

ORIGINAL ARTICLE CLEFT LIP AND PALATE

Using the superiorly based pharyngeal flap to surgically manage cleft velopharyngeal insufficiency: a cohort study

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Abstract

Introduction: The surgical management of velopharyngeal insufficiency is traditionally guided by algorithms based on dynamic imaging, such as nasoendoscopy and video fluoroscopy. In practice, however, surgeons often favour a single surgical technique in all patients—irrespective of observed velopharyngeal closure pattern. In this study, we examine the utility of the superiorly based pharyngeal flap for correcting velopharyngeal insufficiency in a cohort of patients with varied velopharyngeal closure patterns.

Methods: A retrospective cohort study was conducted of velopharyngeal insufficiency patients treated by a single surgeon at the Royal Children's Hospital, Melbourne, between 2008 and 2015. Prior to surgery, patients underwent speech evaluation as well as nasopharyngoscopy for assessment of velopharyngeal closure pattern. Irrespective of the closure pattern observed, patients were treated using a superiorly based pharyngeal flap. Following surgery, serial evaluations for residual velopharyngeal insufficiency and surgical complications were performed.

Results: A total of 18 cleft palate patients met the criteria for study inclusion. Preoperative speech evaluation revealed mild velopharyngeal insufficiency in one patient (5.6%), moderate velopharyngeal insufficiency in nine patients (50%), and severe velopharyngeal insufficiency in eight patients (44.4%). Repeat speech evaluation one year after surgery demonstrated correction of velopharyngeal insufficiency in 17 patients, representing a 94.4 per cent success rate. Furthermore, only two patients experienced postoperative snoring (11.1%).

Conclusion: Consideration of velopharyngeal closure pattern is not required for effective surgical management of velopharyngeal insufficiency.

Introduction

Velopharyngeal insufficiency (VPI) arises from an inability to completely close the velopharyngeal sphincter. The velopharyngeal sphincter is formed primarily by the levator veli palatini and the superior pharyngeal constrictor. Balanced constriction of both muscles produces a sphincteric effect that ultimately separates the oropharynx from the nasopharynx. Impaired closure of the velopharyngeal sphincter produces a residual nasopharyngeal orifice, resulting in the unintelligible speech and impaired feeding associated with VPI. A history of cleft palate is the most common cause of VPI and it is reported in 5–36 per cent of patients following primary palatoplasty.¹

Velopharyngeal insufficiency is diagnosed on the basis of formal evaluation by a speech pathologist. Diagnosis involves both perceptual speech evaluation as well as dynamic assessment of velopharyngeal function. Dynamic assessment of velopharyngeal function is conducted via nasoendoscopy, which allows for direct visualisation of velopharyngeal sphincter closure. The observed pattern of velopharyngeal closure can, in turn, be used to guide algorithmic approaches to selecting a surgical technique.^{2–6} Traditionally, for a coronal closure pattern in which the velum moves well but the lateral pharyngeal walls do not, sphincter pharyngoplasty is favoured in an effort to preserve existing palatal mobility. Conversely, for sagittal or circular closure patterns in which the lateral walls move well but the velum does not, pharyngeal flap is favoured in an effort to preserve existing lateral wall mobility.

While such algorithmic approaches are widely touted, many surgeons favour one procedure over another in all patients.^{7–9} In this study we evaluate the utility of a single technique—the pharyngeal flap—for correcting VPI irrespective of velopharyngeal closure pattern.

Methods

Study design

A retrospective cohort study was conducted of VPI patients treated by a single surgeon at the Royal Children's Hospital, Melbourne, between 2008 and 2015. The Royal Children's Hospital Ethics Committee reviewed this study and considered it exempt given its retrospective nature and because there is no identifiable personal health information (Reference QA/61292/RCHM-2020).

Inclusion criteria were:

1. diagnosis of VPI requiring surgical intervention
2. cooperation with preoperative speech evaluation.

Exclusion criteria were:

1. loss to follow up
2. syndromic cleft
3. non-cleft VPI.

Study subjects underwent preoperative speech evaluation by two speech pathologists. Evaluations consisted of both conversational and elicited speech and were scored on the basis of consensus listening by both speech pathologists according to the Great Ormond Street Speech Assessment (GOS.SP.ASS '98) for cleft-related speech disorders.¹⁰ For each VPI component measured by GOS.SP.ASS (resonance, nasal air emission, nasal turbulence and grimace), a rating of 0 was designated absent, a rating of 1 was designated mild, a rating of 2 was designated moderate, and a rating of 3 was designated severe. The overall degree of VPI was then designated by combining the non-zero ratings for each of the VPI components observed. For example, a patient with moderate resonance and moderate nasal air emission was given an overall VPI rating of moderate. A patient with moderate nasal air emission and severe nasal turbulence was given an overall VPI rating of moderate–severe. Preoperative speech evaluation also included flexible nasoendoscopy performed and reviewed together by both speech pathologists and the senior author. The observed pattern of velopharyngeal closure was rated as:

1. coronal if closure was predominantly accomplished by the soft palate
2. sagittal if closure was predominantly accomplished by the lateral pharyngeal wall
3. circular if closure was accomplished by balanced contributions by the soft palate and lateral pharyngeal walls.

Following a minimum of three months, patients underwent serial postoperative speech evaluations using the same rating scale by the same two-person speech pathology team. Absent or mild VPI was considered a success, while moderate or severe VPI was considered a failure. Patients were also evaluated for postoperative complications, including surgical site events and parent-reported snoring.

Surgical technique

Patients all underwent Hogan's modification to the superiorly based pharyngeal flap.⁹ The procedure began with midline division of the soft palate, extending posteriorly from the hard-soft junction

to the uvula (**Figure 1 A1 and A2**). Posteriorly based nasal mucosal flaps were then elevated on both sides of the divided soft palate (**Figure 2 B1 and B2**).

Next, a superiorly based pharyngeal flap was elevated on the posterior pharyngeal wall (**Figure 1 A3**). The secondary defect was closed primarily.

The pharyngeal flap was then transposed into the nasopharynx and inset onto the nasal aspect of the soft palate (**Figure 1 A4**). The bilateral nasal mucosal flaps were then turned down and inset onto the raw surface at the base of the pharyngeal flap (**Figure 2 B3**).

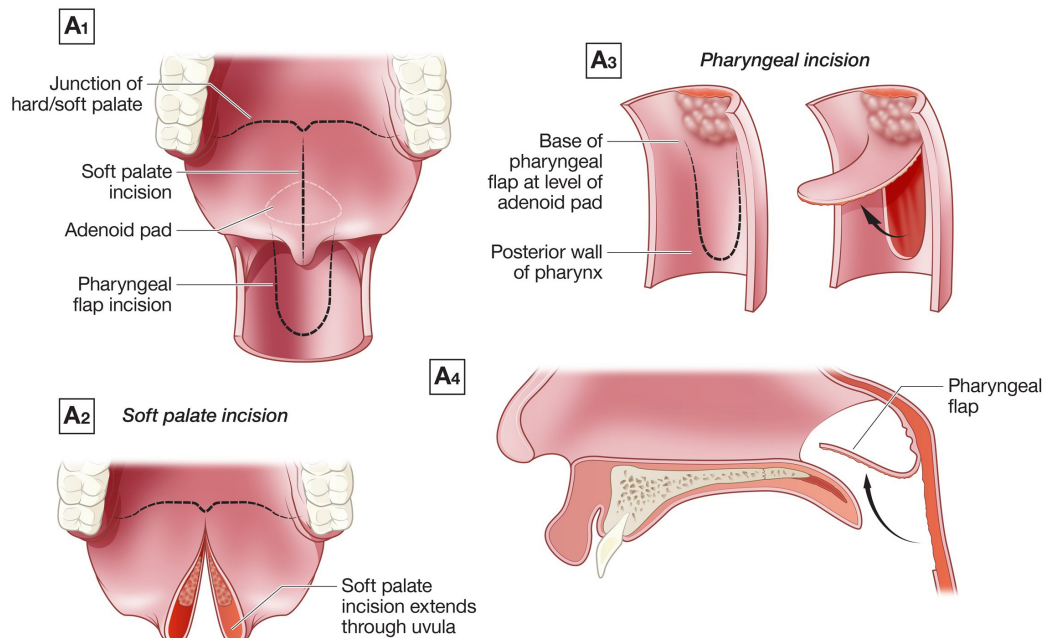


Fig 1. (A1) Anatomical landmarks for Hogan's modification to the superiorly based pharyngeal flap; (A2) soft palate incision; (A3) flap design on the posterior pharyngeal wall; (A4) flap transposition into the nasopharynx. Illustration supplied by David Chong

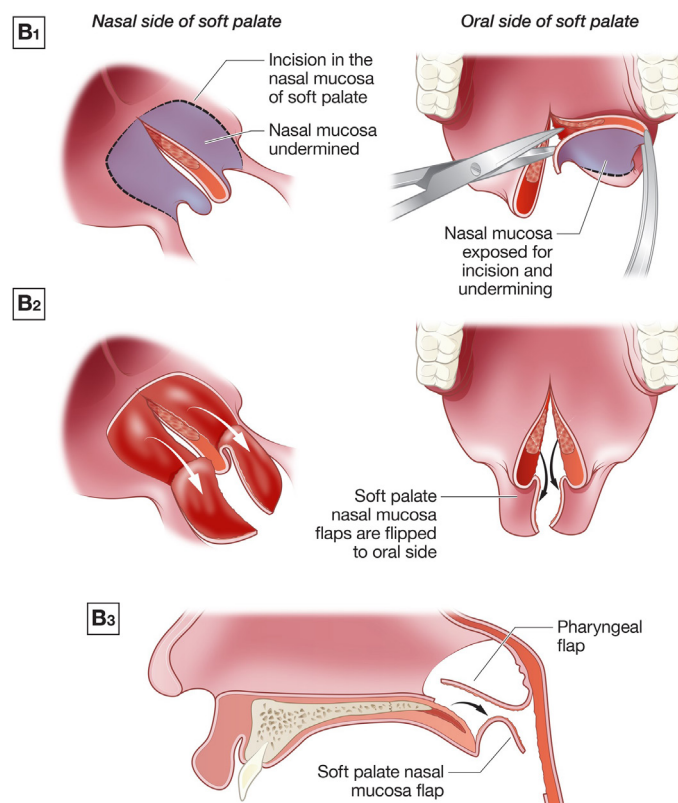


Fig 2. (B1) Dissection of soft palate nasal mucosal flaps; (B2) soft palate nasal mucosal flaps turned over into oropharynx; (B3) dual flap inset into corresponding defects. Illustration supplied by David Chong

Results

A total of 181 patients underwent cleft palate repair by the senior author during the study period. Of those, 24 patients (13.2%) were diagnosed with VPI, among whom 18 met the criteria for study inclusion. Of those 18 patients, there were nine males and nine females, and their mean age at surgery was 5.5 years. The cohort consisted of six patients with isolated cleft palate, nine patients with unilateral cleft lip and palate, and three patients with bilateral cleft lip and palate.

Preoperative speech evaluation revealed one patient with mild VPI (5.6%), nine patients with moderate VPI (50%), and eight patients with severe VPI (44.4%). Of the 18 VPI patients, 10 tolerated preoperative nasoendoscopy for assessment of velopharyngeal closure pattern. Of those, seven patients demonstrated a sagittal pattern of velopharyngeal closure, two patients demonstrated a coronal pattern of velopharyngeal closure and one patient demonstrated a circular pattern of velopharyngeal closure.

All 18 VPI patients underwent surgical management via superiorly based pharyngeal flap, as described above. Intraoperatively, flap width was tailored to specific parameters within each patient's preoperative evaluation. Flap length was maximised, with the cephalad extent limited only by the position of the adenoid pad.

Postoperative speech evaluation conducted after one year revealed complete resolution of VPI in seven patients (38.9%) and mild residual VPI in 10 patients (55.6%), representing an overall success rate of 94.4%. A single patient (5.6%) with severe preoperative VPI demonstrated moderate residual VPI after surgery. There were no patients with severe residual VPI at the one year postoperative timepoint. Mild postoperative snoring was observed in two patients (11.1%).

Discussion

The objective of VPI surgery is to restore velopharyngeal sphincter competence without untoward complications. Multiple surgical techniques have been described to maximise this quotient, including double opposing z-plasty, sphincter pharyngoplasty and pharyngeal flap, among others. In an attempt to tailor these available techniques to each patient's unique pathophysiology, algorithmic approaches based on velopharyngeal closure pattern have been proposed. In this study we demonstrate a high success rate with the exclusive use of pharyngeal flaps, irrespective of velopharyngeal closure pattern.

The pharyngeal flap was introduced by Schoenborn in 1876 and has since undergone multiple modifications and widespread adoption.¹¹ Its mechanism of action is based simply on narrowing the velopharyngeal space, thereby facilitating sphincter competence in the setting of velopharyngeal muscle dysfunction. Theoretically, the specific pattern of velopharyngeal muscle dysfunction is entirely immaterial to the effectiveness of this space-filling mechanism. That is, the therapeutic mechanism of pharyngeal flaps may not depend on the presence of any specific velopharyngeal closure pattern.

In practice, the efficacy of pharyngeal flaps for managing VPI across various velopharyngeal closure patterns is well-evidenced. Ekin and colleagues reported an overall pharyngeal flap success rate of 91 per cent with no significant difference by closure pattern.⁷ Yamaguchi and colleagues reported a similarly high success rate of 95 per cent within a cohort of both coronal and non-coronal closure patterns.² Emara and colleagues demonstrated a 92 per cent success rate using a modified pharyngeal flap in a cohort of mixed closure pattern patients, as well as no cases of obstructive sleep apnoea.⁸ Pharyngeal flap efficacy is even corroborated by randomised control trials, reporting success among 81–89 per cent of patients randomised to pharyngeal flaps irrespective of velopharyngeal closure pattern.^{12,13}

These outcomes are strikingly similar to those obtained from algorithmic applications of pharyngeal flaps based on velopharyngeal closure patterns. For example, Instrum and colleagues reported a success rate of 94 per cent with the selective use of pharyngeal flaps in patients with sagittal and circular closure patterns only.¹⁴ Peat and colleagues demonstrated similar success in 81 per cent of pharyngeal flaps performed exclusively in patients with non-coronal closure patterns.⁵ All in all, limiting the application of pharyngeal flaps to narrow categories of closure pattern is not associated with measurably greater surgical success rates.

Limitations of our study include its retrospective design, small sample size and single-surgeon perspective. Furthermore, our cohort included a minority of patients with a coronal pattern of velopharyngeal closure, which is theoretically the least favourable morphology for success with a pharyngeal flap. While both of these patients demonstrated success with the pharyngeal flap in our hands, additional studies within this specific patient subset may be warranted.

Conclusion

All in all, we challenge the paradigm of tailoring secondary speech procedures to observed velopharyngeal closure patterns. While we continue to recommend nasoendoscopy for diagnostic purposes, we refrain from selecting surgical technique on its basis. Ultimately, our high success rate with pharyngeal flap alone adds to the body of evidence favouring single technique approaches to VPI management.

Patient consent

Patients/guardians have given informed consent to the publication of images and/or data.

Conflict of interest

The authors have no conflicts of interest to disclose.

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