



Research

Kinesio Taping does not decrease swelling in acute, lateral ankle sprain of athletes: a randomised trial

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KEYWORDS

Bandages
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Lymphatic system
Oedema
Sprains and strains



ABSTRACT

Question: Does Kinesio Taping reduce swelling in athletes who have suffered an acute, lateral ankle sprain? **Design:** Randomised controlled trial with concealed allocation, intention-to-treat analysis and blinded assessment. **Participants:** Thirty-six athletes who participated regularly in one of seven different sports modalities and suffered an acute ankle sprain. **Intervention:** The experimental group received Kinesio Taping application for 3 days, which was designed to treat swelling. The control group received an inert Kinesio Taping application. **Outcome measures:** For the comparison between groups, the swelling was measured via volumetry, perimetry, relative volumetry and two analyses of the difference in volume and perimetry between ankles of each participant. Data were collected immediately after the 3 days of intervention and at follow-up, which was 15 days post intervention. **Results:** At 3 days after intervention, there were no differences between groups for swelling in volumetry (MD -2 ml, 95% CI -28 to 32); perimetry (MD 0.2 cm, 95% CI -0.6 to 1.0); relative volumetry (MD 0.0 cm, 95% CI -0.1 to 0.1); and the other analyses. At day 15 follow-up, there were no significant between-group differences in outcomes. **Conclusion:** The application of Kinesio Taping, with the aim of stimulating the lymphatic system, is ineffective in decreasing acute swelling after an ankle sprain in athletes. **Trial registration:** Brazilian Registry of Clinical Trials, RBR-32sctf. [Nunes GS, Vargas VZ, Wageck B, dos Santos Haupenthal DP, da Luz CM, de Noronha M (2015) Kinesio Taping does not decrease swelling in acute, lateral ankle sprain of athletes: a randomised trial. *Journal of Physiotherapy* 61: 28–33]

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Introduction

Ankle sprain is one of the most common sports-related injuries.¹ A study that analysed the occurrence of ankle sprains, in the United States between 2003 and 2006, calculated that there were around 3 million ankle sprains during that period and half of them were related to sport.² For high-performance athletes, an ankle sprain can not only limit activities but also generate financial consequences due to absence from participation.³ Perhaps the most significant consequences of an ankle sprain in the acute phase are the pain and swelling commonly seen in this injury.^{1,3,4} When such a condition is not treated properly in the acute phase, it can progress to synovitis, tendinopathy, joint stiffness, muscle weakness, joint instability, and persistent pain and swelling.^{3,4} After an ankle sprain, around 60% of cases are likely to present with symptoms up to 18 months after the injury,^{5,6} increasing the chance of recurrence.³

Among the acute consequences of an ankle sprain, swelling is one of the symptoms that requires the most immediate attention because it is related to the progression of the inflammation and can be a limiting factor during rehabilitation.³ Among the techniques used to reduce or contain the swelling, Kinesio Taping seems to be gaining popularity among some rehabilitation professionals.⁷ The Kinesio Taping technique involves the use of adhesive elastic tape

that – unlike traditional strapping tape – has some inherent extensibility. Some proponents of Kinesio Taping claim that the Kinesio Taping technique, when applied at the ankle, is expected to stimulate the drainage of the oedema present in the interstitial space towards less-congested lymphatic channels, thus reducing the swelling.⁷

Some recent studies have shown positive results after the application of Kinesio Taping when compared to placebo taping⁸ or to other manual techniques that treat swelling, such as manual lymphatic drainage.⁹ Aguilar-Ferrández and colleagues⁸ reported a positive effect of Kinesio Taping on lower-limb swelling in post-menopausal women with chronic venous insufficiency. In this controlled trial, Kinesio Taping decreased extracellular liquid in the lower limbs, pain and severity of disease, while improving function.⁸ However, that study only included participants with chronic venous insufficiency, so it is not possible to extrapolate the effects of Kinesio Taping for oedema from an acute ankle sprain. Other studies have attempted to investigate the effect of Kinesio Taping in swelling;^{9,10} however, the quality of those studies is questionable, as blinding of assessors and comparison to a control or placebo group were not always present. Therefore, there is a lack of good-quality studies that have investigated whether Kinesio Taping is effective in treating acute swelling.

Therefore, the research question for this study was:

Is Kinesio Taping effective in reducing swelling in athletes who have suffered an acute, lateral ankle sprain?

Method

Design

In this parallel-group, randomised, controlled trial, participants were randomly allocated to an experimental group or a control group. The experimental group received a Kinesio Taping application designed to treat swelling, while the control group received a sham intervention (ie, an inert Kinesio Taping application).⁷ The randomisation was performed in a concealed fashion using opaque, sealed envelopes, which were prepared by a researcher who was not involved in the recruitment or assessment of participants. The Kinesio Taping applications were left in situ for 3 days; participants were measured at baseline, 3 days, and 15 days (Figure 1).

Participants, therapists and centres

Thirty-six athletes from the metropolitan area of a state capital in Brazil took part in the present study. The participants attended practice sessions and competitions for their respective sports on a regular basis. They were athletes who participated in one of seven exercise modalities: 17 soccer, five athletics, four volleyball, three basketball, two rugby, two swimming, two dance and one European handball.

To be included, participants had to report a lateral ankle sprain that had occurred between 48 and 96 hours before the first assessment, with visible swelling of the ankle. Participants were

not included in the study if they: had a fracture; had an open wound; had systemic lower-limb swelling related to cardiac, kidney or venous diseases; or were suspected to be pregnant.

The interventions and assessments were conducted at Clínica Escola de Fisioterapia of Universidade do Estado de Santa Catarina and at the participants' training sites. An initial assessment was conducted to confirm that the participant met the inclusion/exclusion criteria. After the initial assessment, both ankles were shaved and cleansed, and the volume of the ankles was assessed (see Volumetry under Outcomes measures, below). Participants were then allocated to either the experimental group or the control group. There were two post-intervention assessments: one at 3 days after the Kinesio Taping application and one at a follow-up assessment 15 days after the Kinesio Taping application. An assessor who was blinded to group allocation performed both post-intervention assessments.

Intervention

The experimental group received the Kinesio Taping application called a 'fan cut'.⁷ The participants were positioned in supine and marked at 13 cm above the lateral malleolus and at 10 cm above the medial malleolus of the affected ankle. Participants were then asked to perform a plantar flexion and 5 deg inversion of the ankle, so that the length of the Kinesio Tape to be applied could be measured (ie, the distance from the lateral skin mark to the fifth toe) (Figure 2A). The Kinesio Tape that was applied to the medial ankle was the same length as the one applied to the lateral ankle. The Kinesio Tape was applied starting from the skin marks to the metatarsal region of the foot, with an elastic tension of 20%.⁷ The Kinesio Tape was divided into four strips and applied with a distance of approximately 1 cm between strips. The lateral Kinesio Taping application commenced along the fibula and the strips were placed in the following order: posterior to the lateral malleolus

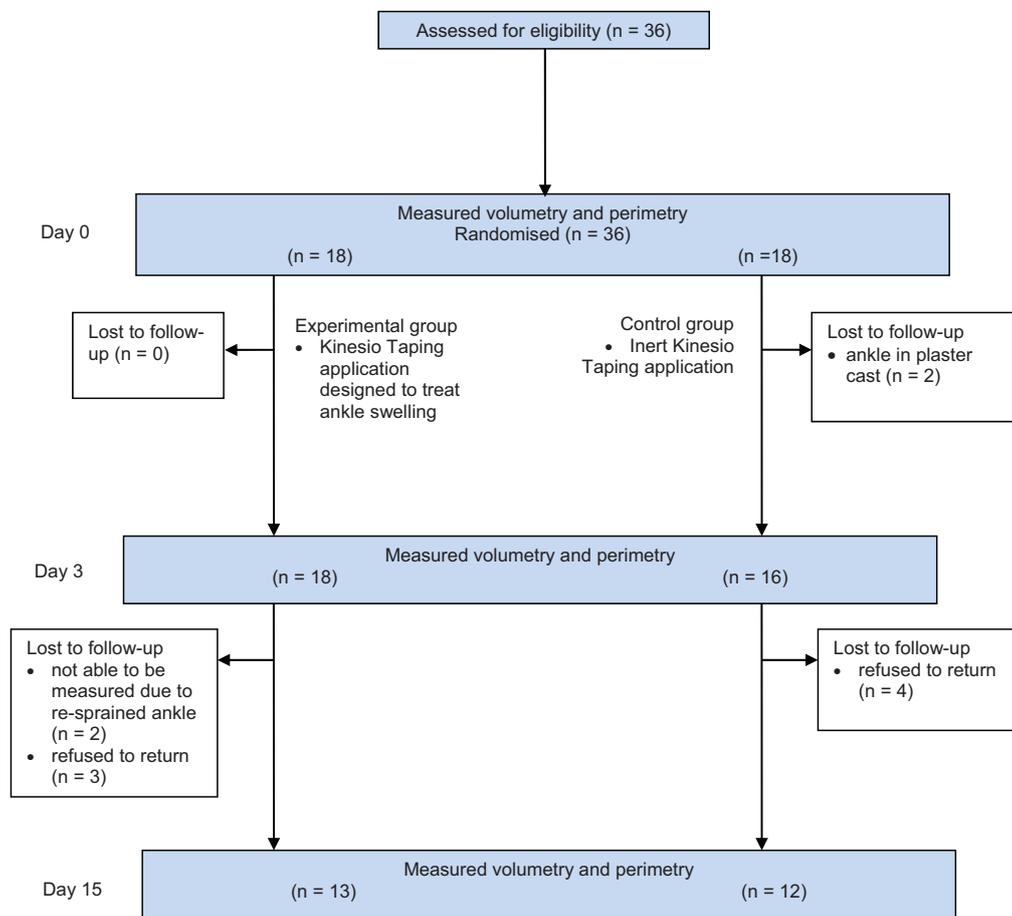


Figure 1. Flow of participants through the study.

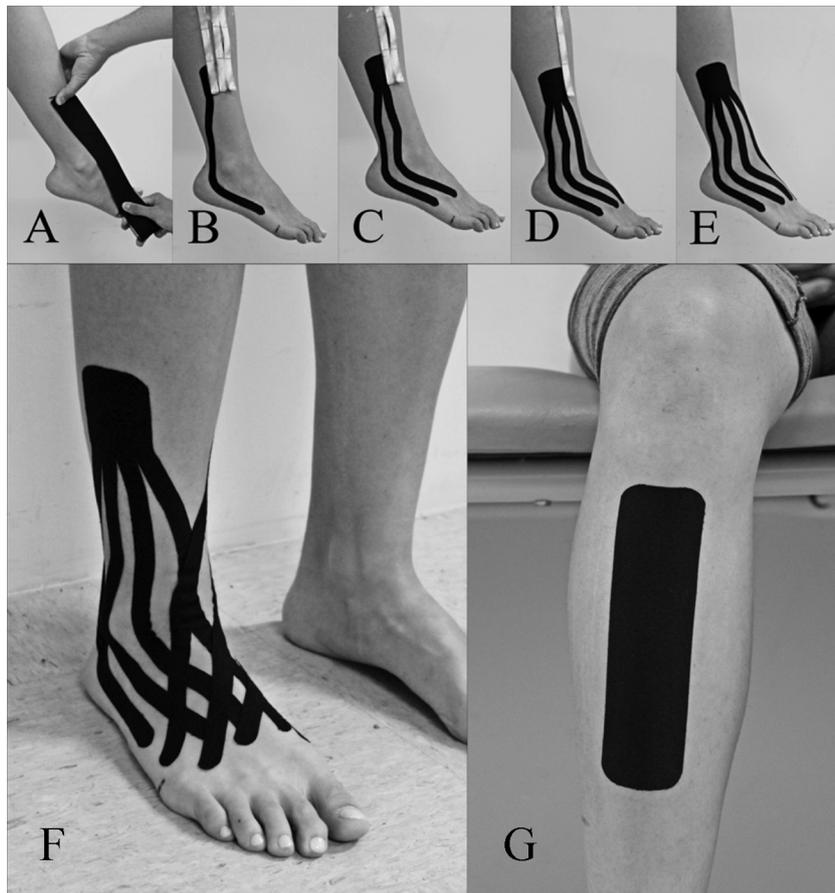


Figure 2. Kinesio Taping application. A – how the Kinesio Taping was measured and cut; B – application of 1st strip; C – application of 2nd strip; D – application of 3rd strip; E – application of 4th strip; F – full Kinesio Taping application; G – application to the control group.

(Figure 2B), on the lateral malleolus (Figure 2C), anterior to the lateral malleolus (Figure 2D) and towards the hallux (Figure 2E). The medial Kinesio Tape application was slightly diagonal to the tibia and the strips were applied in the following order: posterior to the medial malleolus, on the medial malleolus, anterior to the medial malleolus and towards the fifth toe.⁷ The undivided start section of the Kinesio Tape was applied with the ankle in a neutral position, and the strips were applied with the ankle in maximum plantar flexion and inversion of approximately 5 deg. Therefore, the final presentation of the application had the strips of the lateral and medial Kinesio Taping application crossing each other (Figure 2F).

The control group received a 15-cm strip of Kinesio Tape in an 'I' shape. The application started on the tibial tuberosity and was applied along the tibia (Figure 2G), with the tension applied to the Kinesio Tape at 20%.

For both groups, an investigator, who was not involved in the assessment, applied the Kinesio Taping and removed it before the assessment on Day 3. Along with the Kinesio Taping application, both groups received instructions on how to apply ice and elevate the lower limb in order to decrease the pain for 20 minutes, three times a day, during the 3 days of Kinesio Taping application.¹¹

Outcome measures

Volumetry

An acrylic box (14 x 34 x 30 cm) with a simple water escape hole (2.5 cm in width and positioned at 22 cm from the floor of the box) was used to assess ankle/foot volume.¹²⁻¹⁵ The acrylic box was filled with water at 30 deg C (± 2 deg C).^{12,16} Water temperature was measured with a digital infrared thermometer^a and the room temperature was also maintained around 25 deg C. The participant was instructed to remain comfortably seated with the back supported

by the chair, forearms on the thigh, knees bent around 90 deg, and the sole of the foot that was not being assessed fully in contact with the floor in neutral plantar flexion/dorsiflexion. The participant was then required to slowly insert the foot to be assessed into the acrylic box until the sole of the foot made full contact with the bottom of the box, and to hold the position in silence as much as possible. In that position, the water that overflowed through the escape hole was collected in a separate container. The container was kept in place until all dripping stopped. The overflow was then weighed using an electronic scale^b with a precision of 1 g. To ensure consistency in the measurement, the distance between the feet, the distance between the chair and the acrylic box, the position of the foot in the box, and the water temperature were recorded. These distances were used every time a participant was assessed. At each assessment, both feet were assessed twice in an alternating fashion, with the first side randomly decided. For the analysis, the mean of the two measures were used. This procedure has an intra-rater and inter-rater intraclass correlation coefficient between 0.98 and 0.99.¹²

Perimetry

This procedure was performed with a measuring tape positioned around the ankle in a figure-eight fashion.¹² The participant was positioned in prone with the ankle in neutral position. The following reference landmarks were used to position the measuring tape: the tibialis anterior tendon, the navicular tuberosity (going under the foot), the base of the fifth metatarsal, the tibialis anterior tendon again, the medial malleolus, the Achilles tendon, the lateral malleolus, and the tibialis anterior tendon again. On each assessment day, each foot was assessed three times in an alternating fashion, with the first foot randomly decided. For the analysis, the mean of the three measures was used. This procedure also had an intra-rater and inter-rater intraclass correlation coefficient between 0.98 and 0.99.¹²

Data analysis

For one primary analysis of volumetry, the absolute values from the injured ankles were used. For that, the data given in g were converted into ml, assuming 1 g is equivalent to 1 ml.^{16,17} The second primary analysis of volumetry used the ankle volume as a percentage of the body mass, measured in g (ankle volume/body mass) x 100, and was termed relative volumetry. For the secondary analyses, the raw data for perimetry from the injured ankle were used, and the difference between the injured and the healthy ankles for each participant for both volumetry and perimetry were also calculated. Analysis of Variance (ANOVA) linear mixed models were used to compare the effect of Kinesio Taping on swelling between the groups.

A level of significance of $p \leq 0.05$ was adopted for all tests, and data were analysed on an intention-to-treat basis. The ‘last observation carried forward’ approach was used for missing data.

The sample size for the present study was calculated to ensure power of 80% and an alpha of 5%. It was calculated that 16 participants in each group would identify a difference of 2 cm between the groups in the perimetry measures, given an anticipated SD of 2 (sufficient data to perform sample size calculation on the primary outcomes were not available). The minimum difference between groups was chosen to be 2 cm because Kinesio Taping is a low-cost and fast intervention with virtually no risk involved; therefore, a small difference would be sufficient to warrant its application.¹⁸ The 2 cm was chosen because it is half the SD of baseline measures of perimetry from previous studies.^{19–21}

Results

Flow of participants, therapists and centres through the study

Of the 36 participants, two could not be assessed after the intervention because they followed medical instructions to immobilise the ankle with a cast. Both were in the control group, as shown in Figure 1. A further nine participants were unavailable for the Day 15 assessment.

The characteristics of the participants in each group are summarised in Table 1 and in the first two columns of data in Table 2. The groups were well matched with respect to demographic data and baseline scores on the outcome measures.

Effect of intervention

After 3 days, the ANOVA showed no difference between groups for volumetry, perimetry or relative volumetry. When the data for volumetry and perimetry were analysed as the difference between the injured and non-injured sides, there was still no effect of Kinesio Taping after 3 days. Similarly, there was no significant difference between groups after 15 days for any outcomes. Summary data are presented in Table 2 and individual participant data are presented in Table 3 on the eAddenda.

Discussion

In the present study, Kinesio Taping was applied as an adjunct therapy to reduce swelling after a lateral ankle sprain because, according to the creators of this treatment,⁷ Kinesio Taping can

Table 1
Characteristics of participants at baseline (n = 36).

Characteristic	Exp (n = 18)	Con (n = 18)
Gender (male), n (%)	15 (83)	13 (72)
Age (yr), mean (SD)	24 (5)	23 (6)
Height (cm), mean (SD)	176 (7)	177 (8)
Weight (kg), mean (SD)	74 (9)	75 (13)
Time since injury (hr), mean (SD)	75 (21)	73 (17)

Con = control group, Exp = experimental group.

Table 2
Mean (SD) of groups, mean (SD) difference within groups, and mean (95% CI) difference between groups.

Outcome	Groups						Difference within groups						Difference between groups					
	Day 0		Day 3		Day 15		Day 3 minus Day 0		Day 15 minus Day 0		Day 3 minus Day 0		Day 15 minus Day 0		Day 3 minus Day 0		Day 15 minus Day 0	
	Exp (n = 18)	Con (n = 18)	Exp (n = 18)	Con (n = 16)	Exp (n = 13)	Con (n = 12)	Exp	Con	Exp	Con	Exp minus Con	Con	Exp minus Con	Con	Exp minus Con	Con		
Volumetry (ml)	1629 (138)	1712 (232)	1593 (150)	1675 (234)	1586 (133)	1660 (222)	-36 (49)	-37 (38)	-43 (48)	-52 (43)	2 (-28 to 32)	9 (-22 to 40)	-36 (49)	-37 (38)	-43 (48)	-52 (43)	9 (-22 to 40)	
Perimetry (cm)	54.4 (3.0)	55.0 (4.1)	54.6 (2.7)	55.1 (3.8)	54.4 (2.7)	55.0 (3.5)	0.2 (1.4)	0.1 (0.8)	0.0 (1.2)	0.0 (1.1)	0.2 (-0.6 to 1.0)	0.1 (-0.7 to 0.9)	0.2 (1.4)	0.1 (0.8)	0.0 (1.2)	0.0 (1.1)	0.1 (-0.7 to 0.9)	
Relative Volumetry (%) ^a	2.2 (0.3)	2.3 (0.3)	2.2 (0.3)	2.3 (0.3)	2.2 (0.3)	2.2 (0.3)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (-0.1 to 0.1)	0.0 (-0.1 to 0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (-0.1 to 0.1)	0.0 (-0.1 to 0.1)	
Volumetry I-NI (ml)	61 (42)	93 (84)	30 (37)	66 (76)	31 (31)	57 (76)	-31 (40)	-27 (38)	-30 (36)	-37 (38)	-5 (-31 to 22)	6 (-25 to 38)	-31 (40)	-27 (38)	-30 (36)	-37 (38)	6 (-25 to 38)	
Perimetry I-NI (cm)	1.2 (0.9)	1.6 (1.4)	0.7 (0.5)	0.9 (0.9)	0.4 (0.3)	0.9 (0.9)	-0.5 (1.0)	-0.7 (0.6)	-0.8 (1.0)	-0.7 (1.1)	0.1 (-0.5 to 0.7)	-0.1 (-0.9 to 0.6)	-0.5 (1.0)	-0.7 (0.6)	-0.8 (1.0)	-0.7 (1.1)	0.1 (-0.5 to 0.7)	

Con = control group, Exp = experimental group, I-NI = injured minus non-injured, shading = primary outcomes.
^a Relative Volumetry = (volumetry/body mass) x 100 (ie, volumetry mass in relation to body mass).

stimulate the reabsorption of the interstitial liquid via the lymphatic system. The creators of Kinesio Taping believe that such liquid reabsorption is possible due to the decrease in pressure in the epidermis that the Kinesio Taping supposedly creates, which consequently decreases pressure in the lymphatic vessels and increases the lumen of these vessels.⁷ The decrease in pressure, according to the creators of Kinesio Taping, is the consequence of micro-waves that are formed by the Kinesio Taping during active movement where the Kinesio Taping is applied.⁷ Furthermore, the explanation given by the creators of Kinesio Taping is that it also creates some friction on the skin, which is similar to the manual techniques that are widely used in physiotherapy.⁷ Despite applying Kinesio Tape directed by the creators of the tape, the experimental intervention with Kinesio Taping did not show any benefit in terms of a decrease in swelling after an acute ankle sprain when compared to a sham taping technique.

The lack of an effect from Kinesio Taping seen in the present study differs from the result of the trial by Aguilar-Ferrández et al,⁸ in which a reduction in swelling in the Kinesio Taping group was reported. In that study, Kinesio Taping was applied in postmenopausal women with chronic swelling due to chronic venous insufficiency and it reduced extracellular liquid from the lower limbs.⁸ One explanation for this discrepancy is that the effects of Kinesio Taping are limited to swelling related to chronic conditions, without an active inflammatory phase affecting the swelling. Another explanation is that Aguilar-Ferrández et al⁸ measured the swelling reduction via bio-impedance. In a different study by the same research group, Kinesio Taping did not show any positive effect in reducing swelling in lower limbs of postmenopausal women with chronic venous insufficiency.²² For that second study, the reduction in swelling was calculated using a mathematical model that converted perimetry into volume. These conflicting results reinforce the possibility that the effects of Kinesio Taping on swelling are limited to the cellular changes of chronic conditions and not the actual volume of the segment as a whole. That possibility casts doubts on the clinical relevance of measuring swelling at a cellular level only.

Another possibility that needs to be considered is the structural differences of the swelling. Aguilar-Ferrández et al⁸ reported that Kinesio Taping decreases the extracellular liquid in people with chronic venous insufficiency. In conditions such as chronic venous insufficiency, it is expected that the swelling is a consequence of hydrostatic pressure changes and therefore has low levels of protein or transudate.^{23,24} In the present study, the participants had acute ankle sprains with an active inflammatory process and an exudate with a higher quantity of protein.²⁴ Thus, it is also possible that the effects of Kinesio Taping on swelling are limited to a transudate; perhaps due to the higher mobility presented by this type of swelling.

With regard to Kinesio Taping application time, it is recommended that it be applied continuously for 3 to 5 days, while the tape still holds its elastic properties.⁷ That recommendation was followed in the present study; however, it is possible that the time of application used was insufficient to generate the positive results seen in other studies because in some of these studies, the time of application was longer than 3 days.^{8,9} In a study that applied Kinesio Taping for 10 consecutive days, starting at Day 5 after placing an external fixation around the thigh, the results showed a reduction in swelling of that area.⁹ It should be noted, however, that the quality of that study is questionable, as it did not have a comparison group or any blinding. In the study by Aguilar-Ferrández et al,⁸ the Kinesio Taping was applied three times a week, for 4 weeks, which could have increased the possible effect of Kinesio Taping. However, in the present study, the time of application was not increased because the aim was to investigate the effect of Kinesio Taping solely on the acute phase of an ankle sprain.

The fact that we investigated the effect of Kinesio Taping on athletes is also worthy of consideration, because athletes usually have a faster metabolism than non-athletes.²⁴ It is possible that the stimulus generated by the Kinesio Taping on the skin and

lymphatic system was insufficiently powerful to make any difference in this population. This could explain the lack of positive results in the present study and the presence of positive results in studies that have investigated the effect of Kinesio Taping in populations of non-athletes.^{8,9}

Another explanation is that Kinesio Taping is ineffective and that the positive finding in the study by Aguilar-Ferrández et al⁸ was due to chance, bias or confounding. A recent systematic review identified 12 randomised controlled trials of Kinesio Taping for various musculoskeletal conditions.²⁵ All of these trials demonstrated either no effect of Kinesio Taping or a clinically trivial effect. Randomised trials published more recently than this review have further indicated a general lack of effect from Kinesio Taping for more,²⁶ although perhaps not all,²⁷ musculoskeletal conditions.

The application of Kinesio Taping with the aim of stimulating the lymphatic system is not effective in decreasing acute swelling after an ankle sprain in athletes. Further investigation should consider the application of Kinesio Taping for more than 3 days and at different phases of the inflammatory process. The Kinesio Taping technique has become a popular treatment among athletes; however, its real effects are still being investigated.

What is already known on this topic: Depending on the measurement of swelling used, Kinesio Taping may have an effect on chronic swelling due to chronic venous insufficiency; however, the effect on acute swelling is unknown.

What this study adds: Among athletes with a recent ankle sprain, an application of Kinesio Tape recommended by the developer for the reduction of ankle swelling did not significantly reduce swelling, as measured by volumetry or perimetry. A further 12 days after the Kinesio Tape was removed, no effect of the Kinesio Taping on the swelling was evident.

Footnotes: ^aIncoterm thermometer, model Scantemp, Brazil. ^bBD-500, Brazil.

eAddenda: Table 3 can be found online at [doi:10.1016/j.jphys.2014.11.002](https://doi.org/10.1016/j.jphys.2014.11.002).

Ethics approval: The Human Research Ethics Committee of Universidade do Estado de Santa Catarina (number 138/2011) approved this study. All participants gave written informed consent before data collection began.

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