Turkish Archives of Otorhinolaryngology

Turk Arch Otorhinolaryngol 2024; 62(2): 58-65

Investigation of Acoustic Voice Characteristics of Individuals Diagnosed with Muscle Tension Dysphonia

Original Investigation

Elife Barmak[1], Esma Altan[2], Dilara Söylemez[2], Emel Çadallı Tatar[2]

[1]Department of Speech and Language Therapy, Ankara Yıldırım Beyazıt University Faculty of Medicine, Ankara, Türkiye
[2]Clinic of Otolaryngology, Ankara Etlik City Hospital, Ankara, Türkiye

Abstract

Objective: Muscle tension dysphonia (MTD) is a functional voice condition that causes irregular and imbalanced laryngeal and paralaryngeal muscle activation. Our study aimed to examine the acoustic characteristics of patients with MTD and reveal the differences between genders.

Methods: The study retrospectively reviewed the acoustic examination findings from the files of patients diagnosed with MTD during evaluations in the laryngology outpatient clinic at a tertiary reference hospital between 2015 and 2022. The parameters assessed in prolonged vowel phonation analysis were fundamental frequency (F0), jitter, shimmer, noise-to-harmonic-to-ratio, and soft phonation index; in the counting task analysis, they were intensity, frequency, and semitone. Gender differences in acoustic measurements obtained during prolonged vowel phonation and counting tasks were also examined.

Results: The study included 80 individuals diagnosed with MTD. Although all parameters in the acoustic analysis of/a/ phonation were increased, differences were statistically significant only in the F0 and jitter parameters between females and males ($p \leq 0.05$). In the analysis of the counting task, the mean and minimum F0 parameters were significantly higher in females than in males ($p=0.000$). The mean dB level was decreased, particularly in the counting task, but the results for the intensity parameter did not differ significantly between genders ($p>0.05$).

Conclusion: The values in the acoustic voice analysis parameters of patients with MTD were determined. These acoustic parameters are thought to guide the clinician in evaluating voice and determining voice therapy goals for MTD patients.

Keywords: Dysphonia, acoustic analysis, muscle tension, voice disorder, voice quality, laryngology

ORCID IDs of the authors:
E.B. 0000-0002-6479-0553
E.A. 0000-0002-3080-3571
D.S. 0000-0003-2342-719X
E.Ç.T. 0000-0002-8923-1408

Cite this article as: *Barmak E, Altan E, Söylemez D, Çadallı Tatar E. Investigation of Acoustic Voice Characteristics of Individuals Diagnosed with Muscle Tension Dysphonia. Turk Arch Otorhinolaryngol. 2024; 62(2): 58-65*

Corresponding Author:
Elife Barmak;
elifebarmak@gmail.com

Received Date: 2024-03-29
Accepted Date: 2024-07-14

DOI: 10.4274/tao.2024.2024-3-15

Introduction

Primary muscle tension dysphonia (MTD) is a condition associated with excessive, atypical, or abnormal laryngeal activities that happen during phonation without an evident psychological or neurological cause or any organic pathology in the vocal folds (1). Primary MTD is more common in women and constitutes 40% of the dysphonic patients presenting to outpatient clinics (2). The precise cause of abnormal muscle activity in primary

MTD remains unknown. However, it could be associated with the following factors: a) psychological and/or personality factors, b) excessive vocal demands that lead to technical misuse of the vocal mechanism, c) acquired adaptations after upper respiratory tract infections, and d) increased pharyngolaryngeal tone resulting from laryngopharyngeal reflux (3). Individuals with MTD can exhibit variability in the severity of dysphonia, affecting aspects such as the intensity, quality, pitch, resonance, flexibility, and endurance of the voice (4).

MTD patients need to be evaluated in many aspects, such as case history, laryngoscopic examination, auditory-perceptual evaluation, acoustic and aerodynamic analysis, and voice-related musculoskeletal system (5,6). Physical examination usually reveals an increase in extrinsic laryngeal muscle tone. The larynx is located high in the neck, and the thyrohyoid distance is narrowed. During speech, the supraclavicular fossae are tense and prominent (3). On laryngeal examination, various glottic and supraglottic contraction patterns are associated with primary MTD. Laryngeal findings commonly reported in the literature are anterior-posterior compression in the vocal folds, medial compression in the ventricular folds, inadequate glottic closure, and posterior glottic opening (6). There are no specific mucosal changes in primary MTD (7).

Acoustic voice analysis is a computer-based, repeatable, objective, quantitative, and non-invasive method for evaluating voice quality. Using this method, the acoustic characteristics of a normal, artistic, or pathological voice can be detected and analyzed (8). Continuous vowel phonation is utilized more commonly in research than speaking and reading tasks as vocal folds contain richer vibration patterns and can be acquired rapidly and readily (9). Therefore, acoustic parameters such as fundamental frequency (F0), jitter, shimmer, and noise-harmonic ratio (NHR) are commonly examined to evaluate vocal function (10,11). In clinical practice, there are still some aspects that need to be improved, such as following standardized recording, analysis, and reporting protocols; improving the understanding of the relationship between perceptual and instrumental acoustic results; accounting for common variables related to speech and language, such as speech sound pressure level (SPL) and F0, phonetic context, and differences in content; and availability of a much larger database to understand the normal variability within and between individuals with and without dysphonia, depending on age and gender (12). Patients with MTD have also reported abnormalities in acoustic parameters due to hyperfunctional behavior (10). In studies conducted on MTD, it is seen that acoustic voice analyses are mostly performed during vowel phonation. We deemed vowel production and speech activities in MTD essential to enhance comprehension of the voice alterations exhibited by this dysphonic group and expand the database.

Acoustic voice analysis of patients with MTD during different tasks is a crucial tool, particularly in voice clinics, for supporting the diagnosis, developing a patient-specific treatment plan to document the efficacy of treatment, and providing an objective estimate of pathological changes in patients' voice function.

Our study aimed to examine the acoustic voice parameters that can characterize patients with MTD, to create acoustic measurement reference values for subsequent studies, to define acoustic measurement values that can distinguish these patients from other types of voice disorders, and to examine the change in the determined values between gender groups.

Methods

This study used a descriptive method to analyze the acoustic voice characteristics of individuals diagnosed with MTD.

The Study Group

The files of patients who presented to the Otolaryngology Department of the University of Health Sciences Ankara Dışkapı Yıldırım Beyazıt Training and Research Hospital between January 2015 and August 2022 and were diagnosed with MTD because of their evaluation in the voice center due to voice disorders were retrospectively examined. We obtained Ankara Etlik City Hospital No. 1 Clinical Research Ethics Committee before starting the study (decision no.: AEŞH-EK1-2023-145, date: 12.07.2023). Videolaryngoscopic examination and acoustic analysis findings were reviewed from the patients' files. The inclusion criteria for the study were: a) aged over 18 years; b) a diagnosis of primary MTD based on videolaryngoscopic examination, anamnesis, acoustic and auditory-perceptual analyses; and c) absence of any underlying organic or neurogenic disorder that could cause a voice disorder. Data from 80 patients who met the study criteria were reviewed. The review results indicated that the study excluded patients with organic or neurogenic disorders.

Assessment Tools

In our clinic, all patients who are diagnosed with voice disorders undergo routine objective and subjective voice evaluations, including evaluations using anamnesis, laryngeal examination, Grade, Roughness, Breathiness, Asthenia, Strain (GRBAS), self-assessment instruments, and acoustic and aerodynamic measurements. Patients' anamnesis forms and self-reports are stored physically, and voice samples are stored digitally using the Computerized Speech Lab Multi-Dimensional Voice Program (MDVP) and the real-time pitch (KAYPENTAX:PENTAX Medical Company, USA) program. The analysis of acoustic data from patients diagnosed with MTD constituted the only focus of our research.

In videolaryngoscopic examination, a rigid endoscope with Kay Pentax RLS 9100 B equipment (Key Elemetrics, Lincoln Park, New Jersey, USA) was used to record the images and voices of the patients. Videolaryngoscopic examination was performed by two experienced laryngologists.

Acoustic voice analysis was performed using the MDVP and real-time pitch programs (Kay Elementrics Group Computerized Speech Lab-CSL, Model 4500). The recordings were made in a quiet room using a Shure brand microphone (Shure SM48-LC model). The microphone was placed approximately 10 cm away from the mouth at a 45-degree angle. MDVP was used for the acoustic voice analysis of the/a/sound, and the real-time pitch program was used for the analysis of the counting task (counting 1-10). For MDVP measurement, the patient was asked to produce /a/ phonation at a comfortable and normal intensity for five seconds, and then the first and last parts of the recordings were cut and the three seconds in the middle of the phonation interval were analyzed. Among the measurement parameters, F0, jitter (%), shimmer (%), NHR, and soft phonation index (SPI) were recorded numerically. In the real-time pitch program, participants were asked to count from one to 10 in a comfortable tone, and the recordings were analyzed. Intensity, frequency, and semitone parameters were examined in the analysis measurements.

Statistical Analysis

The data from the study were analyzed using the Statistical Package for Social Sciences (SPSS) Version 26.0 (IBM SPSS Statistics for Windows. Armonk, NY, USA). Before analysis, the data was evaluated with the Kolmogorov-Smirnov test to check whether the data conformed to a normal distribution. Test results were used for analysis of normally distributed data [F0, SPI, maximum (max.) dB, mean dB, minimum (min.) hz, max. hz, average hz, range hz, periodicity, semitone range) using a t-test for independent samples; the Mann-Whitney U test was used for analyzing the data that did not show normal distribution (jitter, shimmer, NHR, min. dB, range dB). The results of the score values for the dimensions were reported by descriptive statistical analysis.

Results

A total of 80 individuals with a MTD diagnosis were included in the study. Of these, 33.8% (n=27) were male, and 66.2% (n=53) were female. Descriptive statistical results of acoustic analysis findings in the /a/ vowel and counting tasks (1-10) according to gender are shown in Table 1.

Table 2 reveals a significant gender difference in the F0 scores of individuals diagnosed with MTD ($t=-5.337$; $p=0.000$). Accordingly, the average F0 scores of females and males were 224.24 and 156.08 hz, respectively. It is seen that there is no difference in SPI values in terms of gender ($t=0.690$; $p=0.492$).

When Table 3 is examined, it is seen that the shimmer and NHR scores of individuals diagnosed with MTD do not differ significantly between genders ($z=-0.366$; $p=0.714$; $z=-0.031$; $p=0.976$). It was observed that the jitter scores of individuals diagnosed with MTD differed significantly between the genders ($z=-2.203$; $p=0.028$). Accordingly, it can be said that

Table 1. Descriptive statistical results of acoustic analysis findings by gender

Parameters	Group	N	Min.	Max.	Mean	SD
F0	Male	27	96.149	214.905	156.080	34.102
	Female	53	83.523	386.787	224.248	61.607
	Total	80	83.523	386.787	201.241	62.715
Jitter	Male	27	0.277	6.887	1.738	1.817
	Female	53	0.349	20.015	2.942	3.500
	Total	80	0.277	20.015	2.536	3.079
Shimmer	Male	27	1.997	21.731	6.367	4.198
	Female	53	0.139	35.022	6.503	5.611
	Total	80	0.139	35.022	6.457	5.151
NHR	Male	27	0.112	0.583	0.186	0.114
	Female	53	0.099	2.287	0.240	0.338
	Total	80	0.099	2.287	0.222	0.283
SPI	Male	27	1.096	31.802	13.210	6.808
	Female	53	0.157	34.050	12.106	6.740
	Total	80	0.157	34.050	12.479	6.740
Min. dB	Male	27	35.000	39.420	36.318	1.061
	Female	53	26.920	43.460	36.598	2.484
	Total	80	26.920	43.460	36.503	2.110

Table 1. Continued

Parameters	Group	N	Min.	Max.	Mean	SD
Max. dB	Male	27	37.290	74.400	62.473	7.053
	Female	53	44.030	74.670	61.533	6.263
	Total	80	37.290	74.670	61.850	6.511
Mean dB	Male	27	37.050	66.150	53.142	5.945
	Female	53	38.900	62.630	53.770	5.564
	Total	80	37.050	66.150	53.558	5.665
Range dB	Male	27	0.470	35.060	26.172	6.965
	Female	53	7.960	39.470	24.726	6.043
	Total	80	0.470	39.470	25.214	6.362
Min. hz	Male	27	76.430	142.680	96.097	16.788
	Female	53	70.100	225.960	128.895	42.705
	Total	80	70.100	225.960	117.826	39.201
Max. hz	Male	27	81.070	393.880	297.799	77.237
	Female	53	151.860	392.250	316.703	55.153
	Total	80	81.070	393.880	310.323	63.612
Mean hz	Male	27	79.330	263.220	151.803	41.008
	Female	53	122.550	337.290	216.344	45.968
	Total	80	79.330	337.290	194.562	53.735
Range hz	Male	27	3.370	309.000	197.258	80.585
	Female	53	52.470	306.540	187.726	73.492
	Total	80	3.370	309.000	190.943	75.584
Periodicity	Male	27	0.320	6.240	2.389	1.415
	Female	53	-0.080	9.790	2.912	2.087
	Total	80	-0.080	9.790	2.736	1.894
Semitone Range	Male	27	1.000	26.000	18.962	5.761
	Female	53	4.000	29.000	16.264	6.886
	Total	80	1.000	29.000	17.175	6.617

F0: Fundamental frequency, NHR: Noise to harmonic ratio, SPI: Soft phonation index, Min.: Minimum, Max.: Maximum, SD: Standard deviation

Table 2. T-test results for the comparison of F0 and SPI scores of individuals diagnosed with MTD according to gender

Variable	Group	N	Mean	SD	t	p
F0	Male	27	156.08	34.10	-5.337	**0.000**
	Female	53	224.24	61.60		
SPI	Male	27	13.21	6.80	0.690	0.492
	Female	53	12.10	6.74		

p≤0.005. F0: Fundamental frequency, NHR: Noise to harmonic ratio, SPI: Soft phonation index, SD: Standard deviation, MTD: Muscle tension dysphonia

the female jitter scores (mean=44.60) are significantly higher than the male scores (mean=32.44).

When Table 4 is examined, it is seen that the maximum dB, mean dB, maximum hz, range hz, periodicity, and semitone range scores of individuals with MTD did not differ significantly between the genders (t=608; p=0.545; t=-0.467; p=0.642; t=-1.262; p=0.211; t=0.531; p=0.597; t=-1.171; p=0.245; t=1.747; p=0.085). It is seen that the mean and minimum hz scores of individuals with MTD differed significantly between the genders (t=-6.151; t=-3.833; p=0.000). Accordingly, female mean hz scores (mean=216.34) were significantly higher than male scores (mean=151.80), and female minimum hz scores (mean=128.89) were significantly higher than male scores (mean=96.09).

Table 5 shows that the minimum and range dB scores of individuals with MTD did not differ significantly between the genders (z=-0.198; p=0.843; z=-1.526; p=0.127).

Table 3. Mann-Whitney U test results for comparison of jitter, shimmer, and NHR scores of individuals diagnosed with MTD according to gender

Variable	Group	N	Rank average	U	Z	p
Jitter	Male	27	32.48	499.000	-2.203	**0.028**
	Female	53	44.58			
Shimmer	Male	27	41.83	679.500	-0.366	0.714
	Female	53	39.82			
NHR	Male	27	40.61	712.500	-0.031	0.976
	Female	53	40.44			

p≤0.005 NHR: Noise to harmonic ratio, U and Z: Statistical values in Mann-Whitney U test

Table 4. T-test results for comparison of scores obtained from acoustic analysis findings in the counting task of individuals with MTD according to gender

Variable	Group	N	Mean	SD	t	p
Max. dB	Male	27	62.47	7.05	0.608	0.545
	Female	53	61.53	6.26		
Mean dB	Male	27	53.14	5.94	-0.467	0.642
	Female	53	53.77	5.56		
Min. hz	Male	27	96.09	16.78	-3.833	**0.000**
	Female	53	128.89	42.70		
Max. hz	Male	27	297.79	77.23	-1.262	0.211
	Female	53	316.70	55.15		
Mean hz	Male	27	151.80	41.00	-6.151	**0.000**
	Female	53	216.34	45.96		
Range hz	Male	27	197.25	80.58	0.531	0.597
	Female	53	187.72	73.49		
Periodicity	Male	27	2.38	1.41	-1.171	0.245
	Female	53	2.91	2.08		
Semitone Range	Male	27	18.96	5.76	1.747	0.085
	Female	53	16.26	6.88		

p≤0.005 MTD: Muscle tension dysphonia, Min.: Minimum, Max.: Maximum, SD: Standard Deviation

Table 5. Mann-Whitney U test results for comparison of scores obtained from acoustic analysis findings in the counting task of individuals with MTD according to gender

Variable	Group	N	Rank average	U	Z	p
Min. dB	Male	27	41.22	696.000	-0.198	0.843
	Female	53	40.13			
Range dB	Male	27	46.06	565.500	-1.526	0.127
	Female	53	37.67			

MTD: Muscle tension dysphonia, Min.: Minimum, p≤0.005, U and Z: Statistical values in Mann-Whitney U test

Discussion

Acoustic voice analysis is a beneficial technique for detecting voice disorders that can be identified by measuring various acoustic parameters. A series of voice parameters are acquired by recording and analyzing a voice signal. This method enables the identification of voice disorders by comparing voice parameters acquired from individuals with healthy voices and those with dysphonic voices (13). In our study, the acoustic voice analysis parameters of patients with MTD were reviewed, and the changes in acoustic parameters related to MTD were noted.

MTD is a prevalent problem observed in women of middle age and younger. Due to the imbalance between synergist and antagonist muscles, this vocal issue disrupts the position of the vocal folds and induces tension in the remaining portion of the vocal tract. Numerous factors, such as possible psychological or personality traits, could contribute to this tension in muscle activity (14). In our study, 66.2 percent of participants with MTD were women. According to Ali et al. (14), 43 of the 72 patients diagnosed with MTD were women. According to another study, 64% of female participants had MTD (15). The high number of female participants in our research and other studies supports the idea that MTD is more common in females.

Symptoms such as varying degrees of tense or effortful voice quality, hoarseness, glottal fry, breathiness, abnormal pitch, voice breaks, voice fatigue (16), odynophonia, vocal tract, and neck discomfort occur in primary MTD (15). A correct diagnosis of MTD is essential. A proper diagnosis depends on first recognizing auditory-perceptual traits and then rigorously eliminating other structural or neurological diseases with comparable voice characteristics. Therefore, knowing the endoscopic, acoustic, and aerodynamic features facilitates the accuracy of the diagnosis (1,17). Furthermore, the therapy for these patients can include techniques aimed at specific aspects of voice production. Furthermore, there is a lack of outcome statistics on specific therapy elements meant to alter voice production toward maximum function (18). Thus, objective evidence is required to expose both diagnosis and therapeutic efficacy. Vocal hyperactive behaviors in MTD cause abnormalities in the voice's perceptual and acoustic parameters (10). These patients may exhibit distinctive behavioral alterations during voice production, such as glottal muscle tension or glottal attack. As a result, acoustic analyses serve as a valuable instrument for assessing these modifications (19). In studies on the acoustic properties of voice, acoustic parameters such as F0, first formant frequency, jitter, shimmer, and NHR have been commonly used (20).

F0 represents the number of cycles generated by the vocal folds per second and indicates the first harmonic of the voice (2). Pitch is strongly perceptually related to F0. F0 varies significantly between males and females, primarily because of anatomical distinctions. In addition to having a longer vocal tract than females, males also have thicker, more prominent vocal folds. As a result, they generate a lower F0 by vibrating at approximately half the frequency of females during phonation (21). The average F0 in females is 180-230 hz; in males, it is 100-150 hz (22). Bengisu et al. (23) reported the mean F0 of female patients with primary MTD as 222.95 hz.

In another study, the mean cepstral peak prominence (CPP) F0 of patients with MTD was 207.6±20.2 hz (24). In our study, the F0 mean of the isolated vowel sound in the acoustic analysis was 224.2 hz, with a minimum of 83.5 hz and a maximum of 386.7 hz in females, while the F0 mean in males was 156.0 hz, with a minimum of 96.1 hz and a maximum of 214.9 hz. Furthermore, the counting task yielded similar results for these values in both males and females. According to the findings obtained in our study, the F0s of males and females were found to be within a range that defines their gender. However, it is worth noting that although the F0 averages of females and males were within their respective voice ranges, the minimum and maximum F0 values varied. Increased F0 in patients with MTD is associated with increased tension. It has also been reported that the tension in the vocal folds increases in these patients due to excessive contraction in the laryngeal muscle. Generally, stiffness and excessive tension of the intrinsic and extrinsic muscles of the larynx, as well as the high vertical position of the larynx in the neck, cause the formation of a high-pitched voice quality (25). Studies indicate that F0 is a crucially perceived acoustic quality of dysphonic voice (10). Even if the average F0 values of MTD patients reflect their gender, knowing the differences in F0 values (minimum and maximum hz values) in some patients will guide the clinician in evaluating the voice and planning appropriate voice therapy approaches.

Perturbation measurements such as jitter and shimmer parameters reveal short-term variations in the intensity and fundamental frequency between cycles. From cycle to cycle, the frequency and intensity of a healthy voice show some variation. On the other hand, excessive variability indicates unhealthy vocal fold function. Effective differentiation between healthy and pathological voices has been demonstrated using perturbation measurements (11). Jitter was measured at 1.319 and shimmer at 0.779 in 20 female participants diagnosed with MTD (23). De Oliveira Lemos et al. (26) found jitter to be 0.46 and shimmer to be 4.58 in individuals with MTD. Jitter and shimmer measurements in our study revealed that the associated values for females were 2.94 and 6.50, whereas, for males, these values were 1.73 and 6.36, respectively. Jitter values in females are significantly higher than in males. Although there is no difference in terms of gender, shimmer values are seen to be relatively higher than the studies conducted in the literature. The higher these parameters were in our study, the higher the effect on voice quality. This situation is thought to cause irregularities in the vibration of the vocal folds due to increased tension in individuals with MTD (20). This resulted in the observation that both frequency and intensity parameters were impacted. The literature reports the mean NHR value for individuals with MTD to be 0.105 and the average SPI value 29.80 (23). Ten individuals with MTD were evaluated by Mathieson et al. (27) regarding NHR and SPI values in connected speech and vowel phonation. The researchers determined that the NHR value for vowel production was 0.121, and the SPI value was 29.86. In connected speech, the NHR value was 0.250, and the SPI value was 28.36. The NHR value determined in our study was 0.222, while the mean SPI value was 12.47. It is important to note that the maximum mean SPI value among all participants was 34.0. This finding shows that the vocal folds in patients with MTD do not close entirely due to muscle tension during phonation. Knowing the SPI value will assist the clinician in both the evaluation and treatment phases (before and after treatment) in determining appropriate voice therapy techniques.

Acoustic analysis has revealed a reduced intensity in patients with MTD due to the tension in the phonatory mechanism (28). A study conducted at a voice center in New York reported that, in a comparison of the group with primary MTD and the group without MTD, SPL (dB) during vocalization was one of the critical parameters affected and explained 65% of the variance between the variables [airflow during vocalization, SPL (dB), mean air pressure, peak F0, CPP mean vowel (dB)] (15). Another study conducted with individuals with MTD stated the average vocal intensity as 66.95 dB SPL (28). Altman et al. (29) reported that 86% of patients with MTD complained about excessive use of voice or the need to use loud sounds in daily activities. A study reported that as voice intensity increased, acoustic perturbation parameters improved, in other words, jitter, shimmer, and NHR decreased (30). In our study, all participants' mean minimum, maximum, and mean intensity levels during the counting task were 36.5 dB, 61.8 dB, and 53.5 dB, respectively. The low mean maximum intensity level especially shows us that the vocal intensity decreases in patients due to the tension in the phonatory mechanism.

Further studies examining the acoustic parameters of healthy individuals may provide more detailed information about the deviation in the voice characteristics of individuals with MTD. It is also known that MTD involves components such as stress and anxiety that can significantly affect voice production. Our study did not address psychological aspects that could affect acoustic sound characteristics. Future studies incorporating psychological assessments may further elucidate the interplay between physiological and psychological factors in MTD patients. Addressing these limitations in subsequent studies will increase the robustness and applicability of the findings, ultimately advancing the field of voice disorders and improving clinical practice.

In our study, we investigated the acoustic voice parameter values of individuals diagnosed with MTD during vowel and counting tasks. In the vowel phonation analysis, the average F0 value was 224 hz (min.-max.: 83 hz-386 hz) in females and 156 hz (min.-max.: 96 hz - 214 hz) in males. Likewise, F0 values were similar in the counting task. Although the F0 averages of males and females were within the range of their respective genders, the minimum and maximum F0 values differed. The average jitter, shimmer, NHR, and SPI values of all MTD patients were 2.53, 6.45, 0.222, and 12.47, respectively. The average intensity in the counting task was found to be 53.5 dB (min.-max.: 36.5-61.8 dB).

In our study, we studied a larger sample group diagnosed with MTD compared to studies in the literature. We believe that gender-specific differences in acoustic voice characteristics provide valuable information about the nature of MTD. This study will constitute an important reference value for future studies, especially for patients with MTD. Moreover, we believe that when determining targets and treatment plans for patients with MTD, appropriate intervention plans should be prepared by considering the individual acoustic values caused by the tension in the phonatory mechanism.

Ethics Committee Approval: We obtained Ankara Etlik City Hospital No. 1 Clinical Research Ethics Committee before starting the study (decision no.:AEŞH-EK-2023-145, date: 12.07.2023).

Informed Consent: The study retrospectively reviewed the acoustic examination findings from the files of patients diagnosed with MTD during evaluations in the laryngology outpatient clinic at a tertiary reference hospital between 2015 and 2022

Authorship Contributions

Concept: E.B., E.A., D.S., E.Ç.T., Design: E.B., E.A., D.S., Data Collection and/or Processing: E.B., E.A., D.S., E.Ç.T., Analysis and/or Interpretation: E.B., E.A., E.Ç.T., Literature Search: E.B., D.S., Writing: E.B., D.S., E.Ç.T.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support

Main Points

- Muscle tension dysphonia (MTD) affects the voice quality of patients.
- We established reference values for the acoustic voice parameters of patients with MTD.
- Acoustic parameters must be considered in the voice evaluation and intervention of MTD patients.

References

1. Verdolini K, Rosen CA, Branski RC. Classification manual for voice disorders-I. Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc., Publishers; 2006. [Crossref]
2. Boone DR, McFarlane SC, Von Berg S, Zraick RI. The voice and voice therapy, 10th ed. Boston, MA: Pearson Higher Ed; 2020. [Crossref]
3. Stemple JC, Hapner E.R. Voice therapy: clinical case studies, 4th ed. San Diego, CA: Plural Publishing; 2019. [Crossref]
4. Barsties V Latoszek B, Watts CR, Hetjens S. The efficacy of the manual circumlaryngeal therapy for muscle tension dysphonia: A systematic review and meta-analysis. Laryngoscope. 2024; 134: 18-26. [Crossref]
5. Thomas SA, Maruthy S. Comparison of habitual and high pitch phonation in teachers with and without vocal fatigue. J Voice. 2022; 36: 141.. [Crossref]
6. Ferrand CT. Voice disorders scope of theory and practice. 2nd ed. Boston: Pearson Education; 2019. [Crossref]

7. Khoddami SM, Nakhostin Ansari N, Izadi F, Talebian Moghadam S. The assessment methods of laryngeal muscle activity in muscle tension dysphonia: a review. Scientific World Journal. 2013; 4; 2013: 507397. [Crossref]

8. Liu S, Shao J. [Current methods of acoustic analysis of voice: a review]. Lin Chuang Er Bi Yan Hou Tou Jing Wai Ke Za Zhi. 2022; 36: 966-76. [Crossref]

9. Yamauchi A, Imagawa H, Yokonishi H, Sakakibara KI, Tayama N. Gender- and age- stratified normative voice data in japanese-speaking subjects: analysis of sustained habitual phonations. J Voice. 2024; 38: 619-29. [Crossref]

10. Tarazani M, Khoddami SM, Jalaie S, Moghadam ST, Akbari M. The correlation between voice handicap index and specific acoustic measures in patients with muscle tension dysphonia. Thrita J Neu. 2013; 2: 24-8. [Crossref]

11. Demirhan E, Unsal EM, Yilmaz C, Ertan E. Acoustic voice analysis of young Turkish speakers. J Voice. 2016; 30: 378. [Crossref]

12. Brockmann-Bauser M, de Paula Soares MF. Do we get what we need from clinical acoustic voice measurements? Appl Sci. 2023; 13: 941. [Crossref]

13. Cavallaro G, Di Nicola V, Quaranta N, Fiorella ML. Acoustic voice analysis in the COVID-19 era. Acta Otorhinolaryngol Ital. 2021; 41: 1-5. [Crossref]

14. Ali I, Hussain RT, Wagay FA, Ahmad R. Muscle tension dysphonia: experience from a conflict zone. Indian J Otolaryngol Head Neck Surg. 2022; 74(Suppl 2):2082-7. [Crossref]

15. Shembel AC, Lee J, Sacher JR, Johnson AM. Characterization of primary muscle tension dysphonia using acoustic and aerodynamic voice metrics. J Voice. 2023; 37: 897-906. [Crossref]

16. Roy N. Assessment and treatment of musculoskeletal tension in hyperfunctional voice disorders. Int J Speech Lang Pathol. 2008; 10: 195-209. [Crossref]

17. Kunduk M, Fink DS, McWhorter AJ. Primary muscle tension dysphonia. Curr Otorhinolaryngol Rep 2016; 4: 175-82. [Crossref]

18. Madill C, Chacon A, Kirby E, Novakovic D, Nguyen DD. Active ıngredients of voice therapy for muscle tension voice disorders: a retrospective data audit. J Clin Med. 2021;10:4135. [Crossref]

19. Zheng YQ, Zhang BR, Su WY, Gong J, Yuan MQ, Ding YL, et al. Laryngeal aerodynamic analysis in assisting with the diagnosis of muscle tension dysphonia. J Voice. 2012; 26: 177-81. [Crossref]

20. Rad AR, Moradi N, Yazdi MJSZ, Soltani M, Mehravar M, Latifi SM. Efficacy of manual circumlaryngeal therapy in patients with muscle tension dysphonia. Shiraz E-Medical Journal. 2018; 19 : e64478. [Crossref]

21. Cussigh G, Ballester-Arnal R, Gil-Llario MD, Giménez-García C, Castro-Calvo J. Fundamental frequency of the female's voice: a cross-country empirical study on its influence on social and sexual selection. Pers Individ Diff. 2020; 160: 109937. [Crossref]

22. Watts CR, Awan SN. Laryngeal function and voice disorders: basic science to clinical practice. New York, USA: Thieme Publishers, Inc; 2019. [Crossref]

23. Bengisu S, Topbaş S, Koçak I. Kas gerilimi disfonisi tip 1 hastaliği ile yumuşak fonasyon indeksi arasindaki ilişki ve ses terapisinin etkinliği [The relationship between muscle tension dysphonia type 1 and soft phonation index and the effectiveness of voice therapy]. Kulak Burun Bogaz Ihtis Derg. 2008; 18: 131-8. [Crossref]

24. Shim HJ, Jung H, Koul R, Ko DH. Spectral and cepstral based acoustic features of voices with muscle tension dysphonia. Clin Arch Commun Disord. 7-42 :1 ;2016. [Crossref]

25. Martinez CC, Lemos IO, Madazio G, Behlau M, Cassol M. Vocal parameters, muscle palpation, self-perception of voice symptoms, pain, and vocal fatigue in women with muscle tension dysphonia. Codas. 2021; 33: e20200035. [Crossref]

26. de Oliveira Lemos I, da Cunha Pereira G, Druck SantAnna G, Cassol M. Effects of a voice therapy program for patients with muscle tension dysphonia. Folia Phoniatr Logop. 2017; 69: 239-45. [Crossref]

27. Mathieson L, Hirani SP, Epstein R, Baken RJ, Wood G, Rubin JS. Laryngeal manual therapy: a preliminary study to examine its treatment effects in the management of muscle tension dysphonia. J Voice. 2009; 23: 353-66. [Crossref]

28. Belsky MA, Rothenberger SD, Gillespie AI, Gartner-Schmidt JL. Do phonatory aerodynamic and acoustic measures in connected speech differ between vocally healthy adults and patients diagnosed with muscle tension dysphonia? J Voice. 2021; 35: 663. [Crossref]

29. Altman KW, Atkinson C, Lazarus C. Current and emerging concepts in muscle tension dysphonia: a 30-month review. J Voice. 2005; 19; 261-7. [Crossref]

30. Brockmann-Bauser M, Bohlender JE, Mehta DD. Acoustic perturbation measures improve with increasing vocal intensity in individuals with and without voice disorders. J Voice. 2018; 32: 162-8. [Crossref]