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Original Article

The acute effect of kinesio taping on hamstring extensibility in university students

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Abstract
Objectives: The aim and rationale of our study was to determine the acute effect of kinesio taping on the extensibility of the hamstring muscle among university students.
Design: An intra-subject experimental design was used to evaluate the possible acute effects of KT using the X-shaped taping technique in order to affect hamstring muscle extensibility.
Method: Forty-three healthy university students (age 21.98 ± 4.68 years, body mass 71.50 ± 13.49 kg, height 172.35 ± 8.17 cm) were assessed for hamstring flexibility. All participants had both legs tested under three different randomly ordered conditions (kinesio tape, sham tape and control) using the Passive Straight Leg Raise Test. All measurements were made during the same testing session. Participants performed three sets of tests, each set measured twice, to determine hamstring extensibility in both legs. There was a 12 minute rest period between each set and a one minute break between each repetition.
Results: An analysis of variance (ANOVA) with repeated measurements showed no statistically significant differences either in the right (p=0.503) or the left leg (p=0.948) between the three study conditions.
Conclusions: The application of kinesio taping does not seem to acutely increase hip flexion range of motion in healthy subjects.
Key Words: Kinesio Tape, Taping, Range of Motion, Passive Straight Leg Raise Test.

Introduction

Hamstring extensibility is an important component of fitness and a factor associated with the health of the spine (Lopez-Miñarro et al., 2008; Sainz de Baranda et al., 2005). The polyarticular condition of the hamstring muscle, its diversity of functions, tonic-postural character and the high number of tensional forces to which it is subjected (Davis et al., 2005), tends to shorten this muscle (Ayala and Sainz de Baranda, 2008). Thus, poor hamstring flexibility values have been associated with lower back (McGill, 2002) and lower extremities injuries (Croisier et al., 2002; Sexton and Chambers, 2006). In light of this, many authors recommend a systematic use of a stretching programme (Ayala and Sainz de Baranda, 2008; Sainz de Baranda et al., 2005) in order to maintain or improve hamstring muscle extensibility.

Kinesio taping (KT) is an alternative taping technique, based on the functions of the tape, that may improve the range of motion (ROM) (Kase et al., 1996; Sijmonsma, 2007). Two theories may provide insight in how KT works. One theory posits that KT increases blood circulation in the taped area (Kase, 1994) and that this physiological change may affect the muscle and myofascia functions after the application of KT. Another theory suggests that KT stimulates cutaneous mechanoreceptors at the taped area, and this stimulation may affect the ROM (Halseth et al., 2004; Murray and Husk, 2001). Therefore, muscle functioning could be improved with KT by regulating muscle tone (Sijmonsma, 2007).

The tape application method varies depending on the specific objectives: to improve ROM, to relieve pain, to adjust a misalignment, or to improve lymphatic circulation (Kase et al., 2003). As a consequence, KT could theoretically improve sporting performance (Nosaka, 1999), and that is why, its use has increased in recent years (Kase et al., 2003), being widely used to prevent injuries for athletes (Cools et al., 2002; Halseth et al., 2004) and also in several studies to treat musculoskeletal disorders (Jaraczewska and Long, 2006; Fu et al., 2008; Yasukawa et al., 2006).

As the information available from small case studies and pilot tests data has been inconsistent, these results are not scientifically conclusive (Thelen et al., 2008). Regarding the application of KT for ROM improvement, studies have been done with young sports subjects who experienced acute improvement after its application (McConnell and McIntosh, 2009; Hsu et al., 2009; Merino et al., 2010). However, other research with non-athletes (Ebbers and Pihnappel, 2006; Salvat and Salvat, 2010) and with young people with shoulder pain have not arrived at the same conclusions (Thelen et to., 2008), although it is true that some of them found certain improvement several days after its application (Ebbers and Pihnappel, 2006; Thelen et al., 2008).

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In conclusion, currently there has been a lack of conclusive scientific data on the use of KT as a valid option to increase flexibility, and due to the paucity of consistent results, further research is necessary to clarify this issue (Yoshida and Kahanov, 2007). The aim of this research is to assess the acute effect of KT using the X-shaped taping technique on hamstring muscle extensibility in healthy university students.

Methods

Participants

Forty-three university students volunteered in this study (Table I). Participants were healthy Physical Education students at the University of Malaga, Spain. In this study we established the following exclusion criteria (Ayala and Sainz de Baranda 2008; López-Miñarro et al., 2008) for subjects who: a) suffered from any kind of disease that could be aggravated by this study; b) had skeletal muscle limitations c) experienced spinal or hip pain that would limit their participation in the test; d) had muscular pain at the time of the assessments. The study was approved by the University of Malaga Ethics Committee. Participants were informed of the protocols and procedures before their participation, and informed consent was obtained from them all.

Table I. General characteristics of participants. Values are expressed as mean (SD)

Gender (n)	Age (years)	Body weight (kg)	Height (cm)
Male (n=36)	21.86 (4.87)	74.20 (13.01)	174.03 (7.47)
Female (n=7)	22.57 (3.82)	57.58 (4.07)	163.71 (6.15)
Total (n=43)	21.98 (4.68)	71.50 (13.49)	172.35 (8.17)

Procedures

An intra-subject experimental design was used to evaluate the possible acute effect of KT using the X-shaped taping technique on hamstring muscle extensibility in university students. All measurements were carried out during the same testing session, administered one day, at the same time (from 10 to 15 pm) at the Human Movement Laboratory of the University of Malaga College of Education. Students were examined without shoes and were only wearing their underwear. No warm-up or stretching exercises were performed by the participants prior to the test measurements.

Participants performed three sets of two repetitions of the hamstring extensibility assessment for both legs. Between each set, subjects were given a 12 minute rest, and between each repetition, a one minute break. The test was performed on all participants on both legs under three randomly ordered conditions: (kinesio tape, sham tape and control). Both legs were always evaluated in the same order (right and then left).

The criterion measure of hamstring flexibility was determined by executing a maximum PSLR on each limb (American Academy of Orthopaedic Surgeons, 1996). This test was selected due to its widespread acceptance as the criterion measure for hamstring flexibility and its high reliability (0.95-0.99) (Minkler and Patterson, 1994; Patterson et al., 1996). A manual goniometer (Lafayette®, U.S.A.) was used to measure the hip angle. Tests were administered by three experienced clinicians, one responsible for fixing the pelvis and the opposite thigh to the table, another in charge of lifting the leg, while the third carried out the measurement with the goniometer.

While the participant laid supine on a firm surface, the axis of the goniometer was aligned with the axis of the hip joint. The tester placed the stationary arm in line with the femur. With the knee held straight, the participant's leg was moved passively into hip flexion until tightness was felt by both the participant and the tester. The score was the maximum angle (degree) obtained at the point of maximum hip flexion. The hamstring flexibility score was determined as the average of the two measurements on each leg. Scores were recorded to the nearest degree for each leg.

Taping

A white 5 cm wide kinesio tape (Kinesiology tape®, Korea) was applied to the hamstrings using the X-shaped taping technique (Kase, 1994; Kase et al., 2003; Sijmonsma, 2007). The base of the tape was placed unstreched with the subject in a neutral body position, just distal to the insertion of the muscle in order to achieve a relaxing effect. Then, functional strips were applied on the stretched muscle belly, maintaining the original 10% tape pre-stretching. Afterward, the anchorage was applied without stretching, just proximal to the insertion of muscle in neutral body position (Sijmonsma, 2007) (Figure I).

Figure I. Kinesio taping on hamstring muscle with the X-shaped taping technique.

The main steps undertaken were the following (Sijmonsma, 2007):

- *First step*. Application of the midpoint "X" in the neutral position just above the popliteal fosse and placing the short strips both medially and laterally to the popliteal fosse.
- *Second step*. Hip flexion and knee extension and then application of the medial strip on semimembranosus and semitendinosus muscles and the lateral strip on the femoral biceps.
- *Third step*: Joining the anchorages in a neutral position on the ischial tuberosity.

To use the correct length of the tape for each person, they were measured in a stretched position from the medial or lateral condyle of the tibia to the ischial tuberosity. For application of the sham tape, a white 5 cm wide tape (Lenotape, Farmaban®) was used following the same procedure described above. The sham tape is seemingly like the KT, designed for functional and sports taping, but it is not elastic.

Statistical analyses

Descriptive statistical methods were used to calculate the mean and standard deviations. The average of the two repetitions for each condition was used for subsequent statistical analysis. The equality of variances was checked with the Mauchly's Sphericity Test. An analysis of variance (ANOVA) with repeated measures and taping conditions (kinesio tape, sham tape and control) as an intra-subject factor was used to assess the acute effect of KT on the degree of hamstring extensibility. The alpha risk level accepted for all hypothesis tests was $p<0.05$. Data was recorded and analyzed using Microsoft Office Excel 2007 and SPSS for Windows version 17.0 (SPSS® Inc, Chicago, IL).

Results

The mean values and standard deviation of the extensibility of the hamstrings, for the right leg and the left between each taping condition, in addition to the results of the application of the ANOVA repeated measures are presented in Table II.

Table II. Comparison of the extensibility of the hamstrings of the right leg and left among the three taping conditions and result of application of repeated measures ANOVA. Values are expressed as mean (SD)

Leg	Condition			F	df	p
	Control (n=43)	kinesio tape (n=43)	Sham tape (n=43)			
Right	87.75 (14.39)	89.05 (13.93)	87.94 (14.15)	.692	2	.503
Left	87.27 (13.35)	86.90 (13.38)	87.23 (12.28)	.054	2	.948

After the comparison of the scores of the test results PSLR between different taping conditions (kinesio tape, sham tape and control), the repeated measures ANOVA showed no significant differences in the right ($p=0.503$) or left leg ($p=0.948$) in either case.

Discussion

In this study we have determined that there are no acute effects ($p>0.05$) on hamstring extensibility as a result of the application of KT on the hamstring muscle on healthy university students. This data is consistent with that found by other authors (Salvat and Salvat, 2010; Thelen et al., 2008; Yoshida and Kahanov, 2007). However, in other studies, improvements in ROM were found both acutely afterwards (McConnell and McIntosh, 2009; Merino et al., 2010; Yoshida and Kahanov, 2007) and a few days after the application of KT (Ebbers and Pijnappel, 2006).

McConnell and McIntosh (2009) in a study of 21 young elite tennis players (age 14.9 ± 0.8 years) on the influence of KT on the shoulder ROM, found that there were statistically significant differences ($p<0.05$) for KT group versus the control group and placebo. Hsu et al. (2009) in a study of 17 baseball players with shoulder impingement syndrome (age 23 ± 2.8 years) found that KT improved scapula mobility.

Merino et al. (2010) in a pilot study with 10 healthy male triathletes (age 29.40 ± 9.07 years) on lower back and hamstring flexibility found significant improvement ($p<0.05$) as a result of the use of KT measured by

the SRT. Yoshida and Kahanov (2007) in a study on the effect of KT in the ROM of the trunk carried out on 30 healthy university student volunteers (15 females 26.9 ± 5.9 years, 20 males and 15.9 ± 12.1 years), observed that there were significant differences ($p<0.05$) in the ROM of the trunk flexors measured with toe touch test. However, they found no significant differences ($p>0.05$) in the scores of the lateral flexion and trunk extension.

In previous studies, apart from the low number of participants, some studies have had substandard control of extraneous variables as a result of the order, the sensitivity of the measuring instrument, or the absence of a placebo group. In other more rigorous studies in which there was greater control of possible contaminating variables, no statistically significant differences were found ($p>0.05$) compared with the control or placebo group acutely after application of KT (Salvat and Salvat, 2010; Thelen et al., 2008).

Ebbers and Pihnappel (2006) in a study of 98 individuals of 44.7 ± 12.7 years on the influence of the flexibility KT measured with the SRT found no acute improvements. However, after three days, the same authors found a positive influence on the results of that test. Therefore, the results of our study perhaps are due to the fact that the effects of KT are not acute, but rather take place sometime after its application.

In addition, the effectiveness of KT on flexibility might be more effective for people with muscle shortness. Looking at results obtained in this research, we encountered students clearly within the normal hamstring extensibility range (Kendall et al., 2007; Travell and Simons, 2004). However, among the participants who show moderate-high hamstring extensibility, KT may not produce expected results. There were also no significant differences between left and right PSLR, coinciding with the data found by other authors on the same population (Ayala and Sainz de Baranda 2008; López-Miñarro et al., 2008).

We also noticed, as in the study of Salvat and Salvat (2010), that the tape used as a placebo tape (sham tape) was difficult to cut, due to the absence of a protective roll as in the case of KT. Furthermore, it was much more difficult to use (it got stuck to itself, was very difficult to separate and also had a poorer adhesion to the skin).

The available information on the application of KT to improve flexibility from small pilot trials and studies is in general inconsistent, which is why the conclusions reached show a lack of scientific rigor (Merino et al., 2010). Currently there is a dearth of consistent scientific data on the use of KT as a valid option for increasing flexibility, which is why further research is necessary to clarify this issue (Yoshida and Kahanov, 2007). Future research should test the effectiveness of KT on people with muscle shortness and/or few days after its application.

Conclusion

The application of KT on the hamstring does not acutely improve the range of motion (ROM) in hip flexion in healthy university students assessed using the test PSLR. The current research is scarce regarding the use of KT as a viable option for increasing flexibility.

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