RESULTS: The mean age was 24 ± 5.54 years. Six male patients (85.7%) and one female were included (14.3%). None of the patients had comorbidities. Four patients had primitive neuro-ectodermal tumors (57.1%) while three had osteogenic sarcomas (42.9%). All patients had the radial nerve preserved during onco-resection. The average gap between implant surgery and salvage with FFFs was 77.5 ± 49.024 months. The indications for salvage with the FFF were infection of implants (42.9%) and aseptic loosening (57.1%). The defects were located proximally in seven patients (85.7%) and mid-shaft in one patient (14.3%). Seven patients had adjuvant chemotherapy (85.7%), while two had neoadjuvant radiotherapy (28.6%). The defect length after debridement and implant removal was 13 ± 5.62 cm. The fibula head was incorporated in 57.1% of the flaps (n=4). For flap fixation dynamic compression plates were used in one patient (14.3%); number 20 cerclage wiring, prolene mesh, and ethibond was used in another patient (14.3%); K wires were used in four patients (57.1%); and ethibond in 1 patient (14.3%). Only one flap had a double venous anastomosis. Two patients underwent re-exploration of the anastomosis (57.1%), the only flap harvested with a skin paddle required debridement of the cutaneous component (14.3%). T wo patients underwent re-exploration of the anastomosis (57.1%), the only flap harvested with a skin paddle required debridement of the cutaneous component (14.3%). Six flaps survived (85.7%). Bone union was achieved at 17 ± 1.25 weeks on average. The average follow up was 59.57 ± 43.48 months.

CONCLUSION: The FFF is a resourceful alternative for the management of a failed prosthesis after oncologic resection of the proximal and mid-humerus, especially with previously infected prosthetic material. Due to its anatomical shape and the vascularized nature of tissue, the FFF provides a long bone segment for humeral reconstruction.

TRACK: RESEARCH/TECHNOLOGY
PAPER
The Better to Ear You With:
Bioengineering Full-scale Auricles
Using 3D-printed External Scaffolds and
Decellularized Cartilage Xenograft

Presenter: Nicholas A. Vernice
Co-Authors: Carly Ann Askinas, Sabrina Shih, Xue Dong, George Corpuz, James Shin, Jason A. Spector, MD

PURPOSE: Faithful reconstruction of the human auricle is a notorious challenge for the plastic surgeon. While the gold standard remains harvest and shaping of autologous costal cartilage, such procedures obligate donor site morbidity, scarring, and prolonged operative time, often coupled with suboptimal aesthetic results and biomechanical properties that bear little semblance to the structure they intend to replicate. In response, we have endeavored to bioengineer neo-ears utilizing decellularized ovine costal cartilage as a biocompatible xenograft placed within a full-scale, 3D-printed human ear external scaffold to foster tissue growth that predictably mimics the size, shape, and biomechanical properties of the native human auricle.

METHOD: Polylactic acid (PLA) ear scaffolds were fabricated to match the anatomy of an adult human ear using 3D photo capture and subsequent modeling. All scaffolds were printed on a 3D printer (Prusa i3 MK3S) and sterilized. Ovine costal cartilage was isolated and processed either through mincing (1 mm³) or zesting (<2 mm³) and decellularized in-house through our usual protocol. Decellularized cartilage was packed into the ear scaffolds and implanted subcutaneously on the dorsa of immunocompetent Sprague-Dawley rats. After 3 and 6 months in vivo, the constructs were explanted for gross, histologic, biochemical, and biomechanical analyses.

RESULTS: Upon de-molding, both the minced and zested neo-ears maintained the size and contour complexities of the native human ear through 6 months in vivo. Massing of minced and zested ears, respectively, revealed a 1.45 ± 0.09 fold increase (p=0.05) and 1.11 ± 0.07 fold increase in construct mass with respect to preimplantation mass after 3 months in vivo. Zested ears implanted for 6 months in vivo revealed a 1.20 ± 0.18 fold increase in construct mass over time, while preliminary explantation of a minced ear revealed a 1.21 fold mass increase after 6 months in vivo. Micro-CT scanning revealed de-caged auricular explant volumes of 4,237.9 mm³ and 4,838 mm³ for zested and minced ears after 3 months in vivo. Zested ears implanted for 6 months in vivo revealed a 1.20 ± 0.18 fold increase in construct mass over time, while preliminary explantation of a minced ear revealed a 1.21 fold mass increase after 6 months in vivo. Micro-CT scanning revealed de-caged auricular explant volumes of 4,237.9 mm³ and 4,838 mm³ for zested and minced ears after 3 months in vivo, while zested and minced ears after 6 months in vivo exhibited volumes of 4,053.2 ± 256.7 mm³ and 3,987.7 mm³, respectively. H&E staining confirmed a mild inflammatory infiltrate and corresponding fibrovascular tissue ingrowth enveloping individual cartilage particles, while safranin-O staining revealed an expected depletion of glycosaminoglycans (GAG) secondary to the decellularization process. All constructs were pliable and resumed their native conformation.
when twisted or bent and detailed biomechanical studies are ongoing.

CONCLUSIONS: Utilization of decellularized ovine xenograft has proven highly efficacious at generating neo-ears that maintain their size and shape after 6 months in vivo. The use of scaffolds as a means of protecting grafted material after implantation allows for fibrovascular tissue formation between cartilage particles that successfully resists contractile forces, thereby producing a nonimmunogenic, full-scale construct that strongly resembles the adult human ear. Such constructs have demonstrated mass increases secondary to neotissue formation as well as grossly favorable biomechanical properties and deformability. Multiple ears fabricated using the same in vivo bioreactor approach will be explanted over the ensuing several months to provide further insight into construct longevity.

TRACK: RESEARCH/TECHNOLOGY
PAPER
Gender, Racial, and Socioeconomic Determinants of Choosing a Surgical Career

Presenter: Meera Reghunathan, MD
Co-Authors: Carolyn Rocha, Jessica D. Blum, Tanvi Shah, Amanda Gosman, MD, Christopher Reid, MD
Affiliation: Division of Plastic Surgery, UC San Diego, La Jolla, CA

PURPOSE: Across all specialties we see a leaky pipeline for diversity, from applying to residency to matriculating to residency and ascending in the ladder of academia [1]. These disparities in representation often disproportionately affect surgical specialties, for which long training programs, socioeconomic stressors, and cultural influences may dissuade qualified but underrepresented students from pursuing a surgical career. This study examines how demographic and socioeconomic variables affect the choice of specialty.

METHOD: A qualtrics survey was disseminated via email to a listserv of all residents at a single institution between September 2021 and February 2022. The survey queried (1) demographic information, (2) childhood socioeconomic information, (3) residency socioeconomic information, and (3) reasons for specialty choice. Data analysis was performed using SPSS and included chi squared analysis, Fisher’s exact test, and multiple logistic regression with subgroup analysis comparing medical and surgical specialties, and the Top 10 earning specialties (of which 7 are surgical).

RESULTS: A total of 294 responses (86 in surgical fields, 204 in medical fields) were collected, with a response rate of 46%. Seventy-six individuals (25.9%) identified as belonging to a disadvantaged group. The average amount of student debt was $183,000. Residents pursuing a Top 10 earning residency were more likely to cite loan repayment (45%, 23%, p<0.001) and potential salary after residency (72%, 55%, p=0.013) as concerns factoring into their specialty decision. Medical residents were significantly more likely to cite concern with length of training as a deciding factor in choosing a specialty than surgical residents were (S:35%, M:59%, p=0.001). Surgical residents were significantly more likely to be pursuing a fellowship than medical residents (S:69%, M:49%, p=0.013). In a multiple logistic regression, race (p=0.041), ethnicity (p=0.046), and being part of a disadvantaged group (p = 0.072) were seen to be the most significant unique predictors of choosing a medical residency over a surgical residency. Specifically, 17% of medical residents were Black, Native Hawaiian, or Mixed Race as compared to 10% of surgical residents. Female gender (46% v 61%), 0.014) and being the sole source of income (17% v 26%, p=0.018) were predictive of not pursuing a top 10 earning residency. On the other hand, higher parent/guardian level of education was predictive of choosing a top 10 paying residency (p=0.05).

CONCLUSION: Understanding the socioeconomic influences on specialty choice provides insight into how we can work to alleviate barriers that dissuade qualified and diverse applicants from pursuing surgical careers. Loan repayment concerns, the length of training, and the need to support one’s family financially are all reasons that dissuade students from pursuing surgery, alongside persistent gender and racial barriers. It is imperative that we actively help alleviate these financial burdens and create a culture supportive of diversity in order to attract the most diverse and highly qualified candidates.

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1. Nieblas-Bedolla E, Williams JR, Christophers B, Kweon CY, Williams EJ, Jimenez N. Trends in Race/Ethnicity Among Applicants and Matriculants to US Surgical Specialties, 2010-2018. JAMA Netw Open.