Effects of Myofascial Release in erector spinae myoelectric activity and lumbar spine kinematics in non-specific chronic low back pain: randomized controlled trial

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ABSTRACT

Background: Flexion-relaxation response of the lumbar erector spinae has been previously studied after different interventions such as exercise programs or spinal manipulation, in subjects with chronic low back pain. The objective of the study was to investigate the effects of an isolate myofascial release protocol on erector spinae myoelectric activity and lumbar spine kinematics in chronic low back pain.

Methods: Thirty-six participants, with nonspecific chronic low back pain, were randomized to myofascial release group (n=18) receiving four sessions of myofascial treatment, each lasting 40 minutes, and to control group (n=18) receiving a sham myofascial release. Electromyographic and kinematic variables as well as pain and disability questionnaires were analyzed.

Findings: There was a bilateral reduction of the flexion relaxation ratio in individuals receiving myofascial release and who did not show myoelectric silence at baseline (right difference M = .34, 95% CI [0.16, 0.33], $p \leq .05$ and left difference M = .45, 95% CI [0.16, 0.73], $p \leq .05$). There was also a significant reduction in pain in the myofascial release group (difference M = −9.1, 95% CI [−16.3, −1.8], $p \leq .05$) and disability (difference M = −5.6, 95% CI [−9.1, −2.1], $p \leq .05$), compared with control group. No significant differences between groups were found for the kinematic variables.

Interpretation: The myofascial release protocol contributed to the normalization of the flexion- relaxation response in individuals who did not show myoelectric silence before the intervention, and also showed a significant reduction in pain and disability compared with the sham group.

Keywords: electromyography, low back pain, fascia, myofascial release, physical therapy modalities

1. INTRODUCTION

Trunk flexion-extension is a very common movement in the activities of daily life, work, leisure, and sport and therefore the behavior of the different structures involved in this movement has aroused great interest in the scientific community. In healthy individuals the electromyographic (EMG) activity of the lumbar erector spinae muscles is reduced or silent when the trunk flexion is near complete (approximately 75%–80% of full flexion; Lalanne et al., 2009). This response, which was first described by Floyd and Silver (Floyd WF & Silver PHS, 1951), is known as the flexion-relaxation phenomenon (FRP) and its absence is often associated with low back pain (LBP) (Dankaerts et al., 2006;. Neblett et al., 2003; Watson et al., 1997). Therefore, assessing FRP is considered a valuable objective clinical tool which can aid the diagnosis and treatment of patients with LBP (Colloca & Hinrichs, 2005; Geisser, 2007; Mayer et al., 2009). Neblett et al. showed that the absence of FRP in individuals with chronic LBP (CLBP) could be corrected with treatment (Neblett et al., 2003). Their intervention consists of a quantitatively directed and progressive exercise program initially focused on regaining mobility in the injured musculoskeletal structures, accompanied by a multimodal disability-management program.

Some other studies have also examined the impacts of therapeutic interventions such as a spinal manipulation on the FRP in LBP individuals, although in this sense the findings were inconsistent between studies. Whereas Lehman and McGill did not find consistent changes following the manipulation, Lalanne et al. and Bicalho et al. showed a statistically significant increase in the flexion relaxation ratio (FRR), calculated by dividing the EMG activity during the flexion phase by that during the relaxation phase (Lehman & McGill, 2001; Lalanne et al., 2009; Bicalho et al., 2010). Similarly, Marshall

and Murphy reported a reduction in EMG activity during the relaxation phase at full trunk flexion after a 12-week Swiss ball exercise program (Marshall & Murphy, 2006). In contrast, Ritvanen et al. showed an increase in the EMG activity during full flexion after two different interventions: traditional bone setting and physical therapy (Ritvanen et al., 2007). More recently, Neblett et al. found that interdisciplinary functional-restoration rehabilitation combined with a surface EMG-assisted stretching biofeedback training protocol, normalized the FRP (Neblett et al., 2010).

Myofascial release (MFR), which involves the application of a low-load, long-duration stretch to the myofascial complex (Barnes, 1990), is widely used by physical therapists in the management of LBP. Fascia is densely innervated by mechanoreceptors which are responsive to manual pressure (Schleip, 2003); their stimulation in other spinal structures including the posterior ligaments (Holm et al., 2002; Solomonow et al., 2003) and zygapophysial joint capsule (Lalanne et al., 2009) has been related to changes in the neuromuscular response of the erector spinae. Although the mechanisms of action underlying MFR are still unclear, stimulation of fascial mechanoreceptors may induce similar neuromuscular changes. Previous studies have reported that MFR combined with other treatments can help to reduce pain and disability in individuals with CLBP (Licciardone, 2003; Ajimsha et al. 2014). Indeed, a previous randomized clinical trial of our group found similar improvements in pain and disability, but in this case using an isolated MFR protocol lasting 2 weeks (Arguisuelas et al., 2017). Nevertheless, to date, no studies have specifically analyzed the effects of MFR on the FRP. Therefore, the present study is an extension from the aforementioned clinical trial in which our purpose is to analyze the effects of the same isolated MFR protocol on erector spinae myoelectric activity and lumbar spine kinematics in individuals with CLBP. Our hypotheses is that a

MFR protocol can induces changes in the myoelectric activity of the erector spinae in order to normalize the FRP, in subjects with CLBP.

2. MATERIALS AND METHODS

2.1 Design overview

This was a double-blind, parallel sham-controlled trial with balanced randomization (1:1).

2.2 Participants

The study was carried out at our center's research laboratory which was designed for conducting clinical trials. We recruited 36 individuals aged between 18 and 60 years with a diagnosis of nonspecific CLBP of at least 3 months' duration (Airaksinen et al., 2006) from the Orthopaedic Surgery Service based at a tertiary hospital. The study participants were randomly assigned to the MFR (n = 18) or sham groups (n = 18) using a computer-generated random number sequence (Saghaei, 2004).

Individuals were excluded if they were pregnant or met any of the following criteria: suffering from a spinal tumor, infection, or fracture, autoimmune, infectious, vascular, endocrine, metabolic, or neoplastic systemic disease, fibromyalgia, cauda equina syndrome, submission to a previous spine surgery, or musculoskeletal injuries of the lower limbs. Other exclusion criteria were any of the contraindications described for myofascial treatment (Shea, 2014), previous experience with myofascial therapy, or a history of rehabilitation treatment for back pain within the preceding two months.

The study was conducted following the ethical requirements established by the Helsinki Declaration of 1964 and its sixth revision in 2008 (Williams, 2008). All participants read an information leaflet and then signed an informed-consent statement before starting the

study. In addition, the study protocol was approved by the local ethics committee and the trial was registered at ClinicalTrials.gov with registration number NCT01241071.

2.3 Interventions

Upon their arrival at the laboratory, the patients completed a questionnaire about their perception of their disability (the *Roland Morris Questionnaire*, RMQ; Kovacs et al., 2002) and another about their pain intensity (the *Short Form McGill Pain Questionnaire*, SF-MPQ; Lázaro et al., 1994). Subsequently, participants were asked to perform two consecutive exercises.

The first one was a trunk flexion-extension task. The patients were given verbal instructions and the task was live-demonstrated, and then they were given time to practice before commencing the data recording. From an upright standing position with their arms positioned along their trunk, participants were instructed to keep their knees straight and bend forward, as far forward as they could**,** over the count of 4 seconds (flexion phase). They were then required to hold the fully flexed position for 1 second before returning to their initial upright position over the count of 4 seconds (extension phase). The participants completed five flexion-extension cycles, each with a 1-second pause in the upright position between repeats. The speed and duration of all the movement phases were standardized by using a metronome.

The second exercise was a maximum trunk range of movement (ROM) task. From an upright standing position, individuals were told to perform their maximum trunk ROM following this sequence: flexion, extension, right side-bending, and left side-bending; they were told to hold the final position of each movement for 3 seconds. The erector spinae EMG activity was recorded during the flexion-extension exercise and the lumbar spine ROM was recorded during both exercises.

The interventions were undertaken by a trained physical therapist with more than 10 years' practical experience in manual therapy. The MFR group received four sessions (twice a week for two weeks) of myofascial treatment, with each session lasting 40 minutes. The MFR treatment protocol included four previously described techniques (Arguisuelas et al., 2017; Barnes, 1990; Pilat, 2003), as follows: (1) Longitudinal sliding along the lumbar paravertebral muscle complex (Figure 1A), performed with the physical therapist's olecranon, three times on each side of the spine. (2) MFR of the thoracolumbar fascia (Figure 1B); pressure was applied continuously for 5 minutes along the fascia, without sliding over the skin or forcing the tissue, using a crosshanded hold with the hands placed at the T12-L1 levels and on the sacrum. (3) MFR of the quadratus lumborum (Figure 1C); the elbow of the cranial arm was placed above the iliac crest and lateral to the lumbar paravertebral muscles and over the quadratus lumborum region, and the caudal hand was placed on the subject's thigh. Low-level pressure was then applied with the elbow obliquely directed toward the center of the spinal column while the other hand exercised gentle traction along the patient's leg; this technique was applied for 7 minutes on each side. (4) MFR of the psoas muscle (Figure 1D): with the hands placed laterally and positioned 3 cm from the umbilicus, a MFR of the muscle was induced by transversally sliding the fascia of the psoas; this sliding was repeated 15 times on each side.

The control sham group received a sham MFR for 40 minutes per treatment session, twice a week for 2 weeks. The sham MFR was applied by gently placing their hands over the same areas treated in the MFR group, but without sliding, just enough to maintain contact for the required time (Ajimsha et al., 2014; Saíz-Llamosas et al., 2009; Tozzi et al., 2011).

All the participants maintained their standard protocol treatment for LBP during the duration of the study.

2.4 Instrumentation

EMG data were collected using bipolar Ag/AgCl surface electrodes applied bilaterally at the L3 level; a ground electrode was placed over the 12th rib on each side. Electrodes were positioned longitudinally to the erector spinae fibers, 3 cm laterally to the spinous process, with an inter-electrode distance of 2 cm (MacIntosh & Bogduk, 1991). To reduce impedance, the skin was carefully prepared by shaving, gently abrading with a fine-grade sandpaper, and then cleaning with an alcohol swab. EMG activity was recorded with an electromyographic system (ME6000, Mega Electronics Ltd, Kuopio, Finland) operating at 1000 Hz (bandwidth 15–500 Hz, common mode rejection ratio of 110 dB at 60 Hz). Kinematic data were collected using a 3-Space Fastrak motion-analysis system (Polhemus Inc., Colchester, VT, USA). The motion sensors were placed over the spinous process at the L1 and S1 levels, respectively and kinematic data were recorded at 120 Hz. An external trigger device was connected to both recorders in order to synchronize the recording of the EMG and kinematic signals.

2.4 Data analysis

EMG data were full wave-rectified and averaged with a time constant of 0.02 seconds. For the purpose of EMG data normalization, submaximal voluntary isometric contractions (SMVICs) of the aforementioned muscles were performed and recorded prior to the trials, as recommended for LBP individuals (Allison et al., 998). A modified version of the Sorensen test (Biering Sorensen, 1984) was used as the normalization task. Each subject lay prone with their iliac crest aligned with the edge of an examination couch and their arms crossed on their upper trunk. The lower body was fixed to the couch by straps at the pelvis, knees, and ankles to limit lower limb muscle activation. The study

individuals were asked and verbally encouraged to maintain a horizontal and unsupported trunk position for 5 seconds.

Lumbar angles were obtained by calculating the difference between sensor L1 and S1 (Sánchez-Zuriaga et al., 2016) and the kinematic data was normalized by expressing these angles as a percentage of the maximum lumbar flexion value. The rectified EMG signals and kinematic data were then plotted to determine the lumbar flexion angle corresponding to EMG cessation during the flexion phase (onset of the FRP) and the lumbar flexion angle of EMG activation (cessation of the FRP) during the extension phase; EMG cessation and activation were identified by visual inspection of the rectified EMG signal (Descarreaux et al., 2008; Gupta, 2001; Kippers & Parker, 1984; O'Sullivan et al., 2006). Kinematic and EMG signals from the median three of five flexion-extension cycles were selected for further analysis, and the mean of the three repetitions was calculated for each of the variables.

2.5 Outcomes

The primary study outcomes were the changes in EMG variables. EMG-dependent variables were (1) the average erector spinae EMG amplitude during the eccentric and concentric phases of the erector spinae activity pattern (fig. 2): these variables were related to the myoelectrical silence of the erector spinae and therefore could not be calculated in individuals without a FRP; (2) the FRR (Paquet et al., 1994) calculated by dividing the average EMG activity measured during 85%–100% of the flexion phase by the average EMG activity measured during 45%–60% of the flexion phase. The secondary outcomes of the study were measurements of kinematic variables, pain, and disability. Kinematic-dependent variables included: (3) the average lumbar flexion angle corresponding to the onset and cessation of the FRP (which could only be calculated in

individuals showing the FRP) (fig. 2); and (4) the maximum ROM during flexion, extension, and bilateral side-bending.

Pain perception was assessed by means of the SF-MPQ (Lázaro et al., 1994). This questionnaire consists of a 15-point descriptor of average pain which is articulated in 11 points of sensory experience and 4 points of affective experience. The sensory and affective pain-rating scores give a total pain-experience value ranging from 0 (no pain) to 45 (maximum pain). The degree of disability resulting from back pain was measured using the RMQ (Kovacs et al., 2002) with a score ranging from 0 (no disability) to 24 (maximum disability). All the variables were assessed before the treatment (baseline) and immediately after the intervention (week 2).

MATLAB R2010a (MathWorks, Natick, MA) was used to collect all the data. An investigator from the Orthopaedic Surgery Service was responsible for enrolling the participants, and an external investigator was responsible for the assignment of individual patients to the intervention groups. Both the participants and the investigator assessing the outcomes were blinded to the patient group assignments and so allocation concealment and masking were preserved throughout the study.

2.6 Statistical analysis

The SPSS (SPSS, Version 20, Armonk, NY: IBM Corp) statistical package was used for all the statistical analyses. Normality of the variables was confirmed using the Shapiro-Wilk test. Two-way mixed ANOVA tests were carried out to compare the results of the pain and disability scores between the groups, using time as the within-group factor and the intervention type as the between-group factor, with two levels each one. To compare the study effects on EMG and kinematic variables, three-way mixed ANOVA tests were used also adding the absence of FRP as another between-group factor. Pearson's

correlation coefficient was used to examine the relationship between pain and disability scores and EMG parameters.

An a priori analysis of effect size and sample size was conducted for an α-level of 0.05 and for the desired power of 90%. The effect size was estimated using Cohen's d based on the results of previous studies with similar dependent variables and which also used of myofascial therapy as the independent variable (Bicalho et al., 2010). Thus, the recruitment target number was 32 participants (G*Power 3.0.10). The sampling size was increased by 10% to compensate for possible alterations in the statistical significance of the results caused by potential participant dropouts. The statistical significance level of this study was set at $p < 0.05$.

3. RESULTS

Thirty-six individuals participated in the study and were randomly allocated to the MFR or sham group. Figure 3 shows a flow diagram of the study and the baseline descriptive characteristics of all patients are summarized in Table 1. The results of the two-way mixed ANOVA tests showed a significant group × time interaction for SF-MPQ ($F = 6.816$, $p = .01$), and RMQ ($F = 5.771$, $p = .02$). As reported in Table 2, at the end of the study protocol there was a significant reduction in both outcome measures in the MFR group as compared with the control group. The only EMG variable that showed a significant three-factor interaction was the FRR on both sides (right $F = 4.174$, $p = .05$ and left $F = 10.997$, $p = .002$; Table 3). At the end of the treatment protocol there was a bilateral reduction in the FRR among individuals in the MFR group who had not shown the FRP at baseline, compared to the sham group and the individuals who had shown the FRP at baseline. No significant differences between groups were found in terms of the kinematic

variables. The changes observed in terms of pain and disability did not significantly correlate with any of the EMG parameters.

4. DISCUSSION

The results of this study showed a decrease both in pain and disability at the end of the protocol among individuals who received MFR compared to the control sham group. These results are consistent with other studies dealing with the FRP which also reported a reduction in pain and/or disability after other manual interventions (Ritvanen et al., 2007) or exercise programs (Marshall & Murphy, 2006; Neblett et al., 2003). However, Lalanne et al. did not find differences in pain scores after spinal manipulation in these patients (Lalanne et al., 2009). One possible explanation for this discrepancy may be that this latter intervention only comprised one session whereas other interventions (Marshall & Murphy, 2006; Neblett et al., 2003; Ritvanen et al., 2007) including this study, consisted of a 2–12 week-long program. Like previous reports (Dankaerts et al., 2006; Lalanne et al., 2009; Watson et al., 1997) we did not observe the FRP during maximum flexion in some of the individuals included in this present study. In addition, we included the absence or presence of the FRP as an additional factor in the statistical analysis of the FRP-related variables, although this factor has not been considered in previous studies.

We observed a statistically significant bilateral reduction in the erector spinae FRR in individuals from the MFR group who had not shown an FRP at baseline. Previous studies have also examined the impact of different therapeutic interventions on the FRP in individuals with LBP. Neblett et al. assessed the influence of a 7-week rehabilitation program consisting of supervised, progressive exercises combined with education sessions about pain and stress management (Neblett et al., 2003) and found that after this treatment more individuals obtained a normal FRP response. Marshall et al. and Lalanne

et al. also reported a reduction in the erector spinae EMG activity during full flexion after a 12-week Swiss ball exercise program and spinal manipulation, respectively (Marshall & Murphy, 2006; Lalanne et al., 2009).

Consistent with these studies, we also observed an improvement in the FRP response after MFR treatment when compared to sham group. Individuals in whom myoelectric silence was not present, after the intervention showed a reduction in the EMG activity of erector spinae in the full flexion phase as well as a decrease in the FRR. In contrast to these results, Ritvanen et al. reported an increase in the erector spinae EMG activity when approaching full trunk flexion both in patients who underwent a spinal mobilization intervention or manipulation and physiotherapy (Ritvanen et al., 2007). However, these results were not conclusive because its participants were retested a month after the end of the intervention when the possible positive impacts of treatment may have already decreased. The reduction in the FRR observed in the MFR group after the intervention might be related to stimulation of the fascia mechanoreceptors resulting in a modification in the neural control unit input to the spinal stabilizing system; ultimately, this would allow the erector spinae to relax in the full flexion phase. This ligamento-muscular relationship has also been observed between erector spinae and other spinal structures such as the posterior ligaments (Holm et al., 2002; Solomonow et al., 2003) or the zygapophysial joint capsule (Lalanne et al., 2009).

Regarding the kinematic variables, we did not observe any significant differences between groups for the FRP onset and cessation angles. These results are in line with those reported by Lalanne et al. who found that these variables were not affected by spinal manipulation (Lalanne et al., 2009). In addition, no significant differences between the MFR and sham groups were found in any of the kinematic variables registered during the maximum ROM exercise. Neblett et al. suggested that achievement of flexion-relaxation

is associated with major improvements in ROM and observed that individuals who had shown the FRP before treatment also achieved higher ROMs than their counterparts who had not shown this phenomena (Neblett et al., 2003). Consistent with these results we also observed higher lumbar flexion ROM before the intervention in individuals who had shown the FRP compared to those who had not, both in the MFR group (ROM° in FRP-individuals vs. non-FRP individuals: 47.97 ± 13.18 vs. 35.26 ± 9.69) and the sham group (ROM° in FRP-individuals vs. non-FRP individuals: 44.52 ± 9.95 vs. 31.98 ± 14.02). Likewise, after the intervention, from among the MFR group, only those who had not shown FRP prior to treatment saw an improvement in the ROM. Nonetheless, this increase in lumbar flexion ROM was only about 3° and did not reach statistical significance, perhaps because of the low number of individuals who had not shown the FRP in each group (6 individuals). The resulting lower statistical power makes it difficult to find statistically significant differences in these data. Thus, further studies with larger groups of LBP individuals who do not show the FRP will be required to determine the nature of this relationship.

In our study the changes observed in pain and disability did not significantly correlate to any of the EMG parameters we assessed. Previous studies (Ritvanen et al., 2007; Ahern et al., 1988; Arena et al., 1991; Watson et al., 1997) also failed to find a relationship between pain or disability and EMG activity parameters among individuals with LBP, although disability has been weakly associated with FRR values (Ritvanen et al., 2007). Back muscle function EMG tests are commonly used to assess the capacity of patients with LBP to improve their physical performance during rehabilitation (Ritvanen et al., 2007). Here we showed that EMG activity (the FRR) is sensitive to clinical changes in pain and disability; we found major improvements in the FRR in individuals receiving MFR treatment who had not shown FRP before the intervention. This might suggest that

the effect that the MFR technique has is mediated by changes in trunk neuromuscular responses, allowing normalization of the FRP response. According to this hypothesis, findings from this study might contribute to improving our understanding the physiological mechanisms of MFR.

One of the limitations of our study, which is inherent to the nature of the intervention we applied, was the lack of therapist blinding. However, manual therapy techniques are influenced by many factors which depend on the person applying the technique (for example, manual dexterity, pressure exerted, hand size, tactile sensitivity, etc.). It is extremely difficult to standardize these parameters and it is generally assumed that these represent another inherent limitation to studies on myofascial therapies (Kidd, 2009). To minimize the repercussions of this limitation in our work, the physical therapist who applied the treatment protocol had ten years' experience in the field of manual therapy and was the same for all the individuals. Finally, we have also to state as a limitation the final sample size.

5. CONCLUSIONS

In conclusion, in this study the application of a myofascial release protocol in patients with LBP significantly reduced pain and disability compared with the sham group. The myofascial release protocol could have contributed to the normalization of the FR-response in individuals who had shown the absence of myoelectric silence before the intervention. Further studies including larger samples could bring light over this possible effect.

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FIGURES

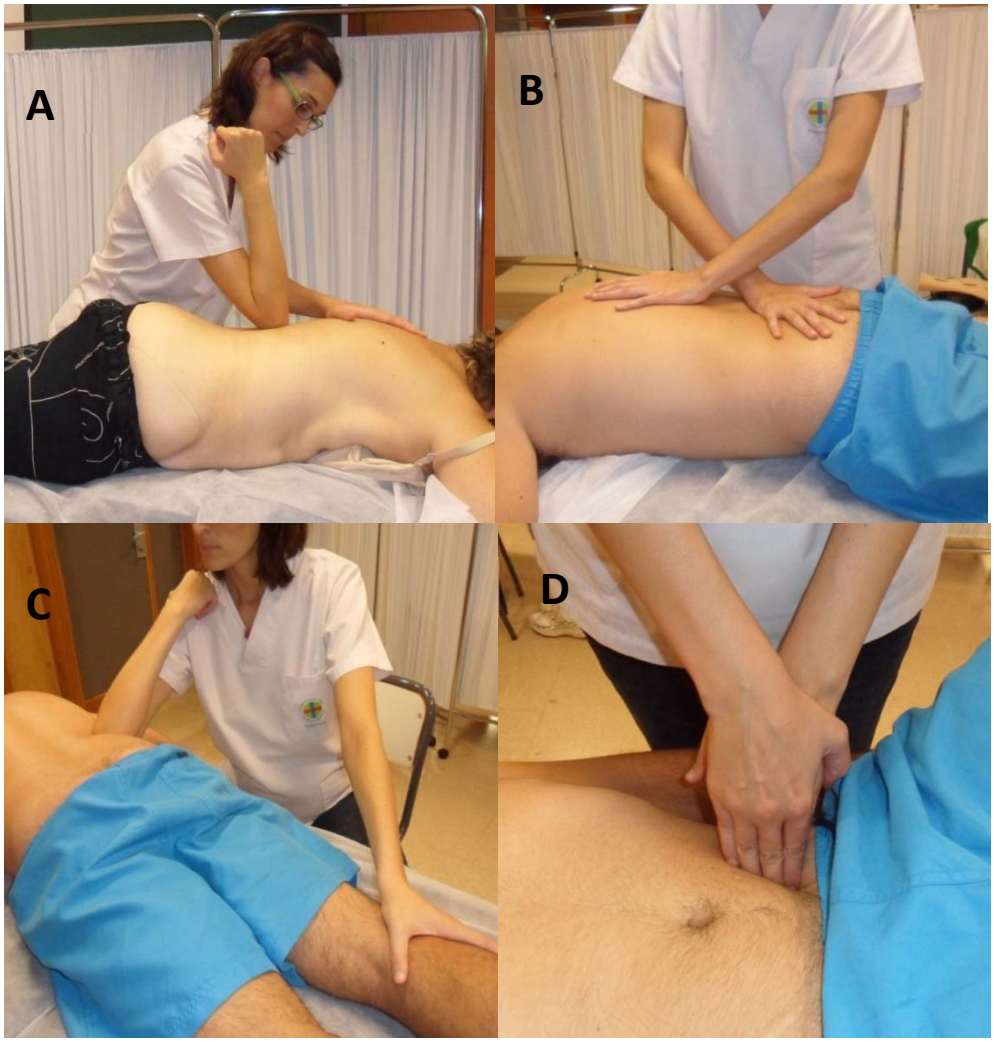

Figure 1**.** Myofascial Release protocol for the intervention group. (A) Longitudinal sliding of lumbar paravertebral muscles (B); Myofascial release of the thoracolumbar fascia; (C) Myofascial release of quadratus lumborum; (D) Myofascial release of psoas muscle.

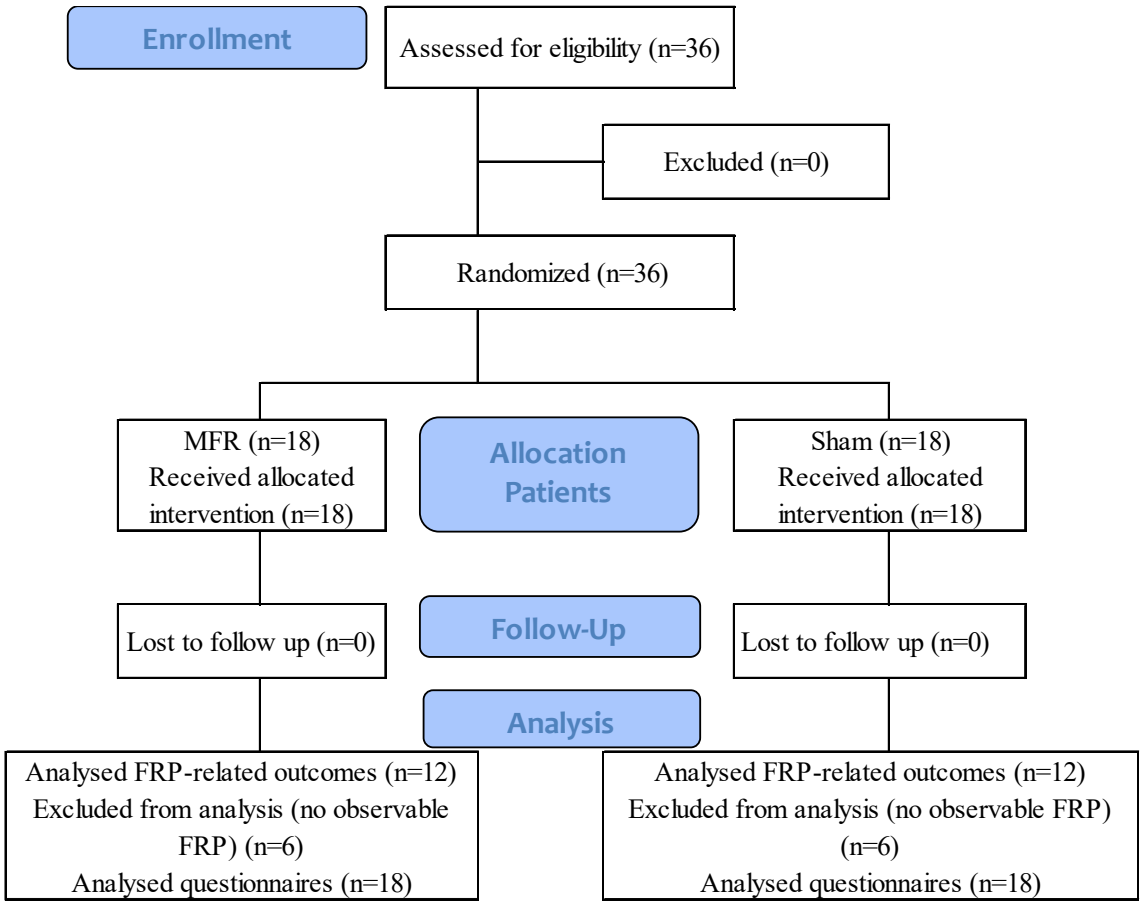

Figure 2. Flow diagram of the study

TABLES

TABLE I. Anthropometric and clinical features of patients

Parameter	MFR (n=18)	Sham (n=18)
Age (years)	47.2 ± 9.8	48.6 ± 10.1
Gender (male/female)	6/12	6/12
Body mass index (Kg/m2)	25.8 ± 4.8	25.8 ± 3.7
Disease duration (years)	6.8 ± 4.6	8 ± 8.2
SF-MPQ (0-45)	21.5 ± 7.8	22.2 ± 9.9
RMQ (0-24)	8.8 ± 4.7	11 ± 4.6
Subjects without FRP at baseline	6	6

Data are mean ± SD. SF-MPQ; Short Form McGill Pain Questionnaire; RMQ: Roland Morris Questionnaire; FRP: flexion- relaxation phenomenon

Table II. Differences between groups of the pain and disability outcome measures

Outcome	Group				Difference between groups
	Baseline		Week 2		Week 2
	MFR	Sham	MFR	Sham	MFR minus Sham
SF-MPQ *(0-45)*	21.5 (17.2 - 25.8)	22.1 (17.8 - 26.4)	9.2 (4.1 - 14.3)	18.3 (13.1 - 23.4)	-9.1 (-16.3 to -1.8)*
R*MQ (0-24)*	8.8 (6.6-11.1)	11 (8.7 -13.2)	4.1 (1.7 - 6.6)	9.7 (7.3 -12.2)	-5.6 (-9.1 to -2.1) *

Data are mean (CI 95%). *<0.05
SF-MPQ, Short Form McGill Pain Questionnaire; RMQ, Roland-Morris Questionnaire

Table III. Differences between groups in FRR before and after the intervention

Group		Outcome					
		FRR_ RES			**FRR_ LES**		
		PRE	POST	Difference between groups (PRE-POST)	PRE	POST	Difference between groups (PRE-POST)
	FRP present at baseline	0.25 (0.05 to 0.46)	0.36 (0.08 to 0.65)	- 0.11 (-0.37 to 0.15)	0.36 (0.10 to 0.61)	0.43 (0.08 to 0.77)	-0.07 ('-0.29 to 0.14)
MFR							
	FRP no present at baseline	0.91 (0.65 to 1.16)	0.56 (0.22 to 0.91)	0.35 (0.16 to 0.66) *	1.12 (0.79 to 1.45)	0.67 (0.22 to 1.12)	0.45 (0.16 to 0.73) *
	FRP present at baseline	0.23 (0.05 to 0.42)	0.3 (0.05 to 0.56)	-0.07 (-0.17 to 0.31)	0.22 (-0.01 to 0.46)	0.24 (-0.08 to 0.57)	-0.02 (0.22 to 0.19)
SHAM							
	FRP no present at baseline	0.94 (0.68 to 1.19)	1.14 (0.79 to 1.48)	-0.2 (-0.52 to 0.12)	1.14 (0.82 to 1.47)	1.45 (1 to 1.9)	-0.31 (-0.58 to - 0.02)

Data are mean (CI 95%). * , P<0.05. FRP: flexion relaxation phenomenon; FRR_RES: flexion relaxation ratio of the right erector spinae; FRR_LES: flexion relaxation ratio of the left erector spinae