

Efficacy of wrist manipulation in the management of lateral epicondylitis

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ABSTRACT

Background: Lateral epicondylitis is the most common clinical condition characterized by pain generally localized around the lateral epicondyle but sometimes radiating distally to the forearm.

Objectives: The study's primary objective was to find out the efficacy of multiple therapeutic interventions consisting of wrist manipulation, ultrasound therapy, and stretching exercise on lateral epicondylitis patients.

Subjects and methods: A pre-test, post-test experimental study design was used. A criterion-based simple random sampling was used to recruit patients (N=30) diagnosed with lateral epicondylitis, and they were randomized into two treatment groups. The experimental group-1 was exposed to ultrasound therapy and stretching exercises, whereas those assigned to experimental group-II were given ultrasound therapy, stretching exercise, and wrist manipulation for the period of 2 weeks. The efficacy of treatment was measured through visual analogue scale (VAS), manual hand dynamometer, and DASH Scale. Both paired and unpaired 't' test was employed to study the treatment effectiveness. A p-value <0.05 was considered 'significant'.

Result: The group, which was exposed to the treatment combinations of wrist manipulation, ultrasound therapy, and stretching exercise showed a better reduction in pain intensity (mean difference 1.4) & self-reported upper extremity disability score (mean difference 8.06) and a notable improvement in grip strength (mean difference 4.73) than the other group, that was exposed to the treatment combinations of ultrasound therapy and stretching exercise at 0.05 levels of significance.

Conclusion: There is a significant reduction in pain intensity, improvement in pain-free grip strength, and the overall function of the arm following the application of 2 weeks of wrist manipulation technique along with conventional treatment in Lateral Epicondylitis patients.

Clinical Implications: Manipulation of the wrist is found to produce a significant effect when combined with conventional methods like ultrasound stretching and strengthening to manage lateral epicondylitis patients.

KEY WORDS: Lateral epicondylitis, Ultrasound, Passive stretching, Wrist manipulation.

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BACKGROUND

Lateral epicondylitis (also known as Tennis Elbow) is the most common diagnosis in patients with elbow lesions. This disorder was first described in 1883 as a condition producing lateral elbow pain in tennis players [1]. The prevalence of lateral epicondylitis ranges from 1-3% in the overall population, highest in 30-50 age groups [2]. This clinical condition is characterized by pain generally localized around the lateral epicondyle but sometimes radiating distally to the forearm [3]. A wide range of aetiologies and risk factors has been proposed; these include overuse, repetitive movements, training errors, misalignments, flexibility problems, aging, poor circulation, strength deficits, or muscle imbalances [4]. Tennis elbow stems from overuse of the extensor carpi radialis brevis [ECRB] muscle, and it occurs due to repetitive microtrauma resulting in primary tendinosis of the ECRB, with or without the involvement of the extensor digitorum communis [EDC] [5]. Therefore, the predominant activity of the wrist extensors might be one reason that predisposes to the condition. Further, a possible correlation between handgrip strength and lateral epicondylitis of the humerus has been proposed, where the pain is often exacerbated by gripping activities with impaired grip strength [6,7]. Thus, the patient is at a disadvantage in many situations and may experience difficulty with numerous activities of daily living. In addition, it can interfere with the affected person's ability to function at work, recreation, and home and impose a financial cost in the community [8].

Improper wrist kinematics is considered one of the ergonomic causes of Lateral epicondylitis, a disorder found in 76% of manual laborers carrying out hammering, bricklaying, and chopping activities [9]. Improper wrist position during repeated gripping activities with forearm pronated, wrist flexed, and ulnar deviation is the leading cause in this population [10]. Continuous use of this position causes eccentric load on the wrist extensor, causing strain in the ECRB and positional faults at the radio-carpal joint, which if not corrected will cause recurrence and prolongation of symptoms.

On exploration of the literature, several treatment options have been described to manage

lateral epicondylitis, and it consists of ultrasound, friction massage, strengthening exercise, stretching, and electrical stimulation to rehabilitate those patients [11,12]. An earlier study also demonstrated that ultrasound therapy is thought to be the most widely used modality for tennis elbow for its thermal and mechanical effects on the target tissue leading to increased metabolism, circulation, extensibility of connective tissue, and tissue regeneration [13]. Down the line, recently, studies have demonstrated that both Laser therapy and proximal forearm strap effectively reduce pain, increase grip strength and improve the quality of life (QoL) in people with lateral epicondylitis [14]. Besides the modalities mentioned above, manipulation has been a recommended treatment for lateral epicondylitis since the 1920s, beginning with techniques advocated by Mills and Cyriax [15]. Other manipulative techniques used include Kaltenborn and Stoddard's varus thrust, Mennell's extension thrust, and Mulligan's mobilization with movement [16, 17 18]. Among those approaches adopted by the therapists, Lewit had advocated manipulation of the wrist for the treatment of Lateral epicondylitis [19]. A more recent study also demonstrated that Wrist Manipulation and Progressive Exercises as suitable treatment methods in managing Tennis Elbow Patients [20]. The concept behind the efficacy of manipulation is that it appears to cause muscle relaxation and free the motion segments that have undergone disproportionate displacement or are felt to be hypo mobile. In addition, wrist Manipulation directly affects the articular surface; modulation of nociceptive afferent transmission to the central nervous system is influenced [21].

Even though several studies have been conducted to ascertain the efficacy of different treatment approaches for lateral epicondylitis, the authors attempted to study the combined effect of Wrist Manipulation with other conventional therapies in the form of ultrasound and stretching to manage patients with lateral epicondylitis.

METHODOLOGY

Study design: A pre-test, post-test experimental study design was used with two different intervention groups to assess the effectiveness

of multiple therapeutic interventions consists of ultrasound therapy, stretching exercise and wrist manipulation on lateral epicondylitis patients.

Subjects: All those patients complaining of elbow pain visiting the Department of Physiotherapy, Ceeyam Hospital, Vatakara, Kerala state formed the population for this study. Among them, those patients (N=30) whose job involve repetitive wrist movements and are diagnosed to have lateral epicondylitis were recruited using criterion-based sampling approach. Before selection, all the subjects were examined by the physician to exclude structural bony abnormalities and degenerative disorders around the upper extremity. The criteria adopted to include the subjects with lateral epicondylitis consist of: (i) both genders aged between 35 and 45 years; (ii) Unilateral Lateral epicondylitis in the dominant side; (iii) symptom duration of greater than 3 weeks and less than 6 weeks (iv) 'Mild' to 'Moderate' pain intensity in the Visual analogue scale, (v) positive cozen's test.

Methods: After obtaining the informed consent, subjects were randomized into two groups of 15 each using a simple random technique before applying the planned therapeutic interventions. The demographic characteristics of the subjects are shown in table 1. All the subjects (N=30) were identical before the application of selected therapeutic interventions ($p > 0.05$) (Table 2). Subjects assigned to the experimental group-1 were exposed to ultrasound therapy and stretching exercises, whereas those assigned to the experimental group-II were given ultrasound therapy, stretching exercise, and wrist manipulation. Both the groups were advised to continue a common set of home advice that they have to adopt after applying the treatment. Subjects in both groups were not given any medications during the period of the study. All the therapeutic interventions were given for two weeks, excluding weekends. In order to study the effectiveness of the therapeutic interventions, three outcome parameters were chosen. These include pain intensity measured by the Visual Analogue Scale [VAS], grip strength measured by manual hand dynamometer, and overall function of the arm evaluated through the disabilities of the arm, shoulder, and hand (DASH) questionnaire.

All the three measurement tools used in the study are reliable and valid as shown by the previous studies viz, Visual Analog Scale [22]. Manual hand dynamometer [6, 23, 24] and DASH scale [25, 26]. The handgrip strength was measured using a manual hand dynamometer three times with an interval of 60 seconds rest, and the mean score was considered as the grip strength. The grip strength was measured before beginning the first session and after the end of the tenth session in each group. Dash scale is a self-administered region-specific outcome tool developed to measure self-rated upper-extremity disability and symptoms. It consists mainly of a 30-item disability/symptom scale, scored 0 (no disability) to 100 [27]. The assessment was taken for all the 30 patients using VAS, manual hand dynamometer, and DASH scale on the 1st day (the day treatment begins" and at the end of 2 weeks (i.e., on the day of completion of therapy).

Description of Experimental Interventions

Wrist Manipulation Technique: The wrist manipulation technique used in this study is a thrust technique and it is performed based on the manoeuvre described by Lewit⁸. Each subject rested the forearm of his or her affected side on a table with the palmar side of the hand facing down. The therapist sat at a right angle to the subject's affected side and gripped the subject's scaphoid bone between his thumb and index finger. The therapist strengthened this grip by placing his other hand's thumb and index finger on top of them. The therapist then extended the subject's wrist dorsally at the same time the scaphoid bone was manipulated ventrally, and this part of the manoeuvre was repeated approximately 15 times. This procedure was repeated about 20 times, alternated by either forced passive extension of the wrist or extension against resistance. The entire duration of this therapeutic intervention session was lasting for 15 to 20 minutes.

Ultrasound Therapy: Ultrasound therapy is given for the period of 2 weeks in this study. During the 2-week intervention period, the subjects underwent eight sittings of pulsed ultrasound therapy at a frequency of 3 MHz and intensity 1.5 W/cm² (five sessions during the first week and three sessions during the second

week). Every session included 8 minutes of pulsed ultrasound therapy with 1 min on and 1 min off around the lateral humeral epicondyle. The ultrasound machine manufactured by Electro Care systems used throughout the study.

Stretching exercise: In addition to the above therapeutic intervention, all the subjects in both experimental groups were advised to perform wrist extensor and thumb stretching for two weeks (i.e., Five sessions per week). Each type of stretch was maintained for 15 to 30 seconds and repeated five times per session under the therapist’s supervision. The stretching exercise adopted in this study is based on the protocol suggested by Khandaker et al. 2014 [28].

Statistical analysis: Data were analysed using SPSS (Statistical Package for Social Sciences) for Windows, version 20.0. Related ‘t’ test (i.e., paired t-test) was used to compare each experimental group’s pre and post-test scores separately. Unrelated ‘t’ test (i.e., unpaired t-test) was utilized to compare the outcome measures (i.e., pre-test scores and post-test scores) between the two experimental groups. A p-value <0.05 was considered ‘significant’.

RESULT

The demographic presentation of subjects is shown in Table 1. The experimental group-I consisted of 8 males and seven females, while experimental group-II consisted of 5 males and ten females. The mean age of experimental group-I was 40.2 years, and that of the experimental group-II was 39.13 years. The mean duration of pain for experimental group-I was 4.2 weeks, and that of the experimental group-II was 4.4 weeks.

Table 1: Demographic characteristics of the subjects.

Demographic profile	Experimental group-I		Experimental group-II	
	Mean	SD	Mean	SD
Age	40.2	3.256	39.13	3.889
Duration (in weeks)	4.2	0.882	4.4	0.859
Gender (Male: Female ratio)	8:07		5:10	
No. of patients	15		15	

The three outcome measures’ pre-treatment scores were subjected to statistical treatment using an unrelated t-test, and the obtained t value is less than the required t table value at 0.05 levels [Table 2]. Hence it is inferred that

the mean scores of all the dependent variables consisting of pain intensity, grip strength, and self-rated upper-extremity disability were identical at the Pre-intervention stage before being subjected to the selected therapeutic interventions.

Table 2: Comparison of pain intensity, grip strength and self-reported upper extremity disability of subjects with lateral epicondylitis in both experimental group 1 and experimental group II during the preintervention stage.

Outcome Parameter	Groups	Mean	SD	T-value*
Pain intensity	Experiential Group-1	7.87	1.4075	1.027
	Experiential Group-II	7.4	1.0556	
Grip strength	Experiential Group-1	7.7	3.8257	1.187
	Experiential Group-II	9.2	3.0519	
Self-rated upper-extremity disability	Experiential Group-1	40.2	10.352	1.871
	Experiential Group-II	33.73	8.4808	

*Non-significant at 0.05 levels (p>0.05)

Further exploration was made to ascertain whether any significant difference was observed in the dependent variables between the two-time intervals (i.e., pre-treatment phase and at the end of 2 weeks) in both experimental groups. As a result, it is found that both groups showed a significant reduction in the pain intensity and self-rated upper-extremity disability score and better improvement in grip strength between the pre-intervention phase and at the end of the second week of the intervention phase at 0.05 levels significance as shown in table 3.

Further, a significant difference is observed between the two experimental groups while analysing the effect of 2 weeks of therapeutic intervention on the three dependent variables such as pain intensity, grip strength, and self-rated upper-extremity disability. Furthermore, while considering the mean score of all the three outcome variables, Experimental group-II is better than the Experimental group-I (Table 4).

From table 4, it is inferred that the experimental group II, which was exposed to the treatment combinations of ultrasound therapy, stretching exercise, and wrist manipulation showed a better reduction in pain intensity (mean difference 1.4) & self-reported upper extremity disability score (mean difference 8.06) and a notable improvement in grip strength (mean difference 4.73)

Table 3: Comparison of pain intensity, grip strength, and self-reported upper extremity disability of subjects with lateral epicondylitis among the two experimental groups between the pre-intervention and post-intervention phase.

Dependent Variable	Groups	Pre-intervention Stage		Post intervention Stage (At the end of 2 weeks)		T-value
		Mean	SD	Mean	SD	
Pain Intensity	Experiential Group-1	7.87	1.4075	3.333	1.1751	16.562*
	Experiential Group-II	7.4	1.0556	1.933	0.7988	19.972*
Grip strength	Experiential Group-1	7.7	3.8257	10.7	3.0868	5.123*
	Experiential Group-II	9.2	3.0519	15.43	1.6352	11.717*
Self-rated upper-extremity disability	Experiential Group-1	40.2	10.352	16.66	7.2473	14.188*
	Experiential Group-II	33.733	8.4808	8.6	4.6414	19.760*

*Significant at 0.05 levels (p<0.05)

Table 4: Comparison of pain intensity, grip strength and self-reported upper extremity disability of subjects with lateral epicondylitis at the end of 2 weeks of post-intervention stage.

Outcome Parameter	Groups	Mean	SD	T-value
Pain intensity	Experiential Group-1	3.333	1.1751	3.816*
	Experiential Group-II	1.933	0.7988	
Grip strength	Experiential Group-1	10.7	3.0868	5.248*
	Experiential Group-II	15.43	1.6352	
Self-rated upper-extremity disability	Experiential Group-1	16.66	7.2473	3.630*
	Experiential Group-II	8.6	4.6414	

*Significant at 0.05 levels (p<0.05)

than the experimental group-I, that was exposed to the treatment combinations of ultrasound therapy, and stretching exercise at 0.05 levels of significance.

DISCUSSION

This study is the documentation of the effectiveness of wrist manipulation in managing patients with lateral epicondylitis. To execute this research work, the researchers advocated two experimental intervention combinations in which the first experimental group (Experimental group-I) was given ultrasound therapy and stretching exercises. In contrast, the second experimental group (Experimental group-II) received ultrasound therapy, stretching exercise, and wrist manipulation to see whether there is any significant difference between the groups regarding three outcome parameters (i.e., pain intensity, Self-rated upper-extremity disability, and grip strength). The treatment combination adopted in our study is supported by an earlier study that the treatment intervention of tennis elbow is usually accompanied by an exercise

program which may include strengthening, flexibility, or endurance training exercises [12]. Conformance with our choice of including stretching of wrist extensors as a treatment combination, an earlier study by Stasinopoulos et al (2005) recommended the use of static stretching of the Extensor Carpi Radialis Brevis (ECRB) and eccentric strengthening exercises for the wrist extensors in treating lateral epicondylitis [29].

The results of this study show that the group treated with the treatment combination of ultrasound therapy, and stretching exercise produced a significant reduction in pain as measured by VAS, improvement in pain free grip strength and improvement in the functional outcome as measured by DASH questionnaire when compared with its pre-intervention score (Table 3). The mechanism behind pain reduction in both experimental groups might have been due to the physiological and mechanical effect of ultrasound therapy. Earlier studies have explained the pain-relieving effects of ultrasound, where it produces vibration of the tissue creating microscopic bubbles to form, which transfer the vibrations in a way that directly stimulates cell membranes. This physical stimulation seems to enhance the cell-repair effects of the inflammatory response and thereby reducing pain [30, 31]. Further, ultrasound therapy has its effect on tissue by focused on the changing the extensibility of the collagenous tissues to improve the range of motion and decrease pain [32]. Ultrasound can also alter membrane permeability to various ions like calcium, which have profound effect on cell activity by increasing synthesis and secretion of wound factors by cells involved in the healing process [33]. There is a significant increase

in tensile strength, reduction in inflammation and energy absorbing capacity of the tendon with therapeutic ultrasound. The mechanical effect of ultrasound helps to remove traumatic exudates and reduces the danger of adhesion formation [34]. Accelerated protein synthesis occurs during ultrasound therapy stimulates the rate of repair of damaged tissues. These effects of ultrasound therapy might have caused healing of the tendon which indirectly might have caused reduction in the pain.

Another reason which might have caused the reduction in pain could be the sustained static stretch given. Stretching causes stimulation of the Golgi Tendon Organ (GTO) and causes the firing of the GTO, leading to an inhibiting response that causes the muscle to relax, and such relaxation might have caused the reduction in pain. Our findings are in conformance with previous studies, which have shown that the combination of stretching exercise, deep friction massage, and ultrasonic therapy is effective in relieving pain in the management of tennis elbow [35, 36].

The results of this study also demonstrated that the group treated with the treatment combination of ultrasound therapy, stretching exercise, and wrist manipulation produced a better & significant reduction in pain, improvement in pain free grip strength and functional outcome than the group treated with ultrasound therapy, and stretching exercise alone. (Table 3). The significant improvement in all the outcomes in the experimental group-II could be due to the incorporation of wrist manipulation technique since both ultrasound therapy, and stretching exercise were applied to both the experimental groups. An earlier study also demonstrated wrist manipulation's mechanical effect on reducing pain by modulation of nociceptive afferent transmission to the central nervous system [37]. Even though stretching the forearm muscles is considered a significant part of the management of lateral epicondylitis [5, 38], to achieve effective stretching, the wrist joint has to be moved to the endpoint of joint movement [i.e., movement to both maximal extension and maximal flexion], which necessitates the incorporation of wrist manipulation technique in the management of tennis elbow. Further, an earlier study

demonstrated that reduced joint mobility could often result from a 'mechanical block' from inert structures and positional fault within a joint [19].

Joint afferent discharge and optimal muscle recruitment are closely linked [39]. Joint movement is reduced due to reflex muscle splinting which prevents further damage and reduces nociceptor discharge from the joint by holding it in the midrange position [39, 40]. During repeated wrist activities, these positional faults would cause restriction of accessory motions in the wrist joint. Biomechanically scaphoid plays a vital role in the kinematics of wrist movements. Movement is initiated at the distal carpal row with the metacarpals gliding on the relatively fixed scaphoid. In the final degrees of wrist movements, all the carpals form a complex to glide on the inferior surface of the radius. Any restriction of the accessory glide of the scaphoid would cause continuous strain on the forearm muscles, which might result in continuous strain of the ECRB at the tenoperiosteal junction. As a result, a vicious cycle is setup. The primary effect of manipulating the joint is to restore its mobility. A secondary effect might be to decrease pain if the pain was a direct result of abnormal tension on structures due to incorrect functioning of the joint. As the joint is manipulated, the surfaces caused a gap, creating space. The movement of the surfaces together with greater space created possibly causes any physical obstruction between the joint surfaces to be moved clearly; joint surfaces may re-align, causing the correct afferent information to be sent to the spinal cord.

Thus, this manipulation might have helped free-motion segments that have undergone disproportionate displacement, thereby reducing the abnormal distribution of stresses within the joint; therefore, a pain-free function is restored, and several repetitions bring about lasting improvements. While performing stretching, the wrist joint is moved to the endpoint of joint movement, i.e., movement to maximal extension. A secondary effect of this stretching might be freeing up of displaced motion segments and stretching also helps the brain remember the correct reciprocation of movement during repeated activities. Another hypothesis regarding

the reduction in pain is due to the stimulation of joint receptors during manipulation. Thrust manipulation normalized joint motion by stretching periarticular tissue and reduced pain by normalizing mechanoreceptor activity. Mechanoreceptor discharge had an inhibitory effect on the pre-synaptic cells of substantia gelatinosa, which depresses nociceptive activities via the pain gate mechanism.

It is noteworthy to mention that the grip strength has improved in both the experimental groups. Specifically, the improvement seen in the experimental group-II was found to be significant than the experimental group-I. Thus, the observed improvement in the pain-free grip strength might be due to two-fold reasons viz, one might be due to the decrease in pain, and the second reason might be the correction of the biomechanical alignment that would have increased the muscle recruitment, thereby improving the efficiency of the muscles spanning the elbow and wrist, which in turn increased the pain-free grip strength.

The DASH score showed significant improvement in the experimental group-II than in the experimental group-I. There is a strong correlation between pain reduction and improvement in function. The items in the DASH are mainly concerned with functional activities which require the optimum use of hand grip function. So, it is rational to assume that the improvement in the DASH score is due to reduction in pain and improvement in pain-free grip strength.

To sum up, our findings, comparing the pre-test and post-test analysis of pain, grip strength, and functional improvement of the arm within each experimental group, show significant improvement in all three outcome parameters. However, on analysing the post-test result of experimental group 1 and experimental group-II, it is evident that the experimental group-II has a statistically significant improvement in reducing pain, grip strength, and functional ability of the arm. The present study results indicate that the patients with unilateral Lateral epicondylitis who were given manipulation of the wrist along with conventional treatment had a statistically significant improvement in their performance.

Limitations: There is no control group included in this study that might impact isolating the effect of the therapeutic interventions used. This study reported the short-term effect of manipulation, and its long-term impact needs to be studied. Short study duration and a sample size might have affected the generalization of the result, and future studies should increase both the number of samples and the duration of therapeutic intervention to see its impact on the outcome.

Further directions of this study: Long-term follow-up to evaluate whether there occurs any sustained or carry-over effect after the treatment. The study should be replicated as a large-scale randomized clinical trial that would include a large group and longer follow-up. A future study should be conducted on both genders separately. A similar study could be conducted in different occupations.

CONCLUSION

There is a significant reduction in pain intensity, improvement in pain-free grip strength, and the overall function of the arm following the application of 2 weeks of wrist manipulation technique along with conventional treatment in Lateral Epicondylitis patients.

The present study adds value to the literature that applying wrist manipulation combined with therapeutic ultrasound and stretching exercise reduces pain, improving the arm's grip strength and functional ability in patients with lateral epicondylitis. In addition, manipulation enables the therapist to perform treatment more dynamically, and it reduced pain and improved upper limb function and ability to work.

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Conflicts of interest: None

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