Imaging of the Seronegative Spondyloarthopathies

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INTRODUCTION

Spondyloarthritis refers to a diverse group of diseases involving inflammation of the axial skeleton and peripheral joints.1–3 The individual entities are distinguished by specific clinical and laboratory features with disease presentation often on a spectrum that is dynamic and progressive rather than static and unchanging. These diseases can be grouped based on common clinical and imaging features such as inflammatory back pain, sacroiliitis, spondylitis, and enthesitis. Laboratory studies, with the exception of the strong association with the genetically determined human leukocyte antigen B27 (HLA-B27), are generally nonspecific, with elevated inflammatory markers such as C-reactive protein and erythrocyte sedimentation rate sometimes present. Clinical features may allow some differentiation (such as urethritis in Reiter syndrome or reactive spondylitis), but there remains significant overlap.1,3

The original concept of a group of interrelated but distinctive disorders was developed by Moll and colleagues4 in 1974 to describe a group of inflammatory diseases affecting the spine and sacroiliac joints. The term seronegative spondyloarthopathies was coined to indicate that rheumatoid factor was not present in these patients, with the individual forms of the disease including ankylosing spondylitis, psoriatic arthritis, reactive arthritis (formerly known as Reiter syndrome), arthritis related to inflammatory bowel disease, and a form of juvenile idiopathic arthritis distinguished only by the age of the patient.5 Undifferentiated spondyloarthopathy and late-onset spondyloarthropathy are also sometimes included in this grouping.6,7 In addition to the distinction by the absence of rheumatoid factor, the seronegative spondyloarthopathies uniquely affect entheses. The definition and subcategorization of the spondyloarthopathies has evolved over time, and multiple groups have attempted to characterize the symptoms and natural history of the spondyloarthopathies, including the New York criteria8 for sacroiliitis and similar criteria for ankylosing spondylitis, in the 1960s and 1970s.1,3 In the 1990s there was a move to reclassify the entire

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disease spectrum; this grouped all patients with inflammatory arthritis involving the axial skeletal as seronegative spondyloarthritis, despite a wide variety of clinical symptoms. The Amor criteria addressed the difficulty in diagnosing these disorders through the creation of a scoring system. A newer (2009) classification was proposed by the Assessment of Spondyloarthritis International Society (ASAS) after a large cross-sectional study. Rather than focusing on specific subtypes such as ankylosing spondylitis, this classification depends on 2 important clinical features: axial symptoms and peripheral involvement. The investigators proposed the term “axial spondyloarthritis” for the entire spectrum of diseases whereby axial involvement predominates. This type can then be broken down into the more traditional subtypes based on clinical features, HLA-B27 positivity, and the presence or absence of sacroiliac involvement based on the detection of active inflammation by advanced imaging techniques such as magnetic resonance (MR) imaging. The ASAS criteria for axial spondyloarthritis consists of active sacroiliitis on imaging plus 1 or more features of spondyloarthritis or HLA-B27 positivity with 2 or more features of spondyloarthritis. In comparison, the criteria for peripheral spondyloarthritis are more complex and include such options as Crohn disease or ulcerative colitis, prior infection (as in Reiter syndrome), inflammatory back pain, or positive family history. The diagnosis of a peripheral spondyloarthritis also can depend on the presence of sacroiliitis on imaging (ie, arthritis with sacroiliitis alone meets these criteria). Although classification remains of interest for these complex disorders, the main challenge at the current time is the development of strategies for early diagnosis and treatment aimed at limiting disability and disease progression over time. The newer classifications all depend on advanced imaging techniques such as MR imaging, supplanting the prior use of radiography (and radiographic atlases) in assisting clinical decision making.

**IMAGING TECHNIQUES**

Although the spondyloarthropathies can involve the entire axial and appendicular skeleton, including central and peripheral entheses and joints, the hallmark for all types of spondyloarthritis remains sacroiliitis. Inflammation of one or both sacroiliac joints is the most characteristic and consistent feature of these disorders. Involvement of the remainder of the axial skeleton is rare in the absence of sacroiliitis, as is peripheral involvement even when those symptoms, such as enthesitis at the heel, dominate the clinical picture. Inflammatory back pain is commonly associated with sacroiliitis, but is a nonspecific symptom and may be seen in other disorders unrelated to spondyloarthropathy. HLA-B27 positivity on its own is not an indication of spondyloarthritis in the absence of symptoms or positive imaging findings. The unifying diagnostic tool for the seronegative spondyloarthropathies is imaging of the sacroiliac joints.

Conventional radiography remains the most common initial imaging study for patients suspected of having inflammatory arthritis of all kinds (Fig. 1). Plain radiography of the pelvis for assessment of the sacroiliac joints has significant limitations, including the need for ionizing radiation in young patients as well as low sensitivity for detection of early disease. Experience and knowledge of the clinical context may improve detection, but it is common for radiologists to miss advanced cases of sacroiliitis on radiography. Five stages of radiographic changes in the sacroiliac joints have been described, ranging from 0 (normal) through 4. The most difficult stages are 1 (unclear) and 2 (small erosions, sclerosis), with more advanced disease (3, definite erosions and 4, ankylosis) less problematic to detect, testifying to the poor specificity and moderate sensitivity of radiography in detecting sacroiliitis. The relatively low utility of radiography for sacroiliitis is exacerbated by poor interobserver and intraobserver reliability for subtle changes in early disease. The detection of the structural changes of sacroiliitis is challenging enough, but the physiologic parameter of disease activity is beyond the capabilities of radiography, which precludes using radiography to monitor response to therapy.

The complexity of the sacroiliac joints themselves and the difficulty in seeing the entire joint in a 2-dimensional projection is part of the challenge, but studies comparing more specialized views such as the angled anteroposterior oblique Ferguson view have not shown significant improvement in accuracy. Conventional views of the pelvis may actually have some added value over dedicated imaging of the sacroiliac joints, in that the hips are usually included in such images. Despite these limitations, conventional radiographs are important, especially in distinguishing ankylosing spondylitis from other types of spondyloarthropathies. Radiographic imaging of the entire spine and symptomatic individual peripheral joints can help to classify the various types of spondyloarthropy and to visualize complications such as discectentral fractures in ankylosing spondylitis, although with lower sensitivity than with computed tomography (CT).
Scintigraphy is another technique that has been traditionally used to evaluate the skeleton when spondyloarthritis is suspected. In the past, when radiography was the primary diagnostic tool, scintigraphy enhanced the sensitivity of plain radiographs for early-stage disease. Unfortunately, though sensitive, scintigraphy is too nonspecific to be used in isolation in the diagnosis of sacroiliitis.18,19 In fact, mild activity at the sacroiliac joints can lead to overdiagnosis of sacroiliitis when only mild degenerative change is present.20 Scintigraphy may be helpful in establishing bilateral disease whereby only unilateral disease has been seen on radiography, but it is inferior to more advanced cross-sectional imaging such as CT and especially MR imaging. The use of colloidal agents for joint imaging is similarly nonspecific when evaluating the spondyloarthopathies. Positron emission scanning (PET), with or without CT, has little role in the assessment of spondyloarthropathy at this time.

CT can be useful in assessing the spine and sacroiliac joints, having a higher degree of sensitivity than radiography and with better specificity than scintigraphy (Fig. 2).20 Because of the high spatial resolution possible with CT, subtle erosions and subchondral sclerosis in the sacroiliac joints may be seen to better effect than with radiography; early syndesmophytes and “shiny corners” can be better seen in the spine. Unlike radiography the images may be obtained in any plane, so that visualization of the entire joint and individual disc spaces is optimized regardless of orientation. In fact, most modern CT acquisitions are essentially volumetric because of their isotropic nature, making multiplanar and even 3-dimensional reformatting easy to perform on a routine basis. CT is preferred for the detection of very early erosions of the sacroiliac joints and for early ankylosis.21–23 CT requires the use of ionizing radiation in what are usually young patients; it is not an ideal method for following patients over time. Furthermore, active inflammation can be difficult to assess, as bone marrow edema is not generally visible on CT; burnt-out sclerosis without active disease may have a similar appearance to very active inflammation.22,23 A final caveat is the normal progression of age-related subchondral sclerosis at the sacroiliac
joints. Care must be taken not to confuse normal senescent changes or degenerative osteoarthritis with the erosions, irregularity, and subchondral sclerosis seen in sacroiliitis.\textsuperscript{21}

Ultrasonography has some utility for the evaluation of sacroiliitis when it is very active, by using Doppler ultrasonography to assess blood flow and synovitis.\textsuperscript{3,24} It may also be useful in some cases in young children as an initial study, but is limited to the evaluation of soft tissues surrounding the joint and not the joint itself.\textsuperscript{17} Ultrasound guidance may be used for diagnostic and therapeutic injections into the sacroiliac joint as an alternative to fluoroscopy in some cases.\textsuperscript{25}

MR imaging has become the gold standard for the imaging diagnosis of spondyloarthropathies of the spine and sacroiliac joints (Fig. 3).\textsuperscript{1–3,13,21,26–30} MR imaging is highly sensitive and specific for the presence of inflammatory changes in and around the spine and sacroiliac joints.\textsuperscript{31} As with CT, multiplanar acquisitions are routinely performed, which optimize visualization of the entire sacroiliac joint with the added benefit of improved soft-tissue and bone marrow contrast. Serial studies over time are not problematic in terms of radiation exposure. Subtle erosions may be difficult to see because of the relatively lower spatial resolution of MR imaging compared with CT, but T2weighted sequences with fat suppression are exquisitely sensitive and specific in the detection of bone marrow edema, joint widening, and joint fluid and, thus, synovitis.\textsuperscript{22,23} With contrast enhancement, MR imaging can distinguish active from inactive disease and can be used to monitor treatment response: a decrease in enhancement even in the presence of persistent bone marrow edema has been strongly correlated with clinical response to treatment.\textsuperscript{32} Alternatively, a lack of response by imaging with no change in baseline enhancement suggests treatment failure and a need to alter the therapeutic regimen. Postcontrast imaging can be performed in a variety of ways using delayed enhancement, rapid imaging with dynamic enhancement, and with or without the use of image subtraction, which can be especially helpful when low-field (<1.5 T) imagers are used.\textsuperscript{33} Enhancement can be measured in semiquantitative ways in addition to the qualitative visual assessment during image interpretation. All of these techniques can be very helpful when determining the value of drug regimens with significant side effects and high cost.\textsuperscript{33}

MR imaging is also the preferred modality for imaging the remainder of the spine and for the peripheral joints (Fig. 4). The soft-tissue contrast is ideal for assessing the structures within the spinal canal (including the cord) and for assessing inflammatory or destructive changes in the joints. Dural ectasia and cauda equina syndrome seen in ankylosing spondylitis (AS) can be best evaluated with MR imaging.\textsuperscript{34} Direct visualization of the atlantoaxial interval in the cervical spine can also be well seen on MR imaging; atlantoaxial subluxation can be evaluated in some upright MR imaging scanners, but is more typically assessed with radiography with flexion and extension.\textsuperscript{6} CT may be used as an alternative to MR imaging when patients are unable to undergo MR imaging for any reason, and when rapid assessment is desired as in assessing discovertebral fractures after trauma.\textsuperscript{28}

**Fig. 3.** Normal MR images of the sacroiliac joints. (A) Oblique coronal T2-weighted MR image of the sacroiliac joints with fat suppression showing no abnormal signal around the joint. (B) Coronal oblique T1-weighted MR image with fat suppression after contrast administration shows normal sacroiliac joints with no enhancement.
IMAGING FINDINGS IN THE SERONEGATIVE SPONDYLOARTHROPATHIES

The seronegative arthropathies are a group of diverse disorders, which share some common features (such as an increased incidence of genetically determined HLA-B27 histocompatibility antigen and inflammation in the musculoskeletal system) but which can also be subclassified into specific entities based on imaging findings, clinical presentation, and natural history of the disease. Most of the entities described here have juvenile forms in addition to the usual presentation in young adulthood; rare patients present in old age with late-onset spondyloarthropathy, which may be difficult to characterize because of comorbid degenerative arthritis. A small number of patients who cannot be categorized into one of the following subtypes are categorized as having undifferentiated spondyloarthritis.

Ankylosing Spondylitis

AS is the prototypical seronegative spondyloarthropathy. AS is primarily a disease of white males with the male to female ratio being between 4:1 and 10:1, with generally milder presentations in women. The normal prevalence of the HLA-B27 antigen in the North American population is 6% to 8%, but for patients with in AS it is more than 90%. The disease commonly presents in late adolescence or early adulthood; presentation after age 40 years is very unusual. The most common presenting features of AS are morning stiffness and low back pain. Patients presenting at younger ages may experience peripheral symptoms such
as heel pain rather than the usual inflammatory back pain. Because symptoms are nonspecific, the time to diagnosis from the first symptoms averages 7 years. About 20% of patients progress to severe debilitation primarily related to systemic manifestations of AS, such as lung fibrosis.\textsuperscript{2,3,5}

AS is primarily a disease of the axial skeleton that affects the spine and sacroiliac joints. Sacroilitis is a required element for diagnosis of AS.\textsuperscript{2,3,8–10} The disease typically begins in the sacroiliac joints with small erosions resembling the serrated edges of a postage stamp, typically beginning on the iliac side of the joint, due to the thinner cartilage there compared with the sacrum. As the disease advances proliferative changes associated with the enthesitis dominate, with sclerosis seen in the subchondral areas progressing finally to complete ankylosis of the joint. When the fusion is complete the sclerosis resolves completely.\textsuperscript{2} The sacroilitis may appear asymmetric in the early stages, especially if MR imaging is used in early diagnosis, but the disease inevitably progresses to bilateral, symmetric involvement.

Spondylitis occurs in about 50% of AS patients, with females relatively less affected.\textsuperscript{2,3,6} The changes in the spine occur first in thoracolumbar and lumbosacral regions with extension to the midlumbar, midthoracic, and cervical regions. Involvement of the cervical spine alone is very rare. The orderly progression of spine involvement is a unique feature of AS when compared with the other spondyloarthopathies, in which spine involvement tends to be more random. In AS the earliest changes in the spine are due to enthesitis at the insertion of the outer fibers of the annulus fibrosus on the ring apophysis of the vertebral endplate. This process results in subtle erosions with reactive sclerosis in the vertebral corners, known as shiny corners or Romanus lesions.\textsuperscript{2,3} These phenomena are generally very short lived, with progression to the more commonly seen syndesmophytes, representing the ossification of the outer fibers of the annulus fibrosus.\textsuperscript{2} These lesions are very fine and symmetric, bridging individual vertebral bodies from corner to corner. This same process results in the “squaring” of the vertebral bodies as the fusion progresses, and is best visualized in the lumbar spine where there is loss of the normal concave profile of the vertebrae. Other spinal elements are also ossified and fused as part of this progressive process, including the apophyseal joints, paraspinous ligaments, and spinous processes. When complete the appearance is very characteristic, and is termed the bamboo spine (Fig. 5).\textsuperscript{2} The changes in the spine itself are very well visualized with conventional radiography but can also be seen on CT. MR imaging obtained in the active phase of enthesitis will show the inflammatory changes around the disc and at the apophyseal joints of the spine.

Pseudarthrosis in the spine may develop as a complication of erosions or because of trauma, resulting in fracture through the syndesmophytes in the fused spine.\textsuperscript{3,7} Rarely a pseudarthrosis may develop at a level of lesser disease involvement between long fused segments.\textsuperscript{2} The most common

\textbf{Fig. 5.} Ankylosing spondylitis. (\textit{A}) AP radiograph of the lumbar spine showing fusion of both sacroiliac joints and the typical bamboo spine of AS. (\textit{B}) Lateral view in a different patient showing the fine, bridging osteophytes representing ossification of Sharpey fibers. Note also the loss of the normal concave contour (squaring) of the anterior aspect of the lumbar vertebrae.
site of traumatic lesions is at the thoracolumbar or cervicothoracic junctions, which commonly involve all 3 columns of the spine (Fig. 6). These lesions may be easily missed at the time of initial evaluation of trauma and may progress to a true pseudarthrosis with instability at the fracture site, potentially leading to cord injury and paralysis. AS patients suffering even modest trauma should be considered to harbor a spinal fracture until excluded by advanced imaging, preferably CT. Similarly, atlantoaxial subluxation may be seen in AS, but it is uncommon and is more likely to be present when patients have peripheral joint involvement. Dural ectasia and leptomeningeal sacculations are common and may result in cauda equine syndrome, best evaluated with MR imaging (Fig. 7). Large peripheral joints may be involved, but this is more likely when presenting symptoms occur before age 21 years. Small joint involvement is rare, but when present can lead to ankylosis and loss of mobility, especially in the hands.

The most common extraskeletal manifestation of AS is progressive lung disease, including bullous emphysema and fibrosis, often complicated by unusual infections such as intracavitary aspergillosis. Pulmonary changes occur late in the disease but may be the source of significant morbidity and mortality. Inflammatory changes in the heart and aorta may result in conduction abnormalities and aortic insufficiency. The association of inflammatory bowel disease and AS is tentative, but both are associated with HLA-B27 positivity.

Psoriatic Arthritis

Psoriatic arthritis (PA) is an asymmetric, polyarticular disorder included in the spondyloarthropathies, as up to 40% of patients with PA will develop spondylitis or sacroiliitis. PA affects only about 7% of patients with cutaneous psoriasis. The arthritis may antedate the skin changes by several years; the severity of the arthritis seems independent of the severity of the skin disease. The presence of pitting nail changes correlates with the arthritis, especially when distal interphalangeal (DIP) joint involvement is severe. Male/female involvement is nearly equal; the disease has a later onset than other spondyloarthropathies, with a typical onset between age 30 and 50 years.

Sacroiliac involvement is not universal in PA. Only 5% of patients have exclusive spinal involvement without sacroiliitis. The sacroiliac disease is generally asymmetric and ankylosis of the sacroiliac joints is very rare. MR imaging is most sensitive for the detection of subtle bilateral changes, which can be important in distinguishing PA from septic sacroiliitis in the early stages of the disease. The spondylitic changes in PA (and reactive spondyloarthritis) appear more randomly than those seen in AS, and are usually but not always associated with sacroiliitis. Large, chunky-appearing paravertebral ossifications are commonly seen in the thoracolumbar junction. These ossifications do not bridge the intervertebral discs as seen in AS but rather seem to attach

Fig. 6. Ankylosing spondylitis. (A) Sagittal reformatted CT image of the cervical spine showing a discovertebral fracture (Andersson lesion) at C5-C6 in this patient following a face-first fall. (B) AP radiograph in the same patient showing typical changes of AS with fusion of the sacroiliac joints and early changes of bamboo spine.
to the lateral aspect of the vertebral bodies (Fig. 9A). Ankylosis of the apophyseal joints, squaring of the vertebral bodies, and spinal fusion are very rare in PA.

More distinctive in PA are the changes in the hands and feet. In the hands erosive changes develop within the interphalangeal joints, without the sparing seen in rheumatoid arthritis of the

Fig. 7. Ankylosing spondylitis. Sagittal (A) and axial (B) T2-weighted MR images of the lumbar spine showing dural ectasia and sacculations in a patient with AS. This patient presented with cauda equina syndrome secondary to the tethering of the spinal nerve roots seen on these images.

Fig. 8. Psoriatic arthritis. (A) AP view of the spine in a patient with psoriatic arthritis showing the large, chunky peripheral bridging osteophytes typical of psoriatic and reactive arthritis. Bilateral sacroilitis is also present. (B) PA view of the hand in a different patient with psoriatic arthritis showing classic marginal erosions and proliferative periostitis in the digits. This patient does not have cutaneous psoriasis.
DIP joints (Fig. 9B).² The erosions are marginal and are often associated with marked soft-tissue swelling of the digits. Proliferative changes including fluffy periostitis are a common feature. Erosion of the distal portion of the phalanx with remodeling of the joint, the pencil-in-cup deformity, may be seen, as well as resorption or sometimes proliferation at the ungual tufts. The appearance is occasionally confused with erosive osteoarthritis (OA) but the presence of erosions at the marginal or bare areas of the phalanges in PA should be discernible from the central, subchondral erosions in erosive OA. Dense, circumferential periostitis may result in the so-called ivory phalanx on radiography. The interphalangeal joint of the great toe in the foot is the most common site for PA and may be confused with gout. If this is a serious concern, dual-energy CT may be helpful in this unique instance to determine whether the urate deposition of gout is present.⁴²

**Reactive Spondyloarthritis (Reiter Syndrome)**

As with PA, reactive spondyloarthritis (RS) is a polyarticular, asymmetric arthritis. Unlike PA, RS preferentially affects the foot and large, peripheral joints.² If the hands are involved the interphalangeal joints are commonly involved, with relative sparing of the metacarpophalangeal and DIP joints. A common presenting symptom is heel pain caused by the fluffy enthesitis that can be seen with heel spurs in patients with RS (Fig. 10A).⁴³

![Fig. 9.](image) (A) Coronal oblique T2-weighted MR image without fat suppression showing bilateral sacroiliitis, more prominent on the right. (B) Coronal oblique T1-weighted MR image with fat suppression after contrast shows patchy areas of enhancement consistent with active sacroiliitis in a patient with severe cutaneous psoriasis.

![Fig. 10.](image) Reactive arthritis. (A) Lateral radiograph of the hindfoot in a different patient with reactive arthritis showing enthesitis and periostitis at the plantar calcaneus. This patient presented with heel pain. (B) AP radiograph showing bilateral sacroiliitis, which is worse on the right in a patient with urethritis and uveitis. The patient had a history of Chlamydia infection.
Because of the historical association with venereal infection, this has sometimes been called lover’s heel. Sacroiliitis and spondylitis are seen more commonly than in PA, with sacroiliitis present in up to 45% of patients. The asymmetric and bilateral imaging appearance of sacroiliitis in RS is identical to that seen in PA, with ankylosis even less common than in PA (Fig. 10B). The radiographic appearance of the spinal changes is the same as in PA, with marginal, coarse syndesmophytes that appear to be randomly placed in the lower thoracic and lumbar spine. Spine involvement is more common than in PA, seen in the lumbar spine in about 30% of patients with RS. Upper thoracic and cervical spine involvement is very rare. It may sometimes be impossible to differentiate PA and RS on radiographs, but the clinical syndromes are usually distinct. Relatively few findings in the upper extremities, sparing of the DIP joints, and involvement of the sacroiliac joints and spine may tilt the diagnosis toward RS.

Classically RS has been diagnosed when the triad of urethritis, uveitis, and arthritis have been present, often in association with Chlamydia infection. Patients with RS have a higher than average prevalence of HLA-B27 positivity, which may predispose them to develop the arthritis in the presence of a triggering event such as infection. The term Reiter syndrome is only used when the specific triggering organism can be identified and when the arthritis appears within about a month of the original illness. In addition to the classic association with venereal disease, RS can be seen in enteric infections from organisms such as Shigella, Salmonella, and Yersinia. Human immunodeficiency virus (HIV) infection can of course coexist with both RS and PA, and the arthritis may be particularly severe in such cases. HIV can itself be associated with joint symptoms but without the typical radiographic findings seen in RS, and generally with more involvement of peripheral joints than the axial skeleton. HIV infection may exacerbate existing rheumatoid arthritis or PA; if severe, unexplained worsening is seen clinically, HIV testing may be warranted.

Undifferentiated Spondyloarthropathy

Undifferentiated spondyloarthropathy is a term used when clinical symptoms are present such

**Arthritis Associated with Inflammatory Bowel Disease (Enteropathic Arthritis)**

Enteropathic arthritis may be seen equally in association with Crohn disease or ulcerative colitis. The arthritis may have 1 of 2 forms that rarely coexist. Up to 20% of patients with inflammatory bowel disease may develop a nondestructive and often transient peripheral arthritis, the severity of which parallels the progress of the underlying bowel disease and which may actually resolve with surgery or other successful treatment. This primarily involves joints such as the knees, ankles, elbows, and wrists, and is most often bilateral and symmetric.

The other form of enteropathic arthritis can involve the spine and/or sacroiliac joints. An isolated spondylitis that is radiographically identical to AS with the same fine, marginal syndesmophytes proceeding in orderly fashion from the thoracolumbar junction may be present in up to 6% of patients. Shiny corners and squaring of the vertebral bodies may be present, although this is less common. Rarely this spondylitis may be present without sacroiliitis, an important distinction from AS. Sacroiliitis, when present, is similar to that seen in AS, with bilateral, symmetric findings and later ankylosis of the joints (Fig. 11). Isolated sacroiliitis is more common than isolated spondylitis; it may be seen in up to 18% of patients with inflammatory bowel disease. In contradistinction to the peripheral arthritis seen with inflammatory bowel disease, the severity of the spondylitis progresses independent of the course of disease or treatment of the primary intestinal problem. The spondylitis may even precede the development of the bowel disease by months or years (Fig. 12). As with other forms of spondyloarthropathy, there is a predilection for HLA-B27 positivity but without the high prevalence seen with AS.

**Fig. 11.** Enteropathic arthritis. AP radiograph of the pelvis showing bilateral sacroiliitis and a right lower quadrant ostomy in a patient with Crohn disease.
as peripheral arthritis, sacroiliitis, and enthesitis with inflammatory low back pain, but without distinguishing clinical or imaging features that would allow further subclassification. Key features are sacroiliitis and increased HLA-B27 positivity, as in other forms of seronegative spondyloarthritis, but other stigmata such as inflammatory bowel disease or distinguishing patterns of peripheral joint involvement or inciting infection are absent. Atlantoaxial subluxation as an unusual manifestation of undifferentiated spondyloarthropathy was recently described in a case report in a young patient, reinforcing the need for a high degree of clinical suspicion when young patients present with inflammatory back or spinal pain (Fig. 13). Awareness of this syndrome may allow earlier diagnosis and treatment in the absence of classic findings of AS, PA, or RS.

**Late-Onset Spondyloarthropathy**

Although much more commonly seen in young patients, AS and other spondyloarthropathies may present in the elderly. The clinical presentations are sometimes confusing, often combining age-related degenerative osteoarthritis with imaging features more typical for spondyloarthropathy such as sacroiliitis. HLA-B27 positivity is
elevated in this group, as in the syndromes presenting in younger patients. The presenting disease is often more severe than in younger patients, and treatment options may be more limited because of the toxicity associated with treatments such as anti–tumor necrosis factor agents and comorbidities such as cardiovascular disease. In some older patients the new onset of symptoms of inflammatory back pain may be confused with diseases such polymyalgia rheumatica or even chronic pain syndromes such as fibromyalgia. Awareness of this entity and the use of advanced cross-sectional imaging is increasing, allowing more accurate diagnosis and treatment in this unique group of patients.

SUMMARY

The seronegative spondyloarthropathies are a diverse group of disorders affecting the axial skeleton and peripheral joints. Based on clinical presentation and imaging findings the individual entities have some unique features that can help to distinguish them, but all share inflammatory changes in the sacroiliac joints and spine and may present with back pain. Plain radiography is the mainstay of
imaging, but MR imaging has significantly better sensitivity and specificity for detecting bone marrow edema and enhancement indicating inflammation. MR imaging may also be used to monitor therapy with disease-modifying drugs. Early MR imaging can help to establish the diagnosis in the early stages of disease, avoiding unnecessary delays and facilitating earlier treatment.

REFERENCES