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# Evaluation of short-term and residual effects of Kinesio taping in chronic lateral epicondylitis: A randomized, double-blinded, controlled trial

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ABSTRACT

*Background:* Lateral epicondylitis is degenerative tendinosis of the extensor carpi radialis brevis muscle and is the most common work/sports-related chronic musculoskeletal problem affecting the elbow.
*Purpose:* This study aimed to evaluate the short term and residual effectiveness of the Kinesio taping method on pain, grip force, quality of life, and functionality.
*Study Design:* Randomized, double-blinded, controlled study.
*Methods:* Subjects were 50 patients diagnosed with chronic unilateral lateral epicondylitis with a symptom duration of at least 12 weeks. During the first four weeks, the study group received a true inhibitor Kinesio taping while the control group received sham taping. In both groups, progressive stretching and strengthening exercises were given as a home program for six weeks. The primary outcome measure was the Numerical Rating Scale (NRS) for self-report of pain intensity; secondary outcome measures were Cyriax resistive muscle test evaluation, maximal grip strength, Patient- Rated Tennis Elbow Evaluation (PRTEE), and Short Form-36 (SF-36). After the treatment, patients were evaluated by the first assessor who was blinded to taping types.
*Results:* There was a significant decrease in NRS scores overtime during the first four weeks in both groups ($P < .001$,) and effect sizes were large. There was no significant difference in Cyriax muscle resistance test maximal grip strength between groups ($P > .05$). However, there was a significant improvement in muscle strength of elbow extension and pronation in the study group detected in the intragroup analysis. Intragroup comparisons also showed a significant improvement in all subunits of the PRTEE and SF-36 except energy/vitality, social functioning, and pain in both groups ($P < .05$) with moderate to high effect sizes. PRTEE pain scores were significantly decreased in the study group compared to the placebo group ($P < .05$, $d = 0.48$).
*Conclusion:* The effects of Kinesio taping on muscle strength, quality of life, and function in chronic lateral epicondylitis are not superior to placebo. However, NRS scores showed that in the two weeks after Kinesio taping treatment, pain reduction persisted as a residual effect which may improve the exercise adherence and functionality.



## Introduction

Lateral epicondylitis (LE), also known as "Tennis Elbow," is degenerative tendinosis of the extensor carpi radialis brevis. The least mechanical advantage position for the ECRB is wrist flexion in a fully stretched position and less commonly ulnar deviation.[1] LE presents with significant pain in the lateral of the elbow, disability, and loss of labor.[2] Its prevalence is 1%-3% in the general population without any gender predominance and more common between 35 and 50 years old. It is a common condition in people who are deal-

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*E-mail address:* elifbalevi@hotmail.com (E.B. Batur).
# **Address**: Selçuk University Faculty of Medicine, Konya, Turkey, Department of Physical Medicine This study was performed in the Physical Medicine and Rehabilitation and Orthopedics and Traumatology clinics at the Gazi University Faculty of Medicine. The Ethics Committee of the University of Health Sciences, Zekai Tahir Burak Women's Health Practice and Research Center (no:20/2017) approval was obtained.

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ing with intense activities that require the use of the hand or who are exposed to hand-arm vibration, particularly in their dominant extremity.[3,4] No specific treatment method has been shown to be superior to the other in the literature. Among conservative treatment methods, the taping technique first described by Kenso Kase, has been widely accepted in recent years. Kinesio taping elevates the skin to create extra space for blood and lymphatic circulation to help regeneration of injured tissues. It also increases proprioception and joint stability often during the maintenance of optimal function in damaged musculoskeletal areas.[5] The data published in the literature for lateral epicondylitis are controversial. Au et al[6] reported that Kinesio taping did not provided immediate effect on pain intensity and grip strength in lateral epicondylitis (LE). However, they did not assess the short and long time periods. Yet, another showed that Kinesio taping improved function, grip strength and pain after the treatment in LE. However, there was no control group, and the investigators were not blinded to the applications.[7] A recent meta-analysis demonstrated that Kinesio taping reduces pain and is effective for improving grip strength at one month and three months.[8] Another study performed by Giray et al[9] showed that the effects of Kinesio taping in LE are superior to sham taping and only exercise. They suggested that true taping provided pain relief and improved grip strength immediately after implementation. However, they did not evaluate the patients with chronic LE.[9] Although many studies have shown the efficacy of Kinesio taping in LE, well designed randomized controlled studies are still needed to understand the utility of this treatment approach.

In this randomized, double-blinded and controlled trial, besides the short-term effects, we aimed to evaluate the residual effects of Kinesio taping in chronic LE.

## Materials and methods

### *Study design*

Patients were divided into two groups: true Kinesio taping (study group) and sham (placebo) Kinesio taping (control group). According to the "NRS", the primary outcome measure, 80% power, and 5% margin of error (type I error) was used and it was calculated that 25 individuals for each group must participate. Patients were evaluated at the baseline, fourth, and sixth weeks.

### *Participants*

The study included a total of 50 individuals who were admitted to the outpatient clinics of Physical Medicine and Rehabilitation, and Orthopedics and Traumatology, and diagnosed with lateral epicondylitis during a routine examination. Ethics committee approval was obtained before the study (No:20/2017). This study was registered on the Clinical Trials Registry (registration number: NCT04518527). All patients provided informed consent. The inclusion criteria were as follows: having pain on or near the lateral epicondyle and increase of pain at least one of the following provocations tests for lateral epicondylitis resisted wrist extension (Cozen's test); resisted elbow supination (Mill's test) and 3rd finger extension (Maudley's test); unilateral elbow pain for at least 12 weeks; not received injection therapy to the elbow in the last six weeks; not received a physical therapy program in the previous three months; presence of normal elbow radiographic findings; normal elbow joint range of motion; and having no neurological deficits. Patients with degenerative joint disease, radial tunnel syndrome, cervical nerve root compression, pain reflected from the neck, shoulders, and wrist, radiohumeral joint osteochondritis dissecans, tendon rupture, osteoporosis, infection, malignancy, and inflammatory disease, and pregnant women were excluded from the study. All patients in the study group and the physician who made the diagnosis were blinded to the treatment allocation. One non-blinded therapist applied the tapes. The patients were randomized into two equal groups by that therapist using a simple randomization method using GraphPad QuickCalcs software (Graphpad, San Diego, CA). All patients who agreed to participate in the study were advised not to take any analgesic except for paracetamol during the study period.

### *Outcome measures and assessments*

In this study, the primary outcome measure was the NRS. Secondary outcome measures of this study were; resisted muscle test evaluation, Maximal Isometric Handgrip Strength, The Patient-rated Tennis Elbow Evaluation (PRTEE), and 36-Item Short-Form Health Survey (SF-36). The same blind physician performed the assessments after the tape was removed.

### *Evaluation of pain level*

The Numerical Rating Scale (NRS) is the preferred method for documenting self-reported pain due to its high reliability and validity, as stated by MacDermid et al[10] Therefore, NRS was used to evaluate the pain level of the patients included in the present study. It is a one-dimensional scale (0-10) that measures pain intensity in adults and is a segmented, numerical version of the visual analog scale (VAS). It is preferred because of its high validity and reliability. It is preferred because of its high validity and reliability.[11] Using this scale, participants must put a tick from 0 to 10 integers (0 means no pain and 10 means the worst pain), on the horizontal bar or line.[12] Patients were asked to determine the severity of pain (0 to 10) they felt in the last 24 hours and then indicate the score on the scale.

### *Resisted muscle test evaluation*

According to the Cyriax method, each joint tested was kept in the midrange of motion, without allowing movement The patients were asked to apply a maximum force against the applied resistance for at least three seconds. Resisted wrist extension, third finger extension, elbow supination, and pronation were evaluated. With each test, it was recorded whether the contraction caused pain and whether the contraction was strong or weak. The results were rated based on the rating system defined by Cyriax[13]; 5 = strong and painless, 4= strong and painful, 3 = weak and painless, 2 = weak and painful, and 1 = painful in all resistive tests.

### *Maximal isometric handgrip strength*

The maximal isometric handgrip strength was measured in pounds using the Jamar hand dynamometer (JAMAR, Sammons Preston, Inc., Bolingbrook, IL). Measurement was performed in two different positions with elbow in 90° flexion and in full extension. In the first position, the patient was in the sitting position, shoulder abducted to 0° and in neutral rotation, elbow position was at 90° flexion, the forearm was in neutral rotation and wrist was in the neutral position. In the second position, while the patient was standing, shoulder abducted to 0°, and in neutral rotation, the elbow was in full extension, forearm, and wrist were in the neutral position. The patient was asked to squeeze the dynamometer with full force for three seconds every 30 seconds. This procedure was repeated three times, and the mean measurement values were obtained.[2,14]

### *Evaluation of functionality*

PRTEE is a questionnaire with subscales related to pain and function, which is used to evaluate upper extremity functionality.

It is specially prepared for patients with lateral epicondylitis and is a condition-specific criterion that provides patient monitoring. The total score can be 100 points maximum and low scores refer to better functionality.[15] Turkish validity and reliability were proven by Altan et al.[16]

*Quality of life*

Quality of life was evaluated using the SF-36. Pretreatment and post-treatment scores were noted for each patient. The SF–36 is valid and reliable for patients with chronic musculoskeletal disorders. The items include eight different domains that indicate physical functioning, physical role limitation, pain, general health, vitality, social functioning, emotional role limitation, and mental health. The score of each domain ranges from 0 (worst quality of life) to 100 (the best quality of life).[17]

*Treatment*

*True inhibitor Kinesio taping group (study group) (with tension)*

The inhibitory taping method was applied to the first group according to the method determined by Kase.[18] According to this method, the Kinesio tape should be applied from muscle insertion to origin to inhibit muscles' overuse. Also, it provides an eccentric force to decrease muscle contraction.[19] Before application, it is important to place the muscles in a stretched position. When the muscles are relaxed, the tape will create convolutions that will lift the skin, thereby creating extraspace under the subcutaneous tissue to accelerate healing by facilitating blood circulation to this area.[20]

In our study, we used this method to inhibit the wrist extensors which are the most affected muscles in LE. For the application, a 2-inch (5 cm) wide Kinesio tape (Kinesio Tex Gold TM FP, USA) was measured from the second-third metacarpal base to the lateral epicondyle while the elbow was extended, and the wrist was in the neutral position. The tape was applied in the shape of a "Y." In a position where the wrist extensors were most stretched (wrist flexion – forearm pronation), the anchor point of the tape was applied to the insertion of the muscle without creating any tension. Then, the tape was applied along the extensor carpi radialis longus and brevis and extensor carpi ulnaris muscles by applying a 15%-25% tension toward the origin of the muscle. Both ends of the Y-shaped tape were terminated without tension on the lateral epicondyle (Fig. 1). Kinesio taping was performed to patients once a week for four weeks by the same therapist.

*Placebo (Sham) Kinesio taping group (control group) (without tension)*

In the placebo group, the 10 cm I-shaped tape was placed 5 cm inferior to the lateral epicondyle using the same Kinesio tape in the study group. It was applied transversely, unrelated to muscle origin and insertion points starting from the painless side of the midline on the forearm extensor face directing toward the lateral side of the forearm without a tension incompatible with the method recommended by Kase et al. (Fig. 2). The instructions given to the study group were also given to the placebo group. Similar to the study group, Kinesio taping was performed to patients once a week for four weeks by the same therapist.

*Home exercise program*

All of the patients performed the exercise once under the supervision and guidance of the therapist. Then, they started the home exercise program. In addition to this, both groups received activity modification education.

A six-week home exercise program consisting of the same type of eccentric strengthening and stretching exercises was given to both groups as described by Wegener, Eraslan, and Pienimaki et al.[7,21,22] Eccentric strengthening was performed in a seated position, with maximum elbow extension, forearm pronation, and maximum wrist extension. From this position, the patients slowly lowered their wrists to flexion. The patients returned the affected wrist to maximum extension using contralateral hand until they felt a stretch on the forearm. Eccentric strengthening program consisted of the wrist and elbow flexion and wrist extension strengthening by using a Theraband. Patients were instructed not to continue exercises if it caused excessive pain. The exercise program was organized three times a day, and each program consisted of three sets for each movement and ten repeats per set. One-minute rest breaks are recommended between sets. Patients were informed that each movement should be done slowly, counting up

**Fig. 1.** The application of true inhibitor taping.

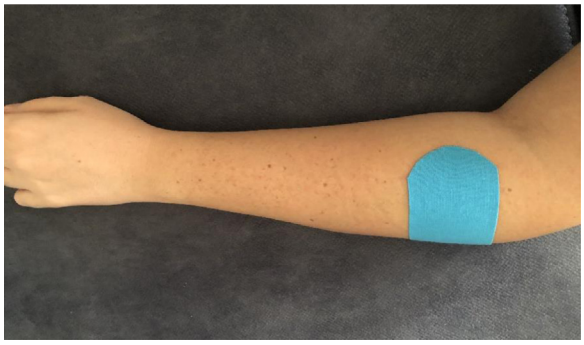

**Fig. 2.** The application of sham (placebo) taping.

to eight (8 seconds), to increase exercise adherence and avoid further damage.

Furthermore, it was explained to the patients that the exercises also should be done with the Kinesio tape during the first four weeks and without the Kinesio tape during the last two weeks. During the six-week treatment period, patients were contacted every two weeks by phone. Their adherence with weekly exercises was questioned, and they were encouraged to do exercises. Also, they were warned to avoid nonsteroidal anti-inflammatory drugs.

*Statistical analysis*

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 22.0 (Armonk, NY). Numerical variables were expressed as mean ± standard deviation and median (min-max), and qualitative variables were expressed as number and percentage. Shapiro Wilk test was used to determine whether the numerical variables distributed normally. T-test was used in independent groups to compare the variables that provided parametric conditions among the numerical variables. Variables that did not provide parametric test conditions were compared using the nonparametric Mann-Whitney U test. For intergroup comparisons effect sizes were calculated as described by Cohen and defined as small (d = 0.2), medium (d = 0.5), and large (d = 0.8).[23] Qualitative variables were compared using Pearson's chi-squared test and Fisher's Exact test. Mann-Whitney U test was used to determine whether there was a difference between the two groups in terms of the evaluation parameters. Temporal differences in the group were evaluated using the Friedman test. In groups with temporal differences, these differences were compared using the Dunn test to reveal from which period these differences originated. Effect sizes were calculated for intragroup comparisons by using Kendall's w value used as the measure of the Friedman test effect size.[24,25] A *P*-value of $<.05$ was considered statistically significant.

## Results

The Consolidated Standards of Reporting Trials (CONSORT) diagram for recruitment of participants is presented in Fig. 3. A total of 50 patients who met the inclusion criteria were enrolled into the study. Among the 25 patients from the study group, there were four dropouts; three patients were not consented to participate; one of them developed an allergic reaction due to the tape. In the placebo taping group, there was one drop out due to not consented to participate. Finally, twenty-one patients from the study group and twenty-four patients from the placebo taping group completed the 4th and 6th follow-ups of the study. Intention-to-treat analysis was performed due to the loss of four patients in the study group and one patient in the control group. Data from total 50 patients were analyzed with effect sizes and its 95% confidence intervals.

There was no significant difference between the groups in terms of age, gender, height, weight, body mass index, dominant limb involvement, and symptom duration (Table 1). There were significant improvements in the NRS scores and maximal grip strength over time in both groups ($P < .001$) (Table 2). However, there was no significant difference between groups, intragroup analysis showed that there was a significant improvement in the Cyriax resisted muscle test elbow pronation and maximal grip strength of elbow extension in the study group ($P = .002$ and .001, respectively) (Table 3). In PRTEE pain scores, there was a significant improvement in the study group compared to the sham taping group ($P < .05$, d = 0.48) (Table 4). In the study group SF-36 subgroups except pain and social functions showed improvement and the positive effect was observed to persist for up to six weeks without change (Table 5).

## Discussion

This study demonstrated that the patients with chronic LE who received true Kinesio taping did not show statistically significant more improvements in pain, maximal handgrip strength, quality of life, and functionality compared to the sham taping. However, in true taping group the positive effect obtained in the early period especially with regard to pain continued up to six weeks as a residual effect. Although Kinesio taping is widely used in LE, the results reported in the studies about its effectiveness are controversial.

In a meta-analysis evaluating the effect of Kinesio taping applications on maximal muscle strength, in eight out of 19 studies it has been reported that Kinesio taping applications may have some beneficial effects in treatment, similar to our study.[26] Studies that included electromyographic recordings from different muscles suggested that the Kinesio taping application might cause greater muscle activity.[27-29] Regarding this result, a hypothesis claimed that cutaneous receptor stimulation provided by Kinesio taping might increase muscle strength by stimulating large motor units through type 2 mechanoreceptors located in the deep layer of the dermis.[30,31] However, in this meta-analysis, authors also suggested that Kinesio tapes' significant effect on improving muscle strength is negligible.[26] They added that this result might have arisen due to methodological quality and the variability of effect sizes. In our study, intragroup analysis showed the improvement in muscle strength of elbow extension and elbow pronation, crucial in functionality, in the study group. This may be explained by increased exercise adherence with true inhibitory Kinesio taping due to pain relief as well as stimulating cutaneous receptors. Besides, we detected that muscle strength improvement continued up to two weeks after the treatment due to its residual effect on pain. In a study by Wegener et al[7] involving 40 patients with LE, eccentric exercises combined with Kinesio taping and sham taping separately and eccentric exercises applied alone were compared. Improvement in functionality was observed in all groups, including placebo. The results of this study are comparable to our study. Similarly, in a study by Au et al[6] involving 30 patients with LE, which drew on the placebo effect, facilitator, inhibitor, sham taping, and tapeless applications were performed in different order. They suggested that measurements after taping applications showed no significant change between the groups in terms of muscle activity and functional performance. Similar to this research, in the present study, we could not detect a significant improvement in functionality compared to sham taping. In our opinion, gain in the functionality might be related to the long duration of the exercise treatment. In contrast to our results, a study evaluating the effect of Kinesio taping on LE reported the upper limb functionality superior to placebo.[32] Although the blinded assessment was performed in the mentioned study, the patients only received Kinesio taping application without exercise programs.

Pain in LE is one of the factors that affect the functionality and should be evaluated from different perspectives. As a result of the pain assessment, in the short term there was a significant improvement in PRTEE pain scores in our study group. In our study, we applied the true Kinesio-tapes while stretching the muscle to provide the sarcomere length correction and pain relief. This position also facilitates blood circulation and alleviates inflammation and pain. Another mechanism related to decreased pain in the short term might be stimulation of Golgi tendon organ and its inhibitory effect on muscle contraction.[33] Pain-relieving effect was observed within the first four weeks, during which taping was applied, and continued unchanged in the last two weeks, during which taping was not applied. The maintenance of the residual effect during the period without taping application may be attributed to the

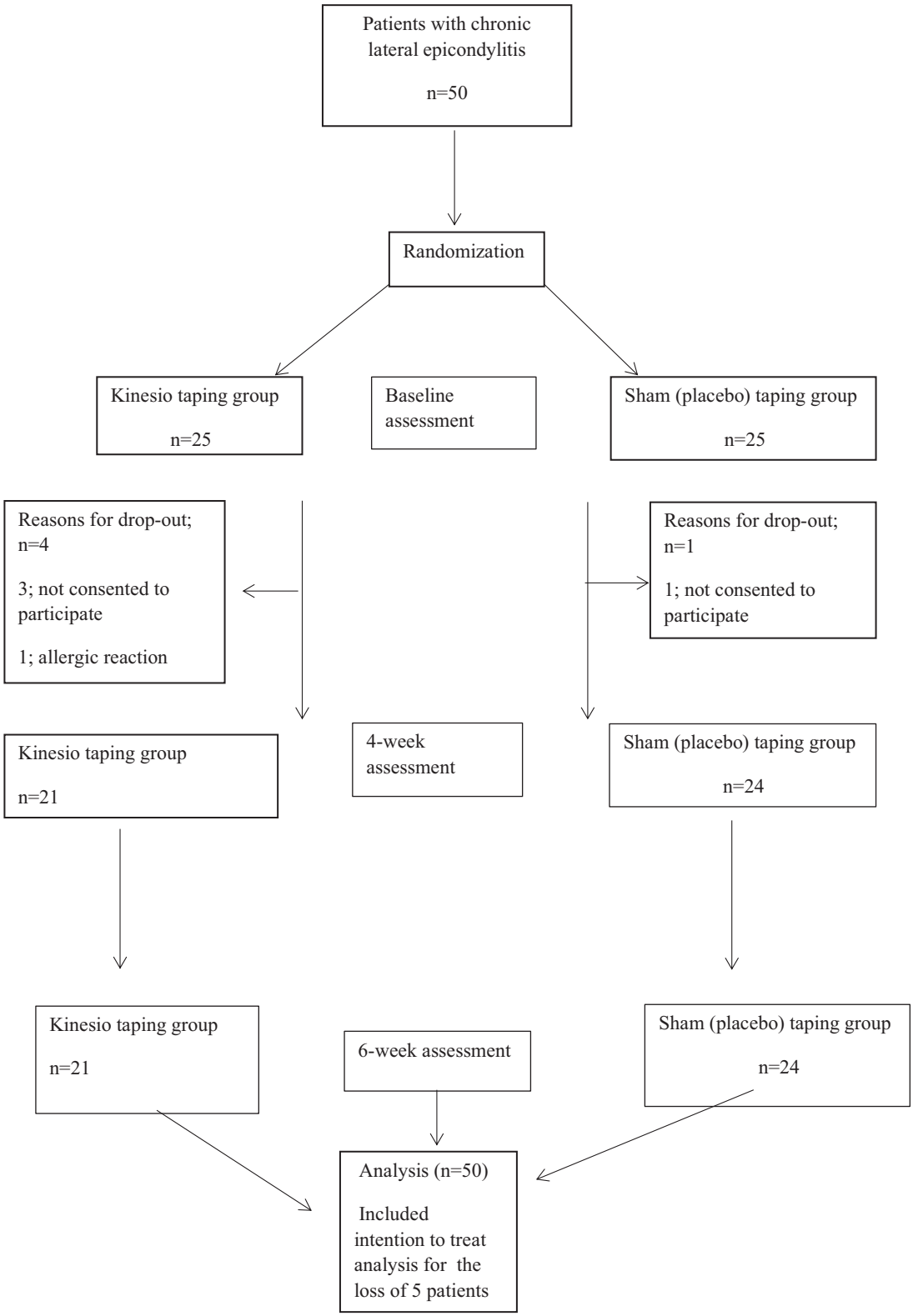


**Fig. 3.** Consort diagram of the study.

**Table 1**
Demographic and clinical characteristics of the patients

| | Study group ($n$ = 25) | Control group ($n$ = 25) | $P$ value |
|---|---|---|---|
| Height (cm) (mean ± SD) | 163.7 ± 6.4 | 164.1 ± 9,7 | .87 |
| Weight (kg) (mean ± SD) | 73.9 ± 9.1 | 76.6 ± 16.3 | .45 |
| BMI (mean ± SD) | 27.5 ± 2.8 | 28.7 ± 6.5 | .44 |
| Age (years) (mean ± SD) | 47.5 ± 8.2 | 47.1 ± 6.8 | 0.80 |
| Symptom duration (month) (median min-max) | 12 (2-60) | 6 (2-120) | .43 |
| Gender (female) (%) | 18/25 (72%) | 17/25 (68%) | 1.00 |
| Dominant extremity (right) (%) | 23/25 (92%) | 23/25 (92%) | 1.00 |
| Affected side (right) (%) | 15/25 (60%) | 19/25 (76%) | 0.36 |

SD = standard deviation; BMI = body mass index.

**Table 2**
Comparisons of numeric rating scale (NRS) between intragroup and intergroups

| NRS | Study group ($n$ = 25) | Control group ($n$ = 25) | Intergroup comparisons ($P$ value) | Effect size (d value) | Mean difference (95% CI) |
|---|---|---|---|---|---|
| The worst pain | | | | | |
| Baseline (median, min-max) | 8 (5-10) | 9 (4-10) | 0.404 | | 0.64 (-0.35-1.63) |
| 4th week (median, min-max) | 5 (0-10) | 6 (2-10) | | 0.12 | -0.40 (-1.83-1.00) |
| 6th week (median, min-max) | 4 (0-10) | 4 (0-10) | | 0,05 | 0.14 (-1.44-1.72) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.63) | **.000***(w = 0.69) | | | |
| Pain at rest | | | | | |
| Baseline (median, min-max) | 3 (0-8) | 4 (0-10) | 0.62 | | -1.20 (-2.57-0.17) |
| 4th week (median, min-max) | 1 (0-8) | 3 (0-10) | | 0.53 | -1.36 (-2.81-0.08) |
| 6th week (median, min-max) | 1 (0-8) | 2 (0-10) | | 0.37 | -0.88 (-2.20-0.44) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.63) | **.000***(w = 0.50) | | | |
| Pain at night | | | | | |
| Baseline (median, min-max) | 4 (0-10) | 6 (0-10) | 0.065 | | -1.88 (− 3.67-0.08) |
| 4th week (median, min-max) | 2 (0-8) | 4 (0-10) | | 0.66 | -1.66 (− 3.07-0.24) |
| 6th week (median, min-max) | 1 (0-7) | 2 (0-10) | | 0.33 | -0.80 (-2.17-0.57) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.61) | **.000***(w = 0.59) | | | |
| Repeated elbow motion | | | | | |
| Baseline (median, min-max) | 8 (5-10) | 8 (4-10) | 0.883 | | 0.08 (-0.92-1.08) |
| 4th week (median, min-max) | 5 (0-9) | 5 (1-10) | | 0.30 | -0.76 (-2.16-0.64) |
| 6th week (median, min-max) | 4 (0-9) | 3 (0-10) | | 0.15 | -0.44 (-2.06-1.18) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.62) | **.000***(w = 0.65) | | | |
| Weight-bearing | | | | | |
| Baseline (median, min-max) | 8 (3-10) | 8 (4-10) | 0.595 | | -0.24 (-1.36-0.88) |
| 4th week (median, min-max) | 5 (0-10) | 5 (2-10) | | 0.28 | -0.72 (-2.18-0.74) |
| 6th week (median, min-max) | 3 (0-10) | 3 (0-10) | | 0.15 | -0.46 (-2.17-1.25) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.64) | **.000***(w = 0.65) | | | |

* $P < .05$ using Friedman test; CI = confidence interval; w = effect sizes using Kendall's W value.

fact that exercise adherence may be enhanced by taping within the first four weeks.

Similar to the methods of the present study, Wegener et al[7] evaluated the effects of Kinesio taping in true and sham groups for 12 weeks in combination with exercise therapy. They demonstrated improvements in PRTEE, grip strength, and SF-36 in both groups, similar to our study. Unlike the result of this study, we also found a significant improvement in PRTEE pain scores in the study group compared to the control group.

Although, Kinesio taping method is frequently used in LE and its exact mechanism is not clearly known, it is suggested that it reduces the pressure on the muscle through mechanoreceptors in the skin. Furthermore, it provides extra space for blood and lymphatic circulation by elevating the subcutaneous tissue. Therefore, the inflammatory mediators can be reduced from the region and the healing can be accelerated. The most accepted mechanism is explained as the change in the tension (biomechanics) of the skin as a result of the Kinesio tape forming a tension and mechanical pressure on the skin. The afferent stimulation that occurs with this tension is that by strengthening the inhibitory mechanism on the pain with the gate control theory, it affects the pressure pain threshold and therefore local pain perception.[34] Therefore, in our study, we applied the sham taping to the painless area without tension to avoid this effect.

The most commonly used exercise procedure in tendinopathies is the eccentric exercises to accelerate healing by loading the tendon. Due to the increased loading, collagen production occurs and starts the recovery.[35,36] A recent meta-analysis investigating the effectiveness of different exercise protocols in LE suggested that in the short term, eccentric exercises were superior to other types of strengthening modalities.[37] Therefore, in the present study, we preferred to use the eccentric exercise procedure. Since the exercise is essential for the tendon rehabilitation, we added an exercise program to both of the groups in our study. Besides, isolated eccentric exercises are not sufficient alone in the treatment. In LE, the common treatment approach is to combine exercise therapy with other modalities.[37,38]

In this study, we used patient education and home exercise program as a rehabilitation approach. We aimed to represent a cost-effective treatment. Furthermore, considering the low financial cost of Kinesio taping, we can say that we could have provided a low health-care cost. Related to this issue, a study done by Mcqueen et al[39] defined that a therapy consisting of a low number of visits and based on patient-centered self-education and exercise pro-

**Table 3**
Comparisons of Cyriax resistant muscle test and maximal grip strength at baseline, 4th and 6th weeks between groups

| | Study group ($n$ = 25) | Control group ($n$ = 25) | Intergroup comparisons ($P$ value) | Effect Size (d value) | Mean Difference (95% CI) |
|---|---|---|---|---|---|
| **Wrist extension** | | | | | |
| Baseline (median, min-max) | 4 (2-5) | 4 (1-5) | 0.706 | | 0.12 ( -0.46-0.70) |
| 4th week (median, min-max) | 5 (2-5) | 5 (4-5) | | 0,13 | -0.08 (-0.43-0.27) |
| 6th week (median, min-max) | 5 (2-5) | 5 (1-5) | | 0,10 | 0.08 (-0.37-0.53) |
| Intragroup comparisons ($P$ value) | .053(w = 0.11) | 0.10 (w = 0.18) | | | |
| **3rd finger extension** | | | | | |
| Baseline (median, min-max) | 4 (3-5) | 4 (2-5) | 0.9 | | 0.04 (-0.42-0.50) |
| 4th week (median, min-max) | 5 (3-5) | 5 (3-5) | | 0.20 | -0.12 (-0.45-0.21) |
| 6th week (median, min-max) | 4 (3-5) | 5 (4-5) | | 0.29 | -0.24 (-0.54-0.06) |
| Intragroup comparisons ($P$ value) | 0.674 (w = 0.01) | 0.064 (w = 0.10) | | | |
| **Elbow supination** | | | | | |
| Baseline (median, min-max) | 4 (2-5) | 4 (2-5) | 0.705 | | -0.08 (-0.66-0.50) |
| 4th week (median, min-max) | 4 (2-5) | 5 (2-5) | | 0.37 | -0.44 (-0.93-0.05) |
| 6th week (median, min-max) | 4 (2-5) | 5 (2-5) | | 0.07 | -0.40 (-0.85-0.05) |
| Intragroup comparisons ($P$ value) | 0.192 (w = 0.06) | 0.15 (w = 0.16) | | | |
| **Elbow pronation** | | | | | |
| Baseline (median, min-max) | 4 (2-5) | 5 (2-5) | 0.415 | | -0.12 (-0.60-0.35) |
| 4th week (median, min-max) | 5 (2-5) | 5 (3-5) | | 0.24 | -0.16 (-0.53-0.21) |
| 6th week (median, min-max) | 6 (2-5) | 5 (4-5) | | 0.26 | -0.16 (-0.50-0.18) |
| Intragroup comparisons ($P$ value) | **.002***(w = 0.24) | 0.62 (w = 0.11) | | | |
| **Maximal grip strength Elbow 90° flexion** | | | | | |
| Baseline (median, min-max) 4th week (median, min-max) | 45 (18.3-80)<br>46.7(16.7-85) | 40 (10-83.3)<br>41(6.7-90) | 0.676 | 0.08 | 0.64 (-9.13-10.41)<br>1.47 (-8.57-11.50) |
| 6th week (median, min-max) | 53.3 (16.7-88.3) | 43 (30-88.3) | | 0.34 | -0.60 (-10.10-8.90) |
| Intragroup comparisons ($P$ value) | **.002***(w = 0.24) | 0.02*(w = 0.15) | | | |
| **Elbow extension** | | | | | |
| Baseline (median, min-max) | 48.3 (21.7-75) | 40 (5-100) | 0.771 | | 0.40 (-10.15-10.95) |
| 4th week (median, min-max) 6th week (median, min-max) | 48.3 (25-85) 53.3 (23.3-85) | 45 (10-101.7)<br>45(23.3-88.3) | | 0.08 0.12 | 1.66 (-9.28-12.62)<br>-4.00 (-14.08-6.08) |
| Intragroup comparisons ($P$ value) | **.001***(w = 0.26) | 0.12 (w = 0.09) | | | |

* $P < .05$ using Mann Whitney U and Friedman tests; CI = confidence interval; w = effect sizes using Kendall's W value.

**Table 4**
Comparisons of patient-rated tennis elbow evaluation (PRTEE) scores between groups

| | Study group ($n$ = 25) | Control group ($n$ = 25) | Intergroup comparisons ($P$ value) | Effect size (d value) | Mean difference (95% CI) |
|---|---|---|---|---|---|
| Pain | | | | | |
| Baseline (median, min-max) | 30 (15-43) | 33 (9-46) | **.04*** | | -4.72 (-9.43-0.005) |
| 4th week (median, min-max) | 15 (0-43) | 21 (5-49) | | 0.48 | -5.52 (-12.0-0.94) |
| 6th week (median, min-max) | 10 (0-43) | 13 (0-49) | | 0.24 | -3.00 (-9.95-3.95) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.62) | **.000***(w = 0.53) | | | |
| Specifical activity | | | | | |
| Baseline (median, min-max) | 32 (8-49) | 35 (8-57) | .29 | | -3.48 (-10.48-3.52) |
| 4th week (median, min-max) | 18 (0-43) | 21 (1-59) | | 0,15 | -4.76 (-12.61-3.09) |
| 6th week (median, min-max) | 16 (0-43) | 21 (0-59) | | 0.17 | -2.60 (-11.09-5.89) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.63) | **.000***(w = 0.61) | | | |
| Daily activity | | | | | |
| Baseline (median, min-max) | 22 (4-33) | 23 (10-39) | .248 | | -3.32 (-8.34-1.70) |
| 4th week (median, min-max) | 13 (0-30) | 14 (2-39) | | 0.04 | -3.60 (-8.70-1.50) |
| 6th week (median, min-max) | 9 (0-30) | 14 (0-39) | | 0.19 | -1.84 (-7.31-3.63) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.63) | **.000***(w = 0.61) | | | |
| Function | | | | | |
| Baseline (median, min-max) | 25.5 (6.5-40) | 30 (9-45) | .273 | | -3.40 (-9.09-2.29) |
| 4th week (median, min-max) | 15.5 (0-36.5) | 17.5 (1.5-49) | | 0,11 | -4.18 (-10.50-2.13) |
| 6th week (median, min-max) | 13.5 (0-36.5) | 17 (0-49) | | 0.18 | -2.22 (-9.06-4.62) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.63) | **.000***(w = 0.54) | | | |
| Total score | | | | | |
| Baseline (median, min-max) | 52.5 (23.5-79.5) | 59.5 (18-90) | .107 | | -8.12 (-17.92-1.68) |
| 4th week (median, min-max) | 29 (0-79.5) | 39.5 (7.5-98) | | 0.31 | -9.70 (-22.21-2.81) |
| 6th week (median, min-max) | 24 (0-79.5) | 39 (0-98) | | 0.21 | -5,22 (-18.82-8.38) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.62) | **.000***(w = 0.54) | | | |

* $P < .05$ using Mann Whitney U and Friedman tests, CI = confidence interval; w = effect sizes using Kendall's W value

grams could also improve functions and relieves pain. In addition to this, they suggested that by this way, health-care costs could be minimized.

In the present study, the intragroup analysis showed a significant improvement in grip strength in the true inhibitor taping group after the treatment at the end of the fourth week and it continued up to the sixth week. This result may explain the residual effects of the true Kinesio taping application on pain relief and increased exercise adherence. A study done by Giray et al[9] showed the increased grip strength in intragroup analysis immediately af-

**Table 5**
Subgroup analysis of SF-36 parameters between groups

| | Study group ($n$ = 25) | Control group ($n$ = 25) | Intergroup comparisons ($P$ value) | Effect size (d value) | Mean difference (95% CI) |
|---|---|---|---|---|---|
| Physical function | | | | | |
| Baseline (median, min-max) | 70 (10-85) | 65(30-100) | 0.585 | | -0.80 (-11.83-10.23) |
| 4th week (median, min-max) | 70 (10-95) | 65(40-100) | | 0.05 | -2.60 (-13.64-8.44) |
| 6th week (median, min-max) | 70 (10-100) | 65(45-100) | | 0.02 | -1.20 (-12.76-10.36) |
| Intragroup comparisons ($P$ value) | **.001***(w = 0.39) | **.000***(w = 0.31) | | | |
| Physical role limitation | | | | | |
| Baseline (median, min-max) | 25 (0-100) | 25(0-100) | 0.925 | | 1.00 (-20.30-22.30) |
| 4th week (median, min-max) | 75 (0-100) | 75(0-100) | | 0.20 | 8.00 (-14.27-30.27) |
| 6th week (median, min-max) | 75 (0-100) | 75(0-100) | | 0.10 | 4.00 (-18.03-26.01) |
| Intragroup comparisons ($P$ value) | **.000*** (w = 0.41) | **.000***(w = 0.35) | | | |
| Emotional role limitation | | | | | |
| Baseline (median, min-max) | 25 (0-100) | 25(0-100) | 0.925 | | 1.00 (-20.30-22.30) |
| 4th week (median, min-max) | 100 (0-100) | 100(0-100) | | 0.58 | 6.67 (-17.18-30.51) |
| 6th week (median, min-max) | 100 (0-100) | 100(0-100) | | 0.00 | 0.00 (-23.35-23.35) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.46) | **.000***(w = 0.39) | | | |
| Energy/vitality | | | | | |
| Baseline (median, min-max) | 33.3 (0-100) | 33.3(0-100) | 0.823 | | -2.00 (-24.62-20.63) |
| 4th week (median, min-max) | 65 (20-80) | 60(25-80) | | 0.45 | 6.60 (-1.72-14.92) |
| 6th week (median, min-max) | 70 (20-85) | 65(25-85) | | 0.15 | 2.60 (-11.09-5.89) |
| Intragroup comparisons ($P$ value) | **.012***(w = 0.37) | 0.085(w = 0.09) | | | |
| Emotional well-being | | | | | |
| Baseline (median, min-max) | 50 (20-80) | 50(20-75) | 0.157 | | 6.80 (-2.35-15.94) |
| 4th week (median, min-max) | 76 (36-92) | 76(32-92) | | 0.11 | 1.76 (-7.29-10.81) |
| 6th week (median, min-max) | 80 (28-92) | 80(32-88) | | 0.10 | 1.76 (-7.70-11.21) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.69) | **.000***(w = 0.78) | | | |
| Social functioning | | | | | |
| Baseline (median, min-max) | 64 (36-88) | 64(20-84) | 0.495 | | 4.96 (-4.53-14.45) |
| 4th week (median, min-max) | 62.5 (25-100) | 62.5(12.5-100) | | 0.36 | 8.00 (-4.42-20.42) |
| 6th week (median, min-max) | 75 (25-100) | 62.5(12.5-100) | | 0.33 | 8.00 (-5.66-21.66) |
| Intragroup comparisons ($P$ value) | 0.224(w = 0.05) | 0.285(w = 0.05) | | | |
| Pain | | | | | |
| Baseline (median, min-max) | 50 (12.5-100) | 50(12.5-100) | 0.724 | | 2.70 (-11.03-16.43) |
| 4th week (median, min-max) | 45 (22.5-100) | 45(0-90) | | 0.20 | 4.80 (-8.28-17.88) |
| 6th week (median, min-max) | 67.5 (22.5-100) | 67.5(0-90) | | 0.13 | 3.40 (-10.66-17.46) |
| Intragroup comparisons ($P$ value) | 0.285(w = 0.05) | 0.065(w = 0.10) | | | |
| General health | | | | | |
| Baseline (median, min-max) | 45(0-100) | 45(0-90) | 0.93 | | 0.70 (-13.50-14.88) |
| 4th week (median, min-max) | 65(30-90) | 60(20-95) | | 0.23 | 4.20 (-6.03-14.41) |
| 6th week (median, min-max) | 70(30-90) | 70(20-95) | | 0.16 | 3.04 (-7.53-13.61) |
| Intragroup comparisons ($P$ value) | **.000***(w = 0.39) | **.000***(w = 0.43) | | | |

* $P < .05$ using Mann Whitney U and Friedman tests; CI = confidence interval; w = effect sizes using Kendall's W value.

ter the treatment compatible with our study. On the other hand, unlike the results of our study, they did not observe the residual effects of taping in grip strength.

Our study is the first research prospectively investigating the residual effectiveness of Kinesio taping in cases with chronic LE in a randomized, placebo-controlled and double-blind design. Furthermore, intention-to-treat analysis was performed to compensate patient loss during follow-up. Contrary to many studies, giving importance to patients' adherence to exercise program, which is a confounding factor since it may affect the response of patients to the treatment, strengthens the study.

## Limitations of the study

This study has some limitations. First, the sample size was small, and more reliable results might be obtained if more patients were involved. Second, the follow-up time was short; thus, it was challenging to comment on how long its effect disappears in the long term. Therefore, there is a need for further studies investigating the duration of the positive effects in the long term. Another limitation is that it would be better to have an exercise-only group, as a third group, to get precise results. Lastly, in our study, the number of female patients was very high. This may be attributed to the increased risk of LE in females.[4,40,41] For this reason, the results cannot be generalized to the whole population.

## Conclusion

The effects of Kinesio taping method on pain, maximal handgrip strength, quality of life, and functionality in LE are not superior to placebo. Furthermore, its early effect especially on pain, persist for a short time as a residual effect without any change. Therefore, as an additional treatment, Kinesio taping can be recommended for reducing pain in addition to an exercise program at the beginning. Accompanied by an effective home exercise program, Kinesio taping, which is a cost-effective and safe method, can improve the patients' adherence to exercise programs and their response to treatment.

The study was registered on the Clinical Trials Registry (registration number: NCT04518527).

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# JHT Read for Credit
## Quiz: # 935

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# 1. The design of the study is
   a. retrospective cohort
   b. RCTs
   c. case series
   d. descriptive

# 2. Outcome factors were
   a. function
   b. grip
   c. pain
   d. all of the above

# 3. The primary outcome measure used was the
   a. quick DASH
   b. DASH
   c. NRS
   d. PREE

# 4. Pain scores were
   a. similar in both groups
   b. significantly reduced in the experimental group
   c. significantly reduced in the placebo group
   d. considered insignificant in the final analysis

# 5. The authors did NOT find that Kinesio taping was superior to placebo in effecting quality of life, muscle strength, or function
   a. true
   b. false

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