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Effectiveness of Percutaneous Needle Electrolysis (PNE) and Intramuscular Electrical Stimulation (IMES) in the Management of Myofascial Pain Syndrome: A Systematic Review

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ADMINISTRATIVE INFORMATION

Support - Provita Medical Centre, Żory , Poland.

Review Stage at time of this submission - Preliminary searches.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 11 July 2025 and was last updated on 11 July 2025.

INTRODUCTION

Review question / Objective What is the effectiveness of PNE and IMES in the treatment of myofascial pain syndrome and tendinopathies in terms of pain reduction and functional improvement?

Rationale Chronic musculoskeletal pain, including myofascial pain syndrome (MPS) and tendinopathies, is a widespread clinical challenge with significant personal and societal burdens. Although various interventions are used in practice, the clinical efficacy and standardization of percutaneous needle electrolysis (PNE) and intramuscular electrical stimulation (IMES) remain unclear. Current studies are limited in number and often vary in methodology, application parameters, and outcome reporting. There is a need for a systematic review to assess and synthesize the existing evidence on the clinical effectiveness, safety, and treatment protocols of PNE and IMES, in order to guide future research and clinical decision-making. This review will address the existing gap in the literature by evaluating available clinical trials and providing a structured comparison of outcomes related to pain and functional improvement.

Condition being studied Myofascial pain syndrome (MPS) is a chronic pain condition characterized by the presence of hypersensitive points known as myofascial trigger points (TrPs) within skeletal muscle and fascia. These TrPs can cause local and referred pain, muscular tightness, and functional limitations, and they are often associated with reduced quality of life. MPS is one of the most common forms of musculoskeletal pain, affecting a significant proportion of the general population, particularly those exposed to repetitive strain, poor posture, or stress.

Tendinopathies, on the other hand, refer to chronic tendon disorders caused by overuse or mechanical overload, resulting in pain, swelling, and loss of function. They are frequently seen in both athletes and the general population, especially in the upper

and lower limbs (e.g., lateral epicondylitis, patellar tendinopathy, Achilles tendinopathy).

Traditional treatment options for these conditions include pharmacological interventions, physical therapy, dry needling, manual therapy, and various electrotherapy modalities. However, despite the widespread use of these interventions, their effectiveness is often limited or temporary.

In recent years, techniques such as percutaneous needle electrolysis (PNE) and intramuscular electrical stimulation (IMES) have gained attention due to their potential to modulate pain pathways, promote tissue repair, and improve neuromuscular function through targeted, minimally invasive electrostimulation. These techniques involve the insertion of acupuncture-like needles with application of low-frequency current directly into TrPs or pathological soft tissues under ultrasound guidance.

PNE and IMES have shown promising results in preliminary studies for reducing pain and improving functional outcomes in patients with myofascial pain and tendinopathies. However, evidence is still emerging, and a comprehensive synthesis of current research is needed to validate their clinical efficacy, define optimal treatment protocols, and inform practice guidelines.

This systematic review focuses on the clinical effectiveness of PNE and IMES in the treatment of MPS and tendinopathies, aiming to clarify their role within the wider context of musculoskeletal pain management.

METHODS

Search strategy The literature will be searched in PubMed, Scopus, and Web of Science databases using keywords such as “PNE,” “IMES,” “trigger point,” “myofascial pain,” “dry needling,” “tendinopathy,” and “electrotherapy,” with no date or language restrictions until June 10, 2025.

Participant or population

Studies including patients with systemic inflammatory conditions (e.g., rheumatoid arthritis), neurological disorders, or post-surgical pain will be excluded unless data related specifically to MPS or tendinopathy can be clearly separated and analyzed.

This review will include studies involving adult and adolescent participants diagnosed with myofascial pain syndrome (MPS) or tendinopathy in any anatomical region. Eligible participants must have clinically confirmed myofascial trigger points (TrPs) or chronic tendon-related pain, as diagnosed by a qualified healthcare professional using physical examination and/or imaging techniques (e.g., ultrasound).

Both acute and chronic cases will be considered, and no restrictions will be applied regarding participants’ sex, age (≥16 years), ethnicity, occupation, or level of physical activity.

Participants may be athletes or non-athletes, sedentary or physically active individuals, as long as they have a clear diagnosis of MPS or tendinopathy and are undergoing treatment with percutaneous needle electrolysis (PNE), intramuscular electrical stimulation (IMES), or related electro-needling techniques.

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Studies including patients with systemic inflammatory conditions (e.g., rheumatoid arthritis), neurological disorders, or post-surgical pain will be excluded unless data related specifically to MPS or tendinopathy can be clearly separated and analyzed.

The population focus of this review is individuals with musculoskeletal pain conditions for whom

PNE or IMES has been applied as a therapeutic intervention.
Studies included randomized controlled trials and cohort studies evaluating the effect of PNE and/or IMES in patients with myofascial pain or tendinopathy. No restrictions on patient age or gender. Excluded: editorials, case studies, and non-peer-reviewed publications.

Intervention The interventions of interest in this review are percutaneous needle electrolysis (PNE) and intramuscular electrical stimulation (IMES), both of which involve the application of electrical current via acupuncture-like needles inserted into soft tissues under ultrasound guidance.

PNE involves the administration of a galvanic (direct) current through a solid needle to target pathological soft tissue areas—such as tendons or fascia—aiming to induce a controlled local inflammatory response, promote tissue regeneration, and reduce pain. It is often used in the treatment of tendinopathies and myofascial trigger points (TrPs).

IMES, on the other hand, uses electrical stimulation via intramuscular needles to stimulate muscle fibers, deactivate TrPs, and enhance neuromuscular function. This technique typically employs low-frequency current to induce localized muscle contractions, aiming to normalize endplate noise and reduce spontaneous electrical activity in TrP regions.

Studies assessing the therapeutic application of either technique—alone or in combination with other physical therapy modalities such as exercise or manual therapy—will be included. The interventions may vary in terms of dosage, frequency, needle type, current intensity, and treatment duration, all of which will be analyzed and compared as part of the review.

Interventions performed with or without ultrasound guidance will be eligible, provided they meet the core criteria of PNE or IMES as defined above.

Comparator This review will consider studies that compare percutaneous needle electrolysis (PNE) and/or intramuscular electrical stimulation (IMES) to a range of control or comparator interventions. Acceptable comparators include:

Sham interventions, such as placebo needling or non-electrical needle insertion;

Conventional physical therapy, including exercise programs, manual therapy, stretching, or modalities like TENS or ultrasound;

Dry needling or acupuncture, used without electrical stimulation;

No treatment or wait-list control;

Pharmacological treatment, when used as a standalone comparator.

Both active and passive comparator groups will be included. The diversity of comparator interventions will be analyzed and discussed in terms of their methodological quality, treatment context, and relative effectiveness in pain reduction and functional outcomes.

Study designs to be included This review will include randomized controlled trials (RCTs) as the primary source of evidence to assess the clinical effectiveness of percutaneous needle electrolysis (PNE) and intramuscular electrical stimulation (IMES).In addition, well-designed prospective cohort studies and controlled clinical trials (CCTs) will also be considered when RCT data is limited or not available, provided they include appropriate comparison groups and clearly report outcome measures.Studies must report quantitative clinical outcomes related to pain reduction, functional improvement, or physiological chang.

Eligibility criteria
P – Population:
Adults and adolescents (≥16 years) diagnosed with myofascial pain syndrome (MPS) or tendinopathies, confirmed by clinical assessment (e.g., presence of myofascial trigger points) or imaging.

I – Intervention:
Percutaneous Needle Electrolysis (PNE)

Intramuscular Electrical Stimulation (IMES)
These interventions may be applied alone or in combination with other modalities (e.g., exercise, manual therapy).

C – Comparator:
Sham intervention (e.g. placebo needling)

Conventional physical therapy (manual therapy, TENS, stretching)

Dry needling without electrical current

No treatment or wait-list control

Pharmacological therapy

O – Outcome(s):
Primary outcomes:

Pain intensity reduction (measured by VAS, NPRS, or other validated scales)

Functional improvement (e.g., range of motion, physical performance tests, patient-reported outcome measures).

Secondary outcomes:

Pressure pain thresholds (PPT)

Electrophysiological markers (e.g., EMG, endplate noise)

Local blood flow changes (Doppler or other imaging)

Patient satisfaction

Adverse events or complications.

Information sources A comprehensive literature search will be conducted in the following electronic databases:

PubMed

Scopus

Web of Science

The search will cover all available records up to Jun 10, 2025, with no restrictions on publication date.

In addition to database searches, gray literature will be explored by screening:

Conference proceedings and academic theses (via Google Scholar and institutional repositories)

Clinical trial registries (e.g., ClinicalTrials.gov, WHO ICTRP)

Reference lists of included studies and relevant systematic reviews

When necessary, corresponding authors of selected studies may be contacted to obtain unpublished data or clarifications related to methodology or outcomes.

Main outcome(s) Primary outcomes will include:

Pain intensity reduction, measured using validated scales such as the Visual Analog Scale (VAS), Numerical Pain Rating Scale (NPRS), or McGill Pain Questionnaire;

Functional improvement, assessed through range of motion tests, physical performance evaluations (e.g., walking tests, muscle strength), or patient-reported outcome measures (PROMs), such as the Disabilities of the Arm, Shoulder and Hand (DASH) or Lower Extremity Functional Scale (LEFS), depending on the body region.

Secondary outcomes will include:

Changes in pressure pain threshold (PPT) measured using algometry;

Electrophysiological parameters, such as endplate noise or muscle activation measured via EMG;

Local blood flow changes, assessed using Doppler ultrasound or similar imaging methods;

Patient satisfaction, measured with standardized scales or survey tools;

Adverse effects, including any complications, discomfort, or withdrawal from intervention.

Time points of outcome assessment will be categorized as:

Short-term (within 4 weeks after intervention),

Medium-term (4 to 12 weeks),

Long-term (over 12 weeks), when reported.

Data will be extracted at all available time points to evaluate the sustainability of the intervention effects over time.

Additional outcome(s) The review will also assess the following additional outcomes, when reported:

Treatment protocol details, including needle type, current parameters (e.g., frequency, amplitude, duration), number of sessions, and total treatment duration;

Adherence to treatment, including dropout rates or session attendance;

Return to activity or sport, for athletic populations;

Healthcare utilization, such as additional physical therapy, medication use, or medical consultations during and after treatment;

Cost-effectiveness, if economic data are available;

Qualitative feedback from patients or clinicians regarding tolerability, expectations, or perceived effectiveness of the interventions.

Data management All records identified through database searches will be imported into reference management software (e.g., Zotero or EndNote) to facilitate duplicate removal and citation organization.

Titles and abstracts will be screened independently by two reviewers using a structured eligibility checklist based on predefined inclusion and exclusion criteria. Full texts of potentially relevant articles will be retrieved and stored securely in a shared cloud-based folder (e.g., Google Drive or OneDrive).

Data extraction will be performed using a standardized data extraction form developed in Excel or Google Sheets. This form will include fields for study characteristics, intervention details, outcomes, follow-up periods, and methodological quality.

Any disagreements between reviewers during screening or data extraction will be resolved through discussion or consultation with a third reviewer.

Final datasets will be archived securely and backed up regularly to ensure data integrity throughout the review process.

Quality assessment / Risk of bias analysis The methodological quality and risk of bias of included studies will be independently assessed by two reviewers using validated tools appropriate for study design:

For randomized controlled trials (RCTs): the Cochrane Risk of Bias 2 (RoB 2) tool will be used, evaluating domains such as randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result.

For non-randomized studies (e.g., prospective cohort studies): the ROBINS-I tool (Risk Of Bias In Non-randomized Studies - of Interventions) will be applied.

In addition, methodological quality of clinical trials will be rated using the PEDro scale, where applicable.

Disagreements between reviewers will be resolved through discussion or adjudication by a third reviewer.

Risk of bias results will be summarized narratively and presented in tables and/or graphs to facilitate interpretation of the overall evidence quality.

Strategy of data synthesis A narrative synthesis of the findings from the included studies will be conducted to summarize and compare the effectiveness of percutaneous needle electrolysis (PNE) and intramuscular electrical stimulation (IMES) in the treatment of myofascial pain and tendinopathies.

Data will be grouped based on intervention type, outcome domain (e.g., pain, function), population characteristics, anatomical location, and follow-up duration.

Where studies are sufficiently homogeneous in terms of participants, interventions, and outcomes, a meta-analysis will be performed using Review Manager (RevMan) or R software. Effect sizes will be calculated as:

Standardized Mean Differences (SMD) for continuous variables (e.g., pain scores),

Risk Ratios (RR) for dichotomous outcomes (e.g., presence/absence of adverse effects),
with 95% confidence intervals.

Heterogeneity will be assessed using the I^2 statistic. If substantial heterogeneity is detected ($I^2 > 50\%$), a random-effects model will be applied; otherwise, a fixed-effects model will be used.

If meta-analysis is not possible, results will be reported descriptively and supported by summary tables. Sensitivity analyses and subgroup analyses (e.g., based on treatment duration or technique) will be conducted if sufficient data are available.

Subgroup analysis If sufficient data are available, subgroup analyses will be conducted to explore potential sources of heterogeneity and assess differential effects of the interventions. Planned subgroups include:

Type of intervention: PNE vs. IMES

Body region: upper limb vs. lower limb vs. spinal region

Condition: myofascial pain syndrome vs. tendinopathy

Treatment frequency or dosage: low-frequency vs. high-frequency electrical current; short vs. long intervention duration

Guidance method: ultrasound-guided vs. non-guided procedures

Population type: athletes vs. general population

Subgroup results will be analyzed using interaction tests within meta-analysis models, or narratively described when meta-analysis is not feasible.

Sensitivity analysis Sensitivity analyses will be conducted to assess the robustness of the review findings by excluding studies at high risk of bias or with methodological limitations (e.g., small sample sizes, incomplete outcome reporting).

Additional sensitivity analyses will be performed to examine the impact of:

Study design (RCTs only vs. all eligible designs),

Language restrictions (English/Polish only),

Outlier data points or extreme effect sizes,

Industry-funded studies (if any).

These analyses will help determine whether the overall conclusions are influenced by specific subsets of studies. Results will be reported narratively and, where applicable, quantitatively.

Language restriction Only studies published in English , Ukrainian and Polish will be included. Articles in other languages will be excluded unless a full English translation is available.

Country(ies) involved Poland , Ukraine.

Other relevant information This protocol is based on an in-depth narrative literature review that has been previously prepared for publication and is being adapted for systematic evaluation and registration.

The authors declare that no external funding was received for this review. The review is being conducted independently and is not affiliated with any commercial interests.

Any substantial amendments to the protocol after registration will be transparently documented and justified in the final publication.

Keywords Percutaneous Needle Electrolysis; Intramuscular Electrical Stimulation; Myofascial Pain Syndrome; Trigger Points; Tendinopathy; Electrotherapy; Physical Therapy; Chronic Musculoskeletal Pain.

Dissemination plans The findings of this systematic review will be submitted for publication in a peer-reviewed scientific journal in the fields of physical therapy, rehabilitation, or pain management.

In addition, results may be presented at national and international conferences related to physiotherapy, manual medicine, and musculoskeletal research.

Upon completion and publication, a summary of the key findings will be made publicly available via academic networks (e.g., ResearchGate) and institutional repositories.

Contributions of each author

Author 1 - Robert Trybulski developed the concept of the review, designed the protocol, conducted the literature search, and drafted the manuscript.
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