_____

Conventional Radiographs versus MRI in the Diagnosis of Hip Pathologies in a Tertiary Care Teaching Hospital: A Comparative Study

Devara Anil Kashi Vishnuvardhan [1], Paka Lavanya[2*], Varun Kumar Paka[3]

[1] Associate Professor, Department of Radiology, Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh, India
[2]Assistant Professor, Department of Radiology, KGH Andhra Medical College, Visakhapatnam, Andhra Pradesh, India
[3] Assistant Professor, Department of Orthopaedics, NIMRA Institute of Medical Sciences, Vijaawada, Andhra Pradesh, India

Abstract
Background: The hip joint is a major weight-bearing joint in the human body. It is often difficult to assess painful disorders of the deeply located hip clinically. This necessitates the need for imaging to arrive at an accurate diagnosis. Magnetic Resonance Imaging (MRI) is an imaging modality with good soft tissue contrast resolution for evaluating hip pathologies. **Subjects and Methods:** 76 of patients, evaluated for traumatic and non-traumatic hip pain that underwent clinical, radiological, and pathological examination at Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh between September 2019 and August 2020 were randomly selected and included in the study. **Results:** 31 (40.8%) out of the total 76 patients had AVN, 9 (11.8%) patients TB hip, 15 (19.7%) patients' osteomyelitis, 3 (3.9%) patients joint effusion, 3(3.9%) patients SCFE, 5 (6.6%) patients tumor/metastasis, 3 (3.9%) patients DDH, 3 (3.9%) perthes, 3 (3.9%) patients OA and 1 (1.3%) patients osteoporosis. **Conclusion:** MRI proved to be an excellent modality not only for the early diagnosis of osteonecrosis but also for the detection of infections as well as occult injuries, in and around the hip joint, with superior contrast resolution and without any harmful radiation.
Keywords: Hip Pathology, Plain Radiograph & Magnetic Resonance Imaging.

Introduction

The hip is categorized as a synovial joint of ball and socket variety. It is an articulation between the acetabulum and femoral head. The anatomy of hip joint is complex due to its morphology and orientation. It is important to localize the exact site of pathology to determine the accurate diagnosis of the primary disease and look for secondary involvement of the surrounding structures.[1] One of the most revolutionary advances in the field of medicine that has essentially changed the face of diagnosis especially in the diagnosis of hip pathologies is Magnetic Resonance Imaging (MRI). MRI 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.[2] Trauma, infection, arthritis, avascular necrosis, tumor, and hip dysplasia can all manifest with extremely subtle radiographic abnormalities in the early stages. Currently, MRI is the modality of choice (following plain radiography) for imaging avascular necrosis (AVN), radiographically occult fractures, marrow replacement disorders, musculoskeletal neoplasms, and osteomyelitis involving the hip.MRI is the most significant diagnostic test performed in the orthopedics and sports medicine patients.

*Correspondence
Dr. Paka Lavanya
Assistant Professor, Department of Radiology, KGH Andhra Medical College, Visakhapatnam, Andhra Pradesh, India
E-mail: lavanyap700@gmail.com

Frequently, it is the definitive examination providing invaluable information to help the surgeon not only to understand the underlying pathology but also to make critical decision regarding surgical intervention. Despite more than two decades of experience in imaging the hip with MRI, its role as a diagnostic imaging modality in the patient with hip pain continues to evolve. Comprehensive studies involving large series of cases with pathologies involving the hip and their evaluation by MRI are few in the Indian literature. Most of the work has been in the form of isolated case reports.[3] The present study emphasizes to compare the role of X-Ray with MRI in patients presenting with hip pain and also assess the severity and extent of the underlying lesion in various conditions of painful hip joint pathologies in a tertiary care teaching hospital.

Subjects and methods

This present study was conducted in the Department of Radiology, Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh during the period between September 2019 and August 2020.The study was conducted after approval from institutional thesis and ethical committee. The main source of data for the study were patients presenting with a history of hip pain to the OPD as well as in patients, being referred to radiology department for X-Rays or MRI examination at Maharajah's Institute of Medical Sciences. In all cases, Informed consent was taken after explaining to the patients about the procedure prior to performing it. 76 cases were selected randomly from patients referred to X-Ray and MRI centre of Maharajah's Institute of Medical Sciences.

_____

_____

Methodology

a) Non-traumatic clinically suspected cases: patients with unilateral or bilateral groin, buttock, thigh or knee pain, deformity or limitation of range of movements at hip joint, b) Traumatic clinically suspected cases: dislocation of hip, fracture head/neck of femur or fracture of acetabulum, c) X-Ray: Imaging was done with samsung/ DXMR machine and d) MRI: Imaging was done with 1.5 Tesla Phillips ingenia machine with the help of dedicated body coil. The tests were performed using following parameters; FOV – 350 to 400 (in adult) and 180 to 200 (in paediatrics), Slice thickness – 4 mm & Matrix size – 512 x 512. The following sequences were obtained: spin-echoT1 weighted (coronal/transverse), PD FAT SAT (coronal/transverse), T2 weighted (oblique/sagittal/ transverse), T2 FAT SAT and inversion recovery (coronal) sequences of both hips. Various MRI imaging characteristics of different hip pathologies like BME (bone marrow oedema), joint effusion, soft tissue signal intensity changes, synovial thickening and enhancement, articular surface changes and subchondral changes were identified and described. With these imaging characteristics, appropriate differential diagnoses of various hip disorders viz., idiopathic, degenerative, infective, developmental pathologies like AVN, OA, TB arthritis, Perthe's, etc., was established. Though there is no standardized classification of hip disorders available in literature, the present study considers a generalized classification based on etiology.

Observation and results

The present study was carried out on 76 patients who have been randomly selected from a group of patients who underwent clinical, radiological and pathological examination at Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh for traumatic and non-traumatic hip pain between September 2019 and August 2020. Table-1 shows the 31 (40.8%) out of the total 76 patients had AVN, 9 (11.8%) patients TB hip, 15 (19.7%) patients' osteomyelitis,3(3.9%) patients' joint effusion,3(3.9%) patients SCFE, 5(6.6%) patients tumor/metastasis, 3 (3.9%) patients DDH, 3 (3.9%) perthes,3(3.9%) patients OA and 1 (1.3%) patients osteoporosis.

Out of the 76 cases, 31 (40.8%) cases were diagnosed as AVN of femoral head. In 31 cases of AVN only 11(35.4%) cases were detected on X-Ray but, all 31 (100%) cases were detected on MRI. 20 (64.5%) cases which were normal (stage 1 & stage 2 of FICATS CLASSIFICATION) on X-Ray proved to have AVN on MRI. Out of 11(35.4%) cases which were detected both on XRay and MRI, 9 (29.0%) cases were detected as stage 2 on X-Ray (FICATS) showed stage 4 or more on MRI (MITCHELL'S). 1 (3.2%) case which was detected as stage 3 on X-Ray (FICATS) showed stage 4 on MRI (MITCHELL'S).

Out of 76 cases, 9 cases (11.8%) showed TB of hip joint. Out of 9 Cases of TB of hip joint, 6(66.6%) cases were detected on X-Ray, whereas all 9 (100%) cases were detected on MRI. Out of 6 cases detected on X-Ray, stage 2 (2case), stage 3 (3 cases), stage 4 (1 case). Out of 9 cases detected on MRI, stage 1 (3 case), stage2 (2 case), stage 3(1 case), stage 4(2 cases) & stage 5 (1 case).

Out of 76 cases, 3 (3.9%) cases show Perthe's disease. All 3 cases were detected on X-ray (100%) and MRI (100%).

Out of the 76cases, 1 case (1.3%) showed features of Osteoid Ostoma. The case was detected both on X-Ray (100%) and MRI (100%).

Out of the 76 cases, 15 cases (19.7%) were diagnosed with Osteomyelitis. Out of 15 Cases of Osteomyelitis, 5(33.3%) cases detected on X-Ray, whereas all the 15 (100%) cases detected on MRI.

Table 1: Various pathologies detected and their percentages in the studied population

Hip Disorders	No. of patients (%)
AVN	31(40.8%)
Osteomyelitis	15(19.7%)
TB Hip	09(11.8%)
Joint Effusion	03(3.9%)
Tumors/Metastasis	05(6.6%)
SCFE	03(3.9%)
Perthes disease	03(3.9%)
DDH	03(3.9%)
OA	03(3.9%)
Osteoporosis	01(1.3%)
Total	76(100.0%)

Table 2: AVN

AVN	On X-ray	On MRI
Total (31)	11(35.4%)	31(100%)

Table 3: X-Ray and MRI Findings

X-ray findings	No. of patients n=11 (%)	MRI Findings	No. of patients n=31 (%)
Osteoporosis	11 (100.0%)	Osteoporosis	27(87.1%)
Sclerosis	05 (16.1%)	Double line sign	25(80.6%)
Subchondral cysts	06 (19.4%)	Subchondral Cysts	23(74.2%)
Crescent sign/ subchondral lucency	05 (16.1%)	Femoral head altered contour	5(16.1%)
Altered morphology	05 (16.1%)	Femoral head fragmentation with collapse	5(16.1%)

Table 4: TB HIP joint

TB HIP JOINT	On X-ray	On MRI
Total (9)	6(66.6%)	9(100%)

_____

_____

Table 5: X-Ray and MRI Findings

X-Ray findings	No. of patients n=06 (%)	MRI Findings	No. of patients n=09 (%)
Osteopenia	06 (100.0%)	Synovial hyperintensity on T2W	03(55.5%)
Joint effusion	01(22.2%)	Joint effusion	09(100.0%)
Soft tissue swelling	03(50.0%)	Bone marrow edema	09(100.0%)
Joint erosions and reduction of joint space	06(100.0%)	Subarticular cysts	05(55.5%)
Subchondral cysts	03(50.0%)	Joint space reduction	09(100.0%)
Joint destruction & bony ankylosis	03 (50.0%)	Joint destruction & bonyankylosis	03 (33.3%)
		Soft tissue hyperintensity on T2W	03 (33.3%)

Table 6: X-Ray& MRI Findings

X-Ray findings	No. of patients n=3 (%)	MRI Findings	No. of patients n=3 (%)
Small epiphyses	02(66.6%)	Epiphyseal hyperintensity onT2W	02(66.6%)
Complete resorption of epiphyses	02(66.6%)	Bone marrow edema	03(100.0%)

Table 7: X-Ray& MRI Findings

X-Ray findings	No. of patients n=1(%)	MRI Findings	No. of patients n=1(%)
Perostial reaction with cortical thickening	01(100.0%)	Bone marrow edema	01(100.0%)
Nidus	01(100.0%)	Synovial enhancement	0 (0.0%)
		Nidus	01(100.0%)

Table 8: X-Ray & MRI Findings

X-Ray findings	No. of patients n=05(%)	MRI Findings	No. of patients n=15(%)
Osteopenia	05(100.0%)	Bone marrow edema	15(100.0%)
Perostial reaction	0(0.0%)	Joint effusion	09(60.0%)
Focal bone lysis	03(60.0%)	Joint deformity	02(13.3%)
Peripheral sclerosis	05(100.0%)	Collections	06(40.0%)
Sequestrum, Involucrum	0(0.0%)		
Joint destruction	02(40.0%)		

Discussion

With the lack of specificity in clinical examination and the imprecise result of conventional radiography and computed tomography, MRI emerged as modality of choice in early diagnosis. The hip joint is a large and complex articulation and can be involved in numerous pathologic conditions. There are many modalities for the evaluation of hip pathologies such as ultrasound, bone scintigraphy, conventional radiography, conventional arthrography, CT scan, and MRI. Although radiographs remain the initial imaging technique, in most instances they detect the pathologies late, only when the bony changes are obvious.[4] Hip disorders may be unilateral or bilateral. Hence both hips must be simultaneously assessed for pathologies. Conditions like AVN, OA and metastasis can have bilateral hip involvement. Overall, hip disorders in the present study presented with unilateral joint involvement. MRI has become the most sensitive, specific and widely used diagnostic imaging modality for evaluation of AVN of femoral head. Primary synovial osteochondromatosis is an idiopathic benign monoarticular disorder affecting joints like knee, elbow, hip and shoulder with a male preponderance. It is characterized by synovial proliferation with metaplastic transformation and formation of cartilage in the joint cavity.[5] This can present in various phases including active, transitional and inactive phase based on the ossification of the cartilaginous intra-articular loose bodies. Multiple intra-articular loose bodies in the hip joint cavity showing blooming on MRI is the distinguishing feature of synovial osteochondromatosis.[6] Joint effusion and synovial enhancement are commonly associated. Secondary osteoarthritis features must also be looked for. Plain radiography is a widely used, economical investigation readily available in all kinds of health setups for imaging the hip joint.[7] Whereas MRI is an expensive, not readily available investigation at the level of primary health care centers. However, MRI is the non-invasive gold standard investigation in early diagnosis, to evaluate the

extent of pathological involvement more accurately and narrow down the differential diagnosis.[8] Our study aims at the 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 the clinician to treat the patient at the early stages to prevent further progression of disease.[9] It also aims at the accurate staging of the disease and assesses the extent of involvement of the pathology in cases which are already detected on X-Ray, using MRI to guide the clinician in appropriate treatment according to the stage of involvement of pathology.[10] Our discussion also proves MRI as gold standard in evaluation of soft tissue and articular cartilage which are having limitations for the detection of pathology on plain radiography. There is noradiographic evidence of demineralization during the early phase of syndrome, as a result advanced imaging is required.[11] Magnetic resonance imaging is the most sensitive and predictable test for an early diagnosis and monitoring of disease progression.

Conclusion

In conclusion, MRI proved to be an excellent modality not only for the early diagnosis of osteonecrosis but also for the detection of infections as well as occult injuries, in and around the hip joint, with superior contrast resolution and without harmful radiation. The hip is a stable, major weight-bearing joint with significant mobility. In adults, hip pain may be caused by intraarticular disorders such as avascular necrosis, arthritis, joint effusion, tuberculosis and metastatic disease. In children common pathologies include DDH, Perthes disease and infections like tuberculosis. Plain radiography is a widely established, economical investigation readily available in all kinds of health setups for imaging the hip joint. Plain film radiography is used in the initial evaluation of any cause of hip pain. Plain film may not detect early pathologies like AVN, also cannot accurately characterize

_____

_____

the articular cartilage pathology and soft tissue involvement. MRI of the hips should be performed early in patients with persistent pain and negative radiography findings. MR imaging is a valuable tool in the evaluation of hip disorders because it enables assessment of articular cartilage, epiphyses, joint fluid, bone marrow and extra-articular soft tissues structures that can be affected by hip disease. MRI is an imaging technique that does not require exposure to radiation. MR imaging is the modality of choice when clinical examination is suspect for hip disease and plain radiographs are normal or equivocal. Early diagnosis and treatment is important in many of the disorders. With MRI one can stage the pathology to prognosticate and influence therapeutic decisions.

References
1. RJ, et al. In: Yochum TR, Rowe LJ. Yochum and Rowe's Essentials of skeletal radiology. 3rd ed. Philadelphia, Pa: Lippincot Williams & Wilkins; 2005.
2. Ragab Y, Emad Y, Abou-Zeid A. Bone marrow edema syndromes of the hip: MRI features in different hip disorders. Clinical rheumatology. 2008;27(4):475-82.
3. Beltran J, Herman LJ, Burk JM, Zuelzer WA, Clark RN, Lucas JG, *et al.* Femoral head avascular necrosis: MR imaging with clinical-pathologic and radionuclide correlation. Radiology 1988;166:215-20.
4. Mitchell DG, Rao VM, Dalinka MK, Spritzer CE, Alavi A, Steinberg ME, *et al.* Femoral head avascular necrosis: Correlation of MR imaging, radiographic staging, radionuclide imaging, and clinical findings. Radiology 1987;162:709-15.
5. Kramer J, Recht M, Deely D, Schweitzer M, Pathria M, Gentili A, et al. appearance of idiopathic synovial osteochondromatosis. J Comput Assist Tomogr. 1993;17(5):772-76.
6. Li KC, Hiette P. Contrast enhanced fat saturation MRI for studying the pathophysiology of ON of the hips. Skeletal Radiol 1992;21: 375-9.
7. Unger E, Moldofsky P, Gatenby R, Hartz W, Broder G. Diagnosis of osteomyelitis by MR imaging. AJR Am J Roentgenol 1988;150:605-10.
8. Hong SH, Kim SM, Ahn JM, Chung HW, Shin MJ, Kang HS. Tuberculous versus pyogenic arthritis: MR imaging evaluation. Radiology 2001;218:848-53.
9. Deutsch AL, Mink JH, Waxman AD. Occult fractures of the proximal femur: MR imaging. Radiology 1989;170:113-6.
10. Mamisch TC,Siebenrock KA, Bittersohl B, Kim YJ, Werlen S. MRI of hip osteoarthritis and implications for surgery. Magnetic Resonance Imaging Clinics. 2010;18(1):111-20.
11. Stoica Z, Dumitrescu D, Popescu M, Gheonea I, Gabor M, Bogdan N. Imaging of avascular necrosis of femoral head: familiar methods and newer trends. Current health sciences journal. 2009;35(1):23.

Conflict of Interest: Nil
Source of support: Nil

_____