Intraoperative Indocyanine Green Laser Angiography in Pediatric Autologous Ear Reconstruction

Jessica Chang, MD; Rachel S. Mandelbaum, BA; Deborah B. Martins, BS; James P. Bradley, MD; Justine C. Lee, MD, PhD

BACKGROUND: Skin flap vascularity is a critical determinant of aesthetic results in autologous ear reconstruction. In this work, we investigate the utility of intraoperative laser-assisted indocyanine green angiography (ICGA) as an adjunctive measure of skin flap vascularity in pediatric autologous ear reconstruction.

METHODS: 21 consecutive pediatric patients undergoing first stage autologous total ear reconstruction were retrospectively evaluated. The first 10 patients were treated traditionally (non-ICGA) and the latter 11 patients were evaluated with ICGA intraoperatively after implantation of the cartilage construct and administration of suction. Relative and absolute perfusion units in the form of contour maps were generated. Statistical analyses were performed using independent sample Student’s t test.

RESULTS: Statistically significant differences in exposure and infection were not found between the two groups. However, decreased numbers of surgical revisions were required in cases with ICGA versus without ICGA (p=0.03), suggesting that greater certainty in skin flap perfusion correlated to a reduction in revision surgeries. In cases of exposure, we found an average lowest absolute perfusion unit of 14.3 whereas cases without exposure had an average of 26.1 (p=0.02), thereby defining objective parameters for utilizing ICGA data in tailoring surgical decision making for this special population of patients.

CONCLUSIONS: Defined quantitative parameters for utilizing ICGA in evaluating skin flap vascularity may be a useful adjunctive technique in pediatric autologous ear reconstruction.

Ultrasound Visualization of the Lymphatic Vessels in the Lower Limbs

Akitatsu Hayashi, MD; Nobuko Hayashi, MD; Hidehiko Yoshimatsu, MD; Takumi Yamamoto, MD

BACKGROUND: Identification of lymphatic vessels for lymphaticovenular anastomosis (LVA), which is an effective surgical treatment for obstructive lymphedema, is important. Indocyanine green (ICG) lymphography is useful for that purpose, but is not common in many institutions. Although ultrasound is a very common modality, no research has yet underlined the feasibility of the device to detect the lymphatic vessels.

METHODS: First, identification of lymphatic vessels in the lower limbs using ultrasound was performed in non-edematous limbs with linear-pattern on ICG lymphography (n=12). The imaging findings and characteristic of the lymphatic vessels in ultrasonography were investigated on transverse scans and 3-D reconstructions. Secondly, to assess the ultrasound detection technique, ICG was injected to healthy volunteers after identification and marking of the lymphatic vessels using ultrasound (n=14). Sensitivity and specificity of the examination were calculated.

RESULTS: In the first part, the lymphatic vessels were detected by ultrasound in all cases. Characteristic ultrasonography findings of lymphatic vessels included homogeneous, hypoechoic and intermittent spicular misshapen images in all cases. In the second part, the overall sensitivity and specificity were 95.5% and 92.9%, respectively.

CONCLUSIONS: Ultrasonography can identify lymphatic vessels of the lower limbs with precision and may aid lymphatic microsurgery for lymphedema.

A Novel Text Messaging Alert System Used with Continuous Tissue Oximetry Monitoring to Improve Free Flap Outcomes

Joseph A. Ricci, MD; Christina R. Vargas, MD; Adam M. Tobias, MD; Samuel J. Lin, MD; Amir H. Taghinia, MD; Bernard T. Lee, MD, MBA, MPH

INTRODUCTION: The time to detection of vascular compromise is a significant predictor of free flap salvage outcomes as early re-exploration has been shown to improve the salvage rate for failing free flaps. Continuous transcutaneous near-infrared tissue oximetry is an objective, quantitative method of detecting flap vascular compromise and
has been shown to allow earlier re-exploration and higher salvage rates than clinical assessment alone. We designed a novel text messaging system to improve communication using tissue oximetry monitoring.

**MATERIALS AND METHODS**: A retrospective review was performed of a prospectively collected database of all microsurgical breast reconstructions from 2008 to 2015. A novel text messaging system was introduced in 2013 and programmed to send text messages alert when the tissue oximetry readings suggested potential flap compromise based on established thresholds. Patient demographics and complications, including rate of re-exploration and flap loss (partial and total) were assessed.

**RESULTS**: There were 900 autologous microsurgical breast free flaps during the study period: 614 were monitored with standard clinical monitoring and tissue oximetry compared with 286 flaps with the additional text messaging system. There were 27 unplanned returns to the operating room in the tissue oximetry group and 5 in the text messaging group with 1 complete flap loss in each group. Re-exploration occurred sooner as a result of these text message alerts (17.5 vs. 26.6 hours postoperatively), however, did not achieve statistical significance.

**CONCLUSIONS**: We were able to demonstrate the use of a novel text messaging system for tissue oximetry. This alert system shows promise in identifying impending flap loss with rapid notification of the surgical team. Improved communication and identification of failing free flaps will allow for an even further improvement of salvage rates.

**DISCLOSURE/FINANCIAL SUPPORT**: This work was not supported by any external sources of funding. None of the authors have any financial interest in any of the products, devices, or drugs mentioned in this manuscript.

---

**ATAC-seq Reveals Heterogeneity of Fibroblasts During Transition from Scarless Fetal to Scar-Forming Adult Wound Repair**

*Michael S. Hu, MD, MPH, MS; Graham G. Walmsley, MD, PhD; Ulrike Litzenburger, PhD; Tripp Leavitt, BS, BA; Zeshaan N. Maan, MD; Rahul Sinha, PhD; Dominik Duscher, MD; Clement D. Marshall,

**INTRODUCTION**: Cutaneous wounds in early gestation heal without a scar in a process resembling regeneration. Although myriad studies have been performed to understand this phenomenon, the exact mechanism for fetal scarless repair is unknown. We previously characterized a fibroblast lineage in the dorsal skin of adult mice defined by embryonic expression of *Engrailed-1* (*En1*) thought to be responsible for scar formation. Here, we investigate the role of this lineage during fetal wound healing.

**MATERIALS AND METHODS**: *En1*-derived fibroblasts were traced by crossing *En1*Cre and ROSA26mTmG mice. A murine model of fetal scarless wound healing allowed for investigation of *En1*-derived fibroblast behavior before and after the scarless to scarring transition. *En1*-derived fibroblasts were characterized using flow cytometry. ATAC-seq (Assay for Transposase-Accessible Chromatin with high throughput sequencing) was also performed in isolated pre- and post-gestational fibroblasts at a series of time points.

**RESULTS**: Dorsal wounds created at embryonic day (E)16.5 healed scarlessly with minimal connective tissue deposition. However, wounds created at E18.5 healed with substantial scar deposited primarily by *En1*-lineage-derived fibroblasts. The abundance of *En1*-lineage-derived fibroblasts and the expression of CD26, a previously identified marker of the *En1* lineage, steadily increased from E12.5 through postnatal day 1. Differential transcriptional activity shown by ATAC-seq further demonstrates the heterogeneic nature of fibroblasts within the dorsal dermis.

**CONCLUSION**: The *En1* lineage of fibroblasts plays a critical role in the transition from scarless wound healing during fetal development. These results hold promise for the development of therapeutic approaches to fibrotic disease and adult wound healing.

**DISCLOSURE/FINANCIAL SUPPORT**: Supported by CIRM Clinical Fellow training grant TG2-01159 (to Dr. Michael S. Hu), Stanford University School of Medicine Transplant and Tissue Engineering Fellowship Award (to Drs. Michael S. Hu, H. Peter Lorenz, and Michael T. Longaker), ASMS/MSF Research Grant Award (to Drs. Michael S. Hu, H. Peter Lorenz, and Michael T. Longaker), PSF Research Fellowship Grant 114288 (to Dr. Zeshaan N. Maan), NIH