International Journal of Medical and Health Research
www.medicalsciencejournal.com
ISSN: 2454-9142
Received: 19-06-2026, Accepted: 20-07-2026, Published: 05-08-2026
Volume 12, Issue 3, 2026, Page No. 33-38

Effect of scapular neuromuscular control training combined with eccentric wrist extensor exercises on pain and functional disability in patients with chronic lateral epicondylalgia: A quasi experimental study

Dr. Yasodha M[1], Dr. Manikandan P[2], Dr. Yashodhan Chaughule[3], Dr. Saravanakumar Kuppusamy[4], Dr. Pragati Chawla[5]

[1] Department of Physiotherapy, Excel College of Physiotherapy and Research Centre, Kumarapalayam, (Affiliated to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, Tamil Nadu, India

[2] HOD, Department of Musculoskeletal Physiotherapy, Rashtrasant Janardhan Swami College of Physiotherapy Kokamthan, (Maharashtra University of Health Sciences, Nashik) Kopargaon, Maharashtra, India

[3] Department of Cardiovascular & Respiratory Physiotherapy, Rashtrasant Janardhan Swami College of Physiotherapy Kokamthan, (Maharashtra University of Health Sciences, Nashik) Kopargaon, Maharashtra, India

[4] Associate Professor, Department of Neuro Physiotherapy, Rashtrasant Janardhan Swami College of Physiotherapy Kokamthan, (Maharashtra University of Health Sciences, Nashik) Kopargaon, Maharashtra, India

[5] Post Graduate, Department of Paediatric Physiotherapy, Dr. D. Y Patil College of Physiotherapy, Sant Tukaram Nagar, Pimpri, Pune, Maharashtra, India

Corresponding Author: Dr. Yashodhan Chaughule

DOI: https://doi.org/10.66856/ijmhr.2026.12.3.12078

Abstract

Background: Chronic lateral epicondylalgia (LE) is a common musculoskeletal disorder of the common extensor origin, with a general population prevalence of 1–3% and peak incidence between 35 and 55 years of age. While eccentric loading of the wrist extensors is the established cornerstone of conservative management, accumulating biomechanical evidence implicates scapular neuromuscular impairment in symptom persistence via altered proximal-to-distal force transmission along the upper-limb kinetic chain.

Objective: To compare the effectiveness of scapular neuromuscular control (NMC) training combined with eccentric wrist extensor exercises against eccentric wrist extensor exercises alone on pain intensity and functional disability in patients with chronic LE.

Methods: In this assessor-blinded randomized controlled trial, 30 participants with chronic LE (symptom duration ≥3 months; Patient-Rated Tennis Elbow Evaluation [PRTEE] score >30) were allocated 1:1, via computer-generated randomization with sealed opaque envelopes, to an Experimental Group (n=15; scapular NMC training combined with eccentric wrist extensor exercises) or a Control Group (n=15; eccentric wrist extensor exercises alone). Both groups trained three sessions per week for 8 weeks. Pain (Numerical Pain Rating Scale, NPRS) and functional disability (PRTEE) were assessed at baseline and week 8. Within-group change was analysed with the paired t-test and between-group differences with the independent-samples t-test.

Results: Both groups showed statistically significant within-group reductions in NPRS and PRTEE scores from baseline to week 8 (p<0.001 for all comparisons). On between-group comparison, the Experimental Group demonstrated significantly greater improvement than the Control Group for both NPRS (t=-5.84, p<0.001) and PRTEE (t=-5.62, p<0.001).

Conclusion: Adding scapular neuromuscular control training to eccentric wrist extensor exercise produces significantly greater reductions in pain and functional disability than eccentric exercise alone in patients with chronic lateral epicondylalgia, supporting a kinetic-chain-informed approach to conservative rehabilitation of this condition.

Keywords: Lateral epicondylalgia, Tennis elbow, Scapular neuromuscular control, Kinetic chain, Eccentric exercise, Randomized controlled trial

Introduction

The elbow functions as an intermediate link in the upper-limb kinetic chain, transmitting forces generated by the trunk and shoulder girdle to the forearm and hand during functional and occupational tasks. The common extensor tendon, arising from the lateral epicondyle of the humerus, gives origin to the extensor carpi radialis brevis, extensor carpi radialis longus, extensor carpi ulnaris and extensor digitorum communis, and is the structure principally implicated in chronic lateral elbow pain.

Lateral epicondylalgia (LE), popularly known as tennis elbow, is characterised by pain and tenderness over the lateral epicondyle that is aggravated by repetitive wrist extension, forearm supination and gripping.

Although historically labelled "lateral epicondylitis," histopathological studies have shown an absence of inflammatory cells and instead reveal fibroblastic proliferation, collagen disorganisation and neovascularisation within the extensor carpi radialis brevis tendon, prompting adoption of the term "epicondylalgia" to reflect its degenerative, multifactorial nature [3]. The condition affects approximately 1–3% of the general population, with peak incidence between 35 and 55 years, and is disproportionately common among individuals engaged in repetitive manual, occupational or racquet-sport activity [1, 2]. Chronic LE, defined as symptoms persisting beyond three months, is associated with substantial functional disability, work absenteeism and healthcare utilisation [1].

Beyond local tendon pathology, accumulating evidence implicates impairment of the proximal kinetic chain in the persistence of LE symptoms. Electromyographic studies have demonstrated reduced activation of the lower trapezius and serratus anterior accompanied by compensatory overactivity of the upper trapezius in patients with chronic LE [4], while dynamometric studies confirm measurable weakness of the scapular stabilisers relative to asymptomatic individuals [5]. The scapula serves as the biomechanical link that stabilises the glenohumeral joint and permits efficient force transfer from the trunk to the distal upper limb; disruption of scapular position, motion or activation timing—termed scapular dyskinesis—has been shown to increase mechanical loading at the elbow and wrist [6, 7]. Sensorimotor studies further report impaired joint-position sense, altered force regulation and diminished proprioceptive acuity in chronic LE [8], consistent with the broader principle that persistent musculoskeletal pain reorganises motor control strategies and perpetuates inefficient movement patterns [9]. Together, these findings support a regional-interdependence model in which impairments at the shoulder girdle contribute to, and may sustain, distal elbow pathology [10].

Eccentric loading of the wrist extensors remains the most extensively validated exercise intervention for LE, promoting tendon remodelling, improved collagen alignment and pain reduction [11, 12]. However, a proportion of patients—reported at 10–20% in some series—continue to experience residual pain and disability despite structured eccentric programmes [14], and contemporary reviews advocate multimodal rehabilitation that addresses sensorimotor and proximal impairments alongside local tendon loading, rather than treating the elbow in isolation [13]. Despite this rationale, few randomised trials have directly compared the addition of scapular neuromuscular control training to eccentric wrist extensor exercise against eccentric exercise alone using validated pain and disability outcomes.

The present study was therefore designed to evaluate the effect of scapular neuromuscular control training combined with eccentric wrist extensor exercises, compared with eccentric wrist extensor exercises alone, on pain intensity (Numerical Pain Rating Scale) and functional disability (Patient-Rated Tennis Elbow Evaluation) in patients with chronic lateral epicondylalgia.

Review of literature

1. Epidemiology and Pathophysiology

Sanders *et al*. reported that the annual incidence of LE is highest among adults aged 40–55 years and is significantly elevated among individuals performing repetitive occupational tasks, with persistent symptoms associated with work absenteeism and increased healthcare utilisation [1]. Occupational-exposure studies corroborate this association, identifying repetitive gripping, forceful exertion and vibration exposure as independent risk factors for LE [2]. Coombes *et al*. characterised LE as a multifactorial disorder encompassing tendon degeneration, altered central pain processing, motor impairment and psychosocial contributors, recommending that management extend beyond isolated tendon loading [3]. Consistent with this, Fernández-Carnero *et al*. demonstrated widespread mechanical hyperalgesia and features of central sensitisation in chronic LE, indicating that altered nociceptive processing not tendon pathology alone contributes to symptom persistence [19].

2. Scapular Dysfunction and the Kinetic Chain

Electromyographic and dynamometric investigations converge on the finding that chronic LE is accompanied by measurable scapular muscle dysfunction. Alizadehkhaiyat *et al*. reported reduced lower trapezius and serratus anterior activation with compensatory upper trapezius overactivity [4], while Chester *et al*. confirmed significant weakness of the lower and middle trapezius and serratus anterior relative to asymptomatic controls [5]. Kibler and colleagues established the theoretical basis for these observations, describing the scapula as the pivotal link governing force transmission across the upper-limb kinetic chain and demonstrating that scapular dyskinesis increases distal joint loading [6, 7]. Struyf *et al*., reviewing scapular rehabilitation across multiple upper-limb conditions, reported improvements in pain, muscle recruitment and function following scapular-focused treatment [15], and Lucado *et al*. applied a regional-interdependence framework specifically to LE, showing that affected patients exhibit shoulder weakness and reduced scapular endurance that improve with proximal rehabilitation [10]. Related work has linked scapular stability directly to distal performance: both Uygur *et al*. and Wettstein *et al*. found that improved scapular stabilisation was associated with greater grip strength and upper-limb force output [16, 17].

3. Neuromuscular and Sensorimotor Contributions

Waugh *et al*. documented deficits in joint-position sense, force regulation and neuromuscular coordination in chronic LE [8], and Hodges and Tucker's influential model explains how persistent pain alters muscle activation timing and produces less efficient, protective movement strategies that can be reversed through targeted neuromuscular retraining [9]. Rio *et al*. extended this rationale through the concept of tendon neuroplastic training, proposing that exercise interventions incorporating motor control and cortical elements may enhance tendinopathy outcomes beyond load-based protocols alone [18].

4. Evidence for Eccentric Exercise

Eccentric loading remains the most rigorously studied intervention for LE. Stasinopoulos and Johnson concluded that eccentric programmes reduce pain, improve tendon structure and restore function more effectively than passive modalities [11], a finding echoed by Bisset and Vicenzino, who identified progressive exercise therapy rather than passive treatment as the foundation of effective physiotherapy management [12]. Peterson *et al*., in a randomised comparison of eccentric versus concentric strengthening, confirmed the superiority of eccentric loading for pain reduction and functional recovery [24]. Vicenzino *et al*., reviewing contemporary evidence, affirmed exercise as the cornerstone of management while noting that chronic presentations frequently involve sensorimotor impairment that warrants multimodal, rather than isolated, tendon-loading approaches [13].

5. Evidence for Combined Proximal–Distal Rehabilitation

Direct evidence for combining scapular and distal interventions remains comparatively limited but consistently favourable. Saito *et al*., in a randomised trial of scapular stabilisation for upper-extremity disorders, reported significant reductions in pain alongside improved muscle-activation efficiency [20]. Bateman *et al*.'s systematic review of neuromuscular control interventions across chronic tendinopathies found consistent reductions in pain and improvements in movement quality and long-term function [21]. Most directly relevant, Martinez-Silvestrini *et al*. demonstrated that combining shoulder strengthening with conventional wrist extensor exercise produced greater pain reduction and faster functional recovery than distal strengthening alone [14], while Kim *et al*., in a recent randomised trial of scapular neuromuscular control training in upper-limb tendinopathy, reported significant improvements in pain, scapular kinematics and patient-reported function relative to conventional strengthening [22]. Yoon *et al*. similarly confirmed favourable clinical outcomes with structured exercise-based rehabilitation across chronic tendinopathy populations [23]. Collectively, this body of evidence provided the empirical and theoretical rationale for the present trial, which examined whether adding scapular neuromuscular control training to eccentric wrist extensor exercise confers measurable benefit over eccentric exercise alone.

Materials and methods

1. Study Design and Setting

This was an assessor-blinded, two-arm, parallel-group randomized controlled trial conducted in the Outpatient Department of Physiotherapy, Excel College of Physiotherapy and Research Centre, Kumarapalayam, Namakkal, Tamil Nadu, India. The overall study period spanned 12 months, comprising a six-month recruitment window, an eight-week intervention period per participant, and a three-month period for data analysis and report preparation. Institutional ethical approval was obtained prior to participant recruitment, and written informed consent was secured from all participants before enrolment.

2. Participants

Thirty participants with a clinical diagnosis of chronic lateral epicondylalgia were recruited by simple random sampling. Eligible participants were aged 20–50 years, with symptom duration of at least three months and pain over the lateral epicondyle reproduced on Cozen's test, Mill's test and Maudsley's test, and a baseline PRTEE score greater than 30. Both sexes were eligible for inclusion.

Participants were excluded if they presented with cervical radiculopathy (C5–C6 nerve root distribution), radial tunnel syndrome, osteoarthritis or rheumatoid arthritis of the elbow, distal biceps tendon rupture, elbow instability, ligamentous injury, or olecranon bursitis.

3. Sample Size, Randomization and Blinding

A total of 30 participants were allocated in a 1:1 ratio to an Experimental Group (n=15) and a Control Group (n=15) using a computer-generated random allocation sequence, with allocation concealment achieved through sequentially numbered, sealed, opaque envelopes. The outcome assessor was blinded to group allocation throughout the study; given the physical nature of the interventions, the treating therapist could not be blinded.

4. Interventions

Both groups received individually supervised physiotherapy for 8 weeks, at a frequency of three sessions per week (one session per day), with each session lasting 45–60 minutes. The Experimental Group received scapular neuromuscular control training combined with eccentric wrist extensor exercises; the Control Group received eccentric wrist extensor exercises alone. Table 1 summarises the intervention protocols.

Table 1: Summary of intervention protocols for the Experimental and Control groups.

Phase / Parameter	Experimental Group (Scapular NMC + Eccentric Exercise)	Control Group (Eccentric Exercise Alone)
Weeks 1–2	Scapular setting, scapular retraction, wall push-up plus, prone Y-raise (low load, motor-control focus)	Eccentric wrist extensor loading (0.5 kg), 3×15 daily; static wrist extensor stretch, 3×30 s; isometric wrist extension as needed
Weeks 3–5	Resistance-band retraction, dynamic hug, push-up plus (progressive loading)	Eccentric wrist extensor loading progressed to 1–1.5 kg; stretching and isometrics continued
Weeks 6–8	Wall slide, medicine-ball reach, quadruped arm lift, rhythmic stabilisation, PNF D2 flexion (dynamic, functional-integration focus)	Eccentric wrist extensor loading progressed to 2–3 kg if pain ≤3/10; stretching and isometrics continued
Dosage	3–10 repetitions × 3 sets per exercise, as specified per exercise	3 × 15 repetitions daily; 5-second eccentric phase per repetition
Precautions	Exercise pain maintained ≤3/10; compensatory shoulder elevation and trunk movement avoided; correct posture and breathing maintained throughout	Forearm fully supported; only the eccentric phase loaded; exercise stopped if pain >3/10 or swelling increased

Adherence was monitored using a participant-maintained exercise diary and session attendance records; a minimum adherence of 80% was required for inclusion of a participant's data in the final analysis.

5. Outcome Measures

Pain intensity and functional disability were assessed at baseline and at the end of week 8 using the following validated tools (Table 2).

Table 2: Outcome measures used in the study.

Outcome Measure	Scale / Range	Reliability (ICC)	Validity (r)	Assessment Points
Numerical Pain Rating Scale (NPRS)	0–10 (higher = worse pain)	0.95	0.94	Baseline, Week 4, Week 8
Patient-Rated Tennis Elbow Evaluation (PRTEE)	0–100 (higher = worse disability)	>0.90	0.89	Baseline, Week 4, Week 8

6. Statistical Analysis

Descriptive statistics (mean ± standard deviation) were computed for all outcome variables in each group. Within-group change from baseline to week 8 was analysed using the paired t-test, and between-group differences in the magnitude of change were analysed using the independent-samples t-test. A p-value of less than 0.05 was considered statistically significant throughout.

Results

Thirty patients with chronic lateral epicondylalgia completed the 8-week study, allocated equally to the Experimental Group (scapular neuromuscular control training combined with eccentric wrist extensor exercises, n=15) and the Control Group (eccentric wrist extensor exercises alone, n=15). No participant was lost to follow-up, and all participants met the pre-specified 80% adherence threshold.

1. Within-Group Change (Baseline to Week 8)

Both groups demonstrated statistically significant within-group improvement in pain and functional disability from baseline to week 8 (Table 3).

Table 3: Within-group descriptive statistics and paired t-test results (baseline vs. week 8).

Outcome	Group	Baseline (Mean ± SD)	Week 8 (Mean ± SD)	p value
NPRS (0–10)	Experimental	7.0 ± 0.8	3.0 ± 1.4	<0.001
	Control	7.0 ± 0.9	5.0 ± 0.9	<0.001
PRTEE (0–100)	Experimental	61 ± 3.9	27 ± 6.0	<0.001
	Control	62 ± 3.8	38 ± 4.9	<0.001

1. Between-Group Comparison

On between-group comparison using the independent-samples t-test, the Experimental Group showed a significantly greater improvement than the Control Group for both outcome measures (Table 4)

Table 4: Between-group comparison of change scores (Experimental vs. Control).

Outcome	Independent t-test (t value)	p value	Interpretation
NPRS	t = −5.84	<0.001	Experimental significantly better
PRTEE	t = −5.62	<0.001	Experimental significantly better

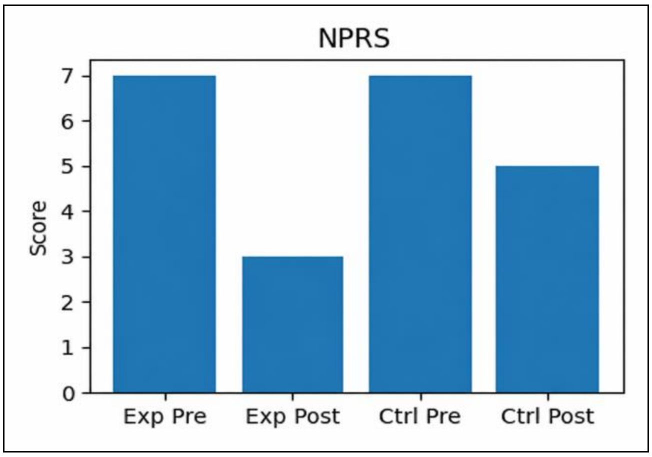

Fig 1: Numerical Pain Rating Scale (NPRS) mean ± SD, Experimental vs. Control, baseline to week 8.

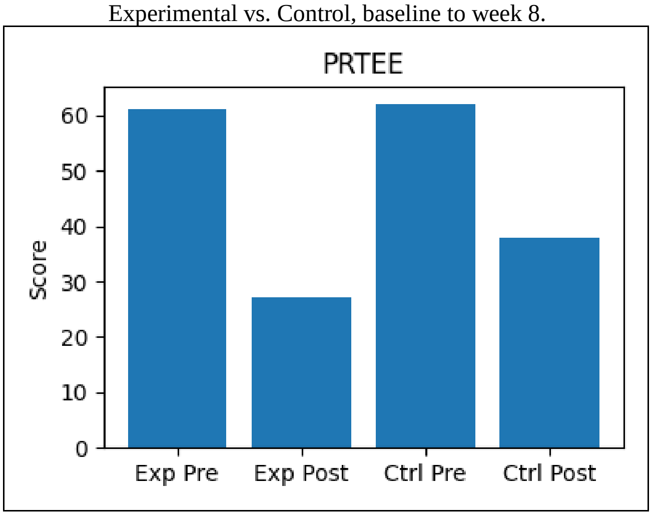

Fig 2: Patient-Rated Tennis Elbow Evaluation (PRTEE) mean ± SD, Experimental vs. Control, baseline to week 8

In summary, both interventions produced statistically significant reductions in pain and functional disability, but the addition of scapular neuromuscular control training to eccentric wrist extensor exercise resulted in significantly greater improvement than eccentric exercise alone, with large between-group effect sizes for both outcome measures. On the basis of these findings, the alternate hypothesis was accepted and the null hypothesis was rejected.

Discussion

The findings of this randomized controlled trial demonstrate that scapular neuromuscular control training, when combined with eccentric wrist extensor exercises, is a more effective physiotherapy intervention than eccentric exercise alone for patients with chronic lateral epicondylalgia. Following eight weeks of intervention, both groups showed a significant reduction in pain, as measured by the Numerical Pain Rating Scale, consistent with the well-established capacity of eccentric loading to promote tendon remodelling and symptom relief [11, 24]. However, the Experimental Group showed a significantly greater reduction in pain than the Control Group, suggesting that restoring scapular stability and neuromuscular control confers additional benefit beyond local tendon loading alone.

Functional disability, assessed using the Patient-Rated Tennis Elbow Evaluation, improved markedly in both groups, with the Experimental Group achieving significantly lower post-treatment scores. This reflects an enhanced capacity to perform activities of daily living and occupational tasks and may be attributable to improved scapular positioning and neuromuscular control, which reduces compensatory loading at the elbow and wrist during functional movement. This pattern is consistent with the principle of regional interdependence, whereby impairments at the shoulder girdle contribute to, and their correction can relieve, distal symptoms at the elbow [10].

These findings align closely with previous work by Coombes *et al*., Chester *et al*., Kibler *et al*. and Martinez-Silvestrini *et al*., who reported that scapular-focused neuromuscular rehabilitation improves muscle activation, movement efficiency and functional outcomes when combined with distal strengthening in patients with upper-limb tendinopathies [3, 5, 6, 14]. The magnitude of between-group difference observed here (NPRS: t=−5.84; PRTEE: t=−5.62; both p<0.001) is also consistent with the superior outcomes reported by Kim *et al*. and Saito *et al*. for scapular neuromuscular control interventions in upper-extremity tendinopathy [20, 22], and with the systematic review evidence of Bateman *et al*. supporting motor-control training as an adjunct to conventional loading in chronic tendinopathy [21].

Mechanistically, these results may be explained by the interaction between altered scapular kinematics and distal tendon loading described by Kibler and colleagues [6, 7], the electromyographic evidence of scapular muscle dysfunction reported by Alizadehkhaiyat *et al*. and Chester *et al* [4, 5]., and the broader neurophysiological model of pain-related motor reorganisation proposed by Hodges and Tucker [9]. By retraining scapular positioning, activation timing and dynamic stability, the Experimental Group intervention may have reduced compensatory overload of the wrist extensor tendon during functional and occupational activity, thereby accelerating symptomatic and functional recovery beyond what eccentric loading achieves in isolation. Overall, the present findings support scapular neuromuscular control training as a valuable adjunct to eccentric wrist extensor exercise, offering a safe, evidence-based conservative treatment approach for patients with chronic lateral epicondylalgia.

Limitations

Several limitations should be considered when interpreting these findings. The sample size (n=30) was relatively small and drawn from a single centre, which may limit the generalisability and external validity of the results. The 8-week intervention period, combined with the absence of long-term follow-up, precludes conclusions about the durability of treatment effects or recurrence rates beyond the immediate post-treatment period. While the outcome assessor was blinded, the treating therapist and participants could not be blinded to group allocation, introducing a potential risk of performance bias. Outcome assessment relied on patient-reported measures of pain and disability, which are inherently subject to individual perception, and confounding factors such as occupational demands, psychological status, prior treatment history and home-exercise compliance outside the supervised sessions were not fully controlled. The study was also restricted to participants aged 20–50 years, limiting applicability to younger or older populations. Future research should employ larger, multicentre samples with longer follow-up, incorporate objective biomechanical and electromyographic outcome measures, and compare scapular neuromuscular control training against other evidence-based adjunctive interventions such as manual therapy or extracorporeal shockwave therapy.

Conclusion

This randomized controlled trial demonstrates that scapular neuromuscular control training combined with eccentric wrist extensor exercises is an effective physiotherapy intervention for patients with chronic lateral epicondylalgia. Following an eight-week treatment programme, both the Experimental and Control groups showed significant reductions in pain and functional disability; however, the addition of scapular neuromuscular control training produced significantly greater improvement than eccentric exercise alone across both outcome measures. These findings indicate that addressing proximal scapular impairments enhances the effectiveness of distal eccentric strengthening and support the incorporation of scapular neuromuscular control training as a safe, evidence-based adjunct to conventional eccentric exercise in the conservative management of chronic lateral epicondylalgia.

Declarations

Ethical Approval: Institutional ethical approval was obtained prior to commencement of the study

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

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author Contributions: All authors contributed to study conception and design, data collection, analysis and interpretation, and drafting and critical revision of the manuscript. All authors read and approved the final manuscript.

References

1. Sanders TL, Maradit Kremers H, Bryan AJ, Ransom JE, Morrey BF, Sanchez-Sotelo J. Epidemiology of lateral epicondylitis. Am J Sports Med. 2015;43(5):1066–1071.
2. Cullinane FL, Boocock MG, Trevelyan FC. Is occupational exposure associated with lateral epicondylitis? A systematic review. BMC Musculoskelet Disord. 2014;15:329.
3. Coombes BK, Bisset L, Vicenzino B. Management of lateral elbow tendinopathy: one size does not fit all. J Orthop Sports Phys Ther. 2015;45(11):938–949.
4. Alizadehkhaiyat O, Fisher AC, Kemp GJ, Frostick SP, Wheway K. Upper limb muscle imbalance in tennis elbow: a functional and electromyographic assessment. J Orthop Res. 2017;35(2):337–345.
5. Chester R, Smith TO, Sweeting D, Dixon J, Wood S, Song F. Shoulder muscle weakness in patients with lateral epicondylalgia. Man Ther. 2018;38:123–130.
6. Kibler WB, Sciascia A, Uhl T. Role of the scapula in athletic shoulder function. Am J Sports Med. 2013;41(5):1106–1116.
7. Kibler WB, Sciascia A. Current concepts: scapular dyskinesis. Br J Sports Med. 2019;53(14):875–885.
8. Waugh EJ, Jaglal SB, Davis AM, Tomlinson G, Verrier MC. Sensorimotor deficits in lateral epicondylalgia. J Orthop Sports Phys Ther. 2015;45(3):198–206.

9. Hodges PW, Tucker K. Moving differently in pain: a new theory to explain the adaptation to pain. Pain. 2011;152(3 Suppl):S90–S98.
10. Lucado AM, Dale RB, Vincent J. Regional interdependence in lateral epicondylalgia. J Hand Ther. 2019;32(1):45–52.
11. Stasinopoulos D, Johnson MI. Eccentric exercise in lateral elbow tendinopathy. J Exerc Rehabil. 2017;13(2):123–130.
12. Bisset L, Vicenzino B. Physiotherapy management of lateral epicondylalgia. J Physiother. 2015;61(4):174–181.
13. Vicenzino B, Bisset L, Coombes B. Current concepts in lateral elbow tendinopathy. Sports Med. 2018;48(6):1237–1250.
14. Martinez-Silvestrini JA, Newcomer KL, Schaefer MP. Combined proximal and distal strengthening in chronic lateral epicondylalgia. J Hand Ther. 2023;36(1):41–50.
15. Struyf F, Nijs J, Meeus M, Mottram S, Truijen S. Scapular-focused treatment in upper limb disorders. Man Ther. 2014;19(5):401–409.
16. Uygur F, Aktaş B, Yılmaz M. Proximal stability and grip strength relationship. J Sports Sci Med. 2021;20(1):78–84.
17. Wettstein J, Queen R, Abbey A, Moorman CT. Scapular stability and grip strength. Am J Sports Med. 2017;45(9):2115–2122.
18. Rio E, Kidgell D, Purdam C, Gaida J, Moseley GL, Pearce AJ, Cook J. Tendon neuroplastic training: changing the way we think about tendon rehabilitation. Br J Sports Med. 2019;53(4):209–215.
19. Fernández-Carnero J, Fernández-de-las-Peñas C, de la Llave-Rincón AI, Ge HY, Arendt-Nielsen L. Widespread mechanical pain sensitivity in tennis elbow. Clin J Pain. 2016;32(3):243–249.
20. Saito M, Nakagawa S, Watanabe T. Effects of scapular stabilization exercises on upper limb disorders. Clin Rehabil. 2020;34(8):1035–1045.
21. Bateman M, O'Donnell J, Littlewood C. Neuromuscular control interventions in chronic tendinopathy: a systematic review. Phys Ther Rev. 2022;27(1):1–12.
22. Kim HJ, Park JH, Lee SY. Scapular neuromuscular training in upper extremity tendinopathy. J Sports Rehabil. 2024;33(2):145–153.
23. Yoon JP, Chung SW, Kim JE, Kim HS, Jeon IH. Clinical outcomes of exercise-based rehabilitation in chronic tendinopathy. Clin Orthop Surg. 2022;14(2):177–186.
24. Peterson M, Butler S, Eriksson M, Svärdsudd K. A randomized controlled trial of eccentric vs. concentric graded exercise in chronic tennis elbow (lateral elbow tendinopathy). Clin Rehabil. 2014;28(9):862–8