

The influence of Kinesio Taping of the ankle joint on stabilometric parameters in women aged 18-25 years

Wpływ aplikacji kinesiotapingu stawu skokowo-goleniowego na zmienne stabilometryczne u kobiet w wieku 18-25 lat życia

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Key words

postural stability, Romberg test, proprioception, balance, stabilometry, Kinesio Taping

Abstract

Introduction: The upright posture uniquely characteristic of humans is dependent upon many factors. Kinesio Taping is used to enhance ankle joint stability, but its effectiveness in relation to body stability in a standing position has not yet been verified in scientific research.

Objectives: Assessment of the effect of ankle Kinesio Taping on stabilometric parameters in young, healthy women.

Material and Methods: The study included 50 healthy women (mean age 21.12 ± 1.83 years) who were randomly assigned to two groups: the taping group (group T) and control group (group C). In the taping group Kinesio Taping was applied according to the method used in ankle sprains (both inversion and eversion). The women performed the Romberg test four times with each trial lasting two minutes on an Alfa AC International East stabilometric platform: two tests without Kinesio taping intervention and two further tests with (group T) or without taping (group C).

Results: Significant differences between the groups were observed in the following parameters: mean speed in the sagittal plane with eyes open; 0.06 cm/s ($p=0.0002$), mean speed in the frontal plane with eyes open; 0.07 cm/s ($p=0.0001$), total path length with eyes open; 5.78 cm ($p=0.0001$) and sway area with eyes open; 0.58 cm² ($p=0.0002$) and in parameters: mean velocity in the sagittal plane with eyes closed; 0.10 cm/s ($p=0.0004$), mean velocity in the frontal plane with eyes closed; 0.11 cm/s ($p=0.0004$) and in total path length with eyes closed; 0.43 cm ($p=0.0004$).

Conclusions: In young, healthy women who received Kinesio Taping, favourable changes in stabilometric parameters were found indicating better ankle stability than in the group without taping.

Słowa kluczowe

stabilność postawy ciała, próba Romberga, propriocepcja, równowaga, stabilometria, kinesiotaping

Streszczenie

Wprowadzenie: Pionowa postawa ciała stanowi unikalną cechę człowieka, zależną od wielu czynników. Kinesiotaping jest stosowany w celu poprawy stabilności stawu skokowo-goleniowego, natomiast skuteczność takiej aplikacji, jak się wydaje w odniesieniu do stabilności ciała w pozycji stojącej nie została wystarczająco zweryfikowana w badaniach naukowych.

Cele: Ocena wpływu kinesiotapingu stawu skokowo-goleniowego na parametry stabilometryczne u młodych, zdrowych kobiet.

Material i Metody: W badaniu wzięło udział 50 zdrowych kobiet (średni wiek $21,12 \pm 1,83$). Badane zostały losowo podzielone na dwie grupy: tejpowaną (grupa T) i kontrolną (grupa K). W grupie badanej wykonano aplikację kinesiotapingu w formie stosowanej po skręceniach stawu skokowo-goleniowego zarówno inwersyjnych, jak i ewersyjnych. Badane kobiety zostały poddane 4-krotnej próbie Romberga trwającej 2 minuty na platformie stabilometrycznej Alfa AC International East. Dwie próby przeprowadzono przed naklejeniem aplikacji kinesiotapingu i kolejno dwie próby: z plastrowaniem (grupa T) bądź bez oklejania (grupa K).

Wyniki: Istotnie statystycznie różnice pomiędzy grupami stwierdzono w parametrach: średnia prędkość ścieżki X przy oczach otwartych; 0,06 cm/s ($p=0,0002$), średnia prędkość Y przy oczach otwartych; 0,07 cm/s ($p=0,0001$), długość ścieżki przy

The individual division of this paper was as follows: A – research work project; B – data collection; C – statistical analysis; D – data interpretation; E – manuscript compilation; F – publication search

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oczach otwartych; 5,78 cm ($p=0,0001$) i pole powierzchni przy oczach otwartych; 0,58 cm² ($p=0,0002$) oraz w parametrach: średnia prędkość X przy oczach zamkniętych; 0,10 cm/s ($p=0,0004$), średnia prędkość Y przy oczach zamkniętych; 0,11 cm/s ($p=0,0004$) oraz w długości ścieżki przy oczach zamkniętych; 0,43 cm ($p=0,0004$).

Wnioski: U młodych, zdrowych kobiet poddanych aplikacji kinesiotapingu stwierdzono korzystną zmianę parametrów stabilometrycznych wskazującą na większą stabilność stawu skokowo-goleniowego w porównaniu do grupy, u której metoda ta nie była stosowana.

INTRODUCTION

Ankle joint stability is an important element maintaining a vertical human posture and plays a key role in the basic mechanism of regaining the body's balance through automatic patterns of movement. The strategy (stability and functionality) of the ankle joint is the first in a hierarchy of strategies for regaining balance. Ankle strategy functions through neuromuscular control, properties of the bone-ligament apparatus and the work of muscles which are engaged in this process^{1,2}.

The influence of Kinesio Taping on the human body has not been unambiguously determined³. In scientific studies, attention is drawn to its impact upon the elevation and folding of soft tissues subjected to taping which enable more favourable conditions for the repair of body structures and to the stimulation of the nervous system by the skin receptors. Many authors also describe the influence of Kinesio Taping on the regulation of muscle tension, improvement of microcirculation, pain reduction and the correction of improper joint positioning⁴⁻⁶.

Recent scientific reports concerning the influence of Kinesio Taping on stabilometric parameters have been based on the results of studies of small population groups (e.g. basketball players with multiple, habitual inversion ankle joints sprains) and do not take into account the significant effect of test learning in determining the change of test outcomes after several repetitions⁷.

In terms of use of the established application of Kinesio Taping, it is reasonable to describe its impact on healthy tissues and systems responsible for ankle joint functionality, in order to verify such operation in the case of structures which have been damaged. Mojza et al.⁸, in a study of 40 healthy women and men, de-

scribed a positive effect of Kinesio Taping on neuromuscular control, as evidenced by an improved ability to maintain dynamic balance in a single-leg stand test. Nakajima et al.⁹ observed an increase in dynamic postural control after the application of Kinesio tape in a mixed sex group of subjects. However, a statistically significant improvement was only seen in 24 women. Meanwhile, Hettle et al.¹⁰, in studying 16 athletes, did not see a significant influence of Kinesio Taping on patients with chronic post-traumatic lateral instability of the ankle joint. The conflicting results of these authors do not allow for a definitive conclusion of the efficacy of this method in physiotherapeutic practice¹¹.

Furthermore, in the process of restoring ankle joint stability following traumatic sprain injuries, it is worthwhile determining the influence of Kinesio Taping on treatment outcomes, both in early and long-term observations.

AIMS

The aim of the study was to assess the effect of Kinesio Taping on stabilometric parameters in young, healthy women, including answers to the following questions:

1. Are there differences in stabilogram parameter values after the application of taping within distal parts of lower limbs in young, healthy women?
2. Does the application of Kinesio Taping on the ankle joints of healthy women of age 18-25 years influence proprioceptive feedback as indicated by comparing the results of the examination performed with eyes open and closed?
3. Is vertical body posture stability in young, healthy women affected by ankle joint strategy strengthened by the application of Kinesio tape?

MATERIALS AND METHODS

The study included 56 women of age 18-25 years (mean 21.12 ±1.83). Prior to entering the study the participants completed a questionnaire concerning anthropometric parameters, physical activity and sleep hygiene.

The criteria of exclusion from the study were traumatic injuries of ankle joint in the six months preceding the study (among them: ankle sprains), anatomical anomalies of the ankle joint, a balance deficit resulting from the presence of diseases of the nervous system, otolaryngological conditions or the presence of cervical vertigo, body posture defects, contraindications to Kinesio Taping (lack of continuity of the skin within the area of application, hypersensitivity to the glue used in tapes), an inability to perform the examination with closed eyes (an inability to maintain balance in a natural standing position) and practicing competitive sports¹². Individuals with sleep deprivation were also excluded from the study, due to the potential influence of this factor on the assessed stabilometric parameters¹³.

Eventually, 50 out of 56 reported women were qualified for the study (4 persons were excluded due to chronic sleep deficiency, and 2 due to lower limbs injury in the last 6 months). Detailed characteristics of the group of tested women are presented in Table 1.

Of the women tested, 80% were characterised by a normal Body Mass Index (BMI), while 12% of the group had a BMI below a normal level and a further 8% had a BMI above the norm. In terms of the mean number of hours per week devoted to physical activity, 44% of the tested women declared 4-5h, 32% of women 1-3h, 12% over 8h, 10% 5-7h, with 2% of tested women declaring up to 1 hour per week.

Table 1

Characteristics of the taped group (T) and control group (C)										
Characteristics of the participants										
Parameter	Mean		Median		Minimum		Maximum		SD	
	T	C	T	C	T	C	T	C	T	C
Group										
Age [years]	21.40	20.84	22.00	20.00	18.00	19.00	24.00	25.00	1.87	1.77
Body height [cm]	165.00	168.36	165.00	169.00	153.00	157.00	179.00	178.00	6.23	5.64
Body weight [kg]	58.56	62.44	58.00	59.00	50.00	52.00	76.00	81.00	6.83	9.01
BMI [kg/m ²]	21.52	22.03	22.06	21.19	18.10	18.25	25.78	28.36	2.32	2.99

The examined women were students of the Bronisław Czech University School of Physical Education in Krakow. Recruitment was conducted electronically through student internet groups. The participants of the study were randomly allocated to two equally numbered groups, each representing the approximate level of test learning: taped group (group T), where Kinesio Taping was used and control group (group C), where stabilometric tests were performed without taping¹⁴. The assessment was conducted by a physiotherapist in the Department of Kinesiotherapy in the Academy of Physical Education in Kraków in December 2019 in accordance with the principles of the Helsinki Declaration with the amendments from 2013.

The Alfa AC International East model stabilometric platform was used to analyse the parameters of centre of pressure path length during the Romberg test, which is one of the set programs on this device¹⁵.

At the beginning of the study, the participants were informed about its aim and the test procedure. The participating women, dressed in sports clothes and barefooted, took their place on the platform at its central point based on the indications of the apparatus and according to the examiner's instructions: hands by the sides, eyes on the indicator present on the wall (within 3m and at the height of 1.7m), feet parallel at hip width. The groups were measured 4 times on the platform with a 15-minute break between the 2nd and 3rd measurement¹⁶. During each examination the full Romberg test was performed: a 1 minute test with eyes open followed by a 1 minute test

with eyes closed; in total 2 minutes. Assessments 1 and 2 were performed without application of Kinesio Taping. During the following break time, a physiotherapist trained in Kinesio Taping applied tapes within the distal parts of lower limbs of the women from the group with tape, while the control group rested in conditions similar to those offered to the tested group. The third and fourth assessments were then made. The test was performed in peace, without any distracting or moving elements in the subject's field of vision². Before each measurement the person recording the measurements, present behind the subject, corrected their posture on the platform and repeated the instructions for the test. The women did not receive any information about the tests results until the completion of all four assessments.

The Kinesio Taping was applied to the subjects while they were sitting in the 10° plantar flexion position of the ankle joint, with the foot rested on a step. Application of the first tape began at the lateral part of the fibula head and was then directed at an angle downwards with 100% tension, so it was placed centrally over the ankle joint and finished on the medial part of the head of the first metatarsal bone and the dorsal part of the head of the first and second metatarsal bone. Application of the second tape began on the medial, proximal part of the tibia and was then directed at an angle downwards with 100% tension and centrally through the middle of the ankle joint onto the lateral part of the fifth metatarsal bone and dorsal part of the fourth and fifth metatarsal bones. Application of the third tape in the Y letter shape began

with a common strip on the calcaneal tuberosity then its two separated tails were applied with 100% tension upwards; the first tail below the medial part of the popliteal fossa, and the second on the lateral part of this fossa. 3NS TEX tapes were used throughout the study¹⁷.

Data analysis was conducted using statistical package Statistica 13.3. For the evaluation of normal distribution of variables, the Shapiro-Wilk test was used. Due to the absence of a normal distribution in the variables, the Wilcoxon signed-rank test was used, and the significance *p* was adopted at the level of 0.05. The arithmetic means were calculated from the first and second trial, before the application of Kinesio Taping in the taped group, and third and fourth trials after taping in the T group, and without the application in the C group. The groups were homogenous in age, body height, body weight and BMI. Homogeneity analysis was performed using the Mann-Whitney U test with continuity correction.

RESULTS

The results are divided into two tables: Table 2 describes the results for the first part of each test, i.e. Romberg test with eyes open and Table 3 with the results of the second part of each test, i.e. Romberg test with eyes closed.

In the Romberg test with eyes open, a significant difference of 14.5% was found in mean speed in the X-plane after Kinesio Taping application. In the group with tapes, a significant speed decrease was observed. In the control group there were no signifi-

cant differences observed between the first and second measurement. Mean speed in the Y-plane also showed a significant decrease following the application of Kinesio Taping: the difference was 15.8%. In the control group the observed difference of 6.1% was not statistically significant. Both parameters describing the mean speed

of movement of the central pressure point, which is a projection of the individual's centre of gravity on the measurement platform, showed a statistically significant difference following Kinesio tape application that was not observed in the control group.

The difference in the parameter of path length after application of Kine-

sio Taping was significant at 15.4%, in contrast to the control group where the difference of 5.7% was not statistically significant.

In the Wilcoxon signed-rank test, a statistically significant difference was also observed in the parameter of sway area: among the group with tapes the difference between the tri-

Table 2

Results of the taped group (T) and control group (C) in Romberg test with eyes open										
Name of parameter	Group	Time	Mean	SD	Difference	Z	p			
Mean speed X [cm/s]	T	Before	0.42	0.18	0.06	3.6728	0.0002			
		After	0.36	0.13						
	C	Before	0.45	0.13				0.02	1.5202	0.1285
		After	0.43	0.14						
Mean speed Y [cm/s]	T	Before	0.44	0.20	0.07	3.9957	0.0001			
		After	0.37	0.13						
	C	Before	0.48	0.13				0.03	1.6010	0.1094
		After	0.45	0.14						
Path length [cm]	T	Before	37.44	16.68	5.78	3.9957	0.0001			
		After	31.66	11.56						
	C	Before	40.46	11.44				2.30	1.4664	0.1425
		After	38.16	12.37						
Sway area [cm ²]	T	Before	2.52	1.91	0.58	3.6728	0.0002			
		After	1.94	1.38						
	C	Before	2.90	1.22				0.08	0.9821	0.3261
		After	2.82	2.04						

Table 3

Results for taped group (T) and control group (C) in Romberg test with eyes closed										
Name of parameter	Group	Time	Mean	SD	Difference	Z	p			
Mean speed X [cm/s]	T	Before	0.59	0.32	0.10	3.5114	0.0004			
		After	0.49	0.24						
	C	Before	0.55	0.20				0.03	1.6279	0.1036
		After	0.52	0.20						
Mean speed Y [cm/s]	T	Before	0.64	0.35	0.11	3.5383	0.0004			
		After	0.53	0.26						
	C	Before	0.61	0.24				0.05	1.3258	0.1974
		After	0.57	0.22						
Path length [cm]	T	Before	53.88	29.89	9.28	3.5114	0.0004			
		After	44.60	22.00						
	C	Before	51.49	19.82				3.49	1.2495	0.2235
		After	48.00	18.95						
Sway area [cm ²]	T	Before	3.38	2.65	0.43	1.7893	0.0736			
		After	2.95	2.99						
	C	Before	3.41	2.44				0.22	0.9821	0.3261
		After	3.19	2.78						

als without Kinesio Taping and with its application was 23%, whereas the result in the control group was not statistically significant, with a difference of 2.8%.

In the Romberg test with eyes closed, a statistically significant difference in mean speed in the X-plane between pre and post-taping measurements was found using the Wilcoxon signed-rank test at the level of 16.9%, while the result in the control group of 5.6% was not statistically significant. For mean speed in the Y-plane with eyes closed, there was a statistically significant difference found at the level of 17% after Kinesio Taping application, whereas in the control group the difference of 7.6% was not statistically significant. In the test with eyes closed the parameters describing the mean speed at which the subjects' centre of gravity moves show statistically significant differences.

From the statistical analysis, a significant difference can be observed in the parameter of the path length with eyes closed; following Kinesio Taping application the difference equalled 17.2%, while in the control group without the Kinesio Taping the difference equalled 6.8%. The sway area parameter with eyes closed was determined as statistically insignificant both in the group with tapes, where the difference was 12.8%, and in the control group, where the difference was 6.4%.

DISCUSSION

A sprain of the ankle joint is one of the most common injuries. The approximate number of people experiencing such injury in Western countries is 1 in 10,000¹⁸. In the process of restoring stability of the ankle joint after a history of trauma, it is important to determine the influence of the specified taping on the structures undergoing treatment, as well as establishing the long term effects of the given therapy.

The key element in maintaining a vertical, anti-gravity body posture is the location of the centre of gravity within the support square of the feet.

In order to optimise the energy consumption of this process, it is necessary to limit body sway in the X and Y planes. The use of Kinesio Taping reduces both path length and speed of sway, creating more ergonomic conditions for maintaining vertical body posture¹³.

In healthy people, the presence of negative effects of taping the ankle joint could disrupt the performance of musculoskeletal and nervous apparatus¹. Therefore, the recovery of a patient's motor skills in its final functional stage would also become significantly impeded.

In this research, Kinesio Taping application positively impacted postural stability both in the case of test with eyes open and test with eyes closed. Taking as the mean level of test learning the level of change in results for the control group, the improvements observed in group with tapes significantly exceed this level. This effectiveness when controlling for learning effects is often overlooked in research and demonstrates the beneficial influence of Kinesio Taping on stabilometric parameters. It is an important finding that invites further studies on the influence of Kinesio Taping on the processes of body tissue restoration in people after ankle sprain injuries and supporting their return to functional fitness.

The results of Mojza et al.⁸ differ from those obtained in the present study since the authors found a negligible impact of Kinesio Taping application on maintaining the balance of the body. In their study, measurements were taken from standing on one leg, which puts the test at risk of significant error due to long-lasting fatigue from remaining in the one-legged standing position. Forcing the whole body to considerable work arising from remaining in the same, very tiring position may significantly influence the test results¹⁹.

Bicici et al.⁷, who included in their studies a very small group of only 20 young men with ankle instability, also reported no significant differences when assessing the impact of Kinesio Taping on balance and stability of the ankle joint. However, using such a small test group makes it difficult

to reliably evaluate the parameters. Moreover, the Star Excursion Balance Test (SEBT) used in this study is characterised by questionable reliability arising from the method of reading the measurements, which forces the maintenance of extreme positions for the entire time needed to take measurements. For their study, Kinesio Taping application was used both in the examined and compared group. Therefore, the second group can neither be presented as a control group, nor to differentiate changes between the application of tapes with tension and the placebo effect³.

Nakajima et al.⁹ obtained results similar to the effects of the present study, identifying an improvement in stabilometric parameters in two directions using Star Excursion Balance Test SEBT also in a group of young and healthy women. As already noted, using the Star Excursion Balance Test SEBT may expose the measurement to variability and intervention by the person recording the measurements, calling into question the reliability of the results.

The limited number of scientific reports on the influence of Kinesio Taping application on stabilometric parameters in tests with eyes closed makes it difficult to compare the results from this study to other trials. A study by Akbari et al.²⁰ observed an improvement in stabilometric parameters in a group of 15 young, healthy women after Kinesio Taping application to the ankle joint. They compared the results of a group performing balance training with another group in which only Kinesio Taping application was used. However, the lack of a control group makes it impossible to infer the size of the test learning effect, and information on the tension of the tapes was not provided. Considering the work of Michalak et al.²¹, which demonstrates a significant influence of visual control on the process of maintaining balance, the results from our eyes closed tests cannot be compared with tests performed with eyes open. However, it is worth noting the clear trend toward improvement of the parameters in the part of the Romberg test with eyes open as well as with eyes closed.

The part of the examination excluding visual control of posture minimises the probability of obtaining random results related to the auto-suggestion of the subjects.

The inclusion of only one gender in the research, i.e. the participation of only young, healthy women in the experiment, is a limitation. Furthermore, the examined groups of students did not show similar initial levels of stabilometric parameters. It would be advisable to run a similar study on a larger population in order to increase the probability of obtaining a normal distribution of the test characteristics.

Kinesio Taping is a quick and relatively cheap therapeutic treatment for the motor system, and may also supplement other forms of treatment. In addition, application of this kind of tape to the bodies of healthy individuals significantly influences the neuromuscular control involved in the strategy of maintaining balance, indicating a positive impact on the anti-gravity mechanisms of the muscular system.

CONCLUSIONS

1. Kinesio Taping application on distal parts of lower limbs in young, healthy women has a positive influence on all stabilometric parameters with eyes open: mean speed in the X-plane, mean speed in the Y-plane, centre of pressure path length and sway area.
2. Kinesio Taping of ankle joints intensifies the response from proprioceptors, since stabilometric

tests performed with visual control excluded returned improved results in 3 out of 4 parameters.

3. Increasing ankle joint stability through Kinesio Taping application in distal parts of lower limbs improves static balance in young, healthy women.

Conflict of interest

The authors declare no conflicts of interest

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