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SHORT-TERM EFFECTS OF TRUNK KINESIO TAPING ON TRUNK MUSCLE ENDURANCE AND POSTURAL STABILITY IN HEALTHY YOUNG ADULTS: A RANDOMIZED CONTROLLED TRIAL

ORIGINAL ARTICLE

ABSTRACT

Purpose: The aim was to investigate the short-term effects of trunk Kinesio Taping (KT) application on trunk muscle endurance and postural stability in healthy young adults.

Methods: Fifty-eight healthy subjects were randomly assigned to KT and Sham groups. According to the group assignment, KT was applied on both sides of the abdominal muscles (rectus abdominis, obliquus externus, and obliquus internus) and sacrospinal muscles. The trunk muscle endurance with McGill's trunk muscle endurance tests and postural stability with a force platform were assessed. To compare the group differences.

Results: It was shown that trunk flexor (p=0.015) and trunk left lateral endurance (p=0.006) increased in the KT group compared to the Sham group. After the KT application, trunk flexor (p=0.004), extensor (p=0.001), right lateral (p=0.001) and left lateral (p=0.001) endurance improved; however, no differences were found in eyes open (p=0.638) and closed (p=0.409) postural stability scores in the KT group. In the Sham group, there was no difference between trunk flexor (p=0.756), extensor (p=0.426), right lateral (p=0.065), left lateral (p=0.968) endurance and eyes open (p=0.709) and closed (p=0.306) postural stability.

Conclusion: The KT application on the trunk muscles increased the muscle endurance; however, it did not improve postural stability in the short term in the healthy subjects. This application might be important for improving or supporting the trunk endurance in different populations whose trunk muscle endurance needs to be improved.

Key Words: Endurance; Postural Stability; Taping; Trunk.

SAĞLIKLI GENÇ YETİŞKİNLERDE GÖVDE KİNEZYO BANTLAMANIN GÖVDE KAS ENDURANSI VE POSTÜRAL STABİLİTE ÜZERİNE KISA SÜRELİ ETKİLERİ: RANDOMIZE KONTROLLÜ BİR ÇALIŞMA

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Sağlıklı genç yetişkinlerde gövde Kinezyo Bantlama (KB) uygulamasının gövde kas enduransı ve postüral stabilite üzerine kısa süreli etkilerini incelemekti.

Yöntem: Elli sekiz sağlıklı birey rastgele KB ve Sham gruplarına atandı. Grup atamasına göre, abdominal kasların (rectus abdominis, obliquus externus, and obliquus internus) ve sakrospinöz kaslarının her iki tarafına KB uygulandı. Gövde kas enduransı McGill gövde kas endurans testleri ile ve postüral stabilite sabit bir platform ile değerlendirildi.

Sonuçlar: KB grubunda Sham grubuna göre gövde fleksör (p=0,015) ve sol lateral (p=0,006) enduransında artma görüldü. KB sonrası, KB grubunda gövde fleksör (p=0,004), ekstansör (p=0,001), sağ lateral (p=0,001) ve sol lateral (p=0,001) enduransı gelişti; ancak gözler açık (p=0,638) ve kapalı (p=0,409) postüral stabilite skorlarında farklılık bulunamadı. Sham grubunda, gövde fleksör (p=0,756), ekstansör (p=0,426), sağ lateral (p=0,065), sol lateral (p=0,968) endurans ve gözler açık (p=0,709) ve kapalı (p=0,306) postüral stabilite arasında fark yoktu.

Tartışma: Gövde KB uygulamasının kısa sürede gövde kas enduransını artırdığı; ancak, postural stabiliteyi geliştirmediği belirlendi. Bu uygulama, gövde kas enduransı geliştirilmesi gereken farklı popülasyonlarda gövde kontrolünü geliştirmek veya desteklemek için önemli olabilir.

Anahtar Kelimeler: Endurans; Postüral Stabilite; Bantlama; Gövde.

INTRODUCTION

The trunk, especially the lumbopelvic or core region, is an integral part of the body regarding spinal stability, postural control, proprioceptive stimuli, and energy transfer between upper and lower extremities (1). Panjabi is the first one to describe the trunk or spinal stability, and according to this description, the neurophysiologic basis of the stabilization system focuses on the activation or reorganization of three anatomical systems including active, passive, and neural systems (2). In addition, trunk stability musculature is composed of local or core (transversus abdominis, multifidus, diaphragm and pelvic floor muscles) and global muscles (rectus abdominis, obliquus externus abdominis, obliquus internus abdominis, paraspinal muscle, quadratus lumborum, psoas major) (1-2). Recent studies have shown that weakness of the trunk muscle strength and endurance, alternations of trunk muscle recruitment pattern, and changes in trunk stability and posture in many disorders such as chronic low back pain, multiple sclerosis, fibromyalgia, and urinary incontinence (3-7).

Improving the trunk muscle endurance, strength and proprioception are vital to increase the trunk function (1). Hence, the rehabilitation protocols mostly focus on the improving trunk muscle functions. Therefore, there are different physiotherapy approaches, including kinesio taping (KT), electric stimulation, exercise, and manual therapy to support and improve the trunk muscle functions (8-11). Application of the electrical stimulation to the trunk muscles has been showed to increase the trunk muscle strength in the patients with chronic low back pain (9). In addition, an 8-week stabilization exercise has been presented to increase the core endurance as well as to decrease the postural pain, spinal curvatures, and postural stability in university students (10). Lastly, KT application on thoracolumbar fascia has been showed to increase the trunk flexibility in healthy young adults (11).

It is assumed that KT application might exert its effects by increasing lymph and blood flow by lifting the skin, improving circulation of blood by facilitating the muscle, reducing local edema by decreasing exudative substances, reducing pain by decreasing nociceptive stimuli, providing a positional stimulus to the skin, muscle and facial structures, and increasing segmental stability (12). Thus, it is believed that KT may contribute to improving trunk muscle endurance and anticipatory postural adjustments by increasing proprioceptive stimuli and muscle activations. However, there is a lack of clinical trials on the efficacy of the trunk KT application on trunk muscle endurance or core endurance as well as postural stability (8,13-16). Therefore, the purpose of the study was to investigate the short-term effects of trunk KT application on trunk muscle endurance and postural stability in healthy young adults. The hypothesis of the present study was the application of the trunk KT would improve the trunk muscle endurance and postural stability in healthy young adults in the short term.

METHODS

This study was designed as a single-blind, randomized, controlled trial. The study was carried out at Yıldırım Beyazıt University, Faculty of Health Sciences, Physiotherapy and Rehabilitation Department. The study was performed between January 2018 and ended in March 2018. The study approved by the Ethics Committee at the Yıldırım Beyazıt University (Approval number: 45/48). The study protocol was also registered at http://clinicaltrials.gov (NCT03449290). A total of 50 healthy individuals were included in the study, 27 in the KT application group and 23 in the sham application group.

All participants answered a questionnaire requesting personal information in order to determine the inclusion and exclusion criteria. Healthy young volunteers aged between 18 and 25 years were included in the study. The participants having disc hernia, any spinal pain complaint, spinal deformity, history related to spinal surgery, vestibulopathy, musculoskeletal injuries related to ankle, knee, and hip joints, orthopedic and/or neurological problems, and allergy to KT were excluded. Patch test was performed for testing possible allergy. All participants were informed about the aims of the study and written informed consent was obtained.

Participants were assessed at baseline before randomization. Demographic characteristics including

age, gender, height, and weight were recorded. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Following the baseline assessments, participants were randomly divided into two groups as KT group and Sham group using a computer-generated randomized table of numbers, created by an individual not involved in the recruitment and applications of participants, before the beginning of the study. Individual, sequentially numbered cards with a random assignment were prepared. The cards were folded and placed in sealed, opaque envelopes for concealed allocation. A physiotherapist (STC), blinded to the baseline assessment findings, opened the envelope and applied KT according to the group assignment.

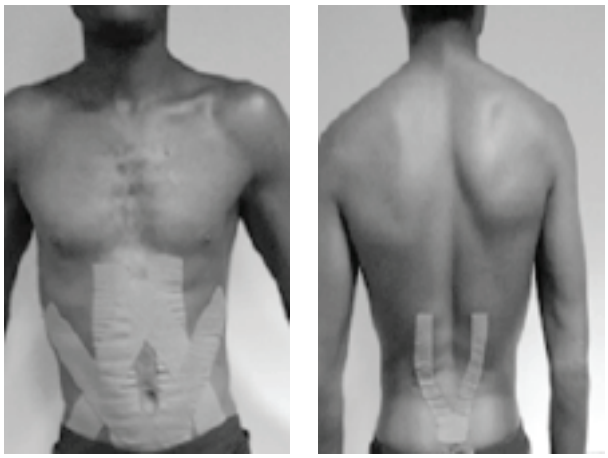
Before and after application, trunk muscle endurance tests were administered and postural stability of the participants were assessed by the same physiotherapists (NOU, TO).

Trunk Muscle Endurance: Trunk muscle endurance was assessed using McGill's trunk muscle endurance tests including the trunk flexor endurance test, trunk extensor endurance test, and trunk right and left lateral endurance tests. A stopwatch was used for the measurements, and the scores were recorded in seconds (s). Tests were terminated when the test position deteriorated, or the subjects stated that he/she could not continue the test. Each measurement was performed twice, and the best measurement score was recorded. Results from previous studies showed that four trunk isometric muscle endurance tests have excellent reliability coefficients: trunk flexor endurance test intraclass correlation coefficient (ICC)=0.97, trunk extensor endurance test (EXT) ICC=0.97, and trunk right and left lateral endurance tests (Lateral-r/ Lateral-l) ICC=0.99 (17).

Postural Stability: The assessment of the static standing postural stability was performed using a force platform (ProKin, Tecnobody, Bergamo, Italy), consisting of three strain gauges set in a triangular position under a surface of 55 cm in diameter with a 20-Hz sampling rate and a sensitivity of 0.1°. Tests were performed in the two-leg stance. The subject was barefooted (with heels touching and metatarsal phalangeal joints in contact), arms along the hips, both in EO and EC condition. Each test lasted 30 s. The position of the feet on the force-platform was standardized using a V-shaped frame. As a result of the tests, the ellipse area (COP area; mm^2) was recorded (18).

Before KT application, the skin was cleaned using alcohol. Patients were taped by an experienced physiotherapist (STC) according to Kenzo Kase's Kinesio Taping Method (12). According to the group assignment, KT was applied on both sides of the abdominal (rectus abdominis, obliquus externus, obliquus internus) and sacrospinal muscles. The muscle technique with 10% to 15% of tension (paper-off tension) in the KT group and placebo applications in the placebo KT group were performed. Six I-shaped and one Y-shaped Kinesio tapes (Kinesio Tex Gold, Kinesio USA, Albuquerque, NM, USA) with a width of 5 cm and a thickness of 0.5 mm were used for both groups. In the KT group, for the rectus abdominis muscle, the base of the I-shaped KT was applied to the pubic tubercle in the supine position. The subject expanded the abdomen with an abdominal breath while the end of the tape was applied to the 5th costal cartilage. For the obliquus externus muscle, the base of the I-shaped KT was applied to the lateral aspect of the 10th rib in the supine position with the hip and knee flexed. Then, the subject adducted and internally rotated the hip and raised the arm on the side to be taped and expanded the thoracic and abdominal spaces with a maximum inspiration. Finally, the end of KT was applied to the superior border of the pubic ramus. For the obliquus internus muscle, the base of the I-shaped KT was applied to the anterior superior iliac supine in the supine position with the hip and knee flexed. The subject extended the leg on the affected side, brought the arms to the opposite side to rotate the trunk away from the side to be taped and expanded the abdomen with an abdominal breath. Lastly, the end of KT was applied to the xiphoid process. For the sacrospinal muscle, the base of the Y-shaped KT was applied to the mid-sacrum in the standing position, the subject was bent forward from the hips to increase tissue tension and Y tails were placed over the prominence of the sacrospinalis muscle (Figure 1.a and Figure 1.b).

In the sham group, KT with no tension and no spe-



a b

Figure 1: (a). Kinesio Tape Applications on Rectus Abdominis, Obliquus Externus and Internus Muscles; (b). Kinesio Tape Application on Sacrospinal Muscles.

cific position was applied on the rectus abdominis, the obliquus externus, and the obliquus internus muscles in the supine position, and on the sacrospinal muscles in the standing position (12).

Statistical Analysis

Eight participants from each group were randomly recruited for the pilot study. G*Power package software program (G*Power, Version 3.0.10, Franz Faul, Universität Kiel, Germany) was used to calculate the required sample size for the study. According to the trunk extensor muscle endurance, it was calculated that a sample consisting of 46 subjects (23 per group) was needed to obtain 80% power with d=0.75 effect size, α=0.05 type I error, and β=0.20 type II error (19). Due to an expected drop-out rate of 20%, we planned to recruit at least 58 patients (29 per group) into the study. Analyses were carried out using IBM SPSS Statistics 21.0 (IBM Corp. Armonk, NY, USA). The variables were investigated using visual (histograms, probability plots) and analytical methods (Shapiro-Wilk test) to determine whether they were normally distributed. Descriptive statistics were calculated for all variables, and the data were shown as mean±standard deviation (SD), median (minimum-maximum), and frequencies and percentages. While age and trunk right endurance test results were normally distributed, BMI, postural stability and other trunk muscle endurance results were not normally distributed. To compare the group differences before and after

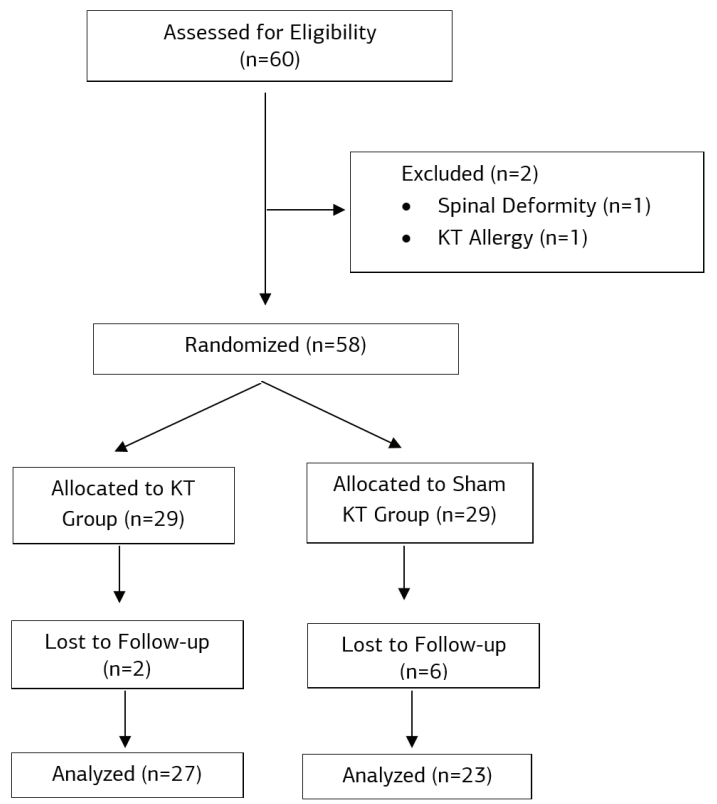


Figure 2: Flow Chart of Participants. KT: Kinesio Taping.

Table 1: Characteristics of the Groups.

Parameter		KT Group (n=27)	Control Group (n=23)	p
		Mean±SD	Mean±SD	
Age (years)		21.00±3.04	20.43±2.37	0.473[a]
BMI (kg/m²)[ϕ]		23.40 (16.94-28.09)	22.04 (16.18-37.64)	0.711[b]
Gender, n (%)	Female	14 (51.9)	13 (56.5)	0.741[c]
	Male	13 (48.1)	10 (43.5)	

[ϕ]Median (Min-Max). a: Student t Test; b: Mann Whitney U Test; c: Chi-squared Test. BMI: Body Mass Index; KT: Kinesio Taping.

the KT application, Student t-test was used for the normally distributed data, and the Mann Whitney U test was used for non normally distributed data. Paired Samples t-test and Wilcoxon test were used for comparison of trunk muscle endurance and postural stability test results of groups' before and after the KT application. The gender difference was compared using the Chi-Square Test. Statistical significance was set at $p<0.05$.

RESULTS

Sixty healthy young adults participated in the study. The study was completed with 50 individuals. The flowchart according to the inclusion and exclusion criteria was shown in Figure 2.

At baseline, there was no difference between groups regarding physical characteristics including age, gender, and BMI ($p>0.05$, Table 1). Before application, there was no difference between groups concerning trunk muscle endurance and postural stability ($p>0.05$). The intergroup comparison showed that trunk flexor, and trunk left lateral endurance scores improved in the KT application group in comparison to the Sham application group ($p<0.05$, Table 2). No significant differences were found in other parameters between the groups ($p>0.05$, Table 2).

After application, in the KT application group, trunk flexor, trunk extensor, and trunk right and left lateral endurance test scores increased ($p<0.05$, Table 3), whereas there was no significant change in postural stability scores ($p>0.05$, Table 3). In the Sham application group, there was no difference between trunk muscle endurance and postural stability scores ($p>0.05$, Table 3).

DISCUSSION

The results of our study showed that the trunk KT application increased trunk muscle endurance interm, but this did not significantly enhance postural stability in healthy young adults. Moreover, trunk flexion and left lateral flexion muscle endurance improved in the KT application group in comparison to the Sham application group in the short term.

In the literature, KT application is currently a prevalent method in therapy, and there are several

Table 2: Comparison of Differences Between Groups' Before and After the KT Application.

Parameter	KT Group (n=27)	Control Group (n=23)	p
	Median (Min-Max)	Median (Min-Max)	
Trunk Muscle Endurance (s)			
Flexor Endurance	6.00 (-12.00-26.00)	0.00 (-19.00-14.00)	**0.015[b]***
Extensor Endurance	3.00 (-3.00-30.00)	0.00 (-30.00-23.00)	0.090[b]
Lateral Endurance-Right[ϕ]	5.44±6.96	4.60±11.35	0.751[a]
Lateral Endurance-Left	7.00 (-11.00-26.00)	0.00 (-34.30-16.00)	**0.006[b]***
Postural Stability (mm²)			
Elips Area-Eyes Open	-5.91 (-321.74-482.50)	0.00 (-217.28-246.93)	0.830[b]
Elips Area-Eyes Closed	-6.95 (-565.59-540.91)	-3.50 (-336.27-597.05)	0.938[b]

*p<0.05. [ϕ]Mean±SD. a: Student t Test; b: Mann Whitney U test. KT: Kinesio Taping.

Table 3: Comparison of Trunk Muscle Endurance and Postural Stability Test Results of Groups' Before and After the KT Application.

Parameter	KT Group (n=27)			Control Group (n=23)		
	Before	After	p	Before	After	p
	Median (Min-Max)	Median (Min-Max)		Median (Min-Max)	Median (Min-Max)	
Trunk Muscle Endurance (s)						
Flexor Endurance	37.00 (11.00-89.09)	54.00 (18-114.03)	**0.004**[d*]	53.00 (21.00-95.60)	48.00 (17.00-103.66)	0.756[d]
Extensor Endurance	59.55 (9.00-137.75)	60.00 (33.00-155.20)	**0.001**[d*]	60.00 (24.00-96.36)	60.00 (23.00-103.00)	0.426[d]
Lateral Endurance-Right[ϕ]	36.49±14.96	41.93±14.83	**0.001**[e*]	42.13±20.19	46.74±20.09	0.065[e]
Lateral Endurance-Left	34.00 (13.05-60.00)	40.68 (13.00-60.00)	**0.001**[d*]	44.29 (8.00-118.53)	42.49 (5.00-114.04)	0.968[d]
Postural Stability (mm^2)						
Elips Area-Eyes Open	138.26 (3.90-402.5)	102.68 (3.84-621.10)	0.638[d]	97.08 (4.01-374.54)	30.17 (3.44-621.47)	0.709[d]
Elips Area-Eyes Closed	131.04 (6.49-576.71)	95.63 (3.25-716.69	0.409[d]	125.74 (4.67-356.84)	20.57 (4.14-923.28)	0.306[d]

*p<0.05. ϕMean±SD. d: Wilcoxon Signed Rank Test; e: Paired Sample t Test. KT: Kinesio Taping.

studies conducted on the different disease groups (13,14) and on healthy individuals (20,21). In these studies, muscle groups in which KT was applied, application methods, and evaluation parameters were different. However, to the best of our knowledge, in the literature, there are a few studies exist, which examined trunk KT applications. Gürşen et al. (13) investigated the effects of KT combined with exercise in women with a cesarean section on abdominal muscle function and recovery compared to the exercise alone. They reported that, after a 4-week program, in the KT combined with exercise group, the strength, and endurance of the rectus abdominis muscle was significantly greater compared to the exercise group. Álvarez-Álvarez et al. (20) investigated the immediate influence of KT on the endurance of the lumbar extensor muscle in young healthy subjects. KT was applied to three groups as KT, placebo, and control. The placebo group performed better than the control group but worse than the KT group. The authors emphasized that the correct application of KT would improve the endurance of the lumbar extensor muscle. In the present study, we examined the short-term effects of trunk KT on trunk muscle endurance in healthy young adults and found that only the trunk flexion and the left lateral flexion muscle endurance scores improved significantly in the KT application group compared to the Sham application group. A possible reason for these results would be because correctly applied KT assumed to stimulate the mechanoreceptors under dermis and mainly provides a positional stimulus to the facial structures; therefore, in the short term, it might induce more motor units and increase muscle activities and endurance (22,23). The reason that the Sham KT application did not show any bigger difference when compared to the correctly applied KT can be also explained by the previously mentioned assumption. In addition, in the present study, the KT applications to the flexor group muscles is more than back muscles. Because of this, the trunk extensor muscle endurance may not have increased. Therefore, these results should be taken into consideration for further studies. Moreover, Hagen et al. (14) assessed the effects of different taping applications (elastic therapeutic, rigid therapeutic, and no tape) on back muscle endurance in patients with low back pain. Their results indicated that back muscle endurance was higher with the elastic therapeutic tape when compared to no tape condition, but not when compared to the rigid therapeutic tape. Ptak et al. (21) stated that, in the short term, the use of KT on rectus abdominis muscles did not affect the force-velocity parameters of the trunk flexor muscles in isokinetic evaluations in healthy women. Different from these results, in our study, we showed that a short-term application of KT could improve

whole trunk muscle endurance parameters.

Trunk and trunk muscle functions are essential for postural control and stability (24,25). In the literature, there are a few studies that examined the effects of the KT application on postural stability or balance, and also in these studies, KT was applied mostly to muscle groups at lower extremity, and the results were contradictory (26-28). Several studies in the literature investigated the effects of trunk KT applications on postural stability or balance (8,16,29). Ruggiero et al. (29) stated that improvements in postural control occurred when KT was applied both in stretched (the recommended manner) and non-stretched manners (placebo) for a short-term period (30 minutes) on the low back region of healthy female athletes. Their findings suggested that KT application in the recommended stretched manner not significantly improve the trunk postural control. Celenay et al. (8) investigated the immediate effects of KT applied on the paraspinal muscle and sacrum on postural stability in patients with chronic low back pain, and they found that KT applications improved static and dynamic postural stability in the short term. Lee et al. (16) performed KT applications to transversus abdominis, internal and external obliques, and the erector spinae muscles in paralyzed individuals, and found that after the taping, balance ability improved. Similar to Lee et al. (16), in the present study, we have focused on trunk muscles. However, different than Lee et al., our results showed that trunk KT for a short-term period in healthy young adults did not improve postural stability. Kase et al. (12) claimed that KT application could be capable of muscle improvement and, motor control and, inconsequent; improvement in postural stability or balance. However, in the current study, it was observed that there was no effect of trunk KT on postural stability. We could explain these findings in the following way: we examined healthy young adults with no neuromuscular dysfunction. In this population, sensory-motor control systems might already be near optimal. This condition may have modified the effects of trunk KT application on postural stability. Besides, we evaluated postural stability parameters 60 min after the KT application. Taping may not have affected postural stability results such a short-term period. In previous studies, the beneficial effects related to especially postural stability or balance ability of KT were observed 24-48 hours after the tape application in healthy people (30-31). These results should be considered when future studies are planned.

Our study had some limitations. First of all, the study was conducted in healthy young adults. These results could not be generalized for patients with insufficient trunk muscle endurance. However, it may construct a base level for future studies in healthy people and patients having insufficient trunk endurance. Secondly, the study was designed to observe the short-term effects. Long-term effects might also be investigated in future studies. Moreover, studies might investigate the effects of trunk KT applications compared to other applications and exercises with long-term follow-ups. Thirdly, in our study, we used Sham KT applications as the control group. The Sham KT applications may contribute the proprioceptive sense; therefore, it should be used in different control groups in comparative KT application studies.

In conclusion, the trunk KT application improved trunk muscle endurance; however, it did not improve postural stability in the short term. Therefore, the trunk KT application might be necessary for improving or supporting trunk endurance in different populations as athletes, geriatric people or patients having low back pain or different neurological or orthopedic diseases.

Sources of Support: None declared.

Conflict of Interest: None declared.

Ethical Approval: This study was approved by the Ankara Yıldırım Beyazıt University Ethics Committee (Number: 45/48).

Informed Consent: Written informed consent was obtained from each subject.

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