

## Role of Magnetic Resonance Imaging in evaluation of adult non-traumatic painful hip

Noha M. Osman, Tarek W. Hemeda, Mariam T. Thabit

Department of Radiodiagnosis, Faculty of Medicine, Ain Shams University

### Abstract

**Aim of the Work:** to assess the role of Magnetic Resonance Imaging as a non-invasive diagnostic modality in adult patients with non-traumatic painful hip joint.

**Patients and Methods:** This study was conducted on 60 adult patients with non-traumatic hip pain, referred from the outpatient orthopedic clinic, Ain Shams University hospitals. The patients were investigated using magnetic resonance imaging (MRI). All MR imaging examinations were conducted at the Department of Radiodiagnosis of the Ain Shams University with the same 1.5-T unit (Philips Healthcare, Best, the Netherlands) with a body coil.

**Results:** avascular necrosis is the commonest cause of bilateral hip pain (25%) of the study patients followed by osteoarthritis (11.7%), while unilateral hip pain is commonly caused by stress fractures (8.3%), isolated joint effusion (10%) and tendinopathies (3.3%). Other causes included Marrow edema with hip effusion, chronic anemic state, migratory osteoporosis, osteoid osteoma, bursitis, bone infarcts, osseous hemangioma, hemosiderosis, sacroiliitis, femoral-acetabular impingement, iliacus abscess and bone marrow edema. Magnetic resonance imaging doesn't only demonstrate disorders of hip joint only; it also gives an accurate assessment of other extra-articular causes of referred hip pain as degenerative disc diseases and pelvic conditions.

**Conclusion:** Magnetic resonance is the best imaging modality to assess hip joint in non-traumatic cases. It has a great ability to diagnose disorders of bone, cartilage, ligaments, muscles and soft tissue. MRI can also detect joint effusion and bone marrow edema.

**Key words:** Magnetic Resonance Imaging, adult non-traumatic painful hip, non-invasive diagnostic modality

### Introduction

Hip joint is a major weight-bearing joint with significant mobility. Hip pain in non-traumatic cases is a non-specific symptom occurring in 14% of the population over 60-year age <sup>(1)</sup>. There are different etiologies for hip pain either articular or extra-articular <sup>(2)</sup>.

In adults, intraarticular causes may include avascular necrosis, arthritis, loose bodies, tendonitis and bursitis, while extra-articular causes may include referred pain from lumbar spine, sacroiliac joint and nerve entrapment syndromes <sup>(3)</sup>.

Normal appearing radiographs, non-reliable history and clinical findings forms a difficult diagnostic dilemma. Many conditions as trauma, infection, arthritis, avascular necrosis, tumor, and hip dysplasia can manifest with non-

significant radiographic findings <sup>(4)</sup>. Here comes the importance of Magnetic

Resonance as a non-invasive diagnostic imaging modality for characterizing hip anatomy and pathology. Magnetic resonance imaging (MRI) advantage is helping in

accurately detection, localization, and characterization of hip pathology, which leads to improve diagnosis and proper managing of

different intra-articular and extra-articular pathologies of hip pain <sup>(5)</sup>, <sup>(6)</sup>.

### Aim of work

The purpose of our study is to assess the role of Magnetic Resonance Imaging as a non-invasive diagnostic modality in adult patients with non-traumatic painful hip joint.

### Patients and Methods

This study is conducted on adult patients with non-traumatic hip pain, referred from the outpatient orthopedic clinic, Ain Shams University hospitals. The patients were investigated using magnetic resonance imaging (MRI).

**Study place:** Ain Shams University Hospitals -Cairo-Egypt.

**Sample size:** 60 patients

**Equipment used:** All MR imaging examinations were conducted at the Department of Radiodiagnosis of the Ain shams University with the same 1.5-T unit (Philips Healthcare, Best, the Netherlands) with a body coil.

**Inclusion criteria:**

A.Age group: adult age (between 18 and 80 years).

B.Both sexes were included.

C.patients with unilateral or bilateral painful hip joint who underwent hip MRI.

**Exclusion criteria:**

Patients with history of trauma and younger than 18 years were excluded from the study.

**MRI protocol including the following:**

1. All MR imaging examinations were conducted at the Department of Radiodiagnosis of the Ain shams University with the same 1.5-T unit (Philips Healthcare, Best, the Netherlands) with a body coil.

2. The images of the selected patients were obtained:

.coronal T1 TSE (TR=1106, TE=24, FOV=39.3x37.7 Cm, slice thickness 4mm).

.coronal T2 TSE (TR=3500, TE=120, FOV=39.3x37.7cm, slice thickness 4mm), coronal T2 FFE (TR=682.9, TE=18.4, FOV=39.3x37.7Cm, slice thickness 4mm).

.coronal STIR TSE (TR=2656.8, TE=55, FOV=39.3x37.7cm, slice thickness 4mm).

.axial T1 TSE (TR=1363.8, TE=24, FOV=36.8x38.6cm, slice thickness 4mm).

.axial T2 TSE (TR=3500, TE=110, FOV=36.8x38.6cm, slice thickness 4mm).

.axial STIR TSE (TR=3600, TE=30, FOV=36.8x38.6cm, slice thickness 4mm).

Contrast administration of Gadolinium injection 0.1 mL/kg body weight (0.1mmol/kg), was given intravenous to selected cases according to clinical suspicion.

**Images Interpretation:**

MRI images were reviewed by musculoskeletal radiologists in the radiodiagnosis department using the different sequences and planes to assess the findings.

**Results**

**1-Demographic data:**

The study included 60 patients, females 41 (68.3%) and males 19(31.7%) (table 6). The mean age group was 20-40 years with 6 patients under the age of 20 years old (10%), 31 patients between the ages of 20 to 40 years old (51.7%), 14 patients between the ages of 40 to 60 years old (23.3%), 9 patients between the age of 60 to 80 years old (15%) (table 7).

**2- Clinical Data:-**

All of the 60 cases (100%) complained of pain in one or both hip joints whereas none of them (0%) had history of trauma.

**3- MRI Data:**

Out of 60 patients, 18 patients (30%) had unilateral abnormalities in MR images and 32 patients (53.3%) had bilateral hip joint abnormalities, while 10 cases (16.7%) showed no MRI signs of any disease (table 1).

	number	Percentage
Unilateral	18	30 %
Bilateral	32	53.3 %
normal	10	16.7 %
total	60	100 %

**Table (1):** laterality of MRI abnormal findings.

MRI images of the 60 patients examined revealed the following results as final main diagnoses:

Out of 60 cases, 15 cases (25%) were diagnosed as Avascular necrosis, 7 cases (11.7%) as osteoarthritis, 6 cases (10%) as isolated hip joint effusion, 5 cases (8.3%) as stress fracture, 3 cases (5%) as combined bone marrow edema with hip effusion, 2 cases (3.3%) as tendinopathy, 2 cases (3.3%) as chronic state of illness likely chronic anemic state, 1 cases (1.67%) as migratory osteoporosis, 1 case (1.67%) as simple ovarian cyst, 1 case (1.67%) as bursitis, 1 case (1.67%) as multiple bone infarcts, 1 case (1.67%) as hemorrhagic ovarian cyst, 1 case (1.67%) as hemosiderosis, 1 case (1.67%) as sacroiliitis, 1 case (1.67%) as femoral-acetabular impingement, 1 case (1.67%) as iliacus abscess, 1 case (1.67%) as femoral neck bone marrow edema only., 10 cases (16.7%) were found to be normal (table 2).

Condition	number	percentage
Avascular necrosis	15	25%
osteoarthritis	7	11.7%
Isolated Hip joint effusion	6	10%
Stress fracture	5	8.3%
Marrow edema with hip effusion	3	5%
tendinopathy	2	3.3%
Chronic anemic state	2	3.3%
Migratory osteoporosis	1	1.67%
Simple large ovarian cyst	1	1.67%
Bursitis	1	1.67%
Bone infarcts	1	1.67%
Hemorrhagic ovarian cyst	1	1.67%
hemosiderosis	1	1.67%
Sacroiliitis	1	1.67%
Femoral-acetabular impingement	1	1.67%
Iliacus abscess	1	1.67%
Femoral head bone marrow edema	1	1.67%
Normal both hips	10	16.7%
Total	60	100%

**Table (2):** distribution of the main pathologies causing hip pain diagnosed by MRI in total 60 patients.

However, there were combined multiple secondary diagnoses as some single cases showed a variety of findings interpreted as below (table 3).

condition	number	percentage
Avascular necrosis	15	25%
osteoarthritis	11	18.4%
Stress fracture	6	10%
tendinopathy	3	5%
Chronic anemic state	2	3.3%
Migratory osteoporosis	1	1.67%
Osteoid osteoma	1	1.67%
Bursitis	2	3.3%
Bone infarcts	1	1.67%
Osseous hemangioma	1	1.67%
hemosiderosis	1	1.67%
Sacroiliitis	2	3.3%
Femoral-acetabular impingement	1	1.67%
Iliacus abscess	1	1.67%
Bone marrow edema	19	31.7%
Hip joint effusion	24	40%
Bony islands	1	1.67%
Bone cysts	1	1.67%
Muscle pathology	3	5%
Osteoporosis	2	3.3%
Pelvic ascites	1	1.67%
Synovitis	2	3.3%
Simple ovarian cyst	2	3.3%
Hemorrhagic ovarian cyst	1	1.67%
Normal both hips	10	16.7%
total	114	190%

**Table (3):** details of abnormal MRI findings as demonstrated in total 60 MRI.

Our study proved that avascular necrosis and osteoarthritis are the most common causes of non-traumatic painful hip joint.

There were specific MRI findings of each of the two diseases. Most cases showed one or more signs.

In all cases of avascular necrosis, focal subchondral sign abnormalities were noted, double line sign in 80%, joint effusion in 66.7%, marrow edema in 60%, collapsed deformed femoral head in 20% of the cases (table 4).

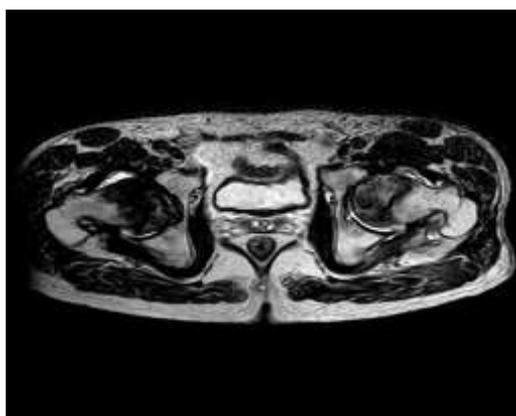
MRI findings	Number	Percentage
Focal subchondral sign abnormality	15	100%
Double line sign	12	80%
Joint effusion	10	66.7%
Marrow edema	9	60%
Collapsed deformed femoral head	3	20%

**Table (4):** diagnostic MRI findings seen in cases of avascular necrosis.

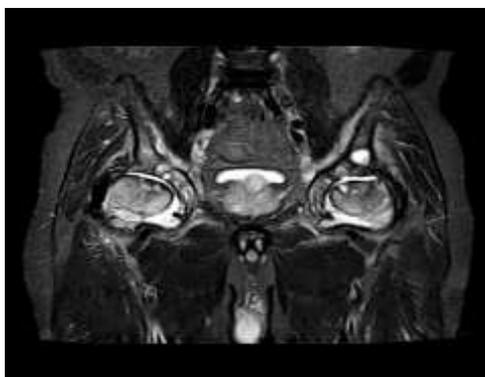
In cases of osteoarthritis, all cases showed joint effusion, joint space narrowing and marginal osteophytes. Subchondral cysts were noted in 85.6%, marrow edema in 42.9%, synovial thickening in 14.3%, and soft tissue edema in 14.3% (table 5).

MRI finding	Number	Percentage
Joint effusion	7	100%
Joint space narrowing	7	100%
Marginal osteophytes	7	100%
Subchondral cysts	6	85.6%
Marrow edema	3	42.9%
Synovial thickening	1	14.3%
Soft tissue edema	1	14.3%

**Table (5):** diagnostic MRI findings seen in cases of osteoarthritis.



**Figure (1):** axial T2WI MRI show right femoral head low signal intensity and left femoral head heterogenous signal with double line sign in male patient 55 years old with history of bilateral hip joints and low back pain for years, denoting right grade D and left grade C avascular necrosis.



**Figure (2):** coronal T2W MRI showing loss of spherical contour of both femoral heads, narrow joint space, osteophytic lipping, synovial thickening and subchondral

cystic changes at both joints in male patient 62 years old with history of bilateral hip joints and low back pain with inability to walk, denoting bilateral osteoarthritis.

## Discussion

Magnetic resonance imaging is having a great role in musculoskeletal disorders as a non-invasive tool due to its multi-planar acquisition capability, excellent soft tissue resolution and non-ionizing radiation<sup>(7)</sup>.

This retrospective study performed at Ain shams university hospitals was aiming to assess the role of magnetic resonance imaging as a non-invasive diagnostic tool in cases of non-traumatic painful hip joint in adults. The study included 60 cases of patients complaining of unilateral or bilateral hip pain in adult age group with exclusion of those who had history of trauma.

Both sexes were included in this study with different age groups. The mean age group was 20-40 years.

The study revealed that hip pain can be resulted by a wide spectrum of different etiologies. Avascular necrosis was the most common cause followed by osteoarthritis and isolated hip joint effusion.

**Reddy**<sup>(2)</sup> in his study reported that the most common causes of unilateral hip pain were avascular necrosis and infection, and the most common causes of bilateral hip pain were avascular necrosis and osteoarthritis. Same observation was made in this study that avascular necrosis and osteoarthritis are the most common causes of bilateral hip pain. However, our study revealed that stress fractures and isolated hip joint effusion and tendinopathy were the most common causes of unilateral hip pain.

In this study, 15 cases (25%) were diagnosed with AVN, 2 of them were unilateral and 13 cases had bilateral AVN. It was reported by **Horia**<sup>(8)</sup> that MRI is the most sensitive imaging

modality used to diagnose AVN, representing the gold-standard of non-invasive diagnostic evaluation.

According to **Boehm and Link**<sup>(9)</sup>, the T1, T2 and STIR were the used sequences to diagnose AVN. The early stage shows high intensity signal on both T1 & T2 WI, because of hyperaemia. On late stage, low signal intensity is seen on both T1 & T2 WI as a result of sclerosis.

**Tushar and Pooja**<sup>(10)</sup>, 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 on T2 weighted images which consists of concentric low- and high signal intensity rims that surround the area of bone marrow signal intensity change within the femoral head. Joint effusion was noted in 62% in AVN cases.

In our study the double line sign was seen in 12 cases (80%), bone marrow edema was seen at 9 cases (60%), joint effusion was seen at 10 cases (66.7%) of the AVN cases. 3 cases (20%) were noted to have collapsed deformed femoral head.

In MRI images OA could be presented as loss of articular cartilage, joint space reduction, Joint effusion, Synovial thickening, Marrow edema, Subchondral cysts, Marginal osteophytes and Soft tissue edema. T1, T2 & STIR WIs were sequences used for diagnosis. **David et al**<sup>(11)</sup> mentioned that T1, T2, fat suppressed T2 weighted fast spin-echo and STIR are the sequences that are used to detect the early changes of OA.

The attenuation of articular cartilage is well demonstrated on either sagittal or coronal fat suppressed T2 images. OA

can also be accompanied with or on top of osteonecrosis of the femoral head.

**Hayam**<sup>(12)</sup>, in her study reported that 100% of osteoarthritis cases showed joint effusion, 70% had synovial thickening, 70% had bone marrow edema, 50% had subchondral cysts, 40% had joint space narrowing, 40% had marginal osteophytes and 30% had soft tissue edema.

In our study, 7 cases (11.7%) were diagnosed as osteoarthritis. One of them was unilateral and 6 cases were bilateral. All the 7 cases 100% had Joint effusion, all the 7 cases (100%) had joint space narrowing, all the 7 cases (100%) had marginal osteophytes, 6 cases (85.6%) had subchondral cysts, 3 cases (42.9%) had bone marrow edema, 1 case (14.3%) had synovial thickening, and 1 case (14.3%) had soft tissue edema.

According to **Tushar**<sup>(10)</sup>, Findings of hip joint effusion on MRI were T2W and STIR high signal intensity within the joint space. MRI is the best modality to assess the amount of fluid minimal, moderate or severe.

In our study 6 cases (10%) were diagnosed as isolated hip joint effusion, 3 cases were unilateral and 3 cases were bilateral.

**Reddy**<sup>(2)</sup> mentioned that the diagnostic features of stress fractures in MRI images included linear low signal intensity in femoral neck (on all sequences) with surrounding bone marrow edema.

According to **Quinn and Carthy**<sup>(13)</sup>, Magnetic resonance imaging can early detect and diagnose stress fracture as it is presented with bone marrow edema best detected on fat-suppressed T2-weighted or (STIR) sequences, the presence of medullary edema or hemorrhage appear as high signal intensity in a dark background of suppressed marrow fat. However, the low signal intensity line of fracture itself is not always seen.

In our study there were 5 cases (8.3%) diagnosed as stress fracture. 4 of them were unilateral and one case had bilateral fractures.

Our study also took non-hip causes of referred hip pain in consideration. Four cases had extra hip causes of unilateral or bilateral hip pain, one case showed large simple ovarian cyst, one case had a hemorrhagic ovarian cyst, one case was diagnosed as bilateral sacroiliitis while the last one was iliacus abscess.

## Conclusion

Magnetic resonance is the best imaging modality to assess hip joint in non-traumatic cases. It has a great ability to diagnose disorders of bone, cartilage, ligaments, muscles and soft tissue. MRI can also detect joint effusion and bone marrow edema.

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