INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

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COMPARATIVE EFFECTS OF DRY NEEDLING AND NEURAL MOBILIZATION ON PAIN, STRENGTH AND RANGE OF MOTION IN PATIENTS WITH GOLFER'S ELBOW

Original Research (ID: 1689)

Dr. Abeela Ashraf[1]*, Dr. Komal Tehzeeb[2], Prof Dr Fahad Tanveer[3], Dr. Izzah Ijaz Syed[4], Dr Muhammad Bin Zia[4], Dr. Wayna Maqsood[1]
[1]Green International University
[2]DPT, MPhil, Assistant Professor, Department of Rehabilitation Sciences, Faculty of Medicine and Allied Health Sciences, Green International University
[3]Head of Rehabilitation Sciences Department, Green International University.
[4]Lecturer, Green International University
Corresponding Author: Dr. Abeela Ashraf, abeelasaim@gmail.com, Green International University, https://orcid.org/0009-0005-9426-1248

Acknowledgement: The authors sincerely acknowledge all participants and clinical staff who supported this study.

Conflict of Interest: None
Grant Support & Financial Support: None

ABSTRACT

Background: Golfer's elbow, or medial epicondylitis, is a tendinopathy affecting the common flexor tendon origin at the medial epicondyle of the humerus. It commonly results from repetitive gripping, wrist flexion, and forearm pronation, leading to pain, reduced grip strength, and restricted upper-limb movement. Dry needling and neural mobilization are used in physiotherapy practice, but their comparative effects on pain, strength, and range of motion in golfer's elbow require further clinical evaluation.

Objective: To compare the effects of dry needling and neural mobilization on pain intensity, strength, and range of motion in patients with golfer's elbow.

Methods: A randomized clinical trial was conducted at Pakistan Rugby Academy, Lahore, over nine months. Twenty-six patients with golfer's elbow were included and allocated into two groups: dry needling and neural mobilization, with 13 participants in each group. Pain intensity was assessed using the Numeric Pain Rating Scale, grip strength was measured using a digital hand dynamometer, and range of motion was assessed using a goniometer. Data were analyzed using parametric tests after confirmation of normality through the Shapiro–Wilk test.

Results: The mean age of participants was 34.62 ± 5.91 years. Overall pain decreased from 7.00 ± 1.81 to 3.46 ± 1.88, while grip strength improved from 21.73 ± 3.88 to 25.81 ± 4.37. Significant improvements were also observed in elbow flexion, elbow extension deficit, wrist flexion, and wrist extension ($p < 0.01$). At baseline, neural mobilization had higher pain scores than dry needling (8.08 ± 1.55 vs 5.92 ± 1.38, $p = 0.001$). Post-treatment, neural mobilization showed significantly lower pain ($p = 0.004$), higher strength ($p = 0.004$), greater elbow flexion ($p = 0.033$), lower elbow extension deficit ($p = 0.004$), better wrist flexion ($p = 0.037$), and better wrist extension ($p = 0.017$).

Conclusion: Both interventions improved pain, strength, and range of motion in golfer's elbow; however, neural mobilization produced greater overall clinical improvement. The findings support neural mobilization as a useful physiotherapy approach for restoring upper-limb function in patients with medial elbow pain.

Keywords: Dry Needling; Elbow Joint; Muscle Strength; Pain Measurement; Physical Therapy Modalities; Range of Motion, Articular; Tendinopathy.

INTRODUCTION

Golfer's elbow, clinically known as medial epicondylitis, is a painful tendinopathic condition involving the common flexor-pronator tendon origin at the medial epicondyle of the humerus. Although the term suggests an inflammatory disorder, the condition is more commonly associated with repetitive microtrauma, collagen disorganization, tendon degeneration, and impaired tissue healing rather than isolated acute inflammation. The flexor-pronator group, including the pronator teres, flexor carpi radialis, flexor carpi ulnaris, palmaris longus, and flexor digitorum superficialis, plays an important role in gripping, wrist flexion, and forearm pronation. Because these muscles repeatedly transmit load across the medial elbow during occupational, recreational, and sporting activities, the tendon origin becomes vulnerable to overload when tissue stress exceeds its capacity for recovery (1). Medial epicondylitis may develop after sudden excessive loading or, more commonly, through repeated low-grade strain over time. Activities such as golf swings, cricket bowling, tennis forehand strokes, throwing sports, carpentry, plumbing, typing, lifting, and forceful gripping may place continuous mechanical demand on the medial elbow. The condition is less common than lateral epicondylitis, yet it remains clinically important because it can significantly interfere with hand function, work productivity, sports participation, and routine daily activities. Its reported prevalence in the general population is relatively low, but the burden is higher among individuals above 35 years of age, athletes exposed to repetitive upper-limb loading, and workers involved in gripping or lifting tasks. Several personal and mechanical factors, including reduced forearm strength, poor biomechanics, sudden changes in activity level, tight forearm musculature, diabetes, smoking, obesity, previous elbow trauma, and repetitive occupational exposure, may increase susceptibility to this condition (2, 3).

Patients with golfer's elbow commonly report pain over the inner aspect of the elbow, which may radiate into the forearm and worsen during gripping, lifting, resisted wrist flexion, or forearm pronation. Weak grip strength, morning stiffness, localized tenderness over the medial epicondyle, reduced functional tolerance, and restricted movement may also be present. In clinical practice, diagnosis is usually based on history and physical examination, including palpation of the medial epicondyle, resisted wrist flexion and pronation testing, range-of-motion assessment, and strength evaluation. Imaging such as ultrasound or magnetic resonance imaging may be considered in persistent, atypical, or unclear cases to identify tendon thickening, degenerative changes, partial tears, or associated soft tissue pathology, while radiographs may help exclude other causes of medial elbow pain such as arthritis, fracture, or calcification (4). Conservative management remains the first-line approach for golfer's elbow and generally includes activity modification, patient education, pain control strategies, stretching and strengthening exercises, eccentric loading, manual therapy, bracing, taping, electrotherapeutic modalities, and progressive return to function. In selected cases, injection therapies or surgical intervention may be considered when symptoms fail to respond to adequate conservative care. However, the best physiotherapy approach for restoring pain-free function is still debated, particularly because medial epicondylitis may involve more than tendon pathology alone. Myofascial trigger points, altered neuromuscular control, protective muscle guarding, reduced local circulation, and neural mechanosensitivity may all contribute to persistent pain, weakness, and limited mobility (5).

Dry needling is one physiotherapeutic technique increasingly used for musculoskeletal pain conditions involving myofascial dysfunction and tendinopathy-related symptoms. It involves the insertion of fine sterile needles into trigger points, taut muscle bands, or sensitized soft tissues with the intention of reducing pain, decreasing abnormal muscle tone, improving local blood flow, and normalizing neuromuscular activity. In golfer's elbow, dry needling may be clinically useful because the flexor-pronator muscles often develop increased tension and trigger point activity in response to repetitive overload. By reducing myofascial tightness and pain-related muscle inhibition, dry needling may help improve grip strength, reduce tenderness, enhance soft tissue mobility, and support more effective participation in exercise-based rehabilitation (6, 7). The proposed effects of dry needling are not limited to local tissue changes. It may also influence peripheral and central pain-processing mechanisms, reduce nociceptive input, stimulate endogenous analgesic responses, and interrupt the pain-spasm-pain cycle. These effects are particularly relevant in chronic tendinopathic conditions, where persistent pain can lead to reduced muscle activation, fear of movement, and gradual loss of functional capacity. When applied appropriately by trained clinicians, dry needling may provide relatively rapid pain relief and allow patients to perform strengthening and mobility exercises with better tolerance. Nevertheless, its effectiveness may vary depending on treatment dosage, needling technique, chronicity of symptoms, and whether it is used alone or as part of a broader rehabilitation program (8).

Neural mobilization is another conservative intervention that may be relevant in patients with golfer's elbow, especially when neural sensitivity coexists with tendon-related pain. The median nerve passes through anatomical regions that may become mechanically irritated due to muscle tightness, soft tissue restriction, repetitive strain, or altered upper-limb biomechanics. When normal nerve gliding is reduced, patients may experience increased pain sensitivity, protective muscle guarding, reduced movement tolerance, and functional limitation. Neural mobilization techniques, commonly performed as sliders or tensioners, aim to restore normal nerve movement, reduce intraneural pressure, improve blood flow, decrease mechanosensitivity, and support more comfortable upper-limb movement (9). In the context of medial elbow pain, neural mobilization may improve symptoms by addressing the neural component that is often overlooked in purely tendon-focused treatment. By improving nerve mobility and reducing neural irritation, it may contribute to better motor control of the forearm and hand muscles, improved range of motion, reduced pain during movement, and better grip performance. The technique is usually applied through controlled positioning of the shoulder, elbow, forearm, wrist, and fingers to produce gentle movement of the neural tissues without provoking excessive symptoms. Its value lies in the fact that it targets a different mechanism from dry needling; while dry needling primarily addresses myofascial and local tissue dysfunction, neural mobilization focuses on restoring nerve mobility and reducing neural sensitivity (10, 11).

Recent literature suggests that both dry needling and neurodynamic techniques may be useful in elbow tendinopathy, but most available evidence has focused on lateral epicondylitis rather than golfer's elbow. Sanchez-Mila et al. reported that dry needling combined with eccentric exercise produced greater short-term improvements in pain and function compared with an NSAID-based approach in chronic elbow tendinopathy (12). Similarly, a systematic review and meta-analysis by Tayyab et al. indicated that dry needling, particularly when combined with exercise, may provide additional short-term pain reduction in tendinopathy, although variation in treatment protocols limited firm conclusions (13). Evidence supporting neurodynamic approaches has also emerged, with studies reporting short-term reductions in pain, improved mechanosensitivity, and better function when nerve mobilization was added to standard care in elbow tendinopathy (14, 15). Despite these encouraging findings, the current evidence remains incomplete for medial epicondylitis. Systematic reviews and clinical trials have generally emphasized lateral elbow pain, while direct comparative trials in golfer's elbow are scarce. Forogh et al. reported short-term benefits of dry needling in lateral epicondylitis, but highlighted uncertainty regarding long-term superiority and protocol standardization (16). Shanmugam et al. also observed faster pain relief following dry needling, while functional outcomes became more comparable when rehabilitation progressed over time (17). Konarski et al. emphasized that medial epicondylitis has been less extensively investigated than lateral epicondylitis and that treatment approaches supported in lateral elbow tendinopathy should be applied cautiously until medial elbow-specific evidence becomes available (18).

This gap is clinically important because golfer's elbow may involve a distinct combination of tendon overload, flexor-pronator dysfunction, grip weakness, restricted mobility, and neural mechanosensitivity. Comparing dry needling and neural mobilization may help clarify whether targeting myofascial dysfunction or neural mobility produces superior improvement in key clinical outcomes. The research question, therefore, is whether dry needling and neural mobilization differ in their effects on pain intensity, strength, and range of motion in patients with golfer's elbow. The present study was designed to compare the effects of dry needling and neural mobilization on pain, grip strength, and range of motion in patients with golfer's elbow, with the objective of identifying which intervention provides greater clinical benefit and contributes more effectively to evidence-based physiotherapy management (19-21).

METHODS

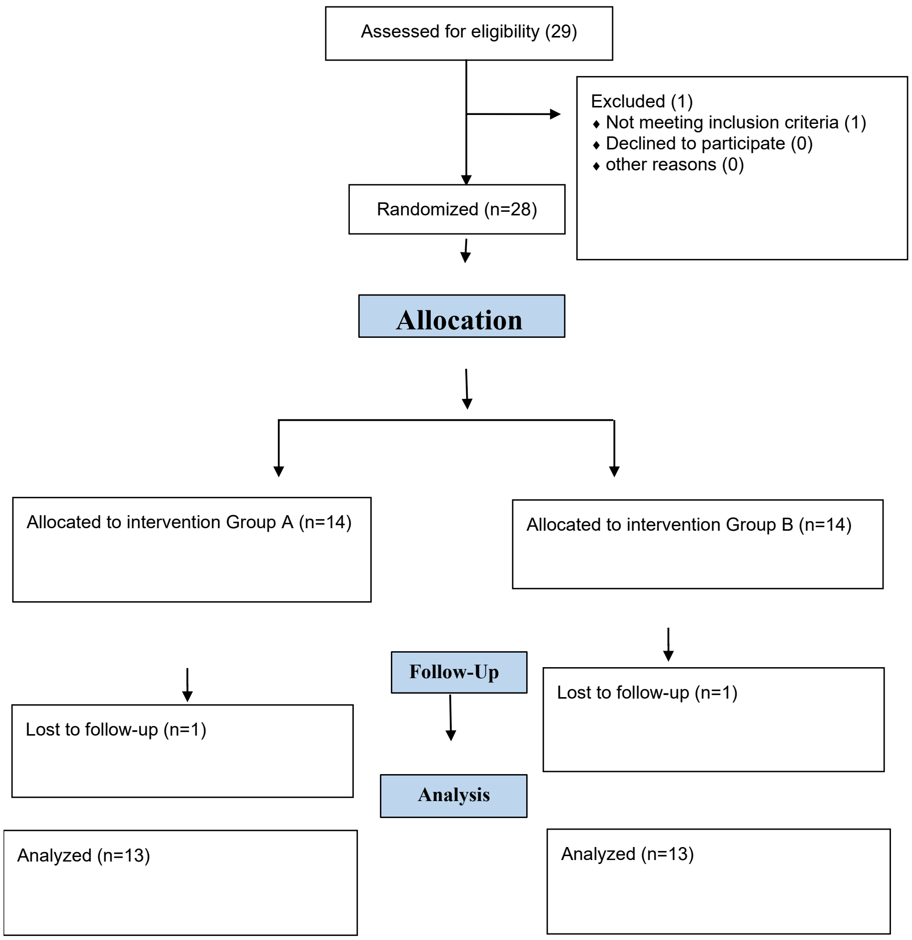
A randomized clinical trial was conducted to compare the effects of dry needling and neural mobilization on pain intensity, strength, and range of motion in patients with golfer's elbow. The study was carried out at Pakistan Rugby Academy, Lahore, after approval of the synopsis, and the total study duration was nine months. The sample size was calculated using G*Power on the basis of pain as the primary outcome measure, with an effect size of 1.483954, alpha error probability of 0.05, power of 0.95, and equal allocation between two groups. The required sample size was 26 participants, and after adding a 10% anticipated attrition rate, the estimated sample size was increased to 29 participants (22). According to the participant flow, 29 patients were assessed for eligibility, one participant was excluded for not meeting the inclusion criteria, and 28 participants were randomized equally into two groups. Fourteen participants were allocated to Group A and fourteen to Group B. One participant from each group was lost to follow-up, and the final analysis was performed on 26 participants, with 13 participants in each group. Participants were recruited through a non-probability purposive sampling technique and were then randomly allocated into two treatment groups. Adult male and female patients were considered eligible for inclusion (23). Patients were included if they had clinically confirmed medial epicondylitis diagnosed by an orthopedic specialist, pain localized over the medial epicondyle, reproduction of pain during resisted wrist flexion and/or forearm pronation, age between 18 and 40 years, symptoms in the acute to subacute stage lasting from at least six weeks up to twelve months, and a baseline Numeric Pain Rating Scale score of 4 or above (24-29). Patients were excluded if they had other elbow pathologies such as lateral epicondylitis, olecranon bursitis, or ligamentous injuries; radial or ulnar neuropathies not associated with medial epicondylitis; systemic or inflammatory tendon-related conditions such as rheumatoid arthritis; diabetes with neuropathy unless diabetes was controlled and neuropathy was absent; previous surgery around the elbow or wrist within the last six months; or corticosteroid injection, platelet-rich plasma therapy, or shockwave therapy within the previous three months (30-34).

After eligibility screening, written informed consent was obtained from all participants before enrollment. Baseline assessment was conducted before allocation to document pre-treatment values for pain, strength, and range of motion. Randomization was performed by the lottery method, and allocation concealment was maintained using sealed envelopes. The study was single-blinded, as the outcome assessor remained unaware of group allocation; however, participants and treating therapists could not be blinded due to the nature of the interventions. Group A received dry needling in addition to a standardized conventional physiotherapy program, while Group B received neural mobilization in addition to the same standardized conventional physiotherapy program. Ethical approval was obtained from the Ethical Committee of Green International University before commencement of data collection (Clinical trial Registration #:

NCT07643740). All participants were informed about the purpose of the study, expected procedures, voluntary participation, confidentiality of data, and their right to withdraw at any stage without penalty. Participant identity was protected through anonymous coding, and all collected information was kept confidential. As dry needling involved an invasive needle-based procedure, participants were informed about possible minor risks such as temporary soreness, bruising, discomfort, or local irritation, and appropriate safety measures were followed, including the use of sterile single-use needles and treatment by a trained therapist.

Pain intensity was assessed using the Numeric Pain Rating Scale. The scale ranged from 0 to 10, where 0 represented no pain and 10 represented the worst imaginable pain. Scores were interpreted as mild, moderate, or severe pain according to standard clinical categories, and the scale was used because of its simplicity, clinical acceptability, and strong reliability in musculoskeletal pain assessment (35). Grip strength was measured using a digital hand dynamometer and was recorded in standard units such as kilograms, pounds, or Newtons, according to device settings. The dynamometer was used because it provides objective quantification of hand grip force and has high reported reliability and validity for strength assessment (36). Range of motion was measured using a universal goniometer, which allowed objective measurement of joint angles relevant to elbow, wrist, and forearm movement. Goniometric assessment was used to document baseline limitation and post-treatment improvement in mobility (37). Both groups received a standardized conventional physiotherapy protocol throughout the intervention period. The program included warm-up activities, active range-of-motion exercises, stretching, and strengthening exercises for the medial forearm musculature, particularly the flexor carpi radialis, flexor carpi ulnaris, pronator teres, palmaris longus, and the flexor-pronator tendon region around the medial epicondyle. Stretching exercises for the forearm flexor-pronator group were performed for 20 to 30 seconds per repetition, with three repetitions per session, to improve flexibility and reduce stiffness. Strengthening exercises were performed using light resistance, such as 1–2 kg dumbbells or resistance bands, and focused on wrist flexion, forearm pronation, and gripping activities. Participants performed two to three sets of 10 to 15 repetitions, and resistance was progressed gradually according to pain tolerance and functional capacity. At the end of each session, gentle active range-of-motion exercises for the elbow and wrist were performed for 5 to 7 minutes to maintain mobility and facilitate recovery.

CONSORT DIAGRAM



Group A received dry needling over six weeks, with two sessions per week, making a total of twelve sessions. Each session lasted approximately 40 to 45 minutes. During dry needling, the participant was positioned supine, with the elbow slightly flexed at approximately 30° to 45° and the forearm comfortably supinated. The therapist palpated the medial epicondyle, common flexor tendon region, and proximal forearm flexor muscles to identify tender points, taut bands, or myofascial trigger points. Sterile, single-use needles measuring approximately 0.25–0.30 mm in diameter and 25–40 mm in length were inserted into the identified trigger points or tender soft tissue regions. Gentle pistoning or rotation was applied when clinically appropriate, and the needles were retained for approximately 10 to 15 minutes. One to two needles were used per treatment site according to patient tolerance and tissue response. After needling, gentle active movement of the elbow and wrist was performed for 5 to 7 minutes to reduce post-needling soreness and restore comfortable mobility (12). Group B received neural mobilization over the same six-week period, with two sessions per week, totaling twelve sessions of approximately 40 to 45 minutes each. The participant was positioned either supine or seated, depending on comfort and therapist preference. The therapist stabilized the proximal limb and guided controlled movements of the shoulder, elbow, forearm, wrist, and fingers to mobilize the involved neural structures. Neural mobilization techniques included nerve sliding movements, and where appropriate, gentle tensioning techniques were applied. The intervention primarily targeted neural mobility of the upper limb, particularly the median and ulnar nerve components where clinically indicated, while radial nerve mobilization was used if symptom behavior suggested its involvement. Each session included three to four sets of 10 to 15 repetitions, with each end-range position maintained for approximately 3 to 5 seconds. The technique was performed within a comfortable and symptom-controlled range, and pain was not allowed to exceed 3 out of 10 on the Numeric Pain Rating Scale. Progression was applied every two to three weeks by gradually increasing range, amplitude, or tolerance-based loading of the neural movement (20).

Data were analyzed using SPSS version 27. Quantitative variables such as pain score, strength, and range of motion were summarized as mean and standard deviation, while qualitative variables were presented as frequency and percentage. Baseline characteristics were compared between groups to assess initial comparability. The Shapiro–Wilk test was used to assess normality because of the small sample size, and Levene's test was used to assess homogeneity of variance. For normally distributed data, within-group pre- and post-intervention comparisons were analyzed using the paired-sample t-test, while between-group comparisons were analyzed using the independent-sample t-test. For non-normally distributed data, the Wilcoxon signed-rank test was used for within-group comparisons, and the Mann–Whitney U test was used for between-group comparisons. If outcomes were assessed at more than two time points, repeated-measures ANOVA was used for normally distributed data, while the Friedman test was used as the non-parametric alternative, followed by post-hoc Wilcoxon signed-rank tests with Bonferroni correction where required. Effect sizes, including Cohen's d, partial eta-squared, or non-parametric effect size estimates, were calculated where applicable to determine the clinical relevance of the findings. Pearson correlation analysis was used for normally distributed variables, while Spearman correlation analysis was used for non-normally distributed variables to explore relationships between pain reduction and improvements in strength or range of motion. A p-value of less than 0.05 was considered statistically significant at a 95% confidence interval.

RESULTS

The study included 26 patients with golfer's elbow, with 13 participants in the dry needling group and 13 participants in the neural mobilization group. The mean age of the participants was 34.62 ± 5.91 years. Overall, 16 participants were male and 10 were female. In the dry needling group, 6 participants were male and 7 were female, whereas in the neural mobilization group, 10 participants were male and 3 were female. Right-sided elbow involvement was reported in 9 participants, while left-sided involvement was reported in 17 participants. In the dry needling group, 3 participants had right-sided and 10 had left-sided involvement, while in the neural mobilization group, 6 participants had right-sided and 7 had left-sided involvement. The Shapiro–Wilk test showed that all baseline outcome variables were normally distributed. The baseline pain score showed a Shapiro–Wilk p-value of 0.075, baseline grip strength $p = 0.549$, baseline elbow flexion $p = 0.577$, baseline elbow extension deficit $p = 0.063$, baseline wrist flexion $p = 0.078$, and baseline wrist extension $p = 0.210$. Since all p-values were greater than 0.05, parametric tests were applied for further analysis.

For the overall sample, statistically significant pre- to post-intervention improvements were observed in all measured outcomes. Pain intensity decreased from 7.00 ± 1.81 to 3.46 ± 1.88 on the NPRS, with a mean reduction of 3.54 points ($t = 6.503$, $p < 0.01$). Grip strength increased from 21.73 ± 3.88 to 25.81 ± 4.37, with a mean gain of 4.08 units ($t = -15.027$, $p < 0.01$). Elbow flexion improved from 121.81 ± 6.62° to 130.96 ± 7.57°, showing a mean improvement of 9.15° ($t = -15.277$, $p < 0.01$). Elbow extension deficit reduced from 11.08 ± 4.29° to 5.12 ± 4.77°, showing a mean reduction of 5.96° ($t = 14.429$, $p < 0.01$). Wrist flexion increased from 48.77 ± 9.41° to 57.88 ± 8.51°, with a mean improvement of 9.11° ($t = -5.353$, $p < 0.01$), while wrist extension increased from 53.27 ± 6.73° to 60.85 ± 6.91°, with a mean improvement of 7.58° ($t = -5.001$, $p < 0.01$) . At baseline, the two groups were statistically comparable for most variables except pain intensity. Baseline NPRS pain score was significantly lower in the dry needling group than in the neural mobilization group, with values of 5.92 ± 1.38 and 8.08 ± 1.55, respectively (mean difference = -2.154, $p = 0.001$). Baseline grip strength did not differ significantly between the dry needling group and neural mobilization group, with values of 20.38 ± 4.09 and 23.08 ± 3.28, respectively ($p = 0.077$). Baseline elbow flexion was 121.15 ± 4.96° in the dry needling group and 122.46 ± 8.11° in the neural mobilization group ($p = 0.624$). Baseline elbow extension deficit was 12.31 ± 4.92° in the dry needling group and 9.85 ± 3.29° in the neural mobilization group ($p = 0.147$). Baseline wrist flexion was 50.00 ± 8.38° and 47.54 ± 10.53° in the dry needling and neural mobilization groups, respectively ($p = 0.516$), while baseline wrist extension was 54.23 ± 6.00° and 52.31 ± 7.50°, respectively ($p = 0.477$).

Post-intervention comparison showed significant between-group differences in all outcome measures. Post-treatment NPRS pain score was lower in the neural mobilization group than in the dry needling group, with values of 2.46 ± 1.66 and 4.46 ± 1.56, respectively (mean difference = 2.000, $p = 0.004$). Post-treatment grip strength was higher in the neural mobilization group than in the dry needling group, with values of 28.15 ± 3.24 and 23.46 ± 4.18, respectively (mean difference = -4.692, $p = 0.004$). Post-treatment elbow flexion was also greater in the neural mobilization group, with values of 134.08 ± 8.70° compared with 127.85 ± 4.74° in the dry needling group (mean difference = -6.231, $p = 0.033$). Elbow extension deficit was lower after treatment in the neural mobilization group, with values of 2.54 ± 2.85° compared with 7.69 ± 4.99° in the dry needling group (mean difference = 5.154, $p = 0.004$). Post-treatment wrist flexion was 61.31 ± 7.83° in the neural mobilization group and 54.46 ± 8.01° in the dry needling group (mean difference = -6.846, $p = 0.037$). Post-treatment wrist extension was 64.00 ± 7.00° in the neural mobilization group and 57.69 ± 5.38° in the dry needling group (mean difference = -6.308, p = 0.017). Based on the mean pre- and post-intervention values, the dry needling group showed a pain reduction of 1.46 NPRS points, grip strength gain of 3.08 units, elbow flexion gain of 6.70°, elbow extension deficit reduction of 4.62°, wrist flexion gain of 4.46°, and wrist extension gain of 3.46°. The neural mobilization group showed a pain reduction of 5.62 NPRS points, grip strength gain of 5.07 units, elbow flexion gain of 11.62°, elbow extension deficit reduction of 7.31°, wrist flexion gain of 13.77°, and wrist extension gain of 11.69°. The recorded post-intervention data showed lower pain scores and higher strength and range-of-motion values in the neural mobilization group across all measured outcomes.

Table 1. Baseline demographic and clinical characteristics of participants

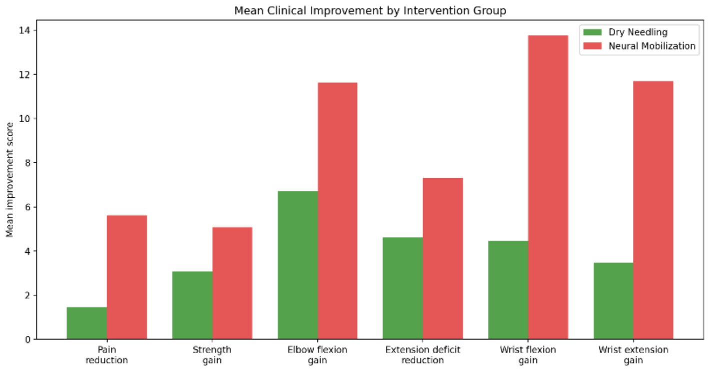
Variable	Category / Unit	Total (N = 26)	Dry Needling (n = 13)	Neural Mobilization (n = 13)	p-value
Age	years, mean ± SD	34.62 ± 5.91	Not reported	Not reported	Not available
Gender	Male, n (%)	16 (61.5%)	6 (46.2%)	10 (76.9%)	0.226
Gender	Female, n (%)	10 (38.5%)	7 (53.8%)	3 (23.1%)	
Affected elbow side	Right, n (%)	9 (34.6%)	3 (23.1%)	6 (46.2%)	0.411
Affected elbow side	Left, n (%)	17 (65.4%)	10 (76.9%)	7 (53.8%)	
Pain intensity	NPRS, mean ± SD	7.00 ± 1.81	5.92 ± 1.38	8.08 ± 1.55	0.001
Grip strength	mean ± SD	21.73 ± 3.88	20.38 ± 4.09	23.08 ± 3.28	0.077
Elbow flexion	degrees, mean ± SD	121.81 ± 6.62	121.15 ± 4.96	122.46 ± 8.11	0.624
Elbow extension deficit	degrees, mean ± SD	11.08 ± 4.29	12.31 ± 4.92	9.85 ± 3.29	0.147
Wrist flexion	degrees, mean ± SD	48.77 ± 9.41	50.00 ± 8.38	47.54 ± 10.53	0.516
Wrist extension	degrees, mean ± SD	53.27 ± 6.73	54.23 ± 6.00	52.31 ± 7.50	0.477

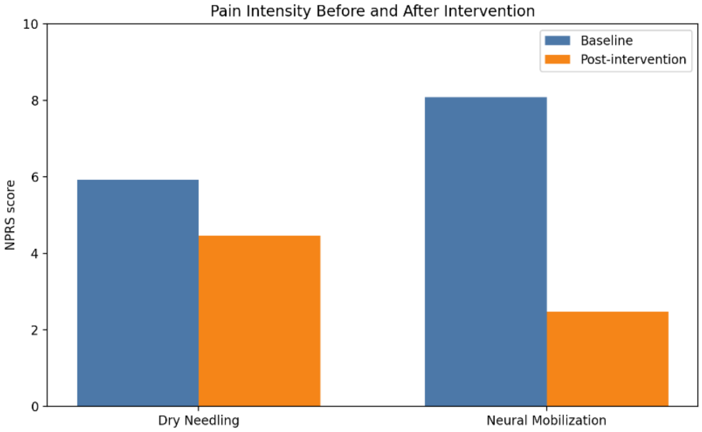
Table 2. Group-wise pre- and post-intervention changes in pain, strength, and range of motion

Outcome variable	Dry Needling Baseline Mean ± SD	Dry Needling Post Mean ± SD	Mean improvement in Dry Needling	Neural Mobilization Baseline Mean ± SD	Neural Mobilization Post Mean ± SD	Mean improvement in Neural Mobilization
Pain intensity, NPRS	5.92 ± 1.38	4.46 ± 1.56	1.46 reduction	8.08 ± 1.55	2.46 ± 1.66	5.62 reduction
Grip strength	20.38 ± 4.09	23.46 ± 4.18	3.08 increase	23.08 ± 3.28	28.15 ± 3.24	5.07 increase
Elbow flexion, degrees	121.15 ± 4.96	127.85 ± 4.74	6.70 increase	122.46 ± 8.11	134.08 ± 8.70	11.62 increase
Elbow extension deficit, degrees	12.31 ± 4.92	7.69 ± 4.99	4.62 reduction	9.85 ± 3.29	2.54 ± 2.85	7.31 reduction
Wrist flexion, degrees	50.00 ± 8.38	54.46 ± 8.01	4.46 increase	47.54 ± 10.53	61.31 ± 7.83	13.77 increase
Wrist extension, degrees	54.23 ± 6.00	57.69 ± 5.38	3.46 increase	52.31 ± 7.50	64.00 ± 7.00	11.69 increase

Table 3. Between-group comparison of post-intervention outcomes and mean change scores

Outcome variable	Mean improvement in Dry Needling	Mean improvement in Neural Mobilization	Difference in improvement (Neural Mobilization − Dry Needling)	Post-treatment mean difference (Dry Needling − Neural Mobilization), 95% CI	Post-treatment p-value
Pain intensity, NPRS	1.46	5.62	4.16	2.00 (0.69 to 3.31)	0.004
Grip strength	3.08	5.07	1.99	-4.69 (-7.72 to -1.66)	0.004
Elbow flexion, degrees	6.70	11.62	4.92	-6.23 (-11.99 to -0.47)	0.033
Elbow extension deficit, degrees	4.62	7.31	2.69	5.15 (1.82 to 8.48)	0.004
Wrist flexion, degrees	4.46	13.77	9.31	-6.85 (-13.26 to -0.44)	0.037
Wrist extension, degrees	3.46	11.69	8.23	-6.31 (-11.38 to -1.24)	0.017





DISCUSSION

The present study compared the effects of dry needling and neural mobilization on pain, grip strength, and elbow and wrist range of motion in patients with golfer's elbow. The findings showed that both interventions produced improvement after treatment; however, neural mobilization demonstrated greater post-intervention benefits across all measured outcomes. Pain intensity decreased in both groups, grip strength improved, and range of motion increased at the elbow and wrist. The neural mobilization group showed lower post-treatment pain scores, higher grip strength, greater elbow flexion, lower elbow extension deficit, and better wrist flexion and extension compared with the dry needling group. These findings indicated that both techniques had therapeutic value, but neural mobilization produced a comparatively stronger clinical response in this sample. Pain reduction was an important finding of the study, as pain over the medial epicondyle is the main clinical complaint in golfer's elbow and often limits gripping, lifting, writing, sports participation, and occupational activities. Dry needling reduced pain, which was consistent with previous literature suggesting that needling techniques may reduce musculoskeletal pain by deactivating myofascial trigger points, improving local circulation, reducing abnormal muscle tone, and influencing peripheral and central pain modulation. A previous study reported that dry needling was effective in reducing pain intensity in musculoskeletal conditions, particularly where myofascial trigger points were present, and similar improvements were also observed in upper-limb tendinopathy-related pain (38). In the present study, this mechanism may have contributed to the reduction in pain among patients receiving dry needling, especially because golfer's elbow commonly involves overactivity and tenderness of the flexor-pronator muscle group.

Despite this improvement, neural mobilization produced a greater reduction in pain than dry needling. This finding was consistent with studies in which neural mobilization was reported to be effective in conditions involving nerve mechanosensitivity, restricted nerve excursion, and altered neurodynamic function. In medial elbow pain, symptoms may not arise only from local tendon degeneration; neural irritation, especially involving the ulnar or median nerve region, may also contribute to pain sensitivity and movement limitation. Neural mobilization was reported to improve intraneural blood flow, reduce nerve-related edema, restore nerve sliding, and decrease mechanosensitivity, which may explain its stronger effect on pain reduction in the present study (39). The greater pain reduction observed in the neural mobilization group suggested that addressing neural mobility may be clinically important in patients with golfer's elbow, particularly when pain is aggravated by upper-limb movement patterns. Some previous studies reported comparable outcomes between dry needling and manual or neurodynamic techniques when dry needling was combined with additional therapeutic approaches. A study conducted in 2023 found that dry needling combined with manual therapy produced outcomes similar to neural techniques in upper-limb conditions (40). The difference observed in the present study may be related to the nature of the intervention protocol, the clinical presentation of medial epicondylitis, or the presence of neural involvement among participants. Dry needling mainly addressed local myofascial and soft tissue contributors, whereas neural mobilization directly targeted nerve mobility and neural sensitivity. This distinction supported the view that treatment response in golfer's elbow may depend on whether the dominant clinical driver is myofascial dysfunction, tendon overload, or neural mechanosensitivity.

Grip strength also improved in both groups, with greater improvement in the neural mobilization group. Strength is an important functional outcome in golfer's elbow because pain-related inhibition and flexor-pronator dysfunction can reduce hand grip performance. A previous study reported that neural mobilization improved hand strength by reducing neural tension and enhancing motor unit recruitment (41). In the present study, improvement in neural mobility may have reduced inhibitory input and allowed better activation of the forearm and hand muscles. Dry needling may also improve strength by reducing pain-related muscle inhibition and improving local muscle activation; however, its effect is often more localized to the treated muscle or trigger point region. A previous report suggested that dry needling could increase muscle performance by reducing pain-related inhibition, but neural mobilization may provide broader neuromuscular effects by improving nerve function throughout the upper-limb kinetic chain (11). Range of motion findings further supported the positive role of neural mobilization. Both groups showed improvement in elbow flexion, elbow extension deficit, wrist flexion, and wrist extension, but greater gains were found in the neural mobilization group. These findings were consistent with literature showing that neurodynamic techniques may improve mobility by reducing nerve mechanosensitivity, decreasing protective muscle guarding, and improving the relationship between neural and musculoskeletal structures. A previous study reported that neural mobilization improved joint mobility in upper-limb disorders by enhancing neural excursion and reducing movement-related sensitivity (9). In the present study, the improvement in range of motion may have resulted from reduced pain, improved nerve gliding, and decreased protective stiffness around the elbow and wrist.

Dry needling also contributed to improvement in range of motion, which was supported by previous literature reporting that dry needling may improve joint mobility by reducing trigger point activity, muscle tightness, and soft tissue stiffness. A previous study found improved mobility after dry needling in patients with musculoskeletal pain conditions (42). However, the comparatively smaller gains in the dry needling group suggested that a localized myofascial approach may not fully address the neural component that can restrict motion in medial elbow conditions. Neural mobilization may therefore offer a more comprehensive effect when restriction is related not only to muscle tightness but also to neural sensitivity and altered movement tolerance. An important methodological consideration was the significant baseline difference in pain between groups. The neural mobilization group had higher baseline pain than the dry needling group, yet demonstrated greater post-treatment improvement. This finding may suggest a meaningful therapeutic response; however, it also required cautious interpretation because baseline imbalance could influence post-treatment comparisons. A previous study reported that neural mobilization was particularly effective among patients with higher pain intensity because of its combined peripheral and central mechanisms of action (43). Nevertheless, future studies should use baseline-adjusted analysis, such as analysis of covariance, to reduce the influence of initial differences and provide a more precise estimate of comparative treatment effects.

The mechanism behind the superior outcomes of neural mobilization appeared to be multifactorial. Neural mobilization may improve neural excursion, reduce intraneural pressure, enhance circulation, decrease mechanosensitivity, and influence central pain modulation. A previous study emphasized that interventions targeting neural structures may alter pain perception at both peripheral and central levels (44). This broader mechanism may explain why neural mobilization produced improvement not only in pain but also in strength and range of motion. In contrast, dry needling primarily targeted the local myofascial component and may have produced indirect effects on function by reducing pain and muscle guarding. This did not reduce the clinical value of dry needling, but it suggested that dry needling may be more useful as an adjunctive therapy in patients with prominent trigger points or localized muscle tenderness. The functional relevance of neural mobilization was also notable. Neurodynamic techniques involve controlled movement patterns of the shoulder, elbow, forearm, wrist, and fingers, which may resemble the movement demands required during daily activity and sports performance. A previous study highlighted that neurodynamic techniques may improve functional outcomes by integrating movement with neural control (45). This movement-based nature may have allowed better carryover into gripping, lifting, and wrist activities. Dry needling, by comparison, is mainly a passive intervention and may require structured exercise therapy, strengthening, and activity modification to produce comparable long-term functional outcomes.

The findings were generally consistent with recent literature supporting multimodal rehabilitation for tendinopathy and upper-limb pain. Although neural mobilization showed superior results in the present study, previous evidence also suggested that different physiotherapy interventions may produce comparable benefits when appropriately selected and combined with progressive rehabilitation (36). Therefore, the findings should not be interpreted as evidence that dry needling was ineffective. Instead, they suggested that neural mobilization may be more beneficial when neural mechanosensitivity contributes to golfer's elbow symptoms, while dry needling may remain useful when myofascial trigger points, localized tenderness, or muscle tightness dominate the clinical presentation. The clinical implications of the study were relevant for physiotherapy practice. Neural mobilization may be considered a useful treatment option for patients with golfer's elbow, especially where pain is associated with movement sensitivity, reduced neural mobility, or symptoms extending into the forearm. Dry needling may still be considered as an adjunct intervention when myofascial trigger points, muscle tightness, or localized soft tissue tenderness are present. The results supported the importance of individualized assessment, as golfer's elbow may involve overlapping tendon, muscle, and neural contributors rather than a single pathological source.

The study had several strengths. It used a randomized clinical trial design, applied standardized outcome measures, and assessed clinically meaningful variables including pain, grip strength, and range of motion. The use of the Shapiro–Wilk test before parametric analysis also strengthened the statistical approach. Both groups received structured interventions over the same duration, which improved comparability of treatment exposure. The inclusion of objective measures such as grip strength and goniometric range of motion added clinical value beyond pain assessment alone. Several limitations were also present. The sample size was small, with only 26 participants included in the final analysis, which limited the generalizability and statistical power of the findings. The study duration was short, and no long-term follow-up was included; therefore, the sustainability of treatment effects could not be determined. Baseline pain differed significantly between groups, which may have influenced the comparative findings. Participants and therapists could not be blinded due to the nature of the interventions, which may have introduced performance bias. The study also did not assess psychological factors such as fear avoidance, stress, pain perception, or activity-related confidence, although these factors may influence recovery in musculoskeletal pain conditions. Occupational load, sports participation, daily activity level, and ergonomic exposure were not fully controlled, which may have affected treatment response.

Another limitation was that neural mechanosensitivity and electrophysiological changes were not directly measured. Although the findings favored neural mobilization, the study did not include specific neurodynamic test scores, nerve conduction assessment, or electromyographic evaluation. Therefore, the underlying neurophysiological explanation remained inferential. In addition, outcome measures such as pain intensity were subjective and may have been influenced by individual pain perception, expectation, or treatment preference. The study was also limited to patients with golfer's elbow, so the findings may not be directly applicable to other elbow or upper-limb disorders. Future studies should include larger sample sizes, multicenter recruitment, and longer follow-up periods to confirm whether the observed improvements are maintained over time. Future trials should ensure better baseline comparability or use baseline-adjusted statistical methods such as analysis of covariance, especially when initial pain levels differ between groups. The inclusion of objective neurophysiological measures such as electromyography, nerve conduction studies, and standardized neurodynamic testing may provide deeper understanding of treatment mechanisms. Future research should also evaluate combined treatment protocols, such as dry needling with neural mobilization and progressive strengthening, to determine whether integrated rehabilitation provides additional benefit. Broader populations, including older adults, non-athletes, and occupational workers with repetitive gripping exposure, should also be included to improve external validity.

Overall, the study showed that both dry needling and neural mobilization improved pain, strength, and range of motion in patients with golfer's elbow. Neural mobilization produced greater improvements across the measured outcomes, but the findings should be interpreted with caution because of the small sample size, short follow-up period, and baseline pain imbalance. The results supported the clinical value of addressing neural mobility in medial elbow pain while also recognizing the role of dry needling as a potentially useful adjunct in selected patients.

CONCLUSION

The study concluded that both dry needling and neural mobilization were effective in improving pain, grip strength, and range of motion in patients with golfer's elbow; however, neural mobilization showed a more favorable overall response. The findings suggest that addressing neural mobility may play an important role in the rehabilitation of medial elbow pain, particularly when symptoms are associated with movement sensitivity, weakness, and restricted upper-limb function. Dry needling remained a useful therapeutic option for reducing localized myofascial pain and muscle tightness, but neural mobilization appeared to provide broader functional benefits. Clinically, the study supports the use of neural mobilization as a valuable physiotherapy approach for golfer's elbow, while also highlighting the potential benefit of individualized treatment planning based on each patient's dominant symptoms and functional limitations.

AUTHOR CONTRIBUTION

Author	Contribution
Dr. Abeela Ashraf	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision
Dr. Komal Tehzeeb	Methodology, Investigation, Data Curation, Writing - Review & Editing
Prof Dr Fahad Tanveer	Investigation, Data Curation, Formal Analysis, Software
Dr. Izzah Ijaz Syed	Software, Validation, Writing - Original Draft
Dr Muhammad Bin Zia	Formal Analysis, Writing - Review & Editing
Dr. Wayna Maqsood	Writing - Review & Editing, Assistance with Data Curation

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