

The Effect of Kinesiotaping on Functional Performance in Chronic Ankle Instability - Preliminary Study

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Abstract

Objective: Chronic Ankle Instability (CAI) is characterised by recurrent giving way and often develops after repeated lateral ankle sprains. Kinesiotape is more elastic than traditional athletic tape and is becoming increasingly popular. It is reported to decrease pain, improve muscle function, circulation and proprioception, however, research examining the effects of Kinesiotape in CAI is limited. The objective of this study was to determine if applying Kinesiotape to chronically unstable ankles improved performance in the Star Excursion Balance Test (SEBT).

Design: Crossover design study with participants randomised to the taped or untaped condition first.

Setting: Lab-based study.

Participants: Sixteen participants (10 female, 6 male; age 22.4 ± 1.41 years; height 1.77 ± 0.08 m; weight 71.9 ± 8.7 kg) from university sports clubs participated in the study. Inclusion criteria was a lateral ankle sprain in the previous year, self-reported history of CAI and Cumberland Ankle Instability Tool score <24 .

Intervention: Kinesiotape was applied to the affected ankles using an adapted form of the lateral sprain technique and participants waited 20 minutes after application or removal before testing.

Main Outcome Measures: Reach distances were measured in antero-medial, medial and postero medial directions of the SEBT in taped and untaped conditions.

Results: There were no significant differences in reach distance in any direction of the SEBT between taped and untaped conditions ($p > 0.05$).

Conclusion: Kinesiotape did not improve reach distance in the SEBT in young, active individuals with CAI. Further research examining the therapeutic effectiveness of Kinesiotape in CAI is warranted.

Keywords: Kinesiotape; Chronic ankle instability; Star excursion balance test

Introduction

Lateral ankle sprains are the most common sports-related injury [1]. In 20-40% of such sprains, Chronic Ankle Instability (CAI) will occur. This is defined as "giving way" following an injury to the lateral ligament of the ankle [2-4]. In addition to structural ankle ligament damage during a lateral ankle sprain, damage is also caused to mechanoreceptors which might contribute to chronic, functional ankle instability through loss of joint position sense and other mechanisms [5].

The Star Excursion Balance Test (SEBT) is a dynamic measure of balance which has been shown to be effective in demonstrating reach deficits in patients with CAI compared to normal individuals [5-7]. The limits of subjects' reach are tested whilst standing on their injured ankle, with this reach demonstrating functional performance. The grid is prepared with 8 lines at 45° as shown in Figure 1.

Ankle taping is the major method in preventing ankle injuries in sports players [8]. Kinesiotaping is an increasingly popular, alternative method of taping. It uses Kinesiotape - a coloured, elastic tape which can be stretched prior to application - to provide a constant shear force to the skin. Rather than being structurally supportive, as white athletic tape is, Kinesiotape claims to be therapeutic. According to Kase et al. [9] there are four mechanisms by which Kinesiotape achieves its therapeutic effect: 1) correcting muscle function by strengthening weakened

muscles; 2) improving circulation of blood and lymph by eliminating tissue fluid or bleeding beneath the skin by moving the muscle; 3) decreasing pain through neurological suppression; 4) repositioning

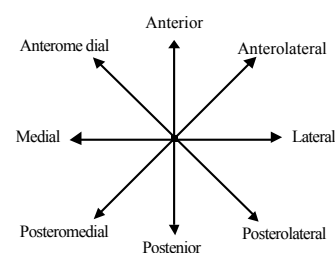


Figure 1: The SEBT as seen from above in a right leg stance. Adapted from Olmsted et al. [25].

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Received January 24, 2013; **Accepted** April 04, 2013; **Published** May 06, 2013

Citation: Hettle D, Linton L, Baker JS, Donoghue O (2013) The Effect of Kinesiotaping on Functional Performance in Chronic Ankle Instability - Preliminary Study. Clin Res Foot Ankle 1: 105. doi:10.4172/2329-910X.1000105

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subluxed joints by relieving abnormal muscle tension, helping to return the function of fascia and muscle. Murray and Husk [10] propose a further mechanism, that inesiotope causes an increase in joint position sense through stimulation of cutaneous mechanoreceptors. Through these mechanisms it is proposed that Kinesiotape will promote healing and improve functional dynamic balance, as measured by the SEBT.

Several studies have examined the effect of taping, particularly the use of white athletic tape, in CAI. Matsusaka et al. [11] demonstrated that taping has a positive effect on functional ankle instability, though Hume and Gerrard [12] reported that in rugby union players, bracing would be more effective than taping, which makes little difference. Whilst there are a number of papers investigating the effects of Kinesiotape, a great deal of these examines its effect on those with healthy ankles, not in those with CAI. However Briem et al. [13], comparing Kinesiotape, white tape and no tape conditions, found no difference in muscle activity between Kinesiotape and no tape conditions, whilst white tape led to an increase in muscle activity.

The scarcity of papers exploring the potential of Kinesiotape to not just structurally support but also promote healing of the chronically unstable ankle was therefore one of the fundamental reasons for this study. The main aim of this study being to investigate the effect of the Kinesiotaping method and tape on subjects with a chronically unstable ankle during the Star Excursion Balance Test. The hypothesis being that Kinesiotaping would lead to a statistically significant improvement in function when applied to a chronically unstable ankle, due to those methods proposed by Kase [9].

Methods

Ethical approval for this study was obtained from the NHS Lothian South East Scotland Research Ethics Service and verbal informed consent was obtained from each participant.

Subjects

As this was a preliminary study, sixteen subjects (10 women, 6 men; age 22.4 ± 1.41 ; height 176.9 ± 7.6 cm; weight 71.9 ± 8.7 kg; leg length 95.9 ± 6.1 cm; foot length 25.6 ± 1.8 cm) with CAI were recruited for this study primarily from sports clubs within the university. For the purpose of the study, chronic ankle instability was defined as repeated episodes of "going over" on, or "giving way" of, the ankle, regardless of the existence of neuromuscular deficits or pathologic laxity⁵. Subjects were also required to have had at least one ankle sprain within twelve months, but not within the last three months, preceding testing. To assess the subject's eligibility, a series of screening questions (box 1) were posed outlining further inclusion and exclusion criteria. Retrospectively questioning using the Cumberland Ankle Instability Tool (CAIT) [14] was also performed to ascertain the severity of instability.

Taping

The Kinesiotape was applied to the unstable ankle as for a lateral ankle sprain [15] (Figure 2). The subject's foot was placed in a relaxed position initially with the foot up. Firstly, a strip of tape was placed from the anterior midfoot to immediately inferior to the tibial tuberosity, over the tibialis anterior muscle, whilst being stretched at 120% of its length. The second strip was applied from the medial malleolus, round the heel, and split just below the lateral malleolus. The first branch was applied anteriorly, the second posteriorly, to the lateral malleolus and from there onwards both ran to attach laterally to the end of the first tape. The third strip was stretched to 140% and was applied across the ankle, just covering the medial and lateral malleoli. Finally, the fourth strip was applied from the arch and stretched to six inches above both

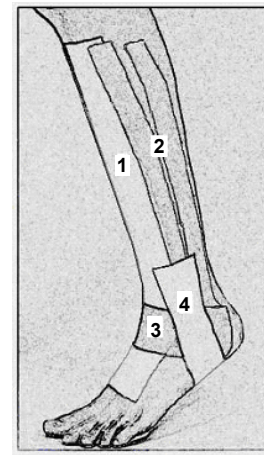


Figure 2: Kinesiotaping for a lateral ankle sprain as carried out in this study. Adapted from Halseth et al. [16].

malleoli [16]. Kinesiotape was applied by the same researcher.

Procedure

The Star Excursion Balance Test (SEBT) was prepared as shown in Figure 1. The examiner then demonstrated visually the SEBT in the antero-medial, medial and postero-medial directions of the star, which Hertel et al. [6] revealed are more efficient in identifying reach deficits in CAI, with PM particularly representing efficiently all 8 limbs of the SEBT. A trial was not valid and was repeated if 1) the subject had lost their balance; 2) the subject placed weight onto the reach foot when touching the line, as this would provide artificial support for the unstable ankle; or 3) the foot did not touch the line. Only 8 trials from 296 tests were discarded.

Subjects were randomised into two groups using web-based randomisation - those who were taped first and those initially untaped. The subjects then performed three practice tests on their stance leg [17] to familiarise themselves with the movements. The subject's barefoot, unstable ankle and foot was used as the stance leg and was placed directly over the centre of the star, using foot length to place the foot correctly. The subjects had to reach as far as possible down the designated line of the star, whilst maintaining their balance, and touch with their foot's most distal point as lightly as possible on the line, which was then marked with a light pen mark, with the intention that the subjects could not see their previous reach mark and subsequently attempt to 'beat' their previous reach. This was done three times in each direction, with a 5 second break between lines, and a ten second break between each set of three reaches. This process (including familiarisation) was carried out with and without tape for each individual, with a 20 minute gap from taping or removal of tape until testing. Measurement of the distance was taken by the examiner following both sessions (once each following with and without tape applied) from the centre of the star to the light pen mark. The same researcher carried out all the measurements.

Statistical analysis

The sample size used was based on the availability of subjects at the time of experimentation. Coefficient of variation was carried out on the three trials for each direction in each patient to detect whether the data were reliable. The mean of each set of three readings were calculated for each patient and condition. The α level was set at $P \leq 0.05$ for all directions and following tests for normality, as all data were

non-parametric and asymmetric, a two-tailed sign test was carried out to evaluate statistical significance. Within this the independent variable is the Kinesiotaping and the dependent variable is the reach in each of the three directions.

Results

Participant details are provided in Table 1. All subjects recorded a CAIT score of less than 24/30. Statistical analysis revealed no significant differences between taped and un-taped reach distances in the AM ($p=0.210$), M ($p=0.454$) or PM ($p=0.077$) directions (Table 2). However this difference was just outside significance for the PM direction suggesting a small increase in functional reach when Kinesiotaping was applied to participants with CAI.

Discussion

The results demonstrate that there is no significant difference in reach distance on SEBT, suggesting that the Kinesiotaping procedure had no effect. This illustrates that the use of Kinesiotape on a chronically unstable ankle has negligible effect on functional performance in these subjects. This suggests that there is little, if any, benefit in using Kinesiotape as used in this study in treatment or rehabilitation of chronic ankle instability.

Previous studies have demonstrated that taping is one of the most common means of supporting a chronically unstable ankle [18] and has a positive protective and rehabilitating effect on those with this condition [19-22]. It is, however, beneficial to note that there have been very few studies in previous research looking particularly at the efficacy of Kinesiotape, especially in relation to CAI. This highlights the need for further research, as Kinesiotape is now being used increasingly worldwide, particularly by sports' players.

Even though there are relatively few studies looking into Kinesiotape, the findings of this study dispute those found by Zajt-Kwiatkowska et al. [23], who stated that the application of Kinesiotape increased the functional capabilities of participants with acute ankle sprain. This could partly explain the differences as the current study used participants with CAI and in an immediate sense, Kinesiotape may allow a more rapid return to painless movement, though ultimately leading to the same degree of recovery [24]. The present study was, however, consistent with Hendrick [25], who found that it was not possible to determine whether or not Kinesiotape had any effect on the ankle. It has also been suggested that subjects with chronic ankle instability perceive greater stability, confidence and reassurance when tape is applied to that ankle even if functionally there appears to be little difference [26,27]. Therefore any benefit which may have

been discovered may not be entirely due to the tape itself, rather the individual's perception of tape having been applied.

Whilst taping with white athletic tape is still very popular and may help with mechanical instability [28] in supporting the chronically unstable ankle, Kinesiotape claims to have therapeutic properties [15] due to the function of the tape. This study did not look explicitly at each of Kinesiotape's therapeutic mechanisms, though an improvement in reach distance, and therefore functional performance, would have revealed that indeed the Kinesiotape had brought about this increase through one of these mechanisms. Functional performance can be affected by various components of the ankle and lower limb, many of which are theoretically enhanced by Kinesiotape. The elasticity of Kinesiotape is unique compared to standard white athletic tape and reportedly leads to the enhancement of joint function [29] as the tape aids the lymphatic and circulatory systems, releasing abnormal muscle tension, thereby restoring normal function. It does this by lifting the skin, producing a greater gap between skin and muscle, allowing more space for blood and lymphatic flow, leading to increased muscle function [30]. Increased ankle proprioception due to Kinesiotape is another matter of some dispute, with Halseth et al. [16] reporting that Kinesiotape appears to have no effect, while Murray and Husk [10], showed that Kinesiotape enhanced proprioception. As this present study did not look specifically at the increase in blood flow or any change in proprioception at the ankle due to Kinesiotape, it cannot neither be accepted nor rejected that Kinesiotape may have these effects on muscle and the ankle, though as this study demonstrated that Kinesiotape did not lead to increased reach distances and hence improved functional performance, all of the theoretical effects of Kinesiotape warrant further investigation.

It was beneficial to this study that it was performed on individuals who had ankle pathology, which allowed for Kinesiotape to have its effect on injured tissue, as it claims to do. Halseth et al. [16] and Ozer et al. [31] performed their studies on previously healthy ankles, finding that Kinesiotape had no difference compared to other or no interventions. It is vital to perform studies investigating the efficacy of Kinesiotape as a treatment, either individually or as an adjunct, in subjects with pathology, as Kinesiotape's effects are not seen on normal tissue [30]. There has been interest in Kinesiotape being utilised as a prophylactic measure in ankle instability, but it was discovered that it was unlikely that Kinesiotape would be effective in this as it had no effect on the fibularis longus, a muscle playing an important role in ankle stability [13].

Kase and Hashimoto [32] state that Kinesiotape takes effect within 10 minutes of application, however an increase in the time granted for

Gender	Age (years)		Height (cm)		Weight (kg)		Leg Length (cm)		Foot Length (cm)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male (n=6)	22.50	1.05	184	3.19	75.00	7.67	100	5.65	27.33	1.40
Female (n=10)	22.30	1.64	173	1.73	70.00	9.07	93	4.88	24.50	0.91
Total (n=16)	22.38	1.41	177	7.62	71.88	8.67	96	6.10	25.56	1.78

SD = Standard Deviation

Table 1: Subject characteristics.

Direction	Mean		Std. Deviation		Minimum		Maximum	
	Tape	No tape	Tape	No tape	Tape	No tape	Tape	No tape
AM average (cm)	77.78	76.55	6.34	6.27	68.7	66.8	88.9	86.1
M average (cm)	81.04	79.45	8.17	7.81	69.1	65.6	94.5	90.2
PM average (cm)	88.33	86.02	11.01	10.42	56.0	55.3	103.5	101.1

Table 2: Subject's reach distances.

the Kinesiotape to produce its effect may be of benefit to any further study. Thelen et al. [24] found an early benefit (within one day) in subjects with shoulder injuries to whom Kinesiotape was applied, rather than within minutes. As Kinesiotape is in some cases regarded as primarily for rehabilitation [25], particularly in dealing with chronic issues such as CAI, which take longer to heal than an acute ankle sprain, further time for effect could be of benefit.

Further, de la Motte [33] states that reach distance alone is inadequate in identifying differences on SEBT between CAI and normal subjects, and suggests also measuring hip and knee angular displacement. The direction of reach (AM, followed by M and then PM) was not randomised, though Olmsted et al. [5] carried out their trials in either a clockwise or counter-clockwise direction.

Finally, it may be useful to include an extra practice trial as recommended by Robinson and Gribble [34] as this will ensure that each subject will have achieved stability, hence maximum reach, following four practice trials.

Participants were not blinded, as initial recruitment methods revealed that Kinesiotape and its effects were being researched. This could mean that subjects expected there to be an effect from the Kinesiotape compared to the untaped condition. This should be looked at for future work and subjects blinded, though this would have been difficult to blind as there would always have been one taped and one untaped condition, with the same subject group used for both conditions. The examiner and the taper were the same person and thus, they too were not blinded, leading to possible further bias regarding results and measurement. Matsusaka et al. [11] found improved functional dynamic balance, through assessment of postural sway on an ankle disk in participants with CAI, when a single strip of white tape was applied over the lateral peroneal muscles. Whether it is specifically Kinesiotape which produces an effect or the presence of any supportive tape leads to the improvement remains to be seen.

Limitations and Future Work

We acknowledge that it may have been beneficial to further analyse the results of the CAIT scores which could have established whether subjects with more severe CAI gained a greater benefit from Kinesiotape compared to those with superior ankle function. This could have been further validated with a larger sample size. Further, it was not determined whether each individual's affected ankle was on their dominant limb. Therefore it is likely that some subjects' affected limb was dominant and for others it was not. Due to differences in neuromuscular ability between dominant and non-dominant limbs, this could be a confounding factor in performance. Finally, a subjective questionnaire could have been created to assess perceptions of stability and performance.

This is still partly due to the small volume of data. Ultimately, a full RCT could be carried out on the different varieties of tape, comparing: 1) no tape; 2) a placebo tape; 3) white zinc oxide athletic tape; and 4) Kinesiotape. Using recommendations previously made, for example, maintaining blinding and using a questionnaire to subjectively assess functional performance, several of the studies raised within this study could be managed.

Conclusions

In young, active subjects with CAI, the application of Kinesiotape to the unstable ankle produces no significant immediate difference to the subject's functional performance. This illustrates that the use of Kinesiotape on a chronically unstable ankle has negligible effect on

functional performance in these subjects. This suggests that there is little, if any, benefit in using Kinesiotape as used in this study in the treatment of chronic ankle instability.

To understand further the role of Kinesiotape in chronic ankle instability, and indeed if it does have any role, more research is required, both into the degree of CAI which requires treatment beyond conservative management and the effects which Kinesiotape can have on the ankle under different conditions. The potential for Kinesiotape to play a part in the rehabilitation of CAI subjects, assisting in more rapid recovery, could be very important in future for sports players, both past and present.

Acknowledgements

The authors would like to acknowledge staff in the Fitness Assessment and Sports Injuries Centre and Irene McTernan, who aided in subject recruitment, as well as the participants of the study.

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