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## Magnetic resonance imaging (MRI) in diagnosis of non-traumatic hip joint pain

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### Abstract

**Background:** The hip is a significant weight bearing, highly mobile, ball-and-socket synovial joint. There are several reasons of hip pain, such as congenital and developmental, viral, arthritic, and malignant conditions. Magnetic resonance imaging is the method of choice for determining the severity of osseous, chondral, and soft-tissue abnormalities of the hip joint, as well as for characterizing numerous illnesses. This study investigate the role of MRI in identifying hip joint discomfort.

**Methods and Results:** Seventy-five both sexes patients with unilateral or bilateral painful hip joint were examined. The patients with age ranged from 10 to 70 years (mean age  $54.74 \pm 10.52$  years) were 42 males (mean age  $51.44 \pm 11.50$ ) and 33 females (mean age  $42.75 \pm 12.24$ ) with male to female ratio 1.3:1. All our patients subjected to careful history taking, thorough clinical examination, routine laboratory investigations and local examination of the diseased hip. The majority of patients were in the age group 40-50 years followed by the age group of 50-60 years, with a male preponderance. The commonest chief complaint, other than pain of the involved hip joint, was restricted movement. All patients underwent MRI examination of both hips using a TOSHIBA 1.5 Tesla MRI machine scanner. Unilateral hip involvement was more common than bilateral. The commonest hip disorder was osteoarthritis, followed by avascular necrosis (AVN) of femoral head, tendinopathy, bursitis, sacroiliitis, Cam type femoral-acetabular impingement, ischio-femoral-impingement and perthe's disease.

**Conclusion:** The MRI is the diagnostic method of choice for evaluating hip issues. It can discover certain features that lead to an accurate diagnosis of the uncomfortable hip joint and play a vital role in treatment and monitoring of sick joint by doctors.

**Keywords:** Arthritis, hip joint, magnetic resonance imaging, hip pain, avascular necrosis

### Introduction

The hip joint links the axial skeleton to the lower extremities via the acetabulum and femoral head. It is a major weight-bearing joint with great mobility in the human body. There are several causes of hip pain, such as intra-articular disorders (avascular necrosis, loose bodies, and arthritis), peri-articular pathology (tendonitis and bursitis), and extra-articular conditions referred pain from lumbar spine, sacroiliac joint and nerve entrapment syndromes) [1].

Hip pain is a common non-specific symptom occurring in 14% of the population over 60 years of age [2]. Inconclusive radiography data, an inconsistent medical history, and unreliable clinical findings provide a significant diagnostic challenge for the physician [3].

This demonstrates the significance of Magnetic Resonance as a non-invasive imaging method for identifying the complete amount of osseous, chondral, and soft-tissue involvement in a variety of disorders. When characterizing hip anatomy and pathology, MRI can also identify synovial proliferations, joint effusion, articular cartilage abnormalities, ligaments, subchondral bone, muscles, and juxtaarticular soft tissue [4].

MRI facilitates the accurate identification, localization, and characterization of hip illness, hence aiding the diagnosis and therapy of a variety of hip pathological conditions [5]. The purpose of this study was to investigate the role of MRI in the diagnosis of non-traumatic hip joint discomfort.

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## Materials and Methods

### Methods

#### Patients

This prospective interventional study was carried out following the approval of the Research Ethical Committee, from May 2021 to February 2022, on both sexes' seventy-five patients, age from 10 to 70 years (mean age  $54.74 \pm 10.52$  years). The inclusion criteria included both sexes, patients presenting with acute or chronic unilateral or bilateral hip joint pain. The exclusion criteria were patients with a history of acute trauma to hip, a history of claustrophobia, previous hip surgery, cardiac pacemakers, and a history of ferromagnetic implants, cochlear implants, and metallic foreign body in situ. All our patients underwent careful history taking, routine laboratory investigations, thorough clinical examination and local examination of the diseased hip. All patients had MRI examinations of both hips with a 1.5 Tesla TOSHIBA MRI scanner.

#### Procedure and Imaging characteristics

##### Protocol of the magnetic resonance scan of the hip joint

Patients frequently lay supine on the exam table. Their feet were turned inwards and taped if required, and their knees were bent slightly. Using the body coil with a wide field of view to examine both hips for probable bilateral abnormalities to identify the extent of the lesions and compare the normal and abnormal sides. Adjusting the slice width to 4-8 mm and employing thinner slices when additional data is required.

#### Images taken in the following sequences:

##### Scout view of the hip:

- Axial T1 T2 fat suppression.
- Coronal T1 T2 fat suppression.
- Sagittal T2 fat suppression.

#### Statistics

Data were presented as mean  $\pm$  standard deviation (SD) or number and frequency percent. All statistical operations done using SPSS 26 (IBM, IL, USA).

#### Results

Seventy-five patients with age ranged from 10 to 70 years (mean age  $54.94 \pm 10.52$  years) were eligible for this study. They were 42 (56%) males (mean age  $51.44 \pm 11.50$ ) and 33(44%) females (mean age  $42.75 \pm 12.24$ ). The majority of patients were in the age group 40-50 years followed by the age group of 50-60 years. There was male predominance with males accounting for 42/75 case (56%), and females accounting for 33/75 cases (44%) with male to female ratio 1.3:1. [Table 1].

Out of 75 patients, 10 patients (13.3%) had normal MRI findings with no disease. The remaining 65 cases presented with bilateral hip involvement in 23 (35.4%), and unilateral hip involvement was found in 42 (64.6%). The commonest chief complaint, other than pain of the involved hip joint was lower back pain 15 (20%), restricted movement in 32 (42.6%) hip joints, pain radiating to the ipsilateral knee in 18 (24%) hip joints, fever in 14 (18.7) joints and weight loss was present in 5 (6.7%) patients. Based on the findings obtained by MRI, 10 cases (13.3%) were normal. However, in the remaining 65 (86.6%) the final diagnoses were as the following: osteoarthritis followed by avascular necrosis (AVN) of femoral head, tendinopathy, Cam type femoral-

acetabular impingement, ischio-femoral- impingement and perthe's disease (Table II-Figs 1-7). The dominant diagnostic MRI findings in cases of osteoarthritis were present in Table (III-Fig. 8). Table IV summarizes diagnostic MRI findings in AVN (Fig.9).

#### Discussion

Hip pain is a prevalent and dangerous condition that affects people of all ages, posing a difficult diagnostic challenge. MRI is the most sensitive diagnostic technology and the benchmark for noninvasive diagnostic evaluation. It allows for the accurate diagnosis of asymptomatic lesions that are not visible on traditional radiographs, allowing for earlier treatment and a more successful response. It provides multiplanar imaging and great soft tissue resolution, and it may demonstrate the therapeutic response of the femoral head [6].

Our study showed the maximum number of patients with painful hip joint falling in the age group of 40-50 years followed by 50-60 years with a mean age of 52.74 years and male predominance with male to the female sex ratio of 1.3:1. Similarly, Ragab *et al.* [7] reported that among 34 patients who complained of hip pain, 21 (61.8%) were men and 13 (38.2%) were women. They showed that unilateral hip involvement was identified in 31 (91.2%) patients, and bilateral hip involvement was found in three (8.8%) patients. Kondeti *et al.* [8] observed the maximum no. of patients with nontraumatic hip joint pain were male with a male to female ratio of 2.8:1. Also Reddy *et al.* [9] showed a male to female ratio of 3:1. RamBhamu *et al.* [10] in their study on MRI of the painful hip joint, found that, the male to female ratio of 2.3:1. The studies by Tripathi *et al.* [11], and Venkateshwar *et al.* [12], also showed a male predominance, with M: F ratios of 2:1 and 3:1 respectively. In our study on 65 cases with abnormal MRI findings, 42 patients had unilateral involvement, which amounts to 64.6% of total patients while 23 (35.4%) patients had bilateral involvement. This coincided with Ragab *et al.* [11] and Dutta *et al.* [13] in their study on imaging of hip pathologies where the 66.6% pathologies detected were unilateral while 33.3% were bilateral. This also, corroborates with the study conducted by Tripathi *et al.* [11], in which 52% had unilateral hip involvement and 48% had bilateral involvement. In addition, in the study by Venkateshwar *et al.* [12], 58% patients had unilateral hip involvement and 42% had bilateral involvement.

The commonest hip disorder in our study was osteoarthritis, followed by avascular necrosis (AVN) of femoral head, tendinopathy, bursitis, sacroiliitis, Cam type femoral-acetabular impingement, ischio-femoral- impingement and perthe's disease. These results were in comparison with the findings of previous researchers who showed that the most common underlying pathology of the painful hip joint was avascular necrosis followed by osteoarthritis. Drar *et al.* [14] Kalekar *et al.* [3] and Reddy *et al.* [9] also showed avascular necrosis as the most common diagnosis in non-traumatic hip pain followed by osteoarthritis. This variation could be attributed to the factors relating to different age of patients, number of cases, nationality and coexisting morbidities in those patients. In addition, Osteoarthritic changes occurred in 50% of AVN patients.

The most common MRI findings in the patients with hip osteoarthritis in the present study was hip joint effusion, bone marrow edema at femoral head and acetabulum,

subchondral cysts, osteophytes formation followed by narrowed joint space and marginal sclerosis. Vaghamashi *et al.* [15] in their study showed the common MRI findings of hip osteoarthritis were osteophytes formation, joint effusion, subchondral cysts, and bone marrow edema similar to our study.

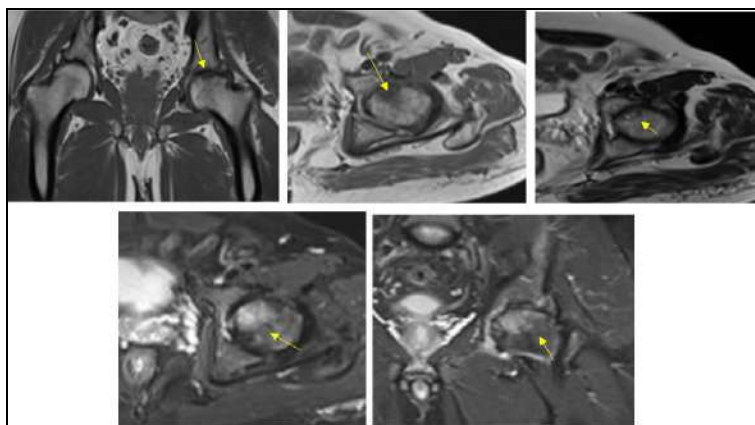
Among the MRI findings of AVN in our study, the most common were double line sign of femoral head and femoral head cortical irregularity and collapse followed by bone marrow edema, and hip joint effusion. Tushar and Pooja [16] in their study mentioned that 87% of AVN cases were noted to have bone marrow edema and 79 % showed a characteristic specific finding of “double line “ sign. MRI findings in a study done by Rekha *et al.* [17] on AVN were bone marrow edema, subchondral cysts, and double line sign. In addition, Vaghamashi *et al.* [15] observed that the most common findings on MRI in patients with avascular

necrosis of femoral head were focal subchondral signal abnormality and hip joint effusion.

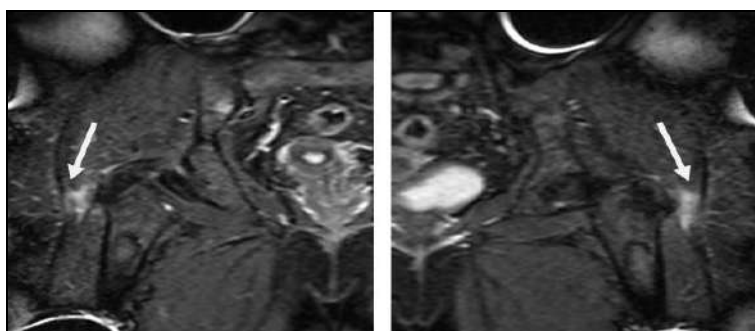
Out of 65 hips examined in present study, three patients (4%) were with femoral-acetabular impingement (FAI). Both of them had CAM type. Vaghamashi *et al.* [15] similarly showed the percentage of cases with a femoroacetabular impingement in their study as 1.92%. Perthe's disease was found in 2 cases (2.7) in our study manifested by cortical irregularities and hypointense line separating proximal and distal area of bone exhibit low T1 and T2 signal intensities (femoral Leg-Calve-Perthe's disease “LCPD”). Daniel *et al.* [18] showed that environmental tobacco smoke is associated with an increased risk of LCPD; also, exposure to wood smoke appears to be a risk factor. Therefore, young children must be kept away of environmental pollution and passive smoke.



**Fig 1:** Male patient aged 53 years old presented by hip pain and limitation of movement. MRI sequences (A) coronal T1WI, (B) coronal STIR and (C) axial STIR show ; Osteoarthritic changes of right hip joint manifested by subchondral sclerosis noted at the superolateral aspect of joint with small subchondral cysts, together with minimal hip joint effusion (A,B and C) (White arrows), these findings consistent with early osteoarthritis of right hip joint.

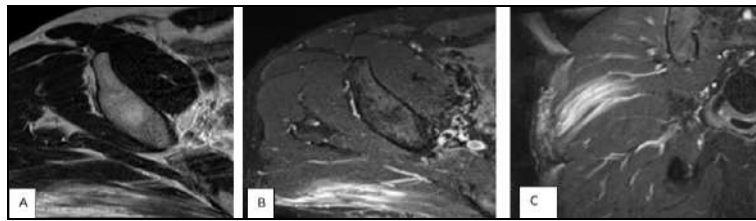


**Fig 2:** Male patient aged 60 years old presented by chronic bilateral hip pain. (A) Coronal T1WI, (B) axial T1WI, (C) axial T2WI, (D) axial STIR and (E) coronal STIR show; cortical irregularities with partial collapse in left femoral head. Areas of altered marrow signal intensity is seen involving the supero-anterior portion exhibiting low T1 and intermediate T2 signal intensities with high signal intensity at STIR (Arrows). This is associated with minimal left sided joint effusion, this MRI picture suggestive for left femoral head avascular necrosis

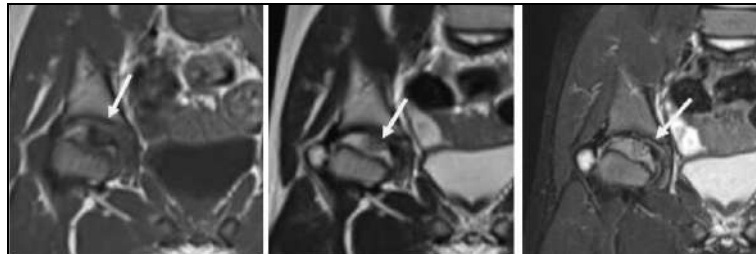


**Fig 3:** Female patient 43 years old presented by bilateral hip pain during movement. MRI STIR sequence of right and left sides (A & B) show: bilateral altered signal intensity of both gluteus medius and minimus at their insertion at greater trochanter (Arrows), MRI picture suggestive for greater trochanter pain syndrome.

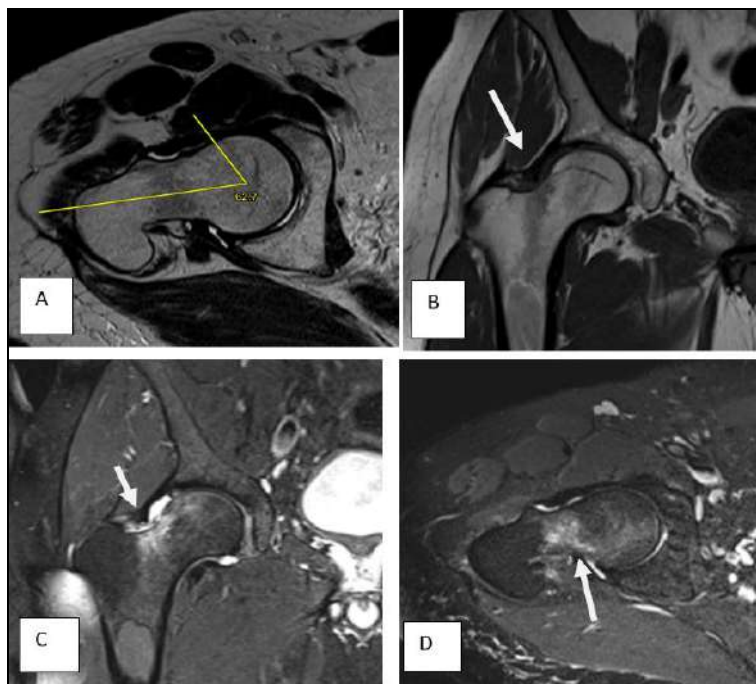




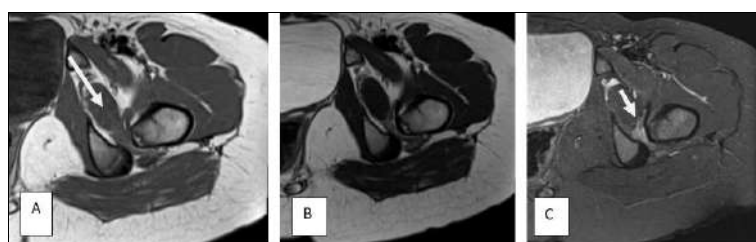
**Fig 4:** Male patient aged 59 years old , MRI sequences (A) axial T2WI, (B) axial STIR and (C) coronal STIR show : Abnormal signal intensity is noted in gluteus maximus muscle with feathery appearance displaying high T2 (A) and STIR (B & C) signal intensity , no fluid collections, likely related to muscle strain.



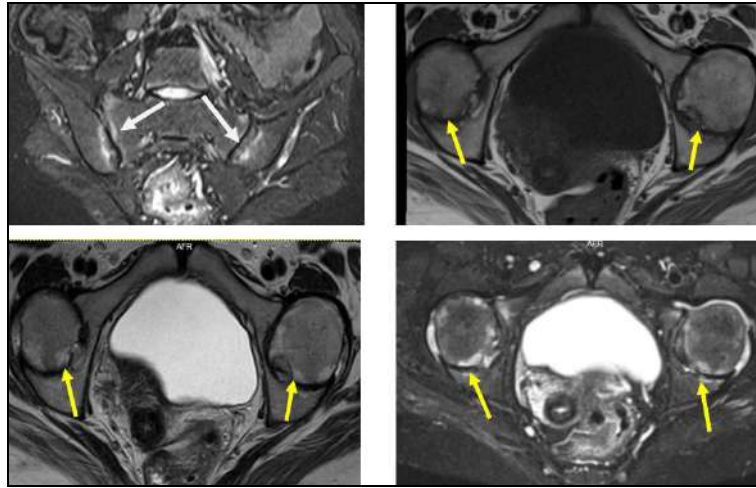
**Fig 5:** Male boy 10 year old presented by unilateral limping. MRI sequences (A) coronal T1WI, (B) coronal T2WI and (C) coronal STIR show: The right femoral head with relative decreased height with minimal cortical irregularities and hypointense line separating proximal and distal area of bone (Arrows) exhibit low T1 and T2 signal intensities associated with subtle right sided joint effusion. MRI findings are suggesting of early affection of right femoral Leg-Calve-Perthe's disease.



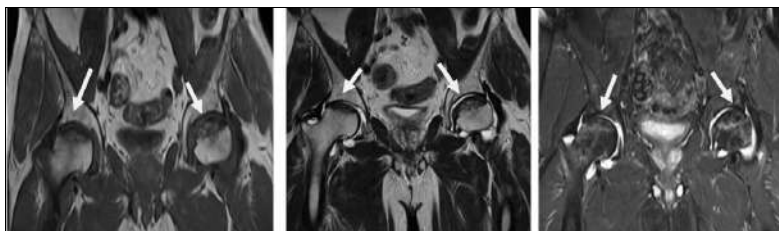
**Fig 6:** Male patient aged 54 years presented by hip pain. MRI sequences (A) Axial T2WI, (B) Coronal T1WI, (C) Coronal STIR and (D) Axial STIR show: Focal bulge seen at head neck junction with increased Alfa angle (about 62.7 degrees). (A) associated with bone marrow edema at superior part of right femoral head and neck displaying low T1, iso T2 & high STIR (White arrows), together with acetabular chondral changes at its anterior superior aspect in form of increased intra substance signal intensity. Overall picture is suggestive of femoro-acetabular impingement (CAM type).



**Fig 7:** Female patient aged 27 years old complains from left hip pain. MRI sequences (A) Axial T1WI, (B) Axial T2WI and (C) Axial STIR show ; Narrowing of ischiofemoral space (measures 8 mm) with compression of quadratusfemoris muscle (quadratusfemoris space= 5 mm) associated with edema of quadratusfemoris muscle displaying high signal intensity in T2WI and STIR sequences. MRI picture is impressive of ischio-femoral impingement syndrome.



**Fig 8:** Female patient aged 38 years old with history of rheumatoid disease. MRI sequences (A) Coronal STIR, (B) Axial T1WI, (C) Axial T2WI and (D) Axial STIR show ; Patchy areas of bone marrow edema noted at subchondral regions at both articulating bones of both sacroiliac joints , displaying high STIR signal intensity with multiple areas of cortical erosions (White arrows). Similar picture noted at both articulating bones of both hip joints , displaying low T1 and high T2 and STIR signal intensity , together with mild bilateral joint effusion (Yellow arrows) these MRI findings consistent with rheumatoid arthritis.



**Fig 9:** Male patient aged 67 years old presented by bilateral hip pain , (A) Coronal T1WI, (B) Coronal T2WI and (C) Coronal STIR: Both femoral heads show cortical irregularities. Geographic areas of altered marrow signal intensity is seen exhibiting low, T2 and STIR signal intensities (subchondral sclerosis) (White arrows), with double line sign, associated with underlying bone marrow edema. The above findings are suggesting late bilateral avascular necrosis.

**Table 1:** Baseline characteristics of patients with painful hip joint

Characteristic	Number (n =75)	Percent (%)
<b>Age (years)</b>		
Mean age	54.74 years	
10-20 years	8	10.7
21-30 years	10	13.3
31-40 years	12	16
41-50 years	25	33.3
51-60 years	15	20
61-70 years	5	6.7
<b>Sex</b>		
Male	42	56
Female	33	44
<b>Laterality of abnormal MRI</b>	65	100
<b>Unilateral</b>	42	64.6
Unilateral right	25	38.4
Unilateral left	17	26.2
Bilateral	23	35.4

**Table 2:** Magnetic resonance imaging in patients with painful hips

Condition	Number	Percentage (%)
Osteoarthritis	12	16
Avascular necrosis	8	10.7
Tendinopathy	11	14.7
Bursitis	8	10.7
Sacroiliitis	7	9.3
Muscle pathology	6	8
Adductor strain	3	
Gluteus maximus strain	3	
Cam femoral-acetabular impingement	3	4
Migratory osteoporosis	3	4

Ischio- Femoral impingement	2	2.7
Perthe's disease	2	2.7
Soft tissue abscess	1	1.3
Osteomyelitis of pubic bone	1	1.3
Slipped capital femoral epiphysis	1	1.3
Normal both hips	10	13.3
Total	75	100

**Table 3:** Showed the diagnostic MRI findings seen in 12 cases with osteoarthritis.

MRI findings	Number	Percentage (%)
Hip joint effusion	11	91.7
Bone marrow edema at femoral head and acetabulum.	8	66.7
Subchondral cysts.	6	50
Osteophytes formation.	5	41.7
Narrowed joint space	5	41.7
Marginal sclerosis	3	25
Labral denudation and perilabral cyst	2	16.7

This overlap is due to bilaterality of some cases.

**Table 4:** Showed the diagnostic MRI findings seen in 8 cases with avascular necrosis.

MRI findings	Number	Percentage (%)
Focal subchondral signal abnormality	7	87.5
Joint effusion	6	75
Bone marrow edema	6	75
Irregularity of the femoral head	5	62.5
Double-line sign	4	50
Osteoarthritic changes	4	50

This overlap is due to bilaterality of some cases.

## Conclusion

Due to its high resolution, improved tissue contrast differentiation, and multiplanar imaging capabilities, magnetic resonance imaging (MRI) is the optimal approach for identifying hip difficulties. It can identify particular characteristics that lead to an accurate diagnosis of the painful hip joint and play a crucial role in the proper treatment and monitoring of the ailing joint by physicians.

## Abbreviations

**MRI:** Magnetic resonance imaging; **AVN:** Avascular necrosis; **SD:** Standard deviations; **FAI:** Femoral-acetabular impingement; **(FAI); LCPD:** Leg-Calve-Perthe's disease.

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