

## Maximizing Flap Inset for Tongue Reconstruction

Steven P. Davison, D.D.S.,  
M.D.

Nazaneen N. Grant, M.D.

Karl A. Schwarz, M.Sc., M.D.

Matthew L. Iorio, B.A.

Washington, D.C.

**F**unctional reconstruction of the oral cavity following a partial glossectomy is vital to rehabilitation of speech, deglutition, and oral hygiene. Despite efforts to restore normal articulation and swallowing after such procedures, many patients are left with suboptimal function.

Principles of anterior tongue reconstruction include preservation of the native tongue's bulk, mobility, and shape. The radial forearm free flap is favored for achieving these goals because of its thinness, pliability, ease of harvest, and reliability. The lateral thigh flap has also been advocated in Asian, thin, or cachectic patients.<sup>1,2</sup> Although techniques have been developed to increase the functional outcome of hemiglossectomy reconstruction, few address the component of flap inset. This article describes two modifications of flap inset in the reconstruction of a hemiglossectomy defect.

The integrity of the tongue tip, including mobility and length, is critical for handling a food bolus<sup>3</sup> and achieving glossopalatal contact for articulation. Proper floor-of-mouth contour assists in maintaining proper salivary flow toward the pharynx and assists in the oral phase of swallowing. Our flap inset modifications address both the tongue tip and the floor of the mouth.

### SURGICAL TECHNIQUE

The first modification involves rotation of the residual tongue toward the defect to create a neotongue made entirely of sensate, native tongue. The native tongue is partly sutured to itself to maintain its rotation before being set into the free flap (Figs. 1 and 2). This allows the native tongue to more effectively move the bulk

of the flap. Although this modification improves tongue mobility, rotation of the native tongue tip could compromise tongue length, which is important in achieving glossopalatal contact for proper articulation and deglutition. This shortcoming can be offset by a Z-plasty at the anterior tongue/flap junction, adding length to the anterior suture line and reducing scar contracture to the floor of the mouth. The combination of tongue tip rotation and Z-plasty translates into significantly improved tongue function.

The second flap inset modification involves the floor of the mouth, which is frequently resected in cases of lateral tongue carcinoma. Typically, the flap is simply folded to create the neotongue and, because of a size discrepancy between the tongue edge and the adjacent floor-of-mouth defect, a concavity results in the floor of the mouth (Fig. 1). This disrupts the normal anteroposterior flow of saliva needed for oral hygiene. Moreover, it causes food trapping in the floor of the mouth which, at times, must be manually pushed toward the pharynx by the patient. Therefore, we suggest that a wedge of the floor-of-mouth portion of the flap be deepithelialized and imbricated at its edges, burying the deepithelialized portion of the flap (Figs. 2 and 3). The resulting suture line runs radially from the medial floor of the mouth toward the alveolar ridge, which does not tether the tongue as would an anteroposterior suture line. This wedge closure reduces the concavity of the new floor of the mouth by adding the bulk of the buried, deepithelialized tissue and imbricating the redundant portion of the flap. It allows for more effective salivary flow and deglutition (Figs. 4 and 5).

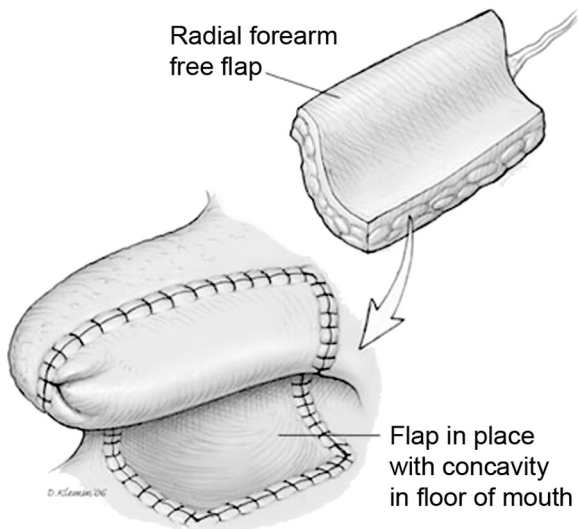
*From the Department of Plastic Surgery, Georgetown University Hospital.*

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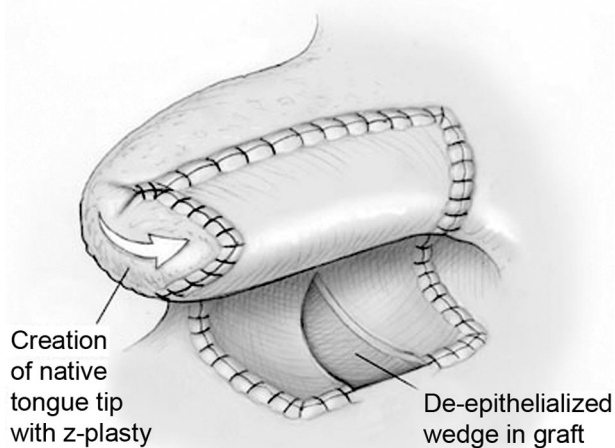
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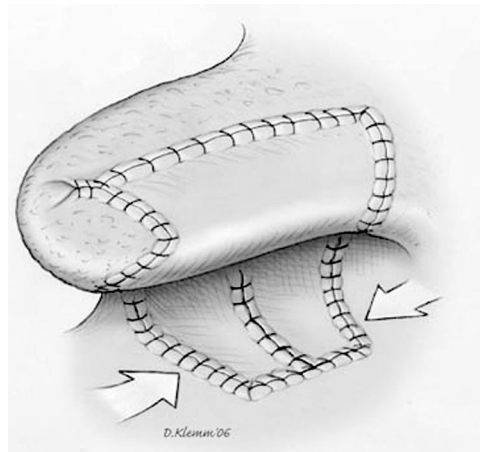
**Fig. 1.** Traditional inset of a radial forearm free flap for reconstruction of a hemiglossectomy/floor-of-mouth defect. One can see that much of the native tongue tip has been replaced by flap. Because the defect in the floor of the mouth is typically shorter (in the anteroposterior direction) than the tongue defect, the flap tends to develop a concavity. This can lead to problems with deglutition and salivary pooling.



**Fig. 2.** One can see the native tongue tip rotation set into the flap. This creates a tongue tip consisting of completely native, sensate tongue. Also shown is the area of the flap in the floor of the mouth that has been deepithelialized and is ready to be imbricated.

### DISCUSSION

The complex anatomy of the tongue, along with its many crucial roles in creating a satisfactory quality of life, makes this organ a major challenge in reconstructive surgery. Speech and swallowing both depend on coordinated three-dimensional movement with dynamic amounts of tongue bulk.

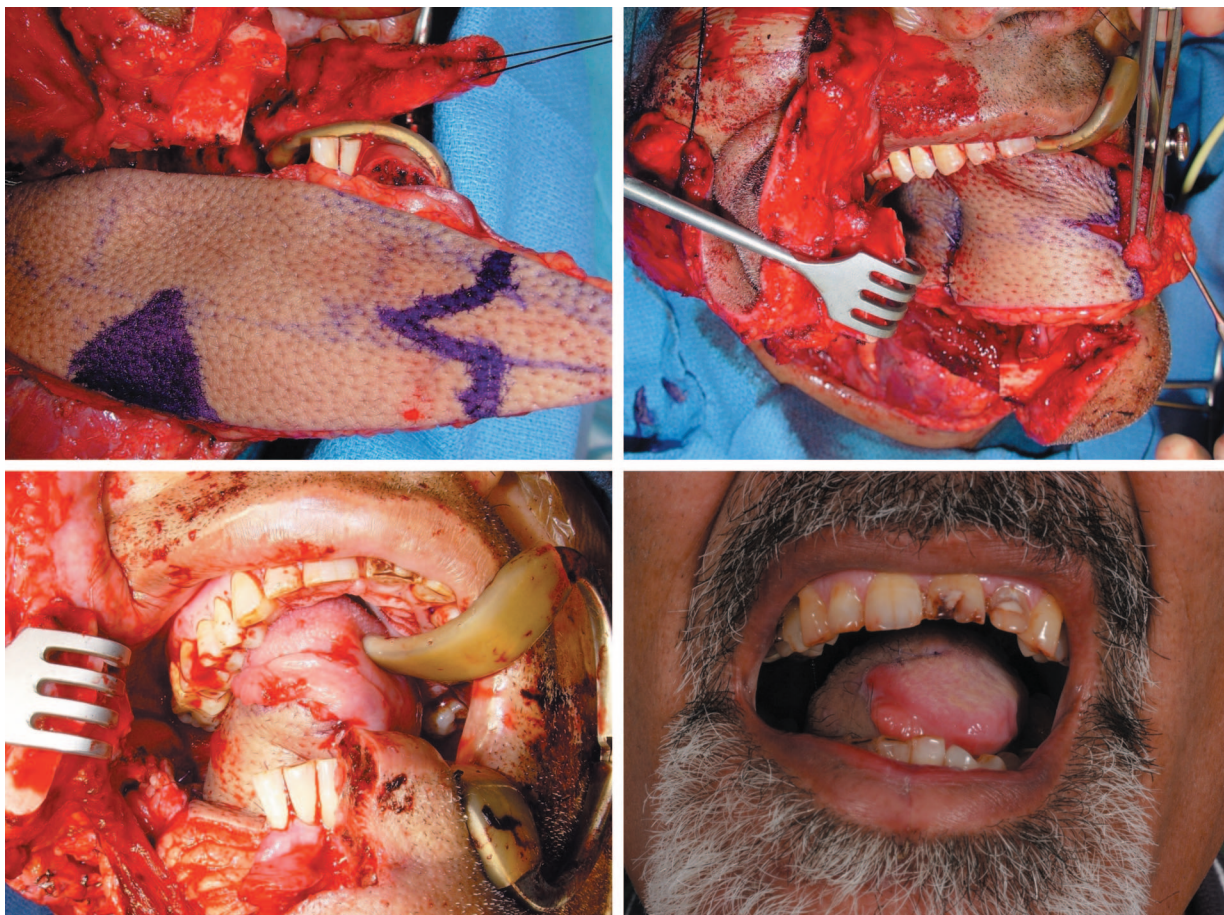


**Fig. 3.** The area in the floor of the mouth has been imbricated, providing volume deep to the flap surface and eliminating flap redundancy. This eliminates the concavity in the floor of the mouth and its deleterious effects.



**Fig. 4.** A 68-year-old woman underwent a hemiglossectomy for tongue carcinoma and reconstruction with a radial forearm free flap. A Z-plasty was performed at the anterior/base portion of the reconstructed tongue to release some tethering, and the posterior portion of the flap was debulked. This led to significant improvements in speech and swallowing. The patient is shown at 7-month follow-up.

The advent of the free flap in the late 1970s drastically improved functional tongue reconstruction, as it replaced the bulky pectoralis flap.<sup>4</sup> Arm and thigh flaps, particularly the radial forearm free flap, have become the preferred modes of reconstruction for the anterior tongue.



**Fig. 5.** A 55-year-old man underwent a right hemiglossectomy and modified radical neck dissection for a T3N2M0 tongue cancer. This patient underwent reconstruction using an anterolateral thigh free flap. The defect included the posterior pharynx, floor of the mouth, and tongue. (*Above, right*) The flap is marked to accommodate the native tongue tip rotation and Z-plasty and the markings for the wedge-shaped deepithelialization and imbrication for reconstructing the floor of the mouth. The wedge-shaped floor-of-mouth area has been imbricated and the tongue tip rotated and set into the flap, creating a sensate, native tongue tip. (*Below, left*) The right-sided floor-of-mouth reconstruction. One can see the lack of dead space and the natural contour, which aid in reestablishing normal deglutition and preventing salivary pooling. The newly reconstructed, mobile, native tongue tip can be seen up against the anterior hard palate. (*Below, right*) At 7 months postoperatively, the patient has normal speech and swallowing.

Few studies examine specific anatomical requirements for optimal function, such as tongue volume, shape, mobility, and sensation. One study confirmed that, as expected, the percentage of tongue resected correlates directly with poor function and that free flap closure is helpful in swallowing outcomes when anterior tongue defects are greater than 30 percent.<sup>5</sup>

Proper speech, particularly fine articulation and vowel production, depends on tongue mobility and glossopalatal contact.<sup>6</sup> Clear articulation after flap reconstruction has been reported in the range of 49 to 79 percent of words. However, it is difficult to interpret studies assessing speech intelligibility because they use varying outcome mea-

asures and often test in different languages.<sup>6,7</sup> Urken and Biller illustrated how mobility is paramount to function and advocated a bilobed design to optimize this factor.<sup>8</sup> Haughey et al. advocated rolling deepithelialized dermis to create a stiffer neotip for improved articulation.<sup>7</sup>

It has been demonstrated that preservation of the tip of the mobile tongue results in improved tongue function, particularly articulation and mastication.<sup>7,9</sup> Our first modification likewise takes into account the importance of the functional tongue tip. Rotation of the native tip and Z-plasty allow the remaining tongue to better move the flap and allow for glossopalatal contact, thus assisting with mastication and articulation.

Not only is sensation of the tongue tip preserved but taste buds are extended onto the contralateral tongue. Although rarely mentioned as a reconstructive goal, this may actually help in restoring taste, as the free flap does not contribute in this regard.

The second modification, a wedge-shaped imbrication of the floor of the mouth, works to restore the anterior to posterior flow of saliva and food, thus avoiding pooling. Postoperative swallow studies of hemiglossectomy patients demonstrate stasis of barium in a deep trough of the floor of the mouth.<sup>10</sup> A previously described solution used bone grafts to raise the floor of the mouth. Although the trough was obliterated by this method, the remaining functioning muscles became tethered secondary to scar formation, worsening the dysphagia.<sup>11</sup> Our wedge deepithelialization and imbrication improves this geometric constraint.

The modifications proposed in this article were performed on fasciocutaneous free flaps. The concepts, though, can also be used on the skin paddles of composite free flaps, such as fibular or scapular flaps. The modifications are beneficial in that they do not affect the integrity of the flap, do not significantly lengthen the duration of the procedure, and do not involve costly technology. They can be combined with other techniques, such as sensory reinnervation, to improve neotongue function. The modifications can be performed at the time of original flap inset or secondarily as illustrated in the two selected cases.

### SUMMARY

Techniques such as tongue tip rotation, Z-plasty, and imbrication have not previously been emphasized in the literature for tongue reconstruction. However, there is no reason that the same creative concepts used to close complex cutaneous wounds should not be applied to the most challenging of microsurgical head and neck reconstructions. By using these novel modifications, partial glossectomy patients should experience

better swallowing, articulation, and oral hygiene as compared with previous methods. These modifications can lead to substantial improvements in tongue function, which is the ultimate test of a successful reconstruction.

**Steven P. Davison, D.D.S., M.D.**

Department of Plastic Surgery  
Georgetown University Hospital  
3800 Reservoir Road, N.W., 1-PHC  
Washington, D.C. 20007  
spd2@gunet.georgetown.edu

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