Rheumatoid arthritis (RA) is a chronic inflammatory and autoimmune disorder that most often affects the small joints in hands and feet. RA primarily affects the synovial lining of the joints, causing a painful swelling that can eventually result in bone erosions and joint deformity. In addition to causing joint problems, RA is a systemic disease affecting multiple organ systems. It is two to three times more common in women than in men and generally occurs between the ages of 40 and 60.

Treatment options have expanded greatly in the past few decades and this disease is increasingly being treated in a very early stage in order to prevent further damage—rather than just treating symptoms. The key factor driving this move is the adoption of Tumor Necrosis Factor-alpha blockers, which have only become widely available in the last decade. One of the major problems with early treatment is...
identifying RA patients among the much larger group of early arthritis patients. MR is a very sensitive imaging technique that may play an important role in this identification process.

For many years, radiographs have been the standard imaging technique to follow RA progression. However, radiographs only show structural bone damage in the form of erosions, which are a relatively late event in the disease. MR, in addition to erosions, also directly shows synovitis (inflammation of the synovial membrane), tenosynovitis (inflammation of the fluid-filled cover called the synovium that surrounds a tendon), and subchondral changes. These inflammatory features are the main process in RA. As a further advantage, MR has been shown to be more sensitive to erosions than conventional radiographs.\textsuperscript{1,2,3} The absence of erosions on MR has a high (80\%) negative predictive value for developing RA.\textsuperscript{5,6,7}

At the outpatient clinic of the rheumatology department at Leiden University Medical Center (Leiden, Netherlands), we asked patients from the early arthritis clinic to help determine the role of MR for non-specific early arthritis. Over a period of two years, patients with a possible diagnosis of RA will be examined with MR at several time intervals. Currently, the first patients are receiving their one-year follow-up examination.

As one of the first institutions in Europe to implement a dedicated 1.5T extremity MR from GE Healthcare, much effort has gone into optimizing the sequences and protocols for optimal image quality and imaging times. The images we obtain from the dedicated scanner have a very high quality, often surpassing that of full-body 1.5T systems for MSK applications.

One critical issue is the availability of scan capacity on our whole-body magnets. By using the dedicated extremity MR, patients can be scanned in the same week, and often on the same day as their initial visit.

Patient comfort is another important factor. Arthritis patients present with painful, swollen joints and are sometimes unable to maintain an awkward position required with imaging on a full-body system. With the dedicated extremity MR scanner, they can comfortably sit in a chair next to the scanner.

We are acquiring several images of the wrist and metacarpophalangeal joints: coronal T1 and T2-weighted images, and coronal and axial fat-suppressed T1-weighted images. The images are then evaluated for the presence of bone erosions, bone marrow edema, synovitis, and tenosynovitis. Evaluation is standardized by using the OMERACT RAMRIS (Outcome Measures in Rheumatology Clinical Trials/Rheumatoid Arthritis Magnetic Resonance Imaging Score), which was developed for MR in RA.

The clinical cases presented on the following pages demonstrate the clinical utility and excellent image quality of the high-field, dedicated extremity MR. We prefer to utilize this scanner for our patient evaluations based on scanner availability, patient comfort and high-quality imaging.
**Case 1**

**Patient history**
Early stage of pathology: Patient suffers from painful feet, right shoulder, and proximal interphalangeal joints (PIP) 4; treated with Arthrotec, Celebrex. Physical exam demonstrated swelling and pain PIP 4. Differential diagnosis of RA, reactive arthritis, and undifferentiated arthritis.

Prior X-ray demonstrates minimal erosive changes of the first carpometacarpal joint and scaphotrapezial joint (Figure 1).

**MR findings**
Coronal T1-weighted (Figure 2A), and coronal (Figure 2B) and axial (Figure 2F) T1-weighted, fat-suppressed, MR images of the wrist show multiple erosions in the carpal bones, including a large erosion in the capitate bone. MR of the metacarpal phalangeal joints (MCP) is unremarkable (Figure 2C, Figure 2D).

Coronal T2-weighted MR (Figure 2E) of the forefoot shows bone marrow edema proximal and distal of the first metatarsal phalangeal joint (MTP).
**Case 2**

**Patient history**
Synovitis and bone marrow edema; seronegative polyarthritis; possible RA; differential diagnosis of gout or polymyalgia rheumatic. Patient treated with Arcoxia, started on Methotrexate. Physical exam shows pain and swelling of the wrist, MCP 1,2,3 and PIP 3,5. X-ray demonstrates normal hands without erosions.

**MR findings**
Coronal (Figure 3A) and axial (Figure 3B) fat-suppressed, T1-weighted images show synovitis of the radio-ulnar, radiocarpal, intercarpal, and carpo-metacarpal joints with tenosynovitis of the flexor tendons. Several small erosions are observed in the carpal bones. The MCP joints (Figure 3E, Figure 3F) appear normal.

Coronal T1 (Figure 3C) and T2-weighted (Figure 3D) MR images of the forefoot show an erosion in the third proximal phalanx with no other abnormalities.
Johan (Hans) L. Bloem, MD, is a Professor, Director of the Residency Program, and Chairman of the Department of Radiology at Leiden University Medical Center. He is an active member in various professional organizations including ESR, RSNA, ISS, ESSR, ISMRM, ESMRMB, and Erasmus (EMRI). Professor Bloem’s research focus is on musculoskeletal radiology in the areas of oncology and degenerative and inflammatory joint disease. He has received numerous grants, regularly lectures at international meetings, and published 11 books, nine educational audio-visual programs, and 147 scientific articles in the published peer-reviewed literature.

Wouter Stomp, MD, is a researcher in the radiology department at Leiden University Medical Center, pursuing his PhD on the use of MR for the early detection of rheumatoid arthritis. Dr. Stomp earned his medical degree at Rijksuniversiteit Groningen and completed an internship and extracurricular internship in radiology at Deventer Hospital. He also completed a pediatric surgery internship at Wilhelmina Children’s Hospital.

The Leiden University Medical Center (LUMC) is one of eight university medical centers in the Netherlands and employs 7,000 people. Patient care is focused on highly specialized and top-level clinical care, including organ transplants, cardiovascular interventions, and all types of bone marrow transplants. The research conducted in the LUMC is both fundamental and patient- and care-oriented. A considerable portion of the research focuses on the translation from fundamental research to use in patient care. The Department of Radiology has a longstanding tradition in scientific research at the interface of technological innovations and healthcare. The aim is to develop imaging technologies that can be used in patients for diagnostic purposes or as instruments to increase the understanding of diseases.

References:

Case 3

Patient history
Late stage RA, seropositive erosive RA. Patient complained of symptoms for 15 years; X-ray demonstrates extensive destruction of the MCP joints. Patient treated with Methotrexate since September 2010; physical exam shows swelling of MCP 2.

MR findings
Coronal (Figure 4E–H) and axial (Figures 4A–D, Figure 4F) T1-weighted, fat-suppressed MR shows extensive synovitis with joint destruction in the wrist, including the first, second, third, and fifth MCP, and fifth PIP joint.