HIP INJURIES: Imaging

Primary Care Approach To Treating The Injured Athlete

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Musculoskeletal Imaging
Disclosures

• No disclosures
I. Why Imaging?

II. Imaging Modalities (brief general overview)
   - Radiographs (XR), Computed Tomography (CT), Ultrasound (US), Magnetic Resonance Imaging (MRI)

III. The Hip
   A. Functions
   B. Anatomy on MRI (very brief overview!)
   C. Pathology on imaging
Why Imaging?

• “In modern medical practice, the term Radiology encompasses the techniques used to investigate the architecture and physiological function of the human body.”

• To help identify the cause of pain, dysfunction, or disability

• If you know where is the ‘pain’ and what is causing the ‘pain’, you will be able to better treat the ‘pain’
Modalities of Imaging

• XR
  – production of an x-ray beam to evaluate anatomy
  – portion of the x-ray beam, not absorbed by the body, used to expose x-ray film, producing the diagnostic image
  – bone and soft tissues require no special preparation for the evaluation
  – 2 dimensional image
  – detail of the bones
Modalities

• CT
  – production of an x-ray beam to evaluate anatomy
  – bone and soft tissues require no special preparation for the evaluation
  – organ and circulatory systems, may require contrast material to enhance the visualization of their shape, size, position, and functional status
  – 3 dimensional images of a cross-section of a part of the body
  – better detail of extra-articular and intra-articular bony architecture; also soft tissues
Hip CT
Modalities

- **US**
  - *high-frequency sound beam used to visualize the structures of interest*
  - sound beam directed into the body
  - resulting densities of body tissue reflected back, analyzed to produce the diagnostic image
  - *Some detail of tendons, ligaments, organs, soft tissues*
  - NOT good for bones or lungs
Hip Ultrasound

http://www.ultrasoundcases.info/files/Jpg/7678.jpg
Modalities

• MRI

  – *based on the magnetic behavior of H atoms in tissues when placed in a magnetic field and excited by radiofrequency pulses*
  
  – after excitation, H atoms return to normal state by emitting energy that is monitored
  
  – this energy characterized by relaxation times, which reflect the chemical and physical properties of tissues, creating an image
  
  – *greatest for soft tissue detail and organ detail; including ligaments, tendons; also very good for bone*
MRI

- Depending on pulse sequence, tissues will show up as black, white, and everything in between (shades of gray)
  - T1, T2, Proton Density (PD)
- T1: fluid black, fat bright, muscle intermediate, tendons and ligaments dark, bone bright
- T2: fluid bright, fat bright or dark (FS), muscle intermediate or darker, tendons and ligaments dark, bone bright or dark (FS)
MRI pelvis protocol

Coronal T1

Coronal FS T2
MRI pelvis protocol

Axial T1

Axial FS T2
Pain

Upper extremity

Bony detail: fractures, dislocations, foreign body

Lower extremity

Same as XR with intra-articular and extra-articular detail, soft tissue detail

Imaging

Soft tissue detail: intra-articular and extra-articular, other

XR

Same as XR with intra-articular and extra-articular detail, soft tissue detail

CT

US

MRI

Greater than US or CT for the soft tissue detail, bone marrow changes

Physical Exam (Dx/Rx)
Anatomy to evaluate/Indications for MRI of the hip

• Non-arthrogram
  – Everything!
    • Bones, Joint, Tendons, Other (tumors)
  – Bilateral hips or pelvis
    • Bilateral pain
    • Unknown pain source
  – Unilateral
    • Unilateral pain
    • Specific symptoms

• Arthrogram
  – Labrum
  – Cartilage

• All else can be commented on if visualized
The hip

- Most stable articulation in the body
- Ball and socket joint, 2nd greatest ROM
The hip
The hip
Hip Functions

- Flexion
- Extension
- Abduction
- Adduction
- Internal/external rotation
Hip anatomy

FIGURE 6-23H. Normal coronal MR anatomy. (A) Sagittal localizer used to graphically prescribe coronal T1-weighted image location from (B) anterior to (L) posterior. From Magnetic Resonance Imaging in Orthopaedics and Sports Medicine, David W. Stoller MD, Lippincott-Raven 1998

www.hwbf.org
Hip anatomy
Hip anatomy

- Articular cartilage
- Piriformis tendon
- Posterior labrum
- Obturator internus tendon
- Obturator externus tendon
- Anterior labrum
- Ischiofemoral ligament
- Iliopsoas tendon
The hip
The hip
Pain

Imaging

Upper extremity
- XR: Bony detail: fractures, dislocations, foreign body
- CT: Same as XR with intra-articular and extra-articular detail, soft tissue detail
- US: Soft tissue detail: intra-articular and extra-articular, other
- MRI: Greater than US or CT for the soft tissue detail, bone marrow changes

Lower extremity

Physical Exam (Dx/Rx)
Pathology

• Fracture spectrum
• Tendon tear/Sports hernia
• Rectus femoris tendon avulsion
• Femoroacetabular Impingement
• Labral tear
Stress reaction
Stress reaction
Stress fracture
Nondisplaced fracture
Nondisplaced fracture
Nondisplaced fracture
Nondisplaced fracture
Fracture spectrum

• MRI findings
  – T1 linear low signal with surrounding low signal edema
  – T2 linear low signal with surrounding high signal edema
  – +/- cortical break, osseous fragments
  – Stress reaction is edema
Stress fracture

- Most commonly around pelvis and hip
- Stress fractures in athletes F>M
- 15% of runners sustain a stress fracture
- 5-10% of all stress fractures involve the femoral neck (usually basicervical)
- MRI exquisitely sensitive for detection (the most sensitive than all other modalities)
  - About 14% of femur and pelvic fractures are missed on CR
  - Kirby, AJR 2010;194:1054-1060.
- * Female Athlete Triad
Tendon tear
Tendon tear

- MRI findings
  - T1 isointense to muscle (low)
  - T2 high signal in tendon (edema)
  - Disruption of fibers (waviness, discontinuity)
  - Edema (high T2 signal) in adjacent muscle and bony attachment
  - For sports hernia also high T2 signal in the pubic symphysis
Sports hernia
AllS avulsion
Tendon avulsion

- Bony avulsion usually clear on radiographs
- MRI findings
  - Similar tendon findings
  - Edema (high T2 signal) in adjacent muscle and bony attachment
  - Cortical break and adjacent bony fragment
AIIS tendon avulsion
AllS tendon avulsion
AIIS tendon avulsion
Femoroacetabular Impingement Syndrome

- Major cause of early osteoarthritis of the hip, especially in young and active patients, including labral abnormalities

- Early pathologic contact during hip joint motion between skeletal prominences of the acetabulum and the femur

- Limits physiologic hip range of motion, typically flexion and internal rotation

- Pain in the groin; +/- pain in the trochanteric region extending to the lateral thigh
Femoroacetabular Impingement Syndrome (FAI)

- 2 types of impingement
  - Pincer
    - acetabular cause of FAI
    - focal or general over coverage of femoral head
  - CAM
    - femoral cause of FAI
    - aspherical shape of femoral head, femoral head-neck bony excrescence (CAM lesion), coxa magna

- Best evaluation is first by radiographs
Normal configuration of hip with sufficient joint clearance allows unrestricted range of motion.

FAI

Excessive acetabular coverage

Aspherical part of the femoral head–neck junction

Subtle joint subluxation
FAI – Normal hip

FAI – Pincer type

FAI – CAM type

Labral tear

• MRI findings
  – Abnormal linear increased signal through the dark signal triangular labrum
  – Deformity or irregularity of the labrum
  – Detachment of the labrum
  – Associated paralabral cysts
Labral tear

- Acute injury, chronic stress (FAI), DDH
- Pain and clicking
- MRI arthrography the best to evaluate labrum (and cartilage)
Labral tear
Labral tear
Case F
Labral tear
Labral tear
Labral tear
Labral tear
Conclusions

• Hip - complex joint with different anatomic structures causing pathology
• Imaging is the best way to evaluate pathology, including the hip joint
• In particular MRI is a great modality for all types of pathology

Thank you!
References

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www.ptcentral.com


References


