



ASSESSMENT OF PAINFUL HIP JOINT AND HIP PATHOLOGY BY USING MAGNETIC RESONANCE IMAGING

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Abstract-

MR imaging is a critical tool in the evaluation of hip pathologies since it enables analysis of articular structures, extra-articular soft tissues, and the osseous structures that can be affected by hip disease. Hip imaging was one of the earliest reported applications of Musculo-skeletal magnetic resonance (MR) imaging.

Aims- Assessment of painful hip joint and hip pathology by using Magnetic Resonance Imaging.

Materials and methods- The study will be conducted in Department of Radio-diagnosis, Peoples College of Medical Sciences and Research Centre, Bhopal from January 2023 to January 2024, after approval from institutional research & ethical committee. Patients with complaints of pain in hip joint referred from various Department for MRI hip will be subjected to MRI after taking written informed consent.

Results- In our study maximum number of patients were males (71.1%), male: female ratio is 2.4:1. Maximum patients were in age group 31-40 year (22%) followed by 21-30 year (18%). Most common pathology was found to be AVN (36%). AVN is more common in males (n= 15). Subchondral signal abnormality in AVN is most common finding (96.42%) followed by femoral head fragmentation with collapse (57.1%). Most common finding in Osteoarthritis is Marginal osteophytes, seen in all hip joints involved (100%).

Most common findings in Perthes disease is bone marrow edema seen in all patients. Most common findings in DDH are displaced epiphyses, dysplastic acetabulum, dysplastic femoral head seen in all the patients. Most common findings in metastasis on MRI is hyperintensity signal on T2/STIR seen in all the patients. Most common findings in synovitis are synovial effusion and synovial thickening seen in all the patients. Bone marrow edema in femoral head and neck, Joint effusion, Absence of subchondral lesions and edema, altered signal in acetabulum were the most common findings in patients with transient osteoporosis of hip. Sensitivity of TB on MRI was found to be 40.4%.

Conclusion- In patients with hip discomfort, we found a wide range of MR results in patients of different ages. The various underlying conditions included AVN, septic arthritis, osteoarthritis, Perthes disease, DDH, transient synovitis, Transient osteoporosis of hip and metastasis. MRI is the method of choice in characterizing the various disorders of the hip joint and it can point out specific features leading to accurate diagnosis of the painful hip joint. It's a precise imaging technique for determining the complete degree of osseous, chondral, and soft tissue abnormalities in the hip joint. Joint effusions, synovial proliferation, articular cartilage abnormalities, subchondral bone, ligaments, muscles, and juxta-articular soft tissues can all be seen using MR imaging. MRI is the

diagnostic method of choice for hip problems because to its high resolution, enhanced tissue contrast differentiation, and multiplanar imaging capability.

Keywords- osteoarthritis, magnetic resonance imaging, osteoporosis.

Introduction

Hip imaging was one of the earliest reported applications of musculoskeletal magnetic resonance (MR) imaging. MR imaging is a critical tool in the evaluation of hip pathologies since it enables analysis of articular structures, extra-articular soft tissues, and the osseous structures that can be affected by hip disease¹. A normal-appearing radiograph, a vague history, and clinical symptoms in patients with chronic hip pain might create a challenging diagnostic conundrum. Trauma, infection, arthritis, avascular necrosis, tumours, and hip dysplasia can all appear on radiographs with extremely mild abnormalities. In all these cases MRI of hip plays vital role.

In the diagnosis and management of pediatric hip disorders MR imaging is becoming increasingly useful. MR imaging provides several advantages that are especially important in the pediatric population. Because the majority of the paediatric hip is cartilaginous, alternative imaging modalities such as plain radiography, ultrasonography (US) (after 6 months of age), and computed tomography (CT) are often ineffective (CT). MR imaging is excellent in its ability to represent cartilage and is, therefore, especially effective in the assessment of the pediatric hip².

A main concern in the juvenile hip is normal development, that depend on proper seating of femoral head in the acetabulum. The position and shape of the femoral head should be precisely assessed with

multiplanar MR imaging. Also, changes in bone marrow can be directly visualized with MR imaging; which is not possible with CT or US.

MR imaging has played an increasingly important role in the assessment of the arthritides. Juvenile rheumatoid arthritis (JRA) is the commonest form of arthritis in children. MR imaging is exceptionally capable of showing the soft-tissue abnormalities that occur in JRA, including synovial inflammation, joint effusion, and articular cartilage destruction.

In sarcoidosis patients with musculoskeletal complaints, MRI shows marrow and soft-tissue lesions that are occult or underestimated on radiographs.

MR imaging can be useful in the assessment of a multiple hip disorders. We believe that attention to the details of MR examination technique and imaging protocol is vital for exploiting 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 basis for successful hip studies. GRE sequences are important in the evaluation of cartilaginous diseases, especially in paediatric hip diseases²

Now a days, high-resolution direct MR imaging of the hip offers the best means for assessing intra-articular pathology. However, radiography remains important for the diagnosis of subtle bony abnormalities associated with femoro-acetabular impingement. Thus, a complete imaging strategy necessitates conventional radiographs and MRI to evaluate intra- and extra-articular sources of pain.

Aims- Assessment of painful hip joint and hip pathology by using Magnetic Resonance Imaging.

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The study will be done on a Siemens 1.5 T MAGNETOM ® Symphony® with Tim technology MR Machine. Imaging will be performed using a body coil placed over the pelvis with the patient in supine position and both hips were examined simultaneously. The following sequences were obtained: Coronal spin-echo T1-weighted (T1W), Proton Density with Fat Saturation, T2-weighted

(T2W) and Short Tau Inversion Recovery (STIR); Subsequent PDFS and T2W images were obtained in the sagittal and axial planes using the same parameters as those in the coronal plane. Axial Gradient Echo (GRE) Image will be taken when required. Renal Function Test (RFT) was performed for patients with clinically suspected infective hip pathology. Patients whose RFT was normal, underwent contrast study. After fasting for 6-8 hours, 0.1 mmol/kg intravenous Gadopentetate Dimeglumine solution was injected and Post Gadolinium (Gd) T1FS images were obtained in axial, coronal and sagittal planes. The findings will be recorded on pre-structured proforma for the study and descriptive statistics will be carried out to identify characteristics of the collected data.

Inclusion Criteria

Patients from all age groups and both sexes presenting with acute or chronic unilateral or bilateral hip pain.

Exclusion Criteria

1. Patients with history of hip trauma.
2. People who are not willing to give consent.
3. Patients in whom MRI is contraindicated.
4. Patients on life support systems.

1. Sample Size

We included 50 patients in our study.

(In our institute, we get on average 2-3 cases per month of CNS tuberculosis for which MRI is being done. Therefore, we are able to achieve our sample size of 50 patients in period of 1.6 years)

Procedure

Informed written consent has been taken from the patient or patients relatives. A pre-structured Proforma is used for collection of base line data. A detailed history and correlation with relevant lab investigations has been done. MR brain has been done on Siemens 1.5 T MAGNETOM Symphony MR machine. Routine MR pulse sequences axial T1WI, T2WI, STIR and PD are obtained using phased-array head coil. Contrast-enhanced T1-weighted spin echo images, are obtained after i.v. administration of gadolinium at dose of 0.1 mmol/kg. Suitable variations are made depending on the patient's condition. Data thus collected is statistically analysed.

Investigation Details

Relevant lab investigations are recorded followed by the MR imaging. The MR images is analyzed by experienced radiologist and relevant data is noted in a Proforma.

Data Collection and Methods

The findings are recorded on pre-structured proforma for the study. The results of the study are tabulated and statistically analyzed. Statistical Analysis Plan Descriptive statistics are carried out to identify the characteristics and features of collected data.

Mean and Percentage are used to represent the data. Microsoft excel will be used to prepare the master charts.

Results-

In our study maximum number of patients were males (70%). male: female ratio is 2.3:1. Maximum patients were in age group 21-40 year (38%), followed by 41-60 year of age group. **most of the cases were of AVN (n = 18)36% followed by septic arthritis (n=12)24%. [Table no-1]**

Table – 1: Distribution on the basis of pathology

| S. No | Pathology | Number of Patients (n=50) | Percentage (%) |
|-------|-------------------------------|---------------------------|----------------|
| 1. | Avascular necrosis | 18 | 36% |
| 2. | Septic arthritis | 12 | 24% |
| 3. | Osteoarthritis | 8 | 16% |
| 4. | Metastasis | 3 | 6% |
| 5. | Developmentaldysplasia of hip | 3 | 6% |
| 6. | Perthes disease | 2 | 4% |
| 7. | Transient Synovitis | 2 | 4% |
| 8. | Transient osteoporosisof hip | 2 | 4% |

AVN and OA is most common in 41 – 60year age group. DDH and Perthes disease were seen only in 0–20-year age group. Transient osteoporosis of hip is most common in 61 – 80-year age group. **AVN is more common in males (n=15)**. Out of 50 cases 18 (36%) cases are diagnosed as AVN of femoral head. In 18 cases of AVN, 10 cases (55.5%) shows bilateral involvement and 8 cases (44.4%) shows unilateral involvement. All 18 (100%) cases are detected on MRI. **Most common cause of AVN (55.55%) is idiopathic followed by alcohol intake (22.2%). most cases of AVN shows bilateralinvolvement (55.55%)**. ARCO grade IV is most common (50%) inboth bilateral and unilateral AVN. Subchondral signal abnormality in AVN is most common finding followed by femoral head fragmentation with collapse.

Synovial thickening and bone marrow edema weremost common (91.6%) findings seen on MRI in septic arthritis. Out of 5 cases of TB detected on MRI only 2 came positive for TB on histopathology. Sensitivity of MRI for TB is 40%. Sensitivity of MRI for pyogenic arthritis on MRI is 100%.

Out of 50 cases, 8 cases shows osteoarthritis, In 8 cases of osteoarthritis, 3 cases (37.5%) shows bilateral involvement and 5 cases (62.5%) shows unilateral involvement. All 8 (100%) cases are detectedon MRI. most common finding in Osteoarthritis is Marginal osteophytes, Joint effusion and Bone marrow edema is seen in all hip joints involved (100%).

Most common findings in metastasis onMRI is hyperintensity signal on T2/STIR.

Most common findings in DDH are displaced epiphyses, dysplastic acetabulum, dysplastic femoral head seen in all the patients.

Out of 50 cases, 2 cases show Perthes disease, most common findings in PERTHESdisease is bone marrow edema seen in all patients.

Most common findings in transient synovitis are joint effusion and synovial thickening seen in all the patients.

All 2 patients with transient osteoporosis of hip showed bone marrow edema, joint effusion and absence of subchondral lesions and edema.

Discussion-

The aim of our study is early detection of the disease before the appearance of signs on radiography or in patients having subtle findings on plain radiography by using MRI that helps in the treatment of the patient at the early stages to stop the further progression of disease.

In our study, 50 patients were included out of which 35(70%) weremale and 15(30%) were female. Our study was comparable to the study of Kalekar et al³in which 36(72%) patients were male and 14 (28%) were female. Similarly, in the study done by K Venkateshwar Reddy et al⁴ in which85 patients were included, 64 patients were male (75%) and 21 were female (25%).

In our study, the age ranged from 2-74 years. Most of the patients inour study were in the second and third decade of life (n=19, 38%). The results are consistent with the study conducted by Kalekar et al³ wherethe maximum number of patients were in age group of 21-30 (n=12,24%). In another study conducted by Arjun Prakash et al⁴⁵ on 70 patients, the most common age group to be

presenting with hip pain was 20-29 years (n=24, 34%). In a study done by Sahil Chhabra et al⁶ showed the maximum no. of patients with painful hip joint falling in the age group of 31-40 years with a mean age of 35.68 years and male predominance with male to the female sex ratio of 2.4:1.

In a study of 60 patients by Ram Bhamu et al⁸ on patients presenting with unilateral or bilateral painful hip, maximum number of patients, 24(40%) presented with AVN, followed by septic arthritis 12(20%). The results are comparable to our study which was done on 50 patients presenting with unilateral or bilateral painful hip with maximum number of cases of AVN i.e. 18 (36%), followed by septic arthritis of hip constituting 24 % cases.

In our study, AVN of femoral head was the commonest pathology identified as the cause for painful hip joint. In our study most common age group for AVN is 51-60 year of age. In our study, unilateral AVN was seen in 8 patients (44.4%) and bilateral AVN in 10 patients (55.5%).

In a study done by Drar HA et al⁹, shows unilateral AVN in 68% and bilateral AVN in 32% of patient. Out of 50 cases, 18 (36%) patients were diagnosed as AVN of femoral head. Out of which 10 patients showed changes in bilateral hip joints. Therefore, total number of hips involved in AVN were 28. In 28 painful hips of AVN all 28 (100%) cases were detected on MRI. In our study, most of the patients have ARCO grade IV n =14 (50%).

Idiopathic AVN accounts for 55.5% cases, which turns out as most common cause, followed by alcohol in 22.2% and steroids in 11.1% of cases. In the study done by done by Turamari et al⁷ on 80 patients with painful hips, also shows idiopathic AVN to be the most common (53.5%) followed by alcohol intake. In the study done by Jacobs B et al¹⁰, alcohol was the commonest risk factor, seen in 39% of cases. Kamal D et al¹¹ concluded smoking is the commonest risk factor in her study which contributed to 36.9% of cases.

In our study, the most common MRI findings of AVN were focal subchondral signal abnormality (geographic pattern with sclerosis) and were seen in 27 hip joints (96.42%), followed by femoral head fragmentation with collapse 16 hip joints (57.1%), double line sign (10 hip joints, 35.7%) seen on T2-weighted sequence as inner bright line representing granulation tissue and surrounding dark zone representing adjacent sclerotic bone. In a study by Turamari et al⁷ on 80 patients with painful hips, 28 cases were that of AVN. The dominant findings were focal subchondral signal abnormality (100%), marrow edema (40%), and double line sign (34.2%). These results are similar to our study.

Also, in a study done by Lovely et al¹², the dominant MRI findings were focal subchondral signal abnormality (96%), double line sign (48%). These findings are same as our study except for bone marrow edema which is seen in 92% cases in their study. In our study, 50% of the lesions were in grade IV, followed by grade III seen in 39.2% lesions. In a study done by Kamal D et al¹¹ shows 51.09% of patients with grade IV and 34.78% of patients with grade III AVN.

In our study out of 50 patients, 12 patients were found to be of septic arthritis. 5 patients were reported as TB on MRI, 2 of them were found to be TB whereas 3 were of pyogenic arthritis on histopathology. 7 patients were reported as pyogenic arthritis on MRI. On histopathology 3 of them were found to be TB and 4 as pyogenic arthritis.

Akhita et al¹³ found that three patients were diagnosed with tubercular arthritis on MRI; however, only one of them who had bone erosions and synovial thickening came out to be true positive. Hence in our study the sensitivity of MRI for tubercular arthritis was 33.33%.

MRI had role of detecting early changes of osteoarthritis compared with radiographs. The signs on MRI included joint space narrowing, joint effusion, marrow edema, articular cartilage defects, subchondral cysts, and osteophytes⁵². In our study most common age group affected was 51-60 years. In our study there were 8 cases of OA of which 3 cases were bilateral and 5 were unilateral. Therefore, total no. of hips showing osteoarthritic changes were 11. All 11 cases were diagnosed on MRI.

In our study, most common MRI findings in OA were marginal osteophytes, joint effusion and bone marrow edema seen in all the patients of osteoarthritis. Akhita et al¹³ in her study of 5 patients of hip osteoarthritis concluded that most common findings in osteoarthritis in their study was marginal osteophytes followed by joint space narrowing. Similar findings were seen in studies done by Noham et al¹⁴ in which Marginal osteophytes, joint effusion is seen in all the patients of osteoarthritis. MRI has high sensitivity and specificity for detection of skeletal metastasis.

MRI is superior in the evaluation of metastatic lesions by not only detecting the abnormal signal intensity lesions, also evaluates the cartilaginous and the extent of soft tissue involvement accurately, which helps in the appropriate treatment plan. Out of 50 cases, 3 (6%) cases were diagnosed as metastasis. MRI detect all the three cases.

One female (50 years) with a history of breast malignancy complaining of pain in hip was referred to the radiology department for MRI hip, which revealed expansile altered marrow signal intensity involving right ilium bone with multiple areas of cortical breach and adjoining soft tissue component. Two male patient with a history of carcinoma prostate (50 and 66 years) also revealed multiple variable sized T1 hypointense and T2/STIR hyperintense lesions in pelvic bone.

Tripathi et al¹⁵ in his study on 60 patients concluded that 1 case was that of metastasis. It was seen as a poorly defined lesion which was

hypointense on T1 and hyperintense on T2/STIR images. The lesion was confirmed on biopsy. Similar findings were seen in the 3 cases of metastasis in our study.

In a study done by Arjun Prakash et al⁵ on 70 patients, 2 cases were that of metastasis, one was a male with carcinoma prostate who presented with bilateral hip metastasis. Another was a female with carcinoma breast who presented with mixed lytic/sclerotic lesions. Both cases showed hypointense signal on T1 and hyperintensity on T2/FLAIR images on MRI images. Similar results were seen in our study.

A 70% of all malignant bone tumors constitute metastatic disease¹⁶. MRI evaluates the extent of medullary and soft tissue involvement, articular extension and involvement of neurovascular bundle¹⁷.

MRI is an excellent modality to quantify the degree of dysplasia found in dislocated hips. MRI must be considered for DDH when reduction has been attempted but is unsuccessful. 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 head⁸.

In our study, we had 3 patients of DDH, all of them were less than 5 year of age. Most common MRI findings in them were displaced epiphysis, dysplastic acetabulum and dysplastic femoral head. These findings are seen in all the 3 patients.

Out of 50 cases, 2 (4%) cases were diagnosed as Perthes' disease, both of them were boys. Both cases showed epiphyseal hypointense signal on T1W (n=2, 100%). Marrow edema was seen in both the cases. (n=2, 100%). Our study is compared to the study done by Toby et al⁷ in the assessment of pediatric hip disease by scanning the hips of 24 children (30 scans). Twelve patients with Perthes disease (17 hips) presented with diagnostic area of low signal intensity of the capital epiphysis. In our study both the cases showed small epiphysis which are seen as hypointense T1W images. MRI helps in better analysis of femoral epiphysis along with showing evidence of bone marrow edema on STIR sequence.

In a study done by Tushar Kalekar et al³, 2 out of 50 cases were that of Perthes disease. MRI findings suggested epiphyseal abnormality in the form of T1 hypointensity and T2 hyperintensity with associated bone marrow edema. Results were similar to our study. In a study done by, Bos CF et al¹⁸, 16 hips with Perthes disease over a mean period of two years. The imaging findings in their study correlated with our current study

In our study, out of 50 cases 2 (4%) patients with hip pain were diagnosed as transient synovitis. MR features revealed joint effusion associated with synovial enhancement (thickening). However, there was no evidence of signal alteration in the adjacent marrow. In a study done by Turamari et al⁷, MR imaging of synovitis shows synovial thickening and enhancement with joint effusion. Absence of significant bone marrow edema and absence of adjacent soft tissue enhancement differentiates it from infective arthritis¹⁹. In the study of Mohd. S El Din Zawawi et al²⁰ on 35 patients, 8 patients were diagnosed with transient synovitis. MRI findings in all 8 cases were joint effusion (100%) followed by synovial thickening in 68.75% cases. The findings are similar to our study except we found

synovial thickening in both the cases (100%).

Transient osteoporosis of hip was diagnosed in 2 (4%) of our cases, a 26-year-old male with left hip pain of three months duration. His plain radiographs were normal with no clinical/ lab abnormality. MRI images revealed diffuse marrow edema in the femoral head and neck with sparing of the subchondral bone. The patient was managed conservatively. A follow-up MRI after 3 months was normal thereby confirming the diagnosis. Another patient of age 74 year old female with pain in right hip for one month duration. Her plain radiograph was normal. On MRI, diffuse marrow edema in the femoral head and neck with sparing of the subchondral bone is seen. Grimm J et al⁶¹ in their study on Transient osteoporosis of hip, described typical stages of transient osteoporosis of hip with normalization of MR findings within 6 to 10 months.

Conclusion-

MRI of the hip joint is the imaging modality of choice for detecting various causes of hip discomfort since it is non-invasive, non-ionizing, safe, and accurate. It can distinguish numerous hip diseases and aid in early diagnosis where radiographs show normal because of its excellent soft tissue resolution and multiplanar imaging capacity. In patients with hip discomfort, we found a wide range of MR results in patients of different ages. The various underlying conditions included AVN, septic arthritis, osteoarthritis, Perthes disease, DDH, transient synovitis, Transient osteoporosis of hip and metastasis. MRI is the method of choice in characterizing the various disorders of the hip joint and it can point out specific features leading to accurate diagnosis of the painful hip joint. It's a precise imaging technique for determining the complete degree of osseous, chondral, and soft tissue abnormalities in the hip joint. Joint effusions, synovial proliferation, articular cartilage abnormalities, subchondral bone, ligaments, muscles, and juxta-articular soft tissues can all be seen using MR imaging. MRI is the diagnostic method of choice for hip problems because to its high resolution, enhanced tissue contrast differentiation, and multiplanar imaging capability.

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