

# Addition Of Eccentric Elbow Exercises To Local Corticosteroid Injection For Tennis Elbow – A Prospective Randomized Study

Niranjanan Raghavn Muralidharagopalan<sup>1</sup>, RaghavGopal<sup>2</sup>, Sugumar Natarajan

<sup>1</sup> Associate Professor, Department of Orthopaedics, Saveetha Medical College, Chennai

<sup>2</sup> Final Year MBBS Student, Saveetha Medical College, Chennai

Email: [nir.rag@gmail.com](mailto:nir.rag@gmail.com)

**ABSTRACT:** Lateral epicondylitis or Tennis elbow is a painful condition of the elbow that is characterized by pain and weakness of grip strength. It is usually due to a tendinopathy involving the origin of the ECRB and EDC tendons. Wide variety of treatment options exists. Injection corticosteroids are considered to be a good choice for short term improvement of the problem but has doubtful effects in the medium to long term.

This study is a randomized study that compares the short to medium term effect of addition of eccentric elbow strengthening exercises to local corticosteroid injections

This is a prospective randomized study with 1 year follow up. 24 subjects received corticosteroid injections alone while 26 underwent eccentric elbow strengthening additionally.

The patients were administered VAS, DASH score and tenderness on resisted dorsiflexion of wrist and middle finger initially. This was followed up after 2 weeks, 6 weeks, 3 months, 6 months and 1 year.

The groups were also well matched for age, sex, time since diagnosis.

The VAS, DASH and the tenderness scores were also similar in the two groups.

In the injection only group there was reduction of VAS from 7.08 to 2.83 in 2 weeks which showed a decreasing trend till 6 months follow up. Similarly, the DASH scores decreased from 33.40 to 13.63 in 2 weeks and the same trend was seen till 6 months. However, at 1 year follow up both scores showed a slight increase.

In the injection plus exercises group the reduction of VAS and DASH scores continues till one year. Also comparing the two groups the injection plus exercise group shows significant improvement at 2 weeks, 6 weeks and 1 year follow up

Addition of eccentric elbow strengthening exercises significantly improves the benefit of having a local corticosteroid injection for tennis elbow

**KEY WORDS:** eccentric elbow strengthening, local corticosteroid injection, tennis elbow, DASH, VAS, randomized

## 1. INTRODUCTION:

Lateral epicondylitis or Tennis elbow is a condition that causes pain around the elbow and is usually associated with over use. The most common structure affected is the origin of the Extensor Carpi radialis brevis tendon. (Morrey BF, 2000). The most common pathology encountered is mechanical overload that causes multiple microtears, which when heals leads to a fibroblastic tendinopathy

The incidence of Tennis elbow is estimated to be 1-3% with equal distribution among sexes and commonly occurs in the 30-50 age group.(Winston et al 2015)(Vicenzino et al 1996)(Verhaar 1994)

Common symptoms are lateral elbow pain and weakness of grip and common signs include tenderness on resisted wrist extension and resisted middle finger extension. (Haker 1993),(Assendelft 2003)

There have been a wide variety of treatment options considered such as NSAIDs (Pattanittum 2013), wait and watch (Bisset 2006), injection steroids, injection PRP (Gosens 2011), Peerbooms 2013), ultrasound therapy, bracing orthotics (Jafarian 2009) , (Struijs 2004),exercises and surgery (Buchbinder 2002)

However systematic reviews have not identified any method as the best course of action.

This is a prospective randomized study that has been conducted with medium term follow up to compare the effects of steroid injection alone versus steroid injection plus eccentric elbow strengthening exercises and to compare the outcomes between the two groups.(Nirschl 1992), ,(Coombes 2015), (Struijs 2002)

**AIM:**

To compare the short term and medium-term effects of Triamcinolone injection alone vs triamcinolone injections plus supervised eccentric elbow strengthening exercises in the treatment of Tennis elbow that has been present for more than 6 weeks

## **2. MATERIALS AND METHODS:**

This is a prospective randomized study conducted at a tertiary care medical college hospital between Jun 2015 to May 2020.

### **SAMPLE SIZE CALCULATION**

$$\text{Sample size} = \frac{Z_{(1-\alpha)}^2 \times p(1-p)}{d^2}$$

where

$$Z_{(1-\alpha)} = 1.95$$

$$P = 0.03 \text{ (3\% incidence)}$$

$$d = 0.05$$

(Charan et al 2013)

Inserting the values into the equation we get sample size = 44.26

So >45 patients in the sample universe is considered acceptable

50 patients with unilateral lateral epicondylitis of the elbow of at least 6 weeks duration who had failed conservative treatment with analgesics, wax bath/ultrasound treatment were enrolled into the study.

### **INCLUSION CRITERIA:**

1. 18-60 years of age
2. Unilateral epicondylitis

3. Willing to enroll in the study
4. Willing to present for adequate follow up

#### EXCLUSION CRITERIA

1. <18 years or >60 years
2. pregnancy
3. Bilateral involvement simultaneously
4. Congenital deformities of upper limb
5. Previous surgery of upper limb
6. Inflammatory joint disorders
7. Not willing to enroll in the study
8. Non willing for follow up

#### BASE LINE WORK UP

All patients were worked up with a thorough history, focused physical examination, including identification of co morbidities, a base line investigation panel (such as cbc, rft etc.)

#### RANDOMIZATION

Patients were randomized into a steroid alone group and a steroid plus eccentric elbow strengthening group using a computer random number generator

#### STEROID INJECTION

All patients were administered an injection of 1 ml of Triamcinolone acetonide (ABBOTT) (40mg/ml ) mixed with 2 cc of 2% Lignocaine and injected into the lateral epicondyle and the most tender areas surrounding it (Figure 1)



Figure 1 – Injection Triamcinolone

## ECCENTRIC STRENGTHENING EXERCISES:

All patients who were randomized into the steroid plus eccentric strengthening group were guided to the hospital Physiotherapy department and taught eccentric elbow strengthening exercises and were monitored remotely for the next two weeks. (Figure 2)



**Figure 2 – Eccentric Elbow strengthening exercises**

## SCORING:

All patients were administered the VAS, DASH Score and checked for tenderness on resisted dorsiflexion of wrist and middle finger (on a 3-point scale: no tenderness, some tenderness, definitive tenderness). Baseline record followed by 2 weeks, 6 weeks, 3 months, 6 months and 12 months following the intervention

STATISTICAL ANALYSIS : Appropriate statistical analyses such as multiple factor anova, paired and unpaired t-test using Microsoft Excel ( Microsoft Inc)

### **3. OBSERVATIONS AND RESULTS:**

There were 24 subjects randomized to the injection alone group and 26 subjects randomized into the injection + exercises group.

The baseline characteristics of both groups were comparable (age: 37.54 (26-51 years) vs 37.57 (26-52 years) . (Table 1) Sex distribution of two groups was also comparable (Table 2) The time since diagnosis is tabulated in Table 3.

Table 1  
Age of the study groups

Group	Mean	Range	Standard Dev
Injection only	37.54	26-51	7.28
Injection + eccentric	37.57	26-53	6.90

Table 2  
 Sex of the study groups

Group	Male	Female
Injection only	10	14
Injection + eccentric	11	15

Table 3  
 Time since diagnosis of the study groups

Group	Mean	Range	Standard Dev
Injection only	7.29	6-12	1.61
Injection + eccentric	7.26	6-10	1.31

**Co morbidities:** There was a patient who was diabetic in each of the groups and a hypothyroid in each of the groups. In the injection only group the diabetic patient was also a hypertensive.

The VAS, DASH and Tenderness scores of the two groups were comparable at the baseline. The VAS scores were  $7.08 \pm 0.95$  and  $7.26 \pm 1.31$  respectively. (p value= 0.98). The DASH scores were  $33.40 \pm 7.36$  and  $34.99 \pm 7.19$  respectively. (p=0.45). So the two groups are adequately randomized and comparable at the base line.

Following injection alone group the VAS improved to  $2.83 \pm 0.74$  and the DASH improved to  $13.63 \pm 0.34$ . (p <0.0001 for both). Subsequently they improved to  $1.20 \pm 0.49$  and  $2.36 \pm 1.52$  (p=0.01 and <0.0001 respectively) on 1 year follow up.(Table 4) and (Table 5)

Table 4  
 VAS Scores in the Injection only group

	Mean	Range	Standard Dev
Pre procedure	7.08	6-9	0.95
2 weeks follow up	2.83	2-5	0.74
6 weeks follow up	2.08	2-3	0.27
3 months follow up	1.04	1-2	0.19
6 months follow up	1	1	-
1 year follow up	1.20	1-3	0.49

Table 5  
 DASH Scores in the Injection only group

	Mean	Range	Standard Dev
Pre procedure	33.40	25.83-50	7.36
2 weeks follow up	13.63	9.16-20.83	3.34
6 weeks follow up	4.83	3.33-5.83	0.82
3 months follow up	1.70	0.83-3.33	0.77
6 months follow up	0.62	0-1.667	0.48
1 year follow up	2.36	0-5.833	1.52

So injection is an effective treatment for tennis elbow when followed up over one year.

In the injection + exercise group the VAS improved to  $2.38 \pm 0.48$  and the DASH improved to  $12.51 \pm 0.62$ . ( $p < 0.0001$  for both). Subsequently they improved to 1 and  $0.7 \pm 0.7$  ( $p < 0.0001$  and  $< 0.0001$  respectively) on 1 year follow up. (Table 6) and (Table 7)

Table 6

VAS Scores in the Injection + exercise group

	Mean	Range	Standard Dev
Pre procedure	7.07	6-9	0.82
2 weeks follow up	2.38	2-3	0.48
6 weeks follow up	1.11	1-2	0.31
3 months follow up	1	1	-
6 months follow up	1	1	-
1 year follow up	1	1	-

Table 7

DASH Scores in the Injection + exercises group

	Mean	Range	Standard Dev
Pre procedure	34.99	25.83-51.667	7.19
2 weeks follow up	12.51	9.16-19.1667	2.62
6 weeks follow up	3.87	2.5-5	0.89
3 months follow up	1.66	0-3.33	0.80
6 months follow up	0.44	0-0.833	0.41
1 year follow up	0.70	0-2.5	0.71

Thus injection plus exercises also provide effective treatment against tennis elbow consistently over a period of 1 year.

While comparing the effects of injection alone and injection + exercise groups on VAS, we get significant differences at 2 weeks, 6 weeks and 1 year follow up ( $p=0.01$ ,  $0.001$  and  $0.05$  respectively).

While comparing the effects of injection alone and injection + exercise groups on DASH scores, we get significant differences at 6 weeks and 1 year follow up ( $p<0.01$  and  $p<0.001$ ) respectively.

Therefore there is significant improvement in the injection plus exercise group when compared to the injection group alone.

This is for the subjective component of the improvement.

Moving on to the objective component, two measurements are taken. The tenderness on resisted wrist extension and tenderness on resisted middle finger flexion.

The pre intervention mean TW was 2.83 and 2.84 respectively, while the TMF was 2.29 and 2.19 respectively which makes it a truly random sample.

Comparing the two groups on follow up, the TW was significantly different better in the injection plus exercise group at 2 and 6 weeks follow up ( $p<0.001$ ).

The TMF was also significantly better in the injection plus exercise group at 2 weeks follow up ( $p=0.01$ )

This objective difference is not found to continue on longer term follow up.

### **Complications**

No complications have been recorded in either group.

## **4. DISCUSSION:**

The term tennis elbow or lateral epicondylitis was described in 1873 by Runge(Runge 1873). However, it has subsequently been found that the name is a misnomer as there is no “true inflammation” of the lateral epicondyle or the common extensor origin.

The pathophysiology points towards a repetitive cumulative overload which causes a degeneration of the origin of the extensor carpi radialis brevis tendon and the extensor digitorum communism tendon. (Coombs et al 2009)(Krogh et al 2013)(Alfredson et al 2000)

A wide variety of treatment options have been tried such as Wait and watch and supportive care, bracing, orthotics use, NSAIDs, Platelet rich plasma etc.

Local corticosteroid injections are one of the mainstays of treatment for the condition which has consistently shown to produce good short-term benefit. (Coombs et al 2009) (Alfredson et al 2000)(Krogh et al 2013)

The exact mechanism of action of how steroids work in tennis elbow is still unclear. However, there are no consistent benefits observed over medium to long term.

This study was designed compare the short to medium term effects of addition of eccentric elbow strengthening exercises to local corticosteroid injections.

In our study, both the groups are well balanced at the baseline. The age, sex distributions were similar in both the groups. The time since diagnosis is also comparable in both groups. So, the randomization can be considered to be adequate.

Moving on to the subjective assessment areas, the VAS in the injection only group steadily decreased from 7.08 to 1 in 6 months follow-up. However, on one year follow up there is a slight increase in mean VAS to 1.20. This is consistent with multiple other studies which cessation of effect of the steroid injection on longer follow up.

A similar picture is seen with the DASH scores in the injection only group. The mean DASH scores follow a similar trajectory to the VAS scores. There is a decrease from 33.40 to 0.62 at 6 months follow up. However, there is a slight increase to 2.36 at 1 year follow up.

Therefore, local corticosteroid injection produces immediate relief but the max effect lasts for around 6 months.

Comparing this with the injection plus eccentric exercises group, the VAS score decreases from 7.07 to reach 1 at 3 months follow up. However, this score is maintained at 1 year follow up. On the other hand, DASH Scores decrease from 34.99 to 0.44 at 6 months follow up but show a very small increase to 0.70 at 1 year follow up.

On comparing the VAS scores between the two groups there are significant differences at 2 weeks, 6 weeks and 1 year follow up. The DASH scores also show significant differences at 6 weeks and at 1 year follow up.

This clearly goes to show that the subjective effects are maximal at 6 weeks and the difference persists even after a year.

As far as the objective measurements are considered, the baseline characteristics of the tenderness on resisted wrist dorsiflexion and middle finger extension are similar. The difference between the two groups was significant at 2 weeks and 6 weeks follow up in TW and 2 weeks alone in the TMF.

However, this is a Likert scale measurement of no tenderness, some tenderness and severe tenderness. This scale may not be sufficient to pick up small differences and a more standardized test with dynamometers may be needed.

The exact mechanism of action of how eccentric exercises is still unclear. (Khan et al 2000),(Khan et al 2002), It is hypothesized that tendon strengthening occurs due to stimulation of mechanical receptors present in the tenocytes. This leads to an increase in production of collagen, which is expected to heal the damaged tendon. Further studies are needed to shed more light on this. (Hawary et al 1997), (Ohberg et al 2004)

## **5. CONCLUSION:**

Addition of eccentric strengthening exercises of the elbow to local corticosteroid injection produces significant improvement in patients with Tennis elbow when compared to local corticosteroid injections alone.

## **6. REFERENCES:**

- [1] Morrey BF. Surgical treatment of extraarticular elbow contracture. *Clin Orthop Relat Res.* 2000;370:57–64.
- [2] Winston J., Wolf J. (2015) Tennis Elbow: Definition, Causes, Epidemiology. In: Wolf J. (eds) *Tennis Elbow*. Springer, Boston, MA. [https://doi.org/10.1007/978-1-4899-7534-8\\_1](https://doi.org/10.1007/978-1-4899-7534-8_1)

- [3] Vicenzino B, Wright A. Lateral epicondylalgia I: epidemiology, pathophysiology, aetiology and natural history. *Phys Ther Rev* 1996;1:23–34.
- [4] Verhaar J. Tennis elbow: anatomical, epidemiological and therapeutic aspects. *Int Orthop* 1994;18:263–7.
- [5] Haker E. Lateral epicondylalgia: diagnosis, treatment and evaluation. *Crit Rev Phys Rehabil Med* 1993;5:129–54.
- [6] Assendelft W, Green S, Buchbinder R, et al. Tennis elbow. *BMJ* 2003;7410:327.
- [7] Nirschl RP. Elbow tendinosis/tennis elbow. *Clin Sports Med*. 1992;11:851–70.
- [8] Jafarian FS, Demneh ES, Tyson SF. The immediate effect of orthotic management on grip strength of patients with lateral epicondylitis. *J Ortho Sports Phys Ther* 2009;39:484-9. doi:10.2519/jospt.2009.2988
- [9] Struijs PA, Kerkhoffs GM, Assendelft WJ, van Dijk CN. Conservative treatment of lateral epicondylitis: Brace versus physical therapy or a combination of both: a randomized clinical trial. *Am J Sports Med* 2004;32:462-9. doi:10.1177/0095399703258714
- [10] Bisset L, Beller E, Jull G, Brooks P, Darnell R, Vicenzino B. Mobilisation with movement and exercise, corticosteroid injection, or wait and see for tennis elbow: randomised trial. *BMJ*. 2006;333(7575):939.
- [11] Buchbinder R, Green S, Bell S, Barnsley L, Smidt N, Assendelft WJ. Surgery for lateral elbow pain. *Cochrane Database Syst Rev*. 2002;(1):CD003525.
- [12] Coombes BK, Bisset L, Vicenzino B. Management of lateral elbow tendinopathy: one size does not fit all. *J Orthop Sports Phys Ther*. 2015;45(11):938–49.
- [13] Gosens T, Peerbooms JC, van Laar W, den Ouden BL. Ongoing positive effect of platelet-rich plasma versus corticosteroid injection in lateral epicondylitis: a double-blind randomized controlled trial with 2-year follow-up. *Am J Sports Med*. 2011;39(6):1200–8.
- [14] 13. Pattanittum P, Turner T, Green S, Buchbinder R. Non-steroidal anti-inflammatory drugs (NSAIDs) for treating lateral elbow pain in adults. *Cochrane Database Syst Rev*. 2013;(5):CD003686.
- [15] Peerbooms JC, Sluimer J, Bruijn DJ, Gosens T. Positive effect of an autologous platelet concentrate in lateral epicondylitis in a double-blind randomized controlled trial: platelet-rich plasma versus corticosteroid injection with a 1-year follow-up. *Am J Sports Med*. 2010;38(2):255–62.
- [16] Struijs PA, Smidt N, Arola H, Dijk V, Buchbinder R, Assendelft WJ. Orthotic devices for the treatment of tennis elbow. *Cochrane Database Syst Rev*. 2002;(1):CD001821.

- [17] Charan J, Biswas T. How to calculate sample size for different study designs in medical research? *Indian J Psychol Med* 2013;35:121-6.
- [18] Runge F. Zur genese und behandlung des schreibekrampfes. *Berl. Klin. Wochenschr.* 1873;10:245–248
- [19] Coombes BK, Bisset L, Connelly LB, Brooks P, Vicenzino B (2009) Optimising corticosteroid injection for lateral epicondylalgia with the addition of physiotherapy: A protocol for a randomised control trial with placebo comparison. *BMC Musculoskeletal Disorders* 10: 76.
- [20] Krogh TP, Fredberg U, Stengaard-Pedersen K, Christensen R, Jensen P, et al. (2013) Treatment of Lateral Epicondylitis With Platelet-Rich Plasma, Glucocorticoid, or Saline: A Randomized, Double-Blind, Placebo- Controlled Trial. *The American Journal of Sports Medicine* 41: 625-635.
- [21] Alfredson H, Ljung B-O, Thorsen K, Lorentzon R (2000) In vivo investigation of ECRB tendons with microdialysis technique--no signs of inflammation but high amounts of glutamate in tennis elbow. *Acta Orthopaedica* 71: 475-479.
- [22] Khan K, Cook J, Taunton J, et al. Overuse tendinosis, not tendinitis: a new paradigm for a difficult clinical problem. *Phys Sportsmed* 2000;28:38–48.
- [23] Khan KM, Cook JL, Kannus P, et al. Time to abandon the “tendonitis” myth. *BMJ* 2002;324:626–7.
- [24] Hawary R, Stanish W, Curwin S. Rehabilitation of tendon injuries in sport. *Sports Med* 1997;24:347–58.
- [25] Ohberg L, Lorentzon R, Alfredson H. Eccentric training in patients with Achilles tendinosis: normalized tendon structure and decreased thickness at follow up. *Br J Sports Med* 2004;38:8–11.
- [26] Funding Support : The authors declare that they have no funding support for this study
- [27] Conflict of Interest - "The authors declare that they have no conflict of interest".