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ORIGINAL ARTICLE

The value of SPARCC sacroiliac MRI scoring in axial psoriatic arthritis and its association with other disease parameters

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Abstract

Objectives: This study aimed to assess patients with axial psoriatic arthritis (AxPsA) using the Canadian Spondyloarthritis Research Consortium (SPARCC) sacroiliac joint (SIJ) scores and to seek correlations between magnetic resonance imaging (MRI) scores and disease characteristics.

Methods: Forty PsA patients (32 females, mean age 46.4 years) who had been documented to have active or structural lesions on SIJ MRI were retrospectively evaluated. Disease duration, medications, and disease activity, including Disease Activity in Psoriatic Arthritis (DAPSA), Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), minimal disease activity (MDA), and Ankylosing Spondylitis Disease Activity Score (ASDAS) were recorded. On sacroiliac MRI scans, the SPARCC scores of sacroiliac joint inflammation (SIS) and sacroiliac joint structural damage (SSS) were evaluated.

Results: The mean disease duration was 51.4 ± 70.4 months. MRI showed active inflammation in 30 patients (75%) and at least 1 structural lesion in 32 patients (92.5%). The most prevalent structural lesion was erosion (82.5%), followed by fat metaplasia (65%), backfill (12.5%), and ankylosis (2.5%). Only fat metaplasia scores were significantly higher in men than in women ($P = .007$). Of clinical and laboratory parameters, only C-reactive protein (CRP) was significantly higher in the presence of active inflammation ($P = .01$). The SIS score was significantly correlated with disease duration ($r = -.35$) and CRP levels ($r = .42$,). The SSS score was inversely correlated with BASDAI ($r = -.37$), ASDAS-CRP ($r = -.39$), and ASDAS – erythrocyte sedimentation rate ($r = -.32$). The overall SPARCC scores did not differ between patients in DAPSA remission and non-remission and between those in MDA and non-MDA.

Conclusion: Although radiologic involvement is generally not severe in AxPsA, MRI still provides additional information about inflammatory activity and structural lesions. CRP may be helpful in monitoring the radiologic disease activity in AxPsA.

KEYWORDS
disease activity, inflammation, MRI, psoriatic arthritis, structural damage

1 | INTRODUCTION

The reported prevalence rates of axial involvement of patients with psoriatic arthritis (PsA) ranges from 25% to 70% depending on the disease duration, occurring generally at later stages of the disease.[1] Even though axial involvement generally accompanies peripheral involvement, pure axial disease is rare, seen in about 2%-5% of patients.[2]

Due to the lack of consensus concerning the definition of axial PsA (AxPsA) and PsA-specific measures, our knowledge on AxPsA is still inconclusive. Recent studies have shown that AxPsA has diverse characteristics from those of ankylosing spondylitis (AS), including genetic, clinical, radiographic, and prognostic features. Patients with AxPsA have lower rates of human leukocyte antigen-B27 positivity, are less symptomatic, and develop the condition at an older age. Furthermore, radiologic involvement also differs, with PsA patients presenting with less severe, more asymmetrical, and unilateral axial involvement.[2]

Although most studies and comparisons have been conducted by the use of radiograms and radiographic sacroiliitis grading, magnetic resonance imaging (MRI) has recently emerged as a useful tool in the early diagnosis of axial disease, with a high sensitivity to detect acute and chronic changes associated with sacroiliitis, for which the Assessment of SpondyloArthritis International Society (ASAS) proposed new classification criteria.[2]

Identifying and scoring MRI lesions are increasingly getting important in the evaluation of inflammatory and structural lesions. Several sacroiliac (SI) MRI scoring methods have been developed, with the most common methods being the Berlin MRI Score, Spondylarthritis Research Consortium of Canada (SPARCC) Score, and Global Score.[3] Among these MRI scoring methods, the SPARCC score, developed for patients with axial spondylarthritis, assesses SI and the spine with 2 components: inflammation (SIS) and structural lesions (SSS).[4,5] Despite a considerable number of studies on SPARCC in AS patients, to our knowledge, patients with AxPsA have not been evaluated using the SPARCC scoring system.

The aim of this study was to assess patients with AxPsA using the SPARCC SI joint scores and to seek correlations between MRI scores and disease characteristics.

2 | METHODS

2.1 | Study design and patients

A retrospective analysis was performed in the Department of Rheumatology, Marmara University, İstanbul, with 201 adult PsA patients, whose diagnoses were made according to the Classification Criteria for Psoriatic Arthritis and who presented between July 2018 and January 2021.[6] Forty patients who had been documented as having active (bone marrow edema) or structural lesions (erosion, fat metaplasia, backfill, and ankylosis) on SIJ MRI according to the ASAS MRI definitions and had full data for clinical evaluation were included in the study.[7] The reasons for obtaining MRI were inflammatory back pain or to evaluate the exacerbation of previously diagnosed disease. Exclusion criteria included history of previous surgery or degenerative findings on MRI or degenerative diseases including hip osteoarthritis, ankylosis or deformity in the lower extremity and scoliosis (Figure 1).

The study was approved by the Ethics Committee of Marmara University Medical School (2021/539) and was conducted in compliance with the Declaration of Helsinki.

Patient characteristics including age, gender, disease duration and features, body mass index (BMI, kg/m^2), and laboratory findings were recorded.

2.2 | Disease activity assessment

Examinations included tender joint count (TJC), swollen joint count (SJC), and the Leeds Enthesitis Index. The Psoriasis Area and Severity Index (PASI) was used to assess the extent of skin involvement.

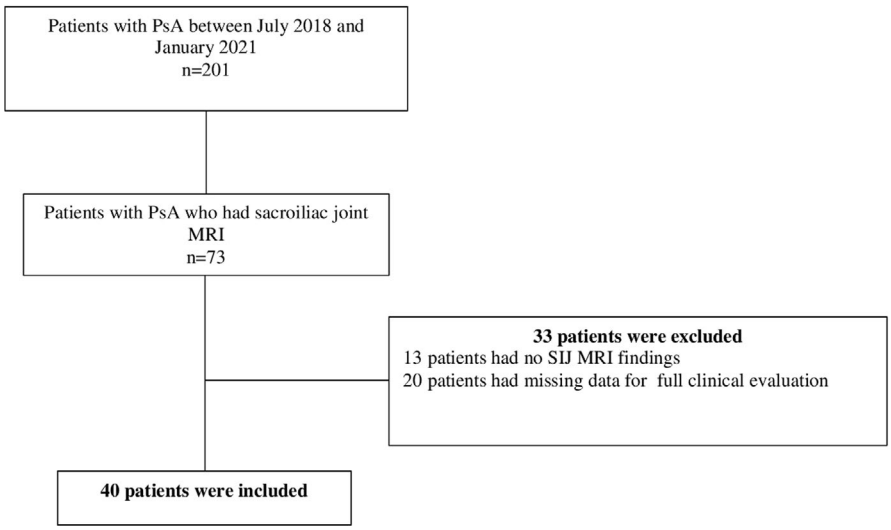

FIGURE 1 Flowchart of patient disposition

Laboratory measurements were erythrocyte sedimentation rate (ESR, mm/h) and C-reactive protein (CRP, mg/L).

Disease activity was assessed using the Disease Activity in Psoriatic Arthritis (DAPSA),[8] Bath Ankylosing Spondylitis Disease Activity Index (BASDAI),[9] Ankylosing Spondylitis Disease Activity Score-CRP (ASDAS-CRP)[10] and Ankylosing Spondylitis Disease Activity Score-ESR (ASDAS-ESR).[10] Minimal disease activity (MDA) was considered when 5 of the 7 clinical parameters (TJC ≤1, SJC ≤1, PASI ≤1, visual analog scale [VAS]-pain ≤1, Patient global assessment [PtGA] ≤1, Health Assessment Questionnaire [HAQ] score ≤0.5, and tender entheseal points ≤1) were fulfilled.[11]

PtGA and pain were rated on a visual analog scale.[12]

2.3 | MRI protocol and analysis

MRI of the SI joints was performed using a 3T MR scanner (Siemens) with appropriate 8-channel surface coils. The sequence protocols were as follows: coronal (along the long axis of the sacral bone) T_1-weighted (T_1W) spin-echo (SE) (time to repeat / echo time [TR/TE], 362/9 ms; matrix, 256 166; slice thickness, 3 mm; field of view [FOV] 250; flip angle [FA], 150), and coronal fat-saturated (FS) T_2-weighted (T_2W) SE (TR/TE, 2460/62 ms; matrix, 256 166; slice thickness, 3 mm; FOV, 250; FA 150).

MRI scores were calculated by a 3 years experienced rheumatologist (HG) who had completed the SPARCC online training modules for SI joints (https://www.carearthritis.com/service/mri-scoring-modules/). The SPARCC SI joint inflammation (SIS) and structural (SSS) scores were used in the evaluation of the SIJs.[4,5]

2.3.1 | Scoring for inflammation

The SPARCC SIS scoring system requires coronal T_1W and short tau inversion recovery (STIR or T_2FS) imaging of the SIJs. Each SIJ was divided into 4 quadrants (upper iliac, lower iliac, upper sacral, and lower sacral) and scored dichotomously for the presence of bone edema in 6 consecutive coronal slices, where 1 denotes an increased signal and 0 a normal signal, totaling a maximum score of 48. In addition, the depth (≥1 cm = 1 point) and intensity (signal from presacral blood vessels = 1 point) of bone edema were separately scored for each slice, yielding a maximum score of 4 per slice. Increased signaling within the ligamentous portion of the SIJ was not scored. The total score of SIJ SIS ranged from 0 to 72.[4] A score ≥2 for SIJ bone marrow edema was considered positive MRI evidence of active inflammation.

2.3.2 | Scoring for structural lesions

The SPARCC SIJ SSS was used to assess the structural lesions in each SIJ quadrant (fat metaplasia, erosion) and each half (backfill, ankylosis) in 5 slices of T_1W images. Erosions and fat metaplasia were separately scored from 0 to 8 per slice (each maximum score 40), while backfill and ankylosis from 0 to 4 per slice (each maximum score 20). The maximum score was 120.[5]

Several MRI findings of inflammatory and structural lesions in the STIR and T_1W/SE sequence of SIJ are represented in Figure 2.

2.4 | Statistical analysis

Patient demographics and disease characteristics were analyzed using descriptive statistics. Data were processed using the Statistical Package for Social Sciences Software (SPSS v22.00, IBM Corp., Armonk, NY, USA). Categorical variables were expressed as percentages, while continuous variables as means (±) or medians (interquartile range [IQR]). The normality of the quantitative data was verified with the Kolmogorov–Smirnov test. The Chi-squared test (Fischer's exact test when expected numbers were below 5) was used for qualitative data. The Mann–Whitney *U* test was used for between-group comparisons. Spearman's correlation coefficient was used to seek correlations between variables. The level of significance was set as $P < .05$.

3 | RESULTS

3.1 | Demographic and clinical data

A total of 40 patients were included, with a female predominance (n = 32, 80%). The mean age was 46.4 ± 10 years (range, 24-63) and the mean disease duration was 51.4 ± 70.4 months (range, 2-384).

Twenty-nine patients (72.5%) were on synthetic disease-modifying antirheumatic drugs (sDMARD) therapy, including methotrexate, sulfasalazine and leflunomide. Five patients (12.5%) were on corticosteroid therapy, 18 patients (45%) were on nonsteroidal anti-inflammatory drug (NSAID) treatment, and 2 patients (5%) were on a biological DMARD (bDMARD) therapy.

Of the 40 patients, 2 (5.1%), 17 (43.6%), 19 (48.7%), and 1 (2.6%) were on DAPSA remission, low, moderate and high disease activity, respectively. Eight (20%) patients were on MDA.

The clinical characteristics of the patients are presented in Table 1.

3.2 | SI MRI scores of the patients

Table 2 shows the MRI scoring for active inflammation and structural lesions. While 30 patients (75%) had bone marrow edema on MRI, 37 patients (92.5%) had at least 1 structural lesion. The most prevalent structural lesion was erosion (84.6%), followed by fat metaplasia (65%), backfill (12.5%), and ankylosis (2.5%). Bone marrow edema defined as active inflammation and consistent with the ASAS sacroiliitis criteria was present in 29 patients (72.5%). Since one of 30

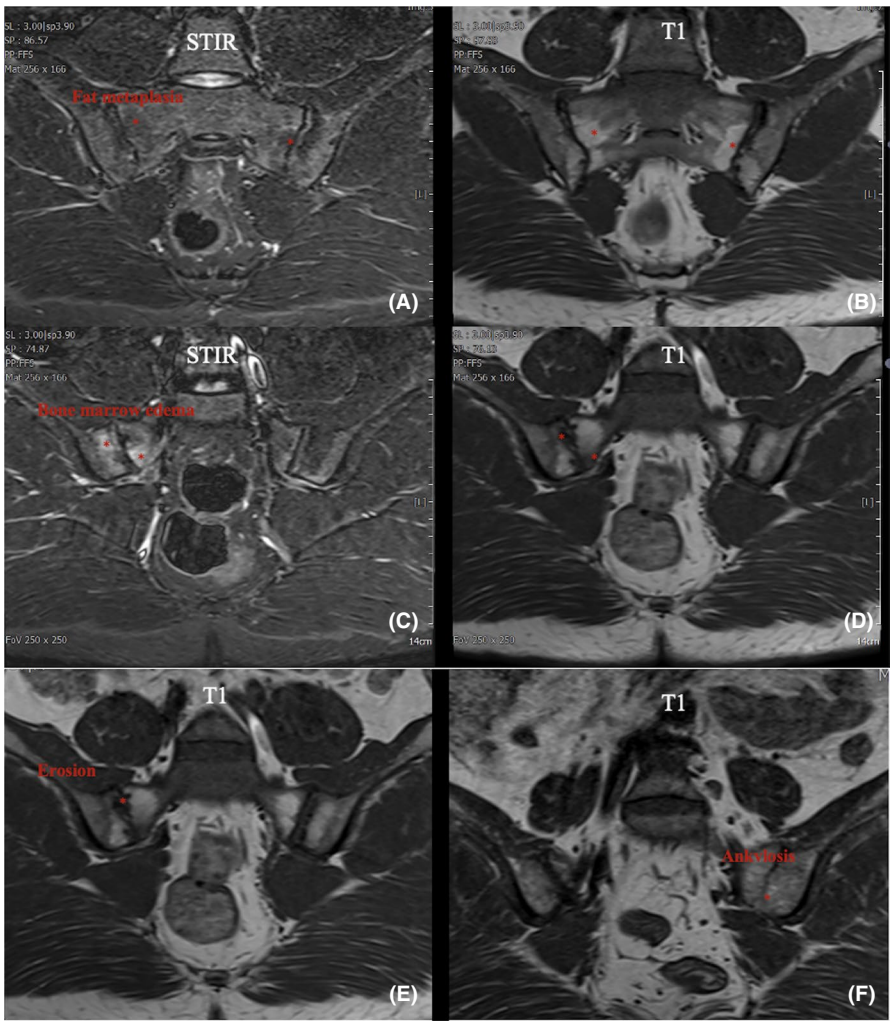

FIGURE 2 Magnetic resonance imaging findings of inflammatory and structural lesions in the short tau inversion recovery and T_1-weighted / spin-echo sequence of sacroiliac joints. A-B, fat metaplasia; C-D, bone marrow edema; E, erosion; F, ankylosis

patients with bone marrow edema had edema in only 1 section, the number of patients with active inflammation was 29.

Fat metaplasia scores were significantly higher in men than in women (12.5 ± 11 vs 3.1 ± 5.2, $P = .008$), the other scores were similar ($P > .05$). The presence of erosion was more frequent in women than in men (93% vs 50%, $P = .01$).

Concerning disease activity, SPRACC scores did not differ between patients in DAPSA remission and non-remission ($P > .05$) and between those in MDA and non-MDA ($P > .05$).

There was no significant difference between the SPARCC scores in terms of DMARD and steroid therapy. However, fat metaplasia and total structural scores were significantly higher in patients using NSAIDs than those who did not ($P = .01$ and .03, respectively).

Of 40 patients, 12 (30%) had unilateral SI involvement. Patients with unilateral and bilateral involvement did not differ in terms of age ($P = .51$), gender ($P = .54$), disease duration ($P = .45$), and CRP levels ($P = .28$). While none of the patients with unilateral involvement had ankylosis, 7 (58.3%), 7 (58.3%), 10 (83.3%), and 2 (16.7%) had bone marrow edema, fat metaplasia, erosion, and backfill, respectively.

3.3 | Clinical and laboratory parameters of patients with and without active inflammation

CRP levels were significantly higher in patients with active inflammation than in those without active inflammation ($P = .01$). Other clinical and laboratory parameters were similar (Table 3).

3.4 | Correlations of MRI scores with disease characteristics

Table 4 shows the correlations between SPARCC SIJ scores and disease characteristics. The SPARCC SIS score was significantly correlated with disease duration ($r = -.35$, $P = .03$) and CRP levels ($r = .32$, $P = .04$).

The SPARCC SSS score was inversely correlated with BASDAI ($r = -.37$, $P = .02$), ASDAS-CRP ($r = -.39$, $P = .01$), and ASDAS-ESR ($r = -.32$, $P = .04$).

TABLE 1 Clinical characteristics of the patients

Clinical parameters	Patients (n = 40)
Tender joint count	1.5 (4.2)
Swollen joint count	0 (0)
PASI score	0 (1.2)
VAS pain score	60 (40)
VAS global score	50 (30)
DAPSA score	15.3 (9.4)
BASDAI score	5.6 (4.4)
ASDAS-CRP score	3 (1)
ASDAS-ESR score	3.5 (1.4)
Erythrocyte sedimentation rate, mm/h	25 (25.5)
C-reactive protein, mg/dL	0.32 (0.26)
Body mass index, kg/m^2	28.3 (6.3)

Note: Data are presented as median (interquartile range).

Abbreviations: ASDAS, Ankylosing Spondylitis Disease Activity Score; BASDAI, Bath Ankylosing Spondylitis Disease Activity Index; DAPSA, Disease Activity in Psoriatic Arthritis; PASI, Psoriasis Area and Severity Index; VAS, visual analog scale.

TABLE 2 The distribution of active and structural magnetic resonance imaging lesions

MRI findings	Mean (±) score	Number (%) of cases
Active inflammation (SPARCC SIS score)		
Bone marrow edema	4.7 ± 5	30 (75%)
Structural lesions (SPARCC SSS score)		
Fat metaplasia	5.1 ± 7.6	26 (65%)
Erosion	2.1 ± 2	33 (84.6%)
Backfill	0.2 ± 0.5	5 (12.5%)
Ankylosis	0.05 ± 0.3	1 (2.5%)
Total	7.4 ± 8.5	
SPARCC SIJ total score	12.2 ± 11.4	

Note: Data are presented as mean or n (%).

Abbreviations: SIJ, sacroiliac joint; SIS, sacroiliac joint inflammation score; SPARCC, Spondylarthritis Research Consortium of Canada; SSS, sacroiliac joint structural score.

TABLE 3 Clinical and laboratory parameters of patients with and without active inflammation

	Active inflammation		
	Present (n = 29)	Absent (n = 11)	P^*
Disease duration, mo	15 (36)	48 (81)	.14
Body mass index, kg/m^2	28.7 (5.5)	27.5 (8.1)	.3
Swollen joint count	0 (0)	0 (1)	.05
Tender joint count	1 (4)	4 (4.5)	.34
Leeds score	2 (4)	4 (4.5)	.39
VAS pain score	55 (50)	60 (25)	.95
CRP, mg/dL	0.38 (0.3)	0.31 (0.001)	***.01***
Sedimentation, mm/h	26 (22)	12 (22.5)	.14
Morning stiffness, min	3 (3)	5 (1)	.52
DAPSA	14.3 (10.3)	16 (7.9)	.58
BASDAI	5.1 (5.1)	6 (2.6)	.71
ASDAS-CRP	3.1 (1.1)	3 (0.7)	.75

Note: Data are presented as median (interquartile range).

P values in bold indicate statistical significance ($P < .05$).

Abbreviations: ASDAS, Ankylosing Spondylitis Disease Activity Score; BASDAI, Bath Ankylosing Spondylitis Disease Activity Index; CRP, C-reactive protein; DAPSA, Disease Activity in Psoriatic Arthritis; VAS, visual analog scale.

*Mann–Whitney *U* test.

4 | DISCUSSION

To the best of our knowledge, this is the first study to assess SPARCC SIJ MRI scores in AxPsA and to seek correlations between MRI scores and disease characteristics. SI involvement in AxPsA has been traditionally evaluated by radiography, and recently, MRI scoring systems have been increasingly used to evaluate treatment outcomes in AS patients. To date, the Berlin MRI scoring system (range, 0-24) which primarily evaluates bone marrow edema has been used in only 1 study of AxPsA, in which the mean SIJ score was found as 1.6-1.8.[13] In a study of SpA patients, the Berlin SI MRI scoring yielded a mean score of 6.[14] Higher SI MRI scores in SpA patients may well correspond to SPARCC scores. In a prospective study of SpA patients, the mean SPARCC SIJ score was 27, which was reduced to 14 after anti-tumor necrosis factor treatment.[15] Given the mean SPARCC SIJ score of 12 found in the present study, it seems that AxPsA may have a less severe radiologic involvement as compared with SpA, which is in agreement with previous reports.[16]

In the current study, the most prevalent lesion on MRI was erosions, followed by bone marrow edema. In a study evaluating morphological features of sacroiliac MRI in axial SpA and controls, fat metaplasia was most common in patients with axial spondylarthritis, followed by erosions and bone marrow edema, respectively.[17] In another MRI study of PsA, in which MRI scoring was not used, the most prevalent acute and chronic lesions on MRI were bone marrow edema and erosion with equal frequency, followed by enthesis and fat metaplasia.[18] Although erosion was the most common lesion in our study, total erosion scores were lower than other lesions scores. In addition, the high rate of erosion in the study may be due to female predominance, that erosions were more common in females than males.

One important finding of the present study is the relationship between CRP levels and active inflammation on MRI. Although several studies have addressed the same relationship for SpA,[19,20] it has not been examined in PsA patients. One study found higher CRP levels in PsA patients with sacroiliitis versus without sacroiliitis, with no further evaluation concerning the relationship of CRP levels with

TABLE 4 The correlations between SPARCC SIJ scores and disease characteristics

	SPARCC SIS score		SPARCC SSS score		SPARCC SIJ total score	
	Correlation coefficient (rho)	*P* value	Correlation coefficient (rho)	*P* value	Correlation coefficient (rho)	*P* value
Disease duration	**−0.35***	**.03**	−0.10	.53	−0.18	.27
Body mass index, kg/m^2	0.15	.34	−0.06	.71	0.05	.76
PASI	0.07	.66	0.09	.58	0.21	.18
DAPSA	−0.23	.16	0.04	.80	−0.23	.18
BASDAI	−0.25	.12	**−0.37***	**.02**	−0.35	.03
ASDAS-CRP	−0.22	.18	**−0.39***	**.01**	**−0.35***	**.03**
ASDAS-ESR	−0.17	.29	**−0.32**	**.04**	−0.28	.08
CRP, mg/dL	**0.42***	**.01**	−0.03	.86	0.24	.14
ESR, mm/h	0.08	.59	−0.13	.42	−0.04	.79

P values in bold indicate statistical significance ($P < .05$).

*indicates significant correlation coefficient.

Abbreviations: ASDAS, Ankylosing Spondylitis Disease Activity Score; BASDAI, Bath Ankylosing Spondylitis Disease Activity Index; BMI, body mass index; CRP, C-reactive protein; DAPSA, Disease Activity in Psoriatic Arthritis; ESR, erythrocyte sedimentation rate; PASI, Psoriasis Area and Severity Index; SIJ, sacroiliac joint; SIS, sacroiliac joint inflammation score; SPARCC, Spondylarthritis Research Consortium of Canada; SSS, sacroiliac joint structural score.

MRI activity.[18] As in AS, CRP may be helpful in monitoring the radiologic disease activity in axial PsA.

On the other hand, in the present study, active inflammation was inversely associated with disease duration. This finding was consistent with that reported for the Italian arm of the SPACE study, in which bone marrow edema tended to decrease over a follow-up of 24 months.[21] Additionally, we found no relationship between active inflammation on MRI and clinical disease activity. This may in part be explained by the small sample size as well as the absence of spinal evaluation. There have been conflicting results concerning MRI activity and clinical disease activity. With the use of STIR-MRI, some studies found a positive association between the ASDAS and spinal inflammation,[20] whereas others did not.[22] Concerning structural lesions, structural scores were inversely associated with axial disease activity as assessed by ASDAS and BASDAI, but as expected not with DAPSA. These results show that axial disease activity decreases with increasing structural damage. Similarly, in a study conducted on patients with radiographic and non-radiographic spondylarthritis, an inverse correlation was found between BASDAI scores and structural lesions including fat metaplasia and erosions.[23] One of the reasons for this may be the regular use of NSAIDs by patients with axial disease activity. In our study, structural scores were found to be higher in patients using NSAIDs. In this group of patients, disease activity may be suppressed by NSAID therapy. Although there was no difference in SPARCC scores in terms of DMARD and steroid therapy, structural scores were significantly higher in patients using NSAIDs, while there was no difference in inflammation scores.

Clinical and radiological manifestations of axial PsA and AS differ considerably. In PsA, axial involvement has been shown to occur in older age than in AS. In a large cohort of patients with PsA and AS, the mean age in the AS group was 38 years versus 46 years in the axial PsA group.[24] Another difference is the pattern of SI involvement in PsA, which tends to be more bilateral and asymmetrical.[25] In both aspects, our findings were consistent with these features of PsA. In an MRI study of patients with PsA, the prevalence of sacroiliitis was found as 38%, with half of the cases having unilateral involvement.[18]

Our study has some limitations. The main limitation is its small sample size and retrospective design. SPARCC scores were calculated by a single rheumatologist, who completed a training course on SPARCC and received a certificate. Another limitation was the absence of spinal evaluation. Although it was shown that cervical and thoracic involvement in PsA often accompanies sacroiliitis or can be seen without sacroiliac involvement, we could not evaluate SPARCC spinal scores due to insufficient data.

In conclusion, axial involvement in PsA has not been fully elucidated in particular MRI characteristics. Further studies are warranted with larger patient groups. The ongoing ASAS-GRAPPA project is expected to provide us with more clear data (Axial Involvement in Psoriatic Arthritis Cohort; Clinical Trials; NCT04434885).

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None.

CONFLICT OF INTEREST

The authors declare there are no conflicts of interest.

AUTHOR CONTRIBUTIONS

All co-authors satisfy all 4 criteria (participated in study design, data collection, analysis, interpretation and writing equally), and take full responsibility for the integrity of the study and the final manuscript.

ETHICS APPROVAL

All procedures performed in studies involving human participants were performed in accordance with the ethics standards of the

institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Ethics approval was taken from the Marmara University Ethics Committee on 09.2021. The protocol number was 539.

CONSENT TO PARTICIPATE

Informed consent was obtained from all subjects before enrollment.

CONSENT FOR PUBLICATION

Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

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