AAP BRS podcast: Knee Ligaments and Meniscus

ACL:
Origin: medial wall of the lateral femoral condyle → runs antero-inferiorly.
Insertion: anterior spine of the tibia

**Anteromedial bundle** tenses with knee flexion

**Posterior bundle** tenses with knee extension
- Test: Lachman (84% sensitive) or Anterior drawer (62% sensitive) – caution: hamstring contraction can complicate these tests.
- Injury is typically from hyperextension or a combo of valgus force with external rotation of the tibia relative to the femur.
- Often + for popping sound/sensation with pain and swelling at time of injury
- Management: RICE, PT, or Surgery
- Prevention: neuromuscular training

PCL:
Origin: medial femoral intercondylar notch → runs posteroinferiorly.
Insertion: posterior tibial spine

**Anteromedial bundle** tenses with knee flexion

**Posterior bundle** tenses with knee extension
- Injury is typically from blunt trauma to the anterior proximal tibia (i.e., dashboard injury).
- Often + for popping sensation, swelling and stiffness at time of injury
- Management: Conservative treatment if isolated, surgery if multi-ligament injury.

“LAMP”: Lateral femoral condyle = ACL
Medial femoral condyle = PCL

**Overall:** ACL tight when ankle is Anterior (knee extension)
PCL tight when ankle is Posterior (knee flexion)

MCL:
Origin: medial femoral epicondyle
Insertion: medial tibial plateau (deep MCL fibers attach to the medial meniscus and can concomitantly tear).

MCL resists valgus force (especially at 30 degrees flexion)
- Injury is typically a rupture at the femoral insertion site, proximal tears heal better than distal.
- Management: RICE, +/- knee immobilizer 1-2 weeks, gentle F/E exercises in first 1-2 weeks, full activity as tolerated over 1-4 weeks depending on severity.
- Isolated MCL injuries heal well with non-operative management.

LCL:
Origin: lateral femoral epicondyle.
Insertion: head of the fibula
(important because the common fibular nerve is in close proximity as it wraps around the fibular head and neck.)

LCL resists varus force. Also resists external rotation
- Injury is much less common (about 5% of all knee ligament injuries).
- Assess foot dorsiflexion and eversion if LCL injury is suspected (fibular nerve in close proximity to insertion)

**Intra-articular Injury:** may present with swelling/effusion.

4 main causes of knee effusion following trauma:
1) ligament injury
2) intra-articular fracture
3) patellar dislocation
4) meniscus injury

**Collateral (extra-articular) ligament injury:**
- May hear a “pop” sound at time of injury.
- Imaging: usually always x-ray first to rule out other trauma, then MRI to see the ligament pathology.

Knee Sprain Grades:
1 = no gross tearing
2 = partial tear (increased laxity)
3 = complete tear (no firm end feel).

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Medial Meniscus: C-shaped
Lateral Meniscus: O-shaped

- Vascularization to both is from the outer rim;
  - only outer 1/3 is considered well vascularized ("red-red zone")
- Centrally located tears (non-vascularized region) makes for a poor surgical candidate as well as older age due to osteoarthritis risk.
- Meniscus injury often occurs due to axial loading with rotation and can cause a popping or catching of the knee.
- Treatment with PT especially if inner 2/3. Consider surgery if outer 1/3.

**O’Donoghue’s Triad:**
Also known as “terrible triad”: concomitant injury to ACL, MCL, and medial meniscus.

**Screw-Home Mechanism:**
- Refers to the unlocking of the knee via an observable rotation with flexion and extension by the popliteus.
- Significant for knee stability and can be retrained

Helpful Resources:
<table>
<thead>
<tr>
<th>Anatomy</th>
<th>ACL</th>
<th>PCL</th>
<th>MCL</th>
<th>LCL</th>
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</thead>
<tbody>
<tr>
<td>O: medial aspect of lateral femoral condyle in the intercondylar notch</td>
<td>O: medial femoral condyle within the notch</td>
<td>Superficial: O: femoral medial epicondyle</td>
<td>O: lateral epicondyle of the femur</td>
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<tr>
<td>I: anterior to the intercondylar eminence of the tibia.</td>
<td>I: posterior aspect of the tibial spine</td>
<td>I: proximally blends into semimembranosus tendon, distally attaches at posteromedial crest of the tibia</td>
<td>I: fibular head</td>
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<td><strong>Superficial:</strong></td>
<td><strong>Deep:</strong> (tibial and meniscal parts) meniscofemoral</td>
<td><strong>Deep:</strong> meniscotibial</td>
<td><strong>Contact:</strong> Varus stress with possible ER</td>
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<td><strong>Meniscotibial:</strong> O: from medial meniscus</td>
<td>O: femur just distal to sMCL</td>
<td>O: distal edge of articular cartilage of medial tibial plateau</td>
<td>Noncontact injury (e.g., hyperextension stress)</td>
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<td><strong>Meniscal:</strong></td>
<td>I: proximally blends into semimembranosus tendon, distally attaches at posteromedial crest of the tibia</td>
<td>Noncontact injury (e.g., hyperextension stress)</td>
<td><strong>Noncontact:</strong></td>
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<td><strong>Most common pattern of injury</strong></td>
<td>Pivoting or sudden deceleration with change in direction (cutting).</td>
<td>Noncontact injury with knee hyperflexion, plantarflexed foot</td>
<td>Valgus stress with possible ER (contact more common)</td>
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<td>Planted foot with valgus/internal rotation on flexed knee</td>
<td>Direct posterior blow to a flexed knee (dashboard injury)</td>
<td>Contact: Varus stress with possible ER</td>
<td>Noncontact injury (e.g., hyperextension stress)</td>
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<td><strong>Physical Exam</strong></td>
<td>Positive: ● Lachman test</td>
<td>Positive: ● Posterior drawer test</td>
<td>Valgus stress -&gt; widening of medial joint space</td>
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<tr>
<td>● Anterior drawer</td>
<td>● Posterior sag sign</td>
<td>Varus stress -&gt; widening of lateral joint space</td>
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<td>● Pivot shift test</td>
<td>● Quadriceps active test</td>
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<td>● Posterolateral drawer</td>
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<td><strong>Management</strong></td>
<td>Conservative tx for mild instability- RICE, analgesics, PT</td>
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<td>• X-rays and MRI used to t/o assoc. injuries</td>
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<td>Arthroscopic surgery</td>
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<td>• Conservative (functional brace and physical therapy) for isolated tears</td>
<td>• X-rays and MRI used to t/o assoc. injuries</td>
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<td>• Surgery if associated injuries are present.</td>
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<td>• Surgery if associated injuries are present.</td>
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<td><strong>Other important details</strong></td>
<td>Most commonly injured knee ligament</td>
<td>Often assoc. with medial meniscus tear</td>
<td>Usually assoc. with ACL or PCL tears.</td>
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<td>Higher incidence in females</td>
<td>More common than LCL</td>
<td>Isolated LCL is rare.</td>
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