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The effects of KinesioTape on the treatment of lateral epicondylitis

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ABSTRACT

Study Design: Randomized clinical trial.
Introduction: KinesioTape (KT) is a noninvasive method to treat pain and muscular dysfunction.
Purpose: To investigate the effect of KT with and without tension on pain intensity, pain pressure threshold, grip strength and disability in individuals with lateral epicondylitis, and myofacial trigger points in forearm muscles.
Methods: Thirty women with lateral epicondylitis and myofacial trigger point in forearm muscles were randomly assigned to KT with tension and placebo (KT without tension). The treatment was provided 3 times in one week, and outcome measures were assess pre-post treatment.
Results: The mean score of visual analogue scale (VAS) during activity decreased significantly from 6.4 and 6 pretest to 2.53 and 4.66 posttest, respectively, for the KT with and without tension groups. The mean score of Disabilities of the Arm, Shoulder and Hand decreased significantly from 16.82 and 22.79 pretest to 8.65 and 8.29 posttest, respectively, for the KT with and without tension groups. A paired *t*-test revealed a significant reduction in VAS during activity and Disabilities of the Arm, Shoulder and Hand before and after treatment in both groups ($P < .05$). Pain pressure threshold, grip strength, and VAS using an algometer revealed no significant differences. The study showed no significant difference in variables immediately after intervention.
Discussion: Improvements in functional disability were superior when KT was used with tension, than obtained with a placebo-no tension application.
Conclusion: The application of KT produces an improvement in pain intensity and upper extremity disability in subjects with LE and MTP in forearm muscles, and KT with tension was more effective than placebo group.
Level of Evidence: NA.
Trial Registration Number: 100-216.

Introduction

Lateral epicondylitis (LE) or tennis elbow is a common musculoskeletal complain, which is characterized by lateral elbow pain often associated with gripping task. Its estimated prevalence in the general population is 1%-3%.[1]

The highest incidence of diagnosed LE, about 64%, was associated with overuse and marked increase activation of wrist and hand in work-related activities.[2-4]There is controversy in the precise etiology and pathophysiology of LE. Based on Cyriax's opinion, microscopic tears of common extensor tendon at its attachment to the lateral epicondyle can be a common reason of LE.[5] It has been reported that variable factors such as macroscopic or microscopic tear in the muscular or tendinous tissue, tissue deterioration, degenerative changes, and scar tissue formation after injuries induced by repetitive and high-load motions could initiate an inflammatory response as the source of symptoms in patients with LE.[6-9] Recent systematic structured reviews of several treatment approaches in clinical practice, including a single or mixture intervention such as ultrasound, stretching, strengthening exercises, steroid injection, iontophoresis, friction message, and counterforce bracing with emphasizing the reduction of tissue inflammatory reactions are used.[6,9,10] Evidence from one randomized clinical trial suggests that muscle energy technique may provide more benefit than one corticosteroid injection in the long term for persistent LE.[11] "Noninflammatory" or "degenerative" theories has been confirmed the pathology of tendinopathy in several recent studies during the first decade of the 21st century.[12,13]

Chop believed that developing myofacial trigger point (MTP) in the origin of the muscle attached to lateral epicondyle due to

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overuse or localized fibrositis would be another pathophysiological cause of the symptoms of LE.[6]

MTP is a spot tenderness in a taut band of muscle which is sensitive to palpation or compression. Referred pain and local twitch responses are signs for it.[14] It has been considered that mechanical overload, trauma, overuse, postural faults, or psychological stress could induce MTP.[14]

In a faulty sequential process, normal mechanical stimulant in an excited tissue causes prolong muscle contraction and lead to muscle spasm and pain. Then, muscle spasm makes muscle fiber shortening and continuous pressure on the involved area causing various pathologies,[15] and chemical changes such as increased level of bradykinin, substance P, and calcitonin gene-related peptide, hypoxia, and lowered pH have been shown in MTP.[16] Reduced oxygen levels and increased inflammatory chemicals induce local tenderness and referred pain following MTP.[15,17-19]

Chaitow attributes that increasing in neural receptors sensitivity in the muscle induces overuse and sudden change in muscle length. Prolonged contractions in a shorted position resulted in developing trigger point in muscle.[20] In support of this content, and in contrast of traditional opinion that considered tendon and connective tissue as the main reason of elbow pain, Simons and Travell[21] believed that TrP in triceps and extensor muscles of the forearm can be one cause of LE. In this view, release of contracture in the taut bands of skeletal muscle in the lateral of the elbow area could effectively reduce symptoms of LE.[21]

They have reported "excessive acetylcholine releasing," sarcomere shortening," and "increasing of sensitizing substances" are the 3 basic reasons for the formation of MTP.[22]

Kinesio tape (KT), as a noninvasive popular therapy to relief pain and treat muscular dysfunction, was first designed by Dr Kenzo Kase in 1973 in Japan.[23] Nonallergenic elastic tape stretched up to 30%-40%, used for mechanical and functional correction, fascia, ligament-tendon correction, lymphatic, and space correction.[20,23]

Mechanisms proposed for using KT method are multidimensional such as: deload the underlying soft tissues, modulate nociceptive processing, stimulate cutaneous mechanoreceptors, and alter skin tension.[24,25]

Vicenzino et al[26] expressed decreasing pain on lateral epicondyle as a result of using taping, lead to facilitate the adaptation to exercise rehabilitation program and improved grip strength and wrist extension muscles force in patients with lateral epicondylalgia.

Purpose of the study

Despite its widespread popularity, minimal evidence exists to support the use of KT in the treatment of common musculoskeletal disorders. However, there are no published randomized clinical trials that have been conducted to determine the effectiveness of KT in the treatment of MTP in subjects with LE. Therefore, the purpose of this study was to investigate the effects of KT method on pain intensity, pain pressure threshold (PPT), grip strength, and disability in individuals with LE with MTP.

Methods

Thirty women with LE and MTP in forearm muscles randomly divided in 2 groups; KT with tension and placebo (KT without tension).

The patients were recruited through public advertisements and referrals from physical therapy clinic of the University of Social Welfare and Rehabilitation Sciences. Subjects selected through simple nonprobability sampling. The main complaint consists of chronic pain in the area of lateral epicondyle extending to the forearm. The participants were included in this study if the pain was elicited by all 3 commonly used clinical pain provocation tests, Cozen's, Mill's, and third finger extension tests. Subjects with proximal upper extremity or neck symptoms, with a history of cervical pathology, nerve entrapment syndromes, nonunion fractures, surgical treatments for LE, and steroid injection for elbow pain during the past 6 months before the study were excluded. The inclusion criteria for having active MTP in forearm muscles were as follows[11,27]:

1. The presence of localized spot of tenderness in a nodule in a palpable taut band of muscle fibers.[21]
2. It is tender to palpation with a referred pain pattern. The pain is often described as spreading or radiate in.[28] To detect active MTP, MTP pressure tolerance was assessed using a mechanical pressure algometer. The investigator applied continuous pressure with the algometer with an approximate pressure of 2.5 kg/cm^2.
3. Spontaneous presence of the typical referred pain pattern and/or patient recognition of the referred pain as familiar.
4. Pain severity >50 mm on a100-mm visual analogue scale (VAS).[29]

Table 1
Reliability of measures

Variable	ICC	SEM
PPT (using algometer)	0.92	1.06
Grip(using dynamometer)	0.96	0.87

ICC = intratester correlation coefficient; PPT = pain pressure threshold; SEM = standard error of measurement.

Patients were randomly assigned to KT with tension group (N = 15, mean age = 37.6 years) and KT without tension (N = 15, mean age = 31.62 years). Randomization was performed by having subjects to draw a card out of a set of cards marked as "Group A" or "Group B." Subjects in group A received KT with tension. All subjects filled informed consent form approved at the University of Social Welfare and Rehabilitation Sciences. Trial registered number is 100-216. Physical characteristics of the patients in each group are shown in Table 1. Subjects had not received any prior or concurrent therapies. The same assessor, who was blinded to the group allocation, made all the measurements for each participant.

KT with tension

In this study, we used of diamond taping. The diamond taping technique consisted of 4 pieces of approximately 8- to 10-cm long,

Fig. 1. Taping technique used in the present study.

Table 2
Independent sample *t* test: Group comparing pretreatment

Variable	KT with tension		Placebo		*P* value
	Mean	SD	Mean	SD	
Age	37.6	11.56	31.62	11.43	.11
Weight	57.37	7.59	58.15	8.52	.78
Height	163.34	6.53	162.81	6.62	.82
BMI	21.47	2.31	22.04	3.75	.61
VAS	6.4	1.99	6	2.23	.9
VAS algo	4.6	1.84	5.66	1.71	.78
PPT	15.92	4.87	12.93	5.16	.35
Grip	38.26	18.55	26.46	14.1	.63
DASH	16.82	9.01	22.79	11.78	.11

BMI = body mass index; DASH = Disabilities of the Arm, Shoulder and Hand; KT = kinesio tape; PPT = pain pressure threshold; SD = standard deviation; VAS = visual analogue scale.

3.8-cm wide, nonelastic, adhesive-backed sports tape (premium quality zinc oxide tape).[30] Subjects lied supine with slightly elbow flexion, then pieces of taping laid on the skin distal to proximal direction toward the lateral epicondyle. In this technique, we applied 75% traction force on the soft tissues perpendicular to the line of the tape toward the lateral epicondyle.

These were laid on the skin distally to proximally in a diamond shape, while simultaneously applying traction force on the soft tissues toward the lateral epicondyle and perpendicular to the line of the tape (Fig. 1). In this technique, we applied 75% tension. The strips overlapped at their ends and were secured with an additional 4 tape strips (Fig. 1). This was applied in supine lying with the elbow in a slightly flexed position.[26,31]

Placebo (KT without tension)

This technique was formed in an identical diamond pattern but without any overlap of the tape strips and also without any traction of the skin and underlying soft tissues.

Outcome measures

The subjects filled upper extremity disability questionnaire (Disabilities of the Arm, Shoulder and Hand [DASH]) before and one week after intervention. VAS was measured before first session and after last session and VAS using with algometer, grip strength and PPT were measured each therapeutic session before and after taping. The frequency of treatment was 3 times per week for each group and 2 days after third treatment session (after 1 week) the posttest measurement were taken.

Reliability

The reliability of the testing procedures using algometer and dynamometer in this study was evaluated from the 2 repeated trials with 30 minutes interval in the no tape control condition on 12 patients. Intratester correlation coefficients and an estimate of error expressed as the mean and 95% confidence intervals were the indices of reliability used. Analysis of the repeated trials indicated high levels of reliability, with an intratester correlation coefficient of 0.92 and 0.96 for pressure pain threshold and maximum grip strength, respectively. The mean absolute error and 95% confidence intervals were 1.06 for pressure pain threshold and 0.87 for maximum grip strength (Table 1).

Assessment of pain intensity

For assessment of pain intensity a 10-cm VAS was used. The level of pain on the VAS was recorded on a 10-cm line distinct at one end “no pain” and marked at the other end, “the worst pain that you can imagine.” Subjects were asked to state their pain level by placing a mark along this horizontal line.[15,25] VAS was used during daily activity and applying pressures on the MTP by mechanical pressure algometer. So, 25 N pressure was exerted on the MTP, and patients were asked to report their pain according VAS. This scale is a simple, sensitive, and reproducible instrument frequently used for the assessment of variations in intensity of pain. In clinical practice, the amount of pain relief, assessed by a VAS, is often considered as a measure of the efficacy of treatment. The reliability of this method has been established previously.[32]

Assessment of PPT

The PPT measurement of MTP by pressure threshold algometer has been established previously as a reliable method.[33] So, in this

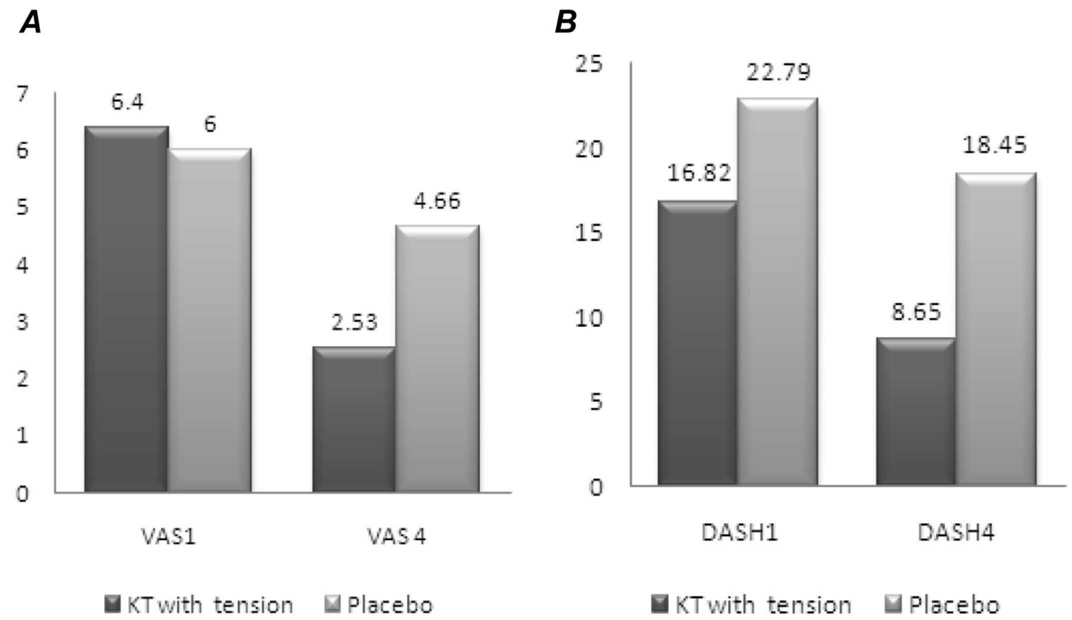

Fig. 2. Pretest and posttest measurements for mean VAS (**A**) and DASH scores (**B**) before and after 4-session treatment. KT = kinesio tape.

Table 3
Paired *t* test of dependent variables in first and fourth sessions for 2 groups (KT with tension and placebo)

Group	Variable	Pretreatment		Posttreatment		T	*P* value
		Mean	SD	Mean	SD		
KT with tension	VAS	6.4	1.99	2.53	1.89	6.54	.00
	VAS algo	4.6	1.84	4.26	2.57	0.53	.8
	PPT	15.92	4.87	17.34	7.05	−1.11	.28
	Grip	38.26	18.55	38.88	16.45	−0.24	.8
	DASH	16.82	9.01	8.65	5.25	3.55	.003
Placebo	VAS	6	2.23	4.66	1.89	2.52	.02
	VAS algo	5.66	1.71	4.93	1.98	1.28	.22
	PPT	12.93	5.16	13.1	4.5	−1.53	.88
	Grip	26.46	14.1	23.8	14.1	1.8	.09
	DASH	22.79	11.78	18.45	8.29	2.41	.02

KT = kinesio tape; DASH = Disabilities of the Arm, Shoulder and Hand; PPT = pain pressure threshold; SD = standard deviation; VAS = visual analogue scale.

study, it was used to assess the PPT of a MTP of the forearm muscles before and at the end of treatment (after 1 week).

At first, all patients became familiar with the procedure. Metal rod of the algometer was put upright on the MTP area then compressed slowly enough until subjects felt increase in pain intensity and discomfort. The compression was stopped when the subject reported "pain." The measurements repeated 3 times with an interval of 30-60 seconds. Average value of the 3 repetitive measurements (expressed as kilograms per square centimeter) was taken for data analysis of the PPT.[18,34]

Assessment of grip strength

A calibrated dynamometer was used to measure grip strength in the affected arm in the standardized recommended position: supine lying position, shoulder internal rotation, and elbow extension. Grip strength was measured 3 times. The average value of the measurements was used for data analysis.[35]

Assessment of Disabilities of the Arm, Shoulder and Hand

The DASH questionnaire is commonly used as an appropriate method to investigate the efficacy of different treatment modalities in the management and improvement of disability in patients with upper limb disorders. In this study, the DASH questionnaire was administered before KT with and without tension and after treatment in both groups to investigate the efficacy of KT with and without tension on improving disability in patients with lateral epicodylitis.[36]

Results

Data were analyzed using SPSS version 16.0. Normal distribution of variables was analyzed by the Kolmogrov-Smirnov test. Paired *t* test was used to determine any significant change in pain intensity, PPT, grip strength, and disability after treatment sessions compared with the pretreatment scores in the 2 groups. The analysis of covariance (ANCOVA) was calculated to determine the significance of differences between 2 groups in posttest measurements with the pretreatment scores used as covariates in the analysis. The test for homogeneity of regression coefficient was conducted because it is a necessary condition for valid application of the ANCOVA.

A total of 30 people based on the inclusion criteria were enrolled in the study. Twenty-five individuals was right dominant hand, and 5 individuals were left handed. Therefore, 85% of the participants presented with their dominant arm being the affected one.

Demographic data and other measures variables pretreatment (mean ± standard deviation) for the subjects in both groups is presented in Table 2.

Premeasurement and postmeasurement scores for the VAS during activity, PPT, VAS using an algometer, grip strength, and DASH in the 2 groups and the results of the paired *t* test are provided in Table 2. The mean score of VAS during activity decreased from 6.4 and 6 pretest to 2.53 and 4.66 posttest, respectively, for the KT with and without tension groups (Fig. 2). The mean PPT scores increased from 15.92 and 12.93 before treatment to 17.34 and 13.1 after treatment, respectively, in the KT with and without tension groups. The mean VAS using an algometer scores decreased from 4.6 and 5.66 preintervention to 4.26 and 4.93 postintervention in the KT with and without tension groups (Fig. 2A). The mean grip strength was not different in the KT with tension group but in the KT without tension decreased from 26.46 to 23.8. The DASH score increased at both of groups (Fig. 2B).

The result of the paired *t* test revealed a significant change in VAS during activity and DASH after treatment in the 2 groups compared with before treatment ($P < .05$). But measurement of PPT, grip strength, and VAS using an algometer revealed no significant difference (Table 3). The study showed no significant difference in variables immediately after intervention (Tables 4 and 5). ANCOVA reported significant difference between 2 groups on the postmeasurement score of VAS during activity and DASH ($P < .05$; Table 6). Functional disability of upper limb and severity of pain during daily activities

Table 4
Paired *t* test for variables onset treatment in 2 groups (KT with tension and placebo)

Group	Variable	Pretreatment		Posttreatment		T	*P* value
		Mean	SD	Mean	SD		
KT with tension	VAS algo	4.6	1.84	4.66	2.25	−0.15	.87
	PPT	15.92	4.87	15.21	4.21	0.74	.46
	Grip	38.26	18.55	40.04	23.3	−0.67	.5
Placebo	VAS algo	5.66	1.71	6.46	1.72	−1.82	.09
	PPT	12.93	5.16	13.26	4.21	0.93	.38
	Grip	26.46	14.1	25.26	23.3	1.45	.16

KT = kinesio tape; PPT = pain pressure threshold; SD = standard deviation; VAS = visual analogue scale.

Table 5
ANCOVA test for comparing change variables after 4-session treatment between 2 groups (KT with tension and placebo)

Variable	Sum square	Df	Mean square	F	*P* value
VAS	30.8	1	30.8	10.18	.004
VAS algo	0.14	1	0.14	0.03	.88
PPT	29.06	1	29.06	1.28	.26
Grip	4806.07	1	4806.07	72.33	.09
DASH	398.62	1	398.62	12.9	.001

ANCOVA = analysis of covariance; DASH = Disabilities of the Arm, Shoulder and Hand; KT = kinesio tape; PPT = pain pressure threshold; VAS = visual analogue scale.

were more effective in group with tension KT than other groups that have no tension.

Discussion

The data of our study demonstrated the significant change in VAS during activity and DASH score after treatment sessions compared with pretreatment score in the KT with and without tension groups.

All the relevant articles in systematic review study by Hamneshin[37] regarding the effect of KT on pain intensity indicated that those who used the tape reported less pain.

KT effect on pain intensity is interpreted by the gate control theory. KT stimulates slow threshold sensory neurons of touch (Aβ mechanoreceptors) and then inhibits transmission of pain afferent inputs from Aδ and C fibers to cortex. This mechanism causes inhibition of pain-spasm circle that results in nerve depolarization and a reduction in pain.[38] Other issue is that KT increases circulation and improves pain intensity.[22,39]

In present study, KT was attached in stretched position of muscle fiber. This position corrects sarcomere length in TrP and decreases pain and spasm. On the other hand, it stimulates Golgi tendon organ in the insertion end and inhibits its own muscle. These mechanisms decrease pain and spasm.[22]

There are different clinical approaches in KT to achieve the optimal therapeutic effect. However, skin lifting after KT facilitates blood and lymph flow and consequently relieving inflammation and pain.[22]

Accordingly, DASH score assessing upper limb functional activity concluded that the KT improves the functional activity which is compatible with the study by Prabhakar[40] and Kachanathu.[41] This could be a result of therapeutic effect of KT on pain relief and improve muscle contraction. In addition, the psychological effect of using KT like easiness should not be ignored which is not observed in other therapeutic interventions.[37]

Our data, however, indicated no significant increase in the PPT after treatment sessions in both groups which may need more treatment. Because KT was applied in direction of muscle fibers therefore could not stimulate mechanoreceptors to increase PPT. Similar to our finding, Vicenzino[26] assessed the variable of pressure pain threshold after kinesio taping, and the results were positive but not statistically significant.

This study showed KT did no effect on PPT and VAS using algometer immediately after intervention that may be because of insufficient time for effective changes on MTP zone.

Table 6
ANCOVA test for comparing change variables onset treatment between 2 groups (KT with tension and placebo)

Variable	Sum square	Df	Mean square	F	*P* value
VAS algo	7.57	1	7.57	2.9	.09
PPT	5.25	1	5.25	0.61	.44
Grip	8705.08	1	8705.08	88.55	.4

ANCOVA = analysis of covariance; KT = kinesio tape; PPT = pain pressure threshold; VAS = visual analogue scale.

In this study, we observed no significant increase in grip either immediately or after a 3-session treatment which can be explained by direction of KT from distal to proximal and results in decreasing muscle tension. There are controversy results in articles that studied grip strength after kinesio taping. A group of writers found out that KT increases grip strength.[31,40,42] In contrast, there was no difference in articles concerning the grip strength.[30,41] A major difference between studies was the test position used to measure pain-free grip strength. The present study and that by Vicenzino[26] tested grip strength in extension of the elbow, whereas the others[9,31,43] had the elbow in 90° of flexion. There is an assumption that the variance between the results is due to differences in testing position. For making a definitive statement as to the effect of different test position on the grip strength, it is proposed that in make a comparative study with both these test positions.

Our study showed no significant difference between groups in variables either immediately or after 1 week. However, only DASH questionnaire and VAS during activity was statistically significant between 2 groups.

In this study after intervention disability decreased the result of improvement of pain intensity.

Conclusion

The application of KT produces an improvement in pain intensity and upper extremity disability in subjects with LE and MTP in forearm muscles, and KT with tension was more effective than placebo group.

Suggestion and limitation

It is proposed that in future work, pain-free grip measurements might have been a more effective measure than an average of 3 grip measures.

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