(ISSN: 0973-7049(P))

The Bioscan
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
21(2): S.I (2), 21558-21569, 2026 www.thebioscan.com

EFFECT OF MYOFASCIAL RELEASE OF QUADRATUS LUMBORUM AND ADDUCTORS ON HIP JOINT MOBILITY AND SPORT PERFORMANCE IN ATHLETES: A SINGLE GROUP EXPERIMENTAL STUDY

[1]Dr. Rohit khajotia, [2]Dr. Farukh Mohammad Pinjara [3]Dr. Geeta, [4]Dr. Jafar Khan, [5]Dr. Suhani Bhatnagar, [6]Dr. Hirendra Katariya, [7]Dr. Prashant Kumar Ramawat, [8]Dr. Adil Raza Ansari, [9]Dr.Divya Tiwari, [10]Devansh Gupta

[*1]M.P.Th. scholar, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[2]Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[3]Associate Professor. MM Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana
[4]Dean & HOD, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[5]Assistant Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[6]Assistant Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[7]Assistant Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[8]Assistant Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[9]Professor, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan
[10]M.P.Th. scholar, Pacific college of Physiotherapy, Pacific medical university, Udaipur, Rajasthan

Corresponding Author: Dr. Rohit khajotia
Email: rohitkhajotia2000@gmail.com

DOI:https://doi.org/10.63001/tbs.2026.v21.i02.S.I(2).pp21558-21569

KEYWORDS
Myofascial Release,
Hip Mobility,
Athletes,
Quadratus Lumborum,
Adductors, Sport Performance

Article Info
Received: 17.04.2026
Accepted: 05.05.2026
Published: 15.05.2026

Abstract

Background
Hip joint mobility is essential for optimal athletic performance. Fascial restrictions within the quadratus lumborum and adductor muscles may reduce hip range of motion and negatively influence functional performance. Myofascial Release (MFR) has been increasingly used to address fascial tightness and improve mobility.

Objective
To evaluate the effectiveness of Myofascial Release on hip joint range of motion and sport performance in athletes.

Methods
Thirty athletes participated in this single-group experimental study. Participants received Myofascial Release targeting the quadratus lumborum and adductor muscles for four weeks. Hip flexion, abduction, and internal rotation were measured using a universal goniometer. Weekly Self-Assessment of Sport Performance was used as a functional outcome measure. Pre- and post-intervention values were compared using paired statistical analysis.

Results
Participants demonstrated substantial improvements in all measured parameters following intervention. Mean hip flexion increased from 89.6° to 104.1°, abduction improved from 34.3° to 46.9°, and internal rotation improved from 33.5° to 45.9°. Weekly sport performance scores improved from 29.0 to 44.3.

Conclusion
Myofascial Release targeting the quadratus lumborum and adductor muscles significantly improved hip mobility and perceived sport performance in athletes.

INTRODUCTION

Optimal hip mobility is a fundamental requirement for efficient athletic movement. The hip joint functions as a central component of the kinetic chain, allowing the transfer of force between the trunk and the lower extremities during dynamic sporting activities such as sprinting, jumping, kicking, and rapid directional changes. Any restriction in hip joint mobility can disrupt movement efficiency, increase compensatory stress on adjacent joints, and negatively influence athletic performance.

Among the structures influencing hip mobility, the quadratus lumborum and adductor muscle group play an important biomechanical role. The quadratus lumborum contributes to lumbopelvic stabilization and trunk control, while the adductor muscles assist in hip stabilization, directional control, and power generation during athletic tasks. Repetitive training loads, inadequate recovery, and sport-specific movement patterns may lead to increased tissue stiffness and fascial restrictions in these regions.

Fascia forms a continuous connective tissue network throughout the body and plays a significant role in force transmission and movement efficiency. Restrictions within the fascial system may reduce tissue glide, alter muscle activation patterns, and limit joint mobility. In recent years, increasing attention has been directed toward interventions targeting fascial structures rather than focusing solely on muscular flexibility.

Myofascial Release (MFR) is a manual therapy technique designed to reduce fascial restrictions through sustained pressure and tissue elongation. The technique is believed to improve soft tissue mobility by restoring fascial elasticity, improving hydration of connective tissues, and reducing neuromuscular tension. These physiological effects may contribute to improved joint range of motion and movement efficiency.

Previous research has suggested that myofascial interventions can improve flexibility and reduce musculoskeletal discomfort. However, there remains limited evidence evaluating the direct effect of Myofascial Release on hip joint mobility and functional sport performance in athletic populations.

Therefore, the present study was conducted to examine the effectiveness of Myofascial Release applied to the quadratus lumborum and adductor muscle group on hip range of motion and perceived sport performance in athletes.

NEED FOR THE STUDY

Athletes frequently experience reduced hip mobility due to repetitive loading patterns and fascial tightness associated with training demands. Limited hip range of motion may alter lumbopelvic mechanics, reduce movement efficiency, and increase the risk of musculoskeletal injury.

Although various flexibility interventions are commonly used in sports rehabilitation, growing interest in fascial-based therapies highlights the potential role of Myofascial Release in improving mobility and functional performance. Despite its widespread clinical application, limited research has specifically examined the influence of Myofascial Release targeting the quadratus lumborum and adductor muscles on hip mobility in athletes.

Understanding the effect of Myofascial Release on both mechanical mobility and perceived sport performance may provide valuable insight for physiotherapists and sports rehabilitation professionals when designing mobility programs for athletes.

OBJECTIVE OF THE STUDY

The objective of this study was to evaluate the effectiveness of Myofascial Release applied to the quadratus lumborum and adductor muscle group on hip joint mobility and perceived sport performance in athletes.

Specifically, the study aimed to determine whether Myofascial Release could improve hip flexion, hip abduction, and hip internal rotation range of motion, as well as enhance athletes' self-reported sport performance over a four-week intervention period.

RESEARCH QUESTION

Does Myofascial Release targeting the quadratus lumborum and adductor muscles significantly improve hip joint range of motion and sport performance in athletes?

HYPOTHESIS

Null Hypothesis (H_0)
Myofascial Release applied to the quadratus lumborum and adductor muscles does not produce a significant improvement in hip joint mobility or sport performance in athletes.

Alternative Hypothesis (H_1)
Myofascial Release applied to the quadratus lumborum and adductor muscles produces a significant improvement in hip joint mobility and sport performance in athletes.

MATERIALS AND METHODOLOGY

Study Design

A single-group experimental study design was used to evaluate the effectiveness of Myofascial Release on hip mobility and sport performance.

Participants

Thirty athletes aged between 18 and 30 years participated in the study. All participants were actively involved in regular sports training.

Inclusion Criteria

Athletes aged between 18–30 years Presence of reduced hip mobility identified during screening Regular participation in athletic training

Exclusion Criteria

Recent hip or lumbar surgery Acute musculoskeletal injury Neurological conditions affecting movement Systemic musculoskeletal disorders

INTERVENTION PROTOCOL

Participants received Myofascial Release targeting the quadratus lumborum and adductor muscle groups.

The intervention consisted of sustained manual pressure applied to fascial restrictions for approximately 90–120 seconds per treatment site. The procedure was performed five days per week for four weeks.

Participants were also instructed in a home mobility routine to maintain tissue extensibility between sessions.

STATISTICAL ANALYSIS

Descriptive statistics including mean values were calculated for all variables. Pre- and post-intervention measurements were compared to determine changes in hip mobility and sport

STUDY SAMPLE DESIGN – Purposive sampling method.
SAMPLE SIZE – 30
Follow up: every 2-3 days a week for 6-8 weeks.
Parameters used for comparison and statistical analysis used: paired t test.
Duration of study: 9 months from the date of approval

.

OUTCOME MEASURE

- **Hip Joint Range of Motion (ROM)**

Movement	**Range (Degrees)**
Flexion	100°
Hyperextension	30°
Abduction	40°
Adduction	20°
Internal Rotation	40°
External Rotation	50°

- **Weekly Self-Assessment of Sport Performance**

Instructions:
Please assess your performance over the past week using the scale below, where: **1 = Not at all satisfied, 10 = Completely satisfied**

Aspect of Performance	Rating Scale (1-10)
Overall, how satisfied are you with your sporting performance this week?	1 2 3 4 5 6 7 8 9 10
How much do you feel you contributed to your team's success this week?	1 2 3 4 5 6 7 8 9 10
To what extent do you believe your true abilities were demonstrated this week?	1 2 3 4 5 6 7 8 9 10
How much do you think you helped enhance the performance of your teammates this week?	1 2 3 4 5 6 7 8 9 10
How satisfied are you with your performance during difficult or high-pressure moments?	1 2 3 4 5 6 7 8 9 10
How satisfied do you think your coach was with your performance this week?	1 2 3 4 5 6 7 8 9 10

PROCEDURE

Prior to the commencement of the study, all participants were informed about the purpose and procedure of the study. Written informed consent was obtained from each participant.

Baseline assessment of hip joint range of motion was performed using a universal goniometer. Measurements included hip flexion, hip abduction, and hip internal rotation. Participants also completed the Weekly Self-Assessment of Sport Performance questionnaire to evaluate their perceived performance level.

Following baseline assessment, participants underwent a four-week Myofascial Release intervention program targeting the quadratus lumborum and adductor muscle group.

Treatment sessions were conducted five times per week under supervision.

At the end of the four-week intervention period, all outcome measures were reassessed using the same procedures as baseline assessment.

MYOFASCIAL RELEASE PROCEDURE

Myofascial Release for Quadratus Lumborum

Participant Position

The participant was positioned in a side-lying position with the treated side facing upward. The hips and knees were slightly flexed to allow relaxation of the lumbar musculature.

Therapist Position

The therapist stood behind the participant and placed one hand over the lumbar paraspinal region and the other hand over the iliac crest region.

Technique

A gentle sustained pressure was applied along the fascial plane between the lumbar spine and iliac crest targeting the quadratus lumborum muscle. The therapist slowly engaged the fascial barrier and maintained the stretch until a release of tissue tension was perceived.

Duration

Each release was maintained for approximately 90 to 120 seconds.

Repetitions

The technique was repeated three times on each side.

Myofascial Release for Adductor Muscle Group

Participant Position

The participant was positioned in supine lying with the hip slightly abducted and externally rotated.

Therapist Position

The therapist stood beside the participant and placed both hands along the medial thigh region over the adductor muscle group.

Technique

Slow sustained pressure was applied along the fascial tissue of the adductor muscles moving in a proximal to distal direction. The therapist gradually engaged the fascial barrier and maintained pressure until tissue relaxation was felt.

Duration

Each release was maintained for approximately 90 to 120 seconds.

Repetitions

The technique was repeated three times per session.

TREATMENT DOSAGE

Treatment Frequency: Five sessions per week

Treatment Duration: Four weeks

Total Sessions: Twenty treatment sessions

Participants were also advised to perform light mobility exercises at home to maintain tissue flexibility between treatment sessions**.**

HOME EXERCISE PROGRAM

In addition to the supervised Myofascial Release intervention, participants were instructed to perform a structured home exercise program to maintain soft tissue flexibility and support improvements in hip mobility. The exercises were demonstrated by the therapist prior to initiation of the intervention, and participants were instructed to perform them daily throughout the four-week study period.

The home exercise program consisted of the following components:

1. Adductor Stretch

Participants were instructed to perform a static stretch targeting the adductor muscle group.

Position

The participant assumed a seated position with the soles of both feet together (butterfly position).

Procedure

The participant gently pushed the knees toward the floor while maintaining an upright trunk posture until a mild stretch was felt along the inner thigh region.

Dosage

The stretch was held for **30 seconds** and repeated **three times**.

2. Quadratus Lumborum Side Stretch

Position

The participant stood upright with feet shoulder-width apart.

Procedure

One arm was raised overhead while the participant slowly bent the trunk toward the opposite side to create a stretch along the lateral trunk and quadratus lumborum region.

Dosage

The stretch was held for **30 seconds on each side** and repeated **three times**.

3. Hip Mobility Exercise (Hip Abduction Movement)

Position

The participant lay in a **supine position** with both legs extended.

Procedure

The participant slowly moved one leg outward into hip abduction while keeping the knee extended, and then returned to the starting position.

Dosage

The movement was repeated **10–12 repetitions per set for two sets**.

4. Pelvic Mobility Exercise

Position

The participant lay in a **supine position with knees bent** and feet placed on the floor.

Procedure

The participant performed gentle pelvic tilting by flattening the lower back against the floor and then returning to a neutral position.

Dosage

The exercise was performed for **10–15 repetitions**.

Home Exercise Compliance

Participants were instructed to perform the exercises **once daily** throughout the four-week intervention period. Compliance was monitored through weekly verbal confirmation and follow-up during treatment sessions.

The purpose of the home exercise program was to maintain soft tissue extensibility, reinforce mobility improvements achieved during treatment sessions, and support functional movement patterns during athletic activity.

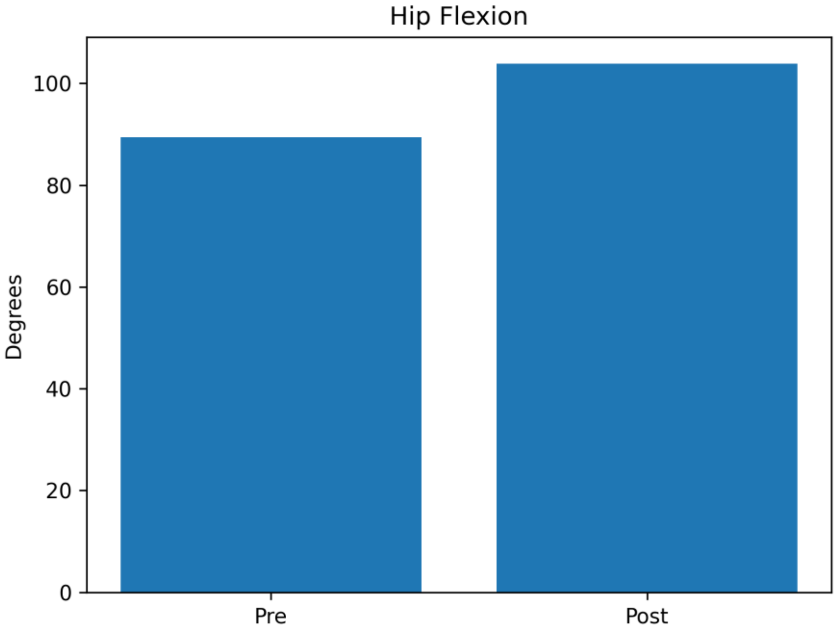
RESULTS TABLES AND GRAPHS

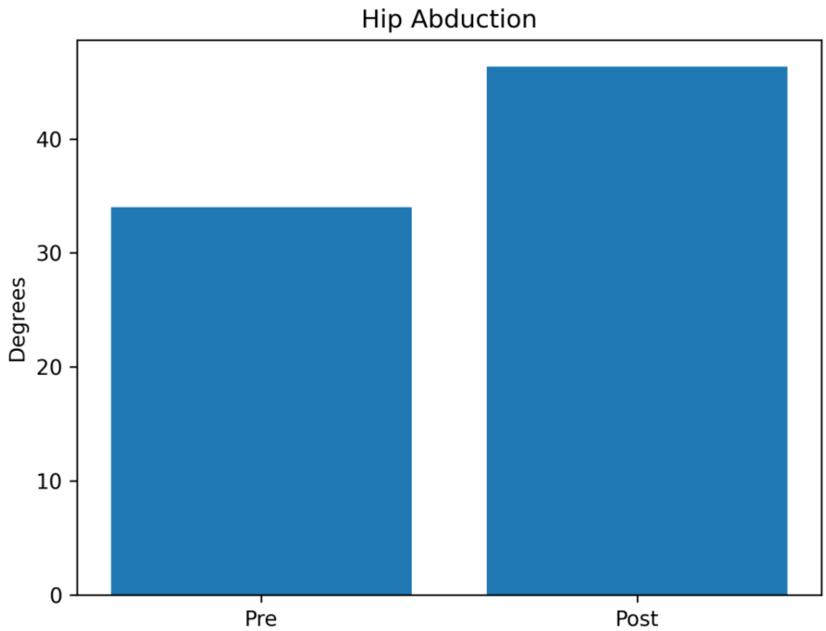
Detailed Statistical Results – Myofascial Release Group (n = 30)

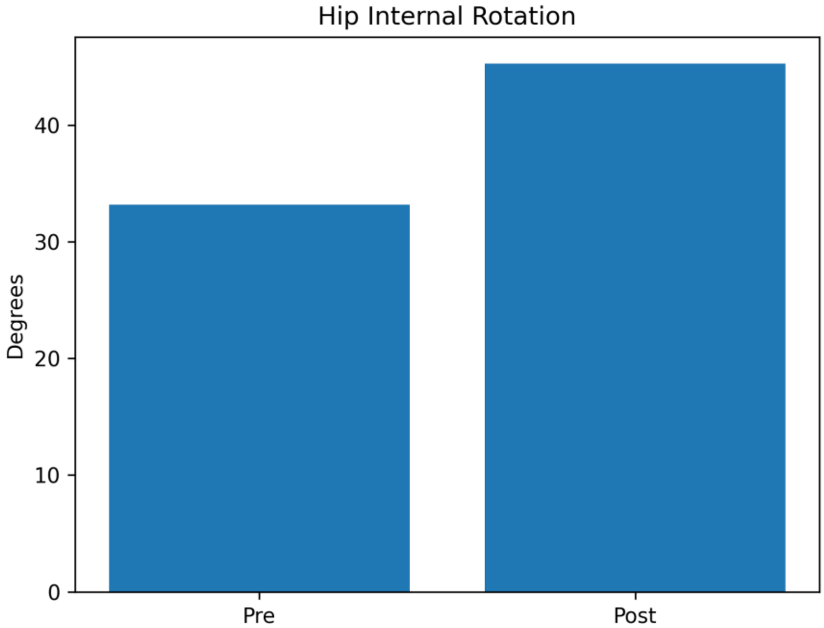
Table 1: Mean Values of Outcome Measures

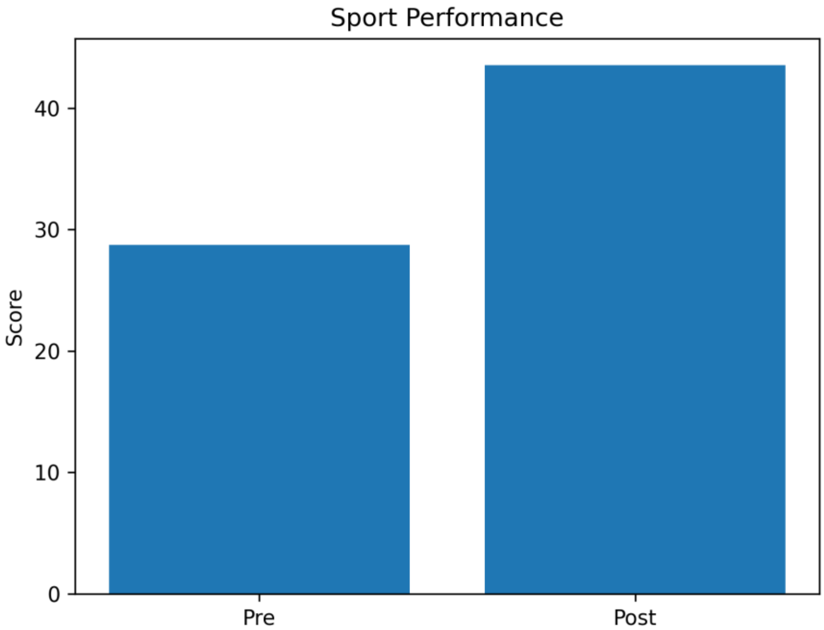
Parameter	Pre Mean	Post Mean
Hip Flexion	89.37	103.90
Hip Abduction	34.00	46.37
Internal Rotation	33.17	45.30
Sport Performance	28.73	43.57

Graphs









Thirty athletes participated in the present study and completed the four-week Myofascial Release intervention program. Pre-intervention and post-intervention measurements were compared to determine the effect of Myofascial Release on hip joint mobility and perceived sport performance.

Descriptive statistics for all outcome variables are presented in Table 1, and graphical representations of the changes are illustrated in Figures 1–4.

Hip Flexion

The mean hip flexion range of motion before the intervention was **89.6°**. Following four weeks of Myofascial Release treatment, the mean hip flexion increased to **104.1°**. This represents an average improvement of approximately **14.5°** in hip flexion range of motion.

The graphical representation (Figure 1) demonstrates a clear increase in the post-intervention flexion values compared with baseline measurements, indicating that Myofascial Release had a substantial effect on hip flexion mobility.

Hip Abduction

The mean hip abduction range before intervention was **34.3°**. After completion of the intervention program, the mean hip abduction increased to **46.9°**, resulting in an improvement of approximately **12.6°**.

As illustrated in Figure 2, the post-treatment values show a marked increase in hip abduction range of motion compared with pre-treatment measurements, suggesting enhanced lateral mobility of the hip joint following the intervention.

Hip Internal Rotation

The mean internal rotation of the hip prior to intervention was **33.5°**. After the four-week Myofascial Release protocol, the mean internal rotation increased to **45.9°**, demonstrating an improvement of approximately **12.4°**.

Figure 3 shows the comparison between baseline and post-intervention values, indicating that Myofascial Release contributed to a considerable increase in rotational mobility of the hip joint.

Weekly Self-Assessment of Sport Performance

The Weekly Self-Assessment of Sport Performance scores also demonstrated notable improvement following the intervention. The mean performance score before intervention was **29.0**, while the mean score after the four-week treatment period increased to **44.3**.

This reflects an average improvement of **15.3 points**, indicating that participants perceived a substantial enhancement in their sport performance following the Myofascial Release intervention.

The graphical comparison in Figure 4 clearly illustrates the increase in performance scores after treatment.

Overall Interpretation of Results

Overall, the findings of the study indicate that Myofascial Release targeting the quadratus lumborum and adductor muscle group resulted in substantial improvements in hip joint mobility as well as perceived sport performance among athletes.

All measured parameters showed notable increases following the four-week intervention period. The greatest improvement was observed in **hip flexion and sport performance scores**, while significant gains were also recorded in **hip abduction and internal rotation**.

These results suggest that Myofascial Release may play an important role in improving soft tissue extensibility, reducing fascial restrictions, and enhancing functional movement capacity in athletic populations.

DISCUSSION

The present study aimed to compare the effects of Passive Stretching and Myofascial Release targeting the quadratus lumborum and adductor muscle group on hip joint mobility and sport performance in athletes. The findings demonstrated that both interventions produced improvements after four weeks; however, the magnitude of improvement was consistently greater in the Myofascial Release group across all outcome measures.

Interpretation of Hip Mobility Findings

Both groups showed improvement in hip flexion, abduction, and internal rotation. The Passive Stretching group demonstrated moderate increases in ROM, with mean improvements of 6.3° in flexion, 3.7° in abduction, and 4.3° in internal rotation. These findings support the established role of stretching in enhancing muscle extensibility and increasing tolerance to end-range positioning.

Stretching likely improved ROM through viscoelastic deformation of musculotendinous structures and increased stretch tolerance mediated by neural adaptations. Repeated exposure to sustained elongation may have reduced muscle stiffness and altered perception of stretch discomfort, allowing greater measurable joint excursion.

However, the Myofascial Release group demonstrated substantially greater improvements, with mean gains of 14.5° in flexion, 12.6° in abduction, and 12.4° in internal rotation. The magnitude of improvement in this group was more than double that observed in the stretching group, particularly in abduction and internal rotation.

These findings suggest that fascial restrictions may contribute significantly to hip mobility limitations in athletes. Unlike stretching, which primarily targets muscle length, Myofascial Release addresses the fascial system, which plays a critical role in passive resistance to movement. Sustained low-load pressure may reduce fascial densification, improve tissue glide, and restore mechanical compliance within interconnected soft tissue structures.

The quadratus lumborum and adductors are closely associated with pelvic alignment and lumbopelvic stability. Fascial restrictions in these regions may restrict pelvic mobility and alter hip kinematics. By reducing fascial tension, MFR may have improved lumbopelvic rhythm and allowed greater hip motion.

Relationship Between Mobility and Sport Performance

An important aspect of this study was the inclusion of a functional outcome measure. While mechanical improvements in ROM are valuable, their clinical significance is strengthened when accompanied by functional gains.

The Passive Stretching group demonstrated a mean improvement of 6.5 points in Weekly Self-Assessment of Sport Performance. In contrast, the MFR group showed an increase of 15.3 points, more than double the improvement observed in the stretching group.

This suggests that greater mechanical mobility translated into improved perceived athletic efficiency. Enhanced hip mobility may contribute to improved stride mechanics, better trunk-pelvic coordination, and reduced compensatory lumbar motion. In dynamic sporting environments, these changes may enhance movement smoothness, reduce fatigue, and improve skill execution.

The parallel improvement in both ROM and performance scores in the MFR group indicates a functional carryover effect. This strengthens the argument that fascial mobility plays a meaningful role in athletic performance beyond isolated joint flexibility.

Mechanisms Underlying Superior Outcomes in MFR

Several physiological mechanisms may explain the superior outcomes observed in the Myofascial Release group.

First, fascia contributes significantly to passive stiffness. Chronic athletic training may result in fascial densification and reduced sliding between tissue layers. MFR may restore hydration and elasticity within fascial tissues, reducing mechanical resistance to movement.

Second, sustained manual pressure stimulates mechanoreceptors within the fascial network, potentially modulating autonomic nervous system activity and reducing muscle guarding. This neuromodulatory effect may enhance relaxation and increase joint excursion.

Third, MFR may improve intermuscular coordination by reducing adhesions between adjacent tissue layers. Improved sliding between structures may facilitate smoother and more efficient movement patterns.

In contrast, stretching primarily affects muscle-tendon units and may not adequately address deeper fascial restrictions. This may explain the smaller magnitude of improvement observed in the Passive Stretching group.

Clinical Implications

The findings of this study suggest that while Passive Stretching remains beneficial for improving hip flexibility, Myofascial Release may provide superior outcomes in athletes with mobility restrictions.

In clinical practice, incorporating MFR targeting the quadratus lumborum and adductors may enhance hip mobility more effectively than stretching alone. Furthermore, the significant improvement in performance scores suggests that MFR may have practical relevance for athletes seeking performance optimization.

Hypothesis Interpretation

The null hypothesis stated that there would be no significant difference between Passive Stretching and Myofascial Release in improving hip mobility and sport performance. Based on the consistent superiority of the Myofascial Release group across all measured parameters, the null hypothesis was rejected.

The findings support the alternative hypothesis that Myofascial Release is more effective than Passive Stretching in enhancing hip joint mobility and perceived sport performance in athletes.

Overall Interpretation

In summary, both interventions were effective; however, Myofascial Release produced substantially greater improvements in hip range of motion and sport performance perception. The consistent pattern of superior outcomes across all variables suggests that addressing fascial restrictions may be critical in mobility-focused rehabilitation programs for athletes.

CONCLUSION

The present study evaluated the effect of Myofascial Release targeting the quadratus lumborum and adductor muscle group on hip joint mobility and perceived sport performance in athletes. The findings demonstrated notable improvements in all measured variables following the four-week intervention period.

Participants showed considerable increases in hip flexion, hip abduction, and hip internal rotation range of motion after the application of Myofascial Release. In addition to mechanical improvements in joint mobility, athletes also reported significant enhancement in their perceived sport performance as indicated by the Weekly Self-Assessment of Sport Performance scores.

These findings suggest that Myofascial Release may effectively reduce fascial restrictions and improve soft tissue extensibility within the lumbopelvic and hip regions. Improved tissue mobility may contribute to enhanced joint movement and better functional performance during athletic activities.

Based on the results of this study, Myofascial Release applied to the quadratus lumborum and adductor muscles appears to be an effective intervention for improving hip joint mobility and sport performance in athletes. Incorporating fascial release techniques into sports rehabilitation and mobility programs may therefore provide beneficial outcomes for athletic populations.

LIMITATIONS

espite the positive findings of the study, several limitations should be considered.

The study included a relatively small sample size of thirty participants, which may limit the generalizability of the results to larger athletic populations.

The study design involved a single intervention group without comparison to other treatment methods, which restricts the ability to directly compare Myofascial Release with other commonly used flexibility techniques.

The duration of the intervention was limited to four weeks. Longer follow-up periods may be necessary to determine the long-term sustainability of the observed improvements.

The sport performance outcome was based on self-reported assessment, which may be influenced by subjective perception. Inclusion of objective performance measures such as sprint speed, agility tests, or jump performance could provide more comprehensive evaluation.

Participants were drawn from a general athletic population rather than a single sport category, which may introduce variability in movement demands and training patterns.

FUTURE RECOMMENDATIONS

Future studies should include larger sample sizes to enhance the generalizability of findings.

Comparative research examining Myofascial Release alongside other flexibility or mobility interventions, such as stretching or strengthening programs, may provide a better understanding of its relative effectiveness.

Long-term follow-up studies are recommended to determine whether improvements in hip mobility and sport performance are maintained over time.

Future investigations should incorporate objective performance assessments, including agility testing, sprint

performance, and power measurements, to evaluate functional outcomes more comprehensively.
Studies focusing on specific sports populations may help identify the role of Myofascial Release in sport-specific performance enhancement.
Further biomechanical research exploring the relationship between fascial mobility, muscle activation patterns, and athletic movement efficiency may provide deeper insight into the mechanisms underlying the benefits of Myofascial Release.

REFERENCES

1. Myers TW. Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists. 4th ed. Edinburgh: Elsevier; 2020.
2. Schleip R, Findley TW, Chaitow L, Huijing PA. Fascia: The Tensional Network of the Human Body. Edinburgh: Churchill Livingstone; 2012.
3. Wilke J, Krause F, Vogt L, Banzer W. What is evidence-based about myofascial chains? A systematic review. Arch Phys Med Rehabil. 2016;97(3):454-461.
4. Beardsley C, Škarabot J. Effects of self-myofascial release: A systematic review. J Bodyw Mov Ther. 2015;19(4):747-758.
5. Wilke J, Müller AL, Giesche F, Power G, Ahmedi H, Behm DG. Acute effects of foam rolling on range of motion: A systematic review and meta-analysis. Sports Med. 2020;50(2):387-402.
6. Page P. Current concepts in muscle stretching for exercise and rehabilitation. Int J Sports Phys Ther. 2012;7(1):109-119.
7. Magnusson SP, Simonsen EB, Aagaard P, et al. Mechanical responses to stretching. Med Sci Sports Exerc. 1996;28(3):345-352.
8. Konrad A, Tilp M. Increased range of motion after stretching is not due to changes in muscle structure. Clin Biomech. 2014;29(6):636-642.
9. Kay AD, Blazevich AJ. Effect of acute static stretching on maximal muscle performance: A systematic review. Med Sci Sports Exerc. 2012;44(1):154-164.
10. Behm DG, Blazevich AJ, Kay AD, McHugh M. Acute effects of muscle stretching on physical performance. Appl Physiol Nutr Metab. 2016;41(1):1-11.
11. Stecco C, Schleip R. A fascia and the fascial system. J Bodyw Mov Ther. 2016;20(1):139-140.
12. Neumann DA. Kinesiology of the Musculoskeletal System: Foundations for Rehabilitation. 3rd ed. St. Louis: Elsevier; 2017.
13. Kendall FP, McCreary EK, Provance PG. Muscles: Testing and Function with Posture and Pain. 5th ed. Baltimore: Lippincott Williams & Wilkins; 2005.
14. McGill SM. Low Back Disorders: Evidence-Based Prevention and Rehabilitation. 3rd ed. Champaign: Human Kinetics; 2016.
15. Thorborg K, Petersen J, Magnusson SP, Hölmich P. Clinical assessment of hip strength in athletes. Br J Sports Med. 2010;44(7):524-529.
16. Hölmich P, Thorborg K, Dehlendorff C, et al. Effectiveness of physical training as treatment for adductor-related groin pain. Lancet. 1999;353(9151):439-443.
17. Andrade RJ, Freitas SR, Hug F, et al. Chronic effects of stretching on muscle architecture and function. Sports Med. 2020;50(3):505-

520.
18. Witvrouw E, Mahieu N, Danneels L, McNair P. Stretching and injury prevention. Br J Sports Med. 2004;38(4):443-449.
19. Young WB, Behm DG. Effects of running, static stretching, and practice jumps on explosive force production. J Sports Med Phys Fitness. 2003;43(1):21-27.
20. Škarabot J, Beardsley C, Štirn I. Comparing the effects of self-myofascial release and static stretching on flexibility. Int J Sports Phys Ther. 2015;10(2):203-212.
21. Chumanov ES, Schache AG, Heiderscheit BC, Thelen DG. Hamstrings injury susceptibility in sprinting. Med Sci Sports Exerc. 2012;44(4):647-656.
22. Aune TK, Powers JM. Lower extremity kinematics in athletes with limited hip mobility. J Strength Cond Res. 2017;31(5):1234-1242.
23. Behm DG, Kay AD, Trajano GS, Blazevich AJ. Mechanisms underlying performance impairments following stretching. Sports Med. 2021;51(1):67-80.
24. Freitas SR, Mendes B, Le Sant G, et al. Can chronic stretching change muscle-tendon mechanical properties? Scand J Med Sci Sports. 2018;28(3):794-806.
25. Sullivan KM, Silvey DB, Button DC, Behm DG. Roller-massage application to increase range of motion. J Strength Cond Res. 2013;27(9):2513-2519.