Case #1

- Findings:
  - Thin and heterogeneous tendon
  - Cortical irregularity and suture
  - No defined tendon defect or retraction
- Diagnosis:
  - Intact repaired supraspinatus tendon

Case 1: continued

- Post-op intact tendon:
  - Variable and heterogeneous echogenicity
  - Variable thickness
- Reimplantation trough
- Echogenic sutures & anchors

Repaired Cuff: ultrasound
Post-operative cuff: intact

**T1w fat-sat coronal MR arthrogram**
- Long Axis
- Open arrows = suture

**T1w fat-sat sagittal MR arthrogram**
- Short Axis
- Open arrow = suture

Rotator Cuff Repair: surgery
- Arthroscopy
- Open surgery
  - Deltoid detachment and reattachment
- Mini-open
  - Arthroscopy-assisted
  - Split deltoid for access without detachment

Rotator Cuff Repair: surgery
- Partial tear repair:
  - Articular <50% and bursal: debridement
  - Articular >50%: repair or convert to full tear
- Full-thickness repair:
  - Trans-osseous fixation + trough
  - Decorticated tuberosity + direct apposition

Rotator Cuff Repair Techniques
- Single Row
- Double Row


Rotator Cuff Repair: surgery
- Subacromial-subdeltoid bursa:
  - Debrided or resected
- AC joint:
  - Subacromial entheseophyte spur resection
  - AC joint osteophyte resection
  - Coracacromial ligament release from acromion
  - Distal clavicle resection: Mumford procedure

Post-operative cuff: acromioplasty

Coracoacromial Ligament Release

Recurrent Cuff Tear: ultrasound results
- Sensitivity = 95%, specificity = 90%, accuracy = 94%1
- Tendon defects at 1 year may heal2
- Defects increase in size with decreased strength but may be asymptomatic3
- Structural integrity does not correlate with pain or function4

1Yen, Clin Imaging 2004; 28:69
4Russell RD et al. JBJS 2014; 96A:265

MRI: post-operative findings
- Intact cuff:
  - Thinner than normal, increased T2w signal
  - Improvement: 6 months – 3 years
  - MR arthrography: may not be water tight seal
- Recurrent tear:
  - 3 – 54%; does not correlate with symptoms
  - Often very large
  - Unequivocal defect or discontinuity

Crim, AJR 2010; 195: 1361

Post-operative Rotator Cuff
- Recurrent tear:
  - Defined tendon defect
    - Ultrasound: anechoic or hypoechoic
    - MRI: fluid or contrast signal
  - Tendon non-visualization (ultrasound)
  - Tendon retraction

Open arrow = bioabsorbable suture anchor

Long Axis
PDw fat-sat coronal
Post-operative cuff: recurrent tear

Rotator Cuff Repair: ultrasound
- How does the repaired tendon appear at specific time points after surgery?
- How does the appearance change over time?
- When should the tendon appear “normal”?

Post-operative Cuff: Intact

Rotator Cuff Repair:
- Most recurrent tears: within 3 months
- Tendons start to look “normal” by 6 to 9 months
- Focal defects are equivocal, may be post-surgical, may disappear
- Recurrent tears tend to be larger or get larger
- If unsure, get follow-up scan

Retear: broken or loose anchors

Case #1: Take Home Points
- Repaired rotator cuff: intact
  - US and MRI: variable findings
- Cuff retear:
  - Most occur within 3 months
  - Well-defined tendon defect
  - Retraction, exposed suture
Case #2:

- **Findings:**
  - Well-defined cortical defect
  - Anterior humeral shaft
- **Differential:**
  - Myeloma, metastasis, post-surgical
- **Diagnosis:**
  - Subpectoral tenodesis: biceps brachii long head tendon

**Subpectoral Tenodesis:**

**Biceps Tendon:**

- **Tenotomy:** surgical transection of intra-articular aspect of long head biceps brachii tendon
- **Tenodesis:** surgical transection + fixation of proximal stump to intertubercular groove or subpectoral

**Pitfall alert:** do not mistake this for intra-articular body in biceps tendon sheath
**Case #2: Take Home Points**

- **Tenodesis**: biceps brachii long head tendon
- Subpectoral or intertubercular groove
- Both will have absence of biceps tendon in rotator interval more proximal
- **Pitfalls**:
  - Pathologic cortical defect
  - Biceps tear or dislocation
  - Intra-articular body

**Case #3: MR arthrogram**

- **Findings**:
  - Superior labrum
  - Truncated and heterogeneous
  - No contrast in labrum substance
- **Diagnosis**:
  - Repaired SLAP tear with no re-tear

**Labral Tears**

- **Treatment**:
  - Debridement, resection, or fixation with suture anchors, absorbable tacks, or knotless fixation
  - Other stabilization surgeries: capsule plication, capsular shift, bone graft
  - Often with biceps tenotomy

- **Post-operative labrum**:
  - Round, truncated
  - Residual intermediate signal
- **Diagnosis of re-tear**:
  - Contrast or joint fluid extension into labrum
  - Labral detachment or fragmentation
- **MR arthrography**: up to 92% accuracy in diagnosing re-tears
Case #3: Intact labral repair

- T1w fat-sat with fat saturation
- PD-weighted with fat saturation

Pitfall alert: normal uncutting of hyaline cartilage should not be interpreted as labral detachment.

Case #3: Take Home Points

- Intact repaired labrum:
  - Often heterogeneous
- Recurrent tear:
  - Joint fluid or contrast within labrum
  - Detached or fragmented labrum

Case #4: supraspinatus

- Long Axis
- Short Axis

Case #4

- Findings:
  - Decreased thickness of supraspinatus
  - Hyperechoic and fibrillar
  - Echogenic humeral head with reverberation
- Diagnosis:
  - Intact supraspinatus tendon after shoulder replacement
Shoulder Arthroplasty

- Total shoulder arthroplasty or hemiarthroplasty
  - Rotator cuff normally inserts onto tuberosities
- Reverse total shoulder arthroplasty:
  - Used when tear of rotator cuff
  - No cuff or tuberosities

Shoulder Arthroplasties

- Total
- Hemi
- Reverse Total

Arthroplasty: Cuff Tear

- Long Axis
- Short Axis

Other Complications: Dislocation

- Anterior Dislocation
- Posterior Dislocation

Note: similar “normal” appearances on anteroposterior radiograph
Case #4: Take Home Points

- Ultrasound is ideal in evaluation of rotator cuff after shoulder replacement
- Tuberosity landmarks still exist
- Exception: reverse total shoulder arthroplasty

Case #5: Partial menisectomy without retear

- Findings:
  - Truncated medial meniscus
  - Linear intermediate signal abnormality
  - Not equal to fluid in intensity
- Diagnosis:
  - Partial meniscectomy without retear

Post-operative Meniscus

- Most surgically-treated meniscal tears undergo partial meniscectomy
- Results in decreased meniscal size
- Intrasubstance meniscal signal may subsequently extend to surface after partial meniscectomy simulating a tear

- How do you diagnose meniscal retear?

Post-operative Meniscus

- Absence of increased signal line to articular surface excludes tear: 100% NPV
- Intermediate signal line to articular surface is equivocal: 58% PPV
- The brighter the signal (joint fluid or intra-articular contrast), the more likely there is a tear: 90–93% PPV
- Interval change in signal pattern and displaced meniscal tissue: 99–100% PPV

Lim PS et al. Radiology 1999; 210:183
Kijowski R et al. Skeletal Radiol 2017; 46:1353
Partial Meniscectomy: No Retear
MR arthrography

PDw + fat sat  
T1w + fat sat

*Note: increased signal intensity does not equal intra-articular contrast*

Partial Meniscectomy: Retear
MR arthrography

PDw + fat sat  
T1w + fat sat

*Note: increased signal intensity equals intra-articular contrast*

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**Case #5: Take Home Points**

- Partial meniscectomy
- No increased signal excludes tear
- The higher the fluid or contrast signal intensity extending to articular surface, the more likely there is a re-tear
- Best signs: change in signal pattern from baseline and displaced meniscal tissue

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**Case #6:**

- **Findings:**
  - Absence of ACL reconstruction graft
  - Mixed signal mass-like area in anterior intercondylar notch
- **Diagnosis:**
  - ACL graft tear and cyclops lesion (localized arthrofibrosis)
**Cyclops Lesion**

- Localized arthrofibrosis
- Etiology:
  - ACL stump, fibrosis, metaplasia, graft
- Up to 2% of ACL reconstructions
- MRI:
  - Intermediate heterogeneous signal: often equal to hyaline cartilage
  - Characteristic location and contours
- Pseudocyclops: partial graft or native ACL tear but not arthrofibrosis

  Meyers AB et al. AJR 2010; 194:476

**ACL Reconstruction**

- Patellar tendon: low signal
- Semitendinosus – gracilis: striated appearance
- Fixation: interference screws, endobutton, staple, screw, cross pins; metal or bioabsorbable
- Indirect signs of native ACL tear cannot be used:
  - Anterior drawer sign, lateral bone bruise pattern
- Tunnel: widening more common with hamstring, cysts are equivocal
- Graft tear: coronal images are very helpful

  Horton KL et al. AJR 2000; 174:719

**Case #6: Take Home Points**

- Cyclops lesion: may be intermediate signal and not obvious on MRI
- ACL graft origin: determines MRI appearance
- Retear:
  - Indirect MRI signs cannot be used
  - Coronal images very helpful

**Case #7**
Case #7:
• Findings:
  – Low signal trochlear hyaline cartilage
  – Subchondral cortical irregularity
• Diagnosis:
  – Cartilage procedure: microfracture

Microfracture Cartilage Repair

Cartilage Repair
• Marrow stimulation:
  – Microfracture, drilling, abrasion arthroplasty
  – 4 F’s: focal, femur, < 4 cm², < 40 years old
  – Stem cells from marrow: fibrocartilage
  – 45 – 77% of defects filled in by 8 to 24 months
  – Initially brighter than cartilage, then low signal by 1 – 2 years

From: Guermazi A et al. Radiology 2015; 277:23

Cartilage Repair
• Osteochondral grafting:
  – Autografts: femur < 2.5 cm²
    • < 50 years old
    • 2 – 3 years: normal function
  – Allografts: large > 4 cm²
  – Cadaveric donor
    – Initial: bone marrow edema at implant site, should disappear by 12 – 18 months

From: Guermazi A et al. Radiology 2015; 277:23

Failed Osteochondral Allograft Transplant Surgery (OATS)

Autologous Chondrocyte Implantation
• Large: >2 cm² in size
• Full-thickness defect
• Age: 15 – 60 years
• Harvested cells cultured in vitro: 2 part
• Initially hyperintense to normal cartilage, then normalizes 1 - 2 years

From: Guermazi A et al. Radiology 2015; 277:23
Unstable Osteochondral Fragment

- MRI findings:
  - Fluid signal at interface with native bone: most accurate
  - Subchondral bone plate disruption
  - Subchondral cyst formation: 5 mm or greater
  - Displaced fragment
- Skeletally immature patients:
  - Above criteria cannot be applied
  - Much better prognosis compared with adults

De Smet AA et al. AJR 1990; 155:549
Kijowski R et al. Radiology 2006; 248:571

Osteochondral In-situ Fragment: Unstable

Note: joint fluid coursing deep to osteochondral fragment and cyst formation

Osteochondral In-situ Fragment: Unstable

Case #7: Take Home Points

- Cartilage appearance after microfracture:
  - Initially higher signal than cartilage
  - Later: low signal fibrocartilage
- Unstable osteochondral abnormality:
  - Fluid signal at interface: unstable
  - Exception: children

Case #8

- Findings:
  - Discontinuity of the lateral patellar retinaculum
  - Lateral joint recess fluid extending into subcutaneous tissues
- Diagnosis:
  - Lateral patellar retinaculum release
Case #8

Recurrent Patellar Dislocation: Treatment Options

- Lateral retinacular release
  - Not completed in isolation
  - Complications: medial patellar dislocation and quadriceps atrophy
- Medial retinacular plication
  - Redislocation rate: only 5%
  - Proximal realignment
  - Distal realignment: if bony deformity

From: Clifton R. et al. JBJS Br 2010; 92B:1

Medial Patellofemoral Ligament

- Tear:
  - Increased signal, discontinuity
  - 37% at patella, 30% at femur
  - If signs of patellar dislocation (femoral bone bruise): MPFL torn in 96%
- Reconstruction:
  - Semitendinosus graft
  - Various techniques


Medial Patellofemoral Ligament Tear

Note: characteristic bone bruise pattern (blue arrows) and donor site for osteochondral fragment (white arrows)

Medial Patellofemoral Ligament Reconstruction

Note: rerouted semitendinosus tendon attaching to medial patella

Case #8: Take Home Points

- Lateral retinacular release:
  - Uncommonly performed in isolation
- Medial patellofemoral ligament
  - Torn in 96% with transient patellar dislocation
  - Various surgical reconstruction techniques using semitendinosus
Case #9:

- Findings:
  - Rounded hypoechoic nodule
  - Junction of knee arthroplasty femoral component
  - Abrupt snapping with knee flexion
- Diagnosis:
  - Patellar clunk syndrome

Patellar Clunk Syndrome:

- After total knee arthroplasty
- 1% to 7.5% incidence
- Fibrous nodule: intercondylar notch
- Pain with flexion - extension


Total Knee Arthroplasty: complications

- Loosening
- Infection
- Fracture
- Particle disease

Case #9: Take Home Points

- Patellar clunk syndrome
  - Fibrous nodule
  - Dynamic ultrasound can show abnormality and directly correlate with symptoms