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MRI in Evaluation of painful Hip Joint

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Abstract: *Hip pain is a common problem that causes difficult diagnostic and therapeutic challenges for the clinician. Magnetic resonance imaging (MRI) has good soft tissue contrast and resolution. MRI offers valuable information regarding occult bony and cartilage injury such as stress fractures, avascular necrosis, osteoarthritis, as well as soft tissue abnormalities such as bursitis. This prospective study included 52 patients with painful hip joint. The following MR sequences were performed to all patients: coronal T1WI, T2WI, STIR &PDFS images, axial T1WI & T2WI, sagittal PDFS images and axial, coronal and sagittal T1WI after contrast injection. The MRI examination revealed pathological findings in 45 (86.53%) out of the 52 patients which were avascular necrosis in 16 (30.7%), fracture in 4 (7.6%), sacro-ilitis in 4 (7.6%),osteoarthritis 3 (5.7%),infective arthritis in 2 (3.8%) intramuscular abscess in 2 (3.8%), synovitis in 2 (3.8%),synovial effusion in 2 (3.8%),muscular edema in 2 (3.8%),bone marrow edema in 1 (1.9%),bone infarct in 1 (1.9%),bursitis in 1 (1.9%), femoro-acetabular impingement in 1 (1.9%),metastatic lesions in 1 (1.9%), multiple myeloma in 1 (1.9%),myositis ossificans in 1 (1.9%) and subchondral cyst in 1 (1.9%) patient with painful hip joint.*

Keywords: *Arthritis, Avascular necrosis,Hipfractures,Hip joint, MRI,*

I. Introduction

The hip joint is a major weight bearing joint with significant mobility. It was one of the first joints of the body to be evaluated by MRI due to its common association with systemic disorders. Painful hip is common disabling musculoskeleteal symptom affecting all age groups. The differential diagnosis is exhaustive, probing a diagnostic challenge, includingjuxta-articular, intra-articularetiologies as well as referred pain mainlyfromspine or sacroiliac joints**.**

With the recent advance technology and imaging, Magnetic resonance imaging (MRI) has evolved as preferred imaging modality in evaluating various causes of pain related to hip joint. Its role in avascular necrosis (AVN) has been extensively studied and is utilized as an important modality in early diagnosis of AVN, where radiographs are unequivocal.[2,3] MRI provides valuable information regarding occult bony and cartilage injury such as stress fractures, marrow edema as well as osteoarthritis.[4] MRI has also proved excellent in evaluation of arthropathies, trauma, osteomyelitis and primary musculoskeletal tumours. Additionally intravenous or intra-articular gadolinium can be used to evaluate synovial pathology, labral pathology, subtle femoral head changes, and articular cartilage derangement. [5]MRI is also useful in evaluation of femoro-acetabular impingement (FAI) andit provides evidence of early degenerative changes in tissues prior to cartilage delamination and labral tear in FAI patients.[6]

Thus due to its good soft tissue contrast and superior resolution, depicting excellent anatomical detail, MRI is the widely utilized modality for hip joint pain. It provides not only the exact site of pathology, but also provides accurate diagnosis of primary disease and helps determining secondary involvement of surrounding structures. It will thus have a profound impact on the subsequent treatment plan of patients and would be a useful tool for clinicians especially in cases where radiographs and first line clinical management has not proved useful.

II. Aims And Objectives

To study the spectrum of imaging findings depicted on MRI in patients with a painful hip joint referred to the radiology department of Shree Krishna Hospital, Anand, which is a rural tertiary care academic hospital.

III. Materials And Methods

This study is a prospective study of 52 patients presenting with complain of painful hip referred to the Department of Radio-diagnosis, Shree Krishna hospital & Pramukh Swami Medical College, Anand from February 2015 to July 2016. MRI hip study was performed on MRI Superconductive 1.5 Tesla Magnetom Symphony Maestro class (Manufactured by Siemens AG Co., Erlangen).

3.1 Inclusion criteria

The study included all patients presenting with complain of painful hip joint, irrespective of age or sex.

3.2Exclusion criteria

Patients with contraindication for MRI like pacemakers, recent metallic implants, aneurysmal clips, cochlear implants & any non-MR compatible prosthetic implant would be excluded from the study.

3.3Technique of examination

MRI hip of all patients was carried out using MRI Superconductive 1.5 Tesla Magnetom Symphony Maestro class MRI scan (Manufactured by Siemens AG Co., Erlangen) with the help of a dedicated body coil. The patient was asked to lie in a supine position and both hips were examined simultaneously. The tests were performed using following parameters. Field of view –350 to 400 (in adult) and 180 to 200 (in paediatrics). Slice thickness – 3-8 mm. Matrix size – 512 x 512. The following sequences were obtained: 3-5 mm thick T1 weighted, T2 weighted, Short tau inversion recovery (STIR) & proton density fat saturation (PDFS) coronal images, 5-8 mm thick T1 weighted & T2 weighted axial images with 3-5 mm thick PDFS sagittal images sequences of both hips. Axial, sagittal and coronal planes were performed immediately after intravenous bolus injection of Gadolinium in dose of 0.1mmoll/kg in the inflammatory and neoplastic cases. Additional sequences 3 mm thick PDFS oblique axial and 3 mm thick T2W oblique axial were obtain whenever required.

IV. Method Of Data Analysis

Collected data was presented in the form of tables and diagrams. Frequency and percentages were calculated wherever applicable.

V. Results

In this study, 52 patients with clinical history of painful hip joint were studied by MRI scan. The age range of patients was from 5 years to 77 years. The maximum number of patients i.e. 11 (21.1%) were in the age group of 41-50 years (table 1).There was a male predominance with 35 (67.3%) and female with 17 (32.7%).

Table - 1 :- Age Distribution

Age in years	No of patients	Percentage (%)
1-10	4	7.69
11-20	4	7.69
21-30	7	13.46
31-40	5	9.61
41-50	11	21.1
51-60	9	17.3
61-70	10	19.2
>70	2	3.84

The study revealed pathological findings in 45 patients of which avascular necrosis of femur head were the most frequent findings followed by rest of the findings as tabulated in table 2.

Table 2: Spectrum of MRI findings

Diagnosis	Number of Patients	Percentages
Avascular necrosis	16	30.76 %
Bone Marrow edema	1	1.92 %
Bone Infarct	1	1.92 %
Bursitis	1	1.92 %
Femoro-acetabular impingement	1	1.92 %
Fracture	4	7.69 %
Infective Arthritis	2	3.84 %
Intramuscular Abscess	2	3.84 %
Metastatic Lesions	1	1.92 %
Multiple Myeloma	1	1.92 %
Muscular Edema	2	3.84 %
Myositis Ossificans	1	1.92 %
Osteoarthritis	3	5.76 %
Sacro-Ilitis	4	7.69 %
Subchondral Cyst	1	1.92 %
Synovial Effusion	2	3.84 %
Synovitis	2	3.84 %
Normal	7	13.46 %

Idiopathic cases of AVN was found to be most common in 50 % of cases. Of the associated risk factors, causes like steroids was observed in 18.7 %, alcohol in 12.5 % and trauma, sickle cell anemia and pancreatitis was found in 6.25 % each(Table 3).

Table 3:- Risk Factors For AVN

Risk Factors	Number of Patients	Percentages
Idiopathic	8	50%
Steroids	3	18.7%
Alcohol	2	12.5%
Trauma	1	6.25%
Sickle cell anemia	1	6.25%
Pancreatitis	1	6.25%

AVN was present unilaterally in 9 patients (56.2 %) and bilaterally in 7 patients (43.7 %).

Table 4: Unilateral versus Bilateral AVN

Number of patients diagnosed as having AVN of the femoral head	Number of femoral heads affected by AVN	Unilateral AVN	% of unilateral AVN	Bilateral AVN	% of bilateral AVN
16	23	9	56.2	7	43.7

Most common MRI finding of AVN was focal subchondral signal abnormality which was present in 100 % of the lesions followed by rest of the findings as tabulated in table 5.

Table 5: MRI Findings In AVN

MRI Findings	Number of Patients	Percentages
Focal subcondral signal abnormality	23	100%
Hip joint effusion	15	65.2%
Bone marrow edema	12	52.2%
Collapse / Flatting of Head	13	56.5%
Double line sign	10	43.5%
Decreased joint space	11	47.8%
Osteophytes	6	26.0%
Thinning / Loss of articular cartilage	3	13.0%
Subchondral cyst	2	8.7%

Stage D was the most common class of AVNaccording to MRI Mitchells classification present in 47.8 % of the lesions followed by stage C 39.1 %.

Table 6 :- Distribution Of AVN Cases According To MRI Mitchells classification

Grade	Number of Patients	Percentages
Stage A	1	4.34%
Stage B	2	8.69%
Stage C	9	39.1%
Stage D	11	47.8%

Grade IV was the most common class of AVN according to Ficat&Arlet classification present in 52.2 % of the lesions followed by grade II 26.1 %.

Table 7:- Distribution of AVN Cases According To Ficat&Arlet classification

Grade	Number of Patients	Percentages
GRADE I	1	4.34%
GRADE II	6	26.1%
GRADE III	4	17.3%
GRADE IV	12	52.2%

Most common MRI finding in osteoarthritis was decreased joint space and osteophytes were present in 100 % of the lesions followed by rest of the findings as tabulated in table 8.

Table 8 :- MRI Findings

MRI Finding	Number of lesions	Percentages
Hip joint effusion	1	33.3%
Decreased joint space	3	100%
Thinning / Loss of articular cartilage	2	66.6%
Osteophytes	3	100%
Subchondral cyst	1	33.3%

VI. Discussion

The common findings as depicted in the MRI in descending order of frequency areas below;

Avascular Necrosis

MRI is the most sensitive modality for diagnosing AVN. It has many advantages, as it allows accurate staging by clearly depicting the size of the lesion and also detects asymptomatic lesions that are undetectable on plain radiographs. In this study, avascular necrosis turned out to be the most common hip pathology (35.5 %) with prevalence in the age group varying from 26 to 68 years and a male: female ratio of 4.3:1. The most common age group was 31-40 years. The mean age of presentation was 43.5 years. In this study 81.2 % patients were male and 18.8 % were female. Patterson et al[7] in their study on AVN had 83% male and 17% female patients. Diana Kamal et al[8]in his study on AVN had 73.91% men and 26.1 % female patients. In this study, idiopathic AVN was found in 50 % cases, followed by steroids in 18.7 %, alcohol in 12.5 % of cases. Jacobs et al[9]concluded alcohol as the most common risk factor in 39% of his cases. Diana Kamal et al[8]in their study found smoking as the most common risk factor in 36.9 % of cases. In this study, AVN was present unilaterally in 9 patients (56.2 %) and bilateral in 7 patients (43.8%). HayamAbdElmonsif et al[10]; in their study showed AVN to be unilateral in 68 % and bilateral in 32 % of patient.

In this study, stage D was the most common class of AVN evident in 47.8 % of the lesions followed by stage C in 39.1 % lesions. Mitchell DG etal[11]; in their study found stage A to be most common (43%); since their studied detection of early AVN. In this study, grade IV was the most common class of AVN present in 52.2 % of the lesions followed by grade II in 26.1 % lesions according to Ficat&Arlet classification. Diana Kamal et al[8] in his study 51.09 % of patients were diagnosed in grade IV and 34.78% of patients were diagnosed in grade III. In this study, focal subchondral signal abnormality was present in 100 % of AVN patients and hip joint effusion was present in 65.2% of AVN patients on MRI. HayamAbdElmonsif et al[10] concluded in his study that focal subchondral signal abnormality was present in 100% patients of AVN and hip joint effusion in 32 %.

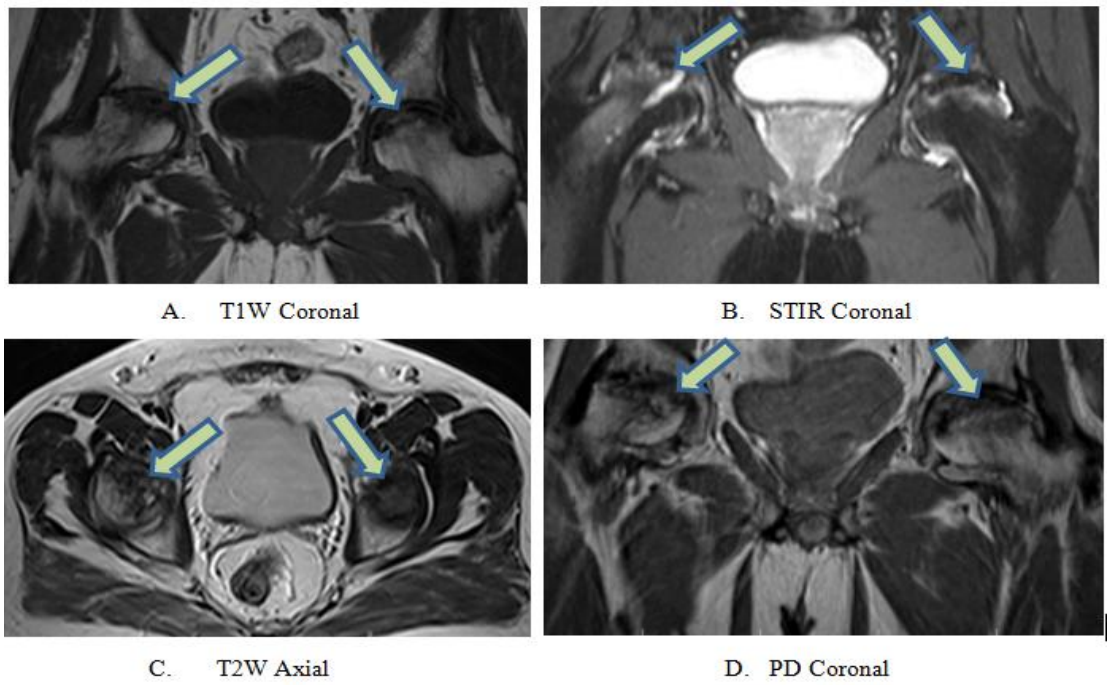


Figure 1 (A to D):- Bilateral AVN of femur head

Fractures

Deutsch et al.[12] reported that magnetic resonance imaging with T1-weighted coronal images is 100% accurate in detecting occult hip fractures. Fractures that are difficult to appreciate on CT such as, stress fractures, non-displaced fractures, and subtle fractures in severely osteopenic patients, are easily recognized at MR imaging because of the marrow changes.[12,13]Magnetic resonance imaging facilitates the early diagnosis of stress fracture as it is present with bone marrow edema which is best depicted on fat-suppressed T2-weighted scans or STIR images.

In our study, two patients had femur neck fractures, one patient had acetabulum fracture and one patient had stress fracture. MRI finding in those cases showedlinear hypointensity (100%) on T1W images and bone marrow edema (100%).

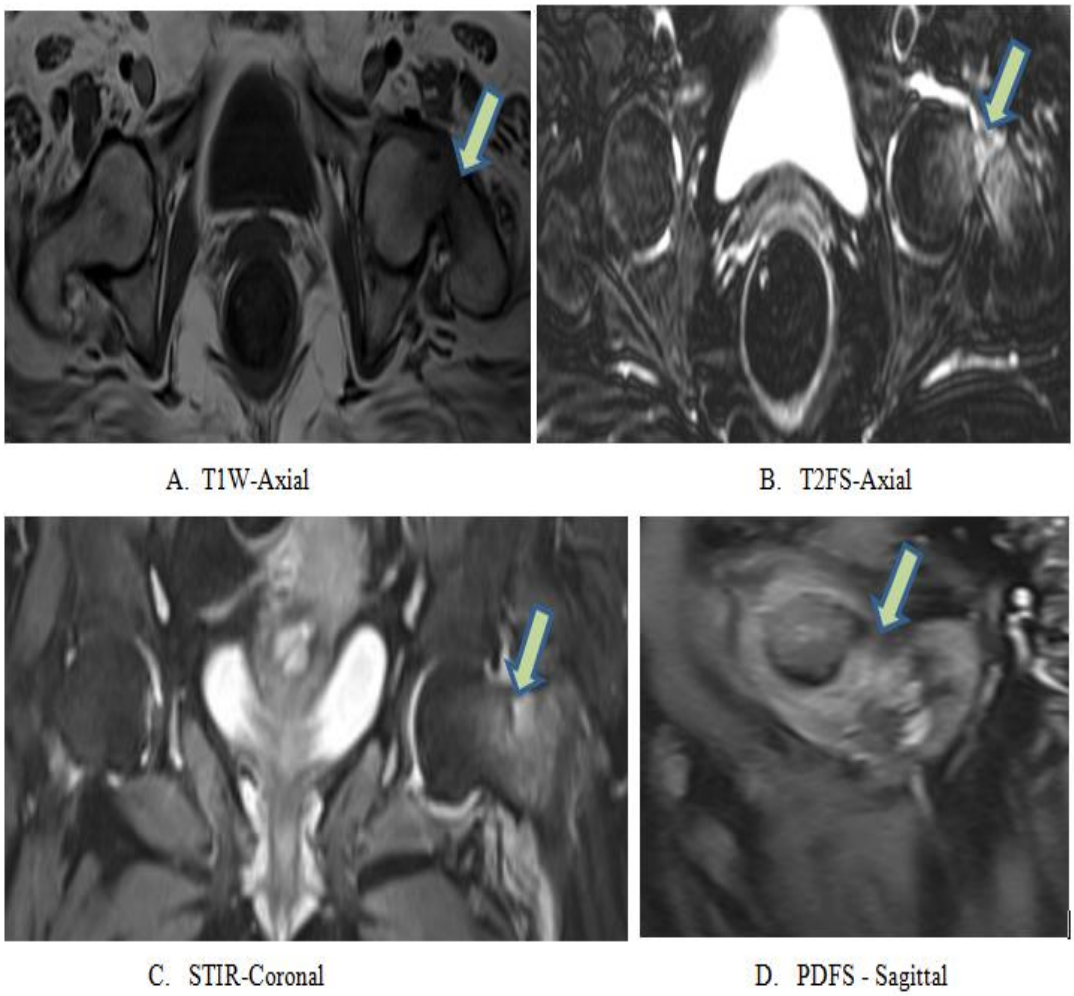


Figure 2(A to D):- Displaced fracture of the neck of left femur with focal marrow edema

Sacro-Ilitis

The sacroiliac joint is a complex joint that has many anatomic variants and undergoes many physiological changes over a lifetime. MRI is useful in the diagnostic evaluation of the sacroiliac joint. The new Assessment of SpondyloArthritis international Society (ASAS) criteria include MR findings that facilitates early diagnosis and assessment of treatment response.[14]MR findings commonly observed in sacro-ilitis are bone marrow edema, changes in the cartilage and adjacent subchondral bone, ligaments, synovium, and capsular region. In this study, four patients had sacro-ilitis, out of which two had bilateral involvement and two patients had unilateral involvement. MRI finding seen were bone marrow edema, cortical erosion and narrowing of joint space.

Osteoarthritis

Osteoarthritis (OA) is a disease causing destruction of synovial joint. The risk for disability and dependency from changes of OA is comparable with that of cardiovascular disease in the elderly. MRI has some credible role as a non-invasive method of depicting early changes of OA when compared with standard radiograph, histology, and other techniques, however still Radiography continues to be used as a confirmatory imaging modality by clinicians due to its ready availability and cost effectiveness.[17]The signs on MRI include joint effusion, reduced joint space, marrow edema, osteophytes, cartilage defects and subchondral cysts and fissures. Boutry et al[13] demonstrated joint effusion (100%), bone marrow edema (83%) and subchondral cysts (83%) in his study on hip osteoarthritis. In this study, total of three cases of osteoarthritis were found. MRI findings in those cases were joint effusion (100 %), osteophytes (100%), subchondral cysts (66.6%) and bone marrow edema (33.3%).

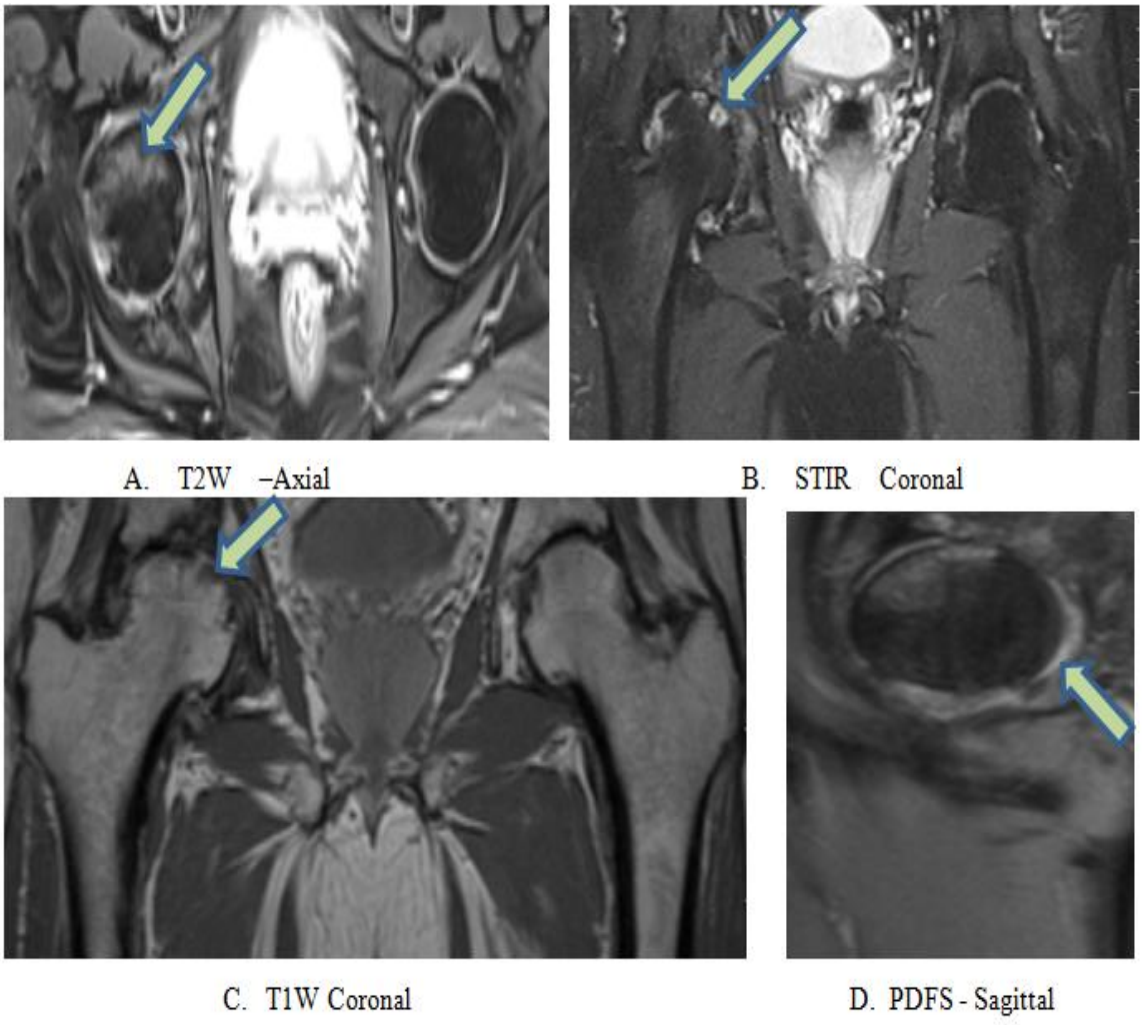


Figure 3 (A to D): Case of right hip joint osteoarthritis showing reduce hip joint space with cortical irregularity and thinning of the cartilage, joint effusion, subchondral cysts and marginal osteophytes.

Septic arthritis

Michael Karchevsky et al[18]in his study MRI findings was septic joints was synovial enhancement (98%), perisynovial edema (84%), joint effusions (70%), fluid out pouching (53%), fluid enhancement (30%), and synovial thickening (22%) and abnormal gadolinium enhancement (81%). In this study, total of two cases of septic arthritis were found. The MRI finding was joint effusions (100%), bone marrow edema (100%), synovial thickening (50%) and abnormal gadolinium enhancement (50%).

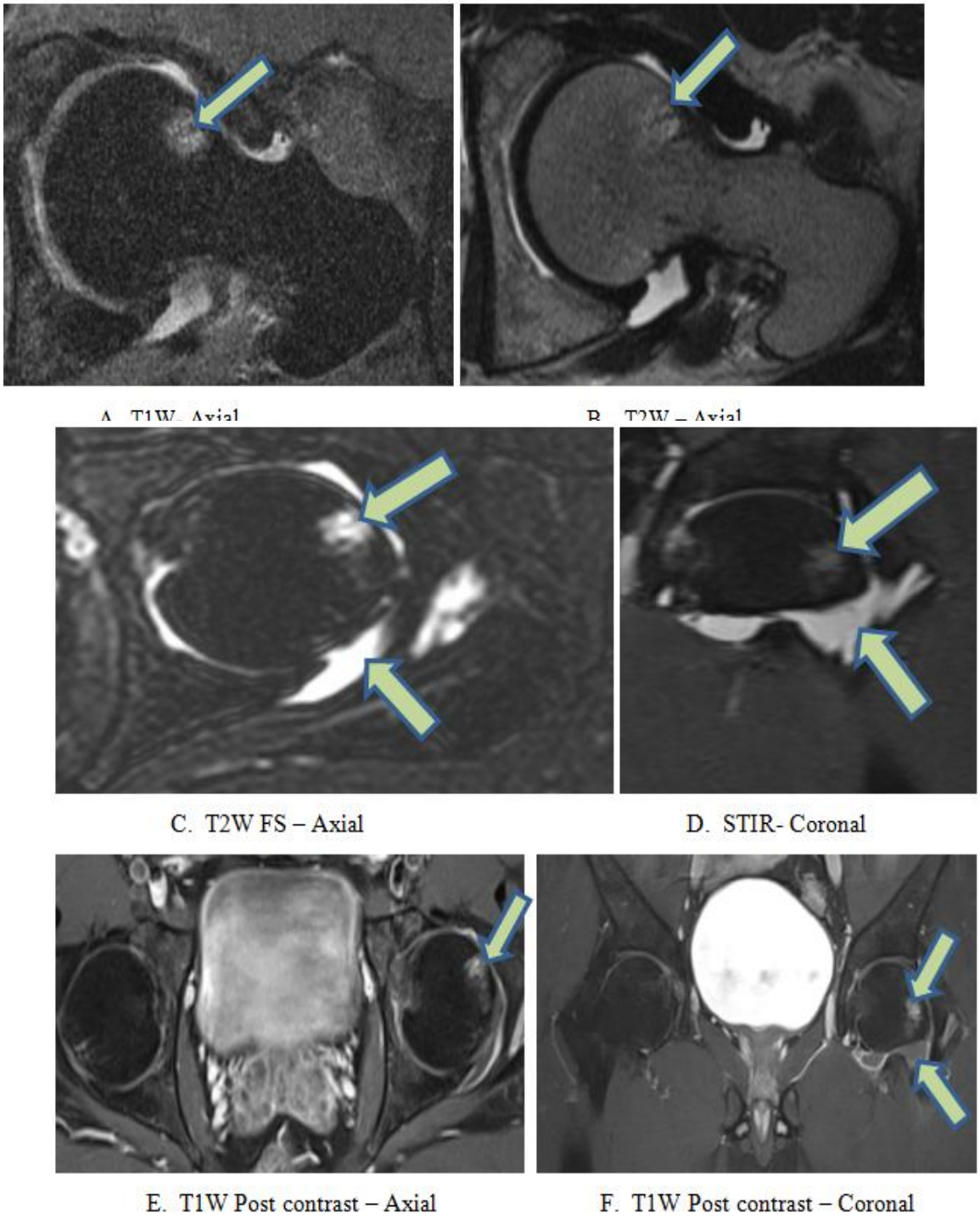


Figure 4 (A to F): Case of infective arthritisinvolving antero-lateral portion of head of left femur.

Intramuscular Abscess

MRI has important role in diagnosis, characterization and extent of the intramuscular abscess. The necrotic center and the cellular periphery of abscess can be delineated after contrast enhancement [19]. Two patients were found to have intramuscular abscess. The lesion on post contrast study showed thick peripheral enhancement and central non enhancing necrotic component.

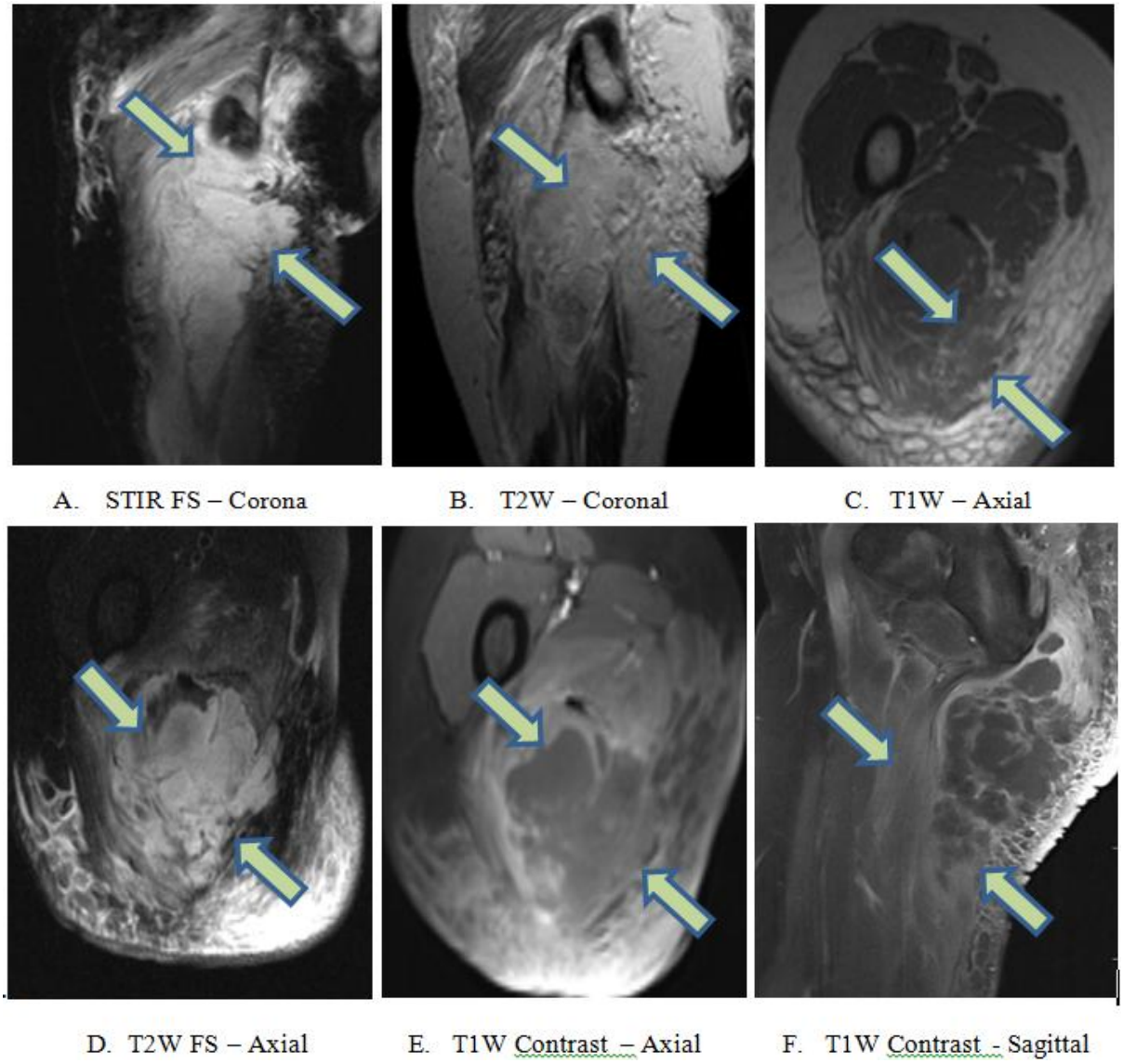
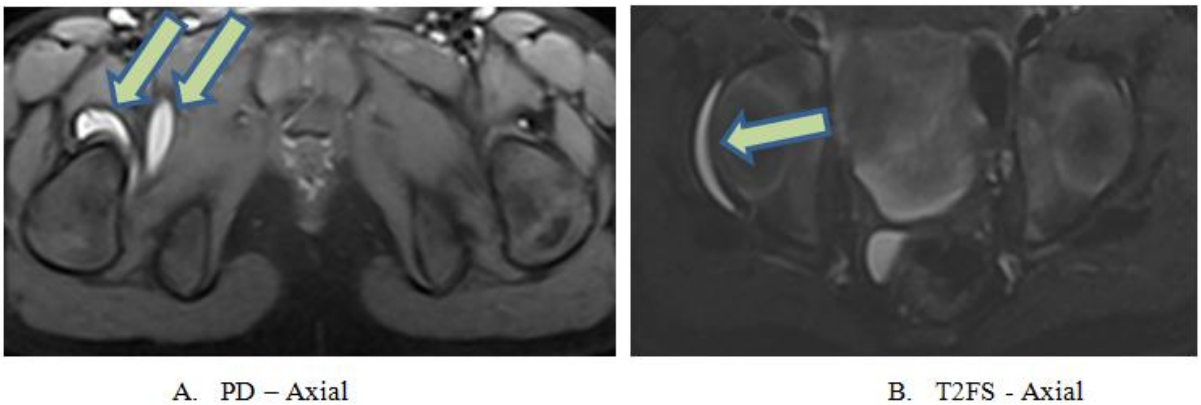
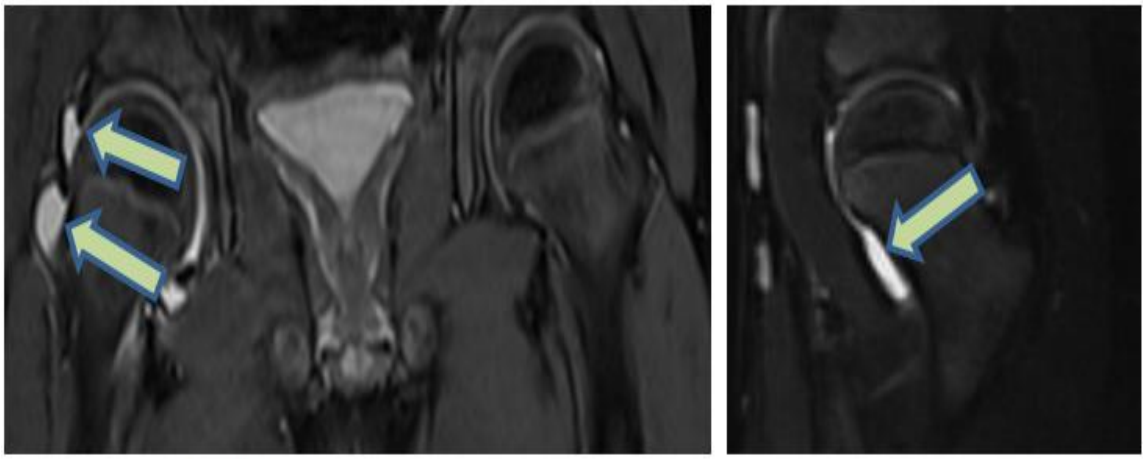


Figure 5(A to F): Case of intramuscular abscess.

Synovitis

MRI in early stages shows synovial effusion and varying degree of bone marrow edema and/or bony destruction.[20]In this study, two patients were diagnosed as having synovitis. Both patients demonstrated evidence of synovial effusion while associated synovial thickening and enhancement and bony erosions were depicted in one patient with more severe disease.



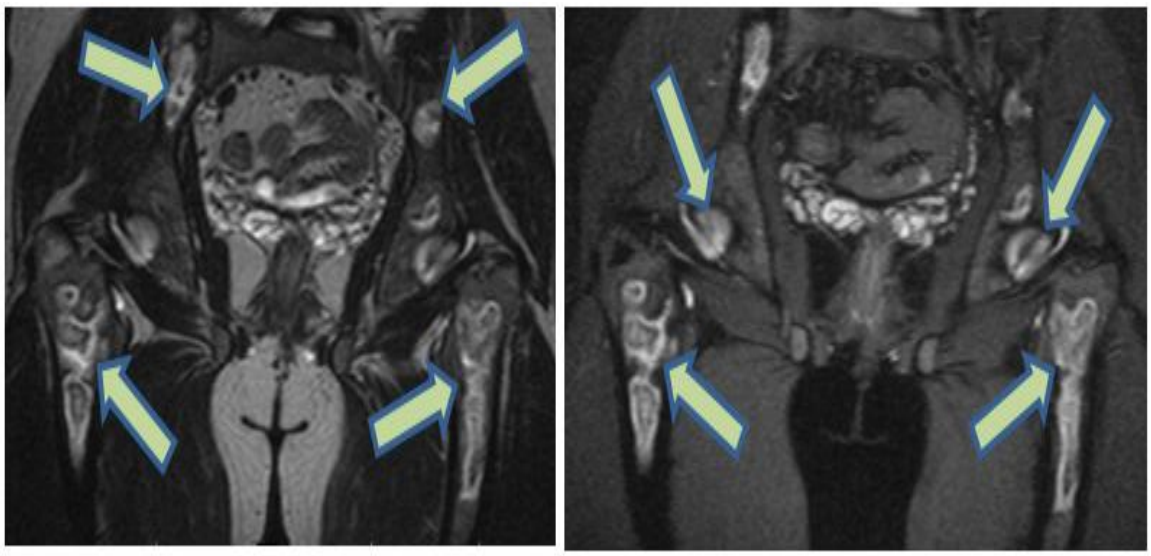


C. STIR - Coronal D. T2W Sagittal

Figure 6(A to D): Case of synovitis involving right hip joint.

Bone Infarct

Acute bone infarct is commonly seen in sickle cell patient.MRI is a useful in distinguishing acute osteomyelitis and bone infarct. In this study, one patient was a known of sickle cell anemia had multiple bony infracts in pelvic bones. Multiple varying sizes altered signal intensity areas seen scattered throughout the pelvic bones, appearing hypointense on T1W images and mildly hyperintense on T2W and STIR images, with peripheral hyperintense rim in all pulse sequences (Double rim sign).



A. T2W Coronal B. STIR Coronal

Figure 7(A & B): Case of bone infarctions scattered throughout the pelvic bones.

Femoro-Acetabular Impingement

There are two types of impingement pincer and cam. Pincer impingement is due to focal or general overcoverage of the femoral head. Cam impingement is due to an aspherical portion of the femoral head–neck junction.[22]In present study, one patient was diagnosed as CAM type femoro-acetabular impingement in neck of femur. It shows STIR and T2 FS hyperintensity with small bony hump in femur neck with tear in intra substance of superior labrum. Alpha angle measures around 62 degrees.

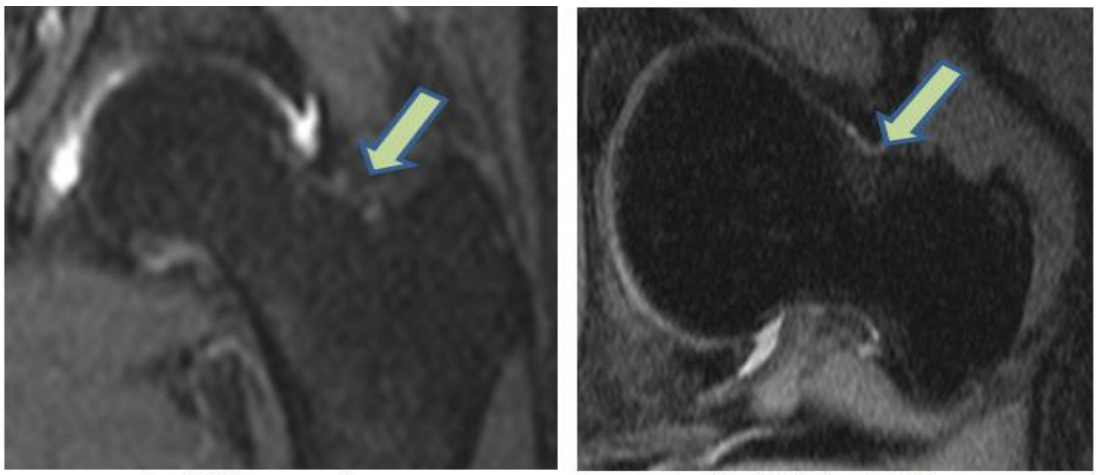


Figure 8 (A & B): Case of CAM type of femoro-acetabular impingement involving left hip joint.

Metastatic lesion

MRI is more sensitive than technetium bone scanning in the detection of bone metastases because earlier marrow abnormalities may be identified and show both lytic and sclerotic lesions. [23]One patient was diagnosed as having metastatic lesion in left iliac bone and upper portion of shaft of left femur, appearing as hypointense areas on T1W images and hyperintense on STIR and T2W images.

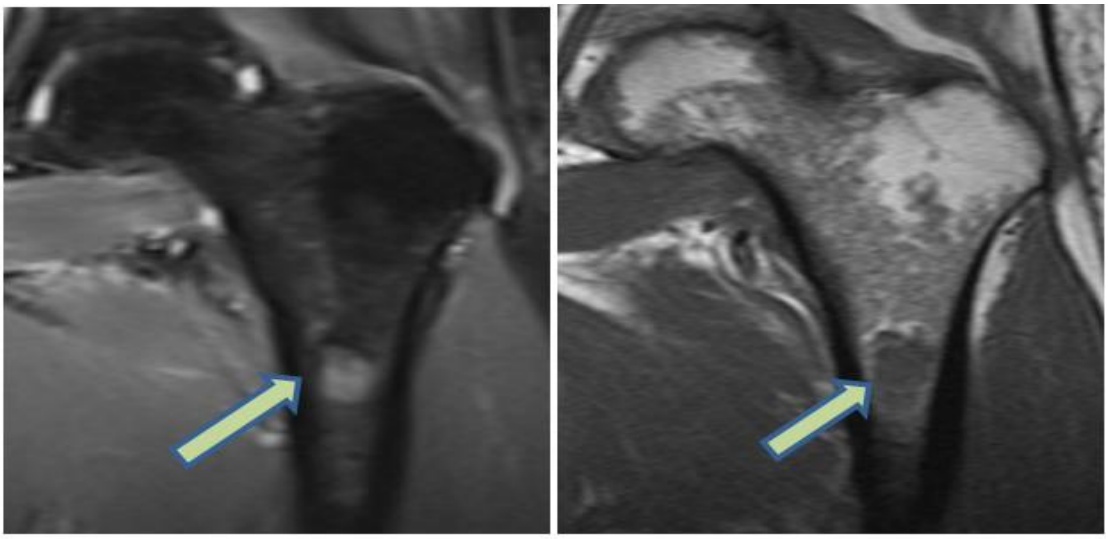


Figure 9 (A & B): Case of metastatic lesions involving upper portion of shaft of left femur

Multiple Myeloma

MRI in imaging of multiple myeloma has dramatically increased within the last decade. It has advantages over both conventional radiography and CT due to excellent depiction of the spinal cord and nerve roots, detection of soft tissue manifestations and the ability to differentiate between physiological and myeloma-infiltrated bone marrow.[24,25]

We only had one patient of multiple myeloma of spine with associated pain in hip joint where MRI detected lesions in upper and mid portion of diaphysis of left femur.

Bursitis

Trochanteric bursitis is characterized by painful inflammation of the bursa.[26]MRI is able to visualize the trochanteric bursa when present and inflamed. We only had one patient with trochanter bursitis.

Myositis Ossificans

Myositis ossificansis a heterotopic bone forming, non-neoplastic, self-limiting, disease commonly noted in large muscles of the extremities as result of past history of trauma, however it can be idiopathic or may be associated with systemic diseases. [27]We had one patient with myositis ossificans involving liliacus muscle and psoas muscle. Other non-specific findings are seen like muscle edema in two patients, synovial effusion in two patients, bone cyst in one patient and bone marrow edema in one patient.

VII. Conclusion

MRI is a noninvasive, safe and accurate imaging modality for diagnosing various etiologies of painful hip joint. Due to its technological supremacy in demonstrating anatomical details, identification of abnormalities like joint effusions, synovial changes, bone marrow signal alteration, articular cartilage abnormalities, muscle pathologies, subchondral bone changes and juxta articular soft tissues, MRI would continue to remain modality of choice in imaging of painful hip. Finding of this study may express the importance of MRI in painful hip joint and its influence in managing patient treatment in setting of rural area like ours.

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