Digital Microscopy Guided Microvascular Anastomosis in Free Flap Reconstructive Surgery

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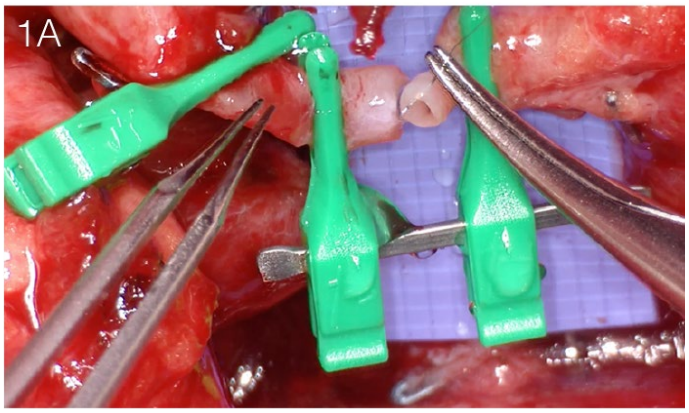
Clinical Presentation

The patient was a 50-year-old male requiring hemiglossectomy for Squamous Cell Carcinoma of the right lateral tongue. Due to the size of the tongue defect, the patient would have some compromised speech and swallowing. The patient was reconstructed with an Anterior Lateral Thigh (ALT) microvascular autologous graft (free flap).



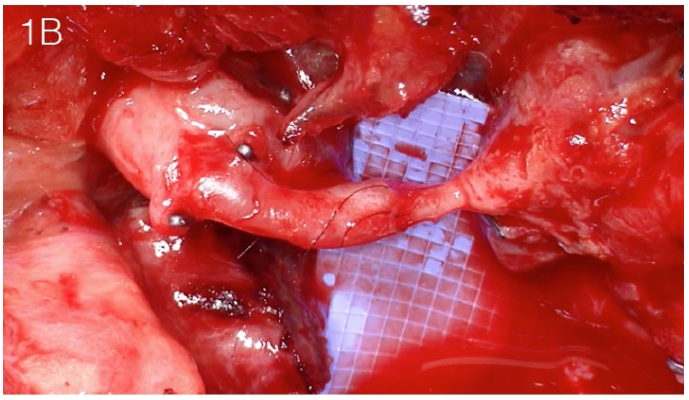
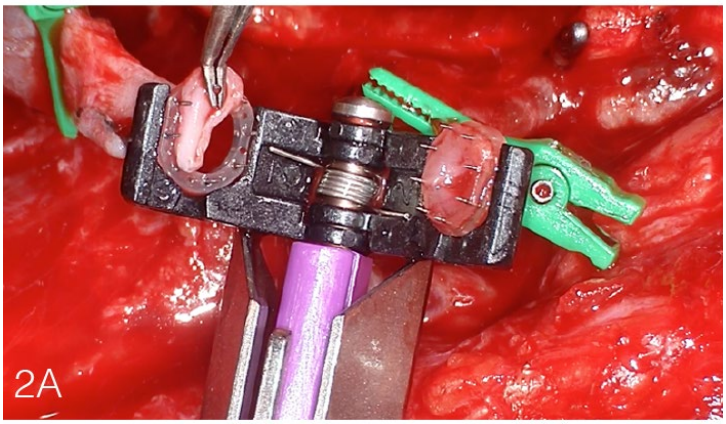


Figure 1: Intra-operative image of arterial suture at 80% zoom.

Surgical Approach

Once the tongue resection was complete the size of the defect was measured. An ALT free flap was harvested for subsequent transfer to the recipient location. Following the approximate inset of the free flap skin paddle to the recipient site, Modus V™ was used to perform the microvascular anastomosis. Modus V is a robotic digital microscope that allows



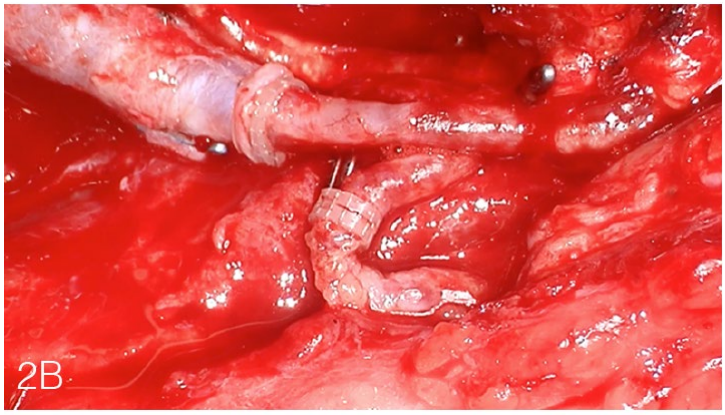


Figure 2: Intra-operative image of venous coupling at 80% optical zoom.

hands-free positioning of a camera and illumination. The tracked instrument feature allows for precise control of the optical focal point using a bayoneted pointer tool. This instrument simultaneously controls the desired viewing angle using robotic co-axial alignment of the camera to the long axis of the tool. The image projects digitally onto a 55" 4K monitor positioned directly across the table from the operating microvascular surgeon, beside the assisting microvascular surgeon, providing an ergonomic operative workflow.

The vascular anastomosis was performed using both sutured and non-sutured microsurgical techniques (Figs. 1 and 2), with optics set to 85% of maximum

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zoom (12.5x). Figure 1 illustrates both preparation (1A) and completion (1B) of the sutured arterial anastomosis. Similarly, the venous anastomosis was performed using a microvascular coupler (2.5mm), as shown during preparation (Fig. 2A) and after completion (Fig. 2B).

Throughout the procedure, the working distance of the camera was fixed at 600 mm from the focal point defined by the tracked pointer tool. This distance enabled a clear unobstructed view of the surgical site as displayed on the monitor (Fig. 3 and 4). Digital post-processing of the camera feed and built-in camera presets provided further control of the color contrast settings needed for optimal visualization. Lastly, the anastomosed vessels were evaluated for patency using an ICG fluorescence device.

Figure 3. Operative setup illustrating positioning of system components and large standoff distance of optics from the surgical field.

Conclusion

The patient's hospital course was uneventful, without complications to the free flap from thrombosis or wound healing. At follow-up, the flap was viable, wounds were intact, and the patient experienced a normal post-operative course. More recent cases have been performed using the latest 3D system (Fig. 4), resulting in similar or shorter anastomosis times relative to conventional microscopy. The authors

Figure 4. Operative setup illustrating commonly required access to mouth, jaw, and neck area. Decoupled positioning of Modus V from the surgeon enables optimized surgical access and views in an otherwise challenging area.

report better short-term ergonomics which may translate into long-term ergonomic benefits. The latest release of Modus V with voice control enhances surgeon efficiency by minimizing time spent adjusting camera settings manually. A case series is currently underway to further evaluate and compare 2D and 3D Modus V digital microscopy systems.

Highlights

- The ergonomic advantage of Modus V minimizes surgeon fatigue during and after microsurgical procedures due to improved head and neck positioning
- Modus V provides clear illumination and excellent magnification relative to the conventional microscope, with digital processing allowing further control over color contrasts needed for optimal tissue differentiation
- The lack of depth perception of 2D requires a minor learning curve, which has been resolved with the latest 3D release
- Currently, 3D is available when operating within 50-100% zoom and future updates would benefit from expanding this range for a larger surgical field of view in 3D

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