**Autologous costochondral cartilage implant in two cases of velopharyngeal insufficiency**

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**Abstract.** Autologous costochondral cartilage implant in two cases of velopharyngeal insufficiency. The velopharyngeal sphincter is critical in enabling the functions of speaking and swallowing. Velopharyngeal insufficiency (VPI) results in hypernasal speech and nasal regurgitation. A frequent cause of VPI is congenital cleft palate, but otolaryngologists sometimes encounter iatrogenic VPI after surgery. Treatment of VPI with prostheses is often successful but not always well tolerated. Many surgical procedures have been proposed to correct palatal length or to enlarge the posterior pharyngeal wall. We report two cases in which autologous costochondral cartilage was used as implant augmentation. This approach is indicated and efficient when the velopharyngeal deficit is less than 5 mm. An autologous costochondral cartilage implant procedure is safe and reversible and can be expected to incite minimal host reaction.

**Introduction**

Velopharyngeal insufficiency (VPI) is defined as an inability to close the velopharyngeal sphincter, resulting in an inability to adequately separate the oral cavity from the nasal cavity during speech and swallowing.

Anatomical congenital conditions affecting velopharyngeal function are most commonly caused by an overt – but also sometimes an occult – cleft palate. Children with occult clefts may also acquire VPI following anatomical changes to the velopharynx, such as following adenoidectomy or even adenoid involution; it is also associated with some neurological diseases.

Various syndromes including Di George or velocardiofacial syndrome are associated with VPI.

There are numerous iatrogenic causes of VPI, including adenoidectomy, surgical excision for cancer or uvulopalatopharyngoplasty (UPPP), and maxillary advancement. VPI following UPPP and tonsillectomy occurs following a widened excision of the levator veli palatini and palatoglossus muscles.

The commonest speech disorder associated with VPI is abnormal tone resonance resulting in excessive nasality or hypernasality. This is frequently associated with excessive abnormal nasal airflow, usually referred to nasal emission or nasal escape. Patients with velopharyngeal dysfunction often present with an associated laryngeal voice disorder, which is believed to develop as a result of a compensatory behavior.

A number of surgical procedures and prosthetic devices have been developed to correct VPI. To improve velopharyngeal competence surgically, procedures that obturate the middle or the lateral portion of the velopharyngeal area can be used. However, the concept of augmenting the posterior pharyngeal wall will continue to receive attention in a few selected patients. In the present paper, the authors wish to report the use of costochondral pharyngeal implants for VPI.

**Technical description of the surgical procedure**

The surgery starts by harvesting the rib cartilage according to the Brent procedure. The costochondral cartilage graft is removed through a slightly oblique incision just above the lower rib margin. Some perichondrium is retained on the external surface of the graft and left adhering to the parietal pleura. The cartilage graft should be about 6 mm thick.

After the graft has been obtained, a McIvor mouth gag is used and the soft palate is retracted using 14G catheters passing through each nostril and out of the mouth. An injection of 1% lidocaine with 1:100,000 adrenaline is given, and a 3- to 4-cm paramedian incision is performed.
immediately superior to the prominence of the atlas. A pocket is elevated superficial to the prevertebral fascia to the height of the nasopharynx, using Metzenbaum scissors.

Once this step is completed, the rib graft is inserted vertically in front of the atlas (Figure 1). An absorbable suture is placed just above and below the graft through the paravertebral fascia and the vertical incision is tightly closed in layers with interrupted 3.0 vicryl sutures. Parasagittal incision prevents exposure of the cartilage graft in case of wound disruption.

Case reports

A 32-year-old man with a history of overt cleft palate operated during infancy had recently completed three years of speech therapy to correct VPI. Despite the therapy, the patient retained an uncomfortable hypernasality and nasal escape. Examination revealed good palatal and lateral pharyngeal wall mobility, with a moderate gap on phonation. A pharyngeal wall augmentation with an autologous costochondral implant was performed. Nine months postoperatively, oronasal reflux and nasal escape were absent. His nasality still persists but does not affect the patient daily. A 31-year-old man suffering from hypernasality secondary to an occult submucosal cleft had attended two years of speech therapy during his childhood without success.

He underwent an autologous costochondral pharyngeal implantation procedure. He received two months of speech therapy postoperatively; oronasal reflux was absent at follow-up and his voice has returned to normal.

Discussion

Normal velopharyngeal function varies between speech blowing and whistling versus dry swallowing and gagging. Physiologic differences in movements between speech and nonspeech activities are consistent with clinical findings in patients who are readily able to obtain good velopharyngeal closure during swallowing but are unable to obtain adequate or variable closure during speech. The velopharyngeal sphincter (VPS) closes completely during oral speech production of explosive consonants, shutting off the nasal cavity. During phonation, the velopharyngeal sphincter closes when the velum moves in a posterolateral direction towards the posterior pharyngeal wall, while the lateral pharyngeal walls move medially.

There is a lot of variation in normal VPS closure between individuals, implying a varying balance of muscular activity. Coronal closure arises from the prominent action of the levator veli palatini muscle, and sagittal closure results from medial motion of the lateral pharyngeal walls. A circular closure pattern occurs when both the lateral pharyngeal walls and levator veli palatini muscle provide a significant contribution to the closure. Complete closure is obtained by an additional anterior movement of the posterior pharyngeal wall that creates a pad described as Passavant’s ridge.

The three types of primary procedures for VPI are the Furlow palatoplasty, sphincter pharyngoplasty, and superior pharyngeal flap. Posterior pharyngeal wall augmentation at the level of the Passavant’s ridge has been advocated for patients having velopharyngeal dysfunction after primary surgery and speech therapy.

Autogenous posterior pharyngeal wall augmentation using a rolled, superiorly based pharyngeal myomucosal flap has been the most common procedure since the last century. However, the pharyngeal flap is associated with snoring, decreased nasal airway, difficulty cleaning nasal secretions, and breathing alterations, especially during sleep.

Gersuny in 1900 and Eckstein in 1904 reported on the first

![Figure 1](image.png)

This midsagittal section shows the relationship of the atlas (1), the soft palate (2) and the chondrocostal implant (3).
Surgery for velopharyngeal insufficiency

Various materials have been used to provide anterior displacement of the posterior pharyngeal wall. These include fascia, fat tissue, collagen, paraffin, Silastic®, Teflon®, and Proplast®. Advantages of retropharyngeal implants are the minor associated neuromuscular disturbance of velopharyngeal function and their relative safety in comparison with the pharyngeal flap technique. However, complications such as foreign-body reaction and rejection have occurred frequently, discouraging the use of xenogeneic materials.

Perthes was the first, in 1912, to suggest the use of a cartilage implant. Wardill originally suggested a transoral approach using implanted cartilage, and Denny et al. described a technique using an autologous costochondral implant. Cartilage seems to have a high rate of late resorption compared with xenogeneic materials, but is better tolerated. Unlike injected material, cartilage implants can be well positioned on Passavant’s ridge and do not tend to migrate downwards. We prefer to use autologous cartilage, in order to decrease destruction by host reaction.

There is general agreement that retropharyngeal implants should be considered only when the VPI anterior posterior aperture does not exceed 5 mm, with the best results achieved in cases of coronal or circular pharyngeal closure patterns.

Conclusion

In conclusion, augmentation of the posterior pharyngeal wall alone cannot correct a cleft palate or a huge velar defect after surgical failure, but serves as a complementary treatment procedure after reconstructive surgery and speech therapy. Autologous costochondral cartilage is a good choice because it is slowly absorbed and can be expected to incite a minimal host reaction compared with alloplastic materials.

References

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