

# SPEECH EVALUATION WITH AND WITHOUT PALATAL OBTURATOR IN PATIENTS SUBMITTED TO MAXILLECTOMY

## AVALIAÇÃO DE FALA COM E SEM OBTURADOR DE PALATO EM PACIENTES SUBMETIDOS À MAXILECTOMIA

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### ABSTRACT

**M**ost patients who have undergone resection of the maxillae due to benign or malignant tumors in the palatomaxillary region present with speech and swallowing disorders. Coupling of the oral and nasal cavities increases nasal resonance, resulting in hypernasality and unintelligible speech. Prosthodontic rehabilitation of maxillary resections with effective separation of the oral and nasal cavities can improve speech and esthetics, and assist the psychosocial adjustment of the patient as well. The objective of this study was to evaluate the efficacy of the palatal obturator prosthesis on speech intelligibility and resonance of 23 patients with age ranging from 18 to 83 years (Mean = 49.5 years), who had undergone inframedial-structural maxillectomy. The patients were requested to count from 1 to 20, to repeat 21 words and to spontaneously speak for 15 seconds, once with and again without the prosthesis, for tape recording purposes. The resonance and speech intelligibility were judged by 5 speech language pathologists from the tape recordings samples. The results have shown that the majority of patients (82.6%) significantly improved their speech intelligibility, and 16 patients (69.9%) exhibited a significant hypernasality reduction with the obturator in place. The results of this study indicated that maxillary obturator prosthesis was efficient to improve the speech intelligibility and resonance in patients who had undergone maxillectomy.

**Uniterms:** Maxillary neoplasm; Palatal obturator; Speech intelligibility; Hypernasality.

### RESUMO

**A** maioria dos pacientes submetidos a ressecções de maxila apresenta alterações nas funções de fala e de deglutição. O acoplamento das cavidades oral e nasal resulta em hipernasalidade de graus variados e no comprometimento da inteligibilidade de fala. A reabilitação protética tem como objetivo separar as cavidades oral e nasal podendo reduzir as alterações de ordem estética, funcional e ainda melhorar o ajustamento social deste paciente. Este trabalho teve como objetivo avaliar a eficácia da prótese obturadora de palato quanto à inteligibilidade e à ressonância de fala em 23 pacientes com idades entre 18 e 83 anos (Média = 49,5 anos) submetidos à maxilectomia inframeso-estrutura. Para fins de gravação, os pacientes foram solicitados a realizar oralmente a contagem de números de 1 a 20; a repetir 21 palavras balanceadas foneticamente e a realizar 15 segundos de conversa espontânea, uma vez com e outra vez sem a prótese. Este material de fala foi apresentado a 5 fonoaudiólogos para os julgamentos de inteligibilidade e ressonância de fala. Os resultados revelaram que 82,6% apresentaram uma melhora significativa da inteligibilidade de fala e 69,6% obtiveram uma redução significativa da hipernasalidade após a adaptação da prótese obturadora de palato. Os resultados deste estudo demonstraram que a prótese obturadora de palato mostrou-se eficaz na melhora da inteligibilidade e ressonância de fala dos pacientes submetidos à maxilectomia.

**Unitermos:** Neoplasma de maxila; Prótese obturadora de palato; Inteligibilidade de fala; Hipernasalidade.

## INTRODUCTION

One of the main impacts of patients submitted to maxillectomy is the impairment of speech intelligibility. The undesirable coupling between the oral and nasal cavities reduces intraoral air pressure during speech production causing articulatory imprecision, hypernasal speech, nasal air emission, and reduced vocal loudness<sup>8</sup>. One of the main problems faced by them is the impairment of speech intelligibility, which interferes with the quality of life.

The defects created by maxillectomy can be repaired by prosthetic obturation or even reconstruction, using free and microsurgical transplants, grafts, and distant or regional flaps. However, an obturator is still considered to be one of the best rehabilitation tools in maxillary resections due to its rapid accomplishment, low cost, and the possibility of modification according to the patient needs.

The aim of obturator prosthesis is to obliterate the undesired communication between the oral and nasal cavities created by the tumor resection surgery, and to improve speech intelligibility and swallowing.

However, studies in the literature correlating maxillary obturator prosthesis with functional aspects and perceptual bases of speech are scarce<sup>1,10,11,13,14,16,17,18</sup>. Many of these studies are case reports and/or shows heterogeneous groups with individuals who have involvement of soft palate, that may not be as successful as in those with resections limited only to the hard palate. Yoshida, et al.<sup>17</sup> (1990) observed improvement in speech intelligibility after prosthetic treatment in only four of eight maxillectomized patients studied. Three patients of this group with soft defects achieved slight improvement in syllable intelligibility with obturator.

Sullivan, et al.<sup>13</sup> (2002) reported speech intelligibility, speaking rate and communication effectiveness results for 32 patients who had undergone partial surgical resection of the maxilla with a wide range of defects involving the hard and soft palate. Their results revealed that prosthodontic intervention resulted in a 33% increase in sentence intelligibility, a 26-word-per-minute increase in speaking rate, and a 4.2 scale point improvement (0-7 scale) in hypernasality across a wide range of maxillary and soft palate defects.

The objective of the present study was to determine the efficacy of palatal obturator prosthesis in speech intelligibility and resonance in patients submitted to inframedial-structural maxillectomy.

## MATERIAL AND METHODS

The records of patients submitted to treatment at the São Paulo Oncology Center Foundation between 1995 and 2001 were reviewed in order to select those who had undergone maxillectomy. One-hundred patients were identified and invited by telephone and/or telegram contact. Thirty-three (33%) of them could not be located and/or did not respond to the invitation. Of the remaining 67 (67%), 19

(19%) had died, 10 (10%) had recurrences and resections in other regions of the oral cavity and/or oropharynx, 4 (4%) had undergone maxillectomy restricted only to the alveolar margin, 3 (3%) had undergone chemotherapy and/or radiotherapy, 3 (3%) were living in long distance areas, 3 (3%) were not Brazilians, and 2 (2%) presented difficulties in motor locomotion, therefore were not included in the sample. The remaining 23 patients (23%) who had undergone inframedial-structural maxillectomy with an oronasal fistula, and were wearing a stable maxillary obturator prosthesis for at least 3 months, were selected for the sample.

Thus, 23 patients participated in the study, 17 females and 6 males, with ages ranging from 18 to 83 years (mean = 49.5 years) who had been submitted to inframedial-structural resection along the maxilla. Out of these, 10 had been submitted to radiotherapy and 6 to speech therapy.

All patients were asked to answer a questionnaire with the following data: patient identification, history of the disease, type of surgery (extent and characteristics of palatal resection), complementary treatments (pre- or postoperative radiotherapy and/or chemotherapy), type of prosthesis, time of prosthesis wearing and speech therapy (Table 1).

The patients who met all inclusion criteria had their speech tape recorded in a silent room with a digital tape recorder (MD-RS37). During recordings, each patient remained standing with the microphone (Lesson SM 58P4) positioned at 12 cm from his/her mouth. The patients were asked to count from 1 to 20, to repeat 21 words which included all phonemes of the Brazilian Portuguese language at initial, medial, and final positions, as well as to perform 15 sec of spontaneous conversation, with and without the obturator prosthesis. All speech recording samples were randomly edited on a CD.

Speech resonance and intelligibility from all patient recordings were assessed by five speech-language pathologists experienced in the care of patients with head and neck cancer. All speech recordings and perceptual judgments were carried out in a silent room.

The speech samples from each patient, with and without the obturator, were presented in random order so that the listeners were unaware of whether the patient was wearing or not the obturator. Speech intelligibility was assessed from a 15s sequence of spontaneous conversation, and from the 1 to 20 counting recordings for all patients with and without the obturator.

Speech intelligibility from spontaneous conversation and counting recordings were assessed using a 6-point scale according to Pegoraro-Krook<sup>9</sup> (1995), where 1 represented normal speech intelligibility, and 6 represented severely impaired speech intelligibility. Speech intelligibility was also judged as the percentage of the correct words that the listeners were able to correctly identify, immediately after hearing the speech stimulus. Speech resonance was judged upon spontaneous speech and counting stimuli, using a 5-point scale, in which 1 represented normal resonance, and 5 represented very severe hyper or hyponasality.

The values established for each patient were extracted by median of five speech-language pathologists.

Comparisons of the speech intelligibility and resonance results of all speech stimulus recordings, with and without the obturator were analyzed by the Wilcoxon test. Correlations between the spontaneous speech intelligibility and intelligibility upon word repetition, with and without the obturator, spontaneous speech intelligibility and resonance with and without the obturator, and intelligibility upon word repetition and resonance with and without the obturator were established using Spearman's Correlation Coefficient Test (r). The concordance between the five speech-language pathologists was extracted using the Kendall Coefficient of Concordance Test (W).

**RESULTS**

The concordance under the conditions without and with obturator among the five speech-language pathologists obtained using the Kendall Coefficient of Concordance Test (W) were 0.70 and 0.85 (p<0.001) for spontaneous speech intelligibility, respectively, 0.79 and 0.85 (p<0.001) for word intelligibility, respectively, and 0.80 and 0.62 (p<0.001) for speech resonance respectively.

Assessment of speech intelligibility by the listeners on the basis of the spontaneous speech recordings revealed a significant improvement in intelligibility with the obturator in place for 19 (82.6%) of the 23 patients, while no difference was found for the remaining 4 (17.4%). Mean levels of spontaneous conversation with and without a prosthesis

**TABLE 1-** Biographical data of patients who participated in the study

Patients #	Age (y)	Gender	Extent Palatal Resection	Radiotherapy	Speech Therapy	Type of Prosthesis	Type of prosthesis wearing (years and months)
1.	83	F	Left L	NO	NO	CMD	1y
2.	77	F	Right L + AR	NO	YES	CMD	3m
3.	76	F	Left L + AR	NO	NO	CMD	2y 5m
4.	73	F	Anterior C + AR	YES	NO	CMD	4y 5m
5.	55	F	C	YES	NO	RPD	5y 4m
6.	54	F	Bilateral + left AR	YES	NO	CMD	2y5m
7.	52	F	Left L + AR	NO	NO	CMD	1y4m
8.	47	F	Left L + AR	NO	NO	RPD	2y2m
9.	46	F	C	NO	NO	RPD	3m
10.	44	F	Right L + AR	NO	NO	RPD	1y2m
11.	40	F	C	NO	NO	CMD	3m
12.	35	F	Left L + AR	YES	NO	RPD	10y
13.	29	F	Left L + AR	YES	YES	RPD	2y4m
14.	27	F	Right L	NO	YES	RPD	2y5m
15.	25	F	Left L + AR	NO	YES	RPD	2y5m
16.	18	F	Right L + AR	YES	NO	RPD	4y6m
17.	18	F	C	NO	NO	RPD	1y4m
18.	77	M	Right L + AR	NO	NO	CMD	9y5m
19.	74	M	Right L	NO	NO	CMD	5y4m
20.	65	M	Right L	YES	NO	RPD	9y
21.	62	M	Right L	YES	YES	CMD	2y
22.	42	M	C + Anterior AR	YES	NO	RPD	5y4m
23.	19	M	Right L + AR	YES	NO	RPD	5y
Mean	49.4						3y4m

Legend: L = lateral; C= central; AR = alveolar ridge; CMD = complete maxillary denture; RPD= removable partial maxillary denture.

were 0.78 and 1.30 respectively. Speech intelligibility judgments results based on repetition of the 21 words demonstrated that the listeners were able to identify 66.7% of correct words without the obturator and 90.4 % with the obturators for 23 patients. The speech resonance results demonstrated a significant reduction in hypernasality with the obturators in place for 16 (69.6%) of the 23 patients. Of the 7 remaining patients, 5 (21.7%) did not show significant difference in hypernasality when wearing the obturator, and 2 (8.7%) presented a slight worsening. Mean levels of speech resonance judgments with and without the obturator were 1.9 and 3.2 respectively (Table 2). The results of speech intelligibility judgments upon spontaneous speech and counting recordings, and upon the difference in correct words were statistically significant ( $p < 0.001$ ) between the conditions with and without obturator. Statistically significant results were found in speech resonance ( $p < 0.001$ ) between the two conditions.

Spearman's Correlation Coefficient Test ( $r$ ) showed significant correlation between spontaneous speech intelligibility and resonance in the absence of the obturator ( $r = -0.78, p < 0.001$ ); between word intelligibility and speech resonance in the absence of the obturator ( $r = -0.83, p < 0.001$ ); between word intelligibility and speech resonance in the presence of the obturator ( $r = -0.87, p < 0.001$ ); and between word and spontaneous speech intelligibility in the absence of the obturator ( $r = -0.80, p < 0.001$ ). No significant correlation was observed between spontaneous speech intelligibility in the presence of the obturator and any of the variables analyzed.

**DISCUSSION**

The standard measurement of communicative function is speech intelligibility since speech is a social instrument, with most significant measurements starting with the extent to which speech can be understood<sup>2</sup>.

In the present study, all assessments of spontaneous speech intelligibility demonstrated improvement in intelligibility with the use of a prosthesis in most patients, in agreement with results reported in the literature<sup>1,10,11,13,17</sup>.

According to Rieger, et al.<sup>11</sup> (2003) there are several important background patient characteristics that cannot be ignored when looking at either clinical speech measurements or patient perceptions regarding obturator function. Comparison of the two assessments of speech

intelligibility has shown that under the condition without prosthesis 15 patients (65.2%) presented poor levels of speech intelligibility, while in the remaining 8 patients (34.8%) intelligibility ranged from mild to normal. We therefore tried to identify the factors that differed in each group.

The first factor was the extent of surgery. Out of 15 patients with lower speech intelligibility scores, 10 (66.7%) had undergone wider resections of the maxilla comprising the length of the alveolar border. In contrast, only 4 (50%) of the 8 patients with better speech intelligibility scores showed wider maxillectomies. Kornblith, et al.<sup>3</sup> (1996) reported that obturators were more functional during communication and swallowing in patients with smaller resections of the hard palate. Moreover, Bohle, et al.<sup>1</sup> (2005) demonstrated for 55 patients who underwent ablative head and neck cancer therapy that as the percentage of resection of palate or tongue increased, the intelligibility of speech decreased. Sullivan, et al.<sup>13</sup> (2002) observed individuals with complete unilateral hard and complete unilateral soft palatal defects and found a mean intelligibility score of 46.5% with the prosthesis removed and 79.7% with it inserted. In addition, maxillectomies, particularly the larger ones, restrict the contact between the tongue and palate, impairing speech intelligibility<sup>5</sup>.

Another important factor was radiotherapy. Out of 15 patients with low speech intelligibility scores, 8 (53.4%) had been submitted to this treatment. One of the main consequences of radiotherapy is xerostomia. According to Novaes<sup>7</sup> (1999), doses ranging from 65 to 70 Gy may lead to persistence of this alteration. Treatment of xerostomia is palliative and artificial saliva can be used to relieve this discomfort but the outcome is poor. Reduced saliva production and/or the presence of thicker saliva (an increased mucous component compared to the serous component) impair stability and retention of the dental prosthesis, mastication and swallowing, as well as causing difficulties in sound articulation<sup>15</sup>. Rieger, et al.<sup>11</sup> (2003) observed that a drier mouth was associated with poorer intelligibility for patients who had resection of maxilla with history of radiotherapy.

A last factor was speech therapy. Most patients (approximately 75%) have not undergone this therapy probably because most of them lived in towns where this treatment was not available. Lack of speech therapy did not interfere with the general results of speech intelligibility evaluations which, according to Pegoraro-Krook<sup>9</sup> (1995), was

**TABLE 2-** Means and standard deviation (SD) scores for spontaneous speech, word intelligibility, and speech resonance for 23 patients with and without palatal obturator prosthesis

Variable	Without Prosthesis		With Prosthesis		Wilcoxon test p
	Mean	SD	Mean	SD	
Spontaneous (level)	1.30	0.34	0.78	0.37	< 0.0001
Word Intelligibility (%)	66.7	3.20	90.4	1.20	< 0.0001
Speech Resonance (level)	3.23	1.45	1.94	0.61	< 0.0001

probably due to the fact that the patients were normal speakers before cancer surgery, and anatomical repositioning alone in combination with palatal obturation was sufficient to recover speech without the need for speech therapy. However, we may infer that patients whose speech intelligibility continued to be poor with the prosthesis in place could have benefited from speech therapy since many of them showed imprecise articulation and increased speaking velocity, among others.

Hypernasality is a perceptive phenomenon which affects the quality of life due to its impact on speech intelligibility<sup>6</sup>. In the present study, the speech resonance results have demonstrated a reduction in hypernasality with the use of the prosthesis in most patients (69.6%), in agreement with some studies in the literature<sup>1,9,13</sup>.

Patients #10, #14, #15, #5 and #19 did not have improved speech resonance when wearing the prosthesis. In the first three patients, speech resonance had already been considered to be normal or close to normal without prosthesis and therefore its use did not change this result. In addition to that, their prostheses have shown better stability and adaptation, which allowed a better articulatory pattern.

In contrast, patients #5 and #19, who continued to have moderate to severe hypernasality and patients #6 and #11, who have shown worsening of hypernasality with the use of the prosthesis, presented stuck or imprecise articulation, reduced loudness and increased speech velocity despite good stability and retention of the prosthesis. None of these patients had undergone speech therapy. According to Russo and Behlau<sup>12</sup> (1993), disorders of the articulatory pattern and speech velocity and rhythm frequently compromise speech. We therefore believe that the assessment of hypernasality by the listeners might be influenced by other parameters related to articulation, such as vocal quality, pitch, rhythm and inflection, with a consequent difficulty in differentiating speech resonance parameters from other communication variables<sup>1,8</sup>.

A significant correlation ( $r = -0.78$ ) was observed between the judgment of spontaneous speech intelligibility and the judgment of speech resonance without the prosthesis, suggesting that the greater the impairment in patient's hypernasality, the higher will be the degree of impairment of speech intelligibility. Thus, patients with higher levels of hypernasality presented significant difficulties in making themselves understood. According to Yoshida, et al.<sup>18</sup> (2000), mild hypernasality can generate only a discrete distortion in speech, while severe hypernasality leads to a drastic reduction in speech intelligibility, compromising the individual's oral communication and social contact. Bohle, et al.<sup>1</sup> (2005) observed that perceptual ratings of resonance were associated with percent intelligibility of words and sentences, i.e. the data indicate that perceptual ratings of resonance indicative of increased hypernasality were associated with poorer intelligibility.

Another significant correlation was observed between the variables speech intelligibility upon word repetition and speech resonance both with and without the prosthesis ( $r =$

$-0.87$  and  $r = -0.83$ , respectively). These results demonstrate that, in both conditions, the larger the number of correctly repeated words, the lower the level of hypernasality. Studies reported a significant increase in the percentage of correctly identified words, associated with a reduction in hypernasality, after prosthetic treatment of maxillectomized patients<sup>1,13,17</sup>.

The correlation observed between the assessment of spontaneous speech intelligibility and intelligibility upon word repetition in the absence of a prosthesis was also statistically significant ( $r = -0.80$ ), i.e. the larger the number of correctly repeated words, the more intelligible will be the spontaneous speech of these patients. Similar results were observed in the literature<sup>10</sup>.

No significant correlation was observed between spontaneous speech intelligibility in the presence of a prosthesis and any of the variables analyzed, probably due to the heterogeneity of the sample and the small number of patients participating in the study<sup>9,11</sup>.

In addition, significant interclass agreement was observed for the assessment of spontaneous speech intelligibility ( $r = 0.70$  and  $r = 0.85$ ) and word intelligibility ( $r = 0.79$  and  $r = 0.85$ ) both with and without the use of the prosthesis, respectively. However, a low, although statistically significant, level of agreement was observed between the listeners of this study in speech resonance assessment without prosthesis ( $r = 0.62$ ). Yoshida, et al.<sup>18</sup> (2000) confirmed that perceptive evaluation shows a poor intra and inter-judgment agreement and suggested the use of objective instruments for the study of speech resonance. In contrast, Kreiman, et al.<sup>4</sup> (1993) reported that total agreement among listeners is not expected, even in the case of experienced examiners, due to the difficulty in assessing minimal changes occurring after prosthetic treatment in a perceptive manner. The authors concluded that perfect agreement and reliability are not achieved, not even from a theoretical viewpoint.

## CONCLUSION

The present study has concluded that obturator prosthesis contributed to improved speech intelligibility in maxillectomized patients. However, the success of prosthetic treatment might be limited by factors such as radiotherapy, the extent of maxillary surgery and speech therapy. We therefore emphasize the integration of an interdisciplinary team in order to increase the efficacy of rehabilitation and the quality of life of these patients.

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