

Systematic Review on Outcomes of Lip and Tongue Trills in Professional Voice Users

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Abstract:

Background: Professional voice users are more prone to acquire or be vulnerable to vocal disorders than others. To keep up good vocal condition, recent advances in voice therapy procedures using lip/tongue trills have been tested in professional voice users, but the results have not been thoroughly recorded. As a result, a comparable systematic evaluation of this treatment strategy's efficacy in terms of voice characteristics is critical.

Aim and Objectives: This study aims to review the overall outcomes of using lip and tongue trills as an intervention in professional voice users with therapeutic implications.

Methods: The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines were used to guide the methodology and reporting of this systematic review. From 2000 to 2021, a systematic search of the literature was accomplished and from 3,135 articles, 11 articles were selected for this study, involving studies of different study designs with a total of 253 participants.

Results and Discussion: Outcomes of studies varied across and overall, the lip trill and tongue trill techniques increase vocal performance and voice quality by reducing vocal fatigue and tension, aiding in maintaining vocal health.

Summary and Conclusion: The lip and tongue trill techniques can be utilized as a warm-up activity for people who use their voices professionally. Therefore, researchers can use the findings of this study to develop therapeutic programs or conduct more advanced evaluations or research papers in the field of voice therapeutics for professionals.

Keywords: *Voice therapy, Professional voice users, Systematic review.*

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I. Introduction:

Voice is the sound that is created by a well-coordinated respiratory, phonatory, resonatory and neurological system. The behavior and physiological concerns of the patient are totally mirrored by the operation of these linked systems (Hamdan, Medawar, Younes, Bikhazi & Fuleihan, 2005).

People who rely on their voices for a living are more likely to develop or are more vulnerable to vocal problems than others. The percentage of professional voice users are growing day by day. The use of voice for specific professional performances varies significantly depending on the content and objective of verbal communication. The multidimensionality of voice which is one of the most essential variables in professional voice users for speech production stems from a combination of acoustic, perceptual and aerodynamic properties which are the fundamental component of professional voice users' income and careers. Physicians and other health care professionals face unique problems and responsibilities towards professional voice users. For their vocal needs, all of these specialists require a wide range of sophistication. Teachers, Coaches, Medical professionals like Speech language Therapists, Counselors, Doctors, Nurses and Day care workers, Clergymen/Religious leaders, Politicians, Sales people, Fitness trainers, Cheer leaders, Actors, Public speakers, Commentators, Emcee/Anchors, Radio jockeys/Video jockeys, Operators, Presenters, Customer care service, Street vendors, Broadcast personalities, Receptionists, Factory workers, Attorneys, Officers who work for Security, Police force, Military, Navy and Air force, Fire fighters, Restaurant staffs, Receptionists and others are included in the group of Professional voice users in addition to Professional Singers and Performers.

Muscle tension dysphonia and vocal fatigue are frequently attributed to overuse of the voice. Musical actors and actresses are among the most advanced voice users since they must ingest both theatrical and musical materials produce short term intensive voice and replicate the voices of a variety of roles. As a result they have highest chance of developing dysphonia followed by actors, priests and other professionals according to literature. Because pneumo phono articulatory incoordination during professional voice usage may cause more serious damage vocal care in these groups should not be disregarded especially in workers who have not displayed signs of dysphonia (Christmann, Scherer, Cielo & Hoffmann, 2013). Professional voice users are

more likely than others in the community to develop voice disorders as a result of the vocal load on the phonatory system (Dargin, DeLaunay & Searl, 2016).

Voice therapy in Professional voice users:

To utilize their voice most effectively and maintain the vocal health professional voice users must grasp the workings of their vocal systems (Freeman & Fawcus, 2000). But in some cases depending on their previous level of training professional voice users may be more aware of vocal mannerisms.

Professional voice users should keep all of the structures involved in phonation in good shape due to increased vocal demand. Voice training for professional voice users should cover a wide range of topics from breathing to voice articulation and projection. Trill exercises require a functional equilibrium between the vibrating organ (the tongue, lips or a combination of both), the vocal tract, the larynx and exhaled air. As a result they are one of the most important instruments for professional voice users' vocal warm up and training program.

The vocal folds and lips/tongue vibrate at the same time indicating that the airstream is the same. The pressure in the lungs is subsequently split between two constrictions in the vocal tract which both serve as sound sources (although at rather different frequencies). Because the lips/tongue trills have a high flow resistance, the intraoral pressure is positive, decreasing the trans glottal pressure (unless the sub glottal pressure is raised). In order to maintain phonation when performing the exercise at high pitches the vocalist must use a lot of abdominal and thoracic effort. Meanwhile due to the overall higher airway pressure tends to separate (abduct) the vocal folds they are not strained as much as they are in open-mouth phonations. Even with the larger sub glottal pressure, less vocal fold collision is anticipated and the vocal folds may vibrate at lower amplitudes (Titze, Finnegan, Laukkanen & Jaiswal, 2002). Thus the use of facilitators (lip and tongue trill techniques) should be faded away once the desired voicing has been attained (Schneider & Sataloff, 2007).

By increasing the efficient use of the vocal mechanism a Speech Language Pathologist (SLP) evaluates and treats voice problems. Other specialists may be added to the interdisciplinary team in some situations. Following rehabilitation with a Speech Language Pathologist and a singing voice expert a referral to a singing voice coach may be beneficial (Schneider & Sataloff, 2007).

Role of Speech-Language Pathologists (SLPs) and Other Health workers:

The diverse yet related fields of Speech Language Pathology and Vocal Arts can be considered as working toward common aims in terms of voice and vocal production: to completely understand the voice and its functions, as well as to fulfill the requirements of voice users. Given our society's current fascination with high profile singers and actors as well as their frequent public vocal demise it is becoming increasingly important for the field of Speech Language Pathology (hereinafter SLP) to identify and address the specific needs of voice disordered professional voice users.

According to Sapir's research 20% of the students he surveyed had discontinued performing, cancelled an audition or failed to participate in shows or concerts due to chronic voice issues. Laryngologists, Speech language pathologists and Voice teachers have traditionally collaborated to treat voice disordered professional voice users with the Speech language pathologist serving as a vital link between the other vocal rehabilitating professions and the professional voice user.

There are few settings that provide in depth experience with voice disorders and even fewer that provide training for Speech language pathologists hoping to work with professional voice users with voice disorders. While many Speech language pathologists will gain experience in the population their setting serves the most (pediatric language, adult swallowing or cognitive disorders, autism etc.). Voice centers exist both in the India and overseas but opportunities within these organizations are scarce. To learn the skills to work with voice impaired patients and especially professional voice users, Speech language pathologists may need to seek extra training outside of their facility (such as seminars, conferences or workshops). Despite the fact that many Speech language pathologists utilize voice professionally for therapeutic programs and are trained to treat voice issues few are likely to be singers, public speakers, etc. Some maybe even have studied music or are vocally trained. As a result few Speech language pathologists are equipped to meet the demands of elite vocal performers (such as singers, voice artists, actors, public speakers, commentators, therapists and other professional voice users) who are having voice problems (Lukkonen, 2009).

Semi occluded vocal tract exercises (SOVTEs) is being used in new breakthroughs and investigations in vocal rehabilitation especially the lip and tongue trills have been investigated in normal population, different types of voice disorders and professional voice users. However these research findings are not properly validated. As a result the study that combines such findings is in need which facilitates in providing effective treatment and obtaining efficient post treatment results in the vocal users. The various perceptual, aerodynamic, acoustic and subjective analyses are done on normal individuals, voice disorders and professional voice users before and after voice treatment. Consequently there is an urgent need for a comparable systematic study of the

efficacy of this treatment technique in terms of voice characteristics with implications for clinical practice. So the current study may throw light on these issues.

Therefore this study aims to review the outcomes of literatures that used lip and tongue trill techniques as an intervention in professional voice users, in order to modify and maintain voice parameters as well as vocal health and its efficacy in terms of voice characteristics, with implications for therapeutic practice.

II. Method:

Inclusion and Exclusion Criteria:

The eligibility criteria for the literature that follow the given guidelines were selected, screened and predefined to answer the research question

Inclusion Criteria:

- Literatures must be from 2000 to 2021
- Studies available in English
- Studies contained original data addressing the review/clinical question
- Studies including Professional voice users (PVUs) who have used their voice for around 3years and more professionally and may be trained or untrained
- Studies including PVUs within the working age :18–65 years
- All study participants not diagnosed or complained of voice disorders, i.e., Non-clinical population
- All study designs like: Observational (pilot), Prospective or Quasi-experimental study were considered
- All outcome measures after lip and tongue trill exercises where considered
- Studies that focused on vocal habilitation/rehabilitation of PVUs using lip and tongue trills
- Studies with lip and/or tongue trill techniques in comparison with other SOVTEs in PVUs
- Studies estimating long term or immediate outcomes of effectiveness of lip and/or tongue trills in PVUs
- Studies having both instrumental and subjective analysis for voice evaluation

Exclusion Criteria:

- Repeated or duplicates studies
- Studies with unclear findings
- Studies which are not within inclusion criteria
- Literatures including PVUs with any present/past history of Speech, Language and Hearing issues
- Studies including PVUs having poor laryngeal control
- Studies involving PVUs with any other pathological conditions affecting voice
- Studies involving PVUs who are under medication
- Studies including PVUs who find difficult to tolerate the laryngeal examination
- Literatures involving PVUs who has not mastered the techniques for performing lip and tongue trills

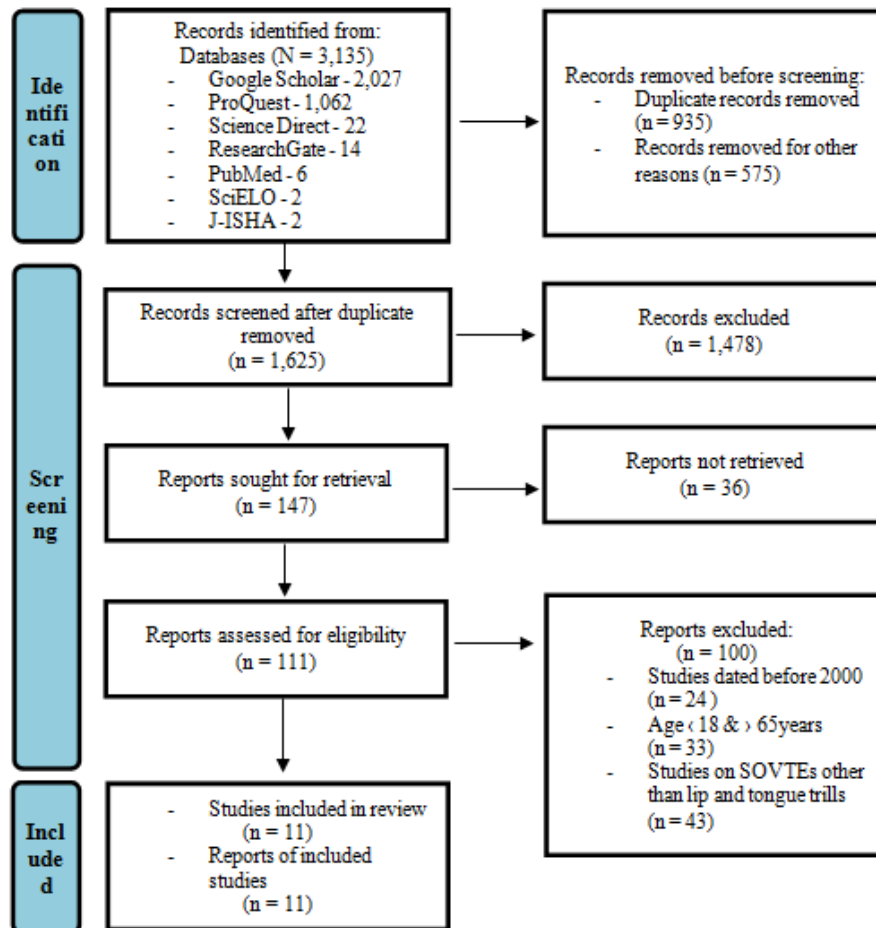
Search process:

The methodology and reporting of this systematic review were based on recommendations from the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (Figure 1). The PRISMA 2020 statement includes a 27-item checklist for a systematic review. This checklist is used to promote transparency. These components include the title, abstract, introduction, methodology, results, discussion, findings and they cover every part of the article (Page, McKenzie, Bossuyt, Boutron, Hoffmann, Mulrow & Moher, 2021). The protocol of this systematic review was not preregistered on PROSPERO (is an International prospective register of systematic reviews). A systematic search of the literature to locate studies was conducted using the following variety of electronic databases with help of key words, related search words, derivatives and MeSH (medical subject headings) phrases pertinent to the study. Offline journals and books, online journals and e-books from Regional, National as well as International registers and databases were considered. They are: - Registers: PROSPERO (Systematic reviews register), Reporter: NIH Research Portfolio Online Reporting Tool; Databases: IndMed, J-ISHA, ResearchGate, PubMed/Medline, Google Scholar, Science Direct, SciELO and ProQuest were used from the year 2000 to 2021. These searches were performed using the following defined search terms: “Trill exercises, lip trill, tongue trill, tongue out trill technique, semi occluded vocal tract exercise, SOVT techniques in voice training, voiced lip trills, semi occluded voice therapy, voiced tongue trills, flow resistant therapy, effectiveness of semi occluded vocal tract exercise, advances in vocal rehabilitations, SOVTE in normal and professional voice users, evidence based study on SOVTE in normal vocal fold conditions, lip trills in professional voice users, tongue trills in professional voice users, voice techniques in professional voice users, lip and tongue trills in singers, SOVTE in teachers, lip and tongue trills in actors and performers, lip and tongue trills in vocal artists, effects of lip and tongue trills in voice therapy and

effectiveness of lip and tongue trill techniques in professional voice users”. From these searches studies were identified and then screened for inclusion and exclusion in this review using the selection criteria below.

The cited references of the included studies were also checked. Furthermore Open Grey (opengrey.eu) and Open Access Thesis and Dissertations (oatd.org) were searched for grey literature, preprints, conference presentations/objects, posters, abstracts or unpublished manuscripts.

Figure 1: PRISMA 2020 flow diagram for Selection of the articles for current systematic review which included searches of varies databases



Data Extraction:

The studies that fit the inclusion and exclusion criteria were selected by screening the titles, abstracts and/or study methods retrieved through the search strategies. After that the complete text of the potential studies were received and evaluated to determine if they were eligible. The data from the selected research was extracted using a pre-study designed table. Study population, methodology, participant demographics, evaluation techniques and treatment outcome were all extracted. Data on the year of publication, kind of publishing, study design, research type, research focus, study origin and author details with affiliation were also gathered from the eligible publications that satisfied the inclusion and exclusion criteria.

III. Results And Discussion:

Selection of literatures for systematic review:

In the first round of article identification 3,135 articles were identified through seven electronic databases using key words. Articles related to Lip and Tongue trill techniques and SOVTEs found in databases were

Google Scholar - 2,027, ProQuest - 1,062, Science Direct - 22, ResearchGate – 14, PubMed - 6, SciELO - 2 and J-ISHA - 2. From the selected articles, 935 duplicates articles were identified and excluded from the study. The 575 articles that did not match the eligibility criteria such as studies focusing poor health conditions, vocal pathologies, articles which were not available in English, literature with unclearing findings were also excluded. For potential study 1,625 articles were selected out of which 1,478 were removed and 147

articles were selected among these articles 36 articles were not retrieved due to inability to assess full text article. Furthermore from 111 articles retrieved 100 articles were excluded from the study depending upon the valid reasons and those reasons were: Studies dated before 2000 (n=24), Age criteria in the study population of these articles were below 18years and above 65years (n=32) and Studies on SOVTEs other than Lip and Tongue trills (n=43). Finally after a long process of identification and screening of articles 11 articles were included in the present study which matched review question and the inclusion and exclusion criteria (Figure 1).

Study characteristics:

The purpose of this systematic review was to explore the results of studies that used lip and tongue trill techniques as an intervention in professional voice users. Table 1 lists the features of the studies that were considered. The papers considered in this systematic review were published between 2005 and 2021 and were done in various parts of the world including Brazil (n=4), the United States (n=4), Italy (n=2) and Iran (n=1). Speech language pathologists, trained singers, untrained singers, singing teachers, student getting trained in music and actors made up the majority of the participants who ranged in age from 18 to 65 years old. A total of 253 individuals were included in the studies 96 of which were males and 157 of which were females. 2 articles (a sum of n = 75 professionals) were on speech language pathologists, 1 article (a sum of n = 4 professionals) was on theatre actors and eight articles (a sum of n = 174 professionals) were on singers in this systematic review (Table 2). These 11 articles were chosen based on randomized control studies, prospective studies, quasi experimental studies, non-randomized comparisons, pilot studies, observational studies and pre-post comparison studies, among others (Table 1).

Study Design:

The majority of the research used a pre and post-test design, with pilot studies, nonrandomized controls, prospective studies, observational, quasi-experimental, and self-assessment studies following (Table 1). The effects of lip and tongue trills in professional voice users including Speech language pathologists, Theater actors and Singers are shown in Table 2. The study design was used to evaluate these papers (Table 1). Lip and tongue trills were also compared to other SOVTEs in several comparative and control studies.

Table 1: Shows the summary of the studies included in current systematic review

Author/Year/ Country	Title of Journal/Book/Conference	Paper Title	Aim of Study	Study design	Study sample size/type	Technique used	Duration/ Training period of each technique	Assessment tool	Findings
Menezes et al., (2005) Brazil	Article, Journal of Voice	Vocal and Laryngeal Effects of Voiced Tongue Vibration Technique According to Performance Time	To assess the unpleasant sensations experienced by the individuals subjected to the 7-minute performance duration of VTVT and evaluate acoustic & laryngostroboscopic changes on the voice & larynx as well	Observational study	N – 30 (M-15 & F-15) Age: 20-42years Speech-Language Pathologists	Voice Tongue Vibration Technique (VTVT)	7 minutes	Vocal evaluation, Laryngoscopy	- Better outcomes from the third minute performance time for females & fifth minute performance time for males

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Van Lierde et al., (2011) Brazil	Article, Journal of Voice	The Impact of Vocal Warm-Up Exercises on the Objective Vocal Quality in Female Students Training to be Speech Language Pathologists	To determine a specific vocal warm-up (WU) programme, which focuses on improving the dynamics of the extrinsic and intrinsic laryngeal muscles, affects objective voice quality in Dutch female speech language pathology students (SLPs)	Randomized control (pre- & post-test) study	N – 45 (F) Age: 18-22years Speech-Language Pathologists	Voiced Lip Vibration Technique (VLVT), Voice Tongue Vibration Technique (VTVT) and other Warm-up exercises	30 minutes	Vocal evaluation , Acoustic evaluation , Dysphonia Severity Index [DSI]	- Increase DSI value - Increased vocal performance (for lower intensity & higher frequency) - increased fundamental frequency (F0)
Di Natale et al., (2019) Italy	Conference presentation	Short Term Effect Of 'Semi-occluded Vocal Tract Exercises' On Healthy Actors' Voices	To investigate a 10-minute warm-up regimen of semi-occluded vocal tract exercises (SOVTE) effect on actors with no voice problems	Pre-post-test Comparative study	N – 4 (M-2 & F-2) Theatre Actors	Voiced Lip Vibration Technique (VLVT), Voice Tongue Vibration Technique (VTVT)	10 minutes	Acoustic evaluation , perceptual evaluation , self-assessment	- No statistically significant variations in perceptual ratings or auditory parameters - Following protocol created may thus be effective in determining a self-perceived improvement in comfort, voice quality and power.
Gaskill & Erickson (2008) USA	Article, Journal of Voice	The Effect of a Voiced Lip Trill on Estimated Glottal Closed Quotient	To determine if there are any significant changes in the glottal closed quotient (CQ) during lip trill production	Experimental study	N – 25 (M) Age: 18-64years Singers	Voice Lip Vibration Technique (VLVT)	1 minute	Vocal evaluation , Electroglottography (EGG)	- Reduction in vocal fold closed quotient, with a more pronounced change in untrained singers
Gish et al., (2012) USA	Article, Journal of Voice	Vocal Warm-Up Practices and Perceptions in Vocalists: A Pilot Survey	To determine duration & frequency of vocal warm-up, differences in vocal warm-up regimens, most frequently used vocal warm-up exercises, the role of vocal warm-up in the prevention of vocal fold injury & preliminary data on the occurrence of vocal fold injury in singers who do not use a vocal warm-up regimen	Pilot study	N – 117 (M-36 & F-81) Age: 18-50years Singers	Voiced Lip Vibration Technique (VLVT), Voice Tongue Vibration Technique (VTVT)	5-10 minutes	Vocal evaluation , Vocal self-assessment,	- The lip & tongue trills were more likely used by participants - The warm-up regimens should be between 5-10 minutes duration using simple vocalizes and non-singing exercises
Cordeiro et al., (2012)	Article, Journal of Voice	Comparative Analysis of the Closed Quotient for Lip and Tongue Trills in Relation to the Sustained Vowel /e/	To compare mean & standard deviation of the closed quotient in lip and tongue trill exercises with sustained vowel /e/ in	Comparative study	N – 14 (M-7 & F-7) Age: 24-48years	Voiced Lip Vibration Technique (VLVT), Voice Tongue Vibration	---	Stroboscopy Electroglottography (EGG)	- Greater amplitude of cord vibration & increased contact/closed quotient for Voiced Lip Vibration Technique & Voice Tongue Vibration

Brazil			opera singers		Singers	Technique (VTVT)			Technique - Higher closed quotient for voiced lip vibration technique in higher intensities
Dargin & Searl (2015)	Article, Journal of Voice	Semi-occluded vocal tract exercises: aerodynamic and electroglottographic measurements in singers	To examine changes in aerodynamic & electroglottographic (EGG) measurements following immediate use of three semi-occluded vocal tract (SOVT) exercises.	Prospective study, pre-post-test Comparative study	N – 4 (M-3 & F-1) Age: 25-32years Singers	Phonation into straw, Voiced Lip Vibration Technique (VLVT), Voice Tongue Vibration Technique (VTVT)	2 minutes	Aerodynamic measurements Electroglottography (EGG)	- Increased sound pressure level and air flow - Increased contact quotient - Decreased laryngeal resistance post-VTVT - Variability within & across participants
Dargin, (2016)	Dissertation, Open Access Thesis and Dissertations	The Impact of Semi-Occluded Vocal Tract Exercises on Vocal Function in Singers: Straw Phonation vs. Lip Trill	To assess & compare the results of lip trill versus straw phonation exercises in singers	Pre-post-test Comparative study	N – 14 (M-8 & F-6) Age: 18-65years Singers	Voiced Lip Vibration Technique (VLVT), Straw phonation	3 weeks (4 times/day)	SVHI (Singing Voice Handicap Index), Evaluation of the Ability to Sing Easily (EASE), Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V), Straw phonation & Lip trills	- Post-SOVT, EASE scores showed improvement in physical functioning - No difference between the two SOVT groups (Straw phonation & Lip trills) - The SVHI had no effects. - The CAPE-V had an unsatisfactory results
de Oliveira et al., (2020)	Article, Journal of Voice	Oropharyngeal Geometry and the Singing Voice: Immediate Effect of Two Semi-Occluded Vocal Tract Exercises	To verify if a flexible resonance tube in water and lip trill had an immediate influence on oropharyngeal geometry and vocal acoustic characteristics in singers without vocal complaints	Pre-post-test Comparative study	N – 22 (M-12 & F-10) Age: 20-45years Singers	Voiced Lip Vibration Technique (VLVT), Flexible Resonance Tube	-	Acoustic evaluation	- Assists in higher lung volume male singers than females. - Post-Lip trill technique increased GNE (Glottal-to-noise excitation) measurements and decrease in noise.
Mezzedimi et al., (2020)	Article, Logopedics Phoniatrics Vocology	Singing voice: acoustic parameters after vocal warm-up and cool-down	To assess the influence of vocal warm-up and cool-down exercise on singing voice through Fundamental Frequency (F0), Jitter, Shimmer	Pre-post-test Comparative study	N – 36 (M-4 & F-32) Age: 24years Singers	Voiced Lip Vibration Technique (VLVT), Voice Tongue Vibration Technique	4 minutes	Acoustic evaluation	- Jitter and Shimmer decrease - HNR increases - The decrease in jitter indicates, minimizing perturbations & allowing better use

Italy			& harmonics-to-noise ratio (HNR)		Singers	e (VTVT)			of the voice during performance. - The decrease in Shimmer indicates decreasing amplitude fluctuations
Savareh et al., (2021)	Article, Journal of Voice	Immediate Effects of Semi-occluded Vocal Tract Exercises as a Vocal Warm-Up in Singers	To explore influence of vocal warm-up and cool-down exercise on singing voice through Fundamental Frequency (F0), Jitter, Shimmer, and the harmonics-to-noise ratio (HNR)	Pre-post-test Comparative (Quasi-experimental) study, a Simple non-random sampling method	N = 11 (M) Age = 24-30 years Singers	Voiced Lip Vibration Technique (VLVT)	20 minutes	Electromyography (EMG)	- The electrical activity of the extrinsic laryngeal muscles in all vocal tasks reduced post warm-up exercises - The acoustic parameters F1 & F1 - F0 different were significantly reduced (P < 0.05).
Iran									

Table 2: Shows the overall study findings for each professional voice user

Population studied	No. of papers	Total no. of participants	Percentage (%)	Overall Findings
Speech language pathologists	2	75	29%	<ul style="list-style-type: none"> Positive outcome when practiced with a given time frame with respect to male & female voice users Advantageous when practiced, show positive effect on voice quality and performance
Actors	1	4	3%	<ul style="list-style-type: none"> Positive outcome with respect to voice quality, comfort & power
Singers	8	174	68%	<ul style="list-style-type: none"> Reduction in vocal fold closed quotient showed significant effect Practicing trill exercises along with other warm up exercises would show better results, giving a neural outcomes Greater the amplitude of cord vibration, greater is the contact/closed quotient for Voiced Lip & Tongue Vibration Technique Increased sound pressure level and air flow Increased in contact quotient Decreased of laryngeal resistance post-VTVT EASE scores showed improvement in physical functioning No difference between the two SOVT groups (Straw phonation & Lip trills) The SVHI & CAPE-V no results. Assists in higher lung volume in male singers than females. Post-Lip trill technique increased GNE (Glottal-to-noise excitation) measurements and decrease in noise. Jitter and Shimmer decrease HNR increases The electrical activity of the extrinsic laryngeal muscles in all vocal tasks reduced post warm-up exercises The acoustic parameters F1 & F1 - F0 different were significantly reduced

Outcomes of Lip and Tongue Trill in Different Voice Users:

Speech Language Pathologist:

There were three papers related to speech language pathologist professionals selected for the present study which contributed to 29% of the total number of papers selected for the study (Menezes, Duprat & Costa, 2005;

VanLierde, D'haeseleer, Baudonck, Claeys, DeBodt & Behlau, 2011). The total numbers of participants included in these 3 articles were 95. After using voiced tongue vibration technique Menezes (2005) found that better outcomes when practiced with the given time frame with respect to male and female voice users. VanLierde et al. (2011) revealed that using voiced lip vibration technique and voiced tongue vibration technique found advantageous when practiced and showed positive effect in voice quality and performance.

Actors:

Among twelve selected articles for the study only one article was relating to theatre actor which consists of total 3% of the present study. DiNatale, Cantarella, Manfredi, Ciabatta, Bacherini, & Dejonckere (2019) found that positive outcomes were noted with respect to voice quality, comfort and power but also suggested that there was no significant statistical variations in perceptual rating or auditory parameters.

Singers:

The present study included total number of eight papers (Gaskill & Erickson, 2008; Gish, Kunduk, Sims & McWhorter, 2012; Cordeiro, Montagnoli, Nemr, Menezes & Tsuji, 2012; Dargin & Searl, 2015; Dargin, 2016; deOliveira, de Lira, daSilva, Lucena & Gomes, 2020; Mezzedimi, Spinosi, Massaro, Ferretti & Cambi, 2020 & Savareh, Moradi, Yazdi, Soltani & Latifi, 2021) for singers which make of 68% of the present study. Gaskil and Eickson (2008) found that voiced lip vibration technique reduced the vocal fold closed quotient (CQ). Similarly Gish et al. (2012) found that practicing trill exercises along with other warm up exercises which show better results. Dargin and Searl (2015) studied on four singers using voiced lip and tongue vibration technique and found that there was increase in sound pressure level and airflow, increased closed quotient and decreased laryngeal resistance. Again Dargin (2016) studied in 14 singers and found that post SOVT score of EASE showed improvement in physical functioning. Similarly Cordeiro et al. (2012) suggested that there was greater amplitude of cord vibration and better closed quotient after practicing voiced lip and tongue trill techniques. DeOliveira et al. (2020) revealed that there was higher slung volume in males singers compared to female singers. On similar note Mezzedimi et al. (2020) also found that there was increase in harmonic noise ration and decrease in jitter and shimmer in 36 singers. In the last article related to singers Savareh et al. (2021) used voiced lip vibration technique in 11 singers and found that the electrical activity of the extrinsic laryngeal muscle in all vocal tasks reduced post warm up exercise and acoustic parameters also significantly reduced.

There have been numerous new developments and studies on voice therapy employing SOVTE particularly lip and tongue trills which have been studied in professional voice users. However these research findings are not properly documented. The lip and tongue trill technique is useful in a variety of clinical situations. But this systematic review highlights the outcomes and limitations of lip and tongue trill techniques in voice therapy in professional voice users. Most of the articles were based on the pretest and posttest comparison followed by experimental and prospective study. Studies whose participants were Speech language pathologists showed increase in vocal performance (VanLierde et al. 2011; Menezes et al. 2005). The study also suggested there was perceptual and acoustic changes after voiced lip trill technique. Laryngoscopy technique was applied to evaluate the outcomes (Menezes et al. 2005) after tongue vibration techniques. VanLierde et al. (2011) applied acoustic evaluation to find out the outcomes depending upon the random control pretest and posttest study. Menezes et al. (2005) study was observational they suggested that the technique can be useful only when the practice is below 3 to 5 minutes. In speech language pathologist participants all these 2 articles used 2 different methods to evaluate the outcomes. In one of the study related actor DiNatale et al. (2019) used self perceptual assessment techniques and found there was no significant variation statistically but also revealed that voiced lip and tongue vibration technique showed some improvement in voice quality, comfort and power. In singers Electroglossography (EGG), Self-assessment, aerodynamic, Singing voice handicap index (SVHI), Evaluation of the ability to sing easily (EASE), consensus auditory perceptual evaluation of voice (CAPE-V), Electromyography (EMG) and stroboscopy techniques were used to find out the outcomes of lip and tongue trill techniques in singers. Gaskill and Erickson (2008) found there was reduction in vocal fold closed quotient (CQ) using electoglossographic (EGG) measurement technique whereas Dargin and Searl (2015) found there was increase in close quotient using same EGG technique. Gish et al. (2012) used self-assessment technique and found this warm up regiments should be between 5 to 10 minutes. On the same note, Menenzes et al. (2005) in SLP suggested only 3 to 5 minutes of exercises whereas Menenzes in singers has suggested 5 to 10 minutes of lip trill and tongue trill exercise for warm up. Stroboscopic techniques were used by Cordeir et al. (2012) and they found there was greater amplitude and CQ. Increased sound pressure level and airflow increase in CQ was found in EGG measurement technique by Dargin and Searl (2015). According to Dargin (2016) there was no significant difference between lip trill and straw phonation. CAPE-V and SVHI techniques also showed no significant improvement in lip trills. In another study deOliveira et al. (2020) found post lip trill technique increased glottal to noise excitation measurement and decrease in noise. In an acoustic evaluation Mezzedimi et al. (2020) found jitter and shimmer decreased and harmonic to noise ratio increased.

Different measurement techniques were applied in different professional voice users. The outcomes varied from subject to subject but in majority of the participants the mean airflow, vocal quality, glottal close

quotient, fundamental frequency, intensity and power all improved after lip and tongue trill techniques. But study on actor showed there was variation in outcomes and there was no significant changes after lip and tongue trill techniques. There was no significant outcome difference in SLPs, actors and singers when compared. Close quotient findings also varied from subject to subject. Some author suggested longer duration of practice may be harmful to the glottal area. on the other hand some author suggested lip trill and tongue till can be used as vocal warm up exercise along other techniques for better outcomes.

Study related to professional voice users is mainly focused in singers and speech language pathologists. Study on other professional voice users like politician, teachers, receptionists, call operators etc., are lacking. The numbers of participants included in the studies are also not satisfactory. Small number of participants and self-perceptual evaluation techniques are the drawbacks of the study. Among 342 participants (male n=123 and female n=230) were included in the studies. It shows the number of female participants were almost double than male participants. Self-assessment, perceptual evaluation can create bias in the result. Acoustic analysis and instrumental analysis of vocal changes after lip trill and trill can be measured for better results. The duration of lip and tongue trill practice also varied across the studies. The longer duration of practice provided better outcomes compared to short term exercise.

The results of the studies included in the review were examined to see if differences in study quality were associated to differences in impact magnitude. However because the quality and impact sizes of the research included varied it was difficult to draw any additional conclusions

IV. Summary And Conclusion:

The number of individuals who utilizes professional voice is steadily increasing. Depending on the content and goal of verbal communication the use of voice for certain professional performances varies greatly. The multidimensionality of voice derives from a combination of acoustic, perceptual and aerodynamic features which are the basis of professional voice users' income and employment. Physicians, Speech language pathologists and other health care workers confront special challenges and responsibilities when it comes to professional voice users. All of these professionals require a wide spectrum of sophistication for the need of intervention in voice issues of professional voice users.

Studies on speech language pathologists showed positive outcomes on lip and tongue trill exercises. In overall findings Vocal performance and voice quality improved in SLPs after using lip and tongue trill exercises and study on theater actors also showed positive outcomes on lip and tongue trill exercises although there were no significant changes statistically. Some studies on singers showed mixed effects or neural effects depending on the perceptual, acoustic and aerodynamic results and some show positive effects of lip and tongue trills on enhancement of vocal care, voice quality and other vocal behaviors for better voice use especially in professional voice users. Lip and tongue trill can be used in long term by the professional voice users as a warm up strategy to keep their vocal function in correct order. This vibration technique reduces the vocal stress and increases the vocal strength and voice quality. Maximum phonation duration, vocal power and comfort all increases when lip and tongue trill exercises are performed correctly. Whatever the studies are done related to lip and tongue trill semi occluded vocal tract exercise each and every article has shown improvement in vocal efficiency and quality. For better outcomes of lip and tongue trill exercise the study design, tools and techniques are most important factor. Perceptual and self-assessment techniques may be biased whereas analysis by Electroglottography, stroboscopic and CAPE-V etc., provide better results. The results also depend upon the participant's knowledge and understanding of the exercise used. If they perform correctly the outcomes are also accurate.

Clinical Implication of the study:

The present study found various positive outcomes from the included articles. None of the articles showed negative impact or worsening of the vocal fold condition after the lip and tongue trill exercises. The articles which showed no significant changes statistically also showed improvement in vocal quality and comfort. This technique can be used as a warm up exercise by all the professional voice users to maintain the vocal efficiency. This study suggests that lip and tongue trill can boost up the vocal performance. This technique reduces the stress and provides easiness and comfort to the vocal folds. This technique can also be used in clinical setup to treat dysphonic individuals. This technique relaxes the muscle of larynx and provides massage effect on vocal organs.

Limitations of the Current Review:

This systematic review has a number of limitations that should be evaluated. For starters this review solely featured items written in English. As a result it's probable that certain research in different languages and certain studies on the effectiveness of trill exercises of different age group or in different pathological conditions in professional voice users, etc., were overlooked. Furthermore many of the studies found were omitted because

they did not answer one of the clinical questions' desired outcomes. More papers would have been available for analysis if the clinical questions of this systematic review had been amended to include effects of lip and tongue trills in pathological circumstances or in any age groups in professional voice users. Finally as noted above the variation across studies in terms of participants, interventions and outcomes meant that there was no common denominator, such as a shared outcome measure on which to conclude that lip and tongue trill techniques are more effective measure than any other phonatory or warm-up exercises. Self-assessment and perceptual evaluation may show biased results and varies from person to person. The study design must include acoustical or instrument measurement technique for better outcomes.

The present study found that the lip and tongue trill exercise showed positive outcomes. Overall lip trill and tongue trill technique showed improvement in vocal performance and voice quality. This technique reduces vocal fatigue and stress of the vocal folds and can be used as warm up exercise in professional voice users to maintain vocal hygiene. This technique can also be useful as a therapeutic approach in clinical set up. Thus the researchers in further can take these review findings as a reference to plan a therapeutic program or when conducting a future advanced reviews or research papers in the professional voice users.

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