MRI findings of active and chronic sacroiliitis in light of recent ASAS criteria for diagnosing axial spondyloarthritis: what the radiologist should know

Poster No.: C-1955
Congress: ECR 2012
Type: Educational Exhibit
Authors: A. Yildiz, S. Akcalar Yildirim, F. Erkus, F. B. Ergen, U. Aydingoz; Ankara/TR
Keywords: Inflammation, Connective tissue disorders, Arthritides, Imaging sequences, MR, Musculoskeletal joint, Musculoskeletal bone
DOI: 10.1594/ecr2012/C-1955

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org


Learning objectives

To present the rules and pitfalls of magnetic resonance imaging (MRI) findings used in the diagnosis of active and chronic sacroiliitis in conjunction with the Assessment in Spondyloarthritis International Society (ASAS) criteria for classification of axial spondyloarthritis (SpA).

Background

The Assessment in Spondyloarthritis International Society (ASAS) defined new criteria in 2009 (Table 1) for the classification of axial spondyloarthritis (SpA) in patients with #3 months back pain aged <45 years at the onset of back pain (ASAS criteria for peripheral SpA have also been recently published) [1,2].

<table>
<thead>
<tr>
<th>Sacroiliitis on imaging¹ or HLA-B27</th>
</tr>
</thead>
<tbody>
<tr>
<td>plus</td>
</tr>
<tr>
<td>#1 SpA feature² plus #2 other SpA features²</td>
</tr>
</tbody>
</table>

¹Sacroiliitis on imaging:
- Active (acute) inflammation on MRI highly suggestive of sacroiliitis associated with SpA

or
- Definite radiographic sacroiliitis according to modified New York criteria

²SpA features:
- Inflammatory back pain
- Arthritis
- Enthesitis (heel)
- Uveitis
- Dactylitis
- Psoriasis
- Crohn's disease/ulcerative colitis
- Good response to NSAIDs
- Family history for SpA
- HLA-B27
• Elevated CRP

Note: Elevated CRP is considered a SpA feature in the context of chronic back pain

Table 1. ASAS classification criteria for axial SpA

in patients with back pain #3 months and age at onset <45 years (modified from reference 1).

These are a culmination of a string of efforts in the last 30 years starting with the 1984 modified New York criteria for ankylosing spondylitis, followed by the 1990 Amor criteria and the 1991 European Spondyloarthropathy Study Group criteria for SpA. The importance of new ASAS criteria for radiologists is that MRI takes center stage and it is one of the major criteria for the diagnosis of axial SpA when active (or acute) inflammation is present on MRI that is highly suggestive of sacroiliitis associated with SpA. According to the new criteria (Table 1), sacroiliitis on imaging plus #1 SpA feature is sufficient to make the diagnosis of axial SpA.

Imaging findings OR Procedure details

Given the high diagnostic accuracy of MRI in determining joint and related bone marrow abnormalities, it is hardly surprising that it has now become one of the cardinal tools for diagnosing active (acute) sacroiliitis associated with axial spondyloarthritis (SpA). We will first review the MRI criteria (according to Assessment in Spondyloarthritis International Society, ASAS) to make the diagnosis of active sacroiliitis [3], mention the MRI criteria of chronic sacroiliitis [3], then proceed to how a sacroiliac MRI study should be tailored to address these criteria, and finally discuss some differential diagnostic considerations [3], pitfalls [3], and a potential shortcoming of these criteria.

MRI criteria for diagnosing active (acute) sacroiliitis associated with axial SpA

There are four MRI findings of active (acute) sacroiliitis associated with axial SpA:

• Osteitis/bone marrow edema
• Enthesitis
• Capsulitis
• Synovitis

Of these four MRI findings, however, osteitis/bone marrow edema is the single indispensable one to call active sacroiliitis [3]. In other words, the presence of enthesitis and/or capsulitis and/or synovitis is not sufficient to make the MRI diagnosis of active sacroiliitis.
**Osteitis/bone marrow edema** is detected as hyperintense signal on STIR (Figure 1) and usually hypointense signal on T1-weighted MRI sequences. When an area of such signal enhances with intravenous (i.v.) contrast, it is then called osteitis (Figure 2). The sacral interfemoral bone marrow signal constitutes the reference for normal bone marrow signal. Although affected bone marrow areas are typically periarticular (subchondral) in location, there is no exact definition of location. Osteitis/bone marrow edema is said to be "clearly present" to call a positive MRI [3]; however, as with the location, no clear definition of the "intensity" of signal required is mentioned along with the ASAS criteria.

The amount of signal required for a positive MRI for active (acute) sacroiliitis, however, is defined. If there is only one signal (suggesting osteitis/bone marrow edema) for each MRI slice, the lesion should be present on at least two consecutive slices. If there is more than one such signal on a single slice, one slice may be sufficient [3].

**Enthesitis** is seen as hyperintense signal on STIR or contrast enhancement at sites where ligaments of the ligamentous portion of the sacroiliac joint attach to the sacrum or iliac bone (Figure 3). The abnormal signal may extend to bone marrow and soft tissue.

**Capsulitis** is also depicted as hyperintense signal on STIR or contrast enhancement at the anterior and posterior capsule (Figure 3). Capsulitis may extend into the periosteum at the anterior capsule (Figure 4) and may therefore essentially represent enthesitis as well.

**Synovitis** is best displayed as contrast enhancement on fat-suppressed T1-weighted images in the synovial part of the sacroiliac joint space (Figure 4). The signal intensity should be similar to blood vessels, the configuration should not.

**MRI criteria for diagnosing chronic (structural damage) lesions of sacroiliitis associated with axial SpA**

There are four types of lesions reflecting structural damage due to previous inflammation of SI joints:

- Subchondral sclerosis
- Subchondral periarticular erosions
- Periarticular fat deposition
- Bony bridges/ankylosis

The sole presence of structural lesions without concomitant osteitis/bone marrow edema is not sufficient for the definition of a positive MRI.
**Subchondral sclerosis** is defined as sclerotic areas that should extend at least 5 mm from the sacroiliac joint surface (Figure 5); smaller areas of periarticular sclerosis may be physiological.

**Subchondral/periarticular erosions** are bony defects at the joint margin (Figure 6). They may unite with each other to result in pseudo-widening of the sacroiliac joints (Figure 6).

**Periarticular fat deposition** probably indicates areas of previous inflammation where esterification of fatty acids have occurred (Figure 7). No further definition of "periarticular", however, has been made and this lack of further definition is prone to ambiguity for some, if not many, lesions.

**Bony bridges/ankylosis** usually results from the fusion of bone buds that have formed during the course of inflammation and face each other. This may be focal or extensive (Figure 8).

All structural damage lesions can be displayed by MRI. However, with the exception of periarticular fat deposition which is best displayed by MRI, their evaluation is usually carried out on direct radiographs by clinicians. It is important for radiologists to point out to clinicians that MRI is very well poised to detect chronic (structural damage) as well as acute sacroiliac lesions in axial SpA (Figure 9). Although direct radiography is readily available and inexpensive, its days of extensive use in the evaluation of sacroiliitis may be numbered. Either negative or positive direct radiographs do not exclude active sacroiliitis. Disease activity is best displayed by MRI and it is an important parameter in the tailoring and follow-up of treatment. From a practical standpoint, the expertise required for the correct evaluation of direct radiography for sacroiliitis is higher and less readily available than that required for the proper evaluation of MRI of the sacroiliac joints. In light of these issues, we propose that the abandonment of direct radiography in the routine work-up of sacroiliitis should be seriously considered.

**Heel enthesitis**

Enthesitis elsewhere in the body such as in the heel can be easily verified by MRI (Figure 10). STIR and T1-weighted long axis, and fat suppressed T1-weighted short axis MRI sequences (before and after i.v. contrast) would readily display enthesitis. Since heel enthesitis is among the SpA features, it is important for radiologists to increase awareness on the side of the clinicians (e.g., rheumatologists) of this capability of MRI.

**Tailoring an MRI examination of the sacroiliac joints to enable evaluation based on the ASAS criteria**
Imaging sacroiliac joints on two planes that are perpendicular to each other (transverse oblique and coronal oblique; Figure 11) would ensure the adequate display of as much cross-sectional interface through these joints as possible in a reasonable amount of time. Giving i.v. gadolinium based contrast material will help detecting or ensuring the presence of subtle osteitis/bone marrow edema, enthesitis, capsulitis, and synovitis.

A typical MRI of the sacroiliac joints would therefore have the following sequences:

1. STIR and T1-weighted coronal oblique (perpendicular to the S1 superior end-plate and covering the entire sacroiliac joints)
2. Fat suppressed T1-weighted (before and after i.v. contrast) transverse oblique (parallel to the S1 superior end-plate and covering the entire sacroiliac joints)

Given the possibility of aborting the MRI exam for any reason (usually due to patient intolerance because of claustrophobia), it is prudent to take the STIR and T1-weighted coronal oblique sequences first, as one or both of these two would provide important information on the presence or absence of osteitis/bone marrow edema, which is essential in terms of the clinical concern (i.e., whether there is active sacroiliitis).

In patients where i.v. contrast is contraindicated, fat-suppressed T1-weighted sequence should be replaced with STIR transverse oblique. It is important to remember that STIR provides usually a much more uniform fat suppression than-and should therefore be favored over-fat-suppressed T2-weighted sequence; although, admittedly, the former usually takes a longer time than the latter.

With a 512x512 image matrix and two signal acquisitions, it is usually possible to obtain images that would provide adequate information on the presence of erosions. Such information, in our practice, is at least consistently equal to or usually better than that provided by direct radiography (i.e., Ferguson view) (Figure 9). Other chronic (structural damage) lesions (namely, subchondral sclerosis, periarticular marrow fat deposition, and ankylosis) are always better depicted by MRI than direct radiography, due to the former’s cross-sectional capability and superb bone marrow imaging property. Overall, in our practice, MRI is sufficient to show all the active (acute) and structural damage (chronic) lesions of axial spondyloarthritis.

**Differential diagnostic considerations for active sacroiliitis on MRI**

Inflammation of SI joints due to infection (septic sacroiliitis) crosses anatomical borders as SpA does not. Septic sacroiliitis spreads diffusely to adjacent soft tissues (Figure 12).
Insufficiency fractures typical of the sacrum (Figure 13), and bone tumors such as plasmacytoma and osteosarcoma can cause bone marrow edema/osteitis-like appearance on MRI.

Osteoarthritis of sacroiliac joints may occasionally be associated with small areas of bone marrow edema along the sacroiliac joint.

Osteitis condensans ili (Figure 14) has a typical location and configuration on MRI as on direct radiography/CT. It is usually seen in middle-aged women in whom it has been attributed to abnormal stresses of pregnancy and delivery.

**Pitfalls of active sacroiliitis on MRI**

Blood vessels crossing through the sacroiliac joints may be confused as active inflammation on STIR images (Figure 15). Consecutive images should be carefully examined to rule out this possibility.

Inadequate fat suppression (usually seen with T2-weighted spectral fat suppression; not with STIR) may cause normal anatomical structures appear hyperintense especially at the posterior part of the sacrum and sometimes of the iliac bone. Similar effects on the adjacent soft tissue help to distinguish from real alterations.

Pulsation artifacts from the pelvic/iliac vessels may be juxtaposed to the otherwise normal bone marrow and may be mistaken for osteitis/bone marrow edema (Figure 16). Alternatively, they may mask underlying osteitis/bone marrow edema.

Finally, it should be borne in mind that children have incompletely ossified bones and the chondral interface between the ossified portions of the sacrum or iliac bone and the sacroiliac joint margin may resemble bone marrow edema (Figure 17).

**A potential shortcoming of the ASAS criteria for diagnosing axial SpA**

Of the ten people that participated in the study of "defining active sacroiliitis on MRI for classification of axial spondyloarthritis" that formed one of the bases of the new ASAS criteria, only two were radiologists (the remainder were rheumatologists) [3]. In daily practice, many rheumatologists apparently feel comfortable evaluating MRI of the sacroiliac joints themselves. It is not surprising that a properly conducted MRI provides quite objective cross-sectional information on axial SpA "for all to see". However, when it comes to the definition and establishment of MRI criteria, the vast experience of musculoskeletal radiologists has to be tapped accordingly.
The wording of ASAS classification criteria for axial SpA has it that sacroiliitis on imaging is either in the form of "active (acute) inflammation on MRI highly suggestive of sacroiliitis associated with SpA" or "definite radiographic sacroiliitis according to modified New York criteria" (see Background, Table 1). ASAS criteria may potentially be used by family physicians, general practitioners, internal medicine specialists, as well as rheumatologists. It is obvious that most rheumatologists would not be content with a negative direct radiography examination, which is currently the initial imaging step for diagnosing axial SpA; many will likely go on to order MRI of the sacroiliac joints in the face of compelling clinical suspicion for SpA. The same does not need to be true, however, for non-rheumatologists, who may inadvertently perceive the wording of the ASAS criteria to indicate that "radiography negative for sacroiliitis" means "imaging negative for sacroiliitis". The wording of the criteria is rather vague in this regard and may easily mean to an inexperienced non-rheumatologist that "when you have a positive MRI for active (acute) sacroiliitis that is a cardinal feature; however, when you do not have an MRI at all, and if you have negative direct radiography, imaging is negative". In other words, in the absence of MRI of the sacroiliac joints, the presence of a direct radiography exam negative for sacroiliitis should not hold back or defer the clinician from ordering an MRI.

Images for this section:
Fig. 1: Coronal oblique STIR MR image shows bilateral periarticular bone marrow edema (asterisks) consistent with active sacroiliitis associated with axial SpA.
**Fig. 2:** Fat-suppressed pre-contrast (top) and post-contrast (bottom) T1-weighted MR images show bilateral sacral and iliac sided periarticular osteitis consistent with active sacroiliitis associated with axial SpA.

![Fat-suppressed pre-contrast (top) and post-contrast (bottom) T1-weighted MR images](image.png)

**Fig. 3:** Transverse oblique fat-suppressed T1-weighted MR images before (left) and after (right) i.v. contrast show enthesitis (long arrow) and posterior capsulitis (short arrow).

![Transverse oblique fat-suppressed T1-weighted MR images](image.png)

**Fig. 4:** Coronal oblique STIR (left), T1-weighted pre-contrast (center) and T1-weighted post-contrast (right) MR images show sacroiliac synovitis (best visible on the post-contrast image), periarticular osteitis and anterior capsular enthesitis (arrows).

![Coronal oblique STIR (left), T1-weighted pre-contrast (center) and T1-weighted post-contrast (right) MR images](image.png)
Fig. 5: Transverse oblique fat-suppressed T1-weighted pre-contrast MR image shows subchondral sclerosis (arrow) more than 5 mm in thickness.

Fig. 6: Coronal oblique T1-weighted MR images before (left) and after (right) i.v. contrast show erosions (arrows), confluence of which has resulted in the pseudo-widened appearance of the right sacroiliac joint. Note that the erosions are more on the iliac, rather than the sacral, sides of the joints as the articular cartilage overlying the iliac side is half as thin as that on the sacral side.
**Fig. 7:** Coronal oblique T1-weighted pre-contrast (left) and STIR (right) MR images show periarticular fat deposition on both sides. Note the iliac-sided subchondral sclerosis adjacent to the left sacroiliac joint.

**Fig. 8:** Coronal oblique T1-weighted pre-contrast (left) and STIR (right) MR images show bony bridging (in the form of near complete ankylosis) in both sacroiliac joints. The patient has ankylosing spondylitis (without active sacroiliitis).

**Fig. 9:** Direct radiograph (Ferguson view, far left) shows erosions (arrow) at the iliac side of the right sacroiliac joint. Coronal oblique post-contrast T1-weighted MR images depict erosions (arrows) at the iliac sides of both sacroiliac joints. Direct radiograph was taken 20 days before MRI.
Fig. 10: Heel enthesitis (arrow) displayed as contrast enhancement of the plantar fascia enthesis on a post-contrast fat-suppressed T1-weighted MR image.
Fig. 11: Approximate locations of extreme slices of the coronal oblique and transverse oblique sacroiliac MRI sequences on a scout image.
Fig. 12: Coronal T1-weighted pre-contrast (left), post-contrast (center), and STIR MR images show periarticular osteitis and adjacent soft tissue inflammation (arrows) in a patient with right septic sacroiliitis. The exam was planned for right sided hip pain.

Fig. 13: Coronal oblique pre-contrast (left) and post-contrast (center) T1-weighted, and STIR (right) MR images show an insufficiency fracture (arrows) of the right sacral ala with surrounding bone marrow edema in a patient under treatment for Hodgkin lymphoma.

Fig. 14: Coronal oblique T1-weighted (left) and transverse oblique fat-suppressed T1-weighted (right) post-contrast MR images show subchondral sclerosis (arrows) at the iliac side of the right sacroiliac joint in a triangular configuration with a base at the bone margin inferiorly and anteriorly (ostearthritis condensans illii). The patient is a 42-year-old woman who had given birth.

Fig. 15: What appears to be focal bone marrow edema/osteitis in the subchondral sacral side of the right sacroiliac joint (arrow) turns out to be a crossing vessel on serial coronal oblique STIR MR images.
Fig. 16: Serial transverse oblique fat-suppressed post contrast T1-weighted MR images show pulsation artifacts (arrows) from a left iliac vessel causing the appearance of enthesitis and osteitis on the left iliac bone.

Fig. 17: Coronal oblique fat-suppressed T2-weighted MR image depicts symmetrical unossified cartilage of the iliac bones and sacrum in a 14-year-old boy. Note the fluid-like interface at the sacroiliac joint margins. Also note poor fat suppression at the right buttock subcutaneous tissue (this is not a STIR image).
Conclusion

MRI technique for sacroiliitis

1. STIR and T1-weighted coronal oblique (perpendicular to the S1 superior end-plate and covering the entire sacroiliac joints)
2. Fat suppressed T1-weighted (before and after i.v. contrast) transverse oblique (parallel to the S1 superior end-plate and covering the entire sacroiliac joints)

In patients where i.v. contrast is contraindicated, fat-suppressed T1-weighted sequence should be replaced with STIR transverse oblique.

Most pertinent radiologic finding(s)

Osteitis/bone marrow edema is the single indispensable MRI finding of active sacroiliitis. It should be noted, however, that MRI is capable of showing all established imaging findings of active and chronic sacroiliitis.

Conclusions

The fact that MRI has now taken center stage in the diagnosis of axial spondyloarthritis is a tribute to this modality’s extensive ability to show joint and bone marrow abnormalities.

Radiologists should take active part in the work-up of patients suspected to have active sacroiliitis. Close collaboration of radiologists with rheumatology and physical therapy and rehabilitation experts would result in mutual benefits for radiologists and clinicians as well as ensuring improved patient care.

Wording of the ASAS criteria should be revised such that resorting--by inexperienced clinicians-- to direct radiography alone in terms of imaging must be avoided. When direct radiography is negative, the need for MRI remains in patients clinically suspected to have acute or chronic sacroiliitis associated with axial SpA. Given the lack of widespread expertise in direct radiography evaluation of sacroiliac joints and the ability of MRI to readily depict acute and chronic sacroiliitis, we propose that the possibility of abandoning direct radiographs altogether in the diagnostic work-up and follow-up of sacroiliitis associated with SpA should be seriously contemplated on.
Increased participation of radiologists in committees responsible for developing imaging criteria for sacroiliitis is necessary. This would help fine tune the establishment and description of such criteria.

**Personal Information**

Department of Radiology, Hacettepe University School of Medicine, Sihhiye, 06100 Ankara, Turkey. 

call to: aelcindr@gmail.com

**References**

