Sacroiliac joint. How to differentiate inflammatory and non inflammatory conditions

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Learning objectives

To describe the anatomy of the sacroiliac joints (SIJ)

To learn the inflammatory or structural lesions found in spondyloarthritis and how to differentiate them from mechanical lesions

To identify other processes that may simulate spondyloarthritis (SpA).
Background

In 2009 the criteria for axial SpA were established, giving rise to a high demand of sacroiliac joint studies. Bone Marrow Edema (BME) was established as the hallmark of sacroiliitis, a marker of inflammation and needs to be significant in degree before a diagnosis of sacroiliitis can be made. BME needs to be visible on at least two contiguous MR images, or at two separate locations on the same image before it can be considered significant.

The recognition of inflammatory-type low back pain helps segregate patients with axial spondyloarthritis (SpA) from those with more common mechanical low back pain. About 20% of patients with low back pain have inflammatory-type pain while about 20% of these patients with inflammatory-type pain will have axial SpA. The prevalence of axial SpA is about 1%.

However edema is a non specific finding, being common to inflammatory and non inflammatory conditions. BME in mechanical (degenerative and overloading disease) is common all over the body and also in SIJ.

Care must be taken when interpreting a study according to ASAS criteria especially when there are mild changes without structural alterations. The prevalence of edema by MRI is 10% in degenerative SIJ disease (up to 21% in controls and in almost a third of patients with non-SpA inflammatory low back pain or young athletes) and 50% in SpA, given that degenerative SIJ disease is about 60 times more prevalent than sacroiliitis, then a patient with SIJ edema by MRI may be 12 times more likely to have degenerative SIJ disease than spondyloarthritis.
Patients with chronic back pain ≥3 months and aged <45 years

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<th>Sacroiliitis on imaging*</th>
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#SpA features
- Inflammatory back pain
- Arthritis
- Enthesitis (heel)
- Uveitis
- Dactylitis
- Psoriasis
- Crohn’s/colitis
- Good response to NSAIDs
- Family history of SpA
- HLA-B27
- Elevated CRP

*Sacroiliitis on imaging
- Active (acute) inflammation on MRI highly suggestive of sacroiliitis associated with SpA
- Definite radiographic sacroiliitis according to modified NY criteria

Fig. 1

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Imaging findings OR Procedure Details

Anatomy and Biomechanics

The main portion of the SIJ joint is surrounded by a complex capsule and lined with cartilage (*diarthrosis*). Its shape is auricular, and 'opens' posteriorly. The sacrum and ilia have an extracapsular, dorsally located articulation (*synarthrosis*), which is augmented by vast ligaments that provides internal stability.

If the sacroiliac joint is craniocaudally divided into thirds, it is widely admitted that all of the inferior one-third is a true synovial-cartilaginous joint. The posterior part of the middle one-third is syndesmotic while the anterior part is synovial-cartilaginous. The posterior part of the superior one-third is syndesmotic along with the most superior aspect of the anterior part Fig. 2 on page 9.

The sacral cartilage is overall about 3 times thicker than the iliac cartilage. Cartilage thickness varies across the joint, with the sacral cartilage being much thicker (6 mm) anteriorly than posteriorly (1 mm), making it more prone to be affected by any pathological change.

Furthermore, the pelvis is anteriorly tilted inward and must be taken into account when interpreting the usually acquired axial or coronal oblique planes.

Although SI joint is firmly fixed, the ligament structures allows a rotational movement of up to 10 degrees and translational up to 6 mm Fig. 3 on page 9.

SIJ is prone to mechanical changes due to trauma or microtrauma secondary to having either too much laxity or excessive compressional stiffness in the joint mainly in the weight bearing area, that is the anterior segment of the upper and middle thirds. Fig. 4 on page 10 Fig. 5 on page 11

Mechanical overload may represent an early stage of osteoarthritis (OA), especially in young active individuals and athletes, and may manifest as in other areas of the body as bone marrow edema (BME), mimicking the Spa pattern.

BME: inflammatory?
When only a mild or equivocal BME is found, the distribution patterns and signal characteristics can be used to differentiate inflammatory from non-inflammatory conditions.

Image features to analyze Fig. 6 on page 12

1.- Location

- OA is restricted to the load bearing areas whilst inflammatory condition can appear also in the most inferior third of the joint (non weight bearing area). Fig. 7 on page 13 Fig. 8 on page 14

- Spa is more common in the iliac side.

- Affected bone marrow areas are typically located periarticularly (subchondral bone marrow).

2.- Edema apparence

- Inflammatory lesions are usually at least 1 cm long or deep.

- Signal intensity is usually greater in inflammatory lesions compared to degenerative lesions.

- In the absence of additional imaging features of SpA in the SIJs or spine, two tiny lesions < 1 cm in diameter are not sufficient for the diagnosis of SpA.

3.- Associate findings

- Erosions are considered the most disease-specific measurable imaging findings in SI MRI of patients with Spa. Although sparse erosions may be present in the anterior part of the degenerative SIJ, and small erosions have been identified in up to 20% of controls, subchondral erosions remain the most helpful MRI feature of sacroiliitis. Fig. 10 on page 15

- Capsulitis, enthesitis, and synovitis are less commonly encountered and are supportive, though not diagnostic, features of SpA. Fig. 11 on page 16

- Backfill phenomenon is reparative fat metaplasia characterized by high T1-signal alongside the sacroiliac joints, and this may be more specific to SpA than initially
"Backfill" may be an intermediate step between erosion and ankylosis. **Fig. 12 on page 16**

-Sclerosis attributable to SpA should extend at least 5 mm from the SI joint space since small areas of periarticular sclerosis can be observed in healthy individuals (physiological sclerosis).

-Spine findings characteristic of SpA can add specificity to the diagnosis although it is now considered that imaging of the spine in addition to the sacroiliac joints significantly increases the length of the MR examination but does not necessarily add to specificity and sensitivity.

**Differential diagnosis**

**Infective sacroiliitis Fig. 13 on page 17**

- BME in infective sacroiliitis tends to be more intense and there is more intra-articular fluid.

- Second, inflammation in infective sacroiliitis spreads to involve the peri-articular soft tissues, particularly the iliacus and gluteal muscles.

- Peri-articular fluid collection or abscess is practically pathognomonic of an infective sacroiliitis.

**Osteoarthritis Fig. 8 on page 14**

- anterior marginal osteophytosis, joint space narrowing, joint surface irregularity with minimal subchondral sclerosis and subchondral cysts.

- BME tends to be milder in degree than in inflammatory sacroiliitis and tends to be confined to the immediate subchondral areas.

- Subchondral fatty change is a common feature of osteoarthritis that can mimic inflammatory 'backfill'.

**Diffuse idiopathic skeletal hyperostosis (DISH) Fig. 14 on page 19**
-Para-articular bony ankylosis that should not be mistaken for the true intra-articular bony ankylosis seen in ankylosing spondylitis

-There are no subchondral erosions or sclerosis in DISH and the synovial joints are spared.

**Sacral insufficiency fracture Fig. 15 on page 18**

-The demographic profile of patients who develop sacral insufficiency fractures is clearly very different to that of most patients with inflammatory sacroiliitis.

-The fracture line is commonly aligned vertically through the sacral ala and horizontally through the sacral body forming an H-shape which has been termed the "Honda sign".

**Osteitis condensans ilii Fig. 16 on page 20**

-It is caused by bone deposition at stress areas alongside the sacroiliac joint.

-Radiography and MRI typically reveal bilateral, symmetrical, sharply circumscribed, triangular-shaped areas of subchondral sclerosis, without erosions or joint space widening, at the anteroinferior aspect of the iliac bone alongside the sacroiliac joint.
Fig. 2

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**Fig. 3:** Some translational motion can be achieved

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**Fig. 4:** The weight bearing area comprises the anterior segment of the upper and middle thirds

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Fig. 5: The weight bearing area comprises the anterior segment of the upper and middle thirds

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OA

1. Location
   - OA is limited to the load bearing areas
   - More common in the sacral side

2. Edema appearance
   - Can be less than 1 cm long or deep.
   - Subtle signal intensity

3. Associate findings
   - Sparse erosions may be present in the anterior part of the degenerative SL in up to 20% of controls.
   - NO Capsulitis, enthesitis or synovitis.
   - NO Backfill phenomenon
   - Variable Sclerosis
   - Spine findings characteristic of OA

SpA

1. Location
   - Inflammatory can appear also in the most inferior third of the joint (non weight bearing area).
   - SpA is more common in the iliac side

2. Edema appearance
   - At least 1 cm long or deep to be suggestive.
   - High signal intensity similar to pelvis vessels

3. Associate findings
   - Subchondral erosions remain the most helpful MRI feature of sacroiliitis.
   - Capsulitis, enthesitis, and synovitis are less commonly encountered and are supportive, though not diagnostic, features of SpA.
   - Backfill phenomenon is nearly specific to SpA
   - Sclerosis attributable to SpA should extend at least 5 mm
   - Spine findings characteristic of SpA can add specificity to the diagnosis

Fig. 6

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**Fig. 7:** Sacriliitis: edema with no erosions in the middle and inferior third.

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**Fig. 8:** Edema in the middle third with sparing of the lower third in a patient with OA

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**Fig. 9:** Tiny lesions. On the right, small lesion (less than 1 cm) on the sacral side with mild high signal. On the left, bigger (1 cm) lesion on the iliac side and with high signal intensity, similar to the presacral vessels

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**Fig. 10:** Erosions. T1 (left), t2* (right)

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**Fig. 11:** Capsulitis (right), sinovitis middle), enthesitis (left)

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**Fig. 12:** Backfill phenomena

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Fig. 13: Infectious sacroiliitis. Soft tissue extension is a hallmark (upper arrow)

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Fig. 15: Sacral insufficiency fracture. Honda sign.

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Fig. 14: Bony bridging anterior to the sacroiliac join, sparing the rest of the joint.

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Fig. 16: Osteitis condensans ilii

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Conclusion

-BME is common to both inflammatory and non inflammatory conditions.

-SIJ edema is common in asymptomatic patients and should not be misinterpreted as inflammatory.

-It is important for radiologist to be familiar with the anatomy and biomechanics of the SIJ to make the right diagnosis.

- Lesion distribution is key when dealing with small BME foci especially in young active individuals since middle and upper third is a weight bearing area and highly susceptible to mechanical damage.

-The associated findings (erosions being, by far, the most important) should also be considered, since they add specificity to the diagnosis of inflammatory sacroiliitis.
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Personal Information

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