

**Combination of magnetic resonance imaging-detected bone marrow edema with
2010 rheumatoid arthritis classification criteria improves the diagnostic probability
of early rheumatoid arthritis**

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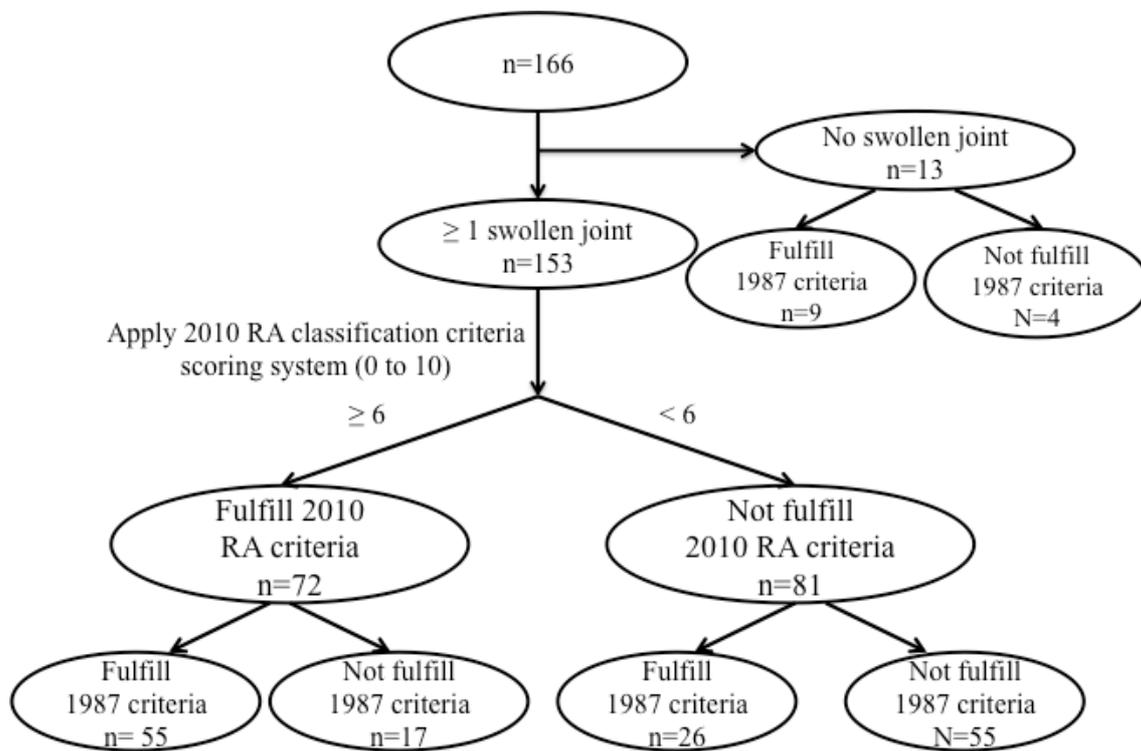
Efficient methods for distinguishing rheumatoid arthritis (RA) at an earlier phase from other diseases are strongly desired since early therapeutic intervention improves clinical and radiographic outcomes of RA (1–4). The clinical 2010 RA classification criteria was established based upon the consensus that RA is an inflammatory disease that develops persistent and/or erosive arthritis (2, 3). Our series of studies as well as the article describing European League Against Rheumatism (EULAR) recommendations for the use of imaging for the clinical management of RA mention that magnetic resonance imaging (MRI) can be used to improve the certainty of a diagnosis of RA above clinical criteria (5, 6). The present study was undertaken to investigate whether MRI findings of wrist and finger joints improves the diagnostic performance of 2010 RA classification criteria. One hundred sixty-six early arthritis patients, who do not fulfill the 1987 RA criteria or other international criteria for rheumatic disease at entry with disease duration less than 6 months (median disease duration at entry was 2 months), were consecutively enrolled from Nagasaki Early Arthritis Cohort at our institution as previously described (6). A total 166 patients are enrolled and includes 13 patients without obvious swollen joints and 2 patients with typical plain radiographic erosion.

Each patient provided a signed consent form to participate in the study, which was approved by the Institutional Review Board of Nagasaki University.

All of the subjects underwent physical examination, blood tests and gadolinium diethylenetriamine pentaacetic acid-enhanced MRI (1.5T system, Sigma, GE Medical Systems, Milwaukee, WI, USA) of both wrist and finger joints on the same day as described previously (6-8). Reference standard RA of present study was considered as reported previously (9, 10) by the following 2 definitions: patients disease-modifying antirheumatic drugs (DMARDs) introduced within the first 1 year or those who fulfill the 1987 RA criteria at 1 year (Table 1). Figure 1 showed the classification of patients by 2010 RA classification criteria at entry or 1987 RA criteria at 1 year. We investigated the diagnostic performance of 2010 RA criteria with or without the finding of MRI-detected pathology. 2010 RA classification criteria classified RA with sensitivity of 61.9%, specificity of 82.6%, positive predictive value (PPV) of 83.3%, negative predictive value (NPV) of 60.6%, and accuracy of 70.5% if reference standard RA is considered as patients DMARDs introduced within the first 1 year (Table 1). The results were similar if RA is considered as the patients who fulfill the 1987 RA criteria at 1 year

(Table 1). As compared with symmetrical synovitis and bone erosion, bone marrow edema was the most useful MRI finding since the PPV of bone marrow edema (84.9%) was higher than symmetrical synovitis (72.0%) or bone erosion (81.0%) in the reference standard RA patients (DMARDs introduced within the first 1 year). The results were similar if RA is considered as the patients who fulfill the 1987 RA criteria at 1 year (data not shown). We used a decision-tree algorithm that involves initially applying 2010 RA classification criteria, and if the patient does not fulfill these criteria, the MRI-detected bone marrow edema rule is introduced. The tree algorithm has been shown to differentiate patients more efficiently than the 2010 RA classification criteria alone, exhibiting better sensitivity, NPV and accuracy for the classification of reference standard RA (Table 1). The present findings are the first evidence that the diagnostic probability of early RA using the 2010 RA classification criteria is improved by combining these criteria with MRI-detected bone marrow edema of the wrist and finger joints. Our study may strengthen the statements of EULAR recommendations for the use of imaging.

Figure 1. Classification of the patients at entry by 2010 RA classification criteria or at 1 year by 1987 RA criteria.



2010 RA classification criteria or 1987 RA criteria was applied toward 166 patients. The former was applied at entry whereas the latter at 1 year, respectively.

Table 1. Classification of the 166 early arthritis patients as reference standard RA by 2010 RA classification criteria or combination of 2010 RA classification criteria with MRI features

	Sensitivity %	Specificity %	PPV %	NPV %	Accuracy %
<u>Reference standard RA1*</u>					
2010 RA classification criteria	61.9	82.6	83.3	60.6	70.5
Add on MRI symmetrical synovitis	92.8	43.5	69.8	81.1	72.3
Add on MRI bone marrow edema	76.3	75.4	81.3	69.3	75.9
Add on MRI erosion	72.2	73.9	79.5	65.4	72.9
<u>Reference standard RA2**</u>					
2010 RA classification criteria	61.1	77.6	76.4	62.8	68.7
Add on MRI symmetrical synovitis	95.6	36.8	64.2	87.5	68.7
Add on MRI bone marrow edema	75.6	69.7	74.7	70.7	72.9
Add on MRI erosion	71.1	68.4	72.7	66.7	69.9

The definition of synovitis, bone marrow edema and bone erosion by MRI is made according to The Outcome Measures in Rheumatology (OMERACT) Rheumatoid Arthritis Magnetic Resonance Imaging Studies (RAMRIS). We have defined the patients as reference standard RA by the 2 methods in the present study.

Reference standard RA1* = patients introduced by any DMARDs within the first 1 year

Reference standard RA2** = patients fulfill the 1987 RA criteria at 1 year

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