

The effect of ankle Kinesio taping on range of motion and agility during exercise in university students

Se Young Eom, Won Jun Lee, Jae Il Lee, Eun Hee Lee, Hye Young Lee, Eun Jung Chung

Department of Physical Therapy, Andong Science College, Andong, Republic of Korea

Objective: The purpose of this study was to examine the effects of ankle Kinesio taping on range of motion and agility during exercise in university students.

Design: Cross-sectional study.

Methods: Thirty subjects were randomly allocated to two groups: taping group (n=15) and non-taping group (n=15). All groups underwent the same exercise program including stretching for 30 minutes. The exercise program proceeded in the following order: five minutes of stretching, a 20-minute exercise program, and additional five minutes of stretching. Of the eight exercise methods suggested by Purcell *et al*, seven were chosen (lateral shuffle, forward and backward running, agility ladder, figure-of-8, forward jogging while jumping over cones, wall jumps and zigzags); 90° cuts with lateral shuffle were omitted. The range of motion of ankle dorsiflexion and plantarflexion was measured using the goniometer. Agility was measured using the side hop test.

Results: For ankle range of motion, the taping group showed significant differences in dorsiflexion and plantarflexion on both sides ($p<0.05$). The non-taping group showed significant differences only in left plantarflexion ($p<0.05$). There was a significant difference in dorsiflexion on both sides between the taping group and the non-taping group ($p<0.05$). All groups showed significant differences in agility on the left and right ankle ($p<0.05$). There was a significant difference in left ankles between the taping group and the non-taping group ($p<0.05$).

Conclusions: Kinesio taping increased range of motion and agility during exercise in university students. Additional research on Kinesio taping for improving range of motion and agility is needed.

Key Words: Agility, Kinesio taping, Range of motion

Introduction

Ankle injury is a common disease incurred during exercise with 85% of ankle injuries being sprains, and 1/3 of ankle injured individuals do not fully recover within a year [1]. Orthosis and taping are used as preventive means to protect the ankle joint. These prevent the ankle joint from an excessive range of motion, and enhance proprioception to adjust balance [2].

Taping is generally used to protect and enhance the joint to prevent further musculoskeletal damage during acute injury, reduce edema, limited the motion of weakened muscles

of the injured joint to prevent additional damage from occurring during continuous exercise. In addition, taping enhances strength, the ability to react instantly, endurance to develop exercise performance ability, and parallel forces. Taping is divided into two major methods: elastic taping and non-elastic taping. In particular, elastic taping, the name of which is Kinesio taping, was devised by Gasegenjo.

Elastic kinesio taping is a recently developed bandage technique, attached to the skin. Kinesio tape is thinner and more elastic than conventional tape, producing less mechanical restraint and avoiding the mobility restriction experienced with conventional methods [3]. Yoshida and Kahanov

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Corresponding author: Eun Jung Chung

Department of Physical Therapy, Andong Science College, 189 Seoseon-gil, Seohu-myeon, Andong 760-709, Republic of Korea

Tel: 82-54-851-3752 Fax: 82-54-851-3559 E-mail: eunjung1984@hotmail.co.kr

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[4] reported that Kinesio tape is theorized to have several functions: (1) restore are correct muscle function by supporting weakened muscles, (2) reduce congestion by improving the flow of blood and lymphatic fluid, (3) decrease pain by stimulating the neurological system, and (4) correct misaligned joints by retrieving muscle spasm.

Aguilar-Ferrández *et al.* [3] reported that Kinesio taping compression therapy improved ankle dorsiflexion during walking, gait parameters, peripheral edema, venous pain, and quality of life in postmenopausal women with chronic venous insufficiency. Kang *et al.* [5] reported that walking with talus taping is effective for increasing ankle dorsiflexion passive range of motion in individuals with limited motion. Merino-Marban *et al.* [6] reported that applying Kinesio tape on the calf seems to immediately increase ankle dorsiflexion range of motion, but not after a duathlon competition.

Some theses have investigated the effect of Kinesio taping the ankles of some athletes on posture control skills and ankle dorsiflexion range of motion. Nevertheless, the preceding research is insufficient to determine the effect of taping on the general population, because most participants were either athletes or patients with disease. Therefore, the purpose of this study was to examine the effect of Kinesio tape on general university students, comparing range of motion and agility in a control group. We hypothesized Kinesio taping would result in a significant improvement in range of motion and agility.

Methods

Subjects

Thirty university students (mean age 20.97 years, height 166.96 cm, weight 63.90 kg) participated in this study. Subjects were randomized into two groups, a taping group and a non-taping group. The inclusion criterion were age between 19 and 25 years and healthy, physically active volunteers [7], with no history of osteomyoarticular lesion or pre-

vious fracture or surgery to the foot [8], free of cardiovascular disease or neurological injury at the time of the experiment [9], non-corrected neurological, vestibular, visual and/or hearing impairments, in addition to displaying no allergy to adhesive material [10].

General characteristics of the subjects are shown in Table 1. There were 9 males and 6 females in the taping group and 7 males and 8 females in the non-taping group. The averages for age was 21.33 years in the taping group and 20.60 years in non-taping group. The averages for height were 169.18 cm in Taping group and 164.73 cm in non-taping group and weight were 67.40 kg in the taping group and 59.87 kg in the non-taping group. This study was approved by the Sahmyook University's Institutional Review Board. All subjects signed a written informed consent prior to participation.

Procedures

The exercise program proceeded in the following order: five minutes of stretching, a 20-minutes exercise program, and additional 5 minutes of stretching. Of the eight exercise methods suggested by Purcell *et al.* [11], seven were chosen; 90° cuts with lateral shuffle were omitted. The line length was dependent on the experiment location. The seven exercises were performed at different stations. Six subjects performed one of the seven exercise methods for one minute; after a 30-second break, they changed places and moved between stations, repeating this pattern until all seven exercises had been performed. (1) For the lateral shuffle, participants stood at the line's starting point. Upon starting a stopwatch, participants moved in the direction of an arrow, changed the direction at the turn of the line, moved laterally, and returned to the starting point (Figure 1). (2) For forward and backward running, participants stood the starting point. Upon starting a stopwatch, participants moved forward along the line. Upon reaching the end of the line, they moved backwards, returning to the starting point. (3) For the agility ladder, participants stood at the starting point of the left

Table 1. General characteristics of the subjects

(N=30)

Variable	Taping group (n=15)	Non-taping group (n=15)	t/x ²	p
Sex (male/female)	9/6	7/8	0.536	0.464
Age (y)	21.33 (2.72)	20.60 (1.99)	0.843	0.406
Height (cm)	169.18 (10.98)	164.73 (7.31)	1.305	0.202
Weight (kg)	67.40 (12.66)	59.87 (10.52)	1.772	0.087

Values are presented as n or mean (SD).

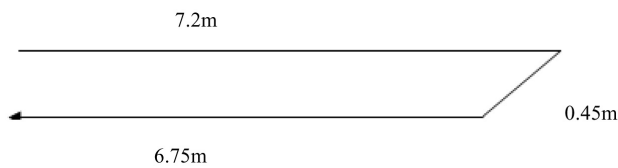


Figure 1. Lateral shuffles road.

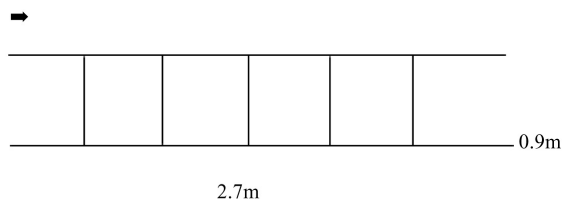


Figure 2. Agility ladder road.

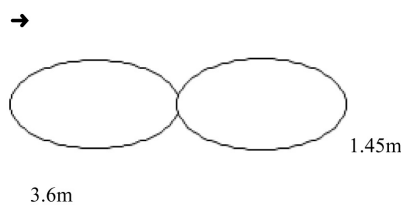


Figure 3. Figure-of-8 road.

arrow. Upon starting a stopwatch, they moved forward along the line, changed direction at the 90° curve, then moved in the opposite direction, changing to the other line (right superior arrow), and sharply turned 90° and walked (Figure 2). (4) In performing the Figure-of-8, participants stood by at the left superior arrow. Upon starting a stopwatch, they moved from the left to the right along the curve, moved to the other ellipse diagonally from the center, moved around along the curve, moved from the right to the left again, and moved to the ellipse on the left after crossing in the center, thus running in the shape of “8” (Figure 3). (5) For forward jogging while jumping over cones, participants were asked to jump over four obstacles placed at 1.35 m intervals along the line. (6) For wall jumps, participants jumped in place in a 4×4 square, jumped over obstacles to move to the right, and jumped in place. (7) For zigzags, participants started moving to the left upon starting a stopwatch, making a 45° right turn. Once the participant moved to the end on the right, they made a 45° right turn (Figure 4).

The Y-type taping method was used. The taping method was attached with elastic tape on the medial heel, along the lateral calf muscle, and the other end was attached on the lateral side superior to the knee. The Y-type tape was also attached on the Achilles tendon along the midline of the calf

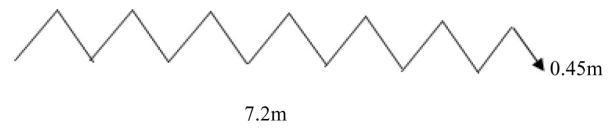


Figure 4. Zigzags road.



Figure 5. Y-taping method.

muscle, and the ends of Y-type tape were attached together (Figure 5).

Outcome measures

In this study, range of motion and agility of the ankle joint was assessed with a goniometer and the side Hop Test of the subjects. A goniometer was used to measure the ankle joint range of motion in the action of dorsiflexion and plantarflexion. To measure dorsiflexion-plantarflexion, an axis was placed on the lateral side of the ankle, the stationary arm was placed parallel to the axis on the ankle, and the moving arm was placed parallel to the lateral surface of the fifth tarsal. Participants' full range of motion was measured.

The side hop test was used to measure agility [12]. Participants moved from the left to the right repeatedly for 10 times along a marked line at intervals of 20 cm. A stopwatch was used to precisely measure the duration time to 1/100 second. In measuring the right leg, participants jumped on a single leg from the vertical line on the left to the vertical line on the right, and jumped again to the vertical line on the left. Participants were told not to step on the line, and the left leg was measured in the same way.

Statistical analysis

SPSS version 12.0 (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses. The dependent variables were the pulmonary function parameters. The general char-

acteristics of the subjects and variables followed a normal distribution. The paired t-test was used to determine whether there were changes in pulmonary function between before and after the training. The independent t-test was used for analysis of changes in dependent variables between groups. Results were considered significant at $p < 0.05$.

Results

Differences in range of motion after the interventions are shown in Table 2. The taping group showed significant differences in dorsiflexion and plantarflexion on both sides ($p < 0.05$). The non-taping group showed significant differences only left in plantarflexion ($p < 0.05$). There was a significant difference in dorsiflexion on both sides between the taping group and the non-taping group ($p < 0.05$).

Differences in agility after the interventions are shown in Table 3. All groups showed significant differences in left and right agility ($p < 0.05$). There was a significant difference in left agility between the taping group and the non-tap-

ing group ($p < 0.05$).

Discussion

Range of motion is defined as the movable range of a joint's potential movement. In other words, it is the angles through which a joint may be moved. Moreover, range of motion is a physical function and is affected by joints and surrounding muscles and ligaments. Range of motion prevents unnecessary energy consumption during movement, enhances accuracy and muscle activity during exercise, and improves coordination. However, injury may occur during exercise when the range of motion is less than optimal [13].

Miller *et al.* [14] reported that applying Kinesio tape on the lumbopelvic region in individuals with unilateral patellofemoral pain syndrome improved reach of the affected limb and double-leg squatting range of motion, thus highlighting the potential for Kinesio taping to improve gluteus medius activation. Wheeler *et al.* [15] reported that applying fibular taping resulted in small changes in ankle dorsiflexion range of motion and posterolateral reach distance, but did not influence ankle dorsiflexion range of motion or balance measures in individuals with chronic ankle instability. Quackenbush *et al.* [16] reported that ankle taping in female athletes involved significant differences in pre- and post-exercise active range of motion for plantarflexor ($p < 0.05$) and dorsiflexor ($p < 0.05$) active range of motion and between no support and taping for plantarflexor range of motion ($p < 0.05$) was found. Kang *et al.* [5] reported that walking

Table 2. Comparison of range of motion with in groups and between groups (N=30)

Variable	Taping group (n=15)	Non-taping group (n=15)
Left dorsiflexion (°)		
Pre	15.13 (2.72)	15.27 (2.79)
Post	18.73 (2.05)	16.00 (2.73)
Change values	3.60 (2.77)*	0.73 (3.06)
t	5.029	0.929
p	<0.001	0.369
Left plantarflexion (°)		
Pre	36.00 (6.87)	37.67 (6.23)
Post	40.67 (4.17)	39.67 (6.40)
Change values	4.67 (5.16)	2.00 (2.54)
t	3.500	3.055
p	0.004	0.009
Right dorsiflexion (°)		
Pre	16.87 (3.07)	16.53 (2.97)
Post	19.67 (2.29)	17.00 (3.16)
Change values	2.80 (3.12)*	0.47 (2.33)
t	3.474	0.777
p	0.004	0.450
Right plantarflexion (°)		
Pre	35.00 (6.27)	38.13 (5.99)
Post	40.33 (5.81)	40.00 (6.27)
Change values	5.33 (7.90)	1.87 (4.07)
t	2.615	1.777
p	0.020	0.097

Values are presented as mean (SD).

* $p < 0.05$ from post-pre between the two groups.

Table 3. Comparison of agility with groups and between groups (N=30)

Variable	Taping group (n=15)	Non-taping group (n=15)
Left agility (sec)		
Pre	18.66 (11.31)	14.20 (4.86)
Post	13.43 (7.24)	11.87 (4.18)
Change values	-5.23 (4.27)*	-2.33 (1.54)
t	4.745	5.858
p	<0.001	<0.001
Right agility (sec)		
Pre	18.00 (10.65)	14.83 (5.10)
Post	12.94 (6.75)	12.03 (3.69)
Change values	-5.06 (4.13)	-2.80 (2.55)
t	4.736	4.245
p	<0.001	0.001

Values are presented as mean (SD).

* $p < 0.05$ from post-pre between the two groups.

with talus taping in individuals with limited ankle dorsiflexion passive range of motion is effective for increasing the ankle dorsiflexion passive range of motion (from 7.33° to 11.44°). In the present study, the taping group showed significant differences in dorsiflexion (from 15.13° to 18.73° on left side and from 16.87° to 19.67° on right side) and plantarflexion (from 36.00° to 40.67° on left side and from 35.00° to 40.33° on right side). The non-taping group showed significant differences only in left dorsiflexion. There was a significant difference in dorsiflexion (right side $p=0.12$ and left side $p=0.28$) between the taping group and non-taping group. This is consistent with prior studies suggesting that, with taping, the ankle range of motion is greater after exercise than before. Because of the loosened taping during exercise, ankle range of motion increases after exercise.

Agility is an ability related to accuracy, quickness, and easiness of a change in direction during exercise of either the partial or the entire body, and it is an ability needed to perform all kinds of sports [17]. Perrin [18] reported that intervals between skin and fascia or muscles may occur after taping. Once blood and tissue fluid are washed away through pumping action and muscle movement, pressure and pain are alleviated due to improved edema and internal hemorrhage, and a lowering of the previously exacerbated tissue pressure.

In the present study, all groups showed significant differences in left and right agility. There was a significant difference in left agility between the taping group and the non-taping group. It is suggested that taping assist and enhances the ability to appropriately coordinate body movements and smooth muscle actions required to perform the agility ladder, figure-of-8, and zigzags as proposed by Purcell *et al.* [11]. Sprigings *et al.* [19] reported that tape attached to the peroneus is thought to lengthen during exercise and provide stability to the ankle joint, thus increasing agility.

There were two limitations to this study. First, due to a small sample size, it is difficult to make any generalizations. Second, this study was a pretest-posttest study, further studies are needed to investigate for the long term intervention effects of Kinesio taping. The findings suggest that Kinesio taping increased range of motion and agility during exercise in university students. We hope that Kinesio taping research for improved range of motion and agility will be conducted continuously.

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