

Estimulação elétrica nervosa transcutânea em mulheres disfônicas*****

Transcutaneous electrical nerve stimulation in dysphonic women

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*****Trabalho Realizado na Unimep.

Artigo Original de Pesquisa

Artigo Submetido a Avaliação por Pares

Conflito de Interesse: não

Recebido em 15.05.2007.

Revisado em 09.05.2008; 4.08.2008.

Aceito para Publicação em 4.08.2008.

Referenciar este material como:



Guirro RRJ, Bigaton DR, Silvério KCA, Berni KCS, Distéfano G, Santos FL, Forti F. Transcutaneous electrical nerve stimulation in dysphonic women (original title: Estimulação elétrica nervosa transcutânea em mulheres disfônicas). *Pró-Fono Revista de Atualização Científica*. 2008 jul-set;20(3):189-94.

Abstract

Background: studies indicate correlation between dysphonia and muscle tension. Aim: to evaluate bilaterally the electrical activity of the suprahyoid muscles (SH), sternocleidomastoid (SCM), and trapezius (T), the presence of pain and the voice, after applying transcutaneous electrical nerve stimulation (TENS). **Method:** ten (10) women with nodules or bilateral mucus thickening, and phonation fissure. Volunteers were submitted to 10 TENS sessions (200 μ s and 10Hz) for 30 minutes. Pain was evaluated using an analogical visual scale; the voice was evaluated through laryngoscopy and through a perceptive-auditory and acoustic analysis; and the myoelectric signal was converted using the Root Media Square (RMS). Voice and EMG data gathering was performed during the production of the E/vowel and during spontaneous speech (SS). **Statistical analysis:** Shapiro-Wilk Test followed by the Wilcoxon Test, or t Student, or Friedman Test ($p < 0.05$). **Results:** It was observed that the TENS decreased the RMS readings, pre and pos treatment, for the Right T (RT) (2.80 ± 1.36 to 1.77 ± 0.93), the Left T (LT) (3.62 ± 2.10 to 2.10 ± 1.06), the Left SCM (LSCM) (2.64 ± 0.69 to 1.94 ± 0.95), and the SH (11.59 ± 7.72 to 7.82 ± 5.95) during the production of the E/vowel; and for the RT (3.56 ± 2.77 to 1.93 ± 1.13), the LT (4.68 ± 2.56 to 3.09 ± 2.31), the Right SCM (RSCM) (3.94 ± 2.04 to 2.51 ± 1.87), and the LSCM (3.54 ± 1.04 to 3.12 ± 3.00) during SS. A relieve in pain was also observed. Regarding the voice analysis, there was a decrease in level of laryngeal injuries; no difference was observed during the production of the E/vowel in the perceptive-auditory analysis; there was a decrease in the level of dysphonia and hoarseness during SS. **Conclusion:** TENS is effective in improving the clinical and functional signs of dysphonic women.

Key Words: TENS; Analgesia; Voice Disorders; Electromyography.

Resumo

Tema: estudos mostram correlação entre disfonia e tensão muscular. **Objetivo:** avaliar a atividade elétrica dos músculos supra-hióideos (SH), esternocleidomastóideo (ECM) e trapézio (T) bilateralmente, a dor e a voz, após aplicação da estimulação elétrica nervosa transcutânea (TENS). **Método:** participaram dez mulheres com nódulos ou espessamento mucoso bilateral e fenda à fonação. As voluntárias receberam dez sessões de TENS (200 μ s e 10Hz) por 30 minutos. A dor foi avaliada pela escala visual analógica, a voz por meio de laringoscopia, análise perceptivo-auditiva e acústica e o sinal mioelétrico pela raiz quadrada da média (RMS). A coleta dos dados de voz e EMG deu-se por emissão da vogal /E/ e fala espontânea. A análise estatística constou do teste de Shapiro-Wilk, seguido do teste de Wilcoxon ou t Student ou de Friedman ($p < 0,05$). **Resultados:** observou-se que a TENS diminuiu o RMS, pré e pós-tratamento, para TD ($2,80 \pm 1,36$ para $1,77 \pm 0,93$), TE ($3,62 \pm 2,10$ para $2,10 \pm 1,06$), ECME ($2,64 \pm 0,69$ para $1,94 \pm 0,95$) e SH ($11,59 \pm 7,72$ para $7,82 \pm 5,95$) durante a emissão da vogal /E/, e TD ($3,56 \pm 2,77$ para $1,93 \pm 1,13$), TE ($4,68 \pm 2,56$ para $3,09 \pm 2,31$), ECMD ($3,94 \pm 2,04$ para $2,51 \pm 1,87$) e ECME ($3,54 \pm 1,04$ para $3,12 \pm 3,00$) durante a fala espontânea (FE), além da diminuição da dor. Quanto à voz, ocorreu diminuição do grau das lesões laríngeas e, na análise perceptivo-auditiva, não houve diferença durante a emissão da vogal /E/, porém durante a FE ocorreu diminuição do grau de disfonia e rouquidão. **Conclusão:** a TENS é eficaz na melhora do quadro clínico e funcional de mulheres disfônicas.

Palavras-Chave: TENS; Analgesia; Distúrbios da Voz; Eletromiografia.

Introduction

The dysphonia by muscular tension is defined as a hyperfunctional phonatory alteration, caused by benign injuries on the larynx, as nodules and mucous thickness (1,2).

With regards to dysphonia treatment, traditional techniques of cervical and larynx relaxation are used aiming the balance of intrinsic muscles of larynx at the glottis closing, concomitantly to the stimulation of the mucosa wave of the vocal folds, objectifying the injury regression. It is important to highlight that several authors (3-5) recommend the prioritization of larynx relaxation in cases of dysphonia by muscular tension.

In this context, transcutaneous electrical nervous stimulation (TENS), beyond the analgesia (6), promotes improvement of the vascularization on the region of application and helps muscular relaxation (7), being possible to be used on dysphonia by muscular tension treatment. However its use on the Speech-Language Pathology area is sufficiently restricted. Guimarães (8) has demonstrated its efficiency in dysphonia by muscular tension, referring the use of this resource for relaxation of larynx muscles as a preliminary phase to the Speech-Language Pathology treatment.

Taking into consideration the exposed, the aim of this study was to evaluate the electrical activity and muscular pain, as well as the vocal quality after of the application of TENS in dysphonic women.

Methods

Subjects

Ten (10) women between 18 and 50 years of age (33,6 ± 8,0 years) with nodules or mucous thickness and phonatory opening evidenced by laryngological evaluation carried through by a otorhinolaryngology Doctor participated in the study. All participants signed a Consent Form and the research was approved by the Committee of Ethics in Research of the Institution (protocol 89/2003). From a total of 15 selected dysphonic women, two did not initiate treatment for schedule non-availability and three gave up during the intervention period.

The exclusion criteria were: previous speech-language pathology and/or physical therapy treatment, age superior to 50 years, retirement or receiving of any therapeutic orientation.

Material

The following materials were used for the experimental procedure:

- . electromyography EMG1000 (Lynx®) with resolution of 16 bits and band of entrance of ± 1 volt, and a microcomputer, as proposed by Guirro, Forti and Rodrigues-Bigaton(9), with distinguishing simple electrodes (Lynx®). Amplification of 1000 times, with filter pass-band of 20-1000 Hz and sampling frequency of 2000 Hz;
- . digital load cell DDK-5Kgf (KRATOS);
- . electric Stimulator Dualpex 961 (Quark Produtos Médicos), with 4 electrodes of silicone-carbon (4,0 X 4,0 cm) and electroconductive gel;
- . matlab 6.5.1 Software;
- . multi Dimensional Voice Program (Kay . Elemetrics®) Software;
- . multi-Speech Model 3700 (Kay Elemetrics®) Software;
- . auricular microphone WH 20 (Shure).

Procedures

For the electromyographic examination, the electrodes were positioned on the suprahyoid (SH), trapezius (T) and ascending portion of sternocleidomastoid (SCM) muscles, bilaterally, according to Cram, Kasman and Haltz(10), being the electrode of reference positioned on the manubrio-sternal. The data collection was carried through in a climatized room ($23 \pm 2^\circ\text{C}$) with the participants seating on the situations of: rest (voluntary standing still, in silence and without swallowing); emission of the /E/ vowel (sustained and isolated) and spontaneous speech (SS). The collection duration was of 4 seconds for rest and the /E/ vowel and of 7 seconds for spontaneous speech, being repeated 3 times, under command of the examiner. The choice for the emission of the vowel /E/ for electromyographic register was due to the neutral position of the tongue in the oral cavity not needing adjustments on the vocal tract(11). This way, the selected situations allowed to evaluate the electromyographic activity with neutral position of the vocal tract (vowel /E/) and with active participation of the structures (FE).

The registers of the vowel /E/ and SS, captured by the Dimensional Multi Voice Program - MDVP (Kay Elemetrics®) software allowed the perceptive-auditive and acoustics analyses and occurred simultaneously to the electromyographic examination before and after the 10 TENS sessions,

being the pain intensity measured before each session.

The TENS (200 µs, 10 Hz, intensity on the motor threshold and bipolar squared pulse) was applied during 30 minutes, two or three times per week. The intensity was increased when the patient affirmed reduction of the sensation. Four electrodes were connected over the muscles trapezius - ascending part of the sternocleidomastoid, one right and one left channel, being the volunteers on dorsal decubitus position.

The perceptive-auditive analysis was carried through by 3 Speech-Language Pathologists, Specialists in voice, where the registers of the vowel /E/ and spontaneous speech were heard on double-blind. The 3 examiners remained in the same room and heard the voices together, classifying the voices based on the GRBASI (12) scale.

The acoustical analysis evaluated the frequency disturbance measures of the vowel/E/: Relative Jitter and variation of the fundamental frequency; measures of intensity disturbance: Relative Shimmer and amplitude variation; measures of noise: relation harmonic-noise.

The electromyographic data were processed in specific routines implemented on the Matlab 6.5.1 software where the root mean square (RMS) was analyzed in V.

The statistical analysis consisted initially on the test of normality of Shapiro-Wilk. The data referring to the electromyography and acoustical analysis were analyzed by the test of Wilcoxon, the intensity of pain by the test of Friedman and the perceptive-auditive analysis by the t Student test (Statistica 6.0), with $p < 0,05$.

Results

After the intervention period, reduction on the average RMS values of the analyzed muscles was observed, with exception of the right sternocleidomastoid, on the vowel /E/ and of the suprahoid on SS (Table 1).

Figure 1 presents the mean values of pain intensity, with reduction from the sixth session for the right side and from the second session for the left side.

The perceptive-auditive analysis of the vowel /E/ did not show significantly difference pre and post-application of TENS for none of the analyzed parameters. However, the perceptive-auditive analysis of spontaneous speech disclosed that there was a significant reduction of the dysphonia degrees, sleep rough, whisperings and tension after application of TENS (Table 2).

The acoustical analysis of the /E/ vowel did not present any difference for none of the analyzed parameters.

TABLE 1. Mean values ± sd of RMS (V) for the rest, vowel /E/ and spontaneous speech (SS), prior and post TENS, for the right and left trapezius (TD and TE), right and left sternocleidomastoid (ECMD and ECME) and suprahoid (SH) muscles, n = 10.

		Electromyographic Activity – RMS (µV)				
		TD	TE	ECMD	ECME	SH
rest	pre – TENS	2,55 ±1,16	3,55 ±1,97	2,35 ±0,45	2,46 ±0,64	8,11 ±5,44
	post – TENS	1,7 ±0,91	2,15 ±1,11	1,65 ±0,8	1,66 ±0,84	3,86 ±3,15
	P	0,0056	0,0039	0,0009	0,0019	0,0004
vowel /E/	pre - TENS	2,80 ±1,36	3,62 ±2,10	2,47 ±0,42	2,64 ±0,69	11,59 ±7,72
	post - TENS	1,77 ±0,93	2,10 ±1,06	2,18 ±1,74	1,94 ±0,95	7,82 ±5,95
	P	0,0082	0,0023	0,14	0,0021	0,0036
spontaneous speech	pre - TENS	3,56 ±2,77	4,68 ±2,56	3,94 ±2,04	3,54 ±1,04	18,55 ±5,34
	post - TENS	1,93 ±1,13	3,09 ±2,31	2,51 ±1,87	3,12 ±3,00	16,56 ±13,06
	P	0,0013	0,0241	0,0058	0,0432	0,3469

FIGURE 1. Mean \pm sd of the pain intensity measured by EVA (cm), on the region of the right (a) and left (b) trapezius, at the beginning of each of the 10 sessions of treatment with transcutaneous electric nervous stimulation (TENS), * $p < 0,05$. $n = 10$

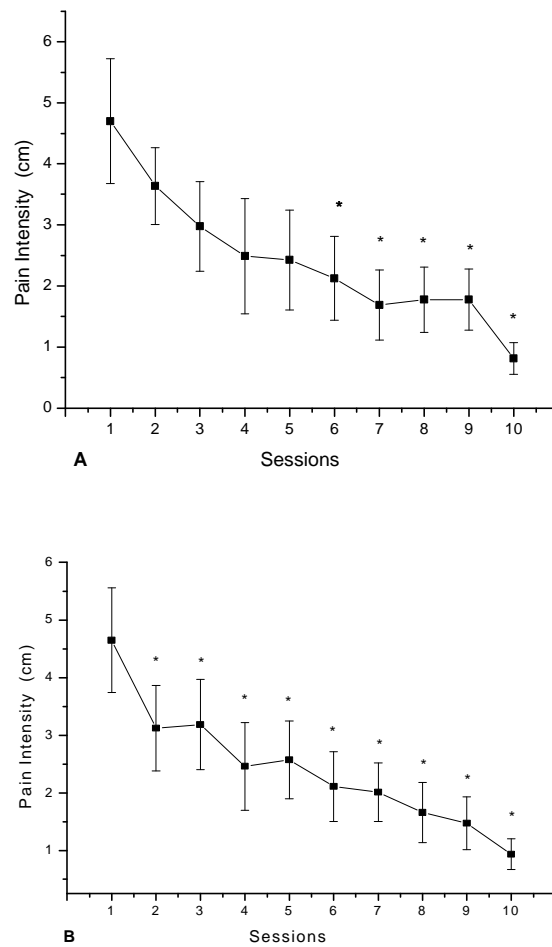


TABLE 2. Mean \pm sd and attributed p value on the perceptual analysis of spontaneous speech, regarding the degrees of dysphonia, sleep rough, whisperings, asthenia, tension and instability, before and after the application of TENS. $n = 10$.

Perceptual analysis - spontaneous speech			
Degrees	Pre-TENS	Post-TENS	p
Dysphonia	1,48 \pm 0,50	0,63 \pm 0,63	0,000094
Sleep rough	1,29 \pm 0,56	0,59 \pm 0,59	0,00009
Whisperings	0,7 \pm 0,61	0,21 \pm 0,42	0,004981
Asthenia	0	0	0
Tension	1,09 \pm 0,68	0,50 \pm 0,69	0,00143
Instability	0	0	0

Discussion

With regards the electromyographic data, in the situation of spontaneous speech, one observes significant reduction of the electric activity of the TD, YOU, ECMD and ECME muscles, however, there was no alteration of the suprahyoid muscle. These findings are justified by the speech activity, therefore the suprahyoid muscles are responsible for the jaw lowering and larynx rise during phonation and deglutition, respectively; therefore, spontaneous speech propitiates increase of the electrical activity, not allowing the differentiation between before and after the application TENS, beyond the great variability between the participants, fact observed on the high value of standard deviation of the sample. Differently, during the emission of the /E/ vowel, there was significant reduction of the suprahyoid muscles, which can be justified by the best muscular stability, during the supported and isolated emission of a unique vowel, without articulation of several sounds and brusque jaw movements (characteristic of spontaneous speech).

It has been demonstrated that after the application of TENS, there is reduction of the electromyographic activity of stimulated muscles (13,14). Kamyszek et al. (15) analyzed the masseter, temporal and digastric muscles after application of low frequency TENS (30 - 40 minutes) and observed reduction of the electrical activity of these muscles, in individuals with or without muscular hyperactivity. For Penkner, Janda and Lorenzoni (7), the muscular relaxation promoted by TENS, is resulted by alterations in physiological and biochemical muscle conditions. All these data corroborate to the ones on the present study, in which reduction of the RMS was verified after 10 sessions of application of low frequency TENS.

Guimarães (8) presented a study on hypercynetic dysphonia, in which the use of TENS for relaxation of larynx muscles as a preliminary treatment phase created better conditions for therapy development and application of conventional techniques. The author affirmed that participants who had received TENS had more quickly reached muscular relaxation and with superior quality, when compared to patients who had not received electrical stimulation.

In another study, Guimarães (16) observed that the larynx relaxation was faster and longer lasting in dysphonic patients who received TENS in comparison to the ones that had not received it. According to the author, the TENS reduces the painful symptomatology and creates better physiological conditions for the development of other therapies.

On the evaluation of pain intensity after the application of TENS, in accordance with the results of this study, it was observed that the TENS had significantly diminished pain in both treated sides, being that for the right side the reduction occurred after the sixth session for the left side and after the second session for the right side, with decreasing values until the last session, which demonstrates its residual effect. This difference can be attributed to the fact that all the volunteers were right handed.

The low frequency TENS was used because of the fact that it is one of the simplest modalities of electrotherapy, with great application spectrum. It is a valuable physical resource for the symptomatic relief of pain, either it proceeding from acute injuries or even caused by chronic processes (17-20). In this study, the use of TENS is not based only on the muscular relaxation, but also associated to the analgesic action that the low frequency can promote, once the low frequency stimulation with intensity on the motor threshold, stimulates such nociceptive fibers of the type A-Delta and C, and also efferent motor fibers, producing visible muscular contractions. Authors affirm that afferent impulses activators of the spinal medulla can generate activity in the intrinsic system that will liberate enkephalin and endorphin, selectively controlling pain (21-23).

TENS is used on physical therapy for pain control of diverse affections, with satisfactory results after application of a unique session in patients with temporomandibular dysfunctions (13,14,24) and in tender points of patients with fibromyalgia who had presented reduction of pain intensity with the increase of TENS (25), fact corroborated by the present study, once that at each treatment session the pain intensity was diminished, thus demonstrating its residual effect.

With regard to the vocal evaluation, improvement of the vocal quality could be verified after the intervention period with TENS.

The treatment with TENS demonstrated efficiency, once it improved important parameters of the vocal quality on a sufficiently short period of time (30 days). It is believed that the improvement of the vocal quality is caused by the exclusive use of low frequency TENS which promotes vibration in tissues when the intensity is at the motor threshold, thus relaxing, the whole vocal tract. It is important to emphasize that during the intervention period with TENS, the participants were not oriented regarding reduction of vocal abuses, hygiene and vocal health neither applied vocal exercises.

Improvement on the parameters of GRBASI scale could be observed only during spontaneous speech. The basic emission standard of a subject defines the type of voice and is related to the selection of the motor adjustments employed regarding the biological dimension of the voice - vocal folds, larynx and resonance (12). Therefore, the effectiveness of this analysis is completed when evaluated on a situation where the spontaneous speech is present and not only during the emission of an isolated vowel. There was no significant difference in the emission of the /E/ vowel, because the tongue is on a neutral position inside the oral cavity not needing adjustments in the vocal tract. The muscular relaxation through vibration generated by TENS caused changes in the adjustments of the vocal tract which happens in spontaneous speech. The acoustical analysis did not demonstrate significant difference, corroborating with the same author, who affirms that the basic frequency in the dysphonia seems not to change with voice therapy. However, on the jitter parameter, the author affirms relation with roughness presence, which was not found in the participants of this study.

Although the results are good, the development of other studies on the measurement of the vibration intensity that this modality of TENS promotes in tissues is recommended. Moreover, it is important to conduct the accompaniment of these subjects, once orientation regarding the habits related to the vocal health, important for the balance of the vocal quality, was not provided and that the treatment of the dysphonia for muscular tension is ample and involves orientations and changes on behavior for maintenance of the good vocal quality reached with this type of resource.

Conclusion

This study allowed concluding that TENS is an efficient resource for the reduction of the electromyographic activity of the sternocleidomastoid, trapezius and suprahyoid muscles, reduction of pain and improves of the vocal quality, revealing a favorable procedure that can make possible an improvement on the health quality dysphonic women.

The inclusion of this modality on the studied parameters as a supporting therapeutic resource on the conventional Speech Pathology treatment is suggested.

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