Evaluation of Lumbar Myofascial Release Effects on Lumbar Flexion Angle and Pelvic Inclination Angle in Patients with Non-Specific Low Back Pain

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Background: Many studies have shown that changes in lumbar flexion angle and the pelvic inclination angle can be affected by the shortening of the lumbar muscles, which can cause low back pain. Decreased lumbar flexion angle and pelvic inclination angle can cause or exacerbate low back pain by disrupting the lumbopelvic rhythm.

Purpose: This study aimed to use myofascial release techniques as a specialized treatment on muscle tissue to cause muscles to reach the optimal length and improve lumbar flexion angle and pelvic inclination angle, and thus improve low-back pain.

Setting: Non-specific low back pain patients, Tarbiat Modares University, Iran.

Participants: 30 chronic non-specific low back pain participants were randomly assigned into two groups.

Research Design: This is a randomized control trial.

Interventions: The myofascial release group (n=15) underwent 4 sessions of myofascial release treatment based on Myer's techniques, and the control group (n=15) underwent 10 sessions of routine electrotherapy for two weeks.

Main Outcome Measures: Before starting the intervention and after the last treatment session, both groups were evaluated by the lumbar flexion angle with a flexible ruler, calculating the pelvic inclination angle by a trigonometric formula, and VAS measured the pain score of the participants.

Results: The results of the paired t test showed that, after treatment in both groups, the severity of pain and lumbar flexion angle changed significantly ($p \leq .001$). However, the pelvic inclination angle was changed considerably only in the myofascial release group, and we did not see significant changes in the control group ($p = .082$). Also, the independent sample t test results to examine the between-group changes showed that changes in the myofascial release group were significantly different from the control group ($p \leq .000$). Also, the effect size shows the large effect of the myofascial release technique compared to the control group (effect size ≥ 1.85).

Conclusion: The present study results showed that myofascial release techniques in patients with low back pain could help decrease pain intensity and increase lumbar flexion and pelvic inclination angle. Based on the present study results, myofascial release can be a treatment to correct posture in patients with chronic non-specific, low back pain. Due to the prevalence of the COVID-19 pandemic, it was not possible to evaluate the long-term effects of treatment.

KEYWORDS: myofascial release; low back pain; lumbar flexion; rang of motion; electrotherapy; posture

INTRODUCTION

Low back pain (LBP) is affected by many factors, including anthropometric, physical, muscular, and postural. Important etiological factors such as obesity, muscles imbalance, decreased lumbar range of motion (ROM), and lumbar lordosis disorders are associated with LBP.[1] Among the reasons mentioned, extensor muscle shortness and decreased lumbar flexion ROM significantly impact LBP incidence.[2] The lumbar lordosis curve is the primary human adaptation to standing on two legs. As the center of mass above the hip joint, this area helps the muscles of the spine control the shear forces and strengthens the bearing capacity of this area against

gravity. Due to the decisive role of lumbar lordosis in optimizing energy during daily activities, studies have shown that its disruption is one of the main causes of LBP.[3-7] In this regard, Gracovetsky stated that the transmission of force across the spine causes the formation of lordotic posture in the spine, which minimizes and equalizes stress in all intervertebral joints.[8,9] Lumbar flexion ROM and lumbar lordosis are critical postural components of significant clinical and research importance. Rheumatic, neurological, and orthopedic standards have shown that impaired lumbar lordosis and decreased lumbar flexion ROM can lead to lumbar spine disorders and motion inhibitions.[10,11]

Previous studies showed that patients prefer to keep their lumbar spine straight to reduce pain, which could affect the increase in lumbar lordosis changes over time and decrease the lumbar flexion ROM.[10,11] Following lumbar flexion decreases, imbalance occurs in the anterior and posterior trunk muscles, increasing the anterior tilt of the pelvic and affecting the angle of pelvic inclination.[12]

Several studies have been performed to investigate the relationship between lumbar lordosis, lumbar flexion ROM, pelvic inclination angle, and LBP, which showed that they are related to each other.[13-15] Changing the lumbosacral angle has increased the pressure on the posterior ligaments and facet joints, and decreased lumbar flexion ROM, which causes LBP.[16] Nevertheless, many studies have shown that LBP occurs following lumbar flexion decreases and shortness of back muscles.[17,18] In this regard, Gracovetsky showed that the central nervous system constantly controls and modifies the geometry of the spine to prevent and minimize the pressures on the vertebral joints. Due to the critical role of muscles in handling the forces on the joints, they will be under a lot of pressure following postural disorders.[19] A study performed on changes in lumbar lordosis in different positions showed that the line of action of the lumbar extensor components changes and could interfere with the control of the shear forces in the lumbar region by decreasing lumbar flexion ROM, and the result is LBP. The study confirmed that the condition of lumbar lordosis, flexion ROM, and back muscles are directly related to each other.[20] Studies have also shown that, in some cases, changes in lumbar lordosis and disturbance of the flexor and extensor components of the trunk can cause changes in the angle of pelvic inclination.[21] But there are many doubts about the direct connection between pelvic inclination, lumbar flexion ROM, and LBP.[15] Following the lumbar lordotic curve disorders and shortening of the lumbar extensor muscles, the ROM of the lumbar flexion decreases. In this regard, studies have shown that people with LBP suffer from decreased lumbar flexion ROM.[22,23]

According to the mentioned issues, shortness of lumbar extensor muscles can be considered one of the main causes of lumbar lordosis disorders and subsequent reduction of lumbar flexion ROM, leading to LBP. As a result, eliminating the shortness of the lumbar extensor muscles makes it possible to reduce LBP. According to previous studies, myofascial release (MFR) has been mentioned as one way to inhibit muscle shortness and, following MFR techniques, muscle shortness improved.[24,25] It is hypothesized that following the MFR techniques in the lumbar region can affect the ROM of lumbar flexion and pelvic inclination, which is a determining factor in controlling LBP severity. This study aimed to evaluate the effect of the lumbar MFR techniques on the ROM of lumbar flexion, pelvic inclination angle, and the severity of pain in patients with non-specific LBP.

METHODS

Study Population

After conducting a pilot study on 8 participants and setting their standard divisions in G-Power software, 15 participants were obtained for each group. Thirty participants, including 15 males and 15 females whose orthopedic specialists confirmed non-specific low back pain, participated in the study. Participants were selected from clients of medical clinics, and the specialist physician was blind to the stages of the study. Inclusion criteria included a history of low back pain in the last 12 months,[26] pain score between 4 and 6 in the Visual Analogue Scale(VAS), normal body mass index (BMI), and an age range of 30 to 50 years. Exclusion criteria included a history of rheumatic, infectious, cardiovascular, and fibromyalgia diseases, and/or a history of surgery and spinal fractures.[27] Participants were randomly

divided into two groups. Randomization was performed using the random number table method. The myofascial release group (MFRG-n=15) underwent four sessions of myofascial release treatment for two weeks,[28,29] and the control group (CG-n=15) underwent ten sessions of routine electrotherapy for two weeks.[30] All stages of the study were planned based on Helsinki declarations. Before starting the survey, participants were informed of the study process and completed the informed consent form. Also, all stages of the study were approved by the Ethics Committee of Biomedical Research at Tarbiat Modares University (Approval ID: IR.MODARES.REC.1398.126) and registered in the Iranian Registry of Clinical Trials (IRCT Id: IRCT20200423047173N1).

Outcome Measures

Participants were examined for lumbar flexion angle, pelvic inclination angle, and pain severity once before starting treatment and once after the last treatment session. A flexible ruler was used to measure the flexion angle of the lumbar. Participants were first asked to stand on a flat surface and place their hands in anatomical positions. The T12 and S2 vertebrae on the spine were marked using a marker in this situation. The patient was then asked to bring the head near the knees by leaning forward. At the end of the range of motion, the subjects were asked to maintain the final position. Then the amount of lumbar curve was recorded by using a flexible ruler. The resulting arc was recorded by fixing the flexible ruler on the lumbar from point T12 to S2 in the flexion position. The arc was converted to angle degree using the Youdas method's formula (Figure 1).[31] To ensure maximum flexion was achieved, participants were asked to perform three flexion movements of the lumbar, and then we recorded the average of the three attempts.

Calculation of pelvic inclination angle by marking the ASIS and PSIS bony landmarks on the subject and calculating the angle from trigonometric formulas were used (Figure 2). For this purpose, the location of ASIS and PSIS on the patient's pelvis was determined. The angle of the line connecting these points and the horizon line was calculated according to the formula.[32,33] Participants were also asked to rate their pain on a 10-point VAS scale to

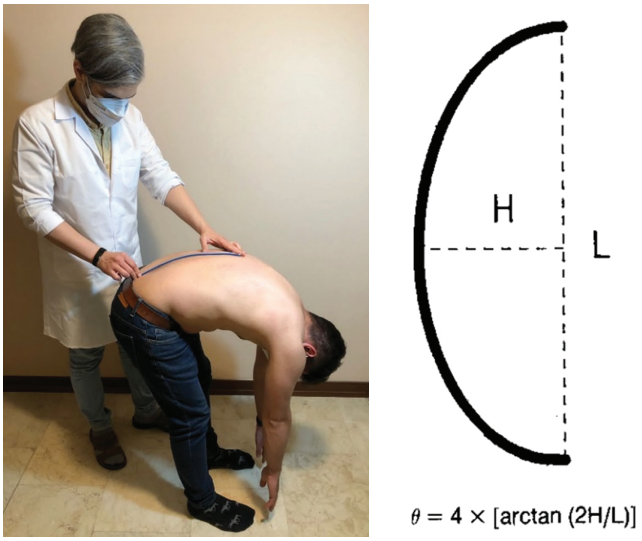

Figure 1. Converting the lumbar flexion arch to the lumbar flexion angle using the Youdas method's formula.

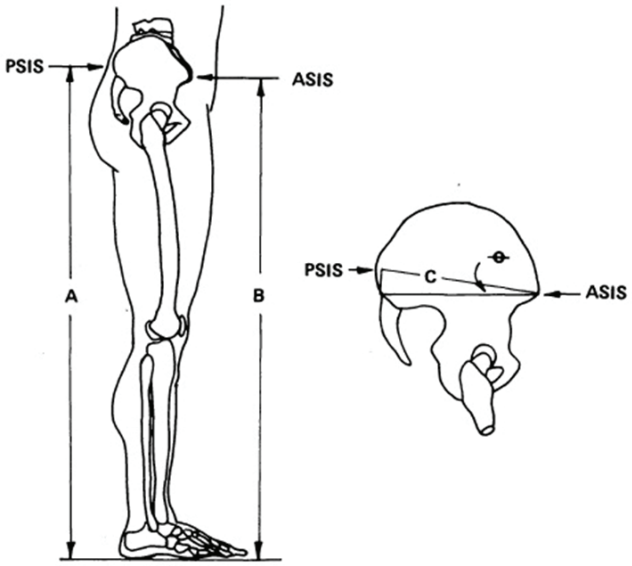

Figure 2. Calculate the angle of inclination of the pelvis using a trigonometric formula.

assess the severity of LBP.[34] Participants were asked to mark their pain on a straight line to do this. The beginning of the line indicated painlessness, and the end of the line stated unbearable pain. To minimize the measurement errors, a therapist, who was blinded to the treatment groups, performed pre- and post-intervention evaluations. Another therapist also performed the treatment.

Study Protocol

Myofascial release group

The myofascial release techniques were performed by a physiotherapist with 10 years of experience in performing manual treatments. Also, to perform the same technique for all participants, myofascial release sessions were performed at specific times of the day. Participants in the myofascial release group underwent four MFR sessions using Myer's techniques for two weeks.[28,29] The patient sat in a chair during the procedures and was asked to bend forward as the therapist started the MFR. The therapist performed the MFR from the mid-thoracic to the pelvis area using the metacarpophalangeal joints of the index, middle, and ring fingers. This movement was repeated five times. The patient sat in a chair, bent forward, and placed elbows on knees in the following three positions. With fingertips of both hands, the therapist applied the MFR of the erector spine muscles on both sides of the lumbar spine. This technique was done in three positions: bending forward, bending forward by turning to the right, and bending forward by turning to the left, and for each part with five repetitions.[28]

Control group

The control group underwent routine electrotherapy for ten sessions over two weeks. Routine electrotherapy included 1 MHz continuous ultrasound (Sonoplus 490); Enraf-Nonius BV, Rotterdam, The Netherlands) for 3 minutes, TENS (Endomed 682v; Enraf-Nonius) (high frequency in the first five sessions and low frequency in the last five sessions) for 20 minutes with the two-channel method. The electrodes were placed on both sides of the lumbar spine at L2 to L5 levels.[30,35]

Statistical Analysis

All statistical analyses were performed using IBM SPSS 16 software (IBM SPSS Statistics, Armonk, NY). Shapiro-Wilk test was used to check the normality of data distribution. Then, an independent sample *t* test was used to examine the baseline data of the two groups before the intervention. At the end of the interventions, paired *t* test was used to investigate changes within-group. An independent sample *t* test was used to examine differences changes between groups. It should be noted that a statistical significance was considered $p < .05$ in all study tests.

RESULTS

Thirty participants, including 15 females and 15 males, were randomly assigned into two groups. The mean age of individuals was 40.07 ± 4.93 yrs. The information of the participants of the two groups is specified in Table 1.

Primary Analyses

Following the primary statistical analyses, the results of the Shapiro-Wilk test showed that the data have a normal distribution, and the independent *t* test results also showed no difference in the baseline information in the two study groups (Table 2).

Within-group changes (in low back pain severity, lumbar flexion angle, and pelvic inclination angle)

TABLE 1. The Basic Information of Participants in the Two Groups

Variable	*MFRG (N=15)*	*CG (N=15)*	*P Value*
Age (Yrs)	39 ± 4	40 ± 5	.000
Male/Female	8/7	7/8	.000
BMI	23.40 ± 2.42	23.81 ± 1.60	.000
Pain Score (VAS)	5.47 ± 0.52	5.47 ± 0.64	.000
Height (Meter)	1.71 ± 0.11	1.72 ± 0.10	.000
Weight (Kilogram)	69.7 ± 14.15	70.5 ± 10.10	.000
LBP History(Month)	16 ± 3	15 ± 2	.000

MFRG = myofascial release group; CG = control group; BMI = body mass index; VAS = visual analogue scale.

TABLE 2. Independent *t* Test Results to Evaluate the Baseline Data of the Two Groups Before the Interventions

Variable	*Mean ± SD*	*P Value*
Low Back Pain (VAS)	MFRG = 5.47 ± 0.51 CG = 5.43 ± 0.64	.862
Lumbar Flexion Angle (Degree)	MFRG = 49.87 ± 5.02 CG = 55.66 ± 1.35	.386
Pelvic Inclination Angle (Degree)	MFRG = 10.26 ± 0.50	.982

Changes of variables before and after treatment sessions were tested by paired *t* test. The results showed that the pain score in both groups decreased after the interventions. The average lumbar flexion angle increased after therapeutic interventions in both groups. Also, pelvic inclination angle increased in the MFR group after therapeutic interventions, but no significant changes were observed in the control group (Table 3).

Between-group changes (in low back pain severity, lumbar flexion angle, and pelvic inclination angle)

An independent sample *t* test was used to compare the mean changes in low back pain, lumbar flexion angle, and pelvic inclination angle between both groups. The statistical analysis results showed that the differences in pain scores, lumbar flexion angle, and inclination angle in the two groups after therapeutic interventions were significantly different (*p* value ≤ .001). The higher upper-band of 95% confidence interval of the difference indicated that the mean of the second group (MFR) was higher than the control group. Cohen's *d* was also used to evaluate the effect size. The obtained values indicated a large effect (above 0.8) in all three variables (Table 4).

DISCUSSION

The present study results showed that the severity of LBP decreased in both groups. Reducing the severity of pain in the control group can refer to the use of TENS. The use of TENS to reduce pain severity in chronic pain conditions has been approved in many studies. Studies have shown that the use of TENS has a significant effect on reducing the severity of pain by affecting the nervous system with several mechanisms such as the pain gate theory, segmental mechanisms, extra-segmental mechanisms, peripheral mechanisms, and neurotransmitters mechanisms.[36-41] Also, ultrasound and its thermal effects on the tissue can help reduce the severity of pain.[42] However, due to the lack of adequate and appropriate information on TENS and its effectiveness, many studies do not introduce it as an independent and isolated treatment.[43-46] Also, some studies with follow-up for several months stated that the therapeutic effects of TENS are short-term in many cases.[47,48]

The decrease in pain severity in the MFR group was also obtained. In this regard, Barnes's study showed that fascia shortens, increases in thickness and stiffness following any trauma and skeletal injuries. Due to its close relationship with the underlying muscle, tissue can transmit these disorders and cause dysfunctions of the musculoskeletal system.[49]

On the other hand, MFR directly affects the fascia layers and improves the damaged condition of the fascia tissue. This treatment can affect the underlying muscular structures and relieve the pain.[50,51] Comparison of the results of the two groups showed that the reduction of pain was more effective in the MFR group.

Other results of the present study include an increase in lumbar flexion angle in both groups. There is a justification for increasing the ROM of lumbar flexion in patients following the reduction of pain. The mean changes in lumbar flexion angle after therapeutic interventions showed a minimal increase in the control group, but an increase

TABLE 3. Paired *t* Test Results to Compare Within-Group Changes After Interventions

Variable	*Group*	*Before Mean*	*After Mean*	*P Value*
Low Back Pain (VAS)	MFRG	5.47 ± 0.51	3.33 ± 0.21	.001
	CG	5.43 ± 0.64	4.40 ± 0.16	.001
Lumbar Flexion Angle (Degree)	MFRG	49.87 ± 5.02	58.00 ± 1.40	.001
	CG	55.66 ± 1.35	51.60 ± 1.42	.001
Pelvic Inclination Angle (Degree)	MFRG	10.26 ± 0.50	14.53 ± 0.48	.001
	CG	10.07 ± 0.64	10.26 ± 0.61	.082

TABLE 4. Independent Sample *t* Test Results to Compare the Difference of Changes Between Groups After Interventions

Variable	*t*	*95% CI of the Difference*		*Mean Difference*	*P Value*	*Effect Size*
		Lower	*Upper*			
Low Back Pain	4.34	0.56	1.57	1.07	.001	2.36
Lumbar Flexion Angle	10.01	5.68	8.71	7.20	.001	1.85
Pelvic Inclination Angle	15.05	3.50	4.63	4.07	.001	7.40

in lumbar flexion angle was obtained in the MFR group. Also, the pelvic inclination angle did not change significantly in the control group, but increased in the MFR group.

Studies have shown that following the occurrence of LBP, lumbar fascia tissue becomes short and stiff. As a result of the shortening of the lumbar myofascial tissue, the ROM flexion and, in some cases, the pelvic inclination angle were reduced.[12,52] Studies have shown the effect of MFR on improving flexibility and increasing the length of myofascial tissue. In this regard, Pollack's research[53] regarding the water content of fascia highlights the important role of fluid dynamics in fascial bodywork. This research proposes that water has another state besides gaseous, frozen, and liquid—that of a gel. In hydrophilic tissue, water organizes itself in a colloidal matrix of particles that forms a liquid crystal. Pollack described this liquid crystal as bound water.[53] Bound water has a high degree of viscoelasticity, giving it a trampoline-like bounce and give. The Pollack study introduced protein collagen as a hydrophilic tissue which is compromise of up to approximately two-third of water. However, they also showed that collagen and elastin fibers are drawn closer together in the restricted fascia, and less bound water is present. Photonic energy, such as heat from the therapist's hand on the client's body, was needed.[53] In this regard, Gracovetsky and Chaudhry et al. in their studies defined fascia as a tissue with nonlinear elastic properties that can be affected by external mechanical forces and turned into heat.[54,55] Other studies on MFR techniques showed a relationship between levels of interleukin with fascial holds. Interleukin 8, which regulates the inflammatory response, was not stimulated until fascial holds reached 3 minutes, and it more than doubled at a 5-minute hold. Interleukin 3, which regulates blood cell production, increased after a 4-minute fascial hold.[56-58] According to the results of previous studies, the role of MFR techniques in controlling inflammation and increasing blood flow can be directly affected by reducing pain and improving the flexibility of myofascial tissue.

The present study results showed that following MFR techniques, pain reduction and increased lumbar flexion and pelvic inclination angle occurred. As a result, it can be concluded that the MFR techniques, by improving the shortness of the lumbar myofascial tissue, led to improved posture and increased the lumbar and pelvic ROM by improving the shortness of lumbar fascial tissue. The present study results also showed that physiotherapy treatment could reduce patients' pain and slightly improve the ROM of lumbar flexion, but does not affect the pelvic inclination angle. In contrast, physiotherapy treatment has fewer therapeutic effects than MFR techniques on patients with chronic non-specific LBP.

Limitations

Our study was based on a limited number of people. Also, we evaluate the effect of myofascial release on low back pain and lumbar ROM without a follow-up period after treatment because of the Covid-19 pandemic; we cannot consider the results as conclusive for an extended period.

CONCLUSION

This study showed that lumbar myofascial release techniques could reduce low back pain and improve the lumbar flexion ROM and pelvic inclination angle in people with chronic non-specific low back pain.

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CONFLICT OF INTEREST NOTIFICATION

The authors declare there are no conflicts of interest.

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