A Comparative Study of Dry Needling and Myofascial Release on Upper Trapezius in Patients with Mechanical Neck Pain

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Abstract
Mechanical neck pain is a prevalent musculoskeletal condition affecting the global population with significant socioeconomic impact. This randomized controlled trial aimed to compare the effectiveness of dry needling (DN) and myofascial release (MFR) techniques on upper trapezius muscle in patients with mechanical neck pain. Sixty participants with mechanical neck pain and active trigger points in the upper trapezius were randomly allocated into two groups: DN group (n=30) and MFR group (n=30). Treatment was administered twice weekly for two weeks. Outcome measures included pain intensity (Visual Analog Scale), pressure pain threshold (algometer), cervical range of motion (CROM device), and neck disability (Neck Disability Index), assessed at baseline and after the 2-week intervention. Both groups demonstrated significant improvements in all outcome measures ($p<0.001$). The DN group showed greater improvement in pain intensity (mean difference: 1.7 points, $p<0.01$) and pressure pain threshold (mean difference: 0.9 kg/cm², $p<0.01$) compared to the MFR group. However, improvements in cervical range of motion and neck disability were comparable between groups ($p>0.05$). Results suggest that while both interventions are effective for mechanical neck pain, DN may offer superior outcomes for pain parameters, whereas functional improvements are similar with both techniques.
These findings provide valuable clinical guidance for physical therapists in selecting appropriate interventions for patients with mechanical neck pain and upper trapezius involvement.

Keywords: Dry needling, Myofascial release, Mechanical neck pain, Upper trapezius, Trigger points

1. Introduction

Mechanical neck pain represents one of the most common musculoskeletal disorders, with a global point prevalence of approximately 4.9% and a lifetime prevalence ranging from 14.2% to 71% (Safiri et al., 2020). It constitutes a significant health burden and contributes to substantial socioeconomic costs through healthcare utilization, work absenteeism, and reduced productivity (Cohen & Hooten, 2017). The condition is characterized by pain and stiffness in the cervical region, often associated with restricted range of motion and functional limitations in daily activities (Blanpied et al., 2017).

Myofascial trigger points (MTrPs) in the upper trapezius muscle frequently contribute to mechanical neck pain, presenting as hyperirritable nodules within taut bands of skeletal muscle that are painful upon compression and can produce referred pain patterns (Simons et al., 2019). These trigger points have been found in 45-85% of patients with mechanical neck pain and play a crucial role in perpetuating symptoms (Cerezo-Téllez et al., 2016).

Various therapeutic approaches have been employed to address MTrPs and neck pain, with dry needling (DN) and myofascial release (MFR) emerging as popular interventions among physical therapists (Dunning et al., 2014; Ajimsha et al., 2015). Dry needling involves the insertion of thin filiform needles into MTrPs to elicit a local twitch response, potentially disrupting the dysfunctional

neuromuscular activity and promoting tissue healing (Gattie et al., 2021). Myofascial release, on the other hand, encompasses manual therapy techniques that apply sustained pressure to fascial restrictions with the aim of restoring optimal length and decreasing fascial tension (Arguisuelas et al., 2019).

While both interventions have demonstrated efficacy in reducing pain and improving function in patients with mechanical neck pain when studied individually (Liu et al., 2018; Rodríguez-Huguet et al., 2018), direct comparative studies examining their relative effectiveness are limited. Previous research has often focused on comparing either technique to control groups or other interventions rather than head-to-head comparisons (Espejo-Antúnez et al., 2017; Llamas-Ramos et al., 2014).

Understanding the comparative effectiveness of DN versus MFR is crucial for clinical decision-making and developing evidence-based treatment protocols. Such knowledge would enable therapists to select the most appropriate intervention based on expected outcomes, thereby optimizing patient care and resource allocation. Additionally, identifying which technique provides superior outcomes for specific parameters (e.g., pain reduction versus functional improvement) could facilitate more tailored treatment approaches.

Therefore, this study aimed to compare the effects of DN and MFR on pain intensity, pressure pain threshold, cervical range of motion, and functional disability in patients with mechanical neck pain and active MTrPs in the upper trapezius muscle. We hypothesized that both interventions would produce significant improvements in all outcome measures, but with potentially different magnitudes of effect across the various parameters.

2. Methods

Study Design and Participants

This study employed a prospective, randomized, single-blinded, parallel-group design. Sixty participants with mechanical neck pain were recruited through physician referrals and advertisement in local healthcare facilities. Eligibility criteria included: (1) age between 18-60 years; (2) mechanical neck pain persisting for at least three months; (3) presence of at least one active MTrP in the upper trapezius muscle; (4) neck pain intensity ≥3 on the Visual Analog Scale (VAS); and (5) no previous experience with either DN or MFR.

Exclusion criteria were: (1) radicular symptoms or cervical radiculopathy; (2) history of cervical surgery or trauma; (3) systemic conditions such as fibromyalgia or rheumatoid arthritis; (4) contraindications to DN such as coagulopathy, immunosuppression, or needle phobia; (5) pregnancy; (6) ongoing litigation or compensation claims related to neck pain; and (7) receipt of any manual therapy or needling intervention in the preceding month.

Randomization and Blinding

Participants were randomly allocated to either the DN group or the MFR group using computer-generated random numbers with a 1:1 allocation ratio. Allocation concealment was ensured through sequentially numbered, opaque, sealed envelopes prepared by an independent researcher not involved in recruitment or assessment. The assessing therapist was blinded to group assignment, while participants and treating therapists could not be blinded due to the nature of the interventions. Participants were instructed not to disclose their treatment allocation to the assessor.

Interventions

Both groups received four treatment sessions over a two-week period (twice weekly). All interventions were performed by two physical therapists with over five years of experience in the respective techniques. The interventions focused on the upper trapezius muscle of the symptomatic side or the more painful side in cases of bilateral symptoms.

Dry Needling Group: Participants received DN targeting active MTrPs in the upper trapezius muscle. After skin preparation with alcohol, sterile, disposable, stainless steel needles (0.30 × 50 mm, Seirin J-Type, Japan) were inserted into

the identified MTrP using the fast-in, fast-out technique described by Hong (1994). The needle was repeatedly inserted and withdrawn to elicit local twitch responses, with the procedure continuing until twitch exhaustion or up to a maximum of two minutes per MTrP. Up to three MTrPs were treated in each session, with the needle manipulation procedure followed by needle retention for 10 minutes.

Myofascial Release Group: Participants received MFR targeting the upper trapezius muscle. With the participant in supine position, the therapist applied a sustained pressure to the identified MTrP with sufficient force to reach the tissue resistance barrier. This pressure was maintained for 90-120 seconds, followed by gently following the release of the tissue barrier in three-dimensional directions. The process was repeated for up to three MTrPs during each session, with the total intervention time matching that of the DN group (approximately 20 minutes). Both groups were instructed in a standardized home exercise program consisting of gentle neck stretches and postural awareness exercises to be performed twice daily. Compliance with the home program was monitored through exercise diaries.

Outcome Measures

Assessments were conducted at baseline (pre-intervention) and after the 2-week intervention period (post-intervention) by a blinded assessor. The following outcome measures were evaluated:

1. **Pain Intensity**: Assessed using a 10-cm Visual Analog Scale (VAS), where 0 represents "no pain" and 10 represents "worst pain imaginable." Participants rated their average pain over the previous 24 hours. The minimal clinically important difference (MCID) for VAS in neck pain is 1.5 cm (Pool et al., 2007).
2. **Pressure Pain Threshold (PPT)**: Measured using a digital algometer (Wagner Instruments, Greenwich, CT, USA) with a 1 cm^2 rubber tip. The algometer was applied perpendicular to the identified MTrP in the upper trapezius at a rate of approximately 1 kg/cm^2/second. Participants were instructed to indicate when the pressure sensation changed to pain. Three measurements were taken with 30-second intervals, and the average was calculated in kg/cm^2. Higher values indicate less sensitivity.
3. **Cervical Range of Motion (CROM)**: Measured using a CROM device (Performance Attainment Associates, Roseville, MN, USA) for flexion, extension, lateral flexion, and rotation. Three measurements were taken for each direction, and the average was recorded in degrees.
4. **Neck Disability**: Assessed using the Neck Disability Index (NDI), a 10-item questionnaire evaluating activities affected by neck pain. Each item is scored from 0-5, with the total score expressed as a percentage (0-100%). Higher scores indicate greater disability. The MCID for NDI is 7 percentage points (MacDermid et al., 2009).

Statistical Analysis

Sample size calculation was performed using G*Power software (version 3.1.9.4), based on detecting a difference of 1.5 points on the VAS (the established MCID) between groups, with an estimated standard deviation of 2.0, 80% power, and a 5% significance level. This yielded a minimum requirement of 28 participants per group. Thirty participants per group were recruited to account for potential dropouts.

Statistical analyses were conducted using SPSS (version 26.0, IBM Corp., Armonk, NY, USA). The normality of data distribution was verified using the Shapiro-Wilk test. Descriptive statistics were presented as mean ± standard deviation for continuous variables and frequencies for categorical variables. Baseline characteristics were compared between groups using independent t-tests for continuous variables and chi-square tests for categorical variables.

Within-group changes from baseline to post-

intervention were analyzed using paired t-tests. Between-group differences were examined using analysis of covariance (ANCOVA), with baseline values as covariates. Effect sizes were calculated using Cohen's d, with values of 0.2, 0.5, and 0.8 representing small, medium, and large effect sizes, respectively. The significance level was set at $p<0.05$ for all analyses.

3. Results

Participant Characteristics

Of the 78 individuals screened for eligibility, 60 met the inclusion criteria and were randomized to either the DN group (n=30) or the MFR group (n=30). All participants completed the study protocol, with no dropouts reported. Baseline demographic and clinical characteristics were comparable between groups (Table 1). The mean age of participants was 39.7 ± 9.8 years in the DN group and 41.2 ± 10.5 years in the MFR group, with a predominance of female participants in both groups (66.7% and 70.0%, respectively). The average duration of symptoms was 12.3 ± 7.6 months for the DN group and 13.1 ± 8.2 months for the MFR group.

Table 1: Baseline Demographic and Clinical Characteristics of Participants

Characteristic	DN Group (n=30)	MFR Group (n=30)	p-value
Age (years), mean ± SD	39.7 ± 9.8	41.2 ± 10.5	0.56
Sex, n (%)			0.78
Female	20 (66.7%)	21 (70.0%)	
Male	10 (33.3%)	9 (30.0%)	
BMI (kg/m²), mean ± SD	25.3 ± 3.5	24.9 ± 3.8	0.67
Duration of symptoms (months), mean ± SD	12.3 ± 7.6	13.1 ± 8.2	0.70
Dominant side affected, n (%)			0.60
Yes	19 (63.3%)	17 (56.7%)	
No	11 (36.7%)	13 (43.3%)	
Number of MTrPs, mean ± SD	2.6 ± 0.7	2.5 ± 0.8	0.59
VAS (0-10), mean ± SD	6.8 ± 1.4	6.6 ± 1.5	0.59
PPT (kg/cm²), mean ± SD	2.1 ± 0.5	2.2 ± 0.6	0.48
NDI (%), mean ± SD	43.7 ± 9.3	42.9 ± 9.7	0.74

DN: Dry Needling; MFR: Myofascial Release; SD: Standard Deviation; BMI: Body Mass

Index; MTrPs: Myofascial Trigger Points; VAS: Visual Analog Scale; PPT: Pressure Pain Threshold; NDI: Neck Disability Index

Within-Group Changes

Both intervention groups demonstrated significant improvements in all outcome measures from baseline to post-intervention ($p<0.001$). The results of within-group analyses are presented in Table 2.

Table 2: Within-Group Changes in Outcome Measures

Outcome Measure	Group	Baseline	Post-intervention	Mean Change (95% CI)	p-value	Effect Size
VAS (0-10)	DN	6.8 ± 1.4	2.3 ± 1.1	-4.5 (-5.0 to -4.0)	<0.001	3.21
	MFR	6.6 ± 1.5	3.8 ± 1.3	-2.8 (-3.3 to -2.3)	<0.001	1.87
PPT (kg/cm²)	DN	2.1 ± 0.5	3.9 ± 0.8	1.8 (1.5 to 2.1)	<0.001	3.60
	MFR	2.2 ± 0.6	3.1 ± 0.7	0.9 (0.6 to 1.2)	<0.001	1.50
CROM Flexion (°)	DN	41.3 ± 7.2	52.4 ± 6.3	11.1 (8.7 to 13.5)	<0.001	1.54
	MFR	42.1 ± 7.5	51.6 ± 6.8	9.5 (7.2 to 11.8)	<0.001	1.27
CROM Extension (°)	DN	38.9 ± 6.6	48.5 ± 5.9	9.6 (7.3 to 11.9)	<0.001	1.45
	MFR	39.5 ± 6.8	47.8 ± 6.3	8.3 (6.1 to 10.5)	<0.001	1.22
CROM Lateral Flexion (°)	DN	33.2 ± 5.4	41.7 ± 4.8	8.5 (6.5 to 10.5)	<0.001	1.57
	MFR	34.0 ± 5.7	41.3 ± 5.2	7.3 (5.4 to 9.2)	<0.001	1.28
CROM Rotation (°)	DN	56.8 ± 8.2	67.5 ± 7.3	10.7 (8.2 to 13.2)	<0.001	1.30
	MFR	57.2 ± 8.5	66.9 ± 7.8	9.7 (7.3 to 12.1)	<0.001	1.14

NDI (%)	DN	43.7 ± 9.3	24.6 ± 8.1	-19.1 (-22.1 to -16.1)	<0.001	2.05
	MFR	42.9 ± 9.7	25.7 ± 8.4	-17.2 (-20.1 to -14.3)	<0.001	1.77

DN: Dry Needling; MFR: Myofascial Release; CI: Confidence Interval; VAS: Visual Analog Scale; PPT: Pressure Pain Threshold; CROM: Cervical Range of Motion; NDI: Neck Disability Index

The DN group demonstrated a 66.2% reduction in pain intensity (VAS), with mean scores decreasing from 6.8 ± 1.4 to 2.3 ± 1.1 ($p<0.001$, $d=3.21$). Similarly, PPT increased by 85.7%, from 2.1 ± 0.5 kg/cm² to 3.9 ± 0.8 kg/cm² ($p<0.001$, $d=3.60$). Cervical ROM improved across all movements, with increases ranging from 24.7% to 26.9% ($p<0.001$). Neck disability as measured by the NDI decreased by 43.7%, from 43.7 ± 9.3% to 24.6 ± 8.1% ($p<0.001$, $d=2.05$).

The MFR group showed a 42.4% reduction in pain intensity, with VAS scores decreasing from 6.6 ± 1.5 to 3.8 ± 1.3 ($p<0.001$, $d=1.87$). PPT increased by 40.9%, from 2.2 ± 0.6 kg/cm² to 3.1 ± 0.7 kg/cm² ($p<0.001$, $d=1.50$). Improvements in cervical ROM ranged from 21.0% to 22.6% across different movements ($p<0.001$). NDI scores decreased by 40.1%, from 42.9 ± 9.7% to 25.7 ± 8.4% ($p<0.001$, $d=1.77$).

Between-Group Comparisons

Between-group comparisons using ANCOVA with baseline values as covariates revealed significant differences in pain-related outcomes (Table 3). The DN group demonstrated significantly greater improvements in VAS scores compared to the MFR group, with a mean between-group difference of 1.7 points (95% CI: 1.1 to 2.3, $p<0.01$, $d=1.29$). Similarly, the improvement in PPT was significantly greater in the DN group, with a mean between-group difference of 0.9 kg/cm² (95% CI: 0.5 to 1.3, $p<0.01$, $d=1.07$).

Table 3: Between-Group Differences in Post-Intervention Outcome Measures

Outcome Measure	Adjusted Mean Difference (DN - MFR) (95% CI)	p-value	Effect Size
VAS (0-10)	-1.7 (-2.3 to -1.1)	<0.01	1.29
PPT (kg/cm²)	0.9 (0.5 to 1.3)	<0.01	1.07
CROM Flexion (°)	1.3 (-1.5 to 4.1)	0.36	0.13
CROM Extension (°)	1.0 (-1.6 to 3.6)	0.44	0.11
CROM Lateral Flexion (°)	0.7 (-1.5 to 2.9)	0.52	0.08
CROM Rotation (°)	0.9 (-2.2 to 4.0)	0.56	0.08
NDI (%)	-1.4 (-5.1 to 2.3)	0.45	0.14

DN: Dry Needling; MFR: Myofascial Release; CI: Confidence Interval; VAS: Visual Analog Scale; PPT: Pressure Pain Threshold; CROM: Cervical Range of Motion; NDI: Neck Disability Index

In contrast, no significant between-group differences were observed for cervical ROM parameters, with mean differences ranging from 0.7° to 1.3° across different movements ($p>0.05$). Similarly, the difference in NDI improvement between groups was not statistically significant, with a mean between-group difference of 1.4 percentage points (95% CI: -5.1 to 2.3, $p=0.45$, $d=0.14$).

The relative changes in pain intensity (VAS) and pressure pain threshold (PPT) across the intervention period for both groups are illustrated in Figures

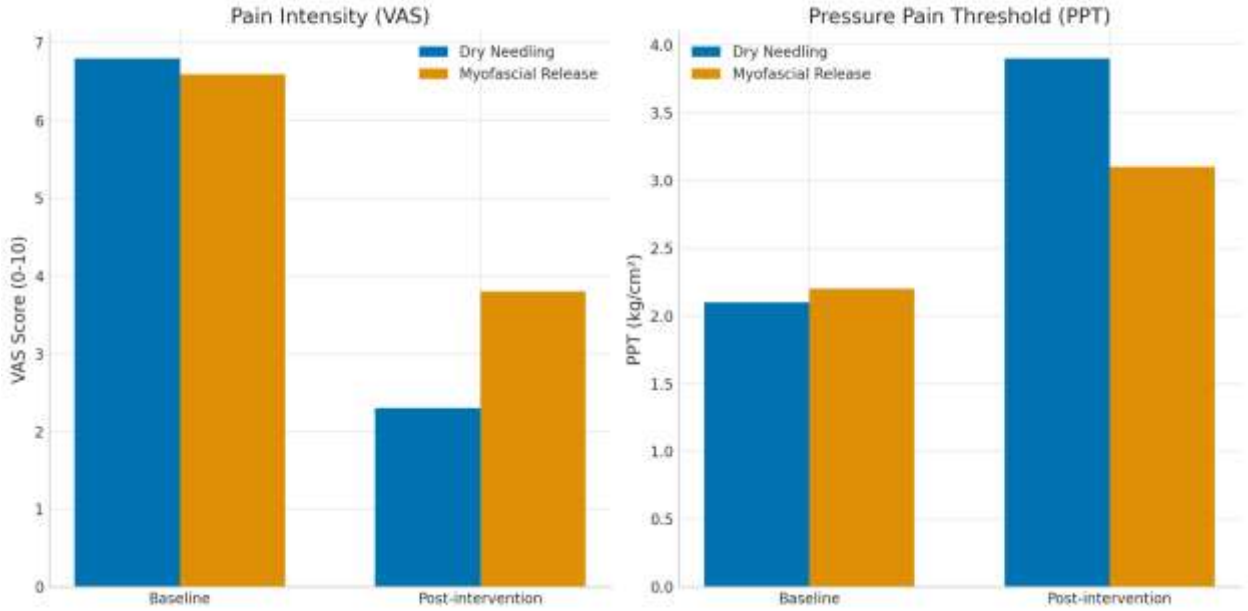

Figure 1: Pain Parameters (VAS and PPT)

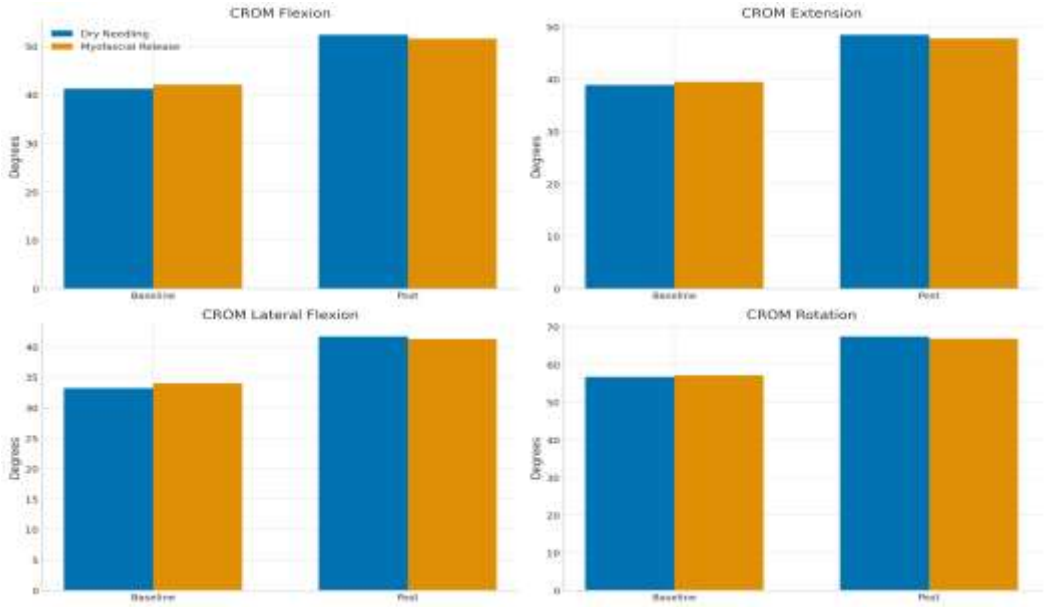

Figure 2: Cervical ROM Parameters

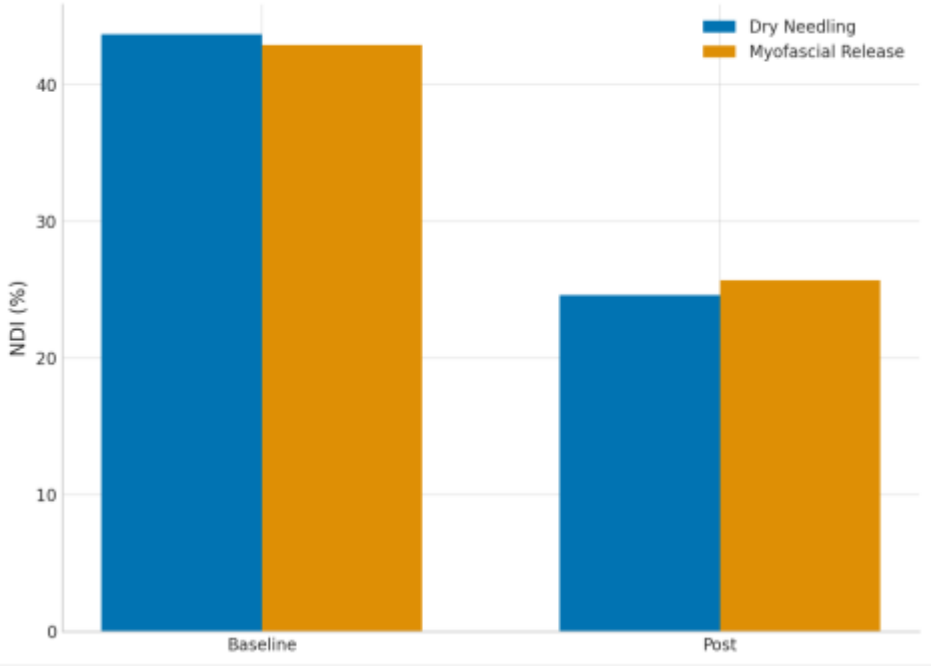

Figure 3: Neck Disability Index

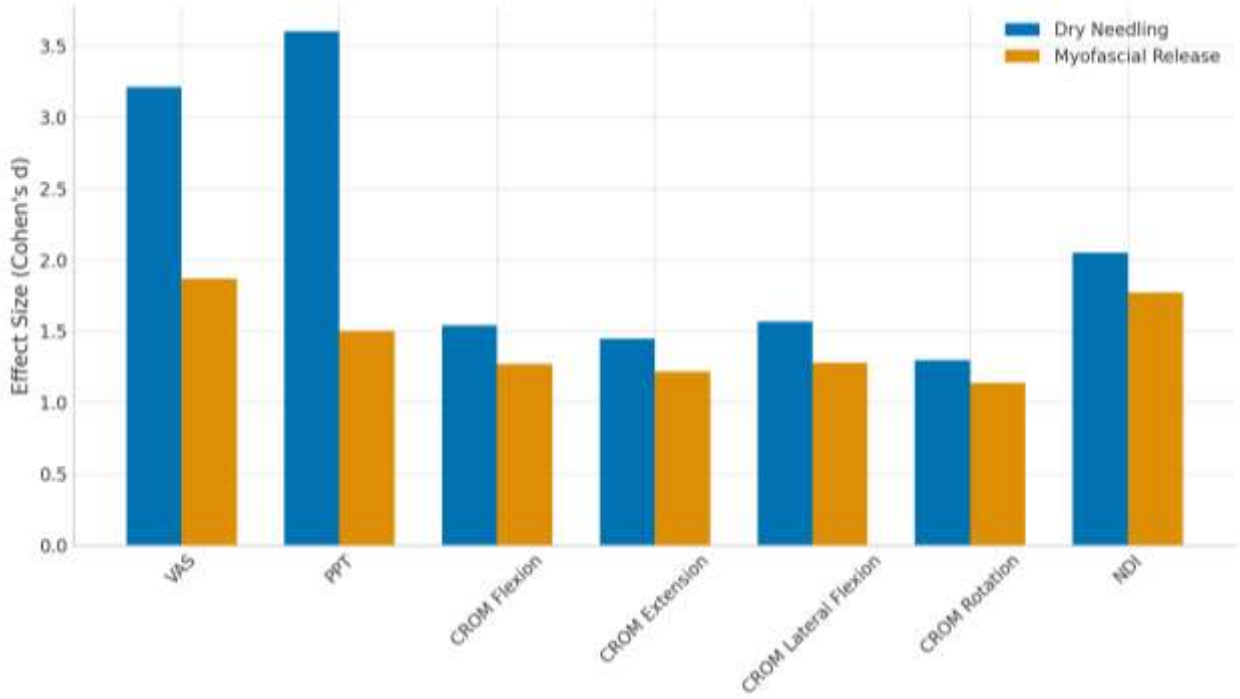

Figure 4: Comparative Effect Sizes

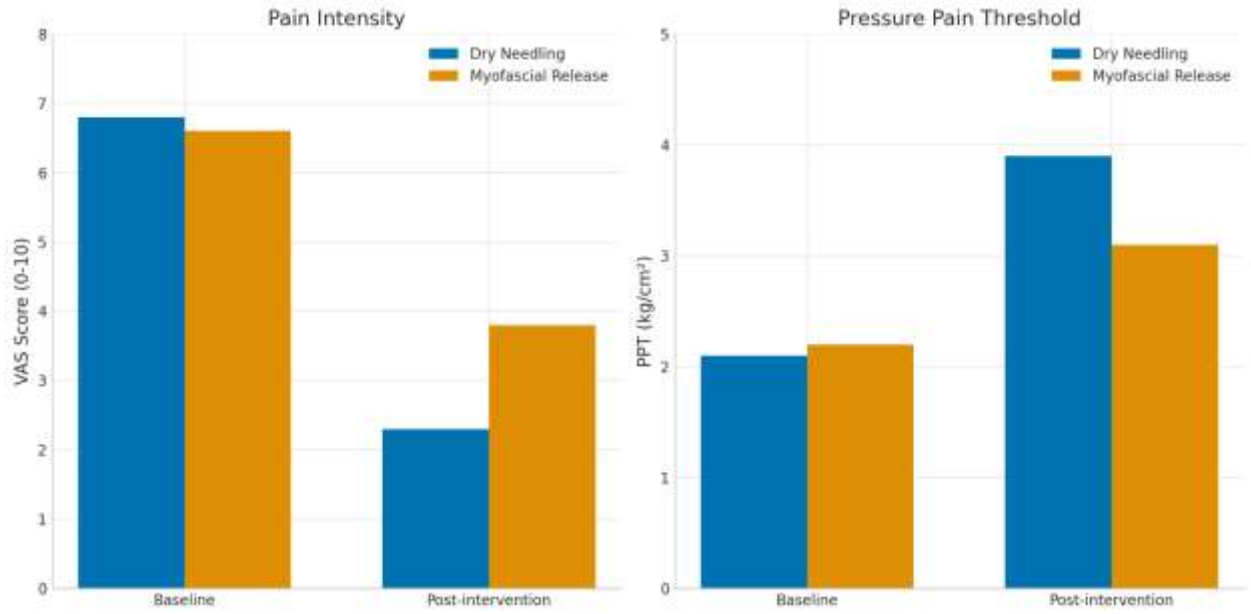

Figure 5: Percentage Improvement

4. Discussion

This randomized controlled trial compared the effectiveness of dry needling and myofascial release in treating patients with mechanical neck pain and active MTrPs in the upper trapezius muscle. The findings demonstrate that both interventions led to significant improvements in pain intensity, pressure pain threshold, cervical range of motion, and neck disability after a two-week treatment period. However, DN exhibited superior efficacy in pain-related parameters, while both techniques produced comparable improvements in cervical mobility and functional disability.

The significant reduction in pain intensity observed in both groups aligns with previous studies investigating these interventions individually. Our findings regarding DN are consistent with those reported by Gattie et al. (2021), who conducted a systematic review and meta-analysis showing moderate to strong evidence supporting DN for decreasing pain in patients with MTrPs. Similarly, the improvements following MFR corroborate the findings of Arguisuelas et al. (2019), who demonstrated significant pain reductions after MFR treatment for myofascial pain conditions.

The superior analgesic effect of DN compared to MFR (mean between-group difference of 1.7 points on the VAS, exceeding the MCID of 1.5 points) may be attributed to several neurophysiological mechanisms. DN directly targets the MTrP through mechanical disruption of dysfunctional endplates and elicitation of local twitch responses, which has been shown to reduce concentrations of inflammatory mediators and nociceptive substances in the immediate vicinity of MTrPs (Shah et al., 2015). Furthermore, DN likely activates endogenous pain inhibitory systems through stimulation of Aδ and C nerve fibers, triggering segmental and descending pain inhibition (Cagnie et al., 2013). The significant increase in pressure pain threshold following DN supports this neurophysiological explanation.

While MFR also demonstrated meaningful improvements in pain parameters, its mechanisms differ from those of DN. MFR primarily works through mechanical deformation of fascial tissue, potentially reducing abnormal crosslinks between collagen fibers and improving fluid dynamics within fascial tissue (Schleip, 2003). This may lead to decreased mechanical stress on nociceptors embedded within fascial tissue, resulting in pain reduction, albeit to a lesser extent than the direct neurophysiological effects triggered by DN.

Regarding cervical range of motion, both

interventions produced comparable improvements across all movement directions, with no statistically significant between-group differences. This suggests that the restriction in cervical mobility associated with mechanical neck pain responds similarly to both types of treatment. The improvement in range of motion following DN may result from reduced muscle guarding and normalized muscle tone after deactivation of MTrPs (Llamas-Ramos et al., 2014). In the case of MFR, enhanced tissue extensibility and reduced fascial restrictions likely contribute to improved mobility (Ajimsha et al., 2015).

Similarly, both interventions resulted in clinically meaningful reductions in neck disability, as measured by the NDI, with no significant between-group differences. The improvements exceeded the MCID of 7 percentage points in both groups, suggesting that these interventions not only alleviate pain but also enhance functional capacity. The comparable effect on disability despite differences in pain reduction might indicate that functional improvements are influenced by multiple factors beyond pain intensity, including psychological aspects, patient education, and the home exercise program that was provided to both groups.

The findings of this study have important clinical implications for physical therapists and other healthcare providers treating patients with mechanical neck pain. While both DN and MFR can be recommended as effective interventions, DN might be preferred when pain reduction is the primary goal of treatment. However, for patients with contraindications to needling or needle phobia, MFR represents an effective alternative that produces similar functional outcomes. Additionally, the results suggest that a treatment duration of two weeks (four sessions) is sufficient to achieve clinically meaningful improvements with either intervention.

Several limitations should be considered when interpreting the results of this study. First, the relatively short follow-up period (immediately post-intervention) precludes assessment of the long-term effects and sustainability of improvements. Second, the study focused exclusively on the upper trapezius muscle, while mechanical neck pain often involves multiple cervical and scapular muscles. Third, the interventions were administered by experienced therapists, and results might vary with less experienced practitioners. Fourth, the study did not include a control or placebo group, which limits our ability to account for natural recovery or placebo effects. Finally, despite blinding of the assessor, complete blinding of participants was not possible due to the nature of the interventions, potentially introducing some bias.

Future research should address these limitations by incorporating longer follow-up periods, investigating multiple muscle groups, comparing these interventions to sham or control groups, and exploring potential combinations of DN and MFR to optimize outcomes. Additionally, studies examining predictive factors for treatment response would facilitate more personalized treatment approaches.

5. Conclusion

Both dry needling and myofascial release techniques are effective interventions for patients with mechanical neck pain and active MTrPs in the upper trapezius muscle, producing significant improvements in pain, pressure sensitivity, cervical range of motion, and functional disability. Dry needling demonstrates superior efficacy in reducing pain intensity and increasing pressure pain threshold, while both techniques yield comparable improvements in cervical mobility and neck disability. These findings provide valuable clinical guidance for physical therapists in selecting appropriate interventions based on patient-specific goals and preferences. Further research investigating long-term outcomes and combination approaches is warranted to optimize treatment protocols for this common musculoskeletal condition.

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