

7 Tesla, high resolution Dixon imaging of the SI joints in patients with Ankylosing Spondylitis

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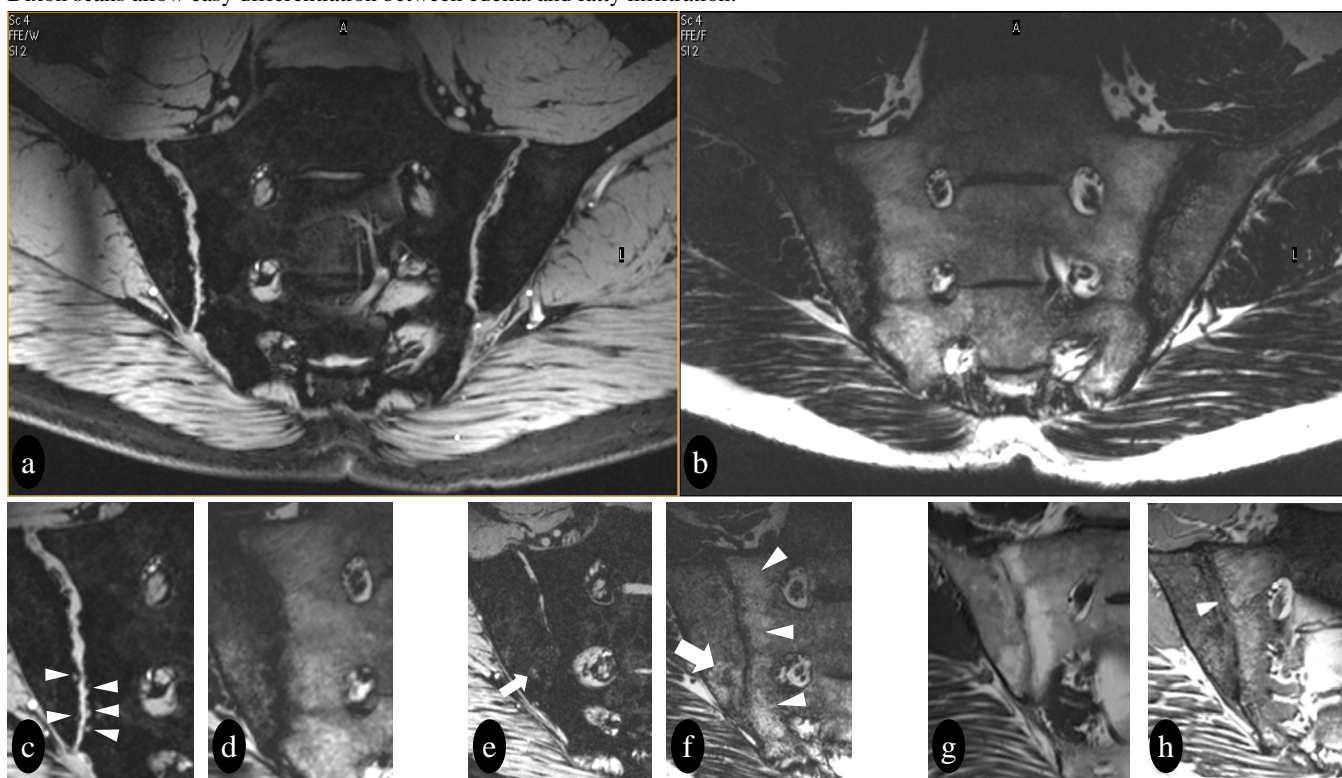
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Target audience. Clinicians and researchers involved in high field musculoskeletal imaging.

Purpose. MRI of the SI joints is used in the OMERACT (Outcome Measures in Rheumatology) to diagnose early spondylo-arthritis (SpA). Early detection of disease is of increasing interest since new effective medication has become available. The purpose of this study is to determine the utility of high resolution 7 Tesla scanning for patients with ankylosing spondylitis in different stages of pathology progression.

Methods Fifteen patients with early- to late-stage ankylosing spondylitis were imaged on a whole body 7T system (Philips Achieva) with subjects positioned feet first in supine position. All studies were approved by the local medical ethics committee. A quadrature transmit surface coil positioned posteriorly was used to acquire coronal-oblique images with the imaging plane parallel to the SI joint. The coil consisted of two overlapping loops, each of diameter 21.5 cm, with eight capacitive segmentations of 2.7 pF each. One variable tuning capacitor per loop was used, with a standard pi-matching network with 1-30 pF variable capacitor. A multiple slice two-dimensional gradient echo sequence was used: TR/TE 20/7.7 ms, field-of-view 360 x 314 mm, in-plane resolution 0.7 x 0.7 mm, 3 mm slice thickness, 0.3 mm interslice gap, 2 signal averages, 11 slices and a total data acquisition time ~6 minutes. The spatial resolution is significantly increased compared to standard clinical scans on the 3T system (1 x 1.2 x 4 mm). Several fat suppression techniques were explored. Due to specific absorption rate (SAR) limitations, a three-point Dixon method with a delta TE of 0.33 ms was chosen.

Results The figure shows results from three different patients, one each from early-, mid- and late-stage disease. Water and fat images from the Dixon scans allow easy differentiation between edema and fatty infiltration.



(a) Water-only image and (b) fat-only image from a three-point Dixon sequence of the entire SI joint. (c) and (d) water and fat images of early stage disease showing very small erosions. (e) and (f) Mid-stage disease showing a fatty lesion (large arrow) with small central core of possible edema. (g) and (h) Comparison of 3T and 7T images of late-stage disease, showing much greater detail around the (closed) SI joint.

Discussion Inflammation of the sacroiliac (SI) joints is one of the earliest hallmarks in patients with ankylosing spondylitis, a chronic rheumatologic inflammatory disorder belonging to the spondyloarthritis (SpA) group [1]. Recently, sacroiliitis on MRI has been included in new classification criteria for axial SpA [2]. In grading sacroiliitis using MR, a differentiation is made between inflammatory changes such as bone marrow edema versus structural changes such as erosions, sclerosis, fatty deposition and ankylosis. However, the distinction between structural changes is difficult at lower field strengths [3]. In this work, we demonstrate that high spatial resolution imaging of the SI joints can be achieved with excellent delineation of the whole SI joint using a 7 T scanner and custom-built RF coils.

Conclusion. 7 Tesla MRI is a promising adjunct imaging modality in following the progression of ankylosing spondylitis. Further improvements in transmit array capability should lead to further improvements in spatial resolution.

References [1] J.Sieper et al. *Ann Rheum Dis*, 68, 1-44, 2009. [2] M.Rudwaleit et al. *Ann Rheum Dis*, 68, 777-83, 2009. [3] M.Ostergaard et al. *Best Pract Res Clin Rheumatol*, 24, 637-57, 2010.