Chapter 7

VELOPHARYNGEAL FUNCTION AND SPEECH. ANALYSIS OF SURGICAL OUTCOME IN YOUNG ADULTS WITH REPAIRED CLEFT PALATE AND RESIDUAL VELOPHARYNGEAL INSUFFICIENCY

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ABSTRACT

The protocol for the evaluation and treatment of young adults with cleft palate at a Cleft Palate Center in Santiago, Chile is described. All the patients studied with this protocol were young adults present with residual velopharyngeal insufficiency (VPI) after palatal repair. All patients underwent a complete speech evaluation. Surgery for correcting VPI was planned individually in each case according to findings of videonasopharyngoscopy (VNP). All cases were operated on with a superiorly based pharyngeal flap. The surgical procedures were performed by the same surgeon in all cases.

Surgical outcomes of velopharyngeal function (VPF) were analyzed with postoperative VNP and a speech evaluation.

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Patients with normal articulation before surgery showed adequate VPF one month after the pharyngeal flap was performed. None of these cases required Speech & Language Pathology (SLP) treatment.

None of the patients with compensatory articulation disorder (CAD) preoperatively showed adequate VPF one month after the pharyngeal flap operation. All these cases required SLP treatment including biofeedback with VNP. After a six-month period of SLP treatment and biofeedback, sixty – three percent of these patients achieved similar results as the group of patients with normal articulation before surgery. After a follow-up period of 6 months, a total of 79% of the cases showed satisfactory results of VPF during speech. Most patients showed good compliance and motivation for treatment.

Keywords: Cleft palate, Speech, Surgery

INTRODUCTION

Velopharyngeal Insufficiency (VPI) refers to any structural alteration of the soft palate and the pharyngeal walls where there is not enough tissue for a complete closure of the velopharyngeal sphincter (VPS) during the production of oral phonemes [1]. The percentage of patients with residual VPI following cleft palate (CP) repair varies from center to center, but in general it is estimated that 10 - 20% of patients with cleft palate will present with VPI post palatal repair. [2-4]

The presence of residual VPI affects various parameters of speech and voice resonance. The characteristic symptomatology is the presence of obligatory errors including: hypernasality, nasal emission, weak oral consonants and compensatory articulation disorder (CAD). [5]

Several surgical techniques for correcting VPI have been described. The selection of a specific technique for each patient depends on closure pattern as observed by videonasopharyngoscopy (VNP) and videofluoroscopy (VF). The most commonly used surgical techniques for correcting VPI include: Modified Orticochea's pharyngoplasty or lateral flaps operation; surgical increase of the posterior pharyngeal wall; superiorly based pharyngeal flap; and secondary surgical repair of velar muscles. [6]

It has been reported that surgery for correcting VPI yields better outcomes when it is performed at an early age, ideally before entering the preschool system, when communication demands increase. At this stage, around 4 years of age, children have usually acquired a greater number of phonemes and

show better compliance for performing procedures which allow a full assessment of VPF including an instrumental evaluation of the VPS through VNP and VF. It has been reported that when VPI is corrected early, there is an improvement in over 90% of the cases. [7]

CAD refers to speech errors derived from unconscious patient attempts to produce a phoneme, usually a high intraoral pressure consonant sound. In these cases, articulation placement is displaced closer to the sound source, usually to the pharynx or the glottis. The most common compensatory errors are: the glottal stop and the pharyngeal fricative. [1] CAD is present more frequently in patients with severe VPI [8]. CAD significantly affects intelligibility.

In cases of CAD, prognosis is less favorable since speech sound errors are incorporated into Linguistic rules. Thus, it becomes much more difficult to change brain motor engrams, affecting surgical outcome and extending the total time of Speech & Language Pathology (SLP) intervention [1]. It has been described that articulatory placement and manner are more malleable at earlier ages. Therefore, even in cases of CAD, surgical correction of VPI can decrease total time of SLP treatment. Also, correcting hypernasality can provide more confidence for developing speech skills and abilities. [9, 10]

Currently, there are health programs and international organizations that promote and support early and timely care of patients with cleft palate (CP). Centers with more experience and better results usually perform the primary surgeries of lip and palate before one year of age. Early repair of the palate is recommended in order to minimize speech disorders. [11] Unfortunately there are patients that for various reasons do not have access to multidisciplinary treatment, thus hampering rehabilitation and integration into society.

Young adults with CP usually have an increased frequency of social, occupational and emotional limitations. [12] These limitations negatively affect the rehabilitation process. In these cases, CAD, VPI, palatal fistulae, abnormal dental occlusion and septal deviation are common findings. All these factors significantly affect quality of life [13, 14].

Some reports studying adult patients describe that there are no significant changes in the speech intelligibility following VPI surgery. This finding seems to be related with the articulatory errors that directly affect VPS motion during speech. Even with an appropriately planned surgical treatment, hypernasality is corrected in only 75% of the cases. [8]

Hamlen (1970) pointed out that poor surgical result in adults can be associated with greater difficulty for acquiring and using new speech abilities, as well as lack of family support. [15]

Several strategies can be used for the management of CAD including: Phonological approach; auditory biofeedback; and biofeedback with VNP. Traditionally it has been described that most patients with CAD respond positively to conventional speech intervention. Witzel et al, (1989) demonstrated that patients with velopharyngeal dysfunction associated with CAD undergoing pharyngeal flap, achieved a consistent closure of the VPS in connected speech after biofeedback therapy using VNP. [16]

Endoscopic feedback would be indicated for patients who do not respond to conventional intervention or those who are progressing too slowly. Fast and consistent positive results have been reported in patients with CAD who have undergone endoscopic biofeedback. With the use of this technique, CAD can be corrected in a few sessions. It has been reported that endoscopic biofeedback therapy seems to be superior to conventional intervention for treating velopharyngeal dysfunction associated with CAD. [17]

Direct visualization of the VPS supports articulation therapy creating a greater impact on the patient, improving learning and reducing total time of therapy. [16, 18]

Young adults with residual VPI require an interdisciplinary management which basically considers the same procedures for evaluation and treatment as used in children, but with some modifications in its application, considering anatomical and emotional differences, as well as self - motivation.

The purpose of this chapter is to describe a protocol for treating VPI in young adults, considering individualized surgical planning and SLP intervention.

MATERIALS AND METHODS

Patients

Patients were recruited at the Fundacion Dr. Alfredo Gantz in Santiago, Chile, from 2005 to 2013. All cases who met the following inclusion criteria were included in the study group: patients with cleft lip and CP or isolated CP; older than 17 years; without associated syndromes; with normal hearing; present with residual VPI after initial palatal repair; without fistulae; without further surgical procedures for correcting VPI other than the initial palatal repair.

All cases were assessed by the cleft palate team. They were guided by personal motivation and they committed themselves to undergo all necessary evaluations and interventions.

Speech Assessment

Each patient was evaluated before and after the surgery by the same Speech & Language Pathologist at the Fundación Gantz. The professional conducting the evaluations had more than 10 years of clinical experience in the evaluation and treatment of patients with craniofacial anomalies.

Severity of the VPI, presence of CAD and size of the gap as observed by VNP before the surgical procedure were assessed.

It should be pointed out that before performing the VNP, all patients should be able to produce at least 2 high oral pressure consonant phonemes with adequate placement during the repetition of syllables and isolated words. Therefore, SLP treatment was provided before the procedure whenever it was considered necessary to do so.

The VPI was classified according to the severity of the hypernasality and nasal emissions (Table 1).

Table 1. Classification of VPI according to severity

VPI Severity	VPI Symptomatology
Without VPI	Normal Velopharyngeal Function; absence of hypernasality*; No nasal emission.
Mild VPI	Mild hypernasality - nasal turbulence.
Moderate VPI	Moderate Hypernasality – as perceived during the production of vowel sounds. Audible nasal emissions during production of most of the high pressure consonant phonemes.
Severe VPI	Severe hypernasality during the production of vowel sounds and oral consonant phonemes. Nasal emission in all high pressure consonant phonemes. Low pressure in oral consonant phonemes. Facial grimaces or movements associated with nasal emission.

* Severity of hypernasality was classified according to a previously reported 4-point scale [18].

Speech was classified according to the presence or absence of CAD. No CAD was considered as the condition in which the patient had normal articulation placement in all speech contexts, despite the presence of hypernasality; CAD was considered when articulation placement was abnormal in different contexts such as repetition of syllables, words, sentences and automatic or spontaneous speech.

Instrumental Evaluation of VPI

Pre and post-operative evaluation of the VPI was performed by VNP. A flexible scope with a diameter of 3.5mm at the tip was used. This procedure was carried out by the same Otolaryngologist and SLP in all cases. A standardized speech sample was used including isolated phonemes, connected speech, automatic speech and sustained fricative phoneme sounds [19]. All procedures were recorded for a thorough further analysis. Size and shape of the gap and velopharyngeal closure pattern during speech were assessed. Ten-percent gaps or bubbling without a discernable gap were considered as small gaps. Gaps larger than 10% but less than 40% were considered as medium size gaps. Gaps larger than 40% were considered as large gaps.

Surgical Procedure

Each surgical procedure for correcting VPI was planned individually according to findings of VNP. In order to prevent postoperative airway obstruction, other factors were also considered for designing the surgical plan, including adenoid and/or tonsil hypertrophy, and nasal septum deviation.

A superiorly base pharyngeal flap would be indicated in cases present with circular or sagittal patterns. The width of the flap was designed to match the maximum displacement of the lateral pharyngeal walls during the production of the speech sample.

A lateral flaps pharyngoplasty would be indicated in cases with a predominantly coronal shape of the gap. Posterior Pharyngeal wall increase using cartilage or fat was used in cases with coronal or circular gaps not greater than 10%.

Post-surgical complications were assessed in all cases.

Speech Therapy Post-Surgery

Postoperative SLP treatment was implemented according with the SLP evaluation which was routinely performed one month after surgery in all cases. Patients with satisfactory outcome of speech and VPF did not receive further treatment. However, they were followed up monthly for a period of 6 months. Patients with postoperative unsatisfactory outcomes as determined by presence of CAD and/or present with incomplete velopharyngeal closure during speech received SLP treatment including 2 modalities: Articulation placement intervention' provided in a 45-minutes session once-per-week and a separate biofeedback 30-minutes session also once-per-week.

The intervention addressing articulation placement and manner was aimed to correct abnormal articulation patterns and carry over adequate articulation into connected speech. Initially, imitations and repetitions strategies were used. Further on, generalization strategies were used in order to enhance carrying over into connected speech. These strategies included reading aloud, singing, conversational speech, and role – play. [16]

Biofeedback therapy included recognition and identification of velopharyngeal structures on the VNP image; analysis of VPS motion during swallowing, blowing and speech; and finally, analysis of VPS motion during the production of oral consonant phonemes with best and worst velopharyngeal closure. Also, during the biofeedback sessions, some of the strategies used during the articulation intervention were also incorporated as velopharyngeal motion was being observed on the screen.

Discharge

The criteria for definite discharge were: normal articulation placement and manner during conversational speech and normal VPF in different speech contexts.

Ethical Aspects

This study was approved by the Ethics Committee of Fundación Gantz. All patients were recruited in this Center. The study was conducted in accordance with the ethical standards of the 1964 Helsinki Declaration. Each patient was carefully briefed about the diagnostic procedures, the surgical

procedure that would be performed and the eventual subsequent SLP treatment that would be provided. All patients signed an informed consent before being accepted as participants.

RESULTS

Fourteen surgical procedures were performed. All patients were older than 17 years of age. Seven patients were males and 7 patients were females. Age range was 17 – 35 years of age. Mean age was 24 years of age. No intraoperative or immediate postoperative complications were detected.

All cases studied for this protocol presented with a circular pattern. Thus, all cases were operated on with a superiorly based pharyngeal flap. No other surgical procedure was performed in this series. Three patients were operated on with a narrow flap; six patients were operated on with a medium flap; and 5 patients required a wide flap. The width of the flap was designed to match maximum lateral pharyngeal wall displacement during speech as observed by VNP. (See Table 2).

Forty-three percent of the patients studied for this protocol did not show CAD preoperatively. All these cases demonstrated adequate VPF as determined by the SLP assessment one month postoperatively. All these cases did not require any further treatment and were discharged.

The remaining 57% of the cases demonstrated CAD preoperatively. None of these cases were able to achieve adequate VPF one month postoperatively (See Table 2). All these patients underwent further postoperative SLP treatment and biofeedback with VNP. Five out of these 8 cases achieved adequate articulation and VPF after an intervention period of 6 months. Finally, the remaining 3 cases which persisted with inadequate VPF and/or abnormal articulation placement showed mild or moderate hypernasality during spontaneous – connected speech. One of these cases demonstrated a flap with scar tissue which decreased the width of the flap. In this case, by using "forced" articulation placement during the production of isolated words, both ports of the flap looked practically occluded as observed by VNP. However, during spontaneous – connected speech, both lateral pharyngeal walls failed to make tight contact with the lateral – free borders of the flap causing hypernasality and inconsistent nasal emission. Another patient presented with a very narrow flap which could not achieve complete closure not even during the production of isolated words. This case required a new surgical procedure.

Table 2. Patient's characteristics and results of the pre and postoperative evaluations

Patients	Age (years)	Cleft Type	Presence of CAD	Preoperative VPI Severity	Preoperative size of the gap (%)	Selected flap witdth	Postoperative VPI (1 months)	VPI severity after SLP treatment (6 months)	Discharged
1	22	UCLP	Yes	Moderate	20	Medium	Moderate	Without VPI	Yes
2	20	CCP	No	Mild	10	Narrow	Without VPI	-	Yes
3	17	ICP	Yes	Severe	50	Width	Moderate	Without VPI	Yes
4	17	ICP	No	Moderate	30	Medium	Without VPI	-	Yes
5	34	BCLP	Yes	Severe	80	Width	Severe	Mild	No
6	18	UCLP	Yes	Severe	70	Width	Severe	Mild to moderate	No
7	24	BCLP	No	Mild	10	Narrow	Without VPI	-	Yes
8	35	UCLP	Yes	Moderate	40	Medium	Severe	Mild	No
9	23	UCLP	No	Mild	10	Narrow	Without VPI	-	Yes
10	20	CCP	No	Moderate	30	Medium	Without VPI	-	Yes
11	32	CCP	Yes	Moderate	40	Medium	Mild	Without VPI	Yes
12	20	BCLP	No	Moderate	20	Medium	Without VPI	-	Yes
13	26	BCLP	Yes	Severe	80	Width	Severe	Without VPI	Yes
14	23	UCLP	Yes	Severe	80	Width	Severe	Without VPI	Yes

Key: UCLP = unilateral cleft lip and palate, BCLP = bilateral cleft lip and palate, ICP = incomplete cleft palate, CCP = complete cleft palate.

Finally, the third patient presented with a flap with an apparent adequate width, good lateral walls motion but it was not possible to achieve a complete seal during connected speech after 6 months of SLP intervention and biofeedback sessions. This patient did not return for a follow up visit in which further surgical treatment would have been discussed. It should be emphasized that these 3 cases with postoperative residual hypernasality and nasal emission demonstrated CAD and a severe VPI preoperatively.

In the overall analysis of the group of patients studied for this chapter, seventy-nine-percent (11 of 14) of the cases achieved a satisfactory outcome following the pharyngeal flap operation and a period not longer than 6 months of postoperative SLP treatment including biofeedback sessions with VNP.

CONCLUSION

The purpose of this chapter was to assess speech and VPF outcome in young adults undergoing surgery aimed to correct VPI.

Poor results have been reported in adult patients who undergo pharyngeal flap surgery [11], hence leading some cleft palate teams to question the implementation of surgery for correcting VPI in this age group. However, a higher success rate (80 - 90%) was reported [20] when general population including children and adults were studied. Another report [8], describes that in young adults, an adequate surgical planning before performing a pharyngeal flap can increase the success rate up to 75%.

The results of this chapter show that 43% of young adults showed improvement of speech and VPF one month following pharyngeal flap surgery. All of these cases were from the Group of patients without CAD. This percentage rose to 79% after SLP intervention aimed to correct CAD including VNP biofeedback.

A relationship between CAD and lateral pharyngeal wall motion has been reported in several papers. [13-14, 16] This could explain why SLP treatment and endoscopic biofeedback increase velopharyngeal closure after a tailor made pharyngeal flap. Moreover, an aberrant lateral walls movements with outward displacement during the production of some fricative phonemes has been reported in cases of CAD [21]. Endoscopic biofeedback seems a safe a reliable tool for correcting this abnormal velopharyngeal motion during speech. In the group of patients studied for this chapter, patients without CAD *demonstrated mild VPI with sizes of the gap equal or below 30%.* (See Table 2).

It has been reported that endoscopic biofeedback can increase lateral walls motion [22]. Thus, the closure pattern can be modified from a circular pattern into a more sagittal pattern. In the patients studied for this chapter, 5 cases managed to successfully mobilize the lateral pharyngeal walls during speech, resulting in a significant improvement in their speech and VPF. As described by Witzel et al. (1989) [16] some patients have the potential to increase movement of the lateral pharyngeal walls with adequate training. However, it should be pointed out that some of our patients failed to achieve adequate lateral pharyngeal walls motion despite the use of endoscopic biofeedback. Moreover, some of our patients were able to increase motion during the production of isolated words but they were not able to consistently carry over this improvement into conversational speech.

Correction of CAD should consider the use of effective strategies of SLP intervention. In adult patients, the use of biofeedback therapy with VNP seems a valuable tool which can provide a direct visualization of the VPS during speech. Patients undergoing this procedure usually increase awareness of VPS motion which facilitates carrying over the improvement into conversational speech. Also, the integration of auditory and visual inputs effectively decreases total time of the SLP intervention. [23]. Nonetheless, it should be considered that endoscopic biofeedback is an additional tool which should be used as a complement to conventional strategies aimed to correct articulation placement.

When articulation strategies including endoscopic biofeedback are used for 6 months following pharyngeal flap surgery, patients with CAD can achieve similar final outcomes as those of patients who did not present CAD preoperatively.

Adult patients often present with various physical and/or functional alterations in addition to preferences and motivations that are usually related with social aspects and job issues. [12-14]Some patients prefer an intervention for improving communication skills, whereas others are more motivated to improve aesthetic appearance, and dental occlusion. It is important for the cleft palate team to consider the individual needs and points of view of each patient. In the group of patients studied for this chapter, all patients sought treatment by personal motivation and the most common goal was to improve communication.

From the results described in this chapter, it is evident that VPI in young adults should be addressed with a specifically designed treatment plan. Anatomy of the palate, degree of VPI, presence of CAD, size of the defect, and patient motivation should be carefully assessed in each case.

The implementation of the Protocol described herein can provide a better guide for diagnosis and treatment. Thus, an appropriate surgical and SLP intervention plan can be designed, improving final outcome.

From the analysis of the group of young adults studied for this chapter, it seems that those patients present with VPI and CAD who do not show an appropriate motivation for following the long term management program, cannot be considered good candidates for surgery.

Although the results described for the group of young adults analyzed for this chapter are promising, it will be necessary to study larger groups of patients with different characteristics in order to support the conclusions of this study. It should be emphasized that young adults with appropriate personal motivation for improvement have an acceptable chance for a favorable outcome. However, as mentioned herein, the best results seem to be associated with absence of CAD preoperatively, as well as the presence of small and medium sizes of gap at the VPS during speech.

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