ORIGINAL RESEARCH ARTICLE

Role of Plain Radiograph and MRI in the Evaluation of Painful Hip Joint

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ABSTRACT

Introduction: Hip joint pain is a common complaint in the present-day practice and could be due to various reasons, as the investigations are invariably used to come to a diagnosis of the cause of pain. Plain radiographs are used as primary investigation followed by MRI which is a valuable tool in the evaluation of hip disorders, because it enables accurate assessment of articular cartilage, epiphyses, joint fluid, bone marrow and extra-articular soft tissues that can be affected by hip disease. The purpose of present study was to evaluate the role of MRI in early evaluation of painful hip joints with/without subtle plain radiographic findings, to establish a differential diagnosis of the various painful hip joint conditions on MRI, to assess the severity and extent of the underlying lesion in various conditions of painful hip joint and their clinical relevance.

Material and Methods: A prospective cross-sectional study was done on a total of 50 patients including both the sexes and of all age groups who presented at Maharishi Markandeshwar Institute of Medical Sciences And Research, Mullana (Ambala) with hip joint pain and subsequently underwent plain radiographs followed by MRI of the hip joint. The data was analysed and the findings on plain radiographs correlated with that of MRI.

Results: Of the 50 cases the males (72%) were commonly affected than females (28%). Majority of the patients fell under the age group of 21-30 years (24%). In our study we found the commonest pathology for the hip joint pain is AVN of femoral head in 19 cases (38%), followed by TB hip in 9 cases (18%), Osteoarthritis in 7 cases (14%), Osteomyelitis in 5 cases (10%), Perthes in 2 cases (4%), septic arthritis in 2 cases (4%), transient synovitis in 2 cases (4%), stress fracture in 2 cases (4%) and metastatic disease in 2 cases (4%). MRI was more sensitive for detection and characterisation of hip pathologies.

Conclusion: MRI is very useful for evaluation painful hip joint.

Keywords: MRI, Hip, Avascular Necrosis, Osteoarthritis

INTRODUCTION

MR imaging is an important tool in the assessment of hip disorders because it helps in evaluation of articular structures, extraarticular soft tissues, and the osseous structures that can be affected by hip disease. In case of chronic hip pain, a normal-appearing X-ray, non-specific clinical history and findings can be a challenge to reach the diagnosis. Trauma, infection, arthritis, avascular necrosis, tumour, and hip dysplasia can all manifest with minute radiographic abnormalities.[1]

MR imaging is proven to be an extremely sensitive modality for diagnosing AVN. Screening of asymptomatic, high-risk patients may lead to early diagnosis and treatment. The prime function of MR imaging is to establish the diagnosis of AVN in symptomatic patients before X-ray findings become

apparently visible.

MR imaging is becoming of prime importance in the diagnosis and management of paediatric hip disorders. Because much of the paediatric hip is cartilaginous, other modalities such as plain radiography, ultrasound (US) (after 6 months of age), and computed tomography (CT) are not usually used. MR imaging is of prime uniqueness in its ability to depict cartilage and therefore the only modality of choice in imaging of paediatric hip. Another condition affecting the paediatric age group is the Legg-Calve-Perthes disease in which the patient presents with hip, knee, or groin pain exacerbated by hip or leg movement, especially internal hip rotation. X rays of the hip may suggest and verify the diagnosis. X-rays usually demonstrate a flattened and later fragmented femoral head. MRI is useful in making the

diagnosis in those cases where X rays are inconclusive.

A major concern in the juvenile hip is normal development, which is dependent on proper seating of the femoral head in the acetabulum. The position and shape of the femoral head should be precisely assessed with rnultiplanar MR imaging. Also, changes in bone marrow can be directly visualized with MR imaging; this is not possible with CT or US.

MR imaging has played an increasingly important role in the evaluation of the arthritis and infective pathologies including tuberculosis where early radiographic findings may be subtle. MR imaging can be useful in the evaluation of a variety of hip disorders. We believe that attention to the details of MR examination technique and imaging protocol is essential for maximizing the diagnostic potential of MR imaging in the work-up of hip disease. Specific protocols that incorporate surface coil imaging, oblique image acquisition, and alternative pulse sequences are the foundation for successful hip studies.[2]

The purpose of present study was to evaluate the role of MRI in early evaluation of painful hip joints with/without subtle plain radiographic findings, to establish a differential diagnosis of the various painful hip joint conditions on MRI, to assess the severity and extent of the underlying lesion in various conditions of painful hip joint and their clinical relevance

MATERIALS AND METHODS

The present study was conducted in Radiodiagnosis department of Maharishi Markandeshwar Institute of Medial Sciences and Research, Ambala. Study was approved by the ethical committee. A prospective cross-sectional study was done on a total of 50 patients including both the sexes and of all age groups who presented with hip joint pain and subsequently underwent plain radiographs followed by MRI of the hip joint.

Inclusion Criteria
The study included
- Patients presenting with acute or chronic hip pain
- Patients of all age groups.

Exclusion Criteria
The study excluded
- Patients with history of acute trauma
- Patient having history of claustrophobia.
- Patient having history of metallic implants insertion, cardiac
- pacemakers and metallic foreign body in situ

Duration of study: 2 years

Radiograph protocol
Image receptor:	14 x 17 inch
Exposure:	70-80 kVp and 20-30 mAs
Surface to image distance:	100cm
Grid:	Yes

MRI
Preparation of the Patient:
Articles such as jewellery, keys, credit cards, watches, coins, and other metallic objects were placed in the locker provided. Before starting the MR study, the procedure was explained to the patient in his/her vernacular language to allay the fear and

the anxiety and written informed consent was taken. Length of the study in magnet was communicated to the patient which varied from 30 min to 45 min. During the entire period of procedure patient was in contact with technologist/doctor by a two-way intercom system. To reduce the artifacts due to patient movement, sedation was given to patients of pediatric age group and uncooperative patients. Imaging was done with 16-channel 1.5 Tesla MRI scanner (Achieva, Philips Medical Systems, The Netherlands).

MRI protocol
Localizer was taken in axial and coronal planes after making proper positioning of the patient. The MRI protocol consisted of
Coronal T1W (TE 10 TR 400-600),
Coronal T2W (TE 90 TR 3000-5000),
STIR Axial (TE 8 TR 3000-6000),
Axial T1W (TE 10 TR 400-600),
Axial T2W (TE 100 TR 300-5000),
SPAIR T2W (TE 80 TR 3500)
Sagittal T1W (TE 20 TR 500-650)
Sagittal T2W (TE 90 TR 3000-5000)
The data was analysed and the findings on plain radiographs correlated with that of MRI.

RESULTS

Out of total 50 patients in our study, 36(72%) of them were males and 14(28%) were females. The maximum number of cases (n=12, 24%) were in the 21-30 age group, followed by 31-40 age group (n=11, 22%). patients (86%) presented with unilateral hip symptoms whereas 7 patients (14%) presented with bilateral hip symptoms. The distribution of cases based on final diagnosis is as shows in Table 1

AVN cases were stage according to Ficat and Arlet system from stages I to stage IV.[3] Stage 0 was excluded as they are clinically and radiologically normally and only evident on histopathology. Mitchell classification was used to classify the central signal intensity of AVN lesions from stages A-D).[4]

Out of 50 cases, 19 (38%) patients were diagnosed as AVN of femoral head, out of which 5 patients showed changes in bilateral hip joints. (n=24). In 24 hips with AVN, only 14 (58.3%) cases were detected on X ray, but all 24 (100%) cases were detected on MRI.Various X-ray findings included: cyst/osteopenia- 2 hip joints (8.3%), mixed osteopenia/sclerosis- 4hip joints (16.6%) and subchondral collapse -8hip joints (33.3%).On 10 hip joints who were normal on X-ray examination, 5 showed Ficat stage I and 5 showed Ficat stage II changes on MRI (Table 2). Of 24 hips with AVN, 6 showed Mitchell stage A, 4 showed Mitchell stage B, 6 showed Mitchell stage C and 8 showed Mitchell stage D changes. (Figure 1)

Tuberculosis was secondary most common hip pathology in our study. On total 9 subject of tuberculosis, all were detected on MRI, while only 7 (77.8%) were detected on X-ray examination (Figure 2).

Primary osteoarthritis was seen in a total on 7 subjects (cases with coexistent AVN or other underlying cause were not included in these cases). It was unilateral in 5 and bilateral in 2 of them (total 9 hip joints with osteoarthritis). X-ray

findings of osteoarthritis were graded 0-4 according to Kellgren and Lawrence grading scale.[5] Similar M findings of osteoarthritis were grade 0-4 according to MRI grading system.[6] Out of 9 cases, 3(33.3%) cases showing stage 3 on X Ray showed stage 4 articular cartilage destruction on MRI which was not seen on X ray. Out of 9 cases detected on X

Diagnosis	No. of cases	Percentage
AVN	19	38.0%
Metastasis	2	4.0%
Primary osteoarthritis	7	14.0%
Osteomyelitis	5	10.0%
Perthes disease	2	4.0%
Septic arthritis	2	4.0%
Stress fracture	2	4.0%
Tuberculosis	9	18.0%
Transient synovitis	2	4.0%
Total	50	100.0%

Table-1: Showing distribution of cases according to final diagnosis

MRI Ficat stage	Number of hip joints with AVN
I	5
II	7
III	6
IV	6

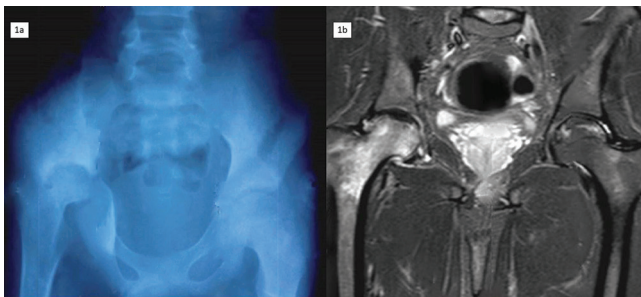**Table-2:** showing distribution of cases according to MRI Ficat stage

Figure-1: Case of bilateral AVN. AP radiograph of pelvic (1a) showing subchondral osteopenia with mild sclerosis in right femoral head with mild subchondral collapse. Left femoral head appears normal. Figure 1b (Coronal STIR MRI) image showing changes of bilateral AVN (Ficat stage III on right side and II on left side)
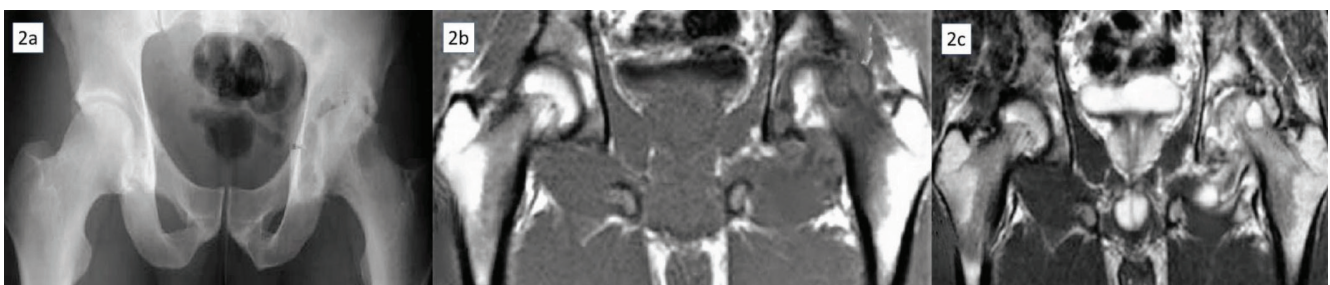
Ray, 1 case presented with stage I disease, 5 cases presented with stage III disease and 3 cases presented with stage IV disease (According to Kellgren and Lawrence grading).

Out of 50 cases, 5 (10%) cases were diagnosed as Osteomyelitis. All the cases were detected both on plain radiography and MRI. Patients presented with pain and fever. On plain radiographs reduction in joint space was seen in 3 cases (60%) whereas joint space widening was seen in 2 cases (40%). Widened tear drop sign i.e. joint effusion was seen in all the cases (n=5, 100%). Soft tissue swelling was also present in all the cases(n=5,100%). Degenerative changes and erosions were seen in 3(60%) cases. MRI, however confirmed all these findings as well as showed additional findings like marrow edema and synovitis in all the cases (n=5, 100%).

DISCUSSION

Plain radiography is a well-known, cost effective modality commonly seen in all types of health setups for studying the hip joint. In contrast MRI is a costly, not commonly accessible modality at the level of primary health care centres. However, MRI is the non-invasive first line modality in early diagnosis and determining the magnitude of pathological involvement more precisely and in turn reduces the differential diagnosis. In our study, maximum number of cases belonged to AVN (38%) followed by tuberculosis (18%) and primary osteoarthritis (14%). Other causes represented minority of cases. Our results are similar to another study by Kaushal et al.[7]

AVN was the most common cause of hip pain in our study representing 38% of cases. Alcohol and steroid intake appear to play most important role for high incidence of AVN especially in young males.[8] 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 our study, most common MRI findings in AVN were: focal subchondral signal abnormality (100%), joint effusion (76%) and diffuse marrow edema (50%). These findings are similar to other studies.[9,10] In our study, sensitivity of MRI for detection of AVN was 100% while x-ray had a sensitivity of only 58.3% which is similar to previous studies.[11,12]

MRI helps to detect AVN when its radiographically occult. Early diagnosis of AVN is important to prevent or delay subchondral collapse. It can help to remove the causative factors and explore early medial and surgical treatment

Figure-2: Case of left femoral hip joint tuberculosis. AP radiograph of pelvis (2a) showing erosions on both sides of left femoral head with joint space narrowing. Coronal T1W (2b) and T2W (2c) MR images showing large joint effusion, marrow edema, erosive changes and also edema of the obturator externus on left side

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options.[13]

Tuberculosis is an important healthcare problem in India. It can affect virtually any organ the body including hip joints. It presents with synovitis with pannus formation which causing progressive articular cartilage destruction with subchondral bone changes. In our study, 9 cases were diagnosed as TB hip. Out of 9 cases only 7 were diagnosed on X Ray and all the cases were diagnosed on MRI. The most common MRI findings were marrow edema (88.8%) and joint effusion (88.8%) followed by synovitis (77.8%), joint space narrowing and destruction of articular cartilage (55.6%) each. Early detection of TB hip is important in order to save the affected limb which is feasible with only MRI.[14]

Out of 50 cases, 5 (10%) cases were diagnosed as Osteomyelitis. All the cases were detected both on plain radiography and MRI. On MRI marrow edema, joint effusion, and synovitis were present in all the cases. (n=5,100%) Whereas articular cartilage involvement was seen in n=4 cases (80%). Joint space widening was seen in n=2 cases(40%) whereas narrowing was seen in 3 cases(60%). Similar findings have been reported in other studies.[12,15]

Only two cases were diagnosed with metastasis in our study and both were detected on X-ray and MRI. Additionally, MRI showed the presence of marrow edema in both the cases. Also, MRI is very useful to depict multiple lesions and any associated soft tissue mass.

Two (4%) cases were diagnosed as Perthes disease, both of them were boys. All the cases are detected both on plain radiography and MRI. Both cases showed increased density of femoral head epiphysis (n=2,100%). On X Ray, femoral head was deformed in both cases with collapsed subchondral bone (n=2,100%). Joint effusion was seen in one case(n=1,50%). On MRI, the femoral head epiphysis appeared small, with low signal intensity subcortical band on coronal T1W images. MRI helps in better analysis of femoral epiphysis along with showing evidence of bone marrow edema on STIR sequence. It also helps to assess growth plate and allows better assessment of femoral head deformity. Our results are similar to other studies.[11]

Out of 50 cases, 2 (4%) cases were diagnosed as Transient synovitis of hip. In 2 cases of transient synovitis, 1 (50%) case was detected on X ray, but both (100%) cases were detected on MRI. One case could not be diagnosed on X ray and showed mild joint effusion with mild joint space widening on MRI. The most common characteristic MRI findings seen in transient synovitis were joint effusion, synovitis and subchondral marrow edema changes.[16]

Two (4%) cases were diagnosed as Septic arthritis of hip. In 2 cases of septic arthritis 1 (50%) case was detected on X ray, but both (100%) cases were detected on MRI. Plain radiograph demonstrated diffuse decrease in bone density and degenerative changes in 1(50%) case, whilst joint space reduction was seen in both cases(n=2,100%). On MRI, joint effusion, joint space reduction, synovitis and marrow edema were seen in both cases (n=2,100%). MRI is more sensitive for early detection of disease. Our results are similar to other studies.[9,12]

Out of 50 cases, 2 (4%) cases were diagnosed as Stress fracture of femoral head. In 2 cases of stress fracture 0 (0%)

cases were detected on X ray, but both (100%) cases were detected on MRI. Both cases showed soft tissue swelling (n=2,100%). Joint effusion and erosions were seen in 1(50%) case. MRI showed marrow edema on STIR images and joint effusion in both the cases(n=2,100%) along with linear hypointense signal on T1 and T2W images which confirmed the diagnosis of stress fracture

Similar findings were seen in other studies. MRI has been advocated as the imaging modality of choice for detection of stress fractures.[12,17]

CONCLUSION

In conclusion, MRI plays significant role in detection as well as characterisation of various hip disorders and offers several advantages over conventional radiographs.

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