# The Effect of Kinesio taping on peak torque and muscle activity of quadriceps muscle in healthy subjects

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***ABSTRACT***

*Kinesio Taping (KT) is widely used by physical therapists to treat a variety of neuromusculoskeletal disorders. In this study it was examined whether or not KT has an effect on the peak torque and muscle activity of the quadriceps muscles in healthy subjects. KT was applied to the anterior thigh and tibia of fifteen healthy males (mean age, 25.42±1.38 years, mean body height 178.58±3.03 ㎝, mean body weight 71.58±6.42 ㎏) who have no problem within past 2 months. The quadriceps peak torque was assessed using an isokinetic dynamometer while the mean data of muscle activity was measured by surface electromyography (EMG). The maximal voluntary isometric contraction was carried out on all subjects at 0°, 30° and 60° before, during, and after KT. There were no significant differences in the peak torque and mean data of quadriceps muscle(vastus lateralis, rectus femoris, and vastus medialis oblique) activity at 0°, 30° and 60° before, during and after application of KT (p>.05). From this study it could be concluded that the application of KT to the anterior thigh and tibia doesn't affect the peak torque and the muscle activity.*

***Keywords***: *Kinesio taping, Peak torque, EMG.*

## 1. INTRODUCTION

KT(Kinesio taping) is widely used by physical therapists as an useful adjunct to prophylactic or rehabilitation programs to treat a variety of neuromusculoskeletal disorders [1]. The therapeutic effects of KT include inhibition of overactive synergists and antagonists, facilitation of underactive synergists, promotion of an optimal inter joint coordination, direct optimization of a joint alignment during static postures or movements, offloading irritable neural tissues, and direct or indirect reduction of pain associated with movement [2].

Tape can be divided into two types, elastic and non-elastic. Currently, KT is a type of elastic taping that is commonly used by many physical therapists or sports professionals in Asia, particularly Japan, Taiwan, and Korea.

KT, which was invented by Kenzo Kase in 1996, is a relatively new application of adhesive tape. It is a thin and elastic tape that can be stretched up to 120 %~140 % of its original length, resulting in less mechanical constraints compared to conventional tape. As a result, it allows the applied muscles and joints to retain the partial to full range of motion with a different pulling force on the skin [3].

KT, which is an organized wrapping technique over and around the muscles to assist and give support, is believed to reduce pain, swelling and muscle spasms, prevent sport injuries [4], increase muscle strength as well as improve the gait pattern and enhance the functional outcome of patients with a sports injury, osteoarthritis and patellofemoral pain syndrome [3],[5],[6]-[9].

It has been suggested that the tactile input of KT applied to the skin surface can interact with the motor control by altering the excitability of the central nerve system [10]. The tactile input through taping might be strong enough to modulate the muscle power [3].

However, there is some controversy regarding the effectiveness of taping in increase or decrease of the muscle activity. Some studies demonstrated an increase in muscle activity after the application of taping [2],[3],[5],[9],[11]-[14]. However, Alexander [1] reported that application of taping along the muscle length decreases the motor neuron excitability. On the other hand, some studies showed that taping neither decreases nor increases the muscle strength [3],[15]-[20].

In this study it was examined whether or not the muscle strength could be changed by KT. Therefore, this study investigated the effects of KT on the peak torque and muscle activity after the application of KT to the rectus femoris and tibia.

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## 2. METHOD

### 1. Subjects

Fifteen healthy male subjects (mean age, 25.42±1.38 years, mean body height 178.58±3.03 ㎝, mean body weight 71.58±6.42 ㎏) were enrolled in this study. The subjects were students at the department of physical therapy in Daegu University, South Korea. Informed consent was obtained from each subject. Subjects who reported any active knee pain, previous knee surgery and knee trauma within the previous 2 months were excluded.

### 2. Measurement

The quadriceps peak torque of the dominant leg of each subject was measured using a Cybex 6000 Dynamometer (CYBEX Division of LUMEX Inc.. Ronkonkoma, New York, NY, USA). The average data of vastus lateralis (VL), rectus femoris (RF), and vastus medialis oblique (VMO) muscles were recorded simultaneously using a surface EMG (BIOPAC System Inc. CA. USA).

#### 2.1 Maximal isometric muscle strength (peak torque)

The subjects were seated with the hip and knee flexed at 90°, and the subject's arms were folded in the front of the chest and stabilized in the chair with straps across the chest, waist and thigh. The ankle cuff was secured to the leg, 1cm above to the lateral malleolus. The anatomical zero degree of the knee was set at 180°. The transverse axis of the knee joint paralleled the transverse axis of the power shift of the dynamometer. All subjects were familiarized with the equipment before collecting the data. The subjects performed the maximal isometric quadriceps contractions of 5 seconds duration at 0°, 30°, and 60° before, during and after KT application. In order to normalize the data, the peak torque was selected during the maximal voluntary isometric contraction (MVIC) at 60° before applying the tape application. This knee position was chosen because it was believed that the maximal quadriceps torque was obtained at 60° in subjects without neuromusculoskeletal disorders [21][22]. Each subject was verbally encouraged to carry out the maximal contraction and was allowed to see the monitor. After the maximal isometric contraction for 5 seconds, a 10-minute-rest was allowed to avoid any bias due to muscle fatigue. The tests were carried out under three conditions: before, during, and after the application of KT.

#### 2.2 Average isometric muscle activity

Surface electromyography MP150 (BIOPAC System Inc. CA. USA) was used to measure the muscle activity on the anterior thigh. The active electrodes (Ag-Ag/Cl; Biopac) were attached parallel to the muscle fibers on the longitudinal midline of the muscle with an inter-electrode distance of 2 cm. For the VMO, the electrodes were placed 4 cm superior and medial to the superior–medial border of the patella, whereas for the VL the electrodes were placed 10 cm superior to the lateral epicondyle of the femur. And for the RF, the electrodes were placed half portion from anterior superior iliac spine to superior border of the femur.

In order to reduce the skin impedance, the subject's skin was prepared by shaving and cleaning with alcohol swabs. After drying, a surface EMG electrode was placed. The sampling rate was set at 1000 Hz with a band-pass filter of 30 to 500 Hz, and a notch filter at 60 Hz was used. After maximal isometric quadriceps contractions for 5 seconds duration, only the 3-seconds values of the RMS were used to compare with the mean value except for the first and last 1-second.

### 3. Taping

Subjects were taped with a Kinesio tape (KINESIO TEX, Kinesio taping Co. Ltd., Japan) at the dominant side of the subjects' leg by the same physical therapist who had a certification of KT technique.

Figure 1 shows the application of KT on the knee. The subjects sat on the table with the hip and knee flexed at 90°. The subjects were then taped with a Y-shaped Kinesio tape at the thigh according to the Kenzo Kase's KT manual [23]. The tape was applied from a point 10 ㎝ below to the anterior superior iliac spine, bisected at the junction between the quadriceps femoris tendon and the patellar, and circled around the patellar, ending at tibial tuberosity. The first 5 ㎝ of the tape was not stretched and acted as an anchor. The portion between the anchor and superior patellar was stretched to 120 %. The remaining tape around the patellar remained un-stretched [19].

Fig. 1. Applying method of kinesio taping for rectus femoris and tibial external rotation.

Tibia external rotation taping was applied from the medial side of the proximal tibia diagonally upward to the lateral side of the knee joint, and ended at the midline of the distal femur. 5~10° external rotation of the tibia with respect to the femur, which is accompanied by knee extension between full extension (0°) and 20° knee flexion, is commonly believed to occur in a normal knee. This motion, the so-called 'screw-home motion', is described as being generated by the asymmetry between the femoral condyles [24].

### 4. Data analysis

The design of the project was a randomized repeated measure on the same subjects involving measurements of the dependent variables of the peak torque and average data of the vastus lateralis, rectus femoris, and vastus medialis oblique. Statistical analysis was carried out using the SPSS Version 12.0 for Windows. The effect of KT on the peak torque and average data of quadriceps femoris muscle were analyzed using a one-way repeated measure ANOVA before, during, and after KT application in each group (degree). The level of statistical significance was set at $p<0.05$.

## 3. RESULTS

### 1. Effect of on quadriceps peak torque and muscle activation during isometric maximum knee extension at 0°

Table 1 shows the mean data and standard deviation of peak torque and muscle activities of the quadriceps muscle at 0° knee angle. It was found that the quadriceps peak torque and muscle activities of vastus lateralis, rectus femoris, and vastus medialis oblique were slightly increased during applying the tape, but there were not statistically significant at zero degree ($p>.05$).

Table 1. The mean data and standard deviation of the quadriceps isometric peak torque and muscle activity during isometric knee extension at 0°

(unit: %)

| | Pre | During | Post | p |
|---|---|---|---|---|
| PT | 42.90±9.37 | 47.18±9.92 | 43.63±7.48 | .184 |
| VL | 61.33±6.61 | 76.64±20.20 | 69.06±18.48 | .278 |
| RF | 63.93±7.18 | 74.67±23.35 | 66.54±13.55 | .578 |
| VMO | 59.63±5.79 | 71.17±15.07 | 64.21±18.87 | .442 |

Values were represented Mean±SD

Abbreviation: PT, quadriceps peak torque in Cybex dynamometer. VL, average for isometric EMG activity of vastus lateralis. RF, average for isometric EMG activity of rectus femoris. VMO, average for isometric EMG activity of vastus medialis oblique.

### 2. Effect of on quadriceps peak torque and muscle activation during isometric maximum knee extension at 30°

Table 2 shows the mean data and standard deviation of peak torque and muscle activities of the quadriceps muscle at 30° knee angle. It was indicated that the quadriceps peak torque and muscle activities of vastus lateralis, rectus femoris, and vastus medialis oblique were slightly increased during applying the tape, but there were not statistically significant at 30° ($p>.05$).

Table 2. The mean data and standard deviation of the quadriceps isometric peak torque and muscle activity during isometric knee extension at 30°

(unit: %)

| | Pre | During | Post | p |
|---|---|---|---|---|
| PT | 65.45±13.23 | 71.90±16.97 | 67.00±11.76 | .124 |
| VL | 81.63±25.08 | 98.12±32.30 | 82.64±32.54 | .196 |
| RF | 79.81±18.59 | 93.04±31.88 | 76.38±25.25 | .328 |
| VMO | 79.78±26.97 | 90.96±27.65 | 78.61±31.03 | .171 |

Values were represented Mean±SD

### 3. Effect of on quadriceps peak torque and muscle activation during isometric maximum knee extension at 60°

Table 3 shows the mean data and standard deviation of peak torque and muscle activities of the quadriceps muscle at 60° knee angle. Similar to table 1 and 2, it shows that the quadriceps peak torque and muscle activities of vastus lateralis, rectus femoris, and vastus medialis oblique were slightly increased during applying the tape, but there were not statistically significant at 60° ($p>.05$).

Table 3. The mean data and standard deviation of the quadriceps isometric peak torque and muscle activity during isometric knee extension at 60°

(unit: %)

| | Pre | During | Post | p |
|---|---|---|---|---|
| PT | 100.00±.00 | 106.27±17.78 | 101.18±10.06 | .321 |
| VL | 100.01±43.51 | 107.45±45.60 | 89.45±39.64 | .240 |
| RF | 87.83±35.24 | 95.31±45.29 | 78.66±20.56 | .513 |
| VMO | 94.38±45.51 | 100.61±39.88 | 81.70±39.91 | .150 |

Values were represented Mean±SD

## 4. CONCLUSIVE DISCUSSIION

In this study it was examined whether or not KT significantly increases or decreases the activity of the quadriceps muscles in healthy subjects. The results showed that the quadriceps peak torque and muscle activities were not changed during the application of KT compared to those before and after application of KT. These results concur with previous studiesin that taping applied to the skin neither increased nor decreased the muscle strength, regardless of the mode of taping [3][15]-[19].

Cowan et al [18] and Chen et al [3] studied the influence of therapeutic taping (rigid zinc oxide tape) and KT on the muscle activities of vastus lateralis and vastus medialis oblique. Their results indicated that muscle activities of vastus medialis oblique and vastus lateralis was significantly increased in patients with PFPS (patella-femoral pain syndrome) compared with control group(no taping) and placebo group(white athletic tape), but there was no statistical difference in normal subjects. Cools et al [17] revealed no significant influence of tape application on EMG activity in three parts of trapezius and serratus anterior muscle in 20 healthy subjects. Lee et al [16] and Kim et al [15] reported that average power, total working quantity and maximum muscular strength with 60°/sec and 180°/sec of KT application on quadriceps femoris by using a isokinetic dynamometer were no significant differences on pre- and post-taping, as well as between taping and no-taping groups. Fu et al [19] examined whether or not KT could alter peak torque and total work after the application of tape to the anterior knee and thigh in 14 healthy young athletes by using a isokinetic dynamometer and also showed that there were no statistical differences between no-taping, immediately after taping and 12 hours after taping.

Therefore, KT neither inhibits nor facilitates muscle strength on the anterior thigh in healthy subjects. Moreover, Janwantanakul and Gaogasigam [20] showed that taping does not affect the muscle activity measured by electromyography.

In contrast to the current study and previous studies, there are a few results that muscle activity was increased by taping on the skin. For example, Jung and Kim [12], Kim and Lee [13], and Wee and Seo [14] stated that taping on the skin without regard to types of tape, made increase muscle activity of normal subjects. And Hsieh et al [11] showed that GRF(ground reaction force) was significantly increased in the application of a elastic tape on the triceps surae in 31 healthy adults. It was suggested that significant increase in GRF after application of elastic tape reflects that the elastic taping might facilitate the muscle contraction capacity of the triceps surae during vertical jump.

The mechanism about the above mentioned results were based on the Morrissey's study [2] that taping will generate greater muscle force in the inner range through the optimized actin-myosin overlap during the cross-bridge cycle if taping can be applied in a way that a long underactive muscle is held in a shortened position.

On the other hand, Alexander et al [1] examined whether or not taping increases or decreases the level of muscle activation using the Hoffman reflex (H-reflex) before, during, and after the application of tape. They reported that the mean amplitude of the H-reflex was significantly lowered during taping along the length of the muscle than during pre and post tape application. This means that taping inhibits the muscle's reflex excitability. After removing the tape, the H reflex reverts to its original amplitude. They suggested that the application of tape along the muscle fiber may shorten the muscle length, thereby unloading the intrafusal muscle fibers of the muscle spindle. If tape does indeed shorten the intrafusal fibers, this might result in a decrease in the tonic discharge rate of the spindle leading to reduced facilitation of the motoneurone pool and a subsequent reduction in the H-reflex amplitude.

As applying a tape on the skin, Morrissey [2] assumed that shortening of skeletal muscles induced by taping increased a muscle activity, but Alexander et al [1] had an opposite presumption that the tension of a intrafusal fiber was reduced by decreasing a length of skeletal muscle and a excitability of motor neuron was also reduced. But α-motor neuron and γ-motor neuron which innervates a skeletal muscles and intrafusal fibers respectively, are simultaneously activated. This phenomenon is called an Alpha-Gamma Coactivation [25].

When intrafusal fibers are contracted, then a sensitization of Ⅰa and Ⅱ afferent neuron is constantly sustained, but not reduced. As a result, an excitability of motor neurons is not decreased or increased and remains consistently. Hence, if a skeletal muscle under the skin is actually shortened by the elasticity of a tape when a tape is attached on the skin, in view of the result of this study, there will be no change in the muscle activity due to sensitization of a afferent neuron in the intrafusal fiber.

Nevertheless, the application of a tape for the disorders of neuromuscular disorders increases the muscle activity with pain reduction. Herrington [7] examined the effects of corrective patellar taping on the quadriceps peak torque and observed the pain levels of PFPS patients during maximal eccentric and concentric contraction at testing velocities of 60 and 180 per second. The results showed that all subjects with patellar taping had reduced perceived pain levels and improved peak torque during both the eccentric and concentric contractions. Chen et al [3] reported that KT improved the EMG activity ratio of VMO/VL in patients with PFPS compared with those without taping. Conway et al [5] and Kowall et al [9] found that taping was associated with a significant increase in quadriceps muscle peak torque in patients with knee pain problem.

However, since mentioned above studies are mainly those for a non-elastic tape, it is thought that widen researches are required for therapeutic effects of KT as the elastic tape to variable neuromuscular disorders.

In summary, this study suggests that KT to thigh and tibia neither increases nor decrease the quadriceps peak torque and muscle activation in healthy subjects.

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