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Clevio Desouza
Junior Resident, Dr D.Y. Patil
Medical College, Hospital and
Research Centre, Pune,
Maharashtra, India

Abhijeet Shroff
Associate Professor, Dr D.Y.
Patil Medical College, Hospital
and Research Centre, Pune,
Maharashtra, India

Disha Assudani
Junior Resident, Dr. D. Y. Patil
College of Physiotherapy, Pune,
Maharashtra, India

Corresponding Author:
Clevio Desouza
Junior Resident, Dr D.Y. Patil
Medical College, Hospital and
Research Centre, Pune,
Maharashtra, India

Comparative study of local corticosteroid injection and therapeutic ultrasound with exercise for quicker functional improvement in tennis elbow

Clevio Desouza, Abhijeet Shroff and Disha Assudani

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Abstract

Introduction: Tennis elbow is also known as Lateral epicondylitis which is an over use injury to the area of the lateral epicondyle of the elbow end of the humerus. It is generally attributed to osteotendinous irritation of the common extensor origins of Extensor Carpi Radialis. Local infiltration with 1ml tramincinolone acetate (10mg/ml) and 1ml 2% lidocaine is most commonly used for therapeutic relief of this condition. Therapeutic Ultrasound is another modality used in the treatment for functional relief of tennis elbow. Therapeutic ultrasound, a deep heater agent is effective with vibration but primarily through heat in lateral epicondylitis. With its thermal and mechanical effects, it increases local metabolism, blood flow, soft tissue flexibility and regeneration and membrane permeability and changes nerve conduction. It reduces pain and increases joint movement opening. Comparative study between Local steroid injections and Therapeutic ultrasound for the quicker functional relief of tennis elbow or lateral epicondylitis was the basis of this study.

Materials and Methods: The present study of 100 cases was conducted in the Department of Orthopedics at Dr. D.Y. Patil Medical College, Hospital and Research Centre, Pune. The results were evaluated for comparison between injection corticosteroids, therapeutic ultrasound and exercise rehabilitation in the functional relief of tennis elbow. Follow-up was done at 10 days, 6 weeks and 6 months. Patient outcome was assessed on their respective follow-up. The Measure of strength through Pain Free Grip and PRTEE which assessed the pain and functional disability of the patient in a standardised way were used as parameters.

Conclusion: In conclusion, the results from our study showed that all three treatment groups were effective showing improvement over time at different intervals of time for different aspects of the clinical picture. The result for injection therapy in our study was that corticosteroid injection has superior effectiveness in the short term when compared with exercise therapy and therapeutic ultrasound. Similarly, in the long term, results of our study supported that exercise was the most effective followed by therapeutic ultrasound and that the effectiveness of exercise and ultrasound in comparison to injection therapy was higher in the long term with injection corticosteroid therapy being the least effective.

Keywords: Corticosteroid injection, therapeutic ultrasound

Introduction

Tennis elbow is also known as Lateral epicondylitis which is an over use injury to the area of the lateral epicondyle of the elbow end of the humerus. It is generally attributed to osteotendinous irritation of the common extensor origins of Extensor Carpi Radialis. In addition, the anterior edge of the origin of the Extensor Digitorum Communis is involved in 30% of cases and rarely the underside of the Extensor Carpi Radialis Longus or the origin of the Extensor Carpi Ulnaris is involved.

Dr R Nirsch and Pettrone were the first to describe the condition as a degenerative more than inflammatory process involving primarily the Extensor Carpi Radialis Brevis [1]. Cyriax stated that the Extensor Carpi Radialis Brevis is involved at the tenoperiosteal insertion at the humeral lateral epicondyle at the body of the tendon or the muscle belly [2]. In clinical practice, the condition is found more often in non-athletes than athletes, probably less than 5% of patients with lateral epicondylitis are tennis players. It is one of the most commonly diagnosed conditions of the elbow. It affects around 1 to 3% of the population. Condition mostly occurs in patients whose activities require strong gripping or repetitive wrist movements.

The high risk people are between the ages of 35-50 years. The dominant arm is most frequently affected. Patients initially complain of activity related lateral elbow pain often a dull aching, lateral pain and show weakness of grip strength. On examination patients have tenderness approximately 1 to 2cm distal to the lateral epicondyle. Patient may experience pain with passive wrist flexion, resisted active wrist extension and during grasping or lifting. Lateral epicondylitis can be confirmed by performing following three tests.

- 1) **Cozens Test:** The patient is asked to make the fist, pronate the forearm, radially deviate and extend the wrist while the examiner resists the motion.
- 2) **Mills Test:** The examiner passively pronates the forearm, flexes the wrist fully and extends the elbow.
- 3) The examiner resists the extension of the third digit of the hand proximal to the interphalangeal joint, stretching the extensor digitorum muscle and tendon.

All the above tests are positive if the patient experiences pain at the lateral condyle of the humerus.

The primary goals of treatment are control of pain, preservation of motion, flexibility and strength and development of endurance overtime. Excessive internal strain to the tendon is to be minimized during stressful activities. It can be achieved by optimizing tissue extensibility. No vigorous activities are allowed until the muscle tendon complex has sufficient extensibility. RICE Therapy comprising of Rest, Ice, Compression and Analgesics form the basis of treatment in Tennis Elbow. NSAID's or Non-Steroidal Anti-inflammatory Drugs are the first line of Management in the therapeutic treatment of this condition. Local steroid injections at the site of the extensor tendon is used as a modality in the treatment for functional relief of tennis elbow or lateral epicondylitis [3]. Local infiltration with 1ml triamcinolone acetate (10mg/ml) and 1ml 2% lidocaine is most commonly used for therapeutic relief of this condition [3]. Therapeutic Ultrasound is another modality used in the treatment for functional relief of tennis elbow. Therapeutic ultrasound, a deep heater agent is effective with vibration but primarily through heat in lateral epicondylitis. With its thermal and mechanical effects, it increases local metabolism, blood flow, soft tissue flexibility and regeneration and membrane permeability and changes nerve conduction. It reduces pain and increases joint movement opening [4]. Comparative study between Local steroid injections and Therapeutic ultrasound for the quicker functional relief of tennis elbow or lateral epicondylitis was the basis of this study.

Materials and methods

This study was conducted at Dr. D.Y. Patil Medical college, Hospital and Research Centre, Pune between May 2017 and May 2019. 100 patients with pain over the lateral aspect of elbow fulfilling the inclusion criteria were included under this study. All patient included in the study had symptoms that fulfilled the Southampton Diagnostic criteria and having Cozens/Mills test positive.

Inclusion Criteria

1. Age between 20-55 years
2. Patients having lateral elbow pain and also having tenderness over the lateral aspect of elbow and patients having positive Cozens/Mills test.

Southampton Diagnostic Criteria was used for the diagnosis of lateral epicondylitis or tennis elbow in these patients:

These criteria are defined as

- i. Pain in the lateral epicondyle zone in resistant active extension of the wrist.
- ii. Pain in the lateral epicondyle zone for 24 hours or more in the last 7 days.
- iii. Sensitivity on the lateral epicondyle zone.

Exclusion Criteria

1. Age < 20 years and > 55 years
2. Recent trauma to the affected upper limb
3. Rheumatoid Arthritis
4. Recent Surgery of the elbow joint
5. Any structural abnormality of the elbow joint
6. Any fracture of the upper limb
7. Pregnant patients
8. Systemic metabolic disorders
9. History of chronic inflammatory or neoplastic disease
10. People with a cervical or shoulder lesion
11. Those people who were treated with corticosteroid or local anaesthetic injection in the last 6 months
12. Contraindications for injection therapy:

The patients were assessed using a standard subjective and objective proforma developed according to the guidelines of this research. A written informed consent was taken from all individuals who were eligible for the study as per the inclusion criteria. They patients were randomised into one of the three treatment groups. The three groups for the treatment of the patients included in this study were injection therapy, physiotherapy exercise rehabilitation programme and ultrasound therapy.

Injection therapy was given using aseptic precautions according to guidelines. The patient was given a supine position with elbow kept in 90 degrees of flexion and forearm in supination supported on a pillow. A 25 G needle was inserted perpendicular to the lateral condyle in line with the cubital fossa crease to caress the bone (Figure 1). A solution of 10 mg Kenacort 40 (Triamcinolone Acetate- Steroid) with 1 ml of lidocaine 2 percent (Local Anaesthetic) was injected around the junction of the tenoperiosteum.



Fig 1: Injection Technique

The ultrasound therapy was performed according to standard guidelines. The patient received six sessions of ultrasound therapy during the first 2 to 4 weeks of treatment as a minimum of twice weekly sessions. The patient was kept in supine position with flexion of the elbow to 90 degrees with forearm in supination supported on a pillow. 3 MHZ continuous ultrasound

therapy was given using a 0.5 transducer with gel to the junction of the tenoperiosteum for five minutes (Figure 2). Physiotherapy was given by an experienced physiotherapist. The

exercise rehabilitation programme followed the stretching and progressive strengthening exercise schedule as per protocol by Pienimaki *et al.* (1996).



Fig 2: Ultrasound Technique

Patient data collection at their respective follow-ups was undertaken in a systematic way to ensure there was uniform consistency throughout the study. The following were the criteria according to which the patient outcome was assessed on their respective follow-up.

- The Measure of strength through Pain Free Grip.
- PRTEE which assessed the pain and functional disability of the patient in a standardised way.

Data collection was done at Baseline along with history taking and routine investigations prior to starting of treatment, at follow-up of the patient at 10 days after commencement of the treatment, follow-up at 6 weeks and at 6 months.

Observation
Age distribution

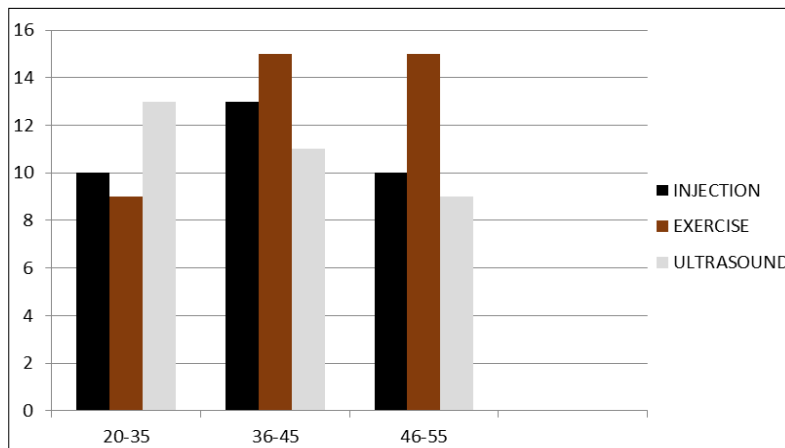


Fig 3: Age distribution in the patients receiving treatment

The mean age in all the three groups of injection therapy, exercise rehabilitation and therapeutic ultrasound was 45 years.

Sex Distribution

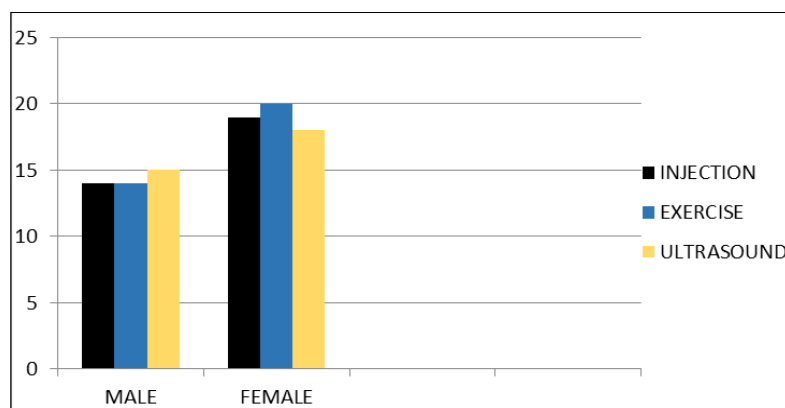


Fig 4: Sex distribution in the patients receiving treatment

There was slight preponderance of females in our study as compared to males. 57 females were included in our study as compared to 43 males.

Side Affected

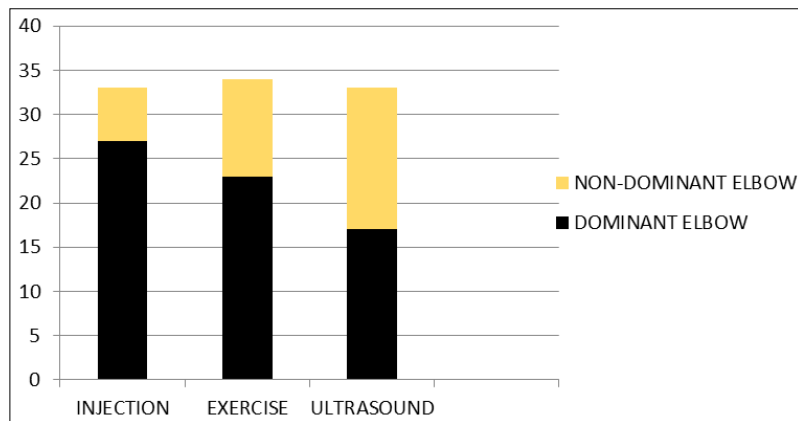


Fig 5: Side affected in the treatment population

The number of patients in the injection group had symptoms on the dominant elbow; however the number of patients having symptoms in the dominant elbow in the exercise group or the

ultrasound group in this population was less.

Table 1 shows the findings of mean and standard deviation which gives us the outcome of the injection group.

Table 1: Standard deviation (SD) mean for population receiving injection therapy

Change from baseline	PFG(kg)	PRTEE pain	PRTEE function	PRTEE total
10 Days	10.3(10.8)	-9.2(13.5)	-9.6(14.8)	-18.8(27.7)
6 Weeks	12.0(14.6)	-13.3(12.3)	-13.1(11.9)	-26.4(23.6)
6 Months	4.0(13.0)	0.2(12.9)	-2.6(14.3)	-2.4(26.5)

Table 2 shows the findings of standard deviation and mean which gives us the outcome of the ultrasound group.

Table 2: Standard deviation (SD) mean for population receiving ultrasound

Change from baseline	PFG(kg)	PRTEE pain	PRTEE function	PRTEE total
10 Days	-1.2(5.6)	0.9(5.6)	1.7(7.8)	2.6(11.4)
6 Weeks	0.8(6)	-2.0(7.5)	-2.0(10.2)	-4.0(15.5)
6 Months	4.0(7.5)	-3.4(8.2)	-5.2(12.3)	-8.6(17.3)

Table 3 illustrates findings of mean and standard deviation which gives us the outcome of the exercise rehabilitation group.

Table 3: Standard deviation (SD) mean for population receiving exercise rehabilitation

Change from baseline	PFG(kg)	PRTEE pain	PRTEE function	PRTEE total
10 Days	1.3(4.4)	-1.1(7.5)	-1.9(8.6)	-3.2(14.9)
6 Weeks	2.7(6.4)	-5.6(10.7)	-4.7(11.2)	-8.9(21.4)
6 Months	5.7(9.9)	-9.1(10.9)	-8.4(21.4)	-17.5(20.3)

Results

The outcome measures for all the groups, which were analyzed using change from baseline, there was use of an ANOVA with alpha set at p value of <0.05 having confidence interval (CI) of 95% and the group analysis was done using the Scheffe post hoc

test.

Table 4 gives the mean difference between groups and significance levels with a CI of 95 % given for the pain free grip (PFG) over time.

Table 4: Pain Free Grip Strength-Mean differences, 95% CI and significance

MDF	Groups	Mean difference	Significance level	95 % Confidence Interval
10 Days	Exercise: Injection	-9.0 kg	0.001	-14.7 to -3.3
	Ultrasound: Injection	-11.5 kg	0.000	-17.3 to -5.8
	Exercise: Ultrasound	2.5 kg	0.6	-3.2 to 8.2
6 Weeks	Exercise: Injection	-9.3 kg	0.01	-16.8 to -1.8
	Ultrasound: Injection	-11.2 kg	0.002	-18.8 to -3.6
	Exercise: Ultrasound	1.9 kg	0.8	-5.6 to 9.4

There was a significant difference which was obtained for the measure in pain free grip from the baseline value in the injection therapy group and both the ultrasound and exercise groups at day 10 follow-up and it was continued through to the 6 week

follow-up.

Table 5 gives the mean difference between groups and significance levels with a CI of 95 % given for the patient rated tennis elbow evaluation (PRTEE) pain over time.

Table 5: PRTEE pain- Mean differences, 95% CI and significance

PRTEE pain	Groups	Mean difference	Significance level	95 % Confidence Interval
10 Days	Exercise: Injection	8.2	0.02	0.9 to 15.4
	Ultrasound: Injection	10.1	0.004	2.8 to 17.4
	Exercise: Ultrasound	-3.6	0.5	-11.9 to 4.6
6 Weeks	Exercise: Injection	7.7	0.059	-0.2 to 15.6
	Ultrasound: Injection	11.4	0.003	3.4 to 19.4
	Exercise: Ultrasound	-2.6	0.7	-11.1 to 5.9

There was a statistically significant difference which was found for the measure in patient rated tennis elbow evaluation (PRTEE) pain from the baseline value between the injection therapy group and both the exercise and ultrasound groups at day 10 follow-up which was maintained only between injection

therapy group and ultrasound group through to the endpoint of 6 weeks.

Table 6 gives the mean difference between groups and significance levels with a CI of 95 % given for the patient rated tennis elbow evaluation (PRTEE) function over time.

Table 6: PRTEE function- Mean differences, 95% CI and significance

PRTEE function	Groups	Mean difference	Significance level	95 % Confidence Interval
10 Days	Exercise: Injection	7.7	0.08	-0.6 to 15.9
	Ultrasound: Injection	11.3	0.005	2.9 to 19.7
	Exercise: Ultrasound	-3.6	0.5	-11.5 to 4.6
6 Weeks	Exercise: Injection	8.4	0.054	-0.1 to 16.9
	Ultrasound: Injection	11.0	0.009	-2.4 to 19.7
	Exercise: Ultrasound	-2.6	0.7	-11.1 to 5.9

There was a statistically significant difference which was found for the measure in patient rated tennis elbow evaluation (PRTEE) function from the baseline value between the injection therapy group and the ultrasound group at day 10 follow-up

which was sustained through to the endpoint of 6 weeks.

Table 7 gives the mean difference between groups and significance levels with a CI of 95 % given for the patient rated tennis elbow evaluation (PRTEE) total over time.

Table 7: PRTEE total - Mean differences, 95% CI and significance

PRTEE total	Groups	Mean difference	Significance level	95 % Confidence Interval
10 Days	Exercise: Injection	15.6	0.04	0.9 to 30.4
	Ultrasound: Injection	21.4	0.003	6.5 to 36.3
	Exercise: Ultrasound	-5.8	0.6	-20.5 to 9
6 Weeks	Exercise: Injection	17.5	0.03	1.8 to 33.2
	Ultrasound: Injection	22.4	0.003	6.5 to 38.2
	Exercise: Ultrasound	-4.9	0.7	-20.6 to 10.8

There was a statistically significant difference which was found for the measure in patient rated tennis elbow evaluation (PRTEE) total from the baseline value between the injection therapy group and both the ultrasound and the exercise group at

10 days which was sustained through to the 6 week endpoint.

Table 8 illustrates the mean between significance levels and groups at CI of 95% for the pain free grip strength over time.

Table 8: PFG strength – Mean difference, significance and 95% CI

PFG	Groups	Mean difference	Significance	95 % CI
6 Months	Exercise: Injection	1.7 kg	0.9	-8 to 11.4
	Ultrasound: Injection	0.04 kg	1	-11.5 to 11.6
	Exercise: Ultrasound	1.7 kg	0.9	-9.6 to 12.9

No significant difference was found between groups for pain free grip strength.

Table 9 illustrates the mean difference between significance

level and groups with 95% CI for the patient rated tennis elbow evaluation pain over time.

Table 9: PRTEE pain – Mean difference, significance and 95% CI

PRTEE pain	Groups	Mean difference	Significance	95 % CI
6 Months	Exercise: Injection	-9.3	0.08	-19.6 to 0.9
	Ultrasound: Injection	-3.6	0.75	-15.8 to 8.5
	Exercise: Ultrasound	-5.7	0.5	-17.4 to 6

No significant difference between groups was found for patient rated tennis elbow evaluation pain. However, a MCID of 5 was obtained between the ultrasound and injection groups and the exercise group.

Table 10 illustrates the mean between groups and significance levels at 95% CI for the patient rated tennis elbow evaluation function over time.

Table 10: PRTEE function – Mean difference, significance, and 95% CI

PRTEE function	Groups	Mean difference	Significance	95% CI
6 Months	Exercise: Injection	-5.8	0.4	-17.2 to 5.6
	Ultrasound: Injection	-2.6	0.9	-16.1 to 10.9
	Exercise: Ultrasound	-3.2	0.8	-16.3 to 9.8

No significant difference was found between the groups for patient rated tennis elbow evaluation function. However, a MCID of 5 was obtained between the injection and exercise group.

Table 11 illustrates the mean difference between groups and the significance levels with 95% CI for the patient rated tennis elbow evaluation total over time.

Table 11: PRTEE total – Mean difference, significance and 95% CI.

PRTEE total	Groups	Mean difference	Significance	95% CI
6 Months	Exercise: Injection	-15	0.2	-35.4 to 5.3
	Ultrasound: Injection	-6.2	0.8	-30.3 to 17.9
	Exercise: Ultrasound	-8.9	0.6	-32.1 to 14.4

No significant difference between groups was found for patient rated tennis elbow evaluation total. However, a MCID of 10 was obtained between the injection and exercise groups only.

At 10 days exercise therapy was found to be the least effective and ultrasound was least effective at 6 weeks. However, our results were converse in the long term at 6 months, with exercise found to be the most effective and injection found to be the most effective. In spite of this no significant differences were found between the three treatment groups.

Discussion

In the short term group analysis, a minimum clinically important difference for pain free grip was found between the injection therapy group and the ultrasound and exercise group at 10 days with the results maintained the same till 6 weeks. No difference was found between the ultrasound and exercise groups in the short term either at day 10 follow-up or at 6 weeks. There was marked increase in the pain free grip in the injection therapy group which supports the fact that injection therapy due to its immediate action in pain relief enables greater amount of grip strength as compared to the individuals receiving the other two treatment modalities.

This is supported by the minimum clinically important difference in the PRTEE pain that was found between both the ultrasound and exercise groups and the injection therapy group at 10 days which is sustained till the follow-up at 6 weeks. No significant difference was found between the exercise and ultrasound groups at either 10 days or 6 weeks, however it was found that between the injection therapy and ultrasound groups there was a significant difference at 10 days which was maintained at 6 weeks. A minimum clinically important difference in PRTEE function was found between the exercise and ultrasound groups and the injection group at 10 days and 6 weeks. No significant difference was found between the exercise group and ultrasound group at 10 days or at 6 weeks. There was marked increase in the function in the group receiving injection therapy at day 10 and this continued to improve till 6 weeks. This is similar to the findings of increased pain free grip and reduced pain seen in the short term in the injection group. A minimum clinically important difference for PRTEE total was found in between the ultrasound and exercise groups and the group receiving injection therapy at 10 days which was maintained to 6 weeks. No difference was found between the exercise and ultrasound groups at either 10 day or at 6 weeks.

So to summarize, both minimum clinically important difference and a significant difference is evident for pain free grip and

PRTEE total which highlighted that injection therapy is effective immediately at day 10 and the result is sustained and continues to improve till the follow-up at 6 weeks. These results that support the treatment of injection therapy for its effectiveness in the short term is well supported in literature by the findings of Smidt *et al.* (2002) [21] and Bisset *et al.* (2005) [25]. Ultrasound therapy has an immediate effect while both exercise and injection have an effect that increases steadily between 10 days and 6 weeks.

As per protocol, analysis was done at 6 months to find out the effectiveness of the three modalities of treatment in the long term. There was no difference of any significance between groups for pain free grip in the long term follow-up at 6 months. There is a marked difference in pain free grip for the injection therapy group at 6 month follow-up in the long term, whereas for both the exercise and ultrasound group an increase in pain free grip continues. There was no difference of any significant value between groups for PRTEE pain although a minimum clinically important difference between exercise groups and both the injection and ultrasound groups in the long term. This minimum clinically important difference was found also between the injection therapy group and exercise group for PRTEE function and total scores. There is a marked increase in pain and reduction in function for the injection therapy group from the long term at 6 month follow-up back to the baseline levels. This was supported in literature by findings of study of Hay *et al.* (1999) [40], Smidt. *et al.* (2002) [21] and Bisset *et al.* (2006) [25] that all were of the opinion that the effectiveness of injection therapy in the short term was not carried into the long term and there were more favourable outcomes for grip strength and relief of pain with physiotherapy.

Previous studies conducted by Bisset *et al.* (2006) [25] and Smidt *et al.* (2002) [21] concluded that injection therapy has superior effectiveness in the short term with both minimum clinically important difference and statistically significant value supporting this when compared to exercise and physiotherapy. However, Bisset *et al.* (2006) [25] and Smidt *et al.* (2002) [21] found that injection was significantly worse when compared to physiotherapy in the long term. These conclusions are supported by findings of analysis of Bisset *et al.* (2006) [25], Tonks *et al.* (2007) [139], Smidt *et al.* (2002) [21] and Coombes *et al.* (2010) [33]. Studies conducted by Bisset *et al.* (2007) [36] and Smidt *et al.* (2005) [6] found similar results for pain in patients who received injection therapy between the studies of Bisset *et al.* (2006) [25] and Hay *et al.* (1999) [40] with that of Smidt *et al.* (2002) [21]. They found a marked reduction in the pain of lateral

epicondylitis with the recurrence of symptoms after 6 months. However, they found that pain and disability relapsed in only one third of patients at 6 months in the long term supporting Hamilton *et al.* (1986) ^[135]. This can be as a result of loss of power at 6 months although study by Coombes *et al.* (2010) ^[33] suggested that effective of single injection is much higher. Also, all conservative treatment must be exhausted before a repeat injection is given which was supported by Bisset *et al.* 2006) ^[25] and Smidt *et al.* (2002) ^[21] who gave up to 2 or 3 injections.

The reason for the recurrence of symptoms suggested that steroids have side effects in the long term or that due to immediate resolution of symptoms the patients overuse their elbows too early. However, if steroids did have side-effects one would expect a higher incidence of reported adverse drug reactions following its injection for lateral epicondylitis (Gaujoux *et al.* 2009) ^[4]. However, if patients are well informed about the injection therapy superiority in the short term and the chance of them remaining symptom free in the long term, as supported by Hamilton *et al.* (1986) ^[135], one can expect a large percentage of patients who would be willing to take those odds.

Also, in our study continuous 3 MHz therapeutic ultrasound for 5 minutes demonstrated that an increase in skin temperature of 0.5 degree Celsius for 5 to 10 minutes following treatment optimised the process of healing which was evident with thermal difference reduction from 10 days. The accumulations of the effects of therapeutic ultrasound have shown with improvement in all outcomes by 6 weeks which are carried forward in the long term. Also, it was concluded that for the resolutions of symptoms exercise is not a pre-requisite which is shown by minimum clinically important difference by 10 days in fatigue and 6 week increase in function. Therapeutic ultrasound can be advocated as an alternative treatment for patients who are unwilling for injection therapy.

This study also showed the slow improvement overtime in the patients receiving exercise therapy with changes in fatigue noticed at only 6 weeks and function change at 6 months when exercise is ranked as most effective. In comparison to study by Smidt *et al.* (2002) ^[21], it was surprising to find patients having a strong aversion to exercise due to difficult in performing exercises in the short term.

Conclusion

In conclusion, the results from our study showed that all three treatment groups were effective showing improvement over time at different intervals of time for different aspects of the clinical picture. The result for injection therapy in our study was that corticosteroid injection has superior effectiveness in the short term when compared with exercise therapy and therapeutic ultrasound. Similarly, in the long term, results of our study supported that exercise was the most effective followed by therapeutic ultrasound and that the effectiveness of exercise and ultrasound in comparison to injection therapy was higher in the long term with injection corticosteroid therapy being the least effective.

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