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Prevalence of Scapular Muscles Weakness in Painters with Lateral Epicondylitis

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ABSTRACT

Background: Lateral epicondylitis (LE), commonly known as tennis elbow, is frequently observed in occupational groups such as painters, where repetitive upper limb activity places stress on both distal and proximal musculature. Emerging evidence suggests that scapular muscle weakness may exacerbate symptoms and functional limitations in individuals with LE.
Objective: To assess the prevalence of scapular muscle weakness in painters diagnosed with lateral epicondylitis and examine its correlation with pain intensity, grip strength, and functional disability.
Methods: A cross-sectional observational study was conducted involving 100 painters aged 30–55 years with clinically diagnosed LE. Primary outcomes included pain intensity (VAS), grip strength (hand dynamometer), and functional status (PRTEE questionnaire). Secondary outcomes involved assessment of elbow and wrist ROM, muscle tenderness, and scapular muscle dysfunction.
Results: Serratus anterior weakness was present in 41% of participants, lower trapezius in 38%, and rhomboid/middle trapezius in 28%. Scapular dysfunction demonstrated a strong positive correlation with PRTEE scores (r = 0.68), moderate positive correlation with pain (VAS) (r = 0.59), and a moderate negative correlation with grip strength (r = –0.61), all statistically significant ($p < 0.001$).
Conclusion: Scapular muscle weakness is highly prevalent among painters with LE and significantly correlates with pain and disability. Integrated rehabilitation targeting scapular stabilization may enhance outcomes in occupational settings with high upper limb demand.

Keywords: *Lateral Epicondylitis, Scapular Muscles Weakness, Occupational Overuse Injury, Grip Strength, Functional Disability*

INTRODUCTION

Tennis elbow, medically termed lateral epicondylitis, is a musculoskeletal condition marked by pain, tenderness, and discomfort along the lateral aspect of the humerus, specifically at the epicondyle. This ailment arises from nonspecific inflammatory changes at the origin of the forearm's extensor muscles, primarily due to repetitive strain and overuse.[1] The resulting microtrauma compromises the integrity of the extensor tendon, leading to functional

limitations. Most commonly affecting the dominant hand, tennis elbow has a reported prevalence of approximately 1–3% in the general population.[2]

Tennis elbow may arise either as an acute trauma or as an overuse injury, typically associated with repetitive wrist extension against resistance.[3] This condition predominantly affects individuals between the ages of 30 and 55, often corresponding to periods of peak occupational or recreational activity.[4] The most commonly involved musculature includes the extensor carpi radialis brevis, followed by the extensor carpi radialis longus, and less frequently, the extensor carpi ulnaris; all originating from the lateral epicondyle of the humerus.

Owing to its anatomical configuration and functional demands, this region is particularly vulnerable to shearing forces during arm movements. Biomechanically, tennis elbow is regarded as a mechanically driven pathology, where cumulative microtrauma disrupts the integrity of the extensor tendon complex.[4]

Lateral epicondylitis, commonly known as tennis elbow, arises from a combination of factors such as poor blood circulation, aging, lack of flexibility, and overuse of the extensor muscles. Key contributors include excessive forearm pronation with an extended elbow, exaggerated wrist flexion during activities like serving, and performing physically demanding tasks repetitively.[4]

Individuals affected by lateral epicondylitis often experience persistent pain and functional limitations that disrupt daily activities, particularly those involving wrist and forearm movements. One of the hallmark symptoms is a reduction in grip strength, accompanied by increased pain during exertion.[4,5]

Among the occupations at higher risk, painters are frequently linked to this condition. The repetitive and forceful use of the forearm muscles, especially during extended wrist and hand movements, can lead to significant strain. Actions such as long-duration reverse gripping, forceful pushing techniques, plastering, and using brushes with short, rapid strokes place intense pressure on the muscles, resulting in inflammation and chronic stress.[4,5]

Individuals with lateral epicondylitis often exhibit significant weakness in the upper, middle, and lower trapezius, as well as the serratus anterior, accompanied by reduced scapular muscle endurance. These muscular deficits disrupt the natural biomechanical harmony essential for upper limb function.[6]

Upper extremity movements follow a proximal-to-distal sequencing pattern, where motion and energy are initiated from the core and shoulder girdle, then transferred toward the wrist and hand. According to the kinetic chain principle, efficient and functional arm movements rely on this synchronized transfer of energy.[6,7]

When proximal stability is compromised, as seen with weakened scapular stabilizers, it places increased mechanical stress on the distal segments of the arm. This imbalance can lead to compensatory overloading, ultimately exacerbating strain and dysfunction in the forearm and wrist areas already vulnerable in individuals with tennis elbow.[6,7]

When proximal motor control is compromised particularly involving the scapular muscles; the distal tissues at the elbow and wrist become more susceptible to strain. This deficiency increases the energy demands placed on the forearm muscles, predisposing them to overuse and injury.[8]

Painters, in particular, are at high risk due to the nature of their work. They often engage in overhead tasks beyond 90 degrees and utilize pushing techniques during shoulder-to-hip movements. Sustained activity with the arms held at or above shoulder level leads to pain and weakness in the scapular stabilizers, while also impeding blood flow to key muscles such as the trapezius and serratus anterior. This vascular compromise contributes to early muscle fatigue and a decline in endurance, further affecting functional performance.[8]

Research indicates that the trapezius and serratus anterior muscles are actively engaged during forearm flexion and hand

lifting. These muscles play a critical role in maintaining scapular stability, which is essential for efficient upper limb function.

When scapular control is compromised, the distal segments of the limb particularly the elbow and wrist must exert significantly more energy to compensate. According to the principles of the kinetic chain, movement of the upper limb follows a proximal-to-distal energy transfer, meaning that motion initiated at the shoulder must flow smoothly to the forearm and hand.[9]

However, when scapular stabilizers are weakened, this transfer becomes inefficient, increasing the mechanical demands on the distal joints. Over time, this elevated energy requirement can lead to excessive loading and overuse of the elbow, contributing to dysfunction and injury.[6]

The aim and objective of this study are centered on understanding the prevalence of scapular muscle weakness in painters diagnosed with lateral epicondylitis. Specifically, the research seeks to determine how commonly this muscular deficiency occurs within this occupational group, shedding light on the potential link between repetitive overhead arm movements and compromised scapular stability in individuals suffering from lateral epicondylitis.

METHODOLOGY

Study Design: A cross-sectional observational study was conducted to examine the clinical profile and biomechanical implications of lateral epicondylitis among 100 individuals aged 30 to 55 years.

Inclusion Criteria: Adults aged 30–55 years with painting profession, Clinical diagnosis of tennis elbow (lateral epicondylitis) confirmed through pain on palpation over the lateral epicondyle and pain during resisted wrist extension, Symptoms persisting for at least 2 weeks, Dominant hand involvement, Painters who works for more than 04 hours.

Exclusion Criteria: History of elbow trauma, rheumatoid arthritis, or neurological disorders affecting the upper limb, Prior surgical intervention on the affected limb, Concurrent musculoskeletal conditions (e.g., carpal tunnel syndrome, rotator cuff injury).

Clinical Evaluation: Diagnosis was established through standardized clinical tests such as the Cozen's Test, Mill's Test, and Maudsley's Test to assess pain provocation during resisted wrist and finger extension.

Outcome Measures: Primary outcomes included Pain intensity measured using the Visual Analog Scale (VAS), Grip strength assessed using a calibrated hand dynamometer, Functional disability evaluated through the Patient-Rated Tennis Elbow Evaluation (PRTEE) questionnaire.[10] Secondary outcomes included Assessment of range of motion (ROM) and muscle tenderness. Anatomical mapping of pain distribution and muscle involvement (primarily ECRB, ECRL, and ECU).

Biomechanical Considerations: Anatomical assessment focused on the vulnerability of the lateral epicondyle to repetitive tensile and shearing forces, especially during wrist extension against resistance. Detailed palpation and resisted movement patterns were documented to correlate symptom severity with mechanical loading.

STATISTICAL ANALYSIS

Data were analyzed using SPSS (Statistical Package for the Social Sciences), version 21.0. Descriptive statistics (mean, standard deviation) were calculated for all continuous variables. Independent t-tests were employed to compare mean values of grip strength and pain between affected and unaffected arms. Pearson's correlation coefficient was used to assess the relationship between pain intensity and functional disability scores. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 100 participants (mean age: 43.2 ± 5.8 years) were included, with the age distribution ranging from 30 to 55 years (Table 1). The majority (83%) were between 22–47 years (Figure 1). All participants were

engaged in painting-related activities, with 63% involved in ceiling, putti removal, and stroking work, and 71% reporting daily activity durations of 6 hours (Table 2).

Primary Outcomes: Pain Intensity (VAS) the mean score was 6.9 ± 1.3, indicating moderate to severe pain, Grip Strength significantly reduced in the dominant (affected) side (22.1 ± 4.9 kg) compared to the non-dominant side (35.5 ± 5.1 kg), Functional Disability (PRTEE) the mean score was 54.1 ± 10.2, suggesting substantial functional impairment (Table 1).

Secondary Outcomes: ROM Restrictions found in 48% at the elbow (extension and supination) and 62% at the wrist (extension and radial deviation), Muscle Tenderness predominantly over ECRB (86%), followed by ECRL and ECU (Table 3).

Scapular Dysfunction: Serratus Anterior dysfunction (41%) as winging and poor protraction, Lower Trapezius (38%) as delayed activation and impaired scapular stabilization, Rhomboids/Middle Trapezius (28%) as incomplete retraction and medial border drift (Table 4).

Pearson's correlation analysis revealed a strong positive correlation between scapular dysfunction and functional disability (PRTEE) ($r = 0.68$, $p < 0.001$), a moderate positive correlation with pain intensity (VAS) ($r = 0.59$, $p < 0.001$), a moderate negative correlation with grip strength ($r = -0.61$, $p < 0.001$). These findings underscore the significant interplay between proximal scapular dysfunction and distal lateral epicondylitis presentation (Table 5).

VARIABLES	Mean ± SD	Range
Age (Years)	43.2 ± 5.8	30 – 55
Pain Intensity (VAS)	6.9 ± 1.3	4 – 9
Grip Strength (Kg) – Dominant Side	22.1 ± 4.9	12 - 32
Grip Strength (Kg) – Non-dominant Side	35.5 ± 5.1	25 – 46
Functional Disability (PRTEE)	54.1 ± 10.2	36 - 72

Table 1: Demographic and Baseline Data

Painting Activity		Frequency (%)
Type of Work	Roller Painting	6%
	Brush Painting	10%
	Ladder Painting	21%
	Ceiling, Putti Removing, Stroking	63%
Duration of Activity	4 Hours	4%
	5 Hours	18%
	6 Hours	71%
	> 6 ours	7%
Dominant Symptoms	Pain	8%
	Tenderness	92%

Table 2: Job Characteristics of the Participants

Secondary Outcomes		% Affected
Restricted ROM	Elbow (Extension, Supination)	48%
	Wrist (Extension, Radial Deviation)	62%
Muscle Tenderness	ECRB	86%
	ECRL	52%
	ECU	18%

Table 3: Secondary Outcomes of the Sample

Scapular Muscles	Dysfunction Prevalence	Clinical Observations
Serratus Anterior	41%	Winging, Poor Protraction
Lower Trapezius	38%	Delayed Activation, Poor Scapular Control
Rhomboids/ Middle Trapezius	28%	Incomplete Retraction and Medial Border Drift

Table 4: Scapular Dysfunction and Clinical Findings

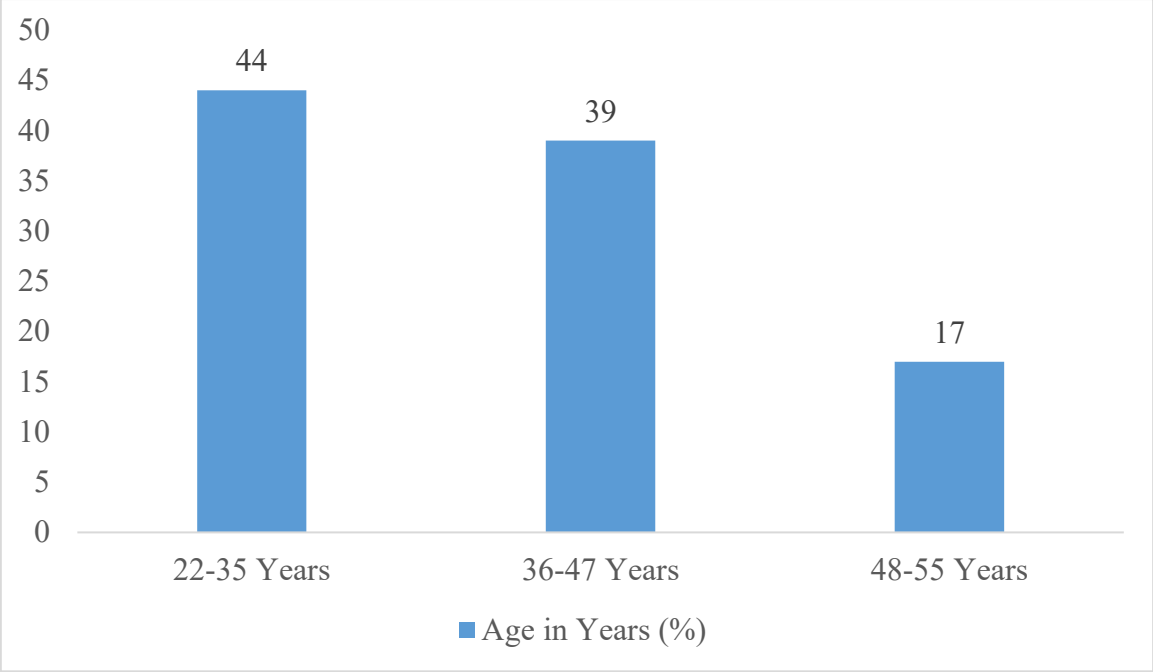

Figure 1: Age Distribution of the Participants

Comparison	r Value	p value	Correlation Strength	Interpretation
Scapular Dysfunction vs PRTEE Score	0.68	<0.001	Moderate to Strong (Positive)	Increased scapular dysfunction linked to higher functional disability
Scapular Dysfunction vs VAS Score	0.59	<0.001	Moderate (Positive)	Greater scapular involvement associated with higher pain levels
Scapular Dysfunction vs Grip Strength	-0.61	<0.001	Moderate (Negative)	Poor scapular control correlated with reduced grip strength

Table 5: Pearson's Correlation between Scapular Dysfunction and Tennis Elbow

DISCUSSION

The present study examined scapular muscle dysfunction among painters diagnosed with lateral epicondylitis (LE), emphasizing its prevalence, clinical significance, and correlation with symptom severity. Findings reveal a striking presence of scapular weakness particularly in the serratus anterior, lower trapezius, and rhomboid/middle trapezius which strongly correlates with higher pain levels, reduced grip strength, and greater functional disability.

Painters are especially prone to LE due to the biomechanical demands of repetitive overhead tasks, wrist extension under load, and static elevation of the upper limbs (Van Rijn et al., 2009).[11] In our study cohort, most participants were involved in ceiling and wall activities for over 6 hours daily, reflecting prolonged kinetic chain loading. The average VAS score of 6.9 and PRTEE score of 54.1 indicate moderate to severe clinical burden.

Consistent with previous studies, the extensor carpi radialis brevis (ECRB) was the most frequently involved muscle (Alizadehkhaiyat et al., 2007), confirming its susceptibility to microtrauma during repetitive wrist extension.[12] However, this study extends the clinical landscape by highlighting how proximal impairments may contribute to or exacerbate distal symptoms.

The most novel finding of this research is the high prevalence of scapular muscle dysfunction. Specifically, 41% of participants demonstrated serratus anterior weakness, 38% had lower trapezius dysfunction, and 28% had compromised rhomboid/middle trapezius function. These muscles are essential for scapulothoracic stability and play a pivotal role in dissipating mechanical load during upper limb motion

(Kibler et al., 2013).[13] When weakened, they may fail to anchor the scapula adequately, altering glenohumeral mechanics and transferring undue strain to distal segments such as the lateral elbow (Kibler W B et al., 2012).[14]

Statistically, scapular dysfunction showed a strong positive correlation with functional impairment ($r = 0.68$, $p < 0.001$), moderate positive correlation with pain intensity ($r = 0.59$, $p < 0.001$), and a moderate negative correlation with grip strength ($r = –0.61$, $p < 0.001$). These correlations align with the regional interdependence theory, which posits that impairments in one anatomical region can influence function in another (Sueki et al., 2013).[15] In the context of LE, scapular dyskinesis appears to compound mechanical stressors through kinetic chain inefficiency.

The role of scapular stabilization in LE has not been extensively studied, though evidence from overhead athletes supports a similar mechanism. Kibler W B et al. (2012) reported that athletes with scapular dyskinesis were more likely to develop elbow and shoulder injuries.[14] Likewise, Rokito A S et al. (1998) demonstrated that proper scapular control is crucial for force coupling and efficient energy transfer during upper limb motion.[16] These studies reinforce the notion that painters whose tasks mimic overhead athletic motion may benefit from similar preventive and rehabilitative strategies (Madhuripu et al. 2018; Riyas et al. 2021).[17,18]

Furthermore, this study documented ROM limitations in 48% of participants at the elbow and 62% at the wrist, mainly affecting extension and supination. These findings are likely multifactorial stemming from pain avoidance behavior, mechanical constraints, and compensatory movement patterns linked to poor scapular mechanics (Susan E G Sims et al., 2014).[19] It is notable that those with scapular dysfunction also reported higher PRTEE scores and symptom duration, suggesting that proximal impairments may hinder recovery and perpetuate chronicity.

From a therapeutic perspective, these insights advocate for a more integrated rehabilitation approach. While eccentric loading of the forearm extensors remains a cornerstone of LE management (Coombes et al., 2015), there is growing rationale for incorporating scapular stabilization exercises into treatment plans.[20] Strengthening the serratus anterior and lower trapezius has been shown to restore normal scapular motion and reduce distal compensatory strain (Sciasca A et al., 2013).[21] For painters, ergonomic adaptations and postural retraining may further alleviate mechanical overload and prevent recurrence.

This study reveals a high prevalence of scapular muscle weakness among painters with LE and highlights its clinical and statistical association with pain, strength deficits, and disability. These findings underscore the importance of addressing proximal kinetic chain dysfunction in both the assessment and rehabilitation of lateral epicondylitis, particularly in occupational settings characterized by repetitive upper limb demand.

This study, while informative, is subject to certain limitations. The cross-sectional design limits causal interpretation between scapular muscle weakness and the severity of lateral epicondylitis, and clinical assessments of scapular dysfunction were based on observation rather than electromyographic validation. Additionally, the sample was restricted to painters, which may limit generalizability to other occupational groups or athletic populations. Future research should consider longitudinal designs to examine temporal relationships, incorporate objective tools such as surface EMG or motion analysis to enhance diagnostic accuracy, and explore the efficacy of scapular-focused rehabilitation protocols. Broader ergonomic assessments and subgroup analyses based on sex, posture, and task type could also provide richer insights for prevention and clinical management.

CONCLUSION

Based on the findings of this study, it can be concluded that scapular muscle weakness is a prevalent and clinically significant feature among painters suffering from lateral epicondylitis. The observed dysfunction in key stabilizing muscles particularly the serratus anterior, lower trapezius, and rhomboid/middle trapezius demonstrates a meaningful association with heightened pain levels, reduced grip strength, and increased functional disability.

These results underscore the importance of considering the proximal kinetic chain, especially scapular mechanics, in the comprehensive evaluation and management of work-related lateral elbow pain. The physically demanding and overhead-intensive nature of painting tasks appears to exacerbate both distal and proximal musculoskeletal imbalances. Incorporating scapular muscles focused rehabilitation and ergonomic strategies into routine care may therefore enhance outcomes and reduce recurrence in this occupational population.

Declaration by Authors

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