

22nd Annual Department of Plastic Surgery Research Day

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Clinical Session 1

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10:10 AM – 10:15 AM Page 7	<i>Altered Lymphatic Patterns and Truncal Lymphedema After Breast Cancer Treatment: The Axillary-Inguinal Pathway as an Optimal Site for Lymphovenous Anastomosis</i> Meeti Mehta, BS; <u>Michael Mazarei</u> , BA; Shayan Sarrami, MD; Korrina Gidwani, BS; Viraj Govani, BA; Carolyn De La Cruz, MD

Patient Reported Outcomes Following Facial Feminization Surgery

Destin Groff, MD; Elizabeth Dominguez, MD; Casey Zhang, BA; Brodie Parent, MD

Background: Facial feminization surgery (FFS) includes procedures that modify facial features to align with feminine aesthetics and is a key element of gender-affirming care. While surgical outcomes and psychosocial impact are increasingly reported, less is documented on safety considerations surrounding FFS. This study explores patient-reported outcomes regarding self-esteem, social functioning, mental health, and experiences of stigma, discrimination, and violence to better understand the impact of FFS on patient well-being and safety.

Methods: We conducted a cross-sectional study of patients aged 18 and older who were considering, awaiting, or had undergone FFS with a University of Pittsburgh Medical Center (UPMC) plastic surgeon between 2023–2025. Participants were recruited in person during clinic visits and completed a survey including validated and study-specific questions.

Results: Fifteen patients participated, of which 14 (93.3%) identified as Caucasian. Gender identities included women (n=6, 23.1%), trans-female (n=7, 26.9%), male (n=3, 11.5%), trans-male (n=2, 7.69%), and gender nonconforming or nonbinary (n=8, 30.75%). Average duration of identifying with their current gender was 2.91 years (SD 1.3). All participants had been on hormone therapy for at least 1 to 5 years. Primary motivations for FFS included passing as their desired gender and avoiding harassment or unwanted attention (n=9, 90%), appearing more feminine and less masculine (n=7, 70%), increasing comfort with appearance (n=6, 60%), and improving self-esteem (n=5, 50%). Over the past year, 80% (n=8) reported verbal harassment at least 1-2 times per month, and 30% (n=3) reported multiple incidents of physical assault per year.

Conclusion: This study highlights the significance of reducing harassment as a motivator for patients pursuing FFS. The prevalence of verbal and physical harassment underscores the need for supportive and safety-focused care frameworks alongside aesthetic outcomes for patients with gender dysphoria.

Predictors of Osteoradionecrosis in Free Fibula Flap Reconstruction of Head and Neck Cancers: A Retrospective Study

Elizabeth Dominguez, MD; Spencer Regelson, MD, DDS; Adriana Duncan BS; Matthew Bottegall, MS; Mario Solari, MD

Background: Osteoradionecrosis (ORN) is a severe complication of radiation therapy, marked by exposed or necrotic bone in the absence of tumor recurrence. Prior studies show that post-operative radiation therapy (PORT) exceeding 60 Gy increases the risk of ORN by 21-fold. Additionally, the number of osteotomies has been associated with ORN development. However, the influence of pedicle characteristics—specifically their number, size, and location—on ORN risk remains unexplored.

Methods: This retrospective study utilizes data from a single-center database of patients who underwent free fibula flap (FFF) reconstruction for head and neck defects between October 2019 and January 2022. Variables collected include surgery and radiation dates, radiation dose, tumor size and stage, number and length of fibular segments, and screw count per segment. CT imaging was reviewed for clinical or radiographic evidence of ORN and time to onset.

Preliminary Results: While final analysis is ongoing, this study aims to establish which surgical techniques prove to be factors that influence ORN development. We hypothesize that increased segment length and optimized screw distribution may serve as protective factors. Currently developed analysis shows that buccal and lingual segment lengths are not significant factors at P-values of 0.31 and 0.35, respectively. It was also found that the number of FFF segments in patients with and without ORN is not significant with a P-value of 0.431.

Conclusion: ORN remains a significant concern in patients undergoing FFF reconstruction following radiation. While existing literature has identified several risk factors, the role of surgical technique—particularly details of bony segment design—remains underexplored. This study seeks to bridge that gap by examining the relationship between pedicle configuration and ORN development, with the goal of refining surgical planning to reduce complication rates.

Barriers to Care for Children with Orofacial Clefts at University of Pittsburgh Medical Center Children's Hospital of Pittsburgh

David L. Kornmehl, DMD; George Yacoub, BDS, DMD; Noor Allanqawi, DDS, MS; Oscar Arevalo, DDS, MS; Lindsay A. Schuster, DMD, MS

Background: Orofacial clefts (OFCs) are among the most common congenital anomalies in the United States, often requiring multidisciplinary, long-term care. Despite the availability of specialized teams and extensive support services, families may still face barriers to accessing comprehensive care. The objective of this research is to identify perceived barriers to care among caregivers of children with OFCs at a quaternary care academic medical center.

Methods: A 23-question survey was administered to caregivers of OFC patients at UPMC Children's Hospital of Pittsburgh over a four-month period. More than 80 completed questionnaires were analyzed.

Results: While most caregivers reported no significant issues obtaining care, several barriers were identified, including difficulty securing appointments, insurance limitations, and challenges finding specialists closer to home.

Conclusion: The findings highlight ongoing challenges in accessing timely, comprehensive care for children with OFCs, even in a well-resourced setting. Addressing these barriers is essential to reducing healthcare disparities and improving outcomes.

Neurocognitive and Psychiatric Outcomes in Pediatric Craniosynostosis: Insights for Plastic Surgery from a Retrospective Risk Analysis

Viraj Govani, BA; Mary Wilding, BS; Janina Kueper, MD; Aileen Cui, BS; Tobi Somorin, MPH;
Siri Ravuri, BS; Ashley Rogers, MD; Jesse Goldstein, MD

Background: Despite surgical advances, evidence shows that patients with craniosynostosis continue to have significant neurodevelopmental differences when compared to their peers. This study examines these differences and their risk factors to guide tailored interventions and improve care.

Methods: We retrospectively reviewed patients with craniosynostosis at UPMC Children's Hospital (2003–2023), examining demographics, clinical presentation, neurocognitive diagnoses, surgeries, and patient outcomes. Descriptive statistics, chi-square tests, t-tests, and logistic regressions were performed using STATA, with significance set at $p < 0.05$.

Results: An analysis of 719 pediatric patients with craniosynostosis (64.3% male, 83.0% Caucasian, mean diagnosis age 36.77 ± 43.61 months) included 132 patients eventually diagnosed with neurocognitive and psychiatric disorders. Our patients had a mean Pediatrics Symptom Checklist score of 17.68 ± 9.24 , General Anxiety Disorder-7 score of 6.78 ± 8.11 , and Patient Health Questionnaire-9 score of 5.32 ± 6.10 .

Patients with squamosal and lambdoid craniosynostosis were significantly more likely to develop developmental delay ($p = 0.013$), and patients with squamosal craniosynostosis were significantly more likely to develop autism spectrum disorder (ASD) ($p = 0.042$). Each additional month of age at the time of diagnosis significantly raises the odds of developing ASD by approximately 1.08% ($p = 0.002$), ADHD by approximately 1.42% ($p < 0.001$), learning disorders by approximately 1.97% ($p < 0.001$), and developmental delay by approximately 1.26% ($p < 0.001$).

Conclusion: This study underscores the critical importance of early diagnosis in craniosynostosis, as delayed detection was associated with increased rates of ASD, ADHD, developmental delay, and learning disorders. These associations highlight the intricate and interconnected relationship between craniosynostosis and the subsequent development of comorbid psychiatric and neurocognitive conditions in pediatric patients.

Clinical Research Neurocognitive and Psychiatric Outcomes in Pediatric Craniosynostosis: Insights for Plastic Surgery from a Retrospective Risk Analysis

Viraj Govani, BA; Mary Wilding, BS; Janina Kueper, MD; Aileen Cui, BS; Tobi Somorin, MPH; Siri Ravuri, BS;
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Clinical Research Psychosocial Drivers of Treatment Goals in Adults with Cleft Conditions

Ethan Richlak, BS; Avery Pope, BS; Hailey Umbaugh, BS; Tobi Somorin, BS; Matt Ford, MS, CCC-SLP; Canice Crerand, PhD; Jesse Goldstein, MD

Background: Patients with cleft conditions may have ongoing appearance and functional care needs that persist into adulthood following pediatric multidisciplinary care. Studies in the United Kingdom have shown that having a cleft is strongly associated with psychosocial burden in adults and patients with this burden may seek out appearance-altering treatment to address social concerns. This study characterized patients seeking cleft-related treatment as an adult and identified the care priorities and psychological burden faced by this population, which are poorly understood in the United States.

Methods: A retrospective chart review was conducted on adult patients (≥ 18 years old) with cleft conditions who were seen at the UPMC Children's Hospital of Pittsburgh Cleft-Craniofacial Center for the first time between 1/1/2013 to 6/30/24. Data abstracted included demographic characteristics, treatment goals and documented psychological concerns. Statistical analyses were conducted using SPSS.

Results: Thirty-five patients met inclusion criteria. The median age at first clinic contact was 26.8 years (IQR: 21.7-39.4). The majority of patients were female ($n = 19$, 54.3%), white ($n = 28$, 80.0%), English-speaking ($n = 33$, 94.3%), and had private insurance ($n = 27$, 77.1%). Psychological concerns were identified in 62.9% ($n = 22$) of patients, and these patients were significantly more likely to identify nasal/lip symmetry ($p = 0.011$) and nasal breathing ($p = 0.022$) as treatment goals. A younger age at first contact with the clinic was associated with more psychological concerns ($r = -0.34$, $p = 0.048$) and antidepressant medication use ($r = -0.36$, $p = 0.033$).

Conclusion: Adults with cleft conditions who present with appearance- and breathing-related treatment goals were more likely to have psychosocial concerns. Younger adults were more likely to experience psychosocial burden. These findings underscore the need for increased psychosocial support for adults with cleft conditions, especially younger adults and those with appearance-related concerns.

Demographic and Clinical Predictors of Suspected Abuse in Genital Burn Injuries: A National Database Study

Hakan Orbay, MD; Hilary Y. Liu, BS; Mare G. Kaulakis, BS; Christopher J. Fedor, José Antonio Arellano, MD; Rebecca Hohsfield, MS; Paul Rusilko, DO; Garth Elias, MD; Alain C. Corcos, MD, FACS; Jenny A. Ziemicki, MD; Francesco M. Egro, MBChB, MSc, MRCS

Background: Genital burn injuries can have serious consequences and may raise concerns about potential abuse. Understanding the relationship between genital burns and suspected abuse is critical for improving patient care and developing evidence-based strategies. This study characterizes genital burn patients with suspected abuse and identifies associated risk factors using a national database.

Methods: A retrospective review was conducted using the ABA Burn Care Quality Platform (BCQP) data from January 2013 to December 2022 on genital burn patients suspected of abuse. Patient demographics, burn characteristics, and clinical data were analyzed. Multiple logistic regression was used to evaluate factors associated with suspected abuse.

Results: Of 11,222 patients (31.6% female, 68.4% male; mean age 33.2 ± 25.7 years) with genital burns, 782 patients (7.0%) were suspected of abuse. Males were slightly less likely to be suspected of abuse than females (OR = 0.989, $p=0.033$). Younger age was significantly associated with higher suspicion, with each year increase in age reducing the likelihood of suspected abuse (OR = 0.998, $p<0.001$). Asian (OR = 0.919, $p=0.002$) and White patients (OR = 0.942, $p=0.014$) had lower rates of suspected abuse compared to other racial groups. Drug use ($p=0.359$) and marital status ($p=0.848$) were not significantly associated with suspected abuse. Patients living in houses/apartments (OR = 0.854, $p<0.001$), institutions/prisons (OR = 0.886, $p=0.022$), and school dormitories (OR = 0.802, $p=0.001$) had lower rates of suspected abuse compared to those living alone.

In regard to burn characteristics, a larger total body surface area (TBSA) was associated with increased suspicion of abuse (OR = 1.0005, $p<0.001$). Electrical burns (OR = 0.934, $p=0.002$), flame burns (OR = 0.971, $p=0.027$), and flash burns (OR = 0.951, $p=0.004$) were associated with lower rates of suspected abuse compared to other burn types.

Conclusion: Several demographic and clinical factors, including younger age, female gender, larger TBSA burns, and living alone, are associated with higher rates of suspected abuse in genital burn patients. Drug use and marital status were not significant factors.

Clinical Research Preventing Amputation in Frostbite Injuries with Thrombolytic Agents or Iloprost: A Systematic Review and Meta-Analysis

Matteo Angelini; Mahi Pachgade, BS; Hilary Liu, BS; José Antonio Arellano, MD; Asim Ejaz, PhD; Francesco M. Egro, MD, MSc, MRCS

Background: Frostbite is a serious injury that occurs when body tissues are exposed to freezing temperatures, potentially resulting in amputation. Tissue damage arises from a combination of direct freezing and subsequent inflammation, vasoconstriction, and thrombosis. Thrombolytic agents are an important component of acute-phase treatment. Iloprost has recently received FDA approval for managing acute frostbite. However, pooled and comparative evidence on their effectiveness remains limited. This study aims to systematically evaluate and compare the impact of thrombolytic agents and iloprost on amputation outcomes in patients with severe frostbite.

Methods: A systematic review and meta-analysis was conducted in accordance with PRISMA guidelines across PubMed, Cochrane Library, EMBASE, and Web of Science. This study was registered on PROSPERO (CRD420250652369). Eligible articles reported on frostbite treatment with either iloprost or thrombolytic agents in 3 or more patients. The primary outcomes were the number of amputated patients and the digital amputation rate.

Results: Of 7,875 studies screened, 12 met the inclusion criteria, including 10 dealing with tPA, 2 with iloprost and 1 reporting about both interventions. They examined 779 patients with severe frostbite (grade 2-4), affecting the upper (50.25%) or lower (49.75%) extremities. Patients were predominantly male (81.64%) with a mean age of 41.63 ± 15.38 years. Thrombolytic agents significantly reduced the odds of amputation (OR: 0.46; 95% CI: 0.26-0.83; $p=0.009$; $I^2=46\%$). Iloprost also showed a trend towards decreased digital amputation rate, even though this was not significant (OR: 0.05; 95% CI: 0.00-3.33; $p=0.17$; $I^2=88\%$). Direct comparison between the two interventions was not possible due to the scarcity of studies.

Conclusion: Amputation is the most feared complication of severe frostbite. Thrombolytic agents emerged as a key acute intervention to prevent tissue loss in eligible patients. Iloprost may contribute to improved amputation outcomes. Additional high-quality comparative studies are needed to determine the most effective strategy for tissue salvage.

Clinical Research Prior Organ Transplant Increases Risk of Wound Infection After Burn Injury: A National Database Study

Rebecca Hohsfield, BS; Hilary Y. Liu, BS; David Orozco, MD; Mare G. Kaulakis, BS; José Antonio Arellano, MD; Christopher J. Fedor, MS; Garth Elias, MD; Alain Corcos, MD, FACS; Jenny Ziembicki, MD; Francesco M. Egro, MD, MSc, MRCS

Background: Transplant recipients face unique challenges in burn injury management due to the use of immunosuppressive therapies, which increase susceptibility to infection, impair wound healing, and heighten the risk of drug-related toxicity. This study evaluates whether a history of organ transplantation serves as an independent risk factor for wound infection in burn patients.

Methods: A retrospective case-control study was conducted for burn patients from the Burn Care Quality Platform Registry from 2013 to 2022. Patients with a history of organ transplant were identified, and a matched cohort of non-transplant patients was selected based on age and total body surface area burned. The data collected included demographics, injury characteristics, surgical interventions, and clinical outcomes.

Results: Of 106,967 burn patients, 50 with a history of organ transplantation were identified. Transplant patients had a significantly higher wound infection rate compared to non-transplant patients (26% vs 6%, $p = 0.006$). No significant differences were observed in hospital length of stay ($p = 0.65$), ICU length of stay ($p = 0.74$), days on a ventilator ($p = 0.77$), number of surgical operations ($p = 0.23$), or mortality rates ($p > 0.99$).

Conclusion: Burn patients with a history of organ transplantation are at a significantly higher risk of wound infection. Tailored management strategies may be necessary to mitigate infection risk and optimize outcomes in this vulnerable population.

The Impact of Cirrhosis on Burn Patient Outcomes: A National Database Review

Joshua S. Yoon, MD; Hilary Y. Liu, BS; Omar Elfanagely, MD; Francesco M. Egro, MD, MSc, MRCS

Background: Cirrhosis leads to a wide range of bodily dysfunction such as coagulopathy and immunosuppression, which may predispose burn patients to worse outcomes. However, the impact of cirrhosis on burn patients remains poorly understood. This study examines the association between cirrhosis and outcomes in burn patients using a large national dataset.

Methods: A retrospective review was performed using data from the Burn Care Quality Platform from 2013 to 2022. Patients with cirrhosis were compared to those without. Demographic, burn characteristics, clinical course, and hospitalization data were extracted. Descriptive statistics summarized the data, t-tests and chi-square tests were used for univariate comparisons, and multiple logistic and linear regression models were performed.

Results: Of the 263,623 patients in the database, 1134 (0.4%) had cirrhosis. Patients with cirrhosis were significantly older (57.6 vs. 37.2 years, $p < 0.001$), with increased rates of smoking (44.1% vs. 23.8%, $p < 0.001$), diabetes (29.2% vs. 11.5%, $p < 0.001$), congestive heart failure (12.4% vs. 2.5%, $p < 0.001$), and hypertension (44.9% vs. 20.4%, $p < 0.001$). Patients with cirrhosis had larger burns (TBSA 9.8% vs. 7.5%, $p < 0.001$), higher rates of mortality (18.8% vs. 3.1%, $p < 0.001$), infection (5.4% vs. 2.3%, $p < 0.001$), and longer hospital (14.8 vs. 9.2 days, $p < 0.001$) and ICU stays (9.3 vs. 5.7 days, $p < 0.001$). On multivariable analysis, cirrhosis was independently associated with increased mortality (OR 6.53, 95% CI 5.17–7.92, $p < 0.001$) and liver failure (OR 7.68, 95% CI 2.56–12.78, $p < 0.001$). In linear regression, cirrhosis was associated with a longer hospital stay ($\beta = 1.15$ days, $p < 0.01$).

Conclusion: Cirrhosis is associated with increased mortality and worse outcomes in burn patients. These findings underscore the need for heightened vigilance and potentially tailored management strategies for this high-risk population.

From Flow to Stasis: Radiation's Impact on Lymphatics and Seroma Development

Meeti Mehta, BS; Shayan Sarrami, MD; Korrina Gidwani, BS; Michael Mazarei, BS; Carolyn De La Cruz, MD

Background: Radiation is a known risk factor of lymphedema development but the extent of its damage on truncal lymphatics has never been assessed. Using indocyanine green (ICG) lymphography damage can be visualized as areas of dermal backflow or absent lymphatic flow following severe destruction. We aim to analyze the effects of radiation on lymphatic structures of the chest, exploring the incidence of no flow zones and identify associated complications.

Methods: We performed a retrospective review of breast cancer patients who received ICG lymphography of their chest from 12/2014-01/2024. Patients were separated into radiation and non-radiation groups. Using ICG lymphography, zones of no lymphatic flow were recorded. Data on breast cancer treatment modalities were collected. Multivariate analysis was conducted to assess associations between radiation, no flow zones, and breast complications, while controlling for other treatment modalities and BMI.

Results: Our cohort included 173 hemi-trunks (95 patients). Of these, 73 sides (42%) underwent radiation and 100 (58%) did not. Most patients had mastectomy (79%), chemotherapy (65%), and axillary dissection (27%), with an average BMI of 30.16. Zones of no lymphatic flow were observed in 79% of the radiation group and 63% of the non-radiation group ($p=0.03$). Most no flow zones were in inferior mastectomy flaps, correlating with clinical findings. On multivariate analysis, radiation increased the odds of absent lymphatic flow by 158% (OR 2.58, CI 1.10–6.02, $p=0.03$). Breast complications were more frequent in the radiation group (52.1%) than the non-radiation group (28.0%, $p=0.002$), including infection (26.0% vs. 13.0%, $p=0.048$) and seroma (37.0% vs. 19.0%, $p=0.014$). Radiation therapy was associated with 162% greater risk of seroma compared to no radiation therapy, when controlling for confounders (OR 2.62, CI 1.15-5.97, $p=0.02$). When controlling for radiation and other confounders, diffuse and absent lymphatic flow were associated with 31% greater risk of seroma compared to less severe dermal backflow patterns (OR 1.31, CI 1.01-1.70, $p=0.04$).

Conclusion: Radiation is significantly associated with zones of absent lymphatic flow, reflecting severe lymphatic damage and stasis. These zones are significantly correlated with an increased risk of seroma formation, and radiation independently increases the likelihood of seroma development. These findings suggest that radiation-induced lymphatic disruption is a critical factor in seroma formation, highlighting the need for targeted interventions to mitigate radiation-associated complications in breast cancer patients.

Altered Lymphatic Patterns and Truncal Lymphedema After Breast Cancer Treatment: The Axillary-Inguinal Pathway as an Optimal Site for Lymphovenous Anastomosis

Meeti Mehta, BS; Michael Mazarei, BA; Shayan M. Sarrami, MD; Korrina Gidwani, BS; Viraj Govani, BS; Carolyn De La Cruz, MD

Background: The use of lymphovenous anastomosis (LVA) to treat breast cancer-related truncal lymphedema has not been well described. A longitudinal pathway, connecting the axillary and inguinal lymph nodes, has been previously demonstrated in cadaveric and indocyanine green (ICG) lymphographic studies. In this study, we analyze the altered lymphatic drainage patterns in affected patients and identify the axillary-inguinal pathway as both protective against truncal lymphedema and an optimal site for LVA.

Methods: Breast cancer patients with suspected truncal lymphedema who received ICG lymphography were included. Radiation, chemotherapy, axillary surgery, mastectomy, and reconstruction data were collected. Axillary and inguinal drainage was assessed using ICG. Multivariate logistic regression, controlling for confounders, was performed to calculate odds ratios (OR).

Results: 173 hemi-trunks (95 patients) were analyzed. Hemi-trunks drained to ipsilateral axillae (45%), contralateral axillae (17%), ipsilateral groins (66%), and contralateral groins (9%). 84% of the mastectomy skin flaps had diffuse or absent lymphatic channels. Axillary surgery was associated with increased odds of contralateral axillary drainage (OR 2.483, $p=0.042$) due to ipsilateral lymphatic disruption. Radiation was associated with greater odds of contralateral axillary (OR 2.783, $p=0.049$) and ipsilateral inguinal drainage (OR 3.804, $p=0.019$), as localized damage promotes alternative pathways. Using fluorescent lymphography to identify patent lymphatic channels and ultrasound to identify nearby veins, two LVAs were performed per patient in the lateral chest, inferior to the IMF. The orientation of each anastomosis supported drainage from the mastectomy flaps to the ipsilateral inguinal lymph nodes. Both patients reported an immediate reduction in swelling and symptoms.

Conclusion: We demonstrate that breast cancer treatments and reconstruction result in alternative flow, disrupting the axillary-inguinal pathway. Preservation of this connection may help reduce the incidence of truncal lymphedema and offer a target for manual lymphatic drainage treatments.

QI and Education Session

10:45 AM – 12:00 PM	Session II – Quality Improvement and Education Presentations <i>Moderator: Dr. Francesco Egro</i>
10:45 AM – 10:50 AM Page 9	<i>Streamlining Burn Care – A Comprehensive Algorithm for Lower Extremity Burn Management</i> <u>Mare G. Kaulakis, BS</u> ; Christopher J. Fedor, MSc; Alexis M. Henderson, MPH; Hilary Y. Liu, BS; José A. Arellano, MD; Garth Elias, MD; Guy M. Stofman, MD; Alain C. Corcos, MD; Jenny A. Ziembicki, MD; Francesco M. Egro, MBChB, MSc, MRCS
10:50 AM – 10:55 AM Page 9	<i>EDUPlast: A Plastic Surgery Symposium Series for Local Underrepresented Learners</i> <u>Chanel Reid, MD, MS</u> ; Alexis Henderson, MPH; Allison Brophy, BS; Emma Hudson, MA; Nerone Douglas, MD, MSc; Carolyn De La Cruz, MD
10:55 AM – 11:00 AM Page 10	<i>Surgical Economic Efficiency: Optimizing RVU Density in Pediatric Plastic Surgery</i> <u>Tobi J. Somorin, BS</u> ; Janina Kueper, MD; Ashley Rogers, MD; Liliana Camison, MD; Michael Bykowski, MD; Alexander Davit III, MD; Joseph E. Losee MD, MBA; Jesse A. Goldstein, MD
11:00 AM – 11:05 AM Page 10	<i>Evaluation of Mixed Reality for Burn Margin Visualization and Surgical Planning</i> <u>Christopher J. Fedor, MSc</u> ; Griffin J. Hurt, BPhil; Edward G. Andrews, MD; Jacob Biehl, PhD; Francesco M. Egro, MBChB, MSc, MRCS
11:05 AM – 11:10 AM Page 11	<i>Assessing Surgical Skills of Residency Applicants: A Systematic Review</i> <u>Malke Asaad, MD</u> ; Shayan M. Sarrami, MD; Alexander Comerc, MS; Aashish Rajesh, MD; Vu Nguyen, MD
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11:25 AM – 11:30 AM Page 11	<i>The Business of Hand Surgery: A Machine Learning Model for wRVU Prediction and Salary Benchmarking of Hand Surgeons</i> <u>Xavier Candela, MD, MBA, MEd</u> , Joseph W. Mocharnuk, MD, MS, Joseph E. Losee, MD, MBA
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11:40 AM – 11:45 AM Page 13	<i>Equidistant Anastomosis Suture Instrument (EASI): Development of a Novel Device to Facilitate Complex Microsurgical Reconstruction in Any Healthcare Setting</i> <u>Hilary Y. Liu, BS</u> ; Simon Cao, MD; Francesco M. Egro, MBChB, MSc, MRCS

Streamlining Burn Care – A Comprehensive Algorithm for Lower Extremity Burn Management

Mare G. Kaulakis, BS; Christopher J. Fedor, MS; Alexis M. Henderson, MPH; Hilary Y. Liu, BS; José A. Arellano, MD; Garth Elias, MD; Guy M. Stofman, MD; Alain C. Corcos, MD, FACS; Jenny A. Ziembicki, MD; Francesco M. Egro, MD, MSc, MRCS

Background: Lower extremity (LE) burns pose significant challenges, often leading to morbidity and long-term functional impairment despite advancements in burn care. This study aims to develop a standardized treatment algorithm to improve LE burn outcomes.

Methods: A retrospective analysis of LE burn patients at a single ABA-verified burn center (2012-2023) included demographics, burn characteristics and treatment. Logistic regression evaluated associations between burn demographics and surgical intervention.

Results: The study included 558 patients (64.87% male, 35.13% female; mean age 38.62 ± 24.25 years; mean BMI 26.64 ± 8.12). Common burn etiologies were flame (48.57%; n=271), scald (34.59%; n=193), chemical (3.23%; n=18), and electrical (1.26%; n=7), with a mean total body surface area (TBSA) of 10.51 ± 14.41 and LE BSA of 3.06 ± 0.85 . 300 (53.76%) patients received surgical intervention; 13 (4.33%) had superficial partial-thickness, 111 (37%) deep partial-thickness, and 176 (58.67%) full-thickness burns to the LEs. Common procedures included excision plus autograft (43.33%; n=130) and two-stage operation (cadaveric allograft followed by autograft) (36%; n=108). Each 1% TBSA increase raised likelihood of surgical intervention by 4% (OR=1.04, p=0.0115) and excision plus cadaveric allograft by 5% (OR=1.05, p=0.0027), while decreasing likelihood of excision plus autograft by 6% (OR=0.94, p=0.0025). Deep partial-thickness burns increased surgical likelihood by 13.23 times (OR=13.23, p=0.0000) while full-thickness increased it by 64.55 times (OR=64.55, p=0.0000).

Conclusion: A standardized treatment algorithm for LE burns is crucial for improving outcomes. This study demonstrates TBSA and burn depth significantly influence surgical decisions, with larger, deeper burns often requiring surgical intervention due to patient instability or limited healthy skin.

EDUPlast: A Plastic Surgery Symposium Series for Local Underrepresented Learners

Chanel Reid, MD, MS; Alexis Henderson, MPH; Allison Brophy, BS; Emma Hudson, MA; Nerone Douglas, MD, MSc; Carolyn De La Cruz, MD

Background: Pipeline programs improve diversity by increasing representation of minority groups, particularly for students underrepresented in medicine (URiM). This progress is important in broadening the diversity of medical school applicants and graduates. However, plastic surgery continues to fall behind with representing trainees and surgeons from minority backgrounds. To address this gap, the Education Symposium Series in Plastic Surgery (EDUPlast), is a Pittsburgh-based pipeline and outreach initiative for local URiM high school and college students. This educational series aims to inspire students to pursue plastic surgery as a future career and foster mentorship.

Methods: Students participated in two separate skills workshops. The first half of workshops consisted of an interactive lecture covering plastic surgery principles relevant to the hands-on portion. The curriculum concluded with a symposium where students participated in panel discussions and breakout groups. Students completed anonymous pre- and post-workshop surveys to assess their interest in pursuing a career in plastic surgery, and their satisfaction with the curriculum. Survey responses were measured using a Likert scale ranging from "strongly disagree" to "strongly agree." Spearman's rho was used to evaluate correlations between students' interest in plastic surgery and their perceived value of the curriculum.

Results: 112 responses were recorded. Students reporting prior consideration of a career in plastic surgery showed lower baseline familiarity with the field (p = 0.014). By the end of the series, students were significantly interested in pursuing plastic surgery (p < 0.001). At the start of the series, 71.4% collectively agreed in beginning to think of their career. Following the symposium, 52% were interested in pursuing a career in plastic surgery. 88% of students found valuable mentorship.

Conclusion: EDUPlast fosters valuable mentorship. This illustrates the impact of intentional early exposure to plastic surgery principles on students who had not previously considered pursuing a career in plastic surgery.

Surgical Economic Efficiency: Optimizing RVU Density in Pediatric Plastic Surgery

Tobi J. Somorin, BS; Janina Kueper, MD; Ashley Rogers, MD; Liliana Camison, MD; Michael Bykowski, MD; Alexander Davit III, MD; Joseph E. Losee MD MBA; Jesse A. Goldstein MD

Background: Plastic surgery has the lowest relative value units (RVUs) per hour among surgical specialties, leading to potential undervaluations. Despite the importance of this metric, there is a notable lack of comprehensive analysis on RVU density (RVUs per hour) across plastic surgery procedures. Additionally, most studies fail to account for the multiple CPT codes that are required for most plastic surgery operations. The objective of our pilot study was to critically assess RVU density and provide suggestions to enhance efficiency in plastic surgery, beginning with a focused analysis of pediatric plastic surgery (pPRS).

Methods: We conducted a retrospective analysis of procedures performed at our institution. We identified the most common procedures performed by three pediatric plastic surgeons. For each procedure type, we selected five patients and collected data on the length of surgery and all associated CPT codes. Microsoft PowerBi was used to assess the RVUs generated per surgical case. Statistical analyses were conducted in Microsoft Excel.

Results: A multiple linear regression was conducted using data from 80 craniofacial and pPRS surgery procedures, from lesion excisions to spring cranioplasties. The model was statistically significant and explained a substantial portion of the variability in RVU/hour. CPT code count remained a strong, independent predictor of higher RVU density ($p < 0.001$), while case time was negatively associated with RVU/hour ($p < 0.05$). The highest RVU-dense procedure was Polydactyly repair at 52.27 RVUs/hour, with the lowest being syndactyly repair 2.88. Hand surgery was significantly more RVU dense than cleft and craniofacial surgery ($p=0.019$).

Conclusion: Our findings can help inform OR block scheduling by incorporating a balanced spread of RVU-dense procedures to maximize surgical productivity and revenue within limited operative hours. Additionally, identifying consistently low-RVU procedures can help target advocacy to re-evaluate RVU assignments and ensure equitable reimbursement for plastic surgery procedures.

Evaluation of Mixed Reality for Burn Margin Visualization and Surgical Planning

Christopher J. Fedor, MS; Griffin J. Hurt, BPhil; Edward G. Andrews, MD; Jacob Biehl, PhD; Francesco M. Egro, MD, MSc, MRCS

Background: Mixed reality (MR) merges virtual content with the physical world, providing novel visualization opportunities. In burn surgery, excision and grafting are standard for deep partial and full-thickness burns, but identifying excision margins is challenging. In this study, we demonstrate a new application of MR for burn surgery by building and evaluating a system that overlays deep burn margins onto a simulated anatomical surface for surgeons to trace. This represents a first step towards creating an MR system that can help physicians interpret burn surface area and depth for surgical planning.

Methods: Three burn surgeons traced MR-overlaid margins on a printed burn image using two MR headsets: see-through (STh) and pass-through (PTh). A control group was included, where surgeons drew margins while referencing an external computer monitor. Image tracking utilized native libraries and three QR code markers positioned on the page. Accuracy was assessed using intersection over union (IOU) against ground truth data. Trace precision was also measured post-alignment via iterative closest point (ICP).

Results: With the raw traces, average trace area IOU was highest for the control (0.718), then for the PTh headset (0.501), and lowest for the STh headset (0.187). When the traces were aligned with the ground truth using ICP, the pass-through headset had the highest IOU (0.797), followed by the see-through headset (0.770), with both outperforming the control condition (0.763) in trace precision.

Conclusions: As a pilot study, these findings demonstrate that MR-assisted visualization can improve precision in burn excision margin identification. Given that precise tissue excision is critical not only in burns but also in traumatic wounds, chronic wounds, and oncologic resections, MR may have broader applications in this realm of plastic surgery.

Assessing Surgical Skills of Residency Applicants: A Systematic Review

Malke Asaad, MD; Shayan M. Sarrami, MD; Alexander Comerici, MS; Aashish Rajesh, MD; Vu Nguyen, MD

Background: Traditional metrics for ranking surgical residency applicants is based on academic accolades and personality traits. As residencies aim to select the best future surgeons out of an increasingly competitive population, surgical skill testing can strengthen current evaluation methods. Through a systematic review, we analyze the available research on various surgical skills tests used by residencies during their interview process.

Methods: The authors performed a systematic literature search of PubMed using terms related to residency applicants and surgical skills testing. The included articles evaluated applicant surgical performance and assessed its usefulness in resident selection.

Results: 1,312 articles underwent abstract screening, 27 were eligible for full-text review, and 14 manuscripts were selected. Surgical residencies using skills assessments during interviews included general surgery and various sub-specialties. Diverse skills tests were utilized, and often tailored to the specific field. Interviewers valued the structured setting for assessing candidates' technical performance and attitudes within a simulated surgical environment. Most articles emphasized the importance of identifying both highly skilled and less proficient candidates, as well as evaluating non-technical skills like communication, self-assessment, and emotional intelligence. Incorporation of these tests on interview day was feasible over several years, including in-person and virtual platforms.

Conclusion: Current literature suggests that adding surgical skills tests to applicant interviews may offer insights beyond traditional methods, though their ability to predict residency performance is uncertain. Next steps would be a prospective study that evaluates applicants' scores on these assessments and tracks how closely they correlate with technical performance throughout residency.

The Business of Hand Surgery: A Machine Learning Model for wRVU Prediction and Salary Benchmarking of Hand Surgeons

Xavier Candela, MD, MBA, Med; Joseph W. Mocharnuk, MD, MS; Joseph E. Losee, MD, MBA

Background: Hand surgeons offer unique services that contribute value to their respective institutions. The goal of this study was to evaluate billing, collection, and compensation patterns in hand plastic surgery and to use machine learning models trained on data collected from our national survey to provide calibrated salary predictions and wRVU benchmarks.

Methods: A survey was distributed to the 93 U.S. hand surgery divisions. Requested information included faculty salaries, relative value units, and distribution of clinical volume and non-surgical professional responsibilities. Data was analyzed using R Studio (Version 1.3.1093). An interactive calculator was created in R Shiny to allow individual surgeons to predict their estimated compensation and wRVU targets.

Results: Of the 93 hand surgery divisions surveyed, 74 were run by orthopedic surgery and 19 were run by plastic surgery. A total of 56 programs responded with complete data, 42 in orthopedics and 14 in plastic surgery. Complete responses were almost evenly distributed across most AAMC regions (27.3% each from the West Coast and South, 31.8% from the Midwest, and 13.6% from the Northeast). Most responding institutions were academic teaching hospitals (86.3%), representing a total of 172 hand surgeons. All institutions (100%) reported accepting some mixture of private and public insurance as well as uninsured and/or self-paying patients. The average starting salary for a fellowship-trained hand surgeon was \$420,476 (SD: \$74,915, Range: \$175,000-\$500,000). Across institutions, the average estimated starting wRVU benchmark for a full-time (1.0 FTE) clinical faculty member was 5,551 (SD: 1707, Range: 2,250-8,272). *Data collection still underway-preliminary results based on simulation.

Conclusions: Our study provides baseline measures and standards for compensation and wRVUs in hand surgery. Using the largest ever survey of hand-fellowship trained orthopedic and plastic surgeons, we were able to construct robust predictive models for compensation based on clinical and administrative responsibilities as well as a centralized user interface to predict hand surgeon starting compensation based on fellowship training, years of clinical experience, proposed distribution of clinical responsibilities, and region of practice.

Assessing the Landscape of Insurance Policies for Gender Affirming Surgery: A Survey-Based Analysis

Viraj Govani, BA; Alexander Comerchi, BS; Tobi Somorin, BS; Adaora Okigbo, MS; Nicolas Kass, MS; Aaliyah Riccardi, MD; Janina Kueper, MD; Ashley Rogers, MD; Jesse Goldstein, MD

Background: Gender-affirming surgeries (GAS) play a critical role in the well-being of transgender and gender-diverse (TGD) individuals by alleviating gender dysphoria and improving mental health outcomes (Almazan 2021). Despite increased demand, access remains hindered by inconsistent insurance coverage and policy limitations (Dozier 2023). This study examines the landscape of insurance policies for GAS, barriers to coverage, and the impact of policy changes on patient access and surgical outcomes.

Methods: An IRB-approved Qualtrics survey was distributed to patients treated at a transgender care center from 2020-2024. Survey questions were adapted from the 2015 National Transgender Survey and supplemented with original items assessing insurance status, surgical access, and experiences with coverage denials. Descriptive statistics and chi-squared analyses ($p < 0.05$) were performed using Stata SE.

Results: Of 214 total participants (64.07% response rate), 77.36% were assigned female at birth, and 68.69% identified as transgender. Insurance denials for GAS were reported by 10% of participants, with nonbinary individuals experiencing higher denial rates for hormone therapy (8.11%, $p < 0.001$). Additionally, 32.35% of transgender women reported a lack of in-network providers despite insurance coverage for surgery, significantly more than other groups ($p < 0.001$). The 2021 expansion of GAS coverage by our institutional health plan significantly influenced the insurance choices of 45.45% of transgender women ($p = 0.023$), yet 63.64% of transgender men were unaware of this policy change.

Conclusion: These results demonstrate that disparities persist, particularly among transgender women and nonbinary individuals, who face higher rates of denials due to restrictive eligibility criteria. The findings underscore the need for standardized policies ensuring equitable access to all gender-affirming procedures. Additionally, increased provider networks, clearer policy communication, and patient navigators could help mitigate existing barriers. Further advocacy, healthcare provider training, and research are necessary to ensure that gender-affirming care is comprehensive, inclusive, and accessible to all who need it.

Evaluating Large Language Model's Accuracy in Current Procedural Terminology Coding Given Operative Note Templates Across Various Plastic Surgery Subspecialties

Mia J. Carrarini, BS; Hilary Y. Liu, BS; Catherine K. Perez, BS; Francesco M. Egro, MD, MRCS, MSc

Background: Manual CPT coding from operative notes is a time-intensive process that adds to the administrative burden in healthcare. Large language models (LLMs) offer a promising solution, but their accuracy in assigning CPT codes based on full operative note templates remains largely untested. Thus, this study evaluates the ability of three LLMs – GPT-4, Gemini, and Copilot – to generate accurate CPT codes from operative note templates across diverse plastic surgery procedures.

Methods: Twenty-six de-identified operative note templates from six plastic surgery subspecialties were entered into each LLM using a standardized prompt requesting appropriate CPT codes. Model outputs were compared to surgeon-verified codes and categorized as correct (all codes accurate), partially correct (some correct codes with errors), or incorrect (no correct codes). Accuracy was analyzed overall and by subspecialty using Extended Fisher's Exact Tests (significance set at $p < 0.05$).

Results: There was a significant difference in overall coding accuracy between the models ($p = 0.02176$). Gemini and Copilot had the highest accuracy rates (19.2% each), though Copilot produced more partially correct outputs (53.8%). GPT-4 had the lowest accuracy (7.7%). Subspecialty analysis showed Gemini performed best in aesthetic surgery (60%), while Copilot was most accurate in general reconstruction (42.9%). None of the models correctly coded breast reconstruction or craniofacial trauma procedures. Frequent errors included misidentification of procedural details and inappropriate bundling of CPT codes.

Conclusion: LLMs show potential for automating CPT coding but currently lack the contextual understanding required for reliable accuracy. Continued human oversight and model refinement are essential for future success of LLM CPT coding.

Equidistant Anastomosis Suture Instrument (EASI): Development of a Novel Device to Facilitate Complex Microsurgical Reconstruction in Any Healthcare Setting

Hilary Y. Liu, BS; Simon Cao, MD; Francesco M. Egro, MD, MSc, MRCS

Background: Microsurgical reconstruction is a cornerstone of modern plastic, orthopedic, and oncologic surgery, yet it remains limited by skill, time, and high-cost equipment. Microsurgical anastomosis, or the reconnection of small-caliber arteries and veins, is particularly prone to error, with complications such as backwalling (needle inadvertently piercing the opposite vessel wall) contributing to a free flap failure rate of up to 10%.

Methods: We developed the Equidistant Anastomosis Suture Instrument (EASI), a novel intraluminal suture guide featuring a central cylindrical core, guiding divots, and an anti-rotation stabilizing rod. EASI standardizes microsurgical anastomosis by ensuring equidistant suturing and preventing backwalling based on tactile feedback alone.

Results: Proof-of-concept testing in an ex vivo chicken thigh vessel model demonstrated that EASI eliminated backwalling, reduced anastomosis time by up to 60%, and improved user confidence. Compared to the venous coupler, which costs \$400 per use and is limited to veins, EASI offers dual-application (arteries and veins) with a projected price of \$200 per surgery—improving affordability and surgical flexibility. Moreover, EASI saves an estimated \$45,000 per avoided salvage procedure and \$88/minute saved in the operating room. These findings support EASI's potential for significant cost savings in both high- and low-resource settings. Upcoming milestones include in vivo testing in a rat carotid artery model to assess surgical timing, perfusion, and safety, followed by licensing negotiations, sterilization and biocompatibility testing, clinical trials, and regulatory submission.

Conclusion: EASI has received strong interest from microsurgeons at UPMC and has won \$20,000 in early-stage innovation awards. With a clear clinical need, robust preliminary data, and a defined regulatory pathway, EASI has the potential to democratize microsurgery by making it safer, more efficient, and accessible across a wider range of surgical settings.

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2:05 PM – 2:10 PM Page 20	<i>Massive Burn Injuries: Global Characteristics and Outcomes from the WHO Global Burn Registry</i> <u>Fuat Baris Bengur, MD</u> ; Daniel Najafali, BS; Hilary Y. Liu, BS; Megan Najafali, MHS; Saeid Rezaei, MD; José Antonio Arellano, MD; Logan G. Galbraith, MD; Mare G. Kaulakis, BS; Erik Reiche, MD; Raman Mehrzad, MD, MHL, MBA; Sameer A. Patel, MD; Quincy K. Tran, MD, PhD; Victor E. Stams, MD; Francesco M. Egro, MBChB, MSc, MRCS
2:10 PM- 2:15 PM Page 20	<i>Far Out: Evaluating the Impact of Distance on Acute Burn Outcomes</i> <u>Alexis M. Henderson, MPH</u> ; Hilary Y. Liu, BS; José Antonio Arellano, MD; Christopher J. Fedor, MSc; Mare G. Kaulakis, BS; Garth Elias, MD; Alain C. Corcos, MD; Jenny A. Ziembicki, MD; Francesco M. Egro, MBChB, MSc, MRCS

Can a Distal Radius Fracture Reduction Simulator Improve Residents' Fracture Reduction?

Elizabeth M. Kenny, MD; Ryan J. Kelly, BS; Benjamin Leslie, BS; Caroline Lindsey, BS; Teun Teunis, MD, PhD

Background: Distal radius fractures (DRF) are the most common fracture of the human skeleton, accounting for 1 of every 6 fractures seen in the emergency room setting. Fracture alignment is an important part in the decision to offer surgery to realign the fracture fragments. Therefore, often closed reduction is attempted to realign the fracture and potentially avoid surgery. Our study aims to assess whether resident training on a reduction simulator affects radiographic reduction and clinical outcomes including volar angulation, radial height, ulnar shortening, and rate of surgery.

Methods: The course training included written reading material, links to videos, and hands-on simulation training with reduction and splinting of DRF. A QI-approved for resident training retrospective review was conducted to assess radiographic and clinical outcomes for closed reductions of distal radius fractures performed by plastic surgery residents who trained and who did not train with a reduction simulator. The primary outcome was difference in volar angulation. Secondary outcomes included radial height, ulnar shortening, rate of surgery, and trainee survey responses.

Results: Radiographic parameters including volar angulation and radial height were significantly improved after attempted reduction. No significant difference was seen in radiographic parameters for those who trained and did not train on a reduction simulator. Rates of surgery did not differ between groups. Survey responses showed that most trainees found the training to provide comfort with performing distal radius reduction and splinting.

Conclusions: While no significant difference was observed in post-reduction radiographic parameters of trainees who trained and did not train on a DRF simulator, trainees found the experience to improve their comfort with performing this procedure.

Bedside Arthrocentesis and Irrigation as Initial Intervention for Septic Wrist

Sripadh B. Sharma, MD, PhD; Teun Teunis, MD, PhD

Background: Septic wrist, while an urgent surgical condition, is not classified as a Category A emergency—leading to frequent delays in operative intervention. These delays can result in prolonged pain, delayed care, and irreversible cartilage damage. To address this, we implemented a bedside protocol aimed at early, definitive management.

Methods: Patients with confirmed septic wrist—defined by either purulence on initial arthrocentesis or definitive lab findings—underwent immediate bedside arthrocentesis and irrigation. Procedures were performed under sterile technique with local lidocaine anesthesia. Using standard 3-4 and 6R portals, the radiocarpal joint was accessed, and sterile saline was flushed from one portal to the other until effluent was clear and/or 50–100 cc was instilled. Pain control, sterile precision, and patient engagement were prioritized throughout.

Results: Four patients have been treated to date under this protocol. All experienced complete resolution of infection without requiring operative intervention. Hospital stays were brief, with discharge in under one week for all cases. No complications or recurrences were observed. Patients demonstrated preserved wrist function and expedited recovery.

Conclusion: Bedside arthrocentesis and irrigation, when guided by a clear diagnostic threshold and executed with surgical precision, offers a compelling alternative to traditional operative management for septic wrist. Our early experience suggests that in appropriately selected patients, this approach may serve not only as a temporizing measure but as definitive treatment. Ongoing prospective data collection and comparative analysis with operatively treated patients are underway to further evaluate outcomes and establish best practice guidelines.

What Is the Probability of Radial Nerve Recovery After Operated Humerus Fractures Accounting for Time Since Injury?

Nienke A. Krijnen, MD; [Alexander J. Comerçi, MS](#); Linden K. Head, MD; Ingmar W. F. Legerstee, MD;
Huub H. de Klerk, BS; Neal Chen, MD; Teun Teunis, MD, PhD

Background: Radial nerve neuropathy after operative treatment of humeral shaft fracture usually improves when the nerve is in continuity, but a subgroup of patients does not recover. Retrospective studies using Frequentist statistical analysis do not effectively incorporate time from injury as a predictive factor, but Bayesian analysis allows for better handling of this variable. Using Bayesian methods applied to a previously reported cohort, we sought to determine (1) the probability of radial nerve motor recovery after operated humerus fractures, accounting for time since injury, and (2) the variables independently associated with timing of radial nerve recovery.

Methods: We retrospectively reviewed records of 53 patients who underwent humeral shaft fracture fixation with a radial nerve palsy with a nerve in continuity. The median age was 43 years (range 18 to 94) and 49% were male. Most palsies were present preoperatively (83%). Motor recovery was defined as Medical Research Council grade 3 or higher for wrist and/or finger extension. We performed Bayesian analysis with a prior probability of recovery derived from a large systematic review and incorporated cumulative recovery rates over time to calculate posterior probabilities of recovery at different time points.

Results: Using an anchor of 90% likelihood of overall recovery, the probability of recovery is greater than 50% (56%, range 48 to 62%) up to 7 months post-injury and drops below 20% (17%, range 13 to 21%) by 12 months. Survival analysis showed that half of the palsies recover just after 4 months. No variables were associated with timing of radial nerve recovery.

Conclusions: Understanding probabilities of recovery at different time points after injury may help surgeons and patients decide whether secondary nerve surgery or early tendon or nerve transfers will be beneficial.

Are the Words Patients Use to Describe their Pain After Upper and Lower Extremity Trauma Different Between Patients With and Without Nerve Injuries?

Nienke A. Krijnen, MD; Aniekanabasi Ufot, MS; [Elou S. Kingma, MD](#); Jason Yoo, MD; Nicole Jarrett, MD;
Dana Bregman, MD; Teun Teunis MD, PhD

Background: Some assume that injury to a nerve results in distinct types of pain. Following this reasoning, pain caused by a nerve injury (neuropathy) can be diagnosed through specific pain descriptions and questionnaires recording these descriptions. We aimed to test this assumption, and asked: (1) do patients with and without confirmed nerve injury provide different descriptions of their pain? (2) is the presence of a nerve injury independently associated with questionnaire scores aimed to identify pain specifically caused by neuropathy?

Methods: We conducted a prospective cross-sectional study of adult patients with traumatic upper or lower extremity injuries up to 6 months post-injury at a tertiary centre. We recorded demographics and injury characteristics, specifically the presence or absence of a nerve injury defined as surgically or EDS confirmed nerve disruption, increased two-point discrimination, or amputation. Patients were asked to describe their pain in an open-ended question. We recorded measures aimed to identify neuropathic pain (DN4 and S-LANSS). 69 patients with 82 injured sites were included (61% male; median age 40 years [range 20 to 84]; median time since injury 32 days [range 2 to 181]). Most injuries (73%) involved the upper extremity. Nerve injury was present in 32%.

Results: Only the descriptions “tingling” (nerve injury 23% [6/26] vs no nerve injury 0% [0/56], $p=0.001$) and “numb” (nerve injury 23% [6/26] vs no nerve injury 5.4% [3/56], $p=0.026$) differed. The presence or absence of a nerve injury was not independently associated with questionnaire scores aimed at measuring neuropathy related pain.

Conclusion: Within the first 6 months after extremity injury relying on pain descriptions to infer neuropathy is likely to lead to misattribution and misdiagnosis. Notably, DN4 and S-LANSS scores were high enough to justify the label neuropathic pain for majority of patients. Instead, open ended questions, prompting known descriptions related to neuropathy (not pain specifically) such as tingling, and numbness, seem most indicative of neuropathy.

Is There a Difference in Adverse Event Rates and Range of Motion Between Fixation with Nails, Wires and Plates or Screws for Extra-Articular Metacarpal and Phalangeal Fractures?

Benjamin E. Leslie, BS; Nienke A. Krijnen, MD; Ishan Patel, BS; Nicolas Aycardi, BS; Nicole Don, BS; John R. Fowler, MD; Teun Teunis, MD, PhD

Background: There is no consensus on the optimal treatment for extra-articular metacarpal and phalangeal fractures. We therefore asked, is there a difference between intramedullary (IM) nail, K-wire, and plate or screw fixation in (1) adverse events and (2) range of motion?

Methods: A retrospective chart review was conducted at a tertiary academic center of all adults surgically treated for extra-articular phalangeal and metacarpal fractures between January 2012 and August 2024. First, patients treated with IM-nail or plate/screw fixation were included. Then, the IM nail group was randomly matched 1:3 with patients treated with K-wires based on age and sex. Patient charts were reviewed for demographics, fixation method, overall adverse events, infection treated with antibiotics, re-operation, and total active motion. This resulted in a cohort of 711 patients, having 873 repairs. Overall, there were 167 fractures repaired with IM nail fixation, 443 with K-wires, and 263 with plate or screw fixation. We used multi-level multivariable analysis to account for relevant baseline differences and other potential confounders.

Results: Compared to K-wires, overall adverse events and re-operation were lower in the IM nail group (adverse events: OR 0.52 [95% CI 0.30 to 0.89, $p=0.018$, re-operation: OR 0.23 [95% CI 0.11 to 0.47, $p<0.000$]). After plate/screw fixation we found a lower rate of infections treated with antibiotics and also a lower re-operation rate (infection with antibiotics: OR 0.33 [95% CI 0.15 to 0.70, $p=0.004$]; re-operation: OR 0.48 [95% CI 0.26 to 0.87, $p=0.016$]). Fractures treated with IM-nails had greater total active motion 3 months after fixation (B-coefficient 29 [95% CI 2.7 to 56, $p=0.031$]) compared to K-wires.

Conclusion: Our results support the increasing use of IM nail fixation. Compared to K-wire fixation, IM nails may result in faster recovery and quicker regain of finger motion. Our results would benefit from confirmation in a prospective randomized study.

Complications in Postbariatric Body Contouring Throughout the Seasons

Darya Fadavi, MD; Arash Samadi, MD; Meeti Mehta, BS; Aileen Cui, MS; Adaora Okigbo, MS; Jeffrey A Gusenoff, MD

Background: With the increase in popularity of GLP-1 inhibitors, the post-massive weight loss patient population is anticipated to continue to grow, and body contouring procedures, including panniculectomy, will be a mainstay in their treatment. There is a known correlation between operative hypothermia and postoperative seroma rates, with lower intraoperative temperatures being associated with increased rates of seroma formation, as well as blood loss and the need for transfusion.¹ In this study we hypothesized that not only intraoperative temperature, but also ambient external temperature may have an effect on post-operative complication rates.

Methods: We performed a retrospective review of patients who underwent panniculectomy between the years of 2022-2024 at our institution. Data was analyzed using Chi square tests, t-tests, and ANOVA to analyze the relationship between procedure month and complications.

Results: One hundred and seventy-six patients were included. When comparing between patients who had their surgeries during Winter, Spring, Summer or Fall, there was no significant association between season of year and seroma rates ($p=0.17$) or overall complication rates ($p=0.90$). There was also no difference in seroma rates ($p=0.37$) or overall complication rates ($p=0.55$) based on procedure month.

Conclusion: We did not find a significant difference in seroma or complication rates based on time of year. This is helpful for surgeons to know, especially because patients will often prefer to undergo surgery during the last few months of the year. Winter provides a more convenient time for patients' schedules as fewer people are traveling, and they have greater flexibility in their schedules to take time off for recovery. Many patients have also often met insurance deductibles closer to the end of the year, and so are eager to have their procedures before their deductible resets with the New Year. It is reassuring that despite lower ambient temperature, we did not find an associated increase in complications postoperatively.

The Mummy Study: Analyzing the Effect of Concomitant vs Staged Brachioplasty and Thighplasty on Operative Outcomes

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Background: After massive weight loss (MWL), patients often experience skin excess and laxity, leading to functional, psychological, and health issues. Body contouring procedures like brachioplasty and thighplasty address these concerns, enhance patient well-being. These procedures may be performed either staged (separate surgeries) or together (referred to as the "mummy procedure"). While staged procedures present scheduling and financial challenges, there is a lack of long-term studies comparing the outcomes of combined procedures. This study explores the outcomes each, contributing to a patient-centered approach to body contouring.

Methods: A retrospective review was conducted for MWL patients who underwent both brachioplasty and thighplasty between July 2003 and October 2023. Demographic, intra-operative, and post-operative data were collected. Statistical analysis included Wilcoxon Rank-Sum, two-sample T-tests, and Fisher's Exact tests for complication data.

Results: Of 343 patients, 36 underwent mummy, and 28 underwent staged procedures. Most patients were female (94% vs. 93%, $p = 0.729$). Median age was 59 (IQR: 17) and 43 (IQR: 17), respectively ($p = 0.3343$). Median follow-up was 139 (IQR: 155.5) and 126 (IQR: 132) days ($p = 0.3673$). Median BMI at time of body contouring for each group was 29.02 (IQR: 5.28) and 28.97 (IQR: 3.92) kg/m² ($p = 0.3759$). Common complications were wound dehiscence (28% vs. 25%), seroma (21% vs. 27%), and cellulitis (10% vs. 7%) ($p = 0.841$, $p = 0.529$, $p = 0.755$). No differences were found for other complications: hematoma (3% vs. 2%), abscess (4% vs. 2%), suture extrusion (10% vs. 9%), fat necrosis (1% vs. 2%), and contour deformity (8% vs. 4%).

Conclusion: Patients who opt for either mummy or staged procedures exhibit similar demographics and post-operative outcomes. The mummy procedure does not result in higher complications compared to staged procedures. Future research should focus on patient-reported outcomes, particularly satisfaction levels with combined versus staged procedures.

Absorbable Antibiotic Bead Prophylaxis for Implant-Based Breast Reconstruction

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Background: Periprosthetic infection is a serious complication in implant-based breast reconstruction (IBR). A promising therapeutic strategy involves the use of biodegradable beads for local delivery of antibiotics at the surgical site. This study aims to describe a single institution's preliminary experience with absorbable antibiotic beads for preventing infection in implant-based breast reconstruction.

Methods: A retrospective cohort study was performed of patients who underwent IBR between January 2021- October 2023. Patients who met one or more high-risk criteria for infection (BMI > 30, prior smoking history, diabetes, and history of radiation) received prophylactic antibiotic-infused beads along with standard of care. Outcomes included development of periprosthetic infection requiring intravenous antibiotic therapy, infection requiring re-operation, wound-healing complications, and bead-related complications. Multivariate logistic regression was performed to control for known risk factors associated with infection.

Results: Two-hundred eighty-seven patients were included in the study. Twenty-seven (9.4%) received antibiotic beads and two-hundred sixty (90.6%) patients received standard of care alone. There was no difference in infection requiring re-operation between the antibiotic-bead group compared to controls (11.1% vs. 16.5%, $p=0.46$), and no difference in explantation rate (7.4% vs. 10.8%, $p=0.59$). After controlling for confounders, BMI was significantly associated with increased odds of infection (OR 1.1 CI 1.04 – 1.14, $p=.001$). In patients who underwent salvage procedures for infection with the application of antibiotics beads ($n=15$), the overall salvage success rate was 86.7% ($n=13$).

Conclusion: These data suggest that prophylactic antibiotic beads may reduce infections in high risk patients undergoing breast reconstruction. In addition, these results suggest that antibiotic beads may be particularly useful in the case of implant salvage for infection. Additional prospective studies are currently ongoing, and are needed help to elucidate safety and efficacy.

Demographic and Clinical Predictors of Skin Graft Loss in Burn Injuries: A National Database Study

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Background: Skin grafting is often used to treat full or partial-thickness burns, but graft loss remains a significant complication with negative outcomes. This study aims to determine the demographic and clinical factors associated with receiving a skin graft and those linked to graft loss.

Methods: A retrospective analysis was conducted using data from the Burn Care Quality Platform (BCQP) from 2013 to 2022. Demographics, burn characteristics, comorbidities, and hospitalization outcomes were analyzed using paired t-tests, chi-squared tests, and multivariable logistic regression models.

Results: Of 286,478 burn patients, 24,046 (8.4%) received a skin graft, and 472 (2.0%) experienced graft loss. Patients who received skin grafts were more likely to be older (39.3 ± 22.3 vs. 36.8 ± 23.8 , $p < 0.001$), male (68.2% vs. 66.0%, $p < 0.001$), and have full-thickness burns (91.5% vs. 79.6%, $p < 0.001$) and a greater total body surface area (TBSA) (10.7% vs. 7.3%, $p < 0.001$). Predictors of skin graft need included increasing age, alcohol use, substance use, and neurologic impairment (all $p < 0.001$). Patients with obesity ($p < 0.001$), diabetes ($p = 0.002$), and dialysis ($p < 0.001$) were less likely to receive a graft. Among patients with grafts, those with graft loss were older (46.4 ± 21.7 vs. 39.2 ± 22.2 years, $p < 0.001$) and had greater TBSA burns ($23.7 \pm 19.9\%$ vs. $10.5 \pm 13.2\%$, $p < 0.001$). Predictive factors for graft loss included alcohol use, obesity, diabetes, hypertension, and inhalation injury (all $p < 0.001$), as well as congestive heart failure ($p = 0.001$) and neurological impairment ($p = 0.007$). Patients with graft loss had longer hospital stays (48.8 ± 40.9 vs. 16.6 ± 20.3 days, $p < 0.001$), more ICU time (25.8 ± 22.7 vs. 7.2 ± 17.4 days, $p < 0.001$), and more operations (4.7 ± 4.8 vs. 1.8 ± 2.2 , $p < 0.001$). They were more likely to be discharged to another facility (43.8% vs. 13.6%) and had a higher in-hospital mortality rate (5.1% vs. 2.4%).

Conclusion: Early recognition of these factors may help inform preventative strategies, perioperative planning, and postoperative care to improve outcomes and reduce graft failure rates.

A 12-Year Analysis of Thermal and Chemical Ocular Burns: Insights into Management and Outcomes from a Single Burn Center

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Background: Acute ocular burns can lead to severe complications such as vision loss or eyelid contractures. While management strategies vary, no standardized algorithm exists. This study examines the etiology, management, and outcomes of ocular burns at a single burn center, with a focus on the differences between thermal and chemical burns.

Methods: A retrospective cohort study was conducted on patients admitted with ocular burns to a burn center from 2012 to 2023. Data on demographics, injury characteristics, treatments, and outcomes were analyzed to identify differences in clinical presentation and management by burn type.

Results: Among 50 patients (84% male, mean age 39.4 ± 20.4 years) with 81 eyes affected, 78% of burns were thermal, 20% chemical, and 2% electrical. Visual acuity was worse in chemical burns (103.3 ± 111.3 vs. 67.0 ± 58.6), though not statistically significant. Chemical burns consistently received immediate irrigation (100% vs. 20.5%, $p < 0.001$) and more frequent anti-inflammatory treatment (70% vs. 23.1%, $p = 0.009$). Hospital stays were longer for thermal burns (24.1 ± 15.0 days vs. 3.7 ± 4.3 days, $p = 0.037$). Complications included two cases of significant vision loss and one case of entropion requiring multiple two surgeries.

Conclusion: In summary, ocular burns differ significantly in management and outcomes depending on burn etiology. Immediate irrigation is critical for chemical burns, while thermal burns often require longer systemic care. Tailored treatment protocols are essential to improve outcomes and reduce complications, with potential benefits of earlier irrigation and targeted ocular therapies for thermal burns.

Massive Burn Injuries: Global Characteristics and Outcomes from the WHO Global Burn Registry

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Introduction: Patients with massive burn injuries represent a unique patient cohort because they are associated with high morbidity and mortality while requiring high care intensity. Given the need for different treatment strategies and higher care intensity, this study aimed to compare the characteristics and outcomes of patients with massive burns (TBSA 40% or greater) versus those without, by utilizing the WHO Global Burn Registry (GBR).

Methods: The data and information used in this study were obtained from the WHO GBR. Patients were classified as having massive burns if their TBSA was 40% or greater. Descriptive statistics summarized demographic and burn characteristics. The primary outcome of the study was the mortality rate during initial hospital admission. Multivariable logistic regression quantified the impact of massive burns on mortality, likelihood of surgical intervention, and functional impairment.

Results: Among 9,274 patients in the database, 1,828 (19.7%) had massive burns, with a median TBSA of 55% (IQR:45-75%). These patients were predominantly managed in low-resource settings (60%) and sustained higher rates of inhalation injury (48% vs. 7%, $p<0.001$) and flame-based burns (83% vs. 40%, $p<0.001$) compared to the non-massive burns cohort. Mortality from massive burns was 68% and 22% survived to discharge. Logistic regression showed that massive burns increased the odds of mortality (OR 7.25, 95%CI 6.08-8.65), functional impairment (OR 1.35, 95%CI 1.004-1.81) while decreased the odds of undergoing surgical intervention (OR 0.55, 95%CI 0.48-0.62).

Conclusion: Massive burn injuries, defined as burns with a TBSA of 40% or greater, represent a high-risk population. Patients with massive burns were associated with sevenfold odds of death, compared with those without massive burns. Survivors are more likely to experience long-term functional impairment. These findings underscore the need for tailored management strategies and comprehensive rehabilitation for this high-risk population, particularly in resource-limited settings.

Far Out: Evaluating the Impact of Distance on Acute Burn Outcomes

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Background: Burn centers are primarily urban, leading to potential healthcare disparities for rural patients due to treatment delays, which may increase hospital stays, complications, healing time, and mortality. This study examines how a patient's distance from a burn center affects their outcomes.

Methods: A retrospective analysis was conducted on patients presenting to a single ABA-verified burn center from 2016-2023. Data collection included demographics, burn characteristics, and treatment results. Logistic regression and ANOVA were performed to assess effects of patient distance to burn center on outcomes.

Results: 2,777 patients (mean age 41.1 ± 24.4 years; 81.4% Caucasian, 13.7% African American, 2.23% Native Hawaiian/Pacific Islander, 0.97% American Indian/Alaska Native) were included in this study. Average patient residential distance to burn center was 146.0 ± 745.2 km, with a 1.04 ± 2.9 -day interval from injury to admission. Ventilator use averaged 0.8 ± 4.0 days, ICU stay 3.2 ± 9.0 days, and hospital stay 9.1 ± 12.15 days, with an average of 0.81 ± 1.5 operations. Most patients (71.7%, $n=1992$) had deep partial-thickness or full-thickness burns, and mean TBSA of $7.3\pm12.4\%$. While Native Hawaiians/Pacific Islanders lived the farthest (386.6 ± 1624.1 km), distance was not significantly associated with mortality ($\chi^2=4.32$; $p=0.825$), ventilator days ($\beta=0.234$; $p=0.968$), operations ($\beta=0.822$; $p=0.966$), TBSA ($\beta=0.210$; $p=0.899$), hospital days ($\beta=-1.831$; $p=0.608$), or ICU days ($\beta=-0.165$; $p=0.959$). Greater distance was associated with longer admission delays ($\beta=15.20$; $p=0.0068$), and notable racial disparities in distance were identified ($\chi^2=268.3$; $p<0.001$).

Conclusion: Patients living far from a burn center are more likely to have a delay between their date of injury and the date of admission than patients living closer, and distances vary significantly between racial groups. Interestingly, distance does not have a significant effect on patient mortality and length of hospital stay. The significant findings outlined here point to potential inequities associated with delays in treatment.

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2:55 PM – 3:00 PM Page 23	<i>Comparative Evaluation of Biomaterial Wraps for Peripheral Nerve Regeneration in a Sciatic Nerve Transection Model</i> <u>Dzana Katana, PhD</u> ; Daiki Kitano, MD, PhD; Yusuf Surucu, MD; Chiaki Komatsu, MD; Vanessa Mroueh, MD; Alex Madanat; Om Yadam; Kevin Yang; Kacey G. Marra, PhD
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3:05 PM – 3:10 PM Page 24	<i>Mechanistic Insights into Nitrogen Mustard-Induced Injury in Ex Vivo Human Skin Using RNA Sequencing</i> <u>Naresh Mahajan, PhD</u> ; Alexa Rivera del Río Hernández, MD; Aniekanabasi Ufot, MS; José Antonio Arellano, MD; Ethan Banks; Samantha Bosco, BS; Jeffrey Gusenoff, MD; J. Peter Rubin MD, MBA; Francesco M. Egro, MBChB, MSc, MRCS; Asim Ejaz PhD.
3:10 PM – 3:15 PM Page 24	<i>Enhancement of Wound Healing Via Adipose-Derived Stem Cell Exosomes and Collagen in an Ex Vivo Skin Perfusion Model</i> <u>Ethan C. Banks</u> ; Alexa Rivera del Río Hernández, MD; Naresh Mahajan, PhD; José Antonio Arellano, MD; Jeffrey Gusenoff, MD; Francesco M. Egro, MD; J. Peter Rubin, MD; Asim Ejaz, PhD
3:15 PM – 3:20 PM Page 25	<i>Optimization for Clinical Translation of Single-Stage Multilaminar Skin and Subcutaneous Composite Reconstruction</i> Shayan M. Sarrami, MD; <u>Shawn J. Loder, MD</u> ; José Antonio Arellano, MD; Vanessa Mroueh, MD; Samantha Bosco, BS; Francesco M. Egro, MBChB, MSc, MRCS; Kacey Marra, PhD; J. Peter Rubin, MD, MBA

Evaluating Metformin as a Mitigator of Radiation-Induced Skin Fibrosis: Safety and Efficacy in Breast Cancer Radiotherapy

Alexa Rivera del Río Hernández, MD; Andrea A. Moreira, MD; Naresh Mahajan, PhD; Ethan Banks; Samantha L. Bosco, BS; Jeffrey A. Gusenoff, MD; Francesco M. Egro, MBChB, MSc, MRCS; J. Peter Rubin, MD, MBA; Asim Ejaz, PhD

Introduction: Radiation therapy (RT) is crucial in breast cancer treatment, however radiation-induced skin fibrosis (RISF) remains a concern. Metformin has exhibited anti-fibrotic effects through the inhibition of TGF- β . Our previous data in mouse and ex-vivo human skin models supports metformin's capability to mitigate RISF. However, its interaction with breast cancer cells during RT is not fully understood. It is essential to establish a safety profile for this agent in oncological settings. This study aims to evaluate metformin's effect on breast cancer cells proliferation under radiation exposure to determine its oncological safety and potential as a radiosensitizer.

Methods: MDA-MB-231 and MCF-7 cells were cultured in the presence of 0, 1mM, 2.5 mM and 5 mM metformin in the contexts of radiation and no radiation. Cell proliferation was assessed with cell counting and Ki67 staining. LIVE/DEAD Assay was used to evaluate cell viability and cell death. Statistical analysis was conducted to assess interaction between metformin concentration and radiation treatment on outcomes such as cell count. The statistical significance was set at $p < 0.05$.

Results: Our results demonstrate a significant effect of metformin on cell death. In both groups, metformin-treated cells showed a decreased proliferation compared to non-treated cells. For all metformin concentrations, irradiated cells have a lower cell proliferation than non-irradiated cells. LIVE/DEAD assay showed a higher percentage of dead cells in metformin-treated groups post-radiation. Number of viable cells in the metformin-treated group was significantly lower compared to non-metformin-treated cells. Additionally, cell count showed a non-significant difference within the metformin concentrations.

Conclusion: Our results underscore metformin's potential as a safe adjunct to RT in breast cancer treatment to mitigate RISF. Cell count of metformin-treated irradiated cells demonstrates that metformin does not interfere with radiation cytotoxicity, and cell count on non-irradiated cells shows that metformin by itself induces cytotoxicity.

Investigating UVB Induced Skin Damage on Human Skin Using an Ex-vivo Perfusion Model

Aniekanabasi Ufot, MS; Naresh Mahajan, PhD; Alexa Rivera del Río Hernández, MD; José Antonio Arellano, MD; Ethan Banks; Samantha Bosco, BS; Jeffrey Gusenoff, MD; J. Peter Rubin, MD, MBA; Francesco M. Egro, MBChB, MSc, MRCS; Asim Ejaz, PhD

Background: Although UVB's carcinogenic effects are established through in-vitro and in animal models, these systems do not replicate human physiology, limiting translational relevance. To address this gap, we perfused human abdominal skin flaps to investigate the extent and type of UVB-induced DNA damage in ex vivo human skin mimicking in vivo conditions. We aim to provide insights into the mechanisms of photodamage and facilitate the development of protective strategies.

Methods: The study involved three groups: acute, chronic, and no UVB. The acute group received a single dose while the chronic received a daily dose for 7 days. Skin biopsies were taken on days 0, 1, 3, 5, and 8. H&E and Fontana Masson staining were used for histological analysis. INOS and γ H2AX were used for immunohistochemistry.

Results: Visually, there was hyperpigmentation on day 5 in both acute and chronic UVB exposed groups, along with a notable blister in the acute group on day 7. With H&E staining, there were no changes in the nucleus or disruption of the epidermal barrier in the control group. In the acute group, scabbing appeared on day 3, with partial separation of the epidermis by day 5. By day 8, the epidermis had significantly separated from the dermis. In the chronic group, we noted separation of the epidermis from the dermis, later confirmed with H&E staining the epidermis detachment.

Conclusions: Our initial findings suggest that the skin on our perfusion system is viable and can be used as a reliable model for any study involving in vivo or animal study groups. Ongoing studies are focused on evaluating DNA damage through TUNEL assay and measuring inflammatory responses and wound healing using qPCR analysis. Additionally, we are exploring the photoprotective effects of metformin as a topical treatment in both UVB treated groups.

Comparative Evaluation of Biomaterial Wraps for Peripheral Nerve Regeneration in a Sciatic Nerve Transection Model

Dzana Katana, PhD; Daiki Kitano, MD, PhD; Yusuf Surucu, MD; Chiaki Komatsu, MD; Vanessa Mroueh, MD;
Alex Madanat; Om Yadam; Kevin Yang; Kacey G. Marra, PhD

Background: Peripheral nerve injuries cause profound sensory and motor deficits, often incompletely resolved by surgical repair alone. Adjunctive biomaterials may enhance regeneration by facilitating axonal growth, stabilizing the repair site, and promoting recovery. This study compared three classes of nerve wraps: human-derived umbilical and amniotic membranes, a biodegradable poly(caprolactone) conduit with glial cell line-derived neurotrophic factor (GDNF) double-walled microspheres (DWMS), and a chitosan- and hydrogel-based adhesive, in promoting nerve regeneration following sciatic nerve repair in rodents.

Methods: Adult male Lewis rats underwent sciatic nerve injury and epineural repair, then received: (1) amniotic or umbilical wraps, (2) poly(caprolactone) conduit with GDNF-releasing DWMS, or (3) a chitosan-based hydrogel adhesive. Control animals received suture repair alone. Functional outcomes included cold allodynia (acetone test), punctate mechanosensation (von Frey), and pressure nociception (rat pincher). Motor function was assessed by gait analysis using sciatic functional index. Electrophysiology and gastrocnemius muscle weight were measured at endpoint to evaluate motor recovery and denervation-related muscle atrophy. Histological evaluation is ongoing to assess axonal regeneration, Schwann cell presence, sciatic nerve and gastrocnemius muscle morphology, and macrophage-mediated immune activity.

Results: Each biomaterial demonstrated a distinct recovery profile. Umbilical and amniotic membranes accelerated sensory recovery, with earlier normalization in cold and punctate sensitivity compared to control. The PCL/GDNF DWMS group exhibited significant mitigation of gastrocnemius muscle atrophy ($p < 0.01$) and improved tetanic force generation. Improved motor response in this group was supported by enhanced contraction force and consistent electrophysiological performance. Sensory assays revealed significant group-by-time interactions in pressure and mechanical thresholds ($p < 0.05$). The hydrogel adhesive group demonstrated favorable trends in sensory recovery across modalities, indicating functional efficacy in supporting early sensory recovery.

Conclusions: These results highlight biomaterial-specific therapeutic potential, supporting tailored strategies for nerve repair based on clinical priorities.

Establishing a Rat Inguinal Lymph Node Transfer Model for Induction of Lymphatic Channels in Peripheral Nerves

Daiki Kitano MD, PhD; Shayan M. Sarrami, MD; Chanel Reid, MD, MS; Chiaki Komatsu, MD; Michael Mazarei, BA;
Kacey G. Marra PhD; Carolyn De La Cruz, MD

Background: The lymphatic system may contribute to peripheral nerve regeneration by preventing edema, modulating inflammatory responses, and promoting neovascularization. The objectives of this study were to (1) establish a lymph node (LN) transfer model to evaluate its potential to induce lymphatic channel formation within nerve fibers, and (2) assess its therapeutic effects on peripheral nerve regeneration.

Methods: Inguinal LNs from Wistar Lewis rats were harvested along with surrounding adipose tissue as pedicled superficial inferior epigastric artery (SIEA) flaps. These flaps were positioned around transected and microsurgically repaired sciatic nerves, ensuring direct contact between the LN and the nerve. Eight weeks postoperatively, immunofluorescent staining was performed on nerve segments covered by the LN flaps to visualize lymphatic structures and evaluate axonal regeneration.

Results: In normal rat sciatic nerves, PDPN/CD31 double-positive areas (lymphatic vessels) were observed adjacent to CD31 single-positive areas (blood vessels) in the fibrofatty tissue surrounding the epineurium; however, these signals were nearly absent within the nerve fibers. The number of PDPN/CD31 double-positive structures within the nerve fibers (per 500- μm^2 region) was significantly higher in the LN flap group (17.4) compared to both the naïve control (3.4, $p = 0.0006$) and the neurotomy-only group without LN flap coverage (3.0, $p = 0.0004$). Additionally, the number of S100 β -positive structures distal to the repair site (regenerated nerve axons) was lower in the LN flap group (135.1) than in the naïve control (228.4, $p = 0.001$), but significantly higher than in the neurotomy-only group (23.8, $p < 0.0001$).

Conclusion: These findings suggest that transferred inguinal LNs promote the formation of lymphatic channels within sciatic nerve fibers in rats, thereby enhancing peripheral nerve regeneration. Further studies are planned to more definitively confirm the induction of lymphangiogenesis and to evaluate the functional recovery of the regenerated nerves."

Mechanistic Insights into Nitrogen Mustard-Induced Injury in Ex Vivo Human Skin Using RNA Sequencing

Naresh Mahajan, PhD; Alexa Rivera del Río Hernández, MD; Aniekanabasi Ufot, MS; José Antonio Arellano MD; Ethan C. Banks; Samantha Bosco, BS; Jeffrey Gusenoff, MD; J. Peter Rubin, MD, MBA; Francesco M. Egro, MBChB, MSc, MRCS; Asim Ejaz, PhD

Background: Nitrogen Mustard (NM), a potent alkylating agent and vesicant, causes severe cutaneous injury marked by inflammation, apoptosis, and structural disruption. Traditional in vitro and animal models often fail to replicate the complexity of human skin responses. To overcome these limitations, we utilized a perfused ex vivo human skin model capable of maintaining tissue viability, immune function, and physiological circulation for over 12 days. This model enables real-time tracking of NM-induced injury and repair in a physiologically relevant human system.

Materials and Methodology: Full-thickness human panniculectomy skin flaps were cannulated and continuously perfused with nutrient-rich media. NM (30 mg/mL) was topically applied to defined areas. A vehicle control group was also included. Biopsies were collected at 2 hr, 6 hr, 24 hr, and 125 hr post-exposure for histological evaluation (H&E), apoptosis detection (TUNEL), immunohistochemistry (cleaved PARP, active Caspase-3), and bulk RNA sequencing. Skin viability was monitored via glucose, lactate, and pH levels in the perfusate.

Results: Histological analysis revealed progressive epidermal thinning and disruption starting at 6 hr and becoming pronounced by 125 hr. TUNEL assays indicated increasing apoptotic cell death over time in NM-treated tissues. Immunostaining showed elevated cleaved PARP and active Caspase-3, confirming apoptosis. Control and vehicle-treated tissues maintained intact epidermis and viability. Transcriptomic analysis showed a time-dependent response: early DNA damage markers (H2AX, RAD9A, USP7) by 2 hr; ECM downregulation and epigenetic changes (MLL3/4) by 6 hr; and at 125 hr, detoxification and transcriptional regulation (ABCC13, ABCG5, TFAP2, KDM5B, ERBB2) were elevated. Altered differentiation (TP63, GATA3, IRF6) and structural genes (KLK11, LAMB3, F11R) indicated barrier disruption.

Conclusions: NM exposure induces time-dependent damage and apoptosis in ex vivo human skin. This model reveals dynamic molecular responses and supports evaluation of countermeasures like metformin for NM-induced injury.

Enhancement of Wound Healing Via Adipose-Derived Stem Cell Exosomes and Collagen in an Ex Vivo Skin Perfusion Model

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Background: Wound healing consists of four phases: hemostasis, inflammation, proliferation, and remodeling. Collagen is utilized in wound healing because it can induce cell proliferation, migration, and new tissue formation. Adipose-derived stem cells (ADSC)-exosomes have become a new addition to wound therapies due to their ability to transport lipids, proteins, and miRNAs. Exosomes and collagen are intrinsic to wound healing: collagen provides support for regrowth, while ADSC-exosomes promote healing by stimulating fibroblast migration and growth, type I and III collagen induction, and deposition. We are studying the role of collagen and exosomes in enhancing wound healing and studying their underlying mechanisms in our novel human skin perfusion model.

Methods: ADSCs were expanded from human tissue acquired as surgical waste. Exosomes were isolated by gradient ultracentrifugation. The skin flap was perfused with our Ex Vivo Human Skin Perfusion System, where we created two wound sites via dermatome, raising the epidermis (0.8 mm thickness), and treated with collagen powder, exosomes, or both.

Results: Histological sections showed maintenance of skin architecture and well-demarcated epidermal borders in the collagen-treated skin, while non-treated skin showed loss of epidermis. Ki67 analysis confirmed increased cellular growth in collagen-treated skin. Immunohistochemistry revealed a greater number of macrophages. The experimental graft presented with features of wound healing mechanisms, whereas in the non-treated group, these mechanisms were missing. Our RNA sequencing screen identified the possible molecular players involved in healing.

Conclusion: Our results demonstrate the ability of collagen to accelerate wound healing and tissue regeneration. Collagen causes the proliferation and migration of key cells in tissue regeneration and wound closure. From these observations, we can determine that our system serves as a platform to investigate how collagen powder possesses the ability to heal wounds and repair tissue. Now we aim to amplify these findings utilizing ADSC exosomes.

Optimization for Clinical Translation of Single-Stage Multilaminar Skin and Subcutaneous Composite Reconstruction

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Background: We developed a single-stage, point-of-care protocol for immediate grafting of layered skin and fat at time of debridement to rapidly restore soft, mobile, pliable skin after burns and trauma. We validated this concept in a Yorkshire swine model demonstrating multilaminar viability and significantly improved mobility of the grafted skin ($p<0.05$). These techniques have been applied to an index clinical case successfully. Now as we translate these techniques for reconstruction of the the complex topology of face and extremity burns we pursue optimization of our technique to determine the limits of thickness for the grafted fat layer related to viability of the reconstruction, and whether the adipose-layer can be secured fibrin sealant.

Methods: Stability of fat/fibrin constructs were assessed ex vivo via compression testing. We used a Yorkshire swine model of medium and large full-thickness burns (16 and 64 cm²), escharectomy, and immediate reconstruction. Control wounds were treated with STSG over fascia, while experimental groups were treated with: (A) thin adipose grafts 5mm, (B) thick adipose grafts 10mm, (C) thin adipose w/fibrin, or (D) thick adipose w/fibrin. We performed gross assessment, of graft viability followed by serial photography, ultrasound, and tensiometry at harvest. In the larger wounds, care was taken to simulate dynamic topography by centering wounds across multiple muscle groups.

Results: All adipose with fibrin sealant formulations reduced displacement forces. In pigs, thicker adipose or fibrin sealant with thin fat are viable. Combining thick fat with sealant decreases STSG survival. Placement of fat allowed for viable skin graft adherence across dynamic topography (convex/concave).

Conclusions: We have validated in animals that single stage layered-composite grafting improves mobility and pliability of the grafted skin, and have demonstrated initial clinical success in an ankle wound. We demonstrate here that an adipose layer 5-mm or less secured with fibrin sealant is optimal for this technique. We demonstrated that thicker fat up to 1 cm (10 mm) may be optimal under specific clinical conditions.