A Multicenter Reliability Study of Extremity-Magnetic Resonance Imaging in the Longitudinal Evaluation of Rheumatoid Arthritis

PHILIP G. CONAGHAN, BO EJBJERG, MARISSA LASSERE, PAUL BIRD, CHARLES PETERFY, PAUL EMERY, FIONA McQUEEN, ESPEN HAAVARDSHOLM, PHILIP O'CONNOR, JOHN EDMONDS, HARRY GENANT, and MIKKEL ØSTERGAARD

ABSTRACT. There are limited data on the reliability of extremity magnetic resonance imaging (E-MRI) in the longitudinal evaluation of rheumatoid arthritis (RA). Our aim was to assess the interreader reliability of the OMERACT RA MRI score in the assessment of change in disease activity and bone erosion scores using 0.2 T E-MRI hand and wrist images from 2 timepoints, evaluated by 3 readers at different international centers. The intraclass correlation coefficients and smallest detectable difference results for the change scores were generally good for erosions and synovitis, but were not acceptable for bone edema. Overall, E-MRI demonstrated ability to detect change comparable to that reported for high-field MRI for erosion and synovitis. (J Rheumatol 2007;34:857–8)

Key Indexing Terms:
EXTREMITY MAGNETIC RESONANCE IMAGING RHEUMATOID ARTHRITIS
EROSIONS SYNOVITIS BONE EDEMA RELIABILITY

While high-field magnetic resonance imaging (MRI) is an established tool for proof-of-concept studies in rheumatoid arthritis (RA), limited data exist on the reliability of low-field extremity MRI (E-MRI) in assessing longitudinal change in RA. Only one study has attempted this, using a single reader and evaluating 35 patients with RA and 9 healthy controls and using a 0.2 T E-MRI unit[1]. This study demonstrated that the unilateral wrist and MCP joint evaluation was superior to radiography of bilateral hands and feet in the detection of erosion progression. Our aim, therefore, was to assess the interreader reliability of the OMERACT RA MRI score (RAMRIS)[2] in a longitudinal RA cohort using low-field E-MR images and readers from multiple international centers.

From the Academic Unit of Musculoskeletal Disease, University of Leeds, Leeds, UK; Departments of Rheumatology and Radiology, Copenhagen University Hospitals at Herlev and Hvidovre, Copenhagen, Denmark; Department of Rheumatology, St. George Hospital, University of New South Wales, Sydney, Australia; Synarc Inc., University of California, San Francisco, California, USA; Department of Rheumatology, Auckland University, Auckland, New Zealand; Diakonhjemmet Hospital, University of Oslo, Oslo, Norway; and the Department of Radiology, Chapel Allerton Hospital, Leeds, UK.

Dr. Conaghan, Dr. Ejbjerg, and Dr. Østergaard contributed equally to this work.

P.G. Conaghan, MBBS, PhD, FRACP, FRCP, Professor of Musculoskeletal Medicine, Academic Unit of Musculoskeletal Disease, University of Leeds; B. Ejbjerg, MD, PhD, Senior Registrar, Copenhagen University Hospital at Herlev; M. Lassere, MB, BS, Grad Dip Epi, PhD, FRACP, FAFPHM, Associate Professor in Medicine, Department of Rheumatology, St. George Hospital, University of NSW; P. Bird, BMed (Hons), FRACP, PhD, Grad Dip MRI, Senior Lecturer, University of NSW; C. Peterfy, MD, PhD, Chief Medical Officer, Synarc Inc.; P. Emery, MA, MD, FRCP, ARC Professor in Rheumatology, Academic Unit of Musculoskeletal Disease, University of Leeds; F. McQueen, MD, FRACP, Associate Professor in Rheumatology, Department of Rheumatology, Auckland University; E.A. Haavardsholm, MD, Research Fellow, Diakonhjemmet Hospital, University of Oslo; P. O'Connor, MBBS, MRCP, FRCR, Consultant Skeletal Radiologist, Department of Radiology, Chapel Allerton Hospital; J. Edmonds, MB, BS, MA, FRACP, Director, Professor of Rheumatology, Department of Rheumatology, University of NSW; H. Genant, MD, FACR, FRCR, Professor of Radiology, University of California; M. Østergaard, MD, PhD, DMSc, Professor in Rheumatology/Arthritis, Copenhagen University Hospitals at Herlev and Hvidovre.

Address reprint requests to Dr. P.G. Conaghan, Academic Unit of Musculoskeletal Disease, Chapel Allerton Hospital, Chapeltown Road, Leeds LS7 4SA, United Kingdom. E-mail: p.conaghan@leeds.ac.uk

MATERIALS AND METHODS

MR images of 15 patients with RA, obtained at 2 timepoints, were selected from a Danish followup study[1]. The median age and disease duration of the patients were 60 years (range 35–75) and 5 years (range 1–27), respectively. Median clinical and biochemical values for measures of disease activity and functional status at baseline were: number of swollen joints 5 (0–9) and number of tender joints 7 (0–25), serum C-reactive protein 9 mg/dl (≤ 8–103), Disease Activity Score-28 of 4.8 (1.8–7.1), and Health Assessment Questionnaire score 0.75 (0.0–2.0). Sixty-five percent of the patients had IgM rheumatoid factor. Images from 2 timepoints 12 months apart were selected for the exercise. MRI of unilateral wrists and 2nd-5th MCP joints was performed using a low-field (0.2 Tesla) dedicated E-MRI unit (Artoscan, Esaote Biomedica, Genova, Italy), equipped with a dual phased-array wrist coil. MRI sequences included coronal T1-weighted 3-D gradient-echo sequence with subsequent multiplanar reconstruction, obtained before and after intravenous contrast injection, and a coronal STIR sequence (see Ejbjerg, *et al*[1] for details). All MR images were read, paired for known chronology, using a commercial software package (Merge eFilm™) and assessed for RAMRIS features by 3 experienced readers from different international centers.

Statistical analysis. Single-measure and average-measure intraclass correlation coefficients (ICC) and smallest detectable differences (SDD) were calculated on the change scores. The SDD[3] is derived from the limits of agreement method[4] and here is expressed in the same units of measurement as calculated for all aggregated scores. The SDD is also expressed as a percentage of the highest actual score to permit comparison of the reliability across different MRI methods or scores.

RESULTS

For the purposes of this exercise, scores for the wrist and MCP sites were combined to provide total scores for each of erosions, synovitis, and bone edema. The ICC for the change scores for the 3 readers, and for paired readers, are presented in Table 1. Overall, the erosion and synovitis ICC were very good and close to those for high-field technology, whereas the results for bone edema were poor. The findings for erosion and synovitis were comparable with the average-measure ICC from another study using 3 experienced readers evaluating longitudinal 1.5 T images (where the ICC for erosion, synovitis, and bone edema were 0.97, 0.95, and 0.96, respectively)[5]. Table 2 shows the SDD data, and importantly, the SDD presented as a percentage of the actual maximal score achieved. These percentage SDD data demonstrate acceptable measurement error compared to both previous MRI and radiographic scoring data[6]. Again, the bone edema results demonstrated the highest SDD.

DISCUSSION

This multireader, multicenter low-field MRI scoring exercise has demonstrated high agreement for change scores of damage and synovitis, with agreement comparable to that from previous high-field MRI studies. This was despite no calibration of the 3 readers involved, although all 3 were conversant with the European League Against Rheumatism-OMERACT scoring atlas. There was, however, poor agreement on the change scores for bone marrow edema. It is worth noting that caution must be applied in generalizing this information to all E-MRI machines, which differ substantially in their image quality and in their ability to perform adequate STIR sequences that are required to identify bone edema. Our findings support the use of low-field MRI for use in clinical trials with erosion and synovitis as endpoints.

Table 1. Intraclass correlation coefficient (ICC) results for the 3 readers. Values are single measure ICC.

	Bone Erosion	Synovitis	Bone Edema
ICC*	0.91	0.89	0.24
ICC — readers 1,2,3	0.78	0.72	0.09
ICC — readers 1,2	0.85	0.72	0.04
ICC — readers 1,3	0.70	0.60	0.09
ICC — readers 2,3	0.76	0.80	0.32

* Average measure ICC.

Table 2. Smallest detectable difference (SDD) results for change scores for the 3 readers.

	Readers	Average Difference	SDD	% SDD of Actual Max
Bone erosion	1,2	1.2	5.4	5
	1,3	1.9	6.3	6
	2,3	0.4	7.0	7
Synovitis	1,2	–2.1	5.3	27
	1,3	–1.2	6.9	34
	2,3	0.5	4.4	23
Bone edema	1,2	–1.4	14.3	48
	1,3	–1.2	16.1	54
	2,3	0.2	6.3	21

% SDD of actual max, SDD as a percentage of the actual maximum score obtained.

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