Assessment of Resonant Voice Therapy in the Treatment of Vocal Fold Nodules

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Summary: Objective. This study aimed to evaluate objective and subjective changes in the voices of adults with vocal fold nodules who received resonant voice therapy.

Methods. Twenty-six female patients who had bilateral vocal fold nodules and 30 healthy women were included in the study. Patients were treated with vocal hygiene education and resonant voice therapy. Voice records were obtained for acoustic and aerodynamic analysis. Fundamental frequency, jitter, shimmer, and noise-to-harmonic ratio were analyzed for acoustic analysis. Maximum phonation time was used for aerodynamic evaluation. Voice Handicap Index 10 was completed by patients for subjective assessment. After 8 weeks of therapy analyses were repeated.

Results. Stroboscopic analysis revealed that 14 patients had total and 9 had partial regression. Fundamental frequency increased from 152.27 ± 28.34 to 199.56 ± 11.25 in study group and this was statistically significant. Jitter, shimmer, and noise-to-harmonic ratio improvements were also significant. Voice Handicap Index scores decreased from 22.25 ± 3.82 to 8.92 ± 5.48 and this was statistically significant.

Conclusion. Our finding that resonant voice therapy improved objective and subjective parameters of vocal function in patients with vocal fold nodules indicates that it is an effective treatment for VFNs and should be considered a therapeutic option.

Key Words: Resonant voice therapy−Nodule−Vocal fold−Acoustic analysis−Voice Handicap Index.

INTRODUCTION

Vocal fold nodules (VFNs) result from cumulative perpendicular stress on the free edges of the vocal fold and most often occur in individuals with an occupation that requires excessive use of the voice.[1] The nodules are generally symmetrical and located on the free edges of the junction between the anterior and middle third of the vocal fold. Histologically, the nodules are characterized by stromal edema with dilated vasculature and fibroblasts.[2]

As occupations requiring frequent voice use increased worldwide, the incidence of, and financial burden associated with, VFNs have also increased. Lawyers, public speakers, call center employees, politicians, and chaplains are at high risk of VFNs because of overuse or misuse of voice.[3]

The goal of voice therapy is to alter voice production patterns to reduce phonotrauma in daily life. Voice therapy is the first-line treatment for VFNs because it typically resolves voice problems and prevents recurrence in most patients.[4–8] Moreover, voice therapy avoids the serious complications associated with surgery, including permanent damage to the vocal folds. Steroid injections and surgical removal of the lesions are alternative treatment options; however, the recurrence and complication rates associated with these interventions are higher than those of voice therapy. Moreover, Holmberg et al[9] reported that although voice therapy improved voice quality, complete restoration was not achieved in all patients.

Resonant voice therapy (RVT) is a holistic approach first described by Lessac and Madsen[10] and later improved and standardized by Verdolini et al.[11] RVT can be used to treat both hypofunctional and hyperfunctional disorders related to VFNs[12,13] and is usually combined with vocal hygiene education.[14] Because previous investigations have not identified an optimal treatment for VFNs,[15–18] no standardized voice therapy has been established. We evaluated objective and subjective changes in the voices of adults with VFNs who received vocal hygiene education and RVT.

MATERIALS AND METHODS

Our study was approved by the Institutional Review Board and Ethics Committee of Okmeydanı Training and Research Hospital. The study included 26 adult female patients with VFNs, who received RVT between January and December 2017, and 30 healthy female adults. All of the subjects signed informed consent forms before participating in the study.

All of the participants underwent a complete otorhinolaryngological examination. Vocal folds were assessed by laryngostroboscopy using a rigid 70° telescope. Patients with vocal fold pathologies other than nodules, a history of previous vocal tract surgery (including adenotonsillectomy), obstructive nasal and adenotonsillar pathology, asthma, or who had previously received voice therapy were excluded from the study. The patients in the study group reported experiencing vocal symptoms between 3 months and 1 year. All patients had bilateral nodules located at the junction of the anterior and middle third of the vocal fold. Nodules were classified as minimal lesions, while irregularities at the junction of the vocal folds were

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considered immature nodules. Finally, hyperemic and edematous lesions and mature nodules were classified as fibrotic in appearance.[19] The treatment outcomes were classified as complete regression of the nodule, partial regression, no change, or enlarged nodules. These classifications were made by blinded review.

All vocal folds in the control group were healthy. All suitable patients who attended our Phoniatrics Clinic and agreed to participate were enrolled in the study. Of the 43 patients enrolled, 26 completed the study.

RVT was performed by Dr. Z.S. in the manner described by Bengisu and Koçak.[7] First, patients were taught relaxation exercises for the shoulder, neck, mouth, floor of the mouth, lips, tongue, and pharynx, and then received instruction regarding abdominal/diaphragmatic breathing. Following this step, the participants were instructed to repeat a "'ma ma ma'" sound to experience the sensation of vibration in the nose, paranasal sinuses, and face. Initially, the exercises were performed at one tone, which was then changed to produce a flexible sound. In the third step, patients used "'ma ma ma'" as they spoke. Finally, the participants were asked to produce words and sentences beginning with the letter "m." This exercise was performed melodically initially.[7] Following this step, patients were asked to produce sentences beginning with other letters melodically. At last step, they began to use this technique in conversation.

Patients were assessed before therapy and at 6 and 8 weeks after therapy. Patients were seen at the clinic once a week and were instructed to repeat the exercises at least five times a day at home. All of the participants were assessed via acoustic voice analysis and the Turkish version of the Voice Handicap Index-10 (VHI-10). The control group was assessed at the beginning of the study and at week 8.

Voice data were recorded using an AKG D5 dynamic microphone (AKG, Vienna, Austria) positioned 15 cm from the participants' lips. After taking a deep breath, the participants were prompted to say "'a'" as long as they could. *Praat* software (version 4.4.13, Institute of Phonetic Sciences, University of Amsterdam, Amsterdam, The Netherlands) was used to perform the acoustic analysis, which objectively assessed fundamental frequency (F0), jitter, shimmer, and noise-to-harmonic ratio. The aerodynamic analysis included maximum phonation time. The Turkish version of the VHI-10, validated by Kılıç et al,[20] was used for subjective analysis of voice dysfunction.

An intergroup analysis was used to compare repeated measurements between the study group and control group. In addition, the study group's results obtained at the beginning and end of the study were compared. *SPSS* software (version 22.0, IBM Corp., Istanbul, Turkey) was used to perform the statistical tests. Student *t* tests were used to compare independent groups, and paired *t* tests were used to detect intragroup differences in repeated measurements.

RESULTS

The mean age was not significantly different between the study group (32 ± 7.24 years) and the control group (29.86 ± 6.23 years) ($P = 0.469$). Of the patients, 10 had grade 1, 11 had grade 2, and 5 had grade 3 nodules at the beginning of the study. Blinded examination of the patients revealed that 14 patients had total regression, 9 patients had partial regression, and 3 patients had no regression. Two patients who had grade 3 and one patient who had grade 2 nodules at the beginning of the study had no improvements.

All of the baseline acoustic and aerodynamic parameters were significantly different between the study and control groups (Table 1). Table 2 illustrates acoustic and aerodynamic parameters at the beginning and end of the therapy in the study group. All of the parameters showed significant improvements. None of the acoustic and aerodynamic parameters had significant difference at the end of the study between the two groups (Table 3).

Within the control group, no significant difference was found between the pre- and post-therapy values for F0

TABLE 1.
Results of Acoustic and Aerodynamic Analysis at the Beginning of the Study

	Study Group (n = 26)	Control Group (n = 30)	*P* Values
F0	152.27 ± 28.34	199.56 ± 11.25	0.0001
Jitter	0.50 ± 0.06	0.20 ± 0.59	0.0001
Shimmer	11.163 ± 1.16	3.44 ± 0.9	0.0001
NHR	0.71 ± 0.07	0.19 ± 0.05	0.0001
MPT	11.33 ± 2.06	17.47 ± 3.07	0.0001

Abbreviations: F0, fundamental frequency; MPT, maximum phonation time; NHR, noise-to-harmonic ratio.

TABLE 2.
Results of Acoustic and Aerodynamic Analysis in Study Group Before and After Therapy

	Before therapy (n = 26)	After Therapy (n = 26)	*P* Values
F0	152.27 ± 28.34	201.41 ± 17.42	0.0001
Jitter	0.50 ± 0.06	0.22 ± 0.09	0.0001
Shimmer	11.163 ± 1.16	3.55 ± 2.90	0.0001
NHR	0.71 ± 0.07	0.26 ± 0.20	0.0001
MPT	11.33 ± 2.06	18.00 ± 2.94	0.0001

Abbreviations: F0, fundamental frequency; MPT, maximum phonation time.

TABLE 3.
Results of Acoustic and Aerodynamic Analysis at the End of the Study

	Study Group (n = 26)	Control Group (n = 30)	*P* Values
F0	201.41 ± 17.42	200.53 ± 9.72	0.868
Jitter	0.22 ± 0.09	0.19 ± 0.07	0.547
Shimmer	3.55 ± 2.90	3.48 ± 0.76	0.381
NHR	0.26 ± 0.20	0.19 ± 0.07	0.197
MPT	18.00 ± 2.94	18.21 ± 3.07	1

Abbreviations: F0, fundamental frequency; MPT, maximum phonation time.

($P = 0.473$), jitter ($P = 0.713$), shimmer ($P = 0.819$), or maximum phonation time ($P = 0.149$).

The pre- and post-therapy VHI-10 scores were 22.25 ± 3.82 and 8.92 ± 5.48, respectively, in the study group ($P = 0.001$) and 4.07 ± 2.22 and 3.93 ± 1.75, respectively, in the control group ($P = 0.783$). The pre- and post-therapy VHI-10 scores were significantly different between the study and control groups ($P = 0.001$ and $P = 0.004$, respectively).

DISCUSSION

Although voice therapy is generally considered the first-line treatment for VFNs, with microsurgery being reserved for refractory cases,[4] the most effective treatment approaches and therapy durations have not been established.[21–24] The various treatment options include vocal hygiene education, behavior modification, psychological support, and reduction in phonotraumatic behaviors.[25]

To the best of our knowledge, our study is the first to assess the efficacy of RVT for VFNs in an adult population. The stroboscopic analysis revealed complete regression of the VFNs in 14 patients, partial regression in 9 patients, and no regression in 3 patients. Following RVT, the acoustic and aerodynamic parameters improved significantly in the study group. Although the VHI-10 scores of the study group showed significant improvement after treatment, they remained significantly higher than those of the control group, suggesting that the patients continued to experience difficulties with vocal function. Our finding that voice therapy improved vocal function in patients with VFNs is consistent with Holmberg et al.[9] Additionally, Holmberg et al[9] reported improvement in perceptual parameters of vocal function. We did not assess changes in perceptual parameters in our study. Holmberg et al[9] compared the effects of vocal hygiene education, respiration, direct facilitation, and carryover therapy and found that all of these approaches improved F0. Niebudek-Bogusz et al[21] compared the efficacy of vocal hygiene education alone and vocal hygiene in combination with voice therapy in female teachers with and without VFNs according to the results of acoustic analysis, videolaryngostroboscopy, and the VHI-10. They found that participants improved under both treatment regimens; however, the vocal hygiene and voice therapy group showed greater improvement than the vocal hygiene alone group. Similar to Niebudek-Bogusz et al,[21] we found that voice therapy improved the noise-to-harmonic ratio. Radish Kumar et al[26] found that the harmonic amplitudes were significantly different between patients with VFNs and control subjects. In a 2003 review of the literature, Johns concluded that behavioral and surgical therapy improved vocal disability.[27]

Patient compliance is a common problem in voice therapy.[6] Therapy requires several visits to the therapist and performance of daily exercises at home. Because many patients are voice professionals, reducing phonotrauma and visiting a therapist regularly may be problematic. In total, 17 participants dropped out of our study or were excluded because they did not attend therapy sessions regularly. Thus, 26 patients were included in the final analysis.

Strengths of our study included the linear design and use of standardized voice therapy techniques. Similar to previous studies such as Holmberg et al[9] and Fu et al,[4] we restricted our study to female participants because VFNs are more prevalent among female versus male adults. The main limitations of our study were the small sample size and nonuse of stroboscopic evaluation report form for stroboscopic evaluation.

CONCLUSION

Our finding that RVT improved objective and subjective parameters of vocal function in patients with VFNs indicates that RVT is an effective treatment for VFNs and should be considered a therapeutic option.

REFERENCES

1. Altman KW. Vocal fold masses. *Otolaryngol Clin North Am*. 2007;40:1091–1108.
2. Wallis L, Jackson-Menaldi C, Holland W, et al. Vocal fold nodule vs. vocal fold polyp: answer from surgical pathologist and voice pathologist point of view. *J Voice*. 2004;18:125–129.
3. Sliwinska-Kowalska M, Niebudek-Bogusz E, Fiszer M, et al. The prevalence and risk factors for occupational voice disorders in teachers. *Folia Phoniatr Logop*. 2006;85:85–101.
4. Fu S, Theodoros DG, Ward EC. Delivery of intensive voice therapy for vocal fold nodules via telepractice: a pilot feasibility and efficacy study. *J Voice*. 2015:696–706.
5. Holmberg EB, Doyle P, Perkell JS, et al. Aerodynamic and acoustic voice measurements of patients with vocal nodules: variation in baseline and changes across voice therapy. *J Voice*. 2003;17:262–282.
6. Verdolini-Marston K, Burke MK, Lessac A, et al. Preliminary study of two methods of treatment for laryngeal nodules. *J Voice*. 1995;9:74–85.
7. Bengisu S, Koçak İ. Rezonan Ses Terapisi Yöntemi. *Turkiye Klinikleri J E.N.T.*. 2013;6:22–26.
8. Behlau M, Pontes P, Vieira VP, et al. Presentation of the Comprehensive Vocal Rehabilitation Program for the treatment of behavioral dysphonia. *Codas*. 2013;25:492–496.
9. Holmberg EB, Hillman RE, Hammarberg B, et al. Efficacy of a behaviorally based voice therapy protocol for vocal nodules. *J Voice*. 2001;15:395–412.
10. Verdolini Abbott K. *Lessac-Madsen Resonant Voice Therapy Clinician Manual*. Oxfordshire, UK: Plural Publishing, Inc.; 2008.
11. Verdolini K, Druker DG, Palmer PM, et al. Laryngeal adduction in resonant voice. *J Voice*. 1998;12:315–327.
12. Desjardins M, Halstead L, Cooke M, et al. A systematic review of voice therapy: what "effectiveness" really implies. *J Voice*. 2017;31:392.e13–392.e32.
13. De Bodt MS, Wuyts FL, Van de Heyning PH, et al. Test−retest study of the GRBAS scale: influence of experience and professional background on perceptual rating of voice quality. *J Voice*. 1997;11:74–80.
14. Özkan ET, Tüzüner A, Demirhan E, et al. Reliability and validity of Turkish Pediatric Voice Handicap Index. *Int J Pediatr Otorhinolaryngol*. 2015;79:680–684.
15. Chen FC, Ma EPM, Yiu EML. Facial bone vibration in resonant voice production. *J Voice*. 2014;28:596–602.
16. Chen SH, Hsiao TY, Hsiao LC, et al. Outcome of resonant voice therapy for female teachers with voice disorders: perceptual, physiological, acoustic, aerodynamic, and functional measurements. *J Voice*. 2007;21:415–425.
17. Roy N. Assessment and treatment of musculoskeletal tension in hyperfunctional voice disorders. *Int J Speech Lang Pathol*. 2008;10:195–209.
18. Verdolini-Marston K, Burke MK, Lessac A, et al. Preliminary study of two methods of treatment for laryngeal nodules. *J Voice*. 1995;9:74–85.

19. Sıgnorelli ME, Madıll CJ, McCabe P. The management of vocal fold nodules in children: a national survey of speech-language pathologists. *Int J Speech Lang Pathol*. 2011;13:227–238.
20. Kılıç MA, Okur E, Yıldırım I, et al. Reliability and validity of the Turkish version of the Voice Handicap Index. *Kulak Burun Bogaz Ihtis Derg*. 2008;18:139–147.
21. Niebudek-Bogusz E, Kotylo P, Politanski P, et al. Acoustic analysis with vocal loading test in occupational voice disorders: outcomes before and after voice therapy. *Int J Occup Med Environ Health*. 2008;21:301–308.
22. McCrory E., Voice therapy outcomes in vocal fold nodules: a retrospective audıt. Speech and Language Therapy Department Royal Group of Hospitals Belfast. Session 1.3. 2001.
23. Lancer JM, Syder D, Jones AS, et al. The outcome of different management patterns for vocal cord nodules. *J Laryngol Otol*. 1988;102:423–427.
24. Fairbanks G. *Voice and Articulation Drill Book*. New York: Harper and Row; 1960.
25. Pedersen M, McGlashan J. Surgical versus non-surgical interventions for vocal cord nodules. *Cochrane Database Syst Rev*. 2012(6):Art. No.: CD001934. https://doi.org/10.1002/14651858.CD001934.pub2.
26. Radish Kumar B, Bhat JS, Mukhi P. Vowel harmonic amplitude differences in persons with vocal nodules. *J Voice*. 2011;25:559–561.
27. Johns MM. Update on the etiology, diagnosis, and treatment of vocal fold nodules, polyps, and cysts. *Curr Opin Otolaryngol Head Neck Surg*. 2003;11:456–461.