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CLINICAL STUDY

SUBJECTIVE AND OBJECTIVE VOICE EVALUATION IN RHEUMATOID ARTHRITIS

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SUMMARY

Objective: To evaluate the sound quality of rheumatoid arhritis patients" voices via an objective method using acoustic analysis and a subjective method using a voice handicap index-10 questionnaire.

Methods: This prospective study assessed 30 patients with rheumatoid arthritis with the aid of laryngoscopy, acoustic analysis and the Voice Handicap Index questionnaire.

Results: Thirty RA patients and 34 healthy controls groups were included in the study. In the acoustic analysis, it was observed that there was deterioration in the fundamental frequency (f0), jitter and shimmer parameters in the patient group.

Conclusion: Airway problems and mild voice changes in rheumatoid arthritis patients are stimulating physiotherapists and specialists in terms of laryngeal involvement.. With the development of computer systems in recent years, patients with rheumatoid arthritis can be screened for laryngeal involvement by acoustic analysis and patients whose acoustic analysis results are impaired can be given advanced examinations.

Keywords: Rheumatoid arthritis, larynx, vocal cord, voice analysis, voice handicap index

ROMATOİD ARTRİTTE SUBJEKTİF VE OBJEKTİF SES DEĞERLENDİRMESİ

ÖZET

Amaç: Romatoit artrit(RA) hastalarının ses özelliklerinin akustik analiz ve Ses Handikap İndeksi -10 (VHI-10) anketi yoluyla objektif ve subjektif yöntemlerle değerlendirilmesi amaçlanmıştır.

Yöntem: Bu prospektif çalışmada RA'lı 30 hasta laringoskopi, akustik analiz ve Ses Handikap İndeks anketi ile değerlendirildi.

Bulgular: Otuz RA hastası ve 34 sağlıklı kontrol grubu çalışmaya dahil edildi. Akustik analiz değerlendirmesinde, hasta grubunda temel frekans (f0), jitter ve shimmer parametrelerinde bozulma olduğu görüldü.

Sonuç: RA hastalarında hava yolu problemleri ve hafif ses değişiklikleri, larinks tutulumu açısından önemli öngörücü parametre olarak değerlendirilmektedir. Son yıllarda bilgisayar sistemlerinin gelişmesiyle, RA hastaları akustik analiz yöntemiyle larinks tutulumu açısından taranabilmektedir. Bozulmuş ses parametreleri ise ileri tetkikler için yol gösterici olabilmektedir.

Anahtar Sözcükler: Romatoid artrit, larinks, vokal kord, ses analizi, ses handikap indeks

INTRODUCTION

Rheumatoid arthritis (RA) is an autoimmune systemic disease affecting 3% of the adult population.[1] This disease is characterized by remissions and exacerbations and the destructive effect may occur in all joints. The temporomandibular joint, larynx, cervical spine and audiovestibular system are sites of involvement in the head and neck region of patients with RA.[2]

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Patients with laryngeal involvement may be asymptomatic or symptoms such as foreign body sensation in the throat, tiredness, dysphonia, cough and dyspnea may occur.[3] The most frequently cited mechanism for the occurrence of these symptoms is cricoarytenoid joint disfunction.[4] RA can cause a significant degree of disruption and ankylosis in the cricoarytenoid joint. RA laryngeal involvement is important because of the possibility of creating life-threatening airway obstruction.[5] A laryngoscopic examination should be performed when there is suspected involvement of the larynx. Laryngoscopic examination may not reveal any findings, but mucosal edema and diffuse or localized inflammation may also be seen. Other laryngoscopic findings of laryngeal involvement include cricoarytenoid joint involvement, interarytenoid fibrosis, vocal cord paralysis, and rheumatoid nodule formation.[6]

In this study, we reveal the findings of laryngoscopy in an RA patient group. We also evaluate the sound quality of these patients" voices via an objective method using acoustic analysis and a subjective method using a voice handicap index-10 (VHI-10) questionnaire. We apply the same process to healthy volunteers and compare the two groups.

MATERIAL and METHODS

This study was performed in accordance with the Helsinki Declaration of the World Medical Association and informed consent was obtained from all participitants. The study was approved by the Research Ethics Committee of a tertiary referral center (2017/382). This study was conducted between December 2017 and February 2018. Thirty RA patients and 34 healthy volunteers were included in the study. Patients and healthy volunteers with a history of previous laryngeal surgery, head and neck cancer/radiotherapy, craniofacial anomalies, or other rheumatic diseases, and smokers were not included in the study. All patients and healthy volunteers who participated in the study signed a consent form.

Revised American College of Rheumatology (ACR)-91 criteria were used to diagnose RA patients. All patients had a positive rheumatoid factor (RF). A detailed history was taken from each patient. The age of the patient, the duration of the illness, the drugs used, and additional diseases were recorded. All subjects underwent a complete head and neck examination, as well as acoustic and aerodynamic analyses. Routine ENT examination was performed after general physical examinations. Laryngeal symptoms such as dysphonia, vocal fatigue, foreign body sensation, coughing, xerostomia, dyspnea, and stridor were assessed in all patients. After indirect laryngoscopy, laryngoscopic examinations were performed with a 70° rigid endoscope (Karl Storz Telecam DX II-Tuttlingen, Germany).

We evaluated voice changes using objective and subjective methods. We examined the subjective change using a questionnaire and the objective change using acoustic analysis. For the subjective evaluation, the Turkish version of the VHI questionnaire constructed by Kılıç et al.[7] was used. In this questionnaire, there are 10 questions evaluating the physical, functional and emotional properties of the patient's voice, scored between 0 and 4.

Voice recordings and voice analyses of all patients were performed for objective evaluation. A portable computer (Samsung intel core i5) and a AKG D5 (Vienna, Austria) dynamic microphone were used for audio recording. Patients were placed in a quiet room and were asked to keep the microphone at a distance of 15 cm from the lip surface after 10 minutes of rest. First, the maximum phonation time was calculated with an 'a' sound recorded after deep inspiration. After a deep inspiration, patients were prompted to make a long 'a' sound. s. This was repeated three times, and the longest recorded time was accepted as the subject's maximum phonation time (MPT). Then, patients were requested to read the Turkish story 'Diyet' written by Ömer Seyfettin for 40 seconds, using comfortable speech. The same procedures were applied to the control group. The acoustic analysis program Praat (version 4.4.13, Boersma and Weenink, University of Amsterdam, Amsterdam, The Netherlands) was used for acoustic analysis. In the acoustic analysis, fundamental frequency (f0), jitter (%), shimmer (%), and noise-to-harmonic-ratio (NHR) parameters were measured.

The data obtained from laryngoscopy, acoustic sound analysis and VHI questionnaire were analyzed statistically. In the analysis of the results, SPSS ver. 17.0 computer programs were used. The Kolmogorov-Smirnov test was used to determine whether the data fit the normal distribution. Chi-square tests were used to determine differences between groups. The results were expressed as mean ± standard deviation, 95% confidence interval and $P < 0.05$ significance level.

RESULTS

Thirty RA patients and 34 healthy control groups were included in the study. The mean age of the RA patients was 42.1 ± 6.3 (range 32-63 years) while that of healthy volunteers was 38.2 ± 7.1 (range 30-56 years). Twenty-five (83.3%) of the RA patients were female and five (16.7%)

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were male. Twenty-seven (79.4%) of the healthy volunteers were female and seven (20.6%) were male. Particular care was taken to ensure that male and female distributions were similar in both groups. The mean duration of disease in RA patients was 13.6 ± 7.1 (range: 2-25) years. According to revised ACR 91 criteria, 11 (36.6%) patients were evaluated as class I, 14 (46.6%) as class II and 5 (16.6%) as class III.

Twenty-two (73.3%) patients in the RA patients and 14 (41.1%) in the control group had laryngeal complaints at the face-to-face interviews conducted with the patients and control group. In the RA group, coughing, foreign body sensation in the throat, and xerostomia were found to be significantly higher than in the control group (Table 1). The most frequent finding of the laryngoscopic examination was arytenoid edema. Arytenoid edema and interarytenoid inflammation were found to be significantly higher in RA patients than in the control group (Table 2).

In the acoustic analysis, it was observed that there was deterioration in the fundamental frequency (f0), jitter and shimmer parameters in the patient group (Table 3). VHI-10 questionnaire results were also evaluated for voice evaluation. There was a statistically significant difference between the control group and the patient group (mean ± SD, 11.04 ± 3.12 in the patient group and 5.12 ± 2.71 in the control group) ($p < 0.05$).

Table1: Comparison of laryngeal complaints between the rheumatoid arthritis (RA) group and the control group.

	Rheumatoid arthritis		**Control**		
	n	**%**	**n**	**%**	**p**
Symptoms					
Dysphonia	12	40	11	34,3	0,643
Coughing	14	46,6	4	11,7	0,232
Foreign body sensation	10	33,3	3	8,8	0,198
Xerostomy	10	33,3	2	5,8	0,176
Vocal fatigue	3	10	3	8,8	0,618

Table 2: Comparison of laryngoscopic findings between the RA group and the control group.

	Rheumatoid arthritis		**Control**		
	n	**%**	**n**	**%**	**p**
Laryngoscopical findings					
Arytenoid edema	14	46,6	4	11,7	0,278
Interarytenoid inflammation	12	40	4	11,7	0,346
Anterior mucus	2	6,6	3	8,8	0,674
Posterior mucus	2	6,6	1	2,9	0,576

Table 3: Comparison of voice analysis results between the RA group and the control group. (Abbreviations: F0, fundamental frequency; MPT, maximum phonation time; NHR: noise-to-harmonic-ratio SD, standard deviation.)

Parameters	Rheumatoid arthritis (n= 30) Mean± SD	Control(n= 34 Mean ± SD	P
MPT	15.11±2,56	17.78 ± 2.90	0,554
F0	211,23±36,27	182.47 ± 30.56	0,327
Jitter	1,27±0,64	0.39 ± 0.19	0,404
Shimmer	4,56±2,99	1.99 ± 0.73	0,398
NHR	0,18±0,08	0,16 ± 0.06	0,654

DISCUSSION

The laryngeal involvement of RA has been known for many years. Prevalence varies between 27-80.9% in various studies.[6,8,9,10] The range of results in different studies may depend on the methodology used. For example, some studies have included smokers in the study.[11] However, the wide range of laryngeal symptoms lead to different results.[12,13] In our study, 22 patients (73.63%) had laryngeal complaints in the RA patient group. The most common complaints were dysphonia, coughing, foreign body sensation in the throat, and xerostomia.

Symptoms involving the larynx can easily be overlooked as they can be quite variable in RA. In the literature, cases or case series with acute airway obstruction have been reported.5 Grosmann reported that five of 11 RA patients had laryngeal involvement in post-mortem examination and only two of them were symptomatic.[14] Miyanohara stated that the laryngeal arthritis was aggravated and postoperative stridor developed following the surgery for wrist arthrodesis in a patient with RA.[15] For this reason, laryngeal evaluation should be performed in RA patients who are scheduled for surgery even if they are asymptomatic. The diagnosis of laryngeal involvement is not difficult, but it should not be forgotten that the symptoms may be ambiguous. Laryngoscopic examination can detect arytenoid edema, interarytenoid inflammation, rheumatoid nodules, restriction of vocal cord abduction, or fixation in adduction. The most common laryngoscopic finding, based on the study of Gairola et al.[16] with 50 RA patients, is arytenoid inflammation. In our study, the most commonly encountered laryngoscope sign in the patient group was arytenoid edema.

In the literature, laryngeal involvement is more likely to occur in RA patients with a disease duration longer than ten years. However, the long duration of the disease is not a risk factor for laryngeal involvement.[6] With the objective sound analysis, various parameters of the voice can be evaluated. Maximum phonation time (MPT) is a simple and useful method for evaluating laryngeal function. It is between 22-34 seconds in males and 16-25 seconds in females. Blosser et al. showed that translaryngeal resistance increases during phonation in patients with rheumatoid arthritis.[13] However, no significant difference was found between the patient group and the control group in terms of MPT in our study (Table 3).

Measurement of acoustic sound parameters also has an important role in objective sound analysis. In our study, F0, jitter, shimmer, and NHR parameters were used. F0 is the number of vibrations of the vocal cords in one second[17], measured in Hertz. In our study, a statistically significant difference was found between the RA patient group and the control group in the F0 parameter values. Jitter and

shimmer are perturbation measurements that express variations in the vibrations of vocal cords. The frequency perturbation parameter is called jitter. The periodic variation between the amplification peaks is called a shimmer. These two parameters are commonly used in voice analysis and these values are usually found to be increased in those with voice disease.[18] In our study, there was a significant difference in these parameters between the RA patient group and the control group (Table 3). Acoustic analysis results vary as the duration of disease progresses. This result was thought to be due to rheumatoid nodule or vocal edema in the patient group.[19]

Fisher et al.[19] found that rheumatoid arthritis is more active in patients with high VHI values. In our study it was seen that the VHI scores increased as the RA grade increased. There was also a correlation between VHI scores in patients with dysphonia.

A multidisciplinary approach is needed to relieve symptoms and provide laryngeal rehabilitation. With the development of computer systems in recent years, patients with RA can be screened for laryngeal involvement by acoustic analysis and patients whose acoustic analysis results are impaired can be given advanced examinations.

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