

# Determination of the Voice Parameters in Patients with Ankylosing Spondylitis

## Ankilozan Spondilitli Hastalarda Ses Parametrelerinin Belirlenmesi

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**ABSTRACT Objective:** To determine voice parameters in patients with ankylosing spondylitis (AS) by objective and subjective methods and to compare them with the healthy group. **Material and Methods:** Forty two (21 AS and 21 healthy volunteers, aged 18-65 years) were included in the study. Participants were evaluated using the Voice Handicap Index-10 (VHI-10) to assess voice complaints. Laryngeal findings of participants with AS were performed by videolaryngoscopy. Maximum phonation time measurements and acoustic voice analysis Praat software (version 6.0.36, University of Amsterdam, The Netherlands) were performed to evaluate the presence of objective dysphonia. **Results:** According to the cut-off score of VHI-10, 19% of the participants in the study group had voice complaints. The prevalence of laryngeal symptoms of participants with AS was %38.1, but there was no cricoarytenoid joint involvement. Fundamental frequency and perturbation parameters of participants in study group were not statistically significant. **Conclusion:** In the present study, while subjective voice complaints rate of individuals with AS were found to be higher than individuals without AS, there was no significant difference in objective values. Although the present study has shown that there could be a relationship between AS and dysphonia, further studies conducted with larger series are required.

**ÖZET Amaç:** Ankilozan spondilitli (AS) erişkin hastalarda, ses parametrelerini objektif ve subjektif yöntemlerle belirlemek ve sağlıklı grup ile karşılaştırmaktır. **Gereç ve Yöntemler:** Çalışmaya, 42 (21 AS, 21 sağlıklı gönüllü, 18-65 yaş arası) katılımcı dâhil edildi. Katılımcıların, subjektif ses şikâyetini değerlendirmek amacıyla Ses Handikap Endeksi-10 (SHE-10) kullanıldı. AS'li katılımcıların laringeal bulguları videolarinoskopi kullanılarak belirlendi. Objektif disfoni varlığını değerlendirmek amacıyla maksimum fonasyon süresi ve akustik ses analizi (Praat yazılımı) değerleri kullanıldı. **Bulgular:** SHE-10'un kesme puanına göre çalışma grubundaki katılımcıların %19'unda subjektif ses şikâyeti belirlendi. AS'li katılımcıların %38,1'inde çeşitli laringeal semptomlar belirlendi, ancak krikooaritenoid eklem tutulumu yoktu. Çalışma grubundaki katılımcıların temel frekans ve pertürbasyon parametreleri istatistiksel olarak anlamlı değildi. **Sonuç:** Çalışmamızda, AS'li katılımcıların subjektif ses şikâyeti oranı daha yüksek olmasına rağmen objektif değerlendirmelerde fark bulunamamıştır. Çalışma, AS ile disfoni arasında ilişki olabileceğini göstermiş olsa da daha geniş katımlı çalışmalara ihtiyaç duyulmaktadır.

**Keywords:** Ankylosing spondylitis; voice; dysphonia; voice quality

**Anahtar Kelimeler:** Ankilozan spondilit; ses; disfoni; ses özelliği

Ankylosing spondylitis (AS) is a chronic inflammatory rheumatic disease mainly characterized by spinal and sacroiliac joint involvement.<sup>1-3</sup> In terms of clinical, radiological, genetic and epidemiological features, it constitutes the largest subgroup of seronegative spondyloarthropathies.<sup>4,5</sup> Genetic and

environmental factors are thought to play a role in the etiology of AS.<sup>6</sup> Major histocompatibility complex class I molecule HLA B27 is the strongest known genetic factor. However, other genetic factors are still unidentified.<sup>1</sup> AS affects approximately 0.2-1.2% of the adult population. It is two or three times more

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common in men. Turkey prevalence has been reported to be 0.49%.<sup>2,3</sup> AS, mainly influences the axial joints, especially the sacroiliac joints. Other sites of involvement include peripheral joint involvement and non-skeletal involvements such as acute anterior uveitis, lung, and heart.<sup>1,2,5,6</sup>

Studies have identified laryngeal involvement and symptoms in rheumatic diseases such as dysphonia, vocal fatigue and sometimes severe glottic obstruction.<sup>7,8</sup> Laryngeal manifestations may include joints, cartilages, and intrinsic muscles of the larynx. Inflammatory changes in the cricoarytenoid joint and intrinsic muscles of the larynx, which play an important role in the phonation process, may cause voice quality disorders called dysphonia.<sup>7,9</sup> Upper airway obstruction has been reported in 16% of patients due to cricoarytenoid joint fixation.<sup>9</sup> Cricorytenoid joint fixation in AS is rarely described.<sup>10,11</sup>

The aim of the study is to examine voice parameters in patients with AS by objective and subjective methods and to compare them with the healthy group.

## MATERIAL AND METHODS

### SUBJECTS

The research was approved by the lokal ethics committee of our university with permission number 916. The study was carried out between September 2018 and April 2019. A total of 42 subjects were included in this study, which was planned as a prospective cohort study. The subjects were included in the study in order of admission to the clinic. The subjects signed an informed consent form, prepared in accordance with human research guidelines and regulatory standards. The study group consists of 21 participants who were diagnosed with AS and followed according to the Modified New York criteria at XXX. Subjects (10 females, 11 males) between the ages of 19-61 (mean age 39.8±12.0) were included in the study group. The control group consisted of 21 subjects without a diagnosis of AS, whose demographic information was compatible with the study group. Exclusion criteria for the study; a) subject other than 18-65 years old, b) history of laryngeal and thoracic surgery, c) neurological diseases and d) other au-

toimmune diseases. The study was carried out in accordance with the Declaration of Helsinki.

### ASSESSMENT

Subjects' demographic information, reflux, smoking and complaints about voice were obtained. Ear, nose and throat inspections were made to all participants to exclude head and neck anomalies.

The Turkish version of the Voice Handicap Index-10 (VHI-10) was used to learn the effect of the subjects' dysphonia complaints on their daily lives.<sup>12</sup> Survey questions were asked to the subjects face to face and they were asked to score between 0 and 4 for each question. The severity of the voice problem experienced by the subjects was recorded as numerical data between 0 and 40 points by adding up the obtained scores. Subjects who scored above 7, which is the cut-off score of VHI-10, were included in the category at risk for voice disorder.<sup>13</sup>

Laryngeal imaging was performed to visualize the presence of pathology in the vocal folds and laryngeal region. Visualization was performed on patients who participated in our study with a diagnosis of AS using the flexible 3.7 mm diameter steerable fiberoptic laryngoscopy (Optim, Sturbridge, MA, USA) and an Atmos Cam 21 endovision camera system (Lenzkirch, Germany).

For aerodynamic assessment, the maximum phonation time (MPT) of the subjects was evaluated. Subjects are asked to take a deep breath and produce a long/a/phonation in pitch and loudness that they feel comfortable with. This process is repeated three times and the longest MPT is recorded.

For acoustic analysis, the voice recordings of all subjects included in the study were recorded in the voice analysis laboratory. Before recording, the interior noise of the room was measured and found to be lower than 35 dB. All recordings were done in the comfortable standing position of the subjects. The distance between the microphone and the mouth was set at a right angle of 15 cm, and the subjects were asked to say the long/a /phoneme for at least 4 seconds in normal pitch and loudness. This process is repeated three times and the best record was recorded as data.

The voice recordings were carried out using Rode NTI Cardioid Condenser microphone (20 Hz-20 kHz) and CSL-Multi-Speech software (Model 3700, Version 3.4.1, 2000-2001 KayPentax, 44100 Hz and 16-bit). Finally, acoustic analysis was made with Praat software.<sup>14</sup> Fundamental frequency (F0), perturbation measurements (jitter local [%], jitter local abs, jitter rap, jitter ppq, shimmer local [%], shimmer local [dB], shimmer apq3, shimmer apq5, shimmer apq11) harmonic-noise ratio (HNR) values were used as acoustic analysis measurements.

## STATISTICAL METHOD

Statistical analysis of the data was made with the Statistical Package for the Social Sciences (SPSS) version 22.0. Normality tests of continuous variables were evaluated using histogram, Shapiro-Wilk and Kolmogorov-Smirnov tests. Independent-sample t-test was used in the analysis of normally distributed data. Mann-Whitney U test was used in the analysis of data that did not show normal distribution. Continuity Correction chi-square test was used to compare categorical variables. Confidence interval of 95% and  $p < 0.05$  were considered statistically significant.

## RESULTS

There was no statistically significant difference between the study and control groups in terms of age, gender, reflux and smoking ( $p > 0.05$ ). Table 1 sum-

**TABLE 1:** Demographic characteristics of the participants in the study and control groups.

Parameters (n=42)	Study (n=21)	Control (n=21)	p value
Age, year			
Mean±SD	39.8±12.0	40.8±8.6	0.659 <sup>1</sup>
Median (minimum-maximum)	41.0 (19.0-61.0)	43.0 (24.0-51.0)	
Gender, n (%) <sup>*</sup>			
Female	10 (47.6)	11 (52.4)	0.758 <sup>2</sup>
Male	11 (52.4)	10 (47.4)	
Reflux, n (%)			
Yes	8 (38.1)	7 (33.3)	0.747 <sup>2</sup>
No	13 (61.9)	14 (66.8)	
Smoke, n (%)			
Yes	10 (47.6)	11 (52.4)	0.758 <sup>2</sup>
No	11 (52.4)	10 (47.6)	

SD: Standard deviation;

<sup>1</sup>Mann-Whitney U test; <sup>2</sup>Continuity correction chi-square test; <sup>\*</sup>Percentage of column.

**TABLE 2:** Comparison of maximum phonation time and Voice Handicap Index-10 findings of the participants in the study and control groups.

Parameters (n=42)	Study (n=21)	Control (n=21)	p value
MPT, sec			
Mean±SD	16.9±5.5	18.7±5.3	0.339 <sup>1</sup>
Median (minimum-maximum)	17.8 (9.3-29.6)	17.6 (10.2-31.8)	
VHI-10, n (%)			
No (≤7)	17 (81.0)	21 (100.0)	NSA
Yes (>7)	4 (19.0)	0 (0.0)	

MPT: Maximum phonation time; VHI-10: Voice Handicap Index-10;

SD: Standard deviation; <sup>1</sup>Mann-Whitney U test; NSA: Not suitable for analysis;

<sup>\*</sup>Percentage of column.

marizes reflux, smoking and demographic information of subjects.

According to the results of the self-assessment questionnaire, it was determined that 19% of persons with AS experienced voice complaints. It was determined that the mean MPT value of persons with AS was 16.9 seconds. However, there is no statistical difference between healthy subjects ( $p > 0.05$ ). MPT and VHI-10 values are shown in Table 2.

According to the fiberoptic endoscopic evaluation results, 61.9% of individuals with AS were found to have normal laryngeal findings. However, 33.3% of the subjects had hyperemia of the arytenoids (Table 3).

In the study group, the mean F0 value was 173.20 Hz, the jlocal value was 0.265%, and the shimmer value was 0.165 dB. It is considered normal that the jitter value is less than 1% and the shimmer value is less than 2.6% in clinics.<sup>15</sup> Findings were not statistically significant compared to the control group. Individuals with AS had worse HNR than healthy subjects. The acoustic analysis results are summarized in Table 4.

## DISCUSSION

Laryngeal pathology in patients with autoimmune diseases are not rare.<sup>16</sup> A wide range of pathologies are implicated, from cricoarytenoid joint inflammations, mucosal edema and vocal fold nodules in autoimmune diseases.<sup>17,18</sup> There are studies in the literature showing that some autoimmune diseases cause dysphonia due to laryngeal involvement.<sup>10,16</sup>

**TABLE 3:** Videolaryngoscopy evaluation findings of the participants of the study group.

Parameters (n=21)	
Videolaryngoscopy, n (%) <sup>*</sup>	
Normal	13 (61.9)
Hyperemia in arytenoids	7 (33.3)
Posterior chink	1 (4.8)

<sup>\*</sup>Percentage of column.

However, laryngeal involvement such as arthritis of the cricoarytenoid joint has been rarely reported in individuals with AS. Rare reports of cricoary-

tenoid joint involvement in AS have been published.<sup>10,11</sup>

In our study, it was determined that 38.1% of the subjects with AS had some laryngeal changes. The most common sign of laryngeal changes was hyperemia in the arytenoids (33.3%). Laryngopharyngeal reflux can cause hyperemia and laryngeal changes in the arytenoid mucosa.<sup>19</sup> Subjects in the study group reported that 38.1% had reflux complaints. These findings suggest that reflux and arytenoid hyperemia may be related. Cricoarytenoid joint involvement was not determined. In AS the finding of the cricoarytenoid joint has been reported rarely.<sup>10,11</sup>

**TABLE 4:** Comparison of acoustic voice analysis parameters of participants in the study and control groups.

Parameters (n=42)	Study (n=21)	Control (n=21)	p value
Mean F0, Hz			
Mean±SD	173.20±49.72	181.78±43.19	0.554 <sup>1</sup>
Median (minimum-maximum)	179.70 (97.42-247.56)	200.53 (116.10-242.86)	
Jlocal, %			
Mean±SD	0.265±0.12	0.205±0.05	0.152 <sup>2</sup>
Median (minimum-maximum)	0.259 (0.123-0.615)	0.190 (0.103-0.342)	
Jabs, µs			
Mean±SD	18.551±14.45	12.369±5.92	0.268 <sup>2</sup>
Median (minimum-maximum)	13.246 (5.681-63.115)	11.145 (5.843-25.483)	
Jrap, %			
Mean±SD	0.136±0.07	0.141±0.15	0.538 <sup>2</sup>
Median (minimum-maximum)	0.133 (0.063-0.345)	0.105 (0.042-0.780)	
Jppq, %			
Mean±SD	0.160±0.07	0.282±0.55	0.597 <sup>2</sup>
Median (minimum-maximum)	0.136 (0.072-0.366)	0.118 (0.056-2.571)	
Slocal, %			
Mean±SD	1.906±0.76	1.816±0.780	0.505 <sup>2</sup>
Median (minimum-maximum)	1.616 (0.843-3.617)	1.477 (0.869-4.165)	
SdB, dB			
Mean±SD	0.165±0.06	0.281±0.31	0.633 <sup>2</sup>
Median (minimum-maximum)	0.140 (0.073-0.312)	0.152 (0.111-1.316)	
Sapq3, %			
Mean±SD	1.043±0.46	1.017±0.45	0.669 <sup>2</sup>
Median (minimum-maximum)	0.856 (0.473-2.032)	0.807 (0.473-2.272)	
Sapq5, %			
Mean±SD	1.190±0.48	1.217±0.60	0.772 <sup>2</sup>
Median (minimum-maximum)	1.031 (0.520-2.360)	1.001 (0.523-3.031)	
Sapq11, %			
Mean±SD	1.389±0.48	1.275±0.50	0.297 <sup>2</sup>
Median (minimum-maximum)	1.205 (0.795-2.350)	1.163 (0.723-2.729)	
HNR, dB			
Mean±SD	25.68±3.39	27.57±2.82	0.057 <sup>1</sup>
Median (minimum-maximum)	25.30 (19.48-30.96)	27.37 (23.55-33.61)	

HNR: Harmonic-noise ratio; <sup>1</sup>Independent sample t-test; <sup>2</sup>Mann-Whitney U test.

In the study, VHI-10 was used to determine the effect of voice on daily life as a self-assessment material. According to VHI-10, 19% of individuals with AS reported dysphonia. There are studies reporting voice complaints in healthy population.<sup>20,21</sup> Roy et al. found dysphonia complaints as 6.2% in healthy population.<sup>20</sup> In our study, dysphonia complaints of AS individuals were found higher than healthy subjects. In computed tomography studies with patients with rheumatoid arthritis, cricoarytenoid joint involvement was shown at 80%, while dysphonia prevalence was shown at ranging from 12% to 27%, depending on the questionnaire being used.<sup>10</sup> Although there is no cricoarytenoid joint finding, mucosal changes may cause voice complaints.

MPT was not statistically significant between the groups. In our study, vocal fold pathology was not determined in individuals with AS. In addition, individuals with known diseases that could affect lung capacity were not included in the study. Therefore, MPT may not be affected in individuals with AS.

In this study, acoustic voice analysis of persons with AS was performed using PRAAT software. There was no difference between the groups according to the acoustic voice analysis results. Sünter et al. stated that the shimmer value was statistically high in individuals with AS.<sup>22</sup> Studies show that HNR was found to be a more sensitive index of vocal function than jitter.<sup>23</sup> In our study, persons with AS had higher HNR values than healthy subjects.

## CONCLUSION

Rheumatic diseases can cause voice disorders. In this study, it was determined that individuals with AS had higher subjective voice complaints than healthy subjects. However, there was no difference between the groups according to the acoustic and aerodynamic analysis results. The present study has shown that there may be a relationship between AS and dysphonia. However, one of the limitations of the studies is that there is no evaluation of videoyngoscopy for individuals in the control group. Studies with broader subjects are required to explain this relationship.

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*During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.*

### Conflict of Interest

*No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.*

### Authorship Contributions

**Idea/Concept:** Elif Tunç Songur; Metin Yılmaz; **Design:** Elif Tunç Songur; Metin Yılmaz; **Control/Supervision:** Metin Yılmaz; **Data Collection and/or Processing:** Hazan Karadeniz, Çiğdem Önen; **Analysis and/or Interpretation:** Elif Tunç Songur; **Literature Review:** Elif Tunç Songur; **Writing the Article:** Elif Tunç Songur.

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