Current Concepts in Magnetic Resonance Imaging of the Hip
Overview

- Technique
- Basic Anatomy/Normal Variants
  - Osseous
  - Soft Tissue
- Pathology
  - FAI
  - RC/Hamstring Tears
  - Ligamentum Teres
  - Adhesive Capsulitis
Technique

- Surface coil used to optimize SNR

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MR Arthrography

- Imaging

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*Special Axial Oblique Sequence used to measure femoral Head-neck offset*
Axial Obliques
Normal Osseous Anatomy

- Hip is ball and socket joint stabilized by its intrinsic anatomy
Normal Osseous Anatomy

- Acetabular notch
Greater Trochanter

- Anterior: g. minimus attachment
- Lateral: g. medius attachment
- Posterosuperior: g. medius attachment
- Posterior: trochanteric bursa
Greater Trochanter Anatomy
Hamstring Anatomy

- **Superolateral:**
  semimembranosus
- **Inferomedial:** conjoint
tenon comprised of
  semitendinosus and
  long head of biceps
  femoris
Hamstring Anatomy

Acetabular Labrum

• Composed of fibrocartilaginous tissue
• Primarily avascular with increased vascularity adjacent to the capsule
• Role is unknown since the hip joint is already stable
• Thickest in posterosuperior extent
• Inferiorly, coalesces with transverse ligament
Labrum

- Triangular 69.2%
- Round 15.8%
- Flat 12.5%
- Absent 2.5%

Pitfalls of the Labrum

- ? Normal sublabral sulcus in anterosuperior labrum
  - Pro: sulcus has sharp margins
  - Con: none have been seen in cadavers or patients but this may be due to lack of intra-articular contrast

Anterosuperior Sublabral Sulcus

- 3 criteria from a recent article:
  - If contrast doesn’t extend through entire labrum
  - If it has smooth margins
  - Also if it remains shallow (<50%)

Labrum

• MR arthrography is a sensitive and specific tool
  – Debate on both sides of spectrum
    • Keeney et al says that arthroscopy is needed
    • Mintz et al states noncontrast is just as accurate
  – Radial imaging has been investigated with some success but low sample sizes
• Classified into traumatic or degenerative
  – Intrasubstance or detachment
• Classification of tears described by Czerny et al.

Stage 0

- Normal triangular labrum
- Normal recess
Stage 1A

- Increased intralabral signal
Stage 2A

- Contrast material extends into labrum
Stage 3A

- Labral Detachment

The B subtypes have a hypertrophied labrum without perilabral sulcus
Cartilage

• Difficult to evaluate with standard MR imaging
  – Inseparable femoral/acetabular cartilage
  – Hip cartilage is extremely thin (1-2mm)
Cartilage

- MR arthrography
  - Schmid et al were able to detect chondral abnormalities with high sens/spec
  - Traction can also be useful
  - Special techniques: water-excitation 3D double-echo steady-state sequence
Cartilage

- MC location of abnormality is anterosuperior acetabulum
  - Can be delaminating
  - Flap > 1mm

- Treatment:
  - microfx
Femoroacetabular Impingement

- Cause for early degenerative changes in young pts
- Symptoms: pain on hip flexion and internal rotation
  - Key feature: PE is disproportionate loss of ROM during internal rotation
- Classified as either cam or pincer-types
Normal femoral head-neck junction and acetabulum allows clearance of femoral head during flexion
Cam-type FAI

• Offset of femoral head/neck junction

• Etiologies:
  – CHD
  – SCFE
  – AVN
  – Trauma
Using an axial oblique plane, alpha angle measured. Normal is 42 degrees with upper limits of 55 degrees.
Cam-type FAI

- Ganz: cartilage torn while the labrum was intact
- Kassarjian: triad of findings including cartilage and labral abnormalities
- Leunig: fibro-cystic change are early manifestations of FAI
Cam Impingement

Cam Impingement
Pincer-type FAI

- Older female patient population
- Abnormal acetabular morphology
- Etiologies:
  - Coxa profunda
  - Acetabular retroversion
  - Protrusio
  - Trauma
  - Labral ossification
• Cross-over sign
  – Sign of retroversion
Pincer-type FAI

• Coxa profunda:
  – Defined by measuring the distance of the medial acetabular wall and the ilioischial line
    • Males: > 2mm
    • Females: > 6mm

• Acetabulo protrusio:
  – Femoral head projects medial to the ilioischial line
Pincer-type FAI

- MR findings: primarily labral abnormalities
  - Cartilage rarely affected
  - Contre-coup injury to the posteroinferior acetabular labrum can be seen
Treatment

• Early diagnosis important for treatment
  – Cam-type: femoral neck osteoplasty
    • Removing redundant portion of the femoral head
  – Pincer-type: removal of the excessive acetabular portion
    • Reverse periacetabular osteotomy used for acetabular retroversion
Rotator Cuff Pathology

• Tears of the g. medius and minimus tendons
• Uncertain etiology
  – ? Friction from IT band
  – Abnormal gait
  – Repetitive stress in runners
  – Trauma
• Elderly most affected
Clinical

• Symptoms include lateral hip pain
  – Arthritis
  – Tendonitis
  – Insufficiency fracture
  – Muscle strain
  – Bursitis
Imaging

- MR findings:
  - Bunker: originate in g. minimus muscle with a circular or oval defect
  - Traycoff: tears usually involve the anterior aspect of g. medius
  - Kingzett-Taylor: pathology always involved g. medius with extension to minimus in minority
  - Chung: atrophy of the g. medius muscle present with tears
Imaging

• Cvitanic et al.
  – Incidence equal for g. medius and minimus
  – Small focal tears > avulsions
  – Most specific/accurate finding for tear:
    • Increased T2 signal superior to the greater trochanter
Treatment

• Complete avulsion: surgical reattachment

• Tendinosis/partial tear: conservative treatment with intensive PT
Hamstring Pathology

• MC site usually involves MT junction
• Focus on pathology to the PHAC to the ischial tuberosity
• Most severe injury avulsion
  – Occurs in athletes during excessive eccentric contraction during running or jumping
  – In children, the apophysis involved
Hamstring Pathology

MR findings

- Most avulsions involve conjoint tendon with partial tearing of SMB
- Ragheb et al:
  - 82% of pathology involved all 3 tendons
  - SMB most common to be torn in isolation
Treatment

• Early surgical intervention required
  – To avoid complications such as gluteal sciatica from localized scarring or neuritis from displaced hamstrings
Ligamentum Teres

- Increasingly recognized as a source of hip pain
- Function unknown: unlikely stability
  - Proprioception
  - Nociception
  - Spreading synovial fluid like a windshield wiper
Ligamentum Teres

• Difficult to visualize on arthroscopy
  – 3rd most common finding arthroscopically in athletes
  – Deep anterior groin pain
• Gray et al described 3 types
  – Complete rupture from trauma/surgery
  – Partial tear in pts with chronic sx’s
  – Degeneration in young pts
    • RF’s include LCP and SCFE

Ligamentum Teres
Treatment

- Debridement and washout
- Total hip arthroplasty performed when conservative treatment fails
Adhesive Capsulitis

- Clinically: painful restricted motion
- Imaging: normal radiographs/MR’s
  - Tightness during arthrography
    - Failed arthroscopy
- Etiology: idiopathic
  - Secondary to pathology (i.e. synovial chondr)
- Demographics: middle aged women

Adhesive Capsulitis of the Hip
Conclusion

• Normal Anatomy:
  – Osseous: ischial tuberosity and greater trochanter
  – Labrum: pitfalls and variants

• Pathology:
  – Labral tears in association with FAI
  – Hamstring/Rotator cuff tears
  – Ligamentum teres
  – Adhesive capsulitis