Longus Capitis Reconstruction of the Soft Palate

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Abstract
Soft palate (SP) reconstruction remains a challenge for the head and neck reconstructive surgeon. One favorable local flap option is the longus capitis muscle (LCM), a deep neck flexor with redundant muscle function, appropriate bulk, and a relatively straightforward surgical harvest. A retrospective review of 3 patients with T2 to T4 tonsil squamous cell carcinoma requiring SP resection and LCM reconstruction at a single institution was performed. Three patients underwent primary transoral resection, all resulting in at least 50% full-thickness SP defects. Reconstruction comprised a superiorly based LCM local flap. Patients underwent adjuvant (chemo)radiation therapy as indicated. Within 3 to 8 months, each patient was tolerating a full oral diet with no dysphagia, nasal regurgitation, or velopharyngeal insufficiency. For select patients with SP defects, a superiorly based LCM flap may provide a functionally acceptable reconstruction with minimal donor site morbidity.

Keywords
soft palate reconstruction, oropharynx cancer, transoral surgery, local flap, longus capitis

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Soft palate (SP) reconstruction remains a challenge for the head and neck reconstructive surgeon. For functionally acceptable outcomes, it must allow space for nasal breathing while providing enough bulk to prevent velopharyngeal insufficiency (VPI) and oropharyngeal dysphagia. The optimal reconstructive method remains controversial. Most authors propose the use of free tissue transfer for a SP defect greater than 50%. However, this approach increases surgical time, prolongs hospital stay, often necessitates a temporary tracheostomy tube, and requires microvascular expertise.

The longus capitis muscle (LCM) was recently described in cadaveric studies and proposed as a local flap given its physiologic role in velopharyngeal closure. Due to its redundant muscle function, appropriate bulk, and ease of harvest, we hypothesized that the LCM would be a favorable option for SP reconstruction after oncologic resection.

Materials and Methods
Patients
A retrospective review was performed between January 1, 2015, and December 31, 2017, of patients undergoing transoral surgery for oropharyngeal squamous cell carcinoma (SCC) who required a full-thickness SP resection and reconstruction with a superiorly based, pedicled LCM flap. The study was approved by the Washington University School of Medicine Institutional Review Board.

Surgical Anatomy
Four paired muscles contribute to the anterior neck flexors (LCM, longus colli, rectus capitis anterior, rectus capitis lateralis). The LCM originates from the C3 to C6 transverse processes and ascends to insert broadly onto the occipital bone. Both muscles have a relatively indistinguishable dividing plane, so some longus colli muscle fibers are inadvertently included during LCM flap elevation. Both muscles receive blood supply from branches of the ascending pharyngeal, transverse cervical, and inferior thyroideal arteries.

Operative Technique
Before flap harvest, the remaining SP is approximated to the posterior pharyngeal wall to minimize the ipsilateral...
nasopharyngeal port. Then, the LCM is exposed with blunt dissection through the posterior pharyngeal wall and superior pharyngeal constrictor to define the lateral and medial extent of the muscle. The internal carotid artery should be palpated transorally and its location identified to avoid exposure. Once the muscle is exposed after tumor resection, if more length is needed inferiorly, the LCM can easily be separated with blunt dissection off the deep plane of the superior constrictor. At this point, the LCM is transected inferiorly and raised in an inferior to superior direction, leaving periosteum on the spine to provide a protective barrier and bed for granulation tissue formation. Dissection continues until the flap can reach the superior SP resection bed without tension. It is then flipped superiorly, pedicled on the occipital bone, and secured to the junction between the posterior pharyngeal wall and the medial SP cut edge (Figure 1). All incision lines are closed with absorbable braided suture. The LCM donor site is left to heal by secondary intention.

Results
Three patients were identified who underwent definitive transoral resection of a primary tonsil SCC, resulting in ≥50% full-thickness SP defects (Table 1). All 3 defects were reconstructed with closure of the nasopharyngeal port to the residual superior constrictor, followed by augmentation of the oral surface with an ipsilateral, superiorly based, transoral LCM flap. Postoperatively, all patients were advanced to a soft diet within 3 to 5 days.

At 18 months postoperatively, patient 1 had no symptoms of VPI or nasal regurgitation. Other than xerostomia-induced mild dysphagia, she tolerated a full oral diet without difficulty. Patient 2 experienced immediate postoperative dysphagia, necessitating a temporary gastrostomy tube that was removed 1 month after completion of adjuvant therapy. At 6 months postoperatively, she was tolerating a full oral diet without VPI (Figures 2 and 3). Patient 3 was eating a full oral diet without dysphagia or VPI at his 3-week follow-up. Four months after completion of adjuvant therapy, he continued to do very well.

Discussion
With the size of the SP defects in this study, most patients would traditionally undergo free tissue reconstruction. The adoption of free tissue transfer has enhanced the ability to
tailor the size and geometry of SP reconstruction, but it often requires increased surgical time, a prolonged hospital stay, a temporary tracheostomy tube, and the need for microvascular expertise. The LCM flap, however, has several distinct advantages. It is technically straightforward, and it can be harvested with standard transoral instruments. The flap is pedicled superiorly and posteriorly, so the resulting scar contracture acts to pull the remaining SP and limit VPI. Since the LCM is often already exposed after advanced tonsillar tumor resection, minimal additional dissection is required. During harvest and inset, a pharyngotomy is not created, decreasing the potential risk of fistula formation. In addition, the LCM has been described as functioning as an integral part of velopharyngeal closure. Thus theoretically, if the muscle retains its innervation after harvest, it could work to prevent VPI and swallow dysfunction.

Limitations to this technique should be considered. The bulk and size of the LCM are limited, and based on our personal experience, SP defects larger than 50% to 70% may be difficult to reconstruct with this technique alone. Day et al\textsuperscript{5} described using this flap for transoral carotid coverage. Although the donor site generally granulates well, 1 patient developed a vertebral infection, possibly due to vertebral body exposure.

**Conclusion**

For select patients with SP defects less than 70%, a superiorly based LCM flap may provide a functionally acceptable reconstruction with minimal donor site morbidity.

**Author Contributions**

Jennifer H. Gross, acquisition, draft and revision, final approval, accountability; Joseph Zenga, concept, revision, final approval, accountability; Jeffrey D. Sharon, design, revision, final approval, accountability; Ryan S. Jackson, acquisition, revision, final approval, accountability; Patrik Pipkorn, concept, revision, final approval, accountability.

**Disclosures**

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