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Ischiofemoral impingement: Clinical perspectives for enhancing diagnosis, and rehabilitation

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ABSTRACT

Introduction: Buttock pain often presents a diagnostic dilemma for healthcare professionals, with misdiagnosis resulting in poor treatment outcomes. Ischiofemoral impingement (IFI) – impingement of the quadratus femoris between the ischium and lesser trochanter – is one of the most overlooked causes of buttock pain. Ischiofemoral impingement is most common in females and results in pathology within the quadratus femoris muscle, with additional changes sometimes present within the iliopsoas and proximal hamstring tendons, and the adjacent sciatic nerve. Structural risk factors that narrow the ischiofemoral space have been identified in the pelvis and proximal femur. Kinematic mechanisms may also play a primary or additional role in pathoaetiology. This understanding provides the basis for clinical reasoning around diagnosis and management of IFI.

Purpose: The goal of this masterclass is to synthesise available evidence and the authors' clinical experience to improve understanding and highlight current best practice approaches for assessment and management of IFI.

Implications: Clinical diagnosis involves performing a reflective patient interview, paying close attention to the location of pain, identifying impairments and patterns of kinematic loading across the region, executing diagnostic tests (long-stride walking and ischiofemoral impingement tests), and screening for other differential diagnoses with or without imaging. Interventions for IFI should address multi-planar contributors to symptoms through patient education, postural and movement training and exercise rehabilitation, with medical or surgical interventions available for recalcitrant cases.

First described in 1977(Johnson, 1977), ischiofemoral impingement (IFI) is an under-recognised source of persistent lower buttock pain (Hernando et al., 2016), that may impact substantially on functional capacity for standing, walking or running. In some cases, IFI is accompanied by sciatica, and sitting tolerance may also be limited. Although prevalence data is unavailable in older adults, IFI is most commonly referred to as a condition experienced predominantly by middle aged females (Nakano et al., 2017). However, a recent study of young adults with hip pain presenting for orthopaedic review reported an overall prevalence of 9% across both sexes, and 16% of the young women in this population (Heimann et al., 2025). It is likely that prevalence has been underestimated previously due to regular misdiagnosis as gluteal tendinopathy, or other hip or lumbar conditions due to overlapping clinical presentations.

IFI involves painful compression of structures, particularly the quadratus femoris (QF) muscle, within the ischiofemoral space (IFS) – the interval between the ischial tuberosity and the lesser trochanter of the femur (Kivlan et al., 2017). This space may be reduced by structural and/or kinematic factors, resulting in pain and dysfunction during weightbearing tasks such as standing, walking and running. Systematic reviews advocate for non-surgical management as the initial approach (Nakano et al., 2020), yet there is limited consensus on assessment and treatment strategies.

This article presents current understanding of pathomechanics of the condition and clinical perspectives of contemporary best practice in assessment and management of IFI. The aim is to enhance early recognition of IFI and equip clinicians with practical, evidence-informed strategies for treating this condition.

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1. Pathology and pathoaetiology

The IFS contains the QF muscle, passing from its origin, the infero-lateral margin of ischial tuberosity, to its insertion, the quadrate tubercle of the intertrochanteric crest of the proximal femur (Fig. 1). QF oedema or increased fatty infiltration may occur when the muscle is exposed to repeated compression and frictional loads between the ischium and the lesser trochanter (Gómez-et al., 2018). Subsequently, it may become a source of pain. Soft tissues that insert onto the lateral ischium (proximal hamstring tendons) and lesser trochanter (iliopsoas tendon) may also become involved. Less frequently, the sciatic nerve may be impacted by oedema in the adjacent QF(Torriani, 2025/02), or by direct bony impingement which is more likely in the context of QF atrophy.

The pathoaetiology of IFI is likely to involve a combination of factors, including a combination of structural factors, such as bony morphology, and kinematic factors such as joint positions and movement patterns that act together to reduce the available IFS. Changes in loading parameters such as frequency and duration of movements that reduce the IFS may contribute to the development of symptoms. Structural and kinematic contributors to IFI may also be acquired through degenerative processes, trauma, or via iatrogenic mechanisms such as surgery (Hernando et al., 2016; Shoji et al., 2017). Further prospective studies are required to establish stronger causal links between structural and kinematic factors and IFI. It is also important to note that the development of musculoskeletal pain states is usually multifactorial in nature, with potential for contribution of systemic and psychosocial factors. These factors are yet to be elucidated for IFI; thus, our focus will be on the structural and kinematic factors for the purposes of this clinical commentary.

1.1. Structural contributors to ischiofemoral impingement

Structural contributors to IFI include bony morphological features of the femur and pelvis that approximate the ischial tuberosity and the lesser trochanter. More remote structural factors that alter pelvic obliquity may also contribute to pathoaetiology.

1.1.1. Femoral factors

Femoral morphological contributors (Fig. 1) include: (i) coxa breva; (ii) coxa valga; (iii) prominence of, or hook-shaped lesser trochanter; (iv) large cross section of the femur at the level of the lesser trochanter and (v) increased femoral anteversion.

Coxa breva is defined as a shortened femoral neck, which brings the lesser trochanter closer to the ischium and reduces the abductor lever arm, predisposing individuals to IFI through both structural and kinematic mechanisms (Hernando et al., 2016). This may occur as an anatomical variation or develop secondary to conditions such as slipped capital femoral epiphysis or Leg Calve Perthes disease (Ghaffari et al., 2020).

Coxa valga, characterised by an increased femoral neck-shaft angle greater than 135°(Boese et al., 2016), has also been associated with a higher risk of IFI when compared to controls (Boschung et al., 2023a, 2023b; Tosun et al., 2012). Like coxa breva, coxa valga brings the femoral shaft and lesser trochanter closer to the ischium, reducing the IFS and the mechanical advantage of the hip abductor musculature (Ohnishi et al., 2018; Tosun et al., 2012).

The rotation profile of the femur may also contribute to reduction of the IFS. Femoral anteversion refers to anterior rotation of the femoral head and neck relative to the distal femoral condyles. Femoral neck anteversion is reported, on average, to be 21.7° in people with IFI compared with 14.1° in asymptomatic controls (Gómez-et al., 2016b). Those with excessive femoral anteversion will be in relatively greater hip external rotation when the patella is facing anteriorly compared to those with typical anteversion. Those with femoral anteversion greater than 35° are reported to have a subsequent reduction in impingement-free hip extension and external rotation (Boschung et al., 2023b).

Size and orientation of the lesser trochanter can also cause structural IFI. A prominent lesser trochanter is more commonly observed in females, which may contribute to sex-based prevalence differences in IFI (Gómez-et al., 2016b).

1.1.2. Pelvic factors

The presence of certain pelvic morphological features has also been linked to IFI. The ischial angle of the pelvis, defined as the angle between the long axis of the ischiopubic ramus and the horizontal plane (Fig. 1), has been reported to be significantly larger in individuals with IFI, even after adjusting for sex and age (Bredella et al., 2015; Taneja et al., 2013). A larger angle will position the ischia further laterally, increasing the distance between the ischial tuberosities (intertuberous distance) and reducing the available space between the lateral ischium and the lesser trochanter. Measures of intertuberous distance have also been reported to be larger in those with IFI (Bredella et al., 2015). The higher prevalence of IFI in females appears to be influenced by the morphology of the female pelvis - wider, with greater ischial angles and intertuberous distance to accommodate childbirth (DiSciullo et al., 2018; Lerch et al., 2024; Tosun et al., 2012).

The width of the ischial tuberosity can also facilitate approximation to the lesser trochanter. A wider ischium may be congenital or acquired, such as through bony response to trauma or apophyseal avulsion injuries

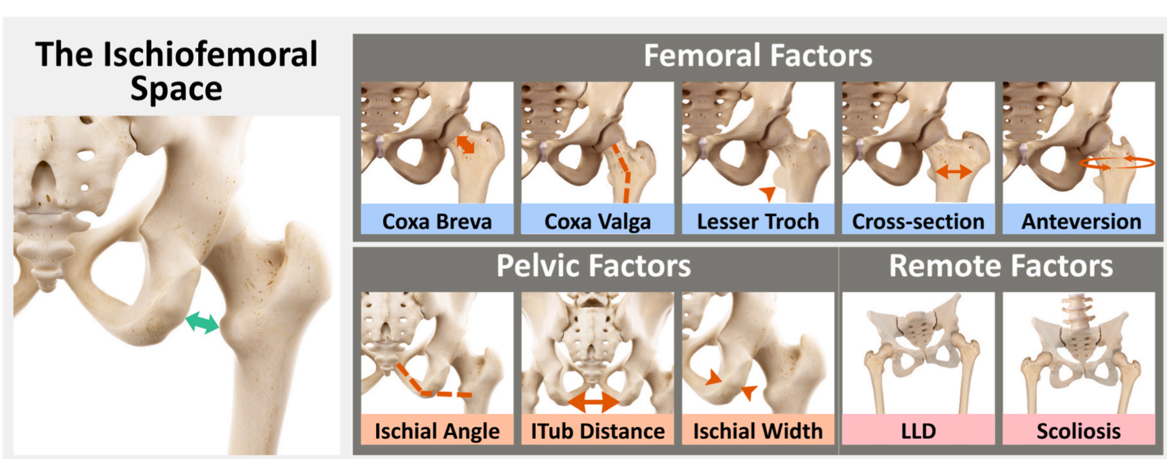


Fig. 1. The ischiofemoral space and structural contributors to ischiofemoral impingement. Ischiofemoral space: between the ischium and lesser trochanter; ITUB Distance: Ischiotuberous distance; LLD: Leg Length Discrepancy.

(Spencer-Gardner et al., 2017). When multiple femoral and pelvic predisposing anatomical features are present, the prevalence of IFI may increase (Boschung et al., 2023a, 2023b).

1.1.3. Remote factors

More remote structural variations such as a substantial leg length difference (>2 cm)(Applebaum et al., 2021) or lumbar scoliosis may alter pelvic obliquity and therefore reduce the IFS on the relatively more adducted hip. Such factors may be involved in some with IFI.

1.2. Kinematic contributors to ischiofemoral impingement

In individuals with IFI, symptoms commonly arise during static positioning or dynamic movement of the hip and pelvis across uniplanar (sagittal, coronal, and axial) or multiplanar movements that reduce the IFS. This dynamic narrowing of the IFS can occur with or without the aforementioned morphological features.

1.2.1. Sagittal plane considerations

The IFS is maximised in hip flexion and becomes progressively narrowed with hip extension, such as during the terminal stance phase of gait (Atkins et al., 2017). This narrowing is further exacerbated by posterior pelvic tilt, which draws the ischial tuberosities closer to the lesser trochanter, reducing the available space for soft tissues such as the QF. Overstriding, with resultant increases in hip extension during walking or running, may provoke symptoms by further reducing the IFS. Cadaveric findings report extension of 10° to contribute to bony contact impingement, but more frequently when combined with external rotation (Kivlan et al., 2017).

1.2.2. Coronal plane considerations

Hip adduction contributes to narrowing of the IFS when the hip is extended. Concurrent external rotation may further reduce the space between the ischium and lesser trochanter (Kivlan et al., 2017). In the coronal plane, the IFS is significantly wider when the hip is abducted, compared with hip neutral or adducted positions (Finnoff et al., 2015). Clinically, movement patterns such as lateral pelvic shift or contralateral pelvic tilt can increase hip adduction during functional tasks like walking or single-leg stance, and may contribute to symptoms of IFI (DiSciullo et al., 2018).

1.2.3. Axial plane considerations

Cadaveric and imaging studies have shown that hip external rotation results in the smallest distance between the lesser trochanter and the ischium, leading to earlier contact and potential impingement (Kivlan et al., 2017; Lerch et al., 2024). Finnoff et al. (2015) demonstrated that the IFS was smallest during adduction combined with external rotation, while abduction and internal rotation created the most space. The extent to which external rotation contributes to impingement may depend on the presence of anatomical variants as well as concurrent movements in the sagittal or coronal plane.

Although each plane contributes uniquely to dynamic narrowing of the IFS, the combined effect of multiplanar loading is most often responsible for symptomatic IFI. A dynamic fluoroscopy study of asymptomatic individuals revealed that static MRI measures of the IFS do not adequately reflect individual differences in the minimum IFS during dynamic tasks such as walking gait (Atkins et al., 2017). The minimum IFS during walking gait was smaller than axial MRI measurements, particularly for females. These sex differences were attributed to both anatomical (e.g., wider intertuberous distances) and movement-related factors (e.g., degree of hip extension, adduction and external rotation), reinforcing the need for careful visual assessment of dynamic function.

2. Assessment

Diagnosis of IFI can be challenging due to its symptom overlap with other hip, pelvic, and spinal conditions. This section aims to highlight key patient interview and physical examination features.

2.1. Patient interview

2.1.1. Patient history

Symptom onset is typically insidious, with patients often reporting a gradual increase in buttock pain without a clear mechanism of injury (Carro et al., 2016; Jeyaraman et al., 2022). In some cases, symptoms may follow trauma or surgical procedures, such as total hip arthroplasty (Johnson, 1977) or avulsion fracture of the ischial tuberosity (Spencer-Gardner et al., 2017).

2.1.2. Area of pain and associated symptoms

Pain is usually felt in the lower buttock region lateral to the ischial tuberosity (Fig. 2), although patients may have difficulty localising the area (Hernando et al., 2016; Singer et al., 2015). Patients with IFI frequently gesture toward the greater trochanter when describing their pain, though careful questioning will likely reveal that pain is retro-trochanteric and deep, rather than superficial and lateral over the greater trochanter, more typical of gluteal tendinopathy (Grimaldi et al., 2025; Kinsella et al., 2024). While retro-trochanteric pain is considered characteristic of IFI, some individuals also report groin discomfort (Hernando et al., 2016), which may be associated with iliopsoas tendon involvement. If the sciatic nerve is involved in IFI, symptoms can include radiating pain, numbness, or tingling in a sciatic nerve distribution (Gollwitzer et al., 2017). Additional features of IFI such as snapping sensations, audible grating, or crepitus may be present during mid-to-late stance phase of gait (Hernando et al., 2016; Spencer-Gardner et al., 2017).

If the pain is located more over the ischium rather than in the IFS lateral to the ischium, the clinician should suspect proximal hamstring tendinopathy, particularly with reports of ischial tenderness in sitting.

Posterior hip pain can also feature in hip osteoarthritis (OA) presentations, though the pain pattern is more mid-rather than lower-buttock and commonly includes deep mid-inguinal, anterolateral and "C-sign" regions (Martin and Palmer, 2013). Associated symptoms such as morning stiffness, progressive loss of hip range of motion and associated functional limitations (e.g., difficulty putting on shoes and socks), further support a diagnosis of hip OA (Grimaldi et al., 2024). Key differential diagnoses are summarised in Table 1.

2.1.3. Aggravating factors

Weightbearing activities that involve hip extension and single-leg loading, such as walking, running, or other movements that expose the structures of the IFS to repetitive or sustained impingement may aggravate symptoms (Lee et al., 2013) (e.g., freestyle kick when swimming, repetitive hip extension in barré class in ballet).

Individuals with IFI often tolerate sitting well, as this position opens the IFS. This contrasts with presentations of hip OA and proximal hamstring tendinopathy, where sustained sitting is provocative (Grimaldi et al., 2024; Nasser et al., 2021b). Although, if the proximal hamstring tendon or the sciatic nerve are repeatedly impinged in the IFS, they may become sensitised to the direct compression of sitting (Nasser et al., 2021a, 2021b). A thorough physical examination is essential to identify all contributing sources of symptoms (Gómez-et al., 2018).

2.2. Physical examination

2.2.1. Postural and movement assessment

The hip has an intimate relationship with spinal and lower limb alignment, making dynamic assessment essential for understanding how everyday postures and movements affect the IFS (Gómez-et al., 2016a).

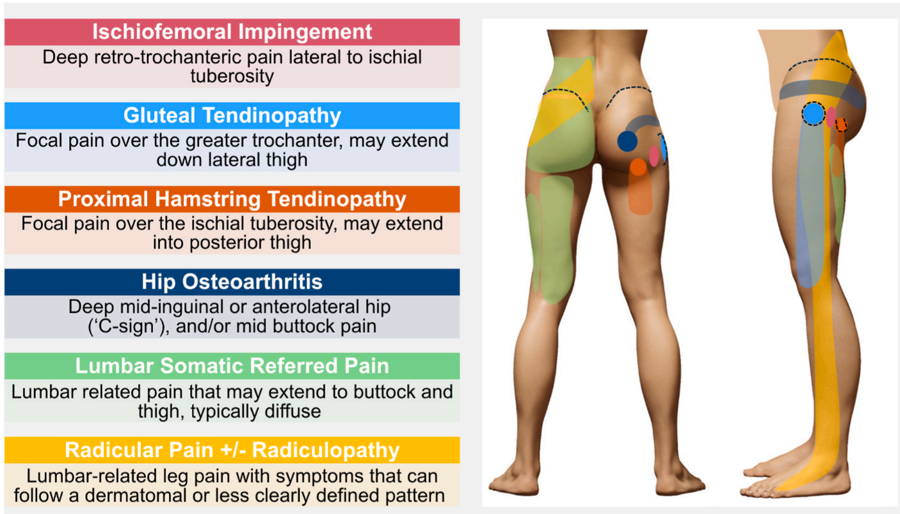


Fig. 2. Typical pain locations associated with ischiofemoral impingement and common differential diagnoses.

Table 1
Common features of key differential diagnoses.

Condition	Common demographics	Common interview features	Physical examination features	Associated imaging findings
Ischiofemoral Impingement	- Middle aged females - Athletes/Performing artists that require large amounts of hip extension in their sport - Those with acetabular dysplasia - Post-Total Hip Arthroplasty	- Retro-trochanteric pain aggravated by standing, walking or running, particularly with long strides, and other repetitive hip extension tasks. - Clicking/grating in mid-late stance phase of gait. - Sitting is usually pain free. - Paraesthesia only if sciatic nerve involved.	- Retro-trochanteric pain on long stride walking and/or IFI test - Hip ROM usually maintained, but may have restricted hip extension, especially in hip neutral/ADD ± hip ER	- MRI: Reduced IFS (≤15 mm) ≤15 mm (77% sensitivity, 81% specificity)(Singer et al., 2015); Reduced QF space: ≤10 mm (78% sensitivity, 74% specificity) (Singer et al., 2015); QF oedema; possible muscle atrophy. - X-ray: Associated structural pelvic or femoral factors may be visualised.
Proximal Hamstring Tendinopathy	- Middle aged runners - Field athletes - Dancers - Post-menopausal women	- Ischial pain aggravated by sitting and tasks that involve high hip flexion particularly with knee extension: walking/running with long strides or uphill; hip hinging movements such as deadlift. - Paraesthesia only if sciatic nerve involved.	- Ischial pain on tests that load the hamstrings, particularly in positions of stretch: bent knee stretch/modified-bent knee stretch test, Puranen-Orava Test, resisted knee flexion at 90deg of hip flexion, single leg supine-plank. (Cacchio et al., 2012) - May be tender on ischial palpation.	- MRI: Increased T2 signal at proximal hamstring origin; tendon thickening/partial tendon tears; possible peritendinous oedema. - US: Hypoechoic tendon changes; tendon thickening; calcifications; doppler hypervascularity.
Gluteal Tendinopathy	- Post-menopausal women - Post-partum women - Those with acetabular dysplasia	- Trochanteric pain aggravated by sidelying, stair climbing, walking/running with long strides or uphill, standing on one leg; prolonged sitting. - May experience 'start-up' pain on first steps, but without stiffness.	- Trochanteric pain on tests that load the hip abductors, particularly in positions of stretch (ADD): 30 s single leg stance test, resisted abduction, FADER-R/De-rotation test. (Kinsella et al., 2024) - Tenderness on palpation of the greater trochanter. - Normal hip ROM	- MRI: Increased T2 signal at gluteus medius/minimus tendon insertion; tendon thickening/tendon tears; associated trochanteric bursal fluid. - US: Hypoechoic tendon changes; tendon thickening; cortical irregularity; calcifications; doppler hypervascularity.
Hip Osteoarthritis	- Middle aged and older adults - Younger adults with risk factors (e.g., cam morphology or acetabular dysplasia, generalised ligamentous laxity, post traumatic dislocation)	- Groin or C-Sign pain and/or mid-buttock pain aggravated by deep hip flexion (squatting, sitting), and walking, particularly long distances or with large strides. - Pain and stiffness on rising from sitting and from bed. - Progressive loss of hip ROM; difficulty with shoes and socks.	- Groin or C-Sign pain and range restriction on dynamic hip flexion tasks such as squatting, FADIR, Scour, and FABER tests. - Decreased global hip ROM.	X-ray: hip joint space narrowing; osteophytes; subchondral sclerosis. MRI: Cartilage loss, bone marrow lesions, labral pathology.
Referred Pain from the lumbar spine	- Common across demographics	- Lumbar and/or referred leg pain aggravated by tasks involving lumbar flexion (e.g., bending); prolonged sitting/standing; lifting; twisting of the trunk. - No paraesthesia if somatic referred but often present with radicular pain.	- Lumbar and/or referred leg pain on active or passive ROM of the lumbar spine. - May be tenderness ± referred symptoms on lumbar joint palpation. - Neurological examination may be positive with radicular pain.	- MRI or CT Scan (Lumbar): Disc injury/degeneration; facet arthropathy; spinal nerve root compression.

Note: Imaging findings alone are not diagnostic and many imaging features are present in people without pain. Correlations with clinical findings is essential. Abbreviations: ROM: Range of Motion; IFI: Ischiofemoral Impingement; ADD: Adduction; ER: External Rotation; MRI: Magnetic Resonance Imaging; IFS: Ischiofemoral Space; FADER-R: Flexion Adduction External Rotation-Resisted; FADIR: Flexion Adduction Internal Rotation; FABER: Flexion Abduction External Rotation.

Observing tasks such as single-leg stance, squatting, walking, stair negotiation, and running often reveal deficits in frontal plane control, such as excessive lateral pelvic shift or pelvic drop. Additional movement patterns that increase hip extension and therefore reduce the IFS in the sagittal plane are commonly observed in IFI. Overstriding, whether during walking or running, naturally increases hip extension. Excessive anterior pelvic translation relative to the base of support ("leading with the pelvis") and posterior pelvic tilt can also increase hip extension independent of stride length.

Change in spinal position associated with ageing or pathology may also contribute to the degree of hip extension used in weightbearing function. For example, individuals with lumbar stenosis will often instinctively reduce lumbar extension to relieve symptoms (Lurie and Tomkins-Lane, 2016). This can include adaptive posterior pelvic tilt, which serves to reduce lumbar extension, but increases hip extension, thereby reducing the IFS. Similarly, age-related increases in thoracic kyphosis may be accommodated in some individuals by translating the pelvis forward, hinging the hips into more extension to bring the upper trunk and head into a more vertical position. This adaptation will once again reduce the IFS. These relationships between spinal and hip positioning should be observed and considered in any intervention.

Clinicians can apply treatment-direction tests, evaluating whether modifying postural or movement patterns alleviate symptoms (Gómez-et al., 2016a). Simple test-retest strategies, like reducing hip extension associated with anterior pelvic shift or posterior pelvic tilt, and/or hip adduction associated with lateral pelvic tilt and/or shift can help maintain the IFS and reduce discomfort. These observations can be used as educational tools during rehabilitation, helping patients understand how their pain can be modified, which may enhance self-efficacy, reduce fear of movement and help patients understand the rehabilitation plan.

2.2.2. Diagnostic tests

To date, two pain provocation tests using combinations of hip extension and adduction, have been described for the diagnosis of IFI: the ischiofemoral impingement test and the long-stride walking test (Gómez-et al., 2016a) (See Fig. 3 for test technique detail and diagnostic test accuracy metrics). These tests have been reported to have good diagnostic utility. When the tests were positive, both tests moderately increased the likelihood of a diagnosis of IFI, confirmed through pain relief after injection and/or surgery. Negative test results reduced the likelihood of having IFI to a small degree for the IFI test and a large degree for the long-stride walking test (Gómez-et al., 2016a). Careful interpretation of results is recommended due to the retrospective, non-blinded, case-controlled nature of this study with small participant numbers (n = 30).

2.2.3. Screening for other differential diagnoses

The physical examination will also include assessments that help exclude or identify other potential pain sources (Table 1). Spine related leg pain (including somatic-referred pain, radicular pain without radiculopathy or radicular pain with radiculopathy)(Schmid et al., 2023) should be considered. In this context, initial screening typically includes standing active range of motion (± overpressure) and palpation (passive accessory intervertebral movements), together with a neurological examination to help exclude radiculopathy. Clinicians should recognise that symptoms may present outside classic dermatomal territories, and this does not rule out an entrapment neuropathy (Schmid et al., 2018/02). Likewise, clinicians should be aware that neurodynamic tests, such as the straight leg raise, can also test negative even when nerve dysfunction is present (Baselgia et al., 2017; Boyd et al., 2010).

The sacroiliac joint may be screened using a cluster of provocation tests, where negative findings reduce the likelihood of sacroiliac joint involvement (92% sensitivity) (Saueressig et al., 2021). Palpation of the greater trochanter, when combined with a negative resisted abduction test, demonstrates high sensitivity and can be used to reduce the likelihood of gluteal tendinopathy when negative (Kinsella et al., 2024). Similarly, proximal hamstring tendinopathy is considered unlikely in the presence of a negative modified bent-knee stretch test (sensitivity 89%) (Cacchio et al., 2012). The flexion-adduction-internal rotation test (FADIR) and flexion-internal rotation tests demonstrate high sensitivity for excluding labral tears (FADIR sensitivity 0.99; flexion–internal rotation sensitivity 0.96) (Reiman et al., 2013) and are commonly used to exclude other causes of intra articular pathology, such as hip osteoarthritis.

2.2.4. Assessment of contributors and key impairments for targeted rehabilitation

Assessment of hip abductor capacity is critical due to its influence on frontal plane control and ability to maintain adequate IFS during dynamic tasks such as gait. DiSciullo et al. described two cases of dynamic IFI developed secondary to hip abductor insufficiency that resulted in a Trendelenburg gait pattern (DiSciullo et al., 2018). Testing the external rotators may highlight pain inhibition and loss of function related to impingement of the QF. Given the influence of surrounding musculature

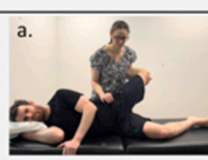
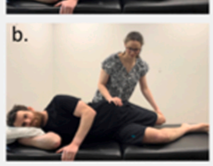
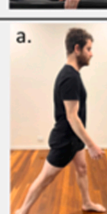
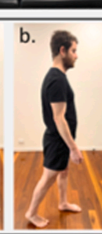
Clinical Test	Position	Description	Diagnostic Utility Information[20]
Ischiofemoral Impingement Test	a.  b. 	a. Patient is positioned in side-lying. The hip is passively extended in a neutral or adducted hip position. This reproduces dynamic impingement of tissues within the IFS. b. The hip is then passively extended in an abducted hip position. This aims to increase the IFS and confirm that pain provocation is associated only with combined hip extension and adduction.	Sensitivity: 0.82 (95% CI 0.56–0.95) Specificity: 0.85 (95% CI 0.54–0.97) + Likelihood ratio: 5.35 (95% CI 1.47-19.52) – Likelihood ratio: 0.21 (95%CI 0.07-0.60)
Long Stride Walking Test	a.  b. 	a. The test aims to reproduce symptoms during walking with exaggerated hip extension. Long strides reduce the IFS and may provoke pain lateral to the ischium. b. When repeated with short strides, symptoms should typically ease.	Sensitivity: 0.94 (95% CI 0.69–0.99) Specificity: 0.85 (95% CI 0.54–0.97) + Likelihood ratio: 6.12 (95%CI 1.70-22.01) – Likelihood ratio: 0.07 (95%CI 0.01-0.48)

Fig. 3. Diagnostic tests for ischiofemoral impingement. IFS: Ischiofemoral Space.

on maintaining optimal joint positioning during functional tasks, it may also be relevant to test the capacity of other hip muscle groups, including the hip flexors and extensors, and look for kinetic chain contributors to movement impairments associated with dynamic reduction of the IFS.

Relative mobility of the thoracic and lumbar spine in comparison to the hip, especially in extension, may also be important to assess in the patient who presents with increased thoracic kyphosis and/or reduced lumbar lordosis, both commonly associated with increased hip extension in standing.

As discussed earlier, skeletal variations such as increased femoral anteversion can significantly influence the dynamics of the IFS (Gómez-et al., 2016b). Screening for femoral malversion involves assessing hip internal versus external rotation range of motion, with a difference of more than 20° increasing the likelihood of malversion. When indicated, Craig's test can help identify increased femoral anteversion (Uding et al., 2019). Imaging modalities such as CT or MRI may be warranted to quantify the anatomical variation.

2.3. Imaging

Imaging can play a role in diagnosis and in identifying predisposing anatomical factors discussed above (Heimann et al., 2025). MRI is considered the gold standard due to its ability to quantify the IFS and evaluate the QF muscle (Torriani, 2025/02). Imaging based diagnosis of IFI typically includes a narrowed IFS on axial MRI with associated oedema within QF (Torriani, 2025/02).

Plain radiographs can rule out hip OA and identify bony features such as altered femoral or ischial morphology. While X-rays are often normal in IFI, osseous changes, like sclerosis or cystic changes at the lesser trochanter and ischium may be seen (Torriani, 2025/02). Ultrasound imaging offers a dynamic and accessible alternative for evaluating the IFS and QF muscle in real time, although it lacks the detail of MRI (Manske et al., 2024).

Imaging findings should always be interpreted in clinical context. Soft tissue changes, including fatty infiltration, oedema, and variability in the IFS and QF morphology can occur in asymptomatic individuals (Maraş et al., 2015). If clinical assessment strongly suggests IFI, a trial of non-surgical management may be initiated without imaging. If symptoms do not respond to treatment within 6–12 weeks, imaging may then be undertaken. Imaging should be considered earlier where symptoms arise following surgery, trauma or in the presence of severe pain. MRI will usually be the imaging modality of choice, due to its ability to both assess structures within the IFS and screen for other pathologies in the hip and pelvic region. X-rays may be warranted where there is a need to gain more clarity on structural (bony or prosthetic) contributors.

3. Management

Management strategies for IFI are largely informed by low-level evidence and expert clinical reasoning. Current literature includes case reports and small case series, with no randomised clinical trials currently available. Surgical and injection-based interventions are more commonly detailed, while physiotherapy management is generally addressed superficially, often limited to brief mention of stretching and strengthening of hip muscles, without elaboration on specific protocols or rationale (Gollwitzer et al., 2017; Nakano et al., 2017).

In the absence of high-level evidence, this section outlines current knowledge on management of IFI and proposes a load management and exercise-based rehabilitation framework informed by pathomechanical principles and clinical experience. A similar approach of specific educational and exercise strategies aiming to reduce exposure to provocative positions or actions for symptom relief, while improving load tolerance of the target tissues has been used in the management of other soft tissue related hip conditions, such as gluteal tendinopathy (Mellor et al., 2018) and proximal hamstring tendinopathy (Rich et al., 2025).

3.1. Load management

The principles of load management for IFI focus on reducing exposure to positions and movements that cause compression of soft tissues within the IFS. This includes strategies to reduce sustained or repetitive exposure to combined hip extension, adduction, and external rotation (Lee et al., 2013; Yanagishita et al., 2012).

3.1.1. Managing sustained loads

Sustained positioning of soft tissues in postures where the IFS is narrowed can be a significant contributor to IFI-related pain. As such, addressing postural contributors is a key component of load management across all three anatomical planes.

3.1.1.1. Sagittal plane considerations. Postural training aims to reduce sustained hip extension associated with anterior translation and posterior tilt of the pelvis. Simple cues such as 'grow tall' or biofeedback using a mirror to encourage the patient to bring the ankle, hip (greater trochanter) and shoulder into a more vertical alignment, may be helpful. The overarching goal is not to enforce a rigid posture, but simply to reduce IFS compression adequately to alleviate symptoms.

Some individuals may find it difficult to achieve a less extended hip position due to other biomechanical contributors. For example, increased thoracic kyphosis, commonly seen in older women, may result in a more anteriorly translated pelvis as a compensatory mechanism to bring the centre-of-mass back over the base of support. In such cases, improving thoracic extension mobility and strength is warranted. Conversely, individuals who stand in relative posterior pelvic tilt may present with limitations in lumbar extension mobility and hamstring flexibility. Addressing these contributors may be necessary, alongside the postural training strategies.

Some contributors to IFI may need to be accommodated rather than corrected. For example, there may be limited scope to improve pelvic position in a patient with posterior pelvic tilt related to lumbar stenosis and secondary hypolordosis. While it is still worthwhile optimising lumbar mobility, reducing retro-trochanteric pain associated with IFI may need to focus more on controlling loads in the coronal and axial plane. Standing with a slightly wider base of support may provide some relief, where IFS cannot be adequately restored with sagittal plane strategies.

3.1.1.2. Coronal plane considerations. In the coronal plane, the priority is to address excessive hip adduction during sustained standing such as 'hanging on one hip'. This position, where weight is shifted towards one limb and the pelvis shifts laterally, results in increased hip adduction. Recommendations to increase the base of support in standing and avoiding crossing of legs will assist with increasing the IFS.

Where a true leg length difference (>1 cm) is identified and appears to be impacting on pelvic obliquity and hip adduction on the painful side, a shoe insert or external lift may be trialled. For adults with pelvic obliquity related to scoliosis, the aim would be to include regular mobility exercises, targeted spinal strengthening, and postural awareness training to minimise the pelvic asymmetry. For adolescents with a notable scoliotic curve (>20° Cobb angle)(Kaelin, 2020), referral to a specialist for consideration of bracing may be appropriate.

3.1.1.3. Axial plane considerations. The axial plane is usually the lower priority in terms of load management strategies; however, the importance may be greater in those with bony morphological features, such as excessive femoral anteversion. In these cases, standing with the knees facing forwards, will cause increased hip external rotation, and subsequent reduction of the IFS. When sustaining static standing, individuals with IFI and excessive femoral anteversion, may be more comfortable standing with a slightly toe-in or knee-in position, bringing the hip into more neutral rotation and opening the IFS.

3.1.2. Managing repetitive loads

3.1.2.1. Reducing pain provocation in gait. Walking and running are key aggravating factors for those with IFI, due to the repetitive hip extension and combinations of hip extension and adduction in mid-late stance phase of gait.

Strategies such as increasing step rate may be useful for reducing stride length and therefore, dynamic hip extension (Heiderscheit et al., 2011). Postural cues that have been helpful for the individual can be extended into gait training. Such strategies have been shown to create immediate and lasting effects on joint moments, pain and functional capacity in the presence of anterior hip pain associated with morphological (mild acetabular dysplasia) and kinematic factors (Lewis et al., 2015). Biofeedback with a mirror or video can enhance the effectiveness of gait training and help the patient visualise mechanics that provoke pain, for example a narrow step width in those with IFI.

3.1.2.2. Reducing pain provocation in other repetitive activities. Addressing other repetitive overloads will be specific to the recreational or sporting context. Exposure to repetitive hip extension, especially when combined with external rotation and/or hip adduction, should be reduced (e.g., in group exercise classes such as Pilates or yoga). Temporarily reducing kicking volume in swimming or using fins to cue a wider foot position can reduce cumulative compression. Similarly, relative rest for classical dancers may be warranted in the shorter term, while they learn how to better control pelvic tilt and translation.

It is important that educational strategies around joint position do not lead to fear-avoidant behaviours. Clinicians should ensure individuals with IFI understand that some compression of structures in the IFI is normal and not damaging, but exposure to excessive compression may contribute to symptoms. Non emotive education around simple practical strategies to reduce overall and cumulative exposure to compression (including controlling loading parameters, especially rapid changes in frequency or duration of compressive loading) should be empowering and provide individuals with useful tools to self-manage any future flares in their symptoms. Such an educational approach was linked with improved pain self-efficacy in participants of a gluteal tendinopathy randomised clinical trial (Mellor et al., 2018).

3.2. Exercise rehabilitation

There is a dearth of published literature for exercise-based rehabilitation in IFI, with available studies offering limited detail (Nakano et al., 2020). Exercise prescription should be guided by the pathomechanical principle of restoring dynamic control of the IFS.

Movement training is an essential component of rehabilitation and should be integrated alongside strength training. Training programs for functional weightbearing tasks progress from low towards higher challenge, in terms of the difficulty in maintaining the IFS dynamically. Shifting from a stable bilateral task to an offset position and then a single leg position represents a gradual increase in frontal and axial plane challenge. In offset and single leg weightbearing tasks, the muscles around one hip must predominantly or solely control the position of the centre of mass and pelvis over the femur, and therefore the IFS. Exercises typically progress from double-leg squats in which the degree of hip adduction is naturally lower and easier to control, to offset squats, single-leg stance, single-leg squats, step-ups, and eventually dynamic landing or sport-specific tasks, depending on the individual's goals.

Hip abductor strengthening is a key component of rehabilitation and will be particularly important in those with coexisting gluteal tendon pathology. Single-leg loading should be minimised in early rehabilitation, with bilateral or offset versions substituted until adequate dynamic control of the IFS is achieved. Spring-resisted sliding platforms such as Pilates reformers or portable sliders can provide high-quality resistance training in the coronal plane without the compressive loading typical of upright single-leg tasks. Home-based alternatives using slide discs and elastic resistance can be useful adjuncts, though generally provide a lower stimulus. Abductor loading will also be imparted through the progressive functional loading strategies, beginning with low-load bilateral loading to high load unilateral strategies, with the addition of external loads as appropriate (Collings et al., 2023).

Isometric strengthening of the QF in hip-flexed positions can be implemented early. In cases where the IFI is structurally reduced, the goal should be to optimise health and basic function of the QF without aggressive hypertrophy, i.e. while loading of the QF through exercise that avoids positions of provocative compression of the muscle is recommended, protocols that aim for muscle hypertrophy may be limited by the confines of the available IFS. Conversely, in cases of dynamic impingement without structural narrowing, a progressive strengthening program aimed at restoring muscle mass and capacity will be appropriate.

Hip flexor or hamstring training may be included to address relevant impairments and/or associated painful tendinopathy. Spinal mobility and strengthening may also be a key element of the intervention for some individuals.

3.3. Injection and surgical interventions

Non-surgical medical management frequently includes anti-inflammatory medications and corticosteroid injections. Case reports describe temporary pain relief following corticosteroid injection into the IFS (Nakano et al., 2020). However, medium-to long-term outcomes and potential adverse effects such as tissue degradation are unknown in this population.

Surgical management is generally reserved for recalcitrant cases or where a significant structural lesion is present. Surgical approaches include endoscopic or open resection of the lesser trochanter, or excision of bony or soft tissue masses contributing to narrowing of the IFS (Aguilera-et al., 2021; Anderson et al., 2025; Elzeiny et al., 2025; Gollwitzer et al., 2017; Nakano et al., 2020). Outcomes from case series have been generally positive in the short-to-medium term, with reductions in pain and improvements in imaging-based measures of the IFS, and low complication rates. However, outcome assessment has often relied solely on patient-reported pain or imaging findings, with limited reporting of functional outcomes. In the rare instances where strength has been assessed post-operatively, only manual muscle testing was used, limiting interpretation (Aguilera-et al., 2021; Nakano et al., 2020).

3.4. Future directions for research

Given the current lack of evidence, future research should prioritise evaluation of rehabilitation strategies for IFI. This could pragmatically begin with a prospective case series or cohort study and progress to a randomised clinical trial. In addition, high-quality diagnostic accuracy studies conducted in cohorts with multiple potential sources of buttock pain are needed to better define the value of clinical tests and assist in earlier recognition of the condition.

4. Conclusion

Effective management of IFI begins with accurate recognition, which is supported by clinical assessment and imaging. Understanding anatomical contributors as well as individual aggravating factors that narrow the IFS is essential. Rehabilitation should include postural education, movement training and strength exercises, tailored to each individual presentation and anatomical constraints. By adopting a patient-centred, biomechanically-informed approach, clinicians can improve outcomes and reduce the burden of this cause of persistent retro-trochanteric pain.

CRediT authorship contribution statement

Alison Grimaldi: Conceptualization, Writing – original draft, Writing – review & editing. **Charlotte Ganderton:** Conceptualization, Writing – original draft, Writing – review & editing. **Anthony Nasser:** Conceptualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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