ISSN 2470-4059

OTOLARYNGOLOGY
Open Journal

Openventio
PUBLISHERS

*Original Research*

# Evaluation of the Effects of Resonance Voice Therapy in Children with Vocal Fold Nodules

**Ziya Saltürk, MD*; Erdi Özdemir, MD; Tolgar Lütfi Kumral, MD; Güler Berkiten, MD; Belgin Tutar, MD; Yavuz Atar, MD; Huseyin Sari, MD; Yavuz Uyar, MD**

*ENT Clinic, Okmeydanı Training and Reseacrh Hospital, Darulaceze cadde, Şişli, Istanbul, Turkey*

***Corresponding author***
**Ziya Saltürk, MD**
ENT Specialist, Okmeydanı Training and Reseacrh Hospital, Darulaceze cadde, Şişli, Istanbul, Turkey; Tel. 090 212 314 55 55; Fax. 090 221 78 00;
E-mail: ziyasalturk@gmail.com

***Article information***
**Received:** March 13th, 2019; **Revised:** March 27th, 2019; **Accepted:** April 1st, 2019; **Published:** April 15th, 2019

***Cite this article***
Salturk Z, Ozdemir E, Kumral TL, et al. Evaluation of the effects of resonance voice therapy in children with vocal fold nodules. *Otolaryngol Open J*. 2019; 5(1): 13-17. doi: 10.17140/OTLOJ-5-153

## ABSTRACT

**Purpose**
We evaluated objective, auditive perceptual and subjective changes in the voices of children who underwent resonance voice therapy to treat vocal fold nodules.

**Methods**
We included 30 children with vocal fold nodules. All were evaluated prior to therapy and 6 and 8 weeks after therapy commenced *via* acoustic voice analysis, the grade, roughness, breathiness, asthenia, strain (GRBAS) scale, and the Turkish version of the pediatric voice handicap index. Fundamental frequency, jitter, and shimmer were recorded. The results were compared.

**Results**
The overall success rate was 86%. All data acquired before therapy differed significantly from those obtained after therapy.

**Conclusion**
Resonance voice therapy is effective for children with vocal fold nodules.

**Keywords**
Children; Vocal fold nodule; Voice therapy; Resonance; Voice analysis; Larynx.

## INTRODUCTION

Vocal fold nodules (VFNs) are the most common benign laryngeal pathology and the most frequent cause of chronic voice problems in children.[1-4] The most common cause of VFNs is chronic phonotrauma.[5-7] Gastroesophageal reflux is among the possible etiologies,[8-10] but physiological problems, psychological factors, and issues related to excessive use, such as a large family, crowded classrooms, a noisy environment, and personal traits, such as a talkative personality, are contributing factors.[5,6,11,12] VFNs are estimated to occur in 17%-30% of children and are more common in boys,[3,4,13] but they usually disappear in both sexes at puberty.[4,14]

Voice is affected by supraglottic structures after voice production in the larynx. The supraglottic structures are resonator organs that add various formants and the final characteristics to the voice.[15] Nasal obstruction forces the voice to use the oral route, rendering the voice hyponasal. Enlarged nasal cavities cause air leakage, triggering hypernasal voice.[11]

Voice is an important aspect of personality; voice disorders may influence personal development during childhood. Adaptation to social life and schooling can be problematic, triggering personality problems such as poor confidence and social phobia.[16]

The management options for VFNs in children include follow-up with no treatment, voice therapy, surgery, medication aimed at treating gastroesophageal reflux, and a combination of approaches.[5,17] However, VFNs in children should be managed conservatively.[18] The aim of voice therapy is to change voice production and usage habits, thus obtaining a change in vocal use in daily life. In most patients, this will resolve the voice problems and

prevent recurrences.[19,20] Resonance voice therapy (RVT) is a holistic approach first described by Lessac and Madsen and then improved and formulated by Verdolini.[21] It can be used to treat both hypofunctional and hyperfunctional problems related to VFNs,[21,22] usually combined with efforts to improve vocal hygiene.[23] Previous studies on the effectiveness of voice therapy have not recommended any specific therapeutic method.[24] Therefore, no standardized therapy and therapy duration are available. In addition, our observations showed that vocal improvement occured before the end of therapy and usually at about 5th to 6th weeks. This study evaluated the objective and subjective changes in the voices of children who received vocal hygiene training and RVT for VFNs.

## MATERIALS AND METHODS

Institutional Review Board approval for this study was obtained from the Okmeydanı Training and Research Hospital Ethical Committee. Thirty children with bilateral VFN treated with RVT between January and May 2017 were included in the study. The parents of all participants gave written informed consent.

All children underwent a complete otorhinolaryngological examination. Their vocal folds were then evaluated using a rigid 70° telescope laryngostroboscopy (Karl Storz Pulsar II, Tuttingen, Germany) after their oropharynx was anesthesized by 10% lidocaine sprey. Patients with vocal fold pathologies other than nodules, previous vocal tract surgery (including adenotonsillectomy), obstructive nasal and adenotonsillary pathology, laryngopharyngeal reflux, or asthma, or patients, who had previously received voice therapy, were excluded. We included all suitable patients treated in our phoniatrics clinic whose parents agreed with inclusion. In all, 36 patients were diagnosed with VFNs, 4 of whom underwent adenotonsillectomies and were thus excluded; 30 of the remaining 32 were enrolled. The vocal symptoms were between 3 months and 1 year in duration. The nodules were located at the bilateral junctions of the anterior and middle portions of the vocal folds in all patients. Nodules were classified as minimal (irregularity at the junction of the vocal folds), immature (hyperemic and edematous lesions), and mature (fibrotic). Full nodular regression, partial regression, no change, and enlargement were scored during therapy.

RVT was performed as described by Koçak and Bengisu[22] and conducted by Dr. Z.S. Patients were taught to relax the shoulders, neck, mouth, mouth floor, lips, tongue, and pharynx, and to engage in abdominodiaphragmatic breathing. Next, they began to repeat a "mamama" sound to feel vibration in the nose, paranasal sinuses, and face. The initial exercises were monotonal, and the tone was later varied. Next, patients voiced "mamama." Finally, words and sentences commencing with "m" were voiced. Initial exercises were performed melodically. Following this step, they were instructed to read books with the taught technique to adapt speech.[25] Patients attended therapy sessions with their parents, who monitored exercise consistency. Patients' compliance to therapy was checked by parents' feedbacks. Patients were evaluated prior to therapy and 6 and 8 weeks later. Patients were seen weekly and were asked to repeat their exercises at least five times daily. All patients were assessed by acoustic voice analysis, the Turkish version of the pediatric voice handicap index (pVHI), and the grade, roughness, breathiness, asthenia, strain (GRBAS) scale.

Vocal data were recorded using an akustische und kino-geräte gesellschaft m.b.H. (AKG) D5 dynamic microphone (Vienna, Austria) positioned 15 cm from the participant's lips. Following deep inspiration, the participant was prompted to say Turkish vowel "a." Praat software (ver. 4.4.13; Boersma and Weenink, University of Amsterdam, Amsterdam, The Netherlands) was used to conduct the acoustic analysis. Standard Praat scripts were employed. To evaluate the voice objectively, the fundamental frequency (F0), jitter, and shimmer were determined during acoustic voice analysis. The grade, roughness, breathiness, asthenia, strain (GRBAS) scale was used for perceptual analyses.[25] Voice recordings were evaluated twice, in a blinded manner, by an experienced speech pathologist and an experienced singing teacher; the mean scores were calculated. The Turkish version of the pVHI, validated by Ozkan et al[26] was used for subjective analyses.

The data were statistically analyzed using SPSS 22 (IBM, Turkey). A repeated analysis of variance (ANOVA) test for the analysis of repeated measurements, and the Bonferroni test to identify differences in the repeated measurements.

## RESULTS

The mean age of the children in the study group was 8.386-13 years old. There were 19 boys and 11 girls in the study group. Nodules were immature in 11 patients and mature in 19. Parents reported that 21 of the children consistently performed their exercises but 9 did not. Consistency improved over time (Table 1).

**Table 1.** *Nodule Size*

| Nodule size | 0 week | 6th week | 8th week |
|---|---|---|---|
| Minimal | - | 15 | 2 |
| Immature | 11 | 3 | 9 |
| Mature | 19 | 8 | 2 |

Therapy for VFN failed to afford complete resolution (the ultimate aim) in four patients, but their nodules regressed partially. The overall success rate was 86% complete resolution. Table 2 provides the results of acoustic voice analyses.

Use of the GRBAS and the PVHI-10, followed by Bonferroni testing, showed that Fo, jitter, and shimmer differed significantly from prior to therapy to week 6, and also between weeks 6 and 8 ($p<0.001$ and $p<0.001$ respectively, for all three parameters). The GRBAS also revealed significant differences between pre-therapy data and those obtained at week 6 (all three parameters), but not between the week 6 and week 8 data on asthenicity and strain ($p=0.24$ and 0.482, respectively). Grade, roughness, and breathiness scores differed between weeks 6 and 8 ($p<0.001$, $p<0.001$, and $p=0.04$, respectively). The PVHI-10 results differed significantly between baseline and week 6 and between weeks 6 and 8 ($p<0.001$ and $p<0.01$, respectively).

**Table 2.** *A Comparison of Vocal Parameters*

| N=30 | Before Therapy | 6th week | 8th week | p |
|---|---|---|---|---|
| Fo | 234.54±5.34 | 252.62±7.18 | 267.37±7.67 | p<0.001 |
| Jitter | 2.64±0.71 | 0.98±0.38 | 0.54±0.29 | p<0.001 |
| Shirmer | 7.91±1.09 | 4.49±0.81 | 4.04±0.85 | p<0.001 |
| Grade | 2.33±0.71 | 0.97±0.49 | 0.20±0.41 | p<0.001 |
| Roıılmess | 2.37±0.72 | 0.87±0.57 | 0.20±0.48 | p<0.001 |
| Breathiness | 2.20±0.81 | 0.63±0.56 | 0.33±0.48 | p<0.001 |
| Asthenicity | 0.87±0.68 | 0.17±0.38 | 0.07±0.25 | p<0.001 |
| Strain | 0.53±0.51 | 0.13±0.35 | 0.07±0.25 | p<0.001 |
| PVHI-10 | 35.90±11.04 | 8.30±2.62 | 4.77±1.31 | p<0.001 |

*Fo: Fundamental frequency; pVHI-10: Pediatric voice handicap index-10*
*Repeated anova p<0.05 is significant*

## DISCUSSION

There is no standardized treatment of VFNs in children, although they are the most common cause of chronic voice problems. Among the available options, voice therapy is the preferred approach. Surgical treatment without voice therapy is usually not indicated because the recurrence rate is extremely high unless vocal behaviors are modified.[27] Voice therapy was shown to be effective alone, but the optimal therapy technique is not clear.[28] Studies on VFNs in children have used combinations of different voice therapy methods that were not clearly defined.[29-32] The primary aim in both non-surgical and surgical therapeutic approaches is reduction of vocal abuse.[32]

Deal et al[29] published the first study of VFNs in children, which reported regression of the nodules in 84% of the patients, 65% of whom had normal larynges after therapy. The children were evaluated with respect to loudness reduction and the easy initiation and maintenance of phonation. Mori[33] compared the results of voice therapy with other treatment options and found that 52% of patients had some degree of improvement after voice therapy, but the exact technique was not specified. That study emphasized the improvements shown by most prepubertal patients after they entered puberty, but also with surgery in those patients who sought immediate resolution. For school-aged children, waiting until puberty may cause emotional and psychological problems because the voice is an important tool for self-expression and social development.[34] We therefore recommend voice therapy for all of our patients at the time of diagnosis. Niedzielska et al[31] used a combination of pharmacological agents and psychological, physical, and voice therapy methods in a group of patients. In a comparison of the results with those of a similarly treated healthy control group, they found flattening of the vocal nodules on stroboscopy and improvement in the acoustic voice analysis. In our study, we excluded patients with gastroesophageal reflux disease and other problems to avoid bias related to medication, among other factors. Tezcaner et al[32] also used a combination of therapies and noted improvements in acoustic voice analysis and perceptual scores. Valadez et al[27] used acoustical analysis, perceptual assessment, and video nasolaryngoscopy to assess the therapeutic results. They suggested that eliminating forceful phonation through speech therapy using visual support and the Speech-Viewer software was effective for treating VFNs in their initial stages.

All of our patients underwent RVT together with vocal hygiene precautions. RVT consists of several well-formulated steps aimed at changing a patient's vocalization habits. Thus, the therapist guides the patient to feel the resonance of the voice at the palate, lips, nose, and paranasal region. This is achieved by having the patients study phonemes first individually and then by using their resonated voice in sentences. Therapy generally consists of eight episodes held once a week.[22]

We found that the fundamental frequency, jitter, and shimmer improved significantly after therapy. Perturbations in these parameters caused by nodule-induced turbulence while voicing seriously affect voice.[33] All acoustic parameters and the GRBAS scores improved significantly after therapy. Significant improvements in our patients were obtained at the end of 6 weeks. The main problem in therapy is compliance, as children often have difficulties in obeying vocal hygiene instructions and have a tendency to shout and talk in social environments. The cooperation of the family and teacher is therefore an important component of therapeutic success. Home exercises should be performed regularly and previous exercises repeated at every session to monitor the child's progress.

The main limitation of our study was the small number of patients. We do not perform surgery for vocal nodules in children and were therefore unable to compare the results of our therapeutic approach with those obtained surgically. Nonetheless, the main advantage of our study is its subjective evaluation of children with VFN and its collection of data at 6 weeks to evaluate the progress before the end of therapy.

## CONCLUSION

RVT combined with vocal hygiene and respiration exercises is an effective approach in children with VFNs. Patients and parents should be informed about the course of therapy and the importance of compliance. Because VFNs regress gradually, therapy should be completed even though dramatic improvement, determined in perceptual and subjective evaluations, may occur before the conclusion of the full 8-week course.

## FINANCIAL DISCLOSURE

No author has any relevant relationship to disclose

## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

## REFERENCES

1. Gray SD, Smith ME, Schneider H. Voice disorders in children. *Pediatr Clin North Am.* 1996; 43: 1357-1384.

2. Herrington-Hall BL, Lee L, Stemple JC, Niemi KR, McHone MM. Description of laryngeal pathologies by age, sex and occupation in a treatment-seeking sample. *J Speech Hear Disord.* 1988; 53: 57-64. doi: 10.1044/jshd.5301.57

3. Dobres R, Lee L, Stemple JC, Kummer AW, Kretschmer LW. Description of laryngeal pathologies in children evaluated by otolaryngologists. *J Speech Hear Disord.* 1990; 55: 526-532. doi: 10.1044/jshd.5503.526

4. von Leden H. Vocal nodules in children. *Ear Nose Throat J.* 1985; 64: 473-480.

5. Pannbacker M. Treatment of vocal nodules: Options and outcomes. *American Journal of Speech-Language Pathology.* 1999; 8: 209-217. doi: 10.1044/1058-0360.0803.209

6. Roy N, Holt KI, Redmond S, Muntz H. Behavioural characteristics of children with vocal fold nodules. *J Voice.* 2007; 21: 157-168. doi: 10.1016/j.jvoice.2005.11.004

7. Boone DR, McFarlane SC, Von Berg SL. Voice disorders. In: *The Voice and Voice Therapy*. 7th (edn). Pearson, Boston, USA: Allyn & Bacon. 2005. 68-71.

8. Kuhn J, Toohill RJ, Ulualp SO, et al. Pharyngeal acid reflux events in patients with vocal cord nodules. *Laryngoscope.* 1998; 108:1146-1149. doi: 10.1097/00005537-199808000-00008

9. Yellon RF, Goldberg H. Update on gastroesophageal reflux disease in pediatric airway disorders. *Am J Med.* 2001; 3(111 Suppl 8A): 78S-84S. doi: 10.1016/S0002-9343(01)00861-0

10. Putnam PE, Orenstein SR. Hoarseness in a child with gastroesophageal reflux. *Acta Paediatr.* 1992; 81: 635-636. doi: 10.1111/j.1651-2227.1992.tb12319.x

11. Carding PN, Roulstone S, Northstone K, ALSPAC Study Team. The prevalence of childhood dysphonia: A cross-sectional study. *J Voice.* 2006; 20: 623-630. doi: 10.1016/j.jvoice.2005.07.004

12. Green G. Psycho-behavioral characteristics of children with vocal nodules: WPBIC ratings. *J Speech Hear Disord.* 1989; 54: 306-312. doi: 10.1044/jshd.5403.306

13. Akif Kilic M, Okur E, Yildirim I, Guzelsoy S. The prevalence of vocal fold nodules in school age children. *Int J Pediatr Otorhinolaryngol.* 2004; 68: 409-412. doi: 10.1016/j.ijporl.2003.11.005

14. Sataloff RT. Structural Abnormalities of the Larynx. In: Sataloff RT (ed). *Professional Voice, The Science and Art of Clinical Care.* 3rd (edn). Plural Publishing, San Diego, 2005. 1259.

15. Nardone HC, Recko T, Huang L, Nuss RC. A retrospective review of the progression of pediatric vocal fold nodules. *JAMA Otolaryngol Head Neck Surg.* 2014; 140: 233-236. doi: 10.1001/jamaoto.2013.6378

16. Angelillo N, Di Costanzo B, Angelillo M, et al. Epidemiological study on vocal disorders in pediatric age. *J Prev Med Hyg.* 2008; 49: 1-5. doi: 10.15167/2421-4248/jpmh2008.49.1.109

17. Wohl DL. Nonsurgical management of pediatric vocal fold nodules. *Arch Otolaryngol Head Neck Surg.* 2005; 131: 68-70. doi: 10.1001/archotol.131.1.68

18. Colton RH, Casper JK, Leonard R. Voice problems associated with the pediatric and the geriatric voice. In: *Understanding Voice Problems.* 3rd (edn). Philadelphia, USA: Lippincott Williams and Wilkins. 2006; 208-209.

19. Koçak İ, Dursun G, Demireller A. Fonksiyonel disfonilerde larengostroboskopi ile vizüel biofeedback terapisi [In: Turkish]. *Ses ve Ses Bozuklukları.* : 1996; 85-93.

20. Morrison MD, Rammage LA. Muscle misuse voice disorders: Description and classification. *Acta Otolaryngol.* 1993; 113(3): 428-434. doi: 10.3109/00016489309135839

21. Verdolini K, Druker DG, Palmer PM, Samawi H. Laryngeal adduction in resonant voice. *J Voice.* 1998; 12(3): 315-327. doi: 10.1016/S0892-1997(98)80021-0

22. Bengisu S, Koçak İ. Rezonan ses terapisi yöntemi [In: Turkish]. *Turkiye Klinikleri J E.N.T.* 2013; 6(2): 22-26.

23. Behlau M, Pontes P, Vieira VP, Yamasaki R, Madazio G. Presentation of the comprehensive vocal rehabilitation program for the treatment of behavioral dysphonia. *Codas.* 2013; 25(5): 492-496. doi: 10.1590/S2317-17822013000500015

24. Desjardins M, Halstead L, Cooke M, Bonilha HS. A systematic review of voice therapy: What "effectiveness" really implies. *J Voice.* 2017; 31(3): 392.e13-392.e32. doi: 10.1016/j.jvoice.2016.10.002

25. De Bodt MS, Wuyts FL, Van de Heyning PH, Croux C. 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. doi: 10.1016/S0892-1997(97)80026-4

26. Özkan ET, Tüzüner A, Demirhan E, Topbaş S. Reliability and validity of Turkish pediatric voice handicap index. *Int J Pediatr Otorhinolaryngol.* 2015; 79: 680-684. doi: 10.1016/j.ijporl.2015.02.014

27. Valadez V, Ysunza A, Ocharan-Hernandez E, Garrida-Bustamante N, Valeria-Sanchez A. Voice parameters and videonasolaryngoscopy in children with vocal nodules: A longitudinal study, before and after voice therapy International *Journal of Pediatric Otorhinolaryngology.* 2012; 76: 1361-1365. doi: 10.1016/j.ijporl.2012.06.007

28. 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(3): 227-238. doi: 10.3109/17549507.2011.549570

29. Deal RE, McClain B, Sudderth JF. Identification, evaluation, therapy, and follow-up for children with vocal nodules in a public school setting. *J Speech Hear Disord*. 1976; 41: 390-397. doi: 10.1044/jshd.4103.390

30. Mori K. Vocal fold nodules in children: Preferable therapy. *Int J Pediatr Otorhinolaryngol*. 1999; 49 (suppl 1): S303-306. doi: 10.1016/S0165-5876(99)00181-0

31. Niedzielska G, Glijer E, Niedzielski A. Acoustic analysis of voice in children with noduli vocales. *Int J Pediatr Otorhinolaryngol*. 2001; 60: 119-122. doi: 10.1016/S0165-5876(01)00506-7

32. Tezcaner CZ, Karataylı Özgürsoy S, Satı I, Dursun G. Changes after voice therapy in objective and subjective voice measurements of pediatric patients with vocal nodules. *Eur Arch Otorhinolaryngol*. 2009; 266: 1923-1927. doi: 10.1007/s00405-009-1008-6

33. Deroche MLD, Limb CJ, Chatterjee M, Gracco VL. Similar abilities of musicians and nonmusicians to segregate voices by fundamental frequency. *J Acoust Soc Am*. 2017; 142(4): 1739. doi: 10.1121/1.5005496

34. Fuchs M. Landmarks of physiological development of the voice in childhood and adolescense (Part 1). *Laryngorhinootologie*. 2008; 87(1): 10-16. doi: 10.1055/s-2007-995343