

## Original Research Article

# Role of magnetic resonance imaging as a diagnostic tool in evaluation of painful hip joint, and early detection of pathological changes, helpful to prognosticate and influence therapeutic decisions

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### ABSTRACT

**Background:** Magnetic Resonance Imaging (MRI) is a well-established imaging technique, which are available at most larger hospitals today. Due to the combination of this high contrast and the fact that it is a non-ionizing radiation, MRI is often used for investigation of a large range of pathologies in almost all parts of the body. This study was performed to describe the MRI features in various types of lesions causing painful hip joint, as well as identify the common lesions seen in painful hip joint and to analyse the severity and extent of the underlying lesion in various conditions of hip joint pain, and early detection of pathological changes helpful to prognosticate and influence therapeutic decisions.

**Methods:** This descriptive study was done on 50 patients with complaints of hip joint pain were included into the study. Appropriate MRI sequences and multi-planar imaging performed for every patient.

**Results:** Out of the 50 patients included in the study, 74% of them were males who were predominantly affected with hip pain. The most common age group which was affected was 51-60 years (20%) and 21-30 years (20%). The most common pathology amongst the patients was Avascular necrosis of femoral head seen in 44% of the patients, osteoarthritis was seen in 54 patients, Tuberculosis in 5 patients, 2 had Perthe's disease, joint effusion was observed in 6 patients.

**Conclusions:** MRI of the hip joint is an informative, diagnostic, non-invasive, rapid and accurate imaging modality for the assessment of hip pain and sufficient imaging modality for delineation of different hip joint pathology.

**Keywords:** Avascular necrosis of femoral head, Hip joint, Magnetic resonance imaging, Painful

### INTRODUCTION

Magnetic Resonance Imaging (MRI) is a well-established imaging technique, which are available at most larger hospitals today. Since its introduction in the 1970s, MRI has become one of the most powerful imaging tools for musculoskeletal imaging.<sup>1</sup> Since MRI is sensitive to the chemical surroundings of the atomic nuclei within the body, the images have excellent contrast between different tissues. Due to the combination of this high contrast and the fact that MRI does not emit any

hazardous ionizing radiation, MRI is often used for investigation of a large range of pathologies in almost all parts of the body.

Of all the joints in the body, hip joint is the one that bears the maximum amount of weight of the body. MR imaging is a valuable tool in the evaluation of hip disorders because it enables assessment of articular structures, extra-articular soft tissues, and the osseous structures that can be affected by hip disease.<sup>2</sup> The principal benefit of the true coronal and axial planes is that they provide

symmetric, bilateral images, which can be important in the diagnosis and can greatly accelerate the time required to evaluate both hips. Normal hip anatomy can be routinely demonstrated on coronal and axial MR images. The femoral head and neck and the inter-trochanteric regions are best appreciated on coronal MR images. Axial MR images provide good visualization of the articular space, hip musculature, and supporting ligaments.<sup>3</sup>

The diagnostic role of MR imaging in the evaluation of AVN is evolving. MR imaging is performed to detect AVN in its early stages, thus allowing early treatment and prevention of subsequent bone destruction, where the radiographs are unequivocal.<sup>4,5</sup> In paediatric hip disorders also, MRI is becoming increasingly useful because much of the paediatric hip is cartilaginous. As a result, it is often not optimally imaged with other modalities such as plain radiography, ultrasound (US) and computed tomography (CT), making MRI highly efficient in the evaluation of the pediatric hip as it has the ability to detect cartilage.<sup>3</sup>

Recent advances in MR sequences together with the implementation of high-resolution MRI due to high-field MR systems as well as sophisticated coil technology have overcome existing limitations and led to promising in vivo approaches in morphological, however, especially in biochemical MRI of cartilage.<sup>6-8</sup> Thus, MRI is the modality of choice for imaging various intra-articular pathology, vascular necrosis, radiographically occult fractures, marrow replacement disorders, musculoskeletal neoplasms, and various arthritides involving the hip joint.<sup>9</sup>

This study was performed to describe the MRI features in various types of lesions causing painful hip joint, as well as identify the common lesions seen in painful hip joint and to analyze the severity and extent of the underlying lesion in various conditions of hip joint pain.

**METHODS**

This descriptive study was done by the department of Radio-diagnosis at Katuri Medical College over a period of August 2016 to September 2017. This study was cleared by the Institutional Ethical Committee of our Institution. 50 patients, of all ages and of both the sexes, who were referred to our department with complaints of hip joint pain, were included into the study.

The procedure was explained to the patients as well as their relatives and an informed consent was taken from all the patients or their guardians in case of pediatric patients. Patients with history of acute trauma, claustrophobia, post-operative cases or those patients having history of metallic implants insertion, cardiac pacemakers and metallic foreign body in situ were excluded from the study.

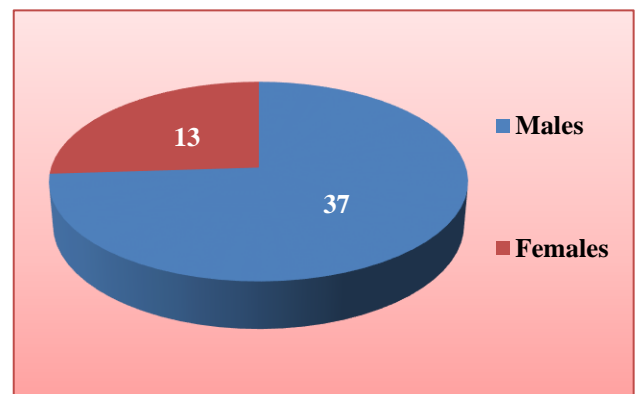
The demographic details such as age, sex, weight, BMI etc. was collected from all the patients. Routine biochemical tests for random blood glucose and complete blood picture also was done for all the patients. After thorough medical and clinical examination, all the patients were sent for Magnetic resonance imaging (MRI) of the hip joint. Appropriate MRI sequences and multi-planar imaging performed for every patient. Imaging was done with 1.5 Tesla Philips Achieva Machine using abdominal surface coils and spine coils.

The sequences selected were TIW coronal - TE (18ms) TR (500-700ms) slice thickness (1-3mm), T1W axial -TE (18ms) TR (500-700ms) slice thickness (1-3mm), T2W coronal -TE (100ms) TR (1000-1500ms) slice thickness (1-3mm), T2W axial - TE (100ms) TR (1000-1500ms) slice thickness (1-3mm). STIR coronal - TE (30ms) TR (2700-6000ms) slice thickness (3-5mm), STIR axial - TE (60ms) TR (4000 - 5000ms) slice thickness (3-6mm) and PD sagittal - TE (30ms) TR (2300-6500ms) slice thickness (3-5mm).

The data such procured was analyzed on Microsoft excel for the calculation of percentages.

**RESULTS**

Out of the 50 patients included in the study, the predominant gender to be affected was males with 37 (74%) of the cases while the females were 13 (26%) (Figure 1).



**Figure 1: Gender wise distribution of the patients in the study.**

The most common age group which was affected was 51-60years (20%) and 21-30years (20%). This was followed by 9 (18%) in the age group 31-40 and 8 (16%) in 41-50years age group. The incidence was much lower in the younger as well as the elderly. Between 1-10years, the incidence was only 4 (8%) and between 11-20 years, it was 6 (12%). Between 61-70, 71-80 and above 80 it was 1 (2%) cases each (Table 1).

The most common pathology amongst the patients was Avascular necrosis of femoral head seen in 22 (44%) of

the patients (Figure 2). Joint effusion was seen in 6 (12%) and tuberculosis was seen in 5 (10%) of the cases. There were 4 (8%) cases of osteoarthritis (Figure 2).

**Table 1: Age wise distribution of the patients.**

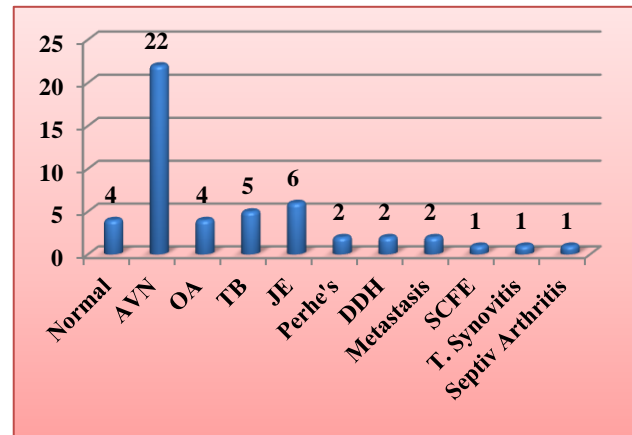
Age group (in years)	Number	Percentage
1-10	4	8%
11-20	6	12%
21-30	10	20%
31-40	9	18%
41-50	8	16%
51-60	10	20%
61-70	1	2%
71-80	1	2%
81-90	1	2%

**Table 2: MRI findings of the patients.**

MRI findings	No. of patients	Percentage
<b>AVN (n=22)</b>		
Bone marrow edema	16	72%
Double line sign	18	81%
Subchondral cysts	14	63%
Femoral head altered contour	6	27%
Femoral head fragmentation with collapse	4	18%
<b>Osteoarthritis (n=4)</b>		
Articular cartilage T2W high signal	4	100%
Indistinct trabeculae / signal loss in femoral head and neck on T1W	4	100%
Subchondral signal loss	2	50%
Femoral head deformity	2	50%
<b>TB (n= 5)</b>		
Synovial hyperintensity on T2W	5	100%
Joint effusion	5	100%
Bone marrow edema	4	80%
Subarticular cysts	3	60%
Joint space reduction	3	60%
Joint destruction & Bony ankylosis	1	20%
Soft tissue hyperintensity on T2W	3	60%
<b>Perthe's Disease (n=2)</b>		
Bone marrow edema	1	50%
Epiphyseal hyperintensity on T2W	2	100%

Among the 22 patients with avascular necrosis of the femoral head, 72% had bone marrow edema and 81% had double line sign, 63% had Subchondral cysts. Among the patients with osteoarthritis, all of them had articular cartilage T2W high signal and indistinct trabeculae/signal loss in femoral head and neck on T1W, while only

half of them had Subchondral signal loss and Femoral head deformity. Among 5 patients with hip pain due to TB, all had Synovial hyperintensity on T2W as well as Joint effusion (Table 2).



**Figure 2: Pathogenesis of hip joint pain.**

The grading of MRI I these cases was 54% with fibrosis signal T1 dark, T2 Dark. 22% was fluid signal. 18% of the AVN patients T1 hyperintense and T2 hyperintense which was analogous top sub-acute blood and 4% i.e. only 1 case had a signal analogous to fat (Table 3).

**Table 3: MRI grading in the AVN patients.**

MRI grading	No. of patients (N=22)	Percentage
<b>Stage A</b>		
T1 hyperintense		
T2 intermediate	1	4%
Signal analogous to fat		
<b>Stage B</b>		
T1 hyperintense		
T2 hyperintense	4	18%
Signal analogous to sub-acute blood		
<b>Stage C</b>		
T1 hypointense		
T2 hyperintense	5	22%
Signal analogous to that of fluid/edema		
<b>Stage D</b>		
T1 hyperintense		
T2 hyperintense	12	54%
Signal analogous to that of fibrosis		

**DISCUSSION**

MRI is a very sensitive and a useful tool for diagnosis, it has many advantages. It is capable of not only depicting the size of the lesion at a very early stage, but also the asymptomatic ones which are undetected by the plain

radiographs. It also provides multiplanar imaging with excellent soft tissue resolution.<sup>10</sup>

Present study aimed at the early detection of the disease using MRI that helps the clinician to treat the patient at the early stages so as to prevent the further progression of disease.

In present study, AVN of femoral head was the commonest pathology identified as the cause for painful hip joint. In 22 (44%) cases of AVN diagnosed on MRI 16 (72%) cases show bone marrow edema, revealing it is the common feature seen and can be detected only on MRI. On MRI 81% cases showed double line sign i.e., on T2W sequences inner bright line representing granulation tissue and outer dark line suggestive of sclerotic bone. 63% cases showed subchondral cysts, which was second commonly seen in our study. 27% cases showed femoral head altered contour and 18% cases shows femoral head fragmentation with collapse. Takatori Y et al, in a similar study reported that 85% of the patients of avascular necrosis show a characteristic “double line” sign on T2 weighted images which is a specific finding.<sup>11</sup> Mitchell et al, and Mitchell et al, found it in 80% and 71% of the cases, respectively.<sup>12,13</sup> Glickestein et al, and Huang et al. in different studies have described the role of MR in evaluation of avascular necrosis and the results were similar with our study.<sup>14,15</sup>

In present study, 04 (08%) cases were diagnosed as osteoarthritis. Out of these 4 cases, all (100%) the cases showed T2W high signal of Articular cartilage and Indistinct trabeculae/ signal loss in femoral head and neck on T1W. Two (50%) cases showed subchondral signal loss and 02 (50%) showed Femoral head deformity. In a study by Hayashi et al, bone marrow signal alteration (bone marrow edema) was found to be is a common magnetic resonance imaging feature of hip OA and the degree of bone marrow edema, as assessed by MRI, correlated with the severity of hip pain.<sup>16</sup> Similar results were observed by other authors in their study.<sup>17,18</sup>

In present study 05 (10%, n=50) cases are diagnosed as TB hip. One case showed only synovial T2W hyperintensity and joint effusion in the form of high signal intensity within the joint space in T2W and STIR sequences. 01case showed synovial hyper intensity, joint effusion and bone marrow edema as high signal intensity within the marrow on STIR sequence. Two case showed Subarticular T2 hyper intense cysts and joint space reduction, while 01) case showed marked joint destruction and bony ankylosis seen as hypo intensity on both T1W and T2W and para articular soft tissue involvement also.

In present study only 2 cases were diagnosed as Legg-Calve Perthes disease. Out of these 2, 1 showed femoral epiphyseal abnormality and bone marrow edema while in both the cases, epiphyseal abnormality in the form of T1 hypointensity, T2W hyperintensity and bone marrow

edema in the form of STIR hyperintensity was present. Present study was corroborated by a similar study by Bos et al, and Toby et al.<sup>19,20</sup>

## CONCLUSION

MRI is more sensitive for the detection of AVN even in early stages where plain radiography shows normal or subtle findings. MRI also helps in detection of bone marrow edema. In proven cases of AVN MRI helps in accurate staging of the disease that helps in appropriate treatment plan by the clinician. Delineation of cartilage destruction, accurate pathological involvement and staging of osteoarthritis was also better with MRI. MRI is a very useful modality in diagnosis and staging of wide variety of conditions causing painful hip joint. With MRI one can stage the pathology to prognosticate and influence therapeutic decisions. MRI of the hip joint is an informative, diagnostic, non-invasive, rapid and accurate imaging modality for the assessment of hip pain and sufficient imaging modality for delineation of different hip joint pathology.

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