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Effect of Eccentric versus Concentric Exercise on Pain, Grip Strength and Function in Lateral Epicondylitis - A Comparative Study

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ABSTRACT

Introduction: Lateral epicondylitis is one of the most common overuse syndrome of the extensor tendon of the forearm, characterized by pain limited ROM and affected functional activity. Symptoms mostly occur in gradual in nature. As there is paucity in literature comparing effect of eccentric exercise versus concentric exercise on Pain, Grip strength and Function in the patients of lateral epicondylitis. There was a need to conduct this study to fulfil the gap in available literature.
Material & method: After taking informed written consent form from patients. They were divided into 3 groups by simple random sampling method. Group A receive Eccentric exercise addition to conventional treatment, Group B receive concentric exercise addition to conventional treatment, Group C receive conventional treatment only.
Result: The data was screened for normal distribution using Kolmogorov-Simonov normality test and Shapiro-Wilk test. Wilcoxon Signed Rank test was applied to analyzed pre and post outcome measure within groups. Inter group comparison of NPRS, Grip Strength and PRTEE was done by using one-way ANOVA test. Multiple comparison between all three groups was using Post HOC analysis test. There was statistically significant difference found in NPRS, Grip strength and PRTEE score at the end of 6 weeks in between group analysis ($p<0.05$). While multiple comparison between groups shows that the patients undergone eccentric exercise gained significantly greater improvement in pain, grip strength and function as compared to the patient undergone concentric exercise addition to conventional and control group only.
Conclusion: From the present study, it can be concluded that eccentric exercise and concentric exercise both are effective in lateral epicondylitis but eccentric exercise more effective in pain, grip strength and function in lateral epicondylitis.

Key words: Lateral epicondylitis, eccentric exercises, pain, concentric exercise, ultrasound, grip strength.

Declaration
Ethical approval was obtained from ethical committee & no financial burden was there on patients. Conflicts of interest were not there.

INTRODUCTION

Lateral epicondylitis also known as lateral elbow tendinopathy or Tennis elbow, it is one of the most common overuse syndrome of the extensor tendon of the forearm. [1] Lateral epicondylitis is a frequent cause elbow pain and it affects 1 to 3% of adult population every year. [2]

Lateral epicondylitis is a degenerative or failed healing tendon response characterized by the increase presence of fibroblasts, vascular hyperplasia and disorganized collagen in origin of the extensor carpi radialis brevis (ECRB). The most common affected structure. [3] Tendinous microtrauma in cases of lateral epicondylitis divided into following four stages. [4]

1) Inflammatory, reversible without pathological alterations.
2) Angiofibroblastic degeneration.
3) Tendinosis associated with structural alteration (tendon tear).
4) Fibrosis and calcification.

Lateral epicondylitis is a painful condition affecting the tendinous tissues of the origin of the wrist extensor muscle at the lateral epicondyle of the humerus leading to loss of functions of the affected limb. It is activated by gripping activities. [5-7]

Lateral epicondylitis is most commonly seen in tennis players and hence it is known as "Tennis elbow". It also occurs in non-tennis players because of work related overuse injuries. Musicians, carpenters, assembly line workers and many others whose activities involve supination, pronation, and overuse of finger extensors or lifting the objects with palm down, on almost daily basis are more prone to have lateral epicondylitis. Although lateral epicondylitis can occur at any age, the peak prevalence age is between 30 to 60 years. Both genders are equally affected, but the disorder appears to be of longer duration and severe in females. [7]

The chief complaints in lateral epicondylitis are increased pain, decreased grip strength and functional activities leading to significant affection in activities of daily living. [8] Although the pathology exists in elbow region, patients present with gradual onset of pain on extension movements of the wrist and fingers and supination of forearm. Clinical features are tenderness at the lateral epicondyle, normal elbow range of motion and pain on resisted movements (particularly resisted third finger extension). [9] Although the actual cause of clinical condition remains unknown.

Symptoms of the lateral epicondylitis are almost always gradual onset in nature and rarely being acute-resulting from trauma. The nature and course of conditions lasts from six months to 2 years with favorable results in 80-90% as lateral epicondylitis finally being self-limiting. [9,10]

Risk factors for tendinopathy consists of systemic intrinsic factors include older age related obesity, increase waist circumference, diabetes, hypertension, dyslipidemia and genetic predisposition. Non systemic risk factors include abnormal biomechanics, muscle inflexibility, decreased muscle strength, malalignment and joint laxity. Extrinsic factors consist of mechanical load, training errors like over training. Rapid progression, poor technique, improper equipment and work tasks with repetitive movements. [11]

Lateral epicondylitis is diagnosed by

– Pain at the lateral epicondyle on palpation.
– Pain on passive wrist flexion with elbow extension
– Pain on actively making a fist, pronation forearm, radially deviating and extending the wrist on resisted extension of wrist.
– Pain on resisted middle finger extension and wrist extension.
– Pain on gripping activities.

Recent review articles have addressed the use of patient's history, differential diagnosis, and physical examination in the diagnosis of lateral epicondylitis. [1-3]

Current treatment option in treating lateral epicondylitis consist of physiotherapy – therapeutic US, phonophoresis, electrical stimulation , manipulation, soft tissue mobilization, neural tension, friction massage, augmented soft tissue mobilization (ASTM), extra corporeal shock wave therapy, laser therapy, stretching and strengthening exercise other medical intervention like NSAIDS, orthosis, corticosteroid injection, autologous blood injection, botulinum type A injection and topical nitrate. Surgery recommended when conservative strategies fail to relieve lateral epicondylitis symptoms after 6 to 12 months including open, percutaneous and arthroscopic techniques. [8-10]

Tendon act as a "springs" to make muscle movement more efficient, and their recoil increases with higher load. Healthy

tendon can strengthen easily in response to gradual increase in load, but can fail if the loading increase is too sudden or too great. Sudden overloaded may alter tendon structure leading to degeneration of tendon. [11]

The word lateral epicondylitis is inappropriate as primary pathology is because of collagen disarray rather than inflammation. The primary pathological process involved in this condition is tendinosis of the extensor carpi radialis brevis (ECRB) tendon, usually within 1-2 cm (0.5-1 in.) of its attachment to the common extensor origin at the lateral epicondyle with more appropriate term extensor tendinopathy or lateral elbow tendinopathy. [11] Initial healing response is to form new collagen in the degenerated tendon mainly consisting of type-!!! Collagen whereas tendons are comprised mainly of type-1 collagen. [12]

Eccentric strength training results in increased collagen synthesis by activating mechanoreceptors in tenocyte. There is increased peri-tendinous type-1 collagen main type of collagen in normal tendon following eccentric strength training. [13,14]

In tendon, there is an acute increase in blood flow and collagen synthesis, and long-term effects lead to tissue hypertrophy and altered material properties. The magnitude and type of adaptation likely depend on the exercise regime, including the magnitude of the load, range of motion performed, contraction mode (eccentric lengthening/ concentric shortening). [1]

Eccentric exercise involves lengthening of muscle-tendon unit as load is applied to it. Eccentric exercise promotes tendon healing and alters pain perception from tendon. Eccentric strength training has been found effective in the treating Achilles, Patellar, Rotator cuff and lateral elbow tendinopathies. [13,15]

MATERIAL AND METHODOLOGY

- **Ethical approval:** Ethical approval was obtained from ethical committee
- **Study design:** Comparative study
- **Study setting:** Physiotherapy department.
- **Sample selection:** According to inclusion and exclusion criteria.
- **Sample design:** Lottery method of simple random sampling.
- **Study duration:** 6 weeks
- **Treatment duration:** 6 sessions per week for 6 weeks
- **Sample size:** 39
  - Group - A: 13
  - Group - B: 13
  - Group - C: 13

INCLUSION CRITERIA:

- ✓ Patient who are diagnosed with lateral epicondylitis from orthopedics OPD.
- ✓ Patients who were willing to participate.
- ✓ Age between 30 to 60yrs.
- ✓ Both males and females.
- ✓ Patient able to understand patient related tennis elbow scale and visual analogue scale
- ✓ Patients who are not taking any medicine like pain killers.

EXCLUSION CRITERIA:

- ✓ Any injury or disease around the shoulder, elbow and wrist on affected side
- ✓ Cervical radiculopathy.
- ✓ Local steroid injection.
- ✓ History of fracture of radius, ulna and humerus with resultant deformity of the affected extremity.
- ✓ Contra indication for ultrasound.

MATERIALS

1. Pen
2. Proforma
3. Consent form
4. Ultrasound gel
5. Cotton
6. Sterilizing agent
7. Ultrasound machine
8. Camera
9. Pillow
10. PRTEE scale and NPRS scale score
11. Jamar hydraulic dynamometer

Figure-1 Materials used in this study

OUTCOME MEASURES:

1) NUMERIC PAIN RATING SCALE (NPRS) [16-18]

The NPRS for pain is a unidirectional measure of pain intensity in adults similar to the pain VAS, the NPRS is anchored by terms describing pain severity extremes. The NPRS can be administered verbally (on telephone) or graphically for self-completion.

Reliability: high test-retest reliability (r=0.96)

Validity: for construct validity, the NPRS was shown to be highly correlated to the VAS in patients with rheumatic and other chronic pain conditions (pain>6 months) correlation range from 0.86 to 0.95.

2) PATIENT RATED TENNIS ELBOW EVALUATION SCALE (PRTEE): [19,20]

Patient rated tennis elbow evaluation (PRTEE) scale is a 15-item questionnaire designed to measure forearm pain and disability in patients with lateral epicondylitis. PRTEE allows patients to rate their levels of pain and disability from 0 to 10.

PRTEE consists of two subscales:

a. pain subscale: 5 items (0= no pain, 10= worst imaginable)

b. Function subscale: 10 items

Specific activities: 6 items

Usual activities: 4 items (0=no pain, 10=worst imaginable)

A total score out of 100 is computed by equally weighing the pain score (sum of five items) and function score (sum of ten items, divided by 2). Reliability: The ICC values show excellent values for test-retest reliability ICC values of0.96 and 0.89 were found for the pain subscale in the original questionnaire and 0.92 and0.83 for the function subscale. English version (0.94).

Validity: DASH should be used to assess construct validity, because this is probably the best alternative for the PRTEE, being a validated questionnaire designed to measure upper limb disabilities and symptoms. A moderate correlation was also found between PRTEE and DASH score (0.65).

3) GRIP STRENGTH [21-23]

Jamar grip dynamometer is reliable and valid measurement of grip strength, in order to measure grip strength, patient was asking to sit with both feet on the floor. The arm was adducted with the neutrally rotated shoulder, elbow flexed to 90^0, forearm in neutral position and wrist in slight extension and ulnar deviation. Each patient was instructed to breath in thought nose and blow out through pursed lips as a maximum grip effort was made. At this time, a verbal command of "squeeze! Harder! Relax! Relax! was given. There trial was taken with rest of the 1 minute in between and mean score of the trials was calculated for data analysis.

Figure-2 Measurement of Max. Grip Strength

PROCEDURE

After taking necessary ethical approval from the institutional ethical committee, the patients coming to physiotherapy department on OPD basis were selected according to inclusion and exclusion criteria. All the patients were informed

about the nature and purpose of the study. Written informed consent was taken from all the patients.

After obtaining consent, the patients were divided into 3 groups by simple random sampling method. Treatment was given 6 sessions per week for 6 weeks.

GROUP A: CONVENTIONAL TREATMENT

Patient in both groups were given conventional physiotherapy in form of stretching, active movements, ultrasound therapy

STRETCHING OF WRIST EXTENSORS

Patients in both the groups were given conventional physiotherapy in the form of Stretching. Stretching was applied with patient in supine line, elbow in extension, forearm in pronation, wrist in flexion and in ulnar deviation, according to patient tolerance. This position is held for 30 secs. 3 repetitions were given before the exercise and the reminder 3 repetitions were given after the exercise during single treatment session. [24]

Figure-3 Stretching of Wrist Extensors

ACTIVE RANGE OF MOTION EXERCISE

Active range of motion exercise was given with patient in supine position with elbow supported on plinth. Patient was asked to move the wrist in flexion and extension in full range with 3 sets of 10 repetitions. Speed and rhythm was slow at starting of exercise and was increased according to tolerance of the patient. [25]

ULTRASONUND:

Ultrasound therapy was around the origin of extensor carpi radialis brevis on lateral epicondyle of affected elbow with forearm in 90 of flexion with support. Treatment was in "pulsed' with an on to off ratio of 1:4 and a frequency of 1Mhz and will be given using coupling medium. The intensity given was 1W/cm^2 and treatment time for 8 minutes during the course of treatment. [26]

Frequency: 1Mhz
Pulse ultrasound: 1:4
Intensity: 1 W/cm^2
Duration: 8min

Figere-4 US given to the patient

ECCENTRIC EXERCISE:

Eccentric strengthening exercise was performed with free weights (which were decided by the 10 RM) with patient in the seated position with full elbow extension, forearm pronation, and maximum wrist extension. From this position, the patient slowly lowers wrist into flexion for a count of 30, use the contra lateral hand to return the wrist to maximum extension. Patients were instructed to continue the exercise even when they experienced mild discomfort and to stop the exercise if the pain worsens and becomes disabling. For whom the eccentric exercise could be performed without minor discomfort or pain, the load was increased using free weights based on the patients 10RM (Repetition Maximum). Three sets of ten repetitions were performed during each treatment, with a 1 min rest interval between each set. [3,12]

Dosage:
Warm-up: with wrist movement without any load for 2-3 minutes
Repetition: Starting from 5till 15
Sets: 3 (each time during treatment)

Frequency: once in a day, 6 days per week except Sunday Duration: 6 weeks

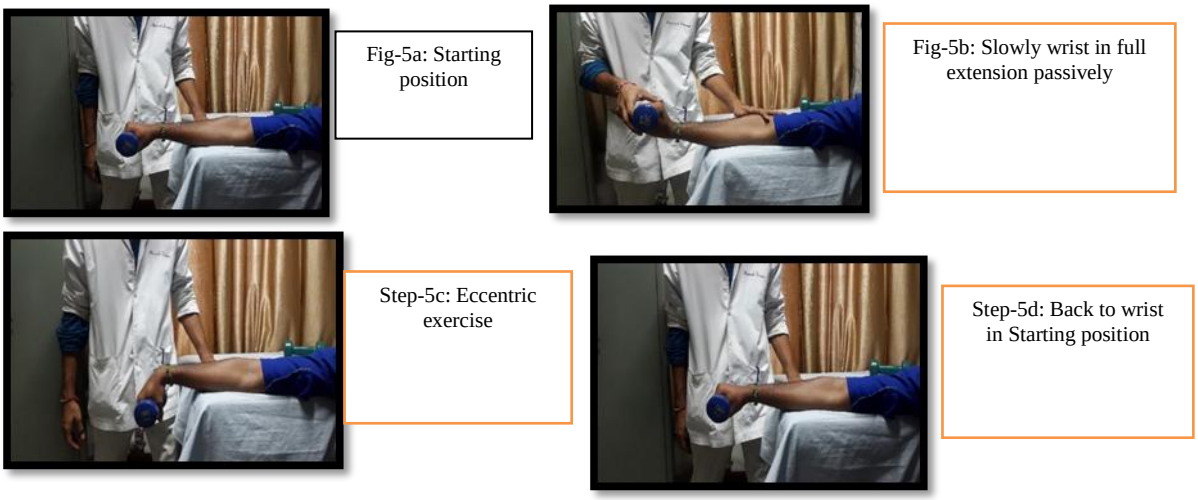

Figure 5: Application of Eccentric exercise of wrist extensors

CONCENTRIC EXERCISE

Concentric strengthening exercise was performed with free weights (which were decided by the 10 RM) with patient in the seated position with full elbow 90^0 flexion, forearm pronation and wrist in neutral position. From this position, the patient slowly wrist into maximum extension for a count of 30, use the contra lateral hand to return the wrist to in flexion. Patients were instructed to continue the exercise even when they experienced mild discomfort and to stop the exercise if the pain worsens and becomes disabling. For whom the concentric exercise could be performed without minor discomfort or pain, the load was increased using free weights based on the patients 10RM (Repetition Maximum). Three sets of ten repetitions were performed during each treatment, with a one-minute rest interval between each set. [3]

Warm up with wrist movement without any load for 2-3 min
Repetitions: starting from 5 till 15
Sets: 3(each time during treatment)
Frequency: once in a day, 6 days per week except Sunday
Duration: 6 weeks

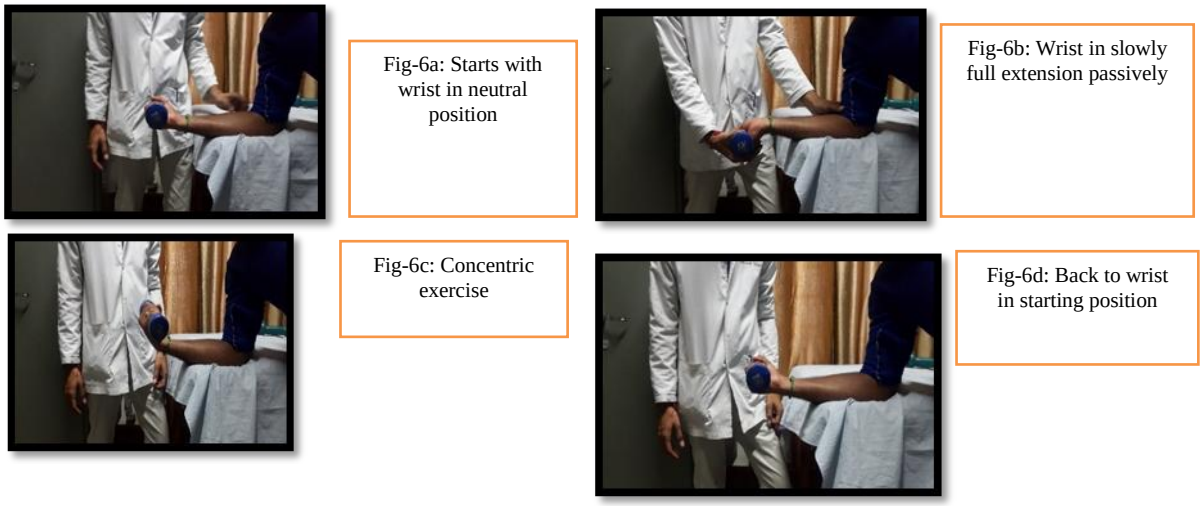

Figure 6: Application of concentric exercise of wrist extensors

RESULT

The data was screened for normal distribution using Kolmogorov-Simonov normality test and Shapiro-Wilk test. Within group analysis was done by Wilcoxon Signed Rank test. Inter group comparison of NPRS, Grip Strength and PRTEE was done by using one-way ANOVA test. Multiple comparison between all three groups was using Post HOC analysis test.

Kolmogorov-Simonov normality test and Shapiro-Wilk test was applied to compare the baseline characteristics of the patients in all groups.

No statistically significant found between all the groups.

TABLE-1: Baseline Data.

Variable	Total (n=39)	Group-A	Group-B	Group-C	p- value
	Mean	Mean (SD)	Mean (SD)	Mean (SD)	
Age (year)	39.81	40.23	39.61	39.61	>0.05
Gender	39	M-6, F-7	M-6, F-7	M-5, F-8	
Side	39	D-8, ND-5	D-9, ND-4	D-9, ND-4	

TABLE-2: Baseline Data for All Outcome Measure.

OUTCOME	Total (n=39)	Group-A	Group-B	Group-C	p- value
	Mean	Mean (SD)	Mean (SD)	Mean (SD)	
NPRS	6.38	6.38(±1.04)	6.30(±1.03)	6.46(±0.87)	>0.05
Grip strength	28.07	28.15(±7.79)	28.00(±7.75)	28.07(±7.73)	>0.05
PRTEE Score	62.2	66.30(±12.03)	58.38(±13.67)	61.92(±18.55)	>0.05

Table-3: Gender distribution in all the groups.

GENDER	GROUP A	GROUP B	GROUP C	TOTAL
MALE	**6**	**6**	**5**	**17**
FEMALE	**7**	**7**	**8**	**22**

Table-4: Mean age of patients in year

GROUPS	MEAN AGE (IN YEARS)	±SD
GROUP A	40.23	±3.98
GROUP B	39.61	±3.59
GROUP C	39.61	±4.25

Within group comparison of NPRS, grip strength and PRTEE Score done with Wilcoxon Signed Rank test

NUMERIC PAIN RATING SCORE

Wilcoxon Signed Rank test was applied to compare pre and post NPRS score in all the groups. Within group analysis showed statistically significant difference in NPRS score ($p<0.05$).

TABLE 5: mean comparison within group analyzed with Wilcoxon Signed Rank test for NPRS

	MEAN(SD)	MEAN(SD)		
	PRE	POST	Z- VALUE	P- VALUE
GROUP A	6.38 (±1.04)	1.61 (±0.86)	-3.236	<0.001
GROUP B	6.30 (±1.03)	3.00 (±1.00)	-3.239	<0.001
GROUP C	6.46 (±0.87)	4.07 (±1.09)	-3.220	<0.001

GRIP STRENGTH:

Wilcoxon Signed Rank test was applied to compare pre and post grip strength score in all the groups. Within group analysis showed statistically significant difference in grip strength score ($p<0.05$).

TABLE 6: mean comparison within group analyzed with Wilcoxon Signed Rank test for grip strength.

	MEAN(SD)	MEAN(SD)		
	PRE	POST	Z- VALUE	P- VALUE
GROUP A	28.15 (7.79)	35.23 (7.70)	-3.192	<0.001
GROUP B	28.00 (7.75)	32.07 (7.53)	-3.195	<0.001
GROUP C	28.07 (7.62)	30.61 (7.28)	-3.108	<0.001

PRTEE SCORE:

Table 6 and graph 7 show pre and post PRTEE score within groups. Wilcoxon Signed Rank test was applied to compare pre and post PRTEE score in all the groups. Within group

analysis showed statistically significant difference in PRTEE score ($p<0.05$) in all three groups.

TABLE 7: MEAN COMPARISON WITHIN GROUP ANALYSED WITH Wilcoxon Signed Rank test

GROUPS	MEAN(SD)	MEAN(SD)	Z- VALUE	P- VALUE
	PRE	POST		
GROUP A	66.30 (6.48)	15.84 (4.72)	-3.185	<0.001
GROUP B	58.38 (6.23)	24.30 (3.59)	-3.185	<0.001
GROUP C	61.92 (7.93)	29.07 (4.90)	-3.182	<0.001

Inter-group comparison of GROUP A-eccentric exercise, group B- concentric exercise and group c- control group was using one-way ANOVA test and multiple comparison between all groups was using post hoc test.

Comparison of different between pre-treatment and post-treatment value of NPRS in group A, group B and group C.

Inter group comparison is shows in following table.

TABLE-8: inter group comparison of NPRS

GROUPS	MEAN(SD)	F VALUE	P VALUE	SIGNIFICANCE
GROUP A	4.76(0.72)	25.87	0.000	YES
GROUP B	3.30(0.94)			
GROUP C	2.38(0.86)			

TABLE-9: Following table shows multiple comparison between groups for NPRS was done using post hoc test.

GROUP COMPARISION	MEAN DIFFERENCE	SIGNIFICANT	95% CONFIDENCE INTERVAL	
			LOWER BOUND	UPPER BOUND
G- A VS G- B	1.461	0.000	0.644	2.278
G-A VS G- C	2.384	0.000	1.567	3.201
G-B VS G-C	0.923	0.024	0.105	1.740

Comparison of different between pre-treatment and post-treatment value of grip strength in group A, group B and group C.

TABLE-10: Inter group comparison is shows in following table.

GROUPS	MEAN(SD)	F VALUE	P VALUE	SIGNIFICANCE
GROUP A	7.07(2.62)	19.02	0.000	YES
GROUP B	4.07(1.65)			
GROUP C	2.53(1.12)			

TABLE-11: Following table shows multiple comparison between groups for GRIP STRENGTH was done using post hoc test.

GROUP COMPARISION	MEAN DIFFERENCE	SIGNIFICANT	95% CONFIDENCE INTERVAL	
			LOWER BOUND	UPPER BOUND
G- A VS G- B	3.000	0.001	1.170	4.529
G-A VS G- C	4.538	0.000	2.709	6.367
G-B VS G-C	1.538	0.114	0.290	3.367

Comparison of different between pre-treatment and post-treatment value of PRTEE in group A, group B and group C.

TABLE-12: Inter group comparison is shows in following table.

GROUPS	MEAN(SD)	F VALUE	P VALUE	SIGNIFICANCE
GROUP A	50.46(3.55)	53.25	0.000	YES
GROUP B	34.07(3.88)			
GROUP C	32.84(6.56)			

TABLE-13: Following table shows multiple comparison between groups for PRTEE score was done using post hoc test.

GROUP COMPARISION	MEAN DIFFERENCE	SIGNIFICANT	95% CONFIDENCE INTERVAL	
			LOWER BOUND	UPPER BOUND
G- A VS G- B	16.384	0.000	11.7	21.04
G-A VS G- C	17.615	0.000	12.95	22.27
G-B VS G-C	1.230	0.796	3.42	5.88

Thus, the result of this study shows that the patients undergone eccentric exercise gained significantly greater improvement in pain, grip strength and function as compared to the patient undergone concentric exercise

addition to conventional and control group only.

Alternative null hypothesis (H_1)

DISCUSSION

Lateral epicondylitis also known as lateral elbow tendinopathy or tennis elbow, is one of the most common overuse syndrome of the extensor tendon of the forearm. Lateral epicondylitis is a frequent cause of elbow pain and it affects 1 to 3 % of adult population every year. lateral epicondylitis can occur at any age. The peak prevalence age is between 30 to 60 years. Both genders are equally affected, but the disorder appears to be of longer duration and severe in females. [7]

The present study was conducted to compare the effect of eccentric exercise and concentric exercise in patients with lateral epicondylitis. Data was analyzed of total 39 subjects; group A (n=13 patients) was treated with eccentric exercise along with conventional physiotherapy and group B (n=13 patients) treated with concentric exercise along with conventional physiotherapy and group C (n=13 patients) treated with only conventional physiotherapy for 6 weeks. All the patients completed the intervention and there were no side effects found during study duration. All outcome measures were taken before and after the completion of the treatment of 6 weeks. All the groups received conventional treatment including therapeutic ultrasound and stretching exercises.

The major findings of the study are that the patients undergone eccentric exercise gained significantly greater improvement in pain, grip strength and function as compared to the patient undergone concentric exercise addition to conventional and control group only.

Control group showed improvement in pain, maximum grip strength and function score. Conventional group received ultrasound, stretching and active movements. Therapeutic ultrasound results in thermal and non-thermal effects in tissues. Thermal effects result in increased blood flow causing reduction in muscle spasm, increase extensibility of collagen fibers and a pro inflammatory response. [27] non-thermal effects of ultrasound are mechanical effects, stable cavitation and micro streamlining. Mechanical effect results in a shorter inflammatory phase of the healing, increased vascularity at the treatment site, and enhanced proliferation of fibroblast. The reparative process is enhanced by acoustic streaming and cavitation by increased diffusion of iron and metabolite across the cell membrane. Change in calcium permeability enhanced tissue healing and increased permeability of sodium may reduce pain and spasm by altering neural activity. [28]

Kachanathu et al (2013) conducted a study to compare the effects of pulsed ultrasound and continuous ultrasound over a period of 2 weeks and demonstrated the effectiveness of pulsed ultrasound in reducing pain score over continuous ultrasound. [29] Akin et al (2010) assessed the short term effects of ultrasound treatment in lateral epicondylitis patients. 60 patients were included and us was provided for 5 mins over 3 weeks (15 sessions). Study concluded that us treatment for lateral epicondylitis improved pain and activities of daily living and resulted in high patients' satisfaction. [30]

In experimental group exercise done with the use of dumbbells provide a practical means of adding isolated training to the treatment of the lateral epicondylitis. A prescription of three sets of 15 rep. daily for approximately 6 weeks appeared to be effective treatment in the majority of patients.

The findings of the present study are similar as found by Magnus Peterson et al. (2014) suggesting the eccentric exercise group had faster regression of pain, with an average of 10% higher responder rate at all levels of pain reduction, both during muscle contraction and elongation, ($p < 0.0001$ and $p = 0.006$, respectively) and also had a

greater increase of muscle strength than the concentric ($p < 0.02$).

Another study was found by Tylert. F. et al (2010) suggesting improvement in VAS, strength tenderness and function in patients with eccentric exercise in patients with chronic tennis elbow. With improvement in VAS 81%, strength 79%, tenderness 71% and function (DASH) 76%.

A previous small-scale study of short duration found no significant differences between eccentric and concentric exercise in chronic tennis elbow. [22] In the present study, eccentric exercise reduced pain and improve strength than concentric exercise in chronic lateral epicondylitis. This supports previous studies on Achilles tendinosis showing eccentric exercise to be superior to concentric exercise. [25]

There was significant improvement in maximum grip strength and PRTEE score in group A patient treated with eccentric exercise in addition to conventional physiotherapy. Possible explanation for improvement are eccentric exercise would lengthen the musculo-tendinous structure relieving the tendon of constant stress. Eccentric exercise will result in increase in tensile strength due to loading induced hypertrophy. The decrease in pain may be a result from lengthening of the musculo-tendinous junction creating less strain and allowing greater range of motion. The painfull eccentric loading had an altering effect on pain perception around the tendon.[14] Effect of eccentric exercise on collagen synthesis in achilles tendinopathy was investigated an eccentric exercise resulted in increased collagen synthesis specially type 1 collagen which is main type of collagen in normal tendon corresponding with decrease pain level. Pain habituation arises from neuromuscular benefits through central adaptation of both agonist and antagonist muscle and increased in tendon stiffness. [13]

Tyler et al (2014) study the additive effects of eccentric exercise in the rehabilitation of previously failed treatment of golfer elbow and included that there was significant improvement in outcome following the addition of isolated eccentrics. [31]

Stasinopoulos D and Stasinopoulos I ((2005) studied the effects of Cyriax physiotherapy, supervised exercise program consisting of eccentric training of wrist extensor and static stretching of ECRB and poly chromatic non-coherent light in lateral epicondylitis patients. It was found that supervised exercise program resulted in the largest effect of change in reduction of pain, improvement in grip and improvement in function. [28]

However Wen et al (2011) studied the effect of eccentric strengthening for chronic lateral epicondylosis for 4 weeks. Superior effect of eccentric training as compared with local modalities and stretching was not demonstrated. [32]

Statistically significant improvement was found in NPRS score in the group treated with eccentric training group mechanism behind improve strength was that Tendinosis pain is associated with neovascularization. Eccentric exercise may halt the growth of blood vessels in tendinosis and subsequently relieve some of the associated pain.

The eccentric loading profile has been shown to reduce vascularity as a result of the program when the tendinopathy is associated with neovascularity. This is likely to be associated with the stresses generated within the tendon as well as the mechanical shear force stimulus between the tendon and the peritendon. These forces may inhibit, and possibly decrease vascular infiltration into the tendon and alter the nociceptive input. This is turn may have secondary effects on the pain response and the ability to load the tendon.

Eccentric training was found to increase collagen synthesis, whereas this was unchanged in the healthy tendon. there was increased peritendinous type 1 collagen, which is the main type of collagen in normal tendon, and this occurred without a corresponding increasing collagen

degradation. These changes corresponded with a decrease in pain level. [33]

Additionally, characteristics of the patient's occupation affect the ability to work. Different type of work in PRTEE questionnaire noted within each group is important. In the experimental group, significant improvement occurs in functional outcome; hence improvement to ability to do their usual work occurs than control group.

The pattern of tendon loading, with its force fluctuations, rather than the magnitude of the force, is responsible for the therapeutic benefit. These fluctuations in force may provide an important stimulus for the remodeling of tendon. [29]

Lateral epicondylitis is a degenerative process with primary pathological process angiofibroblastic tendinosis consisting of abundance of fibroblast, vascular hyperplasia and unstructured collagen rather than inflammation. [5,11]

Eccentric exercise on tendinopathy mediates through pain habituation, collagen synthesis-specially type 1, reduction of neovascularization through repeated interruption of blood flow over time.10 giving possible explanation to superior effect of eccentric exercise over concentric exercise and conventional physiotherapy.

CONCLUSION

Results showed significant improvement in eccentric and concentric exercise therapy groups. But there was statistically more significant difference seen in eccentric exercise group on pain, grip strength and function in patients with lateral epicondylitis. So, it can be concluded that eccentric and concentric exercise are effective in treatment of lateral epicondylitis but eccentric exercise more effective than concentric exercise on pain, grip strength and function in lateral epicondylitis.

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