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Role of Magnetic Resonance Imaging in Diagnosis of Chronic Hip Joint Pain in Adults

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ABSTRACT

Background: Chronic hip pain is a common problem in adults. In the absence of a known acute trauma, it can be a diagnostic problem as it can be attributed to many causes. The most common causes are avascular necrosis, inflammatory causes, transient osteoporosis or neoplastic lesions. **Aim of the Work:** The aim of this study is to evaluate the role of magnetic resonance imaging (MRI) in the evaluation and diagnosis of different causes of chronic hip pain in adults. **Patients and Methods:** The study was conducted on thirty patients who had chronic hip pain and they were referred to undergo MR imaging of hip joints in MRI Unit in Al-Hussain Teaching Hospital in Thi-Qar / Iraq and Ain Shams University Hospital in Cairo / Egypt. **Conclusion:** MRI is an essential imaging modality in musculoskeletal system in general and in hip region specifically. **Recommendations:** MRI should be done preferably with a limited number of sequences. If the diagnosis is still query or whenever inflammation or a neoplastic process is suspected, we should do other sequences in different imaging planes and go for contrast injection and post contrast studies (T1WI).

Key words: MRI , chronic hip joint , adults.

INTRODUCTION

The hip joint is designed to withstand repeated motion and a fair amount of wear and tear. This ball and socket joint (the body's largest) fits together in a way that allows for fluid movement. Whenever you use the hip (for example, by going for a run), a cushion of cartilage helps prevent friction as the hip bone moves in its socket Despite its durability, the hip joint isn't indestructible ,With age and use, can wear down or become damaged. Muscles and tendons in the hip can get overused. The hip bone itself can be fractured during a fall or other injury. Any of these conditions can lead to hip pain [(1)] .

Chronic hip pain is a perplexing clinical problems. Symptoms may be related to numerous etiologies, including trauma, neoplasms, and arthropathies. Pain may be due to osseous, intra-articular, periarticular, or soft tissue pathology. Referred pain from the lumbar spine, sacroiliac joints, or knee may add to the potentially confusing clinical picture [(2)] .

The hip is a primary weight-bearing joint. Disorders of the hip are a potential source of debility to patients of all ages. In the absence of known acute trauma, hip pain is a common diagnostic problem [(3)] .

In patients who have hip complaints, the source of pain often involve surrounding structures (the lower back and pelvis) rather than the hip joint. Therefore, it is important to maintain an awareness of these neighboring structures as well as of the articular hip [(4)] .

Causes of chronic hip pain include avascular necrosis, transient osteoporosis, inflammation, osteoarthritis, traumatic and neoplastic causes [(5)] .

Clinical data is essential for selecting the most appropriate imaging techniques in patients with chronic hip pain. Range of motion, gait abnormalities, locking or snapping, duration of symptoms, and pain patterns (e.g. worse at night increased with exercise, relieved by aspirin) can be very useful for reducing the potentially long list of differential diagnoses. Radiographs may provide specific information for common disorders such as osteoarthritis (OA) or less common disorders such as primary bone tumors. Whether the radiographs are normal or not, they are often of considerable value for the selection of additional techniques and for comparison with studies such as magnetic resonance imaging (MRI) examinations [(2)] **.**

MRI detects osseous, articular, or soft-tissue abnormalities. It is both highly sensitive and specific for detecting many abnormalities involving the hip or surrounding soft tissues and should in general be the first imaging technique used following radiographs [(2)] **.**

MRI has become the imaging study of choice in diagnosing most hip disorders. Also, it is amethod of choice in characterizing the various disorders and assessing the full extent of osseous, chondral and soft tissue involvement. MRI can exquisitely demonstrate joint effusions, synovial proliferations, articular cartilage abnormalities, subchondral bone, ligaments, muscles, and juxta articular soft tissues [(6)] **.**

It has been successfully used in imaging disease processes of the hip because of its optimal spatial resolution, multiplanar acquisition capability, increased soft tissue contrast, and lack of ionizing radiation [(7)] .

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For diagnosis and treatment planning, MRI of the hips should be performed early in patients with persistent pain and negative radiographic findings [8].

AIM OF THE WORK

The aim of this study is to evaluate the role of magnetic resonance imaging (MRI) in the evaluation and diagnosis of different causes of chronic hip pain in adults.

Thirty patients constituted the subject of this study. They had chronic hip pain and they were referred to undergo MR imaging of hip joints in MRI Unit in Al-Hussain Teaching Hospital in Thi-Qar / Iraq and Ain Shams University Hospital in Cairo / Egypt.

Thirty patients (18females and 12 males) were selected 17 patients from Iraq and 13 patients from Egypt.

Inclusion Criteria

1. Age: only adult patients between 18 and 80 years were included.
2. No sex predilection.
3. Clinical presentation: unilateral or bilateral chronic hip pain at least for 1month duration.
4. In our study patients ages ranged from (19) to (80).

Exclusion Criteria

1. Patients with Ages less than 18 Years.
2. Contraindications to Contrast Media, in Patients Who need Contrast Media e.g. Patients with Renal Failure and Patients Allergic to Contrast Media.
3. Contraindications to Magnetic Resonance Imaging, e.g. Claustrophobia, Cardiac Prosthesis and metallic plates.

Methodology

● all the patients were subjected to the following:

1. Full clinical data:

Included gender, age, chief complaint, duration of complain and history of trauma and past medical history.

2.Patient preparation: patients were instructed about the procedure, and were asked to remove all metallic objects.

3. MR imaging: All patients were examined by MRI. The systems used during this study, were(1.5)Tesla imager (AchievaRelease 3.2.1.1) Philips in Iraq and (1.5) Tesla imager (Achieva Release 3.2.3.3) in Egypt.

Technique of MR imaging of the hip: Patients underwent imaging in a supine position, toes strappedtogether, and body matrix coil (Ref_XL_torso) was centered over both hip joints and both were examined together even if the patient complained of unilateral pain.

MRI protocol and sequences:

In MRI Unit in Al-Hussain Teaching Hospital and Ain Shams University Hospital, the standard protocol was as follow:

1) Coronal T1 weighted spin echo:

The parameters were TR 1100-1200 msec and TE 24 msec. The slice thickness 4-5 mm, 1mm gap, field of view 35-50 cm.T1 weighted MR images provided the best anatomic detail.

2) Coronal T2 weighted spin echo images:

The parameters were TR 3500 msec and TE 120 msec, slice thickness 4-5mm, 1mm gap, field of view 35-50 cm.

3) Coronal STIR:

(Fat saturation and short time inversion recovery) sequences, the parameters were TR 2500-3500 msec and TE 55 msec , slice thickness 4-5 mm, 1mm gap, and field of view 35-50 cm.

4) Coronal gradient echo:

The parameters were TR >650 msec and TE 18 msec , slice thickness 4-5 mm, 1mm gap and a field of view 35-50 cm.

5) Axial T1 weighted spin echo image:

The parameters were TR 1100-1200 msec and TE 24 msec , slice thickness 4-5 mm, 1mm gap and a field of view 35-45 cm.

6) Axial T2 weighted spin echo image:

The parameters were TR 3500-5500 msec and TE 110-115 msec. The slice thickness was 4-5 mm, 1mm gap and a field of view 35-45 cm.

●*Contrast was used in some cases if bone tumours or metastases were suspected , after intra–venous administration of Gadopentatedimeglumine (Gd-DTPA); 0.1-0.15 ml/kg, the imaging was completed within an average of 5 min after the injection and the following images were taken:*

I- Coronal Gd-enhanced T1 weighted images:

The parameters were TR 1300-2200 msec and TE 24 msec. The slice thickness was 4-5 mm , 1mm gap and a field of view 35-50 cm.

II- Axial Gd-enhanced T1 weighted images:

The parameters were TR 1500-2500 msec and TE 24 msec , a slice thickness of 4-5 mm, 1mm gap and a field of view 35-45 cm.

-Results were collected, tabulated and discussed compared to previous studies.

The study was done after approval of ethical board of Ain Shams university and an informed written consent was taken from each participant in the study.

Statistical analysis

Data were analyzed using the Statistical Program for Social Science (SPSS) version 20.0. Quantitative data were expressed as mean± standard

deviation (SD). Qualitative data were expressed as frequency and percentage.

The following tests were done:

- Independent-samples t-test of significance was used when comparing between two means.
- Chi-square (X^2) test of significance was used in order to compare proportions between two qualitative parameters.
- Probability (P-value)
  - P-value <0.05 was considered significant.
  - P-value <0.001 was considered as highly significant.P-value >0.05 was considered significant.

RESULTS

50 cases were included in the study 20 of them were normal thus were excluded from our study , the other 30 cases having findings constituted our studied group.

Of these 30 cases 12 (40%) were males and 18 (60%) were females , age range was (19-80) with a mean of (38).

Table (1): Demographic distribution of the studied group.

Demographic Data	Total (N=30)
Sex	
Male	12 (40%)
Female	18 (60%)
Age (years)	
Range [Mean±SD]	19-80 (38±17.3)

Table (2): Relation between sex and age (years).

Age (years)	Sex		t-test	
	Male	Female	t	p-value
Mean±SD	44.17± 17.43	33.89± 16.44	2.683	0.113
Range	19-80	19-75		

This table shows no statistically significant relation between sex and age (years).

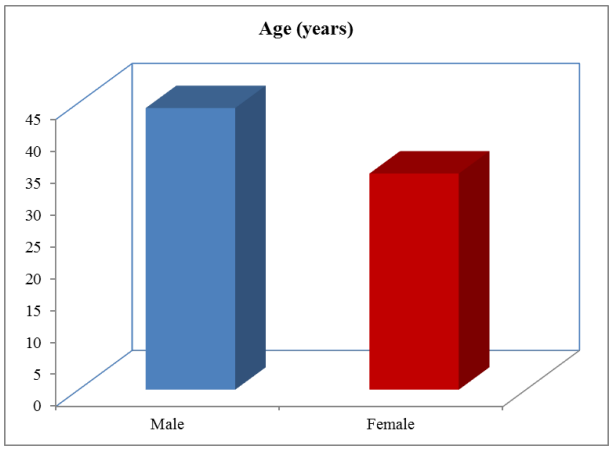

Fig. (1): Bar chart between sex and age (years).

Table (3) : The main complaint pain encountered 30 cases (100%) , movement restriction encountered 24 cases (80%) and slowly progressive pain was encountered 5 cases (16.6%).

Table (3): shows patients complaint of the study group.

Chief complaint	Total (N=30)
Pain	30 (100%)
Restriction of movement	24 (80%)
Slowly progressive pain	5 (16.6%)

Severity of pain ranged from mild to severe pain, some patients complained of movement restriction, other showed slowly progressive pain.

The chief complaint in all our cases was hip pain .Table 4 shows that bilateral hip joint pain was encountered 20 cases (66.6%) , left hip joint pain was encountered 5 cases (16.7%) and right hip joint pain was also encountered 5 cases (16.7%).

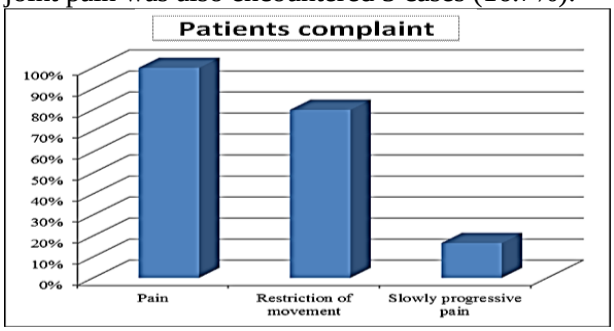

Fig. (2): Bar chart showing patients complaint in the studied group

Table (4): Chief complaint distribution of the studied group.

Chief complaint	Total (N=30)
Bilateral hip pain	20 (66.6%)
Left hip pain	5 (16.7%)
Right hip pain	5(16.7%)

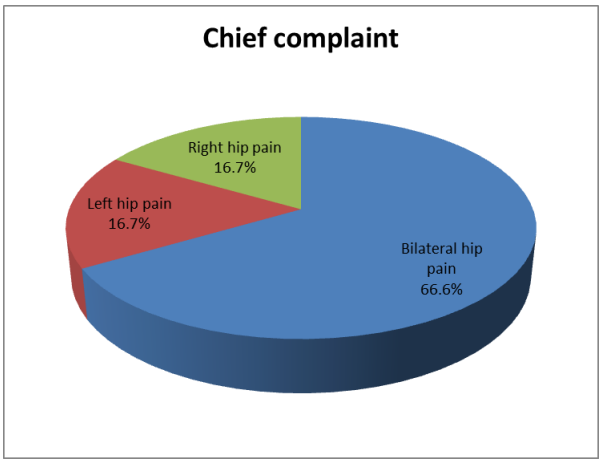

Fig.(3): Pie chart Chief complaint distribution of the studied group.

Table (5): Relation between sex and chief complaint.

Chief complaint	Sex				Chi-square test	
	Male		Female			
	No.	%	No.	%	x2	p-value
Bilateral hip pain	7	58.3%	13	72.2%	2.073	0.557
Left hip pain	2	16.7%	3	16.7%		
Right hip pain	3	25%	2	11.1%		

This table shows no statistically significant relation between sex and chief complaint.
The severity of pain as shown in table 6 was divided in to mild was encountered 8 cases (26.7%), moderate was encountered 17 cases (56.6%) and severe was encountered 5 cases (16.7%) .

Table (6): severity of pain of the studied group.

Severity of pain	Total (N=30)
Mild	8 (26.7%)
Moderate	17 (56.6%)
Severe	5 (16.7%)

The duration of pain varied from 1 month to 2 years.

Table (7): relation between sex and duration of pain (months).

Duration of pain (months)	Sex		t-test	
	Male	Female	t	p-value
Mean±SD	7.17±6.06	6.00±3.91	0.413	0.525
Range	1-24	1-14		

This table shows no statistically significant relation between sex and duration of complaint.
Regarding the past medical history, table 8 summarizes the past medical history of all our 30 cases no significant past medical history was encountered in 24 of cases (80%) , while the rest showed 2 cases having past history of breast cancer (6.6%), the final of 4 cases were divided in to one case of leukemia on chemotherapy and steroid (3.3%) , one case of healed perthes disease (3.3%), one case of rheumatoid arthritis (3.3%) and one case of SLE on steroid (3.3%).

Table (8): Past medical distribution of the studied group.

Past medical history	Total (N=30)
Healed perthesdisease	1 (3.3%)
Leukemia on chemotherapy and steroid	1 (3.3%)
Rheumatoid arthritis	1 (3.3%)
SLE on steroid	1 (3.3%)
Breast Cancer	2 (6.7%)
No	24 (80%)

Relation between sex and past medical history :
All these patients presented with past history were females.
As previously mentioned limitation of movement was encountered in 24 cases (80%)

Table (9): Limitation of movement distribution of the studied group.

Limitation of Movement	Total (N=30)
Mild	17 (56.7%)
Moderate	7 (23.3%)
No	6 (20%)

This table (10) shows that the mild limitation was encountered in 17 cases (56.6%),while moderate limitation of movement was encountered in 7 cases (23.3%) , only 6 cases (20%) showed no limitation of movement.

When comparison was done between the 2 genders regarding the limitation of movement , table 9 showed that mild limitation of movement was encountered in 7 cases (23.3%) in males and 10 cases (33.3%) in females , moderate limitation of movement was encountered in 3 cases (10%) in males and 4 cases (13.3%) in females while 2 cases (6.6%) of males and 4 cases (13.3%) of females had no limitation of movement.

Table (10**):** relation between sex and limitation of movement

Limitation of Movement	Sex				Chi-square test	
	Male		Female			
	No.	%	No.	%	x2	p-value
Mild	7	58.3%	10	55.6%	0.145	0.930
Moderate	3	25%	4	22.2%		
No	2	16.7%	4	22.2%		

This table shows no statistically significant relation between sex and limitation of movement.
T1 , T2 and STIR weighted imaging sequences used in all cases.
Fat suppressed T2 weighted fast spin-echo used to detect the early changes of osteoarthritis**.**
T2 with fat sat WIs used to demonstrate labral tear in femoroacetabular impingement.
T1 with contrast was used in some cases if bone tumours or metastases were suspected**.**

Table (11**):** pathological entities encountered in our study

Pathology	Total (N=30)
AVN	9 (30%)
Bilateral	*7(23.3%)*
Unilateral	*2(6.7%)*
OA	9 (30%)
Joint effusion	3 (10%)
Metastasis	2 (6.7%)
Chondroblastoma	1 (3.3%)
Partial tear at iliopsoas tendon with underlying bursitis	1 (3.3%)
Femoroacetabular impingement	1 (3.3%)
Pathological fracture of femoral neck	1 (3.3%)
Insertional tendinitis of gluteus medius and minimus tendon	1 (3.3%)
Synovial chondromatosis	1 (3.3%)
Premature osteoarthritis (healed perthes disease)	1 (3.3%)

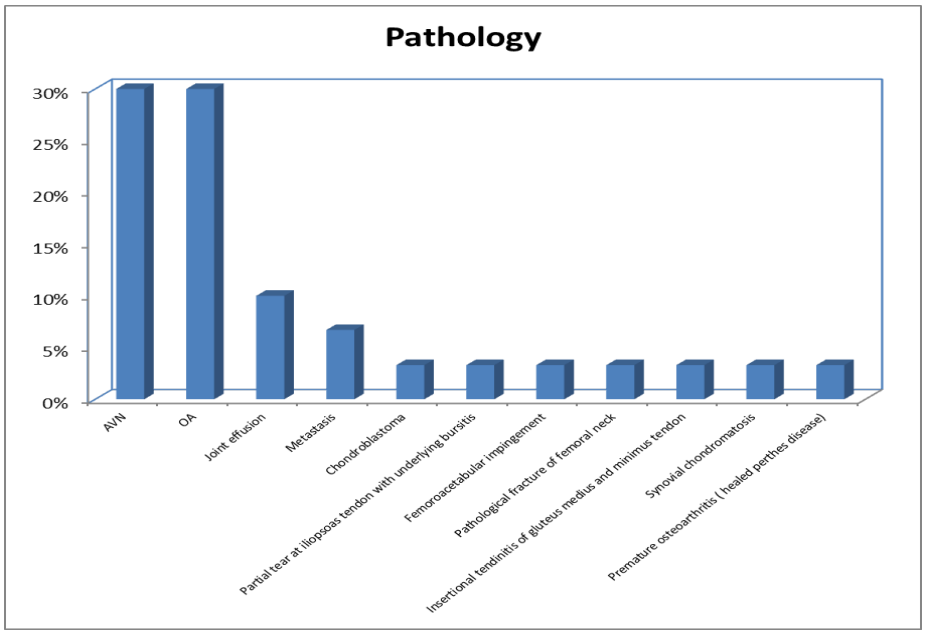

Fig. (4): Bar chart between sex and pathology

Table (12): relation between sex and pathology.

Pathology	Sex				Chi-square test	
	Male		Female			
	No.	%	No.	%	x2	p-value
AVN	1	8.3%	8	44.4%	15.185	0.125
OA	6	50%	3	16.6%		
Chondroblastoma	1	8.3%	0	0.0%		
Metastasis	0	0.0%	2	11.1%		
Joint effusion	1	8.3%	2	11.1%		
Partial tear at iliopsoas tendon with underlying bursitis	0	0.0%	1	5.6%		
Femoroacetabular impingement	0	0.0%	1	5.6%		
Pathological fracture of femoral neck	1	8.3%	0	0.0%		
Insertional tendinitis of gluteus medius and minimus tendon	1	8.3%	0	0.0%		
Synovial chondromatosis	1	8.3%	0	0.0%		
Premature osteoarthritis (healed perthes disease)	0	0.0%	1	5.6%		

DISCUSSION

The hip is a primary weight-bearing joint. Disorders of the hip are a potential source of debility to patients of all ages. **Hamer**[3] mentioned that in absence of known acute trauma, hip pain is a common diagnostic problem with many etiologies .According to **Laslett *et al.*** [5] causes of chronic hip pain include avascular necrosis, transient osteoporosis, inflammation, osteoarthritis, traumatic and neoplastic causes .

Hayem[7] mentioned that MR imaging is gaining increasing use in musculoskeletal imaging because of its multiplanar acquisition capability, increased soft tissue contrast, and lack of ionizing radiation .**Nine** patients in the present study were diagnosed with **AVN** (7) of them had bilateral AVN and (2) case have unilateral AVN. **Horia** [9], mentioned that MRI is the most sensitive means of diagnosing AVN, representing the gold-standard of noninvasive diagnostic evaluation .

As reported by **Boehm and Link**[10], the T1, T2 and STIR were used for diagnosis of AVN. On MRI the early stage show high signal on both T1 & T2 WI, due to hyperaemia. On late stage shows low signal on both T1 & T2 WI due to sclerosis. The appearance of the necrotic bone on MRI may be isointense to normal fatty marrow before trabecular thickening and collapse would set in. The reactive interface represents the body's response to the necrotic bone fragment that is visible on MR images in these cases. It is of low signal intensity on T1-weighted images . **Andrews**[11] when the trabeculae displays coarse or collapse within the necrotic fragment, the necrotic bone becomes low signal intensity on both T1 and T2-weighted images **.** One of our patients with AVN had history of SLE on steroid treatment; According to **Keith and Arthur**[12] corticosteroid treatment is the most common identifiable factor associated with avascularnecrosis of the hip and thus those with systemic lupus erythematosus are at an increased risk.The present study revealed no relation between avascular necrosis with age and sex while **Kamal** [13] concluded that the disease is especially common among younger population, patients are usually between the 3rd and 5th decade of life, affecting mainly men .

Nine patients (30%) of cases have bilateral hip joint OA which show cystic changes, loss of articular cartilage and narrowing of joint space, we used T1, T2 & STIR WIs for diagnosis. **David *et al*.** [14] mentioned that the sequences that are used to detect the early changes of OA were TI, T2, fat suppressed T2 weighted fast spin-echo and STIR. Articular cartilage attenuation is best demonstrated on either sagittal or coronal fat suppressed T2 images, OA may also be associated with or superimposed on osteonecrosis of the femoral head. The present study revealed no relation between OA with age and sex while in other studies; according to **Cooper** [15] the World Health Organization's Scientific Group on Rheumatic Diseases estimated that 10% of the world's population aged 60 years or older have significant clinical problems that could be attributed to osteoarthritis**.** In the Study of Osteoporotic Fractures, the prevalence of radiographic hip OA was analyzed in women over the age of 65 year**.**

One patient of cases in our results had partial tear at iliopsoas tendon with underlying bursitis; we used T1, T2 & STIR WIs for diagnosis which showed low signal in T1 and high signal on both T2 & STIR WIs. **David *et al.*** [14] mentioned that Bursal fluid should not be mistaken for a malignant soft tissue neoplasm such as synovial sarcoma, which has similar imaging characteristics (i.e., low signal intensity on Tl-weighted and bright signal intensity on T2-weighted images). The STIR sequence demonstrate abnormal signal in the bursa .

The present study revealed no relation

between partial tear at iliopsoas tendon with underlying bursitis with age and sex while **Freire *et al.***[16] represented that with the aging of the population, it is likely that the incidence of spontaneous and traumatic iliopsoas tendon tear willincrease. She also added that this entity should be included in the differential diagnosis of an elderly patient who presents with hip or groin pain and of diffuse enlargement of the iliopsoas muscle at CT. One patient of cases in the present results had femoroacetabular impingement, we used T2, STIR, T2 with fat sat WIs, to demonstrate labral tear. **Megan and Herrera**[17] mentioned that the etiology of labral tears includes trauma, femoroacetabular impingement (FAI), capsular laxity/hip hypermobility, dysplasia, and degeneration . **Schmerl *et al.***[18] concluded that labral changes in configuration or tears are seen as high signal intensity on T2-weighted images .

The present study revealed no relation between femoroacetabular impingement with age and sex while **Tannast et al.** [19] Pincer impingement was more common in middle-aged women, occurring at an average age of 40 years, and can occur with various disorders**.** Cam impingement was more common in young men, occurring at an average age of 32 years . **One** patient of the studied cases had pathological fracture of femoral neck due to severe osteoporosis, used T1, T2, STIR which showed low signal in T1 &T2 WIs, high signal in STIR. **Drugova *et al.***[20] reported that The MRI appearance of a fracture is that of a low signal-intensity line on both Tl and T2-weighted images .

The present study revealed no relation between pathological fracture with age and sex while **Landefeld**[21] represented that women experience 80% of all hip fractures. The average age at the time of the fracture in this study was 80 years with almost all patients are older than 65 years , he also added that the lifetime prevalence of a hip fracture is 20% for women and 10% for men. One patient of our cases had **synovial chondromatosis** on left hip joint, we usedT2 & STIR WIs, tumour showed intermediate signal on T2 WI & high signal on STIR WI. On T2-weighted images, the multiple ossified loose bodies were seen as foci of intermediate signal intensity bathed in the surrounding joint effusion that was brighter in signal intensity. According to **Knoeller**[22] these nodules may demonstrate the high signal intensity of fatty marrow on Tl and T2-weighted images .The present study revealed no relation between synovial chondromatosis with age and sex. **McCarthy *et al.*** [23] mentioned that the exact prevalence of synovial chondromatosis is unknown, but the disorder is rare worldwide. Most reported series indicated a male-to-female ratio of 2:1. In addition, most cases were reported in patients aged 20-40 years .

Three patients of the studied cases had **joint effusion** (one) patient had unilateral effusion in the right hip and (two) had bilateral hip effusion, T1, T2 & STIR WIs were used in our cases , effusion showed high signal on both T2 & STIR WIs.

The present study revealed no relation between joint effusion with age and sex. This was in concordance with **Ahedi *et al.*** [24] where they reported that subjects without and with hip effusion had no statistical differences in mean age and sex still they added that subjects with hip effusion were heavier [BMI: 26.1 v 27.9, p = 0.04] in comparison to those without hip effusion and that hip effusion did not associate with presence or severity of hip pain .**One** patient of our cases had **Chondroblastoma** we used T1, T2, STIR and T1 with contrast,mixed signal intensity was seen with predominantly low signal intensity in T1 and T2 (sclerotic) with the cystic areas returning bright in T2 and STIR. Post contrast study revealed rather homogenous enhancement of the cystic component of the lesion only **.**

The present study revealed no relation between chondroblastoma with age and sex. According to **Mattos** [25] most patients being in the second decade of life, or less than 20 years of age. Chondroblastoma shows a predilection towards the male sex, with a ratio of male to female patients of 2:1. Two of our patients had bilateral **Hip joint metastases** with previous history of breast cancer, we used T1, T2, STIR and T1 with contrast. Multiple osseous lesions of variable size were seen. Some of them showed low signal intensity in both T1 and T2 while STIR images showed high signal others showed low signal in T1 and high in T2.Some of them showed post contrast enhancement. **Costelloe *et al.*** [26] concluded that osseous metastases can lead to emergent situations, such as spinal-cord compression or impending fracture of a weight-bearing bone, and imaging guidelines are essential for early detection and initiation of appropriate therapy .

In the present study no relation was detected between Hip metastasis with age and sex still **Barrett-Lee *et al.*** [27] reported that most metastatic bone lesions occur in adults older than 50 years. One patient in our study had unilateral osteoarthritis (healed perthes disease) which show cystic changes, loss of articular cartilage and narrowing of unilateral hip joint space, we used T1, T2 & STIR WIs for diagnosis. The sequences that were used to detect the early changes of OA were TI, T2, fat suppressed T2 weighted fast spin-echo and STIR. Finally, **One** patient of our cases had Insertional tendinitis of gluteus medius and

minimus muscle tendon**,** we used T1, T2 and STIR which showed thickening of the tendon.

According to **Nicholas *et al*.** [28] MRI had proven to be a highly specific diagnostic tool in the work up of gluteus tendinopathy .

CONCLUSION

MRI is an essential imaging modality in musculoskeletal system in general and in hip region specifically. It is not necessary to do all the MRI sequences for all patients complaining of chronic hip pain. We can have coronal T1WI, T2 and STIR sequence as a primary step in the examination; other sequences can be used according to each case.

RECOMMENDATIONS

MRI should be done preferably with a limited number of sequences. If the diagnosis is still query or whenever inflammation or a neoplastic process is suspected, we should do other sequences in different imaging planes and go for contrast injection and post contrast studies (T1WI).

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