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original article

The influence of positional release therapy on the myofascial tension of the upper trapezius muscle

A influência da terapia de libertação posicional sobre a tensão miofascial do músculo trapézio

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Abstract – The objective of this study was to analyze the influence of positional release therapy (PRT) on the myofascial tension of the upper trapezius muscle with an active myofascial trigger point (TrP). We studied 30 subjects (18 men and 12 women), mean age 34.5 ± 9.4 years, with an active TrP in the upper trapezius muscle on one side. A search for TrPs was performed bilaterally and the points were considered to be active when both local and referred pain evoked by manual palpation reproduced a deep aching and burning pain. The patients were evaluated under three conditions: (a) resting baseline, (b) concentric contraction and (c) isometric contraction, before and after treatment with PRT, regarding the following parameters: (i) pain intensity during manual palpation (visual analogue pain scale) and (ii) upper trapezius muscle electromyographic (EMG) signals. A significant decrease in painful symptoms from 5.3 ± 1.9 to 2.8 ± 1.8 ($p < 0.001$) was observed after treatment. There were no significant differences in EMG signals during resting baseline and in the presence of concentric contraction after the PRT session. It was concluded that PRT may be an effective treatment for pain relief and to reduce resting baseline EMG signals in the upper trapezius muscle with a TrP, suggesting that its use as an alternative or an adjunct to other therapies. The effectiveness of this type of treatment should be confirmed by further clinical studies.

Key words: Electromyography; Myofascial pain syndromes; Trigger points.

Resumo – *O objetivo deste estudo foi analisar a influência da Terapia de Libertação Posicional (TLP) sobre a tensão miofascial do músculo trapézio superior, com presença de ponto gatilho (PG) miofascial ativo. Foram estudados 30 indivíduos (18 homens e 12 mulheres), idade média 34,5 ± 9,4 anos, com presença de PG ativo, no músculo trapézio superior, de um dos lados. Os PG foram avaliados em ambos os lados e foram considerados ativos quando era evocada uma dor local, disseminada e persistente, por palpação manual. Os indivíduos foram avaliados em três condições: (a) repouso basal, (b) contração concêntrica e (c) contração isométrica, antes e após da aplicação da TLP, nos seguintes parâmetros: (i) intensidade da dor durante a palpação (escala visual analógica de dor) e (ii) sinais eletromiográficos (EMG) do músculo trapézio superior. Houve uma redução significativa do sintoma doloroso 5,3 ± 1,9 para 2,8 ± 1,8 ($p < 0,001$). Quanto à atividade electromiográfica, em repouso basal e na contração concêntrica, não se observaram diferenças significativas nos sinais EMGs, após a utilização da TLP. Os resultados sugerem que a TLP diminui o sintoma doloroso e reduz os sinais da electromiografia, em repouso basal, do músculo trapézio superior com PG. Isto sugere que a técnica de TLP pode ser utilizada como uma alternativa ou em concomitância com outras terapias. A eficácia desta forma de tratamento deve ser confirmada por outros estudos clínicos.*

Palavras-chave: *Eletromiografia; Síndromes da dor miofascial; Pontos-gatilho.*

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INTRODUCTION

Myofascial pain syndrome (MPS) is defined as a musculoskeletal pain condition characterized by local and referred pain perceived as deep and aching, and by the presence of myofascial trigger points (TrPs) in any part of the body[1].

A TrP is a hyperirritability spot in skeletal muscle or its fascia, located in palpable taut bands, which can be active or latent[1,2]. Active TrPs are defined as those provoking spontaneous pain, thus being responsible for MPS. Latent TrPs have all the other characteristics of TrPs (taut band, local twitch response, and possibly referred pain on compression)[1,3]. Treatment options for TrPs include trigger point injections, dry-needling, stretching exercise, massage therapy, and positional release therapy (PRT)[2,4].

PRT is a technique in which muscles are placed in the position of greatest comfort, causing normalization of muscle hypertonicity and fascial tension, a reduction in joint hypomobility, increased circulation and reduced swelling, decreased pain, and increased muscle strength[4,5].

MPS is a form of musculoskeletal pain and, therefore, most of the available data pertain to musculoskeletal pain in general, which is currently reported to affect approximately 85% of the population at some point during their lives[6]. MPS represents the major cause of this pain, and the mean prevalence of this condition among middle-aged adults (30–60 years) is reported to be 37% in men and 65% in women[7]. This prevalence reaches 85% in older adults (>65 years)[8]. Thus, on the basis of the demographics of aging, MPS can potentially become an increasingly important problem in the general population in years to come.

Several studies have reported a reduction in MPS symptoms after the management of TrPs by different procedures[9-12], but the effectiveness of PRT in the improvement of patients with MPS remains unclear. The objective of the present study was to analyze the influence of PRT on the myofascial tension of the upper trapezius muscle with an active TrP.

METHODOLOGICAL PROCEDURES

Thirty subjects (18 men and 12 women aged 20 to 50 years; mean age: 34.5 ± 9.4 years) with a TrP in the upper trapezius muscle on one side participated in the study. Patients were recruited from the administrative staff of the University of Fortaleza, Ceará, Brazil. Patients were interviewed by an experienced clinician to ascertain that they met the inclusion criteria: active TrP in the upper trapezius muscle, no shoulder injury or surgery in the upper limbs, and no medical diagnosis or suspicion of neuropathy or myasthenia and fibromyalgia. Furthermore, patients who had received any non-pharmacological treatment (physical therapy, relaxation) within 6 months prior to the study were not considered for the study. The study was approved by the Local Research Ethics Committee (161/2011). Informed consent was obtained from all subjects. All procedures were conducted according to the Declaration of Helsinki.

Patients were asked to avoid any analgesic or muscle relaxant 48 h prior to the examination. Myofascial TrPs were bilaterally explored in the upper trapezius muscle by a physiotherapist with more than 8 years of experience in the diagnosis of TrPs. The diagnosis was made according to the criteria described by Simons et al.[1]: (1) presence of a palpable taut band within a skeletal muscle, (2) presence of a hypersensitive tender spot in the taut band, (3) local twitch response elicited by snapping palpation of the taut band, and (4) reproduction of the typical referred pain pattern of the TrP in response to compression.

The following parameters were assessed in the patients before and after PRT: (i) pain intensity during manual palpation using visual analogue pain scale[13,14], and (ii) upper trapezius muscle electromyographic (EMG) signals. The EMG signals of the upper trapezius muscle were acquired during three muscle function tests (baseline, concentric contraction, and maximal isometric voluntary contraction - MIVC).

To assess the EMG signals, participants were placed on a normal chair without back support and asked to relax their upper and lower arm. The resting baseline test was performed over a period of one minute to determine the silent parameters of the EMG signal, with or without TrP. For the measurements of the active elevation movement of the shoulder, the participants were asked to perform 10 elevations (3") controlled by an auditory signal, while EMG data were captured continuously. In addition to the elevation movement (concentric contraction), MIVC was acquired for 5" with 3" of rest between contractions. The participants were asked to perform three sets of three repetitions with 60" of rest between each set. The subject's positions to obtain the MIVC were based on the guidelines of the Surface Electromyography for Non-Invasive Assessment of Muscles (SENIAM)[15,16].

The EMG electrodes were positioned over the upper trapezius muscle according to SENIAM guidelines[15,16]. Myoelectric signals were sampled at 2000 Hz in the single differential mode through a four-channel EMG system (Miotec 400® EMG System) using disposable Ag/AgCI circular bipolar electrodes (Medi-Trace 200 series, Kendall-LTP). The electrodes measuring 10 mm in diameter were coated with an adhesive conducting gel and were positioned on the skin covering the muscles with a center-to-center interelectrode distance of 25 mm[17]. The signal was pre-amplified 10 times at the electrode location and sent to the amplifier (frequency range: 20–450 Hz[18]; signal-to-noise ratio: 3 IV RMS; CMMR: 110 dB), which had a gain factor of 50, achieving a gain of 1000 for the EMG signal. The signal was sent to a 12-bit analog-to-digital converter (DT 3200, AMTI, USA) for subsequent mathematical analysis. For electrode placement, the skin was abraded with an alcohol-soaked gauze at the fixation sites in order to reduce impedance[19].

EMG activity was analyzed quantitatively by the root mean square (RMS) values determined at four central intervals of 500 ms, the mean for each muscle position was calculated, and the values for each position were compared statistically. EMG activity was analyzed qualitatively by visual inspection of the raw signal (density) and of the linear envelopes of each

site of the muscle after full-wave rectification and filtering through a zero lag 4th order Butterworth low-pass filter with a cut-off frequency of 5 Hz.

The patients received PRT as described by D'Ambrogio et al.[20]. While the patient was lying in the supine position, the therapist placed the trapezius muscle in a specific position as follows: the patient's head was flexed laterally toward the TrP and his/her shoulder was abducted to approximately 90º. In that position, the therapist monitored the TrP with her index finger and maintained that position until release was felt. This could take from 5 to 20 min[20].

Data were analyzed statistically using the SPSS® 17.0 software (SPSS, Inc., Chicago, IL). Results are reported as the mean and standard deviation. The Shapiro-Wilk test showed a normal distribution of quantitative data ($p > 0.05$). The differences between the EMG signals were assessed with the *t*-test for independent samples. A paired sample *t*-test was used to assess the differences in the EMG signals of active TrPs within referred pain intensity. Effect size was assessed using Cohen's d (standardized mean differences)[21]. Taking into account the cut-off established by Cohen, the effect size can be small (~0.2), medium (~0.5), or large (~0.8). The Pearson (*r*) test was used for the analysis of correlation between baseline and referred pain. Statistical analysis was conducted at the 95% confidence level, with the level of significance set at $p < 0.05$.

RESULTS

A total of 30 volunteers were evaluated; 12 of these patients were right-handed (40%) and 18 were left-handed (60%). The number of active TrPs was larger on the right side (n = 26; 86.7%) than on the left side (n = 4; 13.3%). No correlation between the dominant hand and TrP side was detected ($p = 0.13$). Table 1 shows the distribution of the dominant and TrP sides in the patients studied.

Table 1. Presentation of the dominant and trigger point (TrP) side [absolute frequency (n), relative frequency (%) and level of significance (p)].

		Dominant side		Total (%)	p
		right	left		
TrP side	right	12	14	26 (86.7)	0.130
	left	0	4	4 (13.3)	
Total (%)		12 (40)	18 (60)	30 (100)	

Prior to the intervention, the patients had a mean of 3.63 ± 2.86 mV in the basal condition on the active TrP side, and a mean of 2.34 ± 1.41 mV on the non-active myofascial trigger point (nTrP) side. Comparison of the two sides before the intervention revealed a significant difference ($p = 0.02$) (Figure 1). After the intervention, the side with a TrP showed a 23.15% reduction (2.79 ± 1.41 mV) in the EMG signal which, however, was not significant ($p = 0.09$; Cohen's $d = 0.4$; $r = 0.2$).

On the nTrP side, the mean value at baseline was 2.34 ± 1.41 mV, with a 3.8% increment (2.43 ± 1.44 mV) after the intervention and no significant

difference compared to the TrP side (p = 0.7; Cohen's d = -0.1; r = 0.0). After the intervention, the difference between the TrP and nTrP sides was not significant (p = 0.3).During MIVC (%), before the intervention a mean value of 19.65 ± 11.26 mV was observed on the TrP side and a mean value of 18.77 ± 16.79 mV on the healthy side (nTrP), with no significant difference between sides (p = 0.8). After intervention, the side with a TrP showed a 9.27% decrease in the EMG signal (17.83 ± 10.68 mV) which, however, was not significant (p = 0.3; Cohen's d = 0.2; r= 0.1). On the healthy side (nTrP), there was a 13% reduction in MVIC (1663 ± 9.05 mV), which was not statistically significant (p = 0.4; Cohen's d = 0.2; r = 0.1). The EMG signals of the upper trapezius muscle acquired during the three muscle function tests (baseline, concentric contraction, and MVIC) are shown in Table 2.

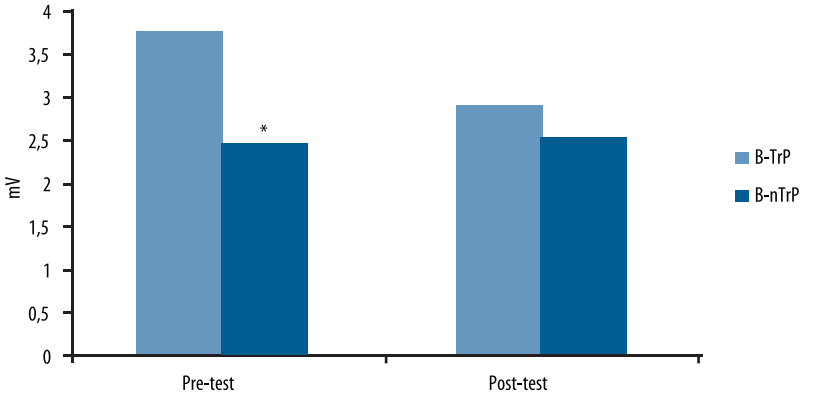

Figure 1. Mean EMG signals during resting baseline, with comparison of the two sides before and after application of positional release therapy (B-TrP: baseline with a trigger point; B-nTrP: baseline without a trigger point). * Statistically significant difference (p = 0.02).

Table 2. EMG data before and after the application of positional release therapy [mean (M), standard deviation (SD), comparison of mean values (t) and level of significance (p). Effect size is expressed as Cohen's d (C'd) and effect-size correlation (r)].

EMG	Time point	M	SD	t	p	Effect size	
						C'd	r
B-TrP	Pre-intervention	3.63	2.86	1.75	0.09	0.4	0.2
	Post-intervention	2.79	1.41				
B-nTrP	Pre-intervention	2.34	1.41	–0.33	0.70	-0.1	0.0
	Post-intervention	2.43	1.44				
IC-TrP (%MIVC)	Pre-intervention	19.65	11.26	0.86	0.30	0.2	0.1
	Post-intervention	17.83	10.68				
IC-nTrP (%MIVC)	Pre-intervention	18.77	16.79	0.77	0.40	0.2	0.1
	Post-intervention	16.33	9.05				

B-TrP: baseline with a trigger point; B-nTrP: baseline without a trigger point; IC-TrP: isotonic contraction with a trigger point; IC-nTrP: isotonic contraction without a trigger point; IC-TrP (%MIVC): isotonic contraction with a trigger point for the percentage of maximal isometric voluntary contraction; IC-nTrP (%MIVC): isotonic contraction without a trigger point for the percentage of maximal isometric voluntary contraction.

Before intervention, the patients showed a mean pain intensity of 5.3 ± 1.9 cm on the TrP side, which was significantly reduced by 47.17% (2.8 ± 1.8 cm, p < 0.001) after intervention (Figure 2).

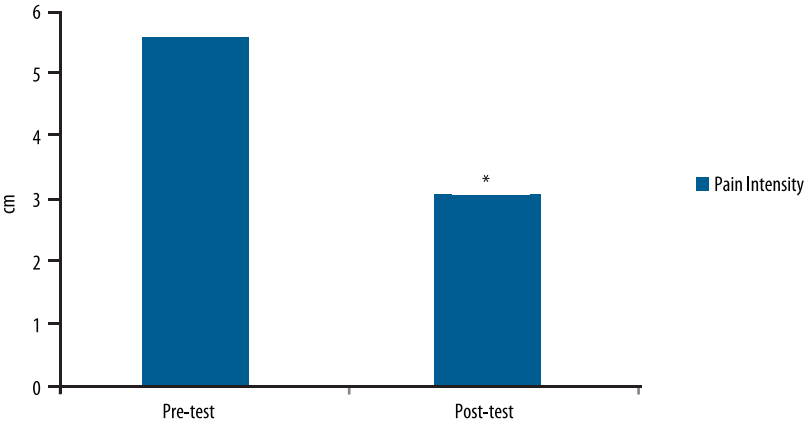

Figure 2. Mean pain intensity (visual analogue pain scale) before and after the application of positional release therapy. * Statistically significant difference ($p < 0.001$).

After intervention, on the TrP side, no correlations were found between resting baseline value and pain intensity ($r = 0.1$ and $p = 0.5$), or between pain intensity and isotonic contraction ($r = 0.04$ and $p = 0.8$).

DISCUSSION

Trigger points play a basic role in many chronic pain syndromes[2]. According to Harden et al.[22], TrPs are associated with end-plate disorder and increased release of acetylcholine, which result in local ischemia and sensitization of nociceptors. An increased release of inflammatory chemical substances such as histamine, prostaglandins, bradykinin and serotonin is observed at the TrP site[22,23]. These substances can affect the membrane of polymodal nociceptive receptors and cause peripheral sensitization, causing central sensitization and chronic pain[23].

The present study showed that the EMG signal of the muscle with TrPs generates a greater change in the electrical signal when compared with nTrP muscle in the resting position (baseline). This result supports the use of EMG for the diagnosis of pain syndromes in order to identify the TrPs[24,25]. Travell and Simons[1] hypothesized that acetylcholine is constantly released in the formation of TrPs, thus activating the release of Ca^{2+} in the sarcoplasmic reticulum. Thus, the presence of free Ca^{2+} leads to a constant interaction of myofilaments and maintains muscle contraction, even in the absence of a voluntary action potential. This fact is in contrast to the EMG activity recorded in our study, in which an increase in the electrical signal was observed on the active TrP side.

Another hypothesis of this study was that the basal tone would decrease after using PRT. This hypothesis was confirmed by the amplitude of the EMG signal normalized by the RMS of the upper trapezius muscle with TrPs. We also observed the presence of an electrical signal during the basal tone, which was higher on the active TrP side, but after PRT these values were approximately the same. A reduction in the electrical signal was observed after PRT application, which became equivalent to the electrical signal recorded at baseline in the nTrP trapezius muscle, thus suggesting

a possible impact of PRT on the reduction in the basal tone of the upper trapezius muscle[4].

We observed that the baseline EMG signal was lower than that observed during MIVC. We perceived that muscle with an active TrP did not influence the reduction in strength during isotonic muscular concentric activity. The literature shows divergent results, with some studies reporting a decrease in muscle activity[26,27], others showing an increase in muscle activity associated with pain intensity[28,29], and still others[30] finding no significant differences between the side with TrP and nTrP during active work, in agreement with the present results.

In the present study, all indicators showed small to medium size effects among patients. The mean pain intensity of the upper trapezius muscle with an active TrP was considered moderate; however, after applying PRT, the trapezius muscle exhibited a low level of pain and this reduction was statistically significant. In PRT, the muscles are placed in the greatest comfort position. The resulting tissue relaxation improves vascular circulation and removes chemical mediators of inflammation[2]. Thus, PRT may eliminate the peripheral and central sensitization. This technique may also directly reduce central sensitization by a damping effect on the facilitated segment in the spinal cord[2].

We should recognize some limitations of the study. First, the sample size was small and therefore future studies with a greater number of patients are recommended. Second, since active TrPs are not found often in healthy controls, in the present study we only included patients. The reason was that we wanted to investigate referred pain areas in active TrPs in a patient population. Future studies should include a larger sample with and without active TrPs to permit better generalization of the present results.

CONCLUSIONS

The authors propose that PRT may be an effective treatment for pain relief, reducing the resting baseline EMG signals in the upper trapezius muscle with a TrP. This suggests that this technique may be used as an alternative or an adjunct to other therapies. The effectiveness of this type of treatment should be confirmed in further clinical studies.

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