

Reporting Sacroiliac Joint Imaging Performed for Known or Suspected Axial Spondyloarthritis: Assessment of SpondyloArthritis International Society Recommendations

Torsten Diekhoff, MD • Iris Eshed, MD • Chiara Giraud, MD, PhD • Hiltrun Haibel, MD • Kay Geert A. Hermann, MD • Manouk de Hooge, PhD • Lennart Jans, MD • Anne Grethe Jurik, MD • Robert G. Lambert, MD • Pedro Machado, MD • Michael Mallinson • Walter P. Maksymowych, MD • Helena Marzo-Ortega, MD, PhD • Victoria Navarro-Compán, MD • Mikkel Østergaard, MD • Susanne J. Pedersen, MD • Monique Reijnen, MD, PhD • Martin Rudwaleit, MD • Fernando Sommerfleck, MD • Ulrich Weber, MD • Xenofon Baraliakos, MD** • Denis Poddubnyy, MD**

From the Department of Radiology, Charité-Universitätsmedizin Berlin, Campus Mitte, Humboldt-Universität zu Berlin, Freie Universität Berlin, Charitéplatz 1, 10117 Berlin, Germany (T.D., K.G.A.H.); Department of Radiology, Sheba Medical Center, Tel Hashomer, affiliated to the Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel (I.E.); Department of Medicine-DIMED, University of Padova, Padova, Italy (C.G.); Department of Gastroenterology, Infectiology and Rheumatology, Charité-Universitätsmedizin Berlin, Campus Benjamin Franklin, Humboldt-Universität zu Berlin, Freie Universität Berlin, Berlin, Germany (H.H., D.P.); Departments of Rheumatology (M.d.H.) and Radiology (L.J.), Ghent University Hospital, Ghent, Belgium; Department of Radiology, Aarhus University Hospital, Aarhus, Denmark (A.G.J.); Department of Clinical Medicine, Aarhus University, Aarhus, Denmark (A.G.J.); Departments of Radiology and Diagnostic Imaging (R.G.L.) and Medicine (W.P.M.), University of Alberta, Edmonton, Canada; Centre for Rheumatology and Department of Neuromuscular Diseases, University College London, London, England (P.M.); National Institute for Health Research (NIHR) University College London Hospitals (UCLH) Biomedical Research Centre, University College London Hospitals NHS Foundation Trust, London, England (P.M.); Department of Rheumatology, Northwick Park Hospital, London North West University Healthcare NHS Trust, London, England (P.M.); Ankylosing Spondylitis International Federation (ASIF), London, England (M.M.); NIHR Leeds Biomedical Research Centre, Leeds Teaching Hospitals Trust and Leeds Institute of Musculoskeletal Medicine, University of Leeds, Leeds, UK (H.M.O.); Department of Rheumatology, La Paz University Hospital, IdiPaz, Madrid, Spain (V.N.C.); Copenhagen Center for Arthritis Research, Center for Rheumatology and Spine Diseases, Center for Head and Orthopedics, Rigshospitalet, Glostrup, Denmark and Department of Clinical Medicine, University of Copenhagen, Copenhagen, Denmark (M.Ø.); Copenhagen Center for Arthritis Research, Center for Rheumatology and Spine Diseases, Center for Head and Orthopedics, Rigshospitalet, Glostrup, Denmark (M.Ø., S.J.P.); Department of Radiology, Leiden University Medical Center, Leiden, the Netherlands (M. Reijnen); Department of Internal Medicine and Rheumatology, Klinikum Bielefeld, University of Bielefeld, Germany (M. Rudwaleit); Rheumatology Unit, Sanatorio Mendez, PANLAR: SPA Study Group, Ciudad Autónoma de Buenos Aires, Argentina (F.S.); Department of Rheumatology, Practice Buchsbaum, Schaffhausen, Switzerland (U.W.); and Rheumazentrum Ruhrgebiet, Ruhr University Bochum, Herne, Germany (X.B.). Received July 14, 2023; revision requested August 15; revision received January 12, 2024; accepted January 26. Address correspondence to T.D. (email: torsten.diekhoff@charite.de).

** X.B. and D.P. are co-senior authors.

Conflicts of interest are listed at the end of this article.

See also the editorial by Gandikota in this issue.

Radiology 2024; 311(3):e231786 • <https://doi.org/10.1148/radiol.231786> • Content codes: **MK** **SQ**

Whereas previous projects attempted to standardize imaging in patients with axial spondyloarthritis (axSpA), few studies have been published about the need for specific details regarding the image acquisition and lesions that may be less familiar to general radiologists. This work reports consensus recommendations developed by the Assessment of SpondyloArthritis International Society (ASAS) that aim to standardize the imaging reports in patients suspected of having or with known axSpA. A task force consisting of radiologists and rheumatologists from ASAS and one patient representative formulated two surveys that were completed by ASAS members. The results of these surveys led to the development of 10 recommendations that were endorsed by 73% (43 of 59) of ASAS members. The recommendations are targeted to the radiologist and include best practices for the inclusion of clinical information, technical details, image quality, and imaging findings in radiology reports. These recommendations also emphasize that imaging findings that indicate differential diagnoses and referral suggestions should be included in the concluding section of the radiology report. With these recommendations, ASAS aims to improve the diagnostic process and care for patients suspected of having or with known axSpA.

© RSNA, 2024

Supplemental material is available for this article.

Axial spondyloarthritis (axSpA) is an overarching term for a group of inflammatory diseases that affect the axial skeleton and are characterized by active inflammation, bone erosion, new bone formation and, in the final stage, ankylosis. The sacroiliac joints (SIJs) are the most affected structures, but patients may also show lesions in the spine or the appendicular skeleton often but not always with contemporary SIJ involvement. Because the SIJ and spine are less amenable to clinical examination compared with peripheral joints, imaging is an essential part of the diagnostic work-up in patients suspected of having axSpA or in patients with an established diagnosis but symptoms of uncertain etiology (1,2). Bone marrow edema at MRI is the most characteristic sign

of active inflammation in axSpA and was previously emphasized by the Assessment of SpondyloArthritis International Society (ASAS) in their definition of active sacroiliitis but may also be present in degenerative conditions such as osteitis condensans ilii, osteoarthritis, or other pathologic abnormalities. Therefore, the observation of structural lesions typical of inflammatory sacroiliitis, as depicted on radiographs, suitable MRI sequences, or CT images (3), may improve the specificity of the test.

Successful diagnosis and treatment of axSpA depends on clear communication between clinicians who refer to the images and the radiologist who evaluates and interprets the images and findings. When providing a report

Abbreviations

ASAS = Assessment of SpondyloArthritis International Society, axSpA = axial spondyloarthritis, SIJ = sacroiliac joint

Summary

The consensus recommendations by the Assessment of SpondyloArthritis International Society provide a structured approach for effective communication from radiologists to rheumatologists for sacroiliac joint imaging of suspected or known axial spondyloarthritis, emphasizing the importance of detailed reporting, consideration of differential diagnoses, and expert collaboration.

Essentials

- Ten recommendations targeted for radiologists emphasized the importance of precise imaging protocols and documenting detailed findings in imaging reports, with potential differential diagnoses, and recommendations for additional imaging if required.
- The guidelines underscored a more affirmative role of the radiologist in patient care, committing to definitive diagnosis where possible, clearly mentioning inconclusive findings, and advising on further investigations when necessary.
- Radiologists should recommend referral to a rheumatologist when imaging indicates possible spondyloarthritis and the imaging has been ordered by a clinician who is not a rheumatologist.

that summarizes the imaging findings and interpretation, radiologists must be aware of specific information that should be included to best inform further treatment (4,5). However, the style, structure, and amount of information included in the radiology report in the context of axSpA may be influenced by radiologist training and experience (6). Many radiologists do not work within a rheumatologic environment or undergo specific training in arthritis imaging, and worldwide there are relatively few musculoskeletal radiology experts who specialize in imaging rheumatic diseases (7). Similarly, most rheumatologists are not formally trained to interpret complex imaging studies, and community-based rheumatologists may rely heavily on the radiology report when deciding on a diagnosis and treatment. Furthermore, understanding image acquisition protocols and potential image artifacts can only be gained by years of training in the respective imaging modality in a wide range of clinical circumstances and requires radiologic expertise (8).

There have been previous attempts by different groups to design recommendations for imaging reporting and requests regarding axSpA. Almodóvar et al (9) reported the joint efforts of the Spondyloarthritis Study Group of the Spanish Rheumatology Society and the Spanish Society of Musculoskeletal Radiology to develop referral and reporting checklists. These checklists were based on more general efforts to improve communication between the two specialists (10). There are also general recommendations on when and how to use imaging in axSpA (11,12). However, to date, there have been no international efforts for developing reporting guidelines.

Therefore, ASAS initiated a project to improve the communication between physicians requesting imaging and the reporting radiologists by developing recommendations that aim to standardize the reports of SIJ imaging in patients with known or suspected axSpA.

Materials and Methods

The recommendations are designed and this article is written according to the Appraisal of Guidelines for Research and Evaluation II concept (13).

Steering Committee and Task Force

A multidisciplinary steering committee and task force of ASAS members was established. The steering committee included two rheumatologists with scientific experience in axSpA imaging (X.B., with 20 years of experience, and D.P., with 14 years of experience) and one board-certified musculoskeletal radiologist specializing in imaging of inflammatory diseases (T.D., with 15 years of experience). The international task force included 11 rheumatologists (H.H., M.d.H., P.M., W.P.M., H.M.O., V.N.C., M.Ø., S.J.P., M. Rudwaleit, F.S., and U.W., with 18, 12, 10, 42, 23, 15, 22, 19, 23, 11, and 30 years of experience, respectively), seven musculoskeletal radiologists (I.E., C.G., K.G.A.H., L.J., A.G.J., R.G.L., and M. Reijnierse, with 22, 14, 23, 19, 33, 24, and 20 years of experience, respectively), and a patient representative (M.M.) from the Axial Spondyloarthritis International Federation. To ensure an equal weight of rheumatologists and radiologists in the task force, despite the former being larger in number, the task force established a veto right for the radiologists in case of disagreement.

Literature Review and Questionnaires

A literature review on PubMed (<https://pubmed.ncbi.nlm.nih.gov/>, search terms (“(Imaging(Title)) AND (axial spondyloarthritis (Title)) AND ((recommendation) OR (use) OR (guideline) OR (checklist) OR (suggestion) OR (advice) OR (endorsement))”) from database inception to date of research was conducted by a steering committee member (T.D.) in February 2021 and focused on current reporting guidelines for imaging in axSpA, including radiography, MRI, and CT. The search terms yielded 45 publications, of which two included recommendations for reporting axSpA imaging (10,14). Items of interest identified during the literature review and additional items found in previous ASAS recommendations and lesion definitions were presented and discussed at the first task force meeting. Following this, the steering committee drafted a project statement and designed the first questionnaire, both of which were reviewed, modified, and eventually agreed on by the task force. Here, the task force members concluded that these recommendations should be targeted to rheumatologists and radiologists working in axSpA. The first questionnaire was then sent to all ASAS members and was composed of 40 questions aimed at identifying specific items and domains to include in the recommendations. An item was included in the next questionnaire only if selected by more than 50% of members.

The results of the first questionnaire were discussed within the task force in a second meeting and used to design a second questionnaire. This questionnaire was again circulated to all ASAS members and consisted of 79 questions that aimed to ascertain whether a specific item should be included in the radiology report and to what level of detail. The steering committee used the results of this second questionnaire to

generate a draft of recommendations. Items were included in the recommendations if they received the majority vote. For questions with more than two possible answers, items agreed on by at least 50% of ASAS members were included in the draft recommendations.

Finalizing the Recommendations

The content and wording of the drafted recommendations were discussed and modified within the task force by email circulation. A finalized list of recommendations was presented to the ASAS members at the annual workshop in 2022 and members voted on whether they were in favor of or against each of the proposed recommendations. Finally, the task force voted for the level of agreement with a numerical rating scale ranging from 0 (do not agree at all) to 10 (fully agree). The averages and SDs are presented, as well as the percentage of participants with a score of at least 8. Figure 1 is a flowchart of the process for developing these recommendations.

Results

Overall, 143 of 190 (75.3%) ASAS members (89.5% [128 of 143] rheumatologists, 7.0% [10 of 143] radiologists, and 3.5% [five of 143] other specialties or nonphysicians) responded to the first questionnaire and 58.9% (112 of 190; consisting of 87.5% [98 of 112] rheumatologists and 8.9% [10 of 112] radiologists) responded to the second questionnaire (Appendix S1). These questions resulted in the generation of 10 recommendations (Table) for the reporting of imaging of the SIJ. One recommendation for lesions in the spine is in Table S1. The recommendations were accepted, with 73% (43 of 59) of ASAS full members voting in favor and 17% (10 of 59) voting against the motion, whereas 10% (six of 59) abstained. Checklists to aid the standardization of MRI SIJ reports for patients with axSpA are in Figure 2. Checklists for every imaging modality, SIJ, and the spine are in Appendix S2.

Recommendations for Standardizing Imaging Reports of the SIJs

Recommendation 1.—The report should start by summarizing essential clinical information, including patient age, sex, a summary of symptoms, the suspected diagnosis, whether the examination was requested for primary diagnosis or follow-up, and what imaging was available for comparison.

Whereas radiology reports usually start with the relevant clinical information and reasoning regarding why a specific imaging modality was performed (15), the ASAS experts indicated it was necessary to emphasize the inclusion of this information because radiology reports are not only reviewed by the referring clinicians or rheumatologists but also by physicians who may provide care to the patient in the future (4). It is not necessary to repeat information when this can be found elsewhere on the document (eg, age; Appendix S3).

The report should also mention what type of imaging was both available for comparison and considered during image interpretation (15). This will ensure the physician reading the report is aware of any reference images used to evaluate

changes in imaging findings and what information was available for cross-correlation and contextual image interpretation.

Recommendation 2.

- A. For radiography, the report should include the number of images, types of projections, and the patient's positioning.
- B. For MRI, the report should include the applied field strength and sequences with section orientation and thickness, if fat suppression was applied, and whether and what type of contrast medium was administered.
- C. For CT, the report should include the patient's position, orientation of reconstructions and section thickness, and a general indication of the radiation dose (eg, dose-length product).

The radiology report should briefly describe the imaging technique used (15) and essential imaging parameters. Therefore, the physician reviewing the report can ensure the imaging was appropriate to address the needs of the referral request. Because these physicians may not have access to the images themselves, these data are essential for an overall estimation of the quality of the imaging protocol and deciding whether additional imaging is necessary to obtain specific information not explicitly mentioned in the report. Whereas ASAS members favored generally understandable MRI sequence names over vendor-specific terminology, this item was not deemed necessary to include in the recommendation text. In accordance with good clinical practice, patient radiation exposure at CT should also be reported. When in doubt, ASAS advocates for following the general reporting guidelines of the respective radiologic societies.

Recommendation 3.—The anatomic coverage of the examination should be indicated.

Protocols and institutional standards vary, especially for cross-sectional imaging. Therefore, the reader of the report must understand how much of the spine is included in an imaging examination of SIJ and if the pelvic SIJ protocol also allows for the detection of hip pathologic abnormalities. The report regarding the anatomic coverage should provide enough information for the reader to judge whether current or past symptoms have been appropriately treated and whether additional imaging is needed to answer any additional clinical questions. For example, it can be useful to know whether the hip joints were covered in an SIJ examination if the patient later reports hip pain (see technical data in the second example in Appendix S3).

Recommendation 4.—The report should include a general statement about image quality and complications from imaging, particularly if the examination or its interpretation is affected.

The image quality, the completeness of the protocol, and the presence of any artifacts are essential for reaching a conclusion from the examination. Reduced quality might necessitate a repeat of the examination or indicate that a different imaging modality should be used, especially if the reduced image quality meant the clinical question for conducting the imaging could not be sufficiently

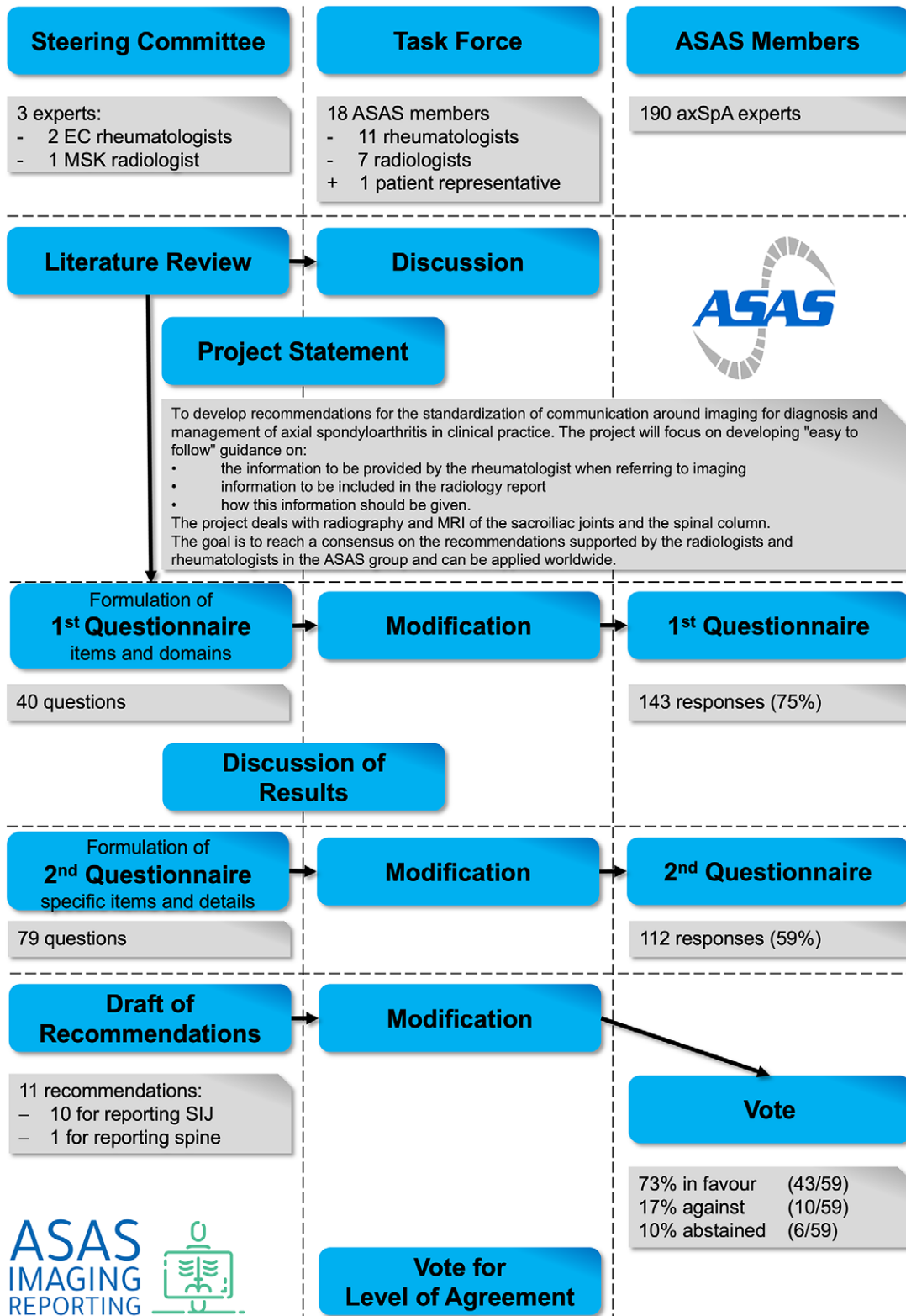


Figure 1: The Assessment of SpondyloArthritis International Society (ASAS) process for developing image request and image reporting recommendations for axial spondyloarthritis (axSpA). In the first questionnaire, ASAS members were asked which item (eg, a specific lesion) or domain (eg, scores) ASAS should be a recommendation, whereas in the second questionnaire the members answered whether an item must or must not be included in the report and to what detail. EC = executive committee, MSK = musculoskeletal, SIJ = sacroiliac joint.

Recommendations from the Assessment of SpondyloArthritis International Society for Reporting Sacroiliac Joint Imaging in Axial Spondyloarthritis

Imaging Report Recommendations: Sacroiliac Joints	Level of Agreement	Percentage of Agreement of ≥ 8 (%)
Clinical data		
1. The report should start by summarizing essential clinical information, including the patient's age, sex, a summary of symptoms, the suspected diagnosis, whether the examination was requested for primary diagnosis or follow-up, and what imaging was available for comparison.	8.4 \pm 1.8 (4–10)	80
Technical data		
2a. Radiography: The report should include the number of images, types of projections, and the patient's positioning.	8.1 \pm 2.5 (2–10)	75
2b. MRI: The report should include the applied field strength and sequences with section orientation and thickness, if fat suppression was applied, and whether and what type of contrast medium was administered.	8.7 \pm 1.6 (5–10)	80
2c. CT: The report should include the patient's position, orientation of reconstructions and section thickness, and a general indication of the radiation dose (eg, dose length product).	7.7 \pm 2.7 (0–10)	65
3. The anatomic coverage of the examination should be indicated.	8.8 \pm 2.1 (3–10)	85
4. The report should include a general statement about image quality and complications from imaging, particularly if the examination or its interpretation is affected.	9.4 \pm 1.0 (7–10)	90
Report		
5a. Bone marrow edema/osteitis, erosions, and fat lesions are clinically significant findings that the report should list semiquantitatively with their localization specified. Their absence should be stated clearly.	9.2 \pm 1.1 (4–10)	80
5b. The report should include whether other active or structural lesions are present. Structural lesions should be reported per individual bone. The radiologists can summarize the absence of those active or structural lesions in the report.	9.3 \pm 1.8 (3–10)	90
6. Findings unrelated to spondyloarthritis but of potential clinical importance should be mentioned when present.	9.8 \pm 0.6 (8–10)	100
Conclusion		
7. The radiologist should state clearly if findings are compatible with axSpA, based on the images and clinical information available. The conclusion should state whether there is active inflammation or structural changes with the most prominent lesions and give an indication of the confidence in interpretation of the findings.	9.4 \pm 1.1 (7–10)	90
8. Based on the examination findings, differential diagnoses and their probability should be detailed, especially if more likely than a diagnosis of spondyloarthritis.	9.8 \pm 0.6 (8–10)	100
9. If the examination findings are inconclusive, radiologists are encouraged to suggest further imaging.	9.4 \pm 0.9 (8–10)	100
10. If the examination indicates spondyloarthritis and a rheumatologist did not request the imaging investigation, the radiologist should recommend referral to a rheumatologist for further assessment.	9.2 \pm 1.9 (2–10)	90

Note.—Assessment of Spondyloarthritis International Society task force members (18 members, including 11 rheumatologists, seven radiologists, and one patient representative) voted for their agreement with each image reporting recommendation on a scale from 0 to 10 (0, do not agree, to 10, fully agree). Levels of agreement are means \pm SDs; data in parentheses are ranges. The percentage of task force members voting for agreement with a score of 8 (ie, mostly agree on the 0–10 scale) or higher is also reported. axSpA = axial spondyloarthritis.

answered (16). Imaging complications (eg, from contrast media or claustrophobia) should also be reported to ensure the imaging strategy is modified appropriately for future examinations.

Recommendation 5.—

- A. Bone marrow edema/osteitis, erosions, and fat lesions are significant findings that the report should list semiquantitatively with their localization specified. Their absence should be stated clearly.
- B. The report should include whether other active or structural lesions are present. Structural lesions should be reported per

individual bone. The radiologists can summarize the absence of those active or structural lesions in the report.

A review of 31 studies indicated that bone marrow edema of the SIJ showed good sensitivity and specificity for the diagnosis of axSpA and this specificity has been reported to increase in the presence of other lesions, namely erosion and (in some but not all studies) fat lesions (12). Inflammatory lesions have also been reported to have moderate sensitivity and specificity for axSpA. Thus, we recommend that all those lesions be listed semiquantitatively using terms such as “mild,” “moderate,” and “severe” to help characterize the extent of the findings.



Checklist for Reporting SIJ MRI of axSpA patients



#	Item	Check
1	Essential clinical information	<input type="checkbox"/>
	summary of symptoms	<input type="checkbox"/>
	suspected diagnosis	<input type="checkbox"/>
	reason for exam (primary diagnosis or follow-up)	<input type="checkbox"/>
	imaging available for comparison	<input type="checkbox"/>
	Technical details	
2	field strength	<input type="checkbox"/>
	sequences (fat suppression)	<input type="checkbox"/>
	slice orientation and thickness	<input type="checkbox"/>
	contrast media	<input type="checkbox"/>
3	anatomical coverage	<input type="checkbox"/>
4	image quality	<input type="checkbox"/>
	Report	
5	osteitis (semiquantitatively, specific localization)	<input type="checkbox"/>
	erosion (semiquantitatively, specific localization)	<input type="checkbox"/>
	fat lesions (semiquantitatively, specific localization)	<input type="checkbox"/>
	other lesions (per bone if present)	<input type="checkbox"/>
6	other findings of potential clinical relevance	<input type="checkbox"/>
	Conclusion	
7	findings compatible with axSpA	<input type="checkbox"/>
	active and structural lesions (present, most prominent)	<input type="checkbox"/>
	confidence of interpretation	<input type="checkbox"/>
8	differential diagnoses	<input type="checkbox"/>
9	suggest further imaging, if findings inconclusive	<input type="checkbox"/>
10	recommend referral to rheumatology (unknown axSpA)	<input type="checkbox"/>

Figure 2: Checklist for reporting MRI of the sacroiliac joint (SIJ) in patients with known or suspected axial spondyloarthritis (axSpA).

For those lesions, it is also important to understand the spatial distribution within the joint to distinguish mechanical from inflammatory disease (17–19). Therefore, the report should list the localization of those lesions clearly and convey whether findings are restricted to the mechanical load zone of the joint. Furthermore, the absence of those findings is essential for ruling out specific differential diagnoses, such as osteoarthritis, osteitis condensans ilii, other mechanical stress conditions, septic arthritis, or others, and must be stated clearly within the report. For other lesions

with less predictive value or prevalence, less detail is needed and only reporting their presence or absence is sufficient. Such lesions include capsulitis, joint space enhancement, inflammation at the site of erosion, enthesitis and joint space fluid for active lesions and fat metaplasia inside an erosion cavity (backfill), sclerosis, ankylosis, and nonbridging bone buds for structural lesions (20). For follow-up examinations, the change in active and structural lesions should be indicated to allow the reader to assess whether the patient responds to treatment.

A recommendation on spine lesions is shown in Table S1.

Recommendation 6.—Findings unrelated to spondyloarthritis but of potential clinical importance should be mentioned when present.

Whereas imaging findings may confirm a diagnosis of axSpA, it is also possible that they may indicate an alternative explanation for the patient's self-reported symptoms (21). Therefore, potentially important pathologic abnormalities such as gas inside the joint (known as vacuum phenomenon) (22), osteophytes (23), transitional vertebrae (24), anatomic variations (25,26), and spinal malposition (27) should be included in the report. These findings can point toward a potential differential diagnosis or help with the interpretation of other findings, especially bone marrow edema. Although not restricted to this list, the ASAS members acknowledged the frequency and importance of these lesions.

Recommendation 7.—The radiologist should state clearly if findings are compatible with axSpA, based on the images and clinical information available. The conclusion should state whether there is active inflammation or structural changes with the most prominent lesions and give an indication of the confidence in interpretation of the findings.

The conclusion of the radiology report is commonly the only section read by referring physicians (4). Radiology societies advocate for a clear and concise style that communicates the results in an unequivocal manner (15). ASAS members were in favor of a contextual interpretation in the conclusion of the radiology report. That is, instead of reporting "sacroiliitis" alone, radiologists should state "sacroiliitis compatible with axSpA," ultimately leaving the final diagnostic decision to the rheumatologists. This was also supported by the patient representative, who stressed that it is essential to find an imaging-based diagnosis in the report and not only a description of imaging findings.

The absence of structural or active lesions or changes in these lesions at follow-up should also be included in the conclusion (see an example in Appendix S3). Additionally, any uncertainty in the interpretation of the imaging findings or in the quality of the examination itself should be communicated in the conclusion to help the referring physician interpret the imaging results in the context of divergent clinical or laboratory findings (28). Especially when findings are equivocal, their nonspecific nature should be stated together with the rationale of the radiologists to decide on a conclusion. Because terms such as *likely* or *suspicion of* have been found to incompletely transfer the degree of certainty to the reader of the report (29), the ASAS group recommends communicating uncertainty in a clear and unequivocal manner (30).

Recommendation 8.—Based on the examination findings, differential diagnoses and their probability should be detailed, especially if more likely than spondyloarthritis.

The conclusion should also list differential diagnoses derived from imaging that are more likely than axSpA and include relevant imaging findings, which was stressed by the patient representative (31). Sometimes, it can be useful to assign likelihoods

to the respective differential diagnoses to help the reader in further treatment of the patient (28,32). Also, nonspondyloarthritis-related findings that can at least partially contribute to the symptoms of the patient, even if the diagnosis of axSpA is supported by the examination, should be listed. This is especially vital from the perspective of the patient representative, who stated that reports should be as comprehensive as possible.

Recommendation 9.—If the examination findings are inconclusive, radiologists are encouraged to suggest further imaging.

Despite high clinical suspicion, imaging findings may be negative or ambiguous for axSpA, and further imaging may thus be warranted to enhance the diagnostic yield (33). Sometimes, it is unclear whether suspicious lesions are inflammatory or mechanical in nature, and an alternative imaging method may be able to resolve this uncertainty. In those cases, the radiologist should use their expertise to suggest the appropriate alternative imaging modality based on the clinical context. For example, consider a patient with high clinical suspicion for axSpA, in whom an MRI scan shows bone marrow edema limited to the mechanical load zone without definitive structural lesions. In such a scenario, a CT scan could help in depicting or helping to exclude joint surface erosion. Similarly, if a spine MRI scan depicts suspicious findings but there have been no prior pelvic examinations, additional SIJ imaging might be necessary to accurately interpret the lesions. This recommendation is not intended to increase the amount of unnecessary imaging in patients with axSpA but to help the clinicians choose further work-up procedures in ambiguous situations.

Recommendation 10.—If the examination indicates spondyloarthritis and a rheumatologist did not request the imaging investigation, the radiologist should recommend referral to a rheumatologist for further assessment.

The SIJs are fully or partially displayed on many radiologic examinations such as body CT or pelvic MRI. Thus, it is possible that examinations performed for a different question may indicate a diagnosis of axSpA. In those cases, ASAS recommends that the radiologist, being the first one to suspect the diagnosis of axSpA, provides a recommendation for referral to a rheumatologist who can establish or refute the diagnosis and initiate appropriate treatment, if necessary (34). Comorbidities in patients with axSpA are common (35), therefore, even if other medical circumstances are paramount, it is important that axSpA-related findings at imaging are reported because early diagnosis and treatment initiation is advantageous for the patient.

Discussion

Assessment of SpondyloArthritis International Society (ASAS) has developed 10 recommendations for reporting sacroiliac joint imaging in patients with or suspected of having axial spondyloarthritis (axSpA). These recommendations are in line with current concepts of structured reporting (31,36), which is supported by most ASAS members (Appendix S1). By providing these recommendations and checklists (Appendix S2), ASAS aims to improve patient care in axSpA. An example of a structured report is presented in the second part of Appendix S3.

ASAS members are mostly rheumatologists and radiologists, and these were therefore the experts who formed the steering committee and task force. However, ASAS also includes some members from other disciplines related to chronic back pain with inflammatory symptoms, and their opinions, or the opinions of other stakeholders, may not have been thoroughly considered.

Whereas the recommendations were approved by ASAS, concerns among rheumatologists and radiologists in the group stimulated discussion. One noteworthy point was that most ASAS members voted for the inclusion of information on sacroiliitis grading according to the modified New York Criteria on conventional radiography (37) or fulfillment of criteria for ASAS positivity at MRI (38). However, the task force members unanimously agreed that these assessments were designed for classification purposes and not for the diagnostic process (39). Therefore, the task force decided not to give a specific recommendation regarding that topic for clinical practice.

The recommendations are purposely not tailored to each imaging modality because future technological developments may influence the abilities of imaging to depict specific findings. For example, dual-energy CT might allow for a reliable depiction of bone marrow edema, which is not currently possible with conventional CT (40). Future developments in imaging techniques might warrant future adaptations of the recommendations.

These recommendations had limitations. Whereas there are some studies and recommendations regarding preparing good radiology reports and what clinical information is essential to report for patients with axSpA, there is little data on how this information influences clinical practice, imaging interpretation, or final treatment and outcome of patients with axSpA. Therefore, these recommendations are expert driven and arose from clinical practice and preferences.

Conclusion

Assessment of SpondyloArthritis International Society has developed 10 recommendations for standardizing the communication by radiologists to referring physicians regarding imaging in patients with an established diagnosis or who are suspected of having axial spondyloarthritis (axSpA). These recommendations standardize the guidance regarding information that is desired in the report. Although these recommendations could cause more effort for radiologists, they inform about clinically relevant information, aiming to improve care provisions for patients with axSpA. These recommendations have already been presented by an arthritis imaging subcommittee to the executive committee of the European Society of Musculoskeletal Radiology, which endorsed the project. The European Society of Musculoskeletal Radiology has agreed to take part in disseminating this information among radiologists, and we aim to continue to disseminate this information among other radiologic and rheumatologic societies.

Author contributions: Guarantors of integrity of entire study, **T.D.**, **D.P.**; study concepts/study design or data acquisition or data analysis/interpretation, all authors; manuscript drafting or manuscript revision for important intellectual content, all authors; approval of final version of submitted manuscript, all authors; agrees to ensure any questions related to the work are appropriately resolved, all authors; literature research, **T.D.**; clinical studies, **H.H.**, **H.M.O.**, **X.B.**; experimental studies, **C.G.**; statistical analysis, **T.D.**; and manuscript editing, all authors

Disclosures of conflicts of interest: **T.D.** Grants/contracts from Canon Medical Systems, ASAS; consulting fees from Lilly; payment or honoraria for lectures from Canon Medical Systems, Novartis, MSD, BioCad, UCB, Roche. **I.E.** Payment or honoraria for lectures from AbbVie, Novartis. **C.G.** Payment or honoraria for lectures from Boehringer Italy. **H.H.** Grants or contract from Sobi; consulting fees from AbbVie, Janssen, Novartis, Pfizer, Roche, Sobi, UCB; payment for lectures from AbbVie, Janssen, Novartis, Pfizer, Roche, Sobi, and UCB; support for attending meetings and/or travel, Pfizer, UCB, AbbVie; participation on a DataSafety Monitoring Board or Advisory Board from UCB, Janssen. **K.G.A.H.** Consulting fees from AbbVie; payment or honoraria for lectures from AbbVie, MSD, Novartis, Pfizer; cofounder of BerlinFlame. **M.d.H.** Payment or honoraria for lectures from UCB Pharma; support for attending meetings and/or travel from UCB Pharma. **L.J.** No relevant relationships. **A.G.J.** No relevant relationships. **R.G.L.** Consulting fees from CARE Arthritis Image Analysis Group. **P.M.** Consulting fees from AbbVie, BMS, Celgene, Eli Lilly, Janssen, MSD, Novartis, Orphazyme, Pfizer, Roche, and UCB; payment for lectures from AbbVie, BMS, Celgene, Eli Lilly, Janssen, MSD, Novartis, Orphazyme, Pfizer, Roche, and UCB; leadership or fiduciary roles in Meteor, MIHRA, ASAS Executive Committee. **M.M.** No relevant relationships. **W.P.M.** Grants or contracts from AbbVie, BMS, Eli Lilly, Pfizer, UCB; royalties or licenses from Augurex Life Sciences; consulting fees from AbbVie, BMS, Eli Lilly, Galapagos, Pfizer, UCB; support for meetings from Eli Lilly; board of directors member for SPARTAN. **H.M.O.** Grants or contracts from Janssen, Novartis, Pfizer, and UCB; consulting fees from Eli Lilly, Janssen, MoonLake, Novartis, Pfizer, UCB; payment or honoraria for lectures from AbbVie, Amgen, Biogen, Eli Lilly, Janssen, Novartis, Pfizer, Takeda, UCB; support for attending meetings and/or travel from Eli Lilly; participation on a DataSafety Monitoring Board or Advisory Board from Eli Lilly, Janssen, MoonLake, Novartis, Pfizer, UCB. **V.N.C.** Consulting fees from AbbVie, Galapagos, Lilly, Novartis, Pfizer, UCB; payment or honoraria for lectures from AbbVie, Eli Lilly, Janssen, Fresenius Kabi, Novartis, Pfizer, UCB; support for attending meetings from AbbVie, Eli Lilly, UCB; executive committee member and executive secretary for ASAS (unpaid). **M.Ø.** Grants and/or contracts from AbbVie, BMS, Merck, Novartis, UCB; consulting fees from AbbVie, BMS, Boehringer-Ingelheim, Celgene, Eli Lilly, Galapagos, Gilead, Hospira, Janssen, MEDAC, Merck, Novartis, Novo, Orion, Pfizer, Regeneron, Roche, Sandoz, Sanofi, and UCB; payment for lectures from AbbVie, BMS, Boehringer-Ingelheim, Celgene, Eli Lilly, Galapagos, Gilead, Hospira, Janssen, MEDAC, Merck, Novartis, Novo, Orion, Pfizer, Regeneron, Roche, Sandoz, Sanofi, and UCB. **S.J.P.** Grants or contracts from Innovation Fund Denmark and Nordic Bioscience; consulting fees from AbbVie, Novartis, MSD, and Pfizer; payment for lectures from AbbVie, Novartis, MSD, and Pfizer; support for meetings and/or travel from AbbVie. **M. Reijnierse** Grant from the International Skeletal Society; consulting fees from ASAS. **M. Rudwaleit** Consultant for UCB; fees from UCB, Lilly, Novartis; payment for lectures from AbbVie, Boehringer, Janssen, Eli Lilly, Novartis, UCB; support for meetings from AbbVie, Janssen, Eli Lilly, Galapagos, Novartis, UCB; patents planned, issued, or pending; participation on a DataSafety Monitoring board for Eli Lilly, Novartis, UCB; consultant for German Society of Bechterew's Disease (unpaid). **E.S.** Payment or honoraria for lectures from AbbVie, Novartis, Janssen; support for meetings from Roche, AbbVie. **U.W.** Payment for lectures from Novartis, Eli Lilly; ASAS full membership. **X.B.** President of ASAS, president-elect of EULAR. **D.P.** No relevant relationships.

References

- Weber U, Jurik AG, Lambert RGW, Maksymowycz WP. Imaging in Axial Spondyloarthritis: What is Relevant for Diagnosis in Daily Practice? *Curr Rheumatol Rep* 2021;23(8):66.
- Khmelnikii N, Regel A, Baraliakos X. The Role of Imaging in Diagnosing Axial Spondyloarthritis. *Front Med (Lausanne)* 2018;5:106.
- Diekhoff T, Hermann KG, Greese J, et al. Comparison of MRI with radiography for detecting structural lesions of the sacroiliac joint using CT as standard of reference: results from the SIMACT study. *Ann Rheum Dis* 2017;76(9):1502–1508.
- Johnson AJ, Ying J, Swan JS, Williams LS, Applegate KE, Littenberg B. Improving the quality of radiology reporting: a physician survey to define the target. *J Am Coll Radiol* 2004;1(7):497–505.
- Clinger NJ, Hunter TB, Hillman BJ. Radiology reporting: attitudes of referring physicians. *Radiology* 1988;169(3):825–826.
- Blackmore CC. Defining quality in radiology. *J Am Coll Radiol* 2007;4(4):217–223.
- Bacceti SJ, Henderson SR, Lo HS, Reynolds K. Using Quality Improvement Methodology to Reduce Costs while Improving Efficiency and Provider Satisfaction in a Busy, Academic Musculoskeletal Radiology Division. *J Med Syst* 2020;44(6):104.
- Patti JA, Berlin JW, Blumberg AL, et al. ACR white paper: the value added that radiologists provide to the health care enterprise. *J Am Coll Radiol* 2008;5(10):1041–1053.

9. Almodóvar R, Bueno Á, Batlle E, et al. Magnetic resonance imaging assessment in patients with axial spondyloarthritis: development of checklists for use in clinical practice. *Rheumatol Int* 2019;39(12):2119–2127.
10. Bennett AN, Marzo-Ortega H, Kaur-Papadakis D, Rehman A; BRITSpA. The Use of Magnetic Resonance Imaging in Axial Spondyloarthritis: Time to Bridge the Gap Between Radiologists and Rheumatologists. *J Rheumatol* 2017;44(6):780–785.
11. Mandl P, Navarro-Compán V, Terslev L, et al. EULAR recommendations for the use of imaging in the diagnosis and management of spondyloarthritis in clinical practice. *Ann Rheum Dis* 2015;74(7):1327–1339.
12. Bray TJP, Jones A, Bennett AN, et al. Recommendations for acquisition and interpretation of MRI of the spine and sacroiliac joints in the diagnosis of axial spondyloarthritis in the UK. *Rheumatology (Oxford)* 2019;58(10):1831–1838.
13. Brouwers MC, Kho ME, Browman GP, et al. AGREE II: advancing guideline development, reporting and evaluation in health care. *J Clin Epidemiol* 2010;63(12):1308–1311.
14. Almodovar R, Bueno A, Garcia Monco C, et al. Quantification of bone marrow edema by MRI of the sacroiliac joints in patients diagnosed with axial spondyloarthritis: results from the ESPERanza cohort. *Scand J Rheumatol* 2022;51(5):374–381.
15. European Society of Radiology (ESR). Good practice for radiological reporting. Guidelines from the European Society of Radiology (ESR). *Insights Imaging* 2011;2(2):93–96.
16. Fitzgerald R. Error in radiology. *Clin Radiol* 2001;56(12):938–946.
17. Diekhoff T, Eshed I, Radny F, et al. Choose wisely: imaging for diagnosis of axial spondyloarthritis. *Ann Rheum Dis* 2022;81(2):237–242.
18. Poddubnyy D, Weineck H, Diekhoff T, et al. Clinical and imaging characteristics of osteitis condensans ilii as compared with axial spondyloarthritis. *Rheumatology (Oxford)* 2020;59(12):3798–3806.
19. Kiil RM, Armbak BA, Zejden A, Schiøttz-Christensen B, Hendricks O, Jurik AG. Pregnancy-related sacroiliac joint findings in females with low back pain: a four-year magnetic resonance imaging follow-up study. *Acta Radiol* 2022;63(6):775–784.
20. Jones A, Bray TJP, Mandl P, Hall-Craggs MA, Marzo-Ortega H, Machado PM. Performance of magnetic resonance imaging in the diagnosis of axial spondyloarthritis: a systematic literature review. *Rheumatology (Oxford)* 2019;58(11):1955–1965.
21. Oei MW, Evens AL, Bhatt AA, Garner HW. Imaging of the Aging Spine. *Radiol Clin North Am* 2022;60(4):629–640.
22. Gohil I, Vilensky JA, Weber EC. Vacuum phenomenon: Clinical relevance. *Clin Anat* 2014;27(3):455–462.
23. Ziegeler K, Kreutzinger V, Diekhoff T, et al. Impact of age, sex, and joint form on degenerative lesions of the sacroiliac joints on CT in the normal population. *Sci Rep* 2021;11(1):5903.
24. Illeez OG, Atıcı A, Ulger EB, Kulcu DG, Ozkan FU, Aktas I. The transitional vertebra and sacroiliac joint dysfunction association. *Eur Spine J* 2018;27(1):187–193.
25. Ziegeler K, Ulas ST, Poddubnyy D, et al. Anatomical variation of the sacroiliac joint carries an increased risk for erosion and bone marrow oedema in axial spondyloarthritis. *Rheumatology (Oxford)* 2023;62(3):1117–1123.
26. Ziegeler K, Kreutzinger V, Proft F, Poddubnyy D, Hermann KGA, Diekhoff T. Joint anatomy in axial spondyloarthritis: strong associations between sacroiliac joint form variation and symptomatic disease. *Rheumatology (Oxford)* 2021;61(1):388–393.
27. Šarčević Z, Tepavčević A. Association between adolescent idiopathic scoliosis and sacroiliac joint dysfunction in young athletes: A case control study. *Medicine (Baltimore)* 2019;98(15):e15161.
28. Bruno MA, Petscavage-Thomas J, Abujudeh HH. Communicating uncertainty in the radiology report. *AJR Am J Roentgenol* 2017;209(5):1006–1008.
29. Khorasani R, Bates DW, Teeger S, Rothschild JM, Adams DF, Seltzer SE. Is terminology used effectively to convey diagnostic certainty in radiology reports? *Acad Radiol* 2003;10(6):685–688.
30. Reiner BI. Using analysis of speech and linguistics to characterize uncertainty in radiology reporting. *J Digit Imaging* 2012;25(6):703–707.
31. Hartung MP, Bickle IC, Gaillard F, Kanne JP. How to create a great radiology report. *RadioGraphics* 2020;40(6):1658–1670.
32. Wallis A, McCoubrie P. The radiology report--are we getting the message across? *Clin Radiol* 2011;66(11):1015–1022.
33. Dalal S, Hombal V, Weng WH, et al. Determining follow-up imaging study using radiology reports. *J Digit Imaging* 2020;33(1):121–130.
34. Pool F, Goergen S. Quality of the written radiology report: a review of the literature. *J Am Coll Radiol* 2010;7(8):634–643.
35. Redeker I, Callhoff J, Hoffmann F, et al. The prevalence and impact of comorbidities on patients with axial spondyloarthritis: results from a nationwide population-based study. *Arthritis Res Ther* 2020;22(1):210.
36. Kahn CE Jr, Langlotz CP, Burnside ES, et al. Toward best practices in radiology reporting. *Radiology* 2009;252(3):852–856.
37. van der Linden S, Valkenburg HA, Cats A. Evaluation of diagnostic criteria for ankylosing spondylitis. A proposal for modification of the New York criteria. *Arthritis Rheum* 1984;27(4):361–368.
38. Lambert RG, Bakker PA, van der Heijde D, et al. Defining active sacroiliitis on MRI for classification of axial spondyloarthritis: update by the ASAS MRI working group. *Ann Rheum Dis* 2016;75(11):1958–1963.
39. Diekhoff T, Lambert R, Hermann KG. MRI in axial spondyloarthritis: understanding an 'ASAS-positive MRI' and the ASAS classification criteria. *Skeletal Radiol* 2022;51(9):1721–1730.
40. Wu H, Zhang G, Shi L, et al. Axial Spondyloarthritis: Dual-Energy Virtual Noncalcium CT in the Detection of Bone Marrow Edema in the Sacroiliac Joints. *Radiology* 2019;290(1):157–164.