

## Central Lancashire Online Knowledge (CLoK)

Title	Kinesio Taping reduces pain and improves disability in Low Back Pain patients: a randomised controlled trial
Type	Article
URL	<a href="https://clock.uclan.ac.uk/id/eprint/23667/">https://clock.uclan.ac.uk/id/eprint/23667/</a>
DOI	<a href="https://doi.org/10.1016/j.physio.2018.07.005">https://doi.org/10.1016/j.physio.2018.07.005</a>
Date	2019
Citation	Macedo, LB, Richards, James, Borges, DT, Melo, SA and Brasileiro, JS (2019) Kinesio Taping reduces pain and improves disability in Low Back Pain patients: a randomised controlled trial. <i>Physiotherapy</i> , 105 (1). pp. 65-75. ISSN 0031-9406
Creators	Macedo, LB, Richards, James, Borges, DT, Melo, SA and Brasileiro, JS

It is advisable to refer to the publisher's version if you intend to cite from the work.  
<https://doi.org/10.1016/j.physio.2018.07.005>

For information about Research at UCLan please go to <http://www.uclan.ac.uk/research/>

All outputs in CLoK are protected by Intellectual Property Rights law, including Copyright law. Copyright, IPR and Moral Rights for the works on this site are retained by the individual authors and/or other copyright owners. Terms and conditions for use of this material are defined in the <http://clock.uclan.ac.uk/policies/>

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

3 Macedo LB, Richards J, Borges DT, Melo SA, Brasileiro JS.

4 **Abstract**

5 **Objectives:** Investigate the effects of Kinesio Taping® (KT) on chronic nonspecific  
6 low back pain (LBP) **Design:** Randomised controlled trial with intention-to-treat  
7 analysis. **Setting:** University laboratory. **Participants:** One hundred eight women with  
8 chronic nonspecific LBP underwent an evaluation pre, three and ten days after  
9 intervention. **Interventions:** After randomization, participants were assigned in four  
10 groups: KT with tension group (KTT) applied Kinesio Taping® with tension in the  
11 region of the erector spinae muscles; KT no tension group (KTNT) applied Kinesio  
12 Taping® with no tension at the same region; Micropore® group (MP) applied  
13 Micropore® tape on the erector spinae muscles; and Control group (CG) did not receive  
14 any intervention. **Main outcome measures:** The primary outcome was pain sensation,  
15 measured by numerical pain rating scale. Secondary outcomes were: disability, trunk  
16 range of motion, strength and electromyographic amplitude, measured by Roland  
17 Morris Disability questionnaire, inclinometry, dynamometry and electromyography,  
18 respectively. **Results:** Pain relief was observed for KTT group (mean difference=1,963;  
19 CI 95%=0,501 - 3,425; p=0,003) and KTNT group (mean difference=1,926; CI  
20 95%=0,464 - 3,388; p=0,004) compared to control group at 3 days after application of  
21 the tape. For disability there was difference between control group and KTT group at 3  
22 (mean difference=3,481; CI 95%=0,825 – 6,138; p=0,004) and 10 days (mean  
23 difference=3,185; CI 95%=0,395 - 5,975; p=0,016). For all the others variables, there  
24 was no differences between group. **Conclusion:** KT with or without tension reduces  
25 pain 3 days after its application. Additionally, when applied with tension it improves  
26 disability after 3 and 10 days in LBP patients.

27 **Trial registration:** NCT02550457 (clinicaltrials.gov).

28

29 **Contribution of the paper**

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

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

38

39

40

41

42

43

## 44 **Introduction**

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

51           Kinesio Taping was developed in 1973 by the Japanese chiropractor Kenzo  
52 Kase [5]. This technique uses an extremely thin functional elastic bandage, with an  
53 approximate thickness of the epidermis. It can be longitudinally extended up to 120-  
54 140% of its original length, having similar elasticity to the skin [6,7]. KT has been  
55 reported to be able to increase blood and lymph circulation, improve muscle  
56 performance, reduce pain, realign joints, reduce muscle tension [7,8,9] and change  
57 motor unit recruitment [10]. However, the mechanism by which KT achieves this is not  
58 clear. It has been suggested that its application to the skin activates cutaneous  
59 mechanoreceptors, which results in pain relief through the pain gate theory [10].  
60 Furthermore, it has been reported to provide an increase of the interstitial space,  
61 permitting improved blood and lymph flow due to its elastic and adhesive  
62 characteristics [7,9]. Regarding the hypothesis of increased muscle activity, this could  
63 be due to neurofacilitation, with a suggested mechanism that the tactile stimulation  
64 provided by the bandage activates cutaneous receptors provoking stimulation of alpha

65 motoneurons [11,12]. However, detailed studies relating to the efficacy and  
66 effectiveness of KT are still limited and controversial.

67         Recent studies on LBP have shown an improvement in pain [8,10], disability  
68 [8], Range of Motion (ROM) of lower trunk [13] and lumbar muscles activation [10] in  
69 subjects who underwent treatment with KT, while others have shown no such  
70 differences with the application of KT or placebo taping [14,15]. For example several  
71 authors analysed pain and disability and shown good results related to these variables  
72 in patients using tape [8,10,16,17,18], however other authors have shown no superiority  
73 of its effects compared to placebo treatments [14,19,20,21], or similar or slightly  
74 superior effects [22,23].

75         There are few studies that have analysed the effect of KT on ROM and  
76 electromyography (EMG) [12,13]. Despite EMG being suggested as a useful tool in the  
77 assessment of muscle dysfunction associated with LBP [24], little work has been  
78 published identifying changes due to taping, with the majority of studies being  
79 conducted using healthy subjects [25,26] or lower limb injuries [27]. Patients with LBP  
80 have been show to demonstrate different EMG patterns compared with healthy subjects  
81 [28,29], however variations EMG between static to dynamic tasks have been observed  
82 due to high tension or inhibitory mechanism of pain, and demonstrate greater  
83 asymmetry in muscle activation and higher fatigability [24], making the comparison of  
84 studies difficult.

85         Considering the lack of consensus in the literature and the increasing use of KT,  
86 it is pertinent to question the effects of Kinesio Taping® in individuals with LBP. Thus,

87 this study aims to evaluate the isolated effect of KT on pain, disability, range of motion,  
88 strength and muscle activity in individuals with chronic nonspecific LBP.

## 89 **Method**

### 90 *Design*

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

### 93 *Ethics*

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

### 99 *Subjects*

100 One hundred eight female with a mean age of 25 (5) years and a mean Body  
101 Mass Index (BMI) of 22.8 (2.9) kg/m<sup>2</sup>, were recruited to the study from the community,  
102 orthopedics and rheumatology clinics, Pilates and fitness centers through verbal and  
103 printed advertising. Inclusion criteria were: age between 18 and 50 years old and having  
104 chronic nonspecific LBP for more than 3 months. Exclusion criteria: diagnosis of  
105 fractures or tumours in the spine, ankylosing spondylitis, disc herniation,  
106 spondylolisthesis with neurological involvement, lumbar stenosis, previous spinal

107 surgery, fibromyalgia and any central or peripheral neurological diseases. Volunteers  
108 were also excluded from the study if they were pregnant, were on their menstrual cycle  
109 or the premenstrual period, had a BMI over 30, had a NPRS less than 2 in the last 24  
110 hours of the first evaluation, or if they had used corticosteroids in the last two weeks or  
111 any anti-inflammatory medication in the last 24 hours. They were also excluded if they  
112 presented signs of allergy/intolerance to the KT during a test conducted before the  
113 initial evaluation or had undergone prior treatment with this technique in the lumbar  
114 region. Furthermore, volunteers were excluded if they demonstrated a lack of  
115 understanding of the instructions in the proposed protocol and/or inadequate  
116 performance of the evaluations.

#### 117 *Procedure*

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

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



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

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

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

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

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

185

### **Insert Figure 2**

186 An EMG assessment was performed using a Telemetry direct transmission  
187 system and 8 channels wireless system (Noraxon®, USA) with 16-bit resolution and  
188 common mode rejection (CMR) > 100 db. Signals were captured with a sampling  
189 frequency of 1500 Hz, amplified 1000 times and filtered with a bandpass of 10 - 500  
190 Hz. The signals were captured using passive self-adhesive surface electrodes (4 x 2.2  
191 cm) in a bipolar arrangement, with an inter-electrode distance of 2 cm. Before attaching

192 the electrodes, participant's skin was shaved and cleaned with alcohol 70%. The  
193 electrodes were placed bilaterally in the longissimus muscles, in accordance with the  
194 SENIAM guidelines [34]. The analysis software used was the MyoResearch 3.8  
195 (Noraxon®, USA).

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

209 **Insert Figure 3**

#### 210 *Statistical Analysis*

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

214 points, estimated from a previous pilot study, with a statistical power of 80%, alpha of  
215 5% and a loss rate of 10% [37].

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

## 226 **Results**

### 227 *Flow of participants through the study*

228 The design of the study is shown on Consort diagram (Figure 4). One hundred  
229 thirty-two volunteers were selected by inclusion. Twenty-four (18%) were excluded  
230 according the eligibility criteria, seven had a NPRS less than 2, one had history of  
231 fracture on lumbar spine, one had spondylolisthesis with neurological involvement, one  
232 was submitted to a previous back surgery, one had utilized KT on lumbar region  
233 previously, two had a BMI>30, three were over 50 years, two were men and six  
234 declined to participate. In total 108 participants were included and randomly allocated

235 to one of four groups: CG n=27, mean age 24 (4) years; KTT n=27, mean age 25 (6)  
236 years; KTNT n=27, mean age 24 (5) years; and MP n=27, mean age 25 (5) years. Ten  
237 data sets were lost in total (9%), one of which was in the control group (withdrew),  
238 three in the KTT group (one volunteer abandoned the study and two where the tape fell  
239 off), two in the KTNT group (where tape fell off) and four in MP group (all due the  
240 tape falling off).

241 **Insert Figure 4**

242 *Analysed variables*

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

246 **Insert Table 1**

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

249 **Insert Table 2**

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

255

### Insert Table 3

256 A significant interaction was seen between group and time ( $p=0.016$ ) for pain.  
257 Further pairwise comparisons showed a mean difference of 2.4 ( $p<0.001$ ) and 1.5  
258 ( $p=0.011$ ) in pain between pre intervention and 3 days and between pre intervention  
259 and 10 days, respectively, for the KTT group. For KTNT group, a mean difference of  
260 2.4 between pre versus 3 days ( $p<0.001$ ) and 1.7 between pre versus 10 days ( $p=0.003$ )  
261 was observed. For MP group, it was observed a mean difference of 1.3 ( $p=0.022$ ) and  
262 1.7 ( $p=0.003$ ) between pre versus 3 days and between pre versus 10 days, respectively.  
263 These changes should be considered with respect to Ostelo et al. [36] who reported  
264 values over 2 points in NPRS to be a clinically important change.

265 The same effect was seen for disability with a significant interaction between  
266 group and time ( $p=0.018$ ). Further pairwise comparisons showed an improvement  
267 between pre versus 3 days ( $p<0.001$ , mean difference of 3.2) and pre versus 10 days  
268 ( $p<0.001$ , mean difference of 3.4) for the KTT group; pre versus 3 days ( $p<0.001$ , mean  
269 difference of 2.9) and pre versus 10 days ( $p=0.009$ , mean difference of 1.9) for the  
270 KTNT group; and pre versus 3 days ( $p=0.005$ , mean difference of 1.8) and pre versus  
271 10 days ( $p=0.002$ , mean difference of 2.3) for MP group. All the values between time  
272 points for KTT group and between pre versus 3 days for KTNT group showed more  
273 than 30% of improvement, which also could be considered as a clinically important  
274 change[36].

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

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

## 288 **Discussion**

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

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

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

314           Kelle et al. [18] and Luz Júnior et al. [20] analysed the effects of KT compared  
315 to a non-intervention group in LBP and both found a statistically significant difference  
316 between the experimental and control group. However, the results of Luz Júnior et al.  
317 [20] did not reach the threshold for a clinically important change. Moreover, they found  
318 the same results to Micropore tape, arguing that this demonstrates a placebo effect.  
319 However this current study did not find differences between control group and

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

322         The potential mechanism by which KT reduces pain is beyond the scope of this  
323 study, however one hypothesis that has been suggested is the gate control theory of pain  
324 [8,10,22], which suggests that the mechanical stimulus provided by the tape would act  
325 through the large-diameter non-nociceptive fibres resulting in pain inhibition and relief.  
326 The analgesia ceases, however, as soon as the stimulus is removed. This is in agreement  
327 with our results, which showed reduction of the pain at 3 days, while the tape was  
328 applied. However, due the lack of differences between Micropore group and the groups  
329 that applied KT, the hypothesis of placebo mechanism must also be considered.

330         In terms of disability, our results showed a clinically important improvement up  
331 to 10 days in the KT with tension group only. In contrast, Parreira et al. [14] despite  
332 observing an improvement of disability in tape with and without tension, showed no  
333 significances between groups. Other authors [8,18,20,38] also observed significant  
334 improvement for disability, but with differing evaluation time points, varying between  
335 48 hours to 5 weeks of intervention. None of the studies found showed improvement  
336 after a follow-up period without tape. However, the variation in these findings could be  
337 due the different protocols used.

338         Besides disability has a direct relationship with pain, its genesis in chronic  
339 conditions is generally multifactorial and may have a different clinical presentation  
340 [39]. It can be suggested that the tension provided by the tape can enhance the  
341 proprioceptive feedback and facilitate the posture and the correct movement, even after

342 its withdrawal. Some authors [40,41] agree that this improvement in proprioception  
343 may provide feedback to achieve and maintain preferred body alignment and give to  
344 the patients more awareness of the back while movements, hence reducing detrimental  
345 movements [8].

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

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

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

364 time, concluding that this technique is not able to improve the performance of back  
365 muscles.

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

374

375

376

377

378

379

380 **Ethical Approval:** The Ethics Committee of X approved this study (protocol number  
381 1.213.864).

382 **Funding:** This work was supported by X.

383

384 **Conflict of interest:** None.

385

386 **Acknowledgements:** For the financial assistance granted for this study, we are grateful  
387 to X.

388

389

390

391

392

393

394

395

396

397

## 398 **References**

399 [1] Hoy D, March L, Brooks P, Blyth F, Woolf A, Bain C et al. The global burden  
400 of low back pain: estimates from the Global Burden Disease 2010 study. Ann  
401 Rheum Dis 2014; 73: 968-74.

- 402 [2] Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML, Genevay S et  
403 al. What low back pain is and why we need to pay attention. *Lancet* 2018; published  
404 online March 21. [http://dx.doi.org/10.1016/S0140-6736\(18\)30480-X](http://dx.doi.org/10.1016/S0140-6736(18)30480-X).
- 405 [3] Foster NE, Anema JR, Cherkin D, Chou R, Cohen SP, Gross DP et al.  
406 Prevention and treatment of low back pain: evidence, challenges, and promising  
407 directions. *Lancet* 2018; published online March 21.  
408 [http://dx.doi.org/10.1016/S0140-6736\(18\)30489-6](http://dx.doi.org/10.1016/S0140-6736(18)30489-6).
- 409 [4] Parreira PCS, Costa LCM, Hespanhol Junior LC, Lopes AD, Costa LOP.  
410 Current evidence do not support the use of Kinesio Taping in clinical practice: a  
411 systematic review. *J Physiother* 2014; 60: 31-9.
- 412 [5] Kase K, Lemos TV, Dias EM. *Kinesio Taping: Introdução ao método e*  
413 *aplicações neuromusculares*. 1st ed. São Paulo: Andreoli; 2013.
- 414 [6] Kase K, Tatsuyuki H, Tomoko O. *Development of Kinesio tape*. Kinesio Taping  
415 *Perfect Manual*. Kinesio Taping Association; 1996.
- 416 [7] Kase K, Wallis J, Kase T. *Clinical therapeutic applications of the kinesio taping*  
417 *method*. 2nd ed. Kinesio Taping Association; 2003.
- 418 [8] Castro-Sánchez AM, Lara-Palomo IC, Matarán-Peñarrocha GA, Fernández-  
419 Sánchez M, Sánchez-Labraca N, Arroyo-Morales M. Kinesio Taping reduces  
420 disability and pain slightly in chronic non-specific low back pain: A randomised  
421 trial. *J Physiother* 2012;58(2):89–95.
- 422 [9] Thelen M, Dauber J, Stoneman P. The Clinical Efficacy of Kinesio Tape for  
423 Shoulder Pain: A Randomized, Double-Blinded, Clinical Trial. *J Orthop Sport*  
424 *PhysTher* 2008;38(7):389–95.
- 425 [10] Paoloni M, Bernetti A, Fratocchi G, Mangone M, Parrinello L, Cooper MDP  
426 et al. Kinesio Taping applied to lumbar muscles influences clinical and

- 427 electromyographic characteristics in chronic low back pain patients. *Eur J Phys*  
428 *Rehabil Med* 2011;47(2):237–44.
- 429 [11] Halseth T, McChesney JW, DeBeliso M, Vaughn R, Lien J. The effects of  
430 Kinesio taping on proprioception at the ankle. *J Sports Sci Med* 2004; 3:1-7.
- 431 [12] Macgregor K, Gerlach S, Mellor R, Hodges PW. Cutaneous stimulation from  
432 patella tape causes a differential increase in vasti muscle activity in people with  
433 patellofemoral pain. *J Orthop Res* 2005; 23(2): 351-58.
- 434 [13] Yoshida A, Kahanov L. The effect of kinesio taping on lower trunk range of  
435 motions. *Res Sports Med* 2007;15(2):103–12.
- 436 [14] Parreira PCS, Costa LCM, Takahashi R, Hespanhol Junior LC, Luz Junior MA,  
437 Silva TM et al. Kinesio Taping to generate skin convolutions is not better than sham  
438 taping for people with chronic non-specific low back pain: A randomised trial. *J*  
439 *Physiother* 2014;60(2):90–6.
- 440 [15] Salvat IS, Salvat AS. Efectos inmediatos del kinesio taping en la flexión  
441 lumbar. *Fisioterapia* 2010;32(2):57–65.
- 442 [16] AlBahel F, Hafez AR, Zakaria AR, Al-AhaidebA, Buragadda S, Melam GR.  
443 Kinesio taping for the treatment of mechanical low back pain. *World Appl Sci J*  
444 2013; 22: 78-84.
- 445 [17] Kaplan Ş, Alpayci M, Karaman E, Çetin O, Özkan Y, İlter S et al. Short-term  
446 effects of Kinesio taping in women with pregnancy-related low back pain: A  
447 randomized controlled clinical trial. *Med Monit* 2016; 22:1297-1301.
- 448 [18] Kelle B, Güzel R, Sakalli H. The effect of Kinesio taping application for acute  
449 non-specific low back pain: A randomized controlled clinical trial. *Clin Rehab*  
450 2016; 30(10): 997-1003.

- 451 [19] Parreira PCS, Costa LCM, Takahashi R, Hespanhol Junior LC, Luz Junior MA,  
452 Silva TM, et al. Kinesio Taping to generate skin convolutions is not better than  
453 sham taping for people with chronic non-specific low back pain: A randomised trial.  
454 J Physiother 2014;60(2):90–6.
- 455 [20] Luz Júnior MA, Sousa MV, Neves LA, Cezar AA, Costa LO. Kinesio Taping®  
456 is not better than placebo in reducing pain and disability in patients with chronic  
457 non-specific low back pain: a randomized controlled trial. Braz J Phys Ther 2015;  
458 19(6): 482-90.
- 459 [21] Vanti C, Bertozzi L, Gardenghi I, Turoni F, Guccione AA, Pillastrini P. Effect  
460 of taping on spinal pain and disability: systematic review and meta-analysis of  
461 randomized trials. Phys Ther 2015; 95(4): 493 – 506.
- 462 [22] Artioli DP, Bertolini GRF. Kinesio taping: application and results on pain:  
463 systematic review. Phys Ther Res 2014; 21(1): 94-9.
- 464 [23] Lim ECW, Tay MGX. Kinesio taping in musculoskeletal pain and disability  
465 that lasts for more than 4 weeks: is it time to peel off the tape and throw it out with  
466 the sweat? A systematic review with meta-analysis focused on pain and also  
467 methods of tape application. Br J Sports Med 2015; 0:1-10.
- 468 [24] Alschuler KN, Neblett R, Wiggert E, Haig AJ, Geisser ME. Flexion-relaxation  
469 and clinical features associated with chronic low back pain: a comparison of  
470 different methods of quantifying flexion-relaxation. Clin J Pain 2009; 25(9): 760-  
471 66.
- 472 [25] Lins CAA, Locks Neto FL, Amorim ABC, Macedo LB, Brasileiro JS. Kinesio  
473 Taping® does not alter neuromuscular performance of femoral quadriceps or lower  
474 limb function in healthy subjects: Randomized, blind, controlled, clinical trial. Man  
475 Ther 2013; 18(1): 41-5.

- 476 [26] Lins CA, Borges DT, Macedo LB, Costa KS, Brasileiro JS. Delayed effect of  
477 Kinesio Taping on neuromuscular performance, balance, and lower limb function  
478 in healthy individuals: a randomized controlled trial. *Braz J Phys Ther* 2016; 20(3):  
479 231-39.
- 480 [27] Oliveira AKA, Borges DT, Lins CAA, Cavalcanti RL, Macedo LB, Brasileiro  
481 JS. Immediate effects of Kinesio Taping on neuromuscular performance of  
482 quadriceps and balance in individuals submitted to anterior cruciate ligament  
483 reconstruction: a randomized clinical trial. *J Sci Med Sport* 2016;19(1):2-6.
- 484 [28] Roy SH, De Luca CJ, Casavant DA. Lumbar muscle fatigue and chronic lower  
485 back pain. *Spine* 1989;14:992–1001.
- 486 [29] Heydari A, Nargol AV, Jones AP, Humphrey AR, Greenough CG. EMG  
487 analysis of lumbar paraspinal muscles as a predictor of the risk of low-back pain.  
488 *Eur Spine J* 2010; 19(7):1145-52.
- 489 [30] Added MAN, Costa LOP, Fukuda TY, Freitas DG, Salomão EC, Monteiro RL,  
490 et al. Efficacy of adding the Kinesio Taping method to guideline-endorsed  
491 conventional physiotherapy in patients with chronic nonspecific low back pain: a  
492 randomised controlled trial. *BMC Musculoskelet Disord* 2013;14:301.
- 493 [31] Kolber MJ, Pizzini M, Robinson A, Yanez D, Hanney WJ. The reliability and  
494 concurrent validity of measurements used to quantify lumbar spine mobility: an  
495 analysis of an Iphone® application and gravity based inclinometry. *Int J Sports*  
496 *Phys Ther* 2013;8(2):129–37.
- 497 [32] Salamh PA, Kolber M. The reliability, minimal detectable change and  
498 concurrent validity of a gravity-based bubble inclinometer and iphone application  
499 for measuring standing lumbar lordosis. *Physiother Theory Pract* 2014;30(1):62–  
500 67.

- 501 [33] Waddell G, Somerville D, Henderson I, Newton M. Objective clinical  
502 evaluation of physical impairment in chronic low back pain. *Spine* 1992; 17:617-  
503 28.
- 504 [34] Hermens HJ, Freriks B, Disselhorst-Klug C, Rau G. Development of  
505 recommendations for SEMG sensors and sensor placement procedures. *J*  
506 *Electromyogr Kinesiol* 2000; 10(5): 361-74.
- 507 [35] Nakagawa TH, Maciel CD, Serrão FV. Trunk biomechanics and its association  
508 with hip and knee kinematics in patients with and without patellofemoral pain. *Man*  
509 *Ther* 2015; 20: 189- 93.
- 510 [36] Ostelo RWJG, Deyo RA, Stratford P, Wanddell G, Croft P, Von Korff M.  
511 Interpreting Change Scores for Pain and Functional Status in Low Back Pain:  
512 towards international consensus regarding minimal important change. *Spine* 2008;  
513 33(1):90-4.
- 514 [37] Sakpal TV. Sample Size Estimation in Clinical Trial. *Perspect Clin Res* 2010;  
515 1(2): 67–9.
- 516 [38] Added MAN, Costa LOP, Freitas DG, Fukuda TY, Monteiro RL, Salomão EC,  
517 Medeiros FC, Costa LCM. Kinesio Taping does not provide additional benefits in  
518 patients with chronic low back pain who receive exercise and manual therapy: a  
519 randomized controlled trial. *JOSPT* 2016; 46(7):506-13.
- 520 [39] Weigl M, Cieza A, Cantista P, Reinhardt JD, Stucki G. Determinants of  
521 disability in chronic musculoskeletal health conditions: a literature review. *Eur J*  
522 *Phys Rehabil Med* 2008;44:67-79.
- 523 [40] Osterhues JD. The use of Kinesio Taping in the management of traumatic  
524 patella dislocation. A case study. *Physiother Theory Pract* 2004; 20(4): 267-70.
- 525 [41] Jaraczewska E, Long C. Kinesio taping in stroke: improving functional use of  
526 the upper extremity in hemiplegia. *Top Stroke Rehabi* 2006; 13(3):31-42.

527 [42] Edin BE. Cutaneous afferents provide information about knee joint movements  
528 in humans. *J Physiol (Lond)* 2001;531:289–97.

529 [43] Preece H, White P. Does kinesiology tape increase trunk forward flexion? *J*  
530 *Bodyw Mov Ther* 2017;21(3): 618-25.

531 [44] Lemos TV, Albino ACG, Matheus JPC, Barbosa AM. The effect of kinesio  
532 taping in forward bending of the lumbar spine. *J Phys Ther Sci* 2014; 26(9):1371-  
533 75.

534 [45] Csapo R, Alegre LM. Effects of Kinesio® taping on skeletal muscle strength -  
535 A meta-analysis of current evidence. *J Sci Med Sport* 2015; 18(4): 450-56.

536 [46] Konishi Y. Tactile stimulation with Kinesiology tape alleviates muscle  
537 weakness attributable to attenuation of Ia afferents. *J Sci Med Sport* 2013; 16(1):45-  
538 8.

539

540

## 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.

<b>Variable</b>	<b>CG (n=27)</b>	<b>KTT (n=27)</b>	<b>KTNT (n=27)</b>	<b>MP (n=27)</b>	<b>p value</b>
<b>Age (years)</b>	24 (4)	25 (6)	24 (5)	25 (5)	0.747
<b>BMI (Kg/m<sup>2</sup>)</b>	23.2 (2.7)	23.2 (3.2)	22.1 (3.2)	22.7 (2.6)	0.516
<b>Pain (0-10)</b>	4.9 (1.6)	4.9 (1.9)	4.9 (1.8)	5.1 (1.7)	0.977
<b>Disability (0-24)</b>	8 (3)	7 (3)	8 (4)	7 (3)	0.221
<b>Flexion (degree)</b>	88 (19)	92 (18)	89 (22)	89 (16)	0.892
<b>Extension (degree)</b>	25 (8)	24 (14)	27 (13)	24 (12)	0.794
<b>Right Lateral Flexion (degree)</b>	29 (5)	32 (7)	30 (6)	29 (5)	0.113
<b>Left Lateral Flexion (degree)</b>	28 (6)	31 (7)	30 (5)	28 (5)	0.189
<b>Right RMS (%)</b>	58.5 (6.8)	59.7 (7.4)	58.0 (5.9)	58.7 (6.3)	0.798
<b>Left RMS (%)</b>	57.7 (7.3)	57.8 (6.1)	57.6 (5.3)	57.9 (6.3)	0.998
<b>Strength (%)</b>	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
<b>Pain (0-10)</b>	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)
<b>Disability (0-24)</b>	8 (3)	7 (3)	7 (4)	7 (3)	4 (3)	4 (3)	8 (4)	5 (5)	6 (6)	7 (3)	5 (3)	4 (3)
<b>Flexion (degree)</b>	88 (19)	87 (18)	86 (15)	92 (18)	95 (18)	94 (19)	89 (22)	90 (21)	90 (22)	89 (16)	88 (17)	86 (16)
<b>Extension (degree)</b>	25 (8)	25 (9)	27 (9)	24 (14)	28 (13)	30 (14)	27 (13)	28 (13)	29 (15)	24 (12)	26 (13)	26 (13)
<b>Right Lateral Flexion (degree)</b>	29 (5)	29 (5)	29 (7)	32 (7)	34 (7)	34 (7)	30 (6)	31 (7)	32 (6)	29 (5)	30 (5)	29 (5)
<b>Left Lateral Flexion (degree)</b>	28 (6)	28 (6)	29 (6)	31 (7)	31 (7)	32 (7)	30 (5)	29 (5)	30 (5)	28 (5)	30 (6)	28 (5)
<b>Right RMS (%)</b>	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)
<b>Left RMS (%)</b>	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)
<b>Strength (%)</b>	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.

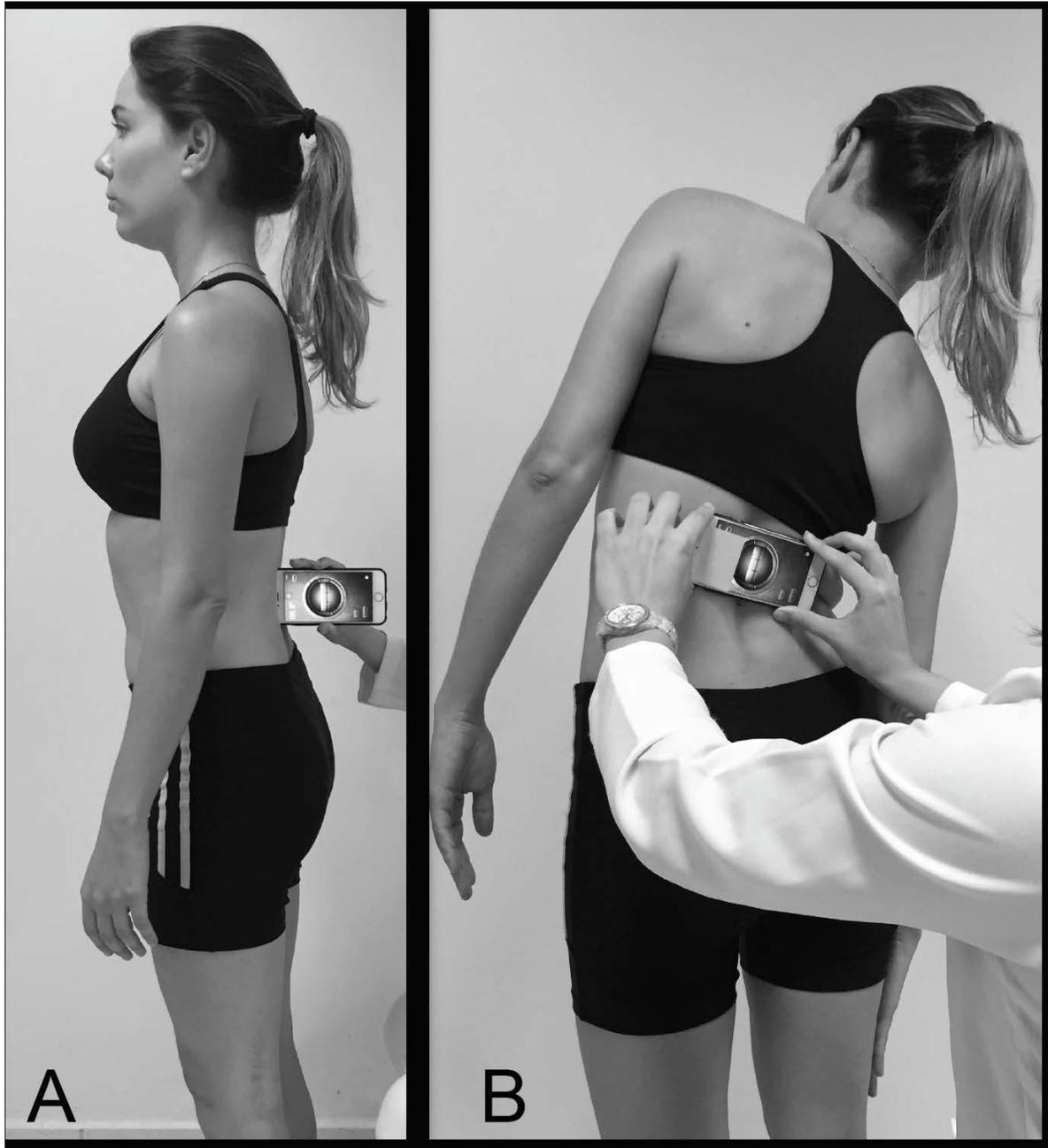
**Table 3.** Mean differences between groups (95% confidence interval) and p value at pre, 3 days and 10 days after intervention for pain and disability variables.

Time	Groups	Pain		Disability	
		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:  $p < 0.05$



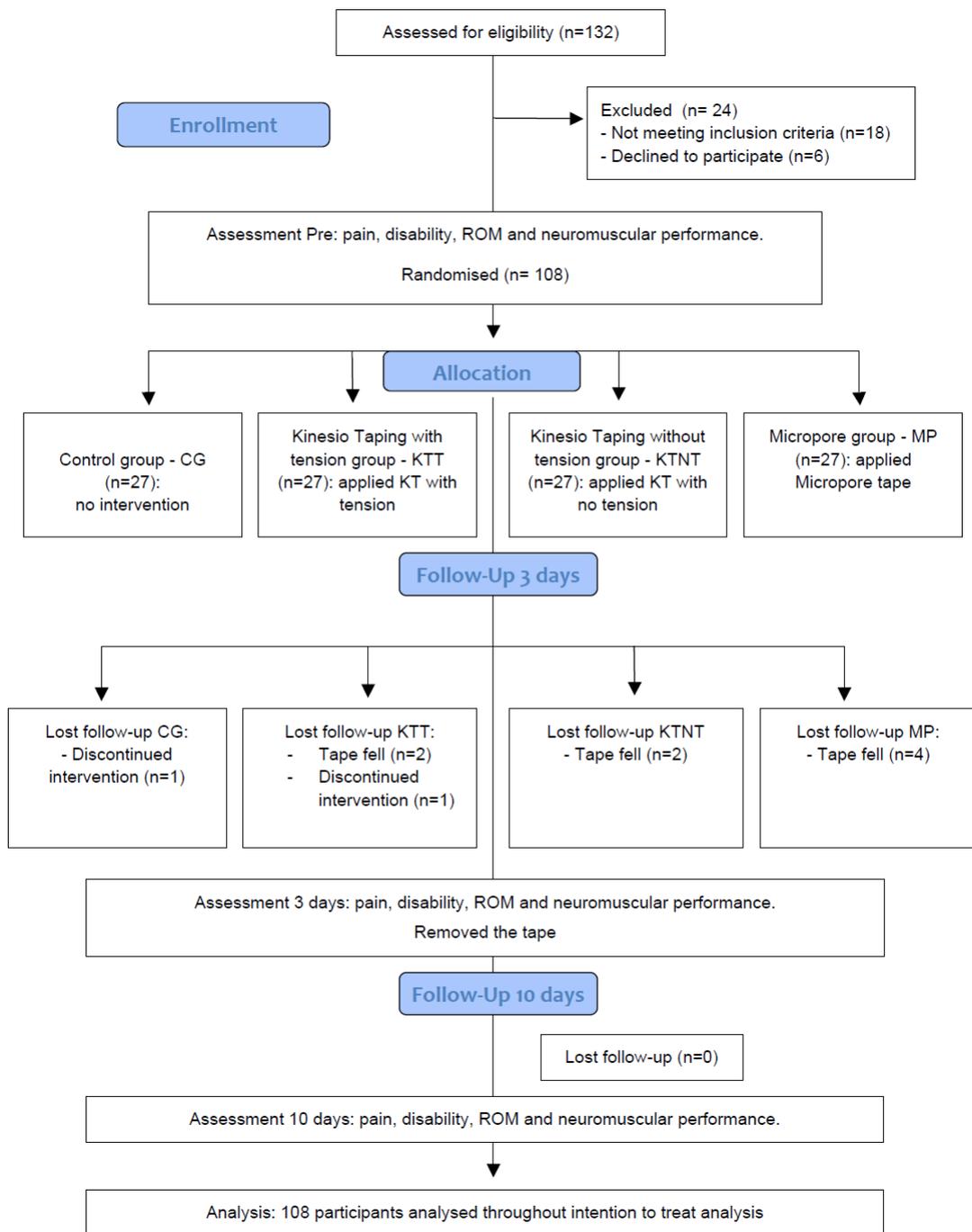
**Figure 1.** Application of the tape with tension (A) and without tension (B) in the region of erector spinae muscles.



**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.