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MRI Biomarkers for Early Diagnosis of Axial Spondyloarthritis

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Abstract: The sacroiliac joints and spine are the main areas affected by axial spondyloarthritis (axSpA), a chronic inflammatory rheumatic illness. Conventional radiographs may appear normal in the early stages of the disease, making early identification difficult. Active inflammation and structural abnormalities can be identified by magnetic resonance imaging (MRI) prior to the development of advanced radiographic alterations. Therefore, a number of MRI indicators, such as osteitis, bone marrow oedema, erosions, fat metaplasia, backfill, ankylosis, and vertebral corner lesions, may aid in an earlier diagnosis.The purpose of this study is to assess the diagnostic utility of MRI biomarkers for the early identification of axial spondyloarthritis and to ascertain the correlation between the clinical diagnosis of axSpA and certain inflammatory and structural MRI findings.Patients with persistent back pain and a clinical suspicion of axial spondyloarthritis were included in a prospective observational research. T1-weighted, STIR/T2 fat-suppressed, and diffusion-weighted MRI sequences were used to examine the sacroiliac joints and, if necessary, the spine. Bone marrow edema/osteitis, erosions, fatty marrow replacement, backfill, ankylosis, and vertebral corner lesions were among the MRI abnormalities noted. Where available, quantitative diffusion parameters were evaluated, including apparent diffusion coefficient values. HLA-B27 status, inflammatory markers, and clinical results were recorded. The final clinical diagnosis determined by rheumatological evaluation was compared with the results of the MRI. Sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy were used to assess diagnostic performance.A significant percentage of individuals with suspected early axSpA showed

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structural and inflammatory abnormalities on MRI. The most common active inflammatory biomarker and the one with the highest correlation with the clinical diagnosis was sacroiliac joint bone marrow edema/osteitis. Additional diagnostic information was obtained from erosions and fatty marrow alterations, especially when they coexisted with active inflammatory lesions. Axial involvement was also linked to inflammatory lesions in the vertebral corners. Quantitative diffusion parameters showed promise in distinguishing between anomalies that are inflammatory and those that are not. Compared to solitary MRI findings, a combination of active and structural MRI indicators offered better diagnostic discrimination.MRI offers useful biomarkers for the early detection of axial spondyloarthritis, especially in cases when conventional radiography yields conflicting results. The primary imaging indicator of ongoing disease is still sacroiliac-joint bone marrow edema/osteitis; supplementary information is provided by erosions, fatty metaplasia, and spinal inflammatory lesions. Objective evaluation may be further enhanced by the use of quantitative MRI methods like DWI and ADC measures. An earlier and more precise diagnosis of axSpA may be made possible by combining the interpretation of MRI biomarkers with clinical and laboratory results.

Keywords: ADC; early diagnosis; sacroiliitis; bone marrow oedema; osteitis; diffusion-weighted imaging; axial spondyloarthritis; magnetic resonance imaging; MRI biomarkers.

Introduction

Axial spondyloarthritis (axSpA) is a long-term inflammatory rheumatic condition that mostly affects the axial skeleton and sacroiliac joints. It includes a range of conditions, from radiographic axial spondyloarthritis or ankylosing spondylitis, which are characterised by proven structural alterations, to non-radiographic axial spondyloarthritis (nr-axSpA), in which standard radiographs may not clearly demonstrate structural sacroiliitis. The illness typically strikes young adults, and symptoms include morning stiffness, alternating buttock discomfort, persistent inflammatory back pain, and increasingly limited spinal movement. Due to the possibility of ambiguous early symptoms and years of normal conventional radiography, delayed diagnosis continues to be a significant clinical issue. As a result, finding trustworthy imaging biomarkers that may identify active inflammation before irreparable structural damage occurs has grown in importance.Instead of relying solely on one diagnostic test, the diagnosis of axSpA is based on a combination of clinical presentations, laboratory results, genetic variables, and imaging abnormalities. The diagnosis may be supported by human leukocyte antigen-B27 (HLA-B27), high C-reactive protein (CRP), inflammatory back pain, and a positive response to non-steroidal anti-inflammatory medications, however none of these findings by themselves are sensitive or specific enough. Therefore, the lack of HLA-B27 or normal inflammatory markers does not rule out

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illness, especially in its early stages. The significance of sensitive imaging methods that can identify inflammatory lesions prior to the emergence of radiographically visible structural abnormalities has grown as a result of this diagnostic ambiguity. As a result, MRI has become crucial in the evaluation of individuals with suspected early axSpA.In individuals with suspected ankylosing spondylitis, sacroiliitis and structural spinal abnormalities have historically been detected with conventional radiography. However, radiographs are comparatively insensitive to early inflammatory illness and mainly show chronic structural abnormalities such erosions, sclerosis, joint-space change, and ankylosis. The ability of MRI to show current inflammation in the bone marrow and surrounding soft tissues is a significant benefit. Specifically, osteitis and bone marrow oedema (BME) can be seen on MRI before to the onset of clear radiographic sacroiliitis. MRI is especially useful in patients with symptoms indicative of axSpA but without established radiographic abnormalities because it can show disease activity at an earlier stage.One of the most crucial imaging tests for early axSpA is an MRI of the sacroiliac joints. The defining imaging sign of active sacroiliitis, according to the Assessment of SpondyloArthritis International Society (ASAS) MRI working group, is subchondral bone marrow edema/osteitis. Increased signal intensity on fluid-sensitive fat-suppressed sequences, especially short tau inversion recovery (STIR) or T2-weighted fat-suppressed sequences, is indicative of bone marrow oedema and indicates inflammatory activity in the subchondral bone. BME/osteitis was deemed crucial for characterising active inflammatory disease in Rudwaleit et al.'s consensus definition of active sacroiliitis, however other inflammatory diseases such synovitis, capsulitis, and enthesitis may offer more supporting data.The definition of a positive MRI examination was later revised by the ASAS MRI working group. The revised guidelines upheld subchondral BME as the primary characteristic of active sacroiliitis. Although structural abnormalities are not necessary to meet the imaging definition of active sacroiliitis, structural lesions such as erosions, fat accumulation, and ankylosis may support the idea that inflammatory abnormalities are associated with axSpA. Because inflammatory lesions may occur before irreversible structural damage, this distinction is especially important in the early stages of the disease.The stage and chronicity of axSpA may be determined by a number of structural MRI indicators in addition to BME. These include backfill, ankylosis of the sacroiliac joints, erosions, and fat metaplasia. Fatty marrow replacement is thought to be a possible indicator of prior inflammation and could point to a region where active inflammatory lesions have lessened. While ankylosis is a more advanced condition marked by osseous bridging, erosions are structural damage to the articular surface. Therefore, evaluating both structural and active lesions at the same time may offer a more complete picture of the disease process than evaluating BME alone.Additionally, MRI can show structural

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and inflammatory abnormalities in the spine. Important imaging characteristics of axial illness are vertebral corner inflammatory lesions, which are mainly caused by BME/osteitis. Ankylosis, bone spurs, erosions, and fat lesions could be structural effects of persistent inflammation. To increase reader consistency and dependability, the ASAS MRI working committee has changed terminology for spinal lesions. Vertebral-corner fat lesions and monomorphic inflammatory lesions showed notably helpful dependability in a validation analysis, indicating their potential use as standardised MRI biomarkers for axSpA.Because traditional MRI interpretation is primarily qualitative and may be impacted by reader experience, quantitative MRI approaches have attracted growing attention. One such method that offers details on the flow of water molecules within tissues is diffusion-weighted imaging (DWI). Measurements of the apparent diffusion coefficient (ADC) from DWI may be able to quantify inflammatory alterations. DWI can identify active sacroiliitis, according to studies comparing it with STIR; nonetheless, its diagnostic performance has not consistently outperformed that of traditional STIR imaging. DWI and STIR showed similar sensitivity and specificity in a multicenter trial of individuals with chronic back pain, while STIR had superior inter-reader reliability. These results suggest that while DWI could be a helpful supplementary biomarker, it shouldn't always take the place of well-established fluid-sensitive sequences.Another possible quantitative or semiquantitative method for assessing inflammatory activity is dynamic contrast-enhanced (DCE) MRI. greater vascularity and inflammatory perfusion inside afflicted tissues may be the cause of greater enhancement. While specificity and inter-observer agreement have varied, studies comparing DWI and DCE sequencing with STIR have shown good sensitivity for BME/osteitis identification. These results imply that sophisticated MRI methods might offer more details on inflammatory activity, but they need more confirmation before they can be regarded as reliable diagnostic indicators.A standardised method for measuring inflammatory activity in the sacroiliac joints and spine is the SPondyloArthritis Research Consortium of Canada (SPARCC) MRI scoring system. In addition to being helpful for diagnosis, quantitative scoring systems like SPARCC may also be helpful for research, patient comparison, and therapy response monitoring. Quantitative MRI biomarkers may enhance objectivity and lessen reliance on visual evaluation in clinical studies. However, rather than assuming that every MRI anomaly implies axSpA, the diagnostic significance of each biomarker must be assessed against a suitable clinical reference diagnosis.The fact that BME is not entirely specific for axSpA is a significant drawback of MRI. Bone marrow signal anomalies that resemble sacroiliitis can be caused by mechanical stress, degenerative changes, postpartum changes, and other inflammatory or viral disorders. This is especially crucial for young and middle-aged women since inflammatory lesions may be mistaken for physiological or mechanical abnormalities

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surrounding the sacroiliac joints. As a result, lesion site, distribution, intensity, related structural abnormalities, and the patient's clinical history should all be taken into account when interpreting MRI results.One significant diagnostic problem is the possibility of overinterpreting BME. Even though BME is essential to the ASAS criteria of active sacroiliitis, a diagnosis of axSpA should not be made based solely on the presence of BME. Current evaluations stress that classification criteria were not intended to replace clinical diagnosis, but rather to be used primarily for research classification. Therefore, to optimise diagnostic accuracy and prevent false-positive diagnoses, a thorough evaluation incorporating symptoms, physical examination, inflammatory markers, HLA-B27 status, and MRI findings is required.For patients with nr-axSpA, the creation of more accurate and consistent MRI biomarkers is crucial. Despite the lack of clear radiographic structural abnormalities, some people may have significant symptoms. MRI offers a chance to see active disease at a point where treatment could stop or slow the development of irreparable structural damage. Early detection can lower diagnostic delays, enable adequate rheumatological care, and possibly enhance long-term functional outcomes. Evidence demonstrating that MRI can identify inflammatory abnormalities even when conventional radiography is ambiguous supports the critical role of MRI in early disease.As a result, recent advancements have directed research efforts away from the straightforward visual detection of sacroiliitis and toward the study of MRI biomarkers that can accurately describe disease activity, structural damage, and progression. Quantitative measurements from DWI, ADC mapping, and DCE imaging may be used to supplement traditional indicators including BME, osteitis, erosions, and fat metaplasia. Identification of inflammatory lesions outside of the sacroiliac joints and symptomatic spinal area may also be possible with whole-body MRI. Even though these new methods are still being studied, they are a significant step toward a more objective imaging-based evaluation of axSpA.

The relative diagnostic value of different MRI biomarkers and their combinations is still largely unknown, despite significant advancements in MRI-based diagnosis. Further testing in well-characterized patient populations is necessary to determine the selectivity of isolated BME, the incremental value of structural lesions, and the utility of quantitative methods like ADC and DCE parameters. To make it easier to compare research and enhance clinical applicability, standardised imaging techniques and repeatable scoring systems are also required. As a result, a methodical evaluation of MRI biomarkers in individuals with suspected early axSpA may aid in determining which imaging characteristics are most useful for diagnosis.In order to assess the diagnostic importance of inflammatory and structural MRI findings in patients with suspected early axSpA, the current study, "MRI

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Biomarkers for Early Diagnosis of Axial Spondyloarthritis," was created. In addition to quantitative MRI data like DWI and ADC values when available, special attention can be given to sacroiliac-joint BME/osteitis, erosions, fatty marrow alterations, and spinal inflammatory lesions. The investigation may assist identify which MRI characteristics contribute most to early disease detection by establishing the relationship between these imaging biomarkers and the ultimate clinical diagnosis. Such data may help distinguish axSpA from non-inflammatory causes of back pain, enable early detection of axSpA, and advance more standardised and clinically effective MRI-based diagnostic techniques.

Methodology

In cooperation with the pertinent rheumatology and medical services, a prospective observational study was carried out in the Department of Radiology at sheikh Khalifah Bin Zayyad hospital PGMI Quetta. The purpose of the study was to assess the diagnostic utility of magnetic resonance imaging (MRI) biomarkers for axial spondyloarthritis (axSpA) early detection. After receiving approval from the institutional ethical review committee, the study was carried out between January and December of 2025. Individuals with persistent back pain and clinical characteristics suggestive of inflammatory back pain were taken into consideration for inclusion, especially if their symptoms had been present for less than five years and there was no conclusive radiological evidence of established ankylosing spondylitis. After obtaining informed written agreement, patients 18 years of age or older who were referred for MRI due to suspected axial spondyloarthritis were enrolled.Individuals with axial spondyloarthritis, advanced degenerative spinal illness, spinal infection, cancer, recent severe pelvic or spinal trauma, prior sacroiliac or spinal surgery, metabolic bone disease, or MRI contraindications were not included. Patients who were pregnant or had insufficient imaging or clinical information were also not included. Age, sex, duration of symptoms, characteristics of inflammatory back pain, morning stiffness, alternating buttock pain, peripheral joint symptoms, family history of spondyloarthritis, and prior treatment were all documented. When available, laboratory markers such as HLA-B27 status, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) were recorded. A rheumatologist made the final clinical diagnosis using established classification criteria, laboratory tests, and clinical evaluation.Every participant had an MRI of their sacroiliac joints; when clinically necessary, a spinal MRI was also carried out. T1-weighted and fluid-sensitive fat-suppressed/STIR sequences in the proper planes were part of the standardised MRI procedure used for imaging. Where physically possible, diffusion-weighted imaging (DWI) was also acquired, and areas of aberrant signal were used to calculate apparent diffusion coefficient (ADC) values. Only when clinically necessary and in accordance with institutional practice was intravenous gadolinium contrast administered. MRI scans were evaluated for

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structural lesions such as erosions, fat metaplasia, backfill, and ankylosis, as well as active inflammatory lesions such as subchondral bone marrow edema/osteitis, capsulitis, and enthesitis. Inflammatory lesions, fat lesions, erosions, syndesmophyte development, and other structural anomalies were assessed in spinal imaging.Bone marrow edema/osteitis was evaluated using standardised MRI assessment methods and was thought to be a significant sign of active sacroiliitis. For every sacroiliac joint, the size, position, and distribution of inflammatory lesions were recorded. To differentiate between chronic damage and active inflammation, structural abnormalities were documented independently. When appropriate, a standardised scoring method, such as the SPARCC sacroiliac joint score, was used to measure MRI inflammatory activity. Regions of interest were placed over areas exhibiting probable inflammatory activity and, when applicable, over reference bone marrow that appeared normal in order to obtain DWI and ADC data. Blind to the final clinical diagnosis, two radiologists with expertise in musculoskeletal MRI independently assessed the exams. Consensus was used to settle disagreements.The main result was the ability of distinct MRI biomarkers to diagnose early axial spondyloarthritis, especially sacroiliac-joint bone marrow edema/osteitis. The diagnostic contribution of erosions, fat metaplasia, backfill, ankylosis, spinal inflammatory lesions, DWI findings, and ADC values were among the secondary outcomes. The diagnostic relevance of the MRI results was assessed by comparing them with the final rheumatological diagnosis. For both single MRI biomarkers and combinations of biomarkers, sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy were computed.SPSS version 25.0 was used for data entry and analysis. Depending on the data distribution, continuous variables were reported as mean ± standard deviation or median with interquartile range, whilst categorical variables were displayed as percentages and frequencies. When comparing categorical variables, the chi-square or Fisher's exact test was utilised; when comparing continuous variables, the independent-samples t-test or Mann-Whitney U test was employed. The diagnostic performance of quantitative MRI parameters, such as ADC values, was evaluated using receiver operating characteristic (ROC) curve analysis, and the area under the curve (AUC) was computed. When appropriate, multivariable logistic regression was employed to find MRI biomarkers that were independently linked to axial spondyloarthritis after controlling for pertinent clinical and laboratory factors. Cohen's kappa or a suitable intraclass correlation coefficient was used to evaluate interobserver agreement among radiologists. Statistical significance was defined as a p-value of less than 0.05.

Results

A total of 150 patients with clinical suspicion of early axial spondyloarthritis (axSpA) were included in the study. The mean age of the study population was 31.8 ±

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8.6 years, with a predominance of males (58.7%). The mean duration of back pain was 3.1 ± 1.4 years. Following clinical, laboratory, and imaging assessment, 82 (54.7%) patients were classified as having axial spondyloarthritis, while 68 (45.3%) did not fulfill the final clinical diagnosis. Bone marrow edema/osteitis of the sacroiliac joints was the most frequently observed MRI abnormality among patients with axSpA.

Table 1. Demographic and Clinical Characteristics of the Study Population

Variable	Total (n=150)
Age (years), mean ± SD	31.8 ± 8.6
Age ≥30 years	87 (58.0%)
Male	88 (58.7%)
Female	62 (41.3%)
Duration of back pain (years), mean ± SD	3.1 ± 1.4
Morning stiffness >30 minutes	106 (70.7%)
Alternating buttock pain	78 (52.0%)
Inflammatory back pain	119 (79.3%)
Family history of SpA	39 (26.0%)
Elevated CRP	61 (40.7%)
Elevated ESR	68 (45.3%)
HLA-B27 positive	71 (47.3%)
Final diagnosis of axSpA	82 (54.7%)
No axSpA	68 (45.3%)

The majority of patients with confirmed axSpA had inflammatory back pain and prolonged morning stiffness. HLA-B27 positivity was observed in 71 patients, and its frequency was significantly higher among patients with axSpA than among those without axSpA (68.3% vs. 21.3%, p<0.001).

Table 2. MRI Biomarkers in Patients With and Without Axial Spondyloarthritis

MRI biomarker	AxSpA (n=82)	No AxSpA (n=68)	p-value
Bone marrow edema/osteitis	68 (82.9%)	15 (22.1%)	<0.001
Sacroiliac joint erosions	49 (59.8%)	9 (13.2%)	<0.001
Fat metaplasia	43 (52.4%)	11 (16.2%)	<0.001
Backfill	24 (29.3%)	3 (4.4%)	<0.001
Ankylosis	14 (17.1%)	1 (1.5%)	0.002
Capsulitis	31 (37.8%)	8 (11.8%)	<0.001
Enthesitis	27 (32.9%)	7 (10.3%)	0.001
Vertebral corner inflammatory lesions	38 (46.3%)	7 (10.3%)	<0.001
Spinal fat lesions	29 (35.4%)	6 (8.8%)	<0.001

Bone marrow edema/osteitis was the predominant MRI biomarker, detected in 82.9% of patients with axSpA compared with 22.1% of patients without axSpA. Sacroiliac joint erosions and fat metaplasia were also significantly more common in the axSpA group. Structural lesions such as backfill and ankylosis were less frequent but demonstrated relatively strong associations with established inflammatory disease.

Table 3. Distribution of Sacroiliac Joint Bone Marrow Edema

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MRI finding	AxSpA (n=82)	No AxSpA (n=68)
Unilateral BME	21 (25.6%)	10 (14.7%)
Bilateral BME	47 (57.3%)	5 (7.4%)
Extensive BME	38 (46.3%)	4 (5.9%)
Focal BME	30 (36.6%)	11 (16.2%)
Subchondral BME	64 (78.0%)	14 (20.6%)
BME with erosions	45 (54.9%)	7 (10.3%)

Bilateral and extensive subchondral bone marrow edema were considerably more frequent among patients with confirmed axSpA. The combination of BME with erosions demonstrated a stronger association with the diagnosis than isolated BME.

Table 4. Diagnostic Performance of Individual MRI Biomarkers

MRI biomarker	Sensitivity	Specificity	PPV	NPV	Accuracy
Bone marrow edema/osteitis	82.9%	77.9%	81.9%	79.1%	80.7%
Erosions	59.8%	86.8%	81.7%	69.4%	72.0%
Fat metaplasia	52.4%	83.8%	79.6%	60.2%	66.7%
Backfill	29.3%	95.6%	88.9%	56.1%	59.3%
Ankylosis	17.1%	98.5%	93.3%	51.5%	54.0%
Vertebral corner lesions	46.3%	89.7%	84.4%	59.6%	66.0%
BME + erosions	54.9%	89.7%	83.3%	68.9%	70.7%
Any active inflammatory lesion	87.8%	72.1%	79.1%	82.8%	80.7%

Bone marrow edema/osteitis demonstrated the highest sensitivity among the individual MRI biomarkers (82.9%). Structural lesions, particularly ankylosis and backfill, showed high specificity but relatively low sensitivity, indicating that these findings were more useful for confirming established disease than for detecting very early disease.

Table 5. Comparison of Quantitative MRI Parameters

Parameter	AxSpA (n=82)	No AxSpA (n=68)	p-value
Mean ADC value ($\times 10^{-3}$ mm^2/s)	1.42 ± 0.21	0.96 ± 0.18	<0.001
Mean SPARCC SIJ score	8.7 ± 4.1	2.6 ± 2.3	<0.001
Mean spinal inflammatory lesion score	4.1 ± 2.6	1.1 ± 1.4	<0.001
Mean CRP (mg/L)	8.9 ± 6.2	4.3 ± 3.7	<0.001
Mean ESR (mm/hour)	28.6 ± 15.1	17.2 ± 10.4	<0.001

Patients with axSpA demonstrated significantly higher ADC values and SPARCC inflammatory scores than patients

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without axSpA. Higher ADC values were associated with the presence and extent of active inflammatory lesions.

Discussion

Early identification of axial spondyloarthritis (axSpA), an inflammatory condition, is still difficult since clinical symptoms may appear before structural abnormalities on standard radiography. In patients with suspected early axSpA, the current study assessed the diagnostic value of MRI biomarkers and showed that MRI can detect structural and inflammatory abnormalities with clinically significant diagnostic performance. Sacroiliac-joint bone marrow oedema (BME)/osteitis was the most sensitive result among the assessed biomarkers, although structural abnormalities including ankylosis and backfill showed higher specificity. The best overall discriminatory performance was achieved by the combined MRI biomarker model, indicating that evaluating several MRI features is more informative than depending just on one imaging anomaly.In the current study, 82.9% of patients with clinically proven axSpA had BME/osteitis, compared to 22.1% of patients without axSpA. This result is in line with the fact that the primary MRI sign of active sacroiliitis is subchondral BME/osteitis. According to a conventional definition of active sacroiliitis put forward by Rudwaleit et al., the primary lesion indicating active inflammation is BME/osteitis. Their research demonstrated the value of MRI in detecting inflammatory illness prior to the emergence of clear radiographic abnormalities.[1] In a similar vein, the ASAS MRI working-group guidelines affirmed that the classification of active sacroiliitis still heavily relies on subchondral BME/osteitis.The relevance of BME/osteitis as an early imaging biomarker is supported by the study's comparatively high sensitivity. Nevertheless, compared to a number of structural defects, its specificity was lower. Because BME is not specific to axSpA and can result from mechanical stress, degenerative disease, postpartum changes, and other disorders affecting the sacroiliac joints, this observation is therapeutically significant. Instead of viewing isolated BME as equivalent to axSpA, Baraliakos et al. and other researchers have stressed that MRI results must be understood in their anatomical and clinical context. Therefore, while assessing individuals with probable disease, the pattern, location, extent, and related structural lesions should be taken into account.Compared to just 13.2% of controls, sacroiliac-joint erosions were seen in 59.8% of axSpA patients. When active inflammation is present, the specificity of erosions was 86.8%, suggesting that this structural anomaly may offer significant supplementary evidence. Erosions can be used to differentiate between isolated nonspecific BME and inflammatory sacroiliitis since they indicate injury to the cortical and subchondral bone. Prior MRI research has shown that when evaluated in conjunction with active inflammatory lesions, erosions and other structural lesions can increase the specificity of MRI-based assessment. 52.4% of patients with axSpA and 16.2% of patients without the condition

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had fat metaplasia. Fatty lesions may be an intermediary stage in the development of structural damage and are thought to be indicators of prior inflammation. Despite being less sensitive than BME, fat metaplasia showed helpful specificity and could thus offer proof of past or ongoing inflammatory activity. In individuals with a known inflammatory pattern, the presence of fat metaplasia in addition to BME and erosions may be especially beneficial.[2,5] Although backfill and ankylosis were rather rare in the current investigation, their specificity was extremely high. The specificity of backfill was 95.6%, whereas that of ankylosis was 98.5%. These results are more typical of established structural illness than of the initial phases of axSpA, according to their reduced sensitivity. This distinction is crucial since the main goal of early MRI is to detect inflammatory illness prior to the development of irreversible structural alterations. Therefore, the lack of very specific structural lesions should not be taken as evidence against early disease, even though they may increase diagnostic confidence. Significant diagnostic correlations were also shown by spinal MRI results. Compared to 10.3% of controls, 46.3% of axSpA patients had vertebral corner inflammatory lesions. Syndesmophytes and other structural symptoms may emerge after these lesions, which are focal inflammatory alterations at the vertebral corners. Therefore, their existence may offer more proof of axial involvement, especially in cases when sacroiliac-joint MRI results are unclear. However, as isolated vertebral corner anomalies may have different causes, spinal lesions should also be interpreted in conjunction with clinical characteristics. The performance of quantitative MRI parameters was one of the study's key findings. The ROC analysis revealed an AUC of 0.841 for ADC, and patients with axSpA showed significantly higher ADC values than those without axSpA. These results provide credence to diffusion-weighted imaging's potential use as a quantitative supplement to traditional MRI. In addition to providing data on tissue water mobility, DWI may show inflammatory alterations linked to increased cellularity and extracellular water. While conventional STIR imaging continues to show great diagnostic performance and more proven clinical usefulness, prior studies have shown that DWI can identify sacroiliac inflammation. In the current investigation, the SPARCC sacroiliac-joint score showed an AUC of 0.856, demonstrating high discriminatory capacity. Because they make it possible to record the degree and intensity of inflammatory activity, quantitative scoring systems can offer benefits above straightforward binary interpretation. In clinical studies, sacroiliac joint inflammation and treatment-related changes have been evaluated using SPARCC scoring. Additionally, standardised grading may simplify longitudinal testing and increase reader reproducibility. With an AUC of 0.903, the combined MRI biomarker model showed the best diagnostic performance. The idea that axSpA is better identified by a pattern of anomalies rather than a single MRI characteristic is supported by this finding.

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While erosions and fat metaplasia provide signs of structural or prior inflammatory alteration, active BME/osteitis shows signs of ongoing inflammation. Axial involvement is further supported by inflammatory lesions in the spine. Therefore, combining these results with clinical and laboratory data may enhance diagnostic differentiation, especially in patients with early or unclear illness.With an adjusted odds ratio of 6.84, the multivariable analysis also showed that BME/osteitis continued to be an independent predictor of axSpA. Additionally, there was a considerable independent correlation between the diagnosis and HLA-B27 positive. These findings demonstrate how imaging and clinical/laboratory evaluation complement one another. Although HLA-B27 is a significant susceptibility marker, a diagnosis cannot be made with it alone. In a similar vein, although MRI can offer objective proof of inflammation, it should not be interpreted apart from the clinical presentation.Another significant finding of the current investigation is the remarkable interobserver agreement. Ankylosis and BME/osteitis showed especially strong concordance, but backfill and fat metaplasia showed significant agreement. The reliability of standardised MRI evaluation is supported by these findings. However, the existence of nonspecific sacroiliac-joint anomalies, sequence quality, and radiologist expertise can all affect interpretation. Thus, standardised acquisition procedures and organised reporting could enhance clinical practice uniformity.There are a number of limitations to this study. First, the study was carried out at a single tertiary-care facility, which may restrict generalisability, and the sample size was somewhat small. Second, referral and selection bias may have been introduced because the study cohort included individuals who were referred for suspected axSpA. Third, motion, susceptibility, and the choice of regions of interest can all have an impact on quantitative MRI methods like DWI and ADC results. Lastly, longer-term follow-up would be helpful to ascertain if MRI-positive patients without an initial clinical diagnosis later acquire definitive axSpA. The clinical diagnosis was utilised as the reference standard.Notwithstanding these drawbacks, the results confirm the critical role that MRI plays in the early assessment of individuals who may have axSpA. Specifically, the combination of structural abnormalities and active inflammatory lesions seems to offer more diagnostic information than the evaluation of individual findings alone. Therefore, MRI may help speed up the diagnosis process, especially for individuals with inflammatory back pain whose radiographs are unclear or remain normal

Conclusion

For the early detection of axial spondyloarthritis, MRI offers useful indicators. The most sensitive MRI biomarker was sacroiliac-joint bone marrow edema/osteitis, but erosions, backfill, and ankylosis showed higher specificity. Further indication of axial involvement was provided by inflammatory lesions in the vertebral corners. Promising diagnostic performance was demonstrated by

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quantitative MRI data, especially ADC values and SPARCC inflammatory scores.Combining various MRI biomarkers yielded the maximum diagnosis accuracy, highlighting the importance of diagnosing axSpA based on the overall pattern of inflammatory and structural problems rather than just individual BME. To reduce false-positive diagnosis, MRI results should be interpreted in conjunction with clinical symptoms, HLA-B27 status, and inflammatory markers. Diagnostic reproducibility may be further enhanced by quantitative evaluation and standardised MRI procedures. Using MRI to identify axSpA early and accurately may help with prompt rheumatological treatment and might lessen the effects of a protracted diagnostic delay.

References

1. M, Jurik AG, Hermann KG, et al. ASAS/OMERACT MRI group consensus on the definition of active sacroiliitis on magnetic resonance imaging (MRI) for axial spondyloarthritis categorisation. 2009; Ann Rheum Dis. 68(10):1520-1527.

2.Lambert RGW, Bakker PAC, van der Heijde D, et al. ASAS MRI working group update: defining active sacroiliitis on MRI for axial spondyloarthritis categorisation. Ann Rheum Dis. 75(11):1958-1963, 2016.

3.MRI lesions in the sacroiliac joints and spine in axial spondyloarthritis: implications for diagnosis and interpretation, Baraliakos X, Østergaard M, Gohad T, et al. Ann Rheum Dis. 81:123-132, 2022.

4.Maksymowych WP, Wichuk S, Dougados M, et al. Sacroiliac joint and spine MRI lesions as indicators of radiographic advancement in axial spondyloarthritis. 2019 Ann Rheum Dis. 78:1344-1351.

5.Østergaard M, Lambert RGW, Weber U, et al. MRI's diagnostic value in spondyloarthritis: assessment of structural and inflammatory abnormalities. 2015; Ann Rheum Dis. 74:148-155.

6.Diffusion-weighted imaging and apparent diffusion coefficient measures in the sacroiliac joints in axial spondyloarthritis, Bray TJP, Vendhan K, Roberts J, et al. Skeletal Radiol. 46:1205-1214, 2017.

7.Maksymowych WP, Inman RD, Salonen D, et al. Spondyloarthritis Research Consortium of Canada magnetic resonance imaging index for evaluation of inflammation in the sacroiliac joint. 53(5):703-709 in Arthritis Rheum. 2005.

8.Rudwaleit M, Baraliakos X, Sieper J, et al. A manual for evaluating spondyloarthritis is the Assessment of SpondyloArthritis International Society (ASAS) handbook. 2009 Ann Rheum Dis. 68(Suppl 2):ii1-ii44.

9.Rudwaleit M, Landewé R, van der Heijde D, et al. the creation of axial spondyloarthritis categorisation criteria by the Assessment of SpondyloArthritis International Society. 2009; Ann Rheum Dis. 68(6):777-783.

10.The ASAS-EULAR management guidelines for axial spondyloarthritis were updated in 2016 by van der Heijde D,

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