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Does Kinesiotaping of the Quadriceps Muscle Provide Improvement in Muscle Strength and Balance?

Kuadriseps Kasına Uygulanan Kinezyolojik Bantlama Kas Gücünde Artış ve Dengede İyileşme Sağlıyor mu?

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This study was presented as an oral presentation at the Turkish Rheumatology Congress with International Participation, March 28, 2018-April 1, 2018, Bafra, Turkish Republic of Northern Cyprus.

ABSTRACT Objective: Kinesiotape is a treatment method developed to support muscles-joints and improve their stabilities without limiting the range of motion. Kinesiotape claims to increase cutaneous stimulation, facilitate motor unit firing and consequently enhance functional performance. In this way, it is claimed that kinesiotape increases the strength of the muscles by supporting the weak muscles. The effect of kinesiotape on balance and functional performance has been controversial because of the inconsistencies of tension and direction of application. Even though there is not enough data about its effect on increasing muscle strength, kinesiotape is used to increase muscle strength in sports. In clinical practice, it is used especially in musculoskeletal problems. Kinesiotape application to quadriceps muscle of healthy participants' dominant leg was investigated in this trial. **Material and Methods:** Voluntary women, healthy and aged from 18 to 40 (average age 24.8±3.3), were included. At first, kinesiotape was applied to the quadriceps with stimulation technique. After a week, sham taping was applied to the same volunteers' same muscles. The isokinetic dynamometer was used to assess the muscle strength and Biodex Balance System was used to assess balance. Assessments were done before taping, after taping, and after 24 hours. **Results:** Kinesiotape not cause a statistically significant increase at peak torque and total work at 60 and 180 degrees angular velocity but caused statistically significant improvement at some of the balance parameters compared to sham tape. **Conclusion:** The results showed that kinesiotape application doesn't increase muscle performance but improves some balance parameters.

Keywords: Kinesiotape; postural balance; muscle strength

ÖZET Amaç: Kinezyolojik bantlama, eklem hareket açıklığını kısıtlamadan kas-eklem yapılarına destek olmak ve stabilitelerini artırmak için geliştirilmiş bir tedavi yöntemidir. Kutanöz stimülasyonu artırdığı, motor ünite ateşlenmesini fasilite ettiği ve sonuç olarak fonksiyonel performansı artırdığı iddia edilmektedir. Bu şekilde kinezyolojik bantlamanın zayıf kasları destekleyerek, kas gücünü artırdığı ileri sürülmektedir. Denge ve fonksiyonel performans üzerindeki etkileri tartışmalıdır. Çünkü gerim ve uygulama yönü konusunda tutarsızlıklar mevcuttur. Kas gücünü artırıcı etkisini destekleyen veriler yeterli olmamasına rağmen kinezyolojik bantlama özellikle sporcularda kas gücünü artırmak amacıyla kullanılır. Aynı amaçla klinikte kas-iskelet sorunlarında da kullanımı yaygındır. Çalışmamızda sağlıklı gönüllülerde dominant alt ekstremitedeki kuadriseps kasına uygulanan kinezyolojik bantlamanın kas gücü ve denge üzerindeki etkisi araştırılmıştır. **Gereç ve Yöntemler:** Çalışmaya 18-40 yaş arasında (yaş ortalaması 24,8±3,3) 30 sağlıklı kadın gönüllü olarak dâhil edilmiştir. Kuadriseps kasına ilk olarak kinezyolojik bantlama uygulaması yapılmıştır. Aynı kişilere ve kaslara 1 hafta sonra yalancı bantlama uygulaması yapılmıştır. Kas gücü değerlendirmesi için izokinetik dinamometre, denge için ise Biodex Denge Sistemi kullanılmıştır. Ölçümler yalancı ve gerçek bantlama öncesinde, bantlama uygulamasından hemen sonra ve 24 saat sonrasında yapılmıştır. **Bulgular:** Kinezyolojik bantlama, sağlıklı bireylerde plasebo ile karşılaştırıldığında 60 ve 180 derece açısal hızlarda pik tork ve total iş değerlerinde istatistiksel olarak anlamlı bir artışa neden olmamıştır ancak denge parametrelerinin bazılarında istatistiksel anlamlı iyileşme elde edilmiştir. **Sonuç:** Kinezyolojik bantlama uygulamasının kas performansında artışa neden olmadığı ancak bazı denge parametrelerinde iyileşme sağladığı sonucuna varılmıştır.

Anahtar Kelimeler: Kinezyo bantlama; postüral denge; kas gücü

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Kinesiotaping was developed in 1973 by Japanese chiropractic and acupuncturist Dr. Kenzo Kase.[1] Standard taping supports muscles and joints but restricts joint movements and functional activities. The underlying mechanism of this method was that good results could be obtained via kinesiotaping method without limiting joint movements.[1]

Kinesiotaping has a broad range of indications, particularly on the musculoskeletal system. There are different application techniques such as muscle technique, fascia and regional correction technique, neural technique, linkage technique, and lymphatic correction technique.[1] It is used to stimulate or inhibit muscles in muscular applications.[1] Its effect on muscle strength has been researched in many previous studies, which have proposed that the band facilitates a rapid increase in muscle strength by creating a concentric pulling force on the fascia.[1] Its use is common in the sports field to increase muscle strength, but scientific evidence supporting this situation is limited and contradictory.[2]

In this study, we aimed to investigate the effect of the kinesiotaping of the quadriceps muscle on balance and muscle strength in healthy women.

MATERIAL AND METHODS

STUDY DESIGN

A total of 30 healthy women were included in the study. Kinesiotaping and placebo taping were applied to the quadriceps muscles on the dominant sides of the participants. At first, kinesiotape was applied to the quadriceps with stimulation technique. After a week, sham taping was applied to the same volunteers' same muscles. Isokinetic muscle strength, balance, and fall risk were evaluated before kinesiotaping and placebo taping, immediately after the application, and at the 24th hour. The study was conducted in accordance with the principles of the Declaration of Helsinki.

PARTICIPANTS

Thirty healthy female volunteers between the ages of 18-40 years were included in the study. Individuals with chronic diseases requiring cardiopulmonary, musculoskeletal or other treatments, those with active knee, ankle, lower back or hip pain, history of lower extremity trauma in the last 3 months, and those who had undergone knee surgery in the previous year were not included. The participants were informed about the purpose of the study, the duration, and the problems that could be encountered. In addition, the participants were given informed consent. Participants knew nothing about kinesiotaping and sham taping.

DATA COLLECTION AND EVALUATION

Demographic data such as age and body mass index of the participants were recorded. Muscle strength was assessed by Cybex Isokinetic Test System (Cybex Norm, Humac, 2014, CA, USA). Biodex Balance System (Biodex Medical Systems, Shirley, NY, USA) was used to evaluate the static-dynamic balance and fall risk. Measurements were performed in the same time zones throughout the day.

BIODEX BALANCE SYSTEM

Biodex Balance System SD-2014 (Biodex Medical Systems, Shirley, NY, USA) was used to evaluate balance and fall risk. The high scores in the indexes show deterioration of the balance and increase in the fall risk. Biodex Balance System calculates anterior-posterior index, medial-lateral index, and overall (total) index values to evaluate postural stability. The device gives an overall index value in the fall risk assessment.[3] In our study, both postural stability and fall risk were evaluated at the static, sixth, and first levels. Besides, we applied the single-leg stability (SLS) test. The evaluations in the SLS test were done at the static and the sixth levels. The overall index, anterior-posterior index, and medial-lateral index values were used to evaluate this test, just like in the postural stability test.

MUSCLE STRENGTH ASSESSMENT

An isokinetic dynamometer (Cybex Norm, Humac, 2014, CA, USA) was used for evaluation. The instrument was calibrated before measurement. Before the measurement, the participants were warmed at the same low resistance for 5 minutes and then rested for 1 minute. The participants were seated in the chair with the back angle of 90° upright. The body was stabilized with a seat belt. The thigh was fixed with the help of a velcro band. The apparatus used to measure the extensor muscle strength of the knee was connected 5 cm above the lateral malleolus. Measurements and taping were performed on the dominant leg of the subjects. During the test, the volunteers held the handles on both sides of the dynamometer seat. Measurements were performed at angular velocities of 60° and 180°. Before each measurement, 3 trials were repeated, and then the test was started. During the application, visual feedback was given via verbal and computer screen. At the angular velocities of 60° and 180°, the participants were repeated 10 times along the range of motion. Ten seconds of resting intervals were allowed between the sets. Peak torque (PT) and total work (TW) values were used for comparison.

KINESIOTAPING

In healthy volunteers who met the inclusion criteria, kinesiotaping was applied to stimulate the quadriceps muscle in the dominant extremity. One week later, placebo taping was applied to the quadriceps muscle in the dominant extremity of the same subjects. For the kinesiotaping application, the taping method applied for stimulation in case of quadriceps muscle weakness described by Kenzo Kase was used.[4] In the method used to stimulate the muscle, the taping was performed from the origin to the insertion of the quadriceps muscle. Following the cleaning of the application region, a "Y-ribbon" was cut with a mean length of 30-35 cm in length and 5 cm in width, and each tail of "Y" was 10-12 cm long. The volunteers were placed in the supine position. The head of the band was adhered to the anterior inferior iliac spine without stretching. Afterward, the band was 25-50% stretched towards the knee region. When reached to the knee, the knee was fully flexed, and the Y-shaped strips were wrapped around the patella to end in the anterior tuberositas region and adhered here. 25-50% stretching was continued until the end zone was 2-5 cm away and the tail sections were adhered without stretching (Figure 1).[4]

An I-shaped strip was cut 10 cm in length in the placebo taping. It was applied transverse to the muscle fibers without stretching at the mid 1/3 of the anterior thigh (Figure 2).[4]

FIGURE 1: A view of kinesiotaping.

FIGURE 2: A view of placebo taping.

ETHICS COMMITTEE APPROVAL

This study was approved by the Non-interventional Clinical Research Ethics Committee of İstanbul Medipol University (registration number 514) on November 2, 2016.

STATISTICAL ANALYSIS

Data were analyzed with SPSS 17.0 package program (IBM Corp., Armonk, NY, USA). Continuous variables are given as median and percentiles, and categorical variables are presented as numbers and percentages. Two dependent groups were compared in terms of numerical variables using the significance test of difference between paired samples when parametric test assumptions were met, and the paired samples Wilcoxon test when the parametric test assumptions were not met. The efficacy of the interventions was compared with the repeated-measures ANOVA test. A p value of <0.05 was accepted as statistically significant.

RESULTS

In our study, a total of 30 volunteer women who are free of any symptoms were included. The participants were active persons but not athletes. The mean age of the participants was 24.8±3.4 years, and the mean body mass index was 21.5±3.1 kg/m².

There was no statistically significant difference between the results of postural stability tests before and after kinesiotaping and placebo taping. When the values before and 24 hours after taping were compared, there was a statistically significant difference in favor of kinesiotaping (Table 1).

Table 1-description: 1st measurement: Just before taping, 2nd measurement: Immediately after taping, 3rd measurement: 24-hours after taping; PSt: Postural stability test; oi: Overall index; api: Anterior-posterior index; mli: Medial-lateral index; sta; Static level; p (1-2), p value of the comparison between 1st and 2nd measurements; p (1-3), p value of the comparison between 1st and 3rd measurements (p values written in bold are statistically significant).

When the fall-risk (FR) before and after placebo taping and kinesiotaping was compared, there was no statistically significant difference except for **FRoi 6** value.

There was no statistically significant difference between the single-leg postural stability test results before and after kinesiotaping and placebo taping. When the values before and 24 hours after taping were compared, there was no statistically significant difference between pre-and post-taping values except some of them (Table 2).

There was no statistically significant difference between the parameters obtained by isokinetic evaluation before and immediately after the kinesiotap-

TABLE 1: Comparison of kinesiotaping and placebo taping with respect to postural stability.

	Taping	1st measurement median (25-75 percentiles)	2nd measurement median (25-75 percentiles)	3rd measurement median (25-75 percentiles)	p (1-2)	p (1-3)
PSt oi sta	Placebo taping	0.30 (0.20-0.40)	0.35 (0.20-0.50)	0.35 (0.28-0.50)	0.3411	0.0490
	Kinesiotaping	0.30 (0.20-0.50)	0.40 (0.30-0.50)	0.30 (0.20-0.50)		
PSt api sta	Placebo taping	0.10 (0.10-0.20)	0.10 (0.10-0.30)	0.20 (0.10-0.30)	0.5792	0.5011
	Kinesiotaping	0.10 (0.10-0.30)	0.20 (0.10-0.30)	0.20 (0.10-0.30)		
PSt mli sta	Placebo taping	0.20 (0.10-0.30)	0.20 (0.20-0.33)	0.25 (0.20-0.30)	0.4461	0.1473
	Kinesiotaping	0.20 (0.16-0.33)	0.20 (0.20-0.30)	0.20 (0.10-0.33)		
PSt oi 6	Placebo taping	0.70 (0.58-0.80)	0.65 (0.50-0.80)	0.70 (0.60-0.90)	0.5434	0.0030
	Kinesiotaping	0.80 (0.70-1.02)	0.80 (0.60-1.00)	0.70 (0.50-0.80)		
PSt api 6	Placebo taping	0.40 (0.38-0.60)	0.50 (0.40-0.60)	0.50 (0.40-0.63)	0.1411	0.0042
	Kinesiotaping	0.60 (0.48-0.80)	0.50 (0.40-0.60)	0.50 (0.40-0.60)		
PSt mli 6	Placebo taping	0.40 (0.30-0.50)	0.40 (0.20-0.43)	0.40 (0.20-0.50)	0.6144	0.1023
	Kinesiotaping	0.50 (0.40-0.60)	0.40 (0.30-0.50)	0.40 (0.28-0.50)		
PSt oi 1	Placebo taping	0.70 (0.58-1.00)	0.70 (0.60-0.90)	0.80 (0.60-0.90)	0.2731	0.1670
	Kinesiotaping	0.90 (0.70-1.10)	0.80 (0.60-1.00)	0.80 (0.58-1.00)		
PSt api 1	Placebo taping	0.50 (0.40-0.70)	0.50 (0.40-0.63)	0.55 (0.40-0.70)	0.3022	0.1624
	Kinesiotaping	0.60 (0.50-0.80)	0.55 (0.40-0.63)	0.50 (0.38-0.73)		
PSt mli 1	Placebo taping	0.50 (0.30-0.50)	0.40 (0.38-0.53)	0.40 (0.30-0.50)	0.2263	0.2433
	Kinesiotaping	0.45 (0.40-0.63)	0.40 (0.30-0.60)	0.40 (0.30-0.60)		

1st measurement: Just before taping, 2nd measurement: Immediately after taping, 3rd measurement: 24-hours after taping; PSt: Postural stability test; oi: Overall index; api: Anterior-posterior index; mli: Medial-lateral index; sta; Static level; p (1-2), p value of the comparison between 1st and 2nd measurements; p (1-3), p value of the comparison between 1st and 3rd measurements (p values written in bold are statistically significant).

TABLE 2: Comparison of kinesiotaping and placebo taping with respect to single-leg postural stability.

	Taping	1st measurement median (25-75 percentiles)	2nd measurement median (25-75 percentiles)	3rd measurement median (25-75 percentiles)	p (1-2)	p (1-3)
SLS oi sta	Placebo taping	0.65 (0.50-0.80)	0.60 (0.50-0.80)	0.65 (0.48-0.80)	0.0572	**0.0160**
	Kinesiotaping	0.70 (0.60-0.90)	0.60 (0.50-0.80)	0.55 (0.50-0.70)		
SLS api sta	Placebo taping	0.27 (0.21-0.37)	0.29 (0.25-0.37)	0.30 (0.18-0.41)	0.1281	**0.0353**
	Kinesiotaping	0.32 (0.26-0.43)	0.29 (0.23-0.40)	0.25 (0.21-0.37)		
SLS mli sta	Placebo taping	0.49 (0.43-0.63)	0.48 (0.40-0.62)	0.52 (0.39-0.60)	0.1874	**0.0421**
	Kinesiotaping	0.58 (0.45-0.70)	0.53 (0.44-0.71)	0.45 (0.38-0.55)		
SLS oi 6	Placebo taping	0.90 (0.70-1.20)	0.90 (0.70-1.00)	0.80 (0.70-1.00)	0.6090	0.6333
	Kinesiotaping	0.90 (0.80-1.10)	0.90 (0.70-1.02)	0.80 (0.70-1.00)		
SLS api 6	Placebo taping	0.63 (0.53-0.86)	0.63 (0.54-0.81)	0.61 (0.51-0.78)	0.4914	0.9772
	Kinesiotaping	0.64 (0.57-0.77)	0.64 (0.50-0.79)	0.57 (0.52-0.76)		
SLS mli 6	Placebo taping	0.58 (0.47-0.72)	0.55 (0.44-0.74)	0.48 (0.37-0.61)	0.3281	0.8571
	Kinesiotaping	0.57 (0.46-0.74)	0.56 (0.40-0.66)	0.57 (0.42-0.66)		

1st measurement: Just before taping, 2nd measurement: Immediately after taping, 3rd measurement: 24-hours after taping; SLS: Single-leg stability test; oi: Overall index; api: Anterior-posterior index; mli: Medial-lateral index; sta: Static level; p (1-2), p value of the comparison between 1st and 2nd measurements; p (1-3), p value of the comparison between 1st and 3rd measurements (p values written in bold are statistically significant).

ing and placebo taping. Also, there was no statistically significant difference between pre-taping values and the values 24 hours after taping.

DISCUSSION

Our findings suggest that in healthy young women, kinesiotaping does not cause a significant change in TW and PT value, but it provides an improvement in some of the balance measurement values in favor of kinesiotaping. Based on these results, we can conclude that the kinesiotaping applied to the quadriceps muscle, which is essential for balance and posture, is superior in terms of improving some of the balance parameters in healthy women compared to placebo, but in terms of increasing muscle strength, there was no difference. We conclude that it may be helpful in adding kinesiotaping treatment in patients with balance problems encountered in daily clinical practice.

Lins et al. studied the effect of kinesiotaping on the balance and functional performance of the anterior thigh muscles in healthy individuals, and they did not find a statistically significant difference.[5] Nakajima et al. investigated the effect of kinesiotaping on balance using the method used to treat ankle sprain due to lateral inversion. In healthy individuals, they applied kinesiotaping to the gastrocnemius, tibialis anterior, and peroneal muscles with 140% stretched from distal to proximal. There was no significant difference in vertical bounce and dynamic posture. It was stated that the results could be related to stretching, application technique, and participants. They explained that excessive stretching would apply pressure instead of activating or inhibiting the muscle and that this would not be desirable when targeting improvement in balance.[6]

In a study by Fu et al. on 14 healthy athletes, they applied a Y-shaped kinesiotaping on the anterior surface of the thigh and together with taping the hamstring muscle. They measured concentric and eccentric muscle strength with an isokinetic dynamometer at angular velocities of 60° and 180°. PT and TW values were measured before taping, immediately after taping and after 12 hours. As a result, no activation or inhibition was observed after taping. In this study, taping was performed to provide tactile stimulation to the skin. It was stated that the tactile inputs interacted with the motor control and could alter the excitability of the central nervous system. The negative results were attributed to the tactile stimulation created by the kinesiotaping, which was not strong enough to increase muscle strength. However, only the activation technique was used in the mentioned study, and there was no comparison with placebo.[7]

Keenan et al. examined the effect of kinesiotaping on internal and external rotation power around the shoulder. The researchers divided the participants into 3 groups. In the first group, they applied kinesiotaping on the supraspinatus and deltoid muscles in the shoulder region of the dominant side of the healthy participants. In the second group, they applied kinesiotaping to the supraspinatus and deltoid muscles in painful shoulders of patients with impingement syndrome. The third group was enrolled as the placebo group and elastic taping was applied to the same muscles instead of kinesiotaping. The internal and external rotation strength of the shoulder was measured at an angular velocity of 60° with an isokinetic dynamometer. The results were evaluated before and after banding, and no significant difference was found in intra-group and inter-group comparisons.[8]

In a study by Chang et al., healthy athletes were divided into three groups: those who underwent real kinesiotaping, placebo taping, and the placebo group without any taping. The placebo taping was applied with the I-shaped kinesiotaping along the flexor muscles of the wrist without stretching. The real kinesiotaping was applied to the wrist flexor muscles with 15-20% stretching from the insertion to the origin of the muscle. The maximum isometric grip strength was measured with the Jamar hand dynamometer. Average values were used in the analysis, and there was no significant difference between the groups.[9] In another study published in 2013, kinesiotaping was applied to the rectus femoris, vastusmedialis-lateralis, and hamstring muscles of the subjects for activation. Isokinetic muscle strength was measured at 60° and 180° angular velocities. They found significant increases in PT and TW values with taping and concluded that kinesiotaping positively affected knee flexor and extensor muscle strengths. The mechanism of this effect was explained by the tactile stimulus theory.[10]

As mentioned above, the effects of kinesiotaping on balance and muscle strength are controversial in previous clinical trials. Some studies support its positive effect on muscle strength and functional performance.[11] The positive findings in these studies might be due to the placebo effect of kinesiotaping.

In this study, some of the balance parameters analyzed after kinesiotaping showed a significant change in favor of kinesiotaping. There was no statistically significant difference in isokinetic measurement parameters compared to placebo. This can be explained by the tactile stimulation of taping, which is not strong enough to change muscle strength. Positive results supporting the increase in muscle strength in previous studies might be due to the placebo effect of banding. Contrary to our results in another study, kinesiotaping did not provide a significant change on balance.[12]

LIMITATIONS

The study's main limitation was that the application was performed only on the quadriceps muscle but not to the other muscles involved in establishing the balance. The second limitation was that only healthy female individuals were enrolled in the study population, but kinesiotaping is most frequently used in musculoskeletal injuries. Therefore, the findings cannot be generalized to the whole population. In future studies, the inclusion of patients in the rehabilitation process may provide more useful information for the clinical efficacy of kinesiotaping, such as function, balance, and neuromuscular performance. Thirdly, the amount of kinesiotaping applied for muscle activation is controversial. A group of researchers applied 25-50% stretching from the origin to the insertion of the muscle, while the others stated that 50-75% stretching should be performed.[13,14] Studies investigating the relationship between the effects of kinesiology taping used for muscle activation with the amount of stretching should be explored in the future.

CONCLUSION

In conclusion, kinesiotaping in healthy individuals does not provide a significant increase in quadriceps muscle strength compared to placebo; however, there was a significant improvement in some of the balance parameters.

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