

The Effects of Kinesio Tape Application on Functional Performance Measurements in Young Female Basketball Players with Chronic Ankle Instability

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Abstract: This study was designed to investigate the effects of kinesio tape (KT) on functional performance of female basketball players with and without chronic ankle instability (CAI). The players with ($n = 15$) and without ankle instability ($n = 16$) were enrolled. KT was applied with tension in the instability group and without tension in the control group. Before KT application, 30 minutes and 48 hours after application; muscle strength and endurance were tested in plantar flexion and dorsiflexion, joint position sense was measured in ankle dorsiflexion and plantar flexion using a dynamometer. Dynamic postural stability was evaluated with a balance system between the levels of 12-4. Vertical jumping heights were measured by jump-meter. The results were statistically assessed by SPSS 19 version. In CAI group, dynamic postural stability showed statistically significant improvement in both legs overall ($P < 0.0001$), antero-posterior ($P < 0.004$) and medio-lateral indexes ($P < 0.009$). CAI group showed significant improvements in one-leg postural stability overall, antero-posterior and medio-lateral indexes after 48 hours ($P < 0.011$, $P < 0.022$, $P < 0.038$, respectively). Joint position sense, vertical jump height and muscle strength and endurance were also compared in both groups, and there was no significant difference between the groups. Postural stability indexes were decreased by supporting function of KT to the ankle. As a result, we can say that KT has a beneficial effect on maintaining posture by correcting standing kinematics in cases with CAI. We may suggest that KT can be utilized in preventing the injuries in CAI.

Key words: Taping, stability, proprioception, balance, recurrent, isokinetic.

1. Introduction

Ankle sprains make up to 10%-28% of all sports injuries. Most commonly ankle sprains occur in the lateral side and recurrent injury rate is 40%-75%, developing the clinical manifestation called chronic ankle instability (CAI) [1-3]. In female basketball players, incidence of lateral ankle sprain is being reported around 48%, which 80% of them get re-injured [1]. In lateral ankle sprains, mechanoreceptor damage and loss of joint position sense are seen as the primary reasons for functional ankle instability.

Ankle taping is a major method in terms of preventing ankle sprains in athletes. Kinesiotape is an alternative taping method to athlete tapes (white tape)

with increasing popularity. The tape is thick as epidermis, colourful and elastic (polymer) in nature with 100% cotton-covered. When applying, the tape is stretched up to 140% of its original length and then attached to the skin. It is believed that this stretching ability provides shear force to the skin therefore increases blood flow and helps elimination of edema [3]. Functions of the tape other than support include: regulating muscle functions, eliminating subdermal bleeding and tissue fluids, decreasing pain and correcting joint positioning. By these, taping is believed to support the healing of the tissues.

Instability and/or laxity of the ankle are the most common indications for taping of the athletes and basketball players. Taping is done extensively in order to support the ankle as well as to prevent the sprains. Kinesiotape is preferred especially by athletes because its extensible, durable against water, it allows sweat to

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evaporate and remains on the skin up to 3-5 days even in training sessions. Because kinesiotaping is easy to perform, provides good support and has beneficial effects on tissue regeneration, healing and rehabilitation applications; the expectations from the method is growing [4-7].

2. Aim

Although the number of research about the effects of kinesiotaping is increasing, the results are controversial. The use of kinesiotape in team sports is becoming more popular; however research brought no sound evidence in prophylactic or therapeutic effects of the tape and this brings the need of new research on this topic. The beneficial effect of kinesiotape was shown to be superior in female athletes to their male counterparts in the literature although the reason could not be explained thoroughly. Additionally, there are not many researches regarding performance enhancing effects of kinesiotape, even though the effects on healing and rehabilitation is present.

Therefore we aimed to investigate whether kinesiotape applied on the ankle has beneficial effects on sportive performance, measured by four different functional performance tests; dynamic postural balance, vertical jump height, ankle muscle strength and joint position sense (proprioception) on professional female basketball players with clinically diagnosed chronic ankle instability.

3. Materials and Methods

The study included 31 female basketball players of the reserve team of a 1st league team, aged between 13-18. The study group ($n = 16$) consisted of players with chronic ankle instability and a control (C) group ($n = 15$) players without CAI. Prior to tests, all athletes filled a Cumberland Ankle Instability Tool (CAIT) questionnaire and those who had a score lower than 24 had an additional clinical examination finalizing the diagnosis of CAI in order to be assigned into study

group. The CAIT has a high inter-rater reliability (ICC: 0.96) [8]. Neuromuscular and cardiovascular physical examinations, as well as functional performance tests are performed in Istanbul University Istanbul Faculty of Medicine, Sports Medicine Department. Ethical Committee of Istanbul Faculty of Medicine approved the study, on meeting at 09/05/2014 with the meeting number 09.

Taping was applied when athletes were sitting and their foot in plantar flexion. Four "I" tapes were used; first one starting from the middle dorsum of the foot and attaching on the tibialis anterior muscle location and ending on tibial tuberosity with 15%-20% tension. The second tape started above the medial malleolus, attached on palmar surface on the mid-foot, going to peroneal side and attaching on the peroneal muscle all the way up to fibular head with the same degree of tension. Third tape was applied anteriorly on the location of distal tibio-fibular ligaments in order to support them, starting at medial malleolus and ending at lateral malleolus with 25% tension, when their ankles were in dorsiflexed position. Fourth and the last tape was applied with 100% tension, starting from plantar surface close to the heel, ended 10-15 cm above the malleoli [7, 9, 10] (Fig. 1).

Control group also received kinesiotaping but with "zero" tension on them. All athletes were tested with functional performance tests, before the kinesiotaping. The performance tests were repeated 30 minutes and 48 hours later. All tapings stayed on the athletes' body for these 48 hours, without interfering their daily life.

The athletes did not participate any strenuous physical activity at last 24 hours before the measurements. At the day of measurements, athletes first warmed up in a stationary bicycle with 50-60 rpm, for 7 minutes followed by light stretchings for 3 minutes. After this first warm up, the athletes were tested for vertical jump height. Athletes then warmed up second time for 7 minutes and followed by light stretchings before the proprioception and isokinetic testings (Fig. 2).

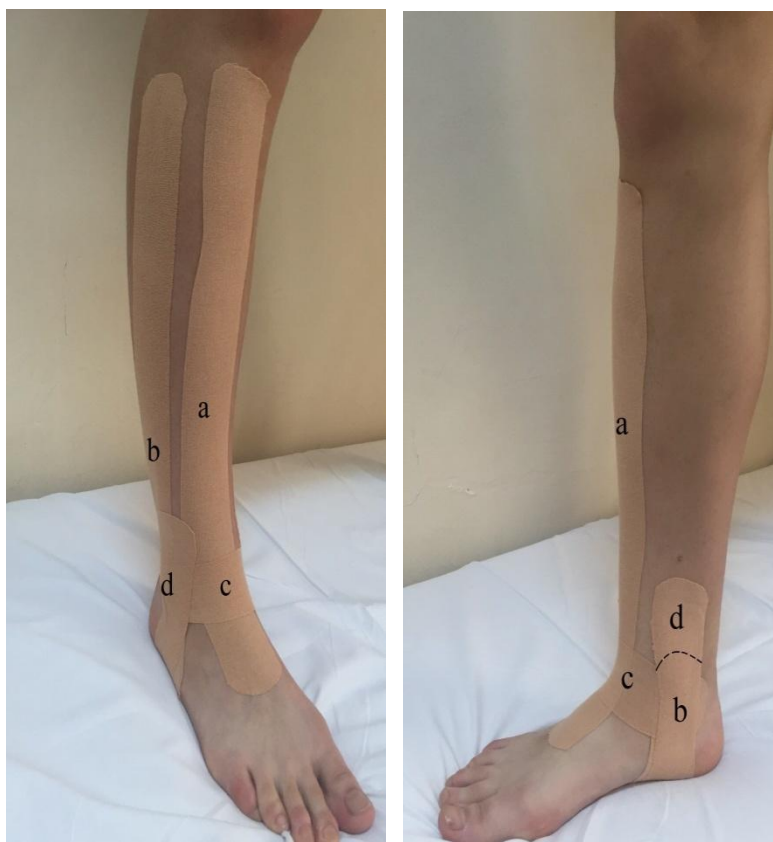


Fig. 1 An example application of kinesiotaping used in our study.

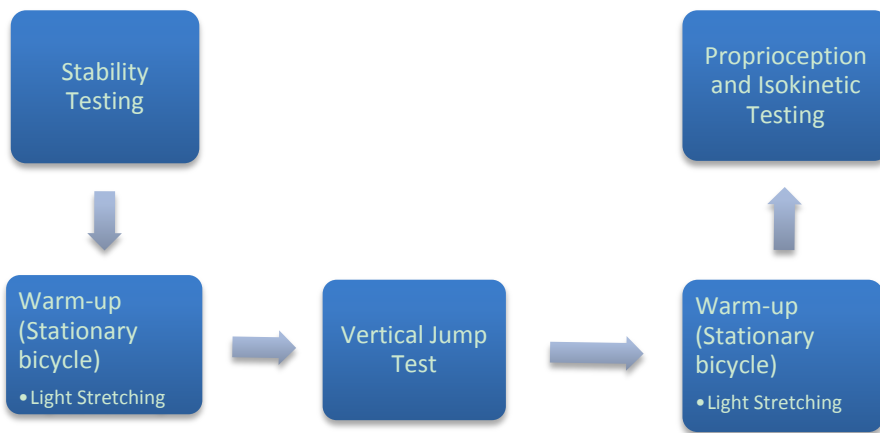


Fig. 2 Diagram shows the order of measurements performed in our study.

3.1 Muscle Strength Measurement

The measurements were performed when the athletes were lying, in prone position, using Cybex Humac Norm (Cybex, Division of Lumex, Inc.,

Ronkonkoma, NY) dynamometer. Knees were in extended position, and upper bodies were fixated on the platform with belts. Isokinetic testing was performed at 30 degrees/second with 3 repetitions for trial and 4 repetitions for maximum contraction.

3.2 Muscle Endurance Testing

Cybex Humac Norm dynamometer was used at 120 degrees/second with 3 repetitions for trial and 15 repetitions for the endurance testing.

3.3 Proprioception Measurement

Joint position sense was evaluated with Cybex Humac Norm dynamometer, athletes in prone position and knees in extension. Athletes were told to put their hands to the handholds at all times and their hips were fixated with a belt. Their ankles were first brought to 20° of dorsiflexion passively and kept still for 10 seconds while they were told to remember this exact position. Then their ankles were brought to neutral passively and they were asked to repeat the movement on their own. The angle reached at final was recorded. The same procedure was repeated for 20° of plantar flexion.

3.4 Vertical Jump Test

Measurement of vertical jump height was measured with an electronic jump-meter. A counter-movement jump was described and then performed initially by the physiotherapist in order to show the correct jump. The jump test was repeated for 3 trials with 3 minutes of rest in between trials. The average score was noted.

3.5 Postural Stability Testing

Postural stability was evaluated with Biodex Balance System device (Biodex, Inc., Shirley, New York) in both leg and one leg on the platform, respectively. Testing was performed when the athletes were barefoot, their eyes open, knees slightly flexed and arms crossed at their chest. The difficulties of the tests were between 12-4 levels for 3 trials. There were 10 seconds of rest between trials. Scorings were obtained for general, antero-posterior and medio-lateral stability. If the athletes lost their balance and needed a touch or their foot lost the initial position, the testing session was cancelled and a new one was performed. The foot with a lower CAIT score was used for one-leg stability testing. If the scores were equal,

preferred leg to jump was chosen for testing. The leg that was not being tested lifted off the platform during the test.

All statistical analysis was performed in IBM SPSS version 19.0. Significance inside the groups was analyzed with Friedmann Test. When the difference reached to a statistical significant level, Post-hoc Dunn test was used in order to find which two situations caused this significance. Mann-Whitney U test was used in order to detect the changes between groups.

4. Results

When CAI and C groups were compared, there was no significant change before and after kinesiotaping in ankle plantar and dorsal flexion muscle strength (30°/second) and muscle endurance (120°/second) for both groups.

In dynamic postural stability index scores, CAI group showed statistically significant improvement in both legs standing position for general index scores ($P < 0.0001$), antero-posterior index scores ($P < 0.004$) and medio-lateral stability scores after 48 hours ($P < 0.009$) (Fig. 3). CAI group showed significant improvements also in one-leg stance position for general, antero-posterior and medio-lateral stability scores (Fig. 4) after 48 hours ($P < 0.011$, $P < 0.022$, $P < 0.038$, respectively) (Table 1).

There were no significant changes in joint position sense values and in vertical jump heights after kinesiotaping in either group.

5. Discussion and Conclusion

We investigated in this study the effects of kinesiotape application to female basketball players with or without chronic ankle instability, on muscle strength and endurance, postural stability, proprioception and vertical jump values by comparing the measurements before and 30 minutes and 48 hours after the application. This study is of importance being solely on professional basketball players. We could not find in the literature a similar study in this regard.

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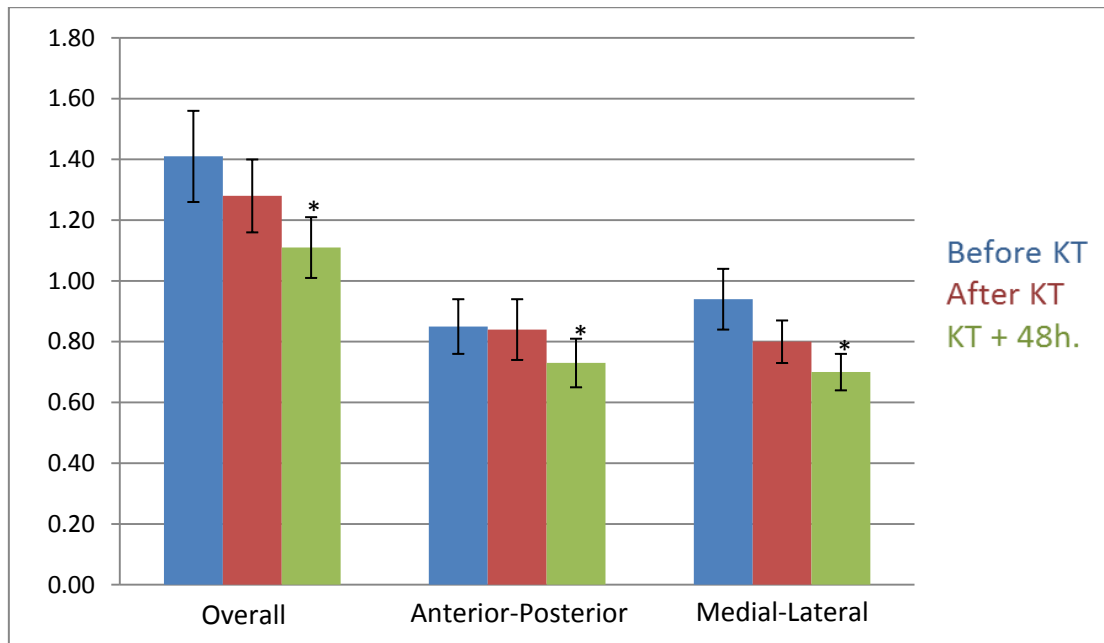


Fig. 3 Both legs postural stability indexes in instability group.

* indicates statistically significant difference.

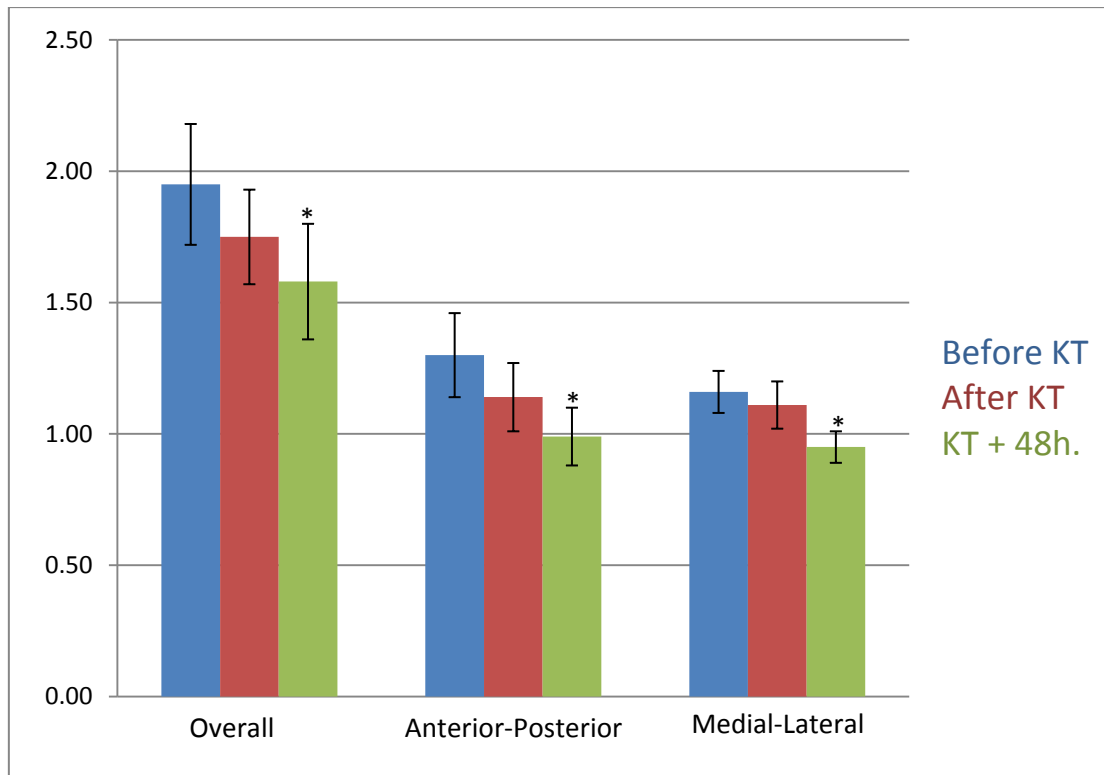


Fig. 4 Single leg postural stability index in instability group.

* indicates statistically significant difference.

Table 1 Standing postural stability scores of the participants before, 30 minutes (After KT) and 48 hours (KT+ 48h) after kinesio tape application.

Postural Stability Index Changes								
Parameters	Both Legs Postural Stability				Single Leg Postural Stability			
	Control group (n = 15)		Instability group (n = 16)		Control group (n = 15)		Instability group (n = 16)	
	Mean ± SD	P	Mean ± SD	P	Mean ± SD	P	Mean ± SD	P
OVERALL								
Before KT	1.47 ± 0.62		1.41 ± 0.60		1.76 ± 0.6		1.95 ± 0.90	
After KT	1.35 ± 0.52	0.404	1.28 ± 0.49	0.0001	1.61 ± 0.42	0.093	1.75 ± 0.72	0.011
KT + 48 h	1.24 ± 0.37		1.11 ± 0.40*		1.51 ± 0.47		1.58 ± 0.88	
Anterior/Posterior Index								
Before KT	0.98 ± 0.44		0.85 ± 0.37		1.21 ± 0.53		1.30 ± 0.65	
After KT	0.87 ± 0.38	0.161	0.84 ± 0.39	0.004	1.09 ± 0.27	0.683	1.14 ± 0.50	0.022
KT + 48 h	0.79 ± 0.28		0.73 ± 0.31*		1.10 ± 0.47		0.99 ± 0.45	
Medial/Lateral Index								
Before KT	0.89 ± 0.40		0.94 ± 0.42		1.21 ± 0.54		1.16 ± 0.33	
After KT	0.86 ± 0.35	0.779	0.80 ± 0.26	0.009	1.05 ± 0.38	0.111	1.11 ± 0.35	0.038
KT + 48 h	0.79 ± 0.24		0.70 ± 0.23*		0.97 ± 0.35		0.95 ± 0.25	

* indicates statistically significant difference.

According to our results, ankle plantar and dorsal flexion peak torque and the body weight percentage of this value (BW%) representing the muscle strength (30°/ second speed) and total work done representing endurance (120°/ second speed) did not statistically differ after kinesiotaping in either group. This result is in accordance with some literature results [11-16], however there are studies that detected significant muscle strength improvements after kinesiotaping [17-19].

Researchers have explained the increase at muscle strength as follows: Taping produces tension on skin which then alters pressure and shearing forces. This altered pressure received by mechanoreceptors of soft tissues in subdermal area and conveyed to central nervous system (CNS) with motor unit firings. This results activation on CNS and with positive feedback mechanism, muscle peak torque and tonus may increase [13, 14, 19]. Another physiologic mechanism that explains the effects include kinesio tape having corrective effect on posture and joint stability, by this support biomechanical modification of joint movements is achieved through proprioception and such sensory inputs may enhance muscle motor functions and results in muscle strength increase [19, 20]. Similarly, we can conclude from our study that

sensory and proprioceptive inputs derived from biomechanical correction did not increase muscle strength.

From our study, we can conclude that the tension of 20% of kinesiotape used to attach on the skin of the ankle did not produce sufficient tension or pressure change enough to stimulate subdermal mechanoreceptors and proprioceptors. It seems that the joint was supported and protected, and the stability of the extremity increased. On the other hand, kinesiotape did not seem to produce significant enough muscle power to modify the biomechanics of the movements. It should be noted that we did not measure muscle strength nor muscle activation after applying the tape exclusively on the ankle muscles.

According to our results, there were improvements in one-leg and both-legs standing index scores of general, antero-posterior and medio-lateral stability before and after taping in control group; however these differences were statistically not significant (Table 1). We may attribute this as a placebo effect because they were clinically healthy basketball players. It is commonly observed that athletes feel more confident and comfortable with kinesiotaping. In the literature, there are conflicting results regarding the effects of kinesiotaping on static and dynamic postural control;

but we found in our study that athletes with ankle instability improve significantly their dynamic postural stability indexes and there are several results similar to ours [5, 17, 21].

Participants in chronic ankle instability group improved their both-legs standing general, antero-posterior and medio-lateral indexes significantly, mainly 48 hours after taping ($P < 0.0001$, $P < 0.004$ and $P < 0.09$, respectively) (Table 1, Fig. 3). Similarly, one-leg standing general, antero-posterior and medio-lateral stability indexes were improved significantly ($P < 0.011$, $P < 0.022$ and $P < 0.038$, respectively) (Table 1, Fig. 4). We think that the postural stability improvement seen in our results may have resulted due to re-gained ankle strategy (maintaining the balance with ankle inversion and eversion movements) with kinesio tape rather than proximal hip strategy (proximal muscle activations responsible for maintaining postural stability). There were no significant differences observed in proprioception values 30 minutes or even 48 hours after taping in either group. Also vertical jump values did not change positively or negatively in either group after taping. Therefore, according to the results of this study, we can conclude that the better control of postural stability effect of kinesiotaping especially in chronic ankle instability group was seen primarily due to mechanical restriction (especially in plantar flexion) rather than improvements in neuromuscular control. Latest research in this topic [2, 22] support the idea that mechanical correction of kinesiotaping may be affecting joint kinematics. These results are in parallel to ours in this regard.

Joint position sense values did not change significantly after kinesiotaping in this study, again in line with a number of previous research [4, 10, 23-25]. It should be also noted that, there was no significant difference between CAI and control groups' baseline scores of joint position sense.

However, there are results that are contrary to ours [26]. Possible explanations for these conflicting results

include methodological differences in evaluating proprioception, various taping and bracing techniques being used in studies and study participants homogeneity, i.e. whether they were healthy or they had neuromuscular disability or not.

We believe that kinesio tape's inability to reduce joint position mis-sense in our study was due to insufficient feedback input derived from skin receptors. On the other hand, participants were trained active individuals with continuous sports participation which includes continuous strength and balance trainings and they did not experience any significant injury that would effect proprioception throughout the study (at least 6 months prior to and during the study), and this may reduced our ability to detect a significant change of joint position sense.

Vertical jump heights did not change at all in basketball players with chronic ankle instability 30 minutes or 48 hours after kinesiotaping. There are conflicting results regarding this parameter in literature [17, 20, 21, 27]. We have found in our study that sensory inputs produced by kinesiotaping were not strong enough to generate muscle force. Therefore we support the idea that vertical jump height did not change because the muscle force did not increase.

In summary, we can conclude that short term ankle kinesiotaping in basketball players with chronic ankle instability was not effective in neuromotor healing and only supports the ankle, therefore has beneficial effect on maintaining posture by correcting standing kinematics. Also we can conclude that this beneficial effect was not reflected to their functional performance. However, to take advantage of its therapeutic effects kinesiotape should still be used in athlete rehabilitation and further research in order to detect performance effects of taping is needed.

In general, female athletes are known having ankle problems more than their male counterparts. There are studies supporting the postural stability difference in both sexes [28, 29] and possible CAI development in female athletes [30]. Even though the stability scores

improved after 48 hours, the performance outcomes of this effect and the preventive perspective of the kinesio tape is still not clear.

Acknowledgements

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