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Modified superior pharyngeal flap for the treatment of velopharyngeal insufficiency in children☆,☆☆

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ABSTRACT

Objective: To describe a modified rolled superior pharyngeal flap for treatment of velopharyngeal insufficiency (VPI) in children.
Methods: Prospective case series at a tertiary care multidisciplinary aerodigestive center. Four children, aged 5–12 years, with VPI refractory to speech therapy resulting after cleft palate (bilateral, submucous, or soft palate only) repair, failed traditional superior pharyngeal flap, fine motor incoordination, or adenoidectomy were studied. All 4 children underwent surgery with a modified superior pharyngeal flap, where aspects of the most commonly employed pharyngeal flap designs were combined to achieve the benefits of each technique and to allow for mucosal covering on either side of the flap, improved control of the lateral port size due to the horizontal-to-horizontal inset technique, and the ability to avoid a vertical or horizontal split in a previously repaired cleft palate.
Results: All 4 patients demonstrated resolution of their VPI as measured by subjective and/or objective criteria. Every patient required additional speech therapy postoperatively.
Conclusions: Our modified superior pharyngeal flap technique may be a good option in patients with small velopharyngeal gaps undergoing revision velopharyngeal surgery. A larger, longitudinal study would better address the overall outcomes of this technique.

1. Introduction

Velopharyngeal insufficiency (VPI) occurs when there is inadequate separation of the nasopharynx from the oropharynx. The velopharynx is a complex three dimensional valve which must close effectively to prevent reflux of food or liquids during deglutition and to limit both hypernasal resonance (a vowel phenomenon) and decreased intraoral pressure for consonants. Patients with moderate to severe VPI and a consistently documented anatomical abnormality despite speech therapy usually require surgery [1]. The general concept is to recruit adjacent tissue to augment the closure of the velopharyngeal sphincter.

The pharyngeal flap originally developed by Schoenborn in 1876 has been the most commonly used surgical method to treat VPI. The goal of this procedure is to recruit tissue from the posterior pharyngeal wall and attach it to the soft palate to bridge the central portion of a large velopharyngeal gap. Two lateral ports are created that remain patent during respiration and nasal consonants but close during oral consonants [2]. Some institutions use this surgical technique for almost every patient, regardless of the part of the velopharyngeal sphincter that is not functioning appropriately. Ideally, a posterior pharyngeal flap is used for a short, weak, or tethered soft palate with the remaining velopharynx demonstrating good lateral wall motion.

The posterior pharyngeal flap has proven itself quite effective through the years. Shprintzen found that when a pharyngeal flap is used randomly to treat patients with typical VPI, it is up to 80% effective in improving hypernasality. With careful diagnosis and patient selection, this procedure may be up to 97% effective in treating VPI [3]. The success rate of traditional pharyngeal flap surgery at our institution is about 90–95%.

The most common reason necessitating revision after superior pharyngeal flap surgery is persistent VPI. The most feared complication of pharyngeal flap surgery is obstructive sleep apnea (OSA), which is estimated to occur in 2–10% of patients undergoing

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this procedure. Witt et al. reviewed 65 patients who underwent superior pharyngeal flap surgery and showed that 20% required revision surgery [4]. The principal cause for failure in all cases was partial or complete flap dehiscence. Morris et al. reviewed 65 patients who underwent pharyngeal flaps, and persistent VPI and nasal airway obstruction were the most common reasons for revision [5].

As a result, modifications have been made in this procedure to attempt to reduce complications and improve outcomes. Hogan not only introduced the use of nasal catheters to improve lateral port control, but he was one of the first to describe the use of palatal mucosal flaps to line exposed areas of the superior pharyngeal flap in an attempt to limit scar contracture [6]. Arneja et al. and Emara et al. both described techniques where the flap was inset into a transverse full-thickness palatal incision [7,8]. However, these techniques and others create large demucosalized areas on the undersurface of the flap and posterior pharyngeal wall that must heal secondarily, increasing the chance of scarring. Stoll et al. showed improved outcomes by lining the exposed muscular undersurface of their pharyngeal flaps with velar nasal mucosal flaps similar to Hogan, but their donor sites had to heal by secondary intention as well [9]. Dividing the soft palate transversely or vertically risks creating a fistula or new cleft in an otherwise intact palate. Creating a low-lying flap or a flap that is too long is another potential complication using standard pharyngeal flap technique. Controlling lateral port size when suturing the pharyngeal flap in a vertical orientation remains difficult. Theoretically, suturing the pharyngeal flap in a horizontal-to-horizontal orientation improves lateral port control and is less likely to narrow over time because a larger piece of tissue is inset.

A small subset of patients exists, where a thicker pharyngeal flap may be more beneficial. Patients with a small velopharyngeal gap who have failed a traditional pharyngeal flap or sphincter pharyngoplasty may be good candidates. The posterior pharyngeal wall tends to be scarred, resulting in a thinner pharyngeal flap with less robust blood supply. We demonstrate a new technique in performing superior pharyngeal flap surgery in which the flap is rolled first and then inset horizontally muscle-to-muscle, ensuring all surfaces are mucosalized. This paper outlines the rationale for the combination of these techniques. As a small series, it does not delve deeply into outcomes, as all patients had resolution of their VPI by objective and/or subjective criteria postoperatively.

2. Methods

2.1. Patients

The Massachusetts Eye and Ear Infirmary institutional review board approved this study. Four patients aged 5–12 years were included in this case series (Table 1). Two patients were male, and 2 were female. The origin of VPI was cleft palate (bilateral, submucous, or soft palate only) repair, failed traditional superior pharyngeal flap, fine motor incoordination, or adenoidectomy.

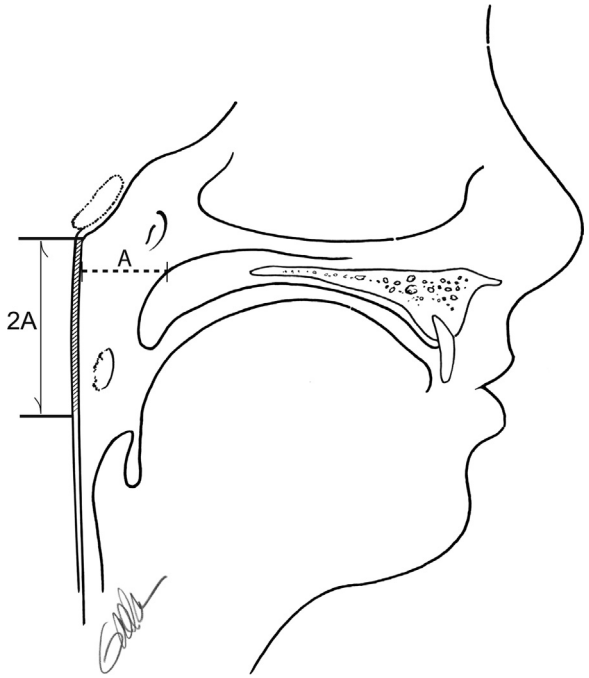

Fig. 1. Diagram depicting length of modified pharyngeal flap.

Preoperative nasopharyngoscopy was performed to determine velopharyngeal closure pattern and to guide our surgical algorithm. Three patients had a sagittal closure pattern and 1 patient a circular pattern. All patients underwent preoperative videofluoroscopic speech evaluation, and preoperative perceptual speech assessment and nasometry with a speech pathologist specialized in VPI. Postoperative perceptual speech assessment and nasometry were performed. The parents of all patients were queried whether the patients exhibited sleep disordered breathing symptoms at night throughout the follow-up period.

2.2. Technique

The patient was placed supine on the operating table and draped with a head drape. A Crow-Davis mouth gag was inserted, allowing good visualization without the need for a Dingman retractor. The distance from the posterior edge of the soft palate to the posterior pharyngeal wall was measured and labeled A (Fig. 1). The soft palate and posterior pharyngeal wall were injected with 1% lidocaine with 1:100,000 epinephrine.

A superiorly based pharyngeal flap with a length of 2*A* was marked out on the posterior pharyngeal wall (Fig. 2). We used this length to allow adequate tissue to reach the soft palate after rolling the flap instead of a length of *A* or 1.5*A* used in other techniques. Using an excessively long flap may result in compromised circulation, especially in patients with scarring after prior failed

Table 1
Patient demographics.

Patient	Age (years)	Gender	VPI etiology	Confounding variables
1	5	M	Bilateral CLP, palatoplasty, failed traditional pharyngeal flap	Adopted, late palate repair with palatal lengthening at age 3 years old
2	5	M	CP of soft palate, palatoplasty and partial dehiscence requiring revision	Persistent uvular deviation, maternal polysubstance abuse, increased muscle tone, mild developmental delay
3	11	F	Adenoidectomy, fine motor incoordination for speech and VP closure	Premature birth at 31 weeks, speech/cognitive/motor delays
4	12	F	Submucous CP, palatoplasty	Adopted, palate repair before age 2 years old, mild glottal web

Abbreviations: VPI = velopharyngeal insufficiency; CLP = cleft lip and palate; CP = cleft palate; VP = velopharyngeal.