

Effect of Ultrasound and Piriformis Stretching in Reducing Pain and Improving Functional Activities in Patients with Piriformis Syndrome: A Randomised Controlled Trial

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ABSTRACT

Objective: Piriformis syndrome is a neuromuscular disorder that occurs when the piriformis muscle compresses or otherwise irritates the sciatic nerve, eliciting pain, tingling and numbness in the buttock region. In piriformis syndrome, a spasming piriformis muscle leads to compression of the sciatic nerve, which limits a person's ability to perform day-to-day activities due to pain and tingling/numbness. The Undiagnosed Somatic Dysfunction turns into long-term dysfunction and can lead to more complex neuromuscular impairments and muscle weakness. This study aims to determine the effectiveness of combining ultrasound therapy with piriformis stretching as a physiotherapy

Material and Methods: The total number of subjects in the present study was 30, and all met the requirements for diagnosis of piriformis syndrome. 15 subjects were assigned to Group A, which received a diathermy and stretching intervention. 15 subjects in Group B received no treatment. Group A pre- and post-intervention data will be obtained during the 12-week session.

Results: Based on the analysis using the Likert scale and lower extremity functional scale in Group A and Group B, Group A showed an extreme statistical significance with a p-value < 0.0001.

Conclusion: Both ultrasound and piriformis stretching are efficient in decreasing pain and disability, increasing muscle stretching and improving ROM of the hip joint in piriformis syndrome

Keywords: ultrasound, stretching therapy, piriformis syndrome, Likert scale, lower extremity functional scale.

INTRODUCTION

Piriformis syndrome refers to buttock pain resulting from a musculoskeletal dysfunction of the piriformis muscle, unrelated to incidental compression of spinal nerve roots. Differential diagnosis of piriformis syndrome can be refined through appropriate physical assessments, radiographic examination and neuroelectric tests. Physiotherapy can be a standalone treatment for Piriformis or when combined with pharmacological agents for pain management in piriformis syndrome to avoid going under the operating table^{1,2}.

Piriformis syndrome is a form of sciatic neuropathy caused by entrapment of the sciatic nerve within the piriformis muscle. It can be categorised into primary and secondary types. The primary type arises from intrinsic issues within the piriformis muscle itself, such as myofascial pain syndrome or myositis ossificans, often following trauma. In contrast, the secondary type is associated with conditions affecting adjacent structures near the sciatic notch, leading to referred hip pain³.

The pear-shaped muscle (piriformis) is located under the biggest muscle of the buttock (gluteus maximus) close to the upper side of the hip joint and forms part of a group of external rotators of the hip. It facilitates leg movement, stabilises the hip, lifts the thigh, and rotates it outward. Moreover, it plays an important role in walking, shifting weight from one leg to another (right or left), keeping balance and moving the thigh in several directions. It is also used during sports that require raising and twisting thighs as well as nearly all movements of the hip or legs. It should be noted that the sciatic nerve is the longest in the human body and runs under this muscle⁴.

The piriformis muscle receives its innervation from the S1 and S2 nerve roots. It functions as an external rotator, a weak flexor, and a weak adductor of the hip joint. A clear understanding of the interaction between the sciatic nerve and the piriformis muscle is essential to comprehend

piriformis syndrome. The sciatic nerve is the largest in the body, providing innervation to the posterior thigh and all regions of the lower leg and foot. Originating from the lumbosacral plexus, it comprises fibres from the L4 and L5 nerve roots⁵.

The piriformis muscle lies beneath the gluteus maximus, where it can spasm and compress the sciatic nerve, causing pain and numbness that may extend along the back of the leg to the foot. Piriformis syndrome predominantly occurs in women aged 40 to 50, with a female-to-male ratio of 6:1. Approximately 6% of individuals seeking treatment for lower back pain are diagnosed with piriformis syndrome. However, determining its prevalence is challenging, as estimates range from 5% to 36%⁶.

Primary piriformis syndrome is linked to the anatomical positioning of the piriformis muscle and the sciatic nerve. In contrast, secondary piriformis syndrome results from microtrauma and localised ischemia. Notably, primary piriformis syndrome is found in about 15% of diagnosed cases. Individuals with this condition often experience pain, numbness in the gluteal region, and a burning and tingling sensation during hip movements. The pain is mechanical and closely associated with body movement and posture. It tends to worsen with prolonged standing or sitting and improves when lying down^{6,7,8}.

Diagnostic assessments may involve the Piriformis Sign: When the patient is lying supine in a relaxed state, the affected foot naturally turns outward. Attempts to actively move the foot toward the midline elicit pain, indicating a positive Piriformis Sign⁹.

The Pace Sign, which is assessed through the FAIR test, involves reproducing sciatic symptoms. To perform the FAIR test, the patient lies on their side with the affected side facing up, the hip flexed at a 60-degree angle, and the knee bent between 60 and 90 degrees. The examiner stabilises the hip and then applies downward pressure to the knee while internally rotating and adducting the

hip. Alternatively, the test can also be conducted with the patient lying on their back or sitting, with the knee and hip flexed and the hip medially rotated, while the patient resists the examiner's attempts to externally rotate and abduct the hip. A positive FAIR test indicates that sciatic symptoms have been reproduced^{10,11}.

Beatty Test – The patient lies on the unaffected side, lifting and holding the upper knee about 4 inches from the examination table. If this action reproduces sciatic symptoms, the test is considered positive. In positive cases, treatment under medical management may include non-steroidal anti-inflammatory drugs (NSAIDs), acetaminophen, local botulinum toxin injection, peri-sciatic injection under fluoroscopy, muscle relaxants, ice, and rest^{12,13}.

Heat therapy, including ultrasound, followed by a passive stretch to the piriformis muscle, is perfect for treating piriformis syndrome. Ultrasound targets myofascial trigger points within the piriformis muscle, making it an essential tool for accurately addressing conditions associated with piriformis syndrome. Concurrently, physiotherapy involving stretching the piriformis muscle aids in alleviating the pain associated with this condition¹⁴.

Stretching the piriformis muscle is a widely used physiotherapy technique for those diagnosed with piriformis syndrome. The goal of stretching is to elongate the shortened piriformis muscle, which compresses the sciatic nerve. This stretch can be performed while standing or lying down and involves intricate movements such as bending the knee, moving the hip joint, and rotating the thigh internally and externally. Initially, stretches should be performed within the patient's comfort level, with general guidelines suggesting three sets of five to ten repetitions, three times a day¹⁵.

MATERIALS & METHODS

a. **Sampling Method:** Simple random sampling.

b. **Place of Study:** The study was conducted at the OPD of Sims College of Physiotherapy.

c. **Sampling Calculation:** A total of 30 participants were included, with 15 individuals in each group.

d. **Study Population:** The study involved subjects diagnosed with Piriformis syndrome.

e. **Treatment Duration:** The intervention lasted for 4 weeks.

1. Inclusion Criteria:

Only those subjects who meet the set guidelines can be chosen for the research.

- Age group between 30 -50 years old.
- Both males and females.
- Tenderness over the lower back, buttocks and hip joint.
- Radiating pain from the posterior thigh, calf and foot.
- Limitations in internal rotation ROM of the hip joint.

2. Exclusion Criteria:

- Age group below 30 & above 50 years.
- Inflammatory joints: hip, knee, ankle.
- Degenerative spine, hip, knee and ankle.
- Fracture and surgery of the spine, hip, knee and ankle.

Outcome Measures

Likert scale

LEFS (Lower extremity functional scale)

PROCEDURE

A randomised controlled study was conducted with a group of 30 subjects diagnosed with Piriformis syndrome, following the specified inclusion and exclusion criteria. Each participant underwent a physiotherapy assessment where pain intensity was evaluated using the Likert scale and functional capacity was assessed through the Lower Extremity Functional Scale (LEFS). The subjects were then divided into two groups: Group A and Group B, each consisting of 15 participants. Group A received treatment involving ultrasound therapy and piriformis muscle

stretching, whereas Group B was given no treatment. This division was done following approval from the institutional ethics committee and after collecting informed consent from all participants. Initial and final assessments were conducted using the Likert scale and LEFS to evaluate changes in pain intensity and functional status¹⁶.

Ultrasound Therapy:

The position of the patient was prone lying on the couch where pillows under the feet. Position of the therapist is in walk standing position. The therapist applies the aqua sonic gel to the treatment area for lubrication and to avoid friction i.e., at the affected area. now the therapist evenly spreads the aqua sonic gel to the treatment area and circularly moves the transducer head. therapeutic ultrasound with the intensity of 1.5w/cm², a frequency of 1 MHz for 10 mins is given in piriformis syndrome.

Stretching Therapy: To restore a pain-free range of motion, stretching exercises for the Piriformis muscle should be performed regularly. Initially, stretches should be done within the patient's tolerance, adhering to general starting guidelines of 3 sets of 5-10 repetitions, performed 3 times a day for one month. As the patient progresses, more advanced techniques such as the PNF (Proprioceptive Neuromuscular Facilitation) contract-relax technique can be introduced.

Some effective and simple stretches include:

- Sitting with one leg forward: Bend one leg forward and hold onto the ankle of your other leg, gently pulling it toward your chest.
- Lying face-down: Bend one knee underneath the belly region and gently lean towards the ground.
- Lying supine: Cross one leg over a knee and pull the other knee toward your abdomen.
- Crossing the affected leg over a straight leg: Bend the affected leg and cross it over the straight leg, gently pulling the crossed leg until a stretch is felt.

For home exercise prescriptions, it is crucial that the physical therapist ensure the patient understands how to perform each exercise correctly. Hot water fermentation should be applied before and after stretching to help relax the Piriformis muscle. The patient should perform these daily sessions for one month.

Cross-body piriformis stretch: Lie on your back and keep your feet straight; bend the knee of the injured leg upwards till it reaches your chest followed by holding its behind area with one of your hands; draping over an opposite shoulder the other hand whilst grabbing its ankle from below would also suffice thus creating more pressure at this part. Alternatively, title back these members sprigged beyond ankle doing the same work thereon depending on each tense curve that might occur around some joints during movement articulation active strain force may well be implicated plus some different factors can enhance this case even more ambitiously causing serious problems concerning the human health system. Do not force down your knee haphazardly against a flat surface even if it hurts terribly- just hold stretches. Return to the starting position after about thirty seconds and stop holding the stretch three times per set¹⁶.

Statistical Analysis

Statistical analysis was performed using GraphPad Prism software version 10.2.3. An unpaired t-test was performed to assess the statistical difference between the groups. To observe the impact of treatment before and after in the groups, the analysis was carried out using statistical tests. For the outcome measures, the Lower extremity functional scale and Likert scale were used. The statistical significance was set at $p < 0.0001$.

RESULT

The study compared the outcomes of two groups (Group A and Group B) using the Likert and LEAF scales before and after intervention.

On the Likert scale, Group A demonstrated a significant reduction in mean scores from 8.00 ± 0.85 in the pre-test to 5.67 ± 1.39 in the post-test ($t = 5.534$, $p < 0.0001$), indicating substantial improvement following the intervention. In contrast, Group B showed no change in scores (pre-test = 8.07 ± 0.88 ; post-test = 8.07 ± 0.88 ; $t = 0.000$, $p > 0.9999$), suggesting the absence of measurable progress. A post-intervention comparison between the groups revealed that Group A (5.67 ± 1.39) performed significantly better than Group B (8.07 ± 0.88), with $t = 5.622$ ($p < 0.001$). Similarly, on the LEAF scale, Group A showed a marked increase in mean scores from 21.87 ± 4.53 in the pre-test to $50.27 \pm$

5.12 in the post-test ($t = 16.08$, $p < 0.0001$), reflecting a highly significant improvement. Group B, however, exhibited no change in LEAF scores (pre-test = 21.87 ± 4.50 ; post-test = 21.87 ± 4.50 ; $t = 0.000$, $p > 0.9999$). Between-group comparison after treatment further confirmed that Group A (50.27 ± 5.12) outperformed Group B (21.87 ± 4.53), with a highly significant difference ($t = 16.08$, $p < 0.0001$). Overall, both scales consistently demonstrated that Group A achieved statistically significant improvements, whereas Group B showed no observable change, indicating that the intervention applied to Group A was considerably more effective than that of Group B.

Table 1: Analysis of mean scores of pre-tests and post-tests on pain with the Likert scale of groups A and B

TEST	MEAN	SD	T-VALUE	P-VALUE
LIKERT				
Likert Group A				
Pre-test	8.000	0.8452	5.534	<0.0001
Post-test	5.667	1.397		
Likert Group B				
Pre-test	8.067	0.8837	0.000	>0.9999
Post-test	8.067	0.8837		
Likert Group A&B				
Post A-test	5.667	1.397	5.622	<0.001
Post B-test	8.067	0.8837		

Table 2: Analysis of mean scores of pre-tests and post-tests on pain with Leaf scales of groups A and B

TEST	MEAN	SD	T-VALUE	P-VALUE
LEAF				
Leaf Group A				
Pre-test	21.87	4.533	16.08	<0.0001
Post-test	50.27	5.120		
Leaf Group B				
Pre-test	21.87	4.5	0.000	>0.9999
Post-test	21.87	4.5		
Leaf Group A&B				
Post A-test	50.27	5.120	16.08	<0.0001
Post B-test	21.87	4.533		

S.D.=standard deviation, Leaf =Lower extremity functional scale

DISCUSSION

A comparative analysis involving 30 individuals diagnosed with piriformis syndrome was conducted. They received treatment through ultrasound and stretching techniques. Group A (n=15) participants underwent both ultrasound and stretching therapy, while Group B (n=15) received no treatment. The findings of this research

indicate that both stretching and ultrasound therapy significantly enhance the condition of patients with piriformis syndrome. In sports medicine, consistent stretching and manual interventions, such as soft tissue mobilisation, often lead to a marked reduction or complete resolution of piriformis syndrome.

Piriformis syndrome is characterised by buttock pain linked to the piriformis muscle, which is not caused by spinal root compression. The goal of examination is to achieve an accurate diagnosis; in this context, radiographic imaging and neuroelectric assessments may be utilised for additional analysis to distinguish piriformis syndrome. Physiotherapy can effectively alleviate the pain associated with piriformis syndrome, either independently or in conjunction with medication, as a means of avoiding surgical interventions.

Heat and cold treatments are generally most beneficial when applied before physical therapy or home therapy sessions, as they can mitigate the discomfort linked to direct interventions on an irritated or tense piriformis muscle.

Piriformis syndrome, a variant of sciatic neuropathy, arises from the compression of the sciatic nerve by the piriformis muscle and can be categorised into two types: primary and secondary. The primary type stems from an inherent pathology originating within the piriformis muscle itself, such as myofascial pain or myositis ossificans due to trauma, followed by the secondary type is related to other causes of hip pain resulting from conditions affecting surrounding structures near the sciatic notch¹⁷.

Employing heat therapy, such as ultrasound, followed by gentle stretching of the piriformis muscle, proves effective in therapeutic approaches for piriformis syndrome. The penetration of ultrasound helps alleviate myofascial trigger points in the piriformis muscle, suggesting that ultrasound therapy can accurately address cases of piriformis syndrome. Conversely, physiotherapy that includes stretching the piriformis muscle aids in alleviating pain associated with this syndrome.

Stretching the piriformis muscle is a form of physiotherapy for patients diagnosed with piriformis muscle syndrome. This stretching is intended to lengthen the shortened piriformis muscle, which exerts pressure on the sciatic nerve. Piriformis stretch can be

performed in either a standing or prone position, such as knee flexion, hip articulation, and internal-external rotation of the thigh.

There is a notable difference in pain levels for the piriformis muscle observed in this study using the Likert scale before and after treatment, likely because conservative measures like ultrasound applications and stretching have been implemented for the piriformis condition, which relaxes tense piriformis muscles and potentially leads to reduced tension on the sciatic nerve.

The piriformis syndrome can result from muscle spasms, hypertrophy, or tenderness. An anatomical variation could lead to entrapment of the sciatic nerve and hip discomfort. The occurrence of piriformis syndrome in individuals with low back pain ranges from 5% to 36%. This condition is more prevalent in women than men, with a ratio of 6:1. It receives its nerve innervation from L5, S1-S2 branches and functions as both an external rotator and abductor of the thigh when flexed at an angle of 60 degrees. When inflamed, the piriformis muscle exerts pressure on the sciatic nerve, resulting in pain that radiates down the leg; this issue may intensify during walking, squatting, or when attempting to stand after prolonged sitting while operating an air compressor. Physiotherapy provides various treatment protocols, including ultrasound, which effectively alleviates pain by enhancing the Range of Motion assessed using the lower extremity functional scale (LEFS) in this research^{18,19}.

CONCLUSION

This study concludes that stretching and ultrasound effectively manage piriformis syndrome by gradually improving pain and increasing the joint range of motion

Declaration by Authors

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