International Journal of Multidisciplinary Research and Growth Evaluation
ISSN: 2582-7138
Received: 10-02-2021; Accepted: 13-03-2021
www.allmultidisciplinaryjournal.com
Volume 2; Issue 2; March-April 2021; Page No. 91-94

Efficacy of voice therapy in hyper-functional voice disorders

Samathana Prabu [1], Aswini R [2], Vishnuram B [3]

[1, 2] Audiologist and Speech Language Pathologist, Department of ENT Head and NECK Surgery, Panimalar Medical College Hospital and Research Institute, Chennai, Tamil Nadu, India

[3] Audiologist and Speech Language Pathologist, Communikare Speech and Hearing Clinic, Chennai, Tamil Nadu, India

Corresponding Author: **Samathana Prabu**

Abstract

Introduction: Hyper-functional voice disorders (HFVD) are conditions of abuse and misuse of the vocal mechanism due to excessive muscular forces. It leads to change in the quality of voice, vocal fatigue and vocal discomfort. Treatment for HFVD is multidimensional, which includes voice therapy as well.

Aim: The study was aimed to evaluate the effects of voice therapy on patients with hyper-functional voice disorders by comparing the acoustic, perceptual and aerodynamic voice parameters before and after voice therapy.

Methods: 30 male individuals with Hyper-functional voice disorder cases and 30 male individuals with clinically normal voice (control group) participated in this study. Cases received voice therapy, which lasted for 6 to 12 weeks. Acoustic, perceptual and Aerodynamic parameters were analyzed before and after voice therapy in cases. These parameters also analyzed in control group.

Results: Before voice therapy, acoustic, perceptual and aerodynamic parameters were worse in the cases than the control group. After 6-12 weeks of voice therapy, acoustic, perceptual and aerodynamic parameters were significantly improved in cases. Voice parameters of control group were compared with the voice parameters of cases after voice therapy and results showed that no significant difference in acoustic, perceptual and aerodynamic measures.

Conclusion: Voice therapy provides a significant improvement in perceptual, acoustic and aerodynamic aspects of voice in hyper-functional voice disorder. Multidimensional assessment provides an objective, recordable data regarding the voice parameters and its pathologies.

Keywords: Voice therapy, hyper functional voice disorders, voice parameters, acoustic analysis, Perceptual analysis, aerodynamic aspects of voice

1. Introduction

The human voice is a complex phenomenon, which is generated by the modulation of airflow expelled through the glottis, the reactionary vibration of the vocal folds and resulting in a voice output. The voice gives us our identity and personality and plays an important role in communication. However, due to voice abuse and lack of knowledge of voice care, voice disorders became a common problem in the general population and also in professional voice users. Hyper-functional voice disorders (HFVD) are conditions of abuse and misuse of the phonatory mechanism due to excessive or imbalanced muscular forces [1]. Vocal hyper-function is characterized by a tense adduction of the vocal folds. In some cases, these vocal abusive behaviors can produce vocal fold lesions such as nodules, contact ulcers, hemorrhage or polyps [2]. These laryngeal pathologies lead to change in the quality of voice, vocal fatigue and vocal discomfort. The Hyper-functional voice disorders are characterized by abnormal voice quality (hoarseness, harshness), altered pitch, abnormal volume and inadequate breath support to produce voice. HFVD affects the acoustic features of voice, aerodynamic aspects, perceptual and emotional aspects also. Treatment for HFVD is multidimensional, which includes voice therapy as well.

Perceptual evaluation of voice involves describing the voice quality (pitch, intensity, loudness and resonance) by listening to voice. Formally the GRBAS scale used to evaluate five voice quality parameters [G-grade, R-rough, B-breathy, A-asthenic and S-strained] is most widely used voice grading method [3]. Acoustic analysis is the assessment of acoustic features of voice [Fundamental frequency (F_0), intensity level, Harmonic-to-Noise Ratio (HNR), jitter, and shimmer] through instrumental analysis. Acoustic analysis has the benefit of measuring and quantifying subtle differences in voice quality more precisely than perceptual measures. Aerodynamic assessments [s/z ratio, Maximum Phonation Duration (MPD)] are used to measure the respiratory function that is required for the phonation. These parameters are used in various studies to determine the prognosis

of voice in different voice disorders and laryngeal pathologies [3-7].

2. Aim

The study was aimed to evaluate the effects of voice therapy on patients with hyper-functional voice disorders by comparing the acoustic, perceptual and aerodynamic voice parameters before and after voice therapy.

3. Methods

3.1 Subjects

This is a comparative study, conducted in a tertiary care hospital. The duration of study was for 1 year from September 2019 to September 2020. Institutional ethical committee clearance was obtained. 30 male patients (30-56 years) diagnosed with HFVD were included in cases group. Patients who presented with voice change, vocal discomfort and who had a history of vocal abuse and misuse were included in this study. Patients with laryngeal conditions like early vocal nodules; polyps and laryngitis were included in this study. Patients who underwent surgery for vocal cord lesions were excluded from the study. The age matched control group consisted of 30 healthy male adults who did not have a history of voice disorder, had no vocal complaints in the recent year. They had no history of smoking, not a professional voice user, no history of neurological disease, and cervical trauma.

3.2 Voice therapy

30 individuals with diagnosed HFVD received voice therapy, which lasted for 6 to 12 weeks. They were scheduled for one therapy session per week for 45 minutes. The therapy sessions consisted of vocal hygiene, muscle relaxation, respiration, phonation and carryover. Vocal hygiene was advised to change the vocal misuse and abuse patterns into normal voice production. It also includes educating the patient about how the normal voice is produced and about what constitutes vocal abuse. They were advised to stop vocal misuse and abuse behaviors. Muscle relaxation was done to reduce the musculoskeletal tension in the whole body by massaging of the shoulders, neck, and laryngeal muscles. The yawn-sigh exercise was used to reduce the vocal hyper function [5]. Voice therapy was directed towards progressive development in abdominal breathing [8]. Humming and different head positions were used during vowel phonation to facilitate better voice quality. In carry over phase, patients were instructed to transfer newly learned vocal behaviors to daily life situations outside therapy settings.

3.3 Voice assessment

Multidimensional voice assessment was carried out in all patients before and after voice therapy. It includes the assessment of structural, acoustic, perceptual and aerodynamic features of voice. These assessments were carried out in control group as well. Structural evaluation was done to identify the status of vocal fold through video laryngoscopy by an otolaryngologist. Acoustic evaluation was conducted in a soundproof room by using PRAAT software, which can analyze and transform the voice. Participant's sustained phonation of /a/ was recorded and middle 1 second segment was selected for acoustic analysis. The acoustic analysis included F_0 in Hertz, vocal jitter in %, shimmer in dB, and HNR in dB. The GRBAS scale was used for the perceptual voice analysis. Speech pathologist rated each participant's voice patterns by analyzing their conversational speech and sustained vowels production. Patient's voice severity rated from 0 to 3 on each parameter such as Grade, Rough, Asthenic, Breathy and Strain. Self-assessment of voice skills was evaluated by Voice Handicap Index (VHI) [9]. The participants rated their voice themselves in three areas, as physiology, function, and emotion. Each part included 10 questions, and the responses represented the frequency of occurrence. Total VHI scores were calculated in all the participants. Aerodynamic measures such as Maximum Phonation Duration and s/z ratio was calculated. MPD was calculated subjectively after taking deep breaths, the participants pronounced the vowel /a/ with a comfortable pitch and intensity for as long as possible. The total duration of phonation is considered as MPD. s/z ratio is a ratio between the sustain production of voiceless /s/ and voiced /z/.

3.4 Statistical analysis

All data were collected and imported into SPSS Statistics 21.0. Mean and standard deviation for all the data were calculated. These data were compared. One way ANOVA test and Wilcoxon sign rank test was done to check the statistically significance between the groups. p value < 0.05 was considered as statistically a significant result.

4. Results

Cases baseline mean voice parameters (before voice therapy) were jitter 2.27±0.9 %, F_0 134.5±19.13 Hz, shimmer 1.73±0.6 dB, HNR 12.67±4.6 dB, MPD 8.27±1.7sec, s/z ratio 1.43±0.23sec and VHI scores 31.53±4.8. After voice therapy, mean voice parameters in cases were jitter 0.93±0.4 %, F_0 137.9±10.5 Hz, shimmer 0.67±0.31 dB, HNR 17.56±2.3 dB, MPD- 15.56±2.3 sec, s/z ratio 1.02±0.12 sec and VHI scores 13.73±6.43. The control group mean voice parameters were jitter 0.62±0.24 %, F_0 135.9±10.8 Hz, shimmer 0.56±0.32 dB, HNR 19.63±2.2 dB, MPD 18.82±1.8sec, s/z ratio 1.1±0.09 sec and VHI scores 8.83±1.73.

4.1 Comparison of voice parameters between control group and cases prior to voice therapy

The mean voice parameters of control group were compared with the voice parameters of cases before voice therapy. One way ANOVA test was applied. Results showed that acoustic parameters [jitter (p=0.00), shimmer (p=0.00) and HNR (p=0.021)], aerodynamic aspects [MPD (p=0.00) and s/z ratio (p=0.02)] and VHI scores (p=0.00) were significantly worse in cases than the control group. The F_0 did not show any significant difference between these two groups (p=0.217). (Table-1).

Table 1: Mean value and standard deviation of acoustic parameters, aerodynamic aspects and VHI scores between pre voice therapy and control group. (* Indicates statistically significance p < 0.05)

	Acoustic features				Aerodynamic aspects		Perceptual aspects
	Jitter (%)	Shimmer(dB)	F_0 (Hz)	HNR (dB)	MPD (Sec)	s/z ratio (Sec)	VHI scores
Pre therapy	2.27±0.9	1.73±0.6	134.5±19.13	12.67±4.6	8.27± 1.7	1.43± 0.23	31.53± 4.8
Control group	0.62±0.24	0.56 ±.32	135.9±10.8	19.63± 2.2	18.82±1.8	1.1±0.09	8.83±1.73
p value	0.00*	0.00*	0.217	0.021*	0.00*	0.02*	0.00*

4.2 Comparison of voice parameters in cases between before and after voice therapy

The mean voice parameters were compared between before and after voice therapy among cases. One way ANOVA test was applied. Results showed a significant improvement in acoustic parameters [jitter (p=0.00), shimmer (p=0.00) and HNR (p=0.03)], aerodynamic aspects [MPD (p=0.01), s/z ratio (p=0.015)] and VHI scores (p=0.00) in after voice therapy than the values of prior to voice therapy. The F_0 did not show any significant difference between these two groups (p=0.368). (Table-2)

GRABS scores was calculated and compared in cases between before and after voice therapy. Wilcoxon sign rank test was applied. Results showed all that parameters **[**G (p=0.00), R (p=0.00), A (p=0.023), B (p=0.00), S (p=0.00)**]** were significantly improved after voice therapy. (Table-3)

Table 2: Mean value and standard deviation of acoustic parameters, aerodynamic aspects and VHI scores between pre and post voice therapy. (* Indicates statistically significance p < 0.05)

	Acoustic features				Aerodynamic aspects		Perceptual aspects
	Jitter (%)	Shimmer (dB)	F_0 (Hz)	HNR (dB)	MPD (Sec)	s/z ratio (Sec)	VHI scores
Pre therapy	2.27±0.9	1.73±0.6	134.5±19.13	12.67±4.6	8.27± 1.7	1.43± 0.23	31.53± 4.8
Post therapy	0.93±0.4	0.67± 0.31	137.9±10.5	17.56±2.3	15.56±2.3	1.02±0.12	13.73±6.43
p value	0.00*	0.00*	0.368	0.03*	0.01*	0.015*	0.00*

Table 3: GRBAS data for pre and post voice therapy. The number of patients with a given score for each parameter of the GRBAS scale before and after voice therapy is given. (* Indicates statistically significance p < 0.05)

	G- Grade		R - Rough		A-Asthenic		B-Breathy		S-Strain	
GRABS score	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
0	0	3	4	14	7	18	12	24	6	19
1	13	20	12	10	12	8	15	6	15	9
2	14	7	10	6	8	4	3	0	8	2
3	3	0	4	0	4	0	0	0	1	0
P value	0.00*		0.00*		0.023*		0.00*		0.00*	

4.3 Comparison of voice parameters between control group and cases after voice therapy

To know whether the cases improved voice is look like a normal voice, the mean voice parameters of control group were compared with the voice parameters of cases after voice therapy. One way ANOVA test was applied. Results showed no significant differences between control group and cases in acoustic parameters [jitter (p=0.05), shimmer (p=0.13), F_0 (p=0.221), and HNR (p=0.12)], aerodynamic aspects [MPD (p=0.07), s/z ratio (p=0.32)] and VHI scores (p=0.42). (Table 4)

Table 4: Mean value and standard deviation of acoustic parameters, aerodynamic aspects and VHI scores between post voice therapy and control group. (* Indicates statistically significance p < 0.05)

	Acoustic features				Aerodynamic aspects		Perceptual aspects
	Jitter (%)	Shimmer (dB)	F_0 (Hz)	HNR (dB)	MPD (Sec)	s/z ratio (Sec)	VHI scores
Post therapy	0.93±0.43	0.67±0.31	137.9±10.5	17.56±2.3	15.56±2.3	1.02±0.12	13.73±6.43
Control group	0.62±0.24	0.56±0.32	135.9±10.8	19.63±2.2	18.82± 1.83	1.1±0.09	8.83±1.73
p value	0.05	0.13	0.221	0.12	0.07	0.32	0.42

5. Discussion

The general goal of voice therapy is to rehabilitate the cases voice to a level of function that enables the patient to fulfill their communication needs. Laryngologists and Speech Pathologists realize the importance of voice therapy and apply it to voice disorders that are not suitable for other treatments and have obtained good results [5, 10, 11]. The present study was focused on the effects of voice therapy in Hyper-functional voice disorders. Our study results showed that cases all voice parameters were improved after voice therapy. Here we found the effects through the multidimensional factors such as acoustic, aerodynamic and perceptual aspects.

Schindler *et al.* [12] reported a study of 16 patients with vocal fold lesions who had 10 voice therapy sessions with an experienced speech-language pathologist for a period of 1–2 months. A clear and significant improvement was found in the mean values of Jitter, HNR, and VHI scores, but no improvement was observed in the aerodynamic and perceptual ratings. In comparison, our study shows a significant improvement in all voice parameters such as acoustic, perceptual and aerodynamic aspects. Additionally, we compared the control group voice parameters with cases after voice therapy and we found no significant difference between these two groups. Our voice therapy mainly focused on vocal hygiene, respiration and phonation skills. Vocal hygiene educated the patients to avoid the vocal abuse and misuse that helped in reducing the occurrence of sustained vocal fold trauma. Respiratory training improved the breathing capacity and Phonation techniques facilitated the better voice quality. Our study results were consistent with the previous study results, that voice therapy improves all voice parameters in hyper functional voice disorders.

Acoustic voice parameters have been used to provide noninvasive, quantitative assessment of vocal fold lesions, but these parameters have produced inconsistent results. Jitter and shimmer are used for the description of voice quality. Jitter is used to identify the instability in the vocal cord vibration [13]. Jitter increase as control over laryngeal muscle tone becomes rough and Shimmer increases with poor and inconsistent contact between the vocal cord edges [14]. Peppard *et al.* [15] found that singers with HFVD (vocal nodule) have significantly different jitter values than the normal group, while the shimmer of the normal and pathological groups showed no significant difference. In contrast, Rosen *et al.* [16] found a significant difference between normal and nodule groups in shimmer but not in jitter. Dan Lu *et al.* [17] found a significant difference between normal and laryngeal pathology groups in jitter, shimmer and HNR. Our results showed significant difference between normal and HFVD groups in jitter, shimmer and HNR but not in F_0. The contradictions in these results may be attributed to

differing population selection. However, methodological dissimilarity among the studies is the application of different analysis systems and software for signal processing. Jitter and shimmer are dependent on pitch extraction algorithms and thus are sensitive to variations in analysis systems [18, 19].

Barcelos *et al.* [20], Pan Zhuge *et al.* [21], Petrovic-Lazic *et al* [6] and Schindler *et al.* [5] found improvement of GRABS and VHI scores after voice therapy in different voice disorders. Our study results were consistent with the previous studies results that state GRABS and VHI scores improved after voice therapy. Improvement in GRABS and VHI indicate that their voice became normal. Because, voice therapy allows patients to have a clearer understanding of the problems with their own voice, it relieves the psychological anxiety caused by the voice quality disorder, and they experience improvement in their voice and greater vocal comfort.

Oliveira Lemos *et al.* [22] found the effect of voice therapy in 30 patients with muscle tension dysphonia through MPD and s/z ratio. Their voice therapy program included indirect and direct therapy approaches. They found significant improvement in MPD after voice therapy but no significant difference in the s/z ratio before and after voice therapy. In our study we found significant improvement in MPD and s/z ratio after voice therapy. Difference in the methodological procedures and applied therapeutic techniques may affect therapy outcomes and study results.

6. Conclusion

From this study we conclude that the voice therapy provides considerable improvement in all the parameters of voice in hyper-functional voice disorders. Multidimensional assessment of voice such as acoustic, perceptual and aerodynamic aspects provides an objective, recordable data regarding the voice parameters and its pathologies. Therefore, it is not recommended to use a single parameter to assess voice quality. Rather the entire voice parameters are needed in diagnosis and treatment of Hyper-functional voice disorders.

7. Conflict of interest: None

8. References

1. Hillman RE, Holmberg EB, Perkell JS, Walsh M, Vaughan C. Objective assessment of vocal hyper function; an experimental framework and initial results. J Speech Lang Hear Res. 1989; 32:373-392.
2. Morrison M, Rammage L, Gilles M, Pullan N. Muscular Tension Dysphonia. J Otolaryngol. 1983; 12:302-306.
3. Giovani A, Revis J, Triglia JM. Objective aerodynamic and acoustic measurement if voice improvement after phonosurgery. Laryngoscope. 1999; 109:656-660.
4. Zhuge P, You H, Wang H, *et al*. An analysis of the effects of voice therapy on patients with early vocal fold polyps. J Voice. 2016; 30:698-704.
5. Schindler A, Mozzanica F, Maruzzi P, *et al*. Multidimensional assessment of vocal changes in benign vocal fold lesions after voice therapy. Auris Nasus Larynx. 2013; 40:291-297.
6. Petrovic-Lazic M, Jovanovic N, Kulic M, *et al*. Acoustic and perceptual characteristics of the voice in patients with vocal polyps after surgery and voice therapy. J Voice. 2015; 29:241-246.
7. Verma P, Pal M, Raj A. Objective acoustic analysis of voice improvement after phonosurgery. Indian J Otolaryngol Head Neck Surg. 2010; 62:131–137.
8. Salomoni S, Vanden Hoorn W, Hodges P. Breathing and singing: objective characterization of breathing patterns in classical singers. PLoS ONE. 2016; 11:e0155084.
9. The Voice Handicap Index (VHI): Development and Validation. Barbara H. Jacobson, Alex Johnson, Cynthia Grywalski, Alice Silbergleit, Gary Jaconsen, Michael S. Benninger. American Journal of Speech-Language Pathology. The Voice Handicap Index is reprinted with permission from all authors and ASHA. Copyright American Speech-Language-Hearing Association. 1997-2001; 6(3):66-70.
10. Watts CR, Hamilton A, Toles L, *et al*. A randomized controlled trial of stretch-and-flow voice therapy for muscle tension dysphonia. Laryngoscope. 2015; 125:1420-1425.
11. Gillespie AI, Dastolfo C, Magid N, *et al*. Acoustic analysis of four common voice diagnoses: moving toward disorder-specific assessment. J Voice. 2014; 28:582-588
12. Schindler A, Mozzanica F, Ginocchio D, Maruzzi P, Atac M, Ottaviani F. Vocal improvement after voice therapy in the treatment of benign vocal fold lesions. Acta Otorhinolaryngol Ital. 2012; 32:304-308.
13. Carding PN. Measuring the effectiveness of voice therapy. London: Whurr publication Ltd, 2000.
14. Wolfe V, Martin D. Acoustic correlates of dysphonia: type and severity. J Commun Disord. 1997; 30:403-415.
15. Peppard RC, Bless DM, Milenkovic P: Comparison of young adult singers and nonsingers with vocal nodules. J Voice. 1988; 2:250-260.
16. Dan Lu, Fei Chen, Hui Yang, Rong Yu, Qi Zhou, Xinyuan Zhang, *et al*. Changes after Voice Therapy in Acoustic Voice Analysis of Chinese Patients with Voice Disorders. Journal of Voice. 2017.
17. Dan Lu, Fei Chen, Hui Yang, Rong Yu, Qi Zhou, Xinyuan Zhang, *et al*. Changes after Voice Therapy in Acoustic Voice Analysis of Chinese Patients with Voice Disorders. Journal of Voice, 2017.
18. Milenkovic P, Read C: CSpeech, Version 4, User's Manual. Madison, 1992.
19. Titze IR. Workshop on Acoustic Voice Analysis: Summary Statement. Denver, National Center for Voice and Speech, 1995.
20. Camila Barbosa Barcelos, Paula Angélica Lorenzon Silveira, Multidimensional effects of voice therapy in patients affected by unilateral vocal fold paralysis due to cancer August Brazilian journal of otorhinolaryngology, 2017; 84(5).
21. Huihua You, Hanqing Wang, Yulan Zhang, Huanle Du. An Analysis of the Effects of Voice Therapy on Patients With Early Vocal Fold Polyps Pan Zhuge, Journal of Voice, 2015.
22. De Oliveira Lemos I, da Cunha Pereira G, Druck SantAnna G, Cassol M. Effects of a Voice Therapy Program for Patients with Muscle Tension Dysphonia, S. Karger AG, Basel, 2018.