Modern Journal of Health and Applied Sciences *(MJHAS)*

E-ISSN 3078-2791; P-ISSN 3078-2783

Journal homepage: https://mucjournals.muc.edu.ps/index.php/MJHAS

Dry Needling Intervention in Treating Musculoskeletal Disorders: A Scoping Review

Muyco John Angelo [1], *Gaspe Micah Grace* [1]*, *Ramirez John Ray* [1], *Perez John Vincent* [1], *E.D.P*[1]

[1] Physical Therapist Registered in the Philippines.Manila Central University Hospital.

ARTICLE INFO

Received:18th March 2024
Received in revised form: 14th February 2025
Accepted: 17th February 2025
Published: 15th September 2025

***Corresponding Author:**
Gaspe Micah Grace
E-mail:
micahgaspe13@gmail.com

Citation : Muyco, J. A., Gaspe, M. G., Ramirez, J. R., Perez, J. V., & P., E. D. (2025). Dry needling intervention in treating musculoskeletal disorders: A scoping review. *Modern Journal of Health and Applied Sciences*, 2(2), 1-22.

Copyright © 2025 The Author(s). Published by Modern University College.

Open Access

This work is licensed under a Creative Commons Attribution NonCommercial 4.0 International license.

DOI: https://doi.org/10.70411/MJHAS.2.2.2025126

ABSTRACT

Dry Needling (DN) has emerged as an effective treatment for various musculoskeletal disorders (MSDs), although the specifics of its application and the range of treated disorders remain unclear. The objective is to map and summarise dry needling practices from a global perspective. This scoping review employs the Joanna Briggs Institute technique, utilising the PCC framework (Participants, Concept, Context) to establish eligibility criteria based on the PRISMA Scoping Review checklist. Searches in PubMed, PEDro, and Google Scholar aim to identify evidence on dry needling, either as a standalone intervention or combined with other treatments, with clinical outcomes such as short-term or long-term effects on pain and physical function. The review includes systematic reviews, RCTs, meta-analyses, literature reviews, and quasi-experimental studies. DN, widely adopted in Europe and gaining traction in North America and Asia, effectively addresses MSDs like myofascial pain syndrome, knee osteoarthritis, and patellofemoral pain syndrome. Studies highlight DN's effectiveness in reducing pain and enhancing muscle function. Further research, incorporating extended follow-up periods of 6 months to 1 year, is crucial to comprehensively evaluate DN's long-term impact on pain, functionality, and overall quality of life.

Keywords: physical therapy, musculoskeletal disorder, ultrasound-guided dry needling, dry needling techniques, global perspective.

1. Introduction

Musculoskeletal disorders (MSDs) pose a significant and complex challenge in healthcare, affecting patient well-being and straining global healthcare systems. According to a new review of Global Burden of Disease (GBD) 2019 data, over 1.71 billion individuals worldwide suffer from musculoskeletal diseases such as low back pain, neck discomfort, fractures, osteoarthritis, amputation, and rheumatoid arthritis. While the prevalence of musculoskeletal problems varies with age and diagnosis, it affects people of all ages all over the world. High-income countries are the most affected (441 million people), followed by countries in the WHO Western Pacific Region (427 million) and South-East Asia Region (369 million). Musculoskeletal diseases are also the leading cause of years lived with disability (YLDs), accounting for approximately 149 million YLDs, or 17% of all YLDs worldwide. In recent years, the therapeutic practice of dry needling (DN) has emerged as a promising solution for mitigating pain and enhancing functionality in individuals grappling with diverse MSDs. According to the American Physical Therapy Association (APTA), Dry needling involves the precise insertion of thin filiform needles beneath the skin's surface, targeting myofascial trigger points, musculature, and connective tissues. APTA supports the inclusion of dry needling in regulatory frameworks, accompanied by appropriate educational qualifications for PTs to engage in the intervention. This technique, endorsed by reputable organizations such as the American Physical Therapy Association (APTA), has gained traction owing to its minimally invasive nature and potential effectiveness in addressing the fundamental causes of musculoskeletal pain and dysfunction. In-depth examination of the current state of dry needling worldwide is presented in this publication, which also explores its uses, effectiveness, underlying mechanisms, and practical consequences in various therapeutic contexts worldwide. There will be a special focus on revealing how dry needling is utilized to treat a variety of MSDs, such as myofascial pain syndrome, patellofemoral pain syndrome, and knee osteoarthritis. Through a thorough analysis of a wide range of literature, including primary research studies, meta-analyses, and systematic reviews, our goal is to reveal the complex ways that dry needling is applied around the world to treat these conditions effectively. The researchers' goal in doing this study is to further our understanding of the critical role that dry needling plays in the worldwide management of MSDs.

2. Materials and Methods

This scoping review was conducted by using the Joanna Briggs Institute technique. It utilised the PCC framework (Participants = studies that utilise DN in the treatment of various MSDs with at least one session of DN and outcome measures (pain, functionality, QOL), Concept = dry needling intervention in physical therapy practice in the management of musculoskeletal disorders such as its techniques and methods, short-term and long-term effects based on their pain and functional outcomes. Context = articles in a clinical (effects) and geographical context (integration of DN in global perspective) to establish its eligibility criteria, which is based on the PRISMA Scoping Review checklist. The researchers provided inclusion and exclusion criteria to determine the extent of the articles that were used for the study.

2. 1. Eligibility Criteria

The gathered studies were eligible if they met the following criteria provided by the researchers. The inclusion criteria encompass studies involving (1) participants ages 12-65 years old, (2) studies which uses dry needling for musculoskeletal disorders (neck pain, shoulder pain syndrome, myofascial pain syndrome, spine disorders, tendinopathy, low back pain, knee & hip oa, plantar heel pain), with measurement of pain and functional outcomes (VAS: Visual Analog Scale; NPRS: Numeric Pain Rating Scale; NDI: Neck Disability Index; KOOS: Knee Injury and Osteoarthritis Outcome Score; PKE: Passive Knee Extension; FFD: Finger-floor distance; WOMAC: Western Ontario and McMaster; DASH: Disability of the Arm, Shoulder, and Hand; SPADI: Shoulder Pain and Disability Index; ODI: Oswestry Disability Index: PSFS: Patient Specific Functional Scale; FHSQ: Foot Health Status Questionnaire) and (4) examination of short-term and long-term effects. Exclusion criteria involve

(1) studies using wet needling which involves injecting medicinal liquids like corticosteroids and anaesthetics into muscles, ligaments, tendons and scar tissue, (2) acupuncture which is based on meridians and qi principles, (3) participants with neurological disorders or underlying medical conditions (such as asthma, cancer, cerebrovascular diseases, and diabetes mellitus), and (4) studies that are not freely accessible.

2. 2. Search Strategy

The primary data were sourced from the English-language literature. They included systematic reviews, randomized controlled trials, meta-analysis papers, review articles and quasi-experimental studies that addressed the key research questions posed. The improvement framework proposed by Peters et al. guided the review process, alongside Arksey and O'Malley's methodological approach, which involved identifying the research question, selecting and identifying relevant studies, charting the data, synthesizing, summarizing, and reporting the findings, and consulting with stakeholders interested in the outcomes for validation.

Search strategy: A comprehensive search using a three-step Joanna Briggs Institute (JBI) search strategy was initially implemented in the PubMed, PEDro and Google Scholar databases, using the appropriate type of terms found in titles, abstracts or as keywords. To provide the highest level of evidence (HLE) possible, all full-text articles that met the inclusion criteria were screened, with a focus on papers published from 2018 onwards. The following searches rested on Medical Subject Headings (MeSH) terms—"Dry Needling," "Musculoskeletal Disorder," and "Physical Therapy Practice"—to demarcate them from other studies that did not meet the inclusion and exclusion criteria.

The initial search process yielded 120 records. A total of 45 articles from PubMed, 20 from PEDro, and 10 from Google Scholar were identified after applying the inclusion and exclusion criteria. After a thorough inspection, 38 papers were ultimately deemed eligible for the final research.

2. 3. Selection Process

The researchers utilized the JBI System for the Unified Management, Assessment, and Review of Information (SUMARI). These guidelines guide all stages of a systematic review or scoping review, including search development and best practices for review methods, data extraction, and data analysis, to lower the risk of error and bias in the review process. In addition to these guides, standards exist to improve systematic review reporting, such as the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which specifies a minimal set of needed items. JBI developed the System for the Unified Management, Assessment, and Review of Information (SUMARI) to guide researchers through the complete systematic review process, based on one of these manuals.

2. 4. Data Collection Process

Two independent reviewers performed extraction, and a third reviewer ensured the completeness of information. The extracted data included the author(s), year of study publication, basic demographic information, disease model (type of musculoskeletal disorder and targeted anatomic region/body area), treatment approach (dry needling point, soft tissue treated, location, and nature of comparator therapies administered), outcome assessments conducted (informed by specific diagnostics employed), duration and time points measured at follow-up, and main findings reported.

2. 5. Characteristics of Included Studies

Distribution of study types in 38 included studies and English-speaking countries showed that the majority were RCTs (55%), followed by systematic reviews with an accompanying range (17.5%) and other designs (27.5%). This highlights the need for

further experimental research approaches to provide better evidence for the therapeutic effects of dry needling. More medically reviewed studies originated from Asia (30%) and Europe (40%) compared to North America (25%). Therefore, continental distribution may potentially have influenced the number of audits included in our sample. A whopping 95% of studies (intercept=−0.01, test statistics = 0.0022; $p < 0.0001$) gathered by the investigators primarily dealt with musculoskeletal disorders that involve dry needling in their intervention component. Among the MSDs reviewed, MPS was the most frequently studied, accounting for 26% of cases combined with DNI, while patellofemoral pain syndrome and headache each accounted for 4% of combined use. According to the distribution of interventions, dry needle alone was evaluated in most included studies (70%), while the remaining studies investigated its combination with other interventions, such as hard block and dry needling groups.

2. 6. Appraisal of Included Studies

Reviewers used the JBI Sumari tool to appraise the collected studies. The tool offers a wide array of critical appraisal instruments for researchers looking to check the methodological shortcomings of the study. JBI Sumari has sections that are presented as a series of questions in a study-specific checklist. Duplicates were first removed from the collected articles, after which two authors screened the titles and abstracts of these articles for potential eligibility. Next, the full texts of all potentially eligible studies were analyzed for eligibility. Two reviewers had to reach an agreement on inclusion and exclusion, and the review of a third party resolved any disagreement arising between the two reviewers to determine article inclusion. Eligible articles were then reviewed independently by two reviewers (AW, SR). One reviewer initially assessed the articles, and the studies were appraised once more by a second reviewer to prevent potential bias. Finally, the senior reviewer then performed a secondary review to make the final decision on whether to include or exclude articles.

3. Results

3. 1. Mapping of Extracted Data

The authors were able to gather the commonly used dry needling techniques employed as an intervention in the treatment of musculoskeletal disorders. These techniques include dry needling combined with the use of manual therapy, dry needling with the use of modalities (US and electrical nerve stimulation), and dry needling alone (trigger point dry needling, superficial and deep dry needling, and dry needling with trigger point compression) (see Supplementary Materials: Table 1).

3. 2. Nature of Dry Needling

Dry needling without other interventions is found to be the most common dry needling intervention in terms of treating musculoskeletal disorders. It is most evident that dry needling without any other intervention (45%) shows positive results in pain reduction, pain-related disability, and pressure pain threshold in the short term when compared to sham and no needling treatments. However, it can be enhanced when combined with other modalities and interventions such as manual therapy (MT) or exercise therapy (ET) (see Supplementary Materials: Table 2).

3. 3. Integration of Dry Needling in a Continental Perspective

The integration of dry needling in Eastern Continent (Europe and Asia) was measured in 29 studies with 17 studies from Europe (15 studies from Spain and 2 studies from Belgium) 12 studies from Asia (6 studies from Iran, 2 studies from Israel, 2 studies from Pakistan, 1 study from Cyprus and 1 study from Saudi Arabia) All of the studies included RCT, systematic review, case series, quasi-experimental study, and prospective questionnaire. 17 out of 38 articles (42.5%) originate from Europe, 4 out of 17 (23.5%) treated myofascial pain syndrome (MPS) using trigger point dry needling (TrpDN) and DN with percutaneous

nerve stimulation. Concurrently, the integration of dry needling in Western Continent (North America and South America) was mapped in 10 studies (6 RCT, 1 case series, 1 quasi-experimental, and 1 prospective questionnaire from the United States and 1 RCT from Brazil). 9 out of 38 (22.5%) articles originate from North America. 2 (5%) out of 9 treated LBP using Dry Needling (DN). (see supplementary materials: Table 3).

3. 4. MSD Commonly Treated Using Dry Needling

Based on the collected data, we learnt that myofascial pain syndrome (MPS), specifically cervicalgia, was the most frequently managed musculoskeletal pathology. Some studies emphasise the role of dry needling interventions in MPS, showing successful outcomes in pain intensity, pain-related disability, pressure pain thresholds (PPT), and cervical range of motion (ROM). These studies were conducted across continents, with significant representation in Europe (especially Spain), followed by North America, Asia, and South America. The interventions usually included dry needling techniques applied to trigger points or myofascial regions, either alone or combined with other treatment modalities like percutaneous electrical nerve stimulation or ultrasound guidance. Standard outcome measures used for evaluating the effectiveness of dry needling include visual analogue scales (VAS)/numeric pain rating scales (NPRS), pressure pain thresholds (PPTs) retest methods, disability measurements (e.g., Neck Disability Index; Quick Disabilities of the Arm, Shoulder and Hand Questionnaire/Shoulder Pain and Disability Index), range of motion measures, and patient-reported outcomes that are not specific to any given region treated with the dry needling (e.g., SF-36/DASH). In general, the numerous studies demonstrating positive outcomes for dry needling in reducing pain and improving function across various musculoskeletal conditions highlight its potential as an effective treatment modality for MPS and associated syndromes (see Supplementary Materials: Table 4).

3. 5. Synthesis of Results

Dry needling interventions for musculoskeletal disorders have been extensively studied across various continents, including Europe (Spain), North America (USA), Asia (Iran, Israel, Pakistan, Saudi Arabia), and South America (Brazil). These studies, comprising a mix of randomized controlled trials (RCTs), systematic reviews, meta-analyses, scoping reviews, cohort studies, pilot studies, and quasi-experimental studies, have focused on a range of conditions such as neck pain, myofascial pain syndrome (MPS), spine disorders, shoulder pain, subacromial syndrome, tendinopathy, upper trapezius myofascial pain syndrome, plantar fasciitis, patellar tendonitis, knee osteoarthritis (KOA), chronic tension-type headache, hip osteoarthritis (OA), chronic nonspecific low back pain (LBP), lower extremity myofascial trigger points, acute golfer's elbow disability, and gluteus medius strength measurements. These interventions, including dry needling, dry needling with percutaneous electrical nerve stimulation, ultrasound-guided dry needling, electrical dry needling, and trigger point dry needling, have been evaluated using various outcome measures such as the visual analog scale (VAS), pressure pain threshold (PPT), neck disability index (NDI), numeric rating scale (NRS), goniometer, Disabilities of the Arm, Shoulder, and Hand (DASH), Quick Disabilities of the Arm, Shoulder, and Hand (Q-DASH), neck pain and disability scale (NPDS), neck pain and disability scale (NPQ), Short Form-36 (SF-36), foot health status questionnaire (FHSQ), quality of life (QOL), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Roland-Morris Disability Questionnaire (RMDQ), Oswestry Disability Index (ODI), quick disabilities of the arm, shoulder, and hand (Q-DASH), knee injury and osteoarthritis outcome score (KOOS), and Victorian Institute of Sport Assessment-Patella (VISA-P). Overall, the effectiveness of dry needling has shown variability across studies, demonstrating positive outcomes in reducing pain intensity, improving functional parameters, increasing pressure pain thresholds, and enhancing range of motion. However, further research is warranted to determine the long-term efficacy and optimal application of dry needling in the management of various musculoskeletal disorders.

3. 5. 1. Utilization of Dry Needling Techniques

The utilization of dry needling was done by varieties of dry needling techniques for musculoskeletal disorders which includes trigger point dry needling, electrical dry needling, ultrasound guided dry needling, and superficial and deep dry needling. The use of trigger point dry needling showed significant pain reductions on patients with patellofemoral pain syndrome, mps in the neck and upper back. Although, according to a systematic review study from Spain, there is low to moderate evidence that supports a positive effect of trigger point dry needling on pain and related impairment in patellofemoral pain, but not on knee osteoarthritis (OA) or postoperative pain, in the short term (Rahou-El-Bachiri et al., 2020). The use of electrical dry needling showed positive effects in pain reduction of chronic low back pain. However, there is a lack of standardisation in terms of the length of the analgesic effect and the necessary dose. Additionally, ultrasound-guided DN of the patellar tendon in combination with conventional physical therapy (CPT) reduced pain, improved function, and showed a tendency to decrease tendon thickness in patients with patellar tendinopathy. One study from Iran examined the effects of using shallow and deep dry needling procedures on the range of motion and functional capacity of the neck. However, the deep dry needling patients experienced more noticeable and significant changes. Moreover, dry needling combined with manual therapy and exercise was utilized in treating musculoskeletal disorders.

Dry needling combined with other therapies may have a favorable short-term impact on pain intensity, pain-related disability, pressure pain thresholds, and cervical range of motion in patients with neck pain linked to TrPs, according to low-to-moderate evidence (Fernández-De-Las-Peñas et al., 2021). Both short-term and long-term impacts were undetectable. Incorporating electrical dry needling into a manual therapy (MT) and exercise regimen was more effective than MT and exercise alone in relieving pain, improving function, and reducing related disability. A study involving patients with plantar fasciitis who received electrical dry needling in addition to manual treatment, exercise, and ultrasound showed considerable improvement, outperforming those who received manual therapy, exercise, and ultrasound alone (Dunning, Butts, Young, et al., 2018).

3. 5. 2. Head and Neck

An RCT study from Asia showed that in individuals with persistent tension-type headaches, trigger point dry needling reduces headache severity, frequency, and duration while also improving health-related quality of life. Two RCT studies from Europe and Asia use trigger point dry needling (TrP-DN) as the main intervention for neck pain and chronic neck pain (Gildir et al., 2019). According to a study from Spain that used TrP-DN, when performed on a trigger point, latent trigger point, or non-trigger point area, deep dry needling of the trapezius muscle has the same positive effects on reducing pain intensity, discomfort, and local mechanical hyperalgesia (Martín-Sacristán et al., 2022) .

Another study from Saudi Arabia found that TrP-DN plus exercise had similar effects on pain, depression, and quality of life at the end of a two-week follow-up period (Almushahhim et al., 2022). One systematic review from Europe uses dry needling for neck pain. The study which originated from Spain showed that dry needling can be used as a treatment option for chronic neck pain. According to the study that was analysed, successful outcomes were obtained in the near term and during the three to six month follow-up period. However, since it only persisted for a year, the long-term effects were found to be limited (Rodríguez-Huguet et al., 2022).

An RCT study from Spain shows DN can be effective for improving neck pain intensity and related disability when compared with a comparative group immediately after and at short but not at mid term follow ups in people with myofascial TrPS associated with neck pain symptoms (Navarro-Santana et al., 2020). Additionally, One RCT study from Spain can be effective for improving neck pain intensity and related disability when compared with a comparative group immediately after and at short but not at mid term follow ups in people with myofascial TrPS associated with neck pain symptoms (Navarro-Santana et al., 2020).

3. 5. 3. Upper Extremities

The effectiveness of DN when combined with conventional physical therapy in the recovery of patients with subacromial syndrome (SAS) of non-traumatic origin for at least three months and had at least four points on VAS and clinically diagnosed with subacromial pain syndrome (SAPS) and found out that DN is effective and safe in reducing the pain and disability produced by SAS, with the best combination of treatment turning out to be conventional physical therapy together with DN, obtaining more stable and longer-lasting benefits than merely applying the techniques in isolation (Blanco-Diaz et al., 2022).

A case series observed the use of DN in conjunction with exercise as a management strategy for patients who meet the clinical diagnostic criteria of SAPS to assess the short and intermediate-term effects of DN in conjunction with exercise. 25 patients met the criteria of SAPS and were given DN treatment first in isolation to observe the immediate effects of DN and exercises were given on their third visit. Results show significant improvement on patients Q-DASH, NPRS, GROC and improvement on ROM at 3 months follow-up. The case series encourages the use of DN in conjunction with exercise therapy in the management of SAPS (Morgan et al., 2019).

1 case report from Iran assessed the acute effects of one session of DN on a patient with a golfer's elbow. A 40-yr old retired male athlete reported an acute pain on the medial side of elbow and was given one session of deep-dry needling on his flexor area (medial epicondyle) and on the inner side of his elbow which lasted for 20 minutes. Results showed no improvements in his range of motion or pain immediately following dry needling. After two days, patient reported reduced pain and being able to do more activities functionally related with the elbow, his movements had improved, and there was no specific movement limitation. At the seven-day follow-up, the patient was able to undertake exercise training with elastic bands without pain (Shariat et al., 2018).

One RCT assessed the effectiveness of Trigger Point Dry Needling (Trp-DN) in sixty-six patients aged 65 years and older with trigger points in the ipsilateral infraspinatus of the painful shoulder with latent MTrP group (pain when compressed) and active MTrP group (pain upon movement) and found out that dry Needling on the ipsilateral infraspinatus showed significant pain reduction, increased pressure pain threshold but no significant improvement on grip strength (Calvo-Lobo et al., 2018).

3. 5. 4. Paralumbar Area

A study from the USA has said that Dry needling appears to reduce resting erector spinae muscle following treatment of patients with low back pain. Therefore, the authors recommended that providers should consider the use of dry needling when patients exhibit aberrant stiffness of the lumbar muscles. Numerical Pain Rating Scale (NPRS) and Oswestry Disability Index (ODI) were used as the outcome measures for the intervention (Koppenhaver et al., 2022). Another RCT study from the USA indicated no between-group differences between patients experiencing non-specific LBP who received a semi-standardized non-thrust manipulation (NTM) or a segmental and distal DN approach without needle manipulation. NPRS, ODI, Patient Specific Functional Scale (PSFS) and Pressure Pain Threshold (PPT) were used by the authors as the outcome measure for the non-specific LBP (Griswold et al., 2019). One Pilot Study from Iran has said that a single session of deep DN improved pain and function and increased hamstring flexibility. The study supports the use of DN in patients with LBP and hamstring tightness. VAS, PKE, FFD test, and FRI were used as the outcome measure for this study (Bazzaz-Yamchi et al., 2021).

3. 5. 5. Lower Extremities

The use of dry needling as an intervention in treating hip osteoarthritis (OA) is evident in Europe. A Systematic Review study from Spain shows that for patients with hip OA, there is extremely low-quality evidence that DN has a favourable effect in the short term on pain severity and physical function. The study's outcome metric was pain intensity. However, more research must be done to evaluate the medium and long-term effects (Jimenez-del-Barrio et al., 2022). An RCT study from North

America/USA assessed the effects of ultrasounded DN compared to DN alone in the management of painful knee osteoarthritis (KOA). US-guided DN with exercise therapy may be more effective than traditional DN with exercise therapy or exercise therapy alone in reducing pain of KOA due to accuracy offered by ultrasound by pin-pointing painful trigger points, VAS and KOOS subscales were used as outcome measures (Pang et al., 2022).

One SR from Europe/Spain investigated the effect of DN in the management of KOA. Very low-quality evidence suggests a positive effect of DN for reducing pain intensity and improving physical function in the short term in patients with osteoarthritis. Further investigation is needed to determine medium- and long-term effects (Jimenez-del-Barrio et al., 2022). One SR from Europe/Spain also evaluated the effects of DN in knee pain syndrome. Low to moderate evidence suggests a positive effect of trigger point dry needling on pain and related disability in patellofemoral pain, but not knee osteoarthritis or post-surgery knee pain, at short-term. More high-quality trials investigating long-term effects are clearly needed (Rahou-El-Bachiri et al., 2020)..

Furthermore, individuals who received the combination of electrical dry needling, MT, and exercise improved much more than those who received MT and exercise alone at 6 weeks and 3 months. At 3 months, patients who received electrical dry needling were 1.7 times more likely than those who received MT and exercise to have completely stopped taking pain medication. Additionally, more patients in the dry needling group achieved a successful outcome than those in the MT and exercise group. At 3 months, the effect sizes were high in favour of the electrical dry needling group for all outcome measures (Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index). Incorporating electrical dry needling into an MT and exercise regimen was more successful than MT and exercise alone in relieving pain, function, and related-disability.

4. Discussion

A search of the literature provided 38 studies that met the inclusion criteria for this scoping review. This resulted in dividing the studies based on their origin of the continent from western and eastern, dry needling techniques and methods on musculoskeletal disorders.

According to the data that we reviewed from Asia about dry needling, only 12 out of 38 (30%) claim the integration of DN in Asia (See Table 1). Geographically speaking, most of the countries that were included from Asia were close to the Western Countries. It can be said that they are mostly influenced by the western practice. It should also be noted that there are few local literatures in regards to the utilization of dry needling as intervention for musculoskeletal disorder. 17 out of 38 (42.5%) included studies have shown the integration of DN in Europe. DN is already established as a part of physical therapy practice mostly in Spain. 10 out of 38 (25%) included studies were found from North America. There are limited studies about dry needling intervention for musculoskeletal disorders from South America with a total of 1 out of 38 (2.5%) included studies.

Dry Needling (DN) is being widely utilised globally as an intervention for pain reduction and improvement of function for patients with musculoskeletal disorders. There is no superiority of DN over other treatments (manual therapy or exercise or physical agent and modality). Although, DN combined with other PT interventions shows improved outcome in patients with MSD's. Multiple DN techniques and methods were used in treating MSD's. Among all of the techniques that were used, DN and TrP-DN showed the most significant improvement in reducing pain for patients with MSD's. Additionally, ultrasound-guided dry needling was found to be more effective compared to traditional DN with exercise therapy or exercise therapy alone when it comes to reducing the pain of patients with knee osteoarthritis (KOA). For the electrical DN, although it has been proven to be effective in reducing pain; the duration of the analgesic effect and the dose required are contradictory. Consequently, electrical dry needling added with manual treatment, exercise, and ultrasound is more effective than manual therapy, exercise, and ultrasound alone.

Accordingly, in this scoping review, musculoskeletal disorders that are often treated include the following: acute and chronic MPS, chronic neck pain, spine disorders, subacromial pain syndrome, shoulder pain, tendinopathies, golfer's elbow, chronic tension-type headache, LBP, Plantar heel pain, knee OA, hip OA, gluteus medius, plantar fasciitis and patellar tendonitis. Almost

all the studies have shown a positive and significant improvement at all domains at short-term (3 weeks follow-up) but there is a need for a longer follow-up to conclude the long-term effects of DN in the treatment of MSD's and multiple studies have recommended that more high quality trials are needed. The MSD's were measured based on their pain and functional outcomes that were assessed using PPT, VAS, NPRS, NDI, KOOS, PKE, FFD, WOMAC, DASH, SPADI, ODI, PSFS, and FHSQ. Dry needling is an invasive treatment but there are minimal to no adverse events reported in the studies. Minor adverse events reported include mild bleeding, bruising, and pain. Overall, the risk of major adverse events to happen during DN is small. In terms of cost, DN is considered cost-effective in the treatment of various MSD. Although other interventions such as percutaneous needle electrolysis may be more cost-effective than DN in the long run. DN is now being considered as a viable treatment for athletes with musculoskeletal problems for improving grip strength by applying DN in the teres major mm. According to the study of Laita et. al, after a single session of DN in active MTrPS of the teres major mm in handball athletes with shoulder pain, the pain during the throwing action decreased, the glenohumeral internal rotation ROM increased and the extensibility was improved. In addition, we have found out that DN can also be used in reducing lumbar muscle stiffness in patients suffering with LBP.

5. Conclusion

Dry needling is widely used on the European continent, and it is found to be an emerging invasive intervention in North America and Asia. There are limited studies that originate in South America about dry needling. The use of dry needling has been primarily associated with treating myofascial pain syndrome (MPS), knee disorders such as knee osteoarthritis and patellofemoral pain syndrome and shoulder pain. Dry needling alone has been shown to be effective in reducing pain and improving muscle function in various studies. However, the effectiveness of dry needling can be enhanced when combined with other modalities and interventions such as manual therapy (MT) or exercise therapy (ET), depending on the specific condition being treated. Moreover, dry needling is proven to be effective in reducing pain in the short term; nonetheless, more intensive studies are needed that include longer follow-up periods to analyse its long-term effects.

6. Strengths and Limitations

The findings of this scoping review should be considered in light of its inherent strengths and limitations. Among its strengths are a broad and comprehensive literature search, adherence to methodological rigour, systematic data extraction, and the inclusion of a diverse range of study designs—including systematic reviews (SRs), randomised controlled trials (RCTs), experimental studies, case reports, and case series. However, the review is not without limitations. One key limitation is the reliance on a relatively small number of locally conducted studies, which may affect the generalisability of the results. Furthermore, while dry needling appears promising, there is a need for greater standardisation in the application of combined therapeutic modalities. Additional research is also warranted to explore its effectiveness in managing a wider range of musculoskeletal disorders (MSDs), such as post-arthroplasty conditions, fractures, and osteoporosis.

7. Recommendations

To further develop this study, the investigators recommended that future researchers should conduct experimental trials regarding the utilisation of DN as an intervention for MSDs which were not included in this study and also include longer follow-up periods, ranging from 6 months to 1 year, to determine the long-term effects of DN in pain reduction, functionality, and overall improvement of QOL. Future researchers should also investigate the integration of dry needling in local physical therapy practice.

Supplementary Materials

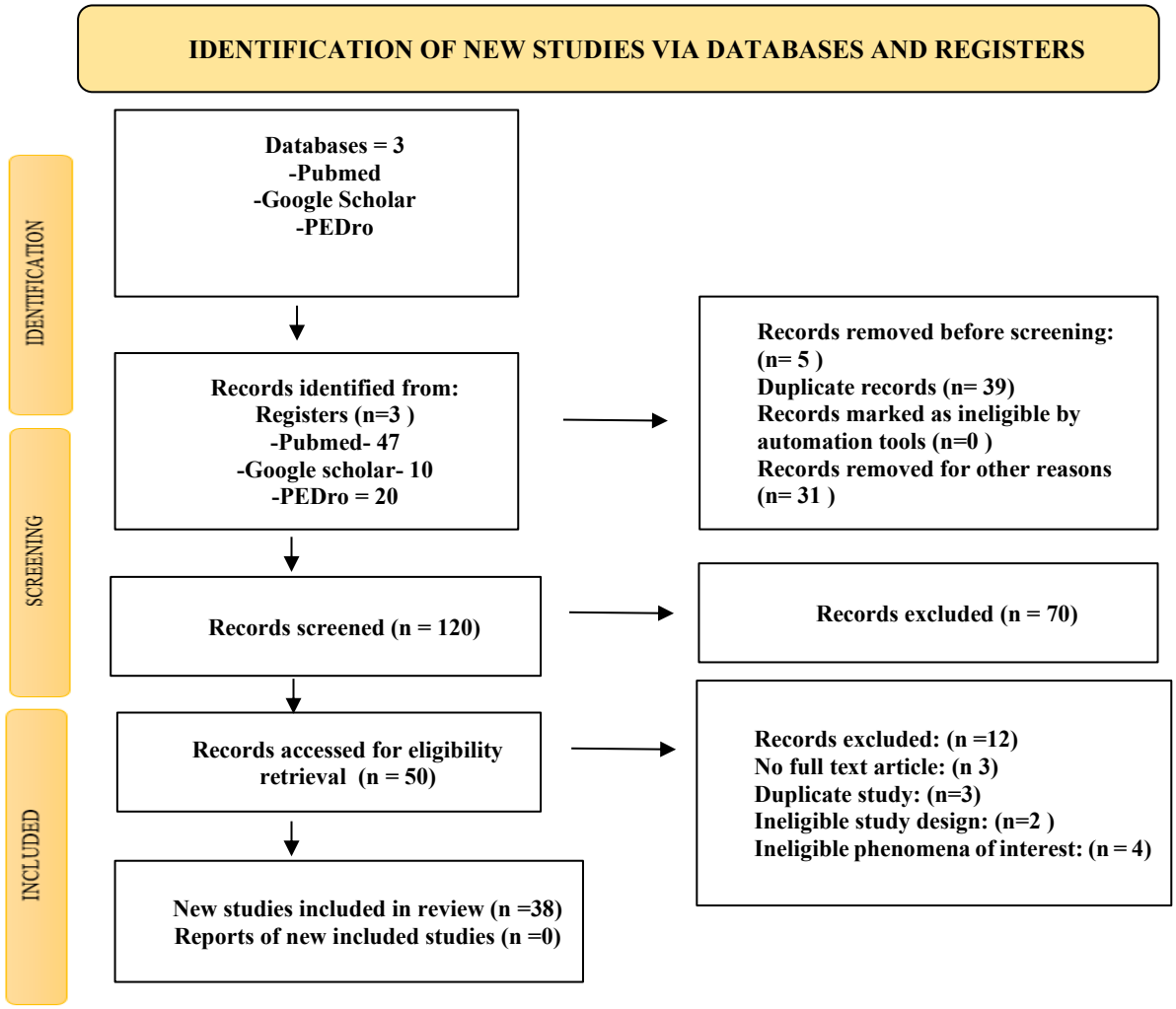

Figure 1. PRISMA-ScR flow diagram for scoping review process.

Table 1. Study Characteristics of Included Reviews

Characteristic		
Study Design	**N = 38**	**Percentage (%)**
systematic review	7	17.5%
RCT	21	55%
Other study design	10	27.5%
Year Published		
2018	7	17.5%
2019	6	15%
2020	7	18.4%
2021	8	21%
2021	9	22.5%
2022	1	2.5%
2023	7	17.5%
Continent		
North America	10	25%
South America	1	2.5%
Europe	17	42.5%
Asia	12	30%
MSD		
Headache	1	4%

Chronic Neck pain	2	9%
MPS	6	26%
Shoulder Pain	3	13%
Spine Disorders	1	4%
Golfer's Elbow	1	4%
Low Back Pain	2	9%
Hip Osteoarthritis	2	9%
Knee Osteoarthritis	5	22%
Patellofemoral Pain Syndrome	1	4%
Plantar Fasciitis	3	4%
Interventions		
dry needling alone	26	68 %
dry needling with other intervention	12	30 %

Table 2. Tabulation of Different Dry Needling Techniques

Dry needling techniques	N	% out of 38
dry needling	17	45 %
dry needling trigger point	9	24 %
ultrasound-guided dry needling	3	8 %
dry needling with percutaneous electrical nerve stimulation	2	5 %
superficial and deep dry needling	2	5 %
electrical dry needling	2	5 %
dry needling trigger point with manual therapy	1	3 %
dry needling and trigger point compression	1	3 %
periosteal electrical dry needling with manual therapy	1	3 %

Table 3. Geographic Distribution of Dry Needling

Geographic Distribution of Dry Needling	N = 38	% out of 38	Most Used Dry Needling Technique	N of studies of said technique
Europe	16	42.5	dry needling	12
Asia	12	30	dry needling	7
North America	9	25	dry needling	6
South America	1	2.5	dry needling	1

Table 4. Tabulation of Musculoskeletal Disorders Commonly Treated Using Dry Needling

MSD	N=38	% out of 38
Mps	9	24 %
Knee region	8	21%
Shoulder pain	6	16%
Neck pain	4	10%
Hip region	3	8%
Low back pain	3	8%
Ankle region	2	5%
Spine disorder	1	3%
Headache	1	3%
Elbow	1	3%

Table 5. Utilization of Dry Needling in Global Perspective

Ref	Study Design	Continent/ Country	MSD	Intervention	Outcome Measure	Results
(Martín-Sacristán et al., 2022)	RCT	Europe/ Spain	neck pain	dry needling trigger point	Visual Analog Scale (VAS), Pressure pain threshold (PPT) and Neck Disability Index (NDI)	Deep dry needling of the trapezius muscle, regardless of whether it is on a trigger point, latent or non-trigger point area produces the same positive effects in improving pain intensity, discomfort and local mechanical hyperalgesia.
(Fernández-De-Las-Peñas et al., 2021)	Systematic Review and Meta-Analysis	Europe/ Spain	MPS	dry needling	pain intensity, pain-related disability, PPT, and cervical ROM	There is a positive effect in the combination of dry needling with other interventions when improving pain intensity, pain related disability, pressure pain thresholds, and cervical ROM in people with neck pain associated trigger point at short-term.
(Fernández-Carnero, 2021)	RCT	Europe/ Spain	MPS	Dry needling with Percutaneous Electrical Nerve Stimulation	VAS and PPT	There is an improvement in both dry needling with percutaneous electrical nerve stimulation of high frequency and low frequency without any noticeable difference between the two.
(Funk & Frisina-Deyo, 2020)	Scoping review	North America/ USA	Spine Disorder	Dry Needling	VAS, PPT, ROM	There are many positive results in the cervical and thoracolumbar-pelvic region. Still, functional outcome tools best suited to tracking the outcomes of dry needling for spine related disorders must be explored.
(Ebrahimi Takamjani et al., 2020)	Systematic Review and Meta-Analysis	Asia/Iran	MPS	Ultrasound-guided dry needling	VAS, NPRS, Goniometer, NDI, DASH	US-Guided may help to treat patients with MPS. Almost all studies reported improvement of pain and functional outcomes at short-term but further RCT's with longer follow-up is needed to provide conclusive results.
(Calvo-Lobo et al., 2018)	RCT	Europe/ Spain	Shoulder Pain	Dry Needling	The Numeric Rating Scale, the pressure pain threshold	Dry Needling on the ipsilateral infraspinatus showed significant pain reduction, increased pressure pain threshold but no significant improvement on grip strength.

(Lew et al., 2021)	RCT	North America/ USA	MPS	Dry needling and trigger point manual therapy	VAS, NRS, PPT	This study was consistent with existing research that demonstrated the effectiveness of DN and TPMT in improving pain and function in the short to medium term for patients with myofascial pain syndrome in the neck and upper back.
(Chys et al., 2023)	Umbrella Review	Europe/ Belgium	MPS	Trigger Point Dry Needling	Risk of bias (RoB) was assessed with the AMSTAR-2 tool	Overall, several studies show that DN is superior to sham/ no intervention and equally effective to other interventions for pain reduction regardless of body region. Some SR favored WN more than DN in short term pain reduction. Limited Data for the medium and long term effects of DN. DN has a short term analgesic effect and may have an additional treatment effect when used as adjunct to other physiotherapeutic interventions compared to these interventions alone.
(Blanco-Diaz et al., 2022)	Systematic Review	Europe/ Spain	Subacromial Syndrome	Dry Needling	VAS, ROM, PPT, Functional with DASH and SPADI	DN has been demonstrated to be effective at reducing the pain and disability produced by SAPS, obtaining the best results in combination with conventional physiotherapy rather than as an isolated technique.
(Morgan et al., 2019)	Case Series	North America/ USA	Subacromial Pain	Dry Needling	Quick Disabilities of the Arm, Shoulder, and Hand (Q-DASH)	This case series provides insight to the observed short- and intermediate-term effects of dry needling combined with exercise for SAPS.
(Ezzati et al., 2018)	Quasi experimental study	Asia/Iran	MPS	Superficial and Deep Dry Needling	Neck Disability Index (NDI) instrument a goniometer	The changes in the range of motion and the functional ability of the neck were observed over time when superficial and deep dry needling techniques were used. However, these changes were more significant and prominent in patients treated with deep dry needling, especially in the follow-up periods.

(Stoychev et al., 2020)	Narrative Review	Asia/Israel	Tendinopathy	Dry Needling	patient-reported and objective findings	Current research provides initial support for the use of tendon dry needling as a stand-alone procedure for tendinopathy. It seems that it is a safe and effective treatment method, although there is a vast diversity regarding the technique of the needling, ultrasound guidance, and additional treatments used.
(Ziaeifar et al., 2019)	RCT	Asia/Iran	Trigger Point Upper Trapezius	Dry Needling and trigger point compression	Pain intensity, and neck, shoulder and arm disabilities	This study revealed that both DN and TPC produced three-month improvement in pain intensity and disability, therefore, could be a potential treatment for individuals with MTrPs in the UT muscle.
(Navarro-Santana et al., 2020)	RCT	Europe/ Spain	MPS	Dry Needling	pain intensity, pain-related disability, PPT and cervical ROM	Dry needling can be effective for improving neck pain intensity and related disability when compared with a comparative group immediately after and at short but not at mid term follow ups in people with myofascial TrPs associated with neck pain symptoms.
(Shariat et al., 2018)	Experimental study	Asia/Iran	Chronic Golfer's Elbow disability	Deep Dry needling	VAS	No changes in his range of motion and pain immediately after dry needling. 2 days follow-up, he reported less pain and was able to do more activities functionally associated with the elbow, movements were improved and there was no specific movement limitation. Seven days, follow-up, patient was able to do exercise training with elastic bands pain free.
(Ceballos-Laita et al., 2021)	RCT	Europe/ Spain	Teres Major	Dry Needling	NPRS, hand-held dynamometer, and inclinometer	A single session of DN in the teres major muscle was effective for improving pain intensity during throwing actions, internal rotation ROM and extensibility in HB athletes with shoulder pain.
(Almushahhim et al., 2022)	RCT	Asia/ Saudi Arabia	Chronic Neck Pain	Trigger point dry needling "fast-in, fast-out needle insertion" method	NPRS, NDI, SF-36 QOLS, and BDI	One session of trigger point dry needling with exercise and exercise alone showed the same pain and quality-of-life outcomes after a two-week intervention. The researchers did not recognize trigger point dry needling as an efficient intervention because there were

						inadequate high-quality studies on the subject and unavailable data on the minimum quantity of injections required for better dry needling outcomes in chronic mechanical neck pain patients.
(Rodríguez-Huguet et al., 2022)	Systematic Review	Europe/ Spain	Chronic Neck Pain	Dry Needling	VAS and NPRS, NDI, NPQ, PPT	Positive results were obtained in the short-term and during the follow-up conducted between three and six months, demonstrating that DN can be an effective therapy option for CNP. Additionally, this strategy may provide superior results to a placebo intervention based on the application of simulated DN.
(Gildir et al., 2019)	RCT	Asia/ Cyprus	Chronic Tension-Type Headache	Trigger Point Dry Needling	Headache intensity, frequency and duration of headache, and quality of life, assessed by the Short Form-36	After treatment, the intensity, frequency, and duration of headaches as well as the scores on the Short Form-36 subscales considerably decreased in the dry needling group (P .05). All the effect sizes for headache factors were large in the dry needling group.
(Pai et al., 2021)	RCT	South America/ Brazil	Shoulder pain	Trigger point Dry needling	NRS and quantitative sensory testing protocol	Dry needling group shows significant pain reduction compared to sham DN. In the active DN group alone, pain reduction scores were substantially different on the second day following needling and remained that way until the seventh day, along with improvements in other pain dimensions and a decrease in the area of mechanical hyperalgesia
(Yehoshua et al., 2022)	Cohort	Asia/Israel	MPS	Dry Needling	SF-MPQ	The study showed reductions in acute pain in all areas of the SF-MPQ 10 minutes and 1 week following DN completed by a GP. DN is a good therapeutic choice for GPs to help MPS patients.
(Khan et al., 2021)	Systematic Review	Asia/ Pakistan	MPS	Trigger point Dry needling	VAS, FHSQ, QOL	On the basis of the best evidence available, dry needling seemed to be effective in pain reduction related to lower extremity myofascial trigger points. Evidence also suggested that there was not much positive effect of myofascial trigger point dry needling on depression, anxiety,

						muscular strength and quality of life.
(Koppenhaver et al., 2022)	RCT	North America/ USA	LBP	Dry needling	NPRS, ODI	Dry needling appears to reduce resting erector spinae muscle following treatment of patients with LBP. Therefore, providers should consider the use of dry needling when patients exhibit aberrant stiffness of the lumbar muscles.
(Al-Boloushi et al., 2019)	RCT	North America/ USA	Plantar Heel Pain	Dry Needling and percutaneous needle electrolysis	Pain subscale of the Foot Health Status Questionnaire visual analogue scale	Plantar heel pain is a common cause of foot pain and discomfort affecting the health and quality of life of patients, with a high tendency for relapse and chronicity . Previous studies have demonstrated the positive effect of conservative treatment in reducing painful conditions associated to PHP, while other RCTs show that DN probably has a higher potential benefit over more conservative approaches
(Dunning, Butts, Young, et al., 2018)	RCT	Europe/ Spain	Knee OA	Periosteal Electrical Dry Needling and Manual therapy	Related disability WOMAC total score	At 3 months, patients who had electrical dry needling were 1.7 times more likely than those who received MT plus exercise to have totally ceased taking pain medication. Based on a threshold score of 5 on the global rating of change, considerably more patients in the dry needling group obtained a successful outcome at 3 months than in the MT plus exercise group At 3 months, the effect sizes were large in favor of the electrical dry needling group for all outcome measures. Incorporating electrical dry needling into an MT and exercise regimen was more successful than MT and exercise alone in relieving pain, function, and related-disability.
(Dunning, Butts, Young, et al., 2018)	RCT	North America/ USA	LBP	Dry Needling	ODI, PSFS, NPRS, and PPT	Results of this RCT indicated no between-group differences between patients experiencing NSLBP who received a semi-standardized NTM or a segmental and distal DN

						approach without needle manipulation.
(Vervullens et al., 2022)	RCT	Europe/ Belgium	Knee OA	Dry Needling	pain, central pain processing, muscle co-contraction and spatiotemporal parameters during gait in knee osteoarthritis patients.	When compared to fake needling, dry needling has no greater effect on pain, central pain processing, muscular co-contraction, or gait pattern 15 minutes and three days after intervention. The mean conditioned pain modulation scores were lower following sham needling than after dry needling. More research is still required.
(Pang et al., 2022)	RCT	North America/ USA	Knee OA	Ultrasound-guided dry needling and dry needling	VAS and KOOS subscales	US-guided DN with exercise therapy may be more effective than traditional DN with exercise therapy or exercise therapy alone in reduce pain of KOA.
(Sutlive et al., 2015)	RCT	North America/ USA	Patello femoral Pain Syndrome	Trigger Point Dry needling	AKPS and LEFS for Pain and Disability, Global Rating of Change (GROC) questionnaire	The authors believe that this was the first study to examine the effects of DN in a population of individuals with PFPS. Both the DN and SH groups experienced clinically meaningful reductions in pain during the study period.
(Jimenez-del-Barrio et al., 2022)	Systematic Review and Meta-Analysis	Europe/ Spain	Hip and Knee OA	Dry needling	Pain intensity	Very low-quality evidence suggests a positive effect of DN for reducing pain intensity and improving physical function in the short term in patients with osteoarthritis. Further investigation is needed to determine medium- and long-term effects.
(Bazzaz-Yamchi et al., 2021)	Pilot Study	Asia/Iran	LBP	Dry Needling	VAS, PKE, FFD test, and FRI	A single session of deep DN improved pain and function and increased hamstring flexibility. This pilot study supports the use of DN in patients with LBP and hamstring tightness; however, future research with a rigorous study design of randomized controlled trial is required to confirm the findings.

(Amani et al., 2022)	Preliminary Study	Asia/Iran	Knee OA	Dry Needling	Visual Analog Scale (VAS)	The application of one session DN can lead to improvement in pain intensity in participant with mild to moderate KOA
(Ceballos-Laita et al., 2019)	RCT	Europe/ Spain	Hip OA	Dry Needling	Pain intensity (visual analogic scale), passive hip ROM (universal goniometer and digital inclinometer) and physical function (30s chair-stand test and 20m walk test)	Pain, hip ROM, and physical function improved after the application of DN in active MTrPs of the hip muscles in patients with hip OA.
(Lara-Palomo et al., 2022)	RCT	Europe/ Spain	Chronic Low Back Pain	Electrical Dry Needling	RMDQ, ODI, VAS	Although physiotherapy with dry needling and electrical dry needling has proven positive effects on chronic low back pain. the results of studies into the duration of the analgesic effect and the dose required, for example, are contradictory . Therefore, further research is required to evaluate the specific components of the treatments administered by physical therapists.
(Schneider et al., 2022)	Quasi-Experimental Randomized Control Study	North America/ USA	Gluteus Medius	Trigger Point Dry Needling	HHD and sEMG	Application of TDN to latent trigger points within the gluteus medius can significantly increase gluteus muscle force production immediately following intervention while reducing the level of muscle activation required during contraction.
(Dunning, Butts, Henry, et al., 2018)	RCT	Europe/ Spain	Plantar Fascitis	Electrical Dry Needling	Numeric Pain Rating Scale, Lower Extremity Functional Scale (LEFS), Foot Functional Index (FFI),Global Rating of Change (GROC)	Patients with Plantar Fasciitis who got electrical dry needling in addition to manual treatment, exercise, and ultrasound improved considerably more than those who had manual therapy, exercise, and ultrasound alone.
(Sharif et al., 2022)	RCT	Asia/ Pakistan	Patellar Tendonitis	Ultrasound guided dry needling	VAS, VISA-P, KOOS	The results of the current study suggest, ultrasound guided DN of patellar tendon in combination with CPT reduced pain, improved function, and showed a tendency to decrease tendon thickness in patients with patellar tendinopathy.

(Rahou-El-Bachiri et al., 2020)	Systematic Review and Meta-Analysis	Europe/ Spain	Knee pain	Trigger Point Dry needling	Pain and pain- related disability	Low to moderate evidence suggests a positive effect of trigger point dry needling on pain and related disability in patellofemoral pain, but not knee osteoarthritis or post-surgery knee pain, at short-term. More high-quality trials investigating long-term effects are clearly needed.

Legend: PPT: Pressure Pain Threshold; VAS: Visual Analog Scale; NPRS: Numeric Pain Rating Scale; NDI: Neck Disability Index; KOOS: Knee Injury and Osteoarthritis Outcome Score; PKE: Passive Knee Extension; FFD: Finger-floor distance; WOMAC: Western Ontario and McMaster; DASH: Disability of the Arm, Shoulder, and Hand; SPADI: Shoulder Pain and Disability Index; ODI: Oswestry Disability Index: PSFS: Patient Specific Functional Scale; FHSQ: Foot Health Status Questionnaire.

Funding Statement

This research did not receive any external funding

Author Contributions

Conceptualization – J.A.M, Methodology – M.G.G and J.A.M , Acquisition, analysis, and interpretation of data – J.A.M, M.G.G, J.R.R, J.V.P, Writing, review, and editing – J.A.M and M.G.G. Research advising – E.D.P. All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Data Availability

No data was used for the research described in the article.

List of Abbreviations

PPT: Pressure Pain Threshold;
VAS: Visual Analog Scale;
NPRS: Numeric Pain Rating Scale;
NDI: Neck Disability Index;
KOOS: Knee Injury and Osteoarthritis Outcome Score;
PKE: Passive Knee Extension;
FFD: Finger-floor distance;
WOMAC: Western Ontario and McMaster;
DASH: Disability of the Arm, Shoulder, and Hand;
SPADI: Shoulder Pain and Disability Index;
ODI: Oswestry Disability Index;
PSFS: Patient Specific Functional Scale;
FHSQ: Foot Health Status Questionnaire;

MT: manual therapy ;

ET: exercise therapy.

References

Al-Boloushi, Z., Gómez-Trullén, E. M., Bellosta-López, P., López-Royo, M. P., Fernández, D., & Herrero, P. (2019). Comparing two dry needling interventions for plantar heel pain: a protocol for a randomized controlled trial. Journal of orthopaedic surgery and research, 14(1), 31.

Almushahhim, M., Nuhmani, S., Joseph, R., Muslem, W. H. A., & Abualait, T. (2022). Short-term effects of dry needling with a standard exercise program on pain and quality of life in patients with chronic mechanical neck pain. Journal of Clinical Medicine, 11(20), 6167.

Amani, M., Shafizadegan, Z., & Taheri, N. (2022). Effects of dry needling on pain in patients with knee osteoarthritis: A preliminary study. Advanced Biomedical Research, 11(1), 47.

Bazzaz-Yamchi, M., Naghdi, S., Nakhostin-Ansari, A., Hadizadeh, M., Ansari, N. N., Moghimi, E., & Hasson, S. (2021). Acute and short-term effects of dry needling in patients with chronic nonspecific low back pain and hamstring tightness: A pilot study. The Scientific World Journal, 2021(1), 7259956.

Blanco-Diaz, M., Ruiz-Redondo, R., Escobio-Prieto, I., De la Fuente-Costa, M., Albornoz-Cabello, M., & Casana, J. (2022). A systematic review of the effectiveness of dry needling in subacromial syndrome. Biology, 11(2), 243.

Calvo-Lobo, C., Pacheco-da-Costa, S., Martínez-Martínez, J., Rodríguez-Sanz, D., Cuesta-Álvaro, P., & López-López, D. (2018). Dry needling on the infraspinatus latent and active myofascial trigger points in older adults with nonspecific shoulder pain: a randomized clinical trial. Journal of geriatric physical therapy, 41(1), 1-13.

Ceballos-Laita, L., Jiménez-del-Barrio, S., Marín-Zurdo, J., Moreno-Calvo, A., Marín-Boné, J., Albarova-Corral, M. I., & Estébanez-de-Miguel, E. (2019). Effects of dry needling in HIP muscles in patients with HIP osteoarthritis: a randomized controlled trial. Musculoskeletal Science and Practice, 43, 76-82.

Ceballos-Laita, L., Medrano-de-la-Fuente, R., Estébanez-De-Miguel, E., Moreno-Cerviño, J., Mingo-Gómez, M. T., Hernando-Garijo, I., & Jiménez-del-Barrio, S. (2021). Effects of dry needling in teres major muscle in elite handball athletes. A randomised controlled trial. Journal of Clinical Medicine, 10(18), 4260.

Chys, M., De Meulemeester, K., De Greef, I., Murillo, C., Kindt, W., Kouzouz, Y., Lescroart, B., & Cagnie, B. (2023). Clinical effectiveness of dry needling in patients with musculoskeletal pain—an umbrella review. Journal of Clinical Medicine, 12(3), 1205.

Dunning, J., Butts, R., Henry, N., Mourad, F., Brannon, A., Rodriguez, H., Young, I., Arias-Buría, J. L., & Fernández-de-Las-Peñas, C. (2018). Electrical dry needling as an adjunct to exercise, manual therapy and ultrasound for plantar fasciitis: A multi-center randomized clinical trial. Plos one, 13(10), e0205405.

Dunning, J., Butts, R., Young, I., Mourad, F., Galante, V., Bliton, P., Tanner, M., & Fernández-de-Las-Peñas, C. (2018). Periosteal electrical dry needling as an adjunct to exercise and manual therapy for knee osteoarthritis: a multicenter randomized clinical trial. The Clinical journal of pain, 34(12), 1149-1158.

Ebrahimi Takamjani, I., Ezzati, K., Khani, S., Sarrafzadeh, J., & Tabatabaei, A. (2020). The effects of ultrasound-guided dry needling on patients with myofascial pain syndrome. Iranian Rehabilitation Journal, 18(4), 369-376.

Ezzati, K., Sarrafzadeh, J., Ebrahimi Takamjani, I., & Khani, S. (2018). The efficacy of superficial and deep dry needling techniques on functional parameters in subjects with upper trapezius myofascial pain syndrome. Caspian Journal of Neurological Sciences, 4(4), 152-158.

Fernández-Carnero, J. (2021). Effectiveness of dry needling with percutaneous electrical nerve stimulation of high frequency versus low frequency in patients with myofascial neck pain. Pain Physician, 24, 135-143.

Fernández-De-Las-Peñas, C., Plaza-Manzano, G., Sanchez-Infante, J., Gomez-Chiguano, G. F., Cleland, J. A., Arias-Buria, J. L., Lopez-de-Uralde-Villanueva, I., & Navarro-Santana, M. J. (2021). Is Dry Needling Effective When Combined with Other Therapies for Myofascial Trigger Points Associated with Neck Pain Symptoms? A Systematic Review and Meta-Analysis. Pain Research and Management, 2021(1), 8836427.

Funk, M. F., & Frisina-Deyo, A. J. (2020). Dry needling for spine related disorders: a scoping review. Chiropractic & Manual Therapies, 28(1), 23.

Gildir, S., Tüzün, E. H., Eroğlu, G., & Eker, L. (2019). A randomized trial of trigger point dry needling versus sham needling for chronic tension-type headache. Medicine, 98(8), e14520.

Griswold, D., Gargano, F., & Learman, K. (2019). A randomized clinical trial comparing non-thrust manipulation with segmental and distal dry needling on pain, disability, and rate of recovery for patients with non-specific low back pain. Journal of Manual & Manipulative Therapy, 27(3), 141-151.

Jimenez-del-Barrio, S., Medrano-de-la-Fuente, R., Hernando-Garijo, I., Mingo-Gomez, M. T., Estebanez-de-Miguel, E., & Ceballos-Laita, L. (2022). The effectiveness of dry needling in patients with hip or knee osteoarthritis: a systematic review and meta-analysis. Life, 12(10), 1575.

Khan, I., Ahmad, A., Ahmed, A., Sadiq, S., & Asim, H. M. (2021). Effects of dry needling in lower extremity myofascial trigger points. JPMA. The Journal of the Pakistan Medical Association, 71(11), 2596-2603.

Koppenhaver, S. L., Weaver, A. M., Randall, T. L., Hollins, R. J., Young, B. A., Hebert, J. J., Proulx, L., & Fernández-de-Las-Peñas, C. (2022). Effect of dry needling on lumbar muscle stiffness in patients with low back pain: A double blind, randomized controlled trial using shear wave elastography. Journal of Manual & Manipulative Therapy, 30(3), 154-164.

Lara-Palomo, I. C., Gil-Martínez, E., Antequera-Soler, E., Castro-Sánchez, A. M., Fernández-Sánchez, M., & García-López, H. (2022). Electrical dry needling versus conventional physiotherapy in the treatment of active and latent myofascial trigger points in patients with nonspecific chronic low back pain. Trials, 23(1), 238.

Lew, J., Kim, J., & Nair, P. (2021). Comparison of dry needling and trigger point manual therapy in patients with neck and upper back myofascial pain syndrome: a systematic review and meta-analysis. Journal of Manual & Manipulative Therapy, 29(3), 136-146.

Martín-Sacristán, L., Calvo-Lobo, C., Pecos-Martín, D., Fernández-Carnero, J., & Alonso-Pérez, J. L. (2022). Dry needling in active or latent trigger point in patients with neck pain: a randomized clinical trial. Scientific reports, 12(1), 3188.

Morgan, B. C., Deyle, G. D., Petersen, E. J., Allen, C. S., & Koppenhaver, S. L. (2019). Dry needling in the management of patients meeting clinical diagnostic criteria for subacromial pain syndrome: a case series. International journal of sports physical therapy, 14(4), 637.

Navarro-Santana, M. J., Sanchez-Infante, J., Fernández-de-Las-Peñas, C., Cleland, J. A., Martín-Casas, P., & Plaza-Manzano, G. (2020). Effectiveness of dry needling for myofascial trigger points associated with neck pain symptoms: an updated systematic review and meta-analysis. Journal of Clinical Medicine, 9(10), 3300.

Pai, M. Y. B., Toma, J. T., Kaziyama, H. H. S., Listik, C., Galhardoni, R., Yeng, L. T., Teixeira, M. J., & de Andrade, D. C. (2021). Dry needling has lasting analgesic effect in shoulder pain: a double-blind, sham-controlled trial. Pain reports, 6(2), e939.

Pang, J. C., Fu, A. S., Lam, S. K., Peng, B., & Fu, A. C. (2022). Ultrasound-guided dry needling versus traditional dry needling for patients with knee osteoarthritis: A double-blind randomized controlled trial. Plos one, 17(9), e0274990.

Rahou-El-Bachiri, Y., Navarro-Santana, M. J., Gómez-Chiguano, G. F., Cleland, J. A., López-de-Uralde-Villanueva, I., Fernández-de-Las-Peñas, C., Ortega-Santiago, R., & Plaza-Manzano, G. (2020). Effects of trigger point dry needling for the management of knee pain syndromes: a systematic review and meta-analysis. Journal of Clinical Medicine,

9(7), 2044.

Rodríguez-Huguet, M., Vinolo-Gil, M. J., & Góngora-Rodríguez, J. (2022). Dry needling in physical therapy treatment of chronic neck pain: systematic review. Journal of Clinical Medicine, 11(9), 2370.

Schneider, E., Moore, E. S., Stanborough, R., & Slaven, E. (2022). Effects of trigger point dry needling on strength measurements and activation levels of the gluteus medius: a quasi-experimental randomized control study. International journal of sports physical therapy, 17(7), 1404.

Shariat, A., Noormohammadpour, P., Memari, A. H., Ansari, N. N., Cleland, J. A., & Kordi, R. (2018). Acute effects of one session dry needling on a chronic golfer's elbow disability. Journal of Exercise Rehabilitation, 14(1), 138.

Sharif, F., Ahmad, A., Gilani, S. A., Bacha, R., Hanif, A., & Arif, M. A. (2022). Efficacy of ultrasound guided dry needling as an adjunct to conventional physical therapy for patients with jumper's knee: A randomized controlled trial. Frontiers in Surgery, 9, 1023902.

Stoychev, V., Finestone, A. S., & Kalichman, L. (2020). Dry needling as a treatment modality for tendinopathy: a narrative review. Current reviews in musculoskeletal medicine, 13(1), 133-140.

Sutlive, T., Golden, A., Harm, K., Morris, W., Morrison, J., Moore, J., & Koppenhaver, S. (2015). EFFECTS OF TRIGGER POINT DRY NEEDLING ON PAIN AND DISABILITY IN INDIVIDUALS WITH PATELLOFEMORAL PAIN SYNDROME: OPL49. Journal of Orthopaedic & Sports Physical Therapy, 45(1), A39.

Vervullens, S., Meert, L., Baert, I., Delrue, N., Heusdens, C. H., Hallemans, A., Van Criekinge, T., Smeets, R. J., & De Meulemeester, K. (2022). The effect of one dry needling session on pain, central pain processing, muscle co-contraction and gait characteristics in patients with knee osteoarthritis: a randomized controlled trial. Scandinavian Journal of Pain, 22(2), 396-409.

Yehoshua, I., Rimon, O., Mizrahi Reuveni, M., Peleg, R., & Adler, L. (2022). Dry needling for the treatment of acute myofascial pain syndrome in general practitioners' clinics: a cohort study. BMC Primary Care, 23(1), 339.

Ziaeifar, M., Arab, A. M., Mosallanezhad, Z., & Nourbakhsh, M. R. (2019). Dry needling versus trigger point compression of the upper trapezius: a randomized clinical trial with two-week and three-month follow-up. Journal of Manual & Manipulative Therapy, 27(3), 152-161.