Journal of Positive School Psychology http://journalppw.com
2022, Vol. 6, No. 9, 4231-4243

The Effect Of Middle And Lower Trapezius Strengthening On Hand Grip Strength In Athletes With Chronic Lateral Epicondylitis

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Abstract

Background: Lateral epicondylitis is a common sports injury of the elbow caused due to altered muscle activation during repetitive wrist extension in athletic and non-athletic endeavors and the purpose of thestudy was to investigate the effect of lower trapezius , middle trapezius strengthening on pain, pain freegrip strength in individuals with lateral epicondylitis.

Methods: 30 patients with lateral epicondylitis were recruited and the subjects were divided into two groups. Group a received scapular muscles strengthening along with conventional physiotherapy and Group B received only conventional physiotherapy for 4weeks and the subjects were measured for pain (NPRS), scapular positioning (LSST) and grip strength using Jamar Dynamometer Pre and Post intervention.

Results: The values showed significant difference in all the three outcome measures but showed highlysignificant difference in pain level and grip strength($p<0.005$) within group A. Also the results showed that there is no significant difference in group B values of LSST test but gave significant difference in values ofpain and grip strength ($p< 0.005$).

Conclusion: The middle and lower trapezius muscle strengthening should be used along with the conventional physiotherapy in athletes with lateral epicondylitis to improve pain, pain free grip strength, muscle strength, scapular position and muscle activity.

Keywords: lateral epicondylitis, pain, grip strength, scapula, eccentric exercises

INTRODUCTION

Lateral epicondylitis (LE), commonly called tennis elbow, is described as tendinopathy at the common extensor origin at the lateral epicondyle of the humerus. 1 in 3% of the population has lateral epicondylitis and in the sporting population, it is1.3% prevalent due to the use of repeated action in sports activities At-risk populations also include those with professions that require repetitive and forceful manual tasks, nonneutral wrist postures, and repetitive gripping. The condition has a significant impact on society and challenges the health care industry. Also, it is characterized by pain and tenderness on resisted dorsiflexionof the wrist and middle finger.

LE is considered to be due to overuse, overstress, or overexertion of the wrist extensors of the forearm, andit is often found to be associated with individuals who have repetitive occupations or hobbies. The origin ofthe extensor carpi radialis brevis (ECRB) is most commonly affected though other tendons like extensorcarpi radialis longus, extensor digitorum, and extensor carpi ulnaris may also be involved and it is a degenerative or failed healing tendon response characterized by the presence of fibroblastic, vascular response and disorganized collagen.

LE is associated with decreased handgrip strength. Also the most important functions of the upper extremity for independent and smooth activities of daily living are the functions of the hand. The representative function of the hand is to hold something and the strength of the fingers when holding something is known as grip strength which is an important index in the evaluation of the motor function ofthe hand.

The force overload implicated in lateral epicondylitis is attributed to the repetitive strong synergistic and fixator role played by the wrist extensors during gripping, gripping activates the flexor muscles thereby creating a flexion moment at the wrist joint and as a result, the extensor muscles are co-activated, producing an extension moment that stabilizes the wrist joint. Moreover, the handgrip strength depends on the synergistic coordination between finger and wrist flexors and extensors which is the important componentin the proper execution of the daily living activities as well as in various sports activities.

In patients with LE, pain at the lateral epicondyle during power grip occurs because the extensor carpi radialis longus and the extensor carpi radialis brevis must work to counteract the flexion moment generatedat the wrist by the digital and

wrist flexors as it is widely accepted that the grip strength provides an objective index of the functional integrity of the upper extremity.

Clinically, based on expert opinion the scapular musculature weakness in individuals with lateral epicondylalgia is commonly addressed by reducing the stresses placed on the wrist or forearm musculature.

Alizadehkhaiyat et al identified weaker rotator cuff musculature in patients with lateral epicondylalgia. Proximal stability is required for the efficient functioning of distal segments in the kinetic chain of upperlimb and the impairment of scapula musculature strength and endurance is noticed in individuals with lateral epicondylalgia.

Also, Lucado et al (2018) found that there is diminished lower trapezius (LT) strength in female tennisplayers compared to asymptomatic female tennis players. A case series which deals with the management of lateral epicondylitis by correcting scapular muscle deficits has been recently reported and clinically, modifying scapular position into adduction in individuals with weak scapular musculature and an abducted scapula also modifies the position of the humerus and reduces lateral epicondylalgia symptoms. More importantly, the shreds of evidence state that the scapular correction often results in an improvement in grip strength.

The dynamic upper extremity dominant tasks such as throwing, hitting and serving occur as a result of the integrated, multisegmented, sequential joint motion and muscle activation system known as the kinetic chain in upper extremity dominant tasks, the energy development and output follows a proximal to distal sequencing.

The middle and lower trapezius muscles are scapular adductors that assist in maintaining scapular and humeral alignment and timing of muscle recruitment with reaching. With scapular correction, the middle and lower trapezius can alter humeral position which will help in kinetic chain alignment, and therefore, the majority of treatment approaches for lateral epicondylitis are based on addressing the elbow region[1] and less on shoulder and scapular muscles.

NEED OF STUDY

From the literature, as mentioned earlier, an exercise program focused on improving the strength of the scapular adductor muscles would result in pain resolution with gripping tasks and improved scapular position. The scapular strengthening often results to alleviate the symptoms of lateral epicondylitis thus improved the grip strength and it coincided with clinically significant improvement in middle and lower trapezius strength.

A majority of treatment approaches focuses on the treatment of the elbow region in lateral epicondylitis, there is a lack of literature on intervention for scapular muscle strengthening for chronic lateral epicondylitis in athletes that can establish a definitive cause or effect relationship between scapular muscle weakness and LE have been recommended. Also suggests that scapular muscle strengthening should be used along with conventional physical therapy in individuals with chronic LE.

Thus, there is a need in investigating the effect of middle and lower trapezius strengthening on handgrip strength in athletes with chronic lateral epicondylitis.

1. AIM AND OBJECTIVES

AIM OF THE STUDY:

The need of the study is to investigate the effect of middle and lower trapezius strengthening on hand gripstrength in athletes with chronic lateral epicondylitis.

OBJECTIVE OF THE STUDY:

To assess the effect of pain in lateral epicondylitis.

To assess scapular muscle strengthening on pain free grip strength in athletes with lateral epicondylitis.To assess the scapular alignment in athletes with lateral epicondylitis.

HYPOTHESIS:

NULL HYPOTHESIS:

There is no significant effect on strengthening of middle and lower trapezius fibres on hand grip strength inathletes with lateral epicondylitis.

RESEARCH HYPOTHESIS:

There is significant effect on strengthening of middle and lower trapezius fibres on handgrip strength inathletes with lateral epicondylitis.

2. REVIEW OF LITERATURE

- **Bhatt JB et al (2019)** in a case report addressed the weakness of the rotator cuff and scapular musculature is often suggested clinically for the treatment of individuals with lateral epicondylitis. The patient who was 54 years old woman within a 5-month history of right lateral epicondylitis whohas got weakness in her middle trapezius and lower trapezius was given treatment on strengtheningof those muscles over 10-week period and the result suggests that the assessment and treatment of scapular musculature warrant consideration in the management of individuals with lateral epicondylitis.[2]
- **Labott BK et al (2019)** studied effects of exercise training on hand grip strength in older adults. A meta-analytical review where 60 or above older adults done non-randomized and randomized controlled trails with an exercise training and hand grip strength taken as outcome parameter and compared handgrip strength between the intervention and controlled groups and a random effects inverse-variance applied for statistical analysis which resulted in significant effects ($p< 0.001$) on hand grip strength observed concluded appropriate training stimulus improve handgrip strength.[17]
- **Bhide D et al (2018)** studied the effects of dynamic scapular muscle exercises on grip strength in young adults to discuss the efficacy of proximal stability on distal function where 30 male individuals between the ages 18-29 were included and intervention involved dynamic scapular muscle strengthening exercise targeting the scapular stabilizing muscle over duration of 4 weeks and pre and post intervention grip strength were measured using a sphygmomanometer and compared using paired t-test and the results were extremely significant and concluded that it significantly increased grip strength in young adults.[16]
- **Sethi K et al (2018)** did a study on scapular muscle strengthening on pain, functional outcome and muscle activity in chronic lateral epicondylalgia, a randomized control trail where 26 patients were divided into 2 groups. Group 1 received scapular muscle strengthening along with conventional physiotherapy and group 2 received conventional physiotherapy for 6 weeks. The results revealed that there was statistically significant difference for time effect for all the outcome measures and concluded the scapular muscle strengthening should be used along with conventional physiotherapy in individuals with chronic lateral epicondylitis.[18]
- **Majeedkutty NA et al (2016)** studied effects of therapeutic eccentric exercises on pain and grip strength in persons with LE- A randomized controlled trail where 24 subjects (11 men and 13 women) were enrolled randomized and sub divided into controlled group received standard physical therapy and experimental group to therapeutic eccentric exercises plus standard physical therapy for 4 weeks of treatment. VAS, grip strength were the outcome and showed significant difference in the experimental group and thus concluded eccentric exercises is more effective.[19]
- **Meenakshi Sharma et al (2015)** studied the effect of rotator cuff strengthening to therapeutic ultra sound and wrist extensors eccentric exercise for lateral epicondylitis a randomized control clinicaltrial. Patients with lateral elbow pain for atleast 4 weeks between 30-60 years were considered and 30 were included in the study and treatment were given for 3 weeks. Group 1 received ultrasound and eccentric exercises for the wrist and group 2 in addition received rotator cuff strengthening and the results showed significant difference in pain free strength in group 2 and concluded adding rotatorcuff strengthening improved pain free grip strength in patients with lateral epicondylitis.[1]
- **Kobesova A et al (2014)** studied the effects of shoulder girdle dynamic stabilization exercise on the hand muscle strength a randomized controlled trail was done to determine hand grip and tripod pinch strength was measured in 20 healthy volunteers weekly over 6 weeks .The training consisted of 6 specific dynamic neuromuscular stabilization exercise performed 5 times per week .The exercise were designed to obtain maximum joint stability within the shoulder and the result was that the training group showed significant improvement relative to the control group on all measures of hand muscle strength and concluded shoulder girdle exercises based on dynamic neuro musculature stabilization may generate clinically significant gains in hand muscle strength.[13]
- **Bhargava AS et al (2010)** studied grip strength at two different wrist positions in chronic LE- comparison of involved vs uninvolved side in athletes and non-athletes a case control study where 22 non-athletes were given jamar hand dynamometer in kilograms force at 15 degree and 35 degree with unilateral lateral epicondylitis at least 3 months duration. The pain was to be elicited with local tenderness and 2 or 3 tests being positive.

Cozen's tests, mill's manoeuvre, resisted middle finger extension tests and result showed statistically significant greater grip strength was found in 15-degree wrist extension than at 35 degree and concluded the grip strength was greater 15-degree wrist extension position.[8]

- **Lee S et al (2014)** studied changes in pain, dysfunction and grip strength of patient with acute lateral epicondylitis caused by frequency of physical therapy: A Randomized controlled trail where the subjects were divided into three, all groups received conventional physical therapy for 40 minutesand therapeutic exercises for 20 minutes per session during 6 weeks ,VAS , PRTEE and grip strength were the outcome measures resulted significant decrease in VAS, PRTEE and concluded the most effective treatment frequency.[20]
- **Dorf ER et al (2007)** studied the effect of elbow position on grip strength in the evaluation of lateral epicondylitis evaluated the maximum grip strength in a position of elbow extension versus flexion of a patient with suspected lateral epicondylitis and identified 81 patients of grip strength with the elbow in full extension and the elbow in 90 degree of flexion for the affected and the healthy extremity and then compared 2 values were compared with paired and unpaired 2-tailed and the result told that the grip strength was no different in flexion and extension for the healthy extremityand 29% stronger in flexion than in extension for the affected extremity. The differences were statistically significant. An 8% differences in grip strength between flexion and extension was foundto be 83% accurate in distinguishing the affected from the unaffected extremities and concluded that the measurement of extension grip strength is a useful objective tool to aid in the diagnosis of lateral epicondylitis.[21]
- **Alizadehkhaiyat O et al (2007)** studied upper limb muscle imbalance in tennis elbow. A functional and electromyographic assessment. There were 16 patients who were clinically diagnosed with tennis elbow were compared with 16 control subjects with no history of upper limb musculoskeletal problem and muscle strength was measured for grip, metacarpo-phalengeal wrist and shoulder on both sides. In tennis elbow compared to control, hand/wrist and shoulder strength and extensor carpi radialis activity were reduced ($p<0.05$), while fatigue was normal. Activation imbalance among forearm muscle in tennis elbow, probably due to protective pain-realted inhibition, could lead to a widespread limb muscle imbalance.[22]

3. METHODOLOGY

4. SOURCE OF DATA

Students from klr College of Physiotherapy, paloncha.

RECRUITMENT:

Subjects who are fulfilling the inclusion criteria will be examined and then recruited for the study.

METHOD OF DATA COLLECTION:

Research design: Randomized controlled trial

Study type: An Experimental study

Target population: Athletes with Lateral epicondylitis

Study duration: 12 months

Study enrolment: March 2021 –March 2022

Sampling design: Simple random sampling

Sampling method: Purposive sampling

Randomization: Lottery method

Sample size: 30

Sample size formula:

$$n = \frac{N \times X}{(N + X - 1)}$$

Where X= X= $\frac{Z^2 \times \sigma^2}{(MOE)^2}$

Where;

Z= Z score

MOE= Margin of Error

σ^2= Assumed Population standard deviation
N=Assumed population size

Based on 5% alpha, 80% power and effect size of 0.55 the sample size required for 2 groups is 30 that is 15in each group.

SELECTION CRITERIA:

INCLUSION CRITERIA

1. Age 18- 25 years
2. Both genders
3. Symptoms of LE from at least past 3 months
4. Pain greater than 3 on NPRS on lateral epicondyle when palpated.
5. Pain in at least two of the following three tests, Cozen's test, Maudsley's test, Mill's test in the dominanthand.
6. Right-hand dominance.

EXCLUSION CRITERIA:

1. Dysfunction in the shoulder, neck or thoracic region.
2. Local or generalized neurological deficit
3. History of surgery in the affected elbow
4. Undergone any treatment for LE in the past 4 weeks.

OUTCOME MEASURES

1. NPRS(Numeric pain rating scale)

The pain was assessed using a numeric pain rating scale (NPRS) which is a valid and reliable scale to measure pain. The NPRS was anchored by terms describing pain severity extremes, scores range from 0-10 integers, the best reflects the intensity of his/her pain

2. LSST(Lateral scapular slide test)

To measure static scapular positions lateral scapular slide test (LSST) was used. LSST had shown good test- retest and inter tester reliability. For test position 1 of the LSST 1, the subjects were asked to keep the upper extremities in a neutral position. For test position 2 (LSST2), the subjects were asked to place both hands onthe ipsilateral hips, placing upper extremities in medial rotation at 45^0 of abduction. In test position 3 (LSST3), the subjects were asked to extend both elbows and to elevate and maximally internally rotate both upper extremities to 90^0. The distance between the inferior angle of the scapula and the closest spinous process in the same horizontal plane was measured bilaterally using inch tape and the difference between the bilateral distances was recorded for all the three positions

3. Pain-free grip strength

It was measured in a sitting position in a sitting position using a Jamar handgrip dynamometer. The shoulder was kept in adduction and neutral rotation, elbow flexed at 90^0 forearms in the neutral position, and 15^0 of wrist extension and were instructed to squeeze the dynamometer handles until they experienced pain. It was performed three times and 20s rest period between repetitions.

MATERIALS TO BE USED:

1. Jamar dynamometer
2. Inch tape
3. Ultrasound machine

Stadiometer

Electronic weighing scale

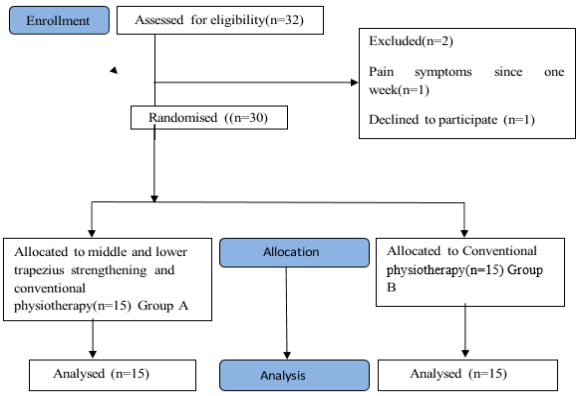
Method

The athletes were approached to meet the inclusion criteria. They have explained the purpose of the

study. After examining, eligible subjects were allocated to group A and group B using the lottery method for randomization. After allotting them to the groups, basic pain assessment on a numeric pain rating scale (NPRS) was taken. After this outcome measures (Lateral scapular slide test, Pain-free grip strength) was taken and the treatment was given 3times per week for 4 weeks.

PROCEDURE

STUDY PROFILE



(**Fig 6**)

Athletes with lateral epicondylitis will be recruited from different colleges of Klr College Athletes will be randomly divided into two groups. Group A will be given strengthening exercises of middle and lower fibers of the trapezius and conventional treatment. Group B will be given only conventional treatment. Both groups will be received treatment for 3 days a week for a total duration of 4 weeks. Pre and Post measurements were taken after the intervention.

INTERVENTION:

Scapular Muscle Strengthening:

The patients in group a received scapular muscle strengthening exercises along with conventional physiotherapy.

It is the exercise given to strengthen the middle and lower trapezius in a functional overhead position. The subject is asked to bring her back against the wall and shoulders are in 90^0 of external rotation at 90^0 of abduction. Then he contracts the middle and lower trapezius, focusing on quality and control of activation without compensation of the upper trapezius. He simultaneously slides his hands up the wall as far as he can, while keeping his back, elbows, and wrists against the wall.

Exercise to strengthen the middle and lower trapezius muscles using a short lever arm for resistance. The subject is asked to contract the middle and lower trapezius muscles, focusing on quality and control of activation without the compensatory use of the upper trapezius and posterior-deltoid muscles and he is askedto lift the elbows toward the ceiling.

Exercise to strengthen the middle trapezius muscle using a long lever arm for resistance. The subject is asked to contract the middle trapezius muscle, focusing on quality and control of the activation without the compensatory use of the upper trapezius and posterior deltoid muscles. With the elbows straight, the subject retracts and adducts his scapulae, lifting his arms toward the ceiling.
The frequency of the exercise was given 3 times per week and the intensity was 3 sets of 10 repetitions and duration was for 4 weeks

Conventional Treatment:

- □ Conventional treatment was received by both the groups and it included pulsedultrasound (8 min 1 MHZ 2w/cm2)
- □ Forearm muscle stretching done with the elbow in extension, forearm in pronation, and wrist in flexion and with ulnar deviation(4 times per session,30-45s hold with the 30srest interval)
- □ Eccentric exercise for wrist extensors done with the elbow supported in full extension, forearm in pronation, wrist in an extended position, and the hand hanging over the edge of the table.

Eccentric exercise for wrist extensors done with the elbow supported in full extension, forearm in pronation, wrist in extended position, and the hand hanging and subject was asked to flex the wrist slowly until full flexion was achieved and then returned to the starting position passively(3sets x10 repetitions,1min rest interval between each set)

STATISTICAL ANALYSIS:

Test: t-test

Data analysis

The data was collected and all the variables and their characteristics were described using tables and graphs. Both descriptive and inferential statistical analysis was done using the SPSS software version 21. All statistical tests were

performed at 5% alpha and 80% power and a p-value of less than 0.05 considered to be statistical significance. The data was entered and coded into software SPSS 21(Statistical Package for Social Sciences) in windows. Descriptive analysis was done by finding the mean and standard deviation of all the grouped variables. The data was then subjected to a test for normality.

Sample Size of Estimation:

Sample size formula:

$$n = \frac{N \times X}{(N + X - 1)}$$

Where X= $X = \frac{Z^2 \times \sigma^2}{(MOE)^2}$

Where;

Z= Z score

MOE= Margin of Error

σ^2= Assumed Population standard deviation

N=Assumed population size

Based on 5% alpha, 80% power and effect size of 0.55 the sample size required for 2 groups is 30 that is 15in each group.

5. DISCUSSION

This randomized controlled trial is designated to evaluate the effect of middle and lower trapezius strengthening on grip strength in athletes with lateral epicondylitis. In this study Group a received strengthening exercises of middle and lower fibers of the trapezius and conventional treatment and Group B received only conventional therapy.

The analysis of the data obtained had no significant difference in age and gender between the groups which indicates that the age and gender of the patients were equally distributed according to the groups. Also, the analysis showed a significant difference in the Body Mass Index (BMI) shows the non-equal distribution between the groups which gives no reasoning and significance could have occurred on purpose. Between the groups analysis of pre and post values for all three outcomes (NPRS, LSST, and PFGs) showed a highly significant difference in pain and pain-free grip strength and less for LSST.

The present study was found to be supported by a randomized controlled trial on scapular muscle strengthening on pain, functional outcome and muscle activity in chronic lateral epicondylalgia by **Sethi K et al**. The author analyzed with different outcome measures that included pain, pain-free grip strength, patient-rated tennis elbow evaluation questionnaire, scapular muscle strength, scapular position, and electromyography. The study revealed significant improvement for all the outcome measures except for scapular position (LSST3). The possible reason given by the author is the limitation that there was no followup for the study. No patients reported any severe adverse effects during the exercise period and few of the subjects reported muscle soreness after the exercise and concluded to investigate the long term effect of scapular muscle strengthening in chronic LE.

In the present study, there was a significant difference in the grip strength when the between-group analysis was done. This was found to be supported by **Bhargava AS et al** who conducted a case-control study to compare the grip strength in athletes with LE in two different wrist positions and compare them between involved and uninvolved sides of athletes and non-athletes. It showed that the grip strength is reduced inchronic LE. The result showed statistically significant greater grip strength that was found in 15-degree wrist Extension as muscle activity of the extensor muscle was found to be less at this position and 35 degrees of wrist extension was found to be the self-selected position for the optimum grip strength. The difference in the grip strength in the involved side between the athletes and the non-athletes was very highly significant. The reason could be due to the heterogeneity in the subject characteristics based on gender and the type of sports. The statistics results showed higher grip strength. This result is consistent with the studies in the normal population. Moreover, the effect of neural adaptation, improved coordination and muscle strengthseen in the athletes may have also influenced the results to some extent.

The above study and the present study were also superimposed by a randomized controlled trial performed by **Majeedkutty NA et al** on the effects of therapeutic eccentric exercise on pain and grip strength in persons with the lateral epicondylitis-A randomized controlled trial. In this study, 24 subjects enrolled, randomized, and subdivided into 2 groups and evaluated at baseline and after 4 weeks of treatment. Control group received standard physical therapy and participants

of the experimental group were subjected to therapeutic eccentric along with standard physical therapy. The experimental group showed a significant improvement that therapeutic eccentric exercises are more effective in reducing pain and improving grip strength in persons with lateral epicondylitis than standard physical therapy. The small-sized of the sample was a limitation and no long term follow-up data was collected past 4-weeks therefore the long term effects of the interventions in the present study remain unknown and concluded that persons with LE procured more substantial benefits in reducing pain and improving grip strength by adding therapeutic eccentric exercises to standard physical therapy and this should be considered in the management of the people with LE.

This study was proved controversial by a case report by **Bhatt JB et al** on middle and lower trapezius strengthening for the management of lateral epicondylalgia, the patient was a 54-year-old woman diagnosed lateral elbow tendinopathy. The patient also demonstrated weakness in her middle and lower trapezius muscle. Based on improved grip strength and reduced associated elbow pain when tested with the scapula manually corrected in a more adducted position treatment focused solely on the strengthening of the middle and lower trapezius muscle over 10 weeks. Following the intervention, the patient presented with an improved scapular position, with the medial border of the scapula bring 9cm lateral to the mid-thoracic spine. The patient scores on the disabilities of the arm, shoulder, and hand questionnaire also improved and the result of this case report suggests that assessment and treatment of the scapular musculature warrant consideration in the management of the individuals with LE. While acknowledging the limitations of these data, the scapula could serve as a stable base from which 2 joint muscles in the upper extremity may work more efficiently and in conclusion, the patient responded well to an intervention solely targeting the musclesof the shoulder girdle.

The present study was also contradicted by a study on the effect of elbow position on grip strength in the evaluation of the lateral epicondylitis done by **Dorf ER et al** Identified 81 patients with grip strength measurements and the diagnosis of LE, collected grip-strength measurements with the elbow in full extension and with the elbow in 90 degrees of flexion for the affected and the healthy extremity and then compared 2 values. The result showed grip strength was no different in flexion and extension for the healthy extremity and the drawbacks were that there was selection bias from our patient population, the patients have failed on or multiple therapeutic modalities. Besides, the extremities were chosen retrospectively based on the diagnosis of LE. The study lacked control data. There was no evaluation of the effect of elbow position on grip strength in patients who ultimately were found to have other conditions and concluded the measurement of extension grip strength is a useful objective tool to aid in the diagnosis of LE as the grip strength decreases as one moves from a position of flexion to a position of extension.

LIMITATION:

- The size of the group was smaller
- The follow-up for symptoms was not followed by the patient
- There proper investigation of the long-term effect of middle and lower trapezius strengthening inathletes with lateral epicondylitis was not followed.

6. CONCLUSION

Based on the study result, it is concluded that the middle and lower trapezius muscle strengthening should be used along with the conventional physiotherapy in athletes with lateral epicondylitis to improve pain,pain- free grip strength, muscle strength, scapular position, and muscle activity.

FUTURE SCOPE:

- More studies can be undertaken with a larger sample size
- The study has significant clinical implications and develops a comprehensive treatment approacheswith leads to better results
- The Implication of middle and lower trapezius strengthening decreases the recurrence rate of LateralEpicondylitis.

7. SUMMARY

This study was undertaken to evaluate the effect of middle and lower trapezius strengthening on grip strength in athletes with LE. This study shows a significant improvement in pre and post values of pain, scapular muscle strength, and grip strength when compared between the groups. But when compared within the group the improvement was similar and showed no significant difference.

8. RESULTS

Data analysis

Both descriptive and inferential statistical analysis was done using the SPSS software version 21. All statistical tests were performed at 5% alpha and 80% power and a p-value of less than 0.05 considered to be statistical significance.

Descriptive statistics

The categorical data were presented in the form of frequency and percentage, qualitative and quantitativedata were mean and standard deviation.

Inferential statistics:

- Baseline characteristics comparison for categorical variables using chi-square test and quantityvariables using independent t-test.
- The within and between-groups difference in the outcomes was analyzed by using the paired andindependent t-test respectively.

Baseline comparison of outcome measures

There was no significant difference seen in the groups when they were analyzed for baseline characteristics for all variables between the groups in demographic data except for BMI. Table 1& 2

Table 1: Between-group comparison of Body Mass Index score using independent t-test

Variables	Group A		Group B		Difference	p.value
	Mean	± SD	Mean	± SD		
BMI	21.33	1.54	23.07	1.49	-1.73	.004

The above table describes the baseline values of BMI. The 30 subjects were equally distributed among 2 groups. THE mean BMI of participants in group A is 21.33 with a standard deviation of 1.54, while in groupB, the mean BMI is 23.07 with a standard deviation of 1.49. Since the p-value is .004 ($p<0.05$) shows the nonequal distribution between the groups which gives no reasoning and significance could have occurred onpurpose.

Mean	Group A	Group B
Age	18.46	19.2

The above table describes the mean age participants of group A is 18.46 and mean age participants of group Bis 19.2.

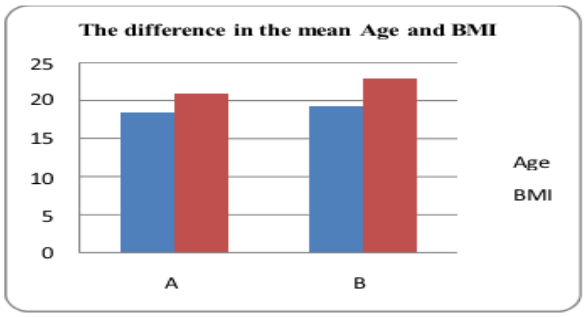


Table 2: Between the group comparison of baseline outcome measures

Variables	Group A		Group B		Difference	p.value
	Mean	± SD	Mean	± SD		
Grip strength	35.74	6.39	34.00	7.28	1.74	.493
Pain	6.20	1.15	6.00	0.76	0.20	.578
ZeroAPreR	8.65	1.74	8.51	2.02	0.13	.848
FortypreR	8.82	1.90	8.69	2.19	0.13	.867
NinetyPreR	9.22	2.37	8.83	2.23	0.39	.649
zeropreL	8.69	1.98	8.67	1.80	0.01	.985
FortyPreL	8.77	2.02	8.96	2.10	-0.19	.806
NinetyPreL	8.99	2.22	9.11	2.24	-0.11	.890

Table 2 shows a comparison of baseline data for each outcome measure (Pain-free grip strength, Numeric pain rating scale, and Lateral scapular slide test) and $p > 0.05$ which indicates equal distribution in both the groups.

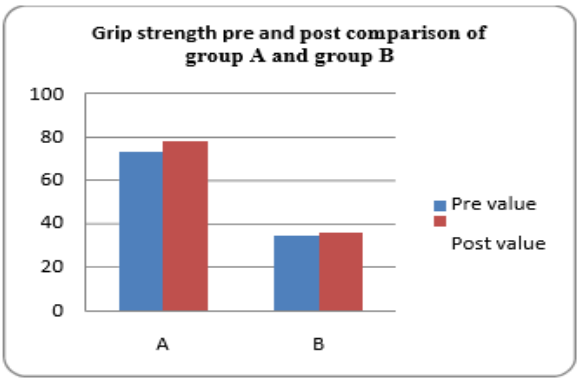
The mean of grip strength of participants in group A is 35.74 with a standard deviation of 6.39 and in groupB is 34.00 with a standard deviation of 7.28 and the p-value is .493 which showed statistically insignificant difference with the p-value >.005.

The mean of the pain of participants in group A is 6.20 with a standard deviation of 1.15 and in group B is 6.00 with a standard deviation 0.76 and the p-value is .578 which showed statistically insignificant difference with the p-value >.005.

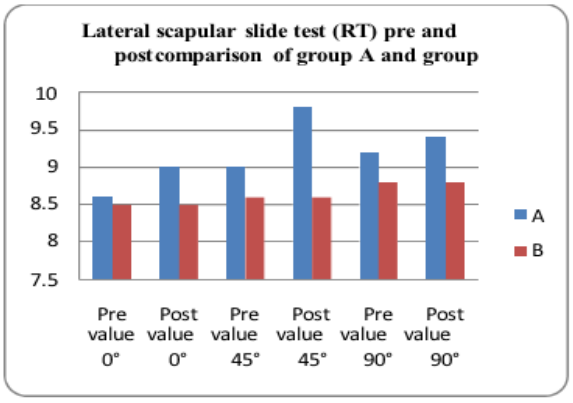
The mean of the Lateral scapular slide test of the right side of group A (LSST1) is 8.65 with a standard deviation of 1.74 and group B LSST1 is 8.51 with a standard deviation of 2.02 and the p-value is .848 showed statistically insignificant difference with the p-value >.005.

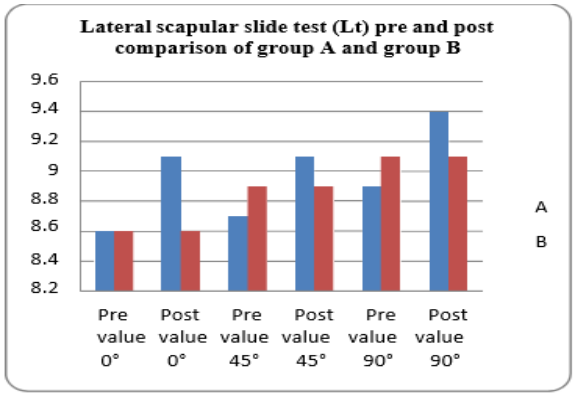
The group A mean of LSST2 is 8.82 with a standard deviation of 1.90 and group B is 8.69 with a standard deviation of 2.19 and the p-value is .867 showed statistically insignificant difference with the p-value >.005. The group A mean of LSST3 is 9.22 with a standard deviation of 2.37 and group B is 8.83 with a standard deviation of 2.23 and the p-value is .649 showed statistically insignificant difference with the p-value >.005.

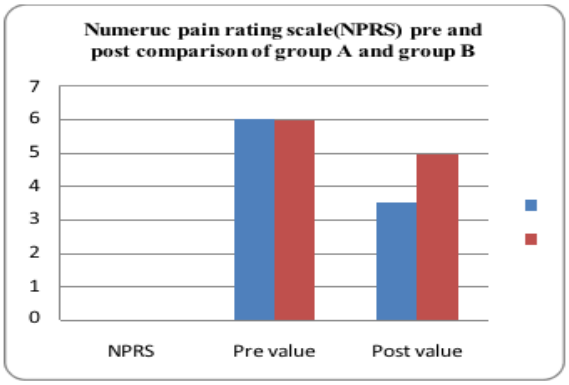
The mean of lateral scapular slide test of the left side of group A (LSST1) is 8.69 with a standard deviation of 1.98 and group B is 8.67 with a standard deviation of 1.80 and the p-value is .985 showed statistically insignificant difference with the p-value >.005. The group A mean value of LSST2 is 8.77 with a standard deviation of 2.02 and group B is 8.96 with a standard deviation of 2.10 and the p-value is .806 showed statistically insignificant difference with the p-value >.005. The group A mean value of LSST3 is 8.99 with a standard deviation 2.22 and group B is 9.11 with a standard deviation of 2.24 and the p-value is .890 showed a statistically insignificant difference with the p-value >.005.



Group A –Strengthening exercises of middle and lower fibers of trapezius and conventional treatment. **Group B** - Conventional treatment







Between-group comparison

Between the group comparison for Pre and Post values is performed and showed a significant difference in pain and LSST ($p<0.005$) and grip strength showed no significant difference

Table 3: Between- group comparison of outcome measures using independent t-test

Outcome measures	Average improvement score: Mean (SD)		Difference (SED)	t-value	p.value
	Group A	Group B			
Grip strength	41.86 (8.86)	38.80 (12.38)	3.06(3.93)	.779	.443
Pain	2.67 (1.29)	1.07 (1.03)	1.60(0.43)	3.748	.001
LSST change at					
0 degree right	-0.39 (0.49)	0.00 (0.00)	-0.39(0.13)	-3.087	.005
45 degree right	-0.26 (0.26)	0.00 (0.00)	-0.26(0.07)	-3.853	.001
90 degree right	-0.44 (0.64)	0.00 (0.00)	-0.44(0.17)	-2.648	.013
0 degree left	-0.18 (0.26)	0.00 (0.00)	-0.18 (0.07)	-2.685	.012
45 degree left	-0.41 (0.54)	0.00 (0.00)	-0.41(0.14)	-2.914	.007
90 degree left	-0.75 (1.00)	-0.43 (0.63)	-0.31(0.30)	-1.027	.313

In the above table between the groups comparison for Pre and Post values of all the outcome measures is performed. The mean value of group A, grip strength is 41.86 with a Standard deviation of 8.86 and the mean value of group B is 38.80 with a standard deviation of 12.38 and the p-value is .443 which showed statistically insignificant difference with the p- value>.005.

The mean value of Pain for group A is 2.67 with a standard deviation of 1.29, while that of group meanvalue is 1.07 with a standard deviation of 1.03 and the p-value is .001 which showed a highly significant difference with the p-value <.005.

The LSST2 group A and group B right side showed a high statistically significant difference with the p- value .001($p<005$). Whereas the rest of the LSST values showed insignificant difference with the value where $p >.005$.

Thus, the results showed a highly significant difference in pain ($p=0.001$) also there was a significantdifference in LSST value ($p<0.005$) but

grip strength showed no significant difference.

Within-group comparison

Within the group analysis for Pre and Post comparison showed a significant difference in group A($p < 0.005$) and no proper difference in group B ($p > 0.005$). Table 4

Table 4: Change of outcome scores within Group A

Outcome measure		Mean (SD) change score		t-value	p-value
		Pre	Post		
LSST change at	0 degree right	8.65(1.74)	9.04(1.76)	-3.087	.008
	45 degree right	8.82(1.90)	9.08(1.86)	-3.853	.002
	90 degree right	9.22(2.37)	9.40(2.29)	-2.685	.018
	0 degree left	8.69(1.98)	9.18(1.88)	-2.09	.055
	45 degree left	8.77(2.02)	9.18(1.90)	-2.914	.011
	90 degree left	8.99(2.22)	9.43(1.99)	-2.648	.019
Grip Strength		35.74(6.39)	77.60(7.54)	-18.29	.000
NPRS		6.20(1.15)	3.53(1.19)	8.000	.000

Table 5: Change of outcome scores within Group B

Outcome measure		Mean (SD) change score		t-value	p-value
		Pre	Post		
LSST change at	0 degree right	8.51 (2.02)	8.51 (2.02)	-3.087	.008
	45 degree right	8.69 (2.19)	8.69 (2.19)	-2.914	.055
	90 degree right	8.83 (2.23)	8.69 (2.19)	-2.685	.077
	0 degree left	8.67 (1.80)	8.67 (1.80)	-2.095	.090
	45 degree left	8.96 (2.10)	8.96 (2.10)	-2.648	.089
	90 degree left	9.11 (2.24)	9.11 (2.24)	-3.853	.093
Grip strength		34.00 (7.28)	72.80 (8.46)	-12.136	.001
NPRS		6.00 (0.76)	4.93 (0.80)	4.000	.000

The above tables indicate within the group analysis for Pre and Post comparison for all the outcome measures. The LSST1 right side of group A pre and post with the p-value .008, LSST3 with the p-value.018, showed a statistically insignificant difference whereas the LSST2 with the p-value .002 showed astatistically significant difference ($p<.005$).

The LSST1 left side of group A pre and post with the p-value .055, LSST2 with the p-value .011, LSST3 with the p-value .019 showed statistically insignificant difference showing p-value >.005

The NPRS and the Pain-free grip strength showed a high statistically significant difference with the p-value<.005.

The within-group analysis for pre and post comparison of group B. The LSST1 right side of group B pre and post with the p-value .008, LSST2 with the p-value .055, and LSST3 with the p-value .077 showed statistically no significant difference as the p-value is <.005.

The LSST1 left side of the group B pre and post values with the p-value .090, LSST2 with the p-value .089, LSST3 with the p-value.093 showed statistically insignificant difference showing p-value >.005

The NPRS showed a statistically significant difference with the p-value <.005 and also the pain-free grip strength with the p-value <.001 showed a statistically significant difference with the p-value <.005.

Thus, the values showed significant differences but showed a highly significant difference in pain level andgrip strength ($p < 0.005$) within the group A. Also, the results showed that there is no significant difference in the group B values of LSST test but gave a significant difference in values of pain and grip strength ($p < 0.005$).

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