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Maximizing Treatment Success in Lateral Epicondylitis: Assessing the Effectiveness of Ultrasonic Therapy as a Standalone Treatment and in Combination with Exercise

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ABSTRACT

Epicondylitis is characterised as epicondyle inflammation. When the wrist extensor muscles become inflamed or irritated at their origin on the lateral humeral epicondyle, this is known as tennis elbow. Activities that require wrist extension exacerbate pain. Based on inclusion criteria, 120 participants between the ages of 20 and 40 were selected for the research. Using the random sample procedure, the individuals were split into two groups of 60 each. Over the course of two weeks, Group A only underwent ultrasonography at a pace of two trials each week. For a period of two weeks, Group B got ultrasound treatment and performed stretching and strengthening exercises twice weekly. The findings indicate that the following therapy, Group B (Ultrasonic therapy in combination with exercise) outperformed group A (Ultrasonic therapy only) in terms of pain-free grip strength, function, and pain reduction. Despite the fact that both groups significantly improved. It can be claimed based on obtained evidence that Ultrasonic therapy in combination with exercise is a promising solution for lateral epicondylitis patients in terms of pain relief and improvement in grip strength & function.

Keywords: *Mobilisation, Exercise, Lateral Epicondylitis, Tennis elbow, Management, Ultrasonic, Therapy.*

INTRODUCTION

Lateral epicondylitis (LE) is a common musculoskeletal ailment that can be characterized based on the precise anatomical component affected, the consequent functional impairment or activity limitation, and the associated social interaction limits. The assigned code for Lateral Epicondylitis within the International Classification of Diseases-10 (ICD-10) is M77, according to the International Statistical Classification of Diseases and Related Health Problems (2016). (Cutts et al. 2020). Lateral epicondylitis, often known as tennis elbow, is a pathological disease characterized by symptoms caused by repeated strain on the extensor tendons in the forearm. Excessive and extended use of a certain body part has a negative impact on the

tendons, resulting in collagen fiber degradation and the formation of small-scale rips. Furthermore, this state has the ability to affect muscle fiber type distribution, neuronal activation, and muscle-tendon complex stiffness (Kraushaar and Nirschl 1999; Sesto et al. 2006; Johnson et al. 2007). lateral epicondylitis is a disorder that limits the use of the hand in frequent, strenuous manual tasks that demand dexterity, such as holding or gripping items, according to Trivedi et al. (2014) and Evans-Laude, Brigden, and Bennett (2012). The characteristic feature of this illness is lateral humeral epicondyle pain that may extend to the forearm. According to Kurppa et al. (1991) and Verhaar (1994), it is a significant condition characterized by functional impairment caused by pain, which degrades job performance and, as a result, lowers productivity. The absence of a discernible pattern in the disease's course can be due to the high diversity found among individual patients. Occupational needs, duration of employment, muscular training, and bone mineralization all impact the prognosis of lateral epicondylitis. Cases observed during 4 weeks to 1 year are classified as resistant and diagnosed as chronic lateral epicondylitis. In contrast to the early stage, where pain is exclusively caused by physical activity, the individual exhibiting persistent symptoms over an extended length of time presents with discomfort that continues even during periods of inactivity. Because wrist extensors are muscles that act on two joints, it is expected that the amount of extension that the wrist can attain will be significantly reduced. In certain chronic situations, the degree of extension that the elbow can accomplish may be limited as well. (Haahr 2003).

A variety of therapeutic techniques for lateral epicondylitis have been recorded, indicating a lack of consensus on a general acceptable procedure. According to a clinical review report published in 2020, the use of well-established therapy for tennis elbow is frequently supported by level five evidence, which is primarily expert opinion (Cutts et al. 2020). Conservative treatment is chosen by around 90% of people with lateral epicondylitis (LE). A variety of physiotherapeutic approaches, in conjunction with an exercise program, are used to treat LE (Smidt et al. 2003; Bisset et al. 2006; Trudel et al. 2004; Labelle et al. 1992; Wright and Vicenzino 1997). External support/taping/bracing, soft tissue therapies, acupuncture, electrotherapy (low level laser, extracorporeal shockwave therapy, TENS, iontophoresis, and ultrasound), and manual therapy are among these modalities. These treatments have various theoretical mechanisms of action, but their unifying purpose is to alleviate pain and enhance local functioning. The large range of treatment options employed implies a lack of consensus on the appropriate treatment approach. Several systematic reviews and clinical assessments of research papers on the treatment of lateral epicondylitis (LE) discovered differences across different cohorts. Only a minority of surgeons, for example, would choose surgery as the primary therapeutic approach, and the vast majority of patients enrolled in a study involving surgical intervention had failed to respond to more conservative treatments such as waiting it out, receiving steroid injections, or engaging in physical therapy (Cutts et al. 2020).

Despite the availability of several therapy choices, such as traditional exercise-based therapies, the efficacy of these treatments in lowering pain and increasing general functioning remains unknown. As a result, the purpose of this study is to evaluate the efficacy of Ultrasonic therapy in combination with exercise to that of ultrasonic therapy alone for people with lateral epicondylitis. The study's goal is to determine which strategy, Ultrasonic therapy alone or in combination with exercise, is more successful in lowering pain and

increasing functional outcomes.

Objective of the study

- To assess the efficacy of Ultrasonic Therapy in combination with exercise as a treatment in individuals diagnosed with lateral epicondylitis.
- to assess the efficacy of Ultrasonic Therapy in combination with exercise in comparison to Ultrasonic Therapy interventions for individuals diagnosed with lateral epicondylitis.

LITERATURE REVIEW

Pienimaki et al. (1998) did a thorough study of the long-term results of people who had carefully treated chronic Lateral Epicondylitis (LE) conditions. They found that exercise was the only effective way to stop LE from becoming chronic. As a result, it is highly recommended that exercise be promptly advocated for as a preventative measure. Furthermore, this research revealed that participants who maintained a consistent exercise regimen were capable of returning to work earlier while maintaining their previous level of performance.

Martinez-Silvestrini et al. (2005) performed an evaluation of the efficacy of a home-based exercise regimen that incorporated concentric and eccentric strengthening exercises and emphasized flexibility. The researcher ascertained that no statistically significant discrepancy was detected between the two exercise programs conducted at home. Furthermore, it was ascertained that the incorporation of eccentric exercises did not lead to a substantial worsening of discomfort.

Stasinopoulos et al. (2009) examined the comparative efficacy of a supervised exercise program versus a home-based exercise program using a sample of seventy patients. The objective of this study was to compare the efficacy of different rehabilitation programs for lateral epicondylitis in terms of pain reduction and functional outcome improvement. According to the study's results, the supervised exercise regimen yielded the desired results more effectively than the at-home exercise regimen.

As an alternative treatment for corticosteroidal injection for lateral epicondylitis, Murtezani Ardiana (2015) conducted a study to determine the effects of therapeutic ultrasound and exercise. Drawing from her research findings, she arrived at the deduction that the application of ultrasound therapy and exercise regimens for the treatment of LE offers significant benefits in comparison to the use of corticosteroid injections.

Dimitrios (2016) conducted a comprehensive review of the evidence concerning the management of LE conditions with physiotherapy. The review determined that an exercise regimen is the most viable treatment strategy for LE. Nevertheless, this underscored the need for additional investigation in order to determine the most effective protocol for this therapeutic approach. Further investigation is required to determine the most effective combination of supplementary physiotherapy techniques, including manual therapy, electrotherapy, taping/bracing, and acupuncture, in order to attain the most favourable outcomes in the treatment of LE conditions, as a single exercise program may not produce satisfactory improvements in a number of patients. From 2000 to 2012, the healthcare burden of LE conditions in the United States population was analysed in an epidemiological study published in 2015. Based on the findings of the research, the incidence rate for the specified condition declined from 4.5 cases per 1000 individuals in 2000 to 2.4 cases per 1000 individuals in 2012. The 8.5% recurrence rate remained unchanged. Over time, there was a threefold increase in the proportion of patients who underwent surgical treatment within two years of receiving their diagnosis. More precisely, surgical intervention was required in approximately one out of every ten patients who presented with persistent symptoms over a period of six

months.

Shirato (2017) provided a recommendation for the use of wrist traction, followed by finger traction, and then wrist varus force, as a technique to extend the extensor muscles. As an alternative to the conventional method of conducting finger and wrist flexion exercises, this method was proposed. The recommendation was formulated following an examination of eight bodies that had been found to be recently deceased.

Barratt (2018) asserts that fortifying should be the central focus of treatment for individuals with LE. As a crucial element of Lateral Epicondylitis rehabilitation, the author emphasized the significance of precisely determining how much load necessary for strengthening. Wrist extension and shoulder stability exercises have been shown in studies to successfully relieve pain and enhance upper extremity function in those suffering from Lateral Epicondylitis (LE).

Lee et al. (2018) did a study to find out how eccentric control exercises for stabilizing the wrist and shoulder affected pain and performance in people with tennis elbow. The participants were categorized into two distinct groups: one was assigned to perform shoulder stabilization exercises, while the other was instructed in eccentric control exercises targeting the wrist extensor muscles. The investigation comprised a cohort of nine patients, of which each group comprised four females and five males. It was noted that the shoulder stabilization exercise group demonstrated a statistically significant improvement in the tenderness threshold measurements for the upper trapezius muscle and grasp strength. Nevertheless, there were no noteworthy variations observed in the pain level or tenderness threshold of the lateral epicondyle. Based on their findings, the researchers concluded that the integration of shoulder stabilization exercises and wrist eccentric control exercises can function as efficacious intervention strategies to mitigate discomfort related to tennis elbow (LE) and promote the restoration of compromised functions induced by the condition.

Trivedi et al. (2019) investigated the efficacy of plyometric exercises in the therapy of individuals with chronic lateral epicondylitis through the utilization of a case report in their study. The study enrolled a cohort of thirty patients who had been diagnosed with CLE. A meticulously crafted protocol comprising plyometric exercises and pulsed ultrasound therapy was administered to the subject for the duration of the four-week treatment period. The results of the research suggested that the integration of pulsed ultrasound therapy with plyometric exercises produced encouraging results in the recuperation of patients diagnosed with chronic lateral epicondylitis.

Manandhar (2021) does a study to find out how eccentric exercise and Mulligan's MWM affect volleyball players with lateral epicondylitis' grip strength and their ability to do daily tasks. A cohort of thirty individuals who fulfilled the predetermined criteria for inclusion were enlisted via referrals. In addition to eccentric exercise, the experimental group engaged in Mulligan's Mobilisation with Movement (MWM), whereas the control group was administered an intervention comprising solely of an eccentric exercise regimen. Both cohorts participated in three sessions weekly over the course of four weeks. The wrist strength measurement was executed utilizing a hand-held dynamometer, whereas the functional abilities assessment was conducted employing the PRTEE. The results of the analysis indicated that there were statistically significant enhancements in performance for both the control and experimental groups. In the context of recreational tennis players who have been diagnosed with lateral epicondylitis, it was found that the combined application of Mulligan's MWM and eccentric exercise resulted in greater improvements in grasp strength and functional capabilities compared to eccentric exercise performed in isolation.

Raja et al. (2022) undertook a study with the objective of evaluating the effectiveness of ultrasound when used in conjunction with strengthening exercises to treat lateral epicondylitis. Furthermore, their objective was to assess the efficacy of a progressive strengthening exercise regimen among participants diagnosed with LE. The research investigation utilized a sample size of fifty participants. The participants were divided into two groups at random and each group comprised 25 individuals. Group B was designated as the control group, whereas Group A was designated as the experimental group. The research investigated the effectiveness of two interventions, specifically strengthening exercises and ultrasound therapy, in diminishing pain and enhancing muscular strength. In contrast to the combined effect of the two interventions, strength training alone demonstrated superior efficacy in pain reduction and muscle strength enhancement, as evidenced by the results. Nevertheless, it is critical to mention that while the correlation between the two interventions did indicate a statistically significant decrease in discomfort, the control group exhibited no significant alteration in muscle strength.

Srinivas et al. (2022) did a study to investigate the efficacy of ultrasonography with strengthening in people with LE and the effectiveness of a progressive strengthening exercise program in people with LE. The research entailed the careful selection of a sample size comprising fifty participants. Individuals who fulfilled the predetermined criteria for inclusion and exclusion were chosen to partake in the research. By means of random assignment, the participants were divided into two groups, denoted as A and B. The experimental group was composed of 25 participants, and the control group was also set up with 25 participants. The research employed a combination of strengthening exercises and ultrasound therapy as interventions in this study. The findings suggested that strength training in isolation yielded superior outcomes in terms of reducing pain and muscle strength enhancement when compared to the control group. Nevertheless, upon combining the two interventions, a statistically significant correlation in pain reduction was observed. It is imperative to acknowledge that the control group exhibited no discernible alterations in muscle strength.

RESEARCH METHODOLOGY

Research Approach: The current investigation employed a research approach that utilised a true experimental design, which was also comparative in nature.

Research Setting: The current investigation was conducted in the "Department of Physiotherapy" situated within "Pacific Medical College and Hospital, Udaipur.

Population: The population for this study consisted of all patients diagnosed with lateral epicondylitis.

Accessible Population: The individuals seeking medical care at the Pacific Institute of Medical Sciences were regarded as the accessible population.

Sample and Sampling Approach: A total of 120 subjects were selected using the systemic random sampling method.

Inclusion/ Exclusion criteria, equipment and tools used during current investigation are given in table 1.

Table 1 Details of Inclusion/ Exclusion criteria, Equipment and tools used

Inclusion Criteria	Exclusion Criteria	Equipment Used	Tools Used
Positive mill's test Positive cozen's test Both genders are included Age 20 - 40 years	Cervical radiculopathy Elbow injuries, whether they result in disfigurement or not Intra - articular pathology Redial tunnel syndrome Surgery of the elbow	Ultrasound Machine Ultrasound gel Frequency: - 1 MHz Hand Held Dynamometer	Thera Band

Procedure and data collection: Patients were divided into 3 groups. Each group received a different treatment. The detail of procedure applied for assessment and data collection is provided in table 2.

Table 2 Procedure detail

	Group -A	**Group-B**
Treated with	UST	UST+ Exercise
Consent	Obtained	Obtained
Subjects count	60	60
Evaluation Test	Cozen's and Mill's Test	Same as group A
VAS, Grip Strength, Questionnaire Measurement	Before and after 2 weeks	Before and after 2 weeks
Ultrasonic Therapy UST (2 times/week, 2 weeks)	Yes	Yes
Exercise Protocol	-	Yes
General Stretching	-	Yes (5 minutes warm-up)
Specific Exercises	-	Yes (Yellow Thera band)
Frequency	1 MHz	-

(UST= Ultrasonic Therapy)

The experimental group A treatment: Ultrasonic Therapy

The individual adopts a sitting posture, with their elbows extended at a 90-degree angle and their forearms fully rotated inward. As a consequence, the lateral epicondyle has increased prominence. The physiotherapist positions themselves in a sitting stance near the patient, proceeding to provide ultrasound therapy at the recommended dose.

- The duration of the study was 14 days, with sessions occurring twice each week.
- The mode: pulsed (1:4).
- The frequency: 1 megahertz (MHz).
- The duration of the activity: 10 minutes, at a rate of 2 minutes per square centimeter of area.
- The dosage: 0.5 W.

The experimental Group B treatment: Ultrasonic Therapy + Exercise

Ultrasonic therapy was provided to Group B as well in same manner as provided to Group A. Following this, the patients underwent the exercise program, which began with an initial phase of overall shoulder stretching. The patients were advised to engage in warm-up activities that target the elbow and wrist joints, lasting for a period of five minutes, while maintaining an upright standing posture. After that, the patients were set up in a sitting position with the elbow joint flexed at an angle of ninety degrees. Exercise protocol given to group B consist of following exercises given in table 3.

Table 3 Exercise Protocol

	Protocol
wrist ➢ flexion ➢ extension elbow ➢ flexion ➢ extension	Three sets of ten repetitions using a yellow-colored Thera band
finger flexion / extension	For a duration of one minute, utilizing a rubber band
forearm pronation / supination	Three sets of ten repetitions using a yellow-colored Thera band.

Data Analysis: Statistical tests including the paired t-test are used to analyse the data collected for intergroup analysis. The statistical analysis was performed with SPSS 11. The computations were performed using a significance threshold of 0.05.

RESULTS

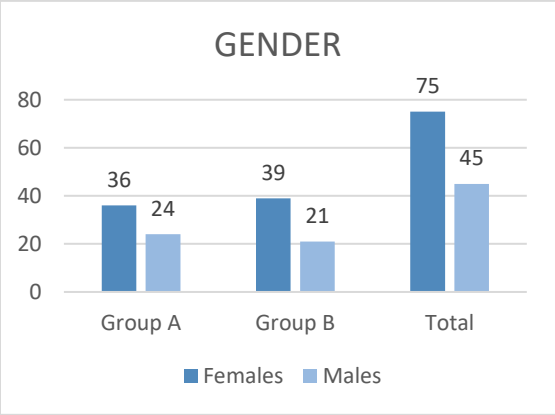

Figure 1Gender details of Subjects

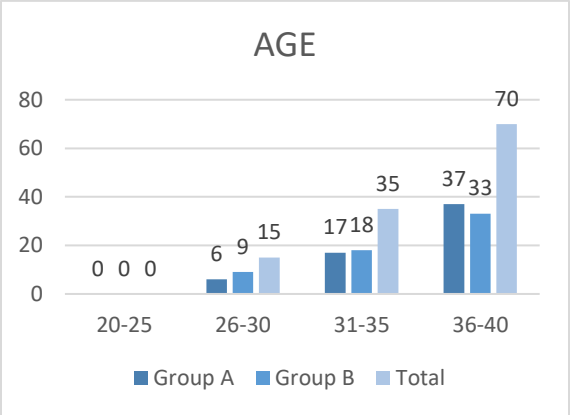

Figure 2 Age details of the subjects

Figure 1 displays a graph showing the proportions of male and female study participants, which are 45 and 75%, respectively. An age-based distribution of the study's participants is shown in a bar graph in Figure 2. According to the results, none of the subjects were between the ages of 20 and 25; 15 were between the ages of 26 and 30; 35 were between the ages of 30 and 35; and 70 were between the ages of 36 and 40.

Table 4. Mean and Standard deviation of age of subjects in each group

Groups	Age (Mean ± SD)
Group A	36.803 ± 3.3006
Group B	35.694 ± 3.6211

The table 4 provided presents the standard deviation and mean of age for the participants in groups. Specifically, the mean age for group A is 36.80 with a standard deviation of 3.30. For group B, the mean age is 35.69 with a standard deviation of 3.62.

- **Grip Strength**

Table 5 Grip Strength results: Pre and Post Interval

Grip Strength	Interval (Mean ± SD)	
	Pre	Post
Group A	34.00 ± 5.19	38.5 ± 4.41
Group B	34.85 ± 11.11	44.55 ± 11.87

Table 6 Pre and after Grip strength measurements using a paired t test for both groups

(Pre Vs Post) Interval	t value	P value
Group A	-7.18	0.05
Group B	-9.159	0.05

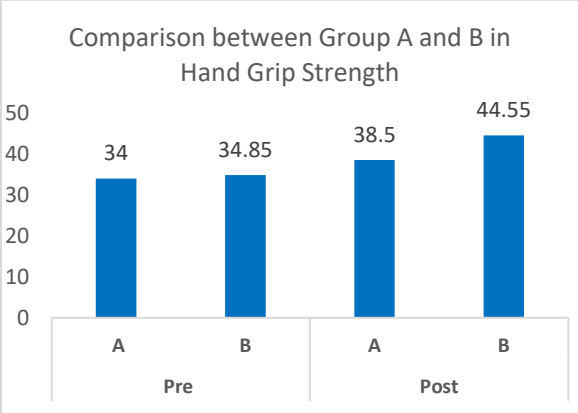

Figure 3 Hand Grip Strength Comparison

The table and graph presented above provides information regarding grip strength during the pre and post intervals. The mean and standard deviation for group A are 34.00 ± 5.19 and 38.5 ± 4.41, respectively. The mean and standard deviation for group B are calculated to be 34.85 ± 11.11 and 44.55 ± 11.87, respectively.

The table presented above provides information regarding the average and variability of the Visual Analogue Scale (VAS) scores during the pre and post intervals. The values for group A are 8.17± 0.64 and 2.86 ± 1.55. In the case of group B, the values are 8.19 ± 0.78 and 1.86 ± 0.85, respective

VAS at Pre and Post Interval

Table 7 VAS results: Pre and Post Interval

VAS	Interval (Mean ± SD)	
	Pre	Pre
Group A	8.17 ± 0.64	2.86 ± 1.55
Group B	8.19 ± 0.78	1.86 ± 0.85

Table 8 Paired t-test comparing pre and post VAS intervals for both groups

(Pre Vs Post) Interval	t value	P value
Group A	12.89	< 0.05
Group B	23.50	< 0.05

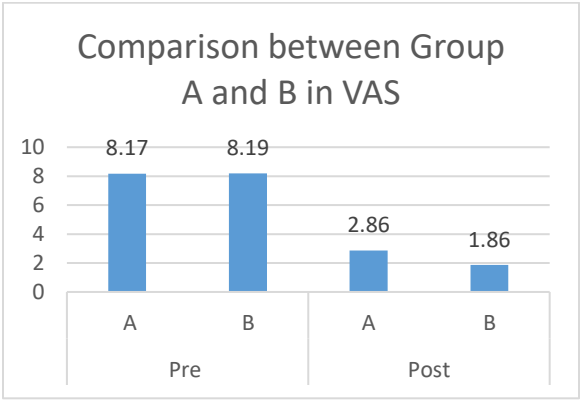

Figure 4 Comparison of mean values of VAS

➢ Pain at Pre and Post Interval

The table presented provides information regarding the average and standard deviation of pain levels during the pre and post intervals. In group A, the values are reported as 30.65 ± 4.00 and 13.30 ± 2.43, respectively. In the case of group B, the values are 30.25 ± 3.98 and 10.75 ± 3.53, respectively.

Table 9 Pain results: Pre and Post Interval

Pain	Interval (Mean ± SD)	
	Pre	Pre
Group A	30.65 ± 4.00	13.30 ± 2.43
Group B	30.25 ± 3.98	10.75 ± 3.53

Table 10 Pre and after pain measurements using a paired t test for both groups

(Pre Vs Post) Interval	t value	P value
Group A	-3.929	< 0.05
Group B	-3.928	< 0.05

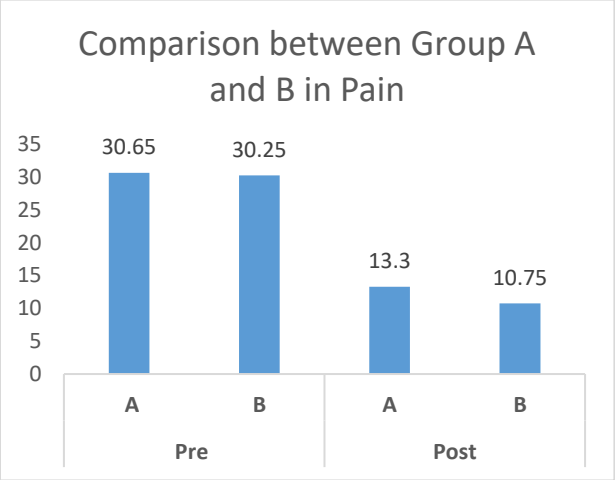

Figure 5 Comparison of mean values in Pain reduction

➢ Function

Table 11Function results: Pre and Post Interval

Function	Interval (Mean ± SD)	
	Pre	Pre
Group A	58.5 ± 8.38	23.95 ± 3.48
Group B	57.90 ± 8.75	18.45 ± 6.41

Table 12 Analyses of function before and after treatment in both groups using paired t-tests

(Pre Vs Post) Interval	t value	P value
Group A	-3.923	< 0.05
Group B	-3.92	< 0.05

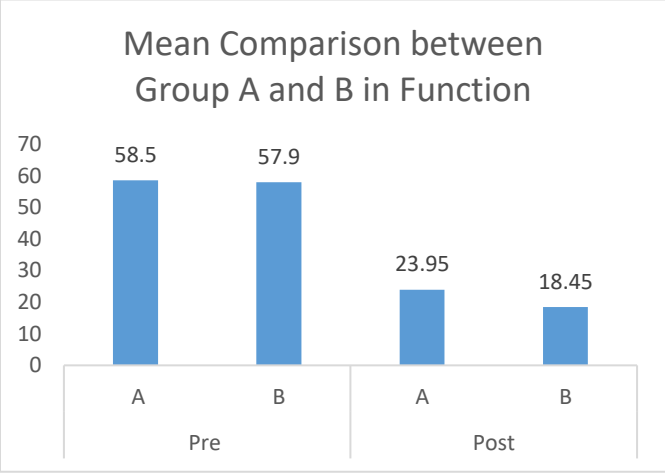

Figure 6 Comparison of mean values of Function

The table and graph presented above provides information regarding the average and standard deviation of pain levels during the pre and post intervals. In group A, the values are reported as 58.5 ± 8.38 and 23.95 ± 3.48, respectively. In the case of group B, the values are 57.90 ± 8.75 and 18.45 ± 6.41, respectively.

DISCUSSION

The examination of intragroup results provides useful insights into the efficacy of Ultrasonic Therapy, both as a standalone treatment and when combined with exercises, for the management of lateral epicondylitis. The evaluation of grip strength's mean and standard deviation before and after therapies in both groups revealed significant improvements. Significantly, Group B exhibited a substantial enhancement, as evidenced by the increase in grip strength from an average of 34.85± 11.11 before the intervention to an average of 44.55 ± 11.87 after the intervention. In contrast, Group A had a very modest improvement, with their average score increasing from 34.00 ± 5.19 before the intervention to 38.5 ± 4.41 after the intervention. The results of the paired t-tests revealed statistically significant differences in grip strength within both groups. Furthermore, while examining the VAS scores, it was seen that both groups saw decreases. Notably, Group B exhibited a mean VAS score of 8.19 ± 0.78 before the intervention, which decreased to 1.86 ± 0.85after the intervention. The paired t-tests indicated statistically significant disparities in VAS scores after and before the treatments for both Group A and Group B, with the t-values of 12.89 and 23.50 (<0.05) respectively. Moreover, the assessment of pain intensity shown significant decreases in both groups, particularly in Group B. The average pain levels before the intervention were 30.25 ± 3.98, which decreased to 10.75 ± 3.53 after the intervention. Similarly, Group A had a reduction in pain levels from 30.65± 4.00 to 13.30 ± 2.43. Additionally, the assessment of functional disability shown significant decreases in both groups, particularly in Group B. The average levels before the intervention were 57.90 ± 8.75, which decreased to 18.45 ± 6.41 after the intervention. Similarly, Group A had a reduction in functional disability levels from 58.5± 8.38 to 23.95 ± 3.48. Ultrasound has been shown to enhance the extensibility of collagen, resulting in the reorientation of collagen fibres, resulting in increased elasticity without compromising strength, hence reducing joint stiffness (Low and Reed, 2000). The finding of group B are similar to Srinivas et al. (2022) Stasinopoulos (2005) and Lee (2018).

CONCLUSION

In conclusion, the thorough analysis of results derived from this study investigating the management of lateral epicondylitis through the utilization of ultrasonic therapy and exercise combination revealed discernible effectiveness trends within the various intervention groups. Both groups shown significant in grip strength, VAS (Visual Analogue Scale) ratings, degree of functional disability reduction and degrees of pain reduction before and after the therapies. Nevertheless, Group B (UST + Exercise) consistently showed more significant improvements across all variables in comparison to Group A (UST). The paired t-test revealed statistically significant differences provided evidence for the efficacy of the combined therapy strategy. Furthermore, Group B also exhibited most significant decline in case of pain levels and functional disabilities. The collective data indicated that the combination treatment, namely in Group B, has potential for effectively managing lateral epicondylitis by considerably strengthening grip strength, lowering pain levels and improving overall functional outcomes.

Declaration by Authors

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

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