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Beyond the Hip Labrum: A Pictorial Review

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Abstract

Magnetic resonance arthrography and 3T magnetic resonance imaging of the hip are a technique commonly performed in young, physically active patients presenting with pain relating to the hip, with the focus on assessing for the presence of labral tears and femoroacetabular impingement. Abnormal signal within the labrum can be misleading, however, as labral tears are a frequent incidental finding and have been identified in a large proportion of the asymptomatic population. A range of extralabral conditions can cause hip-related pain in young patients, including pathology related to the bones, joints, and periarticular soft tissues. It is vital that the radiologist is aware for these pathologies and examines for them even in the presence of a confirmed labral tear. In this article, we review a range of common extralabral pathologies responsible for hip pain and highlight review areas that aid in their diagnosis.

Keywords
- hip
- labrum
- MR arthrography
- MR hip
- extralabral

Introduction

Magnetic resonance (MR) arthrography and high-resolution 3T magnetic resonance imaging (MRI) of the hip are a technique commonly performed in young patients presenting with pain relating to the hip, with the focus on assessing for labral tears and femoroacetabular impingement. The typical MRI arthrography and MR hip protocol involve a small field of view examination focused on the hip, with sequences in multiple imaging planes. Labral abnormalities can be misleading, however, as labral tears are a frequent incidental finding identified in approximately 38% of the asymptomatic population.[1] Focus on the labrum and cartilage can lead to reporting error, as other important pathology in and around the hip can be missed and labral abnormalities overcalled as the main cause of the patient's symptoms. A range of extralabral pathologies can cause hip-related pain in young patients, and it is vital that the radiologist examines for these, even in the presence of a confirmed labral tear. In this article, we review a range of common extralabral pathologies responsible for hip pain and highlight review areas that aid in their diagnosis.

Bones

Bone Lesions

The bones are an important review area on hip MR hip and arthrography as the majority of osseous tumors can involve the proximal femur and pelvis, including both benign and malignant lesions. Small lucent lesions are particularly challenging to diagnose on radiographs as a result of superimposed soft tissues, but are much more conspicuous on MR. Benign bone lesions such as giant cell tumor, simple bone cysts, and chondroblastoma are commonly seen in the proximal femur and are frequently incidental, only requiring treatment if there is risk of pathological fracture (►**Fig. 1**). Osteoid osteoma is a painful osteoblastic lesion seen in young patients in subcortical location and patients typically have history of night pain which is relieved by nonsteroidal

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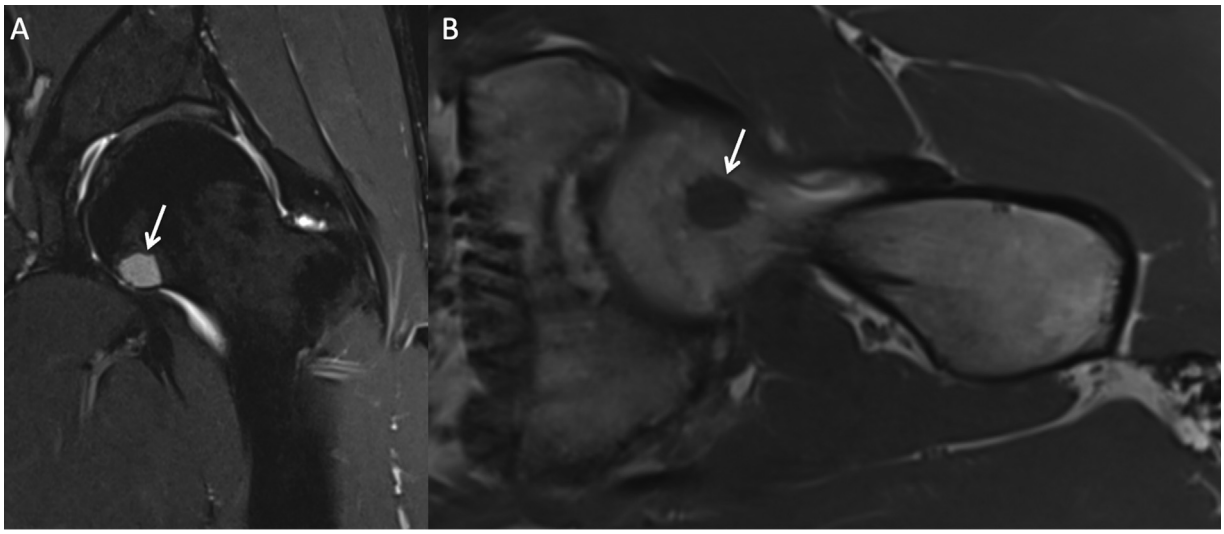

Fig. 1 A 30-year-old keen male runner presented with hip pain. He was found to have a labral tear and incidental chondroid lesion. Sagittal proton density fat-suppressed (**A**) and axial T1 (**B**) magnetic resonance arthrogram images showing a well-defined lesion (*arrows*) in the inferior femoral head with no aggressive features.

anti-inflammatory drugs. Computed tomography (CT) appearances are diagnostic (►**Fig. 2**). Patients with osteoid osteoma may lack clear symptoms and especially in young active patients as was in the case with figures in this article where femoroacetabular impingement was suspected by clinicians.

If there are aggressive features on MRI such as cortical destruction, periosteal reaction, and soft tissue extension, then a malignant lesion should be considered. Malignant lesions involving the hip include primary bone tumors such as osteosarcoma, bone metastases, and plasmacytoma, depending on the patient's clinical history (►**Fig. 3**). Treatment will vary according to the underlying pathology and symptoms but includes radiotherapy and surgical fixation if there is a risk of fracture.

Fractures

Atraumatic femoral fractures are a cause of hip pain in young patients and include stress and atypical femoral fractures. Stress fractures include both insufficiency fractures secondary to abnormally weakened bone and fatigue fractures, when repetitive force results in failure of normal bone.[2]

Femoral stress fractures most commonly involve the femoral neck, and superolateral fractures are considered high risk due to the increased tensile stress with potential to progress to a complete fracture.[2] Early stress fractures manifest as periosteal or mild marrow edema, with a linear cortical fracture line identified in higher grade injuries[2] (►**Fig. 4**). Atypical femoral fractures result from deficient bone turn over and have been reported in patients taking bisphosphonates.[2] On imaging, atypical femoral fractures are predominantly transverse, involving the lateral cortex of the proximal femoral diaphysis.[2]

Treatment is typically conservative, consisting of activity modification and cessation of any contributing medications, with surgical treatment reserved for high risk or complete fractures.[2]

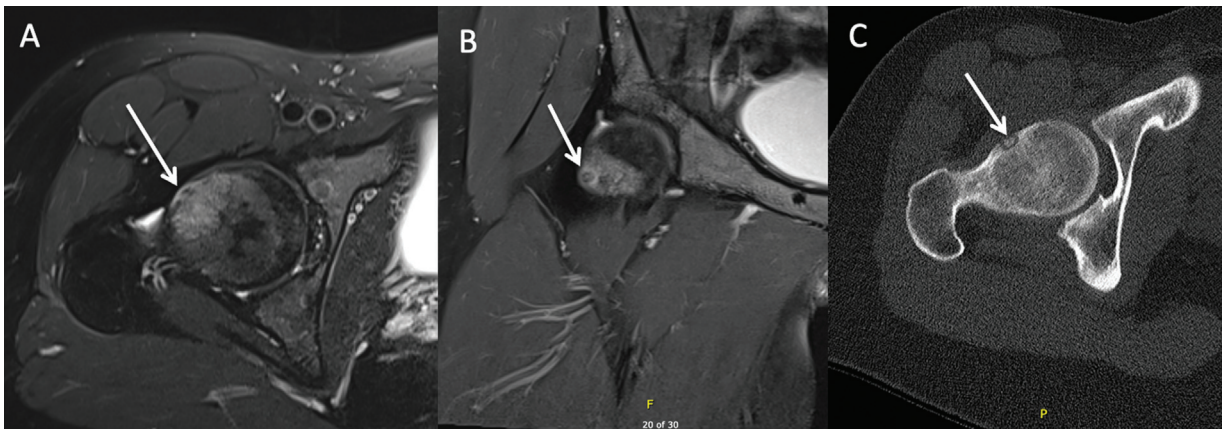

Fig. 2 Osteoid osteoma in a 17-year-old female with a 1-year history of hip pain and positive impingement signs. Axial and coronal proton density fat-suppressed image of right hip (**A** and **B**) with focal low signal abnormality (*arrows*) in subcortical lateral femoral head with adjoining cortical thickening and bony edema. Computed tomographic axial image (**C**) shows a typical nidus (*arrow*).

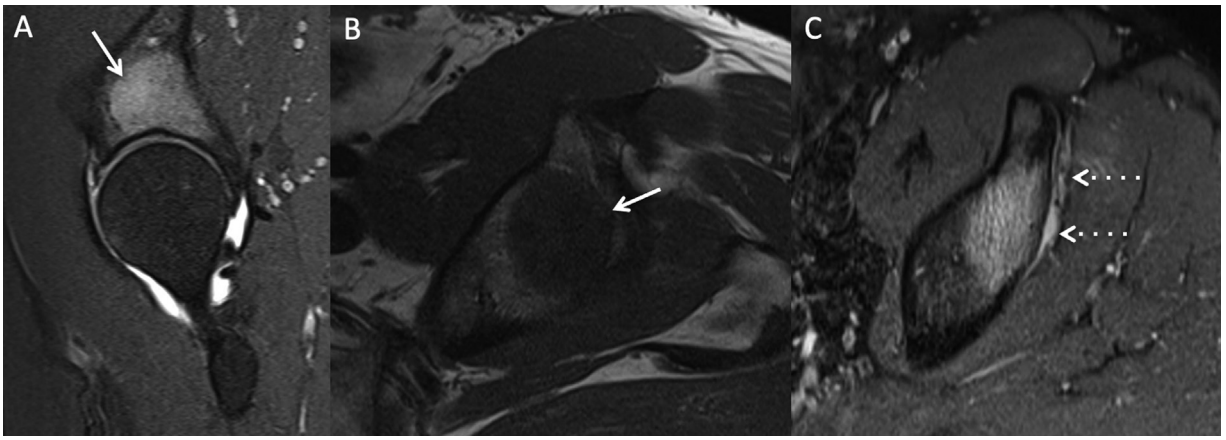

Fig. 3 Bone metastasis in a 40-year-old male patient presenting with hip pain. Sagittal proton density fat-suppressed (PD FS) (**A**), axial T1 (**B**), and axial PD FS magnetic resonance arthrogram images (**C**) show an irregular aggressive acetabular lesion (*solid arrows*) with an associated soft tissue component (*dashed arrows*).

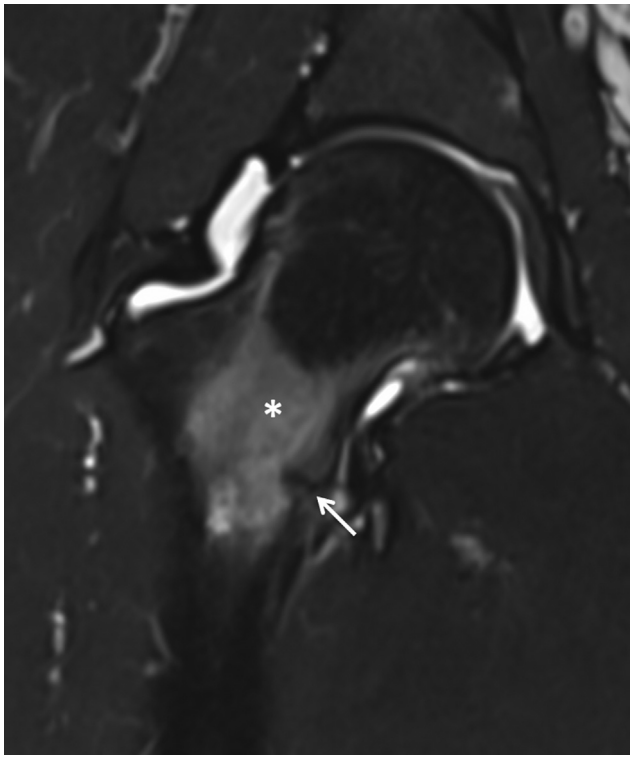

Fig. 4 Stress fracture in a young patient. Coronal proton density fat-suppressed magnetic resonance arthrogram image showing linear hypointensity (*arrow*) involving the medial cortex of the femoral neck with associated marrow edema (*asterisk*).

Bone Marrow Edema Syndrome

Bone marrow edema syndrome (BMOS) is a diagnosis of exclusion with a variable clinical presentation. The condition was first described in pregnant women during the third trimester, but has since been shown to be more common in young men.[3] The pathogenesis remains poorly understood; however, a vascular etiology has been suggested after angiographic studies have shown increased perfusion in the femoral head when compared with the contralateral hip.[3]

Initial radiographs are frequently normal, with osteopenia of the proximal femur seen 3 to 6 weeks after symptom onset,

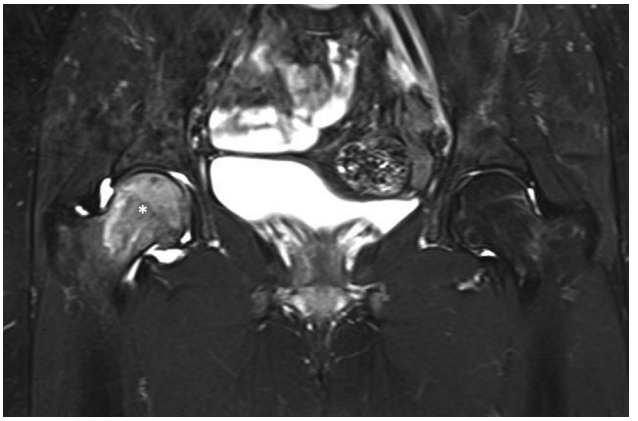

Fig. 5 Bone marrow edema syndrome. Coronal short tau inversion recovery image from an magnetic resonance arthrogram showing diffuse marrow edema throughout the right femoral head (*asterisk*). The left femoral head, by contrast, is normal.

which can be subtle.[3] MRI is the imaging modality of choice and typically shows poorly defined edema within the subchondral marrow of the femoral epiphysis and metaphysis[3] (►**Fig. 5**). MRI findings are present within 48 hours of symptom onset; however, these are nonspecific.[3] Avascular necrosis has similar early imaging findings; however, unlike BMOS avascular necrosis is bilateral in over 70% cases and is progressive, with the development of subchondral fractures and collapse.[3]

Treatment is primarily conservative, consisting of modified weight bearing and analgesia.[4] Several drugs have been reported to reduce the duration of symptoms, including bisphosphonates; however, evidence is lacking.[4] BMOS is self-limiting in the majority of patients and surgical decompression is rarely indicated.[4]

Soft Tissues

Greater Trochanteric Pain Syndrome

Greater trochanteric pain syndrome (GTPS) presents with lateral hip pain in the region of the greater trochanter and is increasingly recognized as a cause of hip pain in young

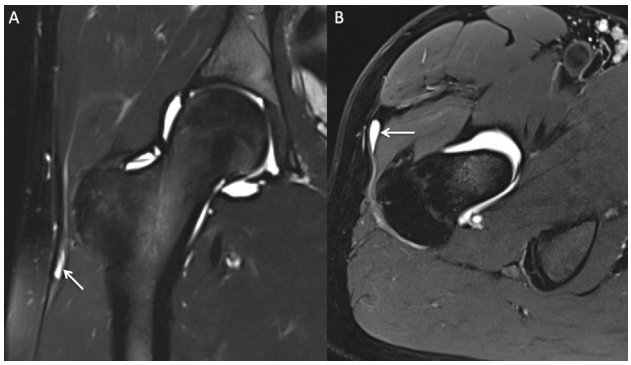

Fig. 6 Trochanteric bursitis in a female runner. Coronal (**A**) and axial (**B**) proton density fat-suppressed magnetic resonance arthrogram images showing fluid within the trochanteric bursa (*arrows*).

athletic patients.[5] Diagnosing GTPS can be challenging as several other common conditions mimic its presentation and imaging findings are not always symptomatic.[6]

On MRI, GTPS manifests as tendinopathy of the gluteus medius or minimus, with thickening and intrasubstance hyperintensity on fluid sensitive sequences.[7] Partial thickness tendon tears are seen as focal defects with hyperintense fluid signal within the defect, and tendon retraction in complete tears.[5] Bursitis is demonstrated in the majority of cases, with fluid within the trochanteric bursa most frequently present[7] (►**Fig. 6**). The subgluteus medius and subgluteus minimus bursae are located deep to the insertion of the respective tendons, and are less frequently involved.[7] Importantly, peritrochanteric edema in the absence of fluid should not be reported as pathological, as it is a frequent finding in asymptomatic patients.[6]

Treatment of GTPS is usually conservative consisting of weight loss, optimization of biomechanics, and analgesia.[8] Local corticosteroid injection is effective in patients with chronic pain, and can be landmark or image guided.[8] When performed under ultrasound guidance, the bursa most symptomatic on sonographic palpation is targeted for injection.

Ischiofemoral Impingement

Ischiofemoral impingement is the result of narrowing of the space between the ischial tuberosity and lesser trochanter, with impingement of the quadratus femoris muscle.[9] It is a challenge to diagnose clinically, with patients presenting with nonspecific hip pain similar to other intra- and extra-articular conditions and imaging is key.[9]

On imaging, ischiofemoral impingement manifests as a reduction in the ischiofemoral space measured between the ischium and lesser trochanter, with edema within the quadratus femoris muscle[10] (►**Fig. 7**). There is significant variation in the normal value for the ischiofemoral distance, which varies according to the degree of hip rotation and adduction.[9] There can also be more than 10% difference in values for the ischiofemoral space between the right and left hip, and abnormal signal within the quadratus femoris muscle has been reported in approximately 9% of asymptomatic patients.[11] The ischiofemoral gap is measured at level of insertion of iliopsoas tendon on the lesser trochanter

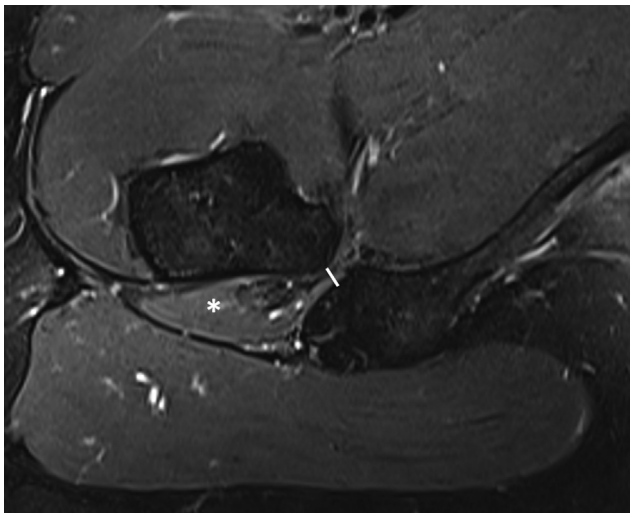

Fig. 7 Ischiofemoral impingement. Axial proton density fat-suppressed image showing marked narrowing of the ischiofemoral space (*line*) with mild edema in the quadratus femoris muscle (*asterisk*).

and less than 15 mm is considered abnormal. Another measurement used is quadratus femoris space and less than 10 mm is considered abnormal.

Image-guided injection of the quadratus femoris muscle is both diagnostic and therapeutic, and is usually performed under CT guidance.[10] Treatment is usually conservative, consisting of physiotherapy to strengthen the spinal and hip musculature.[9]

Joints

Inflammatory Arthropathy

Inflammatory arthropathy frequently presents in patients of working age, with an incidence of approximately 80 to 100 new cases per 100,000.[12] Rheumatoid arthritis is the most common inflammatory arthritis in the United Kingdom and affects approximately 500,000 people, with spondyloarthropathies such as ankylosing spondylitis, psoriatic arthritis, and reactive arthritis less common.[12] Although the small joints of the hands and feet are usually the first to be affected by rheumatoid arthritis, the hips are frequently involved at presentation in older patients.[12] The hips are more commonly involved in patients with spondyloarthropathy, and in these patients sacroiliac disease is common and is an important review area.

Inflammatory arthritis of the hip manifests as synovitis with synovial thickening, frond-like proliferation, and a joint effusion[13] (►**Fig. 8**). In early disease, there may be peritendinitis, with erosions seen in advanced cases.[13] Sacroiliitis is the diagnostic hallmark of spondyloarthropathy, manifesting as bone marrow edema involving both surfaces of the joint, with erosions in established cases[13] (►**Fig. 9**). The addition of axial imaging of the entire pelvis in protocols can aid in the diagnosis of spondyloarthropathy, enabling the detection of sacroiliitis, enthesopathy, and contralateral hip joint effusion.

It is important that inflammatory arthropathy is considered in all young patients presenting with hip pain, as early

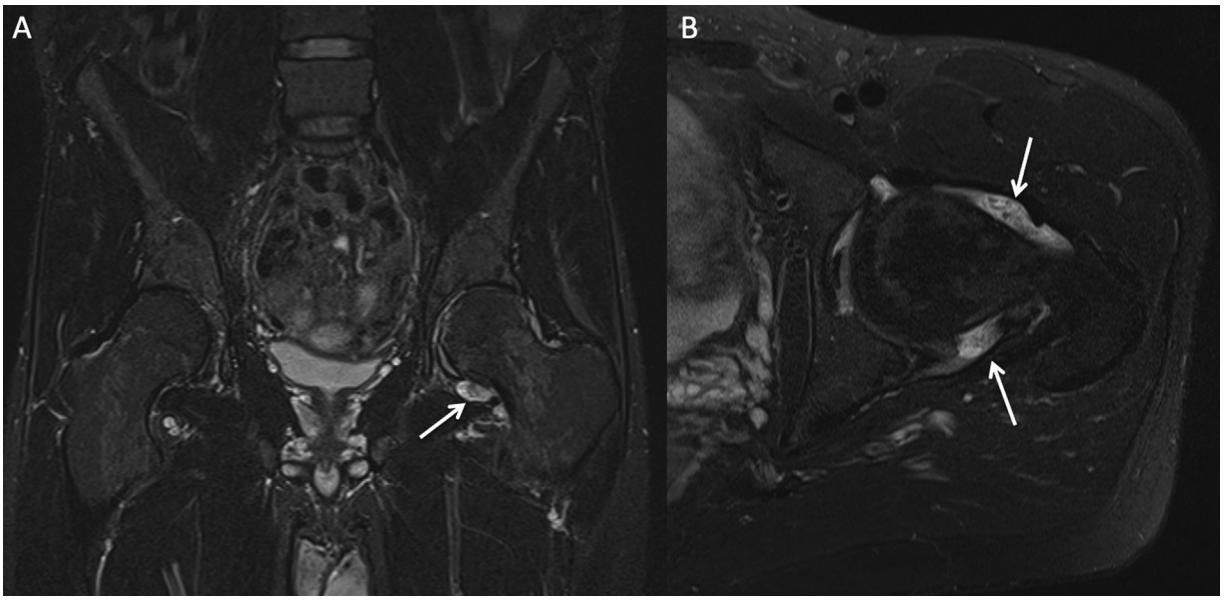

Fig. 8 Rheumatoid arthritis presenting in a 28-year-old female. Coronal (**A**) and axial (**B**) proton density fat-suppressed images show a left hip joint effusion with thickening of the synovium (*arrows*), in keeping with synovitis.

diagnosis can help facilitate treatment with disease modifying antirheumatic drugs and corticosteroids, improving both functional and radiological outcomes.[12]

Osteitis Pubis

The symphysis pubis is an important review area in young athletic patients as several conditions can involve the joint manifesting as osteitis pubis, presenting with nonspecific groin pain. The etiology is often unknown but several conditions are associated, including jumping sports, trauma, and child birth.[12]

On MRI, osteitis pubis manifests as parasymphyseal marrow edema with fluid within the symphyseal joint and peri-pubic soft tissue edema[14] (►**Fig. 10**). If there is marked osseous destruction, then osteomyelitis should be considered, which is usually apparent clinically.[14] Subchondral marrow edema localized to the anterior joint is characteristic of spondyloarthropathy.[14]

Osteitis pubis is typically self-limiting, with treatment consisting of rest, anti-inflammatory medication, and physiotherapy.[14] Local corticosteroid injection is reserved for persistent or severe cases; however, there is limited evidence of long-term benefit.[15]

Tip

By adding another coronal fluid sensitive of the pelvis to routine MR hip and MR hip arthrography, the diagnosis of

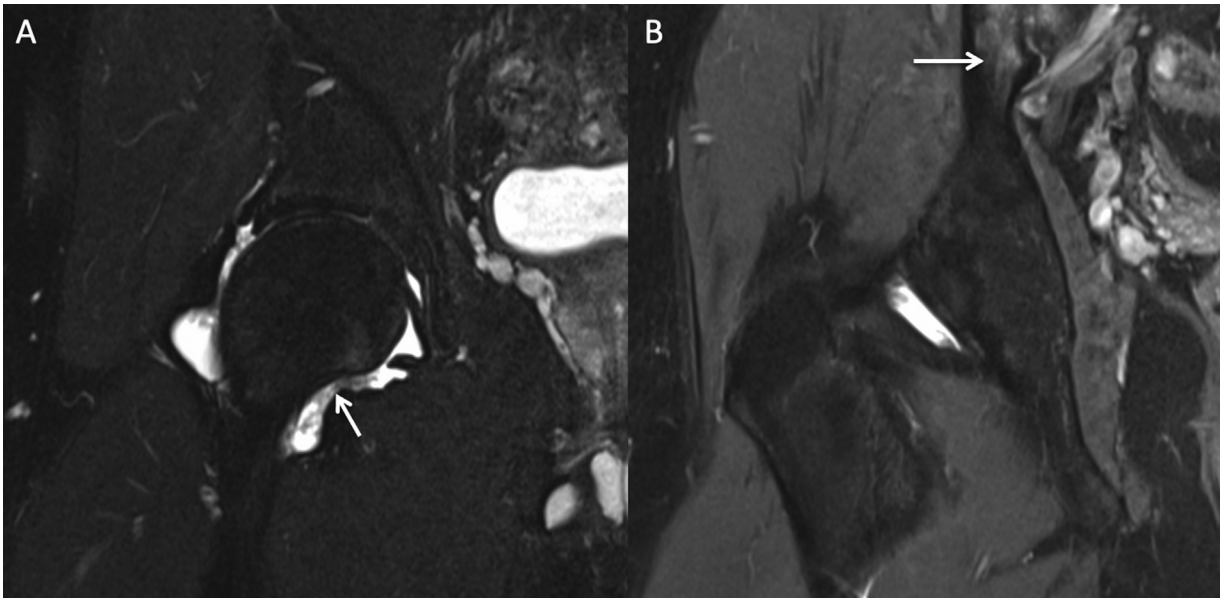

Fig. 9 Ankylosing spondylitis. Coronal T2 fat-suppressed (**A**) and (**B**) magnetic resonance arthrogram sequences show hypointense linear changes in images A (*arrow*) in the joint suggesting synovitis. In the margin of the image B, (*arrow*) active sacroiliitis changes. The patient has CAM type femoral head appearances.

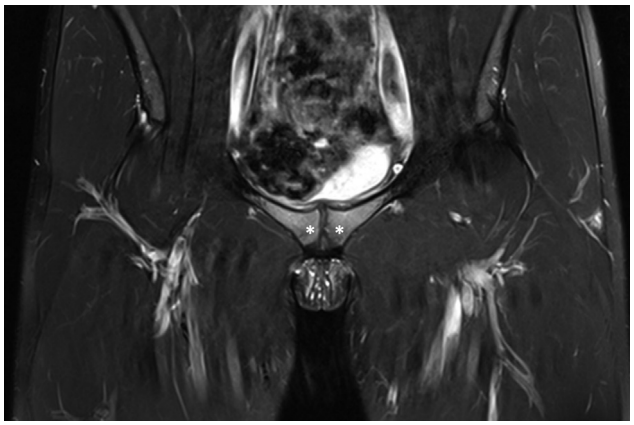

Fig. 10 Osteitis pubis. Coronal short tau inversion recovery image showing marrow edema within the pubic bone either side of the symphysis pubic (*asterisks*).

extralabral pathologies can become easier as it not only helps cover sacroiliac joints, pubic symphysis with rami, and adductor origins but also helps compare the trochanteric bursal changes on both sides for any asymmetry as often the bursal changes can be within normal limits.

Conclusion

Hip pain is a common presentation in young patients, with MR arthrography and 3T MRI hip frequently performed to investigate for labral pathology and femoroacetabular impingement. This article summarizes several other important pathologies responsible for hip pain in young patients and highlights extralabral review areas for radiologists to aid in their diagnosis.

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Conflict of Interest
All the authors declare no conflict of interest related to this article.

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