Sacro-iliac joint imaging: beyond inflammatory disease

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Learning objectives

To discuss and illustrate normal variants and non-inflammatory pathologic conditions that may occur in the sacroiliac joint area.
Background

Significant scientific work on imaging of the sacroiliac joints has been published, most of it focusing on inflammatory disease. Nevertheless, anatomical variants and non-inflammatory conditions can often be encountered when imaging this particular region, many of them clinically relevant. As such, radiologists should be familiar with the imaging findings and clinical characteristics of these various entities.
Imaging findings OR Procedure Details

Anatomical Variants

Knowledge of the spectrum of sacroiliac (SI) joint variants broadens the understanding of the joint anatomy and facilitates image interpretation.

. Accessory SI joints

Accessory SI joints occur in 10-30% of the population. Their etiology remains unclear, as it is not certain if the ASIJ is a congenital condition or an acquired joint [1]. They are usually located at the posterosuperior portion of the SI joints and are often affected by degenerative changes, with findings of reduced joint space, sclerosis, osteophytes and ankylosis [2] (Fig. 1 on page 12). These changes may manifest with symptoms of low back pain and may mimic focal sacroiliitis on imaging.

. Transitional lumbosacral vertebrae

Transitional vertebrae are frequent developmental variants of the spine. The L5 vertebra can be incorporated into the sacrum (ie, "sacralized"), or the S1 vertebra can be incorporated into the lumbar spine (ie, "lumbarized") [3].

Transitional vertebrae are usually incidental findings during radiologic evaluation. Despite the existence of a significant number of asymptomatic patients, transitional vertebrae associated with abnormal transverse mega-apophysis may be the cause of low back pain in others (Bertolotti's syndrome). This symptom may be related to progressive modifications in the biomechanics of the spine, in which the transitional segment is postulated to act as a blocked or fused segment leading to hypermobility at the segment above, leading to an increased incidence of disc degeneration, disc herniation and facet degeneration at vertebral levels just cephalad to the transitional vertebral body. Abnormal lateral contact of transverse mega-apophysis with sacrum or iliac bone can also be the source of local pain (Fig. 2 on page 12, Fig. 3 on page 13) [4]. Bertolotti's syndrome should be included in the differential diagnosis of low back pain in young patients [5].

. Other anatomical variants

Other anatomical variants can be found when imaging the SI joint area. Although they are asymptomatic, radiologists should recognize them as to avoid misinterpretation as pathologic findings.
Iliosacral complex (formed by an iliac projection inserting to a complementary sacral recess, usually at the posterosuperior part of the SI joint) (Fig. 4 on page 14), bipartite appearance of the iliac bony plate (located at the posteroinferior portion of the joint) (Fig. 5 on page 15), ossification centers of the sacral wings (presenting as triangular osseous bodies within the joint space with posterosuperior location) (Fig. 6 on page 16) and paraglenoid sulci (bilateral grooves in inferior ilium just lateral to the SI joints, seen almost exclusively in women, representing focal zones of bone resorption occurring in response to increased stress at the site of attachment of the inferior SI ligament) (Fig. 7 on page 17, Fig. 28 on page 36, Fig. 29 on page 37) are some of these variants [2].

In infants, the posterior neural arches are separated by a cartilaginous cleft, seen as a narrow vertical lucent line on frontal radiographs. This cleft disappears through ossification by 3-5 years of age. A persisting cleft is an extremely common developmental anomaly most frequently seen at S1 (but may be also present at other levels). It is filled with cartilage and fibrous tissue, and, when isolated, is usually of no clinical significance and is called spina bifida occulta [6] (Fig. 8 on page 17, Fig. 9 on page 18).

**Infection**

Infection of the sacrum or SI joints is a relatively rare condition. It can occur due to contiguous spread from adjacent infection, hematogenous spread from the skin, intestines or respiratory or genitourinary tract or from intravenous injections in drug abusers. Also, traumatic injuries to the sacrum and osseous pelvis or iatrogenic injury from gluteal injections, sacral biopsy and SI joint injections can be the cause of infectious sacroiliitis [3].

Septic arthritis results in unilateral SI joint widening and destruction (Fig. 10 on page 19, Fig. 11 on page 20) that may eventually lead to osseous ankylosis. Bone sequestration may occur (Fig. 10 on page 19). It is important to be aware that conventional radiographs are usually normal during the first 2-3 weeks. CT and particularly MR can demonstrate earlier and accurately the extent of bone and soft tissue involvement.

Septic arthritis of the SI joints can be confounded with sacroiliitis of inflammatory arthropaties. Synovitis, bone marrow edema and erosions are common in both entities, but septic sacroiliitis is usually unilateral, involve equally both the ilium and sacrum, and inflammatory changes tend to extend to periarticular soft-tissues. Periarticular abscess formation (Fig. 10 on page 19) is indicative of septic etiology.

**Degenerative joint disease**
Osteoarthritis is a common disorder of the SI joint. It is seen in most people over 40 years of age and is frequently associated with pain and stiffness. Imaging findings, which may be unilateral or bilateral, include focal or diffuse joint space narrowing, particularly at the inferior aspect of the joint, well-defined subchondral sclerosis mainly involving the ilium, and anterior osteophytes (Fig. 12 on page 21, Fig. 13 on page 22), which may fuse anteriorly giving rise to periarticular ankylosis. Although fibrous ankylosis within the joint is typical of advanced osteoarthritis, intra-articular osseous ankylosis is not a feature of osteoarthritis, as opposed to ankylosing spondylitis. Subchondral erosions and cysts, a prominent feature of ankylosing spondylitis, are not common in SI joint osteoarthritis, and, when present, are small and shallow. A nonspecific sign of osteoarthritis, also present in other disorders, is intra-articular vacuum phenomenon (Fig. 12 on page 21, Fig. 13 on page 22), and some of these patients may have an adjacent subchondral pneumatocyst (Fig. 13 on page 22) [7, 8].

Osteoarthritis of the SI joints may present occasionally mild bone marrow edema, subchondral sclerosis, or joint effusion on MR that mimic the imaging appearance of sacroilitis. In contrast to sacroilitis, in SI osteoarthritis, sclerotic changes are confined to the subchondral bone and does not extend at more than 5 mm from the SI joint space.

**Trauma and stress related conditions**

. *Acute fractures*

Fractures of the SI area due to significant trauma may pose diagnostic challenges to the radiologist when cross sectional imaging techniques are not used. Plain radiographs of the sacrum are particularly difficult to interpret in the setting of trauma owing to the overlying soft tissues. Also, the concurrent occurrence of other pelvic fractures may draw the attention of radiologists and trauma physicians away from the sacrum. CT is the examination of choice for imaging suspected sacral fractures and dislocations. The joint may be widened due to an "open book" injury (Fig. 14 on page 23), or there may be vertical displacement of the ilium relative to the sacrum after a vertical shear injury. Sacral or iliac fractures may also extend into the SI joint.

. *Insufficiency stress fractures*

Sacral insufficiency fractures arise from the application of normal loads on a bone that is mineral deficient or abnormally inelastic [9].

Osteopenic elderly women and patients with rheumatoid arthritis, prolonged corticosteroid medication and previous irradiation of the pelvis are at risk. Total hip replacement may contribute to fracture development due to combined fatigue and
insufficiency mechanisms [10] (Fig. 15 on page 24). Insufficiency fractures are also possible complications of spinal instrumentation [11] (Fig. 16 on page 25).

As in the setting of acute trauma, radiographs are often inaccurate in the diagnosis of sacral insufficiency stress fractures [3]. Uni or bilateral sclerotic bands or fracture lines parallel to the SI joints may be identified in some patients. Horizontal fractures through the sacral body often occur in conjunction with the vertical alar fractures. Sacral insufficiency fractures may occur as an isolated finding, although they are frequently associated with other insufficiency fractures of the pelvis, including the ischium, para-acetabular bone, ilium, parasymphysial locations, and acetabular roof. The sclerotic appearance with associated osteolysis of some of these lesions may occasionally mimic malignancy [10].

Bone scintigraphy may show the classic H-shaped pattern, although it isn’t always present. CT reveals a sclerotic band or discrete fracture lines, commonly with disruption of the anterior cortex of the sacral ala (Fig. 15 on page 24, Fig. 16 on page 25, Fig. 17 on page 26), and MR imaging reveals bone marrow edema with or without discrete fracture lines. Stress fractures of the sacrum, mainly of the insufficiency type, are surrounded by bone marrow edema and may mimic sacroiliitis. Age and personal history of the patients, as well as identification of the low signal fracture lines and normal aspect of the SI joint space on MR images allow differentiation between both entities.

. *Fatigue stress fractures*

Fatigue fractures are caused by excessive repetitive stress applied to a normally elastic bone [9].

They are rare in the sacrum, most often presenting in long-distance runners and military recruits, and are usually unilateral [3].

Plain radiographs are often nonrevealing. Bone scans are usually positive and MR imaging is diagnostic, exhibiting decreased signal intensity on T1-weighted images and increased signal intensity on T2-weighted images with or without a discrete fracture line [3]. CT scans may show vertical linear sclerosis or cortical disruption paralleling the SI joint.

**Neoplasia**

A variety of benign and malignant bone tumours, primary and secondary, may involve the SI and sacroccocygeal area. The most frequent benign tumours include teratoma, enostosis (Fig. 18 on page 27), giant cell tumor, aneurysmal bone cyst, osteoblastoma and hemangioma. Malignant neoplasms include metastasis (Fig. 19 on page 27, Fig. 20 on page 28), multiple myeloma (Fig. 21 on page 29), lymphoma (Fig. 22 on page
30), chordoma (Fig. 23 on page 31), chondrosarcoma, Ewing sarcoma, primitive neuroectodermal tumor and osteosarcoma (Fig. 30 on page 38, Fig. 31 on page 39). Metastatic lesions of the sacrum are far more common than primary malignancy [3]. Osteoid osteomas (Fig. 24 on page 32) only rarely involve the SI joint area [12].

Sacral canal and foraminal tumours, such as nerve sheath tumours (Fig. 25 on page 33), ependymomas and drop metastasis, may occasionally occur.

Miscellaneous

Intraosseous pneumatocyst

Intraosseous pneumatocyst is a benign condition, commonly seen in iliac bone or sacrum. In the ilium they are more common in males and may or may not be associated with SI joint degenerative disease [13]. Juxta-articular subchondral gas-filled lesions have also been reported in the sacrum in patients with osteoarthritis of the SI joint (Fig. 26 on page 34).

The etiology of pneumatocyst is unclear. Some have suggested that the cause is spontaneous development of intra-osseous gas or vacuum degeneration of an underlying intraosseous ganglion or synovial cyst. Others have speculated that the gas in the cyst is nitrogen released from the adjacent joints [14].

It is important to recognize these lesions to avoid misdiagnosing them as infection, based on the presence of gas.

Meningeal Cyst

Sacral meningeal cysts (also known as perineural cysts, Tarlov cysts and sacral arachnoid cysts) are a common incidental finding on pelvic cross sectional imaging performed for unrelated reasons [3].

These developmental lesions are abnormal dilatations of the meninges within the sacral canal or foramina, which may or may not communicate with the subarachnoid space. Erosion and remodeling of the sacral canal or foramina may occur due to pulsations of cerebrospinal fluid or raised intraspinal pressure. The enlarged sacral canal or foramen and the relationship to the sacral nerve roots is well demonstrated on MR images (Fig. 27 on page 35). CT shows to better advantage the surrounding thinned cortical margins.
Osteitis condensans ilii

Osteitis condensans ilii (OCI) typically causes well-defined subchondral triangular sclerosis on the anteroinferior aspect of the iliac side of the SI joints. Most frequently it is a bilateral and relatively symmetric process, but occasionally occurs unilaterally [3]. It is seen most commonly after pregnancy in young multiparous women and frequently is associated with paraglenoid sulci (Fig. 28 on page 36, Fig. 29 on page 37). After pregnancy these changes may gradually regress. Rarely, men can be affected [7, 8].

The cause of OCI is not clear. The main theory suggests that it is caused by chronic mechanical stress across the joints, combined with increased vascularity during pregnancy [7].

Radiographic appearance may simulate that of seronegative spondyloarthropathies, but no erosions, joint space narrowing, ankylosis or involvement of the sacrum are seen.

Paget's disease

Paget's disease of the bone (also known as osteitis deformans) is a chronic metabolic bone disorder characterized by excessive abnormal bone remodeling, with an increase in osteoclast-mediated bone resorption and compensatory excessive osteoblast activation [3, 15].

It is a common disorder which can affect up to 4% of individuals over 40 and up to 11% over the age of 80 [3]. There may be a slight male predilection.

The etiology of Paget's disease is not entirely known, but viral infection in association with genetic susceptibility have been described in several studies [15].

The radiographic findings in sacroiliac Paget disease reflect the stage (lytic, mixed lytic-sclerotic, sclerotic) of disease activity. In the early lytic or active phase, an osteolytic lesion is observed. In the sclerotic phase, cortical thickening most commonly involves the sacral foramina and the sacral side of the SI joints, resulting in osseous expansion of the sacrum. Paget disease involving the sacrum is commonly polyostotic, but isolated sacral involvement can occur.

MR imaging findings can be quite variable, depending on the stage of the disease. As such, making the diagnosis of Paget disease on the basis of MR imaging findings is difficult in the absence of plain radiographs or CT scans. In the lytic phase, the underlying fibrovascular matrix is hypointense on T1-weighted images and hyperintense on T2-weighted images. In the sclerotic phase, areas of sclerosis are hypointense on both T1- and T2-weighted images [3].
A change of appearance in sequential radiographic studies or the presence of a new soft-tissue mass indicates the likely possibility of malignant transformation (occurring in approximately 1% of patients), usually into an osteosarcoma (Fig. 30 on page 38, Fig. 31 on page 39).

**Diffuse idiopathic skeletal hyperostosis (DISH)**

DISH or Forestier disease is a common disorder characterized by bone proliferation at sites of tendinous and ligamentous insertion. The incidence of DISH has been reported to be seven in every 100 men and four in every 100 women older than 30 years.

This disorder produces characteristic spinal and extraspinal manifestations. Spinal DISH is typically characterized by the presence of “flowing” ossification along the anterolateral margins of at least four contiguous vertebral bodies, with preserved disc spaces [16]. It may produce bridging ossifications about the anterior, anterosuperior and inferior articular margins of the SI joints, resulting in paraarticular fusion (Fig. 32 on page 40). Asymmetric intra-articular fusion, when it occurs, predominates in the proximal fibrous portion of the SI joints (Fig. 33 on page 41) [16]. Ligament calcification and ossification may occur in the iliolumbar and sacrotuberous ligaments [7, 17].

**Sclerosing dysplasias**

Osteopoikilosis and osteopetrosis are two examples of osteosclerotic dysplasias that may be found when imaging the SI joint region.

Osteopoikilosis (Fig. 34 on page 42) is usually an asymptomatic condition. Multiple small, well-defined, homogeneous, circular or ovoid sclerotic foci distributed symmetrically around the SI joints are diagnostic radiographic findings of this condition [7], that should not be mistaken for pathology (e.g., sclerotic metastasis).

Osteopetrosis (Fig. 35 on page 43) consists of a group of conditions characterized by very dense but weak and brittle bones. Four clinically and radiographically distinct subtypes of osteopetrosis are recognized [7]. All share the common features of dense bones with markedly thickened cortices, with or without preserved corticomedullary differentiation.

**Crystalline arthropathies**
SI joint involvement is seen in around half of patients with calcium pyrophosphate disease (CPPD) [8]. The chondrocalcinosis of CPPD may be difficult to detect radiographically but is usually readily seen with CT (Fig. 15 on page 24). Sacroiliitis-like changes may be present, including bilateral SI joint erosions, sclerosis and joint space narrowing [7].

The incidence of SI joint gouty arthritis ranges from 7% to 17%. Imaging findings, usually asymmetric and more frequently seen in early onset disease, include large areas of erosion, subchondral cyst formation and bony sclerosis [18].

**Hyperparathyroidism**

Hyperparathyroidism often results in subchondral bone resorption around the SI joints, leading to erosions, sclerosis and enlarged and ill-defined joints on radiographs. As in ankylosing spondylitis, it is usually a bilaterally symmetrical process, greater on the iliac side. Unlike in true sacroiliitis, however, joint space narrowing or ankylosis does not develop, and on cross sectional imaging the resorption is mainly subchondral, with only minimal cartilage surface irregularity [7, 8].

**SI joint changes in athletes**

Sclerosis and erosions of the SI joints may be seen in athletes, particularly long-distance runners and soccer players. The SI joint is one of the "letter joints," along with the pubic symphysis (PS) and acromioclavicular (AC) joints, where repetitive shear-stresses at the joint can lead to bone resorption. Many athletes with SI joint changes also have radiographic findings of osteitis pubis, from the vertical shear stresses across that joint [8].
Fig. 1: Accessory sacroiliac joints. A and B. 63 year-old woman with bilateral accessory sacroiliac joints (arrows) exhibiting degenerative changes (sclerosis and small osteophytes). C. In another patient with accessory sacroiliac joints, an ankylosed accessory joint is seen on the left (thin arrow). Insufficiency fractures are present anteriorly at the sacral wings (arrowheads).

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Fig. 2: Transitional lumbosacral vertebra. 49 year-old female with right sided low back pain. CT demonstrates degeneration of an anomalous articulation between the right L5 transverse process and the sacral ala (arrow), with sclerosis, osteophytosis and vacuum phenomenon.

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**Fig. 3:** Transitional lumbosacral vertebra. 31 year-old female with left sided lumbosacral pain. The T1-weighted axial and coronal oblique and STIR coronal oblique images demonstrate a developmental transitional lumbosacral junction with enlargement of the left L5 transverse process (arrows) which articulates with the sacral wing, a configuration referred to as a pseudarthrosis. Notice the subtle bone marrow edema (arrowheads) on the apposing bone structures, representing stress reaction, as well as the hypertrophic changes, with marginal bone spurring (thin arrows), impinging on the L5 nerve root (asterisks).

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Fig. 4: Iliosacral complex. A and B. 85-year-old female. Axial and coronal oblique CT images show iliac projections inserting into complementary sacral recesses bilaterally, at the superoposterior portion of the sacroiliac joints (arrows). C. In another patient, a 37-year-old female, a unilateral iliosacral complex is evident on the right (arrow).

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Fig. 5: Bipartite iliac bony plate. 56-year-old woman. CT scan demonstrates a bipartite appearance of the iliac bony plate at the inferoposterior portion of the joints (arrows).

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Fig. 6: Ossification centers of the sacral wings. 24-year-old man. CT scan demonstrates bilateral ossification centers (arrows) of the sacral wings at the anterosuperior portion of the sacroiliac joints.

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Fig. 7: Paraglenoid sulci. CT scan of a 44 year-old woman displaying bilateral notches within the inferior ilium adjacent to the sacroiliac joints, termed paraglenoid sulci (arrows). These grooves represent a normal variant found almost exclusively in women.

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Fig. 8: Spina bifida occulta. 33 year-old man presenting posterior midline defect of the neural arch at S1 level (arrowheads), detected during an IV urography. This finding was asymptomatic and of no clinical significance. Notice the opacified ureter on the left (asterisk).

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Fig. 9: Spina bifida occulta. 35 year-old woman presenting posterior midline defect of the neural arch at S1 and S2 levels (arrows). Bilateral well-defined subchondral sclerosis is present in the anterior portions of the sacroiliac joints (asterisks), more prominent on the iliac side, probably representing osteitis condensans ilii.

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**Fig. 10:** Pyogenic septic arthritis. CT scan of a 45-year-old man demonstrates unilateral subchondral bone destruction of the left sacroiliac joint (arrows), with joint-space widening, sequestra (arrowheads) and soft tissue abscess extending anteriorly (asterisk). A few weeks before this patient had a Staphylococcus aureus septicemia, which was presumed to be the agent responsible for this infectious sacroiliitis.

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**Fig. 11:** Pyogenic septic arthritis. In another patient, a 35 year-old male, axial T1-weighted MR image shows hypointense bone marrow adjacent to the right sacroiliac joint (asterisks). Coronal and axial T2-weighted image with fat suppression shows high signal intensity within the widened and irregular joint space, representing synovitis or joint effusion, and marrow edema on each side of the sacroiliac joint (arrows). Edematous changes are also seen within the right piriformis muscle (arrowhead). Fluid collections are seen beneath the right iliacus and gluteus medius muscles (curved arrows). CT guided aspiration of the right sacroiliac joint was performed.

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Fig. 12: Degenerative joint disease. Oblique radiograph of the right sacroiliac joint in a 39 year-old woman. Small marginal osteophytes (arrow), subchondral sclerosis (asterisk) and vacuum phenomenon are observed.

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**Fig. 13:** Degenerative joint disease. CT scans of different patients, exhibiting large bridging (arrowheads) and small marginal osteophytes (arrow), subchondral sclerosis (asterisk), irregular joint space narrowing, pneumatocyst (thin arrow) and vacuum phenomenon.

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Fig. 14: Diastasis of the sacroiliac joints (open book pelvic injury). Radiograph and axial CT scan in a 47-year-old man after major trauma show widening of the anterior aspect of the sacroiliac joints (arrows), as the posterior sacroiliac ligaments remain intact. Note also the associated pubic symphysis diastasis (arrowhead), an injury frequently associated with sacroiliac joint diastasis.

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**Fig. 15:** Bilateral sacral insufficiency fractures. 88 year-old osteoporotic woman with a left hip replacement. CT scan of the pelvis shows sacral fractures with vertical and horizontal components (arrows), exhibiting extensive surrounding sclerosis. Note the associated, aggressive looking, lytic left parasymphyseal fracture (thin arrow). Hip prosthesis may be a factor contributing stress. Incidental chondrocalcinosis is noted in the sacroiliac joints and the right hip (arrowheads).

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Fig. 16: Stress fracture of the sacrum. 61-year-old woman with spinal arthrodesis. CT scan reveals coronally oriented linear increased density area on the left sacral wing (arrows). Arthrodesis-related abnormal distribution of stresses may be a contributing factor.

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**Fig. 17:** Bilateral sacral insufficiency fractures. 59 year-old woman. CT scan of the sacrum shows vertical fractures through the lateral masses (arrowheads), disrupting the cortex.

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**Fig. 18:** Enostosis (bone island). 37-year-old female. Solitary, oblong, osteosclerotic lesion in the right ilium (arrow). It is usually a solitary, discrete focus of osteosclerosis within the spongiosa of bone. It may be round, ovoid, or oblong. It often has a brush border composed of radiating osseous spicules that intermingle with the surrounding trabeculae of the spongiosa.

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Fig. 19: Skeletal metastasis: osteolytic pattern. CT scan of a 50-year-old woman exhibits striking osteolysis of the sacrum (asterisk), crossing the sacroiliac joint to involve the ilium. Histology proved it to be skeletal metastasis of renal cell carcinoma.

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Fig. 20: Skeletal metastasis: osteosclerotic pattern. In this 50-year-old female patient with advanced breast carcinoma, osteoblastic skeletal metastasis are evident in the left sacrum and ilium and right femur (asterisks).

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**Fig. 21:** Plasmacytoma. In this 70 year-old male, axial CT and T1-weighted MR images show a large destructive lytic lesion of the right ilium (asterisks), extending to the iliac surface of the sacroiliac joint.

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**Fig. 22:** Sacro-iliac involvement in Hodgkin disease. In this 33 year-old male with known Hodgkin disease, CT scan shows heterogeneous left iliac and inferior sacral bone sclerosis (white asterisks). On MR, low signal on T1 and high signal on T2 fat saturated with enhancement after gadolinium administration are evident in these same regions (yellow asterisks), findings compatible with lymphomatous marrow replacement. Foraminal periradicular infiltration at and below S2 is also apparent (arrowheads).

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**Fig. 23:** Chordoma. Axial and coronal CT scan images of a 39 year-old man with a large well-circumscribed sacral mass (asterisk), centrally located, predominantly osteolytic, with irregular calcifications within its matrix. Chordoma is the most common primary malignant sacral tumour and approximately 50% of all chordomas are sacrococcygeal in location.

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Fig. 24: Osteoid osteoma. CT scan oblique coronal reconstruction. A subarticular iliac nidus with central calcification (arrow) and mild surrounding sclerosis is identified in the right iliac bone.

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**Fig. 25:** Sacral neurofibromas. 32-year-old woman with type I neurofibromatosis. Axial CT scan shows multiple expansile neural foraminal and sacral canal masses (asterisks), with associated remodelling (arrows) and erosion (arrowheads) of bone.

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Fig. 26: Intraosseous Pneumatocysts. A. In a 40 year-old man a subarticular iliac cyst (arrow) with sclerotic margins, containing gas, is identified. B. In another patient, a 76 year-old man, a subarticular sacral gas-filled cyst is present, associated with degenerative joint changes.

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Fig. 27: Tarlov Cysts. 49 year-old woman with symptoms of low back pain. T1 and T2-weighted sagittal images show incidental sacral meningeal (Tarlov) cysts (arrows).

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**Fig. 28:** Osteitis condensans ilii. In this young female patient unilateral triangular sclerosis is evident in the right ilium (asterisk). Also noted are bilateral paraglenoid sulci (arrows).

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Fig. 29: Osteitis condensans illii. A) In a young female patient, bilateral triangular well-defined sclerosis is present in the iliac bones (asterisks). B) In another patient, a 29 year-old female, CT scan shows triangular sclerotic areas adjacent to the inferior portions of the sacroiliac joints (asterisks), more prominent on the iliac bones and on the right side. The joint spaces are maintained and the joint margins are sharply defined. Also noted are bilateral paraglenoid sulci (arrowheads).

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Fig. 30: Paget disease with secondary osteosarcoma. 53-year-old male patient with excruciating right sided lumbosacral and radicular pain. CT scan shows diffuse sclerosis of the vertebrae, sacrum and ilium with accentuation of trabeculae, cortical thickening and poorly defined bone expansion. Lytic bone destruction with adjacent osteoid-like calcifications is apparent in the right sacral ala (arrows).

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**Fig. 31:** Paget disease with secondary osteosarcoma. 53-year-old male patient with excruciating right sided lumbosacral and radicular pain. T1-weighted, T2-weighted with fat supression and T1-weighted fat supressed gadolinium enhanced MR images show a large destructive heterogeneous lesion centered at the right sacral lateral mass with soft tissue (arrowheads), right sacral foramina (small arrows) and sacral canal (curved arrow) extension. Right sided L5 to S3 nerve roots are compromised.

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Fig. 32: Diffuse idiopathic skeletal hyperostosis (DISH). Bridging ossification (arrowheads) is seen at the anterior and superior aspects of the sacroiliac joints in this CT scan of a 80-year-old male patient with dorsal and lumbar spine DISH. The sacroiliac joints are otherwise unremarkable.

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**Fig. 33:** Diffuse idiopathic skeletal hyperostosis (DISH). Axial CT scan shows bridging ossifications (arrows) at anterior aspect of sacroiliac joints in a 60-year-old man with diffuse idiopathic skeletal hyperostosis. Proximal intraarticular fusion is also evident (arrowheads), while the inferior (synovial) portion of the SI joints (not shown) is preserved.

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Fig. 34: Osteopoikilosis. Sacroiliac joint radiograph in a 43 year-old asymptomatic woman, exhibiting multiple circular and ovoid milimetric foci of osteosclerosis, resembling bone islands, distributed symmetrically in a periarticular pattern about the sacroiliac joints.

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Fig. 35: Osteopetrosis. Radiograph of the pelvis in a 70 year-old man. There is diffuse increased radiodensity of the pelvic bones and a pathologic fracture of the left femoral neck.

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Conclusion

Non-inflammatory abnormalities and normal variants in and around the SI joints are frequent. Knowledge and familiarity with imaging of these processes will allow radiologists of all subspecialties to contribute to their diagnosis and, when appropriate, to differentiate them from sacroiliitis, as to allow for adequate patient management.
References


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