EFFICACY OF SOVTE - LAX VOX IN FUTURE

SPEECH-LANGUAGE PATHOLOGISTS

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University of Mysore,

Mysuru

ALL INDIA INSTITUTE OF SPEECH AND HEARING,

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SEPTEMBER 2023

CERTIFICATE

This is to certify that this dissertation entitled "**Efficacy of SOVTE - Lax Vox in Future Speech Language Pathologists**" is a bonafide work submitted in part fulfillment for degree of Master of Science (Speech-Language Pathology) of the student with Registration Number: P01II21S0024. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled “**Efficacy of SOVTE - Lax Vox in Future Speech Language Pathologists**” is the result of my own study under the guidance of Dr. K. Yeshoda, Associate Professor in Speech Sciences, Department of Speech-Language Sciences, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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"Do not be afraid of your struggles. Face them with courage and resolve. In challenges, you discover your true strength." - Bhagavad Gita (Chapter 6, Verse 5)

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CHAPTER I

INTRODUCTION

Humans rely heavily on their voices as a means of emotional, social, and economic communication. The voice portrays an individual's inner self and serves as a mirror of one's personality (Sataloff et al., 1997). Vocal folds vibrate to produce speech signals. “A voice that has the following five characteristics could be regarded as "clinically normal": (i) adequate loudness, (ii) maintaining proper vocal hygiene, (iii) normal vocal quality, (iv) adequate flexibility, and (v) correct representation of the speaker's age and gender. When one or more of the five qualities of the voice deviate from the normal range, the voice is called aberrant or disordered” (Boone et al., 2013). Voice production includes a complex synergy of several physiological, biochemical, and psychosocial subsystems, and thereby the disorder's etiology is frequently multifactorial (Payten et al., 2022). According to Boone et al. (2013), there are three different classes of voice disorder: organic voice disorder, inorganic voice disorder, and neurogenic voice disorder.

According to Koufman & Isaacson (1991), individuals whose jobs require them to use their voices frequently are referred to as Professional voice users. Teachers, singers, actors, salesmen, clergy, politicians, broadcasters, orators, speech-language pathologists, and several other professionals are well-known PVUs. The voice of PVUs plays a crucial role in their ability to make a living as well as serves as a vital component of one's identity. Under this classification of vocal professionals, speech-language pathologists (SLPs) are classified as Level II professional voice users. Professional voice users are more likely to acquire voice-related disorders if proper vocal hygiene is not practised (Stemple et al., 1995).

Gottliebson et al. (2007) used the "quick screen for voice" to screen the vocal features of 104 first-year students preparing to be SLPs. According to the results of the study, 12% of future SLPs had vocal issues, which is greater than the general population. SLPs frequently give voice treatment and are expected to model or perform vocal behaviours and procedures. They concluded that SLPs and those aspiring to be SLPs had excess vocal usage in different demanding situations for communicating effectively with parents and clients during therapy sessions and counselling. It is also critical that they exhibit and model excellent verbal communication and additionally engage in conferences that may be physical or via tele-mode, public speaking during awareness camps, etc.

Warhurst et al. (2012) evaluated the quality of voice in 2 groups of female SLP students, of which forty-one were in their first year and thirty-four were in their final year. The participants performed the prolonged vowel /a/ task in 2 different ways: with their normal speech voices (Habitual Voice) and with a "clear voice" (Performance Voice), as they appeared to be practising during voice therapy. The results showed that the voices of the final-year student SLPs were not perceptually clearer than those of the first-year students. Also, SLP students' performance voices were not perceptually clearer than their normal speech voices. Based on the findings, it was suggested that some techniques, such as, Lee Silverman Voice Treatment (LSVT), the Accent Method, and Resonant Voice Therapy for vocal nodules were some evidence-based voice techniques that were necessary for SLPs to model a vocal target that is perceptually clean and free of dysphonia. In order to communicate efficiently, SLPs must possess an excellent habitual speaking voice as professional voice users.

According to Boone (2013) Speech-language pathology students showed exceptionally higher scores on the Voice Handicap Index (VHI) than students in other health professions. SLPs' voices are always contending with demands for extreme voicing with background noise and pollution. SLPs were advised to initiate a vocal hygiene program, basically for raising awareness about the need to prevent voice from excessive phonation over time, especially when background noise is present. The author suggested that the vocal hygiene program had to be combined with some additional vocal training to aid the professional voice users in keeping a healthy professional voice.

To treat vocal abnormalities, several methods have been developed. Stemple (2000) classified these techniques as physiologic, symptomatic, hygienic, and psychogenic. The core premise of physiologic voice therapy is that voice related issues may be successfully treated by altering the physiological basis of voice production. Also, the physiologic approach had three primary goals, improving the 'balance' of the three essential subsystems involved in voice production: breathing, phonation, and resonance, improving laryngeal muscle strength, balance, tone, and stamina as well as establishing a healthy mucosa covering of the true vocal folds.

According to Andrade et al. (2014), physiological treatments include semi-occluded vocal tract exercises (SOVTEs), phonating into various tubes with one end suspended in the air or submerged into the water or Lax Vox, phonation into a semi-occluded-facemask, cup phonation, voiced fricatives, lip-buzz, Y-buzz, nasal consonants, lip and tongue trills, raspberries, and hand over mouth technique or finger kazoo. The authors included 23 healthy individuals with no voice complaints and performed a series of SOVTEs, which had straw, Lax Vox, humming, tongue trills, hand-over-mouth, lip-trills, and tongue trills and hand-over-mouth SOVTEs are combined. Participants were asked to do phonation comfortably, followed by all the series of 7 SOVTEs. Results suggested there was a significant difference found in CQr (contact quotient range) and F_0r (fundamental frequency range) score for the combined tongue-trill with hand-over-mouth, lip-trill, LaxVox, and tongue-trill when compared with the comfortable phonation. Since SOVTE with a secondary source of vibration affects the vocal fold vibration, the CQr and F0r studies corroborate this claim when compared to SOVTE with a single source of vibration.

Meerschman et al. (2017) examined the immediate impact of two SOVTE (straw phonation and resonant voice training using nasal consonants) on 30 healthy second-year BASLP students for 6 weeks. Aerodynamic assessment, acoustic analysis (AVQI, DSI), maximum phonation task, and Voice Range Profile were assessed before and after therapy, along with subjective measures. Results showed the positive impact of SOVTEs on the overall quality of voice and vocal capacities of future SLPs. The RVT enhanced the DSI while training with straw phonation increased the student's intensity range.

1.1 Lax Vox Voice Therapy Technique

Denizoglu. (2017) explain that the main objective of voice therapy is to achieve the finest voice a patient can have within the constraints of their anatomy and physiology. Lax Vox Therapy technique (LVT) is one of the therapy approaches that combine artificial vocal tract lengthening with semi-occlusion by water resistance and is an outstanding method for treating and strengthening the function of the voice-producing mechanism. LVT delivers multichannel biofeedback and develops holistic cognition of the vocalising process through a variety of exercises. Several functional and organic voice disorders, such as vocal fold nodules, unilateral vocal fold paralysis, muscle tension dysphonia, presbyphonia, mutational falsetto, and habitual and psychogenic dysphonia or aphonia, may be treated well with LVT. It is also a habilitative approach for professional speakers and singers seeking to improve their vocal ergonomics and voice care. The LVT was created to alleviate phonation strain and enhance vocal training (Fadel et al., 2016).

According to Tyrmi et al. (2015), water resistance therapy employs a silicone tube called Lax Vox that is 35 cm long with a diameter of 9 to 12 mm.

Andrade et al. (2014) used the Lax Vox voice therapy training in conjunction with other SOVTEs on individuals with no voice complaints and reported that Lax Vox increased the fundamental frequency (f0) compared to other SOVTEs.

Other investigations by Mailänder et al. (2017) focused solely on the Lax Vox technique in healthy teachers without any voice problems, over the course of three weeks. The results showed that Lax Vox improved the overall quality of voice by lowering roughness and hoarseness, and significantly increased the MPT after Lax Vox training.

1.2 Acoustic Voice Quality Index (AVQI)

Across studies, different outcome measures have been used to evaluate perceptual and objective voice quality. Perceptual voice assessment is a method that uses auditory perceptual processes and information from a rating system to make suitable judgments on the normal character and suitability of an individual's voice (Aronson, 2009). Grade Roughness Breathiness Asthenic Strain (GRBAS) (Hirano, 1981), Consensus Auditory Perceptual Evaluation of Voice (CAPE-V) (Kempster et al., 2009), Buffalo Voice III Profile (Wilson, 1987), Vocal Profile Analysis Scheme (Laver et al., 1991) are several of the widely used perceptual evaluation assessment tools.

According to Srinivas et al. (2021), in multiparametric voice assessment, Subjective evaluation always complements the result of objective measures. Objective evaluation is crucial to their validity since it provides a more quantitative description of voice characteristics and serves as a diagnostic marker. Acoustic measurements, electroglottographic procedures, and aerodynamic assessments are examples of objective measures utilized to examine voice characteristics.

According to Maryn et al. (2010), among the multiparametric voice indices, the Acoustic Voice Quality Index is a tool for evaluating quality of voice based on connected speech and prolonged vowels. Harmonics-to-noise ratio, shimmer local, shimmer local dB, under the quefrency-domain Smoothed Cepstral Peak Prominence, and under the frequency-domain the slope of Long-term average spectrum and tilt of the regression line across the spectrum are the six constituent parameters of AVQI. The overall voice quality declines with increasing AVQI score and vice versa. The AVQI affirms its value as a dependable, impartial outcome measure for voice treatment and is also responsive to changes related to treatment. Reynolds et al. (2012) discovered that the AVQI correlates with the GRBAS scale and that the AVQI is an adequate instrument for assessing and diagnosing dysphonia in children.

Ranjani and Yeshoda (2021) evaluated the effect of SOVT-frication exercise on phononormal SLPs and compared the pre- and post-training AVQI values. Twenty-four healthy phononormals underwent 21-day SOVT exercises- labiodental fricative /v/ for two times per day. The results demonstrated that after therapy, there was an increased AVQI value for both male and female participants, lower CPP values for female participants, lower Shimmer Local for male participants, and lower tilt LTAS for both male and female participants, and there were no significant changes found in the slope Long Term Average Spectrum, Shimmer dB, Shimmer local and HNR after therapy. Lack of improvement in a few measures was attributed to short practice time to notice marked differences in the participants.

1.3 Need of the study

There are minimal evidences that validates changes in voice acoustic characteristics that occur along the course of voice therapy programs. There is currently a scarcity of literature addressing the physiological and physical basis of the SOVT-Lax Vox voice therapy. The clinical purpose of the SOVT-Lax Vox voice therapy technique is to increase voice production while minimising vocal fold impact stress and physical exertion, hence avoiding or reducing the likelihood of vocal fold mucosa damage. Most of the investigations have focused on the influence of the Lax Vox voice therapy in some voice disorders using electroglottographic, aerodynamic, and objective acoustic measures and reported that the effect of the Lax Vox voice therapy varied greatly across and among persons.

Previous studies using the Lax Vox voice therapy training were conducted on healthy teachers, singers, and other professional voice users. They mostly focused on the immediate impact of a single SOVTE (Lax Vox voice therapy) performance rather than the long-term impact of the Lax Vox voice therapy. A few studies have documented the outcome of the Lax Vox approach on future occupational voice users. There is a paucity of research on the Lax Vox voice therapy training's impact on the voice of speech-language pathologists or those who are speech-language pathologist trainees in India. This necessitates a need for obtaining evidence on the SOVT Lax Vox voice therapy training's effects on these professionals so that the benefits of such exercises may lead to conservatory voice production, warranting their recommendation for various occupational voice users and dysphonic populations. Scanty literature reports are found that review the influence of the Lax Vox voice therapy training using acoustic parameters. AVQI, in particular, could be utilized as a prognostic indicator to track the efficiency of the voice therapy program.

1.4 Aim

To investigate the short and long-term effects of SOVT Lax Vox voice therapy training on the voice of future occupational voice users (speech-language pathologist trainees) using AVQI as an outcome measurement.

1.5 Objectives

1. To compare the baseline AVQI values with every 3rd day immediate post-training AVQI values over the course of Lax Vox voice therapy training for 12 days in the phonation and reading samples of speech-language pathologist trainees.
2. To compare the baseline AVQI values with AVQI values of 12th day after the Lax Vox voice therapy training in the phonation and reading samples of speech-language pathologist trainees.
3. To determine the trend of change in AVQI along the course of Lax Vox voice therapy training in speech-language pathologist trainees.

CHAPTER II

REVIEW OF LITERATURE

Voice, a crucial and fundamental component of spoken communication, plays an indispensable part in our lives. Together with language, voice has made significant contributions to the formation of our society and culture (Varshini, 2021). The voice has been recognised as one's own identity as well as an efficient tool for communication. The vibrating vocal folds, which generate voice, can maintain volume, broad range of pitch, and quality. This can be accomplished by adopting a healthy vocal lifestyle that protects the vocal folds from voice disorders like vocal polyps, vocal nodules, etc. However, a variety of inherent and external factors induce damage to the fragile multi-layered vocal folds, leading to dysphonia and/or aphonia. As a result of their tremendous impact on individual personal, professional, and social life, voice problems are increasingly seen as a "public health concern" (Dodderi et al., 2018).

Citizens' access to public health care remains a concern, and the private sector is helping to fill certain gaps. However, the root cause of this neglect is unawareness and apathy towards systems of healthcare. Even citizens' vocal healthcare is important, as is the diverse etiology of voice diseases. Voice issues are becoming more common, with vocal nodules being the most common vocal fold ailment (Dodderi et al., 2018).

Furthermore, a group of people rely heavily on "voice" for their careers and daily living. Their voice is relatively more important and precious in their lives. These groups are referred to as "Professional Voice Users (PVU)" (Vilkman et al., 2004). PVUs primarily rely on their voices, and therefore, the effects of "voice disorders" or "vocal quality changes" are more severe and multifaceted. Because PVUs have higher vocal demands than the general population, they are more likely to experience voice issues (Stemple et al., 2000). Speech-language pathologists (SLPs) are classified as Level II professional voice users under Koufman & Isaacson (1991) classification of vocal professionals.

Van Mersbergen et al. (2001) sent questionnaires to two hundred fifteen students of master's degree graduates in speech-language pathology to investigate their knowledge and comprehension of voice problems, normal voice production, and voice therapy approaches. The results of the 69 responses indicated that students were not given enough clinical training or information on handling common voice problems. In conclusion, it was stated that the lack of knowledge and clinical experience caused students to employ and adopt inappropriate practices, resulting in vocal abuse and voice fatigue.

Mavis and Yeshoda (2022) investigated the symptoms of voice fatigue in working SLPs across different setups using the voice fatigue Index-version 2. Eighty-two SLPs were classified based on their working environment as academic institutions, hospitals and private clinical settings. Though the SLPs reported symptoms of voice fatigue, they were not consistent across all setups. The VFI-2 consisted of questions categorised into three factors, Factor 1 (F) associated with fatigue of voice and refraining of voice use, 2^{nd} Factor (P) associated with the physical discomfort of voice use, and 3^{rd} Factor I associated with improvement in symptoms with rest. Results indicated that there was a link between the number of hours spent speaking and vocal tiredness (Hours Vs F Total: $r = 0.354$, $p < 0.01$; Hours Vs P Total: $r = 0.289$, $p < 0.01$; Hours Vs R Total: $r = 0.271$, $p < 0.05$) suggesting increased voice use hours increased the chances of vocal fatigue symptoms. The reason for these results was speculated as the nature of the work at the setup, varying vocal demands, successful selfimplementation of vocal techniques, consistent practice of vocal hygiene habits, and enough rest for vocal recovery. The study was the first step towards understanding of voice fatigue in SLPs in India.

2.1 Semi Occluded Vocal Track Exercises (SOVTE)

Stemple et al. (2000) opined that applying physiological voice therapy methods such as semi-occluded vocal tract exercises (SOVTEs) to voice production altered three crucial elements. It improved harmony between resonance, phonation, and respiration. Secondly, the laryngeal muscles became stronger, more balanced, toned, and more resilient and thirdly developed an adequate mucosa layer over the true vocal folds.

Laukkanen et al. (1996) investigated the variation in laryngeal function and the vocal source during and after the voiced bilabial fricative /b:/ exercise in six phononormals. Electroglottography, electromyography and inverse filtering of the acoustic signal were used to measure the change. The following tasks were performed by subjects in which first 20 repetitions of /a:p/ at habitual pitch and sound pressure levels, second 20 repetitions of the utterance /b:p/ as a vocal exercise, third, a series of 20 alternations between first and second tasks and fourth was repetition of the first task. The findings implied that the laryngeal muscle activity decreased reflexively during exercise on /b:/, probably as a result of reactive back pressure brought on by the increased supraglottic resistance, and the condition of reduced laryngeal muscle activity persisted in vowel production following /b:/ phonation. Thus, the production of /b:/ resulted in less laryngeal muscle activity and improved vocal economy.

Titze (2006) examined the physical underpinnings of the exercise and therapeutic methods that employed semi-occluded vocal tract shapes. To clarify source-filter interactions for lip and epilarynx tube semi-occlusions, computer simulation was utilised with a self-oscillating vocal fold model and a 44-segment vocal tract. He explained that by increasing the mean intraglottal and supraglottal pressures, semi-occlusion of the vocal tract's anterior portion, i.e., at lips, intensified source-tract interaction. Changed vocal tract length or cross-section because of SOVTE caused impedance matching in the vocal tract and vocal folds, resulting in feeding back of energy to the glottis, producing an in-phase velocity between the supraglottal pressure and airflow and therefore improving voice's effectiveness and economy.

A research pilot was conducted by Vampola et al. (2011) using computer tomography (CT) to determine the morphology of the vocal tract in a female without voice complaints before, during, and after phonation in a glass tube of 27 cm. To explore variations in vocal tract input impedance, three-dimensional finite-element models (FEMs) of the vocal tract were created using CT scans. The findings demonstrated that the morphology of the vocal tract may be affected by tube phonation and that the exercise enhanced input reactance, making the vocal tract more inert. Also, according to the findings, phonation through a tube altered the vocal tract in ways that persist even after the tube was removed. Hence, patients and voice professionals could benefit from these impacts by having better voice production.

In 41 primary school teachers with mildly dysphonic voices, Guzman et al. (2013) examined the immediate effects of voice training over the course of a single 30-minute session. There were two separate groups of teachers, the control group (17) who practised voice training with the open vowel /a/, and the experimental group (24) who practised phonatory tasks with straw phonation. Voice recording was done before and after the session, which included a read-aloud task of a 242-word phonetically balanced text, at habitual intensity level and speaking fundamental frequency. Long-term average spectrum (LTAS) scores were noted, and results revealed that there was a significant immediate effect seen on the LTAS after one single session with straw phonation exercises.

Guzman et al. (2018) reported the effect of double source of vibration SOVTEs on subjective and objective variables in 84 subjects with voice complaints. 82 subjects were randomly assigned to one of four treatment groups that are tongue trills, lip trills, and both tongue and lip trills at the same time, i.e., raspberry and water resistance therapy. Three assessments were done, the 1st was a pre-therapy assessment, 2nd was immediately after voice therapy, and the 3rd assessment was taken after 1 week of home training. Pre and both post-therapy session results show significant differences. The author says that after each exercise, the subject's subjective assessment of the quality of their voice increased and that progress remained consistent after a week of practice. Also, the highest effects were achieved with raspberry and water resistance treatment. In conclusion, in patients with voice complaints, SOVTEs with a secondary vibration source may lessen vocal symptoms associated with physical discomfort.

Laukkanen et al. (2020) in an experiment, used the contact quotient (CQ) and maximum derivative from an electroglottogram (EGG) to examine the impact of stress (IS) associated with water resistance voice therapy and how demanding it may be on the vocal folds. They included a male teacher of a nonclassical singing background and was asked to sustain [u:] or [o:] vowel with natural loudness and pitch and phonate same vowel into a Lax Vox tube made of silicone that was placed in water that was 2 cm deep. They suggested that phonation into the water through a tube increased the EGG's closed quotient and contact quotient, but phonation into the water had a higher stress impact. However, phonation into the water resulted in a reduction in the vocal folds maximum velocity and glottal width during glottal closure, as did the maximum derivative of the EGG (MDEGG). With it, the authors concluded that phonation into the water had a lower impact of stress than prolonged vowels.

Ghosh and Yeshoda (2020) examined how phonation using a straw for 21 days influenced normal voice using some acoustic, aerodynamic, and glottal parameters. For convenience, all 20 subjects were adult female postgraduate students of speech-language pathology. Baseline recordings of phonation of all the participants were measured a day before they started the exercises, and post-training recordings were taken a day after they finished. All of the subjects completed 10 minutes of straw phonation for 21 consecutive days with the drinking straw they were provided. Acoustic, aerodynamic, and glottal parameters were extracted from baseline and post-therapy recordings using the EGG and MDVP modules from the Computerized Speech Lab 4500 model. The analysis of pre and post-therapy values revealed a significant increment in F0, a decrease in absolute jitter values, and an increase in maximum phonation duration. The study's outcome supports the notion that straw phonation benefitted even the normal voice and could even improve the acoustic and aerodynamic measures.

A study done by Manjunatha et al. (2022) investigated twenty-five female speech and language pathologists who underwent intense speech therapy with straw phonation exercises for five hours a day for three months. Changes in MPD, acoustic measures (noise to harmonic ratio, intensity, jitter, shimmer, F0, F1, F2, F3, F4) and self-perceptual assessment were noted. Significant improvement was found in the intensity, maximum phonation duration, fundamental frequency, Format 1, Format 2, Format 4 and self-perceptual measures. Hence, the authors suggested that professional voice users may benefit from straw phonation as a warm-up exercise, and this procedure should also be followed to maximise the overall impact. The SLPs who completed the study reported that they could maintain ideal voice quality and experienced a feeling of relaxation by doing straw phonation exercises, hence, it served as a "warm-up exercise".

2.2 Lax Vox Voice Therapy Training

Since the 1960s, Lax Vox has been used to treat voice patients, and it is based on the Finnish resonant voice tube technique.

A study by Mailänder et al. (2017) looked at the impact of the voice treatment Lax Vox approach on four healthy female teachers over the course of three weeks. Aerodynamics, self-evaluation, perception, and acoustics were among the voice parameters studied, and it also included a survey to assess Lax Vox's usability. The findings conclusively showed that Lax Vox enhanced overall quality of voice by reducing hoarseness and roughness of the voice, notably boosting MPT following Lax Vox training. Furthermore, following three weeks of treatment, the AVQI value dropped, and the Voice Range Profile showed a rise in the intensity level of more than 3 dB at the lower frequencies. Similarly, the findings of the other voice assessment were validated by self-evaluation assessment utilising VHI. The individuals also saw a significant increase in their physical ability after utilising Lax Vox. Ultimately, Lax Vox's applicability showed an evident benefit on training performance, learning process, and transfer to everyday routine. Teachers who received Lax Vox training also noted improved in overall voice quality, increased MPD, perceived applicability, vocal function and self-evaluation.

The effects of Lax Vox® voice therapy on 30 singers with voice issues were described by Matta et al. (2021). Singers' voices were evaluated using aerodynamic, acoustic, perceptive-auditory, and electroglottographic voice analysis and high-speed video laryngoscopy was also employed to inspect the larynx. The subjects were evaluated at the start of the therapy and then after executing 5 minutes of the Lax Vox® voice therapy. Acoustic and aerodynamic examination revealed that using the Lax Vox® voice therapy enhanced fundamental frequency in male individuals, as well as mean airflow values during vocalisation and aerodynamic power in both female and male subjects. The authors concluded that singers with dysphonia should practise the Lax Vox® voice therapy for overall enhanced voice quality.

The effects of the Lax Vox therapy and voiced high-frequency oscillation (VHFO) (35 cm of silicon tube in length) on acoustic and the self-assessed parameters of vocally healthy participants were compared by Antonetti et al. (2022). Additionally, they checked for variations in the effect of exercises done by men and women. The acoustic parameters noted were the alpha ratio, L1–L0 and CPP-s, and the vocal and laryngopharyngeal symptoms by self-assessment. Before beginning the activities, assessments were taken (moment 0: M0), then again after one minute (M1), and finally after three minutes (M3). To minimise lingering effects from the first exercise, all 30 individuals did both exercises with a 7-day washout, and 1 and 3 minutes were the performance times with a 15-minute break. Findings showed that the VHFO and Lax Vox techniques yielded favourable CPP-s results in both genders even after 1 minute of each exercise, which continued after 3 minutes suggesting in vocally healthy participants, the oscillation pattern of the vocal folds improved after 1 minute of therapy. Thus, it was suggested that vocally fit persons may only need one minute of these exercises for voice training. Men benefitted more from VHFO, and women benefited more from the Lax Vox treatment for the tightness symptoms. The Lax Vox approach, which may cause less resistance, was best for women since their vocal tract structures were smaller and more sensitive. Findings suggest that laryngeal discomfort reduced by employing different SOVTE, such as VHFO and the Lax Vox technique.

2.3 Acoustic Voice Quality Index (AVQI)

Despite the fact that various multiparametric techniques for evaluating overall quality of voice exist, the Acoustic Voice Quality Index has found clinical and scientific applications across the world. One benefit of AVQI over other multiparametric methodologies for assessing overall voice quality is that it incorporates acoustic data from both sustained vowel and continuous speech and provides a unitary score between '0' and '10'. Also, the AVQI and the perceptual measures of dysphonia showed link between them. The overall quality of voice declines with increasing AVQI score and vice versa. AVQI constituent parameters are cepstral, spectral, and perturbation measurements that are Smoothed Cepstral Peak Prominence, Harmonics to Noise Ratio, Shimmer local, Shimmer in dB, Slope of Long-Term Average Spectrum (LTAS), and the tilt of trendline through the LTAS (Tilt- LTAS) (Maryn et al., 2010).

Reynolds et al. (2012) determined the AVQI threshold of 3.46 for English language, in order to have greater specificity and sensitivity for the sample. The first revision (AVQI version 2) accommodated all the constituents of AVQI within the software PRAAT.

To generate the AVQI version 2, a three-second SV sample of the vowel [a:] and a CS sample were required (Jayakumar et al., 2022). They examined the influence of age and gender on multiparametric AVQI v.02.02 for the Indian population by including two hundred participants, with an equal number of men and women. Of them, 50 were paediatrics, 100 were adults, and 50 were elderly individuals. The paediatric and older adult groups' AVQI threshold was found to be significantly higher as compared to adult groups. Hence, significant age effects were shown. Adult populations were shown to have greater degrees of AVQI stability than paediatric and elderly groups. Additionally, in the AVQI, gender effects were not noticed. Hence, in conclusion, AVQI is gender-independent but age-dependent measure.

Meerschman et al. (2017) recruited 30 healthy second-year bachelor students specialising in logopedic and audiological sciences for their study to identify the short-term effect of two SOVTE that are “resonant voice training using nasal consonants” and “straw phonation” for 6 weeks. Pre and post-voice assessment was done, including both objective (aerodynamic assessment, acoustic analysis, AVQI, DSI, maximum phonation task, VRP) and subjective (participant’s self-report, auditory–perceptual evaluation, questionnaire). The results showed better vocal skills in terms of intensity range expansion after straw phonation training and enhanced DSI following resonant voice training. Although, for AVQI, there was no significant change still a discernible pre- and post-therapy values difference was noted, where the values of AVQI, CPPs, and HNR increased following straw phonation whereas parameters such as Slope of Long-Term Average Spectrum (LTAS), tilt of trendline through the LTAS, Shimmer local and Shimmer in dB decreased. This was attributed to a number of variables such as frequency of practice and variation between the SOVTE, etc. by the authors. Finally, they proposed that the two SOVTEs were useful in training future occupational voice users and should be used together to have the best cumulative impact.

CHAPTER III

METHOD

3.1 Study design

Quasi-experimental, Pre-post comparison study

3.2 Participants

Thirty-one healthy speech and language pathologist trainees. The participants fulfilling the inclusion and exclusion criteria were enrolled in the study.

Inclusion criteria

- Speech and Language Pathologist trainees [PG students] involved in clinical postings in the speech and language therapy unit
- Age range: 22 - 25 years
- Use of a minimum of 15 hours per week of voice for delivering speech-language therapy services

All the participants were perceptually screened for normal voice using the GRBAS scale (Hirano,.1981) by the experimenter. Only those participants with an overall score of "0" denoting a normal voice, and "1"- denoting a slightly deviant voice in the GRBAS scale, were selected as participants.

Exclusion criteria

- An overall score of >1 on the GRBAS scale

- Any history of alcohol consumption of more than 15ml per day, smoking, respiratory tract illness, neurological impairment, hyper- or hypothyroidism and communication disorders

- Undergoing any hormonal therapy

- Received voice therapy recently

- Any history of head and neck surgery

3.3 Instruments

Olympus LS 100 audio recorder was used to record the voice samples of the participants during the pre- and post-conditions. PRAAT (Version 6.3.04) software loaded onto an HP laptop was used for analysis of the stimuli for all the participants.

3.4 Task

1. Phonation: sustained production of vowel /a/ at comfortable pitch and loudness for 5 seconds 3 times.

   Instructions: "Take a deep breath and prolong the vowel /a/ for 5 seconds at your comfortable pitch and loudness."
2. Reading: Reading samples were collected using "The Rainbow passage" (Fairbanks, 1960) for 30 sec.

   Instruction: "Please read the passage at your comfortable pitch and loudness."

   These two tasks were recorded for every participant at two instances, as shown below:

   a. Baseline (pre-training): Audio recordings were obtained before the beginning of the therapy session.
   b. Post recording: Audio recordings were obtained immediately after completion of training every 3rd day for 12 days, i.e., after training on the 3rd, 6th, 9th and 12th day.

The recorded samples were visually analysed for vocal stability, and a 3-sec sample was manually selected from the middle part of the recording and saved in the (.wav) file format for acoustic analysis.

3.5 Procedure

A questionnaire was shared with PG students of speech and language pathology through an e-platform using Google form to select participants who satisfied the inclusion and exclusion criteria. A summary of the study and Lax Vox voice therapy training was given to those who met the inclusion and exclusion criteria. Informed consent was obtained from all participants before the initiation of the study.

Eighty-two students responded to the Google form, and 39 were identified to satisfy the participation criteria. Finally, 31 participants, of which 27 females and 4 males completed the full course of Lax Vox voice therapy training.

After the selection of the participants, the study was carried out in 3 phases: -

Phase I: (Baseline)

As a baseline protocol, the following procedure was performed on all participants.
The baseline recordings were done in a room with low ambient noise. The participants were asked to sit comfortably on a chair. The recordings were taken using the audio recorder. A distance of 15 cm was maintained between their lips and the microphone of the recorder for all participants.

Phase II: (Voice training)

The participants enrolled for the SOVT exercise- Lax Vox voice therapy training for 12 days. The training was carried out twice a day. Once, a group session conducted by the experimenter and the participants following the experimenter. For the second time at their convenience on the same day, as home training carried out by the participants themselves.

Lax Vox voice therapy training

Each participant was provided with a silicone tube with a length of 35 cm and an internal diameter of 10 mm, and a 500 ml mineral water bottle filled with water till 15 cm. All participants used their personal (distributed on the pre-training day) for the training and practice sessions. During the training, one end of the tube was submerged 3cm below the water (Mailänder et al., 2017; Tyrmi J, 2017; Matta et al., 2021). The following steps were followed during the training:

Step 1- Instructions were given to maintain a good posture ideal for respiratory and laryngeal functioning with relaxed muscles of the face, neck, upper back, and chest.

Step 2 – Instructions were given to place one end of the tube in the water bottle, 3 cm below the water's surface, and the other end between the participants' lips with lips closed around the tube. The participants were asked to breathe through the nose and exhale through the mouth into the tube.

Step 3 – Instructions were given to start bubbling water by phonating: /hhoooo/ into the water through the tube. Next, the participants were asked to vary the pitches and sing familiar melodies (for example- happy birthday).

Step 4 – Instructions were given to perform pitch gliding and altering the resistance by adjusting the tube length (max 4 cm below the water's surface).

Step 5 – Instructions were given to continue phonation without immersing the tube in water.

Step 6 – Instructions were given to continue phonation without the tube.

During 1st four sessions, exercises from stages one to four of the hierarchy were conducted. Following that, the subsequent sessions took up the activities from steps five and six.

Table 1

Lax Vox voice therapy training exercise protocol followed.

Exercise	Steps	Trials and breaks	Total duration
1.	Maintain correct body posture		1minute
2.	Inhale through the nose and exhale through the mouth with one end of tube in between the participants' the lips and lips closed and other (far) end in water for 10 sec	4 trials with 5 seconds break in between.	1minute
3.	Participants were instructed as follows, 1. With far end of tube immersed in water, begin bubbling in water with phonation of /hhoooo/ for 10 seconds 2. With far end of tube immersed in water, vary pitch of phonation sound for 10 seconds	1. 5 trials with 5-seconds break 2. 10 trials with 5 seconds break 3. 5 trials with 20 seconds of break	4 minutes 50 seconds

	3. With far end of tube immersed in water, singing familiar melodies (for example-happy birthday) For 20 seconds		
4.	With far end of tube immersed in water, do pitch glides altering the resistance by immersing the tube deeper in water, position of the tube (max 4 cm in water) for 10 sec.	10 trials for each with 5 seconds of break	2minute
5.	Continue phonation without dipping far end the tube into the water for 10 sec.	5 trials for each with 5 seconds of break	1minute
6.	Continue phonation without tube	5 trials for each with 5 seconds of break	1minute

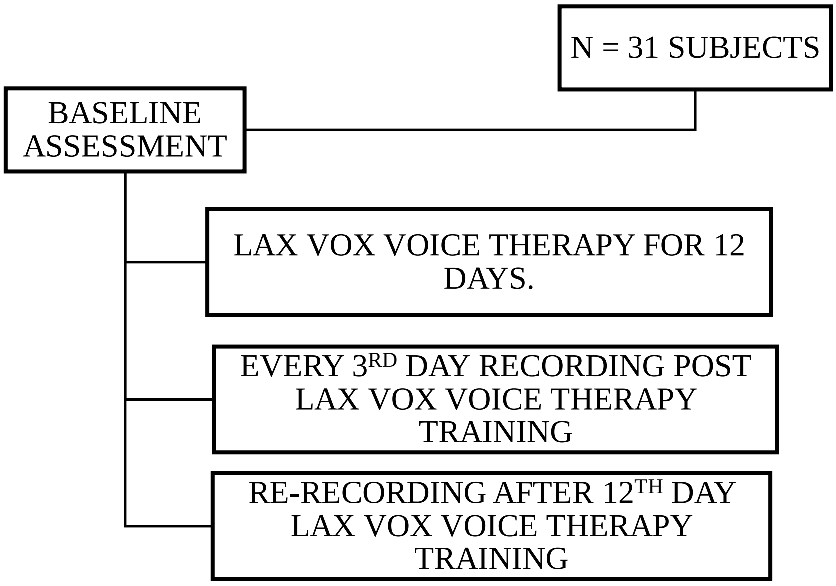
Everyday voice therapy training for the participants was done for 15 minutes.

Phase III: (Post training)

The tasks recorded as baseline before the training, as described in Phase I, were again re-recorded on the last day (12^{th} day) of the completion of the voice training.

Figure 1

Flow chart depicting the procedure of Lax Vox voice therapy training.



3.6 Analysis

Acoustic Analysis

Praat software (version 6.3.04) was used to analyse each participant's samples.

AVQI (v02.02) script was used to measure the algorithm and AVQI formula as follows:

AVQI = 9.072 - 0.245 X CPPSPraat - 0.161 X HNR - 0.470 X SL + 6.158 X SLDB - 0.071 X SLOPE - 0.170 X TILT.

The recorded voice of the participants was opened in the PRAAT, then the stable 3 second segment from sustained vowel and middle segment from read sample was extracted from each participant and then saved as .wav file. The AVQI Script by (Maryn & Weenink, 2015) was copied into a text file. Then, the saved .wav files of the 3 second stable phonation and reading segment were again uploaded on PRAAT with the AVQI (v02.02) script. After executing the algorithm in the Praat software, the value of AVQI and the values of its constituent parameters were obtained.

The measures documented were:

1. Acoustic Voice Quality Index (AVQI)
2. Smoothened Cepstral Peak Prominence (CPPS)
3. Harmonic to Noise Ratio (HNR)
4. Shimmer local (Shim. Loc)
5. Shimmer local dB (Shim. dB)
6. Slope of Long-term average spectrum (S- LTAS)
7. The tilt of the regression line through the Long-term average spectrum (T-LTAS)

Statistical analysis

The descriptive and inferential statistical analysis of the collected AVQI measures for pre- and post-training samples was carried out using the Statistical Package for Social Studies (SPSS) software.

CHAPTER IV

RESULTS

The study evaluated the effect of SOVT LAX VOX voice therapy training on thirty-one speech-language pathologist trainees, twenty-seven females and four males, for 12 days. The values of AVQI and its parameters, Shimmer Local, Shimmer dB, Slope LTAS, Tilt of LTAS, HNR and CPPS, were obtained from the recording taken pre-Lax Vox voice therapy training, post-3rd, 6th, 9th and 12th day Lax Vox voice therapy training. Lax Vox voice therapy was the independent variable, whereas the AVQI and its components were regarded as dependent variables in the present study. SPSS version 26 was used for statistical analyses.

The first aim was to compare the baseline AVQI values with every 3rd day immediate post-Lax Vox voice therapy training AVQI values for 12 days. The data of 27 females were subjected to the Shapiro-Wilk normality test, which revealed a normal data distribution ($p > 0.05$). As a result, parametric tests were run on the data for additional analysis. Below are details of the statistical analysis. Descriptive measures were calculated for each measure. Mixed ANOVA was done to compare pre- and post-Lax Vox voice therapy training recordings across four different time points.

Table 2 represents the mean, standard deviation, F value and p-value of pre and 3rd, 6th, 9th and 12th post-Lax Vox voice therapy training for female participants.

Table 2

Mean, standard deviation, F value and significance p-value across pre and 3rd, 6th,9th and 12th post- Lax Vox voice therapy training for female participants

Para-meters	Mean (Standard Divination)					F value	p value
	PT	D3 Post T	D6 Post T	D9 Post T	D12 Post T		
CPPs	13.05 (1.17)	14.09 (1.42)	14.30 (1.33)	14.53 (0.89)	14.71 (1.20)	18.98	0.00*
HNR	18.24 (1.70)	20.00 (1.96)	20.11 (1.77)	20.50 (1.91)	20.76 (1.46)	15.90	0.00*
SHIM. LOC.	5.56 (1.43)	4.21 (1.26)	4.23 (1.36)	3.88 (1.17)	3.72 (1.13)	13.67	0.00*
SHIM. DB	0.60 (0.10)	0.49 (0.93)	0.50 (0.07)	0.47 (0.88)	0.47 (0.73)	14.61	0.00*
S-LTAS	-19.03 (3.64)	-16.74 (3.96)	-16.68 (3.74)	-15.32 (4.40)	-15.01 (4.99)	6.42	0.00*
T-LTAS	-10.43 (1.16)	-10.71 (0.97)	-10.36 (1.10)	-10.36 (1.03)	-10.65 (1.04)	1.44	0.24
AVQI	3.58 (0.59)	2.86 (0.65)	2.86 (0.61)	2.65 (0.59)	2.51 (0.61)	30.59	0.00*

*Note. PT- pretherapy, D3 Post T – Day 3 post-therapy, D6 Post T – Day 6 post-therapy, D9 Post T – Day 9 post-therapy, D12 Post T – Day 12 post-therapy, *p-value <0.05*

Table 2 represents the values of CPPS, HNR, Shimmer Local, Shimmer dB, Slope LTAS and AVQI that were statistically significant as the $p< 0.05$. Thus, pairwise comparison was also done. Further, Table 3 shows the pair-wise comparison between the pretherapy and the 3rd, 6th, 9th and 12th -day post- Lax Vox voice therapy training, respectively.

Table 3

Pair-wise comparison between pretherapy and 3rd, 6th,9th and 12th post- Lax Vox voice therapy training for female participants

Parameters	PT – D3 Post T		PT – D6 Post T		PT – D9 Post T		PT – D12 Post T	
	MD	p-value	MD	p-value	MD	p-value	MD	p-value
CPPs	-1.03	0.00*	-1.24	0.00*	-1.47	0.00*	-1.65	0.00*
HNR	-1.87	0.00*	-1.87	0.00*	-2.25	0.00*	-2.52	0.00*
SHIM. LOC.	1.35	0.00*	1.33	0.00*	1.68	0.00*	1.83	0.00*
SHIM. DB	0.10	0.00*	0.92	0.00*	0.12	0.00*	0.13	0.00*
S-LTAS	-2.28	0.02*	-2.34	0.04*	-3.71	0.01*	-4.01	0.01*
T-LTAS	0.28	0.49	0.44	1.00	-0.69	1.00	0.21	1.00
AVQI	0.72	0.00*	0.71	0.00*	0.92	0.00*	1.06	0.00*

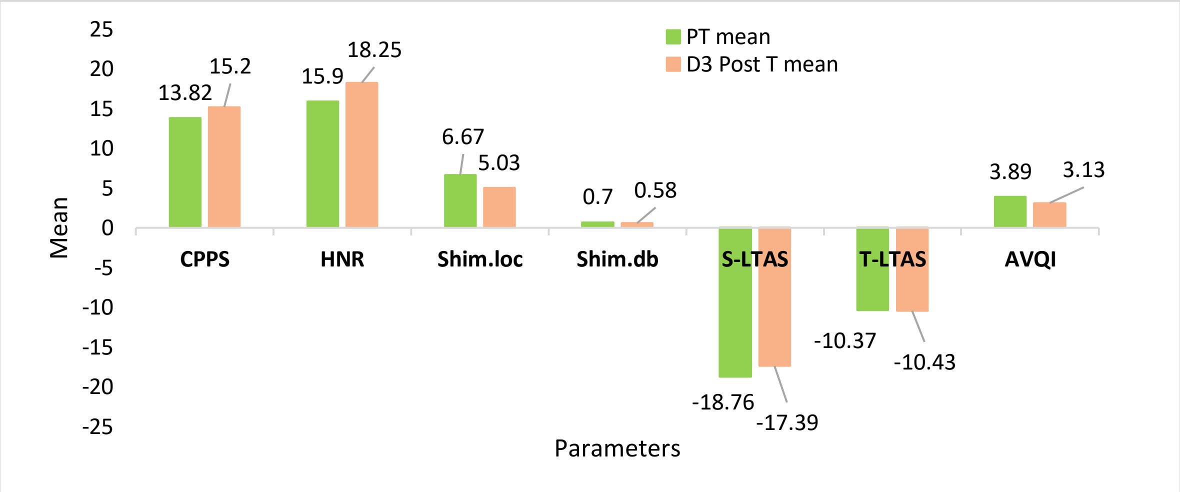
*Note. MD- Mean difference, *p-value <0.05*

Above table 3 shows that parameters CPPS, HNR, Shimmer Local, Shimmer dB, Slope LTAS and AVQI values were statistically significant ($p < 0.05$) across all the 4-time points.

Only four male participants successfully participated and completed the Lax Vox voice therapy training, and their results are represented as Figure. Figures 2, 3, 4 and 5 compare the pretherapy (baseline) mean values of male participants with their 3rd, 6th, 9th and 12th-day post-Lax Vox voice therapy training mean values, respectively.

Figure 2

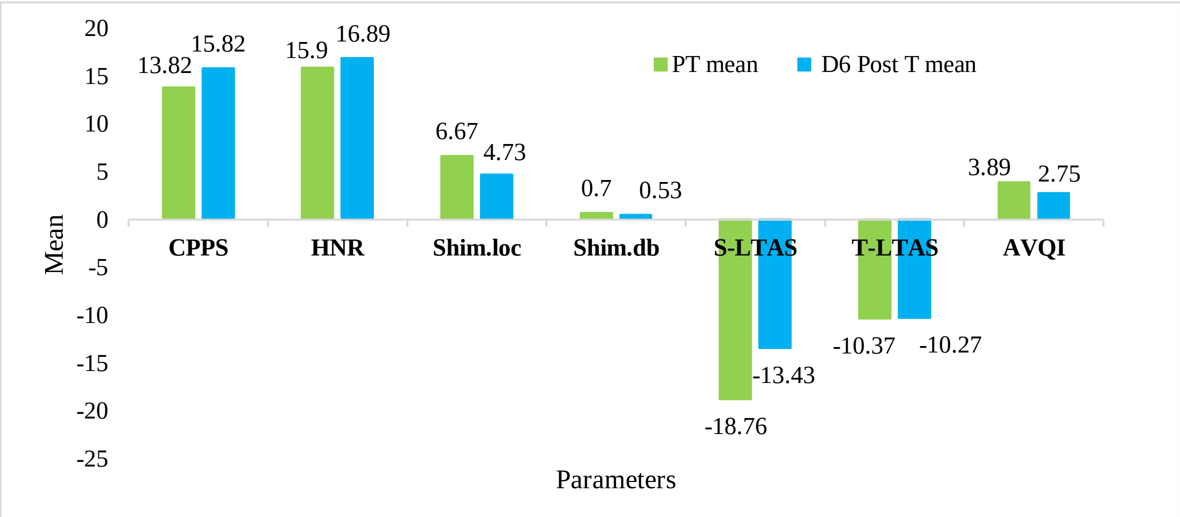
Mean value of pre-and 3rd-day post- Lax Vox voice therapy training of male participants



Note. PT- Pre therapy, D3 Post T - Day 3 post-therapy

Figure 3

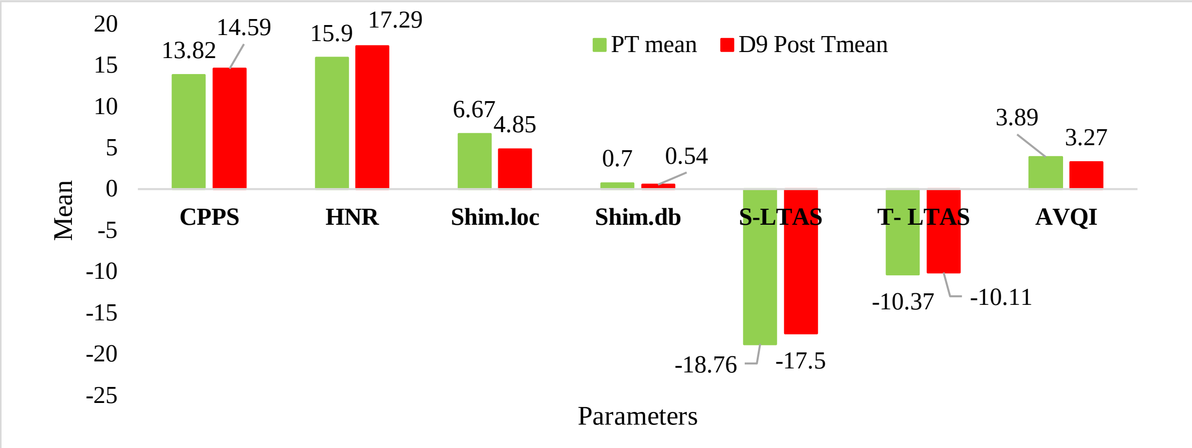
Mean value of pre-and 6th-day post-Lax Vox voice therapy training of male participants



Note. PT- Pre therapy, D6 Post T - Day 6 post-therapy

Figure 4

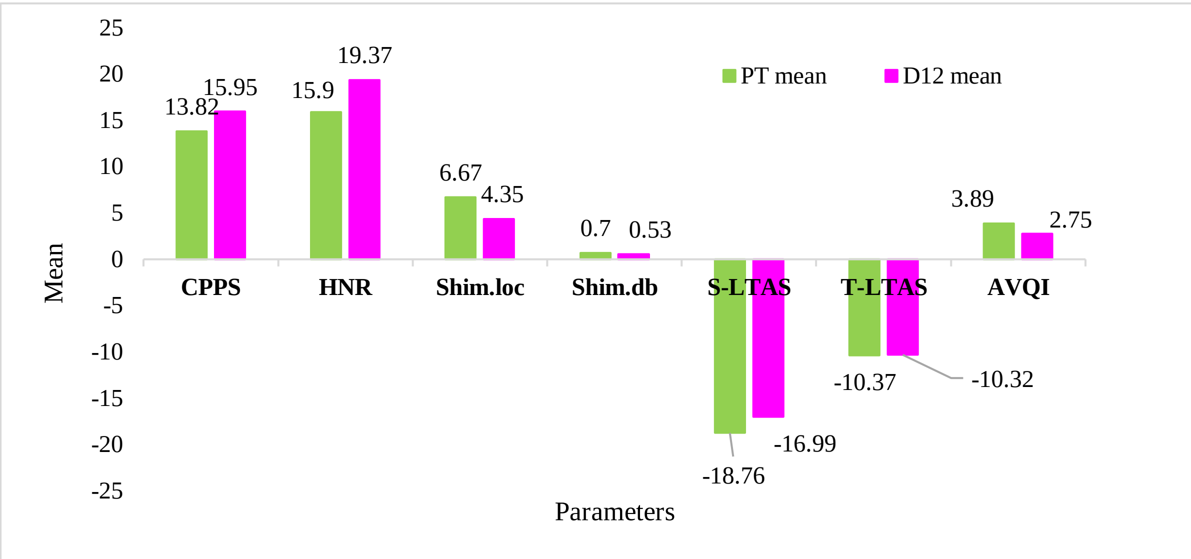
Mean of Pre- and 9th-day post- Lax Vox voice therapy training of male participants



Note. PT- Pre therapy, D9 Post T - Day 9 post-therapy

Figure 5

Mean of Pre- and 12th-day post-Lax Vox voice therapy training of male participants



Note. PT- Pre therapy, D12 Post T - Day 12 post-therapy

Male participants exhibited a difference between pre-and 3rd, 6th, 9th and 12th-day post-Lax Vox voice therapy training mean values for the parameters studied.

The results shown in Tables 2 and 3 are for female participants only. On observation, there was only a slight variation in the mean values of all the parameters between pre- and post-Lax Vox voice therapy training recordings in both females and males. Thus, the combined result of both males and females was also analysed.

The data of 31 participants were subjected to the Shapiro-Wilk normality test, which revealed a normal data distribution ($p > 05$). As a result, parametric tests were run on the data for additional analysis. Below are details of the statistical analysis. Descriptive statistics, the mean (M) and standard deviation (SD) were calculated for each measure along with Repeated measure ANOVA to compare pre-and post-Lax Vox voice therapy training results across 4 different time points and the same are shown in Tables 4 and 5.

Table 4 represents the combined result of males and females AVQI, CPPS, HNR, Shimmer Local, Shimmer dB and Slope LTAS values that were statistically significant as the $p < 0.05$. Further, pairwise comparison is also done. Table 5 shows that parameters AVQI, CPPS, HNR, Shimmer Local, Shimmer dB, and Slope LTAS values were statistically significant ($p < 0.05$) across all the 4-time points.

Table 4

Mean, standard deviation, F value and significance p-value across pre- and 3rd, 6th, 9th and 12th post- Lax Vox voice therapy training for male and female participants

Para-meters	Mean (Standard Divination)					F value	p value
	PT	D3 Post T	D6 Post T	D9 Post T	D12 Post T		
CPPs	13.15 (1.14)	14.23 (1.37)	14.50 (1.35)	14.54 (0.87)	14.87 (1.35)	22.90	0.00*
HNR	17.94 (1.70)	19.77 (1.96)	19.70 (2.09)	20.09 (2.13)	20.58 (1.54)	19.73	0.00*
SHIM. LOC.	5.70 (1.43)	4.31 (1.21)	4.30 (1.36)	4.01 (1.16)	3.80 (1.15)	17.72	0.00*
SHIM. DB	0.61 (0.10)	0.50 (0.92)	0.51 (0.07)	0.48 (0.87)	0.47 (0.74)	19.26	0.00*
S-LTAS	-18.99 (3.50)	-16.83 (3.79)	-16.26 (3.70)	-15.60 (4.29)	-15.27 (4.88)	6.57	0.01*
T-LTAS	-10.42 (1.14)	-10.68 (0.95)	-10.45 (1.05)	-10.33 (1.04)	-10.61 (1.01)	1.41	0.24
AVQI	3.62 (0.57)	2.89 (0.61)	2.85 (0.58)	2.73 (0.59)	2.55 (0.59)	35.66	0.00*

*Note. PT- pretherapy, D3 Post T – Day 3 post-therapy, D6 Post T – Day 6 post-therapy, D9 Post T – Day 9 post-therapy, D12 Post T – Day 12 post-therapy, *p-value <0.05*

Below presented Table 5 shows the pair-wise comparison between the pretherapy and the 3rd, 6th, 9th and 12th-day post-Lax Vox voice therapy training for both males and females, respectively.

Table 5

Pair-wise comparison between pretherapy and 3rd, 6th, 9th and 12th post- Lax Vox voice therapy training for male and female participants

Parameters	PT – D3 Post T		PT – D6 Post T		PT – D9 Post T		PT – D12 Post T	
	MD	p-value	MD	p-value	MD	p-value	MD	p-value
CPPs	-1.07	0.00*	-1.34	0.00*	-1.38	0.00*	-1.71	0.00*
HNR	-1.83	0.00*	-1.76	0.00*	-2.14	0.00*	-2.64	0.00*
SHIM. LOC.	1.39	0.00*	1.40	0.00*	1.69	0.01*	1.89	0.00*
SHIM. DB	0.10	0.00*	0.10	0.00*	0.12	0.00*	0.13	0.00*
S-LTAS	-2.16	0.01*	-2.73	0.00*	-3.39	0.01*	-3.72	0.07*
T-LTAS	0.25	0.63	0.25	1.00	-0.94	1.00	0.18	1.00
AVQI	0.72	0.00*	0.76	0.00*	0.88	0.00*	1.07	0.00*

Note. **p value <0.05*

The second objective of this study was to compare the pre-training AVQI value with the 12th-day post-Lax Vox voice therapy training AVQI value.

The Shapiro-Wilk for normality test was carried out on the data of pre-voice therapy training and 12th-day post-Lax Vox voice therapy training of 27 females. It indicated normal data distribution ($p>0.05$) for the AVQI, HNR, Shimmer in dB and

Slope LTAS values only, but for CPPS, Shimmer local and Tilt LTAS the data was not normally distributed. Therefore, parametric tests (T-Test) were done only for HNR, Shimmer in dB and Slope LTAS parameters and non-parametric tests (Wilcoxon Signed Rank Test) were done for CPPS, Shimmer local and Tilt LTAS parameters. The details of statistical analyses are provided in Table 6. Table 6 lists the parametric test (T-Test) results among the female participants for pre- and post-comparison.

Table 6

The t value and p-value for pre and 12th post-Lax Vox voice therapy training for female participants

Parameters	**t value**	**Significance value (p)**
HNR	-1.683	0.00*
SHIMMER DB	5.656	0.00*
SLOPE LTAS	-3.625	0.00*
AVQI	10.490	0.00*

*Note. *p value <0.05*

Table 6 represents the AVQI, HNR, Shimmer dB and Slope LTAS values that were statistically significant at $p < 0.05$.

Table 7 lists the non-parametric test (Wilcoxon Signed Rank Test) results among the female participants for pre- and post-comparison.

Table 7

Z value, significance p-value for pre and 12th post- Lax Vox voice therapy training for female participants

Parameters	Z value	Significance value (p)
CPPS	4.493	0.00*
SHIMMER LOCAL	-3.880	0.00*
TILT LTAS	-1.321	0.186

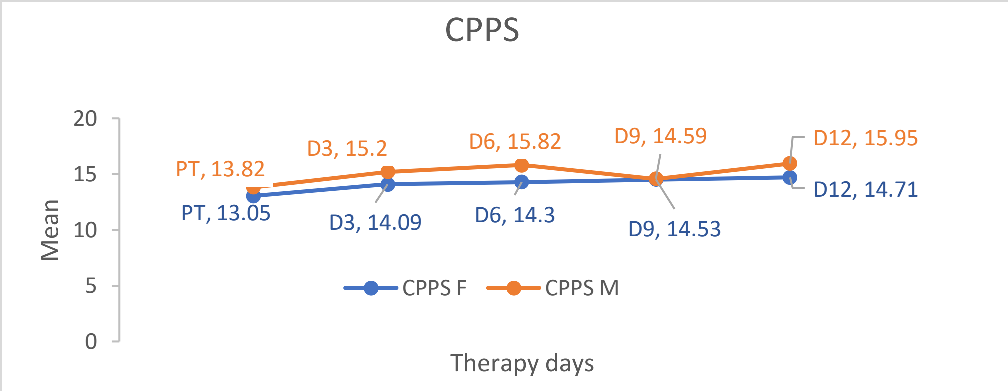
*Note. *p value <0.05*

Table 7 represents the CPPS and Shimmer local that were statistically significant at $p < 0.05$.

The third goal of this study was to assess the pattern of change in AVQI in the participants across all the four-time points of the training period. Figure 6, 7, 8, 9, 10, 11 and 12 represent the trend of the parameters CPPS, HNR, Shimmer Local, Shimmer dB, Slope LTAS, Tilt LTAS and AVQI in the female and male participants across all the four-time points of the training period.

Figure 6

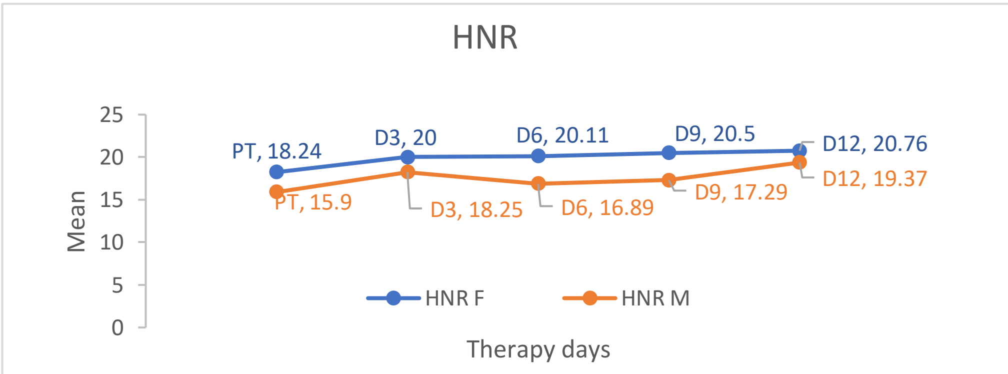
CPPS trend for female and male participants across pretherapy and the 3rd, 6th, 9th and 12th post- Lax Vox voice therapy training.



Note. CPPS F -CPPS in females, CPPS M – CPPS in male

Figure 7

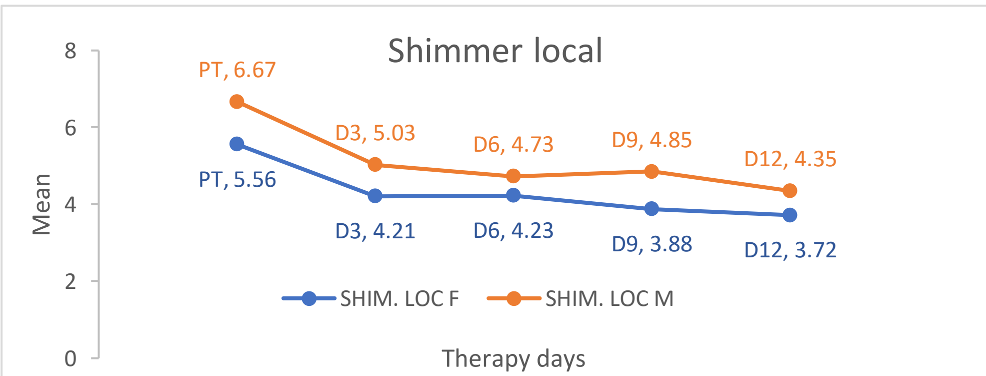
HNR trend for female and male participants across pretherapy and the 3rd, 6th, 9th and 12th day post- Lax Vox voice therapy training.



Note. HNR F – HNR in females, HNR M – HNR in males

Figure 8

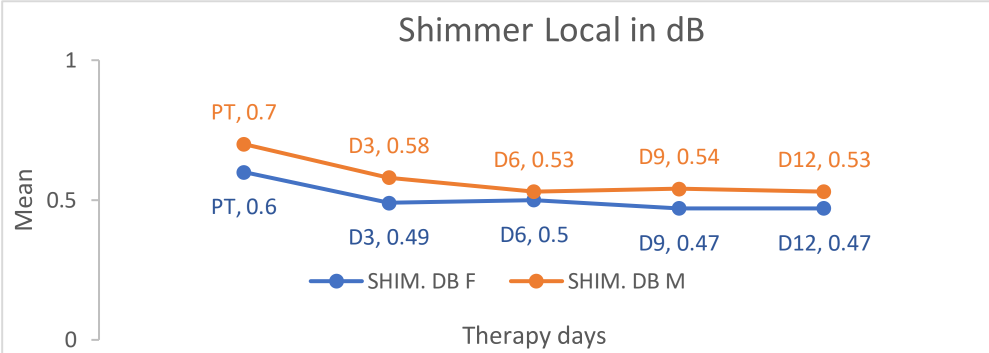
Shimmer local trend for female and male participants across pretherapy and the 3rd, 6th, 9th and 12th-day post- Lax Vox voice therapy training.



Note. SHIM. LOC F - SHIM. LOC in Female, SHIM. LOC M - SHIM. LOC in Male

Figure 9

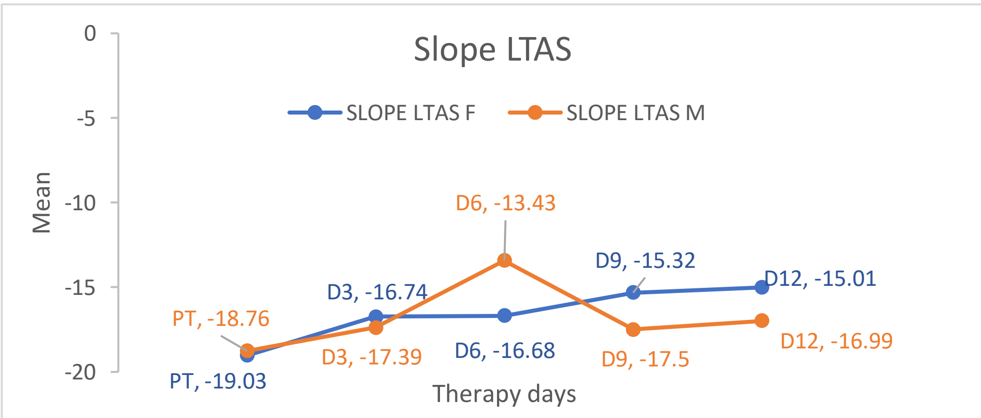
Shimmer Local in dB trend for female and male participants across pretherapy and the 3rd, 6th, 9th and 12th-day post- Lax Vox voice therapy training.



Note. SHIM. DB F - SHIM. DB in Female, SHIM. DB M - SHIM. LOC in Male

Figure 10

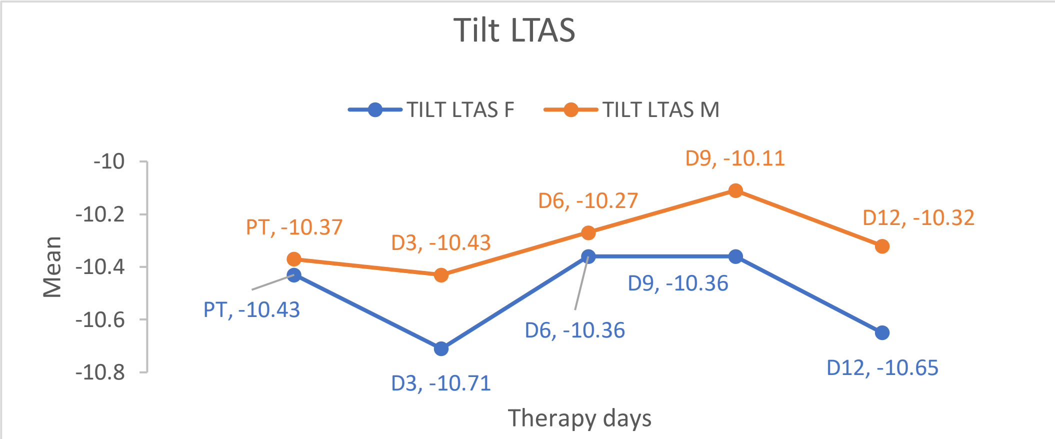
Slope LTAS trend for female and male participants across pretherapy and the 3rd, 6th, 9th and 12th-day post- Lax Vox voice therapy training.



Note. SLOPE LTAS F – SLOPE LTAS in Female, SLOPE LTAS M – SLOPE LTAS in Male

Figure 11

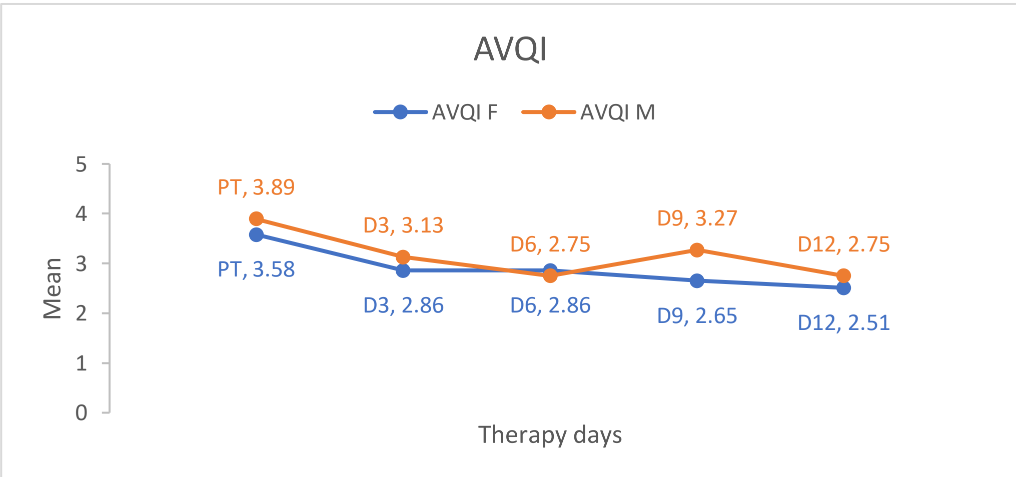
Tilt LTAS trend for female and male participants across pretherapy and the 3rd, 6th, 9th and 12th-day post- Lax Vox voice therapy training.



Note. TILT LTAS F – TILT LTAS in Female, TILT LTAS M – TILT LTAS in Male

Figure 12

AVQI trend for female and male participants across pretherapy and the 3rd, 6th, 9th and 12th-day post- Lax Vox voice therapy training.



Note. AVQI F –AVQI in Female, AVQI M – AVQI in Male

From the Tables 6 and 7 and Figures 6-12, the trend in the post-Lax Vox voice therapy training changes in females may be noticed. Except for Tilt LTAS, all other measures, the CPPS, HNR, Shimmer local, Shimmer local in dB, Slope LTAS and

AVQI showed significant improvement. Similarly, for males from Figures 6-12, the trend in the post-Lax Vox voice therapy training changes was noticed. Again, except for Tilt LTAS, all other measures, the CPPS, HNR, Shimmer local, Shimmer local in dB, Slope LTAS and AVQI showed significant improvement.

CHAPTER V

DISCUSSION

The objectives of the present study were as follows,

1. To compare the baseline AVQI values with 3rd, 6th, 9th and 12th day after the initiation of Lax Vox voice therapy training AVQI values over the course of 12 days using the phonation and reading samples of speech-language pathologist trainees.
2. To compare the baseline AVQI with after 12th day Lax-Vox voice therapy AVQI value training using the phonation and reading samples of speech-language pathologist trainees.
3. To determine the trend of changes in AVQI along the course of Lax Vox voice therapy training in speech-language pathologist trainees.

The results of the present study are discussed under the following headings,

- Comparison of baseline with 3rd, 6th, 9th and 12th day AVQI post Lax Vox voice therapy training for males and females
- Trends in voice changes post Lax Vox voice therapy training for male and female participants

Comparison of baseline with 3rd, 6th, 9th and 12th day AVQI post Lax Vox voice therapy training for males and females.

The Acoustic Voice Quality Index (AVQI) and its components CPPS, HNR, Shimmer Local, Shimmer dB, Slope LTAS and Tilt of LTAS were examined across the four-time points (3rd, 6th, 9th and 12th day) to determine the impact of Lax Vox voice therapy training. The observations revealed that except for the parameter Tilt LTAS, there was statistical significant difference in AVQI values and its constituent parameters: CPPS, HNR, Shimmer Local, Shimmer Local in dB, and Slope LTAS between the pre-and post-Lax Vox voice therapy training for both sexes. In the current study results revealed that the AVQI value decreased as the Lax Vox voice therapy training progressed. The AVQI value showed a statistically significant decrease from pre-therapy to the post-3rd, 6th, 9th and 12th day of Lax Vox voice therapy training indicating that the overall voice quality improved with the specific training method in all the participants. This finding is in agreement with Maryn, et al. (2010) study results wherein, it was concluded that greater AVQI was inversely proportional to the overall voice quality. Mailänder et al. (2017) reported decreased AVQI values post Lax Vox voice therapy in teachers highlighting improved overall voice quality. They remarked that the hoarseness and roughness reduced after the Lax Vox exercise on teachers.

Ranjani and Yeshoda (2021) reported increased AVQI in male and female training to be SLPs participants post SOVTE-Frication exercise which is contradictory to the finding of the current study. The choice of exercise, voice therapy protocol, participant factors, extent of practice may all have contributed to such findings. Further, being COVID-19 pandemic period the training to be SLPs may not have had regular clinical therapy schedule to appreciate the changes in voice quality post SOVTE-Frication therapy.

When the AVQI constituent parameters were considered individually, statistical significant increase in CPPS, HNR and Slope-LTAS were noticed between pre-therapy to the post-3rd, 6th, 9th and 12th day of Lax Vox voice therapy training in all participants. Shimmer Local and Shimmer dB showed significant drop statistically from pre-therapy to the post-3rd, 6th, 9th and 12th day of Lax Vox voice therapy training. Only Tilt LTAS values decreased marginally, and no statistically significant differences were found between pre-and post-3rd, 6th, 9th and 12th day of Lax Vox voice therapy training. Meerschman et al. (2017) reported similar findings for all the AVQI constituent parameters, except for Slope LTAS, which was decreased in his study. Adequate glottal closure, symmetrical vocal fold vibrations result in better glottal valving and a consequent improvement in acoustic measures, namely, higher CPPS, HNR and Slope-LTAS and lowered Shimmer Local and Shimmer dB. All these findings signify improvement in overall voice quality.

Ranjani and Yeshoda (2021) reported reduced CPPs in female participants, reduced Shimmer Local in male participants and reduced Tilt LTAS for both male and female participants post SOVTE-Frication exercise. The authors concluded that three weeks of practice were insufficient to notice change in the participants and the participants were unable to generalize the effects of SOVTE Frication exercise done using phonation to general speaking.

When the AVQI and its parameters were compared between baseline and 12th day post-Lax Vox voice therapy training to understand long-term effects, they showed statistical significant differences. The results were the same as short-term comparisons, i.e., baseline versus every 3rd day post Lax Vox voice therapy training and strongly assert the long-term effect of Lax Vox voice therapy training as shown from these results.

Trend in voice changes post Lax Vox voice therapy training for female and male participants

The study had less number of male participants compared to female participants. The AVQI and its parameters were compared for noticeable trends across the entire training duration and the same are shown in Figures 6 to 12. All parameters, CPPS, HNR steadily increased from baseline to the 3rd, 6th, 9th and 12th day but Shim Local, Shim dB, and AVQI decreased from baseline to 3rd, 6th, 9th and 12th day in all participants. Slope LTAS showed a consistent increase from baseline to all other time points in female participants. But in male participants Slope LTAS reached a peak on 6th day but declined on 9th day and again increased marginally on 12th day. In general, the overall trend for all participants showed increase in CPPS, HNR and decrease in Shim Local, Shim dB, and AVQI from baseline to all other time lines. Slope LTAS and Tilt LTAS showed mixed trend for males alone. Mixed trend was noticed in Tilt LTAS for female participants. The overall trends of AVQI and its constituent parameters prove the benefit of the Lax Vox voice therapy training in all the participants.

CHAPTER VI

SUMMARY AND CONCLUSION

The current study investigated the impact of 12 days of Semi Occluded Vocal Tract (SOVT)-Lax Vox voice therapy training on future speech and language pathologists. A Google forms that the inclusion and exclusion criteria, were filled by eighty-two graduate students studying to become speech and language pathologists. Out of thirty-nine participants recruited into the study, 31 successfully completed the 15 minutes every day Lax Vox voice therapy training for 12 days. There were 27 female and only 4 male participants. Baseline voice audio recordings of the prolonged vowel /a/ thrice and reading of the "Rainbow" passage were carried out prior to the beginning of the training and these recordings were repeated at four precise time points, i.e., days 3, 6, 9 and 12 post-Lax Vox voice therapy training. Multiparametric acoustic measure, Acoustic Voice Quality Index (AVQI) and its six constituent parameters: Smoothed Cepstral Peak Prominence, Harmonics to Noise Ratio, Shimmer local, Shimmer in dB, Slope LTAS and Tilt LTAS were noted. To calculate the AVQI, 3 seconds steady state of vowel /a/ (sv) and mid 3 seconds from "The Rainbow" passage (cs) were analysed using AVQI (v02.02) script in PRAAT software (version 6.3.04).

The Lax Vox voice therapy training was carried out in 3 phases. Phase I was baseline voice recording. Phase II comprised of Lax Vox voice therapy training for all participants spanning 12 days. Phase III involved post-Lax Vox voice therapy training voice recordings. Post- Lax Vox voice therapy training recordings were done every 3rd day immediately after the completion of the therapy.

Based on the objectives of the study, statistical analyses were performed. The first two objectives were to compare baseline AVQI values with 3rd, 6th, 9th and 12th day after the initiation of Lax Vox voice therapy training AVQI values. The results revealed except the Tilt LTAS, statistical significance was found for AVQI values and CPPS, HNR, Shimmer Local, Shimmer Local in dB, and Slope LTAS between the pre-and post-Lax Vox voice therapy training for all participants. AVQI decreased significantly from baseline to post Lax Vox voice therapy training on 3rd, 6th, 9th and 12th day.

Statistical significant increase were seen for CPPS, HNR and Slope-LTAS and statistical significant decrease in Shimmer Local and Shimmer dB between baseline versus post-3rd, 6th, 9th and 12th day of Lax Vox voice therapy training in all participants. Only Tilt LTAS values decreased marginally and did not show statistically significant differences across the time points. The third objective was to check the overall trend in all participants across baseline versus all other time points. It showed increase in CPPS, and HNR, and decrease in Shim Local, Shim dB, and AVQI. Tilt LTAS alone showed mixed trend for female participants but mixed trend was noted for Slope LTAS and Tilt LTAS in male participants. The overall results of AVQI, its constituent parameters and their trends prove that the participants benefitted from the Lax Vox voice therapy training.

Therefore, SOVT-Lax Vox voice therapy training could be a choice of technique for improving/ maintaining good voice quality in professional voice users, specifically, in training to be speech-language pathologist. Also, AVQI could be considered a reliable outcome measure to document changes in voice.

Implications of the study

- The results of the current study add to the evidence and strengthen the evidence-based approach for the SOVT-Lax Vox voice therapy.

- The results of the current study are promising and prove that SOVT Lax Vox voice therapy training has both immediate and long-term benefits.
- SOVT-Lax Vox technique may be used regularly to improve and/ maintain a good voice in speech and language trainees.
- AVQI could be utilised as a prognostic indicator to analyse the impact of the SOVT-Lax Vox voice therapy technique.
- Lax Vox voice therapy training may be safely incorporated with vocal hygiene programs for those with a normal voice and also in other occupational voice users, such as speech-language pathologists and teachers.

Limitations and future directions of the study

- The study did not have equal numbers of female and male participants.
- Replications of this study on other groups of professional or occupational voice users will help in generalization of the present study findings.
- Also, the study will have to be replicated on a population with voice disorders to garner support for the SOVT-Lax Vox voice therapy technique for treatment/ management of voice disorders.
- Future studies employing additional measures, such as EGG, aerodynamics and invasive procedures, may strengthen the evidences for SOVT-Lax Vox as a voice therapy technique for voice disorders.

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APENPENDIX

अखिल भारतीय वाक् श्रवण संस्थान, मैसूरू - 570 006

ALL INDIA INSTITUTE OF SPEECH & HEARING: MYSORE – 6

वाक् भाषा ववज्ञान ववभाग/DEPARTMENT OF SPEECH-LANGUAGE SCIENCES

Informed Consent Form for Dissertation Data Collection

Title:

EFFICACY OF SOVTE - LAX VOX IN FUTURE

SPEECH-LANGUAGE PATHOLOGISTS

Exercise: Comparison of Pre-Post Training

Guide: डॉ. के. येशोदा / Dr. K. Yeshoda
एसोससएट प्रोफे सर इन स्पीच साइंसेज /
Associate Professor in Speech Sciences

Candidate: Ms. Muskan Katheria (Reg. No: P01II21S0024)
II MSc (SLP), AIISH

I do hereby give consent to participate in the study titled "**Efficacy Of SOVTE - Lax Vox In Future Speech-Language Pathologists**". I have been briefed about the purpose of the study which is as follows, to *investigate the effects of SOVT LAX VOX exercise on voice using AVQI measurement.*

I express my wholehearted consent to participate. I have also been informed about the approximate time of testing and understand that the procedure is purely unharming with research benefits only. I agree to cooperate with the investigator in thisstudy and for the project/official communication in journals/magazines/newsletters andresearch purposes.

Furthermore, I have been assured that there will not be any financial commitment on my part during the course of this study. It has been further stated that my identity as a participant in this study will be strictly confidential and will not be divulged without my express consent.

Having read the above, I express my voluntary consent for my participation in this study.

Sl. No.	Name and address with a phone number	Signature with date