

Original Research

The Immediate Effect of Kinesiotape and Wobble Board Training on Ankle Joint Position Sense in Athletes with Functional Ankle Instability

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ABSTRACT

Ankle sprain is one of the most common injuries during a physical activity, which may lead to instability and affect athletes' performance. The present study aimed to investigate the immediate effects of kinesiotape and wobble balance board trainings on ankle joint position sense of individuals with Functional Ankle Instability (FAI). A total of 48 male athletes with FAI voluntarily participated in this study and were stratified into four groups including kinesiotape, wobble board, combined, and control groups. The pre-test was performed by Position sense at angles of (Plantarflexion 10° and 30°) using a gyroscope. Following the intervention, the post-test was taken from the subjects. Four-way repeated measures Analysis of Variance (ANOVA) followed by the post hoc analysis with Bonferroni's test was conducted to compare the groups. In addition, paired sample t test was used to assess the intragroup variable. The results indicated statistically significant differences in applying immediate kinesiotape, wobble board training, and the combination of the two methods in 10 ° and 30 ° of plantar flexion ($p \leq 0.05$). However, there was no statistically significant difference between the practice groups ($p \geq 0.05$). Based on the findings, one-session exercises by wobble board and kinesiotape, as well as the combination of taping and wobble board could be considered as an effective intervention for preventing and reducing injury separately. However, no significant difference was observed among the three training programs.

Keywords: Ankle instability, kinesiotape, Position sense, Wobble board

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Introduction

Functional Ankle Instability (FAI), characterized by persistent ankle pain, swelling, feelings of ‘giving way’, and self-reported disability, has high prevalence in athletes (1–3), and occurs in 15-60% of cases following the initial sprain (4). In addition to structural ankle ligament damage during a lateral ankle sprain, mechanoreceptors are affected, which may lead to chronic FAI through the loss of joint position sense and other mechanisms (5).

Sensory-motor deficits have been proposed in the development of FAI, including impaired proprioception, postural control, strength, and recalling the neuromuscular system (neuromuscular) of the evertor muscles (6). Proprioception includes the realization of stimulation, processing sensory input, and initiating a response by the musculoskeletal system (7). Senses of position, motion, and force are three subsets of proprioception can help control the balance of movements and joint stability with conscious or unconscious perception, which are essential for daily activities (8,9). Cutaneous, articular, and muscular mechanoreceptors provide in-depth sensory information about the changes in environment. These receptors might be damaged either directly during the onset of ankle sprain or indirectly due to inflammation and swelling (7). It is supposed that the receptor joint damage cause impairment in sending sensory messages of joint, which reduces messages from damaged joint to the routes of the afferent and interferes with the operation of proprioceptive receptors (10). In fact, it can prevent the central nervous system from properly understanding the position of the ankle joint in space (11). The decrease in proprioception and awareness of the sense of position is an important factor in reducing balance and consequent re-injuries (7) According to the principle of priority of prevention over treatment, there are several methods such as the use of braces, bandages, and proprioceptive and neuromuscular exercises to prevent recurrent ankle sprains and increase proprioception and flexion (12).

The use of kinesiotape and balance exercises on the wobble board are considered as two types of these interventions. Many practitioners and trainers recommend designing and executing resistance training programs including free weights and machines for strength training (13). Wobble board-related exercises, as a common method in rehabilitation of FAI, are designed to help retrain the sensory system by improving the function of joint mechanical receptors and restoring the neuromuscular feedback loop (7). Several studies have confirmed the effect of wobble board exercises on improving proprioception in people with FAI (14). However, Holmes et al. maintained that there is little evidence to support a reduction in ankle sprain after using balance exercises and called for further studies before the widespread use of these exercises (15). Kinesiotape, one of the most common therapeutic interventions in sports activities, is widely used for prevention and rehabilitation (16). Several studies have examined the long-term effects of wobble balance board exercises and the use of kinesiotape on the sense of position in individuals with FAI. However, little is known about the immediate effects of wobble board training and kinesiotape on posture in athletes with FAI.

The immediate and short-term effects of wobble board exercises with kinesiotape seem to be as important as their long-term effects for athletes with FAI. Increased sense of posture after short-term wobble board exercises and the use of kinesiotape could be effective in faster and safer return of athletes with FAI to exercise. Therefore, the present study aimed to investigate the immediate effect (one session) of exercises with wobble board, kinesiotape, and the combination of the wobble board and kinesiotape on the proprioception of athletes with FAI.

Material and Methods

Subjects

According to G. power software (G*Power, Franz Faul University of Kiel, Germany, version 3.1.9.2.) with an alpha type I error of 0.05, a beta type II error of 0.1, and effect size of 0.5, 12 subjects were required in this study in each group: 1) wobble board, 2) kinesiotape, 3) combination of wobble board and kinesio taping, and 4) control group. In addition, the subjects with FAI were invited through the board of Allameh Tabataba'i University. The inclusion criteria were a history of at least one ankle inversion injury in the past two years, experience of feeling ankle instability or joint emptiness at least twice in the past two years, and a score of less than or equal to 26 in the FAI assessment questionnaire (17). In addition, the participants were required to be able to bear the full weight during the study, and the range of motion of the ankle joint had to be complete. The exclusion criteria were having history of lower limb injury, acute sprain symptoms in the ankle (e.g., inflammation and tenderness) in the past six weeks, a history of lower limb surgery, balance disorders such as disorders relating to the vestibular system, lower extremity postural abnormalities, a history of participation in a rehabilitation program in the past six months, and having mechanical ankle instability through the positive result of anterior sliding and talar tilt test (4). First, all of the subjects were given an explanation of the study objectives and procedures, and their written informed consent was obtained. Ethical approval was obtained from the ethical committee of the Medical Faculty of the Allameh Tabataba'i University (ethics code number: S/9/18/45368).

Procedures

Each subject was invited to the laboratory and completed a single 60-minute testing session. The eligible subjects willing to participate in the study received a consent form and explanation about the test process. In all three experimental and control groups, the subjects' sense of plantar flexion position was measured at 10 and 30 degrees, respectively, and then the test was carried out again after interventions. Measurements were recorded in degrees by the gyroscope, and the degrees of error were calculated. For each test position, the subjects performed three measurements in a random order, and their mean score was used for further analysis. In addition, the target angles were controlled using a goniometer. It should be noted that the participants were in a sitting position during the tests. Before the exercises, the subjects performed standard warm-ups (slow running and lower limb stretching movements) for five minutes.

Proprioception assessment

The sense of the position of the ankle joint in plantar flexion movement was measured using a gyroscope (made by Nasir Industrial Technologists company). The validity of this device in measuring the range of motion of the joints in comparison to the three-dimensional system of motion analysis was 0.99 (18). During the test, the subjects did not bear the weight while the degrees of error were calculated (Fig. 1). The choice of this position was due to the fact that the most common mechanism of ankle sprain occurs in this position (19), which has the highest range of motion in sports activities (16). The main reason for measuring the sense of joint position in the case of lack of weight-bearing position was that most ankle sprains before bearing the full weight of the limb occur when the foot only touches the ground. The desired angle was considered for the reconstruction of 10 and 30 degrees of plantar reflection according to the previous studies (16).



Figure 1. Plantar flexion measurement by the gyroscope

Kinesiotape

In this method, four tapes are used. The first is attached to modify the function in order to limit the plantar flexion and inversion. The beginning of the tape is from the outside of the tibia and on the head of the fibula, and then when the ankle is taken to the dorsiflexion and eversion. The tape is stretched about 20% along the leg (20). The end of the tapes is then stuck to on the foot and in front of the outer ankle. After that, the foot is taken to the plantar flexion and inversion and the tape is completely attached to the left shin. The other three tapes are attached to correct the mechanics and facilitate a proprioception while the person is sitting on the bed with the knees and ankles in the dorsiflexion. The first tape is rotated around the heel from the outside on the foot in the shape of the number 6 and is placed on the outside and above the outer ankle with 50% tension.

The second tape starts just above the inner ankle and is wrapped around the heel with 50% tension like a stirrup and is attached outside the first tape above the outer ankle (21). The third tape is stuck from the middle of the arch of the foot with 20% tension and comes crosswise from both sides with 50% tension (a figure like number 8) to the top of the ankles and is stuck behind the shin (Fig. 2). It should be noted that in all cases the kinesiotape is stuck to the beginning and end of the tape without stretching because the maximum effect of the tape appears after 20 minutes (22).

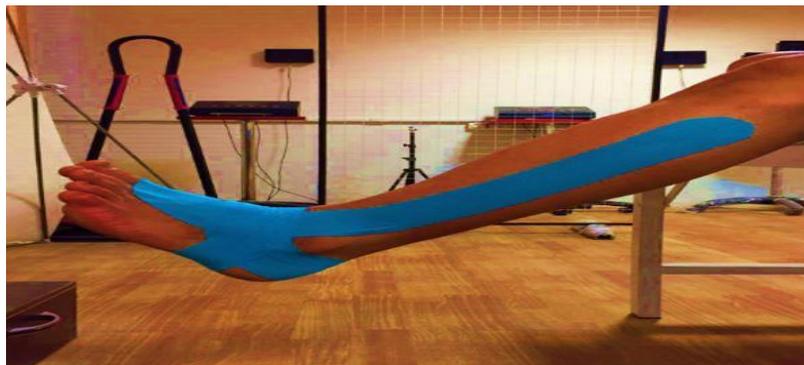


Figure 2. Method of kinesiotape

Wobble board exercise

This exercise was performed in one session. To enhance the generalizability of the results, all four groups were warmed up (including standard warm-up program, generally and specifically) for 15 minutes before the interventions and training (Table 1) (4,7). Five exercises were performed using a wobble board with the dimensions of 40 by 40 cm and a height of 10 cm as follows (Fig. 3).

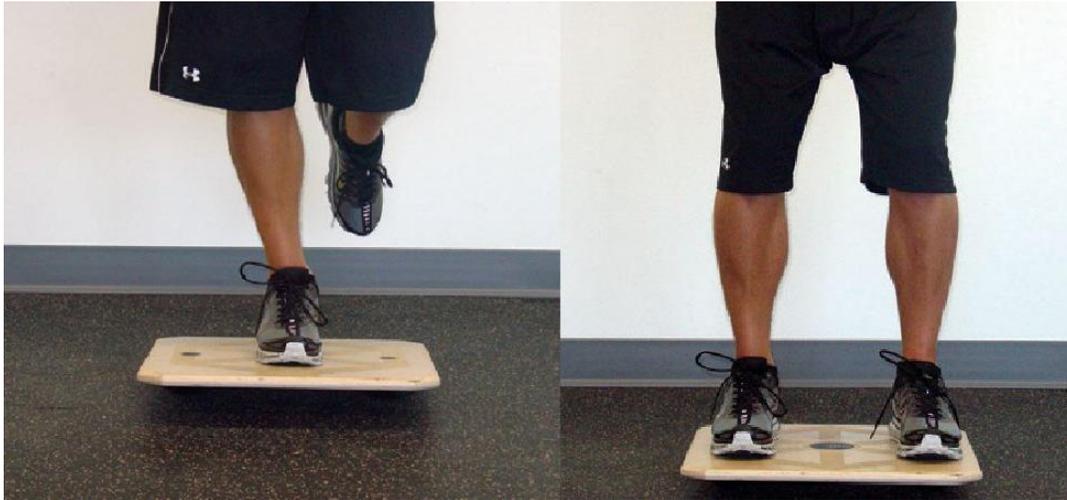


Figure 3. Participants performing the wobble board exercises

Table 1. Wobble board exercise program for one session

Stand with your feet parallel to the board, and then move the board back and forth. The movement lasts 30 seconds, and then rest for 10 seconds.
Stand with your feet parallel to the board and move to the sides. Keep moving for 30 seconds, and then rest for 10 seconds
Stand on the board with your legs slightly apart (about 20 degrees) and move the board from the front to the sides in a circular motion. Keep moving for 30 seconds, and then rest for 10 seconds.
Repeat exercises 1-3 while the knees are slightly bent and the hands are placed on the hips.
Stand with the injured foot on the board and maintain balance for 10 seconds. Repeat the exercise 6 times with standard 10-second breaks between both repetitions.
When the balance in step 5 is maintained without disturbing the stability of the board, the exercise is completed with closed eyes.

Statistical analysis

Descriptive statistics (mean \pm SD) were calculated for evaluating the demographic characteristics including age, height, and weight. The result of Shapiro-Wilk test showed that the data were normally distributed. Four-way repeated measures Analysis of Variance (ANOVA) followed by Bonferroni post-hoc test was applied to compare the groups. In addition, paired sample *t* test was used to assess the intragroup variable. The statistical significance was set at $p < 0.05$. The Statistical Package for the Social Sciences (SPSS, Version 18.0, Microsoft Corp., Redmond, WA) was used for all statistical analyses.

Results

The participants' characteristics are shown in Table 2. There were no significant differences in terms of demographic characteristics between the groups. The results of paired sample *t* test in the control group showed a non-significant difference between the pre-test and post-test values of the studied variables ($p \geq 0.05$) as well as a significant difference between pre-test and post-test values in testing the sense of position in plantar flexion movement of 30 degrees and 10 degrees in all training groups ($p \leq 0.05$) (Table 3). Furthermore, the results of the covariance test and Benferoni post-hoc test (Table 4) indicated a significant difference in the sense of plantar flexion position of 30 and 10 degrees between training groups (kinesiotape, wobble board, and combination of the two methods) compared to the control group ($p \leq 0.05$). Further, no significant difference was observed in terms of effectiveness between the participants receiving the three training methods (kinesiotape, wobble board, and combination of kinesiotape and wobble board) ($p \geq 0.05$).

Table 2. Demographic characteristics of the subjects (Mean \pm SD)

Variable	Control	Wobble board	Kinesiotape	Wobble board and Kinesiotape	p-value
Ager (year)	25.2 \pm 21.01	25.0 \pm 08.81	24.2 \pm 90.26	25.1 \pm 30.63	0.251
Height (cm)	176.1 \pm 20.47	177.1 \pm 20.98	176.1 \pm 70.33	177.1 \pm 5043	0.193
Weight (kg)	72.2 \pm 30.54	76.4 \pm 30.69	75.5 \pm 70.22	74.4 \pm 20.51	0.261

Significant in $p \leq 0.05$ level

Table 3. Mean \pm SD of ankle joint position sense in each group based on the paired t-test (Degrees of error)

Groups	Variable	Pre-test	Post-test	p-value
Control	Ankle plantar flexion 30°	3.20 \pm 0.91	2.70 \pm 1.05	0.450
	Ankle plantar flexion 10°	3.80 \pm 1.22	3.20 \pm 1.05	0.090
Kinesiotape	Ankle plantar flexion 30°	3.40 \pm 0.96	1.30 \pm 0.48	0.001*
	Ankle plantar flexion 10°	2.90 \pm 1.10	0.90 \pm 0.73	0.001*
Wobble board	Ankle plantar flexion 30°	3.80 \pm 0.91	0.90 \pm 0.56	0.002*
	Ankle plantar flexion 10°	2.80 \pm 0.91	0.70 \pm 0.48	0.012*
Wobble board and Kinesiotape	Ankle plantar flexion 30°	4.50 \pm 1.08	1.11 \pm 0.45	0.036*
	Ankle plantar flexion 10°	3.60 \pm 1.26	1.10 \pm 0.56	0.002*

*Significant level $P < 0.05$

Table 4. Comparison of the ankle joint position sense at 10° and 20° of ankle plantar flexion between groups (Degrees of error)

Variable	Repeated measures ANOVA test		Bonferroni post hoc test					
	p-value	Effect size	Wobble board and Kinesiotape			Kinesiotape		Wobble board
			Kinesiotape	Wobble board	Control	Wobble board	Control	Control
Ankle plantar flexion 30°	0.001*	0.55	0.960	0.970	0.001*	0.741	0.001*	0.001*
Ankle plantar flexion 10°	0.001*	0.63	0.872	0.921	0.001*	0.912	0.001*	0.001*

*Significant level P<0.05

Discussion

Based on the results, performing one session of the wobble board, kinesiotape, and their combination could improve the restoration of the sense of position (plantar reflection 10° and 30°) in athletes with FAI. However, there was no statistically significant difference between the groups. In addition, the application of kinesiotape could reduce the error of reconstructing the sense of position.

Proprioception, joint position sense, senses related to the positions of the joints and all extremities after movement help return them to their normal positions (23). The results of the previous studies indicated that Kinesiology taping can improve proprioception (20,24). The results are inconsistent with those of Seo et al. showing a significant difference in the error of position sense reconstruction (dorsiflexion and inversion) before and after taping, and no statistically significant difference in plantar flexion movement before and after taping (19). Zajt-Kwiatkowska et al. (25) reported that kinesiology taping could affect the lower extremity functions of unstable ankles. However, Shields et al. (26) indicated no effect on postural control deficits in the individuals with FAI, which could be explained by the difference in the kinesiotape method. In another study by Simoneau et al., a reduction occurred in the mean error of reconstruction of the plantar flexion joint angle after taping (one tape in front of the Talus, another tape behind the Achilles tendon). In addition, they found that the stimulation of dermal receptors could affect the proprioception, which was independent of the mechanical limitations of the joint (27). Robbins et al. found that taping in healthy individuals could increase the sense of joint position in the weight-bearing state (28). Some other studies indicated some improvements in ankle joint sensation after taping (16,17). Based on the results, after ankle sprain and subsequent ankle instability due to rupture of the external ligaments of the ankle lead to impaired proprioception and defect in the afferent nerves in reporting to the central nervous system, as well as decreased muscle activity in the ankle area, especially the evertor muscles, which causes a lack of posture control (29). The physiological basis of taping techniques is that it can exert effective pressure and tension on the skin mechanoreceptors and ultimately stimulate them, which increases the input of sensory data from the environment to the central nervous system and leads to improved proprioception and muscle function (30). Wobble board exercises in this study reduced the error of regenerating the sense of position. A large body of research indicated that balance exercises are effective methods for retraining proprioception in healthy women (30). and can improve balance time on

one foot and proprioception in the knee and ankle joints (Rajhani Shirazi et al.). Bandages and braces prevent ankle sprain by creating mechanical sensitivity and affecting the proprioception (31). Finally, the results of data analysis demonstrated that wobble board, kinesiotape, and the combination of taping and wobble board could be considered effective interventions to prevent and reduce injury separately. However, no significant difference was observed among the three training programs.

The present study has some limitations. First, the subjects were a few young male athletics, which could affect the generalizability of the results. Second, the time the kinesiotape used can maintain its effect on the position sense was not evaluated in the present study. Third, the effects of the kinesiotape versus a non-elastic tape were not compared. Finally, the effects of kinesiotape on lower-extremity kinetics and kinematic changes were not evaluated.

Conclusion

Based on the results, one-session exercises by wobble board, kinesiotape, and the combination of taping and wobble board can be considered as effective interventions to prevent and reduce injuries separately. However, no significant difference was observed among the three training programs.

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چکیده فارسی

تأثیر فوری کینزیوتیپ و تخته تعادل بر حس پوزیشن مفصل مچ پا در ورزشکاران با بی ثباتی عملکردی مچ

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پیچ خوردگی مچ پا یکی از رایج ترین آسیب‌ها حین فعالیت بدنی است که ممکن است منجر به بی‌ثباتی شود و بر عملکرد ورزشکاران تأثیر بگذارد. بنابراین، هدف از این مطالعه بررسی تأثیر فوری کینزیوتیپ و تخته تعادل بر حس پوزیشن مفصل مچ پا در ورزشکاران با بی‌ثباتی عملکردی مچ پا بود. ۴۸ ورزشکار مرد با بی‌ثباتی عملکردی مچ پا در مطالعه حاضر داوطلب و به چهار گروه تقسیم بندی شدند: کینزیوتیپ، تخته تعادل، ترکیبی و کنترل. پیش آزمون حس وضعیت مفصل مچ پا برای افراد در زاویه‌های ۱۰° و ۳۰° پلانترفلکشن مچ پا با استفاده از ژيروسکوپ انجام شد. همچنین پس از اعمال مداخله، پس آزمون از افراد گرفته شد. تحلیل واریانس اندازه گیری‌های مکرر چهار طرفه و به دنبال آن تجزیه و تحلیل تکمیلی با آزمون بونفرنی برای مقایسه گروه‌ها با هم استفاده شد. همچنین، برای ارزیابی متغیر درون گروهی از تحلیل آزمون t زوجی استفاده شد. نتایج نشان داد که تفاوت معناداری قابل توجهی در استفاده از تمرینات یک جلسه ای تخته تعادل و کینزیوتیپ و ترکیبی در ۱۰° و ۳۰° پلانترفلکشن مچ پا وجود دارد ($p < 0.05$) اما هیچ تفاوت آماری معناداری بین گروه‌های تمرینی در هیچ یک از آزمون‌ها وجود نداشت ($p > 0.05$). نتایج نشان داد که تمرینات یک جلسه‌ای تخته تعادل و کینزیوتیپ و ترکیبی می‌تواند به عنوان یک مداخله موثر در پیشگیری و کاهش آسیب به طور جداگانه در نظر گرفته شود، اما بین این سه برنامه تمرینی تفاوت معنی‌داری وجود نداشت.

واژه‌های کلیدی: بی‌ثباتی مچ پا، کینزیوتیپ، حس وضعیت، تخته تعادل