Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v31i2.4490

EFFECTIVENESS OF MYOFASCIAL RELEASE TECHNIQUE ON ROM AND FUNCTIONAL DISABILITY FOR PATIENTS WITH PIRIFORMIS SYNDROME

Kashaf Faraz[1], Sania Naz[2], Zavata Afnan[3], Sania Anwaar[4], Ayesha Sadiq[5], Maria Riaz[6], Amber Shabbir[7], Kirran Sikandar Gondal[8], Sabahat Ali Sheikh[9*], Zainab Waqar[10*]

[1] University Institute of Physical Therapy, University of Lahore, Sargodha Campus- Pakistan
[2]Government College University Faisalabad, Layyah Campus- Pakistan
[3] Lecturer FRAHS, Riphah International University Malakand Campus- Pakistan
[4] University Institute of Physical Therapy, University of Lahore, Sargodha Campus- Pakistan
[5] Riphah International University Malakand Campus
[6] Department of Physiotherapy, Riphah International University, Lahore Campus- Pakistan
[7] Department of Physical Therapy, Islamabad Medical and Dental College, Islamabad Pakistan.
[8] University Institute of Physical Therapy, University of Lahore, Sargodha Campus- Pakistan
[9*] University Institute of Physical Therapy, University of Lahore, Sargodha Campus- Pakistan
[10 *]Department of Physical Therapy, Riphah International University, Islamabad – Pakistan

***Corresponding Author:** Sabahat Ali Sheikh, Zainab Waqar
*E-mail: sabahat.ali@uipt.uol.edu.pk, Zaiqar511@gmail.com

Abstract

Background: The Piriformis syndrome is a condition leads to encroachment of the sciatic nerve in piriformis muscle, causing pain in buttock, sciatica or both. Physical therapy is considered to be an essential treatment for patients with piriformis syndrome, but the literature lacks the evidence in effectiveness of the myofascial release technique.

Objective: To determine the comparative effects of myofascial release technique along with conventional PT on pain and functional disability in patients of piriformis syndrome.

Methodology: Sixty-six individuals (46 females and 20 males) with deep gluteal syndrome, were assessed from District Headquarter Layyah. The participants were randomly subjected into two groups after fulfilling the inclusion criteria, receiving conventional physical therapy and myofascial release technique along with conventional physiotherapy. The outcome measures were pain (NPRS) and functional disability (LEFS) collected at the baseline, 6th session, and 12th session.

Results: Mean age for participants was 35.99± 7.48 years. The within-group analysis manifested a statistically significant alleviation in pain and functional disability ($P<0.05$). The between group analysis showed myofascial release technique along with conventional physiotherapy was found to be more effective in alleviating pain and functional disability as compared to routine physical therapy group ($P<0.05$) at the 6th week and 12th week).

Conclusion: The present study strongly impasses that conventional physical therapy with and without myofascial release technique (MRT) are significantly effective in alleviating pain and reducing functional disability.

Key words: Conventional physical therapy, myofascial release technique, piriformis syndrome.

INTRODUCTION

When the piriformis muscle, causes pain due to tightness, spasms, or prolonged compression this is known as piriformis syndrome. (Varenika et al., 2017) The sciatic nerve, originating from L4-L5, passes through the piriformis muscle on its way to the big toe. (Poutoglidou et al., 2020) If the piriformis muscle experiences compression, tightness, or spasms, the sciatic nerve passing through it can also become compressed and irritated. Patients with this painful neuromuscular disorder may exhibit neurological symptoms that mimic sciatica. As a result, piriformis syndrome is often misdiagnosed as sciatica, underscoring the importance of a careful and detailed examination for an accurate diagnosis. (Siddiq et al., 2017) (Han et al., 2017)

Potential triggers for this syndrome include pain, muscle tightness (referred to as spasm), muscle irritation for various reasons, muscle tightness, bleeding around the muscle, muscle swelling due to injury, and muscle compression. (Koh et al., 2020) Individuals engaged in occupations that involve extended periods of sitting are prone to developing piriformis syndrome. Many men tend to store their wallets in the back pocket of their pants, which can contribute to tightness in the piriformis muscle when seated. This muscle tightness can lead to compression, consequently putting pressure on the sciatic nerve and causing irritation. . (Siddiq & Siddiq, 2018)Individuals of 30 to 49 years of age are more suspected to Piriformis pain.(Vij et al., 2021)

Most common features found in the piriformis syndrome are hip pain, reduced range of motion at hip joint, greater sciatic notch tender to touch, radiating pain in back of thigh, calf and foot (due to sciatic nerve compression), pain, while walking up the stairs, pain increase with prolonged sitting and with maneuvers that might aggravate the stretch in the piriformis muscle.(Nazir et al., 2022) The low back pain is thought to be around 6% caused by the piriformis syndrome.(Hopayian et al., 2010)

. The past history of any accident, trauma or injury.(Fishman & Hosseini, 2019) The most important part of the diagnosis is the physical assessment and examination of the patient. For physical examination and assessment of the patient following test should be performed on the patients to check for the piriformis syndrome; FAIR test, Lasegue test, Slump test, bowstring test and straight leg raise test. (Berthelot et al., 2021) (Adiyatma & Kurniawan, 2022)

The treatment of the piriformis syndrome includes both the pharmacological and non-pharmacological treatment options. For the pharmacological treatment, opioids and NSAIDs drugs are considered.(Hogan et al., 2020) For the non-pharmacological treatment patient education, posture correction, life style modification and physiotherapy is used that includes electrotherapy: transcutaneous electrical stimulator, low level laser therapy, heating modalities like infrared, ultrasound, diathermy, heating pads and exercises like: core strengthening exercises, isometric exercises, stretching exercises and myofascial release technique.(Fishman et al., 2017; Ro & Edmonds, 2018)

A hands-on soft tissue technique that facilitates a stretch in a restricted fascia is known as myofascial release technique. This technique improves blood, oxygen and lymph circulation around the involved muscle, stimulates a stretch reflex within the muscle and hence relaxes the contracted or tightened muscle.(Brandl et al., 2021) The therapist applies a sustained stretch into the restricted tissue barrier. The change in histological length occurs. The therapist continues to follow the release into the new barrier and after few attempts, the restricted tissue becomes more soft and pliable. (Terlemez & Ercalik, 2019) The pressure on the sensitive structures around the muscle like nerves and blood vessels is also released, hence the alignment and mobility of the joint is also restored.(Chen et al., 2021; Rana et al.)

Myofascial release has proved beneficial effects while treating piriformis syndrome but as per literature the studies previously conducted included just young female population. So, this study aimed to evaluate the effectiveness of myofascial release on individuals of all age groups and for both genders. The main objective of this study is to generalize the use of myofascial release. Hence, increasing the physiotherapy treatment efficacy.

In 2021, M. Dakou and colleagues conducted a RCT focusing on chronic LBP attributed to muscular spasm in the piriformis muscle, accompanied by radiating pain into one or both legs. It assesses the efficacy of myofascial release in individuals with piriformis syndrome. The sixty individuals with hip pain were subjected into two groups: the control group, consisting of thirty individuals who received only stretching exercises, and the myofascial release group, comprising the remaining thirty individuals. The treatment protocol was administered daily for twelve days, and post-treatment readings were recorded on the twenty-seventh day. The outcome measures included pain (NPRS), hip range of motion (Goniometer), and functional disability (Oswestry disability index). The results signified improvement in functional disability scores between the two groups. However, there were no notable improvements in pain and anxiety levels between the groups. The study concluded that individuals with piriformis syndrome in the stretching group exhibited greater change in outcomes of pain, range of motion and functional disability compared to both groups. There was no statistically significant differences observed between the control group (receiving only stretching exercises) and the myofascial release group. (Dakou et al., 2021; Shabbir et al., 2022)

In 2021, Kadam, A. et al conducted research to assess the beneficial effects of myofascial release in individuals with PS. The prolonged inactivity and frequent sitting can lead to pain and the development of trigger points in the piriformis muscle. Utilizing self-myofascial tennis ball release has shown to alleviate discomfort, providing a prompt and effective solution for piriformis pain. This academic study involved 43 subjects including individuals of both genders aged between 35 to 55 years, experiencing hip pain, and displaying positive results on the FAIR and FABER tests. Palpation was used to identify trigger points for piriformis, and pain levels were assessed before and after treatment using the Pain Pressure Algometer and Numeric Pain Rating Scale. Additionally, Goniometer was used to measure ROM. The results indicated that self-myofascial release using tennis ball beneath the buttocks was successful in alleviating pain and increasing the range of motion. (Kadam & Aswale)

A study was conducted in 2020, by Alarab et al to compare various mobilization techniques and stretching exercises. The 32 individuals with Piriformis Syndrome were allocated into two groups. Sixteen individuals were given the stretching exercise group, while the remaining were assigned to the mobilization group. The treatment protocol involved administering interventions to individuals with piriformis syndrome twice a week for approximately one month. Outcome measures included pain, functional disability, and the level of anxiety related to pain. Pain was assessed using the VAS, functional disability scores were recorded using the Roland Morris Low Back Pain Disability questionnaire, and anxiety levels were measured using the Hamilton Anxiety Rating Scale. The results demonstrated an improvement in functional disability scores between the two groups. However, there were no significant improvements in pain and anxiety levels between the stretching exercise group and the mobilization group. The study concluded that individuals with piriformis syndrome in the stretching group experienced greater improvements in pain levels and a reduction in disability index compared to the mobilization group, while anxiety levels were not significantly differ between the two exercise groups. .(Alarab & Unver, 2020)

In 2019, H.A. Kukadia et al conducted a similar study focused on females with piriformis syndrome. The fifty-two individuals with piriformis syndrome were then assigned into 2 groups. 16 individuals with piriformis syndrome were allocated to the group receiving only stretching exercises, while the remaining individuals were allocated to the myofascial release group. The treatment protocol involved daily sessions for four weeks. The pre-treatment and post-treatment readings were recorded to assess muscle flexibility, measured using a Goniometer. The results indicated improvement in the ROM. The study concluded that individuals with piriformis syndrome in the myofascial release group

demonstrated greater enhancement in range of motion, as measured by the Goniometer, compared to the group receiving stretching exercises alone. There was statistical differences between the two groups, highlighting that the myofascial release technique contributed to an improvement in range of motion and increased muscle flexibility. (Kukadia et al., 2019)
Myofascial release has favorable effects in the treatment of piriformis syndrome but as per literature the studies previously conducted included just young female population. So, the objective of this research is to evaluate the effectiveness of myofascial release on individuals of all age groups and for both genders. The purpose of this study is to generalize the use of technique of myofascial release. Hence, increasing the physiotherapy treatment efficacy.

Methodology
Study Design: The study was Randomized Controlled Trial

Settings: The study was conducted in Physiotherapy Department of District Headquarter Layyah.
Duration of Study: It was 9 months after the approval of synopsis

Sample Size: The calculated sample size was 33 in each group. i.e., n = 66. After adding 20% drop out the final sample size became, 72 (36 in each group). The sample size was calculated using following information and formula**:**(Rajendran & Sundaram, 2020)

Sample Size For Comparing Two Means

Input Data

Confidence Interval (2-sided)	95%
Power	80%
Ratio of sample size (Group 2/Group 1)	1

	Group 1	Group 2	Difference*
Mean	2.4	2.9	-0.5
Standard deviation	0.699	0.738	
Variance	0.488601	0.544644	

Sample size of Group 1	33
Sample size of Group 2	33
Total sample size	66

*Difference between the means

The non-Probability Purposive Sampling Technique was used,

Sample Selection:
Inclusion Criteria:
- Age: 25 – 45 years (Sharma et al.)
- Both gender
- Participant with a positive FAIR test.(Sharma et al.)
- Pain intensity level more than 3 point of numeric pain rating scale.

Exclusion Criteria:
- Any pathology or recent injury of lower extremity.
- Lumber Radiculopathy.

- Any systematic disease.
- Sacroiliac joint disorder.
- Fracture of lower extremity
- Any congenital deformity.

Scale: NPRS and LEFS.

DATA COLLECTION PROCEDURE

Screening: The subjects were allocated into the two groups. Subjects selected from the Physiotherapy Department of DHQ Layyah. Subjects were divided randomly into two equal groups.

Blinding: The study was single blinded. Assessor was blind.

Randomization: Subjects were randomized into two groups using computer generated random numbers.

Assessment: Baseline data was collected, then at 6th session (2nd week) and at 12th session (4th week).

Method for data collection: The date was collected by using questionnaire.

Intervention: A total number of thirty-three participants suffering from piriformis syndrome diagnosed by FAIRS test. The patient instructed to be in side lying position. The affected limb will be move in 90° flexion, adduction and internal rotation passively. Then, therapist than applied downward pressure to the knee to adduct and rotate the hip internally while stabilizing the hip. If the patient would feel the pain in the hip or in the gluteal region the test would be considered positive. (Islam et al., 2022)

Patients were allocated into two groups. Both groups would receive conventional physical therapy that includes: Conventional physical therapy included patient education, the electrical and thermal modalities. Transcutaneous Electrical Nerve Stimulator (TENS) was applied with two electrodes covering the affected piriformis muscle for 10 minutes with frequency 110 Hz, 50 µ and continuous mode. Therapeutic Ultrasound was applied in a circular motion with 2.25-2.5 watts/cm2 for 10 minutes, around the piriformis muscle for approximately 8-10 minutes. The range of motion exercises: simply included hip full flexion to full extension, internal to external rotation and abduction to adduction with 10 repetitions. (Bahat et al., 2019) Then the stretching exercises targeted the piriformis muscle, the participant was asked to put the affected side of the muscle into stretch for 10 seconds and repeat it 3 times. Then the strengthening exercises for the piriformis muscle, the participants were instructed to hold the affected side of muscle into isometric contraction for about 10 seconds and repeat it 10 times. The exercise session was carried out for 20 minutes under the physiotherapist's supervision. (Awan et al., 2018)

Allocation:

Group A Control Group: Thirty-three participants received conventional physical therapy.

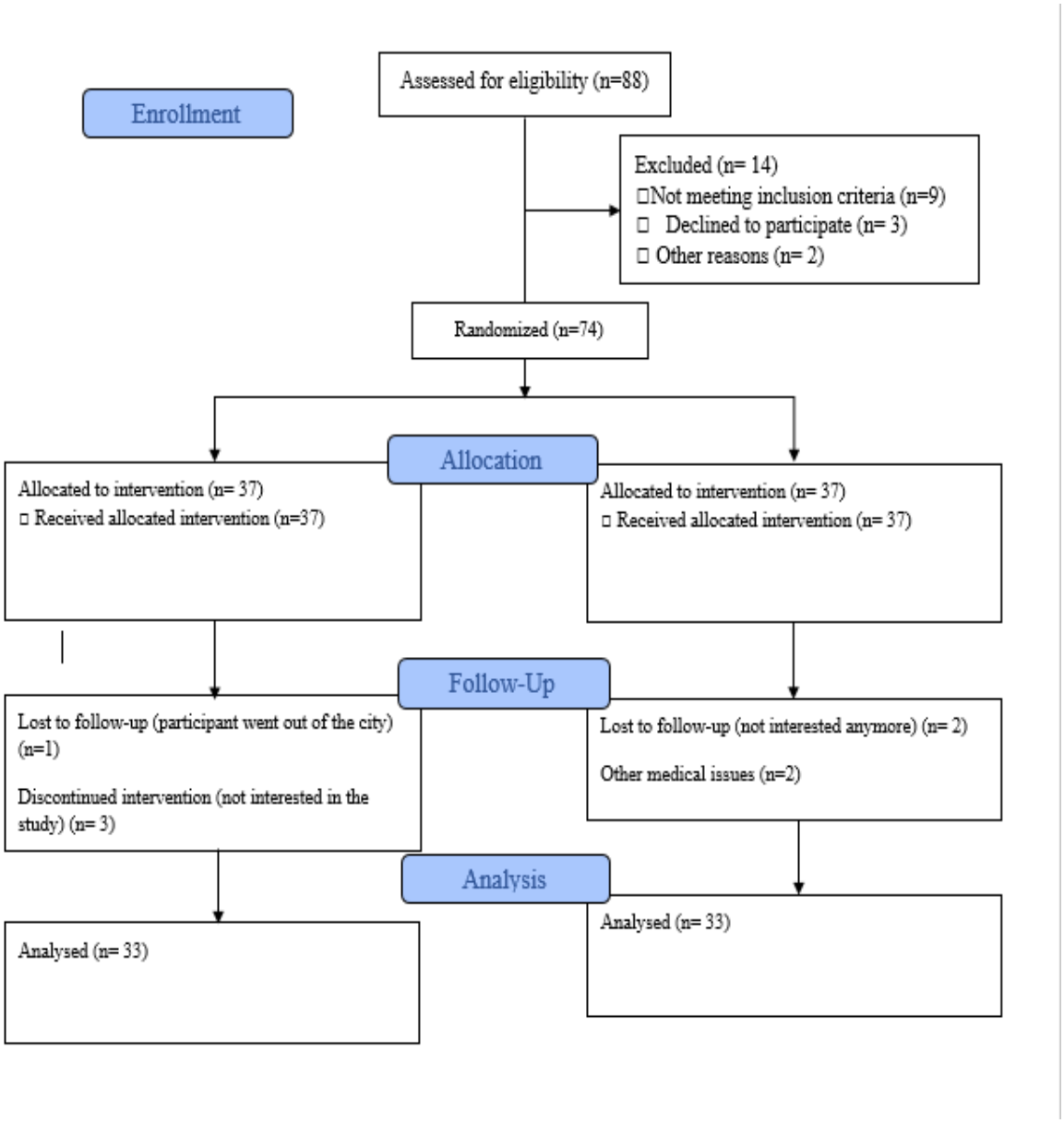
Group B Experimental Group: Thirty-three participants received conventional physical therapy and myofascial release for piriformis.

Kneading Technique for Myofascial Release:

The patient was lying in a prone position. PT was standing on the effected side. Now the therapist applied the myofascial release on the piriformis muscle by using the palm, giving pressure on trigger point by pressing directly on it and hold for about 10 to 100 seconds. Then the therapist applied kneading strokes, that were parallel to and in the direction of the muscle fiber for almost 5 to 10 minutes. (Rajendran & Sundaram, 2020)

The treatment protocol was given to the participants for four weeks (12 sessions on alternate days, 3 session per week) The data was collected at the baseline, at 6th session (2nd week) and at 12th session (4th week). After collecting the data, pain, range of motion and functional disability were compared.

Consort Flow Chart



DATA ANALYSIS PROCEDURE

Data was analyzed by using SPSS version 26. The quantitative variables were presented with mean±SD and the qualitative variables were presented with frequency and percentage. The Shapiro-Wilk normality test was used. The data was not normally distributed so non-parametric test Friedman and Mann Whitney U test were applied. The p-value <0.05 was considered statistically significant

Results

Table 1: Age of Participants for conventional physical therapy and myofascial release technique

Group	**Mean ± Std. Deviation**
Conventional physical therapy	35.99± 7.48
MFR+ Conventional physical therapy	35.18 ± 6.42

The mean age of the participants of the conventional physical therapy (CPT) group was 35.99± 7.48 and of conventional physical therapy and myofascial release technique (CPT+MFR) was 35.18 ± 6..42.

Table 2: Gender Distribution among Groups

Groups	Gender	Frequency
Conventional physical therapy	**Female**	21
	Male	12
MFR+ Conventional physical therapy	**Female**	25
	Male	8

Out of 62 participants, 21 were females and 12 were males in the routine physical therapy group and conventional physical therapy plus myofascial release technique were 25 females and 8 males.

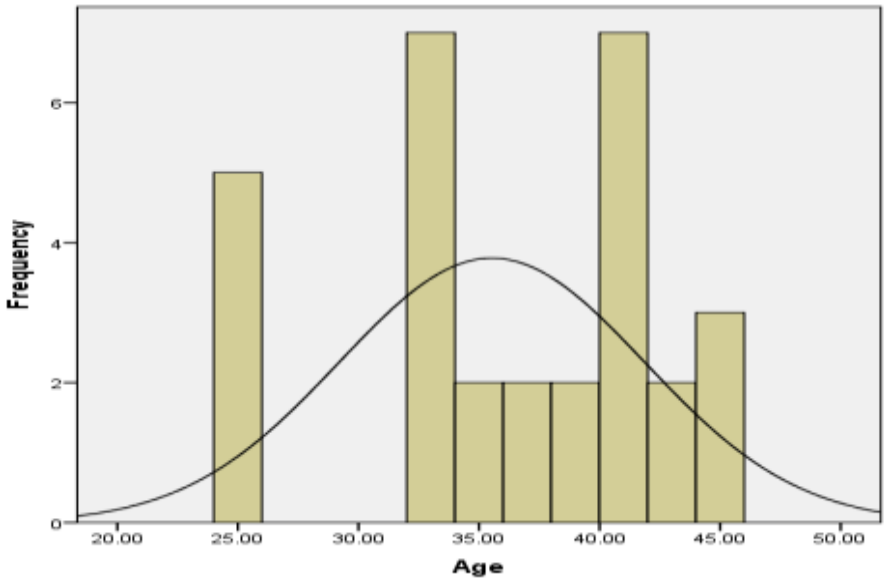


Figure 1: Age distribution among participants of Conventional Physical Therapy Group

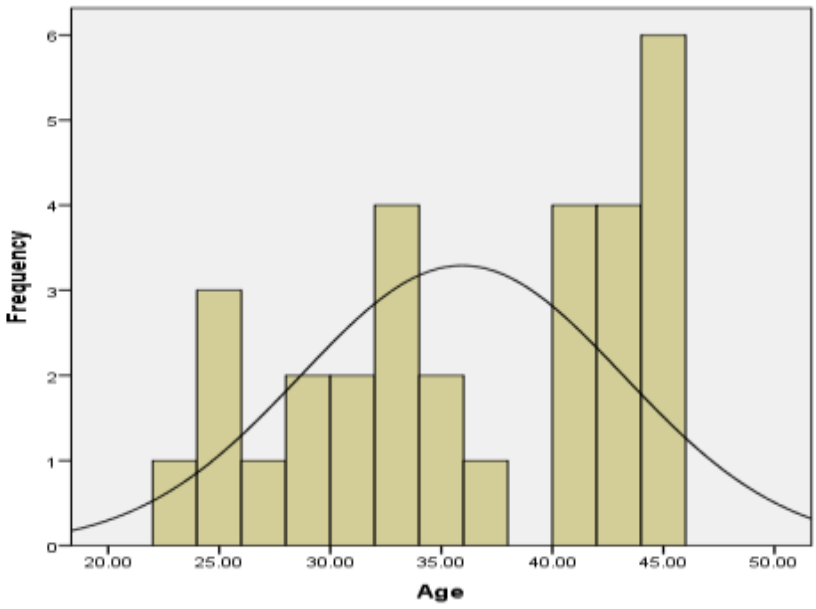


Figure 2: Age distribution among participants of Conventional Physical Therapy + Myofascial Release Group

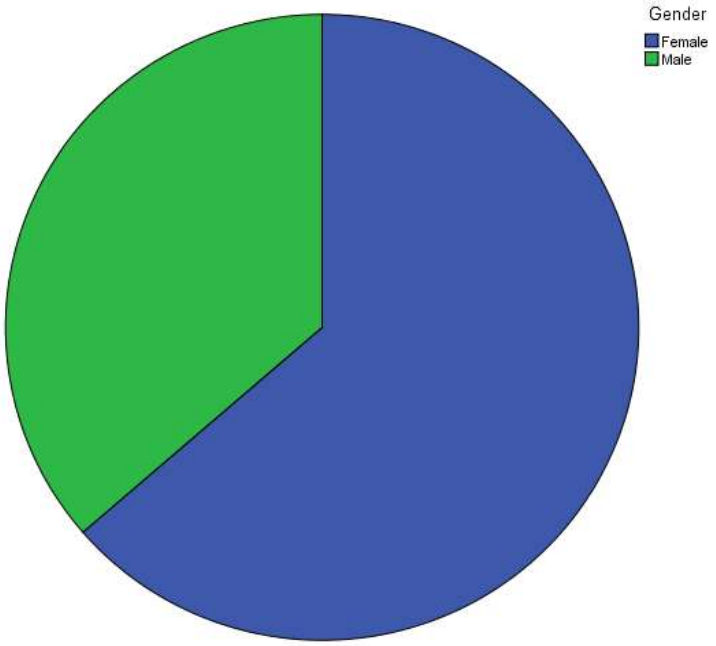


Figure 3: Pie-chart of Gender Distribution among participants of Conventional Physical Therapy Group

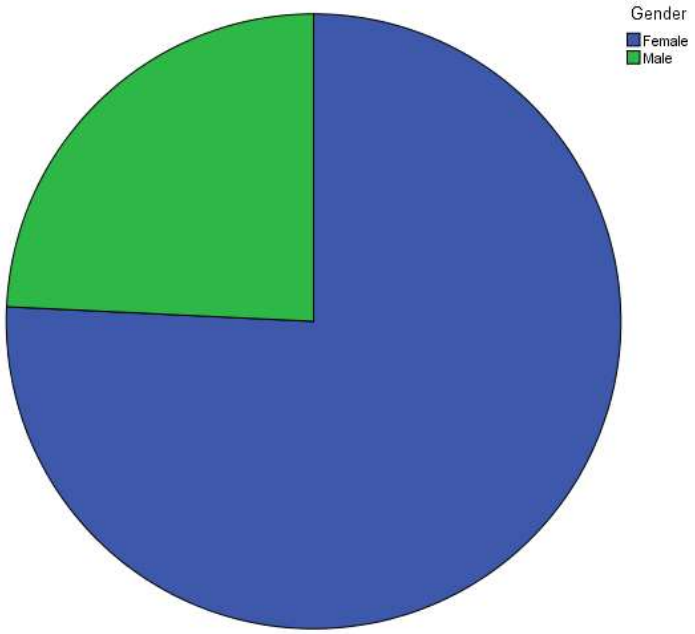


Figure 4: Pie-chart of Gender Distribution among participants of Conventional Physical Therapy + Myofascial Release Group

Variables	Statistic	Sig.
Baseline NPRS	0.222	0.00
Baseline LEFS	0.916	0.000

Normality Test

The p value of baseline NPRS = 0.00, baseline ROM 0.00 and 0.00 for external rotation and abduction respectively and baseline LEFS = 0.000, the data was not normally distributed.

Table 4: Descriptive Statistics Of Cpt Group

Variables	Mean	Std. Deviation	Maximum	Minimum
Age	35.99	7.48	45	23
Baseline NPRS	2.93	0.24	3	2
Baseline LEFS	36.61	13.04	55	11
6th Session NPRS	2.41	0.50	3	2
6th Session LEFS	51.93	11.67	68	25
12th Session NPRS	1.34	0.48	2	1
12th Session LEFS	67.38	12.31	80	33

The mean ± SD age of participants was 35.99±7.84 and having 45 years maximum and 23 years minimum age. The baseline, 6th and 12th session NPRS had mean±SD 2.93±0.24, 2.41±0.50 and 1.34±0.48 At baseline, 6th and 12th session LEFS mean±SD were 36.61±13.04, 51.93±9.07, 67.38±12.31.

Table 5: Clinical and Descriptive Statistics of CPT+MFR

variables	mean	std. Deviation	maximum	minimum
Age	35.99	7..48	45	23
Baseline NPRS	2.96	0.17	3	2
Baseline LEFS	32.48	12.52	54	14
6th Session NPRS	2.87	0.34	3	2
6th Session LEFS	42.25	14.56	68	20
12th Session NPRS	2.3	0.31	3	1
12th Session LEFS	56.06	17.04	80	25

The mean ± SD age of participants was 35.99±7.84 and having 45 years maximum and 23 years minimum age. The baseline, 6th and 12th session NPRS had mean±SD 2.96±0.17, 2.87±0.34 and 2.30±0.31 At baseline, 6th and 12th session LEFS mean±SD were 32.48±12.52, 42.25±14.56, 56.06±17.04.

Table 6: Within-group comparison using Friedman for CPT Group

Variables	Mean Rank	Mean± Std	P-Value
NPRS Baseline	2.50	2.96±0.17	0.00
NPRS 6th Session	2.35	2.87±0.34	
NPRS 12th Session	1.15	2.03±0.31	
LEFS Baseline	6.95	32.48±12.52	0.00
LEFS 6th Session	9.08	42.25±14.56	
LEFS 12th Session	10.19	56.06±17.04	

Non-parametric Friedman test was used for comparison with conventional physical therapy (CPT) group based on NPRS, ROM and LEFS. The mean rank for NPRS baseline, 6th and 12th session were 2.50, 2.35 and 1.15, with the p-value was 0.00. The mean rank of NPRS for the 12thsession was 2.35 and P-value = 0.00. The mean rank for the LEFS baseline, 6thb and 12th session were 6.95, 9.08 and 10,19 and the p-value was 0.00. According to the results, the conventional physical therapy showed significant change in pain, ROM and functional disability during baseline, 6th and 12thsession.

Table 7: Within-group comparison of using Friedman MFR+CPT

Variables	Mean Rank	Mean± Std	P-Value
NPRS Baseline	2.76	2.93±0.24	0.000
NPRS 6th Session	2.24	2.41±0.50	
NPRS 12th Session	1.00	1.35±0.48	
LEFS Baseline	7.58	36.61±13.04	0.00
LEFS 6th Session	10.32	51.93±11.67	
LEFS 12th Session	11.94	67.38±12.31	

Non-parametric Friedman test was used for comparison within the myofascial release technique group based on NPRS, ROM and LEFS. The mean rank for NPRS baseline, 6th and 12th session were 2.76, 2.24 and 1.00 with the p-value was 0.00The mean rank for the LEFS baseline was 7.58, 10.32 and 11.94 with the p-value was 0.00. According to the results myofascial release technique group showed significant change in pain and functional disability during baseline 6th session and 12thsession.

Table 8: Between Groups Comparison for NPRS using Mann Whitney Test CPT and CPT +MFR.

Variables	Groups	Mean Rank	P-value
NPRS base line	CPT	41.35	0.557
	MFR + CPT	37.00	
NPRS 6th session	CPT	38.01	0.000
	MFR+ CPT	24.50	
NPRS 12th Session	CPT	32.50	0.000
	MFR + CPT	21.65	

The results show that there was no significant difference between the groups with the p-value <0.05. According to the results, in baseline NPRS the conventional physical therapy group and myofascial release group showed no significance changes. While at 6th and 12th session the conventional physical therapy group and myofascial release group showed significance p-value <0.05. The experimental group showed improvement in pain.

Table 10: Between Groups Comparison for LEFS using Mann Whitney Test

Variables	Groups	Mean Rank	P-value
LEFS base line	CPT	25.51	0.243
	MFR+ CPT	28.16	
LEFS 6th session	CPT	38.84	0.009
	MFR+ CPT	47.50	
LEFS 12th Session	CPT	45.85	0.006
	MFR+ CPT	56.50	

The results show that there was not any statistically significant difference between the groups with the p-value <0.05. According to the results LEFS showed improvement in myofascial release group.

DISCUSSION

Total sixty-six participants suffering from piriformis syndrome diagnosed by an orthopedic physical assessment. After the inclusion criteria met, patients were divided into 2 groups. Thirty-three participants received conventional physical therapy only and the other thirty-three participants received myofascial release plus conventional physical therapy for 45 minutes/session lasting for 12 sessions on alternate days. The outcome measures were Pain, (NPRS), rang of motion was measured by universal goniometer and functional disability was measured by LEFS. The results suggested that myofascial release plus conventional physical therapy was comparatively more beneficial in reducing the pain and functional disability when compared with conventional physical therapy alone.

A study conducted by Gopal Nambi on muscle energy technique versus myofascial release on participants with piriformis syndrome. He divided the participants into three groups receiving muscle energy technique, myofascial release and conventional physiotherapy. He said in his study that women tend to suffer more than male with piriformis syndrome with ratio of 6:1. He concluded in his study that the groups received MET and MT had great change in pain, range of motion of hip and functional disability.(Bose & Dusad, 2018; Razaq et al., 2023a) But the current study concluded that the group of participants received both the myofascial release and conventional physiotherapy showed improvement in pain and functional disability and as far as range of motion of hip joint

concerned there was no difference in between the two group received myofascial release and conventional physiotherapy and just conventional physiotherapy.

A study conducted in 2021 by Khakneshin et al to review the efficacy of different types of physiotherapy interventions in patients with piriformis syndrome. The included studies presented that using different types of massage technique like muscle energy technique and myofascial release along with piriformis stretching are beneficial in reducing pain and disability and increasing ROM in patients with PS.(Khakneshin et al., 2021; Razaq et al., 2023b) The conclusion of this study is same as that of the current study, but the current study showed improvement only in pain and functional disability. Moreover, the current study did not mention any improvement in the ROM of the hip joint when both the control and experimental group were compared.

Mitushi Kishor et al in 2020 evaluate the effectiveness of myofascial release on pain and ROM of hip joint in the individuals with piriformis syndrome. He divided the participants into two groups receiving the myofascial release and simple stretching. The conclusion was there was an improvement in ROM and hip pain in the group receiving the myofascial release. (Deshmukh et al., 2020; Razaq et al., 2023a) The conclusion of this study was same with the current study in terms of alleviation of pain. Both the studies showed that myofascial release was found to be very effective when done separately as in this study or done in conjunction with conventional physical therapy as discussed in the current study. The contradiction lies in the improvement of the ROM of the hip joint. The current study did not show any difference in the range of motion of the hip joint when compared both the experimental and control group but this study also showed improvement in the range of motion of the hip. This reason behind it might be the use of myofascial release alone while in the current study myofascial release was used in combination with the conventional physical therapy. Also, the comparison group was only the simple stretching of the involved muscles in the present study whereas the comparison group in the current study was the control group receiving the conventional physical therapy that involves electro therapy as well as stretching and strengthening exercises.

REFERENCE

1. Adiyatma, H., & Kurniawan, S. N. (2022). Piriformis syndrome. *Journal of Pain, Headache and Vertigo*, *3*(1), 23-28.
2. Alarab, A., & Unver, F. (2020). Stretching Exercise Versus Tissue Mobilization Technique in Piriformis Syndrome. *European Journal of Medical and Health Sciences*, *2*(6).
3. Berthelot, J.-M., Darrieutort-Laffite, C., Arnolfo, P., Glémarec, J., Le Goff, B., & Maugars, Y. (2021). Inadequacies of the Lasègue test, and how the Slump and Bowstring tests are useful for the diagnosis of sciatica. *Joint bone spine*, *88*(1), 105030.
4. Bose, G., & Dusad, G. (2018). Effect of reciprocal inhibition and post isometric relaxation; types of muscle energy technique in piriformis syndrome–a comparative study. In: EJPMR.
5. Brandl, A., Egner, C., & Schleip, R. (2021). Immediate effects of myofascial release on the thoracolumbar fascia and osteopathic treatment for acute low back pain on spine shape parameters: A randomized, placebo-controlled trial. *Life*, *11*(8), 845.
6. Chen, Z., Wu, J., Wang, X., Wu, J., & Ren, Z. (2021). The effects of myofascial release technique for patients with low back pain: A systematic review and meta-analysis. *Complementary therapies in medicine*, *59*, 102737.
7. Dakou, M., Iakovidis, P., Lytras, D., Kottaras, I., Kottaras, A., & Chasapis, G. (2021). The effect of physiotherapy in the treatment of piriformis syndrome: A narrative review. *Nat. J. Clin. Orthopaed.*, *5*, 24-26.
8. Deshmukh, M. K., Phansopkar, P. A., & Kumar, K. (2020). Effect of Muscle Energy Technique on Piriformis Tightness in Chronic Low Back Pain with Radiation. *Journal of Evolution of Medical and Dental Sciences*, *9*(44), 3284-3289.
9. Fishman, L. M., & Hosseini, M. (2019). Piriformis syndrome-a diagnosis comes into its own. *Muscle & nerve*, *59*(4), 395-396.

10. Fishman, L. M., Wilkins, A. N., & Rosner, B. (2017). Electrophysiologically identified piriformis syndrome is successfully treated with incobotulinum toxin a and physical therapy. *Muscle & nerve*, *56*(2), 258-263.
11. Han, S. K., Kim, Y. S., Kim, T. H., & Kang, S. H. (2017). Surgical treatment of piriformis syndrome. *Clinics in orthopedic surgery*, *9*(2), 136-144.
12. Hogan, E., Vora, D., & Sherman, J. H. (2020). A minimally invasive surgical approach for the treatment of piriformis syndrome: a case series. *Chinese Neurosurgical Journal*, *6*, 1-6.
13. Hopayian, K., Song, F., Riera, R., & Sambandan, S. (2010). The clinical features of the piriformis syndrome: a systematic review. *European Spine Journal*, *19*(12), 2095-2109.
14. Kadam, A., & Aswale, S. The immediate effect of Self-Myofascial Release using tennis ball on pain in individuals with piriformis trigger points.
15. Khakneshin, A., Javaherian, M., & Attarbashi Moghadam, B. (2021). The Efficacy of Physiotherapy Interventions for Recovery of Patients Suffering from Piriformis Syndrome: A Literature Review. *Journal of Rafsanjan University of Medical Sciences*, *19*(12), 1304-1318.
16. Koh, E., Webster, D., & Boyle, J. (2020). Case report and review of the potential role of the Type A piriformis muscle in dynamic sciatic nerve entrapment variant of piriformis syndrome. *Surgical and Radiologic Anatomy*, *42*(10), 1237-1242.
17. Kukadia, H. A., Malshikare, A., & Palekar, T. J. (2019). Effect of passive stretching v/s myofascial release in improving piriformis flexibility in females–a comparative study. *Indian J. Physiother. Occup. Ther*, *13*, 457.
18. Nazir, S., Asmat, G., Ashfaq, U., & Saeed, T. (2022). Frequency of Piriformis Syndrome among Female Physiotherapy Students of Gujranwala, Pakistan: Piriformis Syndrome among Female Physiotherapy Students. *Pakistan Biomedical Journal*, 103-107.
19. Poutoglidou, F., Piagkou, M., Totlis, T., Tzika, M., & Natsis, K. (2020). Sciatic nerve variants and the piriformis muscle: a systematic review and meta-analysis. *Cureus*, *12*(11).
20. Rajendran, S., & Sundaram, S. S. (2020). The effectiveness of myofascial release over stretching on pain and range of motion among female college students with piriformis syndrome. *Malaysian Journal of Movement, Health & Exercise*, *9*(2), 45.
21. Rana, Z., Sheikh, S. A., Anwar, F., Gul, K., Shahid, H., Shaukat, Z., & Kamran, M. Effectiveness of continuous passive motion protocol as an adjunct to standard physiotherapy protocol for post-operative rehabilitation in Total Knee Arthroplasty (TKA) cases.
22. Razaq, H. B., Basharat, A., Sheikh, S. A., Zehra, R. E., Mufti, H. A., Faraz, K., & Waqar, Z. (2023a). Effects of combining both mobilization with movement and spencer's technique in diabetic adhesive capsulitis patients. *International journal of health sciences*, *7*(S1), 2328-2343.
23. Razaq, H. B., Basharat, A., Sheikh, S. A., Zehra, R. E., Mufti, H. A., Faraz, K., & Waqar, Z. (2023b). Effects of combining both mobilization with movement and spencer's technique in diabetic adhesive capsulitis patients. *International journal of health sciences*, *7*(S1), 2328-2343. https://doi.org/10.53730/ijhs.v7nS1.14494
24. Ro, T. H., & Edmonds, L. (2018). Diagnosis and management of piriformis syndrome: a rare anatomic variant analyzed by magnetic resonance imaging. *Journal of clinical imaging science*, *8*.
25. Shabbir, A., Imran, M., Kamran, M., Wassi, A., Amin, H., Balqees, A., ul Ain, Q., Tariq, H., Ahmad, M., & Ullah, I. (2022). Linguistic Reliability & Validity of Urdu Version of Roland-Morris Disability Questionnaire in Patients with Chronic Non-Specific Low Back Pain: Roland-Morris Disability Questionnaire in Patients with Chronic Non-Specific Low Back Pain. *Pakistan BioMedical Journal*, 79-84.
26. Sharma, J., Kumar, N., & Kumar, S. Comparison of the Effectiveness of Core Strenghting Exercise and McKenzie Extension Exercise on the Pain Functional Disability in lumbar PIVD Condition.

27. Siddiq, M. A. B., Hossain, M. S., Uddin, M. M., Jahan, I., Khasru, M. R., Haider, N. M., & Rasker, J. J. (2017). Piriformis syndrome: a case series of 31 Bangladeshi people with literature review. *European Journal of Orthopaedic Surgery & Traumatology*, *27*, 193-203.
28. Siddiq, M. A. B., & Siddiq, M. A. B. (2018). Piriformis syndrome and wallet neuritis: are they the same? *Cureus*, *10*(5).
29. Terlemez, R., & Ercalik, T. (2019). Effect of piriformis injection on neuropathic pain. *Agri*, *31*(4), 178-182.
30. Varenika, V., Lutz, A. M., Beaulieu, C. F., & Bucknor, M. D. (2017). Detection and prevalence of variant sciatic nerve anatomy in relation to the piriformis muscle on MRI. *Skeletal radiology*, *46*, 751-757.
31. Vij, N., Kiernan, H., Bisht, R., Singleton, I., Cornett, E. M., Kaye, A. D., Imani, F., Varrassi, G., Pourbahri, M., & Viswanath, O. (2021). Surgical and non-surgical treatment options for piriformis syndrome: A literature review. *Anesthesiology and Pain Medicine*, *11*(1).