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Original Investigation

Early detection of spondyloarthropathy in patients with psoriasis by using the ultrasonography and magnetic resonance image

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Abstract

Objective: To assess the validity of ultrasound (US) in the early detection of arthritis and enthesitis, with assessment of the validity of magnetic resonance imaging (MRI) in the early detection of sacroiliitis and spondylitis in patients with psoriasis and to compare the findings of clinical examination and conventional radiography.

Material and Methods: The study included 50 patients with psoriasis and 20 healthy controls. All patients and controls underwent US and power Doppler analyses for the joints of both hands and feet and the entheseal sites. MRI of the lumbosacral spine and sacroiliac joints was performed.

Results: Abnormal US findings of arthritis were present in 18% patients, whereas only 6% patients had X-ray abnormalities, the enthesopathy represent 74%, at a higher percentage than clinical and radiological assessment (46, 26% respectively). MRI and radiological study demonstrated evidence of inflammation in the spine in 44% and 16% patients, respectively, and evidence of sacroiliitis in 10% and 6% patients, respectively.

Conclusion: Use of newer imaging modalities allows early diagnosis and early initiation of therapy.

Keywords: Psoriatic arthritis, magnetic resonance imaging, ultrasound, enthesopathy, sacroiliitis

Introduction

Psoriasis is a common inflammatory skin disease characterized by abnormal keratinocyte proliferation and differentiation, increased angiogenesis, and inflammation (1). Psoriasis can be associated with a form of spondyloarthropathy, known as psoriatic arthritis (PsA) (2). PsA is a heterogeneous disease that occurs in 5%-17% patients with psoriasis (3). Study of PsA is difficult and it has not been characterized as well as other arthropathies (4). Psoriasis may precede, occur simultaneously, or follow the onset of arthritis (5). In the latter case, the patient may be erroneously diagnosed as having an inflammatory arthritis other than PsA. In addition to peripheral arthritis, people with psoriasis are also more likely to develop an inflammatory spinal disease similar to ankylosing spondylitis. The inflammatory spinal disease may be indistinguishable from ankylosing spondylitis but may differ from the classic disease in several respects (4). Initially, PsA was considered to be a mild, non-progressive disease compared with rheumatoid arthritis (RA). However, accumulating evidence confirms that a substantial proportion of patients with PsA have persistent inflammation, develop progressive joint damage and disability, and have reduced life-expectancy (6). Improved therapy options and knowledge of the importance of early initiation of aggressive treatments to optimize long-term outcome in patients (7) have led to an increasing focus on developing new sensitive diagnostic and monitoring tools. Musculoskeletal ultrasound (MSUS) has become an established imaging technique for the diagnosis and follow-up of patients with rheumatic diseases (8). Ultrasound (US) has been proved to be effective in demonstrating PsA involvement of joints and tendons and is more sensitive than clinical examination in detecting the underlying pathology (9). In addition, it is more sensitive than plain radiography in detecting structural damage in joints (10). Magnetic resonance imaging (MRI) is very sensitive for the early detection of sacroiliitis in PsA. In a previous study, Williamson et al. (11) showed that MRI-diagnosed sacroiliitis was present in 38% of a group of unselected PsA patients and was not necessarily associated with a clinical history of inflammatory back pain or positive sacroiliac provocation tests. The MRI changes included bone edema, sacroiliac erosions, and the more chronic changes of periarticular fat accumulation and sclerosis.

Material and Methods

Patients

This study included 50 patients with psoriasis (group I) and 20 age- and sex-matched healthy controls (group II). The subjects were consecutively recruited from the outpatient clinic of Rheumatology and Dermatology Department of El-Minia University Hospital. Written informed consent was obtained from all patients who participated in this study. The study was approved by the local research ethics committee

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of El-Minia University. Patients were previously diagnosed by a dermatologist and suspicious cases were confirmed by skin biopsy.

Clinical evaluation

Clinical assessment was performed in all patients by a rheumatologist. All patients were subjected to full history taking and complete clinical examination including general and locomotor examination. All patients were subjected to all provocative tests of sacroiliitis. The modified Ritchie articular index (RAI) was calculated; it includes DIPs that are commonly involved in psoriasis (12). Finger nails were examined to assess the severity of nail changes in terms of the nail score (12). Disability was assessed using the Health Assessment Questionnaire-disability index (13). All sites of enthesopathy were examined to determine the enthesopathy index, which was calculated according to Mander et al (14). The skin lesions were evaluated using the psoriasis area and severity index (PASI) score (15).

Radiological evaluation

1- Plain X-ray of both hands, wrists, feet, lumbar spine, and sacroiliac joint in different radiological positions with X-ray to the sites of enthesopathy.

2- Musculoskeletal ultrasonography (MSUS): Conventional gray-scale US and power Doppler (PD) examinations were performed using Picus 4D, with a 7-12.5-MHz linear transducer. In all patients, US examination was performed on 2 days of clinical evaluation.

A- Musculoskeletal ultrasonography (MSUS) for enthesopathy

- **Sites of examination:** The following entheses were examined bilaterally according to the Madrid Sonographic Enthesitis Index (MASEI) (16): inferior pole of the calcaneus, superior pole of the calcaneus, tibial tuberosity, inferior pole of the patella, superior pole of the patella, olecranon tuberosity.
- **Position and planes during examination:** Each tendon was scanned in both the longitudinal and transverse planes. Knee enthesis examination was performed with the patient in the supine position and the knee flexed to 70°. The Achilles tendon and plantar aponeurosis were examined with the patient lying prone and the feet hanging over the edge of the examination table at 90° of flexion. The triceps insertion was examined with the arm flexed to 90° (16).
- **Ultrasound (US) evaluation of enthesis for the following:** structure, thickness, erosions, calcifications, bursitis, and power Doppler signal (according to MASEI) (16). The total possible score on both sides (12 entheses) was 136.

Table 1. Demographic and clinical data of patients

	Range	Mean±SD
Age (years)	17-75	44.8±17.5
Duration of psoriasis (years)	0.5-40	8.7±8.7
Duration of rheumatic complaint	0-15	1.9±3.3
PASI score	0.4-36.7	6.9±7.8
Nail score	0-24	4.8±6.5
RAI	0-30	4.2±6.4
HAQ	0-1.5	0.2±0.3
Enthesopathy index	0-11	1.8±2.8

PASI: psoriasis area and severity index; RAI: ritchie articular index; HAQ: health assessment questionnaire

B- Musculoskeletal ultrasonography (MSUS) for joint:

*Bilateral 2nd-5th metacarpophalangeal (MCP), proximal interphalangeal (PIP), and distal interphalangeal (DIP) joints and 1st–5th metatarsophalangeal (MTP) joints were examined and scored according to the scoring system proposed by Szkudlarek et al (17). Joint effusion, synovitis, bone erosions, and power Doppler signals in the synovial membrane of the preselected joints were evaluated and classified on 4-grade semiquantitative scales.

3- Magnetic resonant image (MRI): Lumbar spine and sacroiliac joint

All patients recruited in our study underwent MRI, which was performed with SIGNA Profile 0.2 Tesla (GE Medical Systems) using a spine phased-array coil. Imaging was performed in the supine position after routine patient preparation, including removal of all metallic objects.

1. Sacroiliac joints: Coronal oblique STIR plane parallel to the anterior sacrum. Images were analyzed for detection of structural changes (including erosion, sclerosis, and ankylosis) and inflammatory changes (including bone marrow edema and effusion) of the sacroiliac joints. Regarding erosion, subchondral sclerosis, and bone marrow edema, the changes were reviewed at both the iliac side and sacral side of the joint.
2. Lumber spine: The sagittal STIR plane was the main plane of imaging. The STIR sequence used the following parameters: TR, 4000 ms; TE, 30 ms; FOV 32; slice thickness, 4 mm; spacing, 0.5; inv. time, 60 s; echo train length, 15.

Statistical analysis

Data analysis was performed on a personal computer using Statistical Program for Social Sciences (SPSS) version 16 as follows: *Quantitative variables were presented as mean, standard deviation (SD), and range. *Qualitative variables were presented as number (no.) and percentage (%). Comparisons were performed using the chi-square ($\chi 2$) test for qualitative variables; the Student's t-test was used to compare two independent groups with regard to quantitative variables. *Pearson's correlation coefficients (r) were calculated for detection of parametric correlations, whereas Spearman's correlation coefficients (r) were calculated for detection of non-parametric correlations between variables in one group. *P values of <0.05 were considered significant and values <0.01 were consider highly significant.

Results

This study included 50 patients with psoriasis (group I) and 20 age- and sex-matched controls (group II). The age of the patients ranged between 17 and 75 years, with a mean age of 44.8±17.5 years. The age of the controls ranged between 18 and 60 years, with a mean age of 40.6±15.2 years. The duration of psoriasis ranged between 0.5 and 40 years, with a mean duration of 8.7±8.7 years. The demographic and clinical characteristics of the patients are presented in Table 1.

Spondyloarthropathic features of psoriasis: Thirty seven patients had rheumatic complaints (74%), 11 had arthralgia, 14 had inflammatory low back pain (LBP), and 23 had enthesitis clinically.

A- **Psoriatic arthritis (PsA):** There was a highly significant difference between patients and control with respect to arthritis. According to the presence or absence of arthralgia, we further subdivided our patients into the following groups:

- **Group 1A patients:** This group included patients with arthralgia [8 (16%) males and 3 (6%) females] who had psoriasis for 7.05±7.8 years. The clinical characteristics of this group are summarized in Table 2. Peripheral joint examination by US revealed abnormal findings suggestive of PsA in 7/11 patients, with joint effusion in 4 patients; in 1 patient, joint effusion was the only US abnormality. Four patients had synovitis, 4 had erosions (Figure 1), and 5 showed an increased vascularity on PD. Three patients also had one or more X-ray abnormality. Psoriatic nail

involvement was reported to be associated with the development of PsA.

- **Group 1B patients:** The group included patients without arthralgia (21 males and 18 females), with a slightly but not significantly lower PASI score compared with Group 1A patients (p=0.06). Their disease duration was comparable to that of Group 1A. Two patients showed abnormal US findings in the form of synovitis, erosions, and increased vascularity on PD examination, with no X-ray abnormalities.
- There was a statistically significant difference between the two subgroups with regard to RAI and HAQ. In both groups, the MCP joints were the most frequently involved joint on US (8 patients), followed by the MTP joints (4 patients), PIP joints (3 patients), and DIP joints (1 patient). When the PD findings were compared to clinical assessment (swollen and/or tender joints), PD identified a total of 24 joints with Doppler signal, 17 of which were clinically normal. There was a highly significant difference between the patients and controls with regard to arthritis; no arthritis was detected in the control group.

B- Enthesopathy

Enthesitis was detected by US in 37 patients (74%) at a higher percentage than tenderness revealed by clinical and radiological assessment (46% and 26%, respectively). Table 3 shows the MASEI score, frequency of enthesitis, and elementary lesion scores by US in groups I and II. There was a highly significant difference between the groups in terms of the MASEI score (higher in group I) (p=0.001) and number of abnormal enthesis examined by US (p=0.004). We found a highly significant difference between the groups with regard to the structure (p=0.03), bursa (p=0.001), erosion (p=0.008), calcification (p=0.001), and power Doppler signal (p=0.001) scores (higher in group I) (Figure 2, 3).

There was a statistically significant difference between patients with and without enthesopathy regarding the X-ray result, but the difference was not statistically significant regarding ultrasound result. Because of the high frequency of detection of subclinical enthesopathy by US (Table 4). US findings of enthesopathy were not correlated with age and duration or severity of psoriasis according to the PASI score, although they showed a statistical significant correlation with the enthesopathy index, RAI, and HAQ (p=0.03*, 0.03*, 0.02*, respectively). Table 5 shows statistically significant difference between the radiological and US finding of enthesopathy (p=0.01*).

Axial involvement

Fourteen patients (28%) (8 males and 6 females) had inflammatory back pain; their mean age was 38.1±14.7 years. Clinical features of sacroiliitis were found in 8/50 (16%) patients. The relation between inflammatory back pain and other clinical and MRI findings is illustrated in Table 6. MRI demonstrated evidence of inflammation of the central part of the vertebral end plates as well as vertebral corners in 22 (44%) patients (Figure 4); of these, 9 (40.9%) had inflammatory LBP. Among these 22 patients, 7 (31.8%) had ab-

Table 2. Clinical characteristics of the patient subgroups

	Group 1 (A)	Group 1 (B)	p value
Age (years)	42.46±20.83	45.44±16.63	0.62
PASI	10.15±9.74	6.07±7.04	0.06
Mean duration of psoriasis (years)	8.14±7.67	8.86±9.04	0.81
Nail Score	7.91±8.81	3.92±5.58	0.11
HAQ	0.499±0.43	0.076±0.22	0.00*
RAI	11.82±7.99	2.10±3.81	0.000*
Enthesopathy index	4.09±3.81	1.18±2.08	0.01*
Inflammatory LBP	6 (54.5%)	8 (20%)	0.05*
Clinical sacroiliitis	2 (18.2%)	6 (15.4%)	0.99

PASI: psoriasis area and severity index; RAI: ritchie articular index; HAQ: health assessment questionnaire; LBP: inflammatory low back pai

Table 3. MASEI score, frequency of enthesitis, and elementary lesion scores by ultrasound in groups I and II

			Group 1 (n=50)	Group 2 (n=20)	t		p value	
MASEI score	Range		20-38	6-14	10.85		0.001**	
	(Mean±SD)		27.8±5.4	12.2±4.3				
	Male	Range	20-38	6-22				
		(Mean±SD)	26.8±5.6	13.1±4.1				
	Female	Range	22-36	8-22	-1.12"	0.764"	0.2"	0.4"
		(Mean±SD)	29.1±5.04	11.6±4.6				
Abnormal enthesis on ultrasound (no. of abnormal enthesis/total enthesis examined)			407/600 (67.8%)	20/240 (8.3%)	1.22		0.004*	
Structure score (mean±SD)			4.6±1.9	3.5±1.3	2.804		0.03*	
Thickness score (mean±SD)			1.3±1.1	1.6±1.2	-0.840		0.4	
Bursa score (mean±SD)			2.2±1	0.9±0.7	6.102		0.001**	
Erosion score (mean±SD)			2.5±2.5	0.7±1.6	5.133		0.008**	
Calcification score (mean±SD)			7±2.19	3.4±1.7	2.750		0.001**	
Power Doppler score (mean±SD)			10±2	0.6±0.5	8.861		0.001**	

MASEI: madrid sonographic enthesitis ındex

Table 4. X-ray and ultrasound findings in patients with and without clinical features of enthesopathy

		Clinical enthesopathy		
		Absent (n=27)	Present (n=23)	p value
Ultrasound	Normal	8 (29.6%)	5 (21.7%)	0.52
	Abnormal	19 (70.4%)	18 (78.3%)	
X-ray	Normal	24 (88.9%)	13 (56.5%)	0.009**
	Abnormal	3 (11.1%)	10 (43.5%)	

The chi-square test was performed

Table 5. Comparison between radiological and ultrasound findings of enthesopathy

	Ultrasound finding			
Radiological finding	Absent (n=13)	Present (n=37)	X^2	p value
Absent (n=37)	13	24	6.17	0.01*
Present (n=13)	0	13		

Table 6. Relation between inflammatory back pain and other clinical, radiological, and MRI findings

		Inflammatory back pain		
		Absent (n=36)	Present (n=14)	p value
Clinical sacroiliitis	Absent	31 (86.1%)	11 (78.6%)	0.68
	Present	5 (13.9%)	3 (21.4%)	
Schober test	Normal	30 (83.3%)	7 (50%)	0.029*
	Abnormal	6 (16.7%)	7 (50%)	
Lateral flexion test	Normal	31 (86.1%)	7 (50%)	0.023*
	Abnormal	5 (13.9%)	7 (50%)	
MRI of the LSS	Normal	23 (63.9%)	6 (42.9%)	0.16
	Abnormal	13 (36.1%)	9 (64.3%)	
MRI-diagnosed sacroiliitis	Normal	34 (94.4%)	11 (78.6%)	0.12
	Abnormal	2 (5.5%)	3 (21.4%)	
X-ray-diagnosed sacroiliitis	Normal	34 (94.4%)	13 (92.8%)	0.6
	Abnormal	2 (5.5%)	1 (7.1%)	
X-ray of the LSS	Normal	33 (91.6%)	10 (71.4%)	0.08
	Abnormal	4 (11.1%)	4 (28.5%)	

MRI: magnetic resonance imaging; LSS: lumbosacral spine

normal Schober test. MRI-diagnosed sacroiliitis was present in 5 (10%) patients; among them, 3 (60%) had inflammatory BP, 1 (20%) had mechanical, and 1 are asymptomatic (20%). Of the patients with abnormal scans, 3 showed subchondral bone marrow edema alone (Figure 5), and 2 showed edema and chronic changes (erosions and periarticular sclerosis). There was no statistical relation between the clinical features of sacroiliitis and MRI changes. Radiology-diagnosed sacroiliitis was present in 3 (6%) patients; among them, 1 (33.3%) had inflammatory BP, 1 (33.3%) had mechanical, and 1 (33.3%) are asymptomatic. All patients with MRI-diagnosed sacroiliitis had arthritis and enthesopathy. Table 7 shows highly significant differences between MRI results and radiological findings of the SIJ and spine (p<0.0001***). There was no association between MRI changes in the lumbosacral spine (LSS) and the other variables: age, duration of psoriasis, PASI score, nail changes, HAQ except for RAI (p<0.02*).

Figure 1. Right MCP joint showing erosion

Discussion

Thirty seven patients had rheumatic complaints (74%) and 11 patients had arthralgia (22%); in 7 out of 11 patients, US showed findings consistent with synovitis in at least one finger and/or toe. Four patients had US but no X-ray finding. X-ray evaluation disclosed structural damage in 3 patients who also had US abnormalities and whose disease duration was more than 2 years. A larger number of abnormalities (erosions, synovitis, effusion, and PDS) that were eventually diagnosed as PsA were found on US examination than on plain radiographs. The findings of our study confirm previous reports of the ability of US to demonstrate inflammatory and destructive changes in the fingers and toes of PsA patients (9, 18). The results of our study are also in agreement with those reported previously (19), where the authors investigated 52 patients with psoriasis and joint pain for the presence of US abnormalities in fingers and toes. They found US findings suggestive of PsA in 36/52 patients, and 11 also had one or more X-ray abnormality. They found a higher percentage of patients with positive findings than our study because they selected patients with joint pain, whereas we investigated patients with psoriasis, not PsA.

In our study, entheseal abnormalities could be documented by US in 74% patients with psoriasis, whereas clinical examination detected enthesitis in only 46% patients. The results of our study are in agreement with those reported by De Filippis et al. (20) who found that entheseal abnormalities not detected at clinical examination were present in 33% patients with psoriasis who underwent US examination. The findings are in agreement with those of Bandinelli et al. (21) who investigated 92 patients with early PsA for the presence of clinical or US abnormalities at the entheseal sites of lower limbs using GUESS and PD US. They found that all patients had GUESS>1 and 40.2% showed positive PD signal on entheses versus 29.3% on clinical examination. They also found that GUESS and PD did not correlate with PASI or other clinical characteristics, which was similar to our findings.

Table 7. The comparison between MRI and radiological finding of SIJ and spine

Magnetic resonance imaging							
Conventional radiography	Absent	Sacroiliitis	LSS-change	Both	Total	$\chi 2$	p
Absent	24	2	14	0	40	79.4	0.0001**
Sacroiliitis	0	2	0	0	2		
LSS-change	0	0	7	0	7		
Both	0	0	0	1	1		
Total	24	4	21	1	50		

LSS: lumbosacral spine change

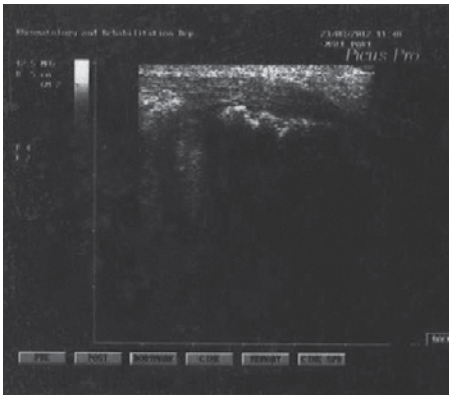

Figure 2. The right Achilles tendon showing multiple erosions and retrocalcaneal bursitis

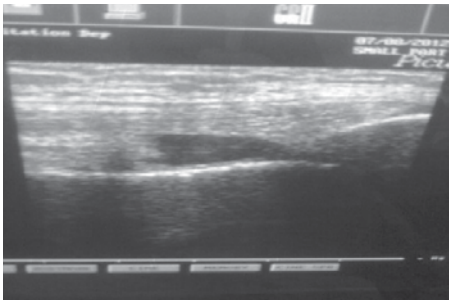

Figure 3. Right quadriceps tendon insertion showing increase thickness and suprapatellar bursitis

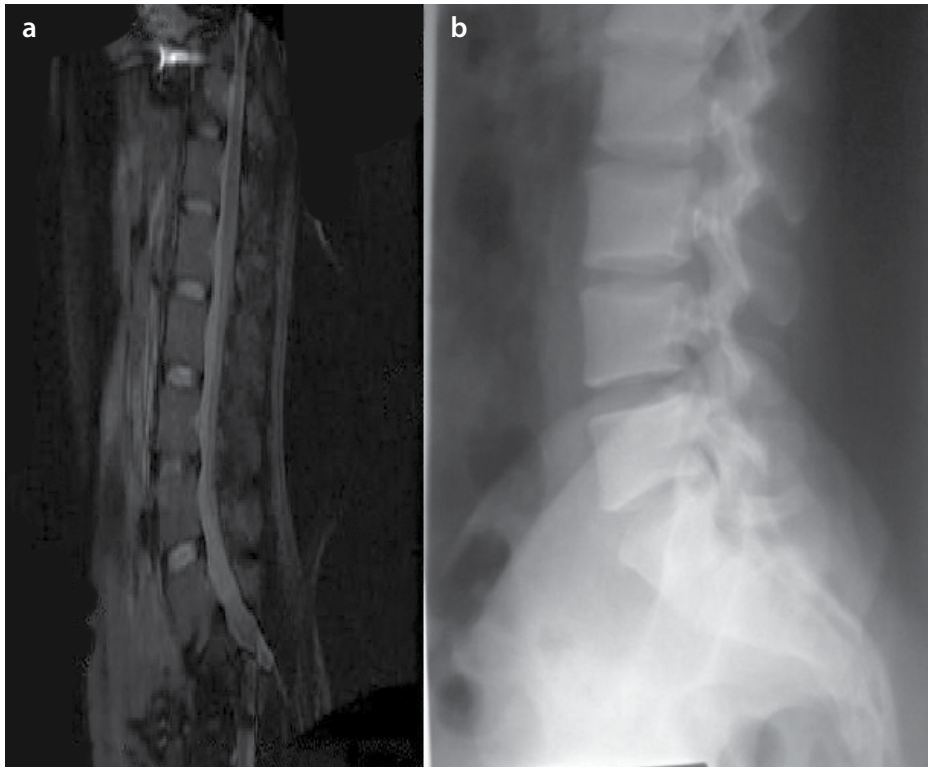

Figure 4. a, b. MRI of the lumbar spine (sagittal STIR sequence) showing signs of active inflammation at several levels. In particular, anterior spondylitis is seen at level L3/L4 (a). Normal plain X-ray of the same patient rather than squaring of vertebrae (b)

Although our study was conducted on patients with psoriasis, not PsA, our results are in concordance with those of Bandinelli et al who investigated patients with PsA.

The findings of our study are supported by those of Gisondi et al. (2) who found that the mean GUESS score was significantly higher in patients with psoriasis as compared with controls. Similarly, Ozcakar et al. (22) found that the mean thickness of the Achilles tendon was significantly higher in patients with psoriasis (without clinical sign of enthesitis) than in healthy volunteers. Achilles sonographic abnormalities in 35 of 59 patients with psoriasis (59.2%) were also reported by De Simone et al. (23). However, they included 15 patients with PsA in their study.

In our study, MRI changes in the sacroiliac joint were present in 2 out of 11 patients of group 1A (18.2%) who had no X-ray changes. Another patient had bilateral sacroiliitis on plain radiography. All 3 patients had peripheral arthritis and enthesitis on US. Presence of inflammatory back pain and restricted spinal movements were the most significant clinical features associated with sacroiliitis on MRI.

The results of our study are in agreement with those of Williamson et al. (11) who investigated 68 patients with PsA for the presence of MRI changes in SIJ. They found that the frequency of MRI-diagnosed sacroiliitis was high (38%). Although they invited 144 patients with PsA to participate in the study, only 68 (47%) proceeded to MRI of the sacroiliac joints. These patients were not selected for the presence of clinically apparent sacroiliitis or axial disease, but there may have been some bias caused by patients with back pain being more likely to consent to MRI.

Similarly, Ibrahim et al. (24) found that MRI changes in the sacroiliac joint were present in 6 out of 18 patients with PsA with asymptomatic sacroiliac involvement (33.3%).

The frequency of sacroiliac joint involvement by MRI in our study population was very low. This may be due to the small number of studied patients. Moreover, bone marrow edema may disappear with treatment.

Sacroiliac provocation and stress tests are widely used in clinical practice, but their reliability has been questioned (25). In our study, presence of positive sacroiliac pain provocation tests did not predict sacroiliitis on MRI. In patients with PsA, these tests may also be confounded by the presence of skin lesions over the sacrum and large joint arthritis in the hips and knees. This agrees with the findings of Williamson et al. (11) who found that neither a clinical history of inflammatory back pain nor the presence of positive sacroiliac pain provocation tests predicted sacroiliitis on MRI.

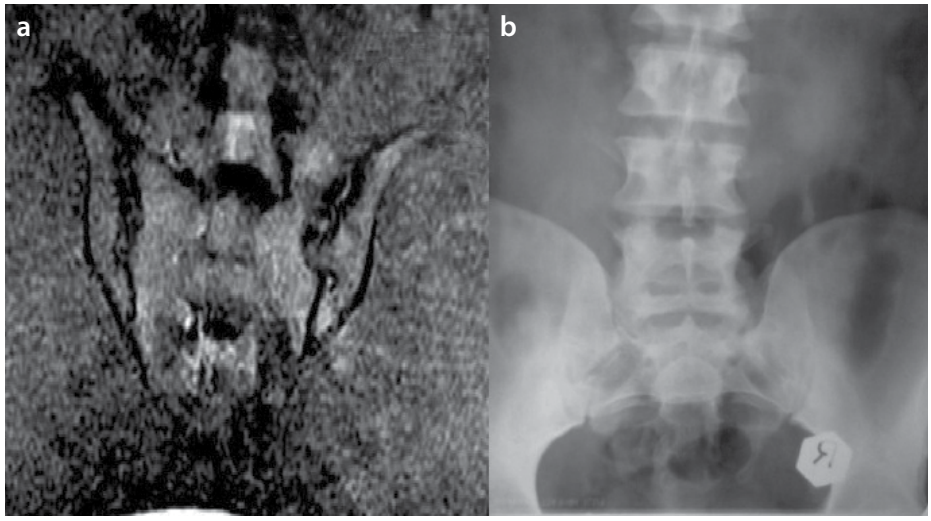

Figure 5. a, b. MRI of the sacroiliac joint (coronal STIR sequence) showing bilateral bone marrow edema (a). Normal plain X-ray of the same patient (b)

In the present study, MRI of the LSS demonstrated evidence of inflammation of the central part of the vertebral end plates as well as vertebral corners in 22 (44%) patients. This was significantly correlated with the presence of inflammatory LBP; however, it was not correlated with the presence of arthralgia and arthritis and the duration or severity of psoriasis.

Direz et al. (26) studied 93 patients with non -radiographic axial spondyloarthritis without active sacroiliitis on MRI and concluded that spinal MRI may allow the diagnosis of PsA in approximately 25% patients. These findings can indicate that these lesions in the spine may appear earlier than sacroiliitis, representing the subclinical or predisease status.

In conclusion, MSUS proved valuable as a simple, non-invasive tool in detecting synovial abnormalities in the fingers and toes compared with X-ray. US helps in the early detection of subclinical enthesopathy in patients with psoriasis. The MASEI score is a valuable tool for the early diagnosis of enthesopathy and can improve the diagnostic accuracy of early psoriatic patients. MRI of the spine and sacroiliac joints is helpful in the early detection of sacroiliitis and spondylitis than radiographs. These new modalities help in the early use of DMARDs and biologics, which delay and stop the development of erosions.

Ethics Committee Approval: Ethics committee approval was received for this study from Al-Minia University Local Research Ethics Committee.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - G.O., R.R., A.S.; Design - A.S., G.O., R.R.; Supervision - A.S., G.O., R.R., M.A.; Materials - M.H., G.O.; Data Collection and/or Processing - M.H., R.R., G.O., A.S.; Analysis and/or Interpretation - R.R., G.O., M.A.; Literature Review - R.R., A.S., G.O.; Writer - R.R., G.O., M.A., A.S.; Critical Review - R.R., G.O.

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