EFFECT OF TWO ISOLATED VOCAL FACILITATING TECHNIQUES, CHEWING AND YAWN-SIGH ON VOICE PARAMETERS OF MALE SPEECH-LANGUAGE PATHOLOGY STUDENTS

FATHIMA MEHJABIN

Registration no: P01II22S123008

A Dissertation Submitted in Part Fulfilment of the Degree of Master of Science (Speech-Language Pathology)

University of Mysore

ALL INDIA INSTITUTE OF SPEECH AND HEARING

MANASAGANGOTRI, MYSURU- 570006

JULY 2024

CERTIFICATE

This is to certify that this dissertation entitled **"Effect of two vocal facilitating techniques, chewing and yawn-sigh on voice parameters of male speech-language pathology students"** is a bonafide work submitted in part fulfilment for the degree of Master of Science (Speech- Language Pathology) of the student Registration number P01II22S123008. 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 award of any other Diploma or Degree.

Mysuru

July, 2024

Dr. M. Pushpavathi

Director

All India Institute of Speech and Hearing

Mysuru- 570006

CERTIFICATE

This is to certify that this dissertation entitled **"Effect of two vocal facilitating techniques, chewing and yawn-sigh on voice parameters of male speech-language pathology students"** is a bonafide work in part fulfilment for the degree of Master of Science (Speech-Language Pathology) of the student Registration number P01II22S123008. This has been carried out under my guidance and supervision. It is also certified that this dissertation has not been submitted earlier to any other University for award of any other Diploma or Degree.

Mysuru
July, 2024

Guide
Dr. R. Rajasudhakar
Associate Professor
Department of Speech Language-Sciences
All India Institute of Speech and Hearing
Mysuru- 570006

DECLARATION

This is to certify that this dissertation entitled **“Effect of two vocal facilitating techniques, chewing and yawn-sigh on voice parameters of male speech-language pathology students”** is the result of my own study under the guidance of Dr. R. Rajasudhakar, Associate Professor, Department of Speech-Language-Sciences, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for award of any other Diploma or Degree.

Mysuru **Registration number**

July, 2024 P01II22S123008

ACKNOWLEDGMENT

KUNFAYAKUN

I want to thank Allah for the countless blessings, knowledge, and opportunities He has bestowed upon me.

My heartfelt gratitude to my guide ***Dr. R. Rajasudhakar***. Sir, I am extremely grateful for having you as my guide. Thank you for your patience in encouraging me to complete the dissertation with ease and grace. I must say, you are a cool guide.

Forever grateful to my financial and emotional support systems, **Uppa, Umma**, **Velyamma** and to you too **Hadi Mayin**.

Thank you, **Dr. Vasantha Lakshmi** for helping me swim and not drown in the world of SPSS, **Dr. Yeshoda** for permitting me to use the recording room, **Moksh** for helping me with your valuable inputs, **Shashikala akka** for helping me with the recording room doors, **Jesnu sir** and **Sumanth sir** for helping me in one way or the other.

To the faculties I look upto, **Freddy sir, Prashant sir, Sreedevi mam, Sreeraj sir** and **Abhishek sir**, thank you for inspiring me.

Majorly, my **junior boys** who participated in the study, you guys are the chicken to my chicken biriyani.

Special mention to **Bala, Chandan** and **DD** for being a part of my study and giving me a kick start, **Swalih sir** for all the help throughout and **Nuhaleem** for the last minute technical support.

Team '**enthino vendi**', in the course of this 4-5 years you guys made me realize you are for '**ellathinum vendi**'. **Neha chunchudu**, **anappara, nunii, anannya** (with extra stress on 'nya'), **Krishna** (my antony perumbavoor), **puchi maji, jillam, meenamma**, **gowraa, johny**, I love you. **drishhti, mEmE** and **shabala**, you trimoorthees, without you nammal 'endha cheyya'.

To my batch **Renaissance**, A sec- speechies, my dissertation partners **Sharon** and **Mudassir**, juniors and seniors, grateful for the good company.

chaathooty and **qunjhooty**, thank you for being my 2 minutes Maggie (iykyk).

Table of content

Chapters	Title	Page Number
I	Introduction	1-5
II	Review of Literature	6-19
III	Method	20-26
IV	Results	27-41
V	Discussion	42-49
VI	Summary and Conclusion	50-52
	References	53-58

List of Tables

Table No:	Title	Page Number
3.1	Session-wise details of chewing and yawn-sigh techniques.	23
4.1	Mean, SD, Median and IQR values for chewing technique between two conditions	29
4.2	Mean, SD, Median and IQR values for yawn-sigh technique between two conditions	30
4.3	Results of repeated measure ANOVA for group and condition comparison	32
4.4	Results of paired sample t-test for within group comparison for chewing technique (group 1)	33
4.5	Results of paired sample t-test for within group comparison for yawn-sigh technique (group 2)	34
4.6	Results of Wilcoxon signed- rank test for jitter, NHR and DSI for group 1 (chewing technique)	38
4.7	Results of Wilcoxon signed- rank test for jitter, NHR and DSI for group 2 (yawn-sigh technique)	39
4.8	Results of Mann-Whitney U test for between group comparison	40

List of Figures

Figure No:	Title	Page Number
4.1	Comparison of F0 between two conditions for Chewing and Yawn-Sigh techniques	34
4.2	Comparison of shimmer between two conditions for Chewing and Yawn-Sigh technique	35
4.3	Comparison of min. intensity between two conditions for Chewing and Yawn-Sigh techniques	36
4.4	Comparison of max. pitch between two conditions for Chewing and Yawn-Sigh techniques	37

Chapter I

Introduction

Voice is produced through a complex interplay of anatomical and physiological processes. When air from the lungs passes through the vocal folds in the larynx, it causes them to vibrate and generate sound. This sound is then shaped by the resonating chambers of the vocal tract. The vocal mechanism is comprised of several interconnected systems: respiratory, phonatory, resonatory and articulatory system. A voice is said to be good when it possesses several characteristics including clarity, resonance, pitch, loudness and variability (Boone et al., 1993). Voice disorders can significantly impact an individual's ability to communicate effectively and may arise from various causes. These disorders are generally classified into three categories: functional, organic and neurological. Functional voice disorders result from improper use or abuse of vocal mechanism without any structural abnormalities. Organic voice disorders are due to physical changes or abnormalities in the vocal folds, such as nodules, polyps, or other lesions. Neurological voice disorders result from impairments in the nervous system that affect the control and coordination of the vocal mechanism.

A variety of treatment options are available for voice disorders, depending on the underlying cause. Surgical interventions may be necessary to correct structural issues in the vocal folds or other parts of the vocal tract. Medical treatments can address conditions affecting the vocal folds, such as inflammation or infection. Lifestyle modifications, such as improving vocal hygiene, reducing vocal strain, and avoiding harmful vocal behaviors, can also play a critical role in managing voice disorders. Voice therapy is a key component of treatment, involving exercises and techniques designed to optimize vocal function and improve vocal quality. Voice therapy can be both indirect and direct voice therapy. Indirect voice therapy focuses on modifying behaviors and environmental factors that affect vocal health. It addresses underlying issues that contribute to voice problems but does not involve direct manipulation of the voice. Indirect voice therapy includes vocal hygiene education and counselling. Direct voice therapy focuses on specific techniques and exercises to improve the mechanics of voice production. It involves active interventions aimed at modifying how the voice is produced. Direct voice therapy includes resonant voice therapy, stretch and flow phonation, accent method, laryngeal massage, manual circumlaryngeal therapy, vocal function exercises and vocal facilitating approaches.

Vocal facilitating approaches are techniques that facilitates the patient achieve a desired or improved vocal response. There are more than 20 vocal facilitating approaches given by Boone et al. (2020). Chewing and Yawn-sigh are two vocal facilitating techniques, among the few listed by Boone and McFarlane (1988) for an appropriate voice in dysphonic individuals. These techniques may be beneficial for hyperfunctional voice disorders including ventricular phonation, vocal nodules, polyps, muscle tension dysphonia (MTD) and spasmodic dysphonia (Boone et al., 2020). However, a wider range of applications of these techniques in the training of voice of occupational voice users and elite performers are observed in literature.

One of the vocal facilitating techniques is chewing as first described by Froeschels in 1943, is based on his observation that individuals can chew and express simultaneously. This technique relies on the idea that since voiced chewing is an innate and intuitive behaviour, it helps to gain a more natural vocal production (Beebe, 1956). Using techniques like chewing can help control the fundamental frequency and coordinate respiration with phonation, making one's voice sound more natural (Thomas & Stemple, 2007).

Yawn-sigh is often mentioned as an effective method, particularly for individuals with hyperfunctional dysphonia (Boone et al., 2020). By lowering the larynx and expanding the supraglottal airway, this method decreases the vocal tract muscle tension (Shrivastav et al., 2000; Titze & Verdolini, 2012). Yawn-sigh can be coupled with other voice therapy because the sigh involves changes in glottal pressure and impedance that matches with yawning which involves a wide epilaryngeal tube and pharynx leading to a 'yawny' vocal tract configuration. Thus phonation happens with slight glottal opening (Boone & McFarlane, 1993).

A study by Meerschman et al. (2015) examined the effects of voice facilitating strategies, specifically chewing, on the phonation of female SLP students. 27 healthy female SLP student trainees were recruited to the study and practiced chewing technique across 18 weeks. Voice range profile (VRP), dysphonia severity index (DSI), acoustic analysis, and aerodynamic measures were measured and compared between the pre and post training conditions. By using Chewing technique there was a notable reduction in jitter and noise-to-harmonic ratio (NHR), increase in fundamental frequency and significant expansion of VRP and increase in DSI. This suggest that chewing technique helps in improving objective vocal measures in female SLP students.

Meerschman et al. (2017) determined the effectiveness of vocal facilitating techniques, yawn-sigh and glottal fry in isolation on the phonation of normophonic female SLP students. 12 participants each were recruited to yawn-sigh and glottal fry groups and practiced the techniques across 18 weeks. Pre and post training conditions were measured and compared within groups and between groups. Group that practiced Yawn-sigh technique experienced a significant rise in fundamental frequency, reduction in shimmer and NHR while the group with glottal fry resulted in a decrement in lowest and highest intensity. Thus, authors concluded that yawn-sigh improves the vocal quality of healthy female SLP students.

Need for the present study

- There are limited studies or published literature which document the effectiveness of voice facilitating techniques in isolation rather than these performed as a holistic programme or investigated in different combinations.
- Studies examining the exact reasons and underlying processes of the potential impact of these enabling techniques are limited. Furthermore, despite these techniques being used for more than 20 years, there is dearth of literature on their effectiveness.
- Evidences has shown that chewing technique and yawn-sigh techniques are effective in professional voice users, namely female SLP students (Meerschman et al., 2015 & 2017). However, there is insufficient data to support the effectiveness of the same in the context of male SLP students. Thus, the need for this study arised.

Aim of the present study

To determine the effect of two vocal facilitating techniques, (a) chewing and (b) yawn-sigh in isolation on voice of normophonic male SLP students.

Objectives of the present study

- To compare aerodynamic and acoustic voice parameters between pre and post therapy conditions of chewing technique in normophonic male SLP students.
- To compare aerodynamic and acoustic voice parameters between pre and post therapy conditions of yawn-sigh technique in normophonic male SLP students.
- To compare the aerodynamic and acoustic voice characteristics between chewing and yawn-sigh techniques in normophonic male SLP students.

Chapter II

Review of Literature

Voice therapy and behavioral management is recommended for all dysphonic patients, in general. For patients with functional dysphonia, such as paradoxical vocal fold motion, muscle tension dysphonia and neurolaryngeal dysphonia, it can be the main course of treatment. Voice treatment might also be beneficial for patients whose benign lesions which are caused by phonotrauma, vocal fold atrophy, vocal fold scarring, or paralysis as a supplement to surgical intervention (ASHA, 2019). Due to their high vocal demands, professional voice users are more susceptible to hyper-functional voice disorders. In order to balance the vocal subsystems and lessen the excessive muscular tension during phonation, recent research has documented detailed direct and indirect therapeutic approaches (Toles & Harris, 2023). Direct voice therapy's rationale lies in its comprehensive and targeted techniques to enhancing and harmonizing the vocal subsystems (respiratory, phonatory and resonatory) guaranteeing efficient and long-lasting voice utilization. Direct voice therapy includes vocal function exercises, Lessac-Madsen Resonant Voice Therapy and general resonant voice therapies, stretch and flow phonation, accent method, laryngeal massage, manual circumlaryngeal therapy, facilitating techniques, and semi-occluded vocal tract exercises whereas indirect voice therapy includes vocal hygiene techniques and counselling to patients with the goal of improving a person's behaviour, emotional state and physical surrounding. Guidance on vocal health can help prevent or treat behavioural dysphonia and encourage the desire to take care of one's voice. Speyer (2008) concluded that direct voice therapies seem to be more effective than indirect voice therapies. Voice facilitating techniques are one among the direct voice therapy techniques that helps producing optimum voice. Two such facilitating voice therapy techniques are Chewing technique and Yawn sigh given by Boone in 2020.

Professional voice users are thought to be more vulnerable in developing voice issues and concerns. In recent years, there has been a growing interest in the vocal health and management of professional voice users (Van Lierde *et al*., 2010). Occasional vocal abuse or misuse can fail to have a substantial effect on vocal parameters, however, the chronic persistent vocal abuse or overuse may result in voice problems such as hoarseness, narrowed pitch range, vocal fatigue and the sensation of pressure, tightness or pain in the throat (Ng, Bailey & Lippert, 2005).

The Speech Language Pathologist is a professional voice user with a certain demand for voice use. The daily vocal demands that SLPs encounter are profession specific (Warhurst *et al.*, 2010). The professional use of voice in SLP students revealed a shift (whether beneficial or adverse) in the traits of voice. A study done by Van der Merwe et al. in 2015 on SLP students to determine the effect of continuous 2 hours of service delivery on voice which indicate several concerning clinically significant symptoms related to vocal health, including decreased vocal effectiveness and efficiency, vocal fatigue, impaired ability to maintain periodicity in voice amplitude, and reduced voice quality. Such alterations may be an indicator of the harmful impacts of vocal abuse, misuse and overuse that are often required by the SLPs in their line of work.

Gottliebson (2007) assessed the prevalence of voice problems amid first-year graduate students pursuing speech-language pathology (SLP) degree. A total of 104 participants from two universities were included in the study. A questionnaire on medical history, voice use and vocal habits and the Quick screen for voice and endoscopic evaluations were carried out. The findings reveal that voice problems are more common (12%) among aspiring SLPs than they are in general population (3-9%). Fifteen out of the 104 SLPs demonstrated aberrant voice characteristics like persistent glottal fry, voice breaks during pitch gliding, low habitual pitch, hyper nasality, harsh, breathy, or strained phonation. Though SLP students have a lower prevalence of voice disorders than other students, a small percentage of SLP students are nonetheless classified as having voice disorder (Gottliebson et al., 2006). The study done by Dodderi et al. (2018) found a prevalence of 21.4% of voice disorders among Speech language pathologists working in a tertiary care hospital and noted that vocal nodules were most common type of disorder. Among adult male SLPs, there was an increased incidence of vocal fold pathology, along with a higher prevalence of perceptually hoarse voice.

Kyriakou et al. in 2022 aimed to identify the risk factors for voice disorders among 121 undergraduate SLP students. The key findings indicated that several factors were commonly observed in students who self-reported experiencing voice problems. These include health, voice use, lifestyle, and environmental factors. The study concluded that these factors were significantly more prevalent among SLP students with self-perceived voice problems, suggesting that addressing this areas could help in prevention and management of voice disorders within this population.

Chewing technique

Studies by Froeschels (1952) and Cabanas (1952) have shown that chewing may facilitate a more natural vocal production through relaxation of the vocal tract, regulation of the basic vocal pitch, and better coordination between respiration and phonation.

Studies on chewing are organized under the following sub-headings;

a) Chewing in individuals with dysphonia

b) Chewing in professional voice users

c) Chewing in phono-normals

a) Chewing in individuals with dysphonia

Chewing technique corrects the vocal hyperfunction, which is frequently seen in voice disorders. The chewed voice has the ability to find the natural level of pitch (Weiss & Beebe, 1951). Brodnitz and Froschels in 1954 presented six cases of vocal nodules who were treated solely by chewing method. 1st case was of a 10-year-old girl with bilateral vocal nodules. Chewing technique was practiced weekly once with twice a week home training for 3 months. After the treatment, voice was clear and the nodules disappeared. 2nd case was of a 6-year-old girl with nodule on the right vocal fold. Patient practiced chewing technique weekly twice and after 2 months voice was clear and no nodule was visible. 3rd case was a 34 year old female with a small nodule on the right vocal fold. Patient took chewing technique therapy for 1 month and vocal nodules disappeared by the end of 1 month. 4th case was a 32 year old priest with bilateral vocal fold nodules. Chewing method was used and after 3 sessions the priest continued the treatment at home. At the follow up evaluation after one and a half months of treatment the nodules disappeared. 5th case was of a 28 year old singer diagnosed with bilateral vocal fold nodules with mild upper respiratory infections. Treatment could be given only for three months and there was an improvement in voice but the size of nodules were barely reduced. 6th case was of a 26 year old dramatic soprano. After 2 weeks of practising chewing method, exercises to improve breathing was added. There was an improvement seen in the voice. All the 6 clients conclude that chewing approach to voice production normalizes the voice in pitch and in muscular equilibrium. By freeing vocal cords from hyper-pressure, it creates favourable conditions for disappearance of vocal nodules.

Klinger and Martin (1971) aimed to find the effect of chewing technique on hyperfunctioning alaryngeal voice. They considered that since chewing is a preparatory phase for swallowing this may relax the cricopharyngeal sphincter for air charging of the easophagus by injection and may ensure voice production. Chewing may also benefit other alaryngeal speech musculatutes. They presented 2 patients for whom several relaxation techniques like yawn sigh and progressive relaxations which did not work in the treatment of hyperfunctioning alaryngeal voice. Hence chewing technique was carried out. The 1st patient was trained in chewing techique by having him chew while exhaling through the stoma, chew during pulmonary inhalation before injection, then inject and chew out the esophageal voice. After 4 months of therapy patient reported of having strain free voice production. The 2nd patient attended voice therapy for 2 weeks immediately after the laryngectomy and was able to produce voice via injection method, but the quality was harsh and forced with high pitch. Chewing technique was applied to the 2nd patient and was able to chew simultaneously with injection, unlike the 1st patient, so that chewing-injection-chewing was achieved with continuity. This showed a rapid improvement in the voice quality. This study thus shows that chewing technique resulted in a more near normal voice quality and reduction of unnecessary strain in alaryngeal speakers, in addition to its value in treating of other voice and speech disorders.

b) Chewing in professional voice users

Aghadoost et al. (2020) compared the effectiveness of manual circumlaryngeal therapy (MCT) and vocal facilitating techniques (VFTs) in teachers with Muscle tension dysphonia (MTD). The study was a randomized clinical trial research. 16

female teachers with MTD with a mean age of 38.6±4.6 years took part in the study. Participants were randomly assigned to two treatment groups, the first group receiving VFT (n= 8) and group two undergoing MCT (n=8). 10 individual sessions of 45 minutes were provided twice a week. The participants were asked to fill the Persian version of VHI questionnaire and DSI was calculated using aerodynamic and acoustic measures recorded using Praat software (version 6.0.39). This was done before starting voice therapy and post 10 sessions voice therapy. The participants were asked to pitch glide starting from their comfortable pitch to high pitch and down to low pitch. They were also asked to sustain vowel /a/ in their comfortable pitch and reduce the loudness to softest as possible. This was done to get the minimum intensity and maximum pitch values. In order to attain jitter values they were asked to sustain vowel /a/ in comfortable pitch for 3 seconds. They were also asked to sustain vowel /a/ as long as possible after a maximal inhalation to calculate MPT. In the first 2 sessions, both treatment group received vocal hygiene; additionally, the first 10 minutes of every session were devoted to reducing and eliminating improper vocal habits. Seven direct VFTs, which relax the larynx and surrounding areas, like chewing, respiration training, Yawn-sigh, open-mouth, loudness variation, glottal fry, and chant talk were used for the first treatment group. The time allocated for each technique depends on the individual's requirement. In group two, MCT was carried out where circular massage was given during rest and sustained vowel production. The results showed that for within group comparison, the VHI, DSI, and their components showed significantly better results after both treatment groups ($P \leq 0.05$). The most improvement, however, was seen on the DSI (η^2=0.92) after VFTs and for physical component of VHI (η^2=0.90) following MCT, which showed that voice therapists can employ appropriate approach based on the voice concerns, problems and results of voice test in MTD.

c) Chewing in phono-normals

A study by Meerschman et al. (2016) examined the effects of voice facilitation strategies, specifically chewing, on the phonation of female SLP students. Twenty-seven female SLP students of 1st year whose mean age was 18 years were recruited to the study. 13 students were randomly assigned to the control group and 14 students to experimental group practicing chewing technique across 18 weeks. For the first 8 weeks, weekly 1 hour chewing training was conducted to experimental group and from week 9 to 18 the participants were asked to repeat the technique at home twice a day for 10 minutes each. Voice range profile (VRP), DSI, MPT and acoustic analysis (F0, jitter, shimmer, NHR) were measured by MDVP of Computerized Speech Lab (CSL, model 4500, KayPENTAX, Montvale, NY) and compared between the pre and post training conditions. By using Chewing technique there was a notable reduction in jitter and noise-to-harmonic ratio (NHR), increase in fundamental frequency (F0) and significant expansion of VRP and increase in DSI. This suggest that chewing technique helps in improving objective vocal measures in female SLP students. However, more research is required to determine how much chewing technique will help with voice measures in the presence of vocal pathology.

Yawn sigh

Research has shown that yawn-sigh technique can help relax the vocal tract and improve symptoms of vocal hyperfunction and vocal fold nodules (Mansuri, 2018; Boone, 1993). It helps in lowering the position of larynx and widen the supraglottal space while facilitating a natural pitch. Yawn sigh technique helps treat symptoms like vocal fatique, vocal strain, hoarsness of voice and professions that require a lot of vocal use may benefit from this technique.

Studies on Yawn Sigh are organized under the following sub-headings;

a) Yawn-sigh in individuals with dysphonia

b) Yawn-sigh in professional voice users

c) Yawn-sigh in phono-normals

d) Yawn-sigh in children

a) Yawn-sigh in individuals with dysphonia

Bello et al. in 2022 investigated the effectiveness of voice therapy in a group of dysphonic patients pre and post therapy through auditory perceptual and vocal self-perception assessments including GRBAS and VSS (vocal symptoms scale). Study was conducted on 22 adults (15 females and 7 males) with a mean age of 59.4$\pm$12.53 years with otolaryngological diagnosis of dysphonia who were allocated into 4 groups according to Behlau et al.'s (2001) classification. Participants underwent 10 sessions of voice therapy based on comprehensive vocal rehabilitation programme (CVRP). Each session was of 30 minutes duration with 10 minutes of indirect therapy and 20 minutes of direct therapy including yawn-sigh, SOVT and breathing exercises. The pre and post therapy recording have shown that there was a significant improvement on VSS score indicating that there is a reduction in voice symptoms post intervention. GRBAS recording shows no significant improvement in post therapy indicating there is no change in auditory perceptual analysis of voice quality post intervention. This suggest that participants experienced modification in their perception of voice in everyday situations and the therapy was effective in reducing the vocal risk factors in work and social life. The results of the above study are the continued effect of techniques like SOVTE and Yawn-sigh and the individual effect of yawn-sigh is not known on voice from the above study.

Roy (2008) examined the influence of yawn sigh in the diagnosis and management of musculoskeletal tension in hyperfunctional voice disorders. Aronson

(1990) described that laryngeal hyperfunction disorders can be directly assessed and treated with focal palpation and the manual laryngeal musculoskeletal tension reduction technique (also called circumlaryngeal massage). The main therapeutic strategy to release muscle tension was suggested to be manual repositioning (i.e., lowering) of the larynx by kneading the circumlaryngeal area. Additional approaches like yawn- sigh, vocal function exercises, resonant voice therapy and accent method were also taken for the treatment of muscle tension. The individual impact of yawn-sigh is not documented in the study rather it was highlighting regarding the combined or cumulative effect of those voice therapy techniques.

Brewer and McCall (1974) presented a case wherein the yawn-sigh method was used to treat an individual with ventricular phonation. They used flexible fiber-optic naso-laryngoscope to visualize the laryngeal structures and monitor the patient's response to yawn-sigh technique. This technology allowed them to simultaneously observe the patient's laryngeal response and hear their audible response to therapeutic instructions. They concluded that use of yawn-sigh alleviated the strain associated with ventricular phonation and encouraged the proper use of true vocal folds for improving the patient's voice quality. McFarlane (1988) focused on treatment of ventricular dysphonia using a combination of yawn-sigh and inhalation phonation. Both the techniques were applied consistently. Yawn-sigh reduced laryngeal tension and encouraged relaxed phonation using true vocal folds. Inhalation phonation was used to retrain the phonation process and engage the use of true vocal folds as false vocal folds are less likely to adduct during inhalation. By the end of the 25 sessions, patient showed significant improvement. This concludes that yawn-sigh together with inhalation phonation is effective in treating ventricular dysphonia.

Komiyama et al. (1991) examined an approach termed the yawn breathing pattern, which in some ways is similar to the yawn-sigh for effective vocalisation. An equipment was created to monitor patient's breath pattern comfortably during voice treatment sessions in order to modify patients breathing pattern. Patient's rib cage was fitted with a respiratory kinematic sensor that was coupled to a TV monitor near the diaphragm. Ninety-one patients, age 17 to 79 years, with a variety of vocal pathologies completed 10 treatment sessions performed for 20-30 minutes each. They were also asked to perform at home for 3 or more times. The most patients reported satisfactory or fair improvement after the yawn-breathing treatment and 94% of the patients could perform the yawning manoeuvre at the end of therapy. The authors concluded that yawning method combined with visual feedback regarding respiratory kinematics could be a useful voice therapy technique. For most of the therapies like yawn-sigh, relaxation training, accent method, and manual circumlaryngeal techniques, it is unclear regarding the optimal number and length of treatment sessions needed to produce optimal voice outcomes (i.e., dose-response relationships).

b) Yawn-sigh in phono-normals

Meerschman et al. (2017) undertook a study to compare between the effect of a short-term intensive voice training (IVT) and a longer-term traditional voice training (TVT) on the vocal quality and vocal capacities of vocally healthy non-professional voice users. Twenty healthy female participants under the age range of 20-24 years were randomly assigned to both short-term intensive voice training (group 1) with facilitatory techniques and long-term traditional voice training (group 2). Group 1 received a treatment for 2 hours a day for 3 consecutive days and group 2 received two 30 minutes sessions a week for 6 weeks. Both subjective (VHI) and objective (acoustic analysis, voice range profile, dysphonia severity index) measurements were used to evaluate the pre-post voice trainings effectiveness. The authors concluded that short-term IVT may be equally, or even more, effective in training vocally healthy non-professional voice users compared with longer-term TVT.

Meerschman et al. (2017) determined the effectiveness of vocal facilitation techniques, yawn-sigh and glottal fry in isolation on the phonation of normophonic female SLP students. 12 participants each, with a mean age of 18.1 years, were recruited to yawn-sigh and glottal fry groups and practiced the techniques across 18 weeks. Two experimenters led six weekly 1 hour group sessions for both the techniques. From week 7-18, the subjects were asked to practice the techniques at home twice a day for 10 minutes. Pre and post training conditions were measured and compared within groups and between groups. Pre-tests were measured 1 week prior to the training and post-test 1 week after the 18 weeks training session. Test included the measurement of MPT and acoustic analysis (F0, jitter, shimmer, noise-to-harmonic ratio (NHR), voice range profile (VRP) and Dysphonia severity index (DSI)). Within group results showed that Yawn-sigh technique experienced a significant rise in fundamental frequency, reduction in shimmer and NHR while the group with glottal fry resulted in a decrement in lowest and highest intensity. Thus, concluded that both yawn-sigh and glottal fry in isolation helps improve the vocal quality of healthy female SLP students.

c) Yawn-sigh in professional voice users

Malkoc and Orhon (2022) evaluated the usability of lip trill, yawn–sigh and tongue relaxation exercises in vocal training programmes for first year students in a music teacher education programme. 31 participants with a mean age of 19 years were included in the study with 16 (11 females and 5 males) in experimental group and 15 (13 females and 2 males) in control group. The voices of the students were recorded before and after each exercise, and Multi-dimensional voice programme (MDVP, Kay

Elemetrics, CSL Multi-Dimensional Voice Programme, Model 5105, Version 2.3) acoustic examination was used to find the effect of these exercises on the quality of voice. The exercises were carried out in 4 stages for 45 minutes a week for 2 months. 1st stage was diaphragmatic breathing followed by lip trill exercises (2nd stage) for 15 minutes. In the third stage participants were asked to do Yawn-sigh and in 4th stage the participants were given different tongue-trill exercises. The significant difference of voice parameters for F0, jitter, vF0, Shimmer and vAm was determined in both the short term (comparison of parameters obtained before the exercise and immediately after the exercise) and in the long term (after the 8-week implementation phase) treatment. A significant improvement was shown in voice quality in terms of frequency and amplitude perturbation parameters in experimental group compared to the control group after each session and at the end of the 8-week exercise programme.

Duan et al. in 2010 did a study on 36 middle school teachers with mean age of 38.7 years [24 participants (21 females and 3 males) in experimental and 12 participants (10 females and 2 males) in control group] who had voice symptoms for more than 3 months. Out of the 36, 14 were diagnosed as having chronic laryngitis and 22 as functional voice disorder. The subjects were allocated to their group based on their signed case numbers. The study was done to determine the efficacy of resonant voice therapy (RVT) and yawn-sigh exercise post 4 weeks treatment. The training protocol included 3 stages: vocal hygiene education, voice training (RVT and yawn-sigh), home-training exercises. An hour was spent on vocal hygiene education. The subsequent group training was given once a week for 4 weeks, in groups of four subjects, in 60 minutes session. Daily homework assignments were given for 1 month. The outcome was assessed by voice handicap index (VHI), maximum phonation time (MPT) and acoustic parameters including jitter, shimmer and noise to harmonic ratio (NHR). The results showed that there was a significant difference between the experimental group and control group post treatment. There was a decrease in the VHI (28.57 ± 18.89 pre training to 11.83 ± 14.20 post training) and NHR (0.122 ± 0.019 before training to 0.114 ± 0.012 post training) and increase in MPT (15.00 ± 6.94 sec before training to 12.58 ± 3.28 sec post training) among experimental group. The pathological changes found in vocal folds were minimal in this study as participants chosen were with chronic laryngitis and functional voice problems. Hence, they had a perturbation value closer to normal and lower than pathological conditions like vocal nodules and polyps. Hence, there were no significant changes reported for jitter and shimmer in both groups post treatment. The study concludes that RVT and yawn-sigh exercise is suitable to treat voice disorders in middle school teachers. Further researches can be done to generalize the results of this study to other pathological conditions like vocal polyps and nodules among different professional voice users.

d) Yawn-sigh in children

Tezcaner et al. (2009) analyzed the efficiency of voice therapy in 39 children (20 boys and 19 girls) with vocal nodules in the age range of 7-14 years. A treatment plan of 8 weeks with RVT in combination with facilitatory techniques like yawn sigh and chewing techniques were given. Each session was for 45 minutes a week and patients were asked to do home training 4 times a day for 10 minutes each. From the 2^{nd} session, RVT was accompanied with relaxation exercises including laryngeal massage, yawn sigh and chewing technique. Home training was recommended to improve both parent's and patient's cooperation to therapy. MDVP (model 5105; version 2.5, Kay Elemetrics Corp.,) was used to obtain the acoustic parameters such as jitter, F0, shimmer and NHR. GRBAS rating scale was used for subjective assessment of voice quality. A significant improvement was found in the acoustic parameters like jitter (2.51 ± 2.31 pre therapy to 1.55 ± 1.11 post therapy), shimmer (6.39 ± 4.15 pre therapy to 4.55 ± 3.32 after therapy), and noise-to-harmonic ratio (0.20 ± 0.20 pre therapy to 0.15 ± 0.08 after therapy). Preventing vocal abuse is the most crucial aspect of voice therapy. During the 2nd week of therapy, it was noted that all 39 children with vocal fold nodules were effectively implementing the voice abuse reduction measures. However, 16 children's vocal misuse and abuse persisted until the fourth week. This demonstrated the significance of personalized therapy planning and monitoring. The voice therapy which was planned according to one's needs, age, compliance and response to therapy had positive effects on pediatric patients with vocal nodules.

Chapter-III

Method

Study design

The present study followed a pre and post-test comparative group design. Participants were selected based on convenient sampling.

Participants

A total of 24 male speech language pathology students in the age range of 18 to 25 years were included in the study. The participants were assigned to two equal groups: Group 1 with 12 participants practiced chewing technique across 4 weeks (2 sessions per week with a total of 8 sessions) and Group 2 with 12 participants practiced yawn-sigh technique across 4 weeks (2 sessions per week).

Inclusion criteria

- First and second year BASLP male students, in the age range of 18-25 years.
- The participants had no history of ear, nose or throat infections at the time of investigation.
- Participants whose overall grade ‘G’ was zero on GRBAS perceptual voice rating scale were considered.
- Participants whose VHI-10 score were less than 11 on self-rating assessment were selected.

Exclusion criteria

- Participants with a past and present history of ENT related complaints were excluded from the study.

- Participants who were trained singers or attended voice therapy sessions before were excluded from the study.

Instrumentation

Stopwatch, SLM recorder (DSL-331), computer, tripod stand, lingWAVES software version 2.5 (WEVOSYS, Germany), PRAAT software (version 6.3.16) and omnidirectional condenser microphone (BY-M1) were used in the study for voice analysis.

Procedure

The aim and objectives of the study was explained to the participants and written informed consent were obtained from each participant on their willingness to participate in the study. The experimenter screened the participants using GRBAS rating scale (Hirano, 1981) and VHI-10 self-rating scale.

The study was divided into 3 phases:

Phase one*: *Baseline Assessment

The following 3 tasks, maximum phonation duration (MPD), vowel phonation and voice range profile (VRP) were elicited from the participants. During the sample collection, the participants were made to sit comfortably on a chair in a noise-free room and were instructed to complete the following three tasks.

- Maximum phonation duration (MPD): MPD is sustained phonation of vowel /a/ at habitual pitch and loudness for as long as the breath lasts. Participants were asked to stand or sit in an upright posture and were instructed to phonate the vowel /a/ at their comfortable pitch and loudness as long as they can after a deep inhalation. The sustained duration of phonation was measured using a stopwatch. The best out of 3 trials were considered for analysis.

- Phonation sample of vowel /a/ was recorded using PRAAT software through a headset microphone, where the distance between microphone and mouth was kept constant (10 cm). The recording was carried out at 44100 Hz sampling frequency. The mid three seconds stable portion of recorded phonation of vowel /a/ was considered for acoustic analysis to extract mean fundamental frequency (MF0), jitter, shimmer and noise to harmonics ratio (NHR) using PRAAT software.
- Voice range profile: VRP of each participant was recorded individually using lingWAVES software (version 2.5) through SLM which was placed at a distance of 10 cm from the position of mouth. Participants were asked to glide vowel /a/ from their lowest pitch to the highest pitch. Participants were asked to hold on to vowel /a/ in normal loudness of voice and then go down to the lowest or softest voice (loudness gliding). Each recording was done by asking the participants to attempt twice and the same is done to improve reliability of the task. The pitch gliding and loudness gliding using Vospector measurement of lingWAVES provided instant data of minimum pitch, maximum pitch, minimum loudness and maximum loudness. Sustained phonation of /a/ vowel provided jitter (%), MPD and Dysphonia Severity Index (DSI) score. DSI score was calculated instantly with the component parameters like jitter, minimum loudness, highest frequency and MPD measures, from lingWAVES software.

All these measurements were obtained pre-training and after 4 weeks (8 sessions) of voice training with chewing and yawn-sigh techniques. This was done to compare the aerodynamic and acoustic voice parameters between both the facilitating technique in pre and post training.

Phase two: Voice facilitating therapy techniques

The chewing technique and yawn-sigh technique were practised for 4 weeks as 2 sessions per week (4 weeks* 2 sessions= 8 total sessions). Each session lasted for about 30 minutes. The sessions were carried out as group therapy sessions by the experimenter. Each group comprised of 2 participants.

The group 1 underwent chewing technique as explained by Boone et al. (2020). Group 2 underwent yawn-sigh technique based on the procedure outlined by Boone et al. (2020). Session wise details of both the techniques were described in Table 3.1.

Table 3.1

Session-wise details of chewing and yawn-sigh techniques

Sessions	Chewing technique	Yawn-sigh (YS) technique
1	First 5 minutes-Rapport building. To educate and counsel about the chewing technique. The experimenter demonstrated the chewing technique, and the subjects imitated and became familiar with it.	First 5 minutes-Rapport building. Educate and counsel about the yawn-sigh (YS) technique. The experimenter demonstrated the technique, and the subjects imitated and became accustomed with it.
2, 3	Practice chewing technique. - To chew with the mouth open and without phonation. - Chew while uttering the sound "njamnjam." -Chew while uttering nonsense words.	Practiced YS: Yawn and then exhale with a mild phonation of - Words beginning with /h/ or open-mouth vowel. -Yawn followed by utterances of nonsense words.

4, 5	Initial 10 minutes: revise last session activities. - Chew while uttering automatic sequences, such as days of the week and number counting. -Chew while uttering monosyllabic, polysyllabic words.	Initial 10 minutes: revise last session activities. Practice YS with: -Words of mono and polysyllables -Automatic sequences, such as counting numbers, days of the week.
6	Initial 15 minutes: revise last session activities; then proceed to - Chew with utterances of phrases -Chew with utterances of sentences.	Initial 15 minutes: revise last session activities; then proceed to Practice YS: - Phrases -Sentences beginning with /h/, open vowels and mid vowels.
7, 8	Initial 20 minutes: revise tasks done in previous sessions. Teach how to reduce the exaggerate (excessive) chewing and to mimic natural oral movement.	Initial 20 minutes: revise tasks done in previous sessions. Teach the participants to maintain a relaxed phonation without actually using the technique.

Phase three: Post-training assessment

Phase one was repeated where aerodynamic and acoustic voice parameters were measured after the 4 weeks training sessions.

Acoustic Analysis

The lingWAVES software (version 2.5) and PRAAT software were used to record the above mentioned tasks and samples were saved in .lpw and .wav format, respectively. PRAAT software was utilized to extract the following acoustic parameters.

(a) Fundamental Frequency (F0): It is the vibratory rate of vocal folds with lowest frequency. It is denoted as F0 and is measured in Hertz (Kent et al., 2002).

(b) Jitter: It is referred to frequency perturbation. It is the measure of frequency variation from cycle to cycle.

(c) Shimmer: It is the amplitude variation of the sound wave.

(d) Noise to Harmonic Ratio (N/H ratio): It is the ratio between the energy in non-harmonic components to harmonic components.

The lingWAVES software was utilized to extract the following acoustic parameters.

(a) Maximum Phonation Time (MPT): MPT is the maximum amount of time a person can sustain phonation of vowel /a/. It is measured in seconds (s).

(b) Minimum intensity: It is the lowest intensity value in phonation or speech. It is measured in dB.

(c) Maximum intensity: It is the highest intensity value in phonation or speech. It is measured in dB.

(d) Minimum pitch: It is the lowest frequency value in phonation or speech.

(e) Maximum pitch: It is the highest frequency value in phonation or speech.

(f) Dysphonia Severity Index (DSI): DSI creates a quantitative and objective correlation between perceptual voice qualities. To calculate the DSI, the following formula is used. DSI= 0.13x MPT+0.0053xF0-high- 0.26x I-low -1.18x jitter (%) +12.4 (Wuyts, 2000).

Statistical analysis

The aerodynamic (MPT) and acoustic (F0, Jitter, Shimmer, VRP and DSI) data were tabulated and analysed using SPSS software (version 26.0) for pre-post training comparison of each technique and for comparison between two techniques. The normality distribution of the data was tested using Shapiro Wilk's test of normality. Repeated measure ANOVA was performed, followed by Paired samples t-test and independent samples t-test. For parameters that were not normally distributed, non-parametric tests, Wilcoxon Signed-rank test was performed for within group comparison and Mann-Whitney U test was performed for between group comparisons.

Chapter IV
Results

The aim of the present study was to determine the effect of two vocal facilitating techniques, (a) Chewing, and (b) Yawn-sigh in isolation on voice of phono-normal male SLP students.

The objectives of the present study were

- To compare aerodynamic and acoustic voice parameters at pre and post therapy conditions of chewing technique in normophonic male SLP students.
- To compare aerodynamic and acoustic voice parameters at pre and post therapy conditions of yawn-sigh technique in normophonic male SLP students.
- To compare the aerodynamic and acoustic voice characteristics between chewing and yawn-sigh techniques immediately post therapy condition.

The following statistical tests were performed to analyze the effect of chewing and yawn-sigh techniques on the voice parameters of male SLP students using the software "Statistical Package for Social Sciences (SPSS, Version 26.0)";

1. Shapiro Wilk's test of normality
2. Descriptive statistics
3. Repeated Measure ANOVA
4. Paired-samples t-test
5. Independent-samples t-test
6. Wilcoxon signed- rank test
7. Mann-Whitney U test

The results of the study are discussed under the following sub-headings;

1. Results of normality
2. Results of descriptive statistics
3. Results of within group comparisons
4. Results of between group comparisons

1. Results of normality

Shapiro Wilk's test of normality was performed. The results showed that data for F0, shimmer, MPT, minimum intensity, maximum intensity, minimum pitch and maximum pitch followed a normal distribution (p-value> 0.05). Hence, parametric test such as repeated measure ANOVA for comparison between pre and post therapy conditions and comparison between two groups, chewing (group 1) and yawn-sigh (group 2) techniques, was done to obtain main effect and interaction effect (groups and condition). If the main effect was significant (p-value < 0.05), then further testing like paired t-test to see within group comparison and independent t-test to see between group comparison was done. For data such as jitter, NHR and DSI, that did not show a normal distribution (p-value < 0.05), non-parametric tests like Wilcoxon signed- rank test to obtain within group comparison and Mann-Whitney U test to see between group comparison was done.

2. Results of descriptive statistics

The voice parameters like F0, jitter, shimmer, NHR, DSI, MPT, min intensity, min. pitch, max. intensity and max. pitch are tabulated and analyzed for descriptive statistics. The mean, standard deviation (SD), median (Mdn) and interquartile range (IQR) values of voice parameters for chewing technique in two conditions are displayed in Table 4.1 and for yawn-sigh are given in Table 4.2.

Table 4.1

Mean, SD, Median and IQR values for chewing technique between two conditions

Parameters	Conditions	Mean	SD	Median	IQR
F0 (Hz)	Pre	126.71	15.02	128.64	25.56
	Post	121.49	16.91	123.28	32.34
Jitter (%)	Pre	0.20	0.16	0.13	0.16
	Post	0.14	0.17	0.09	0.07
Shimmer (%)	Pre	4.73	1.09	4.91	1.59
	Post	3.78	1.37	3.54	2.71
NHR	Pre	0.01	0.008	0.009	0.006
	Post	0.004	0.003	0.002	0.003
DSI	Pre	1.04	2.31	0.75	3.6
	Post	3.96	1.63	4.30	2.7
MPT (sec)	Pre	16.12	2.79	16.37	4.38
	Post	16.44	2.94	15.86	5.51
Min. intensity (dB)	Pre	56.50	9.32	58.0	15
	Post	48.67	8.93	46.50	12
Max. intensity (dB)	Pre	97.83	9.78	98.0	15
	Post	101.58	7.29	102.50	14
Min. pitch (Hz)	Pre	94.25	24.70	91.50	45
	Post	87.75	27.84	82.50	46
Max. pitch (Hz)	Pre	325.50	121.07	299.0	219
	Post	400.92	132.28	366.50	125

Table 4.2

Mean, SD, Median and IQR values for yawn-sigh technique between two conditions

Parameters	**Conditions**	**Mean**	**SD**	**Median**	**IQR**
F0 (Hz)	Pre	134.07	20.04	135.89	34.63
	Post	128.67	18.16	129.81	22.07
Jitter (%)	Pre	0.12	0.05	0.11	0.09
	Post	0.09	0.03	0.09	0.04
Shimmer (%)	Pre	4.37	1.99	3.55	3.55
	Post	2.99	1.20	3.00	1.96
NHR	Pre	0.006	0.003	0.006	0.007
	Post	0.003	0.001	0.002	0.002
DSI	Pre	0.74	3.24	1.20	6.0
	Post	3.40	2.71	4.0	5.2
MPT (sec)	Pre	17.45	7.66	15.62	10.46
	Post	19.23	6.53	17.47	9.28
Min. intensity (dB)	Pre	59.0	10.82	57.0	17
	Post	52.92	11.95	50.50	22
Max. intensity (dB)	Pre	99.75	6.42	97.50	11
	Post	101.75	6.90	101.0	12
Min. pitch (Hz)	Pre	94.83	25.05	92.0	37
	Post	85.0	26.49	89.50	51
Max. pitch (Hz)	Pre	273.08	70.53	250.0	127
	Post	334.58	132.06	292.0	186

From Table 4.1, the mean values of F0, jitter, shimmer, NHR, minimum intensity and minimum pitch reduced after practicing chewing technique for 8 sessions. A notable decrease in jitter mean and median values from pre (mean=0.20 ± 0.16, Mdn= 0.13) to post (mean= 0.14 ± 0.17, Mdn= 0.09) and NHR (pre mean= 0.010 ± 0.008, Mdn= 0.009, post mean= 0.004 ± 0.003, Mdn=0.002) was obtained. There was a significant increase in the mean DSI (pre mean= 1.04 ± 2.31, Mdn=0.75, post mean=3.96±1.63, Mdn=4.30). There were slight increase in the mean MPT, maximum intensity and maximum pitch values.

Table 4.2 showed a decrease in mean values of F0, jitter, shimmer, NHR, minimum intensity and minimum pitch after practicing yawn-sigh technique for 8 sessions. There was a noticeable drop in mean jitter value (pre mean=0.12±0.05, Mdn=0.11, post mean=0.09±0.03, Mdn=0.09). The mean DSI increased notably from pre-therapy (mean=0.74±3.24, Mdn=1.20) to post therapy (mean=3.40±2.71, Mdn=4.0). The maximum intensity, maximum pitch and mean MPT values showed a slight increase.

Overall, the voice parameters like F0, jitter, shimmer, NHR, minimum intensity and minimum pitch decreased from baseline to post 8 sessions of voice facilitating therapy for both chewing (group 1) and yawn-sigh techniques (group 2). As far as DSI, MPT, maximum intensity and maximum pitch is concerned, these values showed an increase from baseline to post therapy in both the therapy techniques.

3. Results of within group comparisons

Voice parameters such as F0, shimmer, MPT, minimum intensity, maximum intensity, minimum pitch, and maximum pitch followed a normal distribution ($p>0.05$), hence forth repeated measure ANOVA followed by paired samples t-test were done. For other voice parameters like jitter, NHR and DSI which does not follow a normal distribution ($p < 0.05$), non-parametric test like Wilcoxon signed- rank test was done.

Table 4.3 depicts the results of repeated measure ANOVA for the voice measures F0, shimmer, MPT, minimum intensity, maximum intensity, minimum pitch and maximum pitch. The F-value and p-value of main effect (factors such as group and conditions) and interaction effects of these variables are tabulated.

Table 4.3

Results of repeated measure ANOVA for group and condition comparison

Parameters		Conditions	Group	Condition*Group
F0 (Hz)	F	6.78	1.11	0.002
	p	0.01*	0.30	0.96
Shimmer (%)	F	20.51	1.14	0.69
	P	0.00*	0.29	0.41
MPT	F	2.42	0.95	1.19
	p	0.13	0.34	0.28
Min. intensity	F	19.01	0.74	0.30
	p	0.00*	0.39	0.58
Max. intensity	F	3.72	0.14	0.34
	p	0.06	0.71	0.56
Min. pitch	F	2.39	0.01	0.10
	p	0.13	0.90	0.75
Max. pitch	F	5.57	2.45	0.05
	p	0.02*	0.13	0.81

(‘*’ indicates statistical significance at 0.05 level)

From Table 4.3, it is noticed that there was no main effect observed for the groups and no interaction effect observed for condition*group. The conditions demonstrated a significant main effect on voice parameters like F0 [$F (1, 22) = 6.78$, $p<0.05$], shimmer [$F (1, 22) = 20.51$, $p<0.05$], min. intensity [$F (1, 22) = 19.01$, $p<0.05$] and max. pitch [$F (1, 22) = 5.57$, $p<0.05$]. Hence, paired t-test was performed to see within group comparison, i.e., difference between two conditions, pre-therapy and post-therapy. Other voice parameters like MPT, min. pitch and max. intensity showed no significant main effect, indicating no significant difference within group (i.e., no difference between two conditions). Hence, paired sample t-test was not run on them.

Table 4.4 and Table 4.5 depicts the results of paired sample t-test for voice parameters, F0, shimmer, min. intensity and max. pitch, for within group comparison which followed chewing technique and yawn-sigh technique respectively.

Table 4.4

Results of paired sample t-test for within group comparison for chewing technique (group 1)

Parameters	**|t| (11)**	**p value**
F0	2.64	0.02*
Shimmer	2.35	0.03*
Min. intensity	3.30	0.00*
Max. pitch	1.85	0.09

(‘*’ indicates statistical significance at 0.05 level)

Table 4.5

Results of paired sample t-test for within group comparison for yawn-sigh technique (group 2)

Parameters	|t| (11)	p value
F0	1.51	0.15
Shimmer	4.34	0.00*
Min. intensity	2.85	0.01*
Max. pitch	-1.48	0.16

('*' indicates statistical significance at 0.05 level)

3.1 Comparison of F0

The mean values of F0 between two conditions for two techniques are depicted in Figure 4.1.

Figure 4.1

Comparison of F0 between two conditions for Chewing and Yawn-Sigh techniques

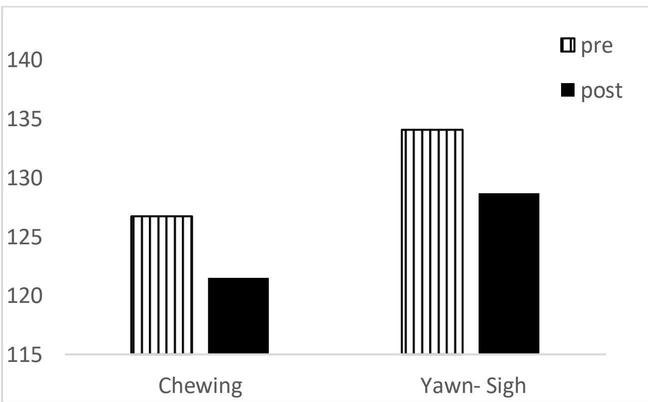

Figure 4.1 shows that F0 decreased slightly after 8 sessions of therapy. The mean for the chewing technique was 121.49 Hz and 128.67 Hz for the Yawn-Sigh technique, compared to baseline means of 126.71 Hz and 134.07 Hz, respectively.

F0 showed a significant main effect ($p<0.05$) in the repeated measure ANOVA. Hence, paired samples t test was carried out to compare the F0 of participant's pre and post 8 sessions of chewing and yawn-sigh techniques. As observed from Table 4.4 there was a significant decrease in F0 of participants after 8 sessions of chewing technique, $t(11) = 2.64$, $p< 0.05$. However, F0 was found to show no significant change in participants who underwent yawn-sigh therapy technique, $t(11) = 1.51$, $p>0.05$.

3.2 Comparison of shimmer

The mean values of shimmer between two conditions for two techniques are depicted in Figure 4.2.

Figure 4.2

Comparison of shimmer between two conditions for Chewing and Yawn-Sigh technique

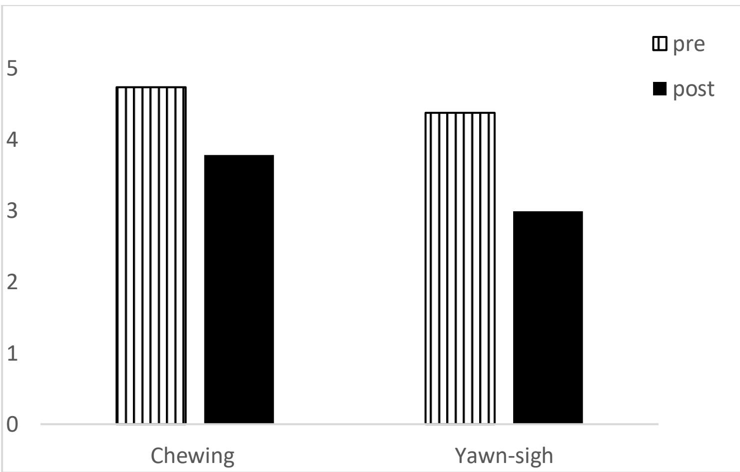

Figure 4.2 revealed that shimmer decreased after 8 sessions of therapy (mean: 3.78 for chewing technique and mean: 2.99 for yawn-sigh technique) when compared to the baseline (mean: 4.73 for chewing technique and mean: 4.37 for Yawn-Sigh

technique). The reduction in mean shimmer was relatively greater for yawn-sigh technique compared to chewing technique.

The results of repeated measure ANOVA revealed a significant main effect ($p<0.05$) found for the variable 'conditions' for shimmer parameter and not for groups. In order to compare the shimmer parameter before and after 8 sessions of chewing and yawn-sigh techniques, paired samples t-test was used. As found from Table 4.4 and Table 4.5, there was a significant reduction in mean shimmer values post 8 sessions for chewing technique, $t(11) = 2.35$, $p< 0.05$ and for yawn-sigh technique, $t(11) = 4.34$, $p< 0.05$.

3.3 Comparison of min. intensity

The mean values of min. intensity between two conditions for two techniques are depicted in Figure 4.3.

Figure 4.3

Comparison of min. intensity between two conditions for Chewing and Yawn-Sigh techniques

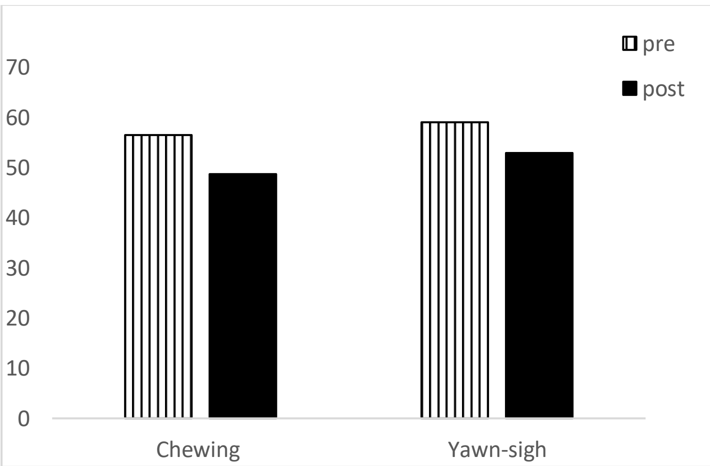

Figure 4.3 revealed that min. intensity decreased after 8 sessions of therapy (mean: 48.67 dB for chewing technique and mean: 52.92 dB for yawn-sigh technique)

when compared to the baseline (mean: 56.50 dB for chewing technique and mean: 59.0 dB for yawn-sigh technique). It can be noted that the min. intensity decreased relatively better after chewing technique compared to yawn-sigh technique.

In the repeated measure ANOVA, min. intensity displayed a significant main effect ($p<0.05$) for conditions as a factor. Therefore, min. intensity of the participants before and after 8 sessions of chewing and yawn-sigh technique was compared using paired samples t-test. Table 4.4 and Table 4.5 showed a significant decrease in min. intensity post therapy for chewing technique $t(11) = 3.30$, $p< 0.05$ and for yawn-sigh technique, $t(11) = 2.85$, $p< 0.05$ when compared to the baseline condition.

3.4 Comparison of max. pitch

The mean values of max. pitch between two conditions for two techniques are depicted in Figure 4.4.

Figure 4.4

Comparison of max. pitch between two conditions for Chewing and Yawn-Sigh techniques

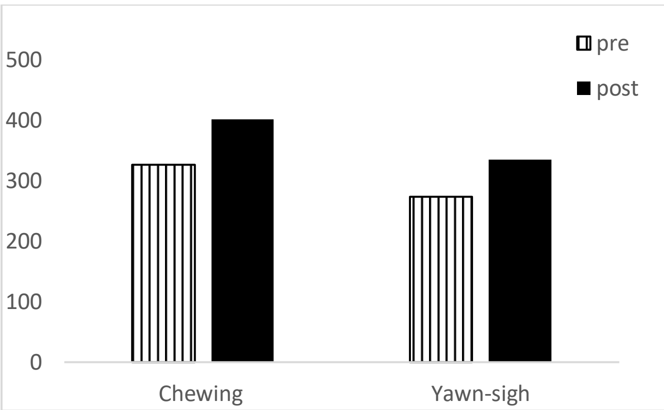

Figure 4.4 revealed that max. pitch increased after 8 sessions of therapy (mean: 400.92 Hz for chewing technique and mean: 334.58 Hz for Yawn-Sigh

technique) when compared to the baseline (mean: 325.50 Hz for chewing technique and mean: 273.08 Hz for yawn-Sigh technique). The increase in max. pitch was relatively higher for chewing technique than yawn-sigh technique.

As max. pitch showed a significant main effect ($p<0.05$) in the repeated measure ANOVA, paired samples t-test was carried out to compare the pre and post therapy condition for chewing technique and yawn-sigh technique in participants after 8 sessions. Table 4.4 and Table 4.5 revealed no significant difference in the max. pitch post therapy for chewing technique $t(11) = -1.85$, $p> 0.05$ and also for yawn-sigh technique, $t(11) = -1.48$, $p> 0.05$.

Other voice parameters that deviated from a normal distribution, such as jitter, NHR and DSI, were tested using Wilcoxon signed-rank test for within group comparison (i.e., compare between the conditions). Table 4.6 shows the result of Wilcoxon signed-rank test for group 1 (chewing technique). The results revealed that all three parameters, jitter, NHR and DSI, showed a statistical significant difference between pre and post therapy conditions using chewing technique. Jitter and NHR values decreased significantly after 8 sessions of practicing chewing technique whereas, DSI value increased significantly in post therapy when compared to pre therapy.

Table 4.6

Results of Wilcoxon signed- rank test for jitter, NHR and DSI for group 1 (chewing technique)

Parameters	|Z| value	p value
Jitter	2.009	0.045*

NHR	2.981	0.003*
DSI	2.945	0.003*

('*' indicates statistical significance at 0.05 level)

Results of Wilcoxon signed-rank test for jitter, NHR and DSI parameters for group 2 (yawn-sigh technique) with p value and |Z| value is presented in Table 4.7. The results revealed that all three parameters, jitter, NHR and DSI, showed a statistically significant difference between the pre and post therapy conditions using yawn-sigh technique, i.e., jitter and NHR values decreased significantly after 8 sessions of practicing yawn-sigh technique. Further, DSI value increased significantly in post therapy when compared to pre therapy condition.

Table 4.7

Results of Wilcoxon signed- rank test for jitter, NHR and DSI for group 2 (yawn-sigh technique)

Parameters	**|Z| value**	**p value**
Jitter	2.123	0.034*
NHR	2.275	0.023*
DSI	2.747	0.006*

('*' indicates statistical significance at 0.05 level)

4. Results of between group comparisons

Parameters like F0, shimmer, MPT, minimum intensity, maximum intensity, minimum pitch and maximum pitch which followed a normal distribution (p>0.05), repeated measure ANOVA was done.

Table 4.3 depicts the results of repeated measure ANOVA for the voice measures F0, shimmer, MPT, minimum intensity, maximum intensity, minimum pitch and maximum pitch where the F-value and p-value of main effect and interaction effects of these variables are tabulated.

From Table 4.3, it is noticed that there was no main effect observed for the groups and no interaction effect for the condition*group. This indicated that there is no significant difference found when comparing both the groups. That is, both chewing technique and yawn-sigh technique have similar impact on the measured parameters after 8 sessions of therapy. Hence, no further independent samples t-test was carried out to show the significance between both the groups.

For other voice parameters like jitter, NHR and DSI which does not follow a normal distribution ($p<0.05$), non-parametric test was done. To compare results of these parameters between chewing technique (group 1) and yawn-sigh technique (group 2), Mann-Whitney U test was carried out.

Table 4.8

Results of Mann-Whitney U test for between group comparison

Parameters		**|Z| value**	**p value**
Jitter	Pre	1.10	0.27
	Post	0.40	0.68
NHR	Pre	1.32	0.18
	Post	0.23	0.81
DSI	Pre	0.02	0.97
	Post	0.34	0.72

Table 4.8 shows the |Z| value obtained on Mann-Whitney U test on jitter, NHR and DSI. The results showed that there is no significant difference in the voice parameters, jitter, NHR and DSI, between both the groups, specifically in the post therapy condition. That is, both chewing and yawn-sigh techniques have similar effect on the measured voice parameters after 8 sessions of therapy in phono-normal individuals.

Chapter V

Discussion

The present study aimed to determine the effect of two vocal facilitating techniques, (a) chewing and (b) yawn-sigh in isolation on voice of phono-normal male SLP students. The main effect of variables like conditions (pre and post) and groups (chewing technique and yawn-sigh technique) on voice parameters such as F0, shimmer, MPT, minimum intensity, maximum intensity, minimum pitch and maximum pitch were determined using repeated measure ANOVA. The results of repeated measure ANOVA revealed that F0, shimmer, min. intensity and max. pitch exhibited a significant main effect on conditions and no significant main effect on groups. Hence, paired samples t-test was carried out for pairwise comparison. Results of paired samples t-test revealed significant change in F0, shimmer and min. intensity for group 1 (chewing technique) and significant change in shimmer and min. intensity for group 2 (yawn-sigh technique). Independent samples t-test was not carried out for between group comparison as repeated measure ANOVA revealed no significant main effect for groups. For other voice parameters (jitter, NHR, DSI) those doesn't follow a normal distribution, Wilcoxon signed-rank test was performed for within group comparison and Mann-Whitney U test was performed for between group comparison. Results of Wilcoxon signed-rank test revealed that all 3 parameters (jitter, NHR and DSI) showed a significant difference between pre and post therapy conditions practicing chewing technique as well as yawn-sigh technique. Results of Mann-Whitney U test revealed that there is no significant difference in the voice parameters, jitter, NHR and DSI, between the groups (chewing technique and yawn-sigh technique).

5.1 Chewing technique

a) Fundamental frequency (F0 in Hz)

There is a slight reduction in mean F0 values observed from pre-therapy (127 ± 15.02 Hz) to post-therapy (121.49 ± 16.91 Hz) condition. Reduction in F0 can be due to relaxation of vocal tract and reduction in strain component which in turn reduces the frequency of vocal fold vibration. With the relaxation of phonatory function of larynx, the person tries to speak in their optimal pitch. Brodnitz and Froschels (1954), reported a reduction in F0 in dysphonic patients using chewing technique. A study done by Meerschman et al. (2015) showed an increase in F0 on female SLP students who practiced chewing technique for 18 sessions. The reason for differences in the findings of the present study and the study by Meerschman et al. (2015) would be differences in duration of session and gender of the participants. Present study has employed 8 sessions of chewing training to male SLP students.

b) Jitter (%)

Jitter mean values reduced from pre-therapy (0.20±0.16) to post-therapy (0.14 ± 0.17) conditions for chewing technique. Jitter is a phonatory sample measurement that varies with mass, stiffness, and tension of vocal cords (Robieux et al., 2015). The suprahyoid muscles of the extrinsic muscles of the larynx undergoes lot of relaxation after chewing technique. Subsequently, it reduces any tension or strain in the vibratory structures and resulted in stable vocal fold vibration. Meerschman et al. (2015) reported the positive effect of chewing technique on jitter. In a study carried out by Mansuri et al. (2019), jitter reduced after chewing exercises on MTD patients.

c) Shimmer (%)

Shimmer value reduced from pre therapy (4.73 ± 1.09) to post therapy (3.78 ± 1.37) condition. Mansuri et al. (2019) reported a decrease in shimmer values on MTD patients using chewing techniques. Breathiness and noise production are associated with shimmer, which changes with glottal resistance. Decreased shimmer results in a voice that is less effortful to produce (Sihvo, 2007). Chewing technique relaxes the muscles of jaw, neck and larynx and reduces the tension in vocal folds. This improves the resonance which reduces amplitude variations. This shows a reduction in the shimmer values. Meerschman et al. (2015) reported no significant change in shimmer values on female SLP students who underwent chewing technique. Results of Meerschman et al. (2015) contradicts with the present study where shimmer values in their study did not change significantly post chewing condition. The difference in the findings of the present study and the study of Meerschman et al. (2015) could be due to methodological variations. Meerschman et al. (2015) considered female SLP students, employed chewing training for 18 sessions and utilized MDVP software. Whereas, the present study considered male SLP students, trained for 8 sessions and utilized PRAAT software.

d) Noise-harmonic ratio (NHR in dB)

NHR value decreased significantly from pre therapy (0.010±0.008) to post therapy (0.004±0.003) condition. Meerschman et al. (2015) also found a decrease in NHR after chewing technique in female SLP students and one of the possible reasons for the same was reduced breathiness component in voice which could be because of better glottal closure. Beebe (1956) reported that chewing technique brings better coordination between respiration and phonation. The results of present study support the findings of Beebe (1956) and Meerschman et al (2015).

e) MPT (sec)

MPT values were found to increase very slightly from pre-therapy (16.12 ± 2.79 sec) to post-therapy (16.44 ± 2.94 sec) condition. This finding is supported by a study done by Meerschman et al. (2015) on female SLP students where the authors reported that MPT did not improve after chewing training. However, Aghadoost et al. (2020) showed an increase in DSI in MTD patients due to chewing technique. This increase in DSI is due to combined changes in aerodynamic parameter (MPT) and other acoustic parameters like jitter, min. intensity and max. pitch which contradicts the findings of the present study. Chewing technique relaxes the neck, jaw and laryngeal muscles which increases the coordination between respiratory and phonatory system. This increase in coordination may contribute to increase in MPT values. However, the increase in MPT values from baseline to post therapy could be evidently observed if the sample size would have been higher. In the study of Aghadoost et al. (2020), the participants were MTD patients, whereas the participants in the present study are phono-normals. The participants of the present study already have MPT values within normal limits or have reached the ceiling effect, so the chewing training did not significantly improve their MPT.

f) DSI

In the present study, it was found that DSI values increased from mean of 1.04 ± 2.31 to mean of 3.96 ±1.63, post therapy. DSI is a multiparametric score including aerodynamic and acoustic components like jitter, higher F0, lower intensity and MPT. A minor improvement in any of these components signifies improved voice quality. Results of the present study shows improvement in both aerodynamic and acoustic parameters post chewing technique. Jitter and min. intensity values decreased significantly post therapy. As chewing relaxes the overall vocal tract, it also relaxes the phonatory system which helps in creating a stable vocal fold vibration. As a result, strain in voice reduced and max. pitch increased after 8 sessions of chewing technique. Though, MPT did not show much improvement, jitter and min. intensity reduced significantly after chewing therapy. The combined effect of all these components increased the DSI value. Meerschman et al. (2015) found an increase in DSI when examining the effect of chewing technique on female SLP students. Aghadoost et al. (2020) reported an increase in DSI among teachers with MTD who practiced chewing technique. The present study findings support the findings of both Meerschman et al. (2015) and Aghadoost et al. (2020).

g) VRP (min. intensity, min. pitch, max. intensity, max. pitch)

Voice range profile is a measurement of the frequency and intensity range of one's voice, which ranges from the lowest note one can produce to the very highest. There is a significant reduction in the min. intensity values from 56.50 ± 9.32 dB to 48.67 ± 8.93 dB after therapy. Practicing chewing technique creates a relaxation in the respiratory, phonatory and articulatory system. This explains the reduction in intensity. Meerschman et al. (2015) reported a reduction in min. intensity on female SLP students practicing chewing technique. Aghadoost et al. (2020) explained the reduction of min. intensity in MTD patients undergoing vocal facilitating techniques. Other parameters like min. pitch, max. intensity and max. pitch showed no significant changes post therapy in the present study. Meerschman et al. (2015) after performing chewing technique on female SLP students found an expansion in the voice range profile. The present study shows an expansion in the voice range profile too, but is not considerable enough to show a change in voice post therapy.

5.2 Yawn sigh technique

a) Fundamental frequency (F0 in Hz)

The F0 value slightly reduced from a mean of 134 ± 20.04 Hz in pre therapy to 128.67 ± 18.16 Hz in post therapy condition. During yawn and sigh, the larynx lowers and pharynx dilates, this relaxes the intrinsic laryngeal muscles which creates a natural pitch (Boone & McFarlane, 2005). Reduced F0 is often associated with reduced tension in vocal cords which is controlled by the thyroarytenoid and cricothyroid muscles (Titze, 2000). During yawning these muscles gets activated. Shrivastav et al. (2000) reported that increased tension in the intrinsic laryngeal muscles causes higher F0. Meerschman et al. (2017) reported increase in F0 on female SLP students after practising yawn-sigh therapy. Malkoc and Orhon (2022) found a significant improvement in F0 in first year music students after practicing yawn-sigh technique. The present study also found a reduction in F0 among male SLP students.

b) Jitter (%)

Jitter value decreased from pre therapy (0.12±0.05) to post therapy (0.09±0.03) condition. By creating an open and relaxed vocal tract during yawning, it helps to place the voice in a more forward resonance. This forward placement can make the voice sound stable and more vibrant, enhancing vocal efficiency. The study done by Chen et al. (2007) found no reduction in jitter among the participants. However, in support to the present study, Meerschman et al. (2017) reported a decrease in jitter values on female SLP students after practicing yawn-sigh technique. Malkoc and Orhon (2022) reported a decrease in jitter values in first year music students after yawn-sigh technique. Therefore, findings of the current study are in no consonance with the study findings of Chen et al. (2007) and is in agreement with the findings of Meerschman et al. (2017)

c) Shimmer (%)

Mean shimmer values reduced from pretherapy (4.37 ± 1.99) to post therapy (2.99 ± 1.20) condition. Following therapy, there was a considerable decrease in shimmer, which is consistent with the yawn-sighs facilitating impact.

This can be due to reduced cycle to cycle abnormalities in terms of amplitude and improved glottal closure. Meerschman et al. (2017) reported a decrease in shimmer values after yawn-sigh technique. Carding et al. (1998) also reported a decrease in shimmer post yawn-sigh therapy. Contrary to these studies, Duan et al. (2010) found no decrease in shimmer on school teachers with chronic laryngitis. However, comparison of this study with current study is difficult as it investigated patients with chronic laryngitis. The results of the present study are in consensus with the study results of Meerschman et al. (2017).

d) Noise-harmonic ratio (NHR in dB)

NHR values decreased slightly at pre therapy from 0.006±0.003 to 0.003±0.001 post therapy condition. Following therapy, there was a decrease in acoustic noise or breathiness in voice. This could be due to enhanced glottal closure and more regular contact between the vocal fold margins owing to yawn-sigh technique. Meerschman et al. (2017) reported a decrease in NHR values after yawn-sigh technique. Duan et al. (2010) found decrease in NHR values after on school teachers with chronic laryngitis. Hence, the results of the present study support the findings of the study of Duan et al. (2010) and Meerschman et al. (2017).

e) MPT (sec)

Mean MPT values slightly increased from baseline 17.45 ± 7.66 sec to 19.23 ± 6.53 sec after therapy. MPT heavily relies on the respiratory support during phonation. In the present study there is a slight increase in MPT post yawn-sigh therapy indicating a fair respiratory and phonatory system coordination. Zhu et al. (2010) reported a significant increase in MPT in the training group when the yawn-sigh was accompanied with respiratory training. Another study by Chen (2007) found no significant increase in MPT as the yawn-sigh treatment does not contain respiratory exercises alongside. Meerschman et al. (2017) reported no significant difference in MPT post yawn-sigh therapy on female SLP students. These studies support that yawn-sigh alone does no bring much difference in MPT in healthy individuals.

f) DSI

Twelve participants underwent 8 sessions of Yawn-sigh therapy and found that DSI scores increased from baseline 0.74 ± 3.24 to 3.40 ± 2.71 post therapy condition. The study showed positive improvement in jitter, min. intensity, slight improvement in max. pitch and MPT after yawn-sigh technique. The combined effect of these parameters showed an increased DSI scores. Meerschman et al. (2017) found an increase in DSI when examining the effect of yawn-sigh technique on female SLP students. The present study results support the study results of Meerschman et al. (2017).

g) VRP (min. intensity, min. pitch, max. intensity, max. pitch)

There is a significant reduction in the min. intensity from 59.0 ± 10.82 pre-therapy to 52.92 ± 11.95 post therapy condition. Yawn-sigh helps relax your voice and improves its range. Meerschman et al. (2017) reported a reduction in min. intensity on female SLP students practicing yawn-sigh technique. Other parameters, such as minimum pitch, maximum intensity, and maximum pitch, showed no significant changes post-therapy in the present study of post yawn-sigh technique. Meerschman et al. (2017) observed an expansion in the voice range profile after applying the yawn-sigh technique to female SLP students. Whereas, the present study also found an expansion in the voice range profile, but it is not considerable enough to demonstrate a change in voice post-therapy.

Chapter VI

Summary and Conclusion

Voice is produced when air from lungs passes through the vocal folds in larynx, causing them to vibrate. The sound is then shaped by the resonating chambers of vocal tract. The vocal mechanism includes the respiratory system, phonatory system, resonatory system and articulatory system. Common voice disorders include functional, organic and neurological voice disorders. Treatment options of voice disorders include surgical, medical, lifestyle modifications and voice therapy. Voice facilitating approaches are techniques that facilitates the patient achieve a desired or improved vocal response. There are more than 20 vocal facilitating approaches given by Boone et al. (2020). Few among them are Chewing technique and Yawn-Sigh technique. Both chewing technique and yawn-sigh technique are relaxation techniques which relaxes the larynx and dilates the pharynx.

The present study aimed to evaluate the effect of two vocal facilitating techniques, (a) chewing and (b) yawn-sigh in isolation on voice of phono-normal male SLP students. The objectives of the study were to compare aerodynamic and acoustic voice parameters between pre and post therapy using chewing as well as yawn-sigh technique in normophonic male SLP students and to compare the aerodynamic and acoustic voice characteristics between chewing and yawn-sigh techniques. The study comprised of 24 male SLP students in the age range of 18-25 years. Two vocal facilitating techniques were considered for the study, chewing and yawn-sigh technique. The voice measurements were taken in pre-therapy and post-therapy conditions. Both aerodynamic and acoustic voice parameters was measured pre-therapy. The participants were randomized to two groups. Group 1 with 12 participants practicing chewing technique for 8 sessions. Group 2 with 12 participants practicing yawn-sigh technique for 8 sessions. Each session was of 30 minutes duration. After 8 sessions of therapy, post-therapy recording was done. The lingWAVES software and PRAAT software were used for acoustic (F0, jitter, shimmer, NHR, DSI, VRP) and aerodynamic (MPT) voice analysis. For measuring the voice parameters, tasks given to participants were phonation of vowel /a/ and pitch gliding from comfortable pitch to possible highest and lowest pitch. Similarly glide from their comfortable intensity to possible loudest intensity and to lowest intensity (i.e., loudness)

The results of the present study revealed several points of interest: -

Firstly, F0, jitter, shimmer, NHR, min. intensity and DSI have shown a significant positive impact on voice post chewing technique.

Secondly, jitter, shimmer, NHR, min. intensity and DSI have shown a significant positive impact on voice post yawn-sigh technique. These findings suggest that both the techniques have similar effect on acoustic voice parameters when measured.

Thirdly, there was no significant difference found when comparing the voice parameters between the two groups (chewing and yawn-sigh technique). This suggest that both the techniques have similar impacts on the vocal system in phono-normal young male SLP students.

Clinical implications of the study

- The present study emphasised on the efficacy of chewing technique and yawn-sigh technique in isolation.
- The study adds on to the literature regarding the use of appropriate facilitating techniques in isolation in future occupational voice users to improve their vocal quality and to maintain healthy voice and thereby prevent any voice related issues.

- The decreased acoustic parameters like F0, jitter, shimmer, NHR and min. intensity and increased DSI and MPT in normo-phonic male SLP students after chewing and yawn-sigh technique suggests improved voice quality. Thus, these techniques can be extended to individuals with dysphonia (hyperfunctional voice disorders).

Limitations of the study and Future directions

- The study comprised of a small sample size consisting of 24 male SLP students. Replicating the study with a larger sample size may provide greater support to the findings.
- The study will have to be replicated on population with voice disorders in order to investigate the underlying mechanisms and effects of both techniques in isolation.
- The study measures the pre-therapy and post-therapy voice parameters. Including mid-therapy session's measurement would have given a comprehensive view, allowing better tracking of progress.
- Follow up assessments could have been extended to examine the long-term impact of these techniques on voice parameters.

References

Aghadoost, S., Jalaie, S., Khatoonabadi, A. R., Dabirmoghaddam, P., & Khoddami, S. M. (2020). A Study of Vocal Facilitating Techniques Compared to Manual Circumlaryngeal Therapy in Teachers With Muscle Tension Dysphonia. *Journal of voice: official journal of the Voice Foundation*, *34*(6), 963.e11–963.e21. https://doi.org/10.1016/j.jvoice.2019.06.002

Beebe H. H. (1956). Practical aspects of chewing therapy. *Folia phoniatrica*, *8*(2), 107–117. https://doi.org/10.1159/000262734

Bello, J. Z., Zencke da Silva, K., de Oliveira Lemos, I., Marchand, D. L. P., Martínez, C. C., & Cassol, M. (2023). Effects of a voice therapy program in a group of patients with dysphonia: a pilot study. *Audiology-Communication Research*, *28*, e2687.

Boone, D. R., & McFarlane, S.C. (1988). *The voice and voice therapy* (4th edn.). Prentice Hall

Boone, D. R., & McFarlane, S. C. (1993). A critical view of the yawn-sigh as a voice therapy technique. *Journal of Voice*, 7(1), 75–80.

Boone, D. R., McFarlane, S. C., Von Berg, S. L., & Zraick, R. I. (2020). *The voice and voice therapy* (10th edn.). Boston, MA: Allyn & Bacon.

Brewer, D. W., & McCall, G. (1974). Visible laryngeal changes during voice therapy: fiber-optic study. *Annals of Otology, Rhinology & Laryngology*, *83*(4), 423-427.

CABANAS R. (1952). Generalization of the chewing method in logopedics and phoniatry. *Folia phoniatrica*, *4*(4), 249–252. https://doi.org/10.1159/000262629

Carding, P. N., Horsley, I. A., & Docherty, G. J. (1998). The effectiveness of voice therapy for patients with non-organic dysphonia. *Clinical Otolaryngology & Allied Sciences*, *23*(4), 310-318.

Chen, S. H., Hsiao, T. Y., Hsiao, L. C., Chung, Y. M., & Chiang, S. C. (2007). Outcome of resonant voice therapy for female teachers with voice disorders: perceptual, physiological, acoustic, aerodynamic, and functional measurements. *Journal of Voice*, *21*(4), 415-425.

Couch, S., Zieba, D., Van der Linde, J., & Van der Merwe, A. (2015). Vocal effectiveness of speech-language pathology students: Before and after voice use during service delivery. *The South African journal of communication disorders = Die Suid-Afrikaanse tydskrif vir Kommunikasieafwykings*, *62*(1), E1–E7. https://doi.org/10.4102/sajcd.v62i1.95

Dodderi, T., Philip, N. E., & Mutum, K. (2018/09//). Prevalence of voice disorders in the Department of Speech-Language Pathology of a tertiary care hospital of Mangaluru: A retrospective study of 11 years. *Nitte University Journal of Health Science*, *8*(3), 12-16. https://www.proquest.com/scholarly-journals/prevalence-voice-disorders-department-speech/docview/2138473464/se-2

Duan, J., Zhu, L., Yan, Y., Pan, T., Lu, P., & Ma, F. (2010). The efficacy of a voice training program: a case–control study in China. *European archives of oto-rhino-laryngology*, *267*, 101-105.

Froeschels, E. (1943). Hygiene of the voice. *Archives of otolaryngology*, 38, 1220130

Gartner-Schmidt, J. L., Roth, D. F., Zullo, T. G., & Rosen, C. A. (2013). Quantifying component parts of direct and indirect voice therapy related to different voice disorders. Journal of Voice, 27, 210–216.

Gottliebson, R. O., Lee, L., Weinrich, B., & Sanders, J. (2007). Voice problems of future speech-language pathologists. *Journal of voice : official journal of the Voice Foundation*, *21*(6), 699–704. https://doi.org/10.1016/j.jvoice.2006.07.003

Hirano, M., & McCormick, K. R. (1986). *Clinical Examination of Voice* by Minoru Hirano. *Journal of the Acoustical Society of America*, *80*(4), 1273. https://doi.org/10.1121/1.393788

Kent, R. D., & Read, C. (2002). *Acoustic Analysis of Speech*. Delmar Learning.

Klinger, H., & Martin, A. D. (1971). Hyperfunctioning alaryngeal voice and the use of the chewing approach. *Folia phoniatrica*, *23*(5), 308–313. https://doi.org/10.1159/000263513

Kyriakou, K., Theodorou, E., Petinou, K., & Phinikettos, I. (2022). Risk Factors for Voice Disorders in Undergraduate Speech Language Pathology Students. *Journal of voice : official journal of the Voice Foundation*, S0892-1997(21)00411-2. Advance online publication. https://doi.org/10.1016/j.jvoice.2021.11.020

Mansuri, B., Tohidast, S. A., Soltaninejad, N., Kamali, M., Ghelichi, L., & Azimi, H. (2018). Nonmedical Treatments of Vocal Fold Nodules: A Systematic Review. *Journal of voice : official journal of the Voice Foundation*, *32*(5), 609–620. https://doi.org/10.1016/j.jvoice.2017.08.023

Mansuri, B., Torabinezhad, F., Jamshidi, A. A., Dabirmoghadam, P., Vasaghi-Gharamaleki, B., & Ghelichi, L. (2019). Effects of Voice Therapy on Vocal Tract Discomfort in Muscle Tension Dysphonia. *Iranian journal of otorhinolaryngology*, *31*(106), 297–304.

Meerschman, I., D'haeseleer, E., De Cock, E., Neyens, H., Claeys, S., & Van Lierde, K. (2016). Effectiveness of Chewing Technique on the Phonation of Female Speech-Language Pathology Students: A Pilot Study. *Journal of voice : official journal of the Voice Foundation*, *30*(5), 574–578. https://doi.org/10.1016/j.jvoice.2015.06.016.

Meerschman, I., D'haeseleer, E., Catry, T., Ruigrok, B., Claeys, S., & Van Lierde, K. (2017). Effect of two isolated vocal facilitating techniques glottal fry and yawn-sigh on the phonation of female speech-language pathology students: A pilot study. *Journal of communication disorders*, *66*, 40–50. https://doi.org/10.1016/j.jcomdis.2017.03.004

Ng M.L., Bailey R.L. & Lippert L.R. (2005). Comparison of vocal characteristics of future professionals in three different university majors. *Contemporary Issues in Communication Science and Disorders*, 32, 142–150.

Orhon, E.Ş., & Malkoç, T. (2022). The effects of yawn-sigh, lip trill and tongue relaxation exercises on frequency and amplitude perturbation of voice in vocal training. *Cypriot Journal of Educational Sciences*.

R. Speyer,Effects of Voice Therapy: A Systematic Review,Journal of Voice,Volume 22, Issue 5,2008,Pages 565-580,ISSN 0892-1997,https://doi.org/10.1016/j.jvoice.2006.10.005.

Robieux, C., Galant, C., Lagier, A., Legou, T., & Giovanni, A. (2015). Direct measurement of pressures involved in vocal exercises using semi-occluded vocal tracts. *Logopedics Phoniatrics Vocology*, *40*(3), 106-112.

Rosen, C.A., Lee, A.S., Osborne, J., Zullo, T., & Murry, T. (2004). Development and Validation of the voice handicap index-10. *The Laryngoscope, 114(9),* 1549-1556. https://doi.org/10.1097/00005537-200409000-00009

Roy N. (2008). Assessment and treatment of musculoskeletal tension in hyperfunctional voice disorders. *International journal of speech-language pathology*, *10*(4), 195–209. https://doi.org/10.1080/17549500701885577

Sihvo, M. (2007). LaxVox tube. In *7th Pan European Voice Conference–PEVOC [Internet]*. Groninger. [Cited 2018 May 30]. www.pevoc.org/pevoc07/index.htm

Shrivastav, R., Yamaguche, H., & Andrews, M. (2000). Effects of stimulation techniques on vocal responses: Implications for assessment and treatment. *Journal of Voice*, 14(3), 322–330. https://doi.org/10.1016/S0892-1997(00)800788.

Tezcaner, C. Z., Karatayli Ozgursoy, S., Sati, I., & Dursun, G. (2009). Changes after voice therapy in objective and subjective voice measurements of pediatric patients with vocal nodules. *European archives of oto-rhino-laryngology : official journal of the European Federation of Oto-Rhino-Laryngological Societies (EUFOS) : affiliated with the German Society for Oto-Rhino-Laryngology - Head and Neck Surgery*, *266*(12), 1923–1927. https://doi.org/10.1007/s00405-009-1008-6

Thomas, L.B., & Stemple, J.C. (2007). Voice therapy: does science support the art? *Communicative Disorders Review,* 1,49-77.

Titze, I. R., & Verdolini Abbott, K. (2012). *Vocology: The science and practice of voice habilitation*. Salt Lake City, UT: National Center for Voice and Speech.

Toles, L.E., Harris, A.L. Direct and Indirect Voice Therapy Approaches for Unloading the Laryngeal Mechanism in Professional Voice Users. *Curr Otorhinolaryngol Rep* **11**, 318–324 (2023). https://doi.org/10.1007/s40136-023-00483-0

Van Lierde, K. M., D'haeseleer, E., Wuyts, F. L., De Ley, S., Geldof, R., De Vuyst, J., & Sofie, C. (2010). The objective vocal quality, vocal risk factors, vocal complaints, and corporal pain in Dutch female students training to be speech-language pathologists during the 4 years of study. *Journal of voice : official journal of the Voice Foundation*, *24*(5), 592–598. https://doi.org/10.1016/j.jvoice.2008.12.011

Warhurst, S., Madill, C., McCabe, P., Heard, R., & Yiu, E. (2012). The vocal clarity of female speech-language pathology students: an exploratory study. *Journal of voice : official journal of the Voice Foundation*, *26*(1), 63–68. https://doi.org/10.1016/j.jvoice.2010.10.008

Wuyts, F. L., De Bodt, M. S., Molenberghs, G., Remacle, M., Heylen, L., Millet, B., Van Lierde, K., Raes, J., & Van de Heyning, P. H. (2000). The dysphonia severity index: an objective measure of vocal quality based on a multiparameter approach. *Journal of speech, language, and hearing research : JSLHR*, *43*(3), 796–809. https://doi.org/10.1044/jslhr.4303.796

Xu, J. H., Ikeda, Y., & Komiyama, S. (1991). Bio-feedback and the yawning breath pattern in voice therapy: a clinical trial. *Auris Nasus Larynx*, *18*(1), 67-77.