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APPLICABILITY OF THE VOCAL TRACT DISCOMFORT (VTD) SCALE IN EVALUATING THE EFFECTS OF VOICE THERAPY OF OCCUPATIONAL VOICE DISORDERS

ZASTOSOWANIE SKALI DYSKOMFORTU TRAKTU GŁOSOWEGO
W OCENIE EFEKTÓW REHABILITACJI ZAWODOWYCH ZABURZEŃ GŁOSU

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ABSTRACT

Background: Occupational voice disorders are characterized by rich symptomatology, which is dominated by symptoms by the vocal tract discomfort. Therefore, in the management it is important to consider these subjective complaints. The aim of the study was to assess the usefulness of using the vocal tract discomfort scale (VTD) in evaluating the effects of rehabilitation concerning occupational dysphonia. **Material and Methods:** The study included 55 teachers (mean age: 47.2) with occupational dysphonia diagnosed by means of videostroboscopy. The test battery covered also: voice self-assessment according to voice handicap index (VHI), perceptual GRBAS scale and the new VTD scale. Each subject underwent intensive rehabilitation, including voice training and voice hygiene education. The post-therapy examination was conducted using the above-mentioned methods. **Results:** Comparing the results obtained in the preliminary and the control test a significant post-therapy improvement ($p = 0.000$) was discovered in relation to the general outcome of the symptoms in the VTD scale – assessed both as for the frequency subscale (24.7 points vs. 10 points) and the severity subscale (25.5 points vs. 10 points). A positive significant effect of the treatment was also observed in the voice VHI disability index ($p < 0.05$) and in perceptual voice evaluation, using the GRBAS scale ($p < 0.05$). In addition, the study revealed a high coefficient of correlation (r) between the subscales of the VTD, both in the preliminary examination ($r = 0.934$) and the control one ($r = 0.935$). **Conclusions:** The vocal tract discomfort scale (VTD) seems to be a valuable tool, useful in monitoring the progress in the treatment of occupational voice disorders. Med Pr 2012;63(2):141–152

Key words: dysphonia, vocal tract discomfort scale, vocal training, voice hygiene education

STRESZCZENIE

Wstęp: Zaburzenia głosu o podłożu zawodowym charakteryzują się bogatą symptomatologią, w której dominują objawy dyskomfortu w obrębie traktu głosowego. Z tego powodu w postępowaniu diagnostyczno-terapeutycznym ważne jest uwzględnienie tych dolegliwości. Celem pracy było zastosowanie skali dyskomfortu traktu głosowego (VTD) w ocenie efektów rehabilitacji dysfonii zawodowych. **Materiał i metody:** Badaniem objęto grupę 55 nauczycieli (średnia wieku: 47,2 lat), u których na podstawie badania foniatrycznego z wideostroboskopią rozpoznano dysfonie zawodowe. Zestaw testów diagnostycznych obejmował również: samoocenę głosu według wskaźnika niepełnosprawności głosu VHI, ocenę percepcyjną głosu według GRBAS, a także badanie za pomocą nowej skali VTD. Każdy z pacjentów poddany był intensywnej rehabilitacji głosu, uwzględniającej trening głosowy oraz edukację higieny głosu. Po zakończeniu terapii przeprowadzono badanie kontrolne z zastosowaniem ww. metod. **Wyniki:** Porównując wyniki uzyskane w badaniu wstępnym i kontrolnym, stwierdzono istotną poprawę po terapii ($p = 0,000$) w odniesieniu do wyniku ogólnego symptomów skali VTD – ocenianego zarówno w podskali częstotliwości (24,7 pkt vs 10 pkt), jak i podskali nasilenia (25,5 pkt vs 10 pkt). Pozytywne istotne efekty terapii zaobserwowano również we wskaźniku niepełnosprawności głosowej VHI ($p < 0,05$), a także w ocenie percepcyjnej głosu, z zastosowaniem skali GRBAS ($p < 0,05$). Ponadto badania dowiodły, że skala dyskomfortu traktu głosowego (VTD) charakteryzuje się wysokim współczynnikiem korelacji (r) pomiędzy podskalami, zarówno w badaniu wstępnym ($r = 0,934$), jak i kontrolnym ($r = 0,935$). **Wnioski:** Skala dyskomfortu traktu głosowego (VTD) wydaje się być wartościowym narzędziem, przydatnym w monitorowaniu postępów terapii zawodowych zaburzeń głosu. Med. Pr. 2012;63(2):141–152

Słowa kluczowe: dysfonia, skala dyskomfortu traktu głosowego, trening głosowy, edukacja higieny głosu

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INTRODUCTION

Human voice is a complex phenomenon, which arises from the interaction of the respiratory organ, the phonatory organ, the resonant cavities and the organs of articulation, which are controlled by the central nervous system. Therefore, the smooth functioning of the vocal organ is possible due to the co-ordination of the above-mentioned mechanisms and processes necessary for the emergence of voice (1,2).

Each year, an increasing number of professionals use their voice to perform their occupation (3). Abnormal mechanisms of voice emission in these patients may lead to occupationally-induced voice disorders. In the literature, these multiform disorders are referred to as dysphonia, whose symptoms are usually paresthesia of the throat and larynx, a temporary or permanent voice hoarseness, dulling of the voice tone and narrowing of its scale, as well as reduced phonation time. Often, the first symptom of these disorders may be the feeling of tickling, irritation, dryness and the feeling of obstruction (the so-called “lump”) in the throat (4,5). Moreover, in these individuals there appear habitual throat clearing, dry cough, the “voice fatigue” and weakening of its strength, especially during prolonged vocal effort. A characteristic feature for a long-lasting, untreated dysphonia is the so-called voice fatigue syndrome, resulting from improper compensation of vocal effort. These patients are observed to suffer from excessive muscle tension in respect of their pharynx, larynx and neck, causing the feeling of discomfort of the vocal tract, and sometimes tenderness and severe pain within these structures, preventing the production of the voice (odynophonia) (6,7).

In the case of long-term problems that are often neglected by patients and physicians, occupational dysphonia can cause physical discomfort, as well as the deterioration of the occupational and social functioning particularly for people who use their voice as a working tool (8–10). Moreover, it can lead to changes in mental health and cause symptoms such as depressed mood, bad mood, depression or anxiety. It produces a kind of a “vicious circle” of causal dependence, which can lead not only to irreversible pathology of the voice, but also to serious mental disorders.

For this reason, occupation-related voice disorders require comprehensive diagnostic work, taking into account also the subjective assessment of the symptoms coming from the vocal organ. Currently, there are few standardized methods for the subjective as-

essment of voice disorders. The methods most widely used in Poland include the voice handicap index (VHI) and the perceptual voice assessment according to the GRBAS scale. Another method for subjective evaluation of voice disorders is the VTD scale (Vocal Tract Discomfort), proposed by Mathieson in 1993 (11), commonly used in Britain. Our study demonstrated the usefulness of the Polish version of the VTD scale in the diagnosis of dysphonia (12,13).

So far, in Poland, studies on the use of the VTD scale in monitoring the progress of rehabilitation have not been performed. For this reason, the purpose of this study was to evaluate the results of voice therapy in patients with occupational dysphonia using the Vocal Tract Discomfort scale (VTD) in comparison with the evaluation of VHI and the GRBAS scale.

MATERIALS AND METHODS

The study comprised 55 occupationally active people with voice dysphonia, including 51 women and 4 men. The average age of the patients was 47.2 years, the youngest person was 30, while the oldest was 59 years old. The patients were enrolled into the study group based on videostroboscopy.

In addition, all patients had been subjected to: a subjective assessment using VHI and VTD, and perceptual voice evaluation according to GRBAS. A simple but objective aerodynamic parameter measurement was also performed, i.e. the maximum phonation time (MPT).

All persons in the study group completed the voice tract discomfort questionnaire (VTD) on 8 symptoms concerning the vocal tract (i.e. burning, tight, dry, aching, tickling, sore, irritable, lump in the throat) assessed as for the subscale of frequency and severity. The assessment of individual items of the scale is made in the scale range from 0 to 6, where – concerning the subscale of frequency – 0 means never, 1–3 mean sometimes, 3–5 often, 6 – always. As for the subscale of severity 0 – means none, 1–3 mean mild, 3–5 moderate, 6 means extreme. The total score can range from 0 (8 questions 0 points each) to 48 points (8 questions 6 points each). The full text of the Polish and English version of the voice tract discomfort (VTD) scale, including the division into subscales is shown in Appendix 1.

Apart from that, a self-assessment of the voice was conducted according to the Voice Handicap Index, which is the most widely used tool for the subjective assessment of voice disorders in Poland (14) and worldwide (15,16). It examines the impact of voice dis-

orders in three domains of life: functional, emotional and physical. The result obtained within the limit 0–30 is defined as a minor voice handicap, 31–60 is an average voice handicap, and the result of 61–120 points indicates a serious voice handicap.

Moreover, all patients were subjected to the perceptual voice assessment using the GRBAS scale by Japan Society of Logopedics and Phoniatics, which describes voice disorders with 5 well-defined parameters: G (grade of hoarseness) – the degree of voice hoarseness, R (roughness) – the roughness of the voice resulting from irregularity of vocal folds vibrations, B (breathiness) – “breathing” voice as a result of air escaping during phonation through unopened glottis, A (asthenic) – weak asthenic voice, S (strained) – tense, hyperfunctional voice. The GRBAS scale has four levels of disorders intensity in which “0” means normal voice, “1” – mild deviance, “2” – moderate deviance, “3” – severe deviance, with respect to all parameters.

After a preliminary study, including the above-described methods, the patients were enrolled into a comprehensive voice rehabilitation consisting of direct therapy (training in scope of techniques of proper voice production) and indirect therapy (vocal hygiene and a healthy lifestyle education). The entire cycle of voice rehabilitation lasted about 3–4 months.

Indirect voice therapy

The first step in the rehabilitation proceedings was vocal hygiene education. It consisted in two meetings in the form of an individual conversation with a speech therapist about the following issues:

- a) physiology of voice formation;
- b) rules of correct voice production;
- c) working environment, paying particular attention to the microclimate of the premises and noise in the workplace;
- d) education on the harmful effects of excessive use of the voice and overstraining the voice;
- e) education on the change vocal habits;
- f) personal hygiene (i.e. taking care of physical fitness, proper hydration of vocal cords – according to the recommendations of the British Voice Association – a person working with his or her voice should drink daily about 8 glasses of still mineral water, avoid substance abuse, including: cigarette smoking, drinking alcohol, taking drugs that affect the dryness of the mucous membrane of the pharynx and larynx);
- g) change in eating habits (i.e. avoiding large meals and night snacks, fatty and spicy foods, drinking strong

coffee and tea, which also plays a role in the prevention of the reflux disease that often accompanies occupation-induced dysphonia);

h) forms of coping with stress at work.

Each patient received a booklet with instructions on the care of the voice organ developed by a team of the Department of Audiology and Phoniatics at Nofer Institute of Occupational Medicine in Łódź.

Direct voice therapy

According to the European guidelines on the treatment of voice disorders, vocal rehabilitation of patients with occupational dysphonia involved correction of voice production and was based on close cooperation between a laryngologist/phoniatician with a speech therapist trained in the techniques of voice production (17).

Direct voice therapy consisted of a series of several meetings (min. twelve 1-hour sessions) in the speech therapist office. The visits took place once a week. The role of the speech therapist was to give the patient the basic principles for the comprehensive program of voice training. In addition, his or her major aim was to motivate and encourage the patient to regular exercise, whose goal was the elimination of wrong habits regarding voice production.

The direct voice training (VFEs – vocal function exercises) was individually tailored to the needs of the patient, taking into account the age, sex and general condition of the rehabilitated person. It included the following steps:

1. Breathing and relaxation exercises. This stage comprised good posture exercises, relaxation exercises to eliminate or reduce facial and neck muscles tension, as well as breathing exercises allowing the patient to master the proper technique of breathing. An extremely important element were respiratory support exercises, the so-called apoggio or deliberate release and deepening of the expiratory phase with controlled tension of the respiratory muscles. Through systematic breathing exercises, the patient learned to conduct the breath properly, which in turn meant that it became effective and efficient.
2. Phonatory exercises. This step allowed the patients to make free, effortless and soft sound emission, and to speak at the frequency/pitch most convenient and economical for the voice, adjusted to the age and sex of the person. The essence of the phonatory exercises was also learning the capability of modeling the strength and pitch of the voice, which depend on proper breathing and correct phonation. Equally

important were also the exercises meant to stimulate and use of all resonators and resonant chambers in order to achieve maximum resonance. Mastering the proper resonant space setting, through a combination of chest resonator with base resonators, was a decisive element as for the volume and tone of the produced sound. In addition, it allowed for effective and efficient operation of the voice organ.

3. Articulation exercises. Direct voice training also included articulation exercises aimed at eliminating from the voice track unnecessary tension and stress and obtaining the natural alignment of its individual elements. For this purpose, the patient was asked to perform exercises improving the flexibility and strength by the muscles of the articulation organs. Another element was to improve the speech techniques paying particular attention to distinctive pronunciation of vowels and consonants, moderate pace of speech, a wide-open mouth and a corresponding lowering of the jaw.
4. Integration and habituation exercises. The initial phase of this training included auditory self-correction exercises, which consisted of teaching the patient to capture the differences between normal and abnormal voice. The patient, during subsequent meetings, was meant to better control the correctness of the performed exercises, using biofeedback, as well as he or she evaluated their own voice, and discussed its character with a speech therapist. During the second stage, the exercises involving learned the fixed elements of correct voice production were introduced into normal conversational speech and tasks requiring increased effort voice. During this training, a speech therapist made an individual assessment of the patient's progress. He or she paid special attention to the posture, proper way of breathing, proper respiratory support, the ability to activate the resonators of the upper and lower areas, the right way of phonation, and articulation during free speech. Then, if necessary, the patient was qualified to take up the following breathing, relaxation, phonatory, or articulatory exercises.

At the end of the cycle of voice rehabilitation (after about 3–4 months), each patient filled again the above-mentioned scales (VHI, VTD), and an assessment of the voice according to the GRBAS scale was performed. In addition, patients also underwent a videostroboscopic test along with the max. phonation time measurement (MPT). The results of these tests were not the subject of this report.

Statistical analysis

Assessing the effects of voice rehabilitation according to the VTD scale, in scope of two subscales, we compared the results obtained in the preliminary (0) and the control (1) examination using the test for dependent samples (T-Test). For the sake of comparison of individual items of frequency and severity of the symptoms contained on the VTD scale, the Wilcoxon test was used. As the threshold for recognition of the result as statistically significant, $p < 0.05$ was adopted.

In addition, statistical analysis was performed in order to compare the frequency and severity of the symptoms of dysphonia, in the preliminary and the control examination, in respect of individual symptoms examined in the VTD scale with the median.

The VHI questionnaire results, obtained in the preliminary test and the control one, were statistically analyzed using the test for dependent samples (T-Test) and the results of the listening evaluation according to GRBAS using the Wilcoxon test.

To assess the relationship between the results of the VHI questionnaire and the VTD subscales Pearson's nonparametric test was used. The analysis of the relationship between the results on the GRBAS scale and VTD was performed using Spearman's rank correlation coefficient.

RESULTS

To assess the effects of voice therapy we compared the results obtained from the VTD scale, VHI questionnaire, perceptual voice evaluation using GRBAS, in the preliminary test (before voice therapy) and the control test (after the treatment).

The analysis of the overall average of the symptoms on the VTD scale showed that the overall result as for the frequency subscale in the preliminary test was 24.7 points and it was significantly higher (worse) than the score obtained in this scale in the control test, which was only 10 points. A similar improvement after treatment was found in scope of the severity of symptoms on the VTD subscale, where the score before the therapy was 25.5 points, and after 10 points. This improvement was statistically significant for both the frequency subscale ($p = 0.000$), and the severity subscale ($p = 0.000$).

Moreover, a comparison of the mean frequency and severity of particular symptoms of voice tract discomfort scale was performed. Due to the ordinal level of the variables measurement, the median was used. It was demonstrated that better results were ob-

tained in the control test (Tab. 1). It is worth noting that in the preliminary test the median for dry, tickling and the lump in the throat feeling was 4 points, while in the control test it was reduced to 1–2 points for these symptoms and for the two subscales.

The analysis of the median value results using the Wilcoxon test showed a statistically significant improvement ($p = 0.000$) for all medical symptoms assessed both in scope of the frequency and severity subscale, following the voice therapy.

In the course of the analysis of individual symptoms (items) for the frequency subscale it was found that symptoms such as tight, dry, aching, tickling, irritable and lump in the throat feeling were much less likely to occur after the treatment (Fig. 1). A similar improvement was seen in case of the results for the same symptoms (items) in the subscale of severity on the VTD scale, where in the control test (1) significantly better results were obtained compared with the initial examination (0) (Fig. 2).

Table 1. Median of the respective items for the VTD frequency and severity subscale in the preliminary and the control examination (Wilcoxon test)

Tabela 1. Mediana dla poszczególnych dolegliwości w zakresie częstotliwości i nasilenie w skali VTD w badaniu wstępnym i kontrolnym przy pomocy testu Wilcoxona

Symptoms Symptomy	Frequency Częstotliwość		p	Severity Nasilenie		p
	median mediana			median mediana		
	preliminary test badanie wstępne	control test badanie kontrolne		preliminary test badanie wstępne	control test badanie kontrolne	
Burning / Pieczenie	2.0	1.0	0.000*	3.0	1.0	0.000*
Tight / Napięcie	3.0	2.0	0.000*	3.0	1.0	0.000*
Dry / Suchość	4.0	2.0	0.000*	4.0	2.0	0.000*
Aching / Ból	3.0	1.0	0.000*	3.0	0.0	0.000*
Tickling / Drapanie	4.0	1.0	0.000*	4.0	1.0	0.000*
Sore / Tkliwość	2.0	0.0	0.000*	2.0	0.0	0.000*
Irritable / Podrażnienie	3.0	1.0	0.000*	4.0	1.0	0.000*
Lump in the throat / Uczucie kluski w gardle	4.0	1.0	0.000*	4.0	1.0	0.000*

VTD – vocal tract discomfort scale / skala dyskomfortu traktu głosowego.

* $p < 0.05$.

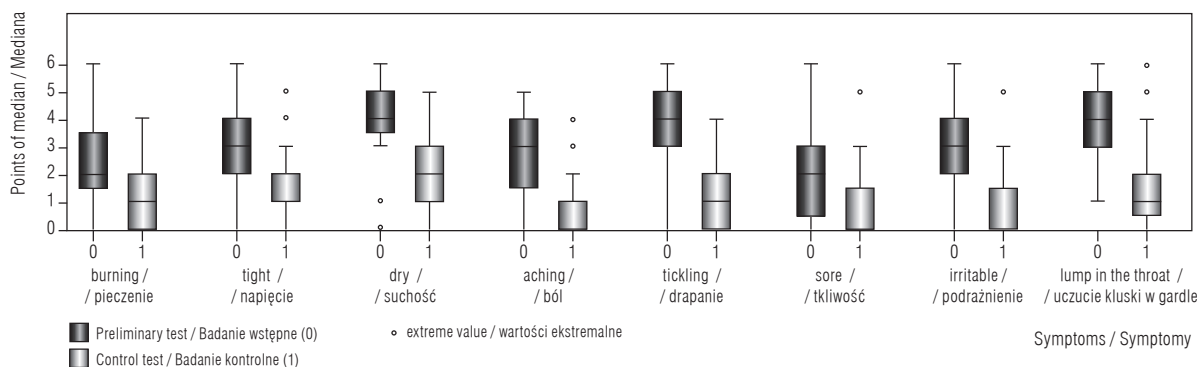


Fig. 1. Box plots used to compare the respective items for the VTD frequency subscale in the preliminary (0) and the control (1) examination
Ryc. 1. Porównanie poszczególnych itemów podskali częstotliwości VTD w badaniu wstępnym (0) i kontrolnym (1)

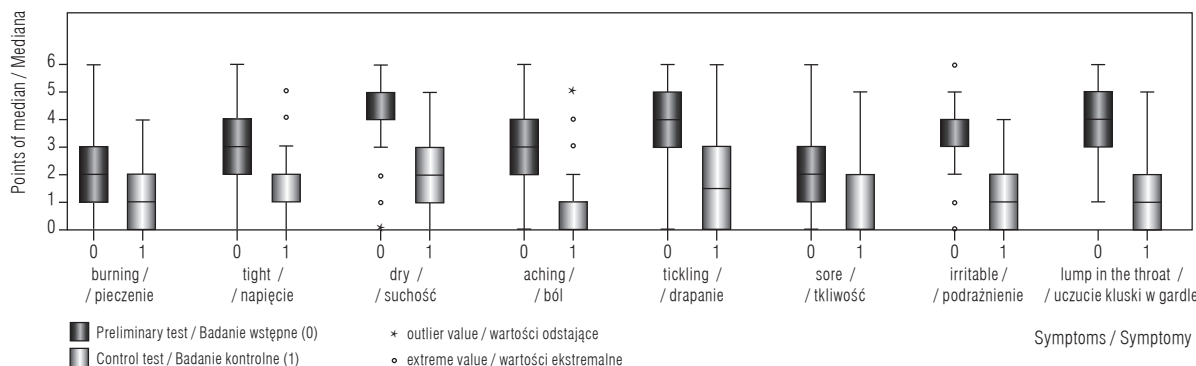


Fig. 2. Box plots used to compare the respective items for the VTD severity subscale in the preliminary (0) and the control (1) examination
Ryc. 2. Porównanie poszczególnych itemów podskali nasilenia VTD w badaniu wstępnym (0) i kontrolnym (1)

The improving proving the effectiveness of the used voice therapy was also observed in VHI (Fig. 3). After the treatment, the average total score of VHI clearly improved compared with its value before the treatment (49.3 vs. 24.5). It should be noted that the average total VHI score before therapy was contained in the second range, which means that the patients rated their voice handicap as moderate, and in control test the vocal problems of the rehabilitated patients were presumed as minor, since the average total VHI score in all subjects was contained within I range.

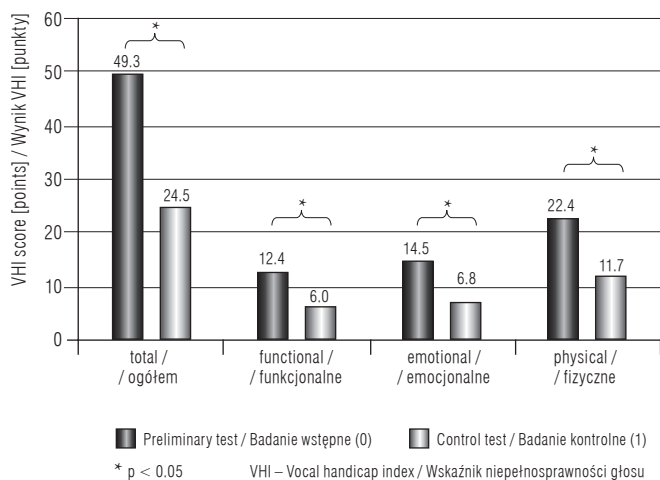


Fig. 3. The results of VHI in the preliminary and the control examination (Test-T)
Ryc. 3. Wyniki skali VHI w badaniu wstępnym i kontrolnym z zastosowaniem testu dla prób zależnych (Test-T)

Similarly, better results in the control test were obtained for each of the subscales of VHI. The improvement was found for both the functional subscale (12.4 vs. 6), the emotional (14.5 vs. 6.8), and the physical (22.4 vs. 11.7).

Statistical analysis using the test for dependent samples (T-Test) showed the improvement of the total VHI score ($p < 0.05$), as well as the results of each of the VHI subscales on the level of significance ($p < 0.05$).

An improvement as for the tone and reduction in the degree of voice hoarseness was also found in perceptual voice evaluation using the GRBAS scale (Fig. 4). The analysis of the results of individual voice self-assessment parameters, using the Wilcoxon test, showed significantly better results in the control test, compared with the initial examination for each of the five parameters ($p < 0.05$).

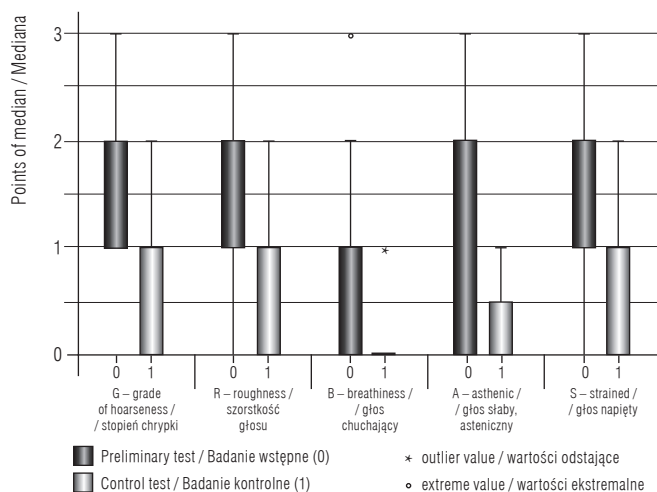
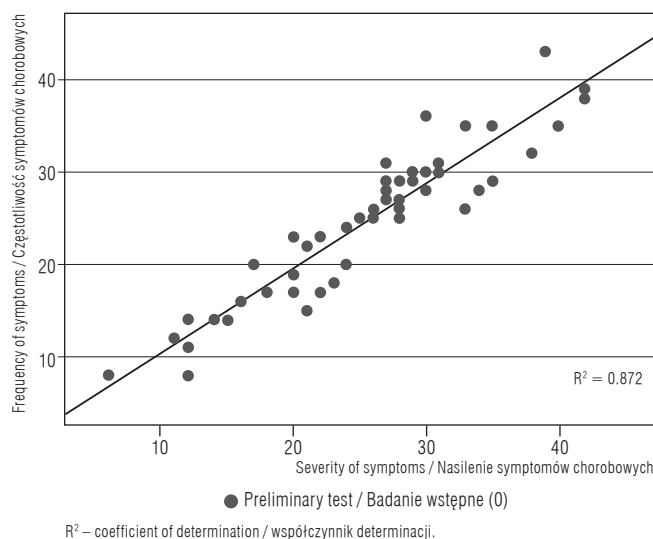


Fig. 4. The parameters of GRBAS scale in the preliminary (0) and the control (1) examination (Wilcoxon test)
Ryc. 4. Wyniki skali GRBAS w badaniu wstępnym (0) i kontrolnym (1) z zastosowaniem testu Wilcoxona

In order to assess the relationship between the results of the GRBAS scale and the VTD scores, Spearman's rank correlation coefficient was used. Statistical analysis showed no correlation between these scales.

To examine the strength of the straight association between the two VTD subscales coefficient of determination was calculated (Fig. 5). It was observed that the correlation points are grouped along a hypothetical straight line, which indicates substantial strength of the association, both in the preliminary test (0): $R^2 = 0.872$, and the control test (1): $R^2 = 0.874$. Moreover, the sign of the correlation coefficient “+” means positive proportional relationship, i.e. the changes in both subscales followed the same direction.



verity of the symptoms from the vocal tract, the smaller subjective self-assessment of the voice.

The analysis of the relationship between the VHI subscales and the VTD scale indicates that the symptoms evaluated in relation to the VTD subscale co-occur with the emotional and physical subscale after the conducted vocal therapy for the frequency subscale the level of significance was $p = 0.429$ for the VHI emotional subscale, $p = 0.466$ for the VHI physical subscale. For the severity subscale $p = 0.428$ and $p = 0.553$, respectively.

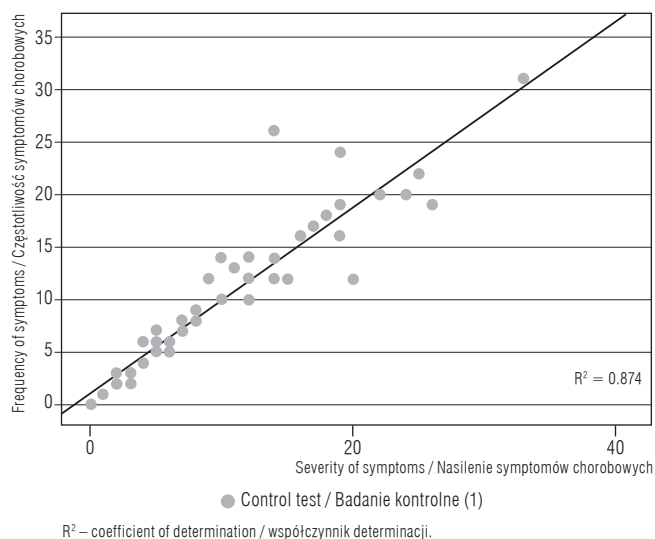


Fig. 5. Scatterplot illustrating the correlation of the frequency and the severity of symptoms in the VTD scale in the preliminary and the control examination

Ryc. 5. Rozrzut korelacyjny nasilenia i częstotliwości symptomów chorobowych w badaniu wstępnym i kontrolnym

The next stage of this study was to analyze the correlation association between the VTD subscales using the Pearson's test (Tab. 2). A very strong positive correlation between the severity of the symptoms and their frequency, as shown in Table 2, was observed. In the preliminary test, the correlation coefficient was as high as 0.934, and in the control test, this coefficient equaled 0.935, which indicates a strong correlation between these subscales, both before the treatment and after it.

Table 2 presents the relationship between the VHI questionnaire results and the scores obtained according to the VTD scale also calculated using the Pearson's test. The results indicate the existence of correlations between variables in the control examination. The total VHI score correlates with the level of frequency ($p = 0.000$, $r = 0.466$) and severity ($p = 0.000$, $r = 0.477$) of the symptoms after therapy, which means that the smaller the subjective level of frequency and se-

In summary, the correlation analysis showed a significant correlation between the results of the VHI and the VTD scale after administering treatment, which suggests that the reduced values of VHI were accompanied by the decrease of the values on the VTD scale, i.e. they improved.

DISCUSSION

In the present study, we assessed the effects of voice therapy using a voice tract discomfort scale in a group of patients with diagnosed occupational dysphonia. It should be emphasized that the subjective voice assessment is widely applied in practice and it makes an important element of a comprehensive examination of the voice organ, next to the objective tests. For this reason, it was decided to use the VTD scale in monitoring the therapy progress in comparison with other subjective voice assessment methods commonly used

Table 2. Correlation between the VHI scale and the VTD subscale results in the preliminary (0) and the control (1) (Pearson's) tests
Tabela 2. Korelacja między wynikami skali VHI a podskalami VTD metodą testu Pearsona w badaniu wstępnym (0) i kontrolnym (1)

Scale Skala	VHF (0)	VHF (1)	VHE (0)	VHE (1)	VHP (0)	VHP (1)	VHIP (0)	VHIP (1)	VHIT (0)	VHIT (1)	Frequency Częstotliwość VTD (0)	Frequency Częstotliwość VTD (1)	Severity Nasilenie VTD (0)	Severity Nasilenie VTD (1)
VHI (0) functional / funkcjonalne	r p	1 0.000	0.808** 0.000	0.609** 0.000	0.553** 0.000	0.255 0.060	0.895** 0.000	0.581** 0.000	0.057 0.681	0.044 0.747	0.036 0.794	0.017 0.901		
VHI (1) functional / funkcjonalne	r p	0.652** 0.000	1 0.000	0.618** 0.000	0.841** 0.000	0.470** 0.000	0.656** 0.000	0.887** 0.000	0.223 0.102	0.312* 0.020	0.151 0.270	0.252 0.063		
VHI (0) emotional / emocjonalne	r p	0.808** 0.000	0.618** 0.000	1 0.000	0.729** 0.000	0.335* 0.012	0.955** 0.000	0.654** 0.000	0.222 0.103	0.148 0.280	0.169 0.218	0.131 0.339		
VHI (1) emotional / emocjonalne	r p	0.609** 0.000	0.841** 0.000	0.745** 0.000	1 0.000	0.570** 0.000	0.722** 0.000	0.929** 0.000	0.324* 0.016	0.429** 0.001	0.281* 0.038	0.428** 0.001		
VHI (0) physical / fizyczne	r p	0.553** 0.000	0.470** 0.000	0.729** 0.000	0.571** 0.000	0.522** 0.000	0.825** 0.000	0.602** 0.000	0.351** 0.009	0.210 0.124	0.305* 0.024	0.240 0.077		
VHI (1) physical / fizyczne	r p	0.255 0.060	0.480** 0.000	0.335* 0.012	0.570** 0.000	1 0.000	0.399** 0.003	0.789** 0.000	0.319* 0.018	0.466** 0.000	0.354** 0.008	0.553** 0.000		
VHIT (0) total / ogółem	r p	0.895** 0.000	0.656** 0.000	0.955** 0.000	0.722** 0.000	0.825** 0.000	1 0.000	0.683** 0.000	0.221 0.105	0.144 0.293	0.178 0.193	0.136 0.322		
VHIT (1) total / ogółem	r p	0.581** 0.000	0.887** 0.000	0.654** 0.000	0.929** 0.000	0.789** 0.000	0.683** 0.000	1 0.000	0.335* 0.013	0.466** 0.000	0.304* 0.024	0.477** 0.000		
Frequency / Częstotliwość VTD (0)	r p	0.057 0.681	0.223 0.102	0.222 0.103	0.324* 0.016	0.319* 0.018	0.221 0.105	0.335* 0.013	1 0.000	0.650** 0.000	0.934** 0.000	0.601** 0.000		
Frequency / Częstotliwość VTD (1)	r p	0.044 0.747	0.312* 0.020	0.148 0.280	0.429** 0.001	0.466** 0.000	0.144 0.293	0.466** 0.000	0.650** 0.000	1 0.000	0.661** 0.000	0.935** 0.000		
Severity / Nasilenie VTD (0)	r p	0.036 0.794	0.151 0.270	0.169 0.218	0.281* 0.038	0.304* 0.024	0.178 0.193	0.304* 0.024	0.934** 0.000	0.661** 0.000	1 0.000	0.673** 0.000		
Severity / Nasilenie VTD (1)	r p	0.017 0.901	0.252 0.063	0.131 0.339	0.428** 0.001	0.240 0.077	0.136 0.322	0.477** 0.000	0.601** 0.000	0.935** 0.000	0.673** 0.000	1 0.000		

r – Pearson's correlation coefficient / współczynnik korelacji liniowej Pearsona.

p – probability / prawdopodobieństwo.

** Significant correlation $\alpha = 0.01$ / Korelacja jest istotna na poziomie $\alpha = 0.01$.

* Significant correlation $\alpha = 0.05$ / Korelacja jest istotna na poziomie $\alpha = 0.05$.

in phoniatic practice, namely: self-assessment by VHI and perceptual assessment by GRBAS.

The subject of the research was evaluation of the effects of voice rehabilitation by means of the VTD scale. The rehabilitation included both the indirect and direct voice therapy. All patients showed an improvement of the voice function, as confirmed by subjective scales: self-assessment of voice using VHI, perceptual voice evaluation carried out according to the GRBAS scale and the VTD scale. The positive effects of voice rehabilitation were also confirmed in an objective qualitative examination – i.e. videostroboscopy, and an objective quantitative parameter – the measurement of maximum phonation time (MPT). The results of these tests will be discussed and presented in the next publication.

The analysis of the overall VTD scale assessment showed significant improvement in the symptoms after the treatment compared with those obtained before the treatment. The incidence of the symptoms after the treatment decreased in comparison with the period before the treatment commenced (24.7 points vs. 10 points). A similar improvement was observed for the symptoms subscale measured on the VTD scale (25.5 points vs. 10 points). This difference was statistically significant both for the frequency subscale ($p = 0.000$) and the severity one ($p = 0.000$). Moreover, significant improvement was also observed for the frequency and severity subscales of the particular items (symptoms) of the VTD scale.

The positive effects of the treatment were also obtained as for VHI, where the total score and the result obtained in each of the subscales: functional, emotional and physical was lower in the control examination compared with the initial examination ($p < 0.05$).

Similar results were also observed in scope of the perceptual voice evaluation carried out according to GRBAS. As a result of direct voice therapy, significant improvement was observed for each of the parameters evaluated by GRBAS.

It should be noted that the coefficient of determination, which is the second – apart from the correlation coefficient measurement of the strength of association between subscales, was high both before the treatment ($R^2 = 0.872$) and after it ($R^2 = 0.874$), indicating a high compliance of the severity and frequency of the symptoms rated on the VTD scale. These results are consistent with the results of the analysis examining the correlation between the subscales of the VTD scale, carried out using Pearson's test. Similarly, there was observed a very strong positive relationship between the sever-

ity of the symptoms and their frequency in the preliminary test (correlation coefficient as high as 0.934), and in the control test (the correlation coefficient is 0.935). The results indicate significant relationships between the frequency of occurrence of the disease symptoms and their severity, which seems obvious, because the more common the symptoms are within the voice tract, the greater their intensity. The confirmation of this observation are studies on the occurrence of subjective voice symptoms in people who use the voice professionally that conducted by Koszyła-Hojna (18). The author proved that discomfort felt within the vocal tract is closely linked to the lack of applying a proper technique of voice production and the ignorance as for the basic vocal hygiene voice.

Furthermore, we analyzed the correlation between the VTD scale and the commonly used indicator of voice handicap index – VHI. A positive relationship was found between the total VHI result and its physical and emotional subscales and the subscales of VTD only in the evaluation following the voice therapy; for the frequency subscale the level of significance was $p = 0.466$ for the relationship with the total VHI, $p = 0.429$ for the VHI emotional subscale, $p = 0.466$ for the VHI physical subscale. For the severity subscale, the results were, respectively, $p = 0.477$, $p = 0.428$, and $p = 0.553$. The observations described above are reflected in clinical practice, since the reduction of vocal tract discomfort accompanying occupation-related dysphonia, induced a significant improvement in the VHI scores, concerning both the total result and its individual subscales, reflecting the improvement of the emotional, functional and physical state of the rehabilitated patients.

It should be noted that in the literature devoted to this subject we found no papers evaluating the relationship between the VTD scale with another subjective voice self-assessment. In our study, we obtained a clear positive correlation between the voice handicap index, which is one of the most widely used methods of subjective voice assessment, and the vocal tract discomfort scale.

Our study showed that all teachers in the study group reported – prior to the treatment – fairly frequent and severe symptoms from the vocal tract, usually in the form of pharyngo-laryngeal paresthesia, such as a burning sensation in the throat and esophagus, tight, dry, tickling and habitual grunts related to it, foreign body sensation in the throat or pain in the throat and larynx. These results are confirmed in clinical interpretation: a characteristic feature of occupation-related dysphonia, especially hyperfunctional dysphonia, is ex-

cessive tightening of the muscles of the larynx, pharynx and neck during phonation, which ultimately leads to the overstraining of these muscles, especially the voice muscles, causing serious discomfort (19–21). For this reason, it is worthwhile to popularize the VTD scale in the diagnostic and therapeutic procedures concerning dysphonia in Poland.

Mathieson applied in her studies the VTD scale in the monitoring of the therapy conducted in patients with voice disorders (11,22). Clinical tests carried out by the author showed that patients with dysphonia of various etiology often reported discomfort in the voice tract area. Moreover, she proved that patients with hyperfunctional dysphonia complain about the presence of symptoms such as tension, tenderness and a feeling of an obstacle in the throat, more often than patients with organic dysphonia. These results are consistent with the findings of Tavares and Martins (23) who in their research showed that people with voice disorders often complain about discomfort in the voice tract area than the healthy subjects. Similar results have been presented by other authors, who found that the symptoms in the form of pain and tension, or irritation and dryness around the vocal tract are common among people who use the voice professionally (18). For this reason, as emphasized by Laukkanen et al., treatment of the above-mentioned illness should be comprehensive – in addition to direct therapy (vocal training) it should also take into account indirect therapy (voice hygiene education) (24). The vast majority of authors acknowledge that the health education concerning the voice organ increases the patients' awareness about the symptoms of voice fatigue, avoiding voice overstraining, ensuring adequate rest and adequate hydration (25,26). Young-Sun et al. in their study in patients with organic lesions in the area of vocal folds proved that the voice organ hygiene education improved the VHI score and reduced the complaints concerning the vocal tract (27). Furthermore, they consider that at least 20% to 38% of patients with changes in the form of polyps can prevent unnecessary surgical interventions, if they follow voice hygiene indications.

On the other hand, Oliveir – while monitoring voice rehabilitation in telemarketers – drew the attention to the positive effect of indirect voice therapy, followed by a significant improvement in the symptoms of the vocal tract, which induced an improvement in the quality of the voice in the subjective and objective assessment in the study group (28).

It is worth noting that in our studies, indirect therapy also contributed to the improvement as for the discomfort experienced within the vocal tract. One component of the voice hygiene education sessions was information on moistening the mucous membrane of the throat and larynx, which increased the awareness of the patients and improved symptoms such as dry, tickling and irritable in the throat, both in the subscale of their frequency and severity. The conducted studies suggest that significantly more often the disorders of the voice organ should be associated with the lack of knowledge or ignorance of the rules of basic voice hygiene (6,23). For this reason, it seems reasonable to include the indirect therapy module into rehabilitation of occupational voice disorders.

In summary, as a result of a comprehensive voice therapy significant improvement in voice quality was achieved as measured by subjective methods. An improvement as for VHI and reduction in the frequency and severity of the discomfort symptoms in the area of the vocal tract were obtained. Due to this, in our study, along with other phoniatic diagnostic methods, the VTD scale was used, whose usefulness in the diagnosis of occupational dysphonia had been demonstrated in our previous studies (12,13). Based on the results presented in this report it was shown that the Vocal Tract Discomfort scale seems to be a valuable tool, useful in monitoring the progress of the voice therapy, including the subjects suffering from occupational voice disorders.

CONCLUSIONS

1. The vocal tract discomfort scale (VTD) seems to be a valuable tool, useful in monitoring the progress in the treatment of occupational voice disorders.
2. Phoniatic treatment taking into account voice rehabilitation based on vocal training and vocal hygiene education is an effective method of therapy in case of occupational dysphonia.

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Appendix 1. Vocal Tract Discomfort Scale (VTD)
Załącznik 1. Skala Dyskomfortu Traktu Głosowego

The following are symptoms or sensations that you may feel in your throat, which may occur as part of your voice problem. Please indicate the frequency with which they occur and the severity of the symptom/sensation, by circling a number in the appropriate column.

Patient identifier: Date:		Frequency						Severity							
		never	sometimes		often	always		none	mild		moderate	extreme			
		0	1	2	3	4	5	6	0	1	2	3	4	5	6
1	Burning	0	1	2	3	4	5	6	0	1	2	3	4	5	6
2	Tight	0	1	2	3	4	5	6	0	1	2	3	4	5	6
3	Dry	0	1	2	3	4	5	6	0	1	2	3	4	5	6
4	Aching	0	1	2	3	4	5	6	0	1	2	3	4	5	6
5	Tickling	0	1	2	3	4	5	6	0	1	2	3	4	5	6
6	Sore	0	1	2	3	4	5	6	0	1	2	3	4	5	6
7	Irritable	0	1	2	3	4	5	6	0	1	2	3	4	5	6
8	Lump In the throat	0	1	2	3	4	5	6	0	1	2	3	4	5	6

Based on: Mathieson L: Vocal tract discomfort in hyperfunctional dysphonia. J Voice 1993;2:40-8.

Poniżej wymienione dolegliwości lub doznania możesz zaobserwować w gardle lub krtani. Mogą one być częścią symptomów Twoich problemów głosowych. Proszę, wskaż częstość oraz nasilenie, z którymi one występują, zakreślając kółkiem jedną odpowiedź w każdym z symptomów w odpowiedniej kolumnie.

Imię i nazwisko: Data:		Częstotliwość						Nasilenie							
		nigdy	czasami		często	zawsze		brak	małe		średnie	duże			
		0	1	2	3	4	5	6	0	1	2	3	4	5	6
1	Pieczenie	0	1	2	3	4	5	6	0	1	2	3	4	5	6
2	Napięcie	0	1	2	3	4	5	6	0	1	2	3	4	5	6
3	Suchość	0	1	2	3	4	5	6	0	1	2	3	4	5	6
4	Ból	0	1	2	3	4	5	6	0	1	2	3	4	5	6
5	Drapanie	0	1	2	3	4	5	6	0	1	2	3	4	5	6
6	Tkliwość (bolesność podczas dotyku)	0	1	2	3	4	5	6	0	1	2	3	4	5	6
7	Podrażnienie	0	1	2	3	4	5	6	0	1	2	3	4	5	6
8	Uczucie kluski w gardle	0	1	2	3	4	5	6	0	1	2	3	4	5	6

Na podstawie: Mathieson L.: Vocal tract discomfort in hyperfunctional dysphonia. J. Voice 1993;2:40-8.