

SPEECH RESONANCE AFTER SURGICAL MANAGEMENT OF VELOPHARYNGEAL INSUFFICIENCY SECONDARY TO ORTHOGNATHIC SURGERY

Ressonância da fala após tratamento cirúrgico da insuficiência velofaríngea secundária à cirurgia ortognática

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ABSTRACT

Purpose: to investigate the effect of surgical management of velopharyngeal insufficiency on the speech resonance in individuals with cleft palate that presented hypernasality after orthognathic surgery. **Methods:** twenty-three cleft palate subjects underwent surgical management of velopharyngeal insufficiency were analyzed. All patients presented normal speech resonance before orthognathic surgery and underwent surgical management of velopharyngeal insufficiency due to hypernasality observed after orthognathic surgery. Patients were submitted to perceptual speech evaluation for classification of nasality in three situations: 3 days before and five months, on average, after orthognathic surgery and 13 months, on average, after surgical management of velopharyngeal insufficiency. Hypernasality was classified using a 4-point scale: 1=absence of hypernasality; 2=mild hypernasality; 3=moderate, and 4=severe. Hypernasality scores in the three situations studied were compared by Friedman test, with a significance level of 5% and then by Tukey test for multiple comparisons. **Results:** from the total of 23 patients, elimination of the speech symptom after surgical management of velopharyngeal insufficiency was observed in 83% (19/23) of the cases, the mean scores of nasality before orthognathic surgery=1, after orthognathic surgery=3 and after surgical management of velopharyngeal insufficiency=1. There was a statistically significant difference among the three clinical situations studied ($p<0.001$). **Conclusion:** surgical management of velopharyngeal insufficiency was an effective treatment in most cases of velopharyngeal insufficiency following to orthognathic surgery, reestablishing normal speech condition.

KEYWORDS: Cleft Palate; Velopharyngeal Insufficiency; Orthognathic Surgery

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INTRODUCTION

Individuals with congenital cleft lip and palate undergo various surgical procedures during infancy and the resulting scars from such may affect facial bone growth, especially in relation to the maxilla, often causing maxillomandibular disproportion¹.

In general, the typical facial deficiency in individuals with cleft lip and palate is Angle class III malocclusion^{2,3}. In these cases, the face has a concave profile. There is difficulty in labial sealing and the tongue tends to settle on the floor or project

itself near the mandible. This maxillomandibular disproportion has a direct impact on orofacial functions^{3,4}. It is also common to observe oronasal breathing, since the deficiency in maxilla growth alters the nasal floor, reducing the internal dimensions of the nasal cavity and producing mouth breathing⁵.

When orthodontics is not sufficient to correct this alteration, as in cases of great dentofacial deformities, orthognathic surgery becomes necessary^{6,7}. Orthognathic surgery, specifically advancing the maxilla, provides balance between orofacial functions and harmony between the face and skull by repositioning the dental arches.

The most employed type of orthognathic surgery for correcting deficiencies of this nature is the Le Fort I osteotomy that basically consists of separating the maxilla from the bones that form the fixed skeleton of the face, permitting anterior-posterior, vertical and transversal movements with the maxilla^{3,8}. In some cases, surgery may be combined with other procedures, such as mandible retropositioning³ and mentoplasty. Indeed, orthognathic surgery has a potential benefit for speech, since the re-establishing of maxillomandibular equilibrium may improve the production of certain sounds by adjusting teeth and tongue positioning⁹. The surgery also improves breathing because advancing the maxilla increase the nasopharyngeal space and permits verticalization of the nasal septum, which favors nasal ventilation⁶.

However, despite the countless benefits this surgery provides for esthetics and for orofacial functions, manipulation of velopharyngeal structures, which occurs with this procedure, may lead to speech impairment in individuals with cleft lip and palate^{3, 6-8,10}. As the posterior edge of the hard palate and the soft palate joined to it are anteriorized, orthognathic surgery with the advancing of the maxilla may have a deleterious effect on the velopharyngeal mechanism responsible for isolating oral and nasal cavities during speech, increasing the anteroposterior and laterolateral diameter of the velopharyngeal orifice, leading to velopharyngeal insufficiency (VPI) and, consequently, to the appearance, or the worsening, when already existing, of hypernasality and other symptoms of speech^{3,7,10,11}.

The diagnosis of speech symptoms resulting from VPI is frequently done by means of a auditory-perceptual assessment of speech^{12,13}, considered the main indicator of the clinical significance of these symptoms and, as such, an essential part of the clinical diagnosis^{14,15}. The auditory-perceptual assessment permits identifying the disorders and

determining symptoms severity and the effectiveness of treatments conducted^{13,16-18}.

Clinically, hypernasality is the most evident sign of VPI resulting from orthognathic surgery and it corresponds to excess nasal resonance observed during the production of oral sounds, that is, the loss of acoustic energy for the nasal cavity^{14,16,19-23}.

In most people, the correction of VPI resulting from orthognathic surgery requires secondary surgery of the palate. The different techniques used include pharyngeal flap surgery, sphincteroplasty and palatoplasty with intravelar veloplasty. The choice of surgery is based on a pre-operative assessment of velopharyngeal structural and functional conditions, including the extension and mobility of the velum palatinum, pharyngeal walls and type of velopharyngeal closure²⁴⁻²⁷, information obtained from an instrumental exam.

Considering the sequence of indispensable surgical procedures for complete success in treating an individual with cleft lip and palate and maxillomandibular disproportion, this study aimed to investigate the effect of corrective surgery for velopharyngeal insufficiency on speech resonance in individuals with a repaired cleft palate and who began to present hypernasality after orthognathic surgery.

■ METHODS

A retrospective study was conducted at the Laboratory of Physiology, Hospital for Rehabilitation of Craniofacial Anomalies of the University of São Paulo, Bauru-SP with the approval of the local ethics committee for human research, number 291.650.

Casuistics

Speech resonance was analyzed in 23 adults, with repaired cleft palate, of both genders, ranging between 18 and 45 years, who underwent surgical correction of VPI three years, on average, after orthognathic surgery. Of these, 15 underwent pharyngeal flap, 7 underwent palatoplasty with intravelar veloplasty and 1 sphincteroplasty. Only patients who presented balanced oronasal resonance before orthognathic surgery and who began to present hypernasality after orthognathic surgery with maxilla advancement were included in this study. Patients with syndromes and/or other craniofacial anomalies associated with cleft lip and palate and patients who underwent other orthognathic surgeries other than the advancement of the maxilla were not include

Procedures

Results of speech auditory-perceptual assessments conducted in three clinical situations were analyzed: 3 days before orthognathic surgery (PRE OS), 5 months, on average, after orthognathic surgery (POST OS) and, 13 months, on average, after surgical treatment of VPI (POST VPI).

Analysis of the Auditory-Perceptual Assessment of Hypernasality

A live speech assessment was conducted at the Laboratory of Physiology, with hypernasality classified on a 4-point scale, where 1=absence of hypernasality (balanced oronasal resonance), 2=mild hypernasality, 3=moderate hypernasality and 4=severe hypernasality. The score obtained for hypernasality in the three situations was considered.

Data Analysis

Hypernasality was expressed in scores. The hypernasality score in the three situations studied, PRE OS, POST OS and POST VPI was compared using the Friedman statistical test, with a significance level of 5%. Since a significant difference

was verified among the three situations studied, the Tukey test was used for multiple comparisons²⁸.

■ **RESULTS**

According to the speech assessment, in POST OS, all patients (100%) began to present hypernasality, with 22% (5/23) presenting mild hypernasality and 78% (18/23) moderate hypernasality. Of those, 65% (15/23) were referred to pharyngeal flap surgery, 31% (7/23) to palatoplasty with intravelar veloplasty and 4% (1/23) to sphincteroplasty. Table 1 shows the proportion of patients distributed over the 4 categories of hypernasality rating after orthognathic surgery and after VPI surgery.

Data analysis revealed that the median score for PRE OS hypernasality was 1 (indicative of the absence of hypernasality), changed to 3 (indicative of moderate hypernasality) in POST OS and returned to 1 at POST VPI. The statistical comparison between the following situations, PRE OS x POST OS and POST OS x POST VPI, revealed a significant difference (p<0.001), as shown in Table 2.

Table 1 – Proportion of patients according to the hypernasality rating after orthognathic surgery with maxillary advancement and after corrective surgery of velopharyngeal insufficiency

	HYPERNASALITY			
	Absent	Mild	Moderate	Severe
POST OS	0% (0)	22% (5)	78% (18)	0% (0)
POST VPI	83% (19)	8.5% (2)	8.5% (2)	0% (0)

POST OS = after orthognathic surgery; POST VPI = after surgical correction of velopharyngeal insufficiency

Of the total of 23 patients who underwent surgical correction of VPI secondary to OS, 83% (19) re-established their PRE OS speech condition, that is, they again presented balanced resonance; 13% (3), in POST VPI, maintained the degree

of hypernasality acquired in POST OS, and 4% (1) remained presenting mild hypernasality after surgical correction of VPI. Table 3 shows the analysis of auditory-perceptual assessment results after correction of VPI secondary to OS.

Table 2 – Median scores for hypernasality, first and third quartiles and result of statistical comparison between pre and postoperative of orthognathic surgery and after correction of velopharyngeal insufficiency according to the Friedman test and the Tukey test

	HYPERNASALITY				P
	n	Median	1 st Quartile	3 rd Quartile	
PRE OS	23	1.00	1.00	1.00	
POST OS	23	3.00 [#]	3.00	3.00	<0.001*
POST VPI	23	1.00	1.00	1.00	

PRE OS = pre-orthognathic surgery; POST OS = after orthognathic surgery; POST VPI = after surgical correction of velopharyngeal insufficiency

*PRE OS vs POST OS vs POST VPI – Friedman statistical test

[#]Multiple comparisons – Tukey statistical test

Table 3 – Proportion of patients according to hypernasality rating after surgical correction of velopharyngeal insufficiency

	POST VPI Hypernasality			
	Absent	Mild	Moderate	Severe
PF (n=15)	86% (13)	7% (1)	7% (1)	0% (0)
IV (n=7)	71% (5)	14% (1)	14% (1)	0% (0)
SP (n=1)	100% (1)	0% (0)	0% (0)	0% (0)
Total (n=23)	83%(19)	8.5% (2)	8.5% (2)	0% (0)

VPI=Velopharyngeal Insufficiency; PF=Pharyngeal Flap; IV=Intravelar Veloplasty; SP=Sphincteroplasty

■ DISCUSSION

Individuals with cleft lip and palate may have disorders related to maxillary growth that are frequently attributed to scar tissue stemming from primary surgeries of the lip, resulting in a concave facial profile and Angle Class III malocclusion. Correction of this maxillomandibular disproportion is achieved through orthognathic surgery with maxillary advancement. However, due to the increase in velopharyngeal space provided by the manipulation of velopharyngeal structures, this procedure may have a negative effect on speech, resulting in the emergence, or worsening, when already existing, of hypernasality, the most evident and characteristic symptom of velopharyngeal insufficiency. In order to verify the existence of speech disorders, as well as their severity, the auditory-perceptual assessment is frequently used. This procedure is considered the main indicator of the clinical significance of speech symptoms. When velopharyngeal insufficiency is diagnosed, surgical procedures may be indicated for its correction. The most used techniques are the pharyngeal flap, the palatoplasty with intravelar veloplasty and the sphincteroplasty.

Considering that the rehabilitation of an individual with cleft lip and palate and maxillomandibular disproportion requires the elaboration of a

complex treatment plan that involves a sequence of surgical procedures vital to the complete success of treatment, this study aimed to investigate the effect of the surgical correction of VPI on speech resonance in patients who began to present hypernasality resulting from OS. One of the important aspects of this study was the sample characterization. Care was taken to include only patients with the absence of hypernasality before OS and who began to present hypernasal resonance after surgery. The speech auditory-perceptual assessment was used to classify hypernasality before and after OS and after corrective surgery of VPI.

Although several authors have addressed the effects of orthognathic surgery on speech resonance, none has investigated the effect of the surgical correction of VPI caused by orthognathic surgery.

Many years ago, Schendel et al.²⁹ had already suggested that individuals with cleft palate who underwent orthognathic surgery with maxillary advancement have less capacity to adapt to changes that occur in the velopharyngeal region. Based on that, many studies have proved that, although orthognathic surgery provides an equilibrium of orofacial functions, maxillary advancement may lead to velopharyngeal insufficiency due to the increase in velopharyngeal space

induced by the procedure^{3,6,7,23}. In a previous study⁸ conducted at the Laboratory of Physiology, the same manifestation was revealed. An instrumental evaluation demonstrated that orthognathic surgery with maxillary advancement modifies the acoustic characteristics of speech in individuals with cleft lip and palate. According to these authors, those individuals who presented inadequate or marginal velopharyngeal closure before OS, objectively evaluated by measuring the size of the velopharyngeal orifice using the pressure-flow technique, were the ones who presented a deterioration of velopharyngeal function after OS. This is probably due to the extension of the soft palate before surgery and the increase in pharyngeal depth after OS, considered the most important risk factors for VPI after OS, when compared to the quantity of maxillary advancement, as demonstrated through cephalometric tracings and nasopharyngoscopy³⁰. These authors suggested that patients who have a short palate in extension are at a disadvantage in relation to those with an adequate extension. That is because these patients may be unable to totally compensate the structural changes caused by the advancement of hard and soft tissue structures of the maxillary complex induced by OS, even if there is an adaptation of the structures after surgery.

Furthermore, the great distance between the posterior nasal spine and the posterior pharyngeal wall compromises the ability of velopharyngeal structures to adapt after maxillary advancement.

The results of this study show that corrective surgery of VPI was an effective treatment for eliminating of hypernasality in the majority of cases. Attention should be given to the high rate of elimination of hypernasality observed after VPI treatment. Of the 23 patients evaluated, only 4 (17%) remained with hypernasality after VPI treatment, with 2 (8.5%) after pharyngeal flap surgery and 2 (8.5%) after intravelar veloplasty. Of those, two cases were classified as mild hypernasality and two cases as moderate hypernasality. An individual with mild hypernasality, even without presenting complete solution of the symptom after corrective surgery of the VPI, revealed improvement in resonance provided by that procedure, since the individual had moderate hypernasality after OS. For the remaining three, there was no change in the degree of hypernasality after VPI correction. Considering only the group of patients who underwent pharyngeal flap, the normalization index becomes 86%. Compared to other studies involving individuals who underwent pharyngeal flap to correct VPI secondary to primary

palatoplasty, this percentage is even higher than those reported in literature. Some authors observed a 40% elimination of the symptom²⁵, others 55% of normalization of the symptom verified by instrumental exam³¹, others 64%³² and, still others 81%³³. Some of these studies found similar percentages, such as an 87%³⁴ elimination of hypernasality and 88%³⁵ in elimination of velopharyngeal insufficiency.

Likewise, when only considering patients who underwent intravelar veloplasty, the elimination rate of hypernasality was also expressive (71%) and greater than most studies in literature, which reported a 40% absence of hypernasality³⁶, 53%³⁷ and 64%³⁸ of elimination of hypernasality in a study conducted at the Laboratory of Physiology on patients who underwent intravelar veloplasty for correcting VPI. However, superior results of 89% elimination of VPI after secondary palatoplasty, using Furlow technique³⁹ and 82% of hypernasality normalization after Sommerlad technique⁴⁰ were also reported. In this latter case, intravelar veloplasty involved ample dissection of muscle, mobilization and radical repositioning of the velum palatinum muscle, called, by the author, radical intravelar veloplasty, a procedure that differs from most of those reported in literature.

One can speculate that this high success rate in this study after surgical correction of VPI resulting from OS is related to the fact that these individuals already had normal speech resonance prior to orthognathic surgery. It is possible the proper functioning of the velopharyngeal sphincter, present throughout the individual's growth, favored surgical treatment of velopharyngeal insufficiency, causing it to return to the condition of balanced speech resonance. This success rate is much greater when compared to individuals who began to present VPI following primary palatoplasty.

It is important to underscore that for those who did not benefit from VPI surgery, adaptation of palate prosthesis may be considered for obtaining normalization of speech resonance.

The findings of this study reinforce the importance of speech pathology follow-up of surgical results of individuals with cleft lip and palate in different phases of treatment.

■ CONCLUSION

Corrective surgery of VPI was an effective treatment in cases of VPI secondary to orthognathic surgery since, in most patients, balanced oronasal resonance was re-established.

RESUMO

Objetivo: investigar o efeito da cirurgia corretiva da insuficiência velofaríngea sobre a ressonância da fala de indivíduos nascidos com fissura palatina que passaram a apresentar hipernasalidade, após a cirurgia ortognática. **Métodos:** foram analisados os resultados da ressonância de 23 pacientes com fissura labiopalatina corrigida cirurgicamente que apresentavam ressonância oronasal equilibrada antes da cirurgia ortognática e foram submetidos à correção cirúrgica da insuficiência velofaríngea, devido ao aparecimento de hipernasalidade após a cirurgia ortognática. Os pacientes foram submetidos à avaliação perceptivo-auditiva da fala para classificação da hipernasalidade, em três situações: 3 dias antes e 5 meses, em média, após a cirurgia ortognática e, 13 meses, em média, após a cirurgia corretiva da insuficiência velofaríngea. A hipernasalidade foi classificada utilizando-se escala de 4 pontos: 1=ausência de hipernasalidade; 2=hipernasalidade leve; 3=moderada e 4=grave. Os escores de hipernasalidade nas três situações estudadas foram comparados por meio do teste de Friedman, com nível de significância de 5% e, posteriormente, pelo teste de Tukey para comparações múltiplas. **Resultados:** do total de 23 pacientes, houve eliminação do sintoma de fala após a correção da insuficiência velofaríngea em 83% (19/23), sendo os escores médios de nasalidade antes da cirurgia ortognática=1, após a cirurgia ortognática=3 e após a correção da insuficiência velofaríngea=1. Houve diferença estatisticamente significativa entre as três situações estudadas ($p<0,001$). **Conclusão:** a cirurgia corretiva da insuficiência velofaríngea foi um tratamento efetivo na grande maioria dos casos que apresentaram hipernasalidade secundária à cirurgia ortognática, com retorno à condição de normalidade.

DESCRITORES: Fissura Palatina; Insuficiência Velofaríngea; Cirurgia Ortognática

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