

Case Report:

Magnet Resonance Imaging in Inflammatory Arthritis

Marius Horger, M.D.

University Hospital Tübingen, Dept. of Diagnostic and Interventional Radiology, Tuebingen, Germany

Introduction

Magnetic Resonance Imaging (MRI) has advanced to the most accurate imaging modality in the diagnosis and response monitoring of inflammatory arthritis. Unlike conventional X-ray technique, MRI delivers information concerning both morphologic changes of the involved joint and pathophysiologic data with respect to the degree of synovial membrane and/or bone and juxta-articular inflammation. Furthermore, the excellent resolution and the high tissue contrast enable not only assessment of inflammatory activity, but also differentiation between the different types of arthritis disorders.

Hence, this short case series should help understand some of the most important benefits of the use of MRI. Early detection of inflammatory activity and onset of bone destruction, irrespective of the underlying arthritis type, remain major goals in the diagnosis. Established technologies (e.g. dynamic contrast enhanced MRI) and newer technologies (e.g. *syngo* ASL Arterial Spin Labeling) make even quantification of inflammation-related synovial perfusion practicable in the routine diagnosis. The latter delivers this information even without the use of intravenous contrast. Finally, MRI also helps to better understand the pathomechanisms responsible for disease progression.

Sequence details

The MR imaging protocol consisted of the following:

Axial T1-weighted 2D spin-echo sequence: Repetition time (TR) 863 ms; echo time (TE) 12 ms; slice thickness (SL) 2 mm; bandwidth (BW) 195 Hz/px; matrix 320 x 204; in-plane resolution (IPR) 0.4 x 0.3 mm; averages (AVR), 2; acquisition time (TA) 4:10 min, coronal T1-weighted 2D spin-echo sequence (TR, 570 ms; TE, 12 ms; SL, 1.5 mm; BW, 195Hz/px; matrix, 320x232; IPR, 0.4 x 0.3 mm; AVR, 2; TA, 5:11 min.)

Coronal T2-weighted 2D fast spin-echo sequence with spectral fat-saturation: TR 7210 ms; TE 81 ms; echo train length (ETL) 15; SL 1.5 mm; BW, 180 Hz/px; matrix 320 x 320; IPR 0.4 x 0.3 mm; AVR 4; TA 5:58 min.

3D DESS (dual-echo steady state): TR 21.6 ms; TE 6.8 ms; ETL 15; BW 180 Hz/px; matrix 256 x 256; resolution 0.6 x 0.6 x 0.6 mm; AVR 2; TA 7:12 min.

3D FLASH (fast low angle shot), a spoiled gradient-echo sequence with spectral fat saturation for dynamic MR imaging: TR 3.95 ms; TE 1.45 ms; resolution 0.6 x 0.6 x 0.8 mm; BW 350 Hz/px; 32 slices per slab; slice partial Fourier 6/8; flip angle 20°; IPR 0.4 x 0.3 mm; AVR 2; TA 13 s.

Axial T1-weighted spin-echo sequence with spectral fat saturation for post-contrast imaging: TR 798 ms; TE 12 ms; SL 1.5 mm; no gap; BW 195 Hz/px; matrix 320 x 2042; IPR 0.7 x 0.6 mm; AVR 2; TA 5:31min.

Case 1

Late rheumatoid arthritis (RA)

Patient history

A 48-year-old female patient with known rheumatoid arthritis presented with progressive swelling of the metacarpophalangeal joints. The patient was known to be in compliant and indolent and had discontinued therapy one year ago. On conventional radiographs of the hands (not shown), newly occurred intraosseous cysts were diagnosed, additionally to the typical erosions in the bare area of the metacarpal bones.

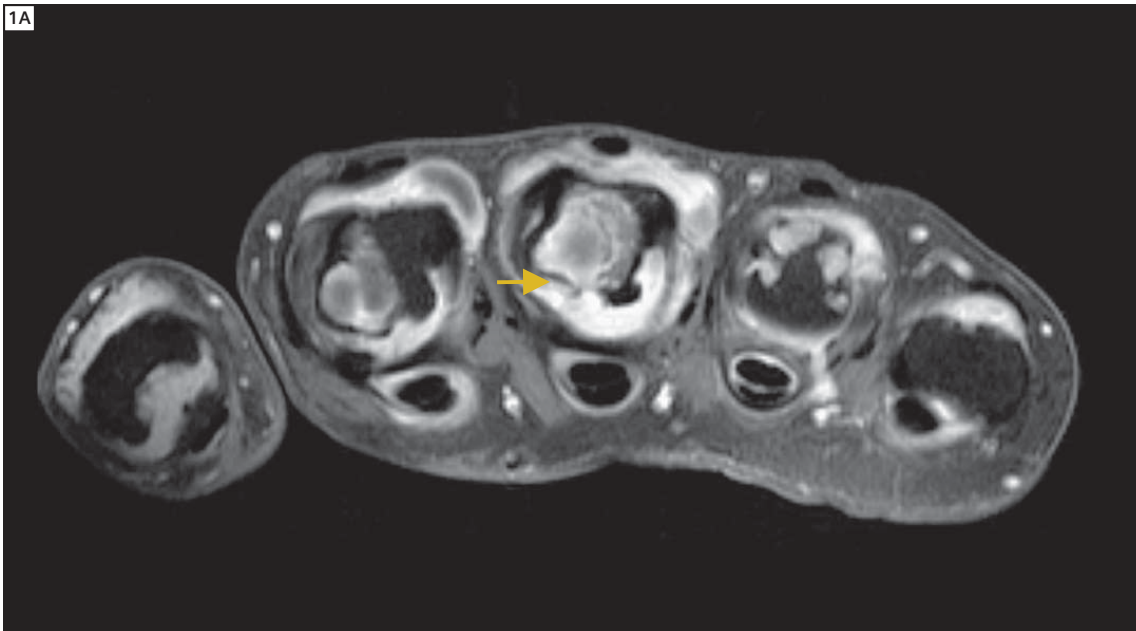
Image findings

High-resolution MRI of both hands using a dedicated hand coil and a 3T magnetic field (Siemens MAGNETOM Trio) revealed typical signs of elevated intraarticular pressure due to overproduction of joint effusion by the inflamed synovia. Due to the excellent image resolution (in plane resolution, 0.3 x 0.4 mm) and contrast and the use of a thin slice protocol (1.5 mm), interruption of cortical bone (arrow) along the metacarpal heads is well depicted on axial fat-saturated T1-weighted post-gadolinium image, demonstrating continuity of the joint cavity with the intraosseous cysts (Fig. 1A). Note enhancement of both articular synovia and metacarpal cystic

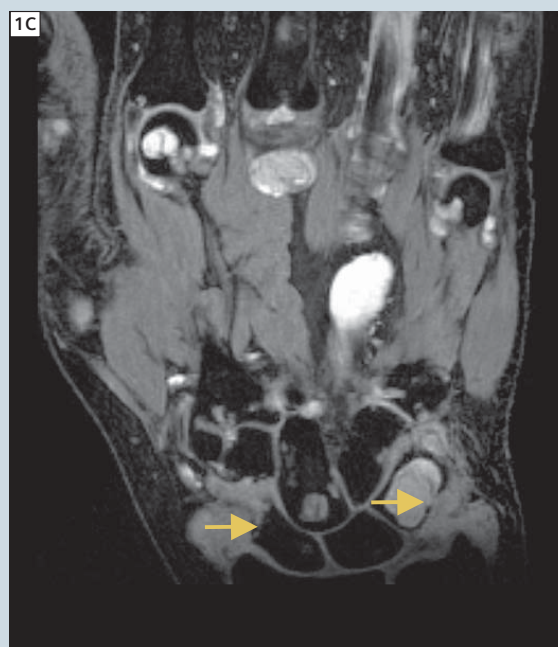
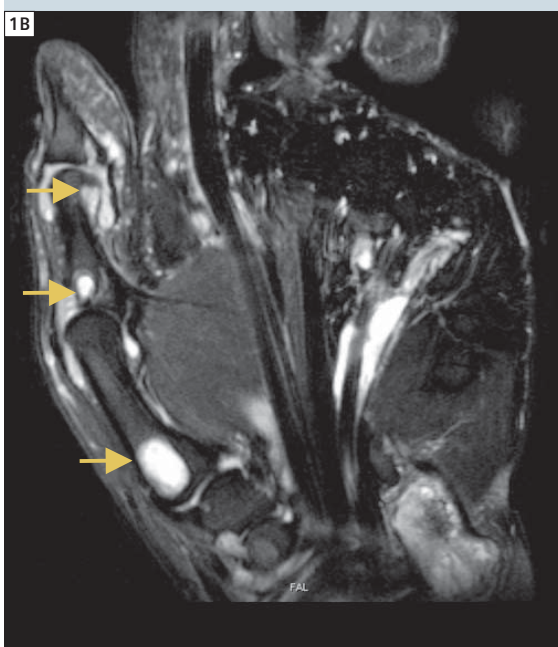
lesion representing extension of articular active pannus into the bony canal. There is only a small amount of effusion in the joint space and in the adjacent involved metacarpal bones II and III. Note also tenosynovitis of the flexor tendon sheaths.

In the other hand, coronal fat-saturated T2-weighted image (Fig. 1B) and coronal DESS image (Fig. 1C) both show the pathways of arousal of intraosseous cysts at sites where the cortical bone has become permeative. Note volar disten-

sion of articular synovial membrane in the interphalangeal joint of the 1st finger denoting overpressure and the accompanying intraosseous cysts (arrows). On the fat-saturated T2-weighted image, differentiation of articular fluid from



1A Axial fat-saturated T1-weighted post-gadolinium image, demonstrating continuity of the joint cavity with the intraosseous cysts.



1B, C B: Contralateral hand to Fig. 1A, coronal fat-saturated T2-weighted image C: Contralateral hand to Fig. 1A, coronal DESS image.

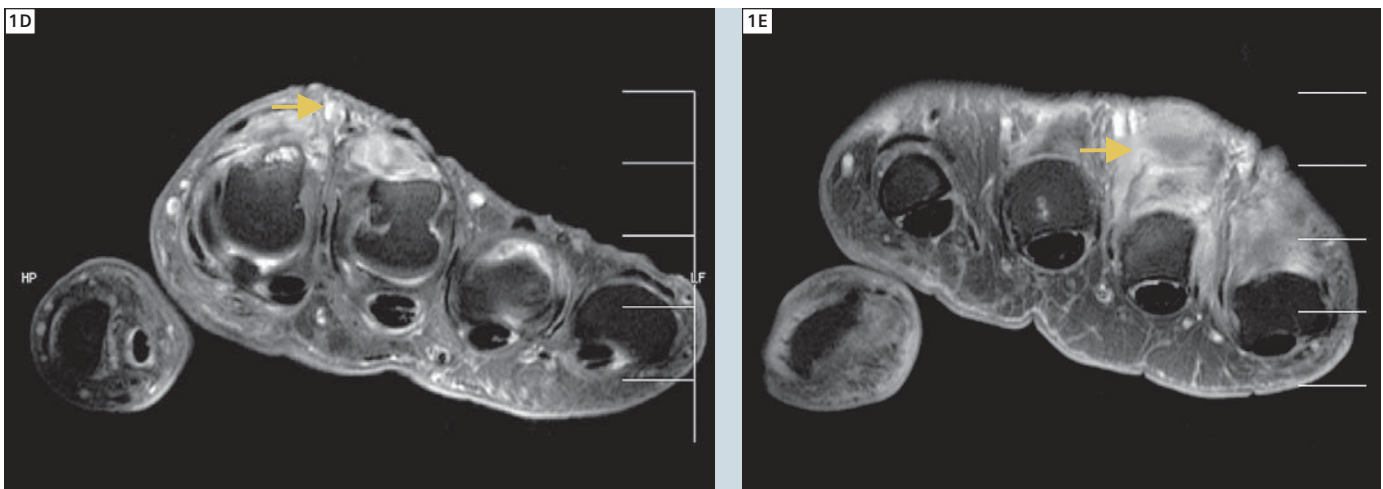
active pannus is not possible. However, on the coronal DESS image synovial proliferation shows lower signal compared to intraarticular effusion. Fig. 1D shows extra-synovial inflammation on the dorsal side of the hand over the metacarpophalangeal joints. Note distension of articular capsule with disruption and formation of fistula (arrow, Fig. 1D) and

pseudocyst, (Fig. 1E) both known decompression forms of inflamed joints occurring especially in untreated patients. Due to the high resolution synovial thickening can be delineated excellently also on the non-enhanced T1-weighted image (Fig. 1F).

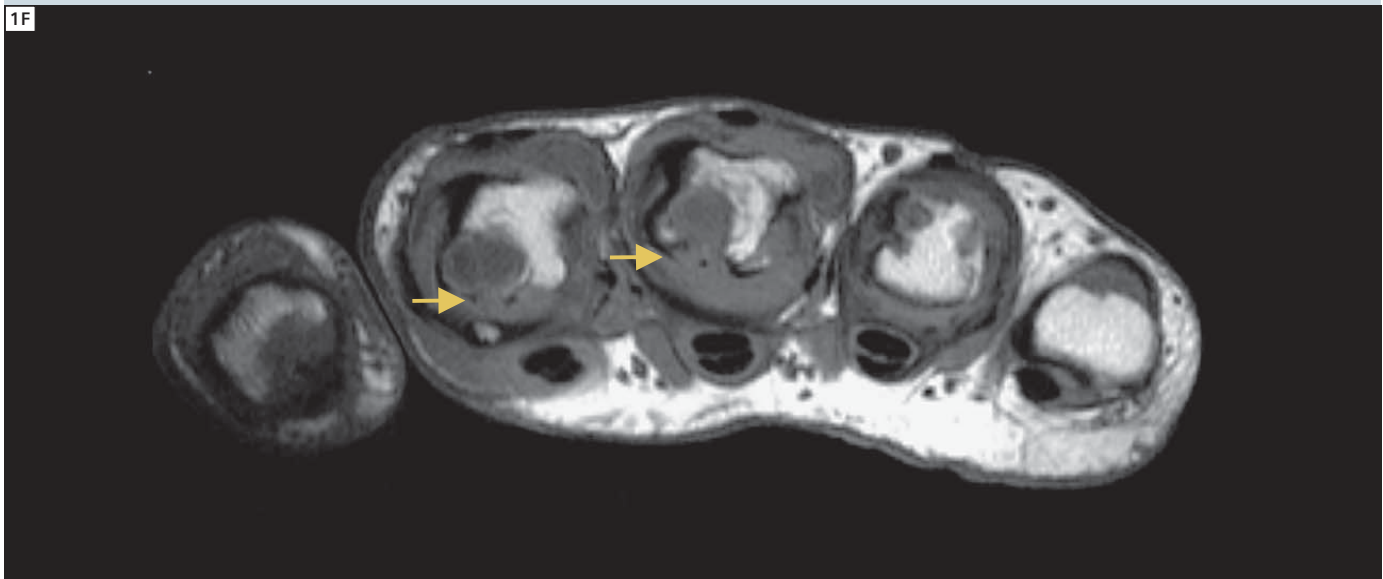
Case 2 Psoriatic arthritis (PsA)

Patient history

A 64-year-old male patient with known psoriatic arthritis (PsA) presented with progressive exercise-induced joint pain and swelling involving all hand joints, despite ongoing immunosuppressive therapy.



1D, E Axial fat-saturated T1-weighted post-gadolinium image, demonstrating extra-synovial inflammation.



1F Axial non-enhanced T1-weighted image; synovial thickening can be delineated excellently due to the high resolution.

Image findings

On conventional radiographs of the hands (Fig. 2A), juxta-articular osteopenia, joint space narrowing with osteophyte formation (bony proliferation) was diagnosed in the wrist joint, intercarpal joint as well as to a lesser degree also in all other hand joints. Fusiforme swelling of the fingers was also noticed presumed to represent polydactylia.

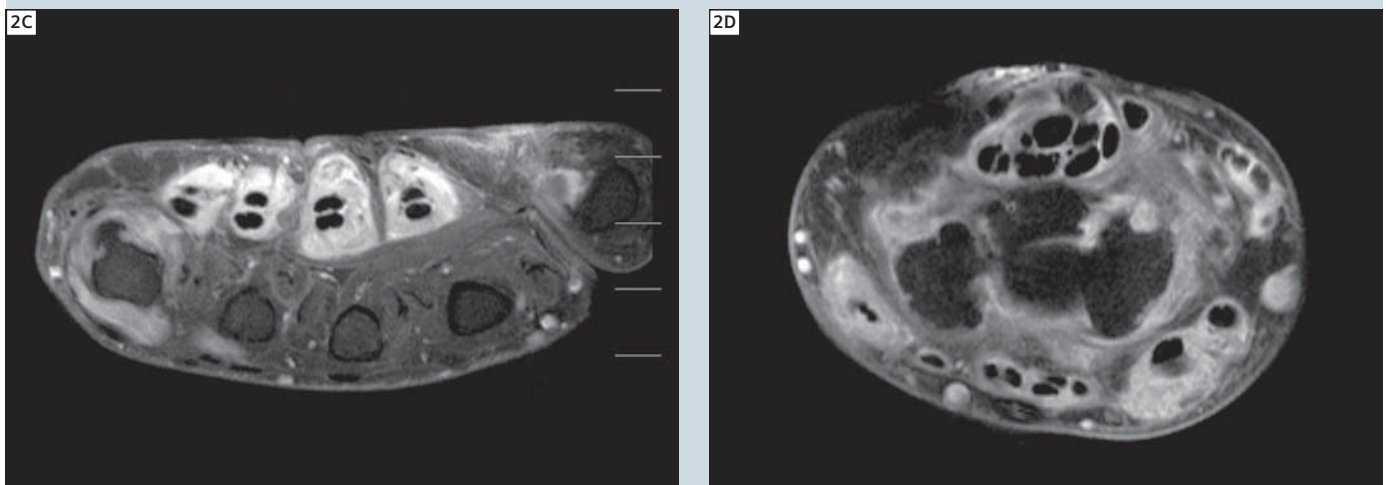
High-resolution MRI of both hands using

a dedicated hand coil and a 3T magnetic field (Siemens MAGNETOM Trio) revealed severe erosions in all joints, particularly in the wrist and the metacarpophalangeal joints (Fig. 2B). Note also tendon tear on the radial side of the wrist joint (arrow). Fig. 2C shows strong inflammation and thickening of the flexor tendon sheaths along the metacarpal bones. Note destruction of the Vth metacarpal head

which differs in its morphology from the classical erosion by rheumatoid arthritis. The latter lacks new bone formation and is mainly localized at the so-called bare area. At the level of the wrist, the destructive character of this inflammatory arthritis becomes more evident. Note also the strong synovial hypertrophy of both extensor and flexor tendon sheaths (Fig. 2D).



2A, B A: Conventional radiograph of the hand; juxta-articular osteopenia and joint space narrowing with osteophyte formation (bony proliferation) and fusiforme swelling of the fingers are present. B: Coronal DESS image visualizing severe erosion in all joints.



2C, D Axial fat-saturated T1-weighted post-gadolinium images.

Case 3 Systemic lupus erythematoses (SLE)-induced arthritis

This case compiles images of three different patients suffering from systemic lupus erythematoses (SLE) and complaining about joint pain. In the 1st patient, conventional X-ray of the hand did not disclose any pathologic findings (Fig. 3A). Axial fat-saturated T1-weighted post-gadolinium image however, shows strong synovial thickening and enhancement involving all joints, but in particular the metacarpophalangeal (MCP) joints (Fig. 3B). Note also extra-synovial extension of inflammation and accompanying tenosynovitis. The latter represents a frequent image finding in SLE-patients. There is no erosion at the level of MCP joints. At the 3rd metacarpal head, partial average volume simulated the presence of a prelesion which was not confirmed in the coronal plane.

In the second patient, a child* with SLE-associated arthritis, coronal DESS image demonstrates incomplete ossification of the carpal bones and open growth plates of the long bones (Fig. 3C). There is also small erosion in the capitate bone which represents an unusual finding for SLE-arthritis.

Nevertheless, axial fat-saturated post-gadolinium image at the level of the basis of the MCP demonstrates further erosions (arrow) and also strong enhancement in the thickened synovial membrane (Fig. 3D).

In the third patient with SLE, focal erosion of the 3rd metacarpal head (arrow) is nicely depicted on axial non-enhanced T1-weighted image (Fig. 3E). There is also thickening of the articular synovia. However, it is only the use of intrave-

nous contrast material that allows appreciation of inflammatory activity of such findings. On the corresponding axial fat-saturated post-gadolinium image, mild enhancement is seen in the synovial membrane of the 3rd and 4th MCP, but none in the intraosseous pannus of the 2nd MCP (Fig. 3F). This finding is compatible with inactive pannus.

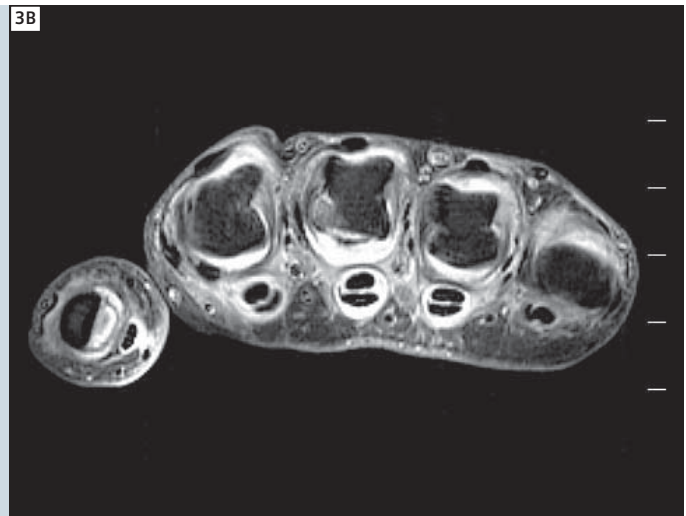
*The safety of imaging fetuses / infants has not been established.

Contact

Prof. Dr. Marius Horger
Department of Radiology
University Hospital of Tuebingen,
Hoppe-Seyler-Straße 6
72076 Tuebingen
Germany
marius.horger@med.uni-tuebingen.de



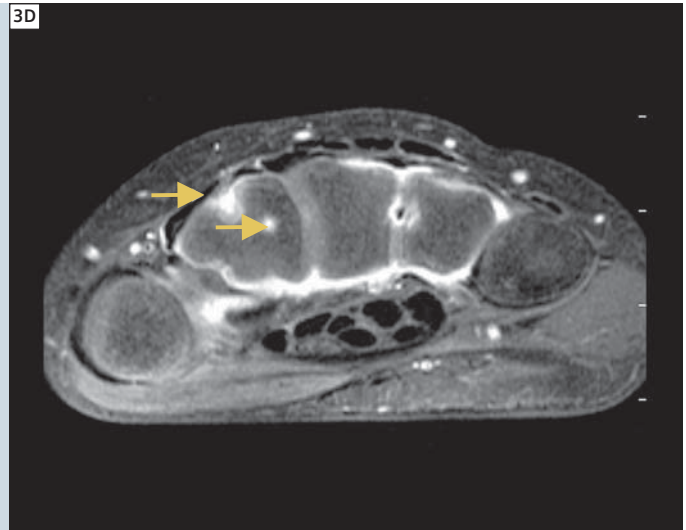
3A Conventional radiograph of the hand; no pathologic findings are disclosed.



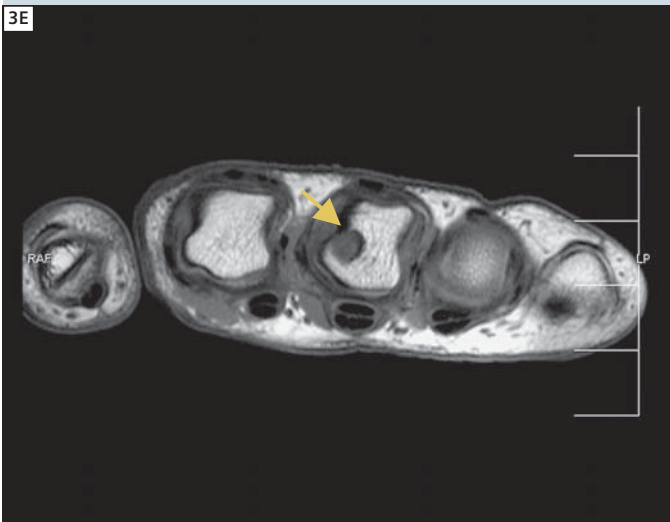
3B Axial fat-saturated T1-weighted post-gadolinium image; strong synovial thickening and enhancement involving of all joints are present.



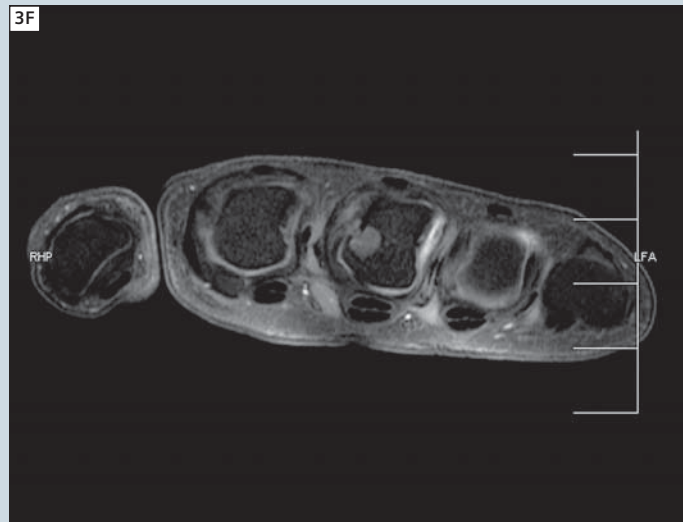
3C Coronal DESS image showing incomplete ossification of the carpal bones and open growth plates of the long bones.



3D Axial fat-saturated T1-weighted post-gadolinium image showing erosions and also strong enhancement in the thickened synovial membrane.



3E Axial non-enhanced T1-weighted image; a focal erosion of the 3rd metacarpal head is delineated in detail.



3F Axial fat-saturated T1-weighted post-gadolinium image.