Modificações laríngeas e vocais produzidas pela técnica de vibração sonorizada de língua***

Vocal and laryngeal modifications produced by the sonorous tongue vibration technique

Karine Schwarz*
Carla Aparecida Cielo**

*Fonoaudióloga. Doutoranda em Neurociências pela Universidade Federal do Rio Grande do Sul. Endereço para correspondência: Rua Pedro Bini, 406 - Tapera - RS - CEP 99490-000 (fonoka@hotmail.com).

**Fonoaudióloga. Doutora em Lingüística Aplicada pela Pontifícia Universidade Católica do Rio Grande do Sul. Professora da Graduação e do Programa de Pós-Graduação em Distúrbios da Comunicação Humana pela Universidade Federal de Santa Maria.

***Trabalho Realizado no Hospital de Clínicas de Porto Alegre pela Universidade Federal de Santa Maria - RS.

Artigo Original de Pesquisa

Artigo Submetido a Avaliação por Pares

Conflito de Interesse: não

Recebido em 25.2.2007.
Revisado em 21.10.2008; 13.02.2009.
Aceito para Publicação em 04.05.2009.

Abstract
Background: effectiveness of the sonorous tongue vibration technique (STVT). Aim: to investigate the sensations and the vocal and laryngeal impact produced by the sonorous tongue vibration technique. Method: The STVT was performed in three sets of fifteen repetitions, in maximum phonatory duration using a normal tone and intensity - with 30 seconds intervals of passive rest between each set. Twenty-four women aged between 20 and 30 years and with no vocal complaints participated in the study. All participants were submitted to a larynx evaluation through videolaryngostroboscopy examination; auditory perceptual and acoustic analysis of the voice, before and after using the STVT, by means of the Multi-Dimensional Voice Program (MDVP), Model 5105 and Real Time Spectrogram, from Key Elemetrics. Results: after using the STVT, a statistically significant difference was observed in terms of: improvement of voice type; focus of vertical resonance; vocal quality; predominance of positive sensations; maintenance of the larynx images parameters (glottis closure, laryngeal vestibule constriction, symmetry and amplitude of vocal folds vibration); increase in fundamental frequency; improvement of spectrographic evaluation parameters, in Broadband and Narrowband filters; and improvement of medial vestibule constriction according to increase in STVT duration. Conclusion: the STVT modifies the glottal source and the resonant filter.
Key Words: Voice; Voice Training; Voice Quality.

Resumo
Tema: a eficácia da técnica de vibração sonorizada de língua (TVSL). Objetivo: investigar o impacto vocal e laríngeo e as sensações surgidas frente à execução da técnica de vibração sonorizada de língua. Método: a TVSL foi aplicada em três séries de quinze repetições, em tempo máximo de fonação com tom e intensidade habituais, com intervalos de 30 segundos de repouso passivo entre cada série. Participaram do estudo 24 sujeitos, do sexo feminino, com idades entre 20 e 30 anos, sem queixas vocais. Todos esses indivíduos foram submetidos à avaliação da laringe, por meio do exame de videolaringoestroboscopia, análise perceptivo-auditiva e acústica da voz, por meio dos programas Multi-Dimensional Voice Programa (MDVP), Model 5105 e Real Time Spectrogram, da Key Elemetrics, antes e após a execução da TVSL. Resultados: após a execução da TVSL evidenciou-se diferença estatisticamente significativa para: a melhora do tipo de voz; do foco de ressonância vertical; da qualidade vocal; o predomínio de sensações positivas; a manutenção dos parâmetros das imagens laríngeas (fechamento glótico, constrição do vestíbulo laríngeo, amplitude e simetria de vibração das pregas vocais); o aumento da freqüência fundamental; a melhora de parâmetros da avaliação espectrográfica, em filtros de Banda Larga e Banda Estreita e a melhora da constrição medial do vestíbulo, conforme o aumento do tempo de execução da TVSL. Conclusão: a TVSL apresenta modificações sobre a fonte glótica e sobre o filtro ressonantal.
Palavras-Chave: Voz; Treinamento Vocal; Qualidade Vocal.

Referenciar este material como:
Schwarz K, Cielo CA. Vocal and laryngeal modifications produced by the sonorous tongue vibration technique (original title: Modificações laríngeas e vocais produzidas pela técnica de vibração sonorizada de língua). Pró-Fono Revista de Atualização Científica. 2009 abr-jun;21(2):161-6.

Introduction

With technological advances in laryngology and modern instruments for voice assessment, scientific research in voice was intensified in an attempt to improve knowledge on vocal tract functioning, diagnosis of vocal problems and effectiveness of voice therapy (1). Thus, the Speech Pathologist specialized in voice, must seek, each time more, for information and recycling, and present scientific evidence resulted from speech therapy interventions that promote a healthy and appropriate use of voice of individuals participating in Speech-Language Pathology treatment.

Among many rehabilitation techniques, the sonorous tongue vibration technique (STVT) is greatly accepted among Speech Therapists, both for its efficacy in different voice disorders and for its easy application (2). However, such technique popularity also means that many individuals use the STVT without prior Speech Therapy orientation. The indiscriminate indication is likely to impair expected performance and cause damage to the voice of the individual.

In scientific literature review, studies that investigated the STVT effectiveness are found. In these studies, the technique is described as effective for specific laryngeal disorders, but few studies report details on implementation and effects on larynx and voice in different populations. Thus, the purpose of this study was to investigate the voice and laryngeal impact and the sensations arising from the STVT in participants without vocal or laryngeal complaints and alterations and to compare the variables of the study with the STVT duration.

Method

The study was approved by the Research Ethics Committee of UFSM, under protocol number 149/2004. Data collection was initiated after all participants read and signed a Term of Free and Informed Consent, according to Resolution 196/96.

Initially, speech sample collection was performed with the participant producing the sustained vowel /a/. In this evaluation, the participant was standing and the microphone was positioned at an angle of 90 ° from the mouth, with a distance of 4 centimeters (cm) maintained between the microphone and the mouth. The following materials were used: digital recorder, model MZ-R7000DPC from Sony; Sony Mini Disc; unidirectional microphone, model 57 A, from Shure; a pedestal; and a stopwatch from Cássio.

Following speech data collection, the videostroboscopy examination was initiated by the introduction on the oral cavity of a rigid laryngoscope type Hopkins, with angulation of 70 degrees, without the use of anesthetic. Recording was made on a VHS tape. The participant produced the sustained vowel /e/ and, following, the vowel /i/ on modal voice register, after deep inhale until the end of exhale. In this evaluation, the same angle and distance from the larynx, and the same type of vocal emission for all participants were carefully maintained.

After the evaluation described above, participants were instructed to produce three series of STVT, with fifteen repetitions each. For the production, participants should inhale deeply and make the tongue vibrate until the end of ex-hale, without using reserved air, comfortably, on habitual medium tone, without pitch or loudness elevation, besides controlling rhythm along all exercises.

There was an interval of 30 seconds of passive rest - when participants remained in silence - after each set of fifteen repetitions. Participants were seated and did not ingest water or any other substance during implementation of STVT.

All evaluations were performed before and after the implementation of STVT in order to verify possible alterations on laryngeal and vocal parameters. The total production time of three series of STVT was also timed in order to verify its possible influence on the analyzed parameters. After this phase, participants answered a questionnaire concerning the perceived sensations post-STVT.

Together with speech sample, the voice auditory perceptual analysis was performed by three Speech Therapists with years of experience in voice disorders. Each Speech Therapist conducted the assessments without knowing which of the samples referred to productions before or after the STVT. During this assessment, the following parameters were evaluated: voice type, resonant focus, pitch, loudness and production quality.

Acoustic measures were performed using the Multi-Dimensional Voice Program (MDVP) from Kay Elemetrics. The obtained measures were: fundamental frequency (f0), Harmonics-to-Noise Ratio (HNR), Pitch Perturbation Quotient (PPQ) and Amplitude Perturbation Quotient (APQ).

Values considered reference in Brazil - 150 to 250 Hz for women (3) - were used to measure the fundamental frequency. Other parameters of normality were obtained from MDVP - Model 5105: HNR (0.11), PPQ (0.36%), APQ (1.39%).

The same speech sample was used on the Real Time Spectrogram Program, from Kay Elemetrics, for the performance of spectrographic analysis. The following parameters were evaluated on broadband filters: formants intensity; high frequency intensity; intensity across the vocal spectrum; definition of formants; and spectrum regularity. The parameters evaluated on the narrowband filters were: high frequency intensity; intensity across the speech spectrum; harmonics definition and spectrum regularity. Two Speech Therapists who had knowledge about when the assessment was conducted - before or after the STVT - individually performed the previous analysis.

The following parameters were analyzed on the laryngoscopic evaluation: glottic closure; vibration amplitude; laryngeal vestibule constriction and symmetry of vocal folds vibration. The analysis of laryngeal images prior and post-STVT were performed by Otolaryngologists. Each Otolaryngologist performed the evaluation by observation of laryngeal images recorded side by side on DVD, of productions of the first vowels /e/ and /i/, being that professionals were not aware of when the images were recorded - before or after STVT.

Data were tabulated and statistically analyzed using Chi-Square; Binomial test; and Analysis of Variance (ANOVA). The significance level of 5% was used on the conclusions.

Results

Twenty-four women, non-professional of the field of voice, with an average age of 25 years, with no laryngeal or voice complaints or alterations participated in the study. The most relevant results in this study are presented on tables 1, 2 and 3. The statistically significant results are marked with *.

TABLE 1. Auditory Perceptual Analysis, Laryngeal Images and Subjective Sensations POST-STVT

Auditory Perceptual Analysis	INCREASE	DECREASE	MAINTAINENCE
Voice Type	50% (Chi-Square: p=0,0012*)	8%	42%
Vertical Resonant Focus	59% (Chi-Square: p=0,0012*)	8%	33%
Production Quality	45% (Chi-Square: p=0,0284*)	13%	42%
Laryngeal Images	INCREASE	DECREASE	MAINTAINENCE
Glottis Closure	-	4%	96% (Binomial: p=0*)
Vibration Amplitude	8%	13%	79% (Chi-Square:p=0,000*)
Laryngeal Vestibule Closure	4%	-	96% (Binomial: p=0*)
Vibration Symmetry	-	-	100%
Subjective Sensations POST-STVT	POSITIVE	NEGATIVE	MAINTAINENCE
Number of Participants	58% (Chi-Square: p=0,0001*)	21%	21%

TABLE 2. Speech Acoustical Analysis PRIOR and POST-STVT

Acoustical Analysis	PRIOR-STVT (mean value)	POST-STVT (mean value)	NORMALITY
Fundamental Frequency	203,49 Hz	211,06 Hz (“t” student: p=0,005*)	150-250 Hz
Harmonics-to-Noise Ratio	0,14	0,13	0,11
Pitch Perturbation Quotient	0,56	0,56	0,36
Amplitude Perturbation Quotient	2,46	2,35	1,39
Spectrographic Evaluation on Broadband filters	INCREASE	DECREASE	MAINTAINENCE
Formants Itensity	50% (Chi-Square: p=0,0010*)	4%	46%
Intensity along Vocal Spectrum	54% (Chi-Square: P=0,0007*)	4%	42%
Formants Definition	62% (Binomial: P=0,0416*)	0%	38%
Spectrum Regularity	63% (Chi-Square: P=0,0001*)	33%	4%
Spectrographic Evaluation on Narrowband filters	INCREASE	DECREASE	MAINTAINENCE
Harmonics Definition	58% (Chi-Square: p=0,1241)	0%	42%
Spectrum Regularity	58% (Chi-Square: p=0,0003*)	4%	38%

TABLE 3. STVT Duration x Study Variables

STVT Duration x Study Variables	INCREASE	DECREASE	MAINTAINENCE
Larynx Vestibule Constriction	4% (ANOVA: p=0,007*)	-	96%

Discussion

It is known that the voice type is related to the motor adjustments employed such on vocal cords and larynx as at the resonance level (4,5). Thus, it is perceived that STVT acts directly at those levels, which was evidenced by the increase on auditory perceptual parameters (Table 1). These results reinforce the indication of the technique in order to: provide a better balance of functional vocal production; facilitate a production with normal tension and balanced on resonance; improve voice quality and organize the muscles, reducing the noise associated with phonatory production (2,6,7,8).

With regards to the resonance focus, the STVT was equally effective. The resonant system is controlled by differences in shape and tension of the vocal tract and the resonance effect depends on the manner in which the individual modifies the laryngeal signal passing through supraglottic cavities (5,6). Thus, it is noticed that STVT promotes an intense vibration of the entire cartilaginous skeleton, helping to release the pharynx tension and reducing the phonatory effort. There is agreement on the literature about the STVT indication. The STVT brings voice up to the mask, projects it upwards and outwards and makes it "rich and full" - that is, reduces the noise of the laryngeal signal spectrum and increases the number of amplified harmonics (6,7,8).

Improvement in vocal quality was evidenced in this study proving, once more, that the STVT acts on the mucosa also as normotension regulator of vocal folds muscles. With the tongue vibration, STVT may have contributed to a decrease on vocal folds compression or even to a decrease on laryngeal vestibule constriction, which would favor a more stable emission.

No statistical significance was found when comparing the technique execution duration with the results of auditory perceptual analysis. These data differ from results of another study (2) - which showed significant deterioration in voice quality of the participants as the execution time of STVT increased. This fact may be due to differences on methodologies. In the present study, a vocal rest of 30 seconds between each set was used, which may have contributed to the better results of auditory perceptual analysis presented by the participants. The vocal rest may also have provided a recovery of larynx intrinsic muscles, in function of the suppression of muscle activity which constitutes passive rest (9). The execution time of STVT on the present study was variable, being conducted according to the maximum phonatory duration of each participant. This duration varied according to vital capacity and pneumophonic coordination, unlike the study cited above (2) that tested each participant for a uniform and continuous duration.

The impression that an individual has on his/her own voice, as well as on signs and symptoms reported, are important data for the development, by the Speech Therapist, of a voice rehabilitation program (10). According to results of the present study (Table 1), other authors (11) also evidenced the predominance of positive signs post-STVT. Participants claimed that, after STVT, voice was better and more projected, there was production facility, and the effect in voice quality was immediately noticeable.

Significant differences are not noticed when comparing the subjective sensations post-STVT to the technique execution duration time. In contrast, in another study (2), authors reported that after three minutes of application for women and five minutes for men, there was an increase in undesirable laryngeal and vocal sensations. These results highlight the need to also consider other aspects of the STVT prescription, such as vocal resistance, mode of technique implementation and number of repetitions.

When relating the results of laryngeal images analysis to STVT execution duration (Table 3), a significant increase on medial vestibule constriction was observed (presented by one participant) as the duration of STVT increased. It is known that the vestibular folds are formed by vestibular ligaments and covered with mucosa. In its lower region, there are some fibers of the superior beam of the thyroarytenoid muscle (TA) and its contraction allows medialization of vestibule folds (12,13). Thus, as one of the purposes of applying STVT is the facilitation of production with normal tension, it is deduced that the technique provides the release of the TA muscle and its beams hypertension, pushing the vestibule folds away and leaving the mucosa loose and relaxed to vibrate.

Authors (9) indicate that the application of vocal exercise for ten minutes, three times daily is ideal for a good muscle conditioning. In the present study, the participant who presented medial vestibule constriction conducted the STVT during

7.52 minutes (the longest duration), approaching the conditioning time proposed by previously cited authors. Thus, the laryngeal vestibule normotension could be seen as a condition of tension equilibrium or of an unconditioned hypertension. Although an isolated case, the statistical significance of the fact draws attention to the rethinking of STVT indications. This fact also highlights the need for more studies that confirm the effectiveness of this technique associated with its execution time in the presence of vestibule constriction, as well as which duration and number of executions of a particular vocal technique are necessary for changes in larynx and vocal patterns.

The acoustic evaluation, from the clinical point of view, complements the findings observed on the auditory perceptual analysis and on the laryngoscopic evaluation (14,15,16). There was a significant increase on fundamental frequency post-STVT (Table 2). These data do not agree to those of a study (17) with participants without vocal complaints submitted to one minute of STVT. The authors justify the findings by the fact that participants did not present mucosa alterations and that they produced emission of sustained vowel at habitual pitch, which would indicate no change in tension and length of the vocal cords, responsible for modification of the fundamental frequency.

According to the literature (2,6,17), the STVT presents normotension action on laryngeal muscles. The f0 increase can occur due to a decrease on TA tension, relieving its contraction and decreasing its weight through a more harmonic distribution of muscle forces among other intrinsic muscles. This fact can be reinforced by other data of the present study, such as the increase of laryngopharyngeal resonance. Thus, this increase in f0 seems to confirm the STVT normotension role, much more than only indicate that there is f0 heightened - which is reinforced by the statistically significant pitch maintenance post-STVT.

The spectrograph analyzes the acoustic wave in its basic components, reflecting data relative to glottal source and vocal tract (6). For the vocal spectrographic analysis in Broadband, the significant increase of several parameters was confirmed (Table 2). These results agree with other studies (18) which also verified an increase on acoustic energy with a larger number of harmonics post-STVT. Other researchers (8) observed an increase on the number of harmonics and a more defined range of harmonics in the spectrum post-STVT in a case of vocal nodules. Another study (19) observed a more defined spectrograph and larger amount of energy in the high frequency region of the spectrum after three minutes of STVT in participants without vocal complaints.

As for the parameters analyzed in Narrowband (Table 2), a more regular tracing was observed. Another author (17) also presented significant data on higher harmonics regularity with a tendency of noise component decrease. In this study, authors found no statistical significance in relation to harmonic regularity and noise on the high area of the spectrum after STVT. They verified statistical significance only after the lips vibration technique.

Conclusion

The application of three sets of fifteen repetitions of STVT, with rest, promoted changes on larynx and vocal parameters of participants of the present study. Thus, the Speech Pathologist should consider the variables time and method of implementation, as well as individual differences of participants, for prescription of the technique in Speech Pathology clinics.

References

1. Ruotsalainen J, Lic JSP, Lehto L, Verbeek J. Systematic Review of the Treatment of Functional Dysphonia and Prevention of Voice Disorders. Otolaryngology Head and Neck Surgery. 2008;138(5):557-65.

2. Menezes MHM, Duprat AC, Costa HO. Vocal and Laryngeal Effects of Voiced Tongue Vibration Technique According to Performance Time. Journal of Voice. 2005;19(1):61-70.

3. Behlau MS, Tosi O, Pontes P. Determinação da Freqüência Fundamental e suas Variações em Altura (jitter) e Intensidade (shimmer) para Falantes do Português Brasileiro. Acta AWHO. 1985;4:5-9.

4. Takemoto H, Adachi S, Kitamura T, Mokhtari P, Honda K. Acoustic Roles of the Laryngeal Cavity in Vocal Tract Resonance. The Journal of the Acoustical Society of America. 2006;120(4):2228-38.

5. Behlau MS, Madazio G, Feijó D, Pontes P. Avaliação de Voz. In: Behlau, M. (Org.). Voz - O Livro do Especialista. v.I. Rio de Janeiro: Revinter, 2001. p. 85-112.

6. Behlau MS, Madazio G, Feijó D, Azevedo R, Gielow I, Rehder MI. Aperfeiçoamento Vocal e Tratamento Fonoaudiológico das Disfonias. In: Behlau, M. (Org.). Voz - O Livro do Especialista. v. 2. Rio de Janeiro: Revinter; 2005.

7. Maffei C, Gonçalves MIR, Biase NG. Avaliação Laringológica e Perceptivo-Auditiva Vocal nas Fases Pré e Pós-aplicação da Técnica de Vibração Sonora de Pregas Vocais na Leucoplasia Plana. Revista Fono Atual. 2004;28(7):52-4.

8. Cunha MG, Pacheco COLC, Menezes MHM, Ubbrig MT. A Eficácia da Vibração Sonorizada de Língua e da Emissão do Som Nasal /m/ em Pacientes com Nódulos de Pregas Vocais: Estudo Comparativo. Anais do XII Congresso Brasileiro de Fonoaudiologia, Santos - São Paulo; 2005. p. 27.

9. Schneider CM, Dennehy CA, Saxon, KG. Exercise Physiology Principles Applied to Vocal Performance: The Improvement of Postural Alignment. Journal of Voice. 1997 Sep 11(3):332-7.

10. Wolfe VI, Martin DP, Palmer CI. Perception of Dysphonic Voice Quality by Naive Listeners. Journal of Speech Language and Hearing Research. 2000 Jun 43(3):697-705.

11. Grillo MHMM, Lima, EF, Ferreira, LPA. Questão Ensino-Aprendizagem num Trabalho Profilático de Aperfeiçoamento Vocal com Professores. Pró-Fono Revista de Atualização Científica, 2000 Setembro 12(2): 73-80.

12. Chan RW, Fu M, Tirunagari N. Elasticity of the Human False Vocal Fold. Annals of Otology Rhinology and Laryngology. 2006 May 115(5):370-81.

13. Maryn Y, De Bodt MS, Van Cauwenberge P. Ventricular Dysphonia: Clinical Aspects and Therapeutic Options. Laryngoscope. 2003 May 113(5):859-66.

14. Pereira JGE, Cervantes O, Abrahao M, Parente SFA, De Angelis EC. Noise-to-Harmonics Ratio as an Acoustic Measure of Voice Disorders in Boys. Journal Voice. 2002;16(1):28-31.

15. Walzak P, McCabe P, Madill C, Sheard C. Acoustic Changes in Student Actors' Voices After 12 Months of Training. Journal of Voice. 2008 May 22(3):300-13.

16. Master S, De Biase N, Chiari BM, Laukkanen AM. Acoustic and Perceptual Analyses of Brazilian MaleActors' and Nonactors' Voices: Long-term Average Spectrum and the ''Actor's Formant''. Journal of Voice. 2008 Mar 22(2):146-54.

17. Rechenberg L, Behlau MS. Estudo Comparativo do efeito das Técnicas de Vibração Sonorizada de Lábios e de Língua através de Análise Acústica. In: Behlau, M.; Gasparini, G. (Orgs). A Voz do Especialista. Rio de Janeiro: Revinter. 2006; III:103-15.

18. Guberfain JC, Muller MM, Sarvat M. The Perceptual, Acoustics and Lariyngological Anlysis of Tip of Tongue Sound Vibration Technique and it's Consequences in Actors. In: World Voice Consortium. 2nd. World Voice Congress and 5th International Symposium Phonosurgery Cientifi Program. São Paulo: 1999. 55 p.

19. Rodrigues S. Análise Múltipla do efeito da técnica de vibração de língua. 1996. 110f. Tese (Mestrado em Distúrbios da Comunicação Humana) - Universidade Federal de São Paulo - São Paulo, 1996.