

The Role Of MRI In The Evaluation Of Painful Hip Joint

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ABSTRACT

BACKGROUND & OBJECTIVES: Hip pain has different etiologies in adults and children. MRI is the method of choice in characterizing the various disorders and assessing the full extent of osseous, chondral and soft tissue abnormality of the hip joint. This study was aimed to evaluate the diagnostic value of MRI in assessment of painful hip joint.

METHODOLOGY: This prospective study included 60 patients with painful hip joint. The following MR sequences were performed for all patients: Coronal T1, T2 & STIR WIs, axial T1&T2WIs, axial T1WI and sagittal T1WI after contrast injection. Patient's history, a local examination of the diseased hip and laboratory investigations were performed.

RESULTS: The most common pathology for which MRI hip advised was avascular necrosis (AVN) (40%), followed by septic arthritis (20%). Male to female ratio was 2.3:1, their ages ranged from 10 months to 76 years with a mean age of 40 years. In this study most common presentation was a pain in hip joint (97%) followed by restricted movement (92%). In the study most common MRI finding of AVN was bone marrow edema (78%) of the lesions followed by joint effusion 63% and Double line sign(58%). In the present study, stage 4 with secondary osteoarthritis was the most common stage of AVN present in 43% of the lesions followed by stage 3 31%. The frequency of MRI findings in septic joints was a synovial enhancement (91%), joint effusions (91%), erosive bone destruction (67%). In the study most common changes of osteoarthritis are joint space reduction noted in 38% of hips studied.

CONCLUSION: MRI of the hip joint is an informative, diagnostic, and accurate for the assessment of hip pain and sufficient imaging modality for delineation of different hip joint pathology.

KEY-WORDS: MRI, Hip Joint, Hip Pain, Arthritis. drreddymadhavi@gmail.com

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INTRODUCTION

The hip is a stable, major weight-bearing joint with significant mobility. Hip pain has different etiologies in adults and children. In adults, hip pain may be caused by intraarticular disorders such as avascular necrosis, arthritis, loose bodies, labral tears; periarticular pathology such as tendonitis and bursitis, or extraarticular conditions such as referred pain from lumbar spine, sacroiliac joint and nerve entrapment syndromes.¹

Imaging of the hip was among the earliest reported applications of musculoskeletal magnetic resonance (MR) imaging. Magnetic resonance imaging (MRI) with its excellent soft tissue contrast and resolution with no operator dependence and no ionizing radiation is the imaging modality of choice for evaluation of hip joint abnormalities.² MRI offers valuable information regarding occult bony and cartilage injury such as stress fractures, avascular necrosis, and osteoarthritis, as well as soft tissue abnormalities such as muscle tears and bursitis.³ MRI provides a useful assessment of patients in whom a femoro-acetabular impingement is clinically suspected. A high resolution non arthrographic technique can provide preoperative information regarding the presence and anatomic site of labral and cartilage abnormalities as well as MRI is an excellent method of preoperative assessment and helps guide the surgeon as to the likely site of labral and chondral abnormalities.

MRI imaging is a valuable tool in the evaluation of hip disorder because it enables assessment of articular structure, extraarticular soft tissue and the osseous structures that can be affected by hip

disorders. In the setting of chronic hip pain, a normal appearing radiograph, a non-specific history and clinical findings can be a difficult diagnostic dilemma. Trauma, infection, arthritis, avascular necrosis, tumour and hip dysplasia can all manifest with extremely subtle radiographic abnormalities. Because much of the pediatric hip is cartilaginous, it is often not optimally imaged with other modalities such as plain radiograph, and computed radiography. MRI has no risk of radiation exposure like X-ray and computed tomography.

MATERIALS AND METHODS

The study group was consist of patients reported to RNT Medical College & Associated Group of Hospitals from different parts of Rajasthan and some from neighbouring states like Madhya Pradesh and Gujarat. A prospective study of 60 patients, with the complaint of painful hip joint during the period from July 2014 to November 2016 was carried out. Each patient's name, age, sex, relevant clinical symptoms and signs were noted down together with their clinical diagnosis from the case papers.

EXAMINATION TECHNIQUE

Items such as jewellery, watches, credit cards, hearing aids, pins, hairpins, metal zippers and similar metallic items and removable dental work were moved prior to the scan. Informed written consent was taken. While performing MRI scan, sedatives were used according to requirement under the supervision of anaesthetist. MRI examinations were performed by 1.5 Tesla MR scanner (Philips ACHIEVA channels,

superconducting magnet) using abdominal surface coils and spine coils, with the study subject in the supine position. The following scans were selected as routine:

- T1WI (TR = 400- 1000ms, TE = 10- 25ms)
- T2WI (TR = 2000-3000ms, TE = 60-100ms)
- STIR (TR = 2500ms, TE = 50- 60ms)
- Post Gado. T1(if any).

RESULTS

The present study included 60 cases of patients with different hip pathologies. The most common pathology for which MRI hip advised was AVN (40%). Next common is septic arthritis 20%. Bone tumors together comprise 10% of patients. In this study most of patients were below 50 years of age with largest group between 41- 50 years (27% of all patients). Youngest patient was 10 months old having transient synovitis and the oldest patient was 76 year old having chondrosarcoma. The most common age group having AVN femoral head was in the range of 31-50yrs, which comprised 64% of the series. The most common age group having septic arthritis was 11-20yrs, which comprised 42% of the series. In this study there were 70% male and 30% female patients out of total 60 patients with different hip pathologies. Among AVN 76% patients were male and 24% were female. In this study most common presentation was a pain in hip joint (97%) followed by restricted movement (92%) and gait abnormality (83%). The head of femur was most commonly involved part of joint in 64 (81%) hips out of 79 total pathological hips. Next most common site is acetabulum /pelvic bones in 35 (44%) followed by neck

femur in 25 (31%) and muscles in 14 (18%) hips.

Table-1: MRI findings in AVN (N=41)

MRI Findings	No of lesions	%
Hip joint effusion	26	63
Loss of articular cartilage	12	29
Joint space reduction	20	48
Bone marrow edema	32	78
Subchondral fracture	11	26
Osteophytes	7	17
Subchondral cyst	8	19
Marginal irregularity	8	19
Collapse of head	10	24
Double line sign	24	58

In the present study most common MRI finding of AVN was bone marrow edema, which was present in 78% of the lesions followed by joint effusion 63%. Double line sign was seen in 58% of the lesions followed by joint space reduction (48), loss of articular cartilage in 29% and subchondral fracture 26%.

Table 2: Distribution of AVN cases according to MRI STAGES: (N=41)

Stages	No. of lesions	%
Stage 1	4	9.7
Stage 2	6	14
Stage 3	13	31
Stage 4	18	43

In the present study, stage 4 was the most common stage of AVN present in 43% of the lesions followed by stage 3 31%.

Table 3: Changes of osteoarthritis on MRI (n=79)

Changes of osteoarthritis	No. of Patients	Percentage
Joint space narrowing	30	38
Subchondral cyst	10	12
Osteophyte formation	12	15

In the present study most common changes of osteoarthritis are joint space reduction noted in 38% of hips studied.

Table – 4: MRI findings in infective arthritis (N=12)

MRI Findings	No. of lesions	%
Hip joint effusion	11	91
Synovial thickening	4	33
Synovial enhancement	11	91
Fluid outpouching / grade 3 effusion	6	50
Intramuscular collections	6	50
Erosive bone destruction	8	67
Bone marrow edema	10	83

The frequency of MRI findings in septic joints was as follows: synovial enhancement (91%), joint effusions (91%), erosive bone destruction (67%), intramuscular collections (50%), fluid outpouching (50%), and synovial thickening (33%). The marrow showed bare area changes are associated with (83%) of infective arthritis.

DISCUSSION

(1) Avascular Necrosis

MRI is the most sensitive mean of diagnosing AVN, representing the gold-standard of noninvasive diagnostic evaluation. It has several advantages, allows accurate staging by clearly depicting the size of the lesion, it also detects asymptomatic lesions that are undetectable on plain radiographs, thus facilitating early treatment and better response. It provides multiplanar imaging and excellent soft tissue resolution and can demonstrate response of the femoral head to treatment. In our study, avascular necrosis (AVN) turned out to be the most common hip pathology (40%) with age varying from 8 years to 70 years and a male:female ratio of 3.1:1. The most common age group was 31-40 years, which comprised 40% of the cases followed by 24% in 41-50 and 12% in 21-30 and 61-70years age group. AVN usually occurs in the patients in their third to fifth decade's unless predisposing conditions exist that place different age groups at risk i.e., LCP and slipped capital femoral epiphysis. In the study done by Jacobs et al; the age range of patient was 15 to 83 years with majority of were less than 50 years. The mean age of presentation was 39.48 years, thus correlating with Khanna et al^{38.5yrs.}⁴

In the present study, 76% patients were male and 24% were female. Patterson et al in their study on AVN had 83% male and 17% female patients. The majority of the patients presented with hip joint pain (97%), followed by restricted movement in 92% and gait abnormality in 83% of the

patients. In our study, painful hip was the most common presenting symptom in 97% followed by restricted movement in 92% and gait abnormality in 83%, which is in concordance with the study of Stainberg et al,⁵ who observed that 77% of the patients of AVN are having pain as the chief complaint.

Table-5: Distribution of cases according to MRI stages: (N=41)

CLASS	No of lesions	%	Diana Kamal's study ¹⁵ (n=92)%
Stage 1	4	9.7	4.35
Stage 2	6	14	9.78
Stage 3	13	31	34.78
Stage 4	18	43	51

In the present study, stage-4 was the most common stage of AVN present in 51% of the lesions followed by stage-3 (34.78%). Diana Kamal⁶ in his study found that most of the patients (85.87%) included in their study were diagnosed in advance evolutionary stages of disease, stage 3 and stage 4.

Double line sign

In our study, 33 patients with AVN were showing double line sign in 24 cases (58%) out of 41 lesions. Mitchell and Steinberg et al in their study on MRI of the ischemic hip on 70 patients found that 45 (80%) of lesions were showing double line sign. This sign correlates closely with the reactive interface between live and dead bone. The low intensity peripheral rim corresponding to sclerosis from reinforcement of exiting trabeculae at the margin of live bone and the high intensity inner vascularised

granulation tissue. However Khanna et al⁴ concluded double line sign to be less common with spin echo sequences and not necessary for the diagnosis of AVN.

Bone marrow edema

In the present study, bone marrow edema was found in 32 (78%) of the lesions. All patients having bone marrow edema have pain. Koo et al⁷ in a study concluded that combination of AVN femoral head and bone marrow edema is strongly associated with pain. Guo-Shu Huang et al⁸ concluded that the peak of bone marrow edema occurred in stage III disease (72%); Kim et al⁹ reported that bone marrow edema was most often found in hips with stage III disease (88%)

(2) Secondary osteoarthritic changes

Secondary osteoarthritic changes include narrowing of joint space, osteophytes formation and subchondral cysts. Narrowing of the joint space and subchondral cyst formation was better detected on MRI than on radiographs due to its multiplanar capacity and better resolution. In the present study most common changes of osteoarthritis are joint space reduction, which were noted in 38% of hips studied.

(3) Septic arthritis

MRI has been increasingly used to evaluate musculoskeletal infections, because it is useful for evaluating bone marrow, soft tissues and joints. MRI findings in patients with septic joints have been described as abnormal as early as 24 hr after the onset of infection. The sensitivity and specificity of gadopentetate dimeglumine—enhanced MRI with fat suppression were found to be

100% and 77%, respectively, for the detection of septic arthritis.

The frequency of MRI findings in septic joints was as follows: synovial enhancement (91%), joint effusions (91%), erosive bony destruction (67%), fluid out pouching (50%), intramuscular collections (60%), and synovial thickening (33%). The marrow edema was associated with (83%) of infective arthritis. The majority of the findings of the present study were correlated with Michael Karchevsky et al,¹⁰ who studied 50 cases of septic arthritis and concluded the frequency of MRI findings in septic joints was as follows: synovial enhancement (98%), joint effusions (70%), fluid out pouching (53%), fluid enhancement (30%), and synovial thickening (22%), the bone marrow edema changes (86%). Associated osteomyelitis more often showed T1 signal abnormalities and was diffuse.

(4) Developmental Dysplasia of Hip

MRI could be a powerful examination to quantify the degree of dysplasia found in dislocated hips. MRI should be considered for DDH when reduction has been attempted but is unsuccessful. Because of the ability of MRI to resolve tissue types, structures that may prevent reduction of the femoral head can be identified. These include an abnormal labrum, shallow acetabular roof, pulvinar, transverse acetabular ligament (connects anterior with posterior labrum), capsular hypertrophy, constriction of iliopsoas tendon, and deformities of the acetabulum or femoral head. In our study, we had one patient of DDH, who was less than one year of age who had elevation of labrum and fat pad

in acetabulum that may have prevented the reduction of femoral head.

(5) Transient synovitis

Septic arthritis and transient synovitis are the two most common diseases among young patients with acute hip pain. In our study, we stamped three patients as having transient synovitis; two of them were pediatric and one was an adult. All three patients had joint effusion and synovial thickening. One patient had altered signal intensities in bone marrow, which turned out to be having septic arthritis on further investigation.

(6) Sacroiliitis

MR imaging is now one of the cardinal tools for diagnosing sacroiliitis associated with axial spondyloarthropathy because it allows assessment of acute inflammatory changes. This means that MR imaging can show incipient changes in the cartilage and acute inflammatory activity in the subchondral bone, ligaments, synovium, and capsular region. Of these findings, bone marrow edema is the first to appear. Because of its ability to help detect and quantify inflammatory activity, MR imaging can serve as a biomarker for disease activity and as a guide for the treatment of sacroiliitis. In addition, MR imaging has a similar sensitivity to the CT in detecting early structural changes and a better sensitivity for assessing fatty deposits, and, unlike CT, it involves no radiation exposure. We had studied four patients with sacroiliitis; two of them are bilateral and male to female ratio was 3:1. All four patients had edema.

(7) Primary Musculoskeletal Neoplasms

For either bone or soft-tissue tumor evaluation, MR imaging provides better soft-tissue contrast than other imaging methods. The improved contrast makes abnormalities more conspicuous.. The appearance of a musculoskeletal neoplasm on MR images varies with tissue type. MR imaging depicts pathologic cellular tumors as low signal intensity on T1-weighted images, similar to that of muscle, and as high signal intensity on T2-weighted images, generally equal to or greater than that of fat. Fibrotic areas are low in signal intensity on both T1- and T2-weighted images, and fat within a tumor always has signal intensity equal to that of subcutaneous fat. We studied 6 patients of primary musculoskeletal neoplasm and one secondary with reasonable accuracy.

CONCLUSION

To summarize, even a study of 60 cases which is by no means large emphasizes the revolution brought about by MRI scan in diagnosing different hip pathologies. MRI is the method of choice in characterizing the various disorders and assessing the full extent of osseous, chondral and soft tissue involvement. Due to its multiplanar capabilities and high soft tissue resolution MRI is the investigation of choice in most of the hip pathologies.

In our study common causes of painful hip joint were avascular necrosis, septic arthritis, bone tumours and others (transient synovitis, sacrolitis, degenerative osteoarthritis etc.). AVN turned out to be most common hip pathology (40%) in which most common finding was marrow edema (78%) followed by joint effusion

(63%). Other common pathology is being septic arthritis (20%) in which most common finding was joint effusion associated with synovial enhancement (91%).

MR imaging can also accurately demonstrate joint effusions, synovial proliferations, articular cartilage abnormalities, subchondral bone, ligaments, muscles and juxta articular soft tissues. In most of the findings, MRI was better in depicting the abnormalities with high sensitivity and specificity. MR imaging can routinely detect early AVN in asymptomatic patients with negative radiographs. Finally we conclude that MRI of the hip joint is an informative, diagnostic, noninvasive, rapid and accurate imaging modality for the assessment of hip pain and sufficient imaging modality for delineation of different hip joint pathology.

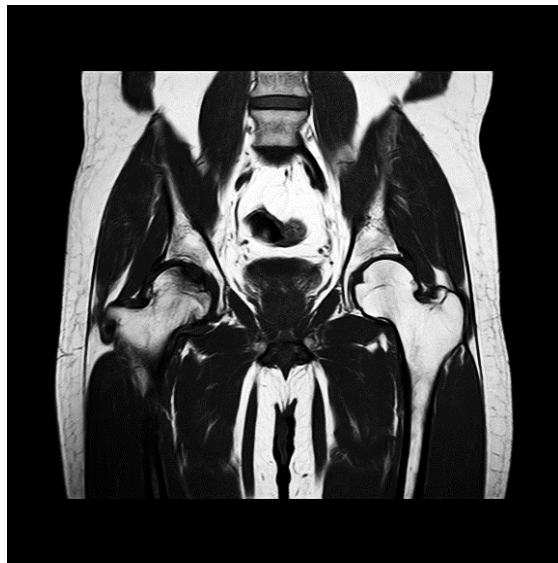
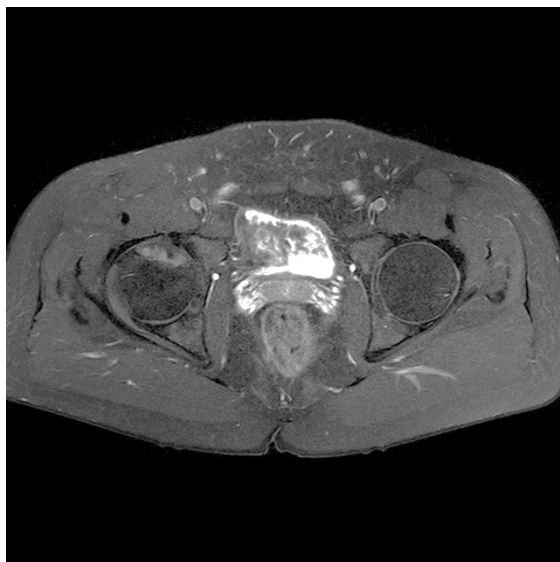
Conflicts of Interest: None.

Source of Funding: Nil.

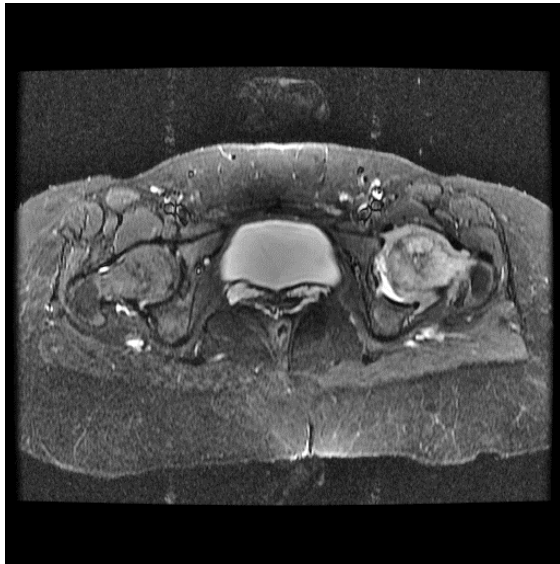
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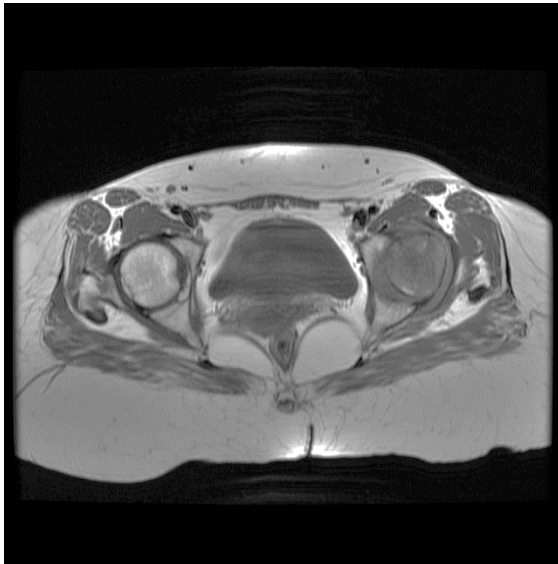
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Figure Legends**CASE 1: A case of avascular necrosis.****T1WI COR****T1WI AXIAL****T1WI AXIAL****STIR AXIAL**

Case 2: A case of septic arthritis



STIR AXIAL



T1WI AXIAL



T1WI COR



STIR COR

CASE 3: A case of Perthe's Disease



T2WI COR



T1WI COR

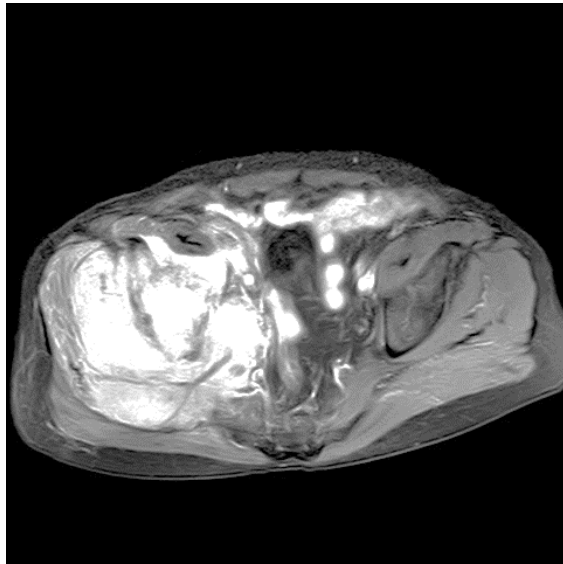


STIR COR

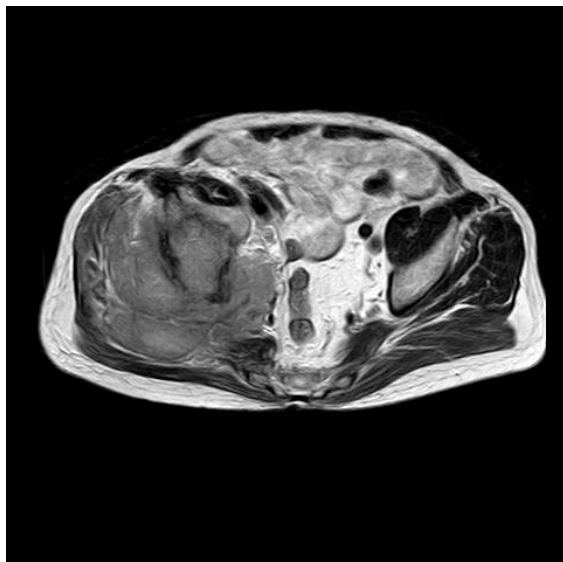
CASE 4: A case of Chondrosarcoma



T1W FS GAD



T1W FS GAD



T2WI AXIAL



T1WI COR