

Role of MRI in Diagnosis of Sacro-iliac Joint Lesions

A.M.El-Sherif¹, M.M.Faheem² and N.M.El-Moniery²

¹Radiology, Dept., Faculty of Medicine, Minia Univ., Minia, Egypt

²Radiology, Dept., Faculty of Medicine, Benha Univ., Benha, Egypt

E-Mail:noura4ever77@gmail.com

Abstract

Background: A number of radiographic techniques have been developed to reveal different aspects of sacroiliac joint pathology. Recent studies have indicated that magnetic resonance imaging (MRI) may be superior to conventional radiography in the detection of early erosive sacroiliitis and joint space narrowing. Magnetic resonance imaging (MRI) has the ability to display the hyaline cartilage in peripheral joints and has therefore been used in the detection of various pathologic joint conditions. MRI is also more efficient than CT and conventional radiography in discriminating between different soft tissue lesions, such as fibrotic and inflammatory tissue. The aim of our study was to evaluate MRI characteristics and the diagnostic sensitivity in patients with sacroiliac joint lesions. **Methods:** Our study was carried out on patients with sacroiliac joint dysfunction, in which a total of 30 patients (15 men and 15 women) were divided into 3 subgroups; acute (n=15), sub acute (n=6) and chronic (n=9) with mean age 41.03 (\pm 11.47 SD) years. Patient aged 25 to 65 years old in the period from October 2020 till April 2021. **Results:** This study showed that the mean age of cases was 2.85 (\pm 11.16 SD) with range (25-65), 55% were male, 45% were female. This study reported that according MRI finding, Rt side 20%, Lt side 20%, 60% bilateral, 30% with Joint Space Narrowing, 50% Irregular articular surface, 70% with BM edema, 45% Subchondral sclerosis, 15% Marginal osteophytes, 20% Joint effusion. This study cleared that 40% of cases had associations. This study showed that there were 5% normal, 35% Early sacroiliitis, 20% Degenerative sacroiliitis, 10% Ankylosing spondylitis, 5% Acute brucella sacroiliitis, 5% Enteropathic arthropathy 5% Psoriatic arthropathy ,5% Septic arthritis, 5% SIJ effusion, 5% SIJ osteomyelitis. **Conclusion:** Our study revealed that most of cases showed early sacroiliitis and associated BM edema So MRI could be as gold standard to diagnose the early stage of arthropathies rather than CT and conventional radiography.

Key words: MRI, Diagnosis, Sacro, iliac Joint, Lesions.

1. Introduction

The sacroiliac joint (SIJ) is the joint in the bony pelvis between the sacrum and the ilium of the pelvis. The SI joint is a complex joint with two parts: the synovial part and the ligamentous part. The synovial part is located in the anterior and lower third of the joint. It is a synovial joint with hyaline cartilage on the joint surfaces surrounded with synovium. The ligamentous part is located in the dorsal and upper two-thirds of the joint, where the sacrum and the ilium are connected with restraining ligaments (anterior and posterior sacroiliac, interosseous, sacrotuberous, and sacrospinous ligaments) [1].

Like most lower extremity joints, one of the SI joints' functions is shock absorption (depending on the amount of available motion at the sacroiliac joint) for the spine, along with the job of torque conversion allowing the transverse rotations that take place in the lower extremity to be transmitted up the spine. The SI joint, like all lower extremity joints, provides a "self-locking" mechanism (where the joint occupies or attains its most congruent position, also called the close pack position) that helps with stability during the push-off phase of walking. The joint locks (or rather becomes close packed) on one side as weight is transferred from one leg to the other, and through the pelvis the body weight is transmitted from the sacrum to the hip bone [2].

The SIJ may be the source of pain in the lower back and buttocks in up to 15–21 % of the population. Pelvic girdle pain (PGP) is a specific form of low back pain that may occur separately or in conjunction with low back pain in pregnancy or the post-partum period [3].

A number of radiographic techniques have been developed to reveal different aspects of sacroiliac joint pathology. Recent studies have indicated that computed tomography (CT) may be superior to conventional radiography in the detection of early erosive sacroiliitis and joint space narrowing [4].

Magnetic resonance imaging (MRI) has the ability to display the hyaline cartilage in peripheral joints and has therefore been used in the detection of various pathologic joint conditions [5].

MRI is also more efficient than CT and conventional radiography in discriminating between different soft tissue lesions, such as fibrotic and inflammatory tissue [6].

Although joint cartilage acts as a relative barrier to neoplastic spread from sub articular bone, no such barrier exists against involvement of a nearby joint space by aggressive soft tissue neoplasms arising close to joints. Such involvement at the sacroiliac joint could mimic sacroiliitis on plain films and, in addition, would significantly compromise the chances of successful surgical outcome. Magnetic resonance imaging of the sacroiliac joint has only been considered relatively recent method in evaluation of neoplastic lesions of SIJ (7).

The aim of this study was to evaluate characteristics and the diagnostic sensitivity of MRI in patients with sacroiliac joint lesions.

2. Patients and Methods

All patients was selected from Benha University Hospitals. Written informed consents obtained from all participants, The study approved by Ethics Committee

on Research involving human subjects of Benha faculty of Medicine.

Technical Design include

- The study design.
- The study setting.
- Time of study
- The study population.
- Data collection tools

Operational design

Time of the study : from October 2020 till April 2021

<i>Topic</i>	<i>Period</i>
Preparatory phase	One month
Design of examination sheet	Two months
Review of literature	One months
Collection, organization, entering of data and statistical analysis	Two months

Target population (Inclusion criteria):

Our study was carried out on thirty Male and female patients suffer from clinical complaint (pain) related to sacroiliac joint and according to the duration of complaint, the patients were classified into three groups;

- Acute group: pain duration less than one months.
- Sub-acute group: pain from two to 6 months.
- Chronic group: more than 6 months.

Exclusion criteria:

- Presences of general contraindications for MRI such a pacemaker, cochlear implant....etc.
- Presence for contraindications for administration of contrast media.
- Patients refuse examination.

Methodology:

- The study protocol was discussed by selected staff members of the Radiology department, Faculty of Medicine, Benha University, and was approved by its council held in 2019. The study protocol was also approved from the IRB "institutional review board".
- After enrolment of patient according to inclusion criteria each patient was interviewed in the clinic, the study design was explained to them in brief and written informed consent was taken that they were informed by the participation in the study and without any problem in their management plan.
- All data of patients had been confidential with secret codes and private file for each patient and the photos applied only to the parts of the body linked to the research.

1) History:

Include:

- Age, sex, residency, occupation & smoking.

3.Results

Table (1):Comparison between the three studied groups according to demographic data

Demographic data	Total sample (n = 30)		Acute (n = 15)		Sub-acute (n = 6)		Chronic (n = 9)		Test of Sig.	p
	No.	%	No.	%	No.	%	No.	%		
Sex										
Male	15.0	50.0	6	40.0	1	16.7	8	88.9	$\chi^2=$	$MCp=$
Female	15.0	50.0	9	60.0	5	83.3	1	11.1	8.506*	0.017*
Age (years)										
Min. – Max.	25.0 – 65.0		25.0 – 55.0		38.0 – 48.0		30.0 – 65.0		F=	0.085

Administrative design

Statistical design

Technical design:

Study design:

This study is across sectional study

Setting:

This study was carried out at radiology department in Benha University Hospitals.

- Patient complaint and its onset, course and duration.
- Presence of comorbidities (e.g.diabetes mellitus or hypertension).

2) Clinical examination:

- General examination.
- Estimationofsacroiliacpain(directlybypalpationofthesacroiliacjointand indirectly by forced abduction of the hip in flexion with the pelvis fixed

3) Lab Investigation:

- Measurement of ESR, C-reactive protein (CRP) and IgA.

4) Technique of MR examination:

For the scan protocol of the sacroiliac joint in our studies we used the classical/typical sequences obtained in adults :

- Para-coronal T1-weighted
- short tau inversion recovery (STIR) images
- Axial STIR images
- Fat – saturated axial and para-coronal T1-weighted sequences after intravenous administration of gadolinium (Gd) contrast.

Para-coronal is defined as slice direction along the long axis of the sacrum, perpendicular to the second sacral (S2) vertebral body.

Next to the sacro-iliac joint, the pelvic entheses and the hip joints were also included in the axial images

The MR exams were reviewed and interpreted by two expert of radiologists (5 and 7 years' experience) – in blind manner- and the findings were described.

IV. Statistical Design:

The collected data were computerized and statistically analysed using SPSS program (Statistical Package for Social Science) version22.

Mean ± SD.	41.03 ± 11.47	36.53 ± 9.44	43.83 ± 4.62	46.67 ± 15.10	2.703
Median (IQR)	39.50(30.0-47.0)	33.0 (29.50-43.0)	46.0 (38.0 – 47.0)	46.0 (34.0 – 61.0)	

IQR: **Inter quartile range** SD: **Standard deviation** F: **F for ANOVA test**

χ^2 : **Chi square test** MC: **Monte Carlo**

p: p value for comparing between the studied groups

*: Statistically significant at $p \leq 0.05$

This table shows that in Acute group, there is 6 (40%) male, 9 (60%) female and mean of age 36.53 (± 9.44 SD), while in Sub-acute group there is 1 (16.7%) male, 5 (83.3%) female and mean of age 43.83 (± 4.62 SD) and in chronic group there is 8 (88.9%) male, 1 (11.1%) female and mean of age 46.67 (± 15.10 SD).

Table (2) Comparison between the three studied groups according to side of lesion.

Side	Total sample (n = 30)		Acute (n = 15)		Sub-acute (n = 6)		Chronic (n = 9)		χ^2	MCp
	No.	%	No.	%	No.	%	No.	%		
Right	6	20.0	3	20.0	3	50.0	0	0.0	6.672	0.135
Left	7	23.3	5	33.3	0	0.0	2	22.2		
Bilateral	17	56.7	7	46.7	3	50.0	7	77.8		

χ^2 : **Chi square test** MC: **Monte Carlo**

p: p value for comparing between the studied groups

This table shows that according to side of lesion, in Acute group, 3 (20%) had right lesion, 5 (33.3%) had left lesion and 7 (46.7%) had bilateral lesion. While in Sub-acute group 3 (50%) had right lesion and 3 (50%) had bilateral lesion and in chronic group 2 (22.2%) had left lesion and 7 (77.8%) had bilateral lesion.

In which there is insignificant difference between three studied groups according to side of lesion.

Table (3) Comparison between the three studied groups according to associations .

Associations	Total sample (n = 30)		Acute (n = 15)		Sub-acute (n = 6)		Chronic (n = 9)		χ^2	MCp
	No.	%	No.	%	No.	%	No.	%		
No	18	60.0	10	66.7	1	16.7	7	77.8	23.347*	0.004*
Left adnexal simple	2	6.7	0	0.0	2	33.3	0	0.0		
Ulcerative colitis	2	6.7	0	0.0	2	33.3	0	0.0		
Psoriatic rash	1	3.3	1	6.7	0	0.0	0	0.0		
Positive brucella	1	3.3	1	6.7	0	0.0	0	0.0		
spinal disorders	2	6.7	2	13.4	0	0	0	0		
Positive HLA-B27	2	6.7	0	0.0	0	0.0	2	22.2		
Psoas abscess	1	3.3	0	0.0	1	16.7	0	0.0		
Degenerative osteoarthritis	1	3.3	1	6.7	0	0.0	0	0.0		

χ^2 : **Chi square test** MC: **Monte Carlo**

p: p value for comparing between the studied groups

*: Statistically significant at $p \leq 0.05$

This table shows that according to associations in Acute group, there is 1 (6.7%) had Psoriatic rash, 1 (6.7%) had positive brucella, 2 (13.4%) had spinal disorders and 1 (6.7%) had Degenerative osteoarthritis.

In Sub-acute group, there was 2 (33.3%) had left adnexal simple, 2 (33.3%) had ulcerative colitis and 1 (16.7%) had psoas abscess.

In chronic group, there was 2 (22.2%) had Positive HLA-B27.

In which there is significant difference between both studied groups as regards associations.

Table (4) Comparison between the three studied groups according to diagnosis.

Diagnosis	Total sample (n = 30)		Acute (n = 15)		Sub-acute (n = 6)		Chronic (n = 9)		χ^2	MCp
	No.	%	No.	%	No.	%	No.	%		
Acute brucella sacroilitis	1	3.3	1	6.7	0	0.0	0	0.0	35.725*	<0.001*
Ankylosing spondylitis	3	10.0	0	0.0	0	0.0	3	33.3		
Degenerative sacroilitis	6	20.0	0	0.0	0	0.0	6	66.7		
Early sacroiliitis	12	40.0	9	60.0	3	50.0	0	0.0		
Enteropathic arthropathy	2	6.7	0	0.0	2	33.3	0	0.0		

Normal study	1	3.3	1	6.7	0	0.0	0	0.0
Psoriatic arthropathy	1	3.3	1	6.7	0	0.0	0	0.0
Septic arthritis	2	6.7	2	13.3	0	0.0	0	0.0
SIJ effusion	1	3.3	1	6.7	0	0.0	0	0.0
SIJ osteomyelitis	1	3.3	0	0.0	1	16.7	0	0.0

χ^2 : Chi square test

MC: Monte Carlo

p: p value for comparing between the studied groups

*: Statistically significant at $p \leq 0.05$

This table shows that according to associations in Acute group, there is 1 (6.7%) had Acute brucella sacroiliitis, 9 (60%) had Early sacroiliitis, 1 (6.7%) had Psoriatic arthropathy, 1 (6.7%) had SIJ effusion and 2 (13.3%) had Septic arthritis.

In Sub-acute group, there was 3 (50%) had Early sacroiliitis, 2 (33.3%) had Enteropathic arthropathy and 1 (16.7%) had SIJ osteomyelitis.

In chronic group, there was 3 (33.3%) had Ankylosing spondylitis and 6 (66.7%) had Degenerative sacroiliitis.

In which there is highly significant difference between both studied groups as regards diagnosis.

4. Discussion

This study showed that the mean age of cases was 2.85 (± 11.16 SD) with range (25-65), 55% were male, 45% were female.

Ziegeler et al. [8] showed that More than half of the patients aged 45 years and older were classified as overweight (55.3%; 273/494). Male and female patients were included in equal proportions in each age group.

Nygaard et al. [9] showed that the mean age of the population was 33.1 years of age (standard deviation (SD): 7.89), The groups primarily consisted of women in both groups

In a study by **Iris and Merav [10]**, Inflammatory sacroiliitis was found in 71 of 281 examinations (25%), 44 males and 27 females. The average age was 47 years. Alternative diagnoses were suggested in 87 additional examinations (31%), 21 males and 66 females. The average age was 62 years. A normal examination with no registered pathology was found in the remaining 123 examinations (44%), 51 males and 72 females

This study reported that according MRI finding, Rt side 20%, Lt side 20%, 60% bilateral, 30% with Joint Space Narrowing, 50% Irregular articular surface, 70% with BM edema, 45% Subchondral sclerosis, 15% Marginal osteophytes, 20% Joint effusion **Sudol-Szopinska and Urbanik [11]** showed that By MRI, 13 of the 27 patients were considered to have normal sacroiliac joints, as defined by comparison with the controls. The normal sacroiliac joint space had a symmetric and homogeneous signal intensity in all sequences. The typical signal intensity pattern of the joint space was an intermediate signal in the T1-weighted and the T2 weighted images and a high signal in the phase-contrast image. The joint space was barely visible in 2 controls as well as in 3 patients who were considered to have normal findings on MRI examinations.

Bredella et al. [12] showed that In all patients with MRI findings of enhancement, bone marrow edema was seen on STIR and fat-saturated T2-weighted images. No difference in the severity of edema was detected on STIR images weighted images; however, edema was slightly better seen on the STIR images than the fat-saturated T2-weighted images.

Bredella et al. [12] also showed that 4 of 10 patients with active disease on MRI showed more extensive enhancement on fat-saturated T1-weighted images compared with the edematous changes seen on STIR or fat-saturated T2-weighted images. MRI findings of disease activity correlated with CRP value. There was no correlation between MRI findings and ESR, BASRI, BASDAI, BASFI, back pain scores, or disease duration.

Kang et al. [13] showed that Bone marrow edema was noted in the sacrum or ilium or both in 20 of 22 patients with spondylo-arthritis (90.9%) and in 28 of 32 patients with infectious sacroiliitis (87.5%). The distribution of bone marrow edema showed a statistically significant difference between infectious sacroiliitis and spondylo-arthritis

This study cleared that 40% of cases had associations

The pathologic process of sacroiliac joint inflammation is poorly understood due to the limited number of direct of studies of this joint. Previous studies have been mainly performed on autopsy specimens from patients with longstanding disease. Some investigators have described pannus formation, while others have not. It has been proposed that capsular ossification is the primary cause of sacroiliac joint inflammation and that enchondral ossification occurs later. Others have claimed that subchondral cartilaginous metaplasia underlies the development of ankylosing. Since our understanding of the histopathologic processes involved has been limited, methods for evaluating therapeutic evaluation have been poorly developed [11].

This study showed that there were 5% normal, 35% Early sacroiliitis, 20% Degenerative sacroiliitis, 10% Ankylosing spondylitis, 5% Acute brucella sacroiliitis, 5% Enteropathic arthropathy 5%Psoriatic arthropathy ,5%Septic arthritis, 5%SIJ effusion, 5% SIJ osteomyelitis

Kang et al. [13] showed that Patients with infectious sacroiliitis (mean age, 47.6 years; range, 16–80 years) were statistically significantly older than patients with spondylo-arthritis (mean age, 32.1 years; range, 20–72 years; $p = 0.005$).

In Bowen et al. [14] study, reported that the iliac cartilage is fibrocartilaginous, whereas the sacral

cartilage is hyaline. This feature may explain the iliac dominance of bone marrow edema in early spondyloarthritis. Traditionally, infectious sacroiliitis has also been thought to involve the iliac side more severely.

Several hypotheses have been postulated for this predilection, including the protection provided by the thicker sacral cartilage and the slow subchondral circulation of the ilium, which predisposes it to infection [13].

Our study had several limitations. First is the relatively small number of patients and the retrospective nature of the study. Second is the absence of pathologic tissue confirmation of disease activity. Also, reviewers evaluated the MR examinations and radiographs without knowledge of the laboratory data; however, the reviewers were aware that the patients had been diagnosed with spondyloarthritis.

5. Conclusion

In conclusion, MRI of the sacroiliac joint is able to depict sacroiliitis in patients with moderate to severe sacroiliac joint pain. MRI findings suggestive of active disease, such as subchondral edema and MRI findings of fatty bone marrow changes show no correlation with clinical parameters except CRP level. This suggests that MRI can reveal changes at a cellular level that are not depicted by clinical parameters (early diagnosis).

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