International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

# DRY NEEDLING IN NEUROLOGICAL DISORDER

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**ABSTRACT:-**

The article examines the application of **dry needling** as a therapeutic intervention for **neuromusculoskeletal pain syndromes**, characterizing it as an **intramuscular technique** involving the insertion of fine filiform needles into **myofascial trigger points (MTrPs)** or **trigger points (TrPs)** within muscle tissue. The terminology has recently been emphasized by the **American Physical Therapy Association (APTA)** and various **state physical therapy boards**. While terms such as **Intramuscular Manual Therapy (IMT)** and **Trigger Point Dry Needling (TDN)** are frequently employed interchangeably, the article posits that they represent **distinct methodologies** with different theoretical frameworks and clinical applications within the broader domain of dry needling.

A growing body of evidence, including **randomized controlled trials (RCTs)** and **peer-reviewed literature**, substantiates the clinical efficacy of dry needling at both TrP and non-TrP anatomical sites, contributing to reductions in **pain intensity and functional impairment** among patients with neuromusculoskeletal conditions. The technique is recognized for its **multifaceted therapeutic effects**, targeting not only myofascial structures but also **tendons, ligaments, scar tissue, and neurovascular complexes**, thereby highlighting its physiological complexity. Furthermore, the article notes that the conceptualization of trigger points and their role in pain modulation has been acknowledged in the scientific literature since at least **1977**, indicating a longstanding investigative interest in the mechanisms underlying needling-induced analgesia. The abstract offers a detailed exposition of dry needling, including its conceptual framework, terminology, and the body of evidence substantiating its therapeutic utility in the treatment of pain disorders.

**Keyword**:- Dryneedling, Neurologicaldisorder,Myofascial trigger point,Acupuncture,Randomized clinical trial.

## INTRODUCTION :-

Local injectable interventions, commonly referred to as **"wet needling,"** utilize hollow-bore needles to administer pharmacological agents such as corticosteroids, local anesthetics, sclerosants, and botulinum toxins.[12] In contrast, **"dry needling"** involves the insertion of fine, solid monofilament needles—akin to those employed in acupuncture—without the injection of any substances.[3–6] This technique is employed in the management of a broad spectrum of **neuromusculoskeletal pain disorders**, with needle placement targeting not only **muscle tissue**, but also **ligaments, tendons, subcutaneous fascia, scar tissue, peripheral nerves**, and **neurovascular structures.**[3–7]

Recently, the **American Physical Therapy Association (APTA)** and several **state physical therapy boards** have restricted the operational definition of dry needling to an **intramuscular approach**, specifically the insertion of needles into palpable nodules within taut bands of skeletal muscle, commonly termed **trigger points (TrPs)** or **myofascial trigger points (MTrPs)**. This narrowed interpretation is problematic in light of the extensive and evolving international body of literature that supports broader clinical applications of dry needling.

Notably, terms such as **"Intramuscular Manual Therapy" (IMT)** and **"Trigger Point Dry Needling" (TDN)** have been used synonymously by regulatory and professional organizations; however, the article argues that such usage is inappropriate. While IMT—which involves targeting TrPs in muscle bellies—is undeniably one component of dry needling, it does not encompass the full methodological and conceptual scope of the practice.

A substantial corpus of research, including **peer-reviewed publications and randomized controlled trials**, supports the clinical efficacy of needle placement at **non-TrP anatomical sites**, demonstrating significant reductions in pain and functional impairment among individuals with neuromusculoskeletal conditions. Analogous to distinct manual therapy schools such as **McKenzie**, **Kaltenborn**, and **Maitland**, TDN and IMT should be viewed as **differentiated modalities** within the broader **dry needling paradigm**, each informed by unique theoretical models and clinical methodologies.[569101725]

**Dry needling exerts therapeutic effects not only on myofascial trigger points (TrPs) but also on a range of musculoskeletal, connective, and neural tissues.**:-

The first peer-reviewed academic publication on dry needling authored by a Western medical physician examined 241 patients and identified only **two of the fourteen target anatomical structures** as **myofascial trigger points (TrPs)**.[6] The remaining structures—**ligaments, tendons, scar tissue, bone surfaces, and teno-osseous insertion sites**—were predominantly **connective tissues**.[6] Moreover, dry needling targets have been shown to contain a **high density of neurovascular structures**,[26] suggesting that its therapeutic effects extend beyond myofascial tissues.

As early as 1977, **Melzack et al.** noted that trigger points are "firmly embedded in the anatomical framework of the muscular and neural systems" and proposed that **stimulation of specific nerves or tissues by needling could modulate central pain processing** via the gate control theory, thereby attenuating nociceptive input.[27] In subsequent work, **Hong** emphasized that the **"fast-in and fast-out" needling technique**, applied in a fan or cone-shaped pattern, was designed to **stimulate the majority of sensitive loci, particularly small nerve terminals**, at the site of pain.[26,28–30] Hong further suggested that **high-pressure needle stimulation** of these nociceptors likely induces a **local twitch response (LTR)**—a powerful neuromuscular reflex that disrupts the nociceptive cycle and alleviates pain.[26,28,31–34]

Notably, **Audette et al.** observed that unilateral dry needling of active TrPs in the symptomatic trapezius can elicit **bilateral LTRs** or **mirror-image evoked potentials** in the contralateral trapezius, implying a **central rather than purely peripheral** mechanism of action.[34] They concluded that LTRs are likely mediated by a **spinal reflex arc**—where mechanical stimulation of sensitive loci initiates afferent input to the spinal cord, triggering an efferent motor response via alpha motor neurons.[34]

Given these findings, it is evident that dry needling **interacts with both muscular and connective tissues**, and likely also stimulates **neural structures**—particularly **small nociceptive fibers**—contributing to pain modulation.[6] As such, multiple research groups support the interpretation that **needling of MTrPs involves direct interaction with peripheral nerve endings** for therapeutic effect. Consequently, contemporary evidence strongly supports revising the **American Physical Therapy Association (APTA)** and **State Boards of Physical Therapy** definitions of dry needling to reflect its **multifaceted targets**, which include **neural**[26,28–31,33,36,38–54], **muscular**[5,17,18,21,26,29,30,33,48,55–69], and **connective tissue structures**[6,48–54,70–72], rather than limiting it solely to trigger points.[73,74]

**The 2013 definition provided by the American Physical Therapy Association (APTA) explicitly states that dry needling is intended to target both connective and muscular tissues.:-**

In the **January 2012 resource paper** titled *Physical Therapists & the Performance of Dry Needling*, the **American Physical Therapy Association (APTA)** defined dry needling as "an invasive technique used by physical therapists (where permitted by state law) to treat myofascial pain that uses a dry needle, without medication or injection, which is inserted into areas of the muscle known as trigger points."[8] However, in the **revised February 2013 APTA publication**, *Description of Dry Needling in Clinical Practice: An Educational Resource Paper*, the definition was expanded to include **muscle and connective tissue**, but notably **excluded neural structures** as targets.[75] According to this document, dry needling is described as "a skilled intervention that uses a thin filiform needle to penetrate the skin and stimulate underlying myofascial trigger points, muscle, and connective tissues for the evaluation and management of neuromusculoskeletal pain and movement impairments."[75]

Interestingly, while the 2013 APTA definition acknowledges the role of muscular and connective tissues in dry needling, it does not recognize the stimulation of **neural elements**, despite mounting evidence that **neurovascular bundles and small nerve endings (i.e., "sensitive loci")** are also relevant targets in the clinical application of dry needling.[26,28,31,34]

This discrepancy raises an important clinical question: **how can physical therapists adequately address the "neuro" component of neuromusculoskeletal disorders using dry needling without targeting or being in proximity to neural structures**—a practice known in the literature as **peri-neural needling**?

Incorporating **neurological targets** into the APTA's official dry needling definition would provide a more evidence-aligned and clinically comprehensive framework. Such a revision would also empower **state licensing boards** with a scientifically substantiated basis for regulatory decisions concerning the scope of physical therapy practice in dry needling.

## (2) ETIOLOGY:- Myofascial pain,

commonly originating in the muscles or associated fascia, is frequently linked to the presence of **myofascial trigger points (MTrPs)**. An **MTrP** is defined as a highly localized, hyperirritable spot within a taut, palpable band of skeletal muscle fibers. The primary clinical manifestations associated with MTrPs include **referred pain** and the **local twitch response**, both of which can be elicited by direct activation of the trigger point. Epidemiological studies conducted in the United States have demonstrated that **MTrPs** are the predominant source of pain in approximately **30% to 85% of patients** seeking medical attention for musculoskeletal discomfort. A study involving **283 patients** admitted to a comprehensive pain clinic indicated that **85% of these patients** reported that **two to four MTrPs** were the primary cause of their pain. Similarly, a study involving **96 patients** with musculoskeletal pain referred to a neurologist at a community pain care center found that **74% of patients** had **MTrPs** as the main etiology of their pain[76]. Furthermore, **30% of 172 patients** presenting with pain at a university-based primary care internal medicine clinic and **55% of 164 patients** referred to a dental clinic for persistent head and neck pain were diagnosed with **active MTrPs** as the underlying cause of their symptoms[77].

As a result, MTrP-induced pain represents a substantial economic burden on both healthcare systems and individual patients. However, there is significant evidence to suggest that **MTrPs**, which contribute to **musculoskeletal pain**, are often underdiagnosed by healthcare professionals, including physical therapists, leading to prolonged pain and dysfunction. A variety of non-invasive therapeutic interventions have been employed to alleviate chronic myofascial pain, including **stretching, massage, ischemic compression, laser therapy, heat application, acupressure, ultrasound, transcutaneous electrical nerve stimulation (TENS), biofeedback**, and pharmacologic treatments. Nevertheless, no single treatment modality has demonstrated consistent and universal efficacy[78,79].

**Dry needling**, also referred to as **intramuscular stimulation**, **Western acupuncture**, or **medical acupuncture**, is a minimally invasive technique that involves the insertion of an acupuncture needle directly into the MTrP to relieve myofascial pain[80,81]. Despite the use of acupuncture needles, the technique is fundamentally based on **Western medical principles**. The needle insertion sites are mapped to well-established skeletal muscle anatomical landmarks. Learning the technique of dry needling is relatively straightforward, with introductory courses typically lasting **two to four days**. This review aims to provide a comprehensive overview of **dry needling** as a treatment modality for chronic musculoskeletal pain, with the goal of informing a broad range of healthcare professionals—including **family physicians, rheumatologists, orthopedic surgeons, physiatrists, pain specialists, dentists, and physical therapists**—about its application in clinical practice.

**Techniques for Dry Needling:-** Travell and Simons were the first to introduce the concept of **myofascial trigger points (MTrPs)** to the medical community, initially suggesting **injection therapies** for their treatment. Subsequently, **dry needling** techniques were empirically developed to address **musculoskeletal disorders**. Following Lewit's[82] publication (1982), which demonstrated that the effects of needling differ from those of injected pharmacological agents, dry needling gained wider clinical adoption. Moreover, multiple **randomized clinical trials (RCTs)** and a comprehensive review[81,83,85] have shown that there is no significant difference in the effectiveness of **dry needling** and **injections** of various pharmacological agents for **MTrP** symptom relief. (Simons et al., 1983; Travell & Simons, 1999).

Over the past three decades, several models and schools of thought surrounding dry needling have emerged, with the most notable being the **MTrP model** and the **radiculopathy model**. **Dr. Chan Gunn**, a Canadian physician and pioneer in dry needling, contributed empirical evidence that laid the groundwork for the **radiculopathy model**. Dr. Gunn coined the term **intramuscular stimulation (IMS)** to distinguish his approach from earlier dry needling techniques. Gunn's hypothesis suggests that **peripheral neuropathy**—also referred to as **radiculopathy**—is the primary underlying cause of **myofascial pain syndrome**. According to Gunn[87], tissues that become denervated develop **denervation supersensitivity**, in accordance with the **Law of Denervation Supersensitivity** proposed by **Cannon and Rosenblueth[88]** (1949). This heightened sensitivity leads to muscle shortening, the formation of **MTrPs**, and the associated pain.

In this model, **peripheral neuropathy** is caused by factors such as **disk compression**, **intervertebral foramina constriction**, or **direct nerve root compression** due to the shortening of **paraspinal muscles** (particularly the **multifidi muscles**). As a result, reduced nerve impulse transmission results in increased **irritability** and **sensitivity** across various innervated structures, including **skeletal muscle**, **smooth muscle**, **spinal neurons**, **sympathetic ganglia**, **adrenal glands**, **sweat glands**, and even brain cells. Gunn's model postulates that these changes contribute to pain and dysfunction in **musculoskeletal disorders[87]**.

The **MTrP dry needling technique** involves inserting a needle directly into a **myofascial trigger point**. This approach was first described by **Dr. Janet Travell** and colleagues in 1942, who pioneered the **injection therapy** for treating **MTrPs**. In 1979, **Karel Lewit[82]** theorized that **mechanical stimulation** of the MTrP via needling was the principal mechanism behind the therapeutic effects of **injection therapies**. Since then, **dry needling** has been widely used to manage **MTrPs**, with the **local twitch response** being a significant therapeutic effect. This response occurs due to the rapid depolarization of muscle fibers, resulting in **local twitching[90]**, which is followed by the cessation of spontaneous electrical activity, leading to a marked reduction in pain and dysfunction.

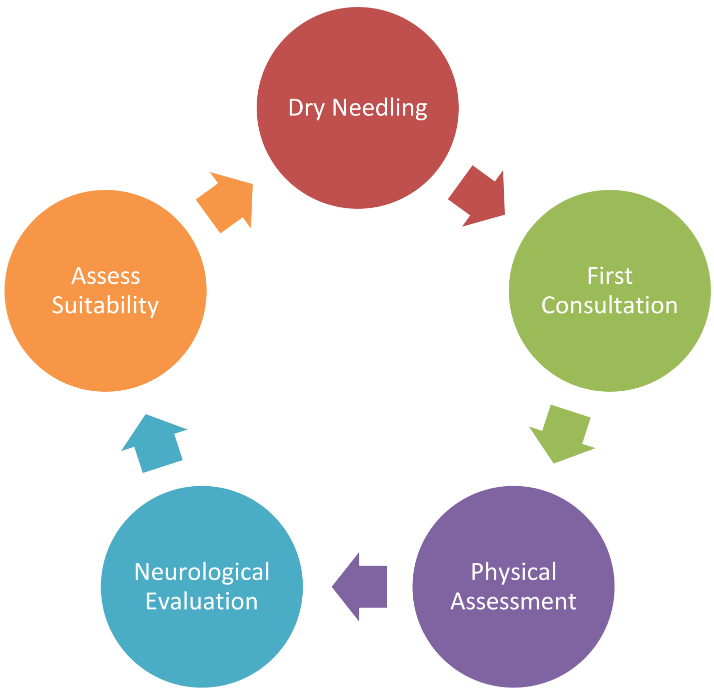
Interestingly, the use of needles in areas of pain can be traced back to **Sun Ssu-Mo**, a Chinese physician in the 7th century, who described the insertion of needles into **Ah-Shi points**, which are now recognized as **MTrPs**. As such, the fundamental concept of needling tender points for pain relief has ancient origins.

For healthcare professionals, including **family physicians**, **rheumatologists**, and **physical therapists**, further reading on the management of **myofascial pain**, **MTrPs**, and related techniques can be found in foundational texts such as **Travell and Simons's "Myofascial Pain and Dysfunction: The Trigger Point Manual"**, **The Gunn Approach to the Treatment of Chronic Pain**, and **Baldry's "Acupuncture, Trigger Points, and Musculoskeletal Pain"**. illustrates examples of **dry needling** application in clinical practice[86,91,92,93].

***The Efficiency of Dry Needling in MTrP Management:-***

Several **randomized controlled trials (RCTs)** and three comprehensive **systematic reviews** have evaluated the efficacy of **dry needling** in the management of **myofascial trigger points (MTrPs)**. These studies have provided valuable insights into the therapeutic potential of dry needling for addressing MTrPs in patients with **musculoskeletal pain**. Specifically, research has demonstrated consistent findings supporting the effectiveness of dry needling in reducing pain, improving muscle function, and enhancing overall treatment outcomes in patients suffering from **myofascial pain syndrome (MPS)[81,94,95]**.

***Patient Evaluation and Assessment: :-***



In their systematic review of **94 randomized controlled trials (RCTs)** on needling therapies (including **dry needling** and **injections**), Mings and White (2010) concluded that while **direct needling of myofascial trigger points (MTrPs)** appears to be an effective treatment, the evidence from clinical trials does not definitively support or reject the hypothesis that needling therapies are more effective than **placebo** treatments. The observed effects of these therapies are likely attributable to the **needle** or **placebo effect** rather than any active medication or saline injections.

Seven RCTs involving **dry needling** and **acupuncture** for MTrP treatment were included in the most recent systematic review.[95] One study demonstrated that, compared to no intervention, **direct needling of MTrPs** effectively reduced pain. However, when comparing **direct needling of MTrPs** to needling in other muscle areas, two trials showed inconsistent results, and the evidence from four additional studies did not support the notion that targeting MTrPs directly was superior to **non-penetrating sham therapies**.

Tough and colleagues (2010) highlighted critical **methodological flaws** in the original studies included in the review. First, while MTrPs were largely identified in the studies, it was unclear whether they were the exclusive source of pain. Second, many studies had small sample sizes, increasing the risk of **type II error**, which can lead to false-negative results.[96] Third, there was significant variation in the number of treatment sessions, session durations, needle insertion depth, and needle placement, complicating direct comparisons between treatment strategies.

Moreover, until the **mechanism of action** for needling therapies is better understood, or until more direct comparisons of different interventions are conducted, there is no clear rationale for selecting the most effective approach.

The **most recent Cochrane systematic review** of 35 RCTs evaluated the effectiveness of **dry needling and acupuncture** for treating **persistent low back pain**. This review found evidence of **pain reduction** and **functional improvement** following acupuncture when compared to **no treatment** or **sham therapy**, though the effects were only observed in the short term and immediately post-treatment. A long-term follow-up RCT conducted by **Gunn et al.[97] (1997)** showed that, after nearly 30 years, the **needling group** significantly outperformed the **control group** ($P > 0.005$).

Additional evidence suggests that when **acupuncture** is combined with conventional therapies, it is more effective in improving function and reducing pain than when used alone, though the effects are generally minimal. In the case of persistent low back pain, **dry needling** may serve as a useful adjunct to other treatments. However, **Furlan and colleagues[94] (2015)** noted that the methodological quality of the studies reviewed was often poor. We agree with **Cummings and White (2010)** in concluding that while patients undergoing needling treatment showed substantial improvements, further research is needed to determine if the effects of **needling MTrPs** extend beyond the placebo effect, particularly with the inclusion of an appropriate **needle control**.

### *Comparing Deep and Superficial Needling:-*

In the early 1980s, **Baldry[93]** introduced the concept of *superficial dry needling*, a technique involving the insertion of an acupuncture needle into the superficial tissue layer directly overlying a myofascial trigger point (MTrP). This method was proposed as a treatment for MTrPs located in deep muscles and other anatomical regions and reportedly yielded favorable empirical outcomes. Baldry[93] recommended inserting a needle to a depth of **5–10 mm** for approximately **30 seconds** over each MTrP. Although **local twitch responses** (LTRs) are typically absent—since the needle may not penetrate the MTrP—the technique often results in an immediate reduction in local tenderness.

If pain persists post-needling, the needle may be reinserted for an additional **2–3 minutes**. Baldry[98] advocated for superficial dry needling over deep dry needling due to its **ease of application**, **reduced discomfort**, **lower risk** of vascular, neural, or structural injury, and **minimal post-treatment soreness**.

To date, only a limited number of studies have investigated the efficacy of superficial dry needling. In a **single-blind, prospective randomized controlled trial (RCT)**, **Edwards and Knowles[99]** allocated participants into three groups: (1) superficial dry needling combined with active stretching, (2) stretching alone, and (3) no treatment. After six weeks, the group receiving superficial dry needling demonstrated significantly greater reductions in pain and higher pressure pain thresholds compared to the stretching-only and control groups.

In another **placebo-controlled RCT**, **Macdonald et al[100].** observed that superficial dry needling produced significantly superior pain relief compared to placebo in a cohort of 17 patients with chronic lumbar MTrPs. Several additional trials have compared **superficial** and **deep dry needling**. **Naslund et al[101].** conducted a study involving 58 patients with idiopathic anterior knee pain, comparing the two needling depths (with superficial dry needling considered a placebo). No significant differences were found between groups, and both demonstrated sustained pain reductions at 3- and 6-month follow-ups.

In a **double-blind RCT**, **Ceccherelli et al[102].** studied 42 patients with lumbar myofascial pain to compare the analgesic effects of superficial (2 mm) versus deep (1.5 cm) dry needling. After three months, deep dry needling produced significantly superior pain relief, although no significant differences were observed at the end of the treatment period. Similarly, **Itoh et al[103].** compared deep dry needling, superficial dry needling, and standard acupuncture in elderly patients with chronic low back pain. While the **deep dry needling group** reported improved pain relief and quality of life compared to the other groups, these differences did not reach statistical significance.

**Ceccherelli et al[102].** proposed that **muscle afferents** play a more prominent role in the mediation of acupuncture-induced analgesia compared to **cutaneous afferents**, a hypothesis further supported by **Chiang et al[104].** who showed that blocking skin afferents did not inhibit acupuncture analgesia, whereas blocking **deep tissue afferents** abolished the effect.

**Itoh et al[103].** further suggested that MTrPs may represent areas where **polymodal nociceptors** have been sensitized through mechanical, thermal, and chemical stimuli. Since such receptors respond to diverse modalities, they are believed to contribute to the analgesic effects of both **acupuncture and moxibustion**[105]. The most recent findings imply that acupuncture at muscle-based MTrPs may potentiate the activity of **sensitized polymodal receptors**, enhancing the resultant analgesic effects. Although superficial needling may also activate such receptors in the **skin**, **fascia**, and **muscle layers**, the extent of its analgesic contribution remains uncertain.

Given the relative safety and simplicity of superficial needling, it may be advisable for use in **anatomically vulnerable regions**—such as overlying the lungs or major blood vessels—pending further high-quality, methodologically robust studies to confirm its efficacy.

### *Using or Not Using Paraspinal Needling:-*

According to **Gunn's method**[15] , needling should be applied not only to the local site of pain but also to the **paraspinal muscles** innervated by the **same spinal segment** as the affected musculature. In a **single-blind randomized controlled trial (RCT)**, **Ga and colleagues**[35] evaluated the efficacy of combining paraspinal dry needling with myofascial trigger point (MTrP) dry needling in **40 elderly patients** diagnosed with myofascial pain syndrome. Participants were randomly assigned to receive either (1) **dry needling of the upper trapezius MTrP alone** (n = 18) or (2) **dry needling of the same MTrP plus paraspinal needling** (n = 22). Each group received three weekly treatment sessions.

At the **4-week follow-up**, the group receiving paraspinal needling exhibited a **more consistent reduction in subjective pain**, as well as **significant improvements** in cervical range of motion—improvements not observed in the MTrP-only group. Furthermore, patients who received paraspinal dry needling showed **greater reductions in depressive symptoms**, as measured by the Geriatric Depression Scale. Based on these findings, the authors suggested that **paraspinal dry needling may be a more effective intervention** for myofascial pain syndrome in elderly patients than MTrP dry needling alone. However, the study's **limited sample size**, **restricted age range**, and **inadequate blinding procedures** necessitate caution in generalizing these results. Further **well-designed, larger-scale studies** are required to confirm the potential benefits of adjunctive paraspinal needling.

### *Participant Selection and Study Design:-*

Participants were recruited from the **HUIS Rehabilitation Service** with the assistance of a physician. A **non-probabilistic sampling strategy** was used. Inclusion criteria included adults aged **18 to 65 years** who had experienced **mechanical neck pain** for at least **12 weeks**, scored **≥10%** on the **Neck Disability Index (NDI)**, and reported **neck-specific pain ≥30 mm** on a **visual analogue scale (VAS)**. Additionally, eligible participants had to exhibit at least one **active MTrP** in the **upper trapezius**, **levator scapulae**, **cervical multifidi**, or **splenius cervicis**, as defined by **Travell and Simons' criteria**. Diagnostic features for active MTrPs included:

- Presence of a palpable taut band,
- A hypersensitive tender spot within the taut band,
- Recognition of **familiar referred pain** upon compression,
- Painful restriction in full stretch range of motion.

**Exclusion criteria comprised individuals with:**

- Neck pain secondary to **whiplash injuries**,
- History of **medical red flags** (e.g., tumor, fracture, metabolic bone disease, rheumatoid arthritis, osteoporosis),
- **Cervical radiculopathy** or **disc herniation** with neurological symptoms,
- Diagnosed **fibromyalgia** (per ACR criteria) (25),
- History of **neck surgery**,
- **Vertigo** due to **vertebrobasilar insufficiency** or **non-cervicogenic headaches**.

Additional exclusions included prior **pain interventions** in the previous **six months**, ongoing **legal proceedings** (e.g., injury compensation), **psychiatric disorders**, **needle phobia**, **pregnancy**, or other contraindications to dry needling techniques.

A technician uninvolved in treatment or assessment employed a **web-based randomization tool** (GraphPad Software, Inc., La Jolla, CA, USA) to allocate participants into one of three study arms. A **single-blind design** was implemented, wherein all assessors of outcome measures were **blinded to group allocation**.

## Interventions:-

Following random assignment, the designated treatment protocols were administered by two **licensed physiotherapists**, each with over **five years of clinical experience**, in accordance with the study's **randomization procedures**. Regardless of group allocation, all participants were instructed to perform **gentle, sustained self-stretching** exercises targeting the **levator scapulae** and **upper trapezius muscles bilaterally**, three times daily throughout the **three-month follow-up period**, as recommended by **Travell and Simons**[95].

### *Intervention Protocol*

Participants were divided into three groups. The **control group** received **customary care (CUC)**, which consisted of **two weeks** of **standard electrotherapy**—a typical protocol within public healthcare systems for the treatment of non-specific neck pain[97] . This included **ten sessions** (five per week), each comprising:

- **15 minutes of transcutaneous electrical nerve stimulation (TENS)** for analgesic purposes, and
- **15 minutes of pulsed microwave therapy**.

Pulsed microwave therapy was administered using a **Radarmed 2500CP® (Italy)** emitter with a **3D-shaped antenna**. The device operated at **120 W** with **70% pulsatility**. The antenna was positioned **81–86 cm** from the patient's skin while seated upright in a wooden chair. TENS therapy was delivered via a **BTL-5000® electrotherapy device**, utilizing **6 × 6 cm self-adhesive electrodes**, a **100 Hz frequency**, and a **100 µs pulse width**.

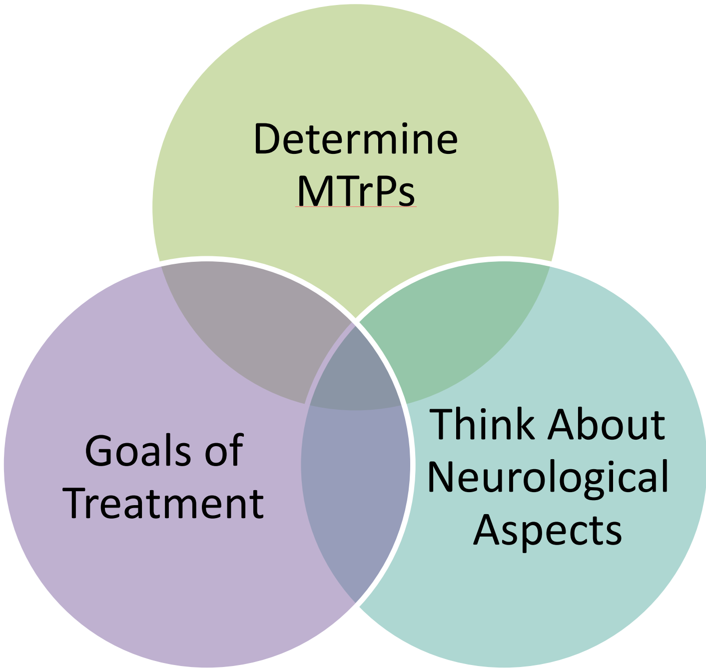
Electrodes were placed bilaterally adjacent to the spinous processes at the site of maximum discomfort. Intensity was titrated by the participant based on therapist instructions to reach a threshold described as **"the most intense but not painful."**

Participants allocated to the **experimental TrPDN (trigger point dry needling) group** received **dry needling of all previously diagnosed active MTrPs** located in the **cervical multifidus, splenius cervicis, levator scapulae**, and **upper trapezius** (see Figure 1). Treatment was delivered using the **Hong technique** ("fast-in, fast-out"), aiming to elicit up to **five local twitch responses (LTRs)** per point (98). **Stainless steel acupuncture needles** (0.32 mm × 40 mm) with guide tubes (ENER-QI; Henry Schein, Melville, NY, USA) were employed. Prior to needling, the area was cleansed with antiseptic, and the physiotherapist donned **nitrile gloves**.

Following needle insertion and stimulation, the area was treated with **ischemic compression**, applied using the **Travell and Simons method**[95] . This involved gradual application of digital pressure to the MTrP until discomfort was perceived, maintaining pressure until the discomfort diminished, then repeating the cycle for a total of **two minutes**. At the conclusion of treatment, the skin was **re-sanitized with an antibacterial solution**.

The TrPDN protocol was administered over a **two-week period**, with **three sessions per week** (Monday, Wednesday, Friday), totaling **six sessions**. During the follow-up phase, participants were monitored for any **adverse effects** associated with dry needling.

***Identifying and Planning the Target:-***

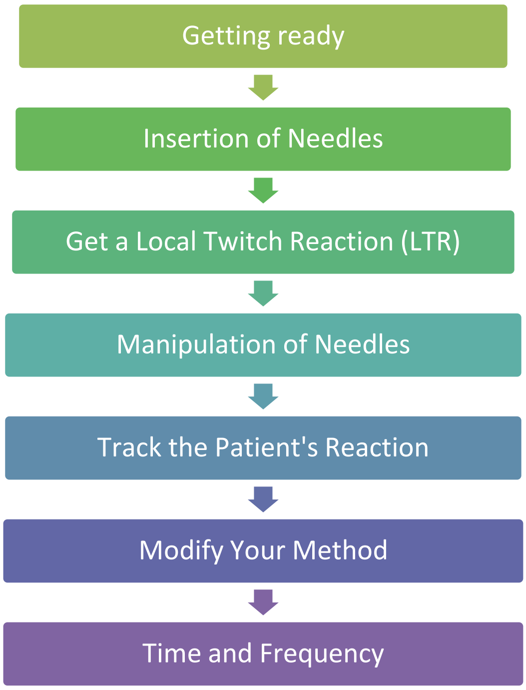



Participants in the *TrPDN + PNE group* received the *same dry needling protocol* as the TrPDN group. However, prior to the initiation of dry needling, they also completed *three individual 30-minute sessions of Pain Neuroscience Education (PNE)* over the course of one week. These sessions were conducted by a *licensed physiotherapist with specialized training in pain neurophysiology*.

The educational content was based on materials endorsed by the *Spanish Pain Society*, including the society's introductory video on chronic pain , and supplemented with structured explanations addressing key PNE concepts. These included the *neurophysiology of pain*, the *influence of cognitive-emotional factors* such as pain-related thoughts and beliefs, and the *utility of adaptive coping strategies* such as *stress management*, *graded return to work*, and *progressive physical activity* .

This approach is consistent with other PNE models previously described and validated in the literature, in which education delivered by trained physiotherapists across multiple sessions has demonstrated benefits in altering pain perception and improving patient outcomes[87].

## 5.APPLICATION OF NEUROLOGICAL DISORDER:-




**(I) Dry needling's effectiveness in treating multiple sclerosis patients:-**

**Multiple sclerosis (MS)** is a chronic autoimmune inflammatory disease that primarily affects the **central nervous system (CNS)**. Clinically, it manifests through the involvement of **motor, sensory, visual, and autonomic systems**, often resulting in progressive functional decline. The condition is more prevalent in **women and young adults**[106,107]. MS is one of the most common neurological disorders globally, with increasing prevalence observed in both **developed and developing countries**, despite its **etiology remaining largely unclear**[108] . Currently, there is no definitive cure for MS; therefore, therapeutic strategies focus on **symptom management**, **dysfunction mitigation**, and **relapse prevention**[109] .

Common clinical manifestations include **fatigue**, **partial or complete paralysis of the extremities**, **spasticity**, **gait and balance disturbances**, **bladder and bowel dysfunction**, **visual disturbances**, **cognitive deficits**, and **depression**[110]. Among the various symptomatic treatments for MS, **dry needling** has emerged as a technique used to alleviate **muscle soreness** and **myofascial trigger points (MTrPs)** in musculoskeletal conditions[111,112] . Recent studies have also explored its potential benefits in **neurological disorders** such as **stroke**[113,114,115,116,117] , **spinal cord injury**[118] , **brain tumors** , and **Parkinson's disease** , demonstrating improvements in **function**, **postural control**, **gait**, **pain**, and **muscle stiffness**. Additionally, evidence suggests that dry needling is a **cost-effective intervention** in stroke rehabilitation, which supports its further investigation in other neurological populations [119,120,121,122,123].

Despite these promising findings, the application of dry needling in MS remains **relatively underexplored**. In contrast, **acupuncture**, which uses similar needles, has a longer history of use in MS treatment. However, the two techniques differ significantly: acupuncture is based on **Traditional Chinese Medicine (TCM)** and targets **meridians**, whereas dry needling is a **Western-based technique** focused on **muscles**, **ligaments**, **scar tissue**, and **peripheral nerves**[124]. While there are existing reviews on acupuncture for MS[125], no systematic review to date has addressed the **use of dry needling in individuals with multiple sclerosis**.

**Therefore, the objective of this review is to critically examine the existing literature on the efficacy of dry needling interventions in patients with MS**, with a focus on outcomes related to **pain, motor function, spasticity, and quality of life**.

**Botulinum toxin type A and dry needling's economics for treating post-stroke spasticity:-**

**Stroke** is among the leading causes of long-term disability and constitutes a significant global public health concern[126]. With the aging of the global population, the absolute number of stroke cases is expected to increase in the coming years. According to the Global Burden of Disease (GBD) Study[127] , although the **prevalence of stroke** has declined in recent decades[128] , its **socioeconomic burden** has continued to rise. This burden includes both **direct costs**, such as those associated with hospital care, medications, and health professionals[131,132] , and **indirect costs**, which stem from loss of productivity due to long-term disability and social limitations, reduced quality of life (QoL), and elevated mortality risk[129,130] .

Damage to **upper motor neurons** often results in **positive symptoms** (e.g., spasticity) and **negative symptoms** (e.g., weakness, loss of dexterity), which can lead to **somatosensory deficits** and impairments in daily activities, further compromising QoL[133,134] . Treatment typically combines **pharmacological interventions**—such as **antispasticity medications** and **botulinum toxin type A (BTX-A) injections**—with **physical therapy**. Recently, **dry needling (DN)** of **myofascial trigger points (MTrPs)** has emerged as a **non-pharmacological alternative** for managing neurological disorders including **multiple sclerosis**[137] , **Parkinson's disease**[136] , and **stroke**[135] .

Although the growing popularity of non-pharmacological approaches like DN is not fully understood, two factors are likely contributors: (1) a shift toward **patient-centered care**, which emphasizes **active participation in treatment decisions**, and (2) the **high cost of pharmacological therapies** like BTX-A from the perspective of healthcare systems. BTX-A, one of the most potent neurotoxins, works through **chemical denervation**, inhibiting neuromuscular transmission to reduce muscle overactivity[138] . In contrast, DN targets **mechanical dysfunction** in the MTrP by disrupting muscle contractile elements and faulty motor endplates, potentially normalizing muscle tone and modulating pain[139] .

The **MTrP** is defined as "a focus of hyperirritability in tissue that is tender to palpation and can produce referred pain, tenderness, autonomic symptoms, or proprioceptive distortion"[140] . DN has been shown to facilitate a **washout of sensitizing agents** in the MTrP region and contribute to **pain modulation**[141] . When applied by a qualified physiotherapist, DN is considered **safe and effective** for improving **motor function and reducing spasticity** in stroke patients[135,142,143] . Furthermore, unlike BTX-A, DN is **not associated with systemic adverse effects**, though **minor complications** such as local pain, bruising, or bleeding may occur. In contrast, BTX-A's **short-term risks** include diffusion to adjacent muscles, potentially causing **unintended weakness**, **dysphagia**, **dysarthria**, or **respiratory compromise** depending on injection site[144,145] . **Long-term use** of BTX-A may result in **muscle atrophy** due to chemodenervation[144]. However, it is also recognized that BTX-A produces **longer-lasting effects** with **fewer treatment sessions**, whereas DN generally requires **more frequent applications** to maintain benefits[139] .

Several studies have conducted **economic evaluations** of BTX-A formulations—namely, **incobotulinumtoxinA (incoBoNT-A)**, **onabotulinumtoxinA (onaBoNT-A)**, and **abobotulinumtoxinA (aboBoNT-A)**—for treating **post-stroke spasticity**[146] . More recently, **cost-effectiveness analyses** have also been performed for **DN interventions** in both **subacute**[147] and **chronic stroke populations**[148] . However, to date, **no comprehensive review** has compared the **economic and clinical outcomes** of these two modalities.

**The objective of this study is to systematically review all available economic evaluations related to dry needling and botulinum toxin type A in the treatment of post-stroke spasticity**, to support evidence-based clinical decision-making and inform healthcare policy. Given the limited and heterogeneous nature of current evidence, a consolidated assessment is essential to clarify the cost-benefit profiles of these treatment strategies.

**Effects of dry needling and exercise treatment together on motor function and muscular stiffness in chronic stroke patients:-**

Approximately **60% of stroke survivors experience spasticity**, making it one of the most common post-stroke complications[149] . Characterized by **velocity-dependent increases in stretch reflexes** and **resistance to passive movement**, spasticity is a hallmark of **upper motor neuron syndrome**[150] . **Upper limb spasticity** is particularly prevalent and can contribute to **contractures, pain, reduced functional ability, and impaired social participation** in individuals post-stroke[151] . A wide range of interventions—including **pharmacologic treatments**, **physical therapy**, **electrical stimulation**, and **botulinum toxin injections**—are commonly employed to manage spasticity[152] .

**Dry needling (DN)** has emerged as a promising intervention, with evidence supporting its effectiveness for reducing spasticity in both **chronic** and **subacute stroke populations**[153,154] . Moreover, DN has been recognized as a **cost-effective treatment option**[155]. For patients with **chronic stroke**, the **combined use of DN and complementary therapies** may yield enhanced outcomes in terms of spasticity management and functional recovery[156] .

Previous studies have established that **exercise therapy** significantly improves **functional capacity** and **range of motion (ROM)** in stroke survivors[156,157] . However, the **combined therapeutic effect of DN and exercise therapy** on upper-limb motor function and spasticity has been explored in only **one case study to date**[158]. Based on this, we hypothesized that **integrating DN with exercise therapy** would yield greater improvements in **motor function and spasticity** in individuals with chronic stroke.

**Therefore, the aim of this pilot study** was to evaluate the **short-term effects** of **dry needling combined with exercise therapy** on **motor function**, **alpha motor neuron excitability**, and **spasticity** in individuals with **chronic stroke**.

## 6.ADVANTAGE OF DRY NEEDLING IN NEUROLOGICAL DISORDER:- The Therapeutic Benefits of Dry Needling in Musculoskeletal Care

Dry needling offers targeted pain relief and improved mobility by focusing on **myofascial trigger points** and promoting **muscle relaxation**. While minor side effects—such as **bruising**, **bleeding**, or **temporary discomfort**—can occur at needle insertion sites, these are typically short-lived and outweighed by the therapeutic gains. Beyond just pain relief, dry needling supports a **holistic approach** to managing musculoskeletal dysfunctions, making it a valuable tool in a physical therapist's treatment arsenal.

### *A. Effective Pain Management*

One of dry needling's primary benefits is its ability to **alleviate pain across various musculoskeletal conditions**, including **chronic back pain**, **neck and shoulder pain**, and **tension headaches**. By targeting trigger points and releasing taut muscle bands, this modality reduces localized tension and modulates pain pathways.

Dry needling is especially appealing as a **drug-free pain management option**, providing relief without the risks associated with pharmacologic treatments such as side effects or dependency—aligning closely with the core principles of physical therapy.

### *B. Enhanced Mobility and Muscle Function*

Tight or overactive muscles can significantly impair **range of motion** and **functional performance**. Dry needling promotes **localized muscle relaxation**, enhances **circulation**, and facilitates **tissue repair**.

By improving muscular function, dry needling supports the **restoration of optimal movement patterns**—beneficial for patients recovering from injury, managing chronic conditions, or aiming to boost athletic performance.

### *C. Targeted and Precise Intervention*

A key advantage of dry needling is its ability to provide **highly localized treatment**. Physical therapists can precisely address specific areas of dysfunction within muscle bellies, tendons, or fascia.

This differentiates dry needling from acupuncture, often misunderstood by patients. While acupuncture is rooted in traditional Chinese medicine and focuses on energy meridians, **dry needling is based on Western medical principles** and is designed to **mechanically disrupt** dysfunctional tissue and **neuromuscular trigger points**.

This level of precision can **enhance outcomes** and potentially reduce the number of sessions required.

### *D. Complementary to Other Therapies*

Dry needling is most effective when **integrated into a broader rehabilitation program**. It is commonly used in conjunction with:

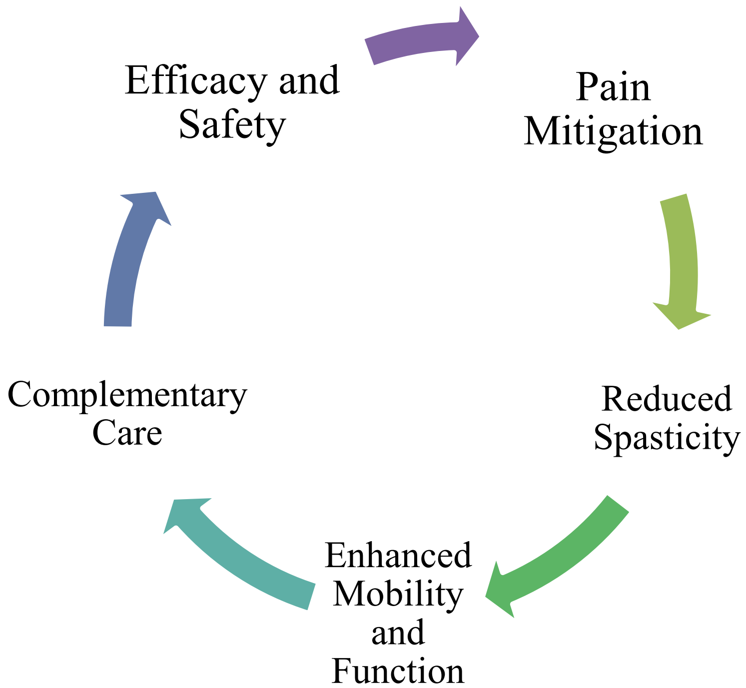
- Exercise therapy
- Manual therapy
- Thermal modalities (heat or cold)
- Neuromuscular re-education

By combining modalities, clinicians can **address multiple components of dysfunction**—including soft tissue, neuromuscular, and biomechanical factors—leading to more comprehensive recovery outcomes.

### *E. Accelerated Recovery with Minimal Side Effects*

Compared to invasive procedures, dry needling is **minimally invasive** and associated with **low risk**. While minor discomfort, soreness, or bruising can occur, these effects are typically transient and resolve within a day or two.

As a result, dry needling is an ideal option for those seeking **non-surgical**, **low-recovery-time** interventions for pain relief and functional restoration.




## Drawbacks of dry needling:- Important Considerations and Potential Risks of Dry Needling

Although **dry needling** has gained popularity as an effective treatment for **musculoskeletal pain and dysfunction**, it may not be the best fit for everyone. As with any medical intervention, patients should be informed of the **potential drawbacks** and engage in open dialogue with their healthcare provider before beginning treatment.

### *A. Discomfort During Treatment*

One of the most commonly reported concerns about dry needling is **pain or discomfort during the procedure**, especially when targeting **sensitive trigger points or tight muscle bands**. Even though the needles used are **very thin (filiform needles)**, the sensation can range from mild irritation to sharp or aching pain depending on the individual and the area treated.
👉 *Open communication is essential.* Patients are encouraged to speak up if they experience significant discomfort so that the therapist can adjust the approach accordingly.

### *B. Risk of Bleeding or Bruising*

Minor **bleeding or bruising** at the needle insertion site can occasionally occur. This is generally minimal and resolves on its own. However, patients with **bleeding disorders**, those on **anticoagulant therapy**, or individuals who bruise easily may be at increased risk.
👉 *Inform your provider of any bleeding tendencies or medications during your initial assessment.*

### *C. Limited and Mixed Evidence in Research*

While growing evidence supports dry needling for many musculoskeletal conditions, **some studies show mixed or inconclusive results**. The **effectiveness of dry needling** may vary depending on the **specific condition**, **treatment frequency**, or **individual patient factors**.
👉 More large-scale, high-quality studies are needed to definitively establish its effectiveness across broader populations.

### *D. Not Suitable for All Patients*

Dry needling is **not recommended for everyone**. Patients who may not be ideal candidates include those with:

- Bleeding or clotting disorders
- Weakened immune systems
- Severe needle phobia
- Certain neurological or systemic illnesses

Additionally, dry needling must be administered with caution in **high-risk anatomical regions** to avoid complications.
👉 Your physical therapist will carefully review your medical history and contraindications to determine if dry needling is appropriate for you.

### *E. Potential for Adverse Reactions*

Though rare, there is a small risk of **adverse events** such as:

- **Infection** (if sterile technique is not followed)
- **Nerve injury**
- **Pneumothorax** (collapsed lung) when needling near the thorax

These events are uncommon, particularly when dry needling is performed by **trained and licensed professionals**. Still, patients should be fully informed and discuss **any concerns** in advance.

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