

Role of Physical Modalities in Chronic Lateral Epicondylitis: A Comparative Perspective

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ABSTRACT

Background: Chronic lateral epicondylitis is a common musculoskeletal disorder that leads to persistent elbow pain and functional limitation, significantly affecting daily activities and work productivity. Physical modalities such as extracorporeal shock wave therapy (ESWT) and therapeutic ultrasound are widely used, yet comparative evidence regarding their relative efficacy remains limited, particularly in low- and middle-income settings. Aim of the study: To compare the effectiveness of focused extracorporeal shock wave therapy and conventional therapeutic ultrasound in reducing pain and improving functional outcomes in patients with chronic lateral epicondylitis.

Methods & Materials: This prospective comparative study was conducted at the Outpatient Department of Physical Medicine and Rehabilitation, Dhaka Medical College Hospital, Bangladesh, between June 2019 and May 2020. Sixty patients with clinically diagnosed chronic lateral epicondylitis were enrolled and allocated into two treatment groups: ESWT (n = 30) and therapeutic ultrasound (n = 30). ESWT was administered using focused shock waves, while the ultrasound group received pulsed therapeutic ultrasound, both delivered three times weekly for four weeks. Pain intensity was measured using the Visual Analog Scale (VAS), and functional disability was assessed using the Patient-Rated Tennis Elbow Evaluation (PRTEE) questionnaire at baseline, 4 weeks, and 8 weeks. Statistical analyses included between-group and within-group comparisons using appropriate parametric or non-parametric tests, with effect sizes calculated using Cohen's d. **Result:** Baseline demographic and clinical characteristics were comparable between groups (p > 0.05). Both

interventions resulted in significant improvements in pain and function over time (p < 0.001). However, the ESWT group demonstrated significantly greater reductions in VAS scores at 4 weeks (mean difference -0.70, p = 0.01) and 8 weeks (mean difference -1.10, p < 0.001), with moderate to large effect sizes. Similarly, functional improvement measured by PRTEE was significantly greater in the ESWT group at 4 weeks (mean difference -6.30, p = 0.004) and 8 weeks (mean difference -8.40, p < 0.001). A higher proportion of patients in the ESWT group achieved minimal clinically important differences for both pain and function. Adverse events were mild and comparable between groups, while patient satisfaction was significantly higher in the ESWT group (80.0% vs. 60.0%, p = 0.04). **Conclusion:** Focused extracorporeal shock wave therapy is more effective than therapeutic ultrasound in reducing pain and improving functional outcomes in patients with chronic lateral epicondylitis. ESWT appears to be a safe, well-tolerated, and clinically superior physical modality and may be considered a preferred treatment option in the conservative management of this condition.

Keywords: Chronic lateral epicondylitis; Extracorporeal shock wave therapy; Therapeutic ultrasound; Pain; PRTEE; Randomized controlled trial

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INTRODUCTION

Lateral epicondylitis (LE), commonly referred to as *tennis elbow*, is a chronic musculoskeletal disorder characterized by pain and tenderness over the lateral epicondyle of the humerus, primarily involving degeneration of the extensor carpi radialis brevis tendon^[1,2]. LE represents a tendinopathic process with angiofibroblastic degeneration rather than acute inflammation, leading to chronic pain, reduced grip strength, and impaired upper-limb function^[1,2]. Globally, LE affects approximately 1–3% of the adult population, with the highest incidence observed between 35 and 50 years of age, and a substantial occupational health burden among manual laborers and individuals performing repetitive upper-limb tasks^[3,4]. Occupational exposure involving repetitive and forceful upper-limb activities

significantly increases the risk of lateral epicondylitis^[4,5]. In South Asia, a comparatively higher prevalence, particularly among populations engaged in repetitive domestic or occupational activities. LE in 39.3% of housewives, with more than half experiencing chronic symptoms lasting over six months^[6]. Although national prevalence data for Bangladesh are scarce but repetitive wrist use for extended periods is significantly associated with lateral epicondylitis in clinical patients and patients using their hand >2 hours per day were significantly more likely to develop LE^[7]. This lack of population-level data highlights an important regional research gap. The etiology of chronic LE is multifactorial. Repetitive wrist extension, forceful gripping, and sustained forearm loading result in micro-trauma at the tendon origin,

leading to collagen disorganization, neovascularization, and impaired tendon healing^[1,8]. Additional risk factors include advancing age, smoking, obesity, poor ergonomic conditions, and prolonged occupational exposure^[10]. Clinically, chronic LE significantly affects daily activities, work productivity, and quality of life, and may impose long-term socioeconomic consequences if inadequately managed^[6]. Conservative management is the cornerstone of treatment for chronic LE, with physical modalities forming a major component of non-operative care. Modalities such as therapeutic ultrasound, low-level laser therapy, extracorporeal shock wave therapy (ESWT), transcutaneous electrical nerve stimulation (TENS), and pulsed electromagnetic field therapy are widely utilized to reduce pain and facilitate tendon

recovery [10,11]. These interventions offer several advantages, including non-invasiveness, relative safety, and suitability for repeated use. However, systematic reviews and meta-analyses report inconsistent and modality-specific outcomes, with many studies demonstrating short-term pain relief but limited improvement in grip strength or long-term functional recovery [11,12]. Methodological heterogeneity, small sample sizes, varied treatment protocols, and insufficient follow-up periods remain major limitations across existing trials [11,12]. Despite widespread clinical use, there is no consensus regarding the comparative effectiveness of different physical modalities, particularly in chronic LE and in low-resource settings such as Bangladesh. Moreover, region-specific evidence remains extremely limited. Therefore, this study aims to comparatively evaluate the role of selected physical modalities in the management of chronic lateral epicondylitis, assess their effectiveness on pain and functional outcomes, and address existing evidence gaps to inform optimized, context-appropriate rehabilitation strategies.

METHODS & MATERIALS

This prospective, randomized controlled trial was conducted at the Outpatient Department of Physical Medicine and Rehabilitation, Dhaka Medical College Hospital (DMCH), Dhaka, Bangladesh, from June 2019 to May 2020. Patients with a clinical diagnosis of chronic lateral epicondylitis were considered for inclusion. A total of 60 participants were enrolled and randomized into two equal groups ($n = 30$ each) using a computer-generated random sequence:

1. **ESWT group:** Received focused extracorporeal shock wave therapy.
2. **Ultrasound group:** Received conventional therapeutic ultrasound.

Allocation concealment was ensured using sealed opaque envelopes. Outcome assessors were blinded to group assignments.

Inclusion Criteria

Participants were included if they met all of the following:

- Age between 30 and 60 years.
- Localized pain over the lateral elbow with a VAS score ≥ 3 on resisted wrist extension.
- Symptom duration >1 month.

- Pain affecting either elbow.
- Both sexes were eligible.

Exclusion Criteria

Participants were excluded if they had any of the following:

- Multiple joint pain or concurrent musculoskeletal disorders.
- Neck pain with radiculopathy or neurological deficits.
- Local infection, skin allergy, or previous corticosteroid injection within 1 month.
- Prior ESWT or ultrasound therapy for lateral epicondylitis.
- Recent NSAID use within 48 hours.
- History of fracture, bleeding disorder, or renal impairment.

Interventions

Extracorporeal Shock Wave Therapy (ESWT)

ESWT was administered using a focused shock wave device (BTL 5000 SWT POWER) at 4 Hz and 3 bar energy, delivering 2,000 pulses per session. Treatments were applied directly over the lateral epicondyle three times per week for four weeks. Aqua sonic gel was used as a coupling medium, and intensity was adjusted to patient tolerance. Participants were prescribed Naproxen sodium 250 mg twice daily for 15 days.

Therapeutic Ultrasound (UST)

UST was delivered using a 3 MHz transducer at 1.5 W/cm² in pulsed mode, applied over the lateral epicondyle for 5 minutes per session, three times per week for four weeks. Aqua sonic gel was used as the coupling medium with full contact and rotational movements. Participants also received Naproxen sodium 250 mg twice daily for 15 days.

All participants were instructed to continue normal daily activities but avoid additional physiotherapy or analgesics during the study period.

Data Collection Procedure

After obtaining written informed consent, baseline demographic and clinical data were collected for all participants, including age, gender, dominant hand, duration of symptoms, and previous treatments. Pain intensity was assessed using the Visual Analog Scale (VAS), and functional disability was evaluated with the Patient-Rated Tennis Elbow Evaluation (PRTEE) questionnaire. Both assessments were administered by trained physiotherapists

blinded to group allocation to minimize observer bias. Following baseline evaluation, participants were assigned to either the ESWT or ultrasound group according to the randomization schedule. Treatment sessions were conducted three times per week for four consecutive weeks, and adherence to the protocol was monitored by study staff. Participants were instructed to maintain their usual daily activities while avoiding additional physical therapy or analgesic medications during the study period. Follow-up assessments were performed at 4 and 8 weeks post-intervention. At each follow-up, VAS and PRTEE scores were recorded to measure changes in pain and functional outcomes. In addition, adverse events and patient satisfaction were documented at the 8-week follow-up to evaluate the safety and tolerability of the interventions. All data were entered into a structured database and cross-checked for completeness and accuracy prior to statistical analysis.

Statistical Analysis

Data were analyzed using SPSS version 20 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean \pm standard deviation (SD) and categorical variables as frequency and percentage. Between-group comparisons were performed using independent t-tests or Mann-Whitney U tests, and chi-square or Fisher's exact tests for categorical variables. Within-group changes were analyzed using paired t-tests or Wilcoxon signed-rank tests. Effect sizes were calculated using Cohen's d . A p -value <0.05 was considered statistically significant.

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.

RESULT

Among 60 patients, the mean age was 42.85 \pm 8.50 years, with most aged 31–40 years (46.67%). Females predominated (68.33%), and the right hand was affected in 86.67%. Symptom duration was <3 months in 58.33%. Baseline pain and functional scores were similar between ESWT and ultrasound groups (VAS 6.85 \pm 1.05; PRTEE 68.15 \pm 8.85). No significant differences were observed across age, gender, hand dominance, symptom duration, or baseline scores (all $p > 0.05$) (Table 1).

Table I
Baseline demographics and clinical characteristics of the study population (n = 60).

Variable	ESWT (n = 30)	Ultrasound (n = 30)	Total (N = 60)	p-value
Age (years)				
31–40	15 (50.00)	13 (43.33)	28 (46.67)	0.43 ^a
41–50	9 (30.00)	15 (50.00)	24 (40.00)	
>50	6 (20.00)	2 (6.67)	8 (13.33)	
Mean ± SD	42.60 ± 9.20	43.10 ± 7.80	42.85 ± 8.50	
Gender				
Male	9 (30.00)	10 (33.33)	19 (31.67)	0.78 ^b
Female	21 (70.00)	20 (66.67)	41 (68.33)	
Dominant hand affected				
Right hand	27 (90.00)	25 (83.33)	52 (86.67)	0.45 ^b
Left hand	3 (10.00)	5 (16.67)	8 (13.33)	
Duration of symptoms				
<3 months	18 (60.00)	17 (56.67)	35 (58.33)	0.79 ^b
3–6 months	8 (26.67)	12 (40.00)	20 (33.33)	
>6 months	4 (13.33)	1 (3.33)	5 (8.33)	
Baseline VAS score, Mean ± SD	6.80 ± 1.10	6.90 ± 1.00	6.85 ± 1.05	0.74 ^a
Baseline PRTEE score, Mean ± SD	68.40 ± 8.60	67.90 ± 9.10	68.15 ± 8.85	0.84 ^a

Pain intensity (VAS) decreased in both groups over time. At 4 weeks, ESWT patients reported lower pain than ultrasound (3.90 ± 1.00 vs 4.60 ± 1.10, p = 0.01, Cohen’s d = 0.65). At 8 weeks, the difference widened (2.10 ± 0.90 vs 3.20 ± 1.00, p < 0.001, d = 0.92), indicating greater pain reduction with ESWT (Table II).

Table II
Comparative analysis of pain intensity (VAS) between ESWT and ultrasound groups.

Time point	ESWT (n = 30) Mean ± SD	Ultrasound (n = 30) Mean ± SD	Mean Difference	p-value	Cohen’s d
Baseline	6.80 ± 1.10	6.90 ± 1.00	-0.10	0.74	0.08
4 weeks	3.90 ± 1.00	4.60 ± 1.10	-0.70	0.01*	0.65
8 weeks	2.10 ± 0.90	3.20 ± 1.00	-1.10	<0.001*	0.92

Functional outcomes (PRTEE scores) improved in both groups. At 4 weeks, ESWT showed greater improvement than ultrasound (42.60 ± 7.80 vs 48.90 ± 8.40, p = 0.004, d = 0.75). At 8 weeks, the difference further increased (26.30 ± 6.90 vs 34.70 ± 7.50, p < 0.001, d = 0.88), indicating superior functional recovery with ESWT (Table III).

Table III
Comparative analysis of functional outcomes (PRTEE) between ESWT and ultrasound groups.

Time point	ESWT (n = 30) Mean ± SD	Ultrasound (n = 30) Mean ± SD	Mean Difference	p-value	Cohen’s d
Baseline	68.40 ± 8.60	67.90 ± 9.10	0.5	0.84	0.06
4 weeks	42.60 ± 7.80	48.90 ± 8.40	-6.30	0.004*	0.75
8 weeks	26.30 ± 6.90	34.70 ± 7.50	-8.40	<0.001*	0.88

Within-group changes from baseline to 8 weeks were significant. ESWT reduced mean VAS scores by 4.70 points (6.80 to 2.10, p < 0.001), while ultrasound decreased by 3.70 points (6.90 to 3.20, p < 0.001). PRTEE scores improved by 42.10 in ESWT (68.40 to 26.30) and 33.20 in ultrasound (67.90 to 34.70), demonstrating greater within-group gains with ESWT (Table IV).

Table IV
Within-group changes in pain and function among the study population from baseline to 8 weeks.

Outcome	Group	Baseline	8 weeks	Mean Change	p-value ^b
VAS	ESWT	6.8 ± 1.1	2.1 ± 0.9	4.7	<0.001*
	Ultrasound	6.9 ± 1.0	3.2 ± 1.0	3.7	<0.001*
PRTEE	ESWT	68.4 ± 8.6	26.3 ± 6.9	42.1	<0.001*
	Ultrasound	67.9 ± 9.1	34.7 ± 7.5	33.2	<0.001*

At 8 weeks, a higher proportion of ESWT patients achieved clinically meaningful improvement: VAS reduction ≥2 points in 86.67% versus 63.33% in the ultrasound group (p = 0.03), and PRTEE improvement ≥11 points in 80.00% versus 56.67% (p = 0.04). Mean percentage reduction in VAS was 69.13% versus 53.57% (p < 0.001), and PRTEE improved by 61.63% versus 48.87% (p = 0.002), favoring ESWT (Table V).

Table V
Percentage Improvement and MCID Achievement at 8 Weeks.

Outcome	ESWT (n = 30)	Ultrasound (n = 30)	p-value
VAS reduction ≥ 2 points	26 (86.67)	19 (63.33)	0.03*
PRTEE improvement ≥ 11 points	24 (80.00)	17 (56.67)	0.04*
Mean % reduction in VAS	69.13	53.57	<0.001*
Mean % improvement in PRTEE	61.63	48.87	0.002*

Adverse events were mild and comparable between groups, with transient pain in 10.00% of ESWT and 13.33% of ultrasound patients ($p = 0.69$), and skin irritation in

3.33% versus 6.67% ($p = 0.55$). Patient satisfaction was higher in ESWT (80.00%) compared to ultrasound (60.00%, $p = 0.04$),

indicating both safety and greater acceptability of ESWT (Table VI).

Table VI
Adverse events and patient satisfaction among the study population.

Variable	ESWT (n = 30)	Ultrasound (n = 30)	p-value
Mild transient pain	3 (10.00)	4 (13.33)	0.69
Skin irritation	1 (3.33)	2 (6.67)	0.55
High patient satisfaction	24 (80.00)	18 (60.00)	0.04*

DISCUSSION

Lateral epicondylitis is a common overuse injury that causes pain and limits elbow function. Conservative therapies such as ESWT and ultrasound are widely used but their relative effectiveness remains unclear. This study evaluated the comparative effects of ESWT and ultrasound on pain, function, and patient satisfaction. Our study presents no statistically significant baseline differences between the ESWT and ultrasound groups in major demographic and clinical values: age distribution (31–40 years: 50.00% and 43.33%; 41–50 years: 30.00% and 50.00%; >50 years: 20.00% and 6.67%; mean age 42.60 ± 9.20 compared with 43.10 ± 7.80), gender (female proportion 70.00% and 66.67%), dominant hand involvement (right hand 90.00% and 83.33%), symptom duration (<3 months: 60.00% and 56.67%), baseline VAS (6.80 ± 1.10 and 6.90 ± 1.00), and baseline PRTEE (68.40 ± 8.60 and 67.90 ± 9.10), with all $p > 0.05$. These comparable baseline values indicate successful randomization and similar clinical severity prior to intervention. These findings are similar to previous comparative studies in lateral epicondylitis where baseline characteristics showed no significant differences between intervention arms [13]. Yalvaç et al. reported therapeutic ultrasound and ESWT groups had comparable mean ages (43.75 ± 4.52 vs 46.04 ± 9.24) and gender distributions, with no significant inter-group differences before treatment allocation [13]. Sanders Jr et al. reported dissimilar baseline characteristics compared with our trial where there was a higher mean age of lateral epicondylitis at 47 ± 11 years, with a more balanced sex distribution (47.00% male and 53.00% female), and a lower proportion of dominant arm involvement (63.00% right elbow) [14]. Our study represents that ESWT produced significantly greater reductions in VAS scores compared with ultrasound at both 4

weeks (3.90 ± 1.00 and 4.60 ± 1.10 , $p = 0.01$) and 8 weeks (2.10 ± 0.90 vs 3.20 ± 1.00 , $p < 0.001$), with moderate to large effect sizes (Cohen's $d = 0.65$ and 0.92). These findings are similar to a controlled trials where ESWT led to significantly greater pain reduction compared to ultrasound (mean difference -0.90 on VAS, $p < 0.0001$) at short-term follow-up, supporting the stronger pain-relieving effect of shockwaves [15]. In contrast, Yalvaç et al. explained VAS improvements in both ESWT and ultrasound arms without a statistically significant between-group difference at 1 month, suggesting that ultrasound may provide similar short-term relief under certain parameters [13]. This study shows functional outcomes assessed by PRTEE, reflected a similar pattern: significant superiority of ESWT over ultrasound at 4 weeks (42.6 ± 7.8 vs 48.9 ± 8.4 , $p = 0.004$, $d = 0.75$) and 8 weeks (26.3 ± 6.9 vs 34.7 ± 7.5 , $p < 0.001$, $d = 0.88$). These differences emphasize the greater functional recovery associated with ESWT in chronic lateral epicondylitis. The systematic review by Alharbi M (2025), reported a trend toward better PRTEE improvements with ESWT compared to ultrasound, but did not achieve strict statistical significance for functional scores (MD -5.3 , $p = 0.05$) and that result is partially consistent with our findings [15]. The differing results reflected methodological heterogeneity across trials due to variations in symptom chronicity, intervention dosage, concurrent therapies and sample size which influence PRTEE outcomes and contribute to the substantial heterogeneity seen in comparing ESWT and ultrasound [15]. In this study, both ESWT and ultrasound groups exhibited significant within-group changes from baseline to 8 weeks in VAS and PRTEE ($p < 0.001$ for each), demonstrating that both interventions are effective physical modalities for chronic

lateral epicondylitis. This is consistent with other study and examined significant improvements in pain and function following either ESWT or ultrasound therapies in RCTs and clinical observation [16]. Perveen et al. presented opposite results where ESWT produced statistically significant better outcomes on PRTEE scores than ultrasound plus deep friction massage at both 3-week and 7-week time points [17]. We identified that a significantly higher proportion of patients achieved clinically meaningful improvements (VAS ≥ 2 points: 86.67% vs. 63.33%, $p = 0.03$; PRTEE ≥ 11 points: 80.00% vs. 56.67%, $p = 0.04$) with ESWT compared to ultrasound are broadly consistent with existing evidence showing ESWT's superior clinical effects in lateral epicondylitis [15]. Alharbi et al. found that while ESWT was significantly better at reducing pain, functional outcomes measured by PRTEE did not differ significantly from ultrasound therapy (MD = -5.28 ; $p = 0.05$), indicating that improvements in function and by extension MCID achievement were often comparable rather than clearly superior with ESWT in pooled data [15]. In the other study, both ESWT and ultrasound improved pain and PRTEE scores but clinical differences at 6–12 weeks were small except in subjective measures, suggesting higher MCID achievement due to protocol or timing differences [18]. In this study, both ESWT and therapeutic ultrasound demonstrated a favorable safety profile, with low rates of mild transient pain (10% vs. 13.33%, $p = 0.69$) and skin irritation (3.33% and 6.67%, $p = 0.55$), consistent with a study where most participants reported only mild discomfort or transient tenderness during or immediately after treatment, and serious complications were not commonly observed, suggesting that both modalities are generally well-tolerated [19]. However, there are dissimilarities compared with a

study reported findings, where the difference in treatment tolerability and patient perception between modalities was less distinct and ESWT caused mild temporary discomfort but did not reduce patient satisfaction or adherence, supporting its use for symptom relief [20].

LIMITATIONS

The study primarily captured short-term clinical responses, limiting insight into the durability of therapeutic effects. Standardized analgesic use may have modulated symptom perception. Dependence on patient-reported outcomes without corroborative imaging or biochemical markers restricted mechanistic interpretation, preventing direct assessment of tendon remodeling or tissue-level adaptations underlying the observed functional improvements.

CONCLUSION

This study demonstrates that extracorporeal shock wave therapy provides superior and sustained improvements in pain relief and functional recovery compared with therapeutic ultrasound in patients with chronic lateral epicondylitis. The observed clinical benefits may be attributed to ESWT-induced Mechan transduction, promoting neovascularization, tissue regeneration, and modulation of nociceptive pathways. Given its favorable safety profile and higher patient satisfaction, ESWT represents a clinically effective, non-invasive modality with meaningful translational value for optimizing conservative management strategies in chronic lateral epicondylitis

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CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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