101–200 cm², 17.2% measured 201–400 cm², and 11.5% measuring >401 cm²). Exposed structures included bone in 62.2%, major vessels in 43.1%, major nerves in 37.4%, and viscera in 11.5%. Endoprostheses were present in only 4%. Amputations occurred in 15% of patients, including forequarter with or without chest wall in 10% and shoulder disarticulations with or without chest wall in 5%. Other large bony resections occurred in 23% of patients, including total humerus, scapulectomy, chest wall, and/or a combination of these bony deficits. Thirty-seven percentage of extirpative defects were closed with local tissue rearrangement only, whereas 47% required a pedicled flap, and 16% required a free flap. Latissimus dorsi and pectoralis major pedicled flaps were most commonly performed. Anterolateral thigh (7.6%) and fillet of forearm (2.7%) were the most commonly performed free flaps. As the size of the defect grew, so did the need for advanced reconstructive techniques. Of the 30 patients who had defects >401 cm², 11 (37%) required a pedicled flap, 8 (27%) required a free flap, and 3 (10%) required both a pedicled and free flap.

CONCLUSION: Extirpative defects of the upper torso and shoulder girdle are rare but serious resections that require dependable reconstruction. In our series, approximately one third of patients were treated with complex closure or local tissue rearrangement, whereas the remaining two thirds required pedicle or free flap reconstruction. In particular, as defect size and exposed structures increased, the necessity for advanced reconstruction also grew. We propose a reconstructive algorithm to guide the reconstruction of these difficult defects.

Nipple Autograft: External Scaffolding Preserves Projection of Minced Costal Cartilage

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INTRODUCTION: Nipple reconstruction is an essential last step of breast reconstruction after total mastectomy, bearing psychological significance for cancer patients, resulting in improved general and esthetic satisfaction. However, most techniques such as local tissue flaps and engineered tissue substitutes such as the Cook Biodesign nipple reconstruction cylinder are limited by secondary scar contracture and loss of neopipple projection leading to inconsistent results and increased patient dissatisfaction. Approximately 30,000 patients undergo deep inferior epigastric perforator flap breast reconstruction annually, during which the excised costal cartilage (CC) is normally discarded. Herein, we propose utilizing minced CC as a highly incorporative viable graft. Furthermore, we have previously shown that biocompatible, biodegradable, 3-dimensional (3D)-printed scaffolds maintain the volume and contour of engineered auricular cartilage in the setting of auricular scaffold fabrication. In this study, we hypothesize that incorporating biodegradable, 3D-printed external scaffold in our nipple constructs will further augment preservation of neopipple projection and contour.

METHODS: Custom external scaffolds were designed with inner dimensions matching the Cook Biodesign nipple reconstruction cylinder (interior volume: ≈900 mm³), then 3D-printed using polyactic acid. Patient-derived CC was minced in sterile fashion, and half of the samples were packed into 3D-printed polyactic acid scaffolds; in the remainder, an equal volume of minced cartilage was wrapped in Surgicel only. The constructs were implanted into nude rats by creating a subcutaneous pocket using a CV flap technique. After 3 months, histologic, topographic, and gross analysis were performed. To measure volume and topography, constructs were imaged via computed tomography with an animal computed tomography scanner and then digitally reconstructed.

RESULTS: After 3 months in vivo, gross analysis showed improved preservation of contour and projection of the “scaffold protected” construct as compared to the “unprotected” implant. Hematoxylin and eosin staining in both groups showed the presence of healthy and viable cartilage after 3 months in vivo which was confirmed by LIVE/DEAD assay. Formation of fibrous tissue around the minced CC was noted in both groups and resulted in consolidation of the minced cartilage into a neopipple-like shape. Preservation of neopipple projection was significantly improved in the scaffold-protected group in comparison to unprotected group (91.6% versus 64.1%; P = 0.045). Similarly, volumetric analysis showed superior preservation of volume in the scaffolded group in comparison to the unprotected group (895.5 versus 607.8 mm³; P = 0.019). Further, the resultant tissue was spongy and compressible much like a native nipple.

CONCLUSIONS: We demonstrate that minced autologous CC, which is usually discarded during a deep inferior epigastric perforator procedure, can be used as a viable implant for nipple reconstruction with favorable biomechanical qualities. Our 3D-printed biocompatible/biodegradable external scaffolds significantly mitigate loss of projection and contour of the constructs. This allows for custom design of desired shape and size of the nipple enabling the immediate fabrication of individualized engineered autologous implants tailored to patient desire (different sizes/levels of projection), without
the loss of projection or topography seen with traditional approaches to nipple reconstruction.

Analysis of Microsurgical Outcomes in Resident-led Reconstruction: A Review of 163 Consecutive Cases

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PURPOSE: With the advances in microsurgery, the published success rate of microsurgical reconstruction by experienced microsurgeon is >95%. However, it is unknown whether the training residents can produce similar results. At our county hospital, although under direct supervision, residents perform and lead all aspects of microsurgical reconstruction, from raising the flap to performing microanastomoses, with only as needed faculty assistance. In this study, we retrospectively reviewed the outcomes of 163 consecutive microsurgical cases to determine the efficacy and safety of resident-led reconstructions at the county hospital.

METHODS: We performed a retrospective review of patients who underwent microsurgical reconstruction at the county hospital from 2016 to 2018. Demographic, surgical procedure, flap data, resident levels, and complication data were collected.

RESULTS: Of the 163 flaps performed, the most commonly performed reconstruction was breast (63.8%), followed by lower extremity (11.7%), upper extremity (6.7%), head and neck (6.1%), and genital (1.2%). The median procedure time was 540 minutes (240–990), and anastomoses time for each flap was 57 minutes (27–180). The venous anastomoses were performed by PGY3 (1.6%), PGY4 (37.1%), PGY5 (3.2%), and PGY6 (58%), whereas the arterial anastomoses were performed by PGY4 (18%), PGY5 (3.3%), and PGY6 (78.7%). The average number of anastomosis attempts was 1.3 with a range of 1–3. The total flap success rate was 96.3% with a take back rate of 4.3%.

CONCLUSION: In conclusion, our analysis shows that resident-led reconstruction can achieve similar microsurgical success as the published rates. We believe that resident-led microsurgical reconstruction can be safely performed with as needed faculty assistance in high-risk and complicated cases while allowing resident education and maturation of technical and decision-making skills.

Symptomatic Neuromas in Lower Extremity Amputees: Implications for Preemptive–targeted Muscle Reinnervation

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OBJECTIVES: Stump neuromas are a debilitating consequence of amputation. Although nerve surgery including targeted muscle reinnervation (TMR) may offer lasting improvement,1 many now advocate for TMR at the time of index amputation to avoid symptomatic neuroma formation. It is as of yet unknown which nerves are responsible for the majority of painful lower extremity neuromas and how TMR outcomes compare to other surgical techniques for neuroma management.

METHODS AND MATERIALS: A retrospective chart review was performed for 32 lower extremity amputees (33 total limbs) who underwent surgery for symptomatic neuromas. Patients were stratified by amputation level and surgical technique for neuroma management. Pre- and postoperative Visual Analog Scale pain scores and phantom limb pain (PLP) were also gathered. Outcomes of interest included which nerves were involved in neuroma formation and changes in pain. The relative frequency of each specific nerve involvement in painful neuroma formation was calculated as were relative changes in pain.

RESULTS: Thirty-three limbs underwent surgery for painful neuromas. A total of 78 painful neuromas were identified with 67% of patients presenting with multiple neuromas at their initial surgery. In patients with confirmed neuromas in their AKA stump, 80% had a single neuroma of the sciatic nerve. Among below knee amputation (BKA) limbs, the superficial peroneal nerve was affected in 76%, medial or lateral sural in 59%, saphenous in 48%, and deep peroneal in 41%. Symptomatic neuroma formation of the tibial nerve was particularly rare, affecting only 1 BKA patient. Overall, 83% of all neuromas were managed by neuroma excision with implantation into muscle and 10% by excision with TMR. Traction neurectomy, centro-central coaptation, nerve capping, and excision with allograft repair combined for the remaining 7%. Average percent improvement in pain at 30-day follow-up was 67% for the TMR cohort versus 45% for others. PLP improved or resolved in 75% of TMR patients (versus 43% for other techniques) and no TMR patients experienced worsened PLP (versus 43% of other techniques).