Original Article

Comparison of the Efficacy of Kinesiotaping and Extracorporeal Shock Wave Therapy in Patients with Newly Diagnosed Lateral Epicondylitis: A Prospective Randomized Trial

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Abstract

Objective: This study aimed to evaluate the efficacy of kinesiotaping (KT) and Extracorporeal Shock Wave therapy (ESWT) for patients with acute/subacute (complaints exist <3 months) lateral epicondylitis(LE) in terms of pain control, hand grip strength, and functionality. **Methods:** In total, 40 patients with newly diagnosed LE (27 females and 13 males with a mean age of 42.6 ± 8.4 years) were randomly allocated to receive a 3-week treatment of either KT for 5 days a week (n = 20) or ESWT once a week (n = 20). Patients were evaluated by the visual analog scale (VAS), hand grip strength (HGS), Roles and Maudsley scale (RMS), and quick DASHat baseline, after 4 weeks, and after 8 weeks of the treatment. **Results:** Both KT and ESWT could achieve significant improvements in VAS, HGS, RMS, and Q-Dash after 4 and 8 weeks of treatment. However, these improvements were more prominent in the KT group compared with ESWT after 4 and 8 weeks. KT group achieved lower VAS scores, higher HGS, lower RMS compared with ESWT (all $P < 0.05$). **Conclusion:** Both KT and ESWT could significantly improve pain, hand strength, and functionality in patients with newly diagnosed LE. However, these improvements were more prominent in the KT group. Considering the feasibility and the low cost of KT compared with ESWT, we recommend that KT should be considered for treating patients with newly diagnosed LE.

Keywords: *Kinesiotaping, lateral epicondylitis, pain, shockwave*

Introduction

Lateral epicondylitis (LE) or tennis elbow is a chronic degeneration of the extensor tendons of the wrist especially the extensor carpi radialis brevis at their attachment to the lateral epicondyle. LE affects about 1%–3% of the general population during their middle age.[1-3] The causes of LE are repetitive stress, tendon injury, and overuse of the wrist extensors, which leads to tendinosis, microtrauma, and tendon treat.[2,3] However, in most of LE patients, the cause of LE cannot be identified.[4]

Patients with LE are first treated with nonsteroidal anti-inflammatory drugs, corticosteroid injections, and bracing. The treatment should be accompanied by a rehabilitation program to restore the functionality, power, and activity of the tendon. Surgery is the treatment of choice for patients who are not responding to nonsurgical treatments; about 90% of LE patients recover within 1 year without the need for surgery.[5]

Kinesiotaping (KT) is a noninvasive treatment to relive pain and musculoskeletal functions. KT improves blood and lymph circulation by removing tissue fluid and bleeding that are supposed to be attributed to pain and muscle and fascia function.[6] Several studies have shown that KT therapy is effective for the treatment of LE.[7] A

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recent RCT by Mansiz-Kaplan *et al*.[8] showed that KT is an effective treatment for LE when compared with NSAIDs; beside improving pain and clinical parameters, KT could significantly improve the tendon thickness and radial nerve cross sectional area.[8] In another recent RCT, KT was compared with sham taping; KT showed superior improvements in pain scores and grip strength.[9]

Extracorporeal shock wave therapy (ESWT) promotes revascularization and stimulates nerve fibers to produce analgesia and induce tissue and bone healing and functional improvement.[5,10] Therefore, ESWT has been considered as a possible treatment option for patients with LE.[11,12] Rompe *et al*.[13,14] demonstrated the efficacy of ESWT in two randomized controlled trials (RCTs). There results were further confirmed by Pettrone and McCall who reported a significant improvement of pain after 12 months.[15] Other studies showed no evidence of clinical benefit from ESWT[16-18] especially on newly diagnosed patients.[19] A Cochrane review analyzed data of >1,000 LE patients and showed that some patients achieved significant benefits; however, current evidence is not sufficient to confirm the efficacy of ESWT for LE and further studies are still needed to confirm its efficacy. In a recent RCT, KT and ESWT were evaluated in patients with LE, both interventions showed significant improvements in pain score, hand grip strength, and functionality. Eraslan *et al*. analyzed results shortly after the treatments and there was no information about post-treatment process. Therefore, this study was designed to evaluate patients' well-being in post-treatment processes at first and second months.[2]

Given the insufficient evidence in the literature about the efficacy of ESWT in newly diagnosed patients and the absence of strong evidence about the head-to-head comparison of KT and ESWT, we conducted this RCT to evaluate the efficacy of KT and ESWT in newly diagnosed LE patients in terms of pain improvement, functionality, and grip strength.

Methods

We followed the Consolidated Standards of Reporting Trials (CONSORT) statement guidelines when reporting this randomized trial.[20]

Registration and ethics

This study was approved by the ethics committee of Kocaeli Derince Training and Research Hospital, Kocaeli, Turkey (approval number: 2013/184). Written informed consent was taken from all participants.

Study design

We conducted a single-blinded randomized study of KT and ESWT in 40 consecutive newly diagnosed LE patients. All interventions were carried out by a single physician who did not know the patients' outcome measurements and who was blinded to randomization.

Setting and participant

The study population was defined as patients with LE complaints for <3 months who were diagnosed with LE according to the Southampton Examination Schedule (pain and tenderness on lateral epicondyle and pain during forceful wrist extension).[21] This study was carried out at our Physical Medicine and Rehabilitation outpatient clinic in a tertiary hospital between June 2013 and June 2014.

We excluded patients in the following conditions:

- Patients of age <18 years
- Patients with cervical radiculopathy
- Patients with upper extremity deformities and trap neuropathies
- Patients with history of malignancy
- Patients with endocrine diseases
- Patients with metabolic diseases
- Patients with chronic inflammatory diseases
- Patients with coagulation disorders
- Pregnant women
- Patients with pacemaker
- Patients who received steroid injections
- Patients using physical therapy modalities during a 1-year period

Random allocation to the treatment groups and follow-up

In our study, one of the researchers enrolled the patients who meet the criteria for the participation in the study. Patients were allocated to the intervention by stratified block randomization according to their age and gender to obtain two equal groups. Randomization was performed by an independent person who was not involved in the study. In the first group, patients received KT 5 days a week for 3 weeks; Fascia correction and wrist extensor inhibition technique were applied in accordance with Kase guideline.[22] In the second group, patients received ESWT with 2,000 shock waves with a 1.6 bar intensity and 16-Hz frequency once a week for 3 weeks. Beside the baseline visits, two follow-up visits were conducted 4 and 8 weeks after the intervention.

Our end point was 1 month after the end of treatment. The results were evaluated both shortly after the treatment (4 weeks) and 1 month after the end of treatment (8 weeks).

In total, 61 patients were diagnosed with LE. About 54 patients who met the inclusion criteria enrolled in the study. Seven patients excluded due to having

inflammatory rheumatic disease, radicular pain, and upper extremity surgery. They were randomized into two groups. First group was applied KT and the second group was treated with ESWT. Four patients were lost after first application of KT due to mild erythema and pruritus on the application surface; five patients were lost in the second group due to increased pain severity. Three patients in first group and two patients in second group were lost at the 8th week follow-up. Figure 1 showed patients flow chart.

Outcome measures

Patients were evaluated by visual analog scale (VAS), hand grip strength (HGS), quick disability of the arm, shoulder and hand (Q-DASH) questionnaire, Roles and Maudsley Score (RMS) before the treatment and at 4 and 8 weeks after the treatment.

Visual analog scale

Pain intensity for elbow was scored using a 10-cm horizontal visual analog scale (VAS) on which 0 means no pain and 10 means the worst pain ever experienced.

Hand grip strength score

The maximum grip strength for involved elbow was assessed with a JAMAR dynamometer (JAMAR, Jackson, MI, USA). The mean score of three measurements taken in the position with the arm adducted, the elbow flexed 90˚ and forearm in neutral position was recorded.

Roles and Maudsley score

RMS scale was also used for functional assessment. It evaluates pain during daily life activities and scored as excellent, good, fair or poor.[19]

Quick disability of the arm, shoulder, and hand questionnaire quick disability of the arm, shoulder, and hand questionnaire

The functional evaluation of the upper extremity was assessed with Q-DASH questionnaire. It contains 11 questions and to score the questionnaire at least 10 of 11 questions must be answered. Each question is scored in five-point scale. Calculated final score is ranged between 0 (no disability) and 100 (severe disability).[23]

Statistical analysis

A power analyses was performed by G* power 3.0.10 program to calculate the adequate sample size. To obtain a power of 0.80 [α (Type I error) was 0.05, repeated-measures analysis of variance test] appropriate total sample size was 27 for each group. Data were described as frequencies and percentages for categorical variables. For continuous variables, data normality was tested by Shapiro–Wilk test, and then data were described as mean and standard deviation for normally distributed data and median (IQR) for non-normally distributed data. The two groups were compared using the Student *t*-test or the Mann–Whitney *U*-test in case of normally and non-normally distributed variables, respectively. Outcomes at baseline and two follow-up points were analyzed using two way repeated-measures analysis of variance followed by *post hoc* tests. The *P*-level < 0.05 was considered statistically significant and results were assessed in a confidence interval of 95% All analyses were done by the IBM SPSS version 21.0 software program (IBM Corporation, Armonk, New York).

Results

Demographics and clinical characteristics of the study groups

Our study was completed with 40 patients. Of them, 27/40 were female, and 13/40 were male. The mean age of the study population was 42.65 years. Demographic and clinical data of the patients are summarized in Table 1.

VAS of pain

Mean VAS score at baseline pre-operatively was 7.19 and 7.0 for the KT and the ESWT groups, respectively. After 4 weeks of follow-up, the mean VAS score was significantly lower in the KT group than the ESWT group (2.85 vs. 4.7, $P = 0.01$). After 8 weeks of follow-up, the mean VAS score remained significantly in favor of the KT group than the ESWT group (2.52 vs. 4.0, $P = 0.02$; Figure 2).

HGS score

In terms of the handgrip strength, the mean HGS score in the KT group was significantly higher than the ESWT

Table 1: The demographic and clinical data of the study population

Variable		KT group	ESWT group	*P*
Age (years, SD)		44.8 (8.7)	40.5 (7.9)	0.95
Gender (*n*, %)	Female	14 (70%)	13 (65%)	0.73
	Male	6 (30%)	7 (35%)	
Affected side (*n*,%)	Right	14 (70%)	18 (90%)	0.11
	Left	6 (30%)	2 (10%)	
Job (*n*, %)	House wife	13 (65%)	12 (60%)	
	Student	1 (%5)	0	
	Paid job	6 (30%)	8 (40%)	
Paid duration (days, SD)		44.8 (20.5)	62.5 (28.07)	0.31
VAS score (SD)		7.2 (0.9)	7 (1.1)	0.19
Hand grip strength (kg, SD)		17.3 (5.9)	14.1 (4.7)	0.73
Roles and Maudsley score		3.3 (0.5)	3.4 (0.5)	0.79
Q-DASH		35.8 (10.5)	43.9 (10.1)	0.01

Continuous variables presented as mean (SD); SD=standard deviaition; VAS=visual analogue scale; Q-DASH=Quick Disability of the Arm, Shoulder, and Hand Questionnaire

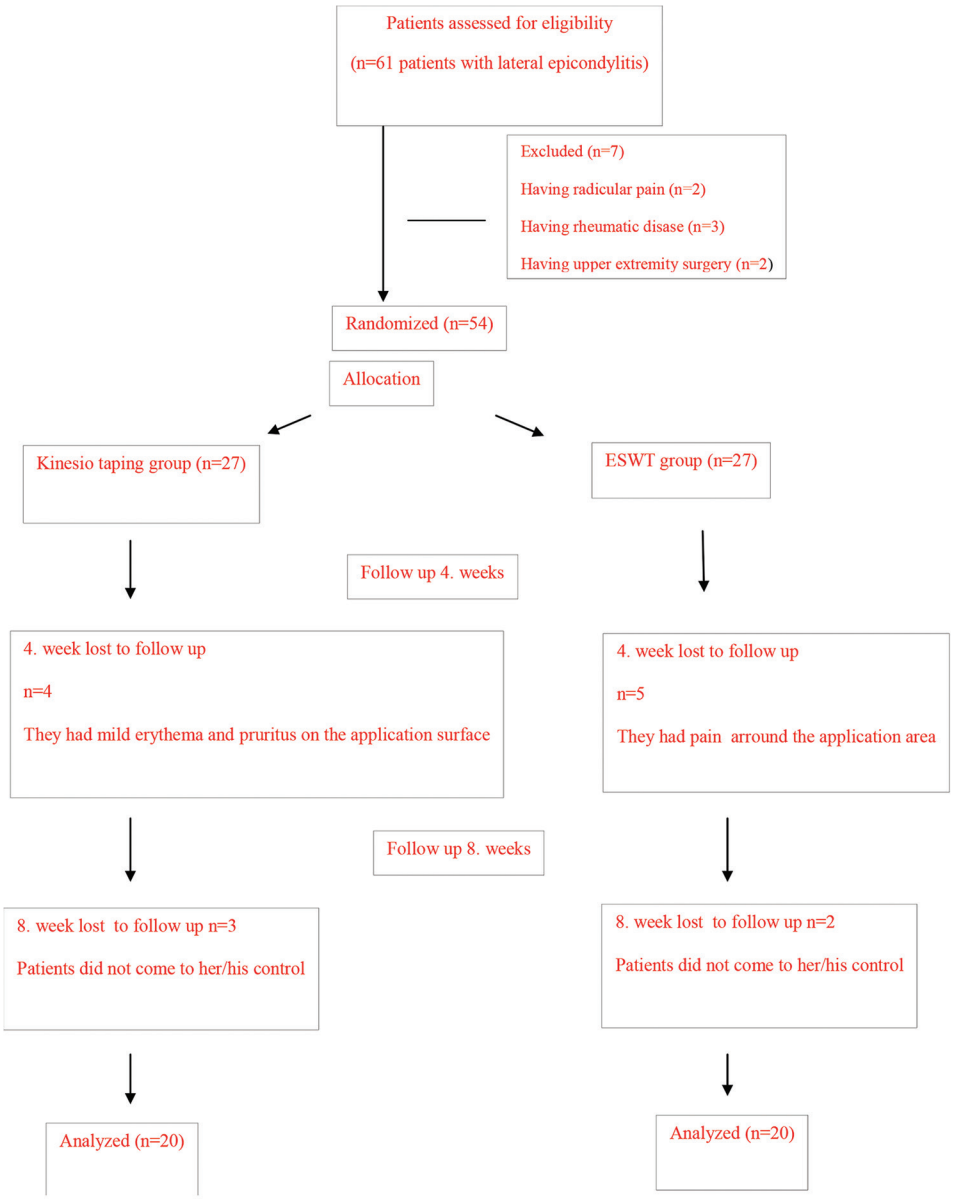

Figure 1: Patient flow chart

group after 4 weeks ($P = 0.009$) and 8 weeks ($P = 0.005$) of the follow-up [Figure 2].

Roles and Maudsley score

Mean RMS at baseline was 3.3 and 3.4 for the KT and ESWT groups, respectively. However, after 4 and 8 weeks of follow-up, there was significantly less RMS scores in the KT score compared with the ESWT group ($P = 0.01$ and $P = 0.02$, respectively; Figure 2).

Quick disability of the arm, shoulder, and hand questionnaire quick disability of the arm, shoulder, and hand questionnaire

After 4 weeks of follow-up, the quick dash score decreased from 25.8 to 18.2 in the KT group and from 43.9 to 30.27 in the ESWT group. At 2-month follow-up, the quick dash score was 14.9 and 24.4 for the KT and the ESWT groups, respectively [Figure 2].

Table 2 points the VAS, HGS, RMS and Q-DASH scores before and after treatment of the two groups. Both of the treatments groups had benefited from the applications at 4th and 8th weeks.

The improvements in clinical variables were compared between two groups. All of the improvements in outcome measurements were better in KT group in baseline-4-week period. Table 3 showed clinical improvements of two groups in terms of baseline-4-week period and baseline-8-week period.

Table 2: Clinical assessments at baseline, 4. and 8. weeks in two treatment groups

	Kinesiotaping group	95% CI		*P**	ESWT group	95% CI		*P**
VAS (mean, SD)								
Pretreatment	7.1 (1.1)	6.7	7.5	<0.001	7.0 (1.1)	6.4	7.4	<0.001
4 week	2.9 (1.2)	2.3	3.3	<0.001	4.7 (1.2)	4.1	5.2	<0.001
8 week	2.4 (1.2)	2.0	2.8		4.0 (1.3)	3.5	4.6	
Hand grip strength								
Pretreatment	17.3 (5.9)	14.6	19.9	<0.001	14.1 (4.7)	12.2	16.3	<0.001
4 week	24.6 (4.2)	22.9	26.7	<0.001	19.1 (6.9)	16.3	22.2	<0.001
8 week	26.8 (4.6)	24.8	28.8		20.6 (7.0)	17.7	23.8	
Roles and Maudsley score								
Pretreatment	3.3 (0.5)	3.1	3.6	<0.001	3.4 (0.5)	3.1	3.6	<0.001
4 week	1.8 (0.4)	1.6	2.1	<0.001	2.5 (0.6)	2.2	2.8	<0.001
8 week	1.7 (0.4)	1.4	1.8		2.2 (0.4)	2.1	2.4	
Q-DASH (mean, SD)								
Pretreatment	35.8 (10.5)	31.1	40.4	<0.001	43.9 (10.5)	39.7	48.1	<0.001
4 week	18.2 (8.3)	14.4	22.1	<0.001	30.2 (13.2)	25.1	36.0	<0.001
8 week	14.9 (7.7)	11.1	18.1		24.4 (11.4)	19.8	29.5	

VAS=visual analog scale; Q-DASH: quick disability of the arm, shoulder and hand questionnaire. *P* values: pretreatment and 4 weeks/pretreatment and 8 weeks

Table 3: Changes in outcome measurements from baseline to first and second months between 2 groups

	ESWT group Mean difference (SD)	Kinesiotaping group Mean difference (SD)	*p*
VAS			
Baseline-4 weeks	2.3 (0.2)	4.2 (3.1)	0.001
Baseline-8 weeks	2.9 (0.2)	4.7 (3.4)	0.001
Hand grip strength			
Baseline-4 Weeks	-4.9 (1.1)	-7.3 (1.1)	0.009
Baseline-8 weeks	-6.5 (1.2)	-9.5 (1.2)	0.005
Roles and Maudsley score			
Baseline-4 weeks	0.8 (0.1)	1.5 (0.1)	0.014
Baseline-8 weeks	1.1 (0.1)	1.6 (0.1)	0.026
Q-DASH			
Baseline-4 weeks	13.7 (2.8)	17.6 (1.9)	0.001
Baseline-8 weeks	19.5 (2.5)	20.9 (2.4)	0.050

VAS=visual analog scale; Q-DASH=quick disability of the arm, shoulder, and hand questionnaire

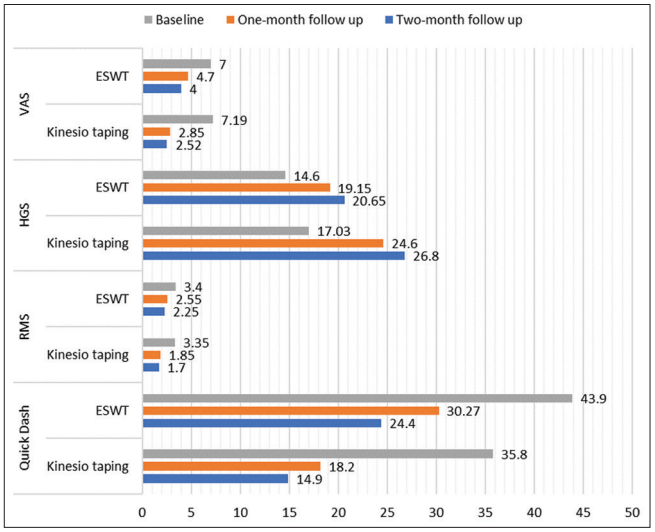

Figure 2: Shows the clinical score at baseline and 4 and 8 weeks after intervention

Discussion

LE patients have decreased quality of life and sports performance owing to the pain and movement restriction. The goal of LE treatment is to reduce pain, prevent further injury, and increase muscle strength to restore functionality. There is no sufficient data in the literature about both the success of nonsurgical treatments for LE.[9] Our study expands the literature by providing information about the efficacy of KT and ESWT in newly diagnosed LE patients after 4 and 8 weeks. This prospective randomized trial shows that both KT and ESWT are effective in improving pain, functionality, and grip strength in patients with newly diagnosed LE. Moreover, KT was superior to ESWT after 4 and 8 weeks of follow-up.

The improvement of pain with KT can be explained that KT improves subcutaneous blood and lymph circulation and removes pain associated mediators from subcutaneous tissue.[9] The other possible mechanisms of pain relief by KT is that keratinocytes act as transducer of mechanical stimuli and cutaneous stretching results in transmitting mechanical stimuli via keratinocytes instead

of pain transmission through the gate control theory. Yen-Ting Cho *et al*.[9] advocated that vertical application might act as elbow brace, and therefore, it reduces stress at lateral epicondyle and they also concluded that parallel application may inhibit the extensor muscle activity thus depress the irritation of enthesis. They found that KT is superior to the sham taping regarding reducing pain during resisted wrist extension. Similarly Eraslan *et al*.[2] found that KT reduces pain in LE. ESWT, another treatment for LE, promotes revascularization and stimulates nerve fibers to produce analgesia. ESWT was used for LE in several studies[17,24,25] Gunduz *et al*.[24] and Notarnicola *et al*.[25] determined lower pain after ESWT seasons in patients with LE. On the other hand, Speed *et al*.[17] did not find a difference in terms of pain reduce between ESWT and sham groups. However it was noted that Speed *et al*.[17] applied ESWT once a month for a total of three sessions. This rare and few allocation may have caused similar results with the sham group. In our study, pain reduced in both treatment groups at early and late control points; in addition, we found better pain scores in KT group as compared with ESWT group. Our results supported Eraslan *et al*.'s[2] results that KT was effective for decreasing pain than ESWT.

The explanation of the improved muscle strength in KT group may be explained by the suggestion of Karahan *et al*.[26] who acknowledged that KT cause a reduction in severity of pain, fascial correction, stabilization, improvement in proprioception which, in turn, leads to increased muscle strength. It is also suggested that the application of KT for a long period might yield long-term effects. Chang *et al*.[27] found no effect of KT on grip strength in healthy athletes following 24 and 72 h of application; they also concluded that short application time might be insufficient to provide enough cutaneous afferent stimulation. A successful treatment and reducing pain would lead to increasing grip strength. This increase is not expected in the period immediately after treatment, but grip strength is likely to improve in later stages of treatment.[2] Studies showed a significant grip strength produce after both KT and ESWT application.[2,24] Our patients improved hand grip strength after two different therapies and KT group had better improvement at 4 and 8 weeks measurements. It was thought that the increase in grip strength was consistent with more pronounced decrease of pain in the KT group.

One of the ultimate goals of treatment in LE is to achieve functional recovery. Notarnicola and Eraslan *et al*. confirmed functional improvement after KT.[2,25] Similar improvements with ESWT were reported by Sang Seok Lee *et al*.[19] who applied ESWT on newly diagnosed LE patients and they found that ESWT was effective in improving pain and clinical symptoms from the first week to the eighth week. They used Roles and Maudleys score like our study and they concluded that ESWT could be one of the treatment choices in newly diagnosed LE. We evaluated function with Roles and Maudsley and Q-DASH and our results were consistent with literature and significant improvement was detected in both groups. As with the pain and muscle strength, the improvement of the KT group higher.

On the contrary with several studies, Ivan *et al*.[28] did not found significant improvement in pain intensity, muscle strength, or functionality in patient with LE. Their study is different in terms of the methodology and the type of the applied KT; they carried out facilitator, inhibitory, and sham KT applications in the same group of patients in same session to evaluate the immediate effect of KT; they concluded that 5 min of resting in each tape application might have resulted in muscle fatigue and might have affected the results.

In our study, we evaluated KT and ESWT in newly diagnosed LE patients at 4 and 8 weeks after the intervention. We found that both KT and ESWT could significantly improve pain, functionality, and grip strength; however, these improvements were more prominent in the KT group.

Strength points and limitations of this study

Our study expands the literature by providing information about the efficacy of KT and ESWT in newly diagnosed LE patients after 4 and 8 weeks. This study has several strength points including (1) patients were randomly assigned to the treatment groups using stratified random allocation which minimizes the risk of selection bias, (2) unlike previous studies that focused on pain only or muscle strength only, we evaluated four clinical parameters, and (3) the study population was patients with newly diagnosed LE. The limitations of this study are (1) the relatively low sample size and (2) the follow-up was limited to 8 weeks. Further studies evaluating the long-term outcomes of KT and ESWT in larger samples are still needed to confirm our findings.

Conclusion

Both KT and ESWT could significantly improve pain, hand strength, and functionality in patients with newly diagnosed LE. However, these improvements were more prominent in the KT group. Considering the feasibility and the low cost of KT compared with ESWT, we recommend that KT should be considered for treating patients with newly diagnosed LE.

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Conflicts of interest

Authors report no conflicts of interest.

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