Clinical Radiology 74 (2019) 409.e1–409.e6

Contents lists available at ScienceDirect

Clinical Radiology

journal homepage: www.clinicalradiologyonline.net

Do we need to perform MRI of the whole spine in addition to MRI of the sacroiliac joints in suspected spondyloarthropathy?

J. Naqvi [a,*], O. Abdulla [a], S. Shamshuddin [a], M. Bukhari [b], R. Proctor [a,*]

[a] Department of Radiology, University Hospitals of Morecambe Bay NHS Trust, Royal Lancaster Infirmary, Ashton Road, Lancaster, LA1 4RP, UK

[b] Department of Rheumatology, University Hospitals of Morecambe Bay NHS Trust, Royal Lancaster Infirmary, Ashton Road, Lancaster, LA1 4RP, UK

ARTICLE INFORMATION

Article history:
Received 9 August 2018
Accepted 15 January 2019

AIM: To identify the incidence of spinal-only changes (including both acute inflammatory and chronic structural changes) in patients with suspected spondyloarthropathy (SpA) to determine whether MRI of the sacroiliac joints would be sufficient in the initial radiological work-up and whether the number of spinal magnetic resonance imaging (MRI) examinations performed could be reduced.

MATERIALS AND METHODS: This was a retrospective study of patients with suspected SpA referred from the rheumatology department of a university teaching hospital undergoing MRI both of the whole spine and of the sacroiliac joints over a 3-year period. Imaging was assessed for the presence of acute inflammatory and chronic structural changes.

RESULTS: Three hundred and sixty-five patients with suspected SpA undergoing both whole spine and sacroiliac joint MRI were identified. The majority (79.2%) had no spinal or sacroiliac joint inflammation. Spinal-only changes (acute inflammatory and/or chronic structural) were detected in only 0.8% (3/365) of cases. The majority of positive spinal cases had inflammatory changes involving the thoracic spine (21/24). The majority of positive sacroiliac joint cases were bilateral (51/73).

CONCLUSION: The extremely low incidence of spinal-only inflammatory or structural change indicates that sacroiliac joint MRI may be sufficient for initial radiological work-up of SpA with spinal MRI reserved for instances where there is spinal symptomatology and uncertainty in the clinical diagnosis following interdisciplinary discussion or where a baseline is required.

Introduction

The National Institute for Health and Clinical Excellence (NICE) published guidance in 2017 on the diagnosis and management of spondyloarthropathy (SpA).[1] A pathway was proposed for imaging patients with suspected SpA,

* Guarantor and correspondent: J. Naqvi. Tel.: +44 01524 516281 / ext 46281.
E-mail address: naqvi.jawad@gmail.com (J. Naqvi).

https://doi.org/10.1016/j.crad.2019.01.008
0009-9260/

which includes initial sacroiliac (SI) joint radiography followed by magnetic resonance imaging (MRI) of the sacroiliac joints and whole spine if the initial radiograph is negative.

Peri-articular osteitis, detected as high signal on short tau inversion recovery (STIR) imaging around the sacroiliac joints on MRI, can facilitate earlier diagnosis of SpA and is included as part of the Assessment of Spondyloarthritis International Society (ASAS) classification criteria for SpA.[2,3]

Although not included in the ASAS classification criteria, MRI-detected spinal inflammatory changes have been described as an important element in the management of suspected SpA, which can assist in the diagnosis and monitoring of treatment response.[4] The utility of spinal MRI is, however, debatable as recent studies have shown that the additive value of spinal MRI to sacroiliac joint MRI in the diagnosis of suspected SpA is poor.[5,6]

The aim of the present was to identify the incidence of spinal only changes (including both acute inflammatory and chronic structural changes) in patients with suspected SpA. This was part of a service evaluation to determine whether MRI of the sacroiliac joints would be sufficient in the initial radiological work-up and whether the number of spinal MRI examinations performed could be reduced.

Materials and methods

This was a retrospective, observational study of consecutive patients who underwent both sacroiliac joint and whole-spine MRI over a 3-year period from 1 January 2014 through to 31 December 2016. Local institutional approval for the study was granted.

Patients were identified through the local radiology information system. Only those patients referred from the Rheumatology Department with clinically suspected inflammatory SpA were included in the final analysis. Imaging requests relating to other suspected clinical entities, such as demyelination, were excluded from the analysis.

The departmental MRI protocol for suspected SpA includes sacroiliac joint coronal oblique STIR (3,800 ms repetition time/41 ms echo time) and coronal oblique T1 (286 ms TR/9.6 ms TE) sequences with 4 mm section thickness and whole-spine sagittal T1 (710 ms TR/11 ms TE), sagittal T2 (2,000 ms TR/93 ms TE), sagittal STIR (4,000 ms TR/36 ms TE) sequences with 3 mm section thickness and thoracic spine coronal STIR (4,100 ms TR/42 ms TE) sequence with 4 mm section thickness to visualise the costovertebral and costotransverse joints. Imaging was undertaken using 1.5 T MRI systems.

The MRI investigations had been initially reported by various observers who were all consultant radiologists and Fellows of the Royal College of Radiologists (FRCR). In the retrospective analysis, each of the sacroiliac joint and whole-spine MRI investigations was subsequently recorded as positive or negative. The features used to identify a positive result are listed in Table 1. If any of the features were identified, which included either acute inflammatory or chronic structural changes, the study was deemed positive. A strict definition as to the number of bone marrow oedema or fatty corner lesions to define a positive spine was not used and was left to the discretion of the reporting radiologist as what they judged to be non-specific versus inflammatory.

Table 1
Individual features used to identify a positive magnetic resonance imaging (MRI) spine or sacroiliac joints for inflammatory spondylo-arthropathy based on Sieper *et al.*[2] and Hermann *et al.*[13]

	MRI spine	MRI sacroiliac joints
Acute	Bone marrow oedema at vertebral body corners Facet joint inflammatory change Costotransverse or costovertebral joint oedema Enthesitis (supraspinous or interspinous ligament oedema)	Peri-articular oedema
Chronic	Fatty or sclerotic vertebral body corner lesions Syndesmophytes Ankylosis	Peri-articular erosions Peri-articular fatty infiltration Peri-articular sclerosis Ankylosis

Results

Three hundred and sixty-five patients were identified that underwent both sacroiliac joint and whole-spine MRI over the specified 3-year period. This included 15 patients who had been imaged on two occasions. The mean patient age was 43 years with range of 14–85 years and 231 (63%) of cases were female.

The majority of patients (79.2%; 289/365) had a normal MRI of the sacroiliac joints and whole spine (Table 2). The incidence of spinal only inflammatory changes (both acute inflammatory and chronic structural changes) was only 0.8% (3/365). Images from these three cases are provided in Figs 1–3. The majority of spinal changes were located in the thoracic spine and the majority of positive sacroiliac joint cases were bilateral (Table 3). Examples of the acute and chronic changes of sacroiliitis seen in this cohort of patients are provided in Figs 4–6.

Discussion

The added role of spinal MRI in the diagnosis of suspected SpA is not clear[7,8] and few studies have been

Table 2
The subdivision of positive and negative cases for sacroiliac joint and whole spine magnetic resonance imaging (MRI).

	MRI of the sacroiliac joints		Total
Whole-spine MRI	Positive	Negative	
Positive	21 (5.8)	3 (0.8)	24
Negative	52 (14.2)	289 (79.2)	341
Total	73	292	365

Data are number of cases and percentage in parentheses.

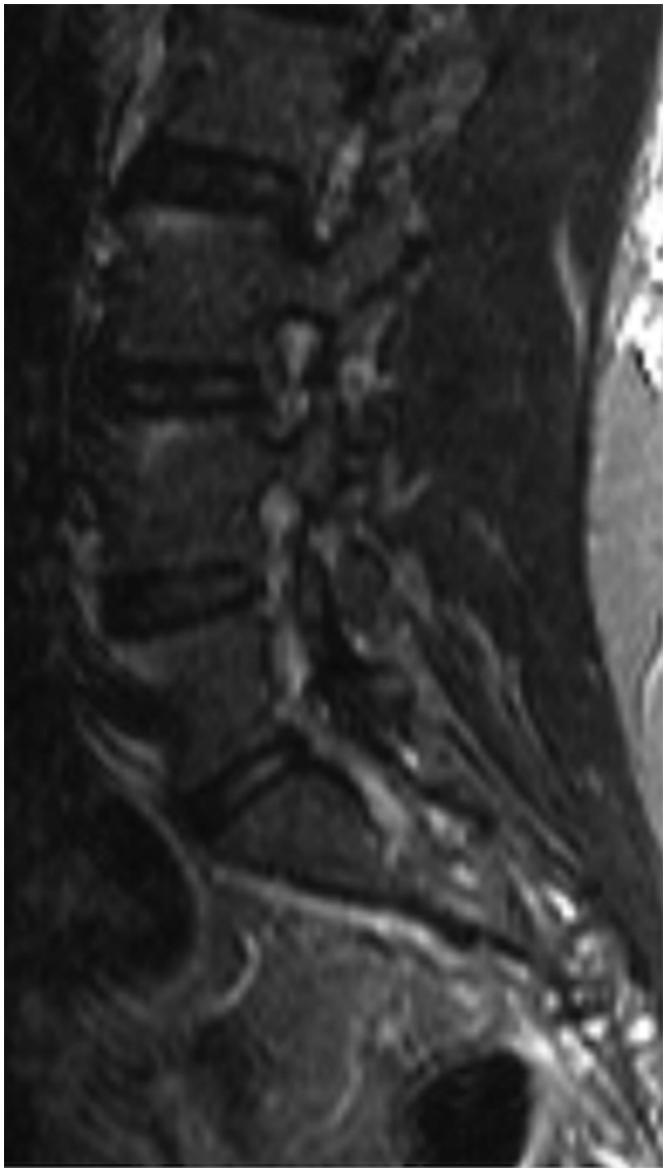

Figure 1 Sagittal STIR image in a 45-year-old female patient referred with back pain and alternating buttock pain to evaluate for seronegative SpA. Imaging demonstrates very subtle foci of oedema at the anterior superior margins of the L3, L4, and L5 vertebral bodies. The sacroiliac joints were normal (not shown).

Figure 2 Sagittal STIR image in a 31-year-old female patient referred with possible SpA. Imaging demonstrates endplate anterior corner signal changes from T7-9 suggestive of osteitis. The sacroiliac joints were normal (not shown).

performed in this regard.[5,6] The present study evaluated the incidence of acute inflammatory and chronic structural changes on whole-spine and sacroiliac joint MRI in patients with suspected SpA, to guide consideration of whether sacroiliac joint MRI alone is sufficient in the initial imaging work-up. A very low incidence of spinal-only positive cases was found (0.82%, n=365).

In ankylosing spondylitis (AS), it is understood that inflammation commences in the sacroiliac joints and ascends to the spine in most patients.[2,9] Theoretically, this would justify the use of sacroiliac joint MRI alone in the diagnostic work-up of suspected SpA; however, several authors have identified significant numbers of patients with spinal-only inflammatory changes, supporting the view for performing whole-spine MRI as part of initial imaging work-up.[3,4,10]

In the original studies used to develop the ASAS classification criteria, Rudwaleit *et al.* demonstrated that of 235 patients undergoing whole-spine and sacroiliac joint MRI, 5.4% of patients with a clinical diagnosis of axial SpA had spinal-only inflammatory change (3). In 2007 Rudwaleit *et al.* described higher incidence of 23% of spinal-only inflammatory in patients with AS (10). The significantly higher incidence of spinal-only MRI changes in these two studies compared to the present findings may be related to the difference in patient selection for imaging. The present cohort comprised patients undergoing MRI to assist in the

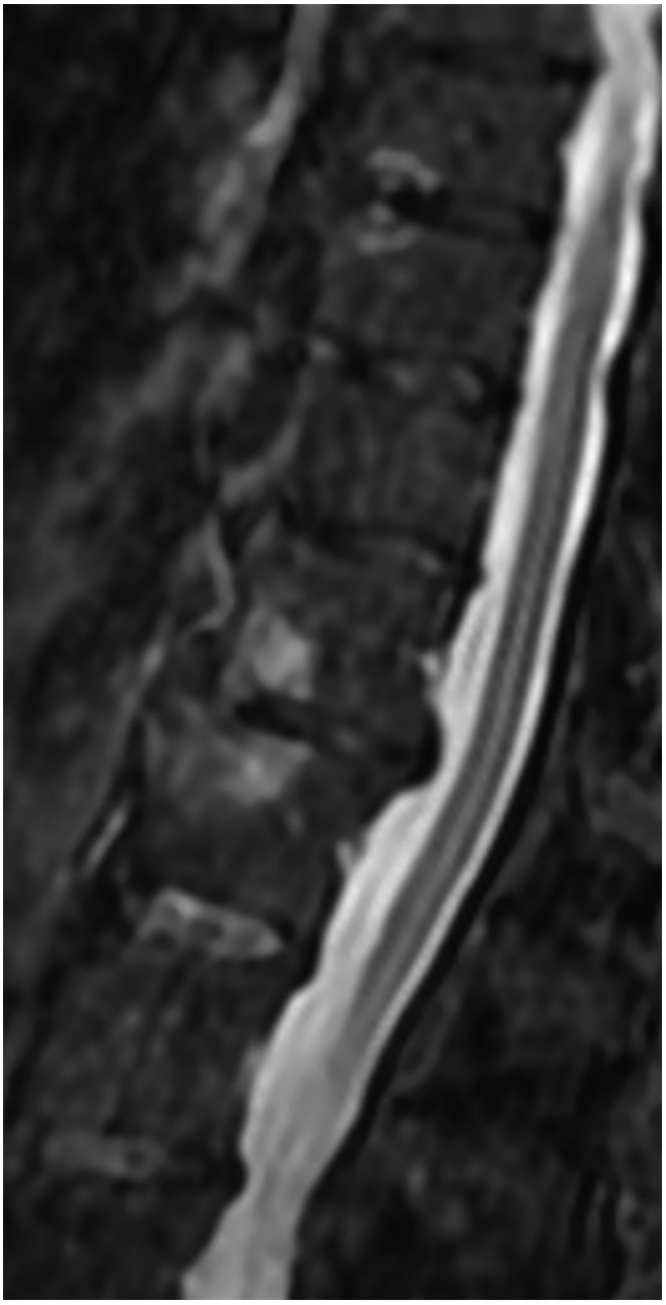

Figure 3 Sagittal STIR image in a 65-year-old female patient referred as seronegative inflammatory arthritis and back pain. Imaging demonstrates oedema within the anterior corners of the T9/10 endplates and also to a greater extent the T12/L1 end plates. There are background multilevel disc space degenerative changes. The sacroiliac joints were normal (not shown).

diagnosis of SpA and not all would have fulfilled the clinical arm of the ASAS classification criteria, whereas the patients in these two studies had a diagnosis of SpA or AS prior to imaging.

Two studies evaluating the added value of spinal MRI (in addition to sacroiliac joint MRI) in the diagnosis of SpA have revealed little added benefit.[5,6] Zaitouni *et al.* examined two large cohorts of patients referred from rheumatology with suspected SpA and defined a positive spine as five or more

Table 3
Distribution of magnetic resonance imaging (MRI) spinal and sacroiliac joint changes.

MRI study	No. of positive cases
Spinal MRI	
Cervical only	0
Thoracic only	12
Lumbar only	3
Cervicothoracic	1
Thoracolumbar	7
Whole spine	1
Total	24
Sacroiliac joint MRI	Total
Unilateral	22
Bilateral	51
Total	73

corner bone marrow oedema lesions.[6] They demonstrated that most patients in the two cohorts with chronic lower back pain had normal whole-spine and sacroiliac joint MRI (82% and 58%) and very few patients had spinal-only inflammation (0.55% and 1.23%). These results are very similar to the present findings in which a similar cohort of patients was examined and normal whole-spine and sacroiliac joint MRI studies were demonstrated in 79.2% and spinal-only inflammation in 0.82%. The additional diagnostic yield with combined sacroiliac joint and spinal MRI versus sacroiliac joint MRI alone was very low in the study by Zaitouni *et al.* as the majority of patients with spinal-only inflammatory change already fulfilled the clinical ASAS criteria for SpA.

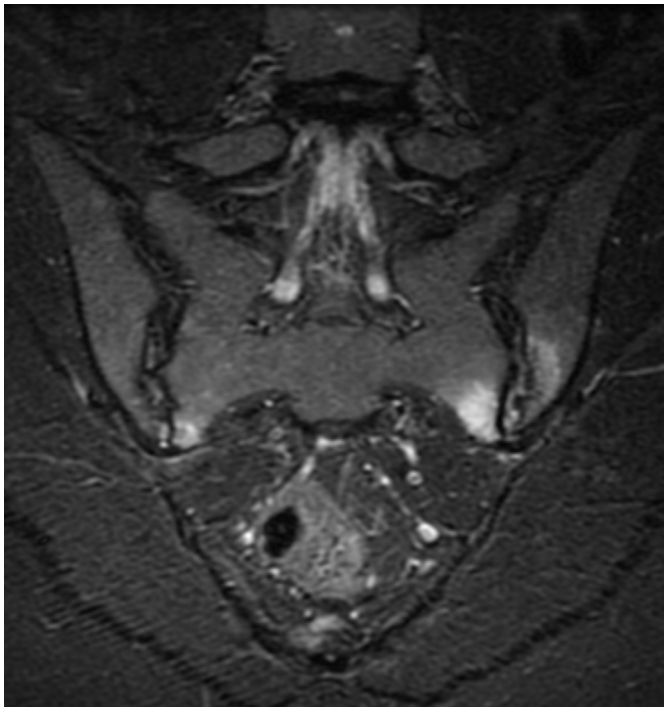

Figure 4 Coronal oblique STIR image of the sacroiliac joints in a 25-year-old female patient. Bilateral peri-articular bone marrow oedema is worse at the left inferior sacroiliac joint consistent with acute sacroiliitis.

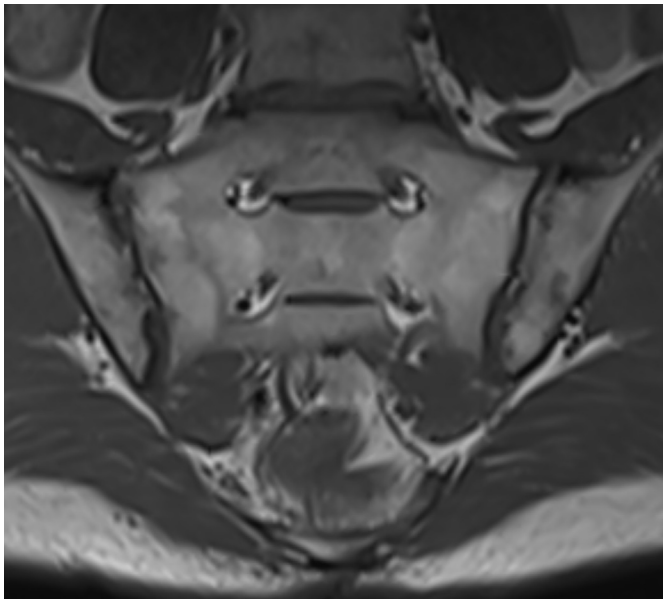

Figure 5 Coronal oblique T1 image of the sacroiliac joints in a 32-year-old man. Bilateral peri-articular fatty infiltration with irregularity of the articular margins in keeping with erosive change is noted.

Similar to the present study, Weber *et al.* examined the incidence of both acute and chronic lesions and their value in the diagnosis of SpA.[5] They demonstrated a 20% incidence of one or more spinal inflammatory lesion with normal sacroiliac joints in patients with lower back pain, a 45% incidence one or more spinal inflammatory lesion with normal sacroiliac joints in healthy controls and a high incidence (approximately 80%) of one or more spinal acute inflammatory or chronic structural lesion in patients with NSBP and healthy controls. Only one patient, however, with low back pain and one or more spinal inflammatory lesion with normal sacroiliac joints was diagnosed with SpA; the rest having non-specific back pain (NSBP). Although Weber et al. identified a significantly higher incidence of spinal-only MRI changes compared to our study findings, most of the patients in their study were not subsequently diagnosed with SpA.[5] This suggests that the observed radiological changes at the vertebral corners were non-specific and not conclusive for SpA. Additionally in their analysis of combined spine and sacroiliac joint MRI versus sacroiliac joint MRI alone, a further 20% of patients with SpA were diagnosed but this also lead to misclassification of significant numbers of patients clinically diagnosed as NSBP and healthy controls as SpA. Overall, this highlights the non-specificity of bone marrow oedema and fatty infiltration at vertebral corners and indeed previous studies have shown the significant overlap in appearances of degenerative disc disease and SpA.[11,12] In the present study, the reporting radiologist may have neglected minor signal changes unlikely to represent SpA or those changes more likely to represent degenerative disc disease. They may also have used a higher threshold for the number of lesions to qualify for a positive MRI spine, thus leading to an overall lower incidence of cases where only the spinal MRI was positive (with normal MRI of the SI joints).

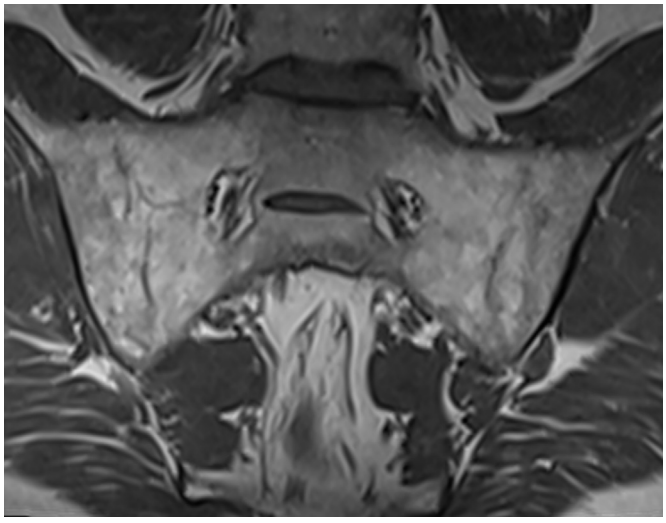

Figure 6 Coronal oblique T1 image of the sacroiliac joints in a 50-year-old man. Bilateral sacroiliac joint ankylosis with obliteration of the joint space and surrounding fatty signal change.

The ASAS currently recommends clinical scoring via BASDAI and expert opinion (usually rheumatology opinion synthesising clinical, biochemical and imaging data) to assess eligibility for and monitoring response to anti-TNF treatment.[2] It could be argued that given the low yield of positive MRI spine without sacroiliac joint changes, as shown by the present data and several other studies, sacroiliac joint MRI should be sufficient to guide the rheumatologist as to the appropriateness of commencing anti-tumour necrosis factor (TNF) therapy; and MRI spine could be reserved for instances where there are equivocal clinical features with spinal symptomatology or definitive need for a baseline.

The strengths of the present study are the large sample (n=365) collected over a 3-year period from referrals from a rheumatology department in which patients have already undergone evaluation for suspected SpA. The criteria for a positive MRI spine are also more inclusive than previous studies, which evaluated acute inflammatory changes only, whereas the present study also included chronic changes. The study is intended as an evaluation of imaging and thus the imaging data have not been correlated with clinical features, such as BASDAI, HLA B27, C-reactive protein (CRP), and the final clinical diagnosis; therefore, the sensitivity and specificity of the imaging data cannot be evaluated. Further prospective studies are warranted to correlate imaging data with clinical features and to confirm the appropriateness of limiting initial MRI to assessing the sacroiliac joints alone. A potential weakness of the present broader definition of positive findings is that the three patients determined as having spinal-only changes may be an overestimate as such changes are known to overlap with degenerative spinal changes and also occur in the normal population.[5]

In conclusion, the present study demonstrated that the yield of spinal MRI for acute inflammatory and chronic structural change in suspected SpA is low. The expense and time required to perform and report such examinations

routinely is considerable, and probably outweighs the small diagnostic yield. The suggested approach to the initial radiological work-up of patients with SpA is MRI of the sacroiliac joints, with MRI of the whole spine reserved for situations where there is spinal symptomatology and there remains uncertainty in clinical diagnosis following interdisciplinary discussion or where there is definitive need for a baseline.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

The authors thank Paul Tickner, Assistant Clinical Librarian, and Marco Massarotti, Consultant Rheumatologist, University Hospitals of Morecambe Bay NHS Foundation Trust for assistance with the literature search. Unrelated to this study, M.B. has been sponsored to attend regional, national and international meetings by UCB celltech, Roche/Chugai, Pfizer, Abbvie, Merck, Mennarini, Janssen, Bristol-Myers Squib, Novartis and Eli-lilly He has received honoraria for speaking and attended advisory boards with Bristol-Myers Squib, UCB celltech, Roche/Chugai, Pfizer, Abbvie, Merck, Mennarini, Sanofi-aventis, Eli-Lilly, Janssen and Novartis.

References

1. National Institute for Health and Care Excellence (UK). *Spondyloarthritis in over 16s: diagnosis and management*. London: National Institute for Health and Care Excellence (UK); 2017 Feb.
2. Sieper J, Rudwaleit M, Baraliakos X, *et al*. The Assessment of SpondyloArthritis international Society (ASAS) handbook: a guide to assess spondyloarthritis. *Ann Rheum Dis* 2009 May 11;**68**(Suppl. 2):ii1–44.
3. Rudwaleit M, van der Heijde D, Landewe R, *et al*. The development of Assessment of SpondyloArthritis international Society classification criteria for axial spondyloarthritis (part II): validation and final selection. *Ann Rheum Dis* 2009 May 12;**68**(6):777–83.
4. Bennett AN, Marzo-Ortega H, Rehman A, *et al*. On behalf of the Leeds Spondyloarthropathy Group. The evidence for whole-spine MRI in the assessment of axial spondyloarthropathy. *Rheumatology* 2010 Feb 11;**49**(3):426–32.
5. Weber U, Zubler V, Zhao Z, *et al*. Does spinal MRI add incremental diagnostic value to MRI of the sacroiliac joints alone in patients with non-radiographic axial spondyloarthritis? *Ann Rheum Dis* 2015 May 5;**74**(6):1–9.
6. Ez-Zaitouni Z, Bakker PA, van Lunteren M, *et al*. The yield of a positive MRI of the spine as imaging criterion in the ASAS classification criteria for axial spondyloarthritis: results from the SPACE and DESIR cohorts. *Ann Rheum Dis* 2017 Oct;**76**(10):1731–6.
7. van Tubergen A, Weber U. Diagnosis and classification in spondyloarthritis: identifying a chameleon. *Nat Rev Rheumatol* 2012 Mar 27;**8**(5):253–61.
8. Slobodin G, Eshed I. Non-radiographic axial spondyloarthritis. *Isr Med Assoc J* 2015 Dec;**17**(12):770–6.
9. Braun J, Sieper J. The sacroiliac joint in the spondyloarthropathies. *Curr Opin Rheumatol* 1996 Jul;**8**(4):275–87.
10. Rudwaleit M, Schwarzlose S, Hilgert ES, *et al*. MRI in predicting a major clinical response to anti-tumour necrosis factor treatment in ankylosing spondylitis. *Ann Rheum Dis* 2007 Nov 30;**67**(9):1276–81.
11. Baraliakos X, Hermann K-GA, Braun J. Imaging in axial spondyloarthritis: diagnostic problems and pitfalls. *Rheum Dis Clin North Am* 2012 Aug;**38**(3):513–22.
12. Bennett AN, Rehman A, Hensor EMA, *et al*. Evaluation of the diagnostic utility of spinal magnetic resonance imaging in axial spondylarthritis. *Arthritis Rheum* 2009 May;**60**(5):1331–41.
13. Hermann K-GA, Baraliakos X, van der Heijde DM, *et al*. Descriptions of spinal MRI lesions and definition of a positive MRI of the spine in axial spondyloarthritis: a consensual approach by the ASAS/OMERACT MRI study group. *Ann Rheum Dis* 2012 Jul 14;**71**(8):1278–88.