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Original Research Article

Effect of Adding Rotator Cuff Strengthening To Therapeutic Ultrasound and Wrist Extensor Eccentric Exercise for Lateral Epicondylalgia - A Randomized Clinical Trial

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ABSTRACT

Objectives: To see the effect of adding rotator cuff strengthening exercise to therapeutic ultrasound and wrist extensor eccentric exercise on pain, pain free grip strength, pressure pain threshold and functional activity of the patient with lateral epicondylalgia .

Methodology: Patients with lateral elbow pain for at least 4 weeks between the age group30-60 were included after they fulfilled the criteria for lateral epicondylalgia. 43 patients were screened and finally 30 were included for the study. The included patients received treatment for three weeks, three sessions per week. Group 1 received therapeutic ultrasound and eccentric exercise for the wrist and group 2 in addition received rotator cuff strengthening. Pain on visual analogue scale (VAS), pain free grip strength (PFGS), pressure pain threshold (PPT) and, functional activity of the patient using Patient-rated Tennis Elbow Evaluation Questionnaire (PRTEE) were evaluated.

Results: No significant difference was seen between the two groups .Within group analysis showed significant difference in pain free grip strength in group 2.

Conclusions: Adding rotator cuff strengthening improved pain free grip strength in patients with lateral epicondylalgia but not pain and functional loss.

Key words: Lateral epicondylalgia, rotator cuff strengthening exercises, eccentric exercises, pain free grip strength, function.

INTRODUCTION

Lateral epicondylalgia (LE) or tennis elbow is a painful debilitating musculoskeletal condition [1] with an overall prevalence of 1-3 %. [2] The condition has a significant impact on the society and challenges the health care industry. [1] It is characterized by pain and tenderness over the lateral epicondyle of the humerus and pain on resisted dorsiflexion of the wrist, middle finger, or both and gripping activities. [3]

LE is considered to be due to overuse, over stress or over exertion of the wrist extensors of the forearm. It is often found to be associated with individuals who have repetitive occupations, and/ or hobbies. It mainly affects the dominant hand and primarily occurs between the ages of 35 and 64 years. [4] The origin of the extensor carpi

radialis brevis (ECRB) is most commonly affected though other tendons like extensor carpi radialis longus, extensor digitorum and extensor carpi ulnaris may also be involved. It is a degenerative or failed healing tendon response characterized by the presence of fibroblastic and vascular response, and disorganized collagen. [5,6]

LE can be treated by a number of treatment options, ranging from medical interventions such as surgery, corticosteroid injections, and medication to physical therapy including electrical modalities, exercise, and manual therapy. [7] Conservatively the management of LE is aimed to reduce pain and increase the strength of the wrist extensor tendons. Ultrasound is most commonly used for reduction in pain and inflammation by increasing the blood flow to the site of injury. [8] For strengthening of wrist extensor tendons, studies have suggested that eccentric exercises are more beneficial than concentric exercises. Eccentric exercises causes strengthening by stimulating mechanoreceptors in tenocytes to produce collagen which determines recovery. [9-11]

Also strengthening of the muscles of the proximal shoulder girdle should be focused in the management of LE. Functional impingement of the shoulder due to altered joint mechanism and muscle imbalance can impair the stabilization of the shoulder resulting in overcompensation of the extensors of the wrist. This may lead to micro trauma of the soft tissue structures present at the lateral epicondyle thus causing symptoms of LE. Changes in the shoulder may lead to altered and compensatory changes in the forearm and hand which may overload the muscles of the forearm during repetitive movements, thus causing symptoms of LE. [12]

Thus there is a need to see if addition of rotator cuff strengthening to physiotherapy management can have added benefit in the management of LE. The aim of the study was thus to see the effect of adding rotator cuff strengthening exercise to therapeutic ultrasound and wrist extensor eccentric exercise on LE and see its effect on pain on visual analogue scale(VAS), pain free grip strength(PFGS), pressure pain threshold (PPT) and, functional activity of the patient using Patient-rated Tennis Elbow Evaluation Questionnaire (PRTEE) .

MATERIALS AND METHODS

The study was approved by the Institutional Ethics Committee of Manipal University and was conducted at Physiotherapy department at Kasturba Medical College hospitals Mangalore, Manipal University. In Patients and out patients diagnosed to have LE referred by physician /orthopedic surgeon to physiotherapy department were taken up for the study. Patients were screened for inclusion and exclusion criteria. All the patients with the following inclusion criteria were included for the study; lateral elbow pain for at least 4 weeks, pain severity equal or greater than 30 mm on a 100 mm VAS, pain over the lateral humeral epicondyle provoked by at least two of: gripping, palpation, stretching of forearm extensor muscles and resisted wrist or middle finger extension, age between 30- 60 years and willingness to comply with treatment and follow-up. Patients were excluded if they had concomitant neck pain, that has prevented participation in usual work or required treatment within the last 6 months, exacerbation of elbow pain with neck movements, evidence of any other primary source of lateral elbow pain, ; pain localized over the radiohumeral joint, sensory disturbance in the affected hand, carpal tunnel syndrome, fracture of the upper limb with residual deformity, malignancy or any medical condition which may contraindicate exercise prescription, presence of an

infection at the time of the evaluation, history of elbow surgery, diffuse pain syndrome (fibromyalgia), elbow osteoarthritis, rheumatoid arthritis, or other inflammatory arthritis affecting the wrist or the elbow.

All subjects meeting the selection criteria were given a detailed explanation about the purpose, method, and benefits of the study and a written informed consent was obtained. They were then randomly allocated to two groups. Group 1 received therapeutic ultrasound and eccentric exercise for the wrist and group 2 received therapeutic ultrasound, eccentric exercise for the wrist and rotator cuff strengthening. In both the groups the treatment was given for 3 weeks with 3 sessions per week. Subjects were asked not to take any other form of physiotherapy treatments other than the one which was being given to them. The ultrasound was applied over the lateral epicondyle at a dosage of 3 MHz, 1.5 W/cm2 pulsed mode of 1millisecond on and 4 milliseconds off for 8 minutes. [8] Eccentric exercise was performed by the subjects using yellow FLEXBAR. [10] The Flex Bar exercise was performed for 3 sets of 15 each. Each repetition took 4 seconds to complete, and a 30 second rest between each set of 15 repetitions was given. [11,13] 3 exercises for strengthening of rotator cuff muscles were performed by the patients. 3 sets of 10 repetitions were given to the patient. The patients performed exercises for 9 clinical visits. The exercises were: 1. Supraspinatus: Full can exercise 2. Infraspinatus and Teres minor: Side-lying External rotation with a towel roll between arm and the trunk 3. Subscapularis: IR diagonal exercise. [14] Home program was given to both the groups which consisted of Wrist Extensor Stretch. [15] Outcome measures were taken before starting the physiotherapy intervention and at the end of 1st, 2nd and the 3rd week. All the patients were called up for a telephonic follow up after 12 weeks. They were asked about pain and recurrence of LE.

All statistical analysis was done by using Statistical Package for Social Science (SPSS) version 17.0. The level of significance of <0.05 was considered to be statistically significant with 95% confidence interval. We have analyzed the results according to the method of intention to treat.

To detect any difference between the two groups independent t test was used. For within group comparisons, ANOVA and Bonferroni test were used for VAS, PFGS and PPT. Paired t test was used for within group comparison of PRTEE.

RESULTS

A CONSORT flow diagram Figure1 shows the flow of patients through each stage of the trial.

Both the groups were homogenous with respect to age; Group 1 - 42.6±5.2 years and Group 2 44.6±7.4 years and duration of LE (Group 1 ;8.93±2.92 weeks and Group 2; 17.6±16.05 weeks).

At baseline no significant difference was seen between the two groups with respect to all the outcome measures. Table 1

No significant difference was seen between the two groups on VAS, PFGS, PPT, and PRTEE by end of 3 weeks. Table 2

Within group highly significant difference was seen on VAS, PPT, PRTEE. PFGS significantly improved by the end of 2nd week in group 2 and was maintained till the 3rd week. PFGS did not show any significant improvement in group 1. Table 3

At twelve weeks follow up on the telephone, out of 30 subjects, 26 responded. None of them reported pain and no recurrence by 12th week.

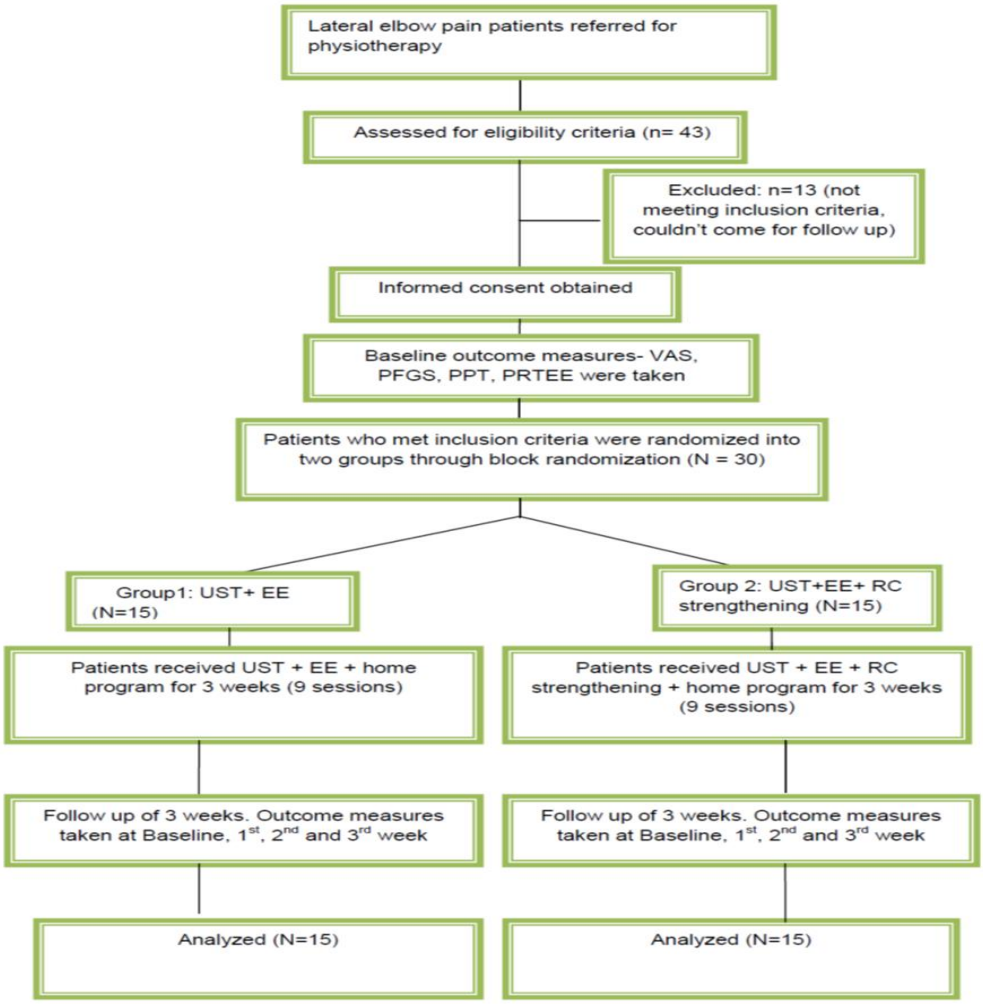

Figure 1: Flow of patients in the study

Table 1: Baseline values of VAS, PFGS, PPT, PRTEE

Variables	**Group 1**	**Group2**	**P value**
VAS(Mean±SD)	7.67±1.18	7.53±.83	.72
PFGS(Mean±SD)	35.330±14.67	37.15±11.44	.38
PPT(Mean±SD)	3.465±1.02	3.26±.92	.58
PRTEE(Mean±SD)	65.70±5.39	67.07±7.14	.56

PFGS in LbF, PPT in LbF
p≤0.05 value significant

Table 2: Values of VAS, PFGS, PPT and PRTEE at the end of 3rd week.

Variables	**Group 1**	**Group 2**	**P value**
VAS(Mean±SD)	1.87±1.41	1.13±.74	0.08
PFGS(Mean±SD)	46.99±14.03	51.38±10.15	0.37
PPT(Mean±SD)	4.84±.99	4.90±.96	0.85
PRTEE(Mean±SD)	31.47±8.98	28.50±6.75	0.32

PFGS in LbF, PPT in LbF
p≤0.05 value significant

Table 3 : Change scores of outcome measures in the two groups

Variables	Groups	1st week	P value	2nd week	P value	3rd week	P value
VAS (Mean± SD)	1	2.87±1.28	0.00*	4.87±.0.94	0.00*	5.8±1.41	0.00*
	2	2.73±0.78	0.00*	5.0±0.64	0.00*	6.4±0.73	0.00*
PFGS (Mean± SD)(LbF)	1	6.0±13.70	1.00	9.84±13.5	0.35	11.67±14.03	0.16
	2	4.91±12.59	1.00	11.29±11.36	0.05*	14.22±10.1	0.00*
PPT (Mean± SD)(LbF)	1	0.50.0±1.03	1.00	1.11±0.91	0.02*	1.37±.99	0.002*
	2	0.76±1.01	0.18	1.29±0.86	0.02*	1.64±0.96	0.00*
PRTEE(Mean± SD)	1	-	-	-	-	34.23±7.5	0.00*
	2	-	-	-	-	38.57±8.1	0.00*

*p≤0.05 is significant

DISCUSSION

This study compared the effectiveness of adding Rotator cuff strengthening exercise to therapeutic ultrasound and wrist extensor eccentric exercise in patients with LE. We hypothesized that adding RC strengthening would result in better pain relief and functional ability compared to patients receiving only therapeutic ultrasound and eccentric exercise. The results showed that there was no added effect of RC strengthening in patients with LE on pain and functional ability but PFGS improved significantly in group 2 which received RC strengthening.

A total of 30 patients were included in our study. The duration of LE in these patients was more than 4 weeks. The mean age of patients in our study was similar to that in other studies. [16,17] Out of 30 patients there were 17 males and 13 females. In most of the other studies, the females were more affected than males. [18,19] The dominant hand was involved in 27 patients which they used for repetitive activities. This is in accordance with the other studies which also reported the involvement of the dominant hand more than the non-dominant one. [15,20,21]

In our study, adding of RC strengthening had no added effect on pain and functional ability. This might be due to the duration of RC strengthening that we gave which was only for 9 sessions (3weeks). RC strengthening should ideally be given for at least 6 weeks in order to achieve positive results. [14] In LE, there is also global shoulder muscle weakness and imbalance in upper limb musculature. [22] Only RC strengthening might not be enough to improve the strength and correct the imbalance in upper limb.

Pain on VAS, PFGS, PPT and PRTEE scores improved after both the treatments but there was no statistical significant difference seen between the two groups($p>0.05$). There was no significant difference in baseline characteristics with respect to age, gender and baseline variables between the two groups so the chances of result getting influenced by all these factors has been reduced.

The decrease in the pain could be due to early resolution of inflammation, increased matrix synthesis, denser collagen fibrils, and increased tissue tensile strength as a result of ultrasound application. [5] A systematic review reported that there is insufficient evidence to either support or refute the use of US as a unimodal treatment for LE but has benefits when added to other treatment like exercise. In our study we added eccentric exercises to the wrist muscles along with ultrasound. [1] Eccentric loading has been recommended specifically in rehabilitation of tendinopathies like LE. [23,24] It is hypothesized that eccentric exercise may inhibit the production of agents that are responsible for producing pain in tendinosis, enhance the mechanical properties of the degenerative tendon, increase the mass of the tendon because of the enhanced deposition of type I collagen and improve neuromuscular control and normalize the loading pattern of the muscle. [5,14,15,24-26]

So, both ultrasound and eccentric exercise could have led to pain reduction which was found to be clinically significant. The MCID for VAS score is 30 mm. In both the groups the MCID exceeded the required value which was 58 mm in group 1 and 64 mm in group 2. Hence both the treatment options seem to be effective in reducing the pain.

The significant improvement seen in PPT in both the groups might be because of the local UST applied and the EE given which might have local effect on the pain threshold at the lateral epicondyle.PPT had significantly improved in one of the studies

with 3 weeks of EE. They hypothesized that repeated low load eccentric exercise resulted in a time dependent increase in PPT post exercise Weeks 3. Low load eccentric exercises lead to many mechanical adaptations which are mediated at various levels and also leads to reduced mechanical sensitivity of the deep tissues thereby increasing the PPT. [23] This implies a gradual adaptation of lateral elbow tissues to repeated low bouts of exercise loading.

One of the main outcome measures in LE is PFGS. Reduction in pain and increased strength might have resulted in improvement of PFGS. It has been noted that proximal muscle strengthening does play a role in the grip strength. [27-30] and the use of hand-grip dynamometry is validated for characterizing upper extremity strength impairment among adults. [31]

It was believed that, during eccentric training, the blood flow is stopped in the area of damage and this leads to neovascularisation, which improves blood flow and healing in the long term. [32,33] This might be the reason for increased in strength and reduced pain accounting for increased PFGS in both the groups.

Adding RC strengthening must have improved the imbalance in shoulder kinematics reducing the overuse of elbow and improving PFGS. [22] Also, it was interesting to note that a significant improvement was seen in group 2 in PFGS at the end of 2 Weeks and not in group 1.. This further shows the effect of proximal muscle strengthening on grip strength. The MCID for PFGS is 11.02 and 13.66 pounds force for the affected dominant and non dominant sides after early stroke. [34] In present study group 1 showed mean improvement in PFGS 11.67 and that in group 2 is 14.93 from baseline to end of 3rd week. Though both groups were clinically significant, group 2 showed better results. We can thus draw inference that adding RC strengthening with UST and EE improves PFGS significantly.

There was no statistical difference seen in PRTEE between the two groups. Both groups improved significantly by the end of 3 weeks. The questionnaire applied in our study aimed to reflect pain in different activities and activity limitation and participation status through pain. The MCID for PRTEE is a reduction of 11 points which was surpassed by both the groups thus showing a significant improvement.

Limitations

Most RCTs on LE have long term follow up which was lacking in present study. Though we did follow up till 12th week but it was subjective and objective follow up is lacking. Due to time constrain we had to limit the sample size to 30. Also, we used yellow Flexbar throughout the study and did not progress the resistance as per the progression that should be done.

CONCLUSION

The result of the present study demonstrated that there was no significant difference on VAS, PFGS, PPT and PRTEE between the two groups. Both the groups significantly improved on VAS, PPT, and PRTEE. On adding RC strengthening, there was significant improvement in PFGS in group 2 which was not seen in group 1. Hence, RC strengthening might help in improving PFGS in patients with LE, though it may not have an effect on pain and functional loss.

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