ORIGINAL ARTICLE

The effects of ankle kinesiotaping on postural control in healthy taekwondo athletes

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Abstract

Background and Study Aim: Although Kinesiotape is widely used by athletes, information about its effect is unclear. Its effect on postural control might directly affect an athlete's performance. In this study, it is aimed to find out whether ankle Kinesiotaping in taekwondo athletes affects postural control.

Material and Methods: Twenty-four healthy university students – taekwondo athletes (12 females, 12 males) were included in the study voluntarily (Age 21.00 ± 1.53 years; height 173.33 ± 7.29 cm; body weight 63.41 ± 9.41 kg). Kinesiotape was carried out to the dominant ankle of the participants. Kinesiotape was applied supportively to peroneus longus, peroneus brevis, and tibiofibular ligament. All participants were taken to postural control measurements twice with Kinesiotape (KT) and without KT. Postural control was measured using the Biodex Balance System with eyes open (EO) and eyes closed (EC). Overall Stability Index (OSI), anterior-posterior sway (AP) and medio-lateral sway (ML) scores were used in the evaluation of postural control. Wilcoxon test was used to compare balance scores under EO condition, and the t-test was used for dependent groups to compare balance scores under EC condition.

Results: In EO condition, no significant difference was found between OSI, AP, and ML scores of the taekwondo athletes with KT and without KT ($p > 0.05$). In EC condition, no significant difference was found between OSI, AP, and ML scores of male taekwondo athletes with KT and without KT ($p > 0.05$). It was found that Kinesiotape in EC condition decreased OSI and AP sway scores in female taekwondo athletes ($p < 0.05$).

Conclusions: It was determined that ankle Kinesiotaping of taekwondo athletes did not change the postural balance in EO condition. In EC condition it did not change the postural sway of male taekwondo athletes, but it improved the postural control performances of female taekwondo athletes.

Keywords: balance, muscle performance, lower extremity, female, students.

Introduction

Taekwondo, which became a more popular sport after being an Olympic Sport in Sydney 2000 Olympics, is a traditional Korean martial art and martial sport [1, 2]. Taekwondo athletes should have a high level of aerobic capacity, anaerobic power, muscular strength, flexibility, and agility [3]. To achieve the best possible results in competitions, taekwondo athletes must have their own postural features in terms of balance and postural control as well as muscle symmetries [4]. Dynamic kicking techniques in Taekwondo require balance along with motoric features such as strength, speed, endurance, flexibility, and coordination [5]. Taekwondo athletes must provide dynamic stability on the support legs to perform fast and irregular movements with the foot they use while kicking [6]. Patti et al. [7] argue that balance in taekwondo control provides more effective stimulation for sensory-motor regulation compared to tennis. In Taekwondo, the lower extremities are the most affected body part of injuries [5] and 46% of the athletes reported that their lower extremity injuries recurred once more [8]. The most common injury in taekwondo athletes is ankle sprain [8].

When the centre of gravity stays within the limits of stability, two different strategies or combinations of strategies are used to move the centre of gravity while maintaining the previous position of the feet on the support surface [9]. Postural balance strategies consist of hip strategy and ankle strategy [10]. Compared to other sports branches, martial arts athletes use the ankle joints much more often. The success of these athletes in maintaining a balanced position predicts a good control of the lower extremity [11].

Postural control includes various physiological systems, including sensory units, muscle reflexes, and central nervous system [12]. Any disruption between components of this mechanism or interactions between components can disrupt postural balance [13]. Human upright posture is protected by the central nervous system through the integration of complex afferent and efferent control signals based on body orientation and movement information provided by vestibular, visual, and somatosensory systems [14].

Sports involvement requires high levels of control as voluntary movements, and external perturbations constantly threaten body stability in activities performed at high speeds [15]. Balance control, which allows the performance of activities ranging from maintaining static positions to complex dynamic activities, is vital for life

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[16]. Ankle, which is a tactile sense organ that keeps body weight in balance [17], plays an important role in posture and locomotion [18]. Peroneus muscles combined with the tibialis muscles support and stabilized the ankle joint [19]. Studies have shown that the peroneus longus muscle plays an important role in maintaining balance [20]. Ankle and foot injuries are common among athletes and physically active people. The most common residual discomfort, ankle sprain, is characterized by the instability of postural oscillation [21].

It is suggested that Kinesiotaping (KT) is an intervention that can improve postural control [22]. Studies have shown that Kinesiotape improves flexibility and increases postural balance as well as functional performance of individuals [23]. KT method can be used not only to prevent the progression of acute and chronic athletic injuries, but also to prevent the occurrence of musculoskeletal injuries and to improve performance [24]. Kinesiotape is completely different from existing sports medical tapes [25]. In addition to improving athletic performance, KT is a very useful method for preventing and treating a large number of musculoskeletal disorders [24]. It increases awareness in the ankle position by stimulating KT mechanoreceptors applied to the ankle. Also, the KT can increase the sense of joint position in the ankle [26].

KT provides a full range of motion for the muscles and joints applied by lifting the skin with different pulling forces to increase the gap between the skin and muscle [27]. The goal of KT is to change the underlying tissue for a long-term effect [28]. The general principle in KT is an activation of the affected area, removal of pathological changes that occur, and restoration of physiological functions. By applying KT, it may be possible to reduce pressure and stimulate certain receptors and nerve endings in a particular area to increase blood flow of damaged tissues and reduce edema [29, 24, 30].

KT reduces pain [31], increases efficiency in sports, accelerates lymph and venous transformation, and improves muscle performance [32]. It has also been seen that KT provides an increase in the bioelectric activity of the muscle [33]. This mechanism is thought to improve microcirculation between the dermis and epidermis. In addition to improving microcirculation, KT increases the activity of the lymphatic system and endogenous analgesic mechanisms; and by affecting muscle function it supports joint function. Furthermore, KT is reported to improve proprioception with normalization of muscle tone, correction of in appropriate position, stimulating effect on skin receptors [34]. However, in some studies, it was concluded that it did not develop proprioception [35, 36]. It has been suggested that by increasing the sensory input, it reduces delay in postural reflexes and improves dynamic balance by increasing postural stability [32]. Therefore, in this study, it was aimed to find out whether the KT applied to the ankle joint of healthy taekwondo athletes has an effect on postural control.

Material and Methods

Participants

The study included 24 healthy university students – taekwondo athletes (12 females, 12 males) who had not suffered from lower extremity injury in the last six months, and who did not have motor control problems, neurological disorders or vestibular disorders. The average age of the participants is 21.00 ± 1.53 years, their average height is 173.33 ± 7.29 cm and their average body weight is 63.41 ± 9.41 kg. Participants who voluntarily agreed to participate in the research were informed about the research. The participants were asked to sign the voluntary consent form. This research, approved by the Ethics Committee of the [Blinded for review], was conducted in accordance with the Helsinki Declaration.

Test procedure

The participants were randomly taken to postural control measurements in two experimental conditions (with KT / without KT). All subjects participated in balance measurements with and without KT. The participants were randomly divided into two groups with equal numbers of males and females (6 females + 6 males = 12 for a group). To randomize the measurement sequence, a group was first applied with KT and then taken into postural control measurement. In the other group, postural control measurement was taken first and then KT was applied. Approximately 40-45 minutes after the application of KT, the participants were taken to postural control measurements.

Postural control

Biodex Balance System (BBS, Biodex Medical Systems Inc., Shirley, NY) was used to detect postural control (fig. 1).

Figure 1. The measurement of postural balance.

This system is a tool that measures and records the ability of subjects to maintain their postures under

dynamic stress. The BBS, which has a movable platform of 55 cm in diameter with a 360-degree movement width, has difficulty levels that can be adjusted from 12 to 1. The high scores obtained from BBS express impaired balance performance [37, 38, 39]. Postural control measurements of participants were performed under two separate experimental conditions, eyes open (EO) and eyes closed (EC). Before the measurements, participants were allowed to experience sufficiently to get used to the measurement tool. Participants joined in measurements with their sportswear. Participants were asked the question "which foot do you use to hit a ball?" and the answer was accepted as the dominant leg, and postural control measurements were performed on the dominant leg in a single-leg stance. Participants were asked to stand on the moving platform of the BBS and stand with one foot-on the dominant foot-with their feet in the center of the platform and cross their arms with their hands touching their shoulders. The non-dominant leg was positioned not to touch the ground. In this experimental position, participants were asked to maintain a balanced posture on the measuring device, they were allowed to receive feedback from the screen of the measuring device, and the foot coordinates were recorded in the measuring device. These coordinates were accepted as reference points in all postural oscillation measurements.

Participants were taken to postural control measurement first in EO and then in EC condition. During this measurement, the difficulty level of the measuring tool was set to "Level 8" for the EO condition and "Static Level" for the EC condition. During the postural control test, the participants were asked to maintain the test positions first and then look at the screen of the measurement tool to provide a balanced posture. During both the EO and EC conditions, participants were asked to maintain their balanced positions for 20 seconds during the test. During postural control tests, the screen of the BBS was closed under EO condition and the subjects were asked to look at a marked spot for 20 seconds- which was in their eye alignment and on the wall about 1 m away; and in the EC condition, they were asked to close their eyes during the test. At the end of the test period, the test measurement tool was completed automatically and the subjects' 3 sway scores were recorded: Overall Stability Index (OSI, Overall Stability Index), Anterior-Posterior Index (AP), Medio-Lateral Index (ML). Participants who could not maintain their posture during the test were re-measured. A 2-minute rest was given between EO and EC measurements.

Kinesiotaping (KT) application

KT application was applied to the dominant ankle of the participants. KT application was performed by a certified physiotherapist in accordance with the technique. KT was applied supportively to peroneus longus, peroneus brevis, and tibiofibular ligament [40]. A 5 cm wide kinesio tapes (Kinesio® Tex) were used for taping (fig. 2).

Statistical Analysis

The normality distribution of the data was carried out by the Shapiro-Wilk test separately for all subjects, female and male subjects. Wilcoxon test was used to compare balance scores in EO condition that did not meet normal distribution conditions. To compare the balance scores under the normal distribution of EC conditions, a t-test was applied for dependent groups. IBM SPSS Statistics (Version 22 for Windows; IBM, Armonk, NY, USA) was used in the analysis of the data. Data results were evaluated at .05 significance level and 95% confidence interval.

Figure 2. KT application.

Results

Descriptive statistics of 24 taekwondo athletes are given in Table 1. In Table 2, postural sway scores of taekwondo players with KT and without KT are presented.

It was seen that OSI scores in EO condition were not affected by the application of KT and in females ($Z = -0.315$; $p = 0.753$), males ($Z = -1.227$; $p = 0.220$) and all subjects ($Z = -0.635$; $p = 0.525$) no statistically significant difference was detected between measurements. Comparing AP sway scores under EO condition; it was observed that the application of KT for females ($Z = -1.341$; $p = 0.180$), males ($Z = -1.207$; $p = 0.227$) and all subjects ($Z = -0.290$; $p = 0.772$) did not have a significant effect and there was no statistically significant difference between repeated measurements. Similar results were determined in the scores obtained for ML sway under EO condition and it was determined that KT did not cause a statistically significant change in ML scores ($Z = -1.357$; $p = 0.175$ for females, $Z = -0.669$; $p = 0.503$ for males, $Z = -1{,}441$; $p = 0.150$ for all subjects).

The postural sway scores of taekwondo athletes measured with KT and without KT under the EC condition are presented in Table 3. Statistical analysis results indicated that OSI scores of female taekwondo athletes were affected by the KT application under EO condition, and OSI scores were significantly lower in the group without KT ($t = -3.672$; $p = 0.004$). As a result of the comparison of male taekwondo athletes and all taekwondo players, OSI scores were not significantly different between the measurements with and without

Table 1. Subjects' physical characteristics.

Variables	Gender	Mean ± SD
Age (year)	Female	20.58 ± 1.44
	Male	21.42 ± 1.56
	Total	21.00 ± 1.53
Body Weight (kg)	Female	57.72 ± 5.33
	Male	69.12 ± 9.28
	Total	63.42 ± 9.42
Height (cm)	Female	168.92 ± 5.86
	Male	177.75 ± 5.83
	Total	173.33 ± 7.29
Sport Experience (year)	Female	6.71 ± 1.98
	Male	8.25 ± 2.05
	Total	7.53 ± 2.10

Table 2. Postural control scores with KT and without KT in EO condition (Mean ± SD).

Subjects	Groups	OSI	AP	ML
Female	With KT	1.64 ± 0.49	1.08 ± 0.45	1.02 ± 0.38
	Without KT	1.78 ± 0.69	1.38 ± 0.64	0.88 ± 0.41
Male	With KT	1.91 ± 0.36	1.18 ± 0.32	1.25 ± 0.26
	Without KT	1.85 ± 0.86	1.03 ± 0.34	1.28 ± 0.90
Total	With KT	1.78 ± 0.44	1.13 ± 0.39	1.13 ± 0.34
	Without KT	1.81 ± 0.76	1.20 ± 0.53	1.08 ± 0.71

NOTE: OSI - Overall Stability Index; AP - Anterior-Posterior Index; ML - Medio-Lateral Index.

Table 3. Postural control scores with KT and without KT in EC condition (Mean ± SD).

Subjects	Groups	OSI	AP	ML
Female	With KT	2.26 ± 0.55*	1.59 ± 0.57*	1.23 ± 0.34
	Without KT	2.77 ± 0.64	2.23 ± 0.62	1.33 ± 0.42
Male	With KT	2.43 ± 0.56	1.64 ± 0.52	1.40 ± 0.33
	Without KT	2.35 ± 0.57	1.66 ± 0.60	1.33 ± 0.28
Total	With KT	2.34 ± 0.55	1.62 ± 0.53*	1.32 ± 0.34
	Without KT	2.56 ± 0.63	1.95 ± 0.66	1.33 ± 0.35

NOTE: OSI - Overall Stability Index; AP - Anterior-Posterior Index; ML - Medio-Lateral Index; * Significantly lower than without KT.

KT (t = 0.378 and p = .713 for males; t = -1.628 and p = .117 for all subjects). When the sway scores in the AP direction under the EC condition were examined; a statistically significant difference was found between the measurements with and without KT of female taekwondo athletes (t = -4.154; p = 0.02) and all subjects (t = -2.543; p = 0.018). There was no significant difference between AP sway scores of male taekwondo athletes (t = -0.099; p = .923). On the other hand, it was determined that there was no effect of the Kinesiotaping on ML direction sway scores in EC condition in females, males and all taekwondo athletes (t= -0.964; p = .356 for females, t = 0.643; p = .533 for males and t = -0.100; p = .921 for all subjects).

Discussion

In this study, the effect of the ankle KT of taekwondo athletes on postural balance in EO and EC conditions was examined. The effect of KT was determined by comparing the measurements of postural sway while the dominant ankle was in two experimental conditions with KT and without KT.

These results indicated that there was no change in postural control performances of both female and male taekwondo athletes in the EO condition with KT and without KT. In other words, it might be said that the KT does not have an effect on the balance abilities of taekwondo athletes in EO condition.

In EC condition, it was found some changes between balance scores in KT and without KT. It was seen that OSI and AP sway in female athletes were decreased by the application of KT in EC condition. However, no change was observed in male taekwondo athletes.

Many studies have investigated the effect of KT

applied to the ankle on postural control [41-47]. In these studies, it is seen that various taping methods are used and the participants have different features. Also, the timing of measurement after KT application varies. As a result of these variations, it is difficult to agree on the influence of the KT.

Nakajima and Baldridge [42] reported that KT applied to the ankle in healthy males had no effect on dynamic postural balance, whereas in healthy females, a short-term effect was not observed, and yet, postural balance improved 24 hours after the application of KT. Participants did not remove KT for 24 hours. Another study in healthy individuals reported that KT applied to the ankle did not improve proprioception [35]. Fayson et al. [45] also concluded that KT did not affect the stabilization time in healthy females. In elder healthy females, no change in postural balance was observed immediately after and after 48 hours of KT application [43]. Contrary to these results, Semple et al. [48], measured postural stability with and without KT measuring instrument (Biodex Balance System) used in this research and determined that KT reduced the OSI, AP, ML scores of the participants who were semi-professional rugby players, namely, increased their postural stability. There are other studies reporting that the KT develops postural balance in healthy individuals [46, 47, 49]. Vinken et al. [50], who examined the effect of KT in terms of performance of active dancers (2 males, 13 females) in terms of postural control and dance-specific routines, reached the conclusion that although the development of postural control was observed, the performance was limited in the performing of modern and classical dance routines. They emphasized that athletes could use KT for comfort and amenity, but the impact of functional performance still requires scientific evidence.

Although Hettle, Linton, Baker, and Donoghue [51], reported that the ankle KT application did not improve the reach of the Star Excursion Balance Test according to an investigation in athletes with chronic ankle instability, Alghamdi and Shawki [41], announced that it improved balance control in a similar sample. Unlike other studies, Jackson et al. [44], maintained the KT application for 48 hours and examined its effects for up to 72 hours. In the participants with chronic ankle instability, they demonstrated that balance improved 48 hours after the application of KT and this improvement continued 72 hours later.

It was observed that the KT applied to the ankle in female volleyball players did not affect the agility and jump performance, and also did not affect the balance scores using as measured by the Balance Error Scoring System, but this test performed in EC condition reduced the scores obtained on the foam surface, that is, fewer errors were detected on the foam surface [56]. Błaszczyk et al. [53], reported that females need higher muscle activity to maintain their body balance during a stable stance. In this study, as a result of the application of ankle KT, it was determined that there was no change in the postural control performances of male taekwondo athletes in the EC condition, while the postural control in the female taekwondo athletes improved in the EC condition. This result suggests that in conditions where the control of the balance is difficult and especially the visual system is obstructed, the KT applied to the ankle of female athletes might change the postural sway and show better postural performance due to the support it provides to the ankle. However, there is a need for new studies examining the effect of the KT in terms of the gender variable and sensory systems that affect balance control as to why this development does not occur in male athletes. KT application may have an effect that facilitates factors such as intermuscular, intramuscular coordination and even muscle co-contraction as well as sensory inputs [50]. Murray and Husk [27] have suggested that KT may cause an increase in joint position sensation as a result of the stimulation of cutaneous receptors, and reported that this may support healing and improve functional dynamic balance. There are studies reporting that 10 minutes after the application of the KT, it causes changes in blood flow [54] and has an effect on balance performance for up to 72 hours. However, it is controversial when the effects of postural control start or exactly what effect it has.

Conclusions

As a result, it is determined that the KT applied to the ankle of taekwondo athletes does not change the postural balance in EO condition, it does not change postural control in male taekwondo athletes in EC condition, but it improves the postural control performances in female taekwondo athletes. It can be said that the application of KT to the ankle does not limit the postural performance of taekwondo athletes and improves postural control under conditions where there is no visual input.

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Conflict of interest

The authors have no conflicts of interest that are directly relevant to the content of this study.

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