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# Vocal Therapy of Hyperkinetic Dysphonia

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**SUMMARY**

**Introduction** Hyperkinetic (hyperfunctional) dysphonia is a common pathology. The disorder is often found in vocal professionals faced with high vocal requirements.

**Objective** The objective of this study was to evaluate the effects of vocal therapy on voice condition characterized by hyperkinetic dysphonia with prenodular lesions and soft nodules.

**Methods** The study included 100 adult patients and 27 children aged 4-16 years with prenodular lesions and soft nodules. A subjective acoustic analysis using the GIRBAS scale was performed prior to and after vocal therapy. Twenty adult patients and 10 children underwent objective acoustic analysis including several acoustic parameters. Pathological vocal qualities (hoarse, harsh and breathy voice) were also obtained by computer analysis.

**Results** The subjective acoustic analysis revealed a significant ($p<0.01$) reduction in all dysphonia parameters after vocal treatment in adults and children. After treatment, all levels of dysphonia were lowered in 85% (85/100) of adult patients and 29% (29/100) had a normal voice. Before vocal therapy 9 children had severe, 13 had moderate and 8 slight dysphonia. After vocal therapy only 1 child had severe dysphonia, 7 had moderate, 10 had slight levels of dysphonia and 9 were without voice disorder. The objective acoustic analysis in adults revealed a significant improvement ($p\leq0.025$) in all dysphonia parameters except SD F0 and jitter %. In children, the acoustic parameters SD F0, jitter % and NNE (normal noise energy) were significantly improved ($p=0.003$-$0.03$). Pathological voice qualities were also improved in adults and children ($p<0.05$).

**Conclusion** Vocal therapy effectively improves the voice in hyperkinetic dysphonia with prenodular lesions and soft nodules in both adults and children, affecting diverse acoustic parameters.

**Keywords:** vocal nodules; GIRBAS scale; objective acoustic analysis

## INTRODUCTION

Hyperkinetic (hyperfunctional) dysphonia is a common pathology in the clinical practice of phoniatric departments. Different studies report the frequency of voice disorders in the general population to be between 3-12%. According to different authors, various forms of hyperkinetic dysphonia compose up to 50% of overall vocal pathology. In children the frequency of hyperkinetic dysphonia disorders ranges from 3-37% [1, 2]. About 25% of occupations impose high vocal requirements on their employees, thus making hyperkinetic voice disorders a common disorder, particularly among people with voice intensive occupations [3].

Diverse classifications of hyperkinetic voice disorder have been formulated by Hribar, Perello, Cvejić, Kosanović, and Milutinović [4, 5]. Early classifications sharply separated organic from functional voice disorders. However, Kotby [6] has emphasized that "prerequisites of normal voice production are directly related to the "instrument" (vocal folds), but also to "the way the player (the subject) uses the instrument". He supported the theory that a functional disorder that lasts for a long time leads to organic changes, such as minimal pathological lesions (MAPLs).

The Phoniatric Department of the ENT Clinic in Novi Sad (Serbia) has been using the etiological classification formulated by Majdevac, the founder of the Phoniatric Department of the ENT Clinic in Novi Sad, for many years, particularly to differentiate between diverse types of hyperkinetic disorder. This classification pays special attention to children's hyperkinetic dysphonia and hyperkinetic dysphonia of vocal professionals [7, 8]. According to the primary ethiological factor, this classification includes eight main types of dyspohonia: 1. dysphonia due to functional disorder, 2. dysphonia due to neurological disorder, 3. dysphonia due to psychological disorder, 4. dysphonia due to somatic disorder, 5. dysphonia due to hormonal disorder, 6. dysphonia due to hard professional requirements, 7. dysphonia due to dysplastic disorder, and 8. dysphonia due to larynx tumors.

Dysphonia due to functional disorder includes: hypokinetic dysphonia, hyperkinetic dysphonia, dysodia and contact hyperplastic dysphonia. According to this special classification, hyperkinetic dysphonias are classified into: 1) juvenile hyperkinetic dysphonia (*dysphonia hyperkinetica juvenilis*), characterized by functional or organic changes in the middle of the vocal fold (*punctum maximum* of the vibration in childhood); 2) juvenile hypekinetic dysphonia prolonged into adulthood

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(*dysphonia hyperkinetica juvenilis prolongata*), characterized by changes in the middle of the vocal fold persisting into adulthood; and 3) hyperkinetic dysphonia in adults (*dysphonia hyperkinetica*) characterized by changes in the juncture of the anterior and medium third of the cords (punctum maximum of the cord vibration in adults).

Each of these dysphonias is classified into three stages, depending on its duration and severity: 1) stage I – organic changes are not apparent, but a hyperkinetic vibration form is detected by stroboscopy; 2) stage I/II – prenodular forms exist, with an hourglass form of the glottic occlusion or a tiny triangular gap between the posterior glottis; and 3) stage II – presence of soft or hard nodules on the vocal cords.

This classification, which is different from others, provides several useful informations: the type and duration of pathological etiological factors, the age of appearance, and the form of the glottic occlusion, thus allowing therapeutic approaches to be more targeted. Therefore, we strongly support the use of this classification system.

### Hyperkinetic (hyperfunctional) dysphonia stage I

During respiration, the larynx has no special features, or only minor ectasia. During phonation, indirect laryngoscopy may reveal a prominent adduction of the cords and a tendency of false vocal folds to mutual approximation. On stroboscopy, hyper adduction of the cords and reduced vibration amplitude are detected, sometimes accompanied by mucosal wave asymmetry. False vocal folds slightly cover the true vocal folds, but do not vibrate. The voice is tight, tense, louder, often deeper and accompanied by vocal fatigue. Many studies report good effects from vocal treatment in this type of dysphonia [8, 9]. The treatment includes elimination of predisposing factors, altered phonation mechanisms, avoidance of firm attacks, reimpostation of voice regarding its pitch, intensity and color [10]. Andrews proposes a 9-stage course of practical exercises to reduce interior muscle tension [11]. The voice exercises are carried out with soft, calm, moderate-intensity phonation.

### Hyperkinetic dysphonia stage I/II (prenodular lesions)

In this type of dysphonia, prenodular forms exist with slight edema and an hourglass gap, or a tiny triangular gap between the posterior part of the glottis. The degree of dysphonia depends on the degree of disturbance in vibration and vocal cord insufficiency. Vocal treatment similar to that for hyperkinetic dysphonia stage I is effective.

### Hyperkinetic stage II dysphonia (nodules)

The presence of chronic abuse, misuse and overuse syndrome induces the development of edematous nodules [12]. If vocal trauma is strong enough to impair microcirculation, angiectatic nodules will develop. If harmful factors are eliminated and vocal treatment is introduced, lesions are reversible. If this does not occur, the nodules may turn fibroedematous and then fibrous. The vocal mechanism does not disturb the "body" function but only the "cover" of the vocal folds. The lesions are bilateral, preventing a good cooptation of the vocal folds, with a small anterior and large posterior gap present. On stroboscopy, higher amplitude is noticed in front of the nodules. The voice is characterized by deepening, pneumophonia and reduced range. Vocal treatment is aimed at improving vocal efficiency to the maximum and reducing the impact of the vocal disorder on social aspects of life. Sataloff et al. [13] recommend a minimum of 6-12 weeks of vocal treatment, even when a surgical resection is planned, in order to prevent relapse. A long-lasting vocal treatment is needed not only to resolve the dysphonia, but also to correct prolonged bad vocal habits. Nodules play a prominent role in the singing voice damage [14]. Hirano citing Gould et al. [15] reports that the epithelial callus is the consequence of long-lasting phonotrauma in hard nodules. This condition is not reversible and must be microsurgically treated.

## OBJECTIVE

The objective of this study was to evaluate the effects of six weeks of vocal therapy on hyperkinetic (hyperfunctional) dysphonia with prenodular lesions and soft nodules in adults and children.

## METHODS

The study was designed as a retrospective study under normal working conditions in recent years in the Phoniatric Department of the ENT Clinic at the University of Novi Sad. We wanted to evaluate the results of vocal therapy in the treatment of serious hyperkinetic disorders such as prenodular lesions and nodules on the vocal folds. Hyperkinetic dysphonia grade I was treated with vocal hygiene. Hard nodules were treated with surgical procedures and vocal hygiene. The study included 100 adult patients (18-55 years) and 27 children (4-16 years) with prenodular lesions and soft nodules. The diagnosis was confirmed by several diagnostic procedures [16]:

1. Case history data

Case history data included gender, age and duration of symptoms. The main inclusion criteria was the presence of any of type of vocal overuse (more than 4 hours of speaking voice use, the normal professional standard for teachers in Serbia, or more than 2 hours of singing voice use per day) [17]; vocal abuse (shouting, excessive coughing and throat clearing) and vocal misuse (inefficient respiration, pitch and intensity of voice, or inefficient voice techniques) [6].

2. Criteria for exclusion were comorbidity factors: laryngopharyngeal reflux, infection, allergy and hormonal disorder [18, 19]. These factors were determined by careful phoniatric examination and laboratory findings.

3. Each patient underwent videostroboscopic examination using the Storz Pulsar Model 20 140020-2002 videostroboscopic system with a Sony video screen. After recording on a compact disc the vibrations of the vocal folds were analyzed frame by frame using a well-known videostroboscopic protocol analyzing amplitude, symmetry, periodicity, homogeneity, glottic gap, open and closed phase of vibration, and mucosal wave [20, 21].

4. Vocal treatment

Following diagnosis, patients underwent a 6-week vocal treatment, three times a week, with daily home voice exercises, including relaxation, respiration, phonation and reimpostation voice exercises, adjusted to individual needs. The phonation exercises were carried out gradually, paying special attention to reducing the hard onset of phonation, vowel purification, elevating the voice pitch to the purest voice level, as well as to the regulation of the speech rate, rhythm and melody. In this treatment stage, we used different forms of Serbian language accents and exercises with automated sequences (days of the week, counting to 10 and similarly) and hyper-melodic text (lyrical poetry, etc.) [22]. We assessed the effects of vocal treatment after six weeks using subjective and objective acoustic voice analysis.

## Subjective acoustic voice analysis

A well-trained human ear is the best judge of hoarseness. A subjective acoustic voice analysis was performed prior to and after six weeks of vocal treatment, applying the GIRBAS scale, assessing phonation of all vowels, prolonged vowel A phonation, as well as phonetically balanced sentences and text [23]. Based on the perceptual assessment, the following parameters were measured: G – grade – overall dysphonia level; I – instability of the voice; R – roughness of the voice; B – breathiness of the voice; A – asthenicity of the voice; S – strain of the voice.

All parameters were assessed by one of four grades: 0 (no voice pathology), 1 (mild disorder), 2 (moderate disorder), and 3 (severe disorder). The assessment was independently performed by a phoniatrician and a phonotherapist, calculating the mean values obtained by both examiners. The assessment was performed at the start of the vocal treatment and then again after six weeks of treatment.

According to the available data, objective acoustic voice analysis was performed in 20 adult patients and 10 children with prenodular or nodular lesions of vocal folds after six weeks of voice treatment. The voice sample (a prolonged, at least three-second phonation of the vowel A, and the best of three attempts) was provided in a soundproof room, produced in a comfortable sitting posture, at the usual pitch and intensity of the speaking voice. The voice was recorded at 5 cm distance from the mouth using a microphone (model Boehringer ultra voice XM 8500*)* with a mixer (Eurorack UB 520 ultra low-noise design 5 – input 2 bus mixer). The most stable segment of the voice sample was analyzed using a TIGER DRS computer system with Dr. Speech (4) Vocal Assessment software, which enabled the following parameters to be analyzed:

- Mean fundamental vocal frequency – mean F0 (Hz);
- Standard deviation of fundamental vocal frequency – SD F0;
- Minimal and maximal fundamental vocal frequency – Min F0 and Max F0;
- Maximum and minimum habitual phonation intensity (dB);
- Jitter % – the parameter representing the variability of vibration frequency in short intervals;
- Shimmer % – the parameter representing the amplitude variability in short intervals;
- Harmonic to noise ratio – HNR (dB) – the parameter representing the ratio between the harmonic and noise elements of the voice;
- Signal to noise ratio – SNR (dB) – the parameter representing the ratio between the overall sound signal and noise components of the voice;
- Normalized noise energy – NNE (dB) – the noise energy magnitude of the voice.

Due to the software capacities of the computer system Dr. Speech, which enables the comparison of the actual voice with 900 pathological and 2,400 healthy voices, three pathological categories of the voice were identified: hoarse voice, harsh voice and breathy voice. Each category was classified for four intensity stages: 0 – normal voice condition, 1 – mild deterioration, 2 – moderate deterioration, and 3 – severe deterioration. The computer voice analysis was performed prior to vocal therapy, and 6 weeks after initiation of the treatment.

## Statistical data processing

Data collected during the study were stored in a database designed for this purpose. After the data had been loaded and checked, they were processed using descriptive and interferential statistics. The following parameters were calculated and presented: sample scope, arithmetical mean, median, range of values, and standard deviation. Absolute and relative numbers represented the attributive features, and these data were compared using the chi square homogeneity test. The mean values for the numerical features with normal distribution before and after treatment were compared by the t-test for matched samples, i.e. by Wilcoxon's test for the features measured by the ordinal scale. Variance analysis was applied, i.e. the Cruscal-Wallis test, depending on the type of data. Statistical data processing was performed using the SPSS 14 program for Windows.

## RESULTS

Regarding the sex of the adult patients in the study, females were predominant: of 100 patients, 88 (88%) were female and 12 (12%) were male. Regarding age structure, the patients ranged from 18-55 years of age.

The ages of the 27 children with prenodular and nodular lesions were between 4-16 years, affecting 13 boys and 14 girls.

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### Subjective acoustic analysis by the GIRBAS scale (100 patients)

Applying the nonparametric Wilcoxon's test, a significant difference was registered in all GIRBAS Scale parameters before and after vocal treatment ($p<0.01$):

- Parameter G (grade): Z=-9.007; $p<0.01$;
- Parameter I (instability): Z=-8,095; $p<0.01$;
- Parameter R (roughness): Z=-7.399; $p<0.01$;
- Parameter B (breathiness): Z=-7.399; $p<0.01$;
- Parameter A (asthenisity): Z=-5.738; $p<0.01$;
- Parameter S (strain): Z=-8.397; $p<0.01$.

The overall dysphonia level – parameter G is presented (Table 1).

Pretreatment, all of the patients presented with dysphonia. After treatment, 29% of them no longer presented dysphonia. Before vocal treatment, 34 patients had mild dysphonia. After treatment, 27 (79.4%) of them were without dysphonia. In 49 cases of moderate dysphonia, after treatment: 2 patients (4.1%) were without dysphonia, 42 (85.7%) patients had mild dysphonia, and 5 (10.2%) of them still presented with moderate disphonia. Severe dysphonia was present in 17 patients. After treatment, only one patient had severe dysphonia. In most of these patients (11 or 64.7%) dysphonia became moderate and in 5 cases (29.4%) there was mild dysphonia. Most of the cases (85%) showed improvement. Analyzing the GIRBAS parameters before and after 6 weeks of vocal treatment in 27 children, a significant ($p<0.01$) improvement was found in all parameters. Before vocal therapy, 9 had severe, 13 had moderate and 8 had mild dysphonia (G). After vocal therapy only one child had severe dysphonia, 7 had moderate dysphonia, 10 had a mild level of dysphonia and 9 were without voice disorder.

### Objective acoustic analysis

Objective acoustic analysis of the pathological voice types showed a significant improvement in hoarse, harsh and breathy voice scores ($p<0.01$) (Tables 2, 3 and 4).

**Table 1.** Parameter G (Grade) values (N=100)

| G | | Post-treatment | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | No | Mild | Moderate | Severe | Aphonia | |
| Pre-treatment | No | 0 | 0 | 0 | 0 | 0 | 0 |
| | Mild | 27 | 7 | 0 | 0 | 0 | 34 |
| | Moderate | 2 | 42 | 5 | 0 | 0 | 49 |
| | Severe | 0 | 5 | 11 | 1 | 0 | 17 |
| | Aphonia | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | 29 | 54 | 16 | 1 | 0 | 100 |

**Table 2.** Hoarse voice (N=20)

| Hoarse voice | | Post-treatment | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | No | Mild | Moderate | Severe | Aphonia | |
| Pre-treatment | No | 1 | 0 | 0 | 0 | 0 | 1 |
| | Mild | 11 | 3 | 0 | 0 | 0 | 14 |
| | Moderate | 1 | 3 | 0 | 0 | 0 | 4 |
| | Severe | 0 | 1 | 0 | 0 | 0 | 1 |
| | Aphonia | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | 13 | 7 | 0 | 0 | 0 | 20 |

**Table 3.** Harsh voice (N=20)

| Harsh voice | | Post-treatment | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | No | Mild | Moderate | Severe | Aphonia | |
| Pre-treatment | No | 14 | 1 | 0 | 0 | 0 | 15 |
| | Mild | 0 | 0 | 0 | 0 | 0 | 0 |
| | Moderate | 3 | 0 | 0 | 0 | 0 | 3 |
| | Severe | 2 | 0 | 0 | 0 | 0 | 2 |
| | Aphonia | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | 19 | 1 | 0 | 0 | 0 | 20 |

**Table 4.** Breathy voice (N=20)

| Breathy voice | | Post-treatment | | | | | Total |
|---|---|---|---|---|---|---|---|
| | | No | Mild | Moderate | Severe | Aphonia | |
| Pre-treatment | No | 0 | 1 | 0 | 0 | 0 | 1 |
| | Mild | 0 | 1 | 0 | 0 | 0 | 1 |
| | Moderate | 5 | 1 | 0 | 0 | 0 | 6 |
| | Severe | 2 | 5 | 2 | 3 | 0 | 12 |
| | Aphonia | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | 7 | 8 | 2 | 3 | 0 | 20 |

**Table 5.** Objective acoustic analysis of numerical parameters

| Parameter | | t-test | p |
|---|---|---|---|
| F0 | Mean | -3.076 | 0.006* |
| | SD | 0.837 | 0.413 |
| | Max | -2.771 | 0.012* |
| | Min | -3.413 | 0.003* |
| Jitter % | | 1.737 | 0.099 |
| Shimmer % | | 2.429 | 0.025* |
| NNE | | 7.105 | 0.000* |
| HNR | | -3.741 | 0.001* |
| Intensity | Min | -2.719 | 0.014* |
| | Max | -2.631 | 0.016* |

* p<0.05
F0 – fundamental vocal frequency; SD – standard deviation; Max – maximum value; Min – minimum value; NNE – normalized noise energy; HNR – harmonic to noise ratio

**Table 6.** Acoustic parameters in children

| Parameter | | t-test | p |
|---|---|---|---|
| F0 | Habitual | -1.135 | 0.300 |
| | Mean | -1.069 | 0.326 |
| | SD | 2.815* | 0.031* |
| | Max | -0,510 | 0.628 |
| | Min | -1.173 | 0.285 |
| Jitter % | | 3.782* | 0.009* |
| Shimmer % | | 0.745 | 0.484 |
| NNE | | 4.857* | 0.003* |
| HNR | | -1.675 | 0.145 |
| Intensity | Min | -1.099 | 0.314 |
| | Max | -1.263 | 0.254 |

* p<0.05

Hoarse voice was present in 19 patients (Table 2). After treatment, the voice was without hoarseness in 68.4% of them. Improvement was seen in 84.2% of cases (16/19). Applying the nonparametric Wilcoxon's test, a significant difference was registered in the hoarse voice parameter before and after vocal treatment (Z=-3.819; p<0.01)

Five patients had harsh voice, which improved to normal after treatment (Table 3). Applying the nonparametric Wilcoxon's test, a significant difference was registered in the harsh voice type before and after the vocal treatment (Z=-2.020; p<0.05).

Most patients (12; 63.2%) had a severe degree of breathy voice (Table 4). After treatment, 75% showed improvement. In 6 patients with a moderate degree of breathy voice, one (16.6%) became mild and 5 (83.3%) were without breathiness after treatment. Applying the nonparametric Wilcoxon's test, a significant difference was registered in the breathy voice parameter before and after vocal treatment (Z=-3.491; p<0.01).

The t-test was applied in the analysis of the acoustic parameters (Table 5). A statistically significant difference (p≤0.025) was registered for all parameters values, except for the values of SD F0 and Jitter % parameters.

Analysis of the computer assessment of hoarse, harsh and breathy voice in 10 children showed a significant (p<0.05) reduction in all pathological voice types.

In the children group, a statistically significant difference (p=0.031–0.003) was registered for the SD F0, Jitter % and NNE acoustic parameters (Table 6).

## DISCUSSION

The analysis of the subjects gender structure reveals that adult hyperkinetic dysphonia with prenodular lesions or soft nodules predominantly affect females, which suggests that females may have certain predisposing factors for the development of hyperkinesias. These may possibly include gender conditioned anatomical features, such as the difference in the length and mass of the vocal folds and a larger angle between the vocal folds in females requiring a greater abductor-adductor activity; the hyaluronic acid quantity in the intercellular matrix is three times higher in males than in females, while there is a longer open vibration phase and greater susceptibility to pneumophonia in females. Sodersten et al. [24] have reported that females have difficulties in achieving loudness in a noisy environment, possibly leading to a phono-traumatic effect. It is also probable that females are professionally more oriented to vocally demanding jobs.

Analyzing the age structure of the children group, we noted that hyperkinetic lesions could be found very early in childhood, pointing to genetic factors such as the structure of the basement membrane lining the vocal folds [25]. However, environmental factors (family factors, school, and noise) can be also etiologic factors. A similar number of boys and girls in the children group suggest that puberty brings anatomical and functional differences between the sexes due to hormonal changes and differences in the selection of occupation. Therefore, it is very important to treat dysphonia before puberty and professional orientation.

Subjective acoustic analysis has demonstrated that vocal therapy has good effects on all subjectively evaluated hoarseness parameters in adults and children. A trained human ear can assess voice quality very well and this has also been confirmed by objective acoustic analysis [26, 27].

The objective acoustic analysis of prenodular and nodular lesions in adults has shown the good effects of vocal therapy on a variety of acoustic parameters, including the Mean F0, Max F0, Min F0, Shimmer %, NNE, HNR, SNR, and pathological voice types (hoarse, harsh and breathy voice). The results of our objective acoustic analysis are very similar to the results of Maia et al. [28] suggesting that the shimmer parameter is improved during vocal treatment by reducing vibration amplitude instability. The good effects of vocal therapy on numerous acoustic parameters suggest that the treatment favorably affects numerous pathophysiological phonation mechanisms, resulting in normalization of voice pitch, reduced vibration amplitude instability, reduced noise components of the voice, and elevated harmonic components contributing to voice pureness. Reduction in noise components is probably due to an improved occlusion, reducing the turbulence of airflow during phonation. Elevation of the harmonic voice components is probably due to a better resonant function of the subglottic and supraglottic structures. Comparing the current voice with the database of both normal and pathological voices, improvement was registered in all pathological voice types (hoarse, harsh and breathy voice) following the applied vocal treatment. Vocal therapy seems to contribute to normalization of several pathological voice types, regardless of the subjective or objective assessment applied.

Objective acoustic analysis in the children group suggests that vocal therapy improves different acoustic parameters (SD F0, Jitter %, and NNE) than those in the adults, or rather affects the frequency of vibrations and glottic competence more than the amplitude of vibrations and resonant function of the larynx. This could be due to the different shape and size of the child's larynx.

Even if there are different effects of vocal therapy in adults and children, six weeks of vocal treatment is effective for prenodular and nodular lesions in both groups. Other authors have also reported that vocal treatment is an important modality in the treatment of hyperfunctional voice disorders [28-34].

## CONCLUSION

The results obtained from both the subjective and objective acoustic analysis confirm the beneficial effects of vocal treatment on hyperfunctional dysphonia with prenodular and nodular lesions in adults and children affecting diverse pathophysiological phonation mechanisms. Vocal treatment is an important modality in the treatment of these voice disorders. A variety of phonopedic methods are available, but individual adjustments are always required.

## REFERENCES

1. Takeshita KT, Aguiar-Ricz L, Isaac M, Ricz H, Anselmo-Lima W. Vocal behavior in preschool children. Intl Arch Otorhinolaryngol. 2009; 13(3):252-8.
2. Oliveira RC, Teixeira LC, Gama AC, Medeiros AM. Auditory-perceptive, acoustic and vocal self-perception analyses in children. J Soc Bras Fonoaudiol. 2011; 23(2):158-63.
3. Amorim GO, Bommarito S, Kanashiro CA, Chiari BM. The vocal behavior of telemarketing operators before and after a working day. J Soc Bras Fonoaudiol. 2011; 23(2):170-6.
4. Cvejić D, Kosanović M. Fonijatrija I deo. Glas. Beograd: Zavod za udžbenike i nastavna sredstva; 1982.
5. Milutinović Z. Klinički atlas poremećaja glasa. Beograd: Zavod za udžbenike i nastavna sredstva; 1997.
6. Kotby MN. The Accent Method of Voice Therapy. San Diego: Singular Publishing Group Inc; 1995.
7. Majdevac Ž. Dečja hiperkinetska disfonija. Med Pregl. 1977; 30(9-10):505-8.
8. Majdevac Ž, Mitrović S, Jović R. Klasifikacija disfonija prema primarnom etiološkom faktoru (I deo). Med Preg. 2001; 54(1-2):39-44.
9. Ramig LO, Verdolini KJ. Treatment efficacy: voice disorders. J Speech Lang Hear Res. 1998; 41(1):101-16.
10. Mumović MG. Konzervativni tretman disfonija. Monografija. Novi Sad: University of Novi Sad, Faculty of Medicine; 2004.
11. Andrews LM. Manual of Voice Treatment. Pediatrics Through Geriatrics. 2nd ed. San Diego: Singular Publishing Group; 1999.
12. Kosztyła-Hojna B, Moskal D, Kuryliszyn-Moskal A, Andrzejewska A, Falkowski D. Morphological changes of the vocal fold mucosa in hyperfunctional dysphonia diagnosed by psychoacoustic and videostroboscopic methods. Adv Med Sci. 2011; 56(2):343-51.
13. Sataloff TR, Spiegel RJ, Hawkshaw M. Voice disorders. Otolaryngol Clin North Am. 1993; 77:551-70.
14. Cvejić B, Cvejić D. Umetnost pevanja. Beograd: „Slobodan Jović"; 1994.
15. Gould JW, Rubin SJ, Yanagisawa E. Benign vocal fold pathology through the eyes of the laryngologist. In: Rubin SJ, Satalof TR, Korovin SG, Gould JW. Diagnosis and Treatment of Voice Disorders. New York, Tokyo: Igaku-Shoin Medical Publishers Inc; 1995. p.137-51.
16. Mumović G. Dijagnostika profesionalnih oštećenja glasa. In: Djukić V. i saradnici, editors. Profesionalni glas. Beograd: Klinički centar Srbije; 2011. p.7-32.
17. Sataloff TR. Voice Science. San Diego-Oxford: Plural Publishing Inc; 2005.
18. Hočevar-Boltežar I, Šereg-Bahar M, Kravos A, Mumović G, Mitrović S. Is an occupation with vocal load a risk factor for laryngopharyngeal reflux: a prospective multicentre, multivariate comparative study. Clin Otolaryngol. 2012; 37:362-8.
19. Roth D, Ferguson JB. Vocal allergy in dysphonia. Curr Opin Otolaryngol Hed Neck Surg. 2010; 18:176-81.
20. Hirano M, Bless MD. Videostroboscopic Examination of the Larynx. San Diego. California: Singular Publishing Group Inc; 1993.
21. Stasney CR. Atlas of Dynamic Laryngeal Pathology. San Diego: Singular Publishing Group Inc; 1996.
22. Mumović G, Vitkai-Kučera A. Nespecifične vežbe glasa. [CD- ROM]. Novi Sad: 2012.
23. Dejonckere HP, Bradley P, Clemente P, Crevier-Buchman LCG, Friedrich G, Van De Heyning P, et al. A basic protocol for functional assessment of voice pathology, especially for investigating the efficacy of (phonosurgical) treatments and evaluating new assesment techniques. Guideline elaborated by Committe on Phoniatrics of the European Laryngological Society (ELS). Eur Arch Otorhinolaryngol. 2001; 258:77-82.
24. Sodersten, M, Ternstrom S, Bohman M. Loud speech in realistic environmental noise: Phonetogram data, perceptual voice quality, subjective ratings and gender differences in healthy speakers. J Voice. 2005; 19(1):29-46.
25. Sapienza C, Hoffman-Rudy B. Voice Disorders. San Diego, Oxford, Brisbane: Plural Publishing Inc; 2009.
26. Trani M, Ghidini A, Bergamini G, Pressutti L. Voice therapy in pediatric functional dysphonia: a prospective study. Int Pediatr Otorhinolaryngol. 2007; 71(3):379-84.
27. Petrović-Lazić M, Babac S, Ivanković Z, Kosanović R. Multidimensional analysis of pathological voice. Srp Arh Celok Lek. 2009; 137(5-6):234-8.
28. Maia ME, Maia MO, Gama AC, Behlau M. Immediate effects of the high-pitched blowing vocal exercise. J Soc Bras Fonoaudiol. 2012; 24(1):1-6.
29. Mumović MG. Vocal therapy with larynx compression after partial laryngectomy. Med Pregl. 2011; 64(7-8):357-61.
30. Holmberg EB, Hillman RE, Hammarberg B, Södersten M, Doyle P. Efficacy of a behaviorally based voice therapy protocol for vocal nodules. J Voice. 2001; 15(3):395-412.
31. Stepp CE, Merchant GR, Heaton JT, Hillman RE. Effects of voice therapy on relative fundamental frequency during voicing offset and onset in patients with vocal hyperfunction. J Speech Lang Hear Res. 2011; 54(5):1260-6.
32. Rodríguez-Parra MJ, Adrián JA, Casado JC. Comparing voice-therapy and vocal-hygiene treatments in dysphonia using a limited multidimensional evaluation protocol. J Commun Disord. 2011; 44(6):615-30.
33. Schindler A, Mozzanica F, Ginocchio D, Maruzzi P, Atas M, Ottaviani F. Vocal improvement after voice therapy in the treatment of benign vocal fold lesions. Acta Otorhinolaryngol Ital. 2012; 32(5):304-8.
34. Halawa EW, Freire FRA, Munoz VI, Perez SS. Assessment of effectiveness of acoustic analysis of voice for monitoring the evolution of vocal nodules after vocal treatment. Eur Arch Otorhinolaryngol. 2014; 271:749-56.

# Вокална терапија хиперкинетске дисфоније

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**КРАТАК САДРЖАЈ**

**Увод** Хиперкинетска (хиперфункционална) дисфонија је веома честа патолошка појава. Посебно се често јавља код вокалних професионалаца с великим гласовним захтевима.

**Циљ рада** Циљ рада је био да се утврде ефекти вокалне терапије на стање гласа код особа с хиперкинетским дисфонијама с пренодуларним лезијама и меким нодулусима.

**Методе рада** Испитивањем је обухваћено 100 одраслих особа и 27 деце узраста од четири године до 16 година. Субјективна акустичка анализа скалом *GIRBAS* је урађена код свих испитаника пре и после вокалне терапије. Код 20 одраслих испитаника и 10 деце урађена је објективна акустичка анализа гласа која је обухватила више акустичких параметара. Објективном акустичком анализом добијени су и патолошки типови гласа (промуклост, храпавост и пнеумофоничност).

**Резултати** Субјективна акустичка анализа је показала да постоји статистички значајно ($p<0,01$) смањење свих параметара дисфоније након третмана гласа, како код одраслих, тако и код деце. Након третмана, степен дисфоније код одраслих испитаника био је мањи за 85%, а 29% је имало нормалан глас. Пре вокалне терапије, деветоро деце је имало тешку, тринаесторо умерену, а осморо благу дисфонију. Након терапије, само једно дете је имало тешку дисфонију, седморо умерену, а десеторо благу. Нормалан налаз гласа забележен је код деветоро деце. Објективна акустичка анализа гласа код одраслих показала је статистички значајно поправљање ($p\leq0,025$) свих параметара дисфоније, изузев два параметра: *SD F0* и *Jitter %*. Код деце, статистичка значајност је добијена код *SD F0*, *Jitter %* и *NNE* ($p$=0,003–0,03). Патолошки типови гласа су се поправили и код одраслих и код деце ($p<0,5$).

**Закључак** Вокална терапија има користан ефекат на квалитет гласа код хиперкинетске дисфоније са пренодуларним лезијама и меким нодулусима, како код одраслих, тако и код деце, и делује на различите акустичке параметре.

**Кључне речи:** вокални нодулуси; скала *GIRBAS*; објективна акустичка анализа

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