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F. Javier Montañez Aguilera, PT ^a

Daniel Pecos Martín, PT ^b

Rosana Arnau Masanet, MD ^c

Ana Camps Botella, PT ^d

Lorena Borja Soler, PT ^d

Francisco Bosch Morell, PhD ^e

^a Professor, Department of Physical Therapy, Universidad CEU-Cardenal Herrera,
Valencia, Spain.

^b Professor, Department of Physical Therapy, Universidad de Alcalá de Henares,
Madrid. Spain.

^c Hospital Clínico Universitario, Valencia. España

^d Physiotherapists.

^e Professor, Department of Physiology, Pharmacology and Toxicology, Universidad
CEU-Cardenal Herrera, Valencia. Spain.

Corresponding Autor:

F. Javier Montañez Aguilera

francisco.monta@uch.ceu.es

Departamento de Fisioterapia, Facultad de Ciencias de la Salud, Universidad CEU-
Cardenal Herrera. Edificio Seminario s/n, 46113 Moncada (Valencia). España.

Tel.: +34 96 136 90 00 (ext 1371)

Fax: +34 96 139 52 72

Immediate effect of ultrasound and ischaemic compression techniques for the treatment of trapezius latent myofascial trigger points in healthy subjects: A randomized controlled study.

Abstract.

Objective: To determine immediate effects of ischaemic compression and ultrasound for the treatment of myofascial trigger points in the trapezius muscle.

Methods: Sixty six volunteers, all CEU-Cardenal Herrera University personnel, participated in this study. Subjects were healthy individuals, diagnosed with latent myofascial trigger points in the trapezius muscle. Subjects were randomly placed into three groups: G1, which received ischaemic compression treatment for myofascial trigger points; G2, which received ultrasound and G3 (control), which received sham ultrasound. The following data were recorded before and after each treatment: active range of motion of cervical rachis measured with a cervical range of motion instrument, basal electrical activity of muscle trapezius measured with surface electromyography, and pressure tolerance of myofascial trigger point measured with visual analogue scale assessing local pain evoked by the application of 2.5 kg/cm^2 of pressure using a pressure analog algometer.

Results: The obtained results show a decrease in basal electrical activity of the trapezius muscle and a reduction of myofascial trigger point sensitivity after treatment with both therapeutic modalities. In the case of ischaemic compression, an improvement of active range of motion of cervical rachis was also been obtained.

Conclusion: Both treatments have been shown to be effective in the treatment of latent myofascial trigger points. The results show a relation between active range of

motion of cervical rachis, basal electrical activity of the trapezius muscle and myofascial trigger point sensitivity of the trapezius muscle gaining short-term positive effects with use of ischaemic compression.

Key Indexing Terms: Myofascial Pain Syndrome, Myofascial Trigger Points, Musculoskeletal Manipulations, Ultrasonic Therapies, Pain Measurement

Introduction.

Myofascial Pain Syndrome (MPS) is considered to be one of the most frequent causes of muscular pains.^{1,2} MPS is characterised by the presence of Myofascial Trigger Points (MTrPs) on a sensitive spot in a taut band of skeletal muscle, which is painful on compression, generating motion and vegetative alterations. They are clinically classified as latent and active MTrPs, the difference being the presence of spontaneous referred pain in the case of the active MTrPs.³ The etiology of the MTrPs is not currently known. The most accepted hypothesis focuses on the existence of dysfunctional endplates leading to a perpetuated shortening of the muscle.^{3,4} This hypothesis is confirmed by the investigations of J Shah.^{5,6}

Studies highlight the importance of the presence of latent muscular MTrPs, as this can cause a possible dysfunction in the muscle activation pattern and could be a determining factor in the appearance of future injuries.⁷

MTrPs can be caused in many ways.⁸ One of which could be related to physical activities associated with carrying light loads and certain postures such as those which are maintained while working in front of a computer for long periods of time.⁹ Repeated muscle activity related to certain positions could explain the existence of muscle pain in certain body parts, such as the neck. Only in the U.S., it has been estimated that 60% of the workforce used a computer at work.¹⁰ Literature has shown that MTrPs could be the main cause of muscular neck pains.^{11,12} Trapezius muscle is one of the most commonly studied.¹³⁻¹⁵

Current literature indicates an important variety of therapeutic techniques used to return the fibre groups affected by MTrPs to their normal lengths, and the endplates to their normal function. These techniques can be placed in the following groups: invasive techniques (injection therapy, MTrP dry needling, etc) and non-invasive techniques (massage, stretching, ultrasound, etc.).¹⁶

Taking into account the recent increase of computer use,¹⁷ the aim of the present study is to investigate the immediate effects of ischaemic compression (IC) and ultrasound (US) on the MTrPs of the trapezius muscle. We have chosen the teaching and research personnel (TRS) of the Faculty of Experimental Science and Health and the administration and service personnel (ASP) of CEU-Cardenal Herrera University (CEU-CHU) for this study, being workers who spend much of their time in front of a computer. Both techniques have been widely used, whether individually or combined with other therapies, in recent years.¹⁸⁻²²

An innovation in our study is the use of surface electromyography (SEMG) to assess muscle changes after treatment. This method is referred in literature.^{23,24}

Our hypothesis is that MTrPs of the trapezius muscle, in its latent state, when exposed to IC or US treatments, induces an improvement in active range of motion (AROM) of cervical rachis, decreases basal electrical activity (BEA) of the trapezius muscle and reduces sensitivity of MTrPs. Moreover, we wish to establish a relation between these three parameters due to the fact that they all responded positively with the application of one single stimulus.

Methods

This experimental study was carried out at CEU-CHU in Valencia, Spain, and was approved by the Ethics Committee of CEU-CHU Research Commission.

Subjects

Volunteers (N=66) were recruited from TRS of the Faculty of Experimental Science and Health and ASP of CEU-CHU. 29 males (43.9%) and 37 females (56.1%), participated in this study. Participants signed a consent form. Table 1 shows inclusion and exclusion criteria.

Table 1. Exclusion and inclusion criteria.

INCLUSION	EXCLUSION
TRS of the Faculty of Experimental Science and Health of CEU-CHU	Analgesic usage within the previous 24 hours. ¹⁸
ASP CEU-CHU	Fail to identify MTrPs of the trapezius clearly. ¹⁸
Full-time employees (40 hours a week)	History of cervical surgery. ¹⁹
Aged between 25 and 65	Receiving myofascial pain treatment within the previous month to the study. ¹⁹
At least 2 hours per day spent in front of computer	History of cervical whiplash. ¹⁹

Mean age was 37.2 (SD=7.6). 40 of these subjects were TRS and the rest (26) were ASP. A number was given to each employer according to the first letters of their surname and were then randomly allocated into three groups, via a list numbers obtained from the web www.randomnumbers.info. IC was applied to group G1, US was applied to Group G2 and sham US to group G3 (control). There were 22 subjects in each group and no one has either abandoned the study. Table 2 shows group characteristics.

Table 2. Group characteristics.

GROUP	Sex	Age	Job	Hours per day spent in front of computer
G1	13 ♀ (59,1%)	38,0	15 TRS (68,2 %)	3,41
	9 ♂ (40,9 %)	(SD=8,7)	7 ASP (31,8 %)	(SD=1,0)
G2	12 ♀ (54,5 %)	39,0	13 TRS (59,1 %)	3,68
	10 ♂ (45,5 %)	(SD=7,9)	9 ASP (40,9 %)	(SD=0,9)
G3	12 ♀ (54,5 %)	34,7	12 TRS (54,5 %)	3,73
	10 ♂ (45,5 %)	(SD=5,7)	10 ASP (45,5 %)	(SD=1,0)

In order to locate trapezius MTrPs, we followed the exploration diagnostic criteria established by Simons and Gerwin:^{25,26}

1. Presence of palpable taut band in a skeletal muscle.
2. Presence of a hypersensitive tender spot in the taut band.
3. Local twitch response provoked by the snapping palpation of the taut band.
4. Reproduction of the typical referred pain pattern of the MTrPs in response to compression.
5. Spontaneous presence of the typical referred pain pattern and/or patient recognition of the referred pain as familiar (only for active MTrPs).

The possibility to manually locate latent MTrPs is described in the literature.²⁷

Interventions

The IC was performed according to the methodology described by Fryer and Hodson, however we extended the treatment from 60 to 90 seconds.¹⁸

In order to perform US the following equipment was used: Megasonic 226 by Electromedicarin (Madrid, Spain). US was applied in pulse mode, at an intensity of 1 W/cm² and a frequency of 1 MHz for 2 minutes on both trapezius alternatively (starting on the right one). The same examiner performed sham US to the control group during 5 minutes on both trapezius simultaneously. The US was chosen due to the fact that subjects are not aware of the apparatus being connected or disconnected, and so, can be used as a control group. This same method was employed in earlier studies.^{20,22} The G3 were blind subjects.

No adverse effects were noted by any of the subjects as a result of either treatment.

Active Range of Motion (AROM) of Cervical Rachis

AROM was measured with a cervical range of motion instrument (CROMI) distributed by Performance Attainment Associates (Lindstrom MN, USA). This apparatus combines inclinometers and magnets to provide accurate measurement of AROM of cervical rachis and it was adjusted to the occipital area using a Velcro© in order to avoid oscillations during cervical movements. The subjects were instructed to sit upright, relax their shoulders and rest their hands on their thighs, with hips and knees flexed at 90°. The right lateral flexion was first measured, followed by the left. These two measures were combined for the statistical analysis.

Basal Electrical Activity (BEA)

BEA of trapezius was measured using a MP 100 SEMG by BIOPAC Systems (Goleta CA, USA) and using adhesive electrodes, sized 32x40 mm, distributed by Lessa. The subjects were lying in the supine decubitus position on a hydraulic therapeutic table, with their heads in a neutral position and extremities relaxed. The electrodes were placed 20mm lateral to the midpoint along a straight line from the spinous process of the seventh cervical vertebra (C7) to the lateral edge of the acromion.²⁸ First the examiner registered data from the right trapezius. Electrodes were left attached throughout the treatment to facilitate post-treatment data collection. The signal was recorded for 10 seconds. The values obtained were expressed in millivolts (mV).

Pressure Tolerance (PT)

PT was assessed using a pressure analog algometer (PAA) distributed by Psymec. A pressure of 2.5 kg/cm² was applied on MTrPs. A visual analog scale (VAS) recorded the sensation the subject perceived in that moment. The VAS was used to evaluate a possible change in pain intensity. Each participant was instructed to indicate the intensity of pain by marking a 100-mm horizontal line with two extremes: no pain and worst imaginable pain.¹⁹

Once the MTrPs in the trapezius muscle (bilateral) were located, AROM, BEA and PT measurements were performed in that order. Subjects then received the treatments described for each group, and again the same measurements were performed post-treatment. The same examiner recorded pre and post treatment data. A different examiner applied treatment to all groups. Both operators have more than 10 years' clinical experience working with MPS and the application of manual therapies.

Analysis of Data

Statistical analysis was conducted using SPSS for Windows (version 15.0). The *t*-test for paired samples was applied to all groups in order to highlight the differences between pre and post data measurements. In order to guarantee uniformity in all groups, ANOVA and Chi square were used for sex, age, job and hours per day spent in front of computer criteria (Table 2). The statistical analysis was conducted at a 95% confidence level. A *P*-value less than 0.05 were considered as statistically significant.

Results

Paired samples test for AROM, BEA and PT are given in Table 3.

Table 3. Paired samples test.

Group	Active range of motion (°)	Basal electrical activity (mV.)	Pressure tolerance (mm.)
	Mean-(SD)-P value	Dominant side Mean-(SD)-P value	Dominant side Mean-(SD)-P value
G1	4,54 (8,43) 0,020	0,00127 (0,00156) 0,002	8,23 (14,78) 0,035
G2	3,86 (8,99) 0,057	0,00089 (0,00091) 0,000	7,50 (7,86) 0,000
G3	0,22 (5,59) 0,85	0,00027 (0,00281) 0,653	1,50 (7,62) 0,390

For G1, AROM, BEA of the trapezius muscle, dominant side, and PT of MTrPs in the trapezius muscle, dominant side, significant changes were found. We have been able to establish a relation between these three parameters due to the fact that they have all responded positively with the application of one single stimulus. Significant changes were also found for G2, in the parameters BEA of the trapezius muscle, dominant side, and PT of MTrPs in the trapezius muscle, dominant side. No significant changes were found for G3.

Discussion

This study show satisfactory short-term results for healthy subjects in the treatment of latent MTrPs in the trapezius muscle with IC and US. We can establish the relation between AROM, BEA of the trapezius muscle and MTrPs sensitivity of this muscle, gaining short-term positive effects with use of the same stimulus (IC).

We have found other studies which have also used IC, either combined with other therapies or not, obtaining satisfactory results.¹⁸⁻²⁰ The subjects of our study are asymptomatic, assuming a limit to compare our results with other studies. Fryer and Hodson were the only exception.¹⁸ These authors used a digital algometer to determine Pressure Pain Threshold (PPT) of MTrPs in the trapezius muscle. PPT is defined as the least amount of pressure required to provoke pain in that specific point. The experimental group received IC whilst the control group received an IC “extremely light”. Although the duration of IC is different in their study and ours (60’ and 90’), both works emphasize the effectiveness of this technique in decreasing latent MTrPs sensitivity.

Fernández *et al* analyzed sensitivity changes in active and latent MTrPs in the trapezius muscle after the application of IC for 90 seconds.¹⁹ Data were collected using a VAS and a pressure threshold meter (PTM), which applied a 2.5 Kg/cm² pressure on this point. This method for measuring sensitivity and the duration of IC application are identical to those used in our study. Results proved satisfactory in both cases.

Gemmell *et al* worked with subjects with non-specific neck pain.²⁰ Three treatment groups (IC, pressure release and sham ultrasound) were created for the treatment of active MTrPs of the trapezius muscle. Examiners obtained measurements of PPT and AROM. IC was performed for 30 to 60 seconds. IC was released when tension of MTrPs decreased, when pain disappeared, or 60 seconds had elapsed, whichever happened first. To determine pressure release, the examiner applied a non-painful pressure with the thumb over MTrPs until a tissue resistance barrier was felt. Pressure was maintained until the barrier disappeared. Then, pressure was increased until a new barrier was found. This process was repeated until tissue resistance disappeared or 90 seconds had elapsed, whichever happened first. IC was found to be statistically significant for PPT and AROM parameters. These results and the results of our study coincide with the fact that MTrPs sensitivity and AROM show improvement after performing a pressure stimulus.

We have found other studies which have also used US with satisfactory results. The subjects of these studies are symptomatic. Moreover, consulted literature does not show consent in the selection of application parameters. Majlesi and Ünalán carried out a study with subjects with pain in trapezius muscle.²¹ Subjects were divided in two groups: a control group, which received US in a “conventional” form (the applicator was moved in concentric circles over the area to be treated for 5 minutes at an intensity of 1.5 W/cm² using continuous mode), and a second group which received an US treatment considered as “high-power” according the parameters: static positioning of the electrode over the area to be treated, gradual increasing of the intensity until the level of maximum pain the subject can bear is reached, this intensity was maintained for 4 to 5 seconds and then reduced to the half-intensity level for 15 seconds. This

procedure was repeated three times. Subjects received several sessions. After each session, they performed active stretching exercises. During these exercises, trapezius sensitivity (with a VAS) and AROM were measured. Results show a greater improvement of MTrPs pain in subjects treated with US using the “high power” mode. This study cannot be strictly compared to ours for several reasons: The authors’ description of “conventional” mode does not correspond to our application, thus it is not possible to compare our technique with “high power” technique. In our study, although far less energy per session was employed on healthy subjects, significant improvement of AROM and PT was still noted. We believe that excessive energy is not necessary for obtaining positive results. Moreover, these authors measure motion sensitivity and not pressure sensitivity, which makes comparing these studies difficult.

Srbely and Dickey performed therapeutic US on a study group for 5 minutes applying a frequency of 1MHz with an intensity of 1.0 W/cm² in a continuous mode.²² Control group received a non-therapeutic dose of US (5 minutes, 1MHz, 100 mW/cm², in a continuous mode). Pre and post treatment measurements of PPT were obtained. The results indicate that the therapeutic use of US can significantly reduce MTrPs sensitivity of the trapezius muscle, while this is not the case with a non-therapeutic use. Concerning the decreasing of the MTrPs sensitivity we coincide with this study.

We believe that the use of BEA as a variable measuring is very interesting. Moreover, we consider having related BEA with the improvement of AROM of cervical rachis and the decreasing of the MTrPs sensitivity to be an interesting development. Although asymptomatic subjects were used in this study, the importance of prevention cannot be overlooked. If latent MTrPs are detected in time, and we are able to improve AROM of

cervical rachis, decrease BEA of the trapezius muscle and MTrPs sensitivity, it is possible to anticipate the appearance of pathological situations whose treatment can later prove complicated.

Future studies should use objective measurement variables such as the BEA. We also believe the establishment of relations between AROM of cervical rachis, BEA of trapezius muscle and MTrPs sensitivity in symptomatic patients to be necessary. Finally, establishing these relations with active MTrPs would also prove interesting.

Conclusions

Both treatments have been shown to be effective in the treatment of latent myofascial trigger points on asymptomatic subjects. The results show a relation between active range of motion of cervical rachis, basal electrical activity of the trapezius muscle and myofascial trigger point sensitivity of the trapezius muscle gaining short-term positive effects with use of ischaemic compression.

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