Combining Preoperative CTA Mapping of the Peroneal Artery and Its Perforators with Virtual Planning for Free Fibula Flap Reconstruction of Mandibulectomy Defects

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Introduction: Computer-aided design and modeling (CAD/CAM) have been applied to fibula flap reconstruction preoperatively to aid in surgical planning and execution. Our surgeons have developed a protocol to combine CAD/CAM modeling with computed tomography angiography (CTA) to map perforators of the peroneal artery for optimized placement of the skin island. We hypothesized that the use of CAD/CAM+CTA decreased operative times and improved patient outcomes with respect to fewer surgical site occurrences and lesser need for revisional surgeries.

Materials and Methods: We retrospectively compared consecutive patients (N=159) at a single major US cancer center who underwent mandibulectomy reconstruction with free fibula flaps for whom CAD/CAM+CTA (N=38), CTA-only (N=64), or neither technology (N=57) were employed preoperatively over a seven-year period (2008-2015). To minimize selection bias, we only included patients of surgeons who selectively employed both CAD/CAM+CTA as well as conventional fibula flap harvest in the study. We employed logistic regression analysis to identify potential associations between patient and reconstructive factors and postoperative outcomes.

Results: Patient characteristics were similar between the three groups. The number of fibular osteotomies was significantly higher in the CAD/CAM+CTA group versus both the CTA-only group and the non-preplanned group (1.4 vs 1.0 vs. 1.0; p=0.02). Flap ischemia time was significantly shorter in both the CAD/CAM+CTA group and the CTA-only group vs. the non-preplanned group (80 vs. 87 vs. 121 minutes; p<0.01), while total operative time was similar between the three groups (616 vs. 641 vs. 646 minutes; p=0.56). Average length of hospital stay was similar, but ICU stay was significantly shorter in both the CAD/CAM+CTA group and the CTA-only group vs. the non-preplanned group (2.1 vs. 2.1 vs. 7.6 days; p<0.01). Surgical complication rates, including flap failure rates, were similar between groups (p=0.49). However, anastomostic thrombosis rates were higher in the non-preplanned group than in the other two groups (p=0.01). There was a trend towards less need for surgical revision for contour deformity and asymmetry in the CAD/CAM+CTA group vs. the other two groups (7.9 % vs. 23.4% vs. 17.5%; p=0.14).

Conclusions: There appear to be advantages for preoperative planning combining the use of CAD/CAM and CTA for mandibular reconstruction with free fibula flaps. Specifically this technology appears to facilitate more complex reconstructions, shorter ischemia times, shorter ICU stays, and improved postoperative outcomes.