Effect of pompage on pain, disability and craniocervical position of female teachers - Randomized clinical trial

Efeito da pompage sobre a dor, incapacidade e postura craniocervical de professoras - Ensaio clínico randomizado

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Abstract

Introduction: Education professionals are one of the most important occupational groups and represents one of the main parts of the economy of modern society. The vocal demands most mentioned by the teachers are talking while standing up, talking a lot and in a closed environment, which corresponds to the most frequent situations encountered in teaching. In addition, remaining in the standing position for a prolonged period may have repercussions on other systems and generate postural deviations, pain and reduced functionality. **Objective:** To verify changes in pressure pain threshold, in disability index and in craniocervical posture of female teachers with vocal and musculoskeletal complaints, and with normal larynx, after myofascial release - pompage. **Methods:** This study was a controlled and randomized clinical trial. The following procedures were performed: anamnesis, videolaryngoscopy, hearing screening, clinical and photogrammetric postural assessment using the SAPo® protocol, completion of the neck pain self-assessment protocol Neck Disability Index, and pain threshold in the cervical muscles using the Pain Pressure Threshold. Myofascial therapy with pompage had a total of 24 sessions of 40 min each, three times a week, in 28 teachers assigned to the study group (SG), and 28 to the control group (CG). Afterwards, the groups were reassessed. **Results:** The SG presented a significant improvement in the pain threshold of all the muscles evaluated, in the posture of most of the body segments evaluated, and in the cervical disability. In the CG there was a significant improvement in angle A2 after therapy. **Conclusion:** After myofascial release therapy with pompage, the subjects presented a reduction in cervical pain and in functional disability, an increase in pain threshold, and posture improvement.

Keywords: Larynx. Musculoskeletal manipulations. Posture. Teachers.

Resumo

Introdução: *Os profissionais da educação são um dos grupos ocupacionais mais importantes e representam uma das principais partes da economia da sociedade moderna. As demandas vocais mais citadas pelos professores são falar em pé, falar muito e em ambiente fechado, correspondendo às situações mais frequentes encontradas no ensino. Além disso, a permanência prolongada na posição ortostática pode repercutir em outros sistemas e gerar desvios posturais, dor e redução da funcionalidade.* ***Objetivo:*** *Verificar alterações no limiar de dor à pressão no índice de incapacidade e na postura craniocervical de professoras com queixas vocais e osteomusculares e com laringe normal, após liberação miofascial - pompage.* ***Métodos:*** *Ensaio clínico controlado e randomizado. Foram realizados anamnese, videolaringoscopia, triagem auditiva, avaliação postural clínica e fotogramétrica por meio do protocolo SAPo®, preenchimento do protocolo de autoavaliação de dor cervical* Neck Disability Index *e limiar de dor nos músculos cervicais por meio do* Pain Pressure Threshold*. A terapia miofascial com pompage teve um total de 24 sessões de 40 minutos cada, três vezes por semana, em 28 professoras do grupo estudo (GE) e 28 do grupo controle (GC). Em seguida, os grupos foram reavaliados.* ***Resultados:*** *O GE apresentou melhora significativa no limiar de dor de todos os músculos avaliados, na postura da maioria dos segmentos corporais avaliados e na incapacidade cervical. No GC houve melhora significativa no ângulo A2.* ***Conclusão:*** *Após terapia de liberação miofascial com pompage, os sujeitos apresentaram redução da dor cervical e da incapacidade funcional, aumento no limiar de dor e melhora da postura.*

Palavras-chave: *Laringe. Manipulações musculoesqueléticas. Postura. Professores.*

Introduction

The group of education professionals is one of the most important occupational groups and represents one of the main parts of the economy of modern society. In addition, it has important roles in the political and cultural scene.[1,2]

Teachers have an intense voice demand in activities that require muscular effort, adequate respiratory and postural control (static and dynamic) for several hours.[3-5] The biomechanical complexity of body posture is the result of the functional integration of multiple systems. Any alteration in this balance generates a change in postural control that affects different body areas, which can generate chronic nonspecific craniocervical pain. This affects joint position, motor control of the head, postural stability, and the intensity and chronicity of pain.[5,6]

The vocal demands most mentioned by the teachers are talking while standing up, talking a lot and in a closed environment, which corresponds to the most frequent situations encountered in teaching.[4] In addition, remaining in the standing position for a prolonged period may have repercussions on other systems and generate postural deviations, pain and reduced functionality.

In this sense, the literature presents evidence of the importance of proper posture for good professional performance and maintenance of vocal health.[3,5,7] The ideal, during the vocal production process, is to keep the torso erect, the head aligned to it, with the chin slightly lowered and the shoulders relaxed. The supra and infrahyoid muscle groups, involved in the phonation process, must be in balance regarding the length-tension relationship, so that the larynx can remain in an appropriate vertical position.[3]

For the synchronicity between vocal production, adequate body posture, especially in the craniocervical and scapular region, and efficient breathing at phonation, it is necessary that the structures and their functions interrelate in a cohesive and balanced way.[8,9]

Among the structures that act on postural control and the phonatory apparatus, muscles influence each other continuously, integrating the entire body through the fascia - myofascia - grouped nature, inseparable from the muscle tissue (myo) and its connective tissue web (fascia).[8,10] All body muscles are surrounded by the fascia, that also involve viscera, arteries and veins, presented as a network connected from the skull to the soles of the feet.[9]

The musculoskeletal manipulation via pompage is a technique that acts on the connective tissue. It is a myotensive work with mobilization added to the sliding of the fasciae. Its objective is muscle relaxation, improvement in circulatory nutrition of soft tissues and joints, dissolution of contractures, shortening, retraction, restoration of the normal shape or length of myotendinous structures, and pain reduction.[9,11] The muscular fascia has stood out in the physiotherapeutic treatment, as it is the mechanical element of force transmission.[9,11,12]

The combination of inadequate postural and respiratory habits, in addition to the excessive and/or inefficient use of the voice, can disorganize the vocal tract[8,9] and cause musculoskeletal complaints in teachers.

This study was carried out with a widely used physiotherapy technique that lacks research to prove its effectiveness.[11] By designating the superficial fascia (below the skin) and the superficial aponeurosis (covering and separating the musculature) as a set of very extensive membranous connective tissue, it is proposed a continuous, global functional entity, in which the lowest tensing, active or passive, may have an impact on the whole body.

The pompages with sliding movements act on muscles, reducing shortening and retraction; on joints, minimizing limitations and rigidity; and as a soothing agent, relieving painful conditions.[11]

Thus, this study aimed at verifying the changes in the pressure pain threshold in the disability index and in the craniocervical posture of female teachers with vocal and musculoskeletal complaints and with normal, and to compare it against the control group after applying the myofascial release technique - pompage.

Methods

This research was a controlled and randomized clinical trial, approved by the Human Research Ethics Committee (2,433,975) from the university where the study was conducted (Universidade Federal de Santa Maria), registered with the Brazilian Registry of Clinical Trials/Consolidated Standards of Reporting Trials – ReBEC/CONSORT (RBR-37428y).

Inclusion and exclusion criteria for sample composition

The study included:[13] active teachers; working at all levels of education in a medium-sized city; of the female sex, as it is predominant in the teaching profession and in the occurrence of vocal problems;[14,15] adults (19 to 60 years of age), in order to exclude vocal changes resulting from the period of vocal change in adolescents[15,16] and presbyphonia;[17] who signed the Informed Consent Form; presenting normal larynx;[18] with musculoskeletal and vocal complaints; with more than 10 h of professional use of the voice per week.[18]

Subject exclusion criteria were:[13] teachers of the speech therapy and physiotherapy courses due to previous knowledge that could interfere with the evaluation results; Brazilian Sign Language, support rooms, singing and or music teachers; teachers of physical education or that perform administrative activities, for presenting differentiated vocal demand; teachers who were on leave period;[14] teachers that had a previous self-reported history of neurological, gastric (gastroesophageal reflux), psychiatric, endocrinological, rheumatic, musculoskeletal, degenerative, pulmonary or oral breathing diseases, as they could affect vocal performance or the understanding of the tasks that were requested; teachers with hearing loss;[15,16,19] with self-reported and/or observation of orthopedic trauma, craniofacial malformations, whiplash injury; with surgical scars on the neck; going through radiotherapy and previous history of laryngeal surgery;[7,19] that reported being in pregnancy, menstrual or premenstrual period, or with infection of upper respiratory tracts or respiratory allergies during the evaluation period, due to possible vocal fold edema;[16] teachers who were or had previously been under speech therapy, physiotherapeutic and/or otorhinolaryngological treatment related to voice or postural correction, to avoid interference from any of the treatments; subjects on drug treatment (use of anti-inflammatory drugs);[19] teachers who also were amateur or professional singers, to prevent possible vocal skills already trained from interfering in the evaluations; alcohol and/or smoking habits;[15,17] underweight or obese subjects, according to the body mass index (BMI) calculated through self-reported measures; and who had a diagnosis of laryngeal disease.[16]

Sampling procedures and instruments

First, the calculation of the sample sizes of the study group (SG) and of the control group (CG) was performed considering the variability estimate measured by the standard deviation of the Pain Pressure Threshold (PPT) variable equivalent to 2.6 kg/cm².[8] Significance was set at 5% and power was 80% (1 - ß). For this calculation, a sampling error of 2 kg/cm² was considered, resulting in 28 teachers in the SG and 28 teachers in the CG; in total, 56 participants. Secondly, from the inclusion in the study, randomization took place using a closed, opaque envelope containing 56 pieces of papers: 28 identified with the number one (1) for the SG and 28 with number

two (2) for the CG. These papers were previously mixed in the envelope. The piece of paper picked by each teacher determined their group.[8,13,19]

In a third moment, after inclusion in the study and randomization of groups, all SG and CG volunteers underwent medical evaluation with videolaryngoscopy[13,20] on a day previously scheduled. On another pre-scheduled day, they performed all the following procedures, in this order: interview to check personal information, complaints and health history and to report their weight and height to calculate BMI; and medical evaluation with videolaryngoscopy was also performed.[20] Hearing screening (Amplivox® A260/2011 audiometer) was performed only by air and use of headphones, with scanning of pure tones at frequencies of 500, 1000, 2000 and 4000 Hz at 25 dBHL. The screening was carried out in a room with noise levels below 5 dBNPS (Icel, DL-4200 sound pressure meter).[13]

Ninety teachers volunteered for this investigation. Of these, two dropped out after the first evaluations and 32 were excluded: two were part of the physiotherapy course; one reported rheumatic disease; two reported being amateur singers; one underwent physiotherapeutic treatment; three reported a benign thyroid gland nodule; three reported gastroesophageal reflux; two underwent speech therapy for the voice; two reported surgery and/or face trauma; two were smokers; one was not a teacher; one was pregnant; one was older than the age limit defined by the inclusion criteria; two were away from the classrooms; two did not respond to contacts; three did not remain interested in participating in the research, and four teachers had laryngeal disease.[13]

Procedures and instruments for data collection and analysis

All SG and CG participants underwent the assessments described below, before and after therapy. The CG did not receive any treatment during the SG intervention period, but was reassessed at the same time as the SG, that is, two months after the start of the intervention.

The assessments were performed on the same day and the first therapy session was started no later than three days after the assessment. Reassessments were performed immediately after the last day of therapy.

The occurrence of chronic cervical pain or chronic neck pain was verified through the Neck Disability Index (NDI).[21] This pain is located in the cervical region and/or is associated with symptoms of the upper limbs lasting three months or more.[8,21,22] The NDI is a self-administered questionnaire used to measure disability associated with cervical pain condition.[8,21,22] It features a scale of ten items: pain intensity, personal care (washing, dressing, etc.), lifting things, reading, headaches, concentration, work/daily activities, driving, sleeping, and leisure activities. Possible responses are rated on a scale ranging from zero to five, where zero corresponds to no disability and five to extreme disability.[8,22] The NDI score consists of the sum of points, totaling a maximum of 50 points. The subject is considered without disability when the result ranges from 0 to 4; with mild disability from 5 to 14; with moderate disability from 15 to 24; with severe disability from 25 to 34; and with complete disability from 35 to 50.[8,21,22]

The occurrence of cervical pain was bilaterally verified via PPT for at least six months in the cervical muscles (semi-spinal head, levator scapular, scalenes, stenocleidomastoids - SCM, suboccipital and upper trapezius).[22,23] Volunteers were asked if there had been any episode of neck pain for at least six months, as recurrent pain in the last six months can be considered neck pain.[23] In order to assess PPT, compression using the algometer (Wagnerinstruments Force Measurement® – FDK Dial Force Gage) was performed three times, with an interval of 30 seconds between each repetition, and the average value was recorded.[23] This device resembles a pressure gauge watch with a small pointed extension and covered by a round rubber disk (1 cm area).[18,22] We considered 0.5 kg/cm² the lowest pressure value for recording, and 4 kg/cm² the maximum pressure applied by the algometer in case the volunteer did not report pain in the assessment of cervical muscles.[23]

Postural deviations were observed through visual analysis in a lighted room[24] in the anterior, right, left and posterior views of the head, cervical, thoracic and scapular girdle (shoulders and scapula) regions of each volunteer, following an adaptation of the classic protocol.[25] The volunteers were evaluated qualitatively in bathing suit (bikini, top, bra).[24] The examiner, trained for this postural assessment, received the assessment protocol, which indicated the standardized options related to observation.

The participants were also subjected to craniocervical biophotogrammetric evaluation with appropriate clothes (bikini, top, bra), hair tied back and barefoot on a rubber mat. They were photographed with a digital camera (Sony Cyber Shot DSC®, 10.1 megapixels), following the recommendations and protocol of SAPo® v0.69/2016.[26] A plumb line with two styrofoam balls glued to the wire and spaced 1 m apart for later image calibration was attached to the ceiling next to the teachers. The teacher was positioned in such a way that she and the plumb line were on the same plane perpendicular to the axis of the camera, located 3 m away and supported on a tripod (Vanguard®) at a height of 1.2 m from the floor.[24,27-29] The participants were photographed in right profile[28,29] and remained in their usual posture.[24,27] The photographic images were used only to extract the data needed for the measures, and not for publication, in order to protect the identity and privacy of all volunteers.

Anatomical references were manually palpated and marked with white styrofoam balls and double-sided adhesive tape, according to SAPo® v0.69/2016.26 Such software was used to analyze the photographic records and to proceed with the calculation of the free angular measurements.[24,28,29] Three angles measure the position of the head, two of which are related to the anteriorized posture: A1 (48.9° ± 6.5°) - angle formed between the tragus, spinous process of the seventh cervical vertebra with the horizontal; and A2 (36° ± 3°) - angle formed between the external auditory canal (vertex), chin and sternal notch. The third angle is related to the position of the head flexion-extension (FE 153.23° ± 6.53°) and is formed by points marked in the spinous process of the seventh cervical vertebra, tragus (vertex) and palpebral commissure. The smaller the angle A1 and the greater the angle A2, the further the head is. Regarding FE, the greater the angle, the greater the hyperextension of the head in the upper cervical spine.[24,27-29]

The photographs were transferred to the computer, coded, randomized and exported to the Google Drive® application in order to be evaluated by a judge, blind to the objectives, non-author of this research, and experienced with SAPo® v 0.69/2016.[26] The normal guidelines, according to the software, are: calibrate the image, mark the references, generate the analysis report and export to Excel. The analysis of the free angles between the anatomical points was estimated by the examiner.[24,28,29]

Musculoskeletal manipulation protocol of myofascial release using pompage

The protocol of musculoskeletal manipulation, myofascial release type, with the use of pompage consisted of 24 sessions, three sessions of 40 min per week (higher frequency than found in literature).[13,30]

Physiotherapy was performed individually, with the participant positioned in the supine position on a stretcher, with elongated lower limbs and upper limbs along the body, relaxed.[13] Physiotherapy students and previously trained physiotherapists, not participating in the assessment, non-authors of this research, and blinded to the objectives applied the protocol. Each teacher was attended by a different therapist in each session.[13]

The protocol was composed of maneuvers previously described in the literature.[11,13] Each session consisted of costodiaphragmatic respiratory reeducation and musculoskeletal manipulation, myofascial release type, using pompage (global pompage, global mobilization of the fascia, pompage of the semi-spinal muscles of the head, scalenes, upper trapezius, levator scapular, SCM and rotations).[13]

The maneuvers occurred due to the importance of the costodiaphragmatic breathing pattern for adequate phonation and balance of vocal emission,[13,31] as well as to the prolonged tension of the superficial muscular cervical region (semi-spinal muscles of the head, scalenes, upper trapezius, levator scapular, SCM) which has been identified as a major cause of muscle fatigue, reduced strength and resistance capacity of the muscles, of joint position and range of motion in subjects with cervical pain.[7-9,13,23,24]

Next we present the description of the maneuvers that were repeated in all protocol sessions, three times, with a 30-s interval between each one, making a total time of 40 min on average.[11,13]

Protocol description

- Costodiaphragmatic respiratory reeducation: manual releases of the diaphragmatic and lower costal muscles.

- Global pompage: both hands were slipped under the head and a gentle and symmetrical tensioning was performed.

- Global mobilization of the fascia: both hands rested on the sternum bone and, at the end of expiration, the descent of the chest was amplified by a light support on the manubrium of the sternum. At the end of inspiration, the chest elevation was increased by a small traction on the xiphoid appendix of the sternum.

- Pompage of the semi-spinal muscles of the head: one hand supported the skull base in the occipital region and the other remained over the spinous processes of the upper cervical vertebrae. The tensioning occurred by traction of the hand positioned on the occipital region.

- Pompage of the scalene muscles: the hand opposite to the scalenes to be worked on held the skull base in the occiput region; and the thumb of the ipsilateral hand rested on the posterior face of the first rib, moving the thumb forward.

- Pompage of the upper trapezius muscle: the previous positioning was maintained in one hand and the other on the shoulder on the side to be treated, moving both hands in opposite directions (as if to separate them).

- Pompage of the scapular levator muscle: the anterior maneuver was also maintained, but with the therapist's thumb in a posterior position on the inner part of the scapula spine.

- Pompage of the SCM muscle: the head was kept turned to the opposite side to the muscle to be treated, with the occipital region stabilized with one of the therapist's hands, while the other was resting on the sternum bone. Tensioning was achieved by pressing down the hand placed on the sternum bone.

- Rotations of the head: one hand was kept at the base of the skull, exerting a slight traction in order to align the cervical region, while the other was resting on the jaw rotated to one side, pulling it.

Some of the pompages such as the scalene muscles, upper trapezius, SCM, levator scapular and on the rotations were performed bilaterally (Figure 1).

After the two-month therapy period of the SG and the reassessments of all teachers, the CG teachers, who did not receive the intervention, were invited to receive the pompage.

In the statistical analysis of the data, the program Statistical Package for the Social Sciences version 17.0 (SPSS) was used. The data were represented by means, medians and standard deviation. In order to compare the pre- and post-intervention moments of the PPT, NDI and SAPo in the groups, the Shapiro-Wilk normality test was used. When the samples showed normal distribution, the paired t test was used. For non-normal data, Wilcoxon non-parametric test was used. In the post-therapy comparison between SG and CG, the Mann-Whitney test was used for data that did not show normal distribution, while the Student t test was used for data with normal distribution. The McNemar test was used to compare the clinical postural assessments before and after intervention in the groups. The significance level was 5% ($p < 0.05$).

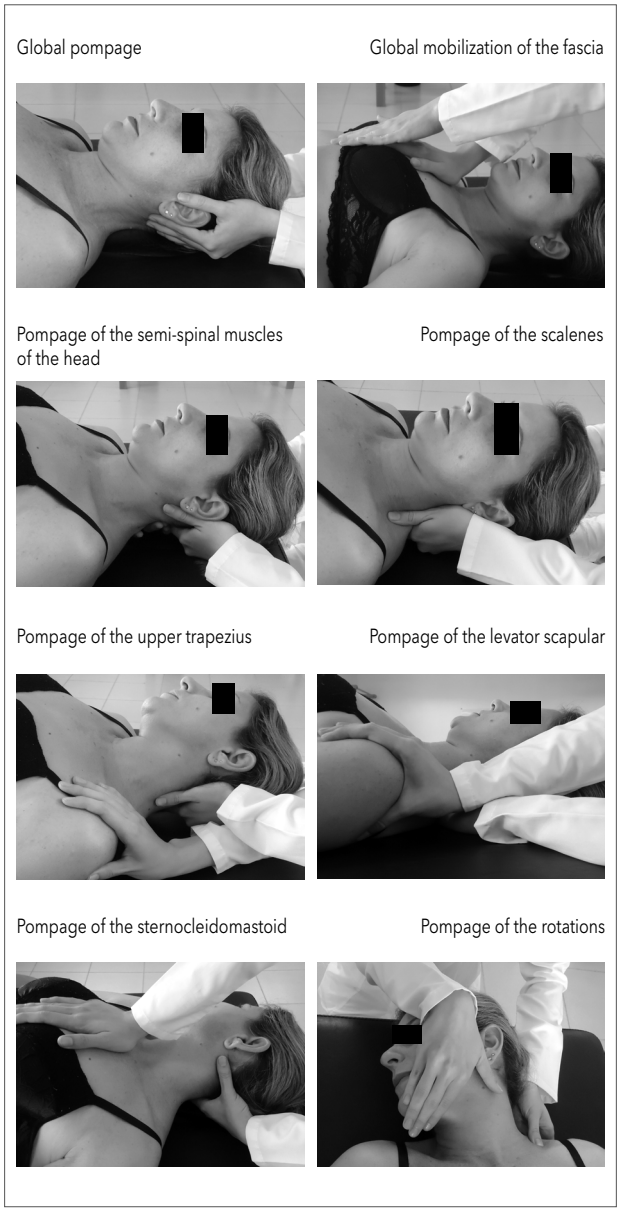

Figure 1 - Pompage protocol (source: authors).

Results

From March 2018 to February 2020, all assessment, intervention and reassessment procedures were carried out with the 56 teachers stipulated by the sample calculation (Table 1). Tables 2 show the results of the NDI for both CG and SG, showing a significant improvement in the functional disability of the neck post-therapy for the SG, in both intra and intergroup analysis.

The results of the PPT for both CG and SG show a significant improvement of all muscles evaluated post-therapy for the SG, and in the right scalene of the post-therapy for the CG in the intragroup analysis, as presented in Table 3. In the intergroup analysis, there was a significant improvement in the SG regarding the muscles on the right side: SCM, upper trapezius, scalene and semi-spinal of the head; on the left side: SCM, upper trapezius, scalene, suboccipital and semi-spinal of the head.

Table 4 brings the results of the clinical postural assessment, showing a significant improvement in most of the body segments of the SG after therapy. Table 5 shows the results of craniocervical biophotogrammetry, with a post-therapy decrease of A2 in the CG.

Table 1 - Sample characterization (female teachers)

Characteristics	Control group	Study group
Number of volunteers	28	28
Minimum age (years)	21	28
Maximum age (years)	60	57
Average age (years)	38.6	41.4
Minimum weekly workload of professional voice use (hours)	14	12
Maximum weekly workload of professional voice use (hours)	27	26
Average weekly workload of professional voice use (hours)	15.4	22.4
Minimum working time as a teacher (years)	5	8
Maximum working time as a teacher (years)	18	18
Average working time as a teacher (years)	9.1	14.8

Table 2 - Distribution of the Neck Disability Index results in the control and study groups, before and after therapy

	Neck Disability Index			
	CG Pre-therapy	CG Post-therapy	SG Pre-therapy	SG Post-therapy
Classification				
No Disability	9 (32.1%)	9 (32.1%)	5 (17.8%)	13 (46.4%)
Mild Disability	13 (46.4%)	16 (57.1%)	19 (67.9%)	14 (50.0%)
Moderate Disability	6 (21.4%)	3 (10.7%)	4 (14.3%)	1 (3.6%)
p-value	0.519		0.047	
Results				
Average	8.61	7.89	8.86	5.36
Standard deviation	5.46	5.10	4.59	4.24
Median	6.50	8.00	8.50	5.00
p-value	0.190*		0.001*	
Pos-tCG x Post-SG p-value	0.048**			

Note: CG = control group; SG = study group; numbers in parentheses followed by the symbol % = percentage proportional to the number of teachers in each classification. Mcnemar test; p <0.05 = data with significant difference. *Wilcoxon test; **Mann-Whitney test; p <0.05 = data with significant difference.

Table 3 - Pain Pressure Threshold results in the control and study groups, before and after therapy

Pain Pressure Threshold							
Right side muscles	**Group**	**Time**	**Average**	**SD**	**Median**	**p-value***	**Post CG x Post SG p-value****
Stenocleidomastoids	CG	Pre	1.76	0.61	1.70	0.615	0.019
		Post	1.72	0.49	1.67		
	SG	Pre	1.77	0.63	1.60	0.007	
		Post	2.12	0.73	2.00		
Upper trapezius	CG	Pre	2.62	0.78	2.60	0.148	0.022
		Post	2.83	0.70	2.72		
	SG	Pre	2.75	0.80	2.75	0.003	
		Post	3.25	0.65	3.45		
Scalenes	CG	Pre	1.68	0.64	1.50	0.020	0.019
		Post	1.89	0.53	1.80		
	SG	Pre	1.84	0.75	1.80	0.001	
		Post	2.29	0.71	2.20		
Suboccipitals	CG	Pre	2.65	0.69	2.60	0.134	0.261
		Post	2.82	0.60	2.75		
	SG	Pre	2.52	0.88	2.45	0.,007	
		Post	3.05	0.77	3.05		
Levator scapular	CG	Pre	3.15	0.76	3.20	0.058	0.464
		Post	3.44	0.64	3.72		
	SG	Pre	2.96	0.84	3.10	0.001	
		Post	3.51	0.65	3.85		
Semi-spinal head	CG	Pre	2.34	0.69	2.30	0.789	0.011
		Post	2.33	0.58	2.20		
	SG	Pre	2.41	0.96	2.45	< 0.001	
		Post	2.93	0.88	2.60		
Left side muscles	**Group**	**Time**	**Average**	**SD**	**Median**	**p-value***	**Post CG x Post SG p-value****
Stenocleidomastoids	CG	Pre	1.59	0.60	1.48	0.346	0.006
		Post	1.64	0.53	1.55		
	SG	Pre	1.74	0.68	1.60	0.017	
		Post	1.99	0.61	1.90		
Upper trapezius	CG	Pre	2.64	0.79	2.65	0.088	0.018
		Post	2.92	0.67	2.80		
	SG	Pre	2.79	0.86	2.65	< 0.001	
		Post	3.32	0.67	3.55		
Scalenes	CG	Pre	1.61	0.58	1.40	0.144	0.004
		Post	1.72	0.55	1.60		
	SG	Pre	1.78	0.64	1.60	0.018	
		Post	2.09	0.57	1.95		
Suboccipitals	CG	Pre	2.66	0.79	2.60	0.229	0.045
		Post	2.80	0.67	2.77		
	SG	Pre	2.49	0.92	2.30	< 0.001	
		Post	3.17	0.70	3.30		
Levator scapular	CG	Pre	3.09	0.79	3.05	0.054	0.200
		Post	3.39	0.69	3.63		
	SG	Pre	2.96	0.92	3.05	< 0.001	
		Post	3.59	0.57	3.98		
Semi-spinal head	CG	Pre	2.33	0.73	2.45	0.939	< 0.011
		Post	2.32	0.49	2.30		
	SG	Pre	2.41	0.92	2.45	< 0.001	
		Post	3.08	0.91	3.00		

Note: CG = control group; SG =study group; Pre = pre-therapy; Post = post-therapy; *Wilcoxon test; **Student's t test; $p < 0.05$ = data with significant difference.

Table 4 - Results of the Clinical Postural Evaluation before and after intervention in the control and study groups

	Clinical Postural Evaluation						
	CG - Presence of postural deviation			SG - Presence of postural deviation			Post CG x Post SG
	Pre n (%)	Post n (%)	p-value	Pre n (%)	Post n (%)	p-value	p-value
Head with anterior/posterior tilt	13 (46.4)	16 (57.1)	0.629	11 (39.3)	8 (28.6)	0.508	0.031
Head with lateral tilt	20 (71.4)	22 (78.6)	0.727	23 (82.1)	14 (50)	0.022	0.026
Head in rotation	14 (50.0)	14 (50.0)	1.000	12 (42.9)	3 (10.7)	0.012	0.001
Head forward	11 (39.3)	9 (32.1)	0.754	12 (42.9)	11 (39.3)	1.000	0.577
Shoulder	26 (92.9)	25 (89.3)	1.000	27 (96.4)	20 (71.4)	0.016	0.093
Cervical spine - total curvature	23 (82.1)	25 (89.3)	0.687	24 (85.7)	16 (57.1)	0.039	0.007
Chest	14 (50.0)	7 (25.0)	0.065	15 (53.6)	11 (39.3)	0.388	0.252
Back	20 (71.4)	18 (64.3)	0.727	19 (67.9)	10 (35.7)	0.022	0.033
Scapula	6 (21.4)	6 (21.4)	1.000	9 (32.1)	4 (14.3)	0.063	0.485

Note: CG = control group; SG = study group; Pre = pre-therapy; Post = post-therapy; McNemar's test; $p < 0.05$ = data with significant difference.

Table 5 - Results of craniocervical biophotogrammetry evaluation before and after intervention in the control and study groups

	Biophotogrammetry											
	Head flexion-extension				Anteriorized posture				Anteriorized posture			
	CG		SG		CG		SG		CG		SG	
Time	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Average	157.61	156.63	158.02	155.33	48.57	49.49	49.65	50.25	36.87	34.63	35.31	35.28
SD	9.85	9.40	9.98	9.83	4.42	4.28	5.72	5.08	4.65	4.65	4.70	4.66
Median	157.40	155.95	156.30	152.95	48.85	50.25	49.40	50.60	37.00	33.90	35.50	35.85
p-value	0.444*		0.062*		0.111*		0.112*		0.005*		0.973*	
Post p#	0.792**				0.427**				0.604***			

Note: CG = control group; SG = study group; Pre = pre-therapy; Post = post-therapy; *Wilcoxon test; **Mann-Whitney test; ***Student's t test; # Post CG x Post SG p-value; $p < 0.05$ = data with significant difference.

Discussion

Teachers stand out among professionals with higher frequency of voice misuse, such as screaming, use of loud voice, increased tension in the cervical muscles, inadequate posture, speaking for many hours, inadequate breathing pattern and lack of vocal rest.[14,16,20] All of these aspects can contribute to the appearance of functional dysphonia and reduced professional efficiency. Thus, this study verified the occurrence of changes in pressure pain threshold, disability index and craniocervical posture of teachers with vocal and musculoskeletal complaints and with normal larynx after applying pompage, and compared the results with a control group. We believe that deviations in these measurements can negatively interfere with voice production.

The increase in tension of the semi-spinal muscles of the head, scalenes, upper trapezius, levator scapular and SCM is the cause of muscle fatigue and reduced muscle strength and endurance. Such increased muscle tension affects the position of joints and range of motion (ROM) in subjects with cervical pain.[7-9,23,24] The results of cervical disability (from NDI) significantly improved, in both intra and intergroup analysis, in the SG after therapy

was performed (Table 2). This result is in agreement with many researches that used several physiotherapeutic techniques and showed reduction in cervical disability, increased PPT, and relief of cervical pain in short and long term.[8,32-34]

A systematic review of clinical trials, in agreement with this study, states that myofascial release decreases pain and improves muscle function.[12] Some researchs that used and/or verified manual release techniques found significant improvement in most variables, such as: PPT, ROM, functionality, chronic cervical pain, quality of life and/or cervical disability, but not in the short term.[35,36]

The SG had a significant post-intervention increase on the PPT, in all the muscles evaluated and in both right and left sides in the intragroup assessment. In the intergroup analysis, there was a significant post-intervention improvement in the SG regarding the following muscles on the right side: SCM, upper trapezius, scalenes and semi-spinal of the head; and on the left side: SCM, upper trapezius, scalenes, suboccipitals and semi-spinal from the head (Table 3).

This result is in line with studies with women who found an association between reduced PPT values in the craniocervical region and pain characteristics, such as frequency, duration or intensity.[18,33,37,38] Pain may be responsible for higher rates of musculoskeletal complaints, even with low-level static efforts.[19] Both exclusively manual therapy and that associated with kinesiotherapy are effective in the treatment of cervical myofascial pain. Myofascial release therapy is a superior therapy for reducing algiogenic processes and muscle hypertension.[19,33,37,38]

Myofascial release is believed to promote benefits through automatic muscle redefinition, which defines the duration and intensity of pain in the affected muscles. Myofascial therapy promotes an increase in sarcomeres (units of actin and myosin that are repeated along the myofibril) in the area where there is contraction. PPT and local pain intensity improve after the application of this therapy, possibly also due to the manual contact component of the treatment and the stimulation of muscle fibers, a process that can lead to pain block,[19] endorsing our results.

In the CG (Table 3), the right scalene muscle showed significant improvement. This result, despite being lower than the values found in the SG, agrees with a study that also found improvement without intervention.[34] The hypothesis for such a result would be the reduction of the excess muscular use of the CG by some factor that could not be verified in the study.

Manual releases may promote postural correction and reduce neck pain and its symptoms.[23,37,39] Deviations from laryngeal posture occur due to muscle adaptations,[7] and dysphonic women have more pronounced craniocervical dysfunction.[6,7] In our study, the clinical postural assessment showed significant changes after intervention in the SG regarding the following aspects: head with anterior/posterior tilt, head in rotation, shoulder, total spine and back curvature. In the intergroup analysis, there were significant post-intervention improvements in the SG regarding the aspects: head with anterior/posterior tilt, head with lateral tilt, head in rotation, total spine and back curvature (Table 4).

These results are in agreement with a research that reported the effectiveness of guidance, awareness and training for the postural balance of women.[40] Another study states that a balanced, dynamic or static posture positively interferes with respiratory function and allows free movement of the larynx, especially of the extrinsic musculature, with benefits for voice production.[5] Our results are in line with studies on myofascial release, manual therapy, mobility exercises, and kinesiotherapy to relieve symptoms of pain and disability in the cervical region, and to improve posture and mobility of the cervical head and spine.[39,41,42]

In the objective postural assessment, there were no significant results after therapy, except for the improvement of A2 in the CG (Table 5). This adjustment requires less flexion of the lower cervical spine associated with the upper cervical extension, possibly to maintain balance and horizontality of the skull.[27,28] We believe that it occurred naturally in the volunteers who were left without intervention for the control period of the study, remaining in pain and, consequently, with postural instability of the head. A research study states that cervical sensorimotor control is related to postural balance and head stability.[21]

In an ideal posture, the head is positioned slightly anterior to the cervical spine, being maintained by mechanoreceptors of the cervical spine.[27] If there is a change in this horizontality relationship due to pain, for instance, postural instability occurs.[21,27] Moreover, a study showed that the use of the A2 angle was not conclusive in the reliability of the investigation of head posture, which may justify the CG result.[28]

A research with global postural correction method in adult women used biophotogrammetry with subsequent analysis by SAPo®.[43] There was a reduction in pain and increased flexibility, but there were no changes in posture, disagreeing with our results regarding the reduction of hyperextension of the head, which showed improvement (Table 4). Pettit and Auvenshine[44] suggested that the resolution of myofascial pain may be correlated to a decreased posture of the head and with relaxation of the suprahyoid muscles.

A study evaluated subjects with organic voice disorders and computerized dynamic posturography, before and after vocal rehabilitation. All volunteers showed significant improvement in vocal aspects and posture after vocal therapy. These results indicated that changes in breathing and vocal patterns allow improvement in postural deviations.[45] Thus, postural changes may influence vocal production and vocal rehabilitation can affect body posture.[45,46] In our study, postural improvement was significant (Table 4), which may have repercussions on both vocal and musculoskeletal complaints.

Myofascial release involves the application of low tension load - and longer duration - to the myofascial complex, in order to restore the ideal length, decrease pain and improve function. A systematic review of clinical trials points out myofascial release as a strategy with a solid evidence base and excellent therapeutic potential.[12]

As a limitation of this work, we highlight the non-blinding of both SG and CG groups and the non-follow-up of the teachers after the end of the intervention, in order to verify whether the effects were maintained over time. We believe that future research should contemplate double-blinding and proof of long-term results.

Conclusion

In the group of teachers with vocal and musculoskeletal complaints that received musculoskeletal manipulations of the myofascial release type through the use of pompage, there was a reduction in cervical pain and functional disability, an increase in pain threshold, and postural improvement. This shows the effectiveness of the physiotherapy protocol proposed, under the evaluated aspects.

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Authors' contributions

DBA and CAC were responsible for the work idealization, guidance and supervision of data collection, and interpretation and discussion of results. DBA also structured and wrote the manuscript, while LFF and CAC reviewed it. All authors read and approved the final version.

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