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ISSN: 2663-9491 e-ISSN: 2789-6897

ORIGINAL ARTICLE

Pain and Functional Recovery in Lateral Epicondylitis: An Evaluation of ESWT and Ultrasound Therapy

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Received: 15 July 2026
Accepted: 24 July 2026
Published Online: 29 July 2026

Published by:
Gopalganj Medical College, Gopalganj, Bangladesh

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DOI:

ABSTRACT

Background*: Lateral epicondylitis is a common degenerative tendinopathy of the elbow that causes pain and functional impairment, particularly in individuals involved in repetitive upper-limb activities. Extracorporeal shock wave therapy (ESWT) and therapeutic ultrasound therapy (UST) are widely used conservative treatment modalities; however, comparative evidence regarding their effectiveness remains limited. Aim of the study: To compare the effectiveness of extracorporeal shock wave therapy and therapeutic ultrasound therapy on pain reduction and functional recovery in patients with lateral epicondylitis.* ***Methods & Materials****: This prospective comparative interventional study was conducted at the Department of Physical Medicine and Rehabilitation, Dhaka Medical College Hospital, from June 2019 to May 2020. Sixty patients with clinically diagnosed lateral epicondylitis were allocated into two groups: ESWT (n = 30) and UST (n = 30). Both groups received their respective modalities along with NSAIDs, activity-of-daily-living advice, and therapeutic exercises for three weeks. Pain intensity was assessed using the Visual Analog Scale (VAS) at rest and during resisted wrist extension (RWE). Functional recovery was evaluated using hand grip strength and the Patient-Rated Tennis Elbow Evaluation (PRTEE) score. Outcomes were assessed at baseline and at the fourth follow-up. Result: Both ESWT and UST groups demonstrated statistically significant improvements in pain and functional outcomes. VAS scores at rest and during RWE significantly decreased in both groups by the fourth follow-up ($p \leq 0.001$). Grip strength significantly improved, and PRTEE scores markedly decreased in both groups ($p < 0.001$). Although improvements were observed in both modalities, the UST group showed slightly greater reductions in pain during resisted wrist extension and marginally better functional outcomes; however, these differences were not consistently statistically significant. Treatment adherence, patient satisfaction, and recurrence rates were comparable between groups. Conclusion: Both extracorporeal shock wave therapy and therapeutic ultrasound therapy are effective, safe, and well-tolerated treatment options for reducing pain and improving functional outcomes in patients with lateral epicondylitis. Therapeutic ultrasound demonstrated slightly better short-term pain relief and functional recovery, though both modalities can be recommended as part of conservative management.*

Keywords: *Lateral epicondylitis; Tennis elbow; Extracorporeal shock wave therapy; Ultrasound therapy; Pain; Functional recovery*

(The Insight 2026; 9(3): 526-530)

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INTRODUCTION

Lateral epicondylitis commonly known as tennis elbow, is a painful condition affecting the outer aspect of the elbow. It results from overuse of the wrist extensor tendons, especially the extensor carpi radialis brevis [1]. The disorder is primarily a degenerative tendinopathy rather than an acute inflammatory condition and patients experience lateral elbow pain that worsens with gripping, lifting, or repetitive wrist extension, leading to functional limitations in daily life [2]. Globally, lateral epicondylitis affects approximately 1% to 3% of adults, with higher rates in populations engaged in repetitive upper-limb activities [3]. The incidence peaks between 35 and 54 years of age, although younger and older adults can also develop the condition [4]. In Bangladesh, musculoskeletal disorders are highly prevalent, and lateral epicondylitis contributes to a notable proportion of chronic elbow complaints, accounting for approximately 2.77% of adult musculoskeletal cases [5,6]. Repetitive household and work-related tasks can increase the risk, with prevalence reaching 31–39% among women performing manual domestic work [7]. Both males and females are affected and the condition is recognized as one of the most common causes of elbow pain in adults worldwide [3]. Occupational and recreational repetitive movements such as in manual labor or racquet sports, increase the risk of developing

ISSN: 2663-9491 e-ISSN: 2789-6897

lateral epicondylitis [8]. The disorder not only causes pain but also affects work productivity, daily function and overall quality of life [2]. The main cause of lateral epicondylitis is repetitive micro-trauma and overload of the extensor tendons [1]. Forceful gripping, repetitive wrist extension, and prolonged forearm activity lead to tendon degeneration also [9]. Occupational exposures such as heavy lifting, vibrating tools, and repetitive tasks, further increase the risk of developing the condition and age-related degenerative changes in tendon structure also predispose individuals to chronic symptoms [10,11]. Lateral epicondylitis leads to ongoing pain and weakened grip, making it difficult to carry out everyday tasks like lifting, carrying, or doing household work [2]. The condition can result in functional disability, decreased work efficiency, and lower quality of life [12]. Patients often seek medical care for pain relief and rehabilitation, which increases healthcare utilization and socioeconomic costs [13]. Conservative management, including activity modification, physical therapy, and therapeutic modalities, is the mainstay of treatment [1]. Extracorporeal shock wave therapy (ESWT) is increasingly used to reduce pain and promote tendon healing by stimulating tissue regeneration [12]. Therapeutic ultrasound improves blood flow, reduces inflammation, and facilitates tissue repair [9]. However, comparative evidence on the effectiveness of ESWT versus ultrasound therapy in pain relief and functional recovery is limited [13]. A direct comparison between ESWT and ultrasound therapy is necessary to determine which modality provides superior pain relief and functional recovery in patients with lateral epicondylitis. The aim of this study is to evaluate and compare the effectiveness of extracorporeal shock wave therapy and ultrasound therapy on pain intensity and functional recovery in patients with lateral epicondylitis.

METHODS & MATERIALS

This was a prospective comparative interventional study conducted in the Outpatient Department of Physical Medicine and Rehabilitation, Dhaka Medical College Hospital (DMCH), Dhaka. The study duration was one year, from June 2019 to May 2020. The objective was to compare the effectiveness of extracorporeal shock wave therapy (ESWT) and therapeutic ultrasound therapy (UST) on pain reduction and functional recovery in patients with lateral epicondylitis. A total of 60 patients with clinically diagnosed lateral epicondylitis were enrolled using purposive sampling technique. Participants were equally allocated into two groups:

ESWT group (n = 30): Patients receiving extracorporeal shock wave therapy
UST group (n = 30): Patients receiving therapeutic ultrasound therapy

Inclusion Criteria

- Age between 30 and 60 years
- Localized pain over the lateral aspect of the elbow
- Involvement of either the dominant or non-dominant elbow
- VAS score ≥3 during resisted wrist extension
- Duration of symptoms greater than 1 month

Exclusion Criteria

- Previous elbow surgery or fracture
- Corticosteroid injection in the affected elbow within the last 3 months
- Inflammatory arthritis or systemic rheumatologic disease
- Neurological disorders affecting the upper limb
- Intake of NSAIDs within 48 hours prior to intervention
- Pregnancy
- Active infection or skin lesions at the treatment site

Ethical Considerations

Ethical approval was obtained from the Ethical Review Committee of Dhaka Medical College. Written informed consent was obtained from all participants prior to enrollment, and confidentiality of patient data was maintained throughout the study. No financial incentives were provided.

Intervention Protocols

ESWT Group:
Participants in Group A received extracorporeal shock wave therapy as the primary intervention, along with NSAIDs, advice regarding activities of daily living (ADL), and therapeutic exercises. ESWT was administered using the BTL-5000 SWT Power device with the following parameters:

- Frequency: 4 Hz
- Energy density: 3 bars
- Number of shocks: 1000 per session
- Treatment schedule: Alternate days for 3 weeks

Aquasonic gel was used as the coupling medium. In addition, naproxen sodium 250 mg was prescribed twice daily for 15 days.

UST Group:
Participants in Group B received therapeutic ultrasound therapy along with NSAIDs, ADL advice, and therapeutic exercises. UST was delivered using the following parameters:

- Frequency: 3 MHz
- Intensity: 1.5 W/cm^2
- Mode: Pulsed
- Duration: 5 minutes per session
- Treatment schedule: Alternate days for 3 weeks

A 4 cm^2 transducer head was applied over the most tender area of the lateral epicondyle using a full-contact circular motion with Aquasonic gel. Naproxen sodium 250 mg twice daily for 15 days was also prescribed. All interventions were administered by trained therapists under the supervision of the researcher.

Data Collection

Data were collected in a structured and systematic manner using a pre-designed data collection sheet completed by the principal investigator. Baseline data included demographic characteristics such as age, sex, residence, occupation, and body mass index (BMI), as well as clinical and exposure-related variables, including duration of symptoms, dominant hand involvement, repetitive upper-limb use, daily household manual activity, occupational overuse history, and prior NSAID use. Height and weight were measured using standardized equipment to calculate BMI. Outcome measures were assessed at baseline before initiation of treatment and during follow-up visits, with the final evaluation conducted at the 4th follow-up. Pain intensity was measured using the Visual Analog Scale (VAS) both at rest and during resisted wrist extension (RWE). Functional recovery was evaluated by measuring hand grip strength using a calibrated hand grip dynamometer and by administering the Patient-Rated Tennis Elbow Evaluation (PRTEE) questionnaire. Treatment-related variables, including session completion rate, early pain relief, clinically significant

ISSN: 2663-9491 e-ISSN: 2789-6897

improvement in pain and PRTEE score, patient satisfaction, and recurrence of pain during follow-up, were recorded prospectively throughout the study period. All measurements were performed using standardized procedures to ensure consistency. Collected data were reviewed regularly for completeness and accuracy before entry into the database for statistical analysis.

Statistical Analysis

Statistical analysis was performed using SPSS version 20. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. Comparisons between groups were conducted using the independent sample t-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables. A p-value <0.05 was considered statistically significant, and p <0.001 was regarded as highly significant.

RESULT

Shows that the mean age was 42.60 ± 9.20 years in the ESWT group and 43.10 ± 7.80 years in the UST group. Overweight participants accounted for 60.00% and 70.00%, respectively. Males represented 30.00% of the ESWT group and 33.30% of the UST group, while females comprised 70.00% and 66.70%. Rural residence was observed in 16.70% of ESWT participants and 26.70% of UST participants, whereas urban residence predominated in both groups. Housewives constituted the largest occupational category (56.67% in ESWT and 50.00% in UST) (*Table I*).

Table I: Demographic characteristics of the study population (*n*=60).

Variable	ESWT (n=30)		UST (n=30)		p-value
	n	%	n	%	
Age (years), Mean ± SD	42.6 ± 9.2		43.1 ± 7.8		0.82
Overweight (BMI ≥25)	18	60.00	21	70.00	0.41
Gender					
Male	9	30.00	10	33.30	0.78
Female	21	70.00	20	66.70	
Residence					
Rural	5	16.70	8	26.70	0.36
Urban	25	83.30	22	73.30	
Occupation					
Housewife	17	56.67	15	50.00	0.6
Official job	2	6.67	1	3.33	
Overuse of upper extremity	3	10.00	5	16.67	
Business	2	6.67	3	10.00	
Others	6	20.00	6	20.00	

Similarly, repetitive upper-limb use was reported in 70.00% of ESWT participants and 76.70% of UST participants (p = 0.56). Daily household manual activity exceeding four hours was present in 56.70% of the ESWT group and 53.30% of the UST group (p = 0.80). Right-hand dominance was noted in 90.00% of ESWT patients and 86.70% of UST patients (p = 0.64). Prior NSAID use was reported by 60.00% of ESWT participants and 66.70% of UST participants (p = 0.59) (*Table II*).

Table II: Baseline characteristics of the study participants (*n*=60) .

Variable	ESWT (n=30)		UST (n=30)		p-value
	n	%	n	%	
Repetitive upper-limb use	21	70.00	23	76.70	0.56
Daily household manual activity >4 hours	17	56.70	16	53.30	0.8
Occupational overuse history	3	10.00	5	16.70	0.44
Dominant hand – Right	27	90.00	2	6.70	0.64
NSAID use prior to enrollment	18	60.00	20	66.70	0.59
Duration of symptoms <3 months	18	50.00	17	56.70	0.6

Baseline VAS scores at rest were 3.83 ± 1.74 in the ESWT group and 4.03 ± 1.63 in the UST group (p = 0.30), decreasing to 1.97 ± 1.71 and 1.73 ± 1.12, respectively, at the fourth follow-up (p = 0.001). VAS during resisted wrist extension decreased from 6.97 ± 1.58 and 6.60 ± 1.43 at baseline to 3.30 ± 1.79 and 1.93 ± 1.04, respectively, at the fourth follow-up (p < 0.001) (*Table III*).

Table III: Pain outcomes over follow-up.

Outcome	Time	ESWT (Mean ± SD)	UST (Mean ± SD)	p-value
VAS at rest	Baseline	3.83 ± 1.74	4.03 ± 1.63	0.3
	4th follow-up	1.97 ± 1.71	1.73 ± 1.12	0.001
VAS during RWE	Baseline	6.97 ± 1.58	6.60 ± 1.43	<0.001
	4th follow-up	3.30 ± 1.79	1.93 ± 1.04	<0.001

ISSN: 2663-9491 e-ISSN: 2789-6897

Grip strength increased from 7.14 ± 8.23 kg to 14.40 ± 9.89 kg in the ESWT group and from 8.18 ± 7.24 kg to 15.64 ± 7.41 kg in the UST group (p < 0.001). PRTEE scores decreased from 65.2 ± 3.78 to 28.7 ± 2.28 in the ESWT group and from 64.5 ± 4.34 to 28.2 ± 2.31 in the UST group (p < 0.001) (*Table IV*).

Table IV: Functional recovery outcomes.

Outcome	Time	ESWT (Mean ± SD)	UST (Mean ± SD)	p-value
Grip strength (kg)	Baseline	7.14±8.23	8.18±7.24	<0.001
	4th follow-up	14.4±9.89	15.64±7.41	<0.001
PRTEE score	Baseline	65.2±3.78	64.5±4.34	<0.001
	4th follow-up	28.7±2.28	28.2±2.31	<0.001

Finally, examines that ≥90% session completion was achieved by 83.30% of ESWT participants and 90.00% of UST participants (p = 0.45). A ≥50% reduction in VAS-RWE was observed in 70.00% and 80.00% of participants, clinically significant PRTEE improvement in 76.70% and 83.30%, early pain relief in 53.30% and 66.70%, and recurrence in 13.30% and 10.00%, respectively (*Table V*).

Table V: Treatment adherence, response pattern, and satisfaction (*n*=60).

Variable	ESWT (n=30)		UST (n=30)		p-value
	n	%	n	%	
Completed ≥90% sessions	25	83.30	27	90.00	0.45
≥50% reduction in VAS-RWE	21	70.00	24	80.00	0.37
Clinically significant PRTEE improvement (≥30 points)	23	76.70	25	83.30	0.52
Early pain relief (by 2nd FU)	16	53.30	20	66.70	0.29
Good to excellent patient satisfaction	20	66.70	23	76.70	0.39
Recurrence of pain during follow-up	4	13.30	3	10.00	0.69

DISCUSSION

Lateral epicondylitis, or tennis elbow, causes pain and weak grip from wrist extensor overuse. Treatments like ESWT and ultrasound aim to relieve pain and improve function. This study compared the two therapies to evaluate their overall clinical benefits and impact on patients' daily activities. In this study, baseline demographic characteristics such as age (42.6 ± 9.2 vs 43.1 ± 7.8 years; p = 0.82), gender (p = 0.78), BMI (p = 0.41), residence (p = 0.36), and occupational stratification (p = 0.6) were similar between the ESWT and UST groups. This balance ensures that any differences in outcomes are more likely related to the treatment effects rather than initial group differences. Yalvaç et al. also showed no significant differences in age or gender distribution between radial shockwave and ultrasound therapy groups before treatment, suggesting that both groups started from a similar clinical baseline [14]. Furthermore, ensuring similarity in baseline characteristics between ESWT and ultrasound groups is considered important for improving internal validity and reducing potential bias [13]. Our study found that clinical and activity-related features were similar between two groups, which include repetitive upper-limb use 70.0 % vs 76.7 % (p = 0.56), daily manual activity >4 hours 56.7 % vs 53.3 % (p = 0.80), NSAID use 60.0 % vs 66.7 % (p = 0.59), and symptom duration <3 months 50.0 % vs 56.7 % (p = 0.60). These balanced baseline profiles indicate that both groups had comparable exposure to common risk factors like repetitive use, manual workload, and medication history. While many RCTs, including those comparing ESWT and ultrasound, do not always report exact percentages for repetitive activity or NSAID use, they consistently ensure no significant baseline differences in clinical features between groups before treatment [14,15]. Similarly, Yalvaç et al. reported that ESWT vs ultrasound remained no significant differences in baseline clinical measures such as pain and functional status between treatment arms, presenting similar clinical starting points before intervention [14]. This contrasts with earlier observational study where baseline clinical variation made it harder to interpret treatment effects [15]. Overall, the similar activity levels of participants in our study show that our groups were well matched. In this present study, both the ESWT and UST groups showed statistically significant reductions in pain by the 4th follow-up. VAS at rest decreased from 3.83 ± 1.74 to 1.97 ± 1.71 in the ESWT group, and from 4.03 ± 1.63 to 1.73 ± 1.12 in the UST group (p = 0.001). VAS during resisted wrist extension fell from 6.97 ± 1.58 vs 6.60 ± 1.43 at baseline to 3.30 ± 1.79 vs 1.93 ± 1.04 at the 4th follow-up (p < 0.001). These results show pain relief with both modalities. Alharbi (2025) in his study found that ESWT yields significantly larger reductions in VAS than ultrasound (mean difference of −0.90, p < 0.0001), confirming that shockwave therapy may have a stronger analgesic effect [13]. Similarly, another study also found that ESWT led to significantly greater decreases in pain than ultrasound at 1-month and 3-month follow-ups (e.g., MD −1.42 to −1.65; p ≤ 0.00001) [15]. In contrast, few studies with smaller sample sizes reported both ESWT and ultrasound significantly reduced VAS scores from baseline with no clear superiority, indicating some variability depending on study design and follow-up duration [14,16,17]. Both ESWT and UST groups in our study experienced significant functional improvements by the 4th follow-up. Grip strength increased from 7.14 ± 8.23 kg to 14.4 ± 9.89 kg in the ESWT group and from 8.18 ± 7.24 kg to 15.64 ± 7.41 kg in the UST group (p < 0.001). PRTEE scores which measure pain and disability in tennis elbow improved from 65.2 ± 3.78 to 28.7 ± 2.28 in ESWT and from 64.5 ± 4.34 to 28.2 ± 2.31 in UST (p < 0.001). These changes show both therapies led to substantial recovery in strength and functional ability. Moreover, a study comparing US, ESWT and found that PRTEE scores significantly decreased in both the ESWT and US groups at 8 weeks, indicating functional improvement with both modalities (P < 0.05), though none was superior [18]. Other study suggested that long-term functional benefits may become more pronounced with ESWT at extended follow-ups, although short-to-medium-term differences are often small or statistically non-significant [15]. Our study reveals that there are high adherence and positive response patterns in both ESWT and UST groups. Most participants completed ≥90 % of sessions (83.3 % vs 90.0%; p = 0.45), and a large proportion achieved ≥50 % reduction in pain during resisted wrist

extension (70 % vs 80.0%; p = 0.37). Clinically significant PRTEE improvement was also high in both groups (76.70% vs 83.30%; p = 0.52), with good-to-excellent overall satisfaction (66.70 % vs 76.70 %; p = 0.39) and low recurrence rates (13.30 % vs 10.00 %; p = 0.69). These results show that ultrasound therapies are safer, well tolerated, and lead to clear clinical improvement in routine practice. These findings are consistent with other comparative research on ESWT and ultrasound in lateral epicondylitis [19]. In a randomized trial comparing focused shock wave and ultrasound therapies, both treatments produced significant pain relief and functional improvements, and subjective evaluations demonstrated high levels of patient-reported effectiveness and satisfaction with both modalities, although pain reduction was larger after ESWT [19]. Furthermore, a study also presented that both shockwave and ultrasound therapy improved quality of life and function in lateral epicondylitis, with high patient compliance and positive reported outcomes, supporting their effectiveness in real-world use [20].

LIMITATIONS

- Both groups received NSAIDs and therapeutic exercises, making it difficult to isolate the sole effect of ESWT or UST.
- Imaging modalities such as ultrasound or MRI were not used to correlate clinical improvement with structural tendon changes.

CONCLUSION

This study demonstrates that both extracorporeal shock wave therapy and therapeutic ultrasound therapy significantly reduce pain and improve functional outcomes in patients with lateral epicondylitis. Both modalities showed high patient adherence, good satisfaction, and low recurrence rates, indicating their effectiveness and acceptability in routine clinical practice. Although therapeutic ultrasound showed slightly superior short-term outcomes in pain relief and functional recovery, the overall benefits of both treatments were comparable.

FUNDING

No funding sources

CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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