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Effect of 8 weeks myofascial release technique of quadriceps with and without stretching of hamstring on pain, lordosis and balance among female students with hyperlordosis

1-Hassani Somayeh, Kasbparast Mehdi

1-Master of Science, Department of sport injury and Corrective Exercises, Karaj Branch, Islamic Azad University, Karaj, Iran
2-Assistant Professor, Department of sport injury and Corrective Exercises, Karaj Branch, Islamic Azad University, Karaj, Iran
(Corresponding author) E-mail:mehdikasbparast@gmail.com

Abstract

The aim of the present study was to compare the effect of 8 weeks of myofascial release technique of quadriceps muscles with and without static stretching of hamstring muscles on pain, lordosis and balance of female students with increased lumbar curvature. 45 female students aged 12-17 years from schools in District 3 and 4 of Education in Karaj city were selected for this study And they were divided into three groups: quadriceps myofascial release with stretching (n=15), quadriceps myofascial release without stretching (n=15), and control group (n=15). In the pre-test phase, static balance, pain, and lumbar lordosis were measured. Each of the experimental groups participated in the respective exercise program, but the control group did not participate in any exercise program. In the post-test, static balance, pain, and lumbar lordosis were measured again. The Shapiro-Wilk test was used to analyze the data to ensure the normal distribution of the data in both the pre-test and post-test stages. Also, paired t-test was used to compare the difference in scores related to each variable in the pre-test and post-test in each group, one-way analysis of variance test was used to examine differences between groups, and Tukey's post-hoc test was used to find the location of differences and compare the groups pairwise. The results showed that there was a significant difference between the effectiveness of myofascial release of the quadriceps muscles with and without static stretching of the hamstring muscles on the level of pain, lordosis, and balance of female students with increased lumbar curvature. There was also a significant difference between the training and control groups ($P \leq 0.05$).

Keywords: myofascial release, stretching, pain, lordosis , balance

Introduction

Lumbar hyperlordosis an excessive anterior curvature of the lumbar spine is a common postural deviation among adolescents and young adults and has been frequently reported in female student populations. Postural abnormalities, including hyperlordosis, affect a substantial proportion of female students and are associated with sedentary lifestyles, prolonged sitting during academic activities, and muscular imbalances (Golalizadeh et al., 2020). These postural deviations not only alter spinal biomechanics but may also predispose individuals to chronic low back pain, impaired balance, and reduced physical performance. Excessive lumbar lordosis alters spinal load distribution and is often accompanied by anterior pelvic tilt, increased lumbar compressive forces, and altered neuromuscular control. Muscular imbalances between the anterior (e.g., quadriceps and hip flexors) and posterior chains (e.g., hamstrings and gluteals) contribute to pelvic misalignment and may exacerbate low back pain and balance impairments (Allam et al., 2023). In particular, hamstring tightness has been linked to reduced pelvic mobility and modifications in lumbar curvature, indicating that posterior chain shortness plays a mechanistic role in sagittal-plane postural deviations. Moreover, quadriceps dominance in female students may further accentuate

anterior pelvic tilt, increasing lumbar lordosis and modifying the center of mass, thereby affecting both static and dynamic balance. Restoration of a more neutral lumbar alignment therefore depends not only on strengthening and motor-control retraining of trunk stabilizers but also on targeted management of soft-tissue flexibility and fascial restrictions across the anterior and posterior muscle chains. Myofascial release (MFR) techniques applied manually or via self-myofascial methods—aim to reduce fascial adhesions, improve tissue extensibility, and recalibrate sensorimotor function. Recent systematic reviews and randomized trials report that MFR interventions can produce clinically meaningful improvements in range of motion, short-term pain, and certain aspects of dynamic balance, although heterogeneity in protocols and outcomes remains (Antohe et al., 2024; Martínez-Aranda et al., 2024).Similarly, targeted hamstring stretching has been shown to reduce pain and influence spinal posture in both acute and longer-term protocols. Meta-analytic evidence indicates that structured hamstring stretching programs can alleviate low back pain severity and improve functional outcomes, while experimental studies suggest that hamstring lengthening may modify sitting and standing lumbar angles through altered pelvic kinematics (Lee et al., 2021; Gou et al., 2024). These findings support the rationale for combining posterior-chain stretching with anterior-chain interventions when addressing hyperlordotic postures. Despite growing evidence for both MFR and stretching as isolated or short-term interventions, there is a relative paucity of randomized controlled studies that specifically evaluate the combined effects of quadriceps-focused MFR and hamstring stretching on pain, lumbar lordosis angle, and balance—particularly within female student cohorts who may present gender-specific patterns of muscle activation and postural tendencies (Shalamzari et al., 2024). Furthermore, few trials have applied structured protocols of sufficient duration (e.g., eight weeks) to test whether soft-tissue-directed interventions translate into sustained postural and functional changes. Understanding these effects is critical, as young women are prone to neuromuscular imbalances and postural deviations that can persist into adulthood, potentially leading to chronic musculoskeletal disorders. Additionally, recent research emphasizes the importance of a myofascial chain approach, in which interconnected fascial structures across the anterior and posterior body are treated as integrated functional units rather than isolated muscles (ClinicalTrials.gov, 2024). By targeting both quadriceps and hamstrings within a structured intervention program, it is hypothesized that improvements in tissue flexibility and fascial mobility will synergistically influence lumbar curvature, reduce pain, and enhance balance performance. This integrated perspective aligns with contemporary biomechanical models, which highlight the interdependence of muscle length, fascial connectivity, and postural control. Accordingly, the present randomized study evaluates an 8-week program of quadriceps myofascial release with and without adjunct hamstring stretching in female students with hyperlordosis. Primary outcomes include perceived pain intensity and lumbar lordosis angle, while secondary outcomes address static and dynamic balance measures. We hypothesize that combining quadriceps MFR with hamstring stretching will yield greater reductions in pain and lumbar curvature, as well as larger improvements in balance, compared with quadriceps MFR alone. This study aims to provide evidence-based guidance for postural correction interventions in young female populations and inform clinical practice regarding the optimization of soft-tissue-focused strategies for hyperlordotic postures.

Materials and Methods

The present study was conducted using a semi-experimental method and is an applied research type, and the research model is an impact assessment-comparative type. The statistical population of the present study consisted of all female students aged 12-17 years in schools in Districts 3 and 4 of Education in Karaj city who had lumbar lordosis and met the inclusion criteria for the study. Subjects were selected conveniently and divided into three homogeneous groups (in terms of height, weight, and BMI) of 15 people: experimental group 1 (myofascial release with stretching), experimental group 2 (myofascial release without stretching), and control group. The inclusion criteria for the study included being in the age range between 12 and 17 years, Completion of the consent form, absence of injury or surgery in the past 6 months, and absence of congenital problems were the criteria for inclusion in the study. For lumbar lordosis, an angle of more than 45 degrees was the criterion for inclusion in the study (Kamali et al., 2015). The exclusion criteria included parental and student dissatisfaction or pain and discomfort during the exercise. Subjects performed quadriceps myofascial release exercises with stretching and quadriceps myofascial release without stretching for eight weeks, three sessions per week, under the direct supervision of the

researcher. After the end of the training period, the subjects were re-administered the same assessment tests as the pre-test. A visual rating scale was used to measure the intensity of perceived pain. This ruler is a 10-centimeter horizontal strip with one end marked with the number zero (no pain) and the other end marked with the number 10 (the most severe pain possible). The subject was asked to mark the point according to the level of pain they were experiencing, and the researcher recorded that point as a number. The resulting number was considered the patient's level of pain. The validity and reliability of this scale have been reported by Joshua et al. (2020). The reliability coefficient (ICC) of this scale has been reported to be 91%. (Rezvani et al., 2016). The degree of curvature of the lumbar spine of the subjects was measured using a non-invasive method using a 30 cm flexible ruler. An angle of more than 45 degrees of lumbar lordosis was the inclusion criterion for the study(Kamali et al., 2015). A flexible ruler was used to measure the increased lumbar curvature. The flexible ruler was placed on the midline of the spine between the two spinous processes L1 and S2, and after appropriate pressure on it, it took on the desired arc shape. Then, the flexible ruler was placed on a piece of paper and by dragging the pen along the flexible ruler on the paper, the two marked points were connected to each other and the lordosis angle was determined using the trigonometric formula (Seydi et al., 2019). Measuring the lumbar curve using a flexible ruler has been reported to have high reliability (ICC=97%) (Hajiloo et al., 2013). To measure static balance, the stork test was used in which the subject placed his hands on his sides, placed the sole of the non-dominant foot against the medial area of the dorsum of the dorsum, and stood as much as possible on the instep of his dorsum.The test is completed when the heel of the column foot touches the floor, or the hands are separated from the sides, or the sole of the non-column foot is separated from the knee of the column foot. The best time recorded in 3 attempts was recorded as the subject's score (Ghaeini et al., 2015). Training sessions were conducted for 8 weeks, 3 sessions per week for 60 minutes. At the beginning of the session, simple warm-up exercises were performed for about 10 to 15 minutes, and then myofascial release was performed using a foam roller with and without static stretching for 45 to 50 minutes. And stretching exercises included hamstring stretching (Nesma et al., 2023). The study groups were scheduled to arrive at the training site at different times so that the groups' training would not be disrupted. After the training period, a post-test was conducted to examine the effect of the exercises on the dependent variables. It should be noted that, considering the age of the subjects, the exercises were conducted in a game-like manner and in a completely friendly environment, which motivated and increased the subjects' interest in participating in the exercise sessions (Debski et al., 2019). The Shapiro-Wilk method was used to examine the normality of the data. The collected data was analyzed using SPSS version 24 software, and in addition to using descriptive statistics indicators such as mean and standard deviation if normal, paired t-test was used to compare the difference in scores for each variable in the pre-test and post-test in each group. One-way analysis of variance test was used to examine differences between groups and Tukey's post hoc test was used to find the location of differences and compare the groups pairwise. The significance level was also considered equal to 95% and the alpha value was considered smaller than or equal to 0.05.

Table 1: Self foam rolling myofascial release protocol

Myofascial Segments	Weeks 1 to 4	Weeks 5 to 8
Quadriceps	30 seconds 1 to 5 reps	**90 seconds 1 to 5 reps**
Erector Spine	30 seconds 1 to 5 reps	**90 seconds 1 to 5 reps**
Sacrolumbar	30 seconds 1 to 5 reps	**90 seconds 1 to 5 reps**
Gastrocnemius	30 seconds 1 to 5 reps	**90 seconds 1 to 5 reps**
Hamstrings	30 seconds 1 to 5 reps	**90 seconds 1 to 5 reps**
Abductor Thigh	30seconds 1 to 5 reps	**90 seconds 1 to 5 reps**



Figure 1 - myofascial release exercises

The demographic characteristics of subjects are in Table 2. All three groups were homogeneous in terms of age, height, weight, and body mass and did not differ significantly from each other.

Group	No.	Age(Year)	Height(Cm)	Weight(Kg)	BMI
Myofascial release with static stretching	15	14.16± 2 24	153.20 ±4.44	57.0 ±5.99	24.34±2.88
Myofascial release without static stretching	15	15.83 ±2.58	158.93± 4.01	53.87 ±5.33	21.28± 2.92
Control	15	17.62 ±2.35	155.47± 4.98	54.53 ±6.61	22.50± 3.35

Table 3 shows the results of the effect of 8 weeks of myofascial training with and without stretching on lumbar lordosis angle, pain and static balance. As can be seen, the training significantly improved the studied factors ($P<0.05$).

Table 3: Mean and standard deviation of static balance, pain and lumbar lordosis in pre- and post-test in the study groups

Pre test	Post test

M	SD	Group	Variable	M	SD	Group	Variable
4.08	0.23	Myofascial release with static stretching	Static balance	5.82	0.042	Myofascial release with static stretching	Static balance
5.18	0.75	Myofascial release without static stretching		6.98	0.23	Myofascial release without static stretching	
4.98	0.43	Control		4.76	0.27	Control	
6.85	1.09	Myofascial release with static stretching	Pain	4.91	0.95	Myofascial release with static stretching	Pain
7.46	0.54	Myofascial release without static stretching		5.97	1.15	Myofascial release without static stretching	
5.81	1.65	Control		5.77	1.42	Control	
49.14	4.39	Myofascial release with static stretching	Lumbar lordosis	41.45	5.52	Myofascial release with static stretching	Lumbar lordosis
51.76	6.51	Myofascial release without static stretching		46.82	4.73	Myofascial release without static stretching	
49.81	3.70	Control		49.35	3.42	Control	

The study of within-group differences showed that the level of pain in the myofascial release group with static stretching and without static stretching had a significant difference between the pre-test and post-test (respectively, (P = 0.000 and t = 6.25) (P = 0.000 and t = 11.07)), while this variable did not differ significantly between the pre-test and post-test in the control group (P = 0.51 and t = 0.11).

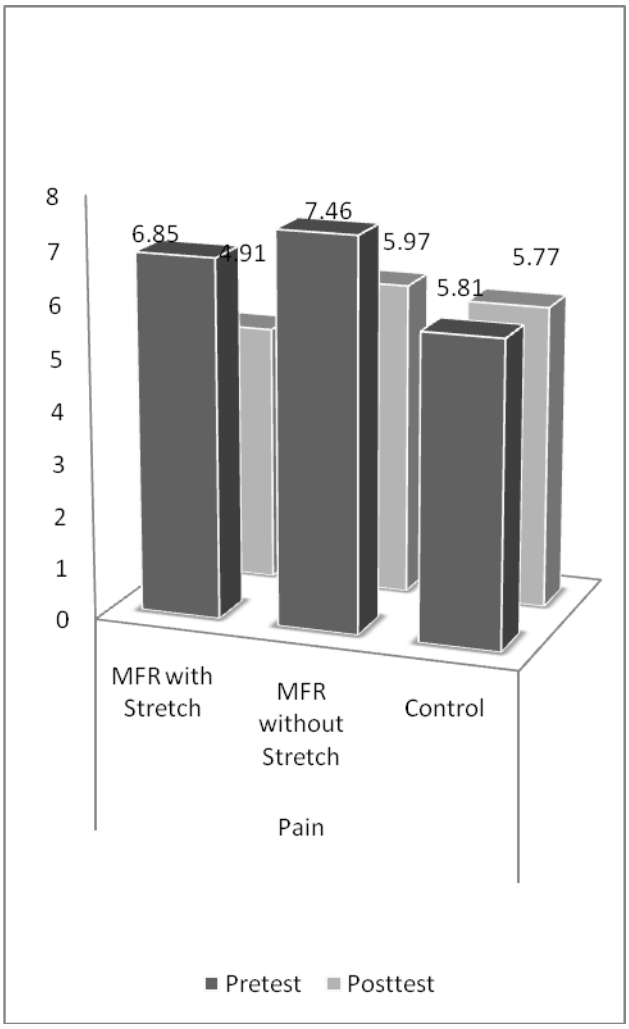


Chart 1 - Comparison of pain levels between research groups

The study of intra-group differences showed that the lordosis level in the myofascial release group with static stretching and without static stretching had a significant difference between the pre-test and post-test, respectively, (P = 0.000 and t = 12.22) (P = 0.000 and t = 15.07), while this variable did not differ significantly in the control group between the pre-test and post-test (P = 0.23 and t = 0.00).



Chart 2 - Comparison of lordosis between different research groups

The study of within-group differences showed that the static balance in the myofascial release group with static stretching and without static stretching had a significant difference between the pre-test and post-test (respectively, (P = 0.000 and t = 7.45) (P = 0.000 and t = 11.07)), while this variable did not differ significantly between the pre-test and post-test in the control group (P = 0.95 and t = 0.01).

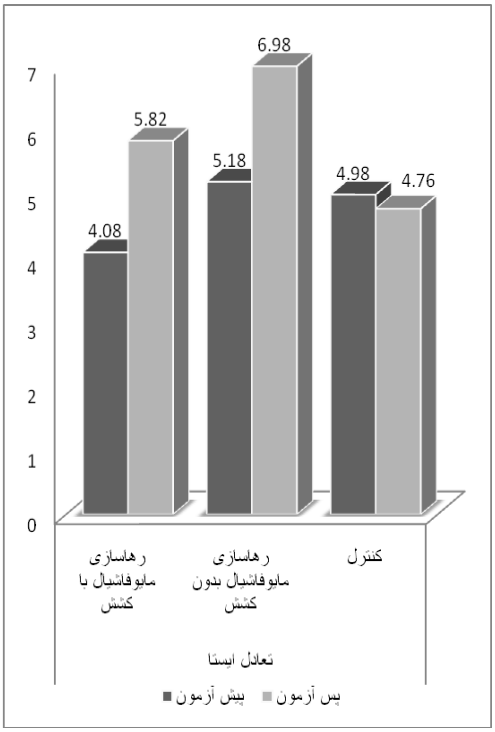


Chart 3 - Comparison of static balance between research groups

Discussion

The aim of the present study was to compare the effect of 8 weeks of quadriceps myofascial release technique with and without static hamstring stretching on pain, lordosis, and balance in female students with increased lumbar lordosis.The results showed that myofascial release with static stretching had a greater effect on the pain level of female students with increased lumbar spondylosis than myofascial release without static stretching, and both methods had a significant effect compared to the control group, which is consistent with the research of Ravichandran et al. (2022), Yildirim et al.(2020) and Motokrishna et al. (2023) are consistent with the present research. Natural spinal curves are essential for optimal posture. Natural curves in the spine reduce pressure on the disc and vertebrae and also prevent secondary and compensatory deformities (Hey et al., 2017). The lumbar vertebrae bear the greatest weight of the trunk and upper limbs, and if the curvature of this region increases, it exposes the individual to risks and secondary and compensatory abnormalities (Jun et al., 2016). Low back pain is one of the most common musculoskeletal abnormalities in adolescents, especially girls.This condition is often associated with lower back pain, decreased flexibility of the hamstrings, and increased tension in the fascial tissues. In sciatica, it is believed that the lumbar spine muscles are tight and overactive, and the opposing muscles are weak or underactive, which causes anterior pelvic tilt and, as a result, an increase in the lumbar lordosis angle. Myofascial release is a passive, manual technique used to release chronic tension in fascia and muscle tissue, and the sustained motion of foam rolling is thought to increase intramuscular tissue temperature and blood flow, both of which can increase the viscoelastic properties of the muscle. When fascia is exposed to heat and pressure, it becomes soft and pliable, becoming more fluid-like. Otherwise, it thickens and becomes more viscous and solid (Brijani et al., 2024). Foam rolling corrects muscle imbalances, reduces muscle soreness, increases range of motion and flexibility, and reduces stress on joints(Shojaei et al., 2017). As previously mentioned, meta-analyses and systematic reviews show that myofascial release interventions generally improve pain, but their effects on balance and lordosis angle are still inconclusive in high-quality studies. These results are consistent with previous reviews that have reported positive

effects on pain/function but inconsistent or inconclusive results on balance and postural parameters. Myofascial release, by applying pressure, rolling, or releasing fascial tissue and muscles, can alter the stimuli of sensory receptors (mechanoreceptors and nociceptors), as well as activate spinal inhibitory mechanisms and central pain modulation, which leads to pain reduction and lower muscle tone. These mechanisms have been suggested in systematic reviews as possible explanations for the pain reduction after myofascial release (Zugui et al., 2023). Fascial release and muscle rolling can increase local elasticity, fascial laxity, and active/passive muscle length to the extent that this increases joint range of motion and improves movement patterns. These changes are immediately visible, especially in the quadriceps and hamstrings, which play a direct role in controlling the pelvic angle and, consequently, lordosis (Luis et al., 2024). Hamstring shortening can cause a change in pelvic position and, consequently, a change in the lordosis angle by limiting pelvic flexion and placing the pelvis in a relative retroversion/antiversion position. Observational and interventional studies have shown that improving hamstring flexibility can alter pelvic angle and sagittal spine parameters; therefore, it is logical to add hamstring stretching, which may have a greater effect on lordosis than myofascial release on the quadriceps alone (Nesma et al., 2023). The quadriceps and hamstrings maintain opposing balance in a musculoskeletal chain. Quadriceps release can reduce anterior adductor tone, but if the short hamstring is not corrected at the same time, full improvement in pelvic alignment may not be achieved; Therefore, the combination of quadriceps release and hamstring stretch may produce the greatest change in standing pelvic position, resulting in improved balance and lordosis (Luis Manuel et al. 2024), which is consistent with the results of research by Zugui et al. (2021), Luis Manuel et al. (2024), and Magdalena et al. (2024). Continuous stretching protocols (8 weeks or longer) are likely to result in more measurable structural/postural changes. Thus, if a change in lordosis is seen, it may be due more to the cumulative effect of hamstring stretching than to myofascial release alone. Studies of 8 weeks or longer on stretching suggest this direction (Magdalena et al., 2024). Some reviews and studies have shown that despite pain reduction, the effects of myofascial release on balance, strength, or postural parameters such as lordosis angle are weak or inconclusive, and that more robust studies with longer follow-up periods are needed. This may be due to protocol variability, lack of blinding, or small sample sizes (Zugui et al., 2023). The combination of myofascial release on the quadriceps and a hamstring stretching program with regular implementation (3 sessions/week for 8 weeks) is reasonable and acceptable because there is evidence of both improved flexibility and reduced pain, improved balance, and reduced lumbar lordosis; the greatest effect of changing lordosis probably occurs when hamstring stretches are performed frequently and regularly. Finally, it is suggested that by adding study arms that also include proprioceptive balance exercises, the combined effects on balance can be determined, and the use of reliable and repeatable lordosis measurement tools (preferably non-radiation 3D methods or standardized inclinometers) and long-term follow-up are also recommended to examine the stability of changes.

Conclusion:

Combining myofascial release on the quadriceps with a regular program of static hamstring stretching appears to be biomechanically and neurophysiologically justified, and its effect on pain reduction is clear, and it probably has a greater effect on correcting lumbar lordosis than myofascial release alone; To improve static balance, it is recommended to add specific balance exercises to the protocol, as evidence suggests that myofascial release and stretching alone rarely produce large, sustained improvements in balance. Interpretation of the results should be made with due regard to methodological limitations and measurement tools, and future studies with more robust designs could fill current gaps in the literature.

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