

# MRI Evaluation of Non Traumatic Painful Hip Joint

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## A B S T R A C T

**Introduction:** 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. Trauma, infection, arthritis, avascular necrosis, tumor, and hip dysplasia can all manifest with extremely subtle radiographic abnormalities. Study aimed to assess the role of MRI in early evaluation of painful hip joint, to establish a differential diagnosis of various painful hip joint conditions on MRI and to assess the severity and extent of the lesion in various conditions of painful hip joint.

**Material and methods:** A prospective study was carried out on 50 patients over a period of 2 years from Dec 2014 to September 2016. Institute Ethics Committee Clearance was obtained before the start of the study.

**Result:** Our study shows all positive findings. Out of 50 cases almost 48% were had avascular necrosis, 20% of the patient had osteoarthritis, 16% of the patient had only joint effusion, 12% patient showed features of infection and only 4% had Perthes's disease.

**Conclusion:** MR imaging is a valuable tool in the evaluation of hip disorders because it enables assessment of articular structures, extra-articular soft tissues, and osseous structures that can be affected by the hip disease. MRI of the hips should be performed early in patients with persistent pain and negative radiographic findings.

**Key words:** MRI, Painful Hip Joint

## INTRODUCTION

Imaging of the hip was among the earliest reported applications of musculoskeletal magnetic resonance (MR) imaging. 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. In the setting of chronic hip pain, a normal appearing radiograph, a nonspecific history and clinical findings can be a difficult diagnostic dilemma. Trauma, infection, arthritis, avascular necrosis, tumor, and hip dysplasia can all manifest with extremely subtle radiographic abnormalities.<sup>1</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 intertrochantric region are best appreciated on coronal MR images. Axial MR images provide good visualization of the articular space, hip musculature, and supporting ligaments.<sup>2-8</sup>

The diagnostic ability 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. MR imaging has been shown to be the most sensitive modality for imaging AVN.

Screening of asymptomatic, high-risk patients may enable early intervention. The principal role of MR imaging is in establishing the diagnosis of AVN in symptomatic patients before radiographic changes become apparently visible.<sup>9-14</sup>

MR imaging is becoming increasingly useful in diagnosis and management of pediatric hip disorders. MR imaging offers several advantages that are especially important in the pediatric hip population. Because much of pediatric hip is cartilaginous, it is often not optimally imaged with other modalities such as plain radiography, ultrasound (US) (after 6 months of age), and computed tomography (CT). MR imaging is unique in its ability to depict cartilage and is, therefore, especially efficacious in the evaluation of the pediatric hip.<sup>15-21</sup>

Currently, high-resolution direct MR imaging of the hip provides the best means for evaluating intra-articular pathology. However, radiography remains important for the diagnosis of subtle bony irregularities associated with femoro-acetabular impingement. Therefore, a comprehensive imaging strategy requires conventional radiographs and MRI to evaluate intra- and extra-articular sources of pain.<sup>22-29</sup>

Study aimed to assess the role of MRI in early evaluation of painful hip joint, to establish a differential diagnosis of various painful hip joint conditions on MRI and to assess the severity and extent of the lesion in various conditions of painful hip joint.

## MATERIAL AND METHODS

### Study population

A prospective study was carried out on 50 patients over a period of 2 years from Dec 2014 to September 2016. Institute Ethics Committee Clearance was obtained before the start of the study.

### Patient selection criteria

The study included patients from all age groups including both men and women presenting with acute or chronic unilateral or bilateral hip pain without recent history of trauma (less than one month). Patients with congenital hip conditions or tumour were not a part of this study. Also patients with history of claustrophobia or history of metallic implants insertion, cardiac pacemakers and metallic foreign body insitu were excluded from this study.

### Method

MRI was performed using SIEMENS 1.5 Tesla MAGNETOM AVANTO Machine. The size of bore was 60 cm and overall length of the system was 160 cm. A body coil was used. Detailed clinical history, physical and systemic examination findings were noted in addition to the laboratory investigations. All the patients were subjected to radiograph of Hip AP View.

### Scanning technique

Patient was positioned in supine position with head pointing towards the magnet.

A body coil was placed over the pelvis to provide a uniform signal to noise ratio. Standard sequences performed namely. Coronal T1W, Coronal STIR, Axial T1, Axial STIR, Sagittal T1, Axial GRE.

## STATISTICAL ANALYSIS

Microsoft office 2007 was used for the analysis. Descriptive statistics like mean and percentages were used for the analysis.

## RESULTS

### Sex distribution

Out of the 50 patients included in our study, 36 (72%) were males and 14(28%) were females.

### Age wise distribution

Age of the patients ranged from 6 to 65 years with the highest incidence seen in the 21-40 age group (as seen in the table -1) comprising of 12 patients each in the 21-30 and 31-40 age groups.

Out of these 60% patients that means 30 were positive on radiography and rest were negative

### MRI findings

All these 50 patients had positive findings on MRI (100%). These are as follows

#### 1. Avascular necrosis of femoral head

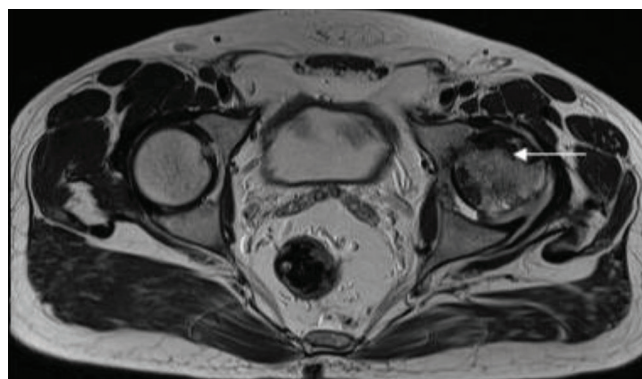
Out of 50 cases 24 (48%) cases were diagnosed as avascular necrosis of femoral head. In 24 cases of AVN, only 10 (42%) cases were detected on radiography whereas all 24 (100%) cases were detected on MRI. Out of 24 cases, 14 (58%) cases which were normal {stage I and stage II of FICAT Classification} on radiography were proved to have AVN on

MRI. Thus MRI is more sensitive than plain radiography. Out of the 10 (42%) cases which were detected both on radiography and MRI, 6 (25%) that were reported as stage II on radiography {FICATS} were staged as stage III on MRI {MITCHELL'S} and 4 (16%) cases which were reported as stage III on radiography {FICATS} were staged as stage III or more on MRI {MITCHELL'S}.

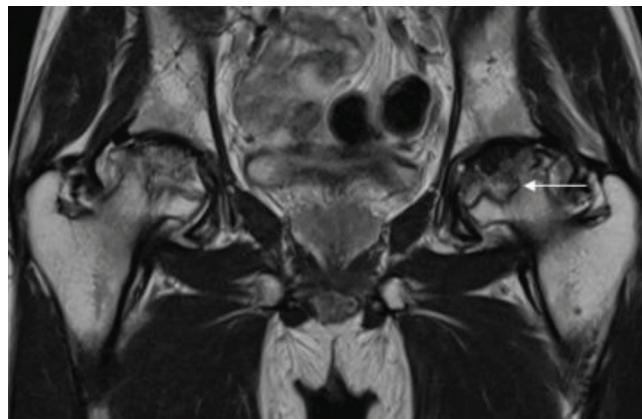
In 42% of the patients AVN was correctly diagnosed on radiography and all 100% were diagnosed on MRI

### MRI findings of AVN

Commonest finding seen on MRI in cases with AVN was that of bone marrow edema which was seen in 25 cases followed by subchondral cysts seen in 16 patients. Joint space



**Figure-1:** Axial T2W image showing well demarcated geographic lesions with typical peripheral low signal intensity rim (arrow) on the antero-superior aspect of the left femoral head (AVN grade II)



**Figure-2:** Coronal T2W image showing "double line sign" (arrow) as a high signal intensity inner border with a low signal intensity peripheral rim, of stage III AVN

Age	Number of patient	Percentage
0-10	4	8
11-20	5	10
21-30	12	24
31-40	12	24
41-50	8	16
51-60	6	12
61-70	3	6
71-80	0	0
total	50	1000

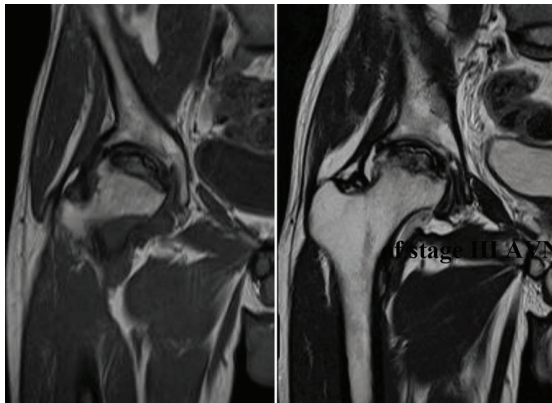
**Table-1:** Age wise distribution

MRI Findings		Number of Patients	Percentage % (n=24)
Bone marrow edema	Femoral head	21	87 %
	Acetabulum	4	16 %
Double line sign		19	79 %
Subchondral cysts	Femoral head	15	62 %
	Acetabulum	1	4 %
Joint Effusion		15	62 %
Joint space reduction		1	4 %
Femoral head altered contour		9	37 %
Femoral head fragmentation with collapse		1	4 %

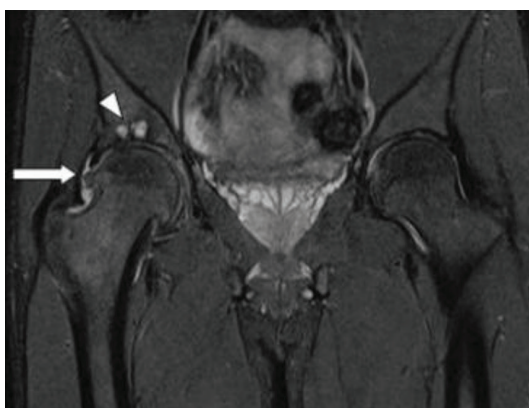
**Table-2:** Showing MRI findings of AVN

Serial No.	Pathology	No. of Patients	Percentage
1.	AVN	24	48 %
2.	Osteoarthritis	10	20 %
3.	Joint Effusion	8	16 %
4.	TB Arthritis	6	12 %
5.	Perthe's	2	4 %
	Total	50	100 %

**Table-3: Pathology**



**Figure-3a and 3b:** Showing Crescent sign on both coronal T1W) images suggestive

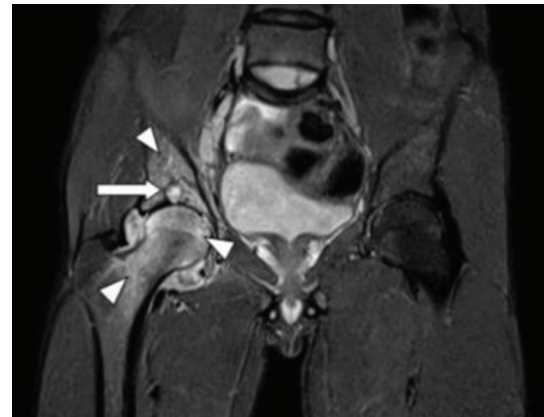


**Figure-4:** Osteoarthritic changes in right hip with thinning of articular cartilage with reduction of the right hip joint space. Marginal osteophytes with multiple subchondral cysts

reduction was not commonly seen and was found in only one patient (table-2).

**2. Osteoarthritis**

Out of 50 cases ten (20%) showed osteoarthritis. All the ten



**Figure-5:** Tuberculosis of right hip showing bone marrow edema in right acetabulum, right femoral head and neck with large erosion along articular surface of right acetabulum. Right hip joint space is narrowed and associated synovial effusion

cases were detected both on plain radiography as well as on MRI. But, out of ten cases three (30%) appeared to be stage I on radiography and stage II or III on MRI.

Of the ten cases 3 (30%) showed stage II on radiography and stage III on MRI. Out of ten cases detected on radiography stage I (4 cases), stage II (4 cases) and stage III (2 cases). On MRI stage I (1 case), stage II (4 cases), stage III (3 cases) and stage IV (2 cases).

**MRI findings of osteoarthrits**

Commonest MRI abnormality seen in cases of osteoarthritis was signal loss in the femoral head and neck on T1W images which was found in 90% cases.

**3. Joint effusion**

Out of 50 cases, 8 (16%) cases showed isolated joint effusion. Of these, three (37%) cases were detected on radiography alone and all eight cases (100%) were positive for joint effusion on MRI.

Findings on radiograph: widening tear drop distance.

Findings on MRI: T2W and STIR hyperintensity within the joint space which is graded as mild, moderate and severe.

**4. Tuberculosis of hip joint**

6 cases (12%) were diagnosed as Tuberculosis of hip, out of which five (83%) cases were correctly detected on radiography, where as all six (100%) cases were detected on MRI.

Out of five cases detected on radiograph stage I (1 case), stage II (1 case), stage III (2 cases), stage IV (0) and stage

V (1 case). Out of six cases detected on MRI shows stage I (1 case), stage II (1 case), stage III (1 case), stage IV (2) and stage V (1 case).

### MRI findings in TB hip joint

Commonest findings of TB hip seen on MRI were adjacent soft tissue hyperintensity and joint effusion each seen in 5 (83%) cases followed by bone marrow edema seen in 4(67%) cases.

### 5. Perthe's disease

Two cases (4%) of Perthe's disease were seen in our study. Both of the cases were correctly detected on radiograph (100%) as well as MRI (100%). MRI findings of Perthe's were T2 weighted epiphyseal hyperintensity and bone marrow edema (table-3).

## DISCUSSION

Our study aims at early detection of the disease before the appearance of signs on radiography or in patients having subtle findings on plain radiography by using MR imaging. It also aims at the accurate staging of the disease and assessment of involvement of pathology in cases which are already detected on plain radiography. This helps the clinician to treat the patient at an early stage and to improvise treatment according to the stage of involvement of the pathology thereby limiting further progression of the disease.<sup>30</sup>

### Avascular Necrosis of Femoral Head

In our study, AVN of femoral head was the commonest pathology identified as the cause for painful hip joint. In 24 (48%, n=50) cases of AVN diagnosed on MRI only 10 (20%, n=50) cases were identified on plain radiography.

Out of 10 (42%, n=24) cases diagnosed on plain radiography, 6 (25%, n=24) cases showed subchondral cysts and osteoporosis suggestive of stage I AVN {FICATS staging}. Rest of the 4 (16%, n=24) cases showed crescent sign, altered head morphology and osteoporosis suggestive of stage II AVN {FICATS staging}.

Of all the 24 cases detected on MRI, 21 (87%, n=24) cases showed bone marrow edema in femoral head, 4 cases (16%, n=24) cases showed bone marrow edema in acetabulum suggesting it to be a common associated feature that can be detected only on MRI as radiography has its limitation in diagnosing bone marrow edema.

MRI demonstrated double line sign i.e, on T2W sequences inner bright line representing granulation tissue and outer dark line suggestive of sclerotic bone in 19 (79%, n=24) cases.

Fourteen (58%, n=24) cases were diagnosed as normal or stage I (FICATS) on plain radiography and stage I or II on MRI.

Out of a total of 10 (42%, n=24) cases detected on plain radiography; 6 (25%, n=24) cases were staged as stage I (FICATS) which showed stage III (MITCHELL'S) with intermediate fluid signal on T1W images and bright signal on T2W images. Four (16%, n=24) cases which were staged as stage II (FICATS) turned out to be stage III or stage IV on MRI (MITCHELL'S) giving fibrous signal, dark on both T1W and T2W sequences, revealing that MRI is better than radiography in staging and assessing the extent of the

pathological involvement in already proven cases of AVN on plain radiography.

In comparison to the study done by Robinson HJ et al.<sup>30</sup> in which twenty-three of the ninety-six hips that were suspected of having early-stage necrosis of the femoral head but showed slight or no radiographic changes were studied by repeat radiographs. Of the twenty-three hips, eighteen (78 per cent) had positive changes on magnetic resonance imaging. In our study out of 24 hips, MRI detected 24 cases (100%), where as radiography could detect only 10 cases (42%).

### Osteoarthritis

In this study, 10 (20%, n=50) cases of osteoarthritis were diagnosed. All of the 10 cases were correctly detected on plain radiography and on MRI.

On plain radiography, four (40%, n=10) cases showed stage I (Kellgren and Lawrence staging) in the form of possible narrowing of the joint space and osteophytes. Four (40%, n=10) cases were diagnosed as stage II with definite narrowing of the joint space inferiorly, minimal sclerosis and osteophytes. Two (20%, n=10) cases showed stage III with marked narrowing of the joint space, definite osteophytes, cyst formation, deformation of femoral head and acetabulum. On MRI, one (10%, n=10) case showed stage I (Higgs and Aiesen staging) that is inhomogeneous high signal on T2W images within the cartilage. Four (40%, n=10) cases showed stage II that is inhomogeneity of articular cartilage seen as high signal on T2W sequences and indistinct trabeculae or signal intensity loss in femoral head and neck on T1W sequences. Three (30%, n=10) cases were diagnosed as stage III having criteria of stage I and II as mentioned above and indistinct zone between femoral head and acetabulum associated with subchondral signal loss due to bone sclerosis. In our study Articular cartilage abnormalities were seen in 5 (50%) cases, joint effusion in 8 (80%) cases and osteophytes at various sites around the joint were noted in 6(60%) cases. Similar findings were noted in the study conducted by Horii et al<sup>15</sup> in 2000 who found articular cartilage abnormalities such as stripping and high signals in the antero-superior portions of the hip joint in about 90% cases, joint effusion in 29 cases and osteophyte formation in 80% cases.

### Joint Effusion

On MRI, joint effusion was seen as high signal intensity within the joint space on T2W and STIR sequences suggestive of fluid collection within the joint capsule.

Also MRI demonstrated an added advantage of better and correct evaluation of the amount of fluid within the joint and grading to the effusion as minimal, moderate and severe joint effusion. Four (50%, n=8) cases had minimal joint effusion, 3 (38%, n=8) moderate and 1 (12%, n=8) case had severe joint effusion. Five (62.5%, n=8) cases diagnosed as normal on plain radiography showed joint effusion on MRI.

Reviewing the above findings, MRI proved to be more sensitive in detection of joint effusion particularly in cases where plain radiography showed normal or subtle changes

### Tuberculosis of Hip joint

In the six cases (100%, n=6) diagnosed on MRI, 1 (17%, n=6) 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. This was diagnosed as normal on plain radiography.

On MRI, 1 (17%, n=6) case showed synovial hyper intensity, joint effusion and bone marrow edema as high signal intensity within the marrow on STIR sequence. Another single (17%, n=6) case showed sub articular T2 hyper intense cysts and joint

space reduction. Joint deformity along with bone marrow edema, joint space reduction and para articular soft tissue hyper intense signal on T2W sequence was seen in two (33%, n=6) cases.

Thus, MRI helped in better delineation of synovial involvement and detection of joint effusion in early stages of TB hip where plain radiography has limitation in diagnosis. MRI also proved beneficial in detection of bone marrow edema in early stages of the disease. In the radiologically diagnosed cases, MRI helped in better evaluation of the extent of the articular cartilage destruction and also para articular soft tissue involvement.

Sawhani V. et al.<sup>24</sup> described the MRI findings of Tuberculous hip which included synovitis, effusion, central and peripheral erosions, active and chronic pannus, abscess, bone chips and hypo-intense synovium. They also emphasized the importance of early diagnosis of the condition in order to salvage the affected limb which is possible only with MR imaging. Similar MR findings were seen in the our study in the cases that were diagnosed as tuberculosis of the hip.

Perthes Disease

In our study 2 (4%, n=50) cases were diagnosed as Perthes disease. Both the cases could be diagnosed on radiography as well as on MRI (100%, n=2)

The plain radiographic findings included cessation of femoral epiphyseal growth in the form of small epiphysis seen in one case and complete resorption of femoral epiphyses in healed/residual stage which was also seen in just one of the two cases. On MRI, one of the cases, showed epiphyseal abnormality in the form of T1 hypo intensity, T2W hyper intensity and bone marrow edema in the form of STIR hyper intensity and metaphyseal T2W hyper intensities which was seen as cessation of femoral epiphyses growth on plain radiography

Similar findings were seen in a study done by Toby EB et. al.<sup>9</sup> who assessed

pediatric hip disease by scanning the hips of 24 children (30 scans). They found twelve patients with Legg-Calvé-Perthes disease (17 hips) showed characteristic areas of low intensity signal representative of necrotic areas of the capital epiphysis. In our study both the cases showed small epiphyses which were seen as hypo intense on T1W and hyperintense on T2W sequences. Thus, MRI helps in better evaluation of femoral epiphyses along with detection of bone marrow edema on STIR sequence.

## CONCLUSION

Plain film radiography is used in the initial evaluation of any cause of hip pain, including suspected avascular necrosis, arthritis, infection, dysplasia and tumour. Plain film cannot accurately characterize the articular cartilage pathology and soft tissue involvement. MR imaging is a valuable tool in the

evaluation of hip disorders because it enables assessment of articular structures, extra-articular soft tissues, and osseous structures that can be affected by the hip disease. MRI of the hips should be performed early in patients with persistent pain and negative radiographic findings.

MR imaging is becoming increasingly useful in the diagnosis and management of pediatric hip disorders. It offers several advantages that are especially important in the pediatric population. MR imaging is performed to detect avascular necrosis in its early stages, thus allowing early treatment and intervention to prevent or delay subsequent bone destruction. It has been shown to be the most sensitive modality for imaging avascular necrosis.

Joint effusion and synovial proliferation can be better detected by MRI than by conventional radiography. In proven cases on plain radiography such as Perthe's and infectious diseases of hip, MRI helps in better staging of the disease, assessing the extent of pathological involvement and soft tissue extension. Additionally, MRI is extremely sensitive to alteration in the bone marrow that may represent pathology occult to plain radiography of the hips.

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