MR Imaging of early Rheumatoid Arthritis and Spondyloarthropathy – Part II

Bone marrow oedema may be seen alone or surrounding bone erosions (Fig 2-3) and is considered to be a potentially reversible phenomenon. Histologic studies of joint replacement specimens have shown that bone marrow oedema corresponds to inflammatory cellular infiltrates in the bone marrow, representing osteitits. Bone marrow oedema is considered to be a very early marker of inflammation, given that its presence correlates with increased levels of acute phase reactants (erythrocyte sedimentation rate and C-reactive protein) and the clinical stage of disease activity. Bone marrow oedema is also closely related to the degree of synovitis and has been associated with subsequent erosive damage; as a result, it is currently considered to be a ‘forerunner’ of erosions.

The detection of erosions in patients with early rheumatoid arthritis is a key imaging finding, since it indicates irreversible joint damage. On radiographs, the presence of erosions is suggested by the loss of visualization of the bone cortex. MR imaging helps detect more bone erosions in the wrist and hand in early rheumatoid arthritis (Fig 4) than does radiography. In early rheumatoid arthritis, MR imaging helps identify bone erosions in 45–72% of patients with disease of less than 6 months duration, compared with 8–40% for radiography. It is also important to identify those patients with early rheumatoid arthritis in whom progressive disease is not seen, since aggressive treatment may not be required in such cases. Indeed, 82% of patients without erosions at baseline MR imaging had no radiographic erosions at 2-year follow-up.

Tenosynovitis is commonly seen in early rheumatoid arthritis of the wrists and hands. MR imaging signs of tenosynovitis include fluid in the tendon sheath, increased thickness or contrast enhancement of the tendon sheath synovium, or a combination thereof (Fig 5). If tendon sheath fluid is minimal, this may be a normal finding, however contrast enhancement of the same sheath is confirmatory of tenosynovitis.

Spondyloarthropathies involving peripheral joints, particularly psoriatic polyarthritis, may pose problems in the differential diagnosis from RA. This is especially true in cases of psoriatic arthritis without psoriatic skin lesions. Radiographic changes in psoriatic arthritis appear late compared to those on MR imaging. Unlike rheumatoid arthritis, there is usually extensive involvement of the DIP joint in psoriatic arthritis. The distribution of psoriatic arthritis within the hand can also differ from that of rheumatoid arthritis, in that two or three whole digits may be involved and the remaining ones spared, whereas in rheumatoid arthritis all MCP or PIP joints tend to be involved uniformly.

Enthesitis is inflammation at sites of bony insertion of tendons, ligaments, or joint capsules, and is the hallmark of these peripheral forms of spondyloarthropathy; in fact it is thought that most joint pathologic changes are the consequence of this inflammatory process at the enthesis. Thus, identification of enthesitis at MR imaging would suggest the diagnosis of spondyloarthropathy. MR imaging findings of enthesitis include diffuse bone marrow edema adjacent to the enthesis, as well as florid inflammatory soft-tissue changes at this site (Fig 6).

Other MR imaging findings of psoriatic arthritis include periostitis with thickening and contrast enhancement of the periosteum, and bone marrow edema observed in the diaphysis of the phalanges at a considerable distance from the subchondral bone and the capsular joint entheses.

In patients with rheumatoid arthritis, bone marrow edema usually occurs adjacent to cartilage in the subchondral bone and is much less extensive than in patients with spondyloarthropathy. Synovitis is not a predominant feature in most peripheral spondyloarthropathies. Moreover, whereas extensor tendons are more often involved than flexor tendons in rheumatoid arthritis, the opposite is true in psoriatic arthritis.

A key finding that may suggest the presence of spondylarthropathy is sacroilitis, which is not a feature of RA. Imaging of the sacroiliac (SI) joints is frequently the first investigation if spondylarthropathy is suspected. The normal SI joint is composed of an anterior inferior cartilagenous portion that shows smooth margins and a posterior superior fibrous portion that shows irregular margins (Fig 7).

The anteroposterior radiograph of the pelvis is still the initial investigation performed in suspected spondylarthropathy, and erosions, ill-defined margins, sacral-side sclerosis, narrowing or ankylosis of the SI joints are key albeit late features of the disease (Fig 8). This is particularly true if there is also hip involvement, which is present in 25% of cases.

Active inflammatory lesions in spondylarthropathy include bone marrow edema, synovitis, capsulitis, and enthesitis are best visualized on STIR, fat-suppressed T2-w, and contrast-enhanced fat-suppressed T1-w images (Fig 9-11). Bone marrow edema manifests with increased signal intensity on fat-saturated fast spin-echo T2-w or STIR images, and with enhancement on gadolinium-enhanced fat-saturated fast spin-echo T1-w images. The presence of subchondral or periarticular bone marrow edema is mandatory for the definition of sacroilitis at MR imaging.

The development of new MR sequences has revolutionized the interaction between MR imaging and...
Figure 2: Synovitis in early RA of the wrist (9 months duration). Radiography revealed small erosions of the distal radius. Axial T1-w (a) and fat-suppressed T2-w (b) MR images show extensive synovitis at the dorsal and volar aspects of the wrist (white arrows), which has intermediate signal intensity in a and intermediate to high signal intensity in b. Black arrows indicate tenosynovitis of the extensor carpi ulnaris tendon. (c) Coronal gadolinium-enhanced fat-suppressed T1-w MR image shows marked enhancement of the wrist synovitis (white arrow at left). Note the diffuse bone marrow oedema, whose area of involvement includes two small erosions of the articular margin of the distal radius (black arrows). There is also enhancing tenosynovitis in the extensor tendon compartment (white arrow at right).

Figure 3: Synovitis early rheumatoid arthritis of the wrist (4 months duration) and inconclusive radiographic findings. (a) Coronal T1-w MR image shows intermediate-signal-intensity tissue in the radiocarpal, radioulnar, and ulnocarpal joints (*). An ill-defined hypointense area in the ulnar styloid process (arrow) represents bone marrow edema. (b) Axial fat-suppressed, heavily T2-w MR image shows hyperintense tissue in the radioulnar joint cavity (*), a finding that corresponds to joint fluid. Note also the intermediate signal intensity of the synovial thickening of the volar aspect of the radioulnar joint (arrows) and of the tendon sheaths of the second to fifth extensor compartments (arrowheads). (c) On an axial contrast material-enhanced fat-suppressed T1-w MR image, the radioulnar joint cavity is unenhanced (*), a finding that corresponds to joint fluid. However, the synovial thickening seen in b is now markedly enhanced (arrows and arrowheads), a finding that corresponds to acute synovitis.

Figure 4: Erosions in early rheumatoid arthritis of the wrist (1 year duration) with normal radiographs. (a) Coronal T1-w MR image shows extensive synovitis (*), along with multiple erosions of the carpal bones, distal radius, and ulnar styloid process (arrows). Coronal (b) and sagittal (c) contrast-enhanced fat-suppressed T1-w MR images again show extensive synovitis (*), with marked enhancement of the multiple erosions (arrows) seen in a. Erosions of the distal radius and lunate bone are seen in both planes.

In summary, MR imaging has revolutionised the management of RA and spondylarthropathy in that it allows much earlier detection of inflammatory joint changes and consequent early treatment to minimise joint damage. MR imaging, particularly with diffusion-weighted imaging and dynamic contrast-enhanced techniques, provides a quantitative assessment of the efficacy of treatment to help improve the outcome in these patients.

A recent study has shown that diffusion-weighted and dynamic contrast-enhanced imaging may be effective in quantifying inflammatory changes at involved skeletal sites and, thus, useful for assessing treatment efficacy in ankylosing spondylitis.
**Figure 5:** Tenosynovitis in early rheumatoid arthritis of the wrist (5 months duration) and normal radiographic findings. Axial T1-w (a), fat-suppressed T2-w (b), and contrast-enhanced fat-suppressed T1-w (c) MR images show marked tenosynovitis (arrows) involving both the dorsal extensor and volar flexor compartments and periscaphoid joint synovitis (*).**

**Figure 6:** Proximal and distal interphalangeal joint arthritis in a patient with undifferentiated spondyloarthropathy (6 months duration) and normal radiographic findings. Coronal contrast-enhanced fat-suppressed T1-w MR image shows soft-tissue enhancement at the entheses surrounding the collateral ligaments of the proximal and distal interphalangeal joints of the fifth finger (arrows), along with mild synovitis.

**Figure 7:** (a) Coronal oblique fat-suppressed T1-w MR image of the normal sacroiliac joint shows the smooth and parallel margins of the cartilaginous lower ventral portion (arrows). (b) Coronal oblique fat-suppressed T1-w MR image obtained more posteriorly shows the irregular edges of the fibrous or ligamentous upper dorsal portion (arrows).

**Figure 8:** Anteroposterior radiograph of the pelvis with ankylosing spondylitis shows total ankylosis (fusion) of both sacroiliac joints (arrows) and uniform narrowing of the hip joints (arrowheads).

**Figure 9:** Coronal oblique fat-suppressed T2-w MR image of the sacroiliac joints in a patient with ankylosing spondylitis shows bilateral periarticular bone marrow edema (arrows).

**Figure 10:** Inflammatory sacroiliitis and spondylodiskitis. Coronal oblique fat-suppressed T1-w MR images obtained before (a) and after (b) the administration of paramagnetic contrast medium show marked irregularity and several erosions of both sacroiliac joints (arrows in a, white arrows in b), as well as a large erosion on the superior S1 endplate (arrowhead). Note the enhancement of the synovial portion of both joints (black arrows in b), a finding that is consistent with synovitis, and the enhancement of the S1 endplate erosion.

**Figure 11:** Capsulitis and enthesitis in ankylosing spondylitis. Coronal oblique (a) and axial oblique (b) contrast-enhanced fat-suppressed T1-w MR images show enhancement of both anterior capsules (arrowheads) consistent with anterior capsulitis; enhancement of the ligamentous portion of both sacroiliac joints (arrows in a), consistent with enthesitis, along with enhancement of the right facet joint (white arrow in b); and endplate erosions (black arrow in b).