Indications

Hip joint complaint
- Pain
- Trauma
- Swelling
- Osteoarthritis

Suspected inflammation or tumors
- Fasting 4-6h
- Supine position
- Body coil
- Cortical bone
- Cartilage
- Mature fibrous tissue (ligaments and tendons)
- Calcifications (physiological, pathological)

\[ \text{Non mobile protons} \]
- **Fat** [Subcutaneous fat, dermoid cyst,...]
- **Fluid** [effusion, cyst, articular cartilage,...]

**T1**
- Low signal

**T2**
- High signal

**T1**
- High signal

**T2**
- Low signal
How to know the pulse sequence?

All these pulse sequences belong to T2.
Protocol of examination

- Axial scout
- Coronal T1, **STIR**
- Axial PD, T2 (gradient, T2*) , axial T1 ?!
- Sagittal T1 or T2 for the diseased hip
- If contrast is injected [Axial, Sagittal, coronal T1 WIs]

- Slice thickness 5mm
- No interslice gap
- FOV 30-42cm
- Ball and socket joint
- Acetabulum covers 40% of the femoral head
- A fibrocartilagenous labrum increases the depth of acetabulum
- 95% of the femoral neck is intraarticular
Axial anatomy
Items to be evaluated

- Avascular necrosis
- Transient osteoporosis
- Perthes disease
- Slipped femoral epiphysis
- Trauma, muscle injury
- Miscellaneous
  - Labral tears
  - Bursitis
  - Loose bodies & chondromatosis
  - Femoral neck antversion
Avascular necrosis

The antrolateral aspect of the femoral head is the commonest site, but no specific area is protected.

MR sensitive 97% specific 98%

Causes:
- Trauma
- Corticosteroids
- Sickle cell disease
- Alcoholism
- Gusher's disease
- Radiation
- Collagen disease, pancreatitis
Plain film findings:
- Contour irregularities and fissures
- Areas of bone sclerosis and porosis
- Structural collapse
- Osteoarthritic changes
Avascular necrosis
Avascular necrosis

CT findings:
- Contour irregularities and fissures
- Areas of bone sclerosis and porosis
- Structural collapse
- Osteoarthritic changes
Avascular necrosis

I. Bone marrow edema
II. Normal marrow + line
III. Fluid signal
VI. Bone sclerosis
Stage 1
<table>
<thead>
<tr>
<th>Stage</th>
<th>Radiographs</th>
<th>Magnetic resonance [MRI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Normal</td>
<td>T1: Low, T2: High</td>
</tr>
<tr>
<td></td>
<td>Marrow edema</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Osteoporosis</td>
<td>T1: High, T2: Intermediate</td>
</tr>
<tr>
<td></td>
<td>Osteosclerosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal marrow + line</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Sclerosis + Cortical irregularities</td>
<td>T1: Low, T2: High</td>
</tr>
<tr>
<td></td>
<td>Fluid signal</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Collapse + OA</td>
<td>T1: Low, T2: Low</td>
</tr>
<tr>
<td></td>
<td>Bone sclerosis</td>
<td></td>
</tr>
</tbody>
</table>
The line is composed of two layers [double line sign]:
Inner layer of hyperemic granulation tissue and an outer layer of osteoblastic activity
The size and location of the lesion will affect the prognosis.
- Lesions < 25% of the weight bearing area of the femoral head respond well to core decompression
- Medially and centrally located lesions have better prognosis
- Contrast injection may be used to assess bone viability
Stage II
Stage III
Stage IV Osteoarthritis
Transient osteoporosis

- Unknown etiology
- Middle aged over weight males
- Male : female = 3:1
- Usually unilateral [left hip in females]
- Resolves spontaneously in 6-8 months
- Pain & limp with no history of trauma
Transient osteoporosis

- X ray  Normal or ↓ bone density
- Bone scan  ↑ uptake in the femoral head and neck
- MRI  Bone marrow edema in the head and neck
- DD  AVN, bone infarct, stress fracture
  Septic arthritis, primary and metastatic tumors
Transient osteoporosis
Transient osteoporosis

- Some cases may demonstrate a line after clearance of edema suggesting that TOH as a precursor of AVN
Transient osteoporosis
Transient osteoporosis
Transient osteoporosis 7/9/99, 9/12/99
Transient osteoporosis with follow up
Transient osteoporosis with follow up
Transient osteoporosis with follow up
Transient osteoporosis  versus  Avascular necrosis
Transient osteoporosis and avascular necrosis

- Careful monitoring by MRI
  - Pain medications
  - Protected weight bearing for 4-6 months until edema regression
  - Core decompression
**Subchondral fracture**

- In young may be a stress fracture
- In elderly may be the squeal of osteoporosis
- Leads to extensive marrow edema which may progress to femoral head collapse and secondary OA
- **DD** include AVN, TOH, Rapidly destructive OA
- MR shows a hypo intense line
Rapidly destructive osteoarthritis

- A rare lesion seen in old women
- Findings are those of osteoarthritis but they rapidly progress to bone resorption and joint destruction
Subchondral fracture

Avascular necrosis

Transient osteoporosis

May progress to AVN as proved in some cases

May progress to AVN as proved in some cases

Not a manifestation of early reversible TOH

May manifest as TOH

May reveal a fracture after edema regression as proved by biopsy
Legg-Calve-Perthes diseases

- Avascular necrosis of the bony femoral epiphysis
- Unknown etiology
- Children 4-9 years old boys: girls = 4:1
- Children with knee pain must be examined for hip pathology
Legg-Calve-Perthes disease

**Stages**

I  Anterior aspect of the epiphysis
II Anterior aspect of the epiphysis + metaphyseal reaction
III All of the epiphysis + metaphyseal reaction
IV Flattening and collapse
Early stage I: Fracture with gas
Healed epiphyseal changes + residual metaphyseal changes
Legg–Calve–Perthes diseases

**MR value**

- Morphology and signal characteristics of femoral epiphysis
- Normal epiphysis shows bright signal in T1 (Fat marrow)
- Intra articular effusion
Anterior aspect of the epiphysis

All of the epiphysis+ metaphyseal reaction

Normal
Spectrum of Perthes disease

I
Anterior aspect of the epiphysis

IV
Flattening and collapse

Spectrum of Perthes disease
Legg-Calve-Perthes disease

Reconstitution of the femoral head over 3 ½ years
Slipped capital femoral epiphysis

- Posterior inferior displacement of the proximal femoral epiphysis
- Unknown etiology (trauma, obesity, ...)
- Bilateral in 20-25% of cases
- Associated avascular necrosis in 15%
Slipped capital femoral epiphysis
Slipped capital femoral epiphysis

F 13 Y
Slipped femoral epiphysis with normal marrow signal
Muscle sprains

I. Muscle edema with preserved morphology

II. Disruption of up to 50% of muscle fibers with subacute blood at the site of tear

III. Complete muscle tear ± retraction and atrophy

[best seen in axial images with comparison to normal side]

Grade I muscle sprain of the obturator externus and adductor longus
Grade I muscle sprain of the obturator externus and adductor brevis.
Grade II tear of semitendinosis muscle
Grade III tear of the rectus femoris muscle with atrophy compared to the left side.
Muscle injury
Fractures

- Intracapsular: Femoral head, subcapital, transcervical
- Extra capsular: Intertrochanteric, subtrochanteric
- Acetabular fracture: best evaluated by CT
  - Retained intra articular fragments (CT)
  - Avascular necrosis of femoral head (MRI)
Acetabular fracture
Deposits of breast cancer with pathological fracture
Lymphoma

M 54Y
Chondrosarcoma
Stress fracture of the femoral neck
Femoral neck fracture with AVN
MR hip arthrogram

- Normal saline or Gd-DTPA
- Mixing 0.1 ml of Gd with 20 ml saline + 5ml of iodinated contrast + Lidocaine
- The joint capacity is 8-20 ml
- Surface coil
- FOV = 14-16 CM
- Slice thickness 3-5 mm
- T1 weighted images without and with fat suppression
- Sagittal, coronal and axial oblique should be obtained
- STIR images for the whole pelvis should be included

- Labral abnormalities
- Loose bodies
- Osteo–chondral lesions
Labral tears

- Normal labrum is a triangular low signal structure at the superior and inferior acetabular margins
- Surface coil
- MR arthrogram
Pain relief after intra-articular injection of Lidocaine is an indicator of an intra-articular source of pain.

Labral lesions correlate with anterior inguinal pain, painful clicking, transient locking...

Labral tears are treated by resection or repair.

Intra-substance signal indicates labral degeneration.

Loss of the perilabral recess indicates abnormal labrum.

A perilabral cyst indicates an underlying labral tear.

Perilabral recess between the capsular attachment and labrum Labral tear & degeneration.
Paralabral cyst extending into the substance of torn labrum
Snapping hip syndrome

- Pain and audible click in the hip with motion
- Pain is due to bursitis, tendinitis, synovitis
- **External**: Gluteus maximus or tensor fascia lata snapping over the greater trochanter
- **Internal**: Ileo – psoas tendon snapping over the femoral head or ileopectineal eminence
- Loose bodies and labral fragments are also internal causes
Bursae are sacs of synovial tissue
- Prevent friction between bones and soft tissues.
- 15-20 Bursae around the hip joint
  - Trochnteric
  - Iseho-gluteal
  - Iliopsoas: the largest in the body
- 10% - 15% communicate with the joint
Ileo - psoas brusitis

- Fluid collection medial to the ileo – psoas muscle
- Usually 1-3 cm and may show marginal enhancement
- Large hip joint effusion may be decompressed in the bursa as in cases of Rheumatoid arthritis
Femro - acetabular impingement

- Micro trauma from impingement of the femoral head against the acetabulum
- Abnormal signal of the acetabular rim and femoral head
- Labral tears and cartilage degeneration are seen
- Clinically recurrent attacks of severe hip and groin pain
- Pain increases by flexion and internal rotation and weight bearing
Effusion, osteoarthritis

- Narrowing of the superior joint space
- Suprolateral migration of the femur
- Osteophytic lipping
- Subchondral sclerosis
- Subarticular pseudo cysts
- Effusion
- Vacuum phenomena
Avascular necrosis versus osteoarthritis

- No acetabular changes
- The superior aspect of the joint space is preserved
- No fissures, but pseudo cystic changes
Loose bodies

Etiology

- Trauma
- Osteoarthritis
- PVNS
- AVN
- Synovial chondromatosis
- Arthritis [gout, septic, rheumatoid,...]
Loose bodies/ osteochondromatosis

Clinical
- Pain
- Locking
- Clicking
- Snapping
Synovial osteochondromatosis

Metaplasia of subsynovial soft tissues → cartilage formation
Affects any joint [knee, hip, elbow]
Age incidence 40 years  M : F = 2 : 1

Findings
- Widening of the joint space
- Bone erosions
- Intra articular loose bodies
- Secondary osteoarthritis changes
Synovial osteochondromatosis
Femoral neck antversion angle
Femoral neck antversion angle

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Antversion Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1 Y</td>
<td>30° - 50°</td>
</tr>
<tr>
<td>2 Y</td>
<td>30°</td>
</tr>
<tr>
<td>3-5 Y</td>
<td>25°</td>
</tr>
<tr>
<td>6-12 Y</td>
<td>20°</td>
</tr>
<tr>
<td>12-15 Y</td>
<td>17°</td>
</tr>
<tr>
<td>16-20 Y</td>
<td>11°</td>
</tr>
<tr>
<td>20 Y</td>
<td>8°</td>
</tr>
</tbody>
</table>
Q.

Avascular necrosis Stage IV
Perth’s disease Stage I
Acetabular fracture with marrow edema of the acetabulum and femoral head and neck
Slipped capital femoral epiphysis
Avascular necrosis Stage II with joint effusion
Transient osteoporosis
Rheumatoid arthritis in a 66-year-old man with right hip pain and a soft-tissue mass anterior to the hip. The radiograph was normal. CT scan shows a cystic mass at the site of the iliopsoas bursa, displacing muscle and vasculature. The osseous structures are normal. This is a typical appearance of decompression of synovial fluid into the iliopsoas bursa, not infrequently seen in patients with rheumatoid arthritis.
Normal red marrow in the femoral neck and shaft
Slipped capital femoral epiphysis
Avascular necrosis Stage II right and stage IV left
Grade I muscle injury, muscle edema
Legg-Calve-Perthes diseases, stage I.
Fissure fracture of the posterior acetabular column
Avascular necrosis Stage II
Avascular necrosis Stage II
Avascular necrosis Stage IV
Transient osteoporosis, bone scan
Acetabular fracture with marrow edema of the acetabulum and femoral head
Transient osteoporosis, bone scan and MRI Left hip
Avascular necrosis Stage IV
Transient osteoporosis, MRI Left hip
سبحانك اللهم و بحمدك نشهد ان لا اله الا انت نستغفرك و نتوب اليك

Thank you

Mamdouh Mahfouz  MD
mamdouh.m5@gmail.com