Radiographic Evaluation of Arthritis: Inflammatory Conditions[1]

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In the presence of joint space narrowing, it is important to differentiate inflammatory from degenerative conditions. Joint inflammation is characterized by bone erosions, osteopenia, soft-tissue swelling, and uniform joint space loss. Inflammation of a single joint should raise concern for infection. Multiple joint inflammation in a proximal distribution in the hands or feet without bone proliferation suggests rheumatoid arthritis. Multiple joint inflammation in a distal distribution in the hands or feet with bone proliferation suggests a seronegative spondyloarthropathy, such as psoriatic arthritis, reactive arthritis, or ankylosing spondylitis.

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Radiology

Radiography is typically the first imaging study in evaluation for arthritis. On radiographs, one critical assessment is differentiating inflammatory arthritis from a degenerative process, because the treatment options are quite different. Identification of an inflammatory joint due to infection often requires diagnostic aspiration followed by administration of antibiotics and possible surgical drainage and lavage. With regard to systemic arthritides, with early diagnosis there are several types of medications used to control joint inflammation and even prevent or reduce subsequent joint destruction. The treatment options for a degenerative process include medication, joint injection, and, later, joint replacement.

The objective of this review is to present a simplified approach to radiographic evaluation of arthritis (Fig 1). This is presented as an algorithm that uses joint space narrowing of the distal extremities as a starting point. While it is acknowledged that it is nearly impossible to include all types of arthritis in one simple algorithm, and that there are always exceptions and variations, this approach will encompass the most common features of the frequently seen arthritides and can be viewed as a framework for radiographic evaluation. This algorithm does not include substantial detail of each topic but rather focuses on radiographic findings that, with the use of this algorithm, lead to a final and usually correct diagnosis. The first critical step in the algorithm is to determine if joint space narrowing detected with radiography is related to an inflammatory or a degenerative condition.

Essentials

- It is important to differentiate inflammatory from degenerative causes of joint space narrowing.
- Inflammatory arthritis is characterized by bone erosions, osteopenia, soft-tissue swelling, and uniform joint space narrowing.
- With monoarticular joint inflammation, it is important to exclude infection.
- Inflammation that involves multiple joints in a proximal distribution of the hands or feet without bone proliferation suggests rheumatoid arthritis.
- Inflammation that involves multiples joints in a distal distribution of the hands or feet with bone proliferation suggests a seronegative spondyloarthropathy.

Inflammatory versus Degenerative Joint Disease

There exist essential radiographic findings that are common to inflammatory arthritis due to any cause. The hallmark of joint inflammation is erosion of bone. This will initially appear as a focal discontinuity of the thin, white, subchondral bone plate (Fig 2). Normally, this subchondral bone plate can be seen even in cases of severe osteopenia, whereas its discontinuity indicates erosion. Although it is true that periarticular osteopenia and focal subchondral osteopenia can appear prior to a true bone erosion, it is the presence of bone erosion that indicates definite joint inflammation. As the bone erosion enlarges, osseous destruction extends into the trabeculae within the medullary space.

One important feature of inflammatory arthritis relates to the concept of a marginal bone erosion. This term is given to bone erosion that is located at the margins of an inflamed synovial joint. This specific location represents that portion of the joint that is intraarticular but not covered by hyaline cartilage; therefore, early joint inflammation will produce marginal erosions prior to erosions of the subchondral bone plate beneath the articular surface (Fig 3). When looking for bone erosions, multiple views of a joint are essential to profile the various bone surfaces.

A second important characteristic of an inflammatory joint process is uniform joint space narrowing. This occurs because destruction of the articular cartilage is uniform throughout the intraarticular space. A third finding of inflammatory joint disease is soft-tissue swelling.

There are essential radiographic features of a degenerative joint, as well. In addition to lack of the findings described for inflammatory joint disease, degenerative findings include osteophyte formation and bone sclerosis (Fig 4). Although underlying cartilage damage is presumed, joint space narrowing does not involve the joint uniformly, as is seen with inflammatory joint disease, and osteophytes are typically present. As the joint space narrows, the osteophytes become larger, sclerosis increases, and subchondral cysts—or geodes—may be seen. If degenerative joint disease involves a synovial articulation, the term *osteoarthrosis* or *osteoarthritis* is appropriate.

Inflammatory Arthritis

Septic Arthritis

Once joint space narrowing and features of inflammatory arthritis are identified, the next step in the algorithm is to determine how many joints are involved. Multiple joints may be involved in as many as 20% of cases (1). If joint inflammation is limited to a single joint, infection must first be carefully excluded (Fig 1). The cause of septic arthritis is usually related to hematogenous seeding owing to staphylococcal or streptococcal microorganisms.

The radiographic features of a septic joint encompass those of any inflammatory arthritis—namely, periarticular osteopenia, uniform joint space narrowing, soft-tissue swelling, and bone erosions (Fig 5). Not all findings may be present simultaneously, and, acutely, bone erosions may not be evident. Furthermore, the joint space may be initially widened owing to the effusion. Joint space widening may also be seen with more indolent and atypical infections, such as those related to tuberculosis and fungal agents; but, again, other inflammatory changes are typically present

Published online
10.1148/radiol.2482062110

Radiology 2008; 248:378–389

Authors stated no financial relationship to disclose.

(Fig 6). The Phemister triad describes these findings classically seen in tuberculous arthritis: juxtaarticular osteopenia, peripheral bone erosions, and gradual narrowing of the joint space (2).

Rheumatoid Arthritis

If joint space narrowing and other radiographic findings of inflammatory arthritis involve multiple joints, a systemic arthritis must be considered. The next step in the algorithm is evaluation of the hands and feet. Proximal distribution at these sites and lack of bone proliferation suggest the diagnosis of rheumatoid arthritis. Rheumatoid arthritis is most common in women aged 30–60 years. Serologic markers such as rheumatoid factor and antibodies to cyclic citrullinated peptide are important indicators of rheumatoid arthritis (3,4).

The radiographic features of rheumatoid arthritis are those of joint inflammation and include periarticular osteopenia, uniform joint space loss, bone erosions, and soft-tissue swelling (Fig 7). Because of the chronic nature of the inflammation, additional findings such as joint subluxation and subchondral cysts may also be evident. Although the radiographic findings are not specific for one condition, the proximal distribution of joint involvement in the hands and feet and the lack of bone proliferation suggest rheumatoid arthritis.

In the hands, target sites of rheumatoid arthritis include the metacarpophalangeal, proximal interphalangeal, midcarpal, radiocarpal, and distal radioulnar joints, with predilection for the ulnar styloid process (Figs 7, 8). Involvement is usually bilateral and fairly symmetric, although isolated carpal joint involvement may occur. Ulnar deviation occurs at the metacarpophalangeal joints. Hyperextension at the proximal interphalangeal joints with flexion at the distal interphalangeal joints results in a swan neck deformity, while flexion at the proximal interphalangeal joint and hyperextension at the distal interphalangeal joint results in a boutonnière deformity. It is important to profile the bone cortices with multiple radiographic views to identify cortical discontinuity. If a round subchondral lucency does not interrupt the bone surface, possibilities include a subchondral cyst or an erosion viewed en face.

In the feet, target sites of rheumatoid arthritis include the metatarsophalangeal, proximal interphalangeal (including the first interphalangeal), and intertarsal joints, and such involvement

Figure 1

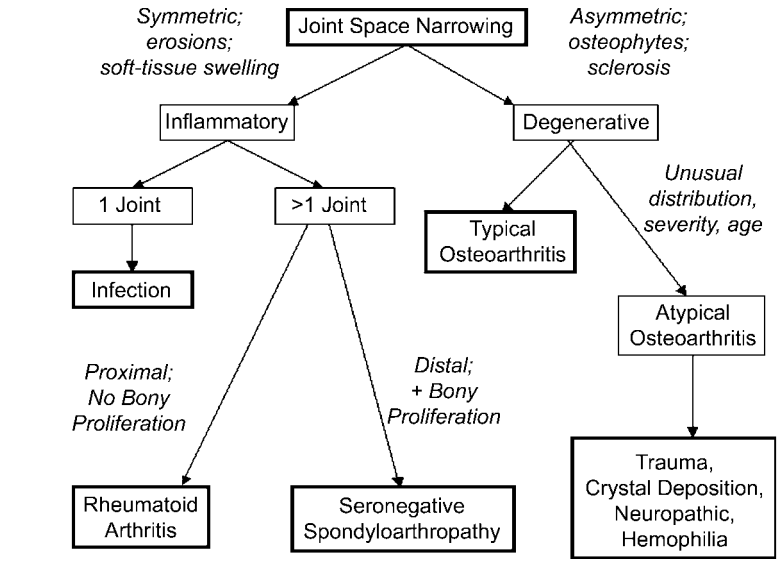


Figure 1: Flow chart shows approach to radiographic evaluation of arthritis. Algorithm begins with joint space narrowing and initially uses differentiation between inflammatory and degenerative findings to reach the final diagnosis.

Figure 2

a. **b.**

Figure 2: **(a, b)** Posteroanterior wrist radiographs show discontinuity of bone cortex representing erosion (arrow) with development of osteopenia. Note progression of disease from **a** to **b**.

is commonly bilateral and nearly symmetric in distribution (Fig 9). It is important to closely evaluate the lateral aspect of the fifth metatarsal head, because this is often the first site of a bone erosion in the foot and, at times, such involvement occurs prior to hand or wrist involvement (Fig 10). Because rheumatoid arthritis is a disease that affects synovium diffusely, other sites of involvement include tendon sheaths and bursae such as the retrocalcaneal bursa. Loss of the normal radiolucent triangle between the posterosuperior margin of the calcaneus and the adjacent Achilles tendon suggests the presence of bursal fluid, with subjacent calcaneal erosions indicating inflammation (Fig 11).

Other peripheral joints may also be involved in rheumatoid arthritis, with similar findings. Joint involvement includes the knees (Fig 12), the hips (Fig 13), and the sacroiliac and glenohumeral joints, with involvement of the last of these often associated with a high-riding humeral head related to a large rotator cuff tear. Spinal involvement is also possible. At the C1-C2 articulation, the odontoid process may be eroded, and the anterior atlantodens interval may be abnormally widened (>3 mm in adults), especially with neck flexion (Fig 14) (5).

Figure 3

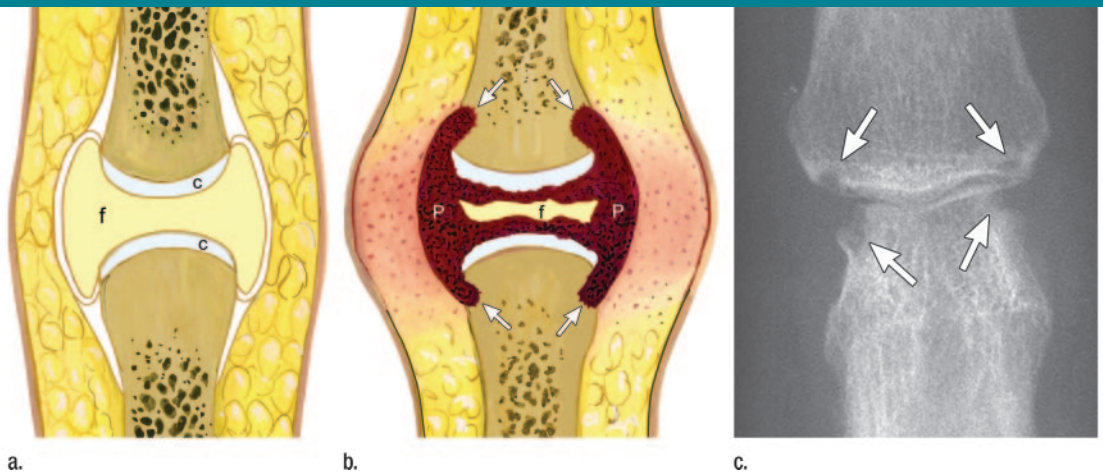


Figure 3: **(a)** Illustration of synovial joint shows joint fluid *(f)* and articular cartilage *(c)*. **(b)** Illustration and **(c)** radiograph show inflammatory arthritis, synovitis, and pannus *(P)* causing cartilage destruction. Marginal erosions (arrows) are seen where subchondral bone plate is exposed to intraarticular synovitis. *f* = Fluid.

Figure 4

Figure 4: Osteoarthritis. Posteroanterior radiograph shows interphalangeal joint space narrowing, subchondral sclerosis, and osteophyte formation (arrows).

Figure 5

Figure 5: Septic arthritis. **(a)** Posteroanterior and **(b)** oblique radiographs show joint space narrowing (arrows), osteopenia, soft-tissue swelling, and a bone erosion (arrowhead).

Figure 6

Figure 6: Septic arthritis (tuberculosis). Mortise radiograph of ankle shows erosions (arrows) of talus and distal tibia with osteopenia. Joint space widening is due to diffuse synovitis.

Figure 7

a. b.

Figure 7: Rheumatoid arthritis. **(a)** Posteroanterior and **(b)** oblique hand radiographs show joint space narrowing, bone erosions, and osteopenia of the metacarpophalangeal, distal radioulnar, radiocarpal, and midcarpal joints (arrows). Note subluxation of proximal interphalangeal joints.

Figure 8

Figure 8: Rheumatoid arthritis. Posteroanterior wrist radiograph shows osteopenia and joint space narrowing of the distal radioulnar, radiocarpal, and midcarpal joints with erosions of the scaphoid (arrow) and the ulnar styloid process (arrowhead).

Figure 9

a. b.

Figure 9: Rheumatoid arthritis. **(a)** Posteroanterior radiograph of right foot and **(b)** oblique radiograph of left foot show joint space narrowing and bone erosions of both metatarsophalangeal joints and several interphalangeal joints (arrows). Note most extensive involvement of fifth metatarsophalangeal and first interphalangeal joints.

Seronegative Spondyloarthropathies

Returning to the proposed algorithm, if one observes joint space narrowing, signs of inflammation, multiple joint involvement, and distal involvement in the hands and feet with added features of bone proliferation, a seronegative spondyloarthropathy is suggested. This category includes psoriatic arthritis, reactive arthritis, and ankylosing

Figure 10

Figure 10: Rheumatoid arthritis. **(a, b)** Posteroanterior radiographs in two patients show small bone erosion about the fifth metacarpophalangeal joint with osteopenia in **a** (arrow) and more extensive involvement in **b** (arrows) with alterations of the fifth metatarsal head and proximal phalanx.

Figure 12

Figure 12: Rheumatoid arthritis. Anteroposterior knee radiograph shows diffuse and uniform joint space loss (arrows) with osteopenia.

Figure 11

Figure 11: Rheumatoid arthritis. Lateral radiograph of calcaneus shows bone erosion (arrow) related to inflammation of the retrocalcaneal bursa.

Figure 13

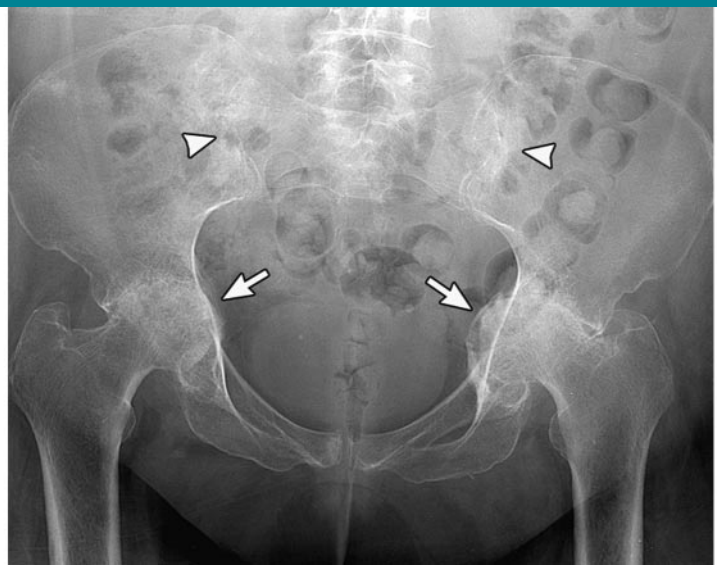


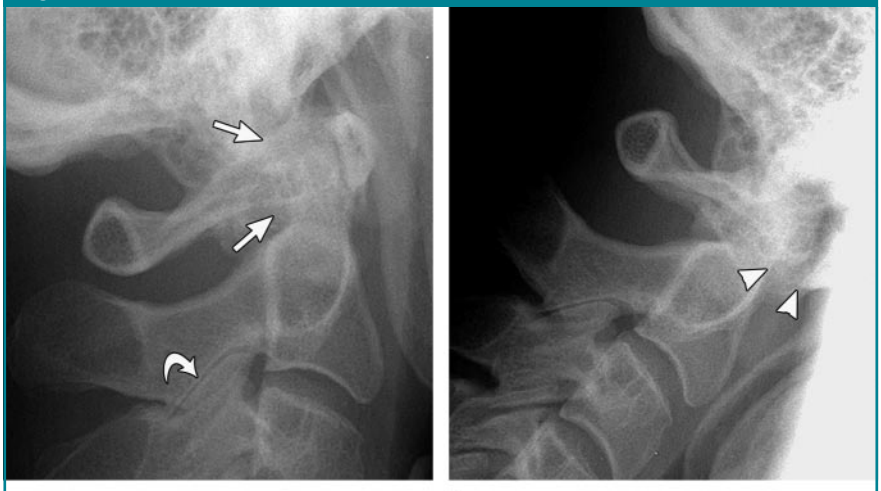
Figure 13: Rheumatoid arthritis. Anteroposterior pelvis radiograph shows bilateral involvement of hips, with uniform diffuse joint space narrowing, bone erosions, osteopenia, and acetabular protrusion (arrows). Note bone sclerosis related to involvement of sacroiliac joints (arrowheads).

spondylitis. Differentiation among these disorders largely relies on the distribution of radiographic abnormalities and clinical information. In addition, other findings that help differentiate the seronegative spondyloarthropathies from rheumatoid arthritis are that cartilaginous joints and entheses are involved to a greater extent, the latter representing the osseous attachment sites of ligaments and tendons. Entheseal involvement leads to increased density and irregular bone proliferation.

Psoriatic arthritis.—The cause of psoriatic arthritis is considered to be a combination of environmental and hereditary factors, with as many as to 60% of patients being HLA-B27 positive (6). Approximately 10%–15% of patients with skin manifestations of psoriasis will develop psoriatic arthritis (6). Usually such manifestations will precede the development of arthritis. The hallmarks of psoriatic arthritis, similar to those of the other seronegative spondyloarthropathies, are signs of inflammatory arthritis combined with bone proliferation, periostitis, enthesitis, and a distal joint distribution in the extremities (Fig 15).

In the hands, wrists, and feet, a distal distribution is characteristic. Findings may be bilateral or unilateral and

Figure 14



a. b.

Figure 14: Rheumatoid arthritis. **(a)** Lateral cervical spine radiograph shows erosions of dens (straight arrows) with narrowing of facet joints (curved arrow). **(b)** Lateral flexion radiograph shows widening of atlantodens interval (arrowheads).

Figure 15

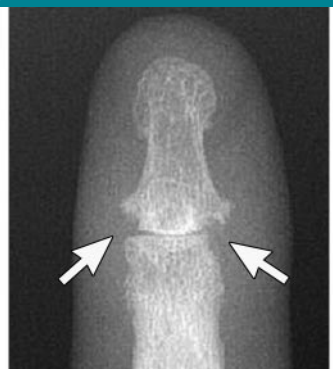
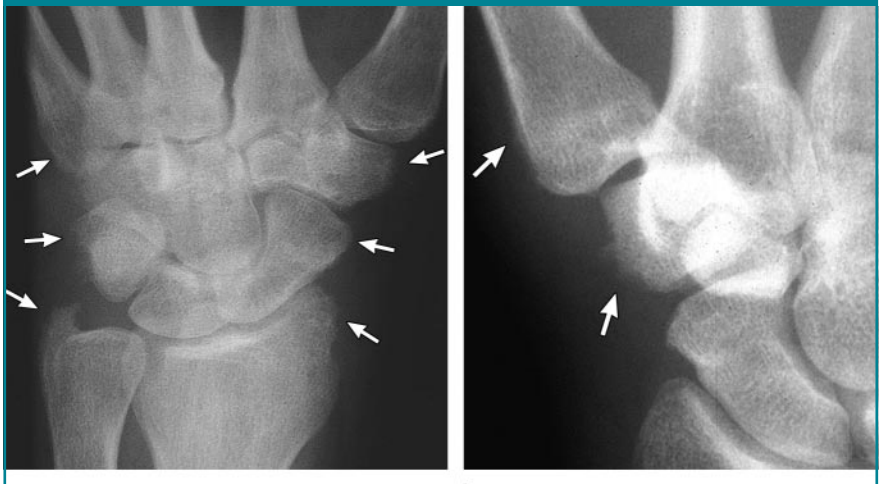


Figure 15: Psoriatic arthritis. Posteroanterior finger radiograph shows marginal bone erosions with adjacent irregular bone proliferation (arrows).

Figure 16

Figure 16: Psoriatic arthritis. Posteroanterior finger radiograph shows narrowing of distal interphalangeal joint. Note bone proliferation and periostitis throughout phalanges (arrows), which appear thicker than in Figure 15, with partial incorporation of new bone into the cortex. There is soft-tissue swelling of entire digit.

Figure 17



a. b.

Figure 17: Psoriatic arthritis. **(a)** Oblique wrist radiograph shows irregular bone proliferation and periostitis about radial and ulnar aspects of the wrist (arrows), with erosion of the ulnar styloid process. **(b)** Contralateral wrist radiograph shows bone erosion and irregular periostitis of the scaphoid, with more distal periostitis involving the metacarpal base (arrows).

symmetric or asymmetric. Involvement of several joints in a single digit, with soft-tissue swelling, produces what appears clinically as a "sausage digit" (Fig 16). The bone proliferation produces an irregular and indistinct appearance to the marginal bone about the involved joint, characterized as a "fuzzy" appearance or "whiskering" (Fig 17).

Periostitis may take several forms: It may appear as a thin periosteal layer of new bone adjacent to the cortex, a thick irregular layer, or irregular thickening of the cortex itself (Fig 17). It may be difficult to define where periostitis ends and bone erosion begins, as both may produce marked irregularity of the

Figure 18

Figure 18: Psoriatic arthritis. Lateral knee radiograph shows irregular thick bone proliferation and periostitis of posterior aspect of the tibia (arrows).

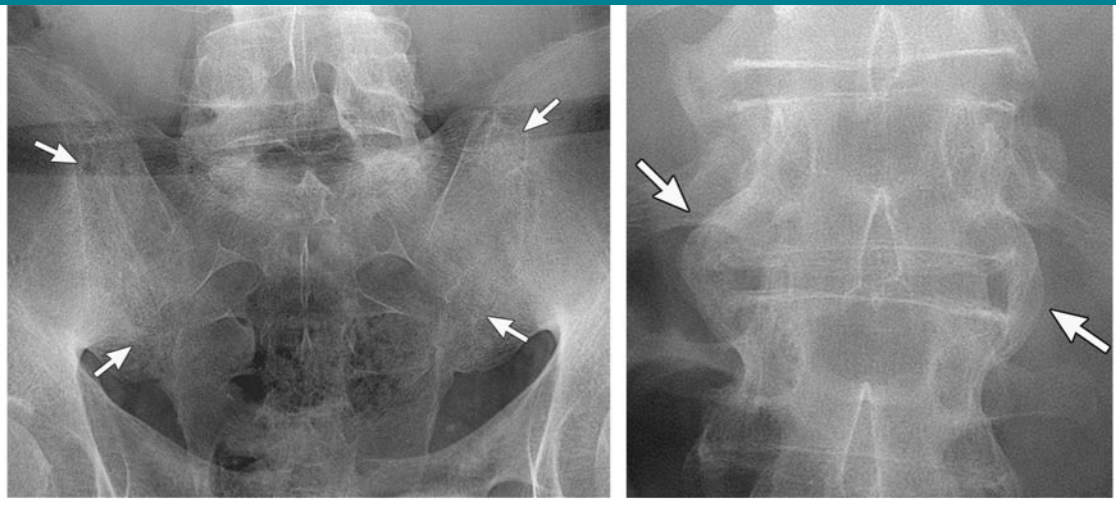
Figure 19

Figure 19: Psoriatic arthritis. Anteroposterior foot radiograph shows inflammatory and destructive changes of fifth metatarsophalangeal and several interphalangeal joints (straight arrows). Note pencil-and-cup deformity (arrowhead) and interphalangeal joint fusion (curved arrow).

Figure 20

Figure 20: Psoriatic arthritis. Anteroposterior radiograph shows increased density and bone proliferation of distal phalanx (ivory phalanx) of the first digit (arrows), with soft-tissue swelling.

Figure 21



a. b.

Figure 21: Psoriatic arthritis. **(a)** Anteroposterior sacrum radiograph shows bone erosions and narrowing of sacroiliac joints with partial fusion (arrows). **(b)** Anteroposterior lumbar spine radiograph shows comma-shaped paravertebral ossifications (arrows).

osseous surface (Fig 18). It is important to note that periostitis may occur in an area without bone erosions; one such site is the radial aspect of the wrist extending into the first metacarpal bone. Because of the degree of bone destruction, an involved joint may take the appearance of a "pencil and cup," with one end of the joint forming a cup and the other a pencil that projects into this cup (Fig 19). This appearance is not specific for psoriatic arthritis or any of the seronegative spondyloarthropathies, but it is most commonly seen in these conditions. One characteristic feature of psoriatic arthritis in the foot is the "ivory phalanx," which classically involves the distal phalanges (especially in the first digit) with sclerosis, enthesitis, periostitis, and soft-tissue swelling (Fig 20). Joint subluxation may also be present.

Psoriatic arthritis may also involve the axial skeleton, a finding that occurs in 20%–40% of persons with peripheral

Figure 22

Figure 22: Reactive arthritis. Lateral radiograph of calcaneus shows bone sclerosis and irregular inflammatory enthesopathy (arrow).

Figure 24

Figure 24: Reactive arthritis. Anteroposterior radiograph of great toe shows bone sclerosis, marginal bone erosions, and bone proliferation (arrows) about interphalangeal joint and distal phalanx, with soft-tissue swelling.

articular disease (6). The sacroiliac joints will show signs of inflammation, with an indistinct subchondral bone plate or osseous erosions, joint space irregularity and mild widening, and eventual joint space narrowing and intraarticular

Figure 23

Figure 23: Reactive arthritis. Posteroanterior finger radiograph shows involvement of multiple joints with joint space narrowing, bone erosions, and bone proliferation (arrows).

bone ankylosis (Fig 21a). Sacroiliac joint involvement in psoriatic arthritis is usually bilateral, either symmetric or asymmetric in distribution. The thoracolumbar spine may show large comma-shaped paravertebral ossifications (Fig 21b); spondylitis is uncommon in the absence of sacroiliitis, however (6). The facet joints are relatively spared, and there is absence of vertebral body "squaring."

Other sites of joint involvement in psoriatic arthritis include the knees (Fig 18), elbows, ankles, and joints about the shoulders.

Reactive arthritis.—Reactive arthritis (also called *Reiter syndrome,* which is currently being used less frequently) is a sterile inflammatory arthritis that follows an infection at a different site, commonly enteric or urogenital (6,7). An association with urethritis and conjunctivitis, as well as seropositivity for the HLA-B27 antigen, has been described (6). Reactive arthritis is most common in young men aged 25–35 years. The radiographic features of reactive arthritis are similar to those of psoriatic arthritis and include joint inflammation, bone proliferation, periostitis, and enthesitis. The features allowing differentiation between reactive arthritis and psoriatic arthritis relate to clinical history, patient sex and age, and distribution of joint involvement.

Similar to psoriatic arthritis, the radiographic features seen in the hands, wrists, and feet in reactive arthritis include joint inflammation, bone proliferation, periostitis, and enthesitis, with a distribution that is unilateral or bilateral and symmetric or asymmetric (Fig 22); lower-extremity involvement is more common than upper-extremity involvement (6). Sausage digit and pencil-and-cup deformities may also occur (Fig 23). In the feet, an ivory phalanx may be seen (Fig 24).

Axial involvement may also occur, leading to bilateral symmetric or asymmetric sacroiliitis. Large, comma-shaped, paravertebral ossification may also be seen. Other peripheral joints are less commonly involved.

Ankylosing spondylitis.—Ankylosing spondylitis is an idiopathic inflammatory arthritis, although a genetic contribution is noted as 96% of patients are HLA-B27 positive (8). Men are affected three times more frequently than women, with the age of onset typically between 20 and 40 years (8). This is a disease that more commonly involves the axial skeleton, although peripheral joints may also be affected. Spine involvement is characterized by osteitis, syndesmophyte formation, facet inflammation, and eventual facet joint and vertebral body fusion. Sacroiliac joint disease is bilateral and symmetric. Other peripheral joints, such as the hips and glenohumeral joints, may be involved. The ra-

diographic appearance of spine and sacroiliac abnormalities in ankylosing spondylitis is identical to that found with inflammatory bowel diseases such as ulcerative colitis and Crohn disease.

Sacroiliac involvement is typically bilateral and symmetric, and it usually precedes spinal involvement. Initially, there is indistinctness and discontinuity of the thin white subchondral bone plate about the sacroiliac joints. These changes can progress to gross bone erosions (Fig 25). Early erosions of the subchondral bone are often best seen in the inferior aspect of the joints because they are in profile in this region on an anteroposterior pelvis radiograph. Along with the bone erosions, the adjacent bone is often sclerotic and joint space narrowing and bone fusion eventually occur (Fig 26). Because the sacroiliac joints may be difficult to interpret on radiographs, magnetic resonance imaging can be useful in the diagnosis of sacroiliitis by showing joint fluid and marrow edema when radiographs are normal or equivocal. When radiographs are abnormal, computed tomography may be used to differentiate bone erosions from osteophytes. The differential diagnosis of bilateral sacroiliac joint erosions includes inflammatory bowel disease (Fig 27) and hyperparathyroidism (Fig 28); however, in hyperparathyroidism, sacroiliac joint space widening is more dramatic, and typically there are other clinical and radiographic features of hyperparathyroidism.

Spine involvement in ankylosing spondylitis is often centered at the thoracolumbar or lumbosacral junction, and coned-down lateral radiographs at these sites optimally depict subtle and early abnormalities. Early radiographic findings are erosions at the anterior margins of the vertebral body at the discovertebral junction. These focal areas of osteitis become increasingly sclerotic, a finding termed the "shiny corner sign" (Fig 29). More extensive discovertebral erosions may also occur. Associated bone proliferation leads to a "squared" appearance of the vertebral body. Thin and slender syndesmophytes are generally evident, representing ossification of the outer layer of the annulus fibrosis (Fig 30). The differential diagnosis for bone production at the vertebral margins includes diffuse idiopathic skeletal hyperostosis, or DISH, although

Figure 25

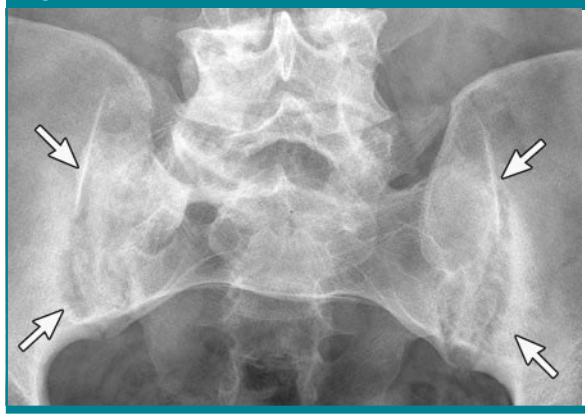


Figure 25: Ankylosing spondylitis. Anteroposterior pelvis radiograph shows bilateral symmetric bone erosions, sclerosis, and widening of sacroiliac joints (arrows).

Figure 26

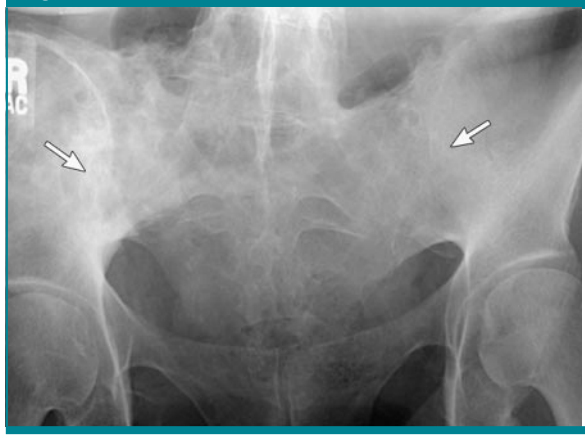


Figure 26: Ankylosing spondylitis. Anteroposterior radiograph of sacrum shows fusion of sacroiliac joints (arrows).

Figure 27

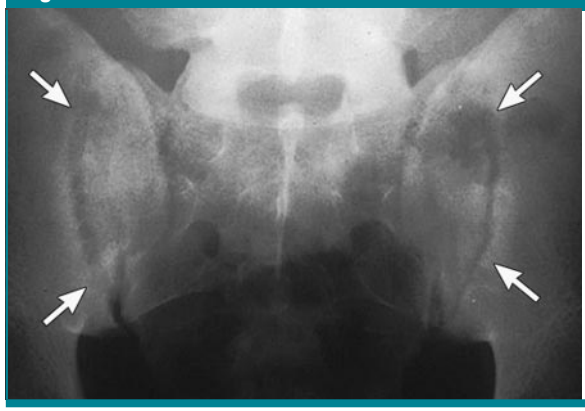


Figure 27: Inflammatory bowel disease. Anteroposterior radiograph of sacrum shows bilateral and symmetric bone erosions, bone sclerosis, and widening of sacroiliac joints (arrows).

Figure 28

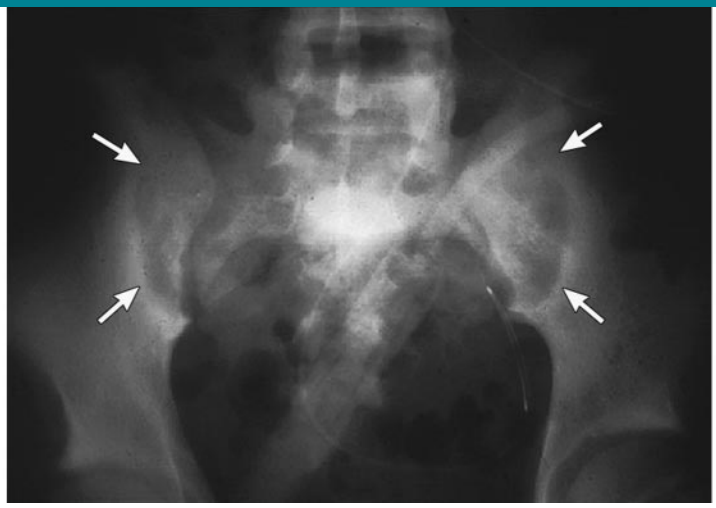


Figure 28: Hyperparathyroidism. Anteroposterior radiograph of sacrum shows bilateral and symmetric bone sclerosis and irregularity of sacroiliac joints (arrow). Note marked widening of sacroiliac joints and renal dialysis catheter.

Figure 29

Figure 29: Ankylosing spondylitis. Lateral lumbar spine radiograph shows sclerosis at anterior aspect of the end plate (shiny corner sign) (arrow), with squaring of anterior margin of vertebral body.

Figure 30

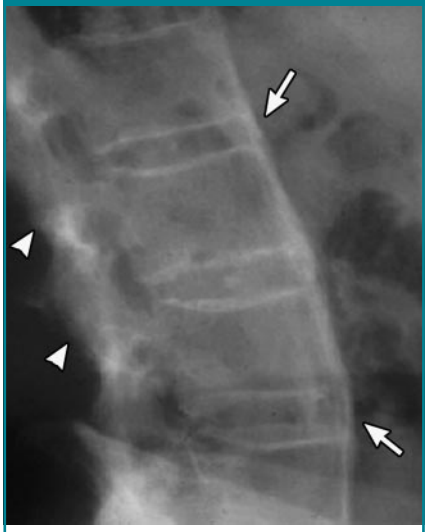


Figure 30: Ankylosing spondylitis. Lateral lumbar spine radiograph shows anterior bridging syndesmophytes (arrows) and facet joint fusion (arrowheads).

Figure 31

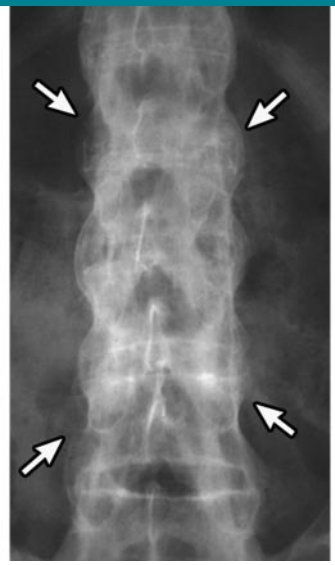


Figure 31: Ankylosing spondylitis. Anteroposterior lumbar spine radiograph shows bridging syndesmophytes (bamboo spine) (arrows).

this latter condition more commonly reveals a flowing and undulating appearance.

As the syndesmophytes thicken and become continuous, the term *bamboo spine* is used to describe the appearance on anteroposterior lumbar spine radiographs (Fig 31). Facet joint inflammation leads to indistinctness and narrowing of the involved joint, and bone fusion of the joints appears later (Fig 30). Ossification of the posterior interspinous ligaments produces a dense radiopaque line, designated the "dagger sign," on anteroposterior radiographs of the lumbar spine (Fig 32). The combination of the fused facets and ossification of the interspinous ligaments produces the "trolley-track sign" (Fig 33). Disk calcification may also occur, possibly due to relative immobilization of the vertebral column.

Other peripheral joints can be involved in ankylosing spondylitis. Hip involvement is usually bilateral in distribution (Fig 34). Uniform joint space loss in these joints is combined with acetabular protrusion, subchondral cysts, and a rim of osteophytes about the femoral neck. Bone erosions and remodeling in the lateral proximal aspect of the humerus produce a "hatchet" appearance.

Conclusion

Once joint space narrowing is recognized, the presence of bone erosions suggests an inflammatory arthritis, while osteophytes indicate a degenerative arthritis. The joint distribution and

the presence of bone proliferation allow distinction between septic arthritis, rheumatoid arthritis, and the seronegative spondyloarthropathies. If inflammation involves a single joint, one must carefully exclude infection. If inflammatory arthritis is diffuse and involves the proximal joints of the hands and feet without bone proliferation, rheumatoid arthritis is most likely. Distal joint involvement with bone proliferation suggests the presence of one of the seronegative spondyloarthropathies.

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Figure 32

Figure 32: Ankylosing spondylitis. Anteroposterior lumbar spine radiograph shows ossification of the interspinous ligament (dagger sign) (arrows).

Figure 33

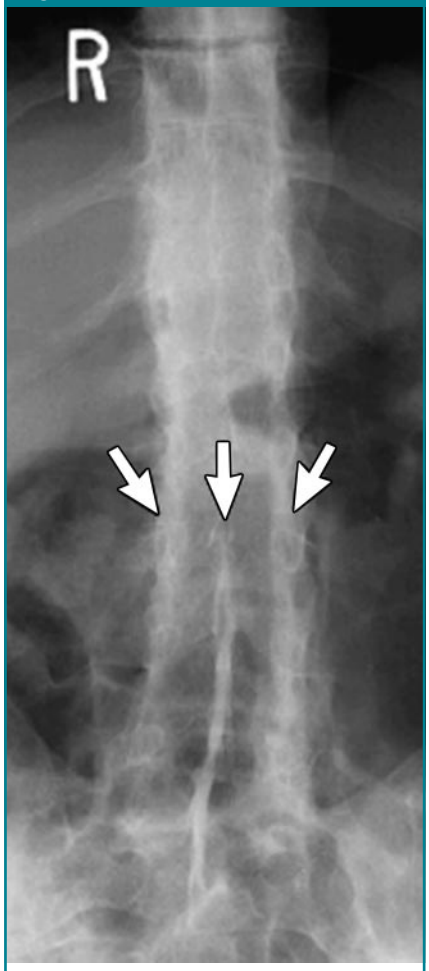

Figure 33: Ankylosing spondylitis. Anteroposterior lumbar spine radiograph shows ossification of interspinous ligament and facet joint fusion (trolley-track sign) (arrows).

Figure 34

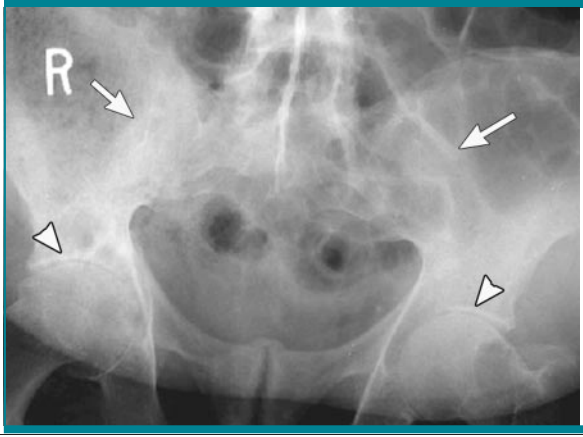

Figure 34: Ankylosing spondylitis. Anteroposterior pelvis radiograph shows bilateral diffuse joint space narrowing and bone erosions of each hip joint (arrowheads), with sacroiliac joint fusion (arrows).