National University of Medical Sciences (NUMSS)

Piriformis Syndrome

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Chapter 1: Piriformis Muscle

The piriformis muscle, a key player in lower body movement and stability, holds a significant anatomical and functional role in the human body. Positioned deep within the gluteal region, this flat, band-like muscle contributes to various actions, from stabilizing the hip joint to facilitating crucial movements like walking and rotation of the lower limb.

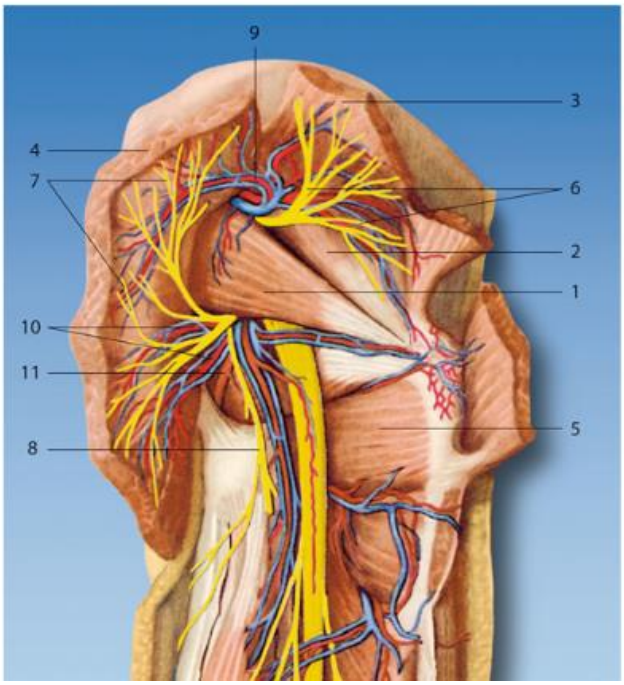

Figure 1: The piriformis muscle (1) and neighboring muscles, nerves, and vessels: 2, gluteus minimus; 3, gluteus medius; 4, gluteus maximus; 5, quadratus femoris; 6, superior gluteal nerve; 7, inferior gluteal nerve; 8. posterior cutaneous femoral nerve; 9, superior gluteal artery: 16 10, inferior gluteal artery and vein; 11, internal pudendal artery'", adopted from (2).

1.1 Anatomy of the Piriformis Muscle

The piriformis muscle originates from multiple anatomical landmarks, including the anterior surface of the sacrum, the gluteal region of the spine, the superior gluteal surface of the ilium, the adjacent sacroiliac joint capsule, and occasionally, the sacrotuberous ligament. Its unique origin points contribute to its complex attachment and function.

The muscle courses parallel to the posterior margin of the gluteus medius and beneath the gluteus maximus, illustrating its deep-seated position within the gluteal region. As it exits the pelvis through the greater sciatic notch, it interacts with neighboring structures, such as the obturator internus and inferior and superior gemelli muscles. The tendons of these muscles merge before inserting onto the superior aspect of the femur's greater trochanter (2).

1.2 Function of the Piriformis Muscle

The piriformis muscle serves as one of the primary lateral rotators of the hip joint, working in conjunction with other muscles like the gemelli, quadratus femoris, and obturator internus and externus. Its main actions include externally rotating the thigh during hip extension and abducting the thigh during hip flexion. These movements are crucial for maintaining balance and stability, particularly during activities

like walking, where femoral abduction helps distribute body weight effectively, reducing the risk of falls (3).

1.3 Clinical Significance and Variations

Beyond its role in movement, the piriformis muscle holds clinical significance due to its spatial relationship with nerves and blood vessels traversing the gluteal region. Variations in the course of the sciatic nerve, such as passing through or above the piriformis muscle, highlight the anatomical complexity and potential for nerve entrapment syndromes like piriformis syndrome. Piriformis syndrome, characterized by compression or irritation of the sciatic nerve by the piriformis muscle, can result in symptoms ranging from buttock pain to radiating pain down the back of the leg. Understanding the anatomical variations and functional aspects of the piriformis muscle is crucial for diagnosing and managing such conditions effectively (4).

The piriformis muscle is supplied by the superior gluteal, inferior gluteal, and internal pudendal arteries, all branches of the internal iliac artery. It is innervated by S1 and S2 nerves. The superior gluteal nerve exits the pelvis above the muscle, while the inferior gluteal nerve exits below it.

The piriformis muscle is located partly on the back wall of the lesser pelvis and partly at the back of the hip joint. It originates from different locations in the pelvis, passes through the greater sciatic notch, and attaches to the upper aspect of the greater trochanter. The piriformis muscle is closely related to the gluteus medius, gluteus maximus, obturator internus, and gemelli muscles.

Chapter 2: Understanding Piriformis Syndrome: Causes, Symptoms, Diagnosis, and Management

Piriformis syndrome is a condition characterized by compression or irritation of the sciatic nerve near the piriformis muscle and presents a complex clinical challenge often misdiagnosed or unrecognized in medical settings (5).

2.1 Causes and Types of Piriformis Syndrome

The etiology of piriformis syndrome can vary, with macrotrauma to the buttocks being a typical trigger. Overuse of the piriformis muscle, as seen in long-distance walking or running with poor postural mechanics, can lead to muscle spasm and soft tissue inflammation, culminating in nerve compression. Additionally, repetitive trauma from sitting on hard surfaces, known as wallet neuritis, can contribute to the development of this syndrome (5).

Piriformis syndrome manifests in two primary forms:

Primary piriformis syndrome has an anatomical cause, which can be due to variations such as a split piriformis muscle, split sciatic nerve or an anomalous sciatic nerve path. However, this type of syndrome is less common, with fewer than 15% of cases having a primary cause. Additionally, there is little evidence to support whether or not an anomaly of the sciatic nerve causes piriformis syndrome or other types of sciatica, so it may not be as important to the pathophysiology of piriformis syndrome as previously thought (2, 5, 6).

On the other hand, secondary piriformis syndrome occurs as a result of a precipitating cause, including macrotrauma, microtrauma, ischaemic mass effect, and local ischaemia. Macrotrauma is the most common cause, accounting for 50% of cases, and is usually caused by inflammation of soft tissue, muscle spasms or both, which result in nerve compression. Muscle spasms of the piriformis muscle can be caused by direct trauma, post-surgical injury, lumbar and sacroiliac joint pathologies or overuse, while shortening of the muscle due to altered biomechanics of the lower limb, lower back and pelvic regions can also cause piriformis syndrome. Dysfunction of the piriformis muscle can cause various signs and symptoms, such as pain in the sciatic nerve distribution, including the gluteal area, posterior thigh, posterior leg and lateral aspect of the foot. Microtrauma can result from overuse of the piriformis muscle, such as in long-distance walking or running or by direct compression, which can cause "wallet neuritis", a repetitive trauma caused by sitting on hard surfaces (5, 7).

2.2 Symptoms and Clinical Presentation

The clinical presentation of piriformis syndrome encompasses a spectrum of signs and symptoms, often overlapping with those of other lower back and hip pathologies. Patients typically complain of chronic pain in the buttocks, which may radiate to the lower leg and worsen with activities such as walking, squatting, or prolonged sitting. This pain can mimic lumbar back pain, complicating diagnosis(5, 7).

One of the hallmark symptoms is a dull ache in the buttock, accompanied by sciatica-like pain down the back of the thigh, calf, and foot. The pain tends to exacerbate after prolonged sitting or walking and may improve with lying down. Other common complaints include difficulty walking, especially with antalgic gait or foot drop, numbness in the foot, weakness in the affected lower extremity, and pain with bowel movements. Women may experience dyspareunia, while men may feel pain in the scrotum. Additionally, patients may report tenderness over the buttock region, particularly at the muscle attachments on the sacrum and medial greater trochanter(5, 8).

Clinical examination aids in the diagnosis of piriformis syndrome. Various tests such as the Pace test, Freiberg test, Beatty maneuver, and palpation for piriformis muscle spasm help elicit symptoms. Patients may demonstrate signs of muscle shortening, difficulty sitting due to buttock pain, or a splayed foot on the affected side when supine. Furthermore, signs such as positive Lasegue sign, limited medial rotation of the ipsilateral lower extremity, or gluteal atrophy in chronic cases provide additional clues(9-12).

2.3 Differential Diagnosis

Piriformis syndrome can be easily mistaken for other common somatic dysfunctions such as thrombosis of the iliac vein, trochanteric bursitis, painful vascular compression syndrome of the sciatic nerve caused by gluteal varicosities, herniated intervertebral disc, post-laminectomy syndrome or coccygodynia, posterior facet syndrome at L4-5 or L5-S1, unrecognized pelvic fractures, lumbar osteochondrosis, undiagnosed renal stones, lumbosacral radiculopathies, osteoarthritis (lumbosacral spine), sacroiliac joint syndrome, degenerative disc disease, compression fractures, intra-articular pathology in the hip joint such as labral tears and femoro-acetabular impingement (FAI), lumbar spinal stenosis, tumors, cysts, gynecological conditions, diseases such as appendicitis, pyelitis, hypernephroma, uterine disorders, prostate disorders, and malignancies in pelvic viscera. Additionally, dysfunction, lesion, and inflammation of the sacroiliac joint, pseudoaneurysm in the inferior gluteal artery following gynecological surgery, sacroiliitis, and psychogenic disorders such as physical fatigue, depression, and frustration can also be mistaken for piriformis syndrome (5, 8, 13).

2.4 Diagnosis of the Piriformis Syndrome

2.4.1 Physical examination:

To arrive at an accurate diagnosis, it is crucial to conduct a comprehensive neurological history and physical examination of the patient. The physical examination should involve the following steps:

- An osteopathic structural examination, which should focus on the lumbar spine, pelvis, and sacrum while also taking into account any discrepancies in leg length.
- Diagnostic tests.
- Testing of deep-tendon reflexes, strength, and sensory abilities (6).

Orthopedic tests, such as the Lasègue sign, Freiberg’s test, and Pace sign, provide additional diagnostic insights.

2.4.1.1 Lasègue test / Straight Leg Raise Test:

Involves the patient experiencing buttock and leg pain during passive straight leg raise by the examiner. Localized pain when pressure is applied over the piriformis muscle and its tendon, especially when the hip is flexed at 90 degrees and the knee is extended(14).

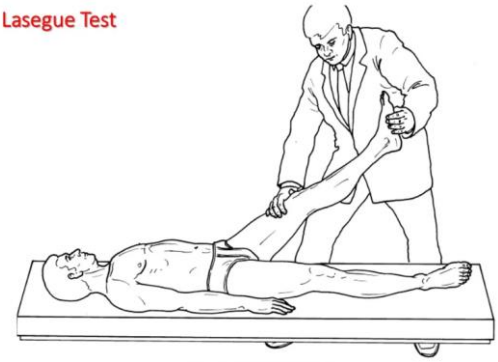

Figure 2: Lasègue test / Straight Leg Raise Test

Adapted from https://orthofixar.com/special-test/lasegue-test/

2.4.1.2 Beatty's Maneuver:

Active test involving elevation of the flexed leg on the painful side while the patient is lying on the asymptomatic side.
Abduction causes deep buttock pain in patients with piriformis syndrome.

2.4.1.3 Freiberg Sign:

Involves pain and weakness on passive forced internal rotation of the hip in the supine position. Pain is thought to result from passive stretching of the piriformis muscle and pressure on the sciatic nerve at the sacrospinous ligament(15).

2.4.1.4 Pace's sign:

Pace's sign consists of pain and weakness with resisted abduction and external rotation of the hip in a sitting position. A positive test occurs in 46.5% of patients with piriformis syndrome (figure 3) (11, 14).

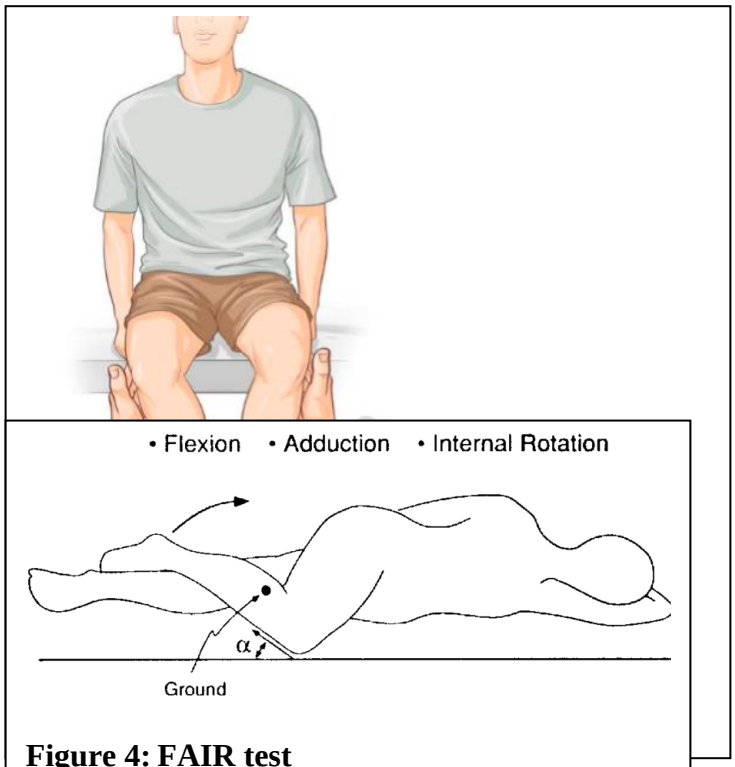

Figure 4: FAIR test

Adapted from (1).

2.4.1.5 FAIR Test (Flexion, Adduction, and Internal Rotation):

Involves painful flexion-adduction-internal rotation.

Performed with the patient in a lateral recumbent position, hip flexed to 60 degrees, knee flexed to 60-90 degrees. The examiner internally rotates and adducts the hip by applying downward pressure to the knee(1, 2, 13).

2.4.2 Imaging and other modalities

The diagnosis of piriformis syndrome remains contentious, largely due to the limited scientific evidence regarding specific diagnostic tests. Physicians debate its prevalence, with concerns of both under and over-diagnosis. While clinical findings often suffice for diagnosis, several tests play a role in confirming the syndrome.

Magnetic resonance neurography (MRI) is a valuable tool that detects inflammation in the sciatic nerve, aiding in diagnosis. Another significant test is the Flexion, Adduction, and Internal Rotation (FAIR) test, which compresses the sciatic nerve and stretches the piriformis muscle, measuring delays in nerve signals.

Neurophysiological testing, including electromyography (EMG), helps differentiate piriformis syndrome from intervertebral disc herniation. Additionally, MRI assists in ruling out disc and vertebral conditions by assessing enlargement of the piriformis muscle.

While no single test definitively confirms piriformis syndrome, a combination of clinical evaluation and diagnostic tests enhances diagnostic accuracy, facilitating appropriate management strategies(3, 9, 13, 16).

Chapter 3: Treatment for Piriformis Syndrome

3.1 Conservative Treatment

Pharmacological agents are commonly used in the initial management of piriformis syndrome. Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) are effective in reducing inflammation and pain and are recommended for short-term use. Muscle relaxants help alleviate muscle spasms and improve pain, also prescribed for short-term relief. Neuropathic pain medication is utilized when nerve pain is significant (17).

Physical therapy plays a crucial role, incorporating stretching exercises focused on the piriformis muscle to reduce tension and strengthening exercises targeting the abductor and adductor muscles to balance muscle strength. Manual techniques such as muscle stretches, Gebauer's spray and stretch technique, soft tissue manipulation, myofascial release, muscle energy techniques, and thrust techniques are also beneficial.

Lifestyle modifications are essential, including rest and activity modification to avoid activities that exacerbate symptoms. Ice and heat application can help manage pain and inflammation. Psychotherapy, particularly pain management strategies like cognitive-behavioral therapy (CBT), and other psychological approaches can assist in managing chronic pain (9).

3.2 Invasive Procedures

Injections of local anesthetics, steroids, and botulinum toxin can serve both diagnostic and therapeutic purposes, with ultrasound-guided injections preferred for their accuracy. Prolotherapy, which involves injecting an irritating solution to strengthen weakened connective tissue, has limited research on its efficacy and carries a common risk of infection.

3.2.1 Surgical Interventions

Surgical interventions are considered when conservative treatments fail and symptoms become severe and disabling. Conditions such as abscesses, neoplasms, hematoma, or vascular compression of the sciatic nerve necessitate surgical intervention. The procedure typically involves the surgical release of the piriformis tendon (tenotomy) to relieve pressure on the nerve, often providing immediate pain relief. Postoperative management includes partial weight-bearing with crutches for two weeks and unrestricted range of motion exercises (9).

3.2.2 Advanced Considerations

The obturator internus muscle should be considered if other causes of sciatic pain are ruled out. Diagnosis involves ruling out other potential causes of sciatic pain. Surgical release may be required if conservative treatments fail, providing both short- and long-term pain relief.

3.3 Additional Therapeutic Options

Acupuncture may be beneficial if manual treatments do not provide adequate relief. Trigger point injections with lidocaine hydrochloride, steroids, or botulinum toxin type A (BTX-A) can be used for pain management.

3.4 Indirect Osteopathic Manipulative Techniques

Osteopaths have a wide array of treatment techniques at their disposal, and selecting the appropriate methods to address specific conditions can significantly enhance patient outcomes. For piriformis syndrome, indirect osteopathic manipulative techniques (OMT) are particularly beneficial in reducing muscle tension and alleviating symptoms. The two most widely used indirect techniques are the counterstrain technique and facilitated positional release.

3.4.1 Counterstrain Technique

The counterstrain technique is designed to alleviate muscle tension and tenderness in the piriformis muscle through precise positioning and gentle pressure.

- **Patient Positioning**: The patient lies prone with the affected side at the edge of the examination table. The osteopathic physician brings the patient's affected leg over the table, placing the hip and knee into flexion, abduction, and external rotation. This position aims to reduce tenderness in the piriformis muscle.
- **Pressure Application**: The physician applies pressure to one of three specific tender points: the mid-pole sacrum, the piriformis muscle, or the posteromedial trochanter. Pressure is maintained for 90 seconds.
- **Key Considerations**: It is crucial that the patient remains passive during the repositioning of the leg back onto the table to avoid canceling out the therapeutic effects. After repositioning, the physician rechecks the piriformis muscle for tenderness to assess the effectiveness of the treatment (figure 2).

3.4.2 Facilitated Positional Release (FPR)

Facilitated positional release is another effective technique for quickly reducing muscle tension in the piriformis.

- **Patient Positioning**: The patient is positioned similarly to the counterstrain technique, lying prone with the affected side at the edge of the table. The hip and knee are flexed, and the hip is abducted and externally rotated.
- **Compression and Pressure**: The physician adds compression through the long axis of the femur from the knee towards the sciatic notch, further shortening the piriformis muscle. Pressure is applied to the muscle for a brief period of 3-5 seconds.

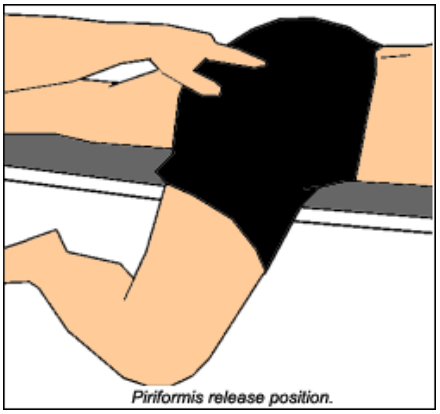

Figure 5: Piriformis release position.

Adapted from https://dynamicchiropractic.com/article/9223-strain-counterstrain

- **Key Considerations**: Like the counterstrain technique, the patient must not engage their muscles while their leg is repositioned back onto the table to ensure the effectiveness of the treatment. The physician rechecks the piriformis muscle for tenderness after repositioning.

3.5 Direct Osteopathic Manipulative Treatment (OMT) Techniques

Direct osteopathic manipulative treatment (OMT) techniques are integral in managing piriformis syndrome, a condition marked by spasm of the piriformis muscle and associated dysfunction in the sacrum and pelvis. These techniques can be either active, requiring patient participation, or passive, performed solely by the practitioner. Here are the primary direct OMT techniques used in treating piriformis syndrome:

3.5.1 Muscle Energy Technique (MET)

- **Purpose**: MET is employed to reduce the spasm in the piriformis muscle and address associated dysfunctions in the sacrum and pelvis.
- **Procedure**: This technique involves the patient actively using their muscles upon request, from a precisely controlled position, in a specific direction, and against a distinctly executed counterforce. The key to its effectiveness lies in the patient's understanding of the required amount and direction of force. The patient contracts the muscle gently against resistance, followed by a period of relaxation and stretching. This process helps in lengthening the muscle and reducing spasm.

3.5.2 Articulatory Technique

- **Purpose**: This technique aims to increase the range of motion in joints that have reached a restrictive barrier.
- **Procedure**: The practitioner moves the joint through its full range of motion in a repetitive manner, advancing and retreating towards the restrictive barrier. This is done until there is a noticeable improvement in mobility. Articulatory techniques can be particularly useful for patients with joint restrictions, but care must be taken if osteoarthritis is present due to potential pain.

3.5.3 Still Technique

- **Purpose**: The Still technique is designed to release joint restrictions and muscle tension by combining both indirect and direct methods.
- **Procedure**: Initially, the joint is positioned away from the restrictive barrier into a position of ease and relaxation. With the patient passive and relaxed, the practitioner applies compression or traction. The joint is then moved in an arching motion towards the restrictive barrier. This gentle approach helps in relieving restrictions and is suitable for patients who might not tolerate more forceful techniques.

3.5.4 High Velocity/Low Amplitude (HVLA) Technique

- **Purpose**: HVLA is used to correct somatic dysfunctions, particularly in the sacrum and pelvis, which are often associated with piriformis syndrome.
- **Procedure**: This technique involves a quick, precise thrust of low amplitude but high velocity to move a joint through its restrictive barrier. The HVLA technique is effective in realigning joints and relieving muscle tension. However, it must be performed cautiously, especially in patients with conditions such as osteoporosis, where the risk of fracture is higher (1).

3.6 Physical Therapy Management

Piriformis syndrome can be effectively managed through various non-invasive treatments. Physical therapy, in particular, plays a crucial role in alleviating symptoms and improving function.

Physical Therapy Interventions include the followings:

3.6.1 Ultrasound Therapy:

- **Parameters:** 2.0-2.5 W/cm², for 10-14 minutes.
- **Application:** Apply ultrasound gel longitudinally along the piriformis muscle from the conjoint tendon to the lateral edge of the greater sciatic foramen.
- **Position:** Patient in contralateral decubitus and FAIR (Flexed, Adducted, Internally Rotated) position.

3.6.2 Thermal Therapy:

- **Hot Packs or Cold Spray:** Apply for 10 minutes before stretching to decrease pain and prepare the muscle for stretching.

3.6.3 Piriformis Stretching:

- **Manual Stretch:** Apply tangential pressure toward the ipsilateral shoulder, avoiding downward pressure to prevent sciatic nerve compression.
- **FAIR Position Stretch:** Patient lies supine with the hip flexed, adducted, and internally rotated. The patient then brings the foot of the involved side across and over the knee of the uninvolved leg. Enhance the stretch with muscle-energy technique: patient abducts limb against light resistance for 5-7 seconds, repeated 5-7 times.

3.6.4 Myofascial Release:

- Target lumbosacral paraspinal muscles to relieve tension.

3.6.5 Functional Exercises:

- **Hip Strengthening Program:** Focus on strengthening hip extensors, abductors, and external rotators to correct faulty movement patterns and reduce piriformis muscle workload.
- **Exercises:** Include McKenzie exercises and other functional movements aimed at re-educating movement patterns and strengthening weak gluteal muscles.

3.6.6 Lifestyle Modifications:

- Avoid prolonged sitting; stand and walk every 20 minutes.
- Make frequent stops to stand and stretch when driving.
- Avoid trauma to the gluteal region and other activities that may aggravate symptoms.
- Daily stretching is recommended to prevent recurrence.(15)

Home Stretches/Exercises include the following:

- **Stretches:**

3.6.7 Glute Stretch:

- Lie on your back with both feet flat on the floor and both knees bent.
- Pull the right knee up to the chest, grasp the knee with the left hand, and pull it towards the left shoulder. Hold for 5-30 seconds. Repeat on the other side.

3.6.8 Piriformis Stretch:

- Lie on your back with both feet flat on the floor and both knees bent.
- Rest the ankle of the right leg over the knee of the left leg. Pull the left thigh toward the chest and hold the stretch for 5-30 seconds. Repeat on the other side(7).

Start Position **End Position**

Seated Piriformis Stretch with Trunk Bend

Adapted from https://protailored.com/piriformis-syndrome/

- **Exercises:**

3.6.9 Side Plank:

- Perform side planks to strengthen the lateral muscles of the abdomen and hip.

3.6.10 Clam Exercise:

- Lie on your side with hips and knees bent. Open and close the top knee like a clam shell to strengthen hip abductors.

3.6.11 Prone Hip Extension with Bent Leg:

- Lie prone and lift one leg with the knee bent, focusing on engaging the gluteal muscles. Repeat for both legs.

3.6.12 Knee Bends:

- Perform knee bends with up to 6 repetitions every few hours.

3.6.13 Hip Bicycle:

- Lie flat on your back, raise the hips with your hands, and pedal your legs as if riding a bicycle.

3.6.14 Standing Rotations:

- Rotate side to side while standing with arms relaxed for 1 minute every few hours.

3.6.15 Rolling Side to Side:

- While lying on each side, roll with flexion and extension of the knees.

3.6.16 Warm Bath:

- Take a warm bath to relax the muscles and reduce tension.

By following these physical therapy interventions and home exercises, patients can achieve significant improvements in pain relief, muscle strength, and overall function, thereby effectively managing piriformis syndrome(5).

Chapter 4: Conclusion

Piriformis syndrome is a complex and often misunderstood condition, primarily characterized by persistent and radiating pain in the lower back and buttocks due to sciatic nerve compression. Proper diagnosis is essential and requires a comprehensive neurological history and physical assessment, including specialized tests and radiographic studies to rule out other pathologies. Osteopathic manipulative treatment (OMT) provides a valuable nonpharmacologic therapy, with both indirect techniques like counterstrain and facilitated positional release, and direct techniques like muscle energy and high-velocity low-amplitude manipulation proving effective in reducing muscle tension, alleviating pain, and improving functional mobility. Patient education on proper gait and biomechanics, along with a holistic and interdisciplinary approach, enhances recovery and quality of life. However, significant gaps in knowledge regarding epidemiologic factors, risk factors, and optimal treatments for piriformis syndrome highlight the need for further research to improve patient care and outcomes.

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