

## Original Research

# Resonance Voice Therapy's Effects on Children with Vocal Fold Nodules are Assessed

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## 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.<sup>1-4</sup> The most common cause of VFNs is chronic phonotrauma.<sup>5-7</sup> Gastroesophageal reflux is among the possible etiologies,<sup>8-10</sup> 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.<sup>5,6,11,12</sup> VFNs are estimated to occur in 17%-30% of children and are more common in boys,<sup>3,4,13</sup> but they usually disappear in both sexes at puberty.<sup>4,14</sup>

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.<sup>15</sup> Nasal obstruction forces the voice to use the oral route, rendering the voice hyponasal. Enlarged nasal cavities cause air leakage, triggering hypernasal voice.<sup>11</sup>

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.<sup>16</sup>

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.<sup>5,17</sup> However, VFNs in children should be managed conservatively.<sup>18</sup> 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.<sup>19,20</sup> Resonance voice therapy (RVT) is a holistic approach first described by Lessac and Madsen and then improved and formulated by Verdolini.<sup>21</sup> It can be used to treat both hypofunctional and hyperfunctional problems related to VFNs,<sup>21,22</sup> usually combined with efforts to improve vocal hygiene.<sup>23</sup> Previous studies on the effectiveness of voice therapy have not recommended any specific therapeutic method.<sup>24</sup> Therefore, no standardized therapy and therapy duration are available. In addition, our observations showed that vocal improvement occurred before the end of therapy and usually at about 5<sup>th</sup> to 6<sup>th</sup> 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 anesthetized by 10% lidocaine spray. 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 phoniatics 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<sup>22</sup> 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.<sup>25</sup> 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 ver-

sion 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.<sup>25</sup> 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<sup>26</sup> 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).

Nodule size	0 week	6 <sup>th</sup> week	8 <sup>th</sup> 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	6 <sup>th</sup> week	8 <sup>th</sup> 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
Shimmer	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
RoIIImess	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.<sup>27</sup> Voice therapy was shown to be effective alone, but the optimal therapy technique is not clear.<sup>28</sup> Studies on VFNs in children have used combinations of different voice therapy methods that were not clearly defined.<sup>29-32</sup> The primary aim in both non-surgical and surgical therapeutic approaches is reduction of vocal abuse.<sup>32</sup>

Deal et al<sup>29</sup> 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<sup>33</sup> 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.<sup>34</sup> We therefore recommend voice therapy for all of our patients at the time of diagnosis. Niedzielska et al<sup>31</sup> 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<sup>32</sup> also used a combination of therapies and noted improvements in acoustic voice analysis and perceptual scores. Valadez et al<sup>27</sup> 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.<sup>22</sup>

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.<sup>33</sup> All acoustic parameters and the GR-BAS 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.

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