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ORTHOPAEDIC SURGERY

USG-guided injection of corticosteroid for lateral epicondylitis does not improve clinical outcomes: a prospective randomised study

**Deniz Gulabi[1] · Mehmet Ali Uysal[2] · Ahmet Akça[3] · Ilker Colak[2] ·
Gultekin Sıtkı Çeçen[4] · Seyitali Gumustas[4]**

Abstract

Background Corticosteroid injection used to be the treatment of choice for lateral epicondylitis. Most injections are performed blindly. In the blinded technique, it could be difficult to determine the exact pathological localisation. The purpose of this single-blinded, randomised controlled clinical study was to compare the clinical therapeutic effects of blinded and USG-guided corticosteroid injection therapy in lateral epicondylitis.

Patients and methods Forty patients with chronic lateral epicondylitis were included in this clinical trial. The patients were randomly allocated to blinded group or USG-guided injection group according to a computer-generated randomisation list. All blinded injections were administered by an orthopaedic surgeon and all ultrasound-guided injections were made by a radiologist experienced in this technique. All patients were injected under aseptic conditions using 40 mg/2 mL methylprednisolone acetate. The outcomes of both treatments were assessed by an independent assessor at pre-injection, then at 6-week and 3- and 6-month follow-up assessments. The assessor evaluated the q-DASH, VAS, and grip strength scores.

Results No statistically significant difference was determined between the groups in respect of the Q-DASH and grip strength scores preoperatively and at 6 weeks and 3 and 6 months post-injection. No statistically significant difference was determined between the groups in respect of the VAS scores preoperatively and at 6 weeks and 6 months. No systemic or local complications were reported during the treatment.

Conclusion There was no statistically significant difference compared to the blinded injection technique, and the mean score differences between the groups are of no clinical relevance.

Keywords Lateral epicondylitis · Corticosteroid injection · Ultrasound-guided

✉ Deniz Gulabi
dgulabi@yahoo.com

Mehmet Ali Uysal
drmehmetaliuysal@hotmail.com

Ahmet Akça
ahmtakca@yahoo.com

Ilker Colak
drilkercolak@hotmail.com

Gultekin Sıtkı Çeçen
gcecen2002@yahoo.com

Seyitali Gumustas
seyitali_gumustas@yahoo.com

[1] Kartal Dr. Lütfi Kırdar Training and Research Hospital, Saglik Bilimleri University, Semsi Denizer Cad. E5, Yanyol Cevizli Kavsagı Kartal, Kartal, 34890 Istanbul, Turkey

[2] Kartal Dr. Lütfi Kırdar Training and Research Hospital, Kartal, 34890 Istanbul, Turkey

[3] Radiology Department, Dr. Lutfi Kirdar Training and Research Hospital, Saglik Bilimleri University, Kartal, Istanbul, Turkey

[4] Orthopaedic and Traumatology Department, Kartal Dr. Lutfi Kirdar Training and Research Hospital, Saglik Bilimleri University, Istanbul, Turkey

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Introduction

Lateral epicondylitis (LE), also known as tennis elbow, is the most common cause of lateral elbow pain [21]. It affects 2–3% of the population, resulting in significant activity restriction and economic burden [7, 25]. Several conservative treatment modalities have been described in literature with variable clinical outcomes [2, 16]. Autolog blood, platelet-rich protein (PRP), botulinum toxin, glycosaminoglycan polysulfate, glucocorticoid, and dextrose injections are widely used for LE treatment [6, 15, 18, 26]. However, there is no consensus on the optimal conservative treatment option.

Local corticosteroid (CS) injection represents a common approach to the treatment of several musculoskeletal disorders. It is a simple, inexpensive procedure, aimed at reducing pain and other symptoms associated with the inflammatory process. Glucocorticoid injection has been widely used in the conservative treatment of musculoskeletal pathologies since the 1950s [15]. CS injection used to be the treatment of choice for LE. CS suppresses the immune system by suppressing the pro-inflammatory proteins [10] but has the potential side-effects of lipodystrophy, skin pigmentation changes, and tendon atrophy/ruptures. Most injections are performed blindly without any imaging guidance. In the blinded technique, it could be difficult to determine the exact pathological localisation. Verhaar [25] stated that as the extensor carpi radialis brevis is the most commonly involved tendon in LE pathology, the injection should be directed to the humeral insertion of this tendon in the blinded technique.

Ultrasound is widely used in the diagnosis of musculoskeletal pathologies and especially for the detection of pathological changes in tendons [12]. Ultrasonography enables visualisation of the tendon structures around the elbow [1, 17]. USG-guided injection is a novel minimally invasive approach which involves the application of a drug through a needle. The needle is directed into the soft tissue lesions under direct visualisation with a US machine. The technique stimulates a local inflammatory response in which there is increased cellular activity and repair of the affected area.

The purpose of this single-blinded, randomised controlled clinical study was to compare the clinical therapeutic effects of blinded and USG-guided corticosteroid injection therapy in lateral epicondylitis during a period of 6 months. The hypothesis was that USG-guided injections do not improve clinical outcomes.

Patients and methods

This prospective randomised controlled trial was approved by the Local Ethics Committee of with decision number, 2016/ 514-88-20. Between June 2015 and January 2016, 44 patients were evaluated for eligibility and 40 patients with chronic lateral epicondylitis were included in this single-blinded randomised clinical trial. The inclusion criteria for the study were an age range of 18–75 years, clinical diagnosis of chronic LE ongoing for at least 3 months, pain intensity of >5 on the visual analogue scale (VAS) [23], failure of previous conservative treatments (rest, ice pack, and NSAID), capable of completing the questionnaires, and signing the consent form. The exclusion criteria were patient choice not to participate, or a documented ipsilateral upper extremity musculoskeletal condition (other than elbow tendinosis). At the time of enrolment, the same hand surgeon clinically confirmed the diagnosis by palpation to reveal the characteristic location of pain and tenderness in the lateral epicondyle. On the basis of this clinical examination, four patients did not satisfy the inclusion criteria due to suspected peripheral nerve entrapment syndrome (two anterior interosseous nerves and two posterior interosseous nerves). Thus, the study group comprised 40 patients. All patients were informed in detail with an oral presentation of the scope and procedures of the study, and written informed consent was obtained. The patients were randomly allocated to blinded group or USG-guided injection group according to a computer-generated randomisation list.

Injection procedure

All blinded injections were administered by an orthopaedic surgeon (…) certified in hand surgery, and all ultrasound-guided injections were made by a radiologist (…) experienced in this technique. All patients were injected under aseptic conditions using 40 mg/2 ml methylprednisolone acetate (Depo-Medrol, Pfizer, Italy). A 26-gauge needle was used for the injections in both groups. At the most tender point over the lateral epicondyle of the involved elbow, 2 ml methylprednisolone (40 mg/ml) was injected under septic conditions in the outpatient room.

Ultrasonography was applied using a 5–7.5 MHz linear array transducer on a Toshiba Aplio Diagnostic Ultrasound System (Toshiba Medical Systems, Co, Ltd, Otawara, Japan). The probe was placed along the lateral aspect of the elbow parallel to the longitudinal axis of the common extensor tendon. The radial head, radiohumeral joint, lateral epicondyle, and common extensor tendon were visualised. The skin was sterilised and the USG probe was
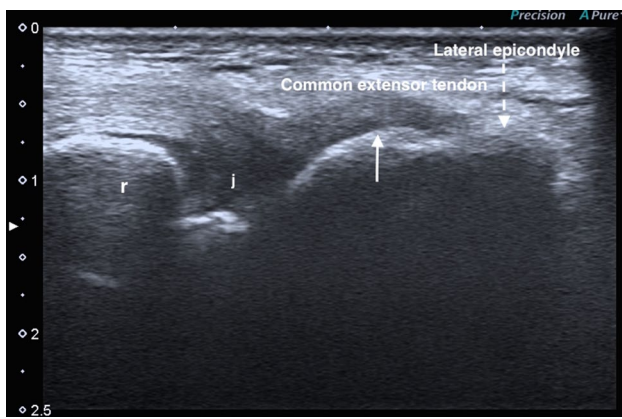
Fig. 1 Transverse plane ultrasonography shows the radial head (*r*), common extensor tendon, lateral epicondyle (*dotted white line*), and joint space (*j*). *Solid white line* shows the thickening and the hypoechogenicity of the common extensor tendon
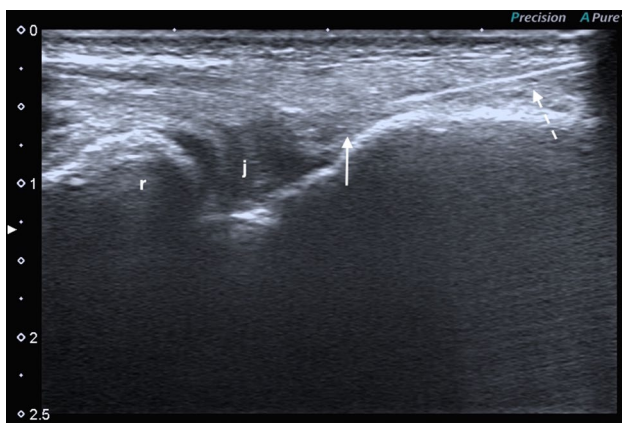
Fig. 2 2 ml methylprednisolone 40 mg/ml injected particularly to the hypointense area of common extensor tendon via fine needle (*white dotted line*). *White line* shows the injected drug

enclosed in a sterile cover. After visualitaion of the tip of the needle at the exact site (hypointense area), 40 mg/2 ml methylprednisolone acetate was injected (Figs. 1, 2).

Post-injection follow-up assessment

After the injection, the patients were rested for 30 min and were advised against massage or hot fomentation. Ice packs or NSAID were recommended in case of any discomfort. For both groups, no further physical therapy or splinting was recommended. The outcomes of both treatments were assessed by an independent assessor at pre-injection, then at 6-week and 3- and 6-month follow-up assessments. The assessor evaluated the q-DASH, VAS, and grip strength scores. The assessor was blinded to the injection technique and performed all assessments twice in 1 day. The mean value of

each score was used for the statistical analysis. The Quick-DASH is a validated short version of the DASH questionnaire, originally designed to assess the physical function and symptoms in patients with musculoskeletal disorders of the upper limb [14]. The QuickDASH is a self-reporting questionnaire consisting of 11 questions (from the 30 items of the original version), investigating symptoms and functional tasks. Like the original version, the QuickDASH score ranges from 0 (no disability) to 100 (severest disability). The VAS consists of a 10-cm line marked at one end with "no pain" and at the other end with "worst imaginable pain". Any early or delayed complications such as haemorrhage, hypopigmentation, atrophy of subcutaneous fat, infection, and tendon rupture which developed immediately following the injection, or during the follow-up period were recorded.

Statistical analysis

For the statistical analysis of the data obtained in the study, the NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) program was used. G'Power (v3.1.9.2) program was used to perform power analysis. The power of the study is stated as 1- Beta (beta = Type 2 error probability). In a study designed by VK Gautam et al. [10], effect size (*d*) was calculated as the main difference between pre-injection and six-month VAS score. In effect size calculation, Cohen's d statistics was used. The sample size calculated was 20 patients per group, so that this study had a power of 80% with type 1 error rate $\alpha = 0.05$, $d = 0.919$. When evaluating the study data, descriptive statistical methods were applied (mean, standard deviation, median, frequency, percentage, minimum, maximum). In the comparison of two groups of quantitative data showing normal distribution, the Student's *t* test was applied, and for those not showing normal distribution, the Mann–Whitney *U* test was used. The Yates Continuity Correction test (Yates corrected χ^2) was used for the comparison of qualitative data. A value of $p < 0.05$ was accepted as statistically significant.

Results

Of the 45 patients recruited for the study, 40 completed the 6-month follow-up period, 20 in each group. The study could not be completed by four patients because they did not satisfy the inclusion criteria. The mean age at the time of treatment was 34.38 ± 7.76 years (range 21–49 years), the male/female ratio was 30:10, and the dominant arm was involved in 30 patients (75%). The demographic characteristics of the 40 subjects who completed the study are shown in Table 1. Overall, the two groups were similar at baseline. No significant differences were found between the groups

Table 1 Demographic characteristics of the groups

	Blinded ($n = 20$)	USG ($n = 20$)	p
Age (years)			
Min–max (median)	21–49 (35.5)	21–47 (35)	0.920[a]
Mean ± SD	34.25 ± 8.05	34.50 ± 7.67	
Gender; n (%)			
Male	16 (80.0)	14 (70.0)	0.715[b]
Female	4 (20.0)	6 (30.0)	
Affected side; n (%)			
Dominant	16 (80.0)	14 (70.0)	0.715[b]
Non-dominant	4 (20.0)	6 (30.0)	

[a]Student's t test

[b]Yates Continuity Correction test

in any variable ($p > 0.05$). All had been treated in different ways before participating in this study.

The outcome variables measured at baseline and at 6 weeks and 3 and 6 months post-intervention for the USG-guided and blinded injection groups are shown in Tables 2, 3, and 4. No significant differences were determined between the two groups in the baseline values for the VAS, Q-DASH, and grip strength scores ($p > 0.05$).

No statistically significant difference was determined between the groups in respect of the VAS scores preoperatively and at 6 weeks and 6 months ($p > 0.05$) (Table 1). At 3 months post-injection, the VAS scores of the blinded application group were statistically significantly higher ($p = 0.028$, $p < 0.05$). In both groups, the improvement observed in the VAS scores deteriorated towards the 6th month and approached pre-injection scores.

No statistically significant difference was determined between the groups in respect of the Q-DASH scores

Table 2 VAS scores of the groups

VAS score	Blinded ($n = 20$)	USG ($n = 20$)	p
Preop			
Min–max (median)	74–87 (80.5)	76–87 (79.5)	0.869[a]
Mean ± SD	80.85 ± 4.20	80.65 ± 3.39	
6 weeks			
Min–max (median)	24–40 (26.5)	23–38 (26)	0.500[a]
Mean ± SD	27.55 ± 3.58	26.80 ± 3.38	
3 months			
Min–max (median)	50–68 (59.5)	53–61 (56.5)	0.028[a,*]
Mean ± SD	59.05 ± 4.21	56.55 ± 2.50	
6 months			
Min–max (median)	68–87 (75.5)	71–85 (77.5)	0.456[a]
Mean ± SD	76.55 ± 5.23	77.60 ± 3.38	

*$p < 0.05$

[a]Student's t test

Table 3 DASH scores of the groups

DASH score	Blinded ($n = 20$)	USG ($n = 20$)	p**
Preop			
Min–max (median)	61.4–72.7 (67.1)	61.4–77.3 (67.1)	0.978
Mean ± SD	66.84 ± 4.25	67.06 ± 4.51	
6 weeks			
Min–max (median)	2.3–15.9 (6.8)	2.3–15.9 (4.5)	0.439
Mean ± SD	7.61 ± 4.06	6.70 ± 4.01	
3 months			
Min–Max (Median)	20.5–29.5 (25)	20.5–29.5 (22.7)	0.397
Mean ± SD	24.89 ± 2.89	24.10 ± 3.23	
6 months			
Min–Max (Median)	47.7–68.2 (56.8)	47.7–68.2 (54.5)	0.403
Mean ± SD	58.39 ± 6.90	56.57 ± 6.08	

Mann–Whitney U test

**$p < 0.01$

preoperatively and at 6 weeks and 3 and 6 months post-injection ($p > 0.05$) (Table 3). As for the VAS scores, the best DASH scores were obtained at 6 weeks post-injection, and toward 6 months they started to approach the baseline values.

No statistically significant difference was determined between the groups in respect of the GRIP scores preoperatively and at 6 weeks, 3 months, and 6 months post-injection ($p > 0.05$) (Table 4). The best GRIP scores were obtained at 6 weeks post-injection and toward 6 months they started to approach the baseline values.

No systemic or local complications were reported during the treatment.

Discussion

Local injections of CSs have remained until now the most widely used method to treat LE [15]. The effect of steroid injection is related to the anti-inflammatory property. Studies have shown an increase in the levels of substance P in patients with LE [3]. Corticosteroids have been shown to reduce substance P levels, so that steroid injections may provide relief for pain in LE [3, 4].

In the present study, there was a statistically significant improvement in VAS, Q-DASH, and grip strength scores at the 6-week follow-up assessments. This improvement was thought to be related to the anti-inflammatory effect of steroids by reducing the substance P levels in the site of inflammation. However, the improvement of the pain and clinical scores deteriorated as time passed. These results were observed to be in accordance with previously published articles. Smidt et al. [24] performed a randomised controlled study of 185 patients, comparing

Table 4 GRIP scores of the groups

GRIP score	Blinded ($n = 20$)	USG ($n = 20$)	p^a
Preop			
Min–max (median)	49–86 (80)	40–87 (80)	0.594
Mean ± SD	75.20 ± 13.01	70.50 ± 16.97	
6 weeks			
Min–max (median)	60–110 (98.5)	47–110 (99.5)	0.892
Mean ± SD	91.25 ± 16.34	88.60 ± 21.70	
3 months			
Min–max (median)	57–99 (87)	46–98 (88)	0.786
Mean ± SD	83.30 ± 14.18	79.00 ± 18.17	
6 months			
Min–max (median)	53–88 (81.5)	45–90 (83)	0.914
Mean ± SD	77.45 ± 12.08	73.85 ± 16.61	

**$p < 0.01$

^{a}Mann–Whitney U test

corticosteroid injections with physiotherapy (PT) and a wait-and-see protocol. It was reported that corticosteroids performed better than PT and the wait-and-see groups at 6 weeks (92 vs 47 and 32% success, respectively), but these patients were worse at 52 weeks (69 vs 91% and 83% success, respectively) [24]. Ozturan et al. [20] demonstrated better outcomes of corticosteroid treatment at 4 weeks than at 1 year. Coombes et al. [5] reported inferior outcomes in patients exposed to steroids in a randomised controlled trial at 1-year follow-up compared with a non-operatively treated control group. In a prospective randomised study by Hay et al. [13], no differences were found between the corticosteroid injection group and naproxen group at the 12-month follow-up examination. The reduction of the improvement in the long-term follow-ups can be considered to be related to the side-effects of the steroids. Steroids may weaken the tendon after injection or patients may further aggravate the tendinosis due to the initial short-term pain relief. Furthermore, given that lateral epicondylitis is thought to result from repetitive microtrauma, rather than an inflammatory process, it is not surprising that corticosteroid injections do not provide long-term relief [11, 22].

Steroid injections are not without risks. In a study by Gaujoux-Viala, patients received injections for shoulder or elbow tendonitis, and it was reported that 10.7% of patients had transient pain after the injection and 4.0% had skin atrophy or depigmentation after steroid injection [9]. No skin atrophy, tendon ruptures, or infections were reported in the present study group. This could be related to the number of injections as previous reports have emphasised that when more than two peritendinous infiltrations are applied, some undesirable side-effects such as local necrosis, tissue atrophy, and tendon tearing may occur [8, 19].

One of the main problems in comparing the clinical outcomes after different injection therapies is the variation of injection techniques. The most commonly used technique is blinded injection to the most painful localisation over the lateral epicondyle. However, using this technique, it is very difficult to localise the exact point of the tenderness. In order to overcome this problem, the USG-guided injection technique was used in the current study. The sterile covered USG probe was centred over the most significant hypoechoic area in the common extensor tendons. In a cadaveric study by Keijers et al. [15], it was reported that only a third of the injections were (partially) localised in the ECRB tendon and 60% had intra-articular localisation. In the current study, there was no evidence to determine the presence of injection fluid in the soft tissue in the blinded group as no imaging or dissection was carried out after the injections. Although the pain scores and clinical scores were better in the USG-guided group, these results were not statistically significant, and the mean difference of 2.5:100 ratio has no clinical relevance. The favourable scores of the blinded group are related to the local effect of steroid injection. The steroid fluid could have diffused to the nearby area, providing beneficial effects.

There were several limitations in this study. First, the sample size was small and secondly, due to the high cost, no post-injection USG was applied to check the distribution of the injection fluid and tendon and osseous changes.

In conclusion, on the basis of the results of the current study, it can be considered that although USG-guided steroid injection for LE treatment had favourable outcomes, there was no statistically significant difference compared to the blinded injection technique, and the mean score differences between the groups are of no clinical relevance. Additional studies including post-injection imaging to demonstrate the morphological changes in tendons are needed to confirm these observations.

Compliance with ethical standards

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