



# Looking beyond Piriformis Syndrome: Is It Really the Piriformis?

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Piriformis syndrome is a common differential diagnosis related to sciatica. The following review provides a concise synopsis of the diagnosis, management, history, and alternatives to diagnosis of piriformis syndrome. A search of the literature for research articles related to piriformis syndrome and associated differential diagnosis of sciatica was conducted. A thorough review of the included articles found that the condition known as piriformis syndrome is over-diagnosed and that potential anatomic and biomechanical variations originating in the pelvic region might be related to the complaint of sciatica. The criteria for diagnosis are based on findings from both physical examination and radio imaging. Piriformis syndrome resembles a variety of clinical conditions; therefore, conduct of future studies should include development of a validated method for evaluation as well as clinical criteria for diagnosis of piriformis syndrome.

**Key Words:** Piriformis syndrome, Sciatica, Pelvis, Differential diagnosis

## INTRODUCTION

Due to its anatomical and biomechanical features, the piriformis muscle has important clinical significance in the gluteal region. Insertion of the piriformis muscle occurs through the anterior portion of the sacrum by three fleshy digitations, and from the margin of the greater sciatic notch

at the superior aspect along with the sacrotuberous ligament and sacroiliac joint capsule<sup>1</sup>). It exits the pelvis from the greater sciatic foramen and is attaches onto the greater trochanter of the femur. Piriformis syndrome (PS), reported in 1947 by Robinson<sup>2</sup>, is a common condition associated with this muscle. The condition usually arises as a result of the proximity of the piriformis muscle to the sciatica nerve, which causes irritation of the nerve (the nerve travels beneath this muscle in the gluteal region); increased pain in the buttocks and referred pain along the sciatic nerve are typically known as sciatica<sup>3</sup>). The proposed aetiology for PS comprises of muscle contracture or spasm due to possible trauma, overuse, and hypertrophy; other factors include scarring of the sciatic nerve or piriformis muscle<sup>4</sup>). Although little is known about the epidemiology of PS, it has been reported in approximately 0.3-0.6% of cases involving either lower back pain or posterior thigh pain. Approximately 2.4 million cases of this syndrome are recorded annually with an incidence of 40 million cases reported so far worldwide<sup>5</sup>).

As a result of recent advancements, PS has become a controversial topic of discussion among researchers and clini-

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cians. With the addition of literature reporting on the important characteristics of the syndrome, we seek to present a perspective regarding its diagnosis and ground value to clinicians through conduct of this review.

## DIAGNOSIS AND MANAGEMENT OF THE SYNDROME

Diagnosis of PS is usually based on symptoms and physical examination. Other advanced tests such as radio-imaging (magnetic resonance imaging [MRI], X-rays, ultrasonography) and nerve conduction tests can also be performed in order to obtain an accurate representation of the clinical features<sup>3</sup>.

Buttock pain during hip flexion combined with either active external rotation of the hip or passive internal rotation of the hip is usually detected during physical examination<sup>6</sup>. Restricted external rotation of the hip and tightness of the lumbosacral muscles have also been observed during biomechanical assessment<sup>7</sup>. A set of clinical symptoms including buttock pain, palpatory pain over the greater sciatic notch, increased pain during the manoeuvre to provoke tension in the piriformis muscle (Freiberg manoeuvre, Pace and Nagle test, Beatty manoeuvre, and flexion abduction internal rotation [FAIR] hip position), and aggravation of pain while in a seated position can be helpful in the diagnosis<sup>8</sup>. Due to the lack of validated and reliable diagnostic tests, the syndrome is often considered as a diagnosis of exclusion after other possible causes have been ruled out<sup>9</sup>.

Management includes the first phase of treatment with implementation of a regimen of stretching exercises, deep transverse friction massage, and neuromuscular therapy such as the Proprioceptive neuromuscular facilitation technique, etc. Injection of corticosteroids into the piriformis is a potential option in cases involving persistent pain<sup>10</sup>. A recent study reported the beneficial use of botulinum toxin type B injection in management of pain<sup>11</sup>. Surgical exploration may become necessary in rare cases; however, complications occurring after such invasive management could be worse than conservative treatment, thus explorative surgery should be the last option<sup>3</sup>. Other options for treatment include ultrasound-guided dry needling, regimen for strengthening hip muscles, and surgical resection of the piriformis muscle. However, there is no gold standard approach or protocol for management of PS<sup>12-14</sup>.

## THE EVOLUTION OF PS

Evidence regarding the persistence of PS as a potential

entrapment myth or truth is conflicting. In 1928, according to Yeoman, there was a lack of focus on the piriformis muscle for the complaint of sciatica<sup>15</sup>. Subsequently, in 1934, by comparing the anatomy of scalenus anticus and the exit of the brachial plexus under the Scalenus anticus muscle, Freiberg and Vinke proposed possible compression of the sciatic nerve by this muscle<sup>16</sup>.

Later, when Mixter and Barr<sup>17</sup> reported disc herniation as a potential cause of sciatica, PS was no longer regarded as a likely cause of sciatica. However, few patients complained of leg pain, without any objective neurological deficits or disc herniation, led to the diagnosis of PS in clinical practice once again<sup>17</sup>. Filler et al.<sup>18</sup> recently revitalized the diagnosis by facilitating surgical treatment using a combination of MRI findings and anaesthesia blocks delivered using computer-assisted guidance. He reported that asymmetry of the piriformis muscle was observed in patients who presented with PS (specificity 66% and sensitivity 46%)<sup>18</sup>. Fishman and Zybert<sup>19</sup> reported an analysis which used a test that demonstrated damage to the sciatic nerve in the context of PS. High-reliability evidence for PS was reported from three major categories of data, including magnetic resonance neurography diagnostic imaging, open magnetic resonance-guided injection studies, and treatment outcome studies<sup>20</sup>.

As a result of these fragments of evidence based on clinical presentation, anatomy, and radio-imaging, PS became an acceptable diagnosis for a non-discogenic cause of sciatica. However, the piriformis muscle is not the only problem.

## SYNDROMES RESEMBLING PS

The fact that the piriformis muscle is solely responsible for entrapment of the sciatic nerve was not established in the literature until the present date. Other muscles such as the obturator internus and Gemelli complex might also be potential causes of neural compression (deep gluteal syndrome)<sup>6</sup>. Buttock pain and pain in the hamstring region can also indicate entrapment of gluteal nerves like posterior cutaneous nerve of the thigh rather than the sciatic nerve alone<sup>6</sup>. Entrapment of the sciatic nerve can also occur in the lower ischial tunnel adjoining the hamstring attachment or quadratus femoris muscle. In addition, compression of the sciatic nerve can also be caused by fibrous bands<sup>18</sup>. A sciatic nerve sandwiched between the two muscles known as Gemelli and piriformis (scissor-like effect) was discovered by cadaveric dissection. In addition, better results were obtained in such cases through integrated management of

both muscles<sup>4</sup>. Meknas et al.<sup>21</sup> reported on the intraoperative discovery of the internal obturator muscle impinging the sciatic nerve without involvement of the piriformis muscle during early hip flexion in six patients with a provisional diagnosis of PS. Surgical dissection of the internal obturator muscle was performed, resulting in alleviation of the patient's symptoms and a return to work was reported in comparison with the nonoperated control group<sup>21</sup>. In 2008, Tiel<sup>20</sup> suggested replacement of the term 'piriformis syndrome' with the term 'non-localising sciatica'. Sciatic nerve damage, EMG (electromyography) changes, ruling out paraspinal muscles and mass lesions, and surgical exploration for compression and to provide relief of symptoms post-decompression of muscle were some of the evidences required for demonstration of true piriformis entrapment<sup>22</sup>. An association of wallet neuritis, also known as fat wallet syndrome, with compression of the ipsilateral sciatic nerve caused by placement of the patient's wallet in the back pocket of the garment beneath the piriformis muscle has also been reported. Confusion of such a syndrome with PS can hinder the diagnosis and management of sciatica<sup>23</sup>. Pain in the buttock region located at the proximal insertion of the hamstring group (ischial tuberosity) is accompanied by referred pain to the posterior aspect of the thigh. Therefore, based on these clinical findings, the pain was classified as hamstring syndrome. In sports medicine, where chronic hamstring pain is a common problem, hamstring syndrome is often regarded as the potential reason for these symptoms<sup>24</sup>. In addition, entrapment of the sciatic nerve can be caused by any structure located in the posterior pelvic region, including the piriformis muscle. As suggested by Filler et al.<sup>18</sup>, such a representation should be classified as 'sciatic notch syndrome'. Anatomical variation plays a role in sciatica due to the presence of the piriformis muscle. The sciatic nerve passes completely or partially through the piriformis muscle, leading to development of sciatica in approximately 17% of patients. In cases of Beaton's type B, a vari-

ation, where common peroneal nerve passes through the piriformis muscle<sup>25</sup>. In rare cases, accessory fibres of the piriformis muscle are attached via the sacral region, although normal signal intensity was detected on MRI in a patient with sciatica on the ipsilateral side who had a history of wallet placement in the back pocket of trousers. In such cases, the anatomical variation of muscle might also affect the clinical representation of patients<sup>26</sup>. The potential presence of space-occupying lesions causing irritation of the sciatic nerve is not within the scope of the following review. Such reports in the literature place emphasis on the question of how often PS can be over-diagnosed without having an actual image of the piriformis muscle. The differential diagnosis for sciatica includes a long list of conditions involving the pelvic region. Some alternate diagnoses are shown in Table 1. Therefore, the clinical presentation should not be regarded merely as PS due to its proximity to the sciatica nerve.

**OPINION**

Our review accounted for cases where the piriformis muscle was not the primary aetiology of sciatica. The discovery of PS has resulted in frequent use of the following diagnosis in our clinics and research. Starting with an alternative diagnosis, which could be deep gluteal syndrome, hamstring syndrome, wallet neuritis, etc., involvement of the piriformis muscle is an umbrella term used for non-discogenic sciatica. Although the cause could be any condition involving the pelvic region, we believe that diagnosis and treatment of PS is preferred, probably due to anatomical or biomechanical characteristics. We are not in opposition to a proven PS; however, the findings of our review could provide various alternative diagnoses that can prove the precise aetiology of sciatica where the piriformis muscle might be normal, which also has led us to end the practice of making diagnoses for conditions such as PS. The accurate diagnosis of PS is difficult due to a lack of resources. In addition,

**Table 1.** Alternate Diagnosis of Non-Discogenic Sciatica (Potentially Mimicking Piriformis Syndrome)

1. Deep gluteal syndrome	The fact that entrapment of sciatic nerve is solely by piriformis muscle has not been established yet. Other muscles namely obturator internus, gemelli complex, quadratus femoris can be involved.
2. Hamstring syndrome	The symptoms of hamstring syndrome are caused by tight tendinous structures of hamstring muscle.
3. Sciatic notch syndrome	Sciatic nerve entrapment can be caused by any structure in posterior pelvis.
4. Wallet neuritis	Compression of ipsilateral sciatic nerve from patient's wallet in back pocket.
5. Alternate nerves involved	Buttock pain can also represent the entrapment of gluteal nerves and hamstring pain can represent the entrapment of posterior cutaneous nerve of thigh.

MRI might be performed before ruling out other reasons for sciatica. Stewart<sup>27</sup> also suggested that use of PS as a diagnosis should be discouraged in most patients with buttock pain or sciatica unless confirmed otherwise, as the piriformis muscle plays a minimal role in the pathogenicity. Possible causes of sciatica like lesions near the site of nerve or muscle and potential systemic nerve or muscular disorders were not considered in our review due to an inclination toward assessment of musculoskeletal causes.

A systematic review reported on sciatic nerve variation and its association with PS, where the most common variation was the passage of the common fibular nerve via the piriformis muscle and the presence of the double piriformis muscle<sup>28</sup>. Trifurcation of the sciatic nerve and variation in the origin of the sural nerve was also reported in the literature, which can impact the understanding of its symptoms and management<sup>29</sup>. Due to conflicting evidence, Bartret et al.<sup>30</sup> in 2018 proposed that there was no association between sciatic nerve variants and PS. Therefore, literature to support such a relationship is still unconcluded.

Diagnostic methods such as ultrasonography can be used for measurement of the thickness in order to confirm involvement of the piriformis muscle in symptoms of sciatica. A thickness of 0.99 cm has been proposed in the literature as the cut-off point for diagnosis of this syndrome with moderate sensitivity and specificity<sup>31</sup>. The ability of MRI in diagnosis has been studied briefly in the literature and conflicting evidence regarding the association of symptoms and involvement of the piriformis muscle has been reported. This evidence has been defended by discussion of the involvement that might occur in performance of daily activities that involve stretching of the piriformis muscle, such as prolonged sitting; however, the patient's radio-imaging might appear normal during performance of MRI due to the relative supine position. However, future conduct of case-control observational studies will be required in order to attain a better understanding<sup>32</sup>. Various diagnostic clinical tests can be used for evaluation of PS, such as FAIR position, etc.; however, discussion regarding reliability is not within the scope of this review. When considering surgical treatment options for management of piriformis muscle-related sciatica, less experienced surgical practice can also account for injury to the sciatic nerve. And when involvement of the piriformis muscle was not confirmed, performance of surgery could result in catastrophe for the patient and possibly the surgeon<sup>33</sup>. Use of arthroscopic techniques as an option for invasive management of deep gluteal syndrome was addressed in a review conducted by Hwang and

Noh<sup>34</sup> in 2017. In addition, in a study reported by Han et al.<sup>35</sup>, surgical resection of the piriformis muscle was performed on 12 patients; they concluded that determining involvement of the piriformis muscle can be difficult, however, use of a systemic approach to diagnosis of the piriformis muscle as a cause and further performance of surgical resection of the muscle in relation to sciatica can actually benefit the patients in cases of failure of conservative treatment. Management of a potential alternative diagnosis for sciatica other than PS which can guide clinical practice and patient care should be considered in conduct of observational/clinical trial studies. The future scope should consider conduct of studies that come close to establishing specific criteria for diagnosis of PS.

## CONCLUSION

When considering the evidence and suggestions, PS is an over-diagnosed condition in terms of clinical representation. The symptoms of PS overlap with a variety of other aetiologies. Therefore, diagnostic options such as MRI and even explorative surgeries are required in order to confirm involvement of the piriformis muscle. In addition, the diagnostic criteria are based on findings of both physical examination and radio imaging. Future studies should be conducted for examination of the associated risk factors and for development of validated and reliable criteria for diagnosis of PS.

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## CONFLICT OF INTEREST

The authors declare that there is no potential conflict of interest relevant to this article.

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