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Original Article

The effects of kinesio taping on architecture, strength and pain of muscles in delayed onset muscle soreness of biceps brachii

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Abstract. [Purpose] This study aimed to confirm the effects of kinesio taping (KT) on muscle function and pain due to delayed onset muscle soreness (DOMS) of the biceps brachii. [Subjects and Methods] Thirty-seven subjects with induced DOMS were randomized into either Group I (control, n=19) or Group II (KT, n=18). Outcome measures were recorded before the intervention (application of KT) and at 24, 48, and 72 hours after the intervention. DOMS was induced, and muscle thickness was measured using ultrasonic radiography. Maximal voluntary isometric contraction (%MVIC) was measured via electromyography (EMG). Subjective pain was measured using a visual analogue scale (VAS). [Results] Group I exhibited a positive correlation between muscle thickness and elapsed time from intervention (24, 48, and 72 hours post induction of DOMS); they also showed a significant decrease in MVIC(%). Group II showed significant increases in muscle thickness up to the 48-hour interval post induction of DOMS, along with a significant decrease in MVIC (%). However, in contrast to Group I, Group II did not show a significant difference in muscle thickness or MVIC (%) at the 72-hour interval in comparison with the values prior to DOMS induction. [Conclusion] In adults with DOMS, activation of muscles by applying KT was found to be an effective and faster method of recovering muscle strength than rest alone.
Key words: Delayed Onset Muscle Soreness (DOMS), Kinesio taping, Muscle change

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INTRODUCTION

Delayed onset muscle soreness (DOMS) is defined as muscle injury caused by movements people are unaccustomed to, by intensive physical activity, etc[1)]. DOMS is usually experienced within 12 hours of the offending activity, with the pain reaching a maximum in the following 48 to 72 hours, and it commonly resolves within 5 to 7 days[2)].

Eccentric exercises are more likely to induce DOMS, movements which are rarely used in daily activities[3)]. Muscle pain and loss of strength occur due to excessive eccentric contractions, which produce pools of intramuscular lactic acid[4)]. Increases in muscle resting tension also temporarily alter muscle function[5)]. DOMS manifests as limitations of range of motion (ROM), swelling, reduced muscle strength, increased muscle thickness, and limited functional movement[6–8)].

Taping has been used in general to protect joints, reduce swelling, and stabilize joints following acute injuries[9)]. Elastic kinesio taping (KT) of muscle is effective for pain control due to increases in both blood and lymph circulations[10)]. It is used for earlier recovery of muscle strength after exercise[11)].

Muscle thickness is a measure of muscle function that is taken using ultrasound while the muscle is actively contracting[12)]. Electromyography (EMG) is used to assess the functional changes in muscle[7, 13)]. A visual analogue scale (VAS) is also used to assess subjective changes in pain experienced[14)].

The objective of this study, therefore, was to ascertain how KT affects the thickness and %MVIC of muscle, and subjective pain experienced, as caused by induced DOMS, at different times of measurement.

SUBJECTS AND METHODS

Subjects

This study was conducted with male participants in their twenties. The inclusion criteria were as follows: no orthopedic problems in the preceding 6 months, no cardiovascular problems, no medications that may affect performance or measurement, no limitation in ROM, andright-handed dominant side. All of the subjects voluntarily consented

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to participate in this study. Data collection was initiated after approval was obtained from the Dongshin University Institutional Review Board (BM-006-01). The general characteristics of the subjects are shown in Table 1.

Methods

Out of the 50 participants, only 37 experienced DOMS following the procedure outlined below. These 37 were then grouped into Group I (control, no treatment, n=19) and Group II (KT, n=18) by picking up a ball with either group labeled on it. Dumbbells to elicit 70% of maximal isometric muscle strength (1 RM) of each subject were used to induce DOMS in the following way. With their nondominant arms on a table, the subjects were asked to flex their shoulders to 45 degrees, and elbows to 90 degrees and to maintain this position for 3 seconds. Following this, they slowly extended their elbows to the fully extended position. After full extension, they were passively returned to the starting position of 90 degrees of elbow flexion. This exercise was performed for 7 sets of 10 repetitions per set. The subjects were rested for 1 minute between sets[15]. In Group II, KT was applied to the biceps brachii on the nondominant side in a direction perpendicular to the muscle fibers. Ultrasonography (Sonoace X49900, Medison, Seoul, South Korea) was used to measure muscle thickness. This was measured at the midpoint of the muscle belly, which was calculated to be at a point 30% of the way along the biceps muscle and proximal to the elbow joint. The measurement was taken with the subject sitting and the elbow fully extended. For measurement of the maximal voluntary isometric contraction (%MVIC), a surface EMG (BTS Pocket EMG, BTS S.p.A.,Milan, Italy) was used. Data were collected with subjects sitting and the elbow flexed to 90 degrees against resistance. The sample collection rate was 1,000 Hz, and filtering was 20 to 500 Hz. A VAS was used to assess subjective pain level. Each session was repeated 3 times with a 1 minute break between sessions. Outcome measures were collected a total of 4 times, before the intervention and at 24, 48, and 72 hour postintervention.

For statistical analysis, SPSS 12.0 for Windows was used. Comparison between groups at different times was performed by one-way repeated measure ANOVA. When a significant difference was found, a contrast test was performed. The statistical significance level was set at α=0.05.

Table 1 . Characteristics of study participants

Parameters	Group I (n=19)	Group II (n=18)
Age (years)	23.5±1.2	22.5±1.4
Height (cm)	169.1±3.1	171.4±3.6
Weight (kg)	65.1±3.7	66.5±5.0

All data are expressed as means with standard deviations (SDs).
Group I, control; Group II, kinesio taping

RESULTS

Upon analysis of muscle thickness and MVIC (%) before and after induced DOMS, Group I showed increases in muscle thickness and decreases in MVIC (%) over time ($p<0.001$). Group II mirrored the increase in muscle thickness and decrease in MVIC (%) up to the 48 hour interval post induction of DOMS ($p<0.001$), but at the 72 hour interval, the measurements obtained showed no significant difference in muscle thickness and MVIC (%) for Group II when compared with those from before induction of DOMS ($p>0.05$) (Tables 2 and 3).

DISCUSSION

Delayed onset muscle soreness (DOMS) after excessive or unaccustomed use of muscles can occur in anyone[16]. It is related to inflammation resulting from damage to muscle and connective tissue[17]. KT reduces pain via mechanical stimulation[18]. It is also known to be effective in the restoration of ROM and muscle strength[19]. KT maintains consistent muscle tension and further improves muscle function by enhancing stability[20]. The aim of this study was to find out how KT influences muscle thickness, MVIC (%), and subjective pain in adults with deliberately induced DOMS 24 hours, 48 hours, and 72 hours postintervention.

To properly assess muscle function, it is important to compare and analyze muscle with ultrasound[21]. This makes it possible to assess characteristics of muscle such as size, thickness, shape, and function[8]. Muscle thickness is an especially important gauge of the mechanical properties of muscle and the changes that are occurring to inner structures[22].

After induction of DOMS, muscle thickness in both Group I and II showed increases at the 24 hour and 48 hour intervals. At the 72 hour interval, Group II showed a muscle thickness that was similar to the measurements obtained before induced DOMS. We believe this to be due to KT stimulating γ-motor neurons within skeletal muscle with a subsequent effect on resting muscle tension.

DOMS causes reduced muscle function and damages muscle fibers more in eccentric contractions than concentric ones[23]. Surface EMG analyzes the electrical activity of individual muscles and provides information about changes in motor control[24].

Changes in muscle function are measured via %MVIC[7]. Following induction of DOMS, Group II had decreases in MVIC (%) at 24 and 48 hours intervals, although MVIC (%) recovered by the 72 hour interval. Group I showed significant decreases in MVIC (%) at all intervals. We believe this to be due to metabolic problems occurring within the muscle due to the increase in muscle thickness, the buildup of cellular waste products, and to a decrease in contractility as a result of myofiber microtrauma. We also believe that the recovery of altered tissues in Group II was facilitated by KT due to its elastic nature, which raises the skin and muscle fascia.

Changes in subjective pain levels were measured by VAS[15]. Both Group I and Group II with induced DOMS showed increased pain levels 24 hours after the intervention, reaching a maximum 48 hours post intervention and decreasing at the 72 hour mark. We propose that this proves that elastic KT is effective in reducing pain. We further suggest that this will have a positive psychological effect and hasten the return to daily routine (Table 4).

In conclusion, elastic KT was found to reduce pain by

Table 2. The changes of muscle thickness (cm)

	−24 h	24 h	48 h	72 h
Group I	1.20±0.18	1.48±0.11[a)***]	1.50±0.12[b) ***]	1.41±0.11[c) ***]
Group II	1.30±0.97	1.51±1.56[a) ***]	1.58±0.4[b) ***]	1.31±0.11

All values are shown as the mean±SD
Group I, control; Group II, kinesio taping
[a)] −24 h vs. 24 h, [b)] −24 h vs. 48 h, and [c)] −24 h vs. 72 h by one-way repeated measures ANOVA and post hoc testing with a contrast test (***; p<0.001)

Table 3. The changes of MVIC (%)

	−24 h	24 h	48 h	72 h
Group I	33.1±1.3	28.1±1.5[a) ***]	28.8±1.3[b) ***]	29.5±1.8[c) ***]
Group II	31.1±1.0	26.2±1.8[a) ***]	27.9±1.3[b) ***]	30.9±1.8

All values are shown as the mean±SD
GroupI, control; Group II, kinesio taping
[a)] −24 h vs. 24 h, [b)] −24 h vs. 48 h, and [c)] −24 h vs. 72 h by one-way repeated measures ANOVA and post hoc testing with a contrast test (***; p<0.001)

Table 4. The changes of VAS (scores)

	−24 h	24 h	48 h	72 h
Group I	0	5.29±1.37	5.86±0.13	4.52±1.36
Group II	0	5.07±1.28	5.74±0.17	2.19±0.23[a) ***]

All values are shown as the mean±SD
GroupI, control; Group II, kinesio taping
[a)]24 h vs. 72 h by one-way repeated measures ANOVA and post hoc testing with a contrast test (***; p<0.001)

improving muscle function and strength, as it provides an environment conducive to recovery. It achieves this by activating muscles with DOMS. KT was found to be an important modality in the treatment of musculoskeletal disorders.

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