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MAGNETIC RESONANCE IMAGING

Results of an expert Delphi consensus from the Italian Society of Medical and Interventional Radiology (SIRM) and the Italian Society of Rheumatology (SIR) on standardized requesting and reporting magnetic resonance imaging in patients with suspected or known axial spondyloarthritis

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Abstract

Objectives To develop a practical consensus for standardizing communication between rheumatologists and radiologists regarding magnetic resonance imaging (MRI) of the sacroiliac joints and spine in the diagnosis and management of axial spondyloarthritis (axSpA).

Methods A task force comprising six rheumatologists and five musculoskeletal radiologists with expertise in axSpA imaging reviewed the Assessment of SpondyloArthritis International Society (ASAS) framework to draft initial recommendations and define project goals. A broader expert panel (21 rheumatologists, 19 radiologists) then participated in a voting process to refine and validate these recommendations. Final endorsement was sought from the steering committees of the Italian Society of Medical and Interventional Radiology (SIRM) and the Italian Society of Rheumatology (SIR) using a modified Delphi method.

Results Thirty-one recommendations were validated, organized into eight domains. Domain 1 outlines five overarching principles. Domain 2 comprises recommendations on clinical features, symptoms, and risk factors. Additional domains address MRI technical parameters, including image quality and sequencing (Domain 3), and standardized reporting criteria. For the sacroiliac joints (Domains 4 and 5), five signs of inflammation and six of structural damage are defined. For the spine (Domains 6 and 7), five inflammatory and four structural features are specified. Domain 8 provides guidance on report conclusions. The recommendations were endorsed by SIRM/SIR with 88.5% approval.

Conclusion This consensus offers structured guidance for MRI requesting and reporting in axSpA, fostering clear communication between radiologists and rheumatologists. The standardized approach aims to improve diagnostic accuracy and patient outcomes.

Keywords Axial spondyloarthritis · Radiologists · Rheumatologists · Magnetic resonance imaging · Delphi consensus

Introduction

The term axial spondyloarthritis (axSpA) refers to a group of chronic inflammatory rheumatic diseases with a shared genetic background, characterized by enthesitis and both axial and peripheral joint involvement [1]. One of the major

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challenges in managing axSpA is the considerable diagnostic delay, which typically averages 8–9 years [2]. This delay persists despite ongoing symptoms of inflammatory back pain (IBP) and is largely attributable to the slow progression of radiographic changes in the sacroiliac joints (SIJs), the limited sensitivity of laboratory tests, and the nonspecific nature of early clinical signs. The social burden of delayed axSpA diagnosis is also substantial, largely due to productivity loss [3]. These challenges prompted the Assessment of SpondyloArthritis International Society (ASAS) to conduct a comprehensive reevaluation of SpA classification criteria. Through a series of data-driven studies, ASAS demonstrated that magnetic resonance imaging (MRI) could significantly improve patient stratification by reclassifying individuals presenting with back pain into more accurate diagnostic categories [4]. Consequently, MRI was incorporated as an imaging criterion in the updated classification framework for axSpA (5). According to ASAS-defined criteria, baseline MRI demonstrates strong diagnostic performance for axSpA, as confirmed by concordant reader data. The utility of MRI in the diagnosis of axSpA, compared to expert opinion, shows a positive likelihood ratio of 11.8 (with a sensitivity of 66% and a specificity of 94%, respectively). Moreover, the sensitivity of MRI in predicting the subsequent development of radiographic sacroiliitis is 100% [5].

Given the variability in MRI accessibility and the limited familiarity with axSpA imaging in some clinical settings, a collaborative effort among radiologists and rheumatologists aimed to develop practical consensus for the appropriate use of MRI in axSpA. It became evident that a standardized, reliable definition of a "positive MRI" for sacroiliitis and spondylitis was crucial for the broader application of these criteria in both clinical practice and research. To address this, a working group from ASAS and Outcome Measures in Rheumatology (OMERACT) reached a consensus on defining MRI positivity [6–8].

This consensus outlines precise criteria for identifying inflammatory lesions (sacroiliitis and spondylitis) and structural changes (e.g., fat deposition), providing descriptions of disease-related abnormalities in the SIJs and spine. These definitions can be consistently applied in both research contexts and routine clinical evaluations of patients with axSpA.

Specifically, "active sacroiliitis on MRI" is defined by the presence of synovitis, enthesitis, capsulitis, and bone marrow edema (BME)/osteitis—with BME/osteitis being essential for confirming active inflammation. MRI can also detect structural lesions such as ankylosis, sclerosis, erosions, and fat metaplasia. However, the diagnostic and classificatory significance of these structural lesions remains less well defined, particularly when they are subtle. In the spine, six types of inflammatory lesions have been described: spondylodiscitis, zygapophyseal joint arthritis, anterior and posterior spondylitis, and enthesitis of the spinal ligaments. Four types of structural lesions have also been identified: fatty deposition, erosions, syndesmophytes, and ankylosis. Among these, anterior/posterior spondylitis and fat deposition at vertebral corners are considered hallmark features of axSpA. Based on the literature and expert consensus, a spinal MRI is considered positive for inflammation when anterior/posterior spondylitis is present at three or more sites. In young adults, fat deposition at multiple vertebral corners is particularly suggestive of axSpA.

To improve MRI reporting in axSpA, ASAS has published specific guidelines for radiological interpretation [9]. The currently available guidelines have been developed within international forums, while no consensus documents contextualized to the Italian setting are presently available. Based on these considerations, the primary objective of this study is to develop a consensus document aimed at bridging the communication gap between radiologists, who interpret imaging studies, and rheumatologists, who request them, in the context of suspected or confirmed axSpA, with adaptability to the Italian healthcare setting.

Methods

A modified Delphi method [10] was conducted in four stages between June 2024 and March 2025:

1. Formation of a steering committee task force composed of radiologists and rheumatologists;
2. Review of the ASAS statements and development of new items tailored to the Italian healthcare context, emphasizing the key role of sacroiliac joint and spinal imaging as facilitators of diagnosis and management;
3. Online voting on the newly proposed statements;
4. Evaluation, revision, and potential re-voting on any statements that did not reach consensus.

The objective of the process was to identify essential components for imaging recommendations and refine them for practical implementation [10]. The first in-person meeting was held in Milan on June 28, 2024. The task force consisted of six rheumatologists with expertise in axSpA imaging and five musculoskeletal radiologists specialized in inflammatory musculoskeletal diseases. Members were selected based on their publication records and previous engagement in related initiatives. After reviewing and discussing the ASAS framework, the task force developed a preliminary set of recommendations. Subsequently, a broader group of 19 radiologists and 21 rheumatologists from various regions of Italy—selected to reflect potential regional differences in clinical practice—were invited to participate in a decisive round of voting. These participants were identified through consensus among the steering committee members and in

consultation with two national scientific societies: the Italian Society of Medical and Interventional Radiology (SIRM) and the Italian Society of Rheumatology (SIR), based on their professional contributions to the field. Each proposed statement was evaluated for its relevance in real-world clinical practice, with special attention to the following aspects:

1. Critical challenges and barriers to implementation;
2. Proposals to improve applicability;
3. The potential role of digital health in facilitating adoption.

All the invited members were asked to complete an online survey, rating their agreement with the 33 proposed statements using a scale from 0 (no agreement) to 10 (complete agreement). A statement was considered validated if it met two criteria: (1) a mean score of ≥ 8 and (2) at least 75% of responses scoring ≥ 8. These dual thresholds were adopted to account for possible skewed vote distributions or the presence of strongly dissenting opinions, ensuring a more robust consensus process than using a single metric alone.

Following the survey, the steering committee revised the statements as needed and finalized the wording. The results of the final survey were reviewed and finalized during a consensus meeting held via teleconference on January 10, 2025. Upon achieving full agreement, a final consensus document was drafted. A summary of the main findings, along with the final statements and their corresponding agreement percentages, is presented below.

Results

A total of 33 comprehensive recommendations were developed to guide clinicians in the imaging referral process for patients with suspected or confirmed axSpA. These recommendations cover clinical features suggestive of axSpA, relevant medical history, prior imaging, potential contraindications for specific imaging modalities or contrast agents, and the rationale for requesting imaging. Of the 33 statements, 31 (93.94%) achieved a mean agreement score of ≥ 8/10 and met the additional criterion of at least 75% of responses scoring ≥ 8. One general principle statement and one regarding MRI findings of structural damage in the SIJs did not meet these thresholds. The statements (validated and not) included in the online survey are presented in Table 1.

A summary of the task force's internal discussions on the applicability of ASAS statements to the Italian healthcare system and radiology/rheumatology practice is provided below, along with commentary on the rationale behind new proposed statements aimed at enhancing ASAS implementation in Italy.

Domain 1: overarching principles

Consensus was reached on the importance of considering all available data—including active inflammatory and structural lesions—when interpreting SIJs and spinal MRI in the context of axSpA (Statement 1A). However, Statement 1E narrowly met the minimum validation threshold, with only 65% of respondents scoring ≥ 7/10, reflecting some divergence in expert opinion.

Domain 2: communication of clinical information

The panel emphasized the need for effective communication between the referring rheumatologist and the radiologist, including comprehensive clinical data (e.g., age, sex, HLA-B27 status, symptom profile, physical activity level, and previous imaging). A checklist was developed (Table 2) to standardize referrals. Statement 2C achieved the minimum validation threshold, with noted barriers including limited consultation time, lack of communication training among rheumatologists, and inadequate use of adherence assessment tools.

Domain 3: MRI protocol standardization

A standardized imaging acquisition protocol (IAP) including at least four sequences (3-semicoronal and 1-semiaxial) across two imaging planes was recommended for diagnostic ascertainment of sacroiliitis and its differential diagnoses. The European Society of Skeletal Radiology's Arthritis Subcommittee released its guidelines for a SIJs MRI IAP in 2015, which called for four MRI sequences for diagnostic reasons [11]. Although validated, the statement achieved relatively lower agreement (mean score of 8, with 82.5% scoring ≥ 8/10), reflecting concerns about training, access, and implementation. Definitions and an atlas of inflammatory and structural lesions of the spine were created by the creators of the Canada-Denmark (CANDEN) MRI working group in 2009 [12, 13]. They also reported on the reliability of scoring the individual lesions in a multireader exercise [14]. The CANDEN technique makes it possible to systematically evaluate spine MRI from the standpoint of diagnostic determination and to quantify structural and active inflammatory abnormalities based on their exact anatomical positions and their relationships across time [15]. Short Tau Inversion Recovery (STIR) and sagittal T1-weighted (T1W) MRI sequences of the vertebral bodies and the posterior components of the vertebrae (i.e., the costotransverse, costovertebral and facet joints, transverse and spinous processes, and the surrounding soft tissues) served as the basis for the definitions.

Table 1 Final consensus on the applicability of the Italian expert group of 19 radiologists and 21 rheumatologists and level of agreement with the statements

Statements of each domain	Criterion 1 Mean agreement (0-10)	Criterion 2 % of votes ≥ 8 (80-100)
1. Overarching principles		
1A. When interpreting imaging studies of the sacroiliac joints (SIJs) and spine in the context of axial spondyloarthritis (axSpA) for diagnostic or classification purposes, all available images from the same modality should be reviewed concurrently. This is because different slice orientations or sequences may reveal additional findings that are essential for accurate interpretation. Magnetic resonance (MR) images demonstrating various features of sacroiliitis—such as signs of active inflammation and structural damage—should be evaluated simultaneously and interpreted within the broader context of all imaging findings	8.75	92.5%
1B. Numerous artifacts can occur in MRI of the SIJs and spine. When a finding of uncertain significance is identified in a single imaging plane, it should, whenever possible, be confirmed in a second orientation. This approach is particularly important in imaging studies used for diagnostic or classification purposes, where accuracy and reproducibility are essential	8.50	90.0%
1C. Lesions of the SIJs and spine must be clearly identifiable, located in anatomically typical regions, and exhibit imaging characteristics that are highly suggestive of axSpA. The presence of a small solitary lesion should be interpreted with caution, as it is uncommon for such a lesion to be definitively characterized as "clearly present" or diagnostic in isolation. Relevant lesions are typically expected to be either multiple or visible across several images (e.g., slices, sequences, or orientations). When a lesion is identified but its relevance to axSpA remains uncertain, the interpretation may be guided by the presence of additional, concomitant lesions that support the diagnosis	8,25	87.5%
1D. In research settings, MRI interpretation is typically performed without access to patient-specific clinical information. However, in clinical practice, the MRI report should always be interpreted in the full context of the patient's demographic, clinical, and laboratory data. Even when MRI findings of the SIJs and spine are reported as suggestive of axSpA, the final diagnosis may still be that the patient does not have axSpA. Several other SIJs conditions—including fracture, osteoarthritis, infection (sepsis), trauma, neoplasia, and imaging artifacts—can mimic the appearance of axSpA-related lesions on MRI	8.25	82.5%
1E. In patients with axSpA, it is recommended to perform follow-up imaging of active inflammatory lesions in the SIJs and spine after initiation of specific therapies. Monitoring these lesions over time can provide valuable information regarding treatment response, disease progression, and the resolution or persistence of inflammatory activity.	7.00	65.0% Not validated
2. Clinical data (Checklists for requesting imaging in axSpA)		
2A. Referring rheumatologists should provide relevant clinical information when requesting imaging studies. This should include, at a minimum, the patient's age, sex, and HLA-B27 status (see Table for details).	9.50	100%
2B. Imaging requests should also specify the presence or history of back pain, including its duration, anatomical localization, and whether it exhibits inflammatory characteristics. In the case of follow-up imaging, any changes in clinical symptoms should be clearly indicated (see Table).	9.25	95.0%
2C. Radiologists should be informed if the patient is engaged in physically demanding or high-impact activities, as this may influence the interpretation of certain findings.	8.00	82.5%
2D. Radiologists should have access to prior imaging studies for direct comparison. If previous images are unavailable, corresponding radiological reports should be provided to assist with longitudinal assessment.	8.25	87.5%
2E. Imaging requests should include information on any known contraindications to specific imaging modalities or contrast agents, as applicable (see Table 2).	8.25	85.0%
3. Technical data		
3A. MRI sequences The lead authors (M.C./F.S.) developed the definitions with an emphasis on gold-standard imaging protocols, specifically T1-weighted (T1W) and fat-saturated T2-weighted (FS T2) or short tau inversion recovery (STIR) sequences, applying a consistent and homogeneous approach to ensure clarity and standardization in the definition process.	8.00	82.5%

Semicoronal is defined as parallel to the dorsal cortex of the S2 vertebral body (anterior border of sacral spinal canal)	T1-weighted spin echo (fat sensitive)	2–3 min (1.5T–3 min) (3T–2 min)	Structural damage	Fat lesion, erosion, sclerosis, backfill, ankylosis.
	T2-weighted with suppressed fat	2–4 min (1.5T–4 min)	Active inflammation	BME, capsulitis, enthesitis, fluid in the joint space, inflammation

Table 1 (continued)

	signal (BME sensitive) STIR, T2FS, T2-Dixon or equivalent.	(3T–2–3 min)		in an erosion cavity.		
	T1-weighted thin slice (erosion sensitive) T1 weighted 3D gradient echo is strongly recommended. Suppressed fat signal is also recommended	4 min (2D T1FS at 1.5T–4 min) (3D T1FS at 3T–4 min)	Structural damage	Erosion of the articular surface, alteration of joint space width (widening, narrowing, ankylosis). Also, findings more common with OA: intraarticular gas, osteophyte, extra-articular bone bridge, subchondral cyst.		
Semiaxial is defined as perpendicular to semicoronal	T2-weighted with suppressed fat signal (BME sensitive) STIR, T2FS or equivalent. T2 Dixon may be preferred (Include whole pelvis suggested)	2–5 min (Acquisition time depends on number of slices, Dixon, spatial esolution and Tesla strength)	Active inflammation	BME, capsulitis, fluid in the joint space, inflammation in an erosion cavity. Pelvis: parasymphyseal BME (osteitis ubis), pelvic enthesitis, hip arthritis.		
A four-sequence imaging acquisition protocol (IAP)—comprising three semicoronal and one semiaxial sequence—is recommended for the diagnostic assessment of sacroiliitis and its differential diagnoses (see Table). This protocol should adhere to the following technical requirements. Semicoronal sequences must be acquired parallel to the dorsal cortex of the S2 vertebral body and include: • a fluid-sensitive sequence for detecting active inflammation (e.g., T2-weighted with fat suppression or STIR). • a T1-weighted sequence optimized for identifying structural damage involving the bone and bone marrow. • a high-resolution sequence targeting the bone–cartilage interface of the SIJs, optimized for the detection of bone erosions. A semiaxial sequence sensitive to inflammation (e.g., fat-suppressed T2-weighted or STIR) should also be included to improve spatial characterization and lesion confirmation across planes.						
4. Standardized Imaging Reporting (Lesion Definitions): MRI Signs of Inflammatory Activity in the Sacroiliac Joints These observations are made using MRI sequences that are sensitive to inflammatory activity. This includes T2-weighted (T2W) sequences with fat suppression (FS), such as short tau inversion recovery (STIR), which are sensitive to free water and useful for detecting bone marrow edema. Additionally, T1-weighted sequences with fat suppression following gadolinium administration (T1WFS post-Gd) are used to identify contrast enhancement associated with active inflammation.						
4A. Bone Marrow Edema (BME). An ill-defined area of low signal intensity on T1-weighted (T1W) images and high signal intensity on fluid-sensitive sequences, such as STIR or T2-weighted fat-suppressed images, located in the subchondral bone marrow adjacent to the SIJs. When visible as a hyperintense signal on contrast-enhanced T1-weighted fat-saturated (T1WFS post-Gd) images, the finding reflects increased vascularity and is referred to as osteitis. The sacral interforaminal bone marrow serves as the internal reference for determining normal bone marrow signal intensity. To be considered pathological, inflammation must be clearly present and located in a typical anatomical region, i.e., the subchondral bone.					9.75	100%
4B. Capsulitis is characterized by increased signal intensity on fluid-sensitive sequences, such as STIR or T2-weighted fat-suppressed images, associated with diffuse thickening of the capsular margins along the anterior superior aspect of the SIJs on coronal oblique images. This finding corresponds to capsular inflammation, adjacent reactive edema, and enthesitis of the bone. Imaging Features: • Hyperintense signal on STIR or T2-weighted fat-suppressed sequences. • Diffuse thickening of the anterior superior capsule on coronal oblique images. Clinical Relevance: Capsulitis indicates active inflammation of the SIJs capsule and may be associated with adjacent bone marrow edema and enthesitis.					9.25	92.5%
4C. Enthesitis is identified as increased signal intensity in the bone marrow and/or adjacent soft tissue on STIR and/or T1-weighted fat-suppressed post-gadolinium (T1FS post-Gd) images at sites where ligaments and tendons attach to bone, excluding the interosseous ligaments of the SIJs. Imaging features: • Hyperintense signal at ligamentous or tendinous insertion sites on STIR or T1FS post-Gd sequences. • Absence of involvement of interosseous ligaments. Clinical Relevance: Enthesitis reflects inflammation at the enthesis and is a hallmark of spondyloarthropathies.					8.75	90.0%
4D. Joint space enhancement refers to increased signal intensity on contrast-enhanced images within the joint space of the cartilaginous portion of the SIJs, indicative of synovial inflammation. Imaging features: • Hyperintense signal on T1-weighted fat-suppressed post-gadolinium images within the cartilaginous joint space.					8.00	85.0%

Table 1 (continued)

Clinical Relevance: This finding suggests active synovitis and is considered a sign of active sacroiliitis.		
4E. Joint space fluid is observed as a bright signal within the joint space on STIR images, with intensity equivalent to that of cerebrospinal fluid, indicating the presence of intra-articular fluid. Imaging features: • Hyperintense signal on STIR sequences within the SIJs space. Clinical Relevance: While joint space fluid can be a nonspecific finding, in the appropriate clinical context, it may support the diagnosis of active sacroiliitis.	8.25	80.0%
5. Standardized Imaging Reporting (Lesion Definitions): MRI Signs of structural damage in the Sacroiliac Joints These observations are made using MRI sequences sensitive to the detection of structural changes in the SIJs. Most structural lesions are best visualized on sequences that preserve fat signal—specifically T1-weighted (T1W) spin echo sequences without fat suppression.		
5A. Fat Lesion (Fat Metaplasia): A homogeneously hyperintense signal on T1W non-fat-suppressed images, brighter than normal bone marrow, meeting all of the following criteria: • Located in a typical anatomical location, i.e., the subchondral bone. • Homogeneous signal intensity throughout the lesion. • Sharply defined along its non-articular border with adjacent normal marrow.	9.50	97.5%
5B. Erosion: a defect in subchondral bone associated with full thickness loss of the dark appearance of the subchondral cortex at its expected location, with loss of signal on a T1W non-fat-suppressed sequence compared to the normal bright appearance of adjacent bone marrow. Erosion. A defect in the subchondral bone characterized by: • Loss of the normal dark cortical line at the expected site of the subchondral cortex. • Hypointense signal on T1W non-fat-suppressed images in comparison to the surrounding bright bone marrow, indicating cortical and trabecular bone loss.	9.25	90.0%
5C. Fat Metaplasia in an Erosion Cavity (Backfill). Hyperintense signal on T1W images within the location of a prior erosion or cluster of erosions, with the following features: • Complete loss of the normal dark cortical subchondral line. • Clear demarcation from adjacent marrow by an irregular, hypointense band representing sclerosis at the margin of the original erosion.	9.00	82.5%
5D. Sclerosis. A region of markedly hypointense signal on all MRI sequences, located in the subchondral bone, consistent with increased bone density or mineralization.	8.75	92.5%
5E. Ankylosis. Abnormal hyperintense signal on T1W non-fat-suppressed images, matching bone marrow intensity, and observed: • In the expected location of the SIJs space, • With bridging of the joint and continuity of marrow signal between the ilium and sacrum, • Associated with full-thickness loss of the normal dark subchondral cortex on both sides.	9.50	100%
5F. Bone bud. A T1-hyperintense focus (similar to marrow signal) located in the expected region of the SIJs space, but: • Not bridging the joint—i.e., it is continuous with the subchondral bone of either the ilium or the sacrum, but not both. • Associated with full-thickness loss of the dark subchondral cortical line on one side only.	77.5	73.0% Not validated
6. Standardized Reporting Imaging (lesion definitions). MRI spine lesion definitions indicating signs of activity These observations are based on MRI sequences that are sensitive to active inflammatory changes. Specifically: • T2-weighted sequences with fat suppression—such as short tau inversion recovery (STIR) or T2 fat-saturated (T2FS)—are sensitive to free water content, and are therefore optimal for detecting bone marrow edema and soft tissue inflammation. • T1-weighted sequences with fat suppression following gadolinium administration (T1FS post-Gd) are sensitive to contrast enhancement, aiding in the identification of active synovitis, capsulitis, and enthesitis.		
6.A. Anterior corner inflammatory lesions: geographic, triangular-shaped high signal intensity pattern on fluid sensitive sequences (FS T2/STIR/Dixon Water MRI images) and low signal intensity on T1W MRI images, commonly presenting with the long axis along the anterior vertebral body and the short axis along the endplate. The signal abnormality is typically centered on the enthesis of Sharpey's fibers of the annulus fibrosus onto the endplate and may extend along the insertion of the anterior longitudinal ligament onto the vertebral body.	9.50	100%
6B. Posterior corner inflammatory lesions. A geographically-defined, triangular-shaped area of high signal intensity on fluid-sensitive sequences, commonly: ▪ Aligned with the long axis along the posterior vertebral margin and the short axis along the vertebral endplate. ▪ Centered at the enthesis of Sharpey's fibers from the annulus fibrosus onto the endplate. ▪ May extend along the insertion of the posterior longitudinal ligament into the vertebral body.	8.00	82.5%
6C. Andersson—central lesion. A central third vertebral endplate lesion, presenting as high signal intensity on fluid-sensitive sequences, located in the subchondral region of the vertebral body: • No associated endplate buckling or disc material invagination is present. • The signal corresponds to inflammation of the cartilage endplate.	8.50	87.5%
6D. Costo-vertebral joint inflammatory lesions. A focal or ring-like area of high signal intensity on fluid-sensitive sequences:		

Table 1 (continued)

• Located at the posterior corner of the vertebral body. • May span two adjacent vertebral levels and extend to adjacent costovertebral facets. • Reflects osteitis, synovitis, and enthesitis at the insertion of the radiate ligaments and inflammation at the costal demi-facet. • Most commonly observed from T2 to T9, with T1, T10, T11, and T12 generally excluded due to their anatomical variability.	8.25	82.5%
6E. Costo-transverse joint inflammatory lesions: A high signal intensity area on fluid-sensitive sequences (e.g., STIR or T2FS), typically observed on far lateral sagittal slices, spanning the head of the rib and the adjacent transverse process of the thoracic vertebra. • The signal abnormality reflects osteitis originating from the fibrous capsule and synovitis within the costotransverse joint.	8.00	82.5%
7. Standardized Reporting Imaging (lesion definitions). MRI spine lesion definitions indicating signs of structural damage These observations are made using MRI sequences sensitive to the detection of chronic structural changes, most of which are best visualized on sequences that preserve fat signal—specifically T1-weighted (T1W) spin echo sequences without fat suppression. These structural lesions can be categorized into the following types:		
7A. Anterior corner fat lesion. A bone marrow lesion with fatty signal characteristics, appearing as high signal intensity on T1W images and low signal intensity on fat-suppressed fluid-sensitive sequences (e.g., STIR, FS T2, or Dixon Water), located at the superior or inferior anterior corner of a vertebral body. • The lesion reflects the quiescent or chronic phase following a prior anterior corner inflammatory lesion. • The shape is often triangular, and an L-shaped configuration is considered more suggestive of axSpA.	9.25	92.5%
7B. Posterior corner fat lesion. A triangular, geographic lesion showing hyperintense signal on T1W and T2W images and hypointense signal on fluid-sensitive sequences, commonly: • With the long axis along the posterior vertebral body margin and the short axis along the endplate. • Centered at the enthesis of Sharpey's fibers of the annulus fibrosus, and potentially extending along the posterior longitudinal ligament. • The fatty signal is considered indicative of the chronic, post-inflammatory phase following a posterior corner inflammatory lesion.	8.00	82.5%
7C. Anterior corner sclerotic lesion (ACSL) (Romanus lesion). A focal area of osteosclerosis, presenting as low signal intensity on T1W, T2W, and fat-suppressed fluid-sensitive sequences, located at the superior or inferior anterior corner of a vertebral body. • Sclerosis is interpreted as the chronic, hyperostotic phase following an anterior corner inflammatory lesion.	9.00	87.5%
• May be associated with: • Bone erosion or resorption at the vertebral corner. • Squaring of the vertebral body contour. • New bone formation, potentially evolving into syndesmophytes. .		
7D. Ankylosis. Abnormal bright signal on T1W images, extending from one vertebra to the next, indicating bony continuity across previously separated structures. Ankylosis can be subclassified as: • Anterior Corner Ankylosis: bridging involving the anterior vertebral corners. • Posterior Corner Ankylosis: bridging at the posterior vertebral corners. • Vertebral Endplate Ankylosis: fusion involving the endplate but sparing the anterior and posterior corners. • Facet Joint Ankylosis: bony bridging or fusion across a facet joint.	8.50	87.5%
8. Discussion		
8A. The radiologist should state clearly if findings are compatible with axSpA, based on the images and clinical information available. The conclusion should provide 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 radiologist should clearly state whether the imaging findings are compatible with axSpA, taking into account both the imaging features and any available clinical information. • The conclusion should specify whether there is evidence of active inflammation, structural changes, or both. • The report should highlight the most prominent lesions observed and include an indication of the level of diagnostic confidence in the interpretation.	9.75	100%
8B. These recommendations, developed by the Italian Society of Medical Radiology (SIRM) and the Italian Society of Rheumatology (SIR), are intended to: • Provide standardized guidance for the requesting and reporting of imaging studies in the context of axSpA. • Facilitate and improve interdisciplinary communication between rheumatologists and radiologists, thereby supporting more accurate diagnosis, consistent reporting, and improved patient management	9.25	95.0%

Domain 4: MRI sacroiliac joint lesion definitions indicating signs of activity

The panel agreed that accurate identification of BME requires strong T2-weighting and fat suppression, while contrast-enhanced sequences offer minimal additional value [16]. For the interpretation of MRI of the inflammatory SIJs lesions in the diagnosis of axSpA in the UK, the British Society of Spondyloarthritis issued a study of the subject in 2019 with seven suggestions [17]. Some patients with non-radiographic axSpA (nr-axSpA) do not exhibit MRI signs of inflammation, nevertheless, and this can also happen nonspecifically [18]. Proper T2-weighting of the necessary BME-sensitive sequence is necessary. This is not unexpected because, at most ages, sacral bone marrow is made up of both fatty and erythropoietic marrow. The erythropoietic marrow may appear relatively bright on a dark background when sequences are fat suppressed; however, this issue can be resolved with appropriate T2-weighting. T2-weighting has the effect of weakening the signal in bound water (like cartilage, muscle, or erythropoietic marrow), while leaving the signal strong in free water (like cerebrospinal fluid or BME). From a technical standpoint, this implies that the echo period must be sufficiently lengthy, roughly 80 + ms for spin echo sequences and 50 + ms for STIR. When compared to STIR or T2 with fat saturation, the water component of T2-weighted Dixon imaging seems to be just as successful at detecting BME [19]. Strong T2-weighting and the reduction or eradication of the bone marrow fat signal are essential components of the suggested strategy. Every author concurred that there are enough data to support the idea that contrast-enhanced sequences are typically not required in adults or children and ought to be saved for exceptional situations. With little added value, contrast enhancement would come with extra expense and difficulty. Furthermore, contrast enhancement of inflammatory tissue in the joint space and synovitis, which may be easier to discern with contrast enhancement, hardly ever occurs in adults without accompanying BME [20, 21]. In order to accurately show anatomy, visualize particular lesions, and diagnose sacroiliitis in all patients—not just those with axSpA—a T1W spin echo (T1WSE) sequence is thought to be necessary. Fat lesions and backfill in subchondral bone, which are significant axSpA-related lesions, are best visible on T1WSE sequences because they are "fat-sensitive." Any sequence acquisition can be divided into distinct fat-only and water-only pictures using the Dixon approach. According to Özgen, a T2-weighted multipoint Dixon sequence has a better contrast-to-noise ratio than traditional sequences and can show the BME, sclerosis, and fat lesions of sacroiliitis [20]. Nevertheless, neither erosion detection nor diagnosis accuracy was evaluated in the publication. While Chien et al. found that the presence of subchondral edema in active sacroiliitis reduced the diagnostic accuracy of SIJs erosion detection on T2W Dixon MRI [22], Athira et al. suggest that T2 Dixon sequences are superior or equivalent to conventional MRI sequences [21]. The fact that these investigations primarily addressed the MRI results of axSpA and included a small number of individuals severely limited them. The accuracy of T2-Dixon imaging against traditional sequences for a variety of SIJs disorders in larger populations of patients with low back pain is not yet compared in any publication. Therefore, it is not now possible to provide a substitute for incorporating a T1WSE.

Domain 5: MRI sacroiliac joint lesion definitions indicating signs of structural damage

In early axSpA, there is a predictive and longitudinal correlation between inflammation found on MRI and the emergence of structural damage on MRI in the spine (fatty lesions) and SIJs (fatty lesions and erosions) over a 5-year period [23]. Because it supports its use for prognostic stratification, evidence showing inflammation on MRI induces structural damage in early axSpA is pertinent to practicing rheumatologists [24]. A number of structural MRI abnormalities in the SIJs have been reported in earlier research [25]. When radiographs are normal or ambiguous, MRI of the SIJs may show structural abnormalities, especially erosions, in individuals with nr-axSpA [26]. When the cortical bone of the iliac or sacral bones is breached, it appears dark on both T1WSE and STIR sequences. Additionally, on T1WSE MRI, the strong signal from the surrounding marrow matrix is gone, indicating the presence of erosion [27]. A lesion in bone marrow close to subchondral bone may also be observed on the T1WSE MRI scan. This lesion is differentiated by a consistent rise in marrow signal, which is a hallmark of lipid accumulation, and a visible boundary [28]. This lesion's histopathologic nature is still unknown; it might represent adipose tissue, but it could also reflect lipid accumulation in distinct cell types, which can happen as a cell matures into a different phenotype. This lesion has been called fat metaplasia because it has recently been established to indicate tissue modification after BME clearance [25, 29]. Similar tissue has been shown to form at erosion locations after inflammation has subsided; this phenomenon has been dubbed "backfill." The reparative fatty metaplasia adjacent to the SIJs, which are encircled by sclerosis, is known as the "backfill," an intermediate stage between erosion and ankylosis [25]. Together with a semi-quantitative scoring system that evaluates each unique lesion, standardized classifications for these various lesions have been created and validated [28]. The significance of standardizing an imaging report to best define MRI sacroiliac joint lesions exhibiting evidence of structural deterioration was nearly universally agreed upon, much like the prior assertion. The primary

Table 2 Checklist for communication of clinical information

PATIENT :		SEX M ☐ F ☐	
RESIDENCE:		AGE:	TELEPHONE NUMBER:
PREVIOUS DISEASES OR COMORBIDITIES:			
CURRENT THERAPIES:			
INVESTIGATION TO BE CARRIED OUT			
☐ CERVICAL SPINE _____ ☐ DORSAL SPINE _____		☐ LUMBAR SPINE_____ ☐ SACROILIAC JOINTS_____	
CHECKLIST FOR IMAGING REQUEST OF AXIALSPA ASAS-endorsed recommendation for the early referral of patients with a suspicion of axial spondyloarthritis (Poddubnyy D, van Tubergen A, Landewé R, Sieper J, van der Heijde D; Assessment of SpondyloArthritis international Society (ASAS). Development of an ASAS-endorsed recommendation for the early referral of patients with a suspicion of axial spondyloarthritis. Ann Rheum Dis. 2015;74(8):1483-7).		1. Inflammatory back pain. Any set of criteria, preferably ASAS definition of inflammatory back pain: at least four out of five parameters present: (Calin A, et al. JAMA 1977; 237:2613–4): ☐ age at onset ≤40 years ☐ insidious onset ☐ improvement with exercise ☐ no improvement with rest ☐ pain at night (with improvement upon getting up) 2. Human leucocyte antigen-B27 positivity: ☐ Positive ☐ Negative ☐ Not availble 3. Sacroiliitis on imaging, if available (on X-rays or MRI): ☐ X-Ray ☐ MRI 4. Peripheral manifestations (in particular arthritis, enthesitis and/or dactylitis) (according to the definition applied in the classification criteria for axial spondyloarthritis): ☐ arthritis: past or present active synovitis diagnosed by a physician ☐ enthesitis (heel): past or present spontaneous pain or tenderness at examination of the site of the insertion of the Achilles tendon or plantar fascia at the calcaneus ☐ dactylitis: past or present dactylitis, diagnosed by a physician 5. Extra-articular manifestations: ☐ psoriasis ☐ inflammatory bowel disease ☐ uveitis 6. Positive family history for spondyloarthritis (presence in first-degree (mother, father, sisters, brothers, children) or second-degree (maternal and paternal grandparents, aunts, uncles, nieces and nephews) relatives of any of the following: ☐ ankylosing spondylitis ☐ psoriasis ☐ acute uveitis ☐ reactive arthritis ☐ inflammatory bowel disease 7. Good response to non-steroidal anti-inflammatory drugs (NSAIDs): (24–48 h after a full dose of a NSAID the back pain is not present any more or is much better). 8. Elevated acute phase reactants (C-reactive protein serum concentration or erythrocyte sedimentation rate above upper normal limit after exclusion of other causes for elevation).	
		Possible contraindications to certain types of imaging or contrast:	

barriers to including MRI as a crucial component of the accepted diagnostic procedure for patients with axSpA are the quality of educational programs and the absence of specialized training for radiologists. Statement 5F bone bud met the minimum validation threshold, with only 73% of respondents scoring ≥ 7/10, reflecting some divergence in expert opinion.

Domain 6: role of MRI spine lesion indicating signs of activity

MRI's value in detecting early inflammatory spinal lesions, particularly in nr-axSpA, was affirmed. The use of spine MRI has grown since that 2012 article [8], and knowledge of how to identify and interpret structural and inflammatory

spinal abnormalities in relation to clinical symptoms in axSpA and differential diagnosis has greatly improved. Since MRI can identify inflammatory spinal lesions in patients with early-onset axSpA who do not exhibit radiographic sacroiliitis, it is a valuable supplementary screening tool [7]. The ASAS/OMERACT working group defined a positive spinal MRI scan as having BME next to the vertebral endplates at the point where the anterior and posterior longitudinal ligaments insert into the facet joints and the annulus fibrosus attaches to the vertebral rim [30]. T2-weighted sequences with fat suppression that are sensitive for free water, like STIR, or T2FS or T1W sequences with fat suppression that are sensitive for contrast enhancement, like T1FS post-Gd, are examples of MRI sequences that are sensitive for the detection of disease activity. MRI is frequently used in clinical practice because of its great sensitivity in identifying inflammatory lesions of the spine, particularly when evaluating patients who may have axSpA and/or a history of persistent inflammatory low back pain [8, 31]. Other lesions affecting the vertebral bodies include the thoracic lateral inflammatory lesion (a lesion located posteriorly in a lateral slice, also known as arthritis of the costovertebral joints), which is only documented for the thoracic spine, and the vertebral endplate inflammatory lesion (also known as aseptic spondylodiscitis or Andersson—central lesion). Increased signal in bone marrow in at least one sagittal slice in a water-sensitive sequence in one of the other posterior elements where there are ligamentous or muscular attachments, or at the costotransverse joint (excluding the pedicle, facet processes, and pars interarticularis) is indicative of an inflammatory lesion of the posterior elements, which includes enthesitis of the spinal ligaments and inflammation of the costotransverse joint. The experts agreed that patients are more likely to be motivated and eager to follow treatment suggestions when they receive care that is customized to their preferences and goals. Statements 6D and 6E met only the minimum consensus threshold, possibly due to differences in interpretation and technological limitations.

Domain 7: role of MRI spine lesion indicating signs of structural damage

When typical features such as fat lesions, erosions, sclerosis, syndesmophytes, or ankylosis are clearly present at the vertebrae, they are referred to as structural lesions. Any kind of structural lesion may appear alone or in conjunction with or encircled by BME. Only on sequences that are sensitive to fat signals, specifically T1WSE without fat suppression, can the majority of the data be clearly detected. While the concept of fat lesions was the same, it was thought that erosions, syndesmophytes, and ankylosis needed an update on structural lesions [32, 33]. The MRI sequences used for these observations are sensitive enough to identify structural changes. Only sequences that are sensitive to fat signals, specifically T1WSE without fat suppression, may clearly display the majority of the observations. These can be separated into:

1. Bone erosion occurs when at least one sagittal slice of T1W images shows a full-thickness loss of the black look of cortical bone and a loss of the typical bright appearance of neighboring bone marrow. The only erosions evaluated are those that affect the vertebral corners. There are two types of erosions: anterior and posterior corner erosions;
2. Focal fat lesion: At least two sagittal slices of T1W images show a focally elevated signal in the bone marrow. Only fat lesions that affect the corners of the vertebrae are evaluated. There are two types of fat lesions: anterior and posterior corner fat lesions;
3. Bone spur toward the anterior or posterior longitudinal ligament (also called syndesmophytes): in at least one sagittal slice, a bright signal on T1W images that extends vertically from the vertebral corner to the neighboring vertebral corner. Bone spurs are separated into anterior and posterior corner bone spurs, which are found in the anterior and posterior corners, respectively, and do not extend to the neighboring vertebra;
4. On T1W images, ankylosis is characterized by a strong signal that extends from a vertebra and is continuous with the neighboring vertebra. The anterior and posterior corner ankylosis (found in the anterior and posterior corners, respectively) is the two subtypes of this. Ankylosis affecting the endplate but not the anterior or posterior vertebral corners is known as vertebral endplate ankylosis;
5. Ankylosis of a facet joint is known as facet joint ankylosis.

The experts concurred that any of the above-mentioned structural lesions at the location of a degenerating disk lesion should not be taken as a sign of axSpA. The specialists also underlined that bone spurs, which are found in the longitudinal ligaments and the tissue that is closely connected to them, are known to be harder to find on a traditional MRI than on a traditional radiograph or computed tomography (CT) scan. Additionally, the presence of syndesmophytes may not always be taken as a trustworthy indicator of axSpA, particularly when it comes to the identification on MRI as opposed to the identification on CT or conventional radiographs [34]. Furthermore, experts feel that regular remote patient completion of validated

adherence questionnaires and frequent healthcare providers monitoring of such data can encourage a deeper and faster knowledge of the patient's genuine adherence (6E). Every statement that was prepared and subsequently placed up for online voting satisfied the conditions for validation. It should be highlighted, meanwhile, that statements 6D and 6E only exceeded the second criterion's minimum threshold value (75% of responses equal to or greater than 8/10) because some panelists gave them lower scores.

Domain 8: final considerations and future directions

The definitions for SIJs and spinal MRI abnormalities of patients referred with unidentified back pain and clinical suspicion of axSpA have been updated based on consensus in this publication. In addition to supporting the finding that BME and fat lesions play a significant role in identifying pathologic findings when analyzing spinal MRIs, these results could also be utilized in continuing attempts to reevaluate what constitutes a "positive" MRI of the spine in relation to axSpA versus non-axSpA. With a relatively high proportion of unanimity, both of the supplementary statements have mostly met the validation criteria.

Discussion

To enhance the quality of clinical information included in imaging referrals for suspected or confirmed axSpA, the ASAS has developed a series of important recommendations [2]. This initiative builds upon previous ASAS work, particularly in the areas of imaging acquisition protocols [35], interpretation standards [32, 36], reporting guidelines [9], and broader management strategies for patients with axSpA [2]. The overarching aim of these guidelines is to strengthen collaborative communication among the various medical professionals involved in the diagnosis and care of axSpA patients—namely rheumatologists, radiologists, and imaging technicians. The recommendations align with current diagnostic workflows and decision-making frameworks used in the evaluation of patients with suspected axSpA. The development process was supported by active discussions among radiologists and rheumatologists, which contributed a range of perspectives and helped shape the final consensus. In the sections above, we outlined key areas of agreement as well as some points of contention that emerged during the task force meetings and workshop deliberations.

This consensus is not without limitations. First, the recommendations are expert-driven and rooted in clinical experience and practical preferences rather than population-based data. While certain elements—such as including patient age, sex, and contraindications in referral forms—may appear self-evident or already reflected in national protocols, the SIRM/SIR collaborative group recognizes that healthcare infrastructure and procedural norms can vary significantly across Italian healthcare settings and regions. Second, the scope of this initiative was limited to adult patients with suspected or confirmed axSpA. As such, the recommendations may not be directly applicable to younger populations, who often require tailored imaging strategies and clinical considerations. Lastly, although these statements may place additional demands on referring rheumatologists in terms of documentation and communication, their primary intent is to foster a more reciprocal and effective exchange of clinical information between specialties. Improved communication between rheumatology and radiology teams is essential to optimizing diagnostic accuracy and patient care.

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Declarations

Conflict of interest Antonio Barile is Editor in Chief of La Radiologia Medica. Andrea Giovagnoni and Marcello Zappia are Editors in La Radiologia Medica. All the other authors have no relevant financial or non-financial interests to disclose.

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