



# Effect of Voice Therapy on Benign Vocal Fold Lesions

Shafnaz Muhammed Shafi<sup>1</sup> · Andrews Chakramakal Joseph<sup>1</sup> · Arun Pulakkil<sup>1</sup>

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## Abstract

During phonation, the sub-membranous area of the true vocal folds is the most stressed area which frequently results in the formation of benign lesions, especially owing to vocal abuse. Voice therapy has become an essential treatment approach for various types of lesions. This study sought to determine the effect of voice therapy in the treatment of various benign vocal fold lesions. A cohort study of 160 benign vocal fold lesions was carried out over an 18-month period. Participants were evaluated using 90-degree rigid laryngoscopy, filled out the VHI-30 questionnaire, and had their mean frequency, jitter, and shimmer quantified with PRAAT software. After four voice therapy sessions spread out over two weeks, both voice parameters and lesion status were reviewed. Among the 160 patients studied, vocal fold nodules were the most common lesion, observed in 84 cases (50.6%). Voice abuse was identified as the leading risk factor, present in all 1000 cases. Post-voice therapy, a statistically significant improvement in the VHI total score was noted in patients with vocal fold nodules, Reinke's edema and sulcus vocalis. All acoustic parameters showed significant improvement in the vocal fold nodule group. In cases of sulcus vocalis, significant changes were observed in mean frequency among females, as well as in jitter and shimmer values. For Reinke's edema, mean frequency showed significant improvement in both males and females. However, in patients with vocal fold polyp and cyst, mean pitch values in both males and females did not show statistically significant changes before and after therapy. The most common type of benign vocal fold lesions was vocal fold nodule which demonstrated excellent response to voice therapy. Other lesion types showed partial regression in size and notable improvement in specific acoustic parameters. There was a female predominance among patients, with voice abuse identified as the primary risk factor.

**Keywords** Benign lesions of vocal fold · Voice therapy · Acoustic parameters · Voice handicap index-30

## Introduction

The human voice is a sophisticated and intricate system that allows people to convey emotions, ideas, and spoken communication. For many professions, preserving a strong and healthy voice is crucial. Furthermore, vocal disorders can have a significant impact on a person's quality of life, compromising their physical, emotional, and functional health.

Benign vocal fold lesions account for a high number of patients who arrive with voice changes. Benign vocal fold lesions are those that appear in the subepithelial space of the vocal fold and include vocal fold nodules, vocal fold polyps, vocal fold cysts, Reinke's space edema, and others. These lesions result in poor vocal fold closure, disrupting the vibratory cycle and the formation of compensatory muscular tension. Behavioral factors play a crucial role in the formation of these lesions [1] which generally form in the middle of the membranous part of the true vocal fold due to excessive or forceful vocal fold closure [2,3] or as a result of exposure to irritants in the larynx [4]. Typical symptoms of these lesions include dysphonia, voice fatigue, dryness of throat, limited range of voice, poor quality, and muscle tension dysphonia [5]. These mass lesions on the vocal folds will affect the normal vibration of the neighbouring vocal fold tissues due to changes in their mass and stiffness. Recent basic science and clinical studies [6,7] have

✉ Shafnaz Muhammed Shafi  
shafnazshafi@gmail.com

Andrews Chakramakal Joseph  
andchakra@gmail.com

Arun Pulakkil  
arunpulakkil@gmail.com

<sup>1</sup> Department of Otolaryngology, Amala Institute of Medical Sciences, Thrissur, Kerala 680555, India



significantly enhanced our understanding of benign laryngeal lesions. Over the past few years, further advancement occurred in this field by otolaryngologists, speech pathologists, and voice scientists, thus the causes of vocal fold nodules, polyps, and cysts are becoming better understood, and improvements in diagnostic methods and treatment options are resulting in better outcomes for patients with dysphonia [2]. Benign laryngeal lesions are typically caused by phonotraumatic stress on the vocal cords, and are therefore commonly managed with a combination of voice therapy and phonosurgery to avoid further unintended damage. Trauma and the healing process lead to the formation of various lesions, which can be categorized based on their appearance and stroboscopic findings, although distinguishing between some lesions can be difficult.

Since the role of phonotrauma in the development of vocal fold lesions has been identified, voice therapy has become an essential part of treatment plans aimed at healing and preventing future lesions. This is found to decrease adverse vocal behaviours that helps in voice improvement [3].

Voice therapy includes breathing techniques, such as strengthening diaphragmatic breathing or improving the coordination between breathing and speaking. Relaxation practices to ease physical tension. Postural and movement exercises aimed at enhancing overall body alignment. Mouth and jaw drills, like mimicking chewing motions or practicing deliberate yawns and sighs. The objectives of voice therapy sessions include assisting patients in discovering a more stable, dependable, and effortlessly produced voice quality, to enhance the use of vocal resonance and tonal richness, to broaden the voice flexibility by expanding pitch range and volume with minimal strain, to boost vocal endurance.

The treatment options for polyps and cysts is found to be a combination of preoperative voice therapy, phonosurgery and postoperative voice therapy. Voice therapy and proper vocal hygiene can often be effective in treating lesions or managing symptoms, potentially avoiding the need for surgery [4]. Microsurgical surgery is primarily targeted on improvement or restoration of voice. Advantages of this include the use of different types of laryngoscope enable excellent visualisation of the lesion along with fine microsurgical instruments and use of powered instruments and lasers for better manipulation of the lesion with minimal vocal fold damage. Disadvantages include anaesthetic risk, injury to spine, oral and oropharyngeal structures injury, vocal ligament injury leading to scarring. Professional voice users forms the major bulk of patients with these benign lesions of vocal fold and studies from literature shows consistent voice therapy sessions and vocal hygiene technique education has shown an effective result in professionals with

less recurrence rate. Vocal cyst being effectively treated with voice therapy alone eventually treated with surgical options. This study aimed at the effectiveness of the voice therapy and assess the output objectively and clinically and reduce the need for surgery.

## Materials and Methods

A prospective cohort study was conducted in the Department of Otolaryngology at a tertiary care center in South India, including participants aged 18 to 80 years who met the inclusion criteria and provided consent to participate in the study. Patients with age group 18–70 years and those who are willing to participate in the study were included. Those who are not willing to participate in the study and diagnosed case of malignant lesion were excluded. The study commenced only after the approval from institutional research committee and ethics committee (U.E.C/22-AIMS-610/160 consecutive cases of clinically diagnosed benign lesions of vocal fold for the study period of 18 months was included. Sample size was calculated from a study conducted by Sood H et al [5]. All patients underwent 90 degree rigid videolaryngoscopy, answered a proforma regarding their symptoms, voice handicap index-30 questionnaire, The Voice Handicap Index (VHI), created by Jacobson in 1997, is a voice-specific, patient-focused psychometric tool designed to evaluate how voice disorders affect an individual's life [6]. It consists of 30 items, distributed across 3 domains, functional, physical, and emotional aspects. Voice was analysed acoustically by PRAMI software version 6.4.2 [7]. Patients were given voice therapy sessions in 2 weeks duration for 4–5 sessions and voice reassessed by VHI-30 questionnaire, acoustic parameters compared to the pre-therapy ones & difference in lesion morphologically by 90 degree rigid videolaryngoscopy.

All the data from the proforma, VHI-30 score, acoustic parameters were analysed using R statistical software version 4.2.2 (R Foundation for Statistical Computing, Vienna, Austria). The categorical data presented as frequency (%) and continuous data sets as mean ± SD. The p-value of < 0.05 was considered statistically significant. Association between the categorical data sets was performed using Wilcoxon signed rank test and the continuous data sets were analysed using Student t-test.

## Results

A total of 160 patients with different benign vocal fold pathologies were studied, of which 81 had vocal fold nodule (50.6%), 75 had sulcus vocalis (22%), 7 had vocal



Fig. 1 Distribution of various vocal fold pathology

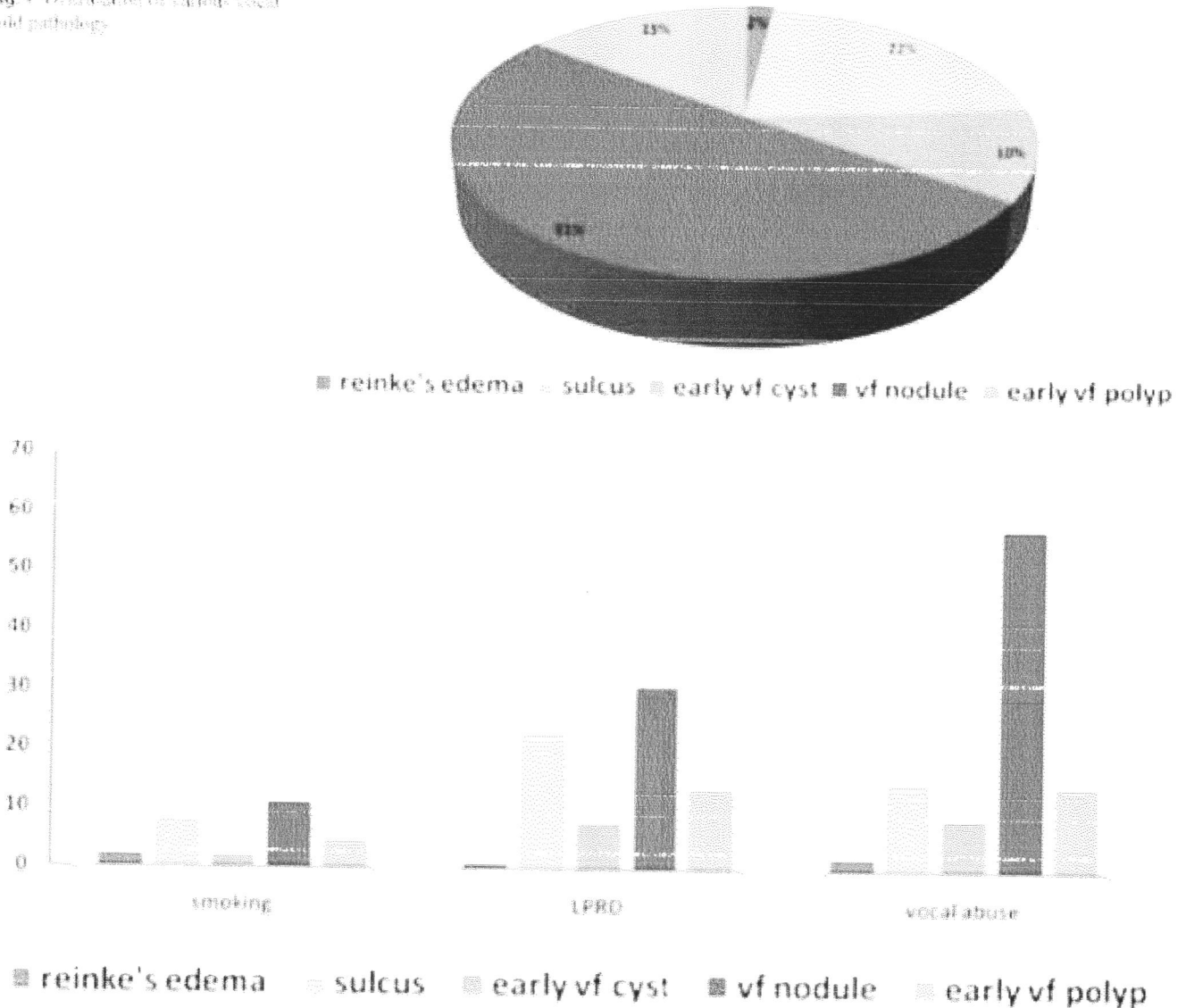


Fig. 2 Distribution of risk factors among various lesions

fold polypoid (5%), 17 had early vocal fold cyst (10%), 3 had reinke's oedema (2%) (Fig. 1). Most were in 31-40 years age range. Average age was 37.5 years, 62% were females. Females were more affected with vocal nodules, cyst, polyp and sulcus while reinke's oedema was more in males (Fig. 2). Most patients diagnosed with vocal nodule were in 31-40 age group (Fig. 3). The main risk factors in the formation of benign lesions of vocal fold were laryngopharyngeal reflux (70), smoking (28) and voice abuse (100) of which 2 out of 3 patients of Reinke's oedema has got smoking as the main risk factor. Other lesions shown voice abuse as the main risk factor.

Voice Handicap Index individual score and total score was calculated before and after therapy in which those with vocal fold nodule, sulcus vocalis and reinke's oedema shows

improvement in scores after therapy with statistical significance ( $p < 0.05$ ) (Table 1).

Patients voice was analysed using the Praat software before therapy and mean frequency, jitter, shimmer was analysed. In vocal fold nodule, mean frequency in males & females, jitter and shimmer values pre and post voice therapy shown improvement and thus with the size of the lesion. Statistical significant difference was seen between two values ( $p$  value  $> 0.05$ ). In patients with sulcus vocalis, females mean frequency value, jitter and shimmer values was improved after therapy and was statistically significant but male patient show no difference in frequency.

In patients with early vocal fold cyst and vocal fold polyp mean frequency value in males and females before and after therapy shown not much improvement and was not statistically significant ( $p$  value  $> 0.05$ ).



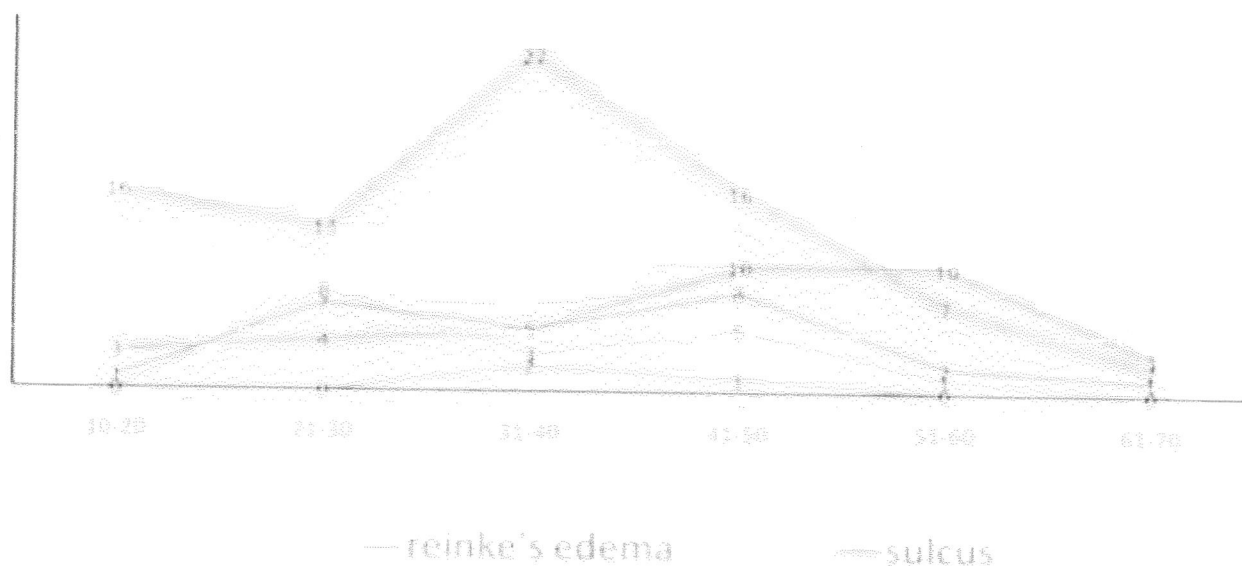


Fig. 3 Age distribution according to diagnosis

Table 1 VHI total score for various pathologies before and after therapy

Diagnosis	Pre therapy	Post therapy	value of t	p value
Vocal fold nodule	67.32 ± 5.09	51.3 ± 7.28	t(80) = 21.974	0.0000000000000022
Sulcus	64.69 ± 4.71	59.54 ± 7.02	T = 1.56	0.0001465
Early stage cyst	77.08 ± 4.51	77.08 ± 4.51		Not significant
Early stage polyp	77.92 ± 4.11	76.21 ± 6.89	T = 23	0.02486
Reinke's edema	62.67 ± 4.51	53.67 ± 4.16	t(21) = 4.5826	0.00017

v/f: vocal fold, t-paired t-test  
s-w: wilcoxon signed rank test

respectively). In reinke's edema shows mean (frequency) values in males and females was statistically significant (p value < 0.05), but not with jitter and shimmer values (Table 2).

### Discussion

Benign vocal fold lesions occur mainly at the mid-membranous part of vocal fold mainly due to phonotrauma classically treated with voice therapy and phonosurgery. Among total 160 patients with benign lesions, voice therapy was given as treatment and the outcome was studied.

Total 160 patients participated, out of which 81 patients was diagnosed with vocal fold nodule (50.6%), sulcus vocalis 35 patients (21.9%), vocal fold polyp 24 patients (15%), vocal fold cyst 17 patients (10.6%), reinke's edema was seen in 3 patients (1.88%). A study conducted by Somi [13] et al. found that most common cause for dysphonia was chronic laryngitis (22%) followed by vocal nodule. Our study did not included patient with chronic laryngitis. In our study majority of the patient population was found to be in the range of 31-40 years (26.25%) with an average age in the sample was 37.54 years which was also similarly observed in a study done by Mahi et al. [14]

Most of the samples in the population were females (62%) which was contradictory to other studies which showed male preponderance in benign lesions [15, 16]. Females were more affected with vocal nodules, cyst, polyp and sulcus while reinke's edema was more in males [15].

The main risk factors found out to be laryngopharyngeal reflux (LPRD), smoking and voice abuse. Out of which voice abuse was present in 100 patients (62.5%), LPRD in 70 patients and smoking in 28 patients. Similar result was seen in the study conducted by Somi et al.

Voice handicap index was calculated before and after therapy in patients with each type of lesion. VHI total score shows improvement after voice therapy. Vocal fold nodule, sulcus vocalis and reinke's edema shows a statistically significant difference in VHI total score. Khorramshahi et al. conducted a study showed VHI improvement in vocal nodule, polyp and cyst after voice therapy [10]. Acoustic analysis of voice was done before and after therapy and jitter, shimmer was evaluated in vocal cord nodule, mean pitch in males & females before and after voice therapy was found statistically significant (p value < 0.05). Jitter and shimmer values was statistically significant pre and post voice therapy (p value < 0.05). Result is consistent with study done by Chhetri et al. [17] also consistent with review



**Table 2** Mean acoustic voice quality index and after therapy

Pathology	Parameter	Sex	Pre assessment	Post assessment	Value (t)	p value
Vocal fold nodule	Mean frequency	Male	154.41 ± 11.02	107.01 ± 10.9	V = 4.96	P = 0.000
		Female	202.94 ± 20.74	184.96 ± 15.4	V = 3.75	P = 0.000
	Jitter		2.16 ± 0.89	0.55 ± 0.41	V = 3.287	P = 0.000
Subglottic oedema	Mean frequency	Male	124.2 ± 45	129.4 ± 39	V = 3.140	P = 0.000
		Female	188.67 ± 14.47	184.45 ± 19.07	V = 1.59	P = 0.117
	Jitter		2.88 ± 1.40	1.43 ± 0.67	V = 5.19	P = 0.000
Vocal fold cyst	Mean frequency	Male	122.52 ± 1.6	129.25 ± 3.22	t = 2.04	P = 0.123
		Female	211.09 ± 28.9	213.28 ± 37.17	t = 2.99	P = 0.058
	Jitter		2.41 ± 1.05	1.62 ± 0.71	t = 2.874	P = 0.01
Vocal fold polyp	Mean frequency	Male	173.99 ± 43.47	123.22 ± 43.3	V = 21	P = 0.026
		Female	271.3 ± 23.80	249.82 ± 25.34	V = 62.5	P = 0.074
	Jitter		2.19 ± 0.87	2.79 ± 0.77	t = 1.590	P = 0.003
Reinke's edema	Mean frequency	Male	141.2 ± 27.93	125.75 ± 31.24	v = 1600.5	P = 0.00
		Female	263.37 ± 23.46	193.33 ± 23.87	v = 4213.5	P = 0.00
	Jitter		2.37 ± 0.70	0.98 ± 0.30	t = 3.98	P = 0.007
	Shimmer		6.71 ± 0.72	1.23 ± 0.42	t = 9.64	P = 0.01

V = Wilcoxon signed rank test, t = paired t test, p = 0.000 or p is less than 0.05 (highly significant or large effect)

conducted by Ikonari [18], showed voice improvement in vocal nodules but not necessarily regression of lesion.

In subglottic oedema patients, mean pitch values in males pre and post voice therapy do not showed a statistical significance, while in females mean pitch value showed statistical significance pre and post therapy (p value = 0.045), jitter and shimmer values was statistically significant (p value = 0.000009, 0.00007).

In patients with vocal fold cyst and polyp mean frequency value in males and females pre and post therapy was not statistically significant (p value = 0.1556, 0.058, 0.72, 0.07) respectively, jitter and shimmer values showed statistical significance in both groups also seen in study by Zhang et al. [19] show a light on early vocal fold polyp and cyst may respond to voice therapy but mature ones needed surgical intervention.

In reinke's edema showed mean pitch values in males and females as statistically significant (p value = 0.05) jitter and shimmer value pre and post therapy was not statistically significant [20].

**Conclusion**

Benign vocal fold lesions may lead to symptoms such as hoarseness and stridor, which can affect social communication and job performance, often resulting in considerable physical and emotional effects. From our study majority patients were females. Most of them belonged to the age group 30-40 years. Most common benign lesion was vocal

fold nodule. Vocal atresia was found to be the major risk factor. The VHI-30 scale has proven to be an effective and convenient tool for assessing voice handicap in patients and tracking improvements. The VHI was significantly improved in patients with vocal fold nodule, subglottic and reinke's edema but not with vocal fold polyp and cyst patients. Vocal fold nodule shows the best result with voice therapy. Vocal fold cyst and polyp do not show significant difference in pitch in males and females but showed jitter and shimmer values difference which warranted microlaryngeal surgery in these groups.

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