

Anterior Cruciate Ligament Tear

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Radiology 4014

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Clinical History

- Quick summary of the history and physical exam with notable findings
 - 28 year old male no PMH presents w/ left knee pain after being tackled from the lateral side playing football
 - Physical exam: significant swelling, limited ROM, positive Lachmann's test of knee
 - Imaging: AP and lateral X-ray knee, MRI knee ordered on 9/25/2019

AP Left Knee

Normal



Impression: no
bony abnormality



Patient



Lateral L Knee

Patient

Normal

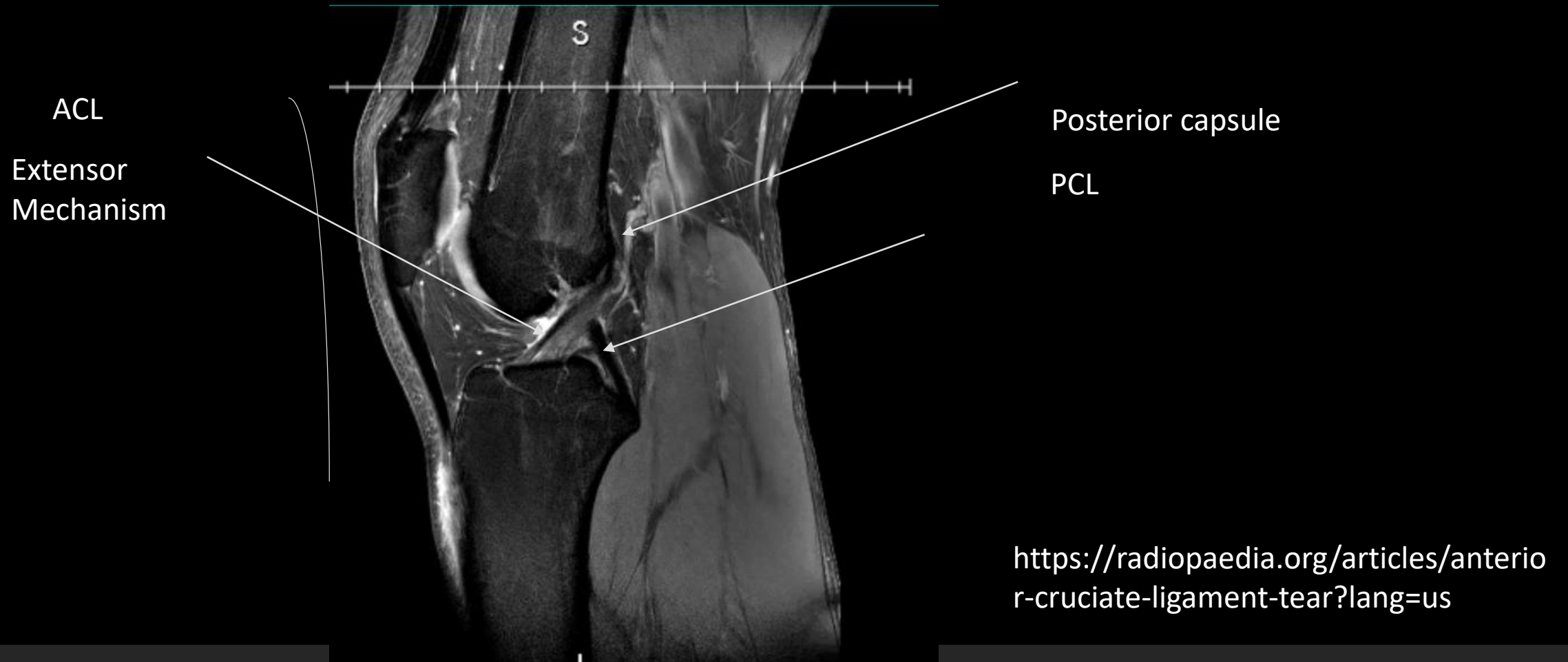


Impression:
hyperextension



<https://radiopaedia.org/cases/normal-knees-x-rays?lang=us>

MRI Sagittal



Sagittal PD FS Obliq to ACL

NORMAL



Edema

PATIENT

Discontinuity in strands, increased signal



Posterior capsule

Sagittal PD FS Obliq to ACL

Discontinuity in
strands,
increased signal



Sagittal PD FS Obliq to ACL



Intact PCL
(okay for it to
be curvy)

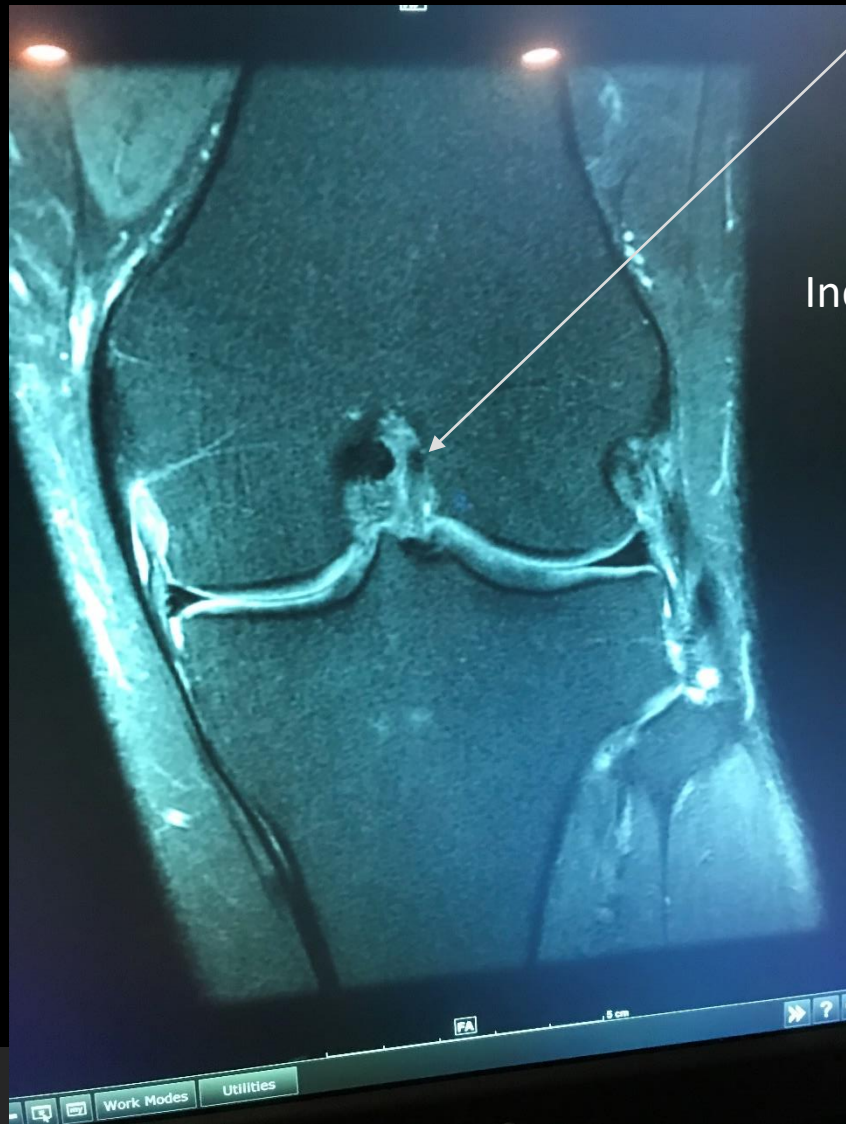


Damage to posterior
capsule

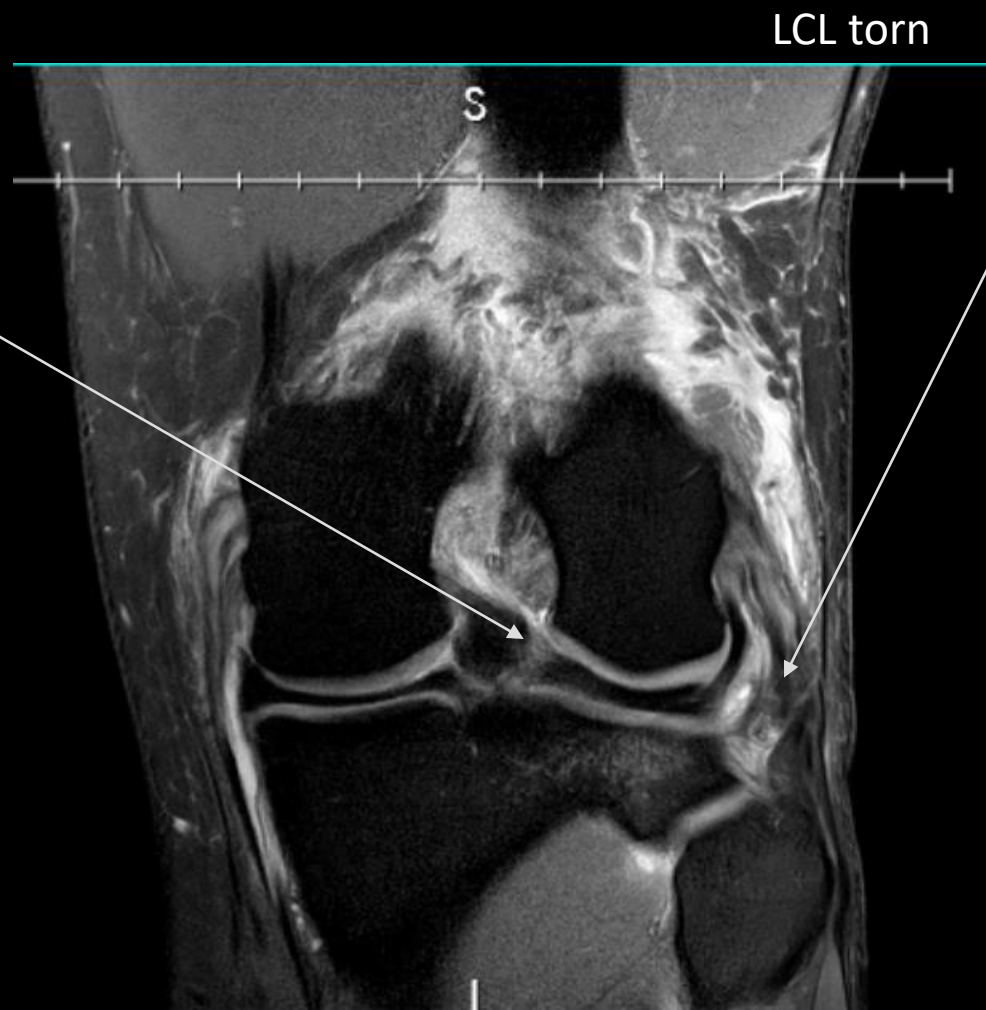


Coronal

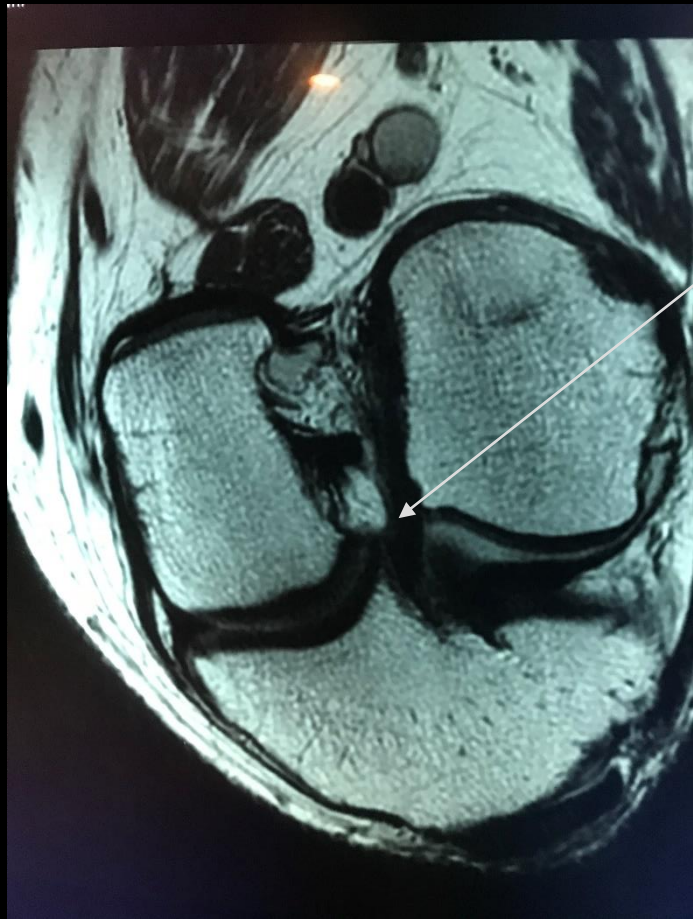
Nice dark continuous stands



Increased signal

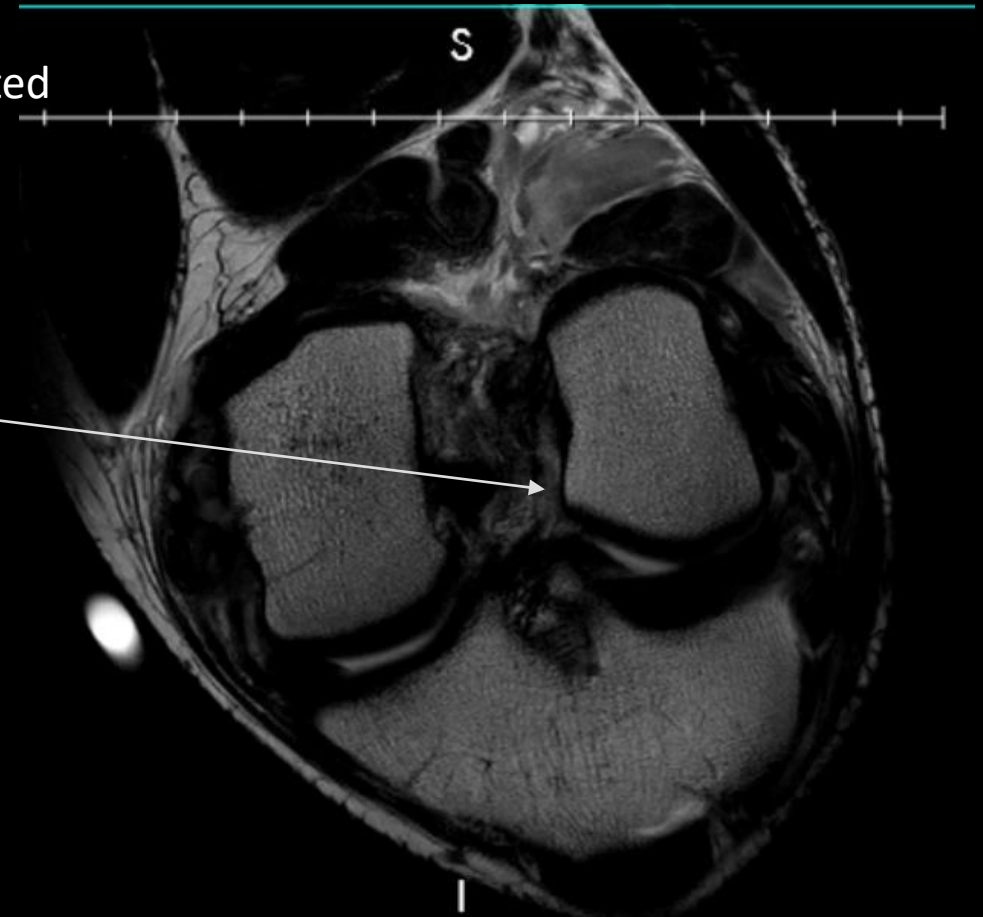


ACL coronal oblique view (same angle as ACL)



Clean dark uninterrupted strip

Intermediate signal



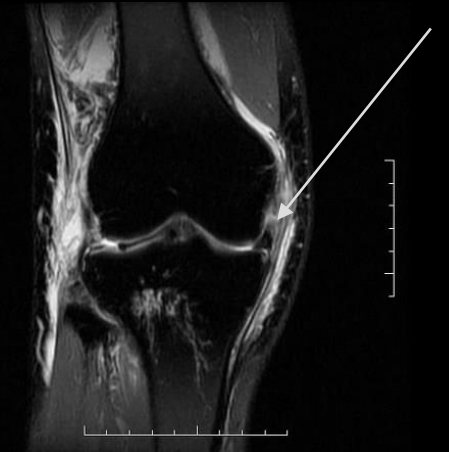
Highlight and summarize key imaging findings

Primary signs of ACL tear

- **Increased ACL signal on T2**
- **Fiber discontinuity**
- **edema**

Some secondary signs:

-MCL or LCL injury



<https://radiopaedia.org/articles/medial-collateral-ligament-injury-grading>

Bone contusion of lateral femoral condyle or tibial plateau



https://www.researchgate.net/figure/Sagittal-image-of-the-knee-in-a-patient-with-ACL-injury-shows-bone-bruises-in-the-lateral_fig1_6998356

More secondary signs

- Anterior tibial translocation sign (>7mm anterior translation of tibia)



- -Second fracture (avulsion fracture of lateral aspect of tibial plateau ~75% second fractures associated w/ ACL damage)



Differential Diagnosis

- From clinical history: “pop” could be ACL, MCL, meniscus tear; these are differentiated with clinical exam maneuvers and confirmed with MRI knee w/out contrast
- Ddx of increased ACL signal: Grades 1, 2, and 3 ACL injury

Final Diagnosis

- Full Thickness (Grade 3) ACL tear
- (Additional Injuries: Grade 2 MCL and LCL tears)

- Ligamentous Grading Scale:
 - Grade 1 = fluid, no tear
 - Grade 2 = partial tear
 - Grade 3 = full tear

Grade	Ligament (on MRI)	Ligament (on physical examination and arthroscopy)
Grade 1	Fluid around ligament	Some tenderness and minor pain at the point of the injury. This means that there have been small tears in the ligament.
Grade 2	Fluid around ligament along with partial disruption of ligament fibers	Noticeable looseness in the knee. There is major pain and tenderness on the inner side of the knee as well as swelling with single bundle tear but it is not completely torn.
Grade 3	Complete disruption of fibers	Considerable pain, tenderness, swelling, and marked joint instability with complete tears of ligament.

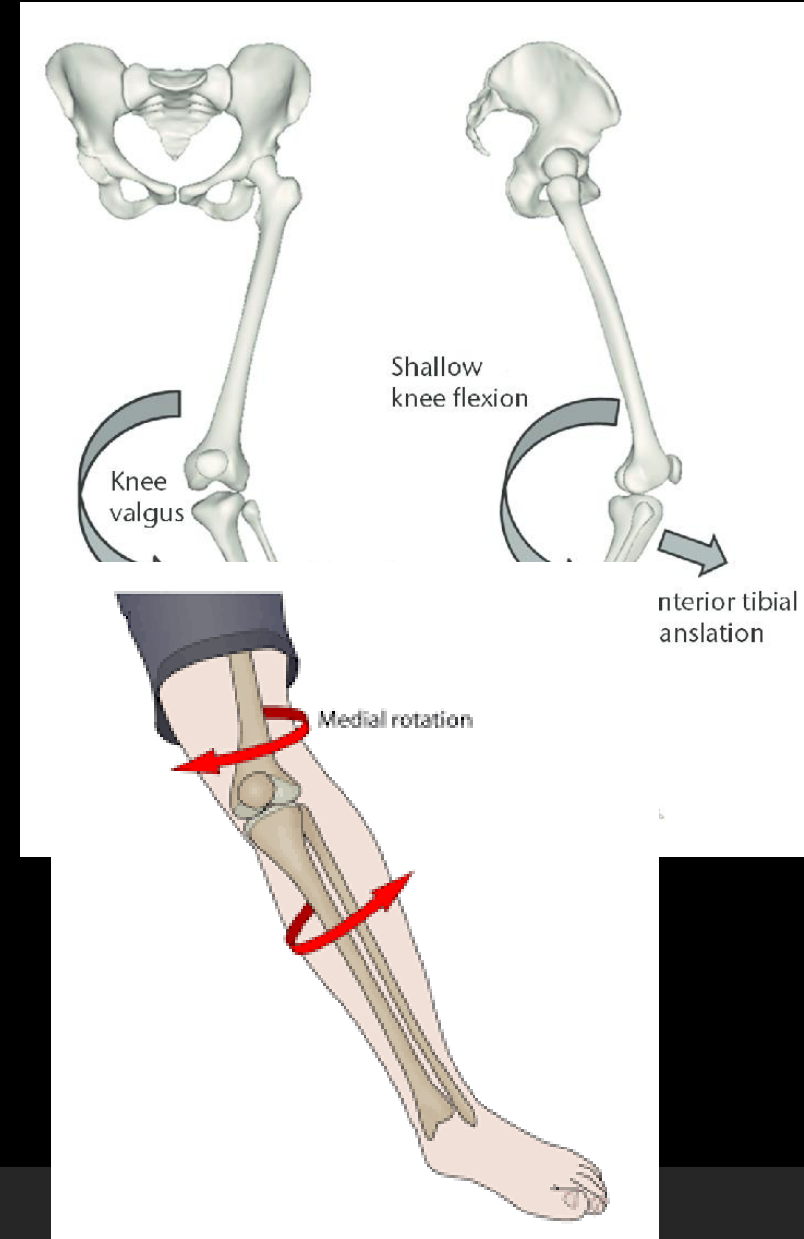
Diagnosis: Full Thickness ACL Tear

- Pathophysiology:
- ACL tear: discontinuity in the fibers
How the diagnosis matches and fits this particular case



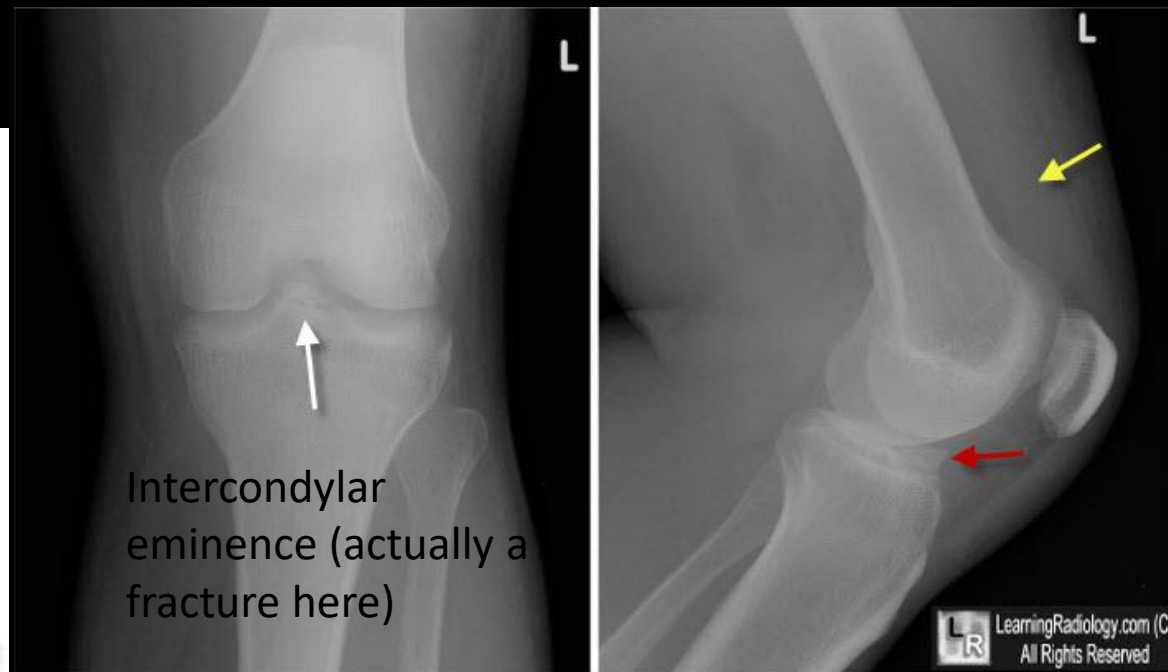
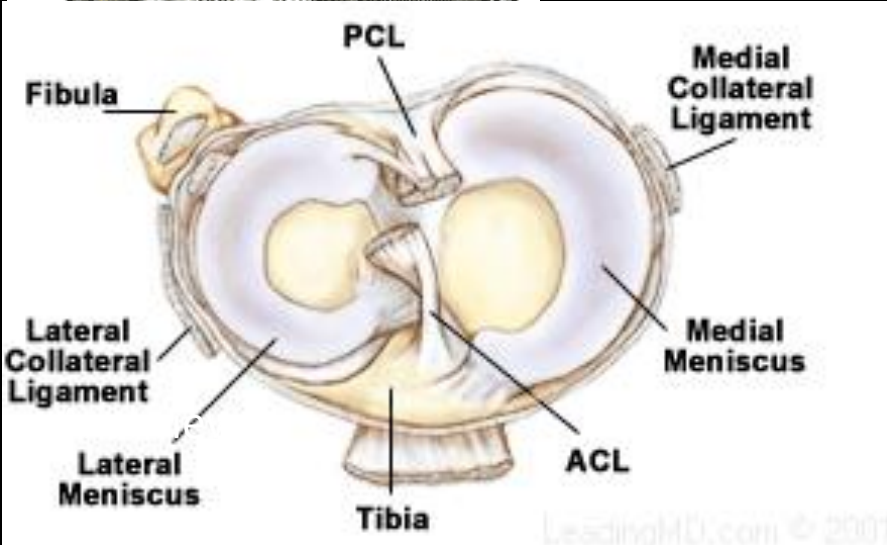
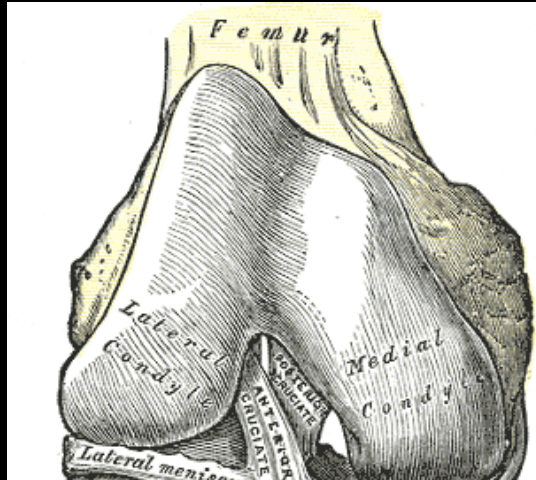
Pathophysiology of ACL Tear

- Two ways:
- 1) non-contact (75% injuries):
planting and cutting (tibia
external/internal rotation and valgus
stress)
- 2) Contact (blow to side of knee)-our
patient



ACL Anatomy

- Origin: medial aspect of lateral femoral condyle
- Insertion: intercondyloid eminence of tibia (blends with anterior horn of medial meniscus)



Associations:

- O'Donoghue unhappy triad-ACL, MCL, medial meniscus tears
- Pivot-foot fracture



Treatment

- Treatment Options:
 - Younger, active patients: surgical reconstruction (this patient)
 - Older, less active patients: nonsurgical, let heal on its own
- Primary ACL Autograft Reconstruction (most commonly Bone—Patellar Tendon—Bone graft or B-PT-B)
- This Patient Outcome: success, back playing football (although free agent right now)



Diagnostic Recap: ACR appropriateness Criteria for Acute Trauma to Knee

- Step 1: KNEE RADIOGRAPH
- Performed as Indicated: yes
- Cost: cheap (~\$100-200)
- Radiation: low
- Step 2: MRI Knee Without Contrast
- Performed as Indicated: yes
- Cost: expensive (~500-\$2500)
- Radiation: none

Revised 2019

**American College of Radiology
ACR Appropriateness Criteria®
Acute Trauma to the Knee**

Variant 1: Adult or child 5 years of age or older. Fall or acute twisting trauma to the knee. No focal tenderness, no effusion, able to walk. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography knee	May Be Appropriate	⊕
Bone scan with SPECT or SPECT/CT knee	Usually Not Appropriate	⊕⊕⊕
CT knee with IV contrast	Usually Not Appropriate	⊕
CT knee without and with IV contrast	Usually Not Appropriate	⊕
CT knee without IV contrast	Usually Not Appropriate	⊕
MR arthrography knee	Usually Not Appropriate	○
MRA knee without and with IV contrast	Usually Not Appropriate	○
MRA knee without IV contrast	Usually Not Appropriate	○
MRI knee without and with IV contrast	Usually Not Appropriate	○
MRI knee without IV contrast	Usually Not Appropriate	○
US knee	Usually Not Appropriate	○

Variant 3: Adult or skeletally mature child. Fall or acute twisting trauma to the knee. No fracture seen on radiographs. Suspect occult fracture or internal derangement. Next study.

Procedure	Appropriateness Category	Relative Radiation Level
MRI knee without IV contrast	Usually Appropriate	○
CT knee without IV contrast	May Be Appropriate	⊕
Bone scan with SPECT or SPECT/CT knee	Usually Not Appropriate	⊕⊕⊕
CT knee with IV contrast	Usually Not Appropriate	⊕
CT knee without and with IV contrast	Usually Not Appropriate	⊕
MR arthrography knee	Usually Not Appropriate	○
MRA knee without and with IV contrast	Usually Not Appropriate	○
MRA knee without IV contrast	Usually Not Appropriate	○
MRI knee without and with IV contrast	Usually Not Appropriate	○
US knee	Usually Not Appropriate	○

Take Home Points / Teaching points

- Suspected ACL tear Imaging: MRI knee non-contrast
- Best MRI views: Sagittal, Coronal, ACL oblique
- Findings: discontinuity of fibers, increased T2 signal
- Associations: unhappy triad, pivot-shift fracture
- Treatment: if young and active → surgery; old/inactive: rest, physical therapy
- Prognosis: Good to Excellent (although long term complications may occur)

References

- [https://www.ypo.education/orthopaedics/knee/acl-reconstruction-with-a-bone-patellar-tendon-bone-\(bptb\)-graft-t292/video/](https://www.ypo.education/orthopaedics/knee/acl-reconstruction-with-a-bone-patellar-tendon-bone-(bptb)-graft-t292/video/)
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4805849/>
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- <https://www.sports-health.com/sports-injuries/knee-injuries/anterior-cruciate-ligament-acl-tears>



Questions?