Original Article

Artigo Original

Surgical outcome of pharyngeal flap surgery and intravelar veloplasty on the velopharyngeal function

Resultado cirúrgico do retalho faríngeo e da veloplastia intravelar sobre a função velofaríngea

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Keywords

Cleft palate
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ABSTRACT

Purpose: To investigate the postoperative outcomes of pharyngeal flap surgery (PF) and secondary palatoplasty with intravelar veloplasty (IV) in the velopharyngeal insufficiency management regarding nasalance scores and velopharyngeal area. **Methods:** Seventy-eight patients with cleft palate±lips submitted to surgical treatment for velopharyngeal insufficiency, for 14 months on an average, were evaluated: 40 with PF and 38 with IV, of both genders, aged between 6 and 52 years old. Hypernasality was estimated by means of nasalance scores obtained by nasometry with a cutoff score of 27%. The measurement of velopharyngeal orifice area was provided by the pressure-flow technique and velopharyngeal closure was classified as: adequate (0.000–0.049 cm^2), adequate/borderline (0.050–0.099 cm^2), borderline/inadequate (0.100–0.199 cm^2), and inadequate (≥0.200 cm^2). **Results:** Absence of hypernasality was observed in 70% of the cases and adequate velopharyngeal closure was observed in 80% of the cases, in the PF group. In the IV group, absence of hypernasality was observed in 34% and adequate velopharyngeal closure was observed in 50% of the patients. Statistically significant differences were obtained between the two techniques for both evaluations. **Conclusion:** PF was more efficient than the secondary palatoplasty with IV to reduce hypernasality and get adequate velopharyngeal closure.

Descritores

Fissura palatina
Insuficiência velofaríngea
Procedimentos cirúrgicos operatórios
Fala
Rinomanometria

RESUMO

Objetivo: Investigar os resultados cirúrgicos do retalho faríngeo (RF) e da palatoplastia secundária com veloplastia intravelar (VI) no tratamento de indivíduos com insuficiência velofaríngea (IVF) secundária quanto ao escore de nasalância e à área velofaríngea. **Métodos:** Foram avaliados 78 pacientes com fissura de palato±lábio submetidos ao tratamento cirúrgico da IVF há 14 meses, em média, sendo 40 com RF e 38 com VI, de ambos os sexos, faixa etária de seis a 52 anos. A hipernasalidade foi estimada a partir da medida de nasalância obtida por meio da nasometria, considerando-se o escore de 27% como limite de normalidade. A medida da área do orifício velofaríngeo foi obtida por meio da técnica fluxo-pressão, sendo o fechamento velofaríngeo classificado em: adequado (0,000–0,049 cm^2); adequado/marginal (0,050–0,099 cm^2); marginal/inadequado (0,100–0,199 cm^2); e inadequado (≥0,200 cm^2). **Resultados:** Ausência de hipernasalidade foi observada em 70%, e fechamento velofaríngeo adequado em 80% dos casos no grupo RF. No grupo VI, ausência de hipernasalidade foi observada em 34% e fechamento velofaríngeo adequado em 50% dos casos. Diferenças estatisticamente significantes foram obtidas entre as duas técnicas cirúrgicas nas duas modalidades de avaliação. **Conclusão:** A cirurgia de retalho faríngeo foi mais eficiente do que a palatoplastia secundária com veloplastia intravelar na redução da hipernasalidade e na adequação do fechamento velofaríngeo.

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INTRODUCTION

The adequate velopharyngeal closure is essential for the balance of oronasal resonance during speech production. The complete velopharyngeal closure occurs from the simultaneous movement of the soft palate and the lateral and posterial pharyngeal walls, which ensures the complete separation between the oral and nasal cavities during the production of oral speech sounds[1]. The term velopharyngeal insufficiency (VPI) refers to a structural flaw in velopharyngeal closure. In this case, there is a communication between the oral and nasal cavities, so, part of the air current is diverged to the nasal cavity during the production of oral speech sounds, leading to the appearance of characteristic symptoms, such as hypernasality[2].

Among the several surgical techniques employed for the correction of VPI are the pharyngeal flap (PF) surgery, and the secondary palatoplasty with intravelar veloplasty (IV)[3–5]. The choice of surgical technique should be based on criteria such as severity of VPI, extension of the velopharyngeal gap, and type of velopharyngeal closure, determined by means of clinical and instrumental evaluations[1,6]. PF surgery is indicated in cases where VPI is considered to be severe, that is, when the nasopharyngoscopy examination shows a large velopharyngeal flaw. Despite the high rates of success in the reduction or elimination of speech symptoms resulting from the VPI, the PF surgery changes the anatomy of the velopharyngeal region with the consequent change in nasopharyngeal permeability, which may lead to unwanted respiratory symptoms[5,7,8]. Because of this, the literature has defended the performance of surgical techniques that enable velopharyngeal closure in a condition that is closest to normal, without changing the anatomy of the velopharyngeal sphincter, thus reducing morbidity risks[8-10].

One of the procedures used for this purpose is the IV, and its goal is to reposition the muscles of the soft palate as posteriorly as possible to offer it more mobility, with the consequent improvement of the velopharyngeal competence. This procedure is used in secondary palatoplasty, and it may be associated with several surgical techniques, such as von Langenbeck and Furlow[4,9]. The main criteria to be considered in the indication of IV is the anterior insertion of palate muscles and the presence of a small velopharyngeal gap with good mobility of the soft palate[2,6,9,11].

Even though the PF surgery and the IV are very much used in the surgical treatment of VPI, there were a few studies comparing quantitatively the speech results between the two surgical techniques. In one of them[6], the authors made a retrospective analysis of the pre and postsurgical resonance of 24 patients with marginal VPI submitted to Furlow palatoplasty and 25 patients with severe VPI submitted to PF surgery and verified similar results after the procedures. They concluded that patients with severe VPI treated with PF, and those with marginal VPI treated with secondary Furlow palatoplasty, can be equally benefited from surgical treatments.

It is consensual in the literature that PF is indicated for patients with severe VPI, and secondary palatoplasty with IV for cases of marginal VPI[1,2,6,9,11]. Therefore, the objective was to investigate the surgical results of PF and secondary palatoplasty with IV in the treatment of individuals with secondary VPI as to nasalance score and velopharyngeal area.

METHODS

Sample

This study was approved by the Ethics Committee on Human Research of the Hospital for Rehabilitation of Craniofacial Anomalies of the Universidade de São Paulo (USP), protocol number 307/2011. All the patients or legal responsible parties who agreed to participate in this study signed the informed consent.

Seventy-eight patients were assessed, aged from 6 to 52 years old (mean age of 21±10 years old), with repaired cleft palate, with or without associated cleft lip, already submitted to secondary palate surgery for the correction of VPI. The group who underwent the PF surgery (PF group) comprised 40 individuals, 27 being male and 13 being female participants. The group submitted to secondary IV (IV group) comprised 38 individuals, 19 being male and 19 being female participants.

Patients were submitted to nasometric and aerodynamic assessment for an average of 14 months after the surgery. According to the criteria adopted in this study, all of those submitted to PF surgery presented large or medium velopharyngeal gap, and those submitted to IV presented small velopharyngeal gap, according to the presurgical nasopharyngoscopic assesment.

The surgeries were performed by four experienced plastic surgeons of the team in the Hospital for Rehabilitation of Craniofacial Anomalies. In all the cases submitted to PF, the superiorly based pharyngeal flap technique was employed, as proposed by Sanvenero-Rosselli[2]. In cases submitted to IV, the procedure to reposition the muscles of the soft palate was conducted according to the proposal by Braithwaite[2], combined or not to the techniques of von Lagenbeck and Furlow.

Procedures

Nasometric assessment of speech

Nasalance was determined using a Nasometer, model 6200-3 IBM (Kay Elemtrics Corp., NJ, USA; software version 30-02-3.22)[12], during the reading of a set of five sentences containing exclusively oral sounds (oral text)[13]. A score of 27% was considered as the normal limit, that is, values higher than 27% indicated hypernasality[14]. Figure 1 shows the representative scheme of nasometry.

Aerodynamic assessment of speech (pressure-flow technique)

The velopharyngeal orifice area was determined by the pressure-flow technique[15] (PERCI-SARS system, version 3.30, Microtronics Corp., NC, USA) during the production of the sound /p/ inserted in the word "rampa". Based on the obtained values of velopharyngeal area, velopharyngeal closure was classified into: adequate (0.000–0.049 cm^2), adequate/marginal (0.050–0.099 cm^2), marginal/inadequate

(0.100–0.199 cm^2), and inadequate (≥0.200 cm^2) [16]. Figure 2 presents the configuration of the system.

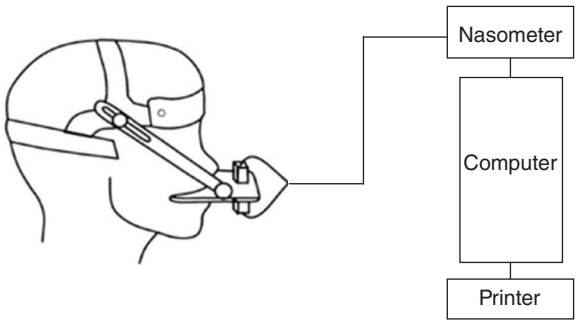
Data analysis

Values of nasalance and velopharyngeal area were compared between the two surgical techniques, by means of the Student's *t*-test. Values of p<0.05 were accepted as significant.

RESULTS

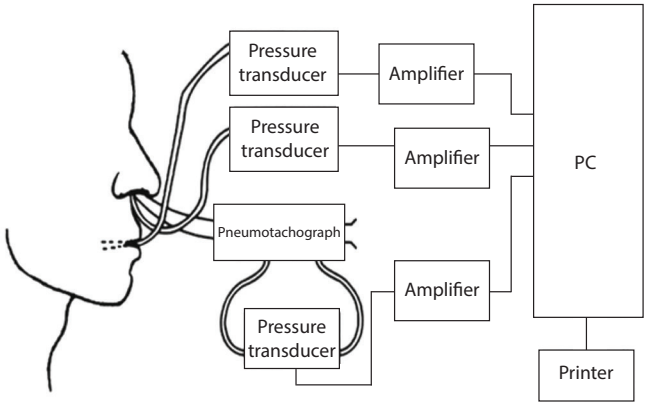
Nasometric assessment of speech

Mean nasalance obtained in the PF group was 23±14%, and in the IV group, 32±12%. Statistical analysis showed that the mean nasalance of the PF group was significantly lower than the IV group (p=0.001). It was observed that the nasalance value for the oral text in the PF group was within the normal limit (≤27%), which was not true for the IV group, as demonstrated in Table 1. By individually analyzing the results, it was possible to observe a higher percentage of patients with normal values in the PF group (70%; n=28) compared to the IV group (34%; n=13).



Source: Trindade et al.[14]

Figure 1. Instrument used to determine nasalance (Nasometer 6200-3 IBM, Kay Elemetrics Corp., Lincoln Park, NJ, USA)



Source: Trindade et al.[14]

Figure 2. Instrument to determine velopharyngeal orifice area (PERCI-SARS System, Microtronics Corp., Chapel Hill, NC, USA)

Aerodynamic assessment of speech

Table 2 indicates that the mean velopharyngeal area in the PF group was 0.034±0.070 cm^2, and in the IV group, 0.113±0.220 cm^2. Statistical analysis showed that the velopharyngeal area obtained in the PF group was significantly smaller than the one in the IV group (p=0.002).

When determining the degree of velopharyngeal closure from the values of valopharyngeal area, it was observed that, on an average, the PF group presented adequate velopharyngeal closure value, while the IV group presented marginal to inadequate velopharyngeal closure.

The individual data analysis showed that, in the PF group, 80% (32/40) of the patients presented adequate velopharyngeal closure, 10% (4/40) adequate to marginal, 7.5% (3/40) marginal to inadequate, and 2.5% (1/40) inadequate. In the IV group, percentages were 50% (19/38) of adequate closure, 21% (8/38) adequate to marginal, 16% (6/38) marginal to inadequate, and 13% (5/38) inadequate.

DISCUSSION

PF and secondary palatoplasty with IV are commonly used for the correction of residual VPI. Both present advantages and disadvantages, therefore, the indication of the best procedure to be employed in each case is based on the assessment of speech and velopharyngeal function, conducted prior to surgery by a multidisciplinary team. In this study, all the patients submitted

Table 1. Mean (±standard deviation), minimum, and maximum values of nasalance obtained during the reading of an oral text in the nasometric assessment after pharyngeal flap surgery and intravelar veloplasty

	Nasalance (%)		
	Mean±SD	Minimum value	Maximum value
PF (n=40)	23±14*	4	63
IV (n=38)	32±12	8	50

*Statistically significant difference p=0.001 (Student's *t*-test).
Caption: PF = pharyngeal flap; IV = intravelar veloplasty; SD = standard deviation

Table 2. Mean (±standard deviation), minimum, and maximum values of velopharyngeal area obtained in the aerodynamic assessment during the production of the phoneme /p/ inserted in the word /"rampa"/, in the group with pharyngeal flap and intravelar veloplasty

	Velopharyngeal area (cm^2)		
	Mean±SD	Minimum value	Maximum value
PF (*n*=40)	0.034±0.070*	0.000	0.359
IV (*n*=38)	0.113±0.220	0.000	1.166

*Statistically significant difference p=0.002 (Student's *t*-test).
Caption: PF = pharyngeal flap; IV = intravelar veloplasty; SD = standard deviation

to PF presented severe VPI, and those submitted to IV presented with marginal VPI, according to clinical assessment and preoperative nasopharyngoscopy.

Nasometry showed higher results for PF in relation to IV. The PF group presented, on an average, normal nasalance values, while the IV group remained with significantly higher mean nasalance values, indicating hypernasality. Results also pointed out to the normalization of nasalance in 70% of the patients submitted to PF and 34% of those who underwent IV, and this difference was statistically significant. The high proportion of patients with normal nasalance values, after PF, was superior to the numbers found by other authors: 35%[17], 55%[18] and, also 35 and 57% of normality, reported among patietns with coronal and non-coronal velopharyngeal closure pattern, respectively[19]. The normalization of nasalance after the IV was reduced in comparison to PF. Higher proportions of nasalance normalization (56%) were observed in a study using the emission of an isolated high vowel and of a syllable containing a high vowel as speech sample[3].

The superiority of PF was also confirmed by the pressure-flow technique, which showed that most patients submitted to this surgical technique presented adequate velopharyngeal closure, while among patients submitted to IV the mean velopharyngeal closure was classified as marginal/inadequate. Besides, it was possible to observe that an expressive percentage of 80% of patients with PF presented adequate velopharyngeal closure in relation to 50% of those with IV. Lower proportions — 48 and 63% — of velopharyngeal closure adequation were found after PF in previous studies[18,20]. Other studies, however, reported adequate velopharyngeal closure at a higher proportion (93%) with PF associated with IV[21].

The adequation of velopharyngeal closure after IV, assessed by the pressure-flow technique, had been previously investigated by the authors of this study, when they observed 47% of adequate velopharygeal closure[22], which is a very similar proportion to that verified in this study. The findings of the aerodynamic assessment suggest that the reduction of the velopharyngeal orifice after the construction of the PF was more efficient to promote the adequate velopharyngeal closure than the reconstruction of the muscle sling after the posterior secondary palatoplasty with IV.

The superiority of PF becomes clearer if we consider that these patients were in worse preoperative velopharyngeal conditions, that is, they presented failures of the velopharyngeal closure larger than those submitted to IV. This result leads us to disagree with the conclusion of some authors that some patients with severe VPI treated with PF and patients with marginal VPI treated with secondary Furlow palatoplasty may equally benefit from the surgery outcomes[6].

The fact that IV improves palatal function, even if not leading to the complete resolution of the velopharyngeal function, makes us think about the possibility of using IV as a first attempt to correct VPI, and not as a definitive solution. The retropositioning of the palatal muscles sling can improve the movement of elevation and posteriorization of the soft palate in a way that even if patients need a future PF, they can present with a more favorable velopharyngeal condition, thus preventing the indication for a very large flap, for instance, and the respiratory effects resulting from the decreased nasopharynx dimensions after surgery[5,7]. Even if it was not the objective of this study, respiratory complaints of patients treated with both surgical techniques were investigated as part of the protocol of service routine. Generally, it was possible to verify that many patients with PF (65%) reported oral respiratory complaints, snoring, and difficulties to breathe while sleeping in comparison to those submitted to IV (21%). For these cases, the necessary actions were conducted.

CONCLUSION

PF was more efficient than IV for the reduction of hypernasality and get adequate velopharyngeal closure in individuals with residual VPI.

**DAB is the main author and was in charge of data collection and analysis, as well as writing the article; RHS collaborated with data collection and tabulation; APF followed-up data collection, collaborated with data analysis, and writing of the article; IEKT participated in writing of the article; RPY lead the group of researchers and was responsible for the study project and design, as well as the general orientation of the steps of execution and elaboration of the manuscript.*

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