Kinesio Taping reduces pain and improves disability in Low Back Pain patients: a randomised controlled trial.

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Abstract

Objectives: Investigate the effects of Kinesio Taping® (KT) on chronic nonspecific low back pain (LBP) **Design:** Randomised controlled trial with intention-to-treat analysis. **Setting:** University laboratory. **Participants:** One hundred eight women with chronic nonspecific LBP underwent an evaluation pre, three and ten days after intervention. **Interventions:** After randomization, participants were assigned in four groups: KT with tension group (KTT) applied Kinesio Taping® with tension in the region of the erector spinae muscles; KT no tension group (KTNT) applied Kinesio Taping® with no tension at the same region; Micropore® group (MP) applied Micropore® tape on the erector spinae muscles; and Control group (CG) did not receive any intervention. **Main outcome measures:** The primary outcome was pain sensation, measured by numerical pain rating scale. Secondary outcomes were: disability, trunk range of motion, strength and electromyographic amplitude, measured by Roland Morris Disability questionnaire, inclinometry, dynamometry and electromyography, respectively. **Results:** Pain relief was observed for KTT group (mean difference=1,963; CI 95%=0,501 - 3,425; p=0,003) and KTNT group (mean diference=1,926; CI 95%=0,464 - 3,388; p=0,004) compared to control group at 3 days after application of the tape. For disability there was difference between control group and KTT group at 3 (mean difference=3,481; CI 95%=0,825 – 6,138; p=0,004) and 10 days (mean difference=3,185; CI 95%=0,395 - 5,975; p=0,016). For all the others variables, there was no differences between group. **Conclusion:** KT with or without tension reduces pain 3 days after its application. Additionally, when applied with tension it improves disability after 3 and 10 days in LBP patients.

Trial registration: NCT02550457 (clinicaltrials.gov).

Contribution of the paper

- Kinesio Taping reduces pain and disability in patients with chronic nonspecific low back pain;
- There is no difference between the use of Kinesio Taping with or without tension for pain;
- The Micropore group showed no differences compared to either Kinesio Tape or Control groups.
- No alterations on physical measures were observed.

Key words: Spine; back muscles; bandage; electromyography.

Introduction

The high incidence of Low Back Pain (LBP) is burdensome in the world population and causes more disability than any other condition [1]. It is associated with psychological, social and biophysical factors that impair function, social participation, job satisfaction and socioeconomic status [2]. Numerous treatments for LBP have been studied [1,3], and recently the use of Kinesio Taping (KT) has become a popular treatment option for many conditions, including LBP [4].

Kinesio Taping was developed in 1973 by the Japanese chiropractor Kenzo Kase [5]. This technique uses an extremely thin functional elastic bandage, with an approximate thickness of the epidermis. It can be longitudinally extended up to 120-140% of its original length, having similar elasticity to the skin [6,7]. KT has been reported to be able to increase blood and lymph circulation, improve muscle performance, reduce pain, realign joints, reduce muscle tension [7,8,9] and change motor unit recruitment [10]. However, the mechanism by which KT achieves this is not clear. It has been suggested that its application to the skin activates cutaneous mechanoreceptors, which results in pain relief through the pain gate theory [10]. Furthermore, it has been reported to provide an increase of the interstitial space, permitting improved blood and lymph flow due to its elastic and adhesive characteristics [7,9]. Regarding the hypothesis of increased muscle activity, this could be due to neurofacilitation, with a suggested mechanism that the tactile stimulation provided by the bandage activates cutaneous receptors provoking stimulation of alpha motoneurons [11,12]. However, detailed studies relating to the efficacy and effectiveness of KT are still limited and controversial.

Recent studies on LBP have shown an improvement in pain [8,10], disability [8], Range of Motion (ROM) of lower trunk [13] and lumbar muscles activation [10] in subjects who underwent treatment with KT, while others have shown no such differences with the application of KT or placebo taping [14,15]. For example several authors analysed pain and disability and shown good results related to these variables in patients using tape [8,10,16,17,18], however other authors have shown no superiority of its effects compared to placebo treatments [14,19,20,21], or similar or slightly superior effects [22,23].

There are few studies that have analysed the effect of KT on ROM and electromyography (EMG) [12,13]. Despite EMG being suggested as a useful tool in the assessment of muscle dysfunction associated with LBP [24], little work has been published identifying changes due to taping, with the majority of studies being conducted using healthy subjects [25,26] or lower limb injuries [27]. Patients with LBP have been show to demonstrate different EMG patterns compared with healthy subjects [28,29], however variations EMG between static to dynamic tasks have been observed due to high tension or inhibitory mechanism of pain, and demonstrate greater asymmetry in muscle activation and higher fatigability [24], making the comparison of studies difficult.

Considering the lack of consensus in the literature and the increasing use of KT, it is pertinent to question the effects of Kinesio Taping® in individuals with LBP. Thus, this study aims to evaluate the isolated effect of KT on pain, disability, range of motion, strength and muscle activity in individuals with chronic nonspecific LBP.

Method

Design

This was an assessor blinded prospective randomised controlled trial. The study was conducted at the University Laboratory of X.

Ethics

This study was approved by the Research Ethics Committee of the local University under the protocol number 1.213.864, registered on the clinicaltrials.gov website (NCT02550457) and it is in accordance with CONSORT recommendations. All volunteers were informed about the objectives of the study and signed the consent form.

Subjects

One hundred eight female with a mean age of 25 (5) years and a mean Body Mass Index (BMI) of 22.8 (2.9) kg/m^2, were recruited to the study from the community, orthopedics and rheumatology clinics, Pilates and fitness centers through verbal and printed advertising. Inclusion criteria were: age between 18 and 50 years old and having chronic nonspecific LBP for more than 3 months. Exclusion criteria: diagnosis of fractures or tumours in the spine, ankylosing spondylitis, disc herniation, spondylolisthesis with neurological involvement, lumbar stenosis, previous spinal surgery, fibromyalgia and any central or peripheral neurological diseases. Volunteers were also excluded from the study if they were pregnant, were on their menstrual cycle or the premenstrual period, had a BMI over 30, had a NPRS less than 2 in the last 24 hours of the first evaluation, or if they had used corticosteroids in the last two weeks or any anti-inflammatory medication in the last 24 hours. They were also excluded if they presented signs of allergy/intolerance to the KT during a test conducted before the initial evaluation or had undergone prior treatment with this technique in the lumbar region. Furthermore, volunteers were excluded if they demonstrated a lack of understanding of the instructions in the proposed protocol and/or inadequate performance of the evaluations.

Procedure

Block randomisation was performed by a researcher independent, and the order of the participants were numbered and sealed in opaque envelopes. Participants were allocated in four different groups: control group (CG), KT with tension group (KTT), KT no tension group (KTNT) and Micropore® group (MP). Separate researchers performed the assessment (researcher 1), intervention (researcher 2) and data analysis (researcher 3) to minimise potential sources of bias. The initial assessment was carried out and data recorded before the envelopes were opened.

Due to the presence of a group without tape, it was not possible for the participants and researchers 1 and 2 to be blinded to the treatment. However, before any analysis was performed the data were coded by researcher 2, so that the statistical analysis performed by researcher 3 was blinded.

Intervention

The KTT group received application of Kinesio Taping that was positioned in the form of "I" over the erector spinae muscles bilaterally [14]. The tape was applied with the participants seated, with the spine in anatomical position for the application of the anchor, which was positioned in the sacral region (S1) without tension [30]. The participants were then asked to perform trunk flexion and rotation to the opposite side to the application of the tape with a slight stretch of approximately 10-15%, which was then repeated on the opposite side [30]. The tape was fixed with tension from the posterior superior iliac spine to the T12 with a final anchor point fixed directly above the T12 with 0% of tension [30] (Figure 1 - A).

For the participants in the KTNT group, KT was applied in a similar way as the previous group, except they were asked to hold a neutral pose and no tension was applied to the tape (Figure 1 - B). Finally, to the participants in the Micropore® group, the application was performed in the same way as the KTT group. The participants of the control group did not receive any intervention.

Insert Figure 1

Participants in the experimental groups were instructed to leave the tape applied to the area for three days until re-evaluation, the time usually recommended in clinical practice and in accordance with Kase et al. [7], after which the KT can start to become detached from the skin.

Outcome measures

Assessments were taken at baseline (pre), 3 and 10 days after the intervention. On completion of the tests during the re-evaluation on 3 days, the tape was removed and the participant was asked to return to the laboratory a week later for the final evaluation, 10 days after the first assessment, which was performed at the same day of the week and time as second evaluation.

Assessment comprised of pain intensity, disability, trunk range of motion, strength and electromyographic amplitude. The assessment of pain intensity was the primary outcome evaluated using a numerical pain rating scale across a range of 11, with 0 being described as "no pain" and 10 as "worst possible pain". Participants were instructed to report the level of pain intensity based on the last 24 hours [30].

Functional status was assessed using the Roland Morris Disability Questionnaire which provides a score on 24 items that describes daily tasks, where 0 represents no disability and 24 represents serious disabilities. Participants were instructed to fill the items that actually apply to them over the last 24 hours [30].

In addition, the trunk range of motion was assessed using an iPhone® (iPhone® model 6, Apple Inc., California) application *iHandy level*®, which was first calibrated on a level surface and worked as a gravity inclinometer. This application has previously been found to be reliable and has been validated by several studies [31,32]. This was used to measure the movements of flexion, extension, lateral flexion to the left and right of the spine, according to the guideline established by Wanddell et al [33].

To measure flexion, the device was positioned horizontally with its upper edge in contact with the skin of the participant, while the central region of this edge was placed at the level of T12-L1 (Figure 2). The participants were asked to flex their trunk moving until the limit of their ROM and hold the position while the angle was recorded. The same procedure was performed for extension, however, for this movement, participants were asked to support their hands on the lower back at the L4-L5 to facilitate their balance [31]. For lateral flexion the device was positioned horizontally parallel to the ground with the display directed to the investigator on the level of T9-T12 (Figure 2). Participants were asked to slide their hand down the side of the leg as far as possible while maintaining trunk and head facing forward whilst keeping both feet on the ground, first moving to the right and then to the left. To ensure the reliability of test-retest, the position and orientation of the iPhone was marked out with a dermographic pen using the spinous processes as a reference. Each movement task was repeated twice with 30-second interval between trials and a familiarization was allowed before trials. The repetition with greater amplitude was used in the analysis.

Insert Figure 2

An EMG assessment was performed using a Telemyo direct transmission system and 8 channels wirelessly system (Noraxon®, USA) with 16-bit resolution and common mode rejection (CMR) > 100 db. Signals were captured with a sampling frequency of 1500 Hz, amplified 1000 times and filtered with a bandpass of 10 - 500 Hz. The signals were captured using passive self-adhesive surface electrodes (4 x 2.2 cm) in a bipolar arrangement, with an inter-electrode distance of 2 cm. Before attaching the electrodes, participant’s skin was shaved and cleaned with alcohol 70%. The electrodes were placed bilaterally in the longissimus muscles, in accordance with the SENIAM guidelines [34]. The analysis software used was the MyoResearch 3.8 (Noraxon®, USA).

A dynamometric evaluation of the trunk extensor strength was performed using a portable hand held dynamometer (Lafayette Instrument®, model 01165, USA). Participants were positioned in prone on a plinth with their hands clasped behind their neck [35] and then guided to conduct trunk extension for two seconds for familiarization (Figure 3). After one-minute rest, two Maximum Voluntary Isometric Contraction (MVIC) were performed during 5 seconds each, with a two minutes interval. The dynamometer was positioned centrally between the two lower edges of the shoulder blades and fixed by a band. Two other bands were used to stabilize the participant, positioned above the popliteal line and above the lateral malleolus. During the two contractions the maximum extensor strength (in Newton) and the Root Mean Square (RMS) of the longissimus muscle were recorded. The electromyographic data (in microvolts) was normalized by the peak of the signal recorded during the MVIC, and strength was normalized to body weight (kg) [35].

Insert Figure 3

Statistical Analysis

A sample size of 108 participants, 27 in each group, was identified as sufficient to detect a 2-point clinically significant difference [36] between groups in the pain intensity outcome, measured by the NPRS. This assumed a standard deviation of 2.5

points, estimated from a previous pilot study, with a statistical power of 80%, alpha of 5% and a loss rate of 10% [37].

All statistical analyses were conducted following the principles of intention to treat using the Statistical Package for the Social Science software (SPSS) version 20.0. A mixed methods ANOVA (4x3) was used to analyse the differences between the four groups (CG, KTT, KTNT, MP) over the three time points (Pre, 3 days, 10 days) and group/time interactions. In addition, the effect size was calculated using ηp^2 which reports the proportion of the total variance within the dependent variables. The homogeneity of variance was verified by the Levene test. When the assumption of sphericity was violated, significance was adjusted using Greenhouse-Geisser. When the effect of the test was significant, *post hoc* pairwise comparisons were performed using a Bonferroni adjustment for multiple comparisons with a 0.05 significance level.

Results

Flow of participants through the study

The design of the study is shown on Consort diagram (Figure 4). One hundred thirty-two volunteers were selected by inclusion. Twenty-four (18%) were excluded according the eligibility criteria, seven had a NPRS less than 2, one had history of fracture on lumbar spine, one had spondylolisthesis with neurological involvement, one was submitted to a previous back surgery, one had utilized KT on lumbar region previously, two had a BMI>30, three were over 50 years, two were men and six declined to participate. In total 108 participants were included and randomly allocated to one of four groups: CG n=27, mean age 24 (4) years; KTT n=27, mean age 25 (6) years; KTNT n=27, mean age 24 (5) years; and MP n=27, mean age 25 (5) years. Ten data sets were lost in total (9%), one of which was in the control group (withdrew), three in the KTT group (one volunteer abandoned the study and two where the tape fell off), two in the KTNT group (where tape fell off) and four in MP group (all due the tape falling off).

Insert Figure 4

Analysed variables

The sample homogeneity between groups at baseline for age, body mass index, pain, disability, range of motion, RMS and strength are shown on Table 1 as mean (standard deviation).

Insert Table 1

Table 2 shows the mean values (standard deviation) of all analysed variables, for the four groups, at the three time points of evaluation.

Insert Table 2

Mixed methods ANOVAs showed significant differences between groups for pain ($p=0.036$, $\eta p^2=0.079$) and disability ($p=0.010$, $\eta p^2=0.102$). Specifically, there was an improvement between KTT and KTNT groups compared to control group for NPRS three days after intervention. For disability, there was an improvement between KTT group and the control group at 3 and 10 days (Table 3).

Insert Table 3

A significant interaction was seen between group and time ($p=0.016$) for pain. Further pairwise comparisons showed a mean difference of 2.4 ($p<0.001$) and 1.5 ($p=0.011$) in pain between pre intervention and 3 days and between pre intervention and 10 days, respectively, for the KTT group. For KTNT group, a mean difference of 2.4 between pre versus 3 days ($p<0.001$) and 1.7 between pre versus 10 days ($p=0.003$) was observed. For MP group, it was observed a mean difference of 1.3 ($p=0.022$) and 1.7 ($p=0.003$) between pre versus 3 days and between pre versus 10 days, respectively. These changes should be considered with respect to Ostelo et al. [36] who reported values over 2 points in NPRS to be a clinically important change.

The same effect was seen for disability with a significant interaction between group and time ($p=0.018$). Further pairwise comparisons showed an improvement between pre versus 3 days ($p<0.001$, mean difference of 3.2) and pre versus 10 days ($p<0.001$, mean difference of 3.4) for the KTT group; pre versus 3 days ($p<0.001$, mean difference of 2.9) and pre versus 10 days ($p=0.009$, mean difference of 1.9) for the KTNT group; and pre versus 3 days ($p=0.005$, mean difference of 1.8) and pre versus 10 days ($p=0.002$, mean difference of 2.3) for MP group. All the values between time points for KTT group and between pre versus 3 days for KTNT group showed more than 30% of improvement, which also could be considered as a clinically important change[36].

Mixed methods ANOVAs showed significant differences between time points; for extension ($p<0.001$, $\eta p^2=0.090$) a difference was seen between pre versus 3 days

(Mean Difference of – 1.8) and pre versus 10 days (Mean Difference of – 2.8); for right lateral flexion ($p=0.008$, $\eta p^2=0.045$) there was difference between both pre versus 3 days (Mean Difference of – 0.9) and pre versus 10 days (Mean Difference of – 1.0); for right RMS ($p=0.001$, $\eta p^2=0.065$) it was observed differences between pre versus 3 days (Mean Difference of – 4.9) and pre versus 10 days (Mean Difference of – 4.3); for left RMS ($p<0.001$, $\eta p^2=0.081$) a difference was observed for both pre versus 3 days (Mean Difference of – 5.1) and pre versus 10 days (Mean Difference of – 5.4); and for strength ($p<0.001$, $\eta p^2=0.180$) it was observed a difference for pre versus 3 days (Mean Difference of – 20) and pre versus 10 days (Mean Difference of –20). However, there was no significance difference between groups and no interaction between group and time.

Discussion

This study aimed to evaluate the effect of Kinesio Taping on individuals with nonspecific LBP using outcomes of pain, disability, range of motion, strength and electromyographic amplitude. To our knowledge, this is the first study to analyse these variables together with the view to compare the effect of different tape and the application of different techniques. The results showed reduced pain after three days in both KT groups (with and without tension), in addition disability showed an improvement at 3 and 10 days for KT with tension group only. All other statistical comparisons between groups did not show any statistical significance, indicating improvements only in the groups who underwent Kinesio Taping.

Our results corroborate with previous authors who found a reduction in pain after KT application [8,10]. Paoloni et al. [10] observed a pain relief shortly after tape application and also after four weeks of intervention. They evaluated the effects of the tape versus tape combined with exercise and only exercise, however they did not find any significant differences between groups, although pain between time points showed clinically important differences. The same was seen in our results, which showed changes greater than those considered to be minimal clinically importance changes in pain [36] for KT with and without tension at 3 days of evaluation. Castro-Sanchez et al. [8] found a greater improvement of pain for the experimental group, which applied KT over the lumbar spine, at seven days of treatment and four weeks after the intervention. Nevertheless, these findings did not pass the threshold of what can be considered clinically important.

Previous studies [14,38] found reductions in pain after treatment which reached the threshold for a clinically important change [36], however these authors did not support its use as no differences were seen between groups. Although, it is important to highlight that these studies did not use a control group without intervention.

Kelle et al. [18] and Luz Júnior et al. [20] analysed the effects of KT compared to a non-intervention group in LBP and both found a statistically significant difference between the experimental and control group. However, the results of Luz Júnior et al. [20] did not reach the threshold for a clinically important change. Moreover, they found the same results to Micropore tape, arguing that this demonstrates a placebo effect. However this current study did not find differences between control group and

Micropore group, and no statistical difference between Micropore tape and Kinesio Taping was seen.

The potential mechanism by which KT reduces pain is beyond the scope of this study, however one hypothesis that has been suggested is the gate control theory of pain [8,10,22], which suggests that the mechanical stimulus provided by the tape would act through the large-diameter non-nociceptive fibres resulting in pain inhibition and relief. The analgesia ceases, however, as soon as the stimulus is removed. This is in agreement with our results, which showed reduction of the pain at 3 days, while the tape was applied. However, due the lack of differences between Micropore group and the groups that applied KT, the hypothesis of placebo mechanism must also be considered.

In terms of disability, our results showed a clinically important improvement up to 10 days in the KT with tension group only. In contrast, Parreira et al. [14] despite observing an improvement of disability in tape with and without tension, showed no significances between groups. Other authors [8,18,20,38] also observed significant improvement for disability, but with differing evaluation time points, varying between 48 hours to 5 weeks of intervention. None of the studies found showed improvement after a follow-up period without tape. However, the variation in these findings could be due the different protocols used.

Besides disability has a direct relationship with pain, its genesis in chronic conditions is generally multifactorial and may have a different clinical presentation [39]. It can be suggested that the tension provided by the tape can enhance the proprioceptive feedback and facilitate the posture and the correct movement, even after its withdrawal. Some authors [40,41] agree that this improvement in proprioception may provide feedback to achieve and maintain preferred body alignment and give to the patients more awareness of the back while movements, hence reducing detrimental movements [8].

Edin et al. [42] suggested that joint motions are associated with a predictable patterns of changing strain in the surrounding skin. The application of the tape would therefore stimulate the skin and change the strain, stimulating cutaneous receptors and improving the movement control.

Although the tape provided improvements in pain and disability, no significant differences were seen between groups for ROM assessed by inclinometry in our study. An improvement was detected for extension and right lateral flexion between time, but without an interaction between group and time. Previous studies used clinical tests or instruments as fleximeters [8,13,15,43,44] and analysed different movements in patient populations, making interpreting difficult.

With regards to neuromuscular performance, literature shows that KT does not alter neither strength nor electromyography [25,26,27,45]. Paoloni et al. [10] used EMG to determine the effect of the tape on back pain. However, they analysed the flexion-relaxation during trunk flexion, whereas our study also included extension and lateral flexion. Our aim was to verify if the KT would improve the strength, increase electromyographic amplitude and enhancing the strength through the stimulation cutaneous receptors [46]. However, even though there was an increase of the RMS and strength in relation to the time, there was no difference between groups or group and time, concluding that this technique is not able to improve the performance of back muscles.

Finally, it is suggest that KT is capable to reduce pain while applied, with or without tension, and improve disability, even after its withdrawal, when applied with tension. However, there was no effect on ROM, electromyography activity or strength. Although there were improvements observed in the subjective measures, but these showed no superiority of the results of KT compared to MP group, a potential placebo effect should be considered. It is important to note that these findings are limited to young women with chronic nonspecific low back pain and that the tape was applied only once with a short follow-up of ten days.

Ethical Approval: The Ethics Committee of X approved this study (protocol number 1.213.864).

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Tables

Table 1. Mean (SD) of age, body mass index (BMI), pain, disability, range of motion for flexion, extension, right lateral flexion, left lateral flexion, RMS of right longuissimus muscle (right RMS – normalized by the peak of the signal), RMS of left longuissimus muscle (left RMS - normalized by the peak of the signal) and strength (normalized by body weight) of the erector spinae muscles for the four groups at the baseline.

Variable	**CG (n=27)**	**KTT (n=27)**	**KTNT (n=27)**	**MP (n=27)**	**p value**
Age (years)	24 (4)	25 (6)	24 (5)	25 (5)	0.747
BMI (Kg/m^2)	23.2 (2.7)	23.2 (3.2)	22.1 (3.2)	22.7 (2.6)	0.516
Pain (0-10)	4.9 (1.6)	4.9 (1.9)	4.9 (1.8)	5.1 (1.7)	0.977
Disability (0-24)	8 (3)	7 (3)	8 (4)	7 (3)	0.221
Flexion (degree)	88 (19)	92 (18)	89 (22)	89 (16)	0.892
Extension (degree)	25 (8)	24 (14)	27 (13)	24 (12)	0.794
Right Lateral Flexion (degree)	29 (5)	32 (7)	30 (6)	29 (5)	0.113
Left Lateral Flexion (degree)	28 (6)	31 (7)	30 (5)	28 (5)	0.189
Right RMS (%)	58.5 (6.8)	59.7 (7.4)	58.0 (5.9)	58.7 (6.3)	0.798
Left RMS (%)	57.7 (7.3)	57.8 (6.1)	57.6 (5.3)	57.9 (6.3)	0.998
Strength (%)	196.5 (86.7)	212.5 (52.5)	196.0 (56.3)	191.6 (69.3)	0.686

CG: control group; KTT: Kinesio Taping with tension group; KTNT: Kinesio Taping No Tension group; MP: Micropore group; RMS: Root Mean Square.

Table 2. Mean (SD) for the analysed variables at three time points.

Variables	CG (n=27)			KTT (n=27)			KTNT (n=27)			MP (n=27)		
	Pre	**3 days**	**10 days**	**Pre**	**3 days**	**10 days**	**Pre**	**3 days**	**10 days**	**Pre**	**3 days**	**10 days**
Pain (0-10)	4.9 (1.6)	4.4 (2.3)	4.6 (2.5)	4.9 (1.9)	2.5 (1.7)	3.4 (1.9)	4.9 (1.8)	2.5 (1.9)	3.2 (2.6)	5.1 (1.7)	3.8 (2.0)	3.4 (2.4)
Disability (0-24)	8 (3)	7 (3)	7 (4)	7 (3)	4 (3)	4 (3)	8 (4)	5 (5)	6 (6)	7 (3)	5 (3)	4 (3)
Flexion (degree)	88 (19)	87 (18)	86 (15)	92 (18)	95 (18)	94 (19)	89 (22)	90 (21)	90 (22)	89 (16)	88 (17)	86 (16)
Extension (degree)	25 (8)	25 (9)	27 (9)	24 (14)	28 (13)	30 (14)	27 (13)	28 (13)	29 (15)	24 (12)	26 (13)	26 (13)
Right Lateral Flexion (degree)	29 (5)	29 (5)	29 (7)	32 (7)	34 (7)	34 (7)	30 (6)	31 (7)	32 (6)	29 (5)	30 (5)	29 (5)
Left Lateral Flexion (degree)	28 (6)	28 (6)	29 (6)	31 (7)	31 (7)	32 (7)	30 (5)	29 (5)	30 (5)	28 (5)	30 (6)	28 (5)
Right RMS (%)	58.5 (6.8)	62.2 (16.0)	59.2 (13.2)	59.7 (7.4)	67.2 (16.0)	65.8 (16.5)	58.0 (5.9)	62.4 (14.1)	63.1 (15.2)	58.7 (6.3)	62.7 (13.4)	64.1 (17.2)
Left RMS (%)	57.7 (7.3)	61.5 (16.4)	58.5 (17.3)	57.8 (6.1)	64.1 (16.6)	63.8 (19.5)	57.6 (5.3)	63.1 (14.5)	64.1 (16.6)	57.9 (6.3)	62.9 (17.0)	66.5 (22.7)
Strength (%)	196.5 (86.7)	212.1 (100.5)	216.5 (98.4)	212.5 (52.5)	238.9 (85.1)	235.2 (58.8)	196.0 (56.3)	215.9 (54.5)	218.2 (56.6)	191.6 (69.3)	214.9 (63.1)	212.4 (75.2)

CG: control group; KTT: Kinesio Taping with tension group; KTNT: Kinesio Taping No Tension group; MP: Micropore group; RMS: Root Mean Square.

Table 3. Mean differences between groups (95% confidence interval) and p value at pre, 3 days and 10 days after intervention for pain and disability variables.

Time		Pain		Disability	
	Groups	**Mean difference (95% CI)**	**p value**	**Mean difference (95% CI)**	**p value**
Pre	CG x KTT	0.037 (-1.244 to 1.318)	1.000	0,852 (-1.570 to 3.274)	1.000
	CG x KTNT	0.037 (-1.244 to 1.318)	1.000	-0,407 (-2.829 to 2.015)	1.000
	CG x MP	-0.148 (-1.429 to 1.133)	1.000	1.296 (-1.126 to 3.718)	0.918
	KTT x KTNT	0 (-1.281 to 1.281)	1.000	1.259 (-1.163 to 3.681)	0.99
	KTT x MP	-0.185 (-1.466 to 1.096)	1.000	0.444 (-1.978 to 2.866)	1.000
	KTNT x MP	-0.185 (-1.466 to 1.096)	1.000	1.704 (-0.718 to 4.126)	0.368
3 days	CG x KTT	1.963* (0.501 to 3.425)	0.003	3.481* (0.825 to 6.138)	0.004
	CG x KTNT	1.926* (0.464 to 3.388)	0.004	1.963 (-0.693 to 4.619)	0.297
	CG x MP	0.611 (-0.851 to 2.073)	1.000	2.593 (-0.064 to 5.249)	0.06
	KTT x KTNT	0.037 (-1.425 to 1.499)	1.000	1.519 (-1.138 to 4.175)	0.763
	KTT x MP	-1.352 (-2.814 to 0.11)	0.087	-0.889 (-3.545 to 1.768)	1.000
	KTNT x MP	-1.315 (-2.776 to 0.147)	0.104	0.63 (-2.027 to 3.286)	1.000
10 days	CG x KTT	1.111 (-0.624 to 2.846)	0.527	3.185* (0.395 to 5.975)	0.016
	CG x KTNT	1.333 (-0.401 to 3.068)	0.247	0.519 (-2.272 to 3.309)	1.000
	CG x MP	1.137 (-0.598 to 2.872)	0.485	2.556 (-0.235 to 5.346)	0.092
	KTT x KTNT	-0.222 (-1.957 to 1.512)	1.000	2.667 (-0.124 to 5.457)	0.069
	KTT x MP	0.026 (-1.709 to 1.761)	1.000	-0.63 (-3.42 to 2.161)	1.000
	KTNT x MP	-0.196 (-1.931 to 1.538)	1.000	2.037 (-0.753 to 4.827)	0.314

CG: control group; KTT: Kinesio Taping with tension group; KTNT: Kinesio Taping No Tension group; MP: Micropore group.
*Significant difference: $p<0.05$

Figure 1. Application of the tape with tension (A) and without tension (B) in the region of erector spinae muscles.

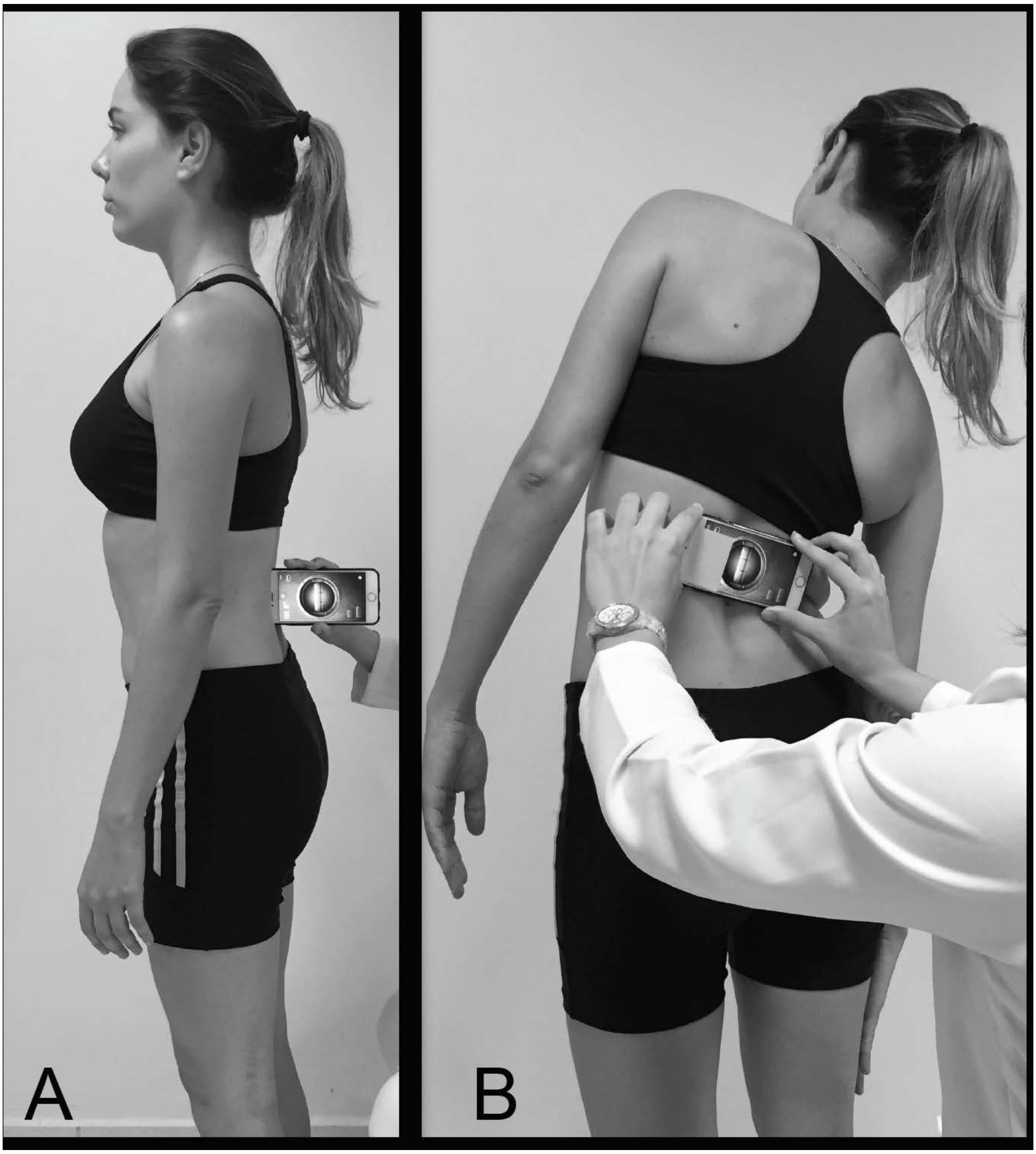

Figure 2. Position of the device to measure flexion and extension (A) and lateral flexion (B) of the spine.

Figure 3. Position of the dynamometer to evaluate trunk extensor strength.

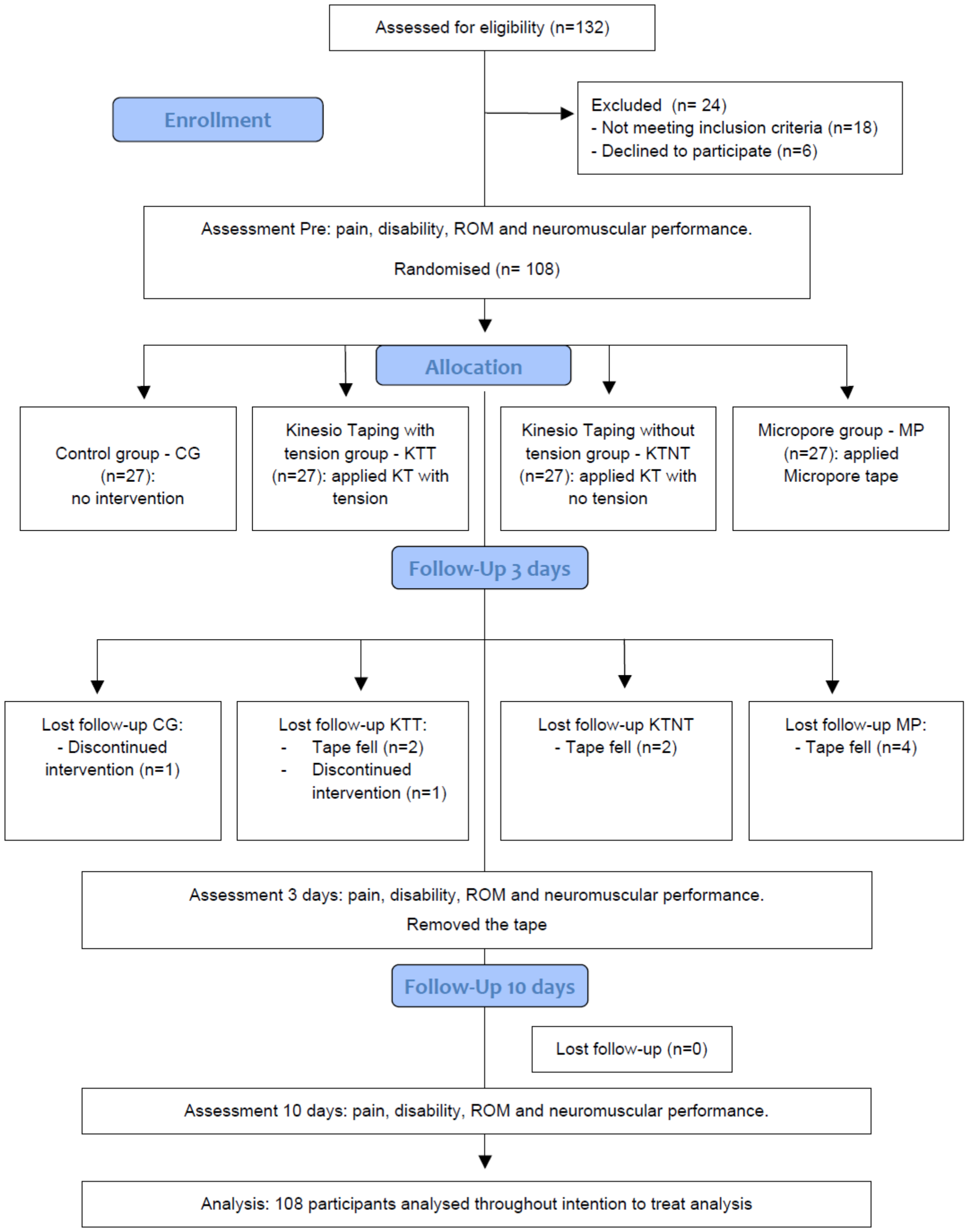

Figure 4. Study flow diagram.