The Effectiveness of Kinesio Taping for Athletes with Medial Elbow Epicondylar Tendinopathy

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Key words
- taping
- golfer's elbow
- proprioception
- grip force

Abstract

Kinesio taping has also been used for athletes with Medial Elbow Epicondylar Tendinopathy (MET) as an additional treatment method. The purpose of this study was to determine the clinical effectiveness of Kinesio tape on maximal grip strength and absolute and related force sense in athletes with MET when applied to the medial forearm. 27 male athletes who voluntarily participated in this study were divided into a healthy group (n = 17) and a MET group (n = 10). All subjects were assessed for the maximal grip strength and grip force sense (absolute and related force sense) under 3 taping conditions: 1) without taping; 2) with placebo Kinesio taping; and 3) with Kinesio taping. No significant interaction was found between groups and taping condition in maximal grip force and related force sense error, except for absolute force sense error ($p = 0.04$). Both groups with absolute force sense measurements had significantly decreased errors in the placebo Kinesio taping and Kinesio taping conditions. Both taping may enhance discrimination of magnitude of grip force control (absolute force sense) in both groups when applied to the forearm. However, Kinesio taping did not change maximal grip strength in either group. The effects of Kinesio taping on other muscle functions remain to be studied.

Introduction

Medial Elbow Epicondylar Tendinopathy (MET), also called golfer's elbow, is caused by repeated strain or overuse at the flexor-pronator mass. It is a common disorder that occurs in overhead throwing, hitting, serving, and racquet sports [3,5,11]. Symptoms included pain at the musculo-tendinous origin of the wrist common flexor, where it arises from the medial epicondyle, and the inability to make a fist and hold a racket or ball [3,5,11]. MET has often been reported in baseball pitchers, golf/tennis players, javelin throwers, and bowlers, and it troubles them when they practice or compete [3,5]. Those prolonged symptoms and frequent relapses affect grip strength and sports performance [3,5,11]. Thus, it is an important issue for clinicians to decrease the influence of MET.

Taping has also been used for athletes as an additional treatment method [3]. In recent years, a new form of cotton and elastic tape with an acrylic adhesive has been introduced, and it is called Kinesio tape [14]. Its features of permeability, elasticity, and suitable adhesive material cause less skin irritation and also allow free movement. The acrylic mounting of Kinesio tape differs from athletic tape in its wave-like grain on the adhesive side. According to the inventor, when the specialized grain and elasticity of the tape are applied to the skin, the tape provides a pulling force on the skin and creates more space by lifting the fascia and soft tissue under the areas where it is applied [7,19]. However, the functions of the special adhesive grain and elasticity of Kinesio tape have not been sufficiently verified with the scientific method, and little research has focused on its use in treating MET.

Chang et al. [2] determined the immediate effects of forearm Kinesio taping on maximal grip strength and force sense in healthy athletes. The results revealed that forearm Y-stripe Kineso taping may enhance either relative or absolute force sense, but no change was seen in maximal grip strength in healthy subjects. Fu et al. [6] examined the effect of Kinesio taping on the quadriceps strength of healthy athletes with isokinetic dynamometry. They found no significant difference in muscle strength either immediately upon taping or 12 h after taping. Vithoulka et al. [20] investigated the effect of Kinesio taping on quadriceps strength in healthy female non-athletes. The results revealed no significant differences in maximum concentric torque among the 3 different taping modes and

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significant improvement in maximum eccentric test in the quadriceps muscle. In brief, the results of those previous studies, which are related to the influence on muscle strength of Kinesio taping, remain controversial and point to the need for further research.

Halseth et al. examined the effects of Kinesio taping on ankle joint position sense [9], and concluded that the application of Kinesio taping did not appear to enhance ankle joint position sense in healthy individuals. Murrary and Husk found that Kinesio taping improved proprioceptive abilities only in the midrange of ankle motion, where the joint receptors were not being stretch and evoked more activation [16]. In contrast, Chang et al. [2] found that force sense improved in healthy athletes when Kinesio taping was applied to the forearm. For these reasons, we believe that the effect of Kinesio taping on proprioception may come from receptors underlying the skin, myofascia, and muscles. In addition to this, a variety of methods have been used to assess proprioception with Kinesio taping applied. Simoneau et al. also mentioned that increased cutaneous sensory feedback provided by strips of athletic tape applied across the ankle joint of healthy individuals can help improve ankle proprioception [18]. However, Kase, the inventor, designed the special wave-like adhesive grain to mimic the skin's elasticity and claimed that it may cause a varying pulling force and lifting space under the skin and myofascia which has abounding cutaneous receptors [17]. On the market, we found 2 types of Kinesio tape, one having special wave-like adhesive grain and elasticity material, and another one made of elastic material only. The role of the wave-like adhesive grain of Kinesio tape in enhanced proprioception and strength is debatable. Nevertheless, no studies on Kinesio taping have explored the role of its adhesive grain and elasticity on proprioceptive function. The purpose of this study was to compare the effects of Kinesio taping on maximal grip strength and force sense in healthy subjects and athletes with MET.

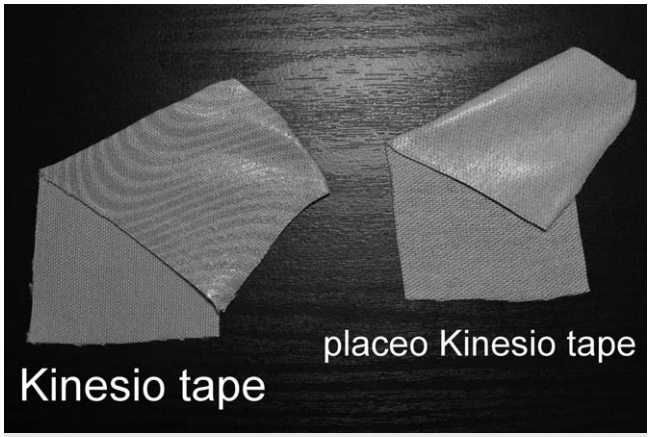

Fig. 1 Adhesive grain pattern of Kinesio tape.

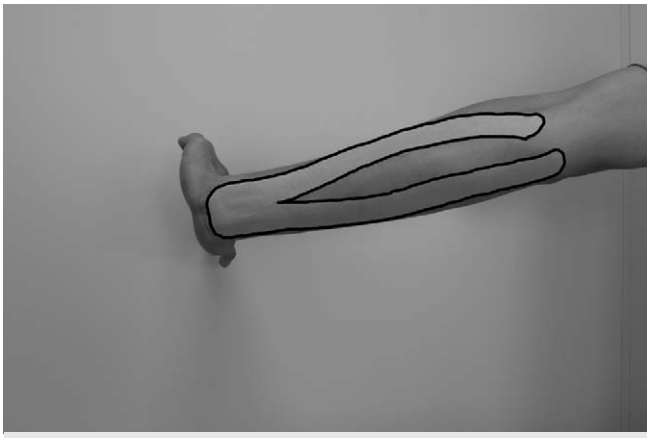

Fig. 2 The application method of Kinesio tape.

Methods

Subjects

The present study was conducted as a subjects-blind, repeated-measures design. 27 male collegiate athletes voluntarily participated in this study. They were divided into a healthy group (n = 17, average age, 19.9 ± 1.5 years; average height, 176.9 ± 4.6 cm; average weight, 75.1 ± 7.6 kg) and a MET group (n = 10, average age, 19.5 ± 1.5 years; average height, 179.1 ± 5.8 cm; average weight, 76.9 ± 8.9 kg; injury duration: 4–10 weeks). The subjects of both groups were all collegiate baseball players and all were right-hand dominant. The criteria for diagnosis of MET were 1) pain arising from the medial epicondyle; 2) tender point over the musculo-tendinous origin of the common wrist flexor muscles; 3) a positive resisted wrist flexion test; 4) pain during fist tightening or holding a racket or ball, resulting in decreased force; and 5) identification of tendinopathy in the medial elbow by ultrasonographic diagnosis; and 6) symptoms had lasted more than 2 weeks. Exclusion criteria included elbow joint or ligament injury or laxity, forearm fracture, or nerve injuries within the previous 6 months [1,3,5]. The Ethics Committee of the local university approved the study, which observed the standards of the International Journal of Sports Medicine [10]. All subjects understood the details of the study procedure and signed informed consent forms prior to participation in the study.

Taping application

Measurements were made under 3 taping conditions performed in a random order: without taping applied (WT), with placebo Kinesio tape applied (PKT), and with Kinesio tape applied (KT) on the forearm, we allowed a 1-week interval between measurements of different taping conditions. Kinesio taping of the forearm was consistent with the protocol for MET of the elbow suggested by Dr. Kase [14]. Kinesio tape was applied on the wrist flexor muscle of the dominant hand for the healthy group. Standard 2-inch (5 cm) Kinesio® Tex Tape (Kinesio Holding Company, Albuquerqe, NM, USA) was used for KT application, and SUN UP Tex Kinesiology Tape (T.C.C. LTD, Japan) was used for PKT application. The only difference between the KT and PKT is the adhesive grain pattern (**Fig. 1**). Before each type of tape was applied, the length of tape was measured from 2 cm inferior to the medial epicondyle of the humerus to the wrist joint line, and multiplied by 0.85 as the length of the tape. In order to keep the stretch tension equal to 15–20 %, the tape was cut down the middle of the strip to produce 2 tails, or a "Y-strip". The Y-strip was applied to the common wrist flexor muscle from its insertion to origin. The first tail of the Y-strip was applied on the middle of the forearm with the wrist in a hyperextended position and the elbow in full extension and supination. The second tail of the Y-strip applied from insertion to origin, was placed along the medial edge of the forearm to wrap the common wrist flexor muscles (**Fig. 2**).

Outcomes measures

The outcome measures for this study consisted of maximal grip strength and force sense measurements. Maximal grip strength was assessed to determine the strength of the hand grip. Strength

was measured by using the JAMAR Hydraulic Hand Dynamometer (Sammons Preston, USA). The maximal grip strength was measured with the upper arm of the limb that was being tested held tightly to the trunk, elbow flexion of 90°, and wrist placed in neutral position, with the subject standing. Subjects held the hand dynamometer and were asked to grasp the handle of the dynamometer with as much exertion as possible for 5 s, and then release the handle [2]. 3 trials were conducted for each subject, and the mean value of the 3 trials was recorded for analysis.

30 min after assessment of maximal grip strength, the force sense was examined using the same hand dynamometer. The value of maximal grip strength was used to calculate the target force or reference value for force sense measurement. A value of 50% of the maximal grip strength was set as the target force [2,4,13]. To begin force sense testing, the subject attempted to squeeze the handle of the hand dynamometer while receiving visual feedback; this was done by putting a mirror behind the subject to allow observation of the force value produced. Once the target force was achieved, the subject was instructed to maintain it for 3 s and to concentrate on how much force was being exerted. We then removed the mirror (visual feedback) and instructed the subject to reproduce the force value. When the subject said that the target force had been achieved, then the force value was recorded. The measurement was repeated 3 times without visual input and with intervals of 5 s rest. During measurements, the investigators concealed the results of each trial from the subjects in order to prevent a learning effect.

The error score of each trial was calculated as the absolute and relative difference between the target force and the verbally reported force of the subject, indicating absolute force sense error (AFSE) and relative force sense error (RFSE). The value of RFSE was scored as negative when the reproduction value was below the reference value or positive when the reproduction value was above the reference value. The value of AFSE indicated the discrimination of magnitude of grip strength and amount of grip force control, while the value of relative force sense error represented over- or under-estimation of grip strength and direction of grip force control [2,4]. The test-retest reliability of force sense was carried out in a pilot study, in which 15 healthy athletes (age 18~24 years old) participated in the reliability test, and the intra-class correlation coefficient of relative and absolute force sense was 0.704 and 0.741, respectively.

Sample size determination

The a priori data from a pilot study were used to determine the sample size. A power analysis demonstrated the need for at least 7 subjects for absolute force sense error measurement, 8 subjects for relative force sense error measurement, and least 207 subjects for maximal grip force measurement to set an alpha level of 0.05 and a power of 80%. However, according to our previous study, the variable of maximal grip force did not achieve a significant difference among 3 taping conditions, consistent with previous studies on strength or force measurement [6,20]. In addition, we chose to calculate the sample size for force sense only, and used the results of sample number from force sense error variables as the force sense measurement was the primary outcome.

Statistics

The independent variables in this study were the taping conditions (WT, PKT, and KT) and groups (healthy and MET group), and the dependent variables were the maximal grip strength (MGS) and absolute and relative force sense errors (AFSE and RFSE). Data analysis was done using SPSS, Version 14.0 (SPSS Inc, Chicago, IL, USA). The independent sample t-test was used to analyze the demographic data of subjects in the healthy and MET group. Descriptive statistics and 2-way ANOVA with LSD post hoc comparison were used to compare the differences among the 3 taping conditions for the healthy and MET groups. The level of statistical significance was set at $p < 0.05$.

Table 1 Maximal grip strength, absolute and related force sense error between groups.

Outcome/Group	WT	PKT	KT
MGS, lb			
control	50.29 ± 6.48	50.35 ± 7.25	50.50 ± 6.30
MET	53.65 ± 8.52	53.70 ± 9.36	55.30 ± 7.29
AFSE, lb			
control	3.14 ± 1.40[a,b]	2.74 ± 1.69[b]	2.01 ± 1.31[a]
MET	3.50 ± 1.10	1.33 ± 0.72	1.53 ± 1.15
RFSE, lb			
control	−0.19 ± 2.84	−0.97 ± 3.05	−0.16 ± 2.27
MET	−1.69 ± 2.71	−0.48 ± 1.40	−0.45 ± 1.84

[a] indicates statistically significantly difference between WT & KT ($p < 0.05$)

[b] indicates statistically significantly difference between WT & PKT ($p < 0.05$)

MET, Medial Elbow Tendinopathy; WT, without taping applied condition; PKT, with placebo Kinesio taping applied condition; KT, with Kinesio taping applied condition; MGS, maximal grip strength; AFSE, Absolute force sense error; RFSE, Related force sense errors

Results

Analysis of demographic data revealed no significant differences in age ($p = 0.997$), height ($p = 0.371$), or weight ($p = 0.534$) between healthy and MET groups. The results of each outcome measure of the subjects are shown in the **Table 1**. Analysis of each outcome measure of the subjects showed no significant interaction effect between taping conditions and groups in MGS ($F_{(2,50)} = 0.35$, $p = 0.50$) and RFSE ($F_{(2,50)} = 1.57$, $p = 0.22$). A significant interaction effect was found only in the AFSE ($F_{(2,50)} = 3.41$, $p = 0.04$). This indicates a difference in the 3 taping conditions between groups in AFSE. The taping conditions and groups were compared for main effect in AFSE. The results revealed that PKT and KT in the MET group had smaller errors in AFSE than WT, respectively ($p < 0.05$). Also, WT in the control group had larger errors than PKT in AFSE. Comparing groups, the MET group had smaller errors than the control group in the PKT condition ($p < 0.05$).

Discussion

Grip strength refers to the functional ability of the fingers and hand to generate muscle power and force [2,15]. If MET affects an athlete's ability to grip and operate sports equipment due to pain, the athlete's overall effectiveness in the sport will be decreased [3,5]. One of the functions of Kinesio taping, as proposed by the inventor [7,19], is enhancement of muscle performance by strengthening weakened muscles and controlling over-active muscles. However, in the present study, the effect of Kinesio taping on muscle function claimed by Kase et al. was not reflected in the maximum grip strength in either group. The results of the current study are similar to those of previous reports [2,6,20]. Future work should focus on the effects of Kinesio taping on other muscle functions, such as muscle endurance or muscle fatigue.

Proprioception is a specific sensation that can provide signal information relative to joint position and movement and send messages to the brain for integration of sensory information, composed of joint position sense, kinesthesia, and force sense [4,8,12]. A previous study reported that proprioception is enhanced by tape application on the skin [17]. Halseth and coworkers reported that the improved proprioceptive ability was observed only in the midrange of joint motion, where the joint position receptors are less active and more muscle receptors are active in response to firing when Kinesio taping is applied [9]. Similar results were reported by Murray and Husk [16]. Their results seem to indicate that force sense testing is more suitable for proprioceptive measurement with applied Kinesio taping than is joint position sense testing. Our results support this argument. We found that both placebo and Kinesio tape applied to the forearm resulted in smaller errors in absolute force sense as compared to no taping in the MET group, although the healthy group also showed similar results. The possible effects of Kinesio taping may be due to the stimulation on skin and muscle proprioceptors. When Kinesio tape is applied on the skin, the elastic material of the tape pulls and stretches the skin and stimulates the mechanoreceptors to sense the alteration of message concerning changes in stretch, load, pressure, and shear force [17]. It has been stated by other researchers that skin and fascia might play a role in detecting the feedback of force production [8,12,13,17]. Those deformation messages are passed to the brain, where they are modulated and integrated before being passed down the command line to alter the tension of muscles [8,13]. Our study also confirmed that, as previously mentioned, Kinesio taping improved the absolute force sense and influenced the discrimination of the magnitude of grip force control in the forearm in healthy and MET subjects. In the healthy group, placebo Kinesio taping applied with the same method also resulted in smaller errors than no taping applied. The healthy subjects who had intact proprioception and muscle function could also sense the cutaneous input from the skin and fascia due to the tape applied on the skin.

In the present study, the placebo and Kinesio tapes were applied using the same methods and elastic material. The only difference was in the grain of the Kinesio tape, a wave-like grain on the adhesive side, which the placebo Kinesio tape does not have. The current results show that both kinds of Kinesio tape can enhance the discrimination of magnitude of grip force control, which may be not attributable to the unique adhesive grain of Kinesio tape. However, in our study, we did not use the applied elastic tape as a control variable, and therefore we cannot conclude on the elastic material effect of the Kinesio tape. This is also one of our experimental limits. Besides, the lack of significant results in RFSE may indicate that discrimination of overestimation or underestimation of grip force was not affected when the Kinesio taping was applied, whether placebo or actual.

Conclusion

The current study demonstrated that Kinesio taping had no influence on MGS. The results also showed that both placebo and Kinesio taping improved the grip force sense immediately upon application on the forearm, in both healthy subjects and subjects with chronic MET. The unique wave-like adhesive grain of Kinesio tape may not have a significant practical function as stated by the manufacturer.

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