MRI Anatomy of the Knee and Shoulder

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Agenda

- **Knee**
  Sagittal, Coronal FSE PD
  Ligamentous (ACL, PCL, MCL, LCL) and meniscal injury

- **Shoulder**
  Sagittal, Coronal T2WI
  Shoulder impingement classification
Anatomy: Knee Sagittal

- patellar articular cartilage
- lateral meniscus (ant.horn)
- infrapatellar fat pad
- tibialis posterior
- plantaris
- gastroc (m)
- lateral meniscus (post.horn)
- tibia, articular cartilage
- BIDMC 2002
Anatomy: Knee Coronal

- vastus lateralis
- biceps femoris
- iliotibial tract
- gastroc. (lateral)
- ACL
- peroneus longus
- popliteal a + v.
- gastroc. (medial)
- PCL
- MCL
- tendon of sartorius

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Anterior Cruciate Ligament

• **Functional Anatomy**
  - Intra-articular, extra-synovial, extends from anterior tibia to inner portion of lateral femoral condyle
  - Limits anterior translation of tibia, hyperextension, internal rotation

• **Mechanism of Injury**
  - External rotation and abduction w/ hyperextension, direct forward displacement of tibia, internal rotation w/ fully extended knee
  - Can occur in conjunction w/ meniscal tears (41-68%), injury of other collateral ligaments, osteochondral or compression fractures
MRI Criteria for ACL rupture

<table>
<thead>
<tr>
<th>Complete Rupture</th>
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</thead>
<tbody>
<tr>
<td><strong>DIRECT SIGNS:</strong></td>
</tr>
<tr>
<td>- complete fiber disruption</td>
</tr>
<tr>
<td>- abnormal course of cruciate ligament</td>
</tr>
<tr>
<td>- intracapsular pseudomass in position of ACL</td>
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</tbody>
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| **INDIRECT SIGNS:** |
| - acute angulation of PCL |
| - drawer phenomenon |
| - ”kissing contusions” |
# MRI Criteria for ACL Rupture

## Incomplete Rupture

<table>
<thead>
<tr>
<th>Criteria</th>
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<tr>
<td>- thinning of ACL &lt; 10mm</td>
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<tr>
<td>- periligamentous pseudomass in presence of intact fibers</td>
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<tr>
<td>- increased intraligamentous signal with remnants of intact fibers</td>
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</table>
ACL Tear

Sagittal PD

Sagittal T2WI

Post Cruciate Ligament

• Functional Anatomy
  - Extends from posterior tibia to inner aspect of medial femoral condyle
  - Limits anterior translation of femur, stabilizes knee in extension

• Mechanism of Injury
  - Isolated tear secondary to fall on flexed knee, assoc. w/ osseous avulsion fracture at tibial insertion site
MRI Criteria for PCL Rupture

- confined areas of increased signal intensity along course of the ligament (= partial rupture)

- continuity disruption (= complete rupture)
Medial Cruciate Ligament and Lateral Cruciate Ligament

• Functional Anatomy

  ➔ MCL: 8-10 cm, from medial epicondylar region to 4-5 cm inferior to tibial plateau

  ➔ LCL: 5-7 cm, extracapsular, from lateral femoral epicondyle to conjoined insertion with biceps femoris tendon on fibular head

• Mechanisms of Injury

  ➔ MCL: valgus stress without rotation, and direct trauma with valgus stress

  ➔ PCL: varus stress without rotation
MRI Criteria for MCL/LCL rupture

Table 1.20  Grading of the injuries of the collateral ligaments

<table>
<thead>
<tr>
<th>Grade</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
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<tbody>
<tr>
<td>MRI criteria</td>
<td>Thickened capsule</td>
<td>Thin or lamellated ligament</td>
<td>Rupture, edema, and retraction of the ligament</td>
<td>Rupture, edema, and retraction, plus meniscal tear and bone bruise</td>
</tr>
</tbody>
</table>

Schema

Meniscus Anatomy

- each meniscus can be divided into 3 zones
- lateral meniscus is more C-shaped, with a shorter radius

Three Units

25-50-25 Rule
MRI Evaluation of Meniscal Damage

- Size
- Configuration of meniscus and signal pattern
- Depth and width of altered signal
- Location within meniscus
Gradation of Signal Alteration in Menisci (Stoller)

0

1

2

3A

3B
Meniscal Tear Morphology

- **Vertical** (traumatic or degenerative)
- **Horizontal** (usually traumatic, posterior horn)
- **Bucket-Handle Tear** (subtype of vertical)
- **Peripheral** (within 5mm of periphery)
- **Amputating** (truncated free border or tip)
- **Radial** (traumatic or degenerative, medial)
Bucket-Handle Tear

Shoulder Anatomy

- **Bones** (shoulder girdle, humerus)
- **Joints** (glenohumeral, scapulothoracic, acromioclavicular; all synovial)
- **Muscles** (attachments at ant/post scapula, ant/post humerus, ant/inf clavicle)
- **Nerves and arteries**
Shoulder Anatomy: Coronal 1

- supraspinatus (+tendon)
- subscapularis
- serratus anterior
- clavicle
- coracoid process
- tendon of biceps brachii (short head)
- coracobrachialis
- brachial plexus
Shoulder Anatomy: Coronal 2

- suprascapular a. + n.
- tendon of biceps brachii m. (long head)
- glenohumeral ligament
- biceps brachii m. (short and long head)
Shoulder Anatomy: Coronal 3

- Trapezius
- Spine of scapula
- Glenoid cavity
- Scapula
- Clavicle
- Acromion
- Superior glenoid labrum
- Inferior glenoid labrum
Glenohumeral Joint

1. Anterior labrum
2. Subscapularis
3. Infraspinatus
4. Posterior labrum
5. Humerus
6. Glenoid cavity
Shoulder Anatomy: Sagittal 1

coracromial lig.
glenohumeral and coracohumeral lig.
biceps t.
deltoid
anterior circumflex humeral a. + v.

acromion
supraspinatus
infraspinatus
teres minor
triceps brachii
Shoulder Anatomy: Sagittal 2

- clavicle
- supraspinatus
- coracoid
- infraspinatus
- tendo biceps brachii m. (long)
- tendo biceps brachii m. (short)
- teres minor
- latissimus dorsi
- teres major

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Shoulder impingement syndrome

- **Stage I**: <25 yrs., w/ edema and hemorrhage
- **Stage II**: 25-40 yrs., w/ tendinitis and fibrosis of rotator cuff, thickening of subacromial bursa
- **Stage III**: > 40 yrs., = tear
References


Acknowledgements

- Steve Reddy, MD
- Larry Barbaras and Cara Lyn D’amour
- Gillian Lieberman, MD
- Pamela Lepkowski