THE COMPARISON OF DIFFERENT ELASTIC TENSION OF KINESIO TAPING ON GASTROCNEMIUS MUSCLE ACTIVATION

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The purpose of this study was to compare the effect of different elastic tension of Kinesio taping on gastrocnemius muscle activation. Thirty-seven healthy athletes was recruited and randomly divided into three groups: Elastic tension 0% (N = 13), 10% (N = 12), and 20% (N = 12). All athletes were applied Kinesio taping on gastrocnemius muscle in 3 different elastic tape tensions. The wireless electromyography was used to assess the gastrocnemius muscle activation before and after applied Kinesio taping while jogging on treadmill. The results showed that a significant interaction between different elastic tape tension and pre-post taping applied ($p<.05$). The elastic tape tension 0% and 10% showed significant decreased on the muscle activation after Kinesio taping applied.

KEY WORDS: elastic taping, electromyography, sports injury.

INTRODUCTION: Taping was often used in the preventing sports injury and in rehabilitation program. Kinesio tape is a newly invented taping material by Japanese scholar in recent years (Kase, 2003). The characteristic of this tapes' material are longitudinal elasticity, breathability, and hypoallergenic. Hence, more and more athletes used this tape to prevent or to treat sports injuries. According to inventor's describe, the Kinesio taping has four main application mechanisms: (1) improving muscle function, like muscle strength or delay muscle fatigue occurs; (2) improving lymph circulation; (3) pain reduction; (4) alignment correction. Recent studies have showed that Kinesio taping can improving local circulation, decreasing inflammation, pain reduction, and enhance proprioception (González-Iglesias, 2009; Paoloni, 2011; Tsai, 2009; Chang, 2010; García-Muro, 2010; Firth, 2010; Kalichman, 2010; Kaya, 2011; Lin, 2011). However, muscle function enhancement was still controversy. Some researchers have agreed that the Kinesio taping could affect the recruitment of muscle fibres (Hsu, 2009; Lin, 2011; Paoloni, 2011; Briem, 2011). But, the others studies showed no change in muscle strength (Fu, 2008; Vithoulka, 2010; Chang, 2010). In other words, the effect of increased muscle fiber recruitment maybe cannot been showed in muscle strength exam when applied Kinesio tapes. Besides, the application skill of Kinesio tape depended on the clinicians' experience. The applied methods have not been standardized, especially the elastic tension. Therefore, the purpose of this study was to determine the appropriate elastic tension of Kinesio tape on the gastrocnemius muscle electromyographic activation for healthy athletes.

METHODS: Thirty seven healthy athletes were voluntarily participated in this study. All subjects were randomly divided into three groups: Applied elastic tension 0% (N = 13), 10% (N = 12), and 20% (N = 12). The subjects' demography data was presented in Table 1.

Table 1.
The subjects' demography

Demography	Applied elastic tension 0% N=13	Applied elastic tension 10% N=12	Applied elastic tension 20% N=12	*P* value
Height,cm	172.0± 6.3	172.5±9.9	170.3± 8.1	.79
Weight,kg	70.0±15.6	66.8±9.0	64.7±10.6	.55
Age,years	20.8± 1.2	21.3±1.5	20.5± 0.5	.30
Exercise frequence, times/week	3.9± 1.6	3.2±1.5	3.6± 1.8	.58
Gender, Male:Female	9:4	10:2	8:4	--

The Kinesio Taping was applied on the gastrocnemius muscle of the both leg. Standard 2-inch (5 cm) Kinesio® Tex Tape (Kinesio Holding Company, Albuquerqe, NM) was used for 3 different elastic tension conditions. In order to hold the elastic tension equally when researchers applied the tape, the elastic tension of taping application was by measured the changed length of tape. The length of tape was measured from calcaneal tuberosity to the popliteal fossa and multiplied by 1 (represented 0% tension), 0.9 (represented 10% tension), or 0.8 (represented 20% tension) as the length of the Kinesio tape. Before appling the tape, the tape was precut into one strip which the length had been determined, then cut the strip in middle to produce 2 tails or a "Y-strip." The Y-strip was applied on the gastrocnemius muscle from calcaneal tuberosity to the popliteal fossa. The one tail of the Y strip was applied on the medial side of the leg with the knee keep in extension position and the ankle in dorsiflexion position. The others tail of the Y strip was applied on the lateral edge of the leg to cover the gastrocnemius muscle from medial to lateral side (Figure 1). The outcome measure for this study was the gastrocnemius muscle electromyographic (EMG) activation while jogging on treadmill (Figure 2). EMG signals were recorded from the gastrocnemius of the dominant leg. The dominant leg was determined by the kick ball leg of subjects. The electrode placement and recording technique were recommended by Cram et al (1998). Before the electrodes were placed over the skin, the leg was shaved and cleaned with 70% ethanol solution. The EMG electrode (Motion Control, Iomed Inc., Utah, USA) apparatus included a reference electrode and 2 bipolar recording electrode units. Each unit consisted of self-adhesive Ag/AgCl bipolar surface electrodes and an on-site preamplifier (Multi Bio Sensors Inc, El Paso, TX). The electrodes were placed over the muscles, and were 10 mm apart (center-to-center distance) from each other. One reference electrode was placed over the proximal tibia. The electrode placement was identified by palpating the bony landmarks of the lower extremities and the most prominent contraction of the muscle belly during an isometric contraction. Each EMG preamplifier unit was connected to a high-impedance (15 GΩ) differential amplifier (CMRR 130 dB at 60 Hz and gain 1000). The frequency response of the overall system was 40 to 4000 Hz, as defined by -3 db points. The EMG activity was processed using the Zebris EMG Measuring System (Zebris Medical GmbH, Germany). The analysis of the frequency content of the rectified signals revealed that 95% of the power was composed of frequencies lower than 6 Hz. Thus, the rectified EMG data were digitally filtered using a fourth-order, zero-phase-shift Butterworth filter, with a cutoff frequency of 6 Hz in this study. The signal was converted from analogy to digital data, and stored in a computer, in which we sampled the raw EMG data at a frequency of 1000 Hz, and stored them as ASCII data for further offline analysis using Spike 2 Version 8.0 software (Cambridge Electronic Design Limited, Cambridge, ENGLAND). To normalize the EMG signals, we conducted maximum isometric voluntary contraction (MVIC) recordings for each muscle group before conducting the main study. We recorded the EMG data for a treadmill jogging with 8 km/hr speed for 60 seconds. The EMG recordings and signals from the gait pattern were divided into stance and swing phases. The repeated measured two-way ANOVA and Scheffe post hoc comparison test were used to compare the differences among the three elastic tension taping conditions and pre-post-test. The level of statistical significance was set at $p<.05$.

Figure 1. The Kinesio tape applied on the gastrocnemius muscle

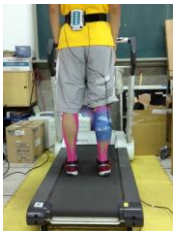

Figure 2. The gastrocnemius muscle electromyographic recording while jogging on treadmill

RESULTS: The results were represented in Table 1. The results were showed that the significantly interaction was found between applied elastic tension conditions and pre-post test in stance phase during jogging (*P*<.05). The EMG activation of the lateral gastrocemius muscle had significantly decreased in applied elastic tension 0% or 10% conditions.

Table 2.
The electromyographic activation of gastrocemius in three elastic tension of Kinesio taping

	Applied elastic tension 0% N=13		Applied elastic tension 10% N=12		Applied elastic tension 20% N=12		Inter-subjects	Interaction
	Pre test	Post test	Pre test	Post test	Pre test	Post test		
Stance Phase								
LGM	358.11±157.38	318.64±143.35	368.47±139.50	328.53±160.35	331.61±102.99	341.75±111.89	**.02***	**.05***
MGM	193.06±43.38	165.36±43.12	215.75±70.41	177.86±60.70	212.29±100.29	204.94±67.16	**.00***	.18
Swing Phase								
LGM	34.11±20.53	23.78±9.31	36.46±31.20	31.69±16.82	50.96±75.02	30.86±13.49	.15	.74
MGM	21.79±10.16	19.17±13.28	25.68±23.46	16.97±7.62	27.00±13.81	23.39±7.26	**.03***	.48

*: P<.05; LGM：lateral gastrocemius；MGM：medial gastrocemius

DISCUSSION: The EMG activation of the lateral gastrocnemius muscle had significantly decreased in standing phase of jogging on treadmill when applied Kinesio taping elastic tension 0% or 10% conditions. The recent studies were showed the decreasing of EMG firing when applied Kinesio tape over athletes' skin. Fayson et al. (2004) found that the EMG firing reduction when the Kinesio tape applied over peroneus longus, tibial anterior and lateral gastrocnemius muscles during the healthy subjects dropped jump from a 35 cm-box. Lins et al. (2013) applied the Kinesio taping on healthy females' quadriceps and assessed the concentric and eccentric strength of quadriceps, electromyography (EMG), hop distance, and balance. Their results revealed that the Kinesio taping did not improve quadriceps muscle strength, EMG, balance, and hop distance. However, the subjects of those studies were healthy. Those studies did not mention the influence on electromyographic signals for injured subjects or athletes. The future works need to explore the related factors to affect the electromyographic signals for healthy or injured athletes.

CONCLUSION: This study revealed that the EMG activation of the lateral gastrocemius muscle had significantly decreased in stance phase of jogging in treadmill when applied Kinesio taping elastic tension 0% or 10% conditions. We suggested that the optimal applied elastic tension of the Kinesio taping were 0~10% tension.

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