**Hints and Tricks for Sacroiliac Joint Imaging**

Lecture by Dr A. Deleeuw

Text by Chatgpt revised by Pr B.Vande Berg

## Introduction: do not diagnose sacroiliitis from bone marrow edema alone

Imaging of the sacroiliac joints (SIJs) is deceptively difficult. The joints are oblique, anatomically complex and subjected to considerable mechanical stress. Normal anatomical variants are frequent, and both inflammatory and non-inflammatory abnormalities can produce bone marrow edema (BME) on MRI. Consequently, the detection of subchondral BME should never automatically lead to a diagnosis of inflammatory sacroiliitis.

The practical challenge for the radiologist is not simply to detect abnormalities but to answer three questions: Where is the lesion? What type of lesion is it? Does its distribution make biological sense for inflammatory disease?

Radiographs, CT and MRI provide complementary information. CT remains the most precise technique for cortical bone, erosions, sclerosis and ankylosis, whereas MRI provides unique information about active inflammation and the bone marrow. Correct interpretation requires integration of lesion morphology, location and clinical context.

## 1. Start with anatomy—and remember that the SIJ is not uniform

The SIJ should not be considered a simple flat synovial joint. Its anterior and inferior portions have a true cartilaginous joint space, whereas the posterior part is predominantly ligamentous. This distinction matters: Inflammatory sacroiliitis predominantly involves the **cartilaginous compartment**, in any area; Mechanical stress focuses on the anterior middle third of the SIJs) on their way between the lumbar spine and the hips. Abnormalities related to ligamentous insertions and anatomical variants occur more posteriorly. On MRI, therefore, the first question when encountering an area of BME should be: Is it really located adjacent to the cartilaginous portion of the SIJ? This simple anatomical check prevents many false-positive diagnoses.

An oblique coronal acquisition parallel to the long axis of the sacrum remains fundamental. An additional oblique axial sequence perpendicular to the joint is extremely useful because it confirms whether an apparent lesion is genuinely subchondral and helps determine its anterior or posterior location. Never diagnose sacroiliitis from a single plane

when the location of an abnormality is uncertain. What appears to be subchondral edema on coronal images may prove to be located posteriorly within the ligamentous compartment on axial images.

**2. Bone marrow edema is a finding, not a diagnosis**

The most common interpretative error in SIJ MRI is probably: BME = sacroiliitis. This is incorrect. Subchondral BME may occur in axial spondyloarthritis, but also in healthy individuals and in association with mechanical loading, sports, pregnancy and the postpartum period, osteoarthritis, stress-related changes and other conditions.

The diagnostic value of BME depends on its intensity, extent, depth, distribution and association with structural lesions. A tiny isolated focus of increased signal on fluid-sensitive images should therefore be interpreted cautiously. More extensive, intense or deep subchondral edema, particularly when accompanied by erosions or other characteristic structural abnormalities, is considerably more convincing.When seeing BME, do not immediately ask *"Is this sacroiliitis?"* Ask instead: "Why is there edema here?" The location and associated structural abnormalities usually provide the answer.

An important finding in inflammatory diseases is the finding of both active (BME) and quiescent (fat metaplasia) marrow changes in the same patient.

**3. Look at distribution before looking at intensity**

The geographical distribution of lesions is one of the most useful diagnostic clues. Inflammatory sacroiliitis tends to involve the subchondral bone of the cartilaginous compartment and may affect both sacral and iliac sides. As disease progresses, lesions may become multifocal and increasingly extensive. Mechanical abnormalities frequently have a more characteristic topography. They are often concentrated in areas subjected to maximal mechanical loading, particularly the anterior portions of the joint.

This concept is especially useful in women after pregnancy. Mechanical and postpartum changes may produce surprisingly extensive BME and occasionally mimic inflammatory sacroiliitis. The radiologist should therefore resist diagnosing inflammation solely on the quantity of edema. Distribution often matters more than the mere presence of edema.

**4. Search systematically for structural lesions**

Active inflammatory lesions attract attention because they are conspicuous on fat-suppressed fluid-sensitive images. Structural abnormalities may be less visually impressive but can provide greater diagnostic specificity.

The radiologist should systematically evaluate:

- erosions;
- subchondral sclerosis;
- fat metaplasia;
- joint-space alteration;
- bone budding or bridging;
- partial or complete ankylosis.

Erosions are particularly important, but they must be genuine cortical defects. Partial-volume effects, vascular channels and irregularities related to anatomical variants may simulate erosions. T1-weighted images remain extremely useful for structural assessment. Fluid-sensitive sequences should not replace high-quality T1 imaging. CT can be invaluable when MRI suggests structural abnormalities but their exact nature remains uncertain.

**5. Learn to recognize mechanical disease**

Mechanical SIJ abnormalities are extremely common and constitute a major source of false-positive MRI interpretation. Mechanical changes typically occur in predictable regions of the joint and may include focal BME, sclerosis and small osteophytes. One useful approach is to mentally divide the SIJ into anatomical and biomechanical regions rather than treating the entire joint as equivalent. Anteriorly located abnormalities in the middle third of the SILs in the coronal plane, particularly when triangular or limited to typical stress-bearing areas and without convincing erosions, should raise the possibility of mechanical disease. When abnormalities are highly localized, ask: "Could loading explain this distribution?" If the answer is yes, inflammatory sacroiliitis should not automatically be the leading interpretation. A simple trick for SIJs analysis is to avoid looking at the most anterior one or two coronal oblique slices.

**6. Osteitis condensans ilii: know the classic appearance—and its variants**

Osteitis condensans ilii (OCI) is an important mimic of inflammatory sacroiliitis. The classic radiographic or CT appearance consists of triangular iliac-sided sclerosis adjacent to the SIJ, generally without significant joint-space narrowing or erosions. At CT, bone sclerosis is typically sharply delineated in OCI whereas the transition zone between abnormal and normal bone is wide in inflammatory conditions. MRI can be more confusing because BME may occur adjacent to the sclerosis. Recognition of the geometric distribution of sclerosis, predominantly on the iliac side, is therefore important. Radiographs or CT may clarify the diagnosis immediately when MRI findings are ambiguous. OCI is a useful reminder of a general principle: Sclerosis plus edema does not necessarily mean inflammatory disease.

**7. Do not forget anatomical variants**

SIJ anatomy is remarkably variable. Accessory SIJs, dysmorphic joints, bipartite iliac bone plates and other variants may create unusual articulations or focal areas of mechanical stress. These regions can develop sclerosis, BME or degenerative changes. An accessory SIJ is particularly important because degenerative changes around an accessory articulation can produce posterior BME that may be mistaken for inflammatory disease if the anatomy is not recognized. Axial images are especially helpful for identifying these variants. Whenever an abnormality has an unusual location, consider the possibility of variant anatomy before invoking systemic inflammatory disease.

**8. Pregnancy and postpartum changes are major traps**

Pregnancy substantially alters pelvic biomechanics. Increased load, hormonal influences and childbirth-related stress can produce SIJ abnormalities that persist into the postpartum period. MRI may demonstrate bilateral or unilateral BME, sometimes extensive enough to resemble active inflammatory sacroiliitis. Clinical information is therefore crucial. In women of childbearing age, the radiologist should know whether imaging was obtained during pregnancy or in the postpartum period. The distribution of lesions and absence or presence of convincing structural abnormalities can help distinguish mechanical postpartum changes from inflammatory disease. This is a particularly important example of why an MRI finding cannot be interpreted independently of the patient.

**9. Degenerative disease can involve the SIJs too**

Osteoarthritis of the SIJs is common, particularly with increasing age. Typical findings include joint-space narrowing, subchondral sclerosis, osteophytes and occasionally subchondral cysts. Reactive BME may occur and should not automatically be considered inflammatory. The presence of osteophytes is particularly useful because they strongly suggest a mechanical/degenerative process. CT is generally superior to MRI for demonstrating small osteophytes and precise cortical changes. In older patients, the prior probability of degenerative abnormalities is high. The threshold for attributing minor SIJ BME to inflammatory disease should therefore be appropriately cautious. Another frequent finding is ligament ossification which may lead to joint ankylosis, even in young patients. In these patients, the subchondral bone plate remains normal whereas erosions are observed in inflammatory ankylosis.

**10. Think about fractures**

Sacral insufficiency and stress fractures can produce extensive marrow edema close to the SIJs. In elderly osteoporotic patients, the characteristic sacral distribution may suggest an insufficiency fracture. In younger athletes, stress injuries may also involve the sacrum, mainly S1. The fracture line may be subtle on MRI and occasionally obscured by extensive surrounding edema. CT can be extremely helpful when fracture is suspected.

**11. Infection is different—and potentially urgent**

Septic sacroiliitis is uncommon but important. Marked unilateral BME, joint effusion, surrounding soft-tissue edema, muscular involvement or abscess formation should raise concern for infection, particularly in the appropriate clinical context. Compared with axial spondyloarthritis, infection is more likely to be markedly asymmetric or unilateral and to demonstrate prominent periarticular soft-tissue abnormalities. Assessment of adjacent soft tissues is critical : theyare always normal in aseptic inflammatory disorders whereas they a frequently abnormal in septic arthritis.  Pay attention to the interface between the iliac bone and the iliac muscle. When infection is suspected, the report should clearly communicate the possibility because additional investigation and treatment may be urgent.

**12. Do not use classification criteria as diagnostic criteria**

Classification systems developed for research in axial spondyloarthritis have had enormous influence on SIJ MRI interpretation. However, classification and clinical diagnosis are not identical processes. An imaging pattern that fulfills a classification definition does not

automatically establish the diagnosis of axial spondyloarthritis in an individual patient. The radiologist should therefore avoid converting imaging criteria mechanically into a clinical diagnosis. A more useful report describes:

1. whether active inflammatory-type lesions are present;
2. whether structural lesions are present;
3. whether their distribution is typical;
4. whether important alternative explanations exist.

The final diagnosis emerges from integration of imaging with symptoms, age, laboratory findings, HLA-B27 status and rheumatological assessment.

**A practical reading strategy**

A reproducible approach substantially reduces interpretation errors.

- First, inspect T1-weighted images and understand the anatomy before looking at fluid-sensitive sequences. Identify the cartilaginous and ligamentous compartments and look for variants.
- Second, assess structural lesions: erosions, sclerosis, fat metaplasia, joint-space abnormalities and ankylosis.
- Third, examine fluid-sensitive images for BME. For every focus, determine its exact anatomical location, depth and extent.
- Fourth, assess symmetry and distribution. Decide whether the pattern is predominantly inflammatory, mechanical, degenerative, traumatic or potentially infectious.
- Finally, correlate the findings with age, sex, pregnancy/postpartum status, physical activity and clinical history.

This sequence is preferable to starting with STIR images, seeing bright subchondral signal and immediately attempting to decide whether the patient has sacroiliitis.

**Conclusion**

Sacroiliac joint imaging is less about detecting abnormalities than about interpreting their distribution and significance. MRI is extraordinarily sensitive to changes in subchondral bone marrow, but this sensitivity comes at the cost of specificity. BME is common and has

numerous causes. The diagnosis of inflammatory sacroiliitis therefore requires anatomical reasoning rather than simple lesion detection.

Three principles are particularly useful in daily practice:

- First: BME at MRI and bone sclerosis at CT are not synonymous with sacroiliitis.
- Second: location and distribution are often more informative than lesion intensity.
- Third: structural lesions and active inflammatory lesions should always be interpreted together.

CT and MRI should consequently be regarded as complementary techniques. MRI reveals active marrow abnormalities and inflammation, whereas CT provides exquisite characterization of cortical and structural changes. CT-like MRI sequences may become very useful in this setting.