

Prolonged Effect of Transcutaneous electrical nerve stimulation (TENS) on Semi-occluded Vocal Tract (TVSO) in Teachers of Chillán

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Keywords : Transcutaneous electrical nerve stimulation (TENS)¹; semi-occluded vocal tract (TVSO)²; acoustic parameters³; Voice⁴

Introduction: Teachers are the group of professionals who need to use their voice for prolonged periods of time, so they are more exposed to suffer vocal disorders[1]. Transcutaneous Electrical Nerve Stimulation (TENS) to treat swallowing and voice disorders is relatively new[2]. TENS uses percutaneous electrodes to transmit waveforms through the skin to stimulate large diameter nerve fibres. This stimulation triggers central inhibitory systems, which reduces fatigue, relaxes the muscles and causes better vascularization [3][4]. The Semi-occluded Vocal Tract (TVSO) exercises refer to a series of postures whose purpose is to lengthen and/or partially occlude the vocal tract, thus causing a change in the vibratory and resonant pattern of the vocal folds [5][6]. The reported benefits of the use of TVSO are greater economy in the production of the voice and changes in the pattern of vibration of the vocal folds. The objective of this research is to determine the prolonged effect of Transcutaneous Electrical Nerve Stimulation (TENS) combined with Semi-occluded Vocal Tract (TVSO) exercises in the voice acoustic parameters of teachers from Chillán.

Methods: A quantitative, longitudinal study of descriptive-comparative level and quasi-experimental design was carried out. The sample consisted of 19 professors between 26 and 50 years old, with a minimum of 2 years of work experience and at least 30 teaching hours per week. For the group assignment, each participant took a number from 1 to 20 and even numbers were assigned to the control group and odd numbers to the experimental group. The intervention with TVSO consisted of: Control Group: First session with tube phonation, Second session with ascending and descending glissandos. Third session with phonation in a tube with water. Fourth session with ascending and descending glissandos in a tube with water. Experimental Group: performed the same sequence of TVSO exercise combined with TENS. TENS was carried out with the CARE TEC IV equipment that includes 4 waveforms TENS, EMS, interferential and Russian Wave, in addition, 4x4 cm square electrodes were used. The occupied electric wave consisted of a two-phase pulse current in a direction between two electrodes through the tissue. The Teachers' voices were analysed with PRAAT software in the following parameters: Jitter, Shimmer, HNR and Maximum Phonation Time (MPT), pre-intervention, post-intervention (Re-ev.1), re-evaluation after a 2 month vocal rest by teachers' holiday period (Re-ev.2) and re-evaluation again after 4 months of vocal load (Re-ev. 3).

In descriptive statistics, mean and standard deviation were used. The assumed error rate corresponds to 95% with a p value of 0,05. The comparison of groups was performed with T-Student.

Results: According to Table N°1, the descriptive results corresponding to the initial evaluation show that the mean of the MPT of the control group has better time than the experimental group, and standard deviation is more dispersed. However the differences in means of both groups favor the experimental group that rises 2,4 seconds in reevaluation 3, while the control group only goes up 1,7 seconds. In the case of Jitter the initial evaluation of the experimental group was maintained in reevaluation 3, while in the control group initial evaluation is 0,3, this is maintained in reevaluation 3, showing that TVSO plus TENS has a better effect on Jitter's final average. For Shimmer, the experimental group starts with 3,9 and gradually decreases through all reevaluations, reaching a difference of 2,1. On the other hand, in the control group the difference only reaches 0,6. In HNR the initial evaluation of the experimental group starts at 21,4, increases to 24,8 and the effect is maintained in the evaluation 3. For the control group the initial evaluation starts with 22,4 and increases its value in the reevaluation 1 but its effect is not maintained until reevaluation 3.

Acoustic Parameters	Evaluation X(SD)	Reev. 1 X(SD)	Reev. 2 X(SD)	Reev. 3 X(SD)	p Intra group	p Inter group
MPT Tens-TVSO	12,6 (3,28)	12,6(3,28)	13,44(5,22)	15,0 (5,22)	0,66	0,59
MPT TVSO	14,2 (3,61)	14,7(3,61)	14,20(3,61)	15,9 (10,07)	0,89	
Jitter Tens-TVSO	0,6 (0,51)	0,3 (0,12)	0,44 (0,23)	0,3 (0,17)	0,24	0,56
Jitter TVSO	0,3 (0,11)	0,3 (0,19)	0,46 (0,99)	0,4 (0,17)	0,40	
Shimmer TensTVSO	3,9 (4,04)	2,0 (0,35)	2,43 (0,94)	1,8 (0,64)	0,16	0,05
Shimmer TVSO	2,6 (0,99)	2,3 (1,02)	3,25 (0,91)	2,0 (0,68)	0,04	
HNR Tens-TVSO	21,4 (4,56)	24,8(1,18)	21,8 (2,67)	24,8(2,88)	0,03	0,00
HNR TVSO	22,4 (2,53)	24,9(2,32)	19,9 (2,62)	23,2(3,32)	0,00	

Table N°1: Averages(X) and standar deviation (SD) of acoustic parameters and intergroup p value with T of students for related samples. P <0.05 is considered. Control Group (TVSO). Experimental Group (TENS-TVSO).

It is noteworthy that in the second reevaluation, which is after vocal rest, the indicators show a tendency to raise disturbance levels in Jitter and shimmer and decrease the aerodynamic effects of MPT, is observed a higher level of noise in HNR for both groups, however the control group has higher perturbation levels than the experimental group. Despite showing that TENS plus TVSO have a better prolonged effect on acoustic parameters than applying TVSO, significant differences were observed in Shimmer of the control group and HNR in both groups. While significant differences intergroup TVSO and TENS plus TVSO only could be demonstrated in HNR.

Discussion: According to the results obtained in MPT, there were improvements in the means in both groups, which indicates that the glottal closure is favored in TVSO and TVSO plus TENS. Similar results were obtained by Ras (2016). In the case of Jitter and Shimmer, improved the means in the last evaluation of both groups. Although there are significant intragroup differences in HNR of both groups, the differences intergroups and in the means to favor the Experimental Group. This differs from other authors who found no differences in any parameter (Mansuri, 2019; Guirró 2008) [8][9]. In TVSO there was significant difference in intragroup Shimmer, but there were no improvements in the means compared to TENS plus TVSO, this differs with the study by Mansuri (2018)[10], who finds differences in Shimmer when applying TENS and Vocal Therapy. In conclusion, when TVSO is combining with TENS, a prolonged effect is observed in the means; however, significant differences only was observed in HNR.

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