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A study to evalute the effect of ultrasound and stretching versus ulrasound and stretching and strengthening to relieve pain and improve grip strength in lateral epicondyltis an experimental study

Savaliya Vidhi Vinod Kumar and Pavana

Abstract
A study to evaluate the effect of ultrasound and stretching versus ultrasound and stretching and strengthening to relieve pain and improve grip strength in lateral epicondylitis. The study included 40 subjects with lateral epicondylitis. The subjects who fulfil the inclusion and exclusion criteria were selected. Informed consent was obtained from the subjects then the patients were randomly assigned into two groups. Group A and group B having 20 subjects in each group. Pre-treatment assessments of pain and grip strength were recorded for both the groups. Visual analogue scale and hand-held dynamometer to measure pain and grip strength. Brief introduction was given about ultrasound, stretching and strengthening exercise. In group A received treatment of ultrasound and stretching. Group B received treatment of ultrasound, stretching and strengthening exercise. On the same assessment parameters, after 2 weeks of the treatment and post treatment assessment of pain and grip strength were taken, at the end of 4 week for both the groups, for comparison with pre-treatment assessment data and 2weeks after the treatment data. At end of 2 weeks group A showed 9.35% change and group B 23.22% change which is statistically significance as $p=0.000<0.01$ and end of 4 weeks of treatment group A showed 16.71% and group B 47.06% change which is statistically significance as $p=0.000<0.01$. So, group B is highly effective compare to group A in improvement of grip strength. At end of 2 weeks group A showed 32.64% change and group B 38.19% change which is statistically significance as $p=0.000<0.01$ and end of 4 weeks of treatment group A showed 61.81% and group B 71.53% change which is statistically significance as $p=0.000<0.01$. So, group B is highly effective compare to group A in reduction of pain level. At the end of 4 weeks of treatment after analysing the result, it had been found that ultrasound, stretching and strengthening exercise significantly reduced symptoms of lateral epicondylitis by minimizing pain and improve grip strength in group B. Parallel treatment observed by comparison of ultrasound and stretching exercise showed significance in controlling the pain and no significance in enhancing grip strength in group A.

Keywords: lateral epicondylitis, ultrasound, stretching, strengthening exercise.

Introduction
Tennis elbow is one of the commonest lesions of the arm. The first description is attributed to Runge in 1873 but the name derives from Morris description of 'lawn tennis arm' in the Lancet of 1882. It affects 1– 3 % of the population occurs mostly between 40 and 60 years and usually affects dominant arm [1].

The term 'tennis elbow' was introduced in the 1880s but it was not until 1979 that pathology of the extensor carpi radialis brevis tendon was associated with lateral tennis elbow. At surgery in over 600 cases of lateral tennis elbow, Nirschl found the extensor carpi radialis brevis tendon to contain disrupted collagen fibres, increased cellularity and neovascularisation. Acute inflammatory cells were almost always nil from the tendon, but a mild sprinkling of chronic inflammatory cells was noted in supportive, or adjacent tissues. When chronic inflammatory cells were present, they resulted from repair of partial tears. Although Nirschl coined the term 'angiofibroblastic hyperplasia' for the histology seen in elbow tendinosis, presumably to emphasize the neovascularisation (angio) and increased cellularity (fibroblastic), these features are both typical of the well-recognised pathological entity of tendinosis [2].

The word tennis elbow and lateral epicondylitis in this review paper have been used synonymously and they refer to lateral epicondylitis which is more common and more serious problems than medial epicondylitis. In an epidemiological study lateral epicondylitis was reported to be 6 times more common than the medial epicondylitis, and right sided epicondylitis was found to be twice as common as left sided epicondylitis. This condition is believed to be primarily a work related syndrome. Golfers, carpenters, bricklayers, squash players, violinist, housewives, dentists, surgeons or anyone involved in activities or occupations requiring repetitive rotation of the forearm, or wrist flexion or extensions are prone to develop lateral epicondylitis. A similar condition has also been described in computer operators in case reports. This was suggested to be related to the use of standard keyboards at nonstandard heights and was reported to be associated with pain, swelling and disability necessitating a week off work [3].

Lateral epicondylitis is painful and debilitating musculoskeletal condition that poses significant challenges to health care industry [4]. Several observations suggest that the anatomy and kinematic around the elbow might be important in the occurrence of tennis elbow. First, the pathological changes occur at a consistent location in the common extensor tendon origin rather than at other locations along the tendon that are also under longitudinal internal stress. Second, evidence suggests that healthy tendons do not rupture in their substance; instead, excessive tension causes either disruption at the musculotendinous junction or avulsion of a fragment of bone. Third, the symptoms of tennis elbow can be elicited by elbow motion, specifically elbow extension, regardless of the position of the wrist, or are more prominent with the elbowextended [5].

Tennis elbow is an inflammatory overuse syndrome affecting the lateral epicondyle and associated contractile elements and capsular structure. The syndrome is characterized by an insidious onset of elbow pain that is elicited during excessive wrist extension and pronation or supination and aggravated by Gripping. This syndrome is not exclusive to tennis players and fewer than 5% of the cases are found in these athletes.

However, close to 50% of tennis players will have had tennis elbow at some point in their career (Schnatz & Steiner 1993). Tennis elbow is prevalent amon people whose occupation requires frequent rotary motion of the arm and forearm as seen with carpenters, manual laborers, and activities that require fine motor movement of the fingers. Repeated wrist extension and rotation may produce a strain on the contractile elements of the elbow and cause micro trauma to these tissues. Repetitive trauma to these structures will lead to granulation tissue formation and a decrease in the inherent functional capacity. It is thought that four of the muscle that originate at the common extensor tendon, the anconeus, the supinator, the extensor carpi radialis longus, and extensor carpi radialis brevis, are predisposed to traumatic forces or overuse leading to lateral epicondylitis [6].

In the case of tennis elbow, the cellular response to internal micro tears leads to tendinosis. One of us previously categorized the stages of repetitive microtrauma. A stage-1 injury is probably inflammatory, is not associated with pathological alterations, and is likely to resolve; a stage-2 injury is associated with pathological alterations such as tendinosis, or angiofibroblastic degeneration; a stage-3 injury is associated with pathological changes (tendinosis) and complete structural failure (rupture); and a stage-4 injury exhibits the features of a stage-2 or 3 injury and is associated with other changes such as fibrosis, soft matrix calcification, and hard osseous calcification. The changes that are associated with a **stage-4** injury also may be related to the use of cortisone. In practice, it is the second stage (angiofibroblastic degeneration) that is most commonly associated with sports-related tendon injuries such as tennis elbow and with overuse injuries in general. Within the tendon, there is a fibroblastic and vascular response (tendinosis) rather than an immune blood-cell response (inflammation). Thus, the terms epicondylitis and tendinitis aremisnomers48. Although it is commonly presumed that any painful structure is inflamed, connective-tissue pain can be perceived by the patient as the result of nociception and a noxious chemical environment. It is a degenerative or failed healing tendon response characterized by the increase presence of fibroblasts, vascular hyperplasia and disorganized collagen in the origin of extensor carpi radialis brevis, the most commonly affected structure.[7]Lateral epicondylitis is common musculotendinous degenerative disorder of extensor origin at the lateral humeral epicondylitis. Repetitive occupational or athletic activity involving wrist extension and supination are thought to be causative. The typical symptoms include lateral elbow pain, pain with wrist extension and weakened grip strength [8].

Tennis elbow rarely occurs before age of 30 and it is by mature adult life that alterations in collagen content, reduction in cell and ground substance and an increase in lipids are found in the enthesis which probably predispose it is injury. Pain is localized to the lateral epicondyle but may spread up and down the upper limb. Grip is impaired due to the pain and this may restrict daily activities. Tenderness over the epicondyle is usually although other nearby sites may sometimes be maximally tender. Like other soft tissue conditions, the assessment of severity and response to treatment is difficult to measure quantitively.

In adding pain, tenderness and pain on resisted wrist dorsiflexion, other clinical tests have been developed and used successfully in monitoring patient. These include lifting graded weight and measuring grip strength [1].

Patient with active lateral epicondylitis have tenderness over the lateral epicondyle of the elbow or over the origin of the extensor carpi radialis brevis. The pain is described as a “burning” pain is of often radiating to forearm and is usually increased in response to simple tasks of daily life. Although articular and neurological signs are normal, grip strength may be decreased. Eventually, even shaking hands, picking up a milk carton or carrying a briefcase may cause severe pain around the epicondyle. In severe cases, pain may occur at rest and is associated with reduced movement at the extremes of flexion and extension. Increased tenderness may be the result of repeated micro trauma causing inflammatory condition of the periosteum with granulation of tissue that contains large number of free nerve endings. On clinical examination, there are three important physical signs (a) tenderness to palpation at the anterior aspect of the lateral epicondyle (b) pain on passive stretching at the wrist with the elbow held in extension and the forearm prone (c) pain on resisted extension of the wrist while the elbow held in extension and the forearm in prone. Resisted test of wrist extension and forearm supination will often increase the pain. One of the most reliable diagnostic tests is to extend the middle finger on the affected site against resistance. This action strains the extensor carpi radialis brevis which inserts at the base of the third metacarpal. The “coffee cup” sign is a description in which patient will develop pain at the lateral epicondyle when he/she picks up a full cup of coffee. It is suggested that a

heavy book (approximately 3kg in weight) can be useful both for diagnosis and for education of patient, on how to lift the objects. When the book is held with elbow flexed and adducted, the patient with tennis elbow does not experience any pain. However, grasping the book while the forearm is pronated causes immediate pain in the elbow, promptly followed by elbow adduction allowing the book to dip below the head of the radius [3].

The examination then proceeds to the elbow. In lateral epicondylitis, the elbow is more tender to palpation over the lateral epicondyle over the extensor mass. These patients have reproducible pain in the region of the lateral epicondyle with the elbow in full extension as the examiner tests resisted wrist extension or maximal wrist flexion. The first maneuver tests ECRB strength, and causes pain at the origin of the muscle in an individual who has lateral epicondylitis. The second maneuver places the ECRB on maximal stretch, again causing pain at the origin of the muscle. While testing muscles for pain, it is important to remember that the common extensor tendon is involved in up to 35% of patients. Grip strength should be tested to determine whether it is decreased compared with the unaffected side or whether gripping causes significant discomfort [9].

As up to 30% of all patients seen primary care with tennis elbow are referred to physiotherapy the aim of this review is to examine the evidence used physiotherapy modalities in the management of tennis elbow. Electrotherapy intervention – Laser, Pulse shortwave, ultrasound and physiotherapy intervention – acupuncture, ice, manual therapy massage, orthotic device and taping, stretching exercises and eccentric strengthening exercises are used for tennis elbow.[10]Since Woods and Lumis first investigated the interaction between ultrasound and living tissue biological effects of the radiation have been recognized. These include enhanced blood flow, increase membrane permeability and altered connective tissue extensibility and nerve conduction. All these sequels were initially attributed to deep thermal effects, but introduction of pulsed ultrasound largely eliminated the rise in temperature with tissue show non-thermal effect also be present [11].

Ultrasound therapy involves a series of electrical and mechanical phenomena that cause thermal and mechanical effect on cells at both superficial and deep level. Ultrasound falls under the classification of the acoustic spectrum. It is used as deep heating tissues modality, because it can reach a depth of 5cm or more. In general, the effect of ultrasound on tissue is thermal. Therefore, when a tissue is heated a number of changes are expected.

These changes are shown below.

Thermal Effect of ultrasound on tissue: Increase extensibility of collagen tissue, decrease joint stiffness, increase pain threshold, reduce muscle spasm, assist in mobilizing inflammatory infiltrates, oedema and exudates, increase blood flow, increase local metabolism, Increase nerve conduction velocity [3].

Exercise is one of the most common used treatments in tennis elbow managed by physiotherapist especially progressive stretching exercises. Strengthening results in tendon strengthening stimulating mechanoreceptors in tenocytes to produce collagen, which is probably the key cellular mechanism that determines recovery from tendon injury.[10] Stretching is a common intervention performed during rehabilitation. Stretching is prescribed to increase muscle length and Range of Motion, or to align collagen fibres during healing muscle.[12]Strengthening, particularly eccentric strengthening has been advocated as a treatment of tendon overuse conditions since the early 1980s. Clinical studies point to the efficacy of eccentric strengthening regimens. Mechanical loading accelerates tenocytes metabolism and may speed repair [2].

Materials and Methods: Data collected from patient who are referred: Wenlock Government hospital, Shreedevi college out-patient department, SCS Hospital Mangalore. Study design: Quasi experimental studyand40 subjects were included by purposive sampling method. Sample size was determined by pilot study conducted over 5 subjects. Duration of the study four weeks 40 patients will be chosen based on inclusion and exclusion criteria. Both female and male patients between 20 to 50 years will be taken. Group A - Consist of 20 subjects with lateral epicondylitis who will be given ultrasound therapy and stretching exercise. Group B - Consist of 20 subjects with lateral epicondylitis who will be given ultrasound therapy and stretching exercise and strengthening exercise. Group A and Group B subjects will be compared to know which treatment is more effective.

Inclusion Criteria: Both males and females will be included, Subjects in age group between 20 to 50yrs**,** suffering from lateral epicondylitis since 5 to 6 months, Presence of tenderness on palpation over the lateral humeral epicondyle, Unilateral symptomatic lateral epicondylitis, Subjects with positive cozen test, mill's test and middle finger extension test.

Exclusion Criteria: Previous surgery or trauma to the region**,** History of previous fracture of Radius/Ulna, History of Rheumatoid arthritis, Any deformity in elbow or upper limb, Peripheral nerve involvement in upper extremity, Patient with recent corticosteroids injections, Elbow bursitis.

Outcome measure: Pain assessment by Visual Analogue Scale (VAS) [15], Pain free grip strength with hand held dynamometer [16].

Material used: Couch and chair, Towel roll, Standard Ultrasound machine, Ultrasound gel**,** Resistance Band**,** Handgrip dynamometer**,** Recording sheets, VAS scale.

Methodology: Primary data was collected using the convenience sampling method and there were 40 subjects chosen based on inclusion and exclusion criteria. The subjects were divided into 2 groups that is Group A and Group B, each group consisted of 20 individuals.

Those subjects, who participated in the study, were given brief idea about the nature of the study. Following their selection a written consent was obtained from each one of them.

The data was collected by assessing the subjects. The assessment obtained information about demographic details, history and subjective and objective assessment along with investigations. The subjects were assessed before the treatment, two weeks after the treatment and at the end of four weeks by VAS scale for pain assessment and hand-held dynamometer for pain free grip strength. The patients who fulfilled the inclusion and exclusion criteria were included in the study and treatment protocol was explained.

Assessment of Pain: Visual Analogue Scale (VAS) has been established as valid and reliable in range of clinical and research application [15]. Grip Strength by Hand Dynamometer**:** Grip strength will be measured using Hand

dynamometer. Hydraulic Dynamometer commonly used to estimate grip strength measurement in clinical and research setting. During the examination patient will be seated comfortably and arm will be held at subject's side with shoulder adducted and naturally rotated, elbow will be flexed at 90 degrees, forearm in neutral position, and wrist 0 – 30 of extension and between 0 – 15 degrees of ulnar deviation and maximal grip reading is noted with pain free maximum contraction. The same procedure will be used to assess hand grip strength before treatment and repeated after 6 weeks [17, 18].

Special Test: Cozen test**:** Subject is asked to make a fist, pronate forearm and radially deviated and extend the wrist while examiner resist movement. A sudden severe pain is present at lateral epicondyle is a positive sign [19]. Mill's test**:** There is pain over the lateral epicondyle when wrist and fingers are completely flexed [20]. Mauldsley's test: The subject may feel pain during resistance of extension of middle finger at the metacarpo phalangeal joint when the elbow is fully extended.[20]Procedure: Subjects were divided into two groups Group A and Group B. Each group consisted of 20 subjects. In Group A ultrasound therapy and stretching exercise were given to 20 subjects for four weeks. In Group B ultrasound therapy and stretching exercise and strengthening exercise with resisted bend were given to 20 subjects for four weeks Treatment was given for one session per day for five days a week and the total treatment period was of 4 weeks. GROUP A: Ultrasound Therapy: It was given in Group A along with stretching exercise. The subject sit on a chair with back rest and the affected side elbow was kept on table with rolled towel or pillow underneath. Therapist stand or sits on the affected side of the subject elbow with ultrasound machine nearby him or her. Frequency 1MHz, Intensity 1W/cm^2 mode, pulsed with 1: 4 ratios and treatment time 10 minutes. A thin layer of water soluble gel was spread over the area to be treated and ultrasound transducer head was placed in contact with gel. The transducer head was moved over lateral epicondyle [13]. StretchingExercise: All subjects were instructed on stretching of wrist extensors. The wrist extensors will be stretched in standing position with the shoulder flexed to 90 degrees the elbow extended, and opposite hand pulling wrist into flexion. Twice a day, subjects performed 3 repetitions held for 30 seconds, with 30 seconds rest between repetitions [14]. Group B: Ultrasound Therapy: It was given in Group B with stretching exercise and strengthening exercise. The subject seated on a chair with back rest and the affected side elbow kept on table with rolled towel or pillow underneath. Therapist stand or sits on the affected side of the subject elbow with ultrasound machine nearby him or her. Frequency 1 MHz, Intensity 1 W/cm^2 mode, pulsed with 1: 4 ratios and treatment time 10minutes. A thin layer of water soluble gel will be spread over the area to be treated and ultrasound transducer head will be placed in contact with gel. The transducer head will be moved over lateral epicondyle [13].

Stretching Exercise: All subjects were instructed on stretching of wrist extensors. The wrist extensors were stretched in standing position with the shoulder flexed to 90 degrees the elbow extended, and opposite hand pulling wrist into flexion. Twice a day, subjects performed 3 repetitions held for 30 seconds, with 30 seconds rest between repetitions [14]. Strengthening Exercise: Each subject in the strengthening groups were provided with elastic resistance band to perform exercise. Therapist provided resistance with a band to patient. Resisted exercise were performed in seated position, with the elbow flexed, forearm resting on the thigh, and the hand extending beyond the edge of the thigh to allow full wrist motion during exercise. The resistance band was held by the handle and fixed on the floor with ipsilateral foot. Strengthening groups performed 3 sets of 10 repetitions once daily with 2 to 5 mins of rest by sets. The resistance was increased by shortening the band in 1-inch increments from the initial length mark [14].

Fig 1: Instrumentation (Ultrasound Machine)

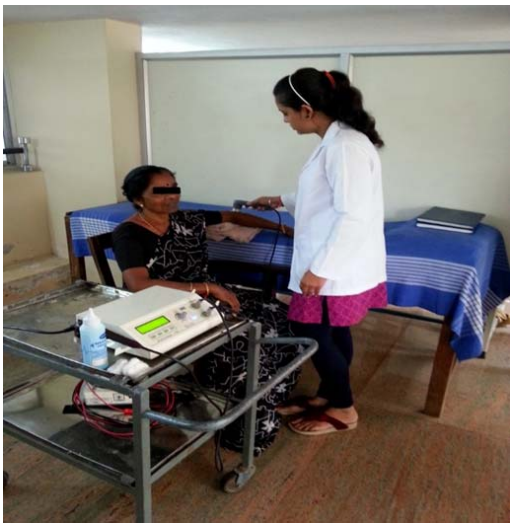

Fig 2: Ultrasound therapy

Fig 3: Wrist extensors streching

Fig 4: Wrist flexors stretching

Fig 5: Strengthening Exercise with Resistance band

Fig 6: Instrumentation (Hand dynamometer)

Fig 7: Standard position for recording pain free grip strength using a hand-held dynamometer

Statistical test: Collected data was analyzed by mean, standard deviation and two factor ANOVA for repeated measures to compare the effect on the parameters of pain and grip strength and further post hoc analysis tested by Bonferroni test.

Results

Age distribution in both groups:

Table 1: Age wise distribution in both group.

	Group	N	Mean	Std. Deviation	
age	Group A	20	38.85	7.597	t = 0.127, p=0.900, NS
	Group B	20	38.55	7.352	

Table 1: Mean age in group A was 38.85 ±7.597. In group B was 38.55±7.352. Test shows that there is no significance difference between the groups as p=0.900>0.05.

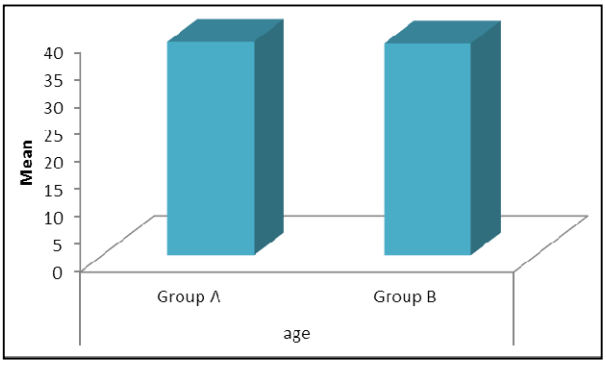

Fig 8: Age wise distribution in both group. Sex wise distribution in both group:

Table 2: Sex wise distribution in both groups.

		Group		
		Group A	Group B	Total
sex	Female	13	11	24
		65.0%	55.0%	60.0%
	Male	7	9	16
		35.0%	45.0%	40.0%
Total		20	20	40
		100.0%	100.0%	100.0%

X2=.417, p=.519, NS Figure 9: In group A, there were 65% female and 35% male and in group B there were 55% female and 45% male. There is no significance different between group A and group B with respect to male and female distribution as p=0.591>0.05.

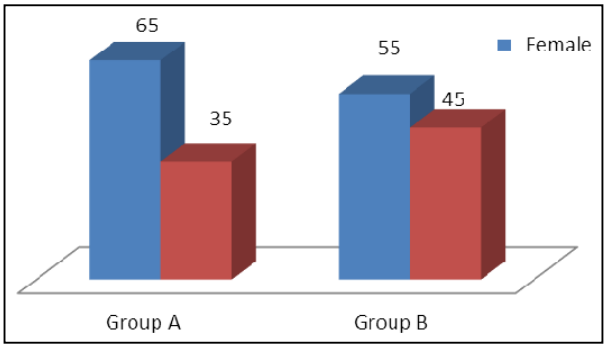

Fig 9: Sex wise distribution in both group Comparison of groups before the treatment:

Table 3: Comparison of groups before the treatment:

Before treatment

Parameter	Group	N	Minimum	Maximum	Mean	Std. Deviation	Median	t value	p value
Hand held dynemometer	Group A	20	12	23	17.65	3.13	17.50	1.669	.103
	Group B	20	12	20	16.15	2.52	17.00		NS
	Total	40	12	23	16.90	2.91	17.00		
Pain	Group A	20	5	9	7.20	1.40	7.50	.000	1.000
	Group B	20	5	9	7.20	1.15	7.00		NS
	Total	40	5	9	7.20	1.26	7.00		

Table 3: There is no significance difference between the groups with respect to pain level and grip strength before the treatment as p>0.05.

Table 4: Comparison of groups before the treatment (hand held dynamometer):

Parameter: Hand held dynemometer

Group		N	Minimum	Maximum	Mean	Std. Deviation	Median
Group A	Before treatment	20	12	23	17.65	3.13	17.50
	Two weeks after treatment	20	14	25	19.30	3.16	19.50
	After 4 weeks of treatment	20	16	26	20.60	2.98	21.00
Group B	Before treatment	20	12	20	16.15	2.52	17.00
	Two weeks after treatment	20	15	25	19.90	3.16	19.50
	After 4 weeks of treatment	20	18	28	23.75	3.14	23.50

Table 4: In group A grip strength level before the treatment was 17.65±3.13 after 2 weeks 19.30 ±3.16 and end of 4 weeks 20.60±2.98. In group B grip strength level before the treatment was 16.15±2.52 after 2 weeks 19.90 ±3.16 and end of 4 weeks 23.75±3.14.

Table 5: Comparison of groups before the treatment (pain):

Parameter: Pain

Group		N	Minimum	Maximum	Mean	Std. Deviation	Median
Group A	Before treatment	20	5	9	7.20	1.40	7.50
	Two weeks after treatment	20	2	7	4.85	1.46	5.00
	After 4 weeks of treatment	20	1	6	2.75	1.33	2.50
Group B	Before treatment	20	5	9	7.20	1.15	7.00
	Two weeks after treatment	20	2	7	4.45	1.57	4.00
	After 4 weeks of treatment	20	0	4	2.05	1.05	2.00

Table 5: In group A pain level before the treatment was 7.20_+1.40 after 2 weeks 4.85_+1.46 and end of 4 weeks 2.75_+1.33. In group B grip strength level before the treatment was 7.20_+1.15 after 2 weeks 4.45 _+1.57 and end of 4 weeks 2.05_+1.05.

Assessment and Two factor ANOVA results

Table 6: Assessment and Two factor ANOVA results (hand held dynamometer):

Parameter: Hand held dynemometer

Source	ANOVA F=	p=	
To compare the difference over the duration	199.041	.000	HS
To compare between the groups over different time point	38.781	.000	HS

Table 6: Two factor ANOVA for repeated measure showed that there is significance difference over the duration as F=199.041, p=0.000<0.01 and also difference is significance between groups over different period time F=38.781, p=000. <0.01. Further post hoc analysis was performed for within group comparison and for between group comparison by Bonferroni test.

Table 7: Assessment and Two factor ANOVA results (pain)

Parameter: Pain

Source	ANOVA F=	p=	
To compare the difference over the duration	494.357	.000	HS
To compare between the groups over different time point	3.643	.043	sig

Table 7: Two factor ANOVA for repeated measure showed that there is significance difference over the duration as F=494.357, p=0.000<0.01 and also difference is significance between groups over different period time F=3.643, p=000. <0.01. Further post hoc analysis was performed for within group comparison and for between group comparison by Bonferroni test.

Post hoc analysis – comparison within the group:

Table 8: Post hoc analysis – comparison within the group (hand held dynamometer)

Post hoc analysis - comparison within the group

Measure: MEASURE_1

Parameter: Hand held dynemometer

Group			Mean Difference	Std. Error	change (%)	p value	
Group A	Beforetreatment	Twoweeksaftertreatment	-1.650	.150	9.35	.000	HS
		After4weeksoftreatment	-2.950	.223	16.71	.000	HS
	Twoweeksaftertreatment	After4weeksoftreatment	-1.300	.193	6.74	.000	HS
Group B	Beforetreatment	Twoweeksaftertreatment	-3.750	.369	23.22	.000	HS
		After4weeksoftreatment	-7.600	.591	47.06	.000	HS
	Twoweeksaftertreatment	After4weeksoftreatment	-3.850	.494	19.35	.000	HS

Table 8: In group A, there was 9.35% change at 2 weeks after the treatment and 16.71% change at the after 4 weeks of the treatment which are statistically highly significance. In group B, there was 23.22% change at 2 weeks after the treatment and 47.06% change at the after 4 weeks of the treatment which are statistically highly significance

Table 9: Post hoc analysis – comparison within the group (pain):

Post hoc analysis - comparison within the group

Measure: MEASURE_1

Parameter: Pain

Group			Mean Difference	Std. Error	change (%)	p value	
Group A	Beforetreatment	Twoweeksaftertreatment	2.350	.196	32.64	.000	HS
		After4weeksoftreatment	4.450	.266	61.81	.000	HS
	Twoweeksaftertreatment	After4weeksoftreatment	2.100	.204	43.30	.000	HS
Group B	Beforetreatment	Twoweeksaftertreatment	2.750	.228	38.19	.000	HS
		After4weeksoftreatment	5.150	.196	71.53	.000	HS
	Twoweeksaftertreatment	After4weeksoftreatment	2.400	.197	53.93	.000	HS

Table 9: In group A, there was 32.64% change at 2 weeks after the treatment and 61.81% change at the after 4 weeks of the treatment which are statistically highly significance. In group B, there was 38.19% change at 2 weeks after the treatment and % change 71.53% at the after 4 weeks of the treatment which are statistically highly significance.

Post hoc analysis – comparison between the group:

Table 10: Post hoc analysis – comparison between the group (hand held dynamometer):

Post hoc analysis - comparison between the group

Measure: MEASURE_1
Parameter: Hand held dynemometer

		Group	Mean Difference	Std. Error	change (%)	p value	
Beforetreatment	Twoweeksaftertreatment	Group A	-1.650	.150	9.35	.000	HS
		Group B	-3.750	.369	23.22		
	After4weeksoftreatment	Group A	-2.950	.223	16.71	.000	HS
		Group B	-7.600	.591	47.06		
Twoweeksaftertreatment	After4weeksoftreatment	Group A	-1.300	.193	6.74	.000	HS
		Group B	-3.850	.494	19.35		

Table 10: At end of 2 weeks group A showed 9.35% change and group B 23.22% change which is statistically significance as p=0.000<0.01 and end of 4 weeks of treatment group A, showed 16.71% and group B 47.06% change which is statistically significance as p=0.000<0.01. So, group B is highly effective compare to group A in improvement of grip strength.

Table 11: Post hoc analysis – comparison between the group (pain):

Post hoc analysis - comparison between the group

Measure: MEASURE_1
Parameter: Pain

		Group	Mean Difference	Std. Error	change (%)	p value	
Beforetreatment	Twoweeksaftertreatment	Group A	2.350	.196	32.64	.191	NS
		Group B	2.750	.228	38.19		
	After4weeksoftreatment	Group A	4.450	.266	61.81	.041	sig
		Group B	5.150	.196	71.53		
Twoweeksaftertreatment	After4weeksoftreatment	Group A	2.100	.204	43.30	.297	NS
		Group B	2.400	.197	53.93		

Table 11: At end of 2 weeks group A showed 32.64% change and group B 38.19% change which is statistically significance as p=0.000<0.01 and end of 4 weeks of treatment group A, showed 61.81% and group B 71.53% change which is statistically significance as p=0.000<0.01. So, group B is highly effective compare to group A in reduction of pain level.

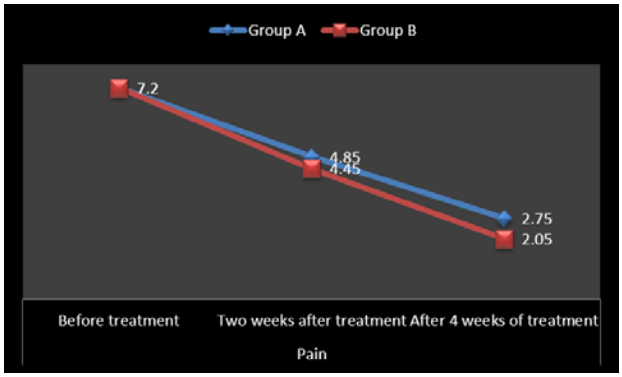

Fig 10: Post hoc analysis comparison for pain.

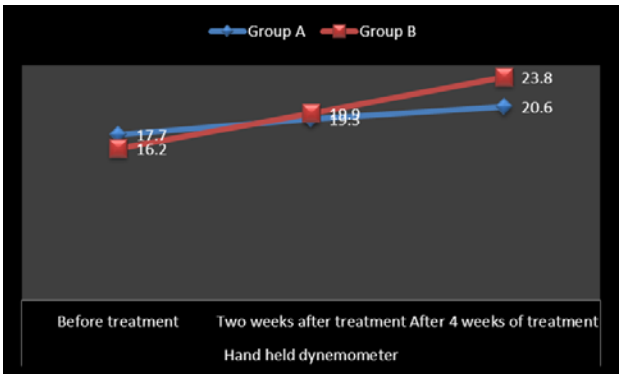

Fig 11: Post hoc analysis comparison for grip strength Effect of gender on the treatment:

Table 12: Effect of gender on the treatment:

Parameter	Group		sex	N	Mean	Std. Deviation	t test p value
Hand held dynemometer	Group A	Change Before - 2 weeks	Female	13	-1.77	.599	.291
			Male	7	-1.43	.787	NS
		Change Before - 4 weeks	Female	13	-3.00	.816	.769
			Male	7	-2.86	1.345	NS
		Change 2 weeks - 4 weeks	Female	13	-1.23	.725	.638
			Male	7	-1.43	1.134	NS
	Group B	Change Before - 2 weeks	Female	11	-3.64	1.629	.743
			Male	9	-3.89	1.764	NS
		Change Before - 4 weeks	Female	11	-7.09	2.737	.355
			Male	9	-8.22	2.539	NS
		Change 2 weeks - 4 weeks	Female	11	-3.45	2.115	.390
			Male	9	-4.33	2.345	NS
Pain	Group A	Change Before - 2 weeks	Female	13	2.54	.877	.197
			Male	7	2.00	.816	NS
		Change Before - 4 weeks	Female	13	4.92	1.038	.011
			Male	7	3.57	.976	sig
		Change 2 weeks - 4 weeks	Female	13	2.38	.768	.054
			Male	7	1.57	.976	NS
	Group B	Change Before - 2 weeks	Female	11	2.45	1.036	.157
			Male	9	3.11	.928	NS
		Change Before - 4 weeks	Female	11	5.00	1.000	.411
			Male	9	5.33	.707	NS
		Change 2 weeks - 4 weeks	Female	11	2.55	1.036	.430
			Male	9	2.22	.667	NS

Table 12: There is no significance effect of gender in both groups and both parameters.

Table 13: Effect of age on the treatment.

Correlations

age

Parameter	Group		Karl pearson correlation value	p
Hand held dynemometer	Group A	Change Before - 2 weeks	-.216	.360
		Change Before - 4 weeks	.161	.499
		Change 2 weeks - 4 weeks	.353	.126
	Group B	Change Before - 2 weeks	.253	.282
		Change Before - 4 weeks	.513*	.021
		Change 2 weeks - 4 weeks	.426	.061
Pain	Group A	Change Before - 2 weeks	-.110	.643
		Change Before - 4 weeks	-.161	.498
		Change 2 weeks - 4 weeks	-.104	.662
	Group B	Change Before - 2 weeks	.314	.177
		Change Before - 4 weeks	.166	.483
		Change 2 weeks - 4 weeks	-.198	.403

*. Correlation is significant at the 0.05 level

Table 13: There is no significance effect of age in treatment in both age groups and both parameters.

Discussion

The aim of the study was to compare the efficacy of ultrasound and stretching versus ultrasound, stretching and strengthening exercise for lateral epicondylitis. 40 subjects satisfying the inclusion criteria were recruited for the study. Mainly care was taken regarding inclusion n exclusion criteria. Informed consent was obtained from the patient. Then the patients were assigned into two groups. In group A and group B 20 subjects in each group. In this study subjects were both female and male between 20 to 50 years. Pretest were recorded for both groups for pain intensity by visual analogue scale and grip strength by hand held dynamometer. Mill's test, cozen test and Mauldsley's test all special test are performed with all subjects. The subjects were assessed before the treatment, during the treatment of 2 weeks and after the treatment of 4 weeks. Brief introduction about ultrasound, stretching and strengthening exercise were given to subjects. In group A subjects received ultrasound therapy and stretching exercise. In group B received ultrasound therapy, stretching exercise and strengthening exercise. The treatment was given for one session per day for five days a week and the total treatment period was 4 weeks. The ultrasound, stretching exercise and strengthening exercise significantly reduced the symptoms of lateral epicondylitis by minimizing the pain and improving grip strength. The parallel treatment observed by comparison of ultrasound with stretching exercise also showed the significance in controlling the pain and not showed the significance in increase grip strength. The results of the study showed that there is significantly improvement in the hand grip strength and minimizing the pain of the group B when compared to group A study was carried out to compare the efficiency of pulsed versus continuous ultrasound therapy in the lateral epicondylitis. The pre-and post-interventional outcome was assessed based on pain intensity by using visual analogue scale n duration of study was 2week. Based on statistical analysis in group A grip strength level before the treatment was 17.65±3.13 after 2 weeks 19.30±3.16 and end of 4 weeks 20.60±2.98. In group B grip strength level before the treatment was 16.15±2.52 after 2 weeks 19.90 ±3.16 and end of 4 weeks 23.75±3.14. Based on statistical analysis value in group A pain level before the treatment was 7.20±1.40 after 2 weeks 4.85±1.46 and end of 4 weeks 2.75±1.33. In group B grip strength level before the treatment was 7.20±1.15 after 2 weeks 4.45 ±1.57 and end of 4 weeks 2.05±1.05The Statistical analysis was done for both the groups. After statistical analysis result showed that group B showed more significant result compared to group A to reduce pain and to improve grip strength.

Conclusion

The purpose of study was to find out effective treatment for the patient with lateral epicondylitis. After analyzing the result, it had been found that ultrasound, stretching and strengthening exercise significantly reduced symptoms of lateral epicondylitis by minimizing pain and improve grip strength in group B. Parallel treatment observed by comparison of ultrasound and stretching exercise showed significance in controlling the pain and no significance in enhancing grip strength in group A.

After the statistically analysis at the end of 2 weeks group A showed 32.64% change and group B 38.19% change which is statistically significance as $p=0.000<0.01$ and end of 4 weeks of treatment group A showed 61.81% and group B 71.53% change which is statistically significance as $p=0.000<0.01$. So, group B is highly effective compare to group A in reduction of pain level. At end of 2 weeks group A showed 9.35% change and group B 23.22% change which is statistically significance as $p=0.000<0.01$ and end of 4 weeks of treatment group A showed 16.71% and group B 47.06% change which is statistically significance as $p=0.000<0.01$. So, group B is highly effective compare to group A in improvement of grip strength.

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