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REVIEW

EFFECT OF DRY NEEDLING ON PAIN AND FUNCTION IN ADULTS WITH AN ACTIVE TRIGGER POINT IN THE UPPER TRAPEZIUS MUSCLE: A SYSTEMATIC REVIEW OF RANDOMIZED CONTROLLED TRIALS

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LEVEL OF EVIDENCE: 1

ABSTRACT

Objective: This systematic review of randomized controlled trials aimed to evaluate the efficacy of dry needling (DN) in improving pain and function among patients with myofascial trigger points in the upper trapezius muscle.

Design: Systematic review conducted according to PRISMA guidelines, including randomized controlled trials.

Methods: Studies were identified by searching PubMed, Scopus, The Cochrane Library, and Physiotherapy Evidence Database. Studies identified by electronic searches were screened against established, pre-defined inclusion criteria. These studies were randomized controlled trials that used DN for treating patients with active trigger points in the upper trapezius muscle with conventional treatments as controls. There are no specific limitations on the duration of treatment, the type of needling, or the severity of symptoms. These studies must have assessed pain sensitivity.

Results: Four studies were included in this systematic review. The mean difference of pain sensitivity in all four studies for DN group was 0.59 kg/cm^2, while in the control group was 0.05 kg/cm^2, mean difference of pain intensity in DN group was 3.7 and control group was 0.7 and regarding to the range of motion (ROM) in DN group was 12.8 and control group was 6.3.

Conclusions: This study showed significant positive outcomes in pain sensitivity, pain intensity, and range of motion following the intervention of DN, compared to the control group. Further high-quality randomized clinical trials with established protocols for applying DN are required.

KEYWORDS

Myofascial trigger point, dry needling, upper trapezius, trigger point needling, musculoskeletal pain, pain management

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INTRODUCTION

Neck pain is the fourth leading cause of disability, affecting over 30% of people annually[1]. In modern society, one of the most prevalent health issues is mechanical neck pain. According to earlier research, 45–54% of adults would feel pain in their neck and upper extremities at some point in their lives[2]. Although most cases of acute neck pain resolve with or without treatment, up to 50% of individuals may continue to experience recurrent or persistent symptoms[1,3,4]. Furthermore, the onset of neck pain is associated with several important factors, particularly occupational demands, stress, and depression[3]. When it comes to employment, neck pain is more common in positions that require extended periods of inactivity and repetitive upper limb movements[5]. Altered muscle activation and proprioceptive deficits have also been reported in individuals with myofascial trigger points, highlighting the potential neuromuscular consequences of MTrPs[6]. Additionally, it has been suggested that patients with mechanical neck pain may have myofascial trigger points (MTrPs) as the source of their pain; as a result, MTrP therapy is used in some trials to treat these patients[7]. The upper trapezius muscle was the most common muscle for MTrP present in individuals with myofascial pain, with a frequency of 93.75%. In the same, the right side had a greater prevalence of active MTrP at 82.1%, compared to the left side's 79%[4]. Due to its constant activity and susceptibility to microtrauma, the upper trapezius is the muscle most commonly affected by MTrPs[8]. MTrPs are considered one of the primary causes of myofascial pain syndrome (MPS) in individuals with musculoskeletal pain, particularly neck pain, with a prevalence ranging from 30% to 85%[9-13]. Hypersensitive nodules inside taut bands of skeletal muscle characterize MTrP, a disease linked to localized pain and tenderness in the muscles. MTrPs were described by Travell and Simons as isolated, spontaneously painful patches of muscular soreness in tense bands of muscle[14] . There have been three minimum clinical diagnostic standards applied: spot tenderness (a localized, hypersensitive, painful location); taut band (a discrete nodule inside a taut band within a muscle); and referred pain sensation with mechanical stimulation of the spot tenderness. Jump signs referred pain, and the local twitch response (LTR) can all be elicited by snapping palpation[15-17]. There may be pain when the afflicted muscle is stretched or contracted, as well as muscle weakening or tightness[18]. There are invasive and non-invasive ways to treat trigger points[19]. Many non-invasive techniques are frequently employed, such as heat, acupuncture, ultrasound, laser treatment, stretching, massage, and ischemia pressure[20-22]. Injections of corticosteroids, anesthetics, botox, and DN are examples of invasive procedures[22]. Numerous studies have demonstrated DN's beneficial effects[23]. Researchers have identified several pathways, including mechanistic, neurophysiologic, and pharmacological impacts, for the therapeutic benefits of DN[24]. It is believed that the constricted cytoskeletal components and shorter sarcomeres within the MTrP receive a localized stretch from DN mechanically. As a result, there would be less actin and myosin filament overlap, allowing the sarcomere to return to its resting length. According to Simons et al., the primary therapeutic element contributing to the success of DN is the mechanical rupture of the MTrP by the needle and the shift in trigger point status from active to latent or palpably normal tissue[24-26]. In the domains of research and clinical practice, DN of MTrPs has been extensively used and examined to lessen pain and disability in individuals with persistent neck discomfort[1]. While the evidence for impacts on functionality and quality of life is minimal, new systematic reviews indicate DN as a potential short- and medium-term treatment for patients with neck pain who have trigger points in the upper trapezius muscle[1,27,28].

This systematic review aims to evaluate the effectiveness of dry needling (DN) on pain and function in adults with active myofascial trigger points in the upper trapezius muscle, based on an analysis of available randomized controlled trials.

METHODS

This study was conducted under the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines[29]. The review protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO; registration number CRD42024583441) on 26 August 2024, following the completion of the screening process. PICO for this study stands on: patients with myofascial trigger points in the upper trapezius muscle(population), intervention was DN, comparison was no intervention and placebo/sham needling and the outcome measures were pain sensitivity measured by pain pressure threshold, pain intensity measured by Numeric Pain Rating Scale and range of motion by goniometer.

Databases and search strategy

The relevant studies were identified by searching PubMed, Scopus, The Cochrane Library, and the Physiotherapy Evidence Database (PEDro). The search included all eligible studies published from the inception up to March 1, 2024. The search strategy was the following:

"dry needling"[MeSH Terms] OR "dry needling"[Title/Abstract] OR "dry needle"[Title/Abstract] OR "trigger point needling"[Title/Abstract] AND ((((((((((((random[Title/Abstract]) OR randomized controlled trial[Publication Type]) OR double blind method) OR single blind method) OR placebos) OR clinical trial[Publication Type]) OR clinical trials) OR controlled clinical trial[Publication Type])) OR ((clin*[Title/Abstract]) AND trial*[Title/Abstract])) OR ((((((singl*[Title/Abstract]) OR doubl*[Title/Abstract]) OR trebl*[Title/Abstract]) OR tripl*[Title/Abstract])) AND ((blind*[Title/Abstract]) OR mask*[Title/Abstract])))) OR placebo*[Title/Abstract])) AND

("Pain"[Mesh] OR "Musculoskeletal Pain"[Mesh] OR "Pain Management"[Mesh]). To identify additional relevant studies that may have been missed by the electronic search, the reference lists of included articles were also reviewed.

Inclusion criteria

The following inclusion criteria had to be met by studies for them to be included in the current systematic review:

1. Be an RCT, or randomized clinical study, examining how DN aids in managing MTrPs. Research would have to contrast the use of DN with no treatment, sham needling, or a placebo.
2. Have used a DN technique that complies with the following definition: an invasive procedure (deep or superficial) that deviates from traditional Chinese medicine principles by employing a needle without a chemical agent inserted into the skin over an active or latent MTrP.
3. Have diagnosed MTrPs using the criteria of Travell et al.[14].
4. Utilizing a numerical pain rating scale, a visual analog scale, or a pain pressure threshold report on at least one outcome associated with the level of pain or pain sensitivity.
5. The language of the article is English.
6. Be carried out on adult human subjects.

Studies were excluded if they did not involve a DN intervention (e.g., acupuncture) or if they compared different forms of DN, as were review articles, editorials or letters to the editor, case reports, and studies in which individuals had other concurrent conditions.

PRISMA flow diagram and checklist

The selection process was conducted following PRISMA 2020 guidelines. A PRISMA 2020 flow diagram *(Fig. 1)* was used to report the study selection process, and the PRISMA 2020 checklist has been completed and is provided as supplementary material.

Variables and outcome measurement

Pain sensitivity

Measurement of pain sensitivity using pain pressure thresholds includes applying controlled pressure to exact points on the body using a device called an algometer. The pressure is progressively increased until the individual reports feeling pain. This threshold shows the point at which pressure becomes painful for that individual[30].

Pain intensity

Pain intensity refers to the degree or severity of pain that an individual is experiencing. It is subjective and can vary greatly from person to person. One commonly used method to measure pain intensity is the Numeric Pain Rating Scale (NPRS). The NPRS naturally involves asking individuals to rate their pain on a scale from 0 to 10, with 0 representing no pain and 10 representing the worst pain imaginable. This scale provides a quantitative measure of pain intensity, allowing us to assess changes in pain over time or in response to treatment[31].

Range of motion

Range of motion (ROM) refers to the extent to which the neck can flex, extend, rotate, and laterally bend. It's an important measure of neck function and mobility, commonly assessed in clinical settings, especially for patients with neck pain, injuries, or conditions affecting the cervical spine. To measure cervical spine ROM, use a goniometer. The patient is asked to perform specific movements to measure the angle formed by the movement using the goniometer. Lateral flexion: the patient tilts their head sideways, bringing the ear towards the shoulder on each side[32].

Selection of studies

Two authors (KHA and AS) independently screened the titles, abstracts, and full texts of studies for eligibility. Any disagreements were discussed and resolved by consensus or, if necessary, by consulting a third reviewer (SSb).

Data extraction, data synthesis, and methodological quality assessment

Data pertinent to the review's objectives, including study design, purpose, sample, diagnosis, dry-needling intervention characteristics, control intervention characteristics, and outcome measures, were independently extracted by two authors using a modified

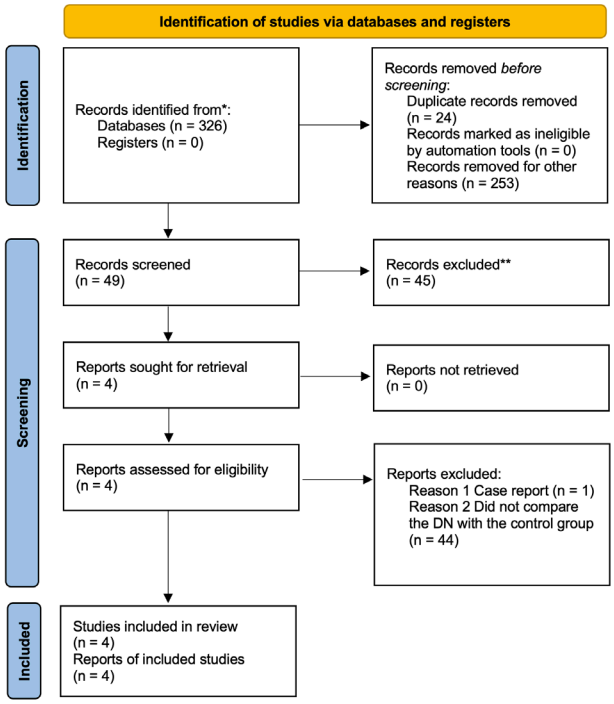


Figure 1. *PRISMA 2020 flow diagram.*

form. The thickness and length of the needles, the insertion characteristics (depth and frequency of movement), the number of needle insertions, the number of DN sessions, and the session completion criteria were all retrieved about the intervention.

Two authors independently evaluated each randomized controlled trial's methodological quality using the PEDro scale[33]. A PEDro score between 6 and 10 is indicative of high quality; a score of 4–5 indicates fair quality; and, a score of ≤3 indicates poor quality. A third author resolved disagreements.

Risk of bias assessment

The risk of bias for each included study was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool, which evaluates five domains: (1) bias arising from the randomization process, (2) bias due to deviations from intended interventions, (3) bias due to missing outcome data, (4) bias in measurement of the outcome, and (5) bias in selection of the reported result. Each domain was rated as "low risk," "some concerns," or "high risk" based on the RoB 2 guidelines. Two reviewers (KHA and AS) independently assessed the risk of bias for each study. Disagreements were resolved through discussion or consultation with a third reviewer (SMM). The results of the RoB 2 assessment were visualized using the RobVis web tool (https://www.riskofbias.info/welcome/robvis), and a risk of bias summary plot is presented in *Figure 2*.

RESULTS

Study selection

From the web-based search, 326 articles were identified. Of these, 253 articles were unrelated and 24 were duplicated and, therefore, were excluded. Of the 49 potentially eligible articles, one was excluded because it was a case report. (n = 44), did not compare the DN with the control group. Therefore, 4 articles remained and were included in this systematic review. The study selection process is detailed in the PRISMA 2020 flow diagram *(Fig. 1)*.

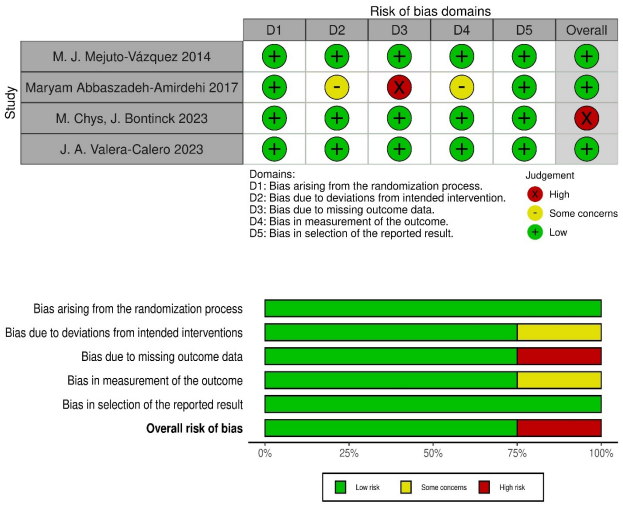


Figure 2. *Risk of bias assessment.*

Study characteristics

The four included studies enrolled a total of 153 participants, with a mean age of 27.6 years, while the percentage of male patients in these 4 studies was 22.1% and the female percentage 77.85%, including participants with myofascial pain syndrome[34-36] and mechanical neck pain[37]. Regarding the DN procedure, all these studies used the fast in fast-in-fast-out technique and the number of entered needles in muscles ranged from 2 to 10 repetitions. While the diameter and length needling for the first study was 0.30 mm diameter and 30 mm length[34], the second study was 0.30 mm diameter and 50 mm length[35], the third study was 0.25 mm diameter and 0.25 mm length[36] and the fourth study was 0.30 mm diameter and 0.40 mm length[37].

Regarding the intervention, the following comparisons were made:

- no intervention
- placebo/sham needling

Regarding the outcome measures, pain sensitivity was the primary outcome in all studies (assessed pain pressure threshold). In addition to pain sensitivity, studies measured pain intensity and also measured range of motion *Table 1*.

Authors	Sample size	Diagnosis	Outcome measures	Period of assessment	Number of sessions
Mejuto-Vázquez et al.[29]	17 (53% female)	acute mechanical neck pain	Pain pressure thresholds Pain intensity ROM	1 wk	1
Abbaszadeh-Amirdehi et al.[30]	40	Active myofascial trigger points of the upper trapezius muscle	Pain pressure thresholds Pain intensity	immediately post-intervention	1
Chys et al.[32]	36	chronic neck pain	Pain pressure thresholds	immediately post-intervention	1
Valera-Calero et al.[31]	60	active myofascial trigger points of the upper trapezius muscle	Pain pressure thresholds	immediately post-intervention	1

Table 1. *Main characteristics of the included trials.*

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Methodological quality of included studies (PEDro)

The four included RCTs demonstrated high methodological quality, with PEDro scores ranging from 7 to 9 out of 10. One study scored 7[34], two studies scored 9[36,37], and one study scored 8[35]. These scores indicate that all studies met the criteria for high-quality trials based on the PEDro scale. The detailed scores for each study are summarized in *Table 2*.

Effects of dry needling on the outcome measures

Pain sensitivity

In total, all 4 studies[34-37] showed that the DN intervention was effective in improving pain sensitivity (pain pressure threshold) in patients with trigger points in the upper trapezius muscle compared to sham/placebo intervention or no intervention. A study by Mejuto-Vázquez et al. 2014 showed the mean difference for the pain pressure thresholds in the DN group was 28.9 kPa, while in the no-intervention group was 11kPa[34]. Also, Abbaszadeh-Amirdehi et al. 2017 presented that the mean difference for the pain pressure thresholds in the DN group was 0.42 kg/cm^2 while in the healthy volunteers' group it was 0.71 kg/cm^2[35]. The third study by Bontinck et al. 2023 found that the mean difference for the pain pressure thresholds in the DN group was 1.03 N/cm^2 while in the sham needling group was 1.14 N/cm^2[37]. Finally, the study of Valera-Calero et al. 2023 showed the mean difference for the pain pressure thresholds in the DN group was 0.54 kg/cm^2 while in the sham needling group it was 0.39 kg/cm^2[36].

Pain intensity

Two studies[34,35] presented that the DN intervention was effective in reducing pain intensity compared to sham/placebo intervention or no intervention. The study by Mejuto-Vázquez et al. 2014 showed that the mean difference for the pain intensity in the DN group was decreased to -3.7 while in the no intervention group it was decreased to -0.7[34]. Another study by Abbaszadeh-Amirdehi et al. 2017 showed that the mean difference for the pain intensity in the DN group was decreased to -3[35].

Range of motion

We found one study that evaluated the effects of DN on ROM. The study of Mejuto-Vázquez et al., published in 2014, showed that the mean difference for the contralateral ROM in the DN group was increased to 12.8 degrees while in the comparison group it was increased to 6.3 degrees[34]. Finally, they found that increase in ROM in treating trigger points in the upper trapezius muscle compared to sham/placebo intervention or no intervention.

Author	Interventions compared to DN	Sample size	Results	Conclusions	PEDro
Mejuto-Vázquez et al.[33]	No intervention	17	**Pain sensitivity (kPa) DN-** Pre: 224.8 ± 100.3 Post: 353.7 ± 92.3 No intervention- Pre: 285.1 ± 102.4 Post: 296.1 ± 89.7 **Pain intensity** DN- Pre: 5.7 ± 1.8 Post: 2 ± 1.7 No intervention - Pre: 5.3 ± 2 Post: 4.6 ± 2.1 **ROM (deg.)** DN- Pre: 39.4 ± 15.1 Post: 52.2 ± 6.6 No intervention- Pre: 36.2 ± 11.5 Post: 42.5 ± 8.5	TrPDN decreases pain intensity and widespread pressure pain sensitivity and increases cervical range of motion. differences between groups in effect sizes were large for almost all outcomes.	7/10
Abbaszadeh-Amirdehi et al.[34]	Healthy volunteers	40	**Pain sensitivity (kg/cm^2)** DN- Pre: 1.1 ± 0.5 Post: 1.52 ± 0.59 healthy volunteers - Pre: 2.42 ± 1.38 Post: 1.71 ± 1.16 **Pain intensity** DN- Pre: 5 ± 2.22 Post: 2 ± 2.207	DN increased PPT and decreased pain.	U/N
Chys, J. Bontinck et al.[36]	sham needling	54	**Pain sensitivity (N/cm^2)** DN- Pre: 18.52 ± 10.59 Post: 19.55 ± 12.4 sham needling - Pre: 19.79 ± 12.54 Post: 20.93 ± 13.65	no superior effect of DN, compared to SN found for PPTs	8/10
Valera-Calero et al.[35]	sham DN	60	**Pain sensitivity (kg/cm^2)** DN- Pre: 1.82 ± 0.77 Post: 2.36 ± 1.26 sham needling - Pre: 1.84 ± 0.95 Post: 2.23 ± 1.3	Increased pain sensitivity in both groups	9/10

Table 2. *Studies that compared dry needling against no intervention, a sham intervention, or placebo.*

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Risk of bias assessment

In *Figure 2*, the risk of bias is expressed in a summary form. Out of 4 studies, 2 studies have a good method to reduce bias. These studies have a low risk of selection bias, performance bias, diagnosis bias, attrition bias, reporting bias, and other biases[34,36]. Single of the involved studies[35] had a high risk of bias in the binding of participants and personnel and one study was at high risk of selective reporting[37].

A synthesis of the risk of bias assessment is presented in *Figure 2*. Overall, the included studies showed a low to moderate risk of bias across all domains. The majority of studies were assessed as having a low risk of bias for the randomization process domain, as appropriate randomization methods were described. However, blinding of participants and personnel domain often presented a moderate risk of bias due to the nature of the interventions, making blinding difficult. Two studies were evaluated as having a low risk of bias across all domains, while one study was assessed as having some concerns due to potential deviations from the intended intervention. The risk of bias related to measurement of the outcome was generally low, indicating that outcome assessors were appropriately blinded in most studies.

DISCUSSION

The purpose of this systematic review was to investigate the efficacy of DN in managing MTrPs and to explore specific aspects of the technique that may influence its effectiveness. This systematic review found and included four RCTs that compared DN with sham or placebo intervention, or no intervention. The findings indicate that DN, as opposed to sham or placebo needling or no intervention at all, is useful for enhancing pain sensitivity in the short term. While all four studies demonstrated improvements in pain sensitivity in the DN groups, it is noteworthy that control groups also exhibited some positive effects in two studies. For these two studies[34,37] where the control group showed more improvement than the DN group in terms of pain sensitivity. The applied combined reduction in pain intensity and pressure pain sensitivity afterward TrPDN proposes a hypoalgesic effect of the intervention. The mechanisms by which TrPDN decreases pain and central sensitization remain hypothetical, and segmental and central mechanisms have been proposed[38-41]. In support of this, Saeedzadeh et al. (2023) demonstrated that individuals with myofascial trigger points in the upper trapezius muscle exhibited impaired force sense compared to healthy individuals, suggesting that trigger points may influence proprioceptive function and neuromuscular control[6]. It has been recommended that the mechanical stimulus, because of the insertion of the needle, stimulates sensitized muscle nociceptors, decreases metabolic mediators[42,43], and increases local microcirculation[44]. The potential decrease in chemical mediators could be associated with the observation of immediate decreases in pain and tenderness after TrPDN. Moreover, following DN, there is a notable significant decrease in the intensity of pain in two studies[34,35] in the DN group. Also, one study showed that there is a significant increase in the contralateral cervical range of motion immediately after applying DN[34]. Furthermore, when DN was contrasted with control or sham, a statistically significant difference was observed in the short term. Therefore, as compared to the control or sham, this study revealed enough data to support the hypothesis that DN had significant therapeutic effects on MTrPs linked to neck discomfort in the short term. Changes in the ROM could be associated with mechanical effects induced by TrPDN, e.g., disruption of contraction knots (TrP), the localized stretch of contracted cytoskeletal structures, and a decrease of the intersection between actin and myosin filaments[38-40]. Because taut bands with TrPs have a greater stiffness than the surrounding muscle tissue[45] TrPDN may reduce muscle stiffness.

Clinical implications

The results of this systematic review support the short-term effectiveness of dry needling (DN) in managing active myofascial trigger points in the upper trapezius muscle. These findings suggest DN may be considered a valuable tool within multidisciplinary pain management programs for patients with neck pain, particularly when rapid symptom relief is desired. Evidence indicates that DN can lead to immediate improvements in pain sensitivity, pain intensity, and cervical range of motion, which may contribute to faster recovery and return to function in both athletic and general populations[1,27].

In clinical practice, professionals such as physiotherapists, physiatrists, pain specialists, and other licensed healthcare providers trained in dry needling may integrate DN into treatment protocols. Although some debate exists about the use of the term “clinicians” for physiotherapists, in many countries, physiotherapists are classified as primary care practitioners and are authorized to perform clinical assessments and interventions[26,38].

For optimal results, it is recommended that DN be applied by appropriately trained practitioners following standardized protocols. Future work should focus on defining optimal dosage, frequency, and long-term outcomes of DN for upper trapezius MTrPs.

Adverse events

None of the included studies systematically reported adverse events associated with dry needling. However, previous literature indicates that dry needling is generally safe when performed by trained professionals. Most reported adverse events are minor and transient, such as local soreness, bruising, post-needling soreness, or minor bleeding, typically resolving within 24–48 hours[46,47].

Serious complications (e.g., pneumothorax, infection) are rare and usually associated with improper technique or

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anatomical inexperience[48]. The overall rate of adverse events for DN is lower than for many other invasive interventions when appropriate precautions are taken. Practitioners must be trained in anatomy, use sterile technique, and perform pre-treatment screening to ensure patient safety[40].

Our review incorporated a comprehensive risk of bias (RoB) assessment covering multiple bias domains. This enabled a more nuanced interpretation of findings, particularly to the methodological rigor of included studies. In contrast to earlier systematic reviews on dry needling, such as those by[49,50], which noted high or unclear RoB but did not fully integrate this into their analysis or discussion, our review systematically evaluated and reported RoB and accounted for its potential influence on outcomes. For example, Alghadir et al. reported a high RoB in all, but one study did not conduct a sensitivity analysis or reflect on the potential impact of these biases on pooled results. Similarly, Santos et al. highlighted methodological shortcomings like inconsistent reporting and dosage variability but did not formally assess RoB using standardized tools. By addressing these shortcomings, our review adds clarity and strengthens the evidence interpretation regarding dry needling effectiveness.

Study limitations

The short-term follow-up of the treatment's success constituted a study constraint. In one trial, the effective treatment was followed for an average of one week, while in the other investigations, the follow-up period was immediately after the intervention. Since the meta-analysis was conducted on data collected both before and right after the intervention, the results of this study are insufficient to support dry needling's long-term efficacy. These methodological limitations may influence the interpretation of outcomes and highlight the need for stricter methodological rigor in future studies. It is advised that future trials be meticulously planned, especially with regard to control group selection and blinding procedures. A limitation of our review is that several included studies were rated as having moderate to high RoB, especially concerning blinding and selective reporting. While previous reviews have acknowledged similar issues, they often lacked formal RoB assessments or did not reflect this bias in their interpretations. In contrast, our review aimed to address this by applying a structured RoB tool and incorporating the results into our overall evaluation and discussion.

CONCLUSIONS

We found that DN might have a positive effect in the short term on pain sensitivity and intensity and ROM. Further randomized clinical trials of high methodological quality, using standardized procedures for DN application, are desirable.

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