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Can the kinesio taping change the pelvic tilt angle in healthy young women?

Pode o kinesio taping alterar a inclinação pélvica de mulheres jovens saudáveis?

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ABSTRACT

Introduction: The pelvis is a key structure for the alignment of the body and its misalignment can cause pain. Weakness of the gluteus maximus (GM) muscle can increase the pelvic tilt angle (PTA). Kinesio Taping (KT) is a technique used to stimulate muscular action, by applying a bandage over the muscle with a longitudinal tension of 25% to 35%. **Objectives:** To assess the immediate effects of the KT stimulating technique over the GM on the PTA of healthy women and verify if the 60% tension would lead to better results. **Methods:** Twenty-six healthy women, with a mean age of 23.3±2.8 years, had their PTA bilaterally assessed by means of computerized photogrammetry before and immediately after received KT application with 30 and 60% tensions. Repeated measure ANOVA (2x2) was used to assess the main and interaction effects between the applied tensions and time. The standard error of the measurement (SEM) was also calculated to evaluate the clinical impact of the techniques. **Results:** The analysis revealed that both KT tensions reduced the PTA. Although no significant differences were observed between the two employed tensions, the clinical effects were higher for the 60% tension. **Conclusion:** Both applied KT tensions reduced the PTA in the standing position of healthy young women, but the tension of 60% led to more clinically significant results.

Keywords: Kinesio taping; Elastic tape; Gluteus maximus; Photogrammetry; Pelvic tilt.

RESUMO

Introdução: A pelve é uma estrutura chave para um adequado alinhamento do corpo e o seu desalinhamento pode gerar dor. A fraqueza do músculo glúteo máximo (GM) pode aumentar o ângulo de inclinação pélvica (AIP). *Kinesio Taping* (KT) é um método empregado para estimular a ação muscular pela aplicação da bandagem com uma tensão longitudinal de 25 a 35%. **Objetivos:** Avaliar os efeitos imediatos da técnica estimulatória do KT no músculo GM sobre o AIP de mulheres saudáveis e verificar se a aplicação de uma tensão de 60% proporcionaria melhores resultados. **Método:** Participaram 26 mulheres saudáveis com média de idade de 23,3±2,8 anos, nas quais o AIP foi mensurado bilateralmente pela fotogrametria computadorizada, antes e imediatamente após a aplicação do KT com 30 e 60% de tensão. ANOVA mista de medidas repetidas (2X2) foi utilizada para investigar os efeitos principais e de interação entre as tensões do KT e o tempo. Foi calculado, ainda, o erro padrão da medida (EPM), para avaliar o impacto clínico dos efeitos das técnicas. **Resultados:** A análise revelou que a aplicação do KT reduziu o AIP nas duas tensões empregadas. Contudo, apesar de não ter havido diferença estatisticamente significativa entre as tensões, o EPM da aplicação com 60% de tensão demonstrou ser esta a aplicação clinicamente mais efetiva. **Conclusão:** Ambas as tensões empregadas na aplicação do KT reduziram o AIP, em posição ortostática, de mulheres jovens saudáveis, mas a aplicação com 60% de tensão apresentou resultados clinicamente mais significativos.

Palavras-chave: Kinesio taping; Bandagem elástica; Glúteo máximo; Fotogrametria, Inclinação pélvica.

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INTRODUCTION

The pelvis is a key structure for proper alignment of the body and its misalignment can lead to changes in the distribution of body weight, causing pain in the spine, hip, and knee joints.[1] Activation of the gluteus maximus (GM) muscle is important for the performance of many activities of daily living, such as standing up, walking, and running and plays an important role in pelvic stability.[2]

Considering that the passive stiffness may be increased with strength training[3] and that the extension portion of the GM muscle influences the pelvic tilt angle (PTA), by reducing an excessive pelvic anteversion, strength training of the GM could be indicated, when changes in PTA are required.[4] In fact, it has been demonstrated that the GM of patients with chronic low back pain is weaker and fatigues faster, when compared to healthy people[5] and, consequently, its weakness should be taken into consideration within clinical contexts.

However, despite the hypertrophic processes start early during treatment, the gains in muscular hypertrophy occur mainly after six weeks of training.[6] Furthermore, it has been suggested that hypertrophy training in untrained individuals should be preceded by resistance and strength training, to avoid excessive muscular injury and hypoglycemia, which are observed after hypertrophy training.[7] It appears, then, that an effective hypertrophy training to generate changes in joint position, may require an long time to achieve all the desired results. In addition, to the extent that the produced average maximum voluntary force is inversely correlated with the pain experienced during maximum contractions and the fear of movement in patients with chronic pain[8], its implementation may also be hampered by the presence of painful symptoms, and more conservative strengthening protocols would have to be adopted, delaying the rehabilitation process.

The Kinesio Taping (KT), which is a technique, that involves the application of an elastic bandage, was developed in the 1970s by chiropractor Kenzo Kase, and has been widely used in sports injuries.[9] The KT application technique depends upon the intended goal. There are techniques that have the purpose of both stimulating or inhibiting the muscles, reducing pain and the occurrence of injuries, and improving circulation and healing, amongst others.[10] According to the creator of the technique, to stimulate the muscles, the bandage application should be from the proximal to the distal end of the muscles with tensions between 25 and 35%.[10] However, there is no evidence that these foundations are true, since it has been shown that the direction of the application did not interfere with the effects of the KT[11] and that a longitudinal tensions between 50 and 100% increased the GM power during jump in athletes.[12]

It was observed that the KT application with tensions between 30 and 40% of its original length over the external oblique and rectus abdominis muscles, and over the anterior superior iliac spine (ASIS) towards the posterior superior iliac spine (PSIS) pulling the pelvis backward, induced mechanical corrections, with reduced anterior pelvic tilt in patients with chronic low back pain.[13] However, despite the GM be an important hip extensor and the evidence of the KT effects on jumping performance,[12] there were not found any studies that evaluated the effect of KT application over the GM on the PTA and/or that compared its effect, when tension above that suggested by the International Association of Kinesio Taping, was employed.

Furthermore, it would be important to determine whether the stimulus generated by the KT on the GM muscle would be sufficient to modify the position of equilibrium of the pelvis, which could assist with the implementation and progress of kinesiotherapic treatment. Thus, the aims of this study were to evaluate the immediate effects of KT application with 30% of longitudinal tension over the GM muscle with stimulatory technique on the PTA in healthy young women and verify if the application with a longitudinal tension of 60% would provide better results.

METHODS

Participants

Participated 26 healthy women, between 18 and 30 years of age, with a body mass index (BMI) below 30 kg/m^2. All participants provided consent, which was previously approved by the Research ethical committee of the Universidade Federal de Minas Gerais (#0368.0.203.000/2011). Participants were excluded if they had complaints of low back pain and/or lower limbs (LL) and any allergic reactions to the KT.

Sample Size Calculation

Sample size calculation was based upon a pilot study with 10 volunteers, which found an effect size of 0.27, and a statistically significant correlation (r=0.77). These data were entered into the G*Power software, considering a power of 0.80 and a significance level of 1%. Twenty-two participants would be required, but considering the possibility of 15% loss, 26 participants were recruited.

INSTRUMENTS AND PROCEDURES

Initially, demographic and clinical data, including age, BMI and dominance of the lower limbs, were collected for characterization purposes. Lower limb dominance was determined by asking the participants “which leg they used to kick a ball”.

Pelvic Position Angle by Computerized Photogrammetry

Static measures of PTA were collected by a trained researcher, who evaluated 10 participants twice, with an interval of one week. Test-rested reliability was high (ICC=0.99). The mean and standard error of the measurement values

for the test and retest were 15.78±0.17 and 15.30±0.16°, respectively.

The photogrammetry, which was used for the assessment of the static pelvic tilt angle[14], is a method that evaluates posture, by combining digital photography with software that allows for the measurement of both horizontal and vertical angles and distances. It is a non-invasive method, affordable, and has no contraindications to be used in clinical practice. The Brazilian postural evaluation software, named SAPo, it free and considered to be reliable assessment method.[14]

For the photographic records, the volunteers were asked to remain in the standing position, with their forearms flexed at 90°. They wore a garment that allowed the visualization of both the ASIS and PSIS, which were located by palpation and marked with a dermatographic pencil. Spherical styrofoam markers of 20mm diameter were attached over the ASIS and PSIS with double-sided adhesive tape.

The photographic records were obtained with a digital camera Kodak® of 10.2 megapixel resolution and the images were analyzed by the SAPo software. To obtain the photographic records in side views, the camera was positioned on a tripod at a distance of three meters. Furthermore, the feet of the volunteers were aligned with their acromion and a plumb line was used as a reference for the vertical alignment.

The PTA was calculated by using the SAPo option "measuring free angles". After calibrating the images, the position of the ASIS and PSIS (Figure 1) were identified and the angle between these two points and a horizontal line created from the PSIS was obtained three times. The means were registered for analysis.

Figure 1. Computerized photogrammetry analysis of a participant, who received KT application with tensions of 30 and 60% on the dominant (right) and non-dominant sides, respectively.

Intervention

The intervention was applied by a trained and experienced physiotherapist with the technique, who was graduated by the International Association of Kinesio Taping. The applied KT tensions were randomized Thus, half of the volunteers received tensions of 30% on the dominant side and 60% on the contralateral side, whereas the other half, received the reverse procedure. Both participants and evaluator were blinded to the applied tensions.

For standardization purposes, the KT was initially applied on the dominant side. Since the retention effects of the KT are not known and aware that KT application over the GM of one side could modify the contralateral side[4], the application on the contralateral side occurred after a period of at least 4 hours. Given that different brands of bandages available on the market do not have the same mechanical behavior and the different colors available in the same brand, differ widely in their maximum traction efforts,[15] the Kinesio® Tex Gold TM bandage in black was always employed.

It is known that the effects of the bandages may vary with the stretch[15] and that the KT has the physical property of lengthening f its length by 50%, when subjected to a longitudinal tension of 100%. Therefore, 30% tension would generate 15% of lengthening, while 60% tension would produce 30% of lengthening. For this reason, a more precise and practical technique of application was developed for this study. To generate 30% tension on the bandage, the KT should be lengthened by 15% of its original length. For determination of the bandages length, the three portions of the stretched GM were measured with a tape-measure, considering their approximate points of origin and insertion. From the value obtained, it was subtracted 15% for apply the KT with 30% tension, and to apply with 60% tension, it was subtracted 30% of its length. As in the proximal and distal anchors of the bandage it cannot be used any tension, it was added five centimeters, in the length previously determinate, for the each portion of GM, in each tension, for the proximal anchor and more five for the distal anchor.

After establishing the tension, the band was cut, their edges were rounded and the KT was applied over the skin from the proximal to the distal insertions of the GM muscle, with the volunteers lying on theirs sides and keeping their hip joint in flexion, adduction and internal rotation, and knee joint semiflexed.[12]

Thus, three bandages with an "I" cut were applied, such that the three distal anchors were partially overlapped, over and immediately below the greater trochanter of the femur (Figure 1). Finally, the KT was stimulated by the hand of the therapist, to increase adherence. Then, the markers were reattached and the photogrammetric imaged were obtained again.

Statistical Analysis

Descriptive statistics and test for normality (Shapiro-Wilk) were calculated, using the SPSS (version 15.0) software. Mixed repeated measures ANOVA (2x2), followed by pre-planned contrasts, were used to assess the main and interaction effect between the applied tensions (30 and 60%) and time (pre- and post- KT application) with a significance level 5%. The EPM was calculated for the employed tensions of both sides.

RESULTS

Characteristics of the participants

Twenty-five of the 26 volunteers had their right lower limb as dominant. Their descriptive data are shown in Table 1.

Inferential results

ANOVA revealed that both KT tensions reduced the PTA ($F=26.35$, $df=1$, $p<0.0001$), with a power of 0,999. There was no significant interaction effect ($F=2.11$, $df=1$, $p<0.152$) between the applied tensions, indicating that the both tensions resulted in similar reductions in the PTA (Figure 2). The PTA data before and after the KT application are given in Table 2. The SEM was 1.27 and 1.40 for the tensions of 30% and 60%, respectively.

The KT application with 30% of tension caused an average decrease of 0.94° in the PTA and the tension of 60% generated an average reduction of 1.68°, i.e., the magnitude of change observed with the 60% tension application was greater than the SEM value, and thus, clinically meaningful.

Table 1. Descriptive data (mean±standard deviation) and range (minimum-maximum) regarding the age, body mass index, and pelvic tilt angle (n = 26).

Variable		Mean ± SD	Range (minimum-maximum)
Age (years)		23.27±2.84	18-29
Body mass index (Kg/m^2)		22.45±3.07	17.46-28.96
Pelvic tilt angle (degrees)	Dominant LL	10.22±3.13	4.6-14.3
	Non-dominant LL	10.45±2.74	5.5-16.3

LL=Lower Limb.

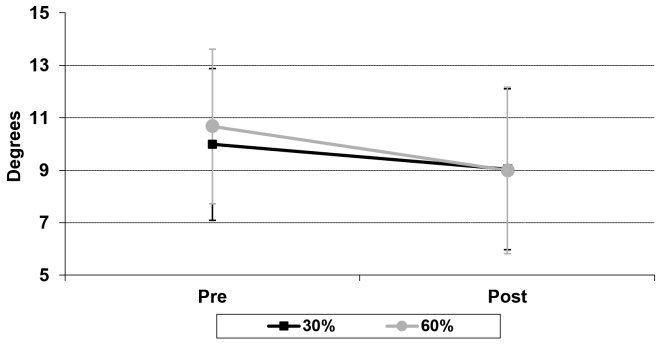

Figure 2. Pelvic Tilt angle before and after the Kinesio Taping application at tensions of 30 and 60% (n=26).

Table 2. Pelvic tilt angle values (mean±standard deviation) and confidence intervals of 95% [minimum-maximum] before and after the Kinesio Taping application with both tensions (n=26).

Tension	Pre	Post	*CI 95%*
30%	9.99±2.89	9.05±3.07	0.23-1.64
60%	10.68±2.95	9.00±3.17	0.90-2.45

CI= confidence interval.

DISCUSSION

The results of this study showed that KT, applied with stimulatory technique with tensions of 30 and 60% over the gluteus maximus muscle, reduced the anterior pelvic tilt of healthy young women. Although both tensions resulted in decreases of the PTA, the changes found with tensions of 60% were higher than the SEM values, and thus, both statistically and clinically significant.

The creator of the technique stated that the KT stimulates the skin mechanoreceptors, leading to improved proprioception and, consequently, to better muscular function. However, no improvement in knee joint position sense was observed in women with patellofemoral pain syndrome after the KT, compared with placebo application.[16] In healthy individuals, of both sexes, improvements in the ankle sense of position immediately after application of KT with corrective technique were also not found.[17] In this regard, one could question the improvements of proprioception and/or increases in nerve conduction as reasons for the effects produced by this bandage.

It has been suggested that the KT application could correct muscular function by strengthening the weak muscles.[10] Evidence indicates, however, that there were no immediate effects of the KT on muscle performance in healthy athletes[18, 19] and in men and women engaged in recreational activities[20,21], although its use appears to induce improvement in the perception of the sense of force.[18] However, the KT application showed positive effects on muscle performance in studies that recruited samples of untrained subjects[22] or those with any musculoskeletal conditions.[16,23,24] Furthermore, positive results on muscle performance were also reported in young athletes, when greater longitudinal tensions on the bandage were employed.[12] These results that, at first appear inconsistent with the KT effect on muscle performance, might indicate that the impact of the bandage on muscle performance depend upon other factors, such as the longitudinal tension applied on the bandage and/or the prior muscular performance of these individuals. Thus, it is possible that more trained individuals respond less to the application of these bandages, while those, who are not trained, show more impressive results. Moreover, it is likely that for individuals with good muscular performance, the application tension on the bandage should be higher to generate the desired effects.

In the present study, the participants were young healthy women, which could explain better effects of the KT application at higher tensions. Future studies should evaluate the effects of KT applied with various tensions in individuals with a given health condition or disease, using muscle performance as a control variable, in order to verify if the obtained results would be influenced by the degree of prior muscle strength and/or the tension applied on the bandage.

Besides the increases in muscular strength in previously weak muscles, the effect of KT was also attributed to the applied tension on the bandage. This tension generates a traction force, which causes changes on the lengthening, pressure, and shear forces, and hence, stimulates the mechanoreceptors of the sub-dermal soft tissues and fascia. Thus, the central nervous system would incorporate the sensory input and modulate the movement via spindle-gamma pathway, which, in turn, would lead to increased muscle tone.[12] However, the effect on increasing the recruitment of motor units, evaluated by surface electromyography, was only checked after 24 hours of KT application, and no effects were observed within 10 minutes of application.[25] As the results of this study showed an immediate and clinically significant effect when a higher tension was applied on the bandage, it appears that probably lower tensions on the bandage do not increase motor unit recruitment and motor reflex stimulus of sufficient magnitude to justify the effects found in the present study.

It has been shown that the KT application to the of ASIS to PSIS, with enough tensions to produce 30 to 40% distensions of the original length of the bandage, would generate a tension on the final position of the anterior pelvic tilt and, thereby, lead to a posterior pelvic tilt position.[13] Since it has been demonstrated that the joints are pre-stressed structures and the antagonic elastic structures are co-tensioned[26], this pre-tension generated by the bandage at the end of the range of motion[10] may probably act as a mechanical stimulus, that is added to the previously existing tissue stiffness and, this way, could also explain the present results. In this context, it is appropriate to assume that, when the KT is applied to the skin with a certain longitudinal tension, it acts as an additional spring, which pulls the skin and fascia, facilitating the generation and transmission of energy and, consequently, increasing tissue stiffness and/or modifying the resting joint position. This assumption is supported by results of a previous study, that found increases in rigidity of the ankle joint immediately and 24 hours after KT application.[27]

It was further demonstrated that the KT application on the lower trapezius muscle with minimal tension in amateur baseball athletes with sub-acromial impingement syndrome generated changes in scapular kinematics with increased posterior scapular inclination during elevation of the arm.[28] Furthermore, KT application on the erector spinae and internal oblique muscles resulted in increased anterior pelvic tilt angles, even after the volunteers remained 30 minutes in the sitting

position.[29] However, KT application with tension of 10% on the posterior tibial muscle in individuals with flat foot generated, after 24 hours, a reduction of the pain symptoms, but without changes in static hindfoot pronation.[30] This finding probably means that the KT effects on the equilibrium position can depend, besides the applied tension on the bandage, on the overloading of the joint and that the static changes can not be kept under dynamic conditions.

The main limitations of this study include the lack of a placebo group, which makes impossible major assertions regarding the mechanisms of changes; the fact that the participants, who had shortening of the hip flexor muscles were not excluded, which could inhibit the KT effects, and also that some participants, who had posterior pelvic tilt were included. In upright position, the vector of the body weight produces an extensor moment at the hip joint, and, as a consequence, favors the posterior tilt of the pelvis. Finally, dynamic PTA measures were not obtained, since that in dynamic conditions, that the GM muscle would play a more important role, for example, when getting up from a chair.

This study provided, however, promising results regarding favoring the action of the GM muscle on the pelvic balance in standing position, when greater tension was used. If this reduction in the PTA remains in dynamic situations, it is possible that the KT application could help therapeutic exercise, when it is used in combination with KT, making this technique an adjoint rehabilitation resource. This can be evidenced in patients with sub-acromial impingement syndrome, who were found to more effectively respond to kinesiotherapy, when KT application was combined, when compared with those who received therapeutic exercises with the addition of placebo.[23]

Nevertheless, despite the KT has widespread clinical use worldwide, there were not found, up to now, studies that can elucidate the effects, which are postulated by the technique in various populations. Consequently, the mechanisms underlying the effects attributed to KT application are not clear.

CONCLUSION

The application of the KT with tensions of 30% and 60% over the GM muscle reduced the PTA in the standing position of healthy young women. However, the tension of 60% led to more clinically significant results.

AUTHORS CONTRIBUTION

JGP was responsible for study design, collection, data analysis, interpretation of results and preparation of the manuscript. WPB, PRA, MRS and GMR contributed to the collection and tabulation of data and preparation of the manuscript. LFTs contributed to the study design, interpretation of results and critical review of the manuscript.

COMPETING INTERESTS

The authors declare no conflicts of interest.

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