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The Role of Progressive Strengthening, Stretching Exercises and Ultrasound in Chronic Lateral Epicondylitis "A Comparative Study"

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Abstract

The most common cause of middle aged people (house wife, working men and sports person), is Tennis Elbow. The study focused on comparing the effects of two different combinations of physiotherapy treatments. The studies done by Morrey B.F.(1985), Binder(1985), and Janta(1986) were the base of this study to make the combination of treatment comparisons.

Objective: This study aimed to find a effective treatment combination intervention to get relieve from their(patients) day today problems and improve functions, of affected by Tennis Elbow, through statistical evaluation techniques.

Methodology: In this study, there were 24 people selected in two different groups and applied with ultrasound, Stretching and Strengthening treatments, in two different combinations, and there effects were compared by measuring the patient's hand grip strength and functional index evaluations.

Conclusion and Result : The study concluded with the effective group was experimental group when it is compared with results found from control group which was observed from the study. The study shows its result to be proved that the Alternate hypothesis is accepted and the Null hypothesis has been rejected.

Keywords:- *Chronic Lateral Epicondylitis, Functional Index, Hand Grip Strength, Progressive Strengthening, Stretching Exercises, Tenomuscular Junction, Ultrasound Therapy.*

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CHAPTER ONE
INTRODUCTION

1.1 INTRODUCTION

In modern world people are facing many problems in their day to day life, who may office going (or) house wife's whoever it may be, facing problems as Epicondylitis.

Epicondylitis is common problem affecting the middle portion of the upper extremity (elbow joint) [19]. It is a chronic painful condition that is due to excessive pronation & supination activities of the forearm that result in damage to the tendons of medial (or) lateral epicondyles [3].

The lateral epicondylitis is a pain syndrome generally a work related (or) sport related pain disorder of the common extensor origin of the forearm. The exact cause is unknown, but fhe condition is probably a chronic tendinitis of the common extensor origin [7]. The disorder may due to stress on the forearm & wrist extensors at the moment of extensor mass contraction.. Primarily affects the extensor carpi radialis brevis muscle [2].

Usually the disease caused by excessive quick, repetitive grasping movements & rotator motions of the forearm & wrist. Quick movement may rupture the proximal attachment of the long extensor muscle, & the pain is maximum during grasping offen radiating proximally & distally. The point of maximum tenderness is 1-2 cm distal to epicondyle [19].

The term tennis - elbow was coined over 100 years ago[24]. 45% of tennis players who play daily, often relates to the syndrome due to use of poor technique6, rarely affects bilaterally. around the age groups 30 to 50 years, affects both male and female equally.

The patient with the problem of lateral epicondylitis usually complains of weakened grip and often, relief is obtained by gentle arm exercises as a result elbow stiffness prevented [3].

In acute cases will usually improve when the cause is avoided as well as with the anti-inflammatory drugs (or) corticosteroid injections. According to several studies of both conservative & operative methods, chronic cases are often difficult to treat. They cause prolonged disability & inability to work **(Binder, Hazleman, 1983).**

Manipulative & electrotherapy methods have used with limited effects **(Wadsworth, 1987; La Freniere, 1979; Mills, 1928).** Only the continuous and pulsed ultrasound treatment has produced Conflicting results **(Binder et al, 1985)** [31]. Generally we take, the physiotherapy treatment of ice, deep heating modalities, electrical Stimulation, stretching & strengthening of the involved musculature can be remarkably effective [8].

There are few publications on the effect of therapeutic exercises are the sole treatment method. Strengthening the damaged attachment of the wrist extensors, so that it can be tolerate repetitive movements for better beneficial [31].

Tissue pathology from trauma, inflammation like conditions can lead to the production of dense fibrous tissue, which replaces normal soft tissue. These soft tissues then loss their normal elasticity & plasticity, resulting in loss of range of motion. Muscle strength can also be altered when soft tissue adaptively shortens over time. As muscle loss its flexibility a change in length-tension relationship of the muscle also occurs. As muscle shortens, it is no longer capable of producing peak tension & tight weakness develops [5a].

The adaptive shortening of soft tissue may be treated with passive stretching combined with relaxation procedures and active inhibition techniques. The stretching procedures are technically designed to elongate the contractile & non-contractile tissues of the musculo-tendinous unit [5b].

For the weak muscles, the strength training programme can be added. Strength training refers to muscle (or) muscle group lifting, lowering (or) controlling heavy loads for a relatively low number of repetitions. Strength training has been shown to cause selective hypertrophy of muscle fibers [5a].

The ultrasound is an effective modality; widely used for soft tissue injuries. When ultrasound travels through tissue a percentage of it is absorbed & leads to generation of heat. The controlled heat can produce desirable effects like pain relief, decrease in joint stiffness & broken dense soft tissues [21].

1.2 AIMS AND NEED OF THE STUDY

The problem of lateral epicondylitis is a major occupational hazard. Nearly 50% of the population was affected with this disease without sex difference [6].

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The average age of people developing the tennis elbow is 40 years [6]. The major crippling occurs in this disease is muscle weakness & later it leads to muscle wasting.

Whatever the age it may, the person lives normally, when he is doing the exercises. After having the problem affected to a person, he (or) she returns to normal by doing strengthening exercises [13].

- Hence, the need was felt to find out, strengthening the teared muscular tendon after repetitive micro trauma will develop the capacity to tolerate quick, repetitive works.
- And exercising the teared tendon will not be prove the condition of the activity level & prevent further injury.
- Furthermore find out the stretching exercises helps with strengthening exercises to elongate the affected tendon and relieves the weakness [5b].
- Finding out the ultrasound helps to the soft tissue injuries and broken dense soft tissues.

1.3 STATEMENT OF THE STUDY

A comparative study on the effectiveness of progressive strengthening and stretching exercises over ultrasound for chronic lateral epicondylitis.

1.4 OBJECTIVES OF THE STUDY

- To study the effects of progressive strengthening and stretching exercises with ultrasound therapy in chronic lateral epicondylitis.
- To study the effects of ultrasound therapy only in chronic lateral epicondylitis.
- To study the difference between the effectiveness of the above two treatments in chronic lateral epicondylitis.

1.5 OPERATIONAL DEFINITIONS

1. Chronic Lateral Epicondylitis:

It is a common clinical entity characterised by pain and tenderness at the common origin of the extensor group of muscles of the forearm. It is an extra-articular condifion believed to be caused by strain (or) incomplete rupture of the forearm extensor muscles (or) aponeurotic fibers af their origin, respectively.

2. Ultrasound Therapy:

Ultra sonic energy (or) ultrasound describes any vibration at a frequency above the sound range, but it's frequencies of a few megahertz that are typically used in physiotherapy, several different frequencies are employeed in the range from 0.5 to 5 MHz [10].

3. Strengthening Exercises (Or) Resisted Exercises:

Resistance exercise is any form of active exercise in which a dynamic (or) static muscular corntraction is resisted by an outside force. The external force may be applied manually (or) mechanically [5a].

4. Stretching:

This technique is used to lengthen the shortened tissue and to identify the 'Tight tissue'. The patient is told to report mild discomfort when the stretch is applied, the stretch is then held (ie) in flexion, the therapist feels the tissue easing usually over 1 to 2 minutes. Generally this procedure is repeated 5 to 10 times in a session twice-daily [5b].

1.6 HYPOTHESIS OF THE STUDY

Null Hypothesis:

It is hypothesized that the study is based on, there is no significant difference in the treatment outcome on comparison between progressive strengthening & stretching exercises along with ultrasound and only ultrasound therapy for chronic lateral epicondylitis.

Alternative Hypothesis:

It is hypothesized that the study is based on the assumption of progressive strengthening & stretching exercises are significantly more effective in treating the chronic lateral epicondylitis along with the ultrasound therapy than the treatment of ultrasound therapy alone to the chronic lateral epicondylitis.

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CHAPTER TWO
REVIEW OF LITERATURE

2.1 PATHOLOGICAL ADAPTATIONS

- **Apley's (1993)** States, the Lateral epicondylitis is a pathological lesion. may be microscopic tearing of the aponeurosis of extensor tendon followed by a local inflammatory reaction (or) vascular congestion (or) crystal deposition.

The condition may also be like supraspinitis tendinitis results in a small tears, fibro cartilaginous metaplacia & painful vascular reaction in the tendon fibers close to the lateral epicondyle[7].

- **David C.Reid (1975),** possible pathological changes, occur in 3 main sites,

In proximal,

- Periostitis.
- Common extensor origin tendinitis.
- Micro tearing with painful granulation.
- Degenerative changes in tendon.

Joint involvement,

- Lateral ligament strain.
- Radio humeral bursitis.
- Inflammation of annular ligament.
- Hypertrophic synovial fringe.
- Degenerative changes in the radial head cartilage.

Third area,

- Extension / abduction ulnohumeral lesions [6].

- **Muneet Kocher & Ankit Dogra (2002),** Alternated tensile loads typically occurs with aging, when loss of mucopolysaccharide chondroitin sulphate makes the tendon less extensible. Hence more energy of tensile loading must be absorbed as internal strain on the collagen fibers rather than deformation of the tissue. Therefore, most people presenting with this problem are above 35 years age [29].
- **Stuart L Weinstein (1994),** The pathologic lesion is a chronic tear especially in the origin of the extensor carpi radialis bravis on the lateral epicondyle. Chronic granulation tissue, fibrinoid degeneration and edematous tendon fibers are noted. The tears vary in size from microscopic to gross rupture[24].
- **Thruston, (1992)** states the main factors in the pathogenesis of tennis elbow are over use, inflammation and degeneration [29].
- **Cyriax, (1992)** states overuse is encountered when the body's physiological capacity to heal lags behind the repetitive microtrauma [29].
- **Putnum and Cohen, (1999)** states the tissue micro trauma damage occurs owing to greater internal strain on tendon fibres over time that might come about from overuse of tendon in such activities. It may also come about with normal activity levels if the capacity of the tendon to alternate tensile loads is reduced [29].
- **Kesler. (1983)** states the inflammatory response is an attempt to speed up tissue production to compensate for an increased rate of tissue micro damage.

2.2 LITERATURE OF TREATMENT

- **Alyea et al (1956),** Gersten (1955) conducted an experimental study to find out the effectiveness of ultrasound on inflammatory conditions with 22 subjects shown that ultrasound decreases pain threshold & increases collagen extensibility [23].
- **Dyson at al (1968),** Duarte, (1983) found in their experimental studies that ultrasound used to stimulate tissue regeneration at 22 subjects without age difference [23].
- **Harvey W, Dyson M. Pond JB, Grahame R, (1975**) they found that human fibroblasts exposed to continuous waves of 3 MHz ultrasound 0.5 to 2.0 W / cm2 intensity, synthesize more protein as demonstrated by proline incorporations on 60 cultured human fibroblasts in average age group of 35 years[28].
- **Jette (1980)** states the functional status index, is an self reporting instrument which measures basic & instrumental activities of daily living for musculo- skeletal problems[13].
- **Heyward (1984)** stated, while using hand grip dynamometer for the measurement of tennis elbow, it must be adjusted to fit for the patient out of the side & squeeze the grip as hard as possible. Average of the 3 can be taken [9].
- **Mathiowetz et al (1985)** conducted an comparative study on 25 patients with average of 43 years age group, gender matched patients of lateral epicondylitis. In this study he reported the grip strength measurements were performed with 2cm grip, in which expected values for grip strength 2cm measurement in lateral epicondylitis of involved of each patient were calculated by Using standardised scores & normative data for adults and the measurements were compared with healthy arm & expected strength [30].
- **Morrey B.F. (1985)** found a functional assessment chart, which is clinically useful in elbow evaluation, providing objective data retrieval and grading as well as information about function. The use of such a rating index in the clinical setting provides an objective means of Comparing different treatment options [16].

- **Binder et al (1985)** studied that ultrasound therapy has been used traditionally for treatment of tennis elbow. He suggested that ultrasound therapy enhanced recovering in 63% of cases Compared to 29% who received a placebo, in his comparative study with 30 patients [29].
- **Halle et al (1986)** conducted an experimental study to find out the effectiveness of ultrasound on 20 patients, found his current literature of only ultrasound therapy for lateral epicondylitis inform weak evidence [27].
- **Janda(1986), Evjenth and Hamberg (1984)** conducted an comparative study, by this they recommended stretching the tight muscles before strengthening the antagonist muscles, because shortened muscles is thought to inhibit the tight antagonist [23.]
- **Harris et al (1986)** compared the results of the functional status index (FSI) with direct observation of the functional activities in an elderly population. The results of these studies indicate that self report is a valid method of assessing basic level of function. When discrepancies between self-report & direct observation (or) professional judgment were noted, patients tended to under estimate their abilities [13].
- **Tipton et al (1987)** suggested that prescribed exercise which increases the force being transmitted to ligaments, tendons, bones will maintain & generally increase the strength & functional capacity of these structures [29].
- **Situberg & Metcalf et al (1988)** were studied by a W experimental design with 30 samples to examine the reliability of the hand held dynamometer used with specific (lateral epicondylitis) testing protocols [13].
- **Lundeberg et al (1988)** reported improvement in 36% of patients treated with ultrasound therapy and he also reported ultrasound proved more effective than rest, it was not superior to the placebo condition[29].
- **Stratford et al (1989)** investigated the intraobserver reliability of grip strength in 35 patients with tennis elbow and reported high intraobserver reliability coefficient for pain free grip strength & maximum grip strength[29] .
- **Enwemeka cs (1989)** conducted an experimental study on 63 male rabbits with 10 to 12 weeks of age & duration of 14 days treatment study, in which he found that ultrasound widely Useful for treating soft tissue injuries & increase strength in healing tendons[28].
- **Kamien (1990),** Palmer et al (1998) outlined the diagnostic tests for chronic lateral epicondylitis as being pain upon palpation of the wrist extensor origin on 337 patients in their experimental study[27],
- **Wilkin et al (1992)** states the functional status index test was designed to measure the degree of dependence, pain & difficulty experienced by people living in the community & it can be Used to assess the patient with epicondyle problems in elbow[12].
- **Wadsworth (1992)** states that isometric strength was assessed by Using a hand grip dynamometer in lateral epicondylitis[28],
- **Grey (1993), Nasland (2001) & Gam & Johannsen (1995)** studied on the effect of ultrasound application in the Treatment of musculo-skeletal disorders like tennis elbow, however no significant effect of ultrasound on pain reduction In their experimental studies with 22 subjects[27].
- **Curwin and Stanish (1994)** have developed a programme to stretching & eccentric strengthening of the wrist extensors[6],
- **Smith (1994)** suggests, a muscle should be stretched by applying a slow, static load for 15- 20 seconds. Each muscle should stretched 3 to 5 times for maximal benefit[23].
- **Fiatarone et al (1994)** stated that progressive resistance training has positive effects on the strength development in lateral epicondylitis[28],
- **Tuula Tarvainen, Tuomo T. Peinimaki et al (1996)** conducted an Comparative study with 29 patients, with average age group of 31 to 53 years, concluded that progressive resisted and stretching exercise therapy is more effective than ultrasound in treating chronic lateral epicondylitis for reducing pain & improving patients ability to work & maximum grip strength [31].
- **Young (1996)** states ultrasound therapy promotes healing of the chronic inflammatory diseases[25].
- **Lockwood (1996)** Suggests exercises for chronic lateral epicondylitis patients is a "hands off" approach &this strategy has been recommended for chronic pain patients[27].
- **Dreschsler et al (1997)** stated that standard treatment for lateral epicondylitis involves stretching, strengthening and ulfrasound over 18 patients with 20% symptoms on recreational status compared to standard treatment[27].
- **Peinimaki et al (1998)** reported beneficial long term effects over 3 years of a graduated resistance exercise programme over ultrasound by 30 patients of average of 35 to 55 years age group, in his Comparative study[29].
- **Garret (2000)** suggested Rehabilitative exercises are thought to improve the quality of the injured tissues, allowing them to absorb safely the forces imposed by the lifestyles of individuals with lateral epicondylitis[29] .
- **Muneet kochar & Ankit Dogra (2002)** conducted an experimental study by 46 subjects with the average age group of 41 years old in male: female ratio of 6:5, in which they conducted that ultrasound and progressive resisted exercises brings about increased & faster recovery in patients with lateral epicondylitis.

In the subsequent study, conducted, the same Treatment programme was instituted in order to enhance strength & facilitate return to work in lateral epicondylitis [29].

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CHAPTER THREE
MATERIALS & METHODOLOGY

METHODOLOGY

3.1 STUDY DESIGN

The study is an experimental in design. The whole sample is divided into two, as experimental and control group. The groups underwent the pre and post test study design.

In the present study, the total number of 24 samples of lateral epicondylitis patients were divided into, both experimental (12) and control group (12). The experimental groups were treated with progressive strengthening & stretching exercises and ultrasound.

The control groups were treated with only ultrasound. The Samples were undergone pretest of the grip strength measurement & disability index measurements. The grip strength dynamometer and the Disability index scale were used to take measurements respectively [14].

3.2 STUDY SETTING

The study was conducted in, the physiotherapy departments of the,

1. Govt. head quarter's Hospital, Dharmapuri.
2. Sri Gokulam Hospitals (P) Ltd., Salem.
3. Outpatient department of Padmavathi College Hospital, Dharmapuri. 16

3.3 POPULATION

All the lateral epicondylitis patients of age group between 30 to 50 years with chronic unilateral problem, attending the physiotherapy outpatient department of the above mentioned hospitals were the population of the study[22],

3.4 SAMPLING AND METHOD OF SELECTION

Twenty four patients satisfying the criteria for selection were selected as sample for study from the population using simple random sampling (Lottery method)[56]. Then, the whole sample is divided into two groups as experimental and control groups randomly. Each group consists of 12 samples.

3.5 CRITERIA FOR SAMPLE SELECTION

INCLUSION CRITERIA:

1. On palpation: Local tenderness over anteroinferior aspect of the lateral epicondyle of elbow and pain increased both with resisted wrist movements and passive stretching of involved motor units.
2. Chronic lateral epicondylitis Patients (ie) suffering more than Three months and below six months.
3. Both sexes were taken.
4. Subjects selected between 30 to 50 years age group.
5. Patients undergone positive Mill's test.
6. Patient undergone positive Cozen's test.
7. All the diagnostic procedures those complete the satisfaction of the orthopaedician and other than the criteria present below (in exclusion criteria)[6, 29].

EXCLUSION CRITERIA:

- Cubital Osteoarthritis.
- Carpal and radial funnel syndrome.
- Rheumatoid arthritis.
- Severe cervical radiculopathy.
- Painful shoulder (or) rotator cuff tendinitis.
- Previous fractures of the arm causing limitations in the arm functions.
- Olecronon bursitis.
- Any nerve injuries.
- Arcad of froshe.
- Diabetes mellitus.
- Patients with associated diseases.
- Clinical signs other than tennis elbow.
- Elbow dislocation.
- TOS (Thoracic Outlet Syndrome).

- Brachial neuralgia.
- Pronator syndrome.

3.6 VARIABLES OF THE STUDY

INDEPENDENT VARIABLES

- Ultrasonic therapy.
- Strengthening technique.
- Stretching procedures were independent variables of the study.

DEPENDENT VARIABLES

- Hand grip strength.
- Functional index were dependent variables.

1. HAND GRIP DYNAMOMETER:

The dynamometer is a piece of equipment designed to measure static strength. It is most commonly used to measure isometric grip strength. Explanation of its use is limited to this particular function. There are varieties of dynamometers.

The dynamometer traditionally has been used for the collection of research data. It's relatively nominal cost ($ 45 - 150) makes it affordable for use in clinical setting.

Grip Strength Measurement:

The dynamometer must first be adjusted to fit the patients hand grip size. The patient positioned properly for the measurement of grip strength without "trick' movement. This test Was performed with elbow flexed (or) extended, which one is less painful can be selected, & the forearm pronated and resting on the table, when function is most compromised. Testing began with the uninvolved limb & was then repeated on the involved limb, the Squeezing as hard as possible without moving the arm.

The scoring were measured in kilograms (0 -100). More than one trial can be given and mostly average of 3 repetitions was recorded. The advantage of this instrument is, the numerical values can be assigned [9].

2. DISABILITY INDEX:

Functional ability may be recorded by questionnaire, whereby the patient is asked to answer questions or to describe what activities are possible or not. This method of documentation is quite different from an observational analysis where by an examiner actually observes the patient's performance [13].

3.7 MATERIALS USED IN STUDY

1. Ultrasound apparatus and accessories.
2. Hand grip dynamometer.
3. Dumbbells.
4. Towel
5. Chair
6. Pillow
7. Table
8. Bed sheets
9. Stick
10. Mackintosh.
11. Supporting pad.
12. Rubber cycle tube.
13. Disability index scale

3.8 TREATMENT TECHNIQUE

The experimental group patients were treated with progressive strengthening, stretching and ultrasound therapy.

PROGRESSIVE STRENGTHENING EXERCISES

The progressive resisted exercises following Delorme & Watkins method was used. Isometric contraction with elbow flexed to 90° **(Zuluage et al, 1995);** the hand of the unaffected arm applies manual resistance over the dorsum of the supinated hand of the affected arm. Pain free isometric contraction of the wrist extensor were initiated and held for 5 to 10 seconds. Progression includes forearm pronation as the starting position and increasing resistance.

Active concentric and eccentric exercises those were introduced as pain allows. The forearm was rested on a table with elbow flexed to 900. The hand hanging over the edge of the table with the wrist flexed and released. The concentric extension of

the Wrist is then carried out until the wrist is in neutral, held for 5 seconds then, slow eccentric work of extensors lowers the hand back to a relaxed starting position. The procedure is then increased in range of movement and resistance. Patients increase the resistance by Using heavier weight as pain allows.

The exercises were progressed within the pain free limits. Patients were advised to perform 10 repetitions for 3 times a day and the treatment should be given for 2 weeks.

The patients were reviewed fortnightly in order to the exercise and motivate them to comply with the progress exercise regime [29].

Exercises followed in Sequence:

- Clenching fist strongly.
- Resisted wrist extension.
- Resisted wrist flexion.
- Wrist rotation with a stick and towel.
- Wrist exercises against elastic band.
- Wrist exercises against weights (initially starts with 0.5 kgs).

STRETCHING PROCEDURE

Gentle stretching exercises initiated through wrist flexion extension and rotation.

Wrist extensor stretching - Grasp the hand and slowly flex the wrist down until standard stretch is felt. Hold for 10 to 30 seconds. Repeat 5 times session and 3 times per day.

Wrist flexor stretching - grasp the hard and slowly extend the wrist until a sustained stretch is felt. Hold for 10 to 30 seconds. Repeat 5 times per session & 3 times a day.

Vigorous stretching is avoided until the patient is pain free[4]. This stretching technique is given initially and repeated after the strengthening exercises are over [6].

Ultrasound Therapy

The treatment was applied at a dosage of 3 MHz., 1.5 w/cm^2 with continuous mode off. The area of the transducer head was 4 cm^2. The treatment head was kept in a motion and in skin contact at the palpated point at the tenoperiosteal junction of the extensor tendon for 5 to 15 min, once in a day for Two weeks.

The control group subjects were treated with only ultrasound, in above mentioned parameter for two weeks. And the home programme also taught to patient to follow it daily[29].

3.9 TREATMENT PROCEDURE

The study is experimental in design. There were 24 samples selected in simple random method and they were divided into two, as experimental and Control groups, each contains 12 samples. In experimental group, the patients were treated with the combination of ultrasound, progressive strengthening and stretching exercises respectively seriously. But in the procedure of exercises, the stretching can be given before and after the strengthening technique.

The control group patients were treated with only ultrasound and home program also be taught to the patients.

The duration for the treatment is two weeks in the both groups.

3.10 VALIDITY AND RELIABILITY

- Ultrasound machine used for the study was manufactured from a standard company.
- Hand grip dynamometer is a valuable tool, **Situberg & Metcalf (1988),** studied to the reliability of the hand grip dynamometer used for the lateral epicondylitis in their experimental study.
- Dynamometer manufactured from a standard Company.
- **Morrey B.F. 1985** - found functional assessment is clinically useful valuable tool in evaluating objective data and grading as well as information about function for the elbow and its diseases.
- Dumbbells used for the study were manufactured from a standard company.

3.11 STATISTICAL TOOLS OF ANALYSIS

Paired‘t’ test was Used to reveal significant difference between pre and post test scores of each group for all variables (ie) experimental and control.

Formulae used :

$$t = \frac{\bar{d}}{S/\sqrt{n}}$$

(ie.),

$$S = \sqrt{\frac{\sum(d-\bar{d})^2}{n-1}}$$

d = difference between pre and post test scores.

$\bar{d}$ = mean of the difference of scores.
S = standard deviation.
n = total no. of samples.
Unpaired 't' test was done between the corresponding Variable of experimental and control groups to reveal any significant difference between both groups.
Formulae used:

$$t = \frac{|\bar{X}_1 - \bar{X}_2|}{S\sqrt{1/n_1 + 1/n_2}}$$

$$S = \sqrt{\frac{(n_1 - 1){S_1}^2 + (n_2 - 1){S_2}^2}{n_1 + n_2 - 2}}$$

S_1,S_2 = Standard deviation of two groups
n_1 = number of sample in group I.
n_2 = number of sample in group ll.
$\bar{X}_1, \bar{X}_2$ Means of difference in group I and ll.

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CHAPTER FOUR
DATA ANALYSIS & INTERPRETATION

4.1 DATA ANALYSIS

This area deals with the analysis & Interpretation of the collected data. A separate proforma prepared for observing and recording the data. It consists of pre test assessment & table for entering data. Follow up chart was used for every subject to observe the post test data.

The calculated data was put into for several suitable statistics treatments to analysis the results of the obtained data. The data organised in the following sections.

1. Demographic characteristics presented through tables & bar diagrams.
2. Pre and Post test scores of grip strength & functional index were analyzed by mean & standard deviation.
3. Paired't test & Independent t tests were done to analysis the collected data of both the groups.

Table 1. Mean difference between pre & post test of Maximum grip strength in (kg).

Experimental Group			Control Group		
Pre mean	Post mean	Mean diff.	Pre mean	Post mean	Mean diff.
10.5	13.3	3.3	11.08	11.91	0.83

Table 2. Mean difference between pre & post test of functional Index (points).

Experimental Group			Control Group		
Pre mean	Post mean	Mean diff.	Pre mean	Post mean	Mean diff.
27.91	42.08	14.17	28.58	31.08	2.50

The above Table 1 and Table 2 shows the significant improvement in mean post test scores of experimental group from pretest scores, compared to control group scores. From Table 1 the mean difference of grip strength of experimental group is 3.3 and the control group is only 0.83. As like Table 1 from Table 2 the mean difference of disability index of experimental group is 14.17 and the control group is only 2 .50.

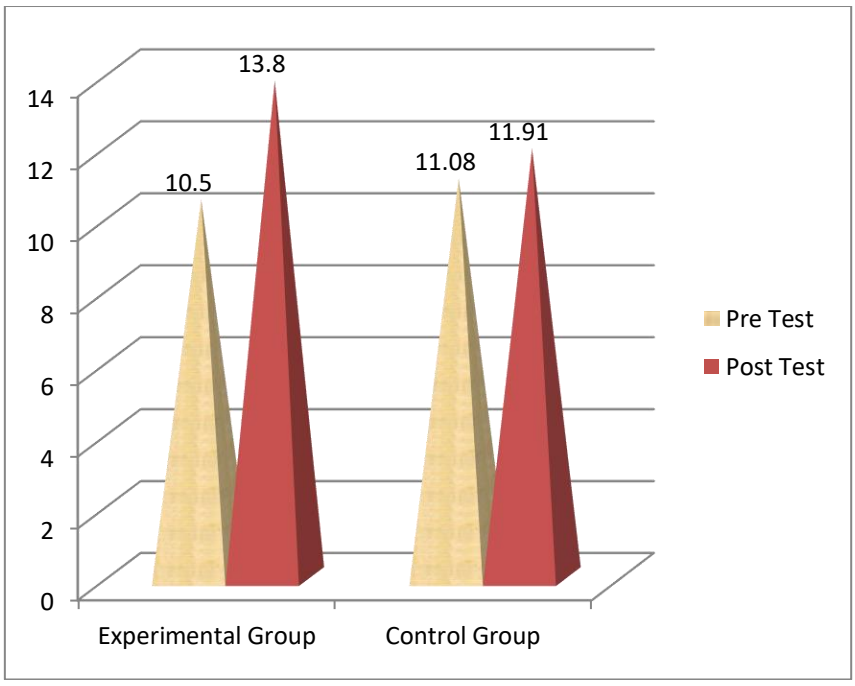

Fig.1 Mean difference between pre & post test scores of maximum grip strength.

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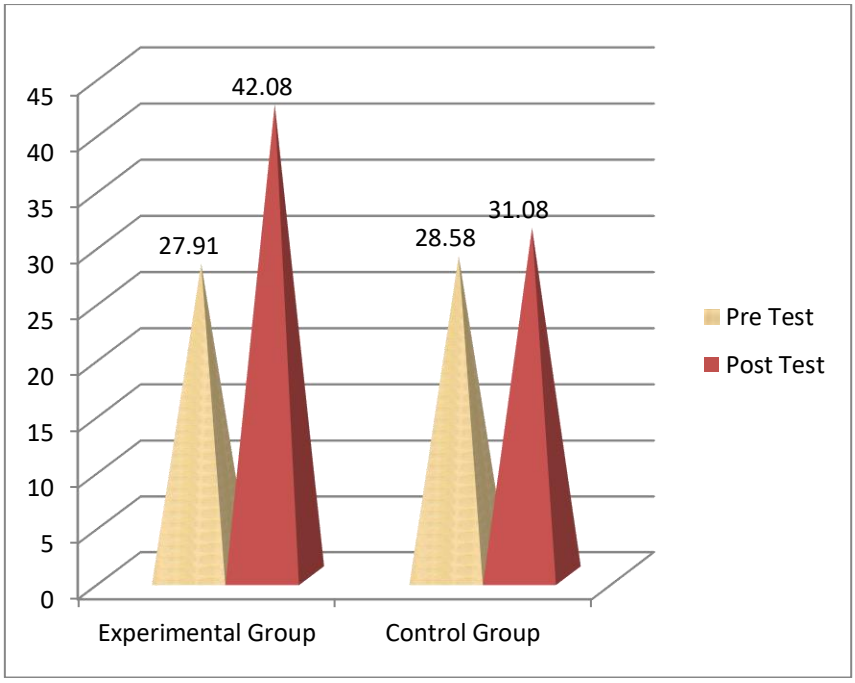

Fig.2 Mean difference between pre & post test scores of Functional Index.

Table 3. Mean & SD of Both groups

Variables	Experimental		Control	
	Mean	S.D.	Mean	S.D.
Grip Strength (kg)	3.3	0.7	0.83	0.39
Disability Index (points)	14.7	5.02	2.50	1.17

Table 3. shows the improvement of mean scores of experimental group Compared to control group and also table shows improvement of SD from control group to experimental group.

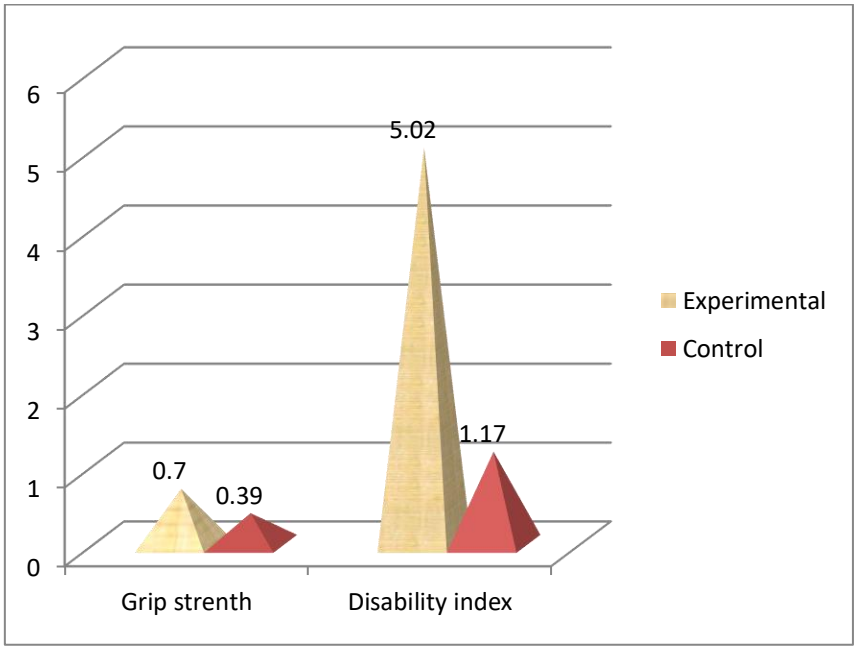

Fig.3 Standard deviation of Both groups

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Table 4. Calculate ‘t’ values of paired ‘t’ test of experimental & control groups.

Variables	Experimental	Control
Grip Strength (kg)	10.09	7.41
Disability Index	9.77	7.57

Table 4 shows calculated 't’ values of period ‘t’ test of grip strength & Disability Index, in which there is significant improvement in experimental group than control group. The results were found to be significant at 5% level (ie.) P<0.05. So, the calculated 't' value is greater than the table value. 't’ table value is (2.201) at 5% level of significance.
The null hypothesis can be rejected and the alternative hypothesis accepted.

Table 5. Unpaired ‘t’ value

Variables	Grip strength	Disability Index
‘t’	20.8	8.6

Table 3 shows the calculated 't’ values of independent 't’ test between experimental & control groups. The calculated 't' value of independent 't’ test between the experimental & control group for grip strength is 20.8 which is greater than the table value (2.074) at 5% level of significance. The calculated 't' value for disability index is 8.6, which is greater than table value (2.074) at 5% level of significance.

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CHAPTER FIVE
DISCUSSION

5.1 DISCUSSION

The purpose of the study is to compare the effectiveness of progressive strengthening, stretching exercises and ultrasound and only ultrasound in chronic lateral epicondylitis. The finding of the study supports the benefits of the progressive strengthening & stretching exercises for chronic lateral epicondylitis.

The result of the study shows that there is a significant improvement in the grip strength following the strengthening, stretching and ultrasound procedures of wrist flexors and extensors in the experimental group. The finding of this study are supported by **Tuomo T. Peinimaki et al (1996)** who proved that there were marked increase in the hand grip strength during stressful activities in response to progressive strengthening, stretching and ultrasound for wrist extensors and flexors.

The result of the study also shows that there is significant improvement in the functional activities following strengthening, stretching procedures and ultrasound of wrist flexors and extensors in experimental group. These findings are supported by **Peinimaki et al (1998),** who proved that there were marked increase in the strength and functional activities in response to progressive strengthening and stretching procedures and ultrasound for common wrist extensors & flexors.

The result of the study shows that there is significant improvement in he hand grip strength & functional activity of the experimental group when compared to the control group.

The mean post test scores of experimental group, Comparatively more than control group, shows that functional capacity increased more by strengthening & stretching exercises along with ultrasound therapy comparing to only ultrasound therapy treatment.

Hence the alternative hypothesis is accepted. So prescribing progressive strengthening & stretching technique along with ultrasound to be found overall rehabilitation of chronic lateral epicondylitis.

5.2 SUGGESTION & RECOMMENDATIONS

- The same study can be repeated in large number of samples.
- The same study can be repeated as follow up studies, to find out the long-term effectiveness of progressive strengthening & stretching exercises.
- The study can be performed by selecting the patients of SU some other age groups.
- The same study can be done for a specific muscle.
- The study can be performed for a specific gender only.
- The effectiveness of the same combination treatment can be performed for some other elbow problems like 'Golfer's elbow'.

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CHAPTER SIX
SUMMARY & CONCLUSION

The aim of the study was a randomized control study to learn the "effect of progressive strengthening and stretching exercises" for chronic lateral epicondylitis. A total number of 24 patients were divided into 2 groups of "12" each. The first group (experimental) was treated with progressive strengthening & stretching exercises in addition with ultrasound therapy. The second group (control) was treated by only ultrasound therapy and home programme. The patients were treated for total period of 15 days. Maximum hand grip strength and functional ability were recorded for pre and post test. The results were analyzed by the paired’t test and independent 't’ test for the groups.

The study is concluded that, there is significant improvement in grip strength and functional ADL activities in patients who received the progressive strengthening & stretching exercise along with ultrasound than who received only ultrasound therapy. So it is clear the techniques are easy to learn and apply. By giving. the treatment we are directly addressing the pathology rather than the pain. Even though the procedure can be followed in community level itself with little modifications also. Therefore we can conclude that the progressive strengthening & stretching along with ultrasound combination therapy is an effective tool for the management of chronic lateral epicondylitis.

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APPENDIX

8.1 PATIENT PROFORMA

ID Data :
Date :
Name :
Age/ Gender :
IPD/OPD No. :
Occupation :
Address :
Duration :
Chief Complaint :

History

(i). History of Present illness :
(ii). History of Past illness :

On observation

(i). Head & Neck :
(ii). Built :
(iii). Deformity :

On Palpation

(i). Tenderness :
(ii). Warmth :

On Examination

(i). Muscle Spasm :
(ii). Atrophy :

Pain

(i). Locality :
(ii). Intensity :
(iii). Duration :
(iv). Type of pain :
(v). Behavior :

Patients Impression due to pain

0 10cm
No Pain Severe Pain

ROM

	Active		Passive	
	Rt	Lt	Rt	Lt
Elbow Flexion				
Elbow Extension				
Supination				
Pronation				

Muscle Power

	Rt	Lt
Elbow Flexion		
Elbow Extension		
Supination		
Pronation		

Grip Strength

Neurological Exam

I. Sensation

(i). Light touch
(ii). Pin Prick
(iii). Vibration
(iv). Two Point Discrimination

II. Motor Myotome function:
III. Reflexes
Superficial -
Deep -
Investigation :
Relevant Examination :
Special Test :

8.2 DISABILITY INDEX
Functional Assessment (12 Points Maximum)
4 = Normal; 2 = Difficulty; 1 = with aid; 0 = unable; NA = not applicable.

1. Use back packet	[ ]
2. Rise from Chair	[ ]
3. Perineal Care	[ ]
4. Wash opposite axilla	[ ]
5. Eat with utensil 1	[ ]
6. Comb hair	[ ]
7. Carry 10-15 pounds with arm at side	[ ]
8. Dress	[ ]
9. Pulling	[ ]
10. Throwing	[ ]
11. Do usual work: Specify work	[ ]
12. Do usual Sport: Specify Sport	[ ]

Points < 25 - severely disabled.
Points > 25 - mild disabled
Points > 40 - Normal.
FOLLOW UP:
1st Day 15 day
Muscle power -
Grip Strength -
Functional status -

8.3 MASTER CHART
Maximum Grip Strength:
[n=no. of days]

S. No.	Experimental		Control	
	Pre test (n=1)	Post test (n=1)	Pre test (n=1)	Post test (n=15)
1	8	11	14	15
2	9	12	13	13
3	12	16	9	10
4	13	16	10	11
5	8	12	7	7
6	7	9	15	16
7	13	17	12	13
8	12	15	16	7
9	12	17	11	12
10	11	12	9	10
11	7	10	13	14
12	14	19	14	15
Total	126	166	133	143
Mean	10.5	13.8	11.08	11.91

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Functional Index (ability):
[n=no. of days]

S. No.	Experimental		Control	
	Pre test (n=1)	Post test (n=1)	Pre test (n=1)	Post test (n=15)
1	30	45	28	30
2	25	40	31	34
3	35	43	40	42
4	20	40	25	28
5	37	46	30	34
6	15	32	35	36
7	20	41	16	20
8	23	45	26	28
9	31	44	38	38
10	28	38	19	22
11	38	46	25	28
12	33	45	30	33
Total	335	505	343	373
Mean	27.91	42.08	28.58	31.08

8.4 Consent To participate in a Research Study

I _____ Voluntarily consent to participate in the research study named "The Role of Progressive Strengthening, Stretching Exercises and Ultrasound in Chronic Lateral Epicondylitis a comparative study".

The researcher had explained me the treatment approach in brief, risk of the participation and has had answered the questions related to the research to my satisfaction.
Participant's Signature

Signature of Witness

Signature of researcher

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