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Editorial:

Evidence as a Source of Excellence in Osteopathy

Original Article:

Fibromyalgia: General Considerations. Review

Effects of the Neuromuscular Abdominal Technique on the Craniocervical angle in patients with Chronic Mechanical Cervicalgia

Immediate Effects of Occipito-atlo-axoid manipulation on Foot Support: Baropodometric Study

Technical Report:

Semidirect thrust technique for rotation disorder in the atlas with index finger contact

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SUMARIO

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European Journal Osteopathy & Related Clinical Research (Eur J Ost Rel ClinRes), es una publicación multidisciplinar, con revisión por pares, electrónica y periódica, dedicada a la información técnica y científica sobre Osteopatía y Ciencias Clínicas, relacionadas con la Salud. Esta revista publica trabajos de investigación originales, informes técnicos, casos y notas clínicas, trabajos de revisión, comentarios críticos y editoriales, así como bibliografía especializada. Usted podrá acceder a ella en la dirección web www.europeanjournalosteopathy.com . Este sitio web está disponible en veinte idiomas diferentes para facilitar la difusión internacional. Esta revista tiene una periodicidad cuatrimestral, integrada por tres números anuales y se publica en acceso libre a todos sus contenidos, gratuito e inmediato (texto completo), en los idiomas español e inglés. European Journal Osteopathy & Clinical Related Research proviene de la revista anteriormente denominada Osteopatía Científica, la cual se encuentra indexada en SCImago-SCOPUS, SciVerse-Sciencedirect , BVS (Biblioteca Virtual en Salud) ,Elsevier Journals y Latindex. Índice SJR (SCImago Journal & Country Rank) 2010: 0,025. Esta revista se encuentra patrocinada por entidades profesionales y científicas. Los lectores, autores, revisores y bibliotecarios no tendrán que realizar abonos por acceder a sus contenidos (acceso abierto) y es el medio oficial de difusión de las siguientes instituciones: Scientific European Federation of Osteopaths – SEFO (Federación Europea Científica de Osteopatía) y Madrid International Osteopathy School (Escuela Internacional de Osteopatía de Madrid – EOM). LOPD: De acuerdo con lo contemplado en la Ley 15/1999, de 13 de Diciembre, le informamos que sus datos personales forman parte de un fichero automatizado de la Escuela de Osteopatía de Madrid. Ud. Tiene la posibilidad de ejercer los derechos de acceso, rectificación, cancelación y oposición en los términos establecidos en la legislación vigente, dirigiendo su solicitud por escrito a: Escuela de Osteopatía de Madrid, C/ San Felix De Alcala,4. 28807 Alcala De Henares. Madrid (España).

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European Journal of Osteopathy & Related Clinical Research

EDITORIAL

Evidence as a Source of Excellence in Osteopathy

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a. Editor of the European Journal of Osteopathy & Related Clinical Research

To all the readers of this issue, we present some of the results from the research conducted by the students at the Madrid School of Osteopathy, in order to complete their Doctorate of Osteopathic Medicine Degree. Great part of this work will be presented at the next CIOST (International Osteopathy Conference) in the city of Porto (Portugal), which will be held in October 2012. We are encouraging all health professionals to attend this important event, where they can bring themselves up to date with the latest research, and where the international community will be able to learn about the latest advances in osteopathy.

This issue of our magazine includes a review of the general considerations on fibromyalgia, an illness about which there is currently much controversy.

In addition, we are publishing several original clinical research articles related to the cervical spine in some specific aspects.

We are also providing information on the effects of the pressure techniques, applied at high cervical levels, such as the occipitoatloid level and their effects on balance.

Finally, we are including, firstly, the results related to the neuromuscular abdominal techniques applied to patients with mechanical cervicalgia and their consequences in the field of employment, both with a curative and preventive purpose and secondly, a technical report on the cervical manipulation technique of the atlas.

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European Journal of Osteopathy
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ORIGINAL ARTICLE

Fibromyalgia: General Considerations. Review

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Keywords:
Fibromyalgia;
Rheumatic diseases;
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ABSTRACT

Introduction: Fibromyalgia is a clinical syndrome of an unknown etiology, characterized by the presence of diffuse and incapacitating chronic musculoskeletal pain that is normally accompanied by other symptoms like fatigue, sleep alterations, stiffness, severe headache, irritable bowel syndrome, depression, anxiety or paresthesia of the extremities and possible balance disorders.

Objectives: To present an updated description of the relevant clinical aspects of fibromyalgia.

Material and methods: We performed a literature search using Medline, ProQuest and Scopus databases, and the terms "fibromyalgia", "manual therapy" and "osteopathy".

Results: A retrospective, systematic review study with a sample for literature analysis, comprising 15 articles (n=15) and satisfying the screening criteria in two phases of analysis. These 15 articles represent 4.54% of the total number of found articles (n=330), and 12% of the articles fulfilling the screening criteria (n=120) (inclusion and exclusion). Fibromyalgia is a disease of an unknown cause that manifests multiple symptoms, particularly the onset of pain. The prevalence of the disease is between 1% and 5% of the population. One possible cause could be the alteration of the various levels of pain processing and modulation in the central nervous system. The diagnostic criteria used since 1990 are being questioned.

Conclusions: The treatment approach is currently based on reducing the intensity of the symptoms. At present, no one´s treatment presents outstanding effectiveness with respect to the others used, and the patient, thus, requires a treatment applied by a multi-disciplinary team.

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INTRODUCTION

Fibromyalgia is a clinical syndrome of an unknown etiology, characterized by the presence of diffuse and incapacitating chronic musculoskeletal pain that is normally accompanied by other symptoms like fatigue, sleep alterations, stiffness, severe headache, irritable bowel syndrome, depression, anxiety or paresthesia of the extremities[1-3] and possible balance disorders[4-7].

Pain can be considered the most common symptom, and, in fact, as explained below in further detail, is the only symptom used as a diagnostic criterion[8].

In 1976, Hench[9] proposed the current term, which etymologically stems from:fibro- (fibre), myo- (muscle), -algos (pain) and -ia (condition). This term is currently accepted internationally, but various authors have also employed other terms in reference to this syndrome10, such as muscular rheumatism, myalgia rheumatica, myogelosis, myofibrositis, myopathic syndrome, etc.

MATERIALS AND METHODS

The literature review was conducted using the PubMed (MEDLINE), Sciencedirect (Scopus) and ProQuest databases. The search terms entered were "fibromyalgia", "osteopathy" and "manual therapy", and all searches were restricted to publications written in English or Spanish up to 2011.

Eligibility and screening criteria

Our review consisted of two search phases. We established the eligibility criteria (inclusion and exclusion) in the first phase and the screening-specific criteria for the second phase.

Eligibility criteria. In phase 1 of the search, the following inclusion criteria were applied: articles published in the indexed scientific journals, in Spanish and/or English regarding any clinical, diagnostic, therapeutic, physiological, epidemiological or socio-economic aspect of fibromyalgia, articles related to any aspect of fibromyalgia and manual, alternative or osteopathic therapies.

Moreover, from our review, we excluded all articles published in any language other than Spanish or English, in indexed scientific and non-scientific journals, as well as any that did not meet the minimum standards for quality, such as the absence of paired reviews, the lack of a control group, and those that were not randomized.

Screening criteria. In phase 2 of our review, we applied screening criteria to the selected articles according to the Title, Abstract and Keywords, the Full Text and Bibliographic citations of the articles included in Phase 1 (Figure 1).

Data analysis

Phase 1.- We performed an initial general search to obtain the published studies that generically addressed fibromyalgia in the framework of osteopathy, manual therapy and/or alternative therapies, and we developed a template for collecting general information based on the following factors: language of the publication, number of authors, public or private institution, paired review of the source journal, existence of a control group, blinded and randomized studies on fibromyalgia.

We obtained a total of 330 studies (n=330), once we had filtered out duplicates. To these, we applied the inclusion and exclusion criteria, which allowed for an initial selection of 120 articles (n=120) (Figure 1).

Phase 2.- Then, our objective was to determine the association between the specific aspects of Fibromyalgia and Osteopathy. To that end, we applied additional filters to all of the articles previously obtained in the initial search (n=330), to identify fibromyalgia studies related to osteopathy, manual techniques and alternative therapies. Thus, we screened by Title,

Abstract and Keywords, which excluded 52 (n=52) of the initially selected articles. We then filtered by full text, which resulted in the definitive inclusion of 15 studies(n=15). Lastly, we analyzed the bibliographical citations of those 15 articles to ascertain whether we could obtain additional information. This was not the case; therefore, we did not obtain any complementary studies (n=0). Considering the above, the sample for this review comprised 15 articles selected in accordance with the PRISMA criteria for systematic reviews (Figure 1).

Of all the journals we used in Phase 1 of this review, Reumatología Clínica was noteworthy for its articles addressing the treatments that could be employed in fibromyalgia. In Phase 2, the journals Manual Therapy and Journal of Manipulative and Physiological Therapeutics with three (n=3) and two (n=2) results, respectively, were the two publications that most contributed to our topic.

RESULTS

Our literature analysis was made up of a total of 15 articles (n=15), satisfying the eligibility and screening criteria in two phases of analysis. These 15 articles represent 4.54% of the total number of articles found, and 12% of the articles fulfilling the eligibility criteria (inclusion and exclusion).

Our search and subsequent analysis of the various publications regarding fibromyalgia provided us information on the following aspects of the disease:

Etiology

Though the cause of the disease is unknown, the studies found suggest nervous system alterations, with the possible involvement of supraspinal centers, such as the thalamus or somatosensory cortex[8,11], affecting the mechanisms of transmission, modulation and processing of the nociceptive stimuli at the central nervous system level.

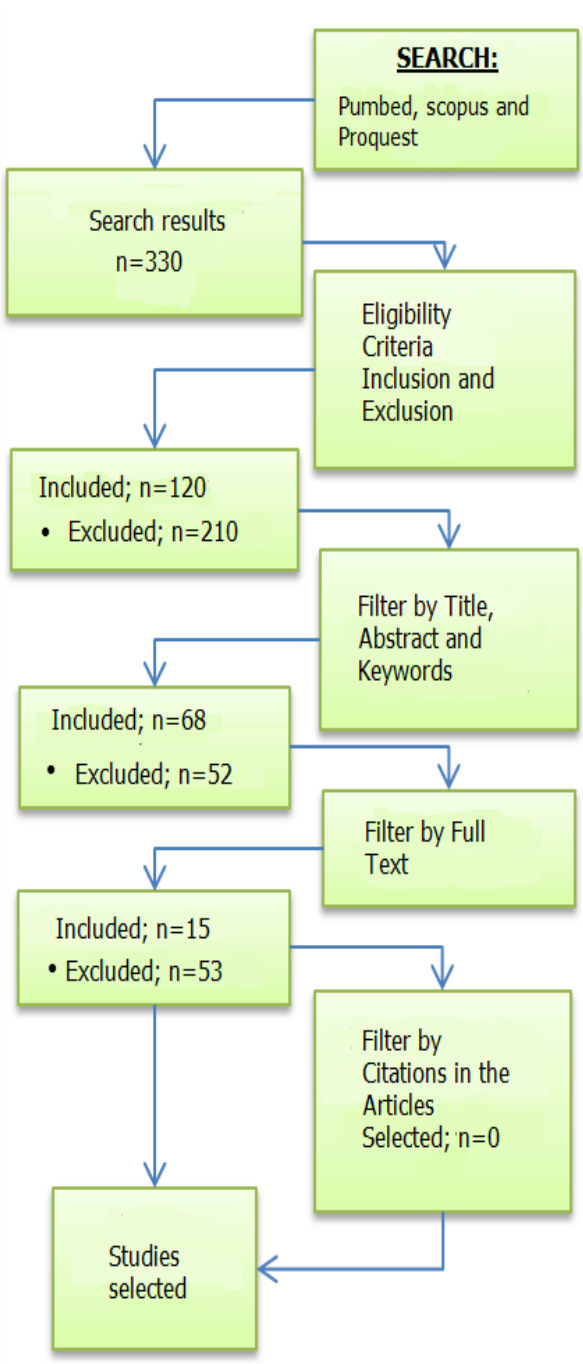

Figure 1.- Flowchart for Article Selection, according to the PRISMA Statement[12] for Reporting Systematic Reviews and Meta-Analyses of Studies that evaluate Health Care Interventions.

These disorders of the processing of central pain are associated with other pathophysiological alterations that lack a clear causal relationship between them, such as the hyporeactivity of the hypothalamus-pituitary-adrenal axis, growth hormone system

alterations, elevated pro-inflammatory cytokine profiles and reduced anti-inflammatory profiles, and changes in the dopaminergic and serotonergic systems[13-16].

Although the majority of the current research on fibromyalgia tends to seek for a systemic explanation for the generalized muscle pain, Gerdle et al.[17], in a recent study, have discovered that in muscles with pain in the fibromyalgic syndrome there is a greater objective concentration of lactate and pyruvate, thus yielding one possible explanation for the decrease in the pressure threshold.

Other suggestions include the increased probability of developing the disease in those subjects with physical or emotional stress at work, or those with a depressed demeanor14. Affective alterations constitute a risk factor for the development and maintenance of the fibromyalgic syndrome[15].

There are even schools of thought that point to a possible correlation between a hormone imbalance in females and fibromyalgia pain[18].

Epidemiology

The prevalence of the disease in the population is between 1% and 5%[8,19,20], and in Spain, in people over 20 years of age, between 2% and 2.7%[1,2,21,21,22].

A recent study[23] on disease prevalence in 5 European countries (France, Italy, Germany, Portugal and Spain) placed it at between 2.9% and 4.7% of the population.

In terms of gender, females suffer this disease more than males, at a 21:1 ratio[21].

A total of 75% of patients are females between the ages of 35 and 55 years[24].

Diagnostic criteria

This disease, classified as such by the WHO in 1992, has become conceptualized, due to its difficulties in diagnosis, as a syndrome from the clinical perspective that is difficult to explain, and is occasionally considered by professionals and the public alike as a psychological disorder, due to the complexity of objectifying the findings of the physical examination, laboratory results and imaging tests[3]. The first formal definition of the disease was established in 1977, by Smythe and Moldofsky, and since then, several other definitions have arisen that vary in terms of the emphasis placed on the different concomitant symptoms and in the number of tender points in the syndrome[25]. Many rheumatologists, neurologists and pain specialists consider the disease to be a combination of pathological changes in the muscles, connective tissues and the central nervous system[19].

As it has been suggested previously, generalized pain is the primary symptom of fibromyalgia, which, when combined with others, in addition to the feeling of incomprehension and uncertainty suffered by these patients, can lead the patients to a situation of anxiety and depression. These, in turn, could further aggravate their symptoms[1,26]. The intensity of the pain experiences appears to be related to the level of physical activity and the emotional state of the patients[27].

The pain suffered by fibromyalgic patients, in addition to being generalized, is chronic and incapacitating. Together with these characteristics, multiple previously-defined points at which moderate pressure triggers pain are confirmed in the physical examination. These are known as “Fibromyalgia Tender Points” (FTP), and at least eighteen have been detected to date[28-30].

The sites of the FTPs are as follows[31]:

- Occiput: bilateral at suboccipital muscle insertions.
- Low cervical region: bilateral, at the anterior aspect of the interspaces, between the transverse processes of C5-C7.

- Trapezius muscle: at the midpoint of the upper border.
- Supraspinatus muscle: bilateral, above the medial border of the scapular spine.
- Second rib: bilateral, at second costochondral junctions.
- Lateral epicondyle: bilateral, 2 cm distal to the lateral epicondyle.
- Gluteal: bilateral, at the upper outer quadrant of the buttocks, near the anterior fold of the muscle.
- Greater trochanter: bilateral, posterior to the greater trochanteric prominence.
- Knee: bilateral, at the medial fat pad proximal to the joint line.

In order to diagnose fibromyalgia, several criteria26,30 were established in 1990, by The American College of Rheumatology, which include:the presence of generalized pain for at least 3 months and, at least, the presence of 11 FTPs[11,28,32]. In the assessment of points, 4kg/cm^2 [33,34] of pressure is applied on each, though, according to Marquet[31], there may be differences in the assessment pressure of the different points depending on their location.

The ACR criteria are currently being questioned by some parties because they were defined 20 years ago and, since then, new symptoms of the disease have been identified that should be considered in its diagnosis, such as anxiety, sleep disorders, etc.

According to Wolfe et al.35, without the need to perform a physical examination of the FTPs, but using an interview to obtain a Widespread Pain Index (WPI) and a severe symptoms scale (SS scale) value, we could achieve a more accurate diagnosis of fibromyalgia. These researchers have confirmed that these criteria identify 25% of the diagnoses excluded with the 1990 criteria. Of those patients diagnosed using the ACR criteria, 88.1% are also diagnosed using these new criteria.

However, due to the absence of standardized tests for evaluation, caution should be exercised when diagnosing this syndrome[26].

Treatment

Given that the disease´s origin is currently unknown, the treatment must be based on the improvement of the various clinical manifestations.

Therefore, there is no defined treatment available at this time, and treatments range from various drugs to physical activity, physical agents, psychotherapy, acupuncture, thermal therapy, homeopathy, osteopathy, etc.[21,25,36-42].

Osteopaths are the most highly demanded healthcare professionals by the fibromyalgic patients, in addition to the primary care physician, rheumatologist, rehabilitation physician and psychiatrist[43].

As a result of the very heterogeneous clinical presentation of this syndrome, optimized personal treatment is required for each patient, in order to attain better results[44], and said treatment must be multi-disciplinary[45-47].

Primary symptoms

According to our literature search, in addition to pain, which we mentioned above, other symptoms manifested in fibromyalgia include:

- **Fatigue.** After pain, this is the second symptom patients hope to be improved after treatment[7]. It also holds the second place for the frequency of onset in patients[48].
- **Cognitive impairment.** Some studies reveal the existence of a cognitive impairment in fibromyalgic patients. It seems that this impairment could depend on the chronic pain presented in the syndrome[49]. Patients

with fibromyalgia report memory alterations[8], though other studies conclude that there are no modifications in the cognitive performance of these patients[50].

• **Sleep alterations.** This symptom affects between 75% and 86% of all patients and is one of the most common symptoms[20,51]. It includes insomnia with 3 potential forms of manifestation: sleep maintenance insomnia, sleep onset insomnia or early-wakening insomnia. The joint manifestation of the three possibilities is the most common among fibromyalgic patients (65.6%). On the individual level, sleep maintenance insomnia is reported in the greatest number of cases (16.1%)[8,46]. Antidepressants are the most commonly used drugs for improving sleep quality[20]. These sleep alterations play an essential role in the exacerbation of other fibromyalgia symptoms[52].

• **Headaches.** A total of 80% of the patients report suffering from this symptom regularly. And 48.7% of this group presents this symptom 15 or more days a month[8].

• **Depression.** Although it is continuously mentioned in the list of fibromyalgia syndrome symptoms[26,28,32], one study states that only 7.1% of patients included in the study fulfilled the diagnostic criterion of depression[53], while other studies state (using the PRIME-MD questionnaire) that 40% of fibromyalgia patients suffer depression[54]. Nevertheless, the reciprocal relationship between depression and pain has been studied, and one can increase the severity of the other, and vice versa[55].

• **Balance alterations.** Some studies propose studying this variable to determine the risk of falling among these patients[56]. Certain studies demonstrate a decrease of balance with fibromyalgia[4], suffered by 63% of the subjects in this group[5].

• **Joint stiffness.** This appears in 2 of every 3 fibromyalgia patients[57,58]. This stiffness, which in other rheumatic diseases seems to be related to the increase of hyaluronic acid levels, may not bear any association with the fibromyalgia syndrome[57].

• **Irritable bowel syndrome.** Irritable bowel syndrome is commonly presented in fibromyalgia and affects between 63% to 81% of all patients[54,59,60], while in the general population, in which it is the most common gastrointestinal pathology, it is presented at 10-15%[61]. It is characterized by the onset of the abdominal pain and the alteration of bowel rhythm.

• **Sexual dysfunction.** Some studies suggest the correlation of fibromyalgia with sexual dysfunction, once the disease has been established[62].

• Other symptoms described by some authors include hemorrhoids, epistaxis, paresthesia[48], irritable bladder[61], photophobia[5] and diverse symptoms of the cardiorespiratory, endocrine, allergy and otorhinolaryngological[10] spheres.

We also found that half of the patients with fibromyalgia are obese and that 30% of the rest are overweight[63].

The same study that defends that data identified an important relationship between said obesity and a greater sensitivity to pain, reduced sleep quality and a decrease of physical strength and flexibility.

Recently, women with polycystic ovary syndrome have been discovered to also present fibromyalgia with greater frequency[64].

Socio-economic aspects

We can also state that due to the high prevalence of fibromyalgia syndrome and the fact that it is a disease whose treatment requires a large number of professionals as a result of its complex manifestation and course[2,3,19,21,26,28,32,53,65], this disease involves an elevated financial cost and resource burden[66-69]. Therefore, it is essential that the most effective diagnostic and treatment measures be established[26].

In Spain, fibromyalgia is one of the chronic processes that require the greatest number of treatments[43]. Despite all of this, it is difficult to quantify the healthcare expenses arising from fibromyalgia care, because the patients frequently present other simultaneous diseases, and work leaves are often classified as the cause of other syndromes[70].

In other countries, where the expenses arising from the disease have been determined, we found figures that range from $606 in Canada and $3,056 in the US[43].

From the standpoint of fibromyalgia's impact on work, we can confirm, after the literature review, that in our country there is no generalized legal recognition of the disease as the cause of work disability.

Of the 139 rulings issued between 1978 and 2008 in the Supreme Court, only 35 were in favour of the worker, and 60% of the cases resulted in permanent total disability, 22.9% permanent absolute disability, 8.6% permanent partial disability and another 8.6% of the cases were recognized as major disability[71]. However, one important piece of data with an economic and labor impact is the fact that 11.5% of people with fibromyalgia are found to be temporarily or permanently disabled, versus 3.2% of people without this disease[43].

Reisine et al., in 2008, ensure that working women have a better state of health that those who do not work, but their symptoms evolve in the same way as those who do not work outside of the home; this initial advantage is, thus, maintained constant[72].

DISCUSSION

It is clear that fibromyalgia is a highly prevalent disease, but we remain unsure about its etiology even though, as mentioned above, fibromyalgia does not appear to be a rheumatic disease, but rather a disease originating in the central nervous system, which makes it a neurological disease.

Moreover, one of the aspects to highlight is the fact that, to date, pain has been the symptom that has been taken as reference to diagnose the disease.

However, another set of symptoms should be included, for example, fatigue and sleep alterations, to name a few.

These symptoms are as important as pain for establishing reliable diagnostic criteria. On the one hand, do not leave patients without a positive diagnosis of fibromyalgia, and, on the other, do not diagnose the disease in patients who actually do not suffer from it.

Not having the clear etiology makes it difficult to be able to act on the root of the problem; this explains why numerous different treatments that are presented only alleviate disease symptoms, but this situation , to date, have not been truly effective in treating all symptoms. Thus, the current approach for fibromyalgia requires the involvement of a wide number of different professionals, and alternative medicine such as Osteopathy is in high demand among these patients.

The need to establish reliable diagnostic criteria and effective treatments for fibromyalgia will not only serve for the purpose of providing patients with a better life quality , but it is also in demand due to the very elevated cost it involves from the perspectives of social-healthcare and pharmaceutical expenses, and temporary work leaves resulting from this disease.

CONCLUSIONS

We can conclude this review paper by highlighting that fibromyalgia is a disease, to date, whose causes remain unknown, and therefore, for which no effective treatments that act on all triggering agents can be established, such that the current treatments are multi-disciplinary and act on the symptoms manifested by the patients.

These symptoms may manifest in very diverse ways, and the diagnostic criteria used to date are being

questioned by the scientific community, due to their exclusive focus on pain-related symptoms.

CONFLICT OF INTEREST

The authors of the manuscript declare no conflict of interest.

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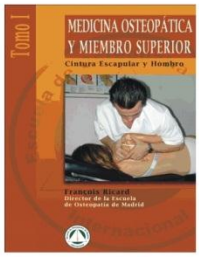

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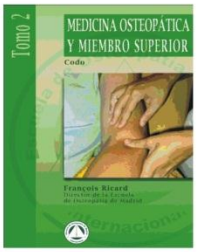

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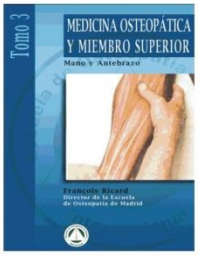

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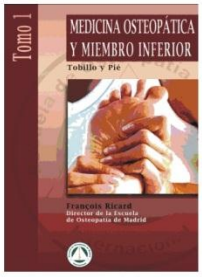

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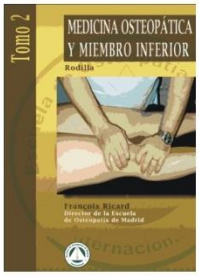

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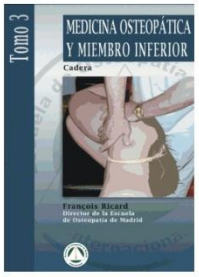

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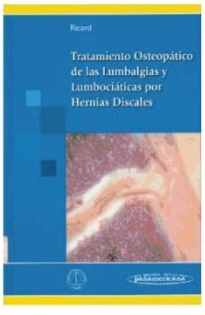

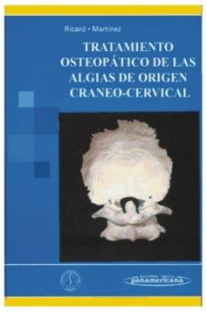

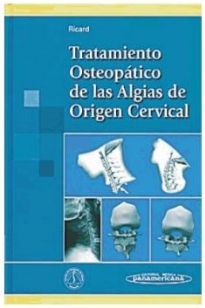

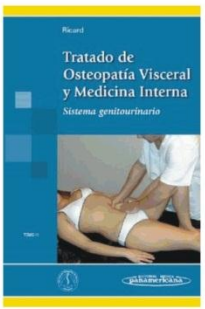

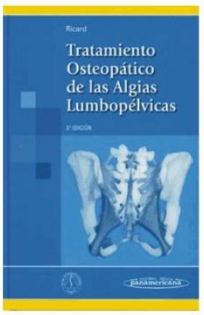

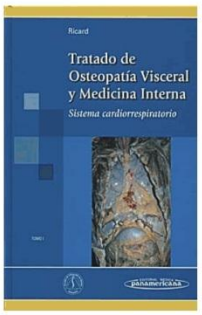

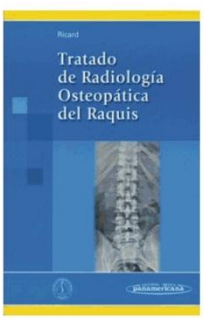

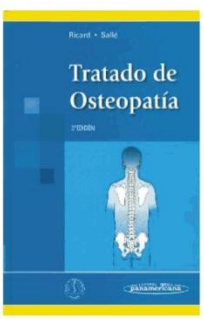

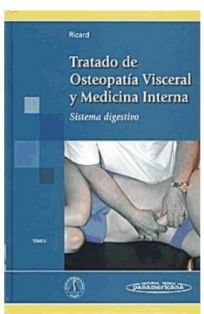

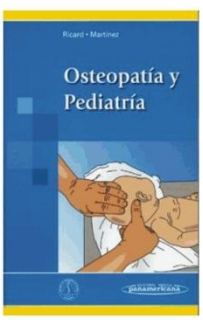

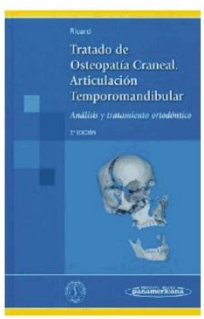

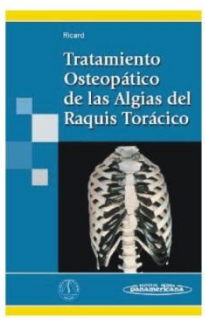

European Journal of Osteopathy & Related Clinical Research

ORIGINAL ARTICLE

Effects of the Neuromuscular Abdominal Technique on the Craniocervical angle in patients with Chronic Mechanical Cervicalgia

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Neck pain;
Perception of motion;
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Risk Prevention Programme for the Work Environment.

ABSTRACT

Introduction: The abdominal muscles play an important role in maintaining the posture. There is evidence that dysfunctions in the abdominal wall have a profound effect on back pain and, in particular, on chronic mechanical cervicalgia (CMC).

Objectives: To assess the immediate effect of the Neuromuscular Technique (NMT) at the level of the rectus abdominis sheath in workers maintaining their position for more than 4 hours in front of a computer, for pain noticed during a cervical movement, in cervical mobility and in the head's position.

Material and methods: A randomised clinical trial was carried out, in parallel with an experimental treatment compared to a control treatment, in 34 patients (n=34), Control Group (CG: n=17) and Experimental Group (EG: n=17). The control group received a technique simulating a functional balance at the epigastric level, and on the experimental group we applied the Neuromuscular Technique at the level of the rectus abdominis sheath.

Results: No statistically significant differences were found in the craniocervical angle in a sitting position (p=0.033) with a 4.93 ± 5.7% change in the experimental group and 0.6 ± 3.77% in the control group. No differences were found in the craniocervical angle in a standing position, in the pain noticed during cervical movement or in the range of neck mobility (p>0.05).

Conclusions: NMT at the level of the rectus abdominis sheath improves the head's position sitting down, but it is not useful to balance the cephalic position when standing, increase the cervical mobility or modify the pain noticed during a cervical movement.

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INTRODUCTION

Posture refers to the position and direction of the human body in its space, as well as the arrangement that the different body segments establish among themselves, with regard to the gravitational force[1,2]. Campignion[3] differentiates between posture and postural attitude. Postural attitude is the body's external arrangement, which is intrinsically related to each person's way of being and to the way each person has of relating with their environment. Posture is determined by the somasensatory, visual and vestibular levels[4].

The supposition that postural behaviour contributes to pain is often made because some positions increase the load on specific tissues and, therefore, could cause damage and/or pain to the tissue. Specific literature does not describe any uniformity between the correlation of posture and pain[5].

Posture is an acquired function and each individual has his own structure. In accordance with needs, each body segment is balanced with the adjacent segment. In the musculoaponeurotic system, everything is connected; each gesture is performed starting from a set of actions that complement each other to achieve the final objective. Therefore, the initial tension is responsible for a succession of related tensions[6].

The forward or backward position of the individual[7, 8], in connection to the vertical line of gravity produces structural changes on the cervical and lumbar curves. From the biomechanical point of view, the muscles that are inserted on the cranium exercise a direct vector action on their skeletal elements[9]. This posture can be altered by the postural attitude maintained whilst working, as in case of the office workers[10-12], desk and/or computer workers who tend to adopt a forward head position (FHP).

Osteopathic treatment can affect balance and posture through numerous central interconnections of the autonomous system and of the balance control that could have a direct effect on the vestibular functioning[13].

Pain in the cervical and lumbar column is one of our daily challenges as physiotherapists and often, they are related and connected to stress[14]. Pain at the cervical column level means a problem for the health system. In 1988, a survey was conducted, in which 66% of the population said they had suffered neck and back pain in the previous year[15]. The prevalence in Spain[16] was 19.5% in 2006, with it being greater in women (26.4% and 24.5%) than in men (12.3% and 15.1%). It affects 45-54% of the population in general during their lifetime[17], which may result in situations of extensive disablement[18].

Activation and perpetuation of the suboccipital muscles, according to Travell and Simons[19], could be due to a FHP, or to the effect of the occipital rotation and for other reasons among which we highlight the abuse of its physiological kinetic brake (control) during the flexion maintained by the head, by abuse of the extensor function during ascending basculation, sustained by the head and by the combination of this latter reason with a maintained cervical rotation, which could cause hyperextension of the neck or an increase of cervical lordosis.

The clinical decision for treating patients with cervical pain[20] is often based on the findings obtained during the medical examination, based on the patient's signs and symptoms and not on technical imaging diagnoses. In a study conducted in 2003 by Wang et al.[21], cervical mobility was used as a measure of the results in a clinical decision algorithm, designed as a therapy for patients with cervical pain. The abdominal muscles and the diaphragm play an important role in maintaining posture[22-24] and in visceral functions, both thoracic and abdominal.

The rectus sheaths, one anterior and the other posterior, are made up from aponeurotic expansions of the oblique and transverse muscles that in the mid line

make up the *linea alba*, the place of sinewy crossover for these muscles [25].

These four pairs of muscles and their aponeurosis are responsible for a large part of the resistance in the abdominal wall. Their insertions in the thoracolumbar fascia strengthen the support of the abdominal viscera and assist in trunk flexion and rotation[26]. This joint connects to the abdominal wall by bonding the thoracolumbar fascia with all the back muscles and the deep fascia of the nape of the neck[27].

This study's approach was to analyse whether the neuromuscular technique applied at the level of the rectus abdominis sheath could contribute to improving cervical mobility and reduce the pain noticed during the neck movement, balancing the head's forward position in patients that have chronic mechanical cervicalgia (CMC) and specific requirements in the neck at work, maintaining a seated position for more than four hours in front of a computer.

In such a case, we think that we could make a contribution to innovative aspects in therapy and health and safety at work.

MATERIAL AND METHODS

Study design

A randomised double-blind clinical trial in parallel with experimental treatment against a control treatment, carried out in Madrid in 2012.

Sampling and size of the sample

We carried out a non-probabilistic sampling for the study's convenience, selecting a sample of the eligible population, comprising patients that attended the main researcher's office in Madrid (Spain) that fulfil the criteria for selection and voluntarily accepted to take part in the study. We calculated the necessary sampling size, using the Granmo version 7.12 (Granmo, IMIM Hospital del Mar, Barcelona, Spain) software for the difference of the two independent media starting with a previous pilot study, accepting an alpha risk of 5% (α=0.05) and a beta risk of 20% (β=0.2) in a unilateral contrast, we found that 16 subjects were required in the first group and 16 in the second to detect a difference equal to or more than 14% (0.14) in the craniocervical angle between the groups. It assumed that the usual deviation was 15% (0.15). A rate of losses in monitoring was estimated at 6% (0.06) with a study potential (1- β) of 80% (0.8). Therefore, we recruited 34 patients in total, distributed over the two groups as 17 patients in each. There were no losses in monitoring.

Study population

Thirty-four patients (n=34) who fulfilled the criteria for selection took part in our study. They were distributed randomly into two groups of seventeen patients each; a control group (CG; n=17) who received a simulation technique of the functional balance as a placebo at the epigastric level and an experimental group (EG: n=17), who received the Neuromuscular Technique at the rectus sheath level, as an experimental procedure.

Criteria for selection

To take part in this study, the following inclusion criteria were strictly followed: patients of either sex, aged between 18 to 50 inclusive, office workers or those working for four or more hours daily sitting in front of a computer who showed CMC[28-30] (more than 8 weeks of progress) with a degree of I-II[31] who had not received osteopathic treatment in the previous month, so as not to interfere in the results and signing an informed consent form.

Participants were excluded from this study who fulfilled at least one of the following criteria: contraindication to the neuromuscular technique [32] (acute injuries in the first 72 hours), showing psychiatric disorders or a diagnosed psychological change (schizophrenia, depression), patients who due to their culture or language would have difficulties in understanding the researcher's orders, rejection for taking part in the study, patients with secondary mechanical cervicalgia, other pathologies such as whiplash in the acute phase, congenital or acquired torticollis, rheumatoid arthritis in an advanced stage, pregnant at the time of the study, taking analgesic and/or anti-inflammatory medicine, be suffering from previously diagnosed neurological pathologies such as

congenital diabetic polyneuritis or any neurological alteration.

Randomisation

The sequence for assignment was generated through software, with a 1:1 ratio, by an unconnected collaborator. The assessors and the patients did not know the randomisation sequence and the assignment in accordance with it, which was concealed and kept safe by administration personnel who did not know the study's objective.

Study protocol

We informed the patients of the study's general aspects using an informed consent form, in accordance with the Spanish legislation on the subject of personal data protection (Act 15/1999). After signing the informed consent the pre-procedure measurements and side photographs were taken and goniometric tests performed. We assessed the patients' weight and size with an electronic medical scale (Seca 703, Seca, Hamburg, Germany) and completed the data collection sheet (name, age, body mass index – BMI – and handedness). Then, photographs were taken using a tripod, in a sitting and standing position. Then, the patient went into another room fitted with an examination bed and a chair, separated by a room divider. Both rooms remained at a constant temperature between 20 and 23ºC. We conducted measurements on pre-procedure cervical mobility, in flexion, extension, rotation (left and right) and lateral flexions (left and right) and assessment of the perception of pain on moving using the visual analogue scale (VAS) for pain. Subsequently, we applied the procedures to each study group (control and experimental) and finally, we performed the post-procedure measurements of cervical mobility and the perception of pain on moving. We collected all the data for their subsequent statistical analysis.

Applied procedures

To the experimental group. We applied the Neuromuscular Technique (NMT) on the rectus abdominis sheath. NMT is a treatment method on the soft tissue capable of improving general function, relaxing muscular tension and through its effects on the points which triggered the muscular aponeurosis, treating the underlying causes of an extensive range of symptoms. The basic abdominal technique was described by Chaitow[33]. This technique has an effect on the central tendon of the lateral side of the rectus muscles' sheaths, and we think it will affect cervical mobility and the forward head position. The period for applying the NMT on the rectus sheath and on its rib insertions was similar to the placebo manoeuvre applied to the control group.

The objective of NMT is to relax the abdomen's musculoaponeurotic tissue and to do this, we proceeded in the following way[33]: the patient remained in the supine position, with the lower limbs in flexion and supported on the bed. During the first phase, pressure is applied on the costal arch and to do this the physiotherapist stands in feint at the height of the patient's shoulder, contacting the costal arch with the thumb and applying a series of brief passes, following the costal arch, starting at the xiphoid apophysis, putting on profound pressure with the thumb and with the fingertips. During the second phase, the procedure focuses on the rectus abdominis sheath, carrying out a series of brief passes of intense and painless pressure using the thumb, from the xiphoid apophysis to the pubic crest (figure 1); the passes to the pubic crest (figure 1) were repeated on each side several times, according to the degree of tension, congestion and sensitivity.

Finally, several brief, deep and slow passes were applied with the thumb from the ribs' arches until reaching the inguinal ligament, on both sides.

To the control group. This group received a placebo technique using a simulation manoeuvre of functional balance at the epigastric level; to do this, the patient remained in a supine position with the lower limbs in flexion, feet supported on the bed. The physiotherapist sat at the patient's left and placed the left hand at the height of the patient's epigastrium and simulated a functional balancing technique, for a minute and a half, without applying a therapeutic purpose. The similarity of the procedures implied the blindness of the subject and to this effect, both techniques were performed at the level of the patient's abdomen and for a similar period of time.

Assessments made

All the assessments of the variables of interest were made before the procedure and immediately after the procedure (pre/post) by experienced osteopaths, different from those who applied the procedures, who did not know the patients in the study groups, the research objectives and the randomisation sequence, which was hidden and kept safe by administration personnel who did not know the study's objectives.

Measurement of the forward head position. The FHP is one of the most common postural alterations that influences those individuals predisposed to pathological conditions, such as head and neck pain, temporomandibular alterations, dyskinesia, scapular-humerus or even alteration to the length and strength in the soft tissue[34]. To assess FHP the craniocervical angle[35-36], can be used or the sagittal C7 tragus angle which is the angle formed by the crossover of the line drawn between the tragus of the ear and C7 with the horizontal (figure 1). This angle describes the head position in relation to C7, in a sagittal photograph, for example, of the left side, the head is placed more forward when this value is increased, measured in degrees. The average standard sagittal angle would be 131.1º (+/- 6.5º), with a confidence interval of 1.0º.

To determine the craniocervical angle, two lateral images are used, from the patient's left side, one in a relaxed standing position and the other in a relaxed sitting position. First the anatomical references are clearly marked. With a demographic marker the colour blue marks the tragus of the ear and the spinal apophysis of the C7 vertebra is marked with a plastic pointer.

The photographs were taken with an Olympus (E-420, Olympus, Hamburg, Germany) camera with an Olympus Digital 14-42 mm objective, mounted on a tripod and placed in marks on the floor at a distance of 1.5 metres from the subject. We placed the camera at a sufficient height so that the patient's head and trunk as well as the marks located on a plumb line and a metric reference (50 cm) that was located in the same plane as the patient appeared in focus through the viewer. The photographs were processed using the SAPO[37] software (software for postural analysis) to discover the craniocervical angle.

Measurement of cervical mobility. Pain related to posture, work or stress causes variations in mobility. Cervical mobility represents an important measurement in the results for assessment of the degree of effort and gravity of the limitation of patients' movements with cervical involvement[38]. The most basic method to assess cervical mobility is visual. Youdas et al.[39], compared visual estimation, goniometry and devices for the range of cervical articular movement (ROM – range of motion). Bad reproducibility was observed in the visual estimation (ICC 0.42-0.7). We used a cervical inclinometer known as CROM (CROM de Luxe, Performance Attainment Associates, Minnesota, USA) that is made up of 2 gravity inclinometers to measure the cervical mobility in flexion, extension, lateral flexion (in the sagittal and frontal planes) and rotation; the latter through a magnetic inclinometer (figure 1). Reproducibility of the obtained results with the device is clinically satisfactory. Studies carried out by Capuano-Pucci et al.[40] and Peolsson et al[41] have established an ICC (Interclass Correlation Coefficient), intra-rater reliability range ICC: 0.63-0.9 for the first measurement and ICC: 0.62- 0.91, for the second measurement; and an ICC intra-rater reliability range: 0.8- 0.87 in the first and ICC: 0.74-0.85 in the second.

The CROM cervical inclinometer was placed on the patient's head and we followed the cervical mobility assessment protocol, sequentially recording the movements in the sagittal plane (flexion-extension), then the frontal plane (left and right lateral flexion) and finally those of the transversal plane (left and right rotation). Each movement was repeated three times consecutively and the arithmetical average of the three measurements was calculated.

Measurement of pain noticed during the cervical movement. In the first measurement by inclinometer (of the three repetitions performed) of each cervical spine movement, both in the pre-procedure and post-procedure tests, the patient was asked to indicate a pain value noticed in cervical movement on the visual analogue scale (VAS) at the end of the movement with 0 being the value relating to the absence of pain and 10 being the value assigned to unbearable pain.

The Visual Analogue Scale (VAS) is considered as an effective, accurate, reliable, sensitive, easy-to-use

and reproducible method[42] to measure acute or chronic pain.

In the bibliography[43], there was a highly reliable intra-rater index (ICC: 0,992-0,998) for assessment using VAS. Each patient was informed on what VAS consisted of.

Statistical analysis

The quantitative variables are described using centralisation and dispersion measurements (average and typical deviation, mid and interquartile range, Q1-Q3). The qualitative variables are described using absolute frequencies (N) and relative frequencies (%). To represent distribution of the data, box-plot diagrams are used that represent the mid and interquartile range and enable identifying the outliers and extreme values. For univariate analysis the control and experimental groups were compared using non-parametric methods for the small sampling size. Univariate tests were performed to study the basal situation; the Fischer exact test in the case of qualitative values and the Mann Whitney U test in the case of quantitative variables. The same test was used to compare the post-procedure measurement and for the absolute pre and post procedure measurements relative to each group.

All the tests were considered bilateral and a p-value of <0.05 as a statistically significant value. The SPSS statistical software v.17 and STATA v.12 for Windows was used.

RESULTS

The total sample for this study was made up of 34 participants, aged between 18 and 50, inclusive (38.38 ± 4.66), assigned randomly to the study groups. Of them, 17 belonged to the procedure group (12 women and 5 men) and the remaining 17 made up the control group (9 women and 8 men). There were no losses in the monitoring phases or during the analysis (figure 2). Table 1 includes the basal characteristics for each group and no notable differences were detected between the groups. Table 2 includes the results of the pre and post-procedure absolute differences, calculated as pre and post for goniometry and as pre/post for VAS; table 3 shows the relative references with regards to the basal measurement in terms of percentage. Statistically significant differences were found in the craniocervical angle in sitting position, p=0.033 with a 4.93 ± 5.7% change in the experimental group and 0.6±3.77% in the control group. Effects of the procedure were not found in VAS, goniometry, nor in the craniocervical angle in a standing position.

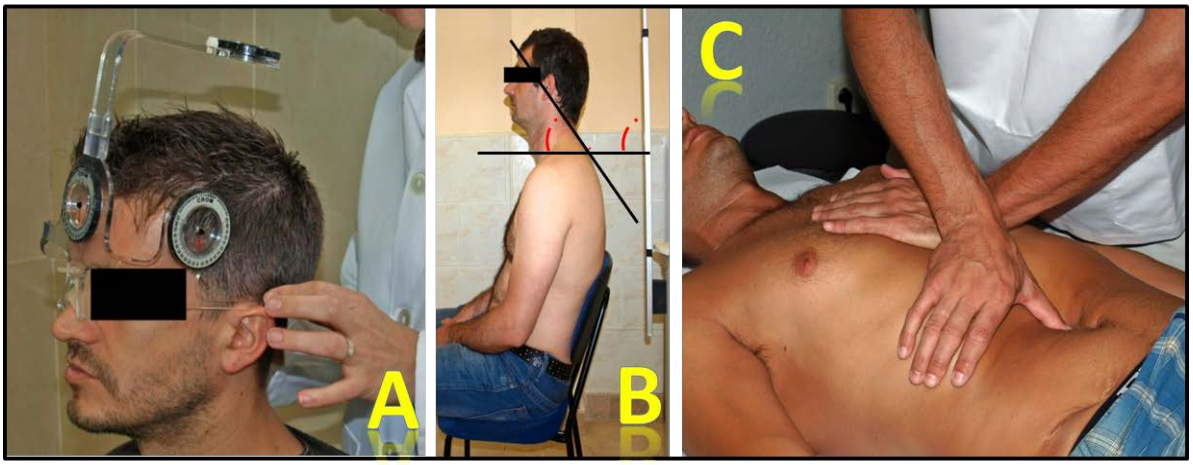

Figure 1.- Cervical mobility assessment (A) and FHP sitting down (B). NMT procedure applied on the Experimental Group (C).

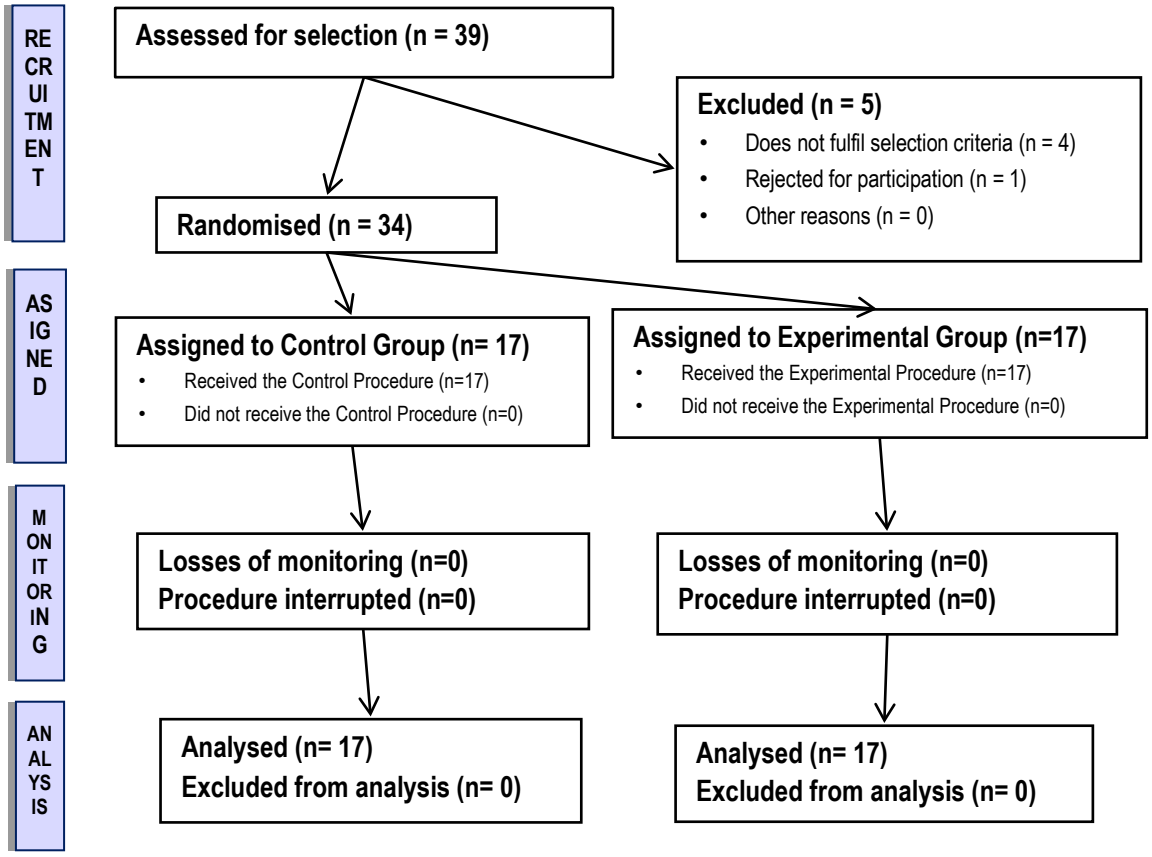

Figure 2. Flow chart according to the CONSORT declaration for the Randomised Trials Reports [44] of the parallel groups

DISCUSSION

After performing NMT at the rectus abdominis level we saw significant changes in the craniocervical angle while in a sitting position, which could benefit patients who show pain, related to positions maintained overtime during their employment activities.

However, we did not find changes in the craniocervical angle standing up, nor did we obtain any significant modifications in the cervical mobility or in the pain noticed during a neck movement.

This leads us to believe that NMT applied at the rectus abdominis level could be an efficient method in the treatment of patients with chronic mechanical cervicalgia, since it could help them to balance the head position in the space, making it match the gravitational vertical position more closely and, thereby, reducing the related mechanical stress on the cervical muscles. However, contrary to what we first thought, this new situation on balance is not connected to a reduction in pain level noticed during neck movements.

		TOTAL (n=34)	CONTROL (n=17)	EXPERIMENTAL (n=17)	P-value
SEX	MAN	13 (38.2%)	8 (47.1%)	5 (23.4%)	0.481
	WOMAN	21 (61.2%)	9 (52.9%)	12 (70.6%)	
AGE (years)		38.38 ± 4.66	37.94 ± 4.41	38.82 ± 4.99	0.808
BODY MASS INDEX (rate)		23.76 ± 2.97	24.23 ± 2.85	23.29 ± 3.09	0.293
CRANIOCERVICAL ANGLE STANDING UP (degrees)		50.10 ± 5.49	49.73 ± 5.56	50.47 ± 5.56	0.667
CRANIOCERVICAL ANGLE SITTING DOWN (degrees)		50.74 ± 5.37	51.24 ± 4.76	50.24 ± 6.03	0.449
GONIOMETRY FLEXION (degrees)		52.55 ± 9.55	53.24 ± 9.34	51.86 ± 9.99	0.593
VAS FLEXION (scale 0-10)		0 (0 - 1.25)	1 (0 - 3)	0 (0 - 0)	0.027*
GONIOMETRY EXTENSION (degrees)		63.87 ± 9.98	61.14 ± 10.50	66.61 ± 8.90	0.148
VAS EXTENSION (scale 0-10)		1 (0 - 3)	2 (0 - 4)	0 (0 - 2.5)	0.225
GONIOMETRY LATERAL FLEXION LEFT (degrees)		45.59 ± 8.99	44.75 ± 8.95	46.43 ± 9.22	0.931
VAS LATERAL FLEXION LEFT (scale 0-10)		2 (1 - 3)	3 (1 - 3.5)	2 (0.5 - 2.5)	0.140
GONIOMETRY LATERAL FLEXION RIGHT (degrees)		43.32 ± 9.52	42.24 ± 9.20	44.41 ± 10.00	0.459
VAS LATERAL FLEXION RIGHT (scale 0-10)		2 (0.75 - 4)	3 (1 - 4.5)	1 (0 - 2.5)	0.112
GONIOMETRY ROTATION LEFT (degrees)		67.92 ± 7.00	66.61 ± 8.08	69.24 ± 5.67	0.309
VAS ROTATION LEFT (scale 0-10)		0 (0 - 1)	1 (0 - 1.5)	0 (0 - 1)	0.221
GONIOMETRY ROTATION RIGHT (degrees)		68.57 ± 7.63	69.41 ± 5.87	67.73 ± 9.17	0.490
VAS ROTATION RIGHT (scale 0-10)		0 (0 - 1.25)	1 (0 - 2.5)	0 (0 - 0.5)	0.018*

TABLE 1. Demographic characteristics and basal measurements in the total sample and by treatment groups. VAS: Visual Analogue Scale; the p-values are the result of the univariate analysis; *Express statistical significance.

We were not able to compare our results with other similar studies, since we have not found any similar study and we suppose that our results are due to the fact that we have assessed the immediate effects of pain noticed after NMT application.

It would be logical to think that balancing the head's position will reduce the mechanical load of the cervical muscles and that those suffering pain will reduce their changes, although in those pain effects it is likely that the time factor will be decisive and, therefore, future research should be conducted that will assess these effects in the medium and long term, in addition to carrying it out immediately after the application of NMT on the rectus abdominis sheath.

The relationship between the function of the abdominal muscles and the position of the cervical spine was analysed by other writers[45] in 1995, objectifying

	Control (n=17)	Experimental (n=17)	P-value
CRANIOCERVICAL ANGLE STANDING UP (degrees)	*2.59 ± 6.54*	*4.47 ± 4.70*	*0.209*
CRANIOCERVICAL ANGLE SITTING DOWN (degrees)	*0.60 ± 3.77*	*4.93 ± 5.78*	*0.031**
FLEXION GONIOMETRY (degrees)	*-2.80 ± 12.82*	*0.32 ± 13.33*	*0.796*
EXTENSION GONIOMETRY (degrees)	*5.53 ± 9.76*	*6.39 ± 10.28*	*0.513*
LEFT LATERAL FLEXION GONIOMETRY (degrees)	*3.79 ± 11.45*	*3.96 ± 8.85*	*0.823*
RIGHT LATERAL FLEXION GONIOMETRY (degrees)	*4.08 ± 9.08*	*3.82 ± 9.39*	*0.730*
LEFT ROTATION GONIOMETRY (degrees)	*4.14 ± 8.28*	*-0.44 ± 8.36*	*0.098*
RIGHT ROTATION GONIOMETRY (degrees)	*0.21 ± 10.88*	*1.55 ± 11.90*	*0.730*

TABLE 2. Pre and post-procedure absolute differences. The data is represented as an average ± typical or mid deviation range (interquartile range).

	Control (n=17)	Experimental (n=17)	P-value
GONIOMETRY FLEXION (degrees)	*-1.92 ± 7.34*	*-0.33 ± 6.72*	*0.743*
VAS FLEXION (scale 0-10)	*0 (0 - 1)*	*0 (0 - 0)*	*0.767*
GONIOMETRY EXTENSION (degrees)	*2.92 ± 5.35*	*4.53 ± 6.5*	*0.293*
VAS EXTENSION (scale 0-10)	*0 (0 - 2)*	*0 (0 - 1)*	*0.595*
GONIOMETRY LATERAL FLEXION LEFT (degrees)	*1.43 ± 5.03*	*1.29 ± 4.1*	*0.877*
VAS LATERAL FLEXION LEFT (scale 0-10)	*1 (0.5 - 2)*	*1 (0 - 1.5)*	*0.457*
GONIOMETRY LATERAL FLEXION RIGHT (degrees)	*1.33 ± 3.89*	*1.33 ± 4*	*0.769*
VAS LATERAL FLEXION RIGHT (scale 0-10)	*1 (0 - 2)*	*1 (0 - 1.5)*	*0.986*
GONIOMETRY ROTATION LEFT (degrees)	*2.61 ± 5.51*	*-0.41 ± 5.65*	*0.088*
VAS ROTATION LEFT (scale 0-10)	*0 (0 - 1)*	*0 (0 - 1)*	*0.924*
GONIOMETRY ROTATION RIGHT (degrees)	*-0.08 ± 7.2*	*0.63 ± 7.54*	*0.783*
VAS ROTATION RIGHT (scale 0-10)	*0 (0 - 1)*	*0 (0 - 0.5)*	*0.762*

TABLE 3. Relative differences in so many percent given a basal situation. *Express statistical significance.

that the neck and pelvis alignment could affect the electromyographic activity of the torso's flexor and extensor muscles.

In our case, we can confirm that this happens in the neck after applying a NMT in the rectus abdominis sheath given that we have not electromyographically assessed the cervical muscles, which we consider useful for future research, although we have objectified the absence of changes in cervical mobility, which could be related to the state of the hypertonic cervical muscles.

Perri et al.[46] analysed in a study the defective respiration and CMC, suggesting that for the treatment of the latter, respiratory disorders must be assessed and treated, due to their great influence on back pain and in particular on cervicalgia. This may be due to the fact that at a myofascial level there is a functional unit. Mihalache, G. et al.[47] observed that the deep cervical fascia is continuous, like a hose, surrounding the neck and torso and that in the mid-ventral line it is very dense and resistant and continues from the hyoid bone to the pubis. At the neck level, it surrounds the sternocleidomastoid and trapezium muscle, continues to the thorax level surrounding the major pectoral and wide dorsal muscles, and at the abdomen´s level, it becomes very fine and covers the anterior rectus sheath of the abdomen. In our case, we are convinced that the respiratory muscles contribute functionally to the state of the neck's mobility and therefore to the state of health or illness, with a relationship existing between both. That is why we recommend that it is integrated into the treatment protocols of patients with CMC or NMT at the rectus abdominis sheath level, since it contributes to balancing the head's position vertically in gravity. It could also be included in the protocols for health and safety at work, in those individuals who perform tasks sitting down with a forward head position for more than 4 hours a day.

Study limitations

Our study has limitations in several aspects, such as the sample size, for example, which we recommend to be increased in subsequent studies. Also, we did not assess the obtained effects after a more prolonged period of time, nor did we monitor in the short, medium and long term and, therefore, these actions could be performed in future researches. Finally, we have to add that we only assessed the effects of one technique and, therefore, the results and conclusions of greater clinical importance in the future must be included within a comprehensive treatment of the subject, in which several therapeutic procedures are included.

CONCLUSIONS

Application of NMT at the level of the rectus abdominis sheath produces an immediate significant increase in the craniocervical angle while sitting down, but no statistically significant differences were seen in cervical mobility, in pain noticed during a neck movement or in the craniocervical angle while standing.

ETHICAL STANDARDS

Our study fulfils the ethical standards of the Helsinki Declaration[48], and its subsequent revisions and was approved by the Ethical Experimentation Committee at the Seville University, on the 26th of November 2011, therefore fulfilling all the requirements demanded for experiments on human beings and animals, and adapting it to the current regulations in Spain and the European Union.

CONFLICT OF INTEREST

The authors declare they do not have any conflict of interest.

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ORIGINAL ARTICLE

Immediate Effects of Occipito-atlo-axoid manipulation on Foot Support: Baropodometric Study

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Spinal manipulation;
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atlantoaxial joint;
propioception;
weight support.

ABSTRACT

Introduction: Postural balance is maintained thanks to a continually changing system of inputs and outputs. The goal of these changes is to maintain the sight and labyrinthine centres horizontal. To do this, the upper cervical spine has an important role, ensuring the head's direction within the area. This study is about assessing the effect on the support of proprioceptive normalisation of the suboccipital spine.

Objectives: To assess immediate changes in pressure distribution on the arch support after occipito-atlo-axoid thrust (OAAT).

Material and methods: A single blind randomised controlled trial (RCT) of an experimental explanatory nature was carried out using the strategy of a blind (no connection between the assessor and inspector) assessor. Each subject was assessed before and after the procedure or placebo using a pressure platform. The subjects were assessed without footwear receiving standardised orders. The sample had 46 subjects (25 men and 22 women) with an average age of 24.98±3.04. For comparison between groups of the variance for parametric variables, the ANOVA statistic was used and for the non-parametric variables the Mann Whitney U test was used.

Results: An increase was seen in the "maximum pressure" (p=0.044) and in the "load percentage on the left foot" (p=0.048) coming close to equitable bilateral distribution.

Conclusions: Occipito-atlo-axoid manipulation increases the maximum support pressure and approaches the percentage for equitable bilateral load distribution in healthy subjects. The results could lead to considering changes in support after the technique, which must be verified in later studies with larger samples.

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INTRODUCTION

Foot support changes with modifications to postural balance[1]. Postural balance is governed by a complex system of inputs and outputs, the first coming from the somatosensory, vestibular and visual systems[1-4] and the second aimed at the muscles, both coordinated by the cerebral cortex, cerebellum and basal ganglia[5]. Therefore, this refers to a continuous dynamic process that seeks balance against gravity and has an effect on support.

The support area, along with control of active body alignment, anti-gravitational tone, the visual range and internal references determine postural direction and balance[2].

Somatosensory information obtained through proprioceptors and exteroceptors plays an important role in maintaining balance[6-8]. These receptors are incorporated into the fascia framework that extends throughout the body[9-11], in such a way that change in fascia tissue can be a cause for alternation in balance[12].

Cervical spine and balance

The articular and periarticular structures of the cervical spine, above all the upper cervical complex, are provided with a large number of mechanoreceptors and nociceptors per unit of mass[10, 11]. Dysfunction of the high cervical spine, therefore, can cause alteration of the somatosensory inputs and affect the workings of the musculoskeletal system, as well as contributing to the appearance of local and regional symptoms[10, 13].

The centre of gravity for balance in the head is immediately before the occipital condyles and, therefore, it tends to move forwards due to gravity.

The posterior cervical muscles take on special importance in this imbalance[10, 14].

Baropodometry

Baropodometry enables registering the characteristics of foot pressure. Knowledge of distribution of foot loads is useful in the diagnosis of the musculoskeletal system and enables the assessment of its biomechanics[15]. It is a non-invasive method, valid for conducting or completing diagnoses and for monitoring treatments[16].

Thrust techniques

High-speed and low-range techniques, also known as thrust, are performed using therapeutic application of an intense movement with specific direction against the motion barrier on joints and other tissues. They frequently cause cavitation, due to the separation of the articular faces. A neurological silence is achieved that inhibits hypertonia of the monoarticular muscles, due to the inverse myotatic reflex mechanism, breaking the irritative articular vicious circle and improving the articular congruence[13].

GOALS

To verify whether the occipito-atlo-axoid thrust technique affects the proprioception of the suboccipital spine, sufficiently as to modify the postural balance and distribution of loads on the arch support.

MATERIAL AND METHODS

Study design

A single-blind randomised controlled clinical trial of an experimental explanatory nature was conducted using the strategy of a blind assessor (no connection between the assessor and inspector).

The subject did not know the group they belonged to and to ensure their blindness, they did not know how many measurements were going to be conducted on them. The assessment was performed before and after the procedure.

Study population

The sample was made up of individuals with no pathology, physiotherapy students at the Cardenal Herrera University CEU in Elche, who fulfilled the criteria for selection into the study.

Selection criteria

Criteria for inclusion: individuals without previous cervical pathology who are Physiotherapy students at the Cardenal Herrera University (CEU) in Elche. The criteria for exclusion was: a) suffering from or having suffered from pathologies of the postural control system (postural captors, central nervous system or locomotor apparatus), b) showing orthopaedic defects or injuries in lower limbs or the spine, c) having suffered traumatic injuries in lower limbs or the spine in the previous 12 months or suffering from the effects of previous injuries, d) having pain at the time of the study, e) showing contraindications to the procedure being studied, f) having received manipulation treatment in the previous six months and g) having had surgery of any type.

Randomisation

The subjects were assigned to groups using simple randomisation.

Study subjects

They formed two groups: OAAT was applied bilaterally to the procedure group (n=26): the same position for pressure was applied to the control group (n=20) as that of the procedure group, but no thrust was performed.

Two adjacent rooms were used to perform the study with identical atmospheric conditions and without any altitude difference between them, always using the same sequence, following the recommendation of the French Association of Posturology[17]. The time between the procedure and post-procedure measurement was always less than one minute.

Study protocol

We informed the subjects of the study's general aspects using an informed consent form, in accordance with the current Spanish legislation (Act 15/1999). After signing the informed consent form, the pre-procedure measurements were taken; then, the related procedures were applied to each group and finally, the measurements were repeated post-procedure.

Assessments performed

A baropodometric[18] platform was used for the assessment (Diagnostic Support S.R.L., "Multisensor Clinical" model; 4 sensors/cm2; 40 captures/second) and the data was recorded by the Milletrix software (Diagnostic Support. V.1.0.0.26). The baropodometric record was performed with the subject's heels aligned in a comfortable position, looking forwards at the eye height, towards a wall 5m away from the subject. A clear panel was positioned at each side closing off a 3 m wide passageway. Silence, a constant temperature (20º-23º) and good light (2000 Lux) were maintained. The baropodometric record lasted five seconds. The measurement was taken without footwear[19, 20] and the orders given to the subject were standardised, so that they did not disproportionately affect the postural attitude[21].

Baropodometric data was recorded for each subject referring to the surface (total support, right hind foot, left hind foot, right forefoot, left forefoot, percentage of the right foot with regards to the total) loads (maximum, average, percentage on the left foot, load over the left forefoot with regard to the load on the left foot, load on the right forefoot with regard to the load on the right foot).

Procedures performed

Procedure group: OAAT was applied bilaterally to the procedure group (n=26). OAAT was applied on rotation on the vertical axis what goes through the odontoid processes of the axis. Neither flexion nor extension was used and very little lateral flexion, always carrying it out bilaterally. It managed to restore mobility in a non-specific way in the joints between the occipital, atlas and axis 22. It was performed with the subject in a supine position, the physiotherapist at the side in order to manipulate in a forward feint, looking at the head of the subject at the arm height; the upper hand takes the cranium so that, on turning the subject's head, it stayed between the bed and the head serving to stabilise it, whilst the forearm was located within the extension of the odontoid processes of the axis; the lower hand

made contact with the opposite side of the cranium with the thumb behind the mastoid processes, the index finger on the temple, keeping within the axis of the radius, middle finger in the direction of an angle with the eye, ring finger towards the nose, little finger in flexion of the metacarpal phalangeal joint and extension of the interphalangeal joints, is placed under the chin, whilst the forearm rests on the sternum in the direction of the left cranium parallel to the spine.

The technique was performed in two stages: a) light cephalic traction and search for the motion barrier using light circumduction movements, b) the left hand makes a movement in pure rotation, at the same time that the cranium makes an axial traction in the axis of the odontoids of the axis. Both actions must make up a helicoidal movement towards the end of the bed[13].

Control group: the same position for pressure was applied to the control group (n=20) as the procedure group, but no thrust whatsoever was performed to rule out the exteroceptive effect related to contact by the physiotherapist and articular movement without thrust.

Statistical analysis

Statistical analysis was conducted using the SPSS programme version 15.0. For the descriptive analysis the average and the standard deviation were calculated. To verify normality the Kolmogorov-Smirnov test was carried out and for homoscedasticity the Levene test.

To assess the pre/post intergroup differences the T test was used for related samples (if normality and homoscedasticity were fulfilled) or the Mann-Whitney U test (if they were not fulfilled).

To conduct the analysis of pre/post intergroup differences between groups, we used the ANOVA statistic. The value of significance was established at $p<0.05$.

RESULTS

Characteristics of the subjects

The sample included 46 subjects (24 men and 22 women) divided into 2 groups; procedure (26 subjects) and control (20 subjects).

The age ranged between 19 and 31 with an average of 25.0± 3.1, the average weight was 68.1±8.4 kg, whilst the average height was 171.2±8.4 cm. This means that the Body Mass Index (BMI) was at an average value of 23.3±1.7.

The average physical activity was 2.63±2.83 hours weekly, with 0 as the most frequent value (43.5% of the subjects).

With the T test on students (Mann-Whitney for the non-parametric variables), we verified the differences according to the pre-procedure characteristics of the sample. No differences were identified according to the level of physical activity (measured in three intervals: 0, 1-5, +6 hours).

The area of total support was better in men than women. There were no significant differences in the baropodometric records in connection to age (in 2 intervals: 19-25 and 26-32 years).

The overweight subjects (BMI>24.9) showed a maximum support pressure, greater than those who showed normal BMI (p=0.044).

Effects of the procedure technique

To check the effect of the procedure, the percentage of change between the pre-procedure and post-procedure records was calculated.

An increase of 4.72±11.75% was identified in the maximum pressure (p=0.044), in addition to a reduction of -3.33±5.02% in the area of support of the left hind foot (p=0.042) over the control group.

For the right foot, the area of support of the hind foot after the procedure was reduced by -2.21±6.79, although the latter did not reach the significant level (p=0.077).

Approach towards symmetry of the load between both feet after the procedure also occurred (p=0.048).

Variables	Pre (n= 26)	Post (n= 26)	Confidence interval for the average at 95%	K-S test (pre/post)	p
SupTotal	188.52±26.59	184.79±26.68	[(-4.24) - 0.44]	0.200/0.200	0.061
PrMax	737.53±115.54	772.53±155.31	[(-0.02) - 9.47]	0.200/0.042	0.036
PrMed	379.02±43.65	396.15±69.93	[(-0.61) - 9.51]	0.200/0.035	0.036
SupApizq	55.96±10.10	54.82±9.62	[(-5.84) - 2.67]	0.200/0.001	0.336
SupApDch	58.11±11.06	56.39±11.16	[(-6.64) - 1.15]	0.200/0.200	0.042
SupRplzq	37.09±5.05	37.02±5.06	[(-2.24) - 2.04]	0.198/0.200	0.666
SupRpDch	37.31±4.81	36.42±4.87	[(-4.95) - 0.53]	0.200/0.200	0.027
%cargaRplzq	52.42±6.48	52.54±6.01	[(-1.66) - 1.90]	0.200/0.200	0.459
%cargaRpDch	54.76±7.71	54.66±7.96	[(-1.46) - 1.26]	0.056/0.200	0.081
%SupDch	50.60±1.65	50.28±2.55	[(-1.56) - 0.93]	0.200/0.200	0.604
%Cargalzq	49.05±2.83	49.81±1.13	[(-0.10) - 1.63]	0.182/0.200	0.125

Table 1.- Baropodometric data for the procedure group

SupTotal=Total support area (cm2); PrMax=maximum pressure (g/cm2); PrMed=Average pressure (g/cm2); SupApIzq/SupApDch/SupRpIzq/SupRpDch=Area of support of the left forefoot, right forefoot, left hind foot and right hind foot respectively (cm2); %cargaRpIzq=Percentage of load on the left hind foot with respect to the total load on the left foot; %cargaRpDch=percentage of load on the right hind foot with respect to the total load on the right foot; %SupDch=percentage of support area of the right foot with respect to the total area; %Carga Izq=percentage of load on the left foot with respect to the total load. The confidence interval shown indicates the pre-post percentage increase.

Variables	Pre (n= 20)	Post (n= 26)	Confidence interval for the average at 95%	K-S test (pre/post)	p
SupTotal	176.19±12.06	175.22±10.87	[(-1.42) - 0.44]	0.001/0.011	0.694
PrMax	776.99±46.17	780.30±49.60	[(-0.68) - 1.52]	0.200/0.200	0.491
PrMed	370.44±23.32	383.91±18.94	(1.83 - 5.76)	0.064/0.001	0.033
SupApizq	55.00±10.57	55.60±10.19	[(-0.86) - 3.85]	0.200/0.200	0.311
SupApDch	56.92±10.44	56.79±9.72	[(-1.61) - 1.86]	0.200/0.200	0.844
SupRplzq	36.81±6.61	35.52±6.38	[(-5.68) – (-0.98)]	0.200/0.200	0.126
SupRpDch	35.86±5.98	36.25±5.91	[(-1.66) - 4.43]	0.200/0.200	0.112
%cargaRplzq	53.42±6.43	53.07±5.56	[(-1.66) - 0.95]	0.200/0.200	0.161
%cargaRpDch	54.36±4.28	54.12±4.07	[(-1.53) - 1.05]	0.120/0.200	0.511
%SupDch	51.53±1.77	49.93±1.71	[(-2.61) – (-0.60)]	0.200/0.132	0.103
%Cargalzq	49.29±2.94	48.86±2.89	[(-1.23) - 0.37]	0.200/0.199	0.164

Table 2.- Baropodometric data for the control group

Variables are the same as table 1. Values expressed as an average ± the standard deviation.

	Control	Procedure	p-value (*ANOVA/ Mann Whitney U**)
SupTotal	-0.49±1.98	-1.90±5.80	0.176 (‡)
PrMax	0.42±2.35	4.72±11.75	**0.044** (‡)
PrMed	3.79±4.19	4.45±12.54	0.626 (‡)
SupApizq	1.50±5.04	-1.5810.53	0.240 (‡)
SupAntDch	-0.24±2.76	-2.75±9.64	0.187 (‡)
SupRplzq	-3.33±5.02	-0.10±5.31	**0.042**
SupRpDch	0.12±3.71	-2.21±6.79	0.077
%cargaRplzq	-0.36±2.79	0.12±4.41	0.674
%cargaRpDch	1.39±6.50	-0.10±3.37	0.881
%SupDch	-1.61±2.15	-0.32±3.09	0.118
%Cargalzq	-0.43±1.71	0.76±2.14	**0.048**

Table 3.- Results of the comparison between groups of the pre-post percentage increase

Variables are the same as table 1. Values expressed as an average ± the standard deviation.

p-value from ANOVA/ Mann Whitney U(‡)

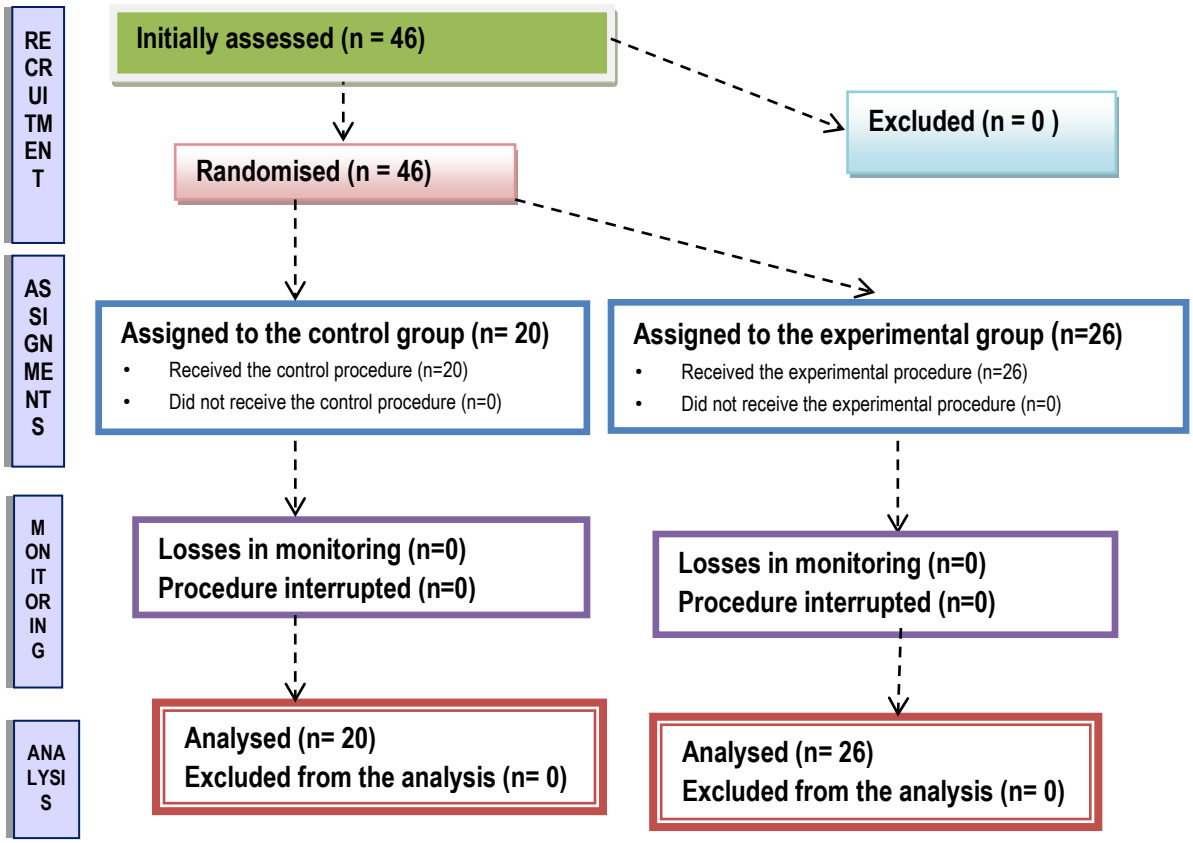

Figure 1.- Flow chart on the distribution of the sample (Consort)

DISCUSSION

The occipito-atlo-axoid manipulation technique changes the baropodometric records. Change in the recorded support shows an increase in the maximum pressure and approach towards symmetry of loads between both feet. Significant changes are also seen in the area of support, although not attributable to the procedure.

Baropodometry has been effectively used in the assessment of common balance disorders, as well as in assessing the effectiveness of a treatment in changes to the central nervous system (cerebellar ataxia[23], incomplete spinal cord injury [24], cervical polyneuropathy [25]…), alterations to the postural captors (vestibulars[26], Menieres disease[27], visual[28], proprioceptive [7, 29-31], cranio-mandibular [32, 33]) or alterations of musculoskeletal elements (gonarthritis[34], articular prostheses[35], lumbago[36], articular reconstruction surgeries[37], spinal defects[38, 39], ankle sprains[40], foot surgery[41, 42], treatment of foot defects with orthotics[43, 44]).

Thrust techniques

Different thrust techniques for the cervical spine were studied to show reduction in pain and increase in the range of mobility [45-48]. Others looked for effects through the action on the autonomous nervous system (changes in pupil reaction[49], in intra-ocular pressure [50] or blood pressure [50, 51]).

The change in baropodometric parameters were studied after the application of certain manual techniques such as overall manipulation of the pelvis [52], decompression of the tibioperoneal astragalus[53], correction of anterior dysfunction in the astragalus [40] or dysfunction of the forefoot varus [54]. The usefulness of the baropodometry is recognised for the study of the somasensatory effect of the thrust techniques[55].

OAAT was studied to establish what its effects are on the mouth's opening range and on pain in the clamping points of the masticatory muscle[56], ocular pressure and blood pressure[50]. In our bibliographic review, we have not found evidence that any study has been conducted on the effect of OAAT on the balance and distribution of foot loads through pressure platforms.

Thrust techniques on the cervical spine have an effect on the cortical areas of the somasensatory integration[57]. The somasensatory effect of OAAT can help improve the head's balance on the spine and, therefore, stability is balanced with the subject approaching symmetry of load between both feet.

The sympathetic effect related to the stimulation of the upper cervical ganglion and release of possible fascia pressure causing small reductions in the vertebral arteries' lumen can help improve vascularisation of the cephalic postural captors and the integration centres of the central nervous system and, thereby, improve function in the postural balance system. In order to confirm this aspect, it would be important, in future research, to assess the OAAT´s effect on the vertebral or carotid arterial lumen.

We did see some evidence that variables of sex, age, physical activity or BMI in the described intervals influence the OAAT effects.

Limits and future research

a) Measurement standardisation. Support continuously changes and our protocol assessed the support for 5 seconds, which makes up a baropodometric recording limit. On indicating specific orders and aware of what is observed maintenance of balance is done consciously and this situation could change the distribution of loads on feet. Use of different assessment protocols could be the subject of future research.

b) By referring to healthy subjects, the information that we obtain is on the technique's physiology and not on its clinical effects. The application of this technique on subjects with instability where the proprioceptive captor is changed (such as for example cerviogenic proprioceptive vertigo[17, 58]), could be the subject of future research. In these cases, we might also find secondary cervical vertigo at temporary alteration of blood flow of one of the vertebral arteries, due to the articular injury or cervical somatic dysfunction[59].

c) Due to the much higher standard deviations seen and much lower effects, the low sample size may have discounted small differences. Future research could be carried out with a large sample.

d) A non-specific overall technique that generally restores mobility in the region, so that it would not be necessary to assess whether each individual showed or not specific dysfunctions in the subocciptal spine. Validation is needed of diagnostic test for cervical mobility[60, 61],in order to determine the stabilometric nature of each osteopathic dysfunction and to apply specific techniques for each of them.

CONCLUSIONS

Occipito-atlo-axoid manipulation applied on subjects without cervical pathology achieves a symmetric approach on the distribution of the loads supported between both feet. The results encourage us to consider changes in support after the technique, which must be verified in later studies with larger samples.

ETHICAL STANDARDS

The Helsinki Declaration recommendations on clinical research (2004) have been followed. Confidentiality of data was guaranteed at all times, in accordance with the 15/1999 Data Protection Act.

CONFLICT OF INTEREST

The authors declare they do not have any conflict of interest.

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TECHNICAL REPORT

Semidirect thrust technique for rotation disorder in the atlas with index finger contact

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ABSTRACT

Due to the large anatomical and functional differences, the study of the craniocervical region is separated from the rest of the cervical column. The craniocervical junction is considered as responsible for very different signs and symptoms to those we find in the inferior cervical spine, such as for example vertigo, headaches with different origins, etc.

The objective of the thrust technique for an atlas rotation disorder with index finger contact is to return mobility and functionality to the vertebra. It is important to master the basic principles of performing the technique to be able to apply the correct therapeutic procedure after having ruled out the possible risks of manipulation.

INTRODUCTION

The superior cervical column (C0-C1-C2) has the most extensive mobility of the entire vertebral column: it carries out more than 50% of the cervical rotation and a third of the cervical flexion-extension1. Trauma or painful procedures for the neck or adjacent structures can cause a reflex muscle spasm to protect the area, resulting in a loss of mobility [2].

Cervical pain affects the patient's quality of life and has significant social and financial consequences[3]. According to Rezai et al., it has a high morbidity rate, both at an occupational level and in daily activities [4]. We must carry out an intense anamnesis and diagnosis, using challenge tests and X-rays to prevent risks and contraindications such as, for example, accidents originating from an injury to the vertebral artery after a careless manoeuvre [5, 6].

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The artery can be damaged at those points where its mobility is less in relation to the neighbouring structures: C2 transverse foramen, C1 posterior arch channel and the intracranial dura mater [7, 8]. With the thrust techniques, we seek to return the muscle spindle to normal. Rapid stretching of the spindle's intrafusal fibres occurs, which causes a series of afferent impulses of such high frequency for the central nervous system that, as protection, it reduces the gamma hypersensitivity [9, 10].

OBJECTIVES

The technique's objective is to overcome the suboccipital muscle spasms that set the posterior vertebra and restore the articular mobility by opening the facet, dislocating it in the direction of the contralateral rotation. Two effects are produced:

-Mechanical effect: the joint is mobilised eliminating adherences and stretching the articular capsule and ligaments, causing a reflex inhibition of the muscle spindles and of the suboccipital muscles in spasm. The facets diverge.

-Neurological effect: the mechanical receptors of the transverse ligament, the main stabiliser of the odontoid processes on the atlas´s interior arch is stimulated[11] and of the alar ligaments that are essential in the control of the atlas rotation and those of the articular capsules that are not as significant as the above, but that also limit rotation and lateral inclination[12]. In this way the gamma hyperactivity is inhibited.

The technique is accompanied by an intra-articular cavitation[13]. We stimulate the sympathetic nervous system through the upper cervical ganglion, restoring the muscle spindles altered by the sympathetic hyperactivity to normal.

There is a local vascular reflex that enables the reduction of the inflammation in the intervertebral foramina.

APPLICATION PRINCIPLES

In a dysfunction of the atlas in rotation, we find the posterior vertebrae of the rotation side. The dysfunction is maintained by the suboccipital muscular spasm of the posterior side. The facet of the atlanto-axial joint on the rotation side is imbricated. The dysfunctions or pathologies at a high cervical level can trigger different types of symptoms, such as, for example, headaches[14,15,16] or pseudovertigo[17,18]. The limited movements are: contralateral rotation with the inferior cervical spine in flexion, homolateral tilt and anterior slipping on the posterior side, which limits a certain degree of the atlanto-axial extension. The technique consists of using direct contact through the distal inter-phalangeal joint of the physiotherapist's index finger on the transverse process of the atlas, regulating the capsular-ligament pressure, using the head as a lever, in a double chin position (neutral flexion-extension), slight anterior slipping, light homolateral lateral flexion (that involves contralateral slipping) and contralateral rotation to the posterior, up to the dysfunction level. Once the parameters are in place, a high speed and short-range thrust on the contralateral rotation are applied to open the imbricated facet and return mobility to the limited components.

DIAGNOSIS ASSESSMENT

The diagnosis for a dysfunction on rotation of the atlas is based on the following clinical tests:

1) ***Radiology*** [19]. Extensive osteopathic information can be obtained from the upper cervical spine X-rays.

-A transoral x-ray from the front shows the occipital condyles and the first two cervical vertebrae. Several lines are drawn:

a) One that joins the two mastoid notches

b) One that joins the junction points between the lateral and transverse mass of the atlas.

c) One that passes through the joint of the axis laminae and pedicles.

d) One vertical line that passes through the C2 spinous tubercles and the point of the odontoids.

The transverse line of the occiput is horizontal in the dysfunctions of the atlas rotation. Posterior rotation is identified because the homolateral lateral mass is apparently smaller. The atlas rotation is related to a lateral-flexion movement and to a homolateral lateral slipping. The vertebra is posterior-inferior. The anterior rotation shows a larger lateral mass. C1 is anterior-superior of the side contrary to the posterior one. The lateral space is measured through the distance between the internal border of the lateral masses and the odontoid processes; it must be equal, and a reduction indicates a lateral space on the opposing side.

-Profile radiography. This enables the study of congenital defects, bone spurs, C1 or C2 fractures. It enables the assessment of the defects at the occipital, atlas and axis level through:

a) An anterior-posterior line of the atlas joining the anterior and posterior tubercles.

b) A basioccipital line that joins an anterior point, determined by the joining of the flat part of the occipital and the posterior part of the condyle and one posterior placed in the join of the flat part, and also the start of the occipital squama.

The normal angle between these is 8º. Although dysfunction in rotation is normal in the atlas, dysfunctions can be added in flexion or extension. When the angle is less than 8º, we are looking at a dysfunction in flexion; when it is greater, we are looking at a dysfunction in extension. The rotation is characterised by a division of the posterior border of the lateral masses of the atlas.

-Radiology through the vertex. This is used to confirm a rotation of the atlas. A line is drawn from anterior to posterior that passes through the nasal septum, the basilar process, the middle of the odontoid processes and the rest of the cranium. Another line is drawn that passes in an anterior direction to the transverse processes of the atlas. Finally, a line is drawn perpendicular to the anterior-posterior line. Any difference between this line and the one which passes through the atlas indicates a rotation between the occipital bone and C1.

-Dynamic radiography. This is done in flexion-extension and is useful when we suspect atlas/axis instability.

2) ***Neurological examination*** [20]. Study of the dermatomes, myotomes, reflexes, etc.

3) ***Palpation*** [20].

4) ***Orthopaedic tests:***

-Klein Test [21]. The cervical column is the region of the musculoskeletal system, where the majority of the reported complications in manual therapy treatment occur. The thrust techniques are used by a large number of physiotherapists during their daily practice [22]. An exhaustive examination, both objective and subjective of the patient must be performed that, along with our anatomical awareness and knowledge at the time of using thrust, increases the technique's safety and specificity [23]. Even though a traumatic injury to the vertebrobasilar arterial system is rare, it is catastrophic. The Klein Test is used as a provocative diagnostic manoeuvre of the artery's integrity. The test consists of extending the patient's head and neck off the bed with the patient in a supine position and initiating rotations to the right and left (figure 1), maintaining the head in each one of the rotations for between 30 seconds and 2 minutes, waiting for nystagmus to appear or adverse symptoms such as nausea, giddiness, loss of consciousness or any symptom that indicates partial or total occlusion of the artery. Appearance of any of these

symptoms is a total contraindication to vertebral manipulation[24]. Some authors state that the responsible manipulation parameters for an injury to the vertebral artery are the range and force of the thrust, whereas the speed can minimise risks [18]. Significant reduction in the vertebral systolic peak and final diastolic occurs in the artery flow on the contralateral side in the pre-manipulation position for the C1-C2 segment. Significant changes are also found in the rotation [25].

Figure 1. - *Performing the Klein test.*

5) ***Active mobility test***. Devices that measure the range of cervical mobility (RCMO) have been shown to be more reliable compared with other measuring methods in all its movement ranges [26-29]. Electromagnetic[30] or radiographic[31] equipment can also be used.

6) ***Osteopathic tests.***

-Flexion-rotation test. This test has been validated by Hall et al. in different studies [32,33], even using live magnetic imaging[34]. Sensitivity and specificity of the test was 90% and 88% respectively with a kappa index of 0.85. The test is done prior to the procedure to determine the side of the dysfunction, and to check afterwards its correction and the relevant increase in mobility. The test is done with the patient in a supine position. The assessor makes contact using the radial border of the index fingers of two hands at the level of the atlas controlling the transverse processes. The thumbs rest on the side of the head. The test consists of putting the mid cervical spine in flexion, to achieve pressure on the posterior soft cervical tissue which blocks all the cervical levels except the atlas that remains free to perform the rotation movements. Maintaining the head in a double chin position at the level of the upper cervical spine the patient's head is turned in rotation on both sides, comparing the range of motion to the left and then to the right; likewise the quality of the restriction is analysed. One rotation restriction to the right becomes one dysfunction in the posterior of the left side [20].

INDICATIONS / BENEFITS

The previously mentioned is indicated for cases of cervicalgia, cervicobrachial neuralgia, Arnold's neuralgia; headache and migraines, cervical disc hernias, position vertigo; and also, related visceral problems [6,9,20] (heart, throat, eyes, nose etc.).

CONTRAINDICATIONS / RISKS

Due to the existence of related risks[6,9,20] this technique is not recommended in the following cases: recent trauma (fractures, grade III sprains, dislocations), vascular alteration (aneurysms, vertebrobasilar insufficiency); metabolic illnesses (significant osteoporosis); congenital defects (Downs´ syndrome, due to the absence of the transverse ligament); basilar impression (Arnold-Chiari, syringomyelia); occipitalisation of the atlas; pontus unticus; psychological changes (rejecting the manipulation or hysteria; peripheral or central paralysis; hyperalgesic syndromes related to neurological pathology; Barré-Lieou syndrome; bone tumours; inflammatory rheumatism (rheumatoid arthritis, ankylosing pelvic spondylitis, etc.); infections (spondylodiscitis).

Likewise, we consider the following relative contraindications[35]: incomplete diagnosis, not having the patient's consent, pain during the performance of

the technique on looking for the pressure, postpartum situations, etc.

TECHNIQUE DESCRIPTION

Position of the party. The patient is in a supine position, with the physiotherapist standing, bended forward of the patient's head, on the side of the atlas posterior, with the centre of gravity above the dysfunction.

Position of the hands. The left hand takes the cranial pressure. The right hand, because of its position "square" to the C1 transverse process between the ramus of the mandible and the mastoid processes, cannot apply a classic contact with the index finger and therefore, it is done with the tip of the third phalange of the index finger strengthened by the big finger, on the posterior part of the transverse process of the atlas. The forearm is placed in the reduction axis.

Carrying out the technique.

1st stage. Set the double chin right position until noticing the pressure in the right index finger.

2nd stage. Light anterior slipping, light homolateral lateral flexion (that leads to contralateral slipping), contralateral rotation, contralateral, after circumductions to perfect the pressure.

3rd stage. Rotational thrust in the direction of the patient's eye, accompanied by a rotation of the physiotherapist's wrist (figure 2).

After performing the manipulation, we find an analgesic effect due to the release of endorphins [36] and a placebo effect thanks to the articular cavitation [37].

Figure 2.- *Thrust technique for a dysfunction on the right rotation of the atlas with an index finger contact.*

PRECAUTIONS

The idea is to assist the release of tissue in the expiratory phase and to reduce the pressure within the correction parameter; the rotation. When performing the technique, elbows are kept touching the body in order to control the thrust´s force and range. The technique is suspended if pain occurs when putting on pressure.

CONCLUSIONS

The technique's objective is to focus a brief and quick, short-range thrust, using fine contact and a construction of parameters using levers to release the joint without any risk for the patient, overcoming the single-articular homolateral muscle spasms that set the dysfunction.

CONFLICT OF INTEREST

The authors declare that they do not have any conflict of interest.

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