Current Concepts in Magnetic Resonance Imaging of the Hip

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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*
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

- Gluteus Minimus
- Gluteus Medius
- Gluteus Maximus
Hamstring Anatomy

- **Superolateral**: semimembranosus
- **Inferomedial**: conjoint tendon 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
  – Intrusubstance 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