ORIGINAL ARTICLE

Role of MRI in Screening of Non-Traumatic Pediatrics Hip Pain

Huda A. A. Muhammed *, Naaila A. M.A. Abu -Madyan, Fatma M. Ramadan

Department of Radiology, Faculty of Medicine for Girls, Al-Azhar University, Cairo, Egypt

Abstract

Background: ***The femoral head and acetabulum are the connecting elements between the axial skeleton and the lower extremities in the hip joint. A ball-and-socket synovial joint that is highly mobile and bears significant weight is the hip. Hip discomfort is a clinical issue that is frequently encountered and has a variety of causes.***

Aim of the work: ***To evaluate the value of magnetic resonance imaging (MRI) as an imaging modality in children who present with non-traumatic hip pain, as well as its capacity to early-stage diagnose the cause of the pain and the MRI appearance of hip joint pathologies.***

Patients and methods: ***This prospective study was carried out on 30 pediatric patients with non-traumatic hip pain, who were investigated using MRI for detection the cause of non-traumatic hip pain, referred from the outpatient pediatric clinic, orthopedic clinic, at Al-Zahraa hospitals. All patients underwent imaging procedure.***

Results: ***10 patients (33.3%) had normal findings, while 20 patients (66.7%) exhibited abnormal findings, including avascular necrosis (AVN) (n=5), transient synovitis (n=3), slipped capital femoral epiphysis with AVN on top (n=2), Slipped capital femoral epiphyses (n=2), and one case each of adductor muscle straining, aneursemal bone cyst, coxa vara deformity, iliac bone exostosis, juvnile idiopathic arthritis), perth's disease, proximal femoral focal deficiency and septic arthritis.***

Conclusions: ***A hip MRI is a non-invasive imaging technique that is well-accepted, accurate, and practicable for acute non-traumatic hip pain in minors.***

Keywords: Magnetic Resonance Imaging; Non-Traumatic Pediatrics Hip Pain; Hip Joint

1. Introduction

The acetabulum and femoral head are the connecting elements between the axial skeleton and the lower extremities in the hip joint. The hip is a ball-and-socket synovial joint that is extremely mobile and bears a significant amount of weight. Hip discomfort is a clinical issue that is frequently encountered and has a variety of causes. Intra-articular disorders (avascular necrosis, loose bodies, and arthritis), peri-articular pathology (tendonitis and bursitis), and extra-articular conditions (referred pain from the lumbar spine, sacroiliac joint, and nerve entrapment syndromes) are all potential causes of hip pain.[1]

A common diagnostic issue is hip discomfort in the absence of known acute trauma.[2] The identification of the precise cause of hip pain can be a challenging task.[3] In the field of medicine, magnetic resonance imaging (MRI) is a revolutionary advancement that has fundamentally altered the nature of diagnosis. Imaging of the hip is one of the earliest reported applications of musculoskeletal MRI. MRI's scope has been significantly expanded in recent years as a result of benefits such as improved image quality and reduced scan duration.[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] In the diagnosis of a diverse array of hip disorders in both infants and adults, MRI is both sensitive and specific.[6] MR imaging is particularly effective in the assessment of the pediatric hip due to its capacity to visualize cartilage.[7]

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* Corresponding author at: Radiology, Faculty of Medicine for Girls, Al-Azhar University, Cairo, Egypt.
E-mail address: hudaashraf685@gmail.com (H. A. A. Muhammed).

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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] In the diagnosis of a diverse array of hip disorders in both infants and adults, MRI is both sensitive and specific.[8] The pediatric hip evaluation is particularly effective due to the unique capacity of MRI to visualize cartilage.[9]

This investigation was designed to assess the efficacy of MRI as an imaging technique in minors who exhibit non-traumatic hip pain. Furthermore, the objective was to assess the early detection of the initial cause of the discomfort and the MRI manifestations of hip joint pathologies.

2. Patients and methods

This prospective study was carried out on 30 pediatric patients with non-traumatic hip pain, who were investigated using MRI to detect the cause of non-traumatic hip pain, referred from the outpatient Pediatric clinic, Orthopedic clinic, at Al-Zahraa hospitals from March 2024 to April 2025. Informed written consent was obtained from the patients and their parents. The study was done after approval from the Ethics Committee of the Faculty of Medicine, Al-Azhar University, and Al-Zahraa hospitals.

Inclusion criteria were pediatric patients aged from 2 to 17 years old and both sexes complaining of hip pain.

Exclusion criteria were patients with a history of trauma to the hip, history of claustrophobia, previous hip surgery, cardiac pacemaker, history of ferromagnetic implants, cochlear implants, and metallic foreign body in situ.

All patients were subjected to an imaging procedure: Device: PHILIPS MR Systems Achieva 1.5 Tesla. Patient position: Patient was examined in a supine position with the head toward the scanner bore using a surface coil around the hip joint.

Table 1: Imaging planes and pulse sequences

SEQUENCE	TE (MS)	TR RANGE (MS)	FOV APXRLXFH (MM)	MATRIX	SLICE THICKNESS/ VOXEL SIZE (MM)	VOXEL SIZE RLXAP
GRADIENT	8	700-800	170x178x94	384	4/0.5	1x1
AXIAL T1 WI	18	450-650	180x180x90	640	4.6/0.3	0.6x0.72
CORONAL STIR	30	135	160x160x70	352	4/0.5	0.8x1.2
CORONAL T1 WI	18	450-650	160x160x70	512	4/0.3	0.5x0.6
CORONAL T2 WI	100	4000-6000	160x160x70	528	4/0.3	0.5x0.6
SAGITTAL T2 WI	100	4000-6000	160x160x86	528	4/0.3	0.7x0.8

Dara is presented as numbers, FOV: Field of view, AP: Anterior-Posterior, STIR: Short Tau Inversion Recovery

Imaging planes and pulse sequences: Axial scout localizer, examination planes in coronal and sagittal planes, MRI pulse sequences. Table 1

Statistical analysis:

The documented data was analyzed using SPSS Inc.'s statistical software for social sciences, version 23.0, located in Chicago, Illinois, USA. Quantitative data were represented using the mean± standard deviation and ranges when their distribution was parametric (normal). The median with inter-quartile range (IQR) was used to represent non-normally distributed variables (non-parametric data). Furthermore, qualitative variables were represented as percentages and numerical values. The Kolmogorov-Smirnov and Shapiro-Wilk Tests were implemented to evaluate the normality of the data.

Case presentation:

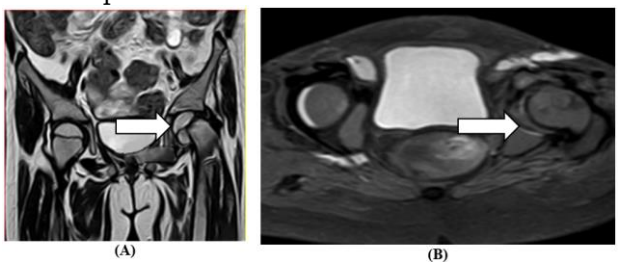


Figure 1. A: coronal T2W showing the left femoral epiphyseal line is seen widened compared to the right side, and posterior slippage of the left femoral epiphysis. B: axial STIR MRI left femoral head showing a localized area of low signal intensity surrounded by a double line sign (white arrow) characteristic of Avascular necrosis

Case 1: 8 An 8-year-old known case of immunodeficiency with interstitial lung disease on corticosteroids, presented with bilateral hip joint pain and limitation of movement, suspected avascular necrosis. Diagnosis: left slipped capital femoral epiphysis (SCFE) with avascular necrosis on top.

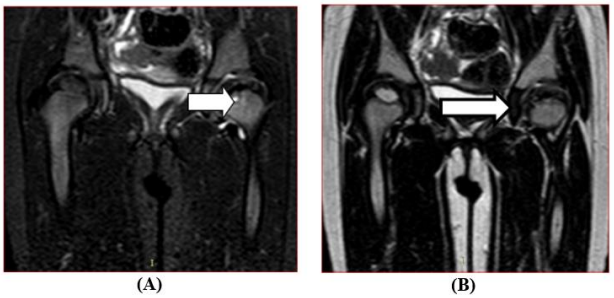
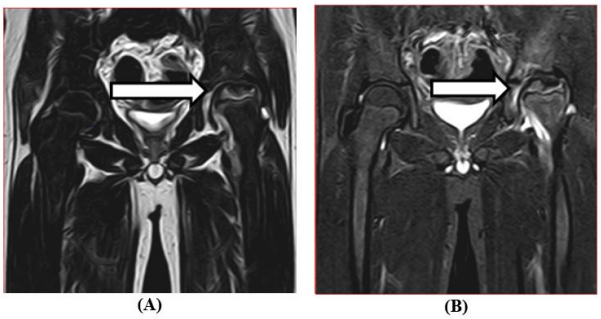


Figure 2: A: coronal STIR, B: coronal T2WIs MRI showing the left capital femoral epiphysis is seen collapsed and sclerotic with low signal in all sequences and irregular contour, as well as a metaphyseal cystic lesion (arrow)

Case 2: 3 A 3-year-old girl with bilateral pain in the hip joints, especially with movement, for 2 weeks. Diagnosis: Left hip joint Perthes disease.



(A) (B)

Figure 3: A: coronal T2WI, B: coronal STIR MRI showing the epiphyseal head of the left femur is shorter than the right, with sclerosis and irregularity of its borders associated with edema and mild joint effusion

Case 3: 9.5 A 9.5-year-old boy with a known case of sickle cell anemia with left hip joint pain for 2 months. Diagnosis: Left hip joint Avascular necrosis.

3. Results

Table 1. Age "years ", sex, hip pain, limitation of movement and inability to walk distribution among study group

		TOTAL =30, NO. (%)
AGE "YEARS"	<5 years	5 (16.7%)
	5-10 years	9 (30.0%)
	>10-15 years	9 (30.0%)
	>15 years	7 (23.3%)
SEX	Female	11 (36.7%)
	Male	19 (63.3%)
HIP PAIN	Negative	2 (6.7%)
	Positive	28 (93.3%)
LIMITATION OF MOVEMENT	Negative	16 (53.3%)
	Positive	14 (46.7%)
INABILITY TO WALK	Negative	21 (70.0%)
	Positive	9 (30.0%)

Data are presented as frequency (%).

Table 2 described the age distribution of the total study population. Age ranged from 2 to 17 years with a mean ± SD of 10.88 ± 4.97. There were 5 patients (16.7%) who were "<5 years," 9 patients (30%) were "5-10 years," 9 patients (30%) were ">10-15 years," and 7 patients (23.3%) were ">15 years." As regarding sex distribution, there was male predominance with 19 males with percentage 63.3% and 11 females with percentage 36.7%. the 28 patients (93.3%) were positive for hip pain and 2 patients (6.7%) were negative for hip pain. The 14 patients (46.7%) were positive for limitation of movement and 16 patients (53.3%) were negative for limitation of movement. The 14 patients (46.7%) were positive for limitation of movement and 16 patients (53.3%) were negative for limitation of movement.

Table 2. Joint effusion, bone marrow edema, soft tissue changes distribution among study group

		TOTAL =30, NO. (%)
JOINT EFFUSION	Negative	16 (53.3%)
	Positive	14 (46.7%)
BONE MARROW EDEMA	Negative	17 (56.7%)
	Positive	13 (43.3%)
SOFT TISSUE CHANGES	Negative	24 (80.0%)
	Positive	6 (20.0%)

Data are presented as frequency.

There was 14 patients (46.7%) were positive for joint effusion and 16 patients (53.3%) were negative for joint effusion. There were 13 patients (43.3%) who were positive for bone marrow edema, and 17 patients (56.7%) were negative for bone marrow edema. Regarding soft tissue changes, 6 patients (20%) were positive and 24 patients (80%) were negative for soft tissue changes. Table 3

Table 3. Contour irregularity, joint narrowing distribution among study group

		TOTAL =30, NO. (%)
CONTOUR IRREGULARITY	Negative	20 (66.7%)
	Positive	10 (33.3%)
JOINT NARROWING	Negative	19 (63.3%)
	Positive	11 (36.7%)

Data are presented as frequency (%).

Regarding contour irregularity, 10 patients (33.3%) were positive and 20 patients (66.7%) were negative. There were 11 patients (36.7%) were positive joint narrowing and 19 patients (63.3%) were negative joint narrowing. Table 4

Table 4. Finding distribution among study group

FINDING	TOTAL =30, NO. (%)
NORMAL	10 (33.3%)
AVN	5 (16.7%)
TRANSIENT SYNOVITIES	3 (10.0%)
SCFE WITH AVN ON TOP	2 (6.7%)
SLIPPED CAPITAL FEMORAL EPIPHYSES	2 (6.7%)
ADDUCTOR MUSCLE STRAINING	1 (3.3%)
ANEURSEMAL BONE CYST	1 (3.3%)
COXA VARA DEFORMITY	1 (3.3%)
ILIAC BONE EXOSTOSIS	1 (3.3%)
JUVNILE IDIOPATHIC ARTHRITIS)	1 (3.3%)
PERTH'S DISEASE	1 (3.3%)
PFFD	1 (3.3%)
SEPTIC ARTHRITIS	1 (3.3%)

SCFE: Slipped capital femoral epiphysis, PFFD: Proximal femoral focal deficiency,Data are presented as frequency (%).AVN: Avascular necrosis

Table 5 demonstrated that 10 patients (33.3%) had normal findings, while 20 patients (66.7%) exhibited abnormal findings, including AVN (n=5), transient synovitis (n=3), SCFE with avascular necrosis (AVN) on top (n=2), Slipped capital femoral epiphyses (n=2), and one case each of adductor muscle straining, aneursemal bone cyst, coxa vara deformity, iliac bone exostosis, juvnile idiopathic arthritis), perth's disease, proximal femoral focal deficiency (PFFD) and septic arthritis.

4. Discussion

Magnetic resonance imaging plays 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. [10]

Both sexes were included in this study with 19 male 11 and female were included in the study (range 2-17 years). The study revealed that hip pain can be resulted by a wide spectrum of different etiologies.

In our study, AVN is the most common cause of non traumatic pediatric hip pain, 5 cases out of 30 (16.6 %) followed by transient synovitis 3 cases out of 30 cases (10%) ,SCFE 2 cases out of 30 cases (6.6%) and SCFE with AVN on top 2 cases out of 30 cases (6.6%).

There are some causes were detected in our study as, Perthes 1 cases out of 30 (3.3 %), septic arthritis 1 cases out of 30 (3.3 %), aneurysmal bone cyst 1 cases out of 30 (3.3 %), PFFD 1 case out of 30 (3.3 %), juvenile idiopathic arthritis 1 case out of 30(3.3%), iliac bone exostosis 1 cases out of 30 (3.3 %) and adductor muscle strain 1 cases out of 30 (3.3 %).

In our study, 10 cases out of 30 were normal (33.3%).

It was revealed that transient synovitis is the most common cause of non-traumatic pediatric hip pain, 37 cases out of 50 (74%), followed by pelvic musculoskeletal infection, 5 cases out of 50 (10 %), followed by Perthes, 1 case out of 50 (2%). [11]

It was revealed that pyomyositis is the most common cause, 15 cases out of 33 (45 %), followed by osteomyelitis, 12 cases (36 %), followed by sacroiliitis, 3 cases (9%), followed by isolated hip effusion, 2 cases (6%), followed by metastatic disease of the bone marrow, 1 case (3%). [12]

In 29 out of 72 cases (40.3%), transient synovitis was the most common diagnosis, followed by septic arthritis in 24 cases (21%), sero-negative enthesopathy and arthropathy syndrome in 8 (11.1%), transient bone marrow edema (BME) in 4 (5.5%), osteomyelitis in 2 (2.8%), osteosarcoma in 2 (2.8%), sciatic nerve injury in 1 (1.4%), coxa vara of both hips and L5/S1 facet joint ankylosis in 1 (1.4%), and a benign bone cyst in 1 (1.4%).[13]

In our study 5 cases were diagnosed. There are different causes of avascular necrosis in our study such as leukemia, systemic lupus arthritis and sickle cell anemia.

MRI is the gold standard of non-invasive diagnostic evaluation, as it is the most sensitive imaging modality used to diagnose AVN, according to their report. [14]

The T1, T2, and STIR were the sequences used to diagnose AVN. The early stage shows a high intensity signal on both T1 & T2 WI, because of hyperaemia. In the late stage, low signal intensity is seen on both T1 and T2 WI as a result of sclerosis. [15]

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. [16]

The limitations of the study were a small sample size and a single-centre study.

4. Conclusion

In adolescents who present with acute non-traumatic hip pain, hip MRI is a non-invasive imaging technique that is pragmatic, widely accepted, and technically accurate.

Therefore, our study recommends MR as an accurate non-invasive diagnostic imaging modality in cases of non-traumatic painful pediatrics hip joint because it saves time as when reach the diagnosis early, MRI can detect early signs of the common diseases causing non-traumatic pain such as Avascular necrosis and synovitis before appearing by X-ray, so we can give the child the proper management early and prevent more complications.

Disclosure

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Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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