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EVALUATING THE EFFECTS OF SOFT TISSUE MOBILIZATION IN PIRIFORMIS SYNDROME

Original Research

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ABSTRACT

Background: Piriformis syndrome is a rare neuromuscular disorder that occurs when the piriformis muscle compresses the sciatic nerve, leading to pain, tingling, or numbness in the buttock region and along the course of the sciatic nerve. It often mimics other causes of sciatica, making diagnosis and management challenging. Conservative physiotherapy management, particularly soft tissue mobilization, has emerged as a potential intervention to alleviate symptoms and restore function in affected individuals.

Objective: To determine the effect of soft tissue mobilization on pain, range of motion (ROM), and functional disability in individuals with piriformis syndrome.

Methods: A quasi-experimental study was conducted at Al-Nafees Hospital, Islamabad, from 23rd September 2022 to 6th February 2023. A total of 20 participants aged 20–60 years with clinically diagnosed piriformis syndrome were enrolled using non-probability convenience sampling. Participants underwent six physiotherapy sessions over the course of the intervention. Outcome measures included the Numeric Pain Rating Scale (NPRS), goniometric assessment of hip external rotation ROM, and the Oswestry Disability Index (ODI). Assessments were conducted at baseline, mid-treatment, and post-treatment. Data were analyzed using SPSS version 21, and p-values less than 0.05 were considered statistically significant.

Results: The mean age of participants was 31.9 ± 10.6 years. Among them, 8 (40%) were male and 12 (60%) were female. The mean BMI was 22.5 ± 2.6 kg/m², with 85% (n=17) having normal weight and 15% (n=3) being overweight. Statistically significant improvements were observed from baseline to the sixth session in NPRS (7.25 ± 1.55 to 1.45 ± 0.66), hip external rotation ROM (34.0 ± 5.1° to 51.3 ± 3.8°), and ODI (33.1 ± 9.1 to 11.0 ± 4.6) with p=0.00 across all measures.

Conclusion: Soft tissue mobilization significantly reduced pain and functional disability while improving hip ROM in patients with piriformis syndrome, supporting its use as an effective physiotherapeutic intervention.

Keywords: Manual Therapy, Numeric Pain Rating Scale, Oswestry Disability Index, Physiotherapy, Piriformis Syndrome, Range of Motion, Soft Tissue Mobilization.

INTRODUCTION

Piriformis syndrome is a neuromusculoskeletal condition characterized by pain, tingling, and numbness resulting from compression or irritation of the sciatic nerve by the piriformis muscle (1). Although relatively uncommon, piriformis syndrome contributes significantly to the burden of low back pain and sciatica. It is estimated that the annual incidence of low back pain and sciatica globally reaches approximately 40 million cases, with piriformis syndrome accounting for about 2.4 million of these (2). Despite this, it remains a frequently underdiagnosed condition due to its overlapping symptoms with other lumbosacral disorders. The female-to-male incidence ratio for piriformis syndrome is reported to be as high as 6:1, suggesting a gender predisposition (3). A study conducted at a regional hospital identified piriformis syndrome in 45 out of 750 patients presenting with low back pain, further highlighting its clinical relevance. Moreover, the prevalence of piriformis syndrome among individuals with sciatica has been estimated to be around 6% (4). The exact etiology of piriformis syndrome is not entirely clear, and risk factor identification remains an evolving area of study. Existing literature suggests that factors such as female gender, high body mass index, prolonged sitting, overuse injuries, and occupations involving repetitive hip movements may predispose individuals to the development of this condition (5). Clinically, patients typically present with persistent, radiating low back pain, chronic buttock pain, and sensory disturbances such as numbness and paresthesia. These symptoms are often aggravated by functional activities like walking, squatting, sitting, or prolonged standing. Given the non-specificity of symptoms and the absence of definitive diagnostic tests, piriformis syndrome remains a diagnosis of exclusion, further complicated by the absence of a universally accepted treatment protocol (6).

Current interventions primarily focus on conservative approaches aimed at relieving the muscle tension believed to cause sciatic nerve compression. These may include stretching exercises, physical therapy modalities such as ultrasound, dry needling, heat and cold therapy, and manual therapies including soft tissue mobilization (7). Among these, soft tissue mobilization (STM) is gaining attention due to its therapeutic impact on myofascial dysfunction and pain relief. STM involves the use of targeted pressure and stretching techniques to release muscle adhesions, restore tissue mobility, and improve local circulation, thereby alleviating pain and inflammation. It is particularly useful in managing soft tissue injuries such as muscle strains and sprains and has been shown to provide symptomatic relief in piriformis syndrome through reduction of muscle tightness and neural irritation. One specialized form of STM is cross-fiber friction, also known as deep friction massage (DFM), which was pioneered by James Cyriax (8). This technique involves the application of deep, transverse pressure across the grain of the affected muscle or tendon. The aim is to disrupt abnormal adhesions, promote realignment of collagen fibers during healing, and prevent scar tissue formation (9). Accurate palpation and identification of the involved structure—be it muscle belly, tendon, or ligament—are crucial for its efficacy. The method requires that the therapist's fingers move in sync with the patient's skin to prevent subcutaneous trauma. Pressure application must be appropriately calibrated; research suggests that a pressure of approximately 2.3 kg/cm² may facilitate earlier onset of analgesia (10). Frequency and duration of sessions are individualized, with acute conditions potentially requiring daily short sessions, while chronic presentations may benefit from longer, intermittent treatments (11). Despite the widespread use of cross-fiber friction in clinical settings, there is limited high-quality evidence on its specific effectiveness in patients with piriformis syndrome. Most of the available literature focuses on general STM or multimodal therapy protocols. This gap necessitates targeted investigation into the therapeutic role of cross-fiber friction as a primary intervention for piriformis syndrome. Therefore, the objective of this study is to determine the effects of soft tissue mobilization, particularly cross-fiber friction, on pain reduction and functional improvement in individuals diagnosed with piriformis syndrome.

METHODS

The study followed a quasi-experimental design to evaluate the effects of soft tissue mobilization in patients diagnosed with piriformis syndrome. A total of 20 participants were recruited through non-probability convenience sampling from Al-Nafees Hospital, Islamabad. Data collection occurred over a span of approximately four and a half months, from 23rd September 2022 to 6th February 2023. Ethical approval for the study was granted by the Advanced Study & Research Committee (ASRC) of the Isra Institute of Rehabilitation Sciences, Isra University, Islamabad. All participants provided written informed consent prior to their inclusion in the study, ensuring adherence to ethical standards in human research. Participants eligible for inclusion were aged between 20 and 40 years and had a confirmed diagnosis of piriformis syndrome, verified through clinical examination and positive findings on at least one of the following

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diagnostic tests: FAIR test, Freiberg test, Pace sign, or Beatty maneuver. Individuals with any imaging-confirmed spinal pathologies (e.g., herniated discs), systemic diseases, spondylolisthesis, prior spinal surgeries, vertebral fractures, stroke, or lower limb amputation were excluded to prevent confounding. Each participant underwent a series of physiotherapeutic interventions, specifically soft tissue mobilization techniques, over the course of six clinical visits. The therapy focused on manual treatment approaches targeting the piriformis muscle, including cross-fiber friction massage and stretching techniques. All sessions were administered uniformly across the participant group to ensure consistency in exposure.

Clinical assessments were conducted at four intervals: baseline, second, fourth, and sixth visits. Outcome measures included the Numeric Pain Rating Scale (NPRS) for pain intensity, goniometric measurement of hip external rotation range of motion (ROM), and the Oswestry Disability Index (ODI) to evaluate functional disability. These instruments were chosen for their clinical relevance and reliability in assessing musculoskeletal function. Additionally, demographic information—age, gender, body mass index (BMI), and occupation—was collected using a structured, self-developed questionnaire at baseline. Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 21. Descriptive statistics summarized demographic variables, while inferential statistics assessed changes across different time points using paired comparisons. Statistical significance was determined using p-values, with results considered significant at $p < 0.05$.

RESULTS

The study included 20 participants who completed pre-, mid-, and post-treatment assessments using the Numeric Pain Rating Scale (NPRS), Oswestry Disability Index (ODI), and goniometry for hip external rotation range of motion (ROM). The majority of participants were between the ages of 20–30 years (55%), followed by those in the 41–50 year group (20%), 31–40 year group (15%), and 51–60 year group (10%). Females represented 60% of the study population, while 40% were male. In terms of body mass index (BMI), 85% of participants had normal weight (18.5–24.9 kg/m²) and 15% were categorized as overweight (25–29.9 kg/m²). Occupationally, 55% were students, 40% belonged to other professions, and 5% were teachers. Significant reductions in pain intensity were observed throughout the treatment sessions. The mean NPRS score at baseline was 7.25 ± 1.55, which decreased to 5.25 ± 1.83 by the second visit, 3.15 ± 1.13 by the fourth visit, and 1.45 ± 0.66 by the sixth visit ($p = 0.00$ across all timepoints). These results indicate a progressive and statistically significant reduction in reported pain levels over the course of treatment. Hip external rotation ROM also showed consistent improvement. The mean ROM increased from 34.0 ± 5.1 degrees at baseline to 38.9 ± 5.3 degrees at the second visit, 44.8 ± 4.7 degrees at the fourth visit, and 51.3 ± 3.8 degrees by the sixth visit ($p = 0.00$ for all comparisons), suggesting a clinically meaningful enhancement in joint mobility. Functional disability, measured by the Oswestry Disability Index, also demonstrated marked improvement. The mean ODI score declined from 33.1 ± 9.1 at baseline to 11.0 ± 4.6 at the sixth visit ($p = 0.00$), reflecting a significant reduction in disability levels after the intervention period.

Table 1: Demographic Characteristics of Study Participants (n=20)

Variable	Category	Frequency (n)	Percentage (%)
Age Categories (years)	20–30	11	55.0
	31–40	3	15.0
	41–50	4	20.0
	51–60	2	10.0
Gender	Male	8	40.0
	Female	12	60.0
BMI Categories (kg/m²)	18.5–24.9 (Normal)	17	85.0
	25–29.9 (Overweight)	3	15.0
Occupation	Students	11	55.0
	Teachers	1	5.0
	Others	8	40.0

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Table 2: Numeric Pain Rating Scale (NPRS) of participants

MEASURES		MEAN±S.D	P-VALUE
At Baseline	At 2nd visit	7.25±1.55	0.00
At 2nd visit	At 4th visit	5.25±1.83	0.00
At 4th visit	At 6th visit	3.15±1.13	0.00
At 6th visit	At baseline	1.45±0.66	0.00

Table 3: Range of Motion of hip (External rotation) among participants

MEASURES		MEAN±S.D	P-VALUE
At Baseline	At 2nd visit	34.0 ± 5.1	0.00
At 2nd visit	At 4th visit	38.9 ± 5.3	0.00
At 4th visit	At 6th visit	44.8 ± 4.7	0.00
At 6th visit	At baseline	51.3 ± 3.8	0.00

Table 4: Oswestry Disability Index (ODI) among participants

MEASURES		MEAN±S.D	P-VALUE
At Baseline	At 6th visit	33.1 ± 9.1	0.00
At 6th visit	At baseline	11.0 ± 4.6	0.00

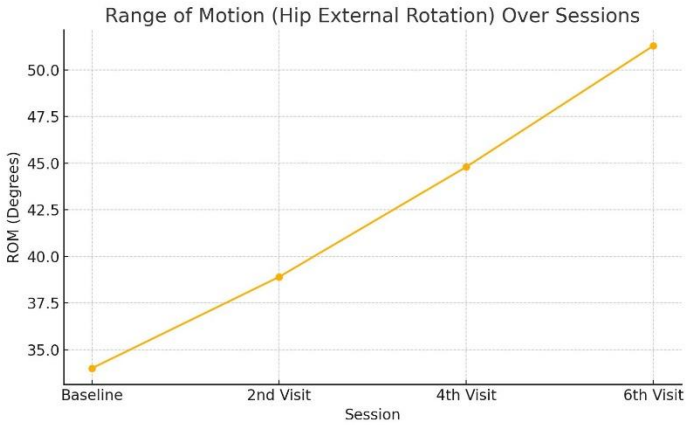

Figure 1 Range of Motion (Hip External Rotation) Over Sessions

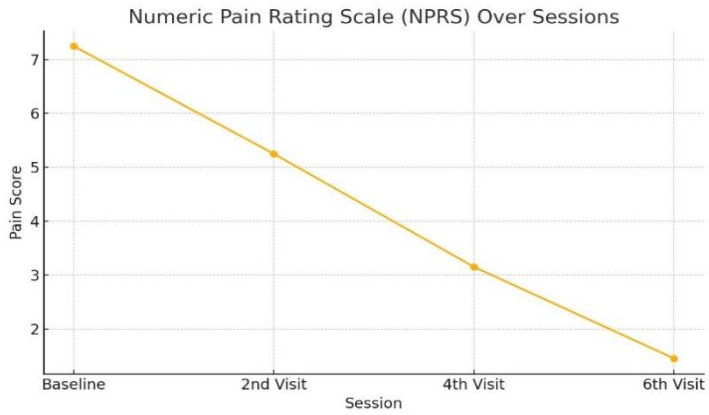

Figure 2 Numeric Pain Rating Scale (NPRS) Over Sessions

DISCUSSION

The findings of the present study demonstrated a significant improvement in range of motion, pain intensity, and functional disability in patients diagnosed with piriformis syndrome following a structured six-session protocol of soft tissue mobilization. The consistent reduction in pain scores on the Numeric Pain Rating Scale (NPRS), the progressive increase in hip external rotation range of motion (ROM), and the marked decrease in Oswestry Disability Index (ODI) scores from baseline to the final session reflect a clear therapeutic benefit of this intervention approach (12,13). These results align with existing literature that supports the effectiveness of soft tissue techniques in managing musculoskeletal conditions associated with restricted movement and pain. Evidence from previous controlled trials has shown that patients receiving soft tissue massage over a similar six-session period exhibited significant improvements in shoulder joint mobility, pain, and functional outcomes (14,15). Those findings complement the present results, particularly with regard to improved ROM, despite the anatomical and functional differences between shoulder and hip musculature. Moreover, studies focusing

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specifically on piriformis syndrome have shown that cross-friction massage—one of the core components of soft tissue mobilization—resulted in greater reductions in pain and disability levels compared to conventional stretching protocols. These collective findings strengthen the evidence base for incorporating manual therapy techniques, especially soft tissue mobilization, into rehabilitation programs for neuromuscular pain syndromes (16,17).

The reduction in ODI scores in this study mirrors outcomes seen in patients treated with cross-fiber friction massage for piriformis syndrome, indicating that soft tissue mobilization not only provides localized muscular relief but also contributes to improved functional independence (18). Similarly, the observed decline in NPRS values further validates the analgesic potential of these manual interventions. The progressive and statistically significant improvements across multiple outcome domains support the role of soft tissue mobilization as a valuable conservative therapy for piriformis syndrome (19,20). Despite its strengths, including consistent treatment application and the use of standardized and validated outcome measures, this study had notable limitations. A small sample size limited the statistical power and generalizability of the findings. The lack of a control group made it difficult to distinguish treatment effects from natural recovery or placebo influence. Participant dropout and non-compliance with session schedules introduced additional variability. The diagnostic process relied on physiotherapy special tests in cases where patients presented undiagnosed, which, while clinically relevant, may have affected diagnostic precision in the absence of imaging or inter-rater reliability assessment.

Time constraints further limited long-term follow-up, preventing an evaluation of sustained effects or recurrence rates. Moreover, the intervention was not supplemented with postural or ergonomic education, which may have further enhanced functional outcomes and reduced recurrence risk. The homogeneity of the sample, mainly composed of young adults with normal BMI, also limits applicability to broader populations, including elderly patients or those with comorbidities. Future studies should adopt randomized controlled designs with larger sample sizes and longer follow-up durations. Integrating postural re-education, ergonomic training, and activity modifications may improve long-term outcomes. Subgroup analysis based on gender, BMI, or activity level could help tailor interventions more effectively (21). Additionally, exploring the mechanistic underpinnings of soft tissue mobilization—whether through neuromodulation, circulation enhancement, or fascial release—could refine clinical applications and optimize treatment protocols for piriformis syndrome.

CONCLUSION

The findings of this study conclude that soft tissue mobilization is an effective intervention in managing piriformis syndrome, resulting in notable improvements in pain, range of motion, and functional ability. The outcomes support the acceptance of the research hypothesis and reject the null hypothesis, confirming the therapeutic value of manual therapy in addressing musculoskeletal dysfunctions associated with piriformis syndrome. These results highlight the practical significance of incorporating soft tissue mobilization into routine physiotherapy protocols, offering a non-invasive and clinically beneficial approach for enhancing patient recovery and quality of life.

AUTHOR CONTRIBUTION

Author	Contribution
Adeela Asad*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Salahudin	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Ayesha Sajid	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Sibghat Ullah	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Taimoor Hassan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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