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Review

Effectiveness of Voice Therapy in Treating Vocal Fold Nodules: A Systematic Review

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Abstract

Despite growing evidence of the benefits of voice therapy, there is a need for further research to establish standardized treatment protocols, evaluate long-term outcomes, and explore psychological factors in patient care. This systematic review aimed to evaluate the effectiveness of various voice therapy interventions and their impact on vocal parameters in the management of vocal fold nodules (VFNs).

The present study followed PRISMA guidelines to evaluate the effectiveness of voice therapy for treating VFNs. Key outcomes measured included voice therapy interventions, Voice Handicap Index (VHI), fundamental frequency (Fo), jitter, shimmer, and other relevant voice-related parameters. A comprehensive search was conducted across PubMed, Cochrane Library, Scopus, and Web of Science databases, with a dual screening process to ensure high-quality selection. Data extraction and quality assessment were carried out independently by two researchers using established tools like the Cochrane Risk of Bias Tool and Newcastle-Ottawa Scale.

The studies reviewed consistently highlight the effectiveness of various voice therapy techniques in treating VFNs. Methods like the ABCLOVE exercise, resonant voice therapy, and DoctorVox therapy have led to significant improvements in both vocal and psychological outcomes. Incorporating psychological evaluations, family-centered approaches, and consistent vocal hygiene practices further boosts the success of voice therapy. Additionally, studies emphasize the long-term benefits of voice therapy, even in cases with remaining nodules, and stress the importance of personalized care plans.

Voice therapy is a key part of VFN treatment, showing significant benefits for both vocal and psychological health. While evidence supports its efficacy, further large-scale, standardized studies are needed to confirm these findings and explore long-term outcomes and psychological factors. Tailoring interventions to individual needs, including psychological support and family involvement, can enhance treatment effectiveness and patient outcomes.

Keywords: *Voice therapy, vocal fold nodules, Voice Handicap Index, fundamental frequency*

Introduction

Vocal fold nodules (VFNs) are noncancerous, bilateral growths of varying sizes that develop in the central portion of the membranous vocal folds. Histologically, they are characterized by an epithelial thickening accompanied by varying levels of inflammatory response in the superficial lamina propria. Patients often seek medical care when they notice symptoms such as "fatigue," a "rough" voice, and a decreased pitch range. Dysphonia presents as a condition involving changes in vocal quality, pitch, and loudness, which hinder communication and negatively impact voice-related quality of life (QoL) (2).

VFNs are most frequently observed in women and constitute the largest patient group in voice clinics. Their prevalence is notably high among individuals in professions that require frequent voice use. Voice quality is affected by various factors, including temperament, stress, and emotional state, which can alter the physiological conditions necessary for phonation (3).

Phonosurgery, pharmacological treatments, and voice therapy are common approaches for managing voice disorders. Specifically, voice therapy and laryngeal microsurgery are often utilized to treat VFNs. Additionally, some studies have explored the use of oral anti-inflammatory corticosteroids to reduce swelling and inflammation in VFN patients. However, surgery carries potential risks, such as complications from general anesthesia and the possibility of scar formation (4, 5).

Surgery is the preferred option for patients requiring immediate voice improvement. For those seeking voice improvement without urgency, voice therapy is recommended. If patients lack motivation, emphasizing vocal hygiene is suggested (6).

Voice therapy is the main treatment approach, though surgery may be required in certain cases. While the surgical procedure is well-established, VFN often have a high recurrence rate, leaving the optimal therapeutic sequence a topic of ongoing debate among experts. Limited data exist on long-term treatment outcomes and recurrence rates. A key concern is the future of young patients who undergo surgery but remain in professions with a high risk of vocal strain (7).

Therapeutic approaches aimed at improving disordered voices can also be effective in enhancing normal voices. A holistic voice therapy approach emphasizes a continuum of voice wellness, ranging from disordered voices to the refined voices of healthy performers. By practicing proper vocal hygiene and engaging in healthy vocal exercises, individuals can actively maintain and improve their vocal wellness. All voices can progress along this continuum toward an ideal state. Techniques that address the three core subsystems of voice production—respiration, phonation, and resonance—are categorized as holistic voice therapies. One such approach, vocal function exercises, has proven effective for both improving voice disorders and enhancing normal vocal performance (8, 9).

Behavioral voice therapy, led by a speech-language pathologist (SLP), is often the primary treatment for voice disorders. When not the main approach, it is frequently recommended alongside medical or surgical treatments. Voice therapy can be classified as either direct, which targets the physiological aspects of the disorder, or indirect, which addresses behaviors and environmental factors contributing to the issue. Recently, Van Stan and colleagues developed a taxonomy of voice therapy, further dividing direct and indirect approaches into specific components. Direct interventions include five categories: auditory, somatosensory, musculoskeletal, respiratory, and vocal function. Indirect interventions encompass pedagogy and counselling. This taxonomy encourages clinicians and researchers to design therapy approaches with a focus on their physiological objectives (10).

This systematic review aimed to evaluate the effectiveness of voice therapy in the treatment of VFN by assessing its impact on vocal quality, nodule resolution, and patient-reported outcomes.

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Materials and methods

The systematic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (11).

Definition of outcomes and inclusion criteria

The inclusion criteria focused on studies examining the effectiveness of voice therapy for treating VFN, published in English within the last 10 years, and involving clinical trials, randomized controlled trials (RCTs), or observational studies. Studies were selected based on key outcomes, including voice therapy interventions, Voice Handicap Index (VHI), fundamental frequency (Fo), jitter, shimmer, other relevant outcomes, and study conclusions. Any discrepancies in study selection were resolved through discussion between two independent reviewers or, if necessary, consultation with a third reviewer.

Search Strategy

A comprehensive search was conducted from 01/12/2024 until 05/12/2024 for systematic review on the effectiveness of voice therapy in treating VFN was conducted using a combination of electronic databases, including PubMed, Cochrane Library, Scopus, and Web of Science. The search strategy employed a combination of keywords and Medical Subject Headings (MeSH) related to the PICO framework. Terms such as "Vocal Fold Nodules," "Vocal Cord Nodules," "Voice Therapy," "Resonant Voice Therapy," "Vocal Function Exercises," and "Treatment Outcomes" were combined using Boolean operators (AND/OR) to capture relevant studies. Filters were applied to include only English-language studies from the last 10 years and focus on specific study types, such as clinical trials, RCTs, and retrospective studies, ensuring relevance to the research question.

Screening and extraction

Articles retrieved through the search strategy underwent a multi-step screening process. First, irrelevant titles or abstracts were excluded during the title and abstract screening phase. Second, the full texts of potentially relevant articles were reviewed to determine their compliance with inclusion criteria. Titles and abstracts were organized and scrutinized for duplicates using reference management software (Endnote X8) (12). A dual screening approach was employed, with one reviewer screening titles and abstracts and another conducting comprehensive examinations of full texts. Disagreements were resolved through discussion.

The data extraction process was carried out by two authors independently. Any disagreement was resolved with a third author. Data was collected with the spreadsheet software Microsoft Excel. Extracted information included study characteristics, participant details, intervention specifics, outcome measures, and funding sources.

Quality Assessment

The quality of the included studies was evaluated using established assessment tools. The Cochrane Risk of Bias Tool was employed for RCTs (13), while the Newcastle-Ottawa Scale (NOS) was used for observational studies (14). The assessment focused on methodological aspects such as study design, sample size, data collection methods, and risk of bias.

Data synthesis

The data of the outcomes in the included studies was quantitatively presented based on different parameters investigating the effects of voice therapy in the management of VFNs.

Results

Search Results

The search strategy yielded 282 citations, which were then reduced to 187 following the removal of duplicates. Only 45 citations were found to be eligible for additional consideration after titles and abstracts were screened. After full-text screening, the selection was narrowed to 11 articles (15-25), published between 2014 and 2024, that met the inclusion and exclusion criteria **(Figure 1).**

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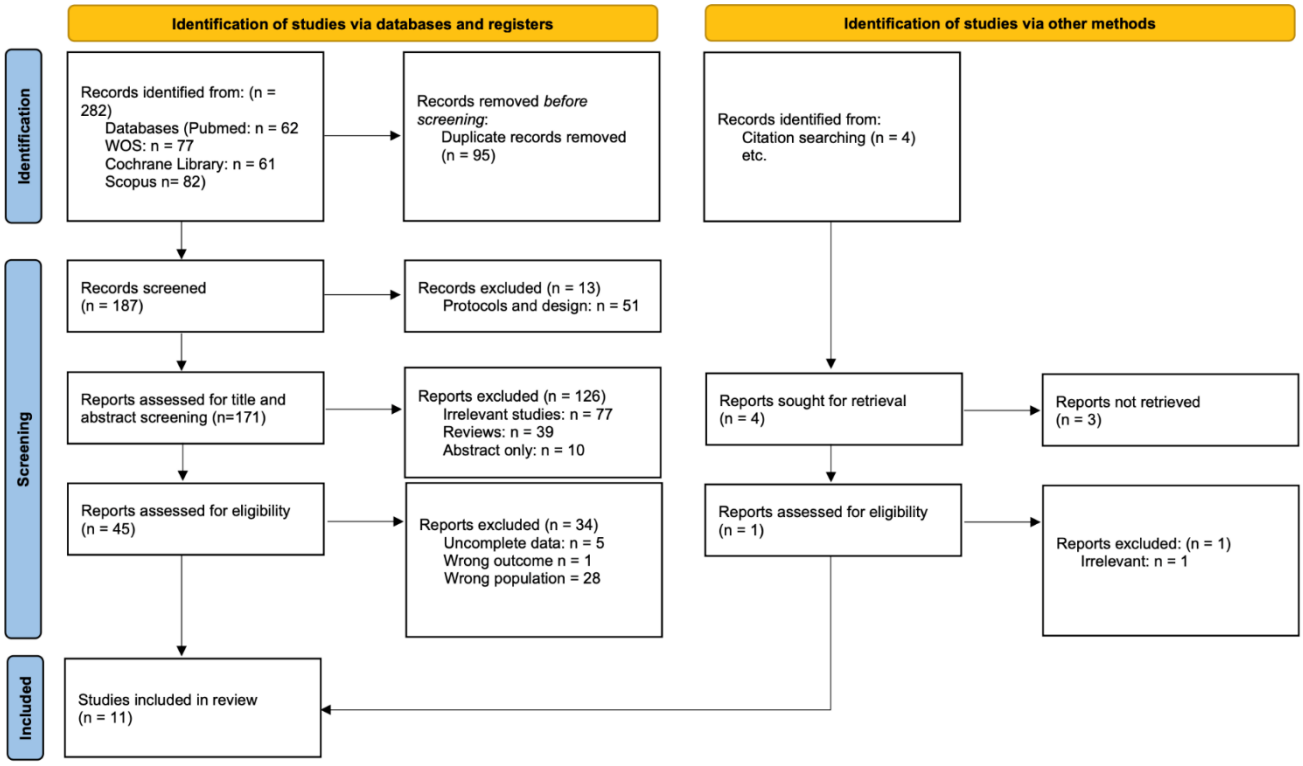

Figure 1: PRISMA Flow Chart

Results of Quality Assessment

The NOS was used to assess the quality of non-randomized studies, assigning stars for selection, comparability, and exposure/outcome. Among the studies, Jo et al., 2019 (19), achieved the highest overall star rating with nine stars due to strong performance in selection, comparability, and exposure. Denizoğlu et al., 2023 (17) followed with seven stars, while other studies like Bian et al., 2024 (15), and Çobanoglu et al., 2021 (16) scored moderately with five and six stars, respectively. Some studies, including Halawa et al., 2014 (18), and Yilmaz et al., 2021 (21), received lower ratings of four stars due to limited comparability or exposure assessment **(Table 1).**

Table 1: New Castle Ottawa scale for non-randomized studies

Studies	Selection	Comparability	Exposure/Outcome	Overall star rating
Bian et al., 2024 (15)	***	*	*	5
Çobanoglu et al., 2021 (16)	***	**	*	6
Denizoğlu et al., 2023 (17)	***	*	***	7
Halawa et al., 2014 (18)	***	-	*	4
Jo et al., 2019 (19)	****	**	***	9
Saltürk et al., 2018 (20)	***	-	**	5
Yilmaz et al., 2021 (21)	***	-	*	4
Bakat et al., 2014 (22)	***	-	***	6
Nupur et al., 2024 (23)	**	-	**	4
Fu et al., 2016 (24)	***	-	**	5

The star symbol (*) in the table represents the scores for each domain, with a greater number of stars indicating higher methodological quality in selection, comparability, and outcome/exposure domains.

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For RCTs, the Cochrane risk of bias assessment evaluated Hartnick et al., 2018 (25), across several domains. The study demonstrated a low risk of bias in random sequence generation, allocation concealment, blinding, incomplete outcome data, and selective reporting. However, a high risk of other bias was identified, indicating an area requiring further attention to ensure robust results **(Table 2).**

Table 2: Cochrane risk of bias assessment for randomized trials

Study	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias
Hartnick et al., 2018 (25)	Low	Low	Low	Low	Low	Low	High

Characteristics of the included studies

Various studies have explored treatments for VFN using different methodologies, including observational, cohort, prospective, and RCTs. These studies examined interventions such as voice therapy, resonant voice therapy, ABCLOVE exercise and intensive voice therapy, often comparing them to no treatment or alternative therapies. Participants ranged in age from children to adults over 40, with gender distributions varying across the research. The findings reflect a broad effort to assess and enhance therapeutic approaches for managing VFN across diverse populations and clinical settings **(Table 3).**

Table 3: The demographic characteristics of included studies

Studies	Study design	Intervention group	Control group	Number of participants (Cases/controls)	Age of cases (Mean)	Age of control (Mean)	Gender of cases Female/Male %	Gender of control Female/Male %
Bian et al., 2024 (15)	Observational study	ABCLOVE exercise to VFN patients	No treatment and without VFN	43/41	9.8 (1.9)	9.3 (2.1)	27.9/72.1	34.9/65.1
Çobanoglu et al., 2021 (16)	Observational study	Voice therapy session to VFN patients	No treatment and without VFN	23/23	41.39 (7.86)	38.69 (8.16)	52.17/47.83	52.17/47.83
Denizoğlu et al., 2023 (17)	Observational study	DoctorVox to VFN patients	No treatment and without VFN	38/40	29.8 (5.3)	28.3 (2.6)	100/0	100/0
Halawa et al., 2014 (18)	Cohort study	Vocal logopedic treatment with VFN	-	97/-	33 (14-63)	-	96.9/3.1	-
Jo et al., 2019 (19)	Cohort study	Voice therapy to VFN patients	-	25/-	39.2 (14)	-	96/4	-
Saltürk et al., 2018 (20)	Observational study	Resonant voice therapy to VFN patients	No treatment and without VFN	26/30	32 (7.24)	29.86 (6.23)	100/0	100/0
Yilmaz et al., 2021 (21)	Observational study	Voice therapy to children with VFN and mothers	Voice therapy to children with VFN	17/16	8 - 12	8 - 12	-	-
Bakat et al., 2014 (22)	Prospective study	Voice therapy to VFN patients	-	18/-	31.56	-	77.78/22.22	-
Nupur et al., 2024 (23)	Cohort study	Voice therapy to VFN patients	-	30/-	41 (8.78)	-	56.7/43.3	-
Fu et al., 2016 (24)	Observational study	Intensive voice therapy to VFN patients	Traditional voice therapy to VFN patients	16/20	38.5	36.4	-	-
Hartnick et al., 2018 (25)	RCT	Direct voice therapy to VFN patients	Indirect voice therapy to VFN patients	56/56	24 (42.9)	24.42 (9)	26.7/73.2	25/75

VFN: Vocal Fold Nodules

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Study outcome measures

A comprehensive review of studies on the efficacy of voice therapy for VFNs highlights various approaches and their outcomes. Bian et al. (2024) (15) investigated the ABCLOVE exercise and found it significantly improved recovery rates (79.1%) compared to the control group (55.8%). Additionally, the therapy was less likely to yield ineffective outcomes (4.6% vs. 20.9%), emphasizing its effectiveness for children with vocal nodules post-budesonide treatment. Çobanoglu et al. (2021) (16) demonstrated improvements in the VHI and psychological parameters such as the Brief Symptom Inventory (BSI) and Beck Anxiety Inventory (BAI), suggesting the importance of psychological evaluations for VFN patients. Denizoğlu et al. (2023) (17) validated the efficacy of DoctorVox therapy through improvements in vocal parameters, including jitter, shimmer, and noise-to-harmonic ratio (NHR), alongside enhanced perceptual and acoustic measures.

Halawa et al. (2014) (18) identified acoustic voice analysis as a valuable diagnostic tool, though pre-treatment parameters did not consistently reflect clinical progression. Jo et al. (2019) (19) reported significant long-term benefits of voice therapy, with perceptual scores and acoustic parameters improving regardless of the presence of remnant nodules. Saltürk et al. (2018) (20) highlighted resonant voice therapy's effectiveness, with significant improvements in maximum phonation time (MPT), fundamental frequency (F0), and NHR, establishing it as a reliable treatment option. Yilmaz et al. (2021) (21) emphasized the role of parental involvement in therapy, with children showing better compliance and motivation when mothers participated, underscoring the value of family-centered interventions.

Bakat et al. (2014) (22) observed significant nodule resolution (83.33%) after six weeks of therapy, with surgical intervention required only for patients with hard nodules. Similarly, Nupur et al. (2024) (23) noted that 96.3% of participants showed improvement with consistent therapy and proper vocal hygiene. Fu et al. (2016) (24) compared intensive voice therapy and traditional voice therapy (TVT), finding both approaches effective, with intensive voice therapy yielding slightly better results in some acoustic parameters **(Table 4).** The studies collectively underscore the efficacy of various voice therapy techniques for VFNs, with many showing significant improvements in vocal and psychological parameters. Tailored interventions, such as the inclusion of family support or psychological evaluations, can enhance outcomes. Voice therapy remains a cornerstone of VFN treatment, offering substantial benefits, especially when coupled with consistent practice and individualized care strategies.

Table 4: The outcomes of included studies

Study	Voice therapy	VHI	Fo	Jitter	Shimmer	Other outcomes	Conclusion
Bian et al., 2024 (15)	ABCLOVE exercise	-	-	-	-	Recovery Rates: Control: 24 (55.8%), ABCLOVE: 34 (79.1%) (p=0.035) Effectual Outcomes: Control: 10 (23.3%), ABCLOVE: 7 (16.3%) Ineffective Outcomes: Control: 9 (20.9%), ABCLOVE: 2 (4.6%)	ABCLOVE therapy proved effective for school-aged children with vocal nodules following treatment with budesonide.
Çobanoglu et al., 2021 (16)	Voice therapy session	Pre-therapy: 17.26 ± 4.8 Post-therapy: 10.70 ± 2.5 (p < 0.001)	-	-	-	BAI: Control Group: 9.87 ± 5.04 Nodule Group Pre-therapy: 16.26 ± 7.00 Nodule Group Post-therapy: 10.87 ± 5.32 BSI: Control Group: 45.57 ± 6.90 Nodule Group Pre-therapy: 58.57 ± 12.40 Nodule Group Post-therapy: 50.9 ± 10.7	Patients with vocal fold nodules should undergo thorough evaluation using psychological assessment tools like the BSI, with psychiatric consultations recommended for any abnormal findings.

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Denizoğlu et al., 2023 (17)	DoctorVox	Pre: 19.52 (7.44) Post: 5.18 (2.69) Control: 0.73 (0.61)	Pre: 201.9 (31.8) Post: 232 (28.7) Control: 234.7 (23.1)	Pre: 1.46 (0.24) Post: 0.85 (0.43) Control: 0.61 (0.27)	Pre: 3.27 (1.01) Post: 2.51 (1.14) Control: 2.19 (0.48)	Significant Improvements (Pre- vs. Post-Treatment): GRB G-value: 2.3 → 0.68 VLS Scores: Decreased SPL: 54.4 dB → 66.1 dB NHR: 1.15 → 0.46	The DVT was found to be an effective method in VFN treatment.
Halawa et al., 2014 (18)	vocal logopedic treatment	-	Mean difference, CI 95%: 1.77 (-2.42, 5.97)	0.14 (0.08, 0.2)	1.17 (0.85, 1.48)	NNE: 0.51 (-0.24, 1.25) SDFo: 0.44 (0.17, 0.71)	Acoustic voice analysis can serve as a valuable complementary tool in diagnosing vocal nodules; however, the pre-treatment parameter values did not align with the clinical progression.
Jo et al., 2019 (19)	-	Changes Before and After Therapy (Nonremnant vs. Remnant): 40.86 ± 32.31 vs. 22.17 ± 16.53 (p = 0.187)	-	Changes Before and After Therapy (Nonremnant vs. Remnant): 2.13 ± 2.71 vs. 0.32 ± 0.91 (p = 0.130)	Changes Before and After Therapy (Nonremnant vs. Remnant): 1.96 ± 3.62 vs. 0.44 ± 1.37 (p = 0.135)	Changes Before and After Therapy (Nonremnant vs. Remnant): GRBAS G score change: 1.43 ± 1.13 vs. 1.28 ± 0.89 (p = 0.728) NHR change: 0.06 ± 0.12 vs. 0.01 ± 0.03 (p = 0.280) VRP change: 316.28 ± 475.76 vs. 48.79 ± 77.09 (p = 0.188) s/z ratio change: 0.39 ± 0.48 vs. 0.19 ± 0.69 (p = 0.492)	Perceptual scores, acoustic parameters, and VHI scores showed significant improvement immediately following voice therapy, regardless of whether remnant nodules were present. These positive effects of voice therapy were sustained over the long term, irrespective of the presence of remnant nodules.
Saltürk et al., 2018 (20)	Resonant voice therapy	-	Pre to post: 152.27 ± 28.34 → 201.41 ± 17.42 (p = 0.0001)	Pre to post: 0.50 ± 0.06 → 0.22 ± 0.09 (p = 0.0001)	Pre to post: 11.16 ± 1.16 → 3.55 ± 2.90 (p = 0.0001)	Pre to post: NHR: 0.71 ± 0.07 → 0.26 ± 0.20 (p = 0.0001) MPT: 11.33 ± 2.06 → 18.00 ± 2.94 (p = 0.0001)	Resonant voice therapy enhanced both objective and subjective vocal function parameters in patients with vocal fold nodules, demonstrating its effectiveness as a treatment for VFNs and supporting its consideration as a therapeutic option.
Yilmaz et al., 2021 (21)	Group 1: voice therapy to children Group 2: voice therapy to children and mothers	Pre to post: Group 1: 22.93 ± 4.38 → 14.2 ± 4.25 (p < 0.001) Group 2: 23.4 ± 3.79 → 12.47 ± 4 (p < 0.001	Pre to post: Group 1: 263.75 ± 23.81 → 270.34 ± 23.87 (p < 0.001) Group 2: 257.93 ± 24.49 → 265.54 ± 24.69 (p < 0.001	Pre to Post: Group 1: 1.062 ± 0.46 → 0.467 ± 0.25 (p < 0.001) Group 2: 1.093 ± 0.44 → 0.352 ± 0.26 (p < 0.001)	Pre to Post: Group 1: 8.859 ± 1.86 → 3.995 ± 0.83 (p < 0.001) Group 2: 9.412 ± 1.53 → 3.915 ± 0.63 (p < 0.001)	Pre to post: MFZ: Group 1: 8.335 ± 1.84 → 9.987 ± 2.22 (p < 0.001) Group 2: 8.366 ± 1.82 → 10.32 ± 2.41 (p < 0.001) s/z: Group 1: 1.264 ± 0.21 → 1.111 ± 0.16 (p < 0.001) Group 2: 1.281 ± 0.24 → 1.114 ± 0.13 (p < 0.001)	Involving families and teachers in voice therapy for children with VFN can enhance its effectiveness. A mother's presence and support during therapy boosts the child's motivation, helping them stay engaged and compliant, especially after a tiring day of school and activities.
Bakat et al., 2014 (22)	-	Initial mean VHI score for 18 patients: 15.61, 83.33% showed significant improvement after 6 weeks of voice therapy.	-	-	-	83.33% had nodule resolution, 16.67% had persistent nodules (linked to hard nodules). 3 patients with hard nodules underwent microlaryngoscopic excision and continued therapy. 6-month follow-up: 1 patient (5.5%) had nodule recurrence (from the hard nodule group).	It was observed that patients who needed surgery despite undergoing voice therapy had hard nodules.

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Nupur et al., 2024 (23)	-	-	-	-	-	Improvement: 26 patients (96.3%).	The results showed that voice therapy was effective for the majority of participants (87%). Regular practice and proper vocal hygiene significantly contributed to the success of the therapy.
Fu et al., 2016 (24)	Intensive voice therapy Traditional voice therapy	-	TVT: Improved from 203.12 (24.44) to 226.01 (32.36) after 6 months. IVT: Improved from 192.31 (36.77) to 217.93 (24.59) after 6 months.	TVT: Decreased from 2.08 (1.12) to 1.50 (1.56) after 6 months. IVT: Decreased from 2.31 (1.01) to 1.15 (0.79) after 6 months.	TVT: Decreased from 4.95 (1.66) to 3.93 (2.14) after 6 months. IVT: Decreased from 6.19 (2.37) to 4.04 (1.34) after 6 months.	NHR TVT: Reduced from 0.17 (0.04) to 0.15 (0.43) after 6 months. IVT: Reduced from 0.16 (0.04) to 0.13 (0.01) after 6 months. VI of prolonged /a/ (dB) TVT: Increased from 74.84 (5.00) to 78.97 (5.81) after 6 months. IVT: Increased from 74.60 (5.29) to 79.12 (6.00) after 6 months. VI of conversation (dB) TVT: Improved from 70.60 (4.00) to 72.96 (4.03) after 6 months. IVT: Improved from 71.65 (3.88) to 72.55 (3.96) after 6 months.	The study offered additional evidence that individuals with vocal fold nodules can sustain improved voice quality and vocal health following intensive voice therapy, achieving results comparable to those of conventional voice therapy.
Hartnick et al., 2018 (25)	Direct and Indirect voice therapy	-	-	-	-	PVRQOL Score Improvement: Direct therapy: Mean increase of 19.2. Indirect therapy: Mean increase of 14.7. Difference: 4.5 (95.3% CI, −10.8 to 19.8). Clinically Meaningful Improvement: Direct therapy: 61% (27/44 participants). Indirect therapy: 53% (26/49 participants). Difference: 8% (95% CI, −12 to 28). Post Hoc Stratification: Older children in direct therapy: Cohen d = 0.50. Latter two-thirds of participants: Cohen d = 0.46. VFNs: Reduction in size: 31% (22/70 participants). Complete resolution: 11% (8/70 participants).	Both direct and indirect voice therapies enhanced the voice-related quality of life in children with vocal fold nodules, with no significant difference observed between the two methods.

BAI: Beck Anxiety Inventory, BSI: Brief Symptom Inventory, DVT: DoctorVox Therapy, Fo: Fundamental Frequency, FTF: Face To Face, GRBAS: Grade, Roughness, Breathiness, Asthenia, Strain (a perceptual voice evaluation scale), IVT: Intensive voice therapy, Jitter: Variability in pitch (frequency), MPT: Maximum Phonation Time, MFZ: Maximum Phonatory Frequency Range, NHR: Noise to Harmonics Ratio, NNE: Number Needed to Treat, PVRQOL: Pediatric Voice-Related Quality of Life, s/z ratio: The ratio of sustained "s" and "z" sounds used for voice assessment, Shimmer: Variability in amplitude (loudness), SPL: Sound Pressure Level, VFN: Vocal Fold Nodules, VHI: Voice Handicap Index, VI: Vocal intensity, VLS: Voice Learning Scores

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Discussion

The reviewed studies consistently demonstrated the efficacy of various voice therapy techniques in the treatment of VFNs. Approaches such as ABCLOVE exercise, resonant voice therapy, and DoctorVox therapy have shown significant improvements in both vocal and psychological parameters. The inclusion of psychological evaluations, family-centered interventions, and consistent vocal hygiene practices further enhances the effectiveness of voice therapy. Studies also highlighted the long-term benefits of voice therapy, even in cases with remnant nodules, and emphasized the importance of individualized care strategies. Overall, voice therapy remains a cornerstone of VFN treatment, offering substantial benefits when tailored to the specific needs of patients.

One systematic review reported comparable findings, indicating that behavioral voice therapy typically results in notable improvements in voice outcomes. However, it emphasized the need for further research to assess the clinical significance of these results and to clarify the true meaning of "effectiveness" in the context of voice therapy (10).

In a previous systematic review, some studies reported significant improvements in at least one outcome parameter following voice therapy. However, some studies did not show significant changes after therapy. The overall quality of the studies was deemed adequate (55%). This systematic review concluded is some evidence supporting the effectiveness of voice therapy for children with VFNs, but further well-designed research, particularly RCTs, is needed to validate these findings (26).

Various techniques and treatment protocols for voice therapy are present in the research reviewed in published literature. All voice therapy programs should incorporate a blend of direct and indirect methodologies in their treatment plans. Indirect therapy encompasses a range of activities aimed at eradicating detrimental vocal habits and fostering optimal vocal utilization. Conversely, direct therapy employs exercises or techniques to restore normal voice production mechanisms, specifically musculoskeletal function, phonation, and respiration (physiologic approach), or utilizes various voice facilitating techniques aimed at addressing abnormal vocal symptoms (symptom approach) (27).

Bian et al. (15) employed a therapeutic approach known as ABCLOVE, comprising activation exercises, breathing techniques, counseling, laryngeal manipulation, mouth resonance, vocal exercises, and the eradication of detrimental habits. The 3-month ABCLOVE therapy dramatically diminished the incidence of vocal nodules among children, evidenced by thirty-four recovery cases in the ABCLOVE group, in contrast to twenty-four cases in the control group. Collectively, these findings indicated the efficacy of voice therapy programs in addressing voice problem symptoms.

Voice therapy is predominantly utilized for treating children with voice disorders, such as vocal nodules, and this intervention has demonstrated its efficacy (28-30). In a prospective study, thirty-nine children with vocal nodules participated in a six-month weekly voice treatment program. A notable enhancement was noted among the participants, corroborated by the findings of acoustic analysis and grade roughness breathiness asthenia strained (GRBAS)-related scores (29). In a separate study including seventy-five children aged 7 to 14 with hoarseness, the application of suitable voice therapy exercises resulted in a considerable improvement in hoarseness (31).

Holmberg et al. (32) reported enhancements in the perceptual aspects of voice function. The study investigated the effects of voice hygiene instruction, breathing techniques, direct facilitation, and carryover therapy, concluding that all three methods enhanced fundamental frequency (F0). Niebudek-Bogusz et al. (33) examined the efficacy of vocal hygiene instruction alone against vocal hygiene combined with voice therapy in female instructors, both with and without VFNs, based on acoustic analysis, videolaryngostroboscopy, and the VHI-10 results. Participants exhibited improvement under all treatment regimens; however, the vocal hygiene plus voice therapy group demonstrated superior

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enhancement compared to the vocal hygiene only group (33). Kumar et al. (34) observed that the harmonic amplitudes exhibited substantial differences between patients with VFNs and control persons. In a 2003 literature analysis, Johns (35) determined that both behavioral and surgical interventions enhanced voice functionality.

Two prominent limitations of any published behavior rehabilitation study, including voice therapy studies, are the insufficient specification of the therapy content and the ambiguity in identifying the essential active ingredients (techniques/components) of the intervention that contribute to its efficacy (36, 37). Furthermore, adherence to voice therapy, particularly in children, becomes a significant challenge.

Yoder et al. (38) emphasize that appropriate voice intensity therapy should be contextualized within the features of the patients. Cherney (36) emphasized that certain individuals may derive greater benefit from additional sessions than others. Certain patients might gain advantages from an alternative method, such as administering intensive voice treatment via telepractice, as evidenced by the research of Fu et al. (39) and Mashima et al. (40). Telepractice, with secure, standardized technology, may serve as a viable method for administering voice treatment in clinical settings. Moreover, it could serve as an effective technique to enhance certain patients' accessibility and dedication to voice therapy. However, additional research is necessary to investigate the care of patients with VFNs using telepractice to better examine the advantages of this prospective method of voice therapy delivery.

Strengths and Limitations

The studies included in this review provide compelling evidence for the effectiveness of various voice therapy techniques for VFNs. Approaches such as the ABCLOVE exercise, resonant voice therapy, and DoctorVox therapy demonstrated significant improvements in vocal and psychological parameters, confirming their practical utility. Furthermore, the inclusion of psychological evaluations, such as the BSI and BAI, suggests the importance of addressing the emotional and mental well-being of VFN patients in treatment. The diverse range of studies, incorporating both subjective (e.g., Voice Handicap Index) and objective (e.g., jitter, shimmer, NHR) measures, strengthens the validity of the findings.

While the studies offer valuable findings, there are several limitations to consider. Many studies had small sample sizes, which can limit the generalizability of the results. Additionally, the variation in therapeutic approaches and outcome measures across studies complicates direct comparisons, making it challenging to determine the most effective treatment universally. Some studies did not report on long-term follow-up outcomes, raising questions about the sustainability of improvements. Furthermore, while psychological factors were addressed in some studies, others did not incorporate these variables, potentially overlooking an important aspect of VFN treatment.

Recommendations for Future Research

Future research should focus on standardizing outcome measures and therapeutic approaches to allow for more consistent comparisons across studies. Larger, multicenter trials with long-term follow-up assessments would provide more robust data on the efficacy and sustainability of voice therapy interventions. Additionally, further investigation into the role of psychological factors, such as anxiety and depression, in the treatment of VFNs could lead to more comprehensive therapeutic strategies. Research exploring the integration of family support and its long-term impact on treatment adherence and outcomes is also recommended, as family involvement has shown promise in enhancing therapy effectiveness.

Conclusion

Voice therapy remains a crucial component of VFN treatment, with a variety of techniques demonstrating significant benefits for vocal and psychological health. While the evidence supports the efficacy of voice therapy, there is a need for more standardized and larger-scale studies to solidify these findings and explore areas such as long-term outcomes and psychological factors.

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Tailoring interventions to the specific needs of patients, including psychological support and family involvement, can enhance the effectiveness of treatment and improve overall patient outcomes.

Disclosures

Author Contributions

The author has reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Not applicable.

Consent for publications

Not applicable.

Data availability

All data is provided within the manuscript.

Conflict of interest

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