Summary

Introduction. Dysphonias due to primary neurogenic disorders are a group of voice disorders that can be caused by both central and peripheral disorders of the larynx innervation. There are numerous causes leading to paralysis of superior and/or inferior laryngeal nerves, particularly of the inferior laryngeal or recurrent nerve. Voice Therapy in Unilateral Vocal Cord Paresis. Vocal therapy is an integral part of the conservative treatment. Specific methods are applied to individual vocal problems, while the non-specific ones are applied to a number of dysphonias. Non-specific methods are further divided into integrated and focused vocal methods. Integrated methods treat the voice and speech disorders as a unified entity of all quality and segments of voice and speech. Focused non-specific methods treat the segments and the quality of voice and speech individually.

Assistive Techniques in Voice Disorders Caused by Unilateral Vocal Cord Paresis. Digital compression of the larynx by Seeman includes the treatment of voice with compression of the thyroid cartilage, thus moving the paralyzed and healthy vocal cord medially and upwards, and medially and downwards, respectively. This leads to the proper occlusion of vocal cords because in these conditions the paralyzed vocal cord is lower than the healthy one. According to the theoretical assumption, when the head and neck are rotated to one or the other side, the anatomic relations in the neck change and thus the vocal cords are brought into contact with the resulting reduction of the gap between them and the reduced air flow. Conclusion. Studies assessing the efficiency of different methods of vocal therapy are scarce bearing in mind the importance of vocal therapy and the fact that many patients refuse surgical treatment. Research on the efficiency of assistive techniques in phoniatric rehabilitation of patients with unilateral vocal cord paresis yields conflicting results. However, assistive techniques are useful practical methods in vocal rehabilitation of these patients.

Key words: Voice Disorders; Voice Training; Vocal Cord Paralysis; Dysphonia

Voicedl članci

Review article

UDK 616.22-009.1:615.8

DOI: 10.2298/MPNS1404091K

VOICE THERAPY AND ASSISTIVE TECHNIQUES IN VOICE DISORDERS CAUSED BY UNILATERAL VOCAL CORD PARESES

FONOTERAPIJSKE I ASISTIVNE TEHNIKE KOD POREMEĆAJA GLASA UZROKOVANIH JEDNOSTRANIM PAREZAMA GLASNICA

Bojana KAŠTEROVIĆ1, Mila VESELINOVIĆ1,2 and Slobodan M. MITROVIĆ1,2

Sažetak


Ključne reči: Poremećaji glasa; Trening glasa; Pareza glasnica; Disfonija

Corresponding Author: Prof. dr Slobodan M. Mitrović, Klinički centar Vojvodine,
21000 Novi Sad, Hajduk Veljkova 1-7, E-mail: mitroslo@eunet.rs
Introduction

Dysphonias due to primary neurogenic disorders are a group of voice disorders that can be caused by both central and peripheral disorders of the larynx innervation [1,2]. There are numerous causes leading to paralysis of superior and/or inferior laryngeal nerves, particularly of the inferior laryngeal or recurrent nerve on its "long way" [3]. This fact requires a systematic and multidisciplinary approach to diagnosis and treatment. Kotby [4] has divided the causes of laryngeal paralysis into central and peripheral, and the peripheral causes can be further divided into idiopathic, cancerous, surgical, traumatic, post-intubation because of chest diseases and others. Mitrovic [3] found that vocal cord paresis was most often due to a neck surgery (strumectomy) in 38% of patients, and idiopathic causes followed immediately, being found in 24% of patients. Mumovic [5] found iatrogenic injuries of the recurrent nerve in 10.36% of patients, most of which were also due to the operations of the thyroid gland. Beljin [6] reported that 38.5% of unilateral vocal cord paresis had iatrogenic cause. According to Jovic et al. [7], bilateral vocal cord paresis was also most common after surgery of the thyroid gland. Mitrovic [1] believes that recurrent laryngeal nerve paralysis is more often reported in women, although Stankovic [8] found that unilateral paresis of the larynx was twice more often in men in his study sample and he considered this fact controversial. The well known fact that the left recurrent nerve is more frequently paralyzed has been confirmed by Mitrovic et al. [3], whereas the right vocal cord paresis is more frequent according to Beljin [6] and Mumovic [9]. More frequent paralysis of the right recurrent laryngeal nerve was found by Mumovic [5] after neck surgery and by Hillstrom et al. [10] after injection of drugs into the neck.

Glottal closure is a very complex mechanism; therefore, glottal disclosing by unilateral vocal cord paresis is an important parameter of phonation dysfunction. Besides causing pathological phenomena of the voice, glottal disclosing leads to other difficulties, primarily the feeling of breathlessness. That is why the reduction of glottal disclosing is one of the goals in treatment as well as in the final evaluation of the efficiency of therapy [3].

Voice Therapy in Unilateral Vocal Cord Paresis

Vocal therapy is an integral part of the conservative treatment which also includes administration of neuroprotective drugs, electrotherapy and acupuncture [11]. Kotby [4] states that the methods of voice therapy can be divided into specific and non-specific ones. Specific methods are applied to individual vocal problems, while the non-specific ones are applied to a number of dysphonias. Non-specific methods are further divided into integrated and focused vocal methods. Integrated methods treat the voice and speech disorders as a unified entity of all qualities and segments of voice and speech. Focused non-specific methods treat the segments and the quality of voice and speech (height, intensity, purity and resonance of voice, rhythm, tempo, accent, tone of speech) individually [12]. The primary treatment goals for a patient with unilateral vocal cord paresis are to improve glottal closure, to increase the intrinsic muscle strength and agility (without causing supraglottic hyperfunction) and to develop abdominal support for breathing [13]. Heuer et al. [14] investigated the efficiency of voice therapy. They concluded that 92% of female patients and 71% of male patients with unilateral recurrent laryngeal nerve palsy showed significant improvement after three treatments on average. In a sample of 40 patients, Schindler [15] found that eight patients had the total occlusion of the glottis before voice therapy and 14 after the treatment, the patient’s voice became less rough and symptoms of dysphonia were reduced.

The importance of early voice therapy is also emphasized because it can result in a significant improvement of voice with the possibility of avoiding surgery [13].

The most frequently used techniques of voice therapy in unilateral paresis are:

**Hard glottal attacks and pushing exercises**

These exercises consist of having the patient breathe in, build air pressure while posturing the vowel without letting the air out, and then release the vowel. The patients are given the list of vowels and one-syllable vowel-consonant combinations to practice twice a day during the week. After that the patient is asked to produce the hard glottal attack with the addition of stretching the vowel while gliding down to a lower pitch. Gliding to a lower pitch encourages contraction of the thyroarytenoid muscle. If a progress is made, the patient incorporates an isometric push to the exercise. The push may be accomplished by pulling his hands up, pressing the chair next to the body. The isometric push is released when the vowel is released [16,17].

**Half-swallow boom**

The author of this technique is McFarlane. The patient is asked to take a breath and initiate the first part of a swallow, which reportedly improves glottal closure through muscle movements of the pharynx and larynx. At the peak of the half-swallow, the patient forcefully says "boom". When this technique is mastered, the word "boom" sounds loud and clear [18,19].

**Abdominal breathing**

The patient should place one hand on his upper chest and one on the lower ribcage. He should be able to feel a slight outward movement of the lower hand on breath with imperceptible movement of the upper hand. The aim is to notice the continuous
movement of the respiratory cycle. As soon as the effortless breathing has been established, the patient should be instructed to breathe more deeply. Inhalation should be shorter, whereas exhalation is getting longer but not extended beyond the available air supply [18,19].

Vocal function
The aim is to strengthen and balance the laryngeal musculature and to balance the airflow to the muscular effort [19].

The program consists of four steps, which are conducted two times each, twice a day for the first six weeks. All exercises should be produced as softly as possible without being breathy [16].

Head, neck, and shoulder relaxation
Compensatory vocal and laryngeal behaviors are frequently associated with increased tension of the shoulder, neck, and upper back. Relaxation of these areas should be practiced on a daily basis and it can be achieved by massage. General body relaxation can be achieved by increased aerobic exercise, yoga, pilates. In addition, it is extremely important to reduce stress at home and at work [16].

Accent method
The therapeutic procedure consists of respiratory, phonatory and articulatory exercises [20]. Practice drills usually start with a relaxed, soft, low pitched voice and then go up to a variety of accentuated vocalizations and intonational contours. Khidir [21] states that the accent method improves the auditory, perceptual, and aerodynamic parameters of patients with unilateral vocal cord paresis.

Lip and tongue trills
These exercises affect normal laryngeal tension by equalizing myoelectric and aerodynamic forces, and they also enhance the coordination of respiration, phonation and articulation. The tongue or the lips act as a valve, creating a difference in pressure of the outside air and the inside cavity, resulting in some oscillatory changes in the air pressure and the velocity of air flow. Subglottal air pressures during the production of trills may be greater than the normal phonation, thus enhancing the oscillation of vocal cords [16].

Appropriate tone focus
A combination of nasal consonants and vowels, such as “um-hum” and “me-me” which place perceptible vibration along the bridge of the nose are used in this treatment. This is useful for the patients with hypofunctional (breathy) and hyperfunctional (rough harsh) voices [16].

Therapy programs, such as Lessac-Madsen Resonant Voice Therapy (LMVRST) [22] and Resonance Therapy [23] are not typically used with patients with vocal cord paralysis or paresis, but they should be taken into consideration if they result in easier production of voice.

Assistive Techniques in Voice Disorders Caused by Unilateral Vocal Cord Paresis

Digital compression of the larynx by Seeman
There are many receptors in the mucosa of supraglottis which are highly sensitive to a vibration of laryngeal mucosa; whereas, tactile receptors are found in the epiglottis, aryepiglottic folds and vocal processes [6]. During phonation, the pressure sensitive receptors within the muscular spindles are activated, they send the impulses about the position of the larynx in the neck and the activities of the external laryngeal muscles [24]. External compression of the larynx improves the occlusion between the vocal cords, resulting in a better proprioceptive sensitivity and better control of voice [25].

In as early as 1910, Gutzman [26] described an improvement of vocal function achieved by digital compression applied on the cartilaginous larynx skeleton in the diagnosis of mutational disorders. He realized that compression on the thyroid cartilage in phonastenic voices causes lowering of pitch, which is retained for a longer period even after the pressure stopped, and in healthy voices the voice returns immediately to normal.

Brodnitz described digital compressive tests in the differential diagnosis of mutational disorders and functional dysphonia. It includes lateral manual compression, cricothyroid approximation, combination of lateral compression and cricothyroid approximation, and anteroposterior compression. These tests are applicable in patients with insufficient glottis occlusion of different etiology.

Van den Berg suggests that the pitch can be lowered by the compression on the thyroid cartilage which moves it posteriorly as well as by lower lateral pressure. However, if the lateral pressure is too strong especially near the arytenoid cartilage, it can result in higher voice [11].

Blaugraund [26] has stated that compression exerted on the thyroid and cricothyroid cartilage modifies the position, shape and tension of the vocal cords. The method is simple, non-invasive, requiring no instruments. The objective evaluation with aerodynamic tests significantly confirms the beneficial effects of the manual compression on the glottis occlusion, as well as the objective acoustic analyses and the videostroboscopic finding. The lateral compression reduces the laryngeal gap, adverse development of compensatory mechanisms and the amount of high-frequency noise components, heard as breathy voice [27].

As a therapy method, compression of the larynx dates back to 1919 when Seeman described it. This method is most frequently applied in glottal insufficiency caused by the recurrent nerve paralysis. Later, the therapists accepted the method in
the evaluation and treatment of different types of dysphonia [11].

The method includes the treatment of voice with compression of the thyroid cartilage by moving the paralyzed vocal cord medially and upwards and the healthy vocal cord medially and downwards [9]. This leads to the proper occlusion of the vocal cords because in these conditions, the paralyzed vocal cord is lower than the healthy one [28].

The efficiency of method

Mitrović found the following results in his study on the efficiency of the method by Seeman, conducted on a sample of 50 people [3]:

1. Indirect laryngoscopy showed that none of the patients had the total occlusion of the vocal cords before treatment. The disocclusion of 1-2 mm and 2-3 mm was reported in 54% and 24% of the patients, respectively. The total occlusion was regained after the treatment in 20% of the patients, while the disocclusion of up to 1 mm, 1-2 mm and 2-3 mm persisted in 36%, 20% and 2% of the patients, respectively.

2. The residual movements, described as minimal and irregular vibrations, with the difference in phase were found by laryngostroboscopy in 60% (30 patients) before treatment. After treatment, the residual movements were present in 45 patients (90%).

3. Subjective acoustic analysis showed that all patients (100%) had dysphonia before treatment. Mild and moderate disphonia was present in 30% and 42% of patients, respectively. After treatment, 48% of the patients regained a satisfactory peach and purity of their voice and 50% of them still had mild dysphonia. Moderate dysphonia was found in 2%, and none of the patients had severe dysphonia.

Mumovic and Arbutina [9] used the objective acoustic analysis with contemporary acoustic means to assess the effects of method by Seeman in their research conducted in the period 2000-2009. In a sample of 27 patients, aphonía was found in 44.44% of patients before treatment and none of the patients had it after treatment. Hoarseness (hoarse voice) was present in 51.8% of patients before voice therapy, being mild in 25.9%, moderate in 14.8% and severe in 11.1% of the patients; whereas only 3.7% of the patients were symptom free. After treatment, hoarseness was absent in 44.4% of patients, it was mild in 40.7% and moderate in 14.8% of the patients.

Before therapy, roughness (harsh voice) was mild in 11.1% of patients, and in 14.8% of patients it was moderate and severe, each. After treatment, roughness was absent in 55.6% of patients, it was mild in 14.8% of patients, moderate in 22.2% and severe in 7.4% of the patients.

Before therapy, breathiness (breathy voice) was severe in 44.4% of patients, moderate in 7.4% and mild in 3.7%. Not a single patient was free of breathiness in the voice before treatment, which suggests the presence of vocal insufficiency in all the patients. After treatment, breathiness was absent in 11.1% of patients, it was mild in 51.9% of patients, moderate in 11.1% and severe in 25.9% of patients.

The analysis of numerical acoustic parameters after voice therapy by Seeman has showed a significant reduction of irregularity of frequency vibration and noisy components in the voice probably by reducing the gap between the vocal cords. Voice therapy by Seeman improves the relation between the sound and noisy components by reducing the gap between the vocal cords, and perhaps by increasing the presence of harmonic components of voice, i.e. by better resonant conditions of phonation [9].

Head and neck rotation

The theoretical assumption underlying this method is that the rotation of the head sideways changes the anatomic relations in the neck, thus bringing the vocal cords into contact with the resulting reduction of the gap between them and reduced air flow. This technique was described as one of the three in the study by McFarlane et al. [29], who reported on the reduction of air flow after therapy, which was attributed to the improved occlusion of the glottis. In addition, hereby described method of digital compression of the larynx and half-swallow boom method was also used in this research.

Within the program of early vocal therapy, Mattioli et al. [17] used the exercise of head rotation sideways towards the healthy vocal cord, in which the therapist pressed his hand to the patient’s cheek on the same side, and the patient had to resist the pressure. In the second exercise, the patient also rotated the neck towards the healthy side and the therapist, coming from the other side, tried to raise the patient’s chin, and the patient had to resist.

The technique of lateral positioning of the head is used at the Department of Ear, Nose and Throat Diseases in Novi Sad. The technique is performed by the therapist, with the hands placed on the top of the patient’s head and slowly lowers the patient’s chin, thus making the lower jaw and the hyoid bone push the larynx down. The lateral rotation of head (right - left, left - right) is performed to achieve the best voice quality, especially in the production of vowels. This maneuver allows the best occlusion of paretic vocal cord, not only in terms of reducing disocclusion between the vocal cords, but also in terms of their alignment, especially if the vocal cords are in two levels.

The efficiency of method

Paseman et al. [30] measured the air flow in patients with unilateral vocal cord paresis during phonation in different head positions (central, rotated to the left and to the right side), while uttering the vowels I and A. The amount of air flow is seen as a reflection of glottal closure. The results obtained in this study...
indicate that the position of the head does not affect the improvement of glottal closure. This is in contrast with the results of McFarlane et al. [18], which show a significant improvement of glottal closure in patients with unilateral paresis after the head rotation. The different results obtained in these studies can be explained by various factors. McFarlane et al. applied three methods on the same sample, so it is possible that there was a cumulative effect. Furthermore, the intensity of voice was not controlled during therapy, and higher intensity can affect the glottis width, regardless of the rotation of the head, and neither the degree of rotation was specified. On the other hand, the respondents in the study of Paseman [30] were tested only once, but not before and after treatment. In any case, the different results obtained in these studies should encourage further assessment of the efficiency of this method.

Cantarella et al. [31] studied the efficiency of voice therapy in relation to the time elapsed from the onset of symptoms. Their study sample consisted of 30 patients who were divided into two groups. The first group included 14 patients with unilateral laryngeal paralysis, the mean duration of symptoms being 1.29 months, and the second group consisted of 16 patients with the average disease duration of 29.8 months. Vocal therapy involved the relaxation, abdominal breathing, pronunciation of the consonant “s” during exhalation, the resonance exercises, digital compression of the thyroid cartilage, neck massage, coughing and laughing exercise and rotation of the head sideways. The results show that vocal treatment alleviates the symptoms of unilateral paralysis of the larynx, both in patients with recent onset of symptoms, and in patients with unilateral paralysis which has been present for some time.

Conclusion

Unilateral vocal cord paresis is one of the most common causes of voice disorders. This condition can impair the quality of life of the patient severely, and it is necessary to develop more methods that would result in the improved quality of voice and alleviation of other symptoms of this disease.

By reviewing literature data it has been concluded that there are very few studies which evaluate the efficiency of different methods of voice therapy. That should be an incentive for experts in this field bearing in mind the importance of vocal therapy, particularly because many patients refuse surgical treatment.

Studies on the efficiency of assistive techniques in phoniatric rehabilitation of these patients described in this paper, compression of the larynx by Seeman and the rotation of the neck sideways have yielded conflicting results. Digital compression of the larynx can be assessed as a very successful method according to the results of the studies hereby presented. On the other hand, the efficiency of head and neck rotation method has not been fully clarified because of different results obtained by the above mentioned studies. That suggests the need for further research in this area. Assistive techniques are useful practical methods in vocal rehabilitation of patients with unilateral vocal cord paresis.

References

Novi Sad: G. Mumović 2009. – 1 elektronski optički disk (CD – ROM); 2009.


