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SYSTEMATIC REVIEW

Effectiveness of dry needling on reducing pain intensity in patients with myofascial pain syndrome: a Meta-analysis

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Abstract

OBJECTIVE: To summarize the literature about the effectiveness of dry needling (DN) on relieving pain and increasing range of motion (ROM) in individuals with myofascial pain syndrome (MPS).

METHODS: Papers published from January 2000 to January 2013 were identified through an electronic search in the databases MEDLINE, Dialnet, Cochrane Library Plus, Physiotherapy Evidence Database (PEDro) and Spanish Superior Council of Scientific Research (CSIC). The studies included were randomized controlled trials written in English and/or Spanish about the effectiveness of DN on pain and ROM in individuals with MPS.

RESULTS: Out of 19 clinical trials that were potentially relevant, a total of 10 were included in the Meta-analysis. Regarding pain intensity reduction when measured before and immediately after the intervention, DN achieved improvement compared with the placebo treatment [d = − 0.49; 95% *CI* (− 3.21, 0.42)] and with the control group [d = − 9.13; 95% *CI* (− 14.70, − 3.56)]. However, other treatments achieved better results on the same variable compared with DN, considering the measurements for pre-treatment and immediately after [d = 2.54; 95% *CI* (− 0.40, 5.48)], as well as the pre-treatment and after 3-4 weeks [d = 4.23; 95% *CI* (0.78, 7.68)]. DN showed a significantly increased ROM when measured before the intervention and immediately after, in comparison with the placebo [d = 2.00; 95% *CI* (1.60, 2.41)]. However, other treatments achieved a significant better result regarding ROM when it was measured before the intervention and immediately after, as compared with DN [d = − 1.42; 95% *CI* (− 1.84, − 0.99)].

CONCLUSION: DN was less effective on decreasing pain comparing to the placebo group. Other treatments were more effective than DN on reducing pain after 3-4 weeks. However, on increasing ROM, DN was more effective comparing to that of placebo group, but less than other treatments.

Key words: Dry needling; Myofascial pain syndromes; Rehabilitation; Meta-analysis

INTRODUCTION

Myofascial pain syndrome (MPS) is one of the most frequent causes of musculoskeletal chronic pain. Myo-

fascial trigger point (MTP) causes MPS due to the presence of hypersensitive nodules.[1,2]

The MTP is a hyperirritable structure located in the tense band of a muscle. After its stimulation, the MTP is responsible for referred pain (outside the area of the MTP) and unspecific pain with a variable severity. These points are of unknown etiology and they are characterized by a motor alteration (resistant muscular band) and a sensitive alteration (numbness and referred pain).[1]

The most accepted theory regarding to the nature of the MTP, known as integrated hypothesis, was described by Simons[2] in 1996 and subsequently expanded[3] and updated.[4] Although it needs to be fully consolidated through experimentation, it provides answers to questions regarding what MTP is, where they are located and what would be the best approaches for their management.[5]

According to this theory, the MTP constitute a neuromuscular pathology initiated by a pre-synaptic dysfunction of the motor plate characterized by an excessive release of acetylcholine (ACh) in the synaptic cleft that causes a localized contracture of the sarcomere closest to the motor plate. This contracture would cause the increase of tension in the affected fibre, hypoxia due to the vascular compression and accumulation of sensitizing substances which are responsible for the hyperalgesia of the MTP and a poor level of acetyl cholinesterase. This deficit could mean a synaptic dysfunction that would add to the presynaptic problem of the excess release of ACh and to any possible postsynaptic conflict related to the amount of ACh receptors or their sensitivity. All this would close the cycle and would explain the capacity of the MTP to self-perpetuate, as there are mechanisms that could continue the alterations even if the initial presynaptic dysfunction would resolve.[5]

The main characteristic of MTPs is that they cause referred pain with a specific pattern for each muscle, what favours the treatment approach through local interventions. Besides, this symptomatology is reproduced when pressure is being applied on that point and they are activated with overpressure, trauma, mood and/or reflex causes.[6]

There are many treatment techniques for the management of MTP and they include conservative and invasive techniques. Scientific evidence shows that conservative techniques are the most applied treatments for this syndrome, including physical therapy,[7,8] stretching, massage and electrotherapy.[9] However, invasive techniques, such as botulin toxin injections,[10] acupuncture, [11] electroacupunture[12] and dry needling (DN), have been introduced recently.

One of the newest therapies used to treat MPS is DN. It is performed by inserting a needle at the MTP at subcutaneous or muscle level. The mechanic stimulus of the needle is used as a physical agent to remove the MTP without injection or extraction of any substance and causing a local spasm response.[5] The needling does not stay in place and it is removed once the MTP has been deactivated.[13] After its deactivation, etiological and disturbing factors of the MTP must be controlled to avoid relapses.[5,13] The dry needling action mechanism is based on the gate control theory of pain developed by Furlan *et al.*[13] DN causes the inhibition of the C fibers that carry the MTP pain impulses. This inhibition is due to the activation of the A-delta fibers when the needle perforates the skin and to the relaxation of the tense MTP muscle band.

Recent investigations showed on conclusive results on the effectiveness of DN to manage MTP. The systematic review carried out by Cummings *et al* [14] in 2001 and other studies, such as the one from Kietrys *et al* [15] in 2013, can be found in the literature. Despite concluding that DN decreased pain immediately after its application when comparing with sham needle or placebo, their search was only done in very few databases. In addition, Tough *et al* [16] published a systematic review in 2009, where DN was compared with acupuncture, standardized care and placebo.

We summarized the literature about the effectiveness of dry needling on decreasing pain and increasing range of motion (ROM) in individuals with MPS.

METHODS

Search strategy

This study is a systematic review of randomized controlled trails. The eligibility criteria were: articles published from January 2000 to January 2013, written in English and Spanish and studies where interventions were applied on patients with MPS, whatever their location, intensity and duration and based on treatments with the DN technique.

The electronic databases MEDLINE, Dialnet, Cochrane Library Plus, "The Physiotherapy Evidence Database" PEDro and CSIC (IME, ISOC) were used. In MEDLINE, "The Physiotherapy Evidence Database" PEDro, Cochrane Library Plus and CSIC databases, the same key words used were: "Dry needling AND myofascial pain syndromes AND Physiotherapy", "dry needling AND trigger points", "myofascial pain syndrome AND trigger points AND physiotherapy". In Dialnet, the following Spanish key words were used: "punción seca y dolor miofascial" (Dry needling AND myofascial pain), "Punción seca y puntos gatillo" (dry needling AND trigger points), "Síndrome de dolor miofascial y puntos gatillo y fisioterapia" (myofascial pain syndrome AND trigger points AND physiotherapy).

Afterwards, a manual search was done on all relevant journals available to the research group, which were not indexed on the searched electronic databases. These included publications in all the pre-indexed issues of Acupuncture in Medicine and Revista Interna-

cional de Acupuntura, and in the research group's own files (excluding un-published studies).

Study selection and data extraction

Two independent reviewers (Juan Rodríguez Mansilla and Blanca González Sánchez) did the search and analysed the articles found. In case of disagreement, data sharing was done concluding in consensus between both reviewers. As a general rule, a pre-selection of the papers was done considering if they were within the proposed subject of the study. A selection of full articles was established followed by reading their abstract. All those papers that did not meet the inclusion criteria before mentioned were excluded. The studies that met the inclusion criteria were read, analysed and included in this systematic review.

The following data were extracted from the studies included in the review: study design, objective of the study, description of the intervention of control and experimental groups, follow up period and outcome measures. This data was compiled in a standard table (Table 1). The data extraction and the risk of bias assessment were done by the two reviewers independently.

The analysis of the methodological quality of the studies was done using the scale Physiotherapy Evidence Database (PEDro) [17] which indicates the quality of clinical trials. It is made of 11 criteria with 'yes' (Y) or 'no' (N) reply and a total range of score of 0 to 10 according to a low to excellent methodological quality.

The 11 criteria that were assessed with the PEDro scale are: (a): Specificity of inclusion criteria; (b) Random allocation; (c) Concealed allocation; (d) Baseline similarity; (e) Blinding of participants; (f) Blinding of therapists; (g) Blinding of assessor; (h) Measures of key outcomes from at least 85% of the participants; (i) Intention to treat analysis; (j) Between-groups statistical analysis; (k) Point measures and measures of variability.

The results obtained in the scale were considered as: high quality, if the score is over 5 (6-8: good, 9-10 excellent); moderate quality, if the score between 4 and 5 (fair quality study); low quality, if the score is under 4 (poor quality study).

Statistical analysis

The statistical analysis was carried out with the EPIDAT 3.1 programme (Galician Public Health General Directorate, Galicia, Spain). The heterogeneity was determined through the Dersimonian and Laird's test with the Cochran's *Q* statistic. When homogeneity was observed, a fixed effect model was used. In case of heterogeneity, a random effect model was used. This model considers the variability of the results due to the differences between studies. For all cases, forest plots were drawn. The forest plots show the differences observed between the mean values of the two treatments that were considered as well as the overall measure, including all the corresponding confidence intervals. In addition, the publication bias was analysed thought the Begg (*Z* statistic) and Egger (*t* statistic) tests.

Pain intensity and range of movement (ROM) were established as primary outcome measures. A Meta-analysis comparing the changes on the effect size was applied to each of the subgroups (post and pre intervention) between DN and its alternative. Therefore, two values were obtained: a value corresponding to the changes achieved by DN (improvement or worsening) and another value corresponding to the changes achieved by other treatments. The difference between these values was then analysed.

As they were continuous variables, the difference of mean values and confidence intervals of 95% were used. $P < 0.5$ was considered as significant level.

RESULTS

Once the characteristics of the studies identified were analysed, a total of 9 studies[1,18-25] were excluded from the Meta-analysis since they did not use the appropriate measurements, the data was insufficient or they were not comparable with other studies due to their nature. The results and conclusions of those studies were explained separately.

The process of identifying eligible studies is outlined in Figure 1 and the characteristics of each study included in the Meta-analysis are shown in Table 1. Out of 191 studies found in the search, 19 articles (which included 852 patients) were selected for the review based on the inclusion and exclusion criteria previously described in the Materials and Methods section. As explained in the Methods section, the characteristics of the 19 studies considered potentially relevant were analysed. Those that did not have the appropriate outcome measures, had not enough data or were not comparable to other studies were excluded from the Meta-analysis. A total of 9 studies were not included in this Meta-analysis.[1, 18-25] These papers were not include in the Meta-analysis for the following reasons: they did not give any effect size which made the analysis difficult; the necessary information for the Meta-analysis was not available (for example, results were described but not supported with numeric values); and it was not possible to compare them with the rest of selected papers.

The 10 selected studies[6,11,26-33] were distributed in 7 subgroups of similar characteristics, intervention type and period of the study. This allowed the establishment of groups that were initially similar in order that the Meta-analysis made sense. Some of the studies appeared in more than one group and even more than once in the same group when DN has been compared with more than one alternative.

The pooled effect size of pain intensity and range of movement (ROM) were calculated. Pain intensity was measured through the visual analogue scale (VAS) with scores between 0 (no pain) and 10 (the worst possible pain). The ROM was measured with a goniometer. All studies compared the application of DN with other treatment approach, including control group (partici-

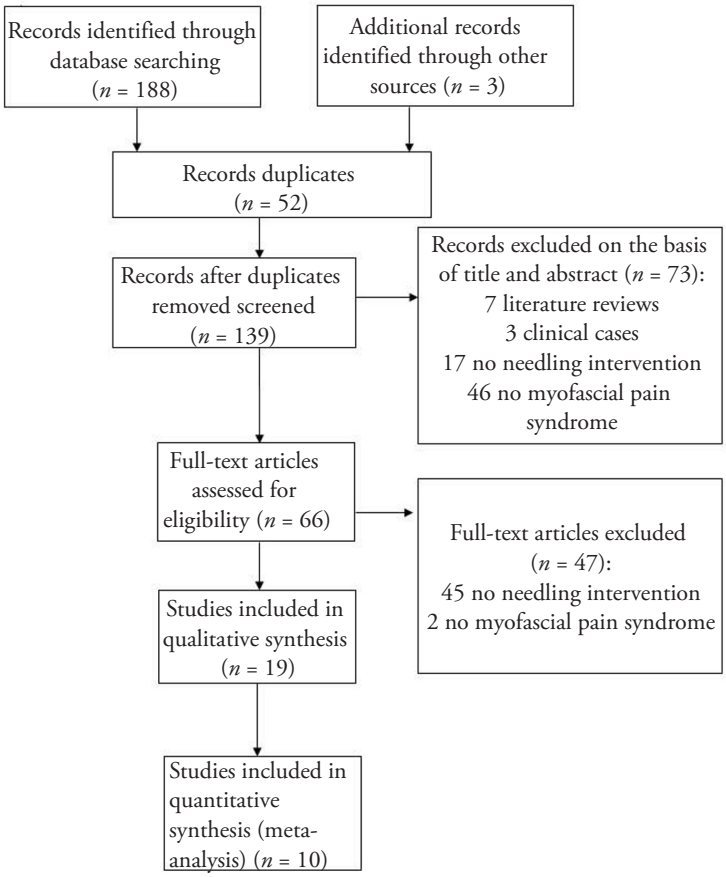

Figure 1 Study selection

pants did not receive any treatment), placebo (participants received a treatment with no specific effect) and other treatments. The studies presented observations of the effect size at different moments that were differentiated in two time frames: (a) progress of the effect size measured before and immediately after the treatment and (b) progress of the effect size measured before and between 3 and 4 weeks after the treatment. The pooled effect size was considered for all groups. There was no need to standardize any measures as all studies presented the same scale. However, it was not possible to compare all the treatment techniques at each assessment as not all studies did the measurements at the same moment of the study. In any case, the moment when the measurement was done, it was considered for the classification of the studies into the groups.

The studies included in the 7 subgroups, their characteristics and the results of the heterogeneity and publication bias tests are shown in Table 2. A, B, C and D subgroups are heterogeneous and E, F and G are homogeneous. On the other hand, the publication bias analysis showed no statistical evidence of bias in any of the groups.

Pain intensity (VAS)

According to the forest plots (Figure 2), we can conclude that there is a better effect of the DN decreasing the intensity of the pain measured before the intervention and immediately after in comparison to the placebo treatment [95% *CI* (− 3.21, 0.42)] and the control group [95% *CI* (− 14.70, − 3.56)] (Groups A and B). However, a better effect on pain intensity was achieved by other treatments in contrast with DN when pretreatment and immediately after measurements were considered [95% *CI* (− 0.40, 5.48)], as well as pretreatment and after 3-4 weeks [95% *CI* (0.78, 7.68)] (Groups C and D). We can highlight that, in groups A and C, the differences were not statistically significant with 95% of confidence interval, although in group C there was a statistically significant difference when considering 90% of confidence level [Group C, 95% *CI* (0.07, 5.01)].

Range of movement

Figure 3 shows a significant better effect of DN increasing ROM when measured before the intervention and immediately after, in comparison with the placebo [95% *CI* (1.60, 2.41)] (Group E). However, other treatments achieved significant improvements in ROM, when it was measured before the intervention and immediately after when compared with DN [95% *CI* (− 1.84, − 0.99)] (Group F).

The weighted estimate that group G obtained based on the fixed effect model [95% *CI* (− 0.45, 0.26)].

Studies not included in the Meta-analysis

The characteristics of each study are shown in Table 1. Regarding the methodology used, the studies are very heterogeneous. The interventions were carried out with two experimental groups and a control group,[18,21] two

Table 1 Characteristics of the studies included

Author	Objective	Muscle-region body characteristic	Intervention	Follow up	Measure	Outcome
Irnich *et al* 2002[11]	To assess immediate effects of two different modes of acupuncture on motion-related pain and cervical spine mobility compared to a sham procedure.	Myofascial neck pain *N*=36 Age=51.9	All patients were treated once with AC, DN and AC-laser.	Duration of Intervention: one session Assessment: before and after intervention	VAS ROM	For motion-related pain, use of acupuncture at non-local points reduced pain scores by about a third (*P*=0.000 06) compared to DN and sham. ROM: non-local acupuncture was significantly superior both to Sham (*P*=0.0001) and DN (*P*=0.008)
Edwards *et al* 2003[18]	To test the hypothesis that superficial dry needling together with active stretching is more effective than stretching alone, 01' no treatment, in deactivating trigger points and reducing myofascial pain.	Myofascial pain (muscle not specified) *N*=40 Age=55-57	EG1 (14): DN and stretching exercises EG2 (13): stretching exercises alone CG (13): no treatment control	Duration of intervention: 3 week Assessment: before and after intervention and 3 weeks after	SFMPQ PPT: An algometer	After intervention there were no significant inter- EG1 and EG2. At 3 weeks GE1 demonstrated significantly improved SFMPQ versus CG (*P*=0.043) and EG2 (*P*=0.011).
Ilbuldu *et al* 2004[26]	Assess the effectiveness of laser therapy *vs* DN in the management of MPS.	MPS in upper trapezius *N*=60	EG1 (20): laser control EG2 (20): DN EG3 (20): laser	Duration of intervention: 4 week Assessment: before and after intervention Follow up assessment: 6 months after treatment	Nottingham Health Profile ROM VAS	Decrease in pain at rest and activity in G3. No significant differences at 6 months. Laser therapy can be useful to treat MPS due to its non-invasive nature.
Di Lorenzo *et al* 2004[27]	The purpose of the trial was to assess the efficacy of dry needling of myofascial pain syndrome trigger points to relieve the hemiparetic shoulder pain resulting from a cerebrovascular accident.	Shoulder pain *N*=101 Age=42-86	EG1: DN + RHB EG2: RHB	Duration of intervention: 4 sessions every 5/7 days EG 1. Total 21 days. Assessment: VAS after day treatment EG1. VAS: EG2 after day treatment, day 9, 15 and 21	Motricity Rivermead Index VAS Sleep Questionnaire	EG1, reported significantly less pain during sleep and physiotherapy.
Kamanli *et al* 2005[28]	To compare the inactivation of trigger points injection with botulinum toxin type A to dry needling and lidocaine injection in MPS.	Cervical, back, or shoulder muscles *N*=29 Age=37.7	EG1 (10): DN EG2 (10): local anesthetic lidocaine injection EG3 (9): local anesthetic botulinum toxin injection	Duration of intervention: one session Assessment: before and 4 week after intervention	ROM VAS Hamilton depression scales Anxiety rating scales NHP	Pain pressure thresholds and PS significantly improved in all three groups. VAS significantly decreased in the EG2 and EG1groups and did not significantly change in the EG1.
Huguenin *et al* 2005[19]	To establish the effect on straight leg raise, hip internal rotation, and muscle pain of dry needling treatment to the gluteal muscles in athletes with posterior thigh pain referred from gluteal trigger points.	Gluteal muscles *N*=59	EG1(30): placebo EG2 (29): DN	Duration of intervention: one session Assessment: before and after intervention At 24 and 72 h after intervention	VAS ROM	Straight leg raise and hip internal rotation remained unchanged in GE1 and GE2 at all times. VAS assessment of hamstring pain and tightness and gluteal tightness after running showed improvements immediately after the intervention in GE1 and GE2 (*P*=0.001), which were maintained at 24 and 72 h.

Table 1 Characteristics of the studies included (continued)

Author	Objective	Muscle-region body characteristic	Intervention	Follow up	Measure	Outcome
García *et al* 2006[20]	To compare the efficacy and evolutionary effects of two types of myofascial treatment: dryneedling and local anaesthetic injection.	Trapezius and other muscles[a] *N*=24 Age=32-70	EG1 (15): DN EG2 (9): local anesthetic injection	Duration of intervention: one session Assessment: before and after intervention At 20 min after intervention.	VAS Algometer: PPT	EG1 and EG2 improved resting and active pain level (P<0.01). Pain threshold improved more in EG1 (P=0.04).
Ga H *et al* 2007[29]	To compare the efficacies of dry needling of trigger points with and without paraspinal needling in myofascial pain syndrome of elderly patients.	Upper trapezius *N*=40 Age=63-90	EG1 (18): DN EG2 (22): paraspinal needles at days 0, 7 and 14	Duration of intervention: 4 weeks Assessment: ROM, VAS Y FACES: before and after intervention and 0, 7, 14, 28 days GDS: 0 and 28 days	GDS ROM VAS FACES	EG2 resulted in more continuous subjective pain reduction and improvements on the GDS that EG1. There was no difference in the l ROM improvement between two groups.
Hsieh *et al* 2007[6]	To investigate the changes in pressure pain threshold of the secondary (satellite) myofascial trigger points after dry needling of a primary active myofascial trigger points.	Bilateral shoulder pain and infraspinatus muscles *N*=14 Age=60.2±13.2	EG1: DN in infraspinatus muscle and the myofascial trigger points randomly applied and in the contralateral side was not applied (control).	Duration of intervention: one session Assessment: before and after DN	ROM VAS Fischer algometer: PPT	Both active and passive ROM of shoulder internal rotation, and the pressure pain threshold of myofascial trigger points on the treated side, were significantly increased (P< 0.01).
Venâncio *et al* 2008[21]	To assess if trigger point injections using lidocaine associated with corticoid would be better than lidocaine alone, as in comparison with DN in the management of local pain and associated headache management.	Myofascial pain patients with headaches *N*=45 Age=18-65	EG1: DN EG2: local anesthetic lidocaine injection EG3: anesthetic lidocaine injection + Corticosteroids	Duration of intervention: 12 weeks Assessment: before, 10 minutes after treatments. Follow up assessment: 1, 4, 12 weeks after injections	SSI Daily Pain Palpation of the trigger point	Statistically, all three groups showed favorable results for the assessed requirements (P< 0.05), but only for post-injection sensitivity did the association of lidocaine with corticoid (EG3) present the best results and ingestion of rescue medication.
Bahadir *et al* 2009[22]	To compare the effects of the high-power pain threshold ultrasound technique and needling on the spontaneous electrical activity of trigger points, local twitch response, and clinical improvement in myofascial pain syndrome.	Upper trapezius muscle *N*=20	EG1 (10): Threshold Ultrasound Therapy + stretching exercises EG2 (10): DN + stretching exercises	Duration of intervention: 3 sessions Assessment: before and after treatments. At finished study (after 5 days)	VAS Cervical ROM LTR	Patients in the study EG1 reported signi fi cantly more reduction in pain (P=0.009). There was no difference in the cervical ROM improvement between two groups (P =0.136).
Ay S *et al* 2010[30]	To compare the efficacy of local anesthetic injection and dry needling methods on pain, cervical ROM, and depression in patients MPS.	Upper trapezius muscle *N*=80 Age=19-58	EG1 (40): trigger point injection+ physical treatment program EG2 (40): DN+ physical Treatment program	Duration of intervention: every day during 12 weeks Assessment: after treatments and after 4, 12 weeks	VAS ROM BDI	There were statistically significant improvements in VAS, cervical ROM, and BDI scores after 4 and 12 weeks in both groups compared to pre-treatment results (P<0.05). No significant differences were observed between the groups (P>0.05).

Table 1 Characteristics of the studies included (continuted)

Author	Objective	Muscle-region body characteristic	Intervention	Follow up	Measure	Outcome
Srbely *et al* 2010[23]	To test the hypothesis that dry needle stimulation of a myofascial trigger point (sensitive locus) evokes segmental anti-nociceptive effects.	Supraspinatus *N*=40 Age=46.8	EG1 (20): DN. CG(20): placebo	Duration of intervention: one session Assessment: before and 1, 3, 5, 10, 15 min after intervention	PPT	Significant increases in PPT were observed in test subjects (EG1) at 3 (*P*=0.002) and 5 (*P*=0.015) min post-needling, compared with control.
Tsai *et al* 2010[31]	To investigate the remote effect of dry needling on the irritability of a myofascial trigger point in the upper trapezius muscle.	Upper trapezius muscle *N*=35	EG (17): DN CG (18): placebo	Duration of intervention: one session Assessment : before and after intervention	VAS ROM PPT	Immediately after dry needling in the experimental group, the mean pain intensity was significantly reduced, but the mean pressure threshold and the mean range of motion of cervical spine were significantly increased.
Fernández *et al* 2010[24]	To investigate the effects of dry needling over active trigger points in the masseter muscle in patients with TMD.	TMD *N*=12 Age= 20-41	All patients received DN treatment and placebo treatment in two different days.	Duration of intervention: two sessions, two different days Assessment: before and 5 min after sessions	PPT	Subjects showed greater improvements in all the outcomes when receiving the deep dry needling compared to the sham dry needling (*P*<0.001).
Huang *et al* 2011[1]	To assess the outcomes in patients who have received dry needling treatments and to identify predictors of pain and disability.	Gluteal muscles *N*=92 Age=50.2	All patients received DN and stretching exercises.	Duration of intervention: 8 months Assessments: before treatment and 2, 4, 8 months after treatment	Pain questionnaire. BPI-T	The proposed dry-needling protocol reduced pain intensity and pain interference. Long duration of pain, high pain intensity, poor quality of sleep, and repetitive stress were associated with poor outcomes.
García *et al* 2011[32]	To compare the effects caused by a single application of elbow manipulation, dry needling and sham dry needling on PPT on subjects MTP in the lateral epicondyle musculature.	The lateral epicondyle musculature *N*=50 Age=26.9	EG1 (18): DN EG2 (17): elbow manipulation EG3 (15): sham dry needling	Duration of intervention: one session Assessment: before, after treatment and 10 min after treatment	Algometer: PPT VAS Hand dynamometer to measure maximum grip strength	Post-hoc tests showed a significant decrease of the PPT (*P*=0.02) 10 min after the intervention compared to the post-intervention value for the manipulation group. It was not possible to demonstrate that manipulation or dry needling are superior to placebo puncture in benefits on pain, PPT and handgrip strength.
González, *et al.* 2012[34]	To assess the usefulness of deep dry needling in the treatment of temporomandibular myofascial pain.	Temporo-mandibular join *N*=36 Age=27	All patients DN in the external pterygoid muscle.	Duration of intervention: one session during 3 weeks Assessment: before treatment, 2 week, 1, 2, 6 mnoths after treatment	VAS ROM	ROM and VAS improvement in pain and jaw movements, which continued up to 6 months after treatment (*P*<0.01).
Tekin *et al* 2012[33]	To test the hypothesis that dry needling is more effective than sham dry needling in the treatment of myofascial pain syndrome.	Trapezius muscle Supraspinatus Deltoid muscle *N*=39 Age=24-65	EG1 (22): DN EG2 (17): sham dry needling	Duration of intervention: 4 weeks Assessment: before treatment VAS: after 1º, 6º session	VAS SF-36	When VAS scores were compared between the groups, the first assessment scores were found to be similar, but the second and third assessment scores were found to be significantly lower in the dry needling group (*P*=00.034 and *P*<0.001, respectively).

Notes: PPT: pain and grip strength threshold; MTP: myofascial trigger point. PPT: Pressure pain threshold. BPI-T: The Taiwan version of the Brief Pain Inventory; DN: dry needling; ROM: range of movement; MPS: myofascial pain syndrome; BDI: Beck Depression Inventory; SSI: the modified Symptom Severity Index; GDS: Geriatric depression scale; NHP: Nottingham health profile; RHB: rehabilitation; SFMPQ: Shor form MCGill pain questionnaire; TMD: temporomandibular disorders; VAS: visual analogue scale; LTR: local twitch response. [a]Levator scapulae muscle, Rhomboid muscle, Latissimus dorsi, Iliocostalis muscle, Extensor digitorum, Quadratus lumborum, Gluteus minimus, Pyramidalis, Fibularis longus muscles.

Table 2 Characteristics of the subgroups of studies included in the Meta-analysis

Subgroup	Studies included	Size effect	Treatments compared	Measurement	Heterogeneity test	Model type	Publishing risk of bias[b]
A	Irnich D 2002[11] Ilbuldu E 2004[26] Tsai CT 2010[31] García R 2011[32] Tekin L 2002[33]	Pain intensity (VAS)	Dry needling *vs* Placebo	Before the treatment and immediately after	There is heterogeneity Q=114,9833; gl=4; P<0.001	Random effects	Non existent Z=0.7348; P=0.4624 t= − 1.5488; md=3; P= 0.2192
B	Di Lorenzo L 2004[27] Hsieh YL 2007[6]	Pain intensity (VAS)	Dry needling *vs* Control group	Before the treatment and immediately after	There is heterogeneity Q=10,6468; gl=1; P=0.0011	Random effects	-
C	Irnich D 2002[11] Ilbuldu E 2004[26] García R 2011[32]	Pain intensity (VAS)	Dry needling *vs* Other treatment[a]	Before the treatment and immediately after	There is heterogeneity Q=75,5062; gl=2; P<0.001	Random effects	Non existent Z=1.0445; P=0.2963 t=1.0370; md=1; P=0.4884
D	Kamanli A 2005a[28] Kamanli A2005b[28] Ga H 2007[29] Ay S 2010[30]	Pain intensity (VAS)	Dry needling *vs* Other treatment[a]	Before the treatment and 3 to 4 weeks after	There is heterogeneity Q=109.3307; gl=3; P<0.001	Random effects	Non existent Z=1.6984; P=0.0894 t=2.2139; md=2; P=0.1573
E	Irnish D 2002[11] Ilbuldu E 2004[26] Tsai CT 2010[31]	Range of movement (ROM)	Dry needling *vs* Placebo	Before the treatment and immediately after	There is homogeneity Q=2.8472; gl=2; P=0.2408	Fixed effects	Non existent Z=1.0445; P=0.2963 t=2.1345; md=1; P=0.2789
F	Irnich D 2002[11] Ilbuldu E 2004[26]	Range of movement (ROM)	Dry needling *vs* Other treatment[a]	Before the treatment and immediately after	There is homogeneity Q=3,4550; gl=1; P=0.0631	Fixed effects	-
G	Ga H 2007[29] Ay S 2010[30]	Range of movement (ROM)	Dry needling *vs* Other treatment[a]	Before the treatment and 3 to 4 weeks after	There is homogeneity Q=0.6426; gl=1; P=0.4228	Fixed effects	-

Notes: the 10 selected studies were distributed in 7 subgroups of similar characteristics, intervention type and period of the study. A, B, C and D subgroups are heterogeneous and E, F and G are homogeneous. VAS: visual analogue scale; ROM: range of motion. md: movement degrees. [a]: other treatment: Non Local Needle Acupuncture (Irnich 2002), Laser (Ilbuldu 2004), Manipulation (García 2011), Lidocaine injection (Kamanli 2005a), BTX-A injection (Kamanli 2005b), Intramuscular stimulation (Ga 2007), Lidocaine injection+Exercise (Ay 2010); [b]: No resutls of this test are shown when a group is formed only by two studies.

experimental groups,[1,20,22] an experimental group and a placebo group,[1,19,24] or just DN was applied to subjects to verify the improvement of the MPS.[33] The intervention groups that were compared with the technique studied were also diverse. They included active stretching exercises,[1,18] ultrasound therapy,[22] injections with analgesics[20] or with lidocaine and corticoids.[21]

The VAS was used in most studies as a tool to assess pain.[1,20,22,32,34] De Abreu *et al* [21] applied the Pain questionnaire the modified symptom severity index and Huang *et al* [1] used the Brief Pain Inventory. Besides, other researchers such as Sberly *et al*,[23] Fernández *et al*,[24] García *et al* [20] and Edwards *et al* [18] used the algometer for the assessment of this variable. Other authors [22,34] tested if there was an improvement of the ROM using DN. Bahardir *et al* [21] did not find any significant improvement between the intervention groups. However, the research done by González *et al* [34] showed statistical improvement between the DN technique and the increase of the temporo-mandibular joint ROM.

Regarding the effectiveness of the technique, in most of the studies that compare the DN with other experimental technique (stretching, ultrasound therapy, corticoids injections, etc.), the results are similar to those obtained in the studies analysed in

Subgroup	Study	*n*	Mean difference (*CI* 95%)	Weights (%)
A	Irnich 2002	67	0.52 (− 1.01, − 0.04)	20.67
	Ilbuldu 2004	40	1.44 (0.74, 2.13)	20.35
	Tsai 2010	35	− 3.93 (− 5.06, − 2.79)	20.36
	Garcia 2011	33	0.31 (− 0.38, 1.00)	17.08
	Tekin 2012	39	− 4.60 (− 5.80, − 3.40)	19.22
	Random effects	214	− 0.49 (− 3.21, 0.42)	
B	Di Lorenzo 2004	101	− 6.50 (− 7.48, − 5.53)	53.93
	Hsieh 2007	28	− 12.20 (− 15.49, − 8.92)	
	Random effects	129	− 9.13 (− 14.70, − 3.56)	
C	Irnich 2002	67	3.31 (2.57, 4.05)	33.66
	Ilbuldu 2004	40	4.66 (3.47, 5.86)	32.54
	Garcia 2011	35	− 0.28 (− 0.94, 0.39)	33.80
	Random effects	142	2.54 (− 0.40, 5.48)	
D	Kamanli 2005a	20	4.22 (2.64, 5.79)	24.58
	Kamanli 2005b	19	1.99 (0.89, 3.09)	25.24
	Ga 2007	40	0.97 (0.31, 1.62)	25.66
	Ay 2010	80	9.98 (8.37, 11.58)	24.52
	Random effects	159	4.23 (0.78, 7.68)	

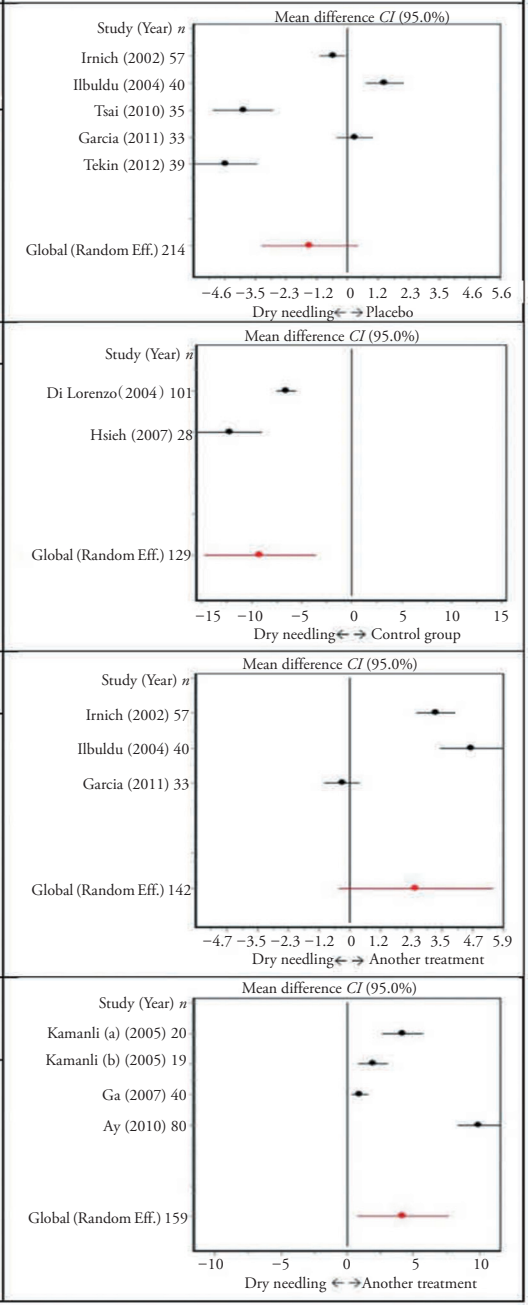

Figure 2 Results of the meta-analysis regarding the mean difference of pain intensity

the Meta-analysis. The intervention group that was compared showed a better significant improvement than the DN in the management of MPS.[18-22] However, in the clinical trials where DN is not compared with any other treatment technique but it is applied in an isolated manner or compared with a placebo treatment, a better effect in the improvement of pain was observed.[1,23,24,34] In some cases, the improvement was only achieved after the needling and it was not maintained over time.[23]

Methodological quality assessment

In relation to the methodological quality, the variables were assessed with the rating "Y" or "N" according to the presence or absence of the criteria studied. This is shown in Table 3. Giving the score "N" means that during the revision of the full article, that requirement was not found in the main text but the lack of it can not be guaranteed.

Two studies [1,34] were not assessed due to the lack of control group. Out of the remaining 17 studies, the scores varied from 8, good [24] to 2, poor quality.[22] The other studies obtained a score of 6-7 (good quality)[11,18,19,23,26,29-33] an 5-4 (fair quality).[6,20,21,27,28] All studies did not have blinding of therapists who applied the treatment (criteria No. 6) and only two of them[20,30] met the criteria No. 9, that is to say, the results of all subjects who received treatment or were assigned to the control group. Two studies[20,22] did not have a random assignment which would guarantee the comparison of the intervention group versus the control group.

Subgroup	Study	*n*	Mean difference (*CI* 95%)	Weights (%)
E	Irnich 2002	67	1.78 (1.22, 2.35)	51.22
	Ilbuldu 2004	40	1.92 (1.77, 2.67)	9.22
	Tsai 2010	35	− 3.93 (− 5.06, − 2.79)	19.56
	Fixed effects	142	2.00 (1.60, 2.41)	
F	Irnich 2002	67	− 1.14 (− 1.66, − 0.62)	51.22
	Ilbuldu 2004	40	− 2.01 (− 2.77, − 1.25)	31.55
	Fixed effects	142	2.00 (1.60, 2.41)	
G	Ga 2007	40	− 0.30 (− 0.93, 0.32)	33.80
	Ay 2010	80	0.01 (− 0.43, 0.45)	66.92
	Fixed effects	120	− 0.09 (− 0.45, 0.26)	

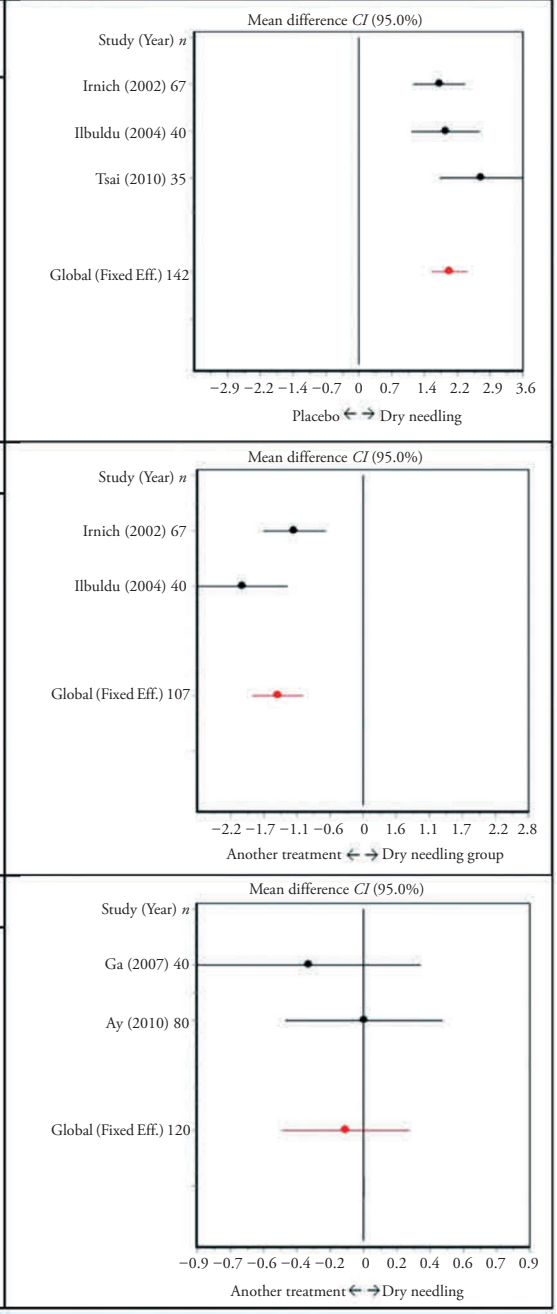

Figure 3 Results of the meta-analysis regarding the mean difference of range of movement

DISCUSSION

As the evidence shows, MPS is one of the most treated conditions in daily physical therapy clinical practice, being MTP the cause of MPS.[1,2] Nowadays, many therapy approaches are applied to treat this pathology with the aim to improve its symptoms and DN is one of them. However, due to the heterogeneity of the studies, the limited number of interventions carried out (corticosteroids injections, continuous ultrasound therapy, etc), the variability of the sample (N = 12, N = 40, N = 101, N = 80, N = 50)[18,24,27,30,32] and the few studies included in this review, it is difficult to confirm that DN is an effective treatment in the management of MPS.

In this way, the results obtained in this review study indicate that there is an improvement of referred pain intensity in patients after the treatment with DN if compared with control group. These results coincide with those from previous systematic reviews such as the studies of Kietrys *et al* [15] or Tough *et al.*[16] Nevertheless, it was observed in this study that the improvement is more evident with the use of other treatment techniques versus DN when measured immediately after as well as in the following assessments. In addition, we have observed that this fact is repeated when the improvement of ROM has been assessed. This aspect was not reflected in previous systematic reviews as Tough *et al.*[16]

In this regard, some studies that compared the effectiveness of DN versus other treatments such as acupuncture,[11] laser therapy,[23] lidocaine and corticoids injections[21] or ultrasound therapy and stretching[22] showed better results than DN in relation to pain and cervical

Table 3 Methodological quality of the studies according to PEDro scale

Study	1	2	3	4	5	6	7	8	9	10	11	Score
Irnich D *et al* 2002[11]	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	6 (Good)
Edwards J *et al* 2003[18]	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	6 (Good)
Ilbuldu E *et al* 2004[26]	N	Y	N	Y	Y	N	Y	N	N	Y	Y	6 (Good)
Di Lorenzo L *et al* 2004[27]	Y	Y	N	Y	N	N	N	N	N	Y	Y	4 (Fair)
Kamanli A *et al* 2005[28]	Y	Y	N	Y	N	N	N	N	N	Y	Y	4 (Fair)
Huguenin L *et al* 2005[19]	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y	7 (Good)
García M *et al* 2006[20]	Y	N	N	Y	N	N	N	Y	Y	Y	N	4 (Fair)
Ga H *et al* 2007[29]	Y	Y	N	Y	Y	N	Y	N	N	Y	Y	6 (Good)
Hsieh YL *et al* 2007[6]	Y	Y	N	Y	N	N	Y	N	N	Y	Y	5 (Fair)
Venâncio Rde A *et al* 2008[21]	Y	Y	N	Y	N	N	N	Y	N	N	Y	4 (Fair)
Bahadir C *et al* 2009[22]	Y	N	N	N	N	N	N	Y	N	Y	N	2 (Poor)
Ay S *et al* 2010[30]	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	6 (Good)
Srbely JZ *et al* 2010[23]	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	7 (Good)
Tsai CT *et al* 2010[31]	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y	7 (Good)
Fernández J *et al* 2010[24]	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	8 (Good)
García M *et al* 2011[20]	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y	7 (Good)
Tekin L *et al* 2012[33]	N	Y	N	Y	Y	N	Y	Y	N	Y	Y	7 (Good)

Notes: Y: studied criteria present; N: studied criteria absent.

spine ROM. In other studies where DN was compared with a control group based on a simulated DN or placebo,[19,23,24,33] the results obtained were different. In some studies the significant improvement of the pain is similar in both control and DN groups.[19] In others, the improvement was found to be statistically significant in the experimental group.[23-31] In other studies, the first measurements showed similar effects but there was a decrease of pain in the experimental group after the re-assessments.[33]

Therefore, despite clinical practice showing that DN is increasingly used nowadays and that this technique is being applied with positive effects in rehabilitation medicine, especially for the management of MPS, we can observe that the scientific evidence observed in the studies analysed do not have consistent results regarding its effectiveness. In some papers, no significant differences were seen in the improvement of MPS between the groups when DN was compared with a control group or a simulated DN group.[19] The comparison of DN with other experimental groups showed that the subjects treated with the alternative technique achieved better results than those treated with DN.[11,21]

Previous studies such as the systematic review carried out by Tough *et al* [16] in 2009, which analysed the effectiveness of acupuncture and dry needling in the treatment of MTP, observed that treatments applied with needles compared with placebo did not show statistical significance in pain improvement. They concluded that further research in this field is needed as well as an improvement of the scientific quality of the studies.

Currently, in 2013, the authors of this study still consider the necessity that Tough *et al* [16] highlighted. There are very few randomized controlled trials on this subject, especially on MPS, which is the focus of this review. Further studies are necessary in order to achieve more reliable results and therefore progress on pain management and ROM improvement and hence, the quality of life of patients.

The conclusions of this study have been made based on the articles identified through the search strategy selected and according to the inclusion and exclusion criteria established. However, the fact that there is the possibility that studies may not have been included in this review due to indexing problems or search filters, must be considered. Further randomized controlled trials are needed in order to determine the effectiveness of this technique in the management of MPS and consequently, recommend or not its use in physical therapy, as other treatment techniques have achieved better results than DN improving pain and joint ROM in this condition.

Despite DN was more effective in decreasing pain comparing to no treatment, it was not significantly different from placebo in decreasing pain. Other treatments were more effective than DN on decreasing pain after 3-4 weeks. In increasing ROM DN was more effective comparing to placebo, but less than other treatments.

REFERENCES

1 **Huang YT**, Lin SY, Neoh CA, Wang KY, Jean YH, Shi

HY. Dry needling for myofascial pain: prognostic factors. J Altern Complement Med 2011; 17(8): 755-762.

2 **Simons DG**. Clinical and etiological update of myofascial pain from trigger points. J Musculoske Pain 1996; 4(1-2): 93-121.

3 **Gerwin RD**, Dommerholt J, Shalp JP. An espansion of Simons' integrated hypothesis of trigger point formation. Curr Pain Headache Rep 2004; 8(6): 468-475.

4 **McPartland JM**, Simons DG. Myofascial trigger points: translating molecular theory into manual therapy. J Man Manip Ther 2006; 14(4): 232-239.

5 **Mayoral O**. Dry needling application on tennis elbow miofascial trigger points. Available in. Jiménez F, Caballero A. TENIS; Toledo (Spain): Castilla la mancha regional community, 2008: 35-45.

6 **Hsieh YL**, Kao MJ, Kuan TS, Chen SM, Chen JT, Hong CZ. Dry needling to a key myofascial trigger point may reduce the irritability of satellite MTrPs. Am J Phys Med Rehabil 2007; 86(5): 397-403.

7 **Bron C**, Wensing M, Franssen JL, Oostendorp RA. Treatment of myofascial trigger points in common shoulder disorders by physical therapy: a randomized controlled trial. BMC Musculoskelet Disord 2007; 8: 107.

8 **Hong CZ**. Treatment of myofascial pain syndrome. Curr Pain Headache Rep 2006; 10(5): 345-349.

9 **Lavelle ED**, Lavelle W, Smith HS. Myofascial trigger points. Anesthesiol Clin 2007; 25(4): 841-851.

10 **Fenollosa P**, De Barutell C, Figueroa J, Miguez A, Nieto C. Toxina Botulínica A (Dysport) asociada a rehabilitación en pacientes con dolor miofascial cervical o dorsal primario: un estudio piloto multicéntrico aleatorizado. Rehabilitación 2011; 45(2): 139-141.

11 **Irnich D**, Behrens J, Gleditsch JM, et al. Immediate effects of dry needling and acupuncture at distant points in chronic neck pain: results of a randomized, double-blind, sham-controlled crossover trial. Pain 2002; 99(1-2): 83-89.

12 **Aranha MF**, Alves MC, Bérzin F, Gavião MB. Efficacy of electroacupuncture for myofascial pain in the upper trapezius muscle: a case series. Rev Bras Fisioter 2011; 15(5): 371-379.

13 **Furlan AD**, Van M, Cherkin D, et al. Acupuncture and dry-needling for low back pain: an updated systematic review within the framework of the cochrane collaboration. Spine 2005; 30(8): 944-963.

14 **Cummings TM**, White AR. Needling therapies in the management of myofascial trigger point pain: a systematic review. Arch Phys Med Rehabil 2001; 82(7): 986-992.

15 **Kietrys D**, Palombaro K, Azzaretto E, et al. Effectiveness of dry needling for upper-quarter myofascial pain: a systematic review and Meta-analysis. J Orthop Sports Phys Ther 2013; 43(9): 620-634.

16 **Tough E**, White A, Cummings M, Richards SH, Campbell JL. Acupuncture and dry needling in the management of myofascial trigger point pain: A systematic review and Meta-analysis of randomised controlled trials. Eur J Pain 2009; 13(1): 3-10.

17 PEDro scale online, 2013-03-05, cited 2013-04-22. Available from URL: http://www.pedro.org.au/spanish/downloads/pedro-scale/.

18 **Edwards J**, Knowles N. Superficial dry needling and active stretching in the treatment of myofascial pain--a randomised controlled trial. Acupunct Med 2003; 21(3): 80-86.

19 **Huguenin L**, Brukner PD, McCrory P, Smith P, Wajswelner H, Bennell K. Effect of dry needling of gluteal muscles on straight leg raise: a randomised, placebo controlled, double blind trial. Br J Sports Med 2005; 39 (2): 84-90.

20 **García M**, Climent JM, Marimon V, Garrido AM, Pastor G, López C. Estudio comparativo de dos técnicas de infiltración miofascial en puntos gatillo: punción seca e inyección de anestésico local. Rehabilitación 2006; 40(4): 188-192.

21 **Venâncio Rde A**, Alencar FG, Zamperini C. Different substances and dry-needling injections in patients with myofascial pain and headaches. Cranio 2008; 26(2): 96-103.

22 **Bahadir C**, Majlesi J, Unalan H. The effect of high-power pain threshold ultrasound therapy on the electrical activity of trigger points and local twitch response on electromyography: a preliminary study. J Musculoskelet Pain 2009; 17 (2): 162-172.

23 **Srbely JZ**, Dickey JP, Lee D, Lowerison M. Dry needle stimulation of myofascial trigger points evokes segmental anti-nociceptive effects. J Rehabil Med 2010; 42(5): 463-438.

24 **Fernández J**, La Touche R, Ortega R, et al. Short-term effects of dry needling of active myofascial trigger points in the masseter muscle in patients with temporomandibular disorders. J Orofac Pain 2010; 24(1): 106-112.

25 Consejo General de Colegios de Fisioterapeutas de España (Madrid).Punción Seca Resolución online, 05/2011 cited 2011-11-19. Available from URL: http://www.consejo-fisioterapia.org/.

26 **Ilbuldu E**, Cakmak A, Disci R, Aydin R. Comparison of Laser, Dry Needling, and Placebo Laser Treatments in Myofascial Pain Syndrome. Photomed Laser Surg 2004; 22 (4): 306-311.

27 **Di Lorenzo L**, Traballesi M, Morelli D et al. Hemiparetic Shoulder Pain Syndrome Treated with Deep Dry Needling During Early Rehabilitation: A Prospective, Open-Label, Randomized Investigation. J Musculoskelet Pain 2004; 12 (2): 25-34.

28 **Kamanli A**, Kaya A, Ardicoglu O, Ozgocmen S, Zengin FO, Bayik Y. Comparison of lidocaine injection, botulinum toxin injection, and dry needling to trigger points in myofascial pain syndrome. Rheumatol Int 2005; 25(8): 604-611.

29 **Ga H**, Choi JH, Park CH, Yoon HJ. Dry needling of trigger points with and without paraspinal needling in myofascial pain syndromes in elderly patients. J Altern Complement Med 2007; 13(6): 617-624.

30 **Ay S**, Evcik D, Tur BS. Comparison of injection methods in myofascial pain syndrome: a randomized controlled trial. Clin Rheumatol 2010; 29(1): 19-23.

31 **Tsai CT**, Hsieh LF, Kuan TS. Remote effects of dry needling on the irritability of the myofascial trigger point in the upper trapezius muscle. Am J Phys Med Rehabil 2010; 89(2): 133-140.

32 **García R**, Tormos L, Vilanova P, Morales R, Pérez A, Segura E. Efectividad de la punción seca de un punto gatillo miofascial versus manipulación de codo sobre el dolor y fuerza máxima de prensión de la mano. Fisioterapia 2011; 33(6): 248-255.

33 **Tekin L**, Akarsu S, Durmuş O, Cakar E, Dinçer U, Kıralp MZ. The effect of dry needling in the treatment of myofascial pain syndrome: a randomized double-blinded placebo-controlled trial. Clin Rheumatol 2013; 32(3): 309-315.

34 **González LM**, Infante P, Granados M, Urresti-Lopez FJ. Treatment of temporomandibular myofascial pain with deep dry needling. Med Oral Patol Oral Cir Bucal 2012; 17(5): e781-e785.