ARTICULATION OF SOUNDS IN SERBIAN LANGUAGE IN PATIENTS WHO LEARNED ESOPHAGEAL SPEECH SUCCESSFULLY

ARTIKULACIJA GLASOVA SRPSKOG JEZIKA KOD PACIJENATA KOJI SU USPEŠNO NAUČILI EZOFAGUSNI GOVOR

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Introduction

The quality of esophageal speech is assessed by rehabilitators, patients themselves and patients’ interlocutors. There are still no uniform criteria for the estimated effectiveness of education, but the researchers themselves decide on what criteria will evaluate esophageal speech of patients [1].

Stanković [2] suggests the following five characteristics of esophageal speech to be evaluated: general impression of voice quality, roughness of voice, clarity, weakness and vocal strain. These characteristics can be evaluated descriptively as excellent, good, average, poor and very poor.

Summary

Introduction. Articulation of pronounced sounds during the training and subsequent use of esophageal speech is very important because it contributes significantly to intelligibility and aesthetics of spoken words and sentences, as well as of speech and language itself. The aim of this research was to determine the quality of articulation of sounds of Serbian language by groups of sounds in patients who had learned esophageal speech successfully as well as the effect of age and tooth loss on the quality of articulation. Material and Methods. This retrospective - prospective study included 16 patients who had undergone total laryngectomy. Having completed the rehabilitation of speech, these patient used esophageal voice and speech. The quality of articulation was tested by the “Global test of articulation.” Results. Esophageal speech was rated with grade 5, 4 and 3 in 62.5%, 31.3% and one patient, respectively. Serbian was the native language of all the patients. The study included 30 sounds of Serbian language in 16 subjects (480 total sounds). Only two patients (12.5%) articulated all sounds properly, whereas 87.5% of them had incorrect articulation. Conclusion. The articulation of affricates and fricatives, especially sound /h/ from the group of the fricatives, was found to be the worst in the patients who had successfully mastered esophageal speech. The age and the tooth loss of patients who have mastered esophageal speech do not affect the articulation of sounds in Serbian language.

Key words: Speech Articulation Tests; Language; Speech, Esophageal; Age Factors; Tooth Loss; Articulation Disorders; Laryngectomy; Serbia

Sažetak

Uvod. Artikulacija izgovorenih glasova tokom edukacije i kasnije upotrebe ezofagusnog govora je značajna jer znatno doprinosi razumljivosti i estetici izgovorenih reči i rečenica, odnosno govora i jezika. Cilj ovog istraživanja jeste da se ispita kakva je artikulacija glasova srpskog jezika po grupama glasova kod pacijenata koji su uspešno naučili ezofagusni govor i da li životno doba i gubitak zuba mogu uticati na kvalitet artikulacije. Materijal i metode. Ovo istraživanje je bilo retrospektivno-prospektivna studija koja je obuhvatila 16 pacijenata, kojima je urađena totalna laringektomija. Ovi pacijenti su završili rehabilitaciju govora i koriste se ezofagusnim glasom i govorom. Kvalitet artikulacije je bio ispitivan globalnim artikulacionim testom. Rezultati. Kod 62,5% pacijenata ezofagusni govor je ocenjen ocenom 5; ocenu 4 dobilo je 31,3%; a ocenom 3 ocenjen je govor jednog pacijenta. Svim pacijentima je maternji jezik bio srpski. Ispitivanje je obuhvatilo 30 glasova srpskog jezika kod 16 ispitnika (ukupno 480 glasova). Samo dva ispitanika, odnosno 12,5% imalo je pravilnu artikulaciju svih glasova, a ostalih 87,5% nepravilnu artikulaciju. Zaključak. Kod pacijenata koji su uspešno savladali ezofagusni govor, najlošija je artikulacija afrikata i frikativa a posebno glasa h koji je iz grupe frikativa. Životno doba kao i nedostatak zuba pacijenata koji su savladali ezofagusni govor ne utiču na kvalitet artikulacije glasova srpskog jezika. Ključne reči: Testovi artikulacije govora; Jezik; Ezofagealni govor; Faktori godina; Gubitak zuba; Poremećaji artikulacije; La ringektomija; Srbija

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Articulation of sounds in Serbian language

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Articulation of spoken sounds during training and later use of esophageal speech is very important. During the process of education, special attention is paid to articulation because it contributes significantly to the intelligibility and the aesthetics of the spoken words and sentences, as well as speech and language.

Articulation can be defined as the pronunciation or forming of sounds. Good articulation implies pure, clear and understandable pronunciation of all sounds in words. Articulation of sounds is composed of three main factors: 1. the quality of the spoken sound; 2. the position which speech organs occupy during the pronunciation of certain sound; 3. the ability to perceive pathological sound and its differentiation from other sounds [3].

Articulation division of speech sounds can be made by the place of articulation, which is determined by the position of speech organs, their relationship or touch. Thus, sounds can be divided into bilabials, labiodentals, dentals, alveolars, palatals, mediopalatals, and velars. According to the manner of articulation, which includes the type of movement and degree of opening or closing the speech organs, the sounds are divided into vowels (when the airflow passes freely, without obstacles) and consonants (when there is an obstacle, the narrowing of air column or redistribution between the nose and the mouth). According to their acoustic characteristics, they can be divided into voiced and voiceless sounds.

The articulation disorders represent an irregularity or failure of saying one or more of the sounds. The basic division of articulation disorders include omission of individual sounds, replacing certain sounds with different sounds (substitutions) and incorrect pronunciation of certain sounds (distortion). The causes of articulation disorders can be divided into organic and functional. The organic causes include congenital anomalies, deviations in the structure of the speech apparatus and hearing damage. Functional causes include inorganic or unknown causes [3].

The aim of this study was to examine the articulation of sounds of Serbian language by groups of sounds in patients who had successfully learned esophageal speech and whether age and tooth loss could affect the quality of articulation.

Materials and Methods

This retrospective - prospective study included 16 patients of the Department of Ear, Nose and Throat Diseases, Clinical Center of Vojvodina in Novi Sad, who, after having been diagnosed with a malignant tumor of the larynx, underwent total laryngectomy. These patients completed the rehabilitation and now they use esophageal voice and speech. When interviewed, the patients provided data on their age, sex, and the presence of teeth, the time when rehabilitation started, and its approximate length. The quality of articulation was examined by a competent speech therapist with years of experience in teaching esophageal speech using “Global test of articulation” which consists of giving scores for each sounds. The articulated sounds were rated with grades 1, 2, 3 depending on the level of their quality. Marginal sounds are those which are slightly devoiced or nasal and they get the grade 4, damaged sounds are rated 5 and 6 and missing sounds are rated 7. The software package Microsoft Excel 2003 was used for statistical analysis of data.

Results

The study sample included 15 men (93.8%) and one woman (6.3%) who had undergone total laryngectomy, who did not have local recurrence of the tumor and successfully completed training in esophageal voice and speech. Most patients belonged to two age groups: 51-60 years and 61-70 years, 37.5% of patients being in either of them. Rehabilitation of speech was introduced in 50%, 12.5% and 37.5% of patients 2 to 4 months after surgery, one month after surgery, and more than 6 months after the operation, respectively. Esophageal speech was learnt by 62.5% in one month, by 31.3% from 1 to 3 months and by only one patient in the period longer than 6 months.

The success of learning esophageal speech was evaluated by Stanković with grade 5 (excellent), 4 (good), 3 (moderate), 2 (weak), 1 (very bad). In 62.5% of patients, esophageal speech was rated as excellent (5), in 31.3%, as good (4), and as medium (3) in one patient. None of the patients received the grades 2 (weak) or 1 (very bad). Of all patients, 56.3% had all the teeth, there was a partial loss of teeth in 31.3% of patients, and 12.4% of the patients were edentulous. The Serbian language was the native language for all patients. In order to quantify the results of global articulation test as a continuous dependent variable, each correctly articulated sound was marked by coefficient 4, the border one by coefficient 3, the damaged and severely damaged ones by coefficients 2 and 1, respectively, and a missing sound by coefficient 0. Thus, the patient who articulated all sounds correctly was scored 120 on the “Global test of articulation”. The study included 30 sounds in Serbian language in 16 patients (480 sounds in total).

Of the 16 subjects tested, only 2 respondents, or 12.50%, had the proper articulation of all sounds, while the remaining 87.50% had incorrect articulation.
In the Serbian language, the group of fricatives includes the highest number of sounds, i.e. 9 (/f/, /v/, /s/, /z/, /š/, /ž/, /h/, /j/, /r/), whereas other groups include from 2 to 6 sounds. Of 14 patients with abnormal articulation of sounds, some articulated sounds incorrectly from only one or more groups of sounds. The group of fricatives was articulated incorrectly by 42.86% of patients and 21.43% of the patients articulated incorrectly both affricates (/c/, /ć/, /đ/, /č/, /dž/).

Incorrect articulation of only affricates; plosives; plosives, affricates and fricatives; affricates, fricatives and laterals (/l/,/lj/); affricates, fricatives and devoicing of nasals /m/, /n/, /nj/) were recorded in one patient only for each of these groups of sounds. As for the type of sounds, fricatives took the first place among the incorrectly articulated sounds, then affricates, nasals and plosives, and laterals. None of the vowels was incorrectly articulated.

However, if one takes into account that 144 fricatives, 96 plosives, 80 affricates and 80 vowels, 48 nasals and 32 laterals were examined, it can be seen that the study subjects articulated incorrectly the group of affricates most frequently - 13 sounds (16.25%), then the group of fricatives - 23 sounds (15.97%), 2 nasals (4.17%), one lateral (3.13%) and 2 sounds from the group of plosives (2.08%) (Graph 1). This result shows the percentage of sounds incorrectly articulated in a particular group in relation to the total number of sounds in that same group.

Of 16 patients, 11 patients (68.75%) had incorrect articulation of sound /h/ (/h/ as in the English word husband). The sound /h/ was not articulated at all by 31.25% of them, and the same number of patients articulated it correctly, whereas the sound /h/ was borderline in 18.75% of patients and severely damaged in 18.75% (Table 1).

Kruskal - Wallis’s test did not show a statistically significant difference when comparing the results of global articulation test between different age groups. Based on the tested sample there is not enough evidence on which it could be argued that patients of different age vary in terms of regularity of articulation sounds. The same test found that the presence or absence of teeth did not affect the quality of articulation.

**Discussion**

In the present study, the ratio of male and female was 93.8% : 6.3%, showing that the incidence was in more frequent in men than in women. A similar relationship was also found in the research of other authors, Rosso et al. [5] - 91.5% : 8.5% in favor of men, Igissinov [6] 91.3% : 8.7% also in favor of men, Dragičević [7] 88.9% : 11.1%, again in favor of men. In his study [2], Stanković reported a significantly lower number of laryngectomized women than men, the ratio being 1:20; while Jović et al. [8] found that the ratio of men and women suffering from cancer of the larynx was 11.2 : 1. In the study sample, the most represented age group was the one from 51 to 70 years (75%), that being in line with the research of Dragičević [7], which shows that most of the patients were aged from 51 to 70 years, as well as with the study of Stanković [2] in which 70% of patients with total laryngectomy were aged from 51 to 70 years. Weisman et al. [9] state that in most countries the disease occurs between 55 and 65 years of age, and in the Scandinavian countries disease occurs later in life, for example in Norway between 70-74 years of age. In the research of Jović et al. [8], the peak incidence both in men and women is between 65 and 69 years. In the present study, as many as 62.5% of patients had an excellent esophageal speech which is significantly higher than in the study of Sokal et al. [10], where only 20% of the patients mastered esophageal speech, 46.67% of patients were rated good, 13.33% of patients were rated sufficient and 20% of them used a whisper. Dragičević [7] reported in his research that 66.7% of patients mastered esophageal speech successfully and they were assessed with grades 5, 4, 3.

The results of global articulation test showed that the patients had the greatest problem in the articula-

<table>
<thead>
<tr>
<th>Mark for sound h/</th>
<th>Ocena za izgovor glasa /h/</th>
</tr>
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<tbody>
<tr>
<td>Properly/pravilna</td>
<td>5</td>
</tr>
<tr>
<td>Border/granična</td>
<td>3</td>
</tr>
<tr>
<td>Damaged/oštećena</td>
<td>3</td>
</tr>
<tr>
<td>Severely damaged/jako oštećena</td>
<td>5</td>
</tr>
<tr>
<td>Missing/nedostaje</td>
<td>16</td>
</tr>
</tbody>
</table>

**Graph 1.** The number of irregular voices by groups

**Grafikon 1.** Broj nepravilnih glasova po grupama
Articulation of fricatives (56.1%), then affricates (31.71%), while the articulation of vowels was correct by all patients. The biggest problem with the articulation of fricatives and affricates can be explained by the fact that some voiced sounds of these groups (/z/, /z/, /d/, /d/) are produced by vibration of the vocal cords [11], which were removed with total laryngectomy in laryngectomized patients. The study subjects had the biggest problem in the articulation of one sound from group of fricatives and it was the sound /h/, which was incorrectly articulated by as many as 68.75% of patients, while 5 patients (31.25%) did not articulate the sound /h/ at all. Veselinović [1] also found that the sound /h/ was the most difficult sound to be learnt, or not learnt at all, because it is a voiced sound, composed of pure noise, and it is articulated in a quite wide space between the back of the tongue and soft palate.

Christensen et al. [12] have used the dynamic palatometric assessment to examine lingua-palatal contact scheme and the duration of pronunciations of sounds /s/ and /z/ in people who use esophageal speech. It has been discovered that the narrowing of the groove, which created by the tongue of laryngectomized, patients is a physiological compensation for reduced air intake in esophageal speech. The average narrowing of the groove created by the tongue is 5-7 mm narrower for the sound /s/ than for the normal pronunciation when air passes through the larynx, pharynx, and all other parts needed for its final shaping. Narrow groove speech was interpreted as a significant articulation maneuver for limited intraoral air intake and affect on the length of duration of fricatives.

Crevier-Buchman [13] recorded the speech of 10 patients after partial supracricoid laryngectomy and recordings were presented to three expert listeners. They observed that the patients articulated the voiced consonants perceived as the production of voiceless consonants. It is believed that this is a direct consequence of the mechanical properties of pseudo-glottis, which is very different from the properties of the vocal cords.

Although no statistically significant results were obtained by comparing the age and the results of global articulation test, it was observed that the results tended to get worse in older patients. This can be attributed to the fact that aging leads to structural changes in general and degenerative changes in the resonant tract. In the elderly, the required volume and the oral cavity increases [14]. Auditory control of speech is worse in the elderly. Tests for functional magnetic resonance imaging show that aging primarily affects the posterior parts of the left upper temporal auditory cortex, whereby the elderly activate the prefrontal and ventral cortical zones compensatory by activating the zones for attention and working memory [15]. It leads to the deterioration of neural control for speech, articulation, and resonance [16]. Very old people have a cognitive impairment, a certain percentage of old people have signs of depression, which may be potentiated with response to malignant disease and the loss of the larynx.

Jokanović et al. [17] state that the teeth are of great importance for the creation of consonants, because sounds such as /c/, /ć/, /č/, /s/, /š/ cannot be properly created without teeth. In addition, these authors state that in the event of loss of teeth, there are a number of abnormalities that interfere with the proper articulation of consonants and normal communication. By comparing the results of global articulation test and the presence of teeth in patients in this study, it was concluded that the quality of articulation in this sample did not depend on the existence of the teeth. Both the patients who have all teeth and those who do not have them at all or have several teeth achieved nearly the same success in articulating sounds of Serbian language as the patients who have successfully mastered esophageal speech. It is possible that orolingual sensitivity and motility show the same compensatory adaptations as in the healthy people who have been edentulous for a longer time.

**Conclusion**

Cancer of the larynx, total laryngectomy, and subsequent learning of esophageal voice and speech are more common in men than in women in the age group from 51 to 70 years. Esophageal speech was rated excellent in more than half of patients and good in one third of patients. The articulation of affricates and fricatives especially of sound /h/, which is the sound belonging to the group of fricatives, was reported to be worse in the patients who mastered esophageal speech successfully.

Age and edentulousness in patients who have mastered esophageal speech does not affect the quality of articulation of sounds in Serbian language.

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