

The Short-Term Effects of Kinesio Tape on Joint Position Sense, Sense of Force and Postural Control in Patients with Functional Ankle Instability

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ABSTRACT

BACKGROUND AND OBJECTIVE: Functional ankle instability is a common musculoskeletal injury. Patients with impaired proprioception and permanent impairment in postural stability. The aim of this study is to investigate the short-term effect of kinesio tape on joint position sense, proprioception and postural control in patients with functional ankle instability.

METHODS: This quasi-experimental study was performed on 20 non-athlete women aged 18 to 45 years with functional ankle instability. The joint position sense test was performed by Motion Analyzer, sense of force was examined by Load Cell, and balance strength test was done by Force Plate before and after kinesio taping. Kinesio tape was used with a tendon correction technique for the anterior tibialis, peroneus and gastrosoleus muscles.

FINDINGS: The absolute error of the joint position sense (0.98 ± 0.79 degrees), the sense of force (5.43 ± 2.89 n) and postural control (5.73 ± 1.37 ms) decreased to ($p < 0.001$, 2.49 ± 1.49 degrees), ($p = 0.004$, 10.18 ± 6.09 n) and ($p = 0.01$, 6.91 ± 1.75 ms), respectively, after using kinesio tape in the affected patients.

CONCLUSION: The results of the study showed that immediately after kinesio taping in patients with functional ankle instability, the absolute error of the joint position sense, the sense of force and postural control decreased and joint proprioception improved.

KEY WORDS: *Kinesio Tape, Instability, Ankle Joint, Proprioception, Sense of Force, Posture.*

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Introduction

Functional ankle instability is a common musculoskeletal injury (1, 2). If not treated, ankle instability leads to chronic pain, muscle weakness, instability, swelling, reduced joint range of motion, repeated sprain, destructive arthritis and loss of job opportunities (3 – 5). The main cause of the functional ankle instability caused by chronic ankle sprain is impaired proprioception (6, 7), which is affected by the sense of motion, the sense of joint position and the sense of force (8, 9). Some studies did not show improvement in the sense of force and postural control immediately after using kinesio tape in people with chronic ankle instability, but recovery was achieved 72 and 24 hours after using kinesio tape (10, 9).

In one study, improved balance was observed immediately after using kinesio tape (11). Previous studies have investigated the effect of kinesio tape on one of dimensions of ankle joint movement and the results were contradictory. The aim of this study was to evaluate the effect of kinesio tape on the joint position sense, sense of force and postural control in patients with functional ankle instability.

Methods

After being approved by the ethics committee of Shahid Beheshti University of Medical Sciences with code of ethics IR.SBMU.REC.1396.37, this quasi-experimental study of pre-post type was conducted among 20 non-athlete women (maximum exercise per week: three 2-hour sessions) aged 18 to 45 years old with the body mass index of 22.94 ± 3.10 kg/m² and functional ankle instability (talotibial joint) using convenience non-random sampling.

Existence of at least two cases of sprain within the 12 months prior to the test, having a score of 90% or less in the Persian questionnaire of foot and ankle ability measure (12), lack of ankle sprain six weeks before the test, no rehabilitation treatment in the last six months, no disturbances of the vestibular system, lack of eye problems that impair balance, and lack of history of head injury three months before the test were necessary. Subjects were excluded from the study if they had surgery, fracture and acute pathological symptoms in the lower extremities, pain and ankle sprain on the day of the test. In cases of bilateral instability, the foot that was more unstable was selected. After explaining the research steps and signing the consent form, subjects entered the study and could be excluded if they did not want to continue their collaboration. First, the joint

position sense, sense of force and postural control were tested, and immediately after using kinesio tape, the subjects participated in the tests. Load cell device (H3-C3-100Kg-3B-D55, ZEMIC, Germany) was used to measure the sense of force (Newton). Subjects sat on the chair and the lower part of the thigh was fixed to the chair; the ankle and subtalar joints were in a neutral position and the knee was at 45 degree flexion. Three maximum plantar flexion contractions were maintained for 5 seconds and one minute rest was between repetitions.

The maximum value was chosen as the maximum voluntary isometric contraction and 30% of it was calculated as the target force. For training, subjects were sitting in the above situation, and first, the target force reproduction was repeated three times with visual feedback. To run the test, subjects created the target force three times without visual feedback and kept it for five seconds; there was one minute rest between repetitions (Fig. 1).



Figure 1. Angle reproduction test

The motion analyzer device (SIMI, China) was used to assess the reproduction of the joint position sense (degree). First, subjects sat on the bed, while knee was in extension and ankle was in neutral condition. The leg was fixed to the bed. Three markers were attached to the fibula (A), the outside of the ankle (B), and the fifth metatarsal (C). The plantar flexion angle was the angle between the marker lines (A) and (B) and the marker lines (B) and (C).

The starting point of the test was zero degree of ankle plantar flexion and a neutral position in the subtalar joint. First, subjects maintained 30 degrees angle of plantar flexion three times for 15 seconds with visual feedback. After one minute rest, they moved their leg to 30 degrees of plantar flexion without visual feedback until reaching the target angle. Then, the average of three repetitions was calculated (Fig. 2).



Figure 2. Force reproduction test

Force plate (Bertec, 6 Wortley Moor Road, Leeds LS124JF, UK) was used to measure the time to reach the balance (milliseconds) and the time to reach maximum vertical force (Newton per milliseconds). Subjects jumped forward with both legs (naked) three times and landed on the device with the affected leg; the maximum value was chosen as the maximum horizontal jump height and 50% of it was calculated.

Then the subject performed 50% of the maximum horizontal jump and kept her balance for 10 seconds. This test was repeated three times with one minute interval (Fig. 3). After the above steps, kinsio tape (BB Kinesiology tape, Korea) was attached to the anterior tibialis, peroneus and gastrosoleus muscles using tendon correction technique:

For anterior tibialis in plantar flexion and eversion, from the middle of the back of the leg to tibial tuberosity (tape I); For peroneus in dorsiflexion and inversion, from the ankle outer surface to the back of the head of the fibula (tape Y), and for gastrosoleus in dorsiflexion, from posterior ankle to knee joint (tape I). The length of the tape with 50% of the maximum tension reached the above sizes. Then, joint position sense, sense of force and postural control tests were performed again. Repeatability of variables was investigated using ICC

coefficient and 95% confidence interval, and variables distribution and comparison of averages were analyzed by Kolmogorov-Smirnov and paired t-test respectively; $P < 0.05$ was considered significant.

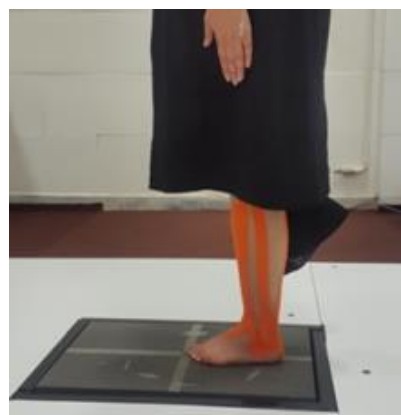


Figure 3. Balance test

Results

The mean age of the subjects was 27.77 ± 8.12 years, mean height was 70.12 ± 27.8 cm, mean weight was 61.20 ± 10.24 kg, and BMI was 22.94 ± 3.10 kg / cm². In patients with functional ankle instability, immediately after using kinsio tape, the absolute error in the sense of joint position ($p < 0.001$), sense of force ($p=0.004$) and postural control ($p = 0.011$) was significantly lower compared to the state before using kinsio tape (Table 1).

Measuring the sense of joint position, sense of force, maximum vertical force and the speed of reaching the maximum vertical force had excellent repeatability (reciprocity coefficient was 0.97, 0.99, 0.93, 0.94, respectively; $p < 0.001$), the time to reach the balance and reach the maximum vertical force had good repeatability (coefficient of repeatability were 0.89, 0.88, respectively; $p < 0.001$).

Table 1. Comparison of mean variables in patients with functional ankle instability before and immediately after using kinsio tape (n=20)

Varibale	Before test Mean±SD	After test Mean±SD	P-value
Joint position sense (degrees)	2.1±49.49	0.0±98.79	*<0.001
Sense of force (Newton)	10.6±18.09	5.2±43.89	* 0.004
Postural control (ms)	6.1±91.75	5.1±73.37	* 0.01
Time to reach maximum vertical force (milliseconds)	0.0±04.02	0.0±04.01	0.26
Speed to reach maximum vertical force (Newtons per milliseconds)	91.65±42.57	96.63±32.85	0.65
Maximum vertical force (Newton)	2.0±48.45	2.0±45.46	0.58

Discussion

In this study, after applying kinsio tape compared to before, individuals with functional ankle instability had less error in angle reproduction, which was similar to the results of study by Seo et al. They found positive effects on the reproduction of the dorsiflexion and inversion movements (13). Spanos et al. showed that Sport kinsio tape without underlayer could improve the reproduction of plantar and dorsiflexion, inversion and eversion in people with ankle sprain (14). The tape may increase the sense of deepness and awareness of the joint by increasing skin stimulation. There was no improvement in the study of Refshauge et al. after using the tape; probably because the type of attachment of sports tapes was meant to limit inversion and eversion in the ankle, while the reproduction test was done for dorsiflexion and plantar flexion (inactive and in the middle range) (8).

The active reproduction of the angle in the lower extremity seems to be more sensitive to joint proprioception disorders. In the study of Kaminski et al. and Halseth et al., no improvement was observed after using the tape. Their study was conducted on healthy people; basically, the healthy ankle joint is not a problem and the effect of the tape on it is not significant (15, 16). Kaminski used sports tapes with underlayer for athletes who were younger than the participants in our study. The underlayer decreases the initial contact between the tape and the skin, and the effect of pulling the tape and the improvement of proprioception disappears. In the present study, kinsio taping was associated with a reduction in force reproduction error. The study of Simon et al. did not show a change in the sense of force in people with functional ankle instability after kinsio taping (9).

Probably the study of younger people of both genders and the examination of the eversion movement with the attachment of the kinsio tape at the anterior surface of the leg might have led to different results. The attachment of kinsio tape in the area that causes skin tightening can increase awareness of joint condition. In

the present study, after the attachment of kinsio tape, the time for reaching balance improved, whereas the speed of reaching the maximum vertical force did not change. De Ridder obtained different results in postural stability assessment. The reason for this can be the use of sports tapes and non-elastic tapes in their study. People with chronic ankle instability use a hip-joint strategy to compensate for the imbalance, which is less effective in controlling the balance (17). In the study of Shield et al., after the attachment of kinsio tape, no effect was found on improving the balance, which was probably due to a longer time (20 seconds) of the balance test. Long test time can cause leg muscle fatigue and reduce the concentration and motivation of individuals for the test (10). In a study to assess postural control, Nakajima et al. used the Star Excursion Balance Test (SEBT) and did not observe any effect on the balance in healthy individuals after using kinsio tape (18).

The cause of obtaining different results may be the fact that their study was conducted among healthy individuals. In addition, the SEBT test is not as sensitive as the force plate to indicate imbalance. In the present study, the balance improved after using kinsio tape. However, there were no changes in other kinetic variables including time and speed of reaching maximum vertical force and the value of maximum vertical force. Possibly the time to reach balance is more sensitive to the use of the kinsio tape. The lack of using the control group was a limitation of our study. The presence of a control group using a tension-free tape can eliminate the likelihood of the effect of the kinsio tape placebo. Immediately after using kinsio tape, the force reproduction error, balance and joint condition improved in people with ankle instability.

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