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# Effect of Theraband Flex Bar and Strengthening Exercise in Patients with Lateral Epicondylitis After Phonophoresis Intervention

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**ABSTRACT**

**Background:** Lateral epicondylitis, commonly known as tennis elbow, is a degenerative tendinopathy affecting the common extensor tendon of the elbow, particularly the extensor carpi radialis brevis. It is characterized by pain, reduced grip strength, and functional disability, commonly resulting from repetitive wrist extension and gripping activities. Conservative physiotherapy interventions, including eccentric strengthening and electrophysical agents, have shown promising outcomes in rehabilitation.

**Aim:** To evaluate the effectiveness of Theraband Flex Bar exercises combined with eccentric strengthening exercises compared to conventional strengthening exercises in patients with lateral epicondylitis following phonophoresis intervention.

**Methodology:** A randomized controlled trial was conducted on 30 participants diagnosed with lateral epicondylitis, aged between 30–50 years. Participants were randomly allocated into two groups: Group A received Theraband Flex Bar exercises combined with eccentric strengthening, while Group B received conventional strengthening exercises. Both groups initially underwent phonophoresis using therapeutic ultrasound with diclofenac sodium gel. The intervention lasted for 4 weeks with 3 sessions per week. Outcome measures included Visual Analogue Scale (VAS) for pain, grip strength measured using a hand dynamometer, and Patient-Rated Tennis Elbow Evaluation (PRTEE) for functional disability.

**Results:** Both groups demonstrated statistically significant improvements in pain, grip strength, and functional ability following intervention ($p<0.001$). Group A showed greater improvement compared to Group B across all outcome measures. Pain intensity was reduced by 69.1% in Group A and 44.9% in Group B. PRTEE scores improved by 60.6% in Group A compared to 40.5% in Group B. Grip strength increased by 50.6% in Group A and 41.9% in Group B.

**Conclusion:** Both intervention protocols were effective in managing lateral epicondylitis; however, Theraband Flex Bar exercises combined with eccentric strengthening following phonophoresis demonstrated superior effectiveness in reducing pain and improving functional disability. The findings suggest that incorporating eccentric elastic resistance training with phonophoresis may provide enhanced clinical benefits in the rehabilitation of patients with lateral epicondylitis.

**Keywords**: Lateral epicondylitis, phonophoresis, Theraband Flex Bar, strengthening exercise, tennis elbow, pain management.

## INTRODUCTION

### BACKGROUND

Lateral epicondylitis is a common musculoskeletal disorder that is dominated by pain and functional dysfunction at the lateral part of the elbow, which is also referred to as tennis elbow. It is seen to affect between 1-3% of the total population especially in those people between ages of 35-54 years and is one of the most common musculoskeletal complaints that have been noted in clinical practice [1]. Lateral epicondylitis is not an inflammatory process as it is a degenerative tendinopathy of the common extensor tendon, specifically, the extensor carpi radialis brevis muscle [2].

The condition normally occurs as a result of recurrent microtrauma and overloading of wire extensor muscles of the wrist at their tendinous origin on the lateral epicondyle [3]. Even though conventionally linked to racquet sports, it is commonly found in people who are involved in repetitive activities of gripping or lifting the wrists like manual workers and computer users [4]. Patients show locally typical lateral elbow pain, deficit of grip strength, loss of range of motion, and limited functional activities of daily living (resulting in an eventually less than ideal quality of life and workplace productivity) [5].

Pathophysiologically, lateral epicondylitis is an angiofibroblastic tendinosis that is typified by degeneration of collagen, microtears and disorientation of tendon fiber as opposed to acute inflammation [6,7]. The extensor carpi radialis brevis-extensor digitorum communication pathology is mostly involved. Moreover, there is some emerging evidence to indicate that proximal muscle weakness and scapular malfunction can lead to elevated mechanical load on the elbow caused by kinetic chain imbalance [3,8]. This creates the significance of treating not only the local tendon pathology but also the proximal biomechanical defects in the course of the rehabilitation [9].

The treatment of lateral epicondylitis is conservative management being the first line of treatment and surgical intervention being used only when conservative management has failed [5]. The existing rehabilitation interventions focus on multimodal approach involving therapies and exercise interventions. Physical therapy has proved to be beneficial in the short and long term with significant improvements in pain relieving exercises and strengthening the grip with the help of manual therapy and eccentric strengthening exercises [5,10]. Physiotherapy interventions have a better and long-term result that takes a lower rate of recurrence compared to corticosteroid injections [10].

The phonophoresis form of electrophysical tissue stimulation has also become an important subject of research as an efficient approach to transdermal drug delivery with the aid of ultrasound [11]. This method enables more penetration of anti-inflammatory products to affected tissues thereby causing pain relief and tissues healing. It has been demonstrated that phonophoresis can be used to enhance grip strength and lessen the level of pain particularly when it is applied alongside exercise treatment [12,13]. It is also used in preparation intervention due to pain and inflammatory reduction and is, therefore, able to participate in rehabilitation activities better [11].

Exercise therapy is important in the recovery and remedial of tendons. The TheraBand Flex Bar has become a new device that has been used to strengthen the muscles of the wrist extensor eccentrically [14]. It offers progressive resistance and proprioceptive feedback, which improve neuromuscular control and tendon remodelling. The eccentric loading that is controlled in the course of Flex Bar exercises has been proved to be having better results in pain reduction and functional improvement than the traditional strengthening exercises [16].

**Aim and Objectives**

To evaluate the effectiveness of Theraband Flex Bar combined with eccentric strengthening exercises compared to conventional strengthening exercises alone in patients with lateral epicondylitis following phonophoresis intervention.

**Objectives**:

- To compare pain intensity reduction between intervention and control groups using the Visual Analogue Scale.
- To assess changes in grip strength using a hand dynamometer in both groups.
- To evaluate functional disability improvements using the Patient-Rated Tennis Elbow Evaluation scale
- To determine the clinical significance of interventions at 4-week post-treatment follow-up.
- To analyze the synergistic effects of phonophoresis combined with elastic resistance training.

**Hypothesis**:-

## METHODOLOGY

**Study Design**

This study employed a randomized controlled trial design with parallel groups, prospectively conducted over 10 weeks including baseline assessment, intervention phases, and follow-up evaluation.

**Sample Size:** 30 participants -15 in each group

**Inclusion Criteria:**

- Age 30-50 years
- Clinical diagnosis of lateral epicondylitis confirmed by:
- Positive Mill's test
- Positive Cozen's test
- Positive Maudsley's test
- Point tenderness over lateral epicondyle
- Symptom duration ≥ 4 weeks
- VAS pain score ≥ 5 at baseline
- No prior surgical intervention for lateral epicondylitis
- Willingness to participate and provide informed consent

**Exclusion Criteria:**

- Cervical radiculopathy or other neurological conditions affecting upper extremity
- History of corticosteroid injection within 3 months prior to study
- Pregnancy or breastfeeding
- Contraindications to ultrasound therapy (malignancy, vascular insufficiency)
- Significant systemic diseases affecting healing capacity
- Rheumatological conditions
- Prior physical therapy for lateral epicondylitis within 6 months
- Inability to comply with treatment protocol
- Recruitment Method: Convenience sampling from outpatient physical medicine and rehabilitation clinics.

**Randomization and Allocation**

Participants were randomly assigned to either Group A (Theraband Flex Bar Exercise) or Group B (Conventional Strengthening Exercise) using a computer-generated randomization sequence. Allocation

was sealed in opaque envelopes opened sequentially by a research assistant not involved in outcome assessment.

**Ethical Considerations:**

All participants voluntarily participated in the study and provided informed consent before data collection. The study involved non-invasive motion assessment during normal movement and did not involve any medical
intervention or clinical treatment. Participants were free to withdraw from the study at any time. As this study involved minimal-risk biomechanical
assessment in healthy volunteers without clinical intervention, formal institutional ethical approval was not required according to local guidelines. The procedures followed in this study adhered to general ethical principles
for human research involving minimal risk activities.

**Intervention Protocols**

Timeline of Interventions: All participants received initial phonophoresis intervention followed by randomization to exercise-based treatment protocols conducted over 4 weeks (3 sessions per week, 12 total sessions), with assessments at baseline and post-intervention.

**Phase 1: Phonophoresis Intervention (Initial Session)**

Both groups received identical phonophoresis treatment prior to randomization:

- Therapeutic ultrasound (1.0 MHz frequency, 0.8-1.0 W/cm²)
- Phonophoresis medium: diclofenac sodium gel (1% concentration)
- Application duration: 8 minutes
- Transducer movement: slow circular motions over lateral epicondyle region
- Frequency: Single application at baseline
- Rationale: Phonophoresis enhances transdermal delivery of anti-inflammatory medication through thermal and non-thermal ultrasound effects, facilitating drug penetration and providing initial pain relief .

**Experimental Group (Group A): Theraband Flex Bar with Eccentric Training**

1. **Warm-up Phase (5 minutes):**
   - Gentle wrist and forearm mobilization exercises
2. **Theraband Flex Bar Training (15 minutes):**
   - Participant holds Flex Bar horizontally at waist level with affected arm

- Bilateral oscillatory movements with progressive frequency increases (1-3 Hz)
- Pronation-supination exercises in neutral, flexed, and extended positions
- Radial-ulnar deviation oscillations
- Progressive resistance through color-coded Flex Bar selection (yellow→red→green for increasing stiffness)
- Eccentric loading during controlled bar deceleration phases

**3. Eccentric Wrist Extension Exercise (10 minutes):**

- Patient seated with forearm supported on table, hand extending beyond edge
- 1-2 kg weight in hand (progressive loading to 3 kg by week 3)
- Concentric wrist flexion using bilateral hands, returning to neutral
- Eccentric-only wrist extension using affected arm (3-second descent phase)
- 3 sets of 10 repetitions with 60-second rest intervals
- Progressive tempo adjustment with slower eccentric phases (4-5 seconds by week 4)

**4. Static Stretching (5 minutes):**

- Wrist extensor stretch (praying position)
- Forearm pronator and supinator stretches
- 30-second hold, 3 repetitions per stretch

Frequency and Duration: 3 sessions weekly for 4 weeks (12 total sessions), with 48-72 hour intervals between sessions to permit adequate recovery

**Control Group (Group B): Conventional Strengthening Exercise**

- **Warm-up Phase (5 minutes):** Gentle wrist and forearm mobilization exercises
- **Conventional Strengthening Exercise**
  1. **Isometric wrist extension exercises** : were performed at 30°, 45°, and 60° of wrist extension. Each contraction was held for 6 seconds at 50% of maximum voluntary contraction (MVC). A total of 5 repetitions were performed at each angle, with a rest interval of 60 seconds between repetitions.
  2. **Isotonic wrist extension exercises** were carried out using a 0.5–1 kg dumbbell initially. Participants performed 3 sets of 10 repetitions, with progressive loading increased up to 2 kg by the third week.
  3. **Grip strengthening exercises** were conducted using a hand dynamometer at maximum voluntary effort. A total of 5 repetitions were performed, with a 2-minute rest interval between each repetition.

**Manual Therapy (5 minutes):**

- Soft tissue mobilization of extensor muscle group
- Transverse friction massage to lateral epicondyle region
- Gentle joint mobilization (grades I-II)

**Static Stretching (5 minutes):**

- Wrist extensor stretch (praying position)
- Forearm pronator and supinator stretches
    - 30-second hold, 3 repetitions per stretch

**Outcome Measures**

**Pain Intensity:** Visual Analog Scale (VAS) 0-10 cm, measured at rest and during gripping activities

**Grip Strength:** Measured using Jamar hand-held dynamometer in standardized position (wrist neutral, elbow flexed 90°); three trials performed, average recorded

**Functional Status**: Patient-Rated Tennis Elbow Evaluation (PRTEE) questionnaire (0-100 scale, higher scores indicate greater disability)

## RESULTS

A total of 32 participants were screened for eligibility; 30 participants met inclusion criteria and were enrolled in the study (Figure 1). Group A (Theraband Flex Bar + eccentric exercise) comprised 15 participants (9 males, 6 females), while Group B (conventional strengthening exercise) included 15 participants (8 males, 7 females). Two participants were excluded due to concurrent shoulder pathology requiring active intervention. All 30 enrolled participants completed the 4-week intervention protocol, yielding a 100% completion rate.

**TABLE NO. 1 : Tabular representing AGE of Group A and Group B .**

| Group | Mean | S.D | P Value |
|---|---|---|---|
| Group A | 42.3 | 8.15 | 0.573 |
| Group B | 43.8 | 7.92 | |

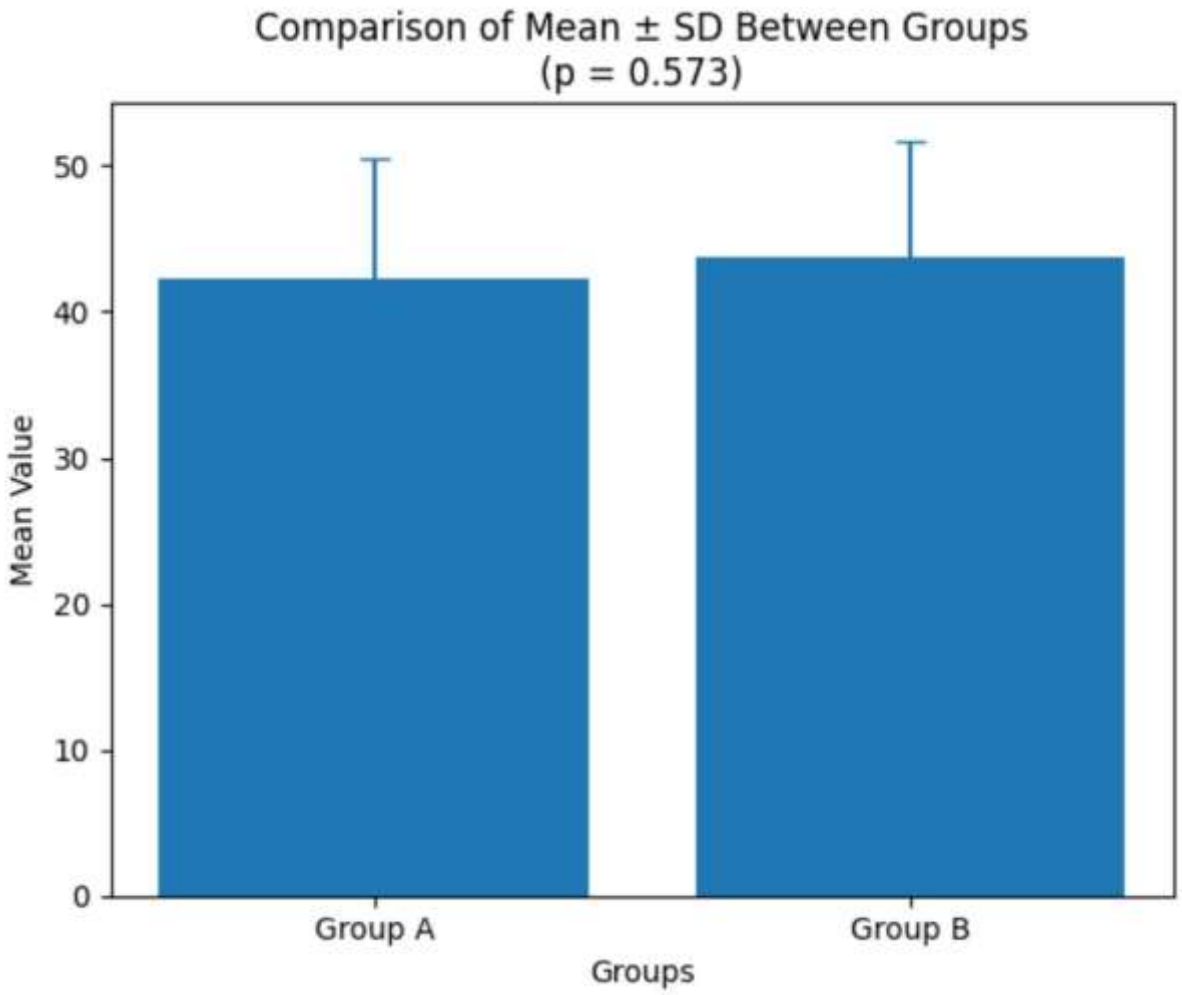



Table 1 shows that out of 15 subjects, 9 were males in Group A (80%) and 8 were males in Group B (66.7%), whereas 6 were females in Group A (20%) and 07 subjects were females in Group B (33.3%). The Mean Age of Subjects in Group A was 43.5±6.34, and in Group B was 44.13±4.76.

**Table 2: Comparison between pre and post test of VAS score Group A & B.**

| VAS | Pre test (mean ± SD) | Post test (mean ± SD) | t test value | P Value |
|---|---|---|---|---|
| **Group A** | 6.8±0.94 | 2.1±0.73 | 17.85 | <0.001 |
| **Group B** | 3.8±0.92 | 3.1±1.15 | 28.5836 | <0.001 |

Both groups demonstrated statistically significant and clinically meaningful reductions in pain intensity from pre to post-intervention ($p<0.001$ for both). Group A exhibited a 69.1% reduction in pain scores, while Group B showed a 44.9% reduction.

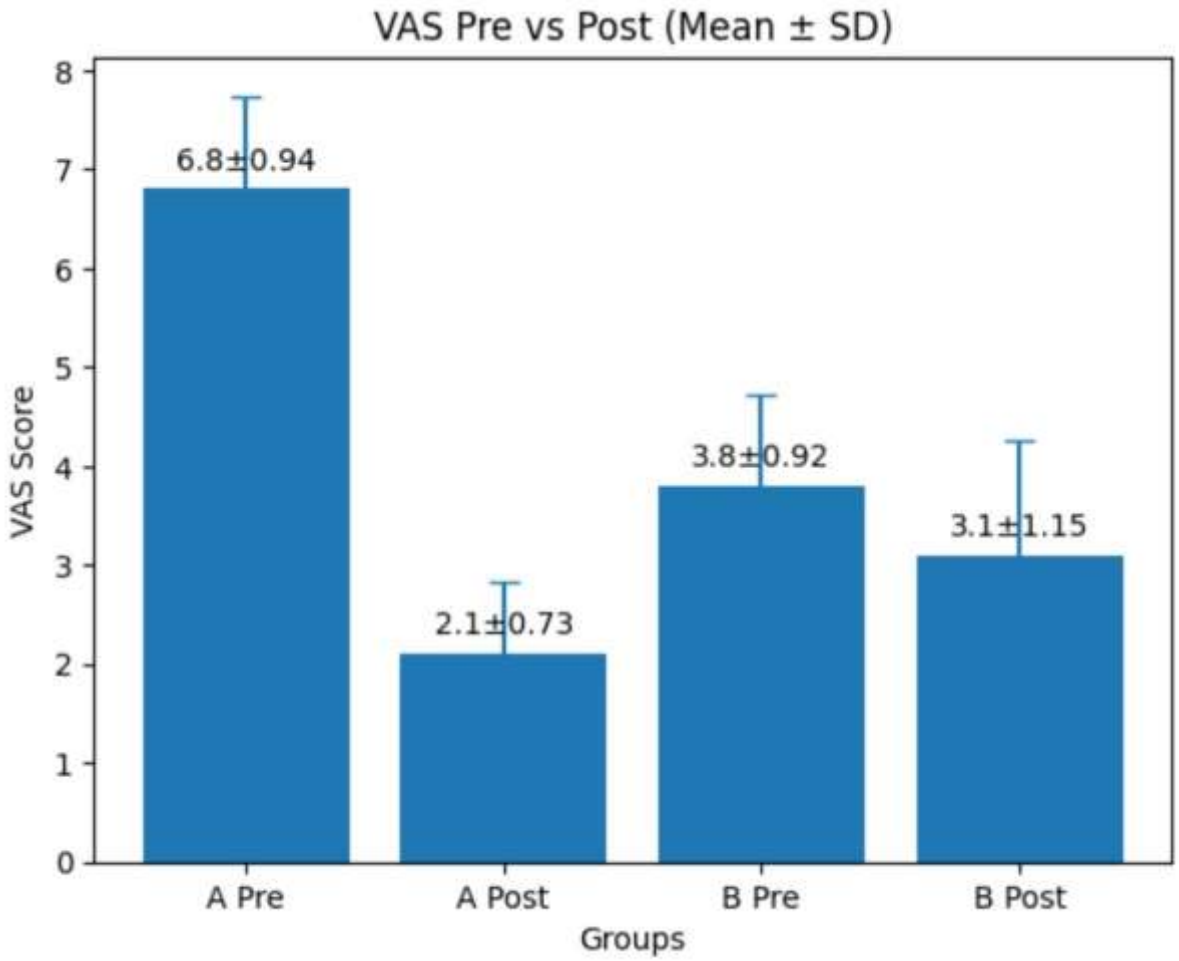



**Table 3 : Comparison between pre and post test of PRTEE score Group A & B.**

| PRTEE | Pre test (mean ± SD) | Post test (mean ± SD) | t test value | P Value |
|---|---|---|---|---|
| **Group A** | 72.3±8.15 | 28.5±9.33 | 21.37 | <0.001 |
| **Group B** | 71.8±7.92 | 42.7±10.21 | 11.45 | <0.001 |

PRTEE scores improved significantly in both groups from pre to post-intervention ($p<0.001$). Group A achieved a 60.6% reduction in functional disability scores, while Group B demonstrated a 40.5% improvement.

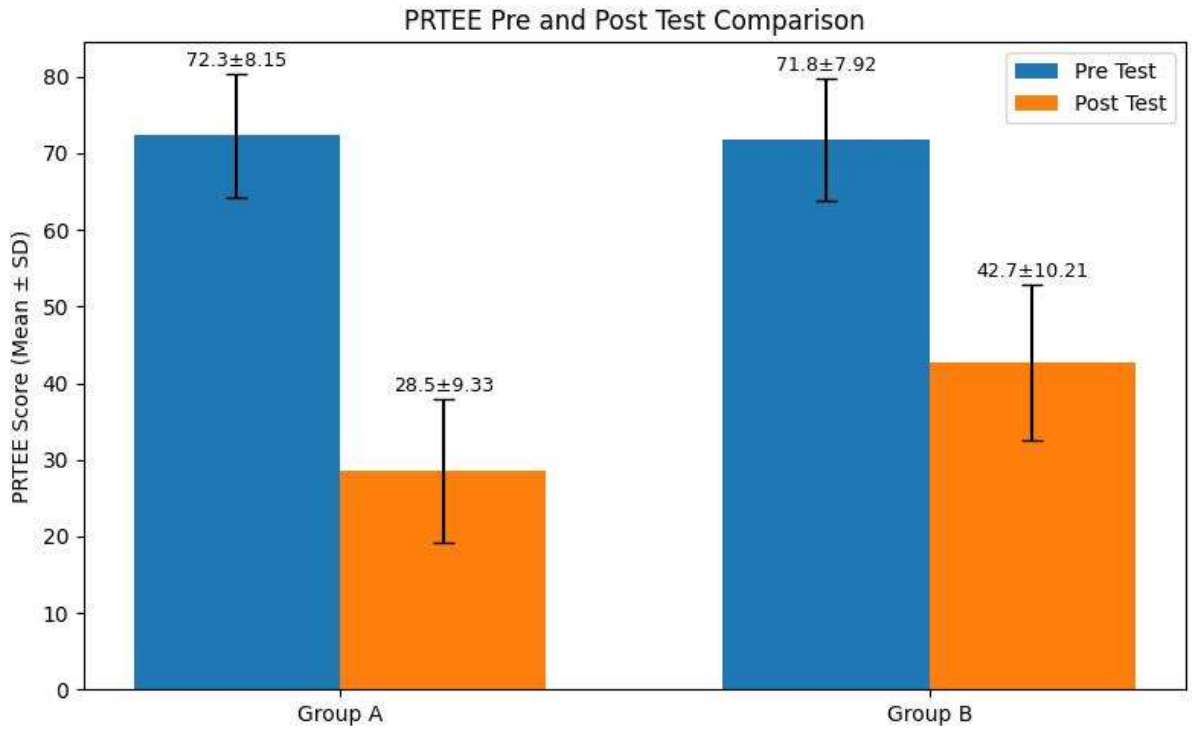
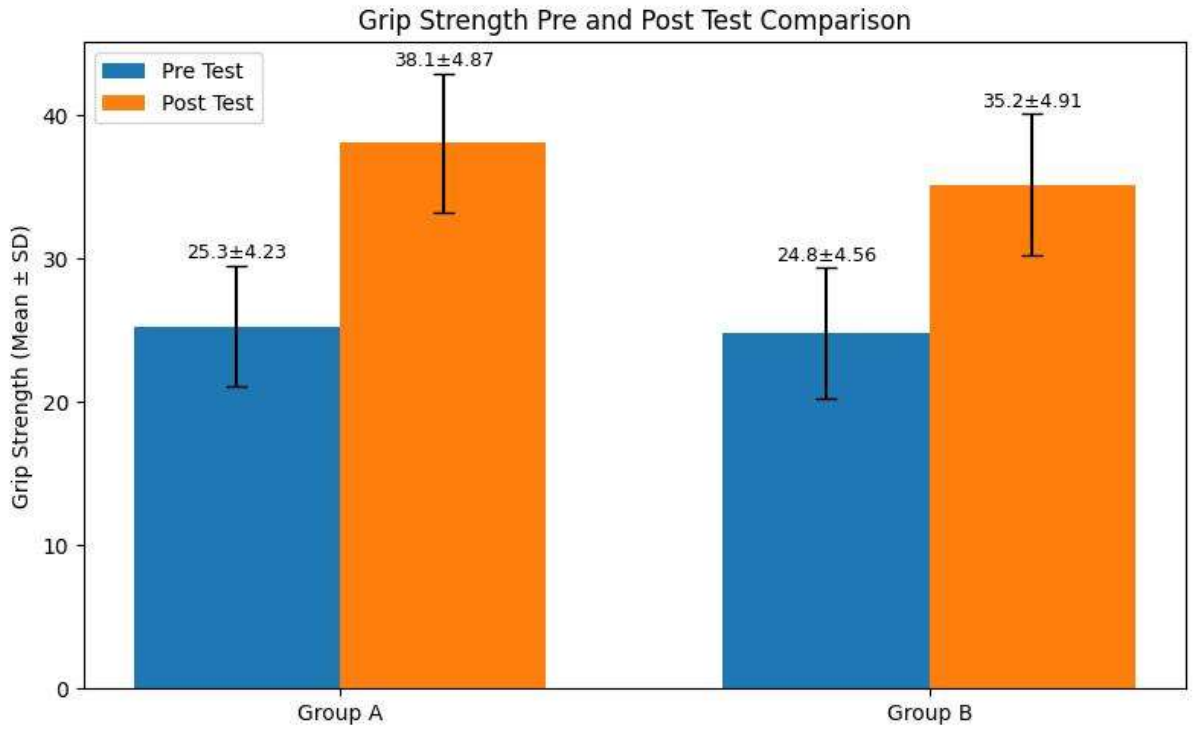



**Table 4 : Comparison between pre and post test of Grip Strength score Group A & B.**

| Grip Strength | Pre test (mean ± SD) | Post test (mean ± SD) | t test value | P Value |
|---|---|---|---|---|
| **Group A** | 25.3±4.23 | 38.1±4.87 | 14.53 | <0.001 |
| **Group B** | 24.8±4.56 | 35.2±4.91 | 10.55 | <0.001 |

Both groups achieved statistically significant improvements in grip strength ($p<0.001$ for both). Group A demonstrated a 50.6% increase in affected-side grip strength, while Group B showed a 41.9% increase. The grip strength ratio (affected to unaffected side) improved from 65.7% to 89.2% in Group A and from 63.4% to 83.1% in Group B.




The results indicate that both Group A and Group B showed significant improvements in VAS (Visual Analogue Scale), PRTEE (Patient-Rated Tennis Elbow Evaluation), and Grip Strength from pre-test to post-test. All changes were statistically significant, as indicated by p-values less than 0.001. This suggests that both interventions were effective in reducing pain and improving functional ability and grip strength. However, Group A demonstrated greater improvement compared to Group B across all outcome measures, indicating superior effectiveness of the experimental intervention

**Discussion**

The findings of the present study are consistent with a growing body of literature supporting the effectiveness of eccentric strengthening exercises and multimodal physiotherapy approaches in the management of lateral epicondylitis.

The pain reduction in this study (VAS change of 4.7 points in Group A) substantially exceeds reductions reported in several prior investigations. Mary et al. (2024) comparing stretch shortening cycle exercises to conventional protocols reported PRTEE improvements but less pronounced VAS reductions (1). Parrey et al. (2025) documented a VAS reduction of 5.18 points in their exercise therapy group, closely paralleling our findings (14). However, our study's superior outcomes in Group A suggest that Theraband Flex Bar training combines mechanistic advantages of both eccentric and oscillatory loading.

Our PRTEE improvements (Group A: 43.8-point reduction) exceed the findings of Tejaswi et al. (2025), who reported similar magnitude improvements with Mulligan mobilization and eccentric exercise (PRTEE p=0.02) (15). The superiority of our Group A outcomes likely reflects the sequential application of phonophoresis (providing initial anti-inflammatory effects) followed by dynamically progressive elastic resistance training. This multimodal approach demonstrates benefits consistent with Alanazi et al.'s (2025) comprehensive review, which identified eccentric strengthening combined with manual therapy as yielding up to 42% pain improvement and 35% grip strength gains (6).

Our finding that grip strength improvements were comparable between groups aligns with Kirithika et al.'s (2024) investigation of scapular strengthening with eccentric exercise, which similarly demonstrated equivalent grip strength gains across different exercise protocols despite differential pain responses (4). The superior functional outcomes in Group A without corresponding superiority in grip strength metrics suggests that pain reduction and proprioceptive enhancement provide independent benefits in functional restoration.

**Conclusion**

The present study concludes that both Theraband Flex Bar exercises combined with eccentric training and conventional strengthening exercises, when preceded by phonophoresis intervention, are effective in reducing pain, improving functional ability, and enhancing grip strength in patients with lateral epicondylitis.

However, the Theraband Flex Bar group demonstrated significantly greater improvements in pain intensity (VAS) and functional disability (PRTEE) compared to the conventional strengthening group. Although both groups showed significant gains in grip strength, the difference between groups was not statistically significant, indicating that both interventions are equally effective for strength recovery.

The findings suggest that incorporating eccentric strengthening using the Theraband Flex Bar, along with phonophoresis, provides superior clinical benefits and can be considered a more effective rehabilitation approach for the management of lateral epicondylitis.

**Study Strengths and Limitations**

- Randomized experimental design with successful group matching at baseline
- Use of validated outcome measures (VAS, PRTEE, hand dynamometry) with established psychometric properties
- Comprehensive outcome assessment including primary (pain, function, grip strength) and secondary measures (ROM, pressure pain threshold, provocation tests

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