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Voice disorder in patients with Fibromyalgia

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ABSTRACT

Objective: To investigate several perceptual, acoustic and aerodynamic voice evaluation parameters in Fibromyalgia patients.
Methods: A total number of 30 Fibromyalgia patients had voice evaluations by means of laryngostroboscopy, acoustic analysis (jitter, shimmer, and harmonic to noise ratio), aerodynamic measurements (maximum phonation time, s/z ratio), and perceptual analysis (GRBAS and Voice Handicap Index-10 scales). Data obtained from the patients was compared to control subjects.
Results: Mean intensity was found to be significantly higher in control subjects (73.70 ± 4.73 dB) than Fibromyalgia patients (64.50 ± 6.92 dB), ($p < 0.001$). There was no statistically significant difference in fundamental frequency, perturbation parameters (jitter and shimmer) and harmonic to noise ratio between groups. Maximum phonation time in control subjects (22.53 ± 4.95 s) was found to be significantly longer than Fibromyalgia patients (16.07 ± 4.87 s), ($p < 0.001$), and s/z ratio was found to be nearly equal between patients (1.00 ± 0.24) and control subjects (0.96 ± 0.16). On the basis of perceptual evaluation by using a GRBAS scale, the patients showed a mean score of 2.50 ± 1.97 and the control group showed a mean score of 0.56 ± 1.04 ($p < 0.001$). "Grade" and "asthenia" parameters of GRBAS scale in Fibromyalgia patients were significantly different from the parameters of control group ($p < 0.001$). The Voice Handicap Index-10 scales revealed a mean score of 7.90 ± 7.58 in Fibromyalgia patients and 1.83 ± 2.82 in control subjects ($p < 0.001$).
Conclusion: Fibromyalgia impairs perceived voice quality either in patient self evaluated or in clinician evaluated rating scales. Furthermore, the results confirm that Fibromyalgia caused short maximum phonation time and low voice intensity. This study is the first report with regards to voice evaluation in Fibromyalgia and in order to make a generalization further researches are needed.

1. Introduction

Fibromyalgia (FM) affects 2–4% of the population and is characterized by symptom of pain throughout the body [1]. Additional symptoms are cognitive and sleep disturbances, and other abnormalities such as increased sensitivity to painful stimuli, increased sensitivity to multiple sensory modalities, and altered pain modulatory mechanisms [2]. Fibromyalgia presents with only subjective complaint and no objective clinical findings [3]. Dysregulation of pain processing has been demonstrated in the nervous system, but objective test in the clinical setting to confirm a diagnosis of FM has yet to be determined. [3,4]. The diagnosis of FM was initially based on the ACR 1990 criteria [5], which included pain and localized tenderness at 11 or more of 18 specific tender point sites. Recent diagnostic criteria for FM [6] do not require the presence of tenderness, but rather include a list of several other symptoms, including fatigue, sleep and cognitive symptoms, headache, depression, and lower abdominal pain/cramping.

The vocal system has three components; power, glottal sound source and vocal tract filtering. Power is the source of energy producing the sound (the respiratory system causes air to be expelled from the lungs), source is the component that the vibratory movement of the vocal folds creates the sound waves and vocal tract filtering is the shaping of the sound waves to create the final result. Fibromyalgia decreased isometric and isokinetic muscle strength and elevated muscles tension [7]. Extrinsic laryngeal muscles influence larynx height and vocal tract shape. An increase in vocal tract size and laryngeal height might change the filtering/resonating components and influence acoustic spectrum. A larger larynx can produce a lower vocal pitch, as its vocal folds are longer and therefore vibrate at a lower frequency compared with the shorter vocal folds of a smaller larynx. In addition, vocal fold vibration depends on the tension of the folds. Fibromyalgia may disrupt the glottal sound source via changing the tension of the intrinsic laryngeal muscles. Supraglottic contribution to pitch rising might also be adversely affected.

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In FM, there is an isometric type muscle dysfunction and despite normal pulmonary spirometric values FM patients were found to have lower maximal respiratory pressures (maximum inspiratory pressure and maximum expiratory pressure) and endurance (maximum ventilatory volume), which indicate reduced respiratory muscle strength [8,9]. Caidahl et al. also indicated that effort dyspnea is related to reduced maximum inspiratory pressure in FM patients [10]. Weiss et al. suggested that chest wall discomfort appeared to be the etiologic factor causing reduced pulmonary muscle strength [11]. As the expiration volume is the aerodynamic energy for phonation, FM may cause a decline in the power supply of voice that leads to a decrease in the intensity and pitch of voice. In addition maximum phonation time may be shortened and s/z ratio may be changed.

In clinical practice many patients complaint about changes in their voice quality, however, to the best of our knowledge, voice related symptoms and findings in FM have never been reported. Either by laryngeal musculature and vocal tract resonance changes or by decreased function of the respiratory system, considerable impairment in voice quality may be determined in FM patients. Therefore, the aim of this study is to investigate several perceptual, acoustic and aerodynamic voice parameters in FM patients.

2. Materials and methods

A total number of 30 patients diagnosed as FM in Gaziosmanpasa University Medicine Faculty, Department of Physical Therapy and Rehabilitation, were included in to the study. Diagnosis of FM was made according to American College of Rheumatology criteria. The control group was recruited from general population and composed of 30 women with no current voice related symptoms and no history of a laryngeal disease or a laryngeal surgery. Exclusion criteria for the patients were as follows: (1) pulmonary complaints or a history of pulmonary disorder; (2) abnormal laryngostroboscopy or a history of laryngeal surgery; (3) comorbid conditions (e.g., morbid obesity, other rhematologic diseases, uncontrolled endocrine disorders); (4) psychiatric illnesses (e.g., schizophrenia or presence of a score >9 points in the Beck Depression Inventory (BDI-II)). Patients and the control subjects were evaluated at the voice laboratory in Gaziosmanpasa University Medicine Faculty, Department of Otolaryngology. The study protocol was reviewed and approved by Ethics Committee of Cumhuriyet University, Sivas.

All of the patients and control subjects had voice evaluations via laryngostroboscopy, acoustic analysis, aerodynamic measurements and perceptual analysis. Laryngostroboscopic examinations were performed by means of a flexible fiber-optic videolaryngostroboscope (Xion Nasopharyngoscope, Endostrop DX. Munich, Germany). For acoustic assessments a headwear microphone was placed 5 cm from the mouth and the subjects were asked to phonate and sustain the vowel/a/at the most comfortable pitch and loudness. Digitally recorded data was transferred to a computer at a sampling rate of 44.1 kHz. Acoustic analysis including fundamental frequency (Fo), intensity, perturbation measurements (jitter, shimmer) and harmonic to noise ratio parameters was made by means of online available Praat program. Praat is an easy to use, noninvasive computer program that measures various aspects of voice.

For aerodynamic assessment; maximum phonation time (MPT) was determined by measuring the duration of/a/vowel following maximum inspiration. The procedure was repeated three times, and the recording with the longest duration was considered as MPT. Maximum phonation time is expected to be longer in professional voice users than non-professionals, therefore, in order to avoid any in equable increase in MPT, control subjects were recruited from non-professional voice users. Subsequently, all of the subjects were asked to phonate/s/and/z/as long as possible after a deep inspiration. This procedure was repeated three times and measurement with the longest duration was recorded as s/z ratio.

For perceptual evaluation; the patients were asked to read a task (the first paragraph of diyet passage) at a comfortable pitch and loudness. A scale (GRBAS) including the subjective voice properties; grade, roughness, breathiness, asthenia and strain, was used to score the recordings. The parameters that make up the GRBAS scale were rated by a jury of four listeners on 4 points (0 = normal, 1 = mild, 2 = moderate, 3 = severe disorder in voice). Sum of G + R + B + A + S was used as GRBAS score. Listeners were experienced in perceptual voice evaluation. For each of the assessments, at least three members' agreement was required for the final result. This method aimed to minimize the inter observer variability. At the subsequent step of the perceptual evaluation, the patients self-assessed their voice disorder using the Voice Handicap Index (VHI-10). This index includes 10 items on the impact of the voice disorder on daily life. The scores range from 0 to 4 according to the frequency of the problem (0 = never, 1 = almost never, 2 = sometimes, 3 = almost always, and 4 = always).

Statistical analysis was performed with SPSS 18.0.0 (SPSS Inc., Chicago, IL). Mann Whitney-*U* tests was used for analysis and statistical significance was assumed at $p < 0.001$.

3. Results

Only female patients were eligible for the study because of the low incidence of FM in men. The mean age of the patients was 34.6 ± 4.8 years. Patients and the control subjects were age and sex matched. Patients with laryngostroboscopic abnormalities were excluded from the study, therefore this examination was within normal limits in all subjects.

Results of acoustic analysis are shown in Table 1. Although mean fundamental frequency (Fo) was slightly higher in control group (227.20 ± 27.22 Hz) than the FM group (217.10 ± 20.27 Hz), the difference was not statistically significant ($p = 0.19$). In contrast, mean intensity was found to be significantly higher in control subjects (73.70 ± 4.73 dB) than FM patients (64.50 ± 6.92 dB), ($p < 0.001$). There was no statistically significant difference in perturbation parameters (jitter and shimmer) and harmonic to noise ratio between groups ($p > 0.001$).

When a comparison was made with regard to aerodynamic measurements (MPT, s/z ratio); MPT in control subjects (22.53 ± 4.95 s) was found to be significantly longer than FM patients (16.07 ± 4.87 s), ($p < 0.001$), and s/z ratio was found to be nearly equal between patients (1.00 ± 0.24) and control subjects (0.96 ± 0.16), (Table 1).

On the basis of perceptual evaluation by using a GRBAS scale, the patients showed a mean score of 2.50 ± 1.97 and the control

Table 1
Results of acoustic analysis, aerodynamic measurement, perceptual evaluations.

	FM patients mean ± SD	Control group mean ± SD	*P*
Fo	217.10 ± 20.27	227.20 ± 27.22	0.19
Intensity	64.50 ± 6.92	73.70 ± 4.73	<0.001
Jitter	0.31 ± 0.18	0.31 ± 0.16	0.10
Shimmer	3.63 ± 2.89	2.63 ± 1.59	0.88
HNR	23.48 ± 5.23	24.90 ± 3.96	0.24
MPT	16.07 ± 4.87	22.53 ± 4.95	<0.001
s/z	1.00 ± 0.24	0.96 ± 0.16	0.43
VHI-10	7.90 ± 7.58	1.83 ± 2.82	<0.001
GRBAS	2.50 ± 1.97	0.56 ± 1.04	<0.001

GRBAS: grade, roughness, breathiness, asthenia and strain scale, VHI-10: Voice Handicap Index 10 scale, Fo: fundamental frequency, HNR: harmonic to noise ratio, MPT: maximum phonation time, s/z: s/z ratio, $p < 0.001$, Mann–Whitney *U* test.