Original Article

The efficacy of voice therapy in vocal cord nodules

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ABSTRACT

Objectives: This study aims to investigate the efficacy of voice therapy in the treatment of vocal cord nodules with subjective and objective measurements.

Patients and Methods: The study included 20 female patients with vocal cord nodules. The patients were divided into two groups randomly as study and control groups. Ten patients in the study group (mean age 30.4±8.1 years; range, 21 to 47 years) received voice therapy and anti-reflux treatment. Ten patients in the control group (mean age 32.1±10.5 years; range, 18 to 49 years) received anti-reflux treatment and vocal hygiene education. Voice Handicap Index-10 (VHI-10) questionnaire was completed, the maximum phonation time (MPT) and s/z ratio were measured, acoustic and aerodynamic analyses were performed on voice recordings before and after the treatments for both groups. Pre- and post-treatment videolaryngostroboscopic examinations were performed and the results were compared.

Results: Maximum phonation time increased in the study group (p=0.042) but did not change in the control group. There was no difference in either group in terms of VHI-10, s/z ratio, average fundamental frequency, mean sound pressure level or air flow rate. In the study group, one vocal cord nodule disappeared, five vocal cord nodules decreased in size, and four remained the same. In the control group, four vocal cord nodules remained the same and six decreased in size.

Conclusion: The majority of the vocal cord nodules did not disappear with voice therapy while they decreased in size. We observed an increment only in the MPT.

Keywords: Acoustic analysis, nodule, vocal cord, Voice Handicap Index, voice therapy.

Vocal cord nodules are fibrous thickenings within the superficial lamina propria. They are usually located at the junction of anterior one-third and posterior two-thirds of the vocal cord.[1] The formation of these nodules is commonly attributed to chronic voice abuse which leads to physiologic reactions of edema, hyalinization, fibrosis, and eventual voice mutation.[2] They are mostly bilateral and can cause dysphonia due to the incomplete closure of the membranous glottis. Vocal cord nodules are the most frequently occurring benign laryngeal pathologies.[3] The symptoms of vocal cord nodules include mild to moderate dysphonia characterized by hoarseness, breathiness, low pitch, and laryngeal hyperfunction.[4]

Vocal cord nodules are the result of vocal abuse and misuse. Gastroesophagopharyngeal acid reflux also plays a contributory role in the

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pathogenesis of some vocal cord nodules.[5,6] First-line treatment options include vocal hygiene, voice therapy, and anti-reflux treatment. If these fail, then surgery is considered.[7]

It has been shown that vocal cord nodules can decrease in size or disappear with voice therapy.[8-10] However, according to our clinical experience, vocal cord nodules persist after voice therapy while the symptoms resolve. In this study, we aimed to investigate the efficacy of voice therapy in the treatment of vocal cord nodules with subjective and objective measurements.

PATIENTS AND METHODS

This study was conducted at the Department of Otolaryngology of Istanbul University Istanbul Medical Faculty between November 2008 and May 2009. Patients who presented to our clinic with hoarseness were evaluated with videolaryngostroboscopy and those diagnosed with vocal cord nodules and older than 18 years of age were asked to participate in the study. The exclusion criteria were being younger than 18 years of age, smoking, history of surgery for vocal cord nodules, having a vocal cord lesion such as polyp or cyst, having a surgery requiring endotracheal intubation during the study, and having another disease involving the larynx such as spasmodic dysphonia or Parkinson's disease. Twenty female patients who met the inclusion criteria were admitted randomly and alternately as the study (n=10, mean age 30.4±8.1 years; range, 21 to 47 years) and control (n=10; mean age 32.1±10.5 years; range, 18 to 49 years) groups. In order to eliminate the effects of gastroesophagopharyngeal reflux, anti-reflux treatment was given and dietary modifications were recommended to both groups. Voice therapy and anti-reflux treatment (esomeprazole 40 mg, twice a day) were given to the patients in the study group for two months (one session/week, totally eight sessions). Only anti-reflux treatment and vocal hygiene were given to the patients in the control group. The study protocol was approved by the Istanbul University Istanbul Medical Faculty Ethics Committee. A written informed consent was obtained from each patient. The study was conducted in accordance with the principles of the Declaration of Helsinki. A detailed history was taken from the patients and a routine ear, nose, and throat examination was performed. The pre- and post-therapy videolaryngostroboscopic (VLS) images that were taken with a 70° rigid endoscope of a KayPENTAX stroboscopy system (Model 9200C, Pentax Medical, New Jersey, USA) were recorded by an otolaryngologist (Figure 1). The post-therapy size of the vocal cord nodules were evaluated by an otolaryngologist and a speech and language pathologist according to the following criteria: *(i)* disappeared, *(ii)* reduced in size, *(iii)* remained the same, *(iv)* increased in size. Voice therapy and other measurements were performed by a speech and language pathologist in our clinic.

Voice Handicap Index-10 (VHI-10) questionnaire was completed at pre- and post-therapy by the patients. Additionally, the patients were requested to evaluate their voices and rate between 0 and 3 (0= normal, 1= mildly disturbed, 2= moderately disturbed, 3= severely disturbed). Pre- and post-therapy voice recordings and analyses were conducted. The recordings were performed in a soundproof room of our voice laboratory.

The patients were asked to generate maximum inspiration and phonate the vowel /a/ at a comfortable pitch and loudness for themselves. Then, they were asked to generate maximum inspiration and phonate the consonants /s/ and /z/ as long as possible. The duration of these phonations were recorded with a chronometer. Maximum phonation time (MPT)

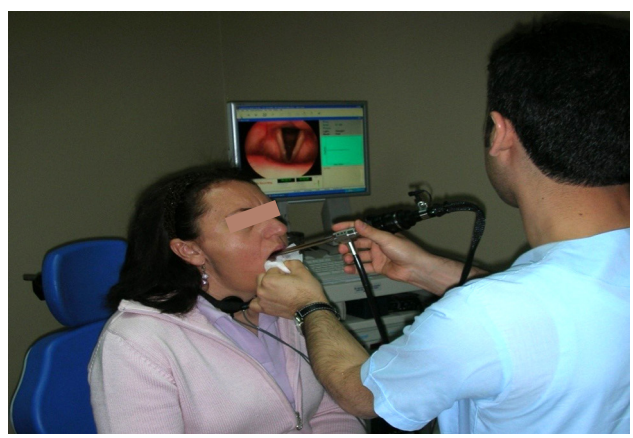

Figure 1. *The videolaryngostroboscopic examination of a patient.*

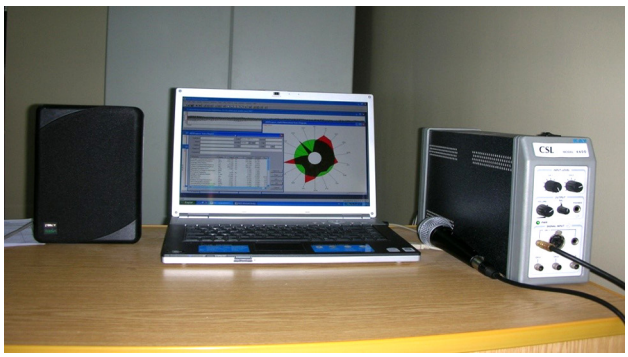

Figure 2. *Acoustic analysis system.*

Figure 3. *Aerodynamic analysis.*

was determined by measuring the duration of vowel /a/ and s/z ratio was determined by comparing the duration of consonants /s/ to /z/.

For acoustic analysis, a Shure PG58 microphone (Shure, Niles, IL, USA) was placed 10 cm from the mouth of the patient. The patient was then asked to generate maximum inspiration and phonate the vowel /a/ at a comfortable pitch and loudness for herself. Digitally recorded data by means of a Kay Computerized Speech Lab machine (Kay Elemetrics Corporation, Lincoln Park, NJ, USA) was transferred to a Sony Vaio Laptop with an Intel Core 2 Duo (2 Gz) processor (Intel, Santa Clara, CA, USA) and SigmaTel High Definition Audio sound card (SigmaTel, Texas, USA). Acoustic analyses of this vowel were performed by means of Multi-Dimensional Voice Program advanced system (Kay Elemetrics Corporation, Lincoln Park, NJ, USA). The recordings of vowel /a/ were used to evaluate fundamental frequency (Fo) (Figure 2).

For the aerodynamic analyses, scores of sound pressure level (SPL) and maximum flow rate (MFR) passing through the glottis were used. These parameters were determined by measuring the duration of vowel /a/. The recorded data were analyzed by Phonatory Aerodynamic System Model 6600 program (Pentax Medical, New Jersey, USA) in a PC with an AMD Athlon 64 X2 Dual Core processor (AMD, Santa Clara, CA, USA) and Realtek High Definition Audio sound card (Realtek, Hsinchu, Taiwan) (Figure 3).

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences version 10.0 software (SPSS Inc., Chicago, IL, USA). Paired two-tailed Student's t-test was used for intergroup comparison of pre- and post-therapy parameters (VHI-10, MPT, s/z ratio, Fo, SPL, MFR). Chi-square test was used for comparison of pre- and post-therapy VLS images and perceptual evaluation of patients' own voices. Statistical significance was assumed at $p<0.05$.

Table 1. Pre- and post-therapy parameters of study group

	Mean±SD		Min-Max	
Parameters	Preoperative	Postoperative	Preoperative	Postoperative
VHI	15.3±4.0	12.9±4.31	9-21	7-20
MPT	9.19±3.74	10.91±3.45	5-15	5-16
S/Z	1.38±0.31	1.33±0.21	0.88-1.91	1.1-1.65
Fo	239.31±21.93	233.47±21.03	205.227-264.671	196.308-263.173
SPL	79.72±3.42	79.21±4.49	75.03-86.87	74.71-90.57
MFR	0.25±0.1	0.25±0.11	0.1-0.39	0.11-0.44

SD: Standard deviation; Min: Minimum; Max: Maximum; VHI: Voice Handicap Index; MPT: Maximum phonation time; Fo: Fundamental frequency; SPL: Sound pressure level; MFR: Maximum flow rate.

Table 2. Pre- and post-therapy parameters of control group

	Mean±SD		Min-Max	
Parameters	Preoperative	Postoperative	Preoperative	Postoperative
VHI	15.2±7.39	13.50±8.7	4-29	2-27
MPT	11.02±4.97	11.87±4.79	6-22	6.5-20
S/Z	1.64±0.82	1.43±0.56	0.93-3.75	0.87-2.6
Fo	217.71±30.91	231.56±23.89	156.603-258.302	193.190-265.327
SPL	79.67±5.5	79.76±4.93	71.3-87.21	75.08-89.95
MFR	0.22±0.1	0.21±0.1	0.11-0.42	0.11-0.41

SD: Standard deviation; Min: Minimum; Max: Maximum; VHI: Voice Handicap Index; MPT: Maximum phonation time; Fo: Fundamental frequency; SPL: Sound pressure level; MFR: Maximum flow rate.

RESULTS

All of the 20 patients completed the study. The results of the pre- and post-therapy parameters (VHI-10, MPT, s/z ratio, Fo, SPL, MFR) were shown for the study and control group, in Tables 1 and 2, respectively.

There was a statistically significant difference in MPT in the study group when the pre- and post-therapy results were compared (p=0.042). There was no significant difference in other parameters (VHI-10, s/z ratio, Fo, SPL, MFR) of either group. We also found no significant difference in the perceptual evaluation of patients' own voices. The evaluation of the VLS images of the patients after the therapies were shown in Table 3. There was no increase in the size of the vocal cord nodules in either group.

DISCUSSION

The primary etiologic factor in vocal cord nodules is trauma to the vocal cord tissues.[11,12] The nodule starts as an edema in the submucosa of the vocal cord. Nodule formation continues with the infiltration of the Reinke's space with edema fluid and blood. It evolves to hyalinized fibrous tissue according to the type and severity of the predisposing factor. Vocal cord nodule is the result of subepithelial scar collection and changes primarily the mass and consistency of the vocal cord.[13] After the formation of the nodules, complete closure of the membranous glottis can be hindered, causing an increase of turbulent air through the glottis. The effort to produce voice can cause further increased muscle tension, increased subglottal pressure, and heightened vocal fold collision forces, triggering a "vicious circle" adding to the vocal trauma.[14]

The treatment of choice for vocal cord nodules is mostly voice therapy. It aims at helping to reduce muscle tension and hyperfunction so that aerodynamic forces (transglottal air pressure and glottal airflow) and acoustic properties (vocal loudness, and pitch) approach normal values. Thus, it lessens the trauma to the vocal folds.[15] Although it is generally acknowledged that voice therapy has a positive effect on the vocal status, there is a paucity of objective data to show the therapy effect.[16] In our study, we

Table 3. Evaluation of videolaryngostroboscopic images of patients after therapies

	Study group	Control group	Total
Videolaryngostroboscopic images	n	n	n
Remained the same	4	4	8
Decreased in size	5	6	11
Disappeared	1	-	1
Total	10	10	20

have found no significant difference in either group in terms of the size of the vocal cord nodules on the VLS images. In the study group, only one vocal cord nodule disappeared. This nodule may have been a soft nodule. It was reported that soft nodules could disappear while hard nodules persist despite voice therapy.[10] The persistence of hard nodules despite voice therapy may be attributable to the collection of fibrous tissue in the subepithelial superficial lamina propria layer. A majority of the vocal cord nodules decreased in size with voice therapy. This result was consistent with the previous studies.[8,17]

All of the patients recruited in our study were females. Vocal cord nodules have been reported generally in females in the literature as well.[9,10] Chagnon and Stone[3] have proposed that female larynx may be more susceptible in their menstrual period due to the hormonal effects. Chernobelsky[10] has reported that vocally abusive singers who used their voice around menses constituted a high-risk group for the development of vocal cord nodules.

The VHI-10 scores did not show any significant difference in either group. Several studies have shown significant decrease in VHI-10 scores after voice therapy.[18,19] In our study, although there was a decrease in VHI-10 scores in both groups after the therapy, this improvement was not statistically significant. This can be due to the patient incompliance in voice therapy.

Maximum phonation time, which was used for aerodynamic evaluation, showed a significant difference in the study group. This result was similar to the previous studies.[7,18] As the muscle tone and the size of the vocal cord nodule decrease with voice therapy, glottal closure improves and the MPT increases.

There was no significant difference in the remaining parameters including s/z ratio, Fo, SPL, or MFR. The main limitation of our study was the small sample size, requiring further studies with larger sample sizes. Moreover, we did not include any male patients; however, vocal cord nodules are usually seen in females. Strengths of our study are the prospective randomized design and use of standardized voice therapy techniques.

In conclusion, the majority of the vocal cord nodules did not disappear with voice therapy while they decreased in size. We observed an increment only in the MPT.

Declaration of conflicting interests

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