Knee MRI

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Disclosures

- No Relevant Disclosures

Objectives

- Basic Acquisition factors for Knee MRI
- MR indications
- Diagnostic Appearance of common MSK knee abnormalities on MRI focusing on sports medicine type patient population

MRI
Field Strength, Configuration

Knee MR

- Dedicated Coil
- Scan Protocol (software)
  - 20-30 min
- Usually no contrast (Gadolinium)
- Use Contrast
  - Inject intravenously to see vascularity (mass)
  - Inject intra-articular to distend join (post op)

Knee MR

- Indications
  - Assess Bone, Ligaments, Cartilage, Joint
- Contraindications
  - Metallic objects can heat, move or generate current
  - Pacemaker, Brain Aneurysm Clips

MR Physics

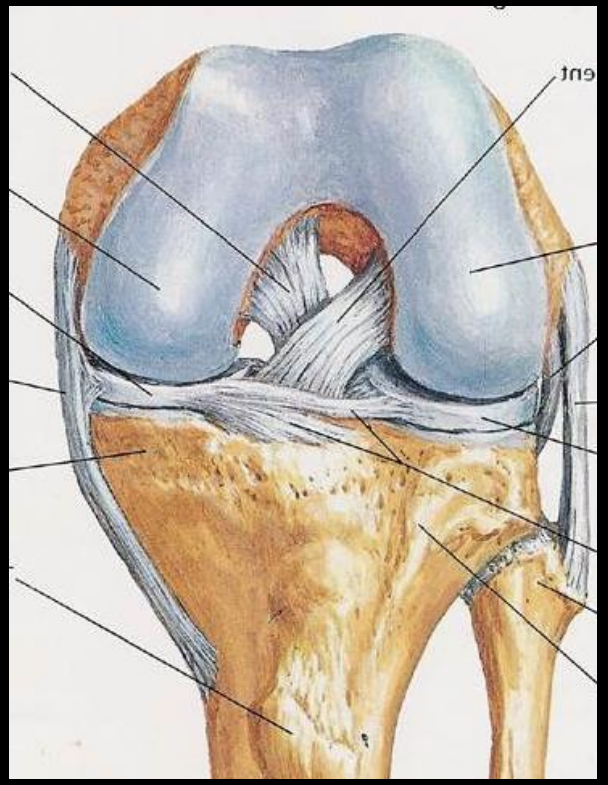
T1	Fat, gadolinium bright	anatomy
T2 or STIR	Water Bright	pathology

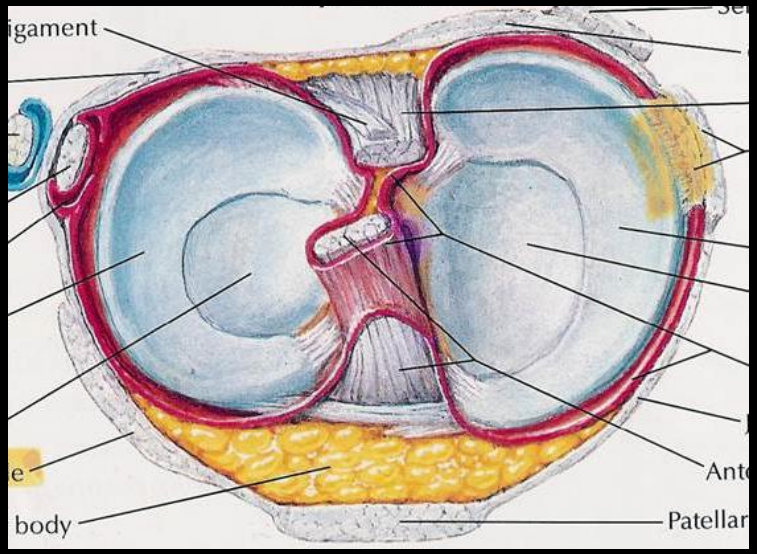
Knee MRI

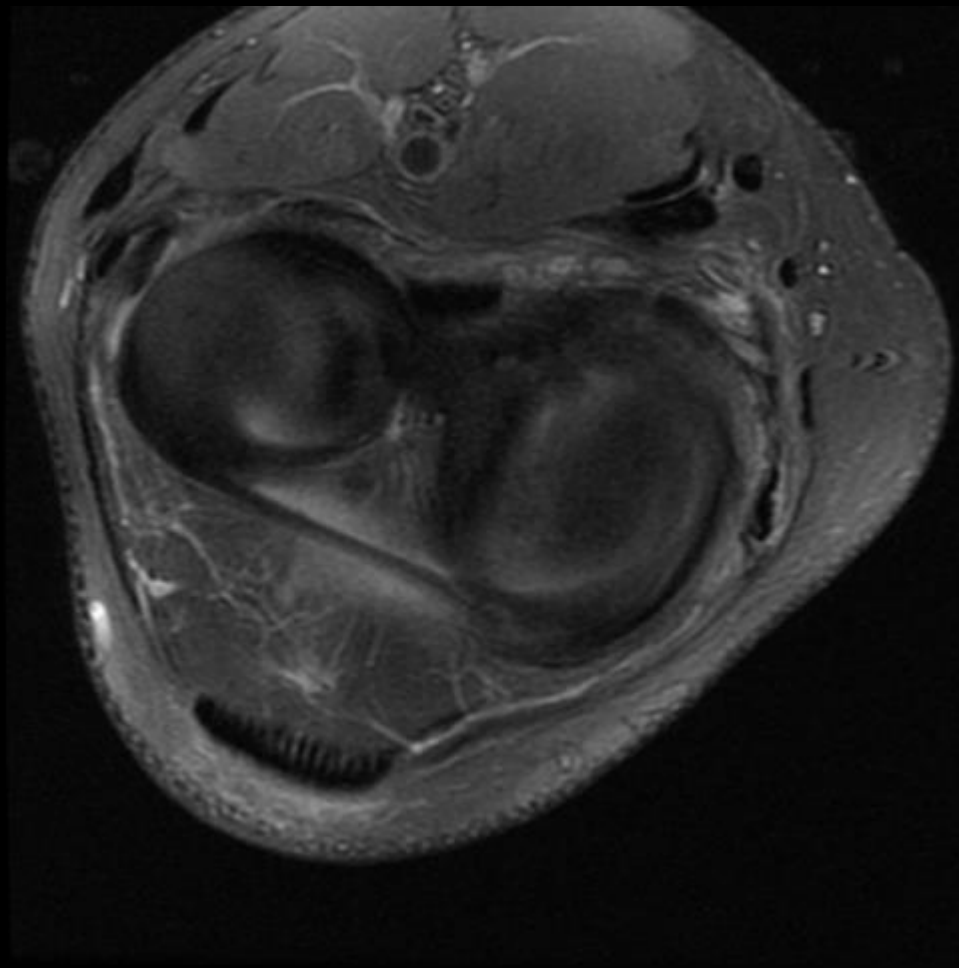
Menisci

- Cruciate
- Collateral ligaments
- Bone marrow
- Cartilage
- Extensor mechanism


P 1.7
6.0cm
15.6kHz
x16
0.0sp/C



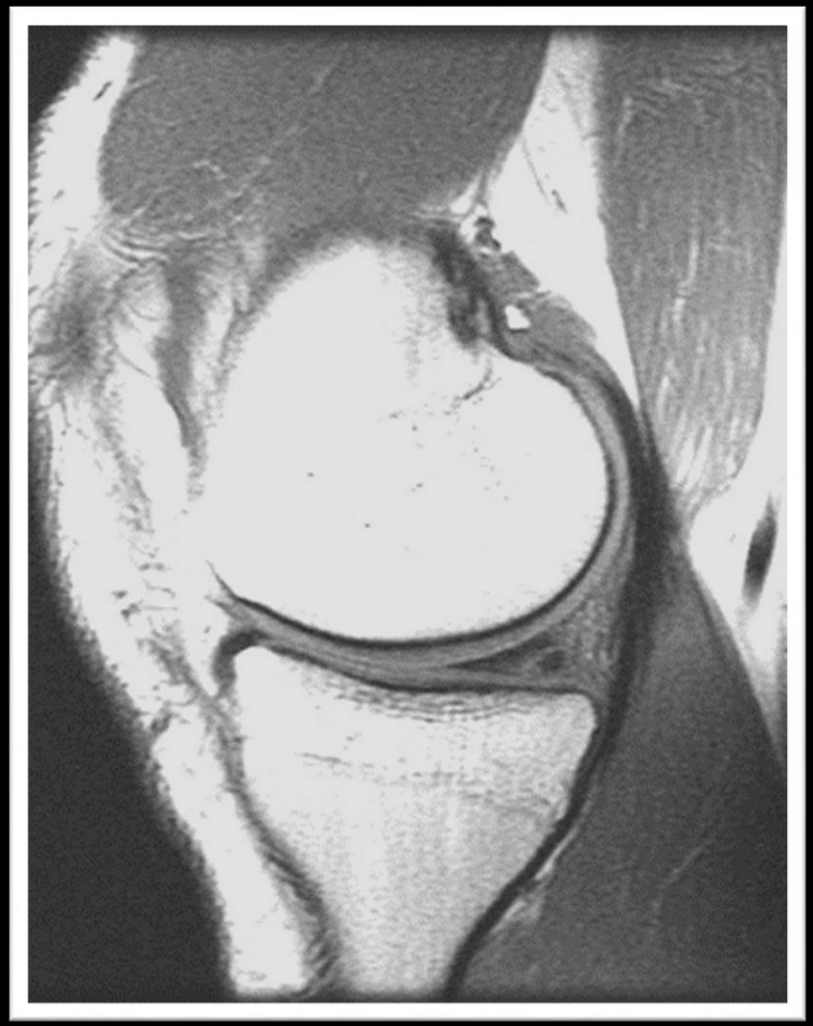

igament
e
body
Patellar




9
.0cm
f
0.8kHz
16
5sp

Meniscal Signal

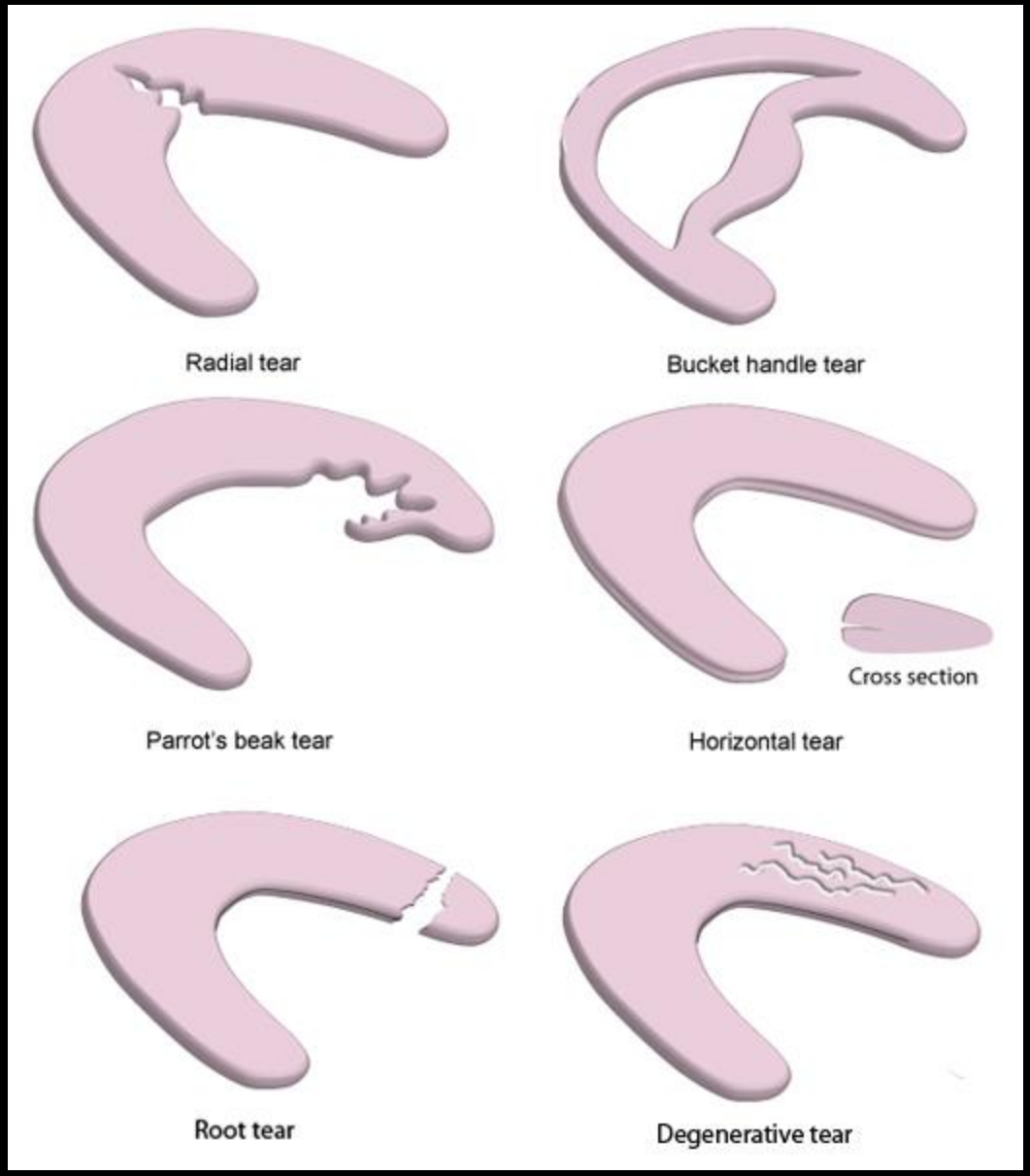
No tear



Tear

Meniscal Tears Morphology

- Traumatic Tears
  - Radial
  - Vertical
  - Displaced
- Degenerative Tears
  - Oblique
  - Horizontal
  - Globular

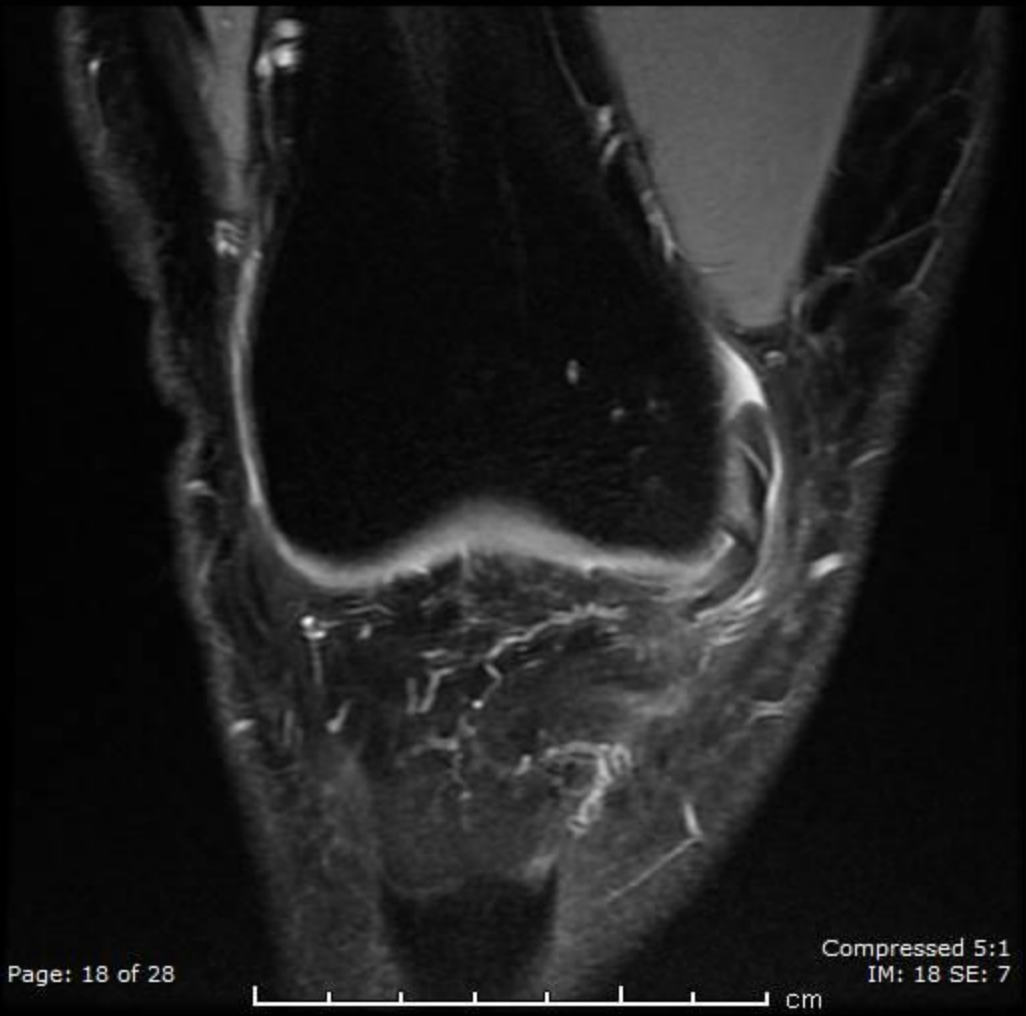

Radial tear
Bucket handle tear
Parrot's beak tear
Cross section
Horizontal tear
Root tear
Degenerative tear

History

- 25 yo male
- Twisted knee 2 months ago playing soccer


Page: 15 of 28
Compressed 5:1
IM: 15 SE: 4
cm


Page: 22 of 28
cm
Compressed 5:1
IM: 22 SE: 5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Compressed 5:1
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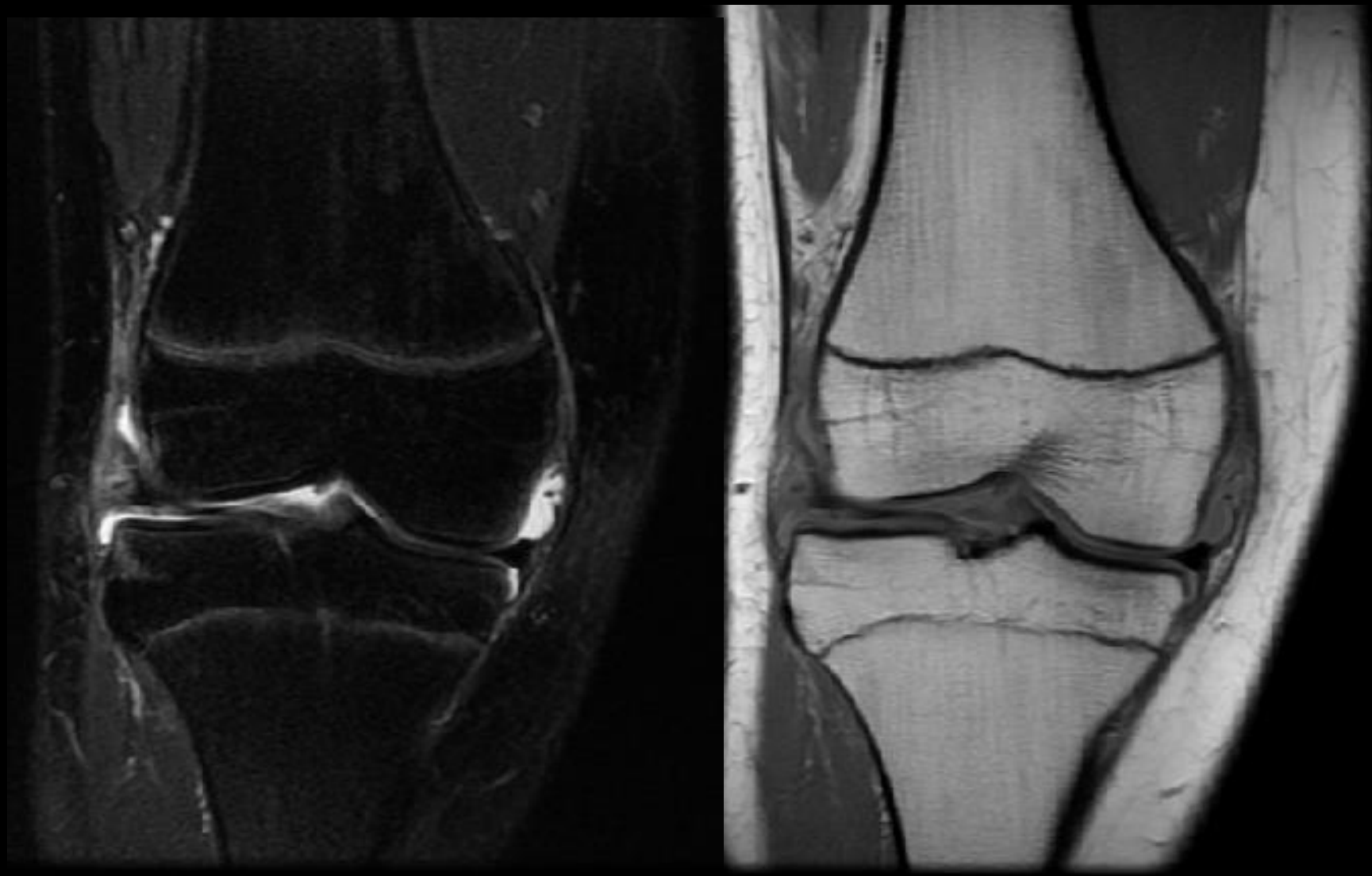
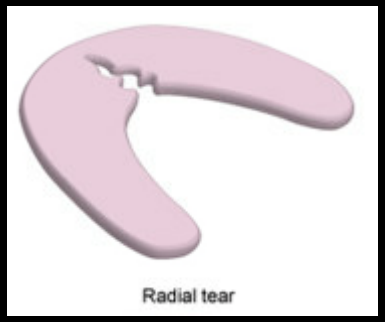
cm

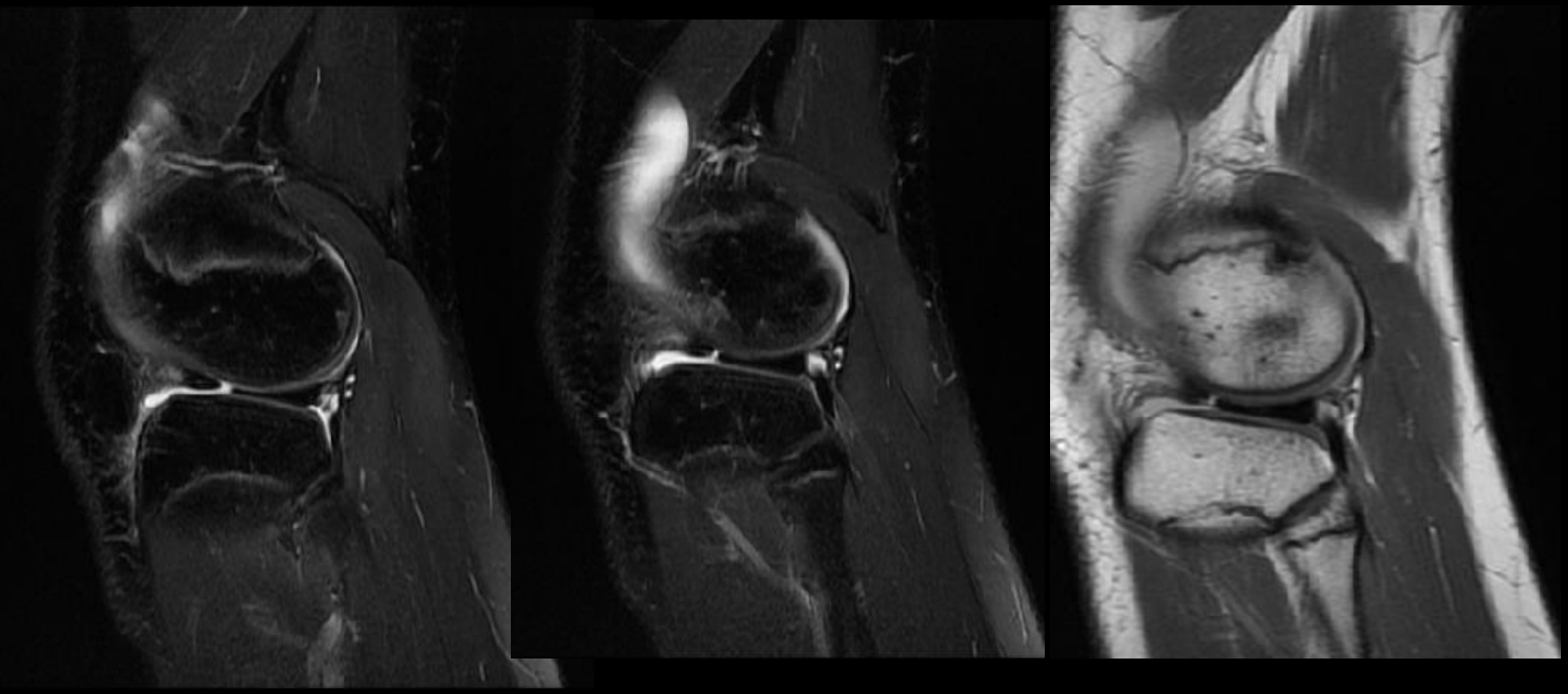
Dx

Large MM tear w Large flipped fragments from ahmm & phmm

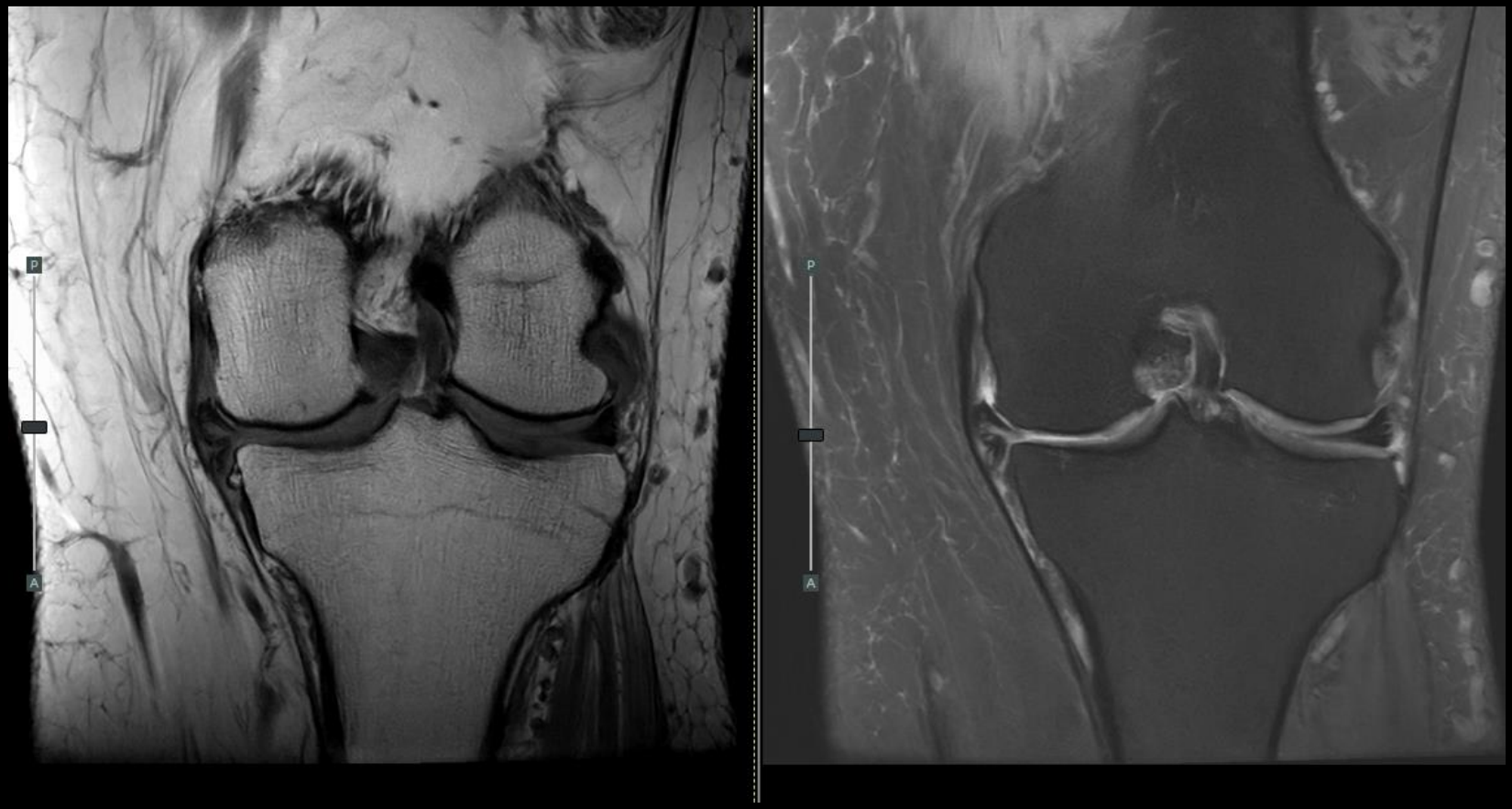
16 yo male lateral pain & stiffness




Radial tear

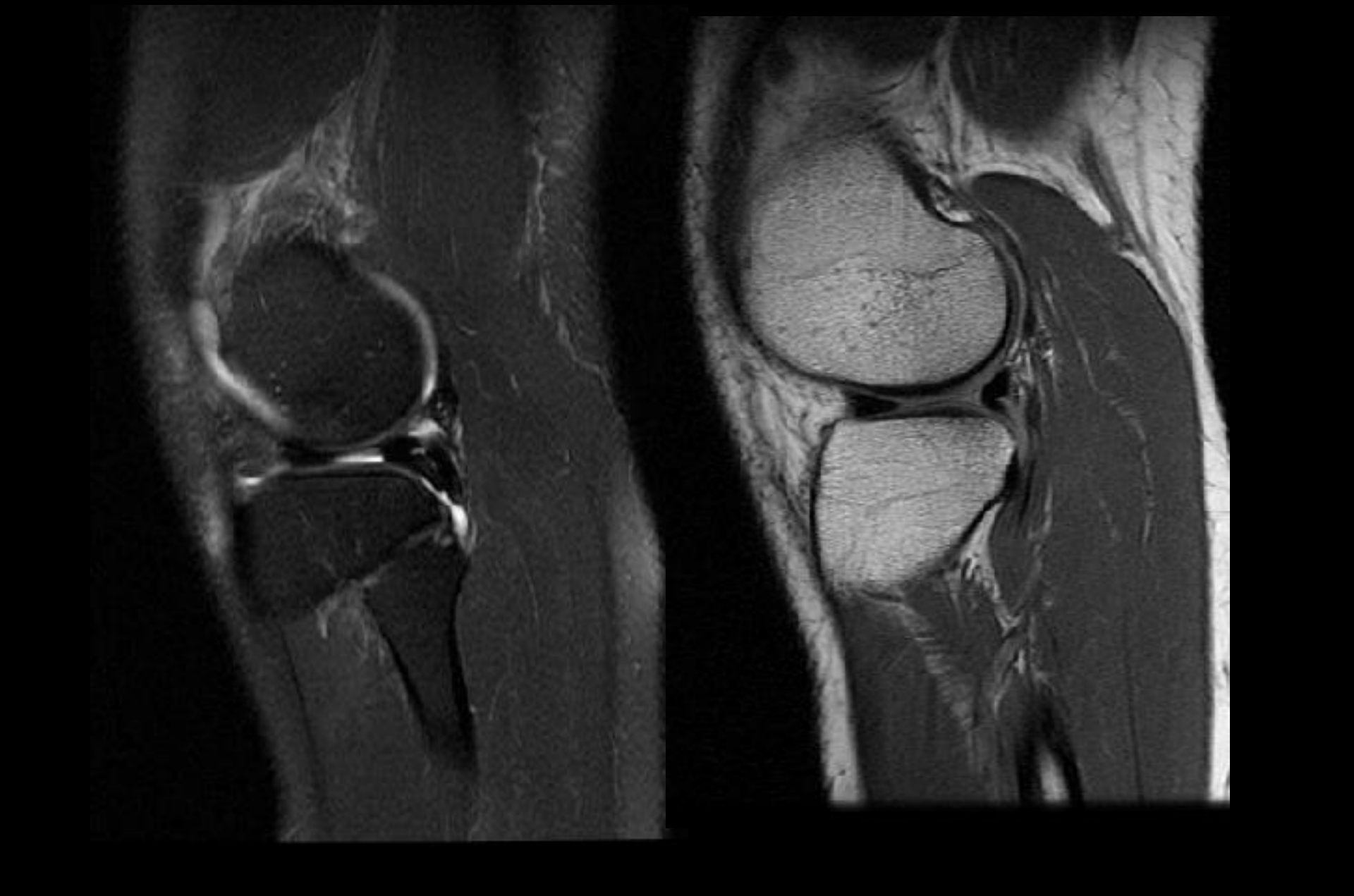


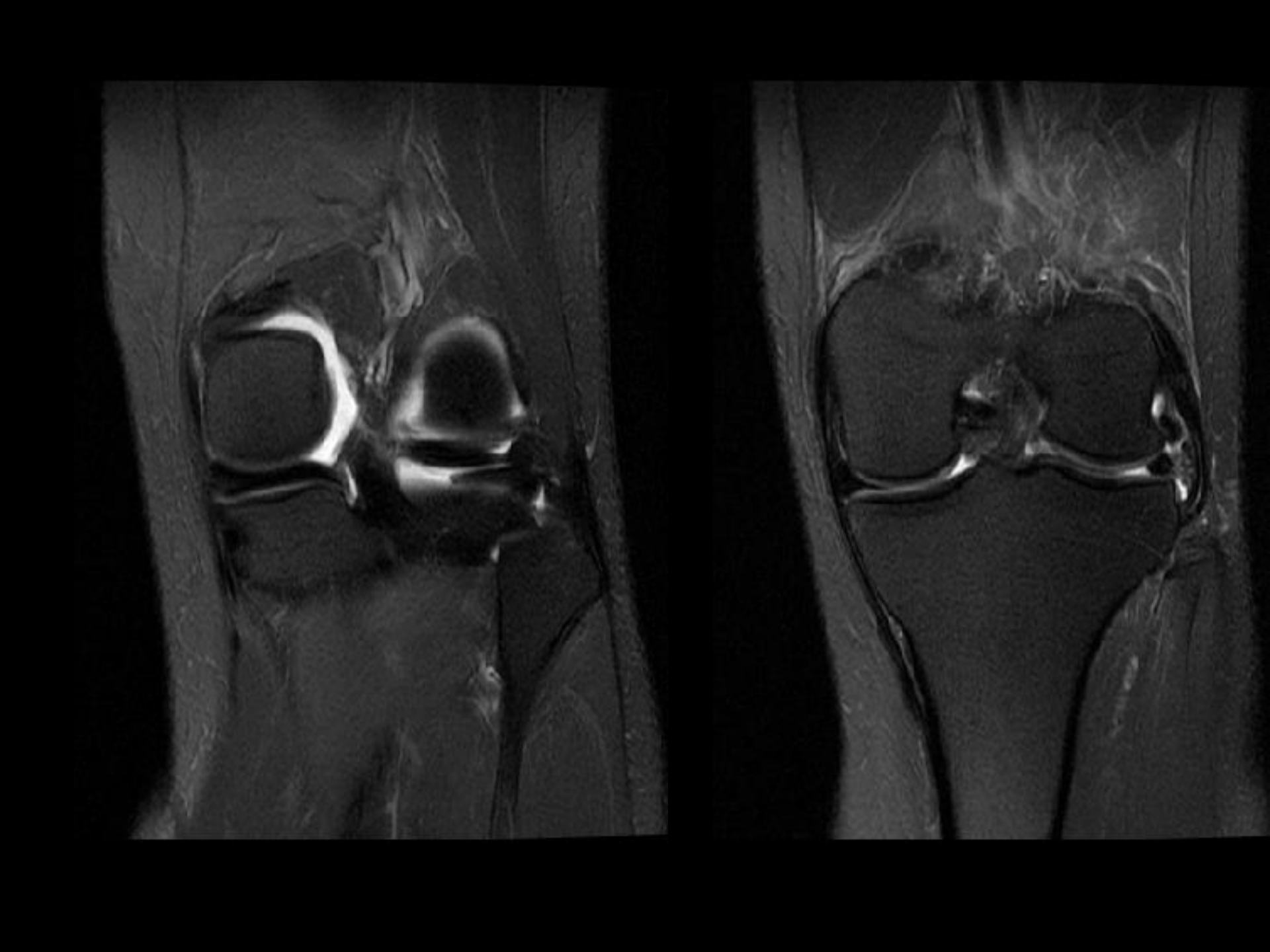
Knee pain & Catching



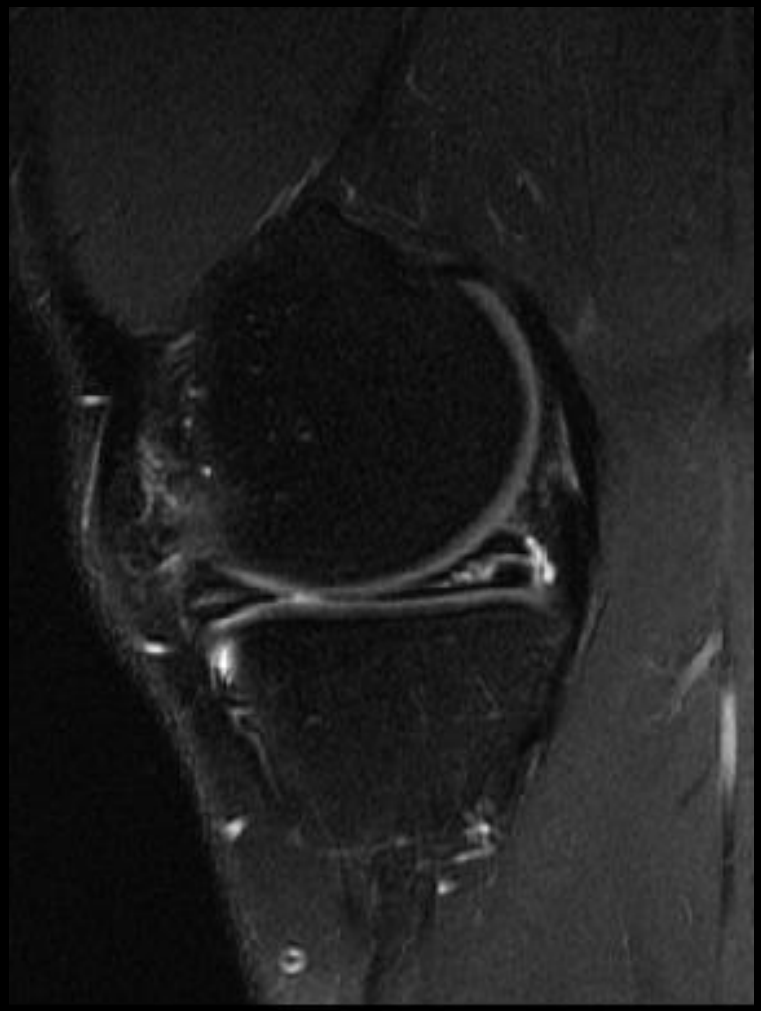
16 yo female Gymnast
Knee pain after tumbling injury

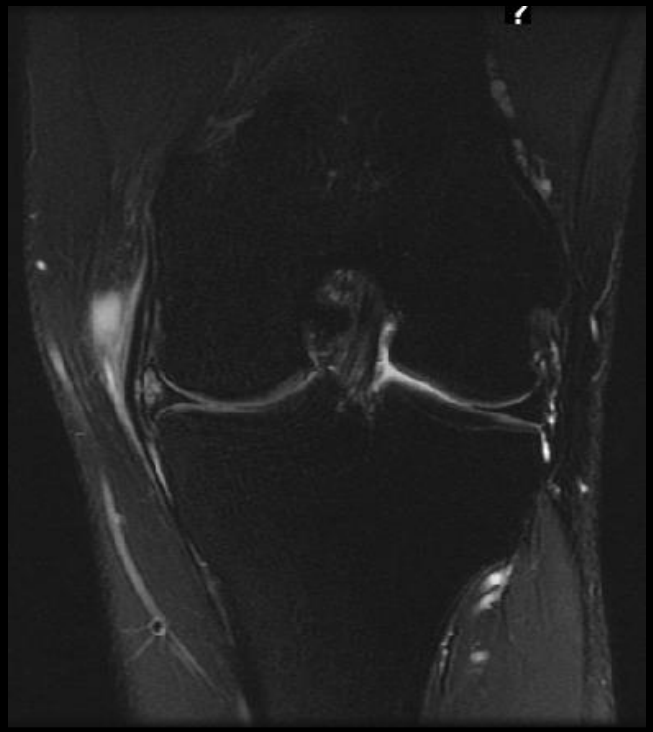
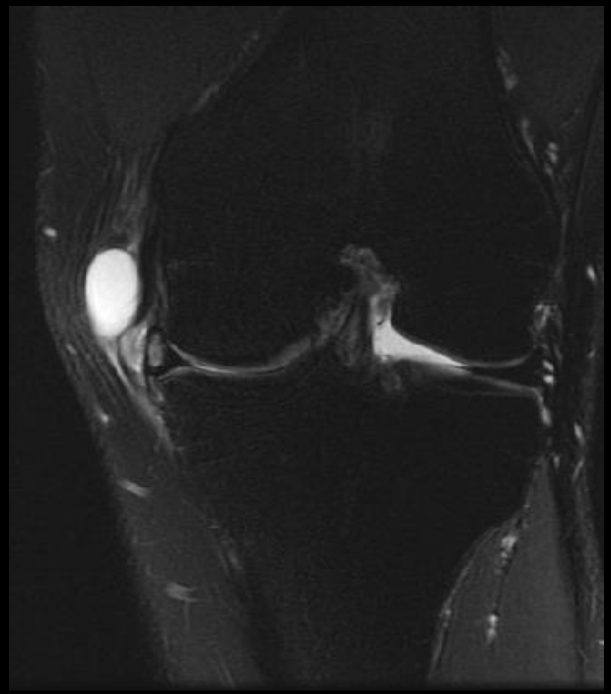
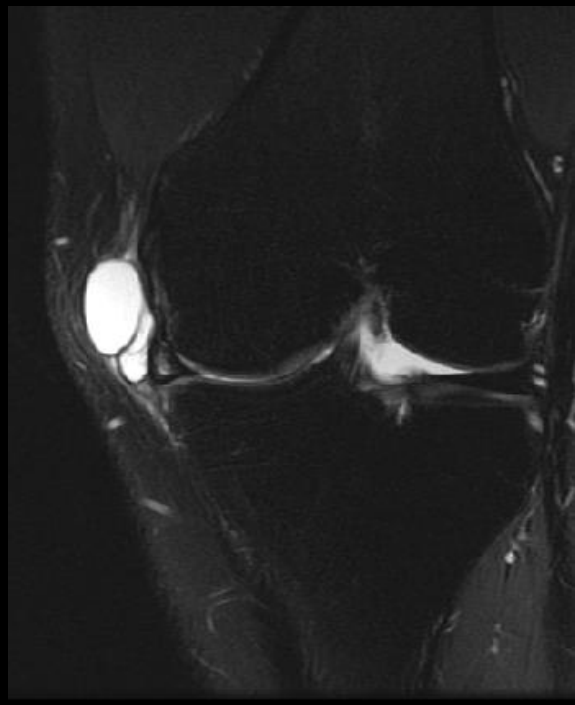
Torn & Flipped LM





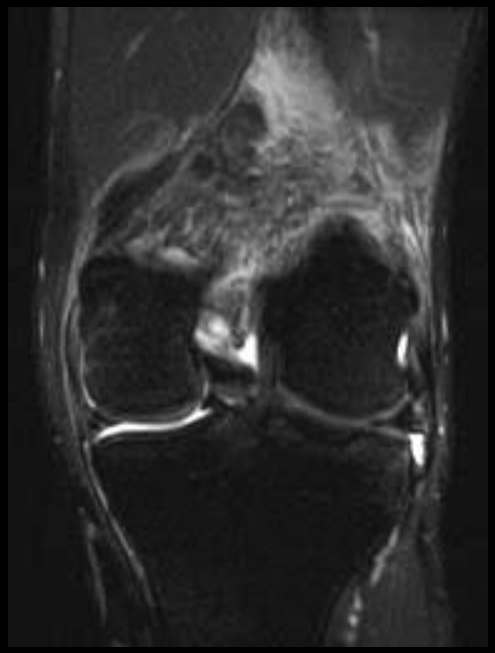
Knee Pain & Mass

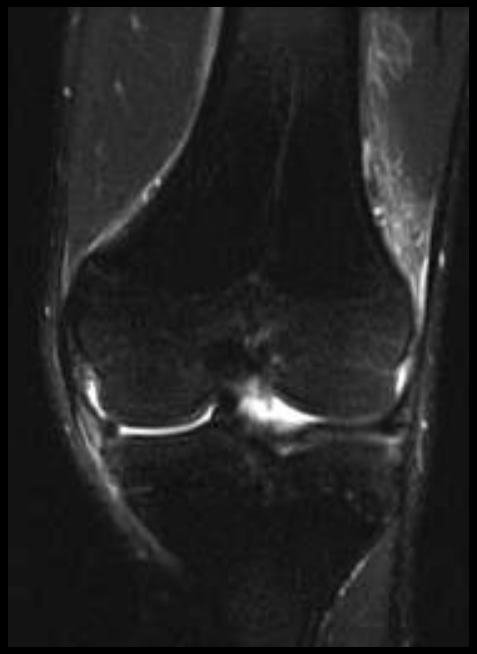
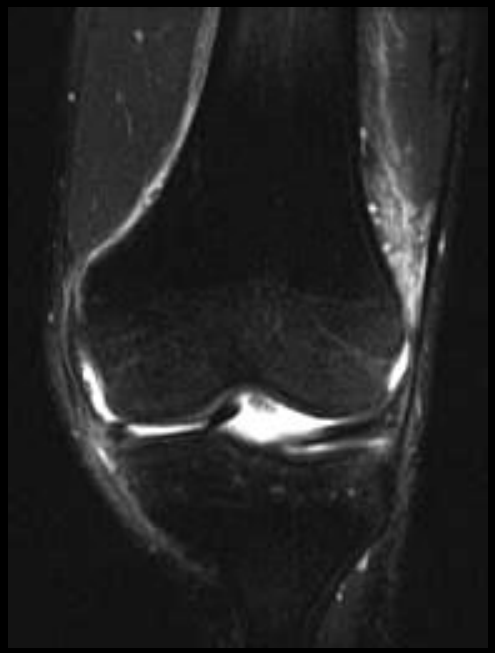
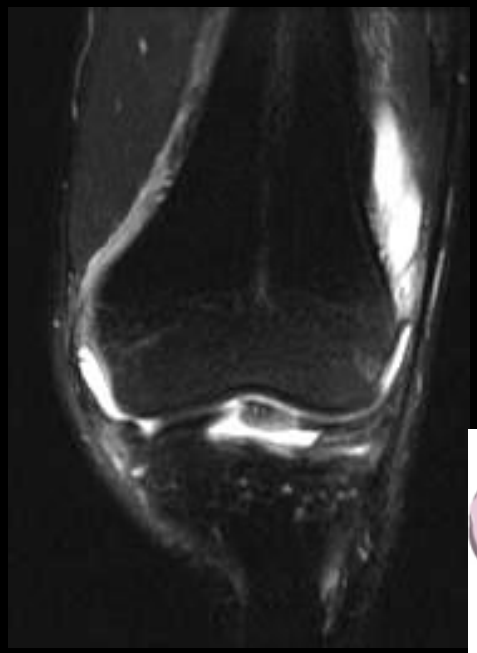
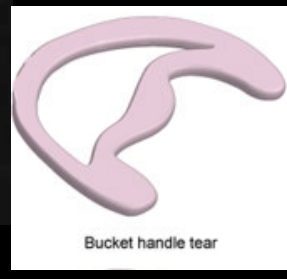


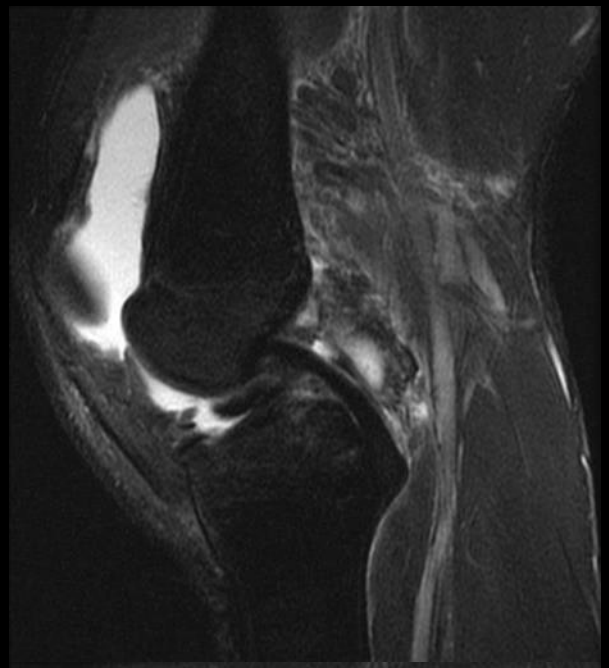
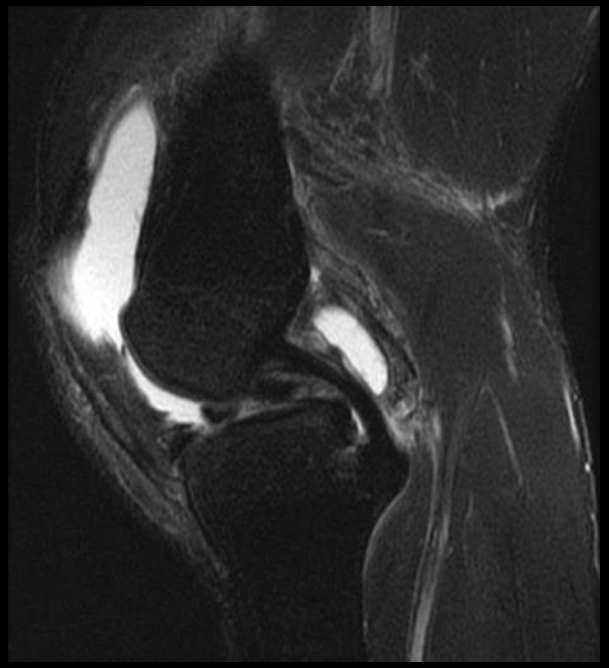
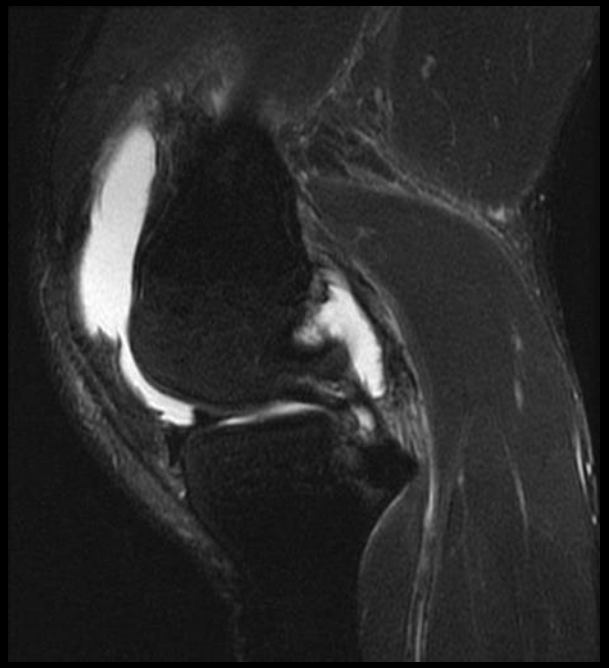




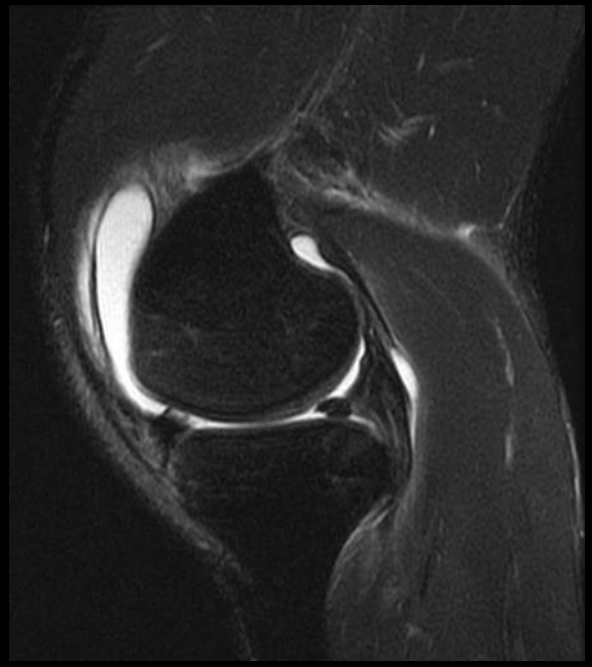
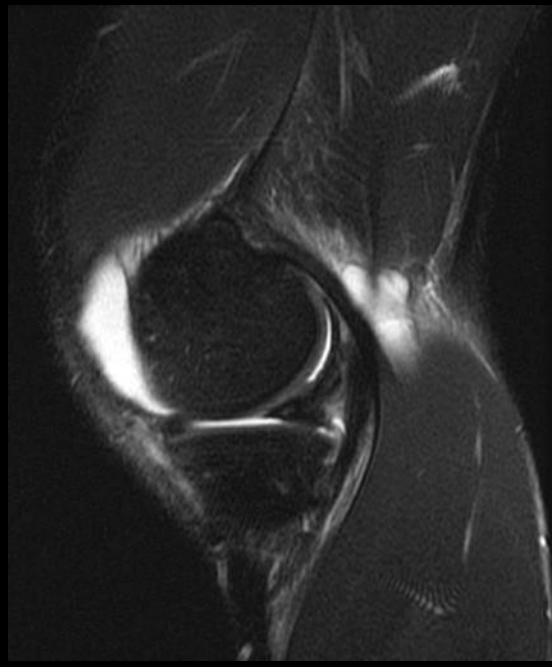
Next case

Locked knee after trauma

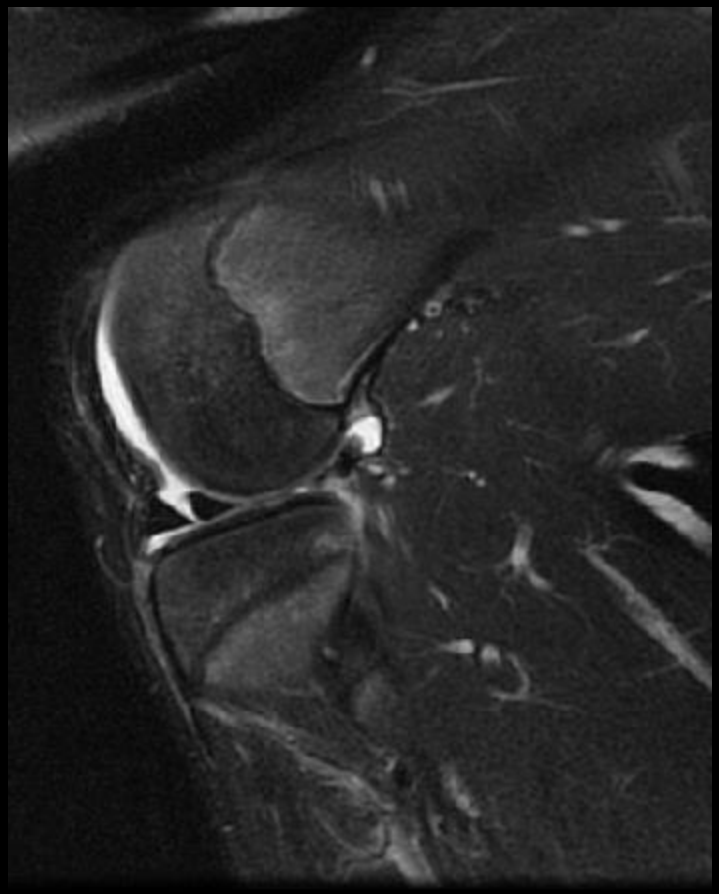



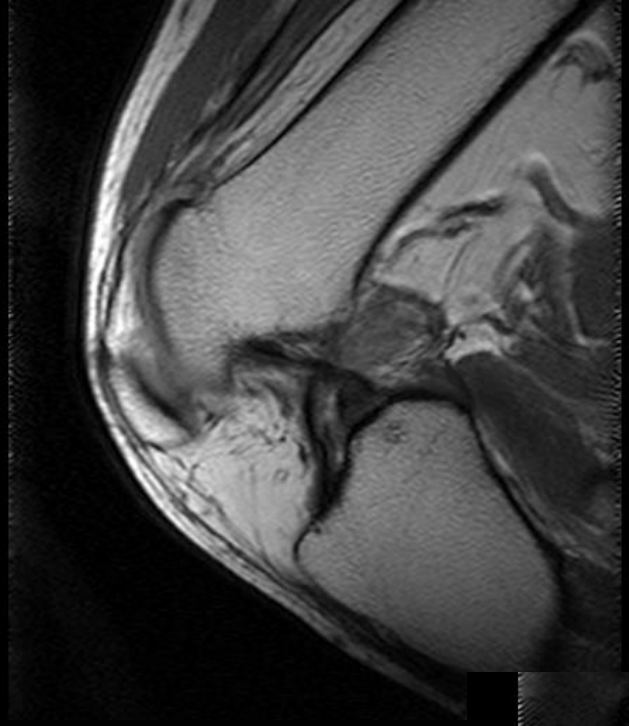




Bucket handle tear

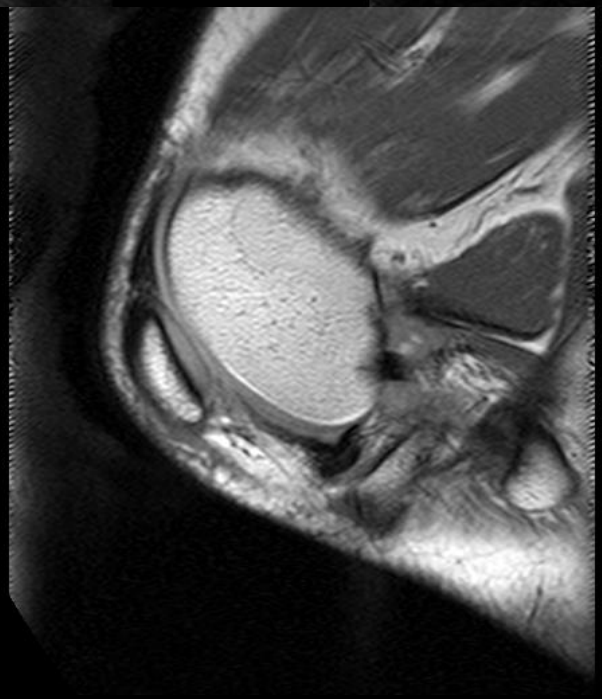




16 yo male, twisted during soccer
Locked Knee





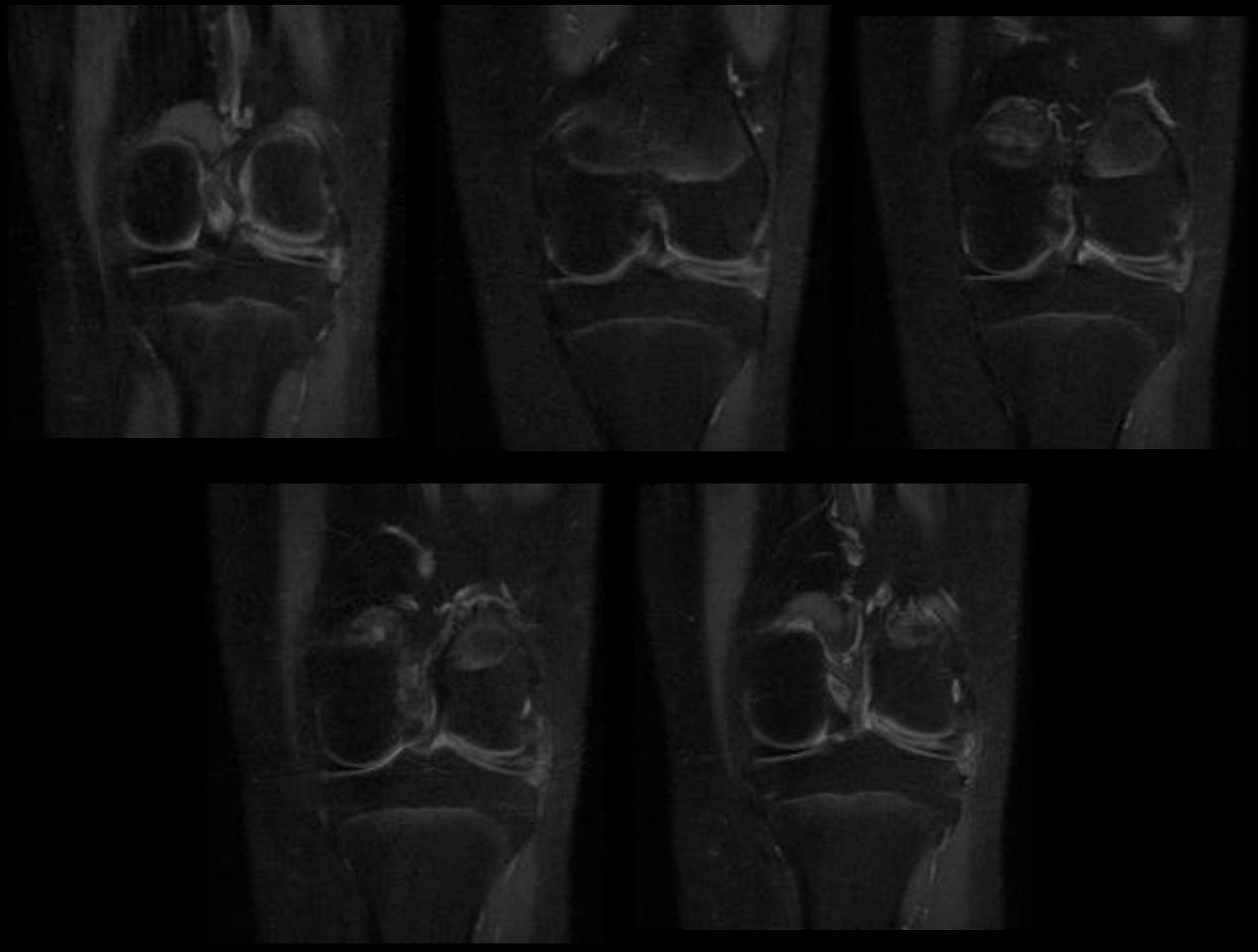


Accuracy of MRI in Meniscal Tears

	Medial	Lateral
Sensitivity	95%	81%
Specificity	88%	96%
Accuracy	92%	92%
NPV	93%	93%
PPV	90%	89%

Overall agreement of MRI and Arthro >90%

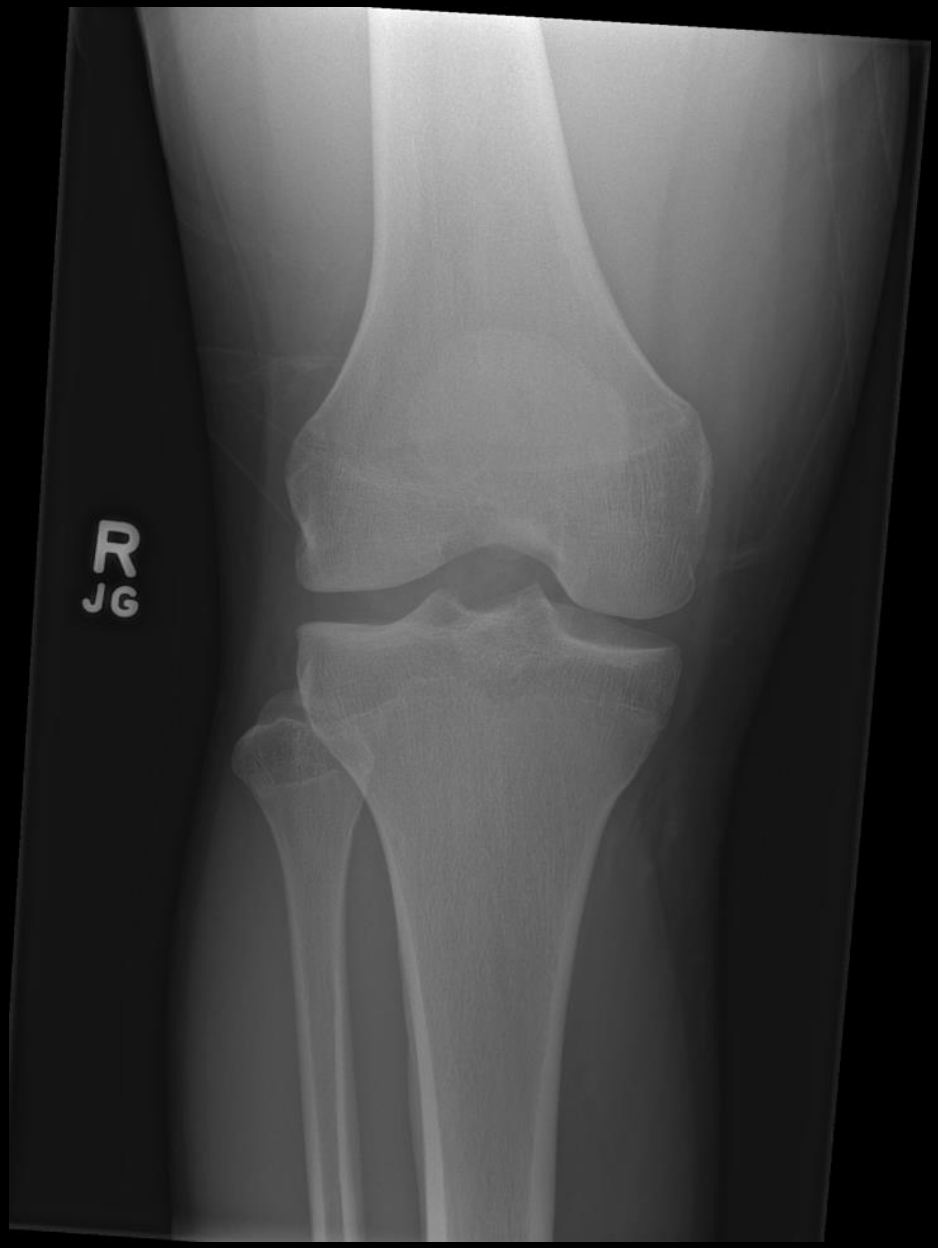
mean of 7 studies



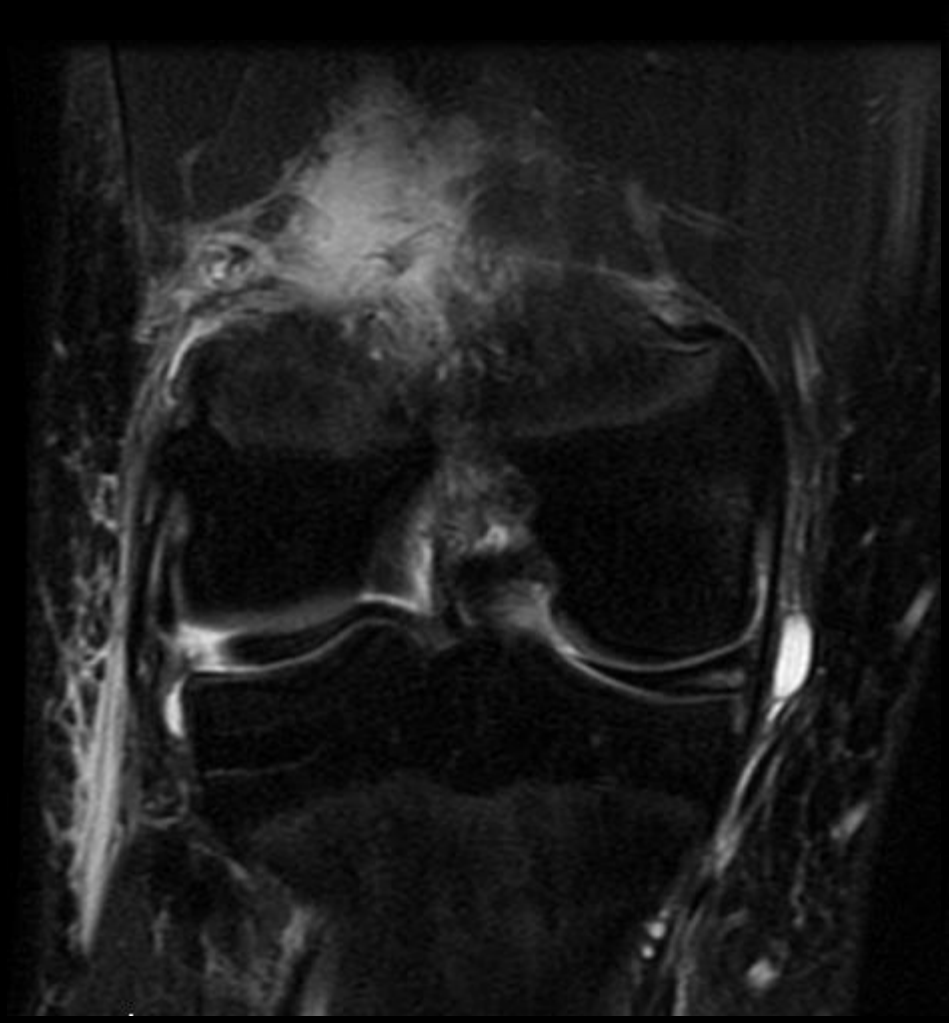
Discoid Meniscus

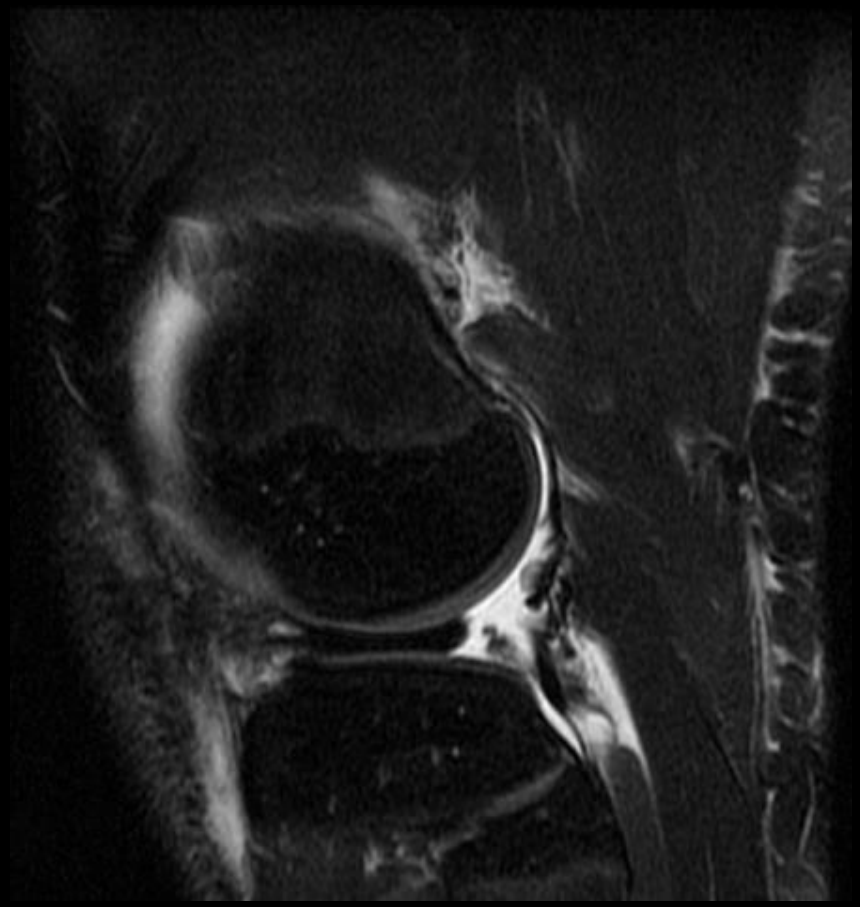
- Thickened wafer shaped
- 5% of population
- Disc or ring shaped
- Usually lateral
- 20% bilateral
- Pain, premature tearing, snapping

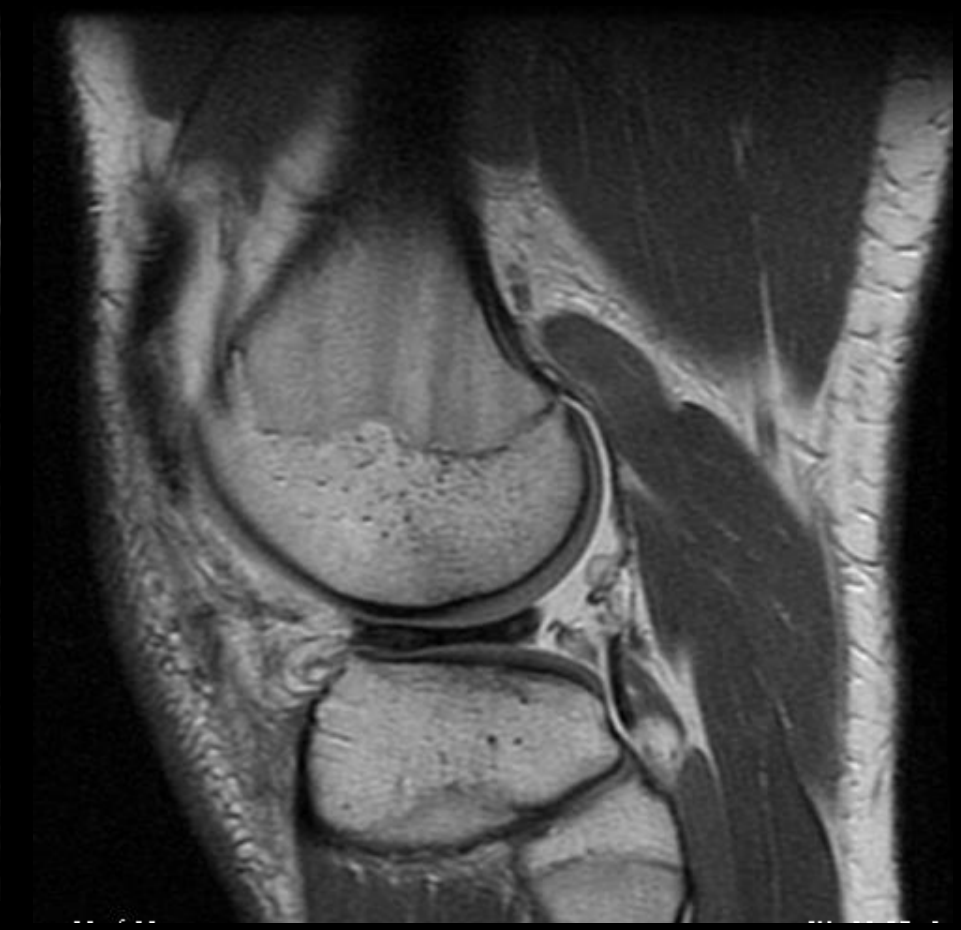
16 yo football player
Injury

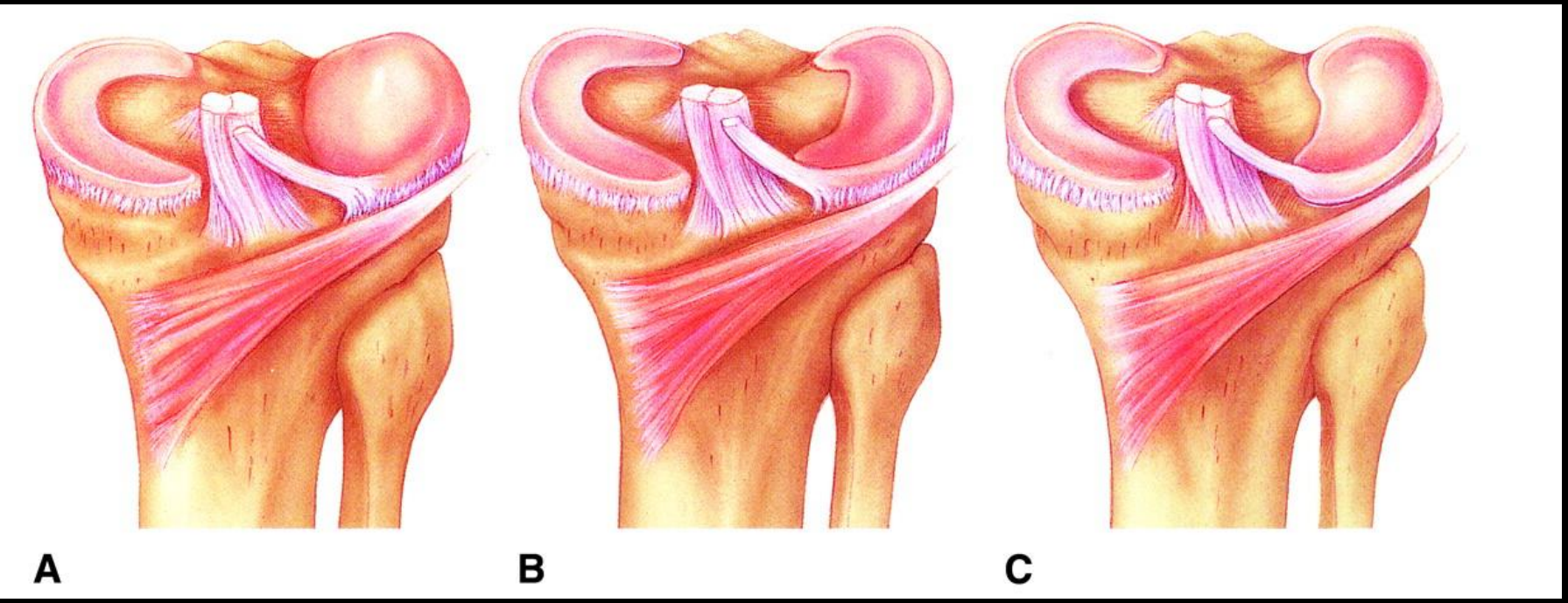


Wrisberg Variant Discoid Meniscus









Watanabe classification of discoid lateral meniscus. **A, Type I, Block-shaped stable, complete meniscus. B, Type II, Block-shaped stable, partial meniscus. C, Type III, Unstable meniscus, with stability arising only from the ligament of Wrisberg. (Reproduced from Andrish JT: Meniscal injuries in children and adolescents: Diagnosis and management. *J Am Acad Orthop Surg 1996:4:231-237.)***

Post Operative Menisci

- Repaired or partial meniscectomy
  - May remain abnormal in signal
  - Should have Smooth edges
  - No fluid tracking into meniscus
  - No displaced fragments
- MR arthrography

MR Physics

T1	Fat, gadolinium bright	anatomy
T2 or STIR	Water Bright	pathology

MR Physics

T1	Fat, Gad Bright	anatomy
T1 Fat suppressed	Gad Bright Fat Dark	Injected Gad
T2 or STIR	Water Bright	pathology

Subchondral Stress fx, No Retear

T2 (fluid bright)
“fat suppressed”

T1 (contrast bright)
“fat suppressed”

Another Patient
Retear

T2 (fluid bright)
“fat suppressed”

T1 (contrast bright)
“fat suppressed”

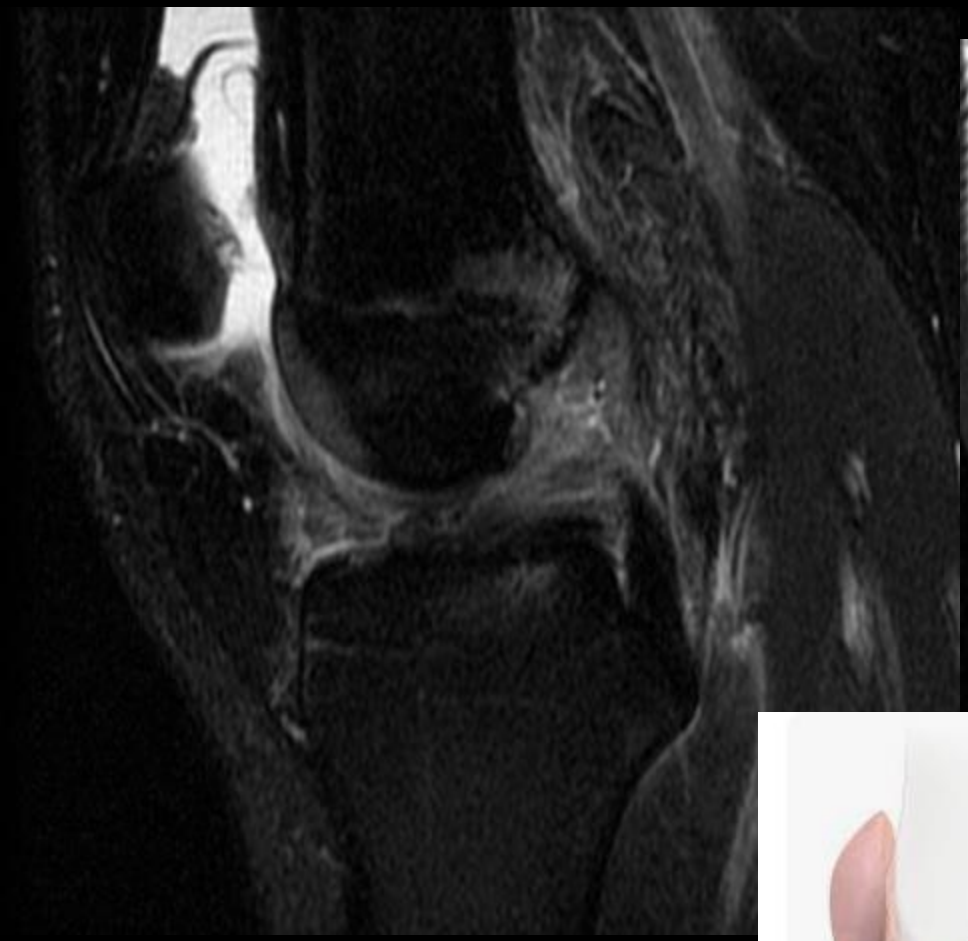
Knee MRI

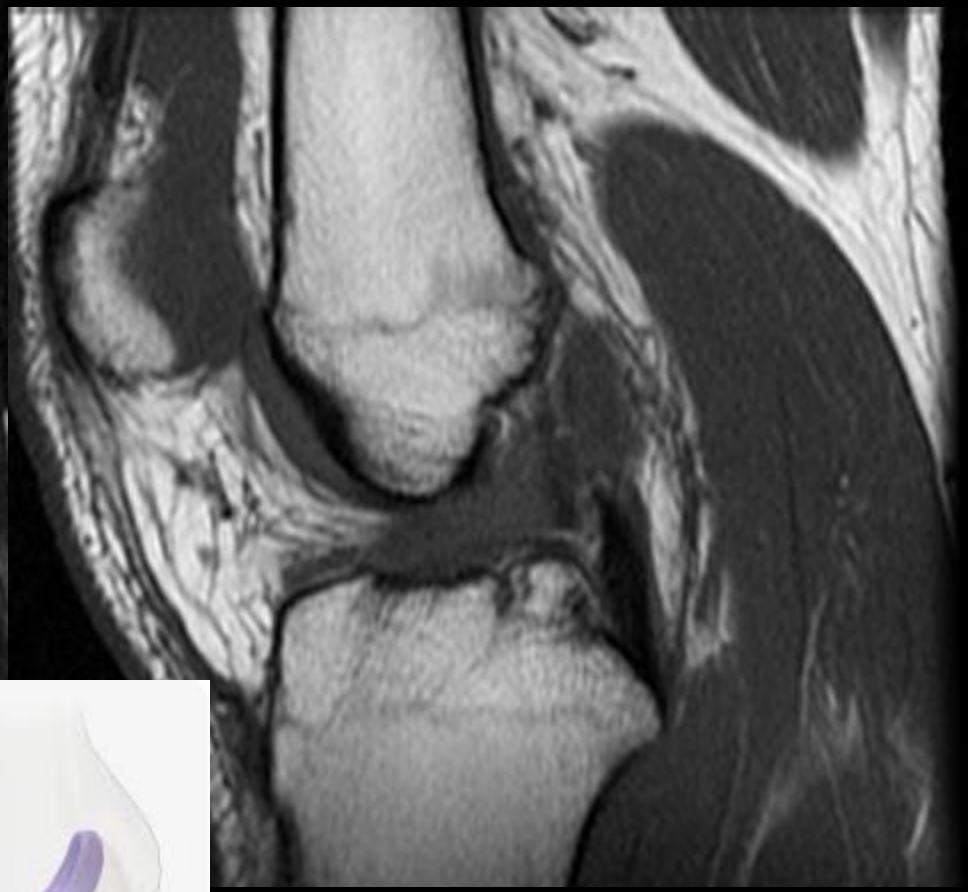
- Specific Pathology
  - Menisci
  - Cruciate
  - Collateral ligaments
  - Cartilage
  - Bone Marrow
  - Extensor Mechanism

Cruciate Tears on MR

- Normal ↓ T1, ↓T2
- Acute Tears ↑T1, ↑T2, Gap
- Chronic

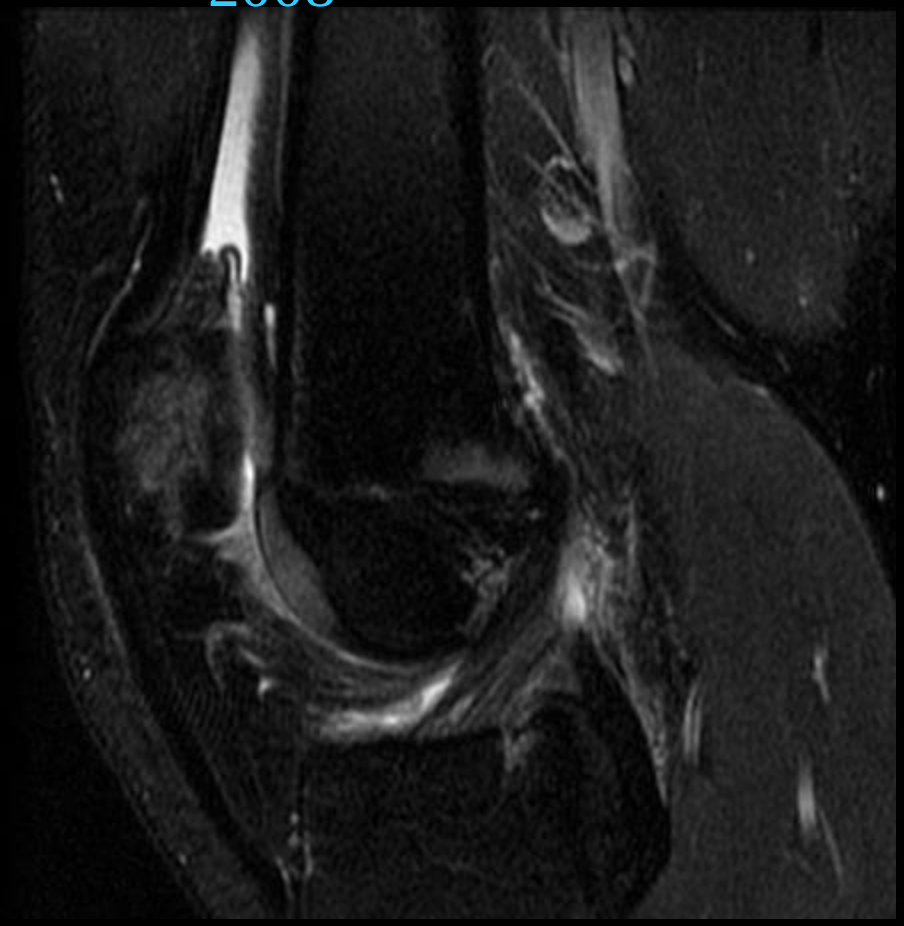
  Resorption May revert to ↓ T1, T2



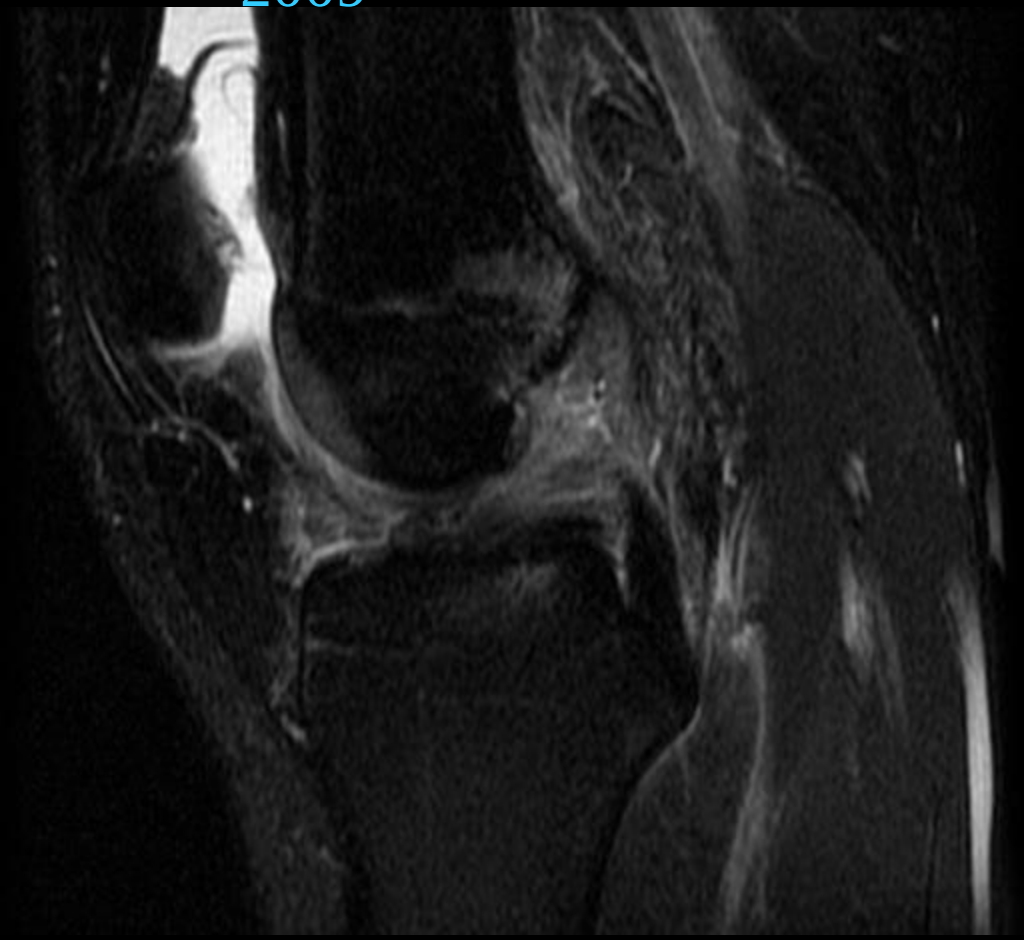


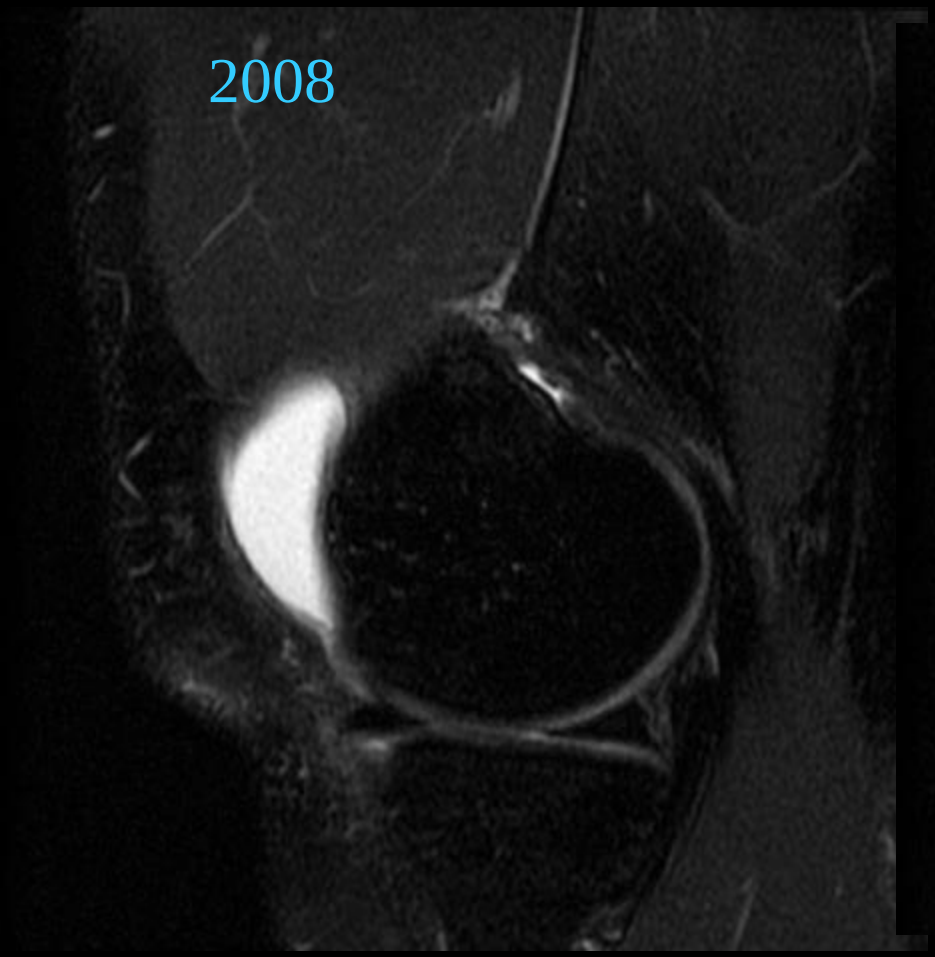
20 yo trauma 2008, 2009

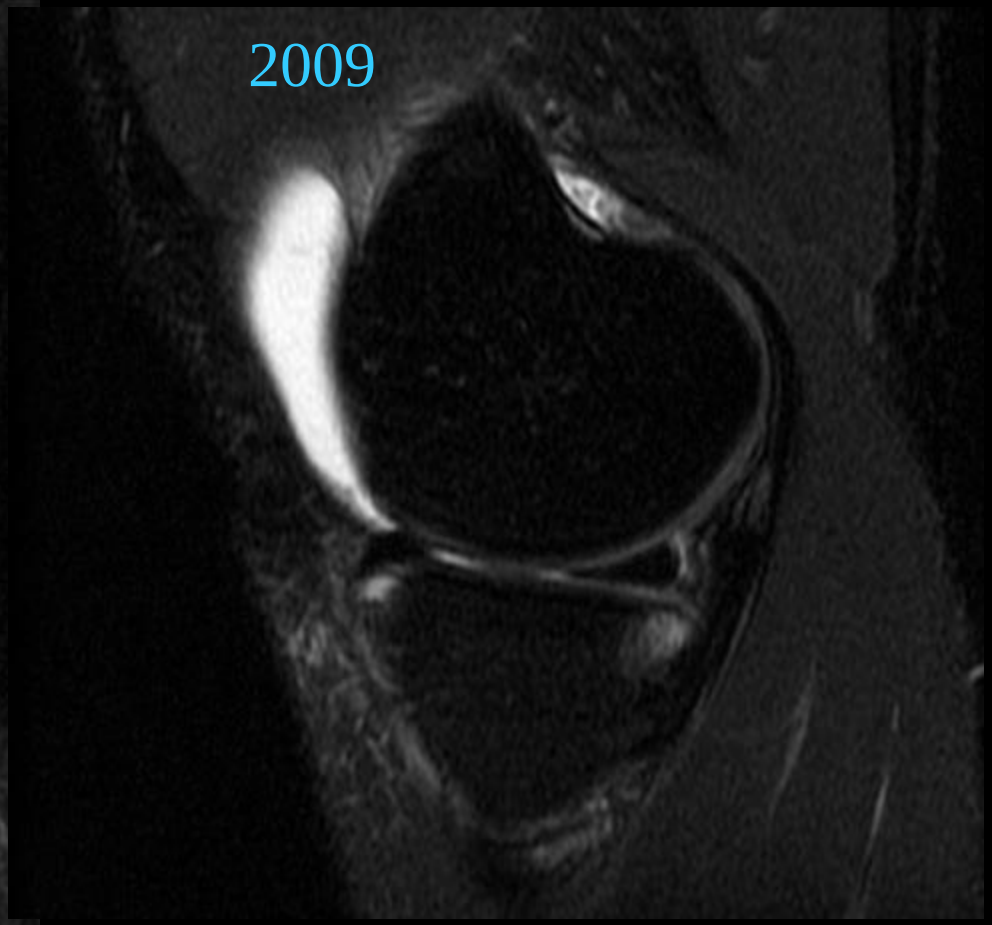
2008



2009



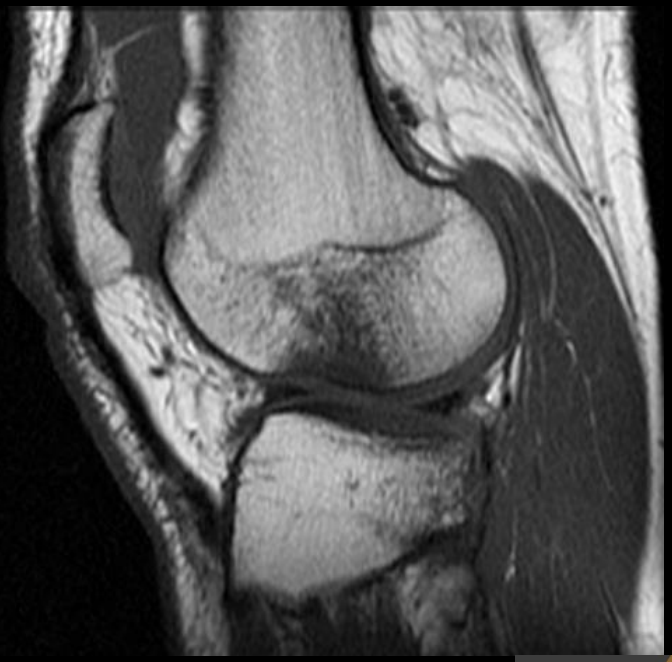

2008

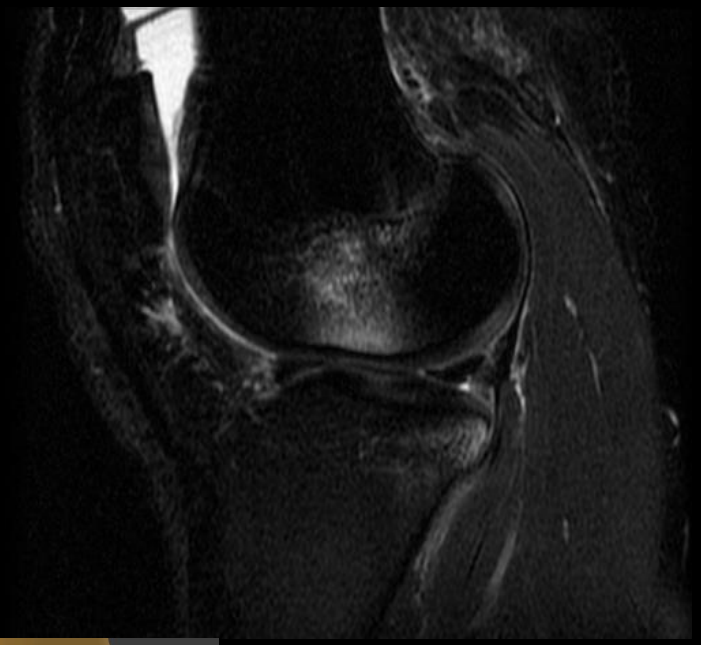

2009

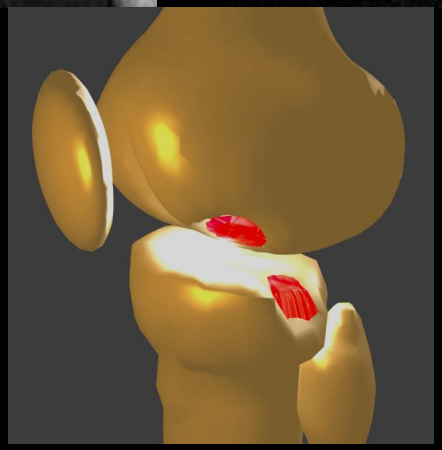
ACL Tear
Secondary Signs

- Bone Bruises
- Deep terminal sulcus
- Anterior Drawer Sign
- Segond

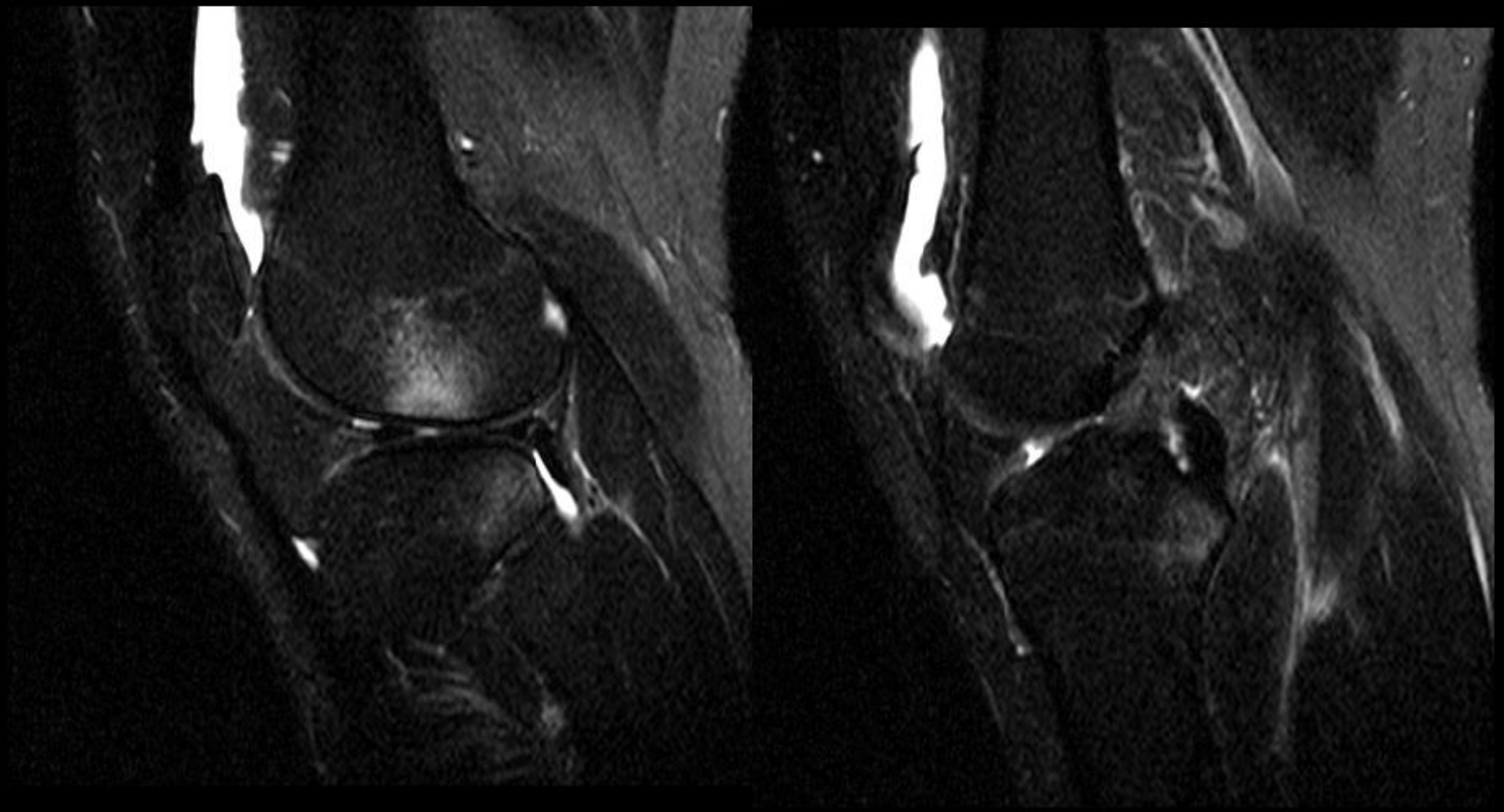
ACL Tear: Bone Bruise Pattern



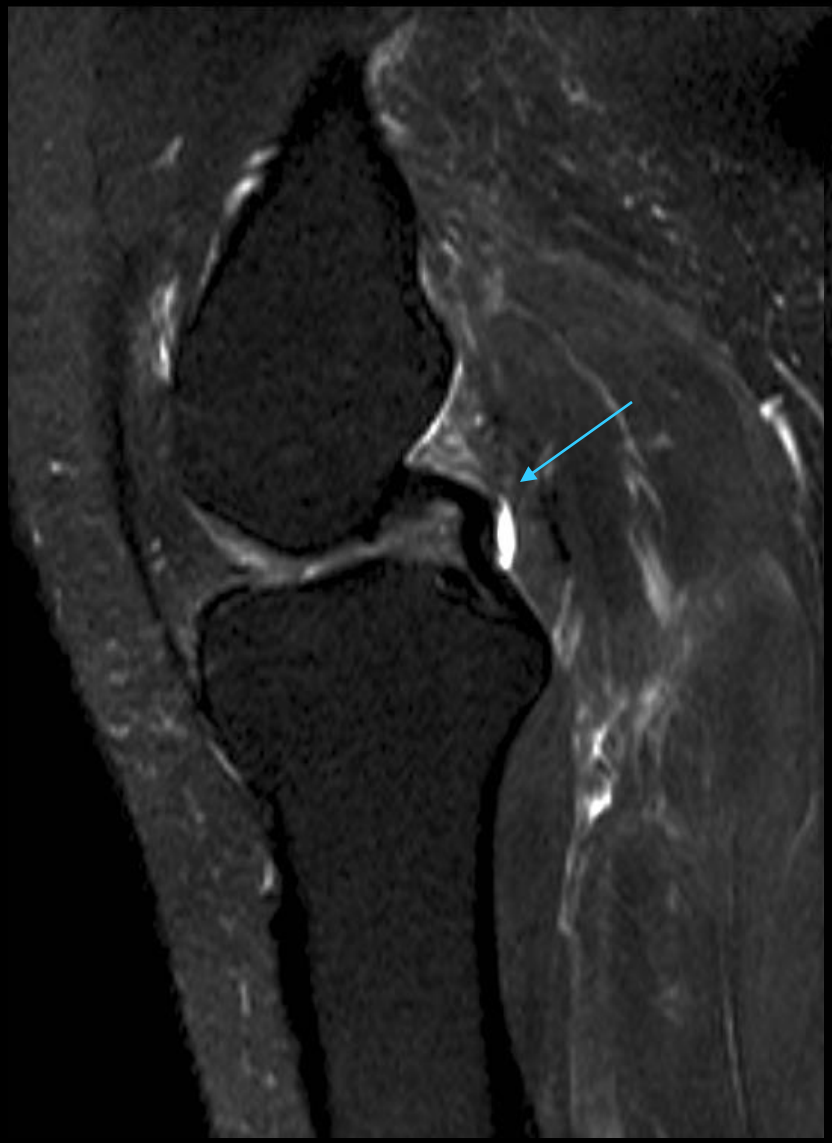




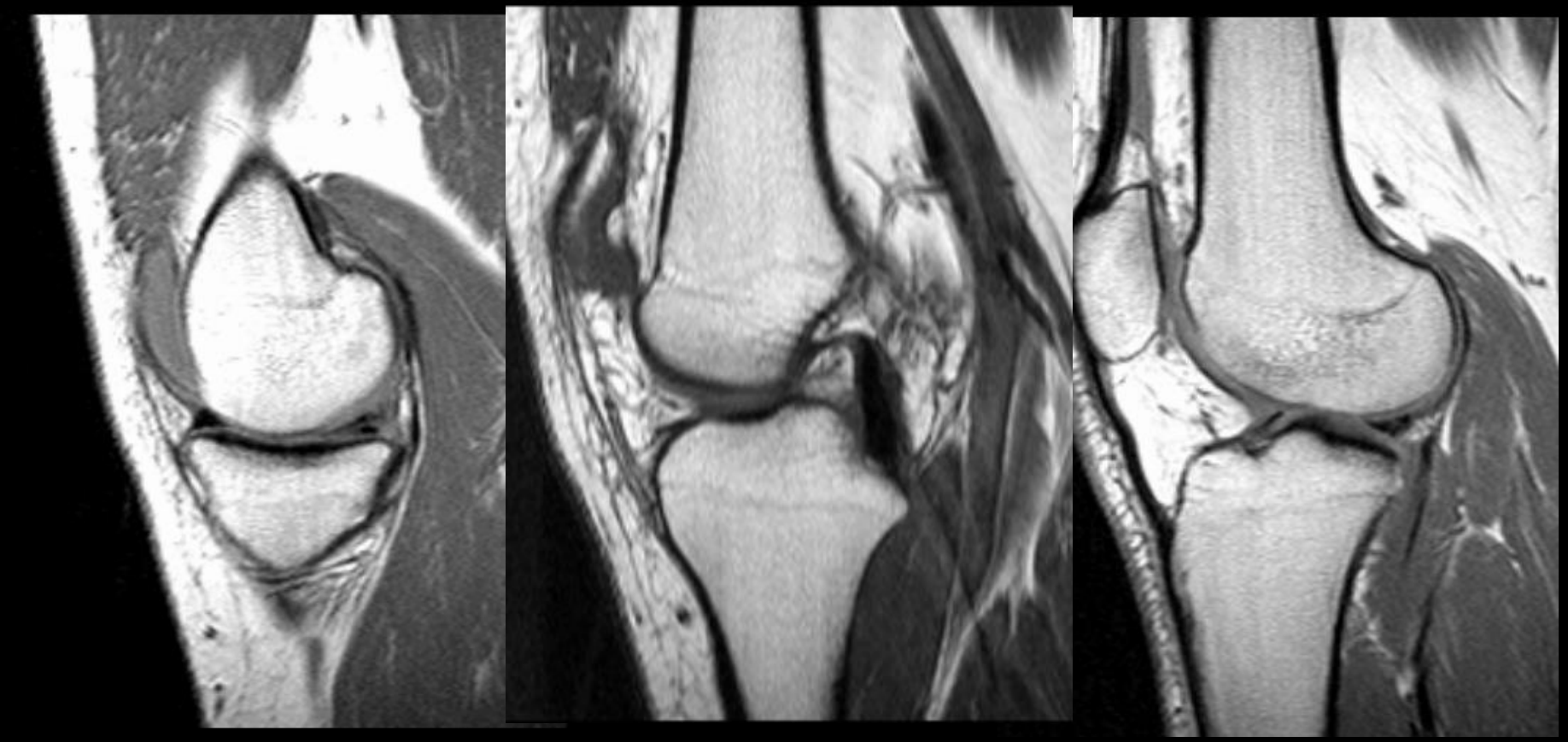
19 yo female soccer player



Acute Injury



1 year later



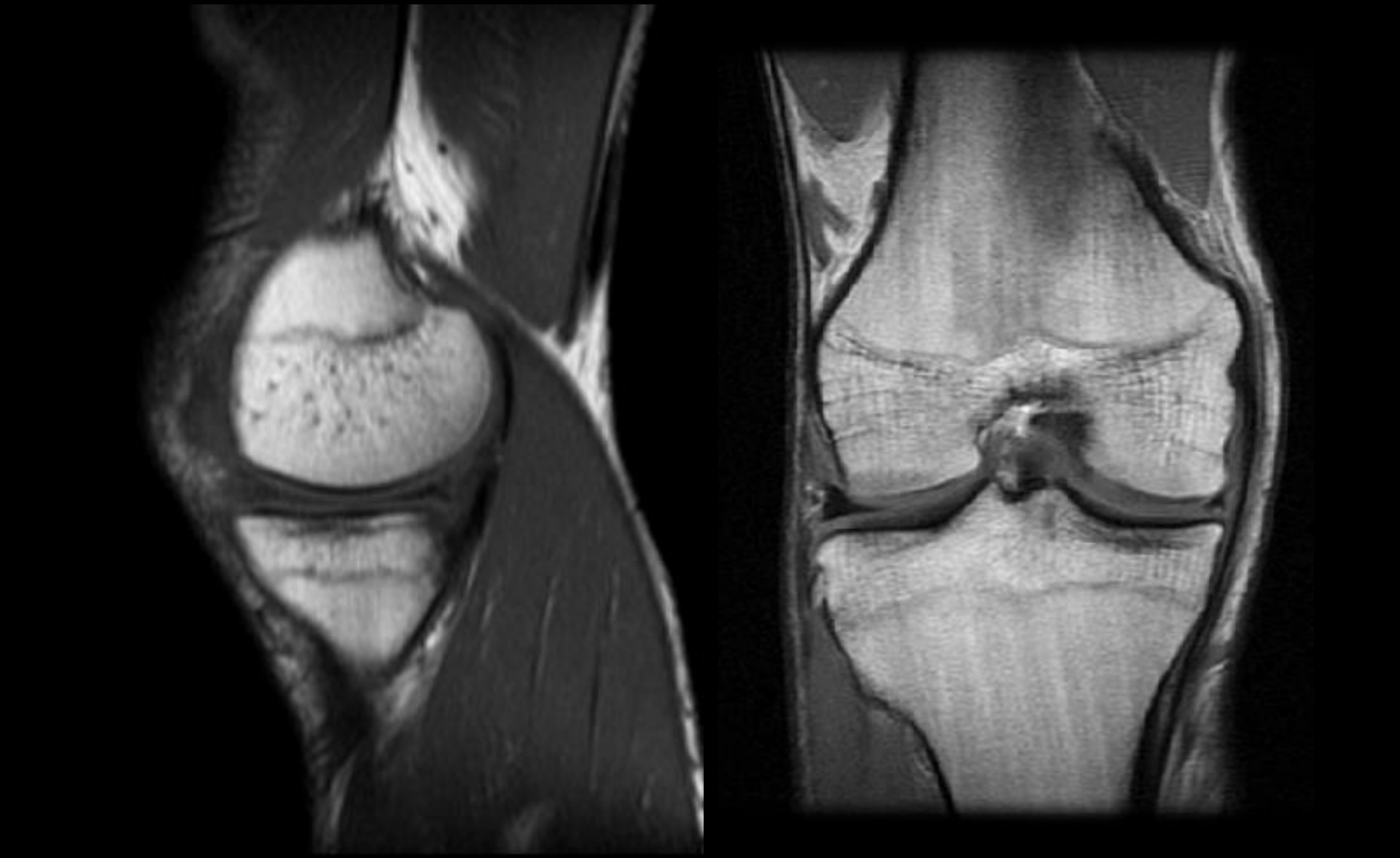
1 year later

normal

Drawer sign

Next Case Acute Injury

Follow up MRI months later



Secondary Signs

- Segond (anterolateral ligament)
- Positive Drawer sign

Next Case

- 19 yo male
- 1 year after basketball injury
- Left knee injury

Right

Left


P
A
11


L
R
12

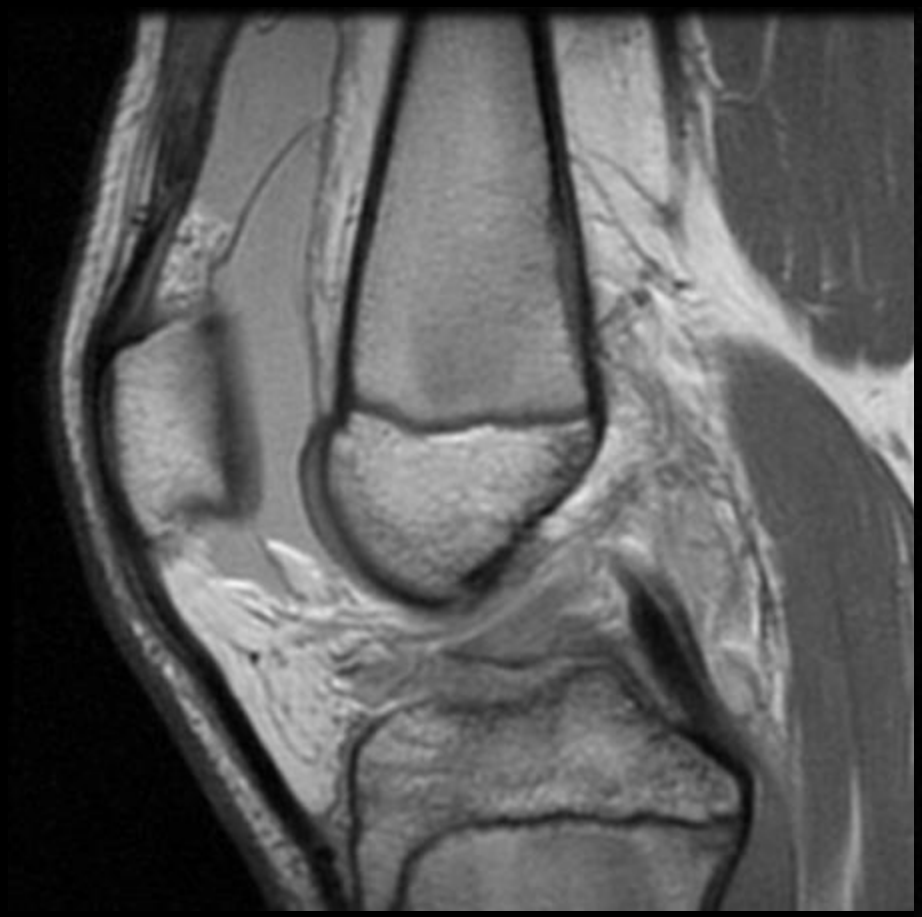

L
R
5

Deep Lateral Femoral Notch Sign

- Depth of >1.5 mm abnormal (ACL Tear)

Acute Trauma

Tibial Spine Avulsion



ACL Tear: MR Accuracy

- Accuracy, 92 - 100%
- Sensitivity, 98%
- Specificity, 93%

Acute PCL Injuries

Midsubstance interstitial tear most common:

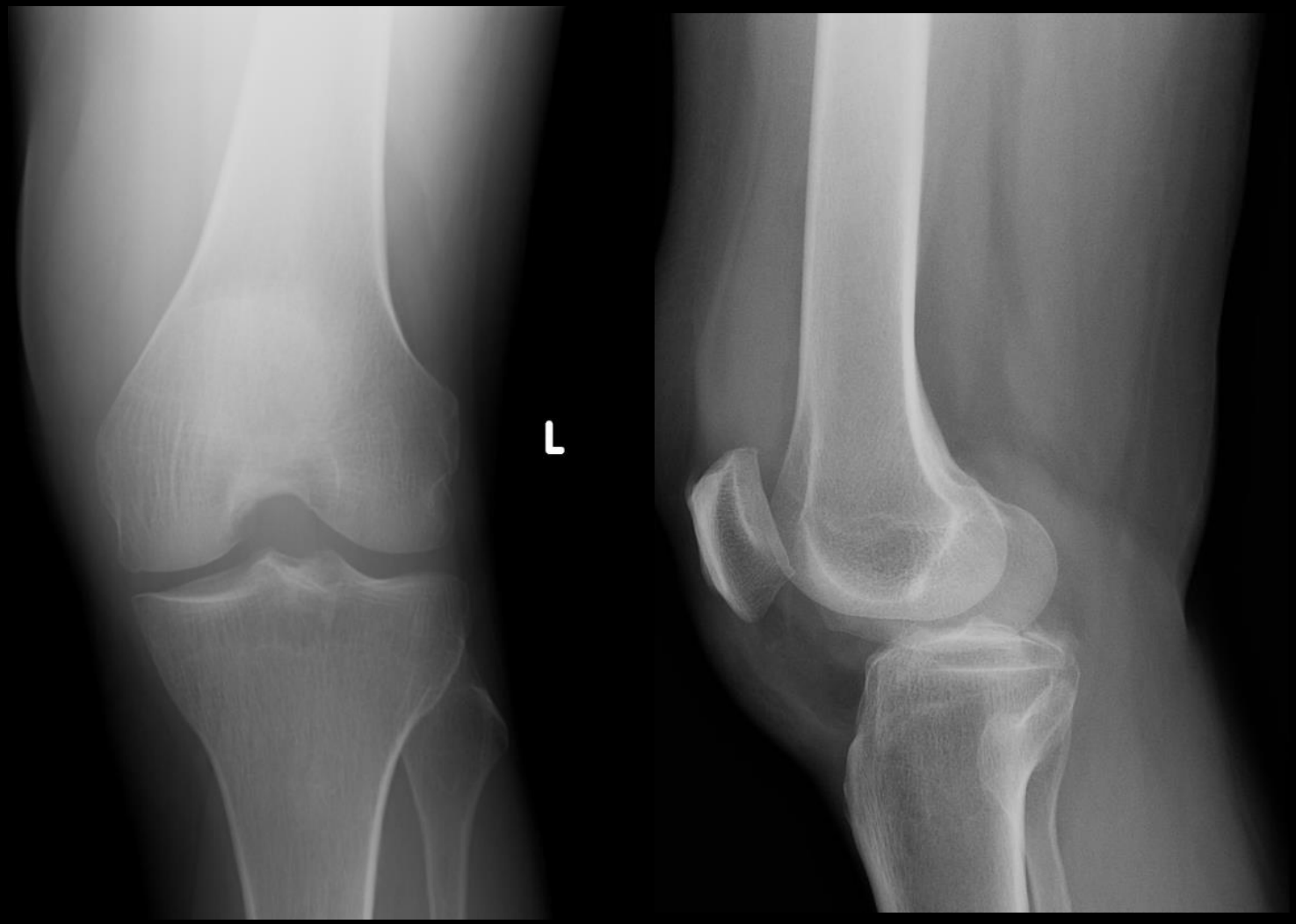
- widening
- increased T1 and T2 signal
- higher SI than ACL on any sequence

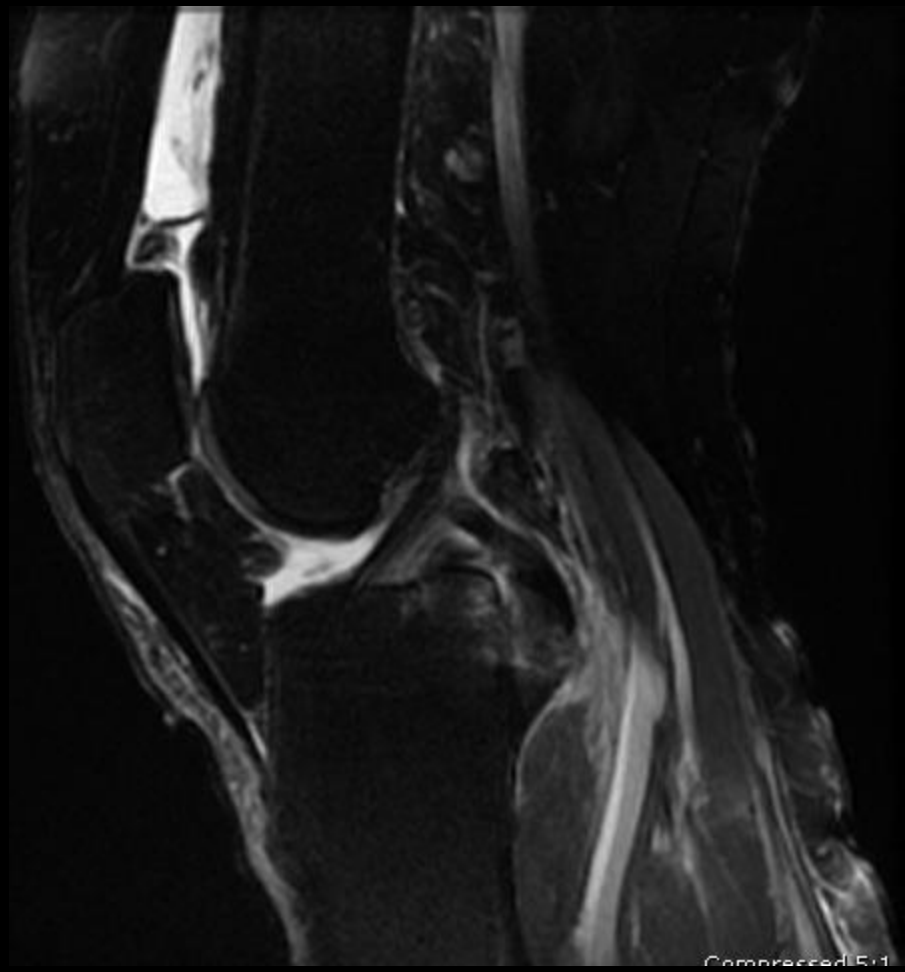
Complete tears show disruption of the ligament

Avulsion of tibial attachment

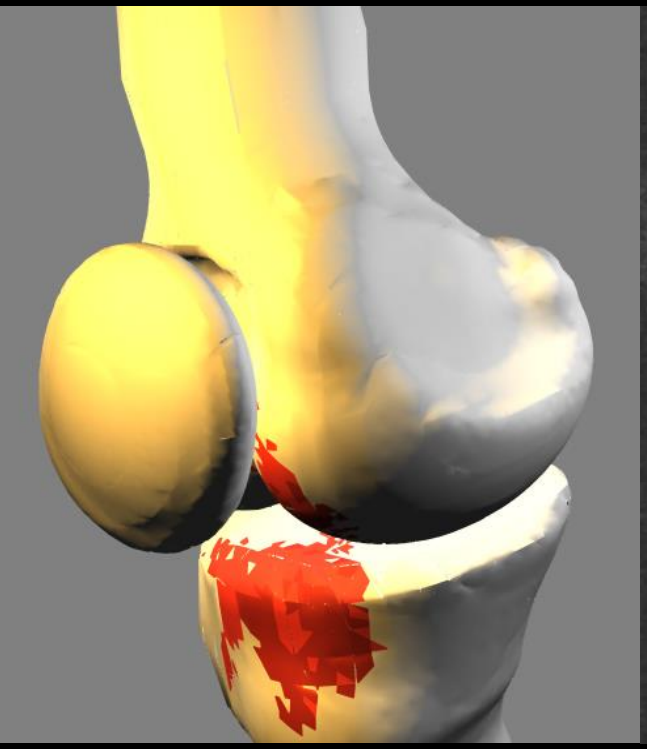
N/A

29 yo Hyperextension Injury





Hyperextension Marrow Edema



Knee MRI

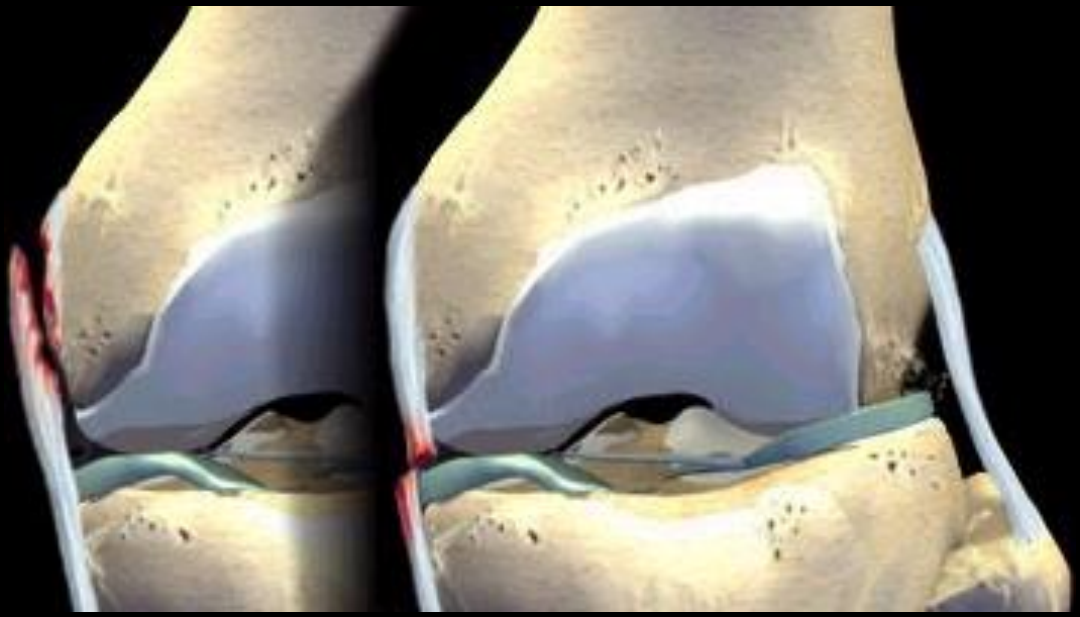
- Specific Pathology
  - Menisci
  - Cruciate
  - Collateral ligaments
  - Cartilage
  - Bone Marrow
  - Extensor Mechanism

Superior view
ligament
Patellar

Right knee in flexion: anterior view

MCL Tear: Site of Rupture

- Proximal attachment to femur
- Mid-substance
- Distal attachment to tibia

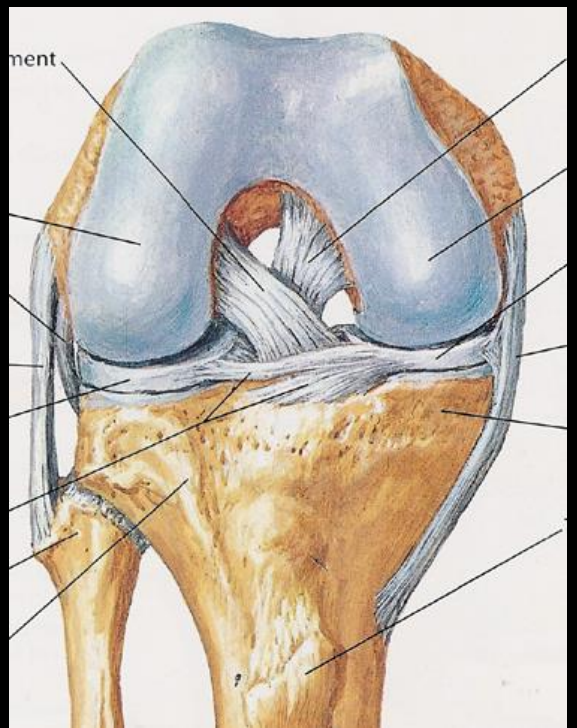


MCL Injuries on MR

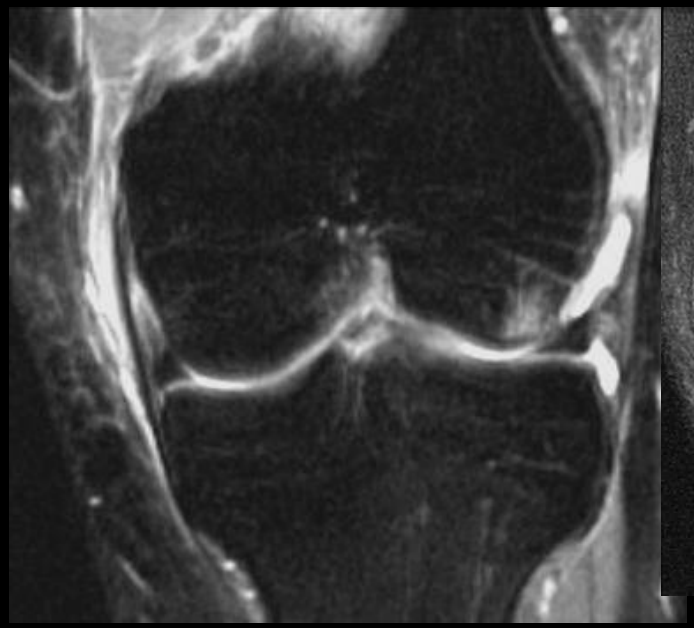
Grade I thickening or edema w/o discontinuity

Grade II intermediate, partial tears

Grade III discontinuity, complete tears



MCL Sprain



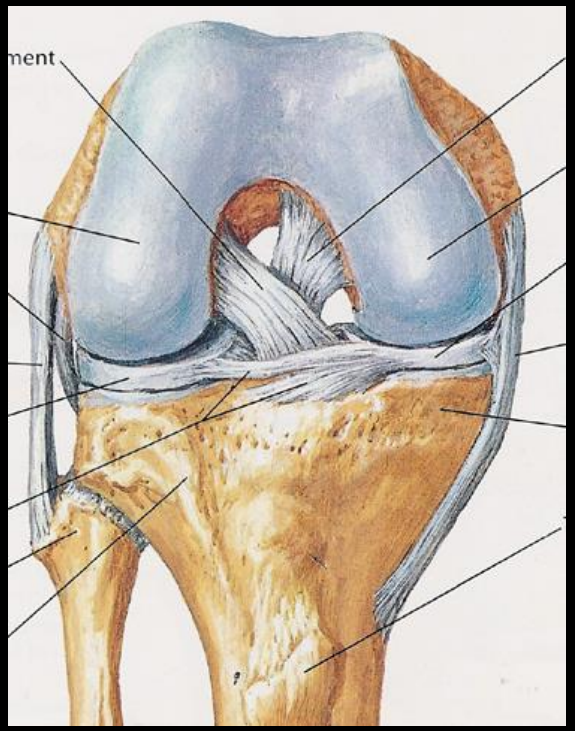
Grade I

Grade II

Grade III

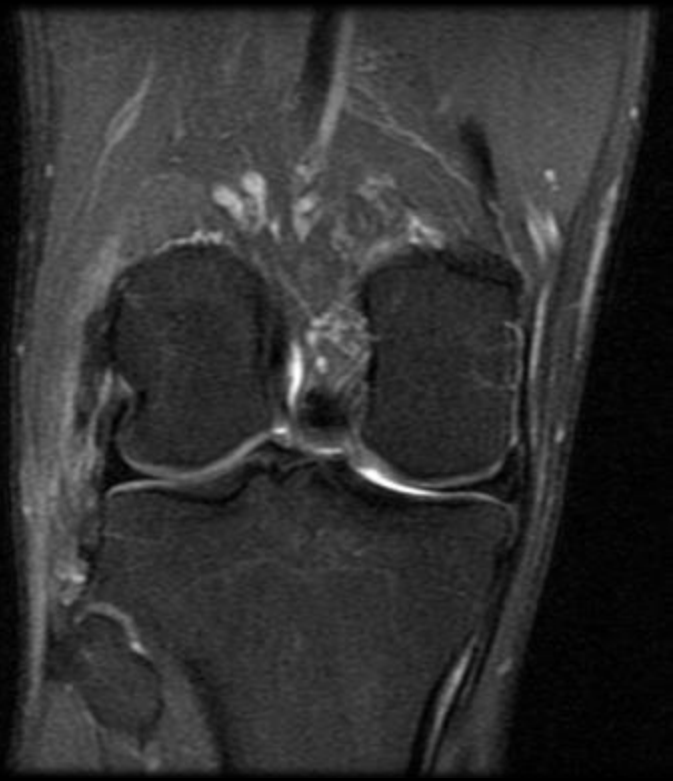
Lateral Collateral Ligament Complex Injury

- Less common than MCL injury
- MR: Edema, redundancy and discontinuity

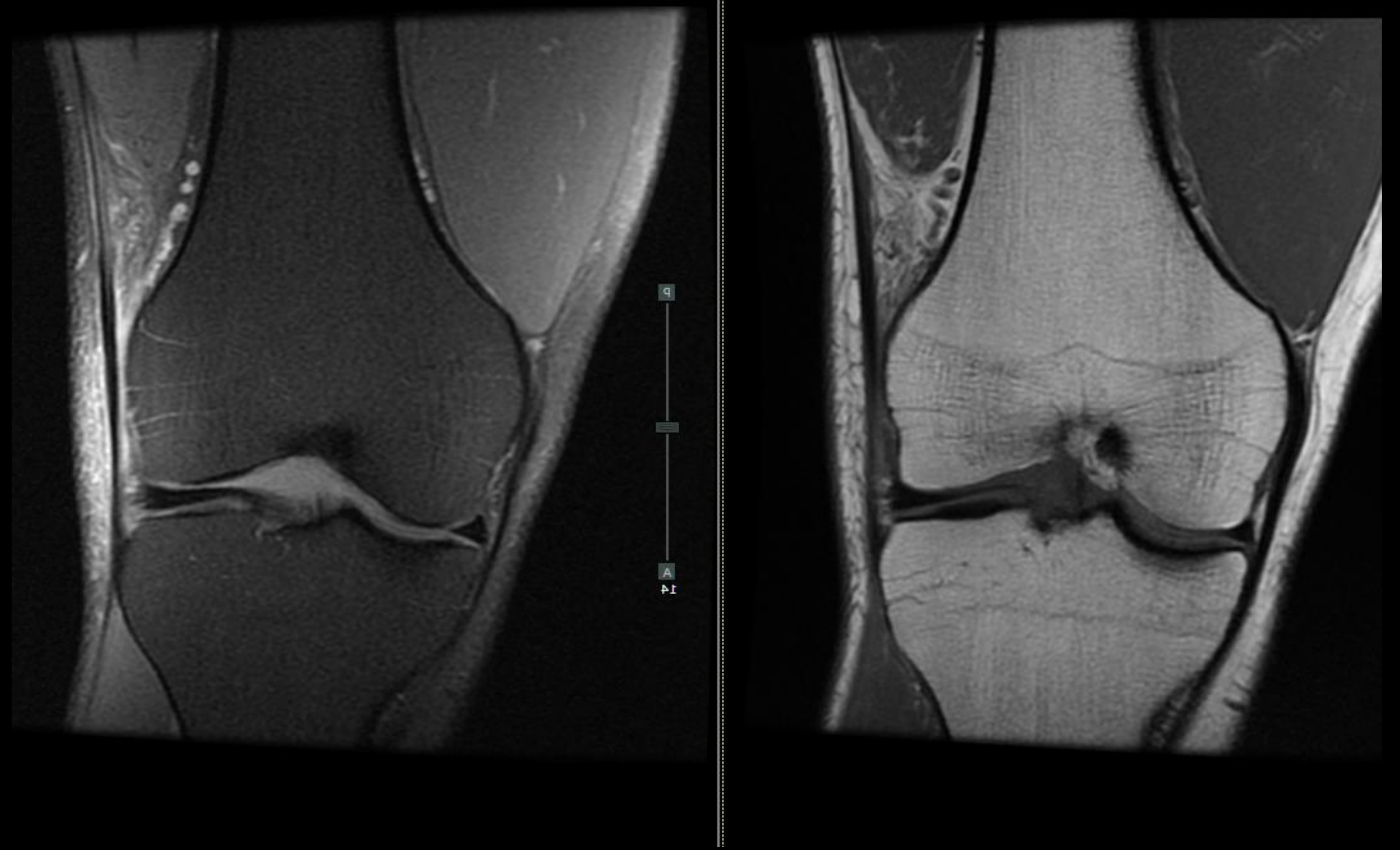


FCL tear

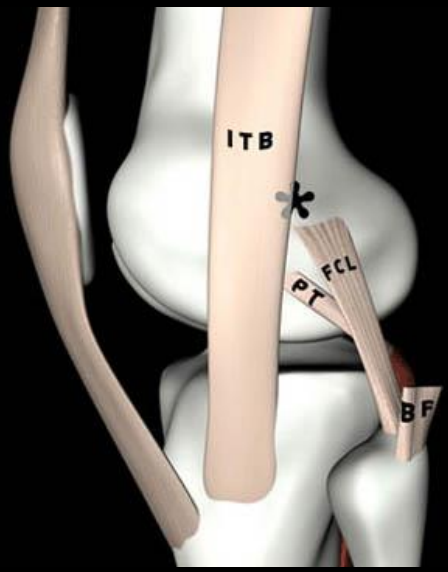




Runner



Iliotibial Band Syndrome



- Inflammation of IT band
- Downhill runners or cyclists
- Often w increased training
- Repetitive flex/ext w weight bearing causing friction
- Accentuated by genu varum, excessive foot pronation or lg LF epicondyle

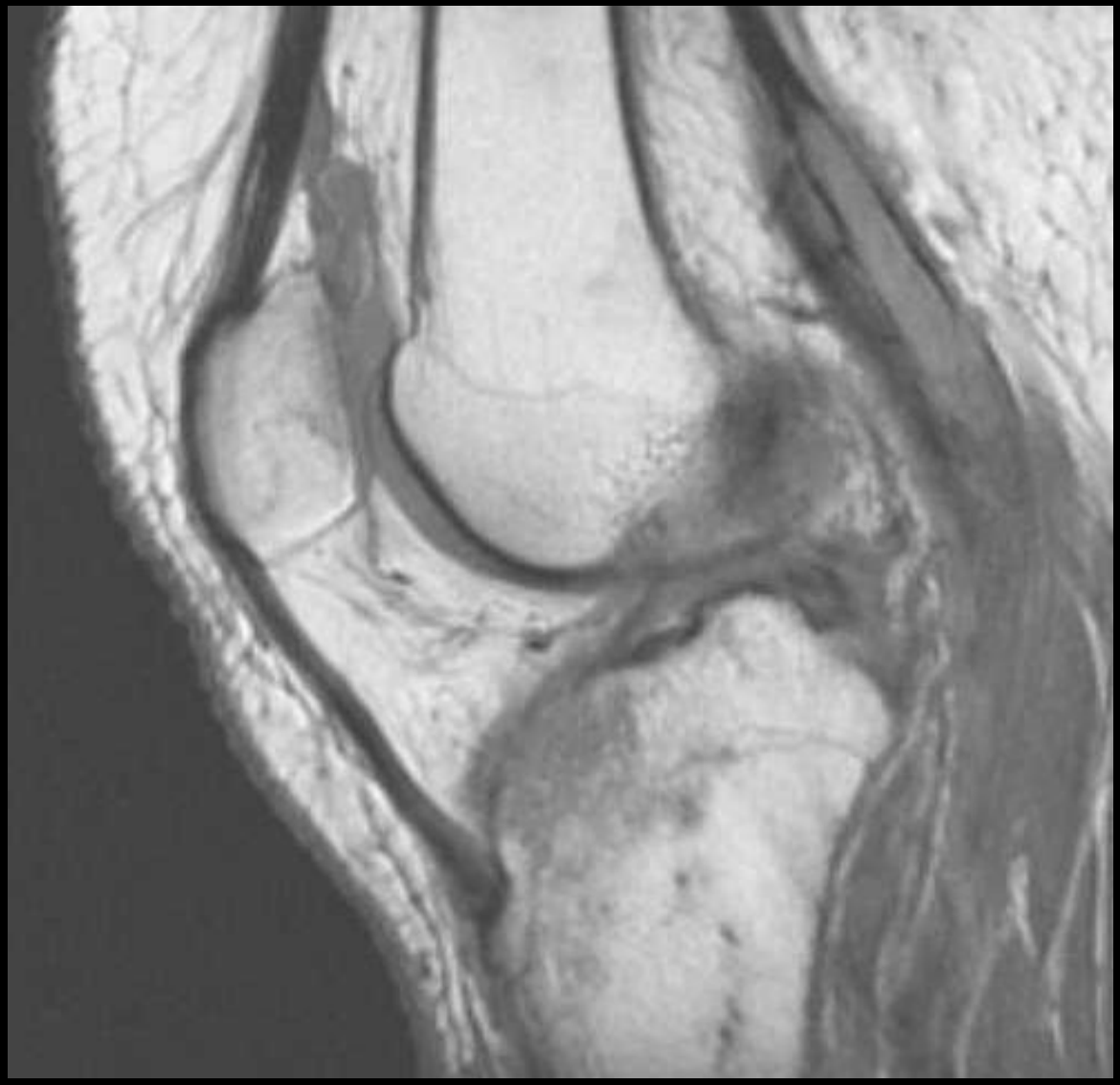
Femorotibial Knee Dislocation

- Relatively rare
- Motor vehicle accidents
- Hyperextension injuries
- ACL, PCL, MCL or LCL
- Popliteal artery injury

Femorotibial Knee Dislocation

Femorotibial Knee Dislocation

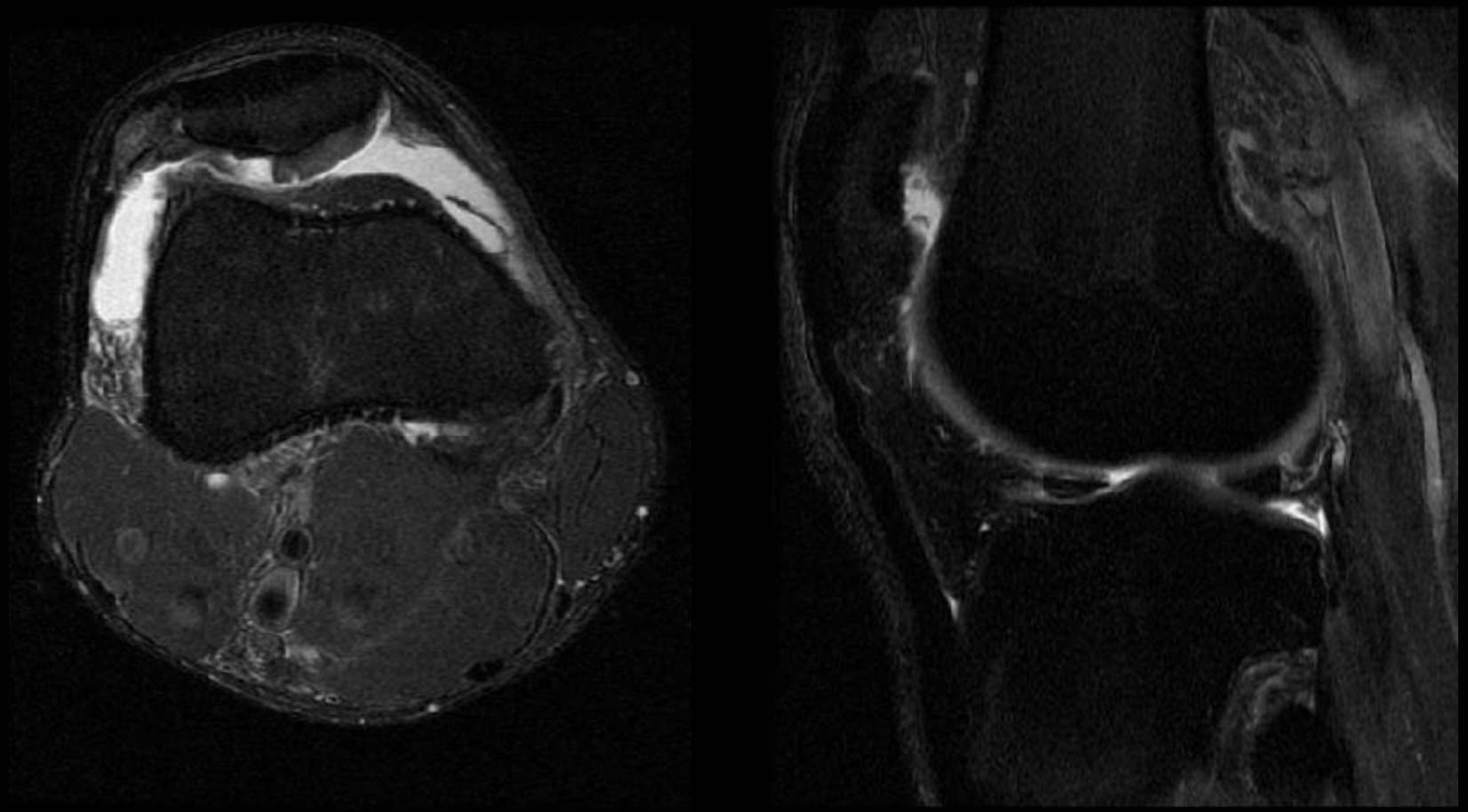
Dislocation: Vascular Thrombosis



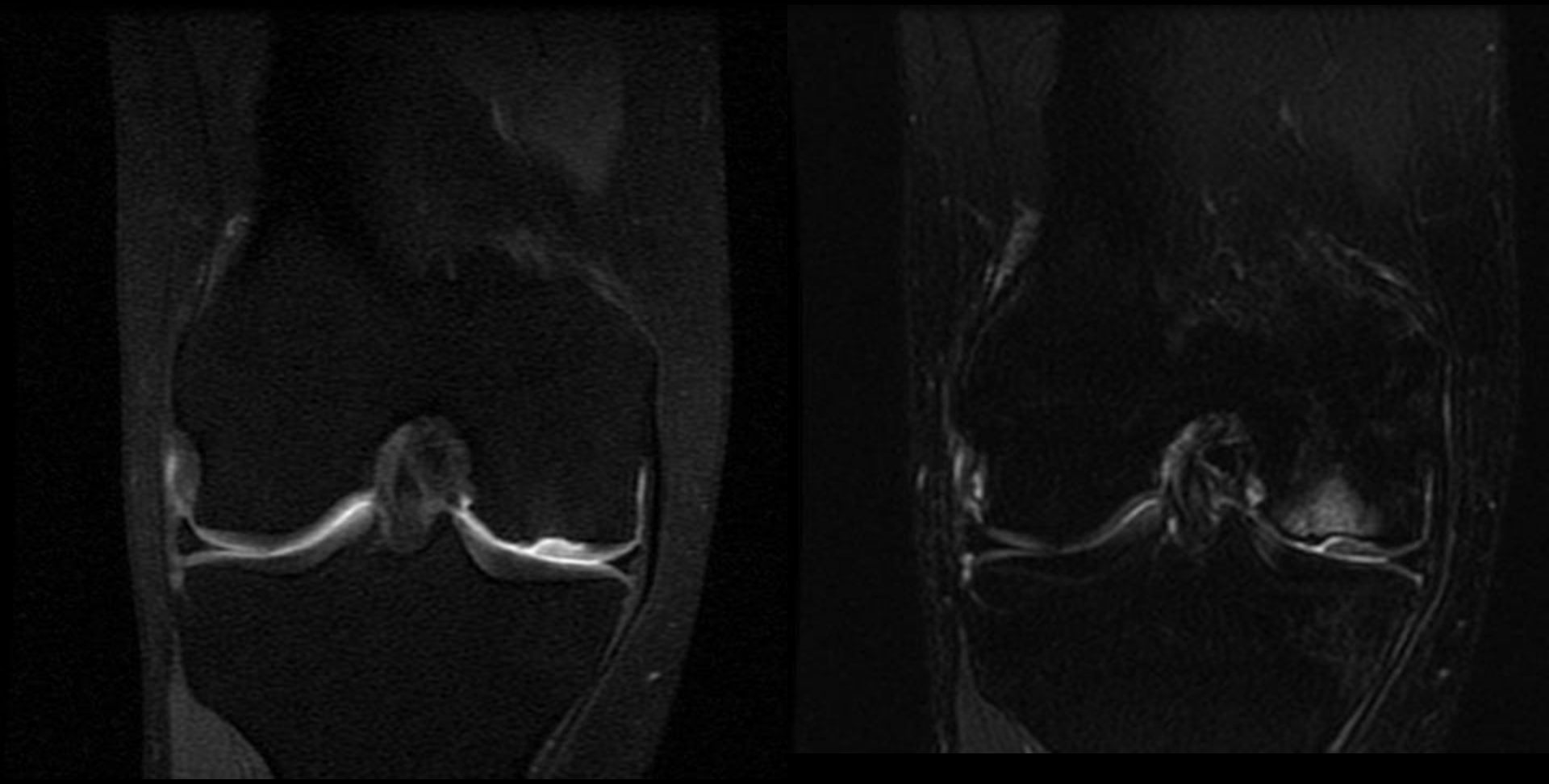
Knee MRI

- Specific Pathology
  - menisci
  - cruciate
  - collateral ligaments
  - cartilage
  - Bone Marrow
  - Extensor Mechanism

Cartilage Defect



Cartilage Flap



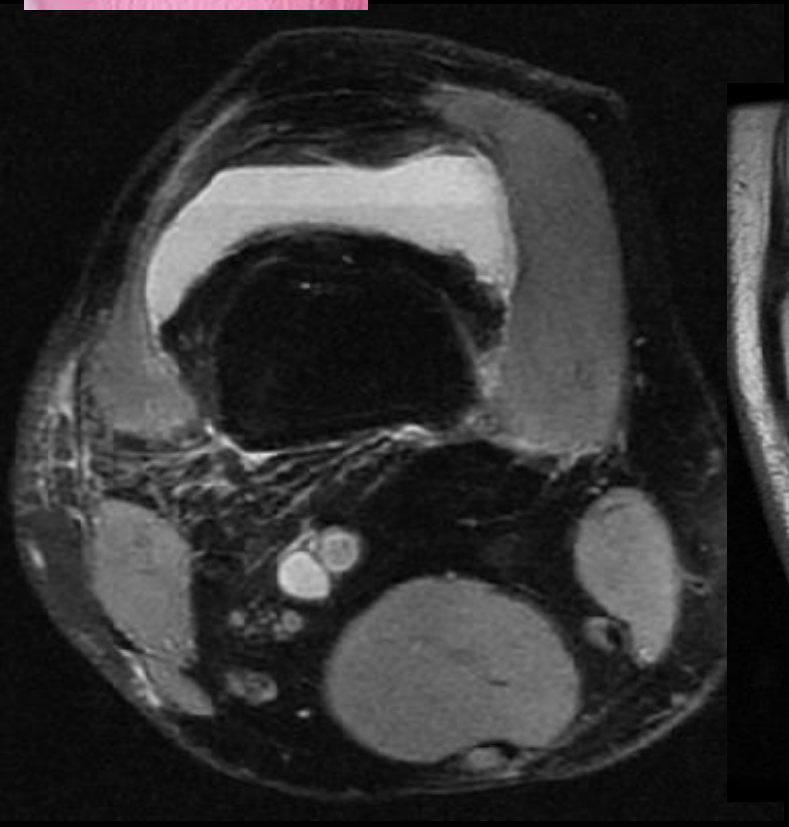
Loose Osteochondritis Dessicans

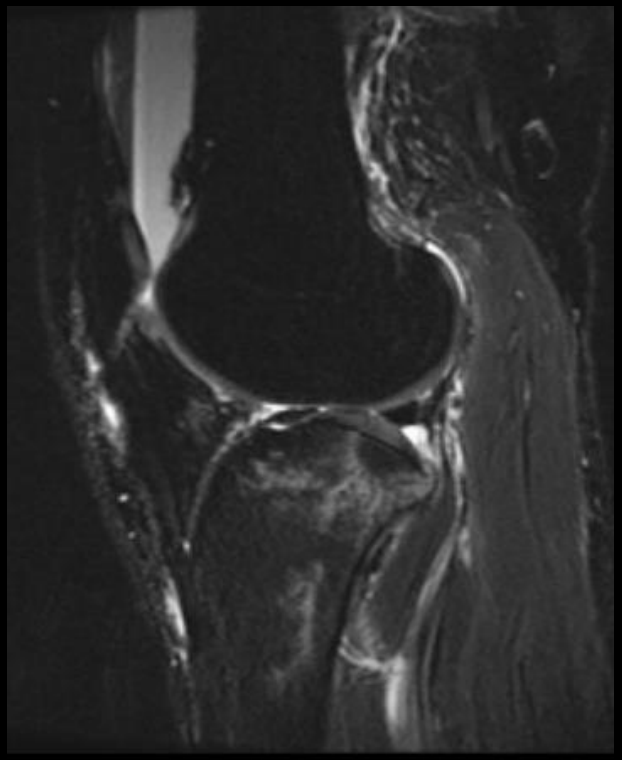
Knee MRI

- Specific Pathology
  - Menisci
  - Cruciate
  - Collateral ligaments
  - Cartilage
  - Bone Marrow
  - Extensor Mechanism

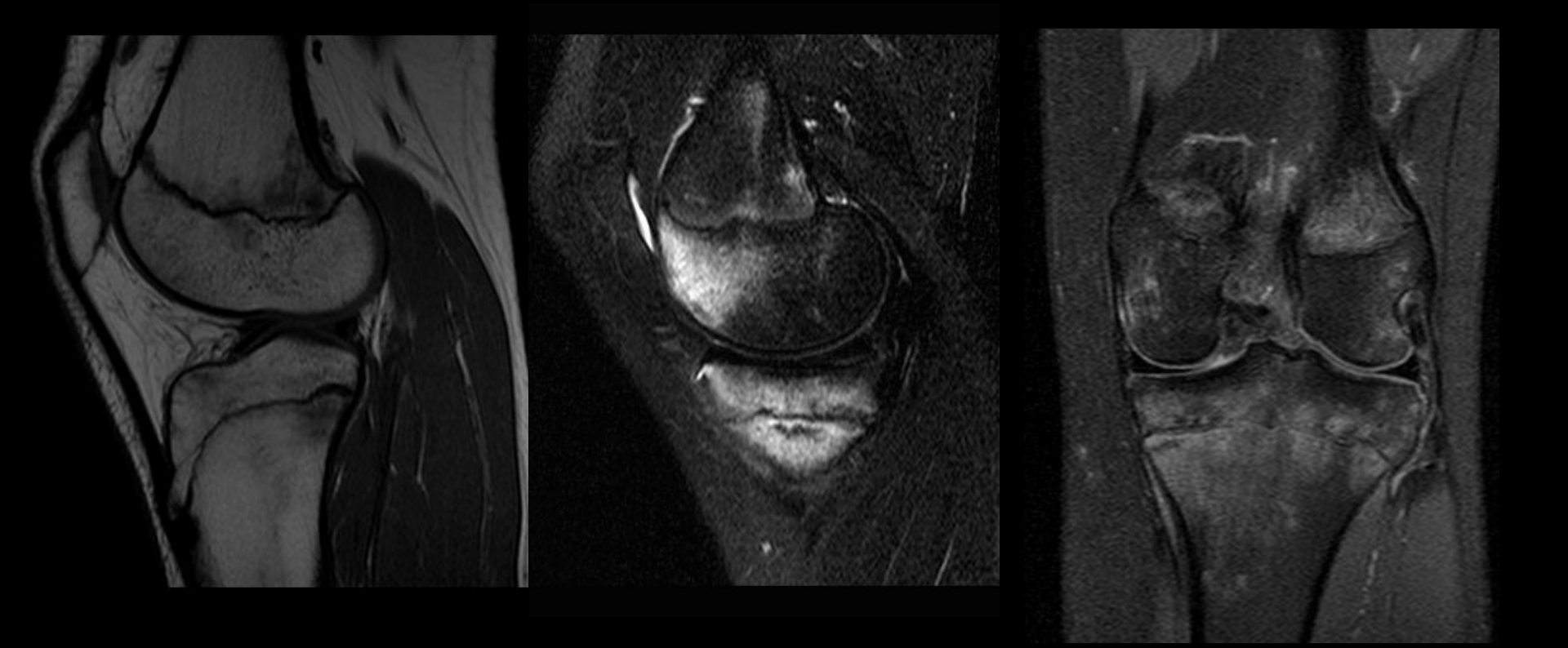
Twisted knee

Lateral Plateau fracture

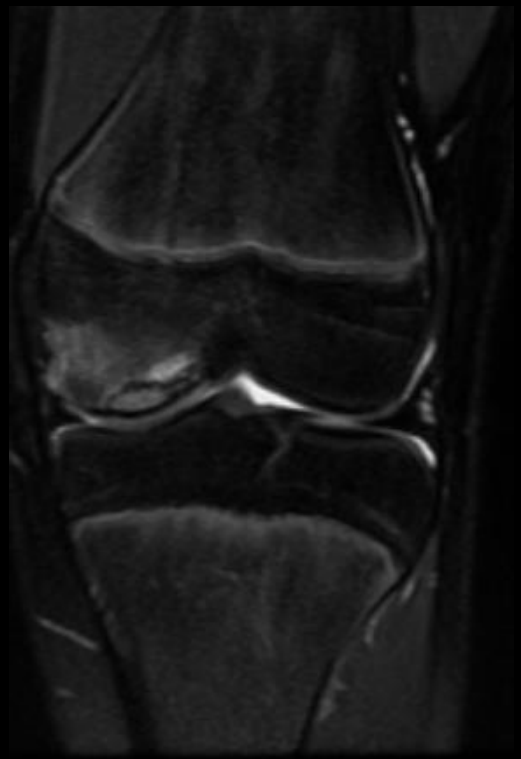




16 yo Female Cheerleader

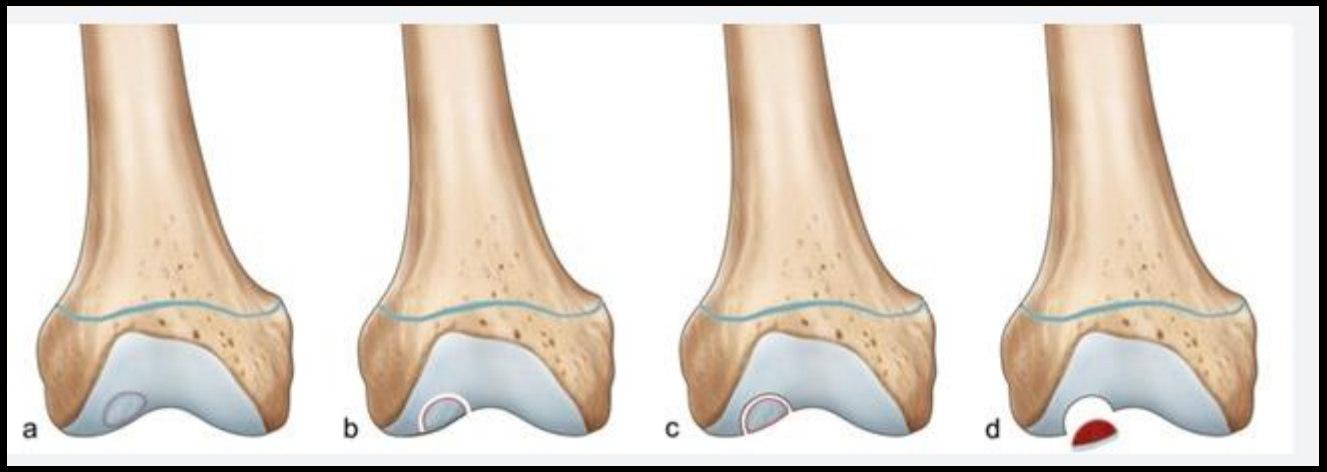


15 yo female
OCD in MFC

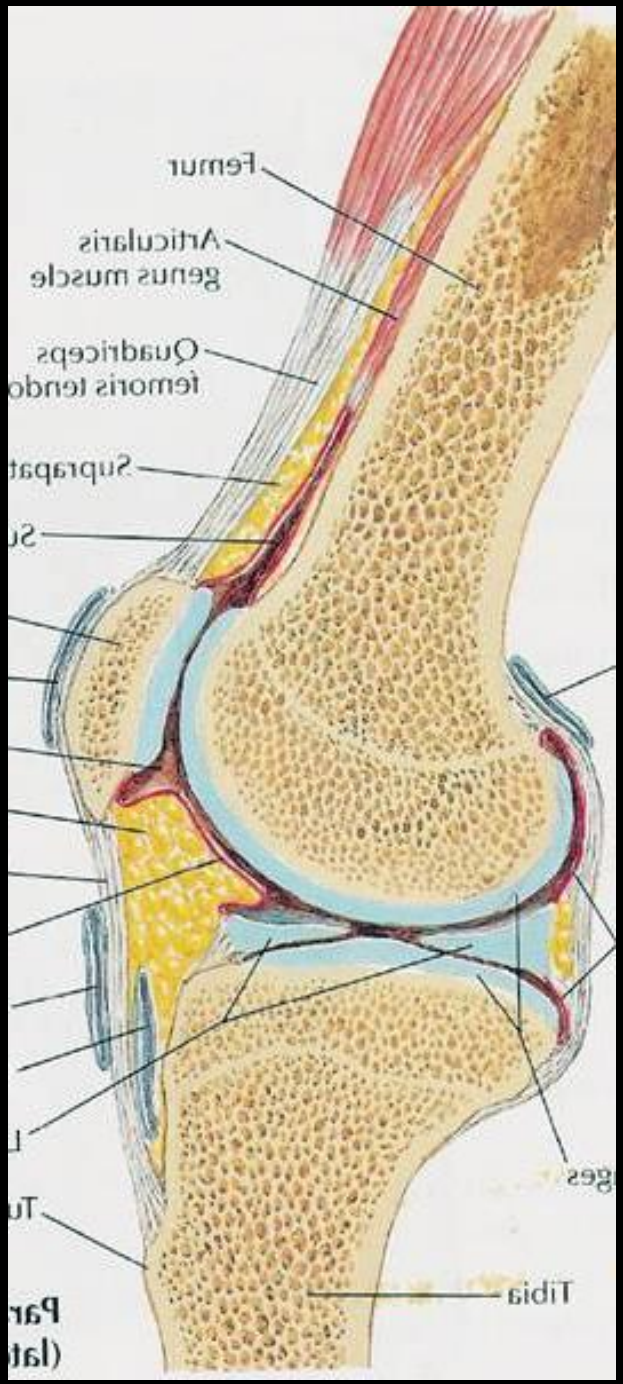


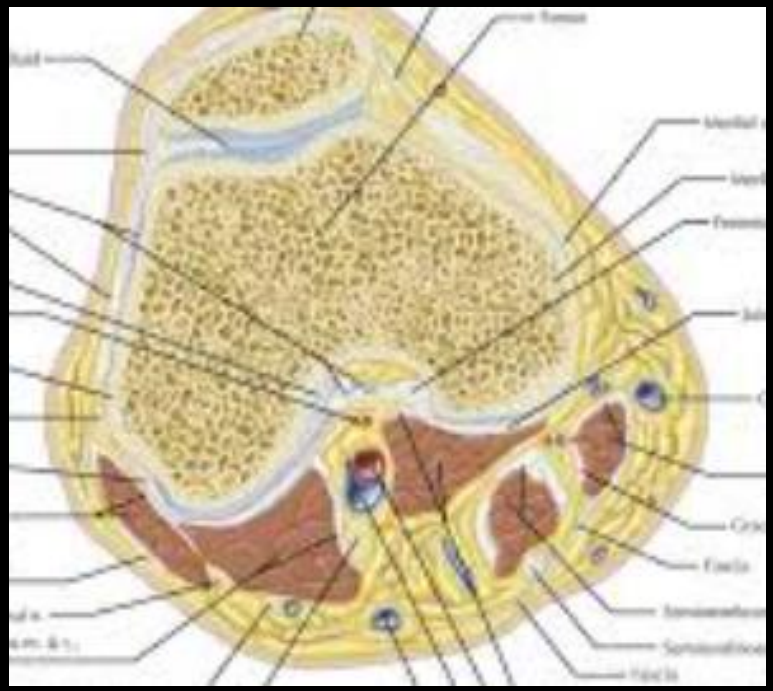
Osteochondritis Dissecans

- Adolescents
- Probable shear stress injury
- Bone failure may progress to cartilage failure

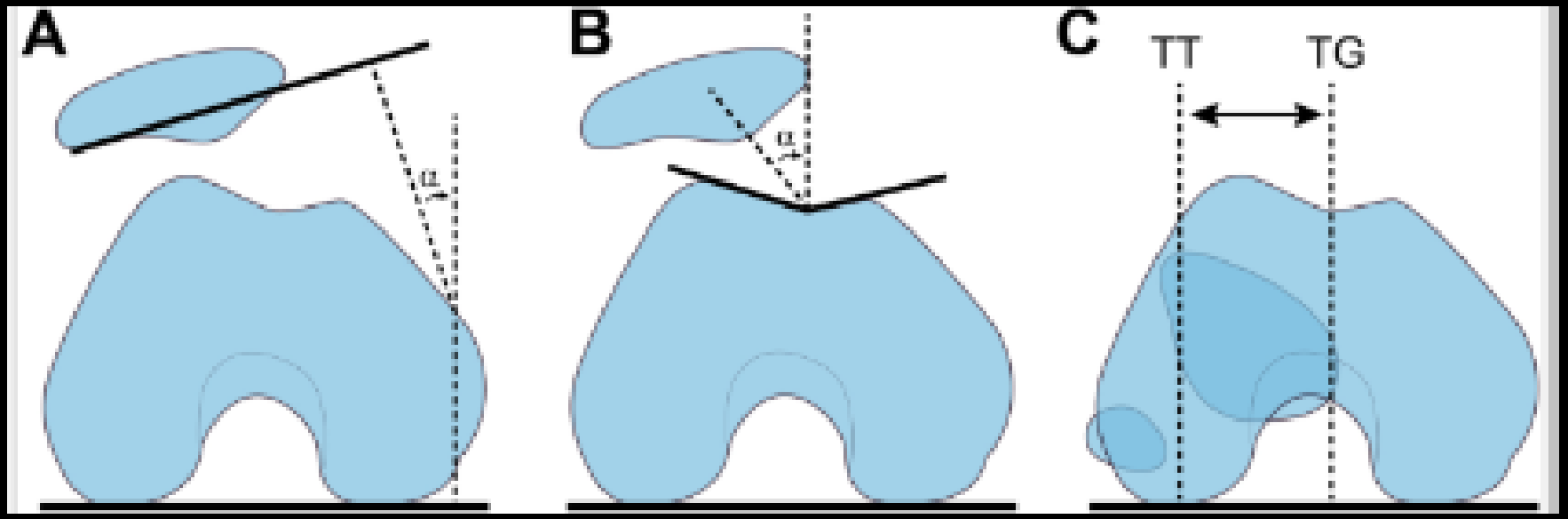


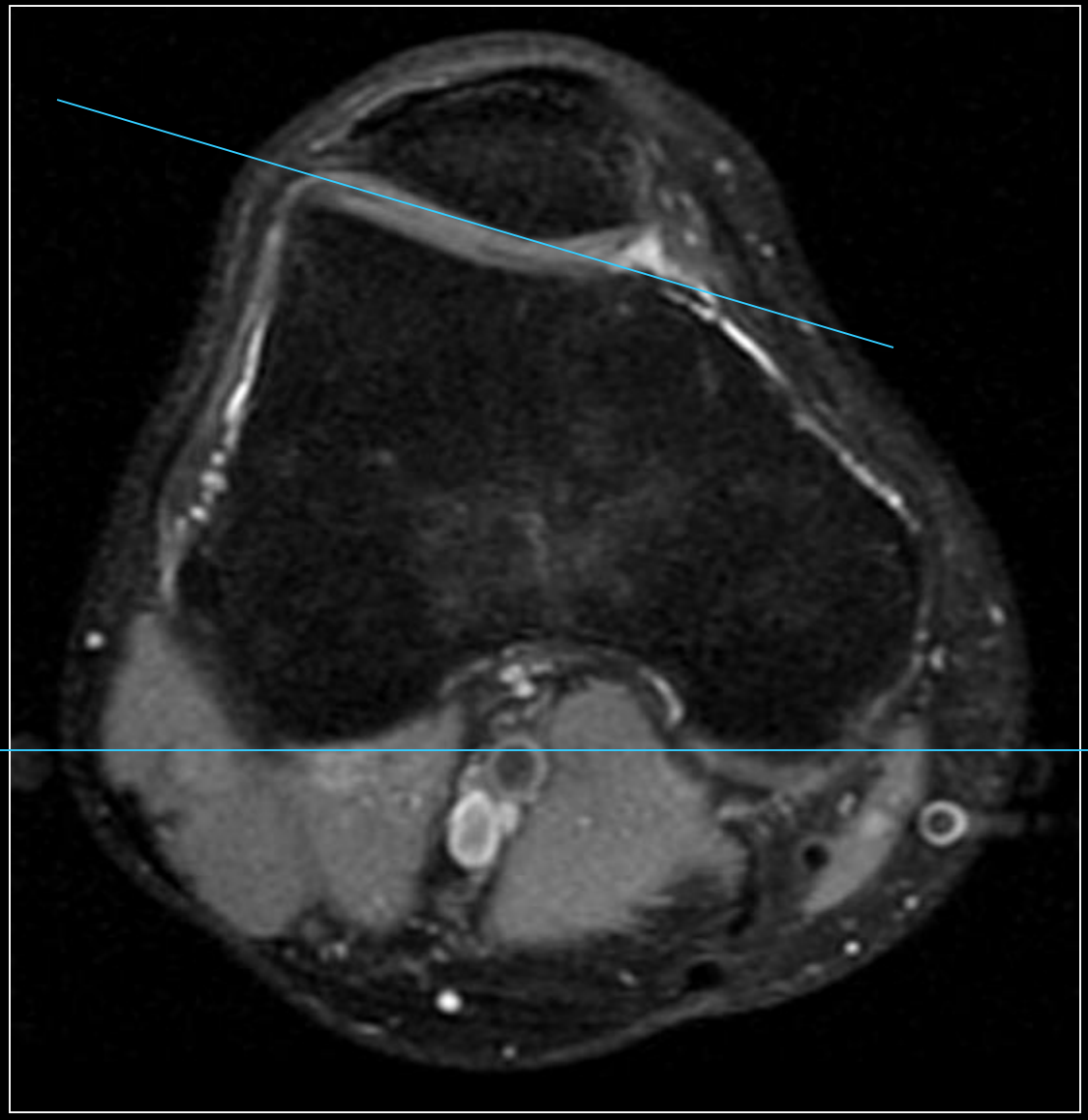
Extensor Mechanism






Quadriceps tendon
Femoral groove
Medial patellofemoral ligament
Tibia

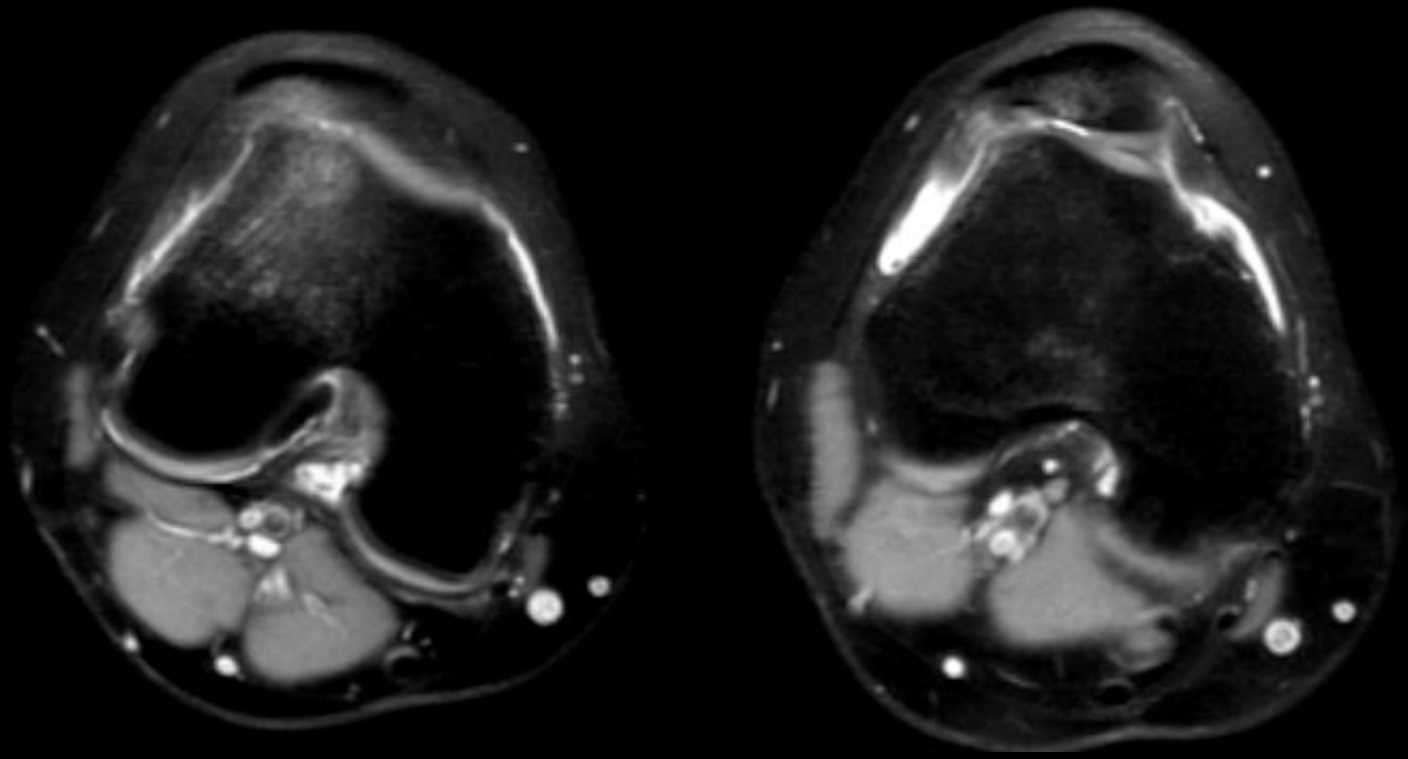

A
B
C
TT
TG


Lateral
Medial

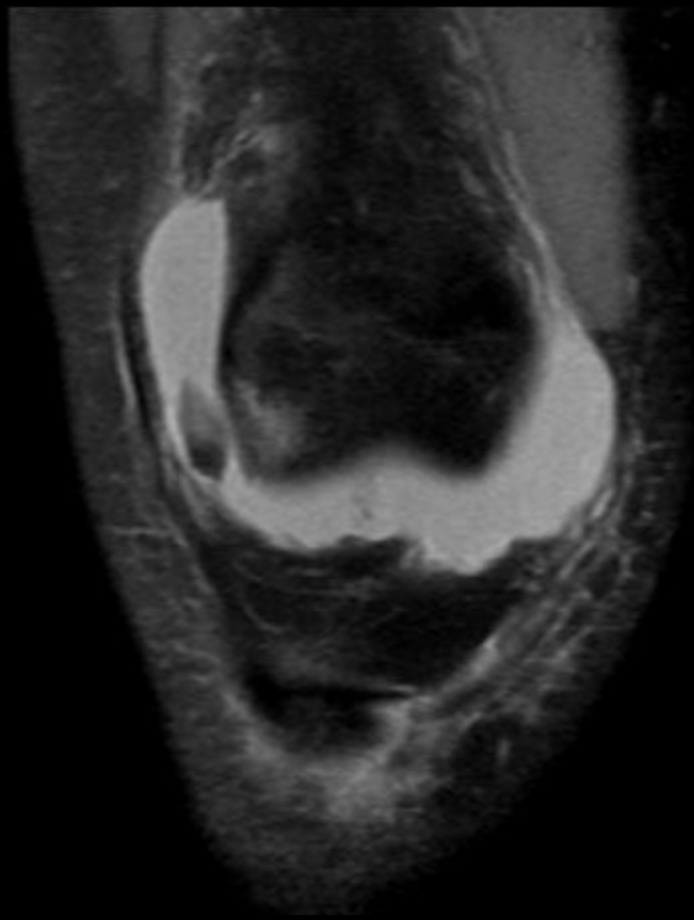
Insall-Salvati

A/B =.8-1.2

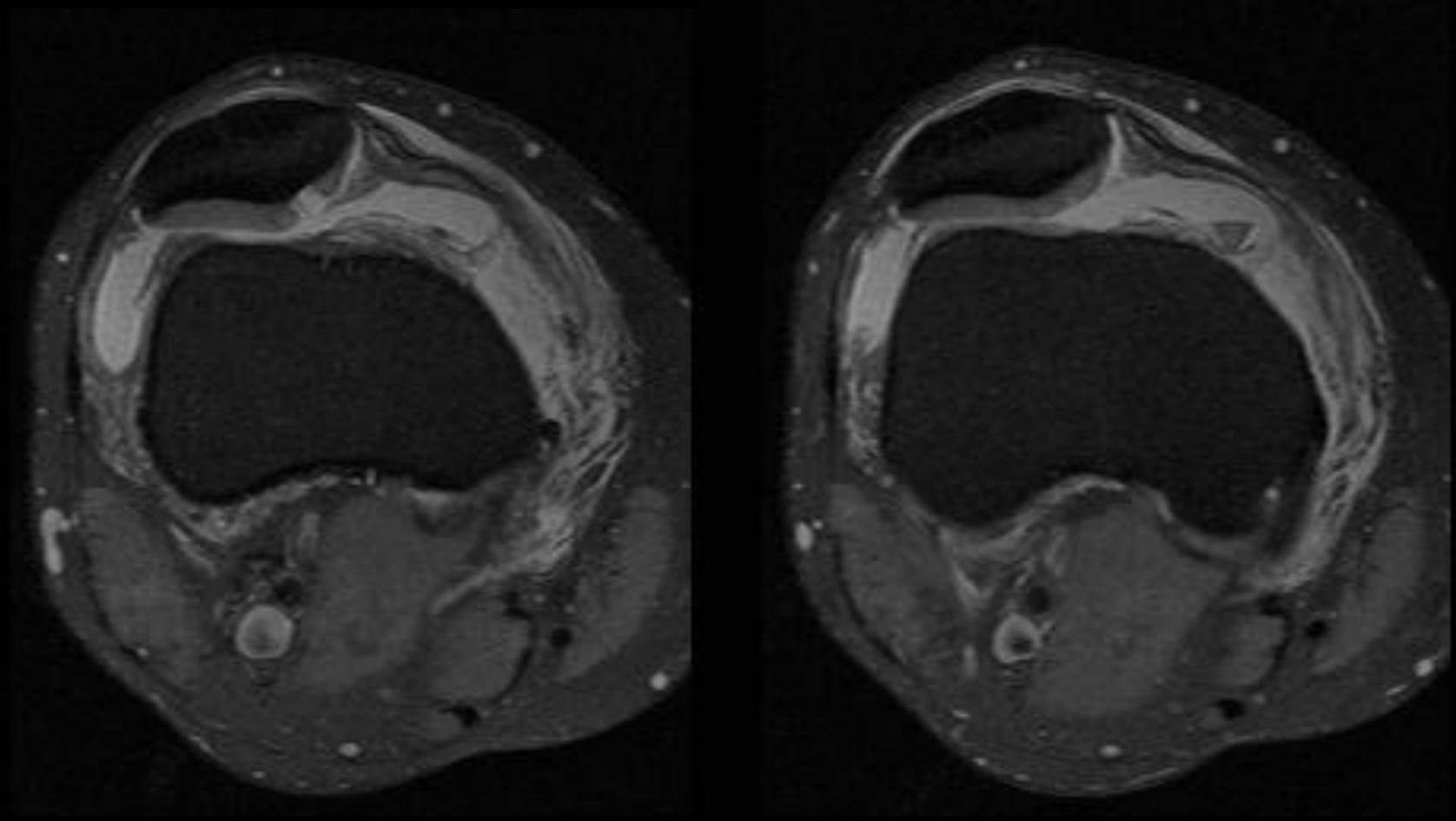
19 yo w chronic PF pain



16 yo female acute trauma



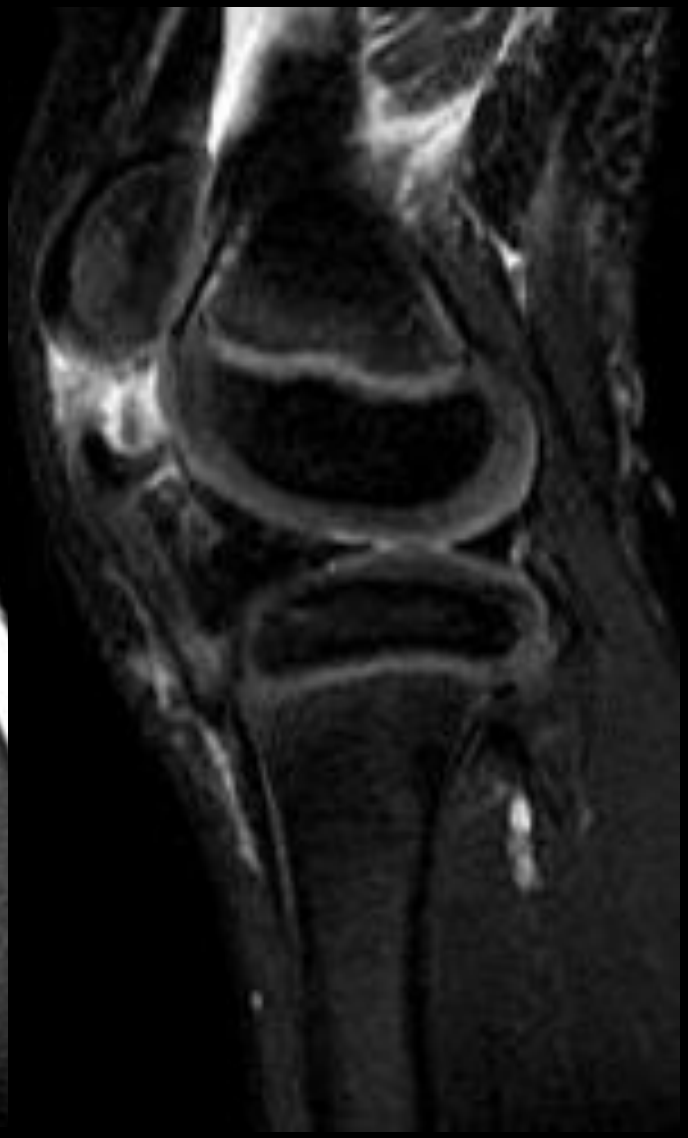
Rutgers Football player w MPFL tear




Quadriceps tendon
Femoral groove
Medial patellofemoral ligament
Tibia

14 yo male OSD w/ acute fall

Next Case Acute Trauma



Patella Sleeve Fracture

- Avulsion of Sleeve of Cartilage from main Patellar body
- Forced flexion against resistance
- Tx: Surgical

Knee MRI

MRI is the non invasive modality of choice for depicting the internal structures of the knee

Including:

- Menisci
- Cartilage
- Ligments
- Tendon
- Marrow


Thank
You!