THE ATLANTIC Journal of Medical Science and Research

Atlantic J Med Sci Res 2026;6(2):185-94
DOI: 10.5455/atjmed.2025.12.045

Original Article

Acute effects of kinesio tape applied to hamstring and quadriceps muscles on balance and proprioception in healthy young adult men: A randomized controlled trial

Mine Pekesen Kurtca[1], Soner Akgun[2], Berna Anil[3], Esra Korkmaz Salkilic[3], Enes Akdemir[3], Didem Aydin[4], Elanur Atar[5], Emre Karaduman[6], Ahmet Serhat Genc[7], Ali Kerim Yilmaz[6]

[1]Ondokuz Mayıs University, Faculty of Health Sciences, Department of Orthotics and Prosthetics, Samsun, Türkiye
[2]Artvin Çoruh University, Faculty of Sport Sciences, Department of Physical Education and Sports, Sakarya, Türkiye
[3]Ondokuz Mayıs University, Institute of Graduate Studies, Department of Physical Education and Sports, Samsun, Türkiye
[4]Hacettepe University, Faculty of Physical Therapy and Rehabilitation, Department of Pelvic Health and Women's Health Physiotherapy and Rehabilitation, Ankara, Türkiye
[5]Ondokuz Mayıs University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Samsun, Türkiye
[6]Ondokuz Mayıs University, Faculty of Yaşar Doğu Sports Sciences, Department of Recreation, Samsun, Türkiye
[7]Samsun Education and Research Hospital, Department of Orthopedics and Traumatology, Samsun, Türkiye

Received: 09 December, 2025
Accepted: 23 February, 2026
Published: 08 June, 2026

Corresponding Author: Ali Kerim Yilmaz, Ondokuz Mayıs University, Faculty of Yaşar Doğu Sport Sciences, Department of Recreation, Samsun, Türkiye
Email: akerim.yilmaz@omu.edu.tr

CITATION
Pekesen Kurtca M, Akgun S, Anil B, et al. Acute effects of kinesio tape applied to hamstring and quadriceps muscles on balance and proprioception in healthy young adult men: A randomized controlled trial. Atlantic J Med Sci Res. 2026;6(2):185-94. DOI:10.5455/atjmed.2025.12.045

Abstract

Aim: The aim of this study was to investigate the acute effects of kinesio tape (KT) applied to the hamstring and quadriceps muscles on balance and proprioception in healthy young adult males.

Materials and Methods: The study was designed as a randomized, double-blind, sham-controlled, within-subject trial. The study included 40 legs from 20 recreationally active participants aged 18-27 years. Participants were randomized so that one leg was assigned to the real KT group and the other leg to the sham KT group. The joint position was assessed using an isokinetic dynamometer (Cybex NORM®, Humac, CA, USA), while balance was assessed using the CSMI-TecnoBody PK-252 at two time points: baseline and 30 minutes after taping. Participants and evaluators were blinded to group assignment.

Results: KT improved proprioception at extension joint angles of 15°, 30°, and 45°; but not for flexion ($p<0.05$). However, a significant main effect of time was observed for joint extension angles in the KT condition ($p<0.05$). KT significantly improved balance scores for center of pressure y-axis (COPy), standard forward-backward deviation (SBFD), standard medium/lateral deviation (SMLD), average forward-backward speed (AFBS), average medium-lateral speed (AMLS), ellipse area (EA), perimeter (P), and stability index (SI) ($p<0.05$). Similarly, a significant main effect of time was observed for balance scores in the KT condition ($p<0.05$). In the sham condition, no significant differences were observed between pre- and post-tests for either balance state ($p>0.05$), except for AMLS ($p=0.045$).

Conclusion: These findings suggest that facilitation-type KT may induce immediate improvements in extension-direction proprioception and in selected static balance parameters in healthy young men, whereas its effects on dynamic balance appear limited.

Keywords: Balance, joint position sense, kinesio taping, knee, proprioception

INTRODUCTION

Balance is defined as the ability to successfully maintain the body's center of gravity within the limits (1). Balance, also known as postural control, is achieved through the integration of vestibular, visual, and somatosensory systems (2). Undoubtedly, one of the most important components of this process is the somatosensory system (3).

One of the most important components of this system is proprioceptive sensation (4). In proprioception, inputs are received from peripheral afferents such as muscle spindles, joint

DOI: 10.5455/atjmed.2025.12.045

receptors, and Golgi tendon organs, and they provide information about limb awareness, position, force, and weight (5). This vital role in the balance mechanism suggests that proprioception has a significant impact on balance abilities (6). Therefore, many different methods have been applied to improve balance and proprioception functions not only in patients but also in healthy individuals (7). Kinesio tape (KT) application is one of these methods (8).

KT is a thin and elastic clinical tape developed by Dr. Kenzo Kase in the 1970s and applied to the target muscle with sufficient tension to create skin folds (9). KT can be applied using different techniques, including facilitation and inhibitory approaches, depending on the direction of application and the intended neuromuscular effect. Technically, it has an acute effect on increasing afferent information, improving proprioception and balance by stimulating cutaneous mechanoreceptors in the area of application (10). However, some studies in the literature argue that KT improves balance and proprioception (11), while others argue that it has no effect (12). Similarly, Joveini et al. (2024) argued that studies in literature have found inconsistent results, as reported in their meta-analysis of the effect of KT on strength and balance (13).

No clear consensus exists on whether KT applied to the knee musculature meaningfully improves proprioception and balance in healthy individuals, and, in particular, on whether its effects differ from those of a tension-free sham application to the same muscle groups. Most previous studies have either focused on clinical populations, have not controlled for sham taping, or have not simultaneously evaluated both proprioception and static and dynamic balance in a single experimental model (12,14). Therefore, the present study aimed to investigate the acute effects of facilitation-type KT applied to the quadriceps and hamstring muscles on knee joint position sense and static and dynamic balance in healthy young adult men, using the contralateral leg as a sham-taped control. We hypothesized that, compared with sham taping, facilitation KT would lead to significantly greater improvements in knee proprioception and balance performance.

MATERIALS AND METHODS

Sample Size

An a priori power analysis was conducted using G*Power 3.1. In the reference study, a large within-subject effect size was reported (dz=1.797) (15). The power analysis, considering that a more conservative effect size (dz=0.80) might realistically be observed in the present study, indicated that a minimum of 19 limbs would be required to achieve 90% statistical power at a 95% confidence level (α=0.05). To account for potential dropouts and ensure sufficient statistical robustness, 20 participants (40 limbs) were ultimately included in the study.

Participants

The study included 20 recreationally active individuals aged 18-27 years. The inclusion criteria for the participants were being male, aged between 18 and 27 years, and volunteering. Exclusion criteria were any musculoskeletal injury in the last six months, auditory/vestibular impairment, active cellulitis or skin infection, history of open wound and/or deep vein thrombosis at the application site, and known allergic reaction to KT application (16).

The subjects were informed in detail, and a "Informed Voluntary Consent Form" was obtained before the study. This study was approved by the Samsun University Clinical Research Ethics Committee (Approval No: SÜKAEK-2023 20/15) and was conducted as per the ethical principles stated in the Declaration of Helsinki. This study is also registered on ClinicalTrials.gov (NCT06965348).

Study Design

The study was designed as a randomized, double-blind, sham-controlled trial with a within-subject crossover design. Demographic characteristics, including age, height, body weight, and dominant side, were recorded during the first visit. All participants were allowed to perform practice trials to familiarize themselves with the testing procedures.

At the second visit (48 hours later), participants underwent assessments of proprioception, static balance, and dynamic balance without the application of tape. Within the study design, one leg of each participant was assigned to receive real KT, while the contralateral leg was assigned to receive sham KT. Following baseline measurements, simple randomization was performed using a coin toss to determine which leg would receive the intervention first. After tape application, the tape remained in place on the participant for 30 minutes, after which the post-intervention assessments were performed. At the third visit (48 hours later), the intervention was applied to the contralateral leg that had not received taping during the second visit, according to the predetermined allocation, and the same evaluation procedures were repeated following the application period. All balance assessments (static and dynamic) were performed under bipedal conditions. Therefore, balance performance reflected the integrated contribution of both lower limbs rather than the performance of individual legs, and no unipedal balance assessment was conducted. The study aimed to evaluate balance and postural control responses rather than isolated leg-specific effects. During testing, participants rested for 30 seconds between assessments (17). Participants were not informed about which intervention condition was applied to each leg. Outcome assessments were performed by a physiotherapist blinded to the intervention conditions, and data analysis was conducted by an independent statistician (18).

Kinesio Taping Application

KT was applied using a standard muscle facilitation technique based on the original Kinesio Taping® method described by Kenzo Kase (19). The KT application was performed by a physiotherapist with more than five years of clinical experience

DOI: 10.5455/atjmed.2025.12.045

in neuromuscular taping method. The tape used in the application was a standard 5 cm wide Kinesio® Tapes product consisting of 97% cotton and 3% elastane, with hypoallergenic acrylic adhesive and approximately 140-150% elasticity 19. Before taping, the skin was cleaned with alcohol to remove oils and moisture. The corners of the tape were rounded to reduce premature peeling, and the tape was gently rubbed after application to activate the adhesive through frictional heat. Both applications followed the standardized KT protocol. All tapes were applied to clean, dry, and hair-free skin to ensure proper adhesion. During this period, participants were instructed to avoid excessive sweating and not to touch the taped area (17).

Intervention Group

For quadriceps facilitation, the participant was positioned in the supine position with the hip in neutral and the knee flexed to approximately 30°, allowing a slight stretch of the quadriceps. A Y-shaped KT was used. The base of the tape was anchored to the anterior inferior iliac spine (AIIS) without tension. The tape was then divided into two tails and applied along the rectus femoris muscle toward the patella. The two tails were guided around the medial and lateral borders of the patella and extended distally toward the tibial tuberosity, in the anatomical direction of the quadriceps muscle fibers. For muscle facilitation, the tape was applied from origin to insertion with approximately 25–50% tension along the tape body, while the anchors were applied without tension. The knee was maintained in slight flexion during application to provide appropriate muscle elongation (19,20) (Figure 1A).

Figure 1. Application of kinesio tape to the rectus femoris (quadriceps) (A) and hamstring (B) muscles

For hamstring taping, the participant stood with the trunk flexed forward and knees fully extended, placing the posterior thigh muscles under stretch. An I-shaped KT was applied along the anatomical course of the hamstring muscles. The base of the tape was anchored at the ischial tuberosity, and the strip was applied distally toward the posteromedial aspect of the tibia, following the direction of the hamstring muscle fibers. Consistent with the facilitation technique, the tape was applied from origin to insertion with approximately 25–50% tension along the body of the tape, while the proximal and distal anchors were applied without tension 19 (Figure 1B).

Control Group

Sham tape was applied to the same anatomical regions with tapes of the same color and size, similar to the actual taping procedure, but without tension and without consideration of the direction of the muscle fibres. The tape ends were applied with minimal tension to avoid mechanical or sensory effects from the application (19).

Outcome Measures

Evaluation of Proprioception

Proprioception was assessed using joint position sense. Joint position sense was assessed as the ability to actively relocate to the previously demonstrated joint position (EPAB) 6. EPAB measurements were performed using an isokinetic dynamometer (Cybex NORM®, Humac, CA, USA). Participants were seated on the dynamometer chair with the trunk stabilized by straps, the hip positioned at approximately 90° flexion, and the thigh secured to prevent compensatory movement. The starting position was at 90° of knee flexion. From this position, the knee was passively moved toward extension, to achieve target angles 75°, 60°, and 45° of knee flexion. These angles represent 15°, 30°, and 45° of knee extension from a 90° starting position. Each target angle was maintained for 10 seconds to allow participants to encode the joint position in memory. The knee was then returned to 90° flexion, and participants were asked to actively reproduce the taught positions. The absolute angular error was calculated as the absolute difference between the reproduced angle and the target angle. For statistical analysis and reporting, angles were expressed as extension angles of 15°, 30°, and 45° relative to the starting position. Three repetitions were performed for each leg at all angles and averaged (21).

Postural Balance Evaluation

The warm-up consisted of 5 minutes of low-intensity cycling on a stationary bicycle ergometer. The intensity was kept low to avoid fatigue-related effects on balance performance.

Static Balance

The measurements were performed with the participants' feet shoulder-width apart on the CSMI-TecnoBody PK-252 balance device platform (representing the x-y axes), with participants' feet shoulder-width apart, equidistant from the starting point, and eyes open. The tests lasted 30 seconds, during which participants maintained their body position, which was monitored on the screen. Data were automatically recorded at the end of the test period.

Dynamic Balance

During dynamic balance measurements, participants were instructed to minimize upper body movements and to complete the test using only foot movements. Biped mode was selected, on the CSMI-TecnoBody PK-252, thereby allowing platform movement and disabling key sensors. The difficulty level of the platform was predetermined in the device software and kept constant for all participants to ensure standardized testing conditions. At the set difficulty level, participants attempted to complete the test within 60 seconds by following the circular route displayed on the screen and rotating the platform five times clockwise. The test was stopped and restarted in case of loss of balance, exposure to environmental factors, or contact between the hands and the device. When participants failed to complete the test within the specified time, the best performance measurement result up to that point was recorded (22).

Statistical Analysis

Data analyses were conducted using IBM SPSS Statistics version 25.0 (IBM Inc., Armonk, NY). Descriptive data are presented as mean, standard deviations (SD), median, minimum (Min), and maximum (Max). The normality assumption was evaluated by applying a Shapiro–Wilk test. Comparisons between groups over time were determined using a 2x2 mixed repeated-measures analysis of variance (RM ANOVA). Mauchly's sphericity test determined if the variances of the differences between levels of the within-subject factors for both conditions (legs) were equal. When a significant difference rejected the assumption of sphericity, the Greenhouse–Geisser correction was applied. For joint angle and balance parameters, both "time" (pre vs. post) and "condition" (KT vs. sham) were treated as within-subject factors, yielding a 2×2 repeated-measures design. As a key assumption, we tested for the time × condition interaction to determine whether changes over time differed between KT and sham taping. All statistical tests were two-tailed. Statistical significance was based on a p value of <0.05.

RESULTS

The study included 40 legs from 20 participants. No participants dropped out of the study due to any skin reactions or other adverse effects. Table 1 presents descriptive information of about the participants.

Table 1. Descriptive information of the participants

Variables	Mean ± SD	Median (Min–Max)
Age (years)	21.7 ± 2.6	21 (18−27)
Height (cm)	179.5 ± 6.0	179 (170−191)
Weight (kg)	74.7 ± 13.1	73 (56−103)
Body mass index (kg/m²)	23.1 ± 3.5	23 (16−29)
Dominant leg		N (%)
Right		16 (80)
Left		4 (20)

SD: Standard deviation, Min: Minimum, Max: Maximum

KT improved 15°, 30°, and 45° extension joint angles for proprioception but not flexion (p<0.050). However, there was a significant main effect of time for extension joint angles in the KT condition (p<0.050). There was no significant difference between pre- and post-tests for the angles of both joint movements (flexion and extension) in the sham leg (p>0.050) (Table 2).

Table 2. The effect of kinesio taping on 15°, 30° and 45° flexion and extension joint angles for proprioception

Variables	Placebo taping			Kinesio taping			Pre vs Pre	Post vs Post	Interaction effects		
	Pre	Post		Pre	Post				Condition	Time	Condition x time
	Mean ± SD	Mean ± SD	p	Mean ± SD	Mean ± SD	p	p	p	p	p	p
15° Flx	2.4 ± 1.9	2.0 ± 1.4	0.324	1.7 ± 1.3	1.6 ± 1.4	0.798	0.201	0.390	0.189	0.329	0.603
30° Flx	3.6 ± 2.4	3.2 ± 2.5	0.562	3.8 ± 3.4	3.2 ± 2.2	0.400	0.840	0.999	0.890	0.316	0.852
45° Flx	2.9 ± 2.0	2.3 ± 1.7	0.470	4.2 ± 3.0	2.8 ± 1.7	0.066	0.122	0.426	0.069	0.071	0.415
15° Ex	3.2 ± 4.3	2.9 ± 2.7	0.809	4.9 ± 5.5	1.7 ± 2.0	0.011*	0.105	0.304	0.830	0.045*	0.092
30° Ex	5.2 ± 8.6	3.4 ± 2.8	0.466	8.5 ± 11.1	2.1 ± 1.6	0.010*	0.076	0.293	0.518	0.020*	0.171
45° Ex	6.8 ± 13.2	2.5 ± 1.8	0.232	10.8 ± 17.6	3.5 ± 2.5	0.042*	0.167	0.413	0.321	0.024*	0.533

* p<0.05, SD: Standard deviation, Flx: Flexion, Ex: Extension

Percentage relative changes (Δ%) of 15°, 30°, and 45° extension joint angles were significantly higher in the KT (Δ15%, 75%, 68%, respectively) than in the sham (Δ9%, 35%, 63%, respectively) condition (Figure 2).

KT statistically improved center of pressure y-axis (COPy), standard forward-backward deviation (SBFD), standard medium/lateral deviation (SMLD), average forward-backward speed (AFBS), average medium-lateral speed (AMLS), ellipse

DOI: 10.5455/atjmed.2025.12.045

area (EA), perimeter (P), and stability index (SI) balance scores ($p<0.050$). Similarly, there was a significant main effect of time for balance scores in the KT condition ($p<0.050$). In addition, a main effect of condition was revealed only for AMLS score ($p=0.045$). There was no significant difference between pre- and post-test results for both balance states (static and dynamic) in the sham condition ($p>0.050$), except for AMLS ($p=0.045$) (Table 3).

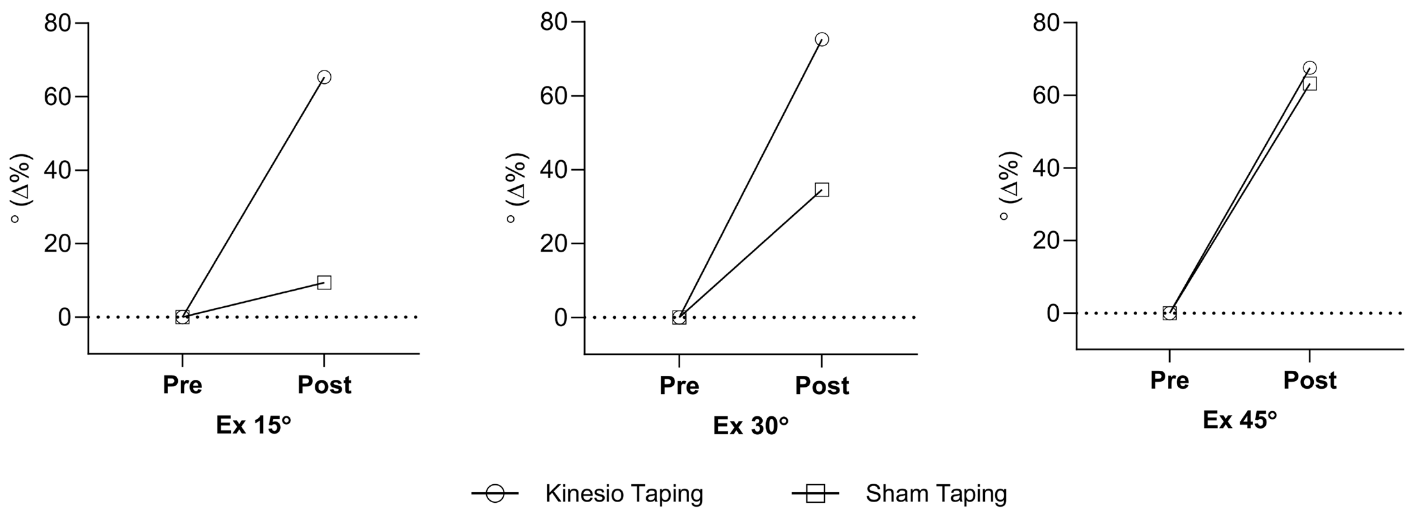

Figure 2. Percentage relative changes (Δ%) of extension angles between pre- and post-means in kinesio taping

Table 3. The effect of kinesio taping on static and dynamic balance

Variables	Placebo taping			Kinesio taping			Pre vs Pre	Post vs Post	Interaction effects		
	Pre	Post		Pre	Post				Condition	Time	Condition x time
	Mean ± SD	Mean ± SD	p	Mean ± SD	Mean ± SD	p	p	p	p	p	p
Static											
COPx (mm)	3.1 ± 2.9	2.6 ± 2.0	0.422	2.7 ± 2.7	1.5 ± 1.3	0.059	0.653	0.042*	0.204	0.058	0.427
COPy (mm)	2.1 ± 1.6	1.4 ± 1.3	0.125	2.9 ± 2.0	1.6 ± 1.8	0.010*	0.169	0.617	0.212	0.004*	0.421
SBFD (mm)	6.4 ± 1.4	5.9 ± 1.3	0.293	6.9 ± 1.4	5.9 ± 1.9	0.039*	0.266	0.999	0.478	0.029*	0.455
SMLD (mm)	4.3 ± 0.8	3.9 ± 0.9	0.076	4.4 ± 0.7	3.6 ± 0.9	0.002*	0.839	0.297	0.564	0.001*	0.266
AFBS (mm/s)	25.1 ± 5.3	23.9 ± 4.1	0.444	25.3 ± 8.0.	20.3 ± 5.0	0.003*	0.926	0.017*	0.250	0.007*	0.091
AMLS (mm/s)	23.2 ± 7.0	20.2 ± 5.1	0.024*	21.4 ± 5.2	15.6 ± 5.4	<0.001*	0.347	0.008	0.045*	<0.001*	0.142
EA (mm²)	482.3 ± 150.5	419.6 ± 111.0	0.138	551.3 ± 143.9	396.4 ± 166.1	0.001*	0.147	0.606	0.518	0.001*	0.123
P (mm)	1116.4 ± 237.3	1024.2 ± 176.8	0.125	1082.3 ± 285.3	841.5 ± 216.3	<0.001*	0.683	0.006	0.081	<0.001*	0.082
Dynamic											
ATE (%)	17.9 ± 7.0	18.3 ± 6.8	0.798	20.9 ± 7.1	18.5 ± 7.7	0.085	0.184	0.914	0.430	0.292	0.160
AFV (kg)	1.1 ± 0.6	1.2 ± 0.6	0.864	1.2 ± 0.5	2.4 ± 4.0	0.054	0.514	0.174	0.159	0.135	0.207
SI (°)	1.9 ± 2.9	1.3 ± 2.1	0.323	1.8 ± 2.5	0.5 ± 0.3	0.021*	0.958	0.105	0.471	0.021*	0.328
TTSD	30.1 ± 0.2	30.7 ± 2.1	0.565	28.8 ± 6.0	31.0 ± 2.5	0.042*	0.318	0.742	0.479	0.065	0.288
TBFSD	2.1 ± 0.8	3.3 ± 6.3	0.465	2.3 ± 1.1	3.9 ± 7.2	0.318	0.549	0.766	0.676	0.223	0.847

* $p<0.05$, SD: Standard deviation, COPx: Center of pressure x-axis, COPy: Center of pressure y-axis, SBFD: Standard forward-backward deviation, SMLD: Standard medium/lateral deviation, AFBS: Average forward-backward speed, AMLS: Average medium-lateral speed, EA: Ellipse area; P:Perimeter; ATE: Average track error, AFV: Average force variance, SI: Stability index, TTSD: Trunk total standard deviation, TBFSD: Trunk forward-backward standard deviation

The percentage relative changes (Δ%) in center of pressure x-axis (COPx), COPy, SBFD, SMLD, AFBS, AMLS, EA and P static balance scores were significantly higher when using KT (Δ44%, 45%, 14%, 18%, 20%, 27%, 28%, 22%, respectively) compared to the sham condition (Δ16%, 8%, 9%, 4%, 13%, 13%, 8%, 32%, respectively) (Figure 3).

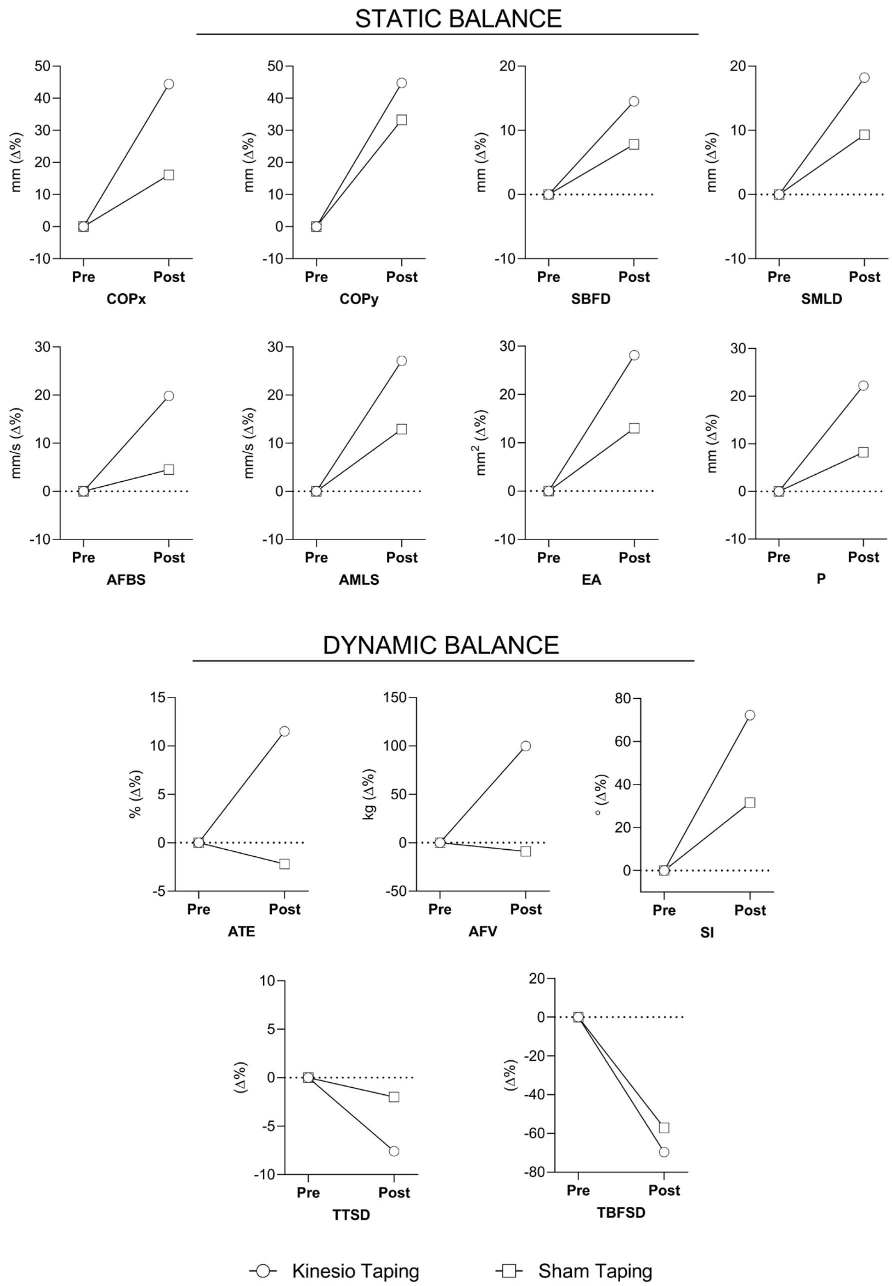

Figure 3. Percentage relative changes (Δ%) of static and dynamic balance between pre- and post-means

The relative percentage changes (Δ%) in the dynamic balance scores average track error (ATE), average force variance (AFV), stability index (SI), trunk total standard deviation (TTSD), and trunk forward-backward standard deviation (TBFSD) showed improvements with KT (Δ12%, 100%, 72%, -8%, -70%, respectively) than those in the sham condition (Δ-2%, -9%, 32%, -2%, -57%, respectively) (Figure 3).

DISCUSSION

In our study, we investigated the acute effects of KT application to the quadriceps and hamstring muscles on balance and proprioception in healthy young adult men. In the group which KT was applied, proprioception improved at all extensions angles, while there was no difference in proprioception in the flexion direction. A significant main effect of time was also observed for joint angles in the extension direction. In the sham taping group, there was no difference in proprioception at joint angles in both directions of motion. The percentage relative changes for proprioception in the KT group were higher than those in the sham taping group. KT was associated with improvements in several balance parameters, particularly static balance measures, while dynamic balance changes were limited to selected indices. The relative percentage changes in all balance scores were higher in the KT group than in the sham group. Our results showed that balance and proprioceptive function in the extension direction were significantly better in the KT group than in the sham group.

Considering that proprioception plays a role in the prevention of acute injuries, the effect of KT on proprioception is of interest (23,24). In our study, proprioception improved significantly at all extension angles, while no significant difference was observed in flexion. This finding suggests that KT may affect proprioceptive feedback differently depending on the direction of movement in which the muscle is actively involved. Since the quadriceps muscle group acts as the primary actor in knee extension, KT applied to this muscle may have improved joint position sensation by stimulating mechanoreceptors more effectively (25,26). Several physiological and methodological factors may explain the lack of significant improvement in flexion. First, the hamstring muscle group generally assumes a more passive role, and the mismatch between the direction of application of KT and the axis of contraction of the muscle may limit proprioceptive feedback 16. Second, the effect of KT application depends on the intensity and regularity of neurosensory mechanisms at the skin-muscle-joint junction, which may not produce the same effect in all directions of movement 19. The lower level of mechanical tension, particularly in the flexion direction, may have reduced the mechanical stimulation provided by KT and the activation level of subcutaneous receptors, thereby preventing a significant change. The directional sensitivity of proprioceptive tests may also play a role in explaining this difference. Some studies have reported that tests used to assess joint position sense may be less sensitive, especially in the flexion direction (27). Therefore, the technical limitations of the test method must be taken into account.

The proprioception assessment protocol used in this study was based on re-measuring the joint position sense at specific angles, and measurements were performed before and immediately after application of KT (30 minutes). This structure allows us to analyze how proprioceptive sensation changes over time. When the time factor, defined as the situation immediately before and after the application were compared, a significant main effect was found, particularly in the angles in the extension direction. This result suggests that proprioception can respond to KT application within a short time. Similarly, it has been reported in the literature that joint position sense tests are particularly sensitive to acute interventions, i.e., they can detect proprioceptive changes after short-term stimulation (27,28). However, these tests may be limited in assessing long-term effects because sensorimotor adaptation processes may change over time (29). Thus, the design of our study is appropriate for assessing both the directional distribution of the effect of KT administration and its early consequences over time. The results of proprioception tests can show not only the effect of the intervention but also the initial speed of the neurophysiological. This feature provides an important advantage for studies aiming to analyze acute effects. In addition, the morphologic, histologic, and physiologic characteristics of the muscles subjected to KT should be taken into consideration when evaluating this finding. The superficial location and wider anatomical structure of the quadriceps provide a more accessible and effective target for KT application. The large volume of the muscle may increase the mechanical stimulation effect of KT (19). KT increases the proprioceptive response by stimulating mechanoreceptors in superficial muscles and tendon structures. Hamstring muscles may have a more limited response to KT application because of their long fiber structure, as the tension distribution may not be sufficient (16). Quadriceps muscles exhibit a better physiological response to KT with their homogeneous structure. The quadriceps muscle gives more active support to KT, whereas the hamstrings may provide a more passive response to KT due to their reactive role in fast movements (26).

To prevent proprioception tests from being affected by factors such as reapplicability and learning effects, it is also important that participants are given enough trial runs before the measurement and that the measurement conditions are standardized (30). In our study, participants were also given a trial before the measurements. As a result, the effect of KT may vary according to the muscle group, the direction of application, and the measured joint position. This directional difference is also noteworthy in the studies reporting similar results. For example, Poon et al. (2015) emphasized that KT had no significant effect on muscle performance or proprioception in some movement plans and that the effects differed according to direction, muscle and application area (31).

Although the same anatomical regions were taped in the sham condition, the tape was applied without tension and without respecting muscle fibre direction, which is unlikely to provide sufficient mechanical deformation of the skin and underlying fascia to activate cutaneous and muscle mechanoreceptors in a manner comparable to facilitation KT. Therefore, the sham application may have produced only a mild tactile stimulus. Our study revealed that there was no significant change in proprioception at both flexion and extension angles in the sham taping group. On the other hand, the higher percentage relative changes for proprioception in the KT group may be related to the mechanical and neurophysiological effects of KT. KT is known to increase neural feedback by stimulating mechanoreceptors through tension on the skin, which can increase the sensitivity of joint position sense (25,26). Since this mechanism of action was not activated in the sham group, no significant improvement in proprioceptive perception was observed. This finding supports the notion that the effect of KT on proprioception cannot be explained solely by sham-based mechanisms, such as psychological expectancy or attentional focus, but is indeed a physiological response. In their study, Lins et al. (2013) reported that KT application was superior to sham taping in some proprioceptive measurements (32); similarly, Halseth et al. (2004) revealed that there may be significant differences between sham taping and KT (33). However, it is not a common finding in literature to find that placebo treatments do not affect proprioception. Some studies have suggested that the placebo effect may increase sensory awareness and therefore produce short-term improvements (34). However, because the methodology used in our study, including the tension-free application of the tape did not produce a stimulus similar to the sensory activation of KT, this effect may not have occurred.

In our study, a significant improvement was observed in selected static balance parameters and in the SI dynamic parameter, rather than across all balance measures. Time was found to be an important main effect, especially in balance scores. In contrast, only the AMLS score showed a significant change in the sham group; no statistically significant difference was found in other balance parameters. The relative percentage change values of the KT group were higher than those of the sham group in all balance scores. These findings suggest that KT may be effective in improving balance control via the proprioceptive system in a short time. The effect of KT on balance may be explained by promoting sensorimotor integration through stimulation of mechanoreceptors via skin and muscle tissue (19). This stimulus may facilitate activation of cerebellar and somatosensory pathways, particularly those governing postural control (35). In the literature, it has been reported that KT application has positive effects, especially on static and dynamic balance performance in the acute period (36). Similarly, in our study, significant improvements in balance scores were observed after short-term practice.

One of the notable findings of our study is that a significant improvement was observed only in the AMLS score in the sham taping group. Although no significant changes were found in other balance parameters, the improvement in this measure alone suggests that the placebo effect may have a limited effect on some aspect-specific postural adaptations. There are several possible explanations for this situation. First, the AMLS parameter includes micro-level adjustments made by the individual in both the sagittal and frontal planes to maintain balance. The mild tactile stimulation created by the placebo patch on the skin, although it does not provide mechanical support, may have temporarily increased body awareness, causing individuals to consciously or unconsciously change their postural strategies (34). Second, the placebo effect may lead individuals to focus more attention on their bodies in anticipation of "receiving an intervention". This focus can create short-term improvements, especially in complex balance measures. Literature has reported that placebo treatments can sometimes produce measurable effects, especially on tasks requiring sensory awareness (37). A third explanation may be that the measurement precision of the AMLS test is higher than that of other balance tests. Due to the nature of the test, it is more likely to detect small changes, which may explain the observation of a significant difference only in this parameter (38). However, the clinical significance of such differences should be carefully evaluated. In general, it is thought that the placebo patch does not provide sufficient activation on the sensorimotor system, because it does not provide the mechanical tension and neurosensory effect on the skin specific to KT (32). Therefore, no significant improvement was observed in other balance scores in the sham group.

The findings suggest that KT may induce short-term improvements in proprioception in the extension direction and in selected static balance parameters, whereas its effects on dynamic balance appear to be limited to specific indices. These results are in line with previous studies suggesting that the KT can modulate the sensorimotor system through mechanoreceptor stimulation (32,39). The improvements observed in proprioceptive perception following tape application support the theory that KT increases central nervous system transmission by stimulating mechanoreceptors through tension on the skin (25). This contributes to a keen sense of joint position, especially when applied around the knee joint region (40). However, it should be noted that the findings on the effects of KT in the literature are not homogeneous. Some studies in the literature show that acute effects on balance are limited or statistically insignificant (31). These differences may be due to variations in application protocols, taping direction, tension rate, participant characteristics, and measurement tools.

The first methodological limitation of the present study is that only male subjects were included. The inclusion of only male participants provided a more homogenous sample, excluding the influence of hormonal differences or tissue elasticity in females. However, this situation limits the generalisability of the findings to women. Secondly, the study's evaluation of acute effects does not provide information about the long-term effects of KT. Therefore, it is recommended that follow-up studies including different gender longer follow-up periods. Third, the protocol used in the study only covers the hamstring and quadriceps muscles. The knee, an intermediate joint, is connected to other joints such as the hip and foot. This joint and other muscles around it also play a role in balance, stability, and proprioception. Additionally, the contribution of both extremities in bilateral tests may have limited the ability to fully demonstrate the effect on the side to which the KT was applied.

CONCLUSION

In conclusion, the main objective of our study was to close the gap in the literature on the effects of KT on proprioception and balance and to clarify inconsistencies. Our findings emphasize the potential of KT to improve proprioception and balance. The results of this study are limited to healthy, recreationally active young men and reflect only the immediate effects of KT. Further

DOI: 10.5455/atjmed.2025.12.045

studies are needed to elucidate the underlying mechanisms, determine the effects of interventions that induce fatigue (which may affect proprioception and balance) or of conditions such as injuries or illnesses that cause musculoskeletal problems, and assess the long-term effects of KT.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that there is no financial support.

Ethical Approval
The study protocol received approval from the Sakarya University Non-Interventional Research Ethics Committee granted ethical approval (Protocol No: E-43012747-050.04-463752), (Decission date: 12/04/2025).

Patient Consent
The subjects were informed in detail, and a "Informed Voluntary Consent Form" was obtained before the study.

REFERENCES

1. Delfa-de-la-Morena JM, Paes PP, de Oliveira DPL, et al. Single-leg balance and lower limb strength: quantitative analysis with the balance master system. J Funct Morphol Kinesiol. 2024;9:282.
2. Peterka RJ. Sensory integration for human balance control. Handb Clin Neurol. 2018;159:27-42.
3. ten Donkelaar HJ, Broman J, van Domburg P. The somatosensory system. In: Clinical neuroanatomy. Springer International Publishing; 2020:171-255.
4. Wang L, Ma L, Yang J, Wu J. Human somatosensory processing and artificial somatosensation. Cyborg Bionic Syst. 2021;2021:9843259.
5. Zampieri N, de Nooij JC. Regulating muscle spindle and Golgi tendon organ proprioceptor phenotypes. Curr Opin Physiol. 2021;19:204-10.
6. Cho SH, Moon HJ. Effects of kinesio taping on balance abilities and proprioception sense. J Int Acad Phys Ther Res. 2017;8:1163-67.
7. Seo HG, Yun SJ, Farrens AJ, et al. A systematic review of the learning dynamics of proprioception training: specificity, acquisition, retention, and transfer. Neurorehabil Neural Repair. 2023;37:744-57.
8. Kim JH. Effects of EMG-biofeedback using closed kinetic chain exercise on Q-angle and quadriceps muscle activation in patellofemoral pain syndrome. J Korean Phys Ther. 2016;28:65-70.
9. Torres R, Trindade R, Gonçalves RS. The effect of kinesiology tape on knee proprioception in healthy subjects. J Bodyw Mov Ther. 2016;20:857-62.
10. Kim JH, Kim KH, Kim DH. Effects of proprioception training with kinesio taping of the knee joints on proprioception, balance, and gait in stroke patients: a single-blind randomized trial. Phys Med Rehabil Kurortmed. 2022;32:389-95.
11. Biz C, Nicoletti P, Tomasin M, et alP. Is kinesio taping effective for sport performance and ankle function of athletes with chronic ankle instability (CAI)? A systematic review and meta-analysis. Medicina (B Aires). 2022;58:620.
12. Stocco MR, Del Antonio ACFT, Oliveira RG, et al. Does kinesio tape alter muscle strength in athletes? A systematic review and meta-analysis. J Bodyw Mov Ther. 2024;38:593-604.
13. Joveini G, Boozari S, Mohamadi S, Jafari H. Does lower limb kinesio taping affect pain, muscle strength, and balance following fatigue in healthy subjects? A systematic review and meta-analysis. BMC Sports Sci Med Rehabil. 2024;16:246.
14. Martonick N, Kober K, Watkins A, et al. The effect of kinesio tape on factors for neuromuscular control of the lower extremity: a critically appraised topic. J Sport Rehabil. 2020;29:841-46.
15. Shafeek MM, Ahmed YF, Ibrahim HM, Elnegamy TE. The immediate and late effect of kinesio taping on dynamic balance in young athletes with anterior cruciate ligament injury. Turk J Physiother Rehabil. 2022;32:3871-77.
16. Li R, Qin R, Tan Y, et al. Effect of kinesio taping intervention on muscle strength and balance of college basketball players with functional ankle instability. Front Physiol. 2023;14:1064625.
17. Zhang L, Lu J, Cai B, et al. Quantitative assessments of static and dynamic balance performance in patients with chronic ankle instability. Medicine (Baltimore). 2020;99:e19775.
18. Stocco MR, Antonio ACFT Del, Oliveira RG, et al. Progressive tension protocol for muscle strength with kinesio tape in runners: double-blind randomized clinical trial. Fisioter Mov. 2023;36:e36104.
19. Kase K, Wallis J, Kase T. Clinical therapeutic applications of the kinesio taping method. Kinesio Taping Association; 2013.
20. Lemos TV, de Souza Junior JR, dos Santos MGR, et al. Kinesio taping effects with different directions and tensions on muscle activity of rectus femoris: a randomized controlled trial. Bull Fac Phys Ther. 2023;28:33.
21. Coelho VK, Gomes BSQ, Lopes TJA, et al. Knee proprioceptive function and physical performance in patellofemoral pain: a matched case-control study. Knee. 2021;33:49-57.
22. Dülger O, Bas O. The effect of leg strength and jump performance on balance in handball players. Middle Black Sea J Health Sci. 2021;7:168-77.
23. Ghai S, Ghai I, Narciss S. Influence of taping on joint proprioception: a systematic review with meta-analysis. BMC Musculoskelet Disord. 2024;25:480.
24. Lephart SM, Pincivero DM, Giraido JL, Fu FH. The role of proprioception in management and rehabilitation of athletic injuries. Am J Sports Med. 1997;25:130-37.

25. González-Iglesias J, Fernández-de-las-Peñas C, Cleland J, et al. Short-term effects of cervical kinesio taping on pain and range of motion in acute whiplash injury. J Orthop Sports Phys Ther. 2009;39:515-21.

26. Chang WD, Chen FC, Lee CL, et al. Effects of kinesio taping versus McConnell taping for patellofemoral pain syndrome: a systematic review and meta-analysis. Evid Based Complement Alternat Med. 2015;2015:471208.

27. Han J, Waddington G, Adams R, et al. Assessing proprioception: a critical review of methods. J Sport Health Sci. 2016;5:80-90.

28. Aman JE, Elangovan N, Yeh IL, Konczak J. Effectiveness of proprioceptive training for improving motor function: a systematic review. Front Hum Neurosci. 2014;8:1075.

29. Grooms DR, Page SJ, Onate JA. Brain activation for knee movement measured before second ACL injury. J Athl Train. 2015;50:1005-10.

30. Relph N, Herrington L. Reliability of clinical knee joint position sense measurements using image capture technique. J Sport Rehabil. 2015;24.

31. Poon KY, Li SM, Roper MG, et al. Kinesiology tape does not facilitate muscle performance: a controlled trial. Man Ther. 2015;20:130-33.

32. Lins CA, Neto FL, Amorim ABC, et al. Kinesio taping does not alter neuromuscular performance of quadriceps. Man Ther. 2013;18:41-45.

33. Halseth T, McChesney JW, Debeliso M, et al. Effects of kinesio taping on ankle proprioception. J Sports Sci Med. 2004;3:1-7.

34. Murray H, Huskisson EC, Bull F. Placebo effects in physical therapy. Physiotherapy. 2010;85:592-96.

35. Simoneau GG, Degner RM, Kramper CA, Kittleson KH. Changes in ankle joint proprioception with athletic tape. J Athl Train. 1997;32:141-47.

36. Boonkerd C, Thinchuangchan K, Chalarak N, et al. Effect of kinesio tape on proprioception, static and dynamic balance in chronic ankle instability. Ann Appl Sport Sci. 2023;11.

37. Finniss DG, Kaptchuk TJ, Miller F, Benedetti F. Biological and clinical advances of placebo effects. Lancet. 2010;375:686-95.

38. Guskiewicz KM, Ross SE, Marshall SW. Postural stability and neuropsychological deficits after concussion. J Athl Train. 2001;36:263-73.

39. Lee JH, Yoo WG, Lee KS. Effects of head-neck rotation and kinesio taping on grip strength. J Phys Ther Sci. 2010;22:285-89.

40. Ahn IK, Kim YL, Bae YH, Lee SM. Immediate effects of kinesiology taping on motor performance after fatigue. Evid Based Complement Alternat Med. 2015;2015:410526.