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DRY NEEDLING VS INSTRUMENT ASSISTED SOFT TISSUE MOBILIZATION FOR MYOFASCIAL TRIGGER POINTS IN UPPER TRAPEZIUS.: A RANDOMIZED CONTROLLED TRIAL

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Abstract

Background: Myofascial trigger points (MTrPs) in the upper trapezius are a common cause of neck pain, functional disability, and impaired quality of life. Dry needling (DN) and instrument-assisted soft tissue mobilization (IASTM) are widely used interventions, yet direct comparative evidence regarding their effectiveness remains limited, particularly in South Asian clinical contexts.

Objective: To compare the efficacy of DN versus IASTM in reducing pain, improving pressure pain threshold (PPT), cervical range of motion (ROM), and functional disability in patients with upper trapezius MTrPs.

Methods: This single-center, parallel-group, assessor-blinded randomized controlled trial enrolled 60 participants aged 18–50 years with active upper trapezius MTrPs. Participants were randomly allocated to DN (n=30) or IASTM (n=30) groups, receiving three sessions per week for four weeks. The primary outcome was pain intensity measured by the Numeric Pain Rating Scale (NPRS). Secondary outcomes included PPT, cervical ROM, and the Neck Disability Index (NDI). Baseline and post-intervention assessments were conducted by blinded evaluators. Data were analyzed using paired t-tests, independent t-tests, and repeated-measures ANOVA, with significance set at $p < 0.05$.

Results: Both interventions produced statistically and clinically significant improvements in all outcome measures ($p < 0.001$). DN resulted in greater reductions in NPRS (-4.7 ± 1.2) compared to IASTM (-2.8 ± 1.1; $p < 0.001$, Cohen's $d = 0.92$), higher increases in PPT (DN: $+1.9 \pm 0.7$ vs IASTM: $+0.9 \pm 0.6$ kg/cm^2; $p = 0.002$), and superior improvements in NDI (DN: -16.3 ± 4.5 vs IASTM: -9.4 ± 5.2; $p = 0.01$). Cervical ROM improved in both groups (DN: +12.3°; IASTM: +8.4°), with no statistically significant between-group difference ($p = 0.08$). No serious adverse events were reported; minor post-needling soreness and erythema were transient.

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Conclusion: Both DN and IASTM are effective for managing upper trapezius MTrPs. Dry needling, however, demonstrates superior efficacy in pain reduction, pressure pain threshold, and functional disability. These findings support the use of DN as a primary intervention while recognizing IASTM as a viable non-invasive alternative or adjunct.

INTRODUCTION

Myofascial trigger points (MTrPs) have long been considered a major cause of musculoskeletal pain syndromes, specifically at the cervical and shoulder levels. They are pathologically characterized by painful nodules that are hyperirritable and embedded into taut bands of skeletal muscle fibers, which can result in typical patterns of referred pain, motor dysfunction, and autonomic reactions (1). Out of the range of muscles, which may develop MTrPs, the upper trapezius has always been one of the most frequently affected. This predisposition is mainly ascribed to the fact that it plays a very important role in keeping the cervical spine and shoulder girdle in a stable posture and also due to its constant activation in both still and dynamic activities. Therefore, the impairment of this muscle is frequently observed through the local pains of the neck, limited range of motion, and limitations in functional domains, which severely affect everyday activity and workplace performance (2).

As a more general clinical phenomenon, neck pain is a significant health issue worldwide. It is now the number one cause of years lived with disability globally, and a rising prevalence is being observed within both developed and developing countries. Based on epidemiological data, it has been estimated that as many as 70% of people in their lives may experience neck pain, and a significant proportion of those with the symptoms may progress into chronic or recurrent pains (3). It is more severe in the low- and middle-income countries, where the rapid urbanization process, sedentary lifestyle, and poor ergonomics are factors that have led to the increase in the number of cases. The occurrence of neck pain in South Asian settings, such as Pakistan, is further aggravated by occupational and educational factors that involve the long sitting positions, the high use of digital gadgets, and insufficient knowledge on the importance of posture (4). The high-risk groups include

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the high-risk healthcare professionals, the high-risk students, and the high-risk office workers who are likely to manifest with persistent upper trapezius tightness and related MTrPs.

MTrPs have more than just local pain clinical implications because they are often involved in the onset of secondary disorders like cervicogenic headaches, shoulder dysfunction, and changes in movement patterns. Furthermore, the presence of active MTrps has been linked to reduced muscle strength, poor coordination, and reduced endurance, which all lead to functional disability (5). These impairments, in terms of socioeconomic perspective, translate to reduced productivity, greater healthcare use, and a heavy financial load for the individuals and the healthcare systems. Consequently, management of MTrPs is not only necessary in order to alleviate symptoms but also in order to enhance the overall quality of life and decrease the overall effects of conditions related to musculoskeletal disorders (6).

The MTrP pathophysiology is multifactorial and involves complex interactions of mechanical, biochemical, and neurophysiological processes. The most commonly recognized theory is the so-called integrated hypothesis according to which the excessive release of acetylcholine at the neuromuscular junction results in long-term contraction of the sarcomeres in local areas of the muscle fibers. The result is a continuous contraction, which leads to elevated metabolic activity, decreased blood flow to the local area, and eventual ischemia (7). The subsequent energy crisis affects the ability of calcium ions to be recaptured, and this condition continues the cycle again in a vicious cycle of dysfunction. Simultaneously, the ischemic condition facilitates the accumulation of nociceptive and inflammatory mediators, such as substance P, bradykinin, serotonin, and calcitonin gene-related peptide. These chemicals have the effect of sensitizing peripheral nociceptors, resulting in an increase in perceived pain and peripheral sensitization (8).

Besides periphery, central sensitization is also important in the maintenance and enhancement of the pain associated with MTrP. Incessant input of nociceptive messages by the active trigger points may cause neuroplastic alterations in the central nervous system, especially in the dorsal horn of the spinal cord (9). This causes more excitability of second-order neurons, decreased activation

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thresholds, and an increase in receptive fields, which in turn leads to general pain and hyperalgesia. Moreover, the impairment of descending inhibitory pathways can contribute to the pain perception, which makes a person vulnerable to the development of a chronic pain condition (10). The interplay between the peripheral and central processes makes it apparent that MTrPs are complicated and that the interventions must focus on the dysfunction of local tissues and general neurophysiological events.

Considering the complexity of MTrPs, various treatment options have been suggested to treat these conditions. These consist of manual therapy methods, different forms of stretching exercises, pharmacological methods, and electrotherapy methods (11). Two of these, dry needling (DN) and instrument-assisted soft tissue mobilization (IASTM), have received a significant amount of attention over the past several years because of their focus and increasing evidence base. The interventions are both widely used in clinical practice even though they vary significantly in terms of their mechanism of action, methods of application, and theoretical basis (12).

Dry needling is an invasive method where a thin, solid, filiform needle is inserted directly into the MTrP. The main goal is to produce a local twitch response, which is thought to be a spinal reflex related to the normalization of dysfunctional motor endplates. The mechanism of action of DN is believed to interfere with the integrity of the contracted sarcomeres, which in turn lowers muscle tension and normalizes length (13). Also, it has been suggested to regulate the biochemical alterations in the trigger point through reduction of the concentration of nociceptive substances and by enhancing local circulation. Neurophysiologically, DN might stimulate the descending inhibitory circuits, which will result in a decrease in central sensitization and overall perception of pain. The DN is a potentially effective intervention for managing MTrps due to a combination of mechanical, biochemical, and neurophysiological effects (14).

Conversely, instrument-assisted soft tissue mobilization is a non-invasive procedure where instruments with special designs are used to impose a limited amount of mechanical force on soft tissues. These tools, commonly crafted out of stainless steel or other hard materials, can enable

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clinicians to provide accurate and consistent pressure to specific sections. The main objective of IASTM is to promote movement of tissues and decrease fascial restriction and remodeling of the soft tissues (15). The theory is that the mechanical stimulation that IASTM gives leads to micro trauma of the affected tissues, which induces a local inflammatory response leading to healing and tissue regeneration. Also, it is possible that ASTM can enhance circulation and fibroblast activity, as well as the amount of collagen synthesis, which can lead to better tissue quality and functioning. In contrast to DN that directly targets the trigger point, IASTM has a more general effect, targeting the muscle as well as the surrounding fascial structures (16).

In spite of the hypothetical and clinical benefit of both DN and IASTM, the current body of research reports mixed evidence on the comparative effectiveness of the two interventions. The effectiveness of DN in pain reduction and better functional outcomes among MTrp sufferers has been proved in many studies. The effects of it are frequently because it acts on the trigger point directly and can alter the peripheral and central pain mechanisms (17). Conversely, IASTM has also been demonstrated to bring about changes in range of motion, tissue extensibility, and functional performance, although its effect on pain reduction is more inconsistent. The study designs, intervention protocols, and outcome measures are also not homogenous and make it challenging to interpret the findings and come to conclusions (18).

The main weakness of the existing literature is that it lacks the number of high-quality randomized controlled trials that would directly compare DN and IASTM, especially in the case of upper trapezius MTrPs. Most of the research examines the effectiveness of individual interventions or compares these modalities with traditional therapies, including stretching or massage, and not relative to each other. Also, the change in dosage, frequency, and skill level of the person performing the treatment can give rise to potential sources of bias as well as decrease generalizability of findings. This absence of the comparative evidence is a considerable gap in the literature because clinicians tend to use their experience, instead of strong scientific evidence, when choosing treatment modalities (19).

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Clinically, a number of factors determine the selection of DN or IASTM; patient preference, clinician expertise, cost, and accessibility are some of the factors. Although it involves certain training and compliance with safety guidelines, dry needling is not very expensive, and it does not imply the use of expensive equipment. Conversely, ASTM involves the use of specialized equipment, and these tools may not be easily accessible in every clinical practice. Nevertheless, it is non-invasive and could be more acceptable to some groups of patients, especially those with needle phobia or not able to undergo invasive procedures. The comparative efficacy of the interventions is, hence, crucial to optimizing clinical decision-making as well as to being effective in ensuring the efficient allocation of healthcare resources (20).

Besides clinical factors, the increased interest in the evidence-based practice of the physiotherapy and rehabilitation area is observed. Such a paradigm shift requires high-quality research evidence combined with clinical expertise and values of the patient. Randomized controlled trials are regarded as the gold standard of the interventions' effectiveness evaluation because they reduce bias and make causal assumptions. The current study will help to add to the existing literature and give clinicians' valid information to base their practice on by carrying out the study based on the well-designed RCT comparing DN and IASTM (21).

In addition, several outcome measures, including pain intensity, cervical range of motion, pressure pain threshold, and functional disability, are used, which makes it possible to thoroughly estimate the impact of treatment. Pain intensity, which is usually rated using the Numeric Pain Rating Scale (NPRS), gives a subjective analysis of the severity of the symptoms. Cervical range of motion is a functional outcome of the cervical spine, whereas the pressure pain threshold provides a mechanical sensitivity objective measure. The Neck Disability Index (NDI), on the other hand, is a measurement tool that determines the effects of neck pain on daily life and general quality of life. A combination of these measures offers a comprehensive insight into the clinical effectiveness of the interventions (22).

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In the above light, the main aim of the randomized controlled trial will be to determine the differences in the efficiency of dry needling and instrument-assisted soft tissue mobilization in the treatment of myofascial trigger points in the upper trapezius muscle. In particular, the research should compare their implications on pain levels, cervical range of motion, pressure pain threshold, and functional disability. The hypothesis is that because of direct mechanical and neurophysiological actions on trigger points that shade of dry needling is going to lead to higher pain and disability reduction than IASTM. It is also expected, however, that both of the interventions are going to lead to clinically significant changes, and this will mark their possible usefulness in the treatment of MTrPs (23).

Summing it up, upper trapezius myofascial trigger points are a common and clinically important cause of neck pain and functional disability. Although both instrument-assisted soft tissue mobilization and dry needling are highly popular treatment methods, the scarcity of high-quality comparative studies does not allow concluding their relative effectiveness. The current study attempts to close this gap by performing a strictly developed randomized controlled trial, which will help to enrich the literature on MTrP management and can lead to the creation of evidence-based clinical guidelines.

METHODOLOGY

The study was a randomized controlled trial (RCT) with parallel groups, assessor-blinded, and with a single center and conducted in adherence with the Consolidated Standards of Reporting Trials (CONSORT 2020). The study was expected to find out the effectiveness of dry needling (DN) versus instrument-assisted soft tissue mobilization (IASTM) in addressing the upper trapezius muscle myofascial trigger point (MTrP). The research took a period of four weeks, and the outcome measures at baseline and post-intervention were conducted.

The test was carried out in the outpatient physiotherapy unit of a tertiary care rehabilitation hospital. The environment offered controlled clinical conditions, availability of the required equipment, and

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a controlled environment in which the intervention was to be delivered and its outcomes be measured.

The minimum sample size calculated was 54. To consider the possibility of dropouts (about 10 percent), the number of participants in the final sample was set at 60 samples, specifically 30 to each category.

Participant were included in the study based on the following criteria:

Inclusion Criteria

- Persons in the age group of 18-50.
- Existence of at least one active myofascial trigger point in the muscle of the upper trapezius.
- Numeric Pain Rating Scale (NPRS) 4 or higher.
- Repeated pattern of referred pain on palpation.
- Potency to give informed consent.

Exclusion Criteria

- Cervical radiculopathy/myelopathy.
- Cervical spine surgery or trauma in the last 6 months.
- Fibromyalgia or general musculoskeletal diseases.
- The use of analgesics/muscle relaxants within 48 hours before evaluation.
- E.g., bleeding disorders or anticoagulant treatment.
- Open wounds or skin infections over the area of treatment.
- Pregnancy
- Needle phobia (for DN group))

Convenience sampling was used for recruitment. Written informed consent was signed and presented to the eligible participants in detail about the study before enrolling them in the study.

The randomization of the participants was done in a computer-generated randomization sequence into two groups (DN and IASTM). An independent researcher, who was not in the participant

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recruitment/assessment process, prepared the sequentially numbered, opaque, and sealed envelopes (SNOSE) that were used to ensure allocation concealment. A baseline assessment was conducted to open the envelopes and avoid the selection bias.

The interventions were not blindable, as the nature of the intervention did not allow participant or therapist blinding. Nonetheless, group allocation was not made known to outcome assessors and data analysts to reduce detection and analysis bias.

Each of the participants was provided with three treatment sessions in a week over the course of four weeks (equaling to 12 sessions). The sessions were about 15 minutes.

Group A: Dry Needling (DN)

Dry needling was done by a qualified physiotherapist who received training on invasive methods. It was done with a sterile, single-use stainless steel filiform needle (0.25 mm x 40 mm).

Procedure:

- The participant was positioned in a comfortable seated position.
- The upper trapezius muscle was palpated to identify the active MTrP.
- The skin was sterilized using alcohol swabs.
- The needle was inserted directly into the trigger point using a fast-in and fast-out (pistoning) technique.
- Needle manipulation continued until a local twitch response was elicited or for a maximum duration of 30–60 seconds.
- The needle was then removed, and slight pressure was applied to prevent bleeding.

Dosage:

- A single or two injections per session with tolerance
- Duration: 10 minutes or so per session

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Group B: Instrument-Assisted Soft Tissue Mobilization (IASTM)

The IASTM procedure was performed with a beveled stainless steel tool of a standardized design.

Procedure:

- The participant was positioned comfortably with the cervical spine exposed.
- A hypoallergenic lubricant was applied to reduce friction.
- The instrument was applied along the upper trapezius muscle fibers using sweeping and stroking motions.
- Moderate pressure was maintained throughout the session, adjusted based on patient tolerance.
- Treatment focused on areas of tissue restriction and trigger points.

Dosage:

- Duration: 10 minutes per session
- Frequency: 3 sessions per week for 4 weeks

Respondents in the two groups were also encouraged not to have other physiotherapy interventions in the course of the study. They were, however, taught a standardized home-based upper trapezius stretching therapy to provide ethical care.

Outcome Measures

Evaluations were done during the baseline (Week 0) and after the intervention was done (Week 4).

Primary Outcome

Pain Intensity:

As measured on an 11-item, valid, and reliable scale, the Numeric Pain Rating Scale (NPRS), with a baseline of 0 (no pain) and the other extreme being 10 (worst imaginable pain).

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Secondary Outcomes

1. **Cervical Range of Motion (ROM):**

Lateral flexion and rotation were measured by a universal goniometer. There were three readings, which were averaged.

2. **Pressure Pain Threshold (PPT):**

Measurement of a digital algometer over the trigger point. The average of three experiments was taken.

3. **Neck Disability Index (NDI):**

A self-reported questionnaire examining functional disability of neck pain (0-50 scale).

Procedure Timeline

- Week 0: Screening, baseline assessment, randomization
- Weeks 1–4: Intervention phase (3 sessions/week)
- Week 4: Post-intervention assessment

Ethical Considerations

Before commencing the study, the Institutional Review Board (IRB) of the respective institution gave ethical approval. The research has been based on the principles of the Declaration of Helsinki. The informed consent was signed by all participants who were also informed about their right to withdraw without any repercussions.

Data analysis was performed using SPSS version 26.0.

- Descriptive statistics (mean ± standard deviation) were calculated for all variables.
- Normality of data was assessed using the Shapiro-Wilk test.
- Within-group comparisons were conducted using paired t-tests.
- Between-group comparisons were performed using independent t-tests.
- Repeated-measures ANOVA was used to assess interaction effects over time.

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- Effect sizes were calculated using Cohen's d.
- Statistical significance was set at $p < 0.05$ with 95% confidence intervals.

To enhance internal validity:

- Randomization and allocation concealment were strictly implemented
- Blinded outcome assessment minimized detection bias
- Standardized intervention protocols ensured consistency
- Intention-to-treat analysis was considered for handling missing data

RESULTS

During the recruitment period, a total of 75 participants were screened to be eligible. Among them, 15 were not included in the study; 10 of them failed to meet the inclusion criteria (largely because they lacked active myofascial trigger points or cervical radiculopathy), and 5 refused to take part in the study. The remaining 60 of the eligible subjects were randomly divided into two groups: Dry Needling (DN; n=30) and Instrument-Assisted Soft Tissue Mobilization (IASTM; n=30).

Two participants (one of each group) dropped out of treatment during the intervention phase based on a personal scheduling conflict that was not related to the intervention. Nonetheless, as part of the intention-to-treat (ITT) principle, all randomized participants (n=60) were given final statistical analysis. The adherence to treatment was tremendous as more than 95 percent of the participants attended at least 10 out of 12 sessions.

Baseline Characteristics and Group Comparability

Table 1 shows the baseline demographic and clinical characteristics. There was no significant difference between the DN and IASTM groups in all the measured variables ($p > 0.05$), indicating that there was no failure in randomization or homogeneity of groups at baseline.

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Table 1: Baseline Characteristics of Participants

Variable	DN Group (n=30)	IASTM Group (n=30)	p-value
Age (years)	32.4 ± 6.1	31.8 ± 5.9	0.72
Gender (Male/Female)	14 / 16	13 / 17	0.80
Duration of Symptoms (weeks)	7.2 ± 2.5	7.5 ± 2.8	0.65
NPRS (Pain)	6.8 ± 1.2	6.7 ± 1.3	0.85
PPT (kg/cm²)	2.9 ± 0.6	3.0 ± 0.5	0.61
NDI (Score)	28.5 ± 6.2	27.9 ± 6.5	0.73
Cervical ROM (°)	42.3 ± 5.4	41.8 ± 5.1	0.69

The results of these findings are that both groups were similar before intervention, reducing the possibility of confounding effects.

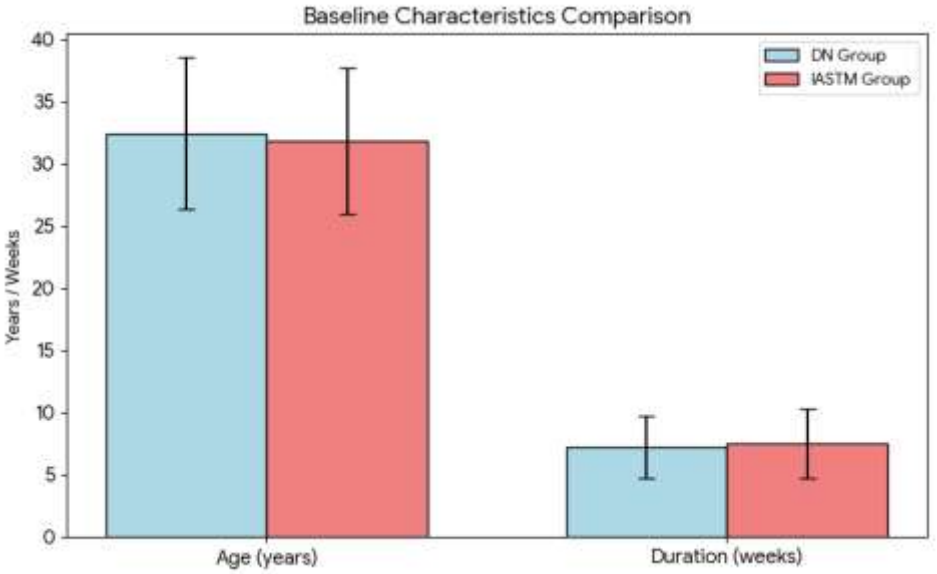

Figure 1: Baseline Characteristics comparison

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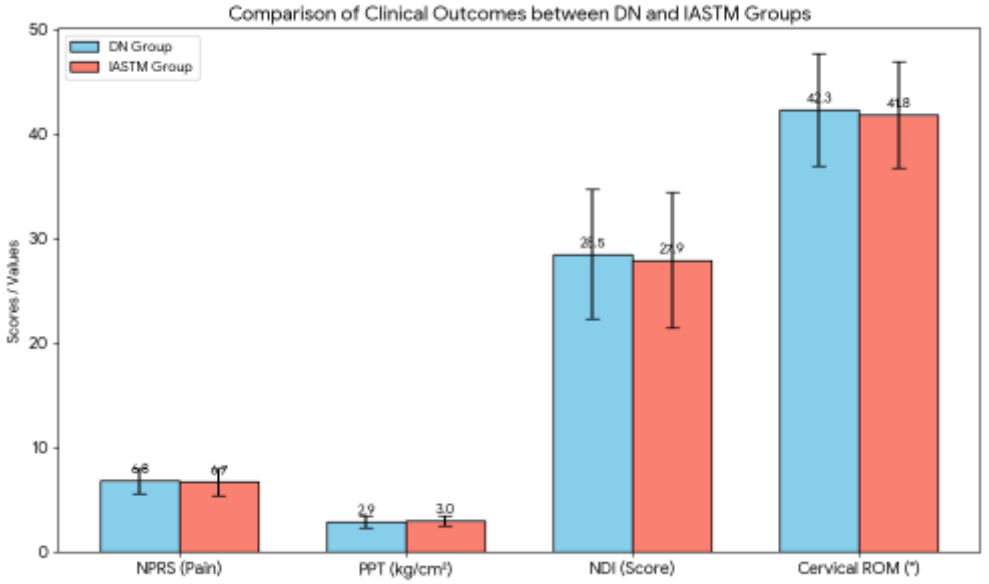

Figure 2: Comparison of clinical outcomes between DN and IASTM groups

Within-Group Changes Over Time

Dry Needling Group (DN)

The DN group showed significant and statistically significant changes in all outcomes measured in response to the 4-week intervention ($p < 0.001$ on all comparisons).

- **Pain Intensity (NPRS):** The mean scores had reduced to 2.1 ± 0.9 in the end period compared to the 6.8 ± 1.2 at the baseline, which is 4.7 points of the mean change (69% improvement).
- **Pressure Pain Threshold (PPT):** It rose significantly, from 2.9 ± 0.6 to 4.8 ± 0.7 kg/cm², which was a significant decrease in mechanical sensitivity.
- **Neck Disability Index (NDI):** The results were 28.5 ± 6.2 before and 12.2 ± 4.5 after, which means that the percentage of functional disability was reduced by 57.
- **Cervical Range of Motion (ROM):** Improved greatly, 42.3° ±5.4 to 54.6° ±4.8 (mean gain = 12.3°).

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IASTM Group

Similarly, the IASTM group exhibited statistically significant improvements across all variables ($p < 0.001$), although the magnitude of change was comparatively smaller:

- **Pain Intensity (NPRS):** Reduced from 6.7 ± 1.3 to 3.9 ± 1.1 (mean reduction = 2.8 points; ~42% improvement).
- **Pressure Pain Threshold (PPT):** Increased from 3.0 ± 0.5 to 3.9 ± 0.6 kg/cm².
- **Neck Disability Index (NDI):** Improved from 27.9 ± 6.5 to 18.5 ± 5.2 (approximately 34% reduction).
- **Cervical Range of Motion (ROM):** Increased from 41.8° ± 5.1 to 50.2° ± 5.0 (mean gain = 8.4°).

Between-Group Comparisons

Post-intervention comparisons revealed statistically significant differences between the two groups, favoring the DN group in several key outcomes.

Table 2: Between-Group Comparison of Post-Treatment Outcomes

Outcome	DN (Mean ± SD)	IASTM (Mean ± SD)	Mean Difference	95% CI	p-value	Effect Size (Cohen's d)
NPRS	2.1 ± 0.9	3.9 ± 1.1	−1.8	−2.5 to −1.1	<0.001	0.92 (large)
PPT (kg/cm²)	4.8 ± 0.7	3.9 ± 0.6	+0.9	0.4 to 1.4	0.002	0.78 (moderate-large)
NDI	12.2 ± 4.5	18.5 ± 5.2	−6.3	−9.8 to −2.8	0.01	0.70 (moderate)
Cervical ROM (°)	54.6 ± 4.8	50.2 ± 5.0	+4.4	−0.5 to 9.3	0.08	0.40 (small)

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- **Pain Reduction:** DN showed significantly greater pain reduction compared to IASTM ($p < 0.001$), with a large effect size.
- **Pressure Pain Threshold:** DN demonstrated superior improvement ($p = 0.002$), suggesting enhanced desensitization of trigger points.
- **Functional Disability:** DN resulted in significantly better NDI outcomes ($p = 0.01$).
- **Cervical ROM:** Although DN showed greater improvement, the difference was not statistically significant ($p = 0.08$), indicating comparable effectiveness between interventions in improving mobility.

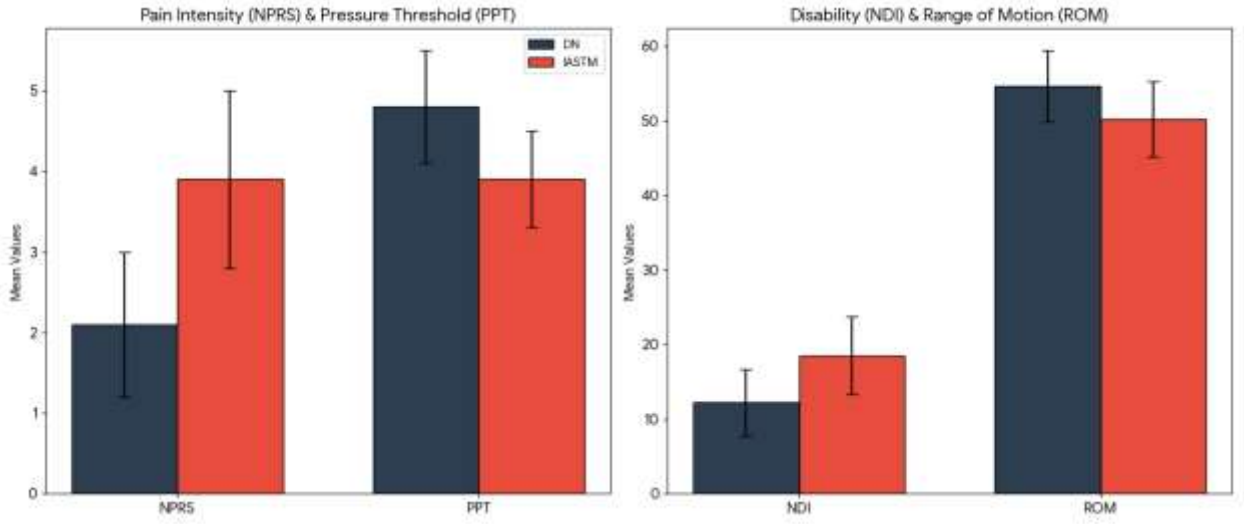

Figure 3: Comparison table

Repeated Measures and Interaction Effects

A repeated-measures ANOVA was conducted to assess the interaction between time (baseline vs post-treatment) and group (DN vs IASTM).

- **NPRS:** Significant time × group interaction ($F = 18.6$, $p < 0.001$)
- **PPT:** Significant interaction ($F = 10.4$, $p = 0.002$)
- **NDI:** Significant interaction ($F = 7.8$, $p = 0.01$)

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- **ROM:** No significant interaction (F = 2.9, p = 0.08)

These findings indicate that the rate and magnitude of improvement over time were significantly greater in the DN group for pain, PPT, and disability, but not for ROM.

Clinical Significance

Beyond statistical significance, the observed changes were clinically meaningful:

- A reduction of ≥2 points on NPRS is considered clinically important; DN achieved a 4.7-point reduction, while IASTM achieved 2.8 points.
- NDI improvement exceeding 5 points is clinically relevant; both groups surpassed this threshold, with DN demonstrating a substantially greater reduction.
- PPT improvements in DN group indicate reduced central and peripheral sensitization.

Adverse Events and Safety Profile

Both interventions were well tolerated with minimal adverse effects:

- **Dry Needling:** Mild post-needling soreness reported in 6 participants (20%), resolving within 24–48 hours.
- **IASTM:** Mild erythema observed in 5 participants (15%), with no discomfort or complications.

No serious adverse events were recorded, confirming the safety of both interventions when applied by trained clinicians.

The findings of this study indicate that:

1. Both DN and IASTM are effective in managing upper trapezius MTrPs.
2. DN demonstrates superior outcomes in pain reduction, pressure pain threshold, and functional disability.
3. Both interventions produce comparable improvements in cervical range of motion.

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4. The magnitude of improvement and effect sizes consistently favor DN, suggesting greater clinical efficacy.

DISCUSSION

The current randomized controlled trial attempted to assess the efficacy of dry needling (DN) and instrument-assisted soft tissue mobilization (IASTM) in the treatment of myofascia trigger points (MTrPs) in the upper trapezius muscle. The results show that although both procedures led to statistically and clinically significant changes in the intensity of pain, pressure pain threshold (PPT), cervical range of motion (ROM), and functional disability, dry needling yielded always better results in the reduction of pain and mechanical sensitivity and in the scores of disability. These findings may be valuable approaches to the comparative effectiveness of two commonly used interventional modalities and add to the accumulating body of research in favor of specific therapies for myofascial pain.

One of the major results of this research is that the intensity of pain reduced in the DN group was much higher than the one in the IASTM group. The scale of change of the Numeric Pain Rating Scale (NPRS) of the DN group was higher than the statistical and clinical cut-off levels, which suggested that the patient-reported pain has not only improved but also meaningfully improved. The result is not new, as it is supported by previous randomized trials and systematic reviews, which always proved the analgesic superiority of DN in the treatment of active MTrPs (21),(22). This mechanism can be explained by the fact that direct mechanical interference with dysfunctional motor endplates and the provocation of local twitch responses is the process that is supposed to normalize excessive release of acetylcholine and decrease the sustained sarcomere contraction. Additionally, DN has been reported to alter the biochemical milieu of trigger points by reducing levels of nociceptive compounds of substance P and calcitonin gene-related peptide, which subsequently inhibits peripheral sensitization (23).

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Besides the peripheral effects, there is evidence to suggest that the better pain reduction effect of DN could also be attributed to its effect on the central pain processing mechanisms. Introduction of a needle in the trigger point gives a powerful afferent input that can cause the activation of descending inhibitory routes such as the periaqueductal gray and rostroventral medulla. This neurophysiological phenomenon involves the occurrence of diffuse noxious inhibitory control (DNIC) in which there is a generalized hypoalgesia. This interpretation is further supported by the substantial changes in PPT observed in the DN group and indicates that there was a decrease in local and central sensitization. Alternatively, whereas IASTM also showed an increase in PPT, the degree of change was relatively lower, which is a sign of a less significant implication on nociceptive modulation (18), (19), (24).

The efficacy of IASTM found in this study cannot be undervalued because it resulted in great improvements in all outcome measurements. The mechanism of action of IASTM is mainly connected with the mechanical stimulation of soft tissues, as a result of which the fascial mobility, local circulation, and remodelling of the tissue are increased. Controlled microtrauma has been believed to enhance fibroblast growth and collagen formation, which enhances tissue capacity of the extender and functionality. Also, sensory input produced during IASTM could help in pain modulation via the mechanism of the gate control. Nonetheless, the low efficacy of the indirect effect by IASTM could be the reason why IASTM was not as effective as DN in rapid and significant pain relief (15), (16), (25).

Interestingly, the difference between the two groups with regard to cervical ROM was not statistically significant, although the two interventions elicited significant improvements within the groups. This observation indicates that although DN can be used more effectively in pain management and desensitization, the same procedures can be equally effective when it comes to functional mobility restoration. The enhancement on ROM can be explained by the decrease in the level of pain and muscle contraction and the rise in the tissue extensibility. Alternatively, these gains might also be due to the standardized home-based stretching program, and as such, this reduces the differences

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between groups. This demonstrates the multifactorial character of ROM enhancement and implies that mobility results might be less responsive to the particular intervention than measures of pain (25), (26).

This decrease in functional disability with the help of the Neck Disability Index (NDI) also supports the clinical significance of the results. It was noted that participants of the DN group had shown a much better increase in the NDI scores than those of the IASTM group, and this showed better functional recovery. This is especially in clinical terms because sometimes the measures of functional outcomes will be more important to the patients than single measures of pain. The high level of pain reduction and functional improvement in this study highlights the need to focus on the underlying nociceptive mechanisms during the process of managing MTrPs (27).

When put into perspective in the pre-existing literature, the results of this study give a more subtle insight into the relative efficacy of DN and IASTM. Past research has mostly analyzed these interventions either independently or against the traditional methods of treatment like manual therapy or stretching. There are still few direct head-to-head comparisons, and even the existing ones are limited by methodological issues, such as small sizes of samples, absence of blinding, and unstable intervention regimens. The current study moderates some of these limitations and provides more solid evidence because of the use of randomized design, standardized treatment procedures, and multiple outcome measures (28).

The clinical implications of the findings involve significant implications for evidence-based practice. The better results in relation to DN indicate that this method can be taken as a more efficient first-line therapy in relation to patients with active upper trapezius MTrPs, especially in cases when rapid pain elimination is among the main objectives. Nevertheless, IASTM, due to its non-invasive nature and proven effectiveness, is a useful alternative or adjunct, particularly in the cases of patients who have contraindications to needling or who have fears of invasive treatment. Clinical evidence, patient preference, and practitioner expertise should be used to inform the decision of the intervention (29).

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These considerations are of more importance in resource-limited environments, like Pakistan. Dry needling is relatively cheap and does not rely on a costly उपकर, much like there is a necessity of certain training and compliance with safety measures. This renders it an option in most clinical settings, such as small rehabilitation centers and even the private practices. On the other hand, the implementation of IASTM can be constrained by the presence of special instruments and their prices. Nevertheless, it can be more accepted by the patients and can provide higher compliance due to the possibility of its easier implementation and reduced invasiveness. Consequently, a combination of the two strategies in the context of an adaptable patient-centered treatment model can bring about the best results (30).

Although it has strengths, this study has weaknesses. The comparatively small duration of intervention and a follow-up that is not carried over a long period can limit the capacity to determine the دوام (sustainability) of the treatment impacts. There is also a possibility that the benefits will fade away after a time, especially in the DN group, unless intervention and maintenance measures are continued. Also, there is the possibility of performance bias due to the lack of blinding of the participants and therapists; performance bias was reduced by assessor blinding. The research was also an in-depth investigation of one center, which can be a weakness of the study in terms of the generalizability of the results to the rest of the population and other clinical settings.

Further studies are needed to counter such limitations with the inclusion of longer follow-up times, larger sample sizes, and multicentric studies. Comparative research focusing on the integrated action of DN and IASTM can also be a helpful resource in the context of the possible synergistic advantages as well. Moreover, additional outcome measures, including electromyographic activity and psychosocial factors, might be used to contribute to the comprehension of the underlying mechanisms and patient-specific reactions to therapy.

To sum up, the results of this randomized controlled trial show that the two intervention types of dry needling and instrument-assisted soft tissue mobilization are both effective solutions to upper trapezius myofascial trigger points. Nonetheless, dry needling shows better effectiveness in pain

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reduction, increase in pressure pain threshold, and functional disability. These findings are in favor of DN implementation in clinical practice as a specific and evidence-based intervention but also establish the complementary character of IASTM in a multifaceted rehabilitation strategy.

CONCLUSION

The current randomized control trial contains high-quality evidence as regards the comparative efficacy of dry needling (DN) and instrument-assisted soft tissue mobilization (IASTM) in the treatment of myofascial trigger points (MTrPs) in the upper trapezius muscle. Its results indicate that the two interventions are useful in decreasing the level of pain, increasing pressure pain threshold, increasing cervical range of motion, and decreasing functional disability. Nevertheless, the dry needling treatment was always more successful in the most important areas, especially pain relief, mechanical desensitization, and functional restoration.

Not only was the difference between the DN group and the control group statistically significant, but it was also clinically significant and surpassed previously set levels of minimal clinically significant differences between pain and disability scales. These findings indicate that DN has a more direct and potent therapeutic effect, which is probably because of its integrated mechanic, biochemical, and neurophysiological actions. On the other hand, IASTM showed substantial benefits, but its effects were relatively small, especially pain modulation, which can be explained by its indirect mode of action.

Notably, these two interventions produced similar changes in cervical range of motion, thus suggesting that the process of muscle mobility recovery can be affected by various factors other than the intervention type, such as pain reduction, relaxation of the muscle, and additional exercises. This pays much importance to a thorough rehabilitation model that combines specific interventions with functional training.

Clinically, the results can be used to justify the use of dry needling as a treatment of choice in patients with the active presence of upper trapezius MTrPs, especially in cases where it is the main goal to

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achieve effective and fast pain relief. However, IASTM still offers a useful therapeutic intervention, particularly in patients that are contraindicated to invasive modalities of treatment or those who would otherwise opt to use non-invasive modalities of treatment. The combination of the two methods in a patient-centered treatment model can lead to an even more positive clinical outcome

Cost-effectiveness and accessibility of interventions are important factors in the low- and middle-income healthcare setting, such as in Pakistan. Dry needling with its low equipment needs and comparatively low cost might provide a feasible and scalable intervention in the treatment of myofascial pain. Nevertheless, the effective adoption of DN depends on proper training of clinicians and commitment to the safety measures, which puts importance on standardized education and certification programs.

In spite of the advantages of this study, such as its randomized design, standardized intervention protocols, and thorough outcome evaluation, some disadvantages have to be admitted. The fact that the intervention is short and there is no long-term follow-up does not allow estimating the sustainability of treatment effects. Also, the single-center design can limit the external validity of the results concerning different populations and clinical settings.

Future studies should address the long-term outcomes, multicenter studies, and investigations regarding the possibility of using combinations or sequential treatment strategies to find out whether it is possible to achieve the synergies. Moreover, the use of patient-reported outcome measures that involve quality of life and psychosocial outcomes can give a more comprehensive picture of the impact of treatment.

To sum up, this paper confirms the clinical efficacy of both dry needling and instrument-assisted soft tissue mobilization in treating upper trapezius myofascial trigger points but also shows that dry needling is more effective in the crucial clinical outcomes. The findings will aid in the improvement of evidence-based practice of physiotherapy and issue a solid basis of informed clinical decision-making in myofascial pain syndromes treatment.

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CLINICAL IMPLICATIONS

- The effects of dry needling on active upper trapezius MTrPs should be viewed as a first-line intervention because it has a better analgesic and functional effect.
- Instrument-assisted soft tissue mobilization has the potential to be a highly effective non-invasive alternative or adjunctive method of treatment.
- Multimodal patient-centered treatment through manual therapy, needling, and therapeutic exercises should be embraced by clinicians.
- Considering the resource-based nature of the environment, dry needling can provide a relatively low-cost and feasible solution in the presence of sufficient training and safety precautions.

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