



Eye On Imaging

MR In The Early Assessment of Rheumatoid Arthritis

Rheumatoid arthritis (RA) is an autoimmune mediated disease that frequently affects the hands and wrists. In the early phase, patients present with joint pain, often accompanied by swelling, warmth, redness, and/or stiffness. In later stages, irreversible joint damage occurs when inflammatory mediators are released into the joint and result in articular and osseous destruction. Fortunately, management of RA has significantly improved with major advancements in disease modifying antirheumatic drugs (DMARDs) such as etanercept and adalimumab. Without treatment, erosions and cartilage loss commonly occur within 2 years of onset of synovitis; it is therefore essential to make or exclude the diagnosis and initiate therapy within 3-6 months.

Conventional radiographic diagnosis depends upon the appearance of erosions and subsequent joint space narrowing, both of which are late findings and represent irreversible change. Only MR, with its ability to directly visualize effusions, synovium, and tendons, can confirm the early diagnosis critical to therapeutic success.

MR is used to examine the most symptomatic limb; the most common imaging routine examines the wrist as one exam, and the MCP and PIP joints as another. If the patient is not able to cooperate for 2 exams, the wrist and MCP joints are assessed on a single examination. All studies are conducted using intravenous contrast (gadolinium- Gd), which allows for assessment of the synovial thickness, distinction of synovium from fluid, and for more precise detection of bone marrow edema and subtle erosions.

Methods of semiquantitative scoring of early RA changes at the wrist and MCP joints have been developed and standardized on MR by the OMERACT (Outcome Measures in Rheumatology Clinical Trials). However, such

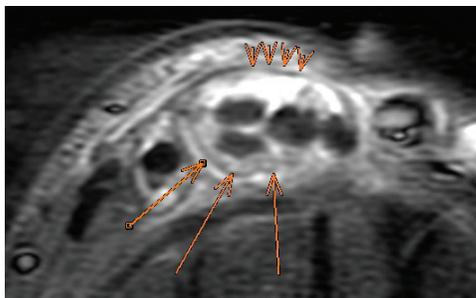
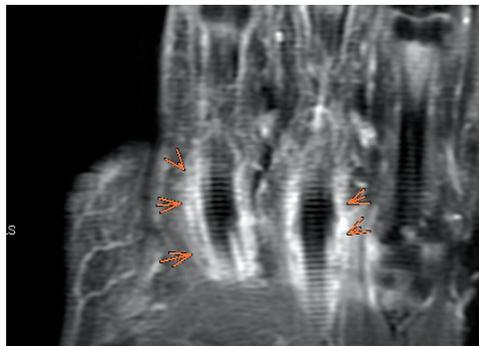


Figure 1 Tenosynovitis at the wrist. This axial image reveals bright fluid (arrowheads) in the dorsal aspect of the 4th extensor compartment sheath, and solid pannus (long arrows) in the volar aspect. The tendons are dark circles within the sheath.

complex scoring remains in the domain of research protocols for the present time.

Synovitis affecting joint membranes, tendon sheaths and bursae, is the earliest MR finding in RA; effusions typically accompany synovitis and through the use of Gd, can be distinguished from synovitis. Both fluid and synovial hyperplasia may be bright on fluid-sensitive sequences, but only synovitis will enhance following Gd injection. Dorsal tendons sheaths at the wrist are more commonly involved than



Figures 2A & B. Gd enhancement of synovial membranes. The arrows define enhancement of the joint capsules of the 2 and 3 MCP in 2A and the flexor sheaths in 2B.

the volar group in early disease; the extensor carpi ulnaris tendon appears to be an early target. Partial tendon tears, usually dorsal, are found in 8% of cases and complete rupture in 3% of RA patients with disease of less than 4 years duration.

Poorly defined zones of subchondral bone marrow edema (BME) are the earliest osseous findings in RA; they are due to the replacement of bone marrow fat by an inflammatory infiltrate resembling a sterile osteitis. BME is a highly suggestive finding for RA in that multiple studies demonstrate a high correlation with laboratory inflammatory markers. By definition, BME lesions have ill-defined margins, and can be seen alone or surrounding erosions. On

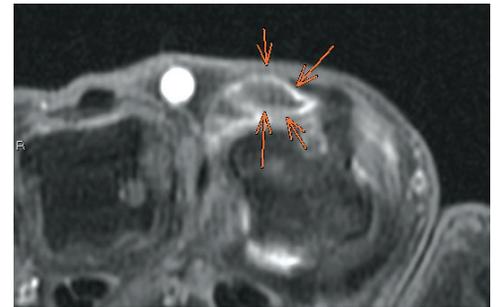


Figure 3 Rupture of an extensor tendon. Instead of the tendon being a solid dark circle, the extensor indicis tendon is poorly defined and has increased signal, typical of a partial tendon tear.

MR imaging, these areas of signal change are usually localized to the juxtaarticular margins of the MCP and PIP joints. The pattern of marrow edema can be more diffuse within the wrist. MR-detected pathology (synovitis, bone erosions and/or BME) of the wrist at disease onset in early RA predicts radiographic



Figures 4A BME. A small focus of BME is present in the juxta articular marrow of the second proximal phalanx.

BIOGRAPHY

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Jerrold Mink M.D., has written more than forty original articles that have been published in the radiology, orthopedic, sports medicine, and rheumatology literature. In addition, he has co-authored four textbooks on the musculoskeletal applications of MRI including the first specialty texts on the knee and foot and ankle.

Vu Bui M.D., was recruited to Mink Radiology from the University of Colorado Health Sciences Center. Prior to that, he had taken a musculoskeletal fellowship at the Brigham and Women's Hospital in Boston. In addition to Dr. Bui's expertise in musculoskeletal imaging, he has extensive experience with musculoskeletal interventional procedures such as spinal interventional procedures and biopsies.



Figures 4B BME. The entire 3rd metacarpal head is edematous.

erosions. A high baseline score of wrist joint MR erosions and synovitis was the best predictor of radiographic erosive progression in the hand, wrists and feet after 10 years in 114 patients with early RA.

In addition, BME at presentation was the strongest predictor of radiographic progression 2 years later. BME is found in 39-75% of RA patients with disease of less than one year. It may resolve without sequelae; conversely, there is a high negative predictive value of BME for the emergence of erosions.

Osseous erosions are a result of invasion of pannus into bone at the bare area, that intra articular zone which is covered by synovium but not covered by articular cartilage; as a result, the pannus erodes bone earlier than in those regions in which the articular cartilage covers it. Erosions are defined as sharply margined bone lesions with a juxtaarticular localization, visible in two planes and with cortical break seen in at least one plane. MR detects erosions in 45-72% of patients with disease of less than 6 months, compared with 8-40% for xray. Detection of erosions in early phases of RA generally correlates with a less satisfactory radiographic and functional outcome. Conversely, 82% of patients without erosions at baseline MR had no xray findings at 2-year follow-up. Gadolinium enhancement aids in the detection of erosions, suggests activity and distinguishes erosions from juxta articular ("degenerative") cysts, which typically do not enhance. Small erosions have been seen in otherwise normal people (2%) but these do not enhance and are not associated with BME or synovitis, thus distinguishing them from early RA.

In the wrist the capitate is a common site of erosion; the triquetrum is commonly affected as well. The 2nd and 3rd metacarpal heads show early disease along their radio-volar margins. There are some reports that erosions in the feet, specifically the lateral aspect of the 5th metatarsal head, can be one of the first sites of erosive disease, and furthermore, the feet may be affected more than the hands. Some authors suggest examining the feet in complex cases in which the diagnosis is uncertain.

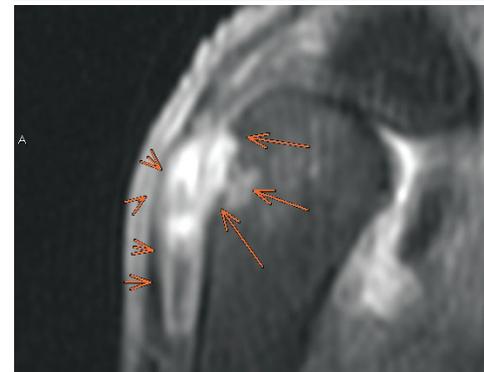
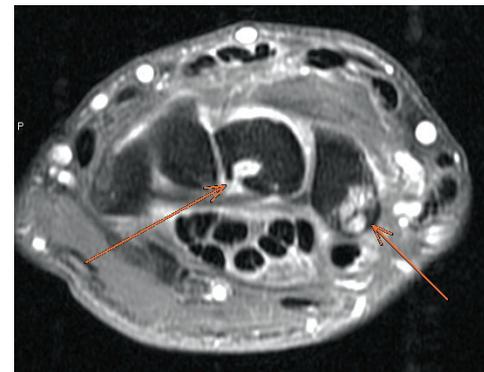


Figure 5A, B & C Erosions. **A.** Axial post gadolinium study demonstrates enhancement of a cortical violation of the lunate, typical of RA (longer arrow). Enhancing zones of BME (shorter arrows) are present in the scaphoid. **B.** The long arrows define an erosion of the dorsal aspect of the metacarpal head, immediately adjacent to extensive tenosynovitis of the extensor tendon (arrowheads). The MCP joint is narrowed and slightly subluxed. **C.** There is massive tenosynovitis of the extensor carpi ulnaris, a frequent target of RA; extensive erosion of the ulnar head (arrowheads) is present.

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