Exploring Other Causes of Hip Pain Beyond Osteoarthritis in Adults: A Narrative Review and Case Series

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Abstract: Nearly 1 in 4 people will experience symptomatic hip osteoarthritis throughout their lifetime [1]. In middle aged and elderly patients, osteoarthritis remains the most recognised cause of hip pain, with over 10% of all adults being diagnosed with this condition [2]. However, there remains a gap in the accurate diagnosis of non-osteoarthritic conditions and appropriate referral to secondary care [3].

This narrative review will explore the sources and unusual presentations of 'hip pain', highlighting key diagnostic features and new evidence in the current literature, to support clinicians towards a holistic approach to the management of patients with hip pain. A case series of unusual presentations of pain around the hip has been included in the second part of this review to further highlight the differential diagnoses discussed.

Literature search was performed on PubMed and Medline using terms such as "Hip pain", "pelvic pain", groin pain", "thigh pain", "Lower back pain", "buttock pain", "Pain around the hip", and "non-osteoarthritic hip pain". All types of articles related to this subject were considered, but only articles written and published in English language were considered for the review.

1. Introduction

Around 1 in 4 people will experience symptomatic hip osteoarthritis throughout their lifetime [1]. In middle aged and elderly patients, osteoarthritis remains the most recognised cause of hip pain, with over 10% of all adults being diagnosed with this condition [2]. However, there remains a gap in the accurate diagnosis of non-osteoarthritic conditions and appropriate referral to secondary care [3]. Accurate diagnosis of the cause of hip pain can be challenging, due to the multi-structural nature of the hip and surrounding soft tissues, with many possible co-existing sources of the pain [4].

It is, therefore, imperative to consider non-osteoarthritic causes of hip pain, including musculoskeletal, neurological, inflammatory, vascular, systemic, traumatic, neoplastic, iatrogenic, or other referred sources of the pain [5, 6]. A thorough diagnostic approach is required to ensure accurate identification, and timely referral or intervention. This narrative review will explore the sources and unusual presentations of 'hip pain', highlighting key diagnostic features and new evidence in the literature, to support clinicians towards a holistic management of patients with hip pain. In addition to that, a case series of unusual presentations of pain around the hip has been included in the second part of this review to further highlight the differential diagnoses discussed.

2. Methodology

Literature search was performed on PubMed and Medline using terms such as “Hip pain”, “pelvic pain”, groin pain”, “thigh pain”, “Lower back pain”, “buttock pain”, “Pain around the hip”, and “non-osteoarthritic hip pain”. All types of articles related to this subject were considered, but only articles written and published in English language were considered for the review. These include Systematic Reviews and Meta-Analysis, Narrative Reviews, Randomised Controlled Trials, Case Controlled Studies, Case Series, Case reports, Commentaries, as well as Editorials.

3. Location and source of Hip Pain

The site of hip pain is an important clue to narrow down the aetiology of hip pain. Hip pain can be from soft tissue or bony structures and may be anterior, lateral or posterior [7]. The source of the hip pain may be intracapsular or extracapsular, with different frequencies based on the demographics of the patient [Table 1] [5]. However, some causes of hip pain do not strictly fit into any of these well-defined categories.

Table 1: Comprehensive Table: Intersection Of Hip Pain Location, Source (Intra-Articular Vs. Extra-Articular) With Age Group

Location Of Hip Pain	Intra-Capsular Sources	Extra-Capsular Sources
Anterior Hip Pain	Osteoarthritis (Middle-Aged, Older 65+)	Hip Flexor Muscle Strain (Young, Middle-Aged)
	Acetabular Labral Tear (Young, Middle-Aged)	Iliopsoas Bursitis (Middle-Aged, Older 65+)
	Femoroacetabular Impingement (Fai) (Young, Middle-Aged)	Referred Pain From Lumbar Spine (Older 65+)
	Avascular Necrosis Of Femoral Head (Middle-Aged, Older 65+)	Proximal Femur Fracture (Older 65+)
	Inflammatory Arthritis (E.G., Rheumatoid Arthritis) (Young, Middle-Aged)	
Lateral Hip Pain (Lateral Hip Syndrome)	Osteoarthritis (Referred Pain) (Older 65+)	Greater Trochanteric Pain Syndrome (Gtps) (Middle-Aged, Older 65+)
		Gluteus Medius/Minimus Tendinopathy (Middle-Aged, Older 65+)
		Iliotibial Band Syndrome (Young, Middle-Aged)
		Trochanteric Bursitis (Middle-Aged, Older 65+)
		Meralgia Paraesthetica (Middle-Aged, Older 65+)
Posterior Hip Pain	Hip Labral Tears (Posterior Tears) (Young, Middle-Aged)	Piriformis Syndrome (Young, Middle-Aged)
	Referred Pain From Lumbar Spine (Disc Pathology, Nerve Compression) (Older 65+)	Sacroiliac Joint Dysfunction (Middle-Aged, Older 65+)
	Sacroiliac Joint Inflammation (Overlap With Intra-Articular Causes) (Middle-Aged, Older 65+)	Hip Extensor Or Rotator Muscle Strain (Young, Middle-Aged)
	Septic Arthritis (Acute Onset, Potentially Diffuse Pain In Older Adults) (Older 65+)	Hamstring Tendinitis
Miscellaneous Group (Pain From The Hip & Surrounding Structers	**Tumor:** Primary Or Metastatic **Pelvic:** Tumours Or Masses **Trauma:** Stress, Insufficiency, Or Pathological Fractures **Iatrogenic:** Failed Metal Work, Previous Surgery/Implants **Fused Hip:** Infection, Pseudoarthrosis, Fracture	

3.1 Anterior Hip Pain

3.1.1 Intra-Capsular Causes of Hip Pain

Acetabular Labral Tear: Over 90% of patients with labral tears present with progressive insidious intermittent sharp or dull anterior hip pain which may radiate to the thigh, buttock or lateral hip [8]. Patients may experience popping sounds, sensation of locking or giving way [9]. These symptoms can lead to functional limitations due to aggravation of pain when walking upstairs, walking long distances and prolonged sitting [10]. The history may elucidate excessive repetitive motion, sports-related or traumatic injury. Hence, labral tears are more prevalent in young patients performing mechanical activities such as running, dance, gymnastics and football [11].

Labral tears occur due to abnormal cam morphology from bony overgrowth of the femoral head and neck, Pincer deformity from excessive acetabular coverage of the femoral head, or a mix of both [12, 13]. Iliopsoas tendon tightness against the anterior capsulo-labral structures can cause snapping during hip rotation and acetabular labral tears in the three o'clock position [14]. However, up to 74.1% are not associated with any specific cause [15].

The Flexion-Adduction-Internal Rotation (FADIR) test for posterior impingement, is the most consistent test used to assess labral tears [16]. This involves the patient lying down supine with hip and knee flexed at 90 degrees. A positive test is pain on internal rotation of the hip while adduction force is applied by the examiner. It may also be tested using the Flexion-Abduction-External Rotation (FABER) [16], which is used to assess for anterior impingement. Imaging is critical in the diagnosis of acetabular labral tears. Magnetic Resonance arthrography provide the best quality of imaging for the diagnosis with up to 91% accuracy [17], but a standard MRI scan may also give enough information, to confirm the diagnosis [23].

The standard management of labral tears is conservative therapy composed of rest, reduced weight bearing, analgesia, anti-inflammatory medications and physical therapy for 10-12 weeks [16, 18]. For older patients or patients with degenerative changes Intra-articular steroid injection may also be used as an adjunct [18]. If conservative treatment is unsuccessful, arthroscopic surgery can be offered to the patient. Indications for surgery depend on the patient's age, baseline function and the specific causes of the impingement or hip pain; associated osteoarthritic change is a poor prognostic indicator for surgery [18]. Labral repair is the gold standard to treat labral tears compared to labral resection or reconstruction [19].

3.1.2 Femoroacetabular Impingement (FAI):

FAI is a common intracapsular cause of anterior hip pain in young and middle-aged adults [13]. It arises due to excessive contact between the femoral head and acetabulum as a result of abnormal hip anatomy [9]. Due to its association with cam, pincer or mixed pathology, FAI can be a precursor to labral tears and osteoarthritis due to repetitive collisions and hyperflexion between the bones, resulting in wearing of the labrum and cartilage [20]. In addition to that, athletes with pain from underlying FAI may overcompensate in their biomechanics due to reduced hip range of motion, leading to adductor tendon overload and subsequently chronic groin pain [21].

FAI is clinically tested in the same manner as labral tears utilising the FADIR or FABER tests, which when positive are indicative of intraarticular pathology [16]. However, these tests of impingement are not specific for the diagnosis of FAI or labral pathology. Standing AP and lateral Pelvic X-rays are the best initial imaging modalities to assess this pathology, but CT or MRI scans can be used to improve the diagnostic accuracy [22]. Magnetic Resonance (MR) arthrography may serve as a diagnostic tool; however, conventional MRI scan demonstrates comparable sensitivity, as it is less invasive, and more cost-effective [23].

Physiotherapy to help improve hip strength, stability and movement patterns is the main conservative management of FAI. Failing conservative treatment, hip arthroscopy for debridement of the impingement points is definitively used to treat FAI [22]. However, further description of this procedure is beyond the scope of this narrative review.

3.1.3 Avascular Necrosis (AVN) of the Femoral Head: Avascular Necrosis (AVN) or Osteonecrosis of the femoral head is an anterior cause of hip pain which tends to present in middle aged to older patients, with a mean age of presentation being 58.5 (40

– 60) years [24]. Patients typically describe a non-traumatic bilateral pain around the groin and thigh which is worsened by movement and weightbearing [25]. The pathogenesis of AVN is unclear, however, it results from inadequate microcirculation to the femoral head, causing loss of subchondral bone structure integrity [26]. There are various risk factors which are associated with AVN [27-29]:

- Iatrogenic: Long term Corticosteroid use, Chemotherapy, immunosuppression, Antiretroviral treatment, previous surgery
- Lifestyle - Alcohol abuse and smoking
- Obesity and Hypercholesteremia
- Genetics – Family history
- Haemoglobinopathies – Sickle Cell Disease, Thalassaemia, Protein C & Protein S Disease
- Caisson's Disease (Decompression illness)
- Autoinflammatory conditions – Systemic Lupus Erythematosus (SLE)
- Legg–Calvé–Perthes disease (Children)
- Trauma - Hip dislocation, fracture of the femoral head, extreme sports

There are a wide range of aetiologies, particularly in iatrogenic cases, that predispose and coexist in patients with AVN which makes it an easy differential to miss [29]. Early diagnosis through a very thorough clinical history, supplemented by diagnostic aids, as well as early referral to specialists, are critical to limit further bone destruction and maximise the effect of joint preserving intervention [27]. However, the definitive treatment for late or advanced stages of AVN is Total Hip Replacement (THR), especially when all other options have failed.

Clinical examination may reveal pain on internal rotation, stiffness, crepitus and limited range of motion [29]. MRI is the gold standard in the diagnosis of AVN. It helps to identify bone marrow oedema, joint effusion and patient risk of femoral head fracture, which are all key prognostic factors [27]. Furthermore, X-ray can be used to evaluate AVN, which may show the "crescent sign" – radiolucency of the subchondral tissue which indicates subchondral collapse. The Steinberg or Ficat classifications are commonly used to classify the severity of AVN [30].

Conservative management such as weight restriction is utilised in patients with pre-collapsed femoral head [31]. The goal is to delay disease progression of the AVN and relieve pain. Pharmacological agents such as bisphosphonates, anticoagulants, and statins may also be utilised, but their effectiveness is limited and most patients eventually require surgical intervention [29, 31]. Core decompression is the most common surgical procedure used in early AVN in young patients with pre-collapse disease [31]. Non-vascularised bone grafting, vascular grafting or osteotomies may also be performed. Total hip arthroplasty is the definitive treatment in patients with femoral head collapse and secondary advanced Osteoarthritis in the hip [29].

3.1.4 Rheumatoid Arthritis (RA):

Although RA typically affects small joints in hands and feet, when uncontrolled and severe it can lead to debilitating pain with progressive, irreversible destruction of the major joints [32]. The pain may present in the anterior or posterior hip and groin, with radiation to the thigh, buttocks (if sacroiliac joint involvement), or less commonly in the lateral hip due to enthesitis or bursitis. Patients typically describe bilateral symptoms of morning stiffness and reduced range of motion which is temporarily relieved by mild activity and worsened by inactivity [33]. Patients may also have associated symptoms such as fatigue, malaise, and systemic signs of inflammation [33].

RA is mediated by autoantibody production of Rheumatoid factor and anti-citrullinated proteins which cause uncontrolled release of inflammatory cytokines. This leads to invasion of hypertrophied synovial tissue, cartilage and bone [32]. Overtime, this process results in structural degradation and bone erosion causing joint space narrowing. A study showed patients with RA are four times more likely to require total hip replacement, compared to non-rheumatoid patients [34].

The American College Of Rheumatology (ACR) classification can be used as diagnostic criteria for RA [35]. A combination of the clinical features and laboratory tests for elevated CRP and ESR helps in narrowing down the differentials [36]. In addition to clinical

examination and laboratory tests, imaging such as X-ray can be used to assess for joint space narrowing and erosion, and MRI can be used to detect bone marrow oedema [32, 36].

Treatment of RA aims to reduce or prevent the progression of structural changes to the joints and reduce physical disability. Disease Modifying Antirheumatic Drug (DMARD) therapy is the mainstay of RA treatment initiated following diagnosis [33]. Short term glucocorticoids and NSAIDs to reduce inflammation, pain and stiffness [33].

3.1.5 Hip Flexor Muscle Strain:

Hip flexor Muscle strain may occur due to repetitive use, trauma, or suboptimal biomechanics of the hip flexor muscle groups [37]. These include the Iliopsoas as the primary muscle, with supporting muscles such as the rectus femoris, tensor fasciae latae (which eventually inserts into the iliotibial tract) and sartorius [38]. Hip flexor muscle strain can occur due to rapid acceleration or deceleration, leading to microtears and inflammation of the hip flexor muscles over time especially in young athletes [38].

Patients typically describe pain and tenderness in the anterior hip/groin area which may radiate to the thigh. This might be associated with swelling and muscle spasms. The pain may be of a sharp or stabbing nature during acute phase or dull pain in chronic cases. These symptoms lead to functional impairment such as difficulty running, walking, or climbing stairs, all worsened due to motion of hip flexion [39].

Physical examination involves a positive Thomas test where patients will experience pain on extension of the affected leg while the unaffected leg is flexed towards chest by the patient [5]. To assess the severity of the hip flexor strain and if muscle or tendon tears are involved, MRI or ultrasound scans can be employed [39].

Treatment involves conservative and self-help techniques initially. The patient is advised to rest the affected leg, apply ice intermittently for 2-3 days with compression and elevation [37]. Simple analgesia such as Ibuprofen can be used by the patient, to reduce inflammation and pain. Ultrasound-guided corticosteroid injection may also be used to provide relief [39]. Physiotherapy can be prescribed to help stretch and strengthen the hip flexors, improve hip flexibility and learn optimal biomechanics [37, 40]. In cases where there is complete tear of the hip flexor muscle fibres or tendon, surgery may be required as a last resort to repair the affected structure [39].

3.1.6 Iliopsoas Syndrome:

Iliopsoas syndrome is characterised by pain associated with the iliopsoas complex which includes the iliopsoas muscle, tendon, or bursa. Iliopsoas syndrome encompasses iliopsoas tendinopathy, impingement, bursitis or internal hip snapping syndrome [37]. Primary Iliopsoas syndrome typically occurs in athletes such as ballet dancers, runners, or football players due to overuse or trauma [41, 42]. It may also occur secondary to hip arthroplasty or arthritis of the hip [37].

Patients typically present with deep aching pain in the anterior hip or groin aggravated with long standing, hip flexion or external rotation movements [43]. It may be associated with tenderness, stiffness, weakness, and functional limitations during exercise. Some patients may experience audible or palpable snapping during movement, due to the iliopsoas tendon snapping over the bony hip prominence or muscle belly [41]. One study showed that about half of patients may also report some lower back pain [44].

Iliopsoas bursitis is characterised by accumulation of synovial fluid in the bursa, which may be isolated due to mechanical stress from overuse, or be complicated by arthritic degeneration, osteonecrosis of the hip or inflammation [39].

A comprehensive physical examination including examination of the spine and pelvis should be performed. Patients may have a limp or shuffling gait, and present with tenderness on palpation of the lesser trochanter [43]. Thomas test is typically used to assess the iliopsoas muscle, which may demonstrate tightness on hip flexion, or resistance of hip flexion when the hip is externally rotated [5]. Manual testing of the hip range of motion should be performed in all planes and any asymmetry should be noted. Hip impingement examinations can be used to rule out intracapsular pathology such as labral tear or arthritis.

Due to the similarity in presentations, iliopsoas syndrome may mimic hip arthritis or labral tears. Ultrasound (US) is an important investigation to show if the pathology is intraarticular or extraarticular [45]. A lidocaine challenge can be performed to investigate tendonitis. This involves injecting lidocaine into the psoas tendon, a positive result of reduced pain suggests iliopsoas tendinitis

[46]. For bursitis, it would show enlargement of the iliopsoas bursa. MRI scan may also be used if ultrasound is unclear or patients do not respond to conservative management [42].

Management of iliopsoas syndrome begins with conservative measures such as physiotherapy and NSAIDs [44]. If unsuccessful, US or x-ray guided corticosteroid injection can be used as previously described for the diagnostic and therapeutic benefit. Finally, surgery may be considered in cases where the psoas tendon needs to be directly released if the condition is refractory and/or disabling [43].

3.2 Lateral Hip Pain (Lateral Hip Pain Syndrome)

3.2.1 Intracapsular Causes of Lateral Hip Pain

Osteoarthritis

Osteoarthritis is a degenerative, chronic and progressive joint disease that affects multiple components such as articular cartilage, ligaments, subchondral bone and synovium [47, 48]. It commonly affects the knee, hips, and small joints of the hands. While osteoarthritis is often recognised as age related “wear and tear”; however, it is further mediated by inflammatory factors leading to joint remodelling [49]. Alongside age, risk factors such as genetics, gender, history of joint trauma, obesity and mechanical factors all contribute to the development of osteoarthritis [47, 48, 50].

Patients with hip osteoarthritis typically describe pain around the anterior and lateral hip which may be referred to the lower thigh or knee. The pain is classically aggravated by weight bearing activity, but is relieved when at rest, and in severe cases, the pain may be present at rest or at night [48, 49]. The patient may also have joint stiffness, swelling and loss of function of the hip [48, 49]. This results in imbalance in muscle function around the hip, gluteus medius strain, inflammation of the bursa (trochanteric bursitis) and a positive Trendelenburg gait [51].

Physical examination of hip osteoarthritis may reveal tenderness around the hip, pain crepitus on movement and the patient may have a fixed flexion deformity and Trendelenburg gait due to weakness in gluteus muscles [50].

Imaging is a critical diagnostic tool for osteoarthritis, X-ray analysis shows signs of loss of joint space, osteophyte formation, subchondral cysts and subchondral sclerosis [49]. Kellgrens scale may be used to grade the severity of the hip osteoarthritis from radiographs [49]. Other imaging modalities such as MRI and CT are not required but may be used to identify secondary causes, rule out other differentials or for pre-surgical planning [49, 50, 52]. Blood and lab tests such as Rheumatoid Factor (RF), Anti-Citrullinated Protein Antibodies (ACPA), C-reactive protein (CRP), and Erythrocyte Sedimentation Rate (ESR) may also be ordered to rule out other conditions such as rheumatoid arthritis [36].

Diagnostic hip injection can be used to differentiate the causes of lateral hip pain syndrome [53]. If the injection relieves the pain, then treatment for the hip OA can be offered such as Total Hip Replacement (THR) [53]. However, if the injection does not yield therapeutic improvement, this could suggest the presence of a partial tear or atrophy of the gluteus medius muscle. Such pathology may contribute to the development of trochanteric bursitis and results in a positive Trendelenburg gait, necessitating more targeted treatment strategies focused on addressing the underlying muscular dysfunction [54]. Specific management options include physiotherapy, pain management, injection of local anaesthetic into the bursa, or as a last resort, surgical debridement of the bursa with repair of the torn gluteus medius muscle [50].

Addressing lifestyle factors is important in holistic management of osteoarthritis. The patient should participate in exercise and physiotherapy to strengthen and stretch the muscles around the hip and maintain hip mobility [50]. These should be relatively low impact as swimming, cycling rather than twisting or high impact exercises such as jogging or playing golf [50]. Weight loss is an important aspect of management to reduce pressure on hip, which is a benefit from regular exercise and positive dietary modification. For activity, appropriate footwear, bracing and assistive devices (e.g. sticks and frames) should be used as applicable to maintain independence [49, 50]. Medications such as NSAIDs can be used for analgesia, and intraarticular injection (corticosteroid, hyaluronic acid or platelet rich plasma injections) can be considered; however the evidence for these remains limited [53, 55]. The

main surgical modality for patients for whom conservative measures have failed is Total Hip Arthroplasty (THA). Hip arthroscopy can be performed in early osteoarthritis [53, 55].

3.3 Extracapsular causes of Lateral Hip Pain

3.3.1 Greater Trochanteric Pain Syndrome (GTPS)

GTPS is a common extracapsular cause of lateral hip pain, seen mostly in middle aged patients [40-60], particularly female patients [56]. Patients typically describe a pain localised to the area of the greater trochanter, worse upon weightbearing activities and exercise (commonly running). There might also be radiation of the pain from the thigh to the knee [57]. GTPS encompasses conditions such as gluteal medius and minimus tendinopathy, trochanteric bursitis, and external snapping hip dysfunction [5, 58].

Upon physical examination, patients classically have localised tenderness on deep palpation over the lateral hip (jump sign) [57]. The patient may also display a positive Trendelenburg sign or a Trendelenburg gait and may have abductor dysfunction. Specific diagnostic tests such as FABER and FADIR tests can be used as adjuncts to increase load on the gluteus medius and minimus, to elicit the hip pain. In addition to that, the 'step up and down test' can be used to assess the functional limitation that GTPS patients present with [59].

Diagnosis involves use of imaging such as X-ray, US, and MRI. X-ray is normal in GTPS but rules out other common differentials such as OA and fractures. Second line investigations involve use of US to check for fluid filled bursa or tears of the tendons. MRI would provide more detail but should only be used in correlation with the clinical picture [60].

Conservative measures such as NSAIDs, activity modification, physiotherapy and weight loss are first line in the management of GTPS. Corticosteroid injections can be used if these are ineffective. There is some role for shock wave therapy however the evidence remains limited. Surgery may be considered if symptoms are refractory or fail conservative measures [59].

3.3.2 Iliotibial Band Syndrome (ITBS)

Iliotibial band syndrome is the most common running injury due to repetitive flexion and extension activities [61]. The pain is typically felt on the lateral side of the knee and less commonly around the lateral hip [61]. The knee pain is caused by impingement of the distal ITB over the lateral femoral epicondyle, and the hip pain is caused the movement of the ITB across the greater trochanter of the ipsilateral proximal femur [62, 63]. Patients with hip pain may describe a deep ache and tightness in the lateral hip. In the knee, patients typically describe a sharp or burning pain superior to the knee joint [64].

Studies show that weakness in hip abductor muscles contributes to improper biomechanics, leading to increased tightness of the ITB [65]. This tightness may lead to compression of gluteal tendons and the greater trochanteric bursa contributing to pain and inflammation seen in GTPS [66]. The knee pathology may also result from valgus OA, which leads to some mal-tracking of the patella and tightness of the ITB, resulting in contracture of the ITB and subsequent proximal trochanteric pain around the ipsilateral hip [67].

Ober test can be used to assess for tightness in the iliotibial band [62, 64]. This involves tension and tightness by flexing the affected leg to 90 degrees at the knee and adducting at the hip. The test is positive if the leg remains elevated when dropped passively. Noble compression test and modified Thomas test can also be used to evaluate for ITB tightness [62]. ITBS is a clinical diagnosis, and further imaging is not usually necessary, however, imaging such as US and MRI may be used to further investigate to exclude intracapsular problems [64].

The management of ITBS in general is mostly conservative such as activity modification, use of proper running shoes, stretching and using NSAIDs for pain management [61]. For patients with valgus knee, diagnostic injection of local anaesthetic can be done around the Gerdy's tubercle to relieve the pain around the lateral part of the fascia lata around the knee joint [68, 69]. As a last resort, surgical intervention such as tibial tubercle transfer can be used to improve the patella tracking and tightness of the fascia lata around the knee joint and also to improve the Q angle of the extensor mechanism of the knee [70]. These procedures help to improve the trochanteric pain around the ipsilateral hip. Alternatively, the ITBS may improve if the patient with valgus knee OA subsequently gets a Total Knee Replacement (TKR) for their knee OA [64]. The TKR will restore the mechanical alignment of the lower limb, which will improve the tightness around the ITB, thereby relieving the lateral knee pain.

3.3.3 Meralgia Paraesthetica

Meralgia Paraesthetica is a syndrome which typically occurs in middle aged patients [7]. The condition occurs due to the compression of the lateral femoral cutaneous nerve at the level of the inguinal ligament, resulting in sensory symptoms such as numbness, dysesthesia, paraesthesia, and burning sensation [71]. These symptoms can be worsened by wearing tight fitting clothing, activities involving prolonged hip extension or increase intra-abdominal pressure [72].

Meralgia paraesthetica can occur spontaneously or be iatrogenic. Spontaneous causes are associated with risk factors such as obesity, diabetes, alcohol abuse, hypothyroidism, pregnancy, and lead poisoning [71, 73]. Surgical repair of structures around the hip and pelvis may lead to iatrogenic cause of the condition if the lateral femoral cutaneous nerve is damaged or compressed for any reason [71].

Physical examination manoeuvres for meralgia paraesthetica include the pelvic compression test [74]. This involves applying pressure to pelvis for 45 seconds to the affected side while the patient lies on the unaffected side. The test is positive if symptoms reduce. Examination should also include a thorough lower neurological examination, to rule out any other deficits or abnormalities [74]. Diagnosis of the condition is generally clinical, however in cases where tumour or metabolic problems are the root cause of the symptoms pelvic X-ray, US or MRI may be used as applicable [73].

Meralgia paraesthetica is usually a self-limiting condition, therefore patient education and reassurance is important in the initial management [72]. Medication such as NSAIDs, topical capsaicin can be helpful to reduce hypersensitivity. If these fail, then anticonvulsants such as gabapentin may be used for the neuropathic symptoms. Nerve block injection may also be considered. Surgical decompression is rare but can be performed in chronic and refractory cases [75].

3.4 Posterior Hip Pain

3.4.1 Intracapsular causes of Posterior Hip Pain

Referred Pain from Lumbar Spine (Posterior hip pain)

In some cases, patients present with posterior hip/groin pain with associated pain in the lower back, gluteus, groin, thigh, and knee. The overlapping of symptoms presents a diagnostic challenge, which might delay correct diagnosis and treatment. These symptoms may be due to isolated pathologies in each joint or anatomical region; however, they may be interdependent, secondary, or mimic other pathologies [6, 76]. In the lumbar spine, conditions such as lumbar foraminal or central stenosis, radiculopathy from a disc prolapse, or scoliosis can cause hip imbalances and pain [77]. In older patients, often with degenerative spinal conditions, radiculopathy may lead to referred pain in the hip or groin [58]. In addition, patients may describe muscle weakness, numbness, tingling or burning sensation in a dermatomal pattern [58].

Physical examination should involve a comprehensive hip and spinal evaluation. Along with a general hip examination, it is important to observe the posture, gait, muscle atrophy, pelvic obliquity, lower limb discrepancy and alignment to investigate spinal involvement [5]. In spinal exam, relief of pain upon a forward bend may indicate lumbar stenosis or instability in spine [78]. Walking on toes and heels may help identify weakness in L4 or S1 nerve involvement [58]. A Trendelenburg gait or positive test may also indicate L5 radiculopathy due to lack of innervation of gluteus maximus and minimus [58]. More specific physical examinations for lumber radiculopathy include the straight and contralateral leg test and femoral nerve stretch test [5, 58, 78]. However, the details of these tests are beyond the scope of this review.

To investigate spinal pathology, radiographs should be performed in AP and lateral views [78]. MRI and CT can be used as a second line. MRI can demonstrate nerve root compression, infection, epidural lesions, disc herniation, pathology in lumbar spine or paraspinal muscles [79]. CT scan can be used to assess fusion, spondylolisthesis, tumours or stress fractures [79]. Other tools such as CT myelogram and nerve conduction study can be utilised to aid diagnosis [78]. Treatment is aimed at the underlying lumbar spine disease, physical therapy, pain management, activity modification, and surgery for serious or disabling symptoms can be considered [78]. Further details of these treatment options are beyond the scope of this narrative review.

3.4.2 Extracapsular causes of Posterior Hip Pain

Sacroiliac Joint Inflammation and Dysfunction:

Sacroiliac Joint (SIJ) pain can be caused by intraarticular or extraarticular components of the sacroiliac joint. Patients' clinical presentations can vary, and the patients usually describe deep aching pain in the axial lower back, while less usually the patient may experience referred pain in the posterior hip up to the knee [80]. This pain may be worsened by activities which place pressure on the joint such as climbing stairs or sitting down [81, 82].

SIJ pain usually follows a triggering event causing torsional strain such as trauma, degeneration, pregnancy, repetitive from sports or iatrogenic [81, 82]. This helps to distinguish the source as it is unlikely to be insidious compared to pain arising from the disc or facet joint. The sacroiliac joint is the largest joint in the body and plays a critical role in weight transfer balance between the axial skeleton and lower limbs. Injury or inflammation of the cartilage, ligaments, joint capsule, or subchondral bone can result in the symptoms [83].

Physical examination of SIJ pain should involve a comprehensive spinal, hip, and lower limb neurological exam. Special test such as FABER test can be used to provoke pain in the sacroiliac joint region [84]. Other tests such Gaenslen, lateral compression, and thigh thrust may also be considered [84].

Imaging such as X-ray and CT can be performed to rule out other conditions such as fracture or malignancy [83]. The use of diagnostic Sacroiliac joint injection with local anaesthetic like lidocaine and steroid is used to diagnose intraarticular SIJ pain; a positive test is if the pain resolves following injection [85]. A fluoroscopy-guided block and neurotomy can also be considered in extra-articular sources of pain [81, 85].

Conservative treatment measures such as NSAIDs and muscle relaxants are effective in pain management, as well as physiotherapy and proper footwear in patients with leg discrepancy [81, 85]. Prolotherapy, radiofrequency pulsation or ablation are interventional treatment options [81, 85]. Surgical intervention such as SIJ fusion may also be considered, but this is extremely rarely required [81].

3.5 Less Common Causes of Hip Pain

3.5.1 Septic Arthritis

Septic Arthritis is an uncommon but serious condition with complications such as joint degeneration, osteonecrosis, disability, and mortality [86]. Patients present with symptoms such as acute atraumatic joint pain, swelling, including systemic signs of infection such as fever if polyarticular [87]. Septic Arthritis is more common in older adults with risk factors such as being immunocompromised, diabetes mellitus, rheumatoid arthritis, or recent surgery [88]. Acute flare up of the infection can also happen in chronic or indolent cases such as in patients with Tuberculosis, where the hip is infected with the Mycobacterium organisms, due to the slow growing nature of the organisms [86].

Septic arthritis is commonly caused by infection by bacteria such as staphylococcus aureus and streptococcus species [87]. The presentation can vary based on the specific causative agent. Physical examination will reveal very tender joint on motion with swelling. Patients who are immunocompromised or in endemic regions of the world may present with more subtle symptoms from atypical infections such as fungal infection, Lyme disease, or tuberculosis as mentioned above [86].

Diagnosis of septic arthritis involves joint aspiration for analysis of synovial fluid in the affected joint, blood tests to check white cell count, lab tests (ESR, CRP, PCR and procalcitonin) and Blood cultures to check for causative pathogen [87]. A synovial biopsy may also be required if synovial fluid findings are negative. Imaging is not necessary in diagnosis of septic arthritis but can be used to rule out other conditions, or to see the severity of joint destruction [87].

Once synovial fluid is obtained empirical antibiotics should be initiated based on suspected or confirmed bacteria from analysis. Surgery may also be considered such as arthroscopic debridement [86]. However, open debridement and washout of the hip joint is the best option, to prevent further deterioration or collapse of the femoral head [86, 89].

3.5.2 Piriformis Syndrome

Piriformis Syndrome refers to sciatica caused by entrapment of the sciatic nerve by the piriformis muscle at the level of the ischial tuberosity [90]. Patients typically describe a pain in the buttocks which may be accompanied by shooting, burning or aching sensation [90, 91]. Tingling, and numbness might also be noted [91]. The pain is usually of a chronic nature, exacerbated by sitting for long period and hip movement [90].

The piriformis muscle functions as an external rotator of the hip. Due to poor biomechanics or acute forceful internal rotation this can cause irritation or inflammation of the muscle leading to the compression of the sciatic nerve [92].

Physical examination should include a comprehensive spinal, hip, and lower limb neurological exam. Special tests such as the FADIR test can be used to irritate the piriformis muscle which is felt in the deep gluteal region [5]. Stretch tests such as Freiberg, Pace and Beatty tests can also be used to reproduce symptoms [90]. Imaging such as US, MRI, CT and EMG can be used to exclude other conditions such as lumbar canal stenosis, disc inflammation, or pelvic causes [92].

Conservative treatment is the main strategy for managing piriformis syndrome. This includes stretching exercises, NSAIDs, muscle relaxants, activity modification and icing [91, 93]. Corticosteroid injections can also be used for temporary relief but does not treat underlying pathology. Surgical decompression can also be considered as a last resort, to reduce tension after failure of conservative measures [94].

3.6 Other Causes of Hip Pain

3.6.1 Neoplastic causes:

There is a wide spectrum of neoplastic conditions which can present with hip pain. Due to the complex anatomy of the hip, a systematic approach is required to ensure that red flags are recognised to allow for timely intervention and improved outcomes. Neoplastic conditions may also arise within intraarticular or extraarticular surfaces which affect the presentation of hip pain in the patient [95-97].

3.6.2 Metastatic Disease:

The hip and its surrounding structures have rich vascular supply, making it a frequent site for metastases [95]. These may arise from primary cancers in the breast, kidney, lung, and prostate leading to irritation in articular cartilage and synovium [96]. This can occur at any age and in patient with history of cancer. Presentation of pain is often insidious and progressive without relief during rest and pain which wakes patient up at night [96, 97]. The patient may also experience pathologic fractures with minimal trauma [97]. Diagnosis may involve imaging such as X-rays to check for signs of metastasis such as bone lytic lesions, and PET-CT scan to check for spread of metastasis [98]. Biopsy can also be performed to confirm the primary tumour source [98].

Management involves systemic therapies (e.g. chemotherapy, immunotherapy etc) to treat the underlying malignancy, radiotherapy or surgery for fractures [99]. Bisphosphonates and denosumab may be used to reduce bone resorption [99]. Palliative treatment strategies may also be employed, especially when there is poor prognosis from the tumour or when the patient has a short life expectancy [99].

3.6.3 Primary Malignant Bone tumours

Primary malignant bone tumours may involve intra-articular and extra-articular components of hip, pelvis, or proximal femur. Tumours such as Osteosarcoma, Ewing sarcoma, and chondrosarcoma may present with deep progressive pain, swelling and stiffness around the hip, pelvis or proximal femur [100, 101]. Ewing Sarcoma may present specifically with aggressive hip pain, palpable mass and classic systemic symptoms such as fever and weight loss [101].

Diagnosis of primary bone tumours involves, imaging such as X-ray, CT, and MRI scans, as well as biopsy. Management may involve chemotherapy, surgical resection, or palliative radiation. Chondrosarcoma is generally resistant to chemotherapy and radiation [101]. Further discussion of these treatment options is beyond the remit of this narrative review.

3.6.4 Benign Bone Tumours

Benign tumours around the hip may also cause pain and disability to patients. Examples of these benign tumours include osteoid osteoma and Giant Cell Tumour (GCT) [102, 103]. Both conditions tend to occur in young adults. Osteoid osteoma classically presents with night pain relieved by Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) [103], and GCT classically presents with chronic hip pain with swelling and reduced range of motion [102]. Imaging is essential to diagnose both conditions [102, 103]. Symptomatic relief (e.g. surgery, ablation) and preservation of function is important in the management of both conditions [102, 103].

3.6.5 Metabolic Disorders

There are various metabolic abnormalities that predispose patients to conditions that present with hip pain. Bone health can be adversely affected by imbalances in minerals such as calcium and vitamin D, which can result in conditions such as osteomalacia, rickets, osteoporosis, and Chronic Kidney Disease (CKD) Mineral Bone Disease [104]. Excess fluoride may cause Fluorosis(105). Furthermore, bone health can also be adversely affected by an imbalance in T3/T4 (hyper/hypothyroidism), parathyroid hormone (hypo/hyperparathyroidism), cortisol (Cushing's disease/syndrome) [104].

These conditions lead to bone fragility, which predisposes individuals to fragility fractures, bone pain, and functional impairment, significantly impacting their ability to perform daily activities and reducing overall quality of life [104]. Diagnosis involves laboratory tests to find the abnormality and imaging of bone for changes or fractures. The general treatment strategy involves identifying and correcting the underlying cause of the symptoms.

Other inflammatory arthropathies include Gout and pseudogout which may present with severe hip pain and swelling [106, 107]. Diagnosis involves joint aspiration to check for monosodium or Calcium pyrophosphate crystals respectively [106, 107]. Imaging such as X-ray may also a play a role. Treatment involves NSAIDs and corticosteroids for acute attacks. For Gout, colchicine may also be used and long-term urate-lowering therapy (e.g., allopurinol, febuxostat) may need to be prescribed [106, 107].

Rare metabolic problems with bone remodelling such as Paget's disease, ankylosing spondylitis, and storage disorders such as Gaucher disease may also result in hip pain [108, 109]. Disease specific therapy like bisphosphonates or enzyme replacement, along with supportive orthopaedic interventions are used to manage these conditions [108, 109].

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4. Case Series Discussions to Illustrate Other Causes and unusual presentations of Pain Around the Hip in Adults.

4.1 Hip Osteoarthritis (OA):

Osteoarthritis involving hips and knees is one of the commonest presentations seen in adult lower limb elective Orthopaedic clinics in the UK [50]. This can be illustrated by the case of a seventy-six-year-old gentleman who presented from his GP with bilateral knee pain, on account of which he was referred to our clinic for consideration of Total Knee Replacement (TKR). The patient presented with severe unremitting bilateral knee pain, which affected his walking, activities of daily living (ADLs), and sleep. The patient denied any history of hip pain.

However, his knee x-rays were unremarkable (Figure 1), further clinical and radiological assessment of his hips revealed severe osteoarthritis of both hips (Figure 2). The patient subsequently had a bilateral sequential Total Hip Replacement (THR), starting with the right hip (Figure 3), which was more severe. This case highlights that hip osteoarthritis (OA) is not only a frequent presentation in orthopaedic clinics but can also manifest with atypical and potentially misleading symptoms. This is primarily due to the referral of pain from the hip to the knee, mediated by the shared nerve supply between these joints [109]. Consequently, to ensure accurate diagnosis and avoid misdiagnosis, it is our standard practice to obtain a pelvic X-ray for all patients presenting with knee pain in our clinics. This approach aids in identifying underlying hip pathology that may be contributing to the patient's symptoms.

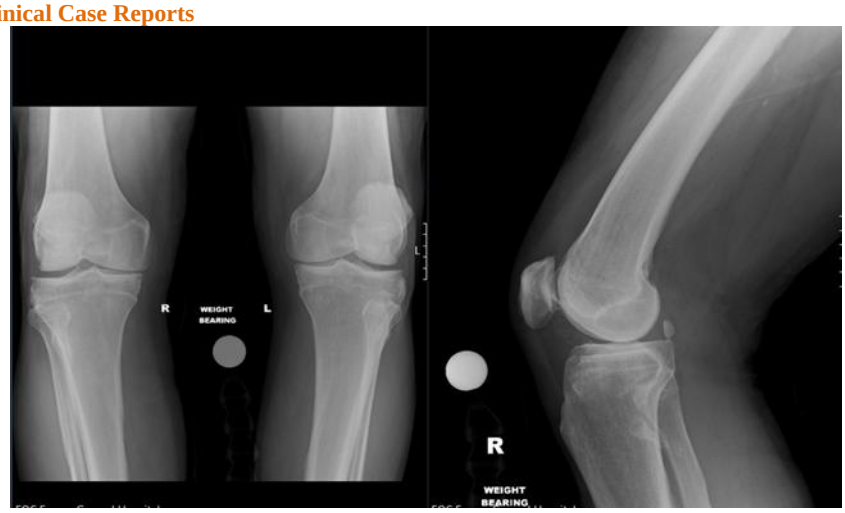

Figure 1: AP Knee X-Ray (Left), Lateral Knee X-Ray (Right)

Figure 2: AP Pelvic X-Ray Showing Severe Osteoarthritis In Both Hips

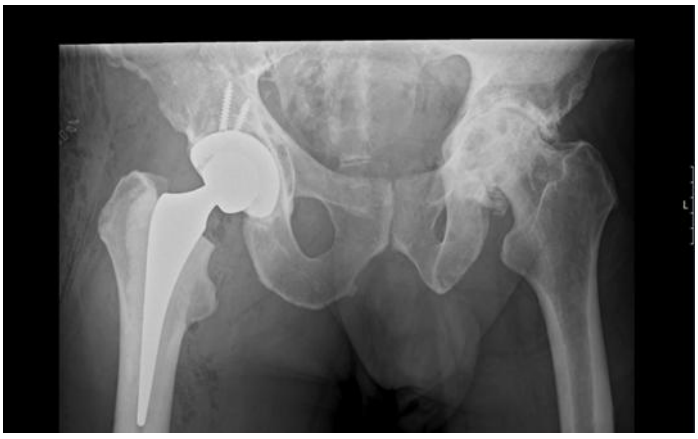

Figure 3: AP Pelvic X-Ray Following Hybrid THR

4.2 Previous Hip Fusion:

As this procedure is now becoming obsolete, it is uncommon to encounter patients with hip fusion in our clinics. A fifty-six-year-old patient was referred from her GP with severe disabling right knee pain. She has recently had a successful left Total Knee Replacement (TKR) and wanted to be considered for right TKR due to her severe symptoms. However, her right knee x-rays were unremarkable (Figure 4), but on clinical and radiological assessment of her hip, she was found to have pain and stiffness in her right hip due to previous surgical fusion in childhood (Figure 5).

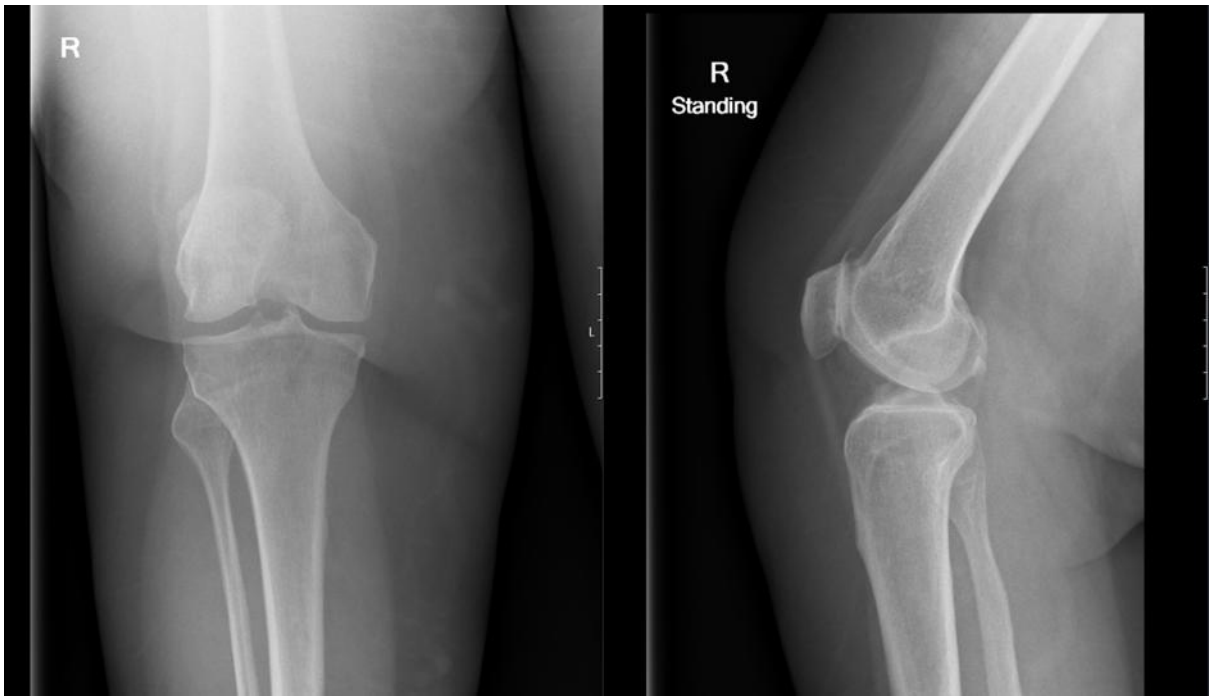

Figure 4: AP Knee X-Ray (Left), Lateral Knee X-Ray (Right)

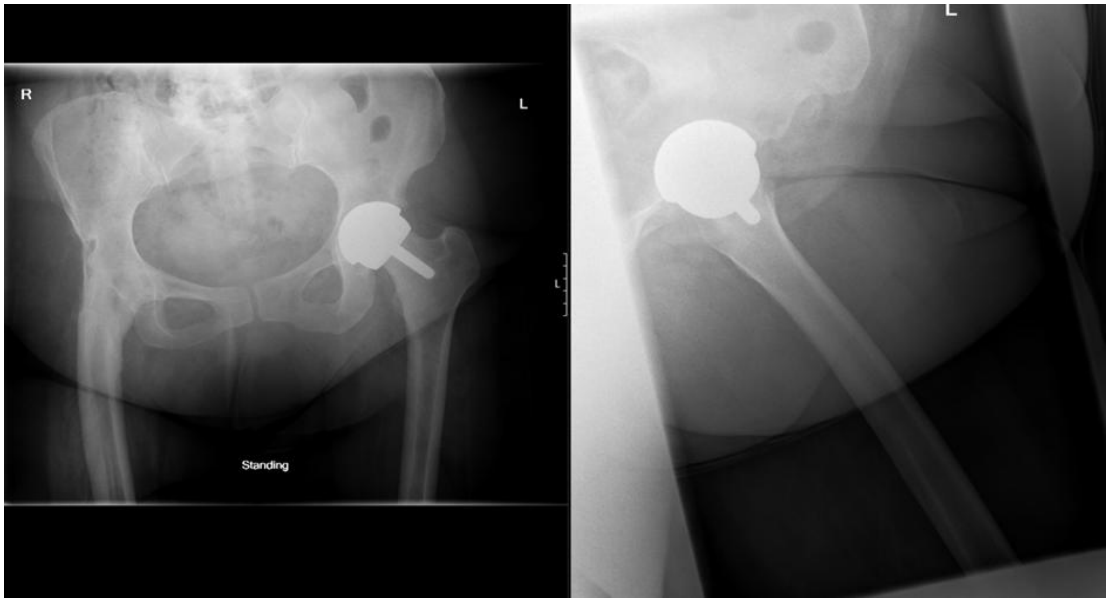

Figure 5: AP Pelvic X-Ray Showing Previous Right Hip Fusion & Left Hip Resurfacing

In this scenario, the important issue was to find the actual cause of her hip pain, and the possible differentials we considered include fracture, infection, pseudo-arthrosis, nerve entrapment or referred pain from the spine [5]. This case highlights an atypical presentation of hip pathology in our patient population. It emphasises the need for advanced diagnostics like CT/MRI, hip aspiration, injections, and blood tests to ensure accurate diagnosis before considering surgical intervention [5].

4.3 Avascular Necrosis (AVN):

AVN is a common condition that is encountered in our clinical practice. seventy-five-year-old gentleman on long term high dose steroids for an inflammatory condition presented with gradually worsening left hip pain. The pain became severe and debilitating within six weeks of the initial presentation (Figure 6). On investigation, the patient had developed AVN, with progressive collapse

of the femoral head, evident on both the repeat X-ray and MRI scans (Figures 7 & 8). The patient was, therefore, appropriately prepared and underwent a left total hip replacement.

Figure 6: AP Pelvic X-Ray Showing No Signs Of Avascular Necrosis

Figure 7: AP Pelvic X-Ray Highlighting Advanced AVN And Femoral Head Collapse

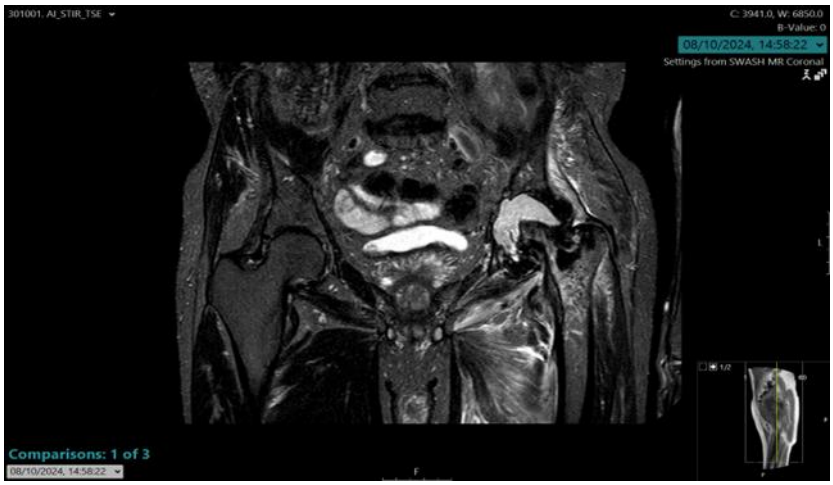

Figure 8: MRI Of Pelvis And Hip Highlighting AVN (Coronal View)

4.4 Lumbar Spinal Stenosis/Fusion:

Back pain with sciatica or radiculopathy is a common presentation in orthopaedic departments, presenting as either acute or chronic pain, and involving unilateral or bilateral leg pain [58]. As previously discussed, symptoms of spinal stenosis or back pain may radiate to the buttock, hip, or thigh, potentially leading to diagnostic confusion [58]. Therefore, a thorough clinical and radiological assessment is essential to ensure accurate diagnosis and appropriate management. A full neurological examination and an MRI scan are mandated, to confirm or exclude spinal pathology, before considering a hip replacement for the patient [58]. A middle-aged patient presented with pain around the hip. Hip x-ray revealed moderate OA (Figure 9), with significant lumbar spinal stenosis and previous Sacro-iliac Joint (SIJ) fusion evident on the MRI scan (Figure 10), which worsened her symptoms. Therefore, the onus lies with the clinician to establish which of the two pathologies is more serious or disabling for the patient, before considering any surgical intervention.

Figure 9: Ap Pelvic X-Ray (Moderate Left Hip OA) And Spinal Fusion

Figure 10: Sagittal MRI Of The Spine Highlighting Severe Degeneration And Stenosis

4.5 Acute Disc Prolapse:

Acute Disc Prolapse is a common presentation seen in adolescents, young and middle-aged patients. Disc prolapse typically presents as acute back pain with sciatica or radiculopathy, which may be accompanied by bowel or bladder symptoms in severe cases due to

nerve compression. It can also manifest as an acute-on-chronic presentation, where sudden worsening occurs in the context of pre-existing chronic symptoms (Figure 11). As a result, pain from disc prolapse may radiate to or around the hip, potentially mimicking hip pathology such as osteoarthritis (OA). Therefore, a comprehensive neurological assessment and MRI scan are essential for accurate diagnosis and effective management, helping to differentiate between spinal and related causes of pain.

Figure 11: MRI Scan (Sagittal View) Highlighting Acute Lumbar Disc Prolapse

4.6 Pelvic Tumour:

This is an uncommon presentation of hip pain. Pelvic tumours can lead to meralgia paresthetica, characterised by neuropathic pain over the trochanteric area due to compression of the lateral cutaneous nerve of the thigh. This compression can occur near the inguinal ligament or, or in the case of pregnancy, by the gravid uterus within the pelvis. In theory, any pelvic mass or tumour can cause a similar presentation around the hip. Our patient was a seventy-nine-year-old lady, who was referred from the General practitioner (GP), due to severe bilateral unremitting hip pain. The pain was severe (pain score 10/10), interfering with her sleep, sitting, walking, and other ADLs.

Pelvic x-ray revealed minimal OA in both hips (Figure 12), but her neurological examination revealed severe bilateral sciatic stretch test, necessitating an urgent MRI scan of the lumbar spine to be obtained. The MRI scan of the lumbar spine was unremarkable in the spine, however, a massive pelvic tumour posterior to the adnexa, which was compressing the pelvic neurovascular structures was revealed (Figure 13). Therefore, the patient was referred urgently to the Gynaecologist, who kindly took her over and arranged for further investigations and excision of the pelvic tumour.

Figure 12: AP Pelvic X-Ray (Minimal OA In Both Hips).

Figure 13: MRI (Sagittal View) Highlighting A Large Pelvic Tumour

4.7 Stress Fracture:

This is not uncommon, and can be seen in young athletes, especially females or middle-aged people [110]. It can also happen in thin cachectic or osteoporotic patients and may happen with minimal or no trauma [110]. A sixty-seven-year-old male patient initially presented with mild symptoms of left hip OA. He then went on holiday where he spent some time doing a lot of walking, and subsequently developed progressive left hip pain, without any significant trauma. His initial x-ray did not show any fracture (Figure 14). Due to the increased severity of his symptoms, an urgent MRI scan was obtained, which revealed a stress fracture across the left femoral neck (Figure 15). The patient was admitted and prepared for a Left Total Hip Replacement (THR).

Figure 14: AP Pelvic X-Ray (Moderate OA)

Figure 15: Stress Fracture Of The Femoral Neck (Left Hip)

4.8 Metastatic Lesions:

The hip and pelvis are common sites of metastases [99]. Common sources of metastatic lesions include breast, lungs, thyroid, prostate, and kidneys [99]. In addition, tumours such as multiple myeloma, bowel and liver cancer can also metastasise to the hips, pelvis, and proximal femur [99]. Our patient was an eighty-one-year-old lady, with a previous history of breast cancer. She was referred to our clinic with right hip pain, her hip x-ray was unremarkable (Figure 16). Following a thorough clinical assessment, an urgent pelvic MRI scan was organised, which revealed metastatic lesions around the right greater and lesser trochanters as the source of the hip pain (Figure 17).

Figure 16: AP Pelvic X-Ray (Normal)

Figure 17: MRI (Coronal View) Of Pelvis Highlighting Metastatic Lesions Around The Right Greater And Lesser Trochanters

4.9 Cancer of Unknown Origin:

Patients may present with symptoms of metastatic cancer, without a known primary [111]. A sixty-three-year-old Caucasian gentleman presented with a few weeks history of progressively worsening left hip pain, without any previous history of trauma. He had no previous known history of cancer, and he was fit and well. However, he was an ex-smoker who had been a heavy smoker for most of his life. He actively used a vape. His initial x-rays revealed a pathological lesion in the left femoral head (Figure 18), which necessitated an urgent MRI scan of the pelvis and both femora (Figure 19), along with a CT scan of the Chest, Abdomen and Pelvis (CAP). The CT CAP revealed a large primary nodule of the lung consistent with a malignancy.

He was therefore urgently referred to the lung MDT, which recommended bronchoscopy and biopsy to confirm the histological diagnosis of the lung nodule and start the appropriate treatment. Following diagnosis, the patient was optimised and offered a left THR for his left hip symptoms (Figure 20). He will be followed up along with the respiratory team and oncologists, who are currently treating his lung cancer at the time of writing this manuscript. This case illustrates the value of heightened level of suspicion in the diagnosis of the causes of unusual presentation of hip pain, and clearly demonstrates that not all hip pain is caused by osteoarthritis [5].

Figure 18: AP Pelvic X-Ray Highlighting Pathological Lesion In The Left Femoral Head/Neck

Figure 19: MRI (Coronal View) Of Pelvis Highlighting Lesion In Left Femoral Head & Neck.

Figure 20: Pelvic AP X-Ray Following Cemented Left THR

Figure 21: AP Pelvic X-Ray Highlighting Pathological Fracture In The Right Femoral Neck

4.10 Pathological Fractures:

These are fractures that can happen in a previously diseased bone [97, 112]. The pathology can be either benign or malignant, and it could be from primary or metastatic lesions around the hip [97]. A seventy-one-year-old patient with pre-existing benign osteochondroma around the femoral neck developed sudden hip pain without any significant trauma. Her x-rays and MRI scan (Figures 21 & 22) confirmed a pathological fracture, but with no signs of malignant transformation. This resulted in right hip hemiarthroplasty after proper planning and optimisation (Figure 23).

Figure 22: MRI (Coronal View) Highlighting Pathological Fracture In The Right Femoral Neck

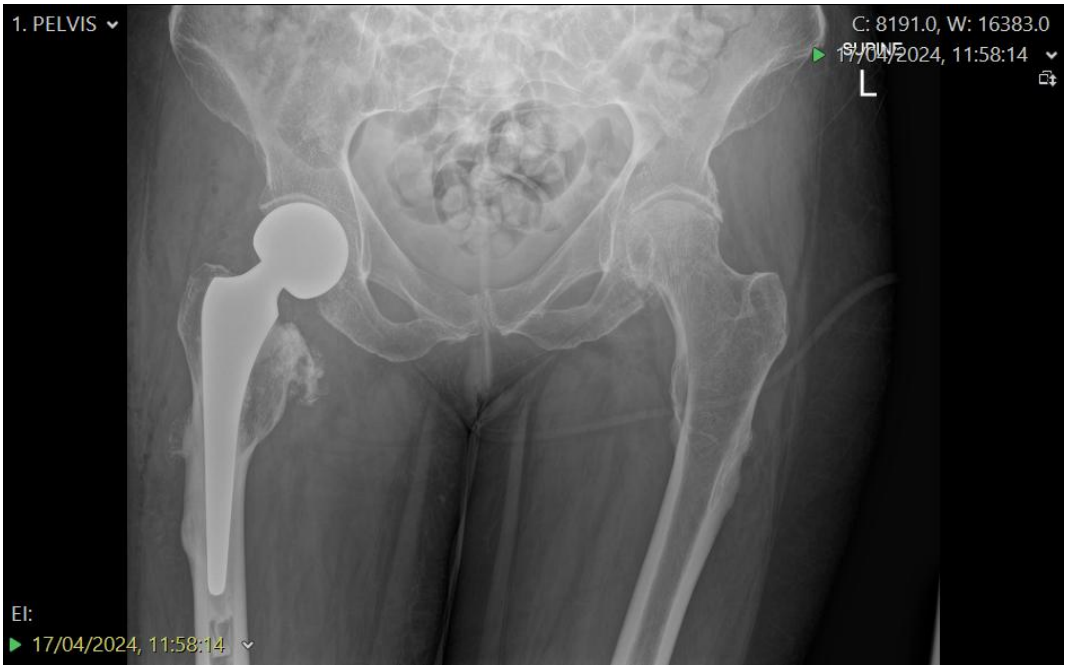

Figure 23: AP Pelvic X-Ray Following Right Hip Hemiarthroplasty

4.11 Iatrogenic (Failed Metalwork):

This is a common cause of pain around the hip. The presentation can be due to painful or failed arthroplasty, metalwork impingement, migration, or penetration into the pelvis [113]. The pain can also result from malunion, non-union, AVN or general metalwork failure, as seen in this patient's x-rays below [113, 114]. An eighty-three-year-old gentleman who underwent left Dynamic Hip Screw (DHS) fixation for an intertrochanteric proximal femoral fracture 12 months prior at another hospital, presented to our clinic with progressive left hip pain. The pain significantly impacted his mobility and ability to perform ADLs. The x-rays

revealed non-union of his fracture and metal work protrusion, which were both thought to be responsible for his pain (Figure 24). Therefore, he is being prepared for metalwork removal and conversion to a THR, as a single or two staged procedures.

Figure 24: AP Pelvic X-Ray Highlighting Failed Metal Work (DHS) In The Left Hip

4.12 Hamstring Tendinitis:

This is a diagnosis of exclusion occasionally seen in General Orthopaedic Clinics [12]. This case involved a sixty-five-year-old male patient, who presented to the clinic with bilateral severe deep-seated groin pain, which was worse around the buttocks. His initial pelvic x-rays were unremarkable for hip OA (Figure 25). Following a clinical assessment, we urgently obtained a pelvic MRI scan, which revealed some evidence of bilateral hamstring tendinitis (Figure 26) as the only significant finding. The patient was referred to physiotherapists and recovered following conservative management for a few weeks.

Figure 25: AP Pelvic X-Ray (Normal)

Figure 26: MRI (Coronal View) Showing Evidence Of Bilateral Hamstring Tendinitis

4.13 Acute Hip Fracture:

Acute hip fracture can happen and is very common in elderly osteoporotic patients, following minimal trauma [6]. However, hip fracture can also happen in young adults because of high energy injuries such as road traffic accidents, fall from height or extreme sporting accidents [115]. Although this review is not about hip fractures, however, this is included as a cause of pain around the hip, because these injuries sometimes happen following unwitnessed falls, in elderly patients who lack capacity. Therefore, it is important to get a good collateral history, which along with clinical examination and imaging, should help clinicians to arrive at a proper diagnosis, so that these serious injuries will not be missed. A common presentation of hip fracture in an elderly patient is illustrated in the x-ray below (Figure 27), which shows an inter-trochanteric proximal femoral fracture. This is usually treated with a Dynamic Hip Screw (DHS) or Intramedullary Nail [116].

Figure 27: AP Pelvic X-Ray Highlighting Left Proximal Femoral Fracture

4.14 Iliotibial Band Syndrome (ITBS):

As discussed in the previous section, Iliotibial Band Syndrome (ITBS), is the most common running injury due to repetitive flexion and extension activities [61]. The pain is typically felt on the lateral side of the knee and less commonly around the lateral hip [61]. The knee pain is caused by impingement of the distal ITB over the lateral femoral epicondyle, and the hip pain is caused by the movement of the ITB across the greater trochanter of the ipsilateral proximal femur [62, 63]. Our case illustrates a sixty-one-year-old lady, who presented with lateral sided knee/thigh pain, due to contracture of her iliotibial band. After a thorough clinical

assessment and investigations, she had tibial tuberosity transfer to improve her patella tracking and Q angle, and this operation led to a complete resolution of her symptoms. (Figures 28, 29) show the pre-operative MRI scan and the post-operative x-rays, respectively.

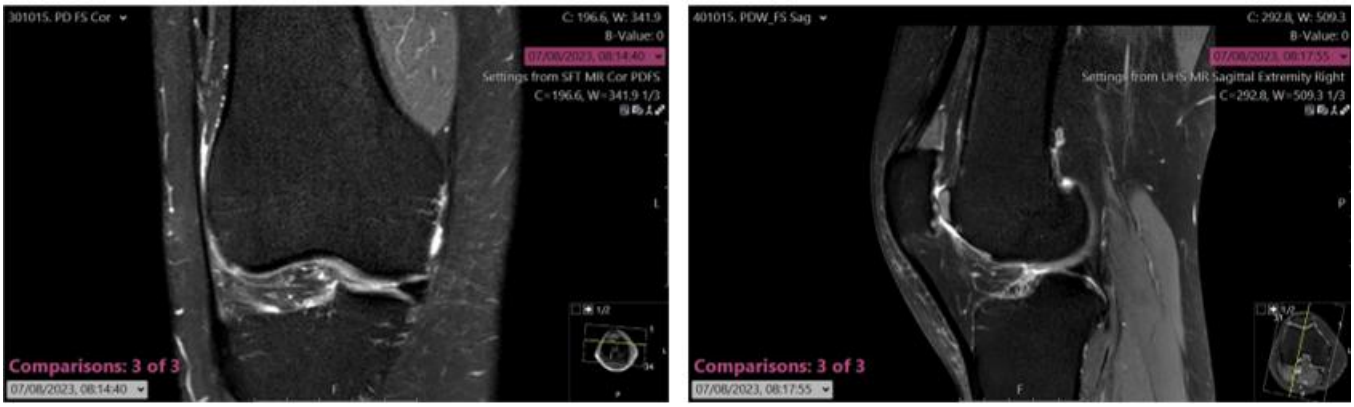

Figure 28: Pre-Operative MRI Scan Of The Right Knee Showing Tight Iliotibial Band (Sagittal & Coronal)

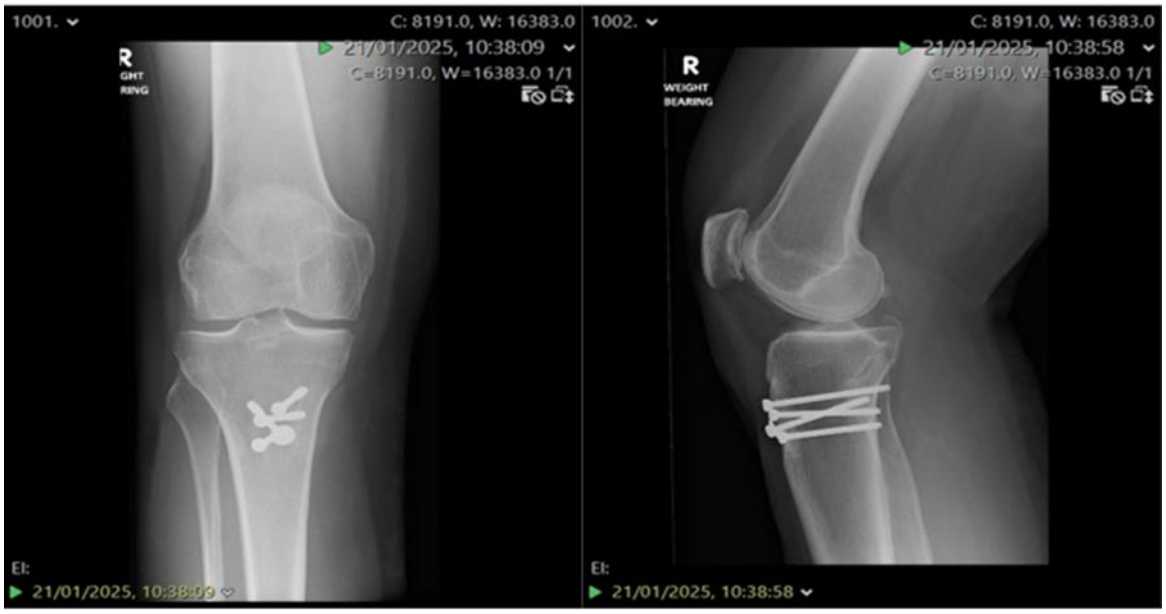

Figure 29: Post-Operative Ap & Lateral X-Rays Of The Right Knee Showing Tibial Tuberosity Transfer

5. Conclusion

Hip pain encompasses a broad differential diagnosis. Whilst common orthopaedic sources such as Osteoarthrosis are easily recognised, it is essential that the diagnostic radar follows a systematic approach to ensure that less common but potentially more serious sources of hip pain are not missed, and that the relevant intervention occurs in a timely manner. Accurate diagnosis must rely on a comprehensive approach which integrates, patient demographics, history, examination, supportive imaging, and laboratory tests. A holistic and individualised approach, as well as a high index of suspicion are important in addressing a diverse and often interrelated sources of hip pain to ensure successful outcomes and improved quality of life for the patient.

References

1. Murphy LB, Helmick CG, Schwartz TA, Renner JB, Tudor G, Koch GG, et al. One in four people may develop symptomatic hip osteoarthritis in his or her lifetime. Osteoarthritis and Cartilage. 2010;18(11):1372-9.
2. Swain S, Sarmanova A, Mallen C, Kuo CF, Coupland C, Doherty M, et al. Trends in incidence and prevalence of osteoarthritis in the United Kingdom: findings from the Clinical Practice Research Datalink (CPRD). Osteoarthritis Cartilage. 2020;28(6):792-801.

3. Lee YJ, Kim S-H, Chung SW, Lee Y-K, Koo K-H. Causes of Chronic Hip Pain Undiagnosed or Misdiagnosed by Primary Physicians in Young Adult Patients: a Retrospective Descriptive Study. Journal of Korean Medical Science. 2018;33(52).
4. Battaglia PJ, D'Angelo K, Kettner NW. Posterior, Lateral, and Anterior Hip Pain Due to Musculoskeletal Origin: A Narrative Literature Review of History, Physical Examination, and Diagnostic Imaging. Journal of Chiropractic Medicine. 2016;15(4):281-93.
5. Ahuja V, Thapa D, Patial S, Chander A, Ahuja A. Chronic hip pain in adults: Current knowledge and future prospective. J Anaesthesiol Clin Pharmacol. 2020;36(4):450-7.
6. Wilson JJ, Furukawa M. Evaluation of the patient with hip pain. Am Fam Physician. 2014;89(1):27-34.
7. Margo K, Drezner J, Motzkin D. Evaluation and management of hip pain: an algorithmic approach. J Fam Pract. 2003;52(8):607-17.
8. Lewis CL, Sahrmann SA. Acetabular Labral Tears. Physical Therapy. 2006;86(1):110-21.
9. Dick AG, Houghton JM, Bankes MJK. An approach to hip pain in a young adult. BMJ. 2018:k1086.
10. Burnett RS, Della Rocca GJ, Prather H, Curry M, Maloney WJ, Clohisy JC. Clinical presentation of patients with tears of the acetabular labrum. J Bone Joint Surg Am. 2006;88(7):1448-57.
11. Cianci A, Sugimoto D, Stracciolini A, Yen YM, Kocher MS, d'Hemecourt PA. Nonoperative Management of Labral Tears of the Hip in Adolescent Athletes: Description of Sports Participation, Interventions, Comorbidity, and Outcomes. Clin J Sport Med. 2019;29(1):24-8.
12. Chamberlain R. Hip Pain in Adults: Evaluation and Differential Diagnosis. Am Fam Physician. 2021;103(2):81-9.
13. Haldane CE, Ekhtiari S, de Sa D, Simunovic N, Ayeni OR. Preoperative physical examination and imaging of femoroacetabular impingement prior to hip arthroscopy-a systematic review. J Hip Preserv Surg. 2017;4(3):201-13.
14. Hartigan DE, Perets I, Meghpara MB, Mohr MR, Close MR, Yuen LC, et al. Biomechanics, anatomy, pathology, imaging and clinical evaluation of the acetabular labrum: current concepts. Journal of ISAKOS. 2018;3(3):148-54.
15. Santori N, Villar RN. Acetabular labral tears: result of arthroscopic partial limbectomy. Arthroscopy. 2000;16(1):11-5.
16. Ishøi L, Nielsen MF, Krommes K, Husted RS, Hölmich P, Pedersen LL, et al. Femoroacetabular impingement syndrome and labral injuries: grading the evidence on diagnosis and non-operative treatment—a statement paper commissioned by the Danish Society of Sports Physical Therapy (DSSF). British Journal of Sports Medicine. 2021;55(22):1301-10.
17. Czerny C, Hofmann S, Neuhold A, Tschauner C, Engel A, Recht MP, et al. Lesions of the acetabular labrum: accuracy of MR imaging and MR arthrography in detection and staging. Radiology. 1996;200(1):225-30.
18. Basheer SZ, Maher N, Holton CS. Acetabular labral tears: diagnosis and management. Orthopaedics and Trauma. 2022;36(1):44-8.
19. Moreira B, Pascual-Garrido C, Chadayamurri V, Mei-Dan O. Eversion-Inversion Labral Repair and Reconstruction Technique for Optimal Suction Seal. Arthroscopy Techniques. 2015;4(6):e697-e700.
20. Leunig M, Beaulé PE, Ganz R. The Concept of Femoroacetabular Impingement: Current Status and Future Perspectives. Clinical Orthopaedics & Related Research. 2009;467(3):616-22.
21. Sansone M, Ahldén M, Jonasson P, Thomeé R, Falk A, Swärd L, et al. Can hip impingement be mistaken for tendon pain in the groin? A long-term follow-up of tenotomy for groin pain in athletes. Knee Surgery, Sports Traumatology, Arthroscopy. 2014;22(4):786-92.
22. Maupin J, Steinmetz G, Thakral R. Management of femoroacetabular impingement syndrome: current insights . Orthopedic Research and Reviews. 2019;Volume 11:99-108.
23. Chopra A, Grainger AJ, Dube B, Evans R, Hodgson R, Conroy J, et al. Comparative reliability and diagnostic performance of conventional 3T magnetic resonance imaging and 1.5T magnetic resonance arthrography for the evaluation of internal derangement of the hip. European Radiology. 2018;28(3):963-71.

24. Cooper C, Steinbuch M, Stevenson R, Miday R, Watts NB. The epidemiology of osteonecrosis: findings from the GPRD and THIN databases in the UK. Osteoporosis International. 2010;21(4):569-77.
25. Roth A, Beckmann J, Bohndorf K, Fischer A, Heiß C, Kenn W, et al. S3-Guideline non-traumatic adult femoral head necrosis. Archives of Orthopaedic and Trauma Surgery. 2016;136(2):165-74.
26. Johnson EO, Soultanis K, Soucacos PN. Vascular anatomy and microcirculation of skeletal zones vulnerable to osteonecrosis: vascularization of the femoral head. Orthop Clin North Am. 2004;35(3):285-91, viii.
27. Petek D, Hannouche D, Suva D. Osteonecrosis of the femoral head: pathophysiology and current concepts of treatment. EFORT Open Reviews. 2019;4(3):85-97.
28. Mont MA, Zywiel MG, Marker DR, McGrath MS, Delanois RE. The natural history of untreated asymptomatic osteonecrosis of the femoral head: a systematic literature review. J Bone Joint Surg Am. 2010;92(12):2165-70.
29. Konarski W, Poboży T, Śliwczyński A, Kotela I, Krakowiak J, Hordowicz M, et al. Avascular Necrosis of Femoral Head—Overview and Current State of the Art. International Journal of Environmental Research and Public Health. 2022;19(12):7348.
30. Steinberg M, Hayken G, Steinberg D. A quantitative system for staging avascular necrosis. The Journal of Bone and Joint Surgery British volume. 1995;77-B(1):34-41.
31. Sen RK. Management of avascular necrosis of femoral head at pre-collapse stage. Indian J Orthop. 2009;43(1):6-16.
32. Smolen JS, Aletaha D, Mcinnes IB. Rheumatoid arthritis. The Lancet. 2016;388(10055):2023-38.
33. O'Neil LJ, Alpízar-Rodríguez D, Deane KD. Rheumatoid Arthritis: The Continuum of Disease and Strategies for Prediction, Early Intervention, and Prevention. The Journal of Rheumatology. 2024;51(4):337-49.
34. Lee Y-H, Ko P-Y, Kao S-L, Lin M-C, Cheng-Chung Wei J. Risk of Total Knee and Hip Arthroplasty in Patients With Rheumatoid Arthritis: A 12-Year Retrospective Cohort Study of 65,898 Patients. The Journal of Arthroplasty. 2020;35(12):3517-23.
35. Fraenkel L, Bathon JM, England BR, St.Clair EW, Arayssi T, Carandang K, et al. 2021 American College of Rheumatology Guideline for the Treatment of Rheumatoid Arthritis. Arthritis & Rheumatology. 2021;73(7):1108-23.
36. Taylor PC. Update on the diagnosis and management of early rheumatoid arthritis. Clin Med (Lond). 2020;20(6):561-4.
37. Tyler TF, Fukunaga T, Gellert J. Rehabilitation of soft tissue injuries of the hip and pelvis. Int J Sports Phys Ther. 2014;9(6):785-97.
38. Serner A, Weir A, Tol JL, Thorborg K, Roemer F, Guermazi A, et al. Characteristics of acute groin injuries in the hip flexor muscles - a detailed MRI study in athletes. Scand J Med Sci Sports. 2018;28(2):677-85.
39. Christopher ZK, Hassebrock JD, Anastasi MB, Economopoulos KJ. Hip Flexor Injuries in the Athlete. Clinics in Sports Medicine. 2021;40(2):301-10.
40. Konrad A, Močnik R, Titze S, Nakamura M, Tilp M. The Influence of Stretching the Hip Flexor Muscles on Performance Parameters. A Systematic Review with Meta-Analysis. Int J Environ Res Public Health. 2021;18(4).
41. Winston P, Awan R, Cassidy JD, Bleakney RK. Clinical examination and ultrasound of self-reported snapping hip syndrome in elite ballet dancers. Am J Sports Med. 2007;35(1):118-26.
42. Tsukada S, Niga S, Nihei T, Imamura S, Saito M, Hatanaka J. Iliopsoas Disorder in Athletes with Groin Pain: Prevalence in 638 Consecutive Patients Assessed with MRI and Clinical Results in 134 Patients with Signal Intensity Changes in the Iliopsoas. JB JS Open Access. 2018;3(1):e0049.
43. Anderson CN. Iliopsoas: Pathology, Diagnosis, and Treatment. Clin Sports Med. 2016;35(3):419-33.
44. Laible C, Swanson D, Garofolo G, Rose DJ. Iliopsoas Syndrome in Dancers. Orthopaedic Journal of Sports Medicine. 2013;1(3):232596711350063.
45. Yeap PM, Robinson P. Ultrasound Diagnostic and Therapeutic Injections of the Hip and Groin. Journal of the Belgian Society of Radiology. 2017;101(S2).

46. Zhu Z, Zhang J, Sheng J, Zhang C, Xie Z. Low Back Pain Caused by Iliopsoas Tendinopathy Treated with Ultrasound-Guided Local Injection of Anesthetic and Steroid: A Retrospective Study . Journal of Pain Research. 2020;Volume 13:3023-9.
47. Salman LA, Ahmed G, Dakin SG, Kendrick B, Price A. Osteoarthritis: a narrative review of molecular approaches to disease management. Arthritis Research & Therapy. 2023;25(1).
48. Loeser RF, Goldring SR, Scanzello CR, Goldring MB. Osteoarthritis: A disease of the joint as an organ. Arthritis & Rheumatism. 2012;64(6):1697-707.
49. Katz JN, Arant KR, Loeser RF. Diagnosis and Treatment of Hip and Knee Osteoarthritis. JAMA. 2021;325(6):568.
50. Aresti N, Kassam J, Nicholas N, Achan P. Hip osteoarthritis. Bmj. 2016;354:i3405.
51. Tateuchi H, Akiyama H, Goto K, So K, Kuroda Y, Ichihashi N. Gait kinematics of the hip, pelvis, and trunk associated with external hip adduction moment in patients with secondary hip osteoarthritis: toward determination of the key point in gait modification. BMC Musculoskeletal Disorders. 2020;21(1).
52. Guermazi A, Hunter DJ, Roemer FW. Plain radiography and magnetic resonance imaging diagnostics in osteoarthritis: validated staging and scoring. J Bone Joint Surg Am. 2009;91 Suppl 1:54-62.
53. Zhang W, Moskowitz RW, Nuki G, Abramson S, Altman RD, Arden N, et al. OARSI recommendations for the management of hip and knee osteoarthritis, Part II: OARSI evidence-based, expert consensus guidelines. Osteoarthritis and Cartilage. 2008;16(2):137-62.
54. Amaro A, Amado F, Duarte JA, Appell HJ. Gluteus medius muscle atrophy is related to contralateral and ipsilateral hip joint osteoarthritis. Int J Sports Med. 2007;28(12):1035-9.
55. Lespasio MJ, Sultan AA, Piuzzi NS, Khlopas A, Husni ME, Muschler GF, et al. Hip Osteoarthritis: A Primer. Perm J. 2018;22:17-084.
56. Fearon AM, Scarvell JM, Neeman T, Cook JL, Cormick W, Smith PN. Greater trochanteric pain syndrome: defining the clinical syndrome. Br J Sports Med. 2013;47(10):649-53.
57. Speers CJ, Bhogal GS. Greater trochanteric pain syndrome: a review of diagnosis and management in general practice. British Journal of General Practice. 2017;67(663):479-80.
58. Buckland AJ, Miyamoto R, Patel RD, Slover J, Razi AE. Differentiating Hip Pathology From Lumbar Spine Pathology: Key Points of Evaluation and Management. JAAOS - Journal of the American Academy of Orthopaedic Surgeons. 2017;25(2):e23-e34.
59. Landry M. Brukner & Khan's Clinical Sports Medicine. Physiotherapy Canada. 2014;66(1):109-10.
60. Chowdhury R, Naaseri S, Lee J, Rajeswaran G. Imaging and management of greater trochanteric pain syndrome. Postgraduate Medical Journal. 2014;90(1068):576-81.
61. Van Der Worp MP, Van Der Horst N, De Wijer A, Backx FJG, Nijhuis-Van Der Sanden MWG. Iliotibial Band Syndrome in Runners. Sports Medicine. 2012;42(11):969-92.
62. Fairclough J, Hayashi K, Toumi H, Lyons K, Bydder G, Phillips N, et al. The functional anatomy of the iliotibial band during flexion and extension of the knee: implications for understanding iliotibial band syndrome. Journal of Anatomy. 2006;208(3):309-16.
63. Ferber R, Noehren B, Hamill J, Davis I. Competitive Female Runners With a History of Iliotibial Band Syndrome Demonstrate Atypical Hip and Knee Kinematics. Journal of Orthopaedic & Sports Physical Therapy. 2010;40(2):52-8.
64. Beals C, Flanigan D. A Review of Treatments for Iliotibial Band Syndrome in the Athletic Population. Journal of Sports Medicine. 2013;2013:1-6.
65. Chen S, Wang Y, Bing F, Zhang M. Effects of Running Speeds and Exhaustion on Iliotibial Band Strain during Running. Bioengineering. 2023;10(4):417.

66. Hutchinson LA, Lichtwark GA, Willy RW, Kelly LA. The Iliotibial Band: A Complex Structure with Versatile Functions. Sports Med. 2022;52(5):995-1008.
67. Utomo DN, Mahyudin F, Yanuar A, Widhiyanto L, Hernugrahanto KD. Correction of severe valgus deformity of knee osteoarthritis with non-constrained total knee arthroplasty implant: A case report. International Journal of Surgery Case Reports. 2018;53:218-22.
68. Walbron P, Jacquot A, Geoffroy J-M, Sirveaux F, Molé D. Iliotibial band friction syndrome: An original technique of digastric release of the iliotibial band from Gerdy's tubercle. Orthopaedics & Traumatology: Surgery & Research. 2018;104(8):1209-13.
69. Hong JH, Kim JS. Diagnosis of Iliotibial Band Friction Syndrome and Ultrasound Guided Steroid Injection. The Korean Journal of Pain. 2013;26(4):387-91.
70. Cheng W, Li Z, Zhang J, Cao Q, Yu H, Qi L, et al. A lateral parapatellar approach with iliotibial band dissection from the Gerdy tubercle for total knee arthroplasty of the valgus knee. Experimental and Therapeutic Medicine. 2020;21(1).
71. Gomez YDLC, Remotti E, Momah DU, Zhang E, Swanson DD, Kim R, et al. Meralgia Paresthetica Review: Update on Presentation, Pathophysiology, and Treatment. Health Psychology Research. 2023;11.
72. Harney D, Patijn J. Meralgia Paresthetica: Diagnosis and Management Strategies. Pain Medicine. 2007;8(8):669-77.
73. Ahmed MS, Varrassi G, Hadjiconstanti D, Zis P. The Diagnosis and Management of Meralgia Paresthetica: A Narrative Review. Pain and Therapy. 2025;14(1):103-19.
74. Nouraei SA, Anand B, Spink G, O'Neill KS. A novel approach to the diagnosis and management of meralgia paresthetica. Neurosurgery. 2007;60(4):696-700.
75. Seror P, Seror R. Meralgia paresthetica: clinical and electrophysiological diagnosis in 120 cases. Muscle Nerve. 2006;33(5):650-4.
76. Devin CJ, McCullough KA, Morris BJ, Yates AJ, Kang JD. Hip-spine syndrome. J Am Acad Orthop Surg. 2012;20(7):434-42.
77. de Schepper EI, Damen J, Bos PK, Hofman A, Koes BW, Bierma-Zeinstra SM. Disk degeneration of the upper lumbar disks is associated with hip pain. Eur Spine J. 2013;22(4):721-6.
78. Lee BH, Moon S-H, Suk K-S, Kim H-S, Yang J-H, Lee H-M. Lumbar Spinal Stenosis: Pathophysiology and Treatment Principle: A Narrative Review. Asian Spine Journal. 2020;14(5):682-93.
79. Malfair D, Beall DP. Imaging the degenerative diseases of the lumbar spine. Magn Reson Imaging Clin N Am. 2007;15(2):221-38.
80. Thawrani DP, Agabegi SS, Asghar F. Diagnosing Sacroiliac Joint Pain. J Am Acad Orthop Surg. 2019;27(3):85-93.
81. Chuang CW, Hung SK, Pan PT, Kao MC. Diagnosis and interventional pain management options for sacroiliac joint pain. Tzu Chi Med J. 2019;31(4):207-10.
82. Chou LH, Slipman CW, Bhagia SM, Tsaur L, Bhat AL, Isaac Z, et al. Inciting Events Initiating Injection-Proven Sacroiliac Joint Syndrome. Pain Medicine. 2004;5(1):26-32.
83. Barros G, McGrath L, Gelfenbeyn M. Sacroiliac Joint Dysfunction in Patients With Low Back Pain. Fed Pract. 2019;36(8):370-5.
84. Laslett M, Young SB, Aprill CN, McDonald B. Diagnosing painful sacroiliac joints: A validity study of a McKenzie evaluation and sacroiliac provocation tests. Aust J Physiother. 2003;49(2):89-97.
85. Simopoulos TT, Manchikanti L, Gupta S, Aydin SM, Kim CH, Solanki D, et al. Systematic Review of the Diagnostic Accuracy and Therapeutic Effectiveness of Sacroiliac Joint Interventions. Pain Physician. 2015;18(5):E713-56.
86. Balato G, De Matteo V, Ascione T, De Giovanni R, Marano E, Rizzo M, et al. Management of septic arthritis of the hip joint in adults. A systematic review of the literature. BMC Musculoskeletal Disorders. 2021;22(S2).
87. Earwood JS, Walker TR, Sue GJC. Septic Arthritis: Diagnosis and Treatment. Am Fam Physician. 2021;104(6):589-97.
88. Lieber SB, Fowler ML, Zhu C, Moore A, Shmerling RH, Paz Z. Clinical characteristics and outcomes in polyarticular septic arthritis. Joint Bone Spine. 2018;85(4):469-73.

89. Li L, Chou K, Deng J, Shen F, He Z, Gao S, et al. Two-stage total hip arthroplasty for patients with advanced active tuberculosis of the hip. Journal of Orthopaedic Surgery and Research. 2016;11(1).
90. Hopayian K, Song F, Riera R, Sambandan S. The clinical features of the piriformis syndrome: a systematic review. Eur Spine J. 2010;19(12):2095-109.
91. Kirschner JS, Foye PM, Cole JL. Piriformis syndrome, diagnosis and treatment. Muscle Nerve. 2009;40(1):10-8.
92. Chang A, Ly N, Varacallo M. Piriformis Injection. StatPearls. Treasure Island (FL): StatPearls Publishing Copyright © 2024, StatPearls Publishing LLC.; 2024.
93. Probst D, Stout A, Hunt D. Piriformis Syndrome: A Narrative Review of the Anatomy, Diagnosis, and Treatment. Pm r. 2019;11 Suppl 1:S54-s63.
94. Shi L, Wang D, Yeung BHY, Chu WCW, Griffith JF, Heng PA, et al. A novel statistical morphometry imaging method for differentiating long bone geometry: methodological development and application with adolescent idiopathic scoliosis (AIS) patients. Medical engineering & physics. 2011;33(9):1103-7.
95. Tepper SC, Lee L, Kasson LB, Herbst LR, Vijayakumar G, Colman MW, et al. Hip Arthroplasty Outcomes in Patients with Metastatic Bone Disease. Orthopedic Reviews. 2024;16.
96. Fornetti J, Welm AL, Stewart SA. Understanding the Bone in Cancer Metastasis. Journal of Bone and Mineral Research. 2018;33(12):2099-113.
97. Jacofsky DJ, Haidukewych GJ. Management of Pathologic Fractures of the Proximal Femur: State of the Art. Journal of Orthopaedic Trauma. 2004;18(7):459-69.
98. Shibata H, Kato S, Sekine I, Abe K, Araki N, Iguchi H, et al. Diagnosis and treatment of bone metastasis: comprehensive guideline of the Japanese Society of Medical Oncology, Japanese Orthopedic Association, Japanese Urological Association, and Japanese Society for Radiation Oncology. ESMO Open. 2016;1(2):e000037.
99. Bonneau A. Management of bone metastases. Can Fam Physician. 2008;54(4):524-7.
100. Bloem JL, Reidsma II. Bone and soft tissue tumors of hip and pelvis. European Journal of Radiology. 2012;81(12):3793-801.
101. Dai X, Ma W, He X, Jha RK. Review of therapeutic strategies for osteosarcoma, chondrosarcoma, and Ewing's sarcoma. Medical Science Monitor. 2011;17(8):RA177-RA90.
102. Jha Y, Chaudhary K. Giant Cell Tumour of Bone: A Comprehensive Review of Pathogenesis, Diagnosis, and Treatment. Cureus. 2023.
103. Carneiro BC, Da Cruz IAN, Ormond Filho AG, Silva IP, Guimarães JB, Silva FD, et al. Osteoid osteoma: the great mimicker. Insights into Imaging. 2021;12(1).
104. Sobh MM, Abdalbary M, Elnagar S, Nagy E, Elshabrawy N, Abdelsalam M, et al. Secondary Osteoporosis and Metabolic Bone Diseases. Journal of Clinical Medicine. 2022;11(9):2382.
105. Godebo TR, Jeuland M, Tekle-Haimanot R, Shankar A, Alemayehu B, Assefa G, et al. Bone quality in fluoride-exposed populations: A novel application of the ultrasonic method. Bone Reports. 2020;12:100235.
106. Salar O, Mushtaq F, Ahmed M. Calcium pyrophosphate dihydrate deposition in the trochanteric hip bursa presenting as acute hip pain. Case Reports. 2012;2012(jul09 1):bcr1220115426-b.
107. Xu S, Emanuelli E, Tarakemeh A, Vopat BG, Schroeppel JP, Mullen S. Gout Presenting as Acute Hip Pain in a Young Woman: A Case Report. JBJS Case Connect. 2019;9(1):e11.
108. Kang H, Park Y-C, Yang KH. Paget's Disease: Skeletal Manifestations and Effect of Bisphosphonates. Journal of Bone Metabolism. 2017;24(2):97.
109. Resorlu M, Aylanc N, Karatag O, Toprak CA. Gaucher's disease in a patient presenting with hip and abdominal pain. Revista da Associação Médica Brasileira. 2017;63(12):1025-7.
110. Dutton RA. Stress Fractures of the Hip and Pelvis. Clin Sports Med. 2021;40(2):363-74.

111. Argentiero A, Solimando AG, Brunetti O, Calabrese A, Pantano F, Iuliani M, et al. Skeletal Metastases of Unknown Primary: Biological Landscape and Clinical Overview. Cancers. 2019;11(9):1270.
112. Riemen AHK, Aherne B, Bruce E, Boddie DE, McCullough LA.
113. Aqil A, Shah N. Diagnosis of the failed total hip replacement. Journal of Clinical Orthopaedics and Trauma. 2020;11(1):2-8.
114. van Leent EAP, Schmitz PP, de Jong LD, Zuurmond RG, Vos CJ, van Susante JLC, et al. Complications and survival of conversion to total hip arthroplasty after failed primary osteosynthesis compared to primary total hip arthroplasty in femoral neck fractures. Injury. 2022;53(8):2853-8.
115. Protzman RR, Burkhalter WE. Femoral-neck fractures in young adults. J Bone Joint Surg Am. 1976;58(5):689-95.
116. Fischer H, Maleitzke T, Eder C, Ahmad S, Stöckle U, Braun KF. Management of proximal femur fractures in the elderly: current concepts and treatment options. European Journal of Medical Research. 2021;26(1)