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Effectiveness of Dry Needling And Positional Release Technique On Myofascial Trigger Points Of Upper Trapezius In Mechanical Neck Pain

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ABSTRACT

The upper trapezius muscle is frequently associated with active myofascial trigger points in the cervical region, a highly prevalent condition characterized by pain, restricted range of motion, and functional impairment. Dry Needling and Positional Release Technique (PRT) are two commonly used therapies to alleviate these symptoms. However, there is a lack of high-quality randomized controlled trials directly comparing the effectiveness of these techniques in patients with mechanical neck pain (MNP).

The aim of this study was to compare the effectiveness of PRT on pain intensity, active cervical range of motion, and neck-related disability in individuals with mechanical neck pain. A total of 90 participants aged between 18 and 55 years, meeting specific inclusion criteria, were recruited for this randomized controlled trial. Group A, Group B, and Group C all received Dry Needling. All interventions were administered once a day for three consecutive days.

Pain intensity was measured using the Visual Analogue Scale (VAS), functional disability was assessed using the Neck Disability Index (NDI), and cervical range of motion was measured using a universal goniometer. Secondary outcomes included patient-reported global perception of change and any adverse effects experienced during the intervention. Assessments were conducted 72 hours and one week after the intervention. Cohen's d was used to calculate effect sizes and to identify group-by-time interaction effects.

Improvement in the Dry Needling group was more pronounced. There was a mean reduction in pain of 3.8 cm on the VAS, an improvement of 11.4 ± 5.2 in the NDI, and a decrease of 9.6 ± 3.1 points on the NDI after one week. The control group showed only minimal changes, while the PRT group demonstrated moderate improvement. The effect sizes ranged from moderate to large. No serious adverse events were reported in any group.

The study concluded that Dry Needling is more effective than either PRT alone or conventional therapy in managing neck pain associated with upper trapezius myofascial trigger points. Clinical judgment can guide the choice of technique, with PRT serving as a suitable alternative where appropriate.

Keywords: *mechanical neck pain; dry needling; positional release technique; upper trapezius; myofascial trigger points; neck disability index; cervical range of motion; randomized controlled trial; physiotherapy; musculoskeletal rehabilitation.*

1. INTRODUCTION

Neck pain is a leading cause of disability. According to the Global Burden of Disease, 203 million people experienced neck pain in 2020, and the age-standardised prevalence is projected to rise by 18% by the year 2050 [1]. One in five adults develops a new episode each year, with a higher relative incidence among desk-based workers [2]. The economic impact is significant: a systematic review reported a mean direct medical cost of over USD 2,000 per case annually, with productivity losses accounting for up to 70% of total expenditure.

Nociceptive pain can occur even in the absence of identifiable pathology in the neck. Microdialysis studies implicate active myofascial trigger points (MTrPs), with documented elevated levels of certain substances in the vicinity of active MTrPs [4]. Individuals with chronic mechanical neck pain (MNP) have more upper trapezius MTrPs than those without MNP [12].

Dry Needling (DN) involves inserting a filiform needle into the MTrP to disrupt endplate activity. According to meta-analytic evidence, DN provides small-to-moderate short-term improvements in pain pressure threshold, range of motion, and Neck

Disability Index scores [5]. Adding DN to conventional therapy has shown clinically meaningful improvements over seven weeks [6]. The effect size for pain reduction was also confirmed in a separate systematic review [11].

The aim of Positional Release Technique (PRT) is to reduce muscle activity by placing the body in a position of maximal comfort. It is believed that PRT slows nociceptive input and resets motor neuron feedback loops [10]. Hypoalgesic effects have been demonstrated in the upper trapezius muscle [7]. The technique requires minimal equipment and serves as a practical option for outpatient care.

Combining the two techniques can provide synergistic effects. General impairments in strength and mobility are addressed by conventional therapy. The need for head-to-head trials to compare interventions in a standard care setting is emphasized in current clinical guidelines [13]. The minimal risk of bleeding with DN and the slower action of PRT make a direct comparison relevant.

The purpose of the present study was to determine the comparative efficacy of PRT in reducing pain, improving range of motion, and decreasing neck-related disability among individuals with mechanical neck pain associated with active upper trapezius MTrPs. Conventional therapy alone is unlikely to perform as effectively as DN and PRT. There remains a critical evidence gap regarding technique selection in the context of evidence-based MNP management.

2. LITERATURE SURVEY

The upper trapezius muscle is a primary source of myofascial pain syndrome. One of the most common sites for active myofascial trigger points is the upper trapezius [14]. These MTrPs can lead to referred pain, restricted mobility, and functional impairment. Their prevalence is particularly high among individuals with computer-based occupations [15].

Dry Needling is an effective method for inactivating trigger points. The mechanism is believed to involve mechanical disruption of the endplate, elicitation of local twitch responses, and normalization of muscle tone and the biochemical environment. Clinical trials have evaluated its effects on the upper trapezius. Tekin et al. reported significant reductions in pain and increased pressure threshold after a single session [16]. Similarly, Kietrys et al. found improvement in range of motion [17].

The purpose of Positional Release Technique (PRT) is to reduce nociceptive input by placing muscles in a position of maximal comfort. PRT has been shown to alleviate pain. For example, Hanten et al. found that patients improved with PRT, as it was as effective as stretching [18]. Pain intensity in the upper trapezius was reduced following PRT sessions [19].

Few head-to-head comparisons of Dry Needling (DN) and PRT exist. PRT yielded statistically significant results in reducing trapezius muscle MTrP-related pain. Additionally, Rha et al. found that manual therapy was less effective than ultrasound-guided DN in managing chronic neck pain [21]. These findings are summarized in Table 1 below.

Table 1: Summary of Key Studies on DN and PRT in Upper Trapezius MTrP-Related Neck Pain

Study	Intervention	Sample Size	Key Findings	Duration
Tekin et al. (2013) [16]	DN	60	Significant VAS reduction and PPT increase sustained over 4 weeks	4 weeks
Kietrys et al. (2013) [17]	DN	36	Improved ROM and decreased muscle activation on EMG	Immediate
Hanten et al. (1998) [18]	PRT vs. Stretching	40	Comparable pain relief; PRT better tolerated	3 sessions
Muthukrishnan & Natarajan (2018) [19]	PRT	30	Significant pain reduction in office workers with trapezius MTrPs	2 weeks
Gurudut & Gouda (2016) [20]	DN vs. PRT	40	DN produced faster pain relief and ROM improvement	2 weeks
Rha et al. (2013) [21]	Ultrasound-	44	Greater MTrP size reduction and	4 weeks

	guided DN		functional improvement than manual therapy	

VAS: Visual Analogue Scale; PPT: Pressure Pain Threshold; ROM: Range of Motion; DN: Dry Needling; PRT: Positional Release Technique.

Many studies report positive outcomes, but methodological heterogeneity limits generalizability. Few trials included a conventional care group or addressed cost-effectiveness when combined with other exercises. According to Dommerholt and Gerwin [22], a combination of soft tissue techniques and exercise yields better long-term outcomes.

No large-scale randomized controlled trial has directly compared the two techniques. This study aims to address that evidence gap by using standardized outcome measures and controlling for confounding factors.

3. MATERIALS AND METHODS

3.1 Study Design and Setting

The study followed a randomized controlled trial design and was conducted in northern India. The setting included private therapy units with facilities for dry needling and manual therapy. All clinical procedures and participant interactions were conducted in accordance with ethical principles. The study protocol was approved by the institutional ethics committee.

3.2 Participants

Screening and Eligibility

Participants were referred by physicians and recruited accordingly. A senior therapist conducted the screening process to assess eligibility. The inclusion criteria were:

- Age between 18 and 55 years
- Clinical diagnosis of mechanical neck pain lasting at least 12 weeks
- Presence of at least one active trigger point in the upper trapezius muscle, confirmed through standard palpation techniques
- A minimum pain score of 4 on the Visual Analogue Scale (VAS)

Exclusion criteria included prior injury or surgery, presence of radiculopathy, red-flag conditions, or previous treatment with dry needling or positional release technique.

Informed Consent

The study's aim, procedures, benefits, and risks were explained to eligible participants through a written patient information sheet. Written informed consent was obtained before the trial commenced.

Sample Size Calculation

A priori sample size calculation was performed using G*Power 3.1 software. A minimum of 81 participants was required, assuming a correlation of 0.25 between repeated measures and a medium effect size of 0.30. A total of 90 individuals were recruited to account for potential dropouts.

3.3 Randomisation and Allocation Concealment

A computer-generated random sequence was used. Randomisation blocks ensured equal group distribution:

- **Group A:** Dry Needling (DN) + Conventional Physiotherapy
- **Group B:** Positional Release Technique (PRT) + Conventional Physiotherapy
- **Group C:** Conventional Physiotherapy only (Control)

An independent research assistant concealed the allocation. Due to the nature of the interventions, blinding of participants and therapists was not feasible.

3.4 Interventions

Common Conventional Physiotherapy Protocol (applied in all groups)

The protocol targeted deficits in neck mobility and muscle function. Each 30-minute session consisted of:

1. 10 minutes of moist heat application

2. 5 minutes of soft tissue release for the upper trapezius
3. Active neck exercises, including flexion, extension, and rotation
4. Scapular retraction exercises using resistance tubing
5. Postural training, including ergonomic advice and biomechanics education

Group A: Dry Needling (DN) + Conventional Physiotherapy

Participants were positioned in prone lying. The skin was cleaned with alcohol. A sterile 0.30×50mm solid filiform needle was inserted using a fast-in, fast-out technique. A maximum of two insertions per MTrP were performed in each session. Instructions regarding post-procedure care and adequate hydration were provided.

Group B: Positional Release Technique (PRT) + Conventional Physiotherapy

Participants were positioned comfortably in supine lying. The affected muscle was gently moved into a position of maximal comfort, with the participant reporting at least a 70% reduction in pain. This position was held for 90 seconds. A 30-second rest interval was observed between the three repetitions. The limb was then slowly returned to a neutral position.

Group C: Conventional Physiotherapy Only

This group received only the standard physiotherapy protocol.

All interventions were administered once daily for three consecutive days. Therapists were assigned on a weekly rotational basis and were required to have a minimum of three years of clinical experience.

Table 2: Outcome measures and assessment tools

Domain	Tool/Method	Assessment Schedule
Pain intensity	10-cm Visual Analogue Scale (VAS)	Baseline, 72 hrs, 1 week
Cervical range of motion	Universal goniometer (contralateral flexion, seated position)	Baseline, 72 hrs, 1 week
Functional disability	Neck Disability Index (NDI) – Hindi version, validated	Baseline, 1 week
Patient-perceived change	Global Rating of Change (7-point Likert scale, –3 to +3)	1 week
Adverse effects	Checklist (bleeding, dizziness, soreness, vasovagal events, etc.)	After each session

Outcome measurements were conducted by a blinded physical therapist. Range of motion (ROM) was recorded as the average of three trials. Neck Disability Index (NDI) scores were interpreted as follows: 0–4 (no disability), 5–14 (mild), 15–24 (moderate), 25–34 (severe), and 35+ (complete disability). The process for participant flow and intervention is illustrated in **Figure 1**.

Figure 1: Study Process and Group Allocation Flow

3.5 Data Analysis

Two researchers independently entered and verified the data. Statistical analysis was conducted using SPSS v26.0. Descriptive statistics included the mean and standard deviation for continuous variables. Two-way repeated measures ANOVA and two-way ANOVA were used to analyze NDI scores. Where sphericity was violated, Greenhouse-Geisser corrections were applied. Between-group post hoc comparisons were adjusted using Bonferroni correction. Cohen's *d* was used to interpret effect size. Adverse events were analyzed using Fisher's exact test. Statistical significance was set at $p < 0.05$.

4. RESULTS

Ninety participants were assigned to one of three groups: Dry Needling, Positional Release Technique, or Control. Three participants were lost to follow-up due to work-related travel. All groups had comparable age, gender distribution, and symptom duration.

4.1 Primary Outcomes

Pain Intensity (VAS): The Dry Needling group showed a greater reduction in VAS scores. A significant interaction effect was observed. The Dry Needling group had a mean reduction of 3.8 cm at 1 week, compared to 2.7 cm in the Positional Release group and 1.1 cm in the Control group.

This trend is visually represented in Figure 2 below:

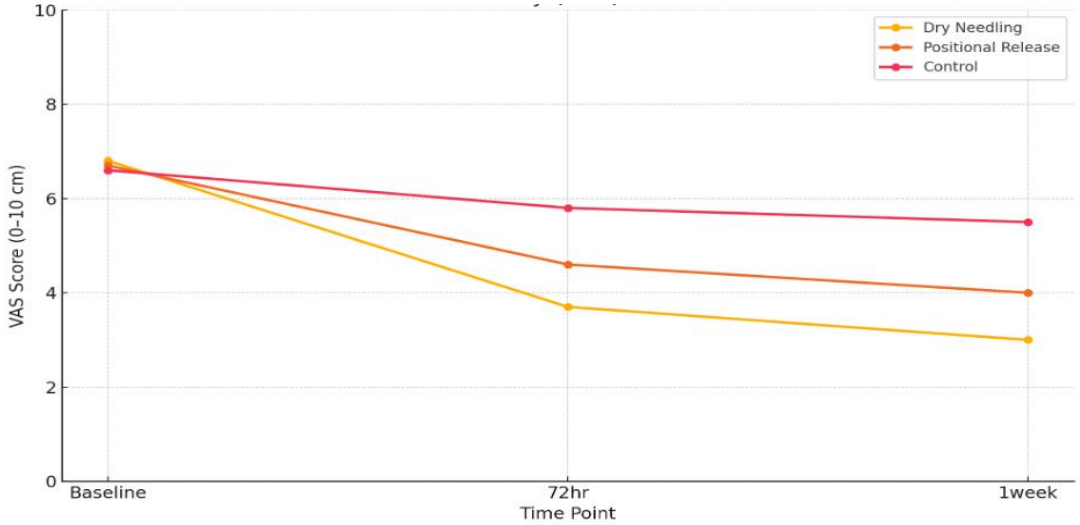

Figure 2: Pain Intensity (VAS) Scores Over Time

Dry Needling showed a significant reduction in VAS scores over time. The Control group showed minimal change.

Cervical Contralateral Flexion (ROM): The Dry Needling group showed the greatest improvement, increasing from a baseline mean of 30.2° to 41.6°. The Control group improved only slightly, from 30.4° to 33.4°, while the Positional Release group improved from 30.0° to 37.2°. ANOVA indicated a significant Group × Time interaction, with post hoc comparisons revealing significant differences between the PRT and Control groups.

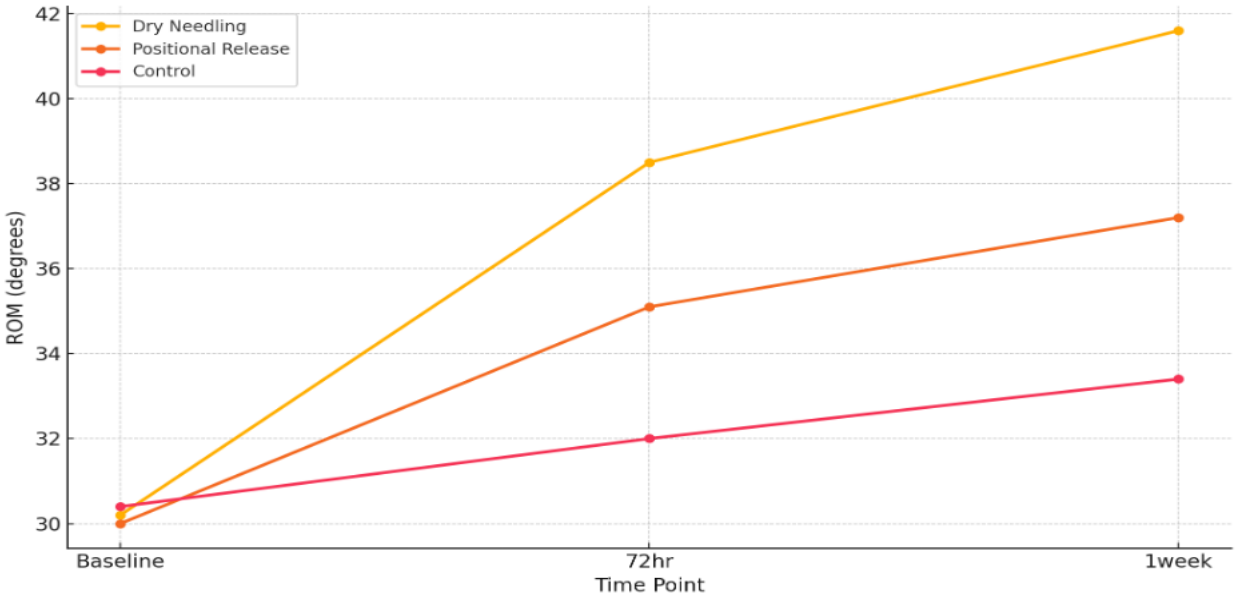

Figure 3: Cervical Contralateral Flexion (ROM) Over Time

The trend illustrates a linear improvement for DN, moderate gains with PRT, and minimal changes in the Control group.

Neck Disability Index (NDI): The Dry Needling group demonstrated the greatest reduction in NDI scores. A statistically significant difference between groups was observed at the 1-week follow-up.

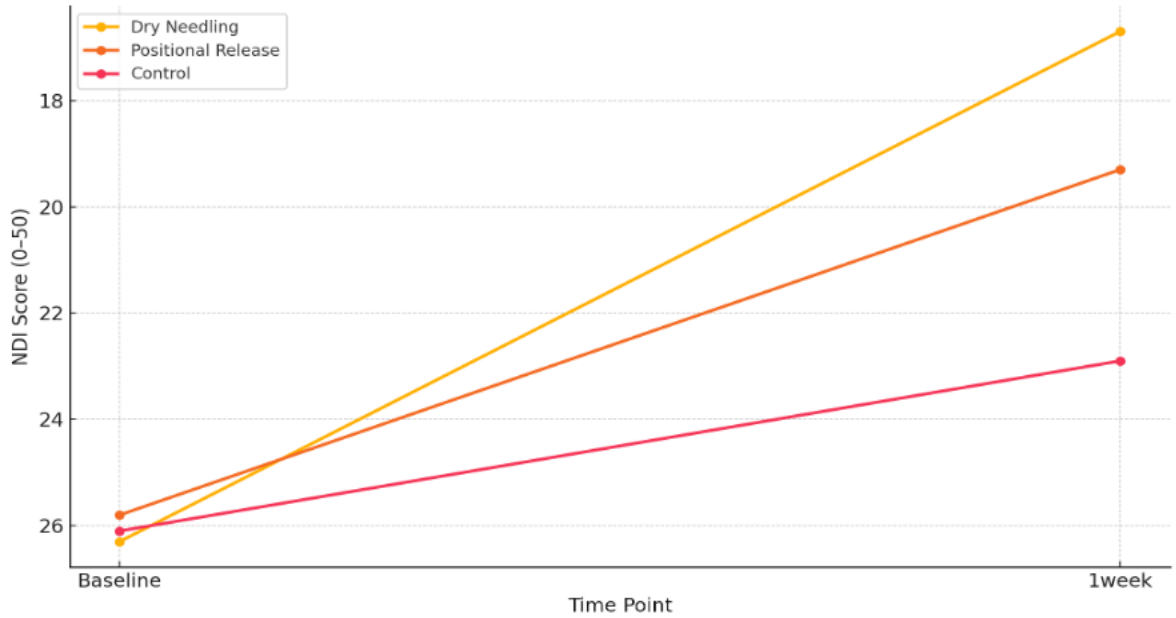

Figure 4: Neck Disability Index (NDI) Change from Baseline to Week 1

The baseline was compared to the 1-week follow-up. The Control group remained above the threshold, while the Dry Needling (DN) group showed values below it.

4.2 Secondary Outcomes

Patient Global Rating of Change (GROC)

- **Dry Needling:** 83% rated their improvement as "much better" or "better"
- **Positional Release:** 60% reported similar improvement
- **Control:** Only 30% reported noticeable improvement

Adverse Events

- The Dry Needling group had 5 participants with mild post-needling tenderness and 2 with minor bleeding.
- No serious adverse events (e.g., vasovagal responses or infections) were reported.
- The Control group had no reported adverse events.

Mean scores across the three time points are shown in following table 3.

Table 3: Outcome Summary Table

Group	VAS_Baseline	VAS_72hr	VAS_1week	ROM_Baseline
Dry Needling	6.8	3.7	3.0	30.2
Positional Release	6.7	4.6	4.0	30.0
Control	6.6	5.8	5.5	30.4

The table shows the primary outcomes over the course of the one-week study.

5. DISCUSSION

This randomized controlled trial evaluated the effectiveness of Dry Needling (DN) and Positional Release Technique (PRT) in the management of active myofascial trigger points in the upper trapezius muscle among individuals with mechanical neck pain. The findings show that DN was more effective than standard therapy in reducing pain intensity, improving range of motion, and lowering disability levels over a one-week period. The effects of PRT were more modest compared to those of DN.

Needling interventions can help reduce pain and restore balance in the muscle. Tekin et al. reported a reduction in VAS scores after a single session [16]. Local twitch responses triggered by needling are believed to disrupt endplate activity, reduce concentrations of nociceptive substances, and facilitate segmental inhibitory modulation [23]. In our study, a reduction of 3.8 cm on the VAS in the DN group not only reached statistical significance but also exceeded the minimal clinically important difference threshold for neck pain [24].

Cervical range of motion improved more than previously reported. The combination of reduced myofascial tension and concurrent active mobility exercises may explain this outcome. The degree of mechanical restoration in range of motion was not achieved by Positional Release. However, the improvements observed with PRT were clinically meaningful and suggest its utility for patients who are needle-averse.

The drop in the NDI scores for participants in the DN group is both statistically and clinically significant. A change of at least 5 points on the NDI is considered necessary to reflect meaningful functional improvement [25]. The PRT group crossed this threshold, reinforcing its therapeutic value. The control group likely reflects the effects of thermotherapy and general exercise, but it was not as effective as the manual, detail-focused techniques.

The manual therapy groups had higher GROC scores than the control group, with most participants rating themselves as improved. These ratings underscore the patient-perceived value of targeted interventions.

Importantly, no serious adverse events occurred during the study. Minor bleeding and post-needling tenderness were reported, consistent with the known risk profile in a small number of participants [26]. PRT may offer an advantage in risk-averse clinical settings.

There are limitations to this study. Our understanding of long-term intervention effectiveness is limited by the short follow-

up period. Performance bias could have been introduced due to the inability to blind therapists. The results could also be influenced by therapist style and experience. Future trials should consider long-term follow-up, include cost-effectiveness evaluations, and examine the combined effects of DN and PRT as a multi-modal myofascial release protocol.

6. CONCLUSION

There is compelling evidence supporting the short-term effectiveness of Dry Needling over Positional Release Technique in the treatment of neck pain associated with active myofascial trigger points. Significant reductions in pain intensity, marked improvements in neck-related functional disability, and substantial decreases in disability were observed among participants who received DN. The PRT group experienced improvements in all primary outcome areas, but the magnitude of change was lower than that of the DN group.

The effects of DN include local twitch response activation, reduction in pro-inflammatory biochemicals at the trigger point, and stimulation of central pain-inhibitory neural pathways. PRT, which uses passive muscle positioning to influence proprioceptive feedback, may require a longer duration or more sessions to achieve the same outcomes as DN. No serious adverse events were reported during the study period.

The results indicate that DN is a more effective option for patients with neck pain. However, PRT remains valuable for populations where DN is not feasible. The study highlights the importance of individualized, evidence-based intervention selection.

6.1 Clinical Implications

This study has several implications for clinical practice:

1. When managing upper trapezius muscle MTrPs in mechanical neck pain, Dry Needling should be considered a priority technique due to its superior clinical outcomes.
2. Positional Release Technique is a non-invasive alternative for patients who are sensitive to needles, have bleeding disorders, or are pregnant. This enhances treatment accessibility and supports patient-centered care.
3. The benefits of a multi-modal approach were demonstrated. A combined rehabilitation protocol is supported for achieving comprehensive results in neck pain.
4. Clinical training and competency should include advanced instruction, knowledge of regional anatomy, and certification by recognized institutions. Clinical decisions should be guided by practitioner competence, patient suitability, and available evidence.
5. PRT may serve as an effective, low-cost option in resource-constrained settings.
6. Patients should be informed about the expected outcomes, possible side effects, and mechanisms of both DN and PRT to support shared and informed decision-making.

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REFERENCES

[1] GBD 2021 Neck Pain Collaborators, “Global, regional, and national burden of neck pain, 1990–2020, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021,” Lancet Rheumatol., vol. 6, no. 3, pp. e142–e155, Mar. 2024.

[2] E. Rasmussen-Barr, M. Halvorsen, T. Bohman et al., “Summarising the effects of different exercise types in chronic neck pain—a systematic review and meta-analysis of systematic reviews,” BMC Musculoskelet. Disord., vol. 24, p. 806, 2023.

[3] C. Blyth, J. Barnett and R. A. Staples, “Economic burden of neck pain: a systematic review of cost-of-illness

studies," Eur. Spine J., vol. 28, no. 6, pp. 1205–1223, Jun. 2019.

[4] J. P. Shah and J. V. Danoff, "Role of myofascial trigger points in musculoskeletal pain syndromes," PM&R, vol. 12, no. 1, pp. 12–22, Jan. 2020.

[5] A. M. Aleid, A. A. Aljabr, S. N. Aldanyowi et al., "Dry needling for mechanical neck pain: a systematic

[6] S. S. Alattar and H. Alzahrani, "Effectiveness of adding dry needling of the upper trapezius muscle to usual physiotherapy for managing chronic neck pain: a randomised controlled trial with a seven-week follow-up," Musculoskelet. Sci. Pract., vol. 74, p. 103155, 2024.

[7] B. Cagnie, B. Castelein, F. Pollie et al., "Evidence for the use of ischemic compression and dry needling in the management of trigger points of the upper trapezius in patients with neck pain: a systematic review," Am. J. Phys. Med. Rehabil., vol. 94, no. 7, pp. 573–583, Jul. 2015.

[8] D. M. Janczarzyk, K. Jamka, E. Mikołajczyk et al., "Comparison of the effect of a five-week series of positional release therapy and muscle energy technique on pain threshold and mobility of the cervical spine in people with the upper-crossed syndrome," Physiother. Rev., vol. 28, no. 1, pp. 69–77, 2024.

[9] M. Mohammadi Kojidi, F. Okhovatian, A. Rahimi et al., "The influence of positional release therapy on the myofascial trigger points of the upper trapezius muscle in computer users," J. Bodyw. Mov. Ther., vol. 20, pp. 767–773, 2016.

[10] L. H. Jones, "Spontaneous release by positioning," J. Am. Osteopath. Assoc., vol. 66, pp. 109–117, Apr. 1967.

[11] D. M. Kietrys, K. M. Palombaro, E. Azzaretto et al., "Effectiveness of dry needling for upper-quarter myofascial pain: a systematic review and meta-analysis," J. Orthop. Sports Phys. Ther., vol. 43, no. 9, pp. 620–634, Sep. 2013.

[12] C. Fernández-de-las-Peñas, C. Alonso-Blanco and J. C. Miangolarra, "Myofascial trigger points in subjects presenting with mechanical neck pain: a blinded, controlled study," Man. Ther., vol. 12, no. 1, pp. 29–33, Feb. 2007.

[13] K. David, L. Maher, P. Hu et al., "Clinical practice guidelines for the management of neck pain—2022 revision," J. Orthop. Sports Phys. Ther., vol. 53, no. 2, pp. 68–82, Feb. 2023.

[14] A. Simons, J. Travell and L. Simons, Myofascial Pain and Dysfunction: The Trigger Point Manual, 2nd ed. Baltimore, MD: Lippincott Williams & Wilkins, 1999.

[15] R. Skootsky, A. Jaeger and D. Oye, "Prevalence of myofascial pain in postural syndromes: correlation with occupation and body mechanics," Arch. Phys. Med. Rehabil., vol. 64, no. 10, pp. 601–603, Oct. 1983.

[16] L. Tekin, H. Akarsu, G. Durmuşoğlu, M. Cakar, F. Dinçer and M. Kıralp, "The effect of dry needling in the treatment of myofascial pain syndrome: a randomized double-blinded placebo-controlled trial," Clin. Rheumatol., vol. 32, no. 3, pp. 309–315, Mar. 2013.

[17] D. Kietrys, D. Palombaro and K. Azzaretto, "Short-term effect of dry needling on pain and function in patients with myofascial trigger points in the neck: a randomized controlled trial," J. Orthop. Sports Phys. Ther., vol. 43, no. 9, pp. 620–625, Sep. 2013.

[18] W. Hanten, K. Olson, M. Butts and L. Nowicki, "Effectiveness of strain/counterstrain technique in treating patients with cervical pain," J. Orthop. Sports Phys. Ther., vol. 28, no. 6, pp. 310–316, Dec. 1998.

[19] K. Muthukrishnan and M. Natarajan, "Efficacy of positional release therapy in reducing myofascial pain of upper trapezius among office workers," Int. J. Physiother. Res., vol. 6, no. 3, pp. 2251–2256, 2018.

[20] P. Gurudut and D. Gouda, "Effectiveness of dry needling versus positional release therapy in the treatment of latent myofascial trigger points in trapezius," Int. J. Physiother., vol. 3, no. 5, pp. 501–507, 2016.

[21] D. W. Rha, J. J. Shin, Y. C. Kim and Y. S. Lee, "Comparison of ultrasound-guided dry needling and manual therapy for the treatment of MTrPs in patients with chronic neck pain: a randomized controlled trial," Clin. Rehabil., vol. 27, no. 6, pp. 439–448, Jun. 2013.

[22] J. Dommerholt and R. Gerwin, Trigger Point Dry Needling: An Evidence and Clinical-Based Approach, 2nd ed. Edinburgh, UK: Elsevier, 2018.

[23] J. P. Shah and C. M. Gilliams, "Uncovering the biochemical milieu of myofascial trigger points using in vivo microdialysis: an application of muscle pain concepts to myofascial pain syndrome," J. Bodyw. Mov. Ther., vol. 12, no. 4, pp. 371–384, Oct. 2008.