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Influence of pharyngeal flap surgery on nasality and nasal scores of nasal sounds production in individuals with cleft lip and palate

Influência do retalho faríngeo sobre a nasalidade e a nasalância na produção de sons nasais em indivíduos com fissura labiopalatina

ABSTRACT

Objective: To verify the influence of pharyngeal flap surgery on the management of velopharyngeal insufficiency on nasality and speech nasalance on nasal sound production in individuals with cleft lip and palate. **Methods:** Prospective study in 159 individuals with repaired cleft palate±lip, of both genders, aged 6 to 57 years old. All the participants presented residual velopharyngeal insufficiency and were submitted to pharyngeal flap surgery. Perceptual speech evaluation and nasometric assessment were performed before and after (14 months on average) the pharyngeal flap surgery. Hyponasality was rated as absent or present, and nasalance scores were determined by means of nasometer using nasal stimuli, with a cutoff score of 43% used as the lowest limit of normality. Nasality and nasalance were compared before and after surgery ($p<0.05$). **Results:** On the basis of correlation between both the methods used, perceptual hyponasality was observed in 14% of the individuals, whereas nasalance scores indicating hyponasality (<43%) were obtained in 25% of the patients after surgery. **Conclusion:** Pharyngeal flap surgery influenced the production of nasal sounds, causing hyponasality in a significant proportion of individuals. The presence of this speech symptom can also be an indicator of upper airway obstruction caused by pharyngeal flap, which should be investigated objectively and prudently postoperatively.

RESUMO

Objetivo: Verificar a influência da cirurgia de retalho faríngeo para a correção da insuficiência velofaríngea sobre a nasalidade e a nasalância da fala na produção de sons nasais de indivíduos com fissura labiopalatina. **Métodos:** Estudo prospectivo realizado com 159 indivíduos com fissura de palato±lábio reparada, de ambos os gêneros, com idades entre 6 e 57 anos. Todos os participantes apresentavam insuficiência velofaríngea residual com indicação para cirurgia de retalho faríngeo e foram submetidos à avaliação perceptivo-auditiva e nasométrica da fala, antes e após (14 meses, em média) a cirurgia de retalho faríngeo. A hiponasalidade foi classificada perceptivamente em ausente ou presente e a nasalância foi determinada por meio do nasômetro, utilizando amostras de fala com sons predominantemente nasais, a fim de se estimar a hiponasalidade. O valor de 43% foi utilizado como limite inferior de normalidade. A nasalidade e a nasalância foram comparadas antes e após a cirurgia ($p<0,05$). **Resultados:** A hiponasalidade perceptiva foi observada em 14% dos indivíduos, enquanto que os valores de nasalância sugestivos de hiponasalidade (<43%) foram obtidos em 25% deles após a cirurgia, havendo correlação entre os métodos utilizados. **Conclusão:** A cirurgia de retalho faríngeo influenciou na produção dos sons nasais, causando hiponasalidade na fala de parcela significativa dos indivíduos. A presença deste sintoma de fala pode ser ainda um indicador de obstrução das vias aéreas superiores provocada pelo retalho faríngeo, que deve ser investigada de forma objetiva e criteriosa no pós-operatório.

Study carried out at the Laboratory of Physiology of the Hospital for Rehabilitation of Craniofacial Anomalies, Universidade de São Paulo – USP – Bauru (SP), Brazil.

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Conflict of interests: nothing to declare.

INTRODUCTION

The pharyngeal flap surgery has been one of the methods used in the correction of residual velopharyngeal insufficiency (VPI) from the primary surgical closure of the cleft palate. The technique involves the construction of a myomucous flap between the posterior pharyngeal wall and the soft palate, which allows, by the reduction of the nasopharyngeal space, the adequacy of the velopharyngeal closure. Consequently, speech characterized by hypernasality, nasal air emission, and weak intraoral pressure may benefit from surgery⁽¹⁻⁸⁾.

With respect to the respiratory aspect, the pharyngeal flap may be associated, in some cases, with the occurrence of obstruction of the upper airway, causing deleterious symptoms such as obstructive sleep apnea, oral breathing, and hyponasality, all arising from an overcorrection of the velopharyngeal dysfunction⁽³⁾. To verify the long-term effects of the pharyngeal flap, one study observed, through aerodynamic measures, a reduction in nasopharyngeal dimensions⁽¹¹⁾. In a previous study by the same group of researchers, the high incidence of hyponasality in speech, associated with respiratory complaints after pharyngeal flap surgery, had already been identified⁽³⁾. International research also found symptoms of nasal obstruction and hyponasality after pharyngeal flap surgery^(7,10). A retrospective study also compared the speech results after pharyngeal flap surgery and noted that the perceptual and auditory evaluation of speech detected hyponasality in 22% of the sample studied after surgery, in addition to the symptoms of obstructive sleep apnea⁽¹²⁾.

Considering the hypothesis of an overcorrection of VPI through the pharyngeal flap, causing obstruction of the upper airway, the study aimed to analyze the impact of this surgery on the production of nasal sounds in the speech of individuals with cleft lip and palate by using the perceptual and nasometric methods.

METHODS

This study was approved by the Research Ethics Committee of the Hospital for Rehabilitation of Craniofacial Anomalies of Universidade de São Paulo (Protocol No. 220/2005) and carried out after participants signed the Free and Informed Consent Form. The study included 159 individuals (of both genders and aged between 6 and 57 years old) with cleft palate, with or without cleft lip, who were submitted to primary surgeries. All the participants had residual VPI and surgical indication for pharyngeal flap. Individuals who had physical and/or mental disability, obvious neurological problems, nasal congestion upon examination, and extensive residual fistulas and who had undergone nasal and orthognathic surgery during the period of examinations were not included. The subjects were submitted to perceptual and nasometric evaluation of speech two days (on average) before surgery and 14 months or so after surgery.

The perceptual and auditory evaluation of hyponasality was performed by an experienced examiner using spontaneous speech samples and repetition of words and sentences with a

predominance of nasal sounds, used in the medical routine⁽¹³⁾. Hyponasality was classified as absent or present.

The nasalance (acoustic correlates of nasality) was determined by using a nasometer, Model 6200-3 by IBM (Version 30-02-3.22)⁽¹⁴⁾, during the reading of a set of five sentences in Brazilian Portuguese that had predominantly nasal sounds to identify hyponasality: “domingo tem neblina”, “o passarinho veio a minhoca”, “Miriam lambeu o limão”, “o menino era bonzinho”, and “Flavinho chamou João”⁽¹⁵⁾. Individuals who couldn't read were asked to repeat the sentences after the examiner's model. For analysis purposes, the normal lower limit score considered was 43%, that is, values below this were considered indicative of hyponasality⁽¹⁶⁾.

Comparison of hyponasality between the pre- and post-surgery periods was verified by the paired *t*-test, and the Wilcoxon's test was done for nasality⁽¹⁷⁾, taking the significance level of 5%. For the correlation between the methods of evaluation, Spearman's correlation was used⁽¹⁸⁾. To know the comparison between nasalance values and the absence and presence of perceptual hyponasality, the Tukey's test criteria were used⁽¹⁹⁾.

RESULTS

Prior to the pharyngeal flap surgery, the perceptual evaluation found that no patient had hyponasality in speech. Confirming the perceptual findings, nasometry noted that all (100%) individuals showed normal nasalance values, above 43%, in the production of nasal sounds. After pharyngeal flap surgery, perceptual evaluation found hyponasality in the speech of 14% (22/159) of the subjects, while nasometric evaluation found nasalance scores below normal, which suggests hyponasality in 25% (40/159) of the subjects.

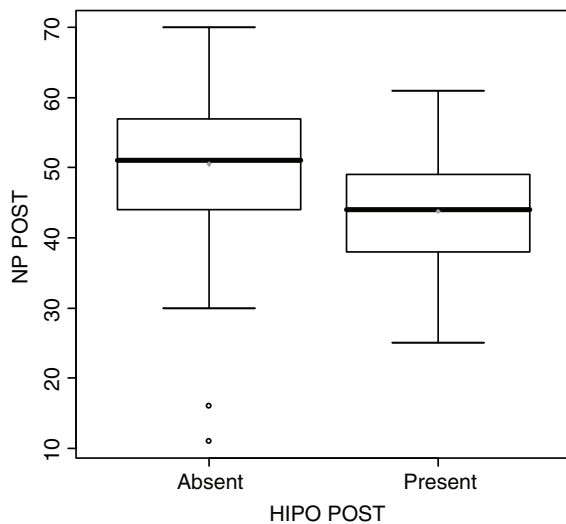
Mean values±standard deviation (SD) of nasalance before and after surgery were 59±8% and 50±10%, respectively, with a difference between them ($p<0.001$).

For individuals with the presence of perceptual hyponasality after surgery, the mean score of nasalance±SD was 44±9%. For those with no hyponasality, the mean ± SD of nasalance increased to 51±10%, with significant differences ($p=0.002$) between the two values regarding the presence and absence of perceptual hyponasality symptoms (Figure 1).

One can also observe a significant correlation ($p=0.001$) between the perceptual and auditory assessment and the nasometric assessment of speech, when comparing the results of these two methods.

DISCUSSION

The pharyngeal flap is a surgical technique most studied in literature, devoted to VPI correction in individuals with cleft palate, due to its effectiveness^(1-8,20). However, studies also show that the pharyngeal flap may present risks to upper airway by the very nature of the procedure, which creates a mechanical obstruction to airflow, thus reducing the airspace. A study carried out in the Laboratory of Physiology of the Hospital for



The horizontal lines represent the median value of post-surgical nasometry, the first and third quartiles, and the maximum and minimum values, excluding the discrepant values, according to the Tukey's test criteria⁽¹⁹⁾

Figure 1. Comparison between nasalance values (%) after pharyngeal flap surgery (NP POST) observed in subjects with absence and presence of hyponasality (HIPO POST) according to perceptual and auditory evaluation.

Rehabilitation of Craniofacial Anomalies shows that the pharyngeal flap decreases the dimensions of the nasopharynx, which results in exacerbating respiratory problems and mouth breathing, snoring, and feeling of obstructed breathing during sleep in 36% of patients undergoing surgery⁽¹¹⁾.

The perceptual and auditory nasality assessment is an important method of judgment of speech as it provides characteristics of phone production and information about the velopharyngeal function⁽²¹⁾, but is subject to errors due to its subjectivity. Therefore, in this study, authors decided to combine this assessment method with the instrumental method.

Among the objective methods to evaluate the results of the procedures used for the correction of VPI is nasometry, applied to quantify the perceptual judgments of hypernasality and hyponasality⁽²²⁻²⁴⁾ and complement the diagnosis obtained by evaluation of speech^(25,26). This technique allows the estimation of the velopharyngeal function indirectly by measuring the nasalance, which is the amount of acoustic energy in the nasal cavity during speech. Gauging the nasalance should be performed during the production of standardized speech samples with essentially oral phones for the diagnosis of hypernasality or predominantly nasal sounds for the diagnosis of hyponasality⁽²⁷⁾, the latter being the procedure used in this study.

Thus, this study observed the hyponasal resonance after pharyngeal flap surgery in 14% of individuals evaluated. Slightly higher proportion was noted in another study, which evaluated the effect of pharyngeal flap surgery in speech and the incidence of hyponasality in 20 individuals, using the same methodology, finding six (30%) participants with hyponasality after surgery,

associated with respiratory complaints. The authors pointed out overcorrection of VPI as a possible cause⁽³⁾.

It should be considered that in the immediate postoperative period, the surgical edema occurs, which can cause momentary airway obstruction and symptoms such as hyponasal resonance, which generally disappear within the first two to six weeks after surgery⁽²⁸⁾. In this study, subjects were evaluated, on average, 14 months after the surgery and still had hyponasality, which led to the conclusion that it was a permanent symptom after surgery, given the long term.

Several studies have examined the effects, in the long run, of the pharyngeal flap with respect to respiratory complaints and nasal obstruction. One study showed that the resulting nasal obstruction of the pharyngeal flap can cause changes in breathing mode and speaking, such as the onset of hyponasality⁽¹⁰⁾. In another study, the authors found the onset of respiratory complaints after pharyngeal flap surgery in 36% of cases, about a year after surgery⁽¹¹⁾.

According to clinical experience, it is observed that a change in the resonance of speech in the presence of hyponasality may be an indicative factor of airway obstruction and should be investigated. The literature shows that the onset of respiratory symptoms as a result of airway obstruction is the main cause for indication of surgical revision of the pharyngeal flap, and a resection of the pharyngeal flap is often required^(3,11).

Perceptual findings of this study identified 14% of patients with results of hyponasality after pharyngeal flap surgery, while the instrumental method identified 20%. This difference can be explained by the subjectivity of the perception method, which is opposed to the greater accuracy aimed by the objective. The interference of other variables related to speech pattern, such as intonation, speed, pitch, loudness, articulation type, and even the possibility of a mixed resonance (hypernasality and hyponasality in the same emission), can confuse the evaluator in determining a specific feature such as hyponasality. Therefore, the combined use of the methods is fundamental even when the perceptual evaluation is performed by experienced professionals.

This proportion of individuals with hyponasality should be monitored through periodic assessments regarding complaints and respiratory symptoms, as respiratory complaints may reflect a condition of obstructive sleep apnea and should be investigated, including using objective measures such as polysomnography⁽¹¹⁾.

Comparing the nasalance values obtained in this study to those of normality, it is observed that even after surgery, the mean value of the 159 individuals remained above the 43%, considered the lower limit of normality. As for individuals detected perceptually with presenting postoperative hyponasality, this average value was reduced to 44% (range of 50 to 44%), very close to the normal range. This result shows in favor, again, of the use of the instrumental method as a confirmation of the listener's perception.

Despite the existence of high correlation between the evaluation methods for the identification of hyponasality, the nasometry was more sensitive in the identification of this

symptom as it reinforces the importance of its use as a tool in the detection of a possible airway obstruction through speech, especially after pharyngeal flap surgery, before the indication of more invasive tests. Speech pathologists should be aware of this speech symptom even if it is not noticeable to the patient, and individuals must be monitored carefully, since the change of resonance can suggest more serious respiratory obstructions.

CONCLUSION

The pharyngeal flap surgery influenced the production of nasal sounds, causing hyponasality in a large portion of individuals. The presence of this speech symptom can also be an indicator of upper airway obstruction caused by the pharyngeal flap, which should be investigated objectively and prudently postoperatively.

**APF is the lead author and participated in the original study conception, data collection, data analysis and drafting of the article; FF participated in the statistical analysis and drafting of the article; RPY participated in data collection and drafting of the article and IEKT is the leader of the research group, participated in the original study conception and drafting of the article.*

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