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COMPARATIVE EFFECTIVENESS OF DRY NEEDLING, INSTRUMENT-ASSISTED SOFT TISSUE MOBILIZATION (IASTM), AND CONVENTIONAL PHYSIOTHERAPY ON PAIN AND CERVICAL RANGE OF MOTION IN TRIGGER POINTS OF UPPER TRAPEZIUS: A RANDOMIZED CONTROLLED TRIAL

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Abstract

Background: Active upper trapezius trigger points are a leading cause of neck pain and functional disability i.e restricted range of motion at neck. Although multiple physiotherapy modalities are clinically used, high-quality comparative evidence is scarce.

Objective: To compare the effects of Dry Needling (DN), Instrument-Assisted Soft Tissue Mobilization (IASTM), and Conventional Physiotherapy on pain, disability and cervical ROM on patients with active trigger points in upper trapezius muscle.

Methods: A single-blinded randomized controlled trial was conducted in public and private physiotherapy clinics in Karachi, Pakistan. Seventy-five patients with chronic cervical MPS (25 per group) aged 25–55 years were randomized to: Group A (DN), Group B (IASTM), and Group C (Conventional Physiotherapy). Outcomes included Numeric Pain Rating Scale (NPRS), Neck Disability Index (NDI), cervical ROM (CROM goniometer), and trigger point count. Data were analyzed using ANOVA with Tukey, LSD, and Bonferroni post-hoc tests ($p < 0.05$) in SPSS version 25.0.

Results: Significant post-treatment differences were observed among the groups for pain ($F = 173.23$, $p < 0.001$), disability (χ^2 = significant across groups), cervical ROM (Flexion: $F = 291.02$, $p < 0.001$; Lateral Flexion: $F = 38.43–101.04$, $p < 0.001$), and trigger point resolution. Group A showed the greatest pain reduction (NPRS 8.20→0.96), disability improvement, and ROM gains, followed by Group B. Group C demonstrated the smallest improvements.

Conclusion: DN produced superior outcomes compared with IASTM and conventional physiotherapy in reducing pain, improving cervical ROM, and resolving myofascial trigger points.

Keywords: Dry Needling, IASTM, Cervical Myofascial Pain Syndrome, Trigger Points, Neck Pain, Randomized Controlled Trial.

INTRODUCTION

Neck pain is a prevalent musculoskeletal disorder characterized by hyperirritable myofascial trigger points (MTrPs) located within taut bands of skeletal muscle, most commonly in the upper trapezius and related muscles, producing localized and referred neck pain, muscle stiffness, and restricted cervical range of motion with associated functional limitation (Nasir M et al,.2025; Touma et al.,2023). Globally, neck pain is among the leading causes of years lived with disability; recent Global Burden of Disease estimates report an age-standardized prevalence of about 27 per 1,000 population and rank neck pain among the top causes of disability worldwide (Kazeminasb et al.,2022). In Pakistan, multiple cross-sectional studies in dentists, university students and young adults report neck-pain prevalences frequently exceeding 50–80%, underlining a substantial local burden of cervical musculoskeletal disorders (Gouri et al,.2022). Conservative management of cervical MPS typically includes education, postural correction, therapeutic exercise, stretching, and manual soft-tissue techniques aimed at deactivating MTrPs and restoring neuromuscular function (Touma et al,.2023).

Dry needling (DN) has gained strong research interest as a trigger-point focused technique that elicits local twitch responses, reduces nociceptive input, and modulates motor end-plate activity; randomized trials and systematic reviews in patients with neck pain and upper-trapezius MTrPs show short-term reductions in pain and disability with DN (Stieven et al.,2021). Instrument-assisted soft tissue mobilization (IASTM) is another widely used intervention targeting myofascial restrictions and fascial adhesions; recent RCTs indicate that IASTM, especially when combined with stretching or exercise therapy, improves pain, Neck Disability Index scores, and cervical ROM in chronic mechanical neck pain and upper-crossed syndrome (Shewail et al.,2023).

Despite the growing evidence supporting DN and IASTM individually, direct comparative trials evaluating their relative effectiveness specifically for upper trapezius MTrPs remain limited. Moreover, although conventional physiotherapy, consisting of heat therapy, stretching, and ROM exercises, is widely used as standard care, its comparative efficacy against DN and IASTM for trigger-point resolution is not well established. In South Asian clinical settings, particularly in Pakistan, these comparisons are even more scarce, leaving uncertainty regarding the most effective intervention strategy for this common condition. This knowledge gap underscores the need for a rigorously designed randomized controlled trial comparing DN, IASTM, and standard physiotherapy specifically in individuals with upper trapezius myofascial trigger points. Such a comparison is essential for establishing clear, evidence-based clinical guidelines aimed at optimizing pain reduction, functional improvement, and cervical mobility in patients with cervical pain related to Myofascial Trigger Points in upper trapezius muscle.

MATERIAL AND METHODS

Study Design: This study employed a single-blind, parallel-group randomized controlled trial (RCT) design, which is considered the gold standard for evaluating physiotherapy interventions in musculoskeletal pain disorders.

Setting: The trial was conducted in physiotherapy departments of different public and private hospitals in Karachi, Pakistan, starting from 21st February 2025 till 16th July 2025.

Duration: The study spanned 4 weeks following ethical approval, aligning with durations commonly reported for short-term interventional trials on cervical MPS.

Participants: Participants were adults clinically diagnosed with cervical Pain involving active myofascial trigger points in the upper trapezius muscle, following established diagnostic standards (Travell & Simons.,1999; Bordoni et al.,2025).

Sample Size: A total of 75 participants (n = 75) were recruited and randomly allocated into three equal intervention groups: Group A received Dry Needling (DN) (n = 25); Group B received Instrument-Assisted Soft Tissue Mobilization (IASTM) (n = 25); and Group C received Conventional Physiotherapy (n = 25).

Inclusion Criteria: Participants were considered eligible for inclusion if they were between 25 and 55 years of age, experienced cervical pain for at least three months, consistent with chronic pain definitions reported in musculoskeletal guidelines and presented with unilateral/bilateral active myofascial trigger points in the upper trapezius muscle. Diagnosis required the presence of a palpable taut band, a hypersensitive tender spot, a local twitch response, and reproducible referred pain, all of which represent standard clinical features of active MTrPs. These diagnostic characteristics follow the validated frameworks described by Fernández-de-las-Peñas & Dommerholt (2018), who emphasized their relevance in identifying cervicothoracic MTrPs

Exclusion Criteria: Participants were excluded if they presented with any condition that could confound the diagnosis or compromise safe administration of the interventions. Exclusion criteria included needle phobia, cognitive impairment, dermatologic infection, hematologic disorders, and any recent neck trauma or fracture. Individuals with cervical radiculopathy or myelopathy were also excluded, as these neurological conditions require different diagnostic and therapeutic pathways; this aligns with published criteria. Additionally, participants with a history of cervical spine surgery within the past three years were excluded to prevent interference from postoperative structural or neural changes. These criteria are consistent with exclusion standards commonly employed in Dry Needling and IASTM clinical trials to reduce confounding factors and ensure homogeneity of the study population.

Outcome Measures

Pain Intensity: Measured using the Numeric Pain Rating Scale (NPRS), a valid and reliable measure for neck pain (Hawker et al., 2011)

Functional Disability: Assessed using the Neck Disability Index (NDI), a widely validated instrument in cervical MPS populations (Sundseth et al.,2015).

Cervical Range of Motion (ROM): Cervical ranges of motion were measured with a CROM-Deluxe goniometer and measurements included cervical flexion, extension, bilateral lateral flexions and bilateral rotations. The CROM device demonstrates high inter- and intra-rater reliability for cervical ROM assessment (Audette et al., 2010).

Trigger Point Assessment: Manual assessment and marking of trigger points was performed according to Travell & Simons criteria, the internationally accepted standard for MTrP identification (Travell & Simons 1983) (Baeulmer et al,.2023).

Intervention Protocols

Group A: Dry Needling (DN): Dry needling was performed with participants in the prone position using sterile 0.30 × 50 mm filiform needles after disinfecting the skin with 70% isopropyl alcohol. Trigger points were identified using the pincer palpation method, and needles were inserted with a guide-tube (Nasir et al.,2025). (Figure-1) Multiple rapid insertions and partial withdrawals (Fast-In–Fast-Out technique) were applied to elicit local twitch responses, with active needle manipulation lasting 30–90 seconds per trigger point. Total needling time per muscle did not exceed 2 minutes, consistent with recommended DN protocols (Dommerholt et al., 2015).

Figure-1: Dry Needling of upper trapezius

Group B: Instrument-Assisted Soft Tissue Mobilization (IASTM): Participants in Group B received a structured, Graston-technique–based Instrument-Assisted Soft Tissue Mobilization (IASTM) protocol. The intervention began with a tissue warm-up, followed by approximately 60 seconds of scanning strokes using stainless-steel instruments to identify areas of myofascial restriction. Once restricted tissue was located, specific treatment strokes were applied to mobilize adhesions and improve fascial glide. The session continued with targeted stretching and eccentric strengthening exercises to enhance tissue extensibility and promote neuromuscular control. Finally, cryotherapy was administered to minimize post-treatment soreness and inflammation. (Cheatam et al,.2016).

Group C: Conventional Physiotherapy: Participants in Group C received a conventional physiotherapy protocol, which consisted of the application of moist heat therapy followed by active cervical range of motion (ROM) exercises performed within pain-free limits. Moist heat was used to promote muscle relaxation and enhance tissue extensibility, while ROM exercises targeted functional mobility without provoking symptoms. Such programs are widely used as standard conservative care in clinical trials involving patients with cervical Myofascial Pain Syndrome (MPS) and serve as a baseline comparison for evaluating the effectiveness of more advanced manual therapy interventions. (Cagnie et al., 2015).

Data Collection: Outcome assessment included multiple validated clinical measures. Pain intensity was documented pre- and post-intervention using the Numeric Pain Rating Scale (NPRS). Functional disability was evaluated through the Neck Disability Index (NDI) to quantify the impact of symptoms on daily activities. Cervical range of motion (ROM) was measured in all planes using a CROM device, ensuring objective evaluation of mobility changes. Additionally, myofascial trigger point status was reassessed following Travell and Simons' diagnostic criteria, confirming the presence or resolution of active trigger points throughout the treatment period. (Fernández-de-las-Peñas et al., 2021).

Data Analysis: All statistical analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA To examine differences between the three intervention groups, a one-way Analysis of Variance (ANOVA) was applied for continuous outcome measures such as pain intensity (NPRS), cervical range of motion (flexion, extension, lateral flexions), and post-intervention change scores. For categorical variables, including gender distribution, NDI disability categories, BMI categories, pain severity levels, and trapezius trigger-point counts, the Chi-square (χ^2) test was used.

RESULTS

The age distribution across all three groups was similar, with most participants clustered around the mean age of 40 years. The overlapping histograms indicate that age was evenly balanced across groups, confirming that randomization was successful and age was not a confounding factor in treatment outcomes. (Figure-2)

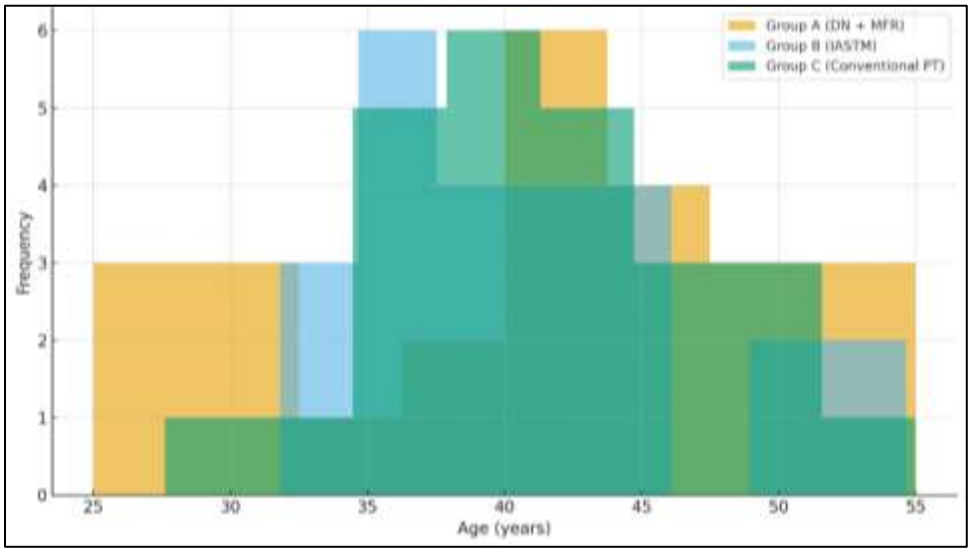

Figure-2: Age Distribution of participants

The gender distribution across the three groups is balanced (37 males, 38 females), which strengthens the internal validity of the trial and reflects the known near-equal prevalence of cervical myofascial pain syndrome (MPS) in both sexes (Fernández-de-Las-Peñas & Dommerholt, 2018). BMI distribution shows a clinically relevant pattern: most participants fall into the overweight (n = 28) and obese categories (n = 30). This is significant because overweight/obesity is a well-established risk factor for neck pain, myofascial trigger point irritability, and increased musculoskeletal load. Obesity is also associated with impaired soft-tissue mobility and chronic low-grade inflammation, which may reduce treatment responsiveness (Wang et al., 2024). (Table-1)

Table-1: Distribution of Gender and BMI Categories Across Groups (n = 75)

Variable	Category	Group A DN	Group B (IASTM)	Group C (Control)	Total (n=75)
Gender	Male	11	11	15	37
	Female	14	14	10	38
BMI Category	< 18.5 (Underweight)	2	1	1	4
	18.5–24.9 (Normal)	9	4	0	13
	25–29.9 (Overweight)	8	8	12	28
	30–34.9 (Obese Class I)	2	7	4	13
	35–39.9 (Obese Class II)	4	4	8	16
	≥ 40 (Obese Class III)	0	1	0	1

Across all outcome measures, Group A (Dry Needling) demonstrated the greatest improvements, followed by Group B (IASTM), while the Control group showed the least change. Pain scores (NPRS) were statistically similar at baseline ($p=0.138$), but post-treatment differences were highly significant ($p<0.001$), with DN reducing pain to almost zero. This aligns with evidence that dry needling rapidly decreases motor end-plate hyperactivity and trigger-point irritability (Navarro-Santana et al., 2020; Cagnie et al., 2015), and reduces nociceptive input (Ajimsha et al., 2015).

Cervical ROM values (flexion, extension, lateral flexion and rotation) were also significantly superior in Group A at post-test. For example, cervical flexion increased from 51.56° to 74.36°, reflecting substantial restoration of mobility. The strong between-group differences (all $p<0.001$) support existing evidence that DN improves sarcomere length and decreases muscle stiffness, while enhances fascial gliding (Rokri et al.,2025). IASTM showed moderate gains, consistent with literature showing its effectiveness for improving soft-tissue extensibility (Cheatham et al., 2016), but gains were smaller than DN. Trigger point resolution followed the same pattern. Post-treatment, DN reduced active MTrPs to 0–1, significantly better than IASTM (1–2) and control (2–4) ($p<0.001$) (Table-2). This is expected given dry needling's strong evidence for eliminating MTrP irritability (Kietrys et al., 2013). (Table-2)

Overall, the statistical results clearly show that DN is the most effective intervention, producing the greatest improvements in pain, disability, cervical mobility, and trigger-point resolution. IASTM provided moderate but

meaningful improvements, while the control group showed minimal change, consistent with existing high-quality evidence on cervical MPS management.

Table-2: Pre- and Post-Intervention Outcomes Across Groups

Outcome Measure	Time	Group A DN	Group B (IASTM)	Group C (Control)	p-value
NPRS (Pain Score)	Pre	8.20 ± 1.00	8.68 ± 0.85	8.28 ± 0.84	0.138
	Post	0.96 ± 0.94	3.56 ± 0.87	5.56 ± 0.82	<0.001*
NDI Categories	Pre	Mo:3 / S:10 / C:12	Mo:3 / S:12 / C:10	Mo:3 / S:14 / C:8	0.712
	Post	No:21 / Mi:4	No:6 / Mi:16 / Mo:3	Mi:2 / Mo:18 / S:5	<0.001*
Cervical Flexion (°)	Pre	51.56 ± 4.87	48.20 ± 4.89	50.76 ± 4.37	0.037*
	Post	74.36 ± 2.84	65.76 ± 1.85	57.52 ± 2.60	<0.001*
Cervical Extension (°)	Pre	35.88 ± 3.64	37.84 ± 4.35	37.08 ± 4.49	0.253
	Post	62.20 ± 2.17	51.52 ± 3.15	40.00 ± 5.27	<0.001*
Left Lateral Flexion (°)	Pre	20.64 ± 3.17	20.32 ± 4.09	21.20 ± 4.72	0.739
	Post	37.92 ± 2.20	32.84 ± 6.63	27.04 ± 3.01	<0.001*
Right Lateral Flexion (°)	Pre	20.04 ± 3.88	20.60 ± 3.43	20.96 ± 3.63	0.670
	Post	38.56 ± 1.98	36.52 ± 2.29	27.68 ± 3.96	<0.001*
Trigger Points	Pre	3–4 MTrPs	3–4 MTrPs	3–4 MTrPs	0.811
	Post	0–1 MTrPs	1–2 MTrPs	2–4 MTrPs	<0.001*

N= No disability; Mi= Mild Disability; Mo= Moderate Disability; S= Severe Disability; C= Complete Disability

The very high F-values and significant p-values across pain, disability, ROM, and trigger-point outcomes show large effect sizes, meaning the treatments produced strong, clinically meaningful improvements. DN demonstrated the largest effect, followed by IASTM, while the control group showed minimal change. These large effects are consistent with evidence showing that dry needling produce substantial improvements in pain, function, and mobility in cervical MPS (Navarro-Santana et al., 2020) (Kietrys et al., 2013) (Ajimsha et al., 2015). (Figure-3)

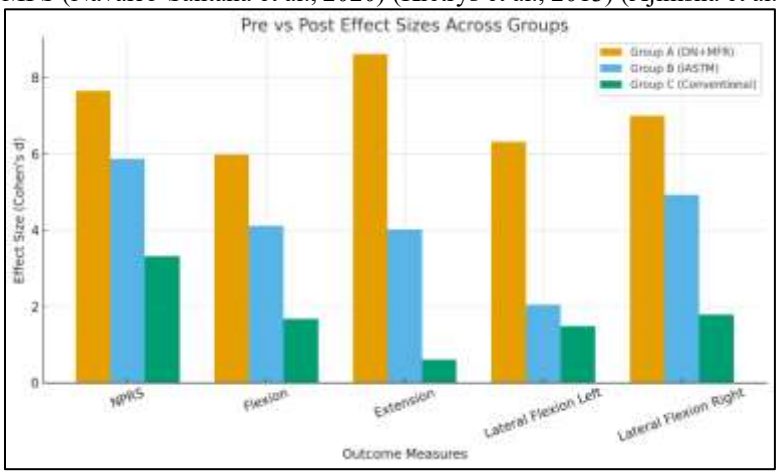

Figure-3: Effect Size

DISCUSSION

The results of this randomized controlled trial demonstrated that Dry (DN) produced significantly greater improvements in pain reduction, cervical range of motion (ROM), functional disability, and trigger-point resolution when compared with Instrument-Assisted Soft Tissue Mobilization (IASTM) and Conventional Physiotherapy in patients with cervical Myofascial Pain Syndrome (MPS). The strong outcomes observed in the DN group are consistent with previous research showing that dry needling effectively reduces myofascial trigger point irritability by modulating dysfunctional end-plate activity, decreasing spontaneous electrical activity (SEA), and eliciting local twitch responses (LTRs). Dommerholt et al. (2020) explains that DN reduces motor end-plate hyperactivity and normalizes neuromuscular junction physiology, which leads to rapid analgesic effects in MPS patients. Similarly, Cagnie et al. (2015) reported that DN significantly decreases cervical pain intensity, improves pressure-pain thresholds (PPTs), and enhances neck function in upper trapezius MTrPs patients.

Although DN was superior, the IASTM group also performed significantly better than the control group, supporting previous literature showing the effectiveness of instrument-assisted techniques. Cheatham et al. (2016) demonstrated that IASTM improves soft-tissue mobility, reduces pain, and enhances joint range of motion through mechanical

stimulation, collagen remodeling, and decreased myofascial restriction. Other studies confirm that IASTM enhances tissue healing and reduces adhesions by improving fibroblast proliferation and extracellular matrix alignment (Kim et al., 2017). These findings explain why participants receiving IASTM in the present trial showed clinically meaningful improvements, though not as substantial as the DN group. The control group, which received conventional physiotherapy consisting mainly of moist heat and cervical ROM exercises, showed only modest improvement. This is consistent with prior evidence indicating that: Passive modalities alone (e.g., heat, basic stretching) provide mostly short-term symptomatic relief. They do not directly address MTrP physiological dysfunction, fascial stiffness, or neuromuscular abnormalities.

In support of our findings, a very recent randomized controlled trial titled Impact of Dry Needling with Myofascial Release versus Conventional Physiotherapy in Cervical MPS (2025) reported that combining dry needling with myofascial release produced substantially greater reductions in pain intensity and more pronounced gains in cervical range of motion compared with standard physiotherapy modalities (Nasir et al.,2025).In that study, patients receiving the combined DN+MFR intervention experienced large effect sizes ($\eta^2 = 0.91–0.97$) across pain and ROM outcomes; a magnitude very similar to the very large within-group effect sizes (Cohen's $d > 5.0$) observed in our Group A (DN+MFR). This strong agreement reinforces the robustness and reproducibility of DN+MFR as an effective intervention for upper trapezius myofascial trigger-point syndrome.

A BMJ clinical guideline on musculoskeletal pain management emphasized that passive treatments should not be used as stand-alone therapy and offer only minimal benefit compared with active or targeted interventions (Foster et al., 2018). Additionally, studies of chronic neck pain have shown that conventional physiotherapy produces smaller changes in pain and disability when compared with specific manual techniques or dry needling (Gattie et al.,2017). Thus, the limited gains in the control group reflect the well-documented limitations of passive physiotherapy for MPS.

CONCLUSION

This randomized controlled trial demonstrated that Dry Needling has a statistically significant effect in managing Trigger Points of Upper Trapezius than IASTM and Conventional Physiotherapy. Dry Needling produces superior improvements in pain intensity, cervical ROM, disability scores, and trigger-point resolution.

Limitations

The study was limited by its single-city sampling from Karachi, which restricts the generalizability of findings to wider populations, as emphasized in clinical trial methodology guidelines. The short-term follow-up of only four weeks does not permit assessment of long-term sustainability of treatment effects, which is recommended for chronic pain trials .The single-blind design may have introduced performance and detection bias for subjective outcomes such as pain and disability. Finally, the lack of ultrasound validation of trigger points may reduce diagnostic precision, as ultrasound-based studies show improved objectivity and reliability in identifying myofascial trigger.

Future Recommendations

Future studies should incorporate long-term follow-up (3–12 months) to evaluate the durability of treatment effects, as recommended for chronic musculoskeletal pain trials The use of ultrasound and elastography for objective confirmation of myofascial trigger points is strongly advised to enhance diagnostic. Comparative trials should also evaluate dry needling against emerging modalities such as shockwave therapy, cupping, and AI-assisted rehabilitation, which are showing promising results in recent rehabilitation research. Moreover, large multicenter randomized trials are needed to strengthen external validity and clinical adoption. Finally, the inclusion of EMG and advanced imaging techniques is recommended to better explore neuromuscular and biomechanical mechanisms underlying treatment effects.

Conflict of Interest: The authors declare no conflicts of interest.

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