To evaluate the effectiveness of movement with mobilization compared with conservative treatment on pain, grip strength, activities of daily living in patients with lateral epicondylitis

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Abstract:

Purpose: To evaluate the effectiveness of movement with mobilization compared with conservative treatment on pain, strength, activities of daily living in patients with lateral epicondylitis.

Methodology: The study has an experimental design. A total of 40 patients having symptomatic lateral epicondylitis were taken and randomly assigned to one of the two groups. Group A (n=20) received mulligan mobilization whereas Group B (n=20) received conservative treatment. Both groups received conventional treatment of pulsed ultrasonic therapy at an intensity of 1.2 W/cm2 for 5 min, progressive resisted exercises and stretching. Fifteen treatment sessions are given. Baseline measurement of pain (VAS score), functional pain scale and strength (using weights) was taken on Day 1 and then subsequently at day 5, day 10 and day 15.

Discussion: Group A improves pain reduction, grip strength and functional activity better than Group B. This early return of strength and functional activity better than Group B. This early return of strength and activity is very useful for a person to return early to his daily activity better than Group B. This improvement in strength will also prevent disuse atrophy or muscle weakness resulting from less or no activity due to pain and disability caused by lateral epicondylitis. This observation that the manipulation exercise group improves better than the ultrasonic group has also been proved by many studies done earlier on lateral epicondylitis patient7,39,40,41.

Paungmali et al42 suggested that MWM for chronic lateral epicondylitis is capable of producing concurrent hypoalgesic effects during and following its application, as well as altering the sympathetic nervous system function.

Manual therapy might be more cost effective due to a reduction in the number of treatment sessions needed for recovery from lateral epicondylitis.39

Results: Both groups show improvement in VAS score. Both Group A (Mulligan mobilization) and group B (Conservative treatment) lead to statistically significant improvement in strength and functional performance. But there was statistically significant difference in these two parameters between group A and B, group A was statistically significant.

Conclusion: The study concludes that both the manual therapy technique i.e. Mulligan mobilization is more effective in reducing pain, improving strength and functional performance when compared with conventional treatment regimen of giving only the stretching and resistance exercises along with pulsed ultrasonic therapy.

INTRODUCTION

Lateral epicondylitis is the most common lesion of the elbow[1].The term lateral epicondylitis or tennis elbow is widely used to describe an overuse injury[2] that is characterized by pain and tenderness over the lateral epicondyle. It was first described in 1873 by Runge[3]. Morris(1982)who called "Lawn Tennis Arm" .Major(1883) and Winckworth(1883) are responsible for coining the term (Lawn) TENNIS ELBOW[4]. Lateral epicondylitis serves as a blanket term for every condition affecting the lateral compartment of elbow.

Lateral epicondylitis is usually defined as the tendinitis of the extensor carpi radilis brevis (ECRB)[1,5,6.] Less frequently, the extensor carpi radialis longus is affected at its attachment to the supracondylar ridge[5] or sometimes the anterior portion of the extensor digitorum communis. The onset of the lateral epicondylitis is either gradual or sudden[7].It is common in 30-60 years of age group whose activity level, sports or occupation requires repetitive activity. Being primarily a mechanical type of overuse injury featuring pain associated with and aggravated by movement particularly of the wrist and decreasing in grip strength[8].

This is most commonly an idiopathic or a work related condition[9].Christopher Greenfield[7] in his study suggested that there is no difference in incidence between the lateral epicondylitis and the dominant arm. J.P Goguin and F.R Rush [1] showed equal ratio of men and women being affected as well as showed it is more common in women.Still more data exists[10] which shows that dominant arm is affected in most cases and the condition is bilateral in a few. Boyer and Hastings[9] suggested that most of the cases diagnosed, as lateral epicondylitis is the result of a work related "repetitive strain injury".Putman and Cohen[3] reported that the activities, in which the load is greater than that which commonly over a period of time are responsible for causing lateral epicondylitis and that these injuries can occur either from concentric or eccentric contractions. It is also seen that flexibility deficiencies in the forearm extensor muscle or inadequate forearm extensor power[11] and endurance to withstand normal, forceful repetitive movements placed against forearm flexors is also one of the causes of lateral epicondylitis.

Various other intrinsic factors including stenosis of orbicular ligament,[12] entrapment neuropathy of radial nerve,[13] radiohumeral bursitis,[5] periostitis[14] of fringe,[15] inflammation of the annular ligament, anconeus compartment syndrome[16], and cervical radiculopathy are enumerated as causes of lateral epicondylitis in numerous studies[17-19]. The main causes of lateral epicondylitis however is believed to be the result of microtrauma[10], the overuse generated by the impact between racket and ball and the vibrations that are transferred to the arm. The incidence of lateral epicondylitis is also elevated with the use of increased racquet weight[15] and string tension,[15] wet bal[14], size of grip(too big or too small) which may lead to a great force being impacted on wrist extensors. Physical examination[15] will confirm tenderness over the common extensor tendon origin often localized to the extensor carpi radialis brevis. The area of maximal discomfort most commonly is located up to 5mm distal and anterior to the lateral epicondyle. Pain may increase with resisted wrist or finger extension, particularly with the forearm in pronation. Isokinetic strength deficits may also be observed[2].The grip becomes weak probably due to voluntary diminution of the effort to avoid undue pain and sometimes wasting of the affected muscles is also seen in long standing cases[5,10].

CAUSES:

1. Poor sports techniques such as tennis back hand stroke.
2. Occupational tasks involving repetitive movements of the wrist and hands.
3. Degeneration either as a primary cause, or secondary to injury.
4. Injury either as a primary cause, or secondary to degeneration.

SIGNS AND SYMPTOMS:

1. Tenderness over the lateral aspect of the forearm – lateral epicondyle, extensor tendons, muscle belly which may radiate into the forearm.
2. Decreased grip strength and pain on gripping.
3. Decreased strength and pain on active wrist extension.
4. Pain on resisted radial deviation and extension of the middle finger.
5. May disturb sleep when severe.
6. In chronic stage – usually a loss of end range elbow extension or adduction with extension (due to intimate relationships between ECRB and capsule/ligaments of the elbow complex).
7. The condition may be irritable (can be "Stirred up" easily), onset may be gradual or related to a specific incident (insidious or traumatic) [20].

LOCATION OF PAIN WITH LATERAL EPICONDYLITIS:

Lateral Epicondyle attachment of common extensor muscles 75%. Lateral muscle mass musculotendinous junction of common 17% extensor just proximal to radial head Medial Epicondyle attachment of common flexor origin 10%. Posterior around margins of olecranon process 08%

MOST PAINFUL STROKES IN TENNIS ELBOW:

STROKE %

- Backhand 38%
- Serve 25%
- Forehand 23%
- Backhand volley 07%
- Overhead smash 04%
- Forehand volley 03%

ANATOMY AND BIOMECHANICS:

Elbow joint is a synovial of hinge variety, the articular surface of the lower end of the humerus mainly capitulum and the trochlear articulates with the upper end of the radius (humero-radial) and upper end of ulna (humero-ulnar) respectively. Elbow is intermediate joint of the upper limb consists the mechanical link between the first segment, the upper arm and the second segment, the forearm of the upper limb[20].

JOINT STABILITY:

JOINT CAPSULE:

The humero-ulnar joint, humero-radial joint and superior radio -ulnar joints are enclosed in a single joint capsule. Anteriorly the proximal attachment of the capsule is just above the coronoid and radial fossae; distally it is inserted into the ulna on the margin of the coronoid process and into annular ligament. Laterally the capsule attaches to the radius and blends with the fibers of the lateral collateral ligament. Medially the capsule blends with the fibers of the medial collateral ligament. Posteriorly the capsule is attached to the humerus along the upper edge of the olecranon fossa. The capsule is fairly large, loose and weak anteriorly and posteriorly, but ligaments reinforce its sides[21, 22].

LIGAMENTS:

Most hinge joints in the body have collateral ligaments and the elbow is no exception. Collateral ligaments are located on the medial and lateral sides of the hinge joints to provide medial or lateral stability to the joint and to keep joint surfaces in opposition. The two main ligaments associated with the elbow joints are the medial(ulnar) and lateral (radial) collateral ligaments[21,22].

MEDIAL COLLATERAL LIGAMENT:

MCL has two parts that is anterior and posterior. It is also classified as anterior fibers, oblique fibers (coopers ligament) and posterior fibers. The anterior part of MCL extends from the anterior aspect, tip and medial edge of the medial epicondyle of the humerus to attach on the ulnar coronoid process. The posterior part of MCL is not distinct as the anterior medial collateral and sometimes its fibers blend with the fibers of the medial portion of the joint capsule. The fibers of posterior portion of the MCL extend from the posterior aspect of the medial epicondyle of the humerus to attach to the ulnar coronoid and olecranon processes[21,22].

LATERAL COLLATERAL LIGAMENT:

LCL is a fan shaped, poorly demarcated structure that extends from the inferior lateral epicondyle of the humerus and attaches to the annular ligament and to the olecranon process[21, 22].

MUSCLES:

The superficial muscle that originates at lateral epicondyle of the humerus includes anconeous, ECRL, ECRB, ED, EDM, ECU and brachioradialis. The deep muscles of the back of forearm include supinator, APL, EPB, EPL and EI. The tendon of their muscle passes under the extensor retinaculum which is divided into six distinct tunnels separated by septa. The septa help in stabilizing the tendons and then help the muscles to be effective stabilizers of the wrist. ECRB is smaller than ECRL but shows more activity during wrist extension. Studies have shown that ECRB is active during all grasp and release activities of the hand, except those performed in supination. ECRL shows increased activity when there is a radial deviation or when forceful finger flexion motions are performed.

The ongoing activity of ECRB makes it vulnerable of overuse and is more likely than the quieter ECRL to be inflamed in lateral epicondylitis. ECU extends and ulnar deviates the wrist. It is active in the wrist extension and flexion when forearm is in pronated position. The crossing of the radius over the ulna causes reduction in the movement arm of the ECU making it less effective as a wrist extensor.

The EDC is a finger extensor as well as a wrist extensor; there appear to be some reciprocal synergy of the EDC with the ECRB in providing wrist extension ECRB actively is seen when the EDC is active[22].

BIOMECHANICS:

When the upper extremity is in the anatomical position the long axis of the humerus and the long axis of the forearm form an acute angle medially when they meet at the elbow. This angle is called “carrying angle”. This is slightly greater in women than men. In women it is about 0º-15º, in men it is about 0º-5º. An increase in angle is considered to be abnormal and it is called “cubitus valgus”. The carrying angle disappears when the forearm is pronated with the elbow in extension and in full flexion[22].

RANGE OF MOTION:

The range of active flexion at the elbow is usually less than range of passive motion, because the bulk of the contracting flexors on the anterior surface of the humerus interfere with the approximation of the forearm and the humerus. The active flexion of the elbow with supinated forearm ranges from 0^0-135^0 to 0^0-145^0. Passive range of flexion is from 0^0-150^0 to 0^0-160^0.

The wrist complex as a whole is biaxial, with motions of flexion/extension around a coronal axis and radial deviation-ulnar deviation around an anteroposterior axis[22].

The range of motion of the wrist complex is Flexion is 0^0-85^0.

Extension is 0º -70º to 0º -80º.

Radial deviation is 0º -20º to 0º -25º.

Ulnar deviation is 0º -30º to 0º -35º.

PATHOLOGY AND PATHOMECHANICS:

The current interest in racquet, paddle tennis, squash and tennis predisposing large numbers of the population to the possibility of elbow injuries. The use of a racquet greatly increases the length of the forearm lever (resistance arm) and subjects the elbow complex structures to great stresses[23].

The classic lateral epicondylitis is caused by repeated forceful contractions of the wrist extensors, primarily ECRB. The tensile stress created at the origin of the ECRB may cause microscopic tears that lead to inflammation of the lateral epicondyle. Repeated tensile stress on the elastic tendon may result in microscopic tears at the musculotendinous junction and result in tendinitis[23].

Nirschl (1973) referred to dull grayish edematous tissue replacing the normal glistening tendon. These tissues often encompassed the entire origin of the ECRB tendon to the level of the radial head. He found pathological changes on the inner side of the extensor apponeurosis in approximately 35% of cases. In 20% calcific exostosis of the lateral epicondyle was present[11].

Steiner (1976) commented on the poor blood supply to the lateral epicondyle and how the fibers of the tendon attached to the periosteum of the epicondyle on relatively avascular compared with the muscle. Damaged to the muscle heals rapidly as compared to tendon. Nutrition becomes even further impaired with age related degenerative changes. Due to the association of ECRB muscle to the capsule of the elbow, irritation of free nerve endings in the capsule has been postulated as a cause of joint involvement[11].

According to **Wadsworth (1987),** the lesion associated with "tennis elbow" is characterized by superficial or deep macroscopic and microscopic tears at the tendinous origin of the ECRB as well as the periosteum of the lateral epicondyle. He indicated that microscopic fracture may be seen as well as round cell infiltration, scattered foci of fine calcification and scar tissue with marginated areas of cystic and fibrinoid degeneration.

Repair is by immatured reparative tissues. All these findings points to fiber rupture within the tendon[11].

Traditional treatment[3] program for people with lateral epicondylitis have focused primarily on the pain control by ultrasound,anti-inflammatory medication,iontophoresis or phonophoresis[2] followed by rehabilitation program which ranges from flexibility to strengthening and endurance training. Numerous treatments have been tried for lateral epicondylitis including drug therapies, corticosteroid injection[9],electrical stimulation[24-25],laser[26-29] accupuncture,[30-31] counterforce bracing[32], ergonomics[5,33] splintage[34] etc. However no one treatment has been found to be universally efficacious. Surgical treatment is needed in 5-10%1 of patients who did not respond after many months to conservative treatment.

Mulligan[35] has proposed the use of mobilization with to movement for lateral epicondylitis. But none of the studies establish the efficacy of one manual therapy over the conservative treatment.

Hence the objective of this study is **to evaluate the effectiveness of movement with mobilization compared with conservative treatment on pain, strength, activities of daily living in patient of lateral epicondylitis.**

AIMS AND OBJECTIVES

AIM: - To evaluate the effectiveness of movement with mobilization compared with conservative treatment on pain, grip strength, activities of daily living in patients with lateral epicondylitis.

OBJECTIVES:-

1. To compare the effectiveness of **Mulligan mobilization technique** of elbow in terms of **pain, strength & functional activities**.
2. To compare the effectiveness of **conservative management** in terms of **pain, strength & functional activities**.
3. To compare the effectiveness of **Mulligan mobilization technique** of elbow versus effectiveness of **conservative management** in terms of **pain, strength & functional activities.**

REVIEW OF LITERATURE

1.Brotzman in 1996 states that Lateral epicondylitis more commonly known as "Tennis Elbow" is an overuse injury of the wrist extensor tendons that attach along the outer side of the elbow leads to inflammation and ultimately to degenerative changes such as tendinosis, micro-teared fibrous tissue at these points[23]. Lateral epicondylitis occurs 7 to 20 times more frequently than Medial epicondylitis.

2.Craig V.E in 1999 describes the Lateral Epicondylitis as the majority of injuries to the elbow are chronic overuse injuries. These injuries are the result of repetitive intrinsic and/or extrinsic overload, which causes microrupture of the soft tissue. Lateral

Epicondylitis is a chronic degenerative and vascular infiltration of the wrist extensor muscles, primarily the ECRB, owing to overuse in terms of intensity and duration.

Surgical studies confirm that the ECRB is the source of pathologic change and pain; however, the anterior EDC, the underside of the EDRL and rarely the origin of ECU may be involved as well[24].

3.Sevier T L, **Wilson J K** in 1999 stated that whether the condition is chronic or not responding to initial treatment physical therapy is initiated. Physiotherapy treatment covers of assessment, application of RICE protocol, selected modalities and rehabilitation along with modification of activities. Common rehabilitation modalities utilized are phonophoresis, laser, ultrasound, electrical stimulation, manipulation, soft tissue mobilization, friction massage, augmented soft tissue mobilization (ASTM) and stretching exercises. Other new modalities include acupuncture and extracorporeal shock wave therapy[25, 26].

4.Donatelli in 2001 said that Nomenclature of the condition includes “Lateral Epicondylitis”, “Humeral Epicondylitis” and colloquially “Tennis Elbow” or “Rower’s Elbow”. It is one of the most common soft tissue lesions of the arm. It is the term used to describe pain felt at the common origin of the wrist extensor muscle[27, 28]. The term tennis elbow has been loosely used to encompass posterior and medial symptoms which have been referred to a posterior and medial tennis elbow respectively. Here tennis elbow will refer only to Lateral Epicondylitis and associated common extensor origin tendonitis[29].

Several studies on the treatment of tennis elbow have been performed. The treatment are aimed of relieving the inflammation, promotion of healing, reducing the overload forces and increasing upper extremity strength, endurance and flexibility[30].

5.Mellor in 2003 states that initially Lateral Epicondylitis can be treated with rest, ice, elbow brace, NSAIDs. Topical NSAIDs are safe and significantly more effective than the placebo with respect to pain and patient satisfaction in the short term course.

There is some evident for short term with respect to pain and function from oral NSAIDs, but this benefit was not sustained, significantly more gastro intestinal side effects were reported by long term treatment. In early phase of the disease, taking NSAIDs drugs and avoiding provoking activities are likely to be beneficial[31, 32].

Corticosteroid injection is one of the most popular methods utilized with high success rate. Corticosteroid injections may be helpful in breaking the pain cycle, but patients should be warned against inflicting further injury by reintroducing during the subsequent pain free “Honeymoon Period”. There is worrying trend for symptoms to recur some months after steroid injections, but in such cases surgical release of the extensor origin, excision of the degenerative tissue, decortication or drilling of anterior Lateral Epicondyle and repair of extensor tendons may give lasting relief[31].

6.Vicenzino B, Wright A in 2001 had great and immediate positive results using the lateral glide technique as described by Brian Mulligan on my patients suffering from 'tennis elbow'. The technique: Ask the patient to grip in the position that produces their symptom e.g. in elbow extension and pronation. Ask the patient to relax, and then a sustained lateral glide mobilization is applied to the proximal forearm either with a belt or with the hands.

While the lateral glide is maintained, the patient is asked to form a grip again and hold for approx. 3 seconds…frequently the patient will report that this time the grip is pain- free.

Step #3 may be repeated 10 times and 3 sets may be required to eliminate the normally painful grip. The technique must be pain-free; never continue if the patient reports of pain[37].

7.Paungmali A et al in 2003 explains that Mulligan has proposed the use of Mobilization with movement for lateral epicondylalgia. In this study, mobilization with movement for the elbow was examined to determine whether this intervention was capable of inducing physiological effects similar to those reported for some forms of spinal manipulation.

Participants: Seven women and 17 men (mean age=48.5 years, SD=7.2) with chronic lateral epicondylalgia participated in the study. Methods: A placebo, control, repeated-measures study was conducted to evaluate whether mobilization with movement at the elbow produced concurrent hypoalgesia and sympathoexcitation.

Results: The treatment demonstrated an initial hypoalgesic effect and concurrent sympathoexcitation. Improvements in pain resulted in increased pain- free grip force and pressure pain thresholds. Sympathoexcitation was indicated by changes in heart rate, blood pressure, and cutaneous sudomotor and vasomotor function.

Discussion and Conclusion**:** This study showed that a mobilization with movement treatment technique exerted a physiological effect similar to that reported for some spinal manipulations[38].

8.Fiona Coldham, Jeremy Lewis and Hoe Lee (July-September 2006) [50] : Grip strength is used in the assessment of hand and upper limb function. Current recommendations state that taking the mean of three repeated grip trials provides more reliable results than only one trial. Sixty-six subjects were recruited (22 asymptomatic subjects, 22 following carpal tunnel decompression, and 22 following flexor tendon repair). Grip strength testing was performed on a Jamar dynamometer using a standardized testing protocol. Pre- and post testing pain levels were recorded using a verbal analogue scale. Each subject's grip strength was tested four times, twice using a single trial protocol and twice using three grip trials in random order. Intraclass correlation coefficients (ICC) (2,1), 95% confidence intervals, and standard error of measurements were calculated. A two-tailed paired samples t-test was used to investigate the difference between the grip strength values obtained and the changes in verbal analogue scale. High levels of test–retest reliability (ICC $\geq$ 0.85) were found for the three methods of grip strength testing (one trial, the mean of three trials, and the best of three trials). The mean values of grip strength generated for each method of grip strength testing produced comparable results. A significant difference ($p \geq 0.0001$) was observed in the verbal analogue scale scores following one trial and three in all three sample groups. Clinically acceptable levels of reliability (≥0.91) were demonstrated by all three methods of grip strength testing other than the mean of three trials for the asymptomatic group. Distribution of the ICC results and the elevated verbal analogue scales associated with three trials suggest that the use of one grip trial may be appropriate. This study suggests that one maximal trial is as reliable as and less painful than either the best of, or, mean of three trials.

9.Roy F. Ashford, Steven Nagelburg and Rodney Adkins (May 1996) [51]**:** Twenty-two people with no extremity disability were tested in a standard fashion using the Jamar Dynamometer to establish their maximum grip strength. Each participant was asked to grip first right-handed then left-handed three consecutive times. The directions were re explained so that each participant would give a consistent, less than optimal effort; three trials right and three trials left were recorded. The standard deviations of each set of these trials were calculated for both right and left hands. These standard deviations were then tabulated as scores for 44 trials of 22 patients, both hands, for maximal and sub maximal efforts. These scores were then compared, maximal versus sub maximal, using a paired *t*-test. We found no statistical difference in the two groups in comparing the variability of results. Therefore, the current protocol for Jamar testing can allow a patient to make a consistently sub maximal effort, resulting in a false apparent loss of grip strength.

10.Shawn W. O'Driscoll, Emiko Horii, Richard Ness, Tom D. Cahalan, Robin R. Richards et al. (January 1992) **[52] :** In the first part of this study, the position assumed by a normal wrist during unconstrained maximal grip and the relationship between wrist position and grip strength were investigated in 20 healthy subjects. Grip strength and wrist position were recorded in the *self-selected* position and then again while the subjects voluntarily deviated the wrist randomly into flexion, extension, or radial or ulnar deviation of 10 to 15 degrees. The self-selected position was 35 degrees of extension and 7 degrees of ulnar deviation. Grip strength was significantly less in any position of deviation from this self-selected position, even after accounting for fatigue. With the wrist in only 15 degrees of extension or in neutral radio-ulnar deviation, grip strength was reduced to two thirds to three fourths of normal. Sex did not affect wrist position. The dominant wrists were within 5 degrees of the nondominant ones but were relatively less extended and in more ulnar deviation. Grip strength is significantly reduced when wrist position deviates from this self-selected optimum position. In the second part of the study, the effect of grasp size on this *self-selected* position was studied in 21 subjects. The degree of wrist extension was inversely and linearly related to how large a setting on the Jamar dynamometer was used. This was true regardless of hand size, although the effect was more significant for smaller hands. Radial and ulnar deviations were not affected by handle position. A minimum of 25 degrees of wrist extension was required for optimum grip strength. Optimum wrist position (i.e., for grip strength only) for the dominant limb can be predicted within 5 degrees of that of the non dominant limb. Although the present data do not describe the optimum position for wrist fusion, they do describe the optimum position for grip strength in normal subjects and predict the effect of wrist position on such strength.

11.R. Härkönen, M. Piirtomaa and H. Alaranta (February 1993) [53] : A primary purpose of this study was to establish data on hand strength by Jamar dynamometer for normal Finnish adults aged 30 to 50 years. A second aim was to find out how five various breadths of grip affect the strength value. A sample of 103 male and 101 female adults, aged 19 to 62, from the southern part of Finland were tested using standardized positioning and instructions.

Male and female subjects reached the highest grip strength using the third handle breadth of dynamometer, except females over 50 years. Female grip strength was 60% to 70% less than male grip strength. There was no significant difference in strength

12.Aatit Paungmali, Shaun O'Leary, Tina Souvlis and Bill Vicenzino (October 8, 2002) [54]: Hypoalgesic and Sympathoexcitatory Effects of Mobilization With Movement for Lateral Epicondylalgia.

Mulligan has proposed the use of mobilization with movement for lateral epicondylalgia. In this study, mobilization with movement for the elbow was examined to determine whether this intervention was capable of inducing physiological effects similar to those reported for some forms of spinal manipulation. Seven women and 17 men (mean age=48.5 years, SD=7.2) with chronic lateral epicondylalgia participated in the study. A placebo, control, repeated-measures study was conducted to evaluate whether mobilization with movement at the elbow produced concurrent hypoalgesia and sympathoexcitation. The treatment demonstrated an initial hypoalgesic effect and concurrent sympathoexcitation. Improvements in pain resulted in increased pain-free grip force and pressure pain thresholds. Sympathoexcitation was indicated by changes in heart rate, blood pressure, and cutaneous sudomotor and vasomotor function. This study showed that a mobilization with movement treatment technique exerted a physiological effect similar to that reported for some spinal manipulations.

13.Leanne Bisset, **Elaine Beller**, **Gwendolen Jull, Peter Brooks**, **Ross Darnell**, **Bill Vicenzino (April 2003)** **[55] :** The study investigated the efficacy of physiotherapy compared with a wait and see approach or corticosteroid injections over 52 weeks in tennis elbow. Single blind randomised controlled trial. Community setting, Brisbane, Australia.198 participants aged 18 to 65 years with a clinical diagnosis of tennis elbow of a minimum six weeks' duration, who had not received any other active treatment by a health practitioner in the previous six months. Eight sessions of physiotherapy; corticosteroid injections; or wait and see. Global improvement, grip force, and assessor's rating of severity measured at baseline, six weeks, and 52 weeks. Corticosteroid injection showed significantly better effects at six weeks but with high recurrence rates thereafter (47/65 of successes subsequently regressed) and significantly poorer outcomes in the long term compared with physiotherapy. Physiotherapy was superior to wait and see in the short term; no difference was seen at 52 weeks, when most participants in both groups reported a successful outcome. Participants who had physiotherapy sought less additional treatment, such as non-steroidal anti-inflammatory drugs, than did participants who had wait and see or injections. Physiotherapy combining elbow manipulation and exercise has a superior benefit to wait and see in the first six weeks and to corticosteroid injections after six weeks, providing a reasonable alternative to injections in the mid to long term. The significant short term benefits of corticosteroid injection are paradoxically reversed after six weeks, with high recurrence rates, implying that this treatment should be used with caution in the management of tennis elbow.

14.J. H. Abbott, C. E. Patla and R. H. Jensen (August 2001)[56] : They investigated that the proportion of patients with lateral epicondylalgia that demonstrate a favorable initial response to a manual therapy technique – the mobilization with movement (MWM) for tennis elbow. Twenty-five subjects with lateral epicondylalgia participated. In a one-group pretest – post-test design, we measured (1) pain with active motion, (2) pain-free grip strength and, (3) maximum grip strength before and after a single intervention of MWM. Results of the study indicate that MWM was effective in allowing 92% of subjects to perform previously painful movements pain-free, and improving grip strength immediately afterwards. Significant differences were found between the grip strength of the affected and unaffected limbs prior to the intervention. Both pain-free grip strength and maximum grip strength of the affected limb increased significantly following the intervention. Pain-free grip strength increased by a greater magnitude than maximum grip strength. It can be concluded that MWM is a promising intervention modality for the treatment of patients with Lateral Epicondylalgia. Pain-free grip strength is a more responsive measure of outcome than maximum grip strength for patients with Lateral Epicondylalgia. Further research is warranted to investigate the long-term effectiveness of MWM in the treatment of impairment and disability resulting from Lateral Epicondylalgia.

15.Tuomo T Pienimäki, Tuula K Tarvainen, Pertti T Siira and Heikki Vanharanta (September 1996) [57]: They studied that Thirty-nine patients suffering from chronic lateral epicondylitis were randomised into two treatment groups. The first group (n = 20) was treated with progressive slow, repetitive wrist and forearm stretching, muscle conditioning and occupational exercises, which were intensified in four steps. The second group (n = 19) was treated with pulsed ultrasound. The effect of six to eight weeks' treatment was measured by a pain questionnaire (visual analogue scale), isokinetic muscle performance testing of wrist and forearm, and isometric grip strength measurements.

In the follow-up visit after eight weeks' treatment, pain at rest and under strain had decreased and subjective ability to work increased in the exercise group significantly more than in the ultrasound group (p = 0.004,0.04 and 0.004). Correspondingly, sleep disturbance was alleviated significantly more in the exercise group (p = 0.01). The isokinetic torque of wrist flexion increased by 45% in the exercise group and declined by 4% in the ultrasound group (p = 0.0002). Maximum isometric grip strength increased 12 % in the exercise group and remained unchanged in the ultrasound group (p = 0.05).During treatment six of eight patients in the exercise group and three of nine patients in the ultrasound group became able to work. All clinical manual provocation tests for tennis elbow improved within the exercise group. The results indicate that progressive exercise therapy is more effective than ultrasound in treating chronic lateral epicondylitis, reducing pain and improving patients' ability to work.

16.Peter AA Struijs, Pieter-Jan Damen, Eric WP Bakker, Leendert Blankevoort, Willem JJ Assendelft and **C Niek van Dijk** (July 2003) [58]: Several non operative interventions, with varying success rates, have been described. The aim of this study was to compare the effectiveness of 2 protocols for the management of lateral epicondylitis: (1) manipulation of the wrist and (2) ultrasound, friction massage, and muscle stretching and strengthening exercises. Thirty-one subjects with a history and examination results consistent with lateral epicondylitis participated in the study. The subjects were randomly assigned to either a group that received manipulation of the wrist (group 1) or a group that received ultrasound, friction massage, and muscle stretching and strengthening exercises (group 2). Three subjects were lost to follow-up, leaving 28 subjects for analysis. Follow-up was at 3 and 6 weeks. The primary outcome measure was a global measure of improvement, as assessed on a 6-point scale. Analysis was performed using independent *t* tests, Mann-Whitney *U* tests, and Fisher exact tests. Differences were found for 2 outcome measures: success rate at 3 weeks and decrease in pain at 6 weeks. Both findings indicated manipulation was more effective than the other protocol. After 3 weeks of intervention, the success rate in group 1 was 62%, as compared with 20% in group 2. After 6 weeks of intervention, improvement in pain as measured on an 11-point numeric scale was 5.2 (SD=2.4) in group 1, as compared with 3.2 (SD=2.1) in group 2. Manipulation of the wrist appeared to be more effective than ultrasound, friction massage, and muscle stretching and strengthening exercises for the management of lateral epicondylitis when there was a short-term follow-up. However, replication of our results is needed in a large-scale randomized clinical trial with a control group and a longer-term follow-up.

17.Julio A. Martinez- Silvestrini, Karen L. Newcomer, Ralph E. Gay, Michael P. Schaefer, Patrick Kortebein and Katherine W. Arendt (NOV 2005)[59]: They evaluated the effectiveness of eccentric strengthening. Ninety-four subjects (50 men) with chronic lateral epicondylitis were allocated randomly into three groups: stretching, concentric strengthening with stretching, and eccentric strengthening with stretching. Subjects performed an exercise program for six weeks. All three groups received instruction on icing, stretching, and avoidance of aggravating activities. The strengthening groups received instruction on isolated concentric and eccentric wrist extensor strengthening, respectively. At six weeks, significant gains were made in all three groups as assessed with pain-free grip strength, Patient-rated Forearm Evaluation Questionnaire, Disabilities of the Arm, Shoulder, and Hand questionnaire, Short Form 36, and visual analog pain scale. No significant differences in outcome measures were noted among the three groups. Although there were no significant differences in outcome among the groups, eccentric strengthening did not cause subjects to worsen. Further studies are needed to assess the unique effects of a more intense or longer eccentric strengthening program for patients with lateral epicondylitis.

18.Moneet Kochar and Ankit Dogra (JUNE 2002)[60]: The effect of a combination of Mulligan mobilization (a manual therapy approach) and ultrasound therapy is compared with that of ultrasound therapy alone. In both cases, a progressive exercise programme followed ten sessions of therapy to improve strength and facilitate return to work. Sixty-six patients (Male: Female ratio 6:5, mean age 41 years) were recruited. Of these patients, 46 were randomised into two treatment groups by a random draw of chits. The remaining 20, who could not be randomised, comprised the control group. The first (MM) group was treated with a combination of ultrasound therapy and Mulligan mobilisation while the second group was treated with ultrasound therapy alone for ten sessions (completed within three weeks). Both groups then followed a progressive exercise regime for a further nine weeks. They were evaluated at weekly intervals from the time of selection until the third week and finally at the 12th week with four outcome measures: visual analogue scale (VAS), isometric grip strength, weight test and patient assessment test.In the follow-up visit after 12 weeks of therapy, there was improvement in VAS, weight test and grip strength in both the MM ($p < 0.01$, 0.01, 0.01) and ultrasound groups ($p < 0.01$, 0.05, 0.05). The MM group showed a greater improvement than both the ultrasound group and the control group on VAS ($p < 0.05$, 0.05); weight test ($p < 0.01$, 0.001) and grip strength (NS, $p < 0.05$). The ultrasound group was superior to the control group on VAS ($p < 0.05$); weight test ($p < 0.01$), but the difference from the control group in grip strength was not significant. The MM group showed improvement on most parameters from the first week onwards whereas the ultrasound group improved only from the second week. Also the patient assessment score improved for the MM group ($p < 0.05$) and for the ultrasound group improvement was significant at three weeks of therapy ($p < 0.05$), but the difference was not statistically significant at 12 weeks. The addition of Mulligan mobilisation to a regimen comprising ultrasound therapy and progressive exercises brings about increased and faster recovery in patients with tennis elbow.

19.Geetu Manchanda, Deepak Grover (2008-01 - 2008-03)[61] **:The** purpose of the study is to evaluate the effectiveness of movement with mobilization compared with manipulation of wrist on pain, strength, activities of daily living in patients with lateral epicondylitis. The study has an experimental design. A total of 30 patients having symptomatic lateral epicondylitis were taken and randomly assigned to one of the three groups. Group A (n=10) received mulligan mobilization whereas Group B (n=10) received wrist manipulation. Group C (n=10) acted as a control group. All the 3 groups received conventional treatment of pulsed ultrasonic therapy at 20% duty cycle, frequency 3MHz and an intensity of 1.2 W/cm^2 for 5 min, progressive resisted exercises and stretching. Fifteen treatment sessions are given. Baseline measurement of pain (VAS score), functional pain scale and strength (using weights) was taken on Day 1 and then subsequently at day 5, day 10 and day 15. Group A (Mulligan mobilization) and group B (wrist manipulation) lead to statistically significant improvement in strength and functional performance when compared with group C. But there was no statistically significant difference in these two parameters between group A and B. The study concludes that both the manual therapy techniques i.e. Mulligan mobilization as well as wrist manipulation are equally effective in reducing pain, improving strength and functional performance when compared with conventional treatment regimen of giving only the stretching and resistance exercises along with pulsed ultrasonic therapy.

MATERIAL AND METHODOLOGY

SOURCE OF DATA:

All patients from orthopedics department AVBRH referred to OPD of RNPC diagnosed as lateral epicondylitis & as per the inclusion criteria were selected.

METHOD OF COLLECTION OF DATA:

Sample size: 40 patients (20 in each group).

Period of study: 1 year

Study design: Comparative study.

Sampling method: Random sampling method.

40 Chits (20 in each group) were prepared and placed them in a box, shuffled at each time and the patient was asked to pick one chit and whatever the method selected was allocated to that patient. Do not replace the selected chits were not replaced back into the box. As per the chit the subjects were assigned to that particular.

INCLUSION CRITERIA:

1. Patient’s between 30-60 years of age.
2. Patients who are positive for Cozen’s test and Kaplan’s sign.
3. Pain over the lateral side of the elbow that was provoked by palpation of the lateral epicondyle region and gripping tasks.
4. Pain had to be experienced over the lateral epicondyle during at least one of the following: resisted static contraction of the wrist extensors or ECRB muscle or stretching of the forearm extensor muscles.

EXCLUSION CRITERIA:

1. Cervical spine or upper limb problems (referred pain).
2. Neurological impairments.
3. Cardiovascular diseases.
4. Neuromuscular diseases.
5. Osteoporosis.

6. Recent steroid infiltration.
7. Active infection.
8. Rheumatoid arthritis.
9. Ossification and Calcification of the soft tissues.
10. Acute lateral epicondylitis.
11. Malignancies.

MATERIALS:

Materials used for assessment:

1. Patient's Consent Form.
2. Assessment Proforma.
3. Chair.
4. Hand Held Dynamometer.
5. Visual Analogue Scale.
6. Functional Pain Scale

Materials Used For Treatment:

1. Table.
2. Couch.
3. Pillow.
4. Mulligan's Belt.

PROCEDURE:

All patients with Lateral Epicondylitis were assessed and those who fulfilled the inclusion criteria alone were selected and assigned to MMWM groups and conservative management.. Before starting the treatment, the patient were positioned with a comfortable position and assessed thoroughly. The present study included 40 patients between 30 – 60 years of age and was randomly assigned into two groups, 20 in each group. Group A were treated with MMWM & conservative treatment and Group B were treated with conservative treatment alone.

The study was conducted at musculoskeletal department of Ravi Nair Physiotherapy College.

Subjects were diagnosed by a certified medical practitioner as having Lateral Epicondylitis. Prior to inclusion, subjects were informed about the study and a written consent was taken from the subjects. Initially patient's age, sex, occupation, duration of pain was recorded. They were asked about the present and past medications.

Procedure for Measuring V.A.S.:

A visual analogue scale (VAS) was used to assess pain in each subject. The VAS used in the study consisted of a continuous horizontal line 10cm in length with anchor points of 'no pain' (0) and 'worst pain' (10) on the left and right ends of line respectively. The patients were asked to judge the intensity of their pain using VAS in last 24 hours.[36]

Grip Strength Measurement:

The subject holds the dynamometer in the hand to be tested, with the arm at right angles and the elbow by the side of the body. The handle of the dynamometer is adjusted if required-the base should rest on first metacarpal (heel of palm), while the handle should rest on middle of four fingers. When ready the subject were asked to squeeze the handle with maximum isometric effort and maintained for about 5 seconds. No other movement was allowed. The subject were encouraged to give a maximum effort in 3 turns in Handgrip Strength Test[37].

Functional Pain Scale Measurement:

The physical function was tested using a functional pain scale for tennis elbow[38]. In this scale, the patients were asked to perform certain set of activities that can be difficult in performing as a result of their problem and accordingly rate the intensity of their pain. (Appendix 1)

Mulligan's Technique:

Mulligan mobilization is given with patient lying in supine position having the elbow extended and forearm pronated. The therapist put the belt around her shoulder and patients' forearm. As the therapist will give the lateral glide, the patient will perform the pain producing movement (such as gripping or wrist extension). If the glide is applied correctly, the patients will not feel any pain. The dosage is 10 MWM in one set, 3 sets per session were given and a total of 15 sessions were given.[35]

SCALES USED

Visual Analogue Scale:

A visual analogue scale (VAS) was used to assess pain in each subject in the study. The VAS used in the study consisted of a continuous horizontal line 10cm in length with anchor points of 'no pain' (0) and 'worst pain' (10) on the left and right ends of line respectively. The patients were asked to judge the intensity of their pain using VAS in last 24 hours.[36]

Functional Pain Scale:

The physical function was tested using a functional pain scale for tennis elbow[38]. In this scale, the patients were asked to perform a certain set of activities that can be difficult in performing as a result of their problem and were asked to accordingly rate the intensity of their pain. Functional pain scale for lateral epicondylitis.6 Maximum possible score on this scale can be 40.

Score -0: no discomfort
1: slight discomfort
2: moderate discomfort
3: Quite a bit discomfort
4: Extreme discomfort

Activities are:

- Usual work, housework or school activities.
- Usual hobbies, sporting or recreational activities
- Using tools or appliances
- Self Dressing
- Squeezing or gripping an object
- Opening doors with the involved limb.
- Activities such as sweeping or raking.
- Carrying a small suitcase with the involved limb.
- Opening a jar or can
- Writing or using a keyboard

INSTRUMENT USED:

Hand Grip Dynamometer:

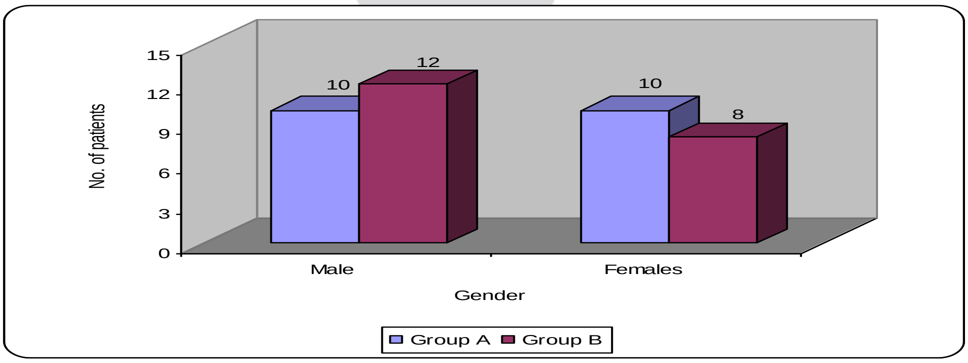
The purpose of this instrument is to measure the maximum isometric strength of the hand and forearm muscles. The scoring by best result from three trials for each hand is recorded, with a recovery between each effort. The rating is done excellent (>64kg for M & >38kg for F), very good (52-64kg for M & 34-38kg for F), above average (48-52kg for M & 30-34kg for F), below average (44-48kg for M & 22-26kg for F), poor (40-44kg for M & 20-22kg for F) & very poor (<40kg for M & <20kg for F).

OBSERVATIONS AND RESULTS

Table 1: Details of the subjects

	Group A	Group B
Total number of subjects	20	20
Male (%)	10 (50%)	12 (60%)
Females (%)	10(50%)	8 (40%)
Average age(in years) SD	35.20 (9.13)	36.85 (7.16)

Group 1-A: Gender wise distribution of subjects



Graph 1-B: Age wise distribution of Patients

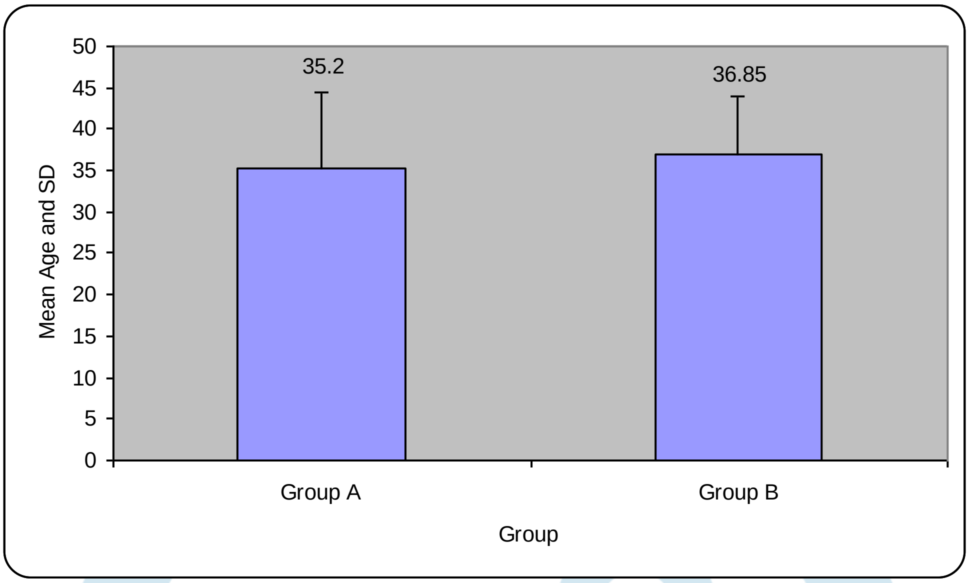


Table 1:- There were 10 Males and 10 Females in Group A and 12 Males and 8 Females in Group B. The **mean age of patient** was 35.20+9.13 years in Group A and that of Group B was 36.85+7.6 years

Table 2: Comparison of VAS pre and post test at Day 1, Day 5, Day 10 and Day 15 in group A : Descriptive Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Day 1	Pre Test	5.85	20	1.34	0.30
	Post Test	4.65	20	1.38	0.31
Day 5	Pre Test	4.75	20	1.40	0.31
	Post Test	2.65	20	0.93	0.20
Day 10	Pre Test	3.75	20	1.01	0.22
	Post Test	1.95	20	0.99	0.22
Day 15	Pre Test	2.50	20	1.05	0.23
	Post Test	1.50	20	1.10	0.24

Students paired t test

Day	Paired Differences					t	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Day 1	1.20	0.83	0.18	0.80	1.59	6.43	19	0.000 S,p<0.05
Day 5	2.10	0.71	0.16	1.76	2.43	13.07	19	0.000 S,p<0.05
Day 10	1.80	0.61	0.13	1.51	2.08	13.07	19	0.000 S,p<0.05
Day 15	1.00	0.45	0.10	0.78	1.21	9.74	19	0.000 S,p<0.05

Graph 2 : Comparison of VAS pre and post test at Day 1, Day 5, Day 10 and Day 15 in group A

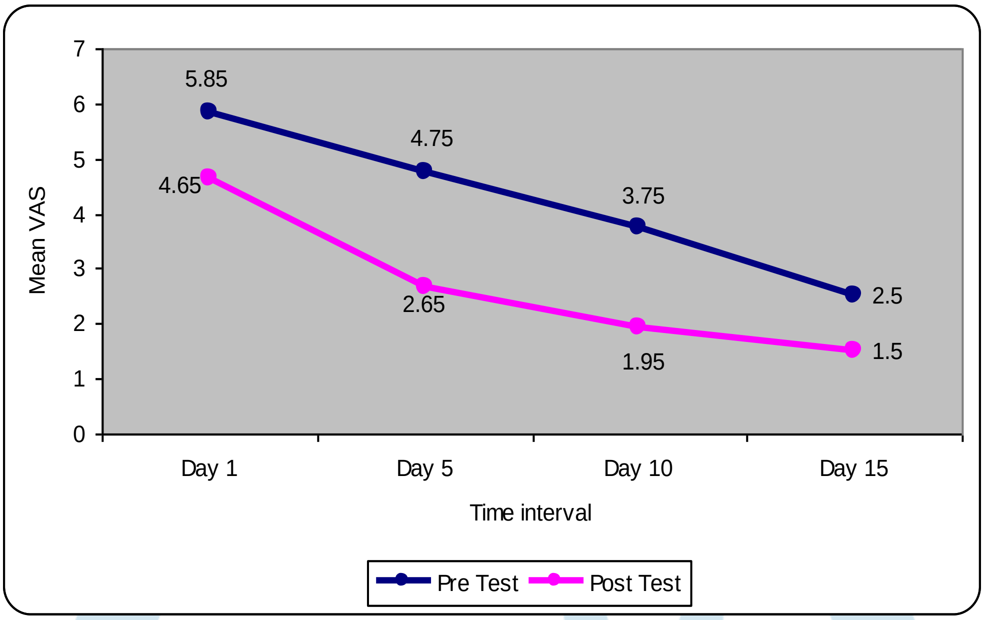


Table 2 :- Mean Pain on VAS at Pre test in Day 1 was 5.85+1.34 and at Post test it was 4.65+1.338 by using student paired 't' test **significant difference** was found at Day 1 (t=6.43,p=0.00).

Mean Pain on VAS at Pre test in Day 5 was 4.75+1.40 and at Post test it was 2.65+0.93 by using student paired 't' test **significant difference** was found at Day 5 (t=13.07,p=0.00).

Mean Pain on VAS at Pre test in Day 10 was 3.75+1.01 and at Post test it was 1.95+0.99 by using student paired 't' test **significant difference** was found at Day 1 (t=13.07,p=0.00).

Mean Pain on VAS at Pre test in Day 15 was 2.50+1.05 and at Post test it was 1.50+1.10 by using student paired 't' test **significant difference** was found at Day 15 (t=9.74,p=0.00).

Table 3: Comparison of VAS pre and post test at Day 1, Day 5, Day 10 and Day 15 in group B

Descriptive Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Day 1	Pre Test	5.45	20	1.14	0.25
	Post Test	4.90	20	1.20	0.27
Day 5	Pre Test	4.65	20	1.34	0.30
	Post Test	4.05	20	1.19	0.26
Day 10	Pre Test	3.70	20	1.30	0.29
	Post Test	3.30	20	1.21	0.27
Day 15	Pre Test	2.90	20	1.11	0.25
	Post Test	2.55	20	0.99	0.22

Students paired t test

Day	Paired Differences					t	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Day 1	0.55	0.60	0.13	0.26	0.83	4.06	19	0.001 S,p<0.05

Day 5	0.60	0.50	0.11	0.36	0.83	5.33	19	0.000 S,p<0.05
Day 10	0.40	0.59	0.13	0.12	0.68	2.99	19	0.008 S,p<0.05
Day 15	0.35	0.48	0.10	0.12	0.57	3.19	19	0.005 S,p<0.05

Graph 3: Comparison of VAS pre and post test at Day 1, Day 5, Day 10 and Day 15 in group B

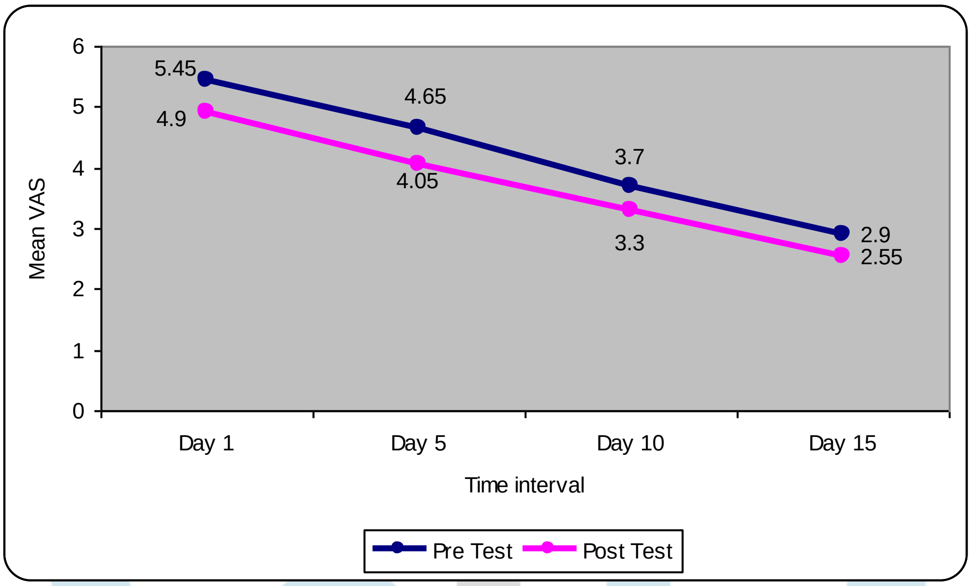


Table 3 :- Mean Pain on VAS at Pre test in Day 1 was 5.45+1.14 and at Post test it was 4.90+1.20 by using student paired 't' test **significant difference** was found at Day 1 (t=4.06,p=0.00).

Mean Pain on VAS at Pre test in Day 5 was 4.65+1.34 and at Post test it was 4.05+1.19 by using student paired 't' test **significant difference** was found at Day 5 (t=5.33,p=0.00).

Mean Pain on VAS at Pre test in Day 10 was 3.70+1.30 and at Post test it was 3.30+1.21 by using student paired 't' test **significant difference** was found at Day 1 (t=2.99,p=0.00).

Mean Pain on VAS at Pre test in Day 15 was 2.90+1.11 and at Post test it was 2.55+0.99 by using student paired 't' test **significant difference** was found at Day 15 (t=3.19,p=0.00).

Table 4: Comparison of Grip Strength pre and post test at Day 1, Day 5, Day 10 and Day 15 in group B

Descriptive Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Day 1	Pre Test	34.65	20	11.41	2.55
	Post Test	34.75	20	11.49	2.56
Day 5	Pre Test	35.90	20	11.54	2.58
	Post Test	36.15	20	11.60	2.59
Day 10	Pre Test	37.45	20	11.26	2.51
	Post Test	37.60	20	11.32	2.53
Day 15	Pre Test	37.90	20	12.16	2.72
	Post Test	39.15	20	11.54	2.58

Students paired t test

Day	Paired Differences				t	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			

				Lower	Upper			
Day 1	-0.10	0.55	0.12	-0.35	0.158	0.809	19	0.428 NS,p>0.05
Day 5	-0.25	0.55	0.12	-0.50	0.007	2.032	19	0.056 NS,p>0.05
Day 10	-0.15	0.36	0.08	-0.32	0.02	1.831	19	0.083 NS,p>0.05
Day 15	-1.25	2.67	0.59	-2.50	0.009	2.091	19	0.050 NS,p>0.05

Graph 4: Comparison of Grip Strength pre and post test at Day 1, Day 5, Day 10 and Day 15 in group B

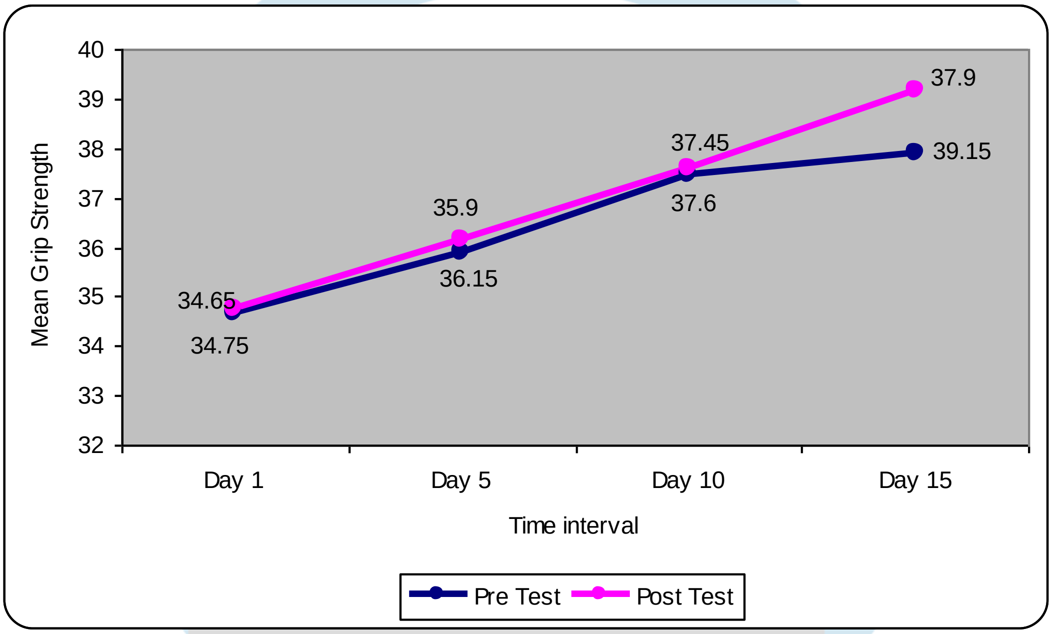


Table 4 :- Mean Grip Strength at Pre test on Day 1 was 34.65+11.49 and at Post test it was 34.75+11.49 by using student paired 't' test **no significant difference** was found at Day 1 (t=0.809,p>0.05).

Mean Grip Strength at Pre test in Day 5 was 35.90+11.54 and at Post test it was 36.15+11.60 by using student paired 't' test **no significant difference** was found at Day 5 (t=2.032,p>0.05).

Mean Grip Strength at Pre test in Day 10 was 37.45+11.26 and at Post test it was 37.60+11.32 by using student paired 't' test **no significant difference** was found at Day 10 (t=1.831,p>0.05).

Mean Grip Strength at Pre test in Day 15 was 37.90+12.16 and at Post test it was 39.15+11.54 by using student paired 't' test **no significant difference** was found at Day 15 (t=2.091,p>0.05).

Table 5: Comparison of Grip Strength pre and post test at Day 1, Day 5, Day 10 and Day 15 in group A

Descriptive Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Day 1	Pre Test	35.05	20	11.01	2.46
	Post Test	34.95	20	10.93	2.44
Day 5	Pre Test	36.95	20	10.68	2.39
	Post Test	37.10	20	10.89	2.43
Day 10	Pre Test	40.10	20	11.43	2.55
	Post Test	40.25	20	11.53	2.58

Day 15	Pre Test	42.15	20	12.58	2.81
	Post Test	42.30	20	12.61	2.82

Students paired t test

Day	Paired Differences					t	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Day 1	0.10	0.44	0.10	-0.10	0.30	1.000	19	0.330 NS,p>0.05
Day 5	-0.15	0.36	0.08	-0.32	0.02	1.831	19	0.083 NS,p>0.05
day 15	-0.15	0.36	0.08	-0.32	0.02	1.831	19	0.083 NS,p>0.05
Pair 4	-0.15	0.36	0.08	-0.32	0.02	1.831	19	0.083 NS,p>0.05

Graph 5: Comparison of Grip Strength pre and post test at Day 1, Day 5, Day 10 and Day 15 in group A

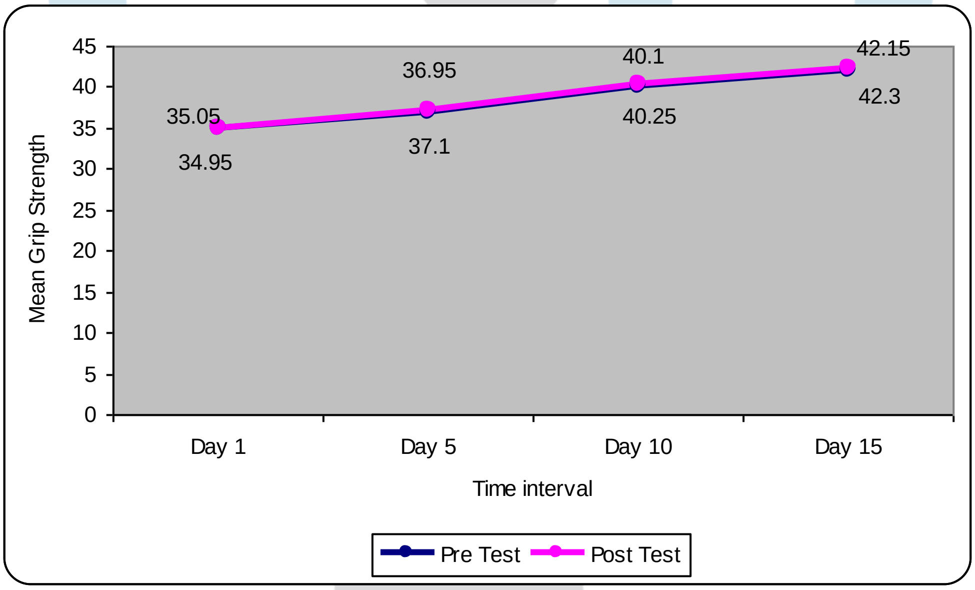


Table 5 :- Mean Grip Strength at Pre test on Day 1 was 35.05+11.01 and at Post test it was 34.95+10.93 by using student paired ‘t’ test **no significant difference** was found at Day 1 (t=1.00,p>0.05).

Mean Grip Strength at Pre test in Day 5 was 36.95+10.68 and at Post test it was 37.10+10.89 by using student paired ‘t’ test **no significant difference** was found at Day 5 (t=1.831,p>0.05).

Mean Grip Strength at Pre test in Day 10 was 40.10+11.43 and at Post test it was 40.25+11.53 by using student paired ‘t’ test **no significant difference** was found at Day 10 (t=1.831,p>0.05).

Mean Grip Strength at Pre test in Day 15 was 42.15+12.58 and at Post test it was 42.30+12.61 by using student paired ‘t’ test **no significant difference** was found at Day 15 (t=1.831,p>0.05).

Table 6: Comparison of Functional Pain Rating Scale pre and post test at Day 1, Day 5, Day 10 and Day 15 in group A

Descriptive Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Day 1	Pre Test	25.15	20	6.85	1.53
	Post Test	24.70	20	6.99	1.56
Day 5	Pre Test	22.90	20	6.85	1.53
	Post Test	22.30	20	7.03	1.57
Day 10	Pre Test	20.55	20	6.94	1.55
	Post Test	18.10	20	6.24	1.39
Day 15	Pre Test	16.85	20	6.60	1.47
	Post Test	14.45	20	5.96	1.33

Students paired t test

Day	Paired Differences					t	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Day 1	0.45	0.94	0.21	0.007	0.89	2.13	19	0.046 S,p<0.05
Day 5	0.60	1.09	0.24	0.08	1.11	2.44	19	0.024 S,p<0.05
Day 10	2.45	2.11	0.47	1.46	3.43	5.18	19	0.000 S,p<0.05
Day 15	2.40	2.37	0.53	1.29	3.50	4.52	19	0.000 S,p<0.05

Graph 6: Comparison of Functional Pain Rating Scale pre and post test at Day 1, Day 5, Day 10 and Day 15 in group A

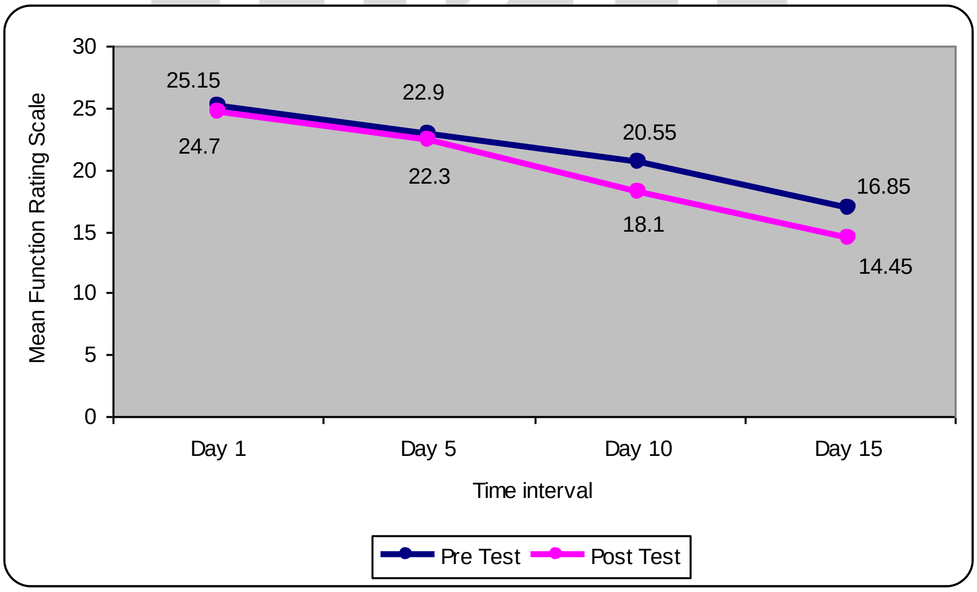


Table 6 :- Mean Score of Functional Pain Score at Pre test on Day 1 was 25.15+6.85 and at Post test it was 24.70+6.99 by using student paired ‘t’ test **significant difference** was found at Day 1 (t=2.13,p=0.00).

Mean Score of Functional Pain Score at Pre test in Day 5 was 22.90+6.85 and at Post test it was 22.30+7.03 by using student paired ‘t’ test **significant difference** was found at Day 5 (t=2.44,p=0.00).

Mean Score of Functional Pain Score at Pre test in Day 10 was 20.55+6.94 and at Post test it was 18.10 + 6.24 by using student paired 't' test **significant difference** was found at Day 10 (t=5.18,p=0.00).

Mean Score of Functional Pain Score at Pre test in Day 15 was 16.85+6.60 and at Post test it was 14.45+5.96 by using student paired 't' test **significant difference** was found at Day 15 (t=4.52,p=0.00).

Table 7: Comparison of Functional Pain Rating Scale pre and post test at Day 1, Day 5, Day 10 and Day 15 in group B

Descriptive Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Day 1	Pre Test	21.65	20	3.63	0.81
	Post Test	19.50	20	3.80	0.85
Day 5	Pre Test	20.00	20	4.30	0.96
	Post Test	17.85	20	4.31	0.96
Day 10	Pre Test	16.25	20	3.93	0.87
	Post Test	14.20	20	3.88	0.86
Day 15	Pre Test	13.40	20	3.63	0.81
	Post Test	11.15	20	3.32	0.74

Students paired t test

Day	Paired Differences					t	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Day 1	2.15	0.484	0.10	1.92	2.37	19.64	19	0.000 S,p<0.05
Day 5	2.15	0.36	0.08	1.97	2.32	26.24	19	0.000 S,p<0.05
day 15	2.05	0.60	0.13	1.76	2.33	15.15	19	0.000 S,p<0.05
Pair 4	2.25	0.78	0.17	1.88	2.61	12.79	19	0.000 S,p<0.05

Table 7: Comparison of Functional Pain Rating Scale pre and post test at Day 1, Day 5, Day 10 and Day 15 in group B

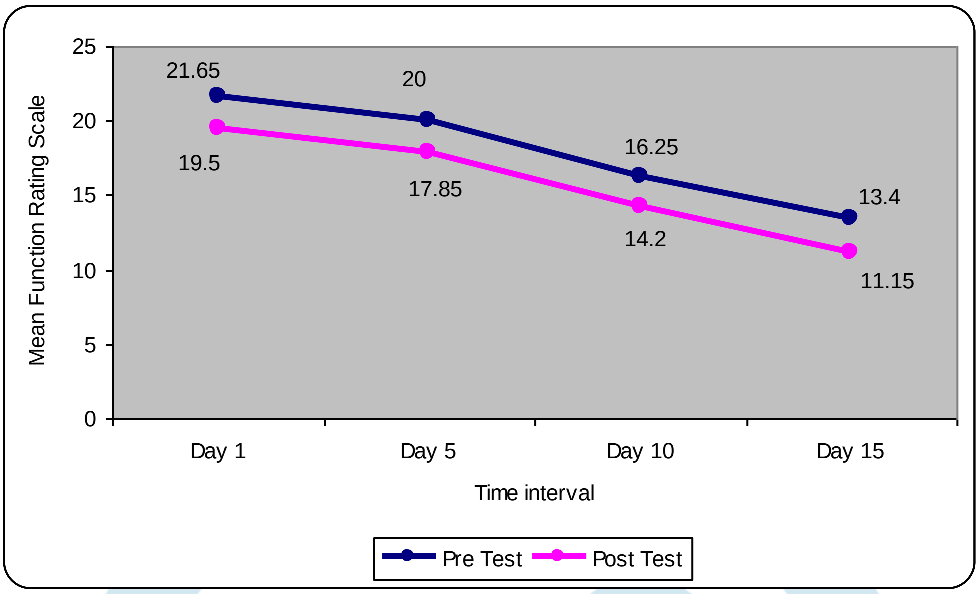


Table 7 :- Mean Score of Functional Pain Score at Pre test on Day 1 was 21.65+3.63 and at Post test it was 19.50+3.80 by using student paired ‘t’ test **significant difference** was found at Day 1 (t=19.64,p=0.00).

Mean Score of Functional Pain Score at Pre test in Day 5 was 20.00+4.30 and at Post test it was 17.85+4.31 by using student paired ‘t’ test **significant difference** was found at Day 5 (t=26.24,p=0.00)

Mean Score of Functional Pain Score at Pre test in Day 10 was 16.25+3.93 and at Post test it was 14.20+3.88 by using student paired ‘t’ test **significant difference** was found at Day 10 (t=15.15,p=0.00).

Mean Score of Functional Pain Score at Pre test in Day 15 was 13.40+3.63 and at Post test it was 14.45+5.96 by using student paired ‘t’ test **significant difference** was found at Day 15 (t=12.79,p=0.00).

Table 8: Comparison of pain on VAS at day 1,5,10 and 15 in group A

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Day 1	Pre Test	5.85	20	1.34	0.30
	Post Test	4.65	20	1.38	0.31
Day 5	Pre Test	4.75	20	1.40	0.31
	Post Test	2.65	20	0.93	0.20
Day 10	Pre Test	3.75	20	1.01	0.22
	Post Test	1.95	20	0.99	0.22
Day 15	Pre Test	2.50	20	1.05	0.23
	Post Test	1.50	20	1.10	0.24

Student’s paired t test

	Paired Differences					T	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			

Day 1-5	-1.40	1.18	0.26	-1.95	-0.84	5.27	19	0.000 S,p<0.05
Day 5-10	-1.45	1.79	0.40	-2.28	-0.61	3.62	19	0.002 S,p<0.05
Day 10-15	-1.55	1.84	0.41	-2.41	-0.68	3.74	19	0.001 S,p<0.05
Day 1-15	-4.40	3.85	0.86	-6.20	-2.59	5.10	19	0.000 S,p<0.05

Graph 8: Comparison of pain on VAS at day 1,5,10 and 15 in group A

Paired Samples Statistics

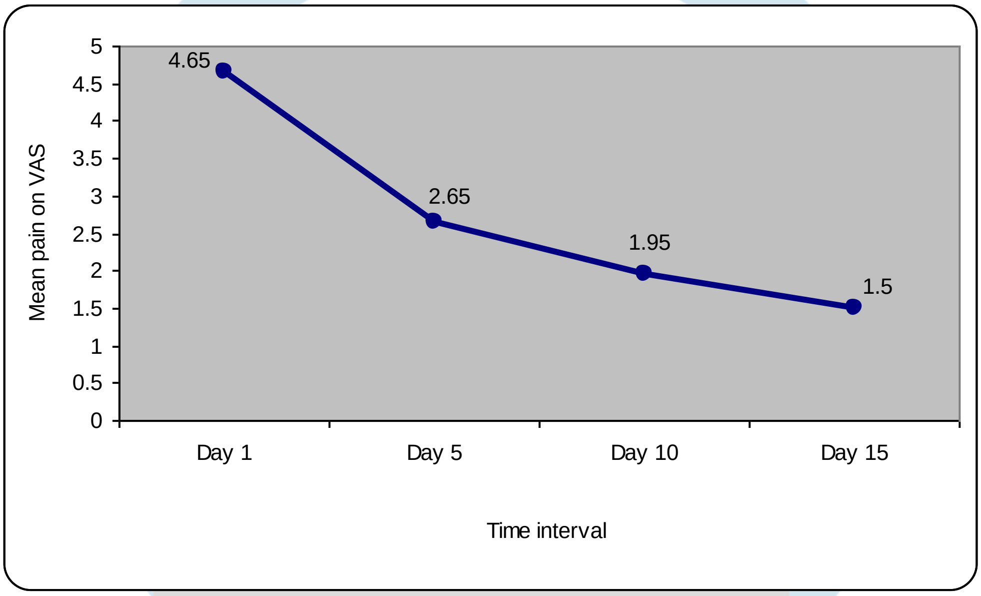


Table 8:- Mean **Pain on VAS in Group A** on Day 1 was 4.65+1.38,at Day 5 was 2.65+0.93,at Day 10 was 1.95+0.99and Day 15 was 1.50+1.10 by using student paired 't' test, **significant difference** is found at Day 1 and Day 5(t=5.27,p=0.00),Day 5 and Day 10(t=3.62,p=0.00),Day 10 and Day 15(t=3.74,p=0.00) and Day 1 and Day 15(t=5.10,p=0.00)

Table 9: Comparison of pain on VAS at day 1,5,10 and 15 in group B

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Day 1	4.90	20	1.20	0.27
Day 5	4.05	20	1.19	0.26
Day 10	3.30	20	1.21	0.27
Day 15	2.55	20	0.99	0.22

Student's paired t test

	Paired Differences					T	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			

Day 1-5	0.85	0.58	0.13	0.57	1.12	6.47	19	0.000 S,p<0.05
Day 5-10	0.75	0.63	0.14	0.45	1.04	5.25	19	0.000 S,p<0.05
Day 10-15	0.75	0.63	0.14	0.45	1.049	5.25	19	0.000 S,p<0.05
Day 1-15	2.30	0.58	0.13	2.07	2.62	17.89	19	0.000 S,p<0.05

Graph 9: Comparison of pain on VAS at day 1,5,10 and 15 in group B

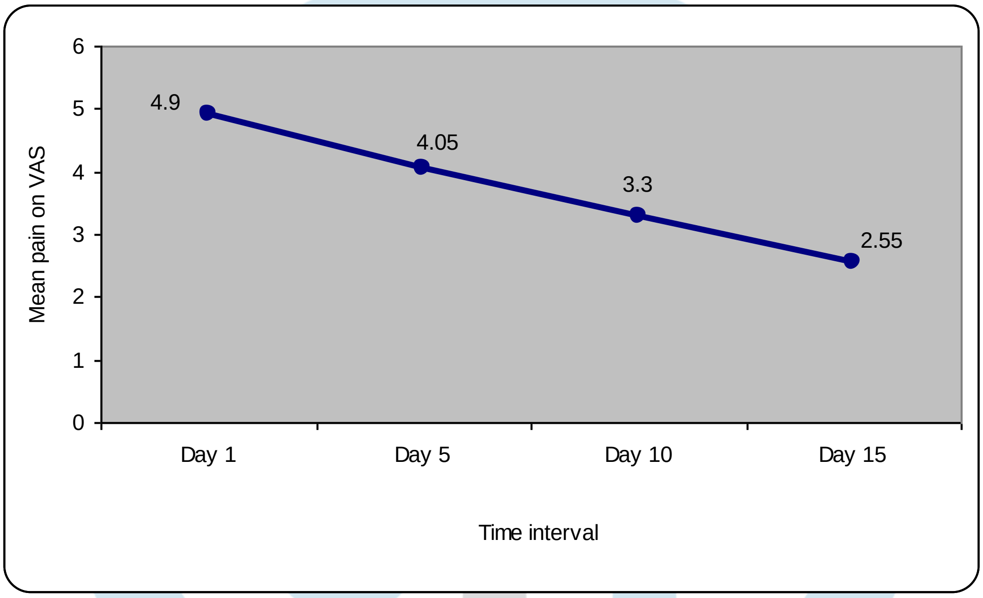


Table 9:- Mean **Pain on VAS in Group B** on Day 1 was 4.90+1.20,at Day 5 was 4.05+1.19,at Day 10 was 3.30+1.21 and Day 15 was 2.55+0.99 by using student paired 't' test, **significant difference** is found at Day 1 and Day 5(t=6.47,p=0.00),Day 5 and Day 10(t=5.25,p=0.00),Day 10 and Day 15(t=5.25,p=0.00) and Day 1 and Day 15(t=17.89,p=0.00)

Table 10: Comparison of grip strength at day 1,5,10 and 15 in group A

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Day 1	34.95	20	10.93	2.44
Day 5	37.10	20	10.89	2.434
Day 10	40.25	20	11.53	2.58
Day 15	42.30	20	12.61	2.82

Student's paired t test

	Paired Differences					T	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Day 1-5	2.15	1.26	0.28	-2.74	-1.55	7.58	19	0.000 S,p<0.05
Day 5-10	3.15	1.53	0.34	-3.86	-2.43	9.20	19	0.000 S,p<0.05
Day 10-15	2.05	2.48	0.55	-3.21	-0.88	3.69	19	0.000 S,p<0.05
Day 1-5	7.35	3.49	0.78	-8.98	-5.71	9.39	19	0.000 S,p<0.05

Graph 10: Comparison of grip strength at day 1,5,10 and 15 in group A

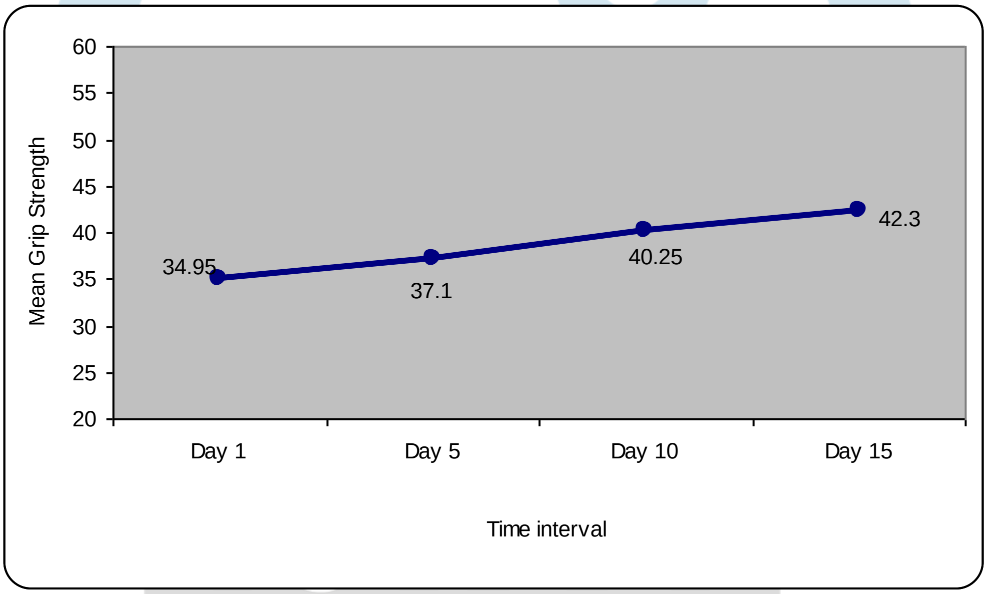


Table 10 :- Mean **Grip Strength in Group A** on Day 1 was 34.95,at Day 5 was 34.95+8.88,at Day 10 was 32.70+9.97 and Day 15 was 34.25+10.64 by using student paired 't' test, **significant difference** is found at Day 1 and Day 5(t=7.58,p=0.00),Day 5 and Day 10(t=9.20,p=0.00),Day 10 and Day 15(t=3.69,p=0.00) and Day 1 and Day 15(t=3.39,p=0.00)

Table 11: Comparison of grip strength at day 1,5,10 and 15 in group B

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Day 1	34.75	20	11.49	2.56
Day 5	36.15	20	11.60	2.59

Day 10	37.60	20	11.32	2.53
Day 15	39.15	20	11.54	2.58

Student’s paired t test

	Paired Differences					t	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Day 1-5	1.40	1.18	0.26	-1.95	-0.84	5.27	19	0.000 S,p<0.05
Day 5-10	1.45	1.79	0.40	-2.28	-0.61	3.62	19	0.002 S,p<0.05
Day 10-15	1.55	1.84	0.41	-2.41	-0.68	3.74	19	0.001 S,p<0.05
Day 1-15	4.40	3.85	0.86	-6.20	-2.59	5.10	19	0.000 S,p<0.05

Graph 11: Comparison of grip strength at day 1,5,10 and 15 in group B

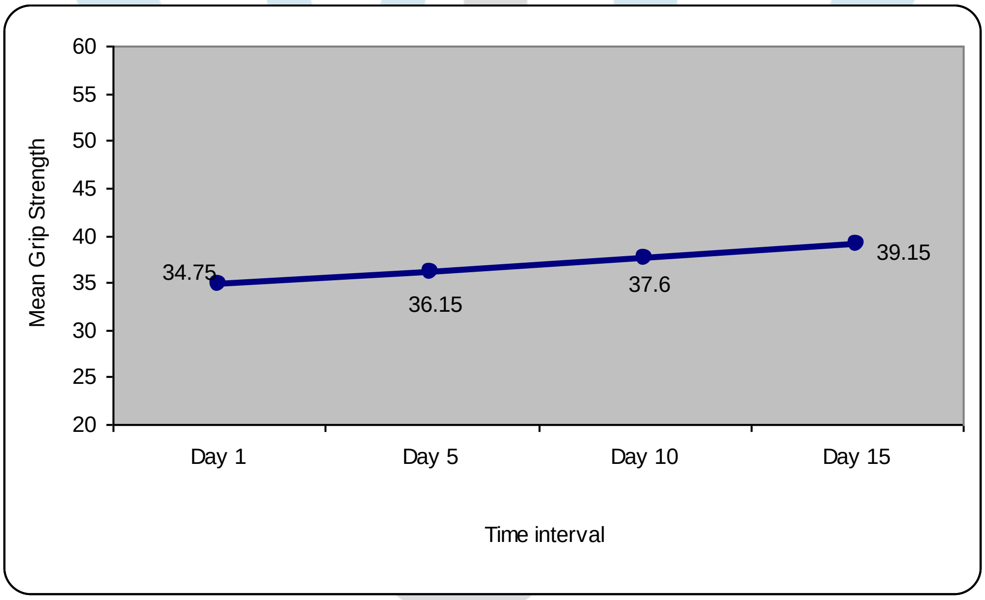


Table 11 :- Mean **Grip Strength in Group B** on Day 1 was 34.75+11.49,at Day 5 was 36.15+11.60,at Day 10 was 37.60+11.32 and Day 15 was 39.15+11.54 by using student paired ‘t’ test, **significant difference** is found at Day 1 and Day 5(t=5.27,p=0.00),Day 5 and Day 10(t=3.62,p=0.00),Day 10 and Day 15(t=3.74,p=0.00) and Day 1 and Day 15(t=5.10,p=0.00)

Table 12: Comparison of functional pain scale at day 1,5,10 and 15 in group A

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Day 1	24.70	20	6.99	1.56
Day 5	22.30	20	7.03	1.57
Day 10	18.10	20	6.24	1.39
Day 15	14.45	0	5.96	1.33

Student's paired t test

	Paired Differences					T	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Day 1-5	2.40	1.39	0.31	1.74	3.05	7.71	19	0.000 S,p<0.05
Day 5-10	4.20	2.04	0.45	3.24	5.15	9.20	19	0.000 S,p<0.05
Day 10-15	3.65	3.80	0.85	1.87	5.42	4.29	19	0.000 S,p<0.05
Day 1-5	10.25	3.97	0.88	8.39	12.10	11.54	19	0.000 S,p<0.05

Graph 12: Comparison of functional pain scale at day 1,5,10 and 15 in group A

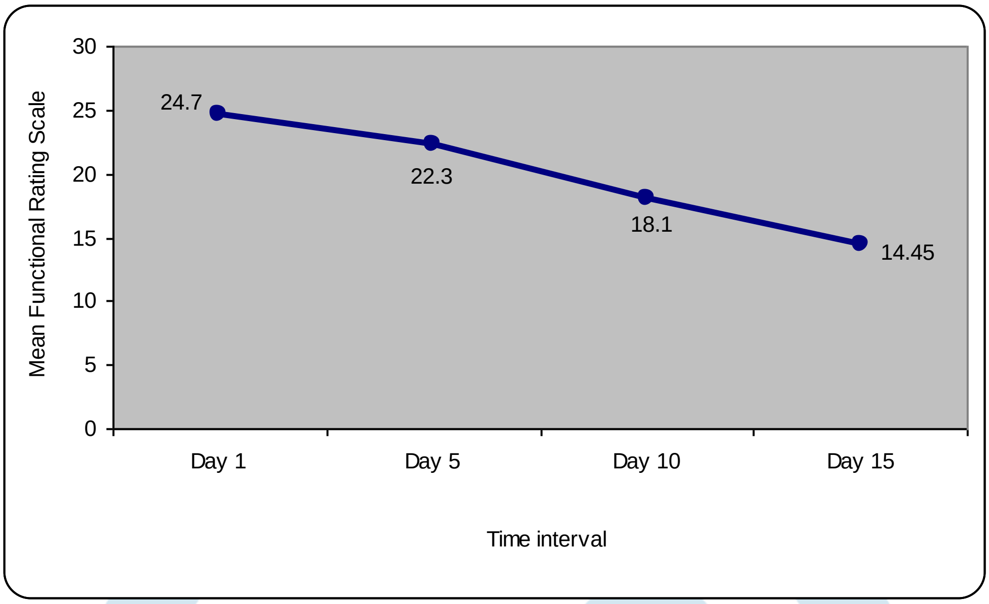


Table 12 :- Mean Score of **Functional Pain Score in Group A** on Day 1 was 24.70+6.99,at Day 5 was 22.30+7.03,at Day 10 was 18.10+6.24 and Day 15 was 14.45+5.96 by using student paired 't' test, **significant difference** is found at Day 1 and Day 5(t=7.71,p=0.00),Day 5 and Day 10(t=9.20,p=0.00),Day 10 and Day 15(t=4.29,p=0.00) and Day 1 and Day 15(t=11.54,p=0.00).

Table 13: Comparison of functional pain scale at day 1,5,10 and 15 in group B Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Day 1	19.50	20	3.80	0.85
Day 5	17.85	20	4.31	0.96
Day 10	14.20	20	3.88	0.86
Day 15	11.15	20	3.32	0.74

Student's paired t test

	Paired Differences					T	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Day 1-5	1.65	1.56	0.35	0.91	2.38	4.71	19	0.000 S,p<0.05
Day 5-10	3.65	1.49	0.33	2.94	4.35	10.90	19	0.000 S,p<0.05
Day 10-15	3.05	1.35	0.30	2.41	3.68	10.05	19	0.000 S,p<0.05

Day 1-5	8.35	2.15	0.48	7.33	9.36	17.29	19	0.000 S,p<0.05

Graph 13: Comparison of functional pain scale at day 1,5,10 and 15 in group B

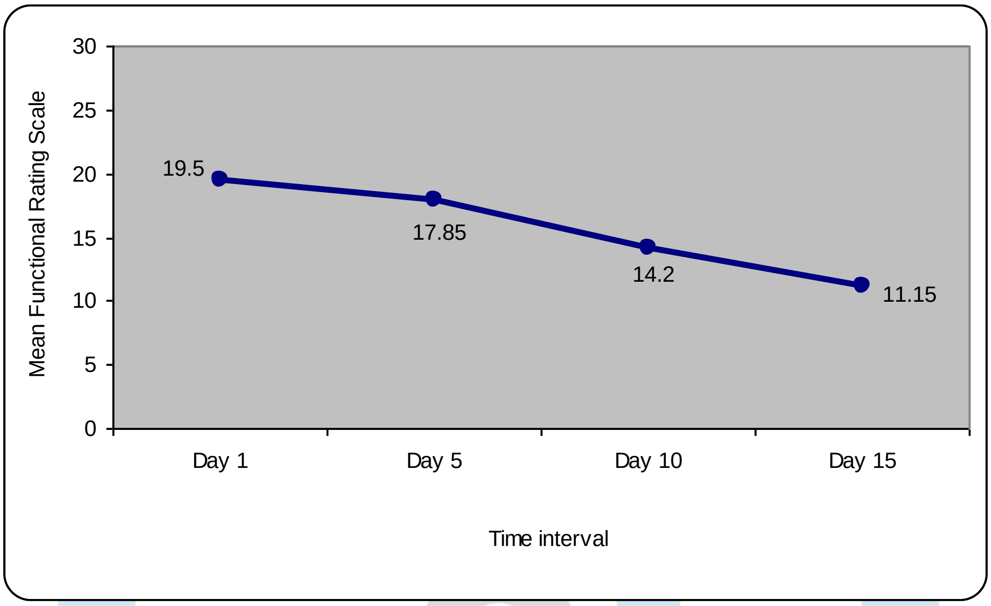


Table 13 :- Mean Score of **Functional Pain Score in Group B** on Day 1 was 19.50+3.80,at Day 5 was 17.85+4.31,at Day 10 was 14.20+3.88 and Day 15 was 11.15+3.32 by using student paired 't' test, **significant difference** is found at Day 1 and Day 5(t=4.71,p=0.00),Day 5 and Day 10(t=10.90,p=0.00),Day 10 and Day 15(t=10.05,p=0.00) and Day 1 and Day 15(t=17.29q,p=0.00)

Table 14: Comparison of pain on VAS at day 1,5,10 and 15 in group A and group B

Descriptive Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Day 1	A	20	4.65	1.38	0.31
	B	20	4.90	1.20	0.27
Day 5	A	20	2.65	0.93	0.20
	B	20	4.05	1.19	0.26
Day 10	A	20	1.95	0.99	0.22
	B	20	3.30	1.21	0.27
Day 15	A	20	1.50	1.10	0.24
	B	20	2.55	0.99	0.22

Students unpaired t test

	t	df	p-value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Day 1	0.60	38	0.547 NS,p>0.05	-0.25	0.41	-1.08	0.58

Day 5	4.13	38	0.000 S,p<0.05	-1.40	0.33	-2.08	0-.71
Day 10	3.83	38	0.000 S,p<0.05	-1.35	0.35	-2.06	-0.63
Day 15	3.16	38	0.003 S,p<0.05	-1.05	0.33	-1.72	-0.37

Graph 14 : Comparison of pain on VAS at day 1,5,10 and 15 in group A and group B

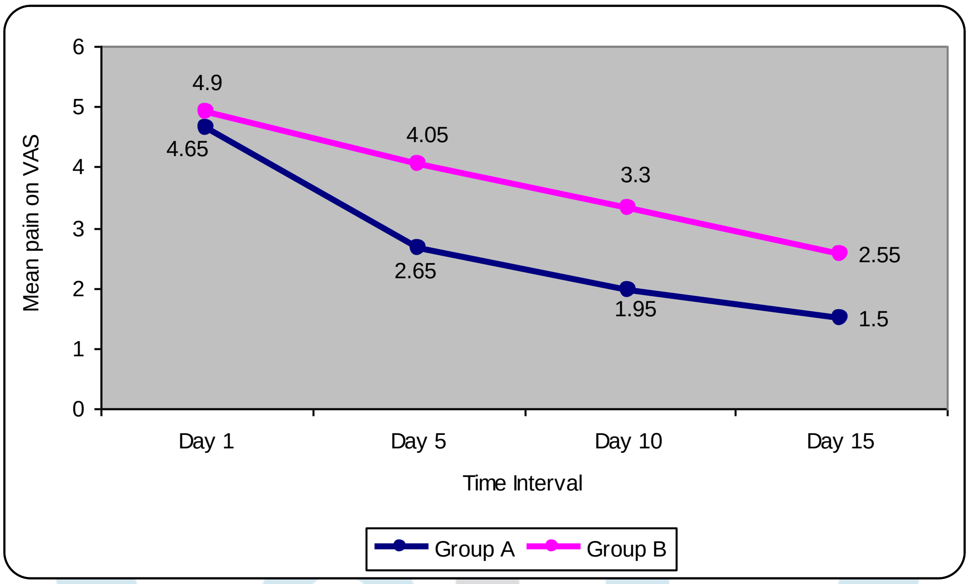


Table 14 :- Mean **Pain on VAS in Group A** on Day 1 was 4.65+1.38 and in **Group B** it was 4.90+1.20 by using student unpaired 't' test ,**no significant** difference in pain on VAS is observed at Day 1 (t=0.41,p=0.547).

Mean **Pain on VAS in Group A** on Day 5 was 2.65+0.93 and in **Group B** it was 4.05+1.19 by using student unpaired 't' test , **significant** difference in pain on VAS is observed at Day 5 (t=0.33,p=0.547).

Mean **Pain on VAS in Group A** on Day 10 was 1.95+0.99 and in **Group B** it was 3.30+1.21 by using student unpaired 't' test , **significant** difference in pain on VAS is observed at Day 10 (t=0.35,p=0.547).

Mean **Pain on VAS in Group A** on Day 15 was 1.50+1.10 and in **Group B** it was 2.55+0.99 by using student unpaired 't' test , **significant** difference in pain on VAS is observed at Day 10 (t=0.33,p=0.547).

Table 15: Comparison of grip strength at day 1,5,10 and Days 15 in group A and group B

Descriptive Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Day 1	A	20	34.95	10.93	2.44
	B	20	34.75	11.49	2.56
Day 5	A	20	37.10	10.89	2.43
	B	20	36.15	11.60	2.59
Day 10	A	20	40.25	11.53	2.58
	B	20	37.60	11.32	2.53
Day 15	A	20	42.30	12.61	2.82
	B	20	39.15	11.54	2.58

Students unpaired t test

	t	df	p-value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Day 1	0.056	38	0.955 NS,p>0.05	0.20	3.54	-6.98	7.38
Day 5	0.267	38	0.791 NS,p>0.05	0.95	3.55	-6.25	8.15
Day 10	0.733	38	0.468 NS,p>0.05	2.65	3.61	-4.66	9.96
Day 15	0.824	38	0.415 NS,p>0.05	3.15	3.82	-4.59	10.89

Graph 15: Comparison of grip strength at day 1,5,10 and Days 15 in group A and group B

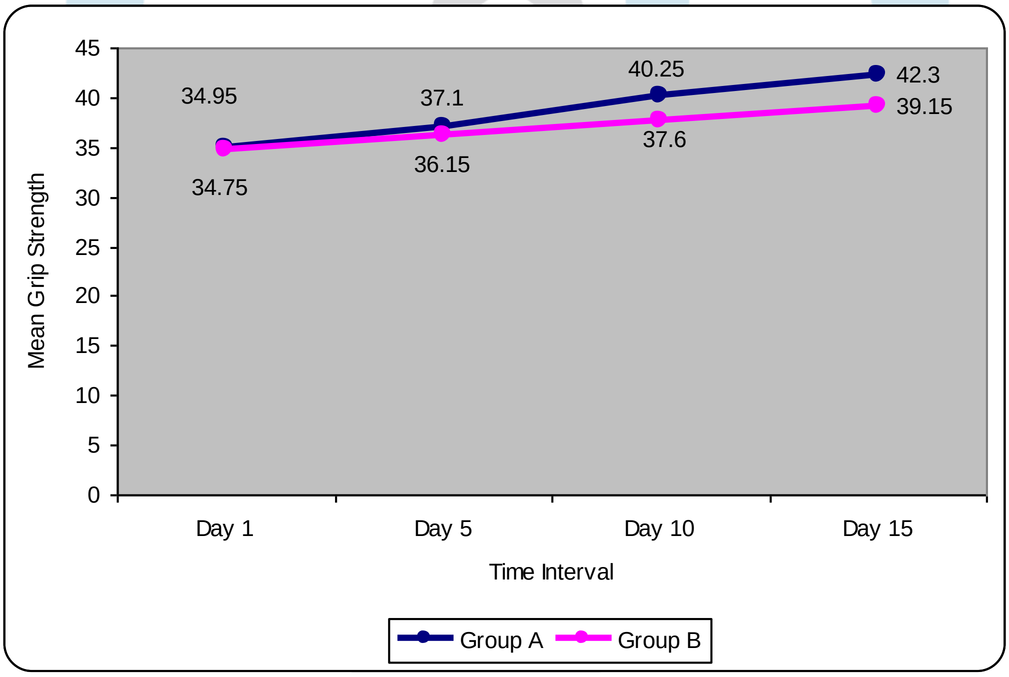


Table 15 :- Mean **Grip strength in Group A** on Day 1 was 34.95+10.93 and in **Group B** it was 34.75+11.49 by using student unpaired ‘t’ test ,**no significant** difference in grip strength is observed at Day 1 (t=3.54,p=0.547).

Mean Pain on **Grip strength in Group A** on Day 5 was 37.10+10.89 and in **Group B** it was 36.15+11.60 by using student unpaired ‘t’ test **, no significant** difference in grip strength is observed at Day 5 (t=3.55,p=0.547).

Mean Pain on **Grip Strength in Group A** on Day 10 was 40.25+11.53 and in **Group B** it was 37.60+11.32 by using student unpaired ‘t’ test **, no significant** difference in pain on VAS is observed at Day 10 (t=3.61,p=0.547).

Mean Pain on **Grip Strength in Group A** on Day 15 was 42.30+12.61 and in **Group B** it was 39.15+11.54 by using student unpaired ‘t’ test , **no significant** difference in pain on VAS is observed at Day 15 (t=3.82,p=0.547).

Table 16: Comparison of functional pain scale at day 1,5,10 and Days 15 in group A and group B

Descriptive Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean

Day 1	A	20	24.70	6.99	1.56
	B	20	19.50	3.80	0.85
Day 5	A	20	22.30	7.03	1.57
	B	20	17.85	4.31	0.96
Day 10	A	20	18.10	6.24	1.39
	B	20	14.20	3.88	0.86
Day 15	A	20	14.45	5.96	1.33
	B	20	11.15	3.32	0.74

Students unpaired t test

	T	Df	p-value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Day 1	2.92	38	0.006 S,p<0.05	5.20	1.78	1.59	8.80
Day 5	2.41	38	0.021 S,p<0.05	4.45	1.84	0.71	8.18
Day 10	2.37	38	0.024 S,p<0.05	3.90	1.64	0.54	7.25
Day 15	2.15	38	0.037 S,p<0.05	3.30	1.52	0.20	6.39

Table 16: Comparison of functional pain scale at day 1,5,10 and Days 15 in group A and group B

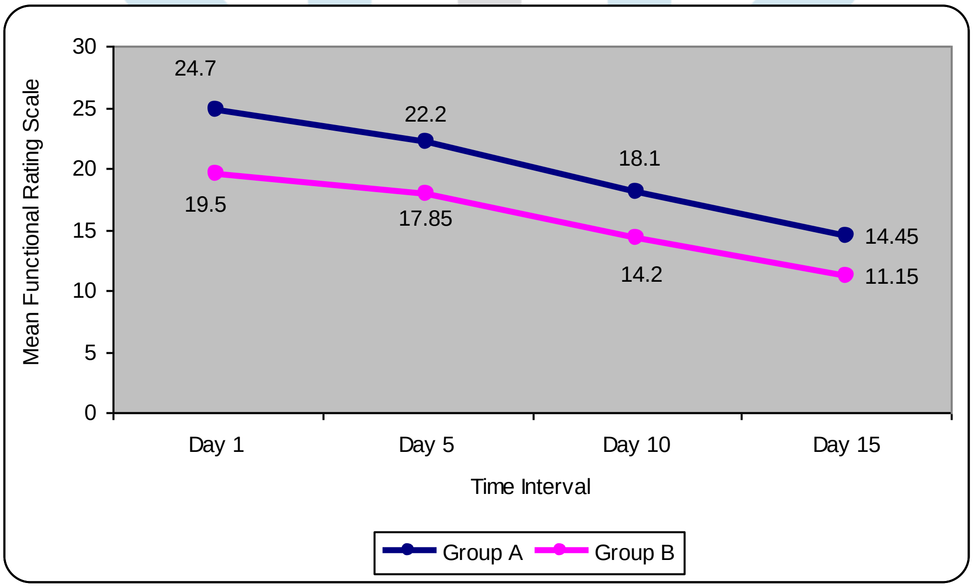


Table 16 :- Mean score of **Functional Pain Scale in Group A** on Day 1 was 24.70+6.99 and in **Group B** it was 19.50+3.80 by using student unpaired ‘t’ test, **significant** difference in functional pain scale is observed at Day 1 (t=1.78,p=0.547).

Mean Pain on **Functional Pain Scale in Group A** on Day 5 was 22.30+7.03 and in **Group B** it was 17.85+4.31 by using student unpaired ‘t’ test , **significant** difference in functional pain scale is observed at Day 5 (t=1.84,p=0.547).

Mean Pain on **Functional Pain Scale in Group A** on Day 10 was 18.10+6.24 and in **Group B** it was 14.20+3.88 by using student unpaired ‘t’ test, **significant** difference in functional pain scale is observed at Day 10 (t=1.64,p=0.547).

Mean Pain on **Functional Pain Scale in Group A** on Day 15 was 14.45+5.96 and in **Group B** it was 11.15+3.32 by using student unpaired 't' test ,**significant** difference in functional pain scale is observed at Day 15 (t=1.52,p=0.547).

DISCUSSION

It is observed that there were **50% Males and 50% Females in Group A** and **60% Males and 40% Females** in **Group B.**

The **mean age of patient** was 35.20+9.13 years in Group A and that of Group B was 36.85+7.6 years(Table 1).

Kivi (1992) reported mean age as 43 years in his series. **Geoffroy et al (1994)** reported common age group in their series of lateral epicondylitis between 30-50 years with mean age group 42 years. The findings of the present study is more or less similar to the findings of all the above workers (**Kivi, 1992 & Geoffroy et al, 1994**). The occurrence of the lateral epicondylitis in the adult and late age group between 40-60 years could be explained on the basis that physical activity like gripping and repetitive supination and pronation remains maximal and natural age related changes starts occurring in this age group.

In the present study no significant difference was found in gender wise distribution of patients(Table 1). Allender(1974) reported that this condition is more common in women as compared to male.

However, Geoffory(1994) and Waugh et al(2004) reported that lateral epicondylitis is equally common in both male and women. J.P. Haar(2003) in his study reported that in the Swedish population study the annual incidence was less than 1% and the prevalence was 1-3% and upto 10% in females of around 40 years.

A Binder(1985) reported that 51% attributed symptoms to a specific cause or activity for example housework, working with tools, lifting or carrying heavy weights and sports.

J.P. Haar and Anderson(2004) opined that tennis elbow occurs in those who having monotonous repetitive work task during atleast half of the early time in last few years among women but not in men. However they agreed that most of the physical job characteristics were associated with tennis elbow. Among women the risk of tennis elbow increase with increasing daily exposure time to work with the arm lifted in front of the body and working with the hand bend or twisted and working with the movements of the arm. Thus the available literature has shown that tennis elbow commonly occurs in dominant ha In the present study,the mean pain on VAS for Group A and Group B **(Table 2 and Table 3)** pre and post test in Day 1,5,10 and 15 was significantly different and was less in post test.

Similarly, the mean pain on VAS for Group A and B **(Table 8 and Table 9)** was statistically significant different and was getting reduced from Day 1-5, Day 5-10, Day 10-15 and Day 1-15.

Also, the mean pain on VAS in Group A was less as compared to Group B **(Table 14)** on Day 5,10 and 15 except Day 1.

Vicenzinoa et al(2001) carried out a study of specific manipulative therapy on chronic lateral epicondylitis. The result demonstrated a significant and substantial increase in pain free grip strength of 58% and 10% change in pressure pain threshold after treatment as compared to control and placebo group.

Donatelli Wooden (2001) explains that how manipulation helps in reduction of pain. Type I(postural) and Type II(dynamic) mechanoreceptors are located in joint capsules. They have a low threshold and are excited by repetitive movements including oscillation. Type II mechanoreceptors are found in joint capsule and extra capsular ligaments. They are similar to Golgi tendon organs in that they are excited by stretching and perhaps thrusting maneuvers. Pain receptors or type IV nociceptors are found in capsules, ligaments, fat pads and blood vessels wall. These receptors are fired by noxious stimuli, as in trauma and have a relatively high pressure.

Pain impulses from type IV nociceptors are conducted slowly. Impulses from type I and type II mechanoreceptors are fast, conducting at a much lower threshold. The difference between types I and type II and type IV conductivity may explain why oscillating a joint relieves pain. Theoretically the faster mechanical impulses overwhelm the slower pain impulses. Whether this is achieved by " closing the gate" or perhaps by release of endorphins in the central nervous system is still under investigation. Muscle relaxation is an additional benefit of passive movement. One theory is that causing type II joint receptors and Golgi tendon organs to fire by stretching or thrusting a joint, result in temporary inhibition or relaxation of muscle . This in itself may cause an increase in range of motion and helps prepare the joint for further stretching and mobilization.

Rad Prasand(2009) studied a 57 year subject of lateral epicondylitis with the combination of manipulation exercise and physical therapy. The treatment was given over 10 weeks protocol. He used high velocity and low amplitude manipulation, high voltage pulsed galvanic stimulation, a hard padded elbow brace, ice and exercise along with restricted use of elbow. Patient was evaluated with patient rated tennis evaluation skill.

Over all there was a systemic reduction of pain(92.86%), specific activity(100%) and usual activity(96.87%) even after 3 weeks of follow up. This case study showed the possible beneficial effects of the specific sequential multimodal treatment approach in a patient with resistant chronic lateral epicondylitis. Thus we believe that reduction in pain results in increase in grip strength.

In present study, the mean grip strength for Group A and Group B **(Table 4 & Table 5)** pre and post test on Day 1,5,10 and 15 was not significantly different.

Similarly, the mean grip strength in Group A and Group B **(Table 10 & Table 15)** was getting increased from Day 1-5, Day 5-10, Day10-15 and Day 1-15.

Also the mean grip strength in Group A **(Table 15)** was more compared to Group B on Day 5, 10 and 15 except on Day 1.

Leanne Bisset(2006) in his study of mobilization with moment and exercise cortico-steroid injection or wait and see reported that at 6 weeks cartico-steroid group was better 51/65(78%) than physiotherapy group 41/63(65%) and wait and see group 16/60(27%). But physiotherapy group was significantly better than wait and see group at 6 weeks. After 52 weeks there was significant improvement in physiotherapy group as compared to cortico-steroid group and wait and see group.

The result of the study suggest that physiotherapy treatment has a long term effect as compared to corticosteroid group and wait and see group.

Varhaar et al(1996) in their series on measurement of outcome of various parameters like grip strength per kg reported no significant difference between study and control group. Moreover there was gradual increase of grip strength at 6 week (2.3±1.06) and at 52 week(11.0±13.8) within the physiotherapy group as compared to initial grip strength.

Similarly they reported that mean grip strength (kg±SD) at 0 week(23.5±13.8), at 6 week(25.6±13.7) and at 52 week(34.5±14.6). Thus there was a significant increase in grip strength from 6 week to 52 weeks. The mean grip strength at 0 week was lower in injection group than physiotherapy and therefore increase or decrease was calculated from 6 weeks. The findings of the present study was more or less similar to the study of Varhaar et al(1996). They further reported that the value of grip strength is known to be related to gender, profession, dominance of arm, types of sports and other activities. We believe that since there was reduction of pain on VAS after manipulation therapy which resulted in pain free grip . Therefore there was gradual increase in grip strength.

Study conducted by Abbott et al(2001) with 25 patients reported that MWM was effective in allowing 92% of subjects to perform previously pain movements pain free and improving grip strength immediately. Both pain free grip strength and maximum grip strength of the affected limb increased significantly following the intervention. They concluded that movement with mobilization is a promising intervention modality for the treatment of patients with lateral epicondylagia.

In present study, the mean score of Functional pain scale for Group A and Group B **(Table 6 & Table 7)** pre and post test on Day 1,5,10 and 15 was significantly different and was less post test.

Similarly, the mean score of Functional pain scale in Group A and Group B **(Table 12 & Table 13)** was getting increased from Day 1-5, Day 5-10, Day10-15 and Day 1-15.

Also the mean score of Functional pain scale in Group A **(Table 16)** was significantly less compared to Group B on Day 1,5, 10 and 15.

Peter Shrujis et al(2003) carried out a study on 30 subjects of lateral epicondylitis. At 3rd week the group A receiving manipulation showed an improvement in global improvement scale as compared to the group B receiving conservative management. There was improvement of (62% in group A, 20% in group B,p-value=0.05). At 6 weeks of intervention there was decrease of 2.8 point in group A and decrease in 1.1 points in group B,p-value=0.03). There was no statistical significant difference between the two groups at 6 weeks.

Vicenzino and Wright(1996) carried out a study to investigate the effects of a course of MWM treatments in patient with lateral epicondylitis and reported that MWM technique in addition to a self – MWM technique performed at home resulted in rapid reduction of pain and improvement in function.

Geetu Manchanda and Groover(2008) in his study of 30 cases and divided in to 3 groups, group A received mulligan mobilization, group B wrist mobilization and group C act as a control group. Conventional treatment of pulsed ultrasound, resisted exercise and stretching was given to all 3 groups at the termination of the treatment. They reported that there was statistical significant improvement in VAS, strength and function in all three groups between day 1 and day 5, day 5 and day 10, day 10 and day 15 and between day 1 and day 15.

A major strength of this study was the relatively successful random allocation and even distribution in both the groups. Randomization enhances the likelihood of equal distribution among groups of patients experiencing of favorable natural history. Therefore, any difference observed between groups are likely because of treatment encountered.

Limitations of the study included the use of subjective assessment tools. As with the use of any subjective evaluation, the chance for subject confusion and/or bias is increased. The use of other objective measures in conjunction with the subjective tests may improve clinical relevance. Possible options include soft tissue assessment.

The generalibility of the study is limited by the use of small sample size.

Further research should be done on a larger sample size with more extensive intervention and co-relation between the outcome measures .

CONCLUSION

It is found that, the **mean score of VAS** is **less** in case of Mulligan's Mobilization with Movement compared to conservative treatment and **mean score of Hand Held Dynamometer is high** in case of Mulligan's Mobilization with Movement as compared to Conservative treatment.The study is suggestive of the mean score of **functional pain rating scale is less** in case of Mulligan's Mobilization with Movement compared to conservative treatment.

The study concludes that **Mulligan's Mobilization with Movement leads to better improvement in pain, strength and functional performance as compared to conventional treatment** regimen of giving only the stretching and resistance exercise along with pulsed ultrasonic therapy.

Hence, the **Mulligan's Mobilization with Movement is better than conservative treatment** in treating Lateral Epicondylitis.

Occupational hazards and injuries are not considered. Further study can be carried out considering occupational hazards and injuries.

Hand dominance in tennis elbow is not considered. Further study can be carried out considering hand dominance and **relationship between hand dominance and hand affected.**

Co-relations between the outcome measures were not considered which can be considered in further study.

CLINICAL IMPLICATIONS

Manual therapy given in the treatment of lateral epicondylitis results in earlier return of strength and reduction of pain and hence reduces the total rehabilitation period. Hence a person can return to his work much earlier. This improved strength enables him to perform better in functional activities.

Manual therapy can easily be applied and are efficient, effective, time saving and well accepted by the patients.

SUGGESTIONS AND LIMITATIONS

1. Study was conducted in a small setup. Therefore sufficient number of patients was not obtained.

   This study can be conducted further with large number of patients.
2. Occupational hazards and injuries are not considered.

   Further study can be carried out considering occupational hazards and injuries.
3. Hand dominance in tennis elbow is not considered.

   Further study can be carried out considering hand dominance and relationship between hand dominance and hand affected.
4. Co-relations between the outcome measures were not considered which can be considered in further study.

SUMMARY

Purpose: To evaluate the effectiveness of movement with mobilization compared with conservative treatment on pain, strength, activities of daily living in patients with lateral epicondylitis.

Methodology: The study has an experimental design. A total of 40 patients having symptomatic lateral epicondylitis were taken and randomly assigned to one of the two groups. Group A (n=20) received mulligan mobilization whereas Group B (n=20) received conservative treatment. Both groups received conventional treatment of pulsed ultrasonic therapy at an intensity of 1.2 W/cm^2 for 5 min, progressive resisted exercises and stretching. Fifteen treatment sessions are given. Baseline measurement of pain (VAS score), functional pain scale and strength (using weights) was taken on Day 1 and then subsequently at day 5, day 10 and day 15.

Discussion: Group A improves pain reduction, grip strength and functional activity better than Group B. This early return of strength and functional activity better than Group B. This early return of strength and activity is very useful for a person to return early to his daily activity better than Group B. This improvement in strength will also prevent disuse atrophy or muscle weakness resulting from less or no activity due to pain and disability caused by lateral epicondylitis. This observation that the manipulation exercise group improves better than the ultrasonic group has also been proved by many studies done earlier on lateral epicondylitis patient[7,39,40,41].

Paungmali et al[42] suggested that MWM for chronic lateral epicondylitis is capable of producing concurrent hypoalgesic effects during and following its application, as well as altering the sympathetic nervous system function.

Manual therapy might be more cost effective due to a reduction in the number of treatment sessions needed for recovery from lateral epicondylitis.[39]

Results: Both groups show improvement in VAS score. Both Group A (Mulligan mobilization) and group B (Conservative treatment) lead to statistically significant improvement in strength and functional performance. But there was statistically significant difference in these two parameters between group A and B, group A was statistically significant.

Conclusion: The study concludes that both the manual therapy technique i.e. Mulligan mobilization is more effective in reducing pain, improving strength and functional performance when compared with conventional treatment regimen of giving only the stretching and resistance exercises along with pulsed ultrasonic therapy.

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ANNEXURE - I

FUNCTIONAL PAIN SCALE

Functional pain scale for lateral epicondylitis.6 Maximum possible score on this scale can be 40.

Score -0: no discomfort
1: slight discomfort
2: moderate discomfort
3: Quite a bit discomfort
4: Extreme discomfort

Activities are:

- Your usual work, housework or school activities.
- Your usual hobbies, sporting or recreational activities
- Using tools or appliances
- Dressing yourself
- Squeezing or gripping an object
- Opening doors with your involved limb.
- Activities such as sweeping or raking.
- Carrying a small suitcase with your involved limb.
- Opening a jar or can
- Writing or using a keyboard

ANNEXURE - II

HANDGRIP STRENGTH TEST

The purpose of this test is to measure the maximum isometric strength of the hand and forearm muscles. Handgrip strength is important for any sport in which the hands are used for catching, throwing or lifting. Also, as a general rule people with strong hands tend to be strong elsewhere, so this test is often used as a general test of strength.

- **Equipment required:** handgrip dynamometer
- **Procedure:** The subject holds the dynamometer in the hand to be tested, with the arm at right angles and the elbow by the side of the body. The handle of the dynamometer is adjusted if required - the base should rest on first metacarpal (heel of palm), while the handle should rest on middle of four fingers. When ready the subject squeezes the dynamometer with maximum isometric effort, which is maintained for about 5 seconds. No other body movement is allowed. The subject should be strongly encouraged to give a maximum effort. See videos of the Handgrip Strength Test
- **Scoring:** The best result from several trials for each hand is recorded, with at least 15 seconds recovery between each effort. The values listed below (in kilograms) give a guide to expected scores for adults. These values are the average of the best scores of each hand.

Rating*	Males (Kg)	Females (Kg)
Excellent	> 64	> 38
Very Good	56-64	34-38
Above Average	52-56	30-34
Average	48-52	26-30
Below Average	44-48	22-26
Poor	40-44	20-22
Very Poor	< 40	< 20

* Source and population group unknown

ANNEXURE - III

ASSESSMENT PROFORMA

Assessment Proforma for Patients:

1. Name:
2. Age:
3. Sex:
4. Address & phone no.:
5. Occupation:
6. Chief complaints:
7. History of present illness:
8. Past history:
9. Medical history:
10. Personal history:

On Observation:

1. Built:
2. Attitude of the limb:
3. Swelling:

On Palpation:

1. Tenderness:
2. Muscle spasm:
3. Oedema:

Special Tests:	Right	Left
1. Cozen's Test		
2 .Mill's Test		

VAS ASSESSMENT(Visual Analoge Scale):

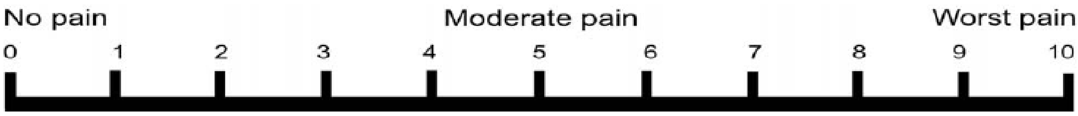
GRIP STRENGTH ASSESSMENT:	Right	Left
Hand Held Dynamometer		

FUNCTIONAL PAIN SCORE:
Activities are:

- Usual work, housework or school activities.
- Usual hobbies, sporting or recreational activities
- Using tools or appliances
- Self Dressing
- Squeezing or gripping an object
- Opening doors with the involved limb.
- Activities such as sweeping or raking.
- Carrying a small suitcase with the involved limb.
- Opening a jar or can
- Writing or using a keyboard

ANNEXURE V

VISUAL ANALOG SCALE



Procedure for Measuring V.A.S.:

A visual analogue scale (VAS) was used to assess pain in each subject in the study. The VAS used in the study consisted of a continuous horizontal line 10cm in length with anchor points of ‘no pain’ (0) and ‘worst pain’ (10) on the left and right ends of line respectively. The patients were asked to judge the intensity of their pain using VAS in last 24 hours.