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Piriformis syndrome: a case series of 31 Bangladeshi people with literature review

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Abstract

Aims To describe a series of piriformis syndrome patient among Bangladesh people with literature review.

Methods Consecutive 31 piriformis syndrome patients were enrolled. Besides history and clinical examination, piriformis muscle thickness was also measured with diagnostic ultrasound (3.5 MHZ). MRI of lumbar spine, X-rays of lumbosacral spine, and pelvis were performed in all patients. Statistical Package for the Social Sciences (SPSS), Windows 8.0, was used for statistical calculation, and univariate analysis of primary data was done. Data present with frequency table. For literature review concerning piriformis syndrome we used Embase, Pubmed, Medline, and Cochrane database.

Results A total of 31 patients (21 female) with PS were enrolled, 21 housewives. Mean age 42.2 ± 14.5 years. All presented with buttock pain, aggravating with long sitting (31), lying on the affected side (31), during rising from a chair(24), and forward bending (28). Six reported pain improvement while walking. Gluteal tenderness, positive FAIR test, and Pace sign were elicited in all patients. A palpable gluteal mass was found in 8 cases, gluteal atrophy in 5 other patients. The mean piriformis muscle thickness on the diseased side was more than on the healthy side (13.6 ± 3.7 vs 10.9 ± 1.9, ($p > 0.05$). Common conditions associated with PS were: preceding fall (9, 29 %), overuse of piriformis muscle, lumbar spinal stenosis, fibromyalgia, intra-muscular gluteal injection, blunt trauma over the buttock, leg length discrepancy and use of rear pocket's wallet.

Conclusions In Bangladesh piriformis syndrome is more common in female, especially among housewives. A fall often precedes the condition. Piriformis syndrome should be considered as possible diagnosis when sciatica occurs without a clear spine pathology.

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Introduction

The Musculus piriformis is a flat and triangular shaped, deep seated gluteal muscle. It originates from the anterior of the sacrum, sacroiliac joint capsule, sacro-tuberous ligament, superior margin of greater sciatic notch, and inserts at the superior portion of the greater trochanter. There are many anatomical structures around the piriformis muscle, and the most important one is the sciatic nerve [1, 2]. So, any pathology intrinsic to the piriformis muscle may irritate the adjacent sciatic nerve. Although the function of the muscle mainly concerns abduction of the flexed thigh and external rotation of extended thigh, it also stabilizes the femoral head to the acetabulum [1]. During walking, abduction of the flexed thigh is important, because it shifts the body weight to the opposite side of the foot being lifted and eventually prevents falling.

The piriformis syndrome (PS) is a complex of symptoms and signs related to the piriformis muscle, where patients complain of pain over the gluteal area [3–5]. To define PS, synonyms have been used in the literature like 'pelvic outlet syndrome', 'deep gluteal syndrome' 'infrapiriform foramen syndrome', 'pseudosciatica' 'wallet neuritis', etc. [3–5]. There are two principal components contributing to PS clinical features, somatic and neuropathic [3]. Pathologic events originating in or involving the piriformis muscle produce somatic pain, whereas irritation or compression of the sciatic nerve contributes to neuropathic pain. Sometimes PS symptoms may arise from a few muscles and nerves in the vicinity [3]. According to the literature review by Hopayian, PS usually has the following four common features: buttock pain, external tenderness over the greater sciatic notch, aggravation of pain through sitting, and pain augmentation with manoeuvres that increase piriformis muscle tension, such as the FAIR test (Flexion Adduction Internal Rotation), the Beatty test, Piriformis sign, Pace sign, and Freiberg's sign. [3–5].

Diagnosis of piriformis syndrome can be made by history and physical examination. In PS, buttock pain is localized around the gluteal region and is deep seated, aching in nature with variable intensity and aggravating-relieving factors. It is aggravated with sitting longer than 10–20 min [4]. External tenderness extends from the greater sciatic notch to the greater trochanter but is more at the greater sciatic notch. Among the available manoeuvres [3–5] for pain augmentation in PS, the FAIR test is the most sensitive test and hence used widely to diagnose PS [4, 5]. The test is performed in supine position, keeping affected hip flexed at 60° and knee flexed at 90° followed by internal rotation and adduction of the hip joint [3–5] (Fig. 2a). The Freiberg sign and Pace sign are found to be positive, respectively, in 56.2 and 46.5 % of the patients [3]. In modified FAIR test, FAIR test is done in association with Lasègue's sign, described by Chen et al. [6]as it is a function of the piriformis muscle to abduct the hip in sitting [1], during the Pace manoeuvre induction of gluteal pain on resisted abduction of the flexed hip while sitting will indicate an ipsilateral piriformis muscle problem [4, 7]. The test is reported to be positive in 30–74 % cases [3]. The medial end of the piriformis muscle can be palpated within the pelvis by rectal or vaginal examination, and this test is positive in almost 100 % of the patients [3]. Digital rectal examination is the most commonly used internal pain provocation technique for PS, and the finding was considered to be positive provided that patients did jump or changed facial expression during finger gliding over the lateral pelvic wall.

According to various reports, piriformis syndrome may be responsible for between 0.33 and 6 % of all causes of low back pain and or sciatica [5, 7]. It is common in middle-aged people (mean age 38 years) with a predominance among women [3]. However, inconsistent clinical features and clinical mimicries of PS from surrounding structures sometimes may cause confusion and influence the figures.

On the basis of associated comorbidity, PS can be divided in two types: primary and secondary. In primary PS, there is spasm/hypertrophy of the piriformis muscle (PM) following trauma or exorbitant use of it, whereas in secondary cases it may be associated with lumbar spinal canal stenosis, following vaginal delivery, myofascial pain syndrome, colorectal carcinoma, myositis ossificans of the piriformis muscle, carcinoma of cervix, leg length discrepancy, etc. [3, 4, 7–9].

The piriformis syndrome usually responds to conservative treatments including physical therapy, lifestyle modification, pharmacological agents, and psychotherapy. When all these approaches have failed, interventional modalities may be considered. In rare circumstances, surgical release of the PM has been described. There is a paucity of controlled trials critically examining the effectiveness of the non-invasive management modalities. Piriformis muscle injection is usually offered to patients as part of a multimodal therapy. The muscle can be approached with a land mark-based technique, with or without the assistance of electrophysiological stimulation or image-guided techniques [3, 4, 7]. The effect of Botulinum toxin injections needs further confirmation [10].

Since clinical presentations of PS frequently confuse with lumbago sciatica [3–5], accurate diagnosis will help pain physicians to avoid unnecessary spine interventions, minimizing treatment cost for patients considerably. Henceforth, in this article we focus on different clinical presentations as well as conditions frequent with piriformis syndrome among Bangladeshi people. We also go through relevant literature concerning the fact.

Patients and methods

All patients with piriformis syndrome attending the physical medicine and rehabilitation department both at Feni diabetes and Chittagong medical college hospital were invited to participate in the study. The study was conducted over a period of 6 months, between March, 2014 and August, 2014. A total of 31 consecutive patients with piriformis syndrome could be included in the study. There were no refusals. Demographic and clinical data of patients were collected in a semi-structured questionnaire. The diagnostic procedure is summarized as a diagram in Fig. 1. Patients were enrolled with the following features [5]:

1. buttock pain,
2. aggravation of the pain through sitting,
3. external tenderness over the greater sciatic notch, and
4. pain augmentation with manoeuvres that increase piriformis muscle tension including the FAIR test

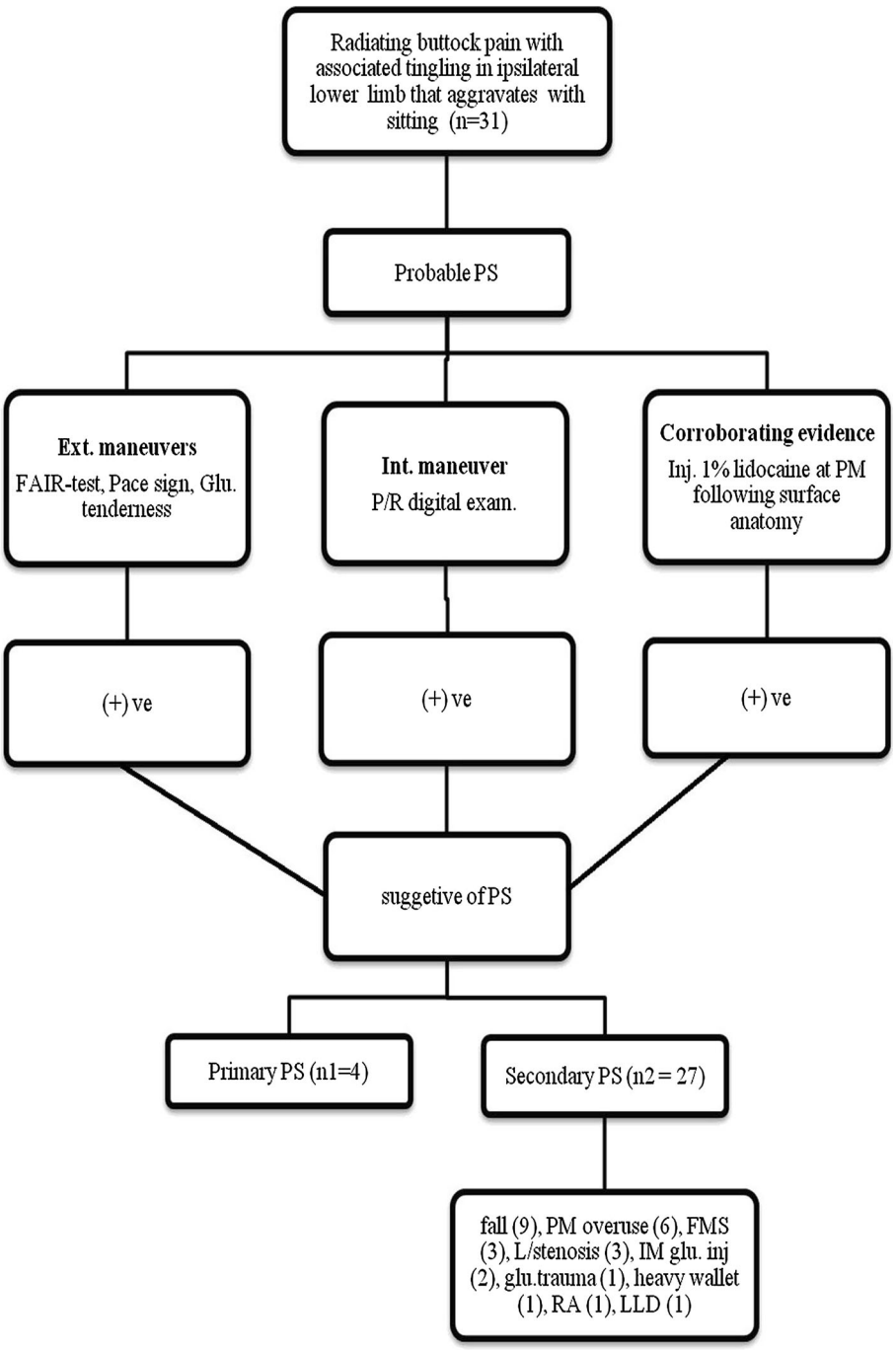

Fig. 1 Diagnostic algorithm of piriformis syndrome. *PS* piriformis syndrome, *Ext.* external, *Int.* internal, *P/R* per-rectal, *PM* piriformis muscle, *FMS* fibromyalgia, *L/stenosis* lumbar spinal stenosis, *IM* intramuscular, *RA* rheumatoid arthritis, *LLD* leg length discrepancy

(Fig. 2a) [4, 5], the modified FAIR test [6], the Pace manoeuvre (Fig. 2b) [4, 7] and digital rectal examination. The finding was considered to be positive providing that patients jumped or changed facial expression during finger gliding over the lateral pelvic wall on digital rectal examination.

Since PS may be confused with pathology in spine and or pelvis, we performed an MRI of the lumbo-sacral spine, an X-ray of the pelvis and of the lumbo-sacral spine to exclude clinical mimicries. In addition, the gluteal region of piriformis subjects was examined with 3.5 MHz frequency diagnostic ultrasound (Siemens Acuson X300 premium edition, transducer: CH 5-2, Germany) in order to measure the thickness of the piriformis muscle on the diseased side and compared with the healthy side. Once we convinced about piriformis muscle involvement, a diagnostic block was performed using surface anatomy at 1.5 cm lateral and 1.2 cm caudal to the lower 1/3rd of the sacroiliac joint [11] with 5 ml of 1 % injection lignocaine local anaesthetic. The test was regarded as positive if there was at least 50 % pain reduction of its initial intensity.

Using Pubmed, Embase, Medline and Cochrane database, we searched the literature as to piriformis syndrome up to March 2016 and following key words were used for this purpose: piriformis syndrome, clinical presentations of piriformis syndrome, piriformis syndrome and risk factors, occupation and piriformis syndrome, wallet neuritis.

Statistics

The Statistical Package for the Social Sciences, SPSS (Windows 8.0), was used for statistical calculation.

Fig. 2 Different clinical presentations of piriformis syndrome. **a** FAIR (Flexion Adduction Internal Rotation) test, **b** pace sign, **c** right gluteal atrophy (*arrow*), **d** gluteal ultrasonogram, left piriformis muscle (D1) is found thicker than right, **e** short left femur neck, **f** MRI of lumbosacral spine reveals disc degeneration, prolapse at L5-S1 (*arrow*) with corresponding spinal canal stenosis

Univariate analysis of primary data was done, and frequency table has been used to present them.

Ethics

The study was approved by the Ethical Review Board, Chittagong Medical College Bangladesh. Written informed consent was given by each patient.

Results

A total of 31 patients (21 female, and 10 male) with piriformis syndrome were enrolled, 21 were housewives. All agreed to participate in the study. The mean age at presentation was 42.2 ± 14.5 years. All patients presented with buttock pain. There was pain aggravation with long sitting (31, 100 %), lying on the affected side (31, 100 %), during rising from a chair (24, 77.41 %), and forward bending (28, 90.32 %). Moreover, six patients reported considerable pain improvement while walking. A flow chart for diagnosis of piriformis syndrome is illustrated in Fig. 1.

The demographic profile of patients with piriformis syndrome is presented in Table 1. A total of 31 patients (21 female and 10 male) were enrolled, with a female and male ratio 2.1. The mean age at presentation was 42.2 ± 14.5 years. Regarding occupation, piriformis syndrome was most common in housewives ($n = 21$), more precisely among rural housewives ($n = 20$).

The clinical profile of the patients (Fig. 2a–f) is summarized in Table 2. The most common clinical feature was low back pain, especially over the buttock area, right side (17, 54.8 %) affected more than the left (14, 45.2 %).The pain was aggravated with long sitting (31, 100 %), sitting more than 10–20 min (31, 100 %), affected side lying (31, 100 %), during standing from sitting (24, 77.4 %), and forward bending (28, 90.3 %). There was associated tingling feelings (28, 90.3 %) and a heavy feeling (25, 80.6 %) in the same lower limb. Yet most of the patients were to find a pain relieving posture, a few of them (6, 19.35 %) reported considerable pain improvement while walking. Gluteal tenderness, positive FAIR test, and the Pace sign were elicited in all patients. Palpable gluteal mass and gluteal atrophy (Fig. 2c) was documented in 8 and 5 cases, respectively. Besides, SLR was positive in 4 cases, whereas it was negative in other patients. Using the diagnostic musculoskeletal ultrasonogram, the average piriformis muscle thickness on the diseased side was documented as 13.55 ± 3.66 mm, relatively higher than that of healthy side (10.9 ± 1.9) for the same individual (Fig. 2d). However, the difference was not statistically significant ($p > 0.05$). On the other hand, piriformis muscle on the healthy side was proportionately thicker with high BMI.

Table 1 Demographic profile of piriformis syndrome ($n = 31$)

Characteristics	PS
Age at presentation (years, mean ± SD)	42.2 ± 14.5
Different age group	
<20	01 (3.2)
21–30	06 (19.3)
31–40	08 (25.8)
41–50	06 (19.3)
51–60	07 (22.6)
>60	03 (9.7)
Gender	
Male	10 (32.2)
Female	21 (67.7)
Occupation	
Housewife	21 (67.7)
Business	03 (9.7)
Farmer	02 (6.4)
Day laborer	01 (3.2)
Driver	01 (3.2)
Student	00
Others	01 (3.2)
BMI[a]	
<18.5	03 (9.7)
18.5–24.9	18 (58.1)
25–29.9	10 (32.2)
>30	00
PM thickness (diseased versus healthy side) (mean, SD)	13.55 ± 3.66 versus 10.9 ± 1.9*
Residence	
Rural	22 (70.96)
Urban	06 (19.35)
Semi-urban	03 (9.67)

PM piriformis muscle, *BMI* body mass index, *SD* standard deviation

* Statistically insignificant ($p = 0.978$)

[a] Razak et al. [32]

The common associated conditions with piriformis syndrome are summarized in Table 3. The following factors were found to be associated with PS: preceding fall, overuse of piriformis muscle, lumbar spinal stenosis, fibromyalgia, intra-muscular gluteal injection, blunt trauma over the buttock, leg length discrepancy (LLD) (Fig. 2e), and use of rear pocket's wallet. Among these, most patients (9, 29.0 %) gave a history of a previous fall. Exorbitant use of the piriformis muscle (6, 19.4 %) was twice as common as either fibromyalgia (3, 9.67 %) or lumbar spinal stenosis (3, 9.7 %) (Fig. 2f). Surprisingly, two of our patients (6.4 %)

Table 2 Clinical presentations of piriformis syndrome ($n = 31$)

Characteristics	Distributions
Pain localization to buttock	
Right	17 (54.8)
Left	14 (45.2)
Pain type	
Deep seated gluteal aching	31 (100)
Radiation in lower limb	28 (90.3)
Associated tingling sensation in lower limb	28 (90.3)
Associated feeling of heaviness in lower extremity	25 (80.6)
Pain aggravation	
Sitting	31 (100)
Sitting 10–20 min	31 (100)
During standing from sitting	24 (77.4)
On lying flat	24 (77.4)
On affected side lying	31 (100)
On forward bending	28 (90.3)
During walking	25 (80.6)
Pain improvement during walking	06 (19.4)
Clinical examination	
Gluteal atrophy	05 (16.1)
Gluteal tenderness	31 (100)
Palpable gluteal mass	08 (25.8)
FAIR test	31 (100)
Pace sign	31 (100)
P/R examination	31 (100)
SLR	
Positive	04 (12.9)
Negative	27 (87.1)
Foot drop[a]	02 (6.4)

Values are expressed in frequency (percentage)

FAIR flexion adduction internal rotation, *SLR* straight leg raise, *P/R* digital per-rectal examination

[a] Foot drop in two PS patients after receiving gluteal intra-muscular diclofenac sodium injection

developed piriformis syndrome following intra-gluteal diclofenac sodium injection. Direct gluteal trauma was documented in one PS. Gluteal pressure from large rear pocket's wallet inducing PS features was found in one patient. One of our patients, a trolley driver, complained of increased buttock pain while sitting on a large rear pocket's wallet also satisfied PS features. In another subject piriformis features developed on the contralateral side with LLD due to femoral neck shortening (left is shorter than right). *Though MRI/X-ray showed osteophytic lipping of vertebral bodies at L3-5/L5-S1 levels in 10 patients, disc degeneration, disc height reduction, and disc herniation at L5-S1 level with corresponding nerve roots compression were consistent with clinical features of lumbar spinal canal stenosis in 3 piriformis patients* (Table 4). We observed one piriformis patient, who had been treated with intra-lesional steroid,

Table 3 Conditions frequent with piriformis syndrome ($n = 31$)

Characteristics	PS
Fall from standing/height	9 (29.0)
Overuse of piriformis muscle[a]	6 (19.3)
Lumbar spinal stenosis	3 (9.7)
Fibromyalgia	3 (9.7)
Intra-gluteal injection	2 (6.4)
Blunt trauma over the buttock	1 (3.2)
Leg length discrepancy	1 (3.2)
Wallet use	1 (3.2)
Rheumatoid arthritis	1 (3.2)
None	4 (12.9)

Values are expressed in frequency (percentage)

Intra-gluteal injection diclofenac sodium

None of the above

[a] Repetitive use of piriformis muscle during home making activities, field work, cycling, stair up and down

Table 4 Radio-imaging in piriformis syndrome ($n = 31$)

Characteristics	Radio-imaging features
X-ray lumbosacral spine (both view)	
Vertebral body osteophytic lipping	10 (32.2)
Reduced disc height (L5-S1)[a]	3 (9.7)
Osteopenia	6 (19.3)
X-ray pelvis/hip (both view)	
Pelvic asymmetry	03 (9.7)
Shortening of neck femur	01 (3.22)
MRI of lumbosacral spine	
Disc degeneration (L3-5)	9 (29.0)
Disc height reduction (L5-S1)[a]	3 (9.7)
Disc herniation (L4-5, L5-S1)	7 (22.5)
Facet hypertrophy (L4-5, L5-S1)	7 (22.5)
Nerve roots compression	
(L4-5)	2 (6.4)
(L5-S1)[a]	3 (9.7)

Values are expressed in frequency (percentage)

MRI magnetic resonance imaging

[a] Consistent with clinical features of lumbar spinal canal stenosis

presented with the features of rheumatoid arthritis 6 months later. We did not find any identifiable risk factors associated with piriformis patients in 4 (12.88 %) cases.

Discussion

The piriformis syndrome is an elusive medical condition, and an inconsistent clinical presentation is its main peculiarity. Although not life-threatening, it can cause

significant associated morbidity. Data regarding PS are often confused with other conditions in terms of differences in definitions, methods of study, and whether occupational groups or general population are surveyed [4, 5]. In three separate studies, documented incidence of piriformis syndrome ranged between 0.33 and 36 % [12–14]. In another survey, lifetime occurrence of PS among general population was found in 12.2–27 % subjects, whereas 2.2–19.5 % showed an annual occurrence [5]. Further studies reported that the proportion of PS was approximately 0.1 % in orthopaedic practice, more frequent in women with a female–male ratio of 3:1 [5, 12]. Some studies reported that this ratio can be up to 6:1 [2, 4, 5]. The condition commonly affects people between third and fourth decade of life, and seldom younger than twenty [12].

Our study results are comparable with the above findings though with a few exceptions. According to our study, piriformis syndrome was two times more frequent in women than their male counterpart and common in the 4th decade of life. We found only one female patient aged below twenty. According to the literature reviews, PS affects people regardless of their occupation [6], but in our study rural housewives were dominating. Why rural housewives were affected most is yet to answer. Wide quadriceps-femoris angle is one of the main reasons for high PS prevalent among female [4], but there might be further factors to explain why our community women are getting more often PS. As is observed, while engaging activities of daily living such as preparing meals in kitchen, homemaking, and participating some religious activities, Bangladeshi women use their lower back differently putting more stress to maintain a particular posture for a long time. Likewise, they are less cautious about their low back during such activities. In contrast with Western countries, women in Bangladesh rarely adopt chair for home activities rather prefer prolonged sitting, cross-legged sitting, squatting, unaccustomed forward bending, etc., during their daily activities, imposing exorbitant pressure on deep gluteal musculatures more precisely on piriformis muscle (Figs. 3, 4, 5). In this study other than housewife, PS features also documented in farmer and day labour. One of our PS patients by occupation truck driver had features comparable with those described by Brown et al. [15].

In the study subjects, piriformis muscle was thicker on the diseased side in comparison to the healthy side, indicating some sort of muscle spasm or hypertrophy. The average piriformis muscle thickness was 10.9 ± 1.9 and 13.55 ± 3.66 mm in healthy and diseased side, respectively. Similarly, heavier bodyweight that expressed in BMI was proportional to the piriformis muscle thickness; the higher the BMI, the thicker the piriformis muscle on healthy side. In a study by Park et al. [16] the measured piriformis muscle diameter among Korean population was between 0.9 and 2.5 cm, while thickness was not assessed. It also had been reported that the distance from the skin to the piriformis was increased with BMI that we did not examine in our study.

Fig. 3 Woman with prolonged squatting while cutting vegetables

Fig. 4 Woman walking after collecting water from pond

Clinical features of piriformis syndrome may be of sudden or gradual onset and may be related to piriformis muscle spasm/hypertrophy, underlying sciatic nerve compression, or both [4]. The most common presenting symptom of piriformis syndrome is buttock pain that increases after sitting on hard surface for longer than

Fig. 5 A girl with stooping forward while cleaning the clay floor

15–20 min, especially over the muscle's attachments [4]. Patients may also complain of difficulty walking and of pain during cross-legged sitting or ambulation. Although patients are yet to find a pain relieving posture, sometimes pain improves while walking, particularly in chronic cases. Occasionally, patients complain of pain in the labia majora and the scrotum [3]. There is associated tingling, numbness, and subjective heaviness in the same lower limb. Dyspareunia [4] might be a reporting feature in few women. Through compensatory or facilitative mechanisms, piriformis syndrome may contribute to neck, upper back, headache, and gastrointestinal symptoms [4, 5, 7]. Tenderness with palpation over the piriformis muscle is common. The sacroiliac joint may also be tender with direct compression over the joint. Some patients have a palpable 'sausage-shaped' mass in the buttock, an evidence of the piriformis muscle spasm. Some piriformis patients may present with externally rotated ipsilateral foot—a feature referred to as a positive piriformis sign. Though there is no single test specific to piriformis syndrome, several clinical tests can be used to diagnose PS such as Lasègue sign, Freiberg sign, and Pace sign, FAIR test, modified FAIR test, and Beatty test, per-rectal digital examination. Among them, the FAIR test has a sensitivity and specificity of 0.881 and 0.832, respectively. The Lasègue sign shows a localized pain due to the fact that pressure is applied directly over the piriformis muscle and its tendon, especially when the hip remains flexed at 90 degrees with extended knee. In the Freiberg sign, the pain is experienced during passive internal rotation of the extended hip. In the Beatty test, the patient lies on the unaffected side, lifting and holding the superior knee approximately 4 inches off the examination table. The Pace sign, revealed with the FAIR test, involves recreation of sciatic symptoms. PS patients also have antalgic gait [4–7, 17]. All these features were found in our study subjects. Although not a frequent finding, a few patients had developed gluteal atrophy that might be due to disuse of the painful gluteal area during ambulation and transfer. Though straight leg raising (SLR) is usually negative for PS, here it was positive in a few cases mostly during acute presentation [5].

Along with these clinical tests, neurophysiologic testing can also be used in diagnosing the piriformis syndrome. Electromyography (EMG) may be able to differentiate piriformis syndrome from inter-vertebral disc herniation. Inter-spinal nerve impingement will cause EMG abnormalities of muscles proximal to the piriformis muscle. In patients with piriformis syndrome, EMG results will be normal for muscles proximal to the piriformis muscle and abnormal for muscles distal to it. The role of unprovoked electrophysiological testing in PS is minimal. However, the diagnostic value of such tests can be improved by stressing piriformis muscle during FAIR test. A prolongation of 1.86 ms in this manoeuvre is an electrophysiological criterion for PS diagnosis [3]. Although MRI and CT scanning, and ultrasound may reveal morphological changes in piriformis muscle, these imaging technologies are most useful owing to ruling out spine pathologies [4, 5, 18]. In this study, all patients had a diagnostic ultrasonogram over the affected gluteal area, and we found that PM was thicker in the diseased side than the healthy side, indicating some sort of muscle spasm in the affected side. We could not evaluate patients using EMG, MRI, CT scanning as it was our study limitation.

The following conditions are likely to be associated with piriformis syndrome: fall [19], overuse of piriformis muscle [4, 18, 20], direct gluteal trauma [4, 20], leg length discrepancy (LLD) [21], piriformis pyomyositis [22], myofascial pain syndrome [18, 23], fibromyalgia [18], wallet use [4], and lumbar spinal stenosis [4, 7].

After a fall or direct gluteal blow, there might be localized haematoma with resultant scars between sciatic nerve and hip extensors. In addition, piriformis muscle spasm may also irritate the underlying sciatic nerve manifesting sciatica symptoms. In LLD, the biomechanics between the spine and lower limb is altered, producing a modified gait pattern. According to the literature review, PS can occur both in ipsilateral and contralateral side to LLD [7, 24]. In general, an individual with an LLD must step down onto the short limb and vault over the long limb with resultant increase in vertical displacement of the centre of mass and hence increased energy consumption. In addition, an individual may shorten the longer leg by increasing pelvic obliquity, circumduction, increasing hip and/or knee flexion, increasing ankle dorsiflexion, or any combination of these owing to minimizing energy consumption. When these are inadequate, the anterior and posterior iliac spines are lower on the side of the short leg, which in turn may result in a sacral base un-leveling [24]. So, a greater amount of pressure is transmitted through the

hip of the longer leg due to either a decrease in the area of contact of the femoral head on the acetabulum or an increase in tone of the contra-lateral hip abductors, such as piriformis muscle, secondary to an increased distance between origin and insertion of them [21]. In another study by Dere it was described that PS ipsilateral to LLD can also be associated with piriformis muscle spasm and contracture. According to Hallin, in LLD, pain and tenderness are most often on the 'long side', but may be bilateral or on the short side only [25]. Furthermore, extravagant use of piriformis muscle may occur during long distance walking, running, repeated squatting, rowing/sculling (strenuous use of legs), kneeling, bicycling, etc. [20, 26]. So, when not offset by lateral movement of the legs, repeated forward movements can lead to disproportionate weak hip abduction and tight adduction with resultant piriformis muscle shortening. This means the abductors on the outside cannot work properly and strain is put directly on the piriformis muscle [26].

Piriformis pyomyositis, an infective condition involving the piriformis muscle, is a clinical scenario that may occur following vaginal delivery and usually is associated with fever and raised inflammatory biochemical markers [22]. Sometimes PS is due to myofascial pain syndrome involving the piriformis muscle with taut bands and trigger points (TrPs). Although the myofascial pain syndrome is a localized painful muscle condition, sometimes it might present as widespread body ache by spreading of TrPs through either axial kinetic chain or by activation of TrPs in the mechanically stressed muscle. Widespread MPS sometimes may be confused with FMS as both conditions may co-exist in the same patient and share a common patho-physiology, central sensitization. In an opinion by Gerwin, 75 % of FMS may have significant MPS at one or more times during the course of their illness. In MPS, an increase in trigger points acetylcholine release could result in sustained depolarization of the post-junctional membrane of the muscle fibre which produces sarcomere contracture with increased local energy consumption and reduction in local circulation with resultant hypoxia. The localized muscle ischaemia stimulates the release of certain chemicals including substance P, sensitizing nociceptors in afferent nerve fibres in muscle and dorsal horn neurons in the spinal cord with pain referral beyond the initial nociceptive region due to spreading of central sensitization to adjacent spinal segments [18, 23]. Additionally, at the level of the central nervous system, spinal neuroplastic changes extend further to involve the second- and third-order neuron pool and produce a long lasting excitability of nociceptor pathways. At the same time, there may be impairments in supraspinal inhibitory descending pain control pathways [18, 23]. The piriformis syndrome is also known as 'wallet sciatica' or 'fat wallet syndrome' as the condition can be caused or aggravated by sitting with a large wallet in the affected side's rear pocket [3]. The association of piriformis syndrome and lumbar stenosis can be explained by the double crush phenomenon [7, 19].

In our study, we analysed all these risk factors in our study subjects. We found that most patients had experienced a recent or previous fall. In another six patients piriformis muscle was used exorbitantly; two gave history of repetitive stair up-down during harvesting; two patients maintained prolonged unaccustomed squatting during kitchen activities; and one patient got hurt on his lower back during prolonged squatting owing to fitting tiles in his village kitchen by his own. There was only one teenage girl who developed PS features owing to repetitive use of her right lower extremity during working with swing machine. Piriformis syndrome with lumbar spinal stenosis and fibromyalgia was also encountered. Lumbar spinal canal stenosis is a condition whereby either the spinal canal or vertebral foramen becomes narrowed, leading to compression of the spinal nerves. Common symptoms of lumbar spinal stenosis are radiating lower back pain, lower limb weakness, numbness, pain, and loss of sensation, and causes are vary ranging from degenerative arthritis (osteoarthritis) to tumour, infection, and metabolic bone disorders, etc. In this present study, along with clinical features, both X-ray and MRI guided lumbar spinal canal stenosis defined in three PS subjects. Moreover, LLD had been documented in one PS patient simulating Dere and colleagues findings [8].

We had two patients who developed piriformis syndrome features within one week following intra-gluteal diclofenac sodium [3]. A few case reports described sciatic neuropathy with resultant foot drop occurring after intragluteal injections with diclofenac, vitamin B12, meperidine, etc. [27]. Iatrogenic sciatic nerve injury or irritation may occur when the site of the needle insertion is located medial to the recommended upper and outer quadrant of the buttock area and patients with low BMI having atrophied gluteal muscles are more predisposed to this kind of nerve injury [27]. Following direct trauma, injured sciatic nerve activates inflammatory mediator secretion and initiates the inflammatory cascade. As a consequence, the ectopic discharges on damaged nerve develop neuropathic pain [27, 28].

We observed that one PS patient who was treated with intra-lesional methylprednisolone injection developed clinical features of rheumatoid arthritis with high titre of anti-cyclical citrullinated peptide (anti-CCP) antibody within 6 months of her follow-up. In one of our cases, direct gluteal trauma induced piriformis. Benson et al. described 15 cases of piriformis syndrome (in fourteen patients), due to blunt trauma to the buttock; release of the piriformis tendon and sciatic

neurolysis led to encouraging results with few complications [29]. We had four more patients with primary PS who did not have any identifiable risk factor for piriformis syndrome, comparable with the literature review by Jankovic et al. [3].

In the literature, total hip replacement has been mentioned as an association of PS. During surgical exploration, each sciatic nerve was found to be entrapped by a tense piriformis muscle and hypertrophic posterior hip capsule. The sciatic-type pain was relieved after sectioning each piriformis muscle with external neurolysis [30]. In dancers the diagnosis might easily be overlooked [31]. But these clinical situations were not documented in our recent study.

Study limitations

We did not do a long-term follow-up of the cases and could not evaluate the results of treatment; however it was not our study aim.

Study strengths

We could include all cases presented in two clinics during a period of 6 months. All patients could be included, and there were no refusals to cooperate. All patients were studied following a strict protocol, so as to leaving no doubt about the diagnosis.

In conclusion, there are many faces of piriformis syndrome. Though more common in women, it is not that much scarce in men. The condition can be defined as a clinical entity of 'radiating sciatica like buttock pain that aggravates with sitting and some special manoeuvres such as FAIR test, Pace sign, per-rectal digital examination, improves substantially with intra-piriformis injection local anaesthetics-steroid combination, with supplemented pain, tingling, and heaviness sensation in the ipsilateral lower extremity'. Patients are yet to find a pain relieving posture, neverthless some may have pain improvement while walking. Piriformis subjects may have a few different risk factors, some of which were not well-described in literature before, for example, fibromyalgia, excessive use of piriformis muscle, intra-gluteal injection, rheumatoid arthritis, however has been stressed in our recent study. We surmise, piriformis syndrome should be considered as a possible diagnosis when sciatica occurs without a clear spinal association; henceforth we recommend further prospective multi-centre study on different risk factors concerning this clinical scenario.

Compliance with ethical standards

Conflict of interest None.

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