Hip: Labrum & FAI

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Outline

• Imaging techniques
• Hip pathology
  – Labrum
  – Articular cartilage
  – Femoroacetabular impingement (FAI)
Conventional MR versus MR Arthrography
Conventional MR

• 3T
• Optimized high resolution
• Multichannel surface coil

Potter HG. J Magn Reson Imaging 2010;31:268-278
MR Arthrography Protocol

- T1-weighted, fat suppression: 3 planes
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  - FOV 14-18cm, 256 X 320 matrix, 3-4 mm thickness
  - Surface coil
- Include T2 fat sat or STIR (coronal)
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- Include T1 without fat sat (axial)
MR Arthrography Protocol

• T1-weighted, fat suppression: 3 planes
  – FOV 14-18cm, 256 X 320 matrix, 3-4 mm thickness
  – Surface coil
• Include T2 fat sat or STIR (coronal)
• Include T1 without fat sat (axial)
• Consider sag PD fat-sat
Radial Imaging
Hip Joint: Injection Technique

• Joint injection under fluoroscopic guidance
  – Direct anterolateral approach
  – ~12 mL total
    • 10 mL anesthetic
    • 5 mL normal saline
    • 5 mL contrast (300)
    • 0.1 mL gadolinium

Hip Anatomy
“Ball and Socket” Joint

Stoller. MRI, arthroscopy, surgical anatomy of the joints. Lippincott Williams & Wilkins 1999
Normal Triangular Labrum
Ligamentum Teres
Transverse Ligament
Junction of Trans. Lig. and Labrum
Zona Orbicularis:
circular fibers of the capsule
Etiology: Labrum Tears

- Hip deformities
  - Cam or pincer impingement
  - Dysplasia
- Acute trauma
- Overuse injuries
- Degeneration
- Hypermobility/capsule laxity

Runnersworld.com, orthopaedics360.com, spineone.com
MR Criteria: Labrum Tears

- Labrum distortion
- High SI on T2 or contrast extension into the labral substance or into the acetabulum-labrum junction
• Anterior to anterior/superior (92%)

• Posterior much less common
  – Younger pt population
  – In athletes due to axial loading in flexed position
  – Following posterior hip dislocation
Anterior-Superior Labrum Tear
Superior Labrum Tear

22 year-old runner with hip pain
42 year-old woman with hip pain
Anterior Labrum Tear
Partial Tear AS Labrum

40-year-old man with hip pain following a work injury

Arthroscopy:
Anterior superior labrum tear, 3A cartilage defect femoral head, 2B acetabular cartilage thinning
Labrum: What to report

• Labrum tear: Yes or No
• Describe tear

Chondrolabral separation

Partial-thickness Tear

Full-thickness Tear

Intrasubstance Tear

Schmaranzer F. Semin Musculoskelet Radiol 2017
Labrum: What to report

- Labrum tear: Yes or No
- Describe tear
- Localize and define extent
Labrum: What to report

- Labrum tear: Yes or No
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Labrum surgical techniques

Debridement

Repair

Larson CM Arthroscopy 2009;4:369-376
25-year-old woman with continued hip pain following right labrum debridement.
MR arthrography post-op labrum

- Normal post-op appearance
  - Shorter labrum

Re-tear criteria after resection*:
1. New line to the labrum surface
2. Enlarged/distorted labrum
3. New paralabral cyst

Labrum Re-Tear

1\textsuperscript{st} MRA

2\textsuperscript{nd} MRA

Shorter
Intra-articular Adhesions

- 2nd most common reason for revision surgery (6% of cases-10 year f/u**)
- Occur at site of FAI correction
- Complete obliteration of intermed SI between femoral neck and capsule or in peripheral recess
- Recurrent impingement due to scar tissue

Haefeli PC, et al. Eur J Rad 2018
**Steppacher SD. Clin Orthop 2015
Arthroscopic Hip Surgery:
Frequency of Postoperative MR Arthrographic Findings in Asymptomatic and Symptomatic Patients

Chan-Hi Olaf Kim, MD
Tobias J. Dietrich, MD
Patrick O. Zingg, MD
Claudio Dora, MD
Christian W. A. Pflirmann, MD, MBA
Reto Sutter, MD

Purpose:
To determine and compare the frequency of imaging abnormalities in asymptomatic and symptomatic patients after arthroscopic hip surgery.

Materials and Methods:
This study was approved by the institutional review board. Informed consent was obtained from all patients. Thirty-four patients (17 asymptomatic and 17 symptomatic patients) underwent 1.5-T magnetic resonance (MR) arthrography of the hip 1 year after arthroscopic treatment of femoroacetabular impingement. Two readers independently analyzed all MR arthrographic images for the presence of abnormal imaging findings, including capsular adhesions at the femoral neck, obliteration of the paralabral sulcus, labral defects, and defects of the hip capsule in several anatomic positions (anterior to posterior). Postoperative findings were compared with linear and generalized linear mixed-effects regression models.

Results:
Capsular adhesions at the anterior femoral neck were present in 12 of the 34 patients (35%), and there were

Adhesions present in 35%
Loss of perilabral recess
Secondary sign: Paralabral Cyst

- Typically extra-articular
- Associated with labrum tears
Pitfall: Iliopsoas Bursa

- Contrast within bursa on MR arthrography does not indicate capsule disruption
- Communicates with hip joint ~15%
Pitfalls
Pitfall: chondrolabral junction

• Normal transition zone 1-3 mm
Pitfalls: Sublabral Sulcus/Recess?

- **Posteroinferior sulcus**
  - Common finding

- **Anterior sulcus**
  - Controversial - ? Healing tear
  - Most common anterosuperior

- **Recesses not**
  - Into labral substance
  - Full thickness
  - Abnormal labral signal
  - Cartilage defects
  - Osseous abnormalities
  - Paralabral cysts

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**Studler U. et al. Radiology 2008;249:947-954.**
30 y/o woman: Sulcus & labrum tear

Sulcus

Tear
Sulcus vs. Tear?

17 year-old with left hip pain

Pain relief with IA anesthetic

T1 FS
**Normal anatomic variant**

**Communicates with hip joint 5% arthrograms**

**May mimic a para-labral cyst**

Kassarjian A. *Eur Radiol* 2009;19:2779-2782
Ligamentum Teres

- LT connects the fovea to the PI acetabular fossa
- Mechanical symptoms can occur with ruptured LT; clicking/ "giving away"
- Hypertrophy/PT: thickened/increased SI/contour deformity

Armfield DR. SSR 29th Annual meeting, 2006 Tucson, AZ.
43♀ hurt while stretching
LT tear confirmed at surgery
Cartilage Lesions
Cartilage Pathology

- Anterosuperior location most frequent
- Posteroinferior location (contrecoup) less frequent
- Osteochondritis dissecans
  - Acetabulum > femur
  - Rare (surgeon preference)
- Joint bodies
- Normal variants
  - Supraacetabular fossa
  - Stellate crease
Cartilage: What to report

Describe in report:
Partial-thickness, full-thickness, delamination, subchondral cysts, BME
Cartilage Assessment

Delamination

Schmaranzer F. Semin Musculoskelet Radiol 2017
21-y/o male athlete

Prior labrum repair & femoroplasty
Normal Variant: Supraacetabular Fossa
Normal Variant: Supraacetabular Fossa

- 12:00
- Smooth
- No edema
- No cartilage defect
Normal Variant: Stellate Crease
FAI

http://www.edwinsu.com/hip-arthroscopy.html
Femoroacetabular Impingement (FAI)

- Controversial...
  - ...but everybody’s doing it
- Morphologic abnormalities of the proximal femur and/or acetabulum
- FAI can cause:
  - Labrum tears
  - Cartilage lesions
  - Premature OA

Ganz Clin Orthop 2003; 417:112-120.
Cam FAI

• Aspherical femoral head
  – Anterior superior

• Shearing forces & outside-in-abrasion of acetabular cartilage
  – Delamination of acetabular cartilage

Courtesy of Dr. Michael Recht

Pfirrmann CW. Radiology 2006
Pincer FAI

• Overcoverage of femoral head
  – Deep socket
  – Focal anterior overcoverage

• Linear impact injury
  – Labrum tears (painful)
  – Chronic injury: ossification of the acetabular rim & osteophytic ridging

Kim YT. Clin Orthop Relat Res 1995

Courtesy of Dr. Michael Recht
Causes of Impingement

• Cam impingement:
  – Insufficient femoral head/neck offset (no neck)
  – Subtle displaced femoral epiphysis
  – SCFE
  – Postsurgical/traumatic deformities

• Pincer impingement:
  – Acetabular retroversion
  – Coxa profunda
  – Protrusio acetabuli
  – Hypertrophic rim!!!
Imaging FAI

http://www.edwinsu.com/hip-arthroscopy.html
Osseous “bump”: loss of the normal head/neck junction

a.k.a. loss of normal “offset”

Location:
Anterior or lateral

Causes with cam impingement
3D MRI

3D MR: Accurately dx & quantify typical FAI osseous changes
Samim M et al. *Skel Radiol* 2018

Cam lesion

Pincer lesion
Cam Impingement

- Classic triad MR arthrographic findings
  - Anterosuperior labrum tear
  - Anterior cartilage defect
  ✓ Frequently delaminating
  - Abnormal alpha angle (> 55°)

Kassarjian et al. Radiology 2005
Method of measuring the alpha angle in this normal hip

An angle of 55° or more is considered abnormal (cam impingement)

Abnormal Alpha Angle

68°

45 year-old woman with hip pain
Cam FAI

20 year-old man with bilateral hip pain

Radiographic findings = morphology
Morphology can “predispose” to cam FAI
Cam FAI

29 year-old athletic male with hip pain.

Labrum tear

Cam morphology
Pincer FAI: Retroversion

3 Signs

1. Posterior wall

2. Anterior wall

https://clinicalgate.com
3

- Deficient posterior wall
  - Posterior acetabular rim medial to the femoral head center


Sutter R. *Radiology* 2012
Normal Acetabular Version at Various CC levels
Pincer FAI: Retroversion

Anterior wall lateral to posterior wall
Other Pincer Contributors

Coxa Profunda:
Teardrop medial to ilioischial line

Protrusio Acetabuli:
Fem head medial to ilioischial line
Treatment of FAI

• **Goals:**
  – Prevent or stop progression of OA
  – Alleviate pain

• **Surgical**
  – Address morphologic problems
    • Acetabular osteoplasty
    • Femoral osteoplasty
  – Address soft tissue defects (as necessary)
    • Labrum repair
    • Cartilage debridement
    • Ligamentum teres debridement
Treatment of FAI

Preop: 21 M

Postop
Treatment of FAI

PRE-OP

INTRA-OP
More Impingement: Ischiofemoral

34 ♀ with right hip pain
More impingement: Ischiofemoral

- Manifests clinically as hip, gluteal, or atypical groin pain
- Decreased distance between the lesser trochanter and ischial tuberosity
- Compression of the quadratus femoris (QF) muscle

Taneja AK. *MRI Clinics* 2013
Tosun O. *Skeletal Radiology* 2012
How do we define IFI?

- Edema and/or atrophy in the quadratus femoris
- Ischiofemoral space (IFS) narrowing
  - 13 mm +/- 5 (23 mm +/- 8)
- Quadratus femoris space (QFS) narrowing
  - 7 mm +/- 3 (12 mm +/- 4)

Torriani. AJR 2009
Summary

• Labrum tears are demonstrated well on MRI and MR arthrography
• Beware of labrum pitfalls
• Correlative signs of FAI are apparent on imaging