ABSTRACTS PRESENTATIONS

Group 1

Basic Science / Research

Abstract #1

TOLL-LIKE RECEPTOR AGONISM WITH THYMOSIN ALPHA 1 IMPROVED CHRONIC WOUND RESILIENCE TO BIOFILM ADHERENCE AND HEALING OF COLONIZED WOUNDS

Phoebe Lee
University of Pittsburgh
School of Medicine

Winner

2nd Place Basic Science

TOLL-LIKE RECEPTOR AGONISM WITH THYMOSIN ALPHA 1 IMPROVED CHRONIC WOUND RESILIENCE TO BIOFILM ADHERENCE AND HEALING OF COLONIZED WOUNDS

Background/Purpose: Biofilm formation is a critical barrier to chronic wound healing. Macrophage activation by toll-like receptors (TLRs) is critical to control and clearance of biofilms. Thymosin alpha-1 is an activator of the innate immune response in part via TLR2/4/9 stimulation. Here we sought to determine if Thymosin alpha-1 modulation of TLR signaling reduces biofilms and improves closure in infected diabetic wounds.

Methods: Male obese diabetic (B6.Cg-Lep^{ob}) mice received bilateral edge-inverted wounds. After 1-week intraperitoneal thymosin alpha-1 daily was initiated. Concurrently, Lubbock-type pre-made polymicrobial biofilms were generated transferred murine wounds. After 72-hours wounds were photographed for biofilm adherence and sacrificed for flow cytometry of granulation tissue. Samples were gated to determine CD11b(null), (low), (med), and (high) populations. Relative fraction of macrophages (CD11b+Ly6G-F4/80+) and neutrophils (CD11b+Ly6G+F4/80-) were assessed.

Results: Thymosin alpha-1 treated animals demonstrated 46.6% reduction in biofilm adherence. Granulation tissue collected from infected chronic wounds demonstrated significantly increased macrophage enrichment after treatment for CD11b(low; 1.11+/-0.07% [vehicle control] vs 2.99+/-0.12% [Thymosin alpha-1]; $p<0.05$); (mid; 0.71+/-0.03 [vehicle control] vs 2.05+/-0.09% [Thymosin alpha-1]; $p<0.05$); and (hi; 0.35+/-0.03% [vehicle control] vs 0.91+/-0.04% [Thymosin alpha-1]; $p<0.05$) populations. 1-week post-infection, no further evidence of healing was noted in infected wounds from vehicle-treated mice (107.98+/-13.30% pre-treatment) vs. decrease by 69.63+/- 8.69% ($p=0.013$) in treated samples.

Discussion/Conclusion: Thymosin alpha-1 improved the resilience of diabetic wound against biofilm adherence and colonization and generated a more robust macrophage-dependent response to biofilm presence. This resulted in enhanced wound healing vs. untreated infected samples.

Abstract #2

TOLL-LIKE RECEPTOR AGONISM WITH SYNTHETIC THYMOSIN ALPHA 1 ENHANCED REVASCULARIZATION AND SPEEDS HEALING IN MURINE CHRONIC DIABETIC WOUNDS

Phoebe Lee
University of Pittsburgh
School of Medicine

TOLL-LIKE RECEPTOR AGONISM WITH SYNTHETIC THYMOSIN ALPHA 1 ENHANCED REVASCULARIZATION AND SPEEDS HEALING IN MURINE CHRONIC DIABETIC WOUNDS

Background/Purpose: In diabetic wounds microvascular injury and dysregulation of periwound vascularity engenders hypoxia and allows for a milieu of inflammatory markers and cells to accumulate and delay wound closure. Thymalfasin is an FDA approved synthetic analog of the Toll-like Receptor (TLR) -2/4/9 agonist Thymosin alpha-1 which can promote endothelial migration and acute wound closure. Given this we hypothesized that Thymalfasin could be used to enhance resolution.

Methods: Male obese diabetic (B6.Cg-Lep^{ob}) mice underwent bilateral wounding with inverted skin-edge flaps, which were allowed to granulate for 4-weeks followed daily intraperitoneal Thymalfasin (250ug/kg) or vehicle for 1-week. Photographs were taken before and after treatment. A second cohort was generated and periwound was collected for flow cytometry against CD31/VEGFR/CD34/CD45.

Results: Prior to treatment, there was no statistical difference in chronic wound area between treatment and control (0.41+/-0.32 vs. 0.42+/-0.26 cm After 1-week treatment, chronic wounds demonstrated a post-treatment area of 0.06+/-0.13 cm2 with only 40% of wounds remaining open. Time-matched vehicle-treated wounds demonstrated area of 0.32+/-0.19 cm2 in area and no closure post-injury week 5. This was a statistically significant decree in the Thymalfasin-treated group (91.58+/-16.48 % [Treatment] vs. 8.19 +/- 23.41% [Control]; p=0.0002). Periwound tissues were significantly enriched for mature endothelial (CD31+VEGFR2+CD34-CD45-) cells in the Thymalfasin-treated group (p<0.0001).

Discussion/Conclusion: In stable murine chronic diabetic wounds, Thymalfasin was sufficient to stimulate rapid closure, significantly decrease wound area, and enrich mature endothelium suggesting the potential for TLR agonism to treatment of diabetic chronic wounds.

Abstract #3

ALLOGENEIC ADIPOSE TISSUE-DERIVED MATRIX MITIGATE RADIATION-INDUCED FIBROSIS (RIF)

Yusuf Surucu, MD
University of Pittsburgh

ALLOGENEIC ADIPOSE TISSUE-DERIVED MATRIX MITIGATE RADIATION-INDUCED FIBROSIS (RIF)

Introduction: Radiation-induced fibrosis (RIF) is a complex tissue response characterized by massive deposition of extracellular matrix (ECM) and excessive fibroblast proliferation resulting in loss of tissue function and quality of life. In this study, we tested the efficacy of allograft adipose tissue-derived matrix (AATM) to mitigate RIF.

Methods: We used 40 Gy hind limb irradiated C57BL/6 mice as a skin fibrosis model and injected 200 µl AATM on the 14^{th} post-irradiation day to investigate the inhibition of fibrosis on day 40. PBS and adipose stem cell (ASC) injection were negative and positive controls, respectively. The degree of limb excursion, skin epithelium thickness, and collagen deposition was measured as a marker of fibrosis. Molecular changes in treated and control skins were measured at gene and protein levels using real-time PCR and Luminex assay respectively. The presence of hepatocyte growth factor (HGF) as a possible contributor to mitigation was measured in AATM using HGF- ELISA assay. In vitro trans-well studies were performed to analyze the effect of direct coculture of irradiated cells with AATM on pro-fibrotic gene expressions.

Results: Our results demonstrate that a single dose of 200 µl of AATM mitigates fibrosis. The mitigation efficiency of AATM was comparable to autologous ASCs. At day 40 epithelial thickness, collagen depositions, and significantly improved limb excursion compared with irradiated controls. Real-time PCR analysis reveals the down-regulation in the expression of pro-fibrotic genes TGF-β, CTGF, Col1, Col2, and TNF-alpha in AATM treated mice. Similarly, direct co-culture studies revealed downregulation of pro-fibrotic genes in irradiated fibroblast upon co-culture with AATM. ELISA results showed the presence of HGF and noncontact trans-well coculture of HGF knockout ASCs above a monolayer of irradiated mouse bone marrow stromal cells failed to downregulate fibrosis-related gene TGF-β expression.

Conclusion: Our findings suggest that allogeneic adipose tissue derived ECM (AATM) is an effective therapeutic option to mitigate fibrosis. Further studies to optimize the time and dose of the therapy will be a significant step forward towards clinical adaptation as a RIF mitigator.

Abstract #4

NERVE GUIDE WITH DOUBLE WALLED GDNF-CONTAINING MICROSPHERES IMPROVES RECOVERY AFTER FACIAL NERVE INJURY IN RODENTS

Fuat Baris Bengur, MD
University of Pittsburgh

The George Manstein, MD Award
Overall 1st Place

NERVE GUIDE WITH DOUBLE WALLED GDNF-CONTAINING MICROSPHERES IMPROVES RECOVERY AFTER FACIAL NERVE INJURY IN RODENTS

Background
Injury to the facial nerve and the resulting facial nerve palsy leads to devastating functional, psychological, and cosmetic challenges. Rapid functional recovery after facial nerve injury is critical to prevent muscle atrophy and restore expression. Bioengineering plays an important role to create artificial scaffolds that can enhance the recovery. This can be improved by addition of exogenous neuro-supportive agents such as glial-derived neurotrophic factor (GDNF). GDNF is a promoter of axonal elongation and branching and has been shown to promote Schwann cell proliferation and migration. In this study, we evaluated efficacy of a composite poly(caprolactone) nerve guide containing double-walled GDNF microspheres on functional, electrophysiological, and histological outcomes in a rat facial nerve injury model.

Methods
GDNF was encapsulated within double-walled poly(lactic-co-glycolic acid)/poly(lactide) microspheres and embedded in the walls biodegradable poly(caprolactone) nerve guides. This nerve guide capable of providing a sustained release of GDNF for >50 days was used to repair a facial nerve injury model in male Lewis rats. After transection and primary repair of the buccal branch of the facial nerve, the rats were divided as follows: a) transection and repair only, b) empty guide, c) GDNF-guide. Marginal mandibular branch of the facial nerve was also transected and ligated to prevent innervation of the whiskers. Weekly measurements of the whisking movements for protraction, retraction and amplitude angles were recorded. At the endpoint of 12-weeks, compound muscle action potentials at the whisker pad were assessed and nerve, muscle, and whisker pad were collected for histomorphometric analysis, including Schwann cell analysis.

Results
GDNF-guide treated rats displayed earliest peak and achieved the highest whisking amplitude with 36% recovery compared to the baseline. Weekly whisking amplitude measurements demonstrated both time and the treatment groups were independently associated with the recovery ($p<0.001$) and GDNF treatment had the highest impact versus all others ($p<0.05$). Compound muscle action potentials were significantly higher after GDNF-guide placement versus all others ($p<0.001$). Mean muscle fiber surface area at the levator labii superioris muscle was the highest ($p<0.01$). The axonal integrity loss was less prominent within the GDNF-guides. Gross morphology of the whisker pad was not different across the groups.

Conclusion
The novel tissue engineered nerve guide containing double-walled GDNF microspheres enhances recovery after facial nerve transection. Results support the clinical viability of these guides to enhance recovery after nerve injury and hold promise to facilitate recovery in defects with larger gaps.

Abstract #5

AUTOMATED MACHINE LEARNING FOR RISK PREDICTION OF INCISIONAL HERNIA IN ABDOMINAL SURGERY PATIENTS

Ankoor Talwar
University of Pennsylvania

AUTOMATED MACHINE LEARNING FOR RISK PREDICTION OF INCISIONAL HERNIA IN ABDOMINAL SURGERY PATIENTS

Introduction: Incisional hernia (IH) is a common, morbid long-term complication following abdominal surgery. Incidence is 500,000 annually. Our group previously developed a logistic regression model to predict risk of IH. The purpose of this study was to determine if automated machine learning (AutoML) is superior to logistic regression (LR) in assessing risk of incisional hernia, and understanding which clinical features are salient for IH formation.

Methods: This retrospective cohort study reviewed adult patients who underwent colorectal surgery at our institution from 2005 - 2016. Development of IH was noted. Two sets of clinical features were tested: a limited set of 18 features previously studied, and an expanded set of 246 clinical features. The four models generated were: LR with limited features, LR with expanded features, AutoML with limited features, and AutoML with expanded features. Primary outcome was the AUC generated by each model. Secondary outcomes included differences in predictions at varying true positive rates and Shapley values for feature importance.

Results: 20,516 patients were included, of which 12.3% developed IH (n=2,519). 67% of patients were used to train the models (n=12,871). The other 33% were the test cohort (n=6,340). AUCs were calculated: LR limited 0.599, LR expanded 0.682, AutoML limited 0.706, AutoML expanded 0.747 (Figure 1). At a true positive rate of 0.8, the AutoML expanded had a False Positive Rate (FPR) of 0.64, compared to AutoML limited FPR of 0.71, LR expanded of 0.78, and LR limited of 0.82 (all $p < 0.0001$). Shapley values of both the limited and expanded feature sets revealed the most critical factors predicting risk of IH were age and BMI followed by others (Figure 2). However feature importances shifted moving from limited to expanded features.

Discussion/Conclusion: Automated machine learning is better at predicting IH development over logistic regression. Predictions generated from expanded features are also better than from limited features. Finally, the importance of clinical features shift when using a larger feature set.

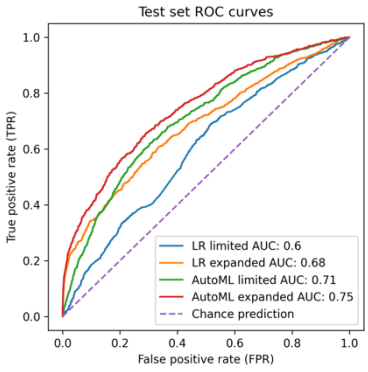


Figure 1.

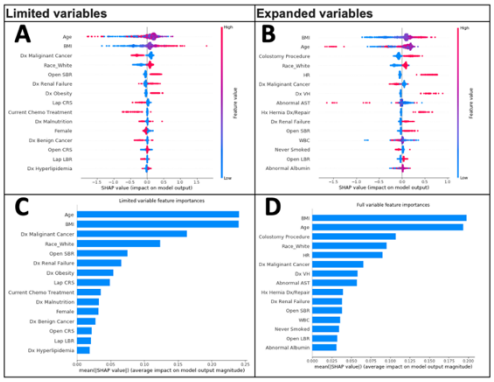


Figure 2.

ABSTRACTS PRESENTATIONS

Group 2

Basic Science / Research

Abstract #6

A 3D-PRINTED FRAME CREATES A NOVEL MODEL TO STUDY WOUND HEALING OVER EXPOSED CRITICAL STRUCTURES IN RODENTS

Fuat Baris Bengur, MD
University of Pittsburgh

A 3D-PRINTED FRAME CREATES A NOVEL MODEL TO STUDY WOUND HEALING OVER EXPOSED CRITICAL STRUCTURES IN RODENTS

Background
Soft tissue defects with exposed critical structures usually require reconstruction with well-vascularized tissues. Skin grafts and biological wound matrices are often inadequate to provide durable coverage because of the lack of blood supply from the wound bed. Current models to test these materials in a clinically relevant avascular wound bed are inadequate or not easily reproducible. We aimed to develop an affordable rodent model to demonstrate the efficacy of non-vascularized materials over a poorly vascularized wound bed.

Methods
We created 20x20 mm full thickness wounds on the dorsal skin of Lewis rats and secured 1-mm thick silicone sheets sized half of the wound's surface area. A similarly sized custom-made 3D-printed wound contraction frame was placed around the wound bed to isolate the wound environment. Either a split thickness skin graft or a single layer Integra dermal matrix was used to cover the silicone sheet inside the wound frame. Additional group with skin graft without an underlying silicone served as controls. The rats were followed for 4 weeks with weekly dressing changes and photography. Samples were retrieved at the endpoint for histologic analysis with H&E and Trichrome.

Results
The total wound sizes were constant throughout the duration of the experiment in all groups and the wound frames were well-tolerated by the rats. Gradual necrosis of the portion of the skin graft and Integra that corresponds to the silicone sheet was observed with eventual complete necrosis and exposure of the silicone sheet at the 4-week endpoint. The portion of the skin graft without the silicone sheet demonstrated coverage of the underlying fascia and histologically integrated epidermis. There were no epidermal elements underneath the silicone sheet. Both groups had similar viability, whereas skin graft controls without the silicone sheet demonstrated 100% graft take ($p<0.001$).

Conclusion
We developed a novel model of rodent wound healing that prevents contracture and isolates the wound environment in a clinically relevant complex wound with an avascular wound bed. The model was able to maintain the same wound size up to 4 weeks, where both skin graft and Integra failed to cover the exposed structure. This cost-effective model will establish an easily reproducible platform to test more complex bioengineered wound coverage solutions.

Abstract #7

HUMAN-ADIPOSE XENOGRAFTS IMPROVE BURN WOUND HEALING AND EPITHELIZATION IN MICE

Fuat Baris Bengur, MD
University of Pittsburgh

HUMAN-ADIPOSE XENOGRAFTS IMPROVE BURN WOUND HEALING AND EPITHELIZATION IN MICE

Background

Acute treatment of complex burns remains a critically unmet need. Regenerative capacity of adipose-derived stem cells has been an area of focus with their utility in the improvement of wound healing and scarring. For their applications in burn treatment, adipose and adipose-derived stem cell therapies have met success in acute a sub-acute thermal injury; however, the exact mechanism or effective agent is still under exploration. Prior reports vary highly as to whether a healthy autologous vascular fraction is necessary or whether xenologous, decellularized, or fractionated adipose extracts and their extracellular matrix may be used - with implications for the possibility of off-the-shelf adipose-derive therapeutics for complex burns.

Methods

Female athymic mice sustained bilateral 1 cm full-thickness thermal injuries and were stratified into either ipsilateral untreated burn controls or contralateral xenograft-adipose injection treatment. 1.0 mm human lipoaspirate of 300 ul was injected subcutaneously immediately post-burn to the treatment-stratified wounds. Mice were followed for 4-to-6-weeks with weekly photography. At the time of sacrifice, wound biopsies were collected for H&E, Trichrome, and protein.

Results

In mice treated with adipose xenograft at time of burn, no difference in surface area or burn morphology at 1-week post-injury were noted. By 2-weeks post injury more rapid resolution of inflammation and wound surface area was noted, which achieved significance by 4-6 weeks in grafted wounds. Adipose engraftment resulted is histomorphometric evidence of scar resolution with consistent revascularization and survival of the subcutaneous adipose xenograft at 6-weeks.

Conclusion

In contrast to prior data suggesting an autologous-only approach, our findings support a hypothesis that the active functional agent in adipose xenograft for burns in not directly dependent on species match. This provides evidence to support more broadly applicable approach to adipose-derived therapeutics in acute burns.

Abstract #8

ESTABLISHMENT OF PROTOCOL TO ENABLE ON-SITE CRYOPRESERVATION OF FAT FOR REPEAT PROCEDURES

Yusuf Surucu, MD
University of Pittsburgh

Winner

1st Place Basic Science

ESTABLISHMENT OF PROTOCOL TO ENABLE ON-SITE CRYOPRESERVATION OF FAT FOR REPEAT PROCEDURES

Introductions: Autologous fat transfer is an effective treatment for soft tissue reconstruction. The main challenge is that, on average, 63% of the graft volume takes, this necessitates repeat procedures. Therefore, preserving harvested tissue on-site for future injections is a clinical need. This study investigates different cryopreservation methods and applies the best results for a clinically usable device.

Methods: Different cryoprotectant combinations, freezing temperatures, and conditions were tested, and the outcome of the cryopreservation was assessed by measuring cell viability using trypan blue and Calcin-Am staining two days post freezing. In vitro validation of optimized conditions was tested for up to 3 months. For in-vivo testing, Nu/Nu athymic mice were used, and human fat cryopreserved for seven days, 21 days, three months, or 11 months was compared to fresh fat for graft weight and volume retention histology at nine weeks post graft. At +4 ^{o}C three months, stored combination compared to fresh.

Results: A combination of 10% DMSO and 2% human serum albumin at -80^{o}C provided optimum cryopreservation. We observed no significant differences in cell viability of cryopreserved fat for up to 3 months compared to the fresh fat. Cryopreserved fat grafts showed weight and volume retention and histological morphology comparable to fresh fat grafts. The cryopreservation solution was stable during storage..

Conclusion: The result of this study will enable the development of devices with clinically compatible appendages and a defined protocol for clinical use for long cryopreservation of fat tissue at -80^{o}C within a closed system.

Abstract #9

A LOW-COST RODENT MODEL OF DIABETIC EPIBOLOUS WOUNDS MIMICS HUMAN CHRONIC WOUND PROGRESSION AND DYSTROPHIC SCAR FORMATION

Phoebe Lee
University of Pittsburgh
School of Medicine

A LOW-COST RODENT MODEL OF DIABETIC EPIBOLOUS WOUNDS MIMICS HUMAN CHRONIC WOUND PROGRESSION AND DYSTROPHIC SCAR FORMATION

Background/Purpose: Chronic diabetic wounds and their resultant dystrophic scars are challenging to model in the preclinical space because of differences in rodent healing from human and consequently are effective, novel therapeutics are limited. We have previously demonstrated that tissue-edge inward folding mimicking the architecture of epibole mitigates contracture and restricts epithelialization. Here we demonstrate that murine epibolous wounds generate a humanized environment of sustained inflammatory infiltration, proliferative granulation, and ultimately resolve into reliably dystrophic scars.

Methods: Diabetic (db/db) mice chronic wounds were generated by incising skin flaps, which were sutured to the dermis side to create a folded skin edge. One cohort was maintained for 14-days and periwound tissues were harvested for flow cytometry: CD11b, Ly6G, and F4/80. Additional histologic samples were assessed for H&E, Trichrome, and for pan-keratin (epithelium) and alpha-smooth-muscle actin (myofibroblasts). A second cohort was maintained until closure up to 12-weeks for photographs and histology.

Results: Wounds remain open >40 days in obese diabetic animals ($p<0.05$). Epibolous wounds demonstrated reduced frequency of epithelialization as defined by pan-keratin signaling. Epibolous wound demonstrate neutrophil-dominant inflammatory infiltrate up to 2-weeks with simultaneous enrichment of macrophage/monocyte populations ($p<0.05$). When allowed to proceed to maturation, scars from epibole injuries remained significantly larger ($p<0.05$). All epibolous injuries show histologic evidence of dystrophic healing.

Discussion/Conclusion: Wound-edge inversion prolongs inflammation, transitions to a more human-relevant granulation pattern, and a consistent dystrophic scar without need for thermal, radiological, chemical or biological interference - enhancing our preclinical ability to study and intervene in chronic wounds.

Abstract #10

ARTIFICIALLY INTELLIGENT FACIAL FEATURE QUANTIFICATION AFTER FACIAL FILLER INJECTION

Abhishek Desai, MD
University of Pennsylvania

ARTIFICIALLY INTELLIGENT FACIAL FEATURE QUANTIFICATION AFTER FACIAL FILLER INJECTION

Purpose: Applications of Artificial Intelligence (AI) are becoming increasingly ubiquitous in surgery. Commercially available AI facial analysis systems can be used to assess aesthetic treatments such as facelift or facial feminization surgery. We hypothesize these algorithms may additionally be useful in the assessment of facial dermal filler injections. The purposes of this study are to determine how cosmetic filler injection impacts AI-estimated age, and to determine if this change correlates with patient-reported perception of aging.

Methods: Women aged 40-65 were recruited and injected with Restylane® dermal fillers in a standardized fashion. Patients were photographed using the Vectra® M3 3D Imaging device and administered the FACE-Q^{TM} quality-of-life questionnaire at five time-points: before injection, immediately post-intervention, 2-weeks, 4-weeks, and 12-weeks post-injection. Age estimation was performed using two commercially available AI algorithms: AWS Rekognition API and Azure Face API. *t*-tests were used for analysis of continuous variables.

Results: Fillers were administered to 69 women. Neither AWS nor Azure showed a statistically significant change in age estimation within 90 days following intervention (Figure 1). Patient-reported perception of aging also did not significantly change post-injection (Figure 1). At 90 days following injection, both AWS (p = -0.65) and Azure (p = -0.39) age estimations were correlated with the patient's perception of aging (p<0.05).

Conclusion: Treatment with facial fillers did not change AI-estimated age nor patient-reported perception of aging throughout the 90 days post-injection. Over the long-term, there is a correlation between AI-estimated age and patient-reported perception of aging. "Aging" may not be the most discerning metric to study facial filler outcomes, inviting future investigation. Plastic surgeons need to be aware of how commercially available AI algorithms analyze their treatments in order to interface with patients who can and will use this technology themselves.

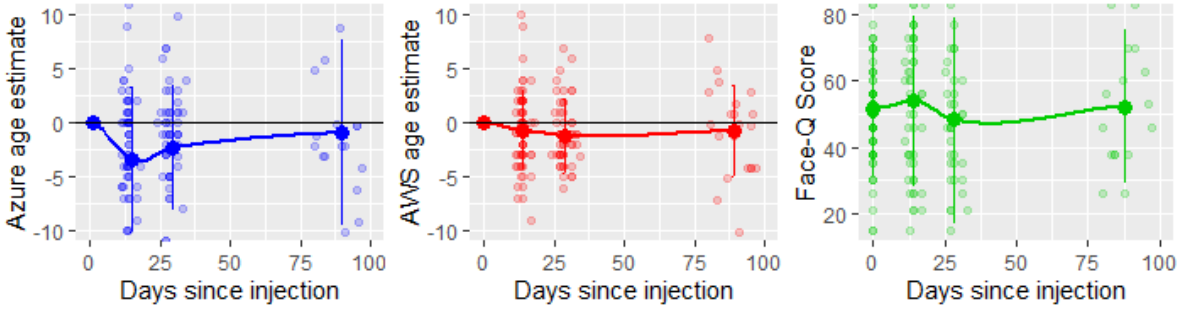


Figure 1. There was no statistically significant change in Azure Face API estimated age, AWS Rekognition API estimated age, nor patient-reported evaluation of aging within 90 days of dermal facial filler injection.

ABSTRACTS PRESENTATIONS

Group 3

Trunk & Lower Extremity

Abstract #11

CHARACTERIZING MORBIDITY AND MORTALITY AFTER AESTHETIC ABDOMINAL SURGERY: A NATIONWIDE ANALYSIS

Abhishek Desai, MD
University of Pennsylvania

CHARACTERIZING MORBIDITY AND MORTALITY AFTER AESTHETIC ABDOMINAL SURGERY: A NATIONWIDE ANALYSIS

Purpose: Abdominoplasty is among the most common aesthetic surgeries performed in the US and is increasing in popularity each year. The procedure, however, is thought to be associated with a relatively high complication rate, with reported mortality as high as one in 3,281 when combined with liposuction. We sought to combine nationwide administrative databases in order to assess modern rates of major morbidity and mortality after aesthetic abdominal surgery using modern techniques.

Methods: Adult patients (>15 years old) undergoing cosmetic abdominoplasty or panniculectomy were identified using State Ambulatory Surgery Databases from four states over 10 years: Florida ['07-'17], New York ['08-'16], Maryland ['14-'16], and Wisconsin ['14-'16] using 1) ICD diagnosis codes for cosmetic surgery and 2) corresponding CPT procedure codes. Patients who underwent a significant concurrent procedure were excluded. Concurrent liposuction, filler injection, or umbilical hernia repair was permitted. The primary outcome was death or need for unplanned medical care within 90 days after surgery. Categorical variables were compared using chi-squared analyses.

Results: 6,139 patients met inclusion criteria. The average patient was 44 years old (IQR 37-52), female (93.48%), and White (54.89%). 8.39% of patients (n = 515) required unplanned medical care within 90 days after abdominoplasty (Table 1). The total cost of this care was approximately $8,051,295 USD. Black and Hispanic patients were significantly more likely to require unplanned medical care as compared to White patients (p = 0.013). There was no significant difference between patients who did and did not receive liposuction regarding need for unplanned medical care or mortality. One patient (0.02%) died in the peri-operative period on post-operative day 2; cause of death was aspiration pneumonitis and subsequent cardiac arrest.

Conclusion: Cosmetic abdominoplasty may be safer than previously reported and appears to carry little risk of peri-operative mortality. Less than 10% of patients will require unplanned medical care within 90 days after cosmetic abdominoplasty, though Black and Hispanic patients appear to suffer a disproportionately higher burden of these complications on a nationwide level. Concurrent liposuction does not appear to affect morbidity or mortality rates.

	N	% OF ALL PATIENTS
ED EVALUATION	70	1.14
INPATIENT ADMISSION	172	2.80
INPATIENT OPERATION	107	1.74
OUTPATIENT OPERATION	326	5.31
ANY OPERATION	433	7.05

Table 1. Breakdown of unplanned medical care, and proportion of all included patients who experienced the adverse event.

Abstract #12

THE BURDEN OF LOWER EXTREMITY FASCIOTOMIES: AN INDICATION FOR THE MULTIDISCIPLINARY APPROACH

Abhishek Desai, MD
University of Pennsylvania

THE BURDEN OF LOWER EXTREMITY FASCIOTOMIES: AN INDICATION FOR THE MULTIDISCIPLINARY APPROACH

PURPOSE: Lower extremity fasciotomies are performed to prevent or combat compartment syndrome after compromise of vascular perfusion, orthopedic trauma, crush, burn, or volume shift. Regardless of precipitating event, the common result is an open wound that may necessitate multiple interventions to attain definitive soft tissue coverage. Management of these wounds is not protocolized at our institution.

METHODS: A retrospective analysis utilizing CPT codes was conducted of patients aged eighteen or older who underwent lower extremity fasciotomy at our institution between 2013-2021. Chronic compartment syndrome patients with elective fasciotomies were excluded. Patients who met inclusion criteria were followed through chart review until the time of their definitive soft tissue coverage or until they were lost to follow up. Patients were compared in terms of baseline demographic characteristics and comorbidities. Details of index surgery including surgical team characteristics, indications for fasciotomies, and initial incisional management were reviewed. We examined their clinical course including subsequent reoperations, related readmissions, and length of stay.

RESULTS: A total of 158 patients met criteria for inclusion. Vascular (45%), Orthopedic (27%), and General Surgery (26%) performed most fasciotomies with 58% of fasciotomy incisions left open at the time of index operation. Average readmissions related to wound management were 0.38 per patient for a mean related length of stay of 21 days, and an average of 2.4 subsequent operations. Patients with diagnosed peripheral vascular disease were more likely to ultimately require amputation (p=0.023). Despite only 47% of patients having their wounds primarily closed, Plastic Surgery was involved for only 10% of the operations, and these patients were ultimately more likely to undergo amputation (p<0.001).

CONCLUSION: Lower extremity fasciotomies are morbid procedures. Certain comorbidities such as peripheral vascular pre-dispose towards worse outcomes after these procedures. Wounds created by these surgeries should be thoughtfully managed as they lead to prolonged hospitalization and high readmission and reoperation rates. Plastic Surgery is often involved late in the treatment course, leading to failed salvage efforts culminating in amputation. Prior studies have demonstrated how an Orthoplastic approach to lower extremity reconstruction improves outcomes, and efforts should be directed toward developing a similar approach for these multidisciplinary patients.

Figure 1. Index surgeon specialty and subsequent care pathway for 158 lower extremity fasciotomy patients.

Abstract #13

PRESSURE ULCERS TRENDS IN THE US 2012-2017

Phoebe McAuliffe
University of Pennsylvania

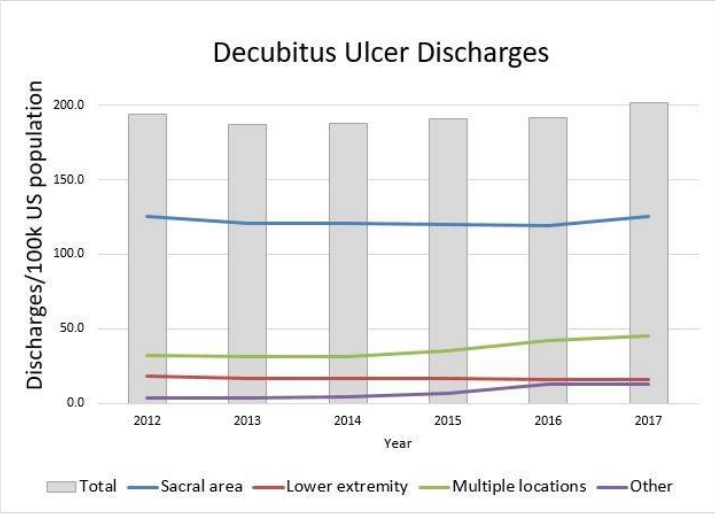
Pressure Ulcers Trends in the US 2012-2017

Purpose: Decubitus ulcers are a morbid and costly problem faced by healthcare systems and patients across the country. They occur frequently after surgical intervention and can require complex treatment including reconstructive plastic surgery. The incidence of decubitus ulcers has been established as a healthcare facility quality indicator, drawing increased attention to this issue. We examine current patterns and characteristics in the US.

Methods: Patients hospitalized with an ICD-9/ICD-10 diagnosis of pressure ulcer were identified. Data was extracted from the Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample (NIS) from January 2012 to December 2017. Clinical, demographic and cost data were collected and analyzed. Statistical analysis was performed to account for the complex survey design of the NIS database.

Results: We identified a total of 3,683,219 discharges associated with pressure ulcers from 2012-2017, 192.1/100K US population. Average annual growth rate was 3.6% per year. Mean total charges were $89,082 per discharge, leading to over $320 billion USD total. Mortality rate was 8.2% and average length of stay was 10.03 days. Severity III and IV ulcers accounted for 33.8% of the discharges, increasing from 32.4% to 35.3% over the time period ($p<0.01$). Locations were 63.4% sacral, 8.7% lower extremity, 18.9% multiple locations and 9.0% other. Lower extremity ulcers decreased at 2.2% per year, sacral decreased at .03% and multiple locations increased at 6% per year. The most common primary diagnoses were sepsis (19.0%), acute kidney failure (2.9%) and urinary tract infection (2.9%); the most common comorbidities were hypertension (36.1%), arrhythmia (34.3%) and renal failure (30.6%). 14.3% of patients had paralysis. The average age and proportion female both decreased significantly over the time period (71.0 vs 69.0, $p<0.01$ and .51 vs .39, $p<0.01$) with no change in mortality or length of stay.

Conclusion: We provide a nationwide analysis of the prevalence of decubitus ulcers in hospital admissions. Despite preventative efforts and incentives by healthcare systems pressure ulcers are growing in prevalence with increasing severity.



Abstract #14

THE FUNDAMENTAL BLOOD-SPARING EFFECT OF TRANEXAMIC ACID (TXA) USE IN LIPOSUCTION: A SYSTEMATIC REVIEW

Eliann Reinhardt
Albany Medical Center

THE FUNDAMENTAL BLOOD-SPARING EFFECT OF TRANEXAMIC ACID (TXA) USE IN LIPOSUCTION: A SYSTEMATIC REVIEW

Purpose: Tranexamic acid (TXA) has been used to improve bleeding outcomes in many surgical procedures.[1] However, its blood-sparing effect in liposuction procedures is not well established.

Methods: A PubMed search was conducted from its inception to September 2021 according to PRISMA guidelines focused on 3 main topics: 1) TXA; 2) liposuction; 3) complications. We included articles evaluating potential blood-sparing effects of TXA in liposuction. Studies were excluded according to the following criteria: systematic review article or protocol paper, animal studies, conference abstract, survey study, and non-English publication.

Results: A total of 62 articles were identified with one retrospective and 4 prospective (3 randomized) studies meeting our inclusion criteria (Figure 1).[2–6] TXA was utilized in various forms: IV either on induction or after the procedure, mixed into the tumescent solution, or infiltrated into the liposuction sites after lipoaspiration. Significant heterogeneity (I^2=95%) precluded a meta-analysis. Patients in non-TXA cohorts experienced adverse effects (such as seroma and need for transfusion) that were not seen in TXA cohorts. Included studies reported that TXA use is associated with decreased bruising (p=0.015)[3], reduced blood loss in liposuction as measured by decantation (p=0.0002)[5], and a smaller decrease in hematocrit values for every liter of lipoaspirate (p=0.02)[6].

Conclusion: TXA use in liposuction seems to be associated with a beneficial blood-sparing effect. Future studies should validate protocols for TXA use in liposuction.

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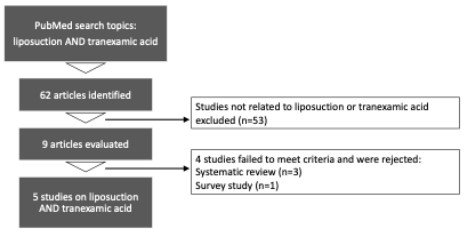

Figure 1. Flow diagram of search strategy.

Abstract #15

ACCESS TO RECONSTRUCTIVE SURGERY FOR FEMALE GENITAL MUTILATION IN THE UNITED STATES AND WESTERN EUROPE

Ankoor Talwar
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ACCESS TO RECONSTRUCTIVE SURGERY FOR FEMALE GENITAL MUTILATION IN THE UNITED STATES AND WESTERN EUROPE

Introduction: Female genital mutilation/cutting (FGM/C) is the intentional alteration, removal, or injury of female genitalia for non-medical reasons. FGM/C affects nearly 200 million women worldwide, many of whom live in developed countries. Genital reconstructive procedures have promising functional and patient-reported outcomes, but it is unclear how many victims have access to surgical and associated psychosocial care. The purpose of this study was to determine how many victims of FGM/C have access to comprehensive care, including reconstructive surgery, in the United States (U.S.) and Western Europe. Additionally, we characterized current plastic surgery resident training and interest in FGM/C reconstruction for the future.

Methods: FGM/C care centers were identified using End FGM European Network. Access to comprehensive care (surgical, psychological, sexological, and gynecologic) and to publicly insured FGM/C care within the region (U.S.) or country (Western Europe) was documented. Population data were extracted from the U.S. Centers for Disease Control and Prevention, U.S. Census Bureau, End FGM European Network, and World Bank. A 10-item survey capturing interest in and exposure to FGM/C reconstruction was administered to residents at our institution.

Results: Approximately 1.3 million women in Western Europe and the U.S. are affected by FGM/C. Reconstructive surgery in these areas is offered by plastic surgeons (36.8%), gynecologists (57.9%), and urologists (5.3%). Overall, 32% (n=411,624) of women do not have access to reconstructive surgical care (U.S.: 33.8%, Western Europe: 30.8%). 57.7% (n=742,784) of affected women do not have access to comprehensive care (U.S.: 80.3%, Western Europe: 42.8%). 69.4% (n=892,621) do not have access to publicly insured care (U.S.: 100%, Western Europe: 49.1%). 12 residents at our institution completed the survey. 83% of residents had some clinical or operative exposure to FGM reconstruction patients. Further, 75% cited a desire for increased exposure in residency. The most preferred method of exposure for most residents (92%) was greater operative experience.

Discussion/Conclusion: Female genital mutilation/cutting affects millions of females in the developed world. One-in-three of these women do not have access to reconstructive surgical options. Most affected women cannot obtain publicly insured comprehensive care. Plastic surgeons should consider incorporating reconstructive surgery into their armamentarium. Residents are likewise interested in incorporating FGM/C reconstruction into their training. There must be a greater effort from plastic surgeons to care and advocate for this vulnerable population.

ABSTRACTS PRESENTATIONS

Group 4

Trunk & Lower Extremity

Abstract #16

PATIENT-REPORTED AND CLINICAL OUTCOMES OF SINGLE VS. TWO-STAGE DIGITAL MOHS RECONSTRUCTIONS

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PATIENT-REPORTED AND CLINICAL OUTCOMES OF SINGLE VS. TWO-STAGE DIGITAL MOHS RECONSTRUCTIONS

Introduction: The management of extensive soft-tissue defects following Mohs resection for skin cancer of the digits remains a challenging task. Two-stage reconstruction with skin substitute and delayed skin grafting may improve post-operative outcomes, but literature comparing these techniques to single-stage reconstruction is lacking. We present a retrospective review of digital reconstruction utilizing these two techniques following Mohs resection at our institution.

Methods: A retrospective review of patients at our institution who received digital reconstruction following Mohs surgery for squamous cell carcinoma, melanoma, and melanonychia between 2014-2021 was conducted. Patient demographic information, cancer information, peri- and post-operative complications, and re-operations were collected and analyzed. Complications included infection, seroma, hematoma, dehiscence, cyst formation, nail spicule, contracture, necrosis, graft failure, and need for secondary amputation. Patients were contacted to complete the PROMIS Upper Extremity patient-reported outcome instrument post-operatively. An intention-to-treat paradigm was used for analysis.

Results: Forty-nine patients with 50 reconstructions met inclusion criteria. Twenty-three reconstructions were single-stage (46%), and 27 reconstructions were two-stage (54%). There were no differences in preoperative demographics or comorbidities between those who had single or two-stage reconstructions. On presentation, those with disrupted periosteum were more likely to have two-stage reconstruction ($p < 0.05$). Those with two-stage reconstruction also had greater variance in their post-Mohs defect size at presentation ($p < 0.05$). Overall, there was no difference in postoperative complications or reoperations between patients who received single-stage reconstruction or two-stage reconstruction (22.7% vs. 16.7%). Analyzing patient-level factors, patients who were current smokers had a greater risk of postoperative contracture than non-smokers or former smokers ($p<0.05$). 32 patients completed a post-operative PROMIS Upper Extremity survey (single-stage = 15, two-stage = 17). There was no difference in mean PROMIS T-scores between those who had single-stage vs. two-stage reconstructions. Patients with hypertension had worse postoperative PROMIS T-scores compared to those who did not ($p < 0.05$).

Discussion/Conclusion: Treatment with either single-stage reconstruction with skin graft or two-stage reconstruction using skin substitute appear to be equivalent in terms of complications, reoperations, and quality-of-life outcomes. However, two-stage reconstruction is used for more complicated defects. Patient-specific factors need to be taken into account, as current smokers and those with hypertension have poorer outcomes following reconstruction.

Abstract #17

AN AESTHETIC COMPARISON OF EXTENDED PEDICLED TECHNIQUE VS. FREE NIPPLE GRAFT REDUCTION MAMMOPLASTY FOR PATIENTS WITH GIGANTOMASTIA

Ankoor Talwar
University of Pennsylvania

AN AESTHETIC COMPARISON OF EXTENDED PEDICLED TECHNIQUE VS. FREE NIPPLE GRAFT REDUCTION MAMMOPLASTY FOR PATIENTS WITH GIGANTOMASTIA

Introduction: Reduction mammoplasty is an increasingly popular procedure for symptomatic macromastia. The operation helps patients improve physical and mental quality of life. Patients with nipple-to-notch distances greater than 40 cm, or who had greater than 1500 g removed from a single breast during reduction mammoplasty, have been defined as having gigantomastia. Reduction mammoplasty for these patients can involve different techniques, such as free nipple graft (FNG) or extended pedicled (EP) techniques. The purpose of this study was to compare aesthetic outcomes of these two surgical techniques.

Methods: A multi-institutional, retrospective review was conducted examining patients with gigantomastia who underwent reduction mammoplasty at two institutions between from 2017 – 2020. Patients at institution 1 were only operated on via the EP technique. Patients at institution 2 were operated on via FNG. Patient baseline characteristics, pre-operative BREAST-Q, post-operative BREAST-Q, and clinical outcomes were collected. Patients were matched 1:1 across the two groups. Their pre-operative and post-operative photos were compiled into a survey instrument assessing breast aesthetics. The survey was administered to individuals associated with one of the institutions at varying academic stations: attending plastic surgeon, microsurgery fellow, resident plastic surgeon, advanced practice provider, medical student, and non-medical individual.

Results: A total of 52 patients met inclusion criteria across both institutions (21 FNG, 31 EP). Patients who had FNG had higher rates of postoperative cellulitis ($p < 0.05$), but there were no differences in SSI, hematoma, seroma, dehiscence, delayed healing, keloid, NAC necrosis, fat necrosis, pain, hypersensitivity, or numbness. Pre-operative BREAST-Q scores showed no differences between the two groups at baseline. Post-operative BREAST-Q revealed EP patients had increased satisfaction with their nipples vs. FNG ($p = 0.001$). Twenty-eight patients were matched 1:1 for the aesthetic survey. The survey was completed by 22 individuals: 4 attending plastic surgeons, 2 microsurgery fellows, 4 resident plastic surgeons, 4 medical students, 4 advanced practice providers, and 4 non-medical individuals. The EP technique showed significantly better aesthetic outcomes in all domains ($p < 0.001$). Further, this preference held true regardless of institution or academic station ($p < 0.01$).

Discussion/Conclusion: The results of this multi-institutional, matched, retrospective study show the extended pedicled technique for reduction mammoplasty provides superior aesthetic outcomes for reduction mammoplasty, compared to the free nipple graft technique. Further, patients with the extended pedicled technique had greater satisfaction with their nipples.

Abstract #18

COMPARISON OF TUMESCENT ANESTHESIA AND PECS II BLOCK IN BILATERAL REDUCTION MAMMAPLASTY

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Comparison of Tumescent Anesthesia and PECS II Block in Bilateral Reduction Mammaplasty

Introduction: With an increasing focus on perioperative multimodal pain control to reduce narcotic requirements, regional and local anesthesia techniques have been investigated in the context of bilateral reduction mammaplasty with variable results. The purpose of this study is to compare tumescent anesthesia with ultrasound-guided pectoral nerve block type II (PECS II Block) in patients undergoing bilateral reduction mammaplasty with respect to postoperative pain and nausea, narcotic consumption, length of stay, and cost.

Methods: A retrospective review of patients undergoing bilateral reduction mammaplasty for macromastia between November 2020 and December 2021 was performed. Demographic information, operative and anesthesia times, antiemetic and morphine equivalent requirements, postoperative numeric pain rating scales, and time until hospital discharge was compared between groups. Chi-squared and Fisher's exact tests were used to examine subgroup differences in categorical variables. Two sample T-test and Wilcoxon rank-sum test were used to evaluate differences in continuous parametric and non-parametric variables, respectively.

Results: 53 patients underwent bilateral reduction mammaplasty by three surgeons, 71.7% (n=38) with tumescent anesthesia infiltrated by the operating surgeon prior to the start of the procedure and 28.3% (N=15) with bilateral PECS II blocks performed by anesthesia prior to the start of the procedure. There was no difference in age, BMI, weight resected, intraoperative medication quantities, or immediate postoperative complications. Non-procedure anesthesia time, postoperative pain scores, and narcotic requirements were similar between the two groups. 21.1% (N=8) of tumescent patients compared to 66.7% (N=10) of block patients required one or more doses of postoperative antiemetics (p-value = 0.002). A total of five patients, one undergoing blocks and four tumescence, required overnight hospitalization. Patients who received blocks spent longer in the postoperative recovery area (5.3 hours, standard deviation [SD] = 5.0 vs 7.1 hours, SD=4.1, p=0.005). However, this did not translate to a significant increase in overnight stays. The block group had higher overall cost by an average of $3,500, driven by pharmacy and procedural cost.

Conclusion: In this cohort of multimodal perioperative pain-controlled reduction mammaplasty patients, tumescent anesthesia was associated with decreased antiemetic requirements, less time in recovery prior to discharge, and lower cost compared to PECS II blocks. Therefore, tumescent anesthesia may be favored over PECS II blocks when considering multimodal pain control strategies in reduction mammoplasty patients. Future directions include evaluation of other regional blocks, such as paravertebral and erector spinae plane blocks, in comparison to tumescent solution.

Abstract #19

BREAST FLAP NEUROTIZATION AFTER AUTOLOGOUS FREE FLAP BREAST RECONSTRUCTION: A PROSPECTIVE TRIAL

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Winner

2nd Place Clinical

BREAST FLAP NEUROTIZATION AFTER AUTOLOGOUS FREE FLAP BREAST RECONSTRUCTION: A PROSPECTIVE TRIAL

Purpose: Restoration of breast sensation is an important factor to consider following autologous breast reconstruction (ABR). Flap neurotization may result in improved sensation after ABR, but current literature regarding both patient-reported outcomes and quantitative sensation after neurotization is inadequate and heterogenous. We present a prospective trial investigating the long-term outcomes of flap neurotization regarding breast sensation.

Methods: 98 patients (n = 166 flaps) were prospectively evaluated for breast sensation and quality-of-life 1-5 years after ABR. This included 55 neurotized patients (n=97 neurotized breast flaps) and 44 non-neurotized patients (n=71 non-neurotized breast flaps). Evaluation consisted of the validated patient-reported questionnaire (BREAST-Q), a sensation-specific patient-reported questionnaire, and pressure-specified sensation testing at 9 locations on the breast using the AcroVal pressure-specified sensory device. Continuous variables were compared using independent *t*-tests. Categorical variables were compared using chi-squared analyses.

Results: Non-neurotized patients were significantly more likely to report breast sensation was affecting their daily lives due to pain or discomfort, while neurotized patients were more likely to report they did not notice a difference in breast sensation after ABR or that the change in sensation was not affecting their daily lives ($p= 0.035$). While there was no significant difference in quantitative sensation between neurotized and non-neurotized patients at 1 year after ABR, neurotized patients were significantly more sensate at 4 of 9 testing locations on the breast ($0.011<p<0.039$) when evaluated 2-5 years after ABR.

Conclusion: Breast sensation affects the daily lives of breast reconstruction patients and is an important long-term outcome to consider following ABR. Neurotization is associated with improved protective sensation as well as improved patient-reported outcomes such as reduced pain and discomfort in the long-term after ABR.

Abstract #20

THE USE OF PRE-OPERATIVE ANTIBIOTICS IN HARDWARE-BASED HAND PROCEDURES IS NOT NECESSARY: A SINGLE SURGEON EXPERIENCE

Emma Dahmus, MD
Geisinger Medical Center

THE USE OF PRE-OPERATIVE ANTIBIOTICS IN HARDWARE-BASED HAND PROCEDURES IS NOT NECESSARY: A SINGLE SURGEON EXPERIENCE.

INTRODUCTION: A recent survey to AHHS members by Dunn et. al. in HAND showed that the use of pre-operative antibiotics was random and not standardized for all hand procedures. Recent data supports not prescribing pre-operative antibiotics for clean, outpatient, soft-tissue procedures including carpal tunnel and trigger finger releases. There is minimal evidence for hardware-based hand procedures regarding the need for pre-operative antibiotics. The literature that supports the need for pre-operative antibiotics comes from large joint procedures, and none specifically from hand procedures. Hand infections can be devastating, but antibiotic use carries its own risks, including allergies, resistance and C.diff infections. The purpose of our study is to investigate and compare outcomes for patients undergoing hardware-based hand surgery between those who do and do not receive pre-operative antibiotics.

METHODS: A retrospective cohort analysis was performed on 425 patients from the senior author's hand practice between January 2015 and October 2021. All patients either received permanent hardware or percutaneous K-wire fixation. Patients were excluded if they were admitted as an inpatient or did not have appropriate follow-up. Primary outcomes measured were 30- and 90-day prescribed antibiotics for surgical-site specific problems and need to return to the operating room for irrigation and debridement.

RESULTS: Of 425 patients included in the study, 254 patients did not receive pre-operative antibiotics and 171 patients did receive pre-operative antibiotics. For surgical-site specific problems, 13 patients in the non-antibiotic group received an antibiotic prescription within 30 days post-op, compared to 5 patients in the antibiotic group ($p=0.39$). 17 patients in the non-antibiotic group received an antibiotic prescription within 90 days post-op compared to 8 patients in the antibiotic group ($p=0.52$). One patient in the non-antibiotic group required return to the operating room for irrigation and debridement.

CONCLUSION: There is no significant difference for 30- or 90-day post-operative antibiotic prescriptions between those who did and did not receive pre-operative antibiotics based on this single surgeon experience.

ABSTRACTS PRESENTATIONS

Group 5

Craniofacial

Abstract #21

CRANIORATE: AN IMAGE-BASED, DEEP-PHENOTYPING ANALYSIS TOOLSET AND ONLINE CLINICIAN INTERFACE FOR METOPIC CRANIOSYNOSTOSIS

Lucas Dvoracek, MD
UPMC

CRANIORATE: AN IMAGE-BASED, DEEP-PHENOTYPING ANALYSIS TOOLSET AND ONLINE CLINICIAN INTERFACE FOR METOPIC CRANIOSYNOSTOSIS

Introduction

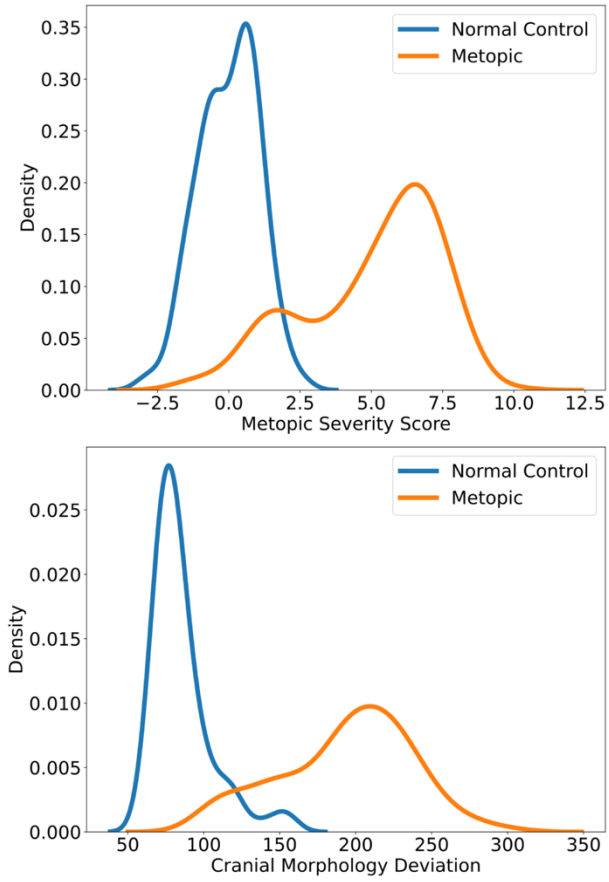
The diagnosis and management of metopic craniosynostosis involves subjective decision-making by craniofacial and neurosurgeons at the point of care. The purpose of this work is to describe a quantitative severity metric and point-of-care user interface to aid clinicians in the management of metopic craniosynostosis and to provide a platform for future research through deep phenotyping.

Methods

Two machine-learning algorithms were developed that quantify the severity of craniosynostosis – a supervised model specific to metopic (Metopic Severity Score) and an unsupervised (Deep) model used for cranial morphology in general (Cranial Morphology Deviation). CT imaging from multiple institutions were compiled to establish the spectrum of severity and a point-of-care tool was developed and implemented.

Results

Over the study period (2019-2021), 244 patients with metopic craniosynostosis and 92 normal control patients who underwent CT scan between the ages of 3 and 18 months were included (Figure). Scans were processed using the CranioRate™ algorithm. The average MSS for normal controls was 0.0 ± 1.0 and for metopic synostosis was 5.0 ± 2.4 ($p<0.001$). The average CMD for normal controls was 85.2 ± 19.2 and for metopic synostosis was 193.7 ± 43.4 ($p<0.001$). Additionally, a point-of-care user interface (craniorate.org) has processed over 40 CT images from 10 institutions.



Conclusion

The resulting quantification of severity using MSS and CMD has shown an improved capacity, relative to conventional measures, to automatically classify normal controls versus patients with metopic synostosis. We have mathematically described, in an objective and quantifiable manner, the distribution of phenotypes in metopic craniosynostosis. These data, in combination with the online interface, provide an objective tool for craniofacial surgeons to use in clinical evaluations of and discussions with patients and their families.

Abstract #22

MANAGEMENT AND OUTCOMES OF PATIENTS WHO PRESENT WITH SAGITTAL CRANIOSYNOSTOSIS AFTER THE AGE OF ONE YEAR

Casey Zhang
UPMC

Winner

1st Place Clinical

MANAGEMENT AND OUTCOMES OF PATIENTS WHO PRESENT WITH SAGITTAL CRANIOSYNOSTOSIS AFTER THE AGE OF ONE YEAR

Introduction
While early diagnosis and management are the hallmarks of successful craniosynostosis treatment, some patients present after the age of one year with new-onset or previously undiagnosed sagittal craniosynostosis. Potential long-term sequelae of untreated craniosynostosis include elevated ICP, vision loss, neurologic deficits, and developmental delay. We previously published our protocol to treat this complex group of patients. Here we present a follow-up and update of this cohort to evaluate intermediate-term outcomes of our treatment protocol.

Methods
This study includes patients with isolated sagittal craniosynostosis who presented to UPMC Children's Hospital between July 2013 and April 2021 for an initial consultation after the age of one year. All patients underwent a detailed physical exam, a dilated fundoscopic exam and visual evoked potential testing. Reconstructive surgical intervention was recommended for patients with abnormal ophthalmic examinations, elevated intracranial pressure or severe head shape anomalies.

Results
108 patients met inclusion criteria. The average age at presentation was 5.2 ± 3.4 years. Seventy-nine (73.1%) were male, and 15 (13.9%) were syndromic. The indications for imaging were head shape (54.6%), headache (14.8%), trauma (9.3%), seizure (4.6%), papilledema (2.8%), and other (13.9%). Of the 108 patients, 12 (11.1%) underwent surgery following their initial consultation: 5 for papilledema, 4 for elevated ICP, 2 for severely scaphocephalic head shapes, and 1 for abnormal fundoscopic findings. Two of these patients underwent additional reconstructive surgery, one for the recurrence of papilledema and headache and the other for forehead contour irregularities. The average length of time between surgeries was 4.9 years. Of the 96 patients who were initially conservatively managed, 4 (4.2%) underwent surgery at an average of 1.2 ± 0.5 years later (average age 4.4 ± 1.5 years) for aesthetic concerns (n=1), persistent, refractory headaches (n=1), Chiari malformation with syrinx (n=1), and shunt-dependent hydrocephalus (n=1). The average follow-up was 23.9 ± 24.5 months.

Conclusion
We present our protocol for the management of late-presenting sagittal synostosis, involving symptomatic evaluation, objective testing, and morphologic assessment to recommend treatment. Patients who present with single-suture sagittal craniosynostosis after the age of one year require surgical correction less often than patients who present earlier in life, likely due to decreased severity of phenotype. The most common indications for operation were related to increased ICP or morphology. Few patients placed in the conservative treatment arm based on our algorithm ultimately required surgery (4%). Cranioplasty remains safe in older patients.

Abstract #23

EXAMINING THE NEED FOR POSTOPERATIVE INTENSIVE CARE UNIT CARE FOLLOWING CRANIAL VAULT REMODELING: A PRELIMINARY ANALYSIS

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EXAMINING THE NEED FOR POSTOPERATIVE INTENSIVE CARE UNIT CARE FOLLOWING CRANIAL VAULT REMODELING: A PRELIMINARY ANALYSIS

Background: Craniosynostosis is defined by the premature fusion of one or more cranial sutures leading to an abnormal skull morphology. Calvarial vault remodeling is considered a safe surgery, relieves any elevated intracranial pressure and confers long-term cranial shape correction while decreasing neuropsychological sequelae. Although there is an extensive body of literature focusing on the operative treatment of craniosynostosis, there is little consensus on optimal postoperative management protocols. In a recent survey regarding postoperative management of craniosynostosis, 100% of respondents routinely send patients to the intensive care unit. This study aims to examine the outcomes of postoperative intermediate care unit admission following cranial vault remodeling as opposed to intensive care unit admission.

Methods: A retrospective analysis was undertaken of all patients who underwent primary cranial vault remodeling from 2018 to 2020 at a single pediatric hospital. Patient demographics, operative factors, peri-operative course, and outcomes were recorded.

Results: Forty patients underwent open surgery for both single and multi-suture craniosynostosis. Sutures affected were sagittal in 15 cases, coronal in 16 (11 unilateral, 5 bilateral), metopic in 6, multi-suture in 2, and 1 lambdoid. Average age of operation was 9.9 months, with a mean follow-up of 17 months. Twenty one patients (51 percent) were admitted to the intermediate unit for postoperative care, while 19 (46 percent) were admitted to the intensive care unit. Among those patients admitted to the intermediate unit, there were no adverse events related to the change in level of care and no patients necessitated a transfer to the intensive care unit. Average hospital stay was 3.7 days. The institution’s financial difference in cost of ICU stay versus intermediate bed was $6,391, on average. Omitting just one intensive care unit post-operative stay for this patient cohort would reduce projected health care costs by a total of $121,429 over the study period.

Conclusion: Despite the common practice of postoperative admission to the intensive care unit following cranial vault remodeling, the findings of this study suggest that patients with craniosynostosis can be managed safely in an intermediate unit and do not require postoperative ICU admission. This not only results in significant health care cost savings but allows for more efficient ICU resource utilization, which is imperative during the COVID-19 pandemic.

Abstract #24

METOPIC SEVERITY AND INTRACRANIAL PRESSURE: THE WHOLE STORY OR JUST A CHAPTER?

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METOPIC SEVERITY AND INTRACRANIAL PRESSURE: THE WHOLE STORY OR JUST A CHAPTER?

Background

Surgical treatment of metopic craniosynostosis is driven by twin goals of correcting the visible frontal deformity and reversing craniocephalic disproportion. Neurocognitive deficits in unoperated patients may be related to local compression, elevated intracranial pressure (ICP), and hypoperfusion of the developing brain. The purpose of this study was to assess metopic synostosis severity and measures of ICP using ocular coherence tomography (OCT) and intraventricular catheterization.

Methods

We retrospectively identified patients with metopic craniosynostosis who underwent surgical correction with concomitant assessment of ICP. Metopic synostosis severity was determined based on pre-operative CT assessment of endocranial bifrontal angle (EBF_a) and CranioRate^{TM} in 49 patients. CranioRate^{TM} is a novel machine learning algorithm trained to recognize morphologic features of metopic craniosynostosis and use statistical shape analysis to provide quantitative ratings of severity. Elevated ICP was determined by established OCT parameter thresholds and directly measured ICP values ≥15mmHg.

Results

Average patient age was 8.3 months at pre-operative CT and 15.2 months at index procedure. Six (12.2%) patients had documented headaches or CT findings concerning for elevated ICP including positive thumbprint sign or ventricular effacement. Twelve (24.5%) patients had diagnosed developmental delay. Fourteen patients (28.6%) exhibited surrogates of elevated ICP at the time of surgery. Mean MSS (5.8) and EBF_a (145.1) in subjects with surrogates of elevated ICP were not different than subjects without elevated ICP (MSS = 5.7, p = 0.701; EBF_a = 144.0, p = 0.293 and .988, respectively). Pearson correlation revealed a significant negative association between MSS and EBF_a (r = -0.573, p < .001). There was no significant association between metopic severity measures and intracranial pressure measures (Figure 2). Point-Biserial Correlation revealed a significant negative correlation between MSS and both developmental delay (r = -0.365, p = .010) and headaches (r = -0.424, p = 0.002).

Conclusion

We did not identify a strong association between phenotypic severity and ICP in patients with metopic craniosynostosis. The association of a milder phenotype with headaches and developmental delay may be explained by the tendency to delay surgical intervention in patients with less pronounced phenotypic dysmorphology. Further research is needed to elucidate the impact of metopic severity on age at initial operation and determine mechanisms of other compensatory cranial or parenchymal changes that may better predict elevated ICP in this cohort.

Abstract #25

MACHINE LEARNING IN METOPIC CRANIOSYNOSTOSIS: DOES PHENOTYPIC SEVERITY PREDICT LONG-TERM AESTHETIC OUTCOME?

Lucas Dvoracek, MD
UPMC

MACHINE LEARNING IN METOPIC CRANIOSYNOSTOSIS: DOES PHENOTYPIC SEVERITY PREDICT LONG-TERM AESTHETIC OUTCOME?

Background

Aesthetic changes after surgical treatment of metopic craniosynostosis may manifest as bitemporal hollowing (TH), lateral orbital retrusion (LOR), or frontal bone irregularities (FBI). Patients with these complications have significant reoperation rates of 18-46%. This study evaluates the relationship between metopic severity and long-term aesthetic outcomes using interfrontal angle (IFA) and CranioRate^{TM}, a novel metopic synostosis severity measure.

Methods

Patients with metopic craniosynostosis who underwent bi-frontal orbital advancement and remodeling (BFOAR) between October 2000 and December 2014 were reviewed. Five-year aesthetic outcomes were assessed by attending craniofacial surgeons using blinded three-rater aesthetic grading of clinical photos (n=25). Graders assessed Whitaker score as well as the presence of TH, LOR, FBI, or a “catch-all” category of visible irregularities. Two aesthetic scores were generated: one totaling the number of irregularities present out of 4 (AS) and a second that additionally included the median Whitaker score (AS_w) with a maximum of 8. Preoperative CT heads were analyzed using CranioRate^{TM}, a machine learning algorithm trained to recognize morphologic features of metopic synostosis and generate quantitative severity ratings including metopic severity score (MSS) and cranial morphology deviation (CMD).

Results

Patients underwent BFOAR at mean 9.5 months of age. Preoperative scan was performed at mean 7.6 months, yielding an average MSS of 6.6/10 and CMD of 201/300. Pearson correlation revealed a significant association between all CranioRate^{TM} parameters and IFA (r=-0.58 to -0.69, p<0.001). Average aesthetic assessment was at 5.5 years (range 4.1 – 7.8) postoperatively. Average AS was 2.7/4.0, average AS_w was 5.0/8.0, visible irregularities were noted in 25 (100%), FBI were noted in 16 (64%), TH in 21 (84%), and LOR in 5 (20%) patients. CMD was associated with FBI (r=0.454, p=0.045) but not TH or LOR. The relationship between AS and MSS trended towards significance (r =0.379, p=0.06), and MSS was significantly associated with the size of frontal bandeau interpositional graft used (r =.508, p = 0.026), suggesting larger grafts were employed for more severe deformities. Fisher’s exact test showed a significant association between a milder MSS (≤4) and a lower (≤4) AS_w (p=0.019) and AS (p=0.0198).

Conclusion

More severe cases of metopic craniosynostosis show increased rates of long-term frontal bone irregularity and cumulative aesthetic dysmorphologies, but not necessarily temporal hollowing or lateral orbital retrusion. Larger bone grafts were employed in more severe cases, attesting to greater surgical expansion in such cases. Stratification of metopic severity showed correlation between mild phenotype and favorable aesthetic outcomes.

ABSTRACTS PRESENTATIONS

Group 6

Head and Neck

Abstract #26

EFFICACY OF GAMMA-IRRADIATED HUMAN SKIN ALLOGRAFT FOR TEMPORARY WOUND COVERAGE IN STAGED SURGICAL EXCISION OF LENTIGO MALIGNA AND LENTIGO MALIGNA MELANOMA

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EFFICACY OF GAMMA-IRRADIATED HUMAN SKIN ALLOGRAFT FOR TEMPORARY WOUND COVERAGE IN STAGED SURGICAL EXCISION OF LENTIGO MALIGNA AND LENTIGO MALIGNA MELANOMA

The earliest histologically recognizable stage of melanoma is melanoma in situ (MIS), in which the neoplasm is limited to the epidermis. There are a variety of MIS subtypes, the most common of which is lentigo maligna (LM), representing 79-83% of MIS cases. Individuals with LM have an increased risk of developing lentigo maligna melanoma (LMM). Management of LM and LMM with complete wide local excision remains challenging as atypical melanocytes often demonstrate an unpredictable extension beyond visible margins. The use of staged surgical excision (SSE) with permanent sections has high cure rates, but requires temporary wound coverage while specimens are being examined by pathology. Gamma-irradiated human skin allograft (IHSA) is an acellular biological dressing consisting of epidermis and dermis that can be stored at room temperature for up to 24 months and has been used in treating difficult wounds and ulcers since the early 2000s. However, few studies have reported on the efficacy and utility of using IHSA as temporary wound coverage in SSE of melanoma.

A retrospective analysis was performed at a single institution from 2008 to 2020. Patients with a pathology-confirmed diagnosis of LM or LMM, who underwent SSE followed by placement of IHSA were included. Patient records were reviewed to obtain several variables, including sex, wound location, allograft adherence rate, and infection rate. Additionally, wound sizes and corresponding allograft costs were reviewed.

One hundred and twenty-eight patients were included in the final study, with 131 total wound defects following the primary surgery. As expected, LM and LMM lesions most commonly occurred on the cheek for both males and females. The wound size after melanoma excision and before IHSA placement ranged from 1-104 cm^2, with an average of 16.6 cm^2. One hundred and twenty-three of the 131 wound defects (94%) measured less than 50 cm^2, indicating that only one piece of IHSA was required in most cases. IHSA was adherent and effective in 130 of 131 cases (99%); the only infected allograft was initially complicated by a hematoma, presumably caused by Aspirin and clopidogrel.

IHSA is a practical acellular biological dressing for temporary wound coverage in patients undergoing SSE of melanoma, with a high adherence rate and minimal risk of infection. IHSA provides an optimum healing environment, and minimizes the need for dressing changes, thereby helping to decrease costs and reduce post-operative pain. Our data reveal that IHSA is an effective option that should be highly considered for use in these patients.

Abstract #27

TRUE INCIDENCE OF MARGINAL MANDIBULAR NERVE PALSY FOLLOWING NEONATAL MANDIBULAR DISTRACTION OSTEOGENESIS

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TRUE INCIDENCE OF MARGINAL MANDIBULAR NERVE PALSY FOLLOWING NEONATAL MANDIBULAR DISTRACTION OSTEOGENESIS

INTRODUCTION
In children with Pierre Robin Sequence (PRS), mandibular distraction osteogenesis (MDO) is routinely performed to alleviate tongue-based airway obstruction. However, the procedure involves risk of injury to the marginal mandibular nerve (MMN), which causes significant deficits in facial expression, eating, and drinking. We hypothesize that the incidence of MMN palsy following MDO, previously reported at 1-15%, is an underestimate due to short follow-up times and small sample sizes. This study aims to investigate the true incidence of MMN palsy after MDO to better guide follow-up care and improve nerve injury treatment.

METHODS
A retrospective single center review of patients with PRS who underwent MDO between 2007 and 2021 was conducted. Patients who underwent MDO at less than one year of age and had postoperative clinical evaluations detailing MMN function at least one month postoperatively were included. A logistic regression analysis was performed to investigate predictors of MMN injury.

RESULTS
Of the 93 patients who underwent MDO, 57 patients (61.3%) met inclusion criteria. In this cohort, 56.1% were female, 42.1% were syndromic, and the average age at MDO was 1.51 ± 2.02 months (0.03-9.63 months). The average length of mandibular distraction was 17.5 ± 4.68 mm (10-30 mm), average duration of intubation was 6.58 ± 2.35 days (0-12 days), and average time until hardware removal was 110.8 ± 23.4 days (71-179 days). Seventeen patients (29.8%) presented with permanent MMN dysfunction on postoperative clinical evaluation: Four patients (7.0%) with bilateral weakness and thirteen (22.8%) with unilateral weakness (8 right-sided, 5 left-sided). Two of the 17 patients (11.8%) presented with chin dimpling. Four patients (7.0%) presented with transient MMN weakness that resolved. The average length of follow-up postoperatively was 5.12 ± 2.87 years (0.26-10.6 years). With logistic regression analysis, there were no significant predictors of nerve injury when considering age at surgery ($p=0.82$), length of distraction ($p=0.38$), time until hardware removal ($p=0.11$), or duration of intubation ($p=0.71$).

CONCLUSION
In this 14-year review of patients with PRS who underwent MDO at our institution, 29.8% demonstrated evidence of permanent MMN palsy. This incidence is much greater than previously indicated in the literature. Several patients experienced transient nerve injury that resolved spontaneously. The results of this study reveal that MMN palsy is a relatively common finding after MDO, encouraging further research to examine contributing factors and delineate efforts to mitigate this complication.

Abstract #28

DISPARITIES IN MANDIBULAR TRAUMA: A RETROSPECTIVE ANALYSIS

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DISPARITIES IN MANDIBULAR TRAUMA: A RETROSPECTIVE ANALYSIS

Introduction: Mandible fracture is an abruptly life-altering event, and its complications (infection, malocclusion, malunion, and nonunion) can have devastating consequences for patients.[1–3] Providers are therefore well-served to proactively identify risk factors and engage mitigation strategies to prevent these complications. This study examines mandible trauma in an urban, tertiary hospital serving an economically disadvantaged population.

Methods: This retrospective chart review analyzed all patients suffering mandible trauma between January 2015 and January 2020. Patients were identified based on ICD-9/ICD-10 codes for mandibular fractures and CPT codes for mandibular fracture repair. The data were analyzed by Chi-square or Fisher's exact test, as appropriate.

Results: This study examined 284 patients presenting with mandible fractures; 65.1% of these injuries were related to interpersonal violence, 82.4% of patients were male, and 49.5% were African American. Patients with a comorbid history of substance use or behavioral health disease suffered an increased incidence of post-surgical complications. Post-surgical complications in this study were defined as infection (including abscess requiring drainage), wound dehiscence, hardware failure, malunion, and nonunion. Increased wound complications were observed in patients with history of phencyclidine usage (χ^2 =8.06, df=1, P=0.005), tobacco use, (χ^2 =5.20, df=1, P=0.023), and cocaine use (χ^2 =5.72, df=1, P=0.017) (Fig. 1). A history of opiate use was not significantly related to complications (χ^2 =2.40, df=1, P=0.122). Furthermore, behavioral health disease (diagnoses including schizophrenia, bipolar depression, anxiety, depression, and post-traumatic stress disorder) was significantly associated with complications (χ^2 =11.19, df=1, P <0.001). Additionally, assault as the mechanism of injury was correlated with increased risk of complication (χ^2= 4.063, df=1, P=0.044), as was dietary nonadherence following surgery (χ^2 =11.071, df=1, P <0.001).

Conclusions: Solutions to alleviate the effects of comorbid substance use disorders and behavioral health disease must be sought at a societal, policy level. However, for providers evaluating and treating patients, these risk factors should be identified early, and steps be taken to mitigate their consequences. Engaging partner services, including addiction medicine, primary care, social work, and others may better serve these vulnerable patients. At a fundamental level, providers must recognize that patients with these comorbidities will ultimately require more patience, support, and attention than patients without these risk factors.

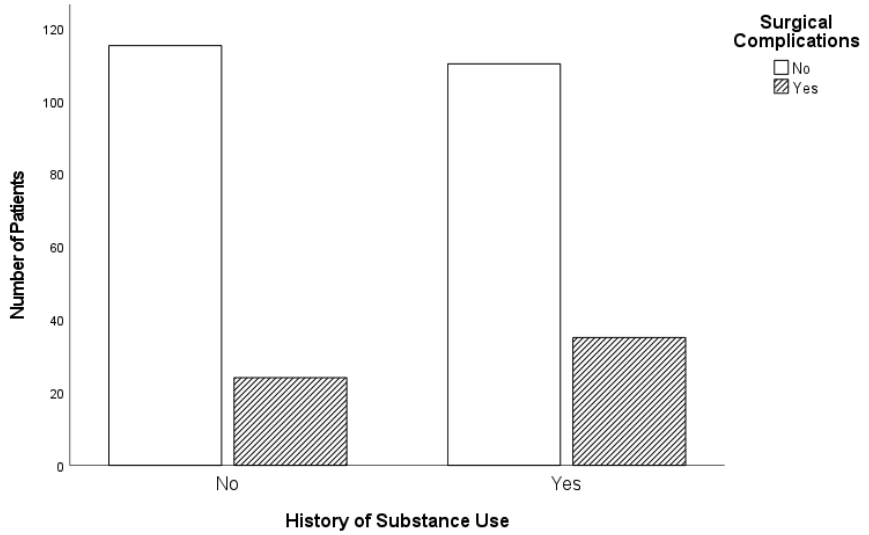

Figure 1: Patients with substance use history suffered a higher incidence of postoperative surgical complications.

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Abstract #29

ASSOCIATION BETWEEN VENOUS THROMBOEMBOLISM RATES AND PROPHYLACTIC ANTICOAGULATION REGIMES IN PATIENTS UNDERGOING FREE FLAP RECONSTRUCTION OF THE HEAD AND NECK REGION

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ASSOCIATION BETWEEN VENOUS THROMBOEMBOLISM RATES AND PROPHYLACTIC ANTICOAGULATION REGIMES IN PATIENTS UNDERGOING FREE FLAP RECONSTRUCTION OF THE HEAD AND NECK REGION

PURPOSE: Venous thromboembolism (VTE) is a life-threatening complication seen in 1.4% to 5.8% of patients after free tissue transfer to the head and neck (H&N) region. There is no consensus on the optimal chemoprophylaxis regimen. Enoxaparin 30 mg twice daily (BID) and heparin 5000 units three times daily (TID) are among the most common. The aim of this study was to compare the 30-day VTE and bleeding rate after surgery among these two different prophylaxis regimens.

METHODS: The population included in this retrospective cohort study are patients who underwent H&N reconstruction with free tissue transfer. Patients received either enoxaparin 30 mg BID (group A) or heparin 5000 units TID (group B) for venous thromboembolism prophylaxis. VTE and hematoma that required surgical intervention within 30 days of surgery were retrospectively recorded. Statistical analysis was performed using chi-square and T-tests.

RESULTS: 737 patients were included. The mean Caprini score was 6.45$\pm$1.65. VTE and hematoma evacuation rates among all patients were 4.5% and 5.6%, respectively. The mean Caprini score between groups A (n=664) and B (n=73) was not statistically significant (6.47±1.68 vs. 6.32±1.34, p=0.457). VTE rates in group A were significantly lower than B (3.9% vs. 9.6%, p= 0.026). The difference in hematoma rates between the two groups failed to reach statistical significance (5.6 vs. 5.5, p= 0.974).

CONCLUSIONS: Enoxaparin 30mg BID achieved significantly lower VTE rates compared to heparin 5000 units TID, while maintaining similar postoperative bleeding rates.

Abstract #30

CHIMERIC VERSUS MULTIPLE FREE FLAPS FOR THE RECONSTRUCTION OF COMPOSITE HEAD AND NECK DEFECT: A META-ANALYSIS

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CHIMERIC VERSUS MULTIPLE FREE FLAPS FOR THE RECONSTRUCTION OF COMPOSITE HEAD AND NECK DEFECT: A META-ANALYSIS

Background: Complex head and neck defects involving multiple tissue layers can be repaired via chimeric flaps; alternatively, multiple flaps with separate anastomoses can be utilized. While chimeric and multiple flap reconstructions have each been extensively described, they have not been compared. The purpose of our review is to compare outcomes between chimeric and multiple flap reconstructions.

Methods: We performed a systematic review of the English literature using PubMed/MEDLINE, Elsevier/Embase, EbscoHost, and Cochrane for reported composite head and neck reconstructions with chimeric or multiple free flaps. Two blinded and independent reviewers screened titles and abstracts for relevancy. A third reviewer resolved all conflicting screening decisions. Next, we extracted data from relevant articles. The primary predictor variable was chimeric versus multiple flap. The primary outcome was free flap survival. Data were analyzed using Stata.

Results: Our algorithm yielded 764 unique results, from which 63 articles comprising 1581 patients were deemed relevant to our study. 571 patients underwent multiple flaps while 1007 had chimeric flaps. Average patient age was 55.7. The most common indication for surgery was immediate cancer reconstruction (1164 patients).

Flap survival was 93% amongst chimeric flap patients (95% confidence interval 90-95%) and 93% for multiple flap patients (95% confidence interval 91-96%), with no statistically significant difference between groups. Partial flap failure (6% for chimeric flaps and 15% for multiple flaps, p=0.072), OR take backs, resumption of diet without G-tube dependence, resumption of speech, and general preoperative complications also had no statistically equivalent differences between groups. 13% of chimeric flap patients and 38% of multiple flap patients needed further free flaps, which was statistically significant. Operative time was 697.3 minutes for chimeric flap patients and 714.74 for multiple flap patients (p=0.07). Hospital stay was 20.57 days for chimeric flap patients and 23.3 amongst multiple flap patients, which was statistically significant (p = 0.05).

Conclusion: This is to our knowledge the first large meta analysis comparing chimeric flaps to multiple free flaps for reconstruction of composite head and neck defects. Flap survival is equivalent between multiple flaps and chimeric flaps, as are OR take backs, diet and speech resumption, and post operative complications. Need for further flap and hospital stay favored chimeric flaps, while OR time and partial flap failure trended toward favoring chimeric flaps without statistical significance.