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ORIGINAL RESEARCH

Characterising axial psoriatic arthritis: correlation between whole spine MRI abnormalities and clinical, laboratory and radiographic findings

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ABSTRACT

Objective To describe the prevalence of inflammatory and structural lesions using whole spine MRI in patients with psoriatic disease, and to assess their correlation with clinical features and with axial spondyloarthritis (axSpA) classification criteria.

Methods This retrospective analysis included patients with whole spine and sacroiliac joints (SIJ) MRI, selected from 2 populations: (1) active psoriatic arthritis (PsA), irrespective of axial symptoms; (2) psoriasis with confirmed or suspected PsA and axSpA symptoms. MRI spondylitis and/or sacroiliitis (MRI-SpA) was defined according to Assessment of Spondyloarthritis International Society (ASAS) consensus and by radiologist impression. Agreement between MRI-SpA and different inflammatory back pain (IBP) definitions (Berlin/ASAS/rheumatologist criteria) and the axSpA classification criteria were calculated considering MRI as gold standard. Logistic regression determined MRI-SpA-associated factors.

Results 93 patients were analysed (69.9% PsA; 30.1% psoriasis). Back pain was present in 81.7%, defined as IBP in 36.6%–57%. MRI-SpA was found in 9.7% of patients by ASAS definition and in 12.9% by radiologist impression, of which 25% had isolated spondylitis.
Low agreement was found between the three IBP definitions and MRI-SpA. Rheumatologist criteria was the most sensitive (50%–55.6%) while ASAS and Berlin criteria were the most specific (61.9%–63%). axSpA criteria had poor sensitivity for MRI-SpA (22.2%–25%). Late onset of back pain or asymptomatic patients accounted for most cases with MRI-SpA not meeting axSpA or IBP criteria. Male sex was associated with MRI-SpA (OR 6.91; 95% CI 1.42 to 33.59) in multivariable regression analysis.

Conclusion Prevalence of MRI-defined axSpA was low and showed poor agreement with IBP and axSpA criteria.

Key messages

What is already known about this subject?

- Axial psoriatic arthritis (axPsA) remains poorly defined.
- While MRI is an important diagnostic tool for spondyloarthritis (SpA), only minimal information is available on MRI features of sacroiliitis and spondylitis in PsA.
- This gap in knowledge impedes better characterisation and understanding of this condition.

What does this study add?

- The prevalence of sacroiliitis and spondylitis by MRI in patients with PsA was low despite a high prevalence of axial symptoms.
- Inflammatory lesions were located along the spine and sacroiliac joints (SIJ), and some patients presented with only isolated spine involvement but no sacroiliitis.
- Inflammatory back pain and current classification criteria for axial SpA showed poor correlation with MRI findings.

How might this impact on clinical practice or further developments?

- Imaging confirmation of SpA would be desirable when axPsA is clinically suspected.
- MRI assessment of the whole spine, in addition to SIJ, should be considered in larger studies for development of axPsA definition.

Axial psoriatic arthritis (axPsA) remains poorly defined despite high prevalence of spinal symptoms among patients with PsA.[1] As no accepted definition for axPsA exists, treatment recommendations for these patients are extrapolated from those of ankylosing spondylitis (AS),[2 3] but differences in clinical, genetic and radiographic features between axPsA and AS[4 5] raise the question whether the same mechanisms underlie both conditions. Inflammatory abnormalities in sacroiliac joints (SIJ) and spine MRI are the cornerstone of diagnosis of axSpA and provide insights regarding the underlying mechanisms of this disease,[6] but limited spinal MRI data in PsA impede better understanding of axPsA. Characterising SIJ and spine MRI abnormalities in PsA is an important step in achieving an acceptable definition of axPsA.

The prevalence of axPsA ranges from 25% to 70% of PsA, depending on disease duration and definition used.[7 8] Studies comparing axPsA with AS have found notable differences in the former including lower prevalence and intensity of inflammatory back pain (IBP), spinal mobility restriction and radiographic sacroiliitis; more frequent asymmetric spine and SIJ involvement, cervical involvement and isolated spondylitis and lower prevalence of human leucocyte antigen B27 (HLA-B27).[4 9 10] A main limitation of these studies is an inconsistent use of axPsA definitions, ranging from radiographic sacroiliitis to rheumatologist diagnosis based on symptoms. While imaging evidence of sacroiliitis or spondylitis is desirable for identifying patients with axial involvement, radiographic diagnosis has low inter-reliability and intra-reliability. As patients with PsA tend to be older than axSpA, identifying radiographic axial disease in PsA can be more challenging due to existing osteoarthritic spine changes.[11]

MRI has become an essential tool for axSpA diagnosis and MRI sacroiliitis is included in the classification criteria for axSpA.[12] Only few small studies have investigated axial findings by MRI among patients with PsA.[13 14] Recent studies from Brazil and Israel investigated MRI sacroiliitis in PsA according to Assessment of Spondyloarthritis International Society (ASAS) consensus, reporting prevalence rates of 37.8% and 26%, respectively.[15 16] Both studies assessed patients with long-standing PsA. Some patients were on biologic disease-modifying antirheumatic drugs (DMARDs) which may have affected the MRI findings. None of these studies evaluated structural and inflammatory spondylitis using whole spine MRI.

Recognition of differences between axPsA and AS and existing knowledge gaps about axPsA, have prompted a joint effort by ASAS and the Group for Research and Assessment of Psoriasis and Psoriatic Arthritis (GRAPPA) to develop a new definition for axPsA.[7] MRI information on spinal involvement in PsA is important to inform this process.

Using existing whole spine and SIJ MRI data, we aimed to describe inflammatory and structural lesions consistent with SpA in patients with PsA and in those with psoriasis with clinical suspicion of axPsA; and to assess their correlation with clinical findings including the presence of IBP and axSpA classification criteria.

METHODS

Study design and population

We performed a cross-sectional analysis of patients followed prospectively in the International Psoriasis and PsA Research Team (IPART) Study cohort at a single centre in Toronto, Canada, from January 2016 to September 2020. The IPART study enrols adult patients with psoriasis or rheumatologist confirmed PsA meeting CASPAR classification criteria for PsA.[17] Patients are assessed every 6–12 months and clinical, laboratory and radiographic information is collected following a standard protocol. MRI of the SIJ or spine are not ordered routinely by protocol, but only when it is clinically indicated or as part of limited substudies in IPART.

For this study, we identified two patient populations with whole spine and SIJ MRI in IPART. The first population (P1) included patients with confirmed diagnosis of PsA who were about to start or switch systemic medications due to active PsA, in whom MRI was performed regardless of axial symptoms, as part of a previous study.[18] The second population (P2) included patients with psoriasis and confirmed or suspected PsA, in whom MRI was ordered for clinically suspicted axPsA based on symptoms, restricted spinal mobility or abnormal radiographs. Patients with incomplete MRI scans and those on biologic DMARDs or Janus Kinase inhibitors at the time of the MRI assessment were excluded.

The study was approved by the research ethics board at Women's College Hospital (REB # 2020-0094-E). All participants signed an informed consent form.

Clinical variables

Clinical and laboratory data collected during the last visit before the MRI assessment were used for this analysis. Clinical variables included demographics, smoking, comorbidities, family history, extra-articular manifestations, medications, peripheral and axial symptoms, musculoskeletal and skin examination findings, patient-reported outcomes, physician global assessment, inflammatory markers and presence of HLA-B27.

Based on the characteristics of axial symptoms collected in IPART, we classified the back pain as IBP according to the Berlin[19] and ASAS definition.[20] IPART protocol also asks the rheumatologist to classify the back pain as inflammatory or mechanical based on their impression at the time of assessment. Patients were also classified as axSpA according to ASAS criteria using clinical, laboratory and imaging data (clinical and imaging arms).[12]

Imaging assessment

Standard radiographs of the entire spine, SIJ, hands and feet were performed for all patients at study entry. Images were read by two rheumatologists (LE, PD), blinded to the clinical and MRI data. SIJ radiographs were scored using modified New York criteria (mNYC)[21] for AS, and spine images according the modified Stoke Ankylosing Spondylitis Spinal Score.[22] Radiographic axial disease (RAD) was defined as sacroiliitis according to the mNYC (at least bilateral grade 2 sacroiliitis or unilateral grade 3) and/or at least one marginal or paramarginal syndesmophyte in the cervical or lumbar spine.

MRI examinations were performed in a 1.5 T machine, following non-contrast protocol for SpA at a single centre. Sagittal T1-weighted (T1w) and T2-weighted fat-suppressed fast spin echo sequences were available for the whole spine (cervical, thoracic and lumbar), while semi-coronal T1w and short inversion recovery sequences for the SIJ. All images were read by a musculoskeletal radiologist (IE), blinded to clinical and radiographic

data. Intrarater reliability for SIJ MRI images using the same protocol was previously found to be good for bone marrow oedema (BME) (0.70) and erosions (0.71), moderate for fat metaplasia lesions (FL) (0.64) and poor for sclerosis (0.36).[16]

Presence of structural and inflammatory changes were defined according to the ASAS definitions.[6 23 24] Berlin score was applied for grading BME and FL.[25 26] MRI-spondyloarthritis (MRI-SpA) was defined according to two definitions:

1. ASAS-MRI-SpA: MRI findings were classified according to the 2016 ASAS criteria for active MRI sacroiliitis (BME lesions highly suggestive of sacroiliitis either: two lesions in one slide or one in two slides) and/or ASAS MRI-spondylitis (three typical BME lesions at the vertebral corners (VC) or five or more FL at the VC in patients younger than 50 years of age).[23 24]
2. Radiologist-MRI-SpA: according to the radiologist global impression considering both inflammatory and structural lesions in the SIJ and spine.

Statistical methods

Wilcoxon rank-sum test and χ^2 test were used to compare continuous and categorical variables, respectively. Sensitivity, specificity, negative and positive predictive values were calculated to assess the agreement between the three IBP definitions and the presence of MRI-SpA (gold standard). Same metrics were calculated to assess the performance of the axSpA classification criteria to detect MRI-SpA. We performed logistic regression analysis to investigate the association between clinical variables and the presence of MRI-SpA. We considered radiologist-MRI-SpA as an outcome and the following variables as model covariates: age, sex, duration of musculoskeletal symptoms and psoriasis, diagnosis of PsA, body mass index, previous or current smoking, HLA-B27, erosions in peripheral joints, C reactive protein. We first performed a univariate analysis including each variable as a single model covariate and reported the OR and the 95% CI for each variable. Subsequently, we performed a multivariable analysis including all variables in a single model and applied backward elimination to remove non-contributing covariates from the multivariable regression model ($p>0.10$). Significance level was set at $p<0.05$.

Patient and public involvement

Patient and public were not involved in developing this study.

RESULTS

Ninety-three patients were analysed (P1: 41; P2: 52), 65 (69.9%) patients had a confirmed diagnosis of PsA. Only 10 (10.9%) patients were HLA-B27 positive (table 1).

The majority of patients experienced axial symptoms (81.7%), and 53 (57%) patients were found to have IBP by the rheumatologist impression, and 34 (36.6%) according to both ASAS and Berlin criteria. Radiographic sacroiliitis (mNYC) was found in 13 (14%) patients, and RAD in 18 (19.4%) patients (table 2).

Whole spine MRI findings

The overall prevalence of MRI findings consistent with SpA was low (table 2). MRI sacroiliitis according to ASAS definition was found in 6 (6.5%) patients, and in 9 (9.7%) according to radiologist impression.

ASAS-MRI-SpA (spondylitis and/or sacroiliitis) was found in 9 (9.7%) patients and radiologist-MRI-SpA in 12 (12.9%) patients. Three of the 4 patients with positive MRI for spondylitis did not have MRI sacroiliitis, which comprise 25% (3 out of 12) of patients with radiologist-MRI-SpA.

Distribution of inflammatory and structural lesions and Berlin score within patients with radiologist-MRI-SpA is presented in figure 1. BME at VC were found along the cervical, thoracic and lumbar spine, while FL were more frequent at the thoracic and lumbar portions.

Agreement between IBP and MRI-SpA

We found poor agreement between both definitions of MRI-SpA and the three definitions of IBP. Considering MRI-SpA by ASAS or radiologist as gold standard. IBP definition by rheumatologist had a higher sensitivity for MRI-SpA by ASAS and radiologist (55.6%–50%) but with low specificity (42.9%–42%), while Berlin and ASAS IBP criteria had higher specificity for MRI-SpA by ASAS and radiologist (61.9%–63%) but with low sensitivity (22.2%–33.3%) (figure 2). The most common reasons for not meeting IBP definitions in patients with MRI-SpA were having late-onset back pain that started after the age of 40 (ASAS-MRI-SpA: 5 out of 9; radiologist-MRI-SpA 4 out of 12 patients) or lack of back pain (ASAS-MRI-SpA: 2 out of 9; radiologist-MRI-SpA: 4 out of 12 patients).

Agreement between MRI-SpA and ASAS classification criteria for axSpA

ASAS classification criteria for axSpA were fulfilled by 12 patients (12.9%), 9 of whom met the imaging arm and 6 the clinical arm. These criteria showed low sensitivity for MRI-SpA according to both radiologist or ASAS definitions (25% and 22.2%, respectively), with high specificity (88.9% and 88.1%, respectively) (figure 3). The low sensitivity rates were explained by patients with MRI-SpA who did not meet entry criteria for axSpA (9 and 7 patients, respectively), due to late onset of back pain (4 and 5, respectively) or absence of axial symptoms (4 and 2, respectively).

Risk factors for MRI-SpA

Patients with radiologist-MRI-SpA were less likely to be females (16.7% vs 58%) and had shorter duration of psoriasis (5.8 years vs 14.7 years, table 3) than those without MRI-SpA. Both univariate and multivariable regression analyses found male sex to be the only variable associated with radiologist-MRI-SpA (OR 6.91; 95% CI 1.42 to 33.59, table 4).

Table 1 Demographic and clinical characteristics of the study participants

Variable	All n=93	Population 1 n=41	Population 2 n=52
Age (years)	41 (22)	47 (20)	37.5 (18.5)
Sex: female	49 (52.7%)	20 (48.8%)	29 (55.8%)
Race: Caucasian	64 (68.8%)		
Disease status			
PsA	65 (69.9%)	41 (100%)	24 (46.2%)
Psoriasis+axial pain	28 (30.1%)	0 (0%)	28 (53.9%)
PsA duration (years)*	1.6 (0.9)	1.7 (2.1)	1.4 (1.1)
Duration of MSK symptoms (years)	4 (7.9)	3.4 (4.4)	4.2 (8.9)
Duration of psoriasis (years)	12.3 (17.7)	14.7 (15.9)	11.4 (18.1)
NSAIDs—daily use (y/n)	6 (6.5%)	2 (4.9%)	4 (7.8%)
DMARDs use (y/n)	22 (23.7%)	12 (29.3%)	10 (19.2%)
Ever smoker (y/n)	36 (38.7%)	12 (29.3%)	24 (46.2%)
Family history of PsA or SpA (y/n)	6 (6.5%)	3 (7.3%)	3 (5.8%)
Anterior uveitis (y/n)	5 (5.4%)	3 (7.3%)	2 (3.9%)
Inflammatory bowel disease (y/n)	2 (2.2%)	1 (2.4%)	1 (1.1%)
Axial symptoms (pain or stiffness) (y/n)	76 (81.7%)	28 (68.3%)	48 (92.3%)
Inflammatory back pain (y/n)			
Rheumatologist impression	53 (57%)	21 (51.2%)	32 (61.5%)
Berlin criteria	34 (36.6%)	12 (29.3%)	22 (42.3%)
ASAS criteria	34 (36.6%)	10 (24.4%)	24 (46.2%)
Location of axial pain (y/n)†			
Cervical	35 (46.1%)	13 (46.4%)	22 (45.8%)
Thoracic	24 (31.6%)	5 (17.9%)	19 (39.6%)
Lumbar	57 (75%)	18 (64.3%)	39 (81.3%)
Sacroiliac/Buttock	26 (34.2%)	6 (21.4%)	20 (41.7%)
Peripheral joint pain (y/n)	83 (89.3%)	40 (97.6%)	43 (82.7%)
Heel pain (y/n)	31 (33.3%)	14 (34.2%)	17 (32.7%)
BMI (kg/m^2)	26.1 (7.8)	25.6 (7.8)	27.1 (7.5)
PASI	2.5 (5.2)	2.7 (6)	2.5 (4.3)
Tender joint count (68 joints)	2 (6)	5 (9)	1 (4)
Swollen joint count (66 joints)	1 (4)	3 (5)	0 (1)
Dactylitis (y/n)	15 (16.1%)	12 (29.3%)	3 (5.8%)
Enthesitis (y/n)	44 (47.3%)	27 (65.9%)	17 (32.7%)
Pain score (0–10)	5 (4)	5 (4)	4 (3.5)
PGA (0–10)	5 (4)	5 (4)	4 (4)
BASDAI	5.5 (3.3)	5.9 (3.3)	4.8 (3.2)
ASDAS	2.4 (1.4)	2.7 (1.5)	2.2 (1.6)
HAQ	0.4 (0.8)	0.6 (0.9)	0.3 (0.6)
hs-CRP (mg/L)	2.1 (7.8)	3.3 (10.2)	1.5 (5.8)
HLA-B27 (y/n)	10 (10.9%)	5 (12.2%)	5 (9.8%)
Erosions in peripheral joints (y/n)	14 (15.4%)	12 (30.8%)	2 (3.9%)

Values are median (IQR) and frequency (%).
*Among patients with established diagnosis of PsA.
†Among those with axial pain.
ASAS, Assessment of Spondyloarthritis International Society; ASDAS, Ankylosing Spondylitis Disease Activity Score; BASDAI, Bath Ankylosing Spondylitis Disease Activity Index; BMI, body mass index; DMARDs, disease-modifying antirheumatic drugs (methotrexate, sulfasalazine, leflunomide, apremilast); HAQ, Health Assessment Questionnaire; HLA-B27, human leucocyte antigen B27; hs-CRP, high-sensitivity C reactive protein; MSK, musculoskeletal; NSAIDs, non-steroidal anti-inflammatory drugs; PASI, Psoriasis Area Severity Index; PGA, patient global assessment; PsA, psoriatic arthritis; SpA, spondyloarthritis; y/n, yes/no.

Table 2 Imaging findings in MRI and radiograph of the SIJ and spine in the entire population, population 1, population 2, patients with confirmed PsA and patients with axial symptoms

Variable	All n=93	Population 1 n=41	Population 2 n=52	PsA n=63	Axial symptoms n=76
SIJ MRI					
Sacroiliitis-ASAS	6 (6.5%)	6 (14.6%)	0	6 (9.53%)	5 (6.6%)
Sacroiliitis-radiologist	9 (9.7%)	7 (17.1%)	2 (3.9%)	7 (11.1%)	6 (7.9%)
Spine MRI					
Spondylitis-ASAS	4 (4.3%)	3 (7.3%)	1 (1.9%)	3 (4.8%)	3 (3.9%)
Spondylitis-radiologist	4 (4.3%)	3 (7.3%)	1 (1.9%)	3 (4.8%)	3 (3.9%)
Spondylitis without sacroiliitis	3 (3.2%)	2 (4.9%)	1 (1.9%)	2 (3.2%)	2 (2.6%)
MRI-SpA					
ASAS-MRI-SpA	9 (9.7%)	8 (19.5%)	1 (1.9%)	8 (12.7%)	7 (9.2%)
Radiologist-MRI-SpA	12 (12.9%)	9 (22%)	3 (5.8%)	9 (14.3%)	8 (10.5%)
Radiographic assessment					
Sacroiliitis (mNYC)	13 (14%)	6 (14.6%)	7 (13.5%)	12 (18.5%)	12 (15.8%)
Syndesmophytes	9 (10%)	7 (18.4%)	2 (3.9%)	9 (15%)	7 (9.3%)
RAD (sacroiliitis and/or spondylitis)	18 (19.4%)	11 (26.8%)	7 (13.5%)	17 (26.2%)	15 (19.7%)

ASAS-MRI-SpA: sacroiliitis and/or spondylitis according to ASAS (sacroiliitis: presence of two or more inflammatory lesions (subchondral bone marrow oedema) on one slice or at least two inflammatory lesions in two consecutive slices; spondylitis: presence of anterior/posterior spondylitis (corner-based bone marrow oedema) in three or more sites). Radiologist-MRI-SpA sacroiliitis and/or spondylitis according to radiologist impression (taking into account inflammatory and structural lesions).
MRI-SpA: sacroiliitis and/or spondylitis according to ASAS or radiologist criteria.
mNYC for ankylosing spondylitis.
ASAS, Assessment of Spondyloarthritis International Society; mNYC, modified New York criteria; RAD, radiographic axial disease; SIJ, sacroiliac joint; SpA, spondyloarthritis.

DISCUSSION

Our study characterised spinal and SIJ MRI abnormalities in patients with PsA or with psoriasis and suspected axPsA, and assessed their correlation with clinical findings. The prevalence of MRI features consistent with axSpA was low, ranging from 9.7% to 12.9%, despite the high prevalence of axial symptoms and IBP in the study patients. Both IBP and classification criteria for axSpA showed poor agreement with MRI-SpA, mainly due to absence of axial symptoms and late onset of back pain in patients with MRI-SpA.

The prevalence of axial MRI involvement in our study was lower than reported in previous studies using SIJ MRI (26%–37.8%).[15 16] One possible explanation

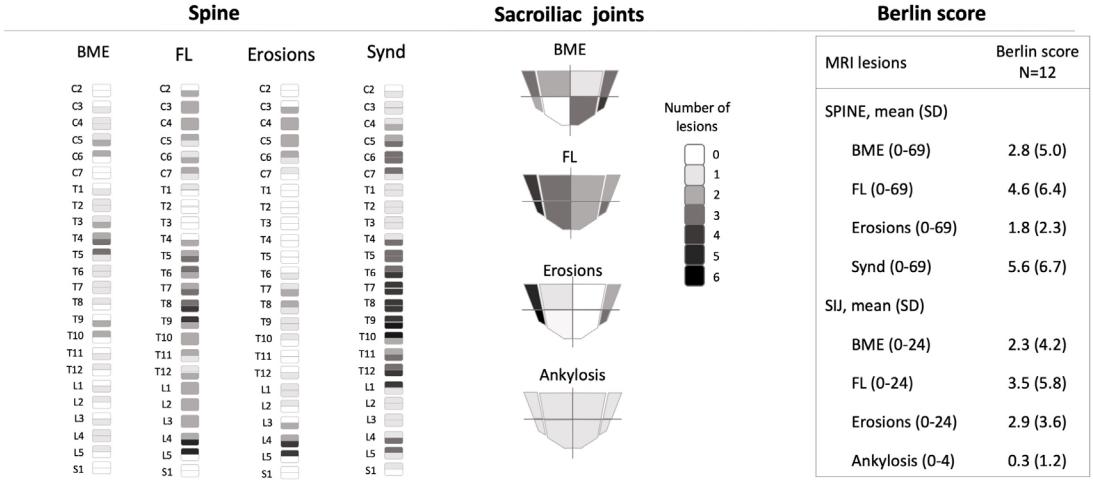

Figure 1 Distribution of inflammatory and structural lesions in spine MRI of patients with radiologist-MRI-SpA (n =12). The presence of inflammatory and structural lesions at each vertebral unit are shown among patients with definition of a positive MRI for spondylitis or sacroiliitis according to radiologist criteria. The grey scale indicates the number of patients with lesions. BME, bone marrow oedema at the vertebral corners; FL, fatty lesions at the vertebral corners; SI, sacroiliac; SpA, spondyloarthritis; Synd, syndesmophytes.

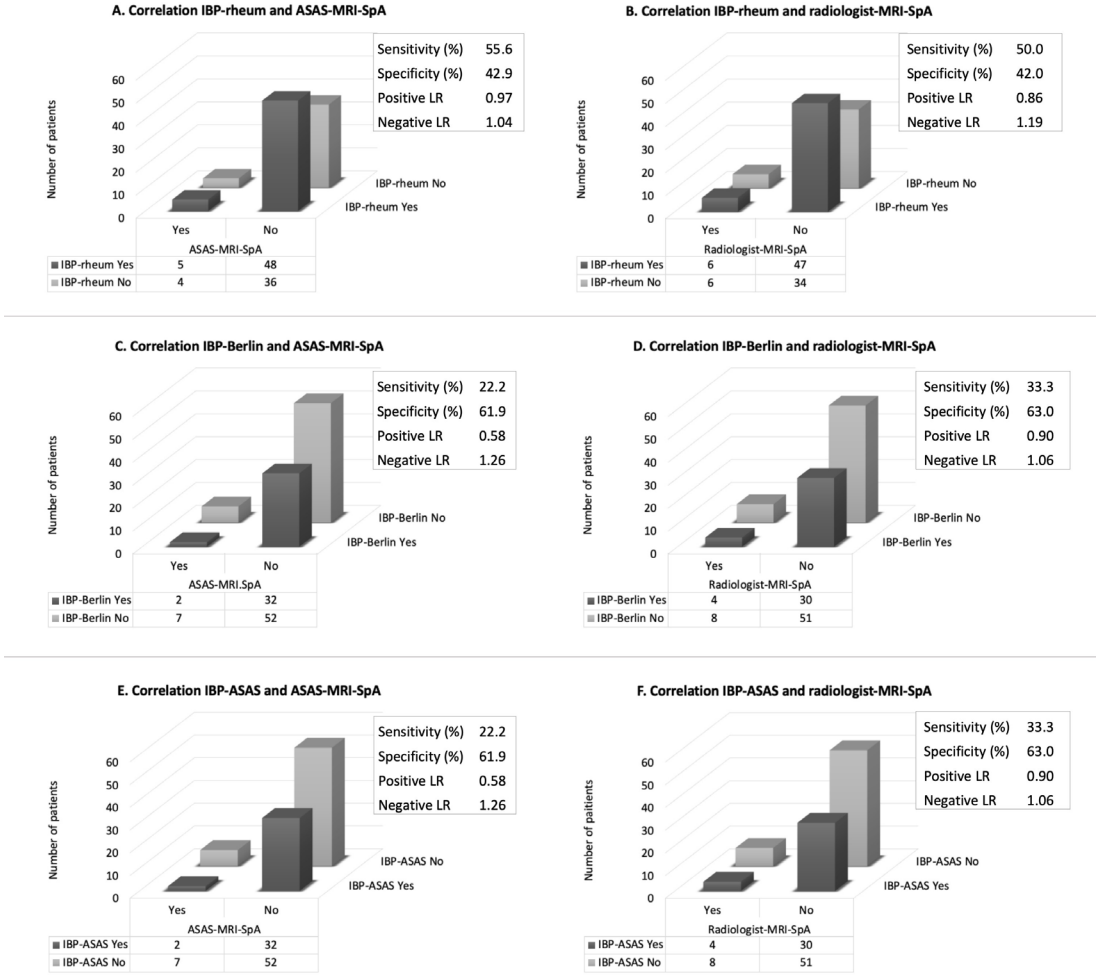

Figure 2 Agreement between the presence of IBP and MRI-SpA. (A) IBP-rheumatologist versus ASAS-MRI-SpA; (B) IBP-rheumatologist versus radiologist-MRI-SpA; (C) IBP-Berlin versus radiologist-MRI-SpA; (D) IBP-Berlin versus ASAS-MRI-SpA; (E) IBP-ASAS versus ASAS-MRI-SpA; (F) IBP-ASAS versus radiologist-MRI-SpA. ASAS, Assessment of Spondyloarthritis International Society; IBP, inflammatory back pain; SpA, spondyloarthritis.

is the shorter duration of PsA in our study population (median <2 years) in comparison with longstanding PsA in previous studies, as longer duration of PsA has been related to axial involvement.[4] Another explanation may be the inclusion of patients with psoriasis and suspected axPsA but without confirmed PsA (28 patients), in whom the probability of MRI-SpA is lower. However, restricting the analysis to only patients with PsA (63 patients) the prevalence was consistently low (9.5%). A third factor may be the low prevalence of HLA-B27 in this study (10.9% vs 20% reported previously in PsA).[27] HLA-B27 has been associated with the presence and severity of sacroiliitis in PsA.[14 28–30] The inclusion of patients with

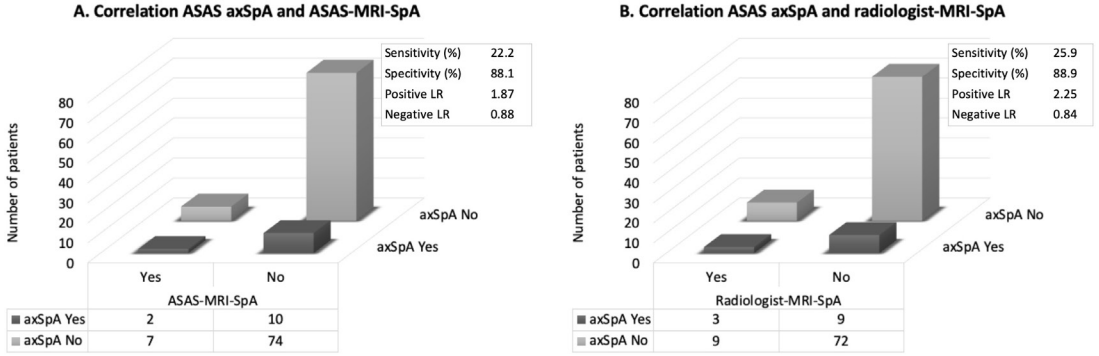

Figure 3 Agreement between the ASAS classification criteria for axSpA and MRI-defined SpA according to ASAS consensus (A) and according to radiologist impression (B). ASAS, Assessment of Spondyloarthritis International Society; axSpA, axial spondyloarthritis; SpA, spondyloarthritis.

Table 3 Characteristics of patients with and without MRI-spondylitis (radiologist impression)

Variable	MRI-spondylitis n=12	No MRI-spondylitis n=81	P value
Age (years)	53 (17)	41 (22)	0.08
Sex: female	2 (16.7%)	47 (58%)	0.007
Disease status			0.08
PsA	11 (91.7%)	54 (66.7%)	
Psoriasis+axial pain	1 (8.3%)	27 (33.3%)	
PsA duration (years)*	1.6 (2.1)	1.6 (0.9)	0.54
Duration of MSK symptoms (years)	3.4 (3.8)	4 (9)	0.73
Duration of psoriasis (years)	5.8 (7.4)	14.7 (14.8)	0.03
NSAIDs use daily	0	6 (7.4%)	0.33
DMARDs use	2 (16.7%)	20 (24.7%)	0.54
Ever smoker	7 (58.3%)	29 (35.8%)	0.13
Family history of PsA/SpA	1 (8.3%)	5 (6.2%)	0.57
History of anterior uveitis	0	5 (6.2%)	0.38
IBD	0	2 (2.5%)	0.58
Axial symptoms	8 (66.7%)	68 (84%)	0.15
Inflammatory back pain			
By rheumatologist	6 (50%)	47 (58%)	0.60
Rudwaleit criteria	4 (33.3%)	30 (37%)	0.80
ASAS criteria	4 (33.3%)	30 (37%)	0.80
Location of axial pain†			
Cervical	3 (37.5%)	32 (47.1%)	0.61
Thoracic	3 (37.5%)	21 (30.9%)	0.70
Lumbar	5 (62.5)	52 (76.5%)	0.39
Sacroiliac/Buttock	1 (12.5%)	25 (36.8%)	0.17
Peripheral joint pain	12 (100%)	71 (87.7%)	0.20
Heel pain	3 (25%)	28 (34.6%)	0.51
BMI (kg/m^2)	29.5 (6.7)	26 (7.4)	0.24
PASI	1.4 (4)	2.7 (5.3)	0.32
Tender joint count (68 joints)	2.5 (9)	2 (6)	0.72
Swollen joint count (66 joints)	1 (3)	1 (4)	0.78
Dactylitis (y/n)	2 (16.7%)	13 (16.1%)	0.96
Enthesitis (y/n)	6 (50%)	38 (46.9%)	0.84
Pain (0–10 scale)	4 (4)	5 (4)	0.73
PGA (0–10 scale)	5.5 (3.5)	4 (4)	0.66
BASDAI	5.5 (3.4)	5.5 (3.3)	0.67
ASDAS	2.5 (0.7)	2.4 (1.7)	0.40
HAQ	0.6 (0.6)	0.4 (0.8)	0.24
hs-CRP (mg/dL)	3.3 (13.2)	2.1 (7.6)	0.42
HLA-B27	2 (16.7%)	8 (10%)	0.49
Erosions in peripheral joints (by modified Steinbrocker score)	4 (33.3%)	10 (12.7%)	0.06

Continued

Table 3 Continued

Variable	MRI-spondylitis n=12	No MRI-spondylitis n=81	P value

Values expressed as median (IQR) or frequency (%).
*Among patients with established diagnosis of PsA.
†Among those with axial pain.
ASAS, Assessment of Spondyloarthritis International Society; ASDAS, Ankylosing Spondylitis Disease Activity Score; BASDAI, Bath Ankylosing Spondylitis Disease Activity Index ; BMI, body mass index; DMARDs, disease-modifying antirheumatic drugs; HAQ, Health Assessment Questionnaire; HLA-B27, human leucocyte antigen B27; hs-CRP, high-sensitivity C reactive protein; MSK, musculoskeletal; NSAIDs, non-steroidal anti-inflammatory drugs; PASI, Psoriasis Area Severity Index; PGA, patient global assessment; PsA, psoriatic arthritis; SpA, spondyloarthritis; y/n, yes/no.

psoriasis without confirmed PsA may have lowered the total prevalence of HLA-B27 in our cohort.

Only four (4.3%) patients had MRI-spondylitis in our study, with no differences between ASAS or radiologist definitions. Noticeable, three of those four patients had spondylitis without sacroiliitis (25% of all radiologist-MRI-SpA). Isolated spine involvement has been suggested as a characteristic feature of axPsA distinguishing it from axSpA in radiographic studies,[28 31] and a recent study that included MRI assessments in patients with axSpA also found more MRI features of spondylitis without sacroiliitis in patients with concomitant psoriasis.[32] As only 5% of patients presented isolated MRI-spondylitis in cohorts used for development of ASAS classification criteria for axSpA, spinal MRI was not included in the imaging arm of this criteria[12]; subsequent analysis in non-radiographic axSpA strengthened these findings, concluding that spinal MRI added little value for classifying patient as axSpA,[33] while other studies have found higher proportions of isolated inflammatory spinal lesions in patients with axSpA.[32 34] Our findings, although based on small numbers, suggest that whole spine MRI in addition to SIJ MRI may be important for the diagnosis and classification of axPsA. This will need to be confirmed in larger cohorts.

The poor agreement found between IBP and MRI abnormalities is in line with previous studies in axSpA and PsA that used SIJ radiographs or MRI as gold standard.[1 16] The low sensitivity of IBP was mostly explained by asymptomatic patients with MRI-SpA or by patients with late-onset back pain that did not meet entry criteria for IBP. Moreover, the three IBP definitions, especially rheumatologist impression, showed poor specificity for MRI-SpA in this study, highlighting the discrepancy between patient symptoms and objective imaging findings. The differences between patients with PsA and AS, for whom IBP classification definitions were developed, may in part explain this poor performance. Patients with PsA tend to be older at the time of diagnosis compared with patients with AS, thus some of them will not meet the criteria for IBP or axSpA solely based on their age at onset of symptoms, despite having spinal involvement. Other patients may have axial symptoms that mimic IBP but are not be due to spine inflammation, which present additional difficulties to the assessing physician.

Male sex was the only factor significantly associated with MRI-SpA. This sex-related dysmorphism in severity of axial abnormalities has been previously reported in cohorts of both PsA and axSpA mostly using radiographs.[5 10 35] Sex hormones and differences in gene

Table 4 Risk factors for radiologist-MRI-SpA by logistic regression analysis (n=93, number of events=12)

	Univariate model			Multivariable model (reduced)		
Variable	OR	95% CI	P value	OR	95% CI	P value
Age (years)	1.04	0.99 to 1.09	0.10			
Sex: male	6.91	1.42 to 33.59	0.02	6.91	1.42 to 33.59	0.02
Duration of symptoms (years)	0.92	0.79 to 1.06	0.24			
Duration of psoriasis (years)	0.96	0.90 to 1.02	0.16			
Diagnosis of PsA versus PsC	5.50	0.67 to 44.85	0.11			
BMI (kg/m^2)	1.07	0.98 to 1.17	0.13			
Smoking (current)	2.51	0.73 to 8.23	0.14			
HLA-B27 (y/n)	1.80	0.33 to 9.70	0.50			
Erosions in peripheral joints (y/n)	3.40	0.86 to 13.40	0.08			
hs-CRP (mg/L)	1.02	0.99 to 1.06	0.17			

BMI, body mass index; HLA-B27, human leucocyte antigen B27; hs-CRP, high-sensitivity C reactive protein; PsA, psoriatic arthrtitis; PsC, psoriasis with no confirmed PsA; radiologist-MRI-SpA, MRI-spondylitis and/or sacroiliitis according to radiologist impression; y/n, yes/no.

expression profiles have been suggested as possible explanations,[36] and more physically demanding occupations in men have also been linked with radiographic progression in AS.[37] Other previously reported risk factors for axPsA, such as young age at PsA presentation, HLA-B27 antigen and peripheral joint damage, were not found to be associated with axSpA in our study, however, due to the relatively small sample size and the low number of patients with MRI-SpA it is possible that our study was underpowered to identify them.

Our study has several strengths. We evaluated a well-phenotyped cohort with comprehensive information about their clinical, radiographic and laboratory findings. All MRI examinations were performed using a standard protocol and scored by an experienced, blinded musculoskeletal radiologist following validated scoring methods. Notably, all our patients underwent whole spine MRI so our study provides additional novel information beyond the SIJ.

One limitation of this study is that it comprised two different populations: the first population included consecutive patients with confirmed and active PsA and the second population included patients with psoriasis and clinically suspected axial involvement (with or without confirmed PsA). This may have contributed to the heterogeneity in the prevalence of MRI findings between the two populations. However, we believe that both populations represent clinically meaningful populations worth investigating. We provided estimates of MRI abnormalities stratified by different definitions (only PsA, consecutive PsA regardless of symptoms, only patients with axial symptoms), which allows better interpretation of the findings.

Whole spine MRI assessment in patients with PsA has also technical limitations, as inflammatory or structural SpA lesions may be confused with degenerative disc disease and diffuse idiopathic skeletal hyperostosis features, that are more expected in patients with PsA due their older age and metabolic abnormalities.[11] For this reason, we used the ASAS group recommended definitions for MRI sacroiliitis and spondylitis, and also the radiologist criteria who considered only lesions highly suggestive of SpA to classify a patient as MRI-SpA. The absence of contrast material in the MRI protocol may limit the ability to detect enthesitis, capsulitis and synovitis in the spine. It is possible that symptomatic patients not classified as MRI-SpA had mostly enthesitis instead of BME lesions, which could not be confirmed with this protocol.

Generalisability of these findings are limited as it was a single-centre study, in a predominant white population, with low prevalence of HLA-B27. Replication of this analysis in other cohorts is required to confirm these findings in a wider spectrum of patients with PsA.

In conclusion, the prevalence of MRI confirmed spondylitis and/or sacroiliitis was relatively low and showed poor agreement with presence of IBP and with classification criteria for axSpA. Clinical and epidemiological differences between axPsA and other axSpA may explain these findings. Current efforts to study axial involvement in PsA led by GRAPPA and ASAS, should help to define this entity in patients with PsA.

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