Outcomes of Sphincter Pharyngoplasty and Palatal Lengthening for Velopharyngeal Insufficiency

A 10-Year Experience

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Objective: To report our experience in the care of patients treated for velopharyngeal insufficiency (VPI) with sphincter pharyngoplasty (SP) with or without the addition of palatal lengthening by Furlow palatoplasty (FP).

Design: Retrospective analysis.

Setting: Tertiary care cleft palate and craniofacial clinic.

Patients: Forty-six children with VPI, most of whom had palatal clefts, treated with SP (1998-2008).

Interventions: Treatment consisted of SP alone (n=20) or SP plus FP (n=26).

Main Outcome Measure: Rate of revision surgery, indicating persistent VPI after surgical treatment.

Results: Of 46 patients, 6 (13%) required surgical revision. Regarding need for revision, no statistically significant differences were found concerning age, sex, cleft type, syndrome, or time between palate repair and SP. Indications for revision included persistent hypernasality (n=2), inferior position (n=2), flap dehiscence (n=1), and obstructed sleep (n=1). Postoperative improvement in velopharyngeal competence was documented in all revision cases. No patients required a second revision. Twenty-six of 46 patients (57%) underwent FP in addition to SP. The remaining 20 patients (43%) had SP alone. The revision rate was 4% (n=1) for the SP plus FP group and 25% (n=5) for the SP alone group (P=.04).

Conclusions: Sphincter pharyngoplasty is an effective procedure for the management of VPI, with a success rate of 87% when using need for surgical revision as the primary outcome measure. This number improved to 100% after a single revision, with elimination of VPI in all revision cases. Concomitant FP and SP may improve outcomes compared with SP alone. Further prospective studies are needed to elucidate this relationship.


VELOPHARYNGEAL INSUFFICIENCY (VPI) is characterized by hypernasality, nasal air emission, and, oftentimes, secondary facial grimacing in a compensatory effort to minimize nasal air escape. Nonspeech symptoms, such as nasal regurgitation during deglutition, can also occur. Velopharyngeal insufficiency results from a deficit at the nasopharyngeal level, where adequate velopharyngeal (VP) closure cannot be accomplished for any number of functional or structural derangements. Most commonly, VPI is seen in children born with palatal clefts, occurring in 20% to 30% of patients after primary palatoplasty.1,2

Surgical management of VPI aims to diminish nasal airflow during speech by allowing closure of the VP port while maintaining upper airway patency. Many modifications have been made in the surgical management of VPI since Passavant1 first introduced the attachment of the posterior velum to the posterior pharyngeal wall in 1862. Surgical options can be classified as palatopharyngeal, pharyngeal, or palatal procedures.

The mainstay of palatopharyngeal procedures is the posterior pharyngeal flap (PF), which creates 2 lateral nasopharyngeal ports by attaching the posterior aspect of the superior constrictor muscle to the soft palate. Favorable outcomes have been achieved with the PF,4,5 and it has become the workhorse of surgical VPI management for many surgeons.

Pharyngeal procedures include sphincter pharyngoplasty (SP). Despite many modifications during the years,6-8 SP aims to narrow the nasopharynx, thereby enabling VP closure.9 This is accomplished by creating superiorly based lateral pharyngeal myomucosal flaps. Outcomes after SP have been favorable in several

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Sphincter pharyngoplasty was performed on 46 patients (23 boys and 23 girls) for VPI, determined by perceptual speech evaluation and flexible nasendoscopy. Mean (SD) age at primary SP was 7.2 (4.5) years. The underlying diagnosis was cleft palate in 36 patients (78%), submucous cleft palate (1 patient with velocardiofacial syndrome) in 9 (20%), and VPI of non-cleft origin in 1 (2%).

Sphincter pharyngoplasty was accomplished by raising bilateral superiorly based palatopharyngeus myomucosal flaps, elevated off the posterior aspect of the posterior tonsillar pillar. A transverse incision was made through the posterior aspect of the superior constrictor at the level of the first cervical vertebra. The flaps were then attached to the transverse incision, with the degree of overlap determined subjectively. Generally, the goal was to create a central port of approximately 10 to 15 mm. Donor sites were then closed.

Furlow double-opposing Z-plasty was performed concomitantly with SP in 21 patients (46%) with a previously repaired cleft palate (n=17) or a submucous cleft (n=4) who were discovered to have a large gap or a particularly short velum as determined by preoperative nasendoscopy. Note that in patients with cleft palate, primary palate repair was performed using 2-flap palatoplasty rather than FP. When FP was performed along with SP, FP was completed in a manner similar to that described by Furlow, with completion of SP before Z-plasty closure. Five patients in whom SP was performed before SP for the primary treatment of VPI were determined to have small gaps by nasendoscopy. Primary SP was undertaken in these patients owing to persistent VPI (determined by perceptual speech and endoscopic evaluation) and only after failed management with speech therapy (1-year duration). For analysis on the effect of FP, we looked at 2 groups: those who had SP alone (n=20) vs those who had FP in addition to SP. We grouped all those having FP plus SP together (n=26), despite 5 of them undergoing FP before SP. These groups are listed according to diagnosis in the Table.

Routine perceptual speech evaluation was performed on all the patients 3 months after pharyngoplasty. The need for revision was determined by perceptual speech evaluation and subsequent flexible nasendoscopy, usually performed only after failed conservative management with aggressive speech therapy (1-year duration). Surgical revision was defined as any secondary surgical modification of the SP, which was completed by advancing or reshaping the primary flaps according to the indication for revision.

Statistical analysis was performed using the t test, with significance set a priori at P<.05. Comparisons were made of patients who required revision and those who did not regarding age, sex, cleft type, syndrome, and time between palate repair and SP. Regarding patients who underwent FP in addition to SP, revision and nonrevision groups were compared using the Fisher exact test, with significance set a priori at P<.05.

RESULTS

Of 46 patients, 6 (13%) underwent surgical revision. According to diagnosis, the revision group was composed of the following: cleft palate (n=4, 67%), submucous cleft palate (n=1, 17%), and VPI of non-cleft origin (n=1, 17%). Indications for revision surgery were as follows: persistent hypernasality (n=2), inferior flap position (n=2), flap dehiscence (n=1), and obstructed sleep (n=1). The median interval between SP and revision was 19 months (range, 3-153 months).

Twenty-six of 46 patients (57%) underwent FP in addition to SP. The remaining 20 (43%) had SP alone. Re-

### TABLE. The SP and SP + FP Groups Stratified by Diagnosis

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>SP Alone, No. (n=20)</th>
<th>SP and FP, No. (n=26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleft palate</td>
<td>14</td>
<td>22</td>
</tr>
<tr>
<td>Submucous cleft palate</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>VPI of non-cleft origin</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Abbreviations: FP, Furlow palatoplasty; SP, sphincter pharyngoplasty; VPI, velopharyngeal insufficiency.

A retrospective assessment was undertaken of all the patients who underwent SP by one of us (V.K.S.) for VPI between January 1, 1998, and December 31, 2008. All the patients were evaluated by the multidisciplinary team in the Craniofacial–Cleft Palate Center at Children’s Mercy Hospitals and Clinics, Kansas City, Missouri. Institutional review board approval was obtained before review of the medical record. Variables collected included race, ethnicity, sex, diagnosis, cleft type, and age at primary palatoplasty (if appropriate); syndrome; preoperative speech assessment, including subjective class of VPI (mild, moderate, or severe) and closure pattern; age at SP; previous, concomitant, or subsequent palatal lengthening; secondary or tertiary procedures; and postoperative speech assessment for those requiring surgical revision.
vision rates for these 2 groups were significantly different (SP alone: 5 patients [25%]; SP and FP: 1 patient [4%]; P = .04, Fisher exact test).

All 6 patients who underwent revision had improvement in VP competence on postrevision (3 months) perceptual speech evaluation. No patients required a second revision. Regarding need for revision, no statistically significant differences were found concerning age, sex, cleft type, syndrome, or time between palate repair and SP (P > .05, t test).

**COMMENT**

Effective surgical management of children with VPI is contingent on achieving adequate closure of the VP port without causing upper airway obstruction. Since first introduced in 1862, surgical management of VPI has seen numerous changes. Currently, prevalent surgical approaches include the posterior PF, SP, and FP (palatal lengthening). Each surgical procedure has its strengths and limitations. Although difficult to measure objectively, surgeon experience contributes to choice of surgical intervention and outcome. Despite recent studies failing to show a difference in outcomes when comparing the PF and SP, albeit with small sample sizes, we favor SP because of experience and because of the perception of increased obstructed sleep after PF. In fact, one center noted a higher likelihood of obstructed sleep symptoms in patients who had PF vs SP.

Hynes first introduced SP in the 1950s for the treatment of failed cleft palate repair using lateral pharyngeal myomucosal flaps to narrow the nasopharynx. Later, Orticochea described the current model of a dynamic velopharynx, including the soft palate, lateral pharyngeal walls, and posterior pharyngeal wall. Orticochea made popular the procedure described by Hynes as a treatment for VPI. Subsequent modifications by Jackson and Silverton included using the palatopharyngeus muscles rather than the superior sphincter. Recognizing the importance of elevating the myomucosal flap insertion to the point of attempted contact between the velum and the posterior pharyngeal wall, Riski et al reported a 78% success rate (n = 139) defined by resolution of hypernasal resonance. Ysunza and Pamplona used electromyography after SP and determined that there was no intrinsic muscle activity in the palatopharyngeus, but there was normal activity of the superior constrictor muscle. Augmentation of the posterior nasopharynx was the benefit, they concluded, rather than active contraction of the sphincter.

Since Riski et al popularized the importance of a high nasopharyngeal insertion point, other retrospective studies reported revision rates similar to ours (13%), with a narrow range of 11.5% to 16%. Of the 6 revisions performed in our study, 2 were indicated for persistent hypernasal alone and 2 for documented inferior flap placement. Notably, the 2 with documented low flap placement were performed in the first 2 years of this review, which indicates the importance of widely distributing the knowledge of high flap placement. Since that time, we routinely place the myomucosal flaps high in the nasopharynx as is feasible possible, which may mean resecting a portion of adenoid tissue. This process may contribute to the comparable success rate (87%). Consistent prognostic predictors for the failure of primary SP have not been identified in this study, which corroborates findings in similar studies.

The success of surgical management of VPI is difficult to determine due to the subjective nature of perceptual speech assessments in postoperative follow-up. Therefore, ideal outcome measures are difficult to define. Complete resolution of VPI is not evident in all patients after primary VPI surgery; however, surgical revision is not undertaken unless it is thought that VP competence cannot yield “normal” speech after aggressive speech therapy (1-year duration). Accordingly, the aim of surgical management is to provide enough VP competence so that resolution of VPI is achievable by speech therapy. Thus, the diagnosis of persistent VPI (by perceptual speech assessment and nasendoscopy) after speech therapy, and, therefore, probable need for surgical revision, implicates revision rate as an important outcome measure. This addresses a potential limitation in this retrospective study. The subjective nature of speech assessment certainly helped define the need for surgical revision and also the success of the surgical intervention. Owing to incomplete records and changes in medical documentation, it was impossible to review speech samples. Ideally, speech samples would have been reviewed independently by other speech pathologists. This would have improved the reliability of subjective speech evaluations in this retrospective study. Future prospective studies would address this issue.

Herein, we report significantly improved outcomes of SP in patients who had previous (n = 5) or concomitant (n = 21) FP vs those who had SP alone (n = 20). Recent literature has suggested increased efficacy of concomitant SP and FP for the surgical management of VPI. Cheng et al describe a modified procedure for the treatment of primary cleft palate repair and secondary VPI. The procedure combines a tunneled palatopharyngeus myomucosal flap behind a bridge of superior constrictor and a double-opposing FP. In describing the Seattle protocol, Sie and Chen consider the use of concomitant SP and FP for patients with VPI and a large gap on nasendoscopy (<50% closure), especially for those with a notch or groove of the soft palate on the nasendoscopic view. Theoretically, the combined procedure addresses all contributing factors and creates a more physiologic velopharynx, which alone, both SP and intravelar palatoplasty (FP) cannot achieve. These factors include repair of velar musculature, improvement in the lateral pharynx, reduction of an enlarged nasopharynx, and lengthening of a shortened soft palate. Given that SP or FP alone neglects the important velar element, no single procedure is suitable for all deformities. Further studies are needed and are under way to illuminate the role of concomitant SP and FP in the surgical management of VPI.

In conclusion, SP is an effective procedure for the management of VPI, and the present outcomes compare favorably with similar studies. Prognostic factors for surgical revision are difficult to identify in retrospective studies. Furthermore, this study suggests that concomitant FP and SP may improve outcomes compared with
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Author Contributions: Drs Carlisle and Singhal had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Carlisle and Singhal. Acquisition of data: Carlisle. Analysis and interpretation of data: Carlisle, Sykes, and Singhal. Drafting of the manuscript: Carlisle and Singhal. Critical revision of the manuscript for important intellectual content: Carlisle, Sykes, and Singhal. Statistical analysis: Carlisle and Sykes. Administrative, technical, and material support: Carlisle. Study supervision: Singhal.

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REFERENCES