Effectiveness of Dry Needling for Myofascial Trigger Points Associated With Neck and Shoulder Pain: A Systematic Review and Meta-analysis

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Effectiveness of Dry Needling for Myofascial Trigger Points Associated With Neck and Shoulder Pain: A Systematic Review and Meta-Analysis

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Abstract

Objective: To evaluate current evidence of the effectiveness of dry needling of myofascial trigger points (MTrPs) associated with neck and shoulder pain.

Data Sources: PubMed, EBSCO, Physiotherapy Evidence Database, ScienceDirect, The Cochrane Library, ClinicalKey, Wangfang Data, China Knowledge Resource Integrated Database, Chinese VIP Information, and SpringerLink databases were searched from database inception to January 2014.

Study Selection: Randomized controlled trials were performed to determine whether dry needling was used as the main treatment and whether pain intensity was included as an outcome. Participants were diagnosed with MTrPs associated with neck and shoulder pain.

Data Extraction: Two reviewers independently screened the articles, scored methodological quality, and extracted data. The results of the study of pain intensity were extracted in the form of mean and SD data. Twenty randomized controlled trials involving 839 patients were identified for meta-analysis.

Data Synthesis: Meta-analyses were performed using RevMan version 5.2 and Stata version 12.0. The results suggested that compared with control/sham, dry needling of MTrPs was effective in the short term (standardized mean difference [SMD] = -1.91; 95% confidence interval [CI], -3.10 to -0.73; Z = 2.02) and medium term (SMD = -1.07; 95% CI, -1.87 to -0.27; Z = 2.09); however, wet needling (including lidocaine) was superior to dry needling in relieving MTrP pain in the medium term (SMD = 1.69; 95% CI, 0.40–2.98; Z = 2.61). Other therapies (including physiotherapy) were more effective than dry needling in treating MTrP pain in the medium term (SMD = 1.87; 95% CI, 0.27–1.47; Z = 2.65). Other approaches (including comprehensive rehabilitation) were more effective than dry needling in relieving MTrP pain in neck and shoulders in the medium term (9–28d).

Conclusions: Dry needling can be recommended for relieving MTrP pain in neck and shoulders in the short and medium term, but wet needling is found to be more effective than dry needling in relieving MTrP pain in neck and shoulders in the medium term (9–28d).

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Myofascial trigger points (MTrPs) are localized, hyperirritable spots in the skeletal muscles associated with palpable nodules in muscle fibers. These spots can be classified into active and latent MTrPs with referred pain and local twitch responses. Epidemiological surveys have shown that 30% to 85% of the population in the United States and 18.7% to 85.1% in Germany has MTrP pain. Numerous studies have shown that MTrPs are prevalent in patients with chronic nontraumatic neck and shoulder pain. A recent survey of 72 patients with shoulder pain showed that active MTrPs were prevalent in the infraspinatus (77%) and the upper trapezius muscles (58%), whereas latent MTrPs were prevalent in the teres major (49%) and anterior deltoid muscles (38%). Persistence of MTrPs in neck and shoulder muscles for long periods will result in headache, neck and shoulder pain, dizziness or vertigo, limited neck and shoulder range of motion, abnormal sensation, autonomic dysfunction, and disability.
Conservative interventions for MTrPs include dry needling, wet needling (eg, lidocaine injection and some local anesthetic injections), ischemic compression, physiotherapy, laser, and oral drugs. Of these therapies, dry needling has been widely used in clinical practice because of its simple operation and good efficacy. In 2001, a systematic review conducted by Cummings and White found that direct needling of MTrPs seems to be an effective treatment, but evidence of the good efficacy of needling therapies beyond placebo from clinical trials was lacking at that time. A systematic review with meta-analysis found that dry needling, compared with sham/placebo, can decrease pain immediately after the treatment and in 4 weeks in patients with upper quarter myofascial pain syndrome. Nonetheless, the number of high-quality randomized controlled trials (RCTs) was limited, and evidence of the long-term efficacy of dry needling for myofascial pain syndrome associated with neck and shoulder pain was lacking in this meta-analysis; thus, large-scale, multiple-term RCTs are necessary to support this recommendation. More recently, another systematic review found no significant difference between dry needling and lidocaine injection for MTrPs in neck and shoulders immediately after the treatment, at 1 month, and at 3 to 6 months; however, some errors affecting the meta-analysis results were identified; there was no difference between dry needling and physical therapy for MTrPs in neck and shoulders.

Therefore, this systematic review and meta-analysis aimed to determine the short-, medium-, and long-term effectiveness of dry needling in relieving pain in patients with MTrPs in neck and shoulders compared with placebo/sham dry needling, wet needling, and other treatments (including physical therapy, botulinum toxin injection, and miniscalpel-needle release).

Methods

Search strategy

A systematic review and meta-analysis was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. We searched sequentially electronic databases (PubMed, EBSCO, Physiotherapy Evidence Database [PEDro], ScienceDirect, The Cochrane Library, ClinicalKey, Wangfang Data, China Knowledge Resource Integrated Database, Chinese VIP Information, SpringerLink) from database inception to January 2014. The searches were limited (where database facilities allowed) to RCTs or clinical trials, but without language restriction. The search terms were (acupuncture OR needling) AND (myofascial pain OR trigger point* OR trigger area* OR taut band*) AND random*. Furthermore, supplementary searches were conducted online (eg, http://www.google.cn and http://www.clinicaltrials.gov) to obtain articles that could not be found in the databases via the university library website and to check for any omitted trials.

Inclusion and exclusion criteria

Studies were included if they (1) had RCT design; (2) included patients with MTrPs associated with neck and shoulder pain; (3) used acupuncture or dry needling as an intervention; and (4) had at least 1 outcome measure of either visual analog scale (VAS) or numerical rating scale (NRS) to assess pain intensity. Meanwhile, studies were excluded if (1) MTrPs were not defined according to the criteria of Simons et al; (2) MTrPs in patients with neck and shoulder pain were latent MTrPs; (3) different types of dry needling were compared with each other; (4) RCT subjects were animals; and (5) RCT reported no data results.

Study selection and data extraction

Two authors scanned the titles and abstracts independently, and studies that satisfied the inclusion and exclusion criteria were retrieved for full-text assessment. We extracted data on the sample size of the population, number of male and female patients, mean age of the population, duration of symptoms, diagnosis, location and interventions adopted for MTrPs, outcome measures, the time to achieve the outcome, and PEDro scores. The results of the study of pain intensity (VAS/NRS) were extracted in the form of mean and SD data.

Outcome measures were classified as short term if the measure was applied immediately to 3 days after the final reported treatment, medium term if applied 9 days to 4 weeks after the final reported treatment, and long term if applied 2 to 6 months after the final reported treatment.

The remaining discrepancies in data extraction were resolved after a discussion between the 2 reviewers. A third reviewer adjudicated when necessary.

Quality assessment

Two reviewers independently assessed the validity of the studies included by using the PEDro quality scale. Any disagreements were resolved with a discussion between the 2 reviewers. A third reviewer adjudicated when necessary. The PEDro scale rates the quality of RCTs that evaluate the therapeutic interventions on the basis of the presence or absence of key methodological components. Studies with scores ≥6/10 were considered as high-quality evidence, and studies with scores ≤5/10 were considered as low-quality evidence.

Data synthesis and statistical analysis

Nine separate meta-analyses were performed with pain on VAS/NRS as the outcome measure. The 9 meta-analyses are as follows: dry needling compared with control/sham in the short, medium, and long term; dry needling compared with wet needling in the short, medium, and long term; and dry needling compared with other treatments in the short, medium, and long term.

Meta-analyses were performed using RevMan version 5.2 with a continuous variable random-effects model to account for the additional uncertainty associated with interstudy variability in effect of the intervention. Heterogeneity was assessed using the Cochran Q test, which had statistical significance ($P < .1$), and the chi-square test ($I^2$), which indicated inconsistency by a quantitative number. An $I^2$ value of 25%, 50%, and 75% represented small, moderate, and large degrees of heterogeneity.
respectively. \(^{24,26}\) Effect sizes were measured using the standardized mean difference (SMD) and 95% confidence interval (CI).

To explore the heterogeneity between studies, we performed stepwise meta-regression using Stata version 12.0 \(^{b}\) and sensitivity analysis. By using random-effects univariate meta-regression models, we assessed the clinical and methodological variables that affected the association between dry needling and changes in pain intensity. On the basis of univariate meta-regression, we conducted sensitivity analyses to assess the subgroups of studies that are most likely to yield valid estimates of the intervention. Funnel plots were constructed to verify the existence of publication bias (outcome level).

**Results**

**Study selection**

The initial search resulted in 1489 hits (fig 1). After applying the inclusion and exclusion criteria, 20 RCTs were eligible and included in the review.

![Flow diagram of search strategy and results](image)

**Study characteristics**

Table 1 summarizes the sample size of the population, number of male and female patients, mean age of the population, country or region of the population, diagnosis, inclusion criteria, intervention groups (independent variables), outcome measurements (dependent variables), time to achieve the outcomes, and PEDro scores.

**Risk of bias within studies**

Table 1 lists the PEDro scores of 20 RCTs, in which 19 are rated as high-quality evidence (\(\geq 6/10\)) and only 1 as low-quality evidence (\(\leq 5/10\)). However, most RCTs did not commonly score points for concealed random allocation and blinding of therapists.

**Effect of dry needling versus control/sham**

By comparing dry needling with control/sham, we found that studies including 6, \(^{29,30,35,37,43,45}\) 6, \(^{31,36,38,43,44}\) and 2 RCTs \(^{36,38}\) in the short, medium, and long term, respectively, assessed the pain effects.
<table>
<thead>
<tr>
<th>Study (Design and Country)</th>
<th>n (M/F)</th>
<th>Mean Age (y) *</th>
<th>Diagnosis (Duration*)</th>
<th>Inclusion Criteria</th>
<th>Intervention Group</th>
<th>Outcome Measure</th>
<th>Time to Achieve the Outcome (Baseline Pain*)</th>
<th>PEDro Scores</th>
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</thead>
<tbody>
<tr>
<td>Ay et al, 2010 (RCT, Turkey)</td>
<td>80 (28/52)</td>
<td>38.08±9.81, 37.20±10.10</td>
<td>MPS (34.27±40.95mo, 30.63±37.25mo)</td>
<td>Regional pain, taut band, referred pain and sensory change, extreme sensitivity in taut band, ROM; at least 1 active MTrP in the upper trapezius muscle (≥1mo)</td>
<td>DN; lidocaine injection</td>
<td>Pain (VAS); AROM of the CS; depression (BDI)</td>
<td>Pretreatment (5.55±1.33cm, 5.82±1.25cm); 4wk; 12wk</td>
<td>6/10</td>
</tr>
<tr>
<td>Byeon et al, 2003 (RCT, Korea)</td>
<td>30 (18/12)</td>
<td>50.9±9.7, 50.2±9.9, 51.2±9.9</td>
<td>MPS</td>
<td>MTrPs in the upper trapezius muscles; palpable taut band in the muscle</td>
<td>DN; IMS; IMES</td>
<td>Pain (VAS); MPQ; PROM of the CS</td>
<td>Pretreatment (6.2±1.1cm, 6.4±1.6cm, 6.2±1.4cm); 3d; 1wk; 2wk</td>
<td>6/10</td>
</tr>
<tr>
<td>Chou et al, 2009 (RCT, China)</td>
<td>20 (8/12)</td>
<td>37.7±11.3, 33.3±7.7</td>
<td>Active MTrPs (5.9±3.3mo, 5.8±2.8mo)</td>
<td>MTrPs in the unilateral upper trapezius muscle; no treatment with acupuncture; poor response to conservative and noninvasive treatments</td>
<td>Acupuncture; sham acupuncture</td>
<td>Pain (NRS); EPN amplitude</td>
<td>Pretreatment (7.4±0.8cm, 7.4±0.8cm); immediately</td>
<td>6/10</td>
</tr>
<tr>
<td>Chou et al, 2011 (RCT, China)</td>
<td>45 (22/23)</td>
<td>34.1±10.7, 33.9±8.3</td>
<td>Unilateral MTrPs (6.1±2.2mo, 6.2±2.2mo)</td>
<td>≥5/10 VAS score on the unilateral shoulder due to MTrPs in the upper trapezius muscle; no acupuncture treatment; poor response to conservative and noninvasive treatments</td>
<td>Modified acupuncture; placebo</td>
<td>Pain (NRS); PPT (algometry); ROM of the CS; EPN amplitude</td>
<td>Pretreatment (7.7±1.0cm, 7.6±1.1cm); immediately</td>
<td>6/10</td>
</tr>
<tr>
<td>DiLorenzo et al, 2004 (RCT, Italy)</td>
<td>101 (28/73)</td>
<td>69.56±6.21, 67.43±9.05</td>
<td>Shoulder pain due to activation of MTrPs (3.53wk)</td>
<td>Patients 4—8 wk post—cerebrovascular accident who had undergone at least 3wk of physical therapy; shoulder pain (≥6/10 score on VAS)</td>
<td>DN; placebo</td>
<td>Pain (VAS); disability (RMI); quality of daytime rest and sleep</td>
<td>Pretreatment (7.93±0.87cm, 8.02±0.83cm); 10d; 16d; 22d</td>
<td>6/10</td>
</tr>
<tr>
<td>Ga et al, 2007 (RCT, Korea)</td>
<td>39 (3/36)</td>
<td>79.22±6.80, 75.90±8.69</td>
<td>Chronic shoulder or neck pain due to MPS</td>
<td>≥6mo; aged &gt;60y; complaining of chronic shoulder or neck pain</td>
<td>Acupuncture; lidocaine injection</td>
<td>Pain (VAS and FACES); PP; PROM of the CS; depression (GDS-5F)</td>
<td>Pretreatment (6.98±3.12cm, 6.43±2.08cm); 1wk; 2wk; 4wk</td>
<td>7/10</td>
</tr>
</tbody>
</table>

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Table 1

<table>
<thead>
<tr>
<th>Study (Design and Country)</th>
<th>Intervention</th>
<th>Outcome Measure</th>
<th>Outcome Score(s)</th>
<th>Time to Achieve the PEDro Scores</th>
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<tbody>
<tr>
<td><strong>MD 5:00, 2005</strong> (Germany)</td>
<td>DN (crossover RCT)</td>
<td>Mean Age (y)</td>
<td>51.9</td>
<td>5.3</td>
</tr>
<tr>
<td><strong>Ilini et al., 2004</strong> (RT, Turkey)</td>
<td>DN; IMS</td>
<td>Pretreatment</td>
<td>14.8 (8/6)</td>
<td>35.6 (16/42)</td>
</tr>
<tr>
<td><strong>Hsieh et al., 2007</strong> (committent subject RCT, China)</td>
<td>DN; placebo</td>
<td>14 (8/6)</td>
<td>34.9 (16/42)</td>
<td></td>
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<tr>
<td><strong>Ilbuldu et al., 2004</strong> (within-subject RCT, Turkey)</td>
<td>Pain (VAS); PPT; ROM of the shoulder and PROM of the trapezius muscle</td>
<td>Pretreatment</td>
<td>32.95±28.14 (14/6)</td>
<td>35.6 (16/42)</td>
</tr>
<tr>
<td><strong>Hong et al., 1994</strong> (RT, USA)</td>
<td>Pain (VAS); PPT; ROM of the shoulder</td>
<td>Pretreatment</td>
<td>36.88±5.2 (14/6)</td>
<td>35.6 (16/42)</td>
</tr>
<tr>
<td><strong>Ga et al., 2007</strong> (RT, Korea)</td>
<td>Pain (VAS); PPT; ROM of the shoulder</td>
<td>Pretreatment</td>
<td>50.8±3.8 (14/6)</td>
<td>74.2±5.2 (14/6)</td>
</tr>
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<tr>
<th>Study (Design and Country)</th>
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<th>Mean Age (y) *</th>
<th>Diagnosis (Duration * )</th>
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<th>Intervention Group</th>
<th>Outcome Measure</th>
<th>Time to Achieve the Outcome (Baseline Pain)</th>
<th>PEDro Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Itoh et al, (RCT, Japan)</td>
<td>40 (11/29)</td>
<td>62.3±10.1,1</td>
<td>Neck pain due to MTrPs (2.9±2.7y,1 2.3±1.5y)</td>
<td>≥6mo with no radiation; normal CS nerve function; aged ≥45y</td>
<td>Acupuncture; sham acupuncture</td>
<td>Pain (VAS); neck disability (NDI)</td>
<td>Pretreatment (6.70±1.32cm, 6.41±2.07cm); weekly; over 12wk</td>
<td>8/10</td>
</tr>
<tr>
<td>Kamanli et al, (RCT, Turkey)</td>
<td>29 (6/23)</td>
<td>37.20±8.08,1</td>
<td>MTrPs (38.5±0.79mo, 1 49.20±34.96mo,1 50.66±19.92mo,1)</td>
<td>At least 1 MTrP on CS, back, or shoulder muscles with disease of at least 6mo in duration</td>
<td>DN; lidocaine injection; BTI</td>
<td>Pain (VAS); PPT; functional status; anxiety and depression; pain score</td>
<td>Pretreatment (7.03±2.68cm, 6.90±1.3cm, 6.09±1.95cm); 4 wk</td>
<td>5/10</td>
</tr>
<tr>
<td>Krishnan et al, (crossover RCT, USA)</td>
<td>30 (20/10)</td>
<td>38.5±0.28</td>
<td>MPS</td>
<td>Presence of trigger points, which are discrete tender areas in the upper trapezius muscles</td>
<td>Needle only; bupivacaine injection; ropivacaine injection; BD injection; RD injection</td>
<td>Pain (VAS)</td>
<td>Pretreatment; immediately</td>
<td>7/10</td>
</tr>
<tr>
<td>Ma et al, (RCT, China)</td>
<td>43 (21/22)</td>
<td>42.2±5.3,1</td>
<td>MPS (22.5±15.3y,1 20.8±16.5y,1 21.8±15.9y)</td>
<td>MTrPs in the unilateral upper trapezius muscles; ROM; no acupuncture or MSN treatment previously; follow instructions and complete a home-based stretching program</td>
<td>Acupuncture needling; placebo; MSN release</td>
<td>Pain (VAS); PPT; ROM of the CS (goniometer)</td>
<td>Pretreatment (6.2±1.9cm, 6.3±1.7cm, 6.3±1.8cm); 2wk; 12wk</td>
<td>6/10</td>
</tr>
<tr>
<td>Rayegani et al, (RCT, Iran)</td>
<td>28</td>
<td>32±10,1</td>
<td>MPS (9.6±8.4y,1 9.8±9.6y)</td>
<td>≥2mo; MPS in the upper trapezius muscles; pain area that might radiate to neck, arm, and upper back and not confined to 1 dermatome or myotome; taut bands pressing pain; neurological test result was normal</td>
<td>DN; physiotherapy</td>
<td>Pain (VAS); PPT; quality of life (SF-36)</td>
<td>Pretreatment (2.9±2.8cm, 3.6±2.6cm); 1wk; 4wk</td>
<td>6/10</td>
</tr>
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</table>

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Table 1 (continued)

<table>
<thead>
<tr>
<th>Study (Design and Country)</th>
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<th>Mean Age (y) *</th>
<th>Diagnosis (Duration †)</th>
<th>Inclusion Criteria</th>
<th>Intervention Group</th>
<th>Outcome Measure</th>
<th>Time to Achieve the Outcome (Baseline Pain ‡)</th>
<th>PEDro Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tekin et al, 2013 (RCT, Turkey)</td>
<td>39 (8/31)</td>
<td>42.9±10.9, 42.0±12.0</td>
<td>MPS (63.5±50.7mo, 57.9±48.3mo)</td>
<td>≥6mo; local spontaneous pain, referred pain or sensory changes from MTrP, palpable taut band, localized tenderness, ROM; at least 1 active MTrP</td>
<td>DN; sham intervention</td>
<td>Pain (VAS); quality of life (SF-36)</td>
<td>Pretreatment (6.6±1.3cm, 6.4±1.6cm); 3d; 4wk</td>
<td>8/10</td>
</tr>
</tbody>
</table>

Tough et al, 2010 (RCT, UK) | 41 (17/24) | 34.2±10.8, 36.9±10.9 | MTrPs pain due to whiplash injury (6.8±4.3wk, 7.3±4.7wk) | Two to 16 wk duration and fulfilling the Grade II Quebec Task Force classification of WAD; ≥18y and making fully informed consent | Acupuncture; sham acupuncture | Pain (VAS); neck disability (NDI); anxiety and depression | Pretreatment (4.9±1.6cm, 5.0±1.6cm); 3wk; 6wk | 7/10 |

Tsai et al, 2010 (RCT, China) | 35 (14/21) | 46.4±12.2, 41.5±10.4 | Unilateral shoulder pain due to MTrPs (7.5±3.9mo, 6.8±4.5mo) | Unilateral shoulder pain caused by digital compression of MTrP in the upper trapezius muscle (tenderness and pain reproduction with palpation of a tight band) | DN; sham needling | Pain (NRS); PPT; ROM of the CS (goniometer) | Pretreatment (7.3±1.4cm, 7.2±1.4cm); immediately | 6/10 |

Ziaeifar et al, 2014 (RCT, Iran) | 33 | 30.06±9.87, 26.5±8.57 | MTrPs | MTrPs in the upper trapezius muscles; taut band, tender spot, referred pain; ≥30mm on a VAS ranging from 0 to 100 mm | DN; compression technique | Pain (VAS); PPT; disability of arm, hand, and shoulder | Pretreatment (6.56±1.63cm, 6.23±1.26cm); 9d | 7/10 |

Abbreviations: AROM, active range of motion; BD, bupivacaine + dexamethasone; BDI, Beck Depression Inventory; BTI, botulinum toxin injection; CS, cervical spine; DN, dry needling; EPN, the end-plate noise; F, female; FACES, Wong-Baker Faces Pain Rating Scale; GDS-SF, Geriatric Depression Scale–Short Form; IMES, intramuscular electrical stimulation; IMS, intramuscular stimulation; LTR, local twitch response; M, male; MPQ, McGill Pain Questionnaire; MPS, myofascial pain syndrome; MSN, miniscapel needle; NDI, Neck Disability Index; NHP, Nottingham Health Profile; PPI, pressure pain intensity; PPT, pressure pain threshold; PROM, passive range of motion; RD, ropivacaine + dexamethasone; RMI, Rivermead Mobility Index; ROM, range of motion; SF-36, 36-Item Short Form Health Survey; WAD ---.

* Values are mean ± SD.
† DN group.
‡ Lidocaine injection group.
§ IMS group.
‖ IMES group.
¶ Placebo/sham group.
# Laser group.
** Nonlocal acupuncture group.
†† BTI group.
‡‡ MSN group.
§§ Physiotherapy group.
# Compression technique group.
Figure 2 shows that there is a high heterogeneity between the trials in the short term ($\chi^2 = 62.09; I^2 = 92\%$, $P < 0.00001$), medium term ($\chi^2 = 38.75; I^2 = 87\%$, $P < 0.00001$), and long term ($\chi^2 = 8.12; I^2 = 88\%$, $P = 0.004$). Therefore, random-effect models were used, and caution should be exercised while drawing the conclusion. We used univariate meta-regression models to explore the source of heterogeneity between studies in the medium term ($P = 0.024$). The decrement in pain intensity induced by dry needling increased as the initial pain intensity increased (Fig 3). Hence, we performed a sensitivity analysis by excluding the 2 studies$^{36,44}$ with the lowest value of the initial pain intensity. In the pooled analysis of the remaining 4 studies$^{31,38,41,43}$, the heterogeneity was significantly low between the individual efficacy estimates ($I^2 = 0\%$, $P = 0.86$).

The meta-analysis revealed statistically significant effects of dry needling compared with control/sham in the short term (SMD = 1.91; 95\% CI, 3.10 to 0.73; $P = 0.002$) and medium term (SMD = 1.07; 95\% CI, 1.87 to 0.27; $P = 0.009$), but the meta-analysis revealed no statistically significant effects of dry
Dry needling for myofascial trigger points

Effect of dry needling versus wet needling

By comparing dry needling with wet needling, we found that 6 studies including 2, 5, 6, 7, 34, 37, and 1 RCTs 36 in the short, medium, and long term, respectively, assessed the pain effects. Figure 4 shows low ($\chi^2 = 7.74; I^2 = 35\%$; $P = .001$) and high ($\chi^2 = 35.70; I^2 = 92\%; P < .000001$) heterogeneities between the trials in the short and medium term, respectively, and no heterogeneity in the long term. Although we observed low heterogeneity in the short term, the choice of the effects model will not have a significant effect on the pooled effect sizes; hence, we used random-effects models to conduct the meta-analysis in all terms. The high heterogeneity ($I^2 = 92\%$) in the medium term reminded us to exercise caution while interpreting the results. Data available from 6 pooled studies presented in fig 4 favored dry needling over wet needling. No statistically significant differences were observed in the short term (SMD = -0.01; 95% CI, -0.41 to 0.40; $P = .98$) and long term (SMD = 0.33; 95% CI, -0.11 to 0.78; $P = .14$); however, significant effects of wet needling compared with dry needling were observed in the medium term (SMD = 1.69; 95% CI, 0.40 to 2.98; $P = .01$).

Effect of dry needling versus other treatments

By comparing dry needling with other treatments, we found that 3 studies including 2 RCTs 28, 37 in the short term and 7 studies including 6 RCTs 28, 29, 32, 36, 44 and 1 caspari 36 in the medium term and 2 RCTs 36, 37 in the long term assessed the pain effects. Figure 5 shows low ($\chi^2 = 2.45; I^2 = 18\%; P = .29$), high ($\chi^2 = 23.80; I^2 = 75\%; P = .0006$), and moderate ($\chi^2 = 2.39; I^2 = 58\%; P = .12$) heterogeneities between the trials in the short, medium, and long term, respectively. The choice of the effects model will not have a significant effect on the pooled effect sizes; hence, we used random-effects models to conduct the meta-analysis in the subgroup. We further used univariate meta-regression models to explore the source of heterogeneity between trials. Publication year was the only covariate associated with the heterogeneity between studies in the medium term ($P = .007$). The decrement in pain intensity due to other treatments decreased as the publication year increased (see fig 3B). Hence, we further performed a sensitivity analysis by excluding 1 study 16 with the highest publication year. In the pooled analysis of the remaining 4 studies, 28, 33, 36, 44, 46 the heterogeneity was significantly low between the individual efficacy estimates ($I^2 = 44\%; P = 11$).

Data available from the 3 pooled studies presented in fig 5 favored other treatments over dry needling: no statistically significant differences were observed in the short term (SMD = -0.33; 95% CI, -0.12 to 0.78; $P = .15$) and long term (SMD = -0.58; 95% CI, -0.18 to 1.34; $P = .13$); however, significant effects of other treatments compared with dry needling were observed in the medium term (SMD = 0.62; 95% CI, 0.02 to 1.21; $P = .04$).

Publication Bias

Three funnel plots were constructed to assess the presence of publication bias (fig 6). The results indicated that 2 funnel plots were generally symmetrical, whereas 1 funnel plot from the comparison between dry needling and wet needling in the medium term was the only covariate associated with the heterogeneity between studies in the medium term ($P = .007$). The decrement in pain intensity due to other treatments decreased as the publication year increased (see fig 3B). Hence, we further performed a sensitivity analysis by excluding 1 study 16 with the highest publication year. In the pooled analysis of the remaining 4 studies, 28, 33, 36, 44, 46 the heterogeneity was significantly low between the individual efficacy estimates ($I^2 = 44\%; P = 11$).

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term was asymmetrical, which indicates that potential publication bias occurred. Publication bias may be attributed to the absence of a substantial number of studies or unpublished studies excluded.

**Discussion**

Twenty RCTs comparing dry needling with placebo or other treatments for MTrPs associated with neck and shoulder pain in different terms were identified for this review. Compared with control/sham, dry needling resulted in significant improvement, specifically in the short and medium term. However, wet needling of MTrPs associated with neck and shoulder pain was more effective than dry needling in the medium and long term. Furthermore, compared with dry needling, other treatments showed significant clinical effects in different terms. To date, data remain insufficient to draw conclusions about the long-term effects of wet needling compared with dry needling on MTrPs associated with neck and shoulder pain.

By comparing dry needling with control/sham, we found that the SMD in the short term was 1.91 cm, which was greater than the 1.3-cm/1.4-cm minimum clinically important difference (MCID) reported by Bijur et al. Moreover, a statistically significant difference in the short term was found when dry needling was compared with control/sham. Therefore, this review found sufficient evidence to support the claim that dry needling has significant clinical effects on MTrPs associated with neck and shoulder pain in the short term as compared with control/sham. In addition, the SMD in the medium term was 1.07 cm, which was lower than the short-term SMD. Furthermore, in the long-term (2–6 months), the SMD was 0.81 cm, which was also lower than the short-term SMD.

**Fig 5** Forest plot for dry needling compared with other treatments in different terms. Abbreviations: BTI, botulinum toxin injection; CI, confidence interval; IMES, intramuscular electrical stimulation; IMS, intramuscular stimulation; MSN, miniscalpel-needle release; NLA, nonlocal acupuncture. *Dry needling vs compression.*

**Fig 6** Funnel plots for all meta-analyses: (A) dry needling compared with sham/control; (B) dry needling compared with wet needling; and (C) dry needling compared with other treatments.
than the reported 1.3-cm/1.4-cm MCID; hence, a statistically
significant difference in the medium term was found when dry
needling was compared with control/sham. However, no statistically
significant difference in the long term was found when dry needling
was compared with control/sham. This effect may be worth
exploring by using large-scale RCTs.

By comparing dry needling with wet needling, we found that
the 1.69-cm SMD in the medium term was greater than
the reported 1.3-cm/1.4-cm MCID. A statistically significant
difference was also found in this subgroup. On the basis of the
current evidence, wet needling is found to be a better treatment
than dry needling in the medium term. We found no statistical and
clinical significance in the short and long term when dry
needling was compared with wet needling, because different inter-
terventions were included in wet needling in the short term
whereas only 1 study was included in the long term. Future studies
will require sufficient sample sizes to adequately determine
whether wet needling was an optimal treatment for MTrPs asso-
ciated with neck and shoulder pain in the short and long term.

By comparing dry needling with other treatments, we found
that the SMD in the short, medium, and long term was .33,.34,.35,.62,
.16,.28,.33,.36,.39,.41 and .58 cm, .36,.41 respectively, and all means
were lower than the reported 1.3-cm/1.4-cm MCID. Nevertheless,
a statistically significant difference in the medium term was
observed when dry needling was compared with other treatments.
Therefore, none of the studies in this review was adequately
powered to determine a significant change in pain when other
treatments were compared with dry needling. This result was due
to the pooled effects from different treatments. Hence, a large
difference was observed among the included studies after
meta-analysis.

Study limitations

In this systematic review, high heterogeneity was observed for
most meta-analyses in the forest plots. High heterogeneity for
these meta-analyses may be explained by clinical diversity
(including some differences in subjects, different inclusion criteria
between these studies, variance in the comparison treatments, and
variance in the outcome measures) and methodological diversity
(such as the design of random trial, use of blinding, and
concealment of allocation). We tried using meta-regression to
explore the sources of heterogeneity; however, ideal results were
not obtained because of the absence of a substantial number of
studies when dry needling was compared with control/sham in
the short term. Therefore, the random-effects model addressed the
heterogeneity of studies by considering the interstudy variation.

Heterogeneity is almost inevitable among studies conducted
independently by different investigators at different geographical
regions. Therefore, using the random-effects model rather than the
fixed-effects model was a conservative strategy when apparent
statistical heterogeneity was observed in the data. Meta-analysis
performed using the random-effects model in the present review
yielded results that were unbiased and provided an accurate esti-
mate of the effects concerned; thus, the results were internally
valid. The results were generalized to regular clinical practice
when different studies of different population groups were com-
brained; thus, the results were also externally valid.

Another limitation of the review is that the data results reported
by Rayegani et al were not included in the meta-analysis,
although the inclusion and exclusion criteria of the systematic
review and meta-analysis were met, because the data results were
not within the scope of the time definition of the short, medium,
and long term. Therefore, large-scale, multiple-term, high-quality
RCTs would be necessary to prove or exclude the significant
advantages or disadvantages.

Conclusions

On the basis of the available evidence to date, dry needling can be
cautiously recommended for relieving MTrP pain in neck and
shoulders in the short and medium term than control/sham, but
dry needling is found to be more effective than dry needling in
relieving MTrP pain in neck and shoulders in the medium term
(9–28d). On the basis of the results of 6 individual
RCTs included in the meta-analysis of 7 studies, other treatments
can be cautiously recommended for relieving
MTrP pain in neck and shoulders in the medium term than dry
needling. However, scientific evidence proving the effectiveness
of dry needling for MTrPs associated with neck and shoulder pain
compared with wet needling and other treatments in the short and
long term is insufficient. Accordingly, further research should
include more large-scale, multiple-center, high-quality RCTs and
adequate follow-up to provide the best evidence that can suggest
the best therapeutic method in the clinic.

Suppliers

a. RevMan version 5.2; The Nordic Cochrane Centre.
b. Stata version 12.0; StataCorp LP.

Keywords

Dry needling; Meta-analysis; Myofascial trigger points; Neck-
shoulder pain; Randomized controlled trial; Rehabilitation

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