

DOES SPHINCTER PHARYNGOPLASTY IMPROVE SPEECH HYPERNASALITY IN CLEFT PATIENTS WITH VELOPHARYNGEAL INCOMPETENCE?

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<https://doi.org/10.51847/2OnbthAhZO>

ABSTRACT

Despite successful cleft palate surgery, 10 to 30% of patients may experience abnormal speech resonance, most notably hypernasal resonance as a result of the velopharyngeal insufficiency (VPI). Surgery remains the most effective means of correcting VPI and among the popular procedures are sphincter pharyngoplasty. The purpose of this study is to compare speech hypernasality after sphincter pharyngoplasty in the management of cleft-related VPI. The study reviewed patients with velopharyngeal insufficiency who were treated by sphincter pharyngoplasty between 2015 and December 2022 by a single surgeon. The subjective evaluation of nasality was done before and after operation by at least 3 months. Hypernasality severity can be assessed using a grading system and this grading system is on a numeric scale with grade 0 being considered normal, grade 1 indicating mild hypernasality, grade 2 representing moderate hypernasality, and grade 3 indicating severe hypernasality. Of the 10 patients, 6 were female, and 4 were male. The average age of patients was 12.5 years (range, 4–27 years). All patients had moderate to severe hypernasality preoperatively, with 7 patients with severe hypernasality. All patients except one experienced an improvement in hypernasality grade following the procedure. Patients with cleft lip and palate may suffer from hypernasality, a serious problem that can impair speech and communication and can render a child's speech unintelligible and sphincter pharyngoplasty can be a safe and effective surgical approach to correcting VPI in patients with cleft palates.

Key words: Velopharyngeal insufficiency, Velopharyngeal dysfunction, Pharyngoplasty, Sphincter pharyngoplasty, Hypernasality, Speech.

Introduction

Velopharyngeal dysfunction (VPD) is a condition in which the velopharyngeal apparatus fails to close fully, resulting in specific speech characteristics. Even after successful cleft palate surgery, a considerable proportion of patients (ranging from 10 to 30%) may still suffer from abnormal speech resonance due to the presence of residual structural anomalies, the most common of which is hypernasal resonance [1, 2]. An essential element of speech production is the interaction between the larynx and soft palate (velum), which together produce controlled, refined, and understandable phonation. Because of the lack of a functional anatomical seal over the nasopharynx, controlled speech cannot be achieved in patients with velopharyngeal insufficiency (VPI) [3]. While speech therapy can address speech articulation errors, restoring velopharyngeal competence is necessary to correct the primary effects of velopharyngeal insufficiency (VPI), namely, hyper nasality and nasal air escape [4].

Surgery remains the most effective means of correcting VPI [4-7]. Many procedures have become popular over the years, including lengthening of the soft palate, pharyngeal flap, sphincter pharyngoplasty, and pharyngeal wall augmentation [5]. A surgeon's preferences may influence the

reconstruction technique chosen, as well as the size and location of the defect. There is no international consensus regarding the optimal repair technique [6, 7].

In the 1950s, Hynes pioneered the surgical procedure that became known as sphincter pharyngoplasty. Orticochea modified Hynes' technique and described a procedure in which "a sphincter is formed by transplanting the posterior tonsillar pillars with their enclosed palatopharyngeus muscle. The pillars are moved from the lateral pharyngeal walls to the mid-section of the posterior pharyngeal wall". Through the narrowing of the nasopharynx and the creation of a dynamic sphincter, the velopharynx closes and allows oral resonance to occur [8]. Approximately 62% to 85% of patients treated with Orticochea pharyngoplasty report improved symptoms of VPI [8].

The purpose of this study is to compare speech hypernasality after sphincter pharyngoplasty in the management of cleft-related VPI.

Materials and Methods

A review was conducted on patients who received treatment for velopharyngeal insufficiency through sphincter pharyngoplasty. The treatment was performed by a sole

surgeon in the Department of Oral and Maxillofacial Surgery at King Abdulaziz University between 2015 and December 2022. The study was approved by the ethical research committee at King Abdulaziz University Faculty of Dentistry, Jeddah, Saudi Arabia.

The patients included in the study met specific inclusion criteria. These criteria included being between 5 and 30 years old at the time of the operation, speaking Arabic, not exhibiting any syndromic symptoms or learning or hearing impairments, and having previously undergone primary palatoplasty but still having velopharyngeal insufficiency. Nasality was subjectively evaluated both before and after the operation, with a minimum of 3 months between evaluations. Due to the lack of access to speech pathologists, the evaluation was made by the surgical team. The hypernasality was subjectively evaluated while the patient speaks in Arabic. Each patient was asked to count to ten and then pronounce variations of the number to elicit all vowels and consonants.

Hypernasality severity can be assessed using a grading system and this grading system is on a numeric scale with grade 0 being considered normal, grade 1 indicating mild hypernasality, grade 2 representing moderate hypernasality, and grade 3 indicating severe hypernasality.

Surgical technique

During general anesthesia, the Dingman retractor was used to expose the posterior wall of the pharynx. To increase exposure, a rubber catheter was passed through the nose and sutured to the uvula, and pulled anteriorly into the nasopharynx. An incision was then made along the anterior mucosa of the posterior tonsillar pillar. The vertical fibers of the palatopharyngeal muscle were dissected bluntly from the transverse fibers of the superior pharyngeal constrictor, being careful not to damage the muscle fibers. The palatopharyngeal muscle was elevated to its maximum extent, and the distal attachments of the palatopharyngeal mucomuscular flap were divided. The donor sites were sutured directly with Vicryl no. 4-0. A transverse incision was made on the posterior pharyngeal wall through the mucosa and muscle, usually at the posterior edge of the adenoid gland. This incision connected the upper limits of the two vertical defects created by the elevation of the palatopharyngeal muscle and was made at approximately the level of the soft palate. The posterior limb of the palatopharyngeal mucomuscular flap was then sutured to the superior margin of the incision on the posterior pharynx using Vicryl no. 5-0 sutures. Finally, the distal ends of the palatopharyngeal mucomuscular flaps were sutured to each other in an overlapping pattern using Vicryl no. 4-0 to create the dynamic sphincter.

Results and Discussion

Of the 10 patients, 6 were female, and 4 were male. The average age of patients was 12.5 years (range, 4–27 years).

Patient information is summarized in **Table 1**. Throughout the follow-up period, which spanned between 18 to 22 months, there were no significant postoperative complications reported. Specifically, there were no occurrences of surgical site infections, bleeding, or flap necrosis. One patient underwent a revision surgery to enhance the velopharyngeal port closure and one patient developed transient mild obstructive sleep apnea symptoms that resolved within 1 month.

All patients had moderate to severe hypernasality preoperatively, with 7 patients with severe hypernasality. All patients except one experienced an improvement in hypernasality grade following the procedure. 3 of the 9 patients who experienced improvement had near complete elimination of their hypernasality and 6 of 9 presented with borderline hypernasality at postoperative assessment. One patient showed no change in hypernasality grade postoperatively and required revision surgery. This patient was 4.5 years old. So, 90% of patients experienced an improvement in their speech hypernasality with varying degrees, with 30% showing near complete resolution (**Figure 1**).

Table 1. Summary of the patients with VPI age, degree of hypernasality, and degree of improvement following sphincter pharyngoplasty

Patient	Age	Hypernasality	Degree of improvement
1	4	Severe	Significant
2	11	Moderate	Moderate
3	4.5	Severe	Moderate
4	15	Severe	Significant
5	4.5	Severe	None
6	17	Moderate	Moderate
7	12	Severe	Significant
8	19	Moderate	Moderate
9	13	Severe	Moderate
10	27	Severe	Moderate

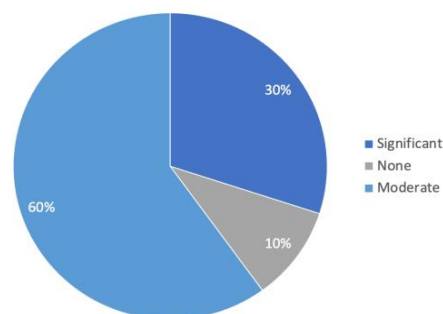


Figure 1. Percentage distribution of degree of improvement in hypernasality following sphincter pharyngoplasty

A person must have velopharyngeal competence to produce normal speech, defined as the ability to completely close the velopharyngeal sphincter between the oro- and nasopharynx. The proper functioning of the velopharyngeal valve is critical to direct sound energy and airflow into the oral cavity, which is necessary for normal oral speech. The sound must resonate in the oral cavity for the production of vowels and to achieve normal resonance. Velopharyngeal insufficiency (VPI) is known to affect resonance by allowing sound to enter the nasal cavity during attempts to produce oral sounds, leading to hyper nasality. Hypernasality is a resonance disorder, characterized by an excessive amount of sound resonating in the nasal cavity during speech, typically caused by VPI [9]. This condition is caused mainly by a short soft palate, inadequate motor function of the soft palate muscles, and a deep palatopharyngeal cavity, which prevents the patient from closing the oronasal cavity effectively during a speech [4]. Two types of speech errors are commonly seen in patients with velopharyngeal insufficiency during speech production, namely obligatory errors and learned errors. Hypernasality and nasal emission are examples of obligatory errors, while compensatory articulation and gloting stop are examples of learned errors. It is important to note that only obligatory errors can be corrected through surgical treatment of velopharyngeal insufficiency, while learned errors must be addressed through speech therapy provided by a speech pathologist [3].

The various techniques used to treat velopharyngeal insufficiency (VPI) aim to replicate or enhance the mechanical functions of one or more of the muscles involved in the velopharyngeal sphincter. There are various surgical methods to correct velopharyngeal insufficiency, which include revision palatoplasty, sphincter pharyngoplasty, pharyngeal flap, and injection pharyngoplasty using tissue filler or fat [5, 10].

Researchers have attempted to determine which technique is superior to another, but have not reached a definite conclusion [11-14]. Collins *et al.* found that pharyngeal flaps and sphincter pharyngoplasty had no significant differences in postoperative outcomes [15]. According to Chen *et al.*, both palatal and pharyngeal procedures could be performed with comparable complications within 30 days, and the surgical modality selected could be influenced by both patient presentation and surgeon comfort [5]. Surgery techniques are ultimately determined by the surgeon's preferences based on their personal experience. Although the pharyngeal flap procedure can successfully address velopharyngeal insufficiency by suturing the mucosal muscle flap of the posterior pharyngeal wall to the nasal surface of the soft palate, it does have a drawback. Specifically, the pharyngeal flap leaves 3-4 mm ventilation holes on either side, which is not a natural way of achieving velopharyngeal competence and this will likely result in complications for the patient [16].

The study explored the role of sphincter pharyngoplasty and the findings suggest a safe and effective modality leading to reduced hypernasality in 90% of patients with varying degrees. Complication rates in the study group were mild including one patient with transient obstructive sleep apnea symptoms that resolved spontaneously within weeks. One of the most serious and frequent complications following secondary pharyngeal surgery is nasal obstruction and the study finding is comparable to the literature showing that in the immediate postoperative period, some patients develop mild obstructive sleep patterns [17, 18]. On the other hand, polysomnography revealed that pharyngeal flap procedures resulted in obstructive sleep apnea syndrome in 60-80% of patients, which persisted for more than a year and negatively impacted their health [19].

So, sphincter pharyngoplasty was found to effectively improve the rate of velopharyngeal competence while avoiding the complications caused by pharyngeal flap [20].

Nevertheless, sphincter pharyngoplasty carries the risk of postoperative complications, which can include nasal obstruction, difficulty with blowing, decreased growth of the anterior mandible, and the need for additional revision surgery [21]. Another complication reported in the current study was the need for revision surgery in one patient who was 4.5 years old. This is consistent with the findings of Chen *et al.* who found that the majority of complications were in younger patients and cautioned that the benefits of earlier intervention might need to be weighed against that [5]. Literature also suggests that patients who benefit the most are those with moderate to severe hypernasality which is similar to the cohort of patients in this study [22]. On a technical note, the insertion point of the pharyngoplasty flap is suggested to be at the bony landmark at the level of the anterior tubercle of the first cervical vertebrae (C1) which can be palpated intraoperatively, the average postoperative inferior movement of pharyngoplasty tissue is expected to be 6.82 mm, and the flap volume will decrease by 30% on average [23].

Conclusion

In conclusion, patients with cleft lip and palate may suffer from hypernasality, a serious problem that can impair speech and communication and can render a child's speech unintelligible. Furthermore, children with hypernasal speech are usually considered less attractive, less intelligent, and less pleasant. This perception can have a serious impact on a child's social life, but sphincter pharyngoplasty can be a safe and effective surgical approach in correcting VPI in patients with cleft palates.

Acknowledgments: None

Conflict of interest: None

Financial support: None

Ethics statement: The informed consent was obtained for all procedures carried out during the study and the study was conducted in compliance with the ethical standards of the institutional and/or national research committee, as well as the 1964 Helsinki Declaration and its subsequent revisions, or equivalent ethical standards.

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