MRI in Seronegative Spondyloarthritis: Imaging Features and Differential Diagnosis in the Spine and Sacroiliac Joints

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OBJECTIVE. Radiologists should be familiar with MRI findings suggestive of spondyloarthritis and its differential diagnosis. Because most publications describing these features are found in the rheumatologic literature, the purpose of this review is to present these imaging findings of axial spondyloarthritis to radiologists.

CONCLUSION. New imaging outcomes have improved the diagnosis and follow-up of spondyloarthritis and the assessment of therapeutic modalities. Diagnostic criteria include MRI of the sacroiliac joint, which facilitates earlier diagnosis.

Keywords: MRI, musculoskeletal, spondyloarthritis

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Spondyloarthritis is a group of diseases with clinical, laboratory, and genetic features in common. The most important of these is the association with human leukocyte antigen HLA-B27. Ankylosing spondylitis is the prototypic disease in the spectrum of spondyloarthritis, usually having axial skeletal manifestations. Other representative disorders in the spectrum of spondyloarthritis include psoriatic arthritis, arthritis related to inflammatory bowel disease, reactive arthritis (formerly Reiter syndrome), a subgroup of juvenile idiopathic arthritis, uveitis related to HLA-B27, and undifferentiated forms [1, 2]. These other disorders usually have peripheral articular involvement, but axial skeleton manifestations are also frequently seen.

In the last decade, new clinical and imaging outcomes have improved the diagnosis and follow-up of spondyloarthritis and the assessment of therapeutic modalities [2]. Until recently, the definitive diagnosis of spondyloarthritis relied on conventional radiography. However, radiographic changes usually develop at least 5 years after symptom onset [3, 4].

Diagnostic criteria for spondyloarthritis proposed by the Assessment of Spondyloarthritis International Society (ASAS) for patients younger than 45 years with low back pain for more than 3 months are as follows: MRI or conventional radiography shows sacroiliitis and at least one of the following clinical findings or the HLA-B27 result is positive and at least two of the clinical findings are present. The clinical findings are as follows: inflammatory back pain, arthritis, enthesitis (Achilles), uveitis, dactylitis, psoriasis, Crohn colitis, family history of spondyloarthropathy, positive HLA-B27 result, good response to nonsteroidal antiinflammatory drugs, and positive C-reactive protein result. The criteria include MRI of the sacroiliac joint because MRI has proved to be most suitable for detecting inflammation, enabling early diagnosis in patients with normal radiographic findings and ensuring appropriate and effective therapeutic management [5].

The estimated sensitivity and specificity of MRI in the diagnosis of this group of disorders are approximately 90%, but they can be higher if the examination is performed and the images interpreted correctly by a musculoskeletal radiologist familiar with rheumatologic diseases [5, 6]. According to the classification criteria, MRI of sacroiliitis combined with at least one specific clinical feature in a young adult with chronic back pain has 97.2% sensitivity and 94.2% specificity for the diagnosis of axial spondyloarthritis [3, 7].

Because most publications describing the diagnostic imaging criteria for spondyloarthritis are found in the rheumatologic literature, our aim is to briefly review the most important clinical and pathophysiologic findings of this disease for radiologists. We discuss the MRI features relevant to the differential diagnosis of axial spondyloarthritis according the ASAS classification criteria.

Pathophysiology and Clinical Findings

Spondyloarthritis affects both men and women but is most frequently seen in men. The disease usually starts between the second and the fourth decades of life and is rarely found after the age of 40 years [1]. A common feature of spondyloarthropathies is a high frequency of the presence of HLA-B27, and approximately 15% of HLA-B27–positive individuals eventually have ankylosing spondylitis due to unknown factors. This group of diseases is characterized by the inflammatory involvement of the entheses, which are junctional areas between bone and tendons, fascia, ligaments, or capsules. Enthesopathy is a prominent clinical feature in patients with spondyloarthritis, usually affecting the axial skeleton and peripheral and sacroiliac joints [1].

The initial inflammatory lesion seems to be responsible for the subsequent finding of erosions in subchondral bone that are filled with subacute or chronic inflammatory tissue and exhibit edema. These erosive lesions are usually healed by new bone formation, which tends to fill the initial bony defect and form a bridge between the deeper bone and the end of the ligament, creating a new enthesis [8]. Such entheses have a high level of metabolic activity, have an abundant nerve supply, and are responsible for the clinical symptoms. Persistent inflammatory back pain for more than 3 months associated with morning stiffness that improves with exercise and worsens with rest is the main clinical feature in patients with spondyloarthritis, especially patients with ankylosing spondylitis [1, 8].

Common extraarticular manifestations of spondyloarthritis are acute anterior uveitis, psoriasis, and inflammatory bowel disease. Although rare, pericarditis, cardiac valve involvement, renal amyloidosis, IgA nephropathy, erythema nodosum, and pulmonary fibrosis of the upper lobes have been described in association with this disease [1]. Laboratory results for rheumatoid factor and other autoantibodies are typically negative, justifying the early definition of seronegative spondyloarthropathies. HLA-B27 is detected in approximately 90% of patients with ankylosing spondylitis. Elevated C-reactive protein concentration is the most important inflammatory marker of disease activity.

MRI Protocol

According to the ASAS classification criteria, active inflammatory lesions are best visualized on fat-suppressed T2-weighted or high-resolution STIR images (512-pixel matrix, 3- to 4-mm slice thickness). Fat-suppressed gadolinium-enhanced T1-weighted images are equally useful for detecting inflammatory lesions, but some authors have recommended the use of gadolinium only in cases of doubt and high suspicion [7, 9–11]. Structural damage and chronic lesions, such as fatty degeneration and erosions, are best visualized on T1-weighted images [7].

For assessment of the sacroiliac joints, coronal and axial oblique images in the plane of the sacroiliac joints should be used. T1- and T2-weighted sequences with fat suppression or STIR sequences are recommended. If gadolinium administration is performed, T1-weighted sequences with fat suppression can be performed in the coronal or axial oblique plane.

An efficient spinal imaging protocol comprises sagittal T1- and fat-suppressed T2-weighted sequences or high-resolution STIR sequences. If gadolinium administration is performed, T1-weighted sequences with fat suppression should be obtained in the sagittal plane. Axial slices can be useful for assessment of the posterior spinal elements, and coronal slices may be best for assessment of the costovertebral, costotransverse, and facet joints.

MRI Findings

MRI is considered the most sensitive imaging method for detecting inflammatory changes of the spine and sacroiliac joints. This technique has been increasingly used in practice to assess disease activity and sometimes to monitor and evaluate therapeutic response [12]. The ASAS has listed the following imaging findings suggestive of active inflammation and chronic lesions of the spine and sacroiliac joints [13–16].

Active Inflammatory Lesions of the Sacroiliac Joints

Bone marrow edema—Bone marrow edema is characterized as high signal intensity on STIR images and fat-suppressed contrast-enhanced T1-weighted images. The edema is located periarticularly or on subchondral bone surfaces of the sacroiliac joints. Bone marrow edema is typically symmetric and appears most commonly in the lower and posterior thirds of the joints [13] (Figs. 1 and 2). When the edema is unilateral, infectious sacroiliitis must be excluded (see later, Differential Diagnosis). Stronger signal hyperintensity more likely reflects disease activity. Bone marrow edema may also be associated with structural changes such as erosions [13]. The asymmetric and unilateral involvement of the sacroiliac joints is not suggestive of ankylosing spondylitis but frequently indicates other forms of spondyloarthritis, most commonly psoriatic arthritis [9, 14, 17, 18].

Synovitis and capsulitis—Synovitis and capsulitis are reflected by high signal intensity in the synovial or anterior and posterior capsules of the sacroiliac joints on fat-suppressed contrast-enhanced T1-weighted images (Fig. 1). Synovitis and joint fluid cannot be differentiated on STIR images; gadolinium administration is necessary for this determination [13].

Enthesitis—Enthesitis is characterized by high signal intensity at the junctional area between bone and tendons, fascia, ligaments, or capsules on STIR images and fat-suppressed contrast-enhanced T1-weighted images. The high signal intensity may extend to adjacent bone marrow and surrounding soft tissue (Fig. 2). The radiologist should recognize that ligaments surrounded by vessels and some coil artifacts may appear as active inflammatory lesions that can simulate enthesitis.

Chronic Inflammatory Lesions of the Sacroiliac Joints

S*ubchondral sclerosis*—Sclerotic areas on both the iliac and sacral surfaces of the joint are depicted as areas of low signal intensity on STIR and T1-weighted images and are not enhancing on fat-suppressed contrast-enhanced T1-weighted images. Sclerosis typically extends at least 5 mm from the sacroiliac joint surface.

Erosions—Erosions are bony defects at the joint surface that appear as areas of low signal intensity on T1-weighted images and may occur throughout the cartilaginous compartment of the joint (Figs. 1 and 2). Erosions appear initially as single lesions and may subsequently become confluent, causing a false appearance of sacroiliac joint enlargement.

Fat depositions—Bone fat depositions present as increased signal intensity in periarticular bone marrow on T1-weighted images. This finding is nonspecific and often indicates areas of previous inflammation in a patient with spondyloarthritis.

Ankylosis—Ankylosis is the fusion of bone surfaces to form bony bridges across a joint and usually presents as low signal intensity in all MRI sequences (Fig. 3). The same signal intensity can be observed in the adjacent bone marrow and is sometimes surrounded by areas of fatty degeneration of high signal intensity on T1-weighted images.

Active Inflammatory Lesions of the Spine

Spondylitis—Spondylitis presents in the bone marrow of the anterior or posterior vertebral corners as high signal intensity on STIR images and fat-suppressed contrast-enhanced T1-weighted images. Anterior spondylitis is radiographically equivalent to a Romanus lesion [13] (Figs. 4–6). These inflammatory lesions are observed in 67% of patients with spondyloarthritis [19]. When more than three corners are involved in the absence of osteophytes or Schmorl nodes, the specificity of this finding is 81%; the specificity reaches 97% in patients younger than 40 years [19].

The lesions of ankylosing spondylitis are usually well defined. Extensive and diffuse vertebral involvement frequently indicates other forms of spondyloarthritis, most commonly psoriatic arthritis [9–14]. Spondylitis of the cervical spine with no involvement of the thoracic or lumbar spine or sacroiliac joints is also suggestive of other forms of spondyloarthritis, given the nonascending nature of vertebral involvement in this subgroup of diseases [9–14].

Spondylodiskitis—Spondylodiskitis (inflammatory Andersson lesions) is characterized by high signal intensity at the cortical plates adjacent to intervertebral disks on STIR images and fat-suppressed contrast-enhanced T1-weighted images [13] (Fig. 5). High signal intensity may also be visible in the center or throughout the intervertebral space, simulating inflammatory diskitis. Andersson lesions are observed in 33% of patients with spondyloarthritis, and this finding has a specificity of 59% for this group of diseases [19].

Facet joint arthritis—Arthritis of any facet joint from C2 to S1 can be observed in patients with spondyloarthritis and is usually associated with bone marrow edema within spinal pedicles (Fig. 6).

Costovertebral arthritis—Any costovertebral joint from T1 to T12 can be affected by arthritis that can be associated with bone marrow edema extending to the pedicles, posterior aspects of the vertebral bodies, and adjacent ribs and soft tissues.

Enthesitis of spinal ligaments—Enthesitis of spinal ligaments is characterized by high signal intensity at the bone insertion sites of the supraspinal, interspinal, and flaval ligaments on STIR images and fat-suppressed contrast-enhanced T1-weighted images. This finding has a specificity of 87% for spondyloarthritis [19] (Fig. 6).

Chronic Inflammatory Lesions of the Spine

According to the ASAS, radiography is the method of choice for the detection of chronic changes and is used in the care of patients with established disease [13]. However, radiography is not suitable for early diagnosis of spondyloarthritis because it does not depict inflammation, whereas MRI does [13]. CT depicts chronic bony changes better than radiography does but is rarely used because of greater radiation exposure [13].

Syndesmophytes and ankylosis—New bone formation occurs at the corners of the vertebral bodies in long-standing disease. It is characterized by thin, vertically oriented new bone formations on the peripheries of disks. These areas of new bone formation are most commonly symmetric and bilateral (Fig. 3). Areas of thick, irregular new bone formation with large implantation bases at the vertebral corners are considered pseudosyndesmophytes and are frequently unrelated to ankylosing spondylitis, suggesting other forms of spondyloarthritis, most commonly psoriatic arthritis [9–14].

Ankylosis—Bony bridges and new bone formation occur in the intervertebral disks in long-standing disease, presenting as low signal intensity in all MRI sequences (Fig. 3). The same signal intensity observed in the sacroiliac joints can also be present in the adjacent bone marrow and is sometimes surrounded by areas of fatty replacement with high signal intensity on T1-weighted images.

Fat deposition on vertebral corners—Bone fat deposits are best visualized on T1-weighted images. These deposits indicate areas of previous inflammation and are significantly predictive of formation of new syndesmophytes. Study results have suggested that the presence of more than five of these lesions may support a diagnosis of spondyloarthritis [20].

Criteria for MRI Positivity

The ASAS diagnostic criteria for spondyloarthritis include MRI of only the sacroiliac joint, but the identification of spinal inflammatory lesions supports the diagnosis. The criteria are as follows: high bone marrow signal intensity on STIR images or contrast enhancement on fat-suppressed T1-weighted images; typical location (periarticular or subchondral bone); and two or more areas of bone marrow high signal intensity on the same image or one area of bone marrow high signal intensity on two consecutive images. Capsulitis, synovitis, or enthesitis with no evidence of high signal intensity in adjacent bone marrow should not be considered a positive MRI sign. The detection of sacroiliitis at MRI has been defined by consensus among radiologists and rheumatologists. According to the ASAS group, MRI positivity requires visualization of areas of bone marrow edema on periarticular or subchondral bone in the sacroiliac joints on fat-suppressed T2-weighted images or STIR images. The presence of more than one bone marrow edema lesion in a single MRI slice may be sufficient for diagnosis, but a single bone marrow edema lesion should be clearly visible in a minimum of two consecutive MRI slices to constitute positivity. In the absence of concomitant bone marrow edema, enthesitis, capsulitis, and synovitis, even when reflecting active inflammation, are insufficient findings for MRI positivity. These findings, however, support the diagnosis of spondyloarthritis in patients with sacroiliitis. Bone marrow edema can be detected on T1-weighted images obtained after gadolinium administration and on T2-weighted and STIR images [3, 7].

To our knowledge, no structural lesions, such as sclerosis, erosions, periarticular fat depositions, and bony bridges, have been selected as criteria for MRI positivity. However, the presence of structural lesions in addition to inflammatory lesions supports and improves the diagnostic performance of MRI. The presence of both bone marrow edema and erosions has had 94% specificity and 75% sensitivity for the diagnosis of sacroiliitis [3, 7].

Although the diagnostic criteria state that MRI of only the sacroiliac joints is sufficient because inflammatory lesions rarely occur in the spine alone [7], one study [21] showed that 27% of patients with spondyloarthritis had spinal lesions and normal sacroiliac joints. Results of another study [20] suggested that approximately 20% of thoracic lesions may be missed unless whole-spine MRI is performed.

Differential Diagnosis

To avoid misdiagnosis, the radiologist should be familiar with the following conditions, which can simulate the imaging findings of spondyloarthritis.

Degenerative Sacroiliitis

Degenerative changes of the sacroiliac joints are characterized by irregularity and narrowing of the articular space, periarticular bone sclerosis, subchondral cysts, and the absence of inflammatory features such as erosions [22]. These changes can be differentiated from spondyloarthritis on the basis of their usual location in the anterior and middle thirds of the sacroiliac joints and their common association with degeneration of the articular surfaces of the pubic symphysis.

Infectious Sacroiliitis

Inflammation secondary to infectious sacroiliitis is visualized as unilateral high signal intensity of the subchondral bone surfaces of the sacroiliac joint on STIR images and fat-suppressed contrast-enhanced T1-weighted images. The surrounding soft tissue usually is involved (Fig. 7). In contrast, the inflammatory sacroiliac lesions of spondyloarthritis do not cross anatomic borders but are limited to the bone and intraarticular space. Identification of an abscess in the soft tissue adjacent to the intraarticular space is helpful for differential diagnosis.

Osteitis Condensans Ilii

Osteitis condensans ilii is described as a localized unilateral or bilateral triangular area of sclerosis on the ilium adjacent to the sacroiliac joint. Patients with this condition are commonly multiparous women (mean age, 35 years) because it has been related to loosening of the pelvic ligaments and increased stress on the sacroiliac joints during pregnancy and childbirth [23]. On MR images, this condition can be visualized as a triangular area of low signal intensity on T1-weighted images of the medial portion of the ilium adjacent to the anterior and middle thirds of the sacroiliac joints. Some authors have described an area of sacral sclerosis wider than 3 mm in approximately 72% of patients with osteitis condensans ilii [23].

Osteophytes of Lumbar Osteoarthritis

Osteophytes are the most important lesion related to osteoarthritis and are usually confused with the syndesmophytes and pseudosyndesmophytes characteristic of spondyloarthritis. Osteophytes are characterized by horizontal initial bone proliferation extending the vertebral plate that is followed by the formation of bony bridges between the vertebral corners (Fig. 8). The presence of bone sclerosis and subchondral cysts and the absence of inflammatory features such as erosions suggest osteoarthritis [22].

In contrast to osteophytes, syndesmophytes are thin, regular new bone formation on disk peripheries that are initially vertical in orientation and are most commonly bilateral and symmetric. They also have a narrow base of implantation on the vertebral corners. Pseudosyndesmophytes are also initially vertical in orientation, but they are thick, irregular new bone formation that is usually unilateral and asymmetric. The paravertebral ossifications of pseudosyndesmophytes have a comma-shaped appearance [22]. These bone proliferations have a wider implantation base than syndesmophytes and an appearance that is indistinct from the marginal bone [24–27].

The most readily detectable difference between osteophytes and syndesmophytes or pseudosyndesmophytes is the horizontal versus vertical orientation of the bone formations [28]. This distinction can be made by drawing one line between the anterior edges of the vertebral body analyzed and a second line at a 45° angle to the edge then measuring the angles of the bone proliferations. Those with an angle greater than 45° from the anterior vertebral edge are defined as syndesmophytes, whereas those with an angle less than 45° are defined as osteophytes [28].

Diffuse Idiopathic Skeletal Hyperostosis

The spinal involvement of diffuse idiopathic skeletal hyperostosis is characterized by exuberant, flowing ossification with a thickness up to 2 cm along the anterolateral aspects of at least four contiguous vertebral bodies. In sacroiliac joints, bridging ossifications can be found on the anterior articular aspect of the joints asymmetrically, although the involvement of this articulation is less frequent. These ossifications can be well visualized on T1-weighted MR images, but they are better identified on radiographs and CT scans. These bone formations can be confused with the paravertebral ossifications of the pseudosyndesmophytes characteristic of spondyloarthritis. The absence of facet joint, costovertebral joint, and sacroiliac joint ankylosis, erosions, and sclerosis differentiates this disease from spondyloarthritis [29].

Modic Lesion

Vertebral endplate degeneration and subchondral bone marrow changes are classified as a type 1 Modic lesion and present as hypointensity on T1-weighted images and hyperintensity on T2-weighted images, representing bone marrow edema and inflammation (Fig. 8). Type 2 Modic changes are associated with the conversion of normal red hematopoietic bone marrow to yellow fatty marrow and are hyperintense on T1-weighted images and isointense or slightly hyperintense on T2-weighted images.

Incorrect differentiation between Modic and Andersson lesions is a common pitfall in the diagnosis of spondyloarthropathies. Modic lesions are usually associated with degenerative changes of the intervertebral disks, although these features can also be found in Andersson lesions. In contrast, Andersson lesions are commonly associated with other findings suggestive of spondyloarthritis [24–26]. However, differentiation between these two conditions based only on MRI results is sometimes impossible, and the diagnostic approach should consider the history, clinical signs and symptoms, and laboratory results [13].

Infectious Spondylodiskitis

Differentiation between infectious spondylodiskitis and Andersson lesions is complex. Infectious spondylodiskitis is characterized by inflammatory changes of the vertebral plates visualized as high signal intensity on STIR images and fat-suppressed T2-weighted images, usually in association with paravertebral and epidural soft-tissue involvement (Fig. 9). Circumferential contrast enhancement of the soft tissue anterior to the vertebral body is also suggestive of an infectious process [24–26]. The border between the vertebral body and the intervertebral disk is usually disrupted and coalesced in infectious spondylodiskitis [24–26]. The presence of a paraspinal or epidural collection should also orient the diagnosis toward an infectious process [30].

Andersson lesions are found in 33% of patients with spondyloarthropathies and are usually associated with other findings suggestive of these disorders. The definite diagnosis can be based on the combined consideration of the patient's history, clinical symptoms, and laboratory results [24–26].

Follow-Up

MRI scoring methods have been developed for assessment and monitoring of acute and chronic lesions in patients with spondyloarthritis. The most commonly used MRI scores for the spine and sacroiliac joints are the Spondyloarthritis Research Consortium of Canada MRI Index for Assessment of Spinal Inflammation in Ankylosing Spondylitis, the Ankylosing Spondylitis Spine MRI score, and the Berlin method (a modification of the Ankylosing Spondylitis Spine MRI score). These three scoring systems are similar, although the Research Consortium of Canada method seems to provide higher interexaminer reliability (intraclass correlation coefficients) [31].

Some authors [3, 32] have determined that the MRI finding of inflammation only in the spine is predictive of a clinical response to tumor necrosis factor α antagonist therapy, particularly in patients with laboratory evidence of inflammation or a disease duration shorter than 10 years. The exact correlation between the disease activity expressed by symptom relief and MRI findings after therapy remains

undetermined. A 2006 study [33] showed the correlation between the MRI finding of abnormal enhancement and subchondral bone marrow edema of the sacroiliac joints and the laboratory finding of C-reactive protein concentration. However, anti–tumor necrosis factor α drugs are known to affect the MRI appearance of inflammatory lesions, with improvement in spinal lesions beginning in the sixth treatment week. The effect on inflammation at the sacroiliac joints is less consistent [3, 21, 34–36].

Conclusion

Validated classification criteria for axial spondyloarthritis emphasize MRI of the sacroiliac joints, which is the most suitable means of detecting inflammation associated with this disease. The early diagnosis of inflammatory lesions in patients with spondyloarthritis allows appropriate and effective therapeutic management [5].

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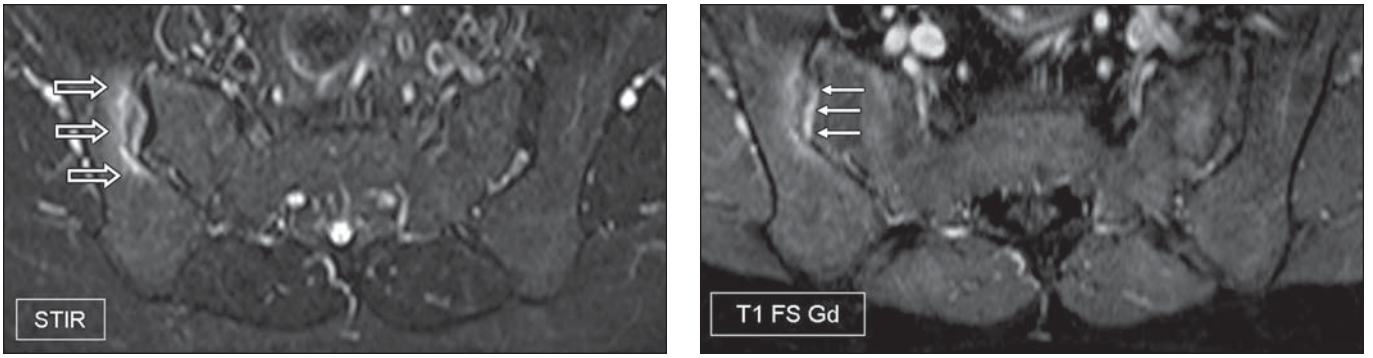


Fig. 1—54-year-old man with spondyloarthritis.
A and **B,** Axial STIR (**A**) and fat-suppressed gadolinium-enhanced T1-weighted (**B**) MR images of sacroiliac joints show high signal intensity of subchondral iliac surface of right sacroiliac joint (*arrows,* **A**) characterizing bone marrow edema and contrast enhancement of articular space of right sacroiliac joint (*arrows,* **B**) characterizing synovitis.

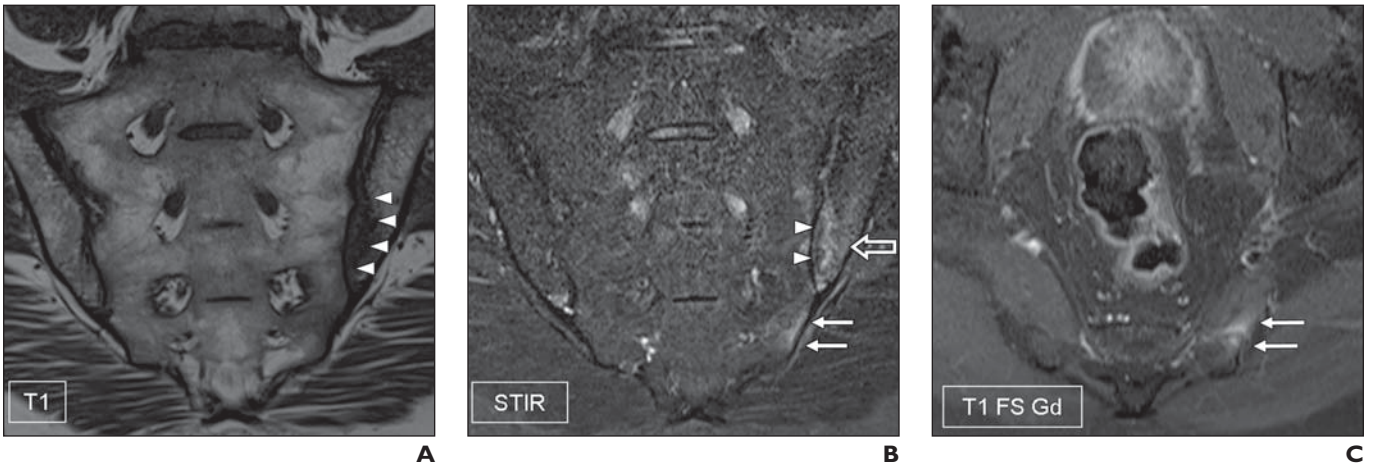
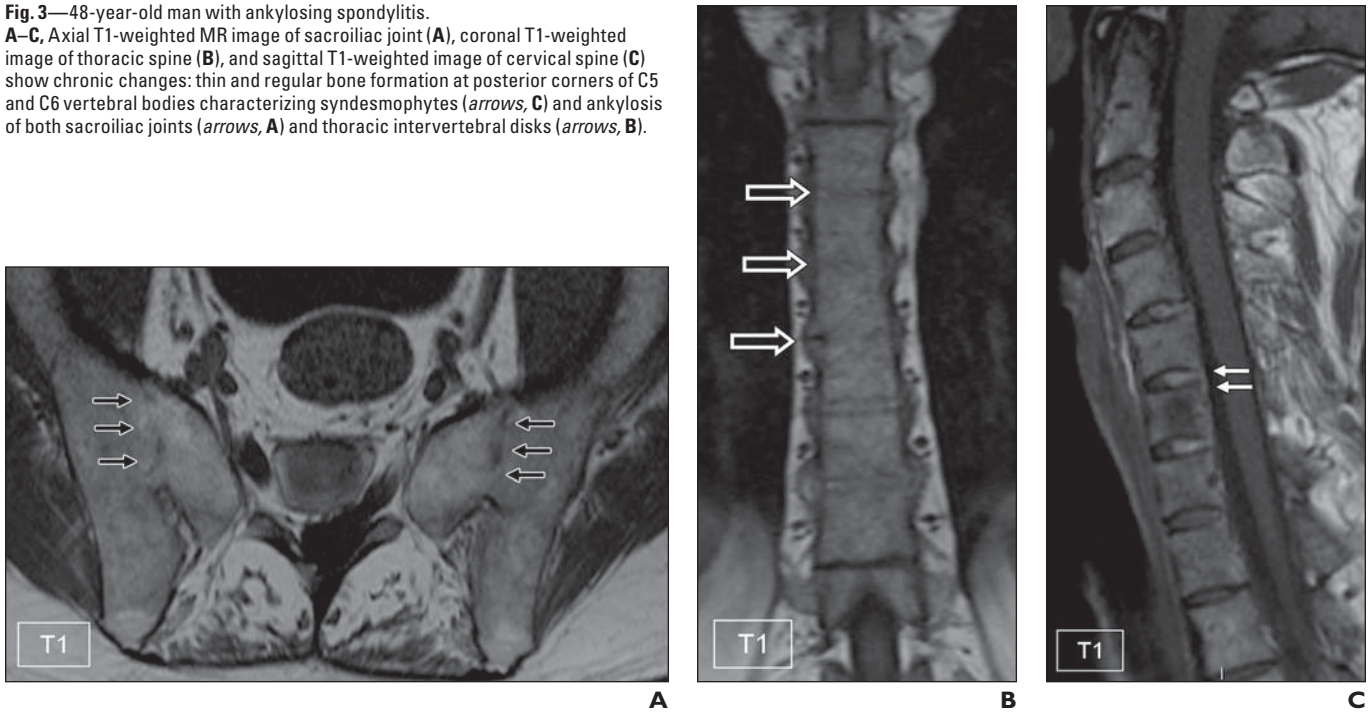


Fig. 2—44-year-old man with spondyloarthritis.
A–**C,** Coronal T1-weighted (**A**), STIR (**B**), and fat-suppressed gadolinium-enhanced T1-weighted (**C**) MR images of sacroiliac joints show bone marrow edema (*open arrow,* **B**) of left subchondral iliac bone, contrast enhancement of distal portion of left sacrum and surrounding tissue characterizing enthesitis (*solid arrows,* **B** and **C**), and small low-signal-intensity bony defects on left subchondral iliac bone characterizing erosions (*arrowheads,* **A** and **B**).

Fig. 3—48-year-old man with ankylosing spondylitis.
A–C, Axial T1-weighted MR image of sacroiliac joint (**A**), coronal T1-weighted image of thoracic spine (**B**), and sagittal T1-weighted image of cervical spine (**C**) show chronic changes: thin and regular bone formation at posterior corners of C5 and C6 vertebral bodies characterizing syndesmophytes (*arrows,* **C**) and ankylosis of both sacroiliac joints (*arrows,* **A**) and thoracic intervertebral disks (*arrows,* **B**).



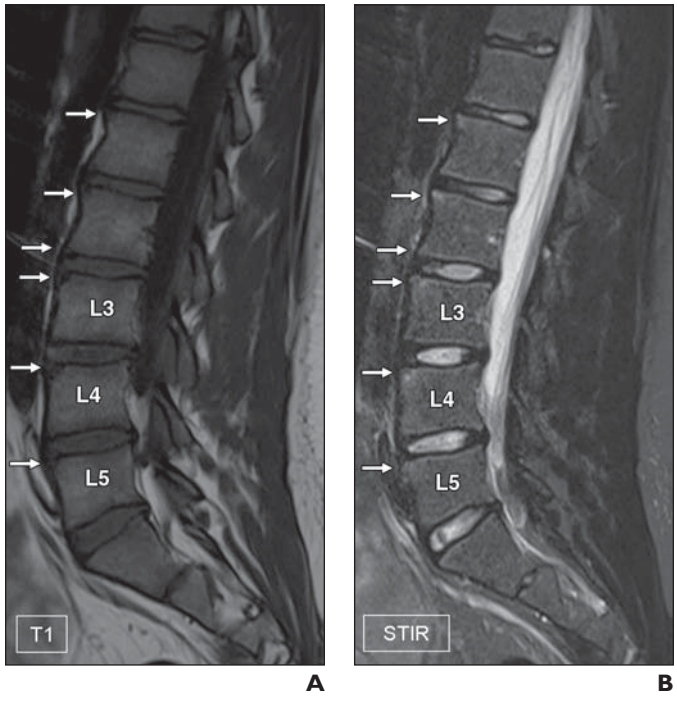


Fig. 4—35-year-old man with spondyloarthritis.
A and **B,** Sagittal T1-weighted (**A**) and STIR (**B**) MR images of lumbar spine show bone marrow edema (**B**) of anterior vertebral corners characterizing spondylitis (*arrows*) and irregularity of L3–L5 anterior vertebral corners (**A**).

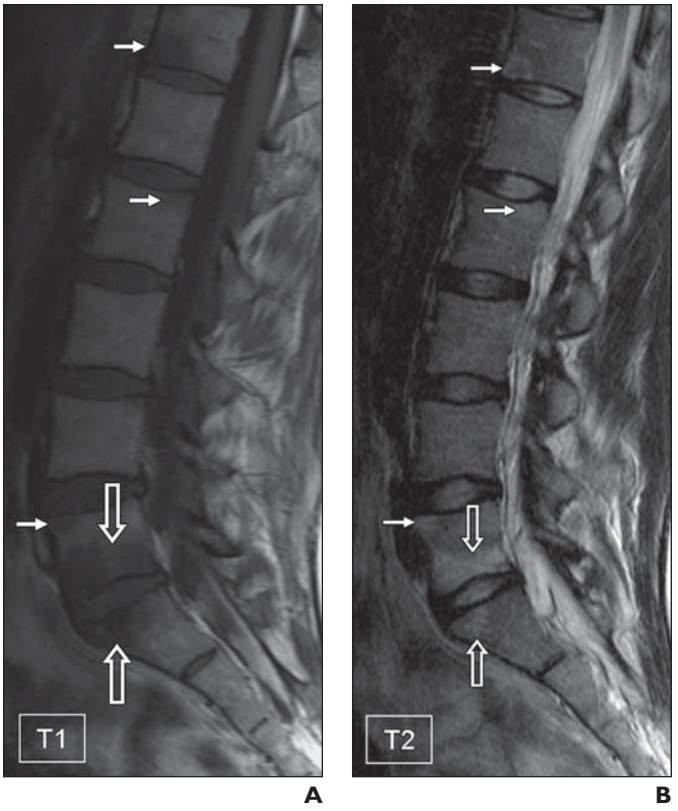


Fig. 5—29-year-old woman with spondyloarthritis.
A and **B,** Sagittal T1-weighted (**A**) and T2-weighted (**B**) MR images of lumbar spine show bone marrow edema (**B**) of cortical plate adjacent to L5-S1 intervertebral disk representing Andersson lesion (*open arrows*) and spondylitis of anterior and posterior vertebral corners (*solid arrows*).

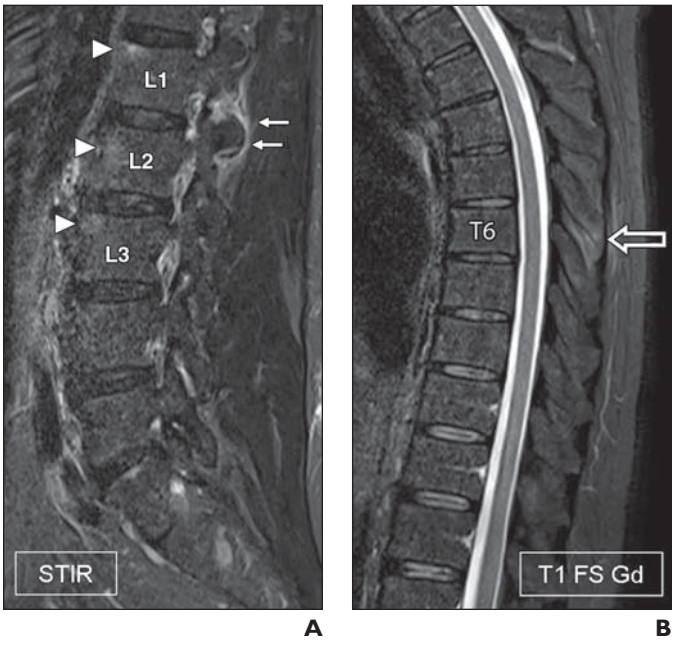


Fig. 6—39-year-old man with spondyloarthritis.
A and **B,** Sagittal STIR MR image of lumbar spine (**A**) and fat-suppressed gadolinium-enhanced T1-weighted MR image of thoracic spine (**B**) show soft-tissue edema surrounding facet joint of L2 (*arrows,* **A**) and enthesitis of T6 spinal process (*arrow,* **B**). **A** also shows anterior spondylitis of L1–L3 (*arrowheads*).

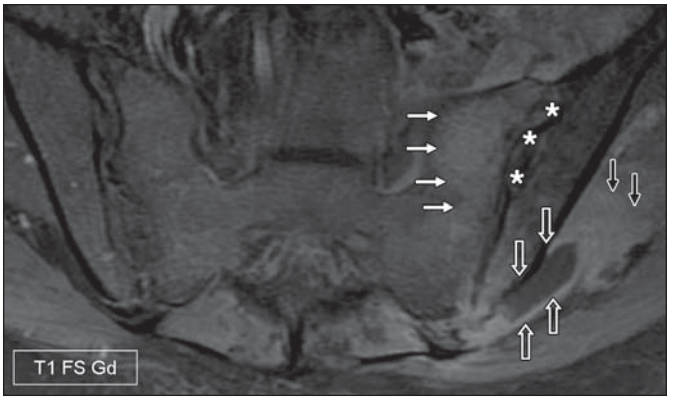


Fig. 7—40-year-old woman with infectious sacroiliitis. Axial fat-suppressed gadolinium-enhanced T1-weighted MR image of sacroiliac joints shows bone marrow enhancement of sacrum (*white solid arrows*), irregularity of articular space of left sacroiliac joint (*asterisks*), abscess (*open arrows*), and enhancement of adjacent soft tissue (*black solid arrows*).

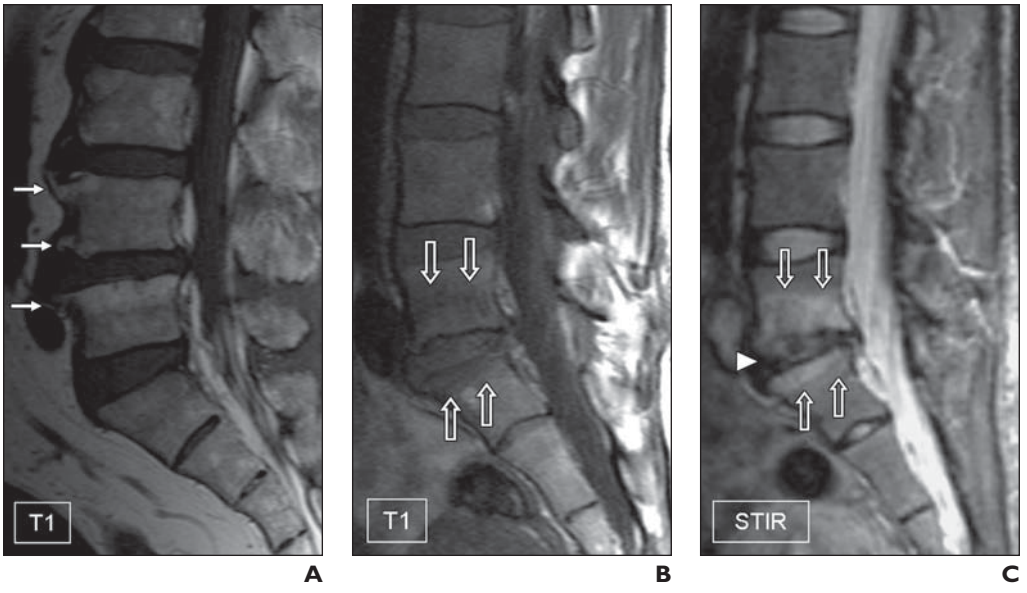


Fig. 8—Lumbar degenerative osteoarthritis.
A, 54-year-old man. Sagittal T1-weighted MR image shows osteophytes (*arrows*) of L4 and L5. Horizontal orientation of bone proliferation is evident.
B and **C,** 48-year-old woman. Sagittal T1-weighted (**B**) and STIR (**C**) MR images show degenerative vertebral endplate and subchondral bone marrow edema at L5–S1 (*arrows*) representing Modic type 1 lesion. Degenerative changes of corresponding intervertebral disk (*arrowhead,* **C**) are usually associated with Modic lesion.

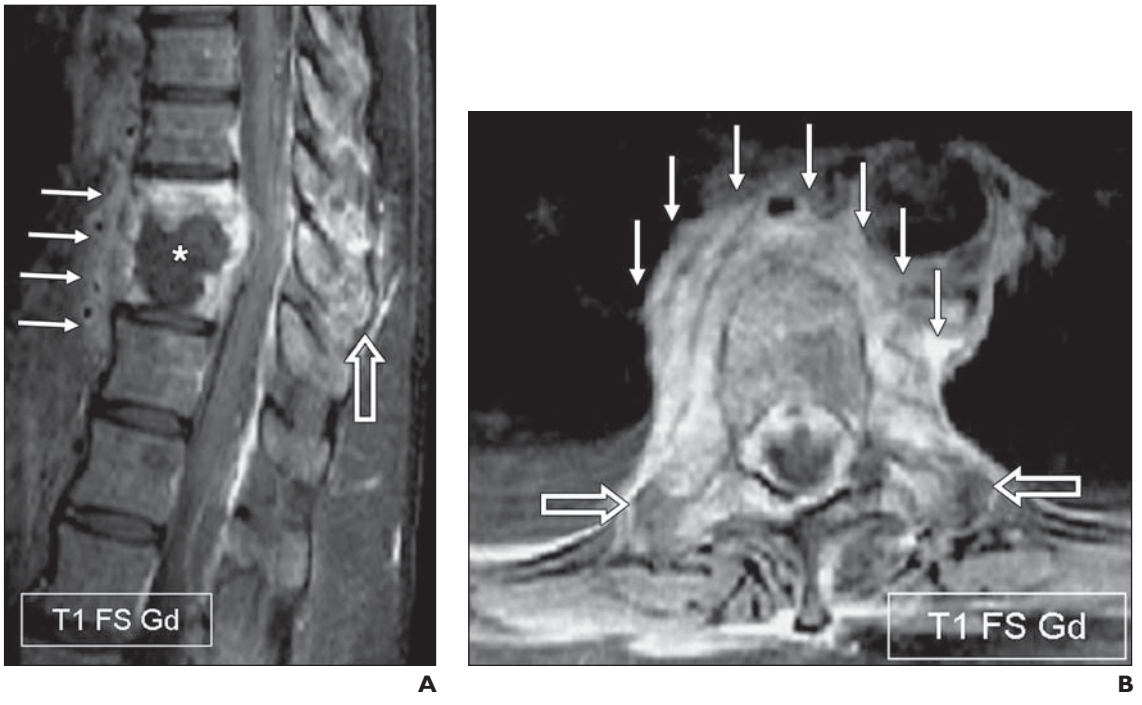


Fig. 9—40-year-old man with infectious spondylodiskitis.
A and **B,** Sagittal (**A**) and axial (**B**) fat-suppressed gadolinium-enhanced T1-weighted MR images show enhancement of two consecutive thoracic vertebrae associated with major irregularity of vertebral plates (*asterisk,* **A**). Circumferential contrast enhancement (*solid arrows*) of anterior soft tissue surrounding vertebral bodies is indicative of infectious process. Involvement of posterior vertebral elements (*open arrows*) is evident.

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