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ORIGINAL ARTICLE

Effect of Kinesio Tape on Proprioception, Static and Dynamic Balance in Individuals with Chronic Ankle Instability

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ABSTRACT

Background. Chronic ankle instability has a detrimental impact on joint proprioception and muscle strength and negatively influences balance. Kinesio tape is gaining popularity among athletes as a technique to prevent ankle injuries while engaging in sports, although its efficiency in treating those limitations has been questioned. **Objectives.** The study aimed to measure how Kinesio tape influenced static and dynamic balance and ankle proprioception in CAI patients. **Methods.** Twenty-eight men with chronic ankle instability were randomly assigned to one of three taping treatments: Kinesio tape (KT), placebo tape (PT), or no taping (NT). Isokinetic dynamometry was used to test joint position sense (JPS) and threshold for detecting passive motion (TTDPM). The static and dynamic balances were assessed using the Balance Error Scoring System (BESS) and the Star Excursion Balance Test (SEBT). The differences in JPS, TTDPM, and static and dynamic balance test results across the three conditions were investigated using one-way repeated-measures ANOVA. **Results.** In the BESS test, the use of KT resulted in a much lower number of errors than the use of NT. The passive JPS maximum inversion test revealed that KT had better proprioception than PT and NT conditions. There were no significant differences in the other assessed variables across the tape. **Conclusion.** In CAI participants, KT may aid preserve static balance and enhance proprioception.

KEYWORDS: ***Kinesio Tape, Proprioception, Balance, Chronic Ankle Instability.***

INTRODUCTION

Lateral ankle sprains are the most common ankle injury, with inappropriate recovery leading to recurrent injuries. More than a year after an acute ankle sprain, over 30% of those who received the damage still reported pain, re-sprains, and emotional instability, indicating chronic ankle instability (CAI), which causes anatomical anomalies such as joint laxity, arthrokinematics deficiencies, and degenerative alterations (1, 2). Proprioception and balance problems may also develop, indicating a loss of neuromuscular control (3, 4). The CAI rehabilitation programs addressed ankle impairments, particularly proprioception and balance deficits. Nevertheless, they need at least 4-6 weeks of training (5).

The therapeutic tape has also been shown to help avoid repeated injuries when playing sports (5-7). Kinesio tape (KT), a breathable and waterproof elastic therapeutic tape that resembles the epidermis, was commonly used to treat and rehabilitate sports-related injuries (8). KT was

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thought to aid in the recovery of injured muscles by improving joint stability, proprioception, and range of motion, increasing blood flow and lymphatic fluid circulation, reducing discomfort, and improving muscular performance (9). KT has improved postural control in people with recurrent ankle instability by modifying the sensory input (10). Furthermore, KT may help CAI patients enhance joint position perception and postural balance and improve sports performance.

Nonetheless, the proven increase in body balance due to enhanced neural and muscle systems varies across studies (11-14). Despite extensive usage in clinical practice, the efficacy of KT in treatment and rehabilitation has yet to be established. More research was needed to determine the effectiveness of KT in people with CAI. As a result, this study aimed to determine how effective KT was at improving proprioception and static and dynamic balance in people with CAI. It was hypothesized that KT would enhance those variables compared to a placebo or non-tape condition.

MATERIALS AND METHODS

Participants. Based on a one-way within-subjects repeated measures design (3 conditions, alpha = 0.05), the sample size was determined with an 80 percent power to detect an effect size (0.65) in joint position sense after tape (11) (G*Power 3.1, Kiel University, Kiel, Germany). Twenty-eight men with chronic ankle instability, ranging in the average age of 22.5±3.8 years, were invited to participate in this study. The individuals had ankle injuries 8.8±3.1 months before taking part in the trial, and the Identification of Functional Ankle Instability (IdFAI) questionnaire was 18.96±2.63. The CAI participants' selection criteria followed the selection criteria for patients with chronic ankle instability in controlled research in 2014 (15). Participants were required to be suffering from at least one severe ankle sprain, with the first sprain occurring at least 12 months ago and the most recent injury arising at least three months before study enrolment. There was also a history of the previously injured ankle joint "giving way" and recurrent sprain, as well as "feelings of instability with an IdFAI score greater than 11" (16). Exclusion factors include a lack of prior ankle surgery, a history of a fractured ankle or severe leg injury, and balance and muscle strength issues. Before the experiment, each participant had a 2x2 inch piece of KT attached to the medial side of their arm for 24 hours to test for tape allergies, and those who tested positive were excluded. The study received approval from Thammasat University's Ethical Review Board (COA No.322/2560) and was registered with the Thai Clinical Registry (TCTR20181002003).

Interventions. Each participant performed three conditions: a Kinesio tape (KT), a placebo tape (PT), and a non-taped (NT) condition in a randomized crossover sequence with a three-day rest interval between testing sessions. All subjects did not attend any ankle rehabilitation program during the experiment time. The taping procedures were performed by the same certified KT practitioner physiotherapist (CB).

The recommended method for lateral ankle sprains, consisting of three different taping strips, was used to apply Kinesio tape to the ankle (17). The participants were first asked to sit on a bed with their testing ankle extended and a single I-strip (5 cm wide and 35 cm long) attached to the anterior tibialis muscle (TA). The tape was put at the TA origin with a 0% tension, and then the participants were requested to flex their foot with inversion while the tape was attached with a 15% –35% stretch from the origin to the lateral malleus. The participants were then instructed to dorsiflex with eversion while pulling the end of the Kinesio tape over the foot's arch to the insertion with a 0% stretch. The KT was rubbed after application to activate the adhesive. The second I-strip was utilized to activate the peroneal muscles. The participants moved their feet in plantar flexion with an inversion direction after the tape was fixed from the origin of the forces with a 0% stretch. The 15%– 35% stretch tape was applied to the muscle to the medial malleolus. The participants were then requested to dorsiflexion with eversion as the end of the tape was pushed across the arch with a 0% stretch to the insertion. Using a figure-eight approach, the final single strip (5 cm broad and 60 cm long) was employed to increase the anterior talofibular ligament's function. The KT was applied with a 15% to 35% stretch along the anterior talofibular ligament from the inner portion of the foot's arch (or tarsal navicular joint) to the outer ankle. The tape was then stretched 75% to 100% above the ankle and 15% to 25% up the inside side of the ankle. The tape was pulled across the foot with a 15% to 25% stretch and angled down towards the heel over the anterior talofibular ligament (17).

The placebo taping condition used the same type of Kinesio tape to regulate the physical quality of the tape. Nevertheless, the KT application technique was not used in this condition. The Two KT strips (5 cm wide by 30 cm long) were prepared. The first strip was wrapped around the outer and inner ankles and had no stretch, while the second strip had no stretch and was tied to the front and back of the leg, aligning both ankles.

Figure 1. Kinesio Taping

Outcome Measures. The subjects were instructed to perform the Joint Position Sense (JPS), Threshold for Detection of Passive Motion (TTDPM), Balance Error Scoring System (BESS), and Star Excursion Balance Test (SEBT) immediately following the Kinesio or placebo taping, with a 15-minute rest period in between each test. The same assessor conducted all tests (ST).

The JPS approach has been proven to give a reliable measure of proprioception (ICC = 0.94) based on measurements at various angles between a target location and the participant's perception of joint work during active and passive movement (18, 19). The isokinetic dynamometer (Biodex Medical System, Shirley, New York, USA) was used to test two distinct angular ranges of motion (inversion at 15° and inversion at -5°). The JPE was randomly allocated to participants to be tested in passive and active measuring modes. To begin the passive mode, participants were requested to arrange their ankles in a neutral position and wear a blindfold and earplugs to minimize visual and auditory disturbance. The isokinetic dynamometer moved the ankle to the target position while the participants' legs relaxed. The machine recorded the joint part in less than 10 seconds before returning the ankle to its starting position, where the work was sustained for another 5 seconds. The participants were then asked to push a stop button when they felt their ankle was in the same position as in the previous trial. This procedure was repeated three times to calculate the average score for each range of motion. In the active mode, the participants were instructed to move their ankles to the goal position and then press the stop button when they believed they had reached the proper condition.

The TTDPM test was shown to have high validity (ICC = 0.82) earlier (20). Participants were blindfolded and wore earplugs to reduce visual and auditory interference, much like the JPS test. The isokinetic dynamometer was set to passive mode, and the test began at a speed of 5 degrees per second from neutral. The dynamometer was programmed to monitor inversion and eversion in random order. When the participants felt a movement, they were requested to hit the stop button, and the angular distance between the point of action and the angle reached when they pressed the stop button was quantified (19). The identical procedure was carried out three times in each direction, with the average scores being computed.

The BESS test has moderate to good validity (21). The participants were instructed to close their eyes and place their hands on their waists while standing. There were three different standing poses: standing on both legs, heel-to-toe, and one leg. Each position was performed on a firm flat board and a foam board. Each stance was held for 20 seconds, with any participant who could not keep their balance for that long being asked to retake the test right away. If the participants could not keep their hands on their waists, opened their eyes, could not retain the position, stumbled, shifted their hips more than 30 degrees, flexed their toes, elevated their heels, or walked beyond the testing area for more than 5 seconds, they were given a one-point penalty. The BESS score was determined by combining all of the impacts.

The SEBT has been a promising approach for measuring dynamic balance (ICC = 0.88 - 0.96) (22). Participants were instructed to stand on a designated board with their wounded leg on the ground and their hands on their waist. After then, the participants were told to kick their second leg as far as possible in three directions (anterior, posteromedial, and posterolateral) in random order. The participants were given 5 minutes to familiarise themselves with the three kicking styles before attempting three times to complete the distinct directional kicks. The farthest distance in each direction obtained from the three trials was measured in centimeters. Participants were instructed to retake the test if they lost their balance, put their foot on the floor, or raised their hands from their waist (22).

Data Analysis. Shapiro-Wilk tests and visual inspection of the quantile-quantile (QQ) plots confirmed the data's normality. The SEBT and BESS variables were examined using one-way analysis of variance (ANOVA) with post hoc Bonferroni adjustments to discover differences between taping conditions. Because the data were not normally distributed, Friedman tests were used to assess the TTDPM and JPS variables, and Conover's post hoc tests were used to discover differences across conditions. The effect sizes for main effects are measured in partial eta squared (2p), with 0.01, 0.06, and 0.14 considered small, medium, and significant, respectively (23). Kendall's W was published with 0.1, 0.3, and 0.5 representations of the small, medium, and considerable impact sizes for non-normally distributed data (23). All data were expressed as a mean difference with 95% confidence intervals (95 percent CI). JASP Version 0.14 Computer software (JASP Team, 2020) was used for all statistical analyses, with the threshold of significance set at $p < 0.05$.

RESULTS

In the BESS test, there was a significant difference between conditions (F [1.56, 42.01] = 3.87, P = 0.267, 2p = 0.38; Figure 2), with lower error scores after using KT compared to NT (mean difference = -2.25 points, 95 percent CI (-4.36, -0.15), P = 0.032). The mean difference between the KT and PT conditions (-1.75 points, 95 percent CI (-3.8, 0.35), P = 0.134) or the PT and NT conditions (mean difference = -0.51 points, 95 percent CI (-2.6, 1.6), P = 1.00) was not significant.

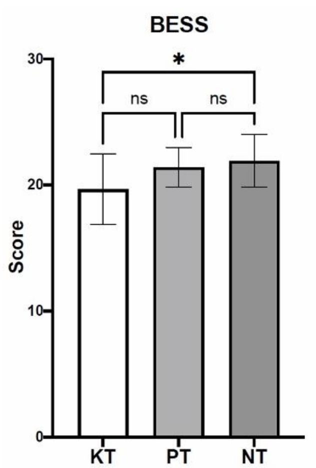

Figure 2. Comparison of the BESS score between the KT, PT, and NT groups. *Significantly different between groups and no significant difference between groups (ns).

In the SEBT, there were no changes between conditions in the anterior-posterior (F [1.38, 37.29] = 2.00, p = 0.161, 2p = 0.07; Figure 3A) or posterior-medial (F [2, 83] = 1.35, p = 0.267, 2p = 0.05; Figure 3B) directions. There was a significant difference between conditions in the posterior-lateral direction (F [2, 54] = 4.51, p = 0.01, 2p = 0.14), with PT achieving a longer distance than NT (mean difference = 0.05 cm, 95 percent CI (0.0, 0.09), p =0.02; Figure 3).

In the TTDPM, no significant variations in inversion (X2 (2) = 2.84, p = 0.242, W = 0.90; Figure 4A) or eversion (X2 (2) = 0.88, p = 0.643, W = 0.84; Figure 4B) locations were found between conditions.

The maximum inversion (X2 (2) = 3.76, p = 0.153, W = 0.29; Figure 5A) and 15° inversion (F [2, 54] = 1.74, p = 0.186, 2p = 0.1; Figure 5B) locations showed no significant between-condition differences in the active JPS test. Similarly, there were no significant changes between conditions at the 15° inversion position in the passive JPS test (2 (2) = 4.10, p = 0.129; W = 0.28; Figure 5C). After maximal inversion, however, there was a significant difference across conditions (2 (2) = 11.37, p = 0.01; W = 0.54; Figure 5D), with stronger proprioception in the KT compared to the PT (p = 0.03) and NT (p = 0.01) conditions, respectively.

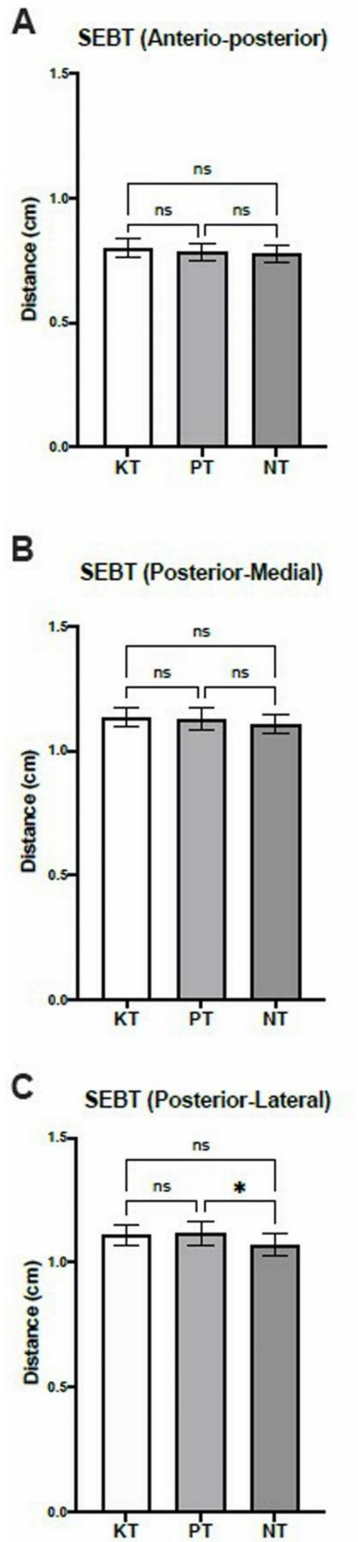

Figure 3. Comparison of the SEBT distance between the KT, PT, and NT groups. A: anterior-posterior direction, **B:** posterior-medial, **C:** posterior-lateral direction). ***Significantly different between groups, **ns:** no significant difference between groups.

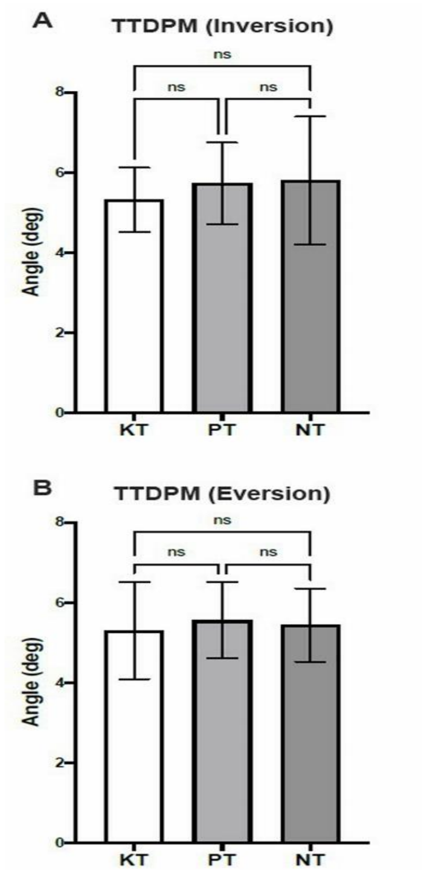

Figure 4. Comparison of the TTDPM angle between the KT, PT, and NT groups. A: Inversion direction, **B:** Eversion direction). *****Significantly different between groups, **ns:** no significant difference between groups.

DISCUSSION

All twenty-eight subjects had chronic ankle instability, with fourteen having it in their left ankle. In contrast, fourteen of them had a similar problem with their right ankle. The significant findings revealed that while applying KT at passive maximum inversion (-5°), there was a more vital awareness of joint position than in the PT and NT circumstances. This finding suggested that KT could improve proprioception by stimulating mechanoreceptors, increasing sensory input, and improving ankle proprioception (17). A previous study found that KT increased proprioception during inversion in individuals with ankle sprains by stimulating the skin (11, 24).

Furthermore, Yu et al. (25) indicated that KT could help CAI participants enhance their ankle inversion proprioceptive ability during landing. In healthy subjects, Athanasiadis and Papadopoulos discovered that KT substantially influenced ankle proprioception, mainly in the sagittal plane motion (26). Conversely, some studies reported no significant difference in proprioception between the KT and non-taped groups, most likely due to the participants being non-CAI subjects (27). Miralles et al. demonstrated that KT had no immediate effect on ankle proprioception in healthy individuals (28). Participants with impaired proprioceptive feeling may be more sensitive to KT treatment, which increases sensory input from mechanoreceptors to the central nervous system (29).

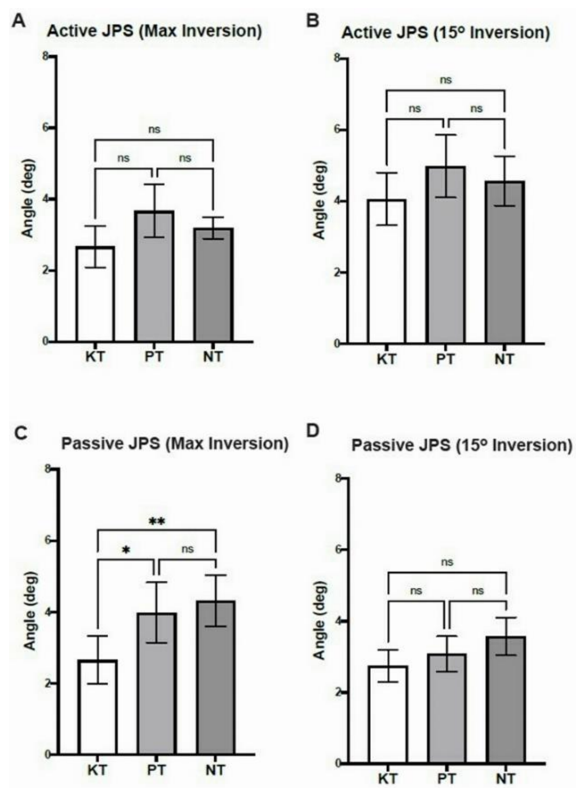

Figure 5. Comparison of the Active and Passive JPS between the KT, PT, and NT groups. A: Active JPS at full inversion, **B:** Active JPS at 15° inversion, **C:** Passive JPS at full inversion, **D:** Passive JPS at 15° inversion). *****Significantly different between groups (*=P <0.05, **=P <0.01), **ns:** no significant difference between groups.

In keeping with earlier findings (30), we discovered that KT did not affect dynamic balance (Figure 3). Furthermore, Ingles et al. in 2019 investigated the effect of KT on dynamic balance in amateur soccer players and discovered that KT application alone does not improve dynamic balance(۳۱) . In contrast, previous research had shown that when KT was administered to subjects with first-degree ankle sprains, a higher SEBT distance (i.e., enhanced emotional balance) might be achieved (32). While the differences in dynamic balance outcomes between our trials were difficult to pinpoint, they might be partly explained by differences in ankle injury severity. Nevertheless, KT significantly improved static balance during the BESS test (Figure 3). Despite the lack of evidence that KT could help restore balance after recurrent ankle sprains, it has been shown to promote proprioception and provide confidence in mobility and stability following this type of injury (33). Thus, practitioners can use KT in conjunction with the recommended technique to immediately improve ankle proprioceptive sensation and static balance in CAI patients. Balance and proprioceptive exercises, on the other hand, have been suggested as useful programs for rehabilitation and prevention in patients with CAI.

All participants in this study were amateur athletes, and the results should be considered when applying to professional athletes due to the difference in physical fitness levels. To identify the impact of Kinesio tape on physical performance, more research needs to be done on other components of physical evaluations, such as power and agility.

CONCLUSION

Kinesio taping improves ankle proprioception and static balance in individuals with chronic ankle instability; as a result, Kinesio tape can be used to treat and rehabilitate people with chronic ankle instability who have lost their ankle proprioception.

APPLICABLE REMARKS

- Kinesio taping may have a beneficial effect on proprioception in an individual with chronic ankle instability.
- However, balance and proprioceptive exercises have been recommended to be an effective program for rehabilitation and prevention in those with chronic ankle instability.

AUTHORS' CONTRIBUTION

Study concept and design: All Authors. *Acquisition of data:* C.B., K.T., N.C., S.T., and R.W. *Analysis and interpretation of data:* C.B., K.T., N.C., S.T., and R.W. *Drafting of the manuscript:* All Authors. *Critical revision of the manuscript for important intellectual content:* C.B., T.K., and T.L. *Statistical analysis:* C.B., T.K., and T.L. *Administrative, technical, and material support:* K.T., N.C., S.T., and R.W. *Study supervision:* C.B.

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