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Radiological Spectrum of Active Sacroiliitis by Conventional Radiography and MRI

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ABSTRACT

Introduction: The aim of the present study was to compare the role of Conventional Radiography and Magnetic Resonance Imaging (MRI), in diagnosis of active sacroiliitis and differentiation between inflammatory and infective sacroiliitis.

Methods: Fifty two cases of active sacroiliitis diagnosed on MRI from August 2017 to August 2019 were included in study. All the patients were subjected to conventional radiology, MRI and findings were co-related with clinical and laboratory findings. Conventional radiography was used to evaluate structural changes. MR images were evaluated for bone lesions (extent and distribution of bone marrow edema and presence of bone erosions), soft-tissue lesions (capsulitis, extra capsular fluid collections, and peri-articular muscle edema) and joint space reduction for differentiation between infective and inflammatory etiology.

Results: Conventional radiography showed sclerosis, erosion, partial and complete ankylosis. Thick capsulitis, extra capsular fluid collection, and peri-articular muscle edema were all more frequently observed in infective sacroiliitis ($p<0.001$). Iliac-dominant bone marrow edema more common in spondyloarthritis ($p<0.001$). When periarticular muscle edema was the sole predictor, unilateral sacroiliitis in spondyloarthritis was correctly identified in 79.16% of cases, and infectious sacroiliitis was correctly identified in 82.14% of cases.

Conclusions: MRI is the optimum imaging modality to diagnose active sacroiliitis. MRI plays an essential role in better demonstrating early alterations and inflammatory activity and aid in differentiation of infective and inflammatory sacroiliitis. Conventional radiography with low sensitivity can be used as a screening tool and follow-up of patients with sacroiliitis.

Key words: *Ankylosis; Bone Marrow; Bursitis; Sacroiliitis; Spondyloarthritis*

INTRODUCTION

Sacroiliitis can be classified as infective and inflammatory sacroiliitis. Non-infective sacroiliitis: It includes seronegative spondyloarthropathies, gouty arthritis and rheumatoid arthritis. Seronegative

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spondyloarthropathies includes: Ankylosing spondylitis,Reactivearthritis,Psoriaticarthritis, Arthritis related with chronic inflammatory disease and Undifferentiated Spondyloarthritis (describes manifestations of the disease that do not meet criteria to be classified into any of the spondyloarthritides, discussed previously). Infective sacroiliitis includes: Septic arthritis and Sacroiliac tuberculosis. Most of times, the clinical diagnosis of sacroiliitis is difficult, depending substantially on the confirmation of radiological findings, where conventional x-ray, and currently, computerized tomography (CT) and magnetic resonance imaging (MRI) assume an essential role.[2] As the symptoms of sacroiliac involvement at presentation are not specific, the diagnosis of sacroiliitis is heavily dependent on confirmatory imaging.[3] In this study, we aim to compare the role of Conventional Radiography and Magnetic Resonance Imaging (MRI) in diagnosis of active sacroiliitis, and differentiation between inflammatory and infective sacroiliitis..

METHODS

A prospective study design was employed with the purpose to analyse the conventional radiography and MRI in the diagnosis of active Sacroiliitis between 2017 to 2019. Patients referred to Department of Radio diagnosis & Imaging from OPD/IPD/EMERGENCY of C.S.S. Hospital, under the ageis of N.S.C.B Subharti medical college, Meerut. Informed consent of all participants was obtained after explaining the purpose of the study. Permission to carry out the study was obtained by Institutional Ethical Committee of NSCB Subharti Medical College.

A total of 52 patients with diagnosis of active sacroiliitis were included for the study. Exclusion criteria included: Pregnant women, Trauma and malignancy.

The following data was collected for each patient: Erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), serology testing, serum urate & rheumatoid factor and HLA-B27.

Each patient underwent conventional radiography and followed by MRI investigation.

X-rays images was obtained in anteroposterior/ posteroanterior views of SI joints and assessed for features of active sacroiliitis like sclerosis, erosion and joint space.

Criteria: New York sacroiliitis radiological grading criteria of Conventional Radiography is;

Table 1: New York sacroiliitis radiological grading criteria of Conventional Radiography

Grading	Criteria
Grade 0	No abnormalities (sacroiliac joints normal)
Grade 1	Suspicious for abnormalities (blurring of the joint margins)
Grade 2	Minimal abnormalities (solitary erosions and juxta-articular sclerosis in small sacral or iliac areas)
Grade 3	Advanced abnormalities (manifested juxta-articular sclerosis, numerous erosions with widening of joint space, possible partial ankylosis)
Grade 4	Complete ankylosis

Magnetic Resonance Imaging: MR imaging was performed at our institute, using a 1.5 T (Magnetom Symphony with Quantum gradients [maximum gradient amplitude, 30 mT/m; slew rate, 125 mT/m/sec]; with use of a spine phased-array coil. MR imaging of the sacroiliac joint was performed with coronal oblique T1, T2 and STIR, axial oblique T1, T2 and STIR and sagittal T1 and STIR to identify and evaluate sacroiliitis.

Criteria: MRI images were assessed for the presence of extent and unilateral, active and chronic inflammatory lesions. According to ASAS (Assessment in Spondyloarthritis International Society) criteria, detection of active inflammatory lesions in the form of Bone Marrow Edema (BME) was the grounds for sacroiliitis diagnosis4. Active sacroiliitis findings include- subchondral bone marrow

edema, erosions, synovitis, joint effusion and capsulitis. Presence of structural lesions (erosions, sclerosis, subchondral fatty change, capsulitis, enthesitis, and bony bridges) alone on MRI in the absence of bone marrow edema is considered insufficient for the diagnosis of active sacroiliitis according to the ASAS criteria, and this is considered to be a prominent limitation.

RESULTS

Of the 52 patients examined, male preponderance was shown with 31(59.6%) and 21(40.4%) were females. Majority of the study population 27(51.9%) were between 21-30 years of age. All patients complained of low back pain while 50(96%) with additional findings of restricted spine movement. In the laboratory assessment of the study population, 26(50%) of them showed elevated CRP, 23(44%) were HLA B-27 positive and 27(51.9%) had elevated ESR. Sacroiliac joint involvement on conventional radiography was noticed in 39(75%) of the patients, with negative findings found in 13 of them. Of the 39 patients with SI joint, 25 presented with unilateral and 14 presented with bilateral involvement. The radiographic findings of SI pathology in the study population presented with sclerosis in 39(75%), erosion in 3(5.7%), partial ankylosis in 4(7.7%) and complete ankylosis in 1(1.9%) patient. The joint space was narrowed in 19(36.5%) patients but none of them exhibited widening of the joint space. The New York grading criteria for X ray diagnosis when performed, it was found that 21 patients had Grade 1(40.4%), 10 had Grade 2(19.2%), seven had Grade 3(13.5%) and 1 (1.9%) had Grade 4 SI joint involvement. The MRI examination revealed unilateral involvement of SI joint in 34(65.4%) while bilateral involvement was noticed in 18(34.6%). MRI examination showed that 52(100%) patients had bone marrow edema. 8(15.4%) of them presented edema in sacral aspect, 11(21.2%) in iliac aspect and 33(63.4%) in sacro-iliac aspect. Around 42.3% exhibited bone erosion. Capsulitis was seen in 30(57.7%). Extracapsular fluid collection was noted in 16(30.7%) of the patients, while peri articular muscle edema was appreciated in 28(53.8%) of them. Joint space had widened in nearly half of the patients in 25(48%) but reduced in 12(23%) of the study population. MRI findings of study population and comparison of the findings among the study population are shown in Table 2 and 3.

Table 2: MRI findings of the study population.

Variables	NUMBER OF PATIENTS	%
1) Bone Marrow Edema	52	100%
• Sacro-iliac aspect	33	63.4
• Sacral aspect	8	15.4
• Iliac aspect	11	21.2
2) Capsulitis	30	57.7
3) Bone Erosion	22	42.3
4) Extracapsular Fluid Collection	16	30.7
5) Peri Articular Muscle Edema	28	53.8
6) Joint Space		
Normal	15	28.9
Wide	25	48.1
Less	12	23

Table 3: Comparison of MRI findings among the study population

Variables	Inflammatory sacroiliitis	Infective sacroiliitis	Chi square	p value
	Number of patients N=24	Number of patients N=28		
Bone Marrow Edema				
Sacro-iliac aspect	13	20	10.42	0.01*
Sacral aspect	1	7		
Iliac aspect	10	1		
Capsulitis				
Absent	18	4	19.52	<0.01*
Present	6	24		
Bone Erosion				
Absent	3	10	3.71	0.05
Present	21	18		
Peri Articular Muscle Edema				
Absent	19	5	19.55	<0.01*
Present	5	23		
Extra capsular Fluid Collection				
Absent	24	12	16.48	<0.01*
Present	0	16		
Joint Space				
Normal	10	4	13.27	0.001*
Wide	5	20		
Less	9	4		

*: statistically significant

DISCUSSION

All the study participants presented with chronic back ache 52(100%) followed by the restricted spinal movement 50(96%), morning stiffness in 18(34.6%) and pain relieved on exercise in 20(38.5%) at the time of study. These results were similar to the study done by Rudwaleit et al. in which majority of their study population (patients with Axial SpA) had back pain for 6- 7 years and pain relieved on exercise and not upon rest in one third of their study subjects.[5] In the study, Sacroiliitis was more common in age 21-40 years (75.6%). Sacroiliitis showed a male predominance with male to female ratio of 1.6:1. The study conducted by Carmona et al.[6] also presented similar findings. HLA B-27 positivity is extremely relevant to the early diagnosis of SpA. Five to 10% of the population are HLA B-27 positive and in patients with AS and SpA the positivity of HLA B-27 changes to 70% to 95% and nearly 70%, respectively.[8] Nearly half of the patients 24 (46.1%) of the present study reported with HLA-B 27 positive. Studies have shown an association between HLA-B27-positive patients, who had a significantly higher degree of both acute and chronic MRI changes compared with HLA-B27-negative patients. This may imply that inflammatory attacks in HLA-B27 positive

patients occur mainly at the beginning of the disease process. The probability of SpA was increased in HLA-B27 positive patients with inflammatory lower backache and MRI proven sacroiliitis.[9] Increased inflammatory activity, is defined by an elevated ESR (> 15 mm/ hour) was present in 27(51.9%) patients in the study population. This was almost similar to the study conducted by Ahlstrom et al.[10] Elevated CRP may indicate the possibility of active inflammation at the sacroiliac joint pathologies detectable by MRI, which is consistent with other studies.[11] Conventional radiography: New York criteria was the grading system used as the criteria for identifying sacroiliac joint disease in Conventional radiography in our study. Other studies like Weber et al. also included same criteria to diagnose sacroiliitis owing to its making it a standard reference.[12] Using the New York criteria, conventional radiographs showed involvement of the sacroiliac joint in 39(75%) patients out of 52. Unilateral involvement was seen in 25(48%) patients and bilateral involvement was detected in 14(27%) patients. 7(13.5%) patients were shown to have partial ankylosis of the sacroiliac joint and one patient showed the complete ankylosis. In a similar study, all 18 patients reported with sacroiliac joint involvement, with unilateral involvement seen in one patient and bilateral involvement in 17 patients. In a study by Miriam et al.[13] 1 patient (1.19%) reported with complete ankylosis while 7 patients in the study showed partial ankylosis, which is slightly higher than our study. Magnetic Resonance Imaging: It seems to be superior to other imaging modalities in the diagnosis of active sacroiliitis due to the evaluation of bone marrow and extracapsular changes. MRI is capable of visualization of early active inflammatory changes of the sacroiliitis, so the early diagnosis of sacroiliitis is usually established by MRI.[14] All 52 patients presented abnormal MRI findings of sacroiliac joint pathologies in the present study, with 34 patients having bilateral involvement and 18 patients presenting unilateral involvement. On comparing with other studies, Miriam et al.[13] reported all 18 patients except one having abnormal MRI findings of the sacroiliac joint: 16(88.9%) patients had bilateral involvement and 1(9.1%) patient had unilateral involvement. 52 (100%) patients in the current study demonstrated bone marrow edema. These changes were seen in patients with MRI findings suggestive of active disease.[4] A study conducted by Braun et al.[15] of SI joint imaging by MRI demonstrated that the technique could be used to detect early abnormalities in the subchondral bone and periarticular bone marrow. Of the 52 patients, 24 were diagnosed as seronegative spondyloarhtritis and 28 as infective sacroiliitis. In the present study, bone marrow edema was observed in 52 patients, out of which 24 and 28 fall in the inflammatory and infective sacroiliitis respectively. Bone marrow edema was noted on the sacral aspect or iliac aspect or on both the aspects. 13(25%), 1(1.9%) and 10(21.2%) subjects of inflammatory sacroiliitis were reported showing bone marrow edema involving sacro-iliac, sacral and iliac aspects respectively, while in patients of infective sacroiliitis the distribution of bone marrow edema was 20(38.5%) on sacroiliac aspect, 7(13.5%) on sacral aspect and 1(1.9%) on iliac aspect. When bone marrow edema categories were compared statistically according to inflammatory and infective sacroiliitis, it was found to be statistically significant. On comparison our study is concordance with that of Yushuhn et al.[16] which also showed the distribution of bone marrow edema showing statistically significant difference between infectious and spondyloarthritis ($p < 0.001$). Capsulitis was present in 6(11.5%) and 24(46.1%) subjects of inflammatory and infective sacroiliitis respectively with statistically significant difference ($p< 0.01$). When periarticular muscle edema was the sole predictor, unilateral sacroiliitis in spondyloarthritis was correctly identified in 79.16% of cases, and infectious sacroiliitis was correctly identified in 82.14% of cases with an overall accuracy

of 80.7%. Extracapsular Fluid collection was noted exclusively in infective sacroiliitis and widening of joint space more frequently in infective sacroiliitis. Similar findings were noted with the study by Carita Tsoi et al.[17] inflammation in infective sacroiliitis spreads to involve the peri-articular soft tissues, particularly the iliacus and gluteal muscles. Peri-articular fluid collection or abscess is practically pathognomonic of an infective sacroiliitis. In a study by Klein et al.[18], all the cases of infectious sacroiliitis showed fluid or inflammation in the iliopsoas muscle that tracked posterior to the iliopsoas muscle. Le Breton et al.[19] reported that swelling of the muscles around the sacroiliac joint, which appeared as a decrease of fat between the iliacus and the psoas muscles, could confirm the diagnosis of infectious sacroiliitis. Our study results show that the presence of bone erosion, capsulitis, extracapsular fluid collection, and periarticular muscle edema on MRI suggest infectious sacroiliitis, whereas iliac-dominant bone marrow edema favor the diagnosis of sacroiliitis in spondyloarthritis. MRI allows an early diagnosis of sacroiliitis (before cortical erosions and subchondral sclerosis appears) because it can detect inflammatory changes that are the hallmark of early disease. MRI can depict active inflammatory lesions and structural damage lesions.[20] Comparison of conventional x-rays with MRI: the study demonstrates that use of MRI in visualizing and staging sacroiliitis by MRI is better than conventional radiography. This finding is similar to the study conducted by Jurgen Braun et al.[15], Shanmuganandhan et al.[21] which concluded that early sacroiliitis can be demonstrated by dynamic MRI in spondyloarthropathy patients in whom abnormalities were not revealed by conventional radiography. Though different radiological methods have been used to examine Sacroiliac joint pathologies, MRI is getting increasingly preferred over conventional radiography and even CT because of its ability to detect inflammatory changes. In addition, MRI has the advantage of no radiation exposure. Taking all aspects of sacroiliitis into consideration, MRI has found to be significantly superior to conventional radiography for the diagnosis of sacroiliitis. Plain radiographs have been used conventionally for the diagnosis of SpA. However, they have been considered to report lack of positivity rates in early disease as it may over 8 years for the sacroiliitis to become visible. Diagnostic criteria of AS are based on the presence of sacroiliitis on plain radiographs hence early cases may be missed. Radiography cannot reveal the cartilage changes and bone marrow oedema, which can be seen in MR images. Due to the ability to image cartilage changes and bone marrow oedema directly, MR imaging may be particularly useful in early diagnosis of sacroiliitis.[21,22,23,24] New treatment options for patients with ankylosing spondylitis require sensitive imaging techniques to not only help diagnose ankylosing spondylitis early, but also determine disease activity and the degree of damage present at diagnosis.[25] Also several trials have shown that MRI is not only capable of finding structural lesions, but they can also detect active inflammatory lesions, unlike X-Ray which can only detect structural lesions.[26] The data adds to the hypothesis that inflammation is the first event, and structural change is a subsequent feature. Depending on the lag time between inflammation and structural changes, a diagnosis of sacroiliitis could be made significantly earlier by using MRI changes of inflammation as an early sign of disease.[7] Representative imaging findings are shown on illustrated in figures 1-3.

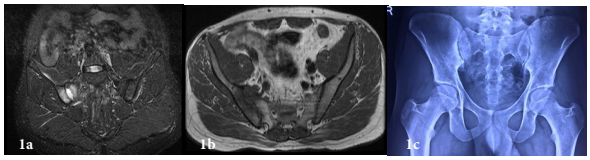

Figure 1. *35 year old male patient diagnosed as infective sacroiliitis* ***1a.*** *Coronal STIR image showing the bone marrow edema involving the iliac and sacral aspect of the right SIJ. Adjacent periarticular muscle edema and fluid signal intensity in the widened right SIJ space s/o capsulitis* ***1b.*** *Axial image showing the bony erosion involving the right*

SIJ involving both the sacral and iliac aspect. ***1c.*** *X-ray AP view of bilateral SIJ shows sclerosis of the right SIj mainly the iliac side.*

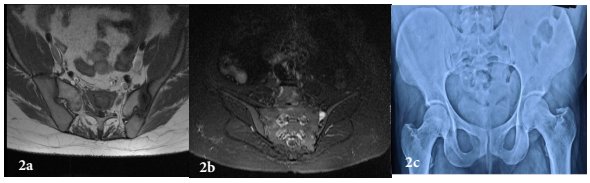

Figure 2. *28 Year old female diagnosed as infective sacroiliitis* ***2a.****T1 image bilateral SIJ showing the bony erosion seen involving the iliac aspect of Left SIJ* ***2b****. MRI Coronal image of SIJ showing extracapsular collection around the left sacroiliac joint* ***2c****. Xray-AP view of Bilateral SIJ of same patient showing the diminished joint space bilaterally.*

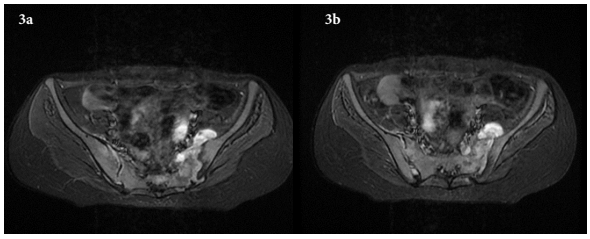

Figure 3. *23 Year old female diagnosed as bilateral infective sacroiliitis* ***3a & 3b.*** *MRI axial stir images showing the extracapsular fluid collection adjacent to the left sacroiliac joint with fluid signal intensity in the left sacroiliac joint space and periarticular muscle edema (Iliacus) on the right side.*

CONCLUSION

Thus, from our study we conclude that conventional radiography and MRI both can be used for the diagnosis of sacroiliitis. However, conventional radiography can be used as a screening tool and follow-up of patients with sacroiliitis. The main limitation of the x-ray film is the low sensitivity for detecting abnormalities in early stages of the disease. MRI plays an essential role in better demonstrating early alterations and inflammatory activity of this process. MRI can identify both inflammation and structural changes caused by inflammation, while radiographs only detect structural changes. MRI findings of extensive extracapsular soft-tissue abnormalities, periarticular muscle edema, capsulitis, and extracapsular fluid collections and bone erosion may enable reliable differential diagnosis of infectious sacroiliitis from sacroiliitis associated with spondyloarthritis, whereas the presence of iliac-dominant bone marrow edema and supports the diagnosis of spondyloarthritis.

CONFLICT OF INTEREST

None

SOURCES OF FUNDING

None

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