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From Piriformis To Plantar Fascia: A Case Study On Functional Interdependence

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Abstract

Background*: Piriformis syndrome and plantar fasciitis are interconnected musculoskeletal conditions that demonstrate the principle of regional interdependence. Dysfunction in proximal muscles can lead to distal complications, requiring comprehensive rehabilitation approaches.*

Aim*: To present a case study demonstrating the rehabilitation process of a patient with piriformis syndrome progressing to plantar fasciitis, emphasizing the role of holistic physiotherapy.*

Objective: To investigate how proximal muscle dysfunction (piriformis syndrome) can lead to distal pathology (plantar fasciitis) through the lens of regional interdependence.

Hypothesis: Addressing piriformis-related dysfunction through targeted physiotherapy will result in improvement of plantar fasciitis symptoms.

Case Presentation: *A man of thirty-two years old arrived with sciatic-like symptoms due to piriformis syndrome, later developing plantar fasciitis over 1.5 years. Clinical evaluation identified tightness in the hamstrings, piriformis, and gastrosoleus muscles, along with weakness in the quadriceps and hip abductors. The physiotherapy intervention included therapeutic ultrasound, muscle energy techniques, and a structured program of stretching and strengthening exercises.*

Results*: Significant improvements were observed in pain levels quantified by the Visual Analogue Scale, hip mobility, & functional capabilities evaluated through the Lower Extremity Functional Scale (LEFS).*

Conclusion*: This case demonstrates the value of treating proximal muscle dysfunction in order to reduce distal consequences and the efficacy of a comprehensive physiotherapy strategy in the treatment of intricate musculoskeletal disorders.*

Keywords: *Physiotherapy management, Piriformis syndrome, Plantar fasciitis, Regional interdependence, Rehabilitation*

Background

The piriformis muscle, which is situated deep in the buttocks, can irritate or compress the sciatic nerve, resulting in piriformis syndrome. This can be caused by muscle tightness, injury, or prolonged sitting. People with this condition usually feel a deep ache in the buttock, often accompanied by a burning or shooting pain that travels down the back of the leg, similar to sciatica [1]. Plantar fasciitis arises from irritation or over stretching of the plantar fascia, a thick band of tissue that runs along the sole of the foot, where it attaches to the heel bone. This usually happens due to repetitive stress, like prolonged standing, excessive walking, or intense physical activity. The condition often causes sharp heel pain, especially with the first steps in the morning or after long rest periods [2].

Regional Interdependence refers to the concept that seems unrelated regions of the body can influence each other, particularly in the context of movement dysfunctions or musculoskeletal pain. Both **piriformis syndrome** and **plantar fasciitis** can be linked through this concept, as dysfunction in one

region (e.g., pelvis/hip or foot/ankle) can create compensatory patterns or stress in other areas of the kinetic chain. Functional interdependence is a physical therapy model that considers show the body works as a whole, rather than just individual parts.

A large body of musculoskeletal research (~60-70%) supports the concept of regional interdependence; often referencing how proximal dysfunctions can influence distal pathologies. There is limited specific evidence quantifying how many studies directly link plantar fasciitis to hamstring tightness as part of regional inter dependence. However, several studies have explored the relationship qualitatively.

Researchers have indicated that hamstring tightness can alter biomechanics, leading to compensatory movements that may strain the plantar fascia. Studies have explored interventions like hamstring stretching to improve symptoms of plantar fasciitis and found positive outcomes, suggesting a relationship between the two conditions. Any increase in the thickness of plantar fasciitis will be associated with decreased active knee extension angle [3].According to the study, hip-strengthening activities significantly reduced pain.

Case presentation

Patient Profile:

A man of thirty-two years old arrived at the outpatient physiotherapy unit in Shri Ram Dharmath Charitable Hospital, Faridabad, Haryana, India with an antalgic gait and complaints of sciatic-like pain persisting for the past 1.5years.Additionally, he developed plantar fasciitis after the onset of sciatic pain. The participant had previously received physiotherapy sessions for plantar fasciitis but reported no significant relief from symptoms.

Medical History and Initial Consultation:

The patient described the pain as initially tolerable, with intermittent exacerbations over time. However, the pain recently became unbearable, prompting him to seek physiotherapy. He had not undergone any prior physiotherapy treatment for his condition.

The patient also consulted an orthopaedic doctor, and radiological assessments were conducted during the diagnostic process. The findings were unremarkable, with no significant abnormalities observed.

Physiotherapy Assessment:

Key findings from the initial evaluation included:

- Pain and Tenderness: Noted in the mid-buttock region upon palpation.
- Weakness: quadriceps, hip abductors
- Tightness: hamstrings, piriformis, gastro soleus.
- Duration and Progression: Pain that progressively worsened over 1.5 years, becoming chronic.
- Symptoms and Functional Limitations: Sciatic-like pain affecting mobility and leading to the development of plantar fasciitis.
- Gait: Antalgic gait was observed, likely compensatory due to pain and dysfunction .

IMAGE 1: PLANTAR FASCITIS

IMAGE 2: PIRIFORMIS SYNDROME

TEST AND MEASUREMENTS

The patient underwent assessments at the beginning of the study (day1) and after the intervention at the 10th, 12th, and15th treatment sessions. **Hip joint range of motion** was measured using **goniometry**, a reliable and widely accepted tool in musculoskeletal assessments [7].A full circle goniometer (360º) was used to measure **plantar flexion**, **dorsi flexion** of the foot, and **hip abduction**, **extension**, and **internal rotation**.

Manual Muscle Testing (MMT) of the external rotators and hip abductors indicated baseline strength of **grade3**, in comparison to the unaffected limb, using the standard **Medical Research Council (MRC) scale** [8].

The **Lower Extremity Functional Scale (LEFS)** was used to evaluate the impact of buttock and heel pain on mobility and activities of daily living. The LEFS includes 20 items, with total scores ranging from 0 to 80—lower scores indicating greater disability. It is a reliable and responsive tool for a variety of lower limb conditions [9, 10].

Pain intensity was tracked using the **Visual Analog Scale (VAS)**, which is widely used in clinical settings due to its sensitivity and ease of use [11].

EXPERIMENTAL PROCEDURE

Thepatientparticipatedintreatmentandassessmentsover21daysusinga **single-subject A-B design**, involving four data collection points and16 treatment sessions. On **Day1 (Phase A)**, baseline data were collected. From **Day 2 (Phase B)** onward, the patient underwent daily physiotherapy for 16 sessions. Outcome measures were reassessed after every fourth session.

BASELINE PHASE (A)

After informed consent, the first visit included a detailed evaluation that lasted approximately 45–50 minutes. No therapeutic intervention was given during this phase.

TREATMENT PHASE (B)

Sixteen physiotherapy sessions were delivered over 20days, with each session lasting around 40 minutes. The treatment protocol was dynamically adjusted based on reductions in pain and improved hip range of motion.

- **Sessions 1–4**:

- **Therapeutic ultrasound** was applied to the gluteal region in prone position for 5 minutes, using a 1:4 pulsed mode, 0.5 W/cm2 intensity, and 1 MHz frequency. Ultrasound therapy is frequently employed in managing soft tissue conditions like piriformis syndrome due to its thermal and non-thermal effects [12].
- **Muscle Energy Technique (MET)** was used for piriformis tightness. The patient contracted the target muscle at~20% of maximum effort for 7–10 seconds, repeated twice per session. MET has demonstrated efficacy in increasing range of motion and reducing muscle tightness [13].
- **Interferential Therapy (IFT)** was administered in continuous mode for15minutes. IFT is effective in managing musculo skeletal pain by promoting circulation and reducing nociceptive input [14].

- **Sessions 4–8**:
  - The protocol included **static stretching** of the piriformis, calf, and hamstring muscles. Stretching these posterior chain muscles is known to alleviate symptoms linked to plantar fasciitis and piriformis syndrome by reducing myofascial tension [15].
- **Sessions 8–12**:
  - **Strengthening exercises** for the quadriceps and hip abductors were added, alongside the existing stretching routine. Proximal muscle strengthening is beneficial for improving lower limb biomechanics and reducing compensatory strain on distal structures.
- **Sessions 12–16**:
  - The final phase focused on enhancing flexibility and functional strength. The patient continued with stretching and strengthening exercises, aiming to stabilize improvements and reduce recurrence risk [16].

Physiotherapy intervention

INTERVENTIONPROGRAM	
Treatment	**Description**
1-4TREATMENTSESSIONS	
Ultrasound	**In a prone position, therapeutic ultrasound was administered to the gluteal region for duration of 5 minutes. The settings used included a pulse ratio of 1:4, 0.5W/cm² of intensity and 1MHz of frequency was applied.**
MET	**The patient starts with initial resistance. He uses his 20% strength and hold for10-20 sec.**
IFT	**Continuous mode for15mins**
4-8 TREATMENT SESSIONS	
Ultrasound	**In a prone position, therapeutic ultrasound was administered to the gluteal region for duration of 5 minutes. The settings used included a pulse ratio of 1:4, 0.5W/cm²of intensity and 1MHz of frequency.**
MET	**The patient starts with initial resistance. He uses his 20% strength and hold for 10-20sec.**
Stretching	**Piriformis, calf and hamstrings**
Strengthening	**Quadriceps, abductors**
IFT	**15mins**
Strengthening	**Quadriceps, abductors**
8-12TREATMENTSESSIONS	
Stretching	**Piriformis, Calf, and hamstrings**

MET	**Starting at the initial resistance point, the patient applies 20% of their strength, holds for 7–10 seconds, and completes two sets.**
Stretching	**Piriformis, calf, and hamstrings**

12-16 TREATMENT SESSIONS	
MET	**The patient starts at the point where they first feel resistance, applying around 20% of their strength, holding for 7-10 seconds, and repeating for 2sets.**
Strengthening	**Quadriceps, abductors**

OUTCOMEMEASURES

The analysis of the VAS, ROM, and LEFS data shows a decrease in variability from Phase A to Phase B, indicating more consistent improvement during the treatment phase. Changes in data points were also noted across different assessment days within Phase B, especially when compared to the initial values of this phase. The average data points from Phase A showed considerable changes in Phase B, highlighting significant improvements after starting the treatments. Additionally, a clear shift in trends was observed across all variables during Phase B, showing a faster rate of progress during the intervention (Table2).

The data was analyzed utilizing a bar chart to visually represent the outcomes of the techniques employed during the intervention phase. This method facilitated a clear comparison of the variables assessed,

allowingforaneffectiveevaluationoftheimpactoftheintervention.Bypresentingthedatainagraphical format, trends and changes in the outcome measures were easily identifiable, providing a comprehensive understanding of the intervention's efficacy.

TABLE 2: RESULTS OF THE BASELINE ASSESSMENT AND TREATMENT

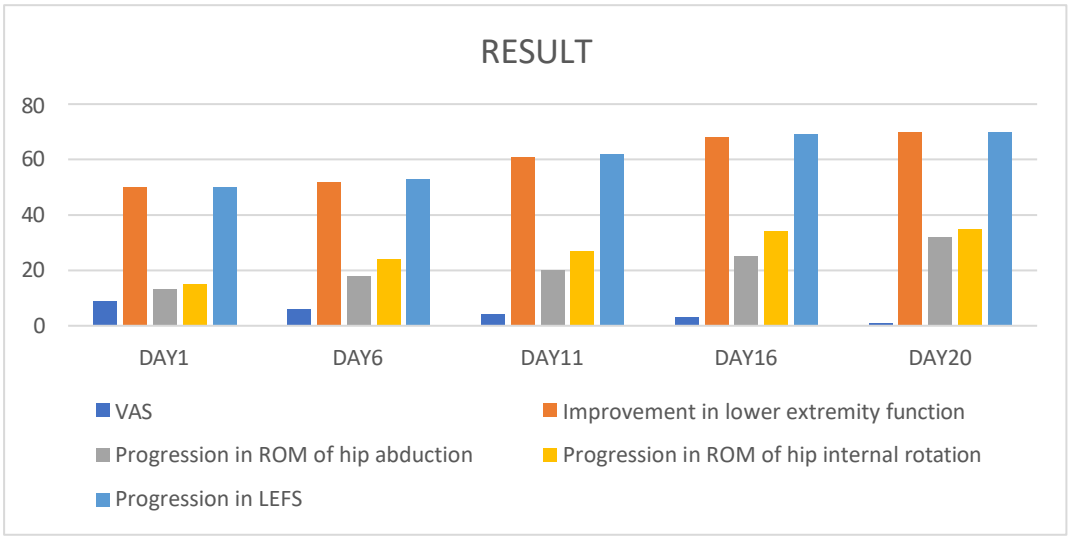
"Phase	**"Pain intensity"**	**"Goniometry(º)"**			**Function"**
		Hip		**Ankle**	
VAS	**ABD**	**IR**	**DF**	**PF**	**LEFS**
Phase A					
Day1	9	13	15	5	35	50
Mean	9	13	15	5	35	50
Phase B					
Day 6	6	18	23	8	35	54
Day 11	4	20	28	10	30	62
Day 16	3	26	34	10	30	68
Day 20	1	32	35	12	30	70
Mean	3.5	24	30	10	31.25	63.5

***VAS=Visual Analogue Scale**
***ABD=Abduction**
***IR=Internal Rotation**
***LEFS=Lower Extremity Function Scale**
***DF=Dorsi flexion**
***PF=Plantar Flexion**

Comparison of Objective Outcome Measures (Phase A vs Phase B)

Measure	**Phase A Mean (Day1)**	**Phase B Mean (Day20)**	**Improvement**
VAS (Pain Intensity)	**9**	**3.5**	**↓ 5.5**

Hip ABD(°)	**13**	**24**	**↑ 11**
Hip IR(°)	**15**	**30**	**↑ 15**
Ankle DF(°)	**5**	**10**	**↑ 5**
Ankle PF(°)	**35**	**31.25**	**↓ 3.75(↓)**
LEFS(Function)	**50**	**63.5**	**↑ 13.5**



DISCUSSION

This case study illustrates the concept of regional interdependence, where in dysfunction or impairments in one region of the body may influence symptoms in a distant, seemingly unrelated area. A32-year-old male presented with piriformis syndrome, which was later followed by symptoms consistent with plantar fasciitis. Upon initiating treatment focused on piriformis syndrome—specifically involving targeted stretching of the piriformis muscle and hamstrings—marked improvement was observed in both conditions.

Piriformis syndrome is frequently associated with tightness and irritation of the piriformis muscle, potentiallycompressingthesciaticnerveandproducingpainthatradiatesdowntheleg [3].In contrast, plantar fasciitis is characterized by inflammation and pain along the plantar fascia, commonly influenced by tension in the posterior kinetic chain, including the hamstrings and calf muscles [4]. In this patient, hamstring tightness appeared to be a critical biomechanical link between the two conditions. Excessive posterior chain tension may alter pelvic alignment, hip function, and foot biomechanics, thereby contributing to or exacerbating plantar fasciitis [5, 6].

The applied stretching interventions improved flexibility and functional movement patterns, alleviating symptoms of piriformis syndrome while also reducing mechanical stress on the plantar fascia. This supports the clinical relevance of addressing proximal dysfunctions to manage distal pathologies. Notably, even without initially targeting the plantar fascia, the patient experienced significant relief of plantar fasciitis symptoms, reinforcing the hypothesis that treating underlying dysfunctions can produce therapeutic effects beyond the site of intervention.

This clinical outcome aligns with the literature supporting regional interdependence as a rehabilitation model. For example, Lee et al. reported that hip muscle strengthening significantly improved symptoms of plantar fasciitis by altering proximal mechanics [1]. Additionally, Hortz et al. emphasized the benefits of multi segmental interventions in managing plantar foot pain, advocating for treatment strategies that consider the kinetic chain as a whole [2].

The patient was advised to follow a structured home exercise regimen aimed at maintaining hip mobility, strengthening, and foot posture correction. A follow-up conducted four weeks post-treatment revealed no symptom recurrence and are turn to normal daily activities. These findings suggest that when combined with adherence to a home care program, the effects of proximal interventions may be sustained overtime. However, further long-term monitoring and larger-scale studies are necessary to

validate these results and fully understand the implications of regional interdependence in clinical practice. This case thus demonstrate show addressing interrelated Musculo skeletal regions canyield meaning ful improvements in recovery and functional mobility.

Impact and Practical Application

This case highlights the importance of addressing interconnected musculoskeletal dysfunctions rather than focusing solely on the site of pain. By targeting proximal impairments—in this case, piriformis tightness—the intervention led to significant improvement in a distal condition, plantar fasciitis. These findings support a broader, kinetic chain-based approach in physiotherapy, encouraging clinicians to assess movement patterns and joint interactions more holistically.

The treatment strategy used in this case is practical, cost-effective, and easily adaptable in outpatient or home-based settings. The inclusion of a follow-up and home exercise program further demonstrates show clinical gains can be sustained with minimal resources. This approach has the potential to influence both clinical decision-making and future research on regionally interconnected dysfunctions.

LIMITATIONS

The study's main limitation is its focus on a single patient, limiting generalizability. The absence of a control group, reliance on subjective measures like the VAS, and short-term follow-up restrict validation and understanding of long-term effects. The self-designed protocol lacks comparison to standardized methods, and contributing factors like plantar fasciitis or systemic influences are not thoroughly explored. The lack of randomized controlled trials further weakens the findings**.** Future research should include long-term follow-upto determine the sustainability of treatment outcomes.

CONCLUSION

This case report emphasizes the concept of regional interdependence, where treating a proximal dysfunction—piriformis syndrome—contributed to notable improvements in a distal condition, plantar fasciitis. The patient experienced a substantial decrease in pain levels (VAS score reduced from 9 to1) and a meaningful enhancement in functional ability (LEFS score improved from 50 to70).Additionally, improvements in hip range of motion and ankle mobility were observed. These findings highlight the importance of considering the entire kinetic chain when assessing and managing musculoskeletal issues. A comprehensive, system-based approach can lead to better clinical outcomes, especially in cases where localized treatment alone may be insufficient.

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Conflicts of Interest: None

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