MRI Protocol for the Assessment of Juvenile Idiopathic Arthritis of the Wrist: Recommendations from the OMERACT MRI in JIA Working Group and Health-e-Child

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J Rheumatol 2016;43;1257-1258
http://www.jrheum.org/content/43/6/1257

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To the Editor:

Magnetic resonance imaging (MRI) is the only imaging tool that allows us to assess all relevant structures in juvenile idiopathic arthritis (JIA): the synovium, cartilage, bone, ligaments, and tendon sheaths. The interpretation of the MRI of the wrist in patients with JIA is challenging because of the complex anatomy and the presence of normal variants mimicking pathology[1,2]. There is a need for a consensus of MRI interpretation in children with JIA and a universal protocol for MRI acquisition, which can enable uniformity of identification of all involved structures.

From 2012 onward, an international collaborative network of clinical and radiological experts on imaging in JIA has set out to standardize the challenging MRI acquisition and interpretation of JIA disease activity at the wrist[3]. For this purpose, experts from the Outcome Measures in Rheumatoid Arthritis Clinical Trials (OMERACT) Working Group "MRI in JIA" and the Health-e-Child Radiology group have joined forces and met twice a year[4]. The group addressed the MRI acquisition and made recommendations on a core set of mandatory protocol settings (Table 1). In Table 2, general optional requisites for an MRI of the wrist are reported. Agreement on the MRI protocol was reached through previous research and plenary group discussions. Consensus-based recommendations on MRI acquisition protocols should facilitate comparison of MRI studies conducted in different centers across the world.

One of the major differences in our suggested protocol compared to the core set of MRI sequences suggested by OMERACT for rheumatoid arthritis is the cartilage-specific sequence[5]. Because cartilage represents the main target of the destructive process in JIA, cartilage-specific sequences should be included in the MRI protocol for a more accurate and comprehensive evaluation of structural damage. Further, cartilage-specific MRI sequences may help us discriminate normal, growth-related bony depressions from pathologic bone erosions[6]. Examples of suitable cartilage-specific sequences are proton density sequences and gradient echo sequences with water-selective excitation specific for cartilage (WATSc)[7]. Together with the Dixon sequence, the WATSc is a newer MRI technique that uses chemical shift for differentiation between water and fat. Whereas Dixon calculates the difference between water and fat based on carefully chosen image acquisition timepoints, WATSc creates a different signal for water and fat by another radiofrequency pulse to selectively excite the water. Dixon is considered very promising and superior to other fat-suppression (FS) techniques in musculoskeletal imaging, especially in children and for complex anatomy because of the high signal-to-noise ratio and homo-

Table 1. Recommendations for sequences for evaluation of wrist joint pathology in JIA.

Sequence	Goal	Plane	Time
Cartilage-specific	Cartilage coverage of bony depressions.	At least coronal, multiplanar reconstruction might be helpful.	5 min
T2 FS or STIR, T2 TSE Dixon sequence is suggested	BME-like changes, joint effusion.	At least coronal for BME-like change pattern. Axial for fluid around tendons optional.	3–4 min per plane
T1 TSE, Dixon sequence is suggested	Anatomy and extent/ severity of BME-like pattern.	At least coronal, axial is optional.	3–4 min per plane
Postcontrast T1 TSE FS, Dixon sequence is suggested. Identical T1 FS precontrast and postcontrast administration are required*.	Synovial enhancement, overall grade of inflammation and tenosynovitis.	Coronal and axial plane required.	3–4 min per plane

* GRE can be considered as alternative to a TSE sequence, while 3-D GRE facilitates multiplanar reconstruction and evaluation. JIA: juvenile idiopathic arthritis; FS: fat suppression; STIR: short-tau inversion recovery; TSE: turbo spin echo; BME: bone marrow edema; GRE: gradient echo.

Table 2. General requisites and recommendations for an MRI wrist protocol in patients with JIA.

Requisites, Obligatory	Recommendations, Optional
Field of view: From distal radioulnar joint and including all carpometacarpal joints	Perform the longest or clinically most important sequence first
Precontrast and postcontrast fat-suppressed sequences in the same plane	Dedicated wrist coil
Scanning time as short as possible because of movement artefacts and patient comfort	Apply venous access prior to MRI suite depending on patient preference
One wrist per session	3T if available
Highest possible voxel resolution within acceptable scan time, i.e., 30 mins	
Neutral position of the wrist joint, no ulnar or radial deviation, with third finger in the longitudinal axis of the forearm	

MRI: magnetic resonance imaging; JIA: juvenile idiopathic arthritis.

geneous FS — this perfectly applies for the patient with JIA with wrist involvement[8]. The Dixon FS technique is also time-saving because both T1 turbo spin echo (TSE) without FS, used to assess bone marrow, and T1 TSE with FS, used to compare postcontrast images, are gained in 1 acquisition. If the Dixon FS technique is not used, identical precontrast and postcontrast T1 FS sequences must be obtained for comparison of findings.

To date, the administration of intravenous gadolinium is necessary for proper appreciation of the inflamed synovium[9]. Preliminary results for research on diffusion-weighted imaging in patients with JIA raise the suggestion that next to intravenous contrast, this technique could also be valuable in differentiating inflamed synovium for joint effusion[10].

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ACKNOWLEDGMENT

The authors thank the members of the OMERACT Working Group "MRI in JIA" and the members of the Health-e-Child Radiology group who have made important contributions to this letter: Derk F.M. Avenarius (Norway), Robert Hemke (the Netherlands), Lil-Sofie Ording Müller (Norway), Marion A.J. van Rossum (the Netherlands), Clara Malattia (Italy), and Andrea S. Doria (Canada).

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J Rheumatol 2016;43:6; doi:10.3899/jrheum.160094