Imaging of the Hip & Pelvis

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Learning Objectives
- At the end of the presentation, each participant should be able to:
  - discuss the imaging options for evaluating a patient presenting with hip and/or pelvic pain
  - list the various anatomic structures that can refer pain to the hip.
  - describe the MR appearances of the anatomic structures of the hip and pelvis as well as those of common pathologic entities that affect each.

Hip/Pelvis Pain: Sources
- Bone
  - Fracture (traumatic or stress), AVN, transient BME
- Articular
  - Labral tear or degeneration
  - Femoroacetabular impingement
  - Arthritis, PVNS, synovial chondromatosis, amyloid
- Soft Tissues
  - Tendons and muscle pathology, bursitis
- Lumbosacral Spine
  - Disc, facet joint, SI joint

Hip/Pelvis: imaging options
- Radiography
- Computed tomography
- Radionuclide bone scan
- MR imaging

MRI: Technique
- Both Hips
  - Body coil
  - Phased array pelvic coil
  - Side to side symmetry
- Single Hip
  - Surface coil
  - High resolution

Hip and Pelvis: Challenges
- Imaging challenges
  - complex anatomy
  - overlying structures
  - elderly - osteopenia
- Clinical challenges
  - referred pain
  - multiple sources

Imaging of the Hip & Pelvis: with an emphasis on MR imaging

Hip/Pelvis: Challenges
- Clinical challenges
  - referred pain
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Hip/Pelvis: imaging options
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- discuss the imaging options for evaluating a patient presenting with hip and/or pelvic pain
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### MRI: Technique
- **Standard pelvis**
  - Cor T1
  - Axial T1
  - Sag STIR
- **Labrum**
  - Intraarticular Gd
  - T1 with/o fat sat
  - At least one T2W

### Anatomy: Ligaments
- **Ligaments**
  - Hip
    - Iliofemoral
    - Pubofemoral
    - Ischiofemoral
    - Teres
  - Post. Pelvis
    - Sacroiliac/Iliolumbar
    - Sacrospinous
    - Sacrotuberous

### Anatomy: Bones
- **Pelvis**
  - Ilium
  - Pubis
  - Ischium
  - Sacrum
- **Acetabulum**
  - Triradiate cartilage
  - Inverted U
  - Acetabular notch
  - Acetabular fossa

### Anatomy: Tendons
- **Pelvis**
  - Sartorius / TFL
  - ASIS
  - Rectus femoris
  - AIIS
  - Hamstrings
  - Ischial tuberosity
  - Rectus Abd
  - Symph/sup rami
  - Abominal wall
  - Iliac Crest
  - Adductors
  - Inf pubic rami

### Anatomy: Bones
- **Proximal Femur**
  - Head (fovea capitis)
  - Neck
    - Subcapital
    - Cervical
    - Basicervical
  - Intertrochanteric
  - Subtrochanteric

### Anatomy: Tendons
- **Femur**
  - Greater Trochanter
    - Gluteus med/min
  - Obturator int/ext
  - Gemelli
  - Intertroch (post)
    - Quad femoris
  - Lesser Trochanter
    - Iliopsoas

### Anatomy: Labrum
- **Labrum**
  - Acetabular rim
  - Transverse ligament

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### Anatomy: Bursae
- **Trochanteric**
- **Iliopsoas**
- **Ischial**
Anatomy: Vessels and Nerves

- Femoral head
  - Med/Lat circumflex femoral
  - ascending cervical branches
  - Artery of the lig teres
- Nerves
  - Femoral
  - Obturator
  - Sciatic

Bone: stress injuries

- Diagnosis
  - clinical information
  - location
  - morphology
- Location
  - sacrum
  - suprascapular
  - pubic rami
  - parasymphysis
  - proximal femur
- Morphology
  - linear component

Hip Pain: osseous sources

- Fracture
  - traumatic, stress/insufficiency, avulsive injury
- AVN
- Transient Bone Marrow Edema

Chronic Avulsive Injuries

- Thigh Splints
  - adductor insertion avulsion syndrome
  - avulsive injury - adductor longus/brevis
  - proximal to mid femoral shaft
  - referred pain in hip and groin
- Radiographs
  - periosteal rxn medial femoral shaft

Bone: acute trauma

- Elderly
  - osteopenic
  - potential displacement
- MRI vs. Bone Scan
  - sensitivity
  - specificity
  - speed
  - cost

Thigh Splints

- MRI
  - findings of stress injury
  - periosteal fluid/edema
  - marrow edema
  - cortical signal

Bone: chronic trauma

- Stress injuries
  - fatigue fracture
  - insufficiency fracture
- Non-specific signal
  - low T1, high T2
- Non-specific symptoms
  - concern for tumor
  - especially in elderly

Bones: AVN

Tenuous Blood Supply

Anterior superior head

Etiology
- Trauma
- Steroids
- Sickle Cell
- Alcoholism
- Radiation
- Idiopathic
Bones: AVN

- Geographic
  - Ant-sup head
- Low SI border
- "Double line" T2
  - Low SI outer
  - High SI inner
- Central tissue
  - Fat
  - Hemorrhage
  - Fluid
  - Sclerosis

Bilateral ~ 50%

Acetabular labrum

- Fibrocartilage
- Acetabular rim
- Incomplete inferiorly
  - Transverse ligament
- Gd-arthrography
- Pathology
  - Tears
  - Paralabral cysts
  - Cystic degeneration

Bones: AVN

- Geomorphic changes – 6-12 hrs
- Cell death – 2 days
- Fat cells – 2-5 days
- Reactive interface
  - Surrounds devitalized tissue
  - Inflammatory response
  - Hyperemia

Femoroacetabular Impingement

- Impingement
  - Femoral head/neck
  - Ant-sup acetabulum
- Two types
  - Cam type
    - "Pistol grip"
  - Pincer type
- Pathology
  - Articular cartilage
  - Labrum
  - Premature DJD?

Transient Bone Marrow Edema

- "Transient osteopenia"
- Males > females
- Pain; +/- limited motion
- Self-limited
- Precursor to AVN??
- MRI
  - Diffuse edema-like SI
  - Head and neck

Articular Pathology

- Arthritis
- Synovial chondromatosis
- Amyloid arthropathy
- PVNS
- Septic arthropathy
- Idiopathic chondrolysis

Hip Pain: articular sources

- Labrum
- Femoroacetabular impingement
- Arthritis
- Synovial processes
  - Synovial chondromatosis, amyloid, PVNS

Arthritis: MRI

- Osteoarthritis
  - Both sides of joint
  - Osteophytes
  - Superior narrowing
  - Subchondral geodes
- Rheumatoid
  - Enhancing synovial pannus
    - Can mimic joint fluid on non-Gd images
  - Erosions +/-
Synovial Processes

- Synovial Osteochondromatosis
  - Metaplastic cartilage foci in synovium
  - Pure cartilage vs. ossification
  - Primary vs. secondary forms

- MRI
  - Synovial masses
  - 1st same size
  - 2nd variable

Synovial Processes

Amyloid Arthropathy
- Protein deposition
  - 1st vs. 2nd (diabetes)

PVNS
- Synovial proliferation
- Hemosiderin deposits
  - 10–30 years old (50% < 40)

MRI
- Low SI - T1 and T2
- PVNS “blooming” - GRE

Synovial Processes

Septic Arthritis
- Effusion (non-specific)
- +/- soft tissue edema
- +/- osseous edema erosions

- Aspirate!

Tendons/Muscles

- Avulsion injuries
  - ASIS – sartorius
  - AIL - rectus femoris
  - Greater trochanter – gluteus medius
  - Ischial tuberosity – hamstrings

- Muscle injuries
  - Strain
  - Partial tear
  - Complete tear

- “Snapping hip”
  - Iliopsoas
  - Iliotibial band

Bursitis

- Trochanteric
- Iliopsoas
- Ischial

Other Sources: lumbar spine

- Lumbar Spine
  - Discogenic pain
  - Annular tears
  - Facet Joint
  - Referred pain
    - Hip, buttock, thigh

Other Sources: sacroiliac joints

- Degeneration
- Sacroilitis
  - Inflammatory
  - Infectious
- Post-traumatic

Osseous Tumor

- Infiltrative or geographic
- T1 – lower SI than muscle
- Multiple lesions
- Single lesion
  - Marrow survey MRI spine
  - Bone scan
Hip / Pelvis: “back to front”

Bones
- fracture, AVN signal STIR
Lucmar spine
SI joints
Hamstring tendons
Greater trochanter
- Trochanteric bursa
- Gluteus medius tendon
- Iliotibial band
Hip joint
- labrum / paralabral cysts
- FAI – femoral morphology, ant-sup joint (sag images)
Anterior tendons