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The role of kinesiotaping in improving the ankle dynamic stability

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ABSTRACT

Background: *Active ankle stability corresponds to the integration of sensory information to allow the modulation of the motor response and its adaptation. Among these different effects, the Kinesio-Taping could have a stabilizing effect on the joints.*

The purpose of this study is to determine if there is a link between the application of Kinesio-Taping and the improvement of active ankle stability. The dissertation is based on a clinical trial.

Methods: *The sample consists of 15 asymptomatic participants, corresponding to recreational athletes. Y Balance Test and Side Hop Test are the functional tests selected to evaluate the stability of the ankle without and then with Kinesio-Taping application. Both the dominant and non-dominant side will be tested.*

Results: *Comparison of the results between passages with and without Kinesio-Taping shows significant differences: Tests with Kinesio-Taping show higher test performance. These data are found for the Y Balance Test as well as the Side Hop Test, during the dominant and non-dominant side passages.*

Conclusion: *Kinesio-Taping allows better motor performances in the case of our study and during the literature review. However, the placebo effect must be taken into account when interpreting the data.*

Keywords: Active ankle stability, Kinesiotaping, Y balance test, Side hop test.

Abbreviations: KT: Kinesi Taping; SHT: Side Hop Test; YBT: Y Balance Test

INTRODUCTION

Sprain of the lateral ankle complex is the most common musculoskeletal trauma. In France, it is the cause of 7% to 10% of hospital emergency consultations, with approximately 6,000 people affected every day. One of the main complications of this sprain is chronic instability of the ankle, making the joint non-functional according to Verhagen et al. [1]. Many teams have shown that a proprioceptive defect and muscular deficiencies in the lateral ankle and pelvic stabilizers are as many factors predisposing to ankle sprain and chronic instability [2-4].

Proprioception corresponds to the perception of oneself through the intermediary of information coming from proprioceptive mecano receptors and processed by the central nervous system. This sensory integration provides information on the position of the different body segments in relation to each other, but also on their respective movements according to Han et al. [5]. Thus, the postural system is based on the integration of sensory information and then leads to a modulation of the motor response that offers the ability to maintain a position or balance during movement. Postural activity is at the center of a network of sensory and motor functions.

Posture is subject to the adaptation of the musculoskeletal system in the face of disturbances. These can come from a movement or an external stress. The postural system acts to maintain the body's equilibrium in an adapted reaction according to the intensity of the disturbance. For this, the integrity of the sensory-motor systems is essential, as is its reactivity, according to Wei et al. [6].

In pathologies such as ankle lateral ligament sprain or instability of the lateral complex of the ankle, the postural system is damaged according to the work of Munn et al. [7]. To our knowledge, there is no tool that can improve the responsiveness of the system and thus alleviate these disorders.

The K-Tape was born in the late 1970s in Japan by Dr. Kenzo Kase. According to Kase, KT would increase proprioception, improve blood and lymphatic flow or reduce pain. KT is made of cotton and is permeable, which allows the skin to maintain its exchange with the outside world. The close contact between the tape and the skin could increase the sensory information from the skin receptors while in motion. In addition, the tape could increase the cutaneous inputs converging towards muscular afferents and increase the excitability of the motor neuron reservoir according to the 2009 work of Refshauge et al. [8].

Taking this information into consideration, the aim of this study is to investigate whether the addition of KT on a healthy ankle improves the stability of the area and thus increases its performance in specific tests.

MATERIALS AND METHODS

Population

The clinical trial is conducted in an asymptomatic and young population. The sample consists of a population of amateur athletes. Fifteen subjects participated in the study (2 women and 13 men) whose anthropometric characteristics are grouped in Table 1.

Table 1 Anthropometric characteristics of the population

	Age (a)	Height (m)	Weight (kg)	Foot Size	BMI (kg/m^2)	Sex	Dominant Side
Average	23,33	1,77	78,4	42,93	25,03	13 H	11 Right
Standard Deviation	3,18	0,065	15,01	2,37	4,16	2 F	4 Left

Exclusion criteria involved semi-professional and professional athletes and subjects participating in another study involving postural control or specific lower limb strengthening. The non-inclusion criteria rejected subjects with vestibular or neurological disorders as well as any subject who has had lower limb-related pathologies in the last three months, as recommended in the work of Chinn et al in 2014 or Mettler et al in 2015 [9,10]. Subjects who did not complete all the tests or failed to perform all the tests are automatically excluded.

Protocol

The study protocol is a comparison of postural and dynamic stability without and with KT using two clinical tests, the YBT and the SHT.

To begin with, each test is tried once in order to allow training, as well as understanding their specificities and their implementation. In addition, these trials offer the possibility to correct the subjects in the performance of the tests and to decrease the learning effect between measurements.

All subjects perform a first pass without applying KT. Arbitrarily, the choice is made to start with the YBT and then the SHT is performed, the dominant side performs the tests first. The starting position of the subjects is standardized: The subject is standing bare foot and his hands must be placed on the hips.

This order of test is kept for the second part where the KT is added, in accordance with the recommendations of Halseth et al. [11] YBT then SHT, on the dominant side then on the non-dominant side. The strips are arranged symmetrically on each lower limb.

Y Balance Test

To perform the YBT, the subject must position himself in the center of the star formed by the anterior band and the two posterior branches. The tested limb corresponds to the foot which remains fixed to the ground. The hallux of the foot being tested settles at the intersection of the branches. The heel is placed in the extension of the anterior branch. The non-supporting limb must touch the support as far as possible in each direction without putting weight on it. Coughlan has established an inter-observer reproducibility of 0.85-0.91 and an intra-observer reproducibility of 0.99 for the YBT based on the 2012 study by Coughlan et al. [12].

During this assimilation phase of the tests, three training trials should be performed for the dominant and non-dominant side of the YBT. The examiner corrects the subjects and insists on the specific rules for each test and the errors to be avoided.

For the YBT, three attempts are proposed, respectively for each member. Between each attempt in the three directions, a five-second break is given to the subject. The measurements are not taken into account if: the heel of the limb on the ground comes off, the free limb takes support, the hands come off the hips, the two lower limbs touch each other. The Y-shape required for the test is recreated on the floor. To facilitate the measurement, the axes are annotated with a graduated ruler of 5 cm by 5 cm. Each axis is graduated identically.

Side Hop Test

The SHT is a dynamic functional test, simple to perform and to understand by the subject according to the work of Caffrey et al. [13]. According to Portney in 2009, the intra class correlation coefficient is 0.84 [14]. It consists in placing two strips on the ground, parallel to each other and 30 cm apart. The subject is positioned parallel to the strips at one end and will have to make 10 round trips as quickly as possible. The data studied is the time needed to perform the test, using a stopwatch.

For the SHT, the subjects are allowed 10 round trips on both sides to understand the test. The examiner checks for imperfections and recalls the rules targeted for this test. Once this training phase has taken place, the tests are carried out. Two tests are performed for the SHT, respectively of each limb. Following the installation of the KT, one trial for each test is performed to feel the difference after the application of the tapes.

K Tape Placement

The installation of KT is identical to the installation proposed by Halseth et al. [11]. He describes its installation by the use of 4 distinctly applied elastic bands.

The skin is washed and then dried before the bands are applied. The first band is applied on the middle of the foot, on the dorsal part and goes up just below the anterior tibial tuberosity, in maximum plantar flexion. The

second band starts above the medial malleolus and ends laterally to the first band, wrapping the heel like a stirrup, in neutral position. The third band is placed at the level of the retinaculum of the extensors, covering the medial and lateral malleoli, in maximum plantar flexion. The fourth band originates at the plantar arch and rises on each side of the malleoli, in neutral position.

STATISTICAL ANALYSIS

The panel tested with KT is related to its own result without KT. Data analysis corresponds to a comparative model of matched data. The T Student test is used to see if there is a significant difference between the two groups. The significance threshold for the results is set such as $\alpha < 0.05$.

RESULTS

The whole protocol was supervised by the same reviewer. The choice was made to keep the best distance of the three attempts for the YBT, and the quickest distance for the SHT, for the dominant and non-dominant sides respectively. The results are grouped in the following Table 2 and 3.

Table 2: YBT test results before and after KT installation

Tests	Without K-tape in cm	With K-tape in cm	p-value
	(Ave ± SD)	(Ave ± SD)	
YBT Anterior dominant side	67.67 ± 4.59	70.93 ± 5.76	0.00326
YBT Poster Medial dominant side	90.67 ± 7.59	97.07 ± 7.24	3.75E-05
YBT Poster Lateral dominant side	88.27 ± 9.92	95.6 ± 9.1	5.31E-05
YBT Anterior non-dominant side	65.53 ± 5.62	70.27 ± 7.29	0.00967
YBT Poster Medial non-dominant side	89.67 ± 7.78	94.87 ± 8.45	6.79E-05
YBT P Poster Lateral non-dominant side	86.47 ± 10.13	92.0 ± 8.99	2.20E-05

Table 3: Results of the SHT before and after KT application

Tests	Without K-tape in s	With K-tape in s	p-value
	(Ave ± SD)	(Ave ± SD)	
Dominant side	9.39 ± 3.50	8.47 ± 3.3	0.00015
Non-dominant side	9.71 ± 3.43	8.59 ± 3.01	1.91E-05

According to the data in Table 2 corresponding to the T-Student Test for YBT, the three tests performed are statistically significant. Each branch of the YBT gives p-values lower than 0.05 for both the dominant and non-dominant side.
According to the data in Table 3 corresponding to the T-Student Test for the SHT, the results are significantly different. The statistical tests give p-values lower than 0.05 for both the dominant and non-dominant side.

DISCUSSION

The aim of this study was to demonstrate the link between the use of a combined KT application and the improvement of active ankle stability. The normality of the sample was tested for age, size and BMI parameters. Each individual is his or her own comparative.

The tests applied are the YBT and SHT. The best of the three tests is taken into account for the YBT, and the best of the two for the SHT. For each test a training trial has been granted in order to avoid a difference related to learning during the measurements.

The results of the statistical tests allow concluding that the KT assembly improves active ankle stability in the context of static postural evaluation. Our data are significant and can be compared with the literature.

Statistical tests concluded that our data were significant, for each branch of the YBT and for the SHT for the dominant and non-dominant side respectively. The comparative scores are numerically higher with KT than without (see Tables 2 and 3). The exploration of the YBT results is divided into the three branches, with each section showing higher scores. The use of KT allows postural performance above that practiced without KT. The measurements performed for the SHT also show a significant difference. The results obtained, regardless of the side examined (dominant or not), are better with KT.

Andreo [15] and Jelinek [16] are working on an identical population. Both compare the effect of a KT band and a rigid band compared to experiments without bands. As in this work, an YBT is performed. In Andreo's study, the findings suggest a significant increase in ankle dynamics for the posteromedial branch of YBT. For the other branches, the distances are greater when tested with KT but not significantly. KT would then decrease the imbalance in the extreme positions. In Jelinek's study, the results are significant in the two posterior branches with the use of KT. The significance of the results obtained here at YBT is consistent with their studies. Both authors agree that the application of KT on the skin influences neurological control as well as the adaptation of the ankle dynamics to maintain postural stability in a balance exercise such as YBT.

Callaghan has been working since 1997 [17] on the application of KT in healthy subjects and subjects with a history of lateral ankle sprain. Tests have been performed on inversion movements but also on daily activities such as walking. The KT helps to prevent movements of extreme amplitude and to reduce abnormal movements. The use of functional tests is different from those used in our study; however the conclusions are in agreement. These results are all the more significant if there is a recent history of trauma to the ankle.

The difference is made by a better recruitment of active and passive means, neuromuscular loops to stabilize the ankle. Stability is a combination of neuromuscular and mechanical aspects. In extreme amplitudes of movement or at the precise moment of injury, there is a deficit of these stabilizing actions. Compensation must be made through active and passive means.

Halim-Kertanegara [18] studies the possible sensory-cognitive effect on a population with functional ankle instability. He contrasts a group without bands with a KT group. The bands did not significantly improve performance during YBT contrary to our study. But the results were significant in jumping tests and when descending stairs. At the same time, they evaluated the sensations felt by the patient through a questionnaire. These recordings show a decrease in apprehension and a higher perceived confidence. Without impacting performance, the feeling of being reassured allows for more difficult physical activity. This sensation is increased in people with chronic ankle instability.

Simon et al. [19,20] collect data from three articles. The authors agree that YBT and the Biodex system did not create enough disturbances to quantify the use of KT to test the ankle within its mechanical limits. In a manner identical to the protocol of our study, they studied the immediate effect of KT, in the very short term. Conversely, they did not find significant increases in the results with KT for the Yand Biodex system. The greatest perception of stability was found with the use of KT. KT has an influence on the confidence of the participants. The authors qualified the data as a placebo effect.

Prevention is one of the supposed characteristics of KT. In the panel of selected studies, this role is confirmed. The parallel with the sensory-cognitive effect is primordial, the preventive idea is partly linked to the subject’s feeling.

On the other hand, the literature is not unanimous regarding the effects of KT and the results of our study. The improvement in scores in the functional tests carried out is not always significant, nor does it exist.

Nakajima and Baldridge [21] published an article opposing a placebo and a KT pose. No significant results have been proven for the realization of vertical jumps. The KT neither helped nor inhibited movement in the male population, the results for women are significant for the postero-medial part of the YBT. Our study is not

representative for a female population with only two subjects, therefore it is not possible to compare our data with that of an exclusively female population.

To our knowledge, there are no comparative literary references to our study dealing with the difference between the effects on the dominant and non-dominant limb.

LIMITATIONS OF THE STUDY

There is no real consensus on the use of functional tests to analyze the active stability of the ankle. However, our work is based on customized tests in line with numerous studies. Ko et al. [22], consider that the combination of YBT and SHT is the most suitable to investigate the stability of the ankle.

However, each test has its own limitations. In the YBT, 5 cm by 5 cm graduations were annotated on the floor to facilitate measurements. Consequently, the counterpart was that the subjects of the study could influence their results by trying to improve their own results with respect to the present graduations. Measurement was reliable through the use of these scales. However, the problem of measurement and potential errors may remain.

The studies analyze the results according to two specificities, the best score of the three trials or the average of the three respective directions as Cain et al. [23].

In the case of the SHT, the possible error is related to the measurement, even if the errors remain limited. The examiner taking care of the stopwatch remains the same during the different tests. But the start of the stopwatch is triggered at the start of the first jump and the stops at the finish of the tenth round trip are subject to a possible latency in the management of the stopwatch. Kamonseki et al., specify that the standard error of relative measurement varied from 0.63 to 0.67.

The SHT is used to put strain on the lateral structures of the ankle. Static and dynamic stabilizers are stressed in the medial and lateral directions according to the work of Cain et al. [23].

CONCLUSION

This study shows significant results in favor of the use of KT, for the functional tests used. The analysis of the literature agrees with our results. KT appears to be a legitimate complement for active ankle stability.

The placebo effect, the increased feeling of confidence and the feeling of compression are data to be taken into account. These principles found in our study and in the literature alter the impact power of KT and modulate our understanding of its mechanical effectiveness.

Research focused on specific sports practices would allow us to clarify our results on representative activities. As the KT is mainly used in a pathological context, an evaluation of its effectiveness on these populations would also be interesting to carry out.

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