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

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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.

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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/m², 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.

129 *Intervention*

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

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

144 **Insert Figure 1**

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

149 *Outcome measures*

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 η^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.

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

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383

384 **Conflict of interest:** None.

385

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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/m²)	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	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.

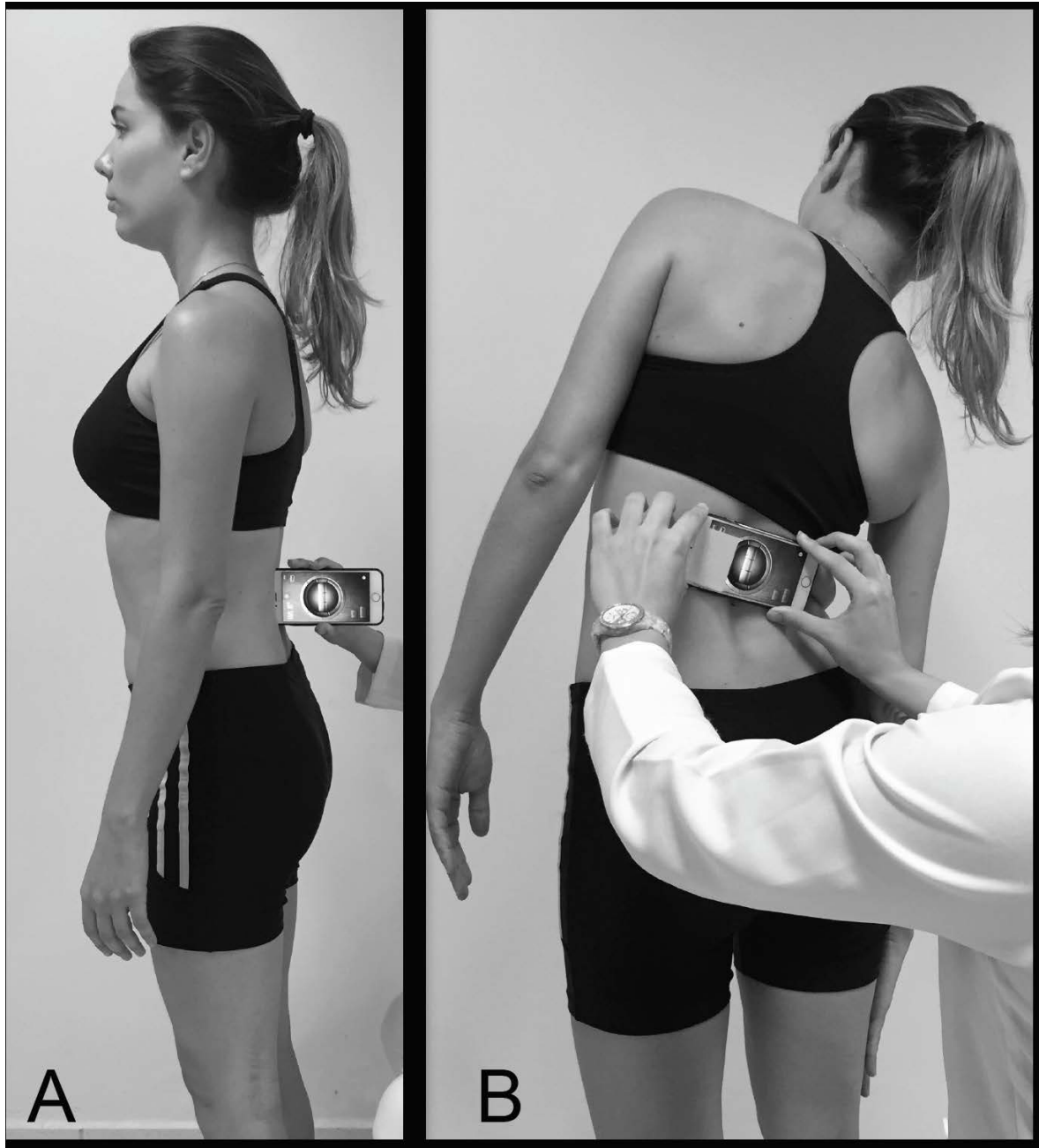


Figure 2. Position of the device to measure flexion and extension (A) and lateral flexion (B) of the spine.



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

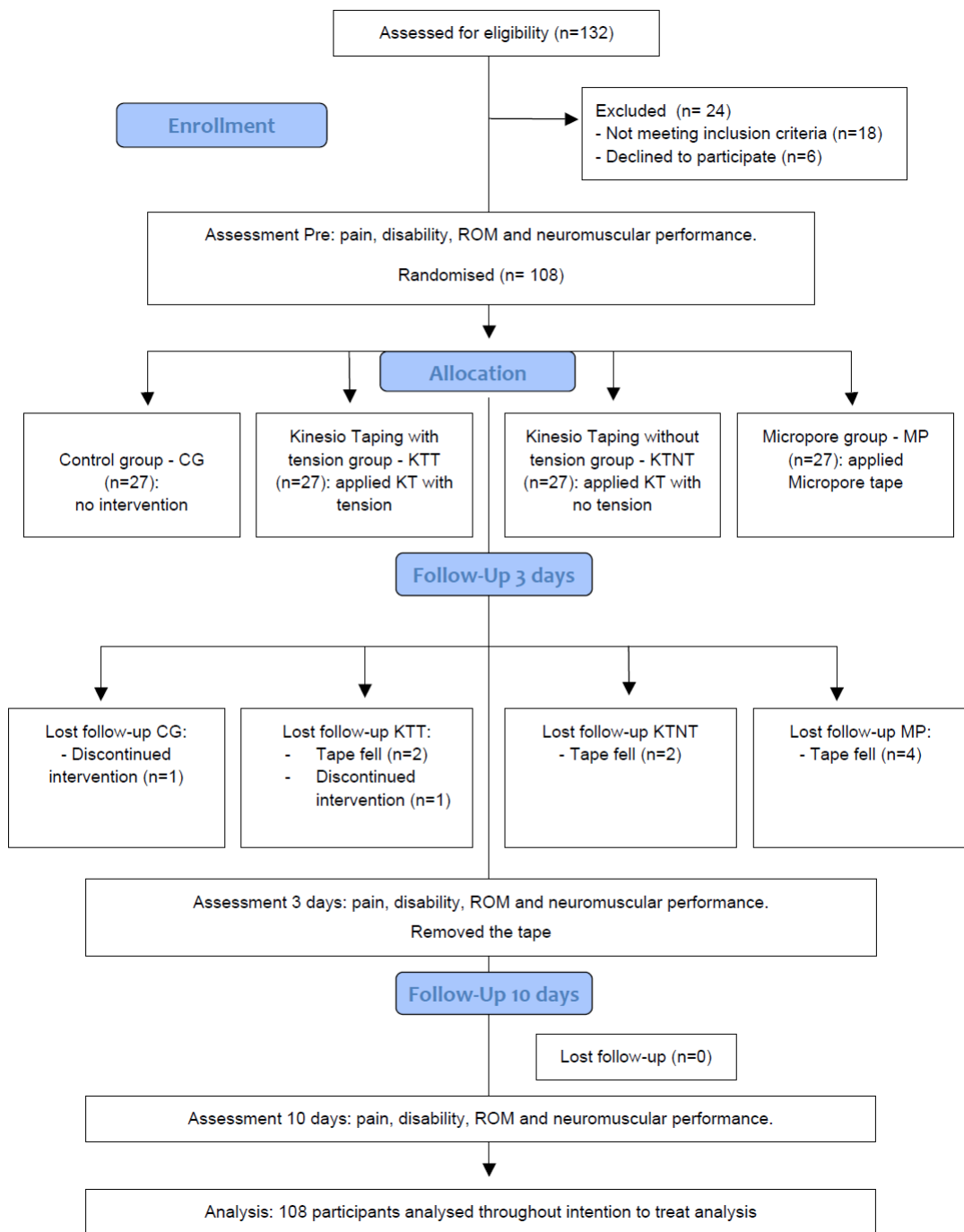


Figure 4. Study flow diagram.