

Speech intelligibility after primary palatoplasty: listener perception

Inteligibilidade de fala após palatoplastia primária: percepção do ouvinte

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ABSTRACT

Purpose: To verify the results of speech intelligibility in individuals submitted to primary palatoplasty, according to perceptual analysis by five examiners, experienced or not with the treatment of cleft lip and palate.

Methods: Analysis of spontaneous speech records, registered in audio-visual system, of 78 individuals with repaired cleft lip and palate, of both genders, aged more than 4 years old, submitted to primary palatoplasty. The speech samples were analyzed by five different examiners, who scored the speech intelligibility using a three-point scale (1=good, 2=regular, and 3=bad). The interexaminer agreement was assessed by the Kappa coefficient. The treatment success was analyzed descriptively regarding the proportion of patients according to the postoperative speech intelligibility, as determined by the examiners. Significance between differences was verified by the chi-square test ($p < 0.05$). **Results:** The interexaminer agreement ranged from fair to substantial. Full agreement between the five examiners was observed in more than half of cases. Based on the mean values assigned by the examiners, a significant proportion of cases showed good speech intelligibility after palatoplasty. **Conclusion:** The present outcomes evidenced adequate speech intelligibility after primary palatoplasty in the majority of cases, suggesting that these individuals are well understood in their social environment. The examiner experience presented to be an important variable in the analysis.

Keywords: Cleft palate; Speech intelligibility; Speech perception; Velopharyngeal insufficiency; Reconstructive surgical procedures

RESUMO

Objetivo: Verificar os resultados de inteligibilidade da fala de pacientes submetidos à palatoplastia primária, de acordo com o julgamento perceptivo de cinco examinadores, experientes ou não, no tratamento de fissuras labiopalatinas. **Métodos:** Foram analisados os registros de fala espontânea, armazenados em sistema audiovisual, de 78 pacientes com fissura labiopalatina previamente reparada, de ambos os gêneros, a partir de 4 anos de idade, submetidos à palatoplastia primária. As amostras de fala foram analisadas por cinco diferentes examinadores, que classificaram a inteligibilidade de fala utilizando uma escala de 3 pontos (1=boa, 2=regular e 3=ruim). A concordância interexaminadores foi verificada por meio do coeficiente de Kappa. O sucesso da reabilitação foi analisado descriptivamente quanto às proporções de pacientes, de acordo com o grau de inteligibilidade pós-operatória, determinada pelos examinadores. A significância entre as diferenças das proporções obtidas para cada categoria foi verificada pelo teste Qui-quadrado ($p < 0,05$). **Resultados:** A concordância entre os examinadores variou de discreta a substancial. Em mais da metade das amostras os examinadores obtiveram concordância plena. Com base nos valores médios dos julgamentos dos avaliadores, uma proporção significativa dos casos apresentou boa inteligibilidade de fala. **Conclusão:** Verificou-se adequação da inteligibilidade de fala após a palatoplastia primária, na maioria dos casos estudados, sugerindo, assim, que esses pacientes são bem compreendidos em seu meio social. A experiência do avaliador mostrou-se uma variável importante na análise.

Descritores: Fissura palatina; Inteligibilidade da fala; Percepção da fala; Insuficiência velofaríngea; Procedimentos cirúrgicos reconstrutivos

Study was conducted at the Hospital for Rehabilitation of Craniofacial Anomalies, Universidade de São Paulo – USP – Bauru (SP), Brazil.

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INTRODUCTION

Cleft lip and palate presents multifactorial etiology and are caused by lack of merging between the embryonic facial prominences, occurring early in intrauterine life, specifically up to the twelfth week of pregnancy. Clefts may present variable anatomical extent affecting the lip and palate, isolated or in combination, and require procedures for esthetic recovery and functional adequacy to allow psychosocial integration of the individual⁽¹⁾.

The basis of cleft treatment are the primary surgeries, which aim to reestablish the anatomical and functional conditions of affected structures to prevent and relieve the alterations, such as speech disorders. Cheiloplasty and palatoplasty are the first reconstructive plastic surgeries performed along the complex treatment process; combined with the other therapeutic approaches, they are fundamental for rehabilitation⁽²⁾.

In clefts affecting the palate, the consequent communication between the oral and nasal cavities may impair the speech production in different manners, becoming one of the main problems for individuals with clefts. The most common manifestations of this disorder of structural origin, called velopharyngeal insufficiency (VPI), are hypernasality, nasal air emission (audible or not) and compensatory articulations^(3,4). These manifestations directly influence the speech intelligibility and may preclude the comprehension and understanding of the message produced by the speaker, impairing the oral communication and interfering with psychosocial integration^(5,6).

Palatoplasty aims at reconstructing the morphological defect of the hard and soft palate; from a functional standpoint, it aims to provide conditions for the palatal vault to aid the velopharyngeal mechanism by separating the oral and nasal cavities during orofacial functions, such as speaking, swallowing and blowing. During speech, correct functioning of this mechanism is fundamental for a balanced oronasal resonance and to generate adequate levels of intraoral pressure. Thus, the surgical success of palatoplasty should be assessed by analysis of speech outcomes^(2,7).

Despite the acknowledged efforts to eliminate these disorders by the primary palate surgery, in many cases the VPI symptoms are not eliminated, thereby requiring a secondary procedure⁽⁸⁾. According to the literature, the prevalence of residual VPI after palatoplasty may range from 5% to 60% between studies, depending on diverse variables.

The perceptual analysis of speech is the main method for diagnosis of speech symptoms secondary to VPI, and is fundamental in the clinical practice^(4,9).

However, since this is a subjective assessment, this procedure is subject to variations and errors, even among listeners experienced with the analysis of speech in individuals with cleft palate^(7,10). For this reason, analysis by more than one examiner is necessary. The utilization of examiners to evaluate

the subjective aspects of speech in individuals with cleft lip and palate has been strongly recommended in the last years, especially for research or institutional audits^(11,12).

Based on these considerations, this study evaluated the speech intelligibility after primary palatoplasty, according to the perception of five different listeners.

METHODS

This study was conducted at the Laboratory of Physiology of the Hospital for Rehabilitation of Craniofacial Anomalies, *Universidade de São Paulo* (HRAC/USP) after approval by the Institutional Review Board (protocol n. 120/2011 SVAPEPE-CEP).

The sample comprised speech records previously obtained during routine outpatient consultations from 78 individuals with cleft palate with or without cleft lip, aged more than 4 years (mean 10 years), registered at the institution. The study comprised analysis of a single group, composed of 30 individuals with isolated cleft palate, 36 with unilateral cleft lip and palate and 12 with bilateral cleft lip and palate. All participants had been submitted to primary palatoplasty at the institution, in the average at 12 months of age. Individuals presenting cleft lip associated to cleft palate were submitted to cheiloplasty, in the average at 3 months of age. Speech therapy was not analyzed in these cases. The study did not include individuals with diagnosis of congenital craniofacial syndromes such as Velocardiofacial syndrome, Apert syndrome, Crouzon syndrome, Robin sequence, Down syndrome, and others, as assessed on the records; individuals submitted to other surgical procedures after palatoplasty that might interfere with the speech outcomes, including correction of palatal fistulae and columella lengthening; and individuals presenting nasal congestion at the moment of speech recording, as assessed by the examiner.

According to the routine protocol employed in the laboratory, the speech samples were recorded simultaneously using a digital audiovisual system. Audio recordings were achieved using a Sony® microphone, model ECM-MS957, positioned on a specific support at a 40-cm distance from the individual's mouth. Video recordings were obtained using a digital camcorder JVC®, model GZ-MG555, supported by a tripod positioned at 1 m from the chair on which the individual was seated.

The spontaneous speech samples presented approximate duration of 30 seconds and were obtained from directed questions, such as "Tell me how old are you, in which grade are you, what you like to do", "Tell me what you did yesterday", "Tell me a place where you liked to go". After random selection, all video samples were watched in full, before edition, so that the investigator could verify any reports of personal information (name, address, city of origin) and edit the samples to keep the individual's anonymity, following

the ethical principles. Then, the samples were edited on a specific software (Windows MovieMaker®), to select only the spontaneous speech of the individual, eliminating the speech pathologist's talks to avoid interference with the analysis of examiners. The 78 videos were then recorded on five 4 GB pen drives (SanDisk®), purchased for that purpose, thus producing five copies of the files. Additionally, all five examiners received a worksheet for insertion of results and an instruction letter on how to perform the analysis, containing the following information: "After listening the speech, we ask you to score the intelligibility – level of understanding of speech – as *Good*, if you understand the entire content; *Regular*, if you partially understood the message; and *Bad*, if understanding is almost null". After analysis and evaluation of videos, the pen drives were returned by the examiners, in the average after two months, for statistical analysis.

The examiners included one speech pathologist experienced with cleft lip and palate (FE), with experience greater than six years; a speech pathologist not experienced with cleft lip and palate (FNE), who worked in the field of Language; one non-speech pathologist health professional (NF), with ten-year experience with cleft lip and palate; and two non-health related professionals, without experience with cleft lip and palate, being one professional of Biology working on Botany (Lay 1), and one Law professional (Lay 2). The five examiners were asked to analyze the samples individually, in a quiet room and for as many times as needed to score the intelligibility for each individual, according to a three-point scale, in which 1=good, 2=regular and 3=bad.

The agreement between examiners in the evaluation of speech intelligibility was assessed by the Kappa coefficient⁽¹³⁾, in which a coefficient below zero indicates no agreement; 0-0.20 slight; 0.21-0.40 fair; 0.41-0.60 moderate; 0.61-0.80 substantial, and 0.81-1.0 almost perfect agreement.

Based on the analysis of the five examiners, a final score of intelligibility was assigned for each individual, determined from the analysis of most examiners. Thus, the treatment success was descriptively evaluated as to the proportions of individuals, according to the score of postoperative intelligibility. After analysis of 78 speech samples of individuals submitted to primary palatoplasty, the proportion of responses for each score of intelligibility was calculated, according to each of

the five examiners. The significance between proportions achieved for each category was analyzed by the chi-square test, at a significance level of 5%.

RESULTS

Calculation of the proportion of responses for each score of intelligibility, according to each of the five examiners, revealed that the FE scored 58 samples (74%) as good intelligibility, 12 (15%) as regular and 8 (10%) as bad. The FNE scored 63 samples (81%) as good intelligibility, 10 (13%) as regular and 5 (6%) as bad. Professional NF scored 45 samples (58%) as good intelligibility, 22 (28%) as regular and 11 (14%) as bad. Lay 1 scored 62 samples (79%), as good intelligibility, 11 (14%) as regular and 5 (6%) as bad. Finally, Lay 2 scored 51 samples (65%) as good intelligibility, 16 (21%) as regular and 11 (14%) as bad. Thus, the proportion of cases considered as good intelligibility ranged from 58% to 81%. Conversely, the bad scored ranged from 6% to 14% (Table 1).

Analysis of the quantity of equal responses for the same sample revealed that, in 58% (45/78), the 5 examiners achieved 100% of agreement. Four examiners agreed about 19% of samples (15/78), 3 agreed in 20% (16/78), and 3% (2/78) presented agreement of only 2 of the 5 examiners (Figure 1).

Therefore, the agreement between examiners, as assessed by the Kappa coefficient, ranged from fair to substantial (0.32 to 0.66), with mean moderate agreement (0.51). The best agreement, substantial (0.66), was observed between FE and FNE, while the worst agreement, fair (0.32) was observed between Lay 1 and NF (Table 2).

The result of primary palatoplasty was assessed based on the median values of analysis by the five examiners. Among the 78 speech samples analyzed, 59 (76%) were scored as good intelligibility, 11 (14%) as regular and 8 (10%) as bad, evidencing the success of palatoplasty concerning the speech intelligibility.

DISCUSSION

According to the treatment protocol of the hospital where this study was conducted, palatoplasty is ideally performed at 12 months of age. Considering that normal speech

Table 1. Distribution of individuals according to speech intelligibility

Intelligibility	Examiners									
	SPE		SPNE		NSP		NH1		NH2	
	n	%	n	%	n	%	n	%	n	%
Good	58	74	63	81	45	58	62	80	51	65
Regular	12	16	10	13	22	28	11	14	16	21
Bad	8	10	5	6	11	14	5	6	11	14

Subtittle: SPE = speech pathologist experienced with cleft lip and palate; SPNE = speech pathologist not experienced with cleft lip and palate; NSP = professional (non-speech pathologist) experienced with cleft lip and palate; NH1 = non-health related professional; NH2 = non-health related professional

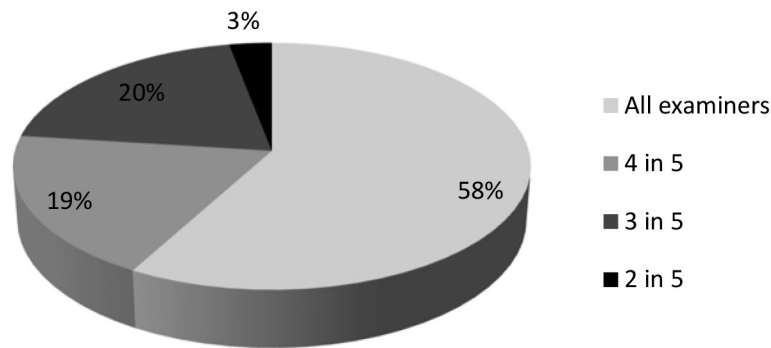


Figure 1. Analysis of inter-examiner agreement in the perceptual analysis of speech: proportion of cases with full agreement (all examiners) and percentage of cases with partial agreement (4p in 5, 3 in 5, 2 in 5)

development is the main objective of surgical repair of cleft palate, intervention at this age provides satisfactory speech outcomes. The quality of speech, according to auditory perception, remains the most important standard through which the clinical results and success of surgical procedure may be analyzed^(9,12).

In fact, in the presence of cleft palate, varied speech disorders are observed, from simple distortions up to unintelligible speech, which may affect the social interactions, precluding the individual from expressing his or her thoughts and feelings effectively. Therefore, individuals with cleft lip and palate are usually the subject in investigations of interpersonal relationships, since the difficult communication may cause several effects, including social isolation⁽⁶⁾.

The main focus of this study was to verify the degree of speech intelligibility after primary palatoplasty, by analysis of how the individual with cleft lip and palate, though repaired, is listened by individuals from the society in general. Due to the structures involved, cleft palate (isolated or combined with cleft lip) is related to disorders related to velopharyngeal dysfunction, which reduce the speech intelligibility, causing difficulties in oral communication. For this reason, the three most common types of clefts involving the palate were

randomly included and analyzed as a single group, namely isolated cleft palate, unilateral cleft lip and palate and bilateral cleft lip and palate.

This study comprised evaluation by five different listeners, to understand how the individual with cleft palate is listened and understood in the social environment, compared to the therapeutic environment. A speech pathologist experienced with cleft lip and palate was purportedly included as reference among the other four examiners. The speech pathologist not experienced with this field was included to check whether the knowledge acquired in the study of human communication, i.e. in the formation of speech pathologists, regardless of their area of expertise, would influence the analysis of samples. Another health professional experienced with cleft lip and palate was included to analyze if the experience with these individuals and/or in the field would facilitate the understanding of speech, or alternatively would make the professional more demanding in the analysis. Finally, lay individuals were included to verify how the individual with cleft is seen by professionals not working with speech rehabilitation, based on analysis by professionals of other fields of knowledge, such as Law and Botany.

Table 2. Agreement between the five examiners concerning the speech intelligibility

Examiners	% of agreement	Kappa coefficient	Interpretation
SPE X SPNE	87.18	0.66	Substantial
SPE X NH1	79.49	0.46	Moderate
SPE X NH2	79.49	0.56	Moderate
SPE X NSP	80.77	0.63	Substantial
SPNE X NH1	84.62	0.54	Moderate
SPNE X NH2	76.92	0.54	Moderate
SPNE X NSP	70.51	0.40	Fair
NH1 X NH2	73.08	0.39	Fair
NH1 X NSP	66.67	0.32	Fair
NH2 X NSP	79.49	0.62	Substantial
Mean of the 5 examiners		0.51	Moderate

Subtittle: SPE = speech pathologist experienced with cleft lip and palate; SPNE = speech pathologist not experienced with cleft lip and palate; NSP = professional (non-speech pathologist) experienced with cleft lip and palate; NH1 = non-health related professional; NH2 = non-health related professional

The speech intelligibility is the ability of an individual to produce recognizable sounds by speech, i.e. when the speaker is understood by the listener⁽¹⁴⁾. It is known that the speech of children with cleft lip and palate may be impaired, or even unintelligible, causing communication problems. This aspect of speech was analyzed in this study to better reflect on the oral production of any individual, regardless of the content of the message.

Speech intelligibility was evaluated in individuals with minimum age of 4 years (n=1), due to the need of patient compliance for evaluation and recording procedures, and also because a child at this age already presents discursion skills in spontaneous speech according to the stages of language development⁽¹⁵⁾. Still, it should be considered that phonological simplifications are expected for the age, and it cannot be ruled out that delays in speech acquisition and development in older patients may have influenced this aspect. The mean age at the moment of evaluation was 10 years.

Analysis of agreement between examiners revealed wide variation, with lower agreement between the non-experienced speech pathologist and the non-speech pathologist experienced professional, and between the two lay individuals and the non-speech pathologist experienced professional. Comparison of professionals of other area without experience with cleft lip and palate (Lay 1 and 2) revealed differences in the analysis and little agreement between them, which may be related to the lack of knowledge on the patterns of normal and abnormal speech, as confirmed by the lack of agreement in the scores. Additionally, the fair agreement between the two lay individuals evidence that each interpreted the speech according to preexisting criteria, even though none of them had previous contact with cleft lip and palate. It may be inferred that Lay 2 interpreted the speech samples in a more demanding manner than Lay 1, since good intelligibility was assigned to 51 samples as compared to 62 samples for Lay 2. Alternatively, the examiner may really have had greater difficulty to understand the speech of individuals with cleft, resulting in lower proportion of individuals with good intelligibility.

Substantial agreement was also observed between the speech pathologists experienced and not experienced with cleft lip and palate, demonstrating little discrepancy in speech analysis between professionals. This may be explained by the extensive contact of speech pathologists with abnormal speech, making him or her familiar with communication disorders, regardless of its nature. When the experienced speech pathologist was compared with the non-speech pathologist experienced professional, substantial agreement was also observed, evidencing demanding analysis of both, which is related to their experience in the field. Lay 1 (Botany professional) exhibited greater disagreement compared the experienced speech pathologist, demonstrating that knowledge of the speech pathologist and the demanding analysis led to substantially different analyses. Lay 2 (Law professional)

presented the worst understanding of speech samples. Among professionals experienced with cleft lip and palate, the non-speech pathologist professional presented less understanding than the speech pathologist.

Similar to the present study, previous investigations also observed variable agreement between different listeners^(12,16,17). A study on hypernasality, based on three examiners with more than 10 years of experience with cleft lip and palate, revealed moderate agreement between them, evidencing that the result can be associated with related to internal standards of each examiner⁽¹²⁾.

Speech intervention plays a fundamental role in the correction of speech disorders in the presence of cleft lip and palate and may influence the results of palatoplasty. However, due to the subjectivity of reports of patients or their caretakers about the frequency, duration and therapeutic goals, speech therapy was not a variable considered in the present study. It is believed that, for the purposes of understanding by lay people, knowledge on the accomplishment of treatment would have little influence on the results.

The perceptual analysis of speech is a very important tool for evaluation, and when there is agreement between perceptual measurements and instruments, there may be greater confidence in clinical findings⁽¹⁸⁾. Thus, the examiners' experience is a determining factor for the evaluation of results, indicating that an experienced examiner is more demanding in the analysis, which favors the accurate diagnosis of speech disorders. This highlights the importance of training and previous experience in the evaluation and treatment of cleft lip and palate⁽¹²⁾.

The visual support from the videos is a variable that should be considered and which may have influenced the assessment by examiners. The high prevalence of good responses may have been influenced by orofacial reading, or even by observation of facial expressions during speech, facilitating the understanding. Also, it should be considered that oral communication occurs from a set of skills additional to speech production, including facial expression and gestures. Isolated analysis of the audio component could confirm this hypothesis.

Concerning the outcome of primary palatoplasty, the success rate of 76% considering the speech outcomes is similar to findings reported in the international literature^(19,20) and lower than others^(21,22), which reported proportions of 90% and 95%. Despite the relevant prevalence, the 24% of individuals with residual VPI will need additional treatment, which is a challenge for clinicians and surgeons. The primary surgical technique used, individual healing, surgeon's experience and postoperative speech therapy should also be considered when analyzing the success of rehabilitation⁽²³⁾.

Additional studies with other groups of examiners are suggested, such as family members who have greater contact with the speech of these individuals and other people from their

social relationships, individuals with different educational levels and from different socioeconomic backgrounds, to observe if these factors influence the analysis and classification of speech. Other speech characteristics, besides intelligibility, should also be addressed in this analysis.

Anyway, the information obtained by this study is extremely important to analyze the speech outcomes of individuals submitted to primary palatoplasty, since it allows better understanding of the difficulties of oral communication of individuals with cleft lip and palate, outside the therapeutic environment.

CONCLUSION

It was observed that primary palatoplasty was markedly effective to achieve adequate speech intelligibility in most cases analyzed, from the standpoint of different examiners, suggesting that these individuals are well understood in their social environment. Also, the listener experiences influenced the determination of speech intelligibility of individuals with cleft lip and palate.

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