS: Pediatric patients undergoing cranial vault expansion for craniosynostosis from September 2014 through December 2019 were prospectively enrolled through an IRB-approved protocol to obtain spectral-domain OCT, which was performed preoperatively after induction of anesthesia. RNFL thickness was measured with the iVue software (Optovue; Fremont, CA) along a peripapillary circumference with radius of 1.725 mm centered on the optic disk. AvgRNFL was defined as the mean thickness of all circumferentially obtained values. Maximal quartile RNFL was defined as the greatest thickness in any quadrant. Retinal parameters from the index procedure to the repeat procedure were compared using related-samples Wilcoxon signed rank test. Scan quality index scores below 45 were excluded.

RESULTS: During the study interval, 25 patients underwent OCT scanning during index surgery for craniosynostosis and repeat OCT scanning during a subsequent procedure. Eighteen patients met inclusion criteria. Age at the index procedure was 7.85 months (Q1 3.8, Q3 17.2), and subsequent procedures for distractor removal were performed at a median interval of 105 days (Q1 91-132). AvgRNFL was significantly (p=.001) higher at the initial procedure (median 96.5 μm, 95%CI 87.0-111.0) than the subsequent procedure (median 90.3 μm, 95%CI 84.5-99.0). Maximal quartile RNFL was significantly (p=.007) higher at the initial procedure (median 122.5 μm, 95%CI 113.0-148.0) than the subsequent procedure (116.5 μm, 95%CI 112.0-130.0).

Similarly noteworthy, many retinal parameters failed to normalize after multiple months of resolved intracranial pressure, including optic nerve head cup volume (p=.441), optic disc area (p=.092), maximal retinal thickness (p=.721), and maximal anterior retinal projection (p=.919).

CONCLUSIONS: In pediatric patients with craniosynostosis, retinal nerve fiber layer thickening secondary to elevated intracranial pressure demonstrated significant resolution after cranial vault expansion. Further vigilance ensuring appropriate cranial growth continues throughout childhood. This study demonstrates promise of this technology to longitudinally follow patients to ensure maintained resolution of intracranial hypertension. Further research is needed to understand the pathophysiology at the micron level allowing this remodeling to occur, as well as factors that may alter the time course of these changes.

Craniomaxillofacial Abstracts

4-7 Year Aesthetic Outcomes of Two Bilateral Fronto-Orbital Advancement and Reshaping (BFOAR) Techniques for Nonsyndromic Metopic Craniosynostosis: Can We "Overcorrect" Our Way out of Aesthetic Deterioration?

Presenter:	Carrie E. Zimmerman, BS
Co-Authors:	Laura S. Humphries, MD, Ari M. Wes, MD, Giap H. Vu, BA, Christopher L. Kalmar, MD MBA, Jordan W. Swanson, MD, MSc, Scott P. Bartlett, MD, Jesse A. Taylor, MD
Affiliation:	Children's Hospital of Philadelphia, Philadelphia, PA

BACKGROUND/PURPOSE: In 2012, the senior authors modified their previously published technique for BFOAR to more radically "overcorrect" the transverse forehead constriction seen in metopic craniosynostosis. The purpose of this study is to compare the 4-7 year aesthetic outcomes of the newer "overcorrected" patients to a similar cohort of patients treated in the years preceding "overcorrection" in an effort to determine whether overcorrection can overcome the aesthetic deterioration of these results over time.

METHODS: A retrospective chart review was performed of patients treated with BFOAR for isolated metopic synostosis between June of 2002 and December of 2014. Patients with 4-7 years of follow-up and complete medical records were included. Patient demographics, operative technique, Whitaker classification as indicated by a senior craniofacial surgeon, and postoperative clinical outcomes were collected. Two-sample t tests, chi-square and Fisher's exact tests as well as multiple regression analyses were performed using STATA 13.0 (StataCorp, College Station, Texas). Both groups underwent similar operations from a technical standpoint—open BFOAR with naso-frontal interpositional bone graft, superior-lateral orbital strut grafts, reshaping of the bandeau into a more "boxy" configuration, particulate cranial bone grafting of osteotomy sites and bony defects, repositioning of the temporalis muscles—with the primary difference in the current technique being a concentration on more radical overcorrection.

RESULTS: 128 patients underwent BFOAR during this time period and 53 patients met all inclusion criteria. 34 (64.2%) patients underwent BFOAR without overcorrection (age at surgery 9.2 ± 2.9 mo, follow-up 5.6 ± .9 yrs) and 19 (35.8%) of patients underwent BFOAR with overcorrection (age at surgery 10.3 ± 4.2 mo, follow-up 5.4 ± .7 yrs). There was no significant difference between the age at surgery (p=.25) or length of follow-up (p=.41) between the cohorts. At follow-up for the cohort without overcorrection, 20 patients (58.8%) were classified as Whitaker class I, 5 patients (14.7%) as class II, 9 (26.5%) as class III. For the overcorrected cohort, 8 patients (42.1%) were classified as Whitaker class I, 10 patients (52.6%) as class II, 1 patient (5.3%) as class III. There were no Whitaker class IV results at the 4-7 year follow-up length in either cohort. On bivariate analysis, overcorrection was associated with significant differences in Whitaker class distribution at follow-up (p=.008).

Neither length of follow-up, age at intervention, nor technique was a significant predictor of Whitaker class, visible irregularities, temporal hollowing, lateral orbital retrusion, or frontal bone irregularities at the .05 significance level.

CONCLUSION: Despite a more aggressive attempt to "overcorrect" the metopic deformity in infancy with BFOAR, we have seen similar deterioration of results over time, with a significant proportion of patients developing bi-temporal narrowing and temporal hollowing in moderate term follow-up. Though this represents a small cohort of patients, this data is important for surgeons and families alike, as it potentially signals a significant need for secondary aesthetic revisions in the teen years.

Craniomaxillofacial Abstracts

The Utility of Dermal Wound Matrices Compared with Local-Tissue Rearrangement and Free-Tissue Transfer for Scalp Wounds: A Multi-Disciplinary Dual Matched-Pair Analysis

Presenter: Sammy Othman, BA

Co-Authors: Said Azoury, MD, Sameer Shakir, MD, John P Fischer, MD MPH, Stephen Kovach, MD

Affiliation: University of Pennsylvania, Philadelphia, PA

BACKGROUND: Scalp reconstruction can pose significant challenges due to a lack of native tissue mobility and/or tissue damage secondary to radiation. Local tissue rearrangement (LTR), free-tissue transfer (FTT), and Bilayer Wound Matrix [BWM, (Integra, Integra Life Sciences, NJ)] are frequently employed for wound coverage of the scalp. We present the first comparative study to evaluate the optimal treatment modality.

METHODS: A retrospective chart review was conducted from January 2008 to June 2019 encompassing all patients requiring soft-tissue reconstruction (BWM, LTR, and FTT) to scalp wounds. Patients were matched into each group based upon patient age, wound defect size, and wound age. Patient demographics, comorbidities, wound characteristics and post-operative healing outcomes were all recorded. Outcomes including 90-day exposure rates, re-operative rates, hospital length of stay, operative times, and wound complications were examined and compared between the modalities.

RESULTS: A total of 361 patients undergoing scalp soft-tissue reconstruction with either FTT, LTR or BWM were identified. Following patient matching, 126 patients were deemed appropriate for inclusion in the LTR/BWM cohort, while 56 were examined in the FTT/BWM groups. The mean defect size of the LTR/BWM group was 45 cm^2. LTR provided significantly better wound coverage at 90 days (95.2%), compared to BWM (84.1%) ($p = 0.040$), although re-operative rates (7.9% vs 15.9%) did not differ significantly ($p = 0.271$). The total mean defect size in the FTT/BWM groups was 129.1 cm^2. Wound coverage success rates at 90-days was similar for the FTT group (92.9%) compared to the BWM group (96.4%) ($p = 1.00$). Re-operative rates (14.3% FTT, 3.6% BWM) were also not significantly different ($p = 0.352$). However, operative time for FTT patients was significantly greater (389.9 minutes) compared to BWM patients (87.2 minutes) ($p < 0.001$), as well as mean hospital length of stay (5.5 days vs 1.2 days, respectively, $p < 0.001$).

CONCLUSIONS: LTR is a more durable option for moderately size wounds when compared to BWM. BWM may be as efficacious as FTT for wound coverage of uncomplicated larger defects, and may be more cost-efficient, given the obvious greater technical difficulty, operative time, and length of stay associated with FTT.

Craniomaxillofacial Abstracts

Postoperative Complications Associated with Choice of Reconstruction in Head and Neck Cancer: An Outcome Analysis from the ACS-NSQIP Database

Presenter: Jacob Y Katsnelson, MD

Co-Authors: Richard O Tyrell, MD, Ely Manstein, BS, Murad J Karadsheh, MD, Brian Egleston, MPP, PhD, Mengying Deng, MS, Sameer A Patel, MD, FACS

Affiliation: Abington-Jefferson Health, Abington, PA

BACKGROUND: Microsurgical free flaps have supplanted myocutaneous pedicled flaps as the gold standard for head and neck cancer reconstruction in terms of lending a superior functional and aesthetic result.[1-4] However, factors relating to postoperative complications based on type of reconstruction have not been well-defined in the literature. In this study, we used the American College of Surgeons, National Surgical Quality Improvement (ACS-NSQIP) database to compare outcomes of patients who underwent free flap, myocutaneous pedicled flap, or no reconstruction after resection for head and neck cancer.

METHODS: Patients undergoing head and neck reconstruction were identified in the 2011-2016 ACS-NSQIP database using ICD codes for head and neck cancers and CPT codes to filter by reconstructive technique used. Demographics were analyzed and covariates balanced using overlap propensity score-based weighting between groups. Logistic regression was used for binary outcomes and Gamma GLM was used for length of stay. Outcomes were defined based on major surgical complications, wound complications, and medical complications within 30 days postoperatively.

RESULTS: 4,712 patients met inclusion criteria. 1,297 patients (28%) underwent reconstruction with free flap, 208 patients (4%) with myocutaneous pedicled flap, and 3,207 patients (68%) had no reconstruction. In unadjusted analyses, patients who underwent pedicled flap reconstruction had a higher incidence of surgical site infection, wound dehiscence, pneumonia, and hospital re-admission compared to free flap reconstruction or no reconstruction ($p<0.001$). After adjustment, pedicled flap reconstruction was found to have a higher risk of developing DVT (OR=2.64, CI 1.02-6.85, p=0.045), sepsis (OR=2.95, CI 1.52-5.71, p=0.001), and infection (OR=2.03, CI 1.39-2.96, $p<0.001$) compared to free flap reconstruction. However, pedicle flap reconstruction had a shorter mean operative time (unadjusted 440 vs 574 min, $p<0.001$), lower incidence of bleeding requiring transfusion (adjusted OR=0.65, CI 0.50-0.85, p=0.002), and lower incidence of prolonged mechanical ventilation after 48hrs (adjusted OR=0.33, CI 0.12-0.92, p=0.04) compared to free flap reconstruction.

CONCLUSION: Myocutaneous pedicled flaps are associated with an overall higher short-term postoperative complication rate compared to free flaps in reconstruction for head and neck cancer, despite having a shorter operative time and lower requirement for transfusion and prolonged intubation. These differences in postoperative complications could reflect selection bias, as patients likely to undergo pedicled flap reconstruction in today's era may not be candidates for free flap reconstruction, be undergoing salvage procedures, or be at centers without the ability to perform free tissue transfer. However, this study once again confirms the superiority of free flaps in head and neck reconstruction.

REFERENCES:

1. Patel SA, Chang EI. Principles and practice of reconstructive surgery for head and neck cancer. *Surg Oncol Clin N Am.* 2015;24(3):473-489.
2. Wong CH, Wei FC. Microsurgical free flap in head and neck reconstruction. *Head Neck.* 2010;32(9):1236-1245.
3. Gurtner GC, Evans GR. Advances in head and neck reconstruction. *Plast Reconstr Surg.* 2000;106(3):672-682; quiz 683.
4. Hurvitz KA, Kobayashi M, Evans GR. Current options in head and neck reconstruction. *Plast Reconstr Surg.* 2006;118(5):122e-133e.

Craniomaxillofacial Abstracts

Surgical Management of Gunshot Wounds to the Face

Presenter:	Venkata S Kothamasu, BSA
Co-Authors:	Paul Deramo, MD, Andrea P Biaggi-Ondina, BSA, Benjamin W Kim, BA, David J. Wainwright, MD
Affiliation:	University of Texas Health Science Center at Houston, Houston, TX

PURPOSE: Gunshot wounds (GSW) to the face are high velocity injuries often resulting in significant destruction of tissues and substantial displacement and comminution of fracture fragments. As a result, operative intervention is commonly an integral part of their care and frequently requires multiple staged procedures. This study was designed to evaluate the surgical management of these injuries.

METHODS: A retrospective chart review of gunshot wound injuries to the face from January 2009 to December 2017 was performed using the database of a major metropolitan Level 1 Trauma Center. Inclusion criteria were patients who had a GSW to the face, survived more than 48 hours, and received care at the admitting institution. Data collected included demographics, type of firearm, structures injured, bones fractured, antibiotic administration, and surgical details. Complex reconstruction was defined as autologous soft-tissue flap, bone flap, or bone graft. Univariate and multivariate statistical analyses were performed to examine the relationships between injury specifics and surgical treatment.

RESULTS: A total of 270 patients met the inclusion criteria for the study. The cohort was predominantly male (82.6%) with an average age of 31.7 +/- 15.5 years. The ethnicity breakdown of the group was 40.4% Black, 31.9% White, 19.6% Hispanic, 3.0% Asian, and 5.4% other.

The majority of patients (207 - 76.7%) had at least one facial surgical procedure. The average day of the first surgical procedure was 3.03 +/- 4.00 days (range 1 - 43). However, 62% of patients went to the operating room within 24 hours of their injury. Of those that had surgery, the average number of procedures was 1.6 +/- 1.8. Intermaxillary fixation was used in 40.6% of all patients, and it was highest when the mandible was involved (79.2%). Open reduction internal fixation was necessary in 45.4% of patients and occurred on day 9.9 +/- 9.97. An external fixation device was used in 12.6% patients. Complex reconstruction had the following breakdown: soft-tissue flaps were required in 11.1% of patients, bone grafts in 7.2%, and bone flaps in 5.3%.

Factors which resulted in a higher likelihood for surgery were teeth involvement (89%), oral cavity involvement (86%), mandibular fracture (86%), and comminuted fracture (86%). All patients who had a shotgun or rifle injury required operative management. On multivariate analysis, patient age ($p = 0.019$), injured teeth ($p = 0.018$), and oral cavity involvement ($p = 0.009$) were associated with higher number of surgeries.

CONCLUSIONS: Surgical intervention is often an integral part to the management of gunshot wounds to the face. An aggressive, early initiation of care is the rule with injuries resulting from a gunshot or rifle, those involving the teeth and oral cavity and comminuted injuries, more likely to require operative management. Multiple procedures are often required with a delayed approach to definitive management of the comminuted facial skeleton.

Craniomaxillofacial Abstracts

3D Printed Rhinoplasty Simulator with Replaceable Nasal Module

Presenter: Michael K Boyajian, MD
Co-Authors: Joseph W Crozier, MA, Albert S. Woo, MD
Affiliation: Warren Alpert Medical School of Brown University, Washington, DC

BACKGROUND: Surgical simulation serves as a key tool in medical training. 3D printing technology may be useful in this effort by allowing for rapid prototyping of affordable, custom anatomic models which can be optimized to target specific surgical skills. Carefully designed simulators can accelerate the learning curve of junior residents, especially for procedures that may be difficult to learn in the live operative setting. One procedure that is particularly difficult to master in early training is rhinoplasty; residents often report lack of comfort with performing the osteotomy portion of the procedure. Herein, the purpose of this project was to develop a 3D printed osteotomy training model that is cost-effective and durable, providing educational utility that can be translated to the operating room.

METHODS: Our osteotomy trainer consists of three parts: a reusable facial bone base, a replaceable nasal bone cartridge, and a reusable soft tissue envelope (Figure 1). Data obtained from a healthy patient's head CT scan was used to segment relevant bony structures (orbits, nasal bone, maxilla) to create the reusable facial bone base, and Blender Software (Amsterdam, The Netherlands) was used to design the nasal bone cartridge. Both of these units were printed from ABS Filament on a UPrint SE+ 3D printer (Stratasys, Eden Prairie, MN). The nasal bone cartridge, which is meant to be broken with an osteotome, is firmly fastened to the facial bone base via digitally incorporated pegs and can be easily replaced for repeat use. Finally, to generate the silicone-based "soft tissue" of the face, we designed and 3D printed a mold derived from the same patient CT scan. Once cured, these reusable silicone soft tissue envelopes were draped over the bony structures (facial bone base with fastened nasal cartridge) to complete the setup of our osteotomy trainer. For a beginner model, we used transparent silicone to allow for easy visualization of the underlying bones. For an advanced model, we used skin-colored silicone, which removes the handicap of direct visualization and challenges users to rely on a foundational understanding of anatomy and tactile feedback.

RESULTS: To test durability of the model, 10 osteotomies were performed. Preliminary trials demonstrated the silicone soft tissue construct to be durable enough to withstand multiple osteotomies without breakdown, and osteotomy manipulations yielded noticeable changes in the overlying nasal soft tissue appearance. Additionally, the nasal bone cartridges felt anatomic when broken during the osteotomy simulations, and they were easily replaced for cost-efficient, repeat practice.

The total cost of material for the reusable soft tissue envelope and reusable bony base was $25, and the replaceable nasal bone cartridges cost $5.

CONCLUSIONS: This pilot study determined that 3D printing and silicone casting can be used to produce a cost effective and reproduceable training tool to practice the osteotomy during rhinoplasty. Future directions include validating this 3D printed training model for educational utility among plastic surgery residents.

Craniomaxillofacial Abstracts

Corneal Neurotization: A Meta-Analysis of Outcomes and Patient Selection Factors

Presenter:	Marco Swanson, MD
Co-Authors:	Roy Swanson, MD, Robert Clark, BS, Yida Cai, BA, Alison Jin, BA, Anand R Kumar, MD, FACS, FAAP, Edward H. Davidson, MD
Affiliation:	Case Western Reserve University, Cleveland, OH

BACKGROUND: Neurotrophic keratopathy (NK) is a well-described process caused by impairment of trigeminal corneal innervation leading to corneal epithelial damage, poor healing and ulceration. Etiologies can vary from congenital anomalies to acquired injury of the ophthalmic trigeminal nerve division. Corneal neurotization has continued to show promising results in restoring corneal sensation. Multiple techniques of corneal neurotization have now been described, whether direct or indirect with varying donor and recipient nerves. This study aims to report a meta-analysis of outcomes as well as characterization of patient selection factors in order to better elucidate the indications for corneal neurotization.

METHODS: Following PRISMA guidelines, the MEDLINE and EMBASE databases were searched to screen and extract all studies available on corneal neurotization. Only primary literature with patients and outcomes was included. All literature reviews, animal and cadaveric studies were excluded.

RESULTS: 81 studies were screened and 18 studies met our inclusion criteria, totaling 57 patients and 64 eyes. 49% were female, mean age at neurotization was 37.2 years, mean denervation time was 70.1 months. NK was congenitally caused in 21% and acquired in 79%. Acquired causes varied from tumor or iatrogenic (45%), herpetic (39%), trauma (11%), to other causes (5%). Neurotization was direct (38%), either ipsilaterally (52%) or contralaterally (48%), using the following donors: supraorbital nerve (SON) and supratrochlear nerve (STN) in 96% and great auricular nerve (GAN) in 4%. For indirect neurotization recipient nerves utilized were SON and/or STN (95%) and infraorbital nerve (ION) in 5%. Donor nerve grafts were sural nerve (98%) and lateral antebrachial cutaneous nerve (2%). No difference was noted between techniques and outcomes. Average follow-up differed between congenital (8.5 months) and acquired (35.8) cases ($p<0.05$). Time to reinnervation was faster in congenital (6 months) vs acquired (14 months) cases ($p=0.01$). NK Mackie staging improved in 84%, remained the same in 16% and did not worsen in any patient. Best-Corrected Visual Acuity improved in 77%, remained the same in 20% and only worsened in 1 patient due to poor compliance. Pre-LogMAR was 1.36±0.78 and post-LogMAR 0.98±0.80 ($p<0.001$). Corneal sensation improved in all patients with 0.68±3.13mm and 44.82±17.2mm pre- and post-neurotization ($p<0.001$), respectively. NK Mackie Stage improved in all patients with 2.46±0.77 and 0.84±0.79 pre- and post-neurotization ($p<0.001$), respectively. Complications reported were persistent epithelial defect (8%) and subgaleal hematoma (1.5%). Age and denervation duration were predictive of disease severity ($R^2=0.25$; $p=0.001$). Age <20 years lead to higher sensation improvement ($p=0.04$) and age >20 years lead to higher visual acuity improvement.

CONCLUSION: Given the low complication rates, remarkable improvement in visual acuity, corneal sensation and NK Mackie staging irrespective of etiology, corneal neurotization should be considered for all patients with NK early on in disease course before irreversible corneal damage occurs, such as scarring or amblyopia, which limits clinical improvement. More standardized outcomes reporting and further study are needed to better delineate the impact of pre-operative factors, technique, and specific etiologies on outcomes.

Craniomaxillofacial Abstracts

An Analysis of Procedural Medicare Reimbursement Rates in Craniofacial Plastic Surgery: 2000-2019

Presenter: Nikita Gupta, BS

Co-Authors: Danielle A Thornburg, MD, Nathan A Chow, BS, Jack Haglin, BS, Davinder J Singh, MD

Affiliation: Mayo Clinic College of Medicine, Scottsdale, AZ

PURPOSE: An understanding of financial trends is important to advance agreeable reimbursement models in craniofacial surgery. This study aimed to evaluate trends in Medicare reimbursement rates for commonly billed craniofacial surgery procedures from 2000 to 2019.

METHODS: Commonly billed craniofacial surgery procedures were identified by a pediatric craniofacial surgeon and referenced with The Centers for Medicare & Medicaid Services Physician and Other Supplier Public Use File. Reimbursement data was extracted from The Physician Fee Schedule Look-Up Tool from the Centers for Medicare & Medicaid Services for each Current Procedural Terminology code. Monetary data was adjusted for inflation to 2019 US dollars utilizing changes to the United States consumer price index. The average annual and total percentage changes in reimbursement were calculated based on these adjusted trends.

RESULTS: The average adjusted reimbursement for all procedures decreased by 14.17% from 2000 to 2019. The greatest mean decrease was observed in repair of oronasal fistula (-21.95%). The only procedure with an increased adjusted reimbursement rate was palatoplasty with attachment of pharyngeal flap (+2.62%). From 2000 to 2019, the adjusted reimbursement rate for all procedures decreased by an average of 0.71% annually.

CONCLUSION: This is the first study evaluating trends in procedural Medicare reimbursement in craniofacial surgery. When adjusted for inflation, Medicare reimbursement for the included procedures has steadily decreased from 2000 to 2019. Increased consideration of these trends will be important for US policy-makers, hospitals, and surgeons to assure continued access to meaningful craniofacial surgery.

Craniomaxillofacial Abstracts

Comprehensive Craniomorphometric Analysis of 167 Patients with Metopic Craniosynostosis

Presenter: Ludmila Chandler, BS

Co-Authors: Kitae Eric Park, BA, Omar Allam, BS, Mohammad Ali Mozaffari, MD, Sumun Khetpal, BS, BA, Navid Pourtaheri, MD, PhD, John Smetona, MD, Xiaona Lu, MD, PhD, John A. Persing, MD, Michael Alperovich, MD, MSc

Affiliation: Yale School of Medicine, New Haven, CT

BACKGROUND: Metopic craniosynostosis is the second most common form of single suture synostosis, associated with a trigonocephalic head shape. Due to physiologic closure of the metopic suture in infancy, controversy persists regarding the most accurate method to assess severity. The goal of this study was to compare and validate previously described and newly developed measurements of severity for trigonocephaly. Additionally, a new severity scale was proposed to help guide clinical decision making.

METHODS: Morphometric analysis using Materialise-Mimics was performed on preoperative CT scans of infants with metopic synostosis and control age-matched infants. Measurements included endocranial bifrontal angle (EBF), adjusted endocranial bifrontal angle (aEBF), frontal angle, anterior fossa angle, metopic index, horizontal cone angle, temporal depression angle, foramen ovale distance, and bitemporal/biparietal distance ratio. Volumetric and area analyses of the frontal cranium were conducted to determine the degree of restriction in the metopic cohort. Pre-operative EEG data was compared for a subset of metopic patients to assess whether the proposed severity scale has neurodevelopmental implications. Results were analyzed using an independent sample t-test, Pearson's correlation coefficient, and receiver operating characteristic (ROC) curve analysis.

RESULTS: Analyses were performed for 167 patients with metopic synostosis (mean age 7.2±4.9 months), and compared to 44 control subjects (mean age 7.6±7.6 months). The EBF, aEBF, frontal angle, anterior fossa angle, horizontal cone angle, and bitemporal/biparietal ratio were all significantly smaller in the metopic cohort compared to the control cohort ($p<0.05$).The metopic index, temporal depression angle, and foramen ovale distance were not significantly different from the control cohort. Metopic skulls demonstrated a significantly decreased anterior cranium area (average 2466.12 mm^2, $p<0.001$) and significantly increased anterior-posterior (AP) length (average 4.00mm, $p=0.003$) and cranio-caudal length of the anterior cranium (average 6.41mm, $p=0.01$) compared to control skulls. There was a significant negative correlation between the anterior cranial area and both the vertical length and AP-length. The frontal angle significantly correlated with the increases in vertical height and AP-length, while the aEBF correlated with only the AP-length. Other measurements did not significantly correlate with changes in anterior calvarium dimensions. ROC curve analysis identified a frontal angle of 101.3 degrees as the diagnostic threshold between operated metopic synostosis and normal skulls. Sixteen metopic subjects with existing EEG data were evaluated. Six patients with frontal angles more acute than the diagnostic threshold exhibited significantly attenuated EEG signals compared to controls ($p=0.037$). Patients with frontal angles greater than the diagnostic threshold did not exhibit any significant change in their EEG compared to controls.

CONCLUSIONS: In the largest radiographic series of metopic synostosis patients to date, this study examined the validity of measurements for severity of metopic craniosynostosis. The frontal angle provides the strongest correlation with growth compensation in the most severe cases of trigonocephaly. Furthermore, a severity classification using the frontal angle correlates with pre-operative EEG analysis. The bitemporal/biparietal ratio, metopic index, cranial volumes, cranial base structures, and orbital structures should be reconsidered as measures of metopic severity as they are either nonconcordant with the anterior-cranium compensatory changes or not significantly different from control.

Craniomaxillofacial Abstracts

The Chimeric Scapulo-Dorsal-Vascularized Latissimus Dorsi Nerve Flap (SD-LDVxN) for Immediate Total Parotidectomy with Facial Nerve Sacrifice Reconstruction: About 24 Cases.

Presenter:	Frederic Jerome Kolb, MD
Co-Authors:	Maria Lucia Mangialardi, MD, Quentin Qassemyar, MD, Jean-Francois Honart, MD, Amanda Gosman, MD
Affiliation:	UCSD, San Diego, CA

OBJECTIVE: Total parotidectomy with facial nerve sacrifice presents 2 challenging reconstructive problems: facial contour restoration and facial nerve rehabilitation. Strong evidences suggesting that vascularized nerve grafts are superior to non-vascularized ones motivated our team to develop a chimeric scapulo-dorsal flap

combining usual harvestable local tissues with the vascularized latissimus dorsi motor nerve. We present our retrospective results, emphasizing on the quality of facial nerve reanimation and facial contour restoration.

MATERIALS AND METHODS: From 2010 to 2018, 24 free chimeric SD-LDVxN flaps have been performed in 13 females and 11 males (median age 48 years) undergoing at least a total parotidectomy with facial nerve sacrifice. The basic flap structure was composed of at least the vascularized LD nerve and a TDAP flap but could include, depending of the defect a second LD flap and/or a lateral segment of the scapula. One patient required a second simultaneous free flap.

Mean follow-up is 5 years (range 10 to 1 year). Assessment of facial nerve used the House-Brackman scale and the Yanagihara 40-point system. Quality of life used the FaCE scale. Evaluation was every 3 months.

RESULTS: 20 out of the 24 patients had post-op radiotherapy. No local tumor recurrence had to be reported. Facial contour restoration was found excellent in all patients but one (a combined maxillectomy-mandibulectomy). Overall facial nerve function has been scored 1 and 2 in 15 patients, 3 in 7 patients. 2 patients are scored 4 and 5. The average reinnervation time is 9 months ranging from 3 months to 15 months. Best facial sub-region function is the orbito-palpebral region followed the commissural one. Eyebrow-frontal sub region has the poorest recovery.

CONCLUSION: The SD-LDVxN flap is a highly resourceful solution to reconstruct complex parotid defects including the facial nerve. Soft and hard tissues components enable near normal facial contour restoration. The vascular nerve graft allows primary facial reanimation. Nerve recovery seems to be superior to what could be expected with a conventional nerve graft. Although, only a prospective randomized study could prove this affirmation true, sufficient data are available to make such a study questionnable.

Craniomaxillofacial Abstracts

Intracranial Volume after Cranial Vault Remodeling: To What Degree Does Intracranial Composition Change after Surgery?

Presenter:	Carrie E. Zimmerman, BS
Co-Authors:	Laura S. Humphries, MD, Giap H. Vu, BA, Christopher L. Kalmar, MD MBA, Sameer Shakir, MD, Jordan W. Swanson, MD, MSc, Jesse A. Taylor, MD, Scott P. Bartlett, MD
Affiliation:	Children's Hospital of Philadelphia, Philadelphia, PA

BACKGROUND: The intracranial cavity is composed of brain tissue as well as cerebrospinal fluid (csf), blood, and air. These fluid components allow volume to be shunted out of the intracranial region in the setting of skull-based compression to minimize the effect of compression on the brain. The degree of change to the intracranial compartment in the setting of craniosynostosis and the speed at which they occur and resolve after surgery are not fully understood. This study sought to rigorously analyze the intracranial volume compositions of patients with craniosynostosis prior to and after CVR.

METHODS: The authors compared volume measurements for age-matched patients with unicoronal (n=4), metopic (n=4), and sagittal (n=4) craniosynostosis. Intracranial segmentation and analysis was performed on Materialize Medical 21.0 (Materialise; Leuven, Belgium) using the following segmentation thresholds: bone 226-3066 HU; csf -281-18 HU and air 19-225 HU, and then manually edited utilizing typical segmentation techniques. On expert consultation, brain segmentation volumes were determined to be less reliable

measurements than intracranial, CSF, and air volumes and were thus calculated by subtracting the other volumes from ICV. Paired t-tests, one way ANOVA, and multiple regression analyses were performed on STATA 15.1 (StataCorp, College Station, Texas).

RESULTS: The average age at surgical repair was 8.7 ± .83 months. All post-operative imaging was performed between 3 and 5 days post-operatively aside from one patient with imaging at 19 days post-operatively. There was a significant increase in total ICV (913772.5 ± 102480.5 mm^3 vs 1068165 ± 95752.5 mm^3; p <.001) and intracranial air volume (18608.8 ± 9639.1 vs 53230.2 ± 32607.4; p= .001) after CVR. On sub-group analysis by affected suture, there was a significant increase in ICV (851748.9 ± 87438.1 vs 1043117 ± 149763; p=.009) and brain volume (737312.3 ± 80166.5 vs 829060.9 ± 61405.6; p=0.021) in the metopic cohort and a significant increase in ICV (1006379 ± 31359.5 vs 1133497 ± 45574.1; p=.013) and intracranial air volume (18056.21± 5397.634 vs 53230.16± 32607; p=.001) in the sagittal cohort. The metopic cohort had the largest percent change in intracranial volume (18 ± 3.4%) and CSF volume (28% ± 24%). There were dramatic post-operative increases in intracranial air volumes in all cohorts (percent change: unicoronal 46 ± 16%; sagittal 58 ± 36%, metopic 58± 23%) at this post-operative time period.

On multiple regression analysis with affected suture, type of CVR, age at repair and time from surgery to post-operative imaging as independent variables, age at repair was the only significant predictor of percent change in ICV (coef, -5.35; 95 percent CI, -10.2—-.51; p= 0.04) at the .05 significance level.

CONCLUSION: The ICV increase created by CVR allows subsequent increases in brain, CSF, and air volumes in the early post-operative time period. Significant brain tissue volume increases were seen in the metopic cohort with significant intracranial air volume increases in the sagittal cohort. We hope to perform additional analysis with follow-up data to determine if some of the noted air volume increase is redistributed to brain tissue or CSF at a later time.

Craniomaxillofacial Abstracts

Opportunities for Risk Reduction in Pediatric Craniofacial Imaging Protocols

Presenter:	Hillary E Jenny, MD, MPH
Co-Authors:	Kavitha Ranganathan, MD, Melike Guryildirim, MD, Richard J. Redett, MD, Robin Yang, MD, Mahadevappa Mahesh, MS PhD, Jordan P Steinberg, MD, PhD, FACS, FAAP
Affiliation:	Johns Hopkins University School of Medicine, Baltimore, MD

BACKGROUND: Imaging-associated radiation exposure is often considered in terms of a single computed tomography (CT) scan's effect. However, managing craniofacial pathology may require more than one CT across the patient's lifetime. Understanding the impact of these diagnoses therefore requires longitudinal analysis, particularly when considering that the pediatric population has a longer follow-up period and greater potential for development of radiation-associated neoplasia. We aim to quantify the lifetime oncologic risk of the image-related radiation exposure associated with craniofacial diagnoses and discuss ways in which practice patterns might be optimized to mitigate risk.

METHODS: Lifetime radiation exposure associated with specific pediatric craniofacial diagnoses was calculated using standard imaging pathways for these diagnoses and the radiation effective doses (ED) for relevant CT protocols. Eligibility for pediatric protocols is determined by patient size rather than age. Lifetime

risks of radiation-induced cancer incidence (RICI) and fatality (RICF) were calculated using methodology from the Biologic Effect of Ionizing Radiation VII report and are expressed as cases or fatalities/100,000 persons.

RESULTS: A majority of patients evaluated for craniosynostosis repair receive a preoperative cranial protocol CT; some may also receive a postoperative scan. Two-scan protocols give the diagnosis of craniosynostosis a lifetime radiation ED of 1.8 mSv, with a statistical lifetime risk of RICI of 14.7 and RICF of 7.4/100,000 persons. Similarly, pediatric and adult patients with craniofacial trauma undergo a preoperative CT maxillofacial protocol for diagnosis and operative planning, but some additionally undergo a postoperative CT to check reduction and plate placement. Two scans expose patients with craniofacial trauma to a lifetime ED of 0.34 mSv (pediatric) or 1.4 mSv (adults). This exposure is associated with a lifetime risk of RICI of 2.7 and 11.4/100,000 persons and a lifetime risk of RICF of 1.4 and 5.7/100,000 persons in pediatric and adult patients, respectively. In both craniosynostosis and trauma scenarios, lifetime cancer risk is dose-dependently halved by omitting postoperative scans. Further risk may be avoided for conditions with practice patterns that vary by more than one scan. For example, a majority of patients with micrognathia presenting for mandibular distraction undergo a preoperative CT. Some patients may also undergo two additional CTs after distractor placement: immediately postoperatively, and prior to distractor removal. Therefore, the lifetime radiation ED associated with micrognathia diagnosis is 2.8 mSv for a 3-scan pathway and 0.9 mSv for one scan. Adopting a preoperative-only imaging protocol avoids an additional lifetime risk of RICI of 14.7 and RICF of 7.4/100,000 persons.

CONCLUSIONS: CT scans are often critical for craniofacial operative planning. However, plastic surgeons have not yet adopted a standard of care for craniofacial imaging, which has a dose-dependent oncologic risk that is particularly relevant considering that many surgeons may obtain multiple images when managing these conditions. This is the first study to quantify oncologic risk associated with different imaging pathways for specific craniofacial diagnoses. We encourage open relative risk and benefit discussions with patients and families, as well as critical assessment of the need for routine postoperative scans obtained outside the context of approved research protocols.

Craniomaxillofacial Abstracts

Novel Surgical Treatment Algorithm for the Treatment of Temporomandibular Joint Disease

Presenter:	Ludmila Chandler, BS
Co-Authors:	Navid Pourtaheri, MD, PhD, Maham Ahmad, BA, Omar Allam, BS, Kitae Eric Park, BA, Yassmin Parsaei, DMD, Seija Maniskas, MS, Derek M Steinbacher, MD, DMD
Affiliation:	Yale School of Medicine, New Haven, CT

BACKGROUND/PURPOSE: The treatment of temporomandibular joint (TMJ) disease is highly variable, from non-surgical management to salvage procedures like joint replacement. Long-term outcomes data are limited and there is no consensus for an optimal treatment algorithm. A relatively new and minimally invasive treatment includes fat grafting to the TMJ performed with or without open TMJ reconstruction. We aimed to study the safety, efficacy, and indications for this new approach in patients with TMJ disease.

METHODS/DESCRIPTION: A retrospective chart review was performed on all patients who underwent a non-salvage procedure under general anesthesia for the relief of TMJ disease by a single surgeon from 2011 through 2019. Patients with minimum 12 months clinical follow-up were included. Patient demographics, diagnosis, pre- and post-operative symptoms, procedure details, complications, and additional interventions for

TMJ disease were recorded. Patients were asked to complete a survey elaborating on their symptoms (TMJ pain on 0-10 Likert scale, other symptoms 0-to-5 scale) before surgery and at their final follow-up. Wilcoxon signed rank test and repeated measures analysis of covariance were performed to compare pre- and post-operative symptoms ($p<0.05$ for significance).

RESULTS: 40 patients were included in the study, 71% female, mean age 34 (range 10-65) years, mean clinical follow-up 4.3 (range 1.6-9.0) years. The prevalence of procedures that patients underwent was 90% TMJ fat injection, 90% masticatory Botox injection, 80% Kenalog injection, 36% open TMJ arthroplasty, and 3% concurrent orthognathic surgery. 26 (65%) patients completed the pre and post-operative surveys. Overall, there was a statistically significant improvement in mean Likert scores at final follow-up vs pre-operatively for: trismus (0.46 vs 1.63, p=0.003), clicking/popping (1.29 vs 3.17, p=0.001), grinding/clenching (0.29 vs 1.58, p=0.007), headache (1.27 vs 2.67, p=0.003), TMJ pain (2.17 vs 6.71, p<0.001), difficulty eating (1.21 vs 3.50, p=0.001), difficulty chewing (1.63 vs 4.06, p=0.001), and muscle soreness (2.12 vs 3.25, p=0.007); but not for facial asymmetry (0.73 vs 1.21, p=0.112). Only 3% of patients experienced worsened symptoms at final follow-up. No patients experienced any major or minor complications during the study period. Patients who exhibited pre-operative trismus (50%) were more likely to undergo open TMJ surgery compared to those who did not (62% vs. 38%, p=0.206). Preoperative mean Likert scores were otherwise similar for patients who underwent fat/botox injection vs open TMJ surgery. Patients who underwent open TMJ surgery vs a more conservative approach demonstrated similar mean reduction in Likert scores for trismus (1.13 vs 1.23, p=0.894), headache (1.70 vs 1.08, p=0.419), muscle soreness (1.34 vs 0.91, p=0.554), difficulty chewing (2.70 vs 2.62, p=0.516), difficulty swallowing (2.50 vs 2.08, p=0.630), grind/clenching (1.00 vs 0.75, p=0.670), facial asymmetry (0.83 vs 0.13, p=0.251), and TMJ pain (5.67 vs 3.42, p=0.064); a significant decrease was only noted for click/popping (2.58 vs 1.16, p=0.048).

CONCLUSIONS: A combination of TMJ fat grafting, masticatory Botox injection, Kenalog injection, open TMJ arthroplasty, and possible concurrent orthognathic surgery can provide much needed improvement for patients with TMJ disease, while postponing the need for salvage operations like joint replacement. A comprehensive treatment algorithm is presented and discussed.

Craniomaxillofacial Abstracts

Optimizing Transfusion-Related Postoperative Outcomes in Craniosynostosis Repair

Presenter:	Hillary E Jenny, MD, MPH
Co-Authors:	Waverley Y. He, BA, Mya Abousy, BA, Anastasia Grivoyannis, MD, Jordan P Steinberg, MD, PhD, FACS, FAAP, Richard J. Redett, MD, Robin Yang, MD, Nicholas Dalesio, MD
Affiliation:	Johns Hopkins University School of Medicine, Baltimore, MD

BACKGROUND: As cranial vault reconstruction for craniosynostosis is associated with significant blood loss and transfusions, managing intraoperative and postoperative hematologic status is a significant challenge for both plastic surgeons and anesthesiologists. Factors contributing to these challenges include young patient age with low total blood volume (TBV), as well as the difficulty of quantifying intraoperative estimated blood loss (EBL) in real time.. However, optimizing intraoperative transfusion management for these cases is critical: blood products are independently associated with an increased risk of overall mortality, postoperative complications, multiorgan failure, and prolonged ICU stays.[2] This study aims to evaluate how intraoperative fluid management, including blood transfusion, affects incidence of postoperative complications and respiratory morbidity.

METHODS: We conducted a retrospective review of prospectively collected data from October 2012-November 2019 using the Pediatric Craniofacial Surgery Perioperative Registry at Johns Hopkins Hospital. Pediatric patients (<18 years) undergoing open craniosynostosis repair were included. Endoscopic strip craniectomies were excluded. Outcomes of interest included postoperative complication incidence, intraoperative and postoperative respiratory complications, and hospital length of stay (LOS).

RESULTS: Sixty-one patients were included with a median age of 1.2 years (SD 3.3); 36% were female, 54% Caucasian, and median ASA score was 2. Mean ICU and total hospital LOS were 3.3 and 6 days, respectively. Intraoperatively, mean EBL was 494 ml (SD 403) and mean EBL/TBV was 0.55 (SD 0.42). Patients were given an average of 1412 ml crystalloid fluids for a mean crystalloid/EBL ratio of 5.1:1. On average, 646 ml blood products were given (mean 75% TBV). When controlling for ASA, odds of any postoperative complication were increased over 14-fold by intraoperatively transfusing >85% TBV in blood products compared to <85% (p=0.028). Increasing %TBV transfused was significantly associated with increased incidence of intraoperative or postoperative respiratory complications, with an odds ratio (OR) of 5.2 (p = 0.049). Total and ICU LOS were increased as intraoperative %TBV transfused increased, although these findings did not reach significance (p=0.08, 0.09). A higher difference between the highest intraoperative and preoperative hemoglobin (Hb) values was also associated with 1.75 increased odds of postoperative complication (p=0.03). Increasing the intraoperative crystalloid:EBL ratio was significantly associated with incidence of any postoperative complication (p=0.04), with a ratio of $\geq$7:1 associated with an OR of 13.07 (p=0.05). Age, gender, surgeon, and specific procedure were not significantly associated with outcome in univariate analysis; crystalloid:blood ratios were not significantly associated with complication rates. Intraoperative %TBV transfused was not associated with postoperative transfusion requirements.

CONCLUSION: Postoperative morbidity may be optimized by utilizing transfusion and crystalloid thresholds. As transfusing >85% TBV was associated with increased postoperative complications, we advocate for adopting practices that may either decrease transfusion need to below this threshold (e.g. antifibrinolytic therapy, bloodless surgical technique) or provide alternative methods to minimize external transfusion (e.g., using cell saver). Additionally, maintaining a crystalloid:EBL ratio of <7:1 may also prevent postoperative complications; colloid replacement may be considered if volume needs exceed this ratio. We aim to conduct further inter-institutional research to identify additional optimal infusion and transfusion practices in this patient population.

Craniomaxillofacial Abstracts

Posterior Cranial Vault Distraction Osteogenesis: Routine Low Occipital Craniotomy Is a Safe Approach That Optimizes Outcomes

Presenter:	Raquel M. Ulma, DDS, MD
Co-Authors:	Gina Sacks, MD, Amy K. Bruzek, MD, MS, Christian J. Vercler, MD, Karin Muraszko, MD, Steven R. Buchman, MD
Affiliation:	University of Michigan - C. S. Mott Children's Hospital, Ann Arbor, MI

OBJECTIVE: Posterior cranial vault distraction osteogenesis (PVD) is a well-established alternative to traditional posterior vault osteotomy for cranial vault expansion in patients with multi-suture craniosynostosis with a narrow cranial base. The benefits of PVD over traditional osteotomy include a more gradual and maximal expansion of both the bone and overlying scalp with decreased rates of relapse. Previously described techniques place the inferior osteotomy above the torcula, which limits a more complete normalization of

volume and morphology. In this study we present a safe low occipital craniotomy extending to the foramen magnum, utilized to restore normal anatomy and improve remediation of the narrow cranial base associated with multi-suture craniosynostosis.

METHODS: We performed a retrospective chart review of all pediatric patients with multi-suture craniosynostosis undergoing PVD surgery at our institution in the years 2012-2019. Extracted data included demographics, perioperative and intraoperative surgical information, and postoperative complications. All included patients underwent preoperative evaluation by neurosurgery, plastic surgery, ophthalmology, and neuropsychiatry. CT and MRI of the brain and cervical spine with cerebrospinal fluid flow imaging were obtained preoperatively to evaluate bony morphometry, venous sinus position, and potential Chiari malformation.

RESULTS: We identified 14 patients undergoing PVD. Thirteen patients had multi-suture synostosis. Clinical syndromes included Saethre-Chotzen, Crouzon, and Apert. The average age at time of PVD was 14.2 months (range 5-93 months). Blood loss averaged 86 cc (range 20-200 cc); 7 patients required transfusion. No patients had hyponatremia requiring treatment. The average hospital length of stay after surgery was 6.4 days (range 2-29 days) and all patients completed distraction of 30 mm. Three patients had Chiari malformation prior to posterior distraction; two improved and one remained stable postoperatively. Complications included distractor device failure requiring reoperation (1 patient), shunt exposure requiring operation (2 patients), and mild scalp wound infection requiring only local wound care (1 patient). Twelve patients underwent secondary fronto-orbital advancement 8-14 months after the initial posterior vault osteotomy and device placement.

CONCLUSIONS: Low occipital craniotomy is a safe and effective technique for PVD. It allows for maximal expansion of the posterior vault, provides superior morphologic outcomes in patients with turribrachycephaly and can indirectly improve overall facial growth. Other benefits include decreased tension on the scalp closure and a greater potential of decompressing the foramen magnum and associated Chiari Malformations.

Craniomaxillofacial Abstracts

Management of Calcified Cephalohematoma of Infancy: A Single Institution 25-Year Experience

Presenter:	Raquel M. Ulma, DDS, MD
Co-Authors:	Gina Sacks, MD, Bridger Rodoni, BS, Anthony L Duncan, MD, Alexandra T. Buchman, --, Brevin C. Buchman, --, Christian J. Vercler, MD, Steven J. Kasten, MD, Karin Muraszko, MD, Steven R. Buchman, MD
Affiliation:	University of Michigan - C. S. Mott Children's Hospital, Ann Arbor, MI

PURPOSE: Calcified cephalohematoma of infancy is a result of a subperiosteal blood collection, that usually forms during birth-related trauma. Calcified cephalohematomas can permanently deform the infant cranium, and significant deformities often require correction. Although several reconstructive techniques have been proposed, there is no consensus on their management. In this study, we present a technique for the excision and reconstruction of calcified cephalohematoma of the infant calvarium, in the context of long term follow-up over the past 25 years.

METHODS: The charts of patients diagnosed with calcified cephalohematoma within our institution between 1994 and 2019 were reviewed. Only patients diagnosed by either our pediatric plastic surgeons or our pediatric neurosurgeons, and had at least 3 months of follow-up were included. Patients underwent observation or

surgery based on the recommendations of the surgical team. Patient demographics, imaging findings, and complications were reviewed.

RESULTS: We identified 160 infants with a diagnosis of cephalohematoma. Of those, 81 met inclusion criteria. Thirty-three patients with calcified cephalohematoma underwent surgical treatment. The mean age at diagnosis was 3.6 months, while the mean age at the time of surgery was 8.4 months. Of those that underwent surgery, 67% were male. Twenty-two surgical patients had a cranial defect requiring inlay bone grafting (66.7%). Six patients had perioperative blood loss requiring transfusion (18.2%) and 3 patients had postoperative complications (9.1%). Complications included superficial wound infection (n=1) and postsurgical subgaleal hematoma (n=2), treated successfully with bedside drainage.

CONCLUSION: Calcified cephalohematoma of infancy is rare entity that can cause significant deformity of the infant cranium. Over a 25-year period, our institution had 81 children with calcified cephalohematomas, with 33 necessitating surgical intervention. This is one of the largest series of calcified cephalohematomas to date. The technique presented herein was excellent for restoring normal cranial contours, while enjoying a low complication profile.

Craniomaxillofacial Abstracts

Palatal Lengthening with Buccal Myomucosal Flaps Improves Hypernasality without Increasing Obstructive Sleep Symptoms

Presenter: Raquel M. Ulma, DDS, MD

Co-Authors: Natalie Wombacher, MS, CCC-SLP, Steven J. Kasten, MD

Affiliation: University of Michigan - C. S. Mott Children's Hospital, Ann Arbor, MI

INTRODUCTION: Children with cleft palate with or without the cleft lip are predisposed to velopharyngeal dysfunction and the perceptual phenomenon of hypernasality. Researchers estimate that roughly 30% of children with cleft palate will have hypernasality during speech. Research also indicates that children with a history of cleft palate are predisposed to obstructive sleep apnea (OSA).

Typical speech surgeries include dynamic sphincter pharyngoplasty (DSP), posterior pharyngeal flap (PPF) and, for minor velopharyngeal gaps, fat grafting (FG) to the posterior pharyngeal wall. DSP and PPF, while effective at decreasing hypernasality, are known to exacerbate obstructive sleep symptoms. These findings lead to the conundrum of how one successfully manages velopharyngeal dysfunction without causing or worsening obstructive sleep apnea in this population. Therefore, we are in need of an operation that effectively decreases hypernasality and overcomes large velopharyngeal gaps, while mitigating the occurrence of obstructive sleep apnea. We propose that palatal lengthening with buccal myomucosal flaps is the solution to this problem.

METHODS: The charts of patients with large velopharyngeal gaps and moderate-to-severe hypernasality that underwent palatal lengthening with bilateral buccal myomucosal flaps between 2016 and 2019, were reviewed in a retrospective fashion. Inclusion criteria include a history of cleft palate or another diagnosis that predisposes to hypernasality, and at least one post-operative speech evaluation with nasometry. All patients were administered the Picture Cued Subtest, and received a perceptual rating from the craniofacial speech-language pathologist. Patients were seen pre-operatively for a perceptual speech evaluation, standardized articulation testing (as needed), nasometry, and nasopharyngoscopy. Post-operatively, patients were followed at 6 month intervals during which each patient participated in a perceptual speech evaluation, standard articulation

testing (as needed), and nasometry in order to better assess resonance changes over time. Ten patients were enrolled in the study, but only 9 met the inclusion criteria, as one patient was excluded for lack of a post-operative speech evaluation.

RESULTS: Nasalance is a nasometry score expressing a ratio of nasal-to-total (nasal plus oral) sound energy, and is reported as percentage. Our study findings indicate that most patients had the same abnormal Nasalance score 6 months post-operatively as they did pre-operatively. However, at the 12-month post-operative evaluation, 89% of patients (n = 8) had nasometry scores that improved to normal resonance. The one patient with abnormal Nasalance scores carried a diagnosis of 22q11.2 deletion syndrome. Patients who underwent a third post-operative evaluation continued to demonstrate a decrease in hypernasality, and began to have Nasalance scores in the hyponasality range. In addition, all patients with OSA reported no worsening in their obstructive symptoms, as indicated by stable CPAP settings.

CONCLUSIONS: Palatal lengthening with bilateral buccal myomucosal flaps improves hypernasality over time, with the greatest benefit seen at the 12-month post-operative nasometry evaluation. This surgical technique does not appear to alter the OSA status of patients thus eliminating the need for supplemental oxygen, or CPAP post-operatively.

Craniomaxillofacial Abstracts

Assessment of Panfacial Fractures in the Pediatric Population

Presenter: Margaret M. Dalena, BS

Co-Authors: Farrah C Liu, MD, Jordan N Halsey, MD, Edward S Lee, MD, Mark S. Granick, MD

Affiliation: Rutgers-New Jersey Medical School, Newark, NJ

PURPOSE: Panfacial fractures are fractures involving the upper, middle, and lower thirds of the face. Management of panfacial fractures is critical and challenging in adults, however there is little literature regarding these fractures in the pediatric population. In this study, the authors present their experience in order to provide insight and further investigation regarding patterns of injury, how these fractures differ from the adult population, as well as prevention and management strategies of pediatric panfacial fractures.

METHODS: A retrospective chart review was performed for all panfacial fractures in the pediatric population between 2002-2014 at an urban, level 1 trauma center, University Hospital in Newark, NJ. Patient demographics were collected, as well as mechanism of injury, location of fractures, concomitant injuries, and surgical management strategies. Comparisons of pattern of injuries between adult and pediatric patients were drawn using Pearson ^{2} test with $P < 0.05$ set as the degree of statistical significance.

RESULTS: 82 patients were identified as 18 years of age or younger and having sustained a panfacial fracture. The mean age at time of injury was 12.9 (range 1 – 18) years, with a male predominance of 64.9%. A total of 335 fractures were identified on radiologic imaging. The most common etiologies were motor vehicle accidents (40.5%), pedestrian struck (20.3%), falls (14.9%) and assault (12.2%). Orbital (79.7%), frontal sinus (59.5%), nasal (45.9%), and zygoma (27%) fractures were the most common. As compared to a study by Choi et al in 2019, comparison of this data showed a statistically significant difference ($p<0.05$) in the number of nasal, zygoma, NOE, Lefort and frontal sinus fractures between pediatric and adult populations. The mean Glasgow Coma Scale on arrival was 12.0 (range 3 – 15). 29 patients were intubated on, or prior to, arrival to the trauma bay. Surgical airway was required in nine patients. The most common concomitant injuries were traumatic brain

injury (64.9%), intracranial hemorrhage (51.4%), and skull fractures (45.9%). Surgical repair was required in 38 patients (48.6%). The cephalic to caudal approach was used in 8 patients (21%), the caudal to cephalic approach in 6 patients (15.8%), the medial to lateral approach in 2 patients (5.3%) and the lateral to medial approach in 1 patient (2.6%). Within a year of their initial surgery, 4 patients underwent reoperation for complications (10.5%). The mean hospital length of stay was 10.6 (range 1 – 134) days. Four patients died.

CONCLUSIONS: The impact of these injuries can be devastating with concomitant life-threatening injuries and complications. Proper management of these fractures is critical in preserving appropriate development of the facial skeleton after injury and more research is necessary to determine the best management approach to these fractures. Given the lack of literature, and preventable nature of these injuries, the authors hope this study can address primary prevention strategies and provide insight towards management and characteristics of these fractures.

Craniomaxillofacial Abstracts

Surgical Management of Stahl's Ear Deformity: Cartilage Reshaping Technique Via Open Otoplasty

Presenter: Phileemon Eric Payne, MD
Co-Authors: Henry Steve Byrd, MD, David A Hill, MD
Affiliation: Craniofacial and Plastic Surgery Center of Houston, Houston, TX

INTRODUCTION: First described by Binder in 1889, Stahl's deformity is a distinct ear anomaly. There is currently lack of consensus about the type of surgical repair performed. Most surgical techniques involve excisional otoplasty to achieve normal ear anatomy. However, this traditional approach can lead to further ear deformity and a visible scar. The purpose of this paper is to describe our surgical approach which corrects the 5 distinct problems associated with a Stahl's ear deformity while avoiding a visible scar and other new deformities.

METHODS: Retrospective review of 4 surgical cases utilizing this new technique performed by 2 surgeons at 2 separate surgery locations with operative outcomes reviewed for each case.

TECHNIQUE: Our otoplasty technique involves an open degloving approach similar to an open rhinoplasty technique with cartilage reshaping maneuvers to create a normal contoured ear while avoiding new deformities and obvious scaring. Principles of the technique involve: 1. Release of abnormal intrinsic muscle causing third crus deformity; 2. Longitudinal cartilage scoring of the concaved surface of the 3rd crus; 3. Placement of concha cartilage strut graft to posterior concave surface of 3rd crus in a transverse orientation; 4. Anterior cartilage scoring with Mustardé sutures for creating superior crus and treating upper pole prominence.

RESULTS: These 4 surgical cases show a normal ear anatomy postoperatively with no recurrence noted and a pleasing aesthetic result.

DISCUSSION: Since Stahl's ear is a rare deformity, few surgeons give it much thought on how to repair it surgically. Most surgeons and textbooks advocate a cartilage excision technique which can lead to more anatomical deformities and a visible scar. There are 5 main characteristics of Stahl's deformity which require correcting: 1. Abnormal 3rd crus; 2. Missing superior crus; 3. Loss of helical rim contour; 4. Widened scapha that is convex; 5. Superior pole prominence. Most surgeons address 3 features of the Stahl's ear deformity and

rarely all 5 issues are treated successfully. Our technique aims to treat all 5 features leading to the optimal aesthetic result.

CONCLUSION: Understanding the variations in severity of some ear deformities can help avoid complications. Our technique of an open degloving otoplasty for cartilage reshaping which addresses all 5 features of the deformity is an ideal procedure for a Stahl's ear repair.

Craniomaxillofacial Abstracts

Racial Disparity of Crouzon Syndrome in Skull and Orbit Morphology, and Their Spatial Relationships

Presenter:	Xiaona Lu, MD, PhD
Co-Authors:	Antonio J Forte, MD, PhD, Fei Fan, MD, Zhiyong Zhang, MD, Li Teng, MD, Bin Yang, MD, Michael Alperovich, MD, MSc, Derek M Steinbacher, MD, DMD, Nivaldo Alonso, MD, PhD, John A. Persing, MD
Affiliation:	Yale School of Medicine, New Haven, CT

BACKGROUND: Racial disparity in pathological consequences in skull and orbit growth may impact the treatment plan for different patient populations. This study explores skull anatomy for potential differences between Asian and Caucasian cranial morphology in Crouzon syndrome.

METHOD: Ninety-one computed tomographic scans were included (Asian Crouzon, n=12; Asian controls, n=22; Caucasian Crouzon, n=16; Caucasian controls, n=41), and measured using Mimics and 3-matics software. Unique cephalometric measurements related to the orbit were designed.

RESULTS: The entire cranial base length was reduced 11.92 mm ($p=0.004$) in Asian Crouzon patients, and 14.58 mm ($p<0.001$) in Caucasian Crouzon patients, compared to respective controls. The cranial base angle on the facial side of basicranium was more narrowed in Crouzon syndrome in both races, with similar changes of degrees (9.61 degrees, $p=0.002$, in Asian Crouzon; 9.20 degrees, $p=0.019$, in Caucasian Crouzon). However, the intracranial side was statistically more narrowed only in the Asian group (9.86 degrees, $p=0.003$). Both Asian and Caucasian Crouzon patients developed reduced posterior fossa volume, by 15% ($p=0.034$) and 17% ($p=0.004$), respectively. However, Caucasian Crouzon patients developed a more shortened anterior and middle cranial base, than that of Asian patients. The separation of lateral pterygoids was only significantly increased in Caucasian patients (5.49 degrees, $p<0.001$).

The orbital roof anteroposterior length of Caucasian Crouzon syndrome patients was shortened by 4.03 mm ($p=0.009$) compared to Caucasian controls. However, this dimension in Asian patients developed normally. The orbital anteroposterior floor length significantly reduced in both Asian and Caucasian Crouzon syndrome patients, to a similar extent. The medial horizontal angle of single orbit was narrower in Asian patients, compared to Asian controls (19.24 degrees, $p=0.002$), yet only insignificantly reduced in Caucasian patients. The visual axes of Caucasian Crouzon syndrome patients had more inferior rotation, by 5.21 degrees ($p=0.005$) than in Caucasian controls, but did not achieve a statistically significant difference in other comparison pairs. A widened ethmoid sinus is the major shortening in the restricted orbit cone angle in Asian Crouzon syndrome patients, while statistically significant widening of the sphenoid is noted only in Caucasian patients.

CONCLUSION: The influence of Crouzon syndrome on cranial and orbital malformation is race-influenced. Asian Crouzon patients developed more kyphotic basicranium evaluated intracranially, while Caucasian Crouzon patients developed more widened lateral pterygoid bones. The unaffected orbital roof length and

shortened orbital floor in Asian Crouzon syndrome patients, indicates the Lefort III osteotomy probably is more beneficial in this group of patients than monobloc advancement.

Craniomaxillofacial Abstracts

The Use of Periorbital Steroids to Reduce Postoperative Swelling in Fronto-Orbital Advancement: An Analysis of Outcomes

Presenter:	Daniel Y Cho, MD, PhD
Co-Authors:	Nicole Marie Kurnik, MD, Amy Lee, MD, Srinivas M. Susarla, MD, DMD, Richard A Hopper, MD, Craig B Birgfeld, MD
Affiliation:	University of Washington School of Medicine, Seattle, WA

PURPOSE: Marked facial swelling is a known consequence following fronto-orbital advancement (FOA), which can result in prolonged eye closure, patient discomfort, and post-operative hospitalization. There are limited reports on the efficacy and safety of periorbital steroids to help reduce facial swelling in craniofacial surgery, which has become standard practice at some centers. The purpose of this study is to compare outcomes with and without the use of periorbital steroids in patients undergoing FOA.

METHODS: A retrospective chart review of patients who underwent FOA at Seattle Children's Hospital between January 2012 and December 2019 was completed. All procedures were performed by two senior surgeons (R.A.H. and C.B.B.) in conjunction with a pediatric neurosurgeon. All patients received pre-, intra-, and post-operative care via a standardized clinical care pathway. In the periorbital steroid cohort, triamcinolone was administered as an injection into the subcutaneous tissues or soaked in gelfoam and placed in the frontal/periorbital region prior to closure of the scalp. Statistical significance between outcomes measures were determined using a two-tailed unpaired Student's t-test or χ^2 test as appropriate.

RESULTS: A total of 167 patients were included in this study (80 control, 87 periorbital steroid). The majority of these patients underwent FOA for isolated metopic synostosis (52.1%) followed by multisuture synostosis (23.9%) and isolated unicoronal synostosis (18%). 15.6% of patients had craniosynostosis as part of a diagnosed craniofacial syndrome. The average post-operative length of stay following FOA was 4.3 ± 2.0 days. Criteria for discharge including adequate PO intake, appropriate pain control, removal of the surgical drain, and improvement in facial swelling with opening of at least one eye. The use of periorbital steroids resulted in a statistically significant decrease in the hospital length of stay (LOS) compared to controls for isolated metopic (12.5 hours, $p = 0.031$) and unicoronal (12 hours, $p = 0.015$) craniosynostosis; there was no statistically significant difference in LOS for multisuture craniosynostosis (5.2 hours, $p = 0.329$).

There was a significantly higher rate of surgical site infection in patients who received periorbital steroids compared to controls (10.2% vs 2.5%, $p = 0.041$). All of these complications represented scalp wound infections requiring operative intervention. 91% of patients required hospital readmission with an average LOS of 17.6 days and 36% required subsequent revision cranioplasty. There was no association between specific suture involvement, craniofacial syndrome, or age at FOA with infectious complications.

CONCLUSIONS: The use of periorbital steroids has been reported in the literature to reduce facial swelling and shorten convalescence following FOA. This study demonstrates that there is a statistically significant decrease in hospital LOS with the use of periorbital steroids in isolated suture craniosynostosis. However, it is

associated with a significantly higher rate of infectious complications requiring operative intervention, extended hospital readmissions, prolonged antibiotic therapy, and secondary reconstruction.

Craniomaxillofacial Abstracts

Management of Deep Margin Involvement and or Perineural Invasion in Cutaneous Squamous Cell Carcinoma in the Head and Neck (cHNSCC) in a Single Unit: 12 Years' Experience.

Presenter:	Rong R Khaw, MBChB (Hons), MRes Med Sci, MRCSEd
Co-Authors:	Kristijonas Milinis, MBChB, MPhil, PGCert Ed, Sasha E Wilson, MBChB, LLM, Ikechukwu E Emecheta, MBBS, FMCS, FRCSI, Aenone Harper-Machin, MBChB (Hons), MSc, FRCSPlast
Affiliation:	St Helens & Knowsley Teaching Hospitals NHS Foundation Trust, Liverpool, United Kingdom

INTRODUCTION:

The 8th Edition of American Joint Committee on Cancer (AJCC) guidelines separated cutaneous squamous cell carcinoma in the head and neck (cHNSCCs) into its own entity within head and neck malignancies with the aim of improving tumour risk stratification. The lack of precise prognostic estimates for cHNSCCs prevents clear guidance on the clinical approach to cHNSCCs resulting in heterogeneity of management.

OBJECTIVE: Detailed review the historical management of cHNSCCs in a single tertiary skin cancer centre with the aim of creating a treatment algorithm that provides guidance in selecting the appropriate workup and treatment while minimizing unnecessary treatment and resulting morbidity.

METHODS: Retrospective review of our institutional pathology database from January 2007 – December 2019 of all recorded head and neck cutaneous lesions excised by St Helens & Knowsley Teaching Hospitals NHS Foundation Trust Plastic Surgery Department. Primary outcomes include recurrence rates and cHNSCC-related mortality.

RESULTS: A total of 442 lesions of cHNSCCs from 216 patients excised from the head and neck region were excised during the study period and 164 cHNSCCs had deep margin involvement +/- perineural invasion. Median age was 78 years (49-98 years). Median follow up was 23 months (0-153 months), 9 patients (4%) were lost to follow up. Seven patients (3%) died prior to their first three-monthly follow up appointment was due. Thirty-nine patients (18%) were immunosuppressed, ten were solid organ transplant recipients. One hundred and thirteen patients (52%) were deceased at the time of review, twenty-five (22%) died directly or from complications of cHNSCCs. Out of 164 cHNSCCS, majority had deep margin involvement (77%, n=126), 21% (n=35) had both deep margin and perineural involvement. Only 5 patients (3%) had cHNSCCs with features of perineural invasion but adequate margins. Forty-five patients (27.4%) in the positive cohort (deep margin involvement +/- perineural invasion) went on to develop local, regional, or distant recurrence with a median disease-free interval of 7.7 months (0.5 – 58 months). Overall recurrence rate was 14.5% (n=64/442) with a false negative rate of 6.8% (n=19/278), The scalp was the most common primary tumour site to recur (45%), followed by the ear (27%) and face (23%). 50% of primary tumours that recurred were moderately differentiated compared to 19% which were poorly differentiated.

CONCLUSIONS: Our study demonstrates increased recurrence risk of both scalp and ear cHNSCCs which warrant calls for more aggressive surgical measures, i.e. primary excision with a wide margin down to

periosteum with flap reconstruction with adjuvant radiotherapy. Routine sentinel lymph node biopsy in high risk cHNSCCs could play a role in locoregional control.

Craniomaxillofacial Abstracts

Airway Volume Is Restricted By Subcranial Skeletal Structural Development in Apert Syndrome

Presenter:	Xiaona Lu, MD, PhD
Co-Authors:	Antonio J Forte, MD, PhD, Alexander T. Wilson, BS, Kitae Eric Park, BA, Omar Allam, BS, Mohammad Ali Mozaffari, MD, Michael Alperovich, MD, MSc, Derek M Steinbacher, MD, DMD, Nivaldo Alonso, MD, PhD, John A. Persing, MD
Affiliation:	Yale School of Medicine, New Haven, CT

INTRODUCTION: Apert syndrome is frequently combined with respiratory insufficiency, because of the midfacial deformity which, in turn, is influenced by the malformation of the skull base. Respiratory impairment resulting from Apert syndrome is caused by multilevel limitations in airway space. Therefore, this study evaluated the segmented nasopharyngeal and laryngopharyngeal anatomy to clarify subcranial anatomy in children with Apert syndrome and its relevance to clinical management.

METHODS: In total of 112 patients (Apert syndrome, n = 49; control, n = 63) were included, and divided into 4 subgroups by age. All of the computed tomographic scans were obtained from the patients preoperatively. Craniometric data relating to the midface, airway, and subcranial structures were analyzed using Materialise software.

RESULTS: Distance between nasion and posterior nasal spine (PNS) of patients with Apert syndrome was shorter than normal before 6 months of age, but then improved gradually, which is synchronous with the reduced nasal airway volume (47%, $p<0.001$). There are significantly reduced sphenethmoid-to-PNS, sella-to-PNS, and basion-to-PNS distances initiated prior to 6 months, 6 months-2 years, between 2-6 years of age, by 16% ($p=0.003$), 15% ($p=0.004$) and 19% ($p=0.002$), respectively. The distances between bilateral condylions and gonions were decreased before 6 months of age, by 12% ($p<0.001$) and 14 percent ($p<0.001$), respectively. The pharyngeal airway volume surprisingly greater than normal by 114% ($p=0.014$) prior to 6 months of age, followed by gradual reduction to its volume at 6 years of age, and 45% less than normal ($p=0.026$).

CONCLUSION: The airway compromise seen in patients with Apert syndrome is attributable more to the nasal cavity in infants but in the older child, it is the pharyngeal region. The pharyngeal airway restriction is gradually worsened from the anterior to the posterior airway with age, resulting in a significantly reduced volume of the hypopharynx.

Craniomaxillofacial Abstracts

Fat Grafting as a Novel Treatment for Xerostomia

Presenter:	Ravi Bamba, MD
Co-Authors:	Scott Shadfar, MD, Bruce Van Natta, MD
Affiliation:	Indiana University, Indianapolis, IN

PURPOSE: Xerostomia is one of the most common side effects after radiation therapy for head and neck tumors. Xerostomia and its consequences provide additional morbidity to this already challenging and deadly disease. Currently, there are minimal effective treatments for xerostomia. Within the context of xerostomia, there is evidence that adipose-derived stem cells (ASCs) can differentiate into salivary gland cells in the appropriate environment. Recently, there have been clinical trials in Europe that have shown success in xerostomia treatment with ASCs. The purpose of this study was to preliminarily investigate if fat grafting as practiced in the US would be an effective treatment for xerostomia.

METHODS: Patients were selected for the study if they were seeking treatment for xerostomia after radiation treatment to the head and neck for cancer treatment. Fat grafting was performed in an outpatient setting. Fat was harvested from the abdomen and was processed by centrifugation per the Coleman technique for facial fat grafting. Fat was then injected into bilateral parotid and submandibular glands in small aliquots. Visual Analog Scale (VAS) of xerostomia was filled out by the patient both preoperatively and postoperatively to assess the effect upon xerostomia symptoms.

RESULTS: Nine patients were included in this study. The average time from last radiation and chemotherapy treatment was 8.6 years (range 1-14 years). All patients had complaints of long-standing xerostomia. The average pre-operative VAS score was 9.1. All patients underwent autologous fat grafting. Seven patients underwent one round of fat grafting. One patient underwent two rounds in two different recipient sites. One patient underwent four rounds of fat grafting to the same sites. All patients tolerated all rounds of fat grafting with no complications. The average postoperative VAS score was 6.0. Compared to preoperative scores, all patients had improvement in VAS scores. The decrease in average VAS score postoperatively (9.1 vs 6.0) was statistically significant ($p=0.007$).

CONCLUSION: The investigation into the therapeutic potential of fat grafting and ASC therapy is still in its infancy. Our study showed that there was improvement in xerostomia symptoms with autologous fat transfer alone. This is a novel finding for fat grafting demonstrating regenerative potential. There has been extensive animal model research that has shown that adipose-derived mesenchymal stem cells can have a protective and restorative role after salivary gland radiation damage. Our case series is the first report of fat grafting having a similar reported outcome.

Craniomaxillofacial Abstracts

Gender-Affirming Health Insurance Reform in the United States

Presenter:	Ledibabari M. Ngaage, MD
Co-Authors:	Shan Xue, BS, Mimi R Borrelli, MD, Bauback Safa, MD, Jens U. Berli, MD, Rachel Bluebond-Langner, MD, Yvonne M Rasko, MD
Affiliation:	University of Maryland School of Medicine, Baltimore, MD

INTRODUCTION: Historically, access to gender transition-related healthcare has been limited. In May 2014, the U.S. Department of Health and Human Services (HHS) prohibited insurance discrimination of transgender individuals. Despite this legislative shift and the international standards of care recommended by the World Professional Association for Transgender Health (WPATH), there are continued insurance disparities; health insurance plans often lack explicit guidelines on gender transition-related care and coverage of surgical procedures is varied. We evaluated the evolution of insurance coverage of gender-affirming care following the 2014 legislative change.

METHODS: We selected the largest and most popular insurance companies based on market share. We then conducted a web-based search and telephone interviews to identify the corresponding policies related to gender-affirming healthcare. We compared policy changes made prior to and following the 2014 HHS decision. Policy revisions were categorized into three groups: (i) coverage of services, (ii) medical necessity criteria, and (iii) terminology.

RESULTS: Of the 92 insurers surveyed, 7% (n=6) did not have a policy. We documented a total of 315 policy revisions. Most policies were established (54%, n=48) and most policy revisions occurred (75%, n=236) after the HHS decision. After the legislation, a significantly higher proportion of policy revisions were related to coverage of services (36% vs 11%, p<0.0001), removal of existing criteria significantly decreased (23% vs 49%, p=0.0044), and addition of criteria unrelated to WPATH standards sharply increased (32% vs 2%, p=0.0002). This resulted in reduced coverage of facial feminization, hair transplantation, laryngochondroplasty, and voice modification surgery. However, nipple reconstruction experienced increased coverage. The percentage of revisions to add pre-authorization criteria to meet WPATH standards (49% vs 45%, p=0.6714) or to change terminology (37% vs 27%, p=0.1055) were similar before and after the legislation.

CONCLUSION: Following the transformative legislation in 2014, an increasing number of insurance companies established gender transition-related policies. Additionally, more revisions were dedicated to coverage status which may reflect the continually changing attitudes to gender-affirming procedures, such as facial feminization. As more patients seek gender-affirming care, insurers appear to deviate from international guidelines and create additional benchmarks that may act as barriers to care.

Craniomaxillofacial Abstracts

Validation of a Ratio-Based Nasophayngoscopic Imaging Measurement for Predicting Speech and Surgical Outcomes Following Conversion Furlow Palatoplasty

Presenter:	Gregory D. Pearson, MD
Co-Authors:	Adriane Bayliss, PhD, CCC-SLP, Ani Danelz, MA, CCC-SLP, Angie Morillas, MD, Caitlin Cummings, MA, CCC-SLP, Meghan O'Brien, MPH, Katie Garcia, MA, CCC-SLP, Richard E. Kirschner, MD
Affiliation:	Nationwide Children's Hospital, Columbus, OH

BACKGROUND: Outcome studies for Conversion Furlow Palatoplasty (CFP) for mild velopharyngeal dysfunction have been limited by retrospective reviews lacking reliability data on speech ratings risking rater bias while relying on videofluoroscopy for surgical procedure selection algorithms. It is important to examine the validity and reliability of nasopharyngoscopy (NP) as it is utilized to inform patient selection criteria and potentially predict outcomes from CFP. The purpose of this study was to assess speech outcomes following CFP at 6 and >12 months post-surgery using blinded multiple listener judgments, and explore NP measurements and other predictors of surgical outcome.

METHODS: Participants included 36 consecutive patients with repaired cleft palate (straight-line technique), who underwent CFP at a single center. All patients completed standard pre/post-operative speech recordings and presurgical NP imaging. Patients with 22q11.2 deletion syndrome, submucous cleft palate, and greater than mild hearing loss were excluded from this study. Three cleft-trained Speech Language Pathologists (SLPs) blinded to patient diagnosis and surgical status rated standard pre- and post-operative speech recordings obtained at 6 and >12 mos post-surgery, using the CAPS-A-AM (Chapman et al., 2016)[1]. Pre-surgical NP

image pairs (VP port open vs max closure) were extracted from videorecordings and independently measured using International Working Group standards (Golding-Kushner et al., 1990)[2]. Syndromic diagnosis, pain medication administration, length of stay (LOS), and nasalance scores were also examined. Statistical analysis included Wilcoxon rank sum tests for continuous data and chi-square or Fisher's exact tests for categorical data. Intraclass correlation coefficients were used to assess rater reliability.

RESULTS: CFP resulted in a significant improvement in ratings of hypernasality at 6 months post-surgery ($p=0.0006$) which was maintained at 12 months post-surgery as well ($p<.04$). Post-op nasalance scores also significantly improved ($p<0.0001$). More severe pre-op hypernasality was associated with lower post-op hypernasality ($r=-0.29$, $p=0.04$). Syndromic status, ratio of VP closure, and age at surgery were not predictors of post-op speech outcomes. Longer length of stay was also found to be associated with higher morphine equivalent units received post-surgically ($p<.02$).

Inter-rater reliability was good for hypernasality (ICC = .717, $p<.001$) and intra-rater reliability was ICC = .94 .94, and .95. Inter-rater and intra-rater reliability for ratio of VP closure measures was also good (ICC = .785, $p<.011$; ICC = .55 to .87).

CONCLUSIONS: For patients with mild VPD, Conversion Furlow Palatoplasty is a viable procedure to improve speech. Speech results at 6 months post-surgery appear to be stable through at least 12 months after surgical intervention. This study is the first to report speech outcomes of CFP based on valid and reliable blinded listener ratings speech.

REFERENCES:

1. Chapman, Kathy L., et al. "The Americleft Speech Project: a training and reliability study." *The Cleft Palate-Craniofacial Journal*1 (2016): 93-108.
2. Goldinq-Kushner, Karen J., Working Group Coordinator Participants, and Corresponding Participants. "Standardization for the reporting of nasopharyngoscopy and multiview videofluoroscopy: a report from an International Working Group." *Cleft Palate Journal*4 (1990): 337-348.

Craniomaxillofacial Abstracts

Velopharyngeal Insufficiency in Craniofacial Microsomia: Prevalence, Diagnosis, and Treatment

Presenter:	Candace H Chan, BS
Co-Authors:	Allison C Hu, BA, Brian N Dang, BS, Anthony A Bertrand, MD, MBA, Libby F Wilson, MD, Justine C Lee, MD, PhD
Affiliation:	David Geffen School of Medicine at University of California, Los Angeles, Los Angeles, CA

BACKGROUND: Craniofacial microsomia (CFM) is characterized by malformations of facial structures that are derived from the first and second brachial arches. While hearing, occlusion, and facial paralysis are the most typical functional considerations for CFM, abnormalities in speech, including velopharyngeal insufficiency (VPI), have also been sparingly reported in several studies. As a result, the purpose of this multicenter study was to analyze the prevalence and management of VPI in patients with CFM. Furthermore, this study sought to investigate the effects of concomitant cleft lip and/or palate (CL/P) on VPI in CFM patients.

METHODS: A retrospective chart review of patients from the University of California, Los Angeles Craniofacial Clinic and the Orthopaedic Institute for Children in Los Angeles was conducted. Inclusion criteria included patients who were diagnosed with CFM, first and second brachial arch syndrome, oculo-auriculo-vertebral sequence, facio-auriculo-vertebral syndrome or Goldenhar syndrome. Patients with isolated microtia were excluded from this study. Included CFM patients were stratified based on the presence or absence of CL/P and all patients were evaluated for VPI, methods of diagnosis, speech therapy, and surgery. All patients received at least one thorough evaluation by a speech pathologist and were diagnosed clinically with VPI if they were noted to have any hypernasal speech, nasal air emission, or nasal turbulence. Chi-squared tests and Levene's test ($p \leq 0.05$) were used for analysis.

RESULTS: Overall, 78 patients with CFM (48 male, 61.5%) were assessed for VPI, aged 4-34 years old at time of review. In the entire cohort, 22 (28.2%) patients were found to be diagnosed with VPI. Of the 78 patients, 8 (10.3%) patients had concomitant CL/P. Of the 70 CFM patients without CL/P, 14 (20.0%) had VPI. Eight (57.1%) of these patients were recommended for nasoendoscopy, while none of these patients required any corrective VPI surgery. Comparatively, all 8 CFM with CL/P patients were diagnosed with VPI and recommended for nasoendoscopy, significantly higher rates than those without CL/P. Furthermore, 6 (75.0%) of these patients eventually underwent VPI surgery, significantly more than those without CL/P.

CONCLUSIONS: This study establishes an overall rate of VPI in CFM at 28.2%, with the largest cohort of CFM looking into VPI in the literature. All of the CFM patients with CL/P had VPI, with a majority requiring surgery, compared to only a fifth of CFM patients without CL/P having VPI and none needing surgery. Findings from this study highlight VPI as a common problem in CFM patients that should be diagnosed and managed early on. In addition, this study displays CL/P as a risk and severity factor for VPI.

Craniomaxillofacial Abstracts

Time-Driven, Activity-Based Costing of Pre-Surgical Infant Orthopedics: A Critical Component of Establishing Value of Latham Appliance and Nasoalveolar Molding

Presenter:	Ingrid M Ganske, MD, MPA
Co-Authors:	Karl Sanchez, BA, Elliot Le, MBA, Olivia C Langa, BA, Banafsheh Sharif-Askary, MD, Elizabeth Ross, DMD, Pedro E. Santiago, DMD, John G. Meara, MD, DMD, MBA, Bonnie L Padwa, DMD, MD, Alexander C. Allori, MD, MPH
Affiliation:	Boston Children's Hospital, Harvard Medical School, Boston, MA

BACKGROUND: Value-based health-care reform requires assessment of outcomes and costs of medical interventions. In cleft care, pre-surgical infant orthopedics (PSIO) is still being evaluated for clinical benefits and risks; however, cost of these procedures has been largely ignored. This study employs robust accounting methods to quantify the cost of providing two variants of PSIO: Latham and nasoalveolar molding (NAM).

METHODS: This is a prospective study of patients with non-syndromic cleft lip and/or palate (CL/P) who underwent PSIO from 2017-2019 at two academic centers. Costs were measured using time-driven activity-based costing (TDABC). Personnel costs, facility costs (operating room, clinic, and inpatient ward), and equipment costs were included. Travel expenses were included as an estimate of direct costs borne by the family, but indirect costs (e.g., time off from work) were not considered.

FINDINGS: Twenty-three patients were treated with Latham and 14 with NAM. For Latham, average cost totaled $7553/patient ($1041 for personnel, $637 for equipment, $4871 for facility, and $1004 for travel over 6.5 visits). Unilateral and bilateral Latham costs were $6891 and $8860, respectively. For NAM, average cost totaled $2541 ($364 for personnel, $151 for equipment, $300 for facility, and $1726 for travel over 13 visits); $2120 for unilateral and $3048 for bilateral treatment.

CONCLUSIONS: The major difference in cost is attributable to operative placement of the Latham' device. Travel cost for NAM is often higher due to frequent clinical encounters required. Future investigation should focus on whether outcomes achieved by PSIO justify the $2100-$8900 expenditure for these adjunctive procedures.

Craniomaxillofacial Abstracts

Long-Term Morphological Evaluation of Conservatively Managed Patients with Single Suture Craniosynostosis.

Presenter: Hari Iyer, M.D., C.M.
Co-Authors: Gaby Doumit, MD
Affiliation: University of Montreal, Montreal, QC, Canada

PURPOSE: Surgical treatment for single-suture craniosynostosis is controversial, with some authors casting doubt over its benefits for intracranial pressure[1] and behavioural development[2]. In this optic, cranioplasty is a purely aesthetic intervention wherein the benefits may not outweigh the risks. There is a paucity of literature objectively evaluating the long-term aesthetic results of unoperated children with craniosynostosis. Our purpose is to clarify the long-term evolution of the cranial deformity in patients with single suture craniosynostosis and thus facilitate decision-making for families faced with the prospect of surgical intervention for their child.

MATERIALS AND METHODS: A retrospective chart review was conducted at our institution to identify unoperated patients with single-suture craniosynostosis followed with standardised photographs. Data on demographics, type of craniosynostosis and cranial deformity were collected. Patient photos were then presented to surgeons trained in craniofacial assessment for evaluation of the severity of deformity on a 5-point Likert scale and candidacy for surgery over time. Laypeople also evaluated the severity of deformity over time and determined their readiness to accept corrective surgery if offered on a similar scale.

RESULTS: 9 unoperated patients with metopic craniosynostosis and 11 with sagittal craniosynostosis were identified. 65% of patients were male, mean age at initial presentation was 36.7 months and mean photographic follow-up was 83.9 months.

Craniofacial surgeons rated the initial deformity as moderate (median 3/5, IQR 2) and would have offered surgery in 70.0% of cases. They found the deformity to be mild at long-term follow-up (4/5, IQR 2), a significant improvement ($p < 0.001$). Surgeons stated that only 64.0% of cases would have needed surgery initially given their evolution and were willing to offer surgery at long-term follow-up in 48.0% of cases. Surgeons over 65 years of age were more likely to offer surgery initially (91.8% vs 33.3%, $p < 0.0001$) and at long-term follow-up (64.7% vs 11.1%, $p < 0.001$) than those 45-64. No differences were found in evolution of deformity or willingness to operate when accounting for affected suture.

Lay evaluators found the initial deformity moderately acceptable (4/5, IQR 1) but were very unwilling to accept surgery at presentation (1/5, IQR 0). They found the deformity to be significantly more acceptable at last follow-up (median 5/5, IQR 1, $p < 0.001$) and were equally unwilling to accept surgery at long-term follow-up (1/5, IQR 0). No significant differences in opinion regarding severity of deformity, change in deformity or willingness to accept surgery were found when accounting for affected suture, participant sex or parenthood.

CONCLUSIONS: In the long-term, the cranial deformity associated with unoperated single suture craniosynostosis improves moderately in the eyes of craniofacial surgeons and laypeople alike. Older surgeons may favour surgery but up to 6.0% of children who undergo operative correction may have good aesthetic outcome without this.

REFERENCES:

1. The effects of craniosynostosis on the brain with respect to intracranial pressure. Seminars in pediatric neurology; 2004. Elsevier.
2. Speltz ML, Collett BR, Wallace ER, et al. Behavioral adjustment of school-age children with and without single-suture craniosynostosis. *Plastic and reconstructive surgery* 2016;138(2):435-45.

Craniomaxillofacial Abstracts

Interfacility Transfers for Isolated Craniomaxillofacial Trauma: Perspectives of the Facial Trauma Surgeon.

Presenter:	Matthew E Pontell, MD
Co-Authors:	Jordan P Steinberg, MD, PhD, FACS, FAAP, Donald R. Mackay, MD, Michael S Golinko, MD, FACS, FAAP, Brian C. Drolet, MD, FACS
Affiliation:	Vanderbilt University Medical Center, Nashville, TN

INTRODUCTION: Secondary overtriage is a burden to the medical system1. Unnecessary transfers overload tertiary trauma centers, occupy emergency transfer resources and ultimately delay definitive patient care1-4. Craniomaxillofacial (CMF) trauma, especially in isolation, is a frequent culprit1-4. The aim of this study is to evaluate the perspective of the facial trauma surgeon with regards to interfacility transfers for isolated CMF trauma. Information collected will be used to construct transfer guidelines with the goal of decreasing the secondary overtriage of such patients.

METHODS: A 31-item survey was developed and distributed anonymously to the American Society of Maxillofacial Surgeons, the North American Division of AO Craniomaxillofacial and the American Academy of Facial Plastic and Reconstructive Surgery.

RESULTS: The survey yielded 196 responses. 77% of respondents did not believe that most isolated CMF transfers required emergency surgery and roughly half (49%) thought that most emergency transfers were unnecessary. 54% of respondents agreed that most patients transferred could have been referred for outpatient management and 87% thought that transfer guidelines could help decrease unnecessary transfers. 27% of respondents had no pre-transfer communication with the referring facility. Perspectives on the transfer of specific fracture patterns and their presentations were also collected.

CONCLUSION: Most facial trauma surgeons believe that emergent transfer for isolated CMF trauma is frequently unnecessary. Such injuries rarely require emergent surgery and can frequently be managed in the outpatient setting without activating emergency transfer services. The fracture-specific data collected are a representation of the national, multi-disciplinary opinion of facial trauma surgeons and correlates with previously published data on which specific types of facial fractures are most often transferred unnecessarily4. The results of this study can serve as the foundation for interfacility transfer guidelines, which may provide a valuable resource in triaging transfers and decreasing associated healthcare costs.

REFERENCES:

1. Sorensen MJ, von Recklinghausen FM, Fulton G, et al. Secondary overtriage: the burden of unnecessary interfacility transfers in a rural trauma system. *JAMA Surg*. 2013:148(8):763-768.
2. Tang A, Hashmi A, Pandit V, et al. A critical analysis of secondary overtriage to a level I trauma center. *J Trauma Acute Care Surg*. 2014;77:969-973.
3. Drolet BC, Tandon VJ, Ha AY, et al. Unnecessary emergency transfers for evaluation by a plastic surgeon: a burden to patients and the health care system. *Plast Reconstr Surg.* 2016;137:1927-1933.
4. Pontell ME, Colazo J, Drolet BC. Unnecessary interfacility transfers for craniomaxillofacial trauma. *Plast Reconstr Surg*. 2019. Accepted for publication.

Craniomaxillofacial Abstracts

Endoscopic Management of Frontal Sinus Fractures: A Systematic Review

Presenter: Robert P. Lesko, BA
Co-Authors: Eric J. Macdonald, BS, Brandon J. De Ruiter, MD, Edward H. Davidson, MD
Affiliation: Montefiore Medical Center/Albert Einstein College of Medicine, Bronx, NY

PURPOSE: Endoscopic approaches to frontal sinus fracture management are an emerging challenge to the traditional algorithmic paradigm, especially in the management of anterior table fractures. Endonasal cannulation and/or stenting of the nasofrontal outflow tract can obviate the need for obliteration. Endoscopic assistance can also be an adjunct to anterior table reconstruction and obliteration. There have been no systematic reviews analyzing utilization and outcomes of endoscopic management of isolated anterior table fractures of the frontal sinus.

METHODS: A comprehensive search of PubMed/MEDLINE, Embase, Web of Science, and Cochrane was performed in September 2019 through consultation with a research librarian using the key terms “frontal sinus fracture” or “frontal sinus injury”. Articles met criteria for inclusion if they were human studies written in English, primary literature, and discussed the management of isolated anterior table frontal sinus fractures. All unrelated articles, non-human studies, case reports, those not in English, and those without outcomes data were excluded. Variables extracted included mean patient age, age range, diagnosis, treatment method, complications, and any other reported outcomes data.

RESULTS: Of 606 articles identified in our initial search, 89 were reviewed in their entirety and 22 were ultimately included in our analysis. 8 papers were retrospective reviews and 14 were case series. 786 patients (mean age 28.8) with isolated anterior table frontal sinus fractures were included in our analysis. 35 patients (4.5%) underwent endoscopically-assisted procedures. 7 patients (0.9%) underwent endoscopically-assisted reduction and 28 patients (3.6%) underwent endoscopically-assisted reduction and fixation with no

complications reported for patients undergoing either surgery. Nasofrontal outflow tract involvement was discussed in 5 (83%) of the papers utilizing endoscopic techniques and obstruction was noted in 2 patients. In the studies describing traditional methods of treating isolated anterior table fractures such as observation, ORIF, and obliteration, reported complication rates ranged from 2.13% to 50%.

CONCLUSIONS: Endoscopically-assisted repair of isolated anterior table frontal sinus fractures is emerging as a safe evolution from traditional methods. Utilization of endonasal cannulation and stenting of the nasofrontal outflow tract has potential to obviate the need for obliteration and challenge the traditional management algorithm but requires further study.

Craniomaxillofacial Abstracts

A Novel Protocol in Early Cleft Lip Repair: Demonstrating Efficacy and Safety in the First 100 Patients

Presenter:	Jordan Wlodarczyk, MD
Co-Authors:	Erik Matthew Wolfswinkel, MD, Alice Liu, B.A., Artur Fahradyan, MD, Pedram Goel, MD, William P. Magee, III, MD, DDS, Mark M. Urata, MD, Jeffrey A Hammoudeh, MD, DDS
Affiliation:	Children's Hospital of Los Angeles, Los Angeles, CA

BACKGROUND: Orofacial clefts are a prevalent birth defect that affects approximately 7.75 neonates out of every 10,000 live births. The optimal timing for repair of the cleft lip has yet to be objectively validated and previous supporting evidence guiding ideal timing may be outdated. Earlier repair takes advantage of the high degree of plasticity within the nasal cartilage and maxilla as a result of high concentrations of circulating maternal estrogen in the infant[1]. Accomplishing the operative repair of the cleft lip in infancy has the capacity to decrease restrictive scar formation, improve aesthetic outcomes, accelerate weight gain, and improve feeding and maternal-infant socialization[2,3]. In this study, we present unilateral cleft patients prospectively enrolled in an early cleft lip repair (ECLR) multidisciplinary protocol created to facilitate the safe and effective repair of the cleft lip and nostril.

METHODS: ASA class I/II patients with unilateral cleft lip and/or palate undergoing repair < 3 months of age were enrolled over 5 years. Chart review abstracted patient demographics, cleft characteristics, cleft width ratio (defined as cleft width divided by commissure length)[4], operative data, anesthetic data, nasal stent data, and complication and readmission rates. Preoperative and postoperative nostril breadth (NB), nostril width (NW), nasal angle (NA), lip length (LL), frontal nasal breadth (FNB), and commissure length (CL) measured as ratios between cleft and non-cleft sides to approximate distance form ideal symmetry. ECLR and unilateral cleft NAM patients were matched for cleft lip severity using their CWR and compared for symmetry outcomes.

RESULTS: The surgical and anesthetic complication rates for 100 ECLR patients were both 2%. Operative and anesthetic times were 123 minutes (SD 37) and 177 minutes (SD 34), respectively. Hospital length of stay was 1 day (SD 0). Age at repair between ECLR and NAM patients was 33 days (SD 15) and 118 days (SD 33) $p \leq 0.001$, respectively. After ECLR, preoperative to postoperative distance from symmetry for all anthropomorphic measurements improved ($p \leq 0.001$). Comparing severity matched ECLR to NAM patients, similar improvements were observed suggesting equivalent results ($p > 0.05$).

CONCLUSIONS: ECLR provides a safe and efficacious method for correcting the unilateral cleft lip and nasal deformity.

REFERENCES:

1. Kenny FM, Angsusingha K, Stinson D, Hotchkiss J. Unconjugated estrogens in the perinatal period. Pediatr Res. 1973;7(10):826-831
2. Weatherley-White RC, Kuehn DP, Mirrett P, Gilman JI, Weatherley-White CC. Early repair and breast-feeding for infants with cleft lip. Plast Reconstr Surg. 1987;79(6):879-887.
3. Petráčková I, Zach J, Borský J, et al. Early and late operation of cleft lip and intelligence quotient and psychosocial development in 3-7 years. Early Hum Dev. 2015;91(2):149-152.
4. Yao CA, McCullough M, Auslander A, Imahiyerobo TA, Vanderburg R, Magee WP. The Smile Index: Part 2. A Simple, Prognostic Severity Scale for Unilateral Cleft Lip. 143(4):790e-797e.

Craniomaxillofacial Abstracts

Risk Factors for Delayed Diagnosis of Positional Plagiocephaly: A Retrospective Review of 25,322 Patients

Presenter: Naikhoba C.O. Munabi, MD, MPH
Co-Authors: Michael S. Nelson, MD, Stacey H Francis, MD
Affiliation: University of Southern California, Los Angeles, CA

PURPOSE: Studies of positional plagiocephaly have found that earlier intervention with repositioning in mild cases or a molding orthosis in more severe presentations leads to more effective correction of asymmetry[1,2]. However, patients with positional plagiocephaly continue to be midiagnosed or diagnosed at an older age. This study aims to understand risk factors for late diagnosis of positional plagiocephaly in order to optimize timely intervention.

METHODS: After obtaining IRB approval, retrospective review was performed of all patients diagnosed with positional plagiocephaly between 2019 and 2019 at a Southern California Kaiser Permanente. Patients were identified with ICD-9 and ICD-10 codes. Those with code descriptions inconsistent with positional plagiocephaly were excluded. Patients were separated into two cohorts according to early (<=4 months) or late (>4 months) age of diagnosis. Cohorts were compared for variables including demographics, gestational history, other diagnoses including torticollis or hydrocephalus, and history of hospitalizations in first year of life. Data were queried in Excel (Microsoft Co, Redmond, WA) and statistical analysis using student's t-test or ANOVA were performed in SAS (SAS Institute, Carey, NC) with significance denoted at $p<0.05$.

RESULTS: 25,332 patients met inclusion criteria. Patients were 61.7% male. 81.5% (n=20,636) of patients were diagnosed early and 19.5% (n=4,686) diagnosed late. Patients diagnosed late were significantly more likely to be Hispanic (51.7% vs 46.9%) and less likely to be Asian/Pacific Islander (15.9% vs 20.3%, $p<0.0001$). Prematurity (30.5% vs 23.3%, $p<0.0001$) and multiple gestation birth (4.9% vs 3.6%, $p<0.0001$) were significantly more common in late diagnoses. Patients with plagiocephaly diagnosed late were significantly more likely to have concomitant hydrocephalus (0.6% vs 0.1%, $p<0.0001$) and less likely to have torticollis (17.1% vs 21.4%, $p<0.0001$). A history of NICU hospitalization (20.8% vs 13.0%, $p<0.001$) was associated with late diagnosis and patients diagnosed late spent significantly more days in hospital in the first 3 months of life (6.8±3.4 days vs 3.9±6.6 days, $p<0.0001$).

CONCLUSIONS: Risk factors for late diagnosis of positional plagiocephaly include Hispanic ethnicity, prematurity, multiple gestation birth, or prolonged neonatal hospitalization including NICU stay. Patients with torticollis tend to be diagnosed earlier, suggesting that positional plagiocephaly is easier to diagnose if torticollis is also present. Further education should be provided to pediatricians to screen for positional plagiocephaly, particularly at the 4-month check-up and in patients without torticollis who have other associated risk factors in order to optimize outcomes from conservative treatment or helmet therapy.

REFERENCES:

1. Felix K, et al. Head Orthosis Therapy in Positional Plagiocephaly: Influence of Age and Severity of Asymmetry on Effect and Duration of Therapy. Plastic and Reconstructive Surgery 2017; 140(2): 349-358.
2. Braun T, and Hollier LH. Discussion: Head Orthosis Therapy in Positional Plagiocephaly: Influence of Age and Severity of Asymmetry on Effect and Duration of Therapy. Plastic and Reconstructive Surgery 2017; 140(2): 359-360.

Craniomaxillofacial Abstracts

Secondary Synostosis after Posterior Vault Distraction in Craniosynostosis: Possible Role of Compression from Distraction.

Presenter: Makoto Hikosaka, MD
Co-Authors: Tsuyoshi Kaneko, MD, Hikaru Kono, MD, Hideki Ogiwara, MD, Nobuhito Morota, MD
Affiliation: National Center for Child Health and Development, Tokyo, Japan

INTRODUCTION: Posterior vault distraction is often performed for correction of brachycephaly associated with craniosynostosis. Secondary fusion of initially patent cranial suture is seldom observed after surgical correction, and its incidence is reported to be between 10-37%. But its incidence, mechanism and influence on cranial growth are not well described specifically after posterior vault distraction. Especially, the influence of compression to the patent suture during distraction on secondary synostosis is yet to be elucidated. This retrospective study was conducted to investigate these questions.

METHODS: To elucidate the influence of compression effect during distraction on secondary synostosis, patients with lambdoid synostosis were selected, in whom patent coronal suture lies perpendicular to the direction of force exerted by the posterior distraction. Retrospective chart review was performed on 5 patients with bilateral lambdoid and sagittal synostosis and1 patient with bilateral lambdoid synostosis who underwent posterior vault distraction between 2002‐2018 at National Center for Child Health and Development, Tokyo, Japan. CT images were used to determine the patency of cranial sutures, and head circumference was used to evaluate cranial growth.

RESULTS: Posterior vault distraction was performed at median age of 12 months (range: 6-15). On CT images, the coronal suture was patent before operation, but it was partially or totally fused at median of 5 months (range: 1-7) after operation in all the patients. At the latest follow up at median of 36 months (range: 13-131), synostosis of the coronal suture progressed to total and remained fused in all the patients. The median head circumference was 62 percentile (range: 44-90) before operation. It increased to approximately 100 percentile at median of 9 months (range 8-14) after operation except for one patient whose data was not available, and it continued to increase along the growth curve afterwards.

DISCUSSIONS: The initially patent coronal suture was fused in all of the 6 patients with lambdoid synostosis after posterior cranial vault distraction. Several possible explanations exist for this phenomenon, including decompression of intracranial pressure after cranial expansion and surgical invasion on cranial bone. But high incidence in the present study compared to the past literature suggests that the compression on the coronal suture during distraction may play important role in the secondary synostosis. The impact of secondary synostosis on cranial growth seems minimal, considering the fact that the normal rate of head growth was observed even after the coronal suture remained fused. The patients in this study were thought to have obtained sufficient cranial volume by distraction, and reached the gradual phase of cranial growth which is not dependent on the patent suture.

Higher risk of secondary synostosis is expected when performing posterior vault distraction, especially when the compression force is exerted on the patent suture during distraction. It is important to obtain sufficient cranial volume by distraction so that cranial volume is maintained with gradual cranial growth even after secondary synostosis. Further study is warranted to elucidate the incidence, mechanism and impact of secondary synostosis after cranial vault distraction.

Craniomaxillofacial Abstracts

Surgical Management of FGFR2 Mutation Related Syndromic Craniosynostosis: Retrospective Review of a 45-Year Experience By a Single Surgeon

Presenter:	Erin M. Wolfe, B.S.
Co-Authors:	Noreen Mohsin, BS, Sydney A. Mathis, BS, Jonatan Hernandez Rosa, MD, S. Anthony Wolfe, MD
Affiliation:	Nicklaus Children's Hospital, Miami, FL

PURPOSE: Mutations in the fibroblast growth receptor 2 (*FGFR2*) gene have been identified in syndromic craniosynostosis syndromes such as Apert, Crouzon and Pfeiffer syndrome. Patients have severe malformations of the skull and face requiring multiple complex reconstructive procedures. As described by Paul Tessier, surgical correction of such patients is performed for three main reasons: functional, morphologic, and psychological. The surgical treatment algorithm has evolved over time. Despite numerous articles describing treatment of syndromic craniosynostosis, there are few reports of long-term results. Long-term follow up of patients after midface surgeries is important for evaluating which techniques result in consistent favorable outcomes, and which should be improved. We present a retrospective review reporting surgical procedures performed by a single surgeon in patients with Apert, Crouzon and Pfeiffer Syndrome over a period of 45 years, with the intent to delineate procedures that have been effective over time. We also present our surgical treatment algorithm for pediatric patients with *FGFR2*-mutation related syndromic craniosynostosis based on the senior author’s experience.

METHODS: A retrospective review was performed of all patients with *FGFR2*-mutation related syndromic craniosynostosis that underwent reconstruction for craniofacial defects, as performed by the senior author between 1975 and 2020. Patients without syndromic craniosynostosis were excluded. Inclusion criteria was limited to Apert, Crouzon and Pfeiffer syndromes. Surgical procedures and complications were recorded for patients at all stages of the reconstructive process.

RESULTS: A total of 68 patients were identified who had complete records for evaluation, including 30 patients with Apert syndrome, 27 patients with Crouzon syndrome and 11 patients with Pfeiffer syndrome. The

verage patient age was 30±15.8 years, with a range of 3-77 years of age. Mean long-term follow-up after initial surgery was 10.5±10.1 years. Primary procedures performed for correction of craniofacial deformities included posterior distraction or expansion (10.3%), frontal expansion (14.7%), fronto-orbital advancement (39.7%), facial bipartition (11.8%), Le Fort III (19.1%) and Le Fort I (23.5%). Mean ages at which procedures were performed were 1.5±1.6 years for posterior distraction or expansion, 1.1±1.2 years for fronto-orbital advancement, 6.2±3.8 years for monobloc frontoacial advancement or 4.6±1.8 years for monobloc frontofacial advancement with facial bipartition, 13.2±8.2 years for Le Fort III and 17.0±3.8 years for Le Fort I. Additional procedures commonly used included nasal bone grafts (25.0%) and lateral canthopexies (19.1%).

CONCLUSIONS: This study, with an extensive long-term follow up period, presents a pediatric surgical treatment algorithm for patients with *FGFR2*-mutation related syndromic craniosynostosis. Our treatment algorithm entails a posterior distraction or expansion and fronto-orbital advancement at 6 months, monobloc frontofacial advancement ± facial bipartition at age 6 or 7, or a Le Fort III if morphologically indicated, and in most cases a Le Fort I at age 17 or 18. Although multiple reconstructive procedures are necessary, complications are rare. This treatment algorithm results in good results in adolescence, allowing patients to integrate into mainstream life. However, patients tend to prematurely age, a problem which is not addressed by the current pediatric surgical treatment algorithm. Future directions include defining aesthetic surgical management of adults.

Craniomaxillofacial Abstracts

The Facial Artery Cheek Subunit and Extended Facial Artery Cheek Subunit Perforator Flaps in Fasciocutaneous Head and Neck Reconstruction

Presenter: Justin Yousef, MBBS, B.Med Sci, Diploma of Anatomy, Master of Surgery
Co-Authors: Michael W Findlay, MBBS, PhD, FRACS
Affiliation: The Canberra Hospital, Garran, ACT, Australia

CONCISE PURPOSE: Resection of head and neck malignancies commonly results in significant fasciocutaneous defects of single or multiple cosmetic subunits[1]. Reconstruction can be challenging due to patient age, comorbidities and previous irradiation[2]. The ideal reconstructive approach delivers locally matched tissue, based on reliable vasculature of the external carotid system[3], and minimises donor site and perioperative morbidity. The Facial Artery Cheek Subunit (FACS) and Extended Facial Artery Cheek Subunit (EFACS) flaps are facial artery perforator flaps based on the aesthetic subunit of the cheek. They were developed to permit a multifaceted reconstructive approach to parotid and other fasciocutaneous defects to simultaneously reconstruct multiple subunits with locally matched tissue and address facial nerve paresis in a single procedure. We describe our experience with the first 50 patients.

METHODS AND MATERIALS: A cadaveric study was undertaken to examine the feasibility of the use of the cheek aesthetic subunit, with extensions into the neck as necessary, to achieve simultaneous reconstruction of adjoining defects (peri-auricular, perinasal and perioral) and management of ipsilateral facial nerve dysfunction. A system was developed that utilises selective facial retaining ligament release, islanding of the skin flap, tunnelling to permit the use of fascial slings and resuspension with elevation of perioral and perinasal skin relative to the cheek aesthetic unit, to achieve effective, and rapid management of facial ptosis. 50 patients whose tumour extirpation resulted in a facial or neck fasciocutaneous defect underwent FACS or EFACS flap reconstruction to dually restore cosmetic subunits and address facial nerve palsy.

EXPERIENCE AND SUMMARY OF RESULTS: FACS and EFACS flaps were applied in over 50 patients for defects up to 120cm^2. There were no cases of flap loss. Only one had tip necrosis. Reconstructive time was under two hours in all patients. Post-operative wound infection occurred in two patients. All wounds healed within two weeks of surgery and adjuvant radiotherapy was not delayed in any patient. No revisional surgery was necessary with the exception of periorbital procedures such as gold weight insertion, brow lift and tarsorrhaphy in some cases. The approach successfully addressed the lower facial stigmata of facial muscle weakness

REASONABLE AND UNDERSTANDABLE CONCLUSIONS: The FACS and EFACS flaps are versatile techniques that can reconstruct head and neck oncology defects and facial nerve palsy in a single operation. They may be used to address cheek, neck, periauricular, perioral and perinasal reconstruction as well as the sequalae of facial nerve palsy. They are especially useful in high-risk patients because of their low complication rate, cost-effectiveness and reduction of donor site morbidity.

REFERENCES:

1. Gonzalez-Ulloa M. Restoration of the face covering by means of selected skin in regional aesthetic units. *British journal of plastic surgery.* 1956;9(3):212-221.
2. Behan FC, Rozen WM, Wilson J, Kapila S, Sizeland A, Findlay MW. The cervico-submental keystone island flap for locoregional head and neck reconstruction. *Journal of Plastic, Reconstructive & Aesthetic Surgery.* 2012;66(1).
3. Imanishi N, Nakajima H, Kishi K, Chang H, Aiso S. Is the Platysma Flap Musculocutaneous? Angiographic Study of the Platysma. *Plastic and Reconstructive Surgery.* 2005;115(4):1018-1024.

Craniomaxillofacial Abstracts

What Is Normal Newborn Sleep? a Characterization of Sleep Patterns in Neonates with and without Airway Obstruction

Presenter: Melissa Kanack, MD
Co-Authors: Neal Nakra, MD, Irfan Ahmad, MD, Raj M. Vyas, MD
Affiliation: UC Irvine Dept of Plastic Surgery, Orange, CA

PURPOSE: Polysomnography is vital in evaluating neonatal airway obstruction. Although many institutions use sleep data to select patients for mandibular distraction osteogenesis (MDO), no “normal” published references exist for this age. We present normative polysomnography data for newborns age 0-1 month. We also compare this normative reference to pre and post-operative data of infants this age undergoing MDO.

METHOD/DESCRIPTION: Following IRB approval, normative subjects were recruited from our NICU to undergo nap polysomnography. Included were infants without airway obstruction, gestational age 37-42 weeks, and age less than 30 days. Data included apnea-hypopnea indices, pulse oximetry, CO2, EEG, and EKG. One blinded sleep physician read all studies. Sleep data for newborns undergoing MDO was collected prospectively (2016-18). All data were collected and analyzed using REDCap and SPSS software.

RESULTS: 19 neonates without airway obstruction provided normative sleep data; median age at polysomnography was 4 days and median sleep time was 182 minutes. Median total apnea-hypopnea (AHI), obstructive apnea-hypopnea (OAHI), and central apnea indices (CAI) were 6.92, 4.92, and 0.66 events/hr. The median O2 nadir was 91%. Polysomnography was done on 12 neonates with airway obstruction before and after

MDO. Compared to the controls, there were no significant differences in age, race, or gender. Median age at pre-operative study was 7 days and median sleep time was 333 minutes. Median AHI was 44.60, OAHI was 41.91, and CAI was 1.97. Median O2 nadir was 82%. Prior to undergoing MDO, neonates with airway obstruction had significantly worse AHI, OAHI and O2 nadir than normative counterparts ($p<.001$). There was no significant difference in CAI. Post-surgical sleep data was collected after activation phase of MDO; median age was 47 days and median sleep time was 332 minutes. In this group, median AHI was 6.08, OAHI was 3.95, and CAI was 1.32. Median O2 nadir was 93.5%. Paired t-tests demonstrated significant improvements in OAHI ($p<.001$), AHI ($p<.001$), and oxygen saturation nadir after MDO ($p=.004$). When comparing the normative group to neonates who underwent MDO, there was no significant difference in oxygenation or any apnea-hypopnea index.

CONCLUSION: In children, OAHI>1 is considered abnormal; this norm has been extrapolated to neonates. Our findings demonstrate "normal" neonates have more obstructive and central apneic events than previously appreciated, with a median of 4.92 obstructive and 6.92 total events per hour. Furthermore, newborns without airway obstruction still exhibit a wide range of "normal" OAHI values (1.66-19.08). Newborns with airway obstruction had significantly worse OAHI/AHI and O2 saturation nadir than their non-obstructed counterparts and exhibited improvement to normative levels following MDO. Each center with a multidisciplinary MDO team should consider collecting normative neonatal sleep data to reflect their regional population, enabling calibration of existing patient selection algorithms and informing important discussions with anxious parents.

Craniomaxillofacial Abstracts

Functional Results of Oral Cavity Organs Reconstruction By Innervated Free Flaps in Oncological Patients

Presenter:	Igor Reshetov, Academician, MD, prof.
Co-Authors:	Albina Zakirova, MD
Affiliation:	I.M. Sechenov First Moscow State Medical University (Sechenov University), Moscow, Russian Federation

INTRODUCTION: Reconstruction of the oral cavity organs by microsurgical autotransplantation after the radical surgical treatment is a method of choice to return patients to the normal life. The tissues used as a donor area provide an opportunity for simultaneous reinnervation. The use of innervated flaps has an advantages, the most important of which are restoration of sensation and decreasing autograft involution.

PURPOSE: Improving the functional results of the reconstruction of the organs of the oral cavity, assessing the benefits of using reinnervated free flaps.

MATERIALS AND METHODS: In 2014-2019 in the Sechenov University were performed 30 reconstructive operations on the oral cavity using reinnervated flaps. Reconstruction was mostly performed with a free radial flap with the inclusion of the lateral cutaneous nerve (n = 18), for the more extensive defects a free thoracodorsal flap with the inclusion of the thoracodorsal nerve was used (n = 8) and also a rectal muscle flap with the inclusion of the 12th intercostal nerve (n = 4). Anastomoses were performed mainly to the branches of the hyoid nerve and the large ear nerve. Such operations were performed simultaneously to the patients without regional and distant metastases - T (1-4) N0M0, and in the delayed period to the patients without continued growth or relapse. The treatment results were evaluated at 0,5, 1 and 1.5 years after surgery. To assess the

results we used modified EORTC QLQ - H&N35 questionnaire [1]. Also, the restoration of sensitivity, speech intelligibility and swallowing were assessed. As an objective method we start to use histological evaluation and immunohistochemical staining of biopsy specimens [2]. To determinate the functional results we use functional magnetic resonance imaging [3].

RESULTS: Research work continues. All patients were discharged 3-4 weeks after surgery. After 5 weeks, all patients were restored nutrition through the mouth, after 5-6 months, intelligible speech appeared. After 6 months the first signs of restoration of sensitivity were noted, for a period of 1 year, the results tended to improve.

CONCLUSION: The use of functional flaps allows patients to return neo-organ sensitivity, which avoids the occurrence of burns and biting, chronic ulcers. Also, the results of restoration of speech formation are significantly better, in 100% the act of swallowing was restored. Most patients were fully rehabilitated and return to the profession. The brain imaging data demonstrate that the cortex adapts tongue movements by expanding the tactile sensory receptive fields, this would suggest that sensate flaps may impart a functional advantage.

REFERENCES:

1. Pipkorn P., Rosenquista K., Zengab J. Functional considerations in oral cavity reconstruction. Curr Opin Otolaryngol Head Neck Surg. 2018 Oct;26(5):326-333
2. Katou F., Shirai N., Kamakura S. et al. Intraoral reconstruction with innervated forearm flap: a comparison of sensibility and reinnervation in innervated versus noninnervated forearm flap. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1995 Dec;80(6):638-44.
3. Mosier K., Liu W.C., Behin B., Lee C., Baredes S. Cortical adaptation following partial glossectomy with primary closure: implications for reconstruction of the oral tongue. Ann Otol Rhinol Laryngol. 2005 Sep;114(9):681-7.

Craniomaxillofacial Abstracts

A Nationwide Analysis of Cleft Palate Repair: Impact of Local Anesthesia on Operative Outcomes and Hospital Cost.

Presenter:	Giap H. Vu, BA
Co-Authors:	Laura S. Humphries, MD, Carrie E. Zimmerman, BS, Christopher L. Kalmar, MD MBA, Jordan W. Swanson, MD, MSc, Scott P Bartlett, MD, Jesse A. Taylor, MD
Affiliation:	Children's Hospital of Philadelphia, Philadelphia, PA

PURPOSE: Limited evidence exists on the impact of local anesthesia on operative outcomes and cost in pediatric craniofacial surgery. This study aims to investigate the associations between local anesthesia choice and short-term outcomes, as well as hospital cost, for cleft palate repair in the United States.

METHODS: Patients undergoing cleft palate repair between 2004 and 2015 were abstracted from the Pediatric Health Information System database. Primary outcomes – which included any operative complication, prolonged hospital length-of-stay (LOS), and increased hospital total cost – were compared among three patient groups: no local anesthesia (LA), LA without epinephrine, and LA with epinephrine. Multiple logistic regressions were used

to control for patient demographics, comorbidities, and hospital characteristics. Area under the receiver operating characteristic curve (AUC-ROC) was calculated to assess the predictive accuracy of logistic regression models.

RESULTS: 17,888 patients from 49 institutions met the study criteria. 5,640 (31.5%) patients did not receive LA, 647 (3.6%) received epinephrine-free LA, and 11,601 (64.9%) received epinephrine-containing LA. Regarding operative complication, compared with epinephrine-containing LA, using no LA was associated with increased odds of complication in both univariate and multivariate analyses (OR = 1.24 [1.07, 1.44], $p = 0.005$; AOR = 1.26 [1.07, 1.48], $p = 0.005$). Complication rate did not significantly differ between using LA with and without epinephrine (OR = 0.84 [0.54, 1.30], $p = 0.430$; AOR = 0.82 [0.51, 1.26], $p = 0.384$). In terms of hospital LOS, patients receiving LA without epinephrine had significantly lower odds of prolonged LOS than those having epinephrine-containing LA both before and after controlling for potential confounders (OR = 0.56 [0.36, 0.88], $p = 0.012$; AOR = 0.41 [0.25, 0.63], $p < 0.001$). The likelihood of prolonged LOS was not significantly different between patients receiving epinephrine-containing LA and those having no LA (OR = 0.92 [0.80, 1.06], $p = 0.263$; AOR = 0.97 [0.83, 1.12], $p = 0.659$). With respect to hospital cost, using no LA was associated with high cost compared with epinephrine-containing LA in both adjusted and unadjusted analyses (OR = 1.19 [1.10, 1.29], $p < 0.001$; AOR = 1.32 [1.22, 1.44], $p < 0.001$). LA without epinephrine was not significantly different from LA with epinephrine regarding odds of increased hospital cost (OR = 0.84 [0.68, 1.04], $p = 0.115$; AOR = 0.86 [0.69, 1.08], $p = 0.198$). For all multiple logistic regressions, AUC-ROC values were greater than the cut-off of 0.70; corrected variance inflation factors (VIF) were below the cut-off of 5.

CONCLUSIONS: After controlling for potential confounders, including patient demographics, comorbidities, and hospital characteristics, epinephrine-containing LA is associated with lower operative complication and hospital cost compared with using no LA in cleft palate repair. However, compared with epinephrine-free LA, epinephrine-containing LA is not only non-superior in terms of complication and cost, but also linked with a higher likelihood of prolonged LOS. Future investigations, especially prospective studies, are needed to further delineate the role of epinephrine and local anesthesia in palatal surgery, as our data indicate an association for which the mechanism is unclear.

Craniomaxillofacial Abstracts

Does the Availability of Craniofacial Surgeons Correspond to Facial Trauma Burden? a Nationwide Population-Level Analysis

Presenter:	Arturo J Rios-Diaz, MD
Co-Authors:	Jessica R Cunning, MD, MBA, Robyn B Broach, PhD, Sameer Shakir, MD, Hani Naga, BA, Cutler Whitely, BS, Joseph M Serletti, MD, Jordan W. Swanson, MD, MSc
Affiliation:	University of Pennsylvania, Philadelphia, PA

BACKGROUND: Prior studies suggest that trauma services are inequitably distributed throughout the U.S. However, it is unknown whether this trend applies to the burden of craniofacial trauma. We aimed to describe the geographical distribution of craniofacial trauma, craniofacial surgeons and training positions nationwide.

METHODS: State-level data were obtained on craniofacial trauma admissions (Healthcare Cost and Utilization Project [HCUPnet] databases), craniofacial surgeons (plastic and reconstructive [PR], head and neck [ENT], and oral-maxillo-facial [OMF] surgeons; American Board of Medical Specialties and American Association of Oral and Maxillofacial Surgeons data), craniofacial surgery fellowship positions (American Medical Association FREIDA™ and National Resident Matching Program data), population size and household income

(U.S. Census data) for 2016-2017. Normalized densities (per million population [PMP]) were ascertained. State-level variation in densities were compared between highest and lowest quartiles using Kruskal-Wallis tests. Risk-adjusted generalized linear models were used to determine the independent association between craniofacial surgeon density, training positions and income with craniofacial trauma density.

RESULTS: There were 790,415 craniofacial trauma admissions (2,447 PMP), 28,004 craniofacial surgeons (86.7 PMP) and 746 craniofacial training positions (2.3 PMP) nationwide. There was significant state-level variation in the density PMP of craniofacial trauma (median 1,999.6 vs. 2,983.5, $p<0.01$), surgeon (70.8 vs. 98.7, $p<0.01$), training positions (0 vs. 3.5, $p<0.01$) between lowest/highest quartiles. Distribution of surgeons was not associated with craniofacial trauma density ($p=0.27$) and was positively associated with income and training positions density ($p<0.01$). Subanalysis of specialties revealed that only the distribution of PR surgeons was positively associated with craniofacial trauma density, yielding an increase in 5.6 PR surgeons/PMP for every increase of 1,000 craniofacial trauma admissions/PMP ($p<0.01$).

CONCLUSIONS: There is an uneven state-level distribution of craniofacial surgeons across the U.S that is associated with income. ENT and OMF craniofacial surgeons' location does not follow the craniofacial trauma care need whereas PR surgeons' location does. As we move towards regionalization of trauma care, further work will be necessary to close the gap between workforce availability and clinical need.

Craniomaxillofacial Abstracts

A Neuroprotective Protocol in Neonatal Anesthesia: A Review of 101 Early Cleft Lip Repairs

Presenter:	Jordan Wlodarczyk, MD
Co-Authors:	Emma Higuchi, B.S., Artur Fahradyan, MD, Alice Liu, B.A., Laya Jacob, B.S., William P. Magee, III, MD, DDS, Mark M. Urata, MD, Marla Matar, M.D., Jennifer Lau, M.D., Jeffrey A Hammoudeh, MD, DDS
Affiliation:	Children's Hospital of Los Angeles, Los Angeles, CA

BACKGROUND: Dogma established by Millard in 1976 regarding the ideal timing of elective surgery in infants has long centered on the Rule of 10s (>10 weeks of age, >10 pounds, and has >10g hemoglobin and <10 white cell count)[1]. These guidelines were built upon archaic anesthetic protocols and do not not accurately represent represent safety profile of modern day agents[2]. Opposition to neonatal anesthesia cite concerns regarding GABA-agonists and NMDA-receptor antagonists being associated with a degree of neural apoptosis. Opioids and low-dose dexmedetomidine, a highly selective alpha-2 agonist, remain among the few agents used for anesthesia that have not shown pro-apoptotic activity[4]. As such, the divisions of plastics and craniofacial surgery and anesthesiology at Children's Hospital of Los Angeles created a neonatal neuroprotective anesthetic protocol (NPP) designed with dexmedetomidine as the dominant agent in early cleft lip repair (ECLR).

METHODS: Patients who underwent ECLR (repair before 2.5 months of age) within the last 4.3 years were identified. These patient were separated into patients receiving NPP and those who did not. Retrospective review of their records included preoperative, perioperative, and postoperative data regarding major and minor complications, and medication side effects. Total anesthetic time was defined as time from induction to extubation. Major complication was defined as a code event, aborted surgery, or intraoperative death. Minor complication was defined as a sustained alteration in heart rate, apnea event, or prolonged emergence time. Medication side effect was defined as a transient alteration in heart rate or hypopnea.

RESULTS: 101 patients underwent ECLR during our study period. All patients were either ASA class 1 or 2. 65% (n=65) received the NPP. The NPP group had a lower weight (4.01 kg (SD 0.61) vs. 4.38 kg (SD 0.72) *p=0.007)* and required less IV morphine equivalents in the PACU (10.8% vs. 30.5%, *p=0.013)*. There were no other statistically significant intraoperative or preoperative variables. There were no major anesthetic complications for either group and the minor anesthesia complication and medication side effect rate for the NPP group vs. the non-NPP group was 6.2% vs. 0%, p=0.166 and 4.6% vs. 2.7%, *p=0.650*, respectively.

CONCLUSION: Our NPP in ECLR patients demonstrated no major complications and an acceptable minor complication rate associated with our novel anesthesia protocol. Millard's rule of 10's governing the ideal timing of elective surgery in infants may not apply to ASA 1 and 2 class patients.

REFERENCES:

1. Wilhelmsen HR, Musgrave RH. Complications of cleft lip surgery. *Cleft Palate J*. 1966;3:223-231.
2. Chow I, Purnell CA, Hanwright PJ, Gosain AK. Evaluating the Rule of 10s in Cleft Lip Repair: Do Data Support Dogma? *Plast Reconstr Surg*. 2016;138(3):670-679.
3. Ikonomidou C, Bittigau P, Koch C, et al. Neurotransmitters and apoptosis in the developing brain11Abbreviations: GABAA, γ-aminobutyric acid; NMDA; N-methyl-d-aspartate; PCP; phencyclidine; TUNEL, terminal deoxynucleotidyl transferase-mediated dUTP nick end labeling. *Biochem Pharmacol*. 2001;62(4):401-405.
4. Sanders RD, Sun P, Patel S, Li M, Maze M, Ma D. Dexmedetomidine provides cortical neuroprotection: impact on anaesthetic-induced neuroapoptosis in the rat developing brain. *Acta Anaesthesiol Scand*. 2010;54(6):710-716.

Craniomaxillofacial Abstracts

Prospective Outcomes of Secondary and Revisionary Facial Feminization Surgery

Presenter:	Ian T Nolan, BM
Co-Authors:	Mona Ascha, MD, David C Ludwig, MD, DDS, Fermin Capitan-Canadas, Anabel Sanchez-Garcia, Marina Rodriguez-Conesa, Raul J Bellinga, Jonathan P Massie, MD, Paul S. Cederna, MD, Daniel Simon, Luis Capitan, MD, Thomas Satterwhite, MD, Shane D Morrison, MD, MS
Affiliation:	New York University School of Medicine, New York, NY

PURPOSE: Facial feminization surgery (FFS) for transgender and nonbinary patients typically addresses masculine characteristics of the brows, nose, mandible, chin, and thyroid cartilage, as these facial areas are most influential to gender perception. Because multiple facial areas are involved, FFS often includes multiple concurrent or staged procedures. Therefore, secondary and/or revisionary FFS are important considerations. Patients may present for completion of a planned second stage procedure, to augment their prior feminization with changes to additional facial areas not addressed in their initial FFS (both of these scenarios will be considered ‘secondary’ if carried out in facial areas not addressed in primary FFS), or to revise an unsatisfactory surgery (revisionary FFS). This study aims to report prospective outcomes of secondary and revisionary FFS.

METHODS: Patients undergoing secondary or revisionary FFS were analyzed from a prospective international multi-center cohort study of FFS patients. Pre-operative and post-operative (1 month and >6 months) endpoints were obtained for self-reported facial feminization outcome scores (a scale of 0-100), satisfaction (on a Likert scale of 0-4), and cephalometric measurements.

RESULTS: Sixty-six total FFS patients were enrolled. Of these, 10 underwent either secondary FFS (N=6) or secondary and revisionary FFS (N=4) and were included in this analysis. Mean age was 41.7 years. All patients had pre-operative hormone therapy, for <1 year (n=1), 1-5 years (n=4), 6-10 years (n=2), or >10 years (n=3). Thirty percent (n=3) reported a history of tobacco use. Self-reported pre-operative most masculine facial features were the jaw/chin (n=6), nose (n=5), and forehead/brow (n=5). Secondary and revisionary FFS procedures included brow reduction (n=9), genioplasty (n=7), mandibular contouring (n=6), tracheal shave (n=2), and rhinoplasty (n=6). Mean facial feminization outcome scores improved from 51.2 preoperatively (SD 8.9) to 71.9 at longest follow-up (SD 14.7), $p<0.01$. Mean post-operative satisfaction was 3.0. Cephalometric values indicating successful feminization included decreased glabellar angle by 6.7º (from 98.9º to 92.2º, $p<0.05$) and increased nasofrontal angle by 6.0º (from 138.0º to 144.0º, $p<0.05$), with other statistically nonsignificant changes as well. Complications included hypertrophic scarring (n=1) and orbital hematoma requiring surgical drainage (n=1).

CONCLUSION: Our cohort of 10 patients reported favorable quality of life, patient satisfaction, and cephalometric outcomes, with low complication rates, comparable to those reported by primary FFS studies. Patients seeking FFS should be aware of the potential need for revisions and secondary procedures. Because of unique challenges of secondary and revisionary FFS, including tissue changes after primary FFS and psychosocial factors relating to dissatisfaction with primary FFS, these should be considered separately from primary FFS and from each other. This study is limited by our small cohort and lack of knowledge regarding our patients' primary FFS procedures.

Craniomaxillofacial Abstracts

NYU Nasoalveolar Molding Protocol: From Birth to Adulthood

Presenter:	Chen Shen, BS
Co-Authors:	Lauren M Yarholar, MD, Barry H Grayson, DDS, Court B Cutting, MD, Buddhathida Wangsrimongkol, DDS, DMSc, Becca T Liu, DDS, David A. Staffenberg, MD, DSc (Honoris causa), Pradip R Shetye, DDS, Roberto L Flores, MD
Affiliation:	NYU Langone Health, New York, NY

INTRODUCTION: One of the most actively debated therapies for patients with a cleft is nasoalveolar molding (NAM). Although supporters cite improvements in nasal symmetry, nasal aesthetics, columellar length, cost benefit, and nasal revision rates, one of the most convincing criticisms of NAM is the absence of reports on its effects at facial maturity, the target timepoint of assessment for cleft care interventions. This study reports clinical outcomes of NAM to facial maturity including rates of revision surgery to the lip and nose, incidence of secondary alveolar bone graft (ABG) and orthognathic surgery (OGS), and effects on facial growth.

METHODS: A single-institution retrospective review of patients all with a cleft who underwent NAM protocol from 1990 to 2000. Patients were included in the study if they had a diagnosis of unilateral or bilateral cleft lip and alveolus, with or without cleft palate. Patients were excluded if they had a syndromic diagnosis or if medical and/or dental records were incomplete. Lateral cephalogram measurements of patients with unilateral cleft lip and palate was obtained at 17 years or older and prior to OGS, if patients received OGS. These measurements were then compared to published Eurocleft cephalometric data.

RESULTS: One-hundred-eighty-nine patients were identified, of which 100 met inclusion criteria. Eighteen patients had cleft lip and alveolus only. The average age at last follow-up visit was 20 years (15y-26y). Average

age at time of unilateral cleft lip repair was 4 months (3m-7m), bilateral cleft lip repair 6 months (3m-10m), unilateral palate repair 13 months (4m-27m), and bilateral palate repair 13 months (6m-17m). Gingivoperiosteoplasty (GPP) was performed in 86% (86/100) of patients. ABG was performed in 52% (52/100). Of those who underwent GPP, ABG was avoided in 56% (48/86). A total of 23% (19/82) of patients with both cleft lip and palate required secondary surgery for VPI, and 8% (4/48) of patients who underwent LeFort I advancement also required surgery for VPI. OGS was performed in 49% (49/100), and revisions to lip and/or nose prior to facial maturity were performed in 49% (49/100). At the time of lip and/or nose revision, 74% (36/49) were older than 14 years. Overall, 17% (17/100) required neither ABG, OGS, nor nose or lip revision. Thirty-four patients with unilateral cleft lip had lateral cephalograms available for analysis. There were no significant differences in SNA (p=0.44), s-n-pg (p=0.78), NSL/NL (p=0.76), NSL/ML (p=0.61), or n-sp/n-gn×100 (p=0.79) when compared to data from Eurocleft centers that used presurgical orthopedics.

DISCUSSION: Cleft lip and palate reconstruction were not delayed because of NAM. Surgery for VPI and OGS rates were comparable to those reported in the literature. Facial growth analysis at facial maturity revealed no significant difference when compared to Eurocleft centers other than ANB (p=0.005). These data suggest that NAM does not inhibit midface growth. Furthermore, ABG was avoided in 56% of patients who underwent GPP; lip and nose revision was avoided in 51%; and ABG, OGS, and any soft tissue revision surgery was avoided in 17%.

Craniomaxillofacial Abstracts

Break the Mold: A Ten-Year Evolution of Ear Molding Techniques

Presenter:	Karina Charipova, BS
Co-Authors:	Ashley Rogers, MD, Manas Nigam, MD, Vikas S. Kotha, BS, Christina Barra, NP, Stephen B. Baker, MD
Affiliation:	Georgetown University School of Medicine, Washington, DC

BACKGROUND: Congenital ear anomalies occur in one-third of the population, and less than one-third of these self-correct without treatment.[1] In the senior author's practice, nonoperative ear molding has surpassed surgery as the preferred method of treatment, sparing operative morbidity and allowing for significantly earlier intervention. There are standardized approaches to molding the ear, but as the senior author's practice has evolved, a more refined, customized approach was developed and applied to specific types of deformities. The purpose of this study is to discuss the modifications we apply to various types of deformities.

METHODS: A retrospective review from January 2010 through December 2019 was performed of infants who underwent ear molding by a single surgeon. The procedure report for each case was reviewed to categorize auricular anatomy using a standardized subclassification of external ear anomalies. The surgeon's approach to each subtype of auricular anomaly was used to develop step-wise customization protocols for existing EarWell and Infant Ear systems.

RESULTS: Two hundred and forty-six patients underwent ear molding. The anomalies were subclassified into Stahl's ear, lidding/lop, cupping, helical rim, prominent, conchal crus, and mixed. Of a total of 385 ears, 58.2 percent of ears exhibited a single anomaly and 37.4 percent exhibited a combination of at least two anomalies. Customization protocols describe use of modifications such as dermal glue, cotton tip applicators (CTA), scaphal wire, dental impression material, and customized stents. Modifications were anomaly specific:

CTA/setting material (Stahl's ear), custom dental compound mold (lidding/lop and cupping), scaphal wire (helical rim), CTA/protrusion excision (prominent), and custom dental compound mold/stent (conchal crus).

CONCLUSIONS: Presentation of auricular anomaly is heterogenous with a substantial volume of patients exhibiting mixed malformations. Although ear molding is traditionally performed with prefabricated systems, this ten-year experience demonstrates that the process should be dynamic and customized, using techniques beyond those listed in system manuals. The described techniques allow treatment to be modified to complement and improve outcomes for each unique ear.

REFERENCES:

1. Chan S, Lim G, Por Y, et al. Efficacy of ear molding in infants using EarWell infant correction system and factors affecting outcome. *Plast Reconstr Surg*. 2019;144(4):648-658.

Craniomaxillofacial Abstracts

Feeding Outcomes Following Mandibular Distraction Osteogenesis in Pierre Robin Sequence

Presenter:	Armin Edalatpour, MD
Co-Authors:	Lisa M Block, MD, Vik Patel, BS, Katherine R Rose, MD, Delora L. Mount, MD, Catharine B Garland, MD
Affiliation:	University of Wisconsin School of Medicine and Public Health, Madison, WI

INTRODUCTION: Neonatal feeding difficulties are commonly associated with Pierre Robin Sequence (PRS). Mandibular distraction osteogenesis (MDO) is effective at relieving airway obstruction, but fewer data are available regarding feeding and growth outcomes after MDO. The purpose of this study is to evaluate short and long-term feeding outcomes after MDO.

METHODS: PRS patients undergoing bilateral MDO prior to 9 months of age between May 2002 and June 2019 were included. Demographic variables, perioperative data, and long-term feeding outcomes and weight percentiles through 2 years of age were collected. Primary outcome of interest was weight percentile at two-year follow-up. Secondary outcomes include need for gastrostomy tube (GT) placement, presence of tube feeding at discharge, and days to full oral feeds.

RESULTS: Forty patients met the inclusion criteria. Eighteen (45.0%) patients carried a syndromic diagnosis. Thirty-one (77.5%) patients had cleft palate (CP). Thirteen (32.5%) patients had associated cardiac pathology. Nine (22.5%) patients were preterm. Pre-operative laryngoscopy identified eight (20.0%) patients with concomitant abnormal lower airway findings. Three (7.5%) patients required tracheostomy after MDO. Fourteen patients (35%) had a GT; 3 placed preoperatively and 11 placed postoperatively. Pre-operative oral feeding ranged from those with no oral feeds (all feeds via NG/OG/GT) in 15 (37.5%), some oral feeds (combination of PO and NG/OG/GT) in 10 (25.0%), or full oral feeds in 15 (37.5%). At hospital discharge (mean 23.8 days after MDO), 20 (50%) patients were on full oral feeds. By 3 months postop, 27 (67.5%) were on full oral feeds.

Mean weight percentile decreased from birth to the perioperative period, but subsequently increased by two-year follow-up ($p=0.002$). Patients with CP had higher birth weight, pre-op weight, and two-year follow-up weight percentiles compared to patients without ($p=0.040$, 0.017, and 0.006). Patients with cardiac pathology

had a lower weight percentile at two-year follow-up (p=0.035). Preterm infants had lower weight percentiles at all time points including at two-year follow-up (p=0.016), with a 1.7 times increased risk of g-tube placement (p=0.032).

Compared to patient without preoperative oral feeding, patients with some pre-operative oral feeds had higher weight percentiles pre-op, at discharge, and at hardware removal surgery (p=0.001, 0.001, and 0.018). Compared to some pre-operative oral feeds, the full oral feed group had lower weight percentile at preop and discharge (p=0.001), but not at hardware removal or two-year follow-up. Neither preoperative feeding status (p=0.16) or days to extubation (p=0.23), were significant predictors of days to full oral feeding. Age at distraction, distance distracted, and use of reflux medication did not influence weight percentiles or feeding outcomes.

CONCLUSIONS: After MDO, 67.5% of PRS patients are on full oral feeds by 3 months compared with 37.5% preoperatively. 35% of patients underwent GT placement, with an increased risk in preterm patients or those who required tracheostomy. Predictors of improved weight percentile at 2 years included presence of CP and absence of cardiac pathology. A combination of oral feeds and enteral feeds via NG/OG/GT during the pre-operative period correlated with higher weight percentiles in the perioperative period, however, no weight differences were seen long-term.

Craniomaxillofacial Abstracts

Accelerating the Degradation Profile of β-Tricalcium Phosphate Bone Replacement through 3D Printing

Presenter:	Chen Shen, BS
Co-Authors:	Maxime M Wang, MD, Lukasz Witek, MSci, PhD, Bruce N Cronstein, MD, Andrea Torroni, MD, Roberto L Flores, MD, Paulo G Coelho, DDS, PhD
Affiliation:	NYU Langone Health, New York, NY

INTRODUCTION: β-tricalcium phosphate (β-TCP), one of the most common synthetic bone replacement products, is frequently used in pediatric craniofacial reconstruction. Although solid β-TCP can be absorbed over time, a relatively slow degradation rate predisposes this product to exposure, infection, and fracture. Our tissue engineering laboratory has successfully leveraged 3D printers to manufacture 3D-printed bioactive ceramic (3DPBC) scaffolds composed of β-TCP in an architecture which optimizes the needs of rigidity with efficient vascular ingrowth, osteogenesis, and degradation kinetics, which are further optimized when using the osteogenic agent dipyridamole (DIPY). This long-term animal study of immature rabbits through the time of facial maturity reports on the new degradation kinetics profile achievable through this novel manufacturing and tissue engineering protocol.

METHODS: Twenty-two one-month-old (immature) New Zealand White rabbits underwent creation of unilateral 10 mm calvarial defects with ipsilateral 3.5×3.5 mm alveolar defects. Each defect was repaired with 3DPBC scaffolds composed of 100% β-TCP and coated with 1,000 μM DIPY. Rabbits were sacrificed at 2 months (n=6), 6 months (n=8), and 18 months (n=8). Bone regeneration and scaffold degradation were calculated using micro-CT images reconstructed in Amira software. Bone density and mechanical properties at 18 months was compared to native uninjured bone using Amira software and nanoindentation, respectively. Cranial and maxillary suture patency and bone growth were qualitatively analyzed using histology.

RESULTS: Results of 3D reconstruction are reported as a percentage of volumetric space occupied by either scaffold or bone. When comparing time points 2 months, 6 months, and 18 month, scaffolds showed significantly decreased *in vivo* defect occupancy in calvaria (23.6±2.5%, 15.2±2.2%, and 5.1±2.2%; $p<0.001$) and in alveoli (21.5±2.2%, 6.7±1.9%, and 0.2±1.9%; $p<0.001$), with annual degradation rates 54.6% and 90.3%, respectively. Between 2 months and 18 months, significantly more bone regenerated in calvarial defects (25.8±7.9% vs. 55.7±6.9%, $p<0.001$) but was similar to native bone density (46.7±6.8%, $p=0.06$), and no difference was found in alveolar defects over time (28.4±8.2% vs. 31.4±7.1%, $p = 0.57$) and compared to native bone (33.8±3.7%, $p=0.34$). Regenerated elastic modulus (E) and hardness (H) were similar to native bone in calvaria (E: 12.6±1.8 GPa vs. 13.2±1.8 GPa, $p=0.62$; H: 0.54±0.06 GPa vs. 0.53±0.06 GPa, $p=0.81$) and alveoli (E: 11.7±1.5 GPa vs. 11.3±1.5 GPa, $p=0.71$; H: 0.64±0.05 GPa vs. 0.66±0.05 GPa, $p=0.70$). Histology revealed vascularized and organized bone without suture fusion.

DISCUSSION: The degradation kinetics of β-TCP can be altered through 3D printing and addition of an osteogenic agent. Our study demonstrates an acceleration of β-TCP degradation from 1-3% a year to 55-90% a year. Absorbed β-TCP is replaced by vascularized, organized bone, with histologic and mechanical properties similar to native bone and without damage noted to the growing suture. This additive manufacturing and tissue engineering protocol has implication to future reconstruction of the craniofacial skeleton, especially as a safe and efficacious method in pediatric bone tissue engineering.

Craniomaxillofacial Abstracts

Early Alveolar Bone Grafting Decreases Regraft Rates and Improves Long-Term Psychosocial Outcomes

Presenter:	Allison C Hu, BA
Co-Authors:	Nirbhay S Jain, MD, Candace H Chan, BS, Sri Harshini Malapati, BS, Brian N Dang, BS, Anthony A Bertrand, MD, MBA, Lee Squitieri, MD, Libby F Wilson, MD, Justine C Lee, MD, PhD
Affiliation:	David Geffen School of Medicine at University of California, Los Angeles, Los Angeles, CA

BACKGROUND: Late childhood (8-10 years of age) has emerged as a vulnerable period in children with cleft and craniofacial anomalies such that increased interventions during this period is associated with worse long-term patient-reported anxiety and depressive symptoms. These findings suggest that one possible practice change may be to consider changes in timing for surgical treatment algorithms. In this work, we investigated outcomes in altering the timing of the most common surgery in late childhood for cleft lip and palate (CLP) patients, alveolar bone grafting (ABG).

METHODS: A two-part, multi-institutional cohort study was conducted. To understand the feasibility of changing ABG timing with respect to the surgical success, reoperation rates were retrospectively compared among patients grafted at different age groups (4-7, 8-10, and 11-13 years of age). To understand the long-term effect of changing ABG timing on psychosocial outcomes, the psychosocial suite of the Patient-Reported Outcomes Measurement Information System (PROMIS) was prospectively administered to CLP teenagers and adults.

RESULTS: Among the three age groups, early grafting (4-7 years of age) demonstrated the lowest regraft rates compared to the other groups. As these results suggested that early grafting is a viable alternative to standard timing, we next compared the differences in long-term psychosocial outcomes. Patients who were grafted early reported lower levels of anxiety and depressive symptoms as teenagers and adults.

CONCLUSIONS: Altering timing of one stage in CLP reconstruction to an earlier age decreases regraft rates and improves long-term patient-reported anxiety and depressive symptoms.

Craniomaxillofacial Abstracts

Standardized Schematics for Facial Trauma Planning: A Clinical Education Tool

Presenter: Brandon J. De Ruiter, MD
Co-Authors: Robert P. Lesko, BA, Edward H. Davidson, MD
Affiliation: Case Western Reserve University, Cleveland, OH

PURPOSE: Learning facial fracture management principles can be challenging for surgical trainees. Targeted educational efforts in the posttraumatic setting are limited by situational acuity and workflow limitations. Operative planning requires nuanced understanding of facial biomechanics and is complicated by complex and/or compound injuries which distort normal anatomy and challenge visuospatial conceptualization. Competency achievement often is incumbent on individual residents who have limited time, variable baseline knowledge, and are subject to institutional differences in training environment, faculty expertise, and case load. The aim of this study was to design a standardized schematic for teaching facial fracture management and evaluate its performance improving resident operative planning.

METHODS AND MATERIALS: Printable schematics of the facial skeleton, coronal and sagittal, with soft-tissue overlay were developed. Instructions on depicting fracture pattern, incisions, plating sequence, load-bearing/sharing plates, locking/non-locking screws, and mono/bicortical screws were given. Senior residents (PGY4-6; n=5) evaluated computed tomography of three unique mandibular fracture patterns (symphyseal, unilateral parasymphysis/contralateral angle, and bilateral angle fractures) and submitted three operative plans per case: first without guidance, then with written instruction, and finally using the schematic (total n=45). Performance in each trial was graded on content (whether operative components were included) and conceptual correctness (whether content was correct). Likert-scale surveys were given assessing understanding, communication, and operative planning.

RESULTS: Schematic use improved operative plan content and facilitated communication of resident operative schemes. Of seven content domains spanning approach, plating strategy, and screw selection, a mean of 2.3, 3.7, and 6.5 were included with no guidance, written instruction, and schematic use respectively. Information on approach ($p=0.001$), plating type ($p=0.02$), screw location ($p<0.000$), monocortical/bicortical screw type ($p=0.000$), and screw locking status ($p=0.000$) were significantly improved when comparing pre- and post-intervention plans. All subjects “agreed” (n=2) or “strongly agreed” (n=3) that schematic use aided operative planning and communication.

CONCLUSIONS: Simple, guided interventions can enhance surgical training by identifying knowledge gaps, improving visuospatial conceptualization, and facilitating targeted discussions with attendings.

Craniomaxillofacial Abstracts

Long-Term Evaluation of Predictors of Alveolar Bone Regrafting

Presenter:	Allison C Hu, BA
Co-Authors:	Amanda C Miller, BS, Candace H Chan, BS, Saloni Gupta, BS, Brian N Dang, BS, Arvin Pal, DDS, Alex Lambi, MD, Claire Liu, BS, Nicole Lee, DDS, Libby F Wilson, MD, Justine C Lee, MD, PhD
Affiliation:	David Geffen School of Medicine at University of California, Los Angeles, Los Angeles, CA

PURPOSE: Alveolar bone grafting (ABG) is a highly-invasive operation performed in cleft lip and palate (CLP) patients. While possible complications include infection, wound dehiscence, and graft resorption, the most critical complication is the need for regrafting. Regrafting not only exposes the patient to a second invasive procedure and additional operative risks, but also increases in the overall cost of treatment and contributes to poorer long-term psychosocial functioning. Therefore, in this work, we investigate the possible predictors of alveolar bone regrafting.

METHODS: CLP patients from two institutions were retrospectively identified. Demographic, clinical, and operative details were collected from patient records. Age at initial ABG was grouped into Early (4-7 years old), Standard (8-10 years old), Late (11-13 years old), and Very Late (>14 years old). Descriptive statistics were summarized, chi-square tests and t-tests were used for bivariate analysis, and multivariate logistic regression was performed in SPSS.

RESULTS: Overall, 143 patients with CLP (84 male, 57.3%) underwent initial ABG between ages 4-20. Mean age at time of initial ABG and time of review was 10.7±3.2 years and 22.2±5.2 years, respectively. Most patients had unilateral CLP (n=104, 72.7%). Average follow-up was 7.9±3.9 years. Of the patients who received alveolar bone regrafting (n=52, 36.4%), average time to regraft was 4.2±3.4 years. No significant differences were found in ethnicity, insurance status, lateral incisor abnormality, operative techniques, graft material, post-operative complications, and hospital length of stay between patients with and without regrafting. However, bilateral cleft lip and longer time to orthodontic movement after ABG were correlated with higher rates of regrafting. Male sex and Early age group at initial ABG on the other hand were predictive of lower rates of regrafting.

CONCLUSIONS: Bilateral cleft lip and longer time to orthodontic movement are predictive of ABG regrafting.

Craniomaxillofacial Abstracts

Infections and Antibiotic Usage in Facial Gunshot Wounds

Presenter:	Andrea P Biaggi-Ondina, BSA
Co-Authors:	Paul Deramo, MD, Venkata S Kothamasu, BSA, Benjamin W Kim, BA, David J. Wainwright, MD
Affiliation:	University of Texas Health Science Center at Houston, Houston, TX

PURPOSE: Gunshot wounds (GSW) to the face are devastating injuries with significant risk of head and neck infection. The associated soft tissue loss, ischemia, bony destruction, and frequent involvement of the oral and sinus cavities are responsible for infections which can be difficult to predict. Most published reports and practice management guidelines recommend broad spectrum antibiotics with various duration of therapies. However, there are few detailed reports on specific injury patterns and rates of infection, and the optimal antibiotic regimen remains controversial. The purpose of this study was to categorize specific injuries, identify predictors of infection, and elucidate the role of antibiotics in GSW to the face.

METHODS: A retrospective review of all patients presenting with GSW to the face from 2009 to 2017 was performed on a single institution trauma database. Inclusion criteria were patients who had a GSW to the face, survived more than 48 hours and received care at our trauma center. Isolated GSW to the skull/brain were excluded. General demographics, firearm information, injured structures, surgical data, antibiotics administered, and head and neck infection results were extracted from each eligible patient's chart. Head and neck infections were defined as culture-positive wound aspirates. Univariate and multivariate statistical analyses were then performed to examine the relationships between injured structures, surgical intervention, antibiotic exposure, and head and neck infection.

RESULTS: Of 537 patients, 270 met inclusion criteria. Median age was 28 (IQR 20-41) years and patients were predominantly male (83%) and injured by handgun (93%). Eighty-nine percent of patients had facial fractures, 52% had oral cavity involvement, and 50% had maxillary sinus involvement. Seventy-seven percent of patients underwent surgery with median 2 (IQR 1-3) number of procedures. Eighty-nine percent of patients received antibiotics on admission for median 4 (IQR 3-8) days and 15.2% of patients developed head or neck infection on median hospital day 9 (IQR 6-14). On univariate analysis, head and neck infections were significantly increased with injuries to oral cavity (10.7% vs. 4.4%, $p<0.01$), maxillary sinus (10.7% vs. 4.4%, $p<0.01$), and bony fracture (14.8% vs. 0.4%, $p<0.01$). On multivariate analysis, factors associated with head or neck infection include oral cavity involvement (OR 1.2, $p=0.04$), sinus involvement (OR 1.2, $p=0.045$) and number of procedures (OR 1.1, $p=0.0005$).

CONCLUSION: GSW to the face cause destructive injuries often requiring multiple procedures and leading to frequent infection. Oral cavity and sinus involvement are associated with statistically higher rates of head and neck infections, even in the setting of antibiotic use. Our data suggest that GSW to the face without oral cavity, sinus involvement, or need for multiple surgeries have low infection rates and may not benefit from antibiotics. Prospective data are needed to assess whether an antibiotic-restrictive protocol is safe in the setting of uncomplicated GSW to the face.

Craniomaxillofacial Abstracts

Orthoptic Vision Therapy: Establishing a Protocol for Management of Diplopia Following Orbital Fracture Repair

Presenter:	Brandon J. De Ruiter, MD
Co-Authors:	Robert P. Lesko, BA, Barry Tannen, OD, FCOVD, FAAO, Noah Tannen, OD, Edward H. Davidson, MD
Affiliation:	Case Western Reserve University, Cleveland, OH

PURPOSE: Non-entrapment associated diplopia following orbital fracture repair is a well-recognized problem affecting up to 25% of patients at three months follow up.[1] Observation is the standard-of-care, however symptoms may be protracted and/or debilitating. Orthoptic therapy is a form of ocular physical therapy that, like occupational therapy following hand injury, achieves functional rehabilitation through targeted exercises. Despite wide application in academic optometry,[2,3] it has yet to be applied postoperatively. In this study, we present a protocol for using orthoptics to treat postoperative diplopia and describe preliminary testing results.

METHODS AND MATERIALS: Protocols for posttraumatic home orthoptic use and in-office visual assessment were developed. Computerized and self-directed programs for training disconjugate, conjugate, smooth tracking (pursuits), and darting eye movements (saccades) were included. Office-assessment incorporated clinical scoring of ocular motility, computerized metrics of binocular function, and surveys assessing symptom burden. Healthy volunteers (n=10) trialed the office-assessment three consecutive times (n=30) and results were compiled to establish normative testing results. Comparative measurements were made in those with chronic (>1year; n=8) and acute (<2 weeks; n=4) orbital fractures. Time-of-therapy was recorded and monetary cost-analysis was performed.

RESULTS: The orthoptics protocol was successfully implemented postoperatively and distinguished acute from chronic fracture and healthy cohorts. Patients with acute fracture displayed limited fusional ability when comparing convergence (mean break/recovery of 8.0/6.5 prism diopters (pd) vs 31.87/21.23pd; p=0.001/0.015) and divergence (3.00/1.50pd vs 18.37/12.83pd; p=0.000/0.001) to the normative values. Those with chronic fracture had lower convergence (15.71/5.00pd; p=0.01/0.001) and divergence (12.29/4.71pd; p=0.04/0.002) when compared with norms, but better function than those with acute injury. Those with acute fracture reported higher symptom burden than chronic (mean score 19 vs 4.6; p=0.01) or healthy (19 vs 3.4; p=0.01) cohorts. Assessment took 7 minutes 41 seconds on average. Per patient software cost was <$70.

CONCLUSIONS: Orthoptic therapy is applicable following orbital fracture repair and may improve fusional capacity and ocular motility. Normative data defined here may serve as a benchmark for clinical use.

REFERENCES:

1. Hsu CK, Hsieh MW, Chang HC, Tai MC, Chien KH. Anatomic Factors Predicting Postoperative Strabismus in Orbital Wall Fracture Repair. *Sci Rep.* 2019;9(1):14785.
2. Huston PA, Hoover DL. Treatment of symptomatic convergence insufficiency with home-based computerized vergence system therapy in children. *J AAPOS.* 2015;19(5):417-21.
3. Serna A, Rogers DL, McGregor ML, Golden RP, Bremer DL, Rogers GL. Treatment of symptomatic convergence insufficiency with a home-based computer orthoptic exercise program. *J AAPOS.* 2011;15(2):140-3.

Craniomaxillofacial Abstracts

Three-Dimensional Anthropometric Analysis of Racial and Ethnic Differences in Unilateral and Bilateral Cleft Nasal Deformity

Presenter: Lucas M Harrison, BS
Co-Authors: Naomi A Cole, BS, Sanchit Sachdeva, BA, Rami R Hallac, PhD, Christopher A Derderian, MD
Affiliation: University of Texas Southwestern Medical Center, Dallas, TX

BACKGROUND: Prior studies have demonstrated variation in nasolabial indices across racial and ethnic groups. Anthropometric data on the racial and ethnic differences in the cleft nasal deformity at the age for definitive rhinoplasty can provide a foundation for operative planning. This study used three-dimensional (3D) stereophotogrammetry measurements to provide a comprehensive nasolabial analysis of patients with unilateral cleft lip and palate (UCLP), bilateral cleft lip and palate (BCLP), and controls across multiple races and ethnicities.

METHODS: A retrospective review of 3D images of patients with UCLP and BCLP captured prior to orthognathic surgery or definitive cleft rhinoplasty was performed. The patients were separated by self-reported identifiers as Caucasian, Hispanic or African American. Twelve measurements (millimeters) were collected: dorsum length, nasal protrusion, columellar height, columellar width, tip width, alar width, alar base width, nasolabial angle, upper lip length, philtrum length, nostril height, and nostril width. An equal number of age, sex, race, and ethnicity matched control patients were analyzed. Two-sample t-tests were performed ($p<0.05$).

RESULTS: Total patients included 90 UCLP, 43 BCLP, and 90 controls. UCLP Caucasians, Hispanics, and African Americans similarly had significantly greater columellar width and tip width and lesser nasolabial angle than respective controls. Caucasian UCLP alar width (33.66±3.12) and alar base width (33.66±3.51) were significantly greater than matched controls (31.21±2.54; 31.33±2.18). Hispanic UCLP alar width (37.52±3.46) and alar base width (36.77±2.81) were significantly greater than matched controls (35.00±3.20; 35.13±3.08). African American UCLP alar width (41.63±3.43) and alar base width (41.93±3.78) were not significantly different from matched controls (39.17±3.35; 40.56±3.97). BCLP Caucasians, Hispanics, and African Americans similarly had significantly greater columellar width and tip width than respective controls. Caucasian BCLP alar width (37.66±0.77), alar base width (38.06±0.65), and nostril width (12.54±1.68) were significantly greater than matched controls (31.21±2.54; 31.33±2.18; 10.34±1.01). Hispanic BCLP alar width (38.75±3.79), alar base width (38.73±3.35), and nostril width (13.23±2.13) were significantly greater than matched controls (35.00±3.20; 35.13±3.08; 11.92±2.13). African American BCLP alar width (40.88±3.92), alar base width (40.56±3.97), and nostril width (13.01±2.07) were not significantly different from matched controls (39.17±3.35; 40.56±3.97; 14.00±1.45). Across UCLP groups the African American group had significantly less nasal protrusion (17.84±1.38) and columellar height (8.96±0.85) and significantly greater columellar width (9.56±1.58) than Caucasians (20.18±1.93; 10.57±1.45; 8.48±1.07) and Hispanics (21.14±2.12; 10.83±1.96; 8.26±1.51). Caucasian alar width (33.66±3.12), alar base width (33.66±3.51), and affected nostril width (10.80±1.51) were significantly lesser than Hispanics (37.52±3.46; 36.77±2.81; 12.04±2.28) and the same measures in both Caucasians and Hispanics were significantly lesser than African Americans (41.63±3.43; 41.93±3.78; 13.96±2.43). Across BCLP groups there were no significant difference in measurements.

CONCLUSIONS: The UCLP deformity differs between groups in alar width and alar base width. African Americans further differ in nasal protrusion, columellar height, and columellar width. The BCLP deformity does not differ between groups. The findings demonstrate that when correcting alar width, alar base width, tip refinement, and projection racially and ethnically congruent goals should be used to better approximate normal appearance.

Craniomaxillofacial Abstracts

Don’t Stahl: Analyzing Ten-Year Trends of Nonsurgical Ear Molding As Early Intervention for Congenital Ear Anomalies

Presenter:	Karina Charipova, BS
Co-Authors:	Ashley Rogers, MD, Manas Nigam, MD, Vikas S. Kotha, BS, Christina Barra, NP, Stephen B. Baker, MD
Affiliation:	Georgetown University School of Medicine, Washington, DC

BACKGROUND: The senior author has employed ear molding as a treatment for infant ear anomalies for over twelve years, and it is now his preferred approach to almost all ear anomalies. During this period, we have observed trends in our treatment approach secondary to our experiences. The purpose of this study is to evaluate the classification of presenting anomalies, duration of treatment, timing of treatment, parent satisfaction, complications, and any identifiable barriers to care.

METHODS: The authors conducted a retrospective review of infants who underwent ear molding with the EarWell or Infant Ear systems by a single surgeon over a ten-year period. Each case was evaluated for key patient demographics, presenting anomalies, treatment duration, device reapplication, complications, outcome satisfaction, and need for adjunct treatment.

RESULTS: Two hundred and forty-six infants with a total of 385 ears were evaluated. Of these patients, 107 underwent unilateral treatment and 139 underwent bilateral treatment. Presenting anomalies included Stahl’s ear ($n = 9$), lidding/lop ($n = 23$), helical rim ($n = 70$), prominent ($n = 26$), cupping ($n = 7$), conchal crus ($n = 8$), and mixed ($n = 92$). Age at the start of treatment ranged from 3 days to 156 days with 61.8 percent of patients presenting prior to age three weeks. Average duration of treatment was 30.5 days and did not vary significantly with age at presentation ($p = 0.653$) or laterality ($p = 0.630$). Duration of treatment was shortest for ears exhibiting lidding/lop anomalies (22.8 days) and significantly longer for ears exhibiting a combination of at least two anomalies (32.4 days, $p < 0.01$). Unilateral treatment required an average of 0.96 device replacements compared to 1.49 for bilateral treatment. Adverse events occurred in only 19.1 percent of cases with skin breakdown ($n = 26$) under the device being the most common. The senior author performed approximately 12.4 cases per year between January 2010 and December 2016 and 53.0 cases per year between January 2017 and December 2019. Average income for treated patients based on zip code was estimated to be $113,087 and treatment was covered by insurance in 244 of 246 cases. At least one parent expressed satisfaction with outcomes in 92.0 percent of cases.

CONCLUSIONS: This study shows that ear molding achieves successful outcomes with high satisfaction and low complication rates across a wide range of presenting anomalies and ages. Treatment of older-presenting infants does not vary significantly in complexity or duration compared to younger infants. There has been a rise in the number of ear molding cases performed by the senior author over the last ten years, indicating increasing interest in nonsurgical correction of auricular anomalies. The overwhelming majority of patients in this study were insured and of high socioeconomic status, suggesting need for broadening awareness and access to ear molding as a treatment option.

Craniomaxillofacial Abstracts

Wide Awake Facial Skin Cancer Surgery: A Way Forward for Safe and Economic Skin Cancer Surgery Under Local Anaesthesia

Presenter: Muhammad Zeeshan Ahmed, MBBS, FCPS
Co-Authors: Winston Andrew McEwan, FRACS
Affiliation: Waikato Hospital, Hamilton, New Zealand

BACKGROUND: Skin cancer surgery is on the rise in Australia and New Zealand, both because of increased incidence of skin cancers in aging population and early detection. Skin cancers are common on exposed parts of the body with head and neck area comprising the major part of that. Early detection and early treatment can avoid complex procedures for those skin cancers. Tumour clearance with good margin should be the goal.

High volume skin cancer surgery under local anaesthesia minimize the operative time and hospitalization and thus reduce the overall health care costs compared to general anaesthesia. Local anaesthetic surgery also improves the turnover of cases and significantly reduces the waiting time for these cases.

The challenge is to achieve the desired oncological, functional and aesthetic outcome without compromising on patient safety and tumour excision margins.

OBJECTIVES: Wide Awake Facial Skin Cancer Surgery (WAFSCS) can be safe, economic and effective way of treating the complex facial reconstruction cases referred for oncological surgery.

METHODS: 2600 head and neck skin cancers were excised under local anaesthesia from August 2016 to December 2019 at Plastic surgery department Waikato Hospital and Alison surgical centre, Hamilton, New Zealand. All surgeries were performed as a day case procedure by one surgeon and 1050 of those cases required medium to complex loco-regional flap reconstruction. We used diluted local anaesthetic adrenaline infiltration (0.4% Lidocaine with 1:125,000 Adrenaline) and performed the cases effectively without compromising on the tumour clearance.

RESULT: 1050 required flaps of various types for head and neck area. 60 % of the patients were males and average age was 70 years. Patients had defects of various size and depths and we manage to cover them with various loco-regional flaps and made an algorithm of flap choice based on the location of the defects. Tumour clearance with adequate microscopic margin was achieved in 95% of cases.

92 % flaps were successful with no problems, 6 % had wound healing problems/ minor infections and 2 % had minor flap necrosis and managed conservatively. 2 % required flap revisions.

CONCLUSION: The proposed model is safe, economic and effective method of treating such increasing number of skin cancer cases.
The proposed algorithm and getting mastered in suggested flaps can improve the outcome of the surgical reconstructed areas on the head and neck.
It can serve as good guide for those doing skin cancers under local anaesthesia in a busy unit.

Craniomaxillofacial Abstracts

Longitudinal Outcomes of a Multimodal Treatment Approach Including Mandibular Distraction Osteogenesis and Continuous Positive Airway Pressure for Pierre Robin Sequence

Presenter:	Giap H. Vu, BA
Co-Authors:	Carrie E. Zimmerman, BS, Laura S. Humphries, MD, Dante Terracciano, Christopher L. Kalmar, MD MBA, Scott Paul P Bartlett, MD, Christopher Cielo, DO, Jesse A. Taylor, MD, Jordan W. Swanson, MD, MSc
Affiliation:	Children's Hospital of Philadelphia, Philadelphia, PA

PURPOSE: Mandibular distraction osteogenesis (MDO) and continuous positive airway pressure (CPAP) may effectively treat more and less severe forms of tongue-based airway obstruction (TBAO) in Pierre Robin Sequence (PRS), respectively. This study aims to demonstrate safety and longitudinal outcomes for these two approaches in accordingly selected patient populations.

METHODS: Patients with non-syndromic PRS treated with MDO or CPAP during 2009-2019 were reviewed. Patients who had mild micrognathia, mild glossoptosis on microlaryngoscopy and bronchoscopy (MLB), and OAHI of less than 20/hr without significant oxygen desaturations were given the option of CPAP-only treatment; patients with more severe disease generally underwent MDO. Study subjects received baseline and follow-up polysomnography (PSG) examinations. Linear mixed-effect models were used to assess longitudinal predictors of TBAO, including baseline PSG, age, cleft palate (CP) status, MDO status, and presence of other airway anomalies.

RESULTS: 134 patients were treated during the study period; 56 who underwent MDO and 23 who received CPAP-only treatment met inclusion criteria and had 147 and 78 follow-up PSGs, respectively. Median ages at first PSG were 24 days [Q1-Q3=9-98 days] and 5 months [1-70 months] for MDO and CPAP-only groups, respectively (p=0.009). Baseline OAHI was significantly higher in MDO group ($\tilde{x}$=32.9[20.1-49.1]) compared with CPAP-only group ($\tilde{x}$=16.9[7.4-25.9], p=0.002). Baseline maximum ETCO2, SpO2 nadir, mean SpO2, and sleep efficiency did not significantly differ between the two groups (p>0.2).

Follow-up OAHI was significantly greater in the MDO compared with CPAP-only group (Δlog1p=0.34 [0.03, 0.65], p=0.031). In the MDO group, patients with repaired and unrepaired CP had significantly higher OAHI after MDO compared with non-CP patients (Δlog1p=3.22[0.87, 5.57], adj-p=0.008; Δlog1p=1.42[0.06, 2.79], adj-p=0.042, respectively). Presence of other airway anomalies was also linked with higher longitudinal OAHI in MDO patients (Δlog1p=0.48 [0.14, 0.81], adj-p=0.006). Older age did not lower OAHI longitudinally (adj-p>0.05). For CPAP-only patients, no longitudinal predictors of OAHI severity were significant (p>0.05).

Follow-up maxETCO2 was not significantly different between MDO and CPAP-only patients (p=0.217). Patients with higher baseline maxETCO2 demonstrated greater decreases in maxETCO2 after MDO compared with those with lower baseline values (Δ=-0.39[-0.59, -0.18], adj-p<0.001). Patients with repaired CP had higher post-MDO maxETCO2 than non-cleft patients (Δ=3.77[0.04, 7.54], adj-p=0.049).

Follow-up SpO2 nadir was not significantly different between MDO and CPAP-only patients (p=0.132). Older age and other airway anomalies were, respectively, associated with higher and lower SpO2 nadir (adj-p=0.044; 0.041). Patients with repaired and unrepaired CP had higher SpO2 nadir compared with non-cleft patients (adj-p=0.002; 0.001). MDO status did not influence SpO2 nadir longitudinally (adj-p=0.808). Similar trends were observed for mean SpO2 over time.

Longitudinally, sleep efficiency did not differ between MDO and CPAP-only patients (p=0.94) and had no significant predictors (adj-p>0.05).

CONCLUSIONS: After controlling for potential confounders, MDO effectively improves OAHI and maxETCO2 longitudinally in patients with Pierre Robin sequence; this benefit is more pronounced in non-cleft than in CP patients. Our analysis does not detect any significant predictor of PSG outcomes over time in CPAP-only patients. Additional analyses are warranted to further assess longitudinal outcomes of CPAP-only treatment for the selected group of patients with milder disease.

Craniomaxillofacial Abstracts

Predicting Velopharyngeal Insufficiency in Patients with Cleft Palate

Presenter:	Brady J. Anderson, BS
Co-Authors:	Kasra N. Fallah, BSA, Moffitt K. Joseph, BS, John F Teichgraeber, MD, Kim-Loan Luu, MA, SLP, Courtney Stout, MS, SLP, Phuong D. Nguyen, MD, Matthew R. Greives, MD
Affiliation:	The University of Texas Health Science Center at Houston, Houston, TX

BACKGROUND: Velopharyngeal insufficiency (VPI) after primary palatoplasty has been associated with various patient and surgical factors, including cleft size, genetic conditions and fistula formation. Despite this information, a predictive risk stratification tool has not been developed for factors associated with VPI development. Although VPI affects the speech of up to 50% of patients undergoing primary palatoplasty, diagnosis requires long-term follow-up after speech development. We reviewed over 15 years of primary cleft repairs to examine predictive factors for VPI.

METHODS: A retrospective review of patients who underwent primary palatoplasty from 1999 to 2014 was performed. Inclusion required follow-up past age 5 and speech production. Patient demographics, Veau class, medical history, surgical details, and follow-up information were collected. The primary outcome was VPI, defined as revision palatoplasty or recommendation for surgery by a speech-language pathologist. Genetic diagnosis was defined as positive genetic testing for a craniofacial syndrome. Univariate analysis was performed, and variables with a $p<0.20$ were included in a multivariate regression analysis.

RESULTS: Of 274 patients included, 158 (57%) were male. Median age at primary repair was 1 year (0.9, 1.1) with a median age of 8.1 at last follow-up. One hundred and four (38%) patients developed VPI at a median age of 4.9 years (3.8, 6.5). 11% of Black non-Hispanic patients developed VPI, compared to 39% of Hispanic patients and 45% of white non-Hispanic patients ($p<0.05$). VPI was 65% in patients who developed posterior fistulae (Pittsburgh 1-4) compared to 13% in those without ($p<0.01$). VPI was lower following Furlow (7%, n=14) than straight-line repairs (40%, n=260; $p<0.05$). VPI in patients with Pierre-Robin was higher (55%, n=38) than those without (35%, n=236; $p<0.05$). Following a bidirectional stepwise selection for a linear model, factors remaining associated with VPI were African-American race (OR 0.18, 0.04-0.66), posterior fistula (OR 12.2, 6.6-23.6) and genetic diagnoses (OR 3.2, 1.2-9.3). There were no differences associated with demographic factors, birth complications, or cardiac issues.

CONCLUSIONS: VPI following palatoplasty is a known complication. Development of a posterior palatal fistula was associated with increased odds of revision surgery, likely due to persistent nasal regurgitation refractory to speech therapy. While limited in number, lower rates of VPI among patients receiving Furlow palatoplasty are promising for improved outcomes, warranting further investigation into follow-up and

implementation rates. Lower rates of VPI in African-American patients and higher rates in patients with a genetic diagnosis may suggest a genetic component.

Craniomaxillofacial Abstracts

First-Ever Analysis of Risk Factors for Delayed Primary Craniosynostosis Surgery

Presenter:	Matthew J Davis, BS
Co-Authors:	Acara Turner, BS, Angela S Volk, MD, Linden Shih, BS, Lesley W Davies, PA-C, Michelle G Roy, MPAP, PA-C, Edward P Buchanan, MD, Laura A Monson, MD
Affiliation:	Baylor College of Medicine, Houston, TX

BACKGROUND: Patients with craniosynostosis often undergo delayed primary surgery, defined as primary operations performed when patients are older than 12 months of age, which places them at a higher risk of complications compared to patients treated earlier. Past studies have investigated risk factors related to delayed presentation for craniosynostosis management. Given the wide variability in time between presentation and surgery, however, patient age at time of surgery would be a superior metric for assessing these risk factors for delay. The purpose of this study is to elucidate risk factors for delayed surgical correction of craniosynostosis and to identify factors predictive of younger patient ages at the time of operation.

METHODS: Retrospective chart review was conducted from November 2011 to September 2018 to identify patients with documented craniosynostosis diagnoses presenting for primary surgical management. We analyzed 19 risk factors potentially associated with delayed primary surgery. A Wilcoxon rank sum test was used to determine *p*-values for comparisons between patients in different age cohorts at time of surgery. Logistic regression was used to model the relationship between potential risk factors and patient age at surgery. Odds ratios (ORs) and 95% confidence intervals (CIs) were generated for each variable. A *p*-value of <0.05 was considered statistically significant.

RESULTS: Of the 208 patients evaluated for craniosynostosis management, 123 (59.1%) met final inclusion criteria. The majority of patients were male (68.3%). We found that a higher percentage of white patients received surgery before 12 months of age compared to non-white patients (58.5% vs 41.5%, $p=0.046$). Significant differences in patient age at time of surgery were also noted based on type of craniosynostosis ($p=0.004$); patients with sagittal craniosynostosis were more likely to receive surgery before 12 months of age, whereas patients with unilateral coronal and multisuture craniosynostosis were more likely to receive surgery after 12 months of age. Patients with syndromic craniosynostosis and congenital anomalies were significantly more likely to receive surgery after 12 months of age ($p=0.019$; $p=0.007$). Logistic regression confirmed that syndromic status and type of craniosynostosis were highly correlated with age at surgical intervention (OR=0.11, CI 0.01-0.94, $p=0.04$; OR=0.20, CI 0.08-0.50, $p<0.01$).

CONCLUSIONS: While previous studies have focused on risk factors for delayed presentation of patients with craniosynostosis, we aimed to explore the risk factors for delayed surgical intervention. We found that non-white patients and patients with syndromic, unilateral coronal, or multisuture craniosynostosis were more likely to undergo surgical intervention after one year of age. Understanding these risk factors can drive evidence-based interventions designed to promote earlier presentation conducive to safer, less invasive surgical treatments.

Craniomaxillofacial Abstracts

Combined Symphyseal and Condylar Fractures: Considerations for Treatment in Pediatric Patients

Presenter:	Pooja Yesantharao, MS
Co-Authors:	Joseph Lopez, MD, MBA, Alvaro A Reategui, B.A, Hillary E Jenny, MD, MPH, Robin Yang, MD, Amir H. Dorafshar, MD, Paul N. Manson, MD, Richard J. Redett, MD
Affiliation:	Johns Hopkins University School of Medicine, Baltimore, MD

BACKGROUND: Combined symphyseal-condylar mandible fractures represent a unique, unstable injury pattern that can cause significant morbidity in pediatric patients (**Figure 1**). However, this particular mandibular injury pattern has not been well-characterized in children. Given the complex biomechanics of the mandibular symphysis and the importance of the condyles in long-term mandibular growth and occlusal development, focused study of pediatric symphyseal-condylar fractures is important.[1,2] This study investigated the etiology and management of symphyseal-condylar fractures in pediatric patients, in order to provide treatment recommendations to improve long-term outcomes.

METHODS: This was a retrospective cohort study of pediatric patients with symphyseal-condylar mandibular fractures both at our institution between 1990-2019 and nation-wide (identified in the Healthcare Cost and Utilization Project Kid Inpatient Database – HCUP KID) between 2000-2016. Two-tailed Mann-Whitney U and Fischer's Exact analyses were used to compare demographic and clinical factors as well as incidence of complications between patients in each dentition stage in our institutional dataset. Also, multiple logistic regression with forward stepwise selection of predictor variables was used to generate adjusted odds ratios for complications, and a treatment algorithm was proposed. National data on pediatric symphyseal/condylar fractures between 2012-2016 abstracted from HCUP KID were used to confirm recommendations in the proposed treatment algorithm using chi square analyses. Additionally, a logistic regression model was used to evaluate the proposed treatment algorithm, by predicting odds of complications based on adherence or nonadherence to the algorithm for patients in each dentition stage. Concordance statistics were used to evaluate model robustness.

RESULTS: Twenty-one patients at our institution and 1708 national database patients met inclusion criteria. At our institution, 26.7% of deciduous dentition patients underwent ORIF, 40% underwent closed treatment (MMF), and 33.3% were treated with soft diet. All mixed dentition patients underwent either ORIF or closed treatment (MMF); all permanent dentition patients underwent ORIF. In the national cohort, most permanent dentition patients (88.7%) underwent ORIF, while most mixed dentition patients (79.2%) underwent closed treatment. Amongst deciduous dentition patients in the national cohort, 53.5% patients were treated with soft-diet and 38% with closed treatment. At our institution, the overall post-treatment complication rate was 62.5% among ORIF patients, 14.3% among closed treatment patients, and 16.7% among patients treated with soft diet. The most common complications were temporomandibular joint dysfunction (50%) and malocclusion (37.5%). A treatment algorithm (**Figure 2**) was developed using study data; algorithm adherence significantly decreased odds of complications (odds ratio: 0.03, 95% confidence interval: 0.001-0.6, $p = 0.03$).

CONCLUSIONS: Symphyseal-condylar fractures were associated with substantial morbidity in children. Using the data from both our institution as well as from review of a national database, we proposed a treatment algorithm, stratified by dentition stage, in order to guide treatment for children who present with this complex fracture type.

REFERENCES:

1. Wolfswinkel EM, Weathers WM, Wirthlin JO, Monson LA, Hollier LH, Khechoyan DY. Management of Pediatric Mandible Fractures. *Otolaryngol Clin North Am*. 2013;46(5):791-806. doi:10.1016/j.otc.2013.06.007
2. Cole P, Kaufman Y, Hollier L. Managing the Pediatric Facial Fracture. *Craniomaxillofacial Trauma Reconstr*. 2009;2(02):077-083. doi:10.1055/s-0029-1202592

Craniomaxillofacial Abstracts

The Vector of Displacement Predicts Need for Operative Intervention in Type I Naso-Orbital-Ethmoid Fractures

Presenter: Vinay Rao, MD
Co-Authors: Lauren O. Roussel, MD, Joseph W Crozier, MA, Albert S. Woo, MD
Affiliation: Warren Alpert Medical School of Brown University, Providence, RI

PURPOSE: Naso-Orbital Ethmoid (NOE) fractures are categorized according to the Markowitz-Manson classification system. Type I NOEs are the most common pattern but have varying clinical and radiographic characteristics. There is no literature to date that accounts for these differences. This study describes critical features of Type I fractures and their effect on clinical symptoms and need for operative intervention.

METHODS: A retrospective review was conducted on patients with NOE fractures from 2011 to 2019. CT scans with 3D reconstructions were used to characterize Type I NOE fractures. The primary outcomes were symptoms necessitating surgery and whether operative intervention was performed.

RESULTS: In total, 106 NOE fractures were identified. Type I pattern was seen in 92% (97/106), Type II in 8% (8/106), and Type III in 1% (1/106). Type I fractures exhibited four patterns of displacement relative to the nasofrontal junction. They were designated as Type 0 “non-displaced” (52%), Type IA “impacted and internally rotated” (34%), Type IB “impacted and externally rotated” (13%), and Type IC “blow-out” fractures (1%). Among Type I fractures, displaced NOEs were thirty times more likely to need operative intervention versus non-displaced ($p<0.001$). Type IA was 1.3 times more likely to need operative intervention and had a greater risk of trouble breathing and internal nasal valve collapse compared to Type 0 and Type IB patterns ($p<0.05$).

CONCLUSIONS: Degree and direction of displacement is critical when assessing Type I NOE fractures. Both displacement and specifically impaction with internal rotation are significantly associated with patient morbidity and need for surgical treatment.

General Reconstruction Abstracts

Surgical Management of Desmoid Tumors: Impact of Reconstruction on Recurrence

Presenter: Ian Wisecarver, MD

Co-Authors: Anna Meade, BS, Justin Davis, MD, Rohit Sharma, MD, Andrew Y. Zhang, MD
Affiliation: University of Texas Southwestern, Dallas, TX

INTRODUCTION: Desmoid tumors are benign, monoclonal neoplasms that arise from musculoaponeurotic structures in a wide age range of patients in some 2-4 million people worldwide.[1] Occurring throughout the body, they can present as aggressive, locally invasive lesions that impede quality of life.[2] In large, en bloc resections, the reported recurrences are high, ranging from 7-60%.[3] There is no validated treatment protocol for desmoid management. We present the multidisciplinary treatment of 20 patients with resectable desmoid tumors, reconstruction method, and experience in managing recurrences.

METHODS: After Institutional Board Review approval, the clinical course of 20 patients diagnosed with desmoid tumors and treated by the University of Texas Southwestern multidisciplinary team were retrospectively reviewed over and eight-year period to analyze patient characteristics and surgical outcomes. Patient, tumor, treatment and outcome data were compared between patients who underwent surgical resection with formal reconstruction and patients who underwent resection with primary closure. Possible protective or risk factors for recurrence were recorded including patient age, sex, body mass index, history of diabetes mellitus, tobacco use, history of syndromic conditions associated with desmoid tumors, preoperative radiation therapy, history of previous reconstruction, recurrent or primary neoplasm, and tumor size.

RESULTS: Twenty patients were included in our study. Of those 11(55%) underwent reconstruction while 9 (45%) underwent primary closure. Mean follow-up time was 24.35 +/- 21.4 months. Primary closure patients were more likely to have positive marginal status post resection (55.6% vs 9.09%; p=0.050) and higher rate of recurrence (66.6% vs 0%; p=0.0012) than patients who underwent reconstruction. They were also signifigantly older (47.2 +/- 13.2 years vs 34.9 +/- 12.2 years; p=0.044), and had more instances of tumor reoccurrence at time of presentation (44% vs 0%; p=0.026) versus those who underwent reconstruction. No recurrences occurred in the reconstructive group; the reconstructive group had significantly higher rates of desmoids located in the abdominal wall than those who underwent primary closure (72.7% vs 11.1%, p=0.009).

CONCLUSION: Reconstructive surgery was not found to be a risk factor for recurrence. In fact, primary closure was associated with higher reoccurrence and positive margins. This might suggest that during resection, surgeons are focusing more on primary wound closure versus insuring negative marginal status. Collaboration between reconstructive and oncologic surgeons is necessary in the management and potential treatment of desmoid tumors.

REFERENCES:

1. Huang K, Fu H, Shi YQ, Zhou Y, Du CY. Prognostic factors for extra-abdominal and abdominal wall desmoids: a 20-year experience at a single institution. *J Surg Oncol.* 2009;100(7):563-569.
2. Li M, Cordon-Cardo C, Gerald WL, Rosai J. Desmoid fibromatosis is a clonal process. *Human pathology.* 1996;27(9):939-943.
3. Janssen ML, van Broekhoven DL, Cates JM, et al. Meta-analysis of the influence of surgical margin and adjuvant radiotherapy on local recurrence after resection of sporadic desmoid-type fibromatosis. *The British journal of surgery.* 2017;104(4):347-357.

General Reconstruction Abstracts

Novel Application of Common Pharmacological Agents Nimodipine and Botulinum Toxin a on Traumatic Nerve Regeneration Following Microsurgical Repair: A Pilot Study

Presenter:	Scott K Odorico, BS
Co-Authors:	Nikita Shulzhenko, MD, Weifeng Zeng, MD, Aaron M. Dingle, PhD, David Francis, MD, Samuel O. Poore, MD, PhD
Affiliation:	University of Wisconsin-Madison,

INTRODUCTION: Peripheral nerve damage is a frequent problem in civilian and military populations; an estimated 2.8-5% of trauma admissions contain a peripheral nerve injury. Currently, end-to-end, tension-free microsurgical nerve repair (neurorrhaphy) is the gold standard treatment. However, neurorrhaphy is not neuroprotective and does not address the complex molecular environment of a regenerating nerve required for complete functional restoration. Current literature indicates that widely used pharmacological agents botulinum toxin A (BTX, a neurotoxic protein) and nimodipine (NDP, a L-type calcium channel blocker) may improve functional recovery of injured nerves, but these agents have not been studied together. This research investigates BTX and NDP, independently and in combination, for their novel capacity to improve neural regeneration and functional recovery following neurorrhaphy.

METHODS: 32 Lewis rats underwent surgical tibial nerve transection and neurorrhaphy. Post-op pharmaceutical treatment groups included: 1) Sham surgery (n=4); 2) Sham surgery+BTX (n=4); 3) NDP+saline injection (control for BTX, N=6); 4) BTX+NDP (n=6); 5) Saline+placebo pill (control for NDP, n=6); 6) BTX+placebo pill (n=6). Outcomes were assessed using behavioral (rotarod, horizontal ladder walk), electrophysiological (CNAP, CMAP velocity and duration), and stereological means (myelinated axon count estimation, myelinated axons density). Statistical significance was determined by one-way ANOVA.

RESULTS: The NDP+saline group outperformed other treatment groups in the ladder walk, resulting in the fewest deep slips (15.07% vs 30.77% in BTX+NDP, $p=0.117$), fewest misses (3.54% vs 4.21% in BTX+NDP, $p=0.809$), and most correct steps (70.53% vs 55.58% in BTX+NDP, $p=0.143$). Rotarod testing resulted in no clear differences between treatment groups with all groups performing worse than sham controls. There was an observed sex bias between groups in which females tended to outperform males within groups in both behavioral modalities, but this was stronger in rotarod testing. Electrophysiological testing portrayed similar outcomes to ladder walk testing in which NDP+saline resulted in the fastest NCV (0.81m/s vs 0.59m/s in BTX+NDP, $p=0.126$), and shortest duration of response (104.17µs vs 326.39µs in BTX+NDP, $p<0.05$) among the treatment groups. Our blinded stereological analyses resulted in the BTX+NDP group having the highest myelinated axon count (9,249.54 vs 7,334.94 in NDP+saline, $p<0.05$), but when epineurial area is controlled for, this difference diminishes ($0.005/um^2$ vs $0.0043/um^2$ in NDP+saline, $p=0.201$). When separated by sex, males tended to have higher axon counts than females (8,615.03 vs 6,052.84 in NDP+saline, $p<0.05$).

CONCLUSIONS: This pilot study represents the first approach to test NDP with BTX in a multimodal assessment of nerve recovery and regeneration following transection and neurorrhaphy. While an additive or synergistic effect between BTX and NDP was expected, NDP alone tended to outperform the combined treatment group in behavioral and electrophysiological assessments. However, and mirroring past studies by our group and others, histologic axon count was inversely related to nerve function recovery, portraying an expected regenerative effect after injury. Our findings of a sex bias parallel observations present in the current literature. Future work will expand on these studies focusing on nimodipine in males and females in an effort to improve nerve recovery in trauma patients.

General Reconstruction Abstracts

Lower Extremity Lymphatic Function Predicted By Body Mass Index: A Lymphoscintigraphic Study of Obesity and Lipedema

Presenter: Christopher L Sudduth, MD
Co-Authors: Arin K. Greene, MD
Affiliation: Boston Children's Hospital, Harvard Medical School, Boston, MA

BACKGROUND: Patients with obesity and lipedema commonly are misdiagnosed as having lymphedema.[1,2] The conditions share phenotypic overlap and can influence each other. The purpose of this study was to delineate these disorders in order to improve their diagnosis and treatment.

METHODS: Our Lymphedema Center database of 700 patients was searched for patients with obesity-induced lymphedema (OIL), obesity without lymphedema (OWL), and lipedema. Patient age, sex, diagnosis, cellulitis history, body mass index (BMI), and treatment was recorded. Only subjects with lymphoscintigraphic documentation of their lymphatic function were included.

RESULTS: Ninety-eight patients met inclusion criteria. Subjects with abnormal lymphatic function (n=46) had a greater BMI (65 +/- 12) and cellulitis history (n=30, 65%) compared to individuals with normal lymphatic function [(BMI 42 +/- 10); (infections n=8, 15%)] ($p<0.001$). Seventeen patients had a history of lipedema and 2 exhibited abnormal lymphatic function (BMI 45, 54). The risk of having lower extremity lymphedema was predicted by BMI: BMI<40 (0%), 40-49 (17%), 50-59 (63%), 60-69 (86%), 70-79 (91%), ≥80 (100%). Five patients with OIL (11%) underwent resection of massive localized lymphedema (MLL) or suction-assisted lipectomy. Three individuals (18%) with lipedema were treated with suction-assisted lipectomy.

CONCLUSIONS: The risk of lymphedema in patients with obesity and lipedema can be predicted by BMI; confirmation requires lymphoscintigraphy. Individuals with OIL are at risk for cellulitis and MLL. Patients with a BMI>40 are first managed with weight loss. Excisional procedures can further reduce extremity size once BMI has been lowered.

REFERENCES:

1. Schook CC, Mulliken JB, Fishman SJ, Alomari AI, Grant FD, Greene AK. Differential diagnosis of lower extremity enlargement in pediatric patients referred with a diagnosis of lymphedema. *Plast Reconstr Surg*. 2011;127(4):1571-1581. doi:10.1097/PRS.0b013e31820a64f3
2. Maclellan RA, Couto RA, Sullivan JE, Grant FD, Slavin SA, Greene AK. Management of Primary and Secondary Lymphedema: Analysis of 225 Referrals to a Center. *Ann Plast Surg*. 2015;75(2):197-200. doi:10.1097/SAP.0000000000000022

General Reconstruction Abstracts

Reducing Complications and Expanding Utilization in Robotic Rectus Abdominis Muscle (RRAM) Harvest for Pelvic Reconstruction

Presenter:	Armando A Davila, MD
Co-Authors:	Joshua J Goldman, MD, Shawna R Kleban, MD, Mitchell Lyons, MD, John Brosious, MD, Ovunc Bardakcioglu, MD, FACS, FASCRS, Richard C. Baynosa, MD
Affiliation:	University of Nevada, Las Vegas School of Medicine, Las Vegas, NV

PURPOSE: Reconstruction of perineal defects has long relied on the rectus abdominis flap.[1] While traditionally approached though an external incision, the morbid nature of the incision and violation of the anterior rectus sheath has led to the development of robotic techniques for harvest.[2,3] However, these procedures have been limited by surgeon comfort with minimally invasive techniques, cost of additional equipment, and minimal outcomes data. In this study we present our experience, evolution, and comparative outcomes of robotic rectus abdominis muscle (RRAM) against non-robotic flaps for perineal reconstruction.

METHODS: A retrospective review RRAM flaps were compared to non-robotic perineal reconstruction techniques during a 6-year period. Descriptive statistics and complication profiles were computed. The evolution and details of our surgical technique including routine use of the posterior fascia for inset, dissection in the setting of previous ostomies, donor site mesh repair, and protocol for flap selection are explored.

RESULTS: Thirty-six (36) patients underwent perineal reconstruction. Sixteen (16) were performed utilizing the RRAM and twenty (20) with traditional repairs; twelve (12) vertical rectus abdominis myocutaneous (VRAM) flaps and eight (8) gracilis flaps. Demographic profiles were similar between cohorts including age, BMI, smoking status, history of diabetes, neoadjuvant radiation, and need for vaginal wall repair. Six (6) robotic patients underwent abdominal wall reinforcement with biologic mesh after two (2) instances of hernia/bulge in non-repaired patients. Surgical times were similar between robotic and non-robotic cohorts with on average 7-hour surgical times including both extirpation and reconstruction (428 vs 422 min; p=0.84). Length of stay and incidence of major complications were similar between cohorts with a trend towards increased minor complications in traditional reconstructions (55% vs 31%; p=0.15).

CONCLUSIONS: Robotic rectus abdominis muscle harvest is a technique that continues to evolve with the potential to ameliorate morbidity and complications of traditional repair and enhancement of cosmesis. Our series explores the largest comparative experience of robotic rectus harvest for perineal reconstruction in the literature which has allowed us to identify risks for complications and refine the indications and technique for robotic harvest. This evolution of our protocol reflects our belief that a skin paddle can be avoided in almost all cases when laparotomy is avoided with the use of the posterior rectus fascia for pelvic floor recreation and/or posterior vaginal wall reconstruction and subsequent prophylactic mesh repair of the donor defect.

REFERENCES:

1. Chessin DB, Hartley J, Cohen AM, et al. Rectus flap reconstruction decreases perineal wound complications after pelvic chemoradiation and surgery: a cohort study. *Ann Surg Oncol.* 2005; 12(2): 104-110.
2. Pedersen JC, Song DH, Selber JC. Robotic, intraperitoneal harvest of the rectus abdominis muscle. *Plast Reconstr Surg.* 2014; 134(5): 1057-1063.

3. Wu LC, Song DH. The rectus abdominis musculoperioneal flap for the immediate reconstruction of partial vaginal defects. *Plast Reconstr Surg.* 2005; 115(2): 559-562.

General Reconstruction Abstracts

Cure for Lymphedema: Myth or Reality

Presenter:	Isis Scomacao, MD
Co-Authors:	Jonathan N. Lensing, BS, Mindy J. Bowen, RN, BSN, Fatma Tuncer, MD, Wei F. Chen, MD, FACS
Affiliation:	Cleveland Clinic, Cleveland, OH

INTRODUCTION: Recent advances in lymphatic supermicrosurgery have increased the hope for patients with limb lymphedema[1]. However, it remains unclear if this procedure fundamentally impacts the disease course[2]. The aim of this study is to investigate whether full reversal of lymphedema disease state, or cure, is feasible.

METHODS: All LVA cases performed by the senior author **between** January 2014 and January 2018 were reviewed. Surgical outcomes were tracked with patient report, clinical examination, limb volume measurement, and indocyanine green (ICG) lymphography. The evaluation was performed preoperatively and postoperatively at 3, 6, 12-month, and then annually. The state of cure was defined as an edema-free state without compression.

RESULTS: Ninety-seven patients underwent to LVA during the study period. All demonstrated improvement based on the four parameters evaluated. Sixteen patients (16.5%) achieved cure at 1 year following surgery. Of these patients, fifteen patients were female and 1 was male. The average BMI, age, and follow-up period were 27.18±4.92 kg/m2, 59.5±9.30 years, and 45.5±12.1 months, respectively. Eleven patients had Campisi stage III, four had stage II, and one had stage IB disease. Fourteen had arm and two had leg disease. At the conclusion of the study, all sixteen patients achieved to stage IA, or no clinically appreciable limb edema. All sixteen patients also demonstrated correlating ICG lymphographic evidence of improvements, while three patients demonstrated complete resolution of pathologic lymphographic patterns – no evidence of disease was seen on their ICG lymphography.

CONCLUSION: Full reversal of lymphedema disease state in patients with limb lymphedema is feasible following supermicrosurgical intervention. In these patients, correlating improvement can be seen on postoperative ICG lymphography. The full disease reversal is seen more frequently in arm than in leg lymphedema. Further studies are necessary to investigate the inconsistency in surgical outcomes

REFERENCES:

1. Schaverien MV, Coroneos CJ. Surgical Treatment of Lymphedema. Plast Reconstr Surg 2019: 144: 738-58.
2. Chang EI, Skoracki RJ, Chang DW. Lymphovenous Anastomosis Bypass Surgery. Semin Plast Surg 2018: 32: 22-27.

General Reconstruction Abstracts

Immediate Lymphatic Reconstruction after Axillary Lymphadenectomy Makes a Difference: Bioimpendence Spectroscopy and Two Year Follow up Analysis

Presenter:	Cagri Cakmakoglu, MD
Co-Authors:	Hirsh Shah, BA, Stephanie Valente, DO, Risal Djohan, MD, Stephen Grobmyer, MD, Steven Bernard, MD, Raffi Gurunluoglu, MD, PhD, Diane Radford, MD, Andrea A. Moreira, MD, Graham S Schwarz, MD
Affiliation:	Cleveland Clinic, Cleveland, OH

BACKGROUND: Axillary lymph node dissection (ALND) in the treatment of breast cancer increases the risk of iatrogenic lymphedema. Current rates after ALND range from 11-30%. We hypothesize that our lymphedema prevention surgical (LPS) paradigm, ALND with axillary reverse mapping (ARM) and lymphatico-venous bypass (LVB), lowers the risk of lymphedema. Here, we present findings from a case control study from patients undergoing this procedure.

METHODS: A review of our prospectively maintained lymphedema surgical registry was performed. One hundred and seventeen consecutive patients with complete ALND underwent LPS at our institution from September 2016 to February 2020. A control group was selected consisting of 92 patients who underwent ALND without LPS in a concurrent time interval from 9/2016-11/2017 to prevent surgical technique or learning curve bias. Patients were followed for both signs and symptoms of lymphedema throughout the post treatment interval and underwent serial assessments for lymphedema via standardized arm circumference measurements by a certified lymphedema therapist. In addition, pre and post-operative bioimpedance spectroscopy used (BIS) to track lymphedema progression**.** Lymphedema was defined as more than a 10% difference in volume between upper limbs in conjunction with characteristic symptoms and signs. Demographic, procedural and oncologic data was compared between groups

RESULTS: Lymphedema occurrence rates were significantly different between control and treatment groups during the follow-up period (16.3% non-LPS vs. 5.3% LPS, p=0.006). Of the 15 non-LPS patients who developed lymphedema, 14 received PMRT and 5 had neoadjuvant chemotherapy. Five LPS patients acquired lymphedema, two had PMRT and all five underwent neoadjuvant chemotherapy.

Clinical staging differed with a higher proportion of advanced nodal stage in LPS patient group. The mean lymph nodes removed per case was slightly higher in the LPS group (14.4 vs. 11.2). Rates of post mastectomy radiation therapy (PMRT) were similar (77% to 89%, respectively), but neoadjuvant chemotherapy rates were lower in non-LPS patients (43% vs 74%). The follow-up time was 15.3 months for the LPS group and 34.6 months for the non-LPS group. Following reverse mapping in LPS, an average of 2.1 blue transected lymphatics were identified per case. An average of 0.1 blue lymphatic vessels was left in continuity per case and 1.6 vessel anastomoses performed per case with intussusception being performed more frequently than end to end technique (55% vs 44%).

CONCLUSION: In one of the largest controlled studies in this topic to date, our findings support that optimizing lymphatic preservation and restoring antegrade lymphatic flow with LPS significantly decreases short term lymphedema rates in patients undergoing axillary lymphadenectomy for breast cancer.

General Reconstruction Abstracts

The Inferior Gluteal Artery Myocutaneous (IGAM) Flap Is Preferable for Reconstructing the Complex Perineal Defect Following Pelvic Exenteration

Presenter:	Ajay Chauhan, MBBS FRACS
Co-Authors:	Edwin Morrison, MBBS FRACS, Sarah Lonie, MBBS, Eric Sham, MBBS, Alexander Heriot, MB MChirg MD FRCS FRACS
Affiliation:	Peter MacCallum Cancer Centre, Melbourne, Australia

PURPOSE: Pelvic exenteration is major surgery associated with high perioperative morbidity in a physically and psychologically debilitated population. Such radical ablative paradigms are justified in large part by the quality of the reconstruction. Equally complications attributable to the reconstruction, which may be associated with prolonged wound management, additional surgeries and delays in discharge from hospital can significantly impact the perioperative course.

Despite significant donor (10-20 percent) and recipient (20-30 percent) site complication rates the vertical rectus abdominus myocutaneous (VRAM) flap is currently the gold standard reconstruction for complex perineal defects. On this background the *inferior gluteal artery myocutaneous (IGAM) flap* was introduced and refined at our institution over a number of years, which includes the use of adjunctive mesh. In fifty-six consecutive patients it has proven to provide a simple and reliable method of achieving primary wound healing allowing for early day one post op mobilisation to minimise perioperative morbidity, and a durable reconstruction of the perineum with almost no donor site morbidity.

METHODS AND MATERIAL: Records of all patients who underwent pelvic exenteration and plastic surgical reconstruction at *Peter MacCallum Cancer Centre, Melbourne, Australia* between January 2015 and December 2019 were retrospectively reviewed following ethics approval. All data relating to patient demographics, comorbidities, tumour pathology and grade, surgeries, adjuvant therapies and peri-operative medical and surgical complications was collected from a prospectively maintained database of pelvic exenterations. Specific to the reconstruction, early outcome measures included partial/total flap failure, donor site or flap dehiscence, haematoma, infection and early (<30days) return to theatre (RTT). Late outcome measures included revision surgeries, abdominal or perineal hernia, fistula and symptomatic flap bulk. The minimum follow-up period was three months.

RESULTS: There were fifty-six consecutive pelvic exenteration patients, all of whom were reconstructed by one of two plastic and reconstructive surgeons. Seventy percent of patients had rectal adenocarcinoma, while thirty percent of patients had recurrent disease. Ninety-eight percent were irradiated. Using the *Royal Marsden Pelvic Exenteration Classification* there were equal rates of anterior, posterior and lateral pelvic exenterations. Mesh was used in fourteen patients, all in the final year of the study. There were no partial/total flap failures. There were three early (<30 days) RTT, two for flap dehiscence, one for evacuation of a donor site haematoma. There was one surgical site infection at each donor and recipient site. The were no mesh complications or fistula. There was one perineal hernia and one late flap revision for excessive bulk.

CONCLUSION: This novel reconstructive method based on the IGAM flap is technically simple and safe allowing for early mobilisation whilst providing a durable reconstruction with minimal donor morbidity. Use of adjunctive mesh is safe. We argue that the IGAM flap, not the VRAM, is the more appropriate reconstruction for the complex perineal defect and for this vulnerable cohort of patients.

General Reconstruction Abstracts

Bony Defects of the Foot Lead to High Rates of Transfer Lesion Development: Soft Tissue Reconstruction Is Not Enough in the Chronic Wound Population

Presenter:	Priya Bhardwaj, MS
Co-Authors:	Elizabeth G. Zolper, BS, Jenna C. Bekeny, BA, Andrew I. Abadeer, MD, MEng, Kenneth L. Fan, MD, Karen K. Evans, MD
Affiliation:	Georgetown University School of Medicine, Washington, DC

BACKGROUND: Bony resection is often necessary prior to soft tissue reconstruction in the chronic wound population due to osteomyelitis and bony abnormalities. While transmetatarsal amputation (TMA) is argued to be the most functional approach when extensive bony resection is required, recent evidence suggests preservation of the first two rays may improve load-bearing at the expense of an increased risk of subsequent procedures.[1] Altering the metatarsal parabola also increases the risk of transfer lesion development as one metatarsal takes on more weight. The aim of this study was to investigate the risks of ulcer recurrence and transfer lesion development after microsurgical soft tissue reconstruction with underlying bony defects.

METHODS: A retrospective review of lower extremity free tissue transfer (FTT) for chronic wounds with underlying bony defects at our institution from 2011-2019 was performed. Data collected included demographics, comorbidities, wound locations, and FTT characteristics. Outcomes of interest were ulcer recurrence and development of transfer lesions post-FTT. Multivariate logistic regression was used to produce adjusted odds ratios for transfer lesion development using a backwards model.

RESULTS: We identified 64 FTT procedures performed for lower extremity salvage with bony defects. Mean age at time of FTT was 55.9 years old (standard deviation [SD] 11.8). Mean Charlson Comorbidity Index was 4.1 (SD 2.0). Common comorbidities included: diabetes 76.6% and osteomyelitis 68.8%. The majority of bony defects involved the tripod of the foot (79.7%) with resection of a portion of the first metatarsal (46.9%), fifth metatarsal (51.6%) or calcaneus (21.9%). Wounds developed post-FTT in 70.3%. The original ulcer recurred in 39.1% while transfer lesions developed in 43.8%.

Median time to transfer lesion development was 3.7 months. On bivariate analysis, neither tripod ($p=0.104$), first metatarsal ($p=0.053$), nor fifth metatarsal ($p=0.198$) defects had significant relationships with increased odds of transfer lesion development. Calcaneal defects also did not exhibit a significant relationship with transfer lesion development ($p=0.939$). Diabetes ($p=0.043$) and plantar weightbearing defect ($p=0.045$) exhibited significant relationships with transfer lesion development. On multivariate analysis, both first metatarsal (odds ratio [OR] 7.2, 95% confidence interval [CI] 1.6-31.8) and plantar weightbearing defects (OR 4.6, 95% CI 1.1-19.1) were independently associated with increased odds of transfer lesion development. Fasciocutaneous flap type was significant for decreased odds of transfer lesions (OR 0.15, 95% CI 0.03-0.66). Diabetes was no longer a significant predictor for transfer lesion development.

CONCLUSIONS: Defects of the load-bearing tripod, particularly the first and fifth metatarsal, significantly increase the risk of transfer lesion development after FTT. While solely soft tissue reconstruction with FTT achieves success in the short term, transfer lesions occur at high rates in the months to years following initial healing. Use of composite osteocutaneous flaps may be valuable in this population to decrease transfer lesion risk by achieving both bony and soft tissue reconstruction.

REFERENCES:

1. Suh YC, Kushida-Contreras BH, Suh HP, et al. Is Reconstruction Preserving the First Ray or First Two Rays Better Than Full Transmetatarsal Amputation in Diabetic Foot? *Plast Reconstr Surg.* 2019;143(1):294-305.

General Reconstruction Abstracts

The Addition of Fluorescence to the University of Wisconsin "Blue-Blood" Chicken Thigh Model Significantly Enhances Its Effectiveness As a Supermicrosurgery Training Tool

Presenter:	Nicholas J. Albano, MD
Co-Authors:	Weifeng Zeng, MD, Christie Lin, PhD, Adam Uselmann, PhD, Kevin W. Eliceiri, PhD, Samuel O. Poore, MD, PhD
Affiliation:	University of Wisconsin Hospital and Clinics, Division of Plastic Surgery, Madison, WI

BACKGROUND: The skills required for supermicrosurgery are hard earned and difficult to master. The University of Wisconsin “blue-blood” chicken thigh model has proven to be an excellent source of small vessels (down to 0.25mm) but assessing the quality of anastomoses at this spatial scale has proven difficult.[1] Without the capacity for self-assessment, the chicken thigh model becomes a much less effective training tool. We evaluated whether augmentation of this realistic training model with fluorescent imaging would enhance assessment of supermicrosurgical anastomoses, and therefore improve real-time feedback to trainees.

METHODS: White light with and without fluorescence imaging overlay captured the infusion of colored saline and fluorescent indocyanine green (ICG) “blood” through the vessels (n=7 with diameters ranging from 0.35 to 0.55 mm). Videos with and without fluorescence overlay were separated, randomized and shown to seven fellowship-trained microsurgeons at the University of Wisconsin-Madison who rated each anastomosis as “patent”, “not patent” or “unsure.” Surgeon accuracy, uncertainty and inter-rater agreement were measured to evaluate the effectiveness of each imaging modality for assessing supermicrosurgical anastomoses. Staff opinion regarding the use of fluorescent imaging was also polled using a Likert scale.

RESULTS: When assessing the quality of supermicrosurgical anastomoses, the use of fluorescence significantly increased surgeon accuracy to 91% compared to 47% with white light alone ($p = 0.015$), significantly decreased surgeon uncertainty to 4% compared to 41% with white light alone ($p = 0.011$), and significantly improved inter-rater agreement to 91.2% compared to 53.0% with white light alone ($p = 0.016$). Additionally, 100% of participating surgeons “strongly agreed” that the use of fluorescence improved their ability to assess the patency of anastomoses. All of the participating surgeons either “agreed” (43%), or “strongly agreed” (57%) that the use of fluorescence improved their ability to assess for anastomotic leaks.

CONCLUSIONS: Augmentation of the University of Wisconsin “blue-blood” chicken thigh model with ICG fluorescence significantly improves accuracy, decreases uncertainty and improves inter-rater agreement when assessing supermicrosurgical anastomoses in a training setting. Now, with fluorescence, the “blue-blood” chicken thigh model is capable of providing high quality, real-time feedback at the supermicrosurgery scale, redeeming it as an effective training tool for supermicrosurgery skills.

REFERENCES:

1. Zeng, W., Shulzhenko, N. O., Feldman, C. C., Dingle, A. M., & Poore, S. O. (2018). "Blue-Blood-" Infused Chicken Thigh Training Model for Microsurgery and Supermicrosurgery. *Plastic and Reconstructive Surgery - Global Open*, *6*(4), e1695–3.

General Reconstruction Abstracts

Implementation of a Stratified Anticoagulation Protocol Increases Lower Extremity Free Tissue Transfer Success in the Setting of Thrombophilia

Presenter:	Elizabeth G. Zolper, BS
Co-Authors:	Christopher V Lavin, BS, Romina Deldar, MD, Jenna C. Bekeny, BA, Kenneth L. Fan, MD, Karen K. Evans, MD
Affiliation:	Georgetown University School of Medicine, Washington, DC

BACKGROUND: Optimal perioperative thromboprophylaxis is crucial to achieve high rates of microsurgical success in the highly comorbid chronic wound population. After implementation of a risk-stratified anticoagulation protocol at our institution, our preliminary data indicated that the new protocol contributed to significant reductions in postoperative thrombotic events and flap loss.[1] We present an updated analysis of lower extremity free tissue transfer (FTT) outcomes and the utility of risk-stratified anticoagulation.

METHODS: A retrospective review of lower extremity FTT at our institution from 2011-2019 was performed. Demographics, comorbidities, chemoprophylaxis regimens, and FTT characteristics were collected. Patients were divided into two cohorts based on the institution of a risk-stratified anticoagulation protocol in July 2015.[1] Under this protocol, weight-based heparin infusions were utilized for patients with intraoperative risk factors for microvascular thrombosis (arterial calcification, pedicle thrombosis, or anastomotic revision). In the absence of intraoperative findings, patients were stratified to subcutaneous heparin or fixed-dose heparin infusion based on historical (venous thromboembolism, cerebrovascular accident, or myocardial infarction) and hematologic (three or more hypercoagulable traits) risk factors. Outcomes of interest were blood transfusion volume and flap success. Multivariate logistic regression was used to produce adjusted odds ratios for flap success using a backwards model.

RESULTS: We identified 148 LE FTT procedures performed for lower extremity salvage in patients who had detectable hypercoagulable traits on preoperative screening.[2] Median age at time of FTT was 58 years old (interquartile range [IQR] 47-66). Median Charlson Comorbidity Index (CCI) was three (IQR 2-4.5). Median number of hypercoagulable traits was two (IQR 2-3). Eighty-two percent of FTT procedures were managed with the stratified anticoagulation protocol. Patients in the stratified cohort received intravenous heparin significantly more often (55.4 versus 7.4%, p=0.005) and had higher rates of flap success (97.5 versus 81.5%, p=0.005). Incidence of postoperative thrombosis (2.5 versus 11.1%, p=0.074) and FTT takeback (3.3 versus 11.1%, p=0.114) were decreased in the risk stratified group but not statistically significant. Volume of transfused blood products within five days after FTT was not significantly different (median [IQR]: 0 [0-642] versus 350 [0-700] ml, p=0.139) between groups. On multivariate analysis, use of stratified anticoagulation protocol (odds ratio [OR] 11.3, 95% confidence interval [CI] 1.9-67.2) was associated with increased flap success. Occurrence of anastomotic revision (OR 0.16, 95% CI 0.03-0.96) and increasing number of hypercoagulable traits (OR 0.46, 95% CI 0.25-0.85) were associated with decreased flap success.

CONCLUSIONS: Hypercoagulability has a significant impact on microsurgical outcomes. Implementation of a standard preoperative panel for common hypercoagulable traits and intraoperative risk factors successfully guide a risk stratified anticoagulation protocol, which has contributed to significant improvements in flap success without creating an increased need for blood transfusion.

REFERENCES:

1. DeFazio MV, Economides JM, Anghel EL, Tefera EA, Evans KK. Lower Extremity Free Tissue Transfer in the Setting of Thrombophilia: Analysis of Perioperative Anticoagulation Protocols and Predictors of Flap Failure. *J Reconstr Microsurg.* 2019;35(4):270-286.
2. DeFazio MV, Hung RW, Han KD, Bunting HA, Evans KK. Lower Extremity Flap Salvage in Thrombophilic Patients: Managing Expectations in the Setting of Microvascular Thrombosis. *J Reconstr Microsurg.* 2016;32(6):431-444.

General Reconstruction Abstracts

A Systematic Review of Primary Vaginoplasty Techniques and Outcomes in the Male-to-Female Transgender Population: A Call to Action

Presenter:	Elizabeth G. Zolper, BS
Co-Authors:	Chris Devulapalli, MD, Alexandra Tilt, MD, Cara K. Black, MD, Kenneth L. Fan, MD, Gabriel A. Del Corral, MD
Affiliation:	Georgetown University School of Medicine, Washington, DC

PURPOSE: Primary vaginoplasty is an integral aspect of male-to-female (MtF) transgender surgery. Surgical techniques vary and outcomes, such as vaginal depth, complications, and patient-reported outcome measures (PROMs) are reported inconsistently. We aim to provide a synopsis of vaginoplasty technique variations and evaluation of outcomes.

METHODS: A multi-database (EMBASE, Ovid, PubMed, and Web of Science) search (2008-2019) was performed using a search strategy executed with MeSH terms and keywords such as *neovagina*, *vaginoplasty*, and *transgender*. Studies describing primary MtF vaginoplasty that sufficiently detailed surgical technique and reported surgical outcomes and/or PROMs were selected.

RESULTS: Twenty-three studies were included; sixteen described unique populations representing 2021 MtF patients. Inversion vaginoplasty was performed in 96.6% of patients (n=1952). Sixty-nine patients underwent intestinal vaginoplasty. Average length of admission was 8.5 days (range 5.7-12.5d). Average follow-up was 49.8 months (range 6-92mo). Average vaginal depth achieved was 11.7cm (range 9.8-15cm) with inversion vaginoplasty (n=513) and 15.3cm (range 12-16.3cm) with intestinal vaginoplasty (n=54). Neovagina was constructed with inversion flap only (69.8%), or augmented with full thickness skin graft (18.6%), spatulated urethra (9.5%), or both (2.0%). For intestinal vaginoplasty, either sigmoid (78.3%) or transverse (21.7%) colon was utilized. The most common complications were wound dehiscence after inversion vaginoplasty (19.2%) and introitus stricture after intestinal vaginoplasty (13.0%). Sixteen studies included PROMs. The most commonly utilized validated PROMs for sexual function were the Female Genital Self-Image Scale (FGSIS) and Female Sexual Function Index (FSFI). Patient satisfaction was high (88.7% inversion, 77.6% intestinal) while regret was low (1.0%). Rates of penetrative intercourse were similar (62.5% inversion, 51.2% intestinal). The majority of patients were able to achieve orgasm (74.5% inversion, 84.0% intestinal).

CONCLUSIONS: Inversion vaginoplasty remains the most common method for neovagina creation. Utilization of adjunct tissue to augment neovaginal depth is more common, which correlates with increasing use of early hormonal therapy. Despite high satisfaction after primary vaginoplasty, standardized reporting of surgical complications and PROMs remains poor. Standardization of the way surgeons evaluate outcomes is critical to establish evidence-based guidelines for this surgical procedure.

General Reconstruction Abstracts

Harvest of the Latissimus Dorsi and Other Derivate Flaps from the Subscapular Angiosome in a Supine Position: A 22 Years' Experience

Presenter:	Kevin Englar, MD
Co-Authors:	Riley Dean, MD, Rachel M Segal, MS, Nicolas Leymarie, MD, Jean-Francois Honart, MD, Frederic Jerome Kolb, MD
Affiliation:	University of California, San Diego, San Diego, CA

INTRODUCTION: The subscapular angiosome is a workhorse donor site for reconstruction as it allows the harvest of simple musculocutaneous to chimeric multicomponent flaps for breast, limb, or head and neck reconstruction. However, for anterior reconstruction, its major reported drawback is the need for position change, as it is typically harvested in lateral decubitus. For the last 22 years, we have successfully harvested a wide variety of flaps from this region in a supine position.

METHODS: The patient is positioned supine on the operating table, with one shoulder roll, midline spine roll and gel hip bump placed to slightly elevate the patient from the table. The arm is left free on an arm rest. This position allows a two-team approach if needed. The usual supine operative technique is applied with three key differences. First, the proximal anterior border of the latissimus is found, raised from the thorax, and the vascular pedicle is dissected first. Second, posterior midline access is achieved by rotating the free arm over the torso. Lastly, lateral traction can be applied to the scapula tip to dissect it free from its medial attachments.

RESULTS: From 1998 to 2019, a total of 1612 flaps (1539 adult, 73 pediatric) have been raised from the subscapular angiosome in a supine position. Their composition was 821 LD (latissimus dorsi), 57 TDAP (thoracodorsal artery perforator), 564 LD+SA (scapular angle), 70 TDAP+SA and 100 flaps including more than 2 components, and were used to reconstruct a variety of anterior defects: head and neck (1340), thorax (211), breast (6), and lower extremity (55).

CONCLUSIONS: We report a simple, reproducible method to safely harvest subscapular angiosome flaps, eliminating patient repositioning or additional draping. This technique allows for simultaneous double team approach (resection or site preparation and flap harvest), and eliminates the need for repositioning, consequently reducing the operative time and simplifying the procedure. Scapular and parascapular skin paddle harvest is difficult due to the shoulder roll position and represents a shortcoming of this approach. We intentionally continued the traditional double positioning technique for breast reconstruction but intend to test the feasibility of the supine approach for this indication moving forward.

General Reconstruction Abstracts

10-Year Experience with the Surgical Treatment of Lipedema – Long-Term Follow-up after Multi-Stage Liposuction

Presenter: Philipp Kruppa, MD
Co-Authors: Iakovos Georgiou, MD, Jeremias Schmidt, MD, Mojtaba Ghods, MD
Affiliation: Klinikum Ernst von Bergmann, Germany

PURPOSE: Liposuction is increasingly being utilized as an established surgical treatment of lipedema. Although conservative treatment is still considered as first-line treatment, removing the pathological adipose tissue with liposuction is possibly the only available therapy with long-term symptom reduction. However, data on long-term outcomes after surgical intervention in lipedema patients is lacking.

METHODS: Between July 2010 and July 2019, 106 patients with lipedema underwent a total of 298 liposuction procedures. All patients completed a standardized questionnaire. Complaints associated with lipedema were assessed using a visual analogue scale (VAS) Score. The need for conservative treatment before and after surgery was compared using a composite complex decongestive therapy (CDT)-score. In cases where preoperative data were missing, retrospective acquisition was performed. Median follow-up time was 20.0 months (IQR 10.3 – 42.0 months).

RESULTS: The mean amount of lipoaspirate was 6354,73 ml (± 2796,72 ml). No serious complications were observed following large-volume liposuction. Overall, a significant improvement of lipedema-associated symptoms could be observed. The need for conservative treatment was significantly reduced in long-time follow-up (CDT-score reduction of 37.5 %, IQR 0 – 88.8 %). In multi-group comparison, better results could be achieved when surgical treatment was performed at earlier stages.

CONCLUSIONS: Liposuction of patients with lipedema is a safe treatment with long-lasting results in reducing the patient's need for conservative treatment and improving lipedema-associated complaints. For an optimal outcome, surgical treatment should be considered at an early stage of the disease. Before performing liposuction, appropriate treatment of severe obesity is advisable.

General Reconstruction Abstracts

Exercise-Enhanced Indocyanine Green Lymphography Protocol: A Fast and Reliable Method of Diagnosing Lymphedema

Presenter: DeAsia D. Jacob, MD
Co-Authors: Evelyn S. Qin, MD, Amy S. Little, DPT, Mindy J. Bowen, RN, BSN, Jonathan N. Lensing, BS, Wei F. Chen, MD, FACS
Affiliation: Cleveland Clinic Foundation, Cleveland, OH

BACKGROUND: Indocyanine green (ICG) lymphography is an advanced imaging tool that can visualize superficial lymph flow, and has been a vital part of lymphedema diagnosis, management, and tracking in patients with lymphedema. The goal of this prospective study was to determine the effect of exercise on the time it takes ICG dye to show full lymphedema disease pattern during ICG lymphography, with the intent to create a standardized and accelerated ICG lymphography protocol in patients with lymphedema.

METHODS: Nine patients (10 arms, 13 legs) with unilateral and bilateral lymphedema exercised on a recumbent cross trainer for five minute intervals at a rated perceived exertion of 11 to 13. ICG lymphography scans were performed before exercise, after each 5 minute exercise interval to identify plateau time, and then every hour after the initial scan for six hours. A post-intervention survey was provided to the patient assessing their opinion of exercise on the process.

RESULTS: The ICG dye plateaued after three cycles of exercise (15 minutes of exercise in total) in all limbs studied, and the dye was shown to start receding after 4 hours. Patients preferred exercising to speed up ICG studies compared to the traditional method which involves waiting between six to 24 hours between initial and delayed ICG lymphography scans.

CONCLUSIONS: Exercise can accelerate lymph flow, with disease pattern plateauing at 15 minutes of exercise in patients with lymphedema. From this we know that exercise allows for more efficient and standardized ICG lymphography studies.

General Reconstruction Abstracts

Prophylactic Targeted Muscle Reinnervation Reduces Pain and Improves Ambulation in Patients Undergoing a below-the-Knee Amputation

Presenter: Brian L Chang, MD

Co-Authors: Joshua Mondshine, BS, Christopher E. Attinger, MD, Grant M. Kleiber, MD

Affiliation: Georgetown University, Washington, DC

INTRODUCTION: 200,000 people will undergo a lower extremity amputation each year. 80% of those patients require an amputation because of a leg critically threatened by ischemia or infection. Following amputation, patients suffer from chronic pain, inability to ambulate, and high mortality rates. Targeted muscle reinnervation (TMR) is a nerve transfer procedure that redirects the surgically transected major sensory nerves into motor nerve to prevent or treat both neuroma and phantom limb pain. The purpose of this study is to evaluate the effect of prophylactic TMR on pain and ambulation in patients undergoing a below-the-knee amputation (BKA).

MATERIALS AND METHODS: This is a matched cohort study comparing 100 patients undergoing BKA who were treated with primary TMR and 100 patients undergoing BKA who were treated with traditional traction neurectomy. Patient charts were reviewed for the comorbidities in the Charlson Comorbidity Index. Post-operative clinic notes were reviewed for the presence of residual (RLP) and phantom (PLP) limb pain, severity of overall pain, and ambulatory status. Pharmacy records were reviewed for opioid and neuroleptic medication usage. Obituary data were reviewed to determine mortality rates.

RESULTS: 100 patients were included in the TMR group with an average age of 60 years and BMI of 29. 84% had diabetes, 55% PVD, 43% ESRD on dialysis, 17% with a prior MI, and 13% with a prior CVA. Average time to follow-up for the TMR group was 6.2 months and 18.7 months for the non-TMR group. 73% of TMR patients were pain free, compared to 34% of non-TMR patients ($P < 0.01$). Average pain was 2.6/10 for the TMR group and 5.4/10 for the non-TMR group ($P < 0.01$). 14% of TMR patients endorse RLP, compared to 59% of non-TMR patients ($P < 0.01$). 18% of TMR patients endorse PLP, compared to 49% of non-TMR patients ($P < 0.01$). 6% of TMR patients were on opioids, compared to 26% of non-TMR patients ($P < 0.01$). 42% of TMR patients were taking neuroleptic medications, compared to 50% of non-TMR patients ($P = 0.15$).

92.9% of TMR patients were ambulatory compared to 71.8% of non-TMR patients ($P < 0.01$). There was no significant difference in 12-month mortality rate (4.9% vs. 6.0%, $P = 0.80$).

CONCLUSIONS: TMR effectively reduces pain and improves ambulation in patients undergoing BKA for a leg critically threatened by ischemia or infection. Decreasing pain and improving ambulation may be critical in improving further morbidity and mortality rates in this very comorbid, high-mortality risk patient population.

General Reconstruction Abstracts

The Impact of Payment Reform on Utilization of Reconstructive Surgery

Presenter: Pooja Yesantharao, MS

Co-Authors: Pathik Aravind, MBBS, Pragna N. Shetty, MPH, Amy Quan, MD, MPH, Oluseyi Aliu, MD MS

Affiliation: Johns Hopkins University School of Medicine, Baltimore, MD

PURPOSE: Medicaid beneficiaries systematically face challenges in accessing healthcare, especially with regards to specialty services such as reconstructive surgery. In January 2014, the Affordable Care Act (ACA) took effect, allowing states to expand Medicaid eligibility. Concurrently, Maryland also launched statewide global budgeting of hospitals, intended to control healthcare costs.[1] However, the impact of such reform on utilization of reconstructive procedures has not been characterized. This study evaluated the impact of Medicaid expansion and global hospital budgeting on utilization of 3 common reconstructive procedures (reconstructive breast surgery, maxillofacial surgery, and hand surgery) by marginalized populations (Medicaid/uninsured patients).

MATERIALS AND METHODS: Adults in New Jersey (Medicaid expansion state), Maryland (expansion state with global hospital budgeting), and Florida (non-expansion state) undergoing the selected reconstructive procedures between 2012-2016 were tabulated using Healthcare Costs and Utilization Project State Ambulatory Surgery and Services and State Inpatient Databases. Interrupted time-series analyses were used to evaluate the impact of policy reform on reconstructive surgery utilization by marginalized patients.

RESULTS: During the study period, 96,662 Medicaid/uninsured patients underwent the selected reconstructive procedures in the 3 states. The likelihood of Medicaid being listed as the primary payer for patients undergoing reconstructive surgery significantly increased in expansion states (Maryland absolute policy effect: 0.02% per quarter, 95% confidence interval: 0.01% to 0.02% per quarter; New Jersey absolute policy effect: 0.04% per quarter, 95% confidence interval 0.02% to 0.05%) when compared to Florida (non-expansion state). There was also an immediate policy effect: within one year of ACA implementation, there was a significant increase in the proportion of Medicaid beneficiaries undergoing the reconstructive procedures (Maryland: 0.03%, 95% confidence interval 0.01% to 0.05%; New Jersey: 0.01%, 95% confidence interval: 0.01% to 0.02%), while there was a significant decline in the proportion of uninsured patients (Maryland: -0.01%, 95% confidence interval: -0.01% to 0.0%; New Jersey: -0.008%, 95% confidence interval: -0.01% to -0.006%). Trends in Maryland versus New Jersey were compared to understand the impact of global hospital budgeting. Global budgeting did not significantly impact overall utilization of reconstructive procedures amongst Medicaid beneficiaries, though there was an increase in utilization of emergent/urgent reconstructive procedures that reached borderline significance (0.03% per quarter, 95% confidence interval: 0.0% to 0.05%).

CONCLUSIONS: Medicaid beneficiaries experienced an increased utilization of reconstructive surgery post-ACA in expansion states when compared to non-expansion states, mirroring trends in other areas of healthcare.

Increased utilization by Medicare beneficiaries was not completely offset by decreases in utilization by uninsured patients, suggesting that the ACA expanded access to reconstructive surgery. It was encouraging that global hospital budgeting did not limit utilization of reconstructive procedures by Medicaid beneficiaries. In fact, utilization of emergent/urgent procedures among marginalized patients in globally-budgeted hospitals increased, perhaps as a result of greater incentives for hospitals to connect vulnerable/high-risk patients to the care they need under this system.

REFERENCES:

1. Rajkumar, R, Patel, A, Murphy, K, Colmers, JM, Blum, JD, Conway, PH, & Sharfstein, JM. Maryland's all-payer approach to delivery-system reform. *The New England Journal of Medicine.* 2014; 370(6): 493.

General Reconstruction Abstracts

Should Antiplatelet Therapy be Held Perioperatively? the First Study Examining Outcomes in Patients Receiving Dual Anti-Platelet Therapy in the Lower Extremity Free Flap Population

Presenter:	Jenna C. Bekeny, BA
Co-Authors:	Elizabeth G. Zolper, BS, Mark Mishu, BA, Christopher M. Fleury, MD, Kenneth L. Fan, MD, Christopher E. Attinger, MD, Karen Kim Evans, MD
Affiliation:	MedStar Georgetown University Hospital, Washington, DC

BACKGROUND: Antiplatelet agents are typically held in the perioperative period due to intraoperative bleeding concerns. Dual antiplatelet therapy regimens, such as aspirin and clopidogrel, have significant morbidity and mortality benefit in patients with a history of ischemic heart disease or peripheral vascular disease making these therapeutic regimens commonly encountered in patients with chronic wounds requiring free tissue transfer (FTT). Emerging evidence suggests holding platelet antagonists for surgical therapy may lead to high thrombotic risks such as perioperative myocardial infarction. Furthermore, our institution has found favorable outcomes in patients on dual therapy receiving skin grafts[1]. The objective of our study is to evaluate the impact of aspirin and platelet antagonist on FTT outcomes and need of the transfusion in the setting of copious hemostasis.

METHODS: A retrospective review of lower extremity FTT at our institution from 2011-2019 was performed. Data collected included demographics, comorbidities, administration of antiplatelet agents, and FTT characteristics. Outcomes of interest were blood transfusion volume, postoperative hematoma, and flap success.

RESULTS: We identified 196 LE FTT procedures performed for lower extremity salvage in the chronic wound population. Median age at time of FTT was 57 years (interquartile range 47-65). Median Charlson Comorbidity Index (CCI) was 3.0 (IQR 1.0-5.0). Comorbidities included: diabetes 44.4%, peripheral vascular disease 20.4%. 35 of these patients (17.9%) were taking dual antiplatelet therapy (aspirin and clopidogrel). Of these 35, clopidogrel was continued throughout the operative course in 14 patients (40.0%) while it was held on the day of surgery in 21 patients (60.0%). Comparisons were made between the dual antiplatelet group (DA, n=35) and non-antiplatelet group (NDA, n=161); the dual antiplatelet group was further analyzed by continued therapy (CT, n=14) versus held therapy (HT, n=21). The volume of intraoperatively transfused blood products was significantly higher for the DA versus NDA groups. Median CCI was significantly higher in the CT versus HT groups (5.0 versus 3.0, $p<0.001$). There was no significant difference in intraoperative transfusion volume for

the CT (median 438mL) versus HT (median 600mL, p=0.427) groups. Intraoperative thrombosis occurred in 2.5% of all FTT patients (n=5/196). While the incidence was highest in the HT cohort (n=2/21, 19.0%), it was not statistically significant. Incidence of postoperative hematoma (NDA 7.5%, DA 17.1%; p=0.100) and flap success (NDA 95.0%, DA 91.4%; p=0.418) were similar between the two groups. One patient in the HT group had a myocardial infarct on postoperative day 1.

CONCLUSIONS: Despite increases in the volume of blood products transfused, FTT can be performed safely and successfully with perioperative administration of dual antiplatelet therapy. Antiplatelet therapy can be given throughout the operative course; holding antiplatelet therapy may result in cardiovascular risk. Holding clopidogrel on the day of FTT was not associated with decreased intraoperative transfusion. A multidisciplinary approach to surgical bleeding versus thrombotic risk is necessary in this comorbid population.

REFERENCES:

1. Walters, E, Naz, I, Mehra, S, Steinberg, J, Evans, KK, Attinger, CE, Akbari, CE, Kim, PJ. Chronic Antiplatelet or Anticoagulant Therapy Does Not Increase Graft Failure After Split Thickness Skin Grafting. *Journal of Vascular Surgery*:67(6).

General Reconstruction Abstracts

Hypertrophic Scars: A Retrospective Review of Etiologies, Treatments, and Outcomes

Presenter:	Kevin M. Klifto, PharmD
Co-Authors:	Pooja Yesantharao, MS, Andres Makarem, BS, Carisa M Cooney, MPH, C. Scott Hultman, MD, MBA, Damon S Cooney, MD
Affiliation:	Johns Hopkins University, Baltimore, MD

PURPOSE: We conducted the current study to review our clinical experience managing hypertrophic scars. Our primary aim was to investigate the outcomes of non-surgical and surgical treatments intended to remove or reduce hypertrophic scars. The secondary aim was to investigate anatomical locations and non-surgical and surgical treatments between burn and non-burn etiologies of hypertrophic scars. Tertiary aims were to assess responses to therapy and recurrence rates associated with different laser settings.

METHODS: A retrospective analysis of a consecutive cohort of patients whose hypertrophic scars were managed and followed up in clinic from January 1, 2017 to January 1, 2019. Patients were included if they were ≥18 years of age and had a documented diagnosis of a hypertrophic scar. Patients were excluded if they did not follow-up after hypertrophic scar treatment or if they had a keloid scar diagnosis. Primary outcomes measured were hypertrophic scar treatment modalities and corresponding changes in pain scores, changes in pruritus scores, and recurrence rates following treatments. Secondary outcomes measured were scar locations, previous treatments, previous surgery in scar location, subsequent treatments, and post-surgical adjuvant therapy between burn and non-burn etiologies. Tertiary outcomes measured were responses to therapy and recurrence rates associated with laser types, settings and handpiece options.

RESULTS: One hundred and forty-two patients (mean age 40.6±15.9 years) had 595 hypertrophic scars. Median length of follow-up was 10.1 months (IQR: 7.3-14.8 months). Surgery or lasers were associated with significant changes in pruritus scores compared to corticosteroid injections or topical steroids alone (p=0.01). Lasers or corticosteroid injections were associated with significantly lower recurrence rates compared to surgery or topical corticosteroids alone (p=0.03). Lasers significantly increased the odds of decreased pain

scores (OR: 1.03, 95%CI: [0.1, 1.9], p=0.023) and no changes in pruritus scores. Lasers significantly reduced the odds of scar recurrence (OR: 0.12, 95%CI: [0.04, 0.41], p=0.001). Burn scars were more commonly located on the face/head (15% versus 7.5%, p<0.001), upper arm/forearm (40.5% versus 12.3%, p<0.001), posterior torso (6.5% versus 1.9%, p=0.005), and thigh/leg (15% versus 1.9%, p<0.001) compared to non-burn scars. Non-burn scars were more commonly located at the hands compared to burn scars (14.1% versus 7%, p=0.007). Burn scars were more commonly treated with lasers compared to non-burn scars (98.8% versus 19.9%, p<0.001). Non-burn scars were more commonly treated with surgery (18.8% versus 10.2%, p=0.03) and corticosteroid injections (75.5% versus 0.8%, p<0.001) compared to burn scars. Different laser handpiece options were significantly associated with successful responses to therapy (DeepFX™=100%, SCAAR FX™=65.8%, and ActiveFX™=48%, p=0.014).

CONCLUSIONS: Lasers increased the odds of decreased pain scores and no changes in pruritus scores for all etiologies of hypertrophic scars. Laser use reduced the odds of scar recurrence for all etiologies of hypertrophic scars. Hypertrophic burn scars were more commonly located on the face/head, upper arm/forearm, posterior torso, and thigh/leg, while hypertrophic non-burn scars were more commonly located on the hands. Hypertrophic burn scars had the greatest response rates with the laser handpiece DeepFX™.

General Reconstruction Abstracts

Prevalence of Autoimmune Disease in Patients with Hidradenitis Suppurativa Seen in Ambulatory Settings from 2008 – 2017

Presenter:	Pragna N. Shetty, MPH
Co-Authors:	Erinola Araoye, BS, Pooja Yesantharao, MS, Adrienne R Kambouris, BS, C. Scott Hultman, MD, MBA, Oluseyi Aliu, MD MS
Affiliation:	Johns Hopkins University, Baltimore, MD

PURPOSE: Hidradenitis suppurativa (HS) is estimated to affect almost 4.1% of the U.S. population and has been thought to be the result of a progressive, inflammatory disease of the apocrine glands. Recent case studies have shown a possible link between HS and autoimmune diseases, including systemic lupus erythematosus (SLE), Type 1 diabetes mellitus (T1DM), autoimmune thyroiditis, and inflammatory bowel disease (IBD), as well as a link to diseases that contribute to or are associated with autoimmune diseases, such as metabolic syndrome and polycystic ovarian syndrome (PCOS). In this study, we examined the associations between HS and these conditions.

METHODS: We used the Healthcare Cost and Utilization Project's (HCUP) State Ambulatory Surgery and Services databases (SASD) for Florida, Maryland, and New Jersey from 2008 – 2017. We identified all adult patients who had been diagnosed with HS using ICD9 705.83 and ICD10 L73.2. Patients with HS were randomly matched to patients who were not diagnosed with HS at a ratio of 1 case:5 controls. A literature review was conducted to identify cases of autoimmune and autoimmune-related diseases that occur with HS.

RESULTS: Our cohort included 83,904 patients, 13,984 of whom were diagnosed with HS. Median age was 54 (36 – 67) with 48,175 (57.4%) females and 35,729 (42.6%). Increasing age was associated with a decreased risk for HS (OR 0.96, P<0.001). Females were 1.7 times more likely to have HS than males (P<0.001). Black patients were 4.9 times as likely to have HS compared to their white counterparts (P<0.001), and Hispanic patients were 2.0 times more likely to have HS compared to their non-Hispanic counterparts (P<0.001). After adjusting for age, sex, and race/ethnicity, SLE was not significantly associated with an increased risk of HS (OR

1.2, P=0.43). T1DM was also not significantly associated with HS (OR 0.76, P=0.17). Autoimmune thyroiditis was associated with a decreased risk of HS (OR 0.51, P=0.03). Patients with metabolic syndrome were found to be 2.4 times as likely to have HS (P=0.02). Patients with PCOS were 4.26 times as likely to have HS and 1.9 times as likely to have IBD (P < 0.001).

CONCLUSIONS: HS has previously been thought to be an inflammatory disease of the apocrine sweat glands. However, recent cases in the literature may indicate an autoimmune component to the disease. In this study of autoimmune diseases that have been linked to HS, we found that patients with HS were associated with significantly higher likelihood of IBD, metabolic syndrome, and PCOS than patients without HS. However, there was no significant increase in likelihood of HS in patients with SLE or T1DM, and autoimmune thyroiditis was associated with a decreased likelihood of HS. This suggests there may be an autoimmune component to HS, and further research is needed to elucidate the relationship between HS and autoimmune disease.

General Reconstruction Abstracts

The Ideal Microsurgery Fellowship: A Survey of Fellows and Fellowship Directors

Presenter: Meera Reghunathan, MD
Co-Authors: Michelle V Zaldana-Flynn, MD, Chris A Crisera, MD, Christopher Reid, MD
Affiliation: University of California San Diego, La Jolla, CA

PURPOSE: Microsurgery fellowship has existed since the 1980s, and there is yet to be an established curriculum. Microsurgery fellowships vary greatly in clinical caseload, case diversity, and training resources, and prior to this study there was no consensus on the appropriate composition of a microsurgery fellowship. Further, there are not great transparent mechanisms to identify the variable experiences between different fellowships. This study surveys microsurgery fellows (MF) and fellowship directors (FD) to identify the characteristics of an ideal microsurgery fellowship.

MATERIALS AND METHODS: A 15-item questionnaire was sent to 38 fellowship directors and 90 recent microsurgery fellowship graduates. This questionnaire addressed program attributes, case volumes and compositions, ideal experiences, and time allocation to different fellowship experiences. Data was analyzed using descriptive statistics, t-tests, and chi-squared tests.

RESULTS: The response rate for MF and FD was 49% and 47% respectively. FD and MF identified 76-100 and 101-125 respectively as the median number of free flaps needed to train a competent microsurgeon. Both MF and FD agree that exposure to microsurgical breast reconstruction (p=0.94) is the most important characteristic of a microsurgery fellowship [Table 1]. FD valued lymphatic surgery and replantation cases as the next most important microsurgical experiences, while MF valued free fibula and anterolateral thigh (ALT) flaps (p<0.01) [Table 2]. Both MF and FD agreed that clinic should be 1 day per week (p=0.53). All FDs and most fellows (81.5%) agreed that microsurgery fellowship should not be solely composed of microsurgery cases, citing revisional surgery as the most valuable non-microsurgical cases (p=0.679). FDs found “case diversity and complexity” and MF identified “autonomy and independence” most commonly as the strength of their respective fellowship programs. Both FDs and MFs agreed that the most common weakness of microsurgery fellowship programs is “lack of non-breast cases/ poor variety of cases”. MFs identified becoming “more competitive for an academic job” as the most important reason to pursue fellowship, while FD emphasized obtaining a “mastery of microsurgery”.

CONCLUSION: Opinions regarding microsurgery fellowship programs are variable but there appears to be consensus on select topics as well as some agreement between fellows and program directors. Breast microsurgery remains a common high-value training experience, but also potentially overly abundant. There currently is not clear information for applicants to understand the distinctive compositions of each program. Educational standardization of microsurgery fellowship may improve the development and diversity of clinical and technical microsurgical skills, but has the potential to undermine educational diversity that allows for unique and personalized training experiences. Understanding the opinions of the microsurgery fellowship training experience allows programs to refine their structure as well for trainees to better identify the correct match for them. Better transparency by the program's should be offered to allow applicants to make informed choices.

General Reconstruction Abstracts

Outcome Analysis of Free Flaps in Patients with Collagen Vascular Disorders: Ten-Year Single Institution Review

Presenter: Maria Yan, MD
Co-Authors: Kuldeep Singh, DO, Brian T. Carlsen, MD, Steven L. Moran, MD, Aparna Vijayasekaran, MD
Affiliation: Mayo Clinic, Rochester, MN

BACKGROUND: Collagen vascular disorders (CVD) are inflammatory diseases that can affect the blood vessels and soft tissues. Patients with CVD are often immunosuppressed, prone to hyper-coagulation and overall represent a challenging patient cohort for free tissue transfer. In this report, we review our outcomes of free tissue transfer in patients with CVD.

METHODS: A retrospective review of patients with CVD who underwent free flap reconstructions from January 2010 to 2020 was performed at our institution. Inclusion criteria were patients 18 years old or older with clinical diagnosis of CVD including Rheumatoid arthritis, Raynaud phenomenon, Systemic lupus erythematosus, Scleroderma, Sarcoidosis, Psoriasis, Dermatomyositis, Polymyalgia rheumatica, Mixed connective tissue disease, Bechet's disease, Sjogren' s syndrome, Ehlers-Danlos syndrome, Gardner Diamond syndrome and Systemic amyloidosis. Patient comorbidities and surgical outcomes were collected. Endpoints for analysis included flap loss, receipt and donor site wound complications, hematomas and return to operative room for flap complications.

RESULTS: A total of 51 patients (36 women and 15 men) with CVD underwent 67 free flap reconstructions. The mean age was 54.7 ± 14 years and mean body mass index was 27.4 ± 5.6 kg/m2. Median follow-up time was 28.1 months (Q1-3: 9.6-44) and median length of hospital stay was 5.5 days (Q1-3: 3-11.80). In total, 64.7% of patients were on steroids preoperatively and 27.5% on other immune-suppressants, 41.3% had history of radiation, 31.7% had undergone neoadjuvant chemotherapy, 7.8% were current smokers and 7.8% of patients had a history of prior flap loss. CVD included Rheumatoid arthritis (n=22), Raynaud phenomenon (n=7), Systemic lupus erythematosus (n=4), Psoriasis (n=3), Scleroderma (n=2), Sarcoidosis (n=2), Dermatomyositis (n=2), Mixed connective tissue disease (n=2), Behcet's disease (n=2), Polymyalgia rheumatica (n=1), Sjogren syndrome (n=1), Ehlers-Danlos syndrome (n=1), Gardner Diamond syndrome (n=1) and Systemic amyloidosis (n=1). Flap reconstructions included transverse rectus abdominis musculocutaneous (n=17), deep inferior epigastric perforator flaps (n=14), latissimus dorsi muscle (n=9), radial forearm (n=7), gracilis muscle (n=6), fibula (n=6), anterolateral thigh (n=4), jejunal (n=1), scapular (n=1) and rectus abdominis muscle flaps (n=1). Reasons for reconstruction were oncologic (n=45), infection (n=11), wound healing problems (n=8), facial

paralysis (n=2) and trauma (n=1). The location of the reconstruction included the breast (n=32), head and neck (n=18) and extremity (n=17).

Of all flaps, 37.3% developed infection, 26.9% required wound debridement , 34.3% developed delayed wound healing, 23.9% developed recipient site wound dehiscence, 17.9% developed donor site wound dehiscence, 13.4% developed seroma, 9% developed full necrosis, 3% developed partial necrosis, 9% developed hematoma, 3% developed deep vein thrombosis and 3% developed acute blood loss. Intraoperative complications due to venous congestions occurred in 6% of flaps and flap loss rate was 10.4%.

CONCLUSIONS: Connective tissue disorders appear to be an independent risk factor for flap loss, infection and wound healing complications and should be approached with caution after carefully evaluating the risks versus benefits in individual patients. This study will be helpful in patient education and informed consent for the procedure and may offer some guidance and caution to the reconstructive microsurgeon.

Hand Abstracts

Opioid Use Following Open Vs. Endoscopic Carpal Tunnel Release – a Population Study

Presenter: Jacquelyn Withers, MD
Co-Authors: Gopal Lalchandani, MD, Ryan Halvorson, BA, Igor Immerman, MD, Paymon Rahgozar, MD
Affiliation: University of California, San Francisco, San Francisco, CA

INTRODUCTION: Open (OCTR) and endoscopic carpal tunnel release (ECTR) are both effective treatments for carpal tunnel syndrome, with similar outcomes and complication rates. However, given the opioid epidemic in the U.S., consideration of how surgical modality impacts narcotic use is important. We compared perioperative and post-operative narcotic use between OCTR and ECTR in order to identify potential risk factors for continued post-operative use.

METHODS: Using the Pearldiver database, we identified Humana-insured patients who underwent OCTR and ECTR from 2008 to 2015. Patients with opioid use were analyzed for trends. Early refills were defined as filling an additional opioid prescription between 2 and 30 days after surgery. Prolonged use was defined as another refill between 30 and 90 days post-op. New persistent use was defined as a previously opioid-naïve patient who filled an additional prescription in the 30 to 90 day post-operative period. Predictors for opioid use studied included age, gender, Charleston comorbidity index (CCI), and surgery type (open vs. endoscopic). Regression analyses were used to calculate odds ratios (OR) and 95% confidence intervals (CIs).

RESULTS: A total of 29,583 patients met inclusion criteria; 4,125 (14%) underwent ECTR and 25,458 (86%) had OCTR. The rate of pre-operative opioid exposure was 22% for the overall cohort, with no significant difference between groups. More OCTR patients filled a perioperative prescription than ECTR patients (62% vs. 60%; $p=0.03$), and the OCTR group filled higher quantities of opioids (411 OME vs. 379 OME; $p<0.001$). With multiple logistic regression, patients in the OCTR group were 19% more likely to obtain an early refill (CI 1.07 -1.33, $p<0.01$). OCTR patients were also 13% more likely to have prolonged post-operative opioid use (CI 1.02-1.25, $p=0.02$). There were no significant differences between the rate of new persistent narcotic use in the ECTR and the OCTR groups (7% vs. 8%, $p=0.27$). The strongest predictor of early refill and prolonged post-operative use was pre-operative exposure.

CONCLUSIONS: When compared to ECTR, patients who underwent OCTR filled higher quantities of opioids in the perioperative period, were more likely to obtain early refills, and were more likely to have prolonged post-operative use. Furthermore, patients with pre-operative opioid exposure were at significantly increased risk of early refills and prolonged use in both groups. These findings suggest a possible lower opioid requirement after ECTR, which may be useful when choosing surgical modality for patients with prior opioid use or risk factors for new opioid abuse.

Hand Abstracts

Comparing Digital Replantation Versus Revision Amputation Patient Reported Outcomes for Traumatic Digital Amputations of the Hand: A Systematic Review and Meta-Analysis

Presenter: Nicholas Stone, MD
Co-Authors: Ajay Shah, BScH, Brian Chin, MD, Victoria McKinnon, MSt, Matthew McRae, MHS, MD
Affiliation: McMaster University, Hamilton, ON, Canada

PURPOSE: Adults with traumatic digital amputation of the hand may be surgically managed with replantation or revision amputation. Preferences between treatment options vary between North American and Asian populations. This study aims to determine whether replantation compared to revision amputation yields superior patient reported outcomes (PROs) and other outcomes. To date, there is no systematic review evaluating patient reported outcomes in this population to suggest the optimal treatment approach depending on digital involvement (i.e. thumb vs. non-thumb) and the level of injury.

METHODS: Three databases (MEDLINE, Embase, and PubMed) were systematically searched from database inception until June 13, 2019 independently and in duplicate by two reviewers. Primary randomized and observational studies comparing replantation and revision amputation for isolated traumatic digital amputation in human subjects were considered for inclusion. Methodological quality of the included studies was assessed using the Methodological Index for Non-Randomized Studies (MINORS) criteria. Data were pooled in a random-effects meta-analysis model with subgroups based on level of injury and the digit(s) involved. The certainty of evidence was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system.

RESULTS: Of 4,350 studies identified, 12 retrospective cohort studies met inclusion criteria and compared outcomes of traumatic digital amputation treated with replantation (n=717; 82.9% male; mean age 40.3) versus revision amputation (n=1,046; 79.8% male; mean age 41.7). The overall replantation survival rate was 85.3%. The average MINORS score for included studies was 13.75/24 (57%, range 10-18). Three studies reported sufficient PRO data for meta-analysis using the Michigan Hand Questionnaire (MHQ) and Disability of Arm, Shoulder and Hand (DASH) tool. Replantation of the thumb had a superior MHQ score (+12.01, 95% CI [7.96 to 16.07], I^2=18%) compared to revision amputation, whether the injury was proximal or distal to the interphalangeal joint. Replantation of single non-thumb digits had a superior MHQ score (+5.32, 95% CI [3.11 to 7.53], I^2=67%) and DASH score (-3.40, 95% CI [-6.72 to -0.09], I^2=0%) compared to revision amputation. Only 12.1% of patients in the meta-analysis subgroup were from North American populations, while the remainder were from Asian populations.

CONCLUSION: There is significant heterogeneity in the reporting of outcome measures for traumatic digital amputation treatment and in the methods of stratifying levels of injury. There is low-quality evidence that replantation of the thumb achieves superior MHQ patient reported outcomes compared to revision amputation,

which may be clinically meaningful to patients based on existing estimates of the minimally important difference (MID). Although replantation also demonstrated superior patient reported outcomes (i.e. MHQ and DASH) for single non-thumb digits, the magnitude of effect is likely not clinically important and is based on very low-quality evidence. Future prospective studies that evaluate patient reported outcomes with stratification based on level of injury and digital involvement are needed to provide more specific treatment recommendations. In particular, more data from North American populations are required to determine if patient reported outcomes vary based on cultural differences toward digital amputation treatment.

Hand Abstracts

Referral Patterns of Pediatric Closed Hand Fractures: An Opportunity to Improve Care

Presenter:	Landis R. Walsh, BA
Co-Authors:	Laura C. Nuzzi, BA, Catherine T. McNamara, BS, Amir H. Taghinia, MD, MPH, MBA, Brian I. Labow, MD
Affiliation:	Boston Children's Hospital, Harvard Medical School, Boston

BACKGROUND: Although pediatric hand fractures are common and generally have good outcomes, they remain a considerable source of anxiety for parents and non-specialist providers. We hypothesized that inefficiencies in referral patterns are prevalent, and opportunities exist to improve care and cut costs for these injuries.

METHODS: The records of pediatric patients with isolated, closed hand fractures, without concurrent trauma seen at our institution by a hand specialist between 01/2017 – 12/2018 were retrospectively reviewed. Patients were sub-analyzed by the following age groups: pre-school (0-6 years old), elementary school age (7-11 years old), and adolescent (12-17 years old). Referral patterns, treatment and outcomes were recorded.

RESULTS: A total of 455 patients were included in analyses; the majority were male (62.2%), and were on average 9.6 years old at initial encounter. Roughly half of all cases (57.8%, n=263) initially presented to an outside provider or facility. Of these cases, 24.3% (n=64/263) were evaluated by 2+ non-hand specialists prior to a hand surgeon at our institution. Most commonly, these patients were referred from an outside ED to our ED before seeing a specialist (n=45/64, 70.3%). A total of 47 (10.3%) patients required surgical intervention, however none were performed urgently. A significantly greater proportion of patients in the adolescent age group required surgery (18.8% adolescent vs. 5.2% elementary school vs. 8.1% preschool, $p<.001$), but a significantly greater proportion of elementary school-age patients saw multiple providers prior to a hand surgeon (33.9% elementary school vs. 15.8% adolescent vs. 17.5% preschool, $p=0.006$).

CONCLUSIONS: Closed hand fractures are common in the pediatric population. These injuries usually do not require operative intervention, and have good outcomes. Opportunities exist for curtailing costs and improving efficiency of care for these injuries.

Hand Abstracts

Opioid Prescription Practices in Hand Surgery

Presenter: Javier Janbieh, BS
Co-Authors: Maya T Harrington, BS, Jordan R Pollock, BS, Chad Teven, MD
Affiliation: Mayo Clinic Alix School of Medicine, Scottsdale, AZ

PURPOSE: A concern with the prescription of opioid medications is the potential to be diverted for harmful and/or non-medical usage. Studies suggest that hand surgery may be susceptible to opioid overprescribing as the number of prescriptions following carpal tunnel release are two to five times more than necessary.[1] Acknowledging this alarming trend, guidelines for opioid prescribing after hand surgery have led to a decrease in overprescribing without affecting pain.[2] The objective of this study is to characterize changes and trends in opioid prescription practices of hand surgeons to trends in Medicare Part D enrollees from 2013 to 2017.

METHODS: A retrospective analysis of Medicare Part D prescriber data from 2013 to 2017 was conducted. This provides information on drugs prescribed by physicians and paid for under the Medicare Part D Prescription Drug Program. For each prescriber and drug, the dataset includes the total number of prescriptions dispensed, (original prescriptions and refills), and total drug cost. The search was limited to hand surgeons and the analyzed data was based on the ten most common prescriptions during the timeframe.

RESULTS: In 2013, the ten most common medications prescribed totaled 114,409 prescriptions, with 89,701 (78.4%) opioid prescriptions. In 2017, the ten most common medications prescribed totaled 147,765 prescriptions, with 111,286 (75.3%) opioid prescriptions. While there was a drop in the percentage of total opioid prescriptions, there was a 24% increase in the net number written during this period. Specifically analyzing the top two prescribed drugs, 75,796 hydrocodone-acetaminophen and oxycodone-acetaminophen prescriptions were dispensed in 2013 while 84,673 such prescriptions were dispensed in 2017. This represents an increase of 11.7%. Oxycodone-acetaminophen prescriptions during this time period rose from 15,399 to 23,297, or a 51.3% increase.

CONCLUSION: The increase in total opioid prescriptions from 2013 to 2017 by hand surgeons in the Medicare Part D Prescription Drug Program is an intriguing trend that does not reflect the shift to non-opioid pain management that is increasingly recommended when appropriate. The reasons for this increase are unclear and deserve further exploration. In our analysis, the overall number of prescriptions for NSAIDs increased in Medicare Part D data by 47%, a promising trajectory forward. The decline in the percentage of total opioid prescriptions by 3.1% is also promising. However this may not be a sufficient enough measure to combat the opioid epidemic when net opioid prescriptions in hand surgery, specifically oxycodone, are on the rise. Therefore, further analysis of these trends is warranted.

REFERENCES:

1. Chapman et al. Prospective Evaluation of Opioid Consumption Following Carpal Tunnel Release Surgery. *Hand (N Y)*. 2017;12(1):39–42. doi:10.1177/1558944716646765
2. Stanek et al. The Effect of an Educational Program on Opioid Prescription Patterns in Hand Surgery: A Quality Improvement Program. The Journal of Hand Surgery, Volume 40, Issue 2. 2015; Pages 341-346, ISSN 0363-5023,https://doi.org/10.1016/j.jhsa.2014.10.054.

Hand Abstracts

The Use of Cadaveric Meniscus for Joint Resurfacing of the Wrist and Hand

Presenter: Meghan McCullough, MD
Co-Authors: David A Kulber, MD
Affiliation: University of Southern California, Los Angeles, CA

HYPOTHESIS: Osteochondral defects of the carpometacarpal (CMC), metacarpophalangeal (MCP) and proximal interphalangeal (PIP) joints often necessitate joint arthrodesis or mechanical arthroplasty. Cadaveric meniscus has long been used for large joint resurfacing(1,2), but its application to smaller joints of the hand is less well understood. In severely arthritic thumb and finger joints, we propose the use of cadaveric meniscus for joint resurfacing as an off-the-shelf alternative to address osteochondral defects and restore articular function.

METHODS: Thirty-six patients with osteoarthritis of the CMC, MCP or PIP joints underwent joint resurfacing with cadaveric meniscus. Patient demographics and operative information were recorded. Postoperative DASH (Disability of the Shoulder, Arm and Hand) scores, Wong-Baker pain scale score, grip strength and pinch strength were compared to preoperative scores at 6 weeks and 6 months.

RESULTS: Twenty-one females and 15 males, with mean age of 56.7 years (42-73), underwent a total 43 joint reconstructions. Reconstructive sites included thumb carpometacarpal joint (n=21), thumb metacarpal joint (n=2), thumb interphalangeal joint (n=2), digit metacarpal joint (n=3) and digit proximal interphalangeal joint (n=2). Mean DASH score decreased from an average of 39.2 (16-91) to 22.7 (3-55) at 6 months and pain scale scores decreased from an average of 6.5 (4-10) to 1.6 (0-4). Grip strength increased from 38.7 (3-84) to 44.5 (8-94) and pinch increased from 10.3 (1-19) to 10.7 (2-20). There were no complications related to the meniscus and no patients required revision surgery.

CONCLUSION: In this series of 42 joint reconstructions, we demonstrate the successful use of cadaver meniscus in hand joint arthroplasty to reducesubjective pain and disability scores, as well as to improve objective strength measures, including grip and pinch strength. Our early results suggest that cadaveric meniscus for small joint arthroplasty represents a viable joint salvage option or adjunct to preserve pain-free motion and avoid total joint arthrodesis.

REFERENCES:

1. Rosso F, Bisicchia S, Bonasia DE, et al. Meniscal allograft transplantation: a systematic review. Am J Sports Med. 2015;43:998–1007
2. Kang RW, Lattermann C, Cole BJ. Allograft meniscus transplantation: background, indications, techniques, and outcomes. J Knee Surg. 2006;19:220–230

Hand Abstracts

Prospective Analysis Comparing Arthroplasty with Cadaveric Meniscus Versus Trapezial Resection Alone in Basilar Joint Arthritis

Presenter: Meghan McCullough, MD
Co-Authors: David A Kulber, MD
Affiliation: University of Southern California, Los Angeles, CA

HYPOTHESIS: Advanced thumb carpometacarpal (CMC) joint arthritis is widely treated with trapeziectomy. To obviate the need for autologous tissue, maintain thumb length and reduce the risk of scaphoid impingement, the senior author developed an interposition arthroplasty technique using cadaveric meniscus. We hypothesize that the use of meniscus improves the subject's outcome and subsequent functionality of the basilar joint arthroplasty procedure when compared with trapeziectomy alone.

METHODS: Twenty-one patients with Eaton stage III-IV CMC osteoarthritis underwent arthroplasty with cadaveric meniscus and seven patients underwent trapeziectomy alone. Postoperative DASH (Disability of the Shoulder, Arm and Hand) scores, Wong-Baker pain scale score, grip strength and pinch strength were compared to preoperative scores at 6 weeks and 6 months for each each patient.

RESULTS: The study group with cadaveric meniscus consisted of fourteen females and seven males, and the control group of five females and two males. Mean age was similar between the groups at 61.4 (48-72) years for the study group and 65.7 years (56-78) for the control group. Reduction in mean DASH score from preoperatively to six months postoperatively was statistically significant only in the study group ($p<0.05$), compared to the control ($p=0.148$). Reduction in Wong Baker scores was statistically significant in both groups ($p<0.05$), although there was a more rapid decrease in the study arm. Strength measures similarly improved in both groups, although did not reach significance in either group.There were no surgical complications in either group.

Conclusion: Joint resurfacing with cadaveric meniscus representsa viable joint salvage option in severe cases of CMC arthritis. Early results suggest that when compared to trapeziectomy alone, interposition arthroplasty with cadaveric meniscus results in a greater reduction in subjective pain and disability scores and similar improvement in strength measures.

Hand Abstracts

A Five-Year Review of Women in Designated Leadership Positions in Assh. Where Do We Stand?

Presenter: Meghan McCullough, MD
Co-Authors: Selina C Poon, MD, Rolanda Willacy, BS, Joshua Azburg, MD, Marilan Luong, MPH
Affiliation: University of Southern California, Los Angeles, CA

Purpose: Despite near equal representation of women in medical schools since 2008, the percentage of women in surgical subspecialties has remained low. Hand surgery accounts for one of the highest percentages of women at 19%, with a steady growth entering the specialty.

Ascension to leadership positions has not yet been fully elucidated among this group. Using membership data obtained through the American Society for Surgery of the Hand (ASSH), our study examines whether increased female representation translated to representation at different levels within the organization.

Methods: The 2014-2018 membership rosters were obtained from ASSH and compared by sex. Leadership and volunteer committee positions were evaluated as published in the annual ASSH Committee Reference Book. Leadership positions were defined as appointment to committee chair, Council or acceptance to the young leader's program, a development program for Candidate and Active members.

Results*:* Between 2014 and 2018, the percentage of female ASSH members steadily increased from 14% to 17%. The average percent of female members who applied for committee positions was 22% with an average of 18% of applicants occupying a committee position. The average number of committee applications submitted per female applicant was similar to that of their male counterparts (1.31-2.00 vs 1.55-1.97, respectively). Ascension of female members to council ranged from 8%-31% with the highest percentage during 2015 to 2016.

Conclusions: There is a steady increase in the percentage of women at every level of ASSH. Female ASSH members applying for leadership positions at a higher rate than their male peers and advanced through the leadership ladder quicker. This may indicate that future women leaders are appropriately supported in the organization. Low representation at the highest levels may be due to a predictable time lag as younger women ascend in the organization.

Hand Abstracts

Sparing the Fifth Toe in Postaxial Polysyndactyly of the Foot

Presenter: Soo Jin Woo, MD
Co-Authors: Byung Jun Kim, MD, PhD, Sung Tack Kwon, MD, PhD
Affiliation: Seoul National University College of Medicine, Seoul, Korea, Republic of (South)

Purpose: In postaxial polydactyly of the foot, deciding which toe to be excised has been controversial. The postaxial polysyndactyly of the foot usually has been treated by resection of the fifth toe to keep lateral neurovascular bundles of the sixth toe safe. The sixth toe is occasionally noticeably short of reaching the arcade of toes with variable degrees of axis deviation, which may require a wedge osteotomy of the proximal phalanx. The wedge osteotomy itself can make the phalanx shorter and may compromise circulation, which results in partial or total loss of the tip of the toe. This study is to propose an individualized method to spare the length and to the axis of preserved fifth toes in the cases of the postaxial polysyndactyly of the foot with short and deviated sixth toes.

Materials & Methods: This study includes 38 post-axial polysyndactyly of feet, which had short and deviated 6th toes from September 2006 and July 2019. Eighteen cases treated by removal of the sixth toe were compared with 20 cases treated by removing the fifth toe. The patients' demographics were reviewed through medical records, and the classification was done through the SAM system. Forefoot width and toe lengths were compared between two groups and with the contralateral side foot. Also, the orderly arcade of the toes was evaluated by measuring the angle between two linear lines connecting the tip of adjacent toes. Postoperative

complications such as valgus deformity, hypertrophic scar, and wound problem and subjective judgments on cosmetic and functional results were also gathered.

Results: There was no significant difference between the two groups in sex distribution, the average age of operation conducted, and the follow-up period. There was a significant reduction of the forefoot width compared to the contralateral side after the surgery in both groups ($p<0.01$). There was a significant reduction of the angle difference compared to the contralateral side after the surgery in the group, which spared the fifth toe ($p<0.01$). However, there was no significant reduction of the angle difference in the control group compared to the contralateral side after the surgery in control group ($p>0.05$). In the experimental group, the toe length was 99.2% compared to the fifth toe in the unaffected foot after the surgery, however, in the control group, the length of the new fifth toe (which was the sixth toe) was 73.2% compared to the fifth toe in the unaffected foot.

Complications of impaired circulation were not observed. Two cases showed hypertrophic scars, and one case needed additional surgery for removal of remained callous. Subjective evaluations revealed satisfactory results.

Conclusion: In cases with short sixth toe with axis deviation of more than 15° (SAM classification, A2, or A3), sparing the fifth toe is a safe and effective way of surgical treatment with high satisfaction functionally and cosmetically after the surgery. Surgical results showed improved appearance as well as more comfortable shoe fitting without any delay of toe growth, varus or valgus deformities with high satisfaction.

Hand Abstracts

Targeted Muscle Reinnervation Utilizing the Distal Anterior Interosseus Nerve

Presenter: Nikhil A Agrawal, MD
Co-Authors: Luke Grome, MD, Eric D. Wang, MD, David T Netscher, MD
Affiliation: Baylor College of Medicine, Houston, TX

PURPOSE: Sensory nerve lacerations of the wrist are common around the wrist and can lead to debilitating neuromas. All the superficial nerves around the wrist including the dorsal ulnar sensory nerve (USN), the distal lateral antebrachial cutaneous nerve (LABC), the distal branches of the superficial branch of the radial nerve (RSN), and the palmar cutaneous branch of the median nerve (PCB) are sources of peripheral nerve neuromas.

The surgical treatment of neuromas has progressed significantly over the past few years. Targeted muscle reinnervation (TMR) and regenerative peripheral nerve interfaces represent the newest members of our reconstructive armamentarium.[1] We present a cadaver study and clinical case evaluating the use of the anterior interosseous nerve (AIN) as a viable recipient for TMR around the wrist.

MATERIALS AND METHODS: The AIN, RSN, USN, and PCB were all dissected in two upper extremity cadaver specimens. Terminal AIN branches to flexor pollicis longus (FPL) and flexor digitorum profundus were identified. The terminal AIN to Pronator Quadratus (PQ) was divided just distal to these branches in order to gain adequate length for TMR to all the other nerves, sparing other muscular function. The remaining nerves were then identified distally to show where along the nerve would be a viable option for coaptation to the distal AIN. (Figure 1) After the cadaveric concept was developed, the technique was utilized in a clinical case.

RESULTS: In one upper extremity two AIN branches to FPL were identified with the most distal one occurring 6cm proximal to PQ and 14cm from the wrist crease. On the other there was only one branch to FPL which occurred 8.5cm proximal to PQ and 18cm from the wrist crease. When divided just distal to the distal FPL branch, there was adequate length to reach all sensory nerves when they were severed at the wrist crease in both specimens.

The technique was then utilized in a clinical scenario. A middle-aged male presented with a neuroma in the PCB two years after carpal tunnel release. The neuroma was identified at the exact location of the painful Tinel sign. The AIN was identified and was dissected proximally until adequate length was achieved. The proximal AIN was divided and PCB was cut just proximal to the neuroma. No muscle branches of the AIN needed to be divided excepting the terminal branch to PQ. Coaptation was completed just superficial to the interosseous membrane. (Figure 2) The patient continues to do well nine months post-operatively with complete resolution of symptoms and no recurrence.

CONCLUSIONS: We do not always think of the distal AIN. It can be taken with a long proximal tail with the only muscle sacrifice is to the pronator quadratus. All of the distal sensory nerves around the wrist can be reached by the AIN. We continue to investigate anatomically and clinically how the terminal AIN can be safely divided without compromising FPL function.

1. Oh C, Carlsen BT. New Innovations in Targeted Muscle Reinnervation: A Critical Analysis Review. *JBJS Reviews*. 2019;7(6). doi:10.2106/JBJS.RVW.18.00138

Hand Abstracts

Immediate Versus Delayed Mobilization after Cubital Tunnel Release Surgery: A Systematic Review and Meta-Analysis

Presenter: Oluwatobi Rilwan Olaiya, MD (c2021), MSc (c2021)
Co-Authors: Minh NQ Huynh, MD, Matthew McRae, MHS, MD
Affiliation: McMaster University, Hamilton, ON, Canada

Purpose: Cubital tunnel syndrome is a consequence of the ulnar nerve being compressed at the elbow. It is unknown whether early mobilization after cubital tunnel decompression improves functional outcomes without increasing complication risk. The objective of this systematic review is to evaluate the benefits and harms of early mobilization compared to delayed mobilization of the elbow after operative management of cubital tunnel syndrome.

Methods: We conducted a systematic review of studies using EMBASE, MEDLINE, and The Cochrane Central Register of Controlled Trials (CENTRAL) from database inception to January 2020. Randomized and non-

randomized controlled trials were selected based on meeting the inclusion criterion of being a comparative study of adult patients who underwent either early mobilization (defined as mobilizing within three days post-operation) or late mobilization (after three days post-operation). When appropriate outcome data were pooled and analyzed with meta-analysis.

Results: Of the 1932 studies identified and screened, five studies (two RCT and three observational design) totalling 224 patients (232 elbows) were included for review. Two studies included patients who underwent anterior subcutaneous transpositions while patients in the other two studies underwent cubital tunnel release with medial epicondylectomy. The evidence from two RCTs (100 patients) suggest that early mobilization may result in a large reduction in the amount of time need to return to work (mean difference 40.1 days, 95% confidence interval [CI] 63.6 days to 16 days earlier, I^2 85%, low-certainty evidence). Pooled results from three observational studies found similar findings (very low-certainty evidence). Pooled results from RCT evidence (100 patients) demonstrated that early mobilization may results in little to no difference in grip strength (0 kg, 95% CI = - 0.17 to 0.17, I^2 = 0%, low-certainty evidence). Furthermore, the evidence suggests that the mobilization strategy employed (early vs late) may have little to no differences in adverse events or range of motion (very-low to low-certainty evidence). Outcomes such as upper extremity quality of life measures were not evaluated in the included studies.

Conclusion: While there is considerable uncertainty around the effect estimates, immobilizing patients for periods longer than three days does appear to delay patients' return to work with no appreciable clinical benefit. There is a lack of robust evidence to guide plastic surgeons on the post-operative management of cubital tunnel syndrome patients. There is a need for high-quality, well-reported, randomized controlled trials evaluating the potential effects and harms associated with early mobilization. Future trials should measure patient-reported outcomes related to upper limb related quality of life. Considering the low-certainty evidence, plastic surgeons should engage in a shared decision-making process with patients when deciding to immobilize them post-cubital tunnel release.

Hand Abstracts

Factors Associated with 30-Day Soft Tissue Complications and Reoperation Following Upper Extremity Sarcoma Surgery

Presenter:	Yannick A.J. Hoftiezer, BSc
Co-Authors:	Jonathan Lans, MD, PhD, Brian B. Freniere, MD, Kyle R. Eberlin, MD, Neal C. Chen, MD, Santiago A. Lozano-Calderon, MD, PhD
Affiliation:	Massachusetts General Hospital, Boston, MA

Purpose: To identify risk factors for the occurrence of 30-day soft tissue complications and reoperations following upper extremity sarcoma excision.

Null hypothesis: There are no pre- or perioperative factors associated with a soft tissue complication or reoperation during the first 30 days following upper extremity sarcoma surgery.

N and follow-up: 620 patients, 30 days postoperative follow-up.

Methods: Using the American College of Surgeons National Surgery Quality Improvement Program (NSQIP)[1] database a total of 620 patients were identified that underwent surgical treatment

of an upper extremity (UE) sarcoma between 2005 and 2018. The primary outcomes were the 30-day occurrence of a soft tissue complication (including surgical site infections, wound dehiscence and soft tissue related reoperations) and any unplanned reoperation. The median age was 62.5 years (IQR: 49-73) and most tumors were soft tissue sarcomas (n=496, 80%) with the upper arm being the most commonly affected location (n=424, 68%). Tumor extirpation was the most common surgical treatment (n=559, 90%) and amputation was performed in 61 patients (10%). To evaluate the factors associated with reoperation a bivariate analysis was performed, and to evaluate the factors associated with soft tissue complication a multivariable analysis was performed.

Results: The 30-day soft tissue complication rate was 4.7% and the 30-day unplanned reoperation rate was 5.5%. The reoperation rate was higher in patients that underwent preoperative radiotherapy (30% vs 6.1%, p=0.027) and in those with longer operative times (median 129 minutes [IQR: 59-280] vs 88 minutes [IQR: 50-156], p=0.035). Soft tissue complications were more common in patients with a higher BMI (β=0.048, p=0.047) and following longer operations (β=0.003, p=0.002) based on the multivariable analysis. In the subset of patients that underwent soft tissue tumor extirpation (n=451), bivariate analysis of tumor characteristics showed that a tumor size ≥5 cm (12% vs 3.8%, p=0.015) was associated with a soft tissue complication.

Conclusions:

- The risk of developing a soft tissue complication or undergoing an unplanned reoperation is approximately 1 in 20 following upper extremity sarcoma surgery.
- Longer operative time and patients with a higher BMI are at higher odds of developing a soft tissue complication following upper extremity sarcoma surgery.
- Preoperative radiotherapy and longer operative procedures are risk factors for unplanned reoperations.
- Larger tumor size seems to be a risk factor in developing a soft tissue complication following tumor extirpation.

References:

1. About ACS NSQIP. https://www.facs.org/quality-programs/acs-nsqip/about. Accessed February 23, 2020.

Hand Abstracts

Development of 3D Printed Distal Finger Prosthesis with Assembly-Free Joint

Presenter:	Daniel A Farrell, BA
Co-Authors:	Ian L McCulloch, MD, Justin Chambers, PhD, Ephraim Pittore, MS, W Thomas McClellan, MD, FACS
Affiliation:	West Virginia University, Morgantown, WV

Purpose: Finger and fingertip amputation is common, with tens of thousands of cases occurring yearly in the United States.[1] Distal fingertip amputation occurs more frequently than complete finger amputation and often in young and productive populations. [2] Apart from loss of sensation, the loss of one or more fingertips often results

in drastic functional deficits. Current options for functional finger prostheses are often cost-prohibitive and generally require additional refinement after fabrication. The purpose of this study was to design an option for prosthesis made exclusively via 3D printing. In doing so we hoped to restore an adequate level of function to patients while keeping costs low and requiring minimal post-production refinement and maintenance.

Methods: Our prototype was made for a patient with amputation at the distal interphalangeal joint (DIJ) of the left ring finger. The patient's intact ring finger was measured in order to produce a digital model using computer aided design (CAD) software. Measurements utilized included metacarpophalangeal (MCP) joint to distal tip, and the widths of proximal, middle, and distal phalanx segments. The length of the amputated digit was also measured from MCPJ to amputation stump. This CAD design was finally submitted to an online 3D printing service (Shapeways) to allow for replicas to be ordered by the patient directly while maintaining low production cost.

Results: Our final model utilized a single, flexible joint consisting of two pins molded directly into the medial and lateral aspects of the prosthesis immediately after 3D printing. High grade nylon material was used during the fabrication process to confer low cost while maintaining comfort and durability. Quality range of motion and improved anatomical grasping of objects was achieved, creating significant return of function.

Conclusions: Our device accomplishes the goal of creating a functional prosthetic fingertip using exclusively 3D printing. In addition, while other 3D printing prosthetics have required significant post-production customization and maintenance, this device's intrinsic joint system makes it essentially maintenance free and can be used immediately following printing. The use of high-grade nylon confers stability and durability at a fraction of the cost of previously used materials. Utilizing a 3rd-party 3D-printing company and freely available CAD plans, a patient will be able to upload their measurements and a device can be created and shipped to them for around $20 USD. We see particular utility of our device in pediatric populations as the customizable design and economical production allows for several devices to be used throughout a child's development.

References:

1. Reavey PL, Stranix JT, Muresan H, Soares M, Thanik V. Disappearing digits: Analysis of national trends in amputation and replantation in the United States. *Plast Reconstr Surg*. 2018. doi:10.1097/PRS.0000000000004368

2. Østlie K, Skjeldal OH, Garfelt B, Magnus P. Adult acquired major upper limb amputation in Norway: Prevalence, demographic features and amputation specific features. A population-based survey. *Disabil Rehabil*. 2011. doi:10.3109/09638288.2010.541973

Hand Abstracts

#Madelungdeformity: Insights into a Rare Congenital Difference Utilizing Social Media

Presenter:	Abbas Peymani, MD, MS
Co-Authors:	Max M Lokhorst, MD, Austin D. Chen, MD, Bernard T. Lee, MD, MBA, MPH, Samuel J. Lin, MD, Simon D Strackee, MD, PhD
Affiliation:	Amsterdam University Medical Center, Amsterdam, Netherlands

Purpose: Madelung deformity is extremely rare and surgeons see very few, if any, cases during their surgical career.[1] The literature is scarce, and the published small-powered studies inadequately describe functional status, let alone consider the patients' perspective.[2] This is remarkable, since it has been shown that congenital hand differences have a profound and lifelong impact on the physical, mental, and social aspects of patients' lives.[3] The purpose of this study is to provide clinicians with a proof of concept of harnessing social media to assess patient outcomes in rare populations, shed light on the burden that Madelung deformity patients carry, and allow for an in-depth overview of demographic characteristics to comprehend the clinical spectrum of patients.

Methods: Using an universal patient-reported outcome tool entitled Patient-Reported Outcomes Measure Information System (PROMIS), we collaborated with several social media communities to conduct a survey. PROMIS Short Form scores were calculated and compared between unoperated and operated patients. Correlations between the scores were calculated using the Spearman's Rank correlation coefficient; correlation strength was interpreted as low (<0.3), moderate (0.3-0.5), or high (>0.5).

Results: Of the 207 persons that opened the survey, a total of 133 participants (64%) completed the survey. A total of 55 participants (49%) had undergone previous surgical correction of the wrist with a mean age of 20.5±9.5 at first surgery, and 2.4±2.7 surgeries in total. Calculated PROMIS scores for adults were as follows: Pain Intensity 4.9±2.8, Pain Interference 57.6±10.0, Upper Extremity 35.2±8.1, Depression 53.8±11.1, Anxiety 55.4±11.4, and Social Participation 42.5±7.7 with no significant differences between operated and unoperated patients. Scores for children included Pain Intensity 5.0±2.8, Pain Interference 55.7±11.3, Upper Extremity Function 24.6±10.4, Depressive Symptoms 57.7±11.3, Anxiety 57.3±11.9, and Peer Relationships 42.2±10.3 with significant more Pain Interference in operated as opposed to unoperated patients (62.3±5.2 versus 51.0±12.0; P=0.045).

Conclusions: This first, and largest to date, study of patient-reported outcome measures in Madelung deformity indicates that patients have a poorer quality of life as compared to the general population with impacts on physical, mental, and social health, especially children show severely decreased upper extremity functioning. Upper extremity function shows an inversely high correlation with pain intensity, pain interference, and depression. Utilizing social media, we were able to compensate for the rarity of Madelung deformity by engaging an international audience.

References:

1. Flatt AE. The care of congenital hand anomalies. Quality Medical Publishing; 1994.
2. Peymani A, Johnson AR, Dowlatshahi AS, et al. Surgical Management of Madelung Deformity: A Systematic Review. *Hand (N Y).* 2019;14(6):725-734.
3. Franzblau LE, Chung KC, Carlozzi N, Chin AY, Nellans KW, Waljee JF. Coping with congenital hand differences. *Plast Reconstr Surg.* 2015;135(4):1067-1075.

Hand Abstracts

Madelung Deformity: Comparison of Reverse Wedge Osteotomy to Preliminary Results of Reconstruction of the Radio-Carpal Joint and Sigmoid Notch

Presenter:	Annelinde R. Piek, BSc
Co-Authors:	Abbas Peymani, MD, MS, Johannes G.G. Dobbe, PhD, Geert A. Buijze, MD, PhD, Michel Chammas, Prof., MD, PhD, Geert J Streekstra, PhD, Simon D Strackee, MD, PhD
Affiliation:	Academic Medical Center, Amsterdam, Netherlands

Purpose: Madelung deformity is a rare wrist anomaly that causes considerable pain while restricting function. Surgeons have aimed to restore the complex deformity with radial/ulnar osteotomies. However, there is still no consensus regarding optimal surgical treatment. In this study we describe a novel surgical approach to reconstruct the radio-carpal joint and sigmoid notch in Madelung deformity and compare results to reverse wedge osteotomy of the distal radius.

Materials & methods: Seven wrists underwent reverse radial wedge osteotomy[1]. Six wrists underwent reconstruction of the radio-carpal joint and sigmoid notch in a two-phase surgery: (1) modified radioscapholunate arthrodesis with triquetrectomy; (2) distal scaphoidectomy. This results in a neo-DRUJ in which the ulnar head articulates with the former lunate. Mean follow-up was 105.4 (SD 80.6) months and 47.6 (SD 18.6) months, respectively. Clinical outcomes between the two approaches were compared using pain intensity, range of motion (ROM), and grip strength measurements; functional outcomes were compared using patient-reported outcome measures (PROMs).

Results: There were no differences found in post-operative VAS, grip strength, or ROM, excluding extension which was significantly smaller in the radio-carpal joint and sigmoid notch reconstruction group (34.2 vs 54.3 degrees, p=0.04). Quality of life scores (EQ-5D-5L) and overall MHQ scores were similar.

Conclusions In this study we describe a surgical approach for the treatment of Madelung deformity. In comparison to the 'classic' osteotomy procedure, we found similar post-operative outcomes. Since the DRUJ in Madelung deformity can be significantly deformed, this novel approach could provide an alternative treatment option for a subset of patients. While short-term outcomes seem satisfactory, longer follow-up is necessitated to confirm a lasting satisfactory result in terms of both functional outcome and preservation of the neo-DRUJ. Future research should focus on methodological reporting of all relevant variables and further investigate these differences, aiming for a systematic division based on characteristics of the deformity.

1. Mallard F, Jeudy J, Rabarin F et al. Reverse wedge osteotomy of the distal radius in madelung's deformity. Orthop Traumatol Surg Res. 2013, 99: S279-83.

Hand Abstracts

The Safety of Walant Hand Surgery: Two Cases of Digital Ischemia

Presenter: Julia Anne Cook, MD
Co-Authors: Daniel P Donato, MD, Jeffrey N Gross, MD, Patrick A Gerety, MD, Sarah E Sasor, MD
Affiliation: Indiana University School of Medicine, Indianapolis, IN

Purpose: Wide-awake, local anesthesia, no tourniquet (WALANT) hand surgery has gained popularity in recent years. Lidocaine with low-dose epinephrine is used to minimize blood loss and improve patient comfort. WALANT surgery reduces the need for pre-operative testing, avoids sedation requirements, allows for patient cooperation during surgery, and decreases cost and procedure time.[1] Multiple studies show that local anesthesia with epinephrine is safe to use in the fingers;[1,2] however, a few cases of ischemia have been reported.[3,4]

Materials and Methods: We present two cases of digital ischemia after WALANT surgery that were successfully reversed with phentolamine.

Results: Case 1 - A 31-year-old female with rheumatoid arthritis underwent nail plate removal for chronic paronychia performed under a digital block (5 mL of 1% lidocaine with 1:100,000 epinephrine). The patient presented to the emergency room twelve hours later with persistent ischemia and anesthesia. Topical nitroglycerin cream and a warm compress were applied with minimal improvement. 5 mg of phentolamine in 1 mL of sterile saline were injected at the base of the proximal phalanx with complete resolution of ischemia within two hours. At one-week follow-up, the patient's finger was perfused.

Case 2 - A 76-year-old female with multiple medical co-morbidities, including cardiac stents (on apixaban) and COPD (on 3 L of home oxygen), underwent trigger finger release under local anesthesia (6 mL of 1% lidocaine with 1:100,000 epinephrine mixed 1:1 with 0.25% plain bupivacaine). She returned to clinic 4 hours later with persistent ischemia. Topical nitroglycerin cream and a warm compress were applied without improvement. 1.5 mg of phentolamine in 1 mL of sterile saline were injected at the level of the A1 pulley. After 90 minutes, there was some improvement but the finger remained ischemic distal to the proximal interphalangeal joint. Another 1.5 mg of phentolamine in 1 mL of sterile saline were injected at the level of the proximal interphalangeal joint with significant improvement. At ten-day follow-up, the patient's finger was perfused.

Conclusion: Prolonged digital ischemia after WALANT surgery is rare, but surgeons should counsel patients on warning signs and be prepared for phentolamine rescue when needed. The incidence of epinephrine-induced digital ischemia may increase as WALANT surgery gains popularity. It is mandatory for surgeons performing WALANT procedures to have access to phentolamine.

1. Al Youha S, Lalonde DH. Update/Review: changing of use of local anesthesia in the hand. *Plast Reconstr Surg Glob Open.* 2014;2(5):e150.
2. Thomson CJ, Lalonde DH, Denkler KA, Feicht AJ. A critical look at the evidence for and against elective epinephrine use in the finger. *Plast Reconstr Surg.* 2007;119(1):260-266.
3. Zhu AF, Hood BR, Morris MS, Ozer K. Delayed-Onset Digital Ischemia After Local Anesthetic With Epinephrine Injection Requiring Phentolamine Reversal. *J Hand Surg Am.* 2017;42(6):479 e471-479 e474.
4. Zhang JX, Gray J, Lalonde DH, Carr N. Digital Necrosis After Lidocaine and Epinephrine Injection in the Flexor Tendon Sheath Without Phentolamine Rescue. *J Hand Surg Am.* 2017;42(2):e119-e123.

Hand Abstracts

Improving Outcome Collection Following International Surgery Trips: A Proof of Concept from a Pediatric Hand Reconstruction Trip to Peru

Presenter:	Connor J Peck, BS
Co-Authors:	Nicole K Le, BS, MPH, Jack J Kanouzi, MD, Anusha Singh, BS, Lily J. Saldaña, MD, Marco Lazo Nunez, MD, Ulises Aguilar Cornejo, MD, Marc E. Walker, MD, J. Grant Thomson, MD, MSc
Affiliation:	Yale School of Medicine, New Haven, CT

Background: Plastic surgeons frequently participate in international surgical trips. This model of care is often criticized due to a lack of post-operative follow-up, which limits outcome measurement and decreases surgeon accountability. This study assessed the efficacy of collecting outcomes from international pediatric patient parents using the social media application "WhatsApp."

Methods: All patients in this study were operated on during a pediatric hand surgery trip to Lima, Peru, in May 2019. All parents of patients receiving surgery were invited to participate in the study. General follow-up and a satisfaction survey utilizing a Likert scale (1-5) was sent to patient providers through WhatsApp at 3- and 6-week intervals.

Results

45 patient providers agreed to participate in this study. 80% (36/45) responded fully to surveys at 3 weeks post-operatively, and 51% (23/45) responded fully at 6 weeks. Patients reported high levels of satisfaction with the outcome of operations (4.3/5), attitude of the treatment team (4.6/5), and changes in quality of life (4.3/5), hand appearance (4.1/5), and hand function (4.1/5). Of those who responded at 3 weeks, 50% (17/34) sent post-operative photos, and 50% (17/34) had specific unanswered questions related to their care. Four patients had concerns of limited finger mobility (8.9%), 3 had continued contracture (6.7%), and one patient (2.2%) was re-hospitalized following surgery for prolonged infection.

Conclusion

The parents of international pediatric hand surgery patients had access and were responsive to provider communication through the WhatsApp application. While most parents reported high levels of satisfaction, many still had unanswered questions related to their care, highlighting the importance of our post-operative follow-up. All plastic surgeons operating internationally should consider using WhatsApp and other related messaging tools for outcome collection and the improvement of patient care. Future studies will aim to establish a more standardized and robust model for this type of outcome collection.

Hand Abstracts

Novel Use of an Internal Distractor for Metacarpal Lengthening

Presenter: Laura E Bashour, MS

Co-Authors: Charles E Hill, MD, Sarah A Frommer, MD, PhD, Steven L Henry, MD, FACS

Affiliation: Dell Medical School at the University of Texas at Austin, Austin, TX

Introduction*:* Proximal digit amputation, especially of the thumb, can result in significant functional compromise. Toe transfer may be the best way to replace the missing tissues, but many patients are reluctant to undergo this procedure. For these patients, distraction osteogenesis of the metacarpal can restore length and improve function. While external distractors are traditionally used for metacarpal distraction, internal distractors are appealing in that they are much less prominent and cumbersome. Although frequently used for craniofacial distraction osteogenesis, the use of internal distractors in the extremities has only been described in case reports for brachymetatarsia. Here we present a case series with the novel use of internal distractors for metacarpal lengthening.

Methods*:* Medical records of all patients who underwent metacarpal distraction using uniplanar internal distractors by the senior author were reviewed. The case series was analyzed with regard to indications, distraction protocol, outcomes, and complications.

Results*:* Four cases were identified. Patients ranged in age from 7 to 33 years. Indications were post-traumatic for cases 1, 2 and 4, and congenital for case 3. In all cases the latency period was 1 week and the distraction rate was 1 mm/day. Mean gain in length was 1.2 cm (1.6 cm for case 1; 1.5 cm for case 2; 1.1 cm for case 3; and 0.8 cm for case 4), and mean time from osteotomy to complete consolidation was 3.1 months. The most common complication was activation arm site infection, seen in cases 2 and 4; case 2 required removal of the internal fixator while case 4 was successfully treated with oral antibiotics alone. Case 3, although not infected, did not tolerate the device well and elected at the end of the distraction period to undergo removal of the device and placement of a K-wire to provide stabilization through the consolidation period; notably, 1.5 cm of length had been gained at the end of the distraction period, but 0.4 cm was lost when the distractor was removed.

Conclusion*:* Metacarpal distraction can be an effective way to restore bone and soft tissue length and improve function in patients who have suffered a proximal digit amputation. However, the use of external distractors has disadvantages, such as bulkiness, long-term exposure (in place during the latency, activation, and consolidation phases), screw tract infections, and scarring at the multiple pin sites. Internal distractors offer the advantages of lower profile and the ability to remove the activation arm after the activation phase, allowing for complete soft tissue coverage of the device during the consolidation phase. Our case series provides proof of concept that an internal distractor can be an effective option for metacarpal lengthening.

Hand Abstracts

Safety of Endoscopic Carpal Tunnel Release Performed Under Local Anesthesia

Presenter:	Omar Allam, BS
Co-Authors:	Kitae Eric Park, BA, Martin Carney, MD, Samuel Kim, MD, Moores Craig, MD, J. Grant Thomson, MD, MSc, Adnan Prsic, MD
Affiliation:	Yale School of Medicine, New Haven, CT

Background: Endoscopic carpal tunnel release (eCTR) is increasingly considered the procedure of choice by many surgeons to treat carpal tunnel syndrome. eCTR has several advantages over open carpal tunnel release due to its low complication and co-morbidity rates. However, eCTR is standardly conducted under additional systemic anesthesia, which carries an independent risk of complications. An alternative is to perform the procedure under local anesthesia instead. This retrospective analysis presents the outcomes and complications of eCTR performed under local anesthesia.

Methods: A retrospective review of patients who underwent eCTR with local anesthesia at a large tertiary center from 2015-2019 by a single fellowship-trained hand surgeon was performed. Patient demographic factors and comorbidities were recorded. The following intra-operative complications and postoperative outcomes were recorded: nerve laceration, surgical revision, infection, neuropraxia, wound dehiscence, and resolution of carpal tunnel syndrome symptoms.

Results: 183 patients were identified to have received isolated eCTR with local anesthesia. 93 (51%) procedures were performed on the right. 37 (20.2%) of patients were diabetic, and 40 (21.9%) patients reported tobacco use. A total of 168 patients (92%) reported resolution of pre-operative carpal tunnel symptoms. 2 (1.09%)

patients required surgical revision. 6 (3.3%) patients experienced infection. 2 (1.09 %) patients experienced neuropraxia and wound dehiscence. There were no nerve lacerations.

Conclusion: This study of a surgeon's experience shows that eCTR can be performed safely under local anesthesia with low complication rates and high rates of symptomatic resolution. Awake eCTR is a safe and effective route for patients who are at high risk for general anesthesia or prefer local anesthesia

Hand Abstracts

Denervation As a Treatment for Arthritis in the Hands: A Systematic Review of Current Literature

Presenter:	Sarah L Zhu, BSc, MD
Co-Authors:	Brian Chin, MD, Mohamed Sarraj, BHSc, MD, Eugene Wang, BSc, Emily Dunn, MKin, Matthew McRae, MHS, MD
Affiliation:	McMaster University, Oakville, ON, Canada

Purpose: Osteoarthritis is a common degenerative condition that can cause pain and swelling in the joints of the hand. Current surgical treatments include osteotomy, arthroplasty and arthrodesis. However, each of these interventions are invasive and carry inherent limitations such as high complication rates, altered joint anatomy, and prolonged recovery times. Joint denervation, which involves selective neurectomy of the articular nerve branches to an osteoarthritic joint, has been proposed as a less invasive treatment option. The purpose of this systematic review was to evaluate and report the efficacy and safety of surgical joint denervation for osteoarthritis in joints of the hand.

Methods: EMBASE, MEDLINE and PubMED databases were searched from January 2000 to March 2019. Studies of adult patients with rheumatoid or osteoarthritis of the hand who underwent joint denervation surgery were included. Two independent reviewers performed the screening process, data abstraction, and quality assessment (MINORS). PRISMA guidelines were followed and this review was registered with PROSPERO (#125811).

Results: Ten studies were included, nine case series and one cohort study, with a total of 211 hand joint denervation in 192 patients. In all studies, joint denervation improved pain and hand function at follow-up (mean=36.8, range=3-90 months). Pooled analysis of three studies on the first carpometacarpal joint showed a statistically significant ($p<0.001$) reduction in pain scores from baseline (mean=6.61±2.03) to postoperative (mean=1.69±1.27). The combined complication rate was 18.8% (n=36/192) and the most commonly reported complication was neuropathic pain or unintended sensory loss (8.8%, n=17/192).

Conclusion: The findings of this review suggest that denervation may be an effective and low morbidity procedure for the treatment of osteoarthritis in the joints of the hand. Denervation may serve as a useful tool in the hand surgeon's armamentarium, particularly for patients failing nonoperative management and looking to pursue less invasive surgical management. Further prospective comparative studies are required to develop a more comprehensive understanding of the outcomes of denervation, especially in comparison to more conventional procedures of osteotomy, arthroplasty and arthrodesis.

Hand Abstracts

Post-Operative Pain-Control in Hand Surgery: A Single Institution Review of Opioid Prescription Practices By Orthopaedic Versus Plastic Surgeons

Presenter:	Martin Carney, MD
Co-Authors:	Connor J Peck, BS, Alexandre Prassinos, MD, Alexander Chiu, MD, Moores Craig, MD, Omar Allam, BS, Kitae Eric Park, BA, Adnan Prsic, MD, J. Grant Thomson, MD, MSc
Affiliation:	Yale University School of Medicine, New Haven, CT

Purpose: There is little consensus regarding post-operative pain management among hand surgeons. This study compares opioid prescription practices following hand surgery by orthopedic versus plastic surgeons.

Methods: We performed a retrospective analysis of all hand surgeries at a level-1-academic medical center from January 2016 – September 2018. Operations were classified by the specialty of the surgeon. The average morphine milligram equivalent (MME) prescribed on discharge following each surgery was calculated. Multivariate linear regression was performed controlling for patient age, race, gender, insurance type, and history of substance use or chronic pain.

Results: 5149 surgeries were identified (2888 in orthopedics, 2261 in plastic surgery). Orthopedic surgeons treated a higher proportion of women (58.5% vs 54.9%, p=.01) and caucasians (74.1% vs 66.6%, p<.0001), and fewer patients with history of substance abuse (9.9% vs 13.7%, p<.0001) than plastic surgeons. The mean MME prescribed across surgeries was 61.4. After adjusting for patient demographics and type of operation, plastic surgeons prescribed 15.9 more MME (p<.0001) per patient than orthopaedic surgeons. For common elective and non-trauma based operations plastic surgeons prescribed 15.2 MME more than orthopaedic surgeons for carpal tunnel release (p<.0001, n = 1967), and 41.1 MME for trigger finger release (p<.0001, n=787). There was no statistically significant difference for operations related to traumatic mechanism (fractures, tendon lacerations and nerve injuries)

Conclusions: Our findings suggest inconsistency in prescribing practices among providers in plastic and orthopaedic surgery, highlighting the need for best practice guidelines relating to post-operative pain management in hand surgery.

Hand Abstracts

Gender, Race, Insurance, and Pain: The Influence of Patient Sociodemographics on Post-Operative Prescribing Patterns Among Hand Surgeons

Presenter:	Martin Carney, MD
Co-Authors:	Connor J Peck, BS, Alexandre Prassinos, MD, Moores Craig, MD, Alexander Chiu, MD, Kitae Eric Park, BA, Omar Allam, BS, J. Grant Thomson, MD, MSc, Adnan Prsic, MD
Affiliation:	Yale University School of Medicine, New Haven, CT

Purpose: Social and demographic factors may influence patient treatment by physicians. This study analyzes the influence of patient sociodemographics on prescription practices among hand surgeons.

Methods: We performed a retrospective analysis of all hand surgeries at a single level 1 academic medical center from January 2016 – September 2018. The average morphine milligram equivalent (MME) prescribed following each surgery was calculated and then classified by age, race, gender, type of insurance, and history of substance use or chronic pain. Multivariate linear regression was used to compare MME among groups.

Results: Overall, patients with a history of substance abuse were prescribed 31.2 MME more than those without ($p < .0001$), and patients with a history of chronic pain were prescribed 36.7 more than those without ($p < .0001$). After adjusting for these variables and the type of procedure performed, women were prescribed 11.2 MME less than men ($p=.0048$) and Hispanics were prescribed 16.6 MME more than Caucasians ($p=.0091$) overall. Both Hispanic and black patients were also prescribed more than Caucasians following carpal tunnel release (19.0 and 20.0 MME, respectively, $p<.001$). Patients with private insurance were prescribed 24.5 MME more than those with Medicare ($p<.0001$), but 25.0 MME less than Medicaid ($p<.0001$). There were no differences across age groups.

Conclusions: Numerous sociodemographic factors influenced post-operative opioid prescription among hand surgeons. Among other factors, the role of implicit biases and insurance reimbursement may be important considerations in order to avoid the over- or under- treatment of pain in certain patient populations.

Hand Abstracts

Operative Pediatric Hand Infections: A Retrospective Review

Presenter:	Luke J. Grome, MD
Co-Authors:	Sarth Raj, BSA, BBA, Amjed Abu-Ghname, MD, Bryce Bell, MD, Edward Reece, MD, MBA, FACS, William C. Pederson, MD, FACS, John Koshy, MD
Affiliation:	Baylor College of Medicine, Houston, TX

Background: Infections in the pediatric population are a less well studied topic in hand surgery. Crucial aspects of the management of pediatric hand infections (PHIs) differ from adults, though much of current treatment is generalized from adult care. The objective of this study was to evaluate our clinical experience with regards to the epidemiology, management, and outcomes of pediatric hand infections (PHI) requiring operative intervention.

Methods: A seven-year retrospective chart review was performed of all pediatric patients who required operative intervention for hand infections at Texas Children's Hospital. Clinical information was collected and analyzed, including demographics, infection characteristics, management and outcomes.

Results: Fifty-seven patients met the inclusion criteria for our study over the seven-year period. Of these, 7% (n=4) had a pre-existing diagnosis of diabetes mellitus, and 5% (n=3) had a recent history of upper extremity infections. The most common infection was noted to be a discrete abscess, whereas urgent/emergent conditions represented 21% (n=12) of infections. Radiographic changes thought to be consistent with osteomyelitis were present in nearly one-quarter of patients (n=13, 23%). The median length of hospital stay was 3 days (95% CI 1.0) and the most common pathogen was Staphylococcus aureus (n=33, 58%), with slightly more being

methicillin sensitive than resistant (n=19, 33% vs n=14, 25%). The incidence of reoperation was found to be 12.5% (n=7).

Conclusions: Hand infections are a common problem in the pediatric population. Cases tend to be associated with accidental trauma and discrete abscesses colonized by MSSA/MRSA. The vast majority of cases require only one operation and a short course of wound care prior to discharge.

Hand Abstracts

Clinical and Lymphoscintigraphic Outcomes of Lymphedema Microsurgeries Versus Conservative Decongestive Therapy in Extremity Lymphedema

Presenter: Marco Pappalardo, MD
Co-Authors: Chia-Yu Lin, MSc, Ming-Huei Cheng, MD
Affiliation: University of Modena and Reggio Emilia, Italy

BACKGROUND: The conservative decongestive therapy (CDT) and lymphedema microsurgeries (LM), including lymphovenous bypass (LVB) or vascularized lymph node transplantation (VLNT) are the major options for treatment of extremity lymphedema. This study was to compare the outcomes of conservative decongestive therapy and lymphedema microsurgeries.

METHODS: Between November 2011 and September 2017, patients with diagnosed extremity lymphedema were suggested to undergo either CDT or lymphedema microsurgeries with detailed of the explanation at clinic. Selection of the lymphedema microsurgeries was based on Cheng's Lymphedema Grading system with the Taiwan Lymphoscintigraphy Staging (TLS) system. LVB was selected for patients with Cheng's Lymphedema Grading 0 unwilling to wear compression garments, and Grading I-II with partial obstruction at TLS stages (P-1, P-2) and patent lymphatic ducts at indocyanine green lymphography. VLNT was selected for Cheng's Lymphedema Grading late II, III, and IV with repeated episodes of cellulitis, partial lymphatic obstruction Stage P-3 or total obstruction Stages T-4, T-5, and T-6. Patients were excluded if they had inability to cooperate with clinical and imaging assessment procedures and less than 2-years of follow-up. Patients were clinically evaluated with the improvement of the limb circumferential difference, computed tomographic (CT) volumetric difference, and episodes of cellulitis. Patient's TLS was further assessed with the down-grading, no-change and up-grading based on the improvement of the lymphatic functions as follow: (1) decreased dermal backflow, (2) re-uptake of proximal lymph nodes, (3) formation of new lymphatico-venous connections, and (4) functioning lymph nodes transplanted in the distal limb.

RESULTS: A total of 204 patients with 225 extremity lymphedema (82 with upper limb and 143 with lower limb) were included and further categorized in 77 patients in CDT group and 148 patient in LM group. There were no statistical differences in sex, BMI, etiology, and lymphedema affected limbs (p = 0.4, 0.4, 0.2, 0.3, respectively) between the two groups. A statistical difference regarding the mean age and self-reported symptom duration 55.2 ± 14.2 years and 72.1 ± 5.9 months in LM group and 59.8 ± 13.3 years and 52.8 ± 6.0 months in CDT group were found (p= 0.02 and p < 0.01). At an average follow-up of 29.1 ± 5.3 months, the improvement of circumferential difference (6.3 cm versus 1.8 cm), CT volumetric difference (-16.3 ± 14.2 cm^3 versus 1.1 ± 22.4 cm^3), and episodes of cellulitis was statistically significant in the LM group than the CDT group, respectively (p< 0.01 for all). The follow-up lymphoscintigraphy showed statistical differences in TLS with down-grading of 62.2% versus 23.4%, no-change of 8.8% versus 26.0%, and up-grading of 29.0% versus

50.6 in the LM and CDT groups, respectively (all $p < 0.01$). 85% of patients who underwent lymphatic microsurgeries returned to their daily routine without the use of any compression garments.

CONCLUSIONS: LM group had statistically significant functional recovery of extremity lymphedema and objectively downgrading of lymphoscintigraphy staging than CDT group.

Hand Abstracts

Clinical and Genetic Characterization of Upper Extremity Anomalies in Robinow Syndrome

Presenter:	Jeffrey Trost, MD
Co-Authors:	Amjed Abu-Ghname, MD, Matthew J Davis, BS, Nicholas Cen, BS, Diana M Guillen, PA-C, Vernon Reid Sutton, MD, Claudia MB Carvalho, PhD, Renata Maricevich, MD
Affiliation:	Baylor College of Medicine, Houston, TX

Purpose: Robinow syndrome (RS) is an extremely rare dwarfing syndrome manifesting as craniofacial, genital, and extremity anomalies.[1] However, due to the low prevalence and phenotypic heterogeneity of this syndrome, a detailed description of associated upper extremity anomalies does not currently exist.[2-5] This study seeks to characterize upper extremity anomalies in the context of known genetic defects to assist in timely and accurate diagnosis of RS.

Methods: Patients with clinically-identified RS were invited to our institution for multi-disciplinary evaluation. A total of 18 patients were evaluated by plastic surgery, urology, orthopedic surgery, neuropsychology, and genetics teams. 12 patients ultimately agreed to genetic testing and were found to have a genetic variant of RS. Limb anomalies were surveyed and documented by three members of the plastic surgery team with particular attention to the upper extremity. Upper extremity findings were compared to individual genetic variants to elucidate any correlations.

Results: A total of 5 genetic variants were identified. Mesomelia (47%) was the most common skeletal dysplasia. Rhizomelia (33%) was limited to patient with variants of the DVL1 and NXN genes. 8 distinct hand anomalies were identified, the most being brachydactyly (92%), broad thumbs (83%), and clinodactyly (75%). Brachydactyly and broad thumbs in particular were evident across all genetic variants. The most common functional deficit was decreased forearm rotation (57%), which was seen in all genetic variants aside from an X-linked GPC4 variant. One patient with a mutation of the NXN gene demonstrated skeletal dysplasia without hand anomalies.

Conclusion: A trained hand surgeon should be aware of the common findings associated with Robinow syndrome. This is the first study to correlate the genotypic and phenotypic presentation of patients with a confirmed diagnosis of RS. A thorough understanding of the breadth of RS-associated hand anomalies can aid in early identification and proactive management of sequelae.

References

1. Robinow M, Silverman FN, Smith HD. A newly recognized dwarfing syndrome. *Am J Dis Child.* 1969;117(6):645-651.
2. Bain MD, Winter RM, Burn J. Robinow syndrome without mesomelic brachymelia : a report of five cases. *J Med Genet.* 1986;23:350-354.
3. Mazzeu JF, Pardono E, Vianna-Morgante AM, Richieri-Costa A, Ae Kim C, Brunoni D, Martelli L, de Andrade CE, Colin G, Otto PA. Clinical characterization of autosomal dominant and recessive variants of Robinow syndrome. *Am J Med Genet A.* 2007;143(4):320-325.
4. Bunn KJ, Lai A, Al-Ani A, Farella M, Craw S, Robertson SP. An osteosclerotic form of Robinow syndrome. *Am J Med Genet A.* 2014;164A(10):2638-2642.
5. Patton MA, Afzal AR. Robinow syndrome. *J Med Genet.* 2002;39(5):305-310.

H**and Abstracts**

Improper Preservation of Amputated Parts: A Pervasive Problem

Presenter: Sameer Massand, MD
Co-Authors: Haley Sinatro, BS, Alexander T Liu, MD, Chan Shen, PhD, John M Ingraham, MD
Affiliation: Penn State Hershey Medical Center, Hershey, PA

Background: Following traumatic amputation, preservation of the amputated part plays a crucial role in its viability for replantation. Proper preservation consists of wrapping the part in saline soaked gauze inside a watertight bag and placing it on ice. Frequently, the amputated part is not preserved according to this protocol, diminishing its viability for replantation. The objective of this study is to examine the rate of proper preservation in patients arriving from home and as transfers from referring medical centers.

Methods: A retrospective review of adult and pediatric patients at a single academic medical institution was conducted using ICD10 codes over the study period of 2015-2019. Patients were included if they suffered an acute traumatic amputation of a digit or an extremity, their amputated part was present for evaluation by the hand surgery team, and their medical record contained documentation regarding modality of preservation. Patients with partial amputations, non-traumatic amputations, and absence of amputated parts were excluded from the study. Additional data including method of patient transport, replantation attempt, and operative outcome were included. Patients were stratified based on whether or not proper preservation was employed and compared using chi-square tests.

Results: A total of 91 patients met inclusion criteria. Thirty-one of these patients (34.1%) had amputated parts which were properly preserved in saline-soaked gauze in a bag on ice. Transfer patients from referring hospitals were more likely to present with properly preserved parts (45.0%) than those presenting from home (25.5%), though this did not meet significance (p=0.051). In total, seventy-four patients arrived via emergency medical services (EMS) with 26 (35.1%) of those patients having properly preserved parts. Of the 31 patients who had properly preserved parts, 58.1% underwent attempted replant; of the 60 patients who had improperly preserved parts, 23.3% underwent attempted replantation (p = 0.001).

Conclusion: The majority of patients who suffer traumatic amputations do not present with properly preserved amputated parts, making it difficult for surgeons to offer replantation. Neither interhospital transfer nor EMS transport is predictive of adherence to protocol. With a direct correlation to attempted replantation, proper preservation is a crucial aspect of care. Dissemination of awareness and education to referring facilities may improve outcomes for patients who experience a traumatic amputation of an extremity or digit.

Hand Abstracts

Social Media Use Among Academic Hand Surgeons

Presenter: Nihaal Reddy, BS
Co-Authors: Tyler A Evans, MD, Austin J Roebke, MD, Ryan C Jefferson, MD, Sonu A. Jain, MD
Affiliation: The Ohio State University Wexner Medical Center, Columbus, OH

Purpose: Social media has revolutionized communication in society and has become an important interface between patients, trainees, and physicians for education, networking, and marketing. A growing number of surgeons are embracing this trend by increasing their social media presence. Many studies have investigated the benefits of a surgeon's web presence in plastic and aesthetic surgery, but a paucity of data exists in use among academic hand surgeons. The objective of this study was to evaluate social media use in fellowship trained, academic hand surgeons and to investigate differences between orthopaedic and plastic surgery trained hand surgeons.

Methods: Hand surgery fellowship programs were identified from the ASSH website and a list of faculty members from each respective program was compiled. A search was performed for faculty members on social media platforms including Facebook, Instagram, Twitter, LinkedIn and personal websites. The respective accounts and/or personal websites were investigated for any content related to hand surgery; accounts with personal content only were not included. Faculty members were analyzed by sex, board certification status, subspecialty of residency training [Plastic Surgery versus Orthopaedic Surgery], years in practice, geographical region [East, West, South, or Midwest], and professional presence on a personal website or accessible social media platform. Analysis of variance (ANOVA) and student t-tests were performed to evaluate the statistical significance ($p=0.05$) of differences between groups.

Results: A total of 469 academic hand surgeons were included. Among academic hand surgeons in the US, LinkedIn is the most common platform utilized at 40.3%, followed by Facebook [15.78%], a personal website [13.86%], Twitter [12.37%], and Instagram [4.05%]. Plastic hand surgeons are more present on Instagram [8.26% vs 2.59%] and Twitter [19.01% vs 10.06%], ($p= 0.0062837$ and $p= 0.009921$, respectively). Male hand surgeons were more likely than female hand surgeons to use LinkedIn [41.19% vs 34.85%], ($p= 0.044956$). Southern [18.89%] and Eastern Region [14.36%] surgeons utilized personal websites more than Western [6.52%] and Midwestern [4.60%] surgeons, ($p=0.0319107$).

Conclusion: Despite the widely known use of social media amongst plastic and aesthetic surgeons, this study shows the use of web based marketing strategies to be quite rare in the academic hand surgery setting. Social media can have a profound impact on medical practices and thus we suggest that academic plastic and orthopaedic hand surgeons throughout the US should consider having a larger social media presence to expand advertising, improve patient education, and enhance networking within their practices.

Hand Abstracts

Risk Factors for Emergency Department Visits after Upper Extremity Surgery

Presenter: Pragna N. Shetty, MPH
Co-Authors: Kavya K Sanghavi, MPH, Aviram M. Giladi, MD, MS
Affiliation: The Curtis National Hand Center at MedStar Union Memorial Hospital, Baltimore, MD

Purpose: The 'global period' after most upper extremity surgeries includes coverage of postoperative visits and routine care with no additional copay or coinsurance for 90 days. Despite this, patients often present to their local emergency department (ED) after surgery with concerns that could be addressed in clinic, resulting in increased costs, over-utilization of ED services, and in many systems, negative quality scores for the hospital or surgeon. We examined patient-reported questionnaire data to identify if patient responses indicate risk of subsequent presentation at an emergency department within the 90-day global period after surgery.

Methods and Materials: All adult patients who underwent surgery at our hand center between January 1, 2018 and August 31, 2019 and consented to data use for research were included. The patients' medical record numbers were used to identify ED visits anywhere in our health system within 90 days of surgery. Presenting diagnosis was used to identify patients with surgery-related complaints. Preoperative and postoperative questionnaires, including the brief Michigan Hand Questionnaire (bMHQ), the Patient Reported Outcome Measuring Information System (PROMIS) Upper Extremity (UE) and Pain Interference (PI), pain scores, and postoperative satisfaction scores from the first postoperative visit were collected prospectively. Satisfaction and pain were scored from 0-10; 10 is highest satisfaction and highest pain score.

Results: Our cohort included 2,056 patients, with 1,033 (50.2%) females and 1,023 (49.8%) males. 61 (3.0%) presented to the ED with hand-related or surgery-related complaints within 90 days after surgery. Preoperative pain scores were higher in the group that presented to the ED compared to those that did not (7 versus 4; $P<0.001$), and for every unit increase in preoperative pain, patients were 1.2 times more likely to return to the ED within the global period ($P<0.001$) after surgery. Patients who presented to the ED also had preoperative bMHQ scores 14.6 points lower ($P<0.001$) and preoperative PROMIS PI scores 5.2 points higher than their counterparts ($P=0.005$). Postoperative satisfaction scores were significantly lower in patients who subsequently presented to the ED (8.1 vs 9.1, $P<0.001$) while other postoperative questionnaire scores were not found to significantly predict likelihood of an ED visit.

Conclusions: Patients who presented to the ED within the global period had significantly higher preoperative pain scores, significantly worse preoperative bMHQ and PROMIS PI scores, and significantly lower postoperative satisfaction scores. These patient-reported scores were associated with an increased likelihood of presenting to the ED for management of a hand or post-operative issue during the global period. These patients should be identified early and counseled on their health care options in order to improve value-based care and decrease health care utilization.

Hand Abstracts

Does the Location of Initial Management after Distal Radius Fracture Impact the Ultimate Need for Operative Intervention?

Presenter: Nicholas J. Albano, MD
Co-Authors: Kevin Beine, BS, Armin Edalatpour, MD, Brett Michelotti, MD
Affiliation: University of Wisconsin Hospital and Clinics, Division of Plastic Surgery, Madison, WI

Background: Fractures of the radius and/or ulna comprise the largest proportion (44%) of the estimated 1.5 million cases of hand and forearm fractures seen in Unites States emergency departments each year.[1] Displaced distal radius fractures [DRF] are often managed with closed reduction and splinting. After initial management of these injuries, patients are referred to tertiary care facilities or specialty groups for continuing care. Failure to obtain a stable, near-anatomic reduction may lead a specialist to recommend and/or perform surgery to re-establish appropriate radiographic relationships. Complication rates associated with non-operative management have been studied though data on conversion to surgical management are not widely reported.[2] Surgery incurs a significant financial and physical cost to the patient and health care system. The primary aim of this study was to assess how location and type of facility at which a distal radius fracture is initially managed impacts rates of surgical intervention. Specifically, we compared a tertiary care facility, staffed with hand specialists, to referring community institutions where no hand specialists were readily available.

Methods: We performed a retrospective chart review of all patients treated at University of Wisconsin - Hospital and Clinics (UW) for distal radius fractures from January 1, 2018 to December 31, 2018. Patients were placed into one of two groups: 1) initial treatment performed at any location within the UW system, 2) initial treatment performed at any location outside of the UW system. We calculated the operative rate for each group. We also analyzed the effect of sex and type of injury on the conversion to surgical management

Results: We identified 1337 patient encounters associated with a distal radius fracture current procedural terminology (CPT) code. 824 patients were initially managed at UW Health while 513 patients were initially managed at non-UW facilities. Patients initially managed at UW went on to surgical intervention at a significantly lower rate of 15.0% (n = 124) compared to those patients initially treated outside of UW Health who underwent surgery 26.3% of the time (n = 135) ($p<0.0001$). Type of injury was not a predictor of conversion to surgery nor initial presentation to UW. Sex was not a predictor of surgical conversion.

Conclusions: These data suggest that initial management of distal radius fractures at UW Hospital and Clinics significantly decreases the rate of operative reduction and fixation. A decrease in operative intervention reduces both the physical and financial impact of distal radius fractures. This indicates that there may be a need to educate community providers to either perform an acceptable bony reduction or refer patients to treating facilities capable of performing these techniques in the early post-injury period.

1. C. Chung, S.V. Spilson The frequency and epidemiology of hand and forearm fractures in the United States. J Hand Surg Am, 26 (2001), pp. 908-915
2. Chung KC, Malay S, Shauver MJ, Kim HM, for the WRIST Group. Assessment of Distal Radius Fracture Complications Among Adults 60 Years or Older: A Secondary Analysis of the WRIST Randomized Clinical Trial. *JAMA Netw Open.*2019;2(1):e187053. doi:10.1001/jamanetworkopen.2018.7053

Hand Abstracts

Utility of Routine Pathologic Specimens in Ganglion Wrist Excisions

Presenter: Darren B LePere, MD
Co-Authors: Rebecca S Bickham, MD, John M Ingraham, MD
Affiliation: Penn State Hershey Medical Center, Hershey, PA

Introduction: As healthcare costs continue to rise, increased emphasis has been placed on cost-benefit optimization. One area of investigation has been the utility of pathologic examination of specimens from routine procedures with low preoperative suspicion for malignant pathology. Previous literature has challenged the established pathology guidelines in other surgical subspecialties, but no studies have been conducted on the value of routine pathology within hand surgery. The goal of this study was to assess the utility and cost of routine pathologic analysis for one of the most commonly performed procedures in hand surgery, ganglion cyst excision.

Methods: A retrospective cohort study was performed following IRB approval. Billing records were searched for CPT code 25111-25112 (Ganglion Cyst Excision) over a 5 year period. All identified records were then searched for associated pathology billing codes, pre-operative diagnoses and post-procedural diagnoses. Pathology reports were then reviewed for final surgical diagnoses. Lastly, associated pathology charges were obtained from our institutions billing department.

Results: A total of 407 patients underwent ganglion cyst excision at our institution between 2015-2019 by seven different fellowship-trained hand surgeons. Of those patients, 318 (78.1%) had specimens sent for pathologic review. Thirty-two of those patients (10.1%) had non-ganglion cyst diagnoses pre-operatively. All 32 charts were reviewed and 31 of the 32 patients had high suspicion for “ganglion cyst” pre-operatively with confirmation of diagnosis after intra-operative findings. One patient had abnormal pathology (0.3% of specimens), which was diagnosed pre-operatively as a “cystic vascular malformation” on pre-operative imaging. All reviewed specimens were associated with a “Level 3 Surgical Pathology” and “Tissue Exam Level 3” billing code, which corresponded to a billing charge of $258.

Conclusion: Current national guidelines for pathologic review of intra-operative specimens are the result of recommendations proposed in 1996 by the College of American Pathologists and do not take into consideration the surgeon’s clinical acumen. Of the 407 patients that underwent excision of a ganglion cyst, seventy-eight percent had specimens sent for pathology, with only 1 non-ganglion diagnosis (0.3%) following pathology evaluation. The one non-ganglion diagnosis identified was suspected to be “non-ganglion” pathology on pre-operative evaluation. Over the past 5 years, $81,786 was spent at our institution to confirm a benign pathologic finding that was correctly diagnosed by the physician pre-operatively/intra-operatively. These findings would suggest that routine pathology specimens are not indicated in cases where surgeons have a high clinical suspicion for ganglion cyst, and pathologic review should be reserved for cases with atypical findings.

Hand Abstracts

Pulley Release and Reconstruction with Acellular Dermal Matrix after Zone 2 Flexor Tendon Injury

Presenter:	David E. Kurlander, MD
Co-Authors:	Marco A Swanson, MD, Leigh-Anne Tu, MD, Anand R. Kumar, MD, Tobias C Long, MD, Kyle D Lineberry, MD, Joseph Khouri, MD
Affiliation:	Case Western Reserve University, Cleveland, OH

PURPOSE: Flexor tendon injuries in zone 2, commonly referred to as “no man’s land”, have high incidence of post-operative stiffness. Historically, it was thought that release or venting of the A2 or A4 pulley would lead to bowstringing and weakness. Building upon the success of acellular dermal matrix (ADM) to maintain strength and avoid adhesions in hostile abdominal hernia repair environments, our group has developed a novel technique for zone 2 flexor tendon repair that includes pulley release and reconstruction using ADM. Here we report our technique and experience with zone 2 flexor tendon repair with pulley release and ADM reconstruction.

METHODS: A retrospective review was performed to identify all patients at a University Level 1 Trauma Center who underwent zone 2 flexor tendon repair with pulley release and ADM reconstruction. Outcomes were reviewed and descriptive statistics performed. Our technique begins, when possible, with wide awake surgery with local anesthesia and no tourniquet. Brunner incisions are made and the proximal and distal cut tendon ends are identified and retrieved. The entire pulley overlying the tendon repair is released by longitudinal midline incision. FDP is repaired with core and epitendinous sutures, and both FDS are repaired for an anatomic reconstruction. The patient then actively ranges the finger and additional liberal pulley release is performed if necessary. Next, pulley reconstruction is performed with 2x4cm ADM, custom-cut and secured to the cut ends of the pulley with tension sufficient to hold the tendons in anatomic position. The finger is again actively ranged to confirm gliding under the ADM. The skin is closed and a splint applied. Early active motion therapy follows, when appropriate.

RESULTS: 12 patients who underwent zone 2 flexor tendon repair with ADM pulley reconstruction were identified over an 18-month period. Six patients were excluded due to follow up shorter than 2 months, leaving 6 patients with 10 fingers treated for inclusion. Mean age was 39 years and mean follow-up 3.0 months. All 10 fingers suffered lacerations to FDP and FDS in zone 2. FDP and FDS were repaired in 80% of fingers, with 20% forgoing FDS repair due to multi-level laceration. Sixty-six percent of patients were non-compliant with hand therapy. No patients demonstrated evidence of bow-stringing at last follow up. Minimal or no stiffness was observed in 60% of patients, including one patient who was non-compliant with therapy. Significant stiffness was observed in 40% of fingers, all in patients non-compliant with therapy.

CONCLUSION: Successful management of zone 2 flexor tendon injuries can be accomplished with pulley release and reconstruction using ADM, with no concern for bowstringing. Therapy compliance remains important to minimizing stiffness. Further comparative studies will be required to evaluate cost-effectiveness and identify specific patients who will benefit most from this technique.

Hand Abstracts

Comparing Open Carpal Tunnel or Trigger Finger Release Procedures Performed Under Local Anesthesia with or without the Use of a Tourniquet

Presenter:	Joseph Saleh, Medical Student
Co-Authors:	Eli Saleh, MD, Alexander Govshievich, MDCM, Genvieve Ferland-Caron, MD, Jenny C Lin, MD, PhD, Dominique Tremblay, MD, BSc OT, FRCSC
Affiliation:	University of Sherbrooke,

Background: Carpal tunnel syndrome and trigger finger are two of the most common conditions treated by the hand surgeon. During these procedures, a tourniquet is often used to minimize bleeding and improve visualization of the operative field. However, it may be associated with pain and discomfort. To date, there are few prospective studies investigating the safety and patient-centered outcomes of tourniquet-free minor hand procedures.

Methods: This is a randomized controlled trial comparing patients undergoing open carpal tunnel or trigger finger release with or without the use of a tourniquet. Peri-operative subjective patient experience was investigated for both techniques. This was measured based on a numerical rating scale (NRS) for pain, anxiety and overall satisfaction. In addition, this was an equivalence trial in terms of operative time, bleeding scores and peri-operative complication rates.

Results: A total of 67 patients were recruited. Both groups were similar with respect to distribution of age, sex, handedness, anti-platelet use and tobacco use. Median scores for operative time, anxiety and overall satisfaction were comparable between the two groups. With regard to patient discomfort, median scores were significantly higher in the tourniquet group when compared to the no tourniquet group(3.0 vs. 1.0, p=0.02). Bleeding scores for the tourniquet group were significantly lower than for the no tourniquet group(p=0.001).

Conclusion: The application of WALANT in minor hand surgery procedures has been shown to decrease tourniquet-associated discomfort, improving peri-operative patient experience. Additionally, it demonstrated the non-inferiority of the tourniquet-free technique with respect to operative time and the rate of peri-operative complications.

Migraine and Peripheral Nerve Abstracts

Novel Therapy for Enhancement of Peripheral Nerve Regeneration Using Human Epineural Sheath Conduits Combined with Human Mesenchymal Stem Cells

Presenter:	Maria Siemionow, MD, PhD
Co-Authors:	Marcin Strojny, MD
Affiliation:	University of Illinois at Chicago, Chicago, IL

PURPOSE: Mesenchymal stem cells (MSC) are considered a promising approach as a supportive therapy for peripheral nerve injuries. We have 20 years of research experience with application of epineural sheath for

enhancement of nerve regeneration in animal models[1-3]. This study aimed to assess effect of human Epineural Sheath Conduit (hESC) supported with human MSC on restoration of 20mm long nerve defect in a rat model.

METHODS AND MATERIALS: Restoration of 20mm sciatic nerve defect with hESC created from human sciatic nerve supported with hMSC was tested in 4 groups: G1 - no repair control, G2 - autograft control, G3 - hESC, G4 - hESC+hMSC. Functional tests of toe spread and pinprick were performed at 1, 3, 6, 9, 12 weeks after repair. At 12 weeks, IF assessed presence of neurogenic, angiogenic and immunogenic markers. Histomorphometry assessed myelin thickness, axonal density, fiber diameter, and percentage of the myelinated nerve fibers. Gastrocnemius Muscle Index and muscle fiber area ratio assessed muscle atrophy.

RESULTS: Evaluation of epineural conduit repair site at 12 weeks confirmed preservation of a normal nerve shape without scar tissue, adhesions or local signs of inflammation and good vascularization in all groups. The best sensory and motor recovery was observed in G2, followed by G4, G3 and G1 (pinprick 3.0 vs. 2.33 vs. 2.0 vs. 0.5; toe spread 1.83 vs. 1.5 vs. 1.0 vs. 0.13, respectively). GMI and muscle fiber area ratio was highest for G2 (0.322/0.414), followed by G4 (0.285/0.306), G3 (0.274/0.286) and G1 (0.167/0.098). The highest expression of VEGF, NGF and laminin B was found in G, followed by Group 4, G3 and G1. G4 confirmed HLA expression. Myelin thickness revealed best values in G4 (0.65 ± 0.06 μm) followed by G2 (0.63 ± 0.10 μm) and G3 (0.47 ± 0.07 μm). Fiber diameter and percentage of myelinated nerve fibers increased in G4 be (4.04. ± 0.31 μm /92 ± 3%) followed by G2 (3.79 ± 0.69 μm /83 ± 2 %) and G3 (3.35 ± 0.19 μm/74 ± 7%). G2 confirmed highest axonal density (322 ± 122), followed by G4 (167 ± 47) and G3 (133 ± 81).

CONCLUSIONS: We established feasibility of human ESC creation. Human ESC conduit efficacy in nerve regeneration after nerve gap repair was comparable with autograft repair as confirmed by electron microscopy, IF and functional tests. Our novel Human ESC introduces alternative technique to autograft nerve repair.

1. Klimczak A, Siemionow M, Futoma K, Jundzill A, Patrzalek D. Assessment of immunologic, proangiogenic and neurogenic properties of human peripheral nerve epineurium for potential clinical application. *Histol Histopathol.* 2017 Nov;32(11):1197-1205.
2. Siemionow M, Bobkiewicz A, Cwykiel J, Uygur S, Francuzik W. Epineural Sheath Jacket as a New Surgical Technique for Neuroma Prevention in the Rat Sciatic Nerve Model. Ann Plast Surg. 2017 Oct;79(4):377-384.
3. Siemionow M, Cwykiel J, Uygur S, Kwiecien G, Oztürk C, Szopinski J, Madajka M. Application of epineural sheath conduit for restoration of 6-cm long nerve defects in a sheep median nerve model. Microsurgery. 2018 Dec 4.

Migraine and Peripheral Nerve Abstracts

Artificial Intelligence-Enabled Evaluation of Pain Drawings to Predict Outcomes in Migraine Surgery

Presenter: Christian Chartier, DEC
Co-Authors: Lisa Gfrerer, MD, William Gerald G Austen, Jr., MD
Affiliation: Massachusetts General Hospital, Harvard Medical School, Boston, MA

Purpose: Recent evidence has shown that patient drawings of pain can predict poor outcomes in trigger site decompression surgery for headaches/ migraine [1]. Pain drawings that were associated with non-responders were used to establish criteria that indicate poor candidacy for surgery: 1) facial pain 2) diffuse pain 3) pain in an atypical location that does not correspond to a known trigger site [1]. Interpretation of pain drawings requires some

clinical and anatomic knowledge in order to recognize aberrant headache pain patterns. In an effort to make this screening tool accessible to less experienced surgeons, general practitioners and even patients, we aim to simplify and automate the pattern recognition process by leveraging artificial intelligence technology. As a first step, the authors developed a machine learning framework capable of automatically interpreting pain drawings to predict outcomes. This screening platform and algorithm can be administered via a mobile application.

Methods: A random forest machine learning algorithm was trained on a dataset of 70 pain drawings provided by patients prior to undergoing trigger site deactivation surgery for migraine headache. Sixteen features were used to describe the anatomic distribution of pain on each drawing for interpretation by the machine learning algorithm. Post-operative Migraine Headache Index (MHI) values recorded at 1-year follow-up were included in the data set. The algorithm was asked to predict MHI outcomes in 10% increments from 0-100%. Poor surgical outcomes were defined as <50% improvement of MHI. The dataset had no missing values and was split such that 75% (n=52) of instances constituted the training set, with the remaining 25% (n=18) of instances constituting the test set used to evaluate the algorithm's performance.

Results: When evaluated using the test set, the algorithm was able to predict surgical outcomes with accuracy >78% in all but one category. The best prediction of outcome (89-94%) was achieved for poor outcomes. Diffuse pain was strongly weighted by the algorithm to predict poor surgical outcomes.

Conclusion: This study indicates that structured algorithmic analysis is able to correlate patient drawn pain patterns to MHI% improvement with good accuracy (> 89%) for poor outcomes (<50% MHI improvement). Moderate accuracy (56-83%) was achieved for good outcomes (>50% improvement). This is the first step towards automated patient screening for trigger site deactivation surgery that would allow less experienced practitioners, untrained medical staff and the non- medical public to determine chances of success and failure after migraine surgery. Further studies on larger datasets and more inclusion of other significant screening variables (response to nerve block, failed medical treatments, trauma, opioid use, etc.) may be required to improve accuracy of outcome prediction and apply this tool to practice.

1. Gfrerer L, Hansdorfer MA, Ortiz R, Nealon KP, Austen WG. Pain Drawings Can Predict Poor Surgical Outcomes in Migraine Surgery. *Plastic and Reconstructive Surgery–Global Open.* 2019;7(8S-1):53.

Migraine and Peripheral Nerve Abstracts

Enhancement of Peripheral Nerve Regeneration Using Intracellular Sigma Peptide

Presenter:	Carlos Ordenana, MD
Co-Authors:	Majid Rezaei, MD, Vahe Fahradyan, MD, Brian Figueroa, MD, Lynn Orfahli, BM, Edoardo Dalla Pozza, MD, Sayf Al-Deen Said, MD, Payam Sadeghi, MD, Francis A. Papay, MD, Antonio Rampazzo, MD, PhD, Jerry Silver, PhD, Bahar Bassiri Gharb, MD, PhD

Affiliation: Cleveland Clinic, Cleveland, OH

PURPOSE: Chondroitin sulfate proteoglycans (CSPGs) are major inhibitory factors for peripheral nerve regeneration. CSPGs upregulate in the extracellular matrix of injured nerves and counteract the effects of Schwann cell derived neurotrophic factors, slowing axonal regeneration. The inhibitory effect of CSPGs is exercised through tyrosine phosphatase σ (PTPσ) receptor. Intracellular sigma peptide (ISP) is a designer peptide that binds and blocks PTPσ receptor. In a spinal injury model, systemic delivery of this peptide restored substantial serotonergic innervation to the spinal cord below the level of injury and facilitated functional recovery of both locomotor and urinary systems. After ventral root avulsion and immediate re-implantation, modulation of PTPσ by systemic delivery of ISP remarkably enhanced motor neuron regeneration. Given unprecedented effects of ISP in CNS regeneration, The goal of this study was to investigate the effect of ISP on peripheral nerve regeneration.

METHODS: Thirty Lewis rats were used. Both sciatic nerves (20 mm) were harvested from 10 Lewis donors. In the recipient animals, a 10 mm defect was created in the sciatic nerve and the isograft was interposed with 10-0 nylon. The animals were randomized in experimental and control groups. Animals in the experimental group received 100µg of ISP along the nerve graft on the day of surgery. Animals in the control group received vehicle alone along the nerve graft on the day of surgery. In both groups the medications were administred subcutaneously once a day following surgery. The investigators were blinded to the administrated medications, until after all outcome measurements were complete. The endpoint of the study was 90 days. Sciatic Function Index (SFI) was measured preoperatively and biweekly after surgery. Nerve conduction latency and amplitude, gastrocnemius muscle weight retention ratio and histomorphometrical analysis of nerves were performed at end point.

RESULTS: SFI declined immediately after surgery, improving gradually with the greatest value dispersion starting at 4 weeks (Graph 1). The average SFI at week 12 was -68±19 in the ISP group and -65±17 in the control group (p=0.64). The average conduction amplitude was 15±8.6 mV in the ISP group vs 15.9±5.6mV in controls, while conduction latency was 2.5±0.7ms in the ISP group vs 3.1±2.2ms in the control group. (p=0.77). The average gastrocnemius weight ratio was 51.7±10.4% in ISP treated animals versus 49±4.9% in the control group (p=0.88). The average axon counts were 12381±2566 in the ISP group vs 16204±4392 in the controls (p=0.21). Fiber diameters were 5.62±1.2 in ISP-treated animals vs 5.15±0.5 in controls (p=0.14). Axon diameters and G-ratios were 3.68±0.8 and 0.62±0.04 (p=0.7) in ISP-treated animals versus 3.39±0.3 and 0.64±0.03 (p=0.92) in controls, respectively.

CONCLUSION: Daily subcutaneous administration of intracellular sigma peptide did not to significantly improve nerve regeneration at the dose and with the administration route tested.

Migraine and Peripheral Nerve Abstracts

Histomorphometry in Peripheral Nerve Regeneration: Experimental Comparison of Different Axon Counting Methods

Presenter: Lynn Orfahli, BM

Co-Authors: Majid Rezaei, MD, Audrey Victoria Crawford, BS, Michael J Annunziata, BS, Carlos Ordenana, MD, Brian Figueroa, MD, Jerry Silver, PhD, Antonio Rampazzo, MD, PhD, Bahar Bassiri Gharb, MD, PhD

Affiliation: Cleveland Clinic, Cleveland, OH

Purpose: Histomorphometry is a common tool to quantitatively evaluate outcomes of peripheral nerve regeneration by measuring axonal parameters such as count, diameter, and myelination. Manual measurement across the entire nerve cross-section is the most accurate technique of histomorphometric analysis, but is extremely labor intensive. Thus, most researchers have opted for analysis of just a sample of the cross-section. Currently, automated sampled analysis is the most common method. However, no study has been performed to compare the accuracy of these techniques, making it difficult to compare results across the literature.

Methods: Rat sciatic nerves were transected and repaired with a 20 mm nerve isograft. A total of 34 sections were stained with toluidine blue and digitized: 24 from native nerve distal to the graft, 5 from nerve proximal to the graft, and 5 from the graft itself. Three blinded researchers manually counted total myelinated fibers in each full cross-section. Total myelinated fiber counts were also extrapolated from sampled fields representing 20% of the cross-sectional area. Sampled counts were performed both manually and automatically with the software ImageJ (National Institutes of Health). Myelinated fiber diameter (FD), axon diameter (AD), and myelin sheath thickness (MTh) were measured manually in the full cross-sections and the sampled fields. Repeated measures MANOVA, Spearman's correlation, and Wilcoxon signed-rank tests were performed.

Results: Results are expressed in mean ± standard deviation. Full manual axon count was 12,504 ± 4,195 overall and 13,506 ± 4,217 distally. Sampled axon counts were significantly higher than full manual, especially distally (sampled manual: 15,316 ± 4,613, $p<0.001$; sampled automated: 16,297 ± 7,733, $p=0.037$). All three methods showed strong, significant correlation with each other, especially for distal sections (full manual and sampled manual: $r_s=0.912$, $p<0.001$; full manual and sampled automated: $r_s=0.599$, $p=0.002$; sampled manual and sampled automated: $r_s=0.708$, $p<0.001$). Overall full manual FD, AD, and MTh were 5.42 ± 1.18 µm, 3.61 ± 0.78 µm, and 0.93 ± 0.28 µm, respectively. They did not differ from sampled measurements ($p=0.144$, $p=0.059$, and $p=0.817$, respectively).

Conclusions: Manual count of sampled nerve sections produces highly correlated, reliable results when using standardized and systematic sampling methods. Automated data should be regarded with more caution as correlation was not as high. However, the significant correlation indicates it is an acceptable technique if manual sampled analysis is not possible. Although the methods explored in this study correlated highly with one another, the accuracy of both sampled techniques differed significantly from full manual analysis. Therefore, comparison of numerical results between papers reporting these parameters (i.e., for a metanalysis) may not be possible. Researchers must be cognizant of the wide variety of techniques reported in the literature and exercise caution when comparing data between studies.

Migraine and Peripheral Nerve Abstracts

Anatomy of the Great Auricular Nerve (GAN): Implications for Diagnosis and Surgical Treatment of Peripheral Nerve Compression Migraine Headache

Presenter:	Anna Schoenbrunner, MD
Co-Authors:	Marko Konschake, MD, Marit Zwierzina, MD, Bernhard Moriggl, MD, FIACA, Francesco M Egro, MBChB, MSc, MRCS, Jeffrey E. Janis, MD
Affiliation:	The Ohio State University, Columbus, OH

Purpose: Migraine headaches have traditionally been thought to have a centrally mediated process.[1] Recent research has identified extracranial peripheral nerve trigger sites to play a role in migraine headache physiology; these trigger sites can be decompressed at known anatomic sites of compression, providing significant relief of symptoms.[2,3] To date, there are six major trigger sites that have been identified.[4] Despite full release of the known trigger sites in patients affected by migraine headaches caused by compression of peripheral trigger sites, there are a subset of patients who have persistent symptoms in the distribution of the great auricular nerve. To date, there are no studies describing the anatomy of the great auricular nerve/ *nervus auricularis magnus* (GAN) as related to migraine headaches. Implications for future diagnosis and treatment of GAN compression headaches are discussed.

Materials and Methods: After IRB approval was obtained, 16 cadaver heads were dissected to identify the course of the GAN. The course of the nerve was identified after its exit point through the superficial cervical fascia ("Erb's Point" – nerve point of neck) at the posterior border of the sternocleidomastoid muscle (SCM) to its terminal anterior and posterior branches. The GAN was measured in relation to internal and external landmarks: Erb's point to mastoid process, Erb's point to angle of mandible, and posterior aspect of sternocleidomastoid to mastoid process.

Results: Following mean measurements of the GAN related to the landmarks were found: Erb's point to mastoid process (right: 7.32cm and left: 7.88cm), Erb's point to angle of mandible (right: 6.04cm and left: 5.88cm), posterior aspect of sternocleidomastoid to mastoid process (right: 3.88cm and left: 4.33cm). Possible points of compression were identified: GAN penetrating the superficial layer of the cervical fascia, entrance into dense connective tissue area near the anterior border of SCM (before entering the parotid gland), and during its intraglandular course.

Discussion: The role of the GAN in peripheral nerve compression headaches has yet been unexplored, particularly in patients with residual migraines in the distribution of the GAN. This study is the first to describe the anatomical course of the GAN as related to possible sites of compression. This study sets the groundwork for diagnosis of GAN-related peripheral nerve compression migraines with diagnostic field blocks and onabotulinumtoxin-A injection.

Sources:
1. Goadsby PJ, Holland PR. An Update: Pathophysiology of Migraine. Neurol Clin. 2019;37(4):651-671.
2. Janis JE, Barker JC, Javadi C, Ducic I, Hagan R, Guyuron B. A review of current evidence in the surgical treatment of migraine headaches. Plast Reconstr Surg. 2014;134(4 Suppl 2):131S-141S.
3. Guyuron B, Reed D, Kriegler JS, Davis J, Pashmini N, Amini S. A placebo-controlled surgical trial of the treatment of migraine headaches. Plast Reconstr Surg. 2009;124(2):461-468.
4. Guyuron B, Kriegler JS, Davis J, Amini SB. Comprehensive surgical treatment of migraine headaches. Plast Reconstr Surg. 2005;115(1):1-9.

Migraine and Peripheral Nerve Abstracts

Use of Ultrasonography in the Identification and Future Treatment of Great Auricular Nerve (GAN) Mediated Peripheral Nerve Compression Migraine Headaches

Presenter:	Marko Konschake, MD
Co-Authors:	Anna Schoenbrunner, MD, Marit Zwierzina, MD, Bernhard Moriggl, MD, FIACA, Francesco M Egro, MBChB, MSc, MRCS, Jeffrey E. Janis, MD
Affiliation:	Medical University of Innsbruck (MUI), Institute of Clinical and Functional Anatomy, Innsbruck, Austria

Purpose: Migraine headaches can have an extra-cranial etiology with six major trigger sites identified to date (1). Despite full release of the known trigger sites in patients affected by migraine headaches caused by compression of peripheral trigger sites, there are a subset of patients who have persistent symptoms in the distribution of the great auricular nerve/ *nervus auricularis magnus* (GAN). We evaluated the anatomical course of the GAN in a related abstract with detailed anatomical measurements of potential points of compression. Herein, we provide results of our related study utilizing ultrasonography to identify the GAN (2). This is the first report of use of ultrasonography in the identification of peripheral nerves related to migraine headaches. The results of this study have implications for diagnosis and treatment of GAN-mediated peripheral nerve compression headaches.

Material and Methods: After IRB approval was obtained, 16 cadaver heads were dissected to identify the course of the GAN. Additionally, the GAN was identified ultrasonographically throuhought its course in volunteers using a 18Mhz probe (MyLab 7, ESAOTE, Italy) and specific anatomical landmarks.

Results: The specific anatomical landmarks for visualization of the GAN were: Erb´s Point (nerve point of neck), which is palpable during contraction of the platysma where the GAN crosses the posterior border of the sternocleidomastoid muscle (SCM) and the SCM enveloped in the superficial cervical fascia. The visualization of the GAN (and its branches) was possible at the external, dorsal border of the SCM penetrating the superficial cervical fasciaand further along its ascending course on the SCM until its intraglandular course into the parotid gland.

Discussion: The role of ultrasonography in the diagnosis of peripheral nerve mediated migraine headaches has yet been unexplored. This study reports our results utilizing ultrasonography to identify the course of the GAN and provides anatomical landmarks identified via ultrasound to guide in the diagnosis and treatment of GAN mediated peripheral nerve compression headaches with local blocks and onabotulinumtoxin-A. Ultrasonography is a powerful diagnostic tool that will undoubtedly play a role in the future diagnosis and treatment of peripheral nerve migraine headaches; this study is the first of its kind to report on the use of the technology in peripheral nerve compression headaches. Visualization of the possible anatomical points of compression reported in our abstract “Anatomy of the Great Auricular Nerve (GAN): Implications for Diagnosis and Surgical Treatment of Peripheral Nerve Compression Migraine Headache” will be evaluated in the future.

Sources:

1. Janis, J. E., Barker, J. C., Javadi, C., Ducic, I., Hagan, R., Guyuron, B. A review of current evidence in the surgical treatment of migraine headaches. *Plast Reconstr Surg* 2014;134:131S-141S.
2. Gruber, H., Loizides, A. & Moriggl, B. *Sonographic Peripheral Nerve Topography: A Landmark-based Algorithm*. (Springer, 2019).

Migraine and Peripheral Nerve Abstracts

The Relationship of Psychiatric Variables in Patients Undergoing Peripheral Nerve Surgery for Migraine Headache

Presenter:	Lisa Gfrerer, MD
Co-Authors:	Ricardo Ortiz, BSc, Marek A. Hansdorfer, MD, Jane M. Tsui, MD, Christian Chartier, DEC, Kassandra P Nealon, Bsc, William Gerald G Austen, Jr., MD
Affiliation:	Massachusetts General Hospital, Harvard Medical School, Boston, MA

Background: Patients seeking peripheral nerve surgery for their headaches often have debilitating symptoms that can affect both their functional and psychological well-being. Although prior studies have shown strong associations between psychiatric variables and migraine headaches, their associations in patients undergoing peripheral nerve surgery have not been fully elucidated. This study aims to explore the relationship of psychiatric comorbidities in patients undergoing peripheral nerve surgery for their headaches.

Methods: One-hundred and twenty-nine patients were enrolled prospectively and completed the Patient Health Questionnaire-2 (PHQ-2) and Migraine Headache Index (MHI) surveys preoperatively and at twelve months postoperatively. Data on psychiatric comorbidities were collected both via survey and via retrospective chart review.

Results: Preoperatively, 38% of patients self-reported a diagnosis of depression, while 45% of patients met PHQ2 criteria for likely major depressive disorder (PHQ-2 score of three or greater). Twenty-seven percent of patients reported a diagnosis of generalized anxiety disorder. Patients with depressive symptoms and self-reported anxiety were more likely to report a higher severity of migraine symptoms. At one year postoperatively, patients reported a significant decrease in their PHQ2 score (P=0.02), with 22% of patients reporting depressive symptoms, as compared to 45% preoperatively. The preoperative presence of anxiety or depression did not affect postoperative outcomes.

Conclusion: There is a high prevalence of psychiatric ailment in patients undergoing migraine surgery. Comorbid psychiatric conditions do not appear to affect postsurgical outcomes. However, surgery is associated with a significant decrease in depressive symptoms. Prior studies have shown that the surgical treatment of migraine headaches is associated with improved headache symptoms and functionality. This study demonstrates that surgery is also associated with improved psychiatric symptoms.

Migraine and Peripheral Nerve Abstracts

Clinical Effectiveness of Peripheral Nerve Blocks for Diagnosis of Migraine Trigger Points

Presenter: Shiva M Rangwani, MD, MBA
Co-Authors: Jason D Hehr, MD, Jeffrey E. Janis, MD
Affiliation: Ohio State University College of Medicine,

Background: With a 13% global prevalence, migraine headaches (MH) are the most commonly-diagnosed neurologic disorder, and are a top five cause of visits to the emergency room. Surgical techniques—such as decompression and/or ablation of neurovasculature—have shown to provide relief in patients suffering from MH. Popular diagnostic modalities to identify trigger loci include handheld doppler exams and botulinum toxin injection. This paper aims to establish the positive predictive value (PPV) of peripheral nerve blocks for identifying therapeutic surgical targets for MH surgery.

Methods: Charts of 36 patients were retrospectively analyzed. These patients underwent peripheral nerve blocks using 1% lidocaine with epinephrine and subsequent surgery on identified MH trigger points. Patients were grouped into successful and unsuccessful blocks and further categorized into successful and unsuccessful surgery subgroups. Group analysis was done using paired t-tests and PPV calculations were done on subgroups.

Results: Mean post-surgical follow up was 11.5 months. Prior to surgery, Migraine Headache Index (MHI) of patients was 168.16 vs. 43.69 after surgery ($p<0.001$). Each of the components of MHI also significantly decreased: frequency (24.54 MH/month vs. 8.53, $p<0.001$), intensity (7.33 vs. 4.75, $p<0.001$), and duration (0.8 days vs. 0.39, $p<0.001$). The PPV of diagnostic peripheral nerve blocks in identifying a MH trigger point responsive to surgical intervention was calculated to be 0.89 (95% CI: 1, 0.74).

Conclusion: Peripheral nerve blocks serve as a clinical tool in mapping migraine trigger points for surgical intervention while offering more flexibility in their administration and recording as compared to established diagnostic methods.

Migraine and Peripheral Nerve Abstracts Tier 1

The Effect of Peripheral Nerve Blocks on Emergency Department Utilization after Upper Extremity Surgery

Presenter: Scott N Loewenstein, MD
Co-Authors: Ravi Bamba, MD, Joshua M Adkinson, MD
Affiliation: Indiana University, Indianapolis, IN

Introduction:

Peripheral nerve blocks demonstrate great utility in producing regional anesthesia and reducing pain after upper extremity surgery. The purpose of this study was to characterize emergency department (ED) utilization after outpatient upper extremity surgery with and without peripheral nerve blocks.

Methods:

We studied a single state population through the Indiana Network for Patient Care, a statewide health information exchange capturing 95% of inpatient and outpatient encounters. Patients who received upper extremity surgery from January 2009 through June 2019 were included. From free text and codified data retrieved through the continuum of healthcare, we built a database incorporating patient demographics (including census-based median household income), preoperative comorbidities, concurrent procedures performed, and postoperative ED visit encounter information. We performed univariate analysis to characterize the population, bivariate analysis with Student's t-tests and Chi square tests to determine relationships between variables, and multivariable logistic regression to assess for independent risk factors for postoperative ED visits.

Results:

Among 152,085 unique upper extremity surgical patients, there were 108,451 (71.3%) who had outpatient surgery. Nine thousand and seventy nine outpatients (8.4%) had peripheral nerve blocks. Within two days of surgery, 69 patients (0.8%) who received blocks and 396 patients (0.4%) who did not went to the ED for evaluation ($p<0.001$). Postoperative pain was the principal cause of this ED visit more frequently in patients receiving blocks compared to those that did not (53.6% versus 35.1%, $p<0.001$). By one postoperative week, the increased risk for postoperative ED visit among patients receiving peripheral nerve blocks returned to baseline. When controlling for comorbidities and demographics, only peripheral nerve blocks (adjusted OR 1.71, $p=0.007$), and pre-procedural opioid use (adjusted OR 1.43, $p=0.020$) conferred independently increased odds for ED utilization within the first two postoperative days.

Conclusions:

Peripheral nerve blocks used for upper extremity surgery are associated with unplanned ED utilization, most likely related to rebound pain. Through proper patient education and pain management we can minimize this unnecessary resource utilization.

Posters

Are Reduction Mammaplasty Complications in Obese Women Decreased By Preoperative Weight Loss?

Presenter: Norma I. Cruz, MD
Co-Authors:
Affiliation: University of Puerto Rico, San Juan, PR

Introduction: Obese patients with symptomatic macromastia are requested to lose weight to comply with the medical policy coverage criteria for reduction mammaplasty (1). However, body weight has no impact on the benefits of reduction mammaplasty and it is not clear if preoperative weight loss results in a significant decrease in postoperative complications (2).

Method: A prospective cohort study was performed to evaluate postoperative complications after reduction mammaplasty in obese women, defined as a body mass index (BMI) greater than 30. The patients were divided into two groups on the basis of preoperative weight loss, those who were successful at weight loss and those who were not successful. All obese women who presented to the Plastic Surgery Clinic for a reduction mammaplasty were invited to participate in the study and the surgery was performed after giving the patients up to 6 months to attempt to lose weight in an effort to obtain medical insurance coverage for surgery. Diet and exercise were used by the patients to obtain weight loss. Data collection included demographic questions as well as the patient's initial weight and height, patient's weight at the time of surgery (amount of weight loss), bra cup size, if diabetic or smoker, breast specimen weight, and postoperative complications. The difference between the groups was evaluated using Student's t-test or Chi-square, whichever was appropriate, with p-value of less than 0.05 being considered significant. This study was approved by the Institutional Review Board.

Results: This study evaluated 274 obese women who had reduction mammaplasty. Of the group 123 (45%) had preoperative weight loss (mean 27±9 lbs) and 151 (55%) had no weight loss. The groups were not significantly different in age (29±10 vs. 28±11, $p>0.05$), initial BMI (34±2 vs. 33±3, $p>0.5$), bra cup size (DD vs. DD) frequency of diabetes (5% vs. 4%, $p>0.05$), frequency of smokers (2% vs. 2%, $p>.0.05$) and weight of breast tissue resection (911±129 vs. 927±113 grams, $p>0.05$). At the time of surgery the mean BMI of the group that loss weight was 30±2 and of the group that had no weight loss was 33±3. No significant difference was noted between the groups regarding postoperative complications such as surgical site infection (9% vs. 8%, $p>0.05$), fat necrosis (5% vs. 5%, $p>0.05$) and nipple necrosis (4% vs. 5%, $p>0.05$). There were no significant differences in the need for revisions or re-operations (3% vs. 3%, $p>0.05$). There were no deaths or major systemic complications in either group.

Conclusion: Our findings indicate that preoperative weight loss does not significantly decrease the complication rate of reduction mammaplasty in obese women. The mean attainable change in BMI prior to surgery does not appear to result in a significant change in postoperative complications.

Reference Citations:

1. Nguyen JT, Wheatley MJ, Schnur PL, Nguyen TA, Winn SR. Reduction Mammaplasty: A review of Managed Care Medical Policy Coverage Criteria. *Plast Reconstr Surg.* 2008;121:1092-1100.
2. Wagner DS, Alfonso DR. The influence of obesity and volume of resection on success in reduction mammaplasty: an outcome study. *Plast Reconstr Surg* 2005;115:1034-1038.

Posters:

The Silent Majority: A Mixed Methods Analysis on the Perspectives of Women Who Forgo Post Mastectomy Breast Reconstruction (PMBR)

Presenter:	Tanvee Singh, MPH
Co-Authors:	Lakshmi Goparaju, PhD, Aviram M. Giladi, MD, MS, Oluseyi Aliu, MD MS, David H. Song, MD, MBA, FACS, Kenneth L. Fan, MD
Affiliation:	Georgetown University School of Medicine,

PURPOSE: Post mastectomy breast reconstruction (PMBR) is an important component of breast cancer care that is associated with improved psychosocial well-being and survival[1-3]. The Women's Heath and Cancer Rights Act of 1998 mandated insurance coverage for reconstruction; however, rates of PMBR remain stagnant at approximately 40%[4]. There is a paucity of research on women who forgo reconstruction despite representing the majority of the post mastectomy patient population [5]. This study addresses that gap by investigating barriers in the preoperative pathway faced by patients who forgo PMBR.

METHODS: A mixed-methods study was performed using in-depth qualitative interviews and the BREAST-Q questionnaire. The study population consisted of women who received a referral to plastic surgery but choose to forgo PMBR. Women were stratified into two groups based on utilization of the referral to plastic surgery or lack thereof. Separate interview guides were developed for both groups and interviews were conducted until data saturation was reached. Interviews were coded and analyzed using iterative methodologies (e.g. open, axial, and selective coding) under the grounded-theory framework. The qualitative interview data and quantitative BREAST-Q data were analyzed using concurrent triangulation methodology. Reliability and validation checks included member-checking and inter-rater reliability using Cohen's kappa statistic (mean kappa =.99).

RESULTS: Interviews with eight patients who forwent PMBR revealed: 1) Lack of trust in both breast and plastic surgeons was salient; 2) Reliance on self-developed support networks and resources; 3) Association between lower post mastectomy BREAST-Q scores and decreased utilization of referral to plastic surgery; 4) Dissonance between numerical BREAST-Q scores for psychosocial well-being and reported satisfaction.

CONCLUSIONS These findings lay the conceptual groundwork acknowledging that non-legislative and non-financial barriers, such as physician distrust and lack of resources and patient-tailored information, contributes to underutilization of PMBR in certain populations. Use of qualitative methodology uncovered deficits in the current pathway to reconstruction faced by the silent majority of women who forgo PMBR including lack of trust in physicians, resources, and counseling. These findings suggest unmet needs of patients considering PMBR which necessitates efforts to address these deficits and increase quality of life and satisfaction after mastectomy by empowering vulnerable patient groups.

1. Ng SK, Hare RM, Kuang RJ, Smith KM, Brown BJ, Hunter-Smith DJ. Breast reconstruction post mastectomy: Patient satisfaction and decision making. Ann Plast Surg. 2016;76:640–644.
2. Lee CN, Deal AM, Huh R, et al. Quality of patient decisions about breast reconstruction after mastectomy. JAMA Surg. 2017;152:741–748.
3. Sheehan J, Sherman KA, Lam T, et al. Association of information satisfaction, psychological distress and monitoring coping style with post-decision regret following breast reconstruction. Psychooncology. 2007;16:342–351.
4. American Cancer Society. What are the key statistics about breast cancer? Available at: http://www.cancer.org/cancer/breastcancer/detailedguide/breast-cancer-key-statistics.
5.Alderman AK, Hawley ST, Janz NK, et al. Racial and ethnic disparities in the use of postmastectomy breast reconstruction: results from a population- based study. J Clin Oncol. 2009;27(32):5325-30.

Posters

Assessment of the "Wisconsin Criteria" for Obtaining Maxillofacial Computed Tomography in Trauma Patients at a Community Trauma Center

Presenter: Ryan D Konik, MD
Co-Authors: Gregory S Huang, MD, FACS
Affiliation: Mercy Health St. Elizabeth Youngstown Hospital, Youngstown, OH

Background: Maxillofacial injury occurs in 25% of trauma patients requiring trauma surgeons to have a high suspicion. Maxillofacial computed tomography (CT) scans is a sensitive method for detecting facial fractures; however, indiscriminate use exposes patients to unnecessary radiation, delays care, and adds additional cost. Sitzman et al. developed the "Wisconsin criteria" as a screening tool for patients at risk for facial fractures that would benefit from imaging. The "Wisconsin criteria" consists of five physical examination findings: bony step-off or instability, periorbital swelling, Glasgow Coma Scale (GCS) less than 14, malocclusion, or tooth absence. The presence of any one of the five criteria resulted in a sensitivity of 98.2% and a negative predictive value of 87.8%. An internal validation study discovered a similar sensitivity and negative predictive value. Harrington et al. failed to achieve similar results at their institution with an 81% sensitivity and a negative predictive value of 60% with the absence of all five exam findings. They concluded that the criteria may be institution specific and not generalizable to other trauma centers. Both study populations were pooled from trauma databases at academic Level 1 trauma centers. The purpose of this study is to assess the "Wisconsin criteria" at a Level 1 community trauma center through a retrospective case study of the trauma database.

Methods: A retrospective case study was performed consisting of all trauma activations within a six-month period from 5/1/2018 to 10/31/2018 who had undergone a maxillofacial CT scan. The electronic medical record was reviewed for demographics, injury severity score, mechanism of injury, GCS, intracranial injuries, cervical spine injuries, presence of facial fracture, type of fracture, and any operation performed. The presence of the "Wisconsin criteria" was based on the documented physical examination findings from the initial or tertiary examination. Sensitivity, specificity, positive predictive value, and negative predictive value were calculated. A $P<0.05$ was consider statistical significance. A comparison analysis of prior study results was performed. Institutional Review Board granted approval of the study.

Results: A total of 177 patients underwent a maxillofacial CT scan during the six-month period. There were 84 patients with facial fractures identified on imaging. The average age was 47.4. The majority were male involved in a motor vehicle collision or ground level fall. A total of 95 patients met the "Wisconsin criteria" on physical examination. The presence of ≥1 of the 5 criteria resulted in a sensitivity of 73.8% (63.1-82.8, 95% CI),

specificity of 64.5% (54.0-74.2, 95% CI), PPV of 65.3% (58.1-71.8, 95% CI), and NPV of 73.2% (64.9-80.1, 95% CI). These findings were comparable to those from the external validation analysis performed by Harrington et al. There were 21 patients with facial fractures requiring operative intervention with only 19 meeting the criteria.

Conclusions: The "Wisconsin criteria" is an adequate screening tool to help aid in selecting trauma patients for dedicated maxillofacial imaging. However, the sensitivity of the criteria is institution specific and not generalizable to all trauma centers.

Posters

Reconstructive Options for Composite Maxillary Defects with Orbital Exenteration – the Royal Adelaide Experience

Presenter:	Muhammad Umair Javed, MD, BSc, MSc (Res), FRCS (Plast)
Co-Authors:	Zehao Dong, MD, Yugesh Caplash, MBBS, MS (Gen Surg), MCh (Plastic Surg), FRACS (Plastic Surg)
Affiliation:	Department of Plastic Surgery,

Purpose: Composite orbito-maxillary defects following maxillectomy and orbital exenteration remain one of the most sophisticated reconstructive challenges in head and neck surgery. We present the outcomes of a 15-year single-centre review of patients who underwent reconstruction of Cordeiro types IIIB & IV defects, and review the reconstructive options.

Methodology: All patients who underwent maxillectomy with orbital exenteration between 2004-2019 were identified from the Royal Adelaide Hospital Plastic Surgery database. Patient's medical records, operation notes, pre- and post-operative photographs were reviewed. The reconstructive methods were analysed based on defect components – skin, maxilla, orbit, palate, and skull base.

Results: A total of 22 patients underwent reconstruction for Cordeiro types IIIB & IV orbito-maxillary defects. The most common pathologies were SCC (59%) followed by melanoma (18%). Fourteen (64%) patients had type IIIB and eight (36%) had type IV defects. The most commonly used free flaps were rectus abdominis with or without skin paddle (55%), ALT (22%), and ALT/vastus lateralis chimeric flap (14%). Reconstructive options for the skin, maxilla, orbit, palate, and skull base were analysed and described in detail. Flap survival rate was 95%. Other post-operative complications included haematoma (9%) and infection (9%).

Conclusion: Reconstruction of Cordeiro types IIIB and IV defects should identify and address each defect component to achieve soft tissue coverage, contour, oro-nasal, and cranio-nasal separation. The most robust and versatile option is the rectus abdominis free flap. In our experience, bony reconstruction is not required for most Cordeiro IIIB and IV defects.

Posters

Preparation of a Surgical Guide for the Prevention of Injury to the Angular and Periosteal Branches While Performing Osteotomy for the Harvest of Vascularized Scapular Chimeric Free Flap for Mandibular Reconstruction

Presenter:	Chihiro Matsui, MD
Co-Authors:	Takakuni Tanaka, DDS, PhD, Doruk Orgun, MD, Yong Moon Kim, DDS, Takumi Imai, DDS, Hiroshi Mizuno, MD, PhD
Affiliation:	Juntendo University Hospital, Tokyo, Japan

A surgical guide for mandibular reconstruction using the scapular chimeric flap to prevent injury of the angular and periosteal branches.

Purpose: Mandibular reconstruction using the scapular free flap is one of the most commonly performed surgical procedures. One of the difficulties of harvesting the scapular flap is the close proximity of the thick infraspinatus muscle to the bone surface.

Another problem is that when a chimeric flap is desired, because bone has a higher peripheral vascular resistance than soft tissue, and the blood flow to the bone flap can be insufficient with the thoraco-dorsal arteriovenous system alone. Thus, we often have to use the circumflex scapular artery to supercharge blood flow for the bone flap.

Therefore, it is important to visualize the angular branch of thoracodorsal and periosteal branches of the circumflex scapular artery while performing osteotomy. These vessels can be easily injured since their course is in close proximity to the insertion of the muscle at the scapular wing. Here we report our experience of using preoperative 3D CT angiography and 3D printed scapular models in order to prepare surgical guides from autoclavable dental silicon impression to easily visualize the angular and periosteal branches for flap harvest.

Materials and methods: Eight patients aged 57 to 78 who had surgery from April 2018 to January 2020 were included in the study. Three patients had ameloblastoma, two had medicine-induced osteonecrosis, two had mandibular gingival cancer, and one had radiation induced mandibular osteonecrosis. Every patient underwent segmental mandibulectomy for lesion resection. Scapular models were prepared using a 3D printer and drill markings of the perforating angular and periosteal branches were added to the models with the guidance of life-sized printouts of 3D CT angiography images of the subscapular artery. A simulation osteotomy to the model was then carried out. The osteotomized bone model was used to mold the autoclavable dental silicon impression surgical guide, which would then be ready for use intraoperatively. All cases included harvesting of chimeric latissimus dorsi and serratus anterior muscle flaps with the scapular bone flap following resection of the mandibular area. Angular and periosteal branches were located by placing the surgical guide on the muscle mass intraoperatively.

Results: No injuries were caused to the angular and periosteal vessels and no complications such as flap necrosis, fistula formation or surgical site infection were recognized in any of our cases. Blood flow to the flaps were excellent. The cost of surgical guide preparation was only 5 USD per patient.

We also checked the differences between pre- and post-operative bone lengths for all cases using simulation surgery models and post operative 3DCT. Mean bone length difference was 1.7mm. The mean flap harvesting time was 43 minutes.

Conclusion: Here we propose an easily preparable surgical guide using sterilizable material, which allows osteotomy to be carried out safely while harvesting the scapular flap without any vessel injury, in a more accurate fashion in less time. The mentioned guide is low-cost compared to other similar models and easily accessible even in smaller clinical settings.

Posters

An MRI Case Study: The Anatomic Palate Restoration Concept Utilizing Buccal Flaps in a Primary Palatoplasty

Presenter: Samuel A. Mann, BS
Co-Authors: Robert J. Mann, MD, Abigail E. Haenssler, MS, Jamie L. Perry, PhD
Affiliation: Spectrum Health, Grand Rapids

Background: Primary palatoplasties using the Anatomic Palate Restoration Concept uses the buccinator myomucosal flap (buccal flap) to correct the tissue deficiency within the cleft palate malformation. Buccal flaps are used to replace the missing tensor veli palatini aponeurosis and mucus membrane. The surgical approach aims to close the palate without tension, lengthen the palate, reconstruct the levator muscular sling, not inhibit craniofacial growth and achieve proper oral-nasal resonance for speech[1-2]. To the best of our knowledge, this is the first study to use magnetic resonance imaging (MRI) to demonstrate the changes that occur to the velopharyngeal anatomy following the surgical repair. The purpose of this study is to present preliminary data on velopharyngeal variables to demonstrate the muscle and tissue morphology in adults with cleft palate who have not received a secondary surgery for speech or orthognathic surgery.

Methods: MRI was used to analyze velopharyngeal variables for a single participant. The participant was a 19-year old Caucasian male with a unilateral cleft lip and palate who received primary palatoplasty using the buccal flap approach. MRI data were viewed in Amira 6.5.0 Visualization Modeling software. Velopharyngeal measurements were obtained on the midsagittal image.

Results: All variables were compared to previously published normative data of velopharyngeal variables for individuals with non-cleft anatomy who are of the same race, sex, and of similar age[3]. Velar length and velar thickness were both greater in the individuals with the buccal flap repair, in comparison to the individuals with non-cleft anatomy. Levator length and the distance from the PNS to PPW were both shorter in the individual with the buccal flap repair. Visually, the individual with the buccal flap presents with a thicker and longer velum.

Conclusions: This study is the first to demonstrate the velopharyngeal muscle and tissue arrangement following primary palatoplasty using the buccal flap approach. The individual presents with a longer and thicker velum in comparison to age- and sex-matched individuals with non-cleft anatomy. This study highlights the utility of using MRI to quantify the changes that occur to the velopharyngeal anatomy following the buccal flap surgical approach. Future studies should assess how these anatomical changes impact speech and compare data to Z-Plasty without the use of the buccal flap repair and to individuals with non-cleft anatomy. Our research team is currently investigating this line of research and specifically seeking to improve our understanding of the functional impact of this surgical method on speech.

1- Mann RJ, Fisher DM. Bilateral buccal flaps with double opposing Z-plasty for wider palatal clefts. *Plast Reconstr Surg.* 1997;100(5):1139-1143.

2- Mann RJ, Martin MD, Eichhorn MG, Neaman KC, Sierzant CG, Polley JW, Girotto JA. The double-opposing z-plasty plus or minus buccal flap approach for repair of cleft palate: A review of 505 consecutive cases. *Plast Reconstr Surg.* 2017;139:735e-744e.
3- Perry JL, Kollara L, Sutton BP, Kuehn DP, Fang X. Growth effects on velopharyngeal anatomy from childhood to adulthood. *J Speech Lang Hear Res*. 2019;62:682-692.

Posters

National Characteristics and Patterns of Facial Fractures in the Elderly Population

Presenter: Zhazira Irgebay, BA
Co-Authors: James Choi, MD, Elizabeth G Zellner, MD
Affiliation: New York Medical College, Valhalla, NY

Background: Given the increasing elderly population in the United States, the number of people seeking care for trauma injuries is expected to rise[1]. However, nationwide studies on the epidemiological profile of elderly facial fractures remain sparse[2]. Our retrospective study presents the characteristics and patterns of elderly facial fractures on a national scale.

Methods: Characteristics of facial fractures among non-elderly adults (64 years and younger) and elderly population (65 years and older) were examined using the 2016 American College of Surgeons - Trauma Quality Improvement Project (ACS – TQIP) database. All elderly patients were further sub-divided into three age groups: 65 – 74 years old, 75 – 84 years old, and 85 years and older. This study examined types of facial fracture patterns, mechanisms of injury, and demographic data. Further subgroup analysis of the different fracture types was also conducted, examining the same variables.

Results: 3,415 (3.3%) elderly patients presented with facial fractures out of 104,183 elderly trauma patients. The majority of facial fractures in the older 85 and over group (60.7%) were experienced by females, whereas only 19.5% of fractures in the younger adult group (<65 years old) were experienced by women. The most common mechanism of injury (MOI) in the elderly was falls, with Motor Vehicle Transport (MVT) being the most common MOI in adults. The most common type of facial fractures among the elderly and non-elderly were nasal fractures ($p = 0.04$). Elderly patients presented with significantly fewer zygoma and mandibular fractures when compared to non-elderly patients ($p = 0.001$ and $p = 0.001$ respectively), while showing significantly more maxillary/malar and orbital bone fractures. Fractures suffered by elderly patients were less severe compared to younger adults ($p = 0.001$) as reflected by the Injury Severity Score (ISS). Elderly patients experienced less operative management (4.3% - 8.2%) compared to younger adults (15.6%), with the rate of operative management decreasing with increasing age of patients. In addition, mortality rates were higher in the elderly patients when compared to their younger counterparts ($p = 0.001$). Elderly patients were also less likely to present with associated skull fractures, but more likely to present with TBI.

Conclusions: Elderly patients presented with different causes of injury, distribution of fractures, comorbidities and rates of operative management as well as mortality compared to their younger adult counterparts.

Citations:

1. Baidwan NK, Naranje SM. Epidemiology and recent trends of geriatric fractures presenting to the emergency department for United States population from year 2004-2014. *Public Health*. 2017; 142:64–9.
2. Shumate R, Portnof J, Anundson M, et al. Recommendations for care of geriatric maxillofacial trauma patients following a retrospective 10-year multicenter review. *Journal of Oral Maxillofacial Surgery*.2018; 76:1931-1936

Posters

Presurgical Maxillary Orthopedics and Primary Alveolar Closure: Protocol and Long-Term Effects on Midfacial Growth in Patients with Complete Unilateral and Bilateral Clefts

Presenter: Erin M. Wolfe, B.S.
Co-Authors: Blake D. Murphy, MD, Marta Mejia, DDS, S. Anthony Wolfe, MD, Ana Tejero, DDS
Affiliation: Nicklaus Children's Hospital, Miami, FL

Background: In a complete cleft lip and palate, a defect exists in the alveolar segment of the maxilla. In order to achieve successful restoration of the maxillary arch, several techniques have been employed with the ultimate goal of achieving continuity and adequate bone stock across the alveolus. Passive orthodontic appliances (POA) and gingivoperiosteoplasty (GPP) are adjuncts utilized by some surgeons with primary cleft lip repair. POA aligns the alveolar segments prior to cleft lip repair, and GPP is utilized to achieve bony union across the cleft at the time of primary lip repair. The use of these treatment remains controversial. Along with the surgical technique of the cleft lip and palate repair, they have the possibility of impacting midface growth. Here, we present our protocol for cleft lip and palate repair utilizing GPP and POA for complete unilateral and bilateral cleft lip and palate patients. We also report preliminary treatment results in complete unilateral and bilateral cleft patients, evaluating midface growth at mixed dentition.

Methods: Ten consecutive complete unilateral and ten consecutive complete bilateral cleft lip and palate patients were recruited. All presurgical molding was performed by a single individual, and all surgical treatments were performed by the senior author. Patients underwent POA treatment (initiated at 7 days) for 35 weeks. The nasal component was incorporated after 6 weeks. GPP was performed by elevating flaps in the subperiosteal or supraperiosteal plane and closing the alveolar defect. Unilateral cleft patients underwent rotation advancement repair at approximately 6 months, whereas bilateral cleft patients underwent staged repair with a similar technique at approximately 6 and 9 months of age. Cephalometric analysis of lateral radiographs of patients at mixed dentition was performed to evaluate maxillary and mandibular growth (SNA, SNB, ANB) and facial growth relative to the facial axis (Facial Axis angle).

Results: Twenty patients underwent POA, cleft lip closure with GPP and cephalometric analysis. Mean age at time of surgery for all patients was 6.8 months±2.6 months of GE with a range of 5 to 14 months of age. Mean cephalometric values were within age-specific normal values for SNA (80±3.7°), SNB (74±3.4°), ANB (4±1.4°) and the Facial Axis angle (90±3.5°). One unilateral patient and zero bilateral patients exhibited skeletal class III malocclusion.

Conclusion: Although controversy exists regarding the impact of GPP and POA on midface growth in cleft patients, our results demonstrate that GPP and POA do not interfere with maxillary grow or cause a Class III

malocclusion at mixed dentition in most patients. POA, combined with GPP at the time of cleft lip repair, leads to normal maxillary development in unilateral and bilateral cleft lip and palate patients at mixed dentition. We feel that the normal maxillary growth justifies continuing the use of GPP and POA, especially when considering the potential advantageous that they can afford at the time of primary cleft lip repair, such as allowing for closure of the alveolus and anterior palate and achieving bony union across the cleft.

Posters

The Impact of Virtual Surgical Planning on Orthognathic Surgery: A Comparison of Two Specialties

Presenter:	Jonlin Chen, co-first, BS
Co-Authors:	Mya Abousy, BA, Viren Patel, BS, Olga Duclos, PA-C, Hillary E Jenny, MD, Jordan P Steinberg, MD, PhD, FACS, FAAP, Richard J. Redett, MD, Robin Yang, MD
Affiliation:	Johns Hopkins University School of Medicine, Baltimore, MD

Purpose: Virtual surgical planning (VSP) is the gold standard for pre-operative treatment planning for orthognathic surgery.[1] Prior to the implementation of VSP, traditional orthognathic pre-operative preparation required hours of labor and utilization of a dental laboratory. This often limited orthognathic surgery to providers with dental training. The combination of VSP and 3D printing has allowed orthognathic surgeons the ability to more accurately and efficiently create treatment plans for these cases.[2] This technology has also allowed practitioners such as plastic surgeons to begin to perform orthognathic procedures. This review serves to illustrate how plastic surgeons use VSP and highlight its impact on surgical outcomes and research output within orthognathic surgery.

Methods: A literature search was conducted in the PubMed database to identify all articles published before January 2020 that report perioperative use of VSP technology in orthognathic surgeries. Only articles that were written in English, involved operations on live human patients, and used VSP to plan or assist with orthognathic surgery were included in the analysis. All articles that fit inclusion criteria were reviewed to determine the year of publication, type of orthognathic surgery performed, how VSP was used, and the primary outcomes measured.

Results: A total of 419 publications regarding VSP in orthognathic surgery resulted from initial search. Of them, 244 publications were authored by oral and maxillofacial surgeons, 28 publications by plastic surgeons, and 34 by surgeons with training in both fields.

Temporal Trend of Publications

Prior to the late 1990's, VSP in orthognathic surgery publications were primarily authored by oral and maxillofacial surgeons. Plastic surgeons first began publishing on VSP technology for orthognathic surgery in 1998. Since then, there has been a rising trend in plastic surgery usage of VSP paralleled by increasing VSP publications in the field, with two publications before the year 2010 (7.2%), nine from 2010-2015 (32%), and 18 between 2015 and 2019 (64%).

Categories of Publications

Most publications from oral and maxillofacial trained surgeons highlight optimal positioning of craniofacial bones, anticipated stability and functionality of occlusion, and the interplay between orthodontic treatments and orthognathic surgery. In contrast, plastic surgeon authored papers often discuss postoperative facial aesthetics by ensuring facial symmetry and treatment especially in the cases of congenital craniofacial abnormalities like cleft lip/palate, Treacher-Collins, and hemifacial microsomia.

Conclusions: VSP is an increasingly utilized tool that reduces the workflow without compromising accuracy and outcomes in orthognathic surgery. This is the first paper to create a temporal relationship between a new technology and the emergence of plastic surgeons into a field typically predominated by oral and maxillofacial surgeons. As plastic surgeons become more familiar with this technology, they have produced literature that provides alternative perspectives on orthognathic surgery that will push the field forward.

References:

1. Langdon, J., Patel, M., & Brennan, P. (2010). Operative Oral and Maxillofacial Surgery Second edition. CRC Press.
2. Baker, S. B., Goldstein, J. A., & Seruya, M. (2012). Outcomes in computer-assisted surgical simulation for orthognathic surgery. Journal of Craniofacial Surgery, 23(2), 509-513.

Posters

Measuring Facial Landmarks of Attractive People Around the World: A Scoping Review

Presenter: Waverley Y. He, BA
Co-Authors: Anna J. Gong, BA, Wilmina N. Landford, MD, Robin Yang, MD
Affiliation: Johns Hopkins University School of Medicine, Baltimore, MD

PURPOSE: The ideal outcome of any craniofacial surgery requires consideration of balance with the patient's whole face. Detailed cephalometric measurement of the face plays an essential role in planning these surgical procedures. "Attractive" facial measurements and proportions vary widely across different racial groups.[1,2] To our knowledge, the variation in facial beauty standards around the world has not yet been reviewed. This scoping review aims to summarize how racial groups are delineated, identify methodologies used for cephalometric analysis of attractive adults, and summarize findings in the existing literature.

METHODS: A scoping review was conducted using the Arksey and O'Malley methodological framework. Five bibliographic databases were queried for studies using keywords relevant to cephalometric analysis, photogrammetry, and race or ethnicity. Two independent reviewers completed abstract and full-text screening to identify original studies with measurements soft tissue facial landmarks in attractive adults of a specified race. Differences were resolved by consensus. Data on subject characteristics, cephalometric analysis methodology, and linear and angular craniofacial measurements were collected.

RESULTS: The search yielded 1,058 unique articles, of which 186 were selected for full-text screening and 19 were included. Overall, cephalometric analysis was conducted on 1,107 attractive adults. One thousand and two (90.5%) of these subjects were female and 105 (9.5%) were male. Six hundred twenty-four (56.4%) were white, 462 (41.7%) were Asian, and 21 (1.9%) were black. Among Asian groups, racial categories tended to be more granular; frequently both countries of descent and nationality were specified (e.g. Korean-American), whereas often only the region or country were specified for white and black groups. Methodologies either utilized 3D

scanners (n=4), 2D cameras (n=8), or photos from the Internet (n=6). While studies tracked similar facial landmarks, calculated linear and angular measurements varied. Studies comparing attractive women from different racial groups did not yield significant differences,[1] although Asian models had more acute angles compared to white models at the alar curvature point and labiale inferius. Studies comparing attractive white models to normal white women concluded that attractive women have more "juvenile" characteristics, including a wider soft tissue orbital area.[2]

CONCLUSIONS: These aesthetic facial measurements should be taken into consideration during preoperative planning to accommodate patients' cultural backgrounds. While existing studies adequately characterize attractiveness in European and Asian countries, it remains challenging to evaluate transcultural beauty standards for people of mixed race and people in ethnically diverse countries, where perceptions of attractiveness are shaped both by their own racial features as well as prevailing norms. There is also a paucity of studies examining attractive males, as well as attractive people from non-white and Asian backgrounds. Cephalometric analyses of attractive adults have been performed mostly using two-dimensional scanning systems or photographs; future analyses should be conducted using three-dimensional scanning systems now that this technology is available.

References:

1. Rhee SC, Kang SR, Park HS. Balanced angular profile analysis. *Plast Reconstr Surg*. 2004;114(2):535-544. doi:10.1097/01.PRS.0000131873.98390.36
2. Sforza C, Dolci C, Grandi G, Tartaglia GM, Laino A, Ferrario VF. Comparison of soft-tissue orbital morphometry in attractive and normal Italian subjects. *Angle Orthod*. 2015;85(1):127-133. doi:10.2319/012814-75.1

Posters

Long-Term Outcomes after Facial Allotransplantation: Systematic Review of the Literature

Presenter:	Bianief Tchiloemba, MSc, MD(c)
Co-Authors:	Martin Kauke, MD, Valentin Haug, MD, Obada Abdulrazzak, BSc, Ali-Farid Safi, MD, DMD, Branislav Kollar, MD, Bohdan Pomahac, MD
Affiliation:	Harvard University, Boston, MA

Background: Facial vascularized composite allotransplantation (fVCA) is a solution for patients with severe facial disfigurement for whom conventional reconstructive techniques do not suffice. However, most evidence about the outcomes of fVCA is derived from single centers, reporting on short term results or technical feasibility. To better understand the risks and benefits of fVCA, it is imperative to pool data from different medical institutions. The aim of this study is to comprehensively synthesize long-term outcomes after fVCA from the available scientific literature.

Methods: Following the PRISMA guidelines, we conducted a systematic review analyzing publications in the PubMed/MEDLINE database. Full text review articles were included if they provided original data on fVCA with at least one outcome measure with three or more years of follow-up.

Results: The literature search retrieved 1812 articles, from which 28 met the inclusion criteria. Thirty different outcome measures on 23 patients from 6 different medical institutions were identified. The mean follow-up was

5.3 ± 1.9 years and the most common mechanism of injury was ballistic trauma (43.5%), followed by burns (30.4%). After fVCA, 100% of the patients depending on tracheostomy and gastrostomy were decannulated. Compared to pre-transplant state, more than 50% of patients had improvements in quality of life (QOL), eating, speech, motor and sensory functions. Overall, the patients had 0.92 acute rejection episodes per 1 transplant-year (TY). The treatment response didn't correlate with histological grades of rejection, since the adjustment of the maintenance immunosuppression alone resolved 27.1% and 36.2% of all grade 2 and 3 rejection episodes, respectively. Bacterial infections had a higher incidence rate (0.59 events/1TR) than viral (0.49 events/1TR) and fungal infections (0.14 events/1TR). For both acute rejection and infectious episodes, the incidence rates decreased after the first post-transplant year. Transient nephrotoxic episodes (30.4%), dyslipidemia (21.7%), chronic kidney disease (13.0%), hypertension (13.0%) and diabetes mellitus (13.0%) were among the most commonly developed metabolic complications post-operatively. Post-transplant lymphoproliferative disease, lung cancer and in situ cervix carcinoma presented all equally in 4.3% of the patients. Chronic skin changes (maculopapular lesions, papillary dermal sclerosis, lichenoid aspect) were observed in 30.4% of patients but they did not correlate with decreased allograft function. Chronic vascular rejections were confirmed in two patients and led to allograft loss after 8 and 9 years. Two patients died after 9 and 4 years post-operatively due to lung cancer and suicide, respectively. The quantitative outcome measures for which an important number of patients had missing data were mouth opening (82.6%), speech intelligibility test (78.3%), two-point discrimination (69.6%), hot/cold discrimination (60.9%), monofilament test (56.5%), motor function (electromyography/manual exam) (56.5%) and the QOL (34.8%).

Conclusion: This multi-center compilation of long-term outcomes after fVCA shows an overall favorable post-operative improvement in QOL and allograft functionality. However, the data suggests that, in some cases, the positive outcomes can be compromised by immunosuppression-related complications and the threat of chronic rejection. Future outcomes research in fVCA should focus on standardizing the outcome measures between the centers as well as refining the tools for measurement of procedure-specific functional and QOL gains.

Posters

Fleur-De-Lys Myocutaneous Flap for Complex Sacral Reconstruction

Presenter: Lucas Kreutz-Rodrigues, MD

Co-Authors: Samir Mardini, MD, Tarek Elgendy, MBBS, Karim Bakri, MBBS

Affiliation: Mayo Clinic, Rochester, MN

Introduction: Massive sacral defect resulting from total sacrectomy presents a reconstructive challenge[1], and in some cases the use of vertical or transverse Rectus Abdominis Muscle (RAM) flap may not provide enough soft tissue to reconstruct it. The use of Fleur-de-lys flap technique has been described in cases of autologous breast reconstruction and for thoracic wound defects.[2,3] The aim of this study is to describe the surgical technique of the combination of Transversal Rectus Abdominis Muscle (TRAM) flap with the Vertical Rectus Abdominis Muscle (VRAM) flap, which assumes the form of a "Fleur-de-lys", and to identify the population of patients reconstructed by this technique followed sacral resection.

Methods: A retrospective chart review was conducted on patients undergoing oncologic sacral resections followed by Fleur-de-lys myocutaneous flap for soft tissue reconstruction between December 2008 and December 2019. Demographics, clinical and surgical characteristics, postoperative outcomes and complications were reviewed.

Results: Two patients underwent Fleur-de-lys myocutaneous flap to sacral reconstruction. A 44 year-old male and a 31 year-old female, both patients presented with a locally advanced sacropelvic chordoma requiring en bloc total sacrectomy and rectal resection. The mean tumor size was 2139 cm^3, and the soft tissue defect 13920 cm^3. Patients underwent pelvic instrumentation with hardware and fibular grafts (one patient bilateral free fibula flap; the other allograft fibular bone) for spine and pelvic reconstruction followed by pedicled Fleur-de-lys flap. The posterior abdominal wall was reconstructed in 1 patient with Alloderm to avoid bowel herniation. One patient developed a minor abdominal wound dehiscence, managed with dressing change, and wound vac. The other patient presented wound infection and minor dehiscence in the abdominal and sacral requiring surgical debridement with successful healing. The mean hospital stay was 74 days (63-85), and the follow-up was 13 months (7-19). One patient expired after 19 months of the initial surgery.

Conclusion: The Fleur-de-lys myocutaneous flap obliterates massive soft tissue defects resulted from total sacral resections, and avoids the need of other flaps with low morbidity associated.

References:

1. Kreutz-Rodrigues L, Banuelos J, Saleem HY, Mills AM, Tran NV, Bakri K. The Use of Vertical Rectus Abdominis Myocutaneous Flap for Pelvic Reconstruction: What Are the Risk Factors for Complications? *Plast Reconstr Surg Glob Open.* 2019;7(8 Suppl):75-75.
2. Marshall DR, Ross DA. A Fleur de Lys modification of the TRAM flap for breast reconstruction. *Br J Plast Surg.* 1994;47(8):521-526.
3. Anthony JP, Foster RD. The reconstruction of complex thoracic wounds: a fleur-de-lys modification of the rectus abdominis myocutaneous flap. *Plast Reconstr Surg.* 2001;107(5):1229-1233.

Posters

Targeted Muscle Reinnervation for the Prevention and Treatment of Post-Amputation Pain and Improvement of Prosthetic Function: A Systematic Review

Presenter: Waverley Y. He, BA
Co-Authors: Amanda L. Chow, BA, Wilmina N. Landford, MD, Jaimie Shores, MD
Affiliation: Johns Hopkins University School of Medicine, Baltimore, MD

PURPOSE: Targeted muscle reinnervation (TMR) is a surgical technique where transected nerves in amputated limbs are redirected to new motor targets.[1] TMR was originally developed to enhance prosthetic control following amputation, but has recently also become popular for managing post-amputation pain.[2] Standardized outcome measures and time points to evaluate pain and prosthetic function in these patients have not yet been established. We aim to identify and recommend assessment tools used to assess pain and prosthetic function following TMR, as well as to summarize early results.

METHODS: A comprehensive search of literature was conducted using five bibliographic databases. Two independent reviewers screened abstracts and full-text articles to select studies describing post-amputation pain and/or prosthetic function outcomes of TMR. Methodological quality was appraised using the Newcastle-Ottawa Scale (NOS) and Cochrane Risk of Bias tool (RoB). Studies with duplicate patient populations were identified. Data was extracted including timing of TMR with respect to amputation, location of amputation, and measured pain and/or prosthetic function outcomes. Differences between reviewers were resolved through consensus.

RESULTS: A total of 476 articles were identified, of which 62 were selected for full-text screening and 16 studies were included. Studies from eight institutions were represented, including 4 cohort studies and 1 randomized controlled trial.[3] Overall, 253 unique patients underwent TMR. One hundred (39.53%) patients were male and 40 (15.81%) were female. Ten studies assessed pain outcomes and 7 described prosthetic function outcomes. Three assessment tools were used to analyze pain: Patient-Reported Outcomes Measurement Information System (PROMIS) in 3 studies, Numerical Rating Scale (n=2), and Visual Analogue Scale (n=3). Studies showed decreased prevalence of neuroma pain and phantom limb pain (PLP) following primary TMR compared to amputation only. Prevalence of pain following secondary TMR also decreased postoperatively, although intensity of PLP transiently increased. Primary TMR lead to a greater decrease in PROMIS pain scores compared to amputation only, although there was no significant difference in pain scores following secondary TMR compared to standard neuroma excision treatment. Nine assessment tools were used to evaluate prosthetic function, including box-and-block test (n=5), clothespin relocation test (n=4), and amputee mobility predictor (n=3). Of the 5 studies using box-and-block test, 4 demonstrated improved prosthetic function following TMR.

CONCLUSIONS: Early reports of TMR for the prevention and treatment of post-amputation pain are convincing, although the variation in prosthetic training time and scarcity of comparative studies makes it difficult to determine comparative effectiveness for prosthetic function. We recommend that future prospective studies evaluating pain and prosthetic function deploy common assessment tools, such as PROMIS and box-and-block test, at consistent time points.

References:

1. Cheesborough JE, Smith LH, Kuiken TA, Dumanian GA. Targeted muscle reinnervation and advanced prosthetic arms. *Semin Plast Surg*. 2015;29(1):62-72.
2. Souza JM, Cheesborough JE, Ko JH, Cho MS, Kuiken TA, Dumanian GA. Targeted Muscle Reinnervation: A Novel Approach to Postamputation Neuroma Pain. *Clin Orthop Relat Res*. 2014;472(10):2984-2990.
3. Dumanian GA, Potter BK, Mioton LM, et al. Targeted Muscle Reinnervation Treats Neuroma and Phantom Pain in Major Limb Amputees: A Randomized Clinical Trial. *Ann Surg*. 2019;270(2):238-246.

Posters

Combined Technique of Local Finger Flap and Partial Toe Flap for Finger Nail Reconstruction

Presenter:	Yuichi Hirase, MD, PhD
Co-Authors:	Arisa Okubo, MD, Hisasuke Onozawa, MD, Mikio Yagishita, MD, Keishu Iwashiro, MD, Tetsuo Yamada, MD, Yuri Kanno, MD
Affiliation:	Yotsuya Medical Cube, Tokyo, Japan

Background: Toe transfer operation for nail reconstruction of the hand is an established technique. However, although reconstruction of a cosmetic nail at the recipient site has become possible, the problem of the donor site in toes has not disappeared. The greatest problem of the conventional wrap-around flap method is a postoperative skin ulcer at the donor site of the toe because a large skin flap is harvested from the great toe and surgical dissection is invasive to the weight-bearing region.
The authors have developed a new method for avoiding postoperative skin ulcer formation at the donor site. It consists of a combination of a finger flap elevated at the recipient site and a partial toe flap harvested from the great toe without dissecting the weight-bearing region.

Methods: A local finger flap is elevated at the recipient site and a partial toe flap including the nail is harvested from the great toe. They are combined to make a finger. Using this procedure, the size of the partial toe flap is slender and the weight-bearing region remains intact.
The donor site wound is closed with artificial dermis once, and skin grafting is performed at 3 weeks after surgery.

Results: This procedure was performed in 31 fingers of 30 patients. In 2 smokers who were older than 60 years old, the partial toe flaps became necrotic but in the other 28 patients, flaps survived well and aesthetic fingertips were achieved. In all patients, the weight-bearing region of the great toe was intact and there was no trouble walking after surgery.

Conclusion: Surgical invasion to the weight-bearing region may produce a skin ulcer postoperatively. However, the combination of a local finger flap and a partial toe flap results in a smaller skin defect of the great toe. This new concept of nail reconstruction is minimaly invasive and simpler as a surgical technique.

Posters

The Role of Reverse Posterior Interosseous Artery (rPIA) Flap in Toe Transfer

Presenter: SuRak Eo, MD
Co-Authors: BumSik Kim, MD; Ki Yong Hong, MD; GiJun Lee, MD; Yea Sik Han, MD; Jung Soo Yoon, MD
Affiliation: DongGuk University, Seoul, South Korea

Background: Reverse posterior interosseous artery (rPIA) flap is an excellent tool for the restoration of defects in the hand and upper extremity. Its reliability and versatility are well established. Compared with the other forearm flaps, it spares the main arteries to the hand. Although very few case reports used the reverse radial forearm flap to provide arterial inflow for the toe-to-thumb transfer, the role rPIA flap in such cases has yet to be described.

Methods and Materials: Five procedures involving four patients performed by a single surgeon to power up a toe-to-thumb transfer were reviewed. In all the cases, the first dorsal metatarsal artery was anastomosed to the transposed proximal posterior interosseous artery.

Results: Three patients underwent unilateral reconstruction and one patient had bilateral thumb base reconstruction using rPIA flaps. Secondary toe-to-thumb transfers were performed at 1 to 7 months after mounding up the thumb base with rPIA flaps. All the flaps and toe transfers survived completely without any partial necrosis. All patients were satisfied with the functional outcome as well as the appearance of the thumb.
Conclusion: The use of the proximal posterior interosseous artery pedicle in rPIA flap is a safe and reliable procedure especially in cases involving traumatic loss of the thumb. In addition to the simple soft tissue coverage around the thumb base, the rPIA flap also provides a satisfactory arterial inflow during subsequent toe-to-thumb transfer.

References
1. Zancolli EA, Angrigiani C. Posterior interosseous island forearm flap. J Hand Surg Br. 1988;13:130-135.
2. Kim J, Yoon AP, Jones NF. Reverse Radial Forearm Flap to Provide Arterial Inflow to a Toe Transfer. Hand (N Y). 2017;12:154-161.
3. Keramidas E, Miller G. The use of the reverse radial fasciocutaneous flap to provide soft tissue coverage and a distal recipient artery in a difficult case of toe-to-thumb transfer. Br J Plast Surg. 2005;58:728-31.

4. Mahoney J, Naiberg J. Toe transfer to the vessels of the reversed forearm flap. *J Hand Surg Am*. 1987;12A:62-65.
5. Zaidenberg EE, Farias-Cisneros E, Pastrana MJ, Zaidenberg CR. Extended Posterior Interosseous Artery Flap: Anatomical and Clinical Study. J Hand Surg Am. 2017;42:182-189.

Posters

Patient-Reported Quality of Life Outcomes in Patients with Neurofibromatoses Undergoing Surgery

Presenter:	Ayana K. Cole-Price, BS
Co-Authors:	Eduardo Gonzalez, MD, Jordan D Frey, MD, Z-Hye Lee, BA, Kaleb Yohay, MD, Sheel Sharma, MD
Affiliation:	New York University School of Medicine, New York, NY

INTRODUCTION: Surgical excision of dermal neurofibromas and peripheral nerve sheath tumors in patients with neurofibromatosis and Schwannomatosis represents a therapeutic challenge as no evidence-based guidelines for indicating surgery in these patients exist. Mainstay of treatment is symptomatic, focused primarily on pain management. We report our Neurofibroma center's experience with surgical excision of Neurofibromas and peripheral nerve sheath tumors by describing patient demographics, tumor characteristics, indications, and the impact of surgery on patient-reported quality of life outcomes.
METHODS: Patients with Neurofibromatosis type 1, type 2, and Schwannomatosis undergoing surgery for excision of neurofibromas or peripheral nerve sheath tumors during a consecutive ten year period (2009-2019) enrolled in a prospective database as approved by our Institutional Review Board. Demographics, medical history, radiology and surgical pathology reports were collected from the electronic medical record. A survey consisting of questions regarding interference of symptoms with daily activities (e.g., dressing, ambulating), pain scale, impression of overall state of health, and experience with surgery was applied either in-person or over the phone. Survey questions were answered using a Likert scale. Primary outcome was comparison of the quality of life survey questions before and after surgery. Measures of central tendency and descriptive statistics were used to describe absolute and mean results of patient demographics and tumor characteristics. Student's t-tests were used to analyze binary data sets. Statistical significance was predetermined at $p<0.05$.
RESULTS: A total of 154 excisions were performed on 106 patients. Seventy-seven patients (72.6%) carried the diagnosis of Neurofibromatosis Type 1, 11 (10.4%) were diagnosed with Neurofibromatosis Type 2, 11 (10.4%) were diagnosed with Schwannomatosis, and 7 (6.6%) of patients were found to be sporadic. Pain was the most common presenting symptom (79%). The most common locations for excision were the extremities with 32.2% of cases occurring in the upper extremity and 35.8% in the lower extremity. Tumor size ranged from 0.2 cm to 25.5 cm, and the majority (46.7%) of lesions were between 2cm and 4.9cm in size. Pathologic analysis from the 154 operations revealed 87 (56.5%) cutaneous neurofibromas, 42 (27.3%) peripheral nerve sheath tumors and 10 (6.5%) plexiform neurofibromas.
Improvement in overall general health after surgery was reported by 79% of patients. Analysis of survey responses demonstrated significantly decreased bodily pain ($p<0.0001$) and interference from pain ($p<0.0001$) post-operatively. One hundred percent of respondents reported improved quality of life after surgery, 85% did not regret undergoing surgical excision and 86% reported that they would "Definitely" undergo surgery again if indicated.
CONCLUSION: Our neurofibroma center's patient-reported outcomes demonstrate that surgical excision of neurofibromas and peripheral nerve sheath tumors improves symptoms, function of daily activities and patients' overall impression of their quality of life. These data can support the creation of multi-disciplinary guidelines on the role of surgery in patients with neurofibromatosis and Schwannomatosis.

Posters

Tactile Hand Sensation Following Split Thickness Radial Forearm Free Flap Phalloplasty

Presenter:	Mya Abousy, BA
Co-Authors:	Wilmina Landford, MD, Annelise Iversen, MSPH, Lauren Eisenbeis, PA-C, A. Lee Dellon, MD, PhD, Devin Coon, MD, MSE
Affiliation:	Johns Hopkins University School of Medicine, Baltimore, MD

PURPOSE: Radial forearm free flap (RFFF) phalloplasty is often referred to as the gold standard for gender-affirming phalloplasty procedures.[1] Forearm neuropathy, a frequently listed complication of RFFF phalloplasty, has yet to be quantified in patients who undergo this procedure with a device as precise as the Pressure Specified Sensory Device (PSSD). The purpose of this study was to determine whether there is a change in tactile hand sensation following RFFF phalloplasty, and whether these changes vary by cutaneous region of the hand. The results of this study will help counsel patients who may view potential neuropathy as a barrier to pursuing this procedure.

METHODS: A total of nine patients undergoing split thickness RFFF phalloplasty were tested pre-operatively and one week post-operatively for tactile hand sensation. Testing was conducted using a two-point static (2 PS) test with a Disk-Criminator and PSSD. The testing sites included the cutaneous regions of the dorsal first webspace and the first phalanx of the index finger and pollex of the RFFF donor arm. The two PSSD prongs were set at a distance determined by initial testing with the Disk-Criminator. The PSSD measured the threshold of pressure necessary for the patient to discriminate two points. Two-sided paired t-tests compared the pre- and post-operative pressure values on each of the three hand locations. The numerical differences in pre- and post-operative pressures were then compared between each of the three locations to determine whether or not there was a difference in post-operative sensation based on hand region. The PSSD pressure values were standardized based on the prong distance determined by the Disk-Criminator, and percent change in standardized PSSD score differences for each cutaneous region were calculated. All tests were considered significant at $p<0.05$.

RESULTS: There were no significant differences between pre- and post-operative PSSD pressures for all cutaneous regions tested ($p>0.05$). However, on average, patients required 8.04% more pressure applied in the dorsal first webspace in order to discriminate two points, 8.43% more in the first phalanx of the index finger, and 16.7% more in the first phalanx of the pollex post-phalloplasty (all n.s.). Furthermore, when comparing each of the three cutaneous regions to each other, there was no difference in the change in pressures between each region ($p>0.05$). In other words, each of the three regions of the hand were similarly impacted by the operation.

CONCLUSIONS: The results of this study suggest that while past literature reports cases of numbness and/or tingling post-RFFF phalloplasty,[1] immediate post-operative sensation is not significantly different than pre-operative sensation. The fear of donor arm neuropathy is a potential barrier for patients seeking this life-changing procedure, yet this study quantifies the degree of neuronal damage and may encourage patients to undergo the procedure. These results will help guide patient-physician conversations regarding RFFF phalloplasty in order to create realistic patient expectations for post-operative outcomes.

1. Kovar A, Choi S, Iorio ML. Donor Site Morbidity in Phalloplasty Reconstructions: Outcomes of the Radial Forearm Free Flap. *Plast Reconstr Surg Glob Open*. 2019;7(9):e2442. doi:10.1097/GOX.0000000000002442

Posters

Evaluation of a Teaching Module to Train Medical Students about the Pathogenesis and Presentation of Dupuytren's Contracture

Presenter: Michele Ryan, BS
Co-Authors: Raj Sawh-Martinez, MD, Riegel Wright, BS, Pooja Selvam, BS, Jeslin Kera, BS, Michael Thompson, BS
Affiliation: , Orlando, FL

Background: Dupuytren's Contracture (DC) is an uncommon disorder of the hand that causes significant deformity and disability. The purpose of this study was to assess the knowledge of medical students about this disorder and to compare efficacy of a traditional reading format to a multimedia module in the knowledge acquisition of medical students.

Methods: This study was prospective, randomized, pretest-posttest designed to assess cognitive improvement in subjects exposed to an online reading module with those assigned to a multimedia presentation about Dupuytren's Contracture. Subjects in the multimedia group watched an online, multimedia presentation. Subjects in the traditional reading group reviewed online material containing the same content and were allowed to study this material over the same maximum duration of time as the multimedia presentation. A pre-test and a post-test was performed to assess the incremental knowledge improvement across for the two groups. We assessed the baseline knowledge and score improvement within the 2 groups. We also compared the improvement in knowledge between the multimedia presentation and the assigned reading group to determine if either modality was superior.

Results: Thirty students volunteered to participate in this study. Fifteen students were randomly assigned to the reading group and 15 students were assigned to the multimedia presentation. The mean score across all students increased significantly from the pretest to the posttest (8.0 to 16.8; $p < .0001$). The traditional reading group score increased significantly (8.3 to 16.0: p,.0001) as did the multimedia presentation group score (7.7 to 17.7; $p<0001$). The mean change in score from pretest to post test was significantly greater for the multimedia group when compared with the traditional reading group (9.9 vs. 7.7; $p = .028$).

Conclusion: Both the traditional reading module and the multimedia presentation significantly increased medical student knowledge of Dupuytren's Contracture. The students in the multimedia presentation group showed a significantly greater increase in knowledge acquisition. This data supports the use of multimedia presentations in medical education.

Posters

The Biomechanical Properties of Meshed Versus Perforated Acellular Dermal Matrices (ADM): Analysis of Surface Area and Fluid Egress

Presenter: Katherine H Carruthers, MD
Co-Authors: Pankaj Tiwari, MD, Ergun Kocak, MD
Affiliation: West Virginia University, Morgantown, WV

Background: Acellular dermal matrices (ADMs) are used for soft tissue augmentation across surgical specialties. The increased use of ADMs has been particularly apparent in the setting of implant-based breast reconstruction, where matrices are used to supplement the thickness of the mastectomy skin flaps and ensure adequate soft tissue coverage of implants. However, long-term review of these devices has indicated that there is a strong correlation between seroma formation and the use of ADM. Since allograft integration and neovascularization is dependent having on direct opposition between the ADM and a vascular bed, the presence of seromas can inhibit the area of the graft which is in contact with the native tissue. As a result, most ADM

products are available in a variety of meshed or perforated forms. Because of the lack of consistency between manufacture designs, we set out to determine the fluid egress properties and the increase in surface area resulting from common cut patterns.

Methods: The fluid egress properties were analyzed for three different commonly encountered commercially available ADM cut patterns: one meshed design and two distinct perforation designs. Mesh Pattern #1 was designed with 1:1 meshed cuts each measuring 1.5mm in length. Perforation Pattern #1 was designed with 3mm diameter perforations at a density of 0.128 perforations per cm^2 . Perforated Pattern #2 was designed with 3mm diameter perforations at a density of 0.25 perforations per cm^2. The surface area of these modified ADM samples was also calculated, accounting for the mesh length or the perforation diameter and frequency. Fluid egress was calculated by passing fluid through each ADM and measuring the amount of time required for complete passage. An ANOVA was used to determine if there was a significant difference in egress properties across the three patterns. A p-value of <0.05 was used to determine statistical significance.

Results: Meshing in a 1:1 pattern resulted in a 97.50% increase in surface area compared to the uncut product. In comparison, only a 0.30% increase resulted from Perforation Pattern #1 and a 0.59% increase resulted from Perforation Pattern #2. There was a significant difference in egress properties across the three cut patterns ($p=0.000$). The average egress time of Mesh Pattern #1 was 1.974 seconds. The average egress time of Perforation Pattern #2 was 6.504 seconds and of Perforation Pattern #1 was 10.369 seconds. Neither donor ($p=0.249$) nor graft thickness ($p=0.914$) had a significant impact on the results.

Conclusion: To our knowledge, this study is the first to directly compare clinically applicable properties between different ADM cut patterns. By comparing a variety of common manufacturer designs, ranging from simple punch-shape perforations to a full 1:1 mesh pattern, we were able to demonstrate that meshing ADM tissue significantly improves fluid egress properties and substantially increases the surface area compared to ADM tissue perforated at levels typically available on the market. Therefore, the use of meshed ADM tissue could improve the ability of the product to incorporate with the recipient, resulting in decreased complications and improved patient outcomes.

Posters

Effect of Ginsenoside Rg3 on Apoptosis in Human Malignant Melanoma Cells

Presenter: Hyun Seung Lee, MD

Co-Authors: Seonghwan Bae, MD, PhD, Yong Chan Bae, MD, PhD

Affiliation: Pusan National university, Busan, Korea, Republic of (South)

Malignant melanoma is the most dangerous among several skin cancers, and melanoma in the case of metastasis is very difficult to treat. Meanwhile, Ginsenoside Rg3 extracted from ginseng has been reported to have an anti-cancer effect in various kinds of cancer. Studies involving melanoma have shown that Rg3 induces apoptosis and inhibits metastasis of melanoma cells derived from mice. We used human melanoma cell lines (A375.S2 cells, G361 cells, MML-1 cells, and MEL-CLS-2 cells) to determine whether Rg3 has anti-cancer effects on human melanoma cells. Thus we investigated whether Rg3 induces apoptosis in these cells and which signaling pathway leads to apoptosis.

In this study, we planned an in vitro test. First, we investigated cell viability, cell morphologic change, colony forming ability, and cell migration ability after treating Rg3 with four human melanoma cells. Then, flow cytometry, Western blot, and immunocytochemistry analysis were performed to determine whether Rg3-treated melanoma cells died through apoptosis. Finally, we investigated cell viability after treatment with various apoptotic kinase inhibitors to identify the signaling pathway leading to apoptosis.

When Rg3 was treated with four kinds of human melanoma cells, cell viability, cell morphologic change, colony forming ability and cell migration ability were changed. It was also confirmed that Rg3 kills these melanoma cells through apoptosis. Finally, apoptosis is associated with the MEK signaling pathway.
The authors confirmed that Rg3 could induce apoptosis of human melanoma cell lines (A375.S2, G361, MML-1 and MEL-CLS-2 cells).

Posters

Rejuvenation of Facial Skin By Transplantation of Autologous Stromal Vascular Fraction Isolated Using a New Type of Clinical-Grade Collagenase

Presenter:	Bin Fang, MD
Co-Authors:	Chen Cheng, MD, Jia Zhou, MD, PhD, Jizhou He, MD, PhD, Poh-ching Tan, MD, PhD, Qingfeng Li, MD, PhD, Ru-lin Huang, Shuang-Bai Zhou, M.D., Ph.D., Taoran Jiang, MD, PhD, Wenhui Liu, MD, PhD, Yun Xie, MD
Affiliation:	Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Background: Stromal vascular fraction (SVF) of fat tissue contributes to skin anti-aging and rejuvenation, but standard isolation methods have not yet been established for obtaining clinical-grade cells[1]. Tissue enzymatic digestion is now the most widely used method. However, most published protocols employ research-grade collagenase containing xenogeneic components, which may cause severe anaphylaxis, immune reactions or infections in patients[2]. And for some products, the enzymatic composition shows lot-to-lot variability that may affect reproducibility[3]. In this study, we utilized a new type of clinical-grade collagenase to determine its suitability and efficacy. Furthermore, we conducted a clinical trial to evaluated the ultrastructural improvement of facial skin after transplantation of autologous SVF isolated by the new collagenase.

Materials and methods: This new type of clinical-grade collagenase mainly consists of aseptically filled, highly purified collagenase, which has been applied to loosen hypertrophic scars. Collagenase NB4 (Sigma) was used as control. For *in vitro* study, adipose tissue specimens were obtained with informed consent from women undergoing elective liposuction (n=5). SVF was isolated according to the published methods with some minor modifications, its yield and viability was detected. Then SVF was cultured and expanded to adipose stem cells (ASCs), the immunophenotype and differentiation potential was also evaluated. Our clinical trial was conducted in 13 patients aged between 30 and 56 years old. All of the cases underwent the lipoaspiration procedure from the abdomen. SVF was isolated and transplanted at dose of 2.5×10^7 nucleated cells in one side of the fronto-temporal area, the other side was used as self-control. The changes in the skin were analyzed by VISIA® and patients' self-assessment.

Results: There are no statistically significant differences on yield and proliferation of SVF isolated by the new collagenase and Collagenase NB4. No morphologic differences were found in cells throughout the entire culturing time. ASCs surface markers expression was similar between two products. And the differentiation potential of the cells was not affected, which was consistent with previously published results. By administration of autologous SVF isolated by new collagenase, the elasticity and density of skin were improved significantly. The score of VISIA® showed slight changes in wrinkle scores. Furthermore, most patients thought that the skin texture of treatment area was improved.

Conclusion: We concluded that this new type of clinical-grade collagenase can replace current research-grade products without any negative effect in the yield or function of SVF, which can be applied to anti-aging and rejuvenation of facial skin.

Reference

1. Zarei, F. and A. Abbaszadeh, *Application of cell therapy for anti-aging facial skin.* Current stem cell research & therapy, 2019. **14**(3): p. 244-248.
2. Carvalho, P.P., et al., *Xenofree enzymatic products for the isolation of human adipose-derived stromal/stem cells.* Tissue Engineering Part C: Methods, 2013. **19**(6): p. 473-478.
3. McCarthy, R.C., et al., *Tissue dissociation enzymes for isolating human islets for transplantation: factors to consider in setting enzyme acceptance criteria.* Transplantation, 2011. **91**(2): p. 137.

Posters

Artificial Dermal Template for Cultured Keratinocyte Sheet Grafting Detached By Temperature Responsive Dish in an Ovine Burn Wound Model

Presenter:	Yosuke Niimi, MD, PhD
Co-Authors:	Alharbi Suzan, PhD, Satoshi Fukuda, MD, Atsuyoshi Osada, MD, PhD, Wataru Kamei, MD, PhD, Perenlei Enkhbaatar, MD, PhD, Hiroyuki Sakurai, MD, PhD
Affiliation:	Tokyo Women`s Medical University, Shinjuku-ku, Tokyo, Japan

Introduction: Although artificial dermis (AD) has been tested for wound bed preparation with cultured epidermal autografts (CEA), low CEA acceptance has been a challenging problem. Previously, we have reported effects of CEA overlaid on the wound bed grafted with ovine cadaver skin. The goal of the present study was to compare the efficacy of CEA overlaid on excised full-thickness burn wounds grafted with either AD or cadaver skin in sheep. We hypothesized that the effects of CEA overlaid on wound beds prepared with AD would be comparable to those prepared using cadaver skin.

Methods: We used our well-characterized ovine burn wound healing model. Six full thickness burn wounds (5×5cm) were induced at the dorsum of sheep. After 24 hours, the eschar was excised down to the fascia, and covered with ovine frozen cadaver skin (CS, n=5); or AD (n=5). Same day, aliquots of healthy skin were harvested for isolation of autologous keratinocytes to be cultured on temperature-responsive dishes (to avoid use of harmful enzymes for detachment) until forming the multilayer sheets. Three weeks after grafting, the keratinocyte sheets were overlaid onto the wounds covered with either CS or AD. The acceptance of cultured keratinocyte sheets and wound epithelialization were assessed for 14 days using intermittent planimetric assay and histological analysis.

Results: Epidermis of grafted CS started rejecting after 10 days, and its complete rejection was observed within 21 days. While, collagen sponge of AD was gradually changed to dermis-like tissue. The dermis thickness was comparable between CS and AD groups at 7 days (1907.5±122.4 vs 766.1±121.8 um, P=0.1), 14 days (2724.0±518.1 vs 2001.5±120.7 um, p=0.4), or 20 days (1814.6±93.0 vs 1724.0±121.3 um, p>0.9999). The percentage of wound epithelialized area after keratinocyte sheet grafting was also comparable between CS and AD groups at 7 days (50.1±7.8% vs 54.2±10.5%, p=0.76) or 14 days (91.2±4.1 vs 87.4±5.8%, p=0.60). The transmission electron microscopy analysis revealed no significant difference in the percentage of lamina densa between CS and AD groups (54.9±1.5 vs 52±1.3%, p=0.18). The number of hemidesmosomes per micrometer was similar between CS and AD groups (1.34±0.04 vs 1.3±0.06, p=0.62).

Conclusions Our results suggest that use of AD can successfully substitute cadaver skin for preparing wound beds. Our results also demonstrate that AD and autologous keratinocyte sheets can substitute autologous skin grafts.

Posters

Relationship of Patient Age to Health-Related Quality of Life for Children with Craniofacial Conditions: The Parent Perspective

Presenter:	Emily Ewing, MA
Co-Authors:	Jessica D Blum, MS, Emma L Longmire, BS, Caitlyn Belza, BS, Alyssa Choi, BA, Burcin Ataseven, PhD, Vanessa L Malcarne, PhD, Amanda A Gosman, MD
Affiliation:	Rady Children's Hospital, San Diego, San Diego, CA

Background and Purpose: Craniofacial conditions (CFCs) can affect health-related quality of life (HRQoL) across multiple domains, yet there is insufficient literature exploring how HRQoL dimensions are affected, and how this varies with patient age. Also, little is known about how age-related variations in HRQoL may intersect with gender, ethnicity, and diagnosis. This study aims to evaluate the relationship between parent-reported HRQoL outcomes on the bilingual Craniofacial Quality of Life Scale (CFC-QoL) and patient age, stratified by gender, ethnicity, and diagnosis.

Methods and Materials: Parents of children with CFCs were recruited from two multidisciplinary craniofacial clinics (California and Tijuana, Mexico). Parents described their children's HRQoL by completing the CFC-QoL in English or Spanish. The CFC-QoL yields five HRQoL subscales: psychological function (PSY), physical function (PF), social impact (SI), family impact (FI), and appearance (APP)[1]. The 5-point scale ranges from 1 (*never*) to 5 (*almost always*), with higher subscale scores representing worse HRQoL. Correlation analyses were used to examine the relationship between scores and age for the total sample, and for gender, ethnicity, and diagnostic groups.

Results: The sample (N = 252) consisted of parents with children younger than 7 years (n = 75) and parents with children 7 years and older (n = 177). The mean patient age was 9.33 (SD = 5.27). The patient gender was 50.8% female and 49.2% male. Patient ethnicity consisted of 67.5% Hispanic and 32.5% non-Hispanic. Patient CFC diagnosis consisted of an acquired condition (2.4%), bilateral cleft lip and palate (CLP; 20.7%), unilateral CLP (23.1%), cleft lip (9.6%), craniosynostosis (23.1%), dermatological condition (6.8%), microsomia (4.8%), microtia (9.2%); 43.8% of the sample belonged to the CLP diagnostic group.

Parent ratings on all subscales were positively correlated with child's age (all p's < .05), suggesting that older children are perceived to have worse HRQoL in every domain. The strongest correlation was between age and APP (r = 0.522). Age was positively correlated with ratings on PSY and APP for boys and girls; age was positively correlated with SI for girls only, and with FI for boys only. For Hispanic versus non-Hispanic, age was positively correlated with SI, PSY, FI, and APP for Hispanic patients but was only positively correlated with APP for non-Hispanic patients. For diagnosis group (CLP versus other diagnoses), age was correlated with ratings on PSY and APP for patients with CLP (unilateral and bilateral) and with other diagnoses, but age was correlated with FI only for CLP, and was correlated with SI only for patients with diagnoses other than CLP.

DISCUSSION: From their parents' perspective, older children with CFCs have worse HRQoL across five domains as mentioned above. The relationship of poorer HRQoL with older child age was strongest for

appearance concerns. This relationship held across all demographic groups. Longitudinal studies should track HRQoL across development for children with CFCs.

1. Tapia VJ, Drizin JH, Ore CD, et al. Qualitative methods in the development of a bilingual and bicultural quality of life outcomes measure for pediatric patients with craniofacial conditions. *Ann Plast Surg.* 2017; 78:248-255.

Posters

Prescribing Practices of Prophylactic Postoperative Antibiotics in the Surgical Management of Gynecomastia: Do Antibiotics Improve Outcomes?

Presenter: Jason Brody, BA
Co-Authors: Akiko M Kozato, BS, Pierce Janssen, MD, Ilana Margulies, MD, Peter J. Taub, MD
Affiliation: Icahn School of Medicine at Mount Sinai, New York, NY

Background: Elective gynecomastia procedures carry low baseline risk for surgical site infections. Nevertheless, no recommendations currently exist in the literature or in the American Society of Plastic Surgeons' evidence-based clinical guidelines for antibiotic prophylaxis after gynecomastia surgery. The purpose of this study was to examine prophylactic antibiotic prescription practices among plastic surgeons performing gynecomastia operations and to evaluate whether those practices are efficacious.

Study Design/Methods: A retrospective review of male patients who underwent gynecomastia surgery at The Mount Sinai Hospital between 2011 and 2019 was performed. Patient medical history, surgical history, age, BMI, procedure type (i.e. liposuction, tissue excision, combination), intraoperative details (e.g. incision, drains), postoperative care (e.g. discharge antibiotics, compression use), and complications were recorded. Rates of postoperative antibiotic prescriptions were calculated, and Fisher's exact test was used to compare statistical differences between subgroups.

Results: A total of 54 operative gynecomastia patients were identified with ICD9/10 codes. Thirty patients (55.6%) underwent tissue excision only, 9 patients (16.7%) liposuction only, and 15 patients (27.8%) tissue excision with liposuction. Parenteral cefazolin was administered to 50 patients (92.6%) prior to incision, while prophylactic postoperative PO cephalexin was prescribed to 38 patients (70.4%) at time of discharge. Four patients (7.4%) received neither pre-incision nor postoperative prophylactic antibiotics. Stratified postoperative antibiotic prescription rates are shown in Table 1. No significant difference in surgical site infections was identified between patients who were prescribed postoperative antibiotics (2.6% SSI) vs. no postoperative antibiotics (6.3% SSI); $p = 0.509$. However, the study had an insufficient power (13%) to determine significance.

Conclusions/Future Plans: This data demonstrates significant variation in postoperative antibiotic prescription rates after operative gynecomastia treatment at our institution. Patient- and procedure-specific factors including age over 30, history of obesity (BMI > 30), and inframammary incisions have association with significantly higher rates of antibiotic prescriptions by our plastic surgeons. No significant difference in surgical site infections was identified between patients receiving postoperative antibiotic versus those receiving no antibiotic. Decisions regarding postoperative antibiotic prophylaxis should be evidence-based, especially for elective gynecomastia operations, which tend to have low baseline risk for surgical site infections. Further

studies are needed to determine which factors, if any, carry risk that warrants postoperative antibiotic prophylaxis after gynecomastia surgery.

Practice Management

Opioid Consumption Following Breast Reconstruction Decreases with a Brief Educational Intervention: A Randomized, Controlled Trial

Presenter:	Katie G Egan, MD
Co-Authors:	Michelle De Souza, MD, Elizabeth Muenks, PhD, Niaman Nazir, MD, MPH, Richard A. Korentager, MD
Affiliation:	University of Kansas Medical Center, Kansas City, KS

Purpose: There has been a focus on opioid consumption and overprescribing, but the utility of patient education in reducing opioid consumption has only recently been explored. This randomized trial aimed to evaluate the effectiveness of a brief patient educational intervention in reducing pain and opioid consumption in patients undergoing mastectomy and breast reconstruction. We hypothesized that implementation of an educational intervention on pain control would decrease postoperative opioid consumption.

Methods and Materials: A parallel, randomized, single-center controlled trial of women undergoing mastectomy and immediate, implant-based breast reconstruction was completed to evaluate the utility of a patient educational instrument. The control group received standard patient counseling, and the treatment group received an additional single-paged handout intervention. Goals of the educational instrument were to normalize the pain experience, set expectations for pain after surgery, and inform patients of alternative (non-opioid) methods of pain control. A questionnaire was administered postoperatively to collect data on pain control and opioid consumption.

Results: Over a 12 month time period, 100 patients were randomized. A total of 46 participants from the control group (92%) and 39 participants from the intervention group (78%) completed the postoperative questionnaire. Postoperative questionnaires were completed a median of 13.0 days after surgery in both groups. Review of the electronic medical record showed similar demographics and comorbidities between the control and intervention groups; however, participants in the control group were statistically more likely to be a current tobacco user (p=.04). There were no statistical differences in surgical characteristics or postoperative prescriptions between the two groups. All outcome analysis was performed according to intended treatment groups. A statistically significant reduction in the number of opioid tablets consumed was seen in the intervention group (control 24.3, SD 21.8; intervention 16.2, SD 16.4; p=.05). Although immediate postoperative prescriptions were equivalent between the two groups, more participants in the control group required a prescription refill compared to the intervention group (control n=10, 21%; intervention n=6, 12%; χ^2=1.3, p=.3). Due to the differences in need for prescription refill, the total average number of opioid tablets prescribed to the control group was statistically higher than the intervention group (control 46.6, SD 21.8; intervention 39.2, SD 11.9; p=.04). There was a marginal trend towards lower average postoperative pain scores reported by the intervention group (control 3.6/10, SD 1.6; intervention 3.0/10, SD=1.8; p=.06).

Conclusions: This study was successful in trialing an easily implemented, brief intervention. When tested in a randomized population of breast reconstruction patients, the instrument was found to reduce opioid consumption, while maintaining non-inferior pain control and need for opioid refills. The effectiveness of a

brief patient education tool on patient opioid consumption has been shown, and implementation of similar protocols in this patient population is recommended.

Practice Management

Standardizing Upper Extremity Indocyanine Green Lymphography in a Lymphedema Outpatient Setting

Presenter:	Itay Wiser, MD, PhD
Co-Authors:	Andrew L. Weinstein, MD, MS, Elizabeth Kenworthy, MD, Babak J. Mehrara, MD, Joseph H. Dayan, MD
Affiliation:	Columbia University, New York, NY

Introduction: Indocyanine green (ICG) lymphography is increasingly used to diagnose upper extremity lymphedema in outpatient settings, but its protocol lacks consensus. The purpose of this study was to standardize the ICG injections location, and optimal timing for ICG lymphatic imaging.

Methods: ICG lymphography was performed on healthy upper extremities. optimal ICG injection pattern was determined by injecting ICG to the sub-dermis in 6 different combinations that included up to 2 locations in the interdigital web spaces or wrist ulnar border. Optimal ICG imaging was determined by comparing lymphatic visualization at 5, 30- and 60-minutes following injections. Outcome measures included number of visualized lymphatic pathways, lymphatic vessels and lymph nodes in the upper extremity.

Results: ICG injection to the 1st and 3rd web spaces yielded higher lymphatic vessel count in the wrist (5.3±1.3 vs. 3.1±0.9, $p<0.001$), forearm (4.4±1.2 vs. 2.4±0.9, $p<0.001$), antecubital fossa (4.5±1.8 vs. 2.9±1.0, $p=0.04$) and the upper arm (3.1±1.4 vs. 1.9±0.7, $p=0.01$); demonstrated higher frequency of dual lymphatic pathways visualization in the wrist (80% vs. 32%, $p=0.001$), forearm (76% vs. 32%, $p=0.002$), upper arm (64% vs. 28%, $p=0.011$), and total upper extremity (44% vs. 0%, $p<0.001$); and higher frequency of axillary lymph node visualization (100% vs. 68%, $p=0.002$). Imaging at 30 minutes compared to 5 minutes after ICG injection yielded higher visualization of lymphatic vessel number in the wrist (4 vs. 3, $p=0.028$), antecubital area (4 vs. 2, $p<0.001$), and upper arm (3 vs. 1, $p<0.001$); demonstrated higher frequency of medial (48% vs. 84%, $p=0.016$) and lateral (60% vs. 92%, $p=0.018$) arm lymphatic pathways; and demonstrated higher frequency of axillary lymph nodes visualization (100% vs. 16%, $p<0.001$). No significant visualization differences were observed between 30- and 60-minute time points.

Conclusion: ICG lymphography in the outpatient settings provides a detailed view of the upper extremity lymphatic system, and can be optimized using ICG Injection pattern of 1st and 3rd web spaces together with imaging time points at 5 and 30 minutes.

Practice Management

Assessing Readability of Patient Education Materials on Breast Reconstruction By Major U.S. Academic Institutions

Presenter: Lauren E Powell, BA
Co-Authors: Emily S Andersen, MD, Andrea L Pozez, MD
Affiliation: Virginia Commonwealth University School of Medicine, Richmond, VA

Purpose: Breast cancer affects 1 in 8 women with 232,400 new invasive cases each year.[1] Women undergoing breast reconstruction post-mastectomy face several choices, and a myriad of written patient education materials exist online. Understanding of these materials, termed health literacy, affects surgical decision making and outcomes.[2] The National Institutes of Health recommend writing patient education materials at a sixth-seventh grade reading level to accommodate the average reading level of the U.S. adult.[3] The primary goal of this study is to assess the readability of breast reconstruction educational materials online.

Methods and Materials: Patient resources were collected from every academic hospital with an integrated plastic surgery residency program, 81 in total. This data was compared to the top non-academic websites ranked by search engine results, 10 in total. Materials were analyzed using three validated readability assessment scales: Coleman-Liau Index, SMOG Readability Formula, and Flesch-Kincaid Grade Level.[4] Average readability was analyzed and results were compared using a one-way analysis of variance (ANOVA) to assess for significance between the different tools and a two-sided t test to assess for significance between academic and non-academic readability results.

Results: The mean readability scores across the academic programs were a Coleman-Liau Index of 13.27 (Standard Deviation (SD) 2.9; 13th grade), Flesch-Kincaid Grade Level of 13.05 (SD 4.07; 13th grade) and SMOG Readability of 14.25 (SD 2.97; 14th grade). For the 10 non-academic sites, results showed a Coleman-Liau Index of 12.1 (SD 0.9; 12th grade), Flesch-Kincaid of 11.93 (SD 2.3; 12th grade), and SMOG Readability of 10.9 (SD 1.7; 11th grade). One-way analysis of variance (ANOVA) demonstrated no significant differences in the scoring between the three readability tools used (academic $F=2.7804$, p-value = 0.06; non-academic $F=1.14$, p-value=0.33).

Conclusions: This study found that readability across all websites were poor, with an average of a 13th-14th reading grade level for academic institutions, and 11-12th grade reading level for the top non-academic websites ranked by search engine results. Plastic surgeons should provide patient education materials fitting a wider range of reading abilities, at a recommended sixth-seventh grade reading level. By focusing on health literacy, plastic surgeons may contribute to improving patient understanding surrounding treatment options, lessening health care expenditure and lowering perioperative complications.[2]

References:

1. Breast Reconstruction. UCLA Health. Available at: https://www.uclahealth.org/plasticsurgery/breast-reconstruction. Accessed 29 January 2020.
2. Ismail IK, et al. An Evaluation of Health Literacy in Plastic Surgery Patients. *Plastic and Reconstructive Surgery*. 2015;136(4S-1):55-59.
3. Hutchinson N, Baird GL, Garg M. Examining the Reading Level of Internet Medical Information for Common Internal Medicine Diagnoses. *Am J Med*. 2016 June;129(6):637-9.
4. Wang L, et al. Assessing readability formula differences with written health information materials: Application, results, and recommendations. *Research in Social and Administrative Pharmacy*. Sep-Oct 2013;9(5):503-516.

Practice Management

The Impact of Hospital Volume in Gender-Affirming Surgery

Presenter:	Austin D Chen, NONE
Co-Authors:	Nargiz Seyidova, MD, David Chi, MD PhD, Abbas Peymani, MD, MS, Yuchi Fang, MD, Amy Maselli, MD, Ryan P. Cauley, MD, MPH, Adam M. Tobias, MD, Samuel J. Lin, MD, Bernard T. Lee, MD, MBA, MPH
Affiliation:	Beth Israel Medical Deaconess Center, Boston, MA

Introduction: Over the past few years, the incidence of gender-affirming surgeries has increased and is likely to continue to do so as the coverage for these procedures increases. However, the relationship between hospital volume and gender-affirming surgery outcomes and resource utilization is unknown.

Methods: Patients diagnosed with gender dysphoria or transsexualism who underwent male-to-female or female-to-male surgery were retrieved from the Healthcare Cost and Utilization Project National Inpatient Sample Database (2010-2014). Hospital volume was determined using the 50^{th} percentile cutoff for cases per year. Pearson's chi-square test/Fisher's-exact test was used to compare categorical variables, with Independent t-test/Wilcoxon-Mann-Whitney used to compare continuous variables. A gamma regression with a log-link function was performed to adjust for potential confounders, inclusive of patient comorbidities and other characteristics, and identify independent factors associated with increased hospital costs.

Results: Of 1,501 identified patients, 695 (46.3%) were treated at low volume centers and 806 (54.7%) at high volume centers. Patients at high volume centers were more often Hispanic and other minority groups ($p<0.001$), did not pay under government or private insurance ($p<0.001$), were in the 3^{rd} and 4^{th} income quartiles ($p=0.003$), and had low severity of illness ($p=0.014$) and Elixhauser Comorbidity scores ($p=0.001$). They more often underwent genital surgery ($p<0.001$) and combined surgeries ($p<0.001$) at urban nonteaching ($p<0.001$), large ($p<0.001$) hospitals in the West ($p<0.001$). They were associated with lower surgical (1.7% vs. 8.6%, $p<0.001$) and systemic complications (1.1% vs. 4.3%, $p<0.001$), as well as a shorter LOS (2.99 vs. 3.44 days, $p<0.001$). However, hospital costs were higher ($33,942.65 vs. $22,313.94, $p<0.001$). After adjustment using a gamma regression with log-link function, it appeared that this held true, with high volume being independently associated with increased hospital costs (Exp[β], 1.106; 95% Confidence Interval (CI), 1.025 – 1.193; $p=0.009$). Other independent associated factors included non-white race (Black: Exp[β], 1.241; 95% CI, 1.151 – 1.339; $p<0.001$; Hispanic: Exp[β], 1.070; 95% CI, 1.003 – 1.142; $p=0.039$; other minority: Exp[β], 1.168; 95% CI, 1.105 – 1.234; $p<0.001$), 4^{th} income quartile (Exp[β], 1.119; 95% CI, 1.063 – 1.178; $p<0.001$), high risk of mortality (Exp[β], 1.530; 95% CI, 1.184 – 1.977; $p=0.001$), concomitant surgery (Exp[β], 1.129; 95% CI, 1.030 – 1.238; $p=0.010$), surgical complications (Exp[β], 1.504; 95% CI, 1.373 – 1.647; $p<0.001$), treatment at an urban non-teaching (Exp[β], 1.408; 95% CI, 1.116 – 1.776; $p=0.004$) or teaching hospital (Exp[β], 1.429; 95% CI, 1.139 – 1.795; $p=0.002$), and increased LOS (Exp[β], 1.092; 95% CI, 1.081 – 1.103; $p<0.001$).

Conclusions: Our results suggest that, when compared to low volume gender-affirming surgery centers, high volume centers were associated with significantly lower surgical and systemic complications, as well as shorter length of stay. However, after adjustment for patient characteristics and outcomes, there was an independent association with increased hospital costs. Given the current upward trajectory of healthcare spending, it is important to identify drivers of both increased cost and savings across institutions with a goal towards decreasing total hospital costs and maintaining optimal patient outcomes.

Practice Management

Intraoperative Administration of Intravenous Dexmedetomidine and Acetaminophen for Improved Postoperative Pain Management in Primary Palatoplasty

Presenter:	Brynne Ichiuji, BA
Co-Authors:	Esperanza Mantilla-Rivas, MD, Md Sohel Rana, MBBS, MPH, Ishwarya Mamidi, BS, Jason Stein, BS, Marudeen Aivaz, BS, Monica Manrique, MD, Jennifer L McGrath, MD, Gary F. Rogers, MD, Albert K Oh, MD
Affiliation:	Children's National Hospital, Washington, DC

Background: Effective pain management for primary palatoplasty (PP) is critical to minimizing risk for postoperative complications including hemorrhage and airway loss. Administration of intravenous (IV) dexmedetomidine and IV acetaminophen is a successful intraoperative analgesic with the additional benefit of being an opioid-sparing technique. The current study assesses the efficacy of intraoperative use of these medications in managing pain after PP.

Methods: We reviewed our ongoing prospective database of patients undergoing PP from April 2009 to July 2018. We excluded patients who did not receive both medications or received additional intraoperative ketorolac. Patients were divided into those who received intraoperative IV dexmedetomidine and IV acetaminophen (Group 1) and those who did not (Group 2). Outcome variables included postoperative narcotic use by morphine milligram equivalents (MME), time to oral intake, need for supplemental oxygen, length of stay (LOS), and rate of complications (e.g. bleeding requiring exploration or readmission) within the 30 day postoperative period. Baseline characteristics were compared in both groups. Continuous variables were compared using t-test for normally distributed data and Mann-Whitney U test for skewed data, while categorical variables were compared using Chi-square test or Fisher's exact test. Multivariable linear regression was used to analyze continuous outcomes and multivariable Poisson regression with robust variance estimation was used to analyze binary outcomes..

Results: 193 patient met inclusion criteria (Group 1 N=54; Group 2 N=139). Median age at PP was 11.7 (IQR: 10.4, 15.5) months for Group 1 and 11.3 (IQR: 9.8, 14.2) months for Group 2 (p=0.13). Baseline characteristics such as weight, gender, type of palatoplasty, Veau classification, syndromic diagnosis, and prior use of Latham device were consistent between groups. ASA scores were found significantly different (ASA 1: 11.1% vs 29.7%, ASA 2: 75.9% vs 61.6%, ASA 3: 13.0% vs 8.7%, for Group 1 and 2, respectively, p=0.02). Group 1 required significantly lower doses of postoperative acetaminophen (mean dose 71.0 mg/kg, 95% CI [57.8, 84.3] vs. 90.9 mg/kg, 95% CI [82.7, 99.1], p=0.01), as well as lower fentanyl requirements in the recovery room (mean dose of 0.68 mcg/kg, 95% CI [0.48, 0.88] vs. 1.18 mcg/kg, 95% CI [1.06, 1.31], p<0.001). Although Group 1 patients had shorter LOS, shorter duration to oral intake, lower pain scores, less narcotic requirements for breakthrough pain, and less 30-day complication rates (1.8% vs 5.0%, p=0.45), these differences did not reach statistical significance.

Conclusions: The addition of intraoperative IV dexmedetomidine and IV acetaminophen during PP provides effective perioperative pain control, resulting in statistically significant decreased need for postoperative pain medication. Our study also documents an overall trend for decrease in LOS, time to oral intake, pain scores, total narcotic requirements, and postoperative complications. These results warrant larger studies to confirm the statistical significance of some variables.

Practice Management

Does the STOP Act Reduce Opioid Prescriptions Associated with Hand Surgery?

Presenter:	Chelsea Viscardi, MS
Co-Authors:	Yifan Guo, MD, Richard S Zeri, MD, Tom Reisler, MBChB, BSc(Hons), MRCSEd, Karen Buckley, MD, William Irish, PhD
Affiliation:	Brody School of Medicine at East Carolina University, Greenville, NC

Purpose: The opioid epidemic has become a leading cause of death in America. Various states have put into effect legislation to limit the amount of opioids that can be prescribed. In North Carolina, The Strengthen Opioid Misuse Prevention (STOP) Act came into effect January 1 2018, which outlined new limitations on prescribing opioids to no more than seven days after surgery. However, the efficacy of state mandated opioid laws have not been evaluated in hand surgery.

Methods and Materials: A single center retrospective chart review was performed for patients who underwent hand surgery between January 2015 and December 2019. Patients were excluded if they were under twelve years of age, had a multisystem trauma, inpatient admission for more than 48 hours, or had incomplete records. A review of the North Carolina Controlled Substances Database (PMP Aware) was conducted to assess for preoperative and perioperative (within 30 days of surgery) prescriptions filled. The total amount of opioids filled was converted to morphine milligram equivalents (MME). The average MME was compared between those who underwent surgery prior to and after initiation of the STOP Act. Subgroup analysis were performed in patients who underwent different types of surgery including metacarpal, tendon, phalangeal, and amputation. Additional analysis was performed to evaluate the patients who received excessive amount of opioids (>600 MME).

Results: Of the 500 patients who met inclusion criteria for the study, 175 were in the before group and 325 were in the after group. The demographics, patient risk factors, and complications did not differ between groups. There was an overall 69.3% (figure 1) decrease in opioids dispensed per patient. This statistically significant decrease was also observed in metacarpal and tendon groups (84.2 and 60.9% respectively). While there was an observed decrease in the phalangeal and amputation groups, this finding did not reach statistical significance. Overall, there is a higher percentage of patients who received less than 300 MME after the STOP Act was enacted (84% vs. 56%, figure 2).

Conclusions: Following implementation of the STOP Act there has been a marked and statistically significant decrease in opioid prescription patterns associated with hand surgery. Additional multi-center and multi-state studies should be considered.

Practice Management

Assessing Secondary Upper Extremity Lymphedema Patients for Surgical Intervention

Presenter:	Itay Wiser, MD, PhD
Co-Authors:	Babak J. Mehrara, MD, Michelle R. Coriddi, MD, Elizabeth Kenworthy, MD, Michelle Cavalli, Elizabeth Encarnacion, Joseph H. Dayan, MD
Affiliation:	Columbia University, New York, NY

Aim: To evaluate preoperative assessment clinical tools forsecondary upper extremity lymphedema surgical candidates.

Methods: A prospective cohort study performed at a tertiary cancer center secondary lymphedema outpatient clinic. Lymphedema evaluation included limb volume measurements, bio-impedance, indocyanine green lymphography, lymphoscintigraphy, magnetic resonance angiography, lymphedema life impact scale (LLIS) and upper limb lymphedema 27 (ULL-27) questionnaires.

Results: A total of 118 patients were evaluated. Limb circumference difference underestimated lymphedema diagnosis compared to limb volume excess. Bioimpedance (L-Dex) scores highly correlated with limb volume excess ($r^2 = 0.714$, $p < 0.001$). L-Dex scores were highly sensitive and had a high positive predictive value for diagnosing lymphedema in patients with a volume excess of 10% or more. ICG was highly sensitive in identifying lymphedema. Lymphoscintigraphy had an overall low sensitivity and specificity for the diagnosis of lymphedema. MRA was highly sensitive in diagnosing lymphedema and adipose hypertrophy as well as useful in identifying axillary vein obstruction and occult metastasis. Patients with minimal limb volume difference still demonstrated significantly impaired quality of life.

Conclusion: Preoperative assessment of lymphedema is complex and requires multimodal assessment. MRA, L-Dex, ICG, and PROMs are all valuable components of preoperative assessment. Lymphedema clinicians can use these tools findings accordingly to taylor an optimal surgical plan for each patient.

Practice Management

Is There a Gap? Examining Gender Disparities in Industry Payments and Their Geographic Distribution Amongst Plastic Surgeons

Presenter:	Jessica R Cunning, MD, MBA
Co-Authors:	Arturo R Diaz, MD, Sammy Othman, BA, Gal Rappaport, BS, John P Gaughan, PhD, Martha S. Matthews, MD
Affiliation:	Drexel University College of Medicine,

Purpose: Various medical specialties have demonstrated gender disparities involving industry-supported payments. We sought to determine if such gender disparities exist within plastic surgery across all practice settings over a multi-year time period and to characterize such discrepancies by payment category and geographical location.

Methods: Industry contributions to plastic surgeons practicing in the U.S. were extracted from the Centers for Medicare and Medicaid Services Open Payments 2013-2017 databases. Specialists' gender was obtained through online searches. Kruskal-Wallis tests compared payments (USD) by gender, both overall payments and by payment category. Linear regression estimated the independent association of female gender with increased/reduced payments while controlling for state-level variations.

Results: Of 1,518 plastic surgeons across private and academic settings, 13.4% were female. Out of $44.4M total payments from the industry, $3.35M were made to females ($p<0.01$). During the study period, female plastic surgeons received lower overall payments than males (median [interquartile range], $3,500 [$800 – $9,500] versus $4,160.60 [$1,000 – $19,728.20]; $p<0.01$). This trend persisted nationwide after normalizing for year (median [IQR], $2,562.50/year [$770 – $5,916.25] versus $3,200/year [$955 – $8,715.15]; $p=0.02$) and at the state-level in all 38 states where there was female representation. Analysis of payment categories revealed that honoraria payments were significantly higher for males (median [IQR], $4,738 [$1,648 – $16,100] versus $1,750 [$750 – $4,100]; $p=0.02$). Within risk-adjusted analysis, female plastic surgeons received $3,473.21/year (95% CI, $671.61 – $6,274.81; $p=0.02$) less than males.

Conclusions: Gender disparities involving industry payments exist in plastic surgery both at a national- and state-level and across all settings – from private to academic surgeons. Factors contributing to this phenomenon must be explored to understand implications of this gap.

Practice Management

Leadership Ambitions in Plastic Surgery: Do Women and Men Want the Same Thing?

Presenter: Farah Sayegh, MD
Co-Authors: Yasmina Zoghbi, MD, Christopher Bellaire, BA, Ilana Margulies, MD, Peter J. Taub, MD
Affiliation: Icahn School of Medicine at Mount Sinai, New York, NY

Background: Gender disparities exist within many medical and surgical specialties. Although there is an increasing number of women pursuing careers in plastic surgery, they are still underrepresented in principal positions of leadership. Studies on these rates of inequality are extensively published in the literature. However, this phenomenon cannot be fully appreciated until we ascertain whether females and males share the same desires and aspirations in advancing to these top leadership roles. The present study examines the relationship between gender and career aspirations within the field of plastic surgery.

Methods: A survey exploring career aspirations and gender was disseminated among plastic surgery colleagues. A propensity score matching algorithm was utilized to generate matched male and female groups. The algorithm matched respondents by age, race, and whether they worked in academia or private practice. The following relationships were then analyzed utilizing chi-squared tests: gender and desire to occupy administrative or leadership roles, gender and desire for positions of greater responsibility, and gender and desire to advance to a higher academic rank.

Results: The survey garnered 360 responses, of which there was a disproportionate percentage of male respondents (male=303, female=57). A propensity score matching algorithm was utilized to two create matched cohorts of females and males. After propensity score matching, each gender cohort had 56 respondents. The majority of the matched respondents had a current role in private practice (females=76.69%, males= 60.71%, p=0.10). Interestingly, there was no significant difference in current roles in administration/leadership (females= 44.64%, males=53.57%, p=0.45). Approaching statistical significance, males had a greater desire to occupy administrative or leadership roles compared to females (females=21.43%, males=39.29%, p=0.051). The male cohort also had a greater proportion of respondents that desired greater career responsibilities (females=26.79%, males=44.64%, p=0.072) and a greater proportion that desired advancement to a higher academic rank (females=16.07%, males=28.57%, p=0.16).

Conclusions: The utilization of a propensity score matching algorithm enabled the simulation of randomization in a context where real randomization is not feasible. Our results suggest that females may desire top leadership positions less than their male counterparts within plastic surgery. However, these results did not reach statistical significance, and as such, larger-scale studies are required in order to investigate this relationship further.

Practice Management

Plastic Surgery Resident Operative Volume and Milestones Performance: What Is the Correlation?

Presenter: Farah Sayegh, MD

Co-Authors: Ilana Margulies, MD, Yasmina Zoghbi, MD, Peter J. Taub, MD

Affiliation: Icahn School of Medicine at Mount Sinai, New York, NY

PURPOSE: The Milestones program was introduced by the Accreditation Council for Graduate Medical Education (ACGME) in 2014 as a means of standardizing resident evaluations across plastic surgery competencies. A previous study examined the relationship between operative volume and performance in the chief year of residency and found no correlation. We sought to further explore this relationship in order to discern whether operative volume could potentially be driving competency achievements during the earlier years of training.

METHODS: A retrospective review of case log numbers performed by residents at our primary training institution was conducted for thirteen residents from 2014-2018. The cases were grouped into categories based on the Milestone competencies. The association between operative volume and levels of achievement in respective Milestones competencies was performed using Spearman's rank correlation coefficient ($p<0.05$).

RESULTS: The average operative volume and average performance on Milestones both increase across all categories as residents progress through their training years. However, no significant correlation exists between overall operative volume and Patient Care Milestones or Medical Knowledge Milestones across the majority of years of training when residents are compared to their peers at a given training level. Significance was reached with positive correlations between operative volume and Medical Knowledge milestone achievement at PGY3 ($r=0.8182$, $p=0.0058$) and between operative volume and Patient Care Milestone achievement at PGY5 ($r=0.7858$, $p=0.0480$).

CONCLUSION: The lack of consistently significant association between operative volume and levels of achievement in Milestones possibly supports the belief that operative exposure does not alone drive competency achievement in surgical education throughout the early years of training. Alternatively, this could suggest that the way the Milestones are being applied is not fully capturing resident competency achievement. Our small sample size is a considerable limitation and larger scale multi-institutional studies are needed to further investigate the relationship between operative volume and milestone achievement performance.

Practice Management

Determining the Factors Associated with 30 and 90-Day Readmissions Following Plastic Surgery within the National Readmissions Database

Presenter: Farah Sayegh, MD
Co-Authors: Andrew Warburton, BS, Paymon Sanati-Mehrizy, MD, Nikki M Burish, MD, Peter J. Taub, MD
Affiliation: Icahn School of Medicine at Mount Sinai, New York, NY

Purpose: Previous studies have characterized factors associated with readmission following common plastic surgery procedures within 30 days postoperatively. However, with recent changes to the bundled payment plans, forcing medical systems to cover patient care up to 90 days postoperatively, it is imperative that a comprehensive analysis is performed in order to appreciate comorbidities associated with 30 and 90-day readmission. The National Readmission Database (NRD) is a powerful tool to look beyond the current literature at 90-day readmission rates as it provides readmission from over 50% of the population. This study utilized the NRD to describe the comorbidities associated with 30 and 90-day readmissions to help hospitals, healthcare mangers, and plastic surgeons improve patient outcomes and reduce bundled payment penalties.

Methods: The 2012-2014 NRD was mined for reduction mammoplasty and subcutaneous mammectomy, augmentation mammoplasty, mastopexy, total breast reconstruction, and abdominoplasty/panniculectomy based on ICD-9 CM codes. Only patients ≥18, those who had elective surgery, those who had a length of stay <365 days (to avoid confounding chronic-care complications), those with a diagnosis of cancer of the brain/nervous system, currently receiving maintenance chemotherapy/radiotherapy, or those with missing data/discharged to a court of law were also excluded. A bivariate and multivariate analysis was conducted on these patients to determine the significant comorbidities associated with a 30 and 90-day readmission using a Pearson's Chi-squared test and Bonferroni correction. Odds ratios were reported to determine the most powerful correlations with readmission.

Results: The overall 30-day readmission rate was 5.7% and the overall 90-day readmission rate was 9.7%. Medical comorbidities that were found to be statistically significant ($p<0.05$) in their association with 90-day readmission include anemia deficiency, congestive heart failure, coagulopathy, depression, diabetes, obesity, and hypertension. On multivariate regression analysis of independent predictors of 90 day readmissions, patients that live in fringe counties of metro areas of ≥1 million population (OR=0.82, $p<0.05$), counties in metro areas of 250,000-999,999 population (OR=0.79, $p<0.05$), and counties in metro areas of 50,000-249,000 population (OR=0.61, $p<0.05$) were less likely to have complicated readmissions.

Conclusion: While the overall readmissions for common plastic surgeries is relatively low compared to other major surgical operations, the readmission rate for 90 vs 30-day readmission increased by 4 percentage points and the comorbidity associations with readmissions shifted. This suggests that current literature defining risk factors for post-operative readmission are not sufficient. Further studies to elucidate causal factors through

prospective studies should be encouraged and are in need to continue to determine and reduce 90-day readmissions.

Practice Management

Trends of Breast Reconstruction in Medicare Beneficiaries

Presenter: Krishna S Vyas, MD, PhD, MHS
Co-Authors: Stephanie Youssef, MD, Samyd S Bustos, MD, Jorys Martinez-Jorge, MD
Affiliation: Mayo Clinic, Rochester, MN

BACKGROUND: In April 2014, the Centers for Medicare and Medicaid Services released millions of billing records for over 880,000 health care providers in an effort to improve the transparency, accountability, and affordability of the U.S. health care system. This study was performed to analyze the overall Medicare landscape with respect to surgeons, beneficiaries, services and reimbursements in the setting of breast reconstruction.

METHODS: This is a retrospective analysis of publicly available Medicare utilization and payment data for surgeons who provided services to Medicare beneficiaries between January 2012 and December 2017. Breast reconstruction Current Procedural Terminology (*CPT*) codes were queried using the Medicare Payment and Utilization Database. Statistical significance was computed using a one-way ANOVA and Levene's test was used to confirm the homogeneity of variances.

RESULTS: Data included trends in the number of breast reconstructions over time and average Medicare reimbursements over time. In general, the number of breast reconstructions increased over the study period, with the greatest increase in free flap breast reconstruction (+55.5%) and the greatest decrease in TRAM reconstruction (-36.9%). On average, the Medicare payment amount per service was about 20% of the submitted charge. For example, reconstruction with latissimus flap charge in 2017 was $6588 and payment amount was $1358, resulting in a 79.4% reduction. Despite inflation and overall increases in health care costs, reimbursements in breast reconstruction have had little or no increase over time (**Table 1**). The highest rate of change was CPT 19366 (breast reconstruction with other technique), which increased from $957 in 2012 to $1136 in 2017, for an +18% rate of change. Over the study interval, implant based reconstruction increased around 12%, while latissimus and free flap reconstruction decreased around 2% over the same time interval.

CONCLUSION: Our study identifies and quantifies wide variations in reimbursement for breast reconstruction procedures. Over the study period, reimbursement for implant based reconstruction increased while autologous reconstruction decreased. Variations in reimbursement may preclude some surgeons from offering certain reconstructive options to a subset of patients. Addressing these potential care disparities in a growing patient population has major implications in quality of care for a large subset of women recovering from breast cancer. It is important for surgeons to understand these trends and to communicate with policy makers toward developing sustainable reimbursement models.

Research -- Technology

Fibronectin Induced Human Pluripotent Stem Cell Derived Vascular Smooth Muscle Cells Enhance Endothelial Network Formation Via Fibroblast Growth Factor

Presenter:	Kaiti Duan, BS
Co-Authors:	Biraja Dash, PhD, Henry C. Hsia, MD
Affiliation:	Quinnipiac University Frank H. Netter MD School of Medicine North Haven, USA, North Haven, CT

Purpose: Induced-pluripotent-stem-cell-derived-vascular smooth muscle cells (iPSC-VSMC) have the potential to treat chronic wounds by secreting proangiogenic factor vascular endothelial growth factor(VEGF) (1). However, there is a paucity of research in how fibronectin-imbued extracellular matrix (ECM) composition may impact the iPSC-VSMC's paracrine secretion profile and how endothelial cells (EC) would respond. In this study, our objective was to optimize fibronectin-collagen matrix to enhance iPSC-VSMC induced endothelial cell network formation and vascularization.

Methods: Either 25ug or 50ug of fibronectin was added to three different density of type-I collagen (1.25mg/ml, 2.5mg/ml, and 5mg/ml) to study iPSC-VSMCs proliferation and paracrine secretion profile. Numerous pro-angiogenetic factors included VEGF, platelet derived growth factor (PDGF), basic fibroblast growth factor (bFGF), Stromal cell-derived factor (SDF), angiopoietin 1 (ANG-1), transforming growth factor (TGF), and IL-8 were investigated. Anti-inflammatory factor IL-10 was also evaluated. Resultant conditioned media from day 3 of fibronectin-collagen VSMC scaffold was evaluated for angiogenetic paracrine potential via using human umbilical vein endothelial cells (HUVECs) cultures.

Result: Human iPSC-VSMCs functional fibronectin-collagen scaffolds showed an increase in cell viability across all the collagen densities compared to the non-functional collagen scaffolds (P-value=0.0001). Elevated VEGF was observed in functionalized scaffolds in 1.25mg/ml (P value=0.0086), whereas no significant difference in VEGF level was found among 2.5mg/ml or 5mg/ml functionalized scaffold group. Interestingly, fibronectin-functionalized 5mg/ml collagen scaffold exhibited substantially elevated bFGF secretion (P value=0.0049). There was also a positive correlation of increasing amount of fibronectin embedment with increasing bFGF paracrine secretion (P value=0.0001). 5mg/ml Fibronectin composited scaffold combination was selected for its bFGF paracrine induction potential. Preliminary measurements and images of HUVECs cultured in fibronectin-functionalized iPSC-VSMC media for 16 hours revealed increased numbers of branch points and total network area compared with SMC media control group. (Image attached)

Conclusion: These findings suggest that fibronectin scaffold functionalization along with density manipulations differentially induce Human iPSC-VSMCs to promote pro-endothelial network development via secretion of bFGF. Future studies in signaling pathways will elucidate the underlying mechanism of how fibronectin promotes bFGF secretion and include in vivo model experiments to investigate the translational healing efficacy of fibronectin-collagen scaffold in wound models. This will ultimately optimize and validate the potential of Human iPSC-VSMCs as a viable therapeutic agent for wound healing and therapeutic revascularization.

Reference:

1. Kuzuya M, Satake S, Esaki T, Yamada K, Hayashi T, Naito M, et al. Induction of angiogenesis by smooth muscle cell-derived factor: Possible role in neovascularization in atherosclerotic plaque. Journal of Cellular Physiology. 1995;164(3):658-67.

Research -- Technology

Limb Transplantation Following Ex Vivo Normothermic Perfusion in an Orthotopic Forelimb Swine Transplantation Model

Presenter:	Carlos Ordenana, MD
Co-Authors:	Majid Rezaei, MD, Vahe Fahradyan, MD, Sayf Al-Deen Said, MD, Lynn Orfahli, BM, Brian Figueroa, MD, William Baldwin, MD, PhD, Francis A. Papay, MD, Antonio Rampazzo, MD, PhD, Bahar Bassiri Gharb, MD, PhD
Affiliation:	Cleveland Clinic, Cleveland, OH

PURPOSE: Ischemia-reperfusion injury remains a major limiting factor for limb replantation and transplantation. Ex-vivo normothermic limb perfusion has been proven to preserve viability and function of amputated limbs longer than cold storage. Our aim was to investigate the feastibility of limb transplantation following EVNLP and possible vascular, inflammatory and infectious complications in a mid-humerus porcine forelimb transplant model.

METHODS: Eight Yucatan miniature pigs, 4 donors and 4 recipients, were used. Right forelimbs of donor animals were amputated at mid-humeral level, to maintain integrity of forearm fascial compartments, and preserved with EVNLP until replantation. The right forelimb of the recipient animal was amputated and a central venous line was placed in the contralateral neck. Perfusate electrolytes, gases, O_2 saturation, muscle contractility, surface temperature (Infrared thermography) and peripheral perfusion (ICG agiography) were assessed during EVNLP. The humerus was fixed with a single 3.5mm LC-DCP plate; microsurgical anastomosis of the brachial artery, cephalic vein, and repair of radial, ulnar, and median nerves were performed under an operative microscope. Tendons of the biceps and triceps were repaired with pulvertaft weave technique. The first animal did not receive systemic immunosuppression. Systemic immunosuppression for the remaining 3 pigs included induction with antithymoglobulin, followed by daily cyclosporine (CSA), mycophenolate mofetil and methylprednisolone. CSA trough levels were measured daily. Limbs were monitored clinically and histologically for signs of rejection. Bone healing was confirmed with CT scan at euthanasia. The endpoint of the study was 90 days.

RESULTS: Warm ischemia time during limb procurement was 20.6±9 minutes and 2.2±0.25 hours during limb transplantation. EVNLP lasted an average of 4.3±0.52 hours. Total time to revascularize was 6.8±0.5 hours. PO_2, pH and Lactate where 557±72mmHg, 7.5±0.1, 5.6±0.9mmol/L respectively. Muscle contractions were 4/5 during EVNLP. All forelimbs were successfully transplanted with no vascular failure. CSA trough levels were on average 678±450, 369±445, and 336±468ng/mL. Animals 2, 3 and 4 developed septic thrombophlebitis of the central line, which was replaced on POD 14, 51, and 28. Animals 3 and 4 lost IV access on POD 54 and 64 respectively and were transitioned to PO medications. The first transplanted limb (animal 1) showed evidence of acute rejection on POD 4 and the animal was euthanized on POD 6. In the remaining animals, the incisions healed and initial edema resolved by day 14.The third animal developed angioinvasive aspergillosis on POD 20 with two areas of full thickness skin necrosis of trunk. Voriconazol was started and the lesions were resected on POD51. The animal lost the central line on POD 55, showed evidence of rejection on POD 57 and was euthanized on POD 60. Animals 2, 3 and 4 showed bone healing and consolidation with the presence of bony callus on CT scans. At endpoint animal 2 and 4 had reached complete weight bearing on the transplanted limb, at the hoof and wrist respectively.

CONCLUSION: Extremity transplantation can be successfully performed following EVNLP. EVNLP does not increase the risk of vascular or infectious complications. The mid-humerus porcine transplantation model is feasible and reproducible.

Research -- Technology

Bone-Selective MRI As a Nonradiative Alternative to CT for Cranial Vault Imaging: Concordance and Implementation of an Automated Segmentation Pipeline for Timely Image Processing

Presenter:	Carrie E. Zimmerman, BS
Co-Authors:	Pulkit Khandelwal, BS, Rosaline S Zhang, BA, Long Xie, PhD, Hyunyeol Lee, PhD, Jesse A. Taylor, MD, Jordan W. Swanson, MD, MSc, Paul Yushkevich, PhD, Felix W Wehrli, PhD, Scott Paul P Bartlett, MD
Affiliation:	Children's Hospital of Philadelphia, Philadelphia, PA

Background: Computed tomography (CT) is the clinical gold standard for high-resolution 3D visualization of cortical bone structures. However, CT ionizing radiation exposure is associated with the development of malignancy. Bone-selective MRI and bone-selective image reconstruction provide a radiation-free imaging modality with diagnostic and surgical planning uses. This technique, though applicable to many realms of plastic and reconstructive surgery, is of specific interest to craniofacial surgeons whose patients often require multiple pre and post-operative CT scans, enduring a higher cumulative risk of malignancy. As it stands, the implementation of bone-selective MRI in clinical practice is prevented by a paucity of CT and bone-selective MRI concordance data and the time and labor intensive process required to produce bone-selective MR-based 3D skull segmentations. The manual segmentation process takes about 1.5 hours of time per MRI image. Our study evaluates both the accuracy of a novel bone selective MRI technique (dual-radiofrequency pulse, dual-echo, 3D ultrashort echo time) and the utility of a segmentation pipeline.

Objectives:

Part 1. Evaluate the concordance between MR-based and CT-based 3D skull renderings

Part 2. Describe and evaluate a novel multi-atlas segmentation pipeline

Design/Methods:

Part 1. A cadaver skull and the skulls of 5 healthy adult volunteers were scanned with bone-selective MR and thin-slice CT. Semi-automatic bone segmentation (1.5 hrs/scan) was performed creating 3D renderings of the skulls. Mimics software was used to measure 8 anatomic distances from the 3D renderings. Lin's Concordance Correlation test (CCC) was applied to assess agreement between MR and CT-based 3D renderings.

Part 2. CT and bone-selective MR images were acquired from 16 additional healthy adult volunteers, yielding 21 MR/CT pairs. The CT images were segmented using a semi-automated method to generate "ground truth" labels for the MR images. An automated multi-atlas segmentation pipeline was then used to segment the 3D MR images using a two-step process consisting of a training and segmentation. The training step develops an "atlas package", which represents the varying anatomy from different subjects. The segmentation step uses the atlas package to generate segmentations for new subjects using several image registration steps.

Results: MR-based measurements differed from CT-based measurements by mean percent difference ranging from 2.3%-5.0%. Lin's CCC ranged from 0.998-1.000. The segmentation pipeline took 10 minutes per segmentation with an average symmetric surface distance of 0.96 mm ± 0.15 between the manual reference segmentation and the corresponding automated segmentations.

Conclusion(s): This study demonstrates high concordance between the gold standard (thin-slice CT) and our novel imaging modality as well as an 89% reduction in segmentation time. This technique is highly applicable to craniofacial surgery as well as cases involving extremity surgery, musculoskeletal trauma, and bone tumors. It additionally allows acquision of data of both soft and hard tissue structures from a single imaging modality with no radiation exposure. The demonstrated reduced segmentation time would allow bone-selective MRI to be used in clinical practice without a delay in treatment. We plan to investigate the accuracy of this technique as a tool for craniosynostosis diagnosis as well as in craniofacial virtual surgical planning.

Research -- Technology

Silicone Implant Shells Increase the Rate of Proliferation of Alk- but Not Alk+ Lymphoma Cells in an Engineered Biomimetic Breast Microenvironment

Presenter:	Ishani D. Premaratne, BA
Co-Authors:	Matthew A. Wright, BA, Mariam Gadjiko, BA, Xue Dong, MD, PhD, Arash Samadi, BS, Daniel O. Lara, BS, Nabih Berri, MD, Paula S. Ginter, MD, Giorgio Inghirami, MD, Kristy A. Brown, PhD, Jason A. Spector, MD
Affiliation:	Weill Cornell Medicine, New York, NY

Purpose: The pathogenesis of breast implant-associated anaplastic large cell lymphoma (BIA-ALCL), an Alk- pathology, remains poorly understood. Our lab has demonstrated the power of studying BIA-ALCL behavior in a high-fidelity tissue engineered *ex vivo* biomimetic, three-dimensional model. Herein we use this model to study the behavior of Alk+ Lymphoma cells, which characterize the most common type of ALCL, within an engineered breast microenvironment, to serve as an important comparator to the behavior of BIA-ALCL cells, which are Alk-.

Methods: Patient-derived breast tissue was processed for its component adipocytes, ductal organoids, and stromal vascular fraction. These were suspended within 50 µl of 0.3% type I collagen matrix to which was added 200,000 cells/mL of Alk+ Lymphoma cells. These were then plated into 6mm wells. As a control, Alk+ Lymphoma cells were also suspended within type I collagen alone at the same seeding density without breast components ("collagen only"). Before plating, wells were lined circumferentially with 1cm by 2cm pieces of either textured, smooth, or no implant shell (dissected from the intact implant). Wells were imaged using confocal microscopy over 8 days.

Results: There was a significant difference in cell counts over 8 days between the six different groups ($p = 0.002$, $R^2 = 0.625$). Cell proliferation over time in the biomimetic groups, regardless of the presence or absence of implant shell, was significantly greater than cell proliferation in the collagen only groups over the same time period ($p < 0.001$). Overall, cell counts trended downward in the collagen only groups over 8 days with a significant decrease in count starting at day 6. There was no difference in the rate of proliferation of Alk+ cells in the presence of silicone shells. This is similar to the proliferation seen in Alk- BIA-ALCL cells, which was significantly more robust in the biomimetic platform compared to collagen-only groups, regardless of implant

shell type ($p < 0.01$). Unlike Alk+ cells, Alk- BIA-ALCL cells grew nearly 30% faster in textured and smooth shell biomimetic groups compared to biomimetic wells lacking an implant shell.

Conclusions: Within a tissue-engineered 3D model of the breast microenvironment, Alk+ Lymphoma cells, which serve as an important comparator cell line to the study of Alk- BIA-ALCL, showed a significant increase in proliferation within the biomimetic groups only over 8 days, regardless of the presence or absence of implant shell. Comparatively, BIA-ALCL cells proliferated significantly more robustly within this platform in the presence of textured and smooth implant shell as well as biomimetic platform. These data suggest that there is thus something inherently unique to Alk- BIA-ALCL cells that drives proliferation in the presence of both biomimetic platform and silicone implant shell as the presence of a silicone implant shell does not drive increased proliferation of Alk+ Lymphoma cells. These data suggest that breast implant silicone shell in combination with the breast microenvironment may drive the growth of BIA-ALCL.

Research -- Technology

Prenatal Diagnosis of Craniofacial Anomalies: How Positive Are We about That Positive Result?

Presenter:	Carrie E. Zimmerman, BS
Co-Authors:	Laura S. Humphries, MD, Julia Bushold, BS, Christopher L. Kalmar, MD MBA, Giap H. Vu, BA, Thomas Reynolds, MBA, Edward R Oliver, MD, PhD, Lori J Howell, DNP MS RN, Scott Paul P Bartlett, MD, Jesse A. Taylor, MD, Jordan W. Swanson, MD, MSc
Affiliation:	Children's Hospital of Philadelphia, Philadelphia, PA

Background: Due to advances in 3D and 4D ultrasonography, it is possible to detect CF anomalies at 10 weeks of gestation as the facial bones begin to ossify. Rates of prenatally diagnosed craniofacial anomalies vary by region and country partially due to varied screening policies and level of technician expertise. Isolated craniosynostosis is a particular diagnostic challenge due to difficulties visualizing cranial sutures on ultrasound. The purpose of this study was to identify the diagnostic accuracy of ultrasound and MRI for various craniofacial anomalies at our tertiary care center associated with a high volume fetal diagnostic unit.

Methods: Our institutional fetal imaging database, Fetal Force, was queried to identify patients with suspected craniofacial conditions from January of 2002 through August of 2019. Parental and demographic data, prenatal imaging, fetal DNA sequencing, postnatal exam findings, and outcomes (delivery, termination, fetal demise, infant demise) were obtained. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of prenatal diagnosis were calculated using postnatal clinical examination as the gold standard. Fetal terminations, demises, and dyads lost to follow-up were excluded from calculations due to lack of gold standard comparison.

Results: Of the 73 parent/fetus dyads identified, 43 fetuses met all inclusion criteria. Thirty dyads were excluded for non-craniofacial anomalies, common facial clefts, or scans obtained due to family history of craniofacial anomalies. The mean maternal age at consultation was 32.8 ± 5 years (range 22.4-41.3), mean gestational age 26w ± 4w6d (range 19w-36w5d). 70% (30) of patients were prenatally suspected to have craniosynostosis, 14% (6) micrognathia, 7.0 % (3) Binder Syndrome, and 9.3% (4) a variety of other conditions; microophthalmos, goldenhar, amniotic band syndrome, and Rubenstein-Taybi syndrome. 69.7% (30) of patients received fetal ultrasound and fetal MRI, 23.3% (10) received fetal US only, and 7.0% of patients (3) received fetal MRI alone. Seven fetuses were terminated (Craniosynostosis n=6, microophthalmos n=1) and 4 infants with multiple congenital anomalies passed away in infancy.

For the diagnosis of any craniofacial anomaly, ultrasound: sensitivity 90%, specificity 43%, PPV 82%, NPV 60%; MRI: sensitivity 86%, specificity 50%, PPV 86%, NPV 50%. For craniosynostosis specifically, ultrasound: sensitivity 100%, specificity 43%, PPV 71%, NPV 100% ; MRI: sensitivity 100%; specificity 50%; PPV 82%, NPV 100%. Ultrasound had a sensitivity and PPV of 100% for both micrognathia and binder syndrome. There were 4 false positive diagnoses of isolated craniosynostosis on prenatal ultrasound that were found to be overriding sutures without synostosis or normal head shape variants on postnatal examination. In the setting of syndromic craniosynostosis, careful attention was paid to associated anomalies (ie hands and feet in Apert Syndrome) to support the diagnosis.

Conclusions: While CF anomalies can be detected as early as 10 weeks gestation, most anomalies are diagnosed in the second trimester after the fetal anatomy scan. Finding ways to maximize diagnostic accuracy is paramount given the profound consequences of parental decision-making subsequent to diagnosis. Additionally, it is essential to communicate the degree of doubt associated with each prenatal diagnosis, especially in the setting of isolated anomalies.

Research -- Technology

Near-Infrared Tissue Oximetry Predicts Outcomes of Flap Preconditioning in Rodents

Presenter: Pooja Yesantharao, MS
Co-Authors: Sarah Persing, MD, MPH, Nima Khavanin, MD, Justin M. Sacks, MD MBA
Affiliation: Johns Hopkins University School of Medicine, Baltimore, MD

Purpose: Stress preconditioning of flaps is a potential strategy to mitigate risk of ischemia-reperfusion injury.[1] The ability to reliably predict the impact of preconditioning on postoperative necrosis even before an incision is made would not only allow for improved operative planning, but would also allow for better risk-stratification of patients. While many devices have been developed to assess perfusion-related complications, they are limited by cost, intravenous dyes, and efficacy. This study assessed a novel, handheld, non-invasive and dye-less device using near-infrared spectroscopy to quantify tissue oxygenation in preconditioned tissue. By doing so, we determined the utility of near-infrared tissue oximetry in reliably measuring preoperative changes in flap oxygenation due to stress preconditioning, as well as this technology's utility in predicting postoperative necrosis in preconditioned tissue.

Methods: Twenty-four Sprague-Dawley rats were divided into three groups: (1)heat stress preconditioning, (2)negative pressure preconditioning, and (3)unconditioned controls. All rats underwent elevation of a dorsal, cranially-based 10cmx3cm random pattern modified McFarlane skin flap. Tissue oxygenation was assessed preoperatively before and after preconditioning, intraoperatively following flap elevation, and at 24-hour/7-day postoperative timepoints. Flap survival was assessed clinically and histologically at postoperative day 7. Chi square and one-way ANOVA were used to study clinical variables. Pearson product-moment correlation

coefficients were used to study tissue oxygenation. ROC curves were used to assess the utility of the Intra.Ox in predicting flap necrosis.

Results: Preoperative tissue oxygenation measurements recorded by the Intra.Ox device significantly increased 24-hours after negative pressure (51.2% versus 58.1%, $p<0.01$) and heat stress preconditioning (50.3% versus 57.1%, $p<0.01$). This correlated histologically to increased heat shock protein-32 staining from heat shocked tissue biopsied at this time point. In all animals, tissue oxygenation at all postoperative timepoints was negatively correlated with distance from the flap pedicle (r=-0.85 for postoperative day 7), with a statistically significant decrease in mean tissue oxygenation in the most distal centimeter of tissue compared to pedicle tissue (19.2% versus 48.9%, $p<0.01$). Preconditioning with negative pressure and heat resulted in improved flap survival compared to unconditioned controls using histologic and clinical endpoints (mean weight of non-necrotic tissue: 6 versus 5 versus 2.3 grams, $p<0.01$; **Figure**). Accordingly, near-infrared spectroscopy demonstrated a significant increase in intraoperative tissue oxygenation in preconditioned distal flap tissue compared to unconditioned controls, with negative pressure preconditioning demonstrating the greatest increase in oxygenation (+19.2%, $p<0.001$ for negative pressure, +15.4%, $p<0.01$ for heat. For all experimental groups, intraoperative tissue oxygenation predicted tissue necrosis (area under ROC curve: 0.922).

Conclusions: Handheld near-infrared tissue oximetry may help in accurately predicting/preventing flap necrosis, as it was able to detect clinically-relevant changes in rodent dorsal flap oxygenation even before a flap was raised. In fact, improved flap survival after preconditioning strongly correlated with preoperative changes in tissue oxygenation. Transcutaneous tissue oximetry should be further studied in clinical settings, in order to assess its utility in patient care.

References:

1. Krauss, S, Rothenberger, J, Mayer, J, Sogorski, A, Held, M, Wahler, T, & Kolbenschlag, J. Tissue conditioning-strategies to improve perfusion and reduce ischemia-reperfusion injury. *Plast Aesthet Res*. 2018; *5*(39).

Research -- Technology

Global Trends in Plastic Surgery Content on Instagram

Presenter: Sterling Braun, MD
Co-Authors: James A Butterworth, MD
Affiliation: University of Kansas Medical Center, Kansas City, KS

Purpose: Despite the ubiquitous presence of Plastic Surgery content on Instagram, data has remained limited to individual time points from posts within the United States.[1,2] Here, we aim to provide a comprehensive analysis of Instagram users and posts pertaining to Plastic Surgery globally.

Methods: Metadata from publicly available Instagram posts containing #PlasticSurgery were collected from December 2018 through January 2020 through an API with Node.JS, an open source JavaScript runtime environment. All posts timestamped within the timeframe were included. Data collected from the posts included username, caption, engagement, time, and tagged location. We then designed and validated a classification algorithm to characterize the user associated with each post. The data were further processed and analyzed using the R programming language.

Results: A total of 993,137 posts from 176 countries were included. On average, there were 2,405 posts per day worldwide. The United States accounted for 40% (308,324) of the total posts where country location data were available (n = 766,815). Istanbul, Turkey was the most prolific city in the study group with 27,481 posts. The other most commonly tagged cities were Seoul (23,577), New York (22,461), Miami (13,298), and Beverly Hills (13,290). The average post received 176.2 likes (Median 37), and 6.9 comments (Median 1). Hashtag use within the post caption was also analyzed. Most commonly tagged surgical procedures differed by region. For instance, in Seoul the most commonly tagged procedure was #VLine (4,262). For Istanbul, the most commonly tagged procedure was #Rhinoplasty (7,264), though translations of rhinoplasty accounted for additional occurrences (14,607). In the United States, surgical procedures involving breast and body contouring were more common. Users were assessed with our classification algorithm (96% sensitivity, 98% specificity, n = 285). Globally, professional accounts made up 31% (304,606) of the total sample (n = 993,137). This was similar when splitting to groups within the US (41%) and outside of the U.S. (33%). International ASPS member surgeons were included by our algorithm, but comprised a smaller portion of professional accounts (12%) than did surgeons verified to be Board Certified in the U.S. (49%). Conversely, international physicians not verified by the ASPS comprised 82% of the professional accounts whereas in the U.S. this group made up only 40% of professional accounts. ASPS verified surgeons accounted for 20% of posts within the U.S. and 8% of posts overall.

Conclusion: Board Certified plastic surgeons account for only half of #PlasticSurgery posts associated with professional accounts in the U.S. and an even smaller proportion globally. Limitations included the current lack of a verification process through Instagram. Allowing members to link from the ASPS website to their social media accounts could serve as a solution.

Reference List:

1. Siegel N, Jenny H, Chopra K, Yang R. What does it mean to be a #PlasticSurgeon? Analyzing Plastic Surgery hashtag utilization in social media. Aesthetic Surgery Journal. 2019. Doi:10.1093/asj/sjz187
2. Dorfman RG, Vaca EE, Mahmood E, Fine NA, Schierle CF. Plastic Surgery-Related Hashtag Utilization on Instagram: Implications for Education and Marketing. *Aesthetic Surgery Journal*. 2017;38(3):332-338. doi:10.1093/asj/sjx120

Research -- Technology

Interactive Ipad-Based Patient Education in Breast Reconstruction Planning

Presenter: Nima Khoshab, MS

Co-Authors: Lauren Michelle, BA, Audrey Nguyen, MD, Raj M. Vyas, MD, Keyianoosh Z. Paydar, MD, FACS
Affiliation: University of California, Irvine, Irvine, CA

Purpose: In the ambulatory setting, one challenge physicians face is the need to address patient concerns in a brief encounter. This is especially true in consultation visits for breast reconstruction planning, where it is critical that patients are well-informed of options and associated risks. A promising solution is to use innovative educational technologies to provide a framework of understanding for patients just prior to their visit. Studies have shown that information presented in an interactive, multi-modal format is better understood and retained than when presented in a static manner. We sought to determine whether an iPad-based interactive education module (iBook) covering breast reconstruction management is effective in patient education.

Methods: We evaluated new patients presenting to our tertiary care plastic surgery outpatient practice for breast reconstruction consultations. Patients received a pre-survey, to asses patient perception of knowledge, comfort level talking to physician, and clinic visit anxiety. Patients were then randomly assigned to two groups; one group received an iPad (iBook), while the other group received the same information in a paper booklet. Patients reviewed the educational module prior to being seen by their physician. After the appointment, they received a post-survey with the same questions and the 'Satisfaction with Surgeon' domain of the BREAST-Q Scale.[1]

The iBook was developed for iPad using *iBooks Author*, a Mac OS application, and was written and illustrated by the research team. Using Hemingway editor software, all text was determined to be at a 5th grade reading level. This work was supported by The Plastic Surgery Foundation (PSF) 2019 Breast Reconstruction Awareness (BRA) Fund – Public Awareness Grant.

Results: Ten new patients and one family member were evaluated in a two-month period (7 iBook and 4 paper booklet). From the cohort, 82% were between 31-60 years old, 70% had a college or graduate degree, and 50% rated their English proficiency at advanced or native. Only patients in the iBook group significantly improved their perceived knowledge score between the pre-survey and post-survey ($t=3.45$, $p=0.016$). Compared to the paper booklet group, the iBook group had both decreased anxiety, (-0.86 vs. -0.25 ($p=0.7$)) and an increased surgeon satisfaction score on the BREAST-Q Scale (mean score 74.1 vs. 63.0 ($p=0.096$)).

Conclusion: The iPad-based educational module significantly improved patient-perceived knowledge. In comparison to the paper booklet group, patients receiving the iBook showed decreased anxiety and increased surgeon satisfaction approaching statistical significance. Interactive educational modalities can be beneficial to a plastic surgery practice by improving patient/family education and satisfaction, as well as decreasing visit anxiety. Providing patients and families with preliminary information can help the visit run more effectively and may help manage patient expectations. Implementation of iBooks to augment patient education should be investigated in other plastic surgery patients, other medical specialties, and different languages. Additional research with a larger cohort will be helpful in improving significance and generalizability.

References:

1. Pusic AL, Klassen AF, Scott AM, Klok JA, Cordeiro PG, Cano SJ. Development of a new patient-reported outcome measure for breast surgery: The BREAST-Q. *Plast Reconstr Surg*. 2009;124(2):345-353. doi:10.1097/PRS.0b013e3181aee807

Research -- Technology

Lipofilling Reduces Dormant Breast Cancer Outgrowth As Opposed to Adipocutaneous Flap Controls in a New Murine Model of Postlumpectomy Breast Reconstruction.

Presenter:	Benjamin Thomas, MD
Co-Authors:	Jan Warzsawski, MD, Florian Falkner, MD, Amir K Bigdeli, MD, Boyan K Garvalov, PhD, Arno Dimmler, MD, Jonathan P Sleeman, PhD, Ulrich Kneser, MD, Volker J Schmidt, MD, Wilko Thiele, PhD
Affiliation:	BG Trauma Center Ludwigshafen, University of Heidelberg, Ludwigshafen, Germany

The transfer of autologous tissue is nowadays considered the gold standard of breast reconstruction. To this end, fat grafting and flap transfer represent the two most common approaches. However, important concerns regarding the oncological safety of fat grafting remain unanswered. In this context, satisfactory experimental models of autologous lipofilling techniques have not been described in the literature so far. Hence, the *in vivo* impact of both autologous tissue transfer approaches on the outgrowth of dormant breast cancer cells retained within the surgical field has so far not been assessed experimentally. Therefore, we devised a new experimental model of lipofilling in immunocompetent mice. As part of our pilot study, murine lipoaspirates were analyzed and compared to adipocutaneous flaps regarding their cellular viability via Calcein AM labelling, volume retention as derived by longitudinal MR imaging, hypoxic stress according to the Hypoxyprobe assay, angiogenesis by means of CD-31 positive vessel counts, proliferation as deduced from the Ki-67 index, and immune cell infiltration upon conventional hematoxylin and eosin staining. Lipografts were found to remain viable for over 30 days post transfer and showed long-term volume retentions of approximately 40 percent. We discovered significantly higher initial levels of hypoxia and proliferation, as well as significantly increased vessel counts, and marked macrophage infiltrates in fat grafted specimens compared to adipocutaneous flaps. Subsequently, orthotopically-implanted syngeneic D2.0R dormant breast cancer cells were exposed to either tissue transfer method in our newly established murine model in order to assess their impact on tumor outgrowth kinetics *in vivo*. Interestingly, all animals with adipocutaneous flaps developed mammary tumors at the same rate as baseline controls. On the contrary, only 20 percent of all lipografted animals developed tumors at a later point in time. In summary, our new immunocompetent murine model of lipofilling is an important addition to the repertory of experimental approaches to autologous breast reconstruction. Furthermore, our data suggest that fat grafting does not fuel local recurrence of dormant breast cancer cells in mice. Quite the contrary, it may even have a suppressive effect.

Research -- Technology

Topical Antibiotic Elution in a Collagen Rich Hydrogel for Healing of Infected Wounds

Presenter:	Uriel J Sanchez Rangel, BS
Co-Authors:	Hiroki Oda, MD, Jack Akerman, Zhen Wang, MD, James Chang, MD, Paige M. Fox, MD, PhD
Affiliation:	Stanford University, Palo Alto, CA

Chronic wounds, those that fail to heal after 4 weeks of standard care, are difficult to treat, often due to biofilm formation. Biofilms impair immune response, deter epithelization, and are resistant to systemic antibiotic treatment by limiting blood flow and bioavailability [1]. Patients necessitate 10-1000 times standard antibiotic concentrations[2-3].

Collagen-rich hydrogel (cHG) is derived from human extracellular matrix and stimulates wound healing[4]. Alongside a simple manufacturing process, high biocompatibility, and the ability to increase neovascularization, a stable three-dimensional polymeric-network makes cHG an excellent candidate for local antibiotic delivery[5]. This study examined a ciprofloxacin/collagen-rich hydrogel preparation for the treatment of Pseudomonas aeruginosa challenged wounds in vivo.

Methods: A cohort of 28 mice were divided into four groups: no infection and no cHG, infection without cHG, infection with cHG alone, and infection with ciprofloxacin-enriched cHG. 5mm skin excisions were performed on the dorsum and stented open with silicone rings. On post-operative day 2, infection groups were inoculated with *Pseudomonas aeruginosa*. On post-operative day 4, 2% collagen-rich, thermoresponsive hydrogel, with or without 2mg/ml ciprofloxacin elution, was applied. Wound dressings and hydrogel were replaced every other day until tissue harvesting at days 10, 12, 14, or 17. Rate of wound healing was assessed via wound photography. Hematoxylin-eosin staining was used to visualize rate of reepithelization and degree of infectious infiltrate.

Results: Wound healing, as defined by reepithelization and biofilm elimination, is accelerated with cHG + ciprofloxacin. On average, wound healing occurs on POD 10 +/- 1, 18 +/- 3, 12 +/-2, 16 +/- 2 for control, infection only, infection with cHG + ciprofloxacin and cHG only, respectively. This improved rate of wound healing is visible particularly at Days 10 and 14, with substantially less yellow exudate and reestablished epithelium.

Histologic analysis of H&E sections, defined total wound length as the absence of follicles and intact basement layer. The return of keratinocytes was measured as a healed length relative to total wound length. P. *aeruginous* challenged biofilms lagged control, cHG + ciprofloxacin treated, and cHG only treated mice. By day 10, control wounds were 100% healed while infection only wounds demonstrated 24.1% +/- 8.12% closure. Infected wounds treated with cHG + ciprofloxacin demonstrated 70.4% +/- 8.6% closure at day 10 and complete closure by day 14.

Conclusion: Antibiotic impregnated collagen hydrogel is a promising treatment for infected chronic wounds. This treatment could limit systemic antibiotic exposure leading to antibiotic stewardship and reduced systemic side effects.

References:

1. Wolcott RD, et al. Chronic wounds and the medical biofilm paradigm. Journal of wound care. 2010;19(2):45-46, 48-50, 52-53. doi:10.12968/jowc.2010.19.2.46966
2. Markakis K,Faris AR, et al. Local Antibiotic Delivery Systems: Current and Future Applications for Diabetic Foot Infections. The international journal of lower extremity wounds. 2018;17(1):14-21. doi:10.1177/1534734618757532
3. Moser C, et al. The clinical impact of bacterial biofilms. International Journal of Oral Science. 2011. doi10.4248/ijos11026
4. Stebbins ND, et al. Antibiotic-containing polymers for localized, sustained drug delivery. Advanced drug delivery reviews. 2014;78:77-87.doi:10.1016/j.addr.2014.04.006
5. Zhao G, et al. Biofilms and Inflammation in Chronic Wounds. Advances in wound care. 2013. doi:10.1089/wound.2012.038

Research -- Technology

A Preclinical Model to Analyze the Oncological Safety of Fat Grafting in Breasts with Residual Cancer in Immunocompetent Hosts

Presenter:	Francisco Claro Jr., MD, PhD
Co-Authors:	Camila de Angelis, MD, Renato Pierre Lima, MS, Joseane Morare, PhD, Emerielle Vanzela, Ph.D, Wandir Antonio Schiozer, PhD, Lício Velloso, PhD, Luis Otavio Zanatta Sarian, PhD
Affiliation:	State University of Campinas (UNICAMP), Sao Paulo, Brazil

INTRODUCTION: Preclinical studies (PS) aiming to evaluate the microenvironment of breast cancer (BC) is very important for analysis of risk and the behavior of this disease to treatments proposed in humans, such as fat grafting to the breast (FGB). These studies, however, present serious methodological problems. They are based on models that use cancer-induced carcinogens that have a residual systemic effect or through the use of non-luminal human BC implanted in immunosuppressed murine hosts. Thus, this study objectives to analyze the effectiveness of cafeteria diet (CD) to trigger BC and yield enough fat for autologous grafting, in order to create a preclinical model able to analyze oncological safety of FGB in immunocompetent hosts.

METHODS: 60 Sprague-Dawley rats with 28-days-of-life were randomly divided into 6 groups, according to their period of life (adolescent=1, adult=2, reproductive-senescence=3): 3 controls (C1,C2,C3), fed with standard diet, and 3 groups that received CD (D1,D2,D3). CD was introduced at rats age of 6 weeks, when they reach sexual maturity. The following variables were collected and analyzed: weight, naso-anal length (NAL), Lee Index (LI), fasting glycemia (FG), perigonadal fat pad weight (PFW), and groin fat pad volume (GFV). Six thoracic breasts, adipose tissue of omentum and subcutaneous of each rat were harvested for analysis. These samples were studied through histological analysis with HE staining. Statistical analyses were performed using paired t-tests, analysis of variance (ANOVA, one way) for ordinal variables and McNemar's test for categorical variables.

RESULTS: The mean weight of rats analyzed with 26-week-old was 263.09g in C1 and 426.76g in D1 ($p<0.001$). The mean LI, were respectively, 298.12 and 332.63 in groups C1 and D1 ($p=0.002$). The mean FG value was 76.06mg/dl ($p=0.26$); the mean PFW was 8.21g ($p<0,001$). The mean GFV was 5.08ml ($p=0.001$). The mammary microenvironment between adolescent rats shows 20% of duct ectasia (DE) in CD vs. 8% in control ($p<0.001$) within 11 only weeks under CD. One fibroadenoma was observed in CD at 12th week after cafeteria diet onset and other at the 13th. In adult phase (between 210 and 600-day-old), 42 rats (C2,D2) were analyzed for tumorigenic status. In D2, 6 rats had tumor (3 adenocarcinomas, 3 fibroadenomas) vs. 2 rats in C2 (1 adenocarcinoma, 1 fibroadenomas). 30 rats (C3,D3) remained for analysis of any residual effect of CD in reproductive-senescence period. Mean weight in C3 was 318.68g and in D3, 382,11g ($p=0.01$). Mean LI, were respectively, 326.50 and 337.889 in C3 and D3 ($p=0.39$). FG value was 89.43mg/dl in Control vs. 91.80 in CD ($p=0.36$). Values for PFW and GFV were statically different between CD and control, respectively representing $p=0.046$ and $p=0.022$.

CONCLUSION: This study showed that the CD not only produce enough fat for autologous grafting, as well as it was an effective method to induce BC in adult rats without bias related to the inductor agent, even in reproductive-senescence period. Thus, this preclinical model of BC in immunocompetent hosts can be effectively used to analyze the oncological safety of FGB in breasts with residual cancer.

Research -- Technology

Comparing Efficacy of Common Pocket Irrigation Protocols in an Infected Breast Implant Model

Presenter:	Dina Gofstein Hayuth, MD

Co-Authors: Yoav Barnea, MD, Anat Lerner, PhD, Jonathan Lellouche, PhD, Zack Shiloah, MD, Gal Bracha, MD, Yehuda Carmeli, PhD, Eyal Gur, MD, Nir Shani, PhD, Ehud Arad, MD

Affiliation: Tel-Aviv Sourasky Medical Center, Tel Aviv, Israel

Introduction: Infection of breast implants is a leading cause for explantation. Contamination of implants may persist over time in the form of biofilm and is extremely difficult to eradicate. This has prompted the development of various peri and post-operative antimicrobial (antibiotic and antiseptic) protocols that include both breast pocket irrigation [1] and prophylactic antibiotic therapy [2].
The authors' aim was therefore to try and define the most efficient antimicrobial treatment protocol, by comparing different pocket irrigation protocols and regiments of antibiotic prophylaxis, in prevention of clinical infection and biofilm formation, in a novel breast implant infection rat model [3].
Methods: Fifty-five rats underwent bilateral implantation of silicone breast implants (total of 110 implants). Implant infection was induced by injection of methicillin resistant staphylococcus aureus (MRSA) at a bacterial load of 10^9 colony-forming units (CFU) to the surgical pocket. Pocket irrigation with either Saline, Povidone-Iodine (PI) 10% solution or Vancomycin was examined. Antibiotic systemic prophylaxis protocols included Intra-peritoneal (IP) Vancomycin injection preoperative and bi-daily injections for 48 hours. After 14 days, microbiological and clinical assessment of all implants was preformed and validated by scanning electron microscopy.

Results: Implants irrigation with saline or PI solutions had no antibacterial effect as a 100% of irrigated implants demonstrated both clinical infection and a high number of bacterial biofilm load, $1.3X10^6$ and $6.8X10^6$ CFU respectively. In contrast, all implants irrigated with Vancomycin demonstrated no signs of clinical infection and only 13% (2/15) subclinical infection with a low bacterial load ($3.7X10^1$ CFU). IP systemic Vancomycin treatment protocol, without pocket irrigation, had no antimicrobial effect and demonstrated a 100% infection rate. Prophylactic Vancomycin therapy combined with Vancomycin pocket irrigation, had the most beneficial antimicrobial effect demonstrating no infections, both in the single pre-operative dose group and the 48-hour post-operative treatment group. Importantly, pockets irrigated with PI led to wound dehiscence and pus discharge.

Conclusions: Pocket irrigation was only efficient when performed with a Vancomycin solution. Combination of Vancomycin pocket irrigation with antibiotic prophylaxis, reduced the incidence of implant infection to zero. Systemic Vancomycin administration alone had no antimicrobial effect. PI pocket Irrigation did not prevent or lower, the infection rate and led to reduced wound healing. Using a breast implant infection model in rats we were able to compare the efficiency of commonly used antibacterial protocols. The findings have the potential to improve the clinical practice of breast implant surgery, decreasing rates of infection and contamination of implants.

References:

1. Jewell ML, Adams WP Jr. Betadine and Breast Implants. Aesthet Surg J. 2018 May 15;38(6):623-626.
2. Phillips BT, Halvorson EG. Antibiotic Prophylaxisfollowing Implant-Based Breast Reconstruction: What Is the Evidence? Plast Reconstr Surg. 2016 Oct;138(4):751-7.
3. Arad E, Navon-Venezia S, Gur E, Kuzmenko B, Glick R, Frenkiel-Krispin D, Kramer E, Carmeli Y, Barnea Y. 2013. Novelrat model of methicillin resistant Staphylococcus aureus-infected silicone breast implants: a study of biofilm pathogenesis. Plast Reconstr Surg. 131(2):205-14.

Research -- Technology

The Morbidity and Mortality of Plastic Surgery Disease in Canada: A Perspective Based on the Global Burden of Disease Study

Presenter: Yaeesh Sardiwalla, MD, BSc
Co-Authors: Emma Price, MSc, Alanna Bridgman, BSc, Sophocles H. Voineskos, MD
Affiliation: McMaster University, Hamilton, ON, Canada

Purpose: Identifying the burden of disease related to plastic and reconstructive surgery in Canada will provide timely population-based data, will inform policy, and will generate important research funding. Using the most current Global Burden of Disease (GBD) data, we present results on the years of life lost (YLLs), years lived with disability (YLDs), and disability-adjusted life years (DALYs) for diseases relevant to our field.

Methods and Patients: Data were extracted through the GBD 2017 results tool for all available and relevant plastic surgery diseases. Incidence, prevalence, mortality and cost were calculated for each disease. The data were analyzed using a Bayesian meta-regression modelling tool to provide epidemiological estimates of YLLs, YLDs and DALYs by combining other available parameters. To quantify and compare the costs of adverse health end points, the monetary value (CAD) of a DALY was ascertained based on previous analysis.

Results: In 2017, plastic surgery related conditions in Canada had an overall age-standardized DALY rate of 481 per 100,000 [95% UI 409-562]. Of these conditions, breast cancer was responsible for over 50% of the overall burden of disease, with an age-standardized DALY rate of 247 per 100,000 [95% UI 222-274], followed by thermal burns (64 per 100,000 [95% UI 51 – 82]) and malignant skin melanoma (54 per 100,000 [95% UI 39–68]). Age-standardized incidence rates were highest for cellulitis (3,008 per 100,000 [95% UI 2,814–3,192]) followed by pyoderma (1,432 per 100,000 [95% UI 1,391–1,478]). Breast cancer had the highest age-standardized cost of care of all plastic surgery related diseases, at $4.6 billion. Summed values for all 13-plastic surgery related diseases demonstrate a total age-standardized cost of $9.2 billion.

Conclusion: Plastic and reconstructive surgery related diseases are responsible for a high burden of disease and significant cost to the Canadian healthcare system. Unsurprisingly, breast cancer is the leading cause of morbidity and mortality of these diseases, followed by thermal burns and malignant melanoma. These results will help guide national policy on healthcare and research funding for plastic surgery related diseases and will direct current efforts toward the highest impact diseases facing the Canadian healthcare system.

Research -- Technology

Cell Free DNA As a Prognostic Factor in Pediatric Burns

Presenter: Nufar Sharon, MD
Co-Authors: Amos Douvdebani, MD, Yaron Shoham, MD
Affiliation: Barzilai Medical Center, Ashkelon, Israel

Introduction: Despite great advances in the treatment of pediatric burns, useful prognostic markers are sparse. During the past years there has been increasing interest in circulating plasma cell free DNA (CFD) as a potential marker for tissue injury, however current methods for CFD analysis are impractical for routine laboratory use due to the cost and time needed to perform them. We have developed a novel rapid direct fluorescent assay for CFD quantification that allows obtaining accurate, fast and inexpensive measurements, and already published its potential use in quantifying admission CFD levels as a prognostic factor in adult burns. The aim of this study was to use this technique for measuring admission plasma CFD levels in pediatric burn patients and explore the use of CFD as a potential marker and prognostic factor in pediatric burns.

Methods: A single center, single arm, prospective study, approved by the Institutional Review Board was preformed. Plasma CFD levels were obtained at admission from otherwise healthy hospitalized pediatric burn patients, 0-18 years old, within 24 hours of injury. DNA levels were quantified using the fluorochrome SYBR® Gold technique which does not require prior processing of samples, i.e. DNA extraction and amplification. The method was tested in comparison with the gold standard, Quantitative PCR, and was found to be in good correlation of R^2=0.9987 ($p<0.0001$). Variables recorded and compared included demographic data, burn cause and depth, TBSA, hospitalization days and surgical intervention.

Results: The study included 16 pediatric burn patients, 8 female and 8 male, aged 4.0±1.83 years old, the majority (12/16=75%) suffering from scald burns. The average TBSA involved was 15.4±13.0%, and the average hospitalization was 15.6±15.5 days. The average CFD level was 1747±1732 ng/ml. There was a significant correlation between CFD levels and hospitalization days (R^2=0.31, AUC=0.854, p=0.027). We did not find significant correlations with TBSA and burn depth, however, we found a strong significant correlation between the multiplication of the CFD levels by TBV (Total Burn Volume, a term previously described as TBSA*burn depth, either 2 for partial thickness, 3 for full thickness, and 2.5 for mixed depth) and hospitalization days (R^2=0.51, AUC=0.98, p=0.002). There was also a significant correlation between CFD levels and the number of surgical procedures (R^2=0.6, p=0.02).

Conclusions: Admission CFD levels may serve as a prognostic factor in pediatric burns**.** Larger patient groups are needed in order to further strengthen these results.

Research -- Technology

Mechanical Stretch Promotes Hypertrophic Scars Formation through Mechanically Activated Ion Channel Piezo1

Presenter:	Jiahao He, MD
Co-Authors:	Bin Fang, MD, Shengzhou Shan, MD, PhD candidate, Yun Xie, MD
Affiliation:	Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Background: Hypertrophic scar (HS) formation is abnormal wound healing characterized by hyperactivation of fibroblasts and overproduction of extracellular matrix (ECM). To date, there are few satisfactory treatments[1]. Mechanical stress has been shown to be a key etiological factor in HS formation while the underlying mechanism is not completely understood[2]. Piezo1 was identified as the first mechanoresponsive ion channel in vertebrates[3], which has recently been emphasized on its mechanotransduction function in mechanics-related diseases[4]. However, currently no research has focused on the biological function of Piezo1 in HS

formation. Here we aim to assess the effect of stretch-induced Piezo1 activation on fibroblasts in *vitro* and HS formation *in vivo*.

Materials and methods: Human dermal fibroblasts were isolated and divided into 4 groups: Control groups (with or without stretch) and GsMTx4 (Piezo1 specific inhibitor) treated groups (with or without stretch). Cyclic mechanical stretch (10%, 24 hours, 0.5 Hz) was applied by the Flexcell®FX-5000™ system. Western blot was performed to assess the expression of myofibroblasts marker α-SMA and ECM components including collagen and fibronectin. Stretch-induced HS model on rat tail was established based on previous work [5] and was treated with GsMTx4 by intralesional injection. The scar hypertrophy evaluation was detected by H&E staining and Masson's trichrome staining. α-SMA expression was confirmed by immunohistochemical staining.

Results: The *in vitro* results showed that GsMTx4-treated fibroblasts exhibited less expression of α-SMA, collagenI and fibronectin compared to non-treated fibroblasts after mechanical stretching. The *in vivo* results showed that GsMTx4 treatment attenuated HS formation with reduced cross-sectional size of the scar(4.21 ± 1.08 *versus* $8.04\pm1.55 mm^2$, $P<0.005$) and decreased scar elevation index (1.69 ± 0.33 *versus* 3.08 ± 0.65, $P<0.005$) compared with the control group. In addition, GsMTx4-treated -scars exhibited the down-regulation of α-SMA expression compared with the control group ($25.4\%\pm1\%$ *versus* $30.5\%\pm2\%$, $P<0.005$).

Conclusion: Mechanosensitive ion channel Piezo1 plays a significant role in fibroblasts activation and hypertrophic scarring under mechanical stretch. Piezo1 might be a novel therapeutic target for HS formation.

Reference

1. Finnerty, C.C., et al., *Hypertrophic scarring: the greatest unmet challenge after burn injury.* The Lancet, 2016. **388**(10052): p. 1427-1436.
2. Duscher, D., et al., *Mechanotransduction and fibrosis.* J Biomech, 2014. **47**(9): p. 1997-2005.
3. Coste, B., et al., *Piezo1 and Piezo2 are essential components of distinct mechanically activated cation channels.* Science, 2010. **330**(6000): p. 55-60.
4. Segel, M., et al., *Niche stiffness underlies the ageing of central nervous system progenitor cells.* Nature, 2019. **573**(7772): p. 130-134.
5. Zhou, S., et al., *A Novel Model for Cutaneous Wound Healing and Scarring in the Rat.* Plast Reconstr Surg, 2019. **143**(2): p. 468-477.

Research -- Technology

Comparison of Adipose Particle Size on Autologous Fat Graft Retention in a Rodent Model

Presenter: Francesco M Egro, MBChB, MSc, MRCS
Co-Authors: Xiaonan Yang, MD, PhD, Jeffrey A. Gusenoff, MD, J. Peter Rubin, MD, Lauren Kokai, PhD
Affiliation: University of Pittsburgh Medical Center, Pittsburgh, PA

Background: Unpredictable retention outcomes remain a significant issue in autologous fat grafting procedures. Liposuction cannula variation leads to variability in fat particle size. Recent data suggest that the size of fat particles is closely related to graft healing outcomes, however this remains a point of contention due to potential confounding variables such as tissue trauma with harvest. The aim of this study was to compare autologous fat grafting outcomes with variable fat particle sizes in an animal model which isolated fat particle

size as the primary experimental variable. The overall goal of this work is to determine if reducing fat particle size is an effective method for enhancing graft retention in autologous fat grafting.

Methods: The range of fat particle diameter harvested by four common liposuction cannulas was quantified to define relevant small and large particle target diameters. To determine if particle size impacted nutrient and oxygen permeability, small and large particles were incubated in vitro in a spinner flask with an abundance of culture media and VEGF secretion was measured with ELISA. Finally, small and large fat grafts were prepared from subcutaneous mouse fat pads and grafted in syngeneic Balb/CJ mice. Weight and volume retention were evaluated at 1,4, 8, and 12 weeks. Histological analysis with Masson's trichrome and perilipin immunofluorescent staining was performed. qRT-PCR was performed for adipogenic, inflammatory and apoptotic genes.

Results: The range of fat particle diameters harvested with four commonly used cannulas was 2-7 mm. In vitro studies showed that 5-7mm particles had significantly increased VEGF secretion normalized to weight, indicating increased tissue hypoxia in these particles compared to 2-4mm. Surprisingly, in vivo comparison in two unique studies showed 2-4mm and 5-7mm fat particles had comparable graft retention ($p=0.5329$). Masson's trichrome staining revealed increased extracellular matrix and fibrosis in the 5-7 mm particle group ($p=0.0115$). Adipocyte survival with perilipin demonstrated comparable viability. Gene expression showed large particles experienced increased inflammation and apoptosis at 1 week after grafting, but overall there were no significant differences between groups.

Conclusions: The ideal fat particle size should be large enough to contain adequate mesenchyme while not so thick as to preclude imbibition. This study suggests that despite changes in hypoxia and VEGF levels, differing fat particles (2-4mm and 5-7mm) can achieve similar graft retention.

Research -- Technology

An Inconvenient Truth of Clinical Assessment of Indeterminate Burns and Indocyanine Green Dye Angiography Precise Marking for Burn Excision: A Prospective, Multicentered, Triple-Blinded Study

Presenter:	Apinut Wongkietkachorn, MD
Co-Authors:	Palakorn Surakunprapha, MD, Kamonwan Jenwitheesuk, MD, Kant Eua-angkanakul, MD, Kengkart Winaikosol, MD, Pattama Punyavong, MD, Nuttapone Wongkietkachorn, MD, Neil Salyapongse, MD
Affiliation:	Khon Kaen University, Khon Kaen, Thailand

Introduction: Indeterminate burn wounds are problematic in burn excision. The accuracy of clinical assessment was as low as 50-75%. The reduced accuracy in determining indeterminate burn wounds can be solved with indocyanine green angiography (ICGA), which was found to provide 100% accuracy, comparing to 50% of clinical assessment.[1] Despite ICGA advantages, there is no data on how much ICGA can make a difference in burn excision comparing to clinical evaluation. This study aimed to evaluate the difference between burn excision from the clinical assessment method and ICGA guided method.

Methods: This was a prospective, multicentered, triple-blinded, experimental study. This study was collaborated by Srinagarind hospital and Khon Kaen hospital in Thailand and the University of Wisconsin in the USA. Inclusion criteria were that patients must be admitted to the hospital with indeterminate burn wounds and were hemodynamically stable. Burn wounds with indeterminate depth were clinically assessed, and area to be

excised was marked by (first) attending surgeon. The marked area was measured by a 3-dimensional wound measurement device, which was reported to yield high accuracy. ICGA marking was then performed by (second) blinded surgeon. Thirty-three percent of maximal perfusion was used as a cut-point between superficial and deep second degree burns.[1-4] The deep burns with maximal perfusion of less than 33 percent were painted with methylene blue to indicate the area to be excised in the operating room.[1-4] The 3-dimensional wound measurement device was later used to measure the painted area. Measurement of the marked area by using clinically assessed and ICGA was conducted by (third) blinded surgeon.

After ICG angiography, the wounds were followed to determine the wound outcome on day 21.

Result: There were 20 burn sites included in the study. Over one hundred and fifty percent difference was found between using ICGA and clinical assessment. Over 90% of the indeterminate burns, which were assessed by ICGA to be superficial burns but was evaluated by clinical assessment to be deep burns, were found to be completely healed on day 21.

Conclusions: ICGA contributes to a vast difference over clinical assessment in the excision of indeterminate burns. A lot of wounds can be assessed precisely and spared.

References

1. Wongkietkachorn A, Surakunprapha P, Winaikosol K, Waraasawapati S, Chaiwiriyakul S, Eua-Angkanakul K, et al. Indocyanine green dye angiography as an adjunct to assess indeterminate burn wounds: A prospective, multicentered, triple-blinded study. J Trauma Acute Care Surg. 2019;86(5):823-8.
2. Wongkietkachorn A, Surakunprapha P, Winaikosol K, Wongkietkachorn N, Wongkietkachorn S. Precise Marking for Burn Excision by Using Indocyanine Green Angiography. Plast Reconstr Surg. 2020;145(1):229e-30e.
3. Wongkietkachorn A, Surakunprapha P, Winaikosol K, Eua-Angkanakul K, Wongkietkachorn N, Punyavong P, et al. Quantitative Burn Depth Analysis Using Indocyanine Green Angiography. J Burn Care Res. 2019;40(5):725.
4. Wongkietkachorn A, Surakunprapha P, Jenwitheesuk K, Winaikosol K, Punyavong P, Chowchuen B, et al. Improvement in interpretation of indocyanine green angiography. J Plast Reconstr Aesthet Surg. 2019.

Research -- Technology

Evaluating the Effects of Brain Death Physiology and Immunosuppression on the Muscle-Derived Stem Cell Niche in a Large Animal Transplant Model

Presenter: Mohamed Awad, MD

Co-Authors: Samuel Boas, MS, Arvin Smith, MS, David Kurlander, MD, Anand Kumar, MD

Affiliation: University Hospitals, Cleveland, OH

Background: Muscle-derived stem cells (MDSCs) have been shown to be robust mediators of tissue regeneration and mixed chimerism in small animal murine transplant models. The effects of transplant and brain death (BD) physiology on MDSCs are understudied in large animal translational models. Our study aim was to evaluate the viability, quantity, and stem cell differentiation of MDSCs under various conditions in a porcine

VCA model. We hypothesized that BD negatively affect the MDSC stem cell-niche in vascularized composite allografts (VCA).

Methods: MDSCs were harvested from the hind-limbs of pigs under the following conditions: 1) pre-BD donor, 2) post-BD donor, 3) immunosuppressed transplanted donor VCA, and 4) immunosuppressed recipient muscle (contralateral leg). Stem cell markers were evaluated in all groups using flow cytometry with standard stem markers (CFS, APC, PERCP) and stem cell presence further confirmed in the pre-BD group with differentiation assays. Samples were harvested at the time of transplant and 7 days after transplantation. MDSC populations were isolated using a modified collagen-sorting pre-plate technique. Fluorescent and bright field microscopy was used at various time points (0-10 days) to evaluate cell expansion and growth. Images were analyzed for confluence and differentiation stains using ImageJ, and statistical analysis was performed using Mathematica.

Results: Flow-cytometry demonstrated significantly higher population of stem cell markers PERCP (27% vs 7%), CFS (43% vs 14%), and APC (61% vs 12%) in pre-BD vs post-BD groups ($p=0.001$). Differentiation assays confirmed stem cell presence in the pre-BD differentiation assays, with significantly increased differentiation with later pre-plates for osteogenesis, chrondrogenesis, and adipogenesis ($p<0.01$).Percent confluence at 10 days was greatest in the pre-BD and lowest in post-BD conditions (81% vs 39%, $p<0.01$). The immunosuppressed transplant donor VCA showed greater percent confluence compared to the immunosuppressed recipient muscle (71% vs 55%, $p<0.01$), although this remained at a lower level than the pre-BD condition (71% vs 81%, $p<0.01$).

Conclusion: BD and immunosuppression each impair MDSC niche expansion and mitosis based on time to confluence. However, our study demonstrates that successful transplantation partially reverses the negative effects of BD. Future investigations will focus on further ameliorating BD effects to optimize the MDSC stem cell niche prior to transplant.

Research -- Technology

Wound Healing Myofibroblasts Proliferate Clonally and in a Mechanoresponsive Manner

Presenter:	Malini Chinta, BA
Co-Authors:	Deshka Foster, MD, Alan T. Nguyen, BS, Ankit Salhotra, BS, Gunsagar Gulati, BS, Chase Ransom, MD, PhD, Shamik Mascharak, BS, R. Ellen Jones, MD, Ashley L Titan, MD, Clement D. Marshall, MD, Michael Hu, MD, Heather E. desJardins-Park, AB, Michael Januszyk, MD, PhD, Geoffrey Gurtner, MD, Derrick C Wan, MD, Jeffrey A. Norton, MD, Howard Y. Chang, MD, PhD, Gerlinde Wernig, MD, Michael T Longaker, MD, MBA
Affiliation:	Stanford University, Stanford, CA

Introduction: Fibroblasts are integral in regulating tissue homeostasis. Notably, activated fibroblasts (myofibroblasts) play critical roles in wound healing including producing and depositing extracellular matrix and driving wound closure. Much research has been aimed at characterizing subpopulations of fibroblasts with specific activities in wound healing; however, information regarding the origins and heterogeneity of myofibroblasts remains incompletely explored. Our lab has previously shown that fibroblast activity in wound healing is dependent on tissue mechanics (specifically focal-adhesion kinase signaling). The aim of our research was to determine the origins of myofibroblasts that respond to dermal injury and to understand their proliferation, mechanoresponsiveness, and heterogeneity.

Methods: In order to study the characteristics of wound healing myofibroblasts we used the Rainbow reporter mouse ($Rosa26^{VT2/GK3}$). The rainbow system has a four-color reporter construct, which after induction and

recombination, cells express one of four fluorescent proteins and all progeny cells are then marked with the same color as their parent cell permitting precise clonal analysis and lineage tracing. We used a wounding model that mimics human wound healing kinetics in which full-thickness wounds were created on the dorsal dermis of Rainbow mice and stented with silicone rings. Wound tissues were examined using confocal microscopy. In order to investigate the influence of local tissue mechanics in our wound healing model, a small molecule FAK-inhibitor (or vehicle control) was applied to the mouse wounds. Imaris software was used for imaging analysis.

Results: Imaging analysis suggests the presence of progenitor-type fibroblasts that proliferate clonally and radially during wound healing. Clonal expansion can be appreciated when comparing cross-sectional images of uninjured control dermis to wounded dermis. Using an activated fibroblast driver (aSMA-Cre^{ERT2}) with the rainbow mouse model, radial proliferation of fibroblast clones is observed. Bulk RNA-seq data shows that the clonal proliferation of wound healing fibroblasts demonstrates an upregulation in mechanoresponsive gene pathways (i.e. those involving expression of FAK). Imaging analysis reveals that FAK-inhibition results in disordered clonal proliferation when compared to normal wound controls.

Conclusions: Fibroblast proliferation in response to dermal injury is clonal, suggesting the presence of progenitor-type fibroblasts. This clonal proliferation is FAK-dependent suggesting that this phenomenon is highly reliant on mechanical signaling pathways.

Research -- Technology

Role of Marijuana Component (Cannabidiol) in Induction of Regenerative Ability of Stem Cells

Presenter:	Henry P Miller, MD
Co-Authors:	Olga Ostrovsky, PhD, Nicholas De Leo, MD, Jeremy Badach, MD, Andrew Lin, MD, Steven C. Bonawitz, MD, John Williamson, MD, Abraham Hakim, MS
Affiliation:	Cooper University Hospital, Camden, NJ

Background/Purpose: Stem cell therapy has been shown to promote tissue regeneration and wound healing.[1,2] However, the isolation and expansion of mesenchymal stem cells can be an invasive, costly, and time-consuming process. Therefore, we sought to improve this process by enhancing the regenerative abilities of stem cells, thereby reducing the quantity of stem cells that must be harvested. Marijuana is a commonly used substance, both recreationally and more recently therapeutically, given its low toxicity and relatively benign side effect profile.[3] Certain marijuana components, namely the non-psychoactive cannabidiol (CBD), have been found to function as immunomodulators.[5] Our aim was to determine whether CBD-exposed stem cells would demonstrate improved regenerative abilities.

Materials/Methods: Human adipose derived stem cells (ASC) and bone marrow-derived mesenchymal stem cells (BM) were treated for 6 hours with either low CBD (300nM) or high CBD (3mM). A Transwell Migration assay was performed, and absorbance measured at 36 hours. Next, the treated ASC and BM underwent an MTT proliferation assay, with absorbance measured at 36 hours. Finally, a wound healing scratch assay in human keratinocytes was performed, again with ASC treated with low and high dose CBD.

Results: Both ASC and BM demonstrated a significant increase in migration with exposure to CBD. Compared to the control, ASC migration increased 412% with low dose CBD, and 251% with high dose CBD. For BM, migration increased 298% and 166% with low and high dose CBD, respectively. BM demonstrated improved

proliferation with exposure to CBD. Compared to the control, proliferation increased 48% with low CBD, and 86% with high CBD ($p<.05$). There were no differences in proliferation in ASCs primed with low or high CBD ($p=0.68$). Compared to unexposed ASCs, the low CBD ASC group had 49% faster wound closure at 20 hours, and 78% at 44 hours.

Conclusion: CBD priming of ASCs and BM, at both low and high doses, enhances a number of regeneration parameters, suggesting that this component of marijuana induces or improves stem cell based therapy. Given the large number of people using various marijuana products, which are largely unregulated and under-studied, these findings may greatly effect management of complex wounds after reconstructive surgery.

References:

1. Chouhan, D., et al. (2019). "Emerging and innovative approaches for wound healing and skin regeneration: Current status and advances." Biomaterials **216**: 119267.
2. Hassanshahi, A., et al. (2019). "Adipose-derived stem cells for wound healing." J Cell Physiol **234**(6): 7903-7914.
3. Whiting, P. F., et al. (2015). "Cannabinoids for Medical Use: A Systematic Review and Meta-analysis." Jama 313(24): 2456-2473.
4. Burstein, S. (2015). "Cannabidiol (CBD) and its analogs: a review of their effects on inflammation." Bioorg Med Chem 23(7): 1377-1385.

Research -- Technology

Hand3D: 3D Printed Hand Simulator for Surgical Education

Presenter:	Daniel A Farrell, BA
Co-Authors:	Travis J Miller, MD, Justin Chambers, PhD, Vinitha A Joseph, BS, Ephraim Pittore, MS, W. Thomas McClellan, MD, FACS
Affiliation:	West Virginia University, Morgantown, WV

Purpose: Simulation based training has become widely used in surgical residency programs to complement traditional learning. Simulators provide an environment for plastic surgery residents to advance their surgical skills while keeping patient safety at a premium. Several hand related procedures, such as percutaneous pinning with Kirshner wires, can be accomplished via a simulation model. In addition, these procedures train many of the basic motor skills required for residents such as proprioceptive feel of bone drilling and fluoroscopy. Unfortunately, many current hand simulators are inadequate. Cadaver labs provide an operation setting similar to living tissue but incur high costs with maintenance facilities and technical upkeep.[1] In contrast, simulation bones or PVC pipes can provide proprioceptive feedback but do not provide realistic tissue anatomy or fluoroscopy training.[2] Our goal was to design a 3D printed, anatomically accurate hand simulator for improving surgical skills.

Methods: We created a training model hand designed entirely from the computerized tomography (CT) data of an adult male’s right hand. Engineers created volumetric solid models of the hand by segmenting the CT using a

DICOM segmentation software package (3D Slicer) and further modified in CAD software (Blender). Metacarpals and phalanges were created with polylactic material with an FDM style printer to mimic dense cortical bone surrounded by a lattice structure resembling cancellous bone. The bones were casted into a clear silicone, chosen to provide accurate density for proprioceptive feel in drilling procedures while still affording high tensile strength and durability.

Results: Our device performs well in joint arthrodesis and CRPP under fluoroscopy. The hand provides excellent proprioceptive feedback to train pinning and plating due to the model's dense cortical bone surrounding an intramedullary bone matrix. The silicone soft tissue is durable yet malleable allowing for the utilization of techniques such as Jahss maneuver or bone forceps. The model also gives high quality fluoroscopic imaging due to the discrepancies in density of the silicone soft tissues, dense cortical bone, and lattice structured intermedullary space. 3D printing using CT data provides accurate anatomy of the hand. Additionally, multiple fracture patterns and anatomic variations can be programmed into the model before printing offering a wide range of simulated clinical scenarios. The estimated cost of the device is between $200-300 making it significantly cheaper than high fidelity simulators or cadaver alternatives, while still providing high quality training for motor skills and spatial reasoning.

Conclusions: With this hand simulator we created a 3D printed, anatomically accurate, polyfracture model for resident education. Due to the model's low cost and ability to represent a wide range of fractures and hand procedures, it has the potential to be an excellent tool in resident education. Future research with a pilot study is warranted.

Reference

1. Kovacs G, Levitan R, Sandeski R. Clinical Cadavers as a Simulation Resource for Procedural Learning. *AEM Educ Train*. 2018. doi:10.1002/aet2.10103
2. Kazum E, Dolkart O, Rosenthal Y, et al. A Simple and Low-cost Drilling Simulator for Training Plunging Distance Among Orthopedic Surgery Residents. *J Surg Educ*. 2019. doi:10.1016/j.jsurg.2018.06.018

Research -- Technology

Harnessing Machine-Learning to Personalize Cleft Lip Markings

Presenter: James B. Hu, B.S.
Co-Authors: Andrew Guan, B.S., Lohrasb R. Sayadi, MD, Raj M. Vyas, MD
Affiliation: University of California: Irvine, Orange, CA

Purpose: Cleft-lip surgery aims to restore oral functionality while striving to achieve normal lip aesthetics. Preoperative planning using anthropological landmarks of the lip guide surgeons through the process. However, identifying and placing these markings on the fine anatomy of the lip in children can be extremely difficult and can lead to compromised functional and aesthetic outcomes. The purpose of the study is to develop a novel approach to improve the accuracy of markings for cleft-lip surgery. To do so we developed a machine learning algorithm which reliably places anthropological landmarks on unilateral cleft-lip pictures in order to guide intraoperative markings.

Methods: We utilized High-Resolution Net (HRNet), a recent family of deep learning models that has achieved state of the art results in many computer-vision tasks, including facial landmark detection.1 HRNet follows the current trend in computer vision of stacking multiple convolutional layers2, but differs in one key area. Whereas previous models generally downsample the dimensionality of the input at each layer, HRNet performs this downsampling in parallel with a series of convolutional layers that preserves dimensionality, which allows for intermediate representations with higher dimensionality while simultaneously extracting lower dimension features.

To adapt the facial landmark detection HRNet for our task, we employed transfer learning, a technique in machine learning to transfer knowledge gained from a source task to a target task.3 Transfer learning has shown to dramatically reduce training time, increase accuracy on target task, and reduce required training examples in the target task.

Results: For model evaluation, we calculated error using the Normalized Mean Error (NME), an evaluation metric in facial landmark detection. Here, a craniofacial plastic surgeon manually marked 50 Mulliken unilateral cleft-lip images, and these images are compared against the detected markings assigned by our algorithm. After training on our dataset, we obtained a test NME of 0.1065. In comparison, the state of the art for facial point detection test NME in other datasets is in the range of 0.0385 (300W) to 0.0460 (WFLW), but our training dataset size is about 1% the size of these benchmarks. These results illustrate the possibility of leveraging relatively small amounts of data to achieve surprisingly accurate labeling in cleft-lip annotations.

Conclusion: In the present study, we developed a deep learning model which accurately places Mulliken unilateral cleft-lip markings on to preoperative photographs. We envision a national and international impact and believe that the usefulness will go beyond teaching residents as this technology can be used by cleft global outreach foundations as an instructional resource application for trainees. In the future, we plan on physically projecting these markings onto the surface of cleft-lips, using technology developed by our team, thereby overcoming discrepancies related to paper to 3D marking transfer.

References

1. Deep High-Resolution Representation Learning for Visual Recognition. https://arxiv.org/abs/1908.07919.
2. Combining Data-driven and Model-driven Methods for Robust Facial Landmark Detection. https://arxiv.org/abs/1611.10152.
3. How transferable are features in deep neural networks? https://papers.nips.cc/paper/5347-how-transferable-are-features-in-deep-neural-networks.

Research -- Technology

Full-Thickness Skin Microcolumns Implanted into a Dermal Regeneration Template: A Novel Method for “Donor-Free” Skin Replacement Therapy

Presenter: Edward M Gronet, MD
Co-Authors: Rodney Chan, MD, Laura Cooper, MD, Anders Carlsson, PhD
Affiliation: Stars Plastic Surgery, San Antonio, TX

Background: Split thickness skin graft is the current standard in the treatment of large full thickness skin defects. The donor site resulting from tangential skin harvest is well recognized as painful and unsightly, even after it has healed. Several efforts have been made in the past to address this problem by limiting the amount of skin harvested while significantly expanding the skin elements (ReCell®, Meek®). These efforts suffer from short comings such as graft fragility and failure to achieve adequate closure in a reasonable period of time. Full thickness skin columns is a novel concept in skin harvest with little to no donor site when the diameter of the columns falls below a certain threshold. There is also a theoretical advantage that the columns harvested contain elements of full thickness skin including sweat glands and hair follicles. Here we present two cases where full thickness skin columns were harvested and implanted into a bilayer dermal regenerative template (Integra®) to achieve durable single-stage skin replacement.

Methods: Wounds in two elderly patients were treated using standard excisional preparation techniques. Both patients refused a standard split thickness skin graft with concerns of difficulty healing the donor site. Informed consent using full thickness skin columns and Integra combination were obtained. Full-thickness skin columns were harvested from a small area of the upper thigh using skin biopsy punches (1.5mm-2mm). The columns were implanted orthotopically into a sheet of Integra dermal matrix with the epidermis placed immediately deep to the silicone layer. The Integra-skin column composites were applied onto the wounds similar to a traditional skin graft. The punch biopsy donor sites were allowed to heal secondarily.

Results: Patient 1 was 90 years old and had a small lower extremity wound treated with 2mm skin columns (n=9) and a 3x1.5cm2 Integra®. Patient 2 was 88 years old had a larger volar forearm wound treated with 1.5mm skin columns (n=51) and an 8x5cm2 Integra®. Visual evaluation showed centripetal healing with epithelial cells radiating from the columns as well as from the periphery. Complete healing was achieved in 3-4 weeks; donor sites healed in less than a week with minimal evidence of skin harvest at 1 month.

Conclusions: Full thickness skin columns implanted into a dermal regeneration template represent a novel technique for skin replacement that allows single stage healing of full thickness skin wounds with little to no donor site, and without any biochemical processing of the tissue.

Surgical Pearls Abstracts

Arteriovenous Malformations of the Hand Case Series: Technical Challenges and Significance of Palmar Arch Reconstruction

Presenter:	Amjed Abu-Ghname, MD
Co-Authors:	Matthew J Davis, BS, Jeffrey Trost, MD, Renata Maricevich, MD, William C. Pederson, MD, Marco A. Maricevich, MD
Affiliation:	Baylor College of Medicine, Houston, TX

Background: Arteriovenous malformations (AVMs) are high-flow congenital vascular anomalies consisting of an abnormal vascular network in which arterial blood flow directly connects to venous drainage. Hand AVMs post a significant challenge given the functional importance of the hand and high recurrence rate of AVMs. This study presents our early experience with treating hand AVMs using complete surgical excision and palmar arch reconstruction.

Methods: A retrospective review was performed on all patients with hand AVMs who underwent surgical excision at our institution between 2014 and 2018. Operative management involved ray amputation and/or

excision of the palmar arch (**Figure 1**). The palmar arch was reconstructed in the majority of the cases with saphenous vein graft or uninvolved common digital arteries. Patient demographics, operative details, and postoperative courses were recorded.

Results: A total of four patients were included in this study. Mean patient age was 32 years. All patients presented with a pulsatile swelling, ulceration, and limited function. Arteriograms demonstrated high-flow AVMs with ulnar artery dominance. Three patients underwent excision of the palmar arch and involved ulnar artery. Additional reconstruction with a lateral arm free flap was required in one patient (**Figure 2**). All patients had excellent recovery with no complications. In patients who underwent palmar arch reconstruction, symptoms completely resolved with no recurrences**.** While no gross recurrence is evident in the only patient whose arch was not reconstructed, persistent high pulses can still be appreciated. Patients were followed for a mean of 2.3 years.

Conclusion: Given precise dissection and microsurgical technique, high-flow AVMs of the palm and fingers can be successfully managed in select cases with wide local excision and immediate palmar arch reconstruction. Our early experience suggests that reconstructing the arch can possibly prevents the postoperative collateralization from adjacent arteries and re-expansion of the lesion.

Surgical Pearls Abstracts

Below-the-Knee Amputation with Targeted Muscle Reinnervation: Operative Technique and Technical Pearls of an Inter-Fascicular Superficial Peroneal Nerve TMR

Presenter: Brian L Chang, MD
Co-Authors: Grant M. Kleiber, MD
Affiliation: Georgetown University, Washington, DC

Introduction: Targeted muscle reinnervation (TMR) is a nerve transfer technique by which the severed ends of sensory nerves are transferred to expendable donor motor nerves to minimize pain. TMR has successfully been used to reduce residual limb and phantom limb pain in patients with upper and lower extremity amputations. For patients with below-the-knee amputations (BKAs), the tibial nerve and superficial peroneal nerve (SPN) are the most common sensory nerves addressed with TMR. While the tibial nerve coaptation is well-protected by the deep posterior musculature, the SPN coaptation is commonly positioned at the weight-bearing portion of the stump without significant soft tissue padding. This study details a novel inter-fascicular SPN TMR technique performed through a proximal incision at the fibular head.

Technique: TMR performed primarily at time of BKA is offered to all patients pre-operatively to prophylactically reduce pain. TMR is also offered secondarily to patients who develop severe neuroma or phantom limb pain after their amputation. When performed primarily, TMR is performed on the SPN and tibial nerve. When performed secondarily, TMR is performed on the involved nerves based on clinical exam. The SPN TMR is performed through an approach to the common peroneal nerve (CPN) at the fibular head. Accessing the CPN at this level allows for complete decompression of the CPN through the peroneal tunnel. An internal neurolysis is performed, and a nerve stimulator is used to map the motor fascicles to identify an expendable target. The extensor digitorum longus is preferentially selected since it is not critical to tibial padding. The SPN is then translocated from the distal wound into the peroneal tunnel incision and an antegrade nerve transfer is performed to the motor target, typically with a close size match. (Video).

Results: This technique for primary TMR for BKAs was performed in 109 patients over a two year period from January 1, 2018 to December 31, 2019. The SPN was transferred to the extensor digitorum longus 78.5% of the time, peroneus brevis 9.3%, redundant branch of tibialis anterior 6.5%, and peroneus longus 5.6%. The tibial nerve was transferred to the tibialis posterior 66.7% of the time, soleus 10.0%, flexor digitorum longus 8.3%, flexor hallucis longus 8.3%, and unspecified muscle of the deep flexor compartment 6.7%. No primary DPN, sural, or saphenous TMRs were performed. There were no added surgical complications attributable to the TMR portion of the case: no surgical site infections at the fibular head incision or reoperation for seromas or hematomas. If patients developed pain in the saphenous or sural distributions a secondary TMR was performed, but this was only required in 2 patients.

Conclusions: TMR has been demonstrated to greatly improve amputees' pain and ambulation following a major lower extremity amputation. This paper provides insight into the technical pearls of the unique inter-fascicular SPN TMR, which places the coaptation away from the weight-bearing stump and allows for a close size match. This technique has been used with excellent clinical outcomes and no procedure-specific complications in over 100 patients.

Surgical Pearls Abstracts

Vascularized Rib Grafts to Augment Spinal Fusion: A Novel Approach

Presenter:	Edward Reece, MD, MBA, FACS
Co-Authors:	Nikhil A Agrawal, MD, Kathryn Wagner, MD, Matthew J Davis, BS, Amjed Abu-Ghname, MD, Rohil Shekher, BS, Michael Raber, MD, Sebastian Winocour, MD, MSc, FACS, Michael A Bohl, MD, Alexander Ropper, MD
Affiliation:	Baylor College of Medicine, Houston, TX

Background: Pseudoarthrosis is a well-known complication following spinal fusion. Rates range from 5-40% and are influenced by both patient factors and technical factors. Patients with pseudoarthrosis may experience a return or worsening of their pre-operative pain, which can significantly decrease quality of life. For patients with complex posterior column defects with either anterior or posterior columnar insufficiency, especially those receiving chemotherapy, radiation, predisposed to recurrent pseudarthrosis or infection, vascularized bone grafts (VBGs) have been shown to provide better outcomes than nonvascularized bone grafts (N-VBGs).[1-5] The purpose of this study is to present an innovative pedicled rib VBG (R-VBG) that can be utilized to augment instrumented spinal fusion.

Methods: Following hardware placement for spinal fusion, an incision is made over the target rib. The intercostal muscle attachments to the superior border of the R-VBG are released, and the rib with its blood supply intact is bluntly dissected from the underlying pleura and inferior intercostal muscle attachments, protecting the subcostal vessels. Particular care is taken when separating the intercostal nerve from the subcostal vessels to prevent postoperative numbness and radicular pain. At the lateral limit of the dissection, the subcostal vessels were controlled, and the rib is cut distally and proximally. The R-VBG is then tunneled under the paraspinous muscles and placed along the posterolateral gutters of the spinal levels being augmented. The natural curvature of the rib is used to match the patient s kyphosis/lordosis. The rib is cut down to size and fixated.

Results: To date, 7 R-VBGs have attempted. Of these 6 (86%) have been successfully harvested, all of which (100%) went on to achieve at least probable radiologic evidence of graft site fusion.

Conclusion: The technique described for rotating a vascularized rib bone graft into the posterolateral space for spinal fusion as far as the L4/L5 joint space is an effective method for augmentation of spinal fusion in patients with complex spinal pathologies. Although additional data needs to be collected before true indications can be elucidated for this procedure, our preliminary prospective results suggest that this approach is relatively low risk, especially compared to free tissue transfer, and it has the benefit of providing well-vascularized, healthy bone to augment the fusion bed.

References

1. Eastlack, R, Dekutoski M, Bishop A, Moran S, Shin A. Vascularized Pedicled Rib Graft: A Technique for Posterior Placement in Spinal Reconstruction. Spinal. Disord Tech 2007;20:610 615
2. Bohl M, Mooney M, Catapano J, Almefty K, Turner J, Chang S, Preul M, Reece E, Kakaria U.. Pedicled Vascularized Bone Grafts for Posterior Occipitocervical and Cervicothoracic Fusion: A Cadaveric Feasibility Study. Operative Neurosurgery 0:1 7, 2017
3. Bradford DS. Anterior vascular pedicle bone grafting for the treatment of kyphosis. Spine. 1980;5:318 323
4. Bradford DS, Daher YH. Vascularised rib grafts for stabilisation of kyphosis. J Bone Joint Surg. 1986;68B:357 361
5. Wilden JA, Moran SL, Dekutoski MB, et al. Results of vascularized rib grafts in complex spinal reconstruction. J Bone Joint Surg. 2006; 88A:832 839

Surgical Pearls Abstracts

Opioid Prescribing and Use Following Common Plastic Surgery Procedures

Presenter:	Colton G. Boudreau, MSc
Co-Authors:	Osama Samargandi, MD, MHSc, Connor McGuire, MD, MHSc., Kaleigh MacIssac, BSc Pharm, Adel Helmi, MD, David Tang, MD
Affiliation:	Dalhousie University, Halifax, NS, Canada

Background: Overprescribing of opioids has become a topic of interest given the potential adverse outcomes associated with their use. Excess prescribing of opioids has been shown to have individual and societal impacts such as addiction, dependence and misuse. Opioids are frequently prescribed for analgesia following plastic surgery procedures. This study aims to investigate prescribing patterns and explores self-reported patient experiences with opioid use, pain control and disposal of unused tablets following common hand and breast surgeries.

Methods: Patients undergoing five common predetermined breast procedures and six common hand procedures in a specified 14-week period were identified by billing code through health information services. 62 hand procedures 46 breast procedures were identified. Collaboration with opioid monitoring services of the Nova Scotia Provincial Monitoring Program (NSPMP) allowed for data surrounding prescription filling rates, drug type, dose and tablets dispensed. Additionally, all patients were contacted to participate in a structured telephone interview surrounding prescription awareness, pain control and disposal of excess medication.

Results: 55.4% and 41.6% of patients received and filled an opioid prescription following a hand or breast procedure, respectively. Hydromorphone was the most commonly prescribed narcotic for both hand and breast procedures. Average number of opioid tablets dispensed following hand and breast procedures was 36.1 and 31.9, respectively. 48 and 52 percent of hand and breast patients completed phone interviews. 4.2% of breast patients required an opioid refill, while no hand patients did. 73% of hand 75% of breast patients used at least

one over-counter analgesic, most common being acetaminophen alone. Average self-reported pain score and total pain period was not significantly different between those using opioids and those not for both hand and breast procedures. 6.7% and 23.1% of patients report returning excess narcotics to pharmacy, while the majority report still having or self-disposing excess tablets.

Conclusions: Opioid prescriptions are frequent following the procedures studied. In general, opioids appear to be prescribed in excess as denoted by self-report low prescription usage, statistically insignificant differences in pain for those using and not using opioids and low refill rates. Additionally, the majority of unused opioids were noted to be still at home or disposed of inappropriately. Taken together, this study suggests a role for reviewing opioid prescribing patterns for common hand and breast procedures to reduce contributions of excess opioids to an ongoing opioid epidemic.

Surgical Pearls Abstracts

Single-Unit Technique for the Use of Acellular Dermal Matrix in Immediate Expander-Based Breast Reconstruction

Presenter: Anna Luan, MD, MS
Co-Authors: Ashraf A. Patel, BS, Shanique Martin, BS, Rahim S. Nazerali, MD, MHS
Affiliation: Stanford University School of Medicine, Stanford, CA

Introduction: The use of acellular dermal matrices (ADMs) in immediate two-stage prosthetic breast reconstruction is now a common practice. However, the manipulation of ADM to create the inferolateral sling can be unwieldy in practice, typically involving the placement of the ADM followed by positioning and anchoring of the prosthetic expander. At best, this may be a minor nuisance, but this may also potentially influence outcomes, including wrinkling or discrepancies in symmetry.

Methods: In this report, we present a novel modification that streamlines this procedure. Perforations are made through the ADM, through which the tissue expander tabs are brought and secured to the allograft *ex vivo* to allow the ADM and expander to be placed into position at the inframammary fold as a single unit. A retrospective review was then performed of all patients who underwent immediate staged partial submuscular expander-based reconstruction using this technique between July 2015 and October 2019. Demographics, comorbidities, oncologic history, and perioperative data were collected for all patients. Complications including infection, malposition, and reoperation were analyzed.

Results: A total of 62 consecutive patients, corresponding to 108 breasts, were identified. Average follow up was 18 months. Of demographic variables, only obesity was statistically associated with increase in complication rate. Most mastectomies were performed using a nipple sparing technique (75.9% of breasts). Average initial fill volume was 235 milliliters. Postsurgical complications occurred in 29.6% of breasts. The most commonly observed complications were mastectomy skin necrosis (9.3%) and major infection (8.3%). There was a 7.4% rate of malposition.

Conclusions: ADM is frequently utilized in breast reconstruction due to several associated advantages. This study reports a novel technique that may make ADM and tissue expander placement simpler and more consistent, with rates of malposition and infection within the lower range of those previously reported (1-5). Our data suggest that this novel modification leads to excellent outcomes with favorable complication rates.

References:

1. Vardanian, A. J., Clayton, J. L., Roostaeian, J., et al. Comparison of implant-based immediate breast reconstruction with and without acellular dermal matrix. Plastic and reconstructive surgery 2011;128:403e-410e.
2. Lee, K. T., Eom, Y., Mun, G. H., Bang, S. I., Jeon, B. J., Pyon, J. K. Efficacy of Partial- Versus Full-Sling Acellular Dermal Matrix Use in Implant-Based Breast Reconstruction: A Head-to-Head Comparison. Aesthetic plastic surgery 2018;42:422-433.
3. Clarke-Pearson, E. M., Lin, A. M., Hertl, C., Austen, W. G., Colwell, A. S. Revisions in Implant-Based Breast Reconstruction: How Does Direct-to-Implant Measure Up? Plastic and reconstructive surgery 2016;137:1690-1699.
4. Lanier, S. T., Wang, E. D., Chen, J. J., et al. The effect of acellular dermal matrix use on complication rates in tissue expander/implant breast reconstruction. Annals of plastic surgery 2010;64:674-678.
5. Ranganathan, K., Santosa, K. B., Lyons, D. A., et al. Use of Acellular Dermal Matrix in Postmastectomy Breast Reconstruction: Are All Acellular Dermal Matrices Created Equal? Plastic and reconstructive surgery 2015;136:647-653.