

# The Effects of Kinesio Taping on Quadriceps Strength During Isokinetic Exercise in Healthy Non-Athlete Women

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**Abstract.** *Purpose:* The purpose of the study was to investigate the effect of Kinesio Taping on quadriceps strength at maximum concentric and eccentric isokinetic exercise mode in healthy non-athlete women in order to examine the Kinesio Taping effect in increasing or decreasing the muscular quadriceps strength.

*Methods:* Three different quadriceps taping modes have been used (no taping, placebo taping, Kinesio Taping) for the study and isokinetic concentric and eccentric strength assessments have been done for both knee extensors and flexors.

*Results:* One-way ANOVA for repeated measures revealed no significant differences in max concentric torque between the three different taping modes but significant differences in max eccentric torque during both the concentric and eccentric mode of the quadriceps muscle.

*Conclusion:* The results suggest that application of Kinesio Taping on the anterior surface of the thigh, in the direction of vastus medialis, lateralis and rectus femoris fascia, could increase the eccentric muscle strength (isokinetic eccentric peak torque), in healthy adults.

Keywords: Concentric exercise, eccentric exercise, isokinetic torque

## 1. Introduction

For several decades taping has been a content of study, by many researchers, in the field of prevention and rehabilitation [1,5]. Recently, the effect of taping techniques, such as Kinesio Taping (K.T.), on muscle strength, has been a content of research with controversial results [7,10-14,3]. For example, the research of Murray H. [11] has shown an increase in the electromyographic quadriceps muscular activity with K.T. application, applied by patients after ACL repair in the postoperative phase. This research gave new perspective related to Taping and its application. It seemed that this application under tendency, at the direction of the fascia, facilitates the strength of that muscle [10]. On the contrary, Tieh-Cheng Fu and his colleagues [3] have shown that K.T. doesn't influence muscle strength, when placed on the knee in healthy athletes. These results are in agreement with Janwantanakul and Gaogasigam [7], who did not find any effect on muscular activity, measured by electromyography, on subjects with taping at both vastus lateralis and medialis quadriceps muscle.

The name of the technique, comes from the field of kinesiology, because the application of the tape allows the body to move normally, and reacts to the fascia via biomechanical or proprioceptive mechanisms. Fascia is a dense irregular connective tissue which surrounds and connects anatomically and functionally every muscle. According to the latest scientific data it plays an important active role in the function of musculoskeletal system. [2,4,6,16-18,20]. The present study took place in healthy adults in an effort to study the K.T. effect in increasing or decreasing the muscular quadriceps strength in terms of two different function modes, concentric and alternation of concentric and eccentric mode, simulating more the athletic activities. The results of this study would be very beneficial for healthy athletes for injury prevention but also for enhancing their performance. Particularly, the purpose of this study was to investigate the effect of Kinesio Taping on quadriceps strength at maximum concentric and eccentric isokinetic testing mode in healthy non-athlete women.

Table 1  
Anthropometric characteristics of the participants

Anthropometric characteristics	Women (N = 20) M (± SD)
Age	27 (± 3.77)
Weight	61.4 (± 8.19)
Height	168 (± 8.17)

## 2. Materials and methods

### 2.1 Subjects

Considering the fact the K.T. is related to several therapeutic effects such as pain reduction, joint alignment, improvement of haematic and lymphoid circulation [8,9], healthy subjects have been selected in order to ensure reliability of the results.

Twenty women (Table 1) randomly selected volunteered to participate in the present study. All participants gave their written

informed consent regarding participation in the study after being informed of all risks, discomforts and benefits associated with the procedures followed the present study. Procedures were in accordance with the ethical standards of the Committee on Human Experimentation at the Institution at which the work was conducted and with the Helsinki declaration of 1975.

## 2.2. Screening

Participants were selected based on the following criteria:

1. Subjects were completely inactive prior to the study.
2. Subjects were healthy, without any knee pain or other muscular, skeletal discomfort.
3. Subjects followed a physical examination for potentially damaging orthopedic and neuromuscular problems.

## 2.3. Measurements

### 2.3.1. Anthropometric measurements

Subjects' body weight was measured while they were wearing underclothes on a balance scale (Seca 707, Hamburg Germany) calibrated to the nearest 0.4 Kg after an 8-10 hour fast (between 7,00-8,00). Barefoot standing height was measured to the nearest 0.1 cm by using a wall mounted stadiometer.

### 2.3.2. Isokinetic concentric-eccentric strength assessments of the knee extensors-flexors muscle group

Peak muscle torque of the dominant knee extensors was measured using an isokinetic dynamometer (ConTrex MJ Zurich). Subjects performed the same tasks while in a seated position on a standard dynamometer chair with the subject's back slightly reclined and thigh well supported on the seat. Stabilization in the seated position was accomplished using pelvic strapping. The subjects were instructed to grip their hands around the chest. The axis of rotation of the knee joint and lever arm were carefully aligned. The tested dominant limb was firmly stabilized at the distal femur, the lower leg at the distal tibia above the ankle joint superior to the medial malleolus. Before each test there was a warm-up session (10 minutes) including cycling (Monark) followed by three sub-maximal and two maximal trials on the isokinetic device.

The test protocol included one bout of 5 concentric maximal knee extension/flexion repetitions at 60 and 240°/s (CON/CON) and one bout of 3 eccentric maximal knee flexion repetitions at 60°/s (CON/ECC) in the same order, separated by 2 min rest intervals. It is important to clarify that during the first testing bout (CON/CON), quadriceps was working in a concentric mode for knee extension but was relaxed for knee flexion. In the second bout (CON/ECC) quadriceps was working continuously in both movements, concentrically for knee extension and eccentrically for knee flexion, meaning that there was a substantial difference in the muscular effort between the two testing modes. The CON/ECC testing mode has been selected also because the alteration of concentric and eccentric muscle function simulates athletic activities where muscle function is never exclusively concentric or eccentric.

The peak torque of the best 5 and 3 trials respectively for each velocity was used as the recorded value. Maximal test efforts began with the leg flexed that is with the knee joint at 110° before flexion and ended at full extension. Correction was applied for the elimination of errors against the effect of gravity on the lower leg and lever arm. During testing there was no visual feedback the verbal instruction at the beginning of the test was "try as hard as you can during flexion and extension of the knee". The dynamometer was calibrated prior to the testing session according to the procedures prescribed by the manufacturer. To verify the reliability of the torque measurements in female adults, the peak torque of the knee extensors at 60 and 240°/s (concentric mode) and 60°/s (eccentric mode) was measured twice (within a week, at the same time of day) in the dominant leg, which was defined as the leg used to kick a ball. The intraclass correlation coefficients between the repeated measurements were 0.96.

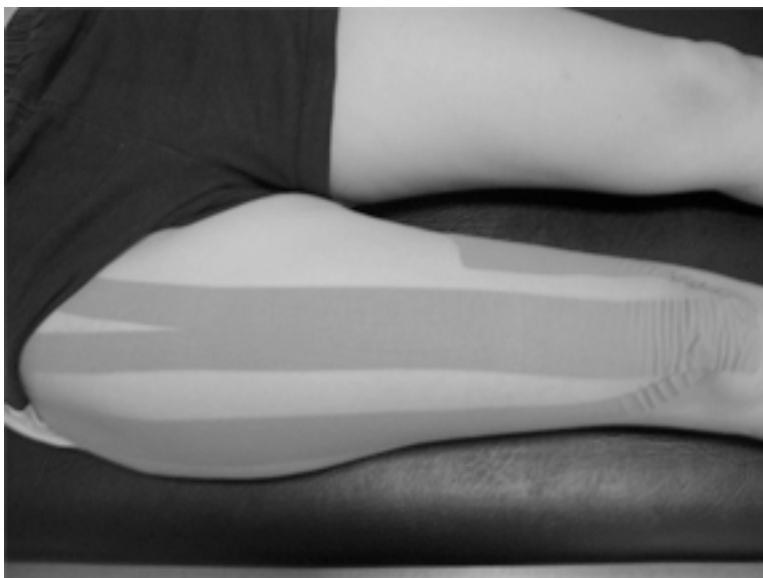


Fig. 1. Kinesio Taping applied on quadriceps muscle.

## 2.4 Taping modes

Three different quadriceps taping modes were used (no taping, placebo taping, Kinesio Taping) for the study. Each type of taping had a specific way of positioning as described below. For the quadriceps Kinesio Taping mode, the tex was applied on rectus femoris, vastus medialis and vastus lateralis. (Fig. 1).

### 2.4.1. Positioning of Kinesio Taping on rectus femoris muscle

The subject was at the supine position, with the thigh hanging off the table in order to increase tissue tension. Then the medial tail of the "Y" tape has been applied to the anterior inferior iliac spine and the lateral tail of the "Y" tape two to three fingerbreadths lateral to the medial tail. While stabilizing the tails and pulling proximally to increase tissue tension, the tape was stretched slightly and applied to the superior border of the patella. Finally the hip and knee were placed into flexion with the foot flat on the table and the Kinesio Tex was peeled off the paper liner and placed the tape temporarily on the skin. The glue was not activated by rubbing. The other end of the Kinesio Tex was applied to the tibial tuberosity (Fig. 1).

### 2.4.2. Positioning of Kinesio Taping on vastus medialis

The patient was at the spine position. The one end, which was not made a slit, of Kinesio Tex was applied to lower part of intertrochanteric line. Kinesio Tex was peeled from the release paper (liner) and the tape was put there temporarily. The inner part of the other end, which was made a slit of Kinesio Tex was applied to pes anserinus. Then the knee was flexed and the outer part of the other end, which was made a slit of Kinesio Tex was applied to the patella (Fig. 1).

### 2.4.3. Positioning of Kinesio Taping on vastus lateralis muscle

The patient was at the spine position. The one end, which was not made a slit, of Kinesio Tex was applied to greater trochanter of the femur. The examiner needed to pull the skin in a direction toward the patient's head while putting his/her one hand on greater trochanter of the femur. Then Kinesio Tex was applied to lateral aspect of the patella like the part of terminal end on the slit of Kinesio Tex was put on superior aspect of the knee. Kinesio Tex was peeled off a release paper (liner) and the tape was put there temporarily. The lateral part of the other end, which was made a slit, of Kinesio Tex was applied to lateral fibular head. Then the knee was flexed and the medial part of the other end, which was made a slit, of Kinesio Tex was applied to the patella like it is enclosed by the tape (Fig. 1).



Fig. 2. Placebo taping applied on quadriceps.

### 2.4.4. Positioning of placebo Kinesio Taping

The patient was at the supine position. Kinesio Tex was applied transverse to the muscle groups of the quadriceps in two levels. One level 5 cm above the middle distance of the femur and the other one 5 cm below (Fig. 2).

## 2.5. Design of the study

Subjects randomly accomplished three isokinetic tests (as described above), with the different quadriceps taping modes (no taping, placebo taping, Kinesio Taping) in a random order. Two or three days prior to the isokinetic tests all subjects accomplished an isokinetic test session in order to be familiar with the isokinetic device. All tests took place in the same room every 3 days, with the same environmental circumstances.

## 2.6. Statistical analysis

Data were analyzed using the SPSS PC (version 10.0). Means  $\pm$  SD were calculated. One-way ANOVA for repeated measures was performed on each depended variable (max torque on concentric 60°/s, concentric 240°/s and eccentric 60°/s) to detect difference in each different taping mode (3 different types).

## 3. Results

The characteristics of the participants are presented in Table 1. The statistical analysis revealed no significant differences in peak concentric torque at 60°/s (CON1/CON) among the three different taping modes. ( $F(1,20) = 1.880, p > 0,05$ ), (Tables 2, 3). Similar results were found for peak concentric torque at 240°/s (CON2/CON) and between the three different taping modes. ( $F(1,20) = 0,165, p > 0,05$ ), (Tables 2, 4).

Nevertheless, the statistical analysis revealed significant differences in max eccentric torque at 60°/s (CON3/ECC) and between the three different taping modes during both the concentric and eccentric mode of the quadriceps muscle. [ $F(1,20) = 6.892, p < 0.05, F(1,20) = 5.184, p < 0.05$ ], (Tables 2, 5, 6).

## 4. Discussion

The results suggest that application of K.T. on the anterior surface of the thigh, in the direction of vastus medialis, lateralis and rectus femoris fascia may increase the eccentric muscle strength (isokinetic eccentric peak torque) in healthy adults. The results revealed a significant statistical increase of the peak torque during eccentric isokinetic exercise of quadriceps muscle. More specifically, the results were statistically significant when the peak torque produced during the K.T. application in the same direction of the fascia on rectus femoris, vastus lateralis and vastus medialis was compared with the peak torque produced by placebo positioning of taping, with the K.T. application running vertical to the fascia and without K.T. application. No significant results were indicated when the peak torque produced during concentric contraction of quadriceps muscle (60°/sec, 240°/sec) with K.T. application were compared with the peak torque produced by the placebo application or without K.T. application under same conditions.

It is important to clarify at this point that during the first testing bout (CON/CON) the quadriceps was working in a concentric mode for knee extension but was relaxed for knee flexion. In the second bout (CON/ECC) quadriceps was working continuously in both movements, concentrically for knee extension and eccentrically for knee flexion and therefore there was a substantial difference in the muscular effort between the two testing modes. This might be the reason why K.T. enhanced muscular performance only in this testing mode where muscular effort was maximal both concentrically and eccentrically. A possible explanation for these results would be that K.T. might be a muscular tone regulator [8,9]. This is further reinforced by the fact that the total work produced in the CON/ECC bout was bigger than that in the CON/CON.

It is well known that the direction of Kinesio Tex applied has an influence on the muscle tone. Application of the tape from muscle origin to insertion is supportive, improves contraction and increases muscle strength. Application from muscle insertion to its origin assists relaxing the muscle tone [8,9]. The wrinkles of the skin formed after the application of K.T. in combination with the direction of the tape, pulls the insertion of the muscle towards the direction of the contraction and increases the muscle tone.

Despite the fact that effect of K.T. is still unknown, this application has been suggested as a possible proprioceptive facilitator in the acute phases of the injury process [12]. In this research K.T. was applied to the skin in order to provide tactile stimulation to the examined muscles. This tactile stimulation seems to interact with the kinetic control at the central nervous system [15,19].

Furthermore, fascia plays an important role as force transmitter in human posture and movement regulation. Fascia is usually seen as having a passive role, transmitting mechanical tension which is generated by muscle activity or external forces. However, there is some evidence to suggest that fascia maybe able to actively contract in a smooth muscle-like manner and consequently influence musculoskeletal dynamics.

It is not clear yet, if the results presented in this study, are related to skin or fascia mechanoreceptors, or to the biomechanical support of the muscle through the application of the tape at the direction of the fascia. It is not also known, if the increased muscle contraction observed immediately after the positioning of K.T. last for a long duration. These questions require further researches directed at the efficacy of K.T. for the relief of pain, the improvement of microcirculation and the decrease of muscle spasm.

This research would be the first step for further use of Kinesio Taping such as strengthening weak muscles systems during activities that require eccentric activation. Many elite athletes (e.g. jumpers) who are considered to be healthy already use Kinesio Tex Tape in order to improve their techniques and facilitate their performance. We hope for the improvement of both functional and athletic performance. as well as to a different approach in prevention and rehabilitation of symptomatic subjects.

Table 2  
Peak torque (in Nm) for extensors muscle group at 60 and 240°/s (concentric) and 60°/s (eccentric) exercise (Nm)

CON1			CON2			CON3			CON4		
kn60	pl60	no60	kn240	pl240	no240	kn60	pl60	no60	kn60	pl60	no60
101.1	108.1	99.3	60.3	60.5	59.7	103.8	98.5	98.6	116.1	137.6	122.4
91.8	89	103.3	65.6	61.1	64.8	84.4	92	85.9	100.9	133.3	118.4

131.7	152.2	140.6	78.7	91.7	86.7	123.2	124.5	110.2	146.4	130.1	141.8
91.8	106.5	94.8	62.3	66.6	60.3	78.8	112	23.1	107.5	81.4	88.7
71.9	71.8	77.8	39.7	48.6	41.7	63.2	37.4	24.5	81.7	50.5	61.5
123.8	105.6	104.3	64.7	61.2	61.5	111.8	99.8	97.9	113.2	103.8	110.4
82.7	83.6	87.9	53.9	54.4	53.2	83.2	91.5	81.5	97.9	80.1	88.6
85.6	94.1	96.2	56.2	55.6	58.5	78.6	83.8	78.2	113.9	92.5	106.8
141.2	129.4	133.1	82.9	89.8	88.7	124	131.1	108.7	175	158.8	155.5
132.6	117	133.4	72.1	71.1	68.5	130.9	111	113.9	176	152.6	163.7
93.2	82.6	88.1	51.5	52.2	56.4	92.3	87.8	83.4	115.6	135.4	124.9
160.6	155.8	166.9	91.3	72.5	81.7	163.6	159.6	163.3	205.3	179.6	191.8
169.7	159.7	167.1	100.3	100.1	109.6	166.5	157	173.3	213.7	216.4	206.9
113.6	113.2	119.5	73.1	77.3	74.2	116.4	115.9	101.3	148.4	157.1	140.4
137.8	123.1	114.1	86.7	83.2	80	111.3	113.8	107	192	171.8	186.1
144.1	134.2	155.8	83.7	79.8	78.8	129	128.9	102.6	182.5	151.5	178.7
105.8	97.5	108.9	61.8	60.4	60.3	95.7	98.7	97.5	163.1	156.5	140.8
110.6	109.9	103.5	62.1	69.4	65	106.8	109.3	96.8	143.4	132.8	117.6
165.9	130.2	138.7	97.6	98.5	96.4	160.7	144.5	143.1	221.4	196.5	216.2
157.6	153.9	147.8	98.5	99.6	94.7	168.5	156.5	148.9	181.3	179.5	166.7

Table 3  
Quadriceps peak torque (in Nm) at 60°/s during the concentric exercise (CON1/CON)

Taping modes	Peak torque at 60°/sec for extensors muscle group (CON1)
Kinesio Tape(kn)	120.65 ± 30.06
Placebo(pl)	115.87 ± 26.14
No taping(no)	119.95 ± 27.14
F (1,20) = 0.165, <i>p</i> > 0.05	

Table 4  
Quadriceps peak torque (in Nm) at 240°/s during concentric isokinetic exercise (CON2/CON, Nm)

Taping modes	Peak torque at 240°/sec for extensors muscle group (CON2)
Kinesio Tape(kn)	72.15 ± 17.19
Placebo(pl)	72.68 ± 16.58
No taping(no)	72.03 ± 17.13
F (1,20) = 0.165, <i>p</i> > 0.05	

Table 5  
Quadriceps peak torque (in Nm) at 60°/s during the eccentric exercise (CON3/ECC)

Taping modes	Peak torque at 60°/s during the eccentric exercise (CON3/ECC)
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Kinesio Tape(kn)	114.63 ± 31.57
Placebo(pl)	112.68 ± 29.40
No taping(no)	101.98 ± 37.6

F (1,20) = 6.892, *p* < 0.05

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Table 6

Quadriceps peak torque (in Nm) at 60°/s eccentric isokinetic exercise (CON3/ECC) at eccentric mode (ECC) of the quadriceps muscle

Taping modes	Peak torque at 60°/sec for extensors muscle group (ECC)
Kinesio Tape(kn)	149.76 ± 42.38
Placebo(pl)	139.89 ± 41.80
No taping(no)	141.39 ± 41.67

F (1,20) = 5.184, *p* < 0.05