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ACUTE EFFECT OF ANKLE DYNAMIC TAPING AND KINESIO TAPING ON BALANCE AND LOWER EXTREMITY FUNCTIONAL PERFORMANCE IN HEALTHY INDIVIDUALS

SAĞLIKLI BİREYLERDE AYAK BİLEĞİNE UYGULANAN DİNAMİK BANT VE KİNEZYO BANDIN DENGE VE ALT EKSTREMİTE FONKSİYONEL PERFORMANSINA AKUT ETKİSİ

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ABSTRACT

Objective: The ankle-foot complex is integral to maintaining balance as it gathers proprioceptive data. Dynamic taping (DT) and Kinesio taping (KT) are special elastic therapeutic tape applied to the skin. This study aims to investigate the acute effect (2 hours) of DT and KT on dynamic balance and functional performance in healthy individuals.

Method: A total of 15 adults (7 males and 8 females) were included in the study. Participants underwent testing under three conditions (No taping, DT, and KT). Balance was assessed with Y Balance Test, while functional performance was evaluated with Single Hop Test, Triple Hop Test, Cross Over Hop Test, and 6 Meter Timed Hop Test.

Results: There was a significant difference in Y balance posteromedial test between three conditions ($p<0.05$). This difference was between no taping and KT. However, there were no significant differences in Single Hop, Cross Over Hop, 6-Meter Timed Hop, and Triple Hop tests among the three conditions ($p>0.05$).

Conclusion: The results of this study suggest that ankle KT enhances dynamic balance in healthy individuals.

Key Words: Ankle, Balance, Kinesio taping, Dynamic taping

ÖZ

Amaç: Ayak ve ayak bileği kompleksi, proprioseptif bilgileri toplayarak dengenin korunmasında önemli bir rol oynar. Dinamik bantlama (DT) ve Kinesio bantlama (KT), cilde uygulanan özel elastik terapatik bantlardır. Bu çalışmanın amacı sağlıklı bireylerde DT ve KT'nin dinamik denge ve fonksiyonel performans üzerindeki akut etkisini (2 saat) araştırmaktır.

Yöntem: Çalışmaya toplam 15 kişi (7 erkek ve 8 kadın) dahil edildi. Katılımcılar üç koşulda (bantlama yok, DT ve KT) değerlendirildi. Denge Y Denge Testi ile değerlendirilirken, fonksiyonel performans Tek Bacak Sıçrama Testi, Üçlü Sıçrama Testi, Çapraz Sıçrama Testi ve 6 Metre Zamanlı Sıçrama Testi ile değerlendirildi.

Bulgular: Üç koşul arasında Y denge posteromedial testinde anlamlı bir fark vardı ($p<0,05$). Bu fark bantlama yokken ve KT arasındaydı. Bununla birlikte Tek Bacak Sıçrama, Üçlü Sıçrama, Çapraz Sıçrama ve 6 Metre Zamanlı Sıçrama Testlerinde üç koşul arasında anlamlı bir fark yoktu ($p>0,05$).

Sonuç: Bu çalışmanın sonuçları, sağlıklı bireylerde ayak bileğine uygulanan KT'nin dinamik dengeyi arttırdığını öne sürmektedir.

Anahtar Kelimeler: Ayak bileği, Denge, Kinezyo bant, Dinamik bant

INTRODUCTION

Ankle sprains frequently occur during sports and physical activities. According to a systematic review and meta-analysis, the prevalence of ankle sprains is approximately 11.88% [1]. Failure to provide adequate treatment for acute ankle sprains or the lack of therapy can result in nearly 40% of patients experiencing Chronic Ankle Instability (CAI) [2]. CAI is a common type of musculoskeletal injury associated with significant socioeconomic burdens. Factors such as female gender, young age, and specific sports activities are often linked to ankle injuries, increasing the risk of sprains. A considerable portion of ankle sprains require medical intervention and can lead to chronic ankle instability. Treatment and prevention methods include ice, taping, immobilization, and functional therapy. Elastic tapes, commonly used among taping methods, are part of the treatment options [3]. Kinesio tape (KT) has emerged as an alternative to traditional sports tapes, standing out with its elastic structure. This tape can extend to 140% of its initial length and aims to strengthen weakened muscles, increase fluid, and blood circulation, reduce neurological pressure, and alleviate muscle tension [4]. The literature contains significant evidence supporting the beneficial impacts of applying KT on ankle instability. However, uncertainties still exist about its impact on postural sway and balance [5-7]. In a study conducted by Simon et al. (2014), significant changes in proprioception sense were observed immediately after KT application in the experimental group. Nevertheless, there was no notable variance observed in the assessment carried out 72 hours following the application [5]. In a study by Jackson et al. (2016), a significant difference in balance parameters was found in the evaluation conducted 48 hours after KT application. It was noted that improvements in balance continued even after the tape was removed at 72 hours [6]. In a study by de-la-Torre-Domingo et al. (2015), no significant differences in balance measurements were noted between KT application and no taping [7]. As can be seen, there are still uncertainties about the effects of KT application on postural sway and balance.

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In recent years, dynamic taping (DT) has emerged as an innovative form of tape offering unique properties. DT is characterized by its elasticity and rebound capabilities, allowing it to stretch up to 200% and provide four-way flexibility. These features enable the tape to support resistance, deceleration, energy storage, and movement without impeding the range of motion during everyday activities or sports performance. Unlike traditional KT, DT is administered to the muscle while it's in a shortened position, imitating bone attachments and optimizing muscle length. Consequently, the tape absorbs energy during stretching and releases it during muscle contraction, facilitating power production by the muscle [8]. Despite growing interest, there remains limited data on the overall impact of DT, particularly on balance and functional performance, especially when applied to the ankle [9]. With this knowledge gap in mind, this study aims to assess the impacts of ankle DT and KT on balance and lower extremity functional performance among healthy individuals.

METHOD

Study Design and Participants

This randomized cross-over, double-blind study was conducted at the Physiotherapy and Rehabilitation Laboratory of Mugla Sitki Kocman University in March 2024. This study required a minimum of 12 participants after considering a power of 0.95, a level of 0.05 in repeated measures analysis of variance (ANOVA), and an effect size of 1.45 obtained in a preliminary study [9].

Inclusion Criteria: The inclusion criteria for participants were as follows:

- Age between 18 and 25 years.
- Enrolled as a university student actively involved in daily activities (individuals categorized as professional athletes or with a sedentary lifestyle were excluded).
- A score of 28 or higher on the Cumberland Ankle Instability Tool (This tool assesses self-reported ankle instability using 9 questions scored on a 30-point scale. Scores below 27 indicate functional ankle instability) [10].

Exculution Criteria: The exculution criteria for participants were as follows:

- History of ankle sprains, lower extremity fractures, and surgery.
- Presence of neurological or vestibular disorders.
- Allergy to taping.

Procedures

The participants were assessed under three conditions (no taping, taping with KT, and taping with DT) on their dominant ankles at 2-hour intervals, following a randomized order. Randomization was supervised by an assistant who was not involved in the intervention, evaluation or participant recruitment. Concealment of assignments was maintained using sealed opaque envelopes containing details of conditions: no taping, KT, or DT. Physical therapists, who were not part of the allocation or intervention process, evaluated participants in a randomized sequence every 2 hours while remaining blinded to previous records. Before formal testing, participants received instructions for each assessment, and the examiner demonstrated each testing procedure.

Taping applications and participant evaluations were carried out by different researchers and the researcher who made the evaluation was blinded to the taping application. Since the participants wore long socks, the evaluator was blinded to the taping application. The taping application lasted approximately 5 minutes. The assessment was performed 2 hours after the taping application. During these 2 hours, the participant was asked to walk, warm up and get used to the tape. At the end of the evaluation, the tapes were removed.

The KT technique (Kinesio USA, Albuquerque, New Mexico, USA) was utilized for the correction of lateral ankle sprain (Figure 1). Two strips of tape were applied: the first strip was used for functional correction, extending from insertion to origin with 50% tension to assist dorsiflexion and eversion. The second strip, applied at 75-100% tension, aimed to correct the anterior talofibular ligament, which is often damaged in lateral ankle sprains. This tape started under the heel and passed under the malleolus, then continued under the heel again and over the malleolus and the taping was complete. All taping procedures were performed by the same researcher [11].

Figure 1. Kinesio tape application

In the DT method, tailored strips of varying lengths were employed, considering the participants' anthropometric features (Figure 2). Participants began by assuming a starting position of plantar flexion and eversion. The DT strip was then affixed and secured at the head of the first metatarsal joint, extending downward to the top of the calcaneus at the rear. Following this, the DT strip was wrapped around the inner side of the heel and anchored from the lateral aspect of the foot. The anchoring point was positioned at one-third of the medial aspect of the tibia [12].

Figure 2. Dynamic tape application

Outcome Measures

Participant demographics were recorded, and leg dominance was established by instructing participants to kick a soccer ball. Both taping and evaluations were conducted on the dominant leg. Balance assessment was carried out with the Y Balance Test. Functional performance was assessed with the Single Hop Test, Triple Hop Test, Crossover Hop Test, and 6-Meter Timed Hop Test.

The Y Balance Test (YBT): YBT is a straightforward and dependable assessment tool utilized to gauge dynamic balance. Its purpose is to evaluate physical performance, demonstrate functional symmetry, and pinpoint athletes at a heightened risk of lower extremity injuries. During the YBT, participants stand on one foot while extending the other foot as far as possible in the anterior, posterolateral, and posteromedial directions simultaneously. This test assesses strength, stability, and balance across multiple planes. Each participant undergoes the test three times, and the average score is determined by dividing it by leg length and multiplying by 100 [13].

The scores for each reach direction were normalized based on the participant's leg length. Three consecutive trials were performed, and the average of these trials was calculated to ascertain the normalized mean reach distance. The composite score was derived using the following equation:

$$Composite score = \left[\frac{(AT+PM+PL)}{(Leglength \times 3)}\right] \times 100$$

AT: Anterior, PM: Posteromedial, PL: Posterolateral

The Single Hop Test (SHT): SHT is a commonly employed assessment tool among clinicians. Particularly prevalent in the functional return phase of rehabilitation protocols, its aim is to evaluate the functional stability of the knee. Participants are tasked with executing the longest possible jump on one leg along a straight line while maintaining balance and securely landing on the ground. The distance from the starting line to the point of landing completion is measured. Participants initiate the test by standing on the taped leg, aligning their toes at the starting line. They are then directed to leap forward as far as possible and land on the same leg, with the distance from the starting line to the landing point recorded. The test is repeated three times, and the average outcome is documented [14].

The Triple Hop Test (THT): THT requires participants to execute three consecutive jumps on one leg, striving for maximum distance while sustaining balance and securing their landing on the ground. The distance is measured from the starting line to the tip of the landing foot. Participants begin by standing on the taped leg with their toes aligned at the starting line. They are instructed to execute a maximum of three jumps. The researcher then measures the distance from the starting line to the point where the participant completes the third jump. The test is conducted three times, and the average outcome is documented [14].

Crossover Hop Test (CHT): In the CHT participants position themselves on the taped leg, aligning their toes with the starting line. If using their right leg for jumping, they stand on the right side of the 8-meter tape; if employing the left leg, they stand on the left side. Participants are then instructed to execute three maximum jumps in a crossover pattern with the taped leg, ensuring that each jump crosses the tape. The distance is measured from the starting line to the point where the participant completes the third jump, with the measured distance recorded at the point where the participant's heel contacts the ground. The test is performed three times, and the average outcome is documented [14].

6-Meter Timed Hop Test (6MTHT): The purpose of 6MTHT was for participants to execute swift jumps on one leg, covering 6 meters without losing balance and securely landing on the ground. Participants positioned themselves on the taped leg, aligning their toes with the starting line. Upon the researcher's cue of "1, 2, 3, start," the stopwatch began, and participants were instructed to traverse the 6-meter distance as rapidly as possible using the designated leg. The test duration was measured until the participant crossed the finish line. The test was repeated three times, and the average outcome was documented [14].

Ethical Approval

All participants gave informed consent after reading and signing an informed consent form. The study protocol was approved by the Health Sciences Ethics Committee of Mugla Sitki Kocman University (date: 18.03.2024, approval number: 49).

Statistical Analysis

All data were analyzed using the IBM SPSS version 20.0 for Windows (IBM Corp., Armonk, NY, USA). Histograms, probability plots and Shapiro-Wilk test were used to determine whether the variables were normally distributed. Descriptive statistics are presented as median and Interquartile Range (IQR). The Kruskal-Walli's test was used to compare balance and performance tests under the three conditions (no taping, DT and KT). The p value was set at $p<0.05$ for statistical significance.

RESULTS

The study included 15 participants that were 8 men and 7 women (mean±standard deviation of age: 21.47±1.84 years, height: 171.00±7.87 cm, body weight: 67.47±14.50 kg, and body mass index: 23.05±4.55 kg/m^2). Median and IQR scores for balance and functional performance in the three conditions are shown in Table 1.

Table 1. Comparison of the balance and functional performance scores among the three conditions (n=15)

Variables	Median (Interquartile range)			p value
	No taping	Dynamic taping	Kinesio taping	
Y balance anterior	117.0 (37.34)	123.33 (31.16)	123.33 (39.67)	0.901
Y balance posteromedial	111.0 (22.0)	120.83 (21.33)	124.0 (17.0)	**0.035** No taping-KT=0.034
Y balance posterolateral	117.67 (19.17)	129.0 (21.5)	126.50 (14.84)	0.085
Composite Score	126.68 (13.14)	137.16 (18.20)	138.25 (17.30)	0.073
Single Hop	89.75 (33.67)	96.91 (46.50)	91.62 (37.5)	0.904
Cross Over Hop	254.81 (110.67)	292.36 (130.34)	282.85 (123.16)	0.428
6 Meter Timed Hop	2.77 (0.93)	2.54 (0.80)	2.72 (0.75)	0.413
Triple Hop	321.83 (115.33)	346.48 (123.0)	343.27 (166.66)	0.682

KT: Kinesio taping; DT: Dynamic Taping; Kruskal-Walli's test was used for all p-values.

There was a significant difference in Y balance posteromedial test between taping conditions ($p<0.05$). This difference was between no taping and KT (Figure 3). However, there were no significant differences in Single Hop, Cross Over Hop, 6-Meter Timed Hop, and Triple Hop tests among the three conditions ($p>0.05$).

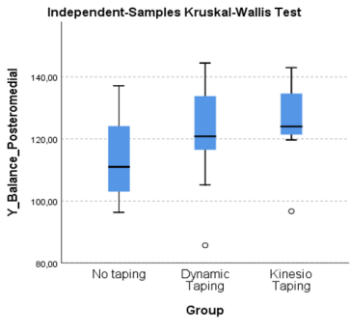

Figure 3. Box plot of Y Balance Posteromedial scores of the participants under the three conditions

DISCUSSION

The aim of this study was to investigate the acute effect of ankle DT and KT on balance and functional performance in healthy individuals. The results indicated that there was no difference in lower extremity functional performance among taping conditions, while there was a notable enhancement in dynamic balance in favoring of KT.

Previous studies have investigated the use of ankle KT and obtained significant evidence [6,15]. Jalaludin et al. (2022) conducted a systematic review that offers proof that KT application confers benefits in enhancing balance for both those with and without ankle instability [15]. Similarly, with this systematic review, the current study showed

that ankle KT enhances dynamic balance in healthy individuals. Additionally, the KT techniques implemented in this study aims to prevent ankle instability. One strip following the anatomy of the foot includes a correction for eversion and dorsiflexion to reduce lateral ankle sprain stress, while the other strip aims to support ankle stabilization. Therefore, this technique may be a prophylactic intervention approach for ankle sprains by improving dynamic balance in healthy individuals.

DT reduces the workload of muscle fibers when applied when muscle short position. The energy held by DT during movement contributes to muscle activation at the end of the movement, thereby enhancing muscle performance. The application techniques of DT differ from KT and are generally applied while the muscle is in a shortened position. There are also material differences between DT and KT. In addition, KT can stretch longitudinally up to 140% of its original length, while DT can stretch in multiple directions (both transversely and longitudinally) exceeding 200% [8]. Therefore, it is thought that the differences in material and application technique between DT and KT lead to different results on dynamic stability.

So far, there are four studies in the literature on DT applied on the foot and ankle [9,12,16,17]. Lim et al. (2021) compared the results of DT and KT applied to the ankle in 15 participants with CAI. Compared to the control group, an increase in reach distances in the AM, M and PM directions was observed with DT, while an increase in the M and PM directions was determined with KT. However, no significant difference was found between DT and KT in balance parameters in their study [9]. The study by Kodesh et al. (2021) compared the results of a total of 36 participants, 18 controls and 18 participants with CAI, after DT application to the gastrocnemius muscle [16]. The dynamic balance of the groups was evaluated 10 minutes and 24 hours after the application. It was found that DT applied to the gastrocnemius muscle improved balance control in both individuals with CAI and the control group. However, a greater increase in balance was observed in those with CAI. Doğan et al. (2021) conducted a study comparing the change in balance after ankle DT, KT and placebo tape in 24 professional football players without injury [17]. The results revealed that DT improved balance better in their study. Lim et al. (2020) showed that DT and KT application on the medial longitudinal arch were not superior to each other in improving dynamic balance in 22 asymptomatic flexible flat-footed individuals [12]. In the present study, although we used the same DT technique as Lim et al. (2021) [9], our balance results differed. However, while DT was applied to individuals with CAI in the Lim et al. study, it was applied to healthy individuals in the current study. We think that the effect of taping on balance may be different in healthy and CAI individuals. The fact that Kodesh et al. (2016) [16] found more improvement in balance with DT in individuals with CAI and Lim et al. (2020) [12] showed no improvement in balance with DT in asymptomatic individuals supports our interpretation.

Rigid taping can also be used on the ankle in addition to DT and KT; however, studies have shown that balance does not improve when using rigid bands [18]. The first effective strategy for maintaining balance is the ankle strategy. The ankle maintains balance with slow and rhythmic oscillations in the anteroposterior and mediolateral directions [19]. Therefore, rigid taping of the ankle may have a negative effect on the balance adjustment strategy. Therefore, it can be said that the rigid and strong material structure of DT provides better stabilization to the ankle than KT, which may have a negative effect on balance.

In the current study, neither DT nor KT showed a significant difference in lower extremity functional performance. Similarly, Doğan et al. (2021) conducted a study that observed no significant difference in functional performance between ankle DT and KT in healthy soccer players [17]. Wang et al. (2018) showed in their systematic review and meta-analysis that KT outperforms other taping techniques in enhancing ankle functional performance [3]. However, this systematic review did not include studies relevant to DT. Therefore, considering the significant differences in materials and application techniques between DT and KT, more research results on this area are needed in the future.

Limitations

There are several limitations to this study. Firstly, it only included a group of healthy individuals. Although the participants were physically active university students, it is unclear how the results would apply to athletes and the injured population. Secondly, future studies should evaluate the long-term effects of these tapes, as this research only examined their immediate effects. Thirdly, there are a variety of taping techniques available and as the effects on the ankle may vary depending on the taping technique used, future studies should compare different taping methods. Finally, more longitudinal studies are needed to assess the practical implications of the results of this study. Such studies could contribute to clinical practice.

CONCLUSION

In this study, the effect of ankle DT and KT on balance and functional performance in healthy individuals was compared and it was found that while there was no difference between the tapes in functional performance, KT improved balance. Therefore, ankle KT before exercise or sport in healthy individuals may improve balance and provide protection from ankle injuries. However, the primary function of DT during movement is a rebound effect that allows for mechanical, deceleration and load absorption. Therefore, DT may show more effective results during more dynamic tasks such as running, jumping or specific exercises. Future studies should take this factor into account in comparisons between the two tapes.

Ethical Approval: *2024/49 Health Sciences Ethics Committee of Muğla Sıtkı Koçman University*

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