

# Voice Quality in Parkinson's Disease in the Croatian Language Speakers

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## ABSTRACT

*Parkinson's disease (PD) is well known to cause voice impairments. The aim of this study is to evaluate subjective and objective changes in voice quality in patients with PD in Croatian language speakers. Twenty one patients (11 male and 10 female) with PD and twenty one age-matched (10 male and 11 female) of the control group were assessed. Voice impairment was scored according to Voice Handicap Index (VHI). Patient's perceptual voice analysis was assessed using GRBAS scale including Grade of Dysphonia, Roughness, Breathiness, Asthenia and Strain items. The analysed objective voice parameters were: fundamental frequency, highest frequency, lowest frequency, voice range, jitter, shimmer, maximum phonation time and s/z ratio. In all patients we performed videolaryngostroboscopic examination. Compared with the control group we found the significant differences in VHI, in GRBAS scale ( $p < 0.05$  in all items except asthenia). On videostroboscopic examination, laryngeal tremor was present only in PD group (6 patients), abnormalities of the mucosal wave was found more frequent in PD group (17 versus 8 patients) and also non-closure glottic pattern (11 versus 6 patients). There was no significant difference in the objective voice parameters except in maximum phonation time which was shorter in PD group (15.8 seconds and 23 seconds,  $p = 0.014$ ) and voice range, which was shorter in PD group (111 Hz versus 147 Hz,  $p = 0.0465$ ). No one of patients with PD was included in any form of speech therapy. The voice disability in PD is generally well known, but very often underestimated. In this study we found which components of voice were more affected. The voice quality has a significant impact on life quality and potential in assessment for severity of disease state and for the efficacy of treatment.*

**Key words:** Parkinson's disease, voice, voice handicap index, speech acoustic

## Introduction

Parkinson's disease (PD) is a neurodegenerative disease. It is a well-known condition caused by the loss of dopaminergic neurons in substantia nigra, which leads to basal ganglia dysfunction. It is characterized by motor symptoms of bradykinesia, muscle rigidity, loss of postural reflexes and tremor<sup>1,2</sup>. The incidence and prevalence increase in the older age. In the US, 1% of the population over 65 years of age and 3% older than 85 have PD. It is less known that PD causes voice problems as well. It is described that 40–80% of patients with PD have some form of voice or speech defect. The voice is often described as monophonic, hypophonic and disarthric, leading to communication problems. Phoniatric examination that also includes laryngostroboscopy usually reveals insufficient glottis, various forms of irregular mucosal wave and laryngeal tremor<sup>3</sup>. The aim of this study is to de-

termine whether voice problems exist, and if so, which ones prevail. Further, the goal is to then assess the voice quality by determining the acoustic parameters and by using the videolaryngostroboscopy to determine the presence of most common clinical signs, as well as to use the benefits of voice and speech rehabilitation in patients with PD who speak Croatian.

## Patients and Methods

The sample group consists of 21 patients with PD, 11 of them men, 10 women, all over 60 years of age (average age of 72) who are treated and checked at Karlovac General Hospital. None of them has any record of previous voice problems or diseases of the throat, or had undergone a surgical procedure in the throat area, nor has in

the past 6 months undergone the surgery with endotracheal intubation. None of the patients at the time of our study had symptoms of upper respiratory tract infection. The control group consists of individuals randomly selected, 10 of whom are men and 11 women, with the test match in age who have no voice symptoms or symptoms of PD.

Voice Handicap Index (VHI) was determined for all the subjects involved. This is a self-assessment method for voice disorders, done by using the standardized questionnaire of 30 questions proposed by Jacobson et al. in 1997 on the impact of voice problems on daily activities. Each answer is rated from 0 to 4 based on the frequency of symptoms: 0 = no pain, 1 = almost never, 2 = sometimes, 3 = almost always, 4 = always<sup>4</sup>.

We evaluated the voice quality with the GRBAS scale. The examiner assesses the gradus of dysphonia (G), roughness (R), breathiness (B), asthenia (A), strain (S) by listening to patient's voice, on a scale from 0 to 3, 0 = regular, 1 = mildly pronounced, 2 = moderate, 3 = very pronounced<sup>5</sup>.

Videolaryngostroboscopy (VLS) was made by using the 70 degree rigid endoscope – Wolf Stroboscope 5052, where the parameters of voice acoustic analysis were read. We recorded the fundamental laryngeal frequency, the highest and lowest tone, jitter, shimmer, s/z consonants ratio, voice range and maximum phonation time. During VLS we observed the absence or presence of laryngeal tremor, glottal closure and mucosal wave. Tremors are recorded qualitatively 0 = no, 1 = present. The closure of the glottis was evaluated at the levels of 1 = normal findings, closed glottis during phonation, 2 = partially open glottis during phonation, 3 = glottis is open from front to rear commissure. Mucosal wave was assessed as 0 = normal or 1 = inadequate.

Statistical analysis was performed by using the Statistica Online Computational Resources program available on: <http://www.socr.ucla.edu/htmls/ana/>, and to compare the significance of observed differences between the groups, we used Student's t-test, Fisher Exact Test and Wilcoxon Rank-Sum Test for independent sample.

## Results

The average VHI in patients with PD was significantly higher than the VHI in the control group (16.09 in the PD group and 4.04 in the control group,  $p < 0.05$ ). By comparing the GRBAS scales, for each of 5 parameters individually, there is a significantly higher sum of points in the PD group for gradus, hoarseness, breathiness and strain, while no significant difference when compared to the control group, was noticed for phonasthenia (Table 1).

Voice range is smaller in the test group of patients than in the control group ones (116.44 Hz and 145.9 Hz,  $p < 0.05$ ). The shorter maximum phonation time was measured in the group of diseased patients (13.4 sec. for women with PD and 19.7 for women in the control group, for men with PD 18.0 seconds and 25.5 seconds in the

**TABLE 1**  
GRBAS SCALE PARAMETERS

	G	R	B	A	S
PD total score (N=21)	25	21	20	12	18
CG total score (N=21)	8	6	4	3	4
p value	0.0015	0.00465	0.00159	0.1411	0.00856

G – gradus of dysphonia, R – roughness, B – breathiness, A – asthenia, S – strain, PD – Parkinson's disease group, CG – control group

**TABLE 2**  
ACOUSTIC ANALYSIS PARAMETERS

	MPT	VR	F0	JITT	SHIMM	s/z r
PD	15.85	111.85	152.23	4.28	21.37	0.66
CG	22	147.85	160.19	4.92	18.14	0.56
P value	0.0014	0.046	0.478	0.333	0.204	0.071

MPT – maximum phonation time in seconds, VR – voice range in Hertz, F0 – fundamental laryngeal frequency in Hertz, JITT – jitter, SHIMM – shimmer, s/z r – s/z ratio, PD – Parkinson's disease group, CG – control group

healthy ones). No significant differences were found for the values of basic laryngeal tone, jitter, shimmer and s/z ratio (Table 2).

Significantly higher number of pathologic findings of videolaryngostroboscopy was found in patients with PD than in the control group. Laryngeal tremor is present in six patients, and in none of the healthy ones. The irregularity of the mucosal wave was described in seventeen diseased and eight healthy subjects ( $p < 0.05$ ). The incomplete glottis closure was noticed in eleven diseased and six healthy subjects (Table 3).

**TABLE 3**  
VIDEOLARYNGOSTROBOSCOPIC PARAMETERS

	Laryngeal tremor N (%)	Incomplet glotal closure N (%)	Mucosal wave irregularity N (%)
PD N=21	6 (28.5)	11 (52.4)	17 (80.9)
CG N=21	0	6 (28.5)	8 (38.1)

PD – Parkinson's disease group, CG – control group

None of our examinees had ever been involved in any kind of speech therapy or is familiar with the possibilities of rehabilitation of their voice or speech.

## Discussion

As presented in our paper, patients, the speakers of the Croatian language with PD have significantly lower

results concerning VHI scores, the GRBAS scale parameters, voice range and maximum phonation time. By examining the larynx, using videolaryngostroboscopy, a significantly higher incidence of pathological laryngeal findings in a group of patients with PD was found.

Voice and speech are disrupted in 60–80% of patients with PD<sup>6</sup>, which in this study means 85%, and can be therefore considered a large majority. As PD usually affects the elderly and Croatia belongs to a group of countries with a very old population, since the share of people who are 65 years and older is 16.65%, a further increase in the incidence and prevalence can be expected, as well as a voice-related distress PD<sup>7</sup>. For the time being, our impression is that voice problems in PD patients are underestimated, we do not pay enough attention to them. None of our respondents have participated in or ever been proposed any kind of speech treatment, although the vast majority of them are aware of their problems and an impact these problems have on their daily activities and quality of life. It is a chronic degenerative disease and we are aware that it should be, like other similar illnesses, viewed through a biopsychosocial approach model to health and illnesses<sup>8,9</sup>. In this particular case, this approach assumes the coordination and multidisciplinary integration of neurologists and otorhinolaryngologists, speech therapists and physiotherapists, psychologists as well as the community involvement.

VHI was significantly higher in patients with PD. Hypophonic and monotonous voice is more difficult to hear and understand which causes difficulties in communication thus resulting in bad communication or the lack of it. Midi et al.<sup>10</sup> found no correlation between motor deficits in PD and VHI. This speaks in favor of our view that neurological assessment of the condition and treatment outcomes may not correspond with the size of voice problems; rather it should be individually evaluated.

Perceptual voice assessment was performed using the GRBAS scale. The voice of people with PD has worse acoustic characteristics, is coarser in texture, has more breathiness, is more phonastenic and strained than in the members of the control group. By comparing these data with the findings of videolaryngostroboscopy, we be-

lieve that the cause can be found in the insufficiency of the glottis and mucosal wave abnormalities present in most patients. These morphological changes lead to audible acoustic phenomena. Laryngeal tremor was present in 28.5% of our patients. The frequency of laryngeal tremor is different, described up to 55%, depending on the severity of clinical picture<sup>11</sup>.

Among the measured acoustic parameters, only the voice range and maximum phonation time proved to be significantly different between the two groups. Patients with PD have impaired lung function, weakened inspiration due to the weak inspiratory musculature<sup>12</sup>, which results in smaller inspiratory volume. Insufficient glottis causes the increased flow and the escape of air through the vocal cords during phonation. The average age of our patients was 72 years; it was confirmed that the process of losing muscle mass and strength of intercostal muscles starts in the older age<sup>13</sup>. Although there are studies that suggest the opposite<sup>14</sup>, because of all this we believe that it is reasonable to expect the PD reduced maximum phonation time as our measurements confirm. As expected, according to the results of similar papers<sup>4,5,10–12,14</sup>, on different languages with different phonetic features, the speakers of Croatian language with PD have significant and frequent voice problems, the importance of which has been underestimated. Despite the tested and proven methods of voice rehabilitation worldwide, (e.g. Lee-Silverman Voice Treatment)<sup>15</sup>, the majority of patients in our country is not included in the voice rehabilitation.

## Conclusion

This paper shows that the voice problems, experienced by the PD patients who speak Croatian language should be further documented and studied. The assessment of voice difficulties should be included in the process of diagnostic treatment of clinically suspicious conditions and in the assessment of the treatment success. What is required is a better cooperation of medical and other professions, neurologists, language pathologists, and voice therapists.

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## **KVALITETA GLASA U BOLESNIKA SA HRVATSKOG JEZIČNOG PODRUČJA OBOLJELIH OD PARKINSONOVE BOLESTI**

### **S A Ž E T A K**

Poznato je da Parkinsonova bolest (PB) uzrokuje i glasovne tegobe. Cilj ovog rada je analizirati subjektivne i objektivne promjene kvalitete glasa u bolesnika s PB koji govore hrvatskim jezikom. Promatrali smo i usporedili 21 pacijenta starije životne dobi s PB (11 muškaraca i 10 žena) i 21 (10 muškaraca i 11 žena) pripadnika kontrolne skupine. U subjektivnoj procjeni glasovnih tegoba koristili smo Voice Handicap Index. Perceptivna procjena glasa provedena je prema GRBAS skali koja uključuje procjenu stupnja disfonije (G), hrapavosti glasa (R), šumnosti (B), fonasteničnosti (A) i naprezanja (S). Analizirali smo i objektivne akustičke parametre glasa: osnovni laringealni ton, najviši i najniži ton, raspon glasa, jitter, shimmer, maksimalno vrijeme fonacije i s/z omjer. Kod svih pacijenata učinili smo videolaringostroboskopski pregled. Uspoređujući s kontrolnom skupinom, u oboljelih od PB našli smo značajnu razliku u VHI i GRBAS skali ( $p < 0,05$  za sve parametre izuzev fonasteničnosti). Videolaringostroboskopskim pregledom, laringealni tremor opazili smo samo u grupi PB (6 pacijenata), promijenjen mukozni val češće u oboljelih (17 prema 8 pacijenata), kao i nepotpuno zatvaranje glotis kod fonacije (11 prema 6). Nije nađena značajna razlika u akustičkim parametrima glasa izuzev u maksimalnom vremenu fonacije koje je kraće u oboljelih (15,8 s i 23 s.  $p = 0,014$ ) i u rasponu glasa koji je manji u pacijenata s PB (111 Hz prema 147 Hz,  $p = 0,0465$ ). Ni jedan od naših pacijenata nije uključen ni u kakav oblik govorne ili glasovne terapije. Glasovne tegobe u pacijenata s PD su dobro poznate, ali često podcijenjene. U ovom radu našli smo koji parametri procjene glasa su promijenjeni u bolesnika koji govore hrvatskim jezikom. Kvaliteta glasa ima značajan utjecaj na kvalitetu života i potencijal kao sredstvo procjene težine bolesti i uspješnosti liječenja.