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ROLE OF MAGNETIC RESONANCE IMAGING IN EVALUATION OF PAINFUL HIP JOINT PATHOLOGIES- A STUDY AT SBKS MI &RC, VADODARA

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ABSTRACT

Introduction- Magnetic resonance imaging (MRI) is frequently employed for assessing painful hips when X-ray results show no abnormalities. MRI is the preferred diagnostic tool due to its superior capability to precisely evaluate articular cartilage, joint fluid, and adjacent soft tissues, which can be sources of hip pain. This imaging technique is particularly beneficial for early detection, facilitating prompt intervention and treatment of hip joint conditions.

Material and Methods- A magnetic resonance imaging (MRI) study was carried out at Dhiraj Hospital, SBKS MI and RC, Sumandeep Vidyapeeth, Vadodara, involving 40 adult patients of both genders who presented with complaints of hip pain. The study utilized a PHILIPS 1.5 T MRI machine for imaging purposes.

Result- Of the 40 cases the males are more commonly affected than females. Major age group affected was between 21 to 30 years of age. The commonest pathology was Avascular necrosis of femoral head seen in 13 patients (32.5%). Followed closely by fractures in the femur bone in 8 patients (20%) followed by changes of osteoarthritis in the hip joint in 7 patients (17.5%). Bone infarcts were seen 6 cases (15%) while hip joint infections and tumors were seen in 3 patients each (7.5%). Magnetic resonance imaging helps in diagnosing with better evaluation of articular and surrounding soft tissue extension.

Conclusion- Among the 40 cases examined, males were more frequently affected than females. The primary age group affected was between 21 to 30 years old. The most common pathology observed was avascular necrosis of the femoral head, which was present in 13 patients (32.5%). This was closely followed by femur bone fractures in 8 patients (20%), and osteoarthritis changes in the hip joint in 7 patients (17.5%). Additionally, bone infarcts were detected in 6 cases (15%), while hip joint infections and tumors were each observed in 3 patients (7.5%). Magnetic resonance imaging proved instrumental in diagnosis, providing enhanced evaluation of articular and adjacent soft tissue involvement.

Keywords- Magnetic resonance imaging, Hip joint, Avascular necrosis of hip, Bone marrow edema, joint effusion, osteoid osteoma.

INTRODUCTION

Various pathologies involving both intra and extra-articular soft tissues, as well as tendon issues, can contribute to hip pain. A thorough history and physical examination, coupled with appropriate imaging and diagnostic techniques, typically lead to accurate diagnosis and treatment[1]. In adults, hip pain often presents with nonspecific symptoms, normal imaging results, and vague findings from examinations. Therefore, plain radiographs and magnetic resonance imaging (MRI) are typically the initial imaging modalities recommended for assessing hip joint conditions[2]. MRI has proven to be a valuable tool in evaluating hip disorders because it allows for assessment of articular structures, extraarticular soft tissues, and osseous structures affected by hip diseases[3]. Its high resolution for soft tissues and sensitivity in detecting bone marrow abnormalities enable early detection of many hip pathologies. MRI assessment includes evaluating tendon integrity, detecting tears, identifying bursae inflammation, and detecting bone marrow edema in the greater trochanter. In adults, hip MRI plays a crucial role in assessing osteoarthritis, particularly in cases of early onset or those related to femoroacetabular impingement. It facilitates the study of anatomical factors associated with impingement and its impact on intraarticular structures like the labrum and femoroacetabular cartilage[4]. Utilizing coronal and axial planes in MRI imaging provides symmetric, bilateral views, which are essential for diagnosis and significantly expedite the evaluation process for both hips. Coronal and axial MR images effectively illustrate the anatomy of the hip joint[5,6].

AIMS AND OBJECTIVES

Detection of various pathologies and to classify them according to various etiologies leading to painful hip.

MATERIALS AND METHOD

Prospective observational type study conducted at Department of Radiodiagnosis in Dhiraj Hospital, SBKS Medical Institute and Research Centre, Sumandeep Vidyapeeth, Vadodara with PHILIPS 1.5T MRI machine. Sample size of 40 patients, referred to Radiodiagnosis department with complaints of painful hip joint are recruited for the study.

INCLUSION CRITERIA-

Patients of adult age group (above 18 years of age) of both the genders and willing to participate in the study.

EXCLUSION CRITERIA-

- Patient below 18 years of age.
- Unwilling to participate in the study.
- Contraindications to MRI (Example- Pacemaker etc).

DATA ANALYSIS

Avascular Necrosis of Femoral Head

The femoral head's blood supply pattern makes it highly susceptible to avascular necrosis[7], a prevalent musculoskeletal condition affecting both middle-aged and younger populations. Typically asymptomatic at the outset, it often remains undetected until it progresses to severe joint damage, often before the age of fifty. Therefore, timely diagnosis of AVN is crucial[8]. Major contributing factors include corticosteroid usage, trauma, and alcoholism, while radiation exposure, infiltrative diseases, and sickle cell disease are also implicated. Magnetic resonance imaging (MRI) exhibits exceptional sensitivity in identifying early AVN cases[9]. It is widely regarded as one of the most sensitive, specific, and commonly utilized diagnostic tools for detecting femoral head avascular necrosis. Numerous studies have reported MRI's ability to diagnose early lesions with over 90% specificity and sensitivity, based on histological evidence or eventual collapse[10]. MRI typically reveals altered signal intensity bands and lines within the femoral head on both T1 and T2 weighted images. Notably, a "double line sign," consisting of a dark band believed to demarcate normal from infarcted marrow, is often observed. Additionally, crescentic areas of low intensity are visible in weight-bearing regions. Necrotic bone typically presents as low signal intensity on T1 weighted images and high signal intensity on T2 weighted images. AVN grading commonly utilizes the Ficat and Arlet classification system[11].

Osteoarthritis

Osteoarthritis is a degenerative condition caused by the breakdown of the cartilaginous membrane within the joint. It is categorized into primary and secondary osteoarthritis. Primary osteoarthritis occurs without any identifiable cause, typically affecting previously healthy joints in older individuals as an idiopathic phenomenon. On the other hand, secondary osteoarthritis arises as a result of predisposing conditions, often seen in younger individuals. This condition is multifactorial, involving systemic risk factors such as age, gender, hormonal imbalances, genetics, as well as intrinsic joint factors like muscle weakness and joint laxity, and extrinsic factors like obesity[12].Magnetic resonance imaging (MRI) is capable of illustrating various changes associated with osteoarthritis, including joint space narrowing, osteophytes, and subchondral alterations. MRI can also aid in detecting articular cartilage damage directly and assessing the extent of the damage. Techniques such as fast spin-echo images or gradient echo images are utilized to visualize cartilaginous damage. Additionally, three-dimensional gradient echo images with fat saturation can highlight abnormalities as bright signals or intra-substance hyperintense signals[13].

Bone Infarcts

Bone ischemia can manifest through various mechanisms, one of which is intravascular thrombosis in sickle cell disease, leading to osteonecrosis[14]. On magnetic resonance imaging (MRI), early bone infarctions typically exhibit intermediate to high signal intensity on T1-weighted images and high signal intensity on T2-weighted images, likely attributed to edema. The margins of the infarcted region appear hypointense compared to the center of the lesion and surrounding normal marrow, indicating fibrosis at the infarct margin.[15]

Infections

In MR imaging, altered bone marrow signal intensity is characterized by appearing hypointense on T1-weighted images, while it exhibits high signal intensity on T2-weighted images and contrast-enhanced T1-weighted images. Additionally, the soft tissue surrounding the infected hip often displays poorly defined areas of high signal intensity on T2-weighted images. Joint effusions are frequently associated with infective etiology in these cases[16].

Fractures and Dislocations

The acetabulum's depth, along with the presence of the labrum, a thick joint capsule, and strong muscular support, makes the ball and socket joint highly resistant to dislocation[17]. Anterior hip dislocation constitutes around 10% of all traumatic dislocations and can be further classified into superior type (caused by abduction, external rotation, and extension of the hip) and inferior type (caused by forced abduction, external rotation, and flexion of the hip). Posterior dislocation typically results from adduction, internal rotation, and flexion of the hip.

Hip dislocations commonly occur due to high-energy injuries, but incidents resulting from simple falls in elderly patients are also observed[18]. Magnetic resonance imaging (MRI) is valuable in detecting undisplaced hip fractures that may be missed on plain radiographs. It has demonstrated 100% sensitivity in identifying occult fractures[19].

Tumors

Magnetic resonance imaging (MRI) is the preferred method for assessing both osseous and soft tissue masses of the hip, offering crucial information for diagnosis and staging purposes. Lesions are visualized using conventional T1-weighted and fluid-sensitive MRI pulse sequences. Axial T1 and T2-weighted images are acquired, with additional imaging planes added as necessary based on the location and size of the lesion[20].

OBSERVATION AND RESULT

Gender Distribution

Gender	Number of patients	Percentage(%)
Male	28	70
Female	12	30
Total	40	100

Age wise Distribution

Age	Number of patient	Percentage (%)
18-20	3	7.5
21-30	11	27.5
31-40	10	25
41-50	09	22.5
51-60	02	5

61-70	01	2.5
71-80	03	7.5
81-90	01	2.5
Total	40	100

Pathologies

S.no.	Pathology	Number of Patients	Percentage (%)
1.	Avascular necrosis	13	32.5
2.	Bone infracts	06	15
3.	Osteoarthritis	07	17.5
4.	Infective	03	7.5
5.	Fracture/dislocations	08	20
6.	Tumors	03	7.5
	Total	40	100

MRI findings in AVN

MRI Findings	Number of Patients	Percentage (n=13)
Bone marrow edema	11	84
Geographical lesion	12	92
Joint effusion	10	76
Double line sign	09	69
Femoral head flattening and collapse	07	53
Secondary osteoarthritic changes	03	23

MRI findings in osteoarthritis

MRI Findings	Number of Patients	Percentage (n=7)
Articular cartilage T2W high signal	6	85.7
Indistinct trabeculae/signal loss in femoral head/neck on T1W images	6	85.7
Subchondral signal loss	3	42.9

Femoral head deformity	1	14.2

MRI findings in infective hip

MRI Findings	Number of Patients	Percentage (n=3)
Joint effusion	3	100
Bone marrow edema	2	66.6
Subarticular cysts	2	66.6
Joint space reduction	1	33.3
Joint destruction and bony ankylosis	1	33.3
Soft tissue hyperintensity on T2WI	2	66.6

MRI findings in bone infarct

MRI Findings	Number of patients	Percentage(n=6)
Hyperintensity on T2WI	6	100
STIR hyperintensity	6	100

MRI findings in fracture and dislocation

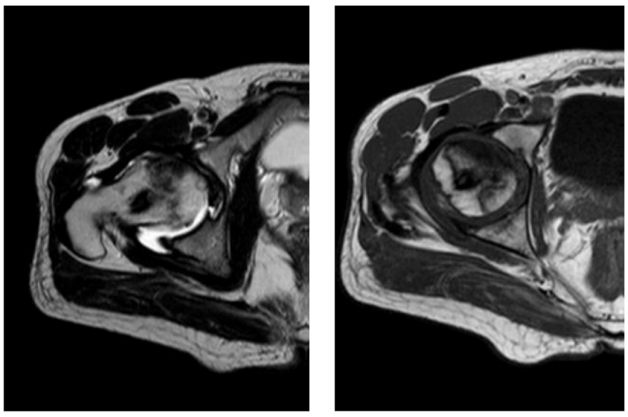
MRI findings	Number of Patients	Percentage(n=8)
Marrow edema	8	100
Joint effusion	5	62.5
T2 and STIR hyperintensity adjacent muscle planes	4	50
Contour irregularities involving head of femur	3	37.5

MRI findings in bone tumors

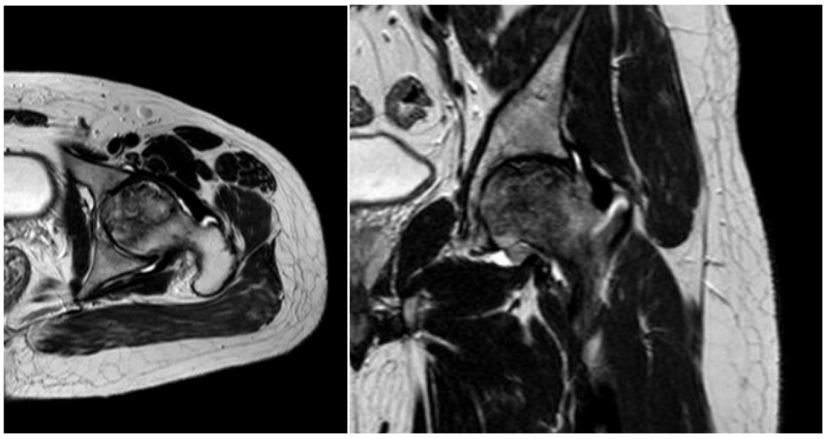
	Number of Patients	Percentage(n=3)
Altered signal	3	100
Altered contour of femur	2	66.7

CASES AND IMAGES

Avascular Necrosis of Femur

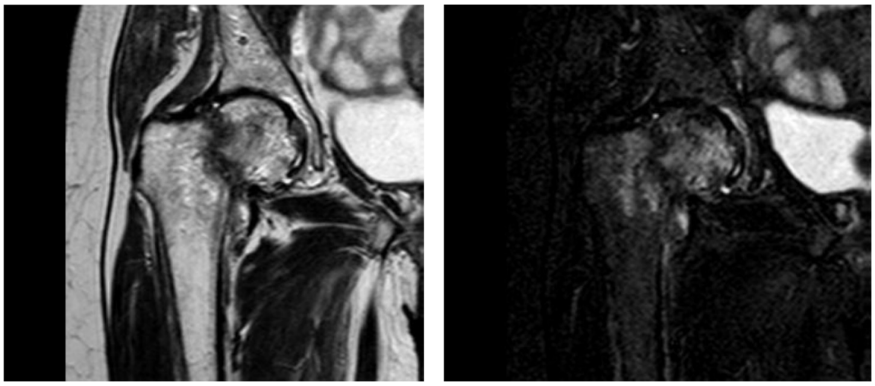


Geographic regions of altered signal intensity are observed in the right head of the femur, characterized by serpiginous areas of hyperintensity on T2-weighted and T1-weighted images. Mild cortical irregularity is also evident. This findings are indicative of Grade IV avascular necrosis of the head of the femur.



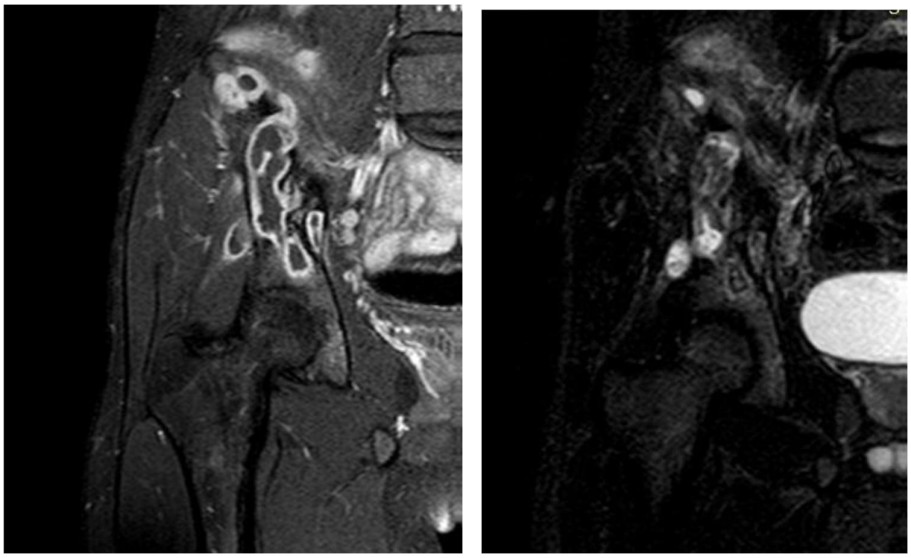
There is an abnormal signal intensity area in the antero-superior aspect of the femoral head, with peripheral hypointensity. Additionally, subarticular cystic changes are observed within the femoral head, along with minimal effusion. These findings are consistent with Grade III avascular necrosis.

Fracture Neck of Femur



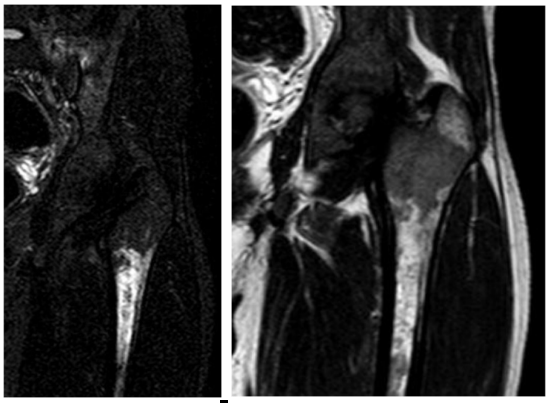
A fracture of the neck of the femur is observed, accompanied by superior subluxation of the greater trochanter. Hyperintense signals on T2-weighted and short tau inversion recovery (STIR) sequences are noted, indicating the possibility of contusion.

Infective Lesions



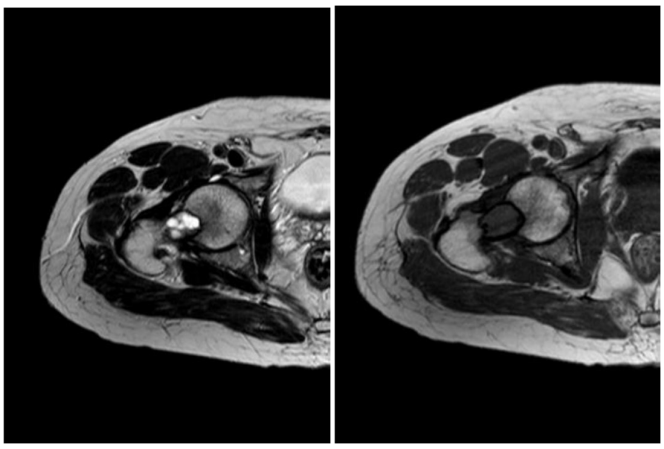
Multiple well-defined peripherally enhancing focal collections are observed in the right iliac bone, which appear to merge together. These collections seem to extend into the deeper layers of the right iliopsoas muscle. On STIR images, the lesion displays a hyperintense signal. These findings strongly suggest the possibility of an infective etiology.

Bone Infarcts



Ill-defined abnormal marrow signal intensity lesions are observed in the visualized portion of the proximal shaft of the femur. These lesions appear hyperintense on T2-weighted and short tau inversion recovery (STIR) sequences, raising the possibility of bone infarcts.

Tumors



A well-circumscribed lesion with altered intensity is observed, appearing hyperintense on T2-weighted imaging (T2WI) and hypointense on T1-weighted imaging (T1WI). A peripheral sclerotic rim is evident, appearing hypointense on both T1WI and T2WI, with a small T2 hypointense focus within the center of the lesion. These findings are indicative of a possible nidus, consistent with osteoid osteoma.

CONCLUSION

In our study conducted at Dhiraj Hospital, SBKS MI and RC, Sumandeep Vidyapeeth, 40 patients with complaints of hip pain underwent magnetic resonance imaging (MRI). The majority of patients fell within the age group of 21 to 30 years, accounting for 27.5% of the cases, closely followed by the 31 to 40 years age group, representing 25% of the cases. Among the 40 patients, 28 were males and 12 were females, indicating a male predominance. Regarding diagnoses, out of the 40 cases, 13 were diagnosed with avascular necrosis of the femoral head, 7 with osteoarthritis, 8 with fractures and dislocations, 3 with tumors, 3 with infections, and 6 with bone infarcts.

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