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Original Article

Efficacy of kinesio tape application on pain and muscle strength in patients with myofascial pain syndrome: a placebo-controlled trial

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Abstract. [Purpose] The purpose of this study was to determine the short- and mid-term effects of Kinesio taping on the trapezius muscle in individuals with myofascial pain syndrome. [Subjects and Methods] Thirty-seven patients with active upper trapezius myofascial trigger points were randomly divided to 2 groups: group 1 received Kinesio taping for the upper trapezius muscle, and group 2 received a sham Kinesio taping application. Neck pain (Visual Analog Scale and pressure algometry) and trapezius muscle strength data were collected at baseline, immediately after Kinesio taping application, and at one month follow-up. [Results] The mean changes in Visual Analog Scale scores were significantly different between groups at T2 and T1, with less pain in group 1. The mean changes in algometry scores were significantly different between groups at T3 compared with T2 in favor of group 1. The mean changes in trapezius muscle strength were significantly different between the groups at T2 compared with T1 in favor of group 1. [Conclusion] Patients with myofascial pain syndrome receiving an application of Kinesio taping exhibited statistically significant improvements in pain and upper trapezius muscle strength.
Key words: Myofascial pain syndrome, Taping, Trapezius

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INTRODUCTION

Janet G. Travell first described myofascial pain syndrome (MPS) in 1942. The terminology used for MPS was established in 1983, and MPS was accepted as a clinical diagnosis[1)]. Myofascial pain syndrome is characterized by multiple trigger points in taut bands and facial constrictions. In clinical practice, MPS is frequently diagnosed, with a prevalence as high as 30%, which combined with a prevalence of myofascial pain as high as 30% results in a ratio of up to 85%[2, 3)].

Treatment strategies for MPS are primarily divided into invasive and noninvasive treatment techniques. The non-invasive treatment techniques include medical treatment, electrotherapy, cold spray/stretching, ischemic compression, and massage. The invasive techniques, such as trigger point injections and dry needling, are preferred but have risks. Physical therapy requires the time of the patient and the therapist for each session[4)].

Kinesio tape (KT) is a relatively new form of elastic therapeutic tape that was developed by Dr. Kenzo Kase in the 1970's and is used in the treatment of a variety of injuries[5)]. Despite its popularity and widespread clinical use, there are relatively few studies that support the effectiveness of KT for neck and upper extremity conditions[6)]. It has been hypothesized that

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KT may exert its effects by (1) increasing local circulation, (2) reducing local edema by decreasing exudative substances, (3) improving circulation of blood by facilitating muscle, (4) providing a positional stimulus to the skin, muscle, or facial structures, and (5) providing proper afferent input to the central nervous system[7]. The KT application techniques include facilitation, inhibition, fascia correction, field correction, functional correction, and mechanic correction techniques. The KT practitioner must decide which muscle group should be treated with which type of technique. The inhibition technique can be used for muscle dysfunction caused by microtrauma or tension[8].

Several studies have investigated the effect of KT on patellofemoral pain syndrome, ankle instability, whiplash injury, spasticity, and low back pain[9–13]. There have been only two studies of the effectiveness of KT on mechanical neck pain[7, 14], and to date, one study and a single case report have evaluated the effects of KT use in patients with myofascial pain[15, 16]. The purpose of the present study was to compare the effects of KT application by the inhibition method to the upper trapezius muscle versus placebo tape application on neck pain and muscle strength in patients with cervical MPS.

SUBJECTS AND METHODS

Fifty-three patients being treated at Physical Medicine and Rehabilitation clinic participated in this study. All subjects signed an informed consent form prior to participation. The study protocol was approved by the University's ethics committee. Demographic data including age, body mass index, and gender were recorded. The trapezius muscle is the most common muscle presenting with MPS symptoms[1]. Therefore, the trapezius muscle was chosen for observing the effect of KT in the present study. Patients with neck and/or upper back pain who had an active myofascial trigger point in the upper trapezius region and taut palpable band were included. MPS was diagnosed according to the diagnostic criteria of Travell and Simon[1]. The inclusion criteria were as follows: age between 18 and 50 years and symptom duration of more than 2 weeks. The exclusion criteria were as follows: diagnosis of fibromyalgia syndrome; diagnosis of psychiatric disorders such as anxiety and depression; symptoms of radiculopathy; brachial plexopathy; or other nerve entrapments. Patients who underwent MPS treatment in last 6 months, had a malignancy, were pregnant, had an infectious disease, had an inflammatory musculoskeletal disease, or had undergone shoulder or neck surgery were excluded.

Fifty-three patients were evaluated, and 40 patients who met the inclusion criteria participated in the study (Fig. 1). Following a baseline examination, the patients were randomly assigned to the therapeutic KT group (group 1) or a placebo (sham) group (group 2) by the closed envelope method. For all patients, KT application was performed by a certified KT practitioner. After the initial evaluation, six patients dropped out of the study for personal reasons. The participants in both groups participated in home exercise programs including neck muscles stretching and strengthening exercises and received a training booklet explaining the exercises that they could do on their own at home.

The KT (Kinesio Tex Tape, Kinesio Holding Corporation, Albuquerque, NM, USA) used in this study was waterproof, porous, and adhesive. Kinesio tape with a width of 5 cm and a thickness of 0.5 mm was used in both groups. The experimental group received a standardized therapeutic KT application. Prior to application, the patient was seated and asked to flex their neck laterally to the contralateral side and to rotate their head to the same side. The anchor was applied inferior to the acromion, and the initial part of the band was stretched maximally before KT was applied through the upper side of the trapezius to the hairline without stretching (the inhibition technique was applied according to the method of Kenzo Kase) (Fig. 2a). The placebo group received improper KT application consisting of an I strip (same material as the real application) applied with no tension. For the placebo taping, the cervical spine of the participants was placed in a neutral position. The I strip was placed from the spine to the acromion along the spina scapula (Fig. 2b). The two different tape applications looked very similar, but in the placebo group, no tension was applied to the cervical structures. Kinesio tape was applied to both groups at the beginning of the week and was to stay on for three days; it was applied twice, with one day of rest between applications.

The occupations of all the participants involved 8 hours of computer-based work per day, and they worked with the tape applied. The outcome measures for this study were Visual Analogue Scale (VAS) score, pressure algometry measurement, and scapular elevator muscle strength measurement. All patients were evaluated before treatment (T_1), immediately after treatment (T_2), and at 1 month after treatment (T_3). The VAS was used to record each patient's current level of neck pain, with 0 indicating no pain and 10 indicating the worst pain that the patient had experienced. Using a ruler marked in centimeters, the examiner obtained the exact values along a 10-cm VAS line. In this study, also an analogue algometer (Baseline FDK) was used to detect pain level. The device is a force gauge fitted with a disc-shaped rubber tip with a surface area of exactly 1 cm^2. Pressure measurements are expressed as kilograms per square centimeter (kg/cm^2). The algometer was placed at a chosen trigger point with the metal rod perpendicular to the surface of the skin and the patient in a seated position. Pressure was applied at an increasing rate of 1 kg/second[17]. The patient was instructed to indicate the point at which pain was perceived. After the dial had been set to zero, the procedure was repeated three times with an interval of 1 munute for each patient. The average of three readings was used for analysis. Patients were evaluated for muscle strength using a back/leg/chest dynamometer (Baseline® dynamometer). External force applied to the dynamometer compressed a steel spring and moved a pointer. Upon knowing the force required to move the pointer a particular distance, one can determine exactly how much external force has been applied to the dynamometer. The dynamometer thus provides a measure of the force the patient generates while performing a standing extension of the torso[18]. The patient was asked to assume approximately 0-degree

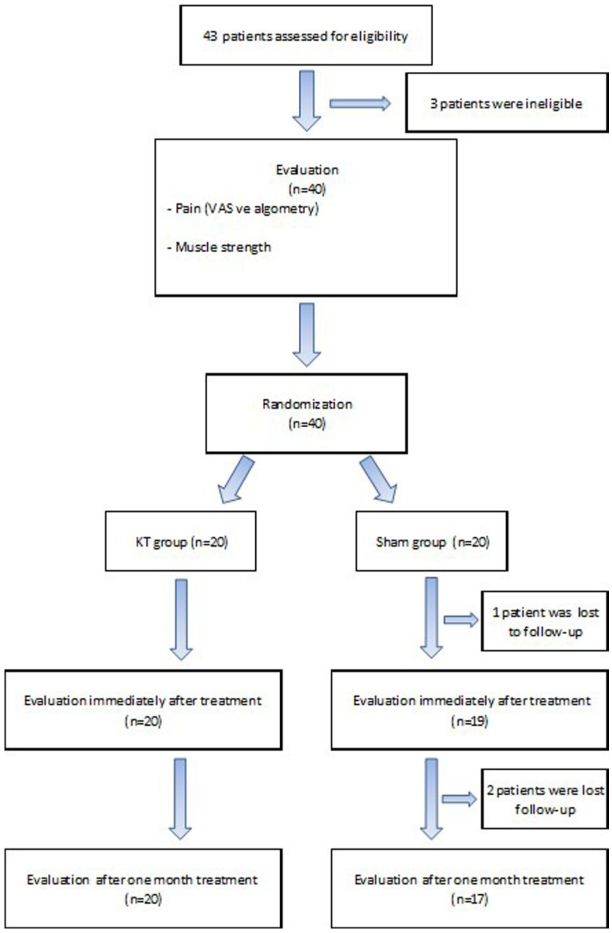

Fig. 1. Flow diagram of the patients

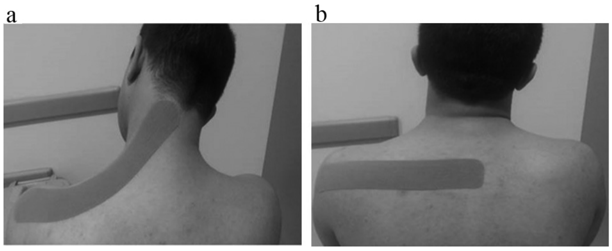

Fig. 2. a. The inhibition application technique in a suitable position. b. The placebo application technique in a neutral position

extension of the knees and 30-degree flexion of the hips while maintaining an appropriate lordotic curve and then told to pull up on the dynamometer using the major muscle groups of the shoulder elevators. The average of two strength measurements for each testing period separated learning effects from training effects. Patients wore sportswear shoes for the test.

Initially, a pilot study was conducted on 10 patients from each group. In order to determine the sample size, power analysis was performed using the G*Power (v3.1.7) program. Twenty patients per group would provide 80% statistical power at a 5% significance level (effect size d = 0.92) according to algometer scores between groups. The Number Cruncher Statistical System (NCSS, 2007, NCSS, LLC, Kaysville, UT, USA) and Power Analysis and Sample Size (PASS, 2008) statistical software (NCSS, LLC, Kaysville, UT, USA) were used to characterize the study sample. Descriptive statistical analysis values (mean, standard deviation, minimum, maximum, median, and ratio) were used according to the distribution variables. Data for continuous variables were compared using Student t tests or the Mann-Whitney U test. Categorical variables were compared by Fisher Exact test and Yates' Continuity Correction test. Within-group comparisons were done using the Friedman Test. For the variables for which significant differences were obtained, the Wilcoxon signed rank test was used (post hoc). A p-value of <0.05 was considered to indicate a statistically significant difference.

RESULTS

Fifty-three patients were screened according to the inclusion criteria. Thirty-seven patients (age, 29.95 ± 4.90 years in the experimental group and 33.86 ± 8.47 years in the placebo group [mean ± SD]) satisfied the inclusion criteria and were randomly assigned to the KT group (n = 20) or placebo group (n = 17). The demographic characteristics of the groups were similar (p >0.05) (Table 1).

The mean changes in VAS scores were significantly different between groups at T_3 compared with T_1 ($p < 0.05$) in favor of group 1 (Table 2). Within-group analysis of VAS scores demonstrated a reduction in group 1 ($p < 0.0001$) and group 2 ($p < 0.0001$) (post hoc analysis is presented in Table 1). The mean changes in algometry scores were significantly different between groups at T_3 compared with T_2 ($p < 0.05$) in favor of group 1 (Table 1). Within-group analysis of algometer scores demonstrated improvement in group 1 ($p < 0.0001$) and group 2 ($p < 0.05$) (post hoc analysis is shown in Table 1). The

Table 1. Demographic characteristics

		KINESIOTAPE (n=20) Average±SD	SHAM(n=17) Average±SD
Age (years)		29.95±4.90	33.86±8.47
BMI (kg/m^2)		22.71±3.02	22.4±4.60
Duration (days)		329±221.19 (365)	532±388.38 (455)
Gender (female/male)	3 (%17.7)	14 (%82.3)	14 (%82.3)
	2 (%10)	3 (%17.7)	3 (%17.7)

Table 2. Comparison of VAS, algometry and trapezius muscle strength within the groups, between the groups

	Group	Pre-treatment (T1)	Post-treatment (T2)	Follow-up (T3)
VAS	1	6.86± 1.87 (7.5)**	3.86± 2.60 (3.5)*	2.64± 3.25 (0.0)***††
	2	6.45± 1.19 (6.5)**	3.05± 2.58 (3.0)*	2.60± 2.82 (2.0)
Algometry (kg/cm^2)	1	3.85± 2.62 (4.0)**	6.00± 3.61 (7.0)*	6.85± 3.68 (7.0)***††
	2	4.93± 2.53 (5.0)**	5.93± 2.87 (6.5)*	6.29± 3.20 (6.5)
M. trapezius elevation strength	1	62.25± 9.24 (90.0)**	65.25± 10.70 (105.0)*†	134.50± 79.70 (105.0)
	2	130.71± 99.73 (120.0)	134.29± 105.23 (115.0)	137.86± 100.47 (115.0)

Post hoc analysis:
*Statistically significant comparison between pre- and postresults ($p < 0.05$)
**Statistically significant comparison between pre- and follow-up results ($p < 0.05$)
***Statistically significant comparison between post- and follow-up results ($p < 0.05$)
Between-group comparisons:
† Statistically significant difference between pre- and postresults of mean change scores ($p < 0.05$)
†† Statistically significant difference between post- and follow-up results of mean change scores ($p < 0.05$)

mean changes in trapezius muscle strength were significantly different between the groups at T_2 compared with T_1 ($p < 0.05$) in favor of group 1 (Table 1). Within-group analysis of trapezius muscle strength demonstrated improvements in group 1 ($p \leq 0.0001$) (post hoc analysis is shown in Table 1).

DISCUSSION

The results of this randomized placebo-controlled, single-blinded study demonstrate that application of KT to the trapezius muscle resulted in a significant improvement in the pain level after KT application, even at a month after the use of KT. Applying KT along the trapezius area also increased trapezius muscle strength at 1 month after KT application.

In the literature, although there have been studies showing an improvement in pain with KT application, the mechanism for this improvement has not been elucidated[6)]. One possible analgesic mechanism may be related to the decreased subcutaneous nociceptor pressure in the skin. Another hypothesis involves the application of afferent stimuli to the soft tissue structures, facilitation of a pain inhibiting mechanism, and activation of the gait control mechanism[19)]. Thelen et al. investigated the efficacy of KT application on rotator cuff tendinitis and impingement syndrome and observed increased abduction angles[20)]. However, improvements in pain were not observed in their study. Contrary to the results of Thelen et al., Garcia-Muro et al. reported a case of myofascial pain of the deltoid muscle that exhibited improvement in terms of pain level with KT application[16)]. Another study by Gonzalez-Iglesias et al. investigated the effect of KT application on whiplash injury, and the authors documented improvements in terms of pain level[7)].

Hernandez et al. compared the efficacy of cervical manipulation and KT application in patients with mechanical neck pain and found results similar to those of Gonzalez-Iglesias et al[7, 21)]. Karatas et al. researched the efficacy of KT application on mechanical neck pain and showed that patients treated with KT exhibited improvements in terms of pain[14)]. The results of our study are similar to those of these recent studies[7, 14, 21)]. In the present study, improvements in terms of pain level after KT application were observed. Furthermore, continuous effects at 1 month after KT application were demonstrated. Significant improvements in terms of pain level immediately after application were also observed in the placebo group. However, improvement in terms of the pain level measured by VAS and algometry persisted in KT group after 1 month from the application, whereas they did not continue in the placebo group. Reduced pain levels after treatment in the placebo group were considered to be the results of possible psychological effects[19, 20)]. However, although the placebo application was improper, it was applied to the same muscle so it probably provided proper sensory feedback during cervical spine movements, which decreased mechanical irritation of the soft tissues[21)]. This sensory feedback may improve patient awareness and thus increase their adherence to the ergonomics principles[19, 20)].

In this study, improvements regarding scapular elevation muscle strength were observed. Correcting muscular imbalance is important for preventing and treating musculoskeletal disorders. If the KT application could influence the strength or flexibility of the healthy muscle, it could be used in cases of muscular imbalance, which is important for the treatment and prevention of musculoskeletal pathologies[22]. According to Williams et al., KT application results in a small immediate increase in muscle strength by producing a concentric pull on fascia, which may stimulate increased muscle contraction, and an additional hypothesis suggests that the facilitated muscle activity and improved muscle alignment may contribute to increases in muscle strength[19]. Lumbroso et al. evaluated the effects of KT application on the hamstring and gastrocnemius muscles and found a significant increase in the peak force in the gastrocnemius group immediately and 48 hours later; however, in the hamstring group, the increase in peak force was only detected 48 hours later. The authors suggested that it was possible that certain muscles react differently to the KT application. On the other hand, Lumbroso et al. indicated that the increase in muscle force could be due to a placebo effect, but their study did not include a placebo group[22]. In the present study, improvement in terms of muscle strength was observed only in the KT group. Lumbroso et al. also concluded that different muscles react differently to the KT application[22]. Therefore, the method of KT application should be should be designed specific to each muscle, because maximum muscle strength dependent on muscle morphology and muscle activation type[23]. The most suitable method of KT application should be tested for each muscle in future studies. The data from the present study are in agreement with those of the previous study[19, 23], but the placebo group also showed an increase in muscle strength. As a limitation of this study, both groups performed an exercise program. The increase in muscle strength in the placebo group may have been related to exercise.

Recent studies investigating the effect of KT application on muscle strength in healthy athletes did not find any significant change in muscle strength[24, 25]. However, there were limitations to these studies. One limitation was the inclusion of only healthy athletes who had already achieved a certain level of muscle strength. Another limitation was the evaluation of muscle strength immediately after KT application. KT application does not cause an immediate effect on muscle strength, but an acute effect can be detected by electroneuromyography (EMG) objectively. One way of exploring muscle activation is to look for a change in the amplitude of a reflex, such as the H reflex.

There are a number of limitations in the current study that should be recognized, in addition to that already mentioned. One of these limitations is the number of participants included. The same study protocol could be performed in a larger population. Another limitation is that the investigators who performed the therapeutic and placebo KT applications and performed measurements were not blinded to the treatment allocation. Thus, the beliefs and expectations of the investigators who performed the therapeutic and placebo KT applications may have affected the measurements unknowingly. Despite this, we tried to be as objective as possible in conducting this study.

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