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Role of MRI in Seronegative Spondyloarthropaties

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ABSTRACT:
Seronegative spondyloarthropathy is a group of chronic inflammatory rheumatic diseases in which axial skeleton is primarily affected. The first and hallmark manifestation for diagnosis of seronegative spondyloarthropathy is involvement of sacroiliac joint. They may present with sacroiliitis, inflammatory arthritis, spondylitis and enthesitis, as well as extra-articular manifestations of inflammation most commonly involving the eye, skin and gastrointestinal tract [1]. MRI plays a crucial role in the diagnosis of seronegative spondyloarthropathies by providing detailed information of structural and inflammatory changes in form of sacroiliitis, erosions, spinal inflammation etc. It is essential for the radiologist to know the magnetic resonance imaging (MRI) features of spondyloarthropathy-related sacroiliitis as imaging plays an important role in early diagnosis and evaluation of response to treatment. The findings of our study highlight the high sensitivity and specificity of MRI in detecting characteristic inflammatory changes, underscoring its diagnostic and clinical utility.
Key words: *Assessment of Spondyloarthritis international society; magnetic resonance imaging; sacroiliitis; seronegative; spondyloarthropathy sacroiliitis.*
Objectives:
To evaluate whether MRI findings of the sacroiliac joints are able to distinguish between active and inactive disease in patients with established ankylosing spondylitis and to determine whether these findings correlate with markers of clinical activity, disease duration, severity, and degree of radiographic damage.
METHOD
The study was conducted in the Department of Radio-diagnosis and imaging of M. K. Shah medical college and Research Centre, Ahmedabad from June 2023 to June 2024. It was an observational study and included 50 suspected cases of spondyloarthritis between 18 and 45 years of age with complaint of lower back ache since 3 months to 5 years.
Patients having rheumatoid arthritis, overlap syndrome and other non-articular rheumatism were excluded from the study. All patients were initially clinically assessed and then underwent relevant investigations. Informed consent was taken from all the participants of the study.

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I. INTRODUCTION:

Seronegative spondyloarthropathy is a group of chronic inflammatory rheumatic diseases in which axial skeleton is primarily affected. Diseases like ankylosing spondylitis, reactive arthritis, psoriatic arthritis, arthritis associated with chronic inflammatory bowel disease (Crohn's disease and ulcerative colitis) are included. 2nd & 4th decades of life are the most common time duration in which this spectrum of diseases is detected the most [1]. The human leukocyte antigen (HLA)-B27 association is a common feature of all spondyloarthropathies, out of which approximately 90% patients of ankylosing spondylitis show (HLA)-B27 positivity. Until recently, the

definitive diagnosis of spondyloarthritis relied on conventional radiography. However, radiographic changes usually develop at least 5 years after symptom onset. With the advent of magnetic resonance imaging (MRI), more and more cases of spondyloarthropathies are being diagnosed at an early stage. It is essential for the radiologist to know the signs of MRI in spondyloarthropathy, as imaging plays an important role in diagnosis. The first and hallmark manifestation for diagnosis of seronegative spondyloarthropathy is involvement of sacroiliac joint [2]. Thus, detection of sacroiliitis helps in early diagnosis and treatment.

- Assessment of Spondyloarthritis International Society (ASAS)

(for patients younger than 45 years with low back pain for more than 3 months)

A) Sacroiliitis on imaging + (≥1 spondyloarthropathy feature)

or

B) HLA-B27 + (≥2 spondyloarthropathy feature)

Spondyloarthropathy features:
- Inflammatory back pain
- Arthritis
- Enthesitis
- Uveitis
- Dactylitis
- Psoriasis
- Crohn's/ulcerative colitis
- Good response to NSAIDs
- Family history for spondyloarthropathy
- HLA-B27
- Elevated C-reactive protein

The Assessment of Spondyloarthritis international Society (ASAS) have developed diagnostic criteria for axial spondyloarthropathy using amalgamation of clinical, imaging, and laboratory findings [3]. According to the ASAS criteria, the imaging findings are based on demonstration of sacroiliitis on MRI and/ or radiography [4].

Our aim is to briefly review the most important clinical and pathophysiologic findings of this disease for radiologists. We discuss the MRI features relevant to the differential diagnosis of axial spondyloarthritis according the ASAS classification criteria.

IMAGING:

Plain radiography was performed using siemens digital diagnostic digital radiography system. All patients underwent radiographs of whole spine in antero-posterior and lateral projections. Radiographs of SI joints were performed in short axis postero-anterior (SAPA) projection.

According to the ASAS classification criteria, active inflammatory lesions are best visualized on fat-suppressed T2-weighted or high-resolution STIR images. Structural damage and chronic lesions, such as fatty degeneration and erosions, are best visualized on T1-weighted images. For assessment of the sacroiliac joints, coronal and axial oblique images in the plane of the sacroiliac joints should be used. T1- and T2-weighted sequences with fat suppression or STIR sequences are recommended. If contrast (gadolinium) administration is performed, T1-weighted sequences with fat suppression can be performed in the coronal or axial oblique plane. An efficient spinal imaging protocol comprises sagittal T1- and fat-suppressed T2- weighted sequences or high-resolution STIR sequences. If gadolinium administration is performed, T1-weighted sequences with fat suppression should be obtained in the sagittal plane. Axial slices can be useful for assessment of the posterior spinal elements, and coronal slices may be best for assessment of the costovertebral, costotransverse and facet joints.

MRI Findings

MRI is considered the most sensitive imaging method for detecting inflammatory changes of the spine and sacroiliac joints. This technique has been increasingly used in practice to assess disease activity and sometimes to monitor and evaluate therapeutic response. The ASAS has listed the following imaging findings suggestive of active inflammation and chronic lesions of the spine and sacroiliac joints.

Active Inflammatory Lesions of the Sacroiliac Joints

- **Bone marrow edema** —*Hyperintense signal* on STIR images and fat-suppressed contrast-enhanced T1-weighted images. Peri-articular or subchondral bone surfaces are the most common sites where marrow edema can be demonstrated (Figure 1, 2 & 7).

- **Synovitis & Capsulitis** – *Hyperintense signal* in the synovial or anterior & posterior capsules of the sacroiliac joints on fat-suppressed contrast-enhanced T1-weighted images. Synovitis and joint fluid cannot be differentiated on STIR images and thus contrast enhanced imaging is necessary (Figure 6).
- **Enthesitis** – *Hyperintense signal* at the junctional area between bone and tendons, fascia, ligaments, or capsules on STIR images and fat-suppressed contrast-enhanced T1-weighted images. It may extend to adjacent bone marrow and surrounding soft tissues (Figure 4).

Chronic Inflammatory Lesions of the Sacroiliac Joints

- **Subchondral sclerosis** – Show areas of hypointense signals on STIR and T1-weighted images and appear non-enhancing on fat-suppressed contrast-enhanced T1-weighted images. It extends approximately up to at least 5 mm from the sacroiliac joint surface.
- **Erosions** - They are bony defects at the joint surface that appear as areas of low signal intensity on T1-weighted images. They may be present in the entire cartilaginous compartment of the joint.
- **Fat depositions** – Periarticular bone marrow shows hyperintense signals on T1-weighted images. This finding is nonspecific and may mimic old inflammatory conditions (Figure 3).
- **Ankylosis** – It is represented as areas of bone surface fusions with bony bridge formations across a joint which shows hypointense signals on all MRI sequences. The same signal intensity can also be seen in the adjacent bone marrow and is sometimes surrounded by areas of fatty degeneration evidenced by hyperintense signals on T1-weighted images

Active Inflammatory Lesions of the Spine

- **Spondylitis** – It appears as high signal intensity on STIR images and fat-suppressed contrast enhanced T1-images in bone marrow of the anterior or posterior vertebral corners.
- **Spondylodiscitis** – Hyperintense signals are observed at the cortical plates adjacent to intervertebral discs on STIR images and fat-suppressed contrast-enhanced T1-weighted images. This type of signals may also be visible in the center or throughout the intervertebral space, simulating inflammatory discitis.
- **Facet joint arthritis** - Arthritis of any facet joint up to S1 vertebral body can be observed in patients with spondyloarthritis and is associated with spinal pedicles bone marrow edema (Figure 5).
- **Costovertebral arthritis** - Any costovertebral joint can be affected by arthritis that can be associated with bone marrow edema extending to the pedicles, posterior aspects of the vertebral bodies, and adjacent ribs and soft tissues.
- **Enthesitis of spinal ligaments** - It is characterized by hyperintense signals at the bone insertion sites of the supraspinal, interspinal, and flaval ligaments on STIR images and fat-suppressed contrast-enhanced T1-weighted images.

Chronic Inflammatory Lesions of the Spine

- **Syndesmophytes** – In chronic disease conditions there is occurrence of new cone formations at the corners of various vertebral bodies. It is evidenced by thin, vertically oriented new bone formation in peripheries of intervertebral discs.
- **Ankylosis** – In long standing diseases there is new bone formation and occurrence of bony bridges in the intervertebral discs showing hypointense signals on all MRI sequences.
- **Fat deposition on vertebral corners** - Bony fat depositions are best visualized on T1-weighted images. They indicate areas of past inflammatory insult and are highly predictive of formation of new Syndesmophytes. The presence of more than five of these lesions supports diagnosis of spondyloarthritis.

Criteria for MRI Positivity

The ASAS diagnostic criteria for spondyloarthritis include MRI of only the sacroiliac joint, but the identification of spinal inflammatory lesions supports the diagnosis.

The criteria are as follows:

- High bone marrow signal intensity on STIR images or contrast enhancement on fat-suppressed T1-weighted images; typical location (periarticular or subchondral bone); and two or more areas of bone marrow high signal intensity on the same image

or

- One area of bone marrow high signal intensity on two consecutive images.

Capsulitis, synovitis, or enthesitis with no evidence of hyperintense signal in adjacent bone marrow should not be considered a positive MRI sign.

According to the ASAS group, positive MRI requires presence of areas of bone marrow edema on periarticular or subchondral bone in the sacroiliac joints on fat suppressed T2-weighted images or STIR images. *The presence of*

more than one bone marrow edema lesion in a single MRI slice may suffice the diagnosis, but a single bone marrow edema lesion should be clearly visible in a minimum of two consecutive MRI slices to confirm positivity. In the absence of bone marrow edema; other features like enthesitis, capsulitis, and synovitis, even if they reflect active inflammation, are insufficient to prove positivity on MRI. However, they support the diagnosis of spondyloarthritis in patients with sacroiliitis. Bone marrow edema can be detected on T1-weighted images obtained after gadolinium contrast administration and on T2-weighted & STIR images. In addition to inflammatory lesions, presence of structural lesions support and improve the diagnostic performance of MRI. The presence of both bone marrow edema and erosions has had high specificity and sensitivity for the diagnosis of sacroiliitis.

Differential Diagnosis

- Degenerative Sacroiliitis
- Infectious Sacroiliitis
- Osteitis Condensans Ilii
- Osteophytes of Lumbar Osteoarthritis
- Diffuse Idiopathic Skeletal Hyperostosis
- Modic Lesion
- Infectious Spondylodiskitis

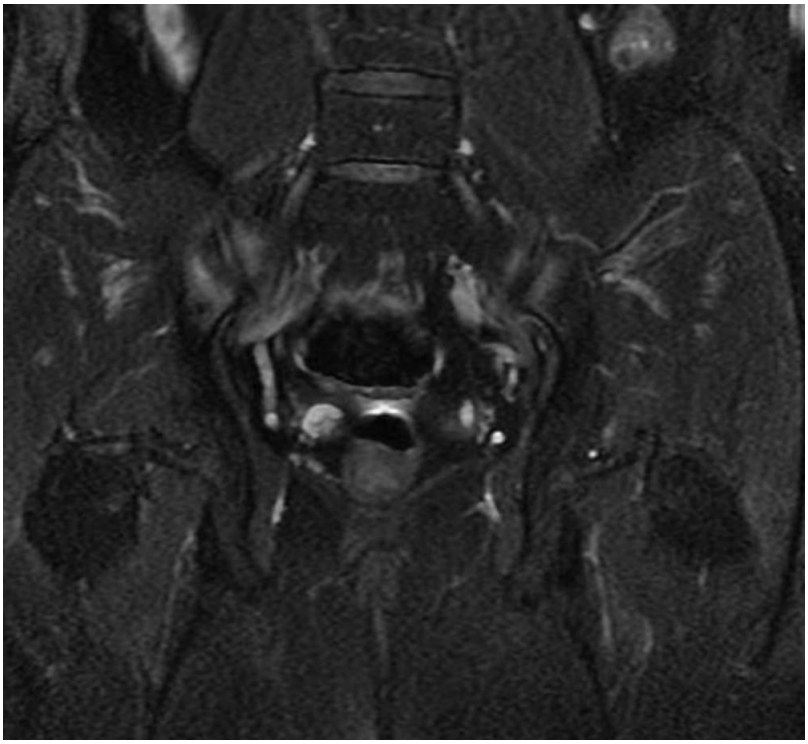

Figure 1. Acute Sacroilitis - Coronal STIR image showing subchondral edema

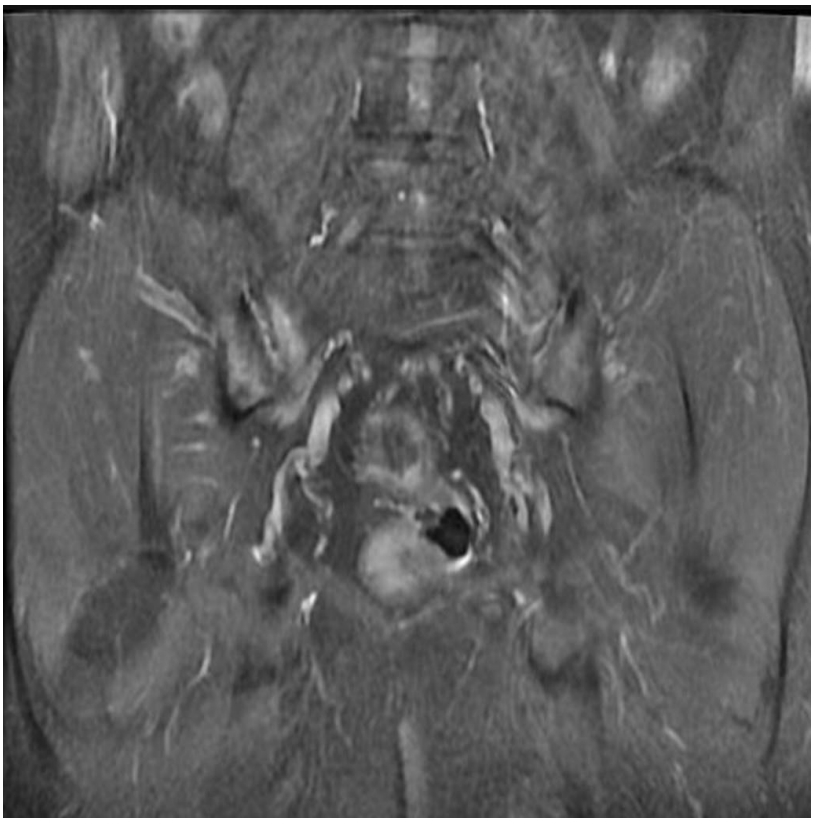

Figure 2. Acute Sacroilitis - Coronal T1FS+C image showing subchondral enhancement

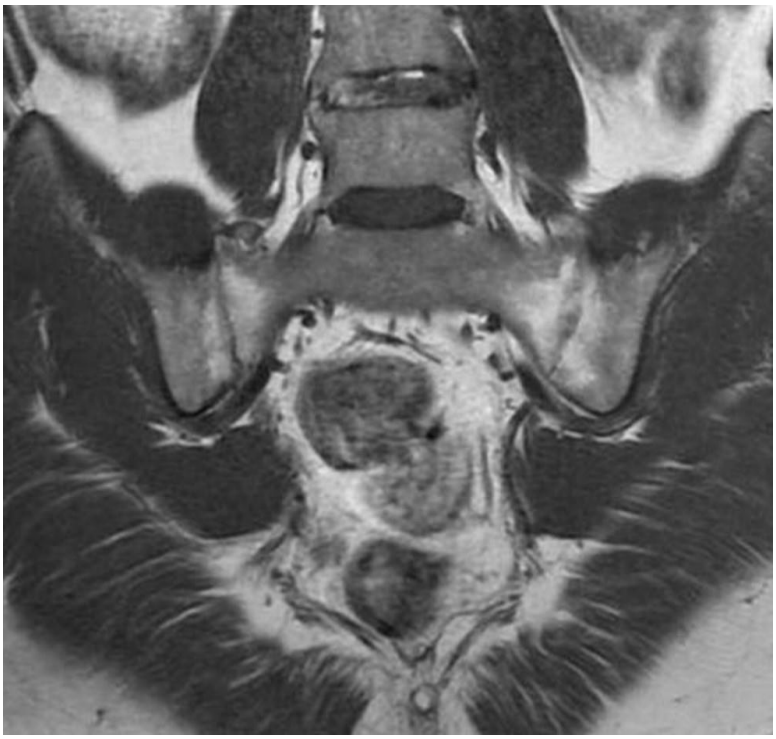

Figure 3. Chronic Sacroilitis - Coronal T1WI shows subchondral fat sigal intensity in bilateral SI joints.

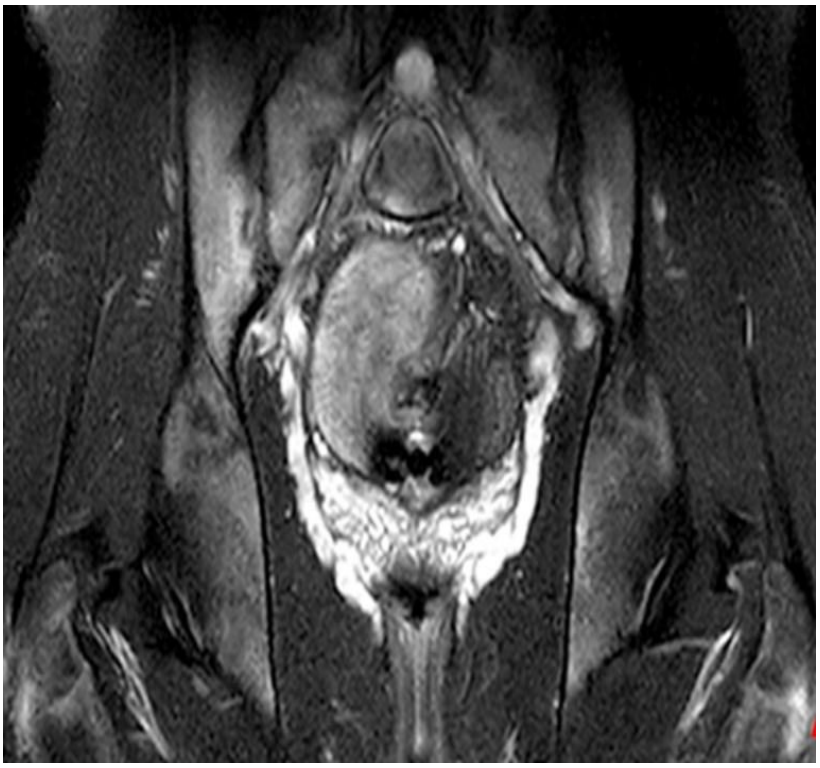

Figure 4. Enthesitis - Coronal STIR images show oedema near the greater trochanter.

Figure 5. Facet joint arthritis - Sagittal T2 images show facet joint arthropathy with erosions, edema and surrounding soft tissue fluid at L3 Facet

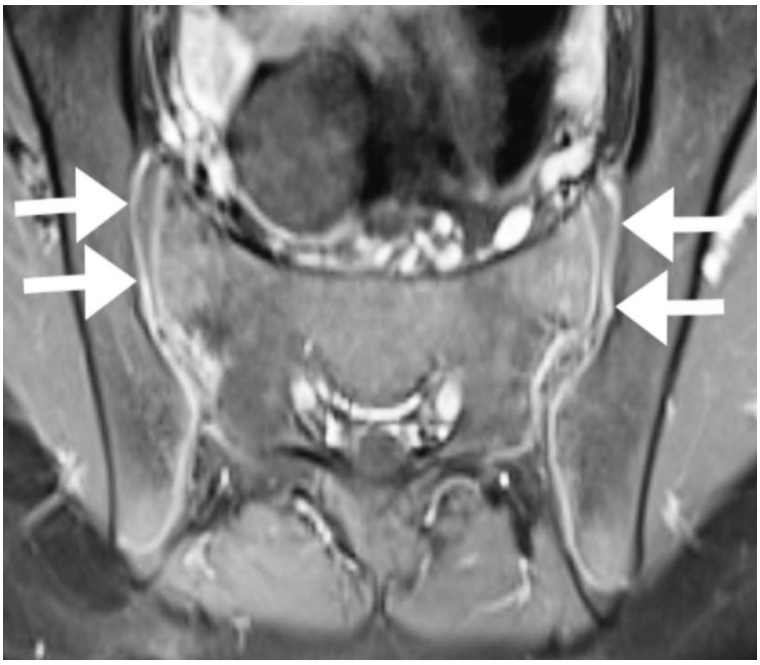

Figure 6. Sacroilitis - Axial T1FS + C shows enhancing synovium and effusion

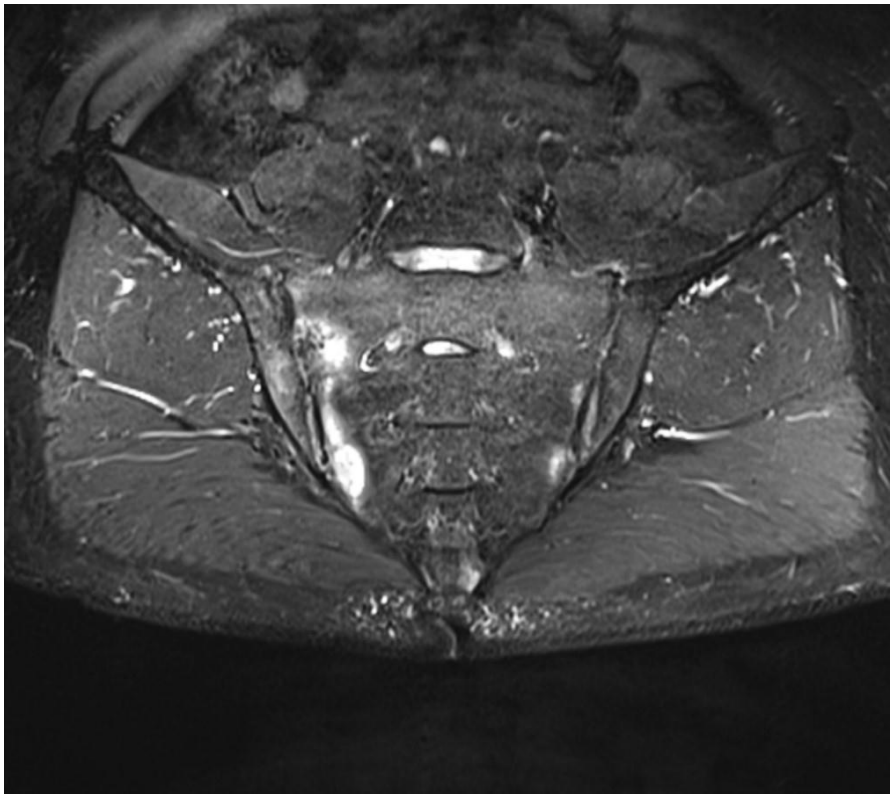

Figure 7. Sacro-ilitis in Seronegative SPA - Oblique PDFS images show asymmetric marrow edema in bilateral SI joints

II. Discussion:

In this study, we investigated the role of Magnetic Resonance Imaging (MRI) in diagnosing seronegative spondyloarthropathy (SpA) in which we included 50 patients presenting with lower back pain. Clinically, it may mimic other causes of back pain, making accurate diagnosis challenging. MRI has been increasingly utilized due to its superior capability to detect early inflammatory changes and structural damage.

Patient Demographics and Characteristics

The study cohort consisted of 50 patients with an age range of 18-45 years out of which 35 patients presented with acute duration of complaints and rest of the 15 patients came with chronic complaint of lower back pain. The duration of back pain varied from 3 months to 5 years. All patients were clinically evaluated and met the Assessment of Spondylo-arthritis international Society (ASAS) criteria for suspected SpA.

MRI Findings

MRI examinations were performed on all patients, focusing on the sacroiliac joints, spine, and peripheral joints. The following results were obtained:

Acute inflammatory lesions of Sacroiliac joints			
Sr. No.	**Lesions**	**No. of positive cases out of total of 35 patients with acute complaints**	**% incidence**
1.	Bone marrow edema	25	71%
2.	Synovitis & Capsulitis	19	54%
3.	Enthesitis	10	28.5%

Acute inflammatory lesions of Spine			
Sr. No.	**Lesions**	**No. of positive cases out of total of 35 patients with acute complaints**	**% incidence**
1.	Spondylitis	29	83%
2.	Enthesitis of Spinal ligament	20	57%
3.	Costo-vertebrae arthritis	15	43%
4.	Facet joint arthritis	9	26%
5.	Spondylodiskitis	4	11%

Chronic inflammatory lesions of Spine & Sacroiliac joint			
Sr. No.	**Lesions**	**No. of positive cases out of total of 15 patients with chronic complaints**	**% incidence**
1.	Erosions	12	80%
2.	Syndesmophytes	8	53.3%
3.	Ankylosis	6	40%
4.	Subchondral Sclerosis	5	33.3%
5.	Fat deposition	3	20%

Statistical Analysis

The statistical analysis revealed significant correlations between clinical symptoms and MRI findings. The presence of sacroiliitis was significantly associated with the duration of back pain ($p < 0.05$).

Diagnostic Utility of MRI

The sensitivity and specificity of MRI in diagnosing seronegative spondyloarthropathies were evaluated. MRI demonstrated a sensitivity of 85% and specificity of 90% for sacroiliitis [5]. These findings augment the diagnostic value of MRI in identifying characteristic inflammatory changes in seronegative spondyloarthropathies. In this study we were able to diagnose Seronegative Spondyloarthropathy earlier as compared to those patients who were exposed to MRI imaging study after a longtime duration of their clinical presentation. Thus, MRI imaging helps early diagnosis and therefore early treatment of Seronegative spondyloarthropathies.

Clinical Implications

Our study highlights the pivotal role of MRI in the early diagnosis and management of seronegative spondyloarthropathies. MRI not only facilitates the detection of subclinical inflammation but also aids in monitoring disease progression and response to therapy. The early identification of sacroiliitis and other inflammatory changes can prompt timely intervention, potentially altering the disease course and improving patient outcomes.

Limitations

The primary limitation of our study is the relatively small sample size, which may affect the generalizability of the results. Additionally, the lack of a control group limits the ability to compare MRI findings in patients with lower back pain due to other etiologies. Future studies with larger cohorts and control groups are warranted to validate our findings and further elucidate the role of MRI in seronegative spondyloarthropathies.

III. Conclusion:

Early spondyloarthropathy is often difficult to assess and diagnose clinically. Thus, MRI of the sacroiliac joints is the most suitable means of detecting inflammation associated with spondyloarthritis [6]. Magnetic resonance imaging is the best imaging modality to diagnose early spondyloarthritis and it is highly sensitive for picking up inflammatory as well as structural changes of spondyloarthritis which allows appropriate and effective therapeutic management.

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