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Perspective Article

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Structural characterization of rheumatoid arthritis by MRI: Applications in clinical research and in clinical practice

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The recent introduction of effective structure-modifying therapies for rheumatoid arthritis (RA) has changed the way that rheumatologists manage patients, and this has created new demands on imaging both in clinical practice and in clinical research. Among other things, it has shifted therapeutic strategy towards early, intensive treatment before the onset of erosive joint damage in order to prevent irreversible functional disability[1-6]. Additionally, it has made it unethical in clinical research to withhold active therapy and therefore to do placebo-controlled clinical trials. This has necessitated using active comparator study designs instead, which require more patients, more clinical sites and longer studies to test the efficacy of putative new therapies. This adds time and cost to drug development, which slows progress and potentially raises the cost of new therapies that do get approved. Enriching study populations with rapidly progressing patients may offset some of this effect, but this necessitates the availability of prognostic markers that can accurately identify which patients are most likely to develop erosive damage, since as many as one third of the patients in early RA cohorts do not progress. Early prognosticators are also needed by clinical practitioners to determine which patients need intensive treatment before the narrow window of opportunity for containing erosive disease closes. Unfortunately, conventional radiography is not well suited for this, particularly in early disease, so rheumatologists must look to more powerful imaging technologies, such as MRI, to provide additional performance.

MRI is unparalleled in its ability to image arthritic joints. Numerous studies have shown MRI to be several times as sensitive as radiography[7-17] or ultrasound[17] for detecting bone erosions. This advantage of MRI has been demonstrated not only with conventional 1.5T MRI but also with small, low-field (0.2T) MRI systems[17-19], which can image joints at a fraction of the cost[20,21]. Moreover, MRI is able to depict pre-erosive features, such as synovitis and osteitis (also called "marrow edema"), visualize articular cartilage directly, and detect paraarticular abnormalities, such as tendonitis and ligament damage[22]. Recent studies have shown these MRI features to be predictive of future radiographic joint damage as well as long-term functional outcome in patients with early RA[7,9,14,23-25]. Accordingly, MRI is able to identify the aggressively erosive phenotype of RA in early disease, and may offer a valuable tool for early-patient management. While MRI is a relatively expensive procedure, its use in RA may prove cost effective if it can reduce unnecessary treatment of patients with costly biological therapies. As noted above, this may apply to more than 30% of RA patients on initial presentation. Moreover, MRI's greater sensitivity for detecting change in RA may also reduce the time and cost of clinical trials and thereby facilitate the development of new therapies for RA[26,27].

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