ABSTRACT

Background: Anterior cruciate ligament (ACL) injury has a high incidence in the athlete population. One of the main problems in individuals with an ACL injury is the defect in balance controlling ability. Kinesio taping is widely used as a tool for the treatment of ACL injuries but its efficacy in solving the balance problem of these cases has not been studied yet.

Objectives: Evaluate the effect of knee Kinesio taping on dynamic balance in young athletes with an ACL injury.

Methods: Thirty young athletes with ACL injury (13 to 18 years) were randomly divided into two groups (Kinesio tape and placebo group) using a coin flip. Biodex system has been used for dynamic balance assessment for each participant at 4 different conditions: baseline before taping, immediately after taping, after 24 h taping, and after 3 days taping.

Results: Mixed design ANOVA revealed statistically significant changes in dynamic balance including overall stability index (OSI), anteroposterior stability index (APSI), and mediolateral stability index (MLSI) after Kinesio taping ($P \leq .05$). However, these variables were not statistically different in the placebo group ($P > .05$).

Conclusion: The dynamic balance could be improved after Kinesio taping in young athletes with an ACL injury.

Keywords: Kinesio taping; Dynamic balance; ACL injury.
Kinesio tape (KT) is an elastic therapeutic tape, which is found to be useful in the prevention and rehabilitation of sports injury by decreasing pain and increasing proprioception, muscle activity, and active ROM.

Kinesio tape, developed by Kenzo Kase who is a Japanese chiropractor, is made of flexible adhesive materials and it is different from classical type ones as physical characteristics. Researchers believed that Kinesio tape moves the skin and increases the space between the muscle and the skin, thereby decreases local pressure and improves blood circulation and lymph drainage. As a result, it reduces pain, swelling, and muscle spasm.

A few studies have been investigated the clinical use of Kinesio tape in patients with an ACL injury, most of them applied on a patient with ACL rupture or after ACL reconstruction surgery and these studies showed a positive effect of Kinesio tape on proprioception, balance, gait pattern, and joint function. The high incidence of regeneration of this ligament and the high cost of treatment required the best and most effective rehabilitation protocol to restore mechanical knee stability and enhance optimal knee function. Therefore, our study’s purpose was to evaluate the effect of knee Kinesio taping on dynamic balance in young athletes with an ACL injury.

II. MATERIALS AND METHODS

Study design

A Randomized control trial (repetitive measurements design) was used for determining the immediate and late effects of Kinesio taping on dynamic balance in young athletes with an ACL injury. The study was conducted from October 2019 to January 2020.

Participants

Thirty ACL injured athletes (20 males and 10 females), their age range from 13 to 18 years were recruited from the orthopaedic clinic of Railway hospital. For all participants, ACL injury was confirmed by both clinical examination and magnetic resonance imaging. They were selected according to the following criteria, ACL injury in only one knee joint, ACL injury in the form of partial-thickness tear, and three weeks to six months passed from an ACL injury. They were excluded if had any kind of musculoskeletal damage such as soft tissue damage or fracture in the weight-bearing joints, abnormal lower limbs pain or swelling, vestibular or visual involvement, neurological disorders, heart and respiratory problems, or leg length discrepancy (figure 1).
Figure 1. Flow Diagram for the participants in the study

Instrumentation

1. For balance assessment, Biodex Medical Systems Inc., Shirley, New York, USA (serial n.: 13020193) was used. The device consists of a circular foot platform that permits tilting in all directions, height-adjustable support rails, height adjustable display screen, and a printer. Balance assessment by the Biodex system is a valid and reliable objective measurement.

2. Kinesio tape from a high-quality cotton 95% fabric for comfortable and breathable application with a waterproof surface to keep adhesive even with the shower, it also elastic permits extent to 170 to 190% of its original length and 5 cm width.

Procedures:

The study procedures were conducted at the biomechanics lab, Faculty Physical Therapy, Modern University for Technology and Information, Cairo, Egypt. A baseline balance assessment was done using the Biodex system for all participants. Before starting the test, all its steps were demonstrated for each participant. Subjects were randomly divided into two groups using a coin flip. Group A (placebo group) and Group B (Kinesio tape group). Kinesio tape was applied in the Kinesio tape group while the placebo group received a sham tape application (adhesive tape). The pattern of taping was the same in both groups but there was a loss of tension applied in the placebo group. Each subject in both groups was assessed in four stages: baseline (before tape application), immediately after applying the tap, 24 hours after applying the tap, and finally 3 days after applying the tap.

Dynamic balance test by BIODEX system: Each participant was instructed to stand with bare feet at the Biodex platform then entering the personal data of the participant including name, age, and height then select the postural stability test and adjust the level of stability at the sixth level for 10 seconds (test period). By the beginning of the test, the participant stands only on the injured limb with arms held at the sides and closing his eye, trying to maintain his position without falling. Measuring data included the overall stability index (OSI), anteroposterior stability index (APSI), and mediolateral stability index (MLSI). A test trial was done before start data recording for each participant to be familiar with test procedures then three trials were obtained for each measurement and the mean was obtained by the Biodex system. Measurements were repeated for the four conditions (baseline, immediately after applying the tape, 24 hours after applying the tap, finally 3 days after applying the tap).
before tape application, immediately, after 24 hours, and after 3 days of tape application) for both groups. The report was gained and printed for each trial including OSI, APSI, and MLSI.

The taping procedure started by cleaning the application area with alcohol and placing the knee joint in slight plantar flexion. I-form strip was used in this study. In that way, the middle of the strip was placed just distal to the tibia tuberosity without any tensile. Then the knee was put in a 30° flexion. A tibia bone was pushed back and both sides of the I strip were stretched of the tibia tuberosity to the one-third of the lower thigh to put the anterior-medial and anterior–lateral in direction of the inner and outer ligamentous. The strip on both sides with 60% of the maximum possible extent was stretched and placed on the end side of the skin without tension16.

Statistical analysis

Data analysis was performed using the SPSS 25 for Windows statistical software. The normality of data distribution was tested through the Shapiro-Wilk test and it was normally distributed. Descriptive data for participants, characteristics, and dependent variables were calculated as mean and SD. Then, One-way repeated-measures analysis of variance (ANOVA) was used to compare between baseline balance and post-test immediately, post 24 h and post 3 days in both groups after tape application. An independent t-test was used to compare the Kinesio tape and placebo groups. The level of significance was set at < 0.5.

III. RESULTS

Thirty volunteers of both genders participated in the study. Each participant was controlled to himself, their characteristics were expressed by descriptive statistics in form of the mean (SD) (Table 1).

Table 1. General demographic of subjects participated in the study

<table>
<thead>
<tr>
<th>Variable</th>
<th>Volunteers X ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs.)</td>
<td>14.9 ± 1.71</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>53.7 ± 6.13</td>
</tr>
<tr>
<td>Height (m)</td>
<td>157.9 ± 4.28</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>21.48 ± 1.346</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>15 (50%)</td>
</tr>
<tr>
<td>Females</td>
<td>15 (50%)</td>
</tr>
</tbody>
</table>

Mean ± SD of Physical characteristics of volunteers

Regarding OSI, the ANOVA test for the Kinesio taping group showed that there was a significant difference between overall stability indices of baseline, immediately after Kinesio tape, after 24h, and finally after 3 days ($P = .033$). While the placebo group ANOVA test showed a non-significant difference between overall stability indices of baseline, immediately after taping, after 24 h, and finally after 3 days ($P = .66$) (Table 2).

Regarding APSI, the ANOVA test for the Kinesio taping group showed that there was a significant difference between APSI of baseline, immediately after Kinesio tape, after 24h, and finally after 3 days ($P = .024$). While the placebo group ANOVA test showed a non-significant difference between APSI of baseline, immediately after taping, after 24 h, and finally after 3 days ($P = .196$) (Table 2).

Regarding MLSI, the ANOVA test for the Kinesio taping group showed that there was a significant difference between the MLSI of baseline, immediately after Kinesio tape, after 24h, and finally after 3 days ($P = .018$). While the placebo group ANOVA test showed a non-significant difference between the MLSI of baseline, immediately after taping, after 24 h, and finally after 3 days ($P = .989$) (Table 2).

Table 2: ANOVA test for both groups

<table>
<thead>
<tr>
<th>OSI Mean ± S.D</th>
<th>APSI Mean ± S.D</th>
<th>MLSI Mean ± S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinesio tap</td>
<td>Placebo</td>
<td>Kinesio tap</td>
</tr>
</tbody>
</table>
An independent t-test was used to show the difference between the post-test in the stability indices between Kinesio taping and the placebo group.

For OSI, the independent t-test showed that there was a significant difference between the immediate post-test for Kinesio taping and the placebo group (t-test = -2.778 and P = 0.01) and there was a significant difference between 24 h post-test for Kinesio taping and the placebo group (t-test = -3.616 and P = 0.017). Also, there was a significant difference between 3 days’ post-test for Kinesio taping and placebo group (t-test = -2.317 and P = 0.024) (Table 3).

For APSI, the independent t-test showed that there was a significant difference between the immediate post-test for Kinesio taping and the placebo group (t-test = -2.575 and P = 0.01) and there was a significant difference between 24 h post-test for Kinesio taping and the placebo group (t-test = -1.776 and P = 0.048). Also, there was a significant difference between 3 days’ post-test for Kinesio taping and the placebo group (t-test = -1.393 and P = 0.003) (Table 3).

For MLSI, the independent t-test showed that there was a significant difference between the immediate post-test for Kinesio taping and the placebo group (t-test = -2.989 and P = 0.029) and there was a significant difference between 24 h post-test for Kinesio taping and placebo group (t-test = -2.917 and P = 0.036). Also, there was a significant difference between 3 days’ post-test for Kinesio taping and the placebo group (t-test = -2.214 and P = 0.035) (Table 3).

Table 3: Independent t-test between kinesio taping and placebo group.

<table>
<thead>
<tr>
<th>Stability Index</th>
<th>Immediate (Post-test) Mean ± S.D</th>
<th>24 h (Post-test) Mean ± S.D</th>
<th>3 days (Post-test) Mean ± S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall stability index (OSI)</td>
<td>kinesio taping group</td>
<td>6.587 ± 1.58</td>
<td>5.127 ± 1.67</td>
</tr>
<tr>
<td></td>
<td>Placebo group</td>
<td>9.11 ± 1.45</td>
<td>8.45 ± 2.21</td>
</tr>
<tr>
<td></td>
<td>Independent t-value</td>
<td>-2.778</td>
<td>-1.616</td>
</tr>
<tr>
<td></td>
<td>P value</td>
<td>0.01*</td>
<td>0.017*</td>
</tr>
<tr>
<td>Anteroposterior stability index</td>
<td>kinesio taping group</td>
<td>4.55 ± 2.09</td>
<td>3.35 ± 1.635</td>
</tr>
<tr>
<td>(APSI)</td>
<td>Placebo group</td>
<td>6.56 ± 2.13</td>
<td>4.95 ± 2.17</td>
</tr>
<tr>
<td></td>
<td>Independent t-value</td>
<td>-2.575</td>
<td>-1.776</td>
</tr>
<tr>
<td></td>
<td>P value</td>
<td>0.01*</td>
<td>0.048*</td>
</tr>
<tr>
<td>Mediolateral stability index</td>
<td>kinesio taping group</td>
<td>3.95 ± 1.65</td>
<td>2.87 ± 1.54</td>
</tr>
<tr>
<td>(MLSI)</td>
<td>Placebo group</td>
<td>6.11 ± 2.78</td>
<td>5.01 ± 2.85</td>
</tr>
<tr>
<td></td>
<td>Independent t-value</td>
<td>-2.989</td>
<td>-2.917</td>
</tr>
<tr>
<td></td>
<td>P value</td>
<td>0.029*</td>
<td>0.036*</td>
</tr>
</tbody>
</table>

* = significant, S.D = Standard deviation
IV. DISCUSSION

The findings of the present study showed that dynamic balance improved immediately, after 24h and after 3 days of Kinesio taping application with more improvement occur after 3 days in Kinesio taping group as there was a statistically significant decrease in (OSI, APSI, and MLSI) as $P \leq .05$ and there was no statistically significant decrease in (OSI, APSI, and MLSI) as $P > .05$ in the placebo group.

These findings are agreeing with Liu et al. $^{21}$ who reported that the use of Kinesio tape can improve balance in a patient with anterior cruciate ligament rupture and also agree with the study done by Hosp et al. $^{22}$ who reported that the use of Kinesio tape in healthy, older adults cause improvement in dynamic balance, postural stability, and knee proprioception. Also, Ebrahimiet al. $^{23}$ showed that the patellar taping reduced pain and increased dynamic balance in female athletes.

On the other hand, the study findings were contradicting with the study of Sawkinset al. $^{24}$ who reported no significant difference regarding the performance of the three conditions including real tape, placebo tape, and control for the hopping test or the modified star excursion balance test. Besides, a study was done by Nunes et al. $^{25}$ reported that the Kinesio tape had no statistically significant effect on the balance of healthy athletes in comparison with the placebo group using non-stretching tape.

The positive effect of using Kinesio tape is proposed to be due to exciting the tactile stimulus on cutaneous mechanoreceptors, which enhances proprioception, joint position sense, and perception, and due to that Kinesio tape may send continuous mechanical/elastic stimuli to skin receptors. $^{26}$ The support and stimuli provided through the Kinesio tape applied to the joints and muscles may increase the activation of big motor units by increasing the muscular strength. $^{11}$

Study Limitations

The athletes participating in the study had activity in different sports fields. Therefore, it causes a lack of homogeneity of the subjects. Also, a limited sample size to only thirty participants may affect the generalization.

V. CONCLUSION

Kinesio tape has become very popular among physiotherapists and athletes to prevent and treat certain injuries. In the present study, we state that the Kinesio tap has positive effects on all aspects of balance. So the use of Kinesio tape in young athletes with ACL injuries is recommended to increase postural stability and balance.

Source of funding

The study didn’t receive any financial support.

Conflict of interest

The authors declare that no conflict of interest.

Ethical approval

The study has been approved by the Research Ethical Committee, Faculty of Physical Therapy, Cairo University, Egypt with the number P.T.REC/012/002331. Parents of each participant signed two copies of written consent that giving an agreement for participation in the study procedures and publication of results.

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REFERENCES


