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RESEARCH ARTICLE

A pilot study on the short-term effects of myofascial release and core stability exercises on balance in chronic low back pain

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Abstract

Background and Aim: Balance disorders are among common complications of chronic low back pain (LBP). Since the tissue and echogenicity of thoracolumbar fascia changes in chronic LBP, the independent motion of fascia layers would negatively alter, and it may affect the control of spine movements. It has been shown that myofascial release (MFR) improves the function of transversus abdominis as a core muscle in LBP. So, MFR may affect the balance and postural control in these patients. The aim of this study was to evaluate the immediate effects of MFR and core stability (CS) exercises on dynamic balance and pain in women with chronic non-specific LBP.

Methods: In this pilot study, with a pretest-posttest design, 10 females aged 30 ± 9.04 participated. The participants received one session of MFR on thoracolumbar fascia and CS exercises. The outcome measures were dynamic balance by Y balance test (YBT) and pain with visual analogue scale (VAS), which were assessed before and immediately after the intervention.

Results: Dynamic balance improved significantly ($p < 0.02$) after intervention. The VAS as an indicator of pain intensity showed significant improvement ($p = 0.005$).

Conclusion: The application of MFR plus CS exercises for a single session is effective in improving dynamic balance and pain in women with chronic non-specific LBP.

Keywords: Dynamic balance; core stability; low back pain; myofascial release

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Introduction

Postural stability is an essential component for different daily activities. Evidence suggest that subjects with low back pain (LBP) have altered automatic postural coordination and thus demonstrated some sort of balance disorders [1]. Lifetime prevalence of non-specific LBP is about 80% so it is a high-priced issue to healthcare services worldwide [2]. Most of people experiencing LBP, will develop chronic symptoms lasting longer than one year [3]. In female subjects, the overall mean prevalence of LBP is significantly higher [4].

In chronic LBP, alternations of passive structures and muscle recruitment patterns are common [5-8]. These factors could easily affect postural stability and balance in subjects with LBP [9]. Postural instability and balance dysfunction would also remarkably affect daily activities of these patients [10,11]. Numerous neuromuscular processes such as sensory input, central processing, and neuromuscular responses are prerequisite for good postural control and balance. The sensory components include the vestibular, visual and proprioceptive systems. An appropriate motor response requires an intact neuromuscular system and sufficient muscle strength [12,13]. Proprioceptive impairment and decreased core muscles' strength has also been known as one of the plausible causes for balance impairments in LBP [13].

Core muscles also make a major contribution to controlling postural alignment, stability and maintaining dynamic balance in different daily activities [14]. Among the therapeutic and strengthening exercises, core stabilization with special focus on transversus abdominis (TrA) got particular attention. An anticipatory activation of TrA helps better stabilizing the spine and therefore providing better dynamic control in various functions [15]. In patients with LBP decreased amplitude of TrA muscle activity or delayed onset of its activation were pointed out that could represent changes in motor control and planning [16].

Manual therapy includes a wide variety of techniques. Myofascial release (MFR) is a form of manual therapy which consists of a low load, long duration stretch to the myofascial complex. It helps enhancing function, reducing pain and retrieving desired structure of the fascia [17]. The thoracolumbar fascia (TLF), that placed posteriorly, from iliac crest and sacrum up to rib cage, plays an essential role in low back pain. It is an important component for transmitting forces and making stability through multiple connections with muscles and vertebral column [18].

In chronic LBP, TLF underwent some changes in its tissue and echogenicity [19], therefore the independent motion of fascia layers would negatively alter and movement control might be changed [8]. There is some evidence suggesting that fascia may act like a smooth muscle and in this way affects musculoskeletal dynamics [20,21]. Chen et al. indicated that MFR on the TLF is efficient in terms of increasing sliding of TrA during contraction [22]. Other researches also investigated the effects of MFR or core stability (CS) exercises on functional mobility, pain, balance separately [17,18,23,24], but to the best of our knowledge this study is the first to investigate the possible effects of MFR beside CS exercises on balance in women with chronic LBP.

Considering the strong relationship between TLF, spinal column and core muscles, and also regarding different changes of TLF and TrA in chronic LBP, we postulated that the combination of MFR on TLF and core stability exercises might have further beneficial effects on pain and dynamic balance in female patients with chronic non-specific LBP.

Methods

In this pilot study with a pretest-posttest design, 10 women with chronic non-specific LBP participated. Inclusion criteria were women aged 18 to 50 years old with a history of LBP for at least three months, absence of conditions like congenital low back disorders, back, abdomen or lower extremities surgery in past three months, lumbar vertebrae fracture, malignancies, chronic vertigo, vestibular disorders, pregnancy and being active athletes. Either the participants who simultaneously participate in other treatment protocols or were unwilling to continue the protocol were excluded from this study. All subjects read and signed an informed consent form before the beginning of study. The Review Board and the Ethics Committee of Tehran University of Medical Sciences approved the study protocol (Approval ID: IR.TUMS.FNM.REC.1398.066).

All participants were interviewed to collect demographic data including age, weight, height and period of low back pain. Outcome measures including dynamic balance and pain were assessed by Y balance test (YBT) and visual analogue scale (VAS), respectively before and immediately after the intervention.

YBT is a reliable and valid tool for measuring dynamic balance and neuromuscular aspects of core stability [25]. The assessor instructed YBT protocols in detail and all patients were allowed to practice a trial on each leg, for all directions prior to performing main trial. The test was performed with bare feet, hands placed on hips and foot in contact with the ground. To perform the test, while the patient stood on the center point, and maintaining single leg stance, tried to reach the free limb to the most possible distal part of the scaled tape in anterior, postromedial and postrolateral directions respectively. Between three trials of each leg for each direction, the best records, normalized to leg length were selected to be analyzed. The lower limb length was measured with the patient in supine lying position and straight legs, from Anterior Superior Iliac Spine (ASIS) to the most prominent part of medial malleolus [26]. Each single trial was rejected and repeated if the patient failed to 1) maintain unilateral stance 2) return the reach foot to the starting position 3) maintain full contact of standing foot to the ground (heel off the ground) [27].

VAS was used for measuring pain intensity. The patients were asked to highlight their pain intensity on the scaled continuum (from none to an extreme amount of pain). For data recording a precise ruler was used. The ruler (from the zero point) placed exactly between the start point of the continuum and the patient's mark to the nearest 1 mm so, the possible range was from 1 to 10 cm [28]. Reliability and validity of VAS had been adequately tested for patients with LBP by various studies [29,30].

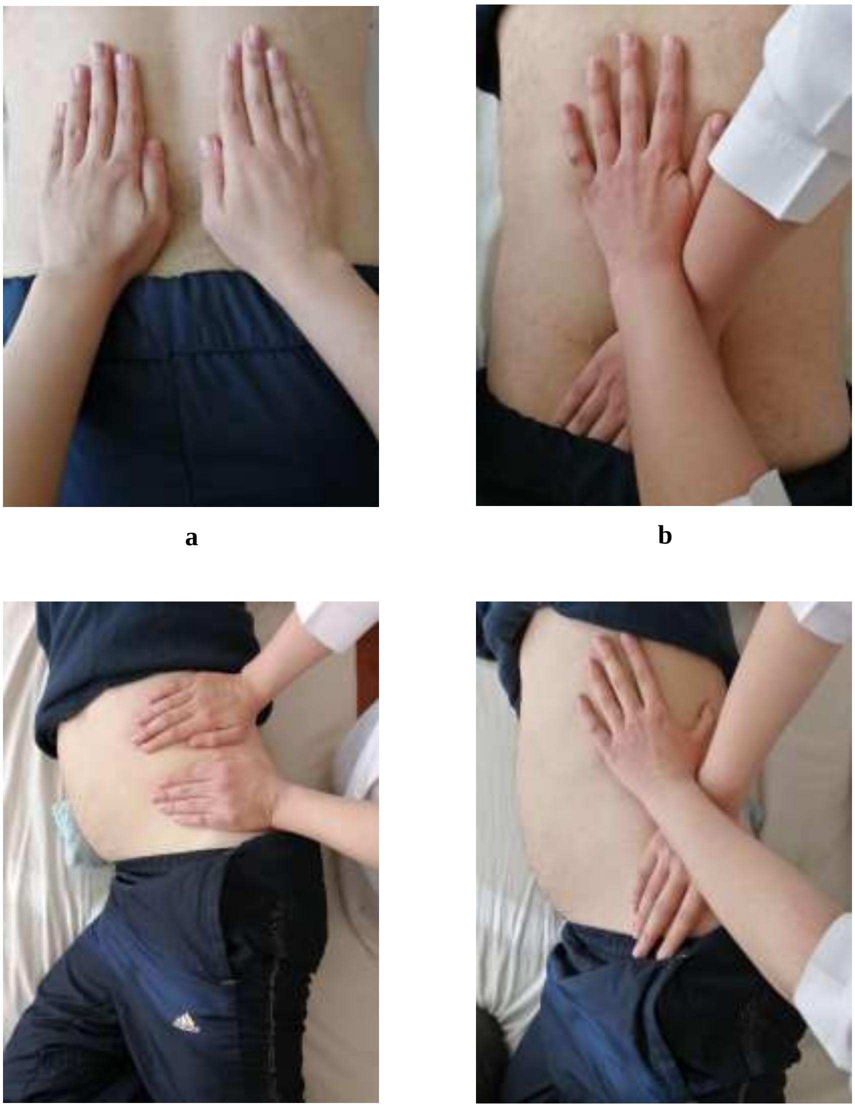
MFR techniques in this study included compression release and cross-hand release in lower back and TLF which were performed in both prone and side lying positions (illustrated as Fig. 1 a-d) the therapist's hands in compression release was side by side and for cross-hand release, was crossed in opposite directions. Each of the mentioned techniques held for 120s and repeated three times in tissue barriers. To perform the techniques physical therapist applied adequate pressure in direction of facial restriction just until the first tissue barrier was felt. Then, the sufficient pressure was engaged for about 120s without gliding over the skin or pushing the tissue tightly [31], until the physical therapist felt a softening feeling under the hands and thoracolumbar fascia starts to yield. As it achieved, the technique would be progressed to the deeper tissue barrier [32]. After MFR, patients performed core stability with abdominal drawing-in maneuver (ADIM) in six positions (illustrated as Fig. 2 a-f) under the therapist supervision. At first, therapist instructed the correct form of ADIM with pelvic floor muscles' activation and all the detailed important points of exercises. Patients were also instructed that breath holding, ribcage depression or abdominal hollowing should not be done during the exercise program. On average exercise program took 15 minutes for each patient.

SPSS statistical software (version 23) was used for data analyzing. One-sample Kolmogrov-Smirnov test was used to determine the distribution of data and showed that all the data were normally distributed. Paired t-test was conducted to compare dependent variables including YBT and VAS before and after the intervention. Cohen's d was also calculated to determine treatment effect size [33].

Results

This study conducted on 10 women with chronic non-specific low back pain (mean and standard deviation of age 30 ± 9.04 year) participated in the present study. All of them had a history of chronic low back pain (mean and standard deviation of low back pain duration 5.02 ± 4.09 year) (Table 1).

For an accurate comparison of balance between subjects all data extracted from YBT were normalized to the patients' leg length and the normalized data were used in analyses. Participants improved significantly on pain intensity measured by visual analogue scale (VAS) ($p = 0.005$) and also dynamic balance measured by YBT of both feet in all directions (anterior, postromedial and postrolateral) ($p \leq 0.02$; Table 2). For all variables including dynamic balance



a b c d

Fig. 1. Myofascial release techniques, a) compression release in prone position, b) cross-hand release in prone position, c) compression release in side-lying position, and d) cross-hand release in side-lying position.

and pain, effect size measures were medium to large ($p<0.05$; Table 2). Test-retest (intra-rater) reliability of YBT scores for all directions of both feet were excellent ($r > 0.97$).

Discussion

The primary findings of the present study were in favor of our hypothesis, so the intervention was effective in terms of improving dynamic balance and reducing pain in women with chronic non-specific LBP. These findings are confirmed by other research articles that showed the useful effects of MFR treatment in different population [17,34], but concurrent investigation of MFR beside CS exercises on dynamic balance of these patients seems limited. Tozzi et al. showed positive short-term improvements in fascial layers' mobility and pain perception of patients with neck or low back pain following MFR [35]. Even on healthy subjects after MFR, TLF stiffness reduction was reported [18]. Findings of another study by Chen et al. showed that sliding

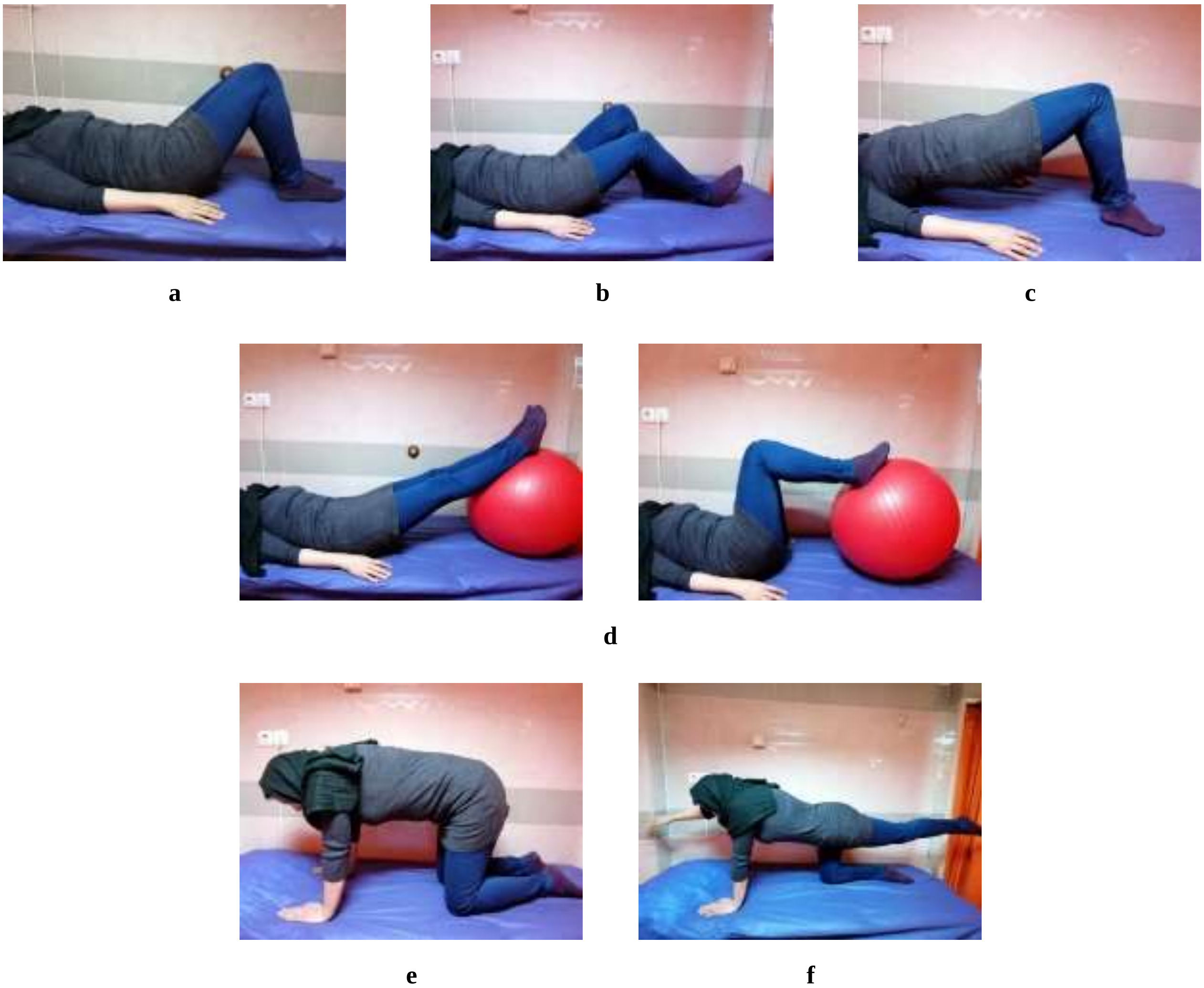


Fig. 2. Core stability exercises, a) abdominal drawing-in maneuver, crook lying 10s hold 10 repetitions, b) abdominal drawing-in maneuver, heel slide, each leg 10 repetitions, c) bridging in supine, 10s hold, 10 repetitions, d) abdominal drawing-in maneuver with moving the swiss ball, 10 repetitions, e) abdominal drawing-in maneuver in quadruped, 10s hold, 10 repetitions, and f) bird dog exercise 10 repetitions on each side.

of musculofascial junctions of transversus abdominis muscle was significantly and clinically improved following MFR in patients with chronic LBP [22]. Some of possible long term complications of chronic LBP are: impaired neuromuscular control [13], altered recruitment patterns of different muscles [36], fewer mechanoreceptors in lumbar fascia [37], impaired lumbopelvic proprioception [38] and increased connective tissue adhesions. All of these factors could lead to mobility restriction, postural control deficits and pain. Some examinations have demonstrated the presence of unmyelinated terminal nerve endings in the lumbodorsal fascia [5]. In some situation like stiffness, they could be entrapped by the myofibrosis parts in tissue [39] so, one possible mechanism of pain reduction in our study could be pressure release of these sensitive free nerve endings [40], after fascial release and improving the layers' mobility. Concerning the researches on CS exercises, Kim and Park showed that these types of exercises could lead to immediate significant improvements in balance [23] also Trampas et al. [24], evaluated

Table 1. Demographic characteristics of patients with chronic low back pain (n = 10)

Characteristics	Mean ± SD
Age (y)	30 ± 9.04
Weight (kg)	63.5 ± 12
Height (m)	1.64 ± 0.05
BMI (kg/m^2)	23.34 ± 3.66
Duration of LBP	5.2 ± 4.09

BMI; Body Mass Index, LBP; low back pain

the immediate effects of clinical massage and CS exercises on dynamic balance performance in chronic LBP. Results demonstrated significant improvements in balance performance and pressure pain threshold. These type of exercises could play an important role in decreasing pain and improving function of patients with chronic LBP [41,42]. However, in long term evaluation CS exercises are not superior to other forms of active exercises [42,43]. Core stability exercises could have the potential to stimulate adaptive processes in the neuromuscular system like: more efficient neural recruitment patterns, faster response of nervous system, increased synchronization of motor units and decreasing of neural inhibitory reflexes [44]. These processes might improve balance performance and functional mobility in older adults [45]. Although for a better understanding of this topic, more research is required.

CS exercises of the present study were executed by special focus on TrA muscle activation. An anticipatory action of this muscle helps stabilizing the spine and provide a better basis for daily movements [15]. Schleip et al. [21], showed that fascia may also express some kind of contractile behavior, therefore it seems that TrA activation alongside with TLF's accurate function would help evoking better stabilization function of core muscles and dynamic balance performances.

Regarding the close connection of TLF with abdominal and back muscles and also considering its alternations in chronic LBP and the beneficial effects of MFR in releasing fascial layers, it seems that implementation of MFR plus CS exercises might be effective in better force transforming mechanics by facilitating the mobility and gliding of layers and hence, increasing stability.

Further studies are needed to investigate the long-term effects of this treatment or to compare different population.

Table 2. Mean and standard deviation of outcome measures pre and post intervention in patients with chronic low back pain (n = 10)

Variable	Pre	Post	p	Effect size*
YBT. L. ant	0.89±0.08	0.96±0.12	0.022	0.69
YBT. L. pm	0.97±0.15	1.11±0.12	< 0.001	0.99
YBT. L. pl	1.04±0.1	1.15±0.1	< 0.001	1.13
YBT. R. ant	0.86±0.1	0.94±0.14	0.029	0.57
YBT. R. pm	0.99±0.12	1.11±0.12	< 0.001	0.93
YBT. R. pl	0.99±0.12	1.1±0.14	< 0.001	0.79
VAS	4.12±1.73	2.4±2.36	0.005	0.83

YBT; Y balance test, L; left, R; right, ant; anterior, pm; postromedial, pl; postrolateral, VAS; visual analogue scale
*Cohen's d

Conclusion

In conclusion, the application of myofascial release (MFR) plus core stability (CS) exercises could immediately improve dynamic balance in anterior, postromedial and postrolateral directions also significantly improvement in pain intensity was achieved in women with chronic nonspecific low back pain (LBP).

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Conflict of interest

No potential conflict of interest relevant to this article was reported.

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