CMBES/SCGB
2025 CMBEC47/ACCES26
Fredericton, NB
May 27-29, 2025

Mixed Reality-Enhanced Translation of CTA Data for DIEP Flap Reconstruction

Tony Jiang[1], Philip Edgcumbe[2], Joshua F[1]. Ho, Michael L. Martin[2], Michael J. Stein[3], Kathryn V. Isaac[4]

[1]*Faculty of Applied Science, University of British Columbia, Vancouver, BC*
[2]*Dept. of Radiology, University of British Columbia, Vancouver, BC*
[3]*Dept. of Plastic Surgery, Lenox Hill Hospital, New York, NY*
[4]*Division of Plastic Surgery, Dept. of Surgery, University of British Columbia, Vancouver, BC*

ABSTRACT

Background: A CT angiogram (CTA) is commonly used to identify perforators in preparation for breast reconstruction with a deep inferior epigastric perforator (DIEP) flap. The utility of this imaging data is limited by a surgeon's ability to precisely translate the vascular anatomy from the CTA onto the patient to inform their flap design and harvest based on perforator location and intramuscular course. This study sought to evaluate the application of Augmented Reality (AR) for optimizing preoperative imaging to improve the efficacy of reconstruction with a DIEP flap.

Methods: A novel software was developed to translate patient-specific CTA data from the institutional imaging system was developed on two separate platforms, the Meta Quest 3 and the Apple Vision Pro. The accuracy of digital imaging segmentation, registration, and projection was evaluated on a mannequin. With institutional ethics approval, patients planned for breast reconstruction with a DIEP flap consented to the use of AR. In this single-surgeon feasibility trial, the visualization, registration, and interaction with the segmented vascular anatomy were evaluated for its safety and utility in pre-operative flap design and intra-operative flap harvest. The AR headset was used to visualize and interact with the segmented imaging data to identify perforators and their intramuscular course.

Results: The reprojection error between the segmented virtual anatomy and the real-world patient anatomy was measured at 1.3mm. Three patients underwent immediate breast reconstruction with AR-assisted DIEP flap planning and harvest. Preoperatively, AR was used to translate the perforator locations and their intramuscular course from the CTA onto the patient, facilitating flap design and perforator selection. Intraoperatively, the application of AR effectively delineated the vascular anatomy of the DIE perforators and pedicle relative to the rectus muscle, fascia, and overlying subcutaneous tissue. With the AR headset, the surgeon registered, visualized and interacted with the digital imaging. Using AR, digital information was safely and effectively applied to inform flap design and harvest, with guidance on perforator selection, fascial incision placement and length, and intramuscular pedicle dissection.

Conclusions: AR can accurately, safely, and effectively translate preoperative imaging for clinical use in DIEP flap design and harvest. By leveraging this immersive technology, AR may serve as an adjunct in reconstructive procedures to optimize safety, efficacy, and operative workflow.

Keywords: Mixed Reality, Augmented Reality, Preoperative Planning, Operative Workflow Optimization, Computed Tomography Angiogram

Conflict of Interest:
Kathryn Isaac, Philip Edgcumbe, and Tony Jiang are cofounders of MAP Medicine Inc., a company focused on augmented reality (AR) solutions for surgery. All other authors declare no conflicts of interest related to MAP Medicine Inc.
Tony Jiang is the holder of the provisional patent 63/652,182 entitled "Augmented Reality System for Surgical Navigation"
The authors declare no additional potential conflicts of interest.