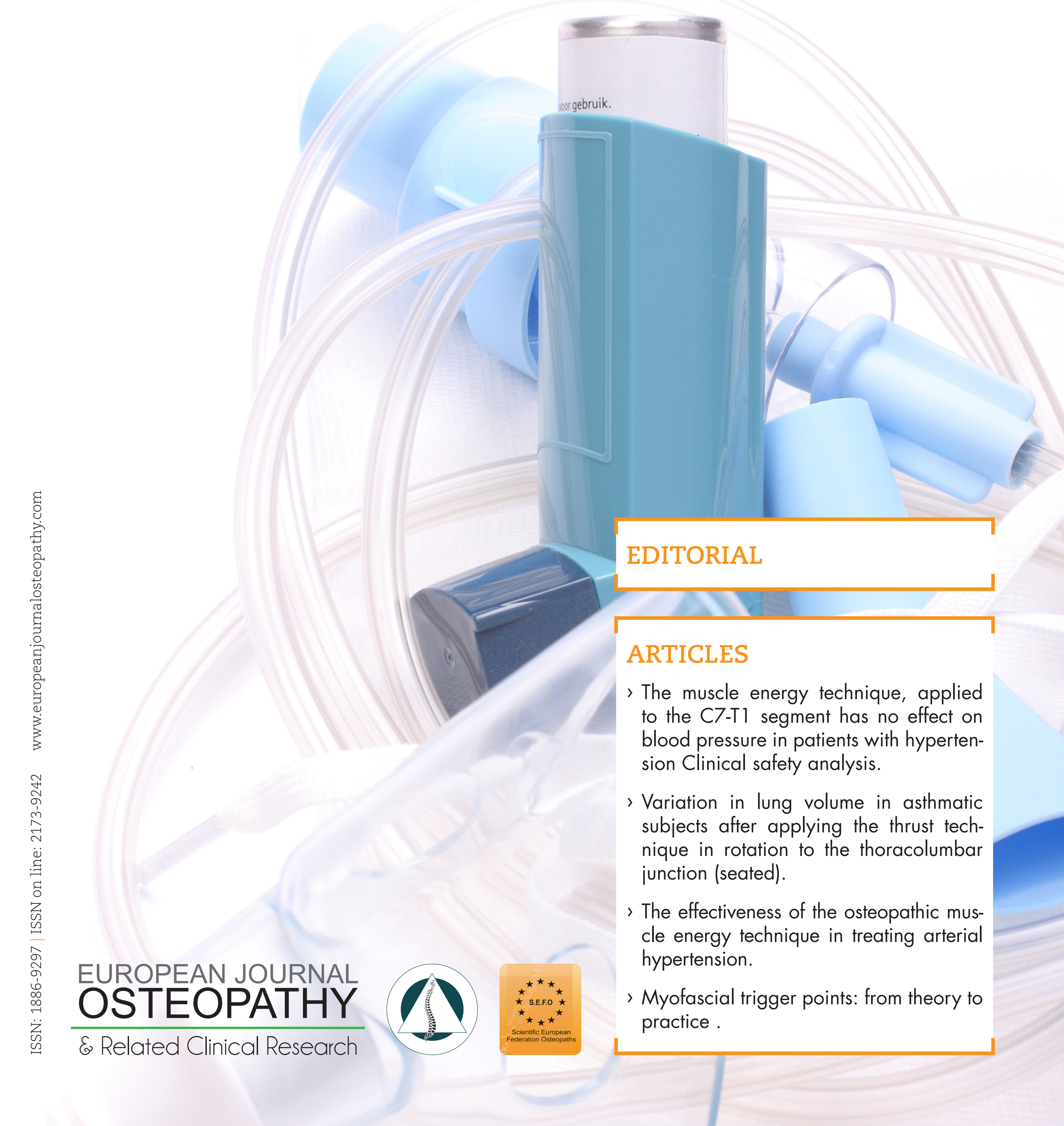
EUROPEAN JOURNAL OF
OSTEOPATHY
& Related Clinical Research

May – August
Volume 11 · Number 2
Quarterly online journal
Peer review
2016



EDITORIAL

ARTICLES

EUROPEAN JOURNAL
OSTEOPATHY
& Related Clinical Research

ISSN: 1886-9297 | ISSN on line: 2173-9242 www.europeanjournalosteopathy.com

ABSTRACT

WHO WE ARE

European Journal Osteopathy & Related Clinical Research (Eur J Ost Rel ClinRes), is a quarterly, online, multidisciplinary, peer review publication, that contains technical and scientific information related to Osteopathy and Clinical Health Sciences. This journal publishes original research papers, technical reports, clinical notes and clinical cases, review papers and critical and editorial commentaries as well as specialist literature. You can access the journal via the website www.europeanjournalosteopathy.com. This website is available in twenty different languages to make it accessible to an international readership. This journal is published quarterly- three issues per year- and its full contents are available to access immediately, at no cost, in Spanish and in English. European Journal Osteopathy & Clinical Related Research originated as a journal formerly known as Osteopatía Científica (Scientific Osteopathy), which is indexed in SCI- mago-SCOPUS, SciVerse-Sciencedirect, BVS (Biblioteca Virtual en Salud), Elsevier Journals and Latindex Índice SJR (SCImago Journal & Country Rank) 2010: 0.025. This journal is sponsored by several professional and scientific institutions. Its contents can be accessed free of charge by readers, authors, reviewers and librarians and it is the official publication of the following institutions: Scientific European Federation of Osteopaths – SEFO (Federación Europea Científica de Osteopatía) and the Madrid International Osteopathy School (Escuela Internacional de Osteopatía de Madrid – EOM). LOPD (Spanish Data Protection Law): In accordance with Law 15/1999, dated 13th December, we inform you that your personal data will be stored electronically at the Escuela de Osteopatía de Madrid. You may exercise your rights to access, rectification, cancellation or opposition in accordance with the terms established in the current legislation, directing your request in writing to: Escuela de Osteopatía de Madrid, C/ San Felix De Alcala,4. 28807 Alcala De Henares. Madrid (España).

EDITORIAL TEAM

Cited as follows: Surname, Name (abbreviated name) - Degree Level– Institution– Country.

[EDITORIAL]

Ángel Oliva Pascual-Vaca (PT, DO, PhD), François Ricard (DO, PhD), Ginés Almazán Campos (PT, PhD, DO)

This edition of the journal contains a series of different articles related to osteopathy.

To demonstrate the safety of osteopathic interventions, we are presenting our research on muscle energy techniques for the cervicothoracic junction in patients with hypertension. We also present an article from a pilot study on variations in lung volume in patients with asthma after applying the thrust technique to the thoracolumbar junction in rotation (seated). This edition also contains two reviews. The first is a systematic review of the effectiveness of the muscle energy technique on arterial hypertension. The second is a literature review on myofascial trigger points, from theory to practice.

We hope that you enjoy reading these articles and that they are useful for your clinical practice.

Corresponding author: angeloliva@us.es
(Ángel Oliva Pascual-Vaca)
ISSN on line: 2173-9242

www.europeanjournalosteopathy.com
info@europeanjournalosteopathy.com

[1] Editor European Journal Osteopathy & Related Clinical Research

[RANDOMISED CLINICAL TRIAL]

THE MUSCLE ENERGY TECHNIQUE, APPLIED TO THE C7-T1 SEGMEMT HAS NO EFFECT ON BLOOD PRESSURE IN PATIENTS WITH HYPERTENSION CLINICAL SAFETY ANALYSIS

Antonio Moro Pantoja[1] (PT, DO, PhD), Miguel Ángel Lérida Ortega[2,3] (PT, DO, PhD), Manuel Saavedra Hernández[2,4] (PT, DO, PhD), Cleofás Rodríguez Blanco[2,5] (PT, DO,PhD)

Received 4th July 2016'; accepted 26th July 2016

Introduction: AHT (arterial hypertension) is a chronic disease, characterised by a continual rise in blood pressure. In recent years, in osteopathy, attempts have been made to analyse the causes of AHT, to find safe techniques for treating patients with AHT and to obtain positive results in changes to blood pressure after applying the different techniques.

Objectives: to analyse the effectiveness of the muscle energy technique (MET), applied to the C7 segment in patients with hypertension in terms of changes in blood pressure. To analyse whether the muscle energy technique applied to the C7 segment in patients with arterial hypertension is safe.

Materials and Methods: Randomized clinical trial (RCT), experimental, blinded and controlled. Sixty one (n=61) patients with hypertension were randomly distributed into two groups: an experimental group (n=31) and a control group (n=30). An initial assessment (pre-intervention) and a final assessment (post-intervention) were carried out, analysing changes in systolic blood pressure (SBP) and diastolic blood pressure (DBP) in patients with hypertension. The tests previously used were the Mitchell, Jackson and Klein tests. The intervention technique used for the study was the muscle energy technique, applied to the spinal segment C7-T1 for spinal somatic dysfunctions.

Results: No significant differences in variations in SBP or DBP were found between the subjects in the control group and the experimental group for any of the four variables, measuring improvements in blood pressure.

Conclusions: The muscle energy technique is a safe technique to apply to the C7-T1 vertebral segment in patients with hypertension.

PALABRAS CLAVE

- Hypertension.
- Heart rate.
- Osteopathic medicine.

Corresponding author: cleofas@us.es
(Cleofás Rodríguez Blanco)
ISSN on line: 2173-9242

www.europeanjournalosteopathy.com
info@europeanjournalosteopathy.com

[1] Salux Clinic. Badajoz. Spain.
[2] Professor, Escuela de Osteopatía de Madrid (Madrid School of Osteopathy). Madrid. Spain.
[3] Professor, Departamento de Ciencias de la Salud (Health Sciences Department). Universidad de Jaén. Jaén. Spain.
[4] Professor, Departamento de Enfermería, Fisioterapia y Medicina (Department of Nursing, Physiotherapy and Medicine). Universidad de Almería. Almería. Spain.
[5] Professor, Departamento de Fisioterapia (Department of Physiotherapy). Universidad de Sevilla. Seville Spain.

INTRODUCTION

Different authors have studied the benefits or the lack of contraindications of osteopathic techniques applied to different areas of the body and different pathologies and obtained positive results.

Boscá[1] studied the absence of contraindications for a cervical manipulation with a thrust, applied to C7-T1 in patients with heart disease. He also found no contraindication for a global hemodynamic manoeuvre, applied to patients with essential arterial hypertension (AHT). In fact, heart rate (HR) dropped, which is a significant result for patients with hypertension who tend to have a high HR.

Having established the lack of contraindications, it would be interesting to read studies with positive results, where blood pressure (BP) and/ or HR decreased after applying osteopathic techniques to different areas of the body, such as the cervical spine. Irvin Korr[6], has explained the benefits of manipulating cervical vertebrae, given that somatic dysfunctions in the vertebrae can cause central sensitization. According to this model, somatic dysfunctions are mainly caused by proprioceptors, primarily neuromuscular spindles (NMS). This is because they are sensitive to muscle stress and they are receptors, which do not adapt when being stimulated mechanically and which act specifically on the joints around the dysfunctioning spinal segment[7], which can irritate the organ innervated remotely[6].

This concept is supported by Mcknight and Boer[8], who showed that manipulating the spine reduces blood pressure.

In 2010, Santiago Gómez Castro carried out a literature review and found that a common symptom among patients with primary AHT was increased sympathetic activity and a partial loss of joint stability, which can affect blood pressure and AHT. He observed the evident effectiveness of upper cervical spine manipulations in correcting this joint instability and restoring the balance of the autonomic nervous system and therefore its effectiveness in treating certain types of AHT[3].

Manipulating a segment of the spine has also been shown to reduce both HR and systolic blood pressure in individuals presenting with stage 1 or 2 AHT, according to the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7). Therefore, Chiropraxis (spinal manipulation) seems to play a significant role, at least in the short term, in managing essential AHT in patients presenting with stage 1 or 2 hypertension, given that there is no contraindication for patients with hypertension.

Rychlicilvá[10] described the relationship between Coronary Heart Disease and musculoskeletal dysfunctions in T3-T4. Other authors have carried out studies, measuring changes in BP and HR after performing reflexotherapy on the feet. The patients' HR decreased, which could be attributed to increased relaxation, experienced as a result of applying the technique, but there were no changes in systemic blood pressure[11]. Benito M.[12] observed a decrease in SBP in patients with hypertension after applying pressure (6mm) onto the projection of the aortic valve for 90 seconds. There have also been studies showing that manipulation of the craniocervical junction is associated with an improvement in peripheral pathologies such as a temporomandibular dysfunction, due to the anatomic-nervous relationship. This study supports the use of craniocervical junction manipulation to improve mouth opening for patients with temporomandibular joint dysfunctions[13]. Caparosi[4] demonstrated that homeostasis can be regulated by manipulating the craniocervical junction.

Having reviewed these scientific studies, it would be interesting to apply the muscle energy technique (MET) to the C7-T1 segment in patients with hypertension to try to have a positive effect on AHT. This would be especially interesting as AHT is one of the most prevalent risk factors for cardiovascular disease in the world[14-16] and is a serious public health issue[17-19]. Furthermore, it has a high cerebrovascular, cardiovascular and renal morbidity and mortality[17]. It is also closely related to diabetes mellitus (DM) with 80% of patients also presenting with AHT[14,20].

OBJECTIVES

To determine whether it is safe to applying the MET to the C7-T1 segment in patients with AHT. To analyse whether the MET applied to the C7-T1 segment affects SBP and DBP the patients' left and right arms

MATERIAL AND METHODS

Study Design

A longitudinal, randomised, experimental, controlled triple-blinded clinical trial with an intervention.

Three examiners participated in the study, allowing us to blind the assessor so that they would not know which group the patient they were testing belonged to. We carried out the Mitchell Test, the Klein Test and the Jackson Test on all of the patients and measured their SBP and DBP in the right and left arm pre and post-intervention.

The patients did not know whether they belonged to the experimental group or the control group. They were told that they were participating in a study, applying a technique to either the shoulders or the cervical spine to see how it affected the cardiovascular parameters being measured. But they were not told which technique was being applied to the experimental group and which technique was being applied to the control group.

The statistical data analyst was not told the objectives of the study.

Measuring Devices

Measuring blood pressure. Blood pressure is taken before and after the intervention using the OMRON ELITE PLUS Blood Pressure Monitor (Elite Plus, OMRON, Kyoto, Japan)[10].

Sampling and Sample Size

We used non-probability sampling for the study, selecting a sample from patients who had been assessed for eligibility: who met the selection criteria and who consented to participating in the study.

We calculated the required sample size, using the Granmo software programme, version 7.12 (Granmo, IMIM Hospital del Mar, Barcelona, Spain) to compare two independent means from a previous pilot study, accepting an alpha risk of 5% (α=0.05) and a beta risk of 20% (β=0.2) in a bilateral contrast. We concluded that we needed 27 subjects in the first group and 27 subjects in the second group in order to be able to detect a difference in heart rate between the groups equal to or higher than 9.5% (0.095). The common standard deviation was 12% (0.12). Loss to follow-up was estimated to be 5% (0.05) and the statistical power (1- β) was estimated to be 80% (0.8). For that reason, we selected 61 patients in total, distributed into two groups of 30 and 31 patients respectively. There was no loss to follow-up.

Subjects

The study population was 61 patients (n=61). They were divided into two groups: An experimental group (n=31), who received the MET on C7, depending on the dysfunction each patient presented with. And a control group (n=30), who received a placebo technique.

Randomisation

The distribution of the patients into the two groups was randomised, using the software provided on the independent website randomized.com[24]. To recruit patients, we selected two Physiotherapy Centres located in Badajoz and Albuquerque. All participating patients were required to meet the following selection criteria:

Inclusion Criteria

Patients over the age of 18 with hypertension and with a positive Mitchell's Test[25,26], who have been diagnosed with AHT, in line with the criteria outlined in the Spanish Guideline for Hypertension (SGH)[27] were included in the study. The SGH criteria states that the patient should have been diagnosed with AHT at least 6 months before inclusion in the study[28,29] and should have been taking stable antihypertensive medication for at least the last three months. Finally, to be included in the study, subjects were required to sign an informed consent form.

Exclusion Criteria

Patients with severe hypertension (BP > 180/100mm hg) at the time of the examination[30], patients who have suffered any pathology with contraindications for the muscle energy technique applied to the cervical or thoracic spine[31], patients diagnosed with hypertension less than 6 months before the study[27], patients with secondary AHT, a terminal illness[30] and patients who have been taking hypertensive medication for less than three months[30] were all excluded from the study.

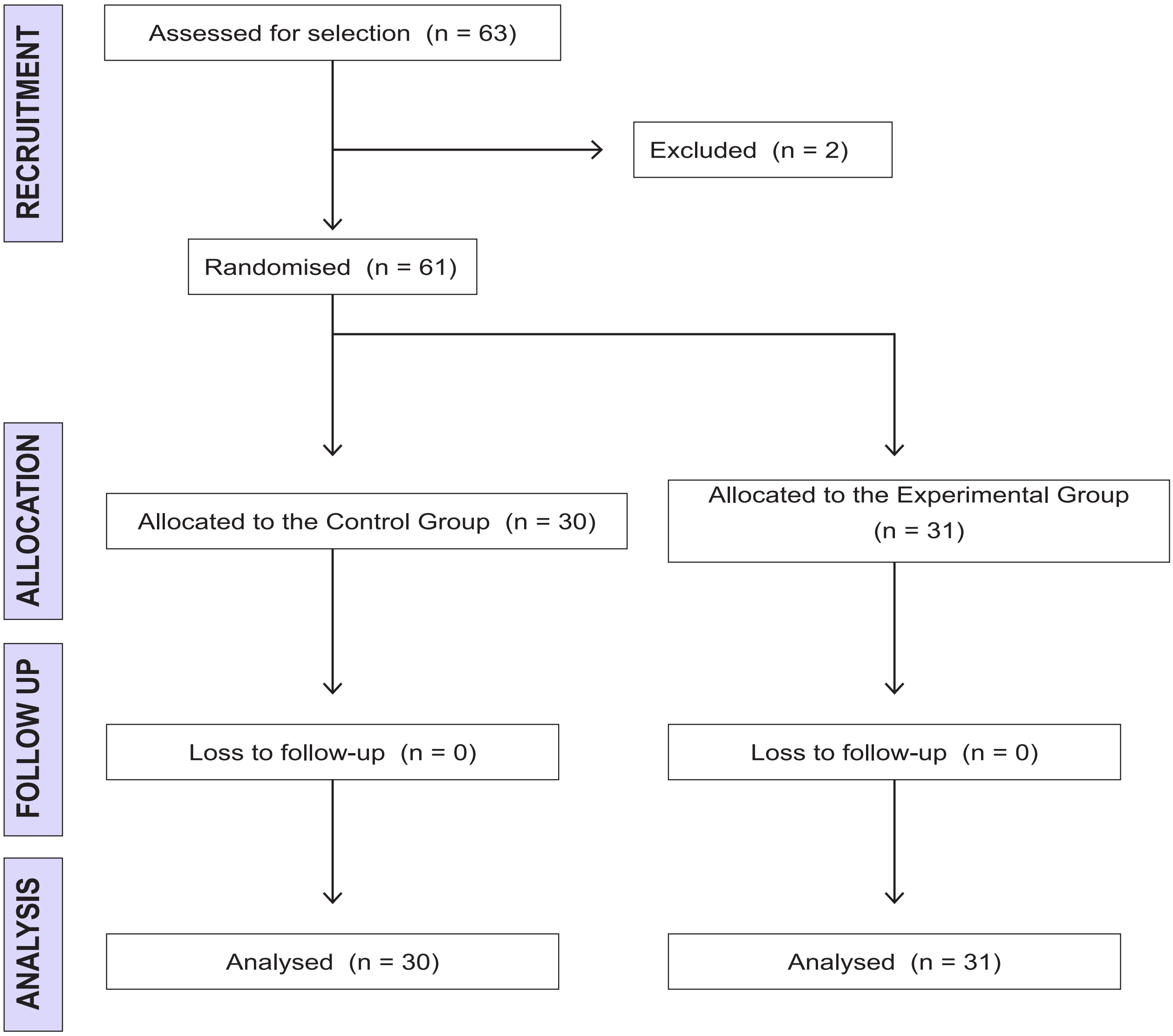


Figura 1. CONSORT Flow Diagram[22,23] for reporting randomised studies.

Evaluation

Prior to the assessment and the intervention, another assessor collects the data in a file designed for the study and the patient signs an informed consent form, giving permission for their data to be used confidentially, in accordance with the Data Protection Law[32]. The assessor explains to the patient what the study will involve. Finally, the assessor measures and weighs the patients, who is wearing no shoes and light clothing.

In order to minimise bias, the assessors undergo a reliability assessment before the study, which involves taking a sample population of 15-20 people. Three assessors then carried out the proposed tests (blood pressure, Mitchell's test) three times on each patient at different times[33].

From Mitchell's test, we found moderate (0.4 > k < 0.6) and good (0.6 > k < 0.8) agreement between the assessors (inter-rater kappa coefficient; ‡ table 1), which supports the reliability of the diagnostic test, which corresponds with other studies that validate the test[34]. We also found good (0.6 > k < 0.8) and very good (k > 0.8) agreement between the results obtained from the repeated tests carried out by each assessor (inter-rater kappa coefficient; § table 1), which supports the reliability of the assessors, as confirmed by the Mitchell's mobility tests. Based on this, we selected the most reliable assessor for our study.

ASSESSOR	ASSESSOR					
	A		B		C	
	K	P-VALUE	K	P-VALUE	K	P-VALUE
A	0,793§	P<0,001*	0,612‡	0,010*	0,579‡	0,027*
B	0,612‡	0,010*	0,802§	P<0,001*	0,586‡	0,002*
C	0,579‡	0,027*	0,586‡	0,002*	0,837§	P<0,001*

Table 1. Reliability Analysis for Assessors A, B and C

A: Assessor 1; B: Assessor 2; C: Assessor 3; k: kappa index; P-value: statistical significance; § inter-rater kappa; ‡ inter-rater kappa.

Tests carried out on both groups

Prior to the intervention, we carried the Mitchell Test[35,36], followed by the Jackson Test[37,38], the Klein Test[31,37] and a blood pressure test. Blood pressure was taken before and after the intervention using the OMRON ELITE PLUS Blood Pressure Monitor (Elite Plus, OMRON, Kyoto, Japan)[21].

Intervention

The intervention received by the experimental group was the muscle energy technique, applied to C7-T1[25,31]. The control group received a placebo technique. The examiner placed the patient in the supine position and sat at the patient's head. The examiner placed their hands lightly on the patient's shoulders for 30 seconds, producing no clinical effect.

Statistical Analysis

We carried out a descriptive analysis of the quantitative variables, calculating the mean, median, standard deviation and the 25th and 75th percentiles. We used the Kolmogorov-Smirnov test to analyse whether or not the distribution of the variables was normal. We used the chi-squared and the student's T-test to check the homogeneity of variance in the groups and to establish whether there were any significant differences between the variables. We then carried out intra-group inter-group comparisons, measuring systolic and diastolic blood pressure (pre and post-intervention) and finally a multivariate analysis to assess whether any changes in blood pressure were related to extrinsic or intrinsic factors. All tests were carried out using the statistics programme PASW Statistics 18 for Windows.

RESULTS

Descriptive statistics and normality tests

We used the normality test to check that all of the variables used in the study followed a normal distribution (table 2).

Intra-group analysis

We analysed four variables to assess whether or not the muscle energy technique applied to C7 would produce any changes in blood pressure. There were no differences in any of the four variables measured in the control group patients before and after the experimental manipulation (table 3).

When we analysed changes in blood pressure caused by applying the muscle energy technique to C7 in the patients in the experimental group, we observed a significant reduction in systolic blood pressure in the right arm after the experimental manipulation. We also observed a reduction in systolic blood pressure in the left arm, diastolic blood pressure in the left arm and diastolic blood pressure in the right arm but these variations were not statistically significant (table 4).

Inter-group analysis

No significant differences in variations in SBP or DBP were found between the subjects in the control group and the experimental group for any of the four variables (table 5).

Multivariate analysis

We used the SBP results obtained from the field study carried out on the 31 patients who received the MET on C7 (experimental group) and completed a secondary analysis, using IMPROVEMENTS IN SBP IN THE RIGHT ARM as the dependent variable, analysing whether changes in SBP in patients with arterial hypertension after receiving the muscle energy technique on C7 were linked to intrinsic factors (gender, age) and/ or extrinsic factors (BMI). We used the General Linear Model (GLM) to analyse whether any of the independent variables studied (gender, age, BMI) significantly influenced the reduction in SBP observed in the right arm. For this multivariate model, we used variation in systolic blood pressure in the right arm (IMPROVEMENTS IN SBP IN THE RIGHT ARM) as the dependent variable and we used gender, age and BMI as the independent variables (explanatory variables) (table 6).

VARIABLES	DESCRIPTIVE STATISTICS					NORMALITY TEST	
	MEAN	MEDIAN	STANDARD DEVIATION	PERCENTILE 25	PERCENTILE 75	Z	P-VALUE
AGE	64,61	64,00	10,30	56,50	71,00	0,532	0,940
WEIGHT	78,99	77,50	16,84	68,60	89,25	0,645	0,800
HEIGHT	159,79	159,00	9,30	152,50	167,00	0,722	0,675
PRE_SBP_L_ARM	140,89	143,00	19,11	127,50	152,00	0,630	0,823
POST_SBP_L_ARM	141,15	141,00	19,85	126,00	155,00	0,311	1,000
PRE_DBP_L_ARM	80,79	80,00	11,30	74,00	88,00	0,604	0,858
POST_DBP_L_ARM	81,13	81,00	12,68	72,00	89,50	0,488	0,971
PRE_SBP_R_ARM	143,15	143,00	19,07	129,00	157,00	0,495	0,967
POST_SBP_R_ARM	141,67	140,00	22,11	125,50	154,00	0,498	0,965
PRE_DBP_R_ARM	81,48	82,00	11,22	74,00	88,50	0,506	0,960
POST_DBP_R_ARM	80,41	79,00	11,73	71,50	88,00	0,591	0,876

Table 2. Descriptive statistics and Kolmogorov-Smirnov normality test used for the quantitative variables of this study: Age (years), Weight (kg), Height (cm), PRE_SBP_L_ARM (pre-intervention systolic blood pressure in the left arm; mmHg), POST_SBP_L_ARM (post-intervention systolic blood pressure in the left arm; mmHg), PRE_DBP_L_ARM (pre-intervention diastolic blood pressure in the left arm; mmHg), POST_DBP_L_ARM (post-intervention diastolic blood pressure in the left arm; mmHg), PRE_SBP_R_ARM (pre-intervention systolic blood pressure in the right arm; mmHg), POST_SBP_R_ARM (post-intervention systolic blood pressure in the right arm; mmHg), PRE_DBP_R_ARM (pre-intervention diastolic blood pressure in the right arm; mmHg), POST_DBP_R_ARM (post-intervention diastolic blood pressure in the right arm; mmHg). The sample size was 61 patients for all variables.

VARIABLES		DESCRIPTIVE STATISTICS			PAIRED T-TEST RESULTS	
		MEAN	N	STANDARD DEVIATION	T	P-VALUE
1	PRE_SBP_L_ARM	145,20	30	19,72	–1,174	0,250
	POST_SBP_L_ARM	146,87	30	21,35		
2	PRE_DBP_L_ARM	83,23	30	12,42	–0,948	0,351
	POST_DBP_L_ARM	84,30	30	12,39		
3	PRE_SBP_R_ARM	144,80	30	21,69	–0,218	0,829
	POST_SBP_R_ARM	145,60	30	26,01		
4	PRE_DBP_R_ARM	83,07	30	12,01	0,263	0,795
	POST_DBP_R_ARM	82,57	30	13,58		

Table 3. Descriptive statistics and student's T-test for paired data, analysing variation in the four variables studied in the patients in the control group. PRE_SBP_L_ARM (pre-intervention systolic blood pressure in the left arm; mmHg), POST_SBP_L_ARM (post-intervention systolic blood pressure in the left arm; mmHg), PRE_DBP_L_ARM (pre-intervention diastolic blood pressure in the left arm; mmHg), POST_DBP_L_ARM (post-intervention diastolic blood pressure in the left arm; mmHg), PRE_SBP_R_ARM (pre-intervention systolic blood pressure in the right arm; mmHg), POST_SBP_R_ARM (post-intervention systolic blood pressure in the right arm; mmHg), PRE_DBP_R_ARM (pre-intervention diastolic blood pressure in the right arm; mmHg), POST_DBP_R_ARM (post-intervention diastolic blood pressure in the right arm; mmHg).

VARIABLES		DESCRIPTIVE STATISTICS			PAIRED T-TEST RESULTS	
		MEAN	N	STANDARD DEVIATION	T	P-VALUE
1	PRE_SBP_L_ARM	136,71	31	17,84	0,625	0,537
	POST_SBP_L_ARM	135,61	31	16,83		
2	PRE_DBP_L_ARM	78,42	31	9,73	0,208	0,837
	POST_DBP_L_ARM	78,06	31	12,39		
3	PRE_SBP_R_ARM	141,55	31	16,34	2,339	0,026 *
	POST_SBP_R_ARM	137,87	31	17,14		
4	PRE_DBP_R_ARM	79,94	31	10,36	1,216	0,233
	POST_DBP_R_ARM	78,32	31	9,37		

Table 4. Descriptive statistics and student's T-test for paired data, analysing variation in the four variables studied in the patients in the experimental group. PRE_SBP_L_ARM (pre-intervention systolic blood pressure in the left arm; mmHg), POST_SBP_L_ARM (post-intervention systolic blood pressure in the left arm; mmHg), PRE_DBP_L_ARM (pre-intervention diastolic blood pressure in the left arm; mmHg), POST_DBP_L_ARM (post-intervention diastolic blood pressure in the left arm; mmHg), PRE_SBP_R_ARM (pre-intervention systolic blood pressure in the right arm; mmHg), POST_SBP_R_ARM (post-intervention systolic blood pressure in

the right arm; mmHg), PRE_DBP_R_ARM (pre-intervention diastolic blood pressure in the right arm; mmHg), POST_DBP_R_ARM (post-intervention diastolic blood pressure in the right arm; mmHg). * Significance level < 0.05

VARIABLE	GROUP	DESCRIPTIVE STATISTICS			STUDENT'S T-TEST	
		N	MEAN	STANDARD DEVIATION	T	P–VALUE
IMPROVEMENT_SBP_LEFT	Control	30	1,667	7,778	1,219	0,228
	Experimental	31	–1,097	9,772		
IMPROVEMENT_SBP_RIGHT	Control	30	1,067	6,164	0,690	0,493
	Experimental	31	–0,355	9,510		
IMPROVEMENT_DBP_LEFT	Control	30	0,800	20,106	1,134	0,261
	Experimental	31	–3,677	8,754		
IMPROVEMENT_DBP_RIGHT	Control	30	–0,500	10,418	0,483	0,631
	Experimental	31	–1,613	7,383		

Table 5. Descriptive statistics and student's T-test for independent data in the four variables used to analyse improvements in blood pressure. IMPROVEMENT_SBP_LEFT (Improvement in systolic blood pressure in the left arm; mmHg), IMPROVEMENT_DBP_LEFT (Improvement in diastolic blood pressure in the left arm; mmHg), IMPROVEMENT_SBP_RIGHT (Improvement in systolic blood pressure in the right arm; mmHg), IMPROVEMENT_DBP_RIGHT (Improvement in diastolic blood pressure in the right arm; mmHg).

In the multivariate analysis carried out, the values obtained for the variables age and BMI were close to the significance level ($p = 0.092$ and $p = 0.068$, respectively) (table 6). In a graph showing the relationship between IMPROVEMENT SBP RIGHT and age, we observed a positive relationship between the variables, indicating that the greatest reduction in systolic blood pressure occurred in younger patients (figure 1). Similarly, we also observed a positive relationship between IMPROVEMENT SBP RIGHT and BMI in a scatter plot, showing a greater reduction in blood pressure, after applying the muscle energy technique to C7, in patients with a lower BMI (figure 2). However, there was no relationship between SBP measured in the right arm and the patient's gender (table 6).

INDEPENDENT VARIABLE	TYPE III SUM OF SQUARES	F	P-VALUE
GENDER	162,646	2,766	0,108
AGE	179,407	3,051	0,092
BMI	212,961	3,621	0,068

Table 6. Factors explaining variation in the reduction of SBP in the right arm (IMPROVEMENT SBP RIGHT) (mm Hg) in patients in the experimental group (n = 31). Gender (male or female), age (years) and BMI were included in the multivariate model (GLM) as predictor variables.

DISCUSSION

The results obtained reveal that the MET is safe and non-aggressive and has few contraindications.

An intra-group analysis of the results from the experimental group revealed that SBP in the right arm decreased significantly after applying the MET. SBP also decreased in the left arm and DBP decreased in both arms in the experimental group, but not significantly. Time was taken into account as a factor when obtaining the results- they were obtained after the intra-group data had been analysed. With a larger sample population, we could probably have achieved significant results from the inter-group analysis, which would be interesting to study in future projects.

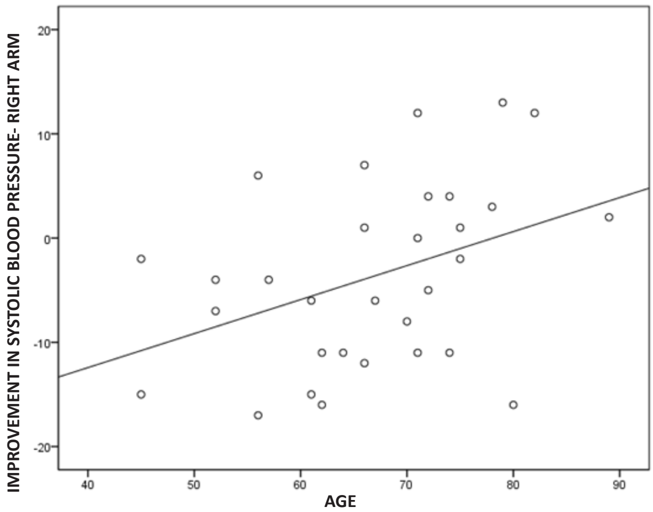


Figure 1. Scatter plot showing the relationship between the variation in systolic blood pressure (BP) measured in the right arm (IMPROVEMENT SBP RIGHT) (mm Hg) and age (years) in patients in the experimental group (n = 31). The results are plotted as a regression line.

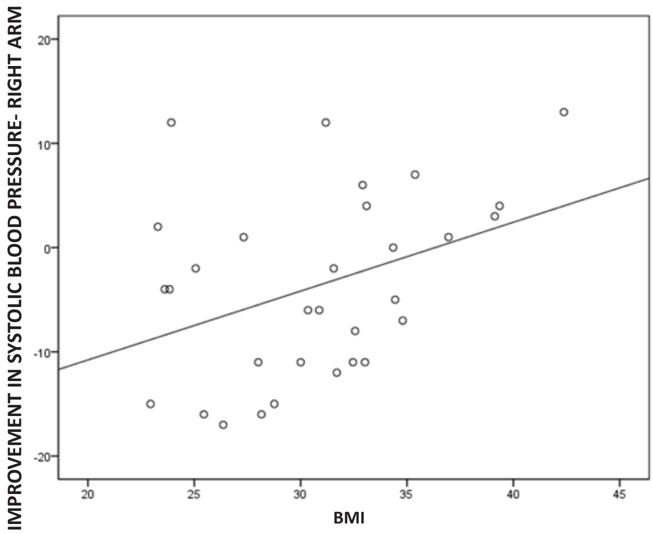


Figure 2. Scatter plot showing the relationship between the variation in systolic blood pressure (BP) measured in the right arm (IMPROVEMENT SBP RIGHT) (mm Hg) and body mass index (BMI) in patients in the experimental group (n = 31). The results are plotted as a regression line.

There were no differences in any of the 4 SBP and DBP measurements taken before the manipulation between the patients in the control group and experimental group.

We have analysed the only variable that showed significant variation, using the GLM (IMPROVEMENT_SBP_R: SPB_R after the manipulation minus SBP_R before the manipulation). P is never lower than 0.05 (table 5). We concluded that applying the MET to C7 produced a variation, reducing SBP in all of the patients, regardless of their age, gender or BMI. The significance level (p) for BMI and age obtained using the GLM for IMPROVEMENT_SBP_R was close to significance (p = 0.068 and p = 0.092, respectively). When we plotted these results in a graph, we observed that although variation (reduction) in SBP was seen in all of the patients, this reduction is more pronounced in younger patients and patients with a lower BMI. These results support other studies in which obesity is observed as being a negative factor in patients with AHT[0].

However, in the inter-group analysis, the difference in POST_SBP_L_ARM was significant (p = 0.026), the difference in POST_DBP_L_ARM was almost significant (p = 0.054) and there was a tendency towards significance in the differences in POST_SBP_R_ARM (p = 0.174) and POST_DBP_R_ARM (p = 0.160). In all of these, AHT was lower in the EG than in the CG.

This supports Luke Hamilton[40] who has pointed out that there has been very little research done on the MET and he found no research relating the MET to AHT or HR studies. There are authors who have obtained significant results, testing other osteopathic techniques, such as "Alternative Rocking of Temporal Bones" attempting to establish and validate the most efficient protocol for this treatment in decreasing blood pressure (BP) and HR, studying its effect immediately and after one month. It was observed that the examiner's subjective assessment correlated with the objectively quantifiable data of time, obtained by employing this method. The most effective treatment protocol is to apply the technique once a week, with support on the occipitalis and mastoid process. It made no difference who administered the technique, nor how much force was used. The use of this technique reduced BP and HR immediately and over 4 weeks. This technique has been shown to be useful when used alongside pharmacological treatment for arterial hypertension[41].

In this study, we are continuing the line of investigation begun by previous authors regarding arterial hypertension, such as the study done by Benito and Calvente in 200812.

They applied the pressure technique onto a projection of the aortic valve on the sternum in patients with hypertension, measuring their heart rate, finding significant changes in heart rate and SBP. On the other hand, Boscá[1] studied the danger of manipulating C7 in heart disease patients, measuring BP, HR and electrocardiographic mapping as indicators to assess the safety of the manoeuvre.

These parameters were measured in both study groups. He concluded that the technique did not produce any significant changes in HR or BP. He completed a follow-up assessment on the patients and confirmed the safety of using the technique on heart disease patients, as it produced no abnormal effects in the parameters studied.

Limitations of the study

The main limitation of this study was not applying the technique to additional cervical vertebrae, to obtain positive results, reducing blood pressure, as well as not controlling the effects of the technique in the patients over time. Another limitation that arose was the difficulty of recruiting patients for the study to allow us to work with a larger sample size, which would have produced more statistically significant results. The reductions we observed in some of the variables would probably have been significant if the sample size used had been bigger. We also cannot know how long-lasting the effects would be from extended treatment over time, as the patients were not re-assessed after different lengths of time, which could be interesting for future studies.

CONCLUSIONS

We have been able to conclude that the MET can be applied safely to the C7-T1 vertebrae in patients with hypertension, as it does not have an adverse effect on their blood pressure. After applying the MET to the C7-T1 vertebrae, we observed no significant changes in SBP or DBP in the right or left arm.

ETHICAL PRINCIPLES

This study complies with the ethical principles outlined in the Declaration of Helsinki and all subsequent amendments and was approved by the Research Ethics Committee of the Extremadura

Health Service (el Comité Ético de Experimentación del Servicio Extremeño de Salud), complying with all requirements for research on humans and animals as well as current legislation in Spain and the European Union.

ACKNOWLEDGMENTS

For all those who have collaborated in the development of this investigation.

CONFLICT OF INTEREST

Los autores declaran que no existen conflictos de intereses asociados a esta investigación.

BIBLIOGRAPHICAL REFERENCES

1. Boscá-Gandía JJ. *La manipulación de la charnela cérvico-torácica ¿es peligrosa en caso de cardiopatías?* Escuela de Osteopatía de Madrid. 2003.

2. Mabel-Garay O. *Cambios en la presión arterial y la frecuencia cardíaca tras la aplicación de la maniobra hemodinámica global en sujetos con hipertensión arterial esencial*. Osteopatía Científica. 2006; 1(3): 81-85.

3. Gómez-Castro SA. *Manipulación de las cervicales e hipertensión arterial*. Revista de fisioterapia. 2010;9(1): 7-19.

4. Caparosi R. *Le sisteme neurovegetatif et ses troubles fonctionels*. Paris; 1989.

5. Levy RL, White PD, Stroud WD, Hilmann CC. *Transient tachycardia prognostic significance alone and in association with transient hypertension*. J Am Med Assoc. 1945;129(9):585-588.

6. Korr I. *Bases psysiologiques de I´osteépathie*. (S.B.O. London); 1982.

7. González I. *Impacto de las técnicas manuales usadas en osteopatía sobre los propioceptores musculares: revisión de la literatura científica*. Osteopatía Científica. 2009; 4(2):70-75.

8. Mcknght ME, DeBoer kF. *Preliminary study of bloor pressure changes in nomotensive subjects undergoing chiropractic care*. J Manipulative Physiol Ther. 1988; 11(4):261-6.

9. Pistacchia R, Ruggieri J, Glavina B. *Comportamiento de la Presión Arterial Sanguínea en Pacientes Hipertensos y Normotensos Tratados con Praxis Vertebral.*

10. Rychlikivá F. *Vertebrokardiálni Syndrom*. Avicenum. Praga; 1975.

11. La Touche Arbizu R, Escalante Reventós K. *Efecto pos-tratamiento de la reflexología podal en la tensión arterial y la frecuencia cardíaca*. Revista de salud, discapacidad y terapéutica física. 2006;28(3):125-131.

12. Benito MCM, Calvente R. *Escuela Osteopatía de Madrid. Cambios en la presión arterial y frecuencia cardiaca después de una presión sobre la válvula aórtica en sujetos con hipertensión arterial esencial*. 2008.

13. Mansilla-Ferragud P, Boscá-Gandía JJ. *Efecto de la manipulación de la charnela occipito-atlo-axoidea en la apertura de la boca*. Osteopatía Científica. 2008;3(2):45-51.

14. Benítez-Camps M, Dalfó-Baqué A, González-Elena LJ, Almazán-Altuzarra J, Martín-Rioboo E, Pérez-Zamora S. *DISEHTAE: diagnóstico, seguimiento y control de la HTA. Visiónde su abordaje global en España*. Hipertensión y Riesgo Cardiovascular Elsevier Doyma. 2010;27(3):99-107.

15. Kaplan NM, Opie LH. *Controversies in hypertension*. Lancet. 2006;367:168-175.

16. Wolf-Maier K, Cooper RS, Banegas JR, Giampaoli S, Hense HW, Joffres M, et al. *Hypertension prevalence and blood pressure levels in 6 European countries, Canada, and the United States*. JAMA: the journal of the American Medical Association. 2003;289(18):2363-2369.

17. Banegas-Banegas JR, Rodríguez-Artalejo F, De La Cruz Troca, JJ, de Andrés Manzano B, del Rey Calero J. *Mortalidad relacionada con la hipertensión y la presión arterial en España*. Med Clin. 1999;112(13): 489-494.

18. Angeles Martinez-Lopez M, Garcia-Puig J. *Medición de la presión arterial en el domicilio*. Med Clin. 2006; 126(3):105-109.

19. Banegas J, Rodríguez Artalejo F. *El problema de la hipertensión arterial en España*. Rev Clin Esp. 2002; 202(1):12-15.

20. Tarnow L, Rossing P, Gall MA, Nielsen FS, Parving HH. *Prevalence of arterial hypertension in diabetic patients before and after the JNC-V*. Diabetes Care. 1994; 17(11):1247-1251.

21. Stergiou GS, Yiannes NG, Rarra VC. *Validation of the Omron 705 IT oscillometric device for home blood pressure measurement in children and adolescents: the Arsakion School Study*. Blood Press Monit. 2006;11(4):229-234.

22. Baker TB, Gustafson DH, Shaw B, Hawkins R, Pingree S, Roberts L, et al. *Relevance of CONSORT reporting criteria for research on eHealth interventions*. Patient Educ Couns. 2010; 81 Suppl:S77-86.

23. Moher D, Hopewell S, Schulz KF, Montori V, Gotzsche PC, Devereaux PJ, et al. *Explicación y elaboración: directrices actualizadas para la presentación de informes de grupos paralelos ensayos aleatorios*. Int J Surg. 2012; 10(1):28-55.

24. Plaugher G, Long CR, Alcantara J, Silveus AD, Wood H, Lotun K, et al. *Practice-based randomized controlled-comparison clinical trial of chiropractic adjustments and brief massage treatment at sites of subluxation in subjects with essential hypertension: pilot study*. J Manipulative Physiol Ther. 2002;25(4):221-239.

25. Gibbons PT. *Muscle energy concepts and coupled motion of the spine*. 1998(Osteopathic Medicine Program, Faculty of Human Development, Victoria University; Private Practice, Melbourne,Australia).

26. Mitchell F, Basmajian J, Nyberg R. *Rational Manual Therapies*. 1993.

27. Komajda M, Lapuerta P, Germans N, González-Juantey JR, Van Veldhuisen DJ, Erdmann E, et al. *Adherence to guidelines is a predictor of outcome in chro-*

nic heart failure: the Mahler survey. Eur Heart J. 2005; 26(16):1653-9.

28. Martín-Baranera M, Campo C, Coca A, de la Figuera M, Marín R, Miguel Ruilope L. *Estratificación y grado de control del riesgo cardiovascular en la población hipertensa española*. Resultados del estudio Dicopress. Med Clin. 2007;129(7):247-251.

29. Martín-Rioboó E, García-Criado E, Pérula-De-Torres L A, Cea-Calvo L, Anguita-Sánchez M, López-Granados A, et al. *Grupo de Hipertensión Arterial de la Sociedad Andaluza de Medicina Familiar y Comunitaria (SAMFyC) y de los investigadores del estudio Prehvia. Prevalencia de hipertrofia ventricular izquierda, fibrilación auricular y enfermedad cardiovascular en hipertensos de Andalucía*. Estudio Prehvia. Med Clin (Barc). 2009:132(7):243-250.

30. Márquez-Contreras E, Von Wichmann MF, Aguilera-de-la-Fuente MT, Garrido-García J. *Influencia de la medida correcta de la presión arterial en la toma de decisiones diagnósticas en la hipertensión arterial*. Estudio Medida. Med Clin. 2008;131(9):321-325.

31. Ricard F. *Tratamiento osteopático de las algias de origen cervical*. Madrid; 2008.

32. Cejo P, Legal L. *Efectos de las técnicas de anclaje miofascial y energía muscular en pacientes con bruxismo*. Osteopatía Científica. 2011.

33. Vanderween L, Oostendrop R, Vaes P, Duquet W. *Pressure algometry in manual therapy*. Man Ther. 1996; 1:258-265.

34. Landis JR, Koch GG. *The measurement of observer agreement for categorical data*. Biometrics. 1977;33(1): 159-174.

35. Fernández-de-las-Peñas C, Downey C, Miangolarra-Página JC. *Validez de la prueba de deslizamiento lateral como herramienta para el diagnóstico de la intervertebral disfunción de la articulación de la columna cervical inferior*. J Manipulative Physiol Ther. 2005; 28(8):610-616.

36. Rey-Eiriz G, Alburquerque-Sendin F, Barrera-Mellado I, Martin-Vallejo FJ, Fernandez-de-las-Peñas C. *Validity of the posterior-anterior middle cervical spine gliding test for the examination of intervertebral joint hypomobility in mechanical neck pain*. J Manipulative Physiol Ther. 2010;33(4):279-285.

37. Guerrero AM, Rodríguez RP. *Técnica semidirecta de thrust para una disfunción somática no neutra en ERS izquierda de la tercera vértebra cervical*. Osteopatía Científica. 2011;6(1):30-34.

38. Cortijo Sánchez CJ. *En caso de neuralgia cervicobraquial, el test de Jackson es patognomónico de patología discal. ¿Corresponde a la realidad?* Revista científica de terapia manual y osteopatía. 2002;(14):12-15.

39. Coca A. *Evolución del control de la hipertensión arterial en atención primaria en España*. Resultados del estudio Controlpres 2003 Hipertensión. 2005;22:5-14.

40. Hamilton L, Boswell C, Fryer G. *The effects of high-velocity, low-amplitude manipulation and muscle energy technique on suboccipital tenderness*. Int J Osteopath Med. 2007;10(2-3):42-49.

41. Martínez-Mateo D. *Influencia del «rodamiento alternativo de temporales» sobre la presión arterial y la frecuencia cardíaca*. Proyecto de investigación: 2013.

ISSN on line: 2173-9242

www.europeanjournalosteopathy.com
info@europeanjournalosteopathy.com

[PILOT STUDY]

VARIATION IN LUNG VOLUME IN ASTHMATIC SUBJECTS AFTER APPLYING THE THRUST TECHNIQUE IN ROTATION TO THE THORACOLUMBAR JUNCTION

David Núñez Fernández[1] (PT, DO), José Antonio Martínez Fernández[1,2] (PT, DO, PhD)

Received 24th August 2014'; accepted 2nd September 2014

Introduction: Asthma is one of the most common chronic diseases in the world; it affects 300 million people. The objective of treatment is to control the disease, reducing the number of exacerbations and improving the patient's quality of life. However, despite the known effectiveness of the medication, it does not control the disease in all patients and it can present risks and secondary effects.

Objectives: To determine whether the thrust technique in rotation applied bilaterally to the thoracolumbar junction in asthmatic subjects while seated produces variations in forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), FEV1/FVC ratio and MiniAQLQ quality of life.

Materials and Methods: We carried out a controlled, randomised clinical trial on 24 asthmatic subjects (n=24). We analysed any variation in the following spirometric variables: FVC, FEV1, FEV1/FVC ratio and MiniAQLQ quality of life. These variables were measured against the pre-intervention values at three points in time: 1 minute post-intervention, 30 minutes post-intervention and 1 week post-intervention.

Results: The results obtained show that the difference in FEV1/FVC ratio 1 minute post-intervention between the Experimental Group (EG) and the Control Group (CG) was statistically significant ($p=0.023$). However there were no statistically significant changes in any of the other variables from pre-intervention to 1 minute, 30 minutes or 1 week post-intervention. We did observe differences between the post-intervention results for both FVC and FEV1. They were higher in the EG than the CG and the difference increased as more time elapsed since the intervention.

Conclusions: There were statistically significant variations in FEV1/FVC ratio 1 minute post-intervention. There were no statistically significant variations in any of the other variables at any point in time post-intervention.

KEY WORDS

› Asthma.
› Spinal manipulation.
› Osteopathic medicine.
› Alternative medicine.

Corresponding author:
davidnunezfernandez@hotmail.com
(David Núñez Fernández)
ISSN on line: 2173-9242

www.europeanjournalosteopathy.com
info@europeanjournalosteopathy.com

[1] Clínica Salud & Pilates. Madrid. España.
[2] Professor, Departamento de Fisioterapia (Department of Physiotherapy), Universidad de Sevilla. Sevilla. España.

INTRODUCTION

Asthma affects 300 million people in the world[1-3]. It is a chronic inflammatory disease of the airways, that increases bronchial hyperresponsiveness, wheezing, dyspnoea and coughing[4], associated with variable airflow obstruction[1,3,5]. Spirometry is considered to be the best test for lung function as it is simple, accessible and reproducible[6-8].

Research justification

The objective of administering medical treatment for asthma is to control the disease, reducing the number of exacerbations and improving the patient's quality of life[9-11]. Rescue medication (short-acting β2-adrenergic agonists) and control medication for the chronic inflammation (inhaled glucocorticoids, long-acting β2-adrenergic agonists etc.)[11,12] are used but they do not control the disease in all patients and they can present risks and secondary effects[12].

Korr has shown that spinal manipulation causes impulses to fire in the afferent fibres of the muscular bundle and the small diameter afferents, silencing the facilitated gamma motor neurons, which reduces pain and increases joint mobility[13-16]. This normalisation of the somatic dysfunction interrupts the spinal facilitation responsible for the local sympathicotonia, the associated neurovascular dysfunction and the loss of physiological movement in the facet joints and joint capsules[17].

Osteopathic techniques applied to the rib cage and the thoracic spine have been shown to increase vital capacity and mobility in the rib cage, improve the functioning of the diaphragm, maximise the efficiency of the respiratory cycle and to help to clear secretions[18,19]. Treatments used in some studies include techniques aimed at restoring muscle, bone and fascial physiological mobility in the rib cage, bearing in mind its relationship with the autonomic nervous system and the viscerosomatic and somatovisceral reflexes[18,20-23]. Another important factor is the treatment of the diaphragm, given its close relationship with the pleura and the lungs, via the endothoracic fascia[24,25].

Because the crura of the diaphragm originate in the inferior surface of T1224-26 and in the anterior and lateral surfaces of the intervertebral bodies and discs of the first 3 or 4 lumbar vertebrae (right crus) and the first 2 or 3 lumbar vertebrae (left crus)27-30, the thrust technique in rotation applied to the thoracolumbar junction while the patient is seated will improve joint mobility and reduce pain, leading to the functioning of the diaphragm and the ventilation mechanics being normalised, which produces changes in lung volume.

HYPOTHESIS AND OBJECTIVES

Hypothesis

Applying the thrust technique in rotation to the thoracolumbar junction to asthmatic subjects while seated produces statistically significant changes in the following spirometric parameters: Forced Vital Capacity (FVC), forced expiratory volume in the first second (FEV_1), FEV_1/FVC ratio and MiniAQLQ quality of life.

Objectives

The proposed objectives of this study are: to quantify the potential variations in FVC after applying the thrust technique in rotation to the thoracolumbar junction to asthmatic subjects while seated; to assess the potential variations in FEV1 after applying the thrust technique in rotation to the thoracolumbar junction to asthmatic subjects while seated; to outline the potential variations in FEV1/ FVC ratio after applying the thrust technique in rotation to the thoracolumbar junction to asthmatic subjects while seated and to determine the potential variations in MiniAQLQ quality of life after applying the thrust technique in rotation to the thoracolumbar junction to asthmatic subjects while seated.

MATERIALS AND METHODS

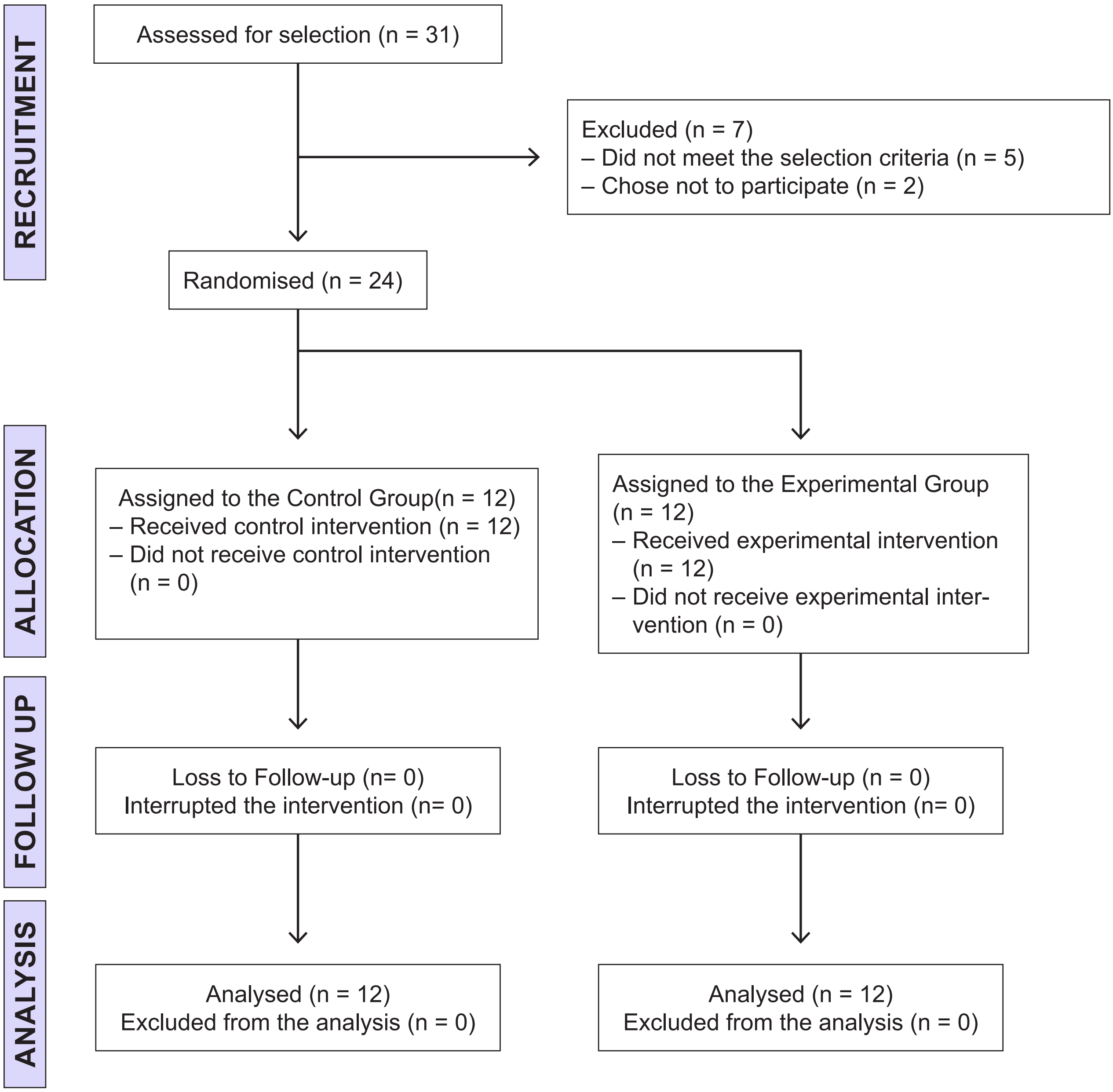
Design

We carried out a controlled, randomised, double-blinded clinical trial (both the patient and the assessor wore a blindfold) in the Clínica Salud & Pilates (Pilates and Health Centre), located on Calle Maldonado in Madrid and in the Consulta de Osteopatía Nuaferda (Nuaferda Osteopathy Centre), located on Calle Estrasburgo de Nuevo Baztán in Madrid. We requested authorisation to carry out this study from the Comité Ético de Experimentación de la Universidad de Sevilla (Research Ethics Committee of the University of Seville) and we received approval.

Study Population

There were 24 subjects (n = 24), referred from the assessor's osteopathy clinic, diagnosed by their doctor with asthma.

16 of the subjects were female (66.7%) and 8 were male (33.3%) and the subjects were distributed into two groups: an Experimental Group (EG) and a Control Group (CG). See Figure 1 for more information about the sample population.



GROUP	VARIABLES				
	SEX MALE FEMALE	AGE (YEARS)	HEIGHT (CM)	WEIGHT (KG)	BMI (KG/M²)
EG (N = 12)	M: 33,3 % (n = 4) F: 66,7 % (n = 8)	32,83 (SD = 8,19)	165,58 (SD = 10)	73,43 (SD = 18,88)	27,06 (SD = 6,04)
CG (N = 12)	M: 33,3 % (n = 4) F: 66,7 % (n = 8)	28,33 (SD = 7,3)	162,83 (SD = 7,29)	64,98 (SD = 11,87)	24,73 (SD = 4,2)

Figure 1. Flow diagram and descriptive statistics for the study sample.

Experimental Group

The EG was formed of 12 subjects (n = 12), 8 of whom were female (66.7%) and 4 of whom were male (33.3%), with an average age of 32.83 years (SD = 8.19) (SD will herein refer to *standard deviation, Stand. Dev.*), an average weight of 73.43kg (SD = 18.88), an average height of 165.58cm (SD = 10) and an average Body Mass Index (BMI) of 27.06 (SD = 6,03).

41.7% were non-smokers, 25% smoked less than 5 cigarettes per day, 8.3% smoked between 5 and 10 cigarettes per day and the remaining 25% smoked more than 10 cigarettes per day. 41.7% had a low level of physical activity, while 58.3% had a medium level of physical activity.

Control Group

The CG was formed of 12 subjects (n = 12), 8 of whom were female (66.7%) and 4 of whom were male (33.3%), with an average age of 28.33 years (SD = 7.30) an average weight of 64.98 kg (SD = 11.87), an average height of 162.83 cm (SD = 7.29) and an average BMI of 24.73 (SD = 4,19).

75% were non-smokers, while the remaining 25% smoked between 5 and 10 cigarettes per day. 50% had a low level of physical activity, 41.7% had a medium level of physical activity and 8.3% had a high level of physical activity.

Randomisation

The method of randomisation was to allocate the subjects with an even inclusion number to the EG and the subjects with an odd inclusion number to the CG.

Research Protocol

The subjects were informed about the type of study they were participating in and were given an informed consent form, which they were required to sign. The personal data required for the purposes of the study was treated with confidentiality, in accordance with the Spanish Data Protection Law 15/1999[31].

The participants were distributed into two study groups (EG or CG). Both groups underwent four spirometric tests: pre-intervention, 1 minute post-intervention, 30 minutes post-intervention and 1 week post-intervention, in order to determine how long any effects of the manipulation lasted on the patient's lung volume. The MiniAQLQ quality of life questionnaire (Annex 5) was used on two occasions: pre-intervention and 1 week post-intervention[32]. The International Physical Activity Questionnaire (IPAQ) (Annex 6) was used to calculate the patients' level of physical activity. The thrust technique in rotation was applied to the thoracolumbar junction in the EG (seated), while the CG received a placebo manoeuvre. Measurements were taken in an air conditioned room, with a stable temperature of between 18 and 25ºC.

The spirometric variables analysed for this study were: FVC- Forced Vital Capacity- which is the amount of air that can be forcibly exhaled from the lungs after a maximum inhalation, in litres; FEV_1- Forced Expiratory Volume- which is the volume of air exhaled in the first second of FVC, in litres and FEV_1/FVC, ratio, which is the total percentage of FVC exhaled in the first second.

Selection Criteria

The subjects who participated in the study all met the following inclusion criteria: diagnosed with asthma 1 year ago or more[33]; aged between 20 and 49 years, inclusive[34] and signed an informed consent form.

The exclusion criteria included: the presence of COPD[35-37], lung cancer[27], emphysema[37], pulmonary oedema[37], heart failure[37], pulmonary hypertension[37], smooth and striated muscle disorders[37], lung surgery and/ or procedures on the rib cage, the use of inhaled β2 agonists in the 24 hours preceding the study[14], changes in asthma medication in the last 6 weeks or during the study[35], admission to hospital for an acute asthma attack and/ or the use of oral corticosteroids in the last month or during the study[35], anxiety[38], depression[39], an infection of the airways in the last month[35], osteopathic treatment in the last month, osteopathic treatment for asthma in the last 5 years[40], and any potential contraindications to the manipulations used in this study: fractures and/ or dislocations, tumours, infections, inflammatory rheumatisms, congenital malformations or osteoporosis[41].

Experimental Group Intervention

The EG received a high-velocity, low-amplitude technique applied to the thoracolumbar spine, known in osteopathy as the "Thrust technique in rotation, applied to the thoracolumbar junction (seated) or the modified Fryette Technique for T12 dysfunction in ERS"[39,40] was applied to the EG. The objective of applying this technique is the increase lung volume, restoring mobility to T12, where the crura of the diaphragm originate.

Subject: Seated, with the hands in the same position as for the lift-off technique.

Assessor: One foot forwards, beside the patient.

Points of Contact: The chest makes contact with the external part of the patient's arm, above the elbow, blocking the trunk. The anterior hand is placed on the posterior surface of the shoulder, rotating the subject's trunk. The patient's elbow is raised, allowing the patient to rest their forehead on their arm. The posterior hand is placed on the T12 facet joint, using the pisiform contact and the ulnar border of the hand (figure 2).

Technique: Ask the patient to rotate their trunk as much as possible towards you then passively rotate the patient's trunk further, bringing the patient's upper arm into contact with the chest. Regulate flexion-extension of the patient's spine, down to T12 and look for the tension in the rotation. Apply the thrust by increasing the rotation of the patient's trunk, rotating your own trunk and applying a slight lateral thrust to the vertebra.

Apply the technique on both sides. In half of the subjects, apply the technique to the dominant side first and then the non-dominant side. In the other half of the subjects, apply the technique in the non-dominant side first and then the dominant side.

Control Group Intervention

The same as the EG but do not reduce the slack or apply the thrust.

Evaluation and Variables

The spirometry tests were carried out by a qualified nurse with more than 5 years of experience, using a *Spirobank USB*[41] (MIR, Rome, Italy) regularly calibrated, following the manufacturer's recommendations and the guidelines outlined by the *American Thoracic Society* (ATS), the *European Respiratory Society* (ERS) and the NIOSH Guide[6,42,43].

The spirometric variables analysed for this study were: FVC, FEV_1 and FEV_1/FVC.

Figure 2. Thrust technique in rotation applied to the thoracolumbar junction (seated). Own source.

Statistical Analysis

The software SPSS version 19.0 was used to carry out the statistical analysis. The student's T-test was used to compare the EG and CG pre-intervention results. The difference between the pre-intervention results and post-intervention results was calculated for both the EG and the CG. Once these variables had been calculated, we compared them using the Mann-Whitney U test. The analysis was carried out with a confidence interval of 95%. Results with a p-value < 0.05 were considered statistically significant, given that in biomedical research, a p-value < 0.05 is universally considered to be sufficient for statistical significance.

RESULTS

There were no significant differences between the EG and the CG in any of the variables measured at the beginning of the study ($p > 0.05$), except for tobacco consumption ($p = 0.04$), with a higher average in the EG.

The results obtained from the EG revealed an average difference in FVC of 0.02L (SD = 0.27) one minute post-intervention, 0.12L (SD = 0.47) 30 minutes post-intervention and 0.2L (SD = 0.68) 1 week post-intervention, compared with the pre-intervention results.

We observed an average difference in FEV_1 of -0.04L (SD = 0.23) 1 minute post-intervention, 0.06L (SD = 0.33) 30 minutes post-intervention and 0.15L (SD = 0.67) 1 week post-intervention. Finally, we found an average difference in FEV_1 / FVC ratio of -1.55% (SD = 2.7) 1 minute post-intervention, -0.08% (SD = 3.65) 30 minutes post-intervention and -0.55% (SD = 5.9) 1 week post-intervention.

In the CG, we found an average difference in FVC of 0.05L (SD = 0.12) one minute post-intervention, 0.09L (SD = 0.22) 30 minutes post-intervention and 0.03L (SD = 0.26) 1 week post-intervention, compared with the pre-intervention We observed an average difference in FEV_1 of -0.06L (SD = 0.11) 1 minute post-intervention, 0.01L (SD = 0.13) 30 minutes post-intervention and 0.01L (SD = 0.17) 1 week post-intervention. We found an average difference in FEV1 / FVC ratio of 0.77 % (SD = 2.4) 1 minute post-intervention, 1.1% (SD = 2.56) 30 minutes post-intervention and 0.3% (SD = 5.07) 1 week post-intervention.

In the EG, we did not observe any statistically significant differences in FVC 1 minute post-intervention (p = 0.225), 30 minutes post-intervention (p = 0.385) or 1 week post-intervention (p = 0.340), compared with the CG. There were also no statistically significant differences in FEV_1 1 minute post-intervention (p = 0.184), 30 minutes post-intervention (p = 0.193) or 1 week post-intervention (p = 0.418), compared with the CG. However, the FEV_1/ FVC ratio results revealed a statistically significant difference between the EG and the CG 1 minute post-intervention (p = 0.023), but not 30 minutes (p = 0.112) or 1 week post-intervention (p = 0.817).

There were no statistically significant differences between the EG and the CG, apart from in the FEV1/FVC ratio 1 minute post-intervention (p = 0.023). Despite this, we did observe that the post-intervention measurements taken for both FVC and FEV_1 were higher in the EG than the CG, and the difference increased as more time elapsed since the intervention (figure 3).

We also observed a strong correlation in both groups between the FEV1 and FVC variables (r > 0.85), as seen in Table 1, as there is a direct relationship between them. This correlation was statistically significant (p < 0.05).

	EG		CG	
VARIABLES	PEARSON'S CORRELATION COEFFICIENT	SIGNIFICANCE	PEARSON'S CORRELATION COEFFICIENT	SIGNIFICANCE
FEV_1/FVC PRE	0,924	0,001	0,942	0,001
FEV_1/FVC 1 MIN	0,926	0,001	0,923	0,001
FEV_1/FVC 30 MIN	0,917	0,001	0,942	0,001
FEV_1/FVC 1 WEEK	0,955	0,001	0,864	0,001

Table 1. Pearson's Correlation Coefficient for FEV_1/FVC.

We did not observe any statistically significant differences in the MiniAQLQ quality of life questionnaire pre and post-intervention, but the differences were greater in the EG than the CG, which reflects a slight positive trend in the EG.

DISCUSSION

Other authors have observed that the use of osteopathic techniques in subjects with asthma did produce changes in pulmonary function, but not statistically significant changes. Nielsen et al. found no statistically significant changes in pulmonary function or the use of bronchodilators but they did observe an unspecified improvement of 36% in bronchial responsiveness and a subjective decrease of 34% in the severity of the condition following spine manipulations for specific dysfunctions, diagnosed by the clinic[38]. Bockenhauer et al. showed that there were no significant changes in spirometry or in symptoms, although they did observe an increase in upper and lower thoracic excursion following osteopathic treatment[46].

Gibbs demonstrated over a series of cases that osteopathic manipulation of the upper thoracic spine combined with medical treatment produces objective improvements in spirometry and subjective improvements in symptoms[23].

	FVC	FEV_1	FEV_1/FVC	Mini AQLQ	Edad	Sexo	Talla	Peso	IMC	Activ. Física	Consumo Tabaco
Sig	,597	,671	,909	,197	,169	1	0,450	,203	,285	,491	,043*

*Significativa $p < 0.05$
* Significance $p < 0.05$

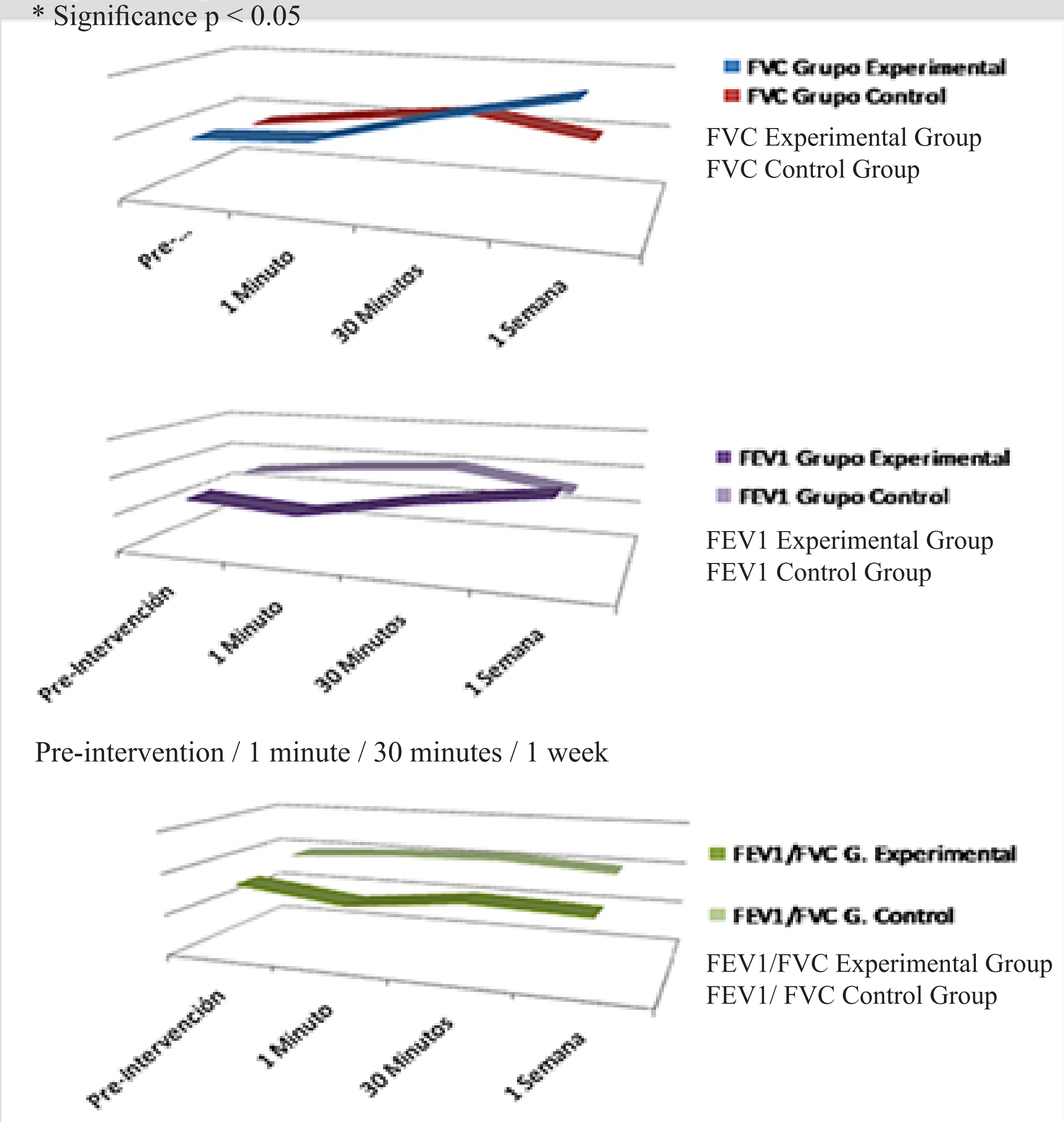


Figure 3. Comparison of the two groups pre-intervention and a frequency polygon for FVC, FEV_1 y FEV_1/FVC.

The majority of these studies included subjective results such as improved quality of life, improved breathing post-treatment, improved symptoms, a decrease in the sense of severity of the condition, a decrease in the use of bronchodilators and even reduced bronchial hyperresponsiveness.

Bronfort et al. concluded after 12 weeks of osteopathic treatment in children, that the subjects reported a substantial improvement in quality of life and reported that their asthma was less severe although there were no significant changes in pulmonary function (FEV_1, PEF and bronchial hyperresponsiveness)[22]. However, in the study carried out by Guiney et al.[18] on similar subjects, the results did reveal statistically significant changes between the experimental group and the control group.

Improvements in PEF were observed in non-smoking subjects after receiving osteopathic manual therapy on the diaphragm[47] and the pulmonary compression technique[48], while there were improvements in FVC and FEV in subjects with no defined pathology, but with irregular pulmonary functioning who received an upper cervical spine manipulation[49].

After completing the study, we found no significant changes in the spirometric variables FVC, FEV_1 and FEV_1/FVC at any of the points of assessment, except for in the FEV_1/FVC ratio 1 minute post-intervention. However we did observe that the differences were higher in the EG than the CG and the difference increased as more time elapsed since the intervention. In this study, we were analysing the potential effect of an isolated technique on lung function. Applying the technique was not part of an intervention protocol related to the pathology, which leads us to believe that the positive trend seen in the EG, compared to the CG could be greater if the technique were applied as part of a treatment protocol.

Limitations of the study

There are several possible limitations of this study, such as the sample size, which we would advise to be increased in future studies. We also recommend that in future studies, a higher number of interventions is carried out to strengthen our conclusions on the possible effect of the technique analysed. We also recommend that the technique be applied as part of a treatment protocol for this pathology in order to assess its practical application, which could improve the results obtained from this study. Furthermore, we did not take into account any specific osteopathic diagnoses for the segment of the spine that we manipulated, which could limit the potential positive effects of the technique.

CONCLUSIONS

The thrust manoeuvre in rotation applied to the thoracolumbar junction (seated) produces statistically significant changes in FEV_1/FVC ratio 1 minute post-intervention, but not in any of the other variables measured at any point in time after the intervention.However, the difference was higher in the EG than the CG, and the difference increased as more time elapsed since the intervention, which indicates a positive trend. There were no statistically significant changes in FVC, FEV_1 or MiniAQLQ quality of life, the differences in these variables were also higher in the EG than the CG, and the differences increased as more time elapsed since the intervention, which indicates a positive trend.

ACKNOWLEDGMENTS

The author would like to thank all those who have made this study possible.

CONFLICT OF INTEREST

The author hereby declares that there are no conflicts of interest associated with this study.

BIBLIOGRAPHICAL REFERENCES

1. Braman SS. *The global burden of asthma*. Chest. 2006 Jul;130(1 Suppl):4S-12S.

2. Demoly P, Gueron B, Annunziata K, Adamek L, Walters RD. *Update on asthma control in five European countries: results of a 2008 survey*. Eur Respir Rev. 2010 Jun;19(116):150-7.

3. Masoli M, Fabian D, Holt S, Beasley R. *The global burden of asthma: executive summary of the GINA Dissemination Committee report*. Allergy. 2004 May;59(5):469-78.

4. Global initiative for asthma. Global Strategy for Asthma Management and Prevention. 2009 update. Available from: www.ginasthma.org. 2009.

5. Global Strategy for Asthma Management and Prevention, Global Initiative for Asthma (GINA) 2006. Available from: http://www.ginasthma.org/.

6. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, et al. *Standardisation of spirometry*. Eur Respir J. 2005 Aug;26(2):319-38.

7. Calverley P. *Fulfilling the promise of primary care spirometry*. Eur Respir J. 2008 Jan;31(1):8-10.

8. Perez-Padilla JR, Regalado-Pineda J, Vazquez-Garcia JC. *Reproducibility of spirometry in Mexican workers and international reference values*. Salud Publica Mex. 2001 Mar-Apr;43(2):113-21.

9. British Guideline on the Management of Asthma. Thorax. 2008 May;63 Suppl 4:iv1-121.

10. Nathan RA, Sorkness CA, Kosinski M, Schatz M, Li JT, Marcus P, et al. *Development of the asthma control test: a survey for assessing asthma control*. J Allergy Clin Immunol. 2004 Jan;113(1):59-65.

11. Kupczyk M, Dahlen B, Dahlen SE. *Which anti-inflammatory drug should we use in asthma?* Pol Arch Med Wewn. 2011 Dec;121(12):455-9.

12. García Hernández G. *Glucocorticoides inhalados y agonistas β2-adrenérgicos inhalados de larga duración*. An Pediatr (Barc). 2004;Monog.2:64-8.

13. Korr IM. *Proprioceptors and somatic dysfunction*. J Am Osteopath Assoc. 1975 Mar;74(7):638-50.

14. Korr I. *Bases fisiológicas de la osteopatía*. Madrid: Mandala; 2003.

15. Pickar JG. *Neurophysiological effects of spinal manipulation*. Spine J. 2002 Sep-Oct;2(5):357-71.

16. Leach RA. *The chiropractic theories: principles and clinical applications*. 3rd ed. Baltimore: Williams & Wilkins; 1994.

17. Ricard F, Salle J. *Tratado de Osteopatía*. 3.ª ed. Panamericana; 2007.

18. Guiney PA, Chou R, Vianna A, Lovenheim J. *Effects of osteopathic manipulative treatment on pediatric patients with asthma: a randomized controlled trial*. J Am Osteopath Assoc. 2005 Jan;105(1):7-12.

19. Rowane WA, Rowane MP. *An osteopathic approach to asthma*. J Am Osteopath Assoc. 1999 May;99(5):259-64.

20. Noll DR, Johnson JC, Baer RW, Snider EJ. *The immediate effect of individual manipulation techniques on pulmonary function measures in persons with chronic obstructive pulmonary disease*. Osteopath Med Prim Care. 2009;3:9.

21. Noll DR, Degenhardt BF, Johnson JC, Burt SA. *Immediate effects of osteopathic manipulative treatment in elderly patients with chronic obstructive pulmonary disease*. J Am Osteopath Assoc. 2008 May;108(5):251-9.

22. Bronfort G, Evans RL, Kubic P, Filkin P. *Chronic pediatric asthma and chiropractic spinal manipulation: a prospective clinical series and randomized clinical pilot study*. J Manipulative Physiol Ther. 2001 Jul-Aug;24(6):369-77.

23. Gibbs. *Chiropractic co-management of medically treated asthma*. Clinical Chiropractic. 2005(8):5.

24. Ricard F. *Tratado de osteopatía visceral y medicina interna*. Buenos Aires: Editorial Medica Panamericana; 2008.

25. AOA. *Fundamentos de Medicina Osteopática*. 2.ª ed: Ed. Panamericana; 2003.

26. Busquet L. *Las cadenas musculares*. 6.ª edición ed. Barcelona: Editorial Paidotribo; 2002.

27. Lippert H. *Anatomía con Orientación clínica*. Marban; 2006.

28. Sobotta J, Putz R, Pabst RDm, Putz R. *Sobotta atlas of human anatomy*. 13th English ed. / edited by R. Putz and R. Pabst, with assistance of Renate Putz ; translated and edited by Andreas H. Weiglein.. [et al.]. ed. Philadelphia, [Pa.] ; London: Lippincott Williams & Wilkins; 2001.

29. Moore KL, Dalley AF, Agur AMR. *Clinically oriented anatomy*. 6th ed. Philadelphia: Wolters Kluwer Health/ Lippincott Williams & Wilkins; 2010.

30. Garcia Porrero J. *Anatomía Humana*. Madrid: McGraw-Hill; 2005.

31. Ley Orgánica 15/1999, de 13 de diciembre, de Protección de Datos de Carácter Personal, B.O.E num. 298.

32. Juniper EF, Buist AS, Cox FM, Ferrie PJ, King DR. *Validation of a standardized version of the Asthma Quality of Life Questionnaire*. Chest. 1999 May;115(5):1265-70.

33. Balon J, Aker PD, Crowther ER, Danielson C, Cox PG, O'Shaughnessy D, et al. *A comparison of active and simulated chiropractic manipulation as adjunctive treat-*

ment for childhood asthma. N Engl J Med. 1998 Oct 8;339(15):1013-20.

34. Baranova IA, Gadzhiev KZ, Toroptsova NV, Demin NV, Benevolenskaia LI, Chuchalin AG. *Bone mineral density and risk factors for developing osteoporosis in bronchial asthma patients*. Ter Arkh. 2003;75(3):27-32.

35. Eugene Braunwald DLC, Anthony Fauci Harrison. *Principios de Medicina Interna*. 16th ed: Mcgraw-Hill; 2005.

36. Richardson LP, Lozano P, Russo J, McCauley E, Bush T, Katon W. *Asthma symptom burden: relationship to asthma severity and anxiety and depression symptoms*. Pediatrics. 2006 Sep;118(3):1042-51.

37. Balon JW, Mior SA. *Chiropractic care in asthma and allergy*. Ann Allergy Asthma Immunol. 2004 Aug;93(2 Suppl 1):S55-60.

38. Nielsen NH, Bronfort G, Bendix T, Madsen F, Weeke B. *Chronic asthma and chiropractic spinal manipulation: a randomized clinical trial*. Clin Exp Allergy. 1995 Jan;25(1):80-8.

39. Ricard F. *Tratamiento osteopático de las álgias de origen torácico*. Buenos Aires: Editorial MédicaPanamericana; 2007.

40. EOM. Material Didáctico 2.º Nivel. : In Press 2007.

41. Degryse J, Buffels J, Van Dijck Y, Decramer M, Nemery B. *Accuracy of office spirometry performed by trained primary-care physicians using the MIR Spirobank hand-held spirometer*. Respiration. 2012;83(6):543-52.

42. Cooper BG. *Limitations to spirometry being performed in 'the office'*. Chron Respir Dis. 2005;2(2):113-5.

43. Standardization of Spirometry, 1994 Update. American Thoracic Society. Am J Respir Crit Care Med. 1995 Sep;152(3):1107-36.

44. Ruiz M. *Epidemiología Clínica*. Investigación clínica aplicada: Editorial Panamericana; 2004.

45. Hartman L. *Handbook of osteopathic technique*. Third Edition ed: Nelson Thornes; 1997.

46. Bockenhauer SE, Julliard KN, Lo KS, Huang E, Sheth AM. *Quantifiable effects of osteopathic manipulative techniques on patients with chronic asthma*. J Am Osteopath Assoc. 2002 Jul;102(7):371-5; discussion 5.

47. Oscoz Muñoa GA. *La influencia de la técnica de stretching de la parte anterior del diafragma en los valores espirométricos en fumadores 2005*.

48. Baño Alcaraz A. *Influencia de la Técnica de Compresión Pulmonar sobre los Valores Espirométricos de los Fumadores: Estudio Piloto*. Eur J Ost Clin Rel Res. 2012;7(1):39-46.

49. Kessinger. *Changes in pulmonary function associated with upper cervical specific chiropractic care*. Journal of Vertebral Subluxation Research. 1997;1(3).

ISSN on line: 2173-9242

www.europeanjournalosteopathy.com
info@europeanjournalosteopathy.com

[SYSTEMATIC REVIEW]

THE EFFECTIVENESS OF THE OSTEOPATHIC MUSCLE ENERGY TECHNIQUE IN TREATING ARTERIAL HYPERTENSION

Antonio Moro Pantoja[1] (PT, DO, PhD), Miguel Ángel Lérida Ortega[2] (PT, DO, PhD), Manuel Saavedra Hernández[3] (PT, DO, PhD), Cleofás Rodríguez Blanco[4] (PT, DO, PhD)

Received 4th July 2016'; accepted 26th July 2016

Introduction Arterial Hypertension (AHT) is a chronic disease, characterised by an increase in the normal levels of blood pressure. It has become more common in recent years across the world and is responsible for an increase in spending on health care.

Objectives: To determine whether or not there exists any evidence in the literature to support or refute the effectiveness and safety of applying different osteopathic techniques to treat arterial hypertension. Secondly to analyse the indications of applying the muscle energy technique (MET) to treat this disease. And thirdly to assess whether or not there exists any evidence in the literature related to the seriousness of AHT, based on its epidemiology and the implications it has on the cost of health care. We will also use the JADAD scale to assess the quality of the randomized clinical trials we review.

Materials and Methods: We carried out a systemic review of the Pubmed, Scopus and Teseo databases, as well as a selection of articles in biomedical journals. We applied certain selection criteria (inclusion and exclusion), followed by eligibility criteria, assessing the articles based on title, abstract, key words and the complete text.

Results: 38 articles, that met the required criteria, were selected from the 227 that were included. We scored each of the articles using the JADAD scale for methodological quality and 50% of the articles had an acceptable score.

Conclusions: The relevance of AHT as a disease is evident to see, as are the possibilities that osteopathy offers for reducing the healthcare costs that AHT brings and treating the disease using safe and effective procedures.

KEY WORDS

› Hypertension.
› Osteopathic manipulation.
› Spinal manipulation.

Corresponding author: cleofas@us.es
(Cleofás Rodríguez Blanco)
ISSN on line: 2173-9242

www.europeanjournalosteopathy.com
info@europeanjournalosteopathy.com

[1] Clínica Salux. Badajoz. España.
[2] Professor, Departamento de Ciencias de la Salud (Health Sciences Department). Universidad de Jaén. Jaén. España.
[3] Professor, Departamento de Enfermería, Fisioterapia y Medicina (Department of Nursing, Physiotherapy and Medicine). Universidad de Almería. Almería. España.
[4] Profesor, Departamento de Fisioterapia (Department of Physiotherapy). Universidad de Sevilla. Sevilla. España.

INTRODUCTION

Arterial Hypertension (AHT) is a truly relevant disease, as it is the most common chronic disease suffered around the world, affecting nearly 40% of all adults in developed countries[1]. It is also one of the main modifiable cardiovascular risk factors and presents a serious Public Health issue in Spain and the rest of the world[2-5].

The incidence rate of this disease has increased around the world. In fact, it is estimated that the prevalence of AHT will be 29% by the year 2025. In absolute terms, this would mean that the number of patients with hypertension would increase from 972 million in 2000 to 1.56 billion in 2025 across the world, which is an increase of approximately 160%[6].

In the scientific literature, there are several studies on the positive (or at least not counter-productive) effects of applying osteopathic techniques to the cervical vertebrae (C0-C7))[7,8], on patients with hypertension. This is because of the relationship that exists between this segment of the spine, in which there are three sympathetic cervical ganglia, and the innervation of the heart[8]. Because of this relationship, we know that an osteopathic dysfunction in this area can have negative repercussions on the heart and that osteopathic normalisation of the cervical spine should be the objective in order to resolve the spinal cord facilitation[9]. This term, spinal cord facilitation, was coined by Korr[10,11], who described it as being responsible for the hyperexcitability of the neurons in the autonomic nervous system and capable of altering a patient's visceral physiology.

These osteopathic treatments with remote physiological effects are featured in the literature. The studies carried out by Mansilla Ferragud are a good example of this, showing that manipulating C0-C1-C2 immediately increases the patient's range of active mouth opening[7]. Morán Benito showed that maintaining pressure on the aortic valve for 90 seconds, in patients with hypertension, homogeneously reduces their systolic blood pressure[12]. However, what we wish to analyse is whether or not any evidence has been published on the effectiveness and safety of applying osteopathic treatment to patients with arterial hypertension.

OBJECTIVES

The objectives of this review were: to determine the relevance of AHT as a disease, based on the healthcare costs it brings and the risk factor it presents for other diseases; to analyse its high prevalence in developed countries (epidemiology); to look for effective osteopathic studies on AHT with no contraindications; to determine whether there is any published evidence for the effectiveness of the muscle energy techniques (MET) in treating AHT and to analyse the quality of the RCTs used for this systemic review, using the JADAD scale.

MATERIALS AND METHODS

We carried out a systematic literature review in order to establish a possible relationship between osteopathy and AHT. This review was carried out in 2012.

Research Strategy

This research was carried out using databases and biomedical journals. We searched for the terms hypertension, osteopathic medicine, muscle energy and thrust in both English and Spanish, across all of the articles selected for the study. The terms would be found if they appeared in the title, the key words or the abstract of the article.

We also searched the PUBMED, TESEO and SCOPUS (Sciencedirect) databases, for the terms cervical manipulation, spine manipulation, osteopathic manipulative treatment, AHT and muscle energy technique either in isolation or combining them using the Boolean operators «AND», «OR» and «NOT».

Initial Search Results

We found a million articles across the three databases (Pubmed, Teseo and Scopus) by searching for the term AHT only so we had to use the Boolean operators to limit the results of the search. We found 69 articles in the Osteopatía Científica journal. Of these, we selected 3 studies containing the term AHT, 16 articles containing the term osteopathy and 9 containing the term thrust. We found 1,023 articles in the Journal of Manipulative and Physiological Therapeutics (JMPT). We selected 9 studies containing the term thrust, 12 containing the term osteopathy and 3 containing the term muscle energy. We found 583 articles in Manual Therapy. Of these, we used 5 studies containing the term thrust. We found 143 articles from the International Journal of Osteopathic Medicine (IJOM): 1 containing the term hypertension, 46 containing the term osteopathy and 7 containing the term thrust. We found 846 articles in Medicina Clínica. Of these, 52 contained the term hypertension.

Selection Strategy

In the first selection phase, we applied inclusion and exclusion criteria and in the second selection phase, we applied eligibility criteria. The articles selected in phase one (n = 227) met the following inclusion criteria: studies published in both Spanish and English, containing the terms osteopathy, manipulation, muscle energy, hypertension and/or thrust. We excluded articles published in any language other than Spanish or English, articles on a topic other than those listed in the inclusion criteria, articles unrelated to the objectives of this review, articles that included interventions carried out on animals and duplicates from another of the databases. In the second phase, we selected a total of (n = 173) articles that would be suitable for this study, excluding the remaining articles (n = 54). Finally, after reading the abstract and/or the entire text and analysing the content of each article, we selected 38 studies (n = 38). The rest (n = 135) were excluded on the grounds that they did not meet the objectives of our review (figure 1).

Assessing the scientific quality of the articles

The JADAD scale[13] was used to assess the quality of the methodology used in each of the articles selected for this review, looking at features of the article related to bias, such as randomisation, blinding and clinical testing as the JADAD scale is known and has been credited for being simple, effective and easy to use. It is used to assess whether the methods of randomisation used in a study are appropriate, whether the study is double-blinded and whether the blinding is appropriate, as well as whether the study contains a description of the loss to follow-up. The way the JADAD scale is structured can be seen in table 1.

The maximum score for the JADAD scale is 5 points and the higher the score, the better the quality of the methodology of the RCT analysed. (5/5 Excellent, 4/5 Good, 3/5 Acceptable, 2/5 Poor).

RESULTS

We began with a sample of 173 studies (n = 173), after applying the selection criteria. We then applied the eligibility criteria, excluding a further

79.19%, leaving us with a sample size of 38 studies (n = 38)-20.81%. These 38 studies were then classified by theme into three categories: The relevance of AHT as a disease, based on the healthcare costs it brings and its epidemiology; the effectiveness of the osteopathic approach to treating AHT and the effectiveness of applying the MET to treat AHT.

The relevance of AHT as a disease, based on the healthcare costs it brings and its epidemiology.

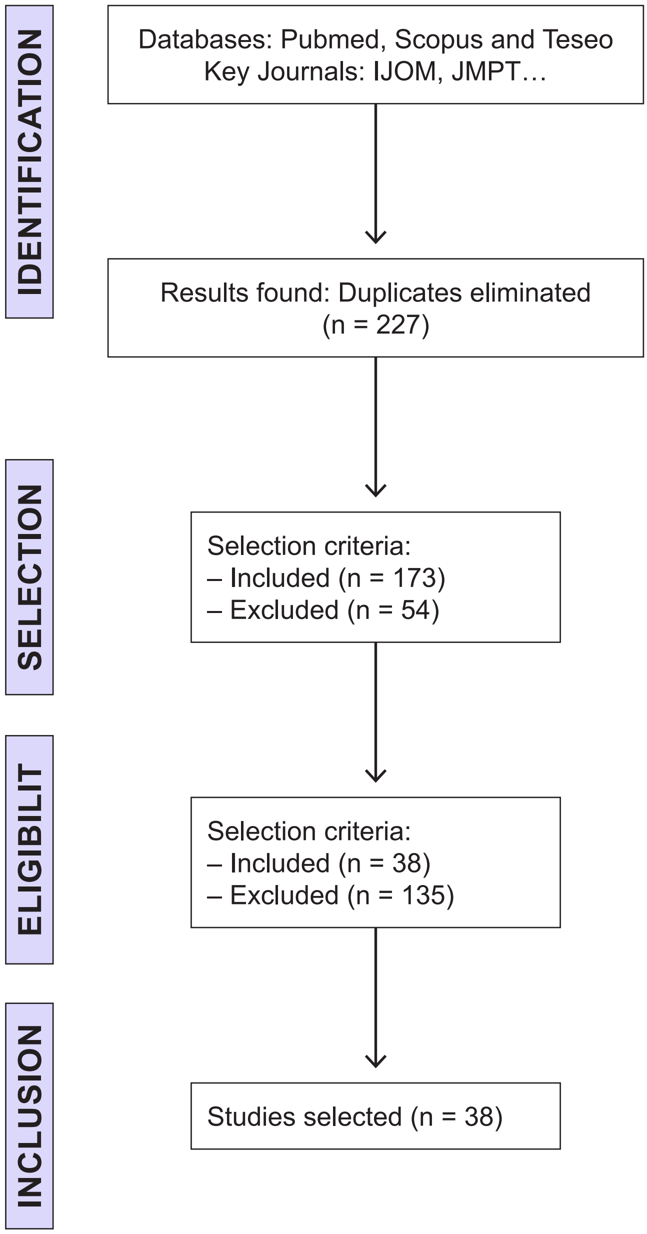


Figure 1. Flow diagram of articles, in accordance with the PRISMA statement for systemic reviews and meta-analyses, related to health care. Source: Own source.

QUESTION	YES	NO	INCORRECT
Is the study described as randomised?	1 point	0 point	
Is the method of generating a random allocation sequence described and is it correct?	1 point	0 point	−1 point
Is the study described as being double-blinded?	1 point	0 point	
Is the method of blinding described and is it correct?	1 point	0 point	−1 point
Is the loss to follow-up described?	1 point	0 point	

Table 1. JADAD scale scoring system.

AHT is one of the main risk factors for cardiovascular disease in any of its manifestations: cerebrovascular disease, coronary heart disease, heart failure, kidney failure and peripheral artery disease. Its prevalence among the adult Spanish population is 35%. This figure increases with age and reaches 68% in adults aged 60 or above. AHT is therefore a serious public health problem, especially in primary care where the majority of these patients are diagnosed and treated. These are the findings of authors such as Castiñeira and Banegas[3,14], Martín-Baranera[15], Manuel Anguita[16] and José L.Llisterri[17]. And beyond Spain, Benítez Camps[18] has stated that AHT is one of the most prevalent risk factors for cardiovascular disease in the world. Banegas and Castiñeira cite that in Spain, 35-40% of the population suffers with AHT, its high morbimortality rate and its relationship with diabetes mellitus- 80% of the population with diabetes mellitus also has AHT. Banegas affirms that in Spain as of 1990, the percentage of patients with hypertension aged between 36 and 65 years ranges from 27% (when the criteria for AHT were systolic blood pressure [SBP] ≥ 160mmHg and diastolic blood pressure [DBP] ≥ 95mmHg) to 45% (when the AHT figures were 140/90 mmHg). He agrees that AHT is a serious public health problem in Spain as it contributes to half of all deaths caused by cerebrovascular disease in the country and to a significant percentage of all the deaths caused by coronary diseases, heart failure, kidney failure etc.

The healthcare costs of AHT in 1994 were 1.2 billion EUR[3]. In another study, Banegas's results revealed that 42% of deaths caused by coronary disease, 46.4% of deaths caused by cerebrovascular disease and 25.5% of the total number of deaths were related to AHT (> = 140/90 mmHg), and patients mostly relapsed in stages 1 and 2. Following those, 8.3% of deaths caused by coronary disease, 10.2% of deaths caused by cerebrovascular disease and 6.2% of the total number of deaths were related to normal-high and normal blood pressure. There were 17,266 deaths in total and 4,502 deaths per year caused by cardiovascular diseases related to AHT and three quarters occurred in men. Of these, 65.5% were caused by coronary diseases and 34.5% were caused by cerebrovascular diseases. Coronary diseases dominated in both sexes. Eight out of ten of the total number of deaths and the deaths caused by cardiovascular disease related to blood pressure occurred in patients who relapsed in AHT and two out of ten relapsed in normal-high or normal blood pressure. Banegas therefore concludes that one in three of the total number of deaths and one in two of deaths caused by cardiovascular diseases were related to blood pressure (BP). A quarter of all deaths and one in every 2.5 deaths caused by cardiovascular disease were related to AHT and a large proportion of those occurred in patients who relapsed in stages 1 and 2 and in normal-high and normal blood pressure[19]. Banegas and Jovell[20] looked beyond Spain and found that in the rest of the developed world, AHT affects 40% of adults, and is one of the main causes of death and disability in the world, due to the cardiovascular, renal and neurological complications it can cause. They also cite the epidemiology of AHT in Spain, and their findings were ratified by Wolf-Maierk and Llisterri[17,21]. They describe the increased prevalence of AHT, which continues to grow around the world, becoming a global pandemic. Some experts have predicted that in 2025, the prevalence of AHT will have increased by 24% in developed countries and up to 80% in developing countries[6].

Gorostidi and Marín[22] have studied the relationship between AHT and chronic kidney disease and concluded that controlling BP and levels of proteinuria can slow the development of the disease. Sicras-Mainar[23] also studied the increased healthcare costs of patients with hypertension, mostly in the area of pharmacy. The total cost increases with age and overall morbidity. AHT should be considered alongside other cardiovascular risk factors. Costs incurred as a result of patients' inability to work were low. In accordance with the *Sociedades Españolas de Cardiología* (Spanish Societies of Cardiology), the European Society of Cardiology and Hypertension, the 2003 WHO/ ISH and the British and Canadian guidelines, Coca recommends reducing BP, as it is directly associated with cardiovascular risk factors. Coca also recommends controlling AHT using non-pharmacological methods such as giving up smoking, losing weight, doing physical exercise and reducing salt intake. Only 30.1% of the patients studies employed these methods. Similarly, Grilo[24] states that AHT is a serious public health problem that affects 10 million people in Spain and that the etiology of AHT is essential in 90-95% of cases while there is also a hereditary factor. There are other hereditary vascular risk factors associated with essential hypertension as well, such as metabolic syndrome. The risk of suffering a stroke or developing a coronaropathy is tripled in patients with metabolic syndrome and deaths caused by cardiovascular disease are 12% more common than in patients without metabolic syndrome.

Lozano[25] shares the data he has gathered indicating that strokes are a cardiovascular risk factor for hypertension and one of the main causes of death in Spain. Cosín Aguilar[26] found that excess weight increases the cardiovascular risk factor in patients with hypertension by around 20% and increases the association between hypertension and diabetes and congestive heart failure. Stiefel[27] arrived at the same conclusion, observing a higher incidence of glucidic anomalies in association with AHT and therefore emphasising the importance of carrying out an oral glucose tolerance test (OGTT) to stop vascular deterioration in patients with AHT and type 2 MD diabetes mellitus and to slow down diabetes mellitus in patients with oral glucose intolerance.

Fernández Villaverde[28] states that left ventricular hypertrophy is a compensatory response to increased BP or volume overload and is the first stage in the development of a clinical disease such as heart failure, coronaropathy, arrhythmia or a stroke. The effects of left ventricular hypertrophy have been widely studied, both in the general population and in patients with cardiopathies and is the most common cardiac anomaly to occur with AHT. Patients with hypertrophy present with a higher cardiovascular risk factor and higher mortality rates, particularly caused by ventricular arrhythmia or sudden death.

The effectiveness of the osteopathic approach to treating AHT

In terms of the effectiveness of the osteopathic approach to treating AHT, Stiefel[27] states that blind, controlled studies are needed to assess whether osteopathy alone or osteopathy with conventional pharmacological treatment helps to improve AHT. In response to Stiefel, many authors have carried out studies to demonstrate the effectiveness of osteopathic treatment for AHT and the remote effects that spine manipulation can have[29,30] Cerritelli[30] for example studied patients affected by cardiovascular disease who had received osteopathic treatment and found that the treatment they received was strongly associated with the improvements in intima–media thickness and systolic blood pressure observed after one year. Santiago Alexander[29], in his literature review, describes studies that show how upper cervical spine manipulations can affect the mechanisms that regulate the responses of the system controlling blood pressure. He identified a lack of joint stability in the cervical spine and the resulting sympathetic hyperactivity as a common sign in patients with AHT that can affect BP and AHT. Other studies, such as the one carried out by Pilar Mansilla[7] reaffirm these findings after observing a significant improvement in mouth opening after manipulating joint instability in the craniocervical junction. I. Korr's10 concept of spinal cord facilitation is once again demonstrated.

An article published in the Journal of Human Hypertension in 2007, describes a double-blinded, controlled study with a placebo carried out on a sample of 50 patients with moderate or grade 1 AHT, where systolic and diastolic blood pressure were reduced (–17mmHg and –12mmHg respectively) and remained at that level for 8 weeks[31]. Similarly, Yates et al carried out a study in which they manipulated 21 patients and found that both systolic and diastolic BP dropped significantly in the treatment group, while there were no significant changes in the placebo group[32]. The same reduction was observed by Mcknight et al after applying a manipulative treatment to the cervical spine in 75 subjects with normotension[33]. In her study, Morán Benito[12] showed that applying 6mm pressure onto the projection of the aortic valve for 90 seconds produced a homogeneous reduction in the following parameters: systolic BP, diastolic BP and HR. Boscá[8] concluded that there are no contraindications for manipulating the craniocervical junction in patients with cardiopathies.

The effectiveness of the MET in treating AHT

Burns DK[34] stated that the MET improved range of motion in the cervical spine in asymptomatic patients. Wilson[35] showed that the MET with supervised motor control and resistance exercises is more effective than neuromuscular rehabilitation and resistance training for improving functioning for patients with acute low back pain. Smith[36] concluded in her study that altering the duration of the passive stretch component does not have a significant impact on the efficacy of MET for short-term increases in muscle extensibility. Selkow reaffirms Smith's results, saying that the studies that have been carried out on the effectiveness of the MET in the long term are limited but the MET does reduce lumbopelvic pain 24 hours after application, measured using a visual analogue scale[37].

Ballantyne[38] defends the effectiveness of the MET compared to ballistic stretching, explaining that increased flexibility was a result of an increased tolerance to stretch and is not caused by visco-elastic changes. She also affirms that there is limited research validating the use of the MET, despite how widely it is used in the world of osteopathy. In the light of Ballantyne's conclusions and the conclusions of previous authors, Gary Fryer and Luke Hamilton agree on the controversies taking place at the time when the muscle energy technique was developed, the lack of research validating its use and the importance of continuing to research the technique[39,40]. Gabriela M. Hunt[41] after comparing the effectiveness of the MET and the thrust technique applied to the piriformis muscle, found that the former is more effective at increasing extensibility and reducing pain.

DISCUSSION

Of the randomised clinical trials (RCTs) studied, 50% scored less than 3 on the JADAD scale, indicating a weak methodology. Although they were randomised, we cannot verify their findings as they do not describe the method used to generate and safeguard their randomised sequences. They also fail to describe specific aspects of the methodology used, such the methods of blinding or loss to follow-up. However, the other 50% scored 3 on the JADAD scale (acceptable). Some described the generation of the randomised sequence used, others described the method of blinding in detail but none described the loss to follow-up.

The importance of controlling AHT is evident, given its growing epidemiology in developed countries, as well as the rise in spending on controlling and treating the disease[3,6]. It is alarming that the prevalence of AHT in people aged 60 and above is 69% as it is one of the main cardiovascular risk factors, contributing to the origins of diseases such as heart failure, ischemic cardiomyopathy, kidney failure etc. This produces worryingly high levels of morbimortality, to the extent that AHT is responsible for half of all deaths caused by cardiovascular disease in the Spanish population. It is considered to be a global pandemic as it is one of the main causes of death and disability due to the cardiovascular, renal and neurological complications it causes. And worse still, it has been predicted that the prevalence of AHT will continue to grow throughout the world, increasing by 24% in developed countries and up to 80% in developing countries by 2025[1,4,6]. Therefore further osteopathic studies are recommended to demonstrate the safety and effectiveness of AHT treatments.

Cerritelli's[30] study analysing patients with cardiovascular disease who received osteopathic treatment is worth mentioning. He carried out a follow-up with the patients after one year. It is very difficult to carry out a long-term study like this, with loss to follow-up being the reason why many RCTs are unsuccessful. Cerritelli's results reveal a significant association between osteopathic treatment and improvements in AHT. Studies like this are rare in the world of osteopathy. Other authors like Bakris[31] have also demonstrated the effectiveness and safety of certain osteopathic techniques, reducing both systolic BP and diastolic BP in patients with moderate AHT. Using a different osteopathic technique, Benito[12] achieved similar results to Bakris[31] reducing BP in her patients but also reducing HR. However, neither Bakris nor Benito's[12,31] studies were as long term as Cerriteli's[30].

It is clear that we need to continue to pursue the osteopathic approach to treating AHT to help to reduce morbimortality rates in Spain and the rest of the world, to reduce healthcare costs and to support other healthcare professionals seeking to control the disease.

We did not find any studies that demonstrated a positive relationship between the MET and AHT. It would be worth studying the relationship further as the technique is safe and could be used to treat patients when there are contraindications to spine manipulation (thrust techniques)[42].

Studies are being carried out, analysing the results of using different osteopathic techniques to treat AHT. We would recommend studying the effects of applying several of these techniques at the same time to see if treating multiple segments of the spine simultaneously produces further positive results. However, it is worth pointing out that osteopathy has been growing as a science in recent years, thanks to the large number of studies that have been carried out, demonstrating the safety and effectiveness of using osteopathic techniques to treat serious conditions such as AHT, which have a growing epidemiology, bring higher healthcare costs and have a severe effect on morbimortality rates.

Limitations of the study

The articles we have analysed have all been in Spanish or English. We have not analysed articles in other languages such as French, Italian, German, Chinese, Russian etc. Furthermore we did not search for articles in all of the databases, just in some of them.

CONCLUSSIONS

The majority of publications on arterial hypertension mention the healthcare costs it can bring and the fact that it is one of the main cardiovascular risk factors. It is very prevalent in Spanish society, where around 35% of the population has hypertension, a figure which rises to 68% in the population aged 60 and above. Globally, the epidemiology statistics suggest that AHT is pandemic. 50% of the RCTs studied were of an acceptable quality (3), using the JADAD scale.

Different osteopathic techniques can have a positive effect on systolic and diastolic BP, HR and the mobility of various joints and segments of the spine. MET has a positive effect on muscle extensibility and has been shown to reduce pain and normalise spine dysfunctions but there is a great deal of controversy surrounding the development of the technique and its use has not been widely validated.

ACKNOWLEDGMENTS

For all those who have collaborated in the development of this investigation.

CONFLICT OF INTEREST

The authors hereby declare that there are no conflicts of interest associated with this study.

BIBLIOGRAPHICAL REFERENCES

1. Banegas Banegas JR. *Epidemiología de la hipertensión arterial en España*. Situación actual y perspectivas. Hipertensión. 2005;22(9):353-62.

2. Angeles Martinez-Lopez M, Garcia-Puig J. *Medición de la presión arterial en el domicilio*. Medicina clínica 2006;126(3):105-109.

3. Banegas J, Rodríguez Artalejo F. *El problema de la hipertensión arterial en España*. Rev Clin Esp 2002; 202(1):12-15.

4. Coca A. *Evolución del control de la hipertensión arterial en atención primariaen España*. Resultados del estudio Controlpres 2003 Hipertensión 2005:22: 5-14.

5. Coca A, Aranda P, Redón J. *Manejo del paciente hipertenso en la práctica clínica*. 2009:4-52,53.

6. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. *Global burden of hypertension: analysis of worldwide data*. The Lancet. 2005; 365(9455):217-223.

7. Mansilla Ferragud P, Boscá Gandía JJ. *Efecto de la manipulación de la charnela occipito-atlo-axoidea en la apertura de la boca*. Osteopatía Científica Elsevier. 2008;3(2):45-51.

8. Boscá Gandía JJ. *La manipulación de la charnela cérvico-torácica ¿es peligrosa en caso de cardiopatías?* Escuela de Osteopatía de Madrid; 2003.

9. Navarro X. *Fisiología del sistema nervioso autónomo*. Rev Neurol. 2002 Sept. 16-30;35(6):553-562.

10. Korr I. *Bases psysiologiques de l'osteépathie*. 1982 (S.B.O. London).

11. Korr IM. *Proprioceptors and somatic dysfunction*. J Am Osteopath Assoc. 1975 Mar;74(7):638-650.

12. Benito MM, Marín RC. *Cambios en la presión arterial y frecuencia cardíaca después de una presión sobre la válvula aórtica en sujetos con hipertensión arterial esencial*. Osteopatía Científica. 2008;3(3):100-107.

13. Jadad AR, Moore RA, Carroll D, Jenkinson C, Reynolds DJM, Gavaghan DJ, et al. *Assessing the quality*

of reports of randomized clinical trials: is blinding necessary? Control Clin Trials. 1996;17(1):1-12.

14. Castiñeira M, González C, Ríos M, Moliner J, Crespo J, Domínguez M. *¿Sabemos tomar correctamente la presión arterial?* Hipertensión y Riesgo Vascular. 2009;26(1):7-13.

15. Martín-Baranera M, Campo C, Coca A, de la Figuera M, Marín R, Miguel Ruilope L. *Estratificación y grado de control del riesgo cardiovascular en la población hipertensa española*. Resultados del estudio DICOPRESS. Med Clin. 2007;129(7):247-251.

16. Anguita M, Toledano F, León C, Castillo JC. *Hipertensión arterial, cardiopatía hipertensiva e insuficiencia cardíaca. Papel de los diuréticos de asa*. Med Clín. 2008;131(17):660-664.

17. Llisterri Caro JL, Rodríguez Roca GC, Alonso Moreno FJ, Banegas Banegas JR, González-Segura Alsina D, Lou Arnal S, et al. *Control de la presión arterial en la población hipertensa española atendida en atención primaria*. Estudio PRESCAP. 2006. Med Clin 2008;130(18):681-687.

18. Benítez Camps M, Dalfó Baqué A, González Elena LJ, Almazán Altuzarra J, Martín Rioboo E, y Pérez Zamora S. *DISEHTAE: diagnóstico, seguimiento y control de la HTA. Visiónde su abordaje global en España. Hipertensión y Riesgo Cardiovascular*. Elsevier Doyma. 2010;27(3):99-107.

19. Banegas Banegas JR, Rodríguez-Artalejo F, De La Cruz Troca JJ, de Andrés Manzano B, del Rey Calero J. *Mortalidad relacionada con la hipertensión y la presión arterial en España*. Med Clin. 1999;112(13):489-494.

20. Banegas JR, Jovell A, Abarca B, Aguilar Diosdado M, Aguilera L, Aranda P, et al. *Hipertension arterial y política de salud en España*. Med Clin. 2009;132(6):222-229.

21. Wolf-Maier K, Cooper RS, Banegas JR, Giampaoli S, Hense HW, Joffres M, et al. *Hypertension prevalence and blood pressure levels in 6 European countries, Canada, and the United States*. JAMA: the journal of the American Medical Association. 2003;289(18):2363-2369.

22. Gorostidi M, Marín R. *Tratamiento de la hipertensión arterial en enfermos con insuficiencia renal. Estadios 2 y 3 de la enfermedad renal crónica*. Hipertensión. 2002;19(3):1-74.

23. Sicras-Mainar A, Navarro-Artieda R. *Coste de la hipertensión arterial según grados de morbilidad en atención primaria*. Med Clin. 2009;133(8):290-295.

24. Grilo Reina A, Pérez Benito M, Ferreiro Madueño M, Prieto Jirón J, Moreno Torres F, Espino Montoro A. *Cribado de hipertensión arterial en hijos de pacientes diagnosticados de hipertensión arterial y síndrome metabólico*. Med Clin. 2008;130(11):410-412.

25. Lozano JV, Redón J, Cea-Calvo L, Fernández-Pérez C, Navarro J, Bonet Á, et al. *Evaluación del riesgo de un primer ictus en la población hipertensa española en atención primaria. Estudio ERIC-HTA*. Med Clin. 2005; 125(7):247-251.

26. Cosín Aguilar J, Rodríguez Padial L, Hernándiz Martínez A, Arístegui Urrestarazu R, Masramón Morell X, Armada Peláez B, et al. *Riesgo cardiovascular en diabetes mellitus e hipertensión arterial en España. Estudio CORONARIA*. Med Clin. 2006;127(4):126-132.

27. Stiefel P, Miranda ML, Muñiz O, Nieto MD, Jiménez L, Villar J. *ORIGINAL BREVE Alteraciones del metabolismo glucídico en la hipertensión arterial esencial. Papel de la sobrecarga oral con glucosa*. Med Clin. 2005;125(5):179-181.

28. Fernández Villaverde JM, Maestro Saavedra FJ, Allut Vidal G, Grigorian Shamagian L, Otero-Raviña F, González-Juanatey JR. *Elevada prevalencia de hipertrofia ventricular izquierda en pacientes con hipertensión arterial de larga evolución*. Med Clin. 2007;129(2):46-50.

29. Castro SAG. *Resumen de manipulación de las cervicales e hipertensión arterial*.

30. Cerritelli F, Carinci F, Pizzolorusso T, Turi P, Renzetti C, Pizzolorusso F, et al. *La manipulación osteopática como un tratamiento complementario para la prevención de complicaciones cardíacas: 12-meses de seguimiento de la íntima media y la presión arterial en una cohorte afectada por la hipertensión*. J Bodyw Mov Ther. 2011 Jan;15(1):68-74.

31. Bakris G, Dickholtz MS, Meyer PM, G K, Avery E, M M, et al. *Reordenación vértebra Atlas y el logro de la*

meta de presión arterial en pacientes hipertensos: un estudio piloto. J Hypertens Hum. 2007;21(5):347-352.

32. RG Y, Lamping DL, Abram NL, Wright C. *Efectos del tratamiento quiropráctico en la presión arterial y la ansiedad: un estudio aleatorizado, ensayo controlado*. J Manipulative Physiolg Ther. 1988 diciembre;11(6):484-488.

33. Mcknght ME, DeBoer KF. *Preliminary study of bloor pressure changes in nomotensive subjects undergoing chiropractic care.* J Manipulative Psysiol Ther. 1988;11(4):261-6.

34. Burns DK, Wells MR. *Rango de movimiento bruto en la columna cervical: los efectos del músculo osteopática La técnica de energía en sujetos asintomáticos*. J Am Osteopath Assoc. 2006 Mar;106(3):137-142.

35. Wilson E, Payton O, Donegan-Shoaf L, Dec K. *Muscle energy technique in patients with acute low back pain: a pilot clinical trial.* J Orthop Sports Phys Ther. 2003 Sep;33(9):502-512.

36. Smith M, Fryer G. *A comparison of two muscle energy techniques for increasing flexibility of the hamstring muscle group*. J Bodywork Mov Ther. 2008;12(4):312-317.

37. Zuil Escobar J, García del Pozo M, González Propin M. *Modificaciones del umbral de dolor en un punto gatillo miofascial tras técnica de energía muscular*. Revista de la Sociedad Española del Dolor. 2010;17(7):313-319.

38. Ballantyne F, Fryer G, McLaughlin P. *The effect of muscle energy technique on hamstring extensibility: the mechanism of altered flexibility.* Int J Osteopath Med. 2003;6(2):59-63.

39. Fryer G. *Muscle energy technique: An evidence-informed approach*. Int J Osteopath Med. 2011.

40. Hamilton L, Boswell C, Fryer G. *The effects of high-velocity, low-amplitude manipulation and muscle energy technique on suboccipital tenderness*. Int J Osteopath Med. 2007;10(2-3):42-49.

41. Hunt GM, Legal L. *Estudio comparativo sobre la eficacia de las técnicas de thrust y energía muscular en el músculo piriforme*. Osteopatía Científica. 2010;5(2):47-55.

42. Dandamudi VS, Thaler DE, Malek AM. *Cerebral embolus following chiropractic manipulation in a patient with a calcified carotid artery*. J Neuroimaging. 2013;23(3):429-30.

ISSN on line: 2173-9242

www.europeanjournalosteopathy.com
info@europeanjournalosteopathy.com

[REVIEW]

MYOFASCIAL TRIGGER POINTS: FROM THEORY TO PRACTICE

Miguel Ângelo Ferreira Faria[1] (PT, DO), Francisco Bautista Aguirre[2,3] (PT, DO, PhD)

Received 24th July 2015'; accepted 12th August 2015

Introduction: Travell defines the myofascial trigger point (MTrP) as a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. The spot is painful on compression and can give rise to characteristic referred pain, referred tenderness, motor dysfunction and autonomic phenomena.

Objective: To assess the role that MTrPs can play in osteopathy as potential sources of pain, to describe their clinical characteristics in order to correctly diagnose them and to underline the importance of treating them within an osteopathic treatment protocol.

Materials and Methods: We carried out a literary review, followed by a discussion of the topic.

Results: MTrPs, despite having a high prevalence, are often forgotten or poorly treated due to the fact that the early training given to medical professionals rarely includes sufficient information to identify and treat MTrPs. There is good inter-rater concordance in detecting the presence or absence of either latent or active MTrPs. This makes diagnosis more reliable. The literature shows that the reliability of the identification of the clinical characteristics of MTrPs depends on the specific characteristic and muscle being studied. Clinical experience is essential for obtaining good results.

Conclusions: As MTrPs are potential sources of pain and noxious afferents, osteopaths should be able to correctly diagnose and deactivate them as soon as possible to avoid the central sensitisation of the nervous system. It is essential that osteopaths are trained to correctly identify MTrPs. A taut band (TB) and local sensitivity are the most reliable clinical signs for diagnosing MTrPs. The biggest obstacle preventing reliable diagnosis of MTrPs is the general lack of consensus surrounding the best diagnosis criteria to use.

KEY WORDS

› Trigger points.
› Diagnosis.
› Referred pain.

Corresponding author:
miguelosteopata@hotmail.com
(Miguel Ângelo Ferreira Faria)
ISSN on line: 2173-9242

www.europeanjournalosteopathy.com
info@europeanjournalosteopathy.com

1 Private practitioner.
2 Clínica de Osteopatía Paco Bautista
3 Universidad Europea de Madrid. Valencia. España.

INTRODUCTION

Travell defines the myofascial trigger point (MTrP) as a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. The spot is painful on compression and can give rise to characteristic referred pain, referred tenderness, motor dysfunction and autonomic phenomena[1]. MTrPs are incredibly common[2]. In a study on the prevalence of MTrPs, it was found that all subjects with unilateral, chronic, non-traumatic pain in the shoulder presented with multiple MTrPs in the shoulder muscles.

MTrPs, despite having a high prevalence, are often forgotten or poorly treated due to the fact that the early training given to medical professionals rarely includes sufficient information to identify and treat them[2].

OBJECTIVES OF THE REVIEW

To assess the role that MTrPs can play in osteopathy as potential sources of pain, to describe their clinical characteristics in order to correctly diagnose them and to study the treatment of MTrPs within an osteopathic treatment protocol.

MATERIAL AND METHODS

Research Strategy

A literature search was carried out between July 2013 and January 2015. The following terms were used for the search: trigger point (MeSH 2012), diagnosis (MeSH 1966), reliability (word anywhere in text). The following databases were consulted: Medline, PubMed and Cochrane, as well as the Google search engine. A manual search was also carried out in the full text articles, to identify additional relevant studies. Any texts containing information that was deemed relevant were included.

Selection criteria

The inclusion criteria for the literature review consisted of articles that contained the following terms: Trigger Points, Diagnosis (included in MeSH), written in Spanish, English or Portuguese. Any articles that that were not related to either the topic or the objectives of this review were excluded as well as any not carried out on human beings.

RESULTS

Etiology

There have been several proposals as to the histopathological mechanisms involved in the development of MTrPs and their pain patterns, but the scientific evidence is insufficient. Many researchers agree that acute trauma or repeat microtraumas could lead to the development of MTrPs. Lack of exercise, prolonged poor posture, vitamin deficiencies, irregular sleep patterns and joint problems combined can lead to the development of a microtrauma[4].

The electromyographical study carried out by Hubbard revealed the existence of spontaneous electrical activity in MTrPs, while the non-sensitive muscle tissue (with no MTrPs) in the same muscle was electrically silent. The author realised that MTrPs are produced by intrafusal fibres contracted by sympathetic activation[5]. These interesting discoveries led Travell and Simons to point to dysfunctional motor end plates as being the underlying cause of MTrPs. The terms "motor end plates" and neuromuscular junction" are interchangable, although the former describes the structure, and the latter reflects the function. Both terms refer to the point where α-motor neurons contact their target muscle fibres[6]. Acute or chronic muscle strain triggers the excessive release of acetylcholine, which creates a local energy crisis, which appears to explain the clinical characteristics of MTrPs[2].

Diagnosis

Distinction between active and latent MTrPs

MTrPs are divided into active MTrPs (AMTrPs) and latent MTrPs (LMTrPs). Active TrPs produce a clinical complaint (usually pain) that the patient recognises when the TrP is digitally compressed[1,7] Compression should be maintained for 10-15 seconds, until you are able to identify whether there is any referred pain[8]. Although latent TrPs can produce the other effects characteristic of a TrP such as increased muscle tension and muscle shortening, they do not produce spontaneous pain, as in the case of AMTrPs. Both AMTrPs and LMTrPs can cause significant motor dysfunction[1].

Patients with active myofascial TrPs usually complain of poorly localised, regional, aching pain in subcutaneous tissues, including muscles and joints. They rarely complain of sharp, clearly-localised cutaneous-type pain. Application of digital pressure on a MTrP can elicit a referred pain pattern characteristic of that muscle. However, if the patient "recognises" the elicited sensation as a familiar experience, this establishes the TrP as being active and is one of the most important diagnostic criteria available when the palpable findings are also present. The myofascial pain is often referred to a distance from the TrP in a pattern that is characteristic for each muscle. Sometimes, the patient is aware of numbness or paresthesia rather than pain[1,7].

Shah et al found significantly higher concentrations of hydrogen ions [H+] (indicative of a more acidic pH level), bradykinin, neuropeptides (Substance P and calcitonin gene-related peptides), cytosine (tumour necrosis factor-α, interleukin-1β) and neurotransmitters (serotonin or 5-HT and norepinephrine in active MTrPs than latent MTrPs, which appears to justify the elevated hyperalgesia observed in active MTrPs[9]. In another study, the same author verified that subjects with active MTrPs in the upper trapezius muscle also presented with higher levels of these biochemical substances in a remote, unaffected muscle, which suggests that these conditions are not limited to local areas of active MTrPs[10].

As muscle stress decreases, TrPs can decrease in number and can diminish in activity. On the other hand, as the level of stress or activity increases, taut bands increase in number and "irritability," and become tender to palpation, or spontaneously painful with activity. A very active TrP will be painful at rest. Thus, the boundary between latent and active TrPs is actually very fluid and dynamic, and TrPs will increase and decrease the amount of pain they produce, depending on the demands placed on the muscle and its ability to meet those demands. The identification of all of the active MTrPs is mandatory, because if only one of them is overlooked the persistence of a certain amount of pain is inevitable. It is therefore necessary to locate MTrPs not only in the primarily affected muscles, but also in their synergists and antagonists (secondary MTrPs). Guidance as to where to look for these MTrPs may be obtained from carefully noting the distribution of pain and by observing which movements are restricted as a result of it[8].

Clinical characteristics of MTrPs

Sensory aspects may include local tenderness, referral of pain to a distant site, and peripheral and central sensitization. Peripheral sensitization can be described as a reduction in threshold and an increase in responsiveness of the peripheral ends of nociceptors, while central sensitization is an increase in the excitability of neurons within the central nervous system. Signs of peripheral and central sensitization are allodynia (pain due to a stimulus that does not normally provoke pain) and hyperalgesia (an increased response to a stimulus that is normally painful). Both active and latent MTrPs are painful on compression[12]. Analysing the local sensitivity and referred pain of a myofascial TrP produced increased inter-rater agreement, as these were the most reliable clinical signs for the diagnosis process for MTrPs[7]. An experienced physiotherapist can reliably identify MTrP locations using a palpation protocol that includes use of the pads of the fingers to locate local pain[13,14]. As well as being the simplest way to identifying MTrPs, clinically speaking, muscle palpation is also the most commonly used method. You can use flat palpation, pincer palpation or both, depending on the muscle you are examining. The best technique to use for the sternocleidomastoid and latissimus dorsi muscles is pincer palpation with the thumb and index finger. However, the infraspinatus and extensor digitorum muscles can only be examined using flat palpation. The trapezius muscle can easily be examined using either technique. The amount of pressure applied by the examiner should vary for each muscle and each different subject[1,7]. You have to be very firm (a pressure of approximately 4kg), otherwise the characteristic reactions of an active or latent MTrP such as a jump sign (withdrawal response) and pain (reported by the patient) will not occur. One of the most common reasons for MTrPs being overlooked is that palpation has been carried out too gently[8]. As of today, no study has managed to report the reliability of diagnosing MTrPs in symptomatic patients in accordance with the latest proposed criteria. Particularly prejudicial to MTrP theory, is the lack of any data on the reliability of pinpointing the exact location of active MTrPs[16]

By gently rubbing across the direction of the muscle fibres in a superficial muscle, the examiner can feel a nodule at the MTrP and a rope-like induration that extends from this nodule to the attachment of the taut muscle fibres at each end of the muscle, no doubt very similar to myalgic cords in osteopathy, corresponding to myotome disorders. The increased tension of the palpable taut band is the result of regional shortening of the sarcomeres of numerous involved muscle fibres in the taut band[2]. Identifying the taut band led to good inter-rater agreement, as it is very high in muscles such as the trapezius, sternocleidomastoid and extensor digitorum[7]. Chen verified that taut bands are detectable and quantifiable with MRE imaging. The findings in the subjects suggest that the stiffness of the taut bands in patients with myofascial pain may be 50% greater than that of the surrounding muscle tissue[17]. When an MTrP is stimulated mechanically, either through needle penetration or snapping palpation, the taut band will contract, producing a local twitch response. Mechanical stimulation of an MTrP can also trigger referred pain, which occurs at a distance from the point of stimulation. The area in which the pain is felt can be local, in the same muscle or adjacent to it or remote (referred pain). Palpation of the MTrP reproduces or increases the spontaneous pain of an active MTrP. Range of motion is reduced because of the taut band and the pain. Muscle weakness occurs, but no atrophy and autonomic phenomena can occur with stimulation of the MTrP in certain muscles, such as the sternocleidomastoid muscle[1,7.] Identification of a local twitch response can be visual or tactile; it is barely palpable by the examiner. Both forms of identification are valid, although of all the clinical characteristics of MTrPs, local twitch response is the least reliable in the majority of muscles. In muscles such as the sternocleidomastoid and infraspinatus, local twitch response is very unreliable[7]. A local twitch response is accompanied by a local chemical alteration. This can be seen when a needle is inserted into the MTrP, after a local twitch response, and the concentration of substance P calcitonin gene-related peptides is reduced[9]. These findings support the reduction of pain and sensitivity observed clinically when the MTrPs were released, after penetration. Changes in analyte levels after a local twitch response might result from increasing local blood flow to the MTrP region, leading to a "wash out" of the pain and inflammatory mediators[10].

Muscles with MTrPs present with a limited passive range of motion (stretching) because of the pain as well as reduced force / resistance. Although muscle weakness is a common characteristic of a muscle with an active MTrP, the level of weakness varies from one muscle and subject to another[1]. Limited range of motion in a muscle while stretching and increased palpable muscle tension (reduced distensibility) are most accentuated in the most active MTrPs[7,18]. Trying to passively stretch the muscle beyond this limit will trigger severe pain as the muscle fibres involved will be tense, even while resting[1].

Diagnostic criteria

A lack of consensus surrounding the most appropriate diagnosis criteria to use to examine MTrPs has greatly impeded the development of a general assessment protocol for MTrPs and prevents us from being able to compare studies on the effectiveness of treating them[1,8].

Simons and Travell established the following essential criteria for diagnosing MTrPs: the presence of a palpable taut band (if the muscle is accessible), the presence of a hypersensitive nodule in the muscle, the patient recognising the pain when the sensitive nodule is palpated (which identifies an active MTrP) and pain and limited range of motion of the muscle when stretched. A local twitch response or pain in the distribution expected from a trigger point in the muscle in question when compressed are considered to be confirmatory observations[1].

Treatment

Clinicians have recognized for more than a century that effective treatment of painful, tense, tender muscles includes stretching the involved muscle fibres, either locally in the region of tenderness (massage) or by lengthening the muscle as a whole. Frequently MTrPs were the cause of the symptoms and were what was being treated[2]. For the successful management of myofascial trigger point (MTrP) pain it is essential to first identify all of the MTrPs from which the pain is emanating, and to deactivate them by one or other of several methods currently employed. Following this, measures should be adopted as necessary to prevent reactivation of the MTrPs. In addition, treatment should be started as early as possible, before pain-perpetuating changes take place, in particular spinal cord neuroplasticity (central sensitisation)[8]. Any treatment that reduces the sarcomere shortening in the region of the MTrP reduces the energy consumption, which in turn reduces the release of sensitizing substances. The degree to which the released sensitizing substances get to actually sensitize nociceptors depends strongly on the closeness of the nociceptors to an affected motor end plate and that depends on variations in local anatomical structure. Generally the end plate and nociceptors are near each other, but not always. This is why MTrPs are primarily a motor dysfunction disease and only secondarily a pain phenomenon. The pain results secondarily from the end plate motor dysfunction. This helps to explain why there is only a general correlation between the motor expression of a MTrP (the taut band) and its degree of painfulness and why latent MTrPs are so much more common than active ones[2].

More than twenty years ago, Travell and Simons described the technique "ischemic compression", used to treat MTrPs, applying firm pressure to the MTrP with the thumb[1]. In the 1999 edition of their work, Travell and Simons recommend applying gentle digital pressure on the MTrPs as firm pressure could create additional ischaemia, which could be harmful. This new myofascial trigger point pressure release technique seeks to restore the shortened sarcomere to its normal length in the contracted nodule. Other techniques associated with osteopathy such as the muscle energy technique, counterstrain and fascial release are also mentioned[1]. Other methods of deactivating MTrPs found in the literature include: ischemic compression, trigger point pressure release[19], transverse friction massage[20], a lidocaine 1% injection[21] and superficial or deep dry needling[22,23]. After MTrP inactivation, muscle stretching exercises are instructed as appropriate. This therapy is accompanied with a gradual increase in daily activities[3].

The osteopath must take all necessary measures should to prevent reactivation of the MTrPs, by correcting posture disorders and imbalanced leg length. It is also essential to underline the importance of teaching post-deactivation muscle stretching exercises. The patient should be taught to identify the activities that increase the pain in order to avoid those activities[22,24].

DISCUSSION AND CONCLUSIONS

The primary objective of this review was to show the importance of MTrPs in osteopathy as potential sources of pain, to describe their clinical characteristics in order to correctly diagnose them and to underline the importance of treating them within an osteopathic treatment protocol. Palpation continues to be the simplest method of diagnosing MTrPs and so increased training for osteopaths is recommended. Palpation allows the osteopath to assess local sensitivity and referred pain from an MTrP, as well as to identify the taut band and clinical signs with increased inter-rater agreement as these signs are deemed reliable for the diagnosis process. The taut band and local sensitivity are the most reliable clinical signs for MTrPs and constitute the minimum criteria for diagnosis. A latent MTrP should have a sensitive point and a taut band, and is differentiated from active MTrPs by the apparition of pain. The presence of a local twitch response or referred pain increases the reliability of a diagnosis of MTrPs and so are useful as confirmatory signs of MTrPs[7].

Palpation is still the main tool used to identify MTrPs and so osteopathic training is essential for a correct diagnosis.

As MTrPs are potential sources of pain and noxious afferents, osteopaths should be able to correctly diagnose and deactivate them as soon as possible to avoid the central sensitisation of the nervous system. A lack of consensus surrounding the most appropriate diagnosis criteria to use to examine MTrPs has greatly impeded the development of a general assessment protocol for MTrPs and prevents us from being able to compare studies on the effectiveness of treating them.

BIBLIOGRAPHICAL REFERENCES

1. Simons DG, Travell JG, Simons LS. *Myofascial pain and dysfunction. The trigger point manual. Upper half of the body. Volume 1*. 2nd ed. Baltimore: Williams & Wilkins; 1999.

2. Simons DG. *Understanding effective treatments of myofascial trigger points*. J Bodyw Mov Ther. 2002;6(2):81-88.

3. Bron C, Dommerholt J, Stegenga B, Wensing M, Oostendorp R. *High prevalence of shoulder girdle muscles with myofascial trigger points in patients with shoulder pain*. BMC Musculoskelet Disord. 2011; 12:139.

4. Han SC, Harrison P. *Myofascial pain syndrome and trigger-point management*. Reg Anesth. 1997;22(1):89-101.

5. Hubbard DR, Berkoff GM. *Myofascial trigger points show spontaneous needle EMG activity*. Spine. 1993;18(13):1803-7.

6. McPartland JM. *Travell trigger points–molecular and osteopathic perspectives*. J Am Osteopathic Assoc. 2004; 104(6):244-249.

7. Gerwin RD, Shannon S, Hong CZ, Hubbard D, Gevirtz R. *Interrater reliability in myofascial trigger point examination*. Pain. 1997;69:65-73.

8. Baldry P. *Management of myofascial trigger point pain*. Acupunct Med. 2002;20(1):2-10.

9. Shah JP, Phillips TM, Danoff JV, Gerber LH. *An in vivo microanalytical technique for measuring the local biochemical milieu of human skeletal muscle*. J Appl Physiol. 2005;99(5):1977-1984.

10. Shah JP, Gilliams EA. *Uncovering the biochemical milieu of myofascial trigger points using in vivo microdialysis: an application of muscle pain concepts to myofascial pain syndrome*. J Bodyw Mov Ther. 2008;12:371-384.

11. Gerwin RD. *Classification, epidemiology, and natural history of myofascial pain syndrome*. Curr Pain Headache Rep. 2001;5:412-420.

12. Dommerholt J, Bron C, Franssen J. *Myofascial trigger points: an evidence-informed review*. J Man Manip Ther. 2006:14(4): 203-221.

13. Barbero M, Bertoli P, Cescon C, Macmillan F, Coutts F, Gatti R. *Intra-rater reliability of an experienced physiotherapist in locating myofascial trigger points in upper trapezius muscle*. J Man Manip Ther. 2012; 20(4):171-177.

14. Bron C, Franssen J, Wensing M, Oostendorp R. *Interrater reliability of palpation of myofascial trigger points in three shoulder muscles*. J Man Manip Ther. 2007; 15(4):203-215.

15. Sciotti VM, Mittak VL, DiMarco L, Ford LM, Plezbert J, Santipadri E et al. *Clinical precision of myofascial trigger point location in the trapezius muscle*. Pain. 2001;93(3):259-66.

16. Lucas N, Macaskill P, Irwig L, Moran R, Bogduk N. *Reliability of physical examination for diagnosis of myofascial trigger points: A systematic review of the literature*. Clin J Pain. 2009;25(1):80-89.

17. Chen Q, Bensamoun S, Basford JR, Thompson JM, An KN. *Identification and quantification of myofascial taut bands with magnetic resonance elastography*. Arch Phys Med Rehabil. 2007;88(12):1658-61.

18. Macdonald AJ. *Abnormally tender muscle regions and associated painful movements*. Pain. 1980;8(2):197-205.

19. Gemmell H, Miller P, Nordstrom H. *Immediate effect of ischaemic compression and trigger point pressure release on neck pain and upper trapezius trigger points: A randomised controlled trial*. Clinical Chiropractic. 2008;11:30-36.

20. Fernández de las Peñas C, Carnero JF. *Masaje de fricción transversal. Una alternativa terapéutica para el tratamiento del síndrome de dolor miofascial*. Fisioterapia. 2004;26(3):126-33.

21. Balbino LF, Vieira LR. *Avaliação objetiva da síndrome dolorosa miofascial: uso da termografia antes e após tratamento associando mesoterapia a bloqueio anestésico*. ACTA FISIATR. 2005;12(3):115-117.

22. Baldry P. *Superficial versus deep dry needling*. Acupuncture Med. 2002;20(2-3):78-81.

23. Dommerholt J, Moral OM, Gröbli C. *Trigger Point Dry Needling*. J Man Manip Ther. 2006;14(4):70-87.

24. Gerwin RD. *The management of myofascial pain syndromes*. J Musculoskel Pain. 1993;1(3-4):83-94.

ISSN on line: 2173-9242

www.europeanjournalosteopathy.com
info@europeanjournalosteopathy.com

EUROPEAN JOURNAL OSTEOPATHY
& Related Clinical Research

EOM Internacional

S.E.F.O
Scientific European Federation Osteopaths