TECHNIQUES OF CLEFT PALATE REPAIR

Key points in the evolution of cleft palate repair are listed in Table 1.1–3 Early techniques focused on hard palate closure, culminating in von Langenbeck recognizing the benefit of a subperiosteal dissection.4 Veau and subsequently Kriens recognized the importance of soft palate reconstruction.5 The current techniques in cleft palate repair share the goals of (1) separation of the oral and nasal components without fistula; (2) sufficient velar length; and (3) functional transverse orientation of the levator muscle sling. The number of techniques has been described to achieve these goals, but they all have the following technical details in common: elevation of oral mucosal flaps based on the greater palatine arteries, tension free nasal lining mobilization, and functional intervelar muscle dissection. After palate repair, speech evaluation needs to be performed by an objective interdisciplinary team following a standardized protocol. Identification of velopharyngeal insufficiency secondary to an incompetent nasopharyngeal port will necessitate secondary speech surgery. These secondary techniques include pharyngeal flaps, soft palate lengthening, or pharyngeal sphincters, which should be tailored to optimize speech, while minimizing the risk of obstructive sleep apnea. (Plast. Reconstr. Surg. 133: 852e, 2014.)

von Langenbeck Palatoplasty

The von Langenbeck palatoplasty combines incisions along the medial cleft margins with lateral relaxing incisions (Fig. 1).2,10 Elevation of mucoperiosteum produces bipedicled flaps that are approximated for oral side closure. Muscle with early soft palate closure with use of an anterior obturator to allow delayed hard palate closure in an attempt to minimize facial growth restriction.6,7 This technique has become less common because of the increased risk of oronasal fistula and worse speech results than with single-stage techniques8,9 (Reference 8 Level of Evidence: Risk, III).

Disclosure: The authors have no financial interest to declare in relation to the content of this article.

Related Video content is available for this article. The videos can be found under the “Related Videos” section of the full-text article, or, for Ovid users, using the URL citations published in the article.
repair is accomplished through intravelar veloplasty, and nasal mucosa is mobilized adjacent to the cleft margins for nasal side closure. The repair is best suited for repair of clefts of the secondary palate because the bipedicled flaps are inadequate for closure of the primary palate behind the alveolus. Although advocates of the von Langenbeck palatoplasty suggest that preserving the anterior attachment offers increased vascularity and less future constriction of facial growth, this has not been substantiated by past studies.\(^{11-15}\) (References 13 and 14 Level of Evidence: Therapeutic, III).

**Table 1. Evolution of Cleft Palate Repair**

<table>
<thead>
<tr>
<th>Year</th>
<th>Advancement</th>
<th>Surgeons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1810s</td>
<td>Staphylorrhaphy (soft palate closure)</td>
<td>von Graefe and Roux</td>
</tr>
<tr>
<td>1826</td>
<td>Uranoplasty of hard palate cleft</td>
<td>Dieffenbach</td>
</tr>
<tr>
<td>1859</td>
<td>Mucoperiosteal advancement flaps</td>
<td>von Langenbeck</td>
</tr>
<tr>
<td>1863</td>
<td>Velopharyngeal insufficiency described</td>
<td>Passavant</td>
</tr>
<tr>
<td>1920s</td>
<td>Pushback operations</td>
<td>Gillies, Fry, and Dorrance</td>
</tr>
<tr>
<td>1920</td>
<td>V-Y palatal posterior advancement</td>
<td>Ganzer</td>
</tr>
<tr>
<td>1922</td>
<td>Midline approximation of “cleft muscles”</td>
<td>Veau</td>
</tr>
<tr>
<td>1937</td>
<td>Posterior advancement with pharyngoplasty</td>
<td>Wardill and Kilner</td>
</tr>
<tr>
<td>1969</td>
<td>Intravelar veloplasty</td>
<td>Kriens</td>
</tr>
</tbody>
</table>

**Fig. 1.** Markings for the von Langenbeck palatoplasty. Lateral releasing incisions along with a submucoperiosteal dissection of the hard palate create paired bipedicled flaps for closure across the cleft. The advantage is increased vascularity of the flaps; the disadvantage is inability to close the fistula of the primary palate. [Reprinted from van Aalst JA, Kolappa KK, Sadove M. MOC-PSSM CME article: Nonsyndromic cleft palate. Plast Reconstr Surg. 2008;121(Suppl):1–14.]

**Veau-Wardill-Kilner (Oxford) Palatoplasty**

The Veau-Wardill-Kilner palatoplasty\(^{16}\) is a variation of the von Langenbeck design that incorporates a V-Y pushback closure of the anterior hard palate (Fig. 2). The bipedicled flaps become unipedicled with an anterior release at the junction of the primary and secondary palates, leaving the mucoperiosteum anterior to the incisive foramen in place. The flaps are transposed posteriorly, producing a degree of palatal lengthening in the process. This posterior movement is accomplished at the expense of large denuded areas of the anterior palate, which may have a detrimental effect on facial growth. The pushback also leaves oral closure of the anterior primary palate unaddressed.

**Bardach Two-Flap Palatoplasty**

The Bardach palatoplasty elevates the entire hard palate behind the alveolus as two flaps based off the greater palatine pedicles (Fig. 3).\(^{17}\) Although this technique requires the largest amount of palatal elevation of the techniques discussed so far, it facilitates two-layer closure along the entire length of the cleft, including the fistula behind the alveolus. It is well suited for repair of complete bilateral clefts and can be used for complete unilateral clefts.

**Hybrid Palatoplasty**

A variation of the above repairs, popularized by Gillett and Clark,\(^{18}\) uses a hybrid technique for
Fig. 3. Bardach palatoplasty. *(Left)* The markings are similar to the Veau technique. *(Center)* The mucoperiosteum from the primary and secondary palates is elevated as unipedicled flaps that allow closure of the nasal lining and the intervelar veloplasty. *(Right)* Opposed to the Veau technique, tips of the flap are secured to the back of the alveolus, with the soft palate lengthening achieved by the intervelar veloplasty. The advantage is the ability to close the anterior fistula of the primary palate; the disadvantage is increased sensitivity of the flap vascularity to surgical technique. [Reprinted from van Aalst JA, Kolappa KK, Sadove M. MOC-PSSM CME article: Nonsyndromic cleft palate. *Plast Reconstr Surg.* 2008;121(Suppl):1–14.]

Fig. 4. Furlow palatoplasty. The double-opposing Z-plasty technique consists of a posterior based musculomucosal flap on both the oral and nasal sides of the soft palate. When these two flaps are transposed, the attached levator muscles are brought from a sagittal orientation to a transverse one. The soft palate length is increased at the expense of a narrowing of the intertonsillar pillar distance. The advantage is a reliable lengthening and muscular repositioning of the soft palate; the disadvantage is increased tension on closure of wide clefts. [Reprinted from van Aalst JA, Kolappa KK, Sadove M. MOC-PSSM CME article: Nonsyndromic cleft palate. *Plast Reconstr Surg.* 2008;121(Suppl):1–14.]
complete unilateral clefts in which the cleft side has a unipedicled Bardach flap and the noncleft side involves a bipedicled von Langenbeck flap to take advantage of the strengths of the two procedures.

**Furlow Double-Opposing Z-Plasty**

The Furlow double-opposing Z-plasty palate repair provides for closure and lengthening of the soft palate (Fig. 4) (Level of Evidence: Therapeutic, IV). It is particularly well suited for isolated clefts of the secondary soft palate and is also used as a secondary lengthening procedure for velopharyngeal insufficiency. Mirror image Z-plasty incisions are made across the cleft on the opposing oral and nasal surfaces of the soft palate. The two posteriorly based limbs are musculomucosal, leaving the levator muscles attached to the mucosa, whereas the anteriorly based flaps are mucosa only. When transposed, the levator assumes a transverse orientation, and the palate is lengthened. The lengthening, however, is at the expense of a decrease in the transverse width of the soft palate, which can tether and deform the posterior pillars. The Furlow palatoplasty provides reliable lengthening, maintains musculomucosal attachment, and causes the nasal lining to take on a tubular shape. The net effect is movement of the velum posterior and superior, which places it in a more functional position relative to the Passavant ridge.

The advantages of the Furlow palatoplasty have led to its combined use with other techniques (e.g., Bardach palatoplasty). This application can be technically demanding, as the Z-plasty results in a near island flap of the anterior palatal flap. Particular caution should be exercised if it is applied to wide complete bilateral clefts.

**COMMON TECHNICAL DETAILS OF CLEFT PALATE REPAIRS**

**Greater Palatine Pedicle Mobilization**

In all techniques, mobilization of the hard palate requires preservation and mobilization of the greater palatine vascular pedicle. During subperiosteal dissection, three bony spikes signal the proximity of the pedicle at the posterolateral corner of the hard palate (Fig. 5). On the lateral side of the foramen, the periosteum invaginates between the maxilla and the pterygoid process of the sphenoid, and a leaf of the tensor muscle inserts into the oral mucosa. These require sharp release. Medially, the posterior nasal spine is variably formed. Just posterior and lateral to this is the cleavage plane between the tensor and levator muscles, where the submucosa and mucosa tend to be tethered and a surface dimple often is seen. Deliberate elevation of the submucosa from between the muscles prevents mucosal tears. After lateral and medial release, circumferential dissection of the pedicle can be completed. If further mobility of the pedicle is required, it can be achieved by release of the periosteal cuff posterior to the pedicle by gentle stroking with a small knife followed by a gentle stretch with opening of scissors. Sudden relaxation signals completion of the periosteal release. Further mobility can be gained by removal of the bone posterior to the pedicle using a 2-mm osteotome. After the osteotomy, the pedicle can lie more transversely, but care must be taken that the medial bone edge is removed so it does not compress the flow.

**Nasal Lining Dissection**

With appropriate release of the nasal mucosa off the medial pterygoid plate of the skull base, tension-free closure of the nasal lining can be achieved in all clefts. Subperiosteal access is gained along the caudal edge of the tensor fascia, at the juncture of the posterior border of the hard palate and the lateral nasal wall. Posterior to the pedicle, medial to the hamulus, there is an adherence of the mucosa at the pterygomaxillary junction. Careful release in the sagittal plane is followed by easy dissection of the nasal lining of the medial pterygoid plate up to the skull base. With the tip of an elevator at the skull base, the mucosa can be levered medially, creating a large

**Fig. 5.** Circumferential dissection of the greater palatine pedicle (g). The anterior three bony spikes of the palatine bone herald the proximity of the pedicle during dissection.
A sheet of mucosa that meets the midline (Fig. 6). Care must be taken to first fully release the adherence of the mucosa and levator at the posterior nasal spine; otherwise, the lining can tear at this point during the levering maneuver.

**Muscle Dissection**

The normal levator palatini muscle forms a sling across the middle third of the soft palate. Clefts result in an abnormal anteroposterior course and insertion onto the posterior hard palate. This sagittal orientation of the muscle impairs closure of the velopharyngeal port during speech. Cleft repair requires realignment into a transverse orientation. For adequate mobilization of the levator, there are two options. One is to release the tensor tendon as it wraps around the hamulus so that the levator and tensor palatini are mobilized en bloc (Fig. 7). The other option is to separate the levator from the tensor palatini within the velum, which may allow greater mobility and retroposition. Once released, the levator course can be traced cranial to the superior constrictor and followed toward the cranial base (Fig. 8). The intervelar separation of the levator may increase mobility, and retain the intrinsic tension of the tensor palatini for eustachian tube function, but the dissection must be meticulous to avoid damage to the muscle fibers. The use of a microscope can aid in visualization. If the tensor cannot be readily visualized, the two muscles are released en bloc. Although the access or dissection may differ among techniques, the same release and transposition of the levator sling is required regardless of what repair is used (Fig. 9).

**Modifications**

Sommerlad has popularized the use of a microscope for better visualization of the soft palate muscle dissection. Some have advocated buccal mucosa flaps based anteriorly or posteriorly to patch small defects of oral or nasal mucosa. Acellular dermal matrix has also been used to patch defects. Although its effectiveness has been reported and it imparts no donor-site morbidity, it is avascular and can potentially act as a foreign body if it is not quickly revascularized. A recent report has questioned the need for nasal lining closure; however, this remains controversial.

**Velopharyngeal Insufficiency**

The velopharyngeal sphincter is created by the soft palate or velum, the lateral pharyngeal walls, and the posterior pharyngeal wall. The muscles that constitute the velopharyngeal sphincter are the levator veli palatini, tensor veli palatini, palatoglossus, palatopharyngeus, musculus uvulae, salpingopharyngeus, and superior pharyngeal constrictors. The key contributors to velopharyngeal sphincter closure are the levator veli palatini, palatopharyngeus, and superior pharyngeal constrictors. The palatoglossus does not contribute to velopharyngeal sphincter animation in speech, but does play a...
role in deglutition. The tensor veli palatini is innervated by the trigeminal nerve (fifth cranial nerve), whereas the rest are innervated by the pharyngeal plexus (ninth and tenth cranial nerves).

The role of the velopharyngeal sphincter is to separate the oral and nasal cavities for speech and swallowing. The velopharyngeal sphincter should remain open for normal breathing and for production of nasal consonants (/m/, /n/, and /ng/). Complete closure of the velopharyngeal sphincter is required for production of oral pressure consonants (e.g., /p/, /b/, /t/, /d/, /k/, /g/, /s/, /z/, /f/, and /v/), sucking, swallowing, and blowing. During connected speech, velopharynx function is a complex coordination of varying degrees of velopharyngeal sphincter opening and closure influenced by both the target sound and the surrounding phonetic context.28–32

Velopharyngeal dysfunction is a general term and includes many causes that may or may not be associated with cleft palate (Fig. 10). Velopharyngeal insufficiency is a type of velopharyngeal dysfunction and is the most common cause of reduced intelligibility of speech in patients with clefts. Velopharyngeal insufficiency is characterized by nasal air emission and/or hypernasality from mechanical restriction, malposition, or insufficiency of velar tissue. In addition to a short palate or a lack of transverse orientation of the levator mechanism, velopharyngeal insufficiency
can also be the result of palatopharyngeal disproportion. This can occur with skull base anomalies (as in 22q11 deletion), scarring or strictures from previous surgery, or mechanical obstruction from tonsillar abnormalities. Although velopharyngeal insufficiency is the most frequent diagnosis in cleft palate patients, velopharyngeal dysfunction can also result from velopharyngeal mislearning with compensatory misarticulation. Finally, nasal air emission may not be related to velopharyngeal insufficiency or velopharyngeal dysfunction. In the case of a patent oronasal fistula and a functioning velopharyngeal sphincter, patients can have nasal air escape through the fistula.

SPEECH EVALUATION OF THE PATIENT WITH A CLEFT PALATE

The most common methods to evaluate velopharyngeal function are: (1) perceptual assessment by a trained speech-language pathologist; (2) transoral examination; (3) nasoendoscopy; (4) multiview video fluoroscopy; and (5) aerodynamic vocal tract measurements (e.g., nasometry and pressure-flow testing). The relative ability of the techniques to detect abnormalities in velopharyngeal structure, movement, closure, and timing is shown in Table 2.

Perceptual evaluation forms the cornerstone of the evaluation process and includes subjective assessment of the presence of nasal air emission, definition of resonance characteristics (i.e., hypernasality versus hyponasality), and overall rating of degree of velopharyngeal insufficiency. Standardized articulation testing is also included to differentially diagnose type of speech errors (developmental, obligatory, or compensatory). Speech, resonance, and airflow control characteristics should be assessed in both short phrases, rote speech (counting), and connected speech whenever possible, as velopharyngeal function may vary depending on the complexity of the speech task and degree of fatigue. It is imperative that perceptual velopharyngeal insufficiency assessment be completed by a clinician trained in diagnosis and management of velopharyngeal insufficiency, as some speech characteristics can be misperceived as velopharyngeal insufficiency. This assessment can be completed as early as 2 years of age in many children. Table 3 lists the resonance, articulation,
and phonation disorders often associated with cleft palate and velopharyngeal dysfunction that can be discerned by a speech-language pathologist experienced in velopharyngeal insufficiency diagnosis and management. Ideally, ratings of velopharyngeal insufficiency characteristics should be reported in a standardized way to enhance communication between team members. An example of such a tool is the Pittsburgh Weighted Speech Scale. The evaluation pathway followed at Seattle Children’s Hospital includes nasendoscopy and video fluoroscopy. These provide information on the timing, closure pattern, and competency of the velopharynx. (See Video, Supplemental Digital Content 1, which displays lateral fluoroscopy of a patient with normal velopharyngeal function, http://links.lww.com/PRS/A995. Note the strong contact of the velum to the pharyngeal wall during oral pressure consonants. See Video, Supplemental Digital Content 2, which displays a nasopharyngoscopic view of a velopharynx with normal closure pattern, http://links.lww.com/PRS/A996. Note the opening of the velopharyngeal port during nasal consonants and the closure during oral pressure consonants. See Video, Supplemental Digital Content 3, which displays a

Table 2. Comparison of Common Evaluation Techniques for Velopharyngeal Structure, Movement, Closure, and Timing

<table>
<thead>
<tr>
<th>Technique</th>
<th>Structure</th>
<th>Movement</th>
<th>Closure</th>
<th>Timing</th>
<th>Patient Tolerance</th>
<th>Expense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceptual</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Good</td>
<td>Low</td>
</tr>
<tr>
<td>Oral examination</td>
<td>Limited</td>
<td>Limited</td>
<td>No</td>
<td>No</td>
<td>Good</td>
<td>Low</td>
</tr>
<tr>
<td>Nasoendoscopy</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Fair</td>
<td>High</td>
</tr>
<tr>
<td>Fluoroscopy</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Good</td>
<td>High</td>
</tr>
<tr>
<td>Nasometry</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Good</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

Table 3. Brief Definitions of Resonance, Articulation, and Phonation Disorders Often Associated with Cleft Palate and Velopharyngeal Dysfunction

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypernasality</td>
<td>The perception of unregulated nasal resonance during the production of <em>vowels</em> resulting from inappropriate connection of the oral and nasal cavities</td>
</tr>
<tr>
<td>Nasal air emission</td>
<td>Nasal air escape that accompanies the production of <em>consonants</em> requiring high oral pressure (i.e., /p/, /b/)</td>
</tr>
<tr>
<td>Hyponasality</td>
<td>A reduction in normal nasal resonance resulting from nasal blockage (i.e., turbinate hypertrophy, septal deviation, obstructing pharyngeal flap)</td>
</tr>
<tr>
<td>Hypernasality and hyponasality</td>
<td>Simultaneous hypernasality and hyponasality usually resulting from incomplete velopharyngeal closure in the presence of high nasal resistance (not complete blockage)</td>
</tr>
<tr>
<td>Cul-de-sac resonance</td>
<td>A variation of hyponasality often associated with tight anterior nasal constriction producing a muffled quality to sounds</td>
</tr>
<tr>
<td>Nasal substitution</td>
<td>The articulating structures are placed appropriately for an intended oral consonant but incomplete velopharyngeal closure causes the sound to be produced as a nasal consonant (i.e., /b/ becomes /m/; /d/ becomes /n/)</td>
</tr>
<tr>
<td>Compensatory misarticulation</td>
<td>The articulating structures are placed inappropriately so that the individual can create the plosive (e.g., /p/) or fricative (e.g., /s/) characteristics of the sound they want to make in the presence of velopharyngeal dysfunction; examples include glottal stops and pharyngeal stops that are used to build up the oral pressure that is usually created by a functioning velopharynx</td>
</tr>
<tr>
<td>Laryngeal symptoms</td>
<td>A variety of phonation disorders that accompany velopharyngeal dysfunction; they are thought to be a compensation for the inability to achieve complete velopharyngeal closure with compensatory activity at the level of the larynx; examples include hoarseness, low speaking volume, strained or strangled voice quality, and unusual pitch alterations</td>
</tr>
</tbody>
</table>

lateral fluoroscopic view of a patient with velopharyngeal insufficiency, http://links.lww.com/PRS/A997. Note the consistent absence of contact of the velum to the posterior pharyngeal wall during oral pressure consonants. See Video, Supplemental Digital Content 4, which displays a nasopharyngoscopic view of a velopharynx with abnormal triangular closure pattern, http://links.lww.com/PRS/A998. Note the V-shaped defect in the velum, consistent with sagittal levator orientation, and the consistent opening of the velopharyngeal port during oral pressure consonants. This patient was subsequently treated with a Furlow secondary lengthening procedure. All videos are available in the “Related Videos” section of the full-text article on PRSJournal.com or, for Ovid users, at http://links.lww.com/PRS/A995.

Video 1. Supplemental Digital Content 1 displays lateral fluoroscopy of a patient with normal velopharyngeal function. Note the strong contact of the velum to the pharyngeal wall during oral pressure consonants. This video is available in the “Related Videos” section of the full-text article on PRSJournal.com or, for Ovid users, at http://links.lww.com/PRS/A996.

Fig. 11. Seattle Children’s Hospital velopharyngeal insufficiency evaluation protocol. Perceptual speech evaluation determines whether patients have hypernasality and/or nasal air emission (NAE). If they do, an instrumental evaluation with nasopharyngoscopy is performed to determine whether physical management (surgery or obturator) is indicated. If there is no hypernasality or nasal air emission, speech therapy is instituted with repeated perceptual evaluation.
These images are used to score and document the status of the velopharynx and provide treatment recommendations. We use the Golding-Kushner scale to subjectively rate the closure pattern and size of the velopharyngeal gap. Briefly, the scale rates lateral wall movement from 0 (no movement) to 0.5 (movement to the midline), right and left palate movement from 0 (no movement) to 1.0 (contact at the posterior pharyngeal wall), and posterior wall movement from 0 (no movement) to 1.0 (movement sufficient to reach the palate).

Nasometry is a noninvasive objective evaluation of nasalance, which is defined as an acoustic ratio of nasal to oral resonance. A higher nasalance score is therefore expected for phrases containing nasal consonants; conversely, a low score is expected with oral phoneme phrases. There are published nasalance normative means and deviations for comparison of an individual’s score with the noncleft population. The McKay-Kummer sensory nerve action potential test is a picture-cued evaluation of hypernasality and hyponasality. Short phrases composed of oral (closed velopharynx) pressure consonants (i.e., “Pick up the book,” “Go get a cookie,” “Suzy sees the scissors”) are used to detect hypernasality and nasal air escape, whereas phrases with nasal consonants (“Mama made some mittens”) can be used to detect hyponasality.

**MANAGEMENT OF VELOPHARYNGEAL INSUFFICIENCY**

Based on the speech evaluation described above, a standardized protocol should be followed to recommend physical treatment based on instrumental assessment (Fig. 11). Nasoendoscopy is used to determine candidacy for a secondary Furlow lengthening palatoplasty (in cases of sagittally oriented levators) or a pharyngoplasty (in cases of transverse oriented levators). If a pharyngoplasty is planned, the videofluoroscopy and nasoendoscopy results are used to help the surgeon tailor the size and position. If the soft palate is short and/or scarred and the orientation of the levators cannot be determined, the palate is explored intraoperatively. If the muscles are found to be sagittally oriented, a Furlow lengthening procedure is performed. Perceptual velopharyngeal insufficiency evaluation is performed 3 months postoperatively, with referral for instrumental evaluation made only in the case of residual velopharyngeal insufficiency, or if there are symptoms of obstructive sleep apnea. The outcomes of this standardized approach to velopharyngeal insufficiency have been reported previously.
in less dynamic velopharyngeal sphincter. More recently, attempts have been made to tailor the flap to the velopharyngeal sphincter gap to optimize speech outcomes while minimizing the risk of sleep apnea.38–40 Some centers have used the superiorly based pharyngeal flap preferentially for sagittal closure patterns (isolated lateral wall movement sufficient to reach the edges of the flap) and sphincter pharyngoplasty for coronal closure patterns (to take advantage of dynamic pharyngeal constrictors in the sphincter)31,41 (Reference 40 Level of Evidence: Risk, II). Bleeding and airway complications related to superiorly based pharyngeal flaps have been shown to decrease through the use of palatal mucosal flaps to resurface the raw surface of the flap and by limiting the number of surgeons performing the procedure.42 Advocates of the sphincter pharyngoplasty technique feel that it provides a more physiologic reconstruction of the velopharyngeal sphincter27; however, two randomized prospective studies comparing sphincter pharyngoplasty and superiorly based pharyngeal flaps did not demonstrate any significant difference in outcome between the two procedures43,44 (Reference 43 Level of Evidence: Therapeutic, II; Reference 44 Level of Evidence: Therapeutic, I). Both studies, however, did recognize small study size and inadequate power.

For the modified Hynes sphincter pharyngoplasty, two lateral superiorly based mucosal flaps are raised containing the palatopharyngeus muscles (Fig. 12).45,46 The flaps are rotated at right angles to attach to a demucosalized transverse strip on the posterior pharynx, just below the adenoid pad. The location of the transverse strip is based on the desired point of palatal contact seen on preoperative videofluoroscopy. In some cases, the adenoid pad is displaced inferiorly and interferes with insetting of the flaps. In these cases, a microdebrider can be used to create space for the flap or, less commonly, a separate adenoidectomy may be required followed by second-stage insetting of the flaps into the scar. The degree of overlap (tightness) of the two flaps is determined by the size of the gap seen on preoperative nasopharyngoscopy. In very large gaps, a portion of the posterior tonsillar pillar can be incorporated into the flaps to create a more substantial sphincter, but this can predispose to sleep apnea, especially when used with small or moderate gaps. Although the sphincter has been described as “dynamic,” electromyographic testing demonstrates no intrinsic function within the transposed flaps. However, the adjacent pharyngeal constrictors still function after sphincter creation.47 Sphincter pharyngoplasty revision can be achieved through elevation, tightening, or lateral release of the sphincter based on postsurgery evaluation.

Patients who are not considered good surgical candidates, because of either medical comorbidities (sleep apnea) or neuromuscular conditions
OBSTRUCTIVE SLEEP APNEA

Patients with a repaired cleft palate are at increased risk of obstructive sleep apnea. Contributing factors may be the associated midface retrusion or iatrogenic obstructive sleep apnea from previous palate and pharyngeal operations. Studies have estimated the risk of obstructive sleep apnea in the cleft lip–cleft palate population to range from 8.5 to 65 percent. The rate of occurrence of iatrogenic obstructive sleep apnea from pharyngeal speech surgery is low and reported at two of 104 patients who underwent tailored pharyngeal flaps and eight of 58 patients who underwent sphincter pharyngoplasty (Reference 51 Level of Evidence: Therapeutic, IV). Patients with Pierre Robin sequence and/or a history of perinatal respiratory difficulties may be at highest risk. Management of obstructive sleep apnea in a cleft palate patient requires multidisciplinary evaluation. The most common procedure is tonsillectomy and/or adenoidectomy followed by pharyngeal flap takedown or sphincter relaxation. Families need to be made aware that treatment of obstructive sleep apnea can exacerbate speech problems.

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