



# Magnetic Resonance Imaging of the Knee

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## Introduction

- One of the most frequently requested examinations in radiology
- Inherent accuracy in depicting internal derangements
- Very high negative predictive value
- Orthopaedic surgeons use it as a road map

## Indications:

- Internal derangement – from acute trauma or degenerative joint disease
- Suspected infection
- Tumour imaging

## Technique :

- Dedicated knee coil
- Small FOV – 14 to 16 cm
- Slice thickness 3-5 mm, 4mm is standard
- Matrix of 256 x 192
- Externally rotated about 5° to 10° so that ACL is orthogonal to Sag plane.



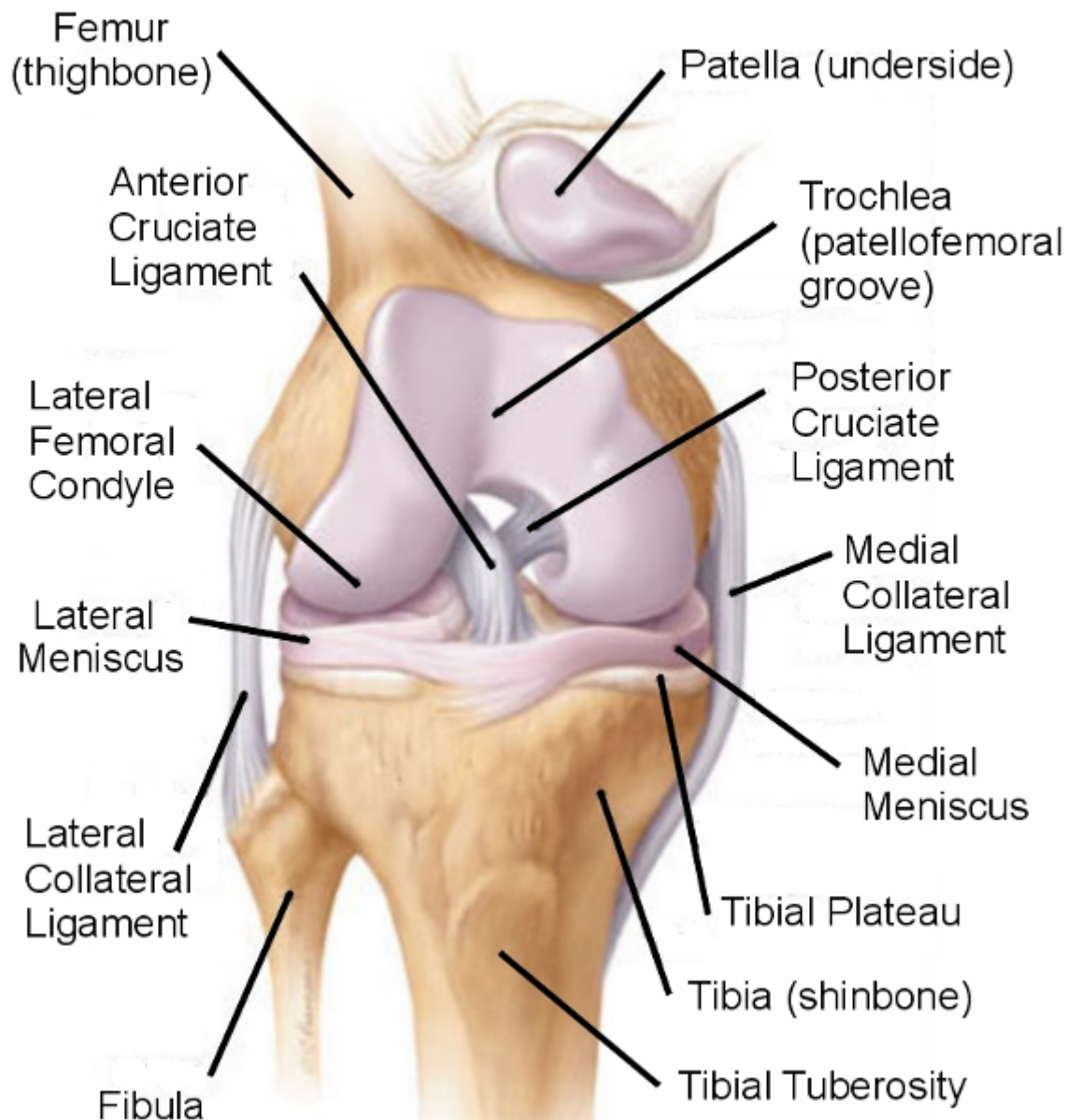
# Knee Protocol

Cor T1  
Cor PD fs

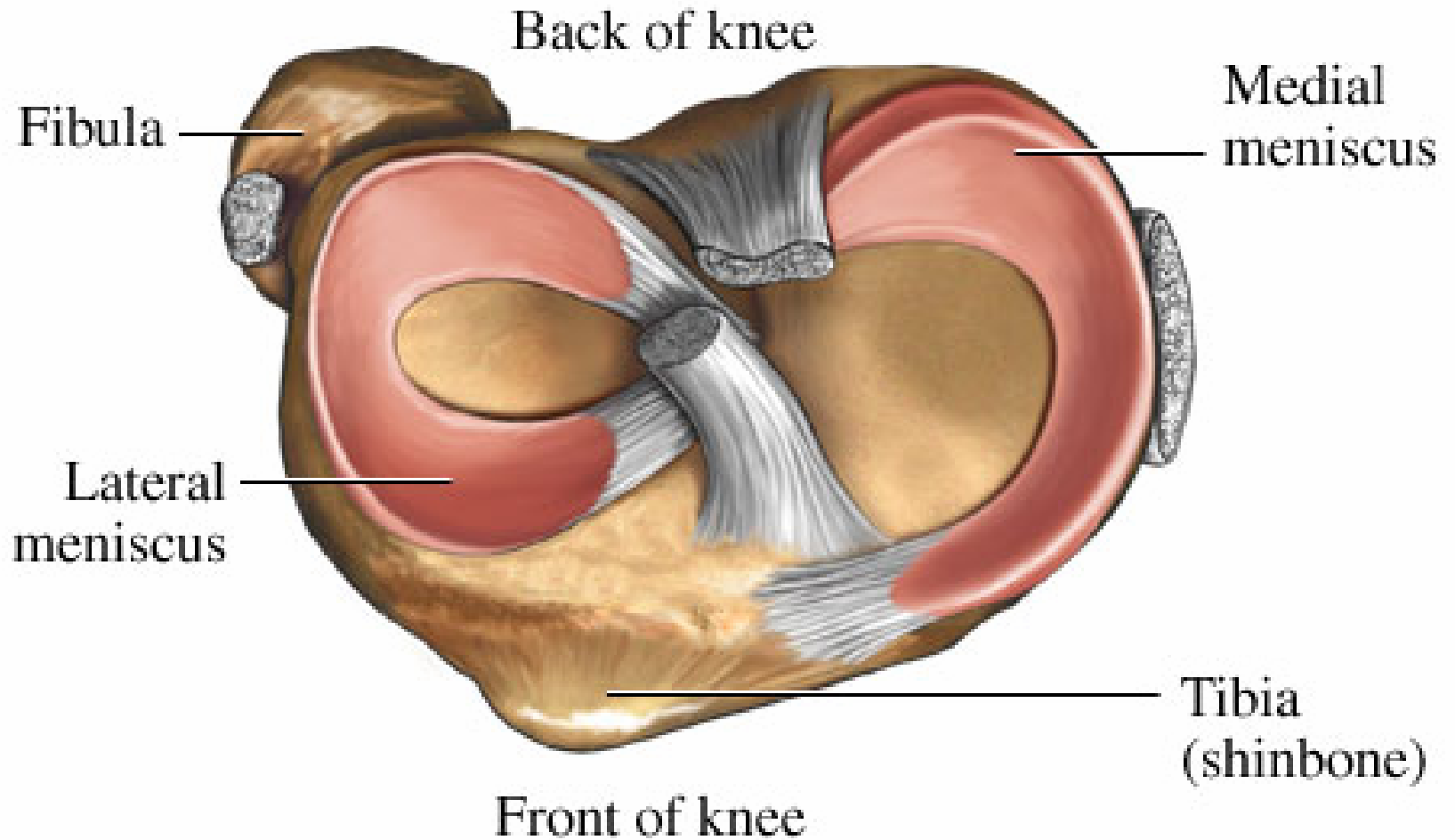
Sag T1  
Sag PD fs

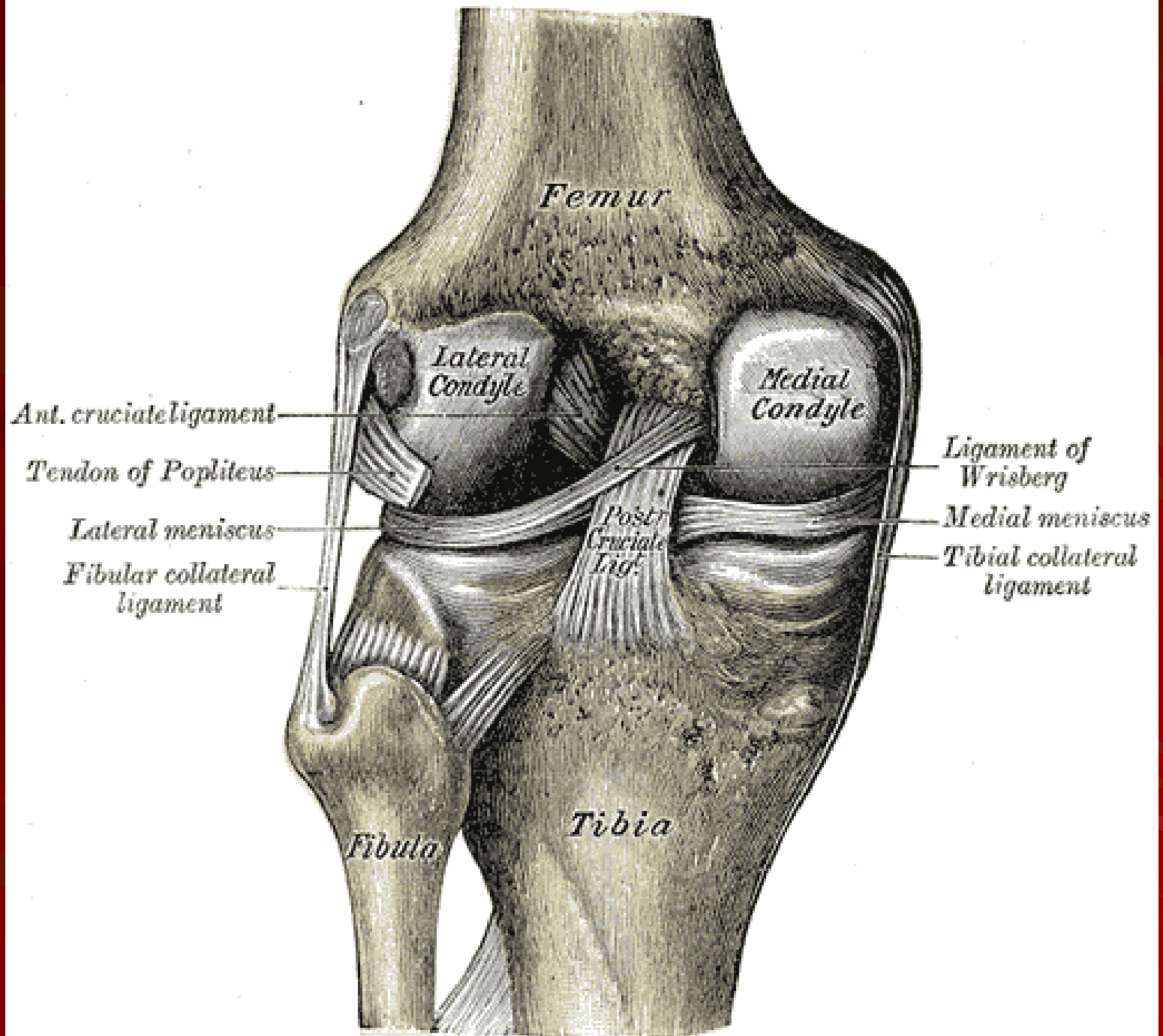
Ax T2 fs  
Ax or Sag 3D SPGR

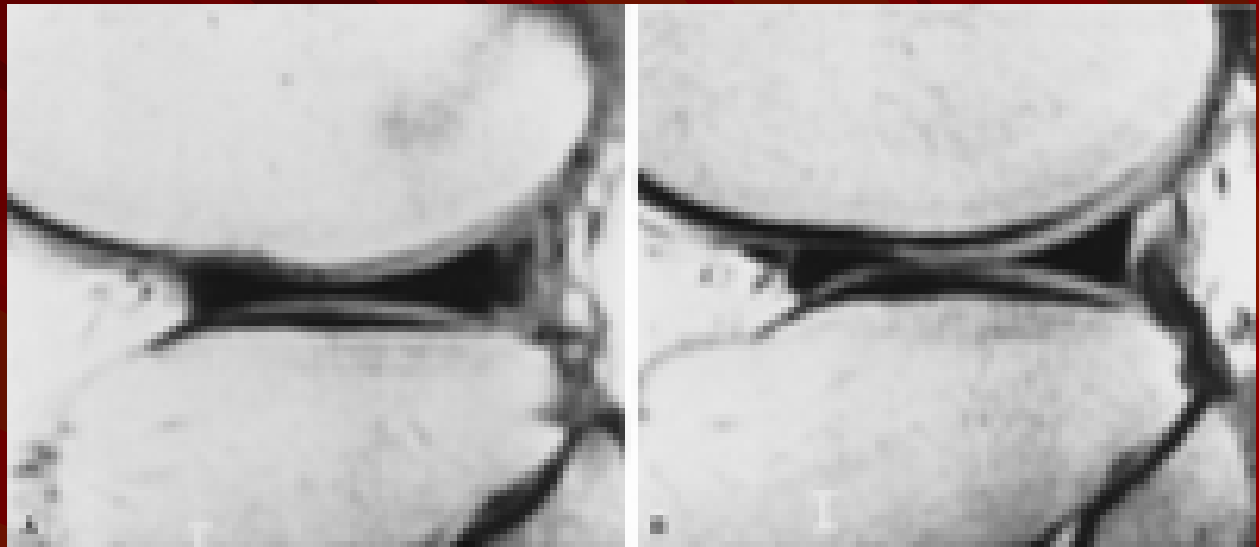
## Frontal View of Right Knee (with patella reflected)



## Superior (top) view of right knee

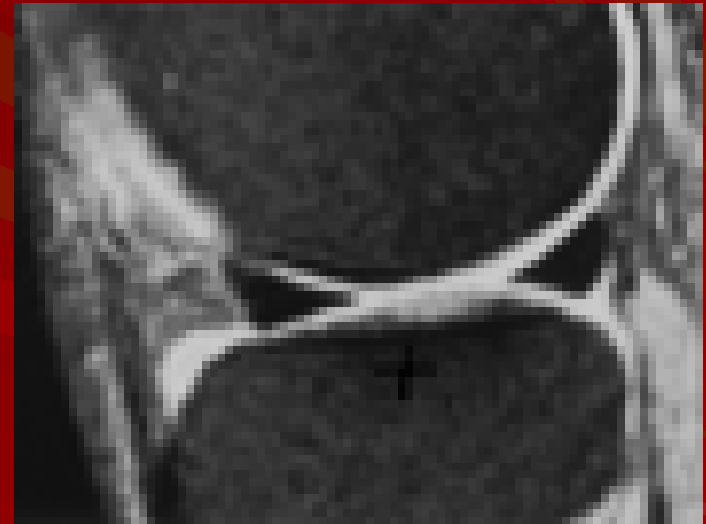


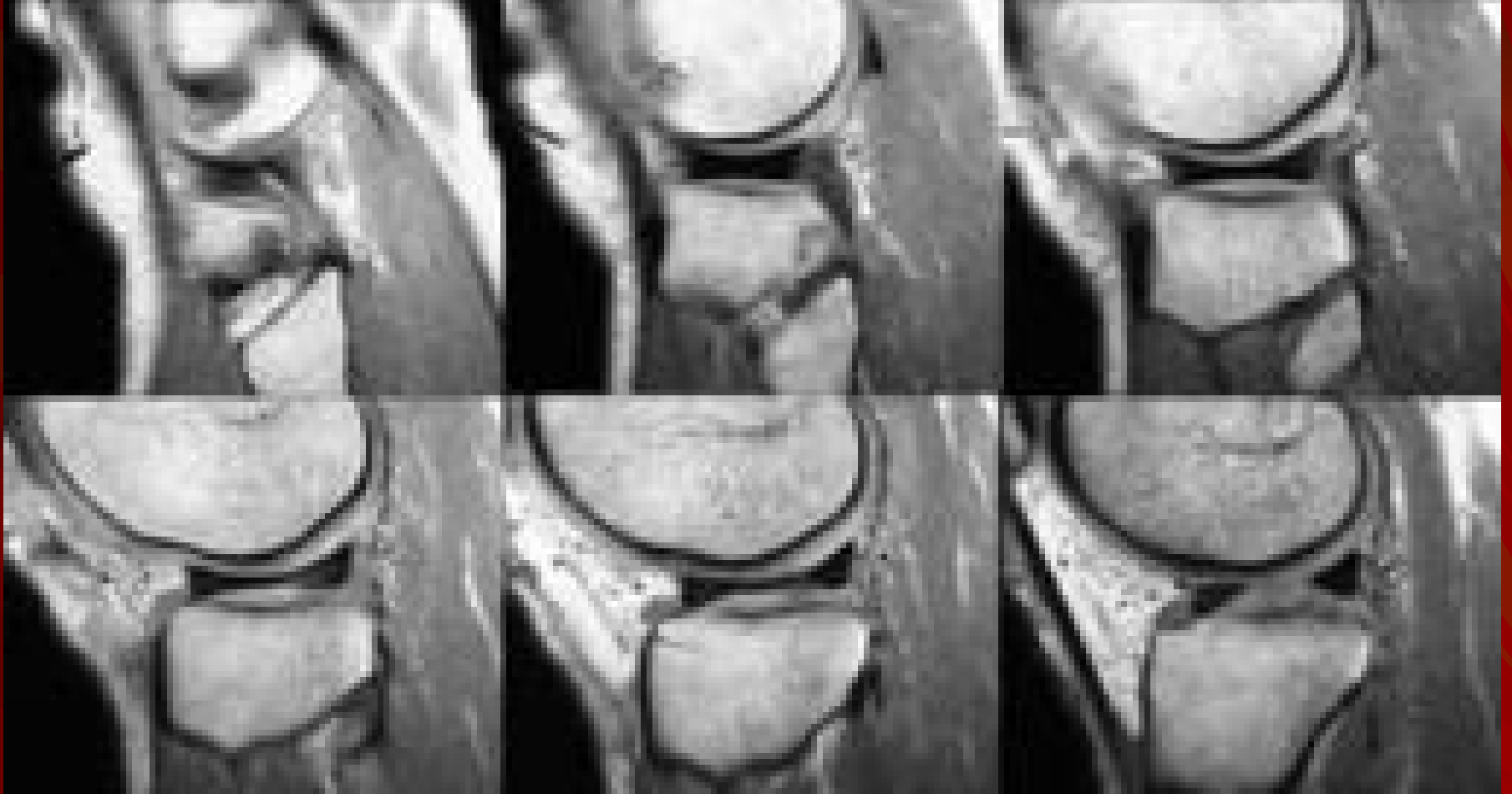




## Normal meniscus

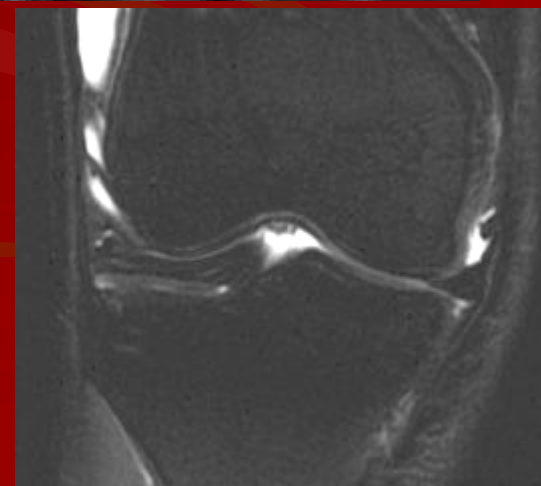
- Bowtie sign
- Sag 3mm images
- 3 slices = normal
- 1-2 slices = bucket-handle tear
- 4 slices = discoid meniscus

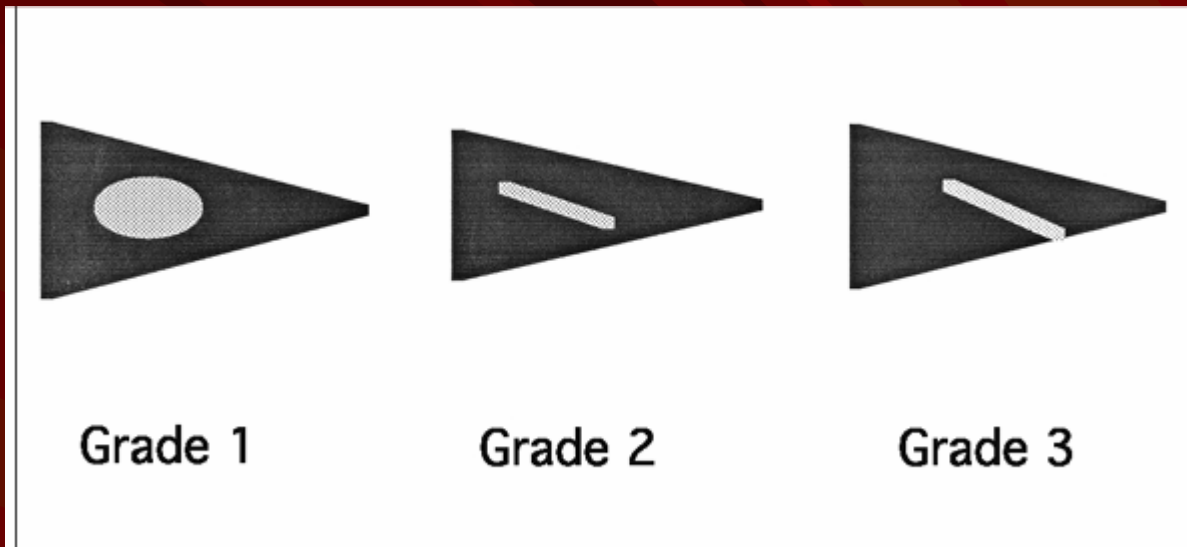




Discoid meniscus

-complete, incomplete, Wrisberg types.





## Meniscal degeneration and Tear

Grade 1 - Intrameniscal globular increased SI

Grade 2 - Intrameniscal linear increased SI

Grade 3 - Increased SI that disrupts an articular surface

Grade 1 and 2 – Intrasubstance  
degeneration

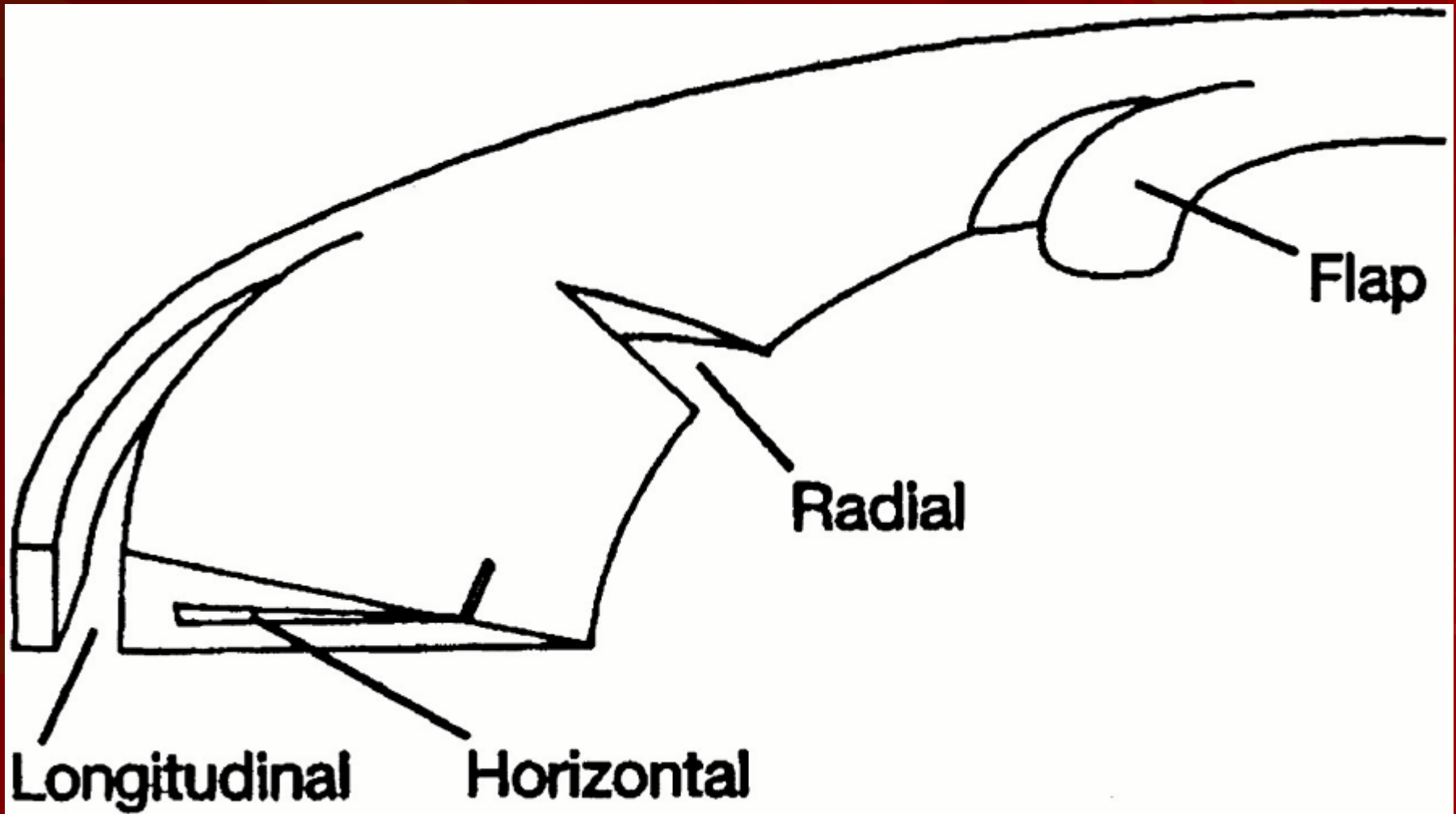
Grade 3 - Tear

# Intrasubstance degeneration - meniscus

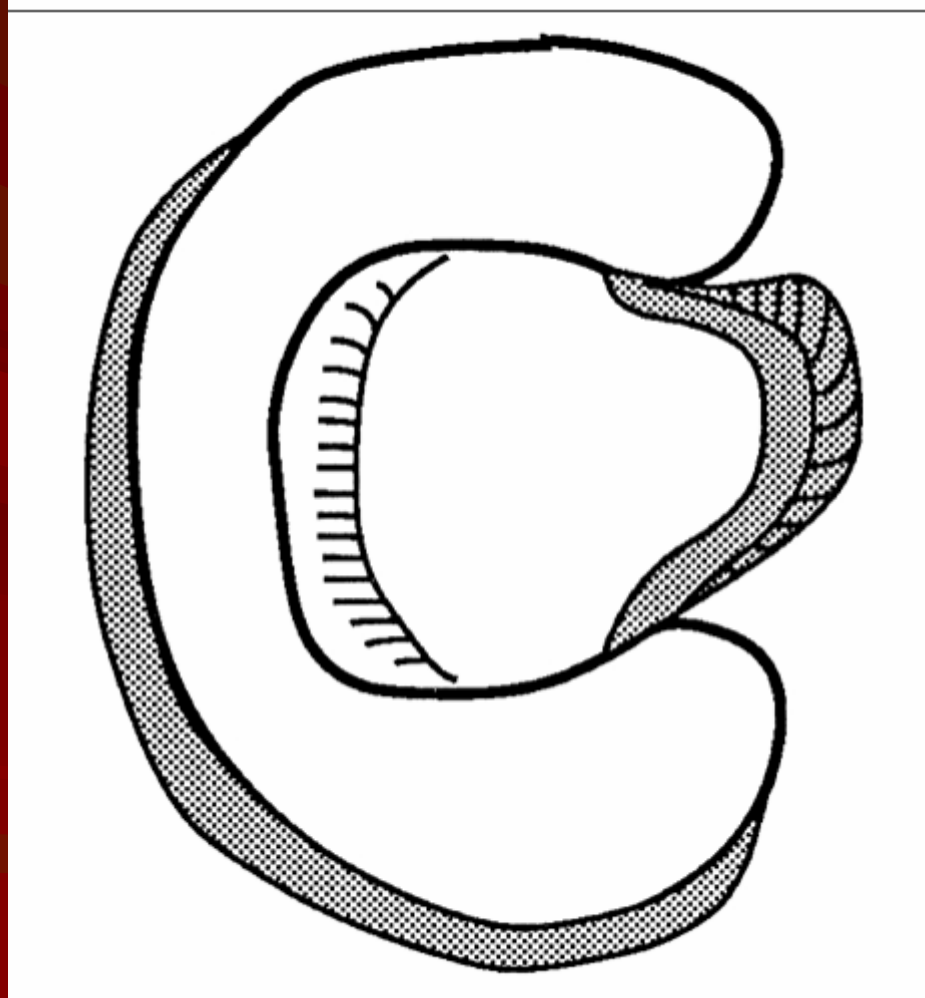




# Meniscal tears Classification



## Bucket – Handle tear



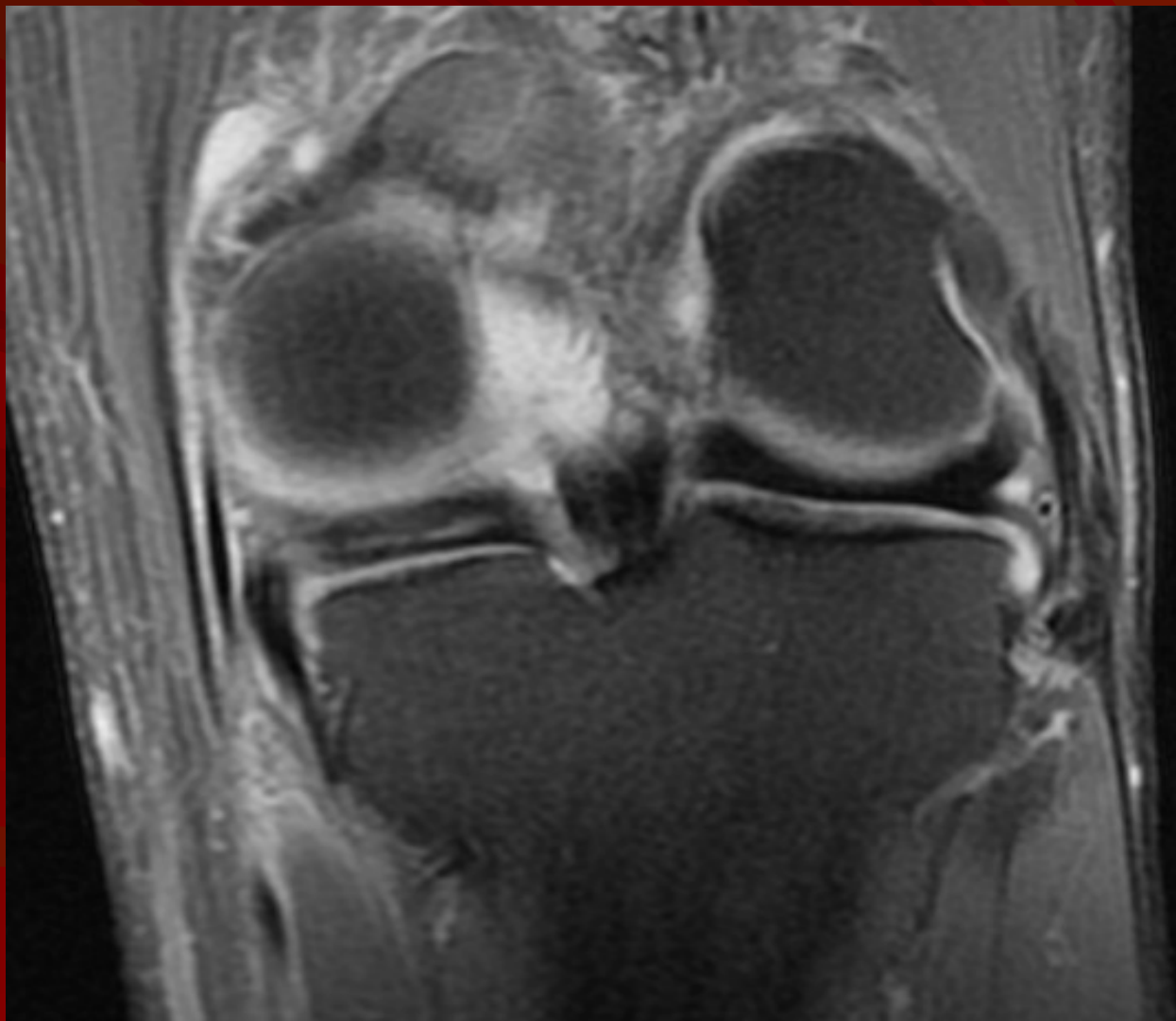
Vertical peripheral tear posterior horn of medial meniscus



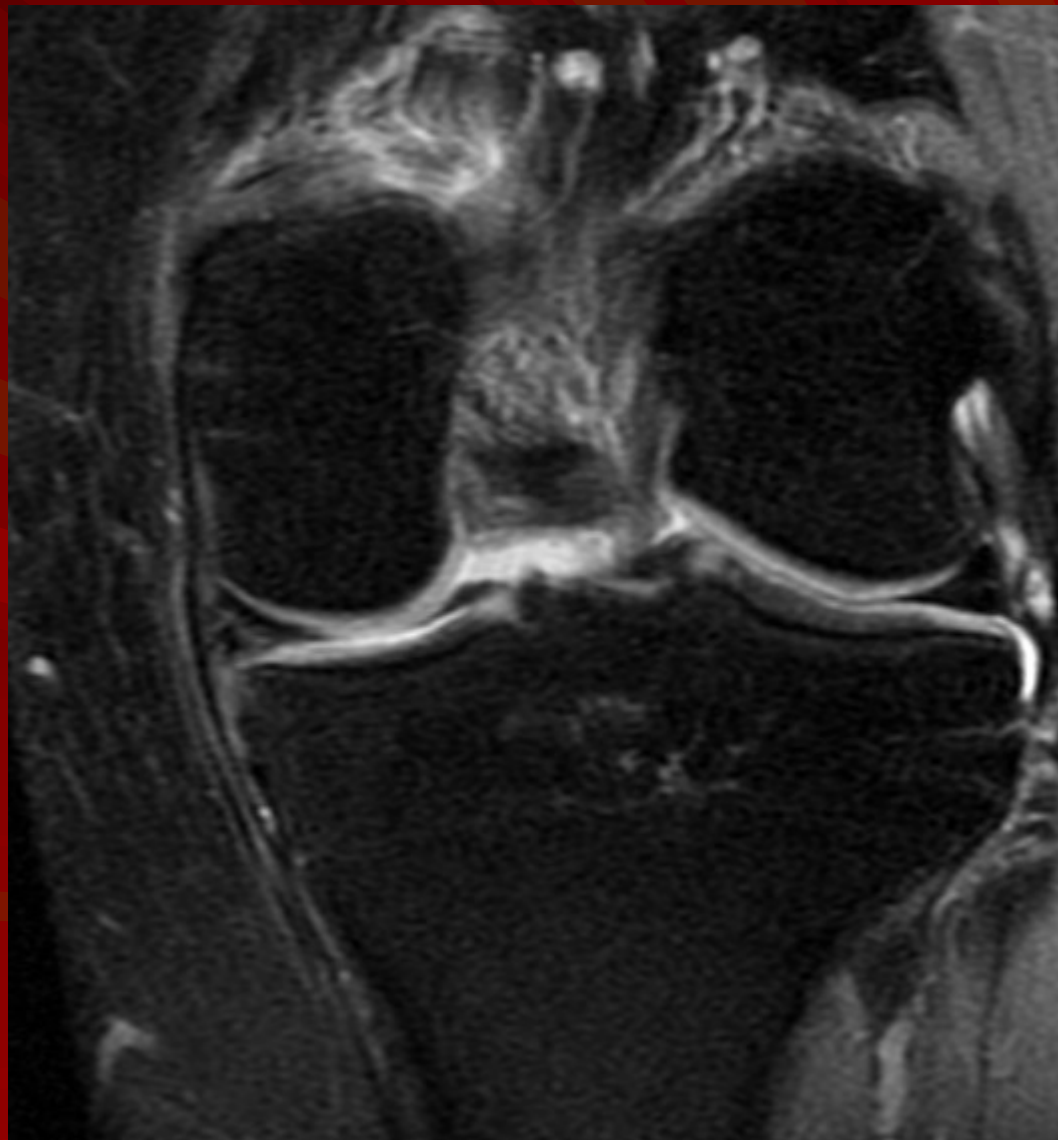
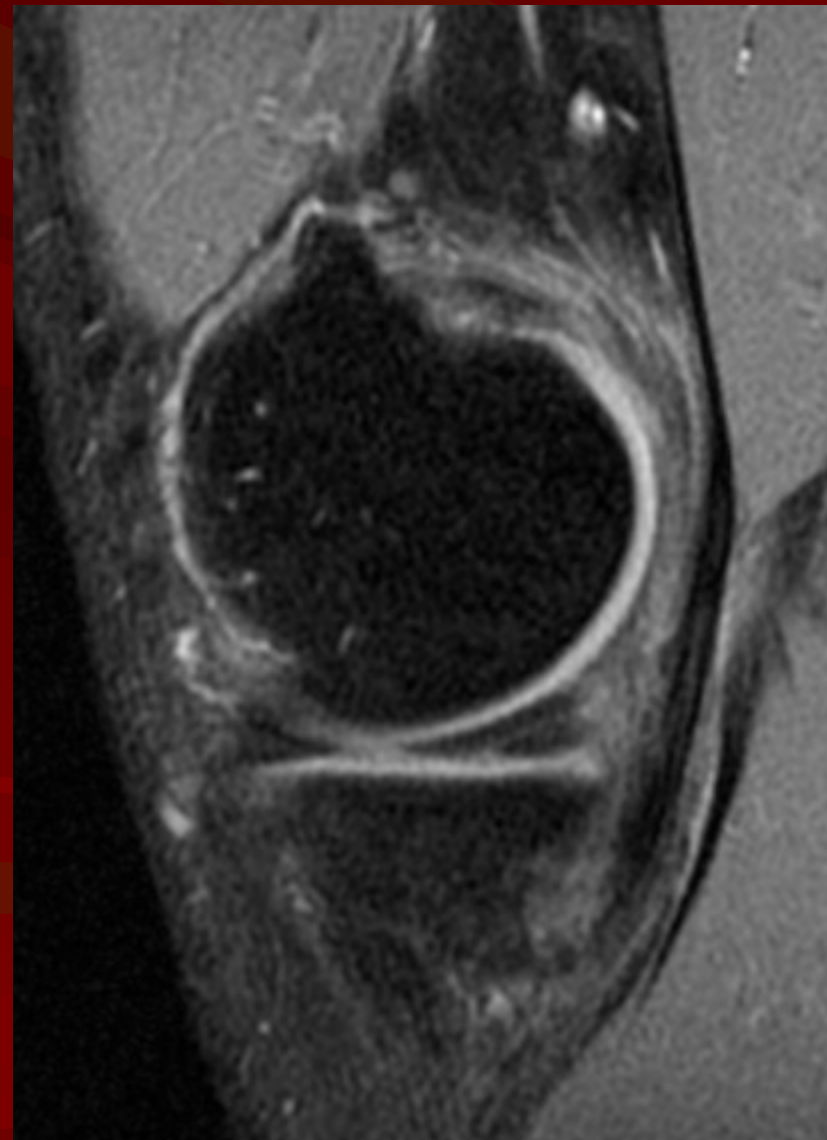
## Vertical tear - PHMM



## Horizontal tear MM

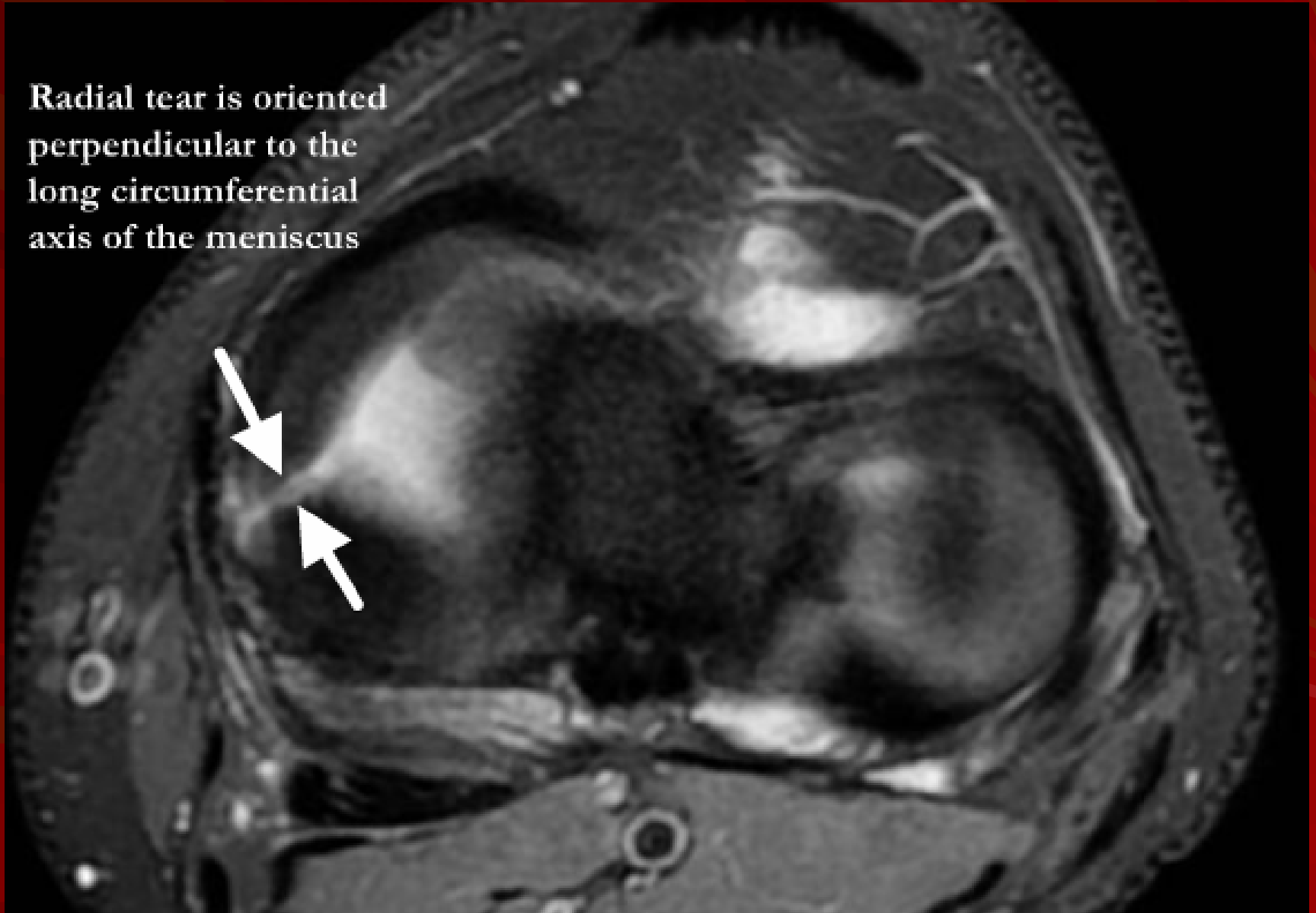


# Oblique tear – MM body



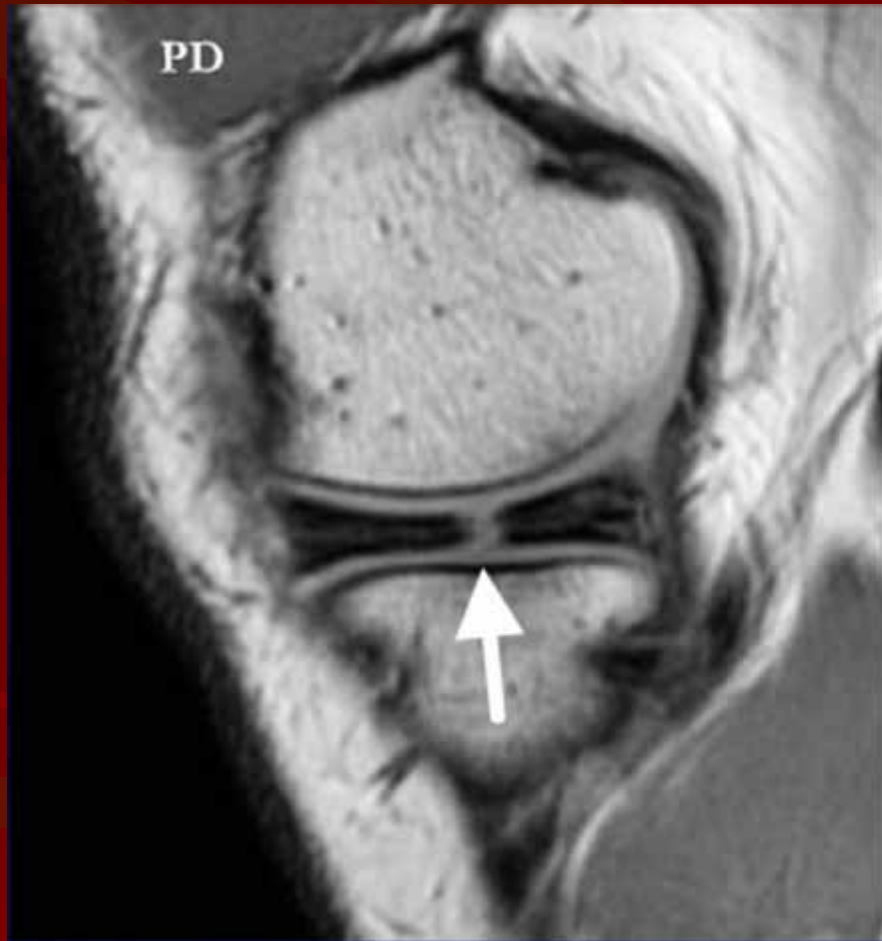
## Radial tear MM

Radial tear is oriented perpendicular to the long circumferential axis of the meniscus





Radial tear – vertical high signal extends through the meniscus





## Radial tear MM - Truncated meniscus sign

T2 fatsat

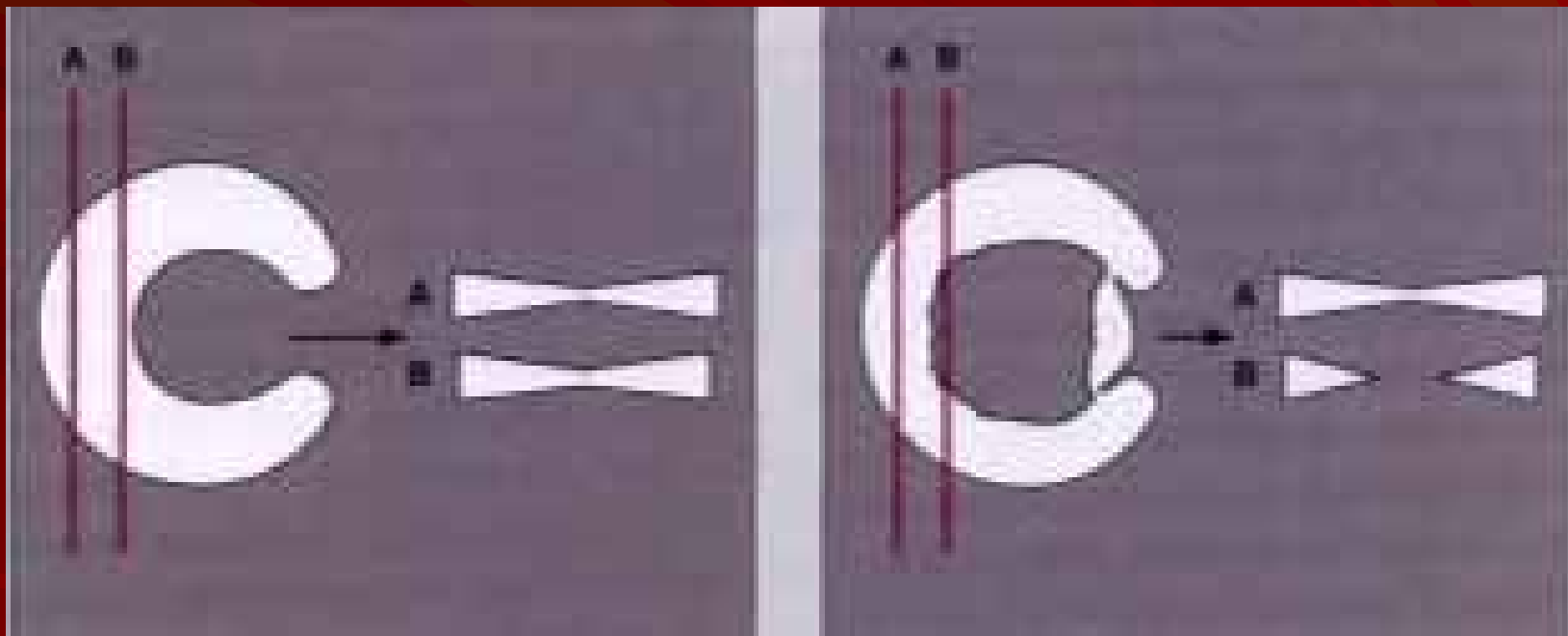
Normal triangular appearance is distorted. Compare with contralateral side, where the meniscus is of normal shape.



## Radial tear MM – Cleft sign

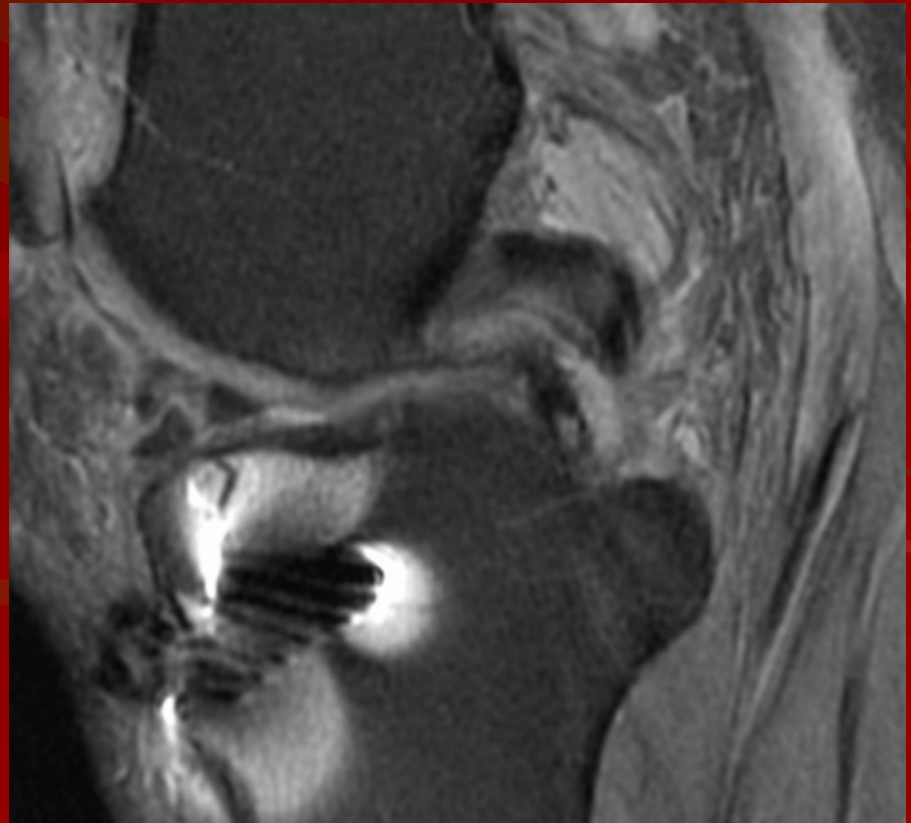


Bucket – handle tear : fewer bowties



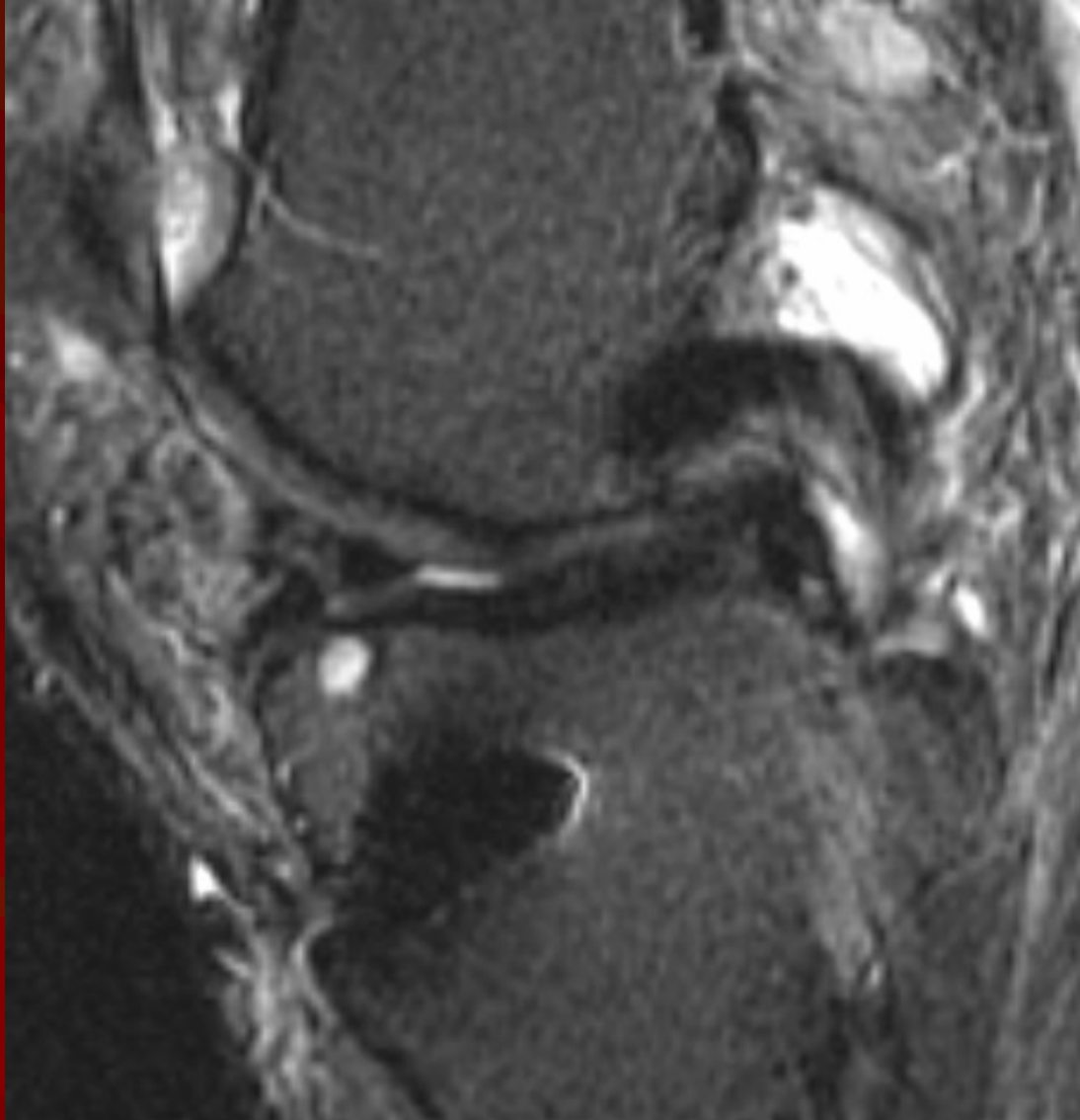
## Bucket – handle tear

Displaced free fragment or handle in intercondylar notch  
Anteriorly flipped meniscus



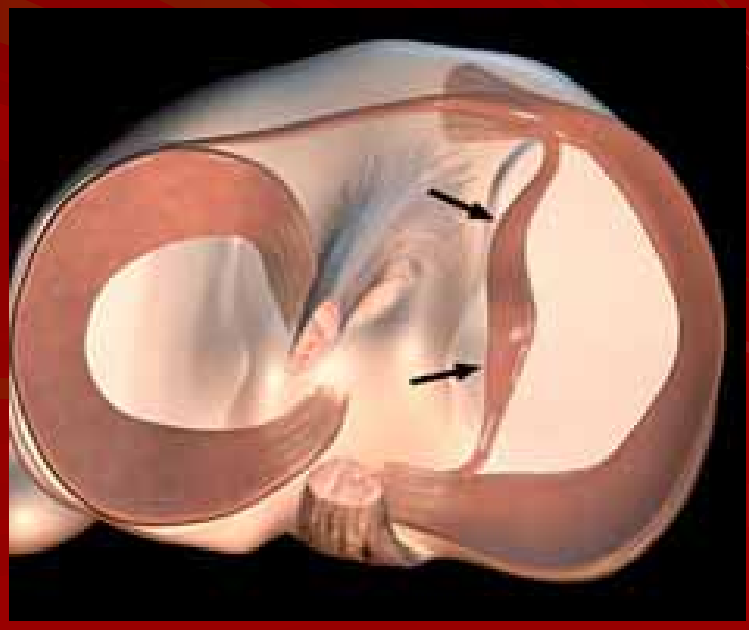
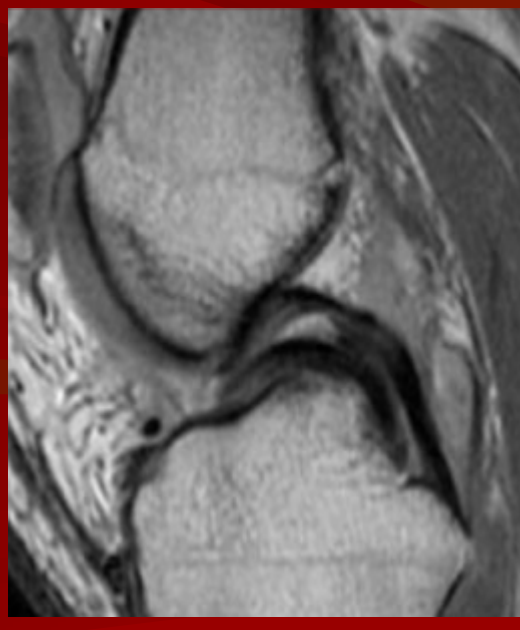
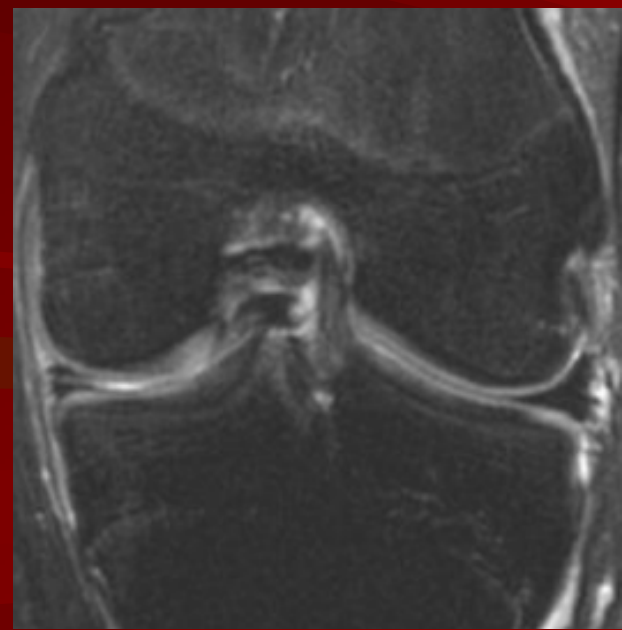
**Bucket – handle tear:**

**Double PCL sign and Anteriorly flipped meniscus**





## Bucket-Handle tear MM

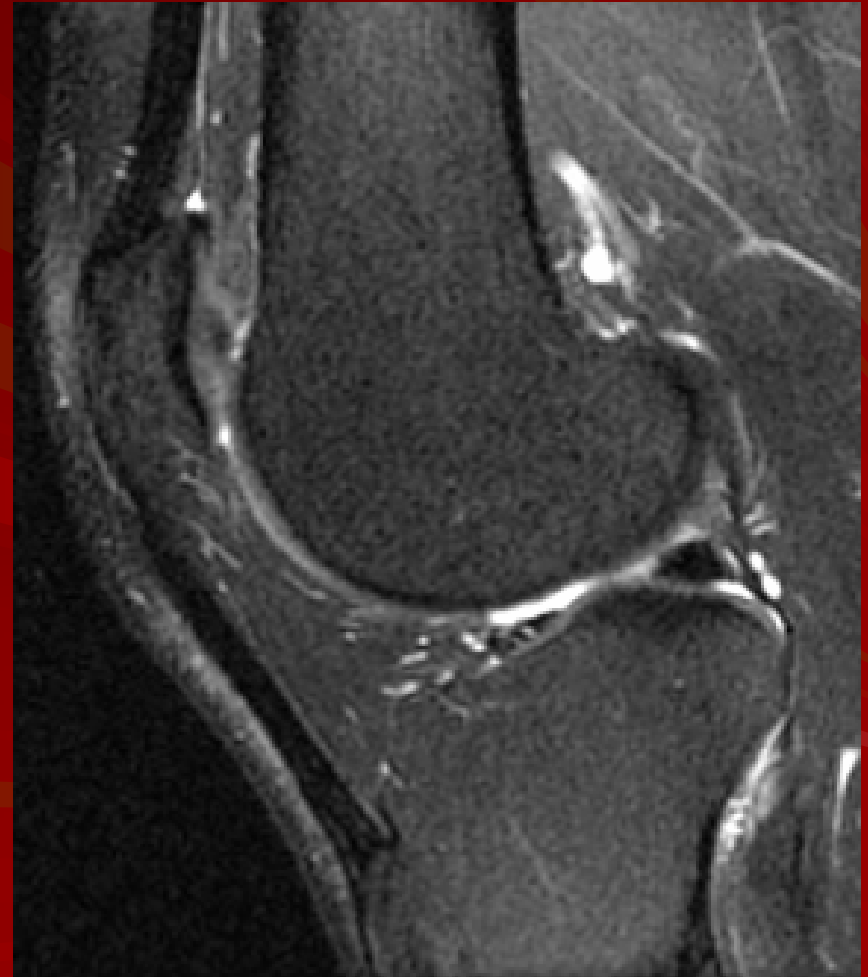


## Bucket-Handle tear

- Absent bow-tie sign
- Truncated triangle sign
- Double PCL sign
- Anteriorly flipped meniscus
- Displaced fragment in intercondylar notch

## Pitfalls

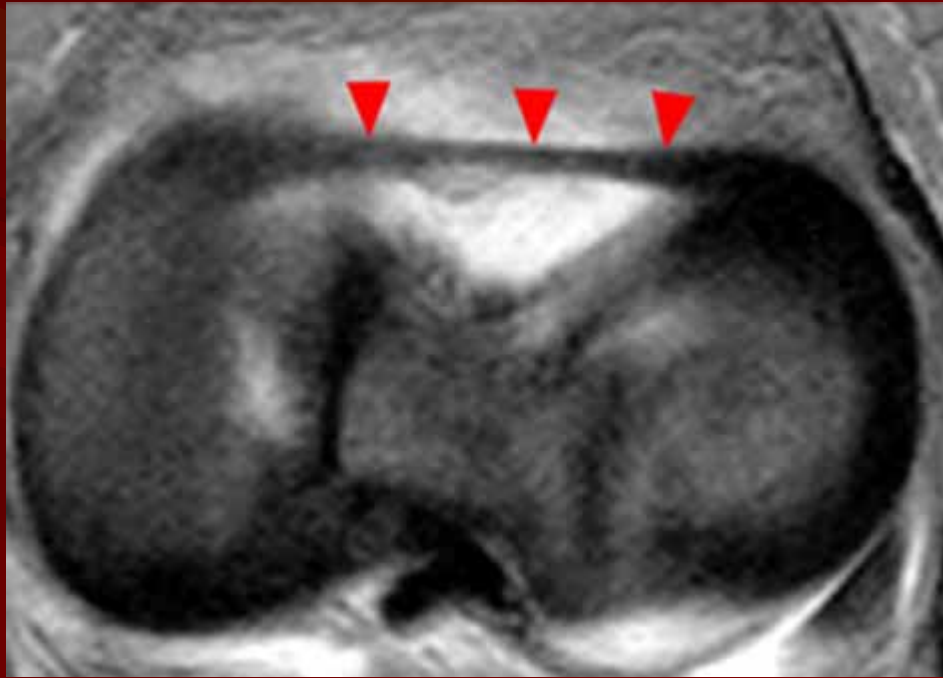
Speckled anterior horn of lateral meniscus –  
normal variant created by insertion of ACL





## Pitfalls

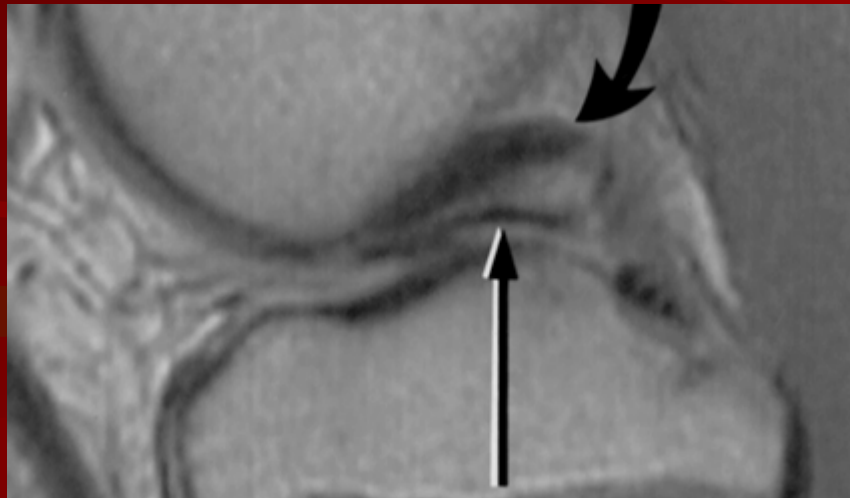
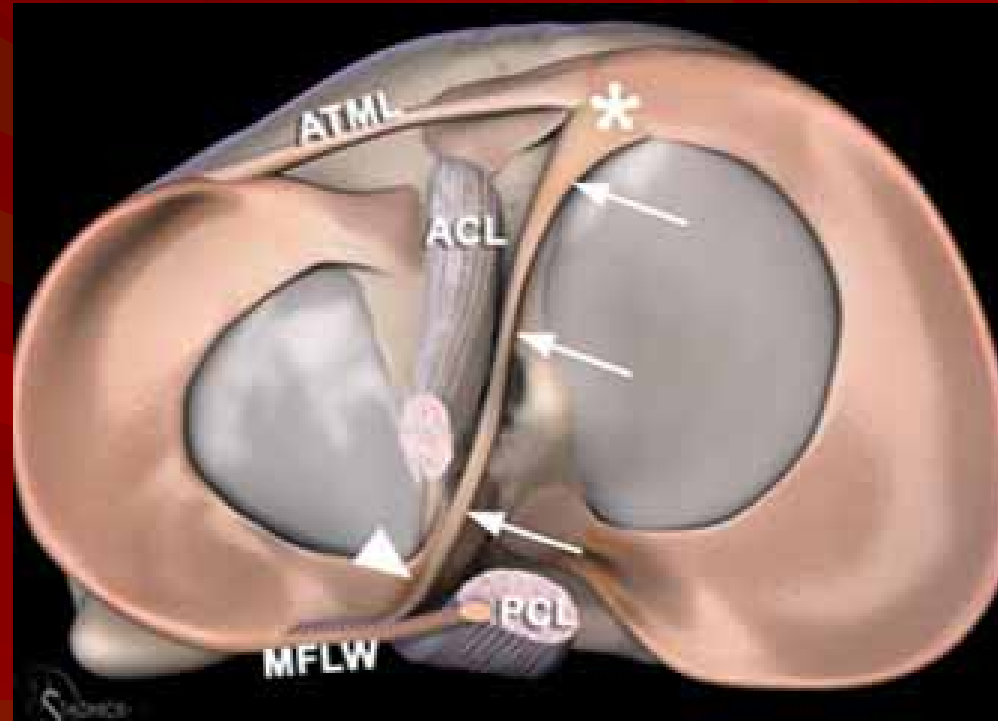
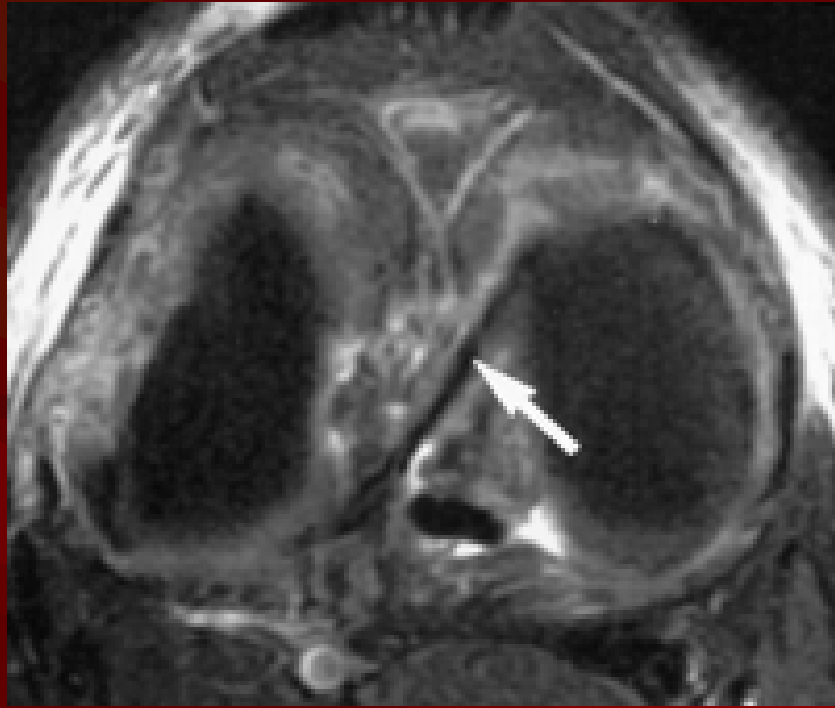
Transverse meniscal ligament –



Pseudotear from Transverse ligament insertion on AHLM

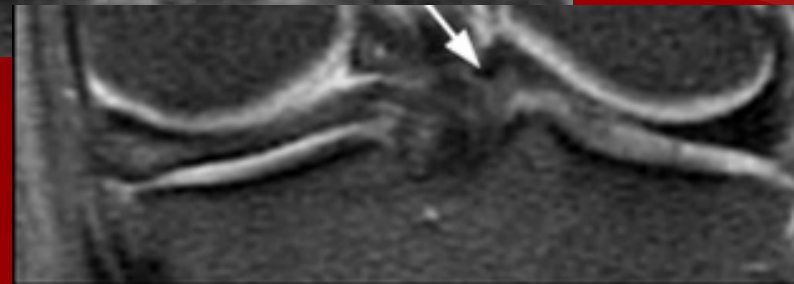
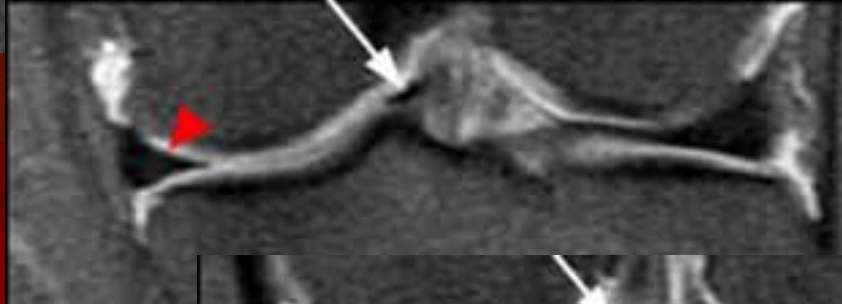


Oblique meniscomeniscal ligament  
seen through intercondylar notch  
at the level of PCL

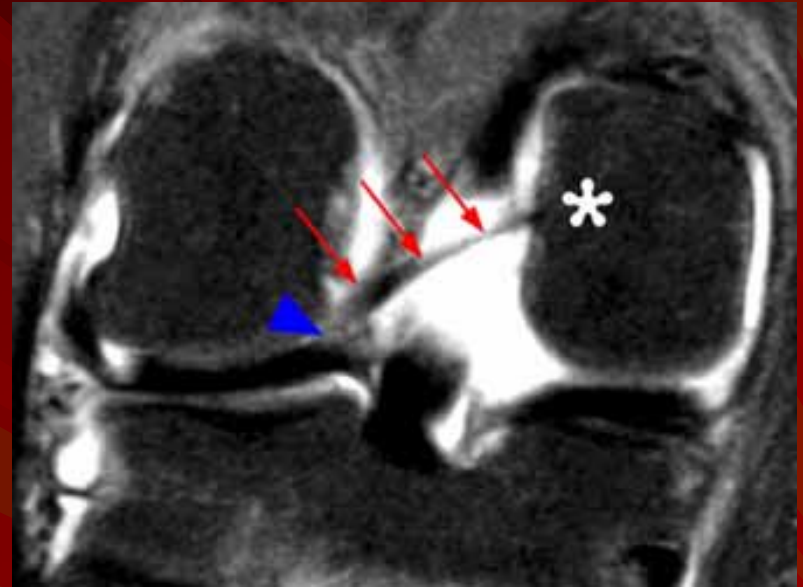


Oblique meniscomeniscal ligament  
seen through intercondylar notch

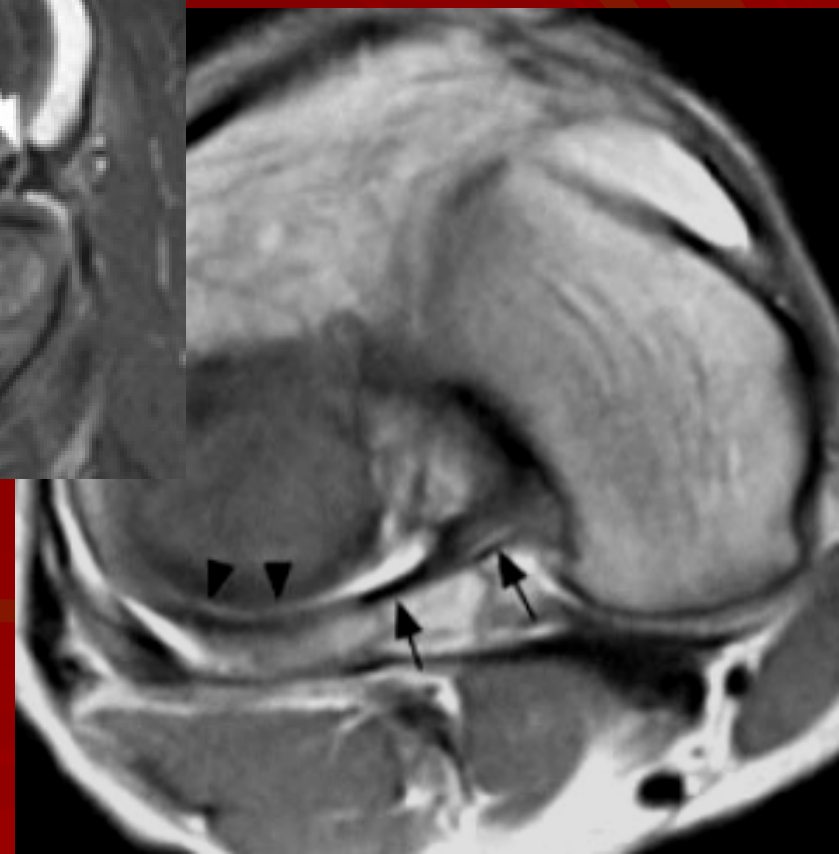
MM



# Ligament of Wrisberg and Humphrey



Wrisberg rip



## Meniscal Flounce

A meniscal flounce is a fold that occurs in the absence of a tear, and presence of it does not increase the prevalence of a tear.

Because tears may result in a flounce like fold, a flounce should be considered a normal variant only in the absence of other indications of a meniscal tear.





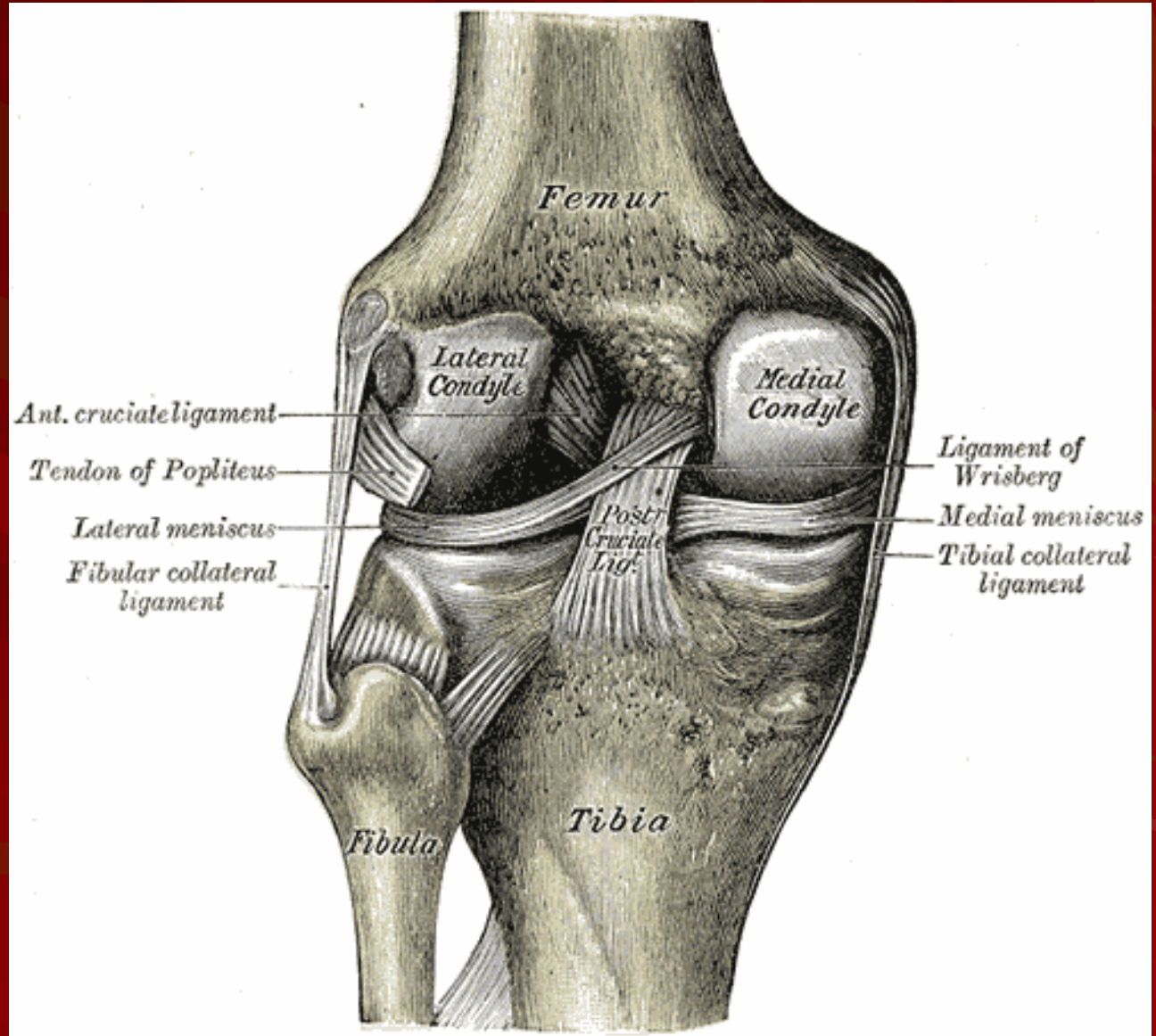
## Knee Ligaments

ACL

PCL

MCL

PLC



“ L A M P “

ACL

From lateral femoral condyle to anteromedial tibia

Isometric ligament

Prevents hyperextension

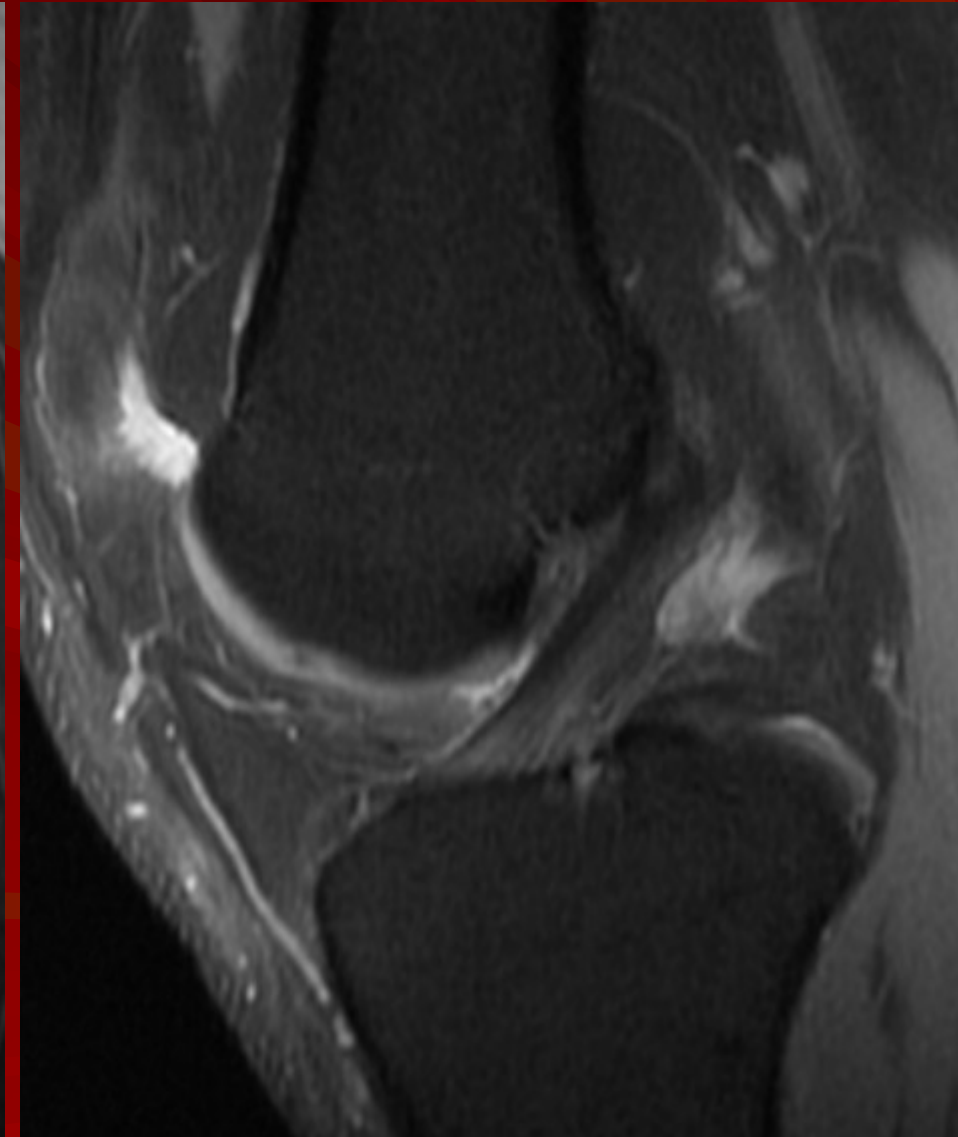
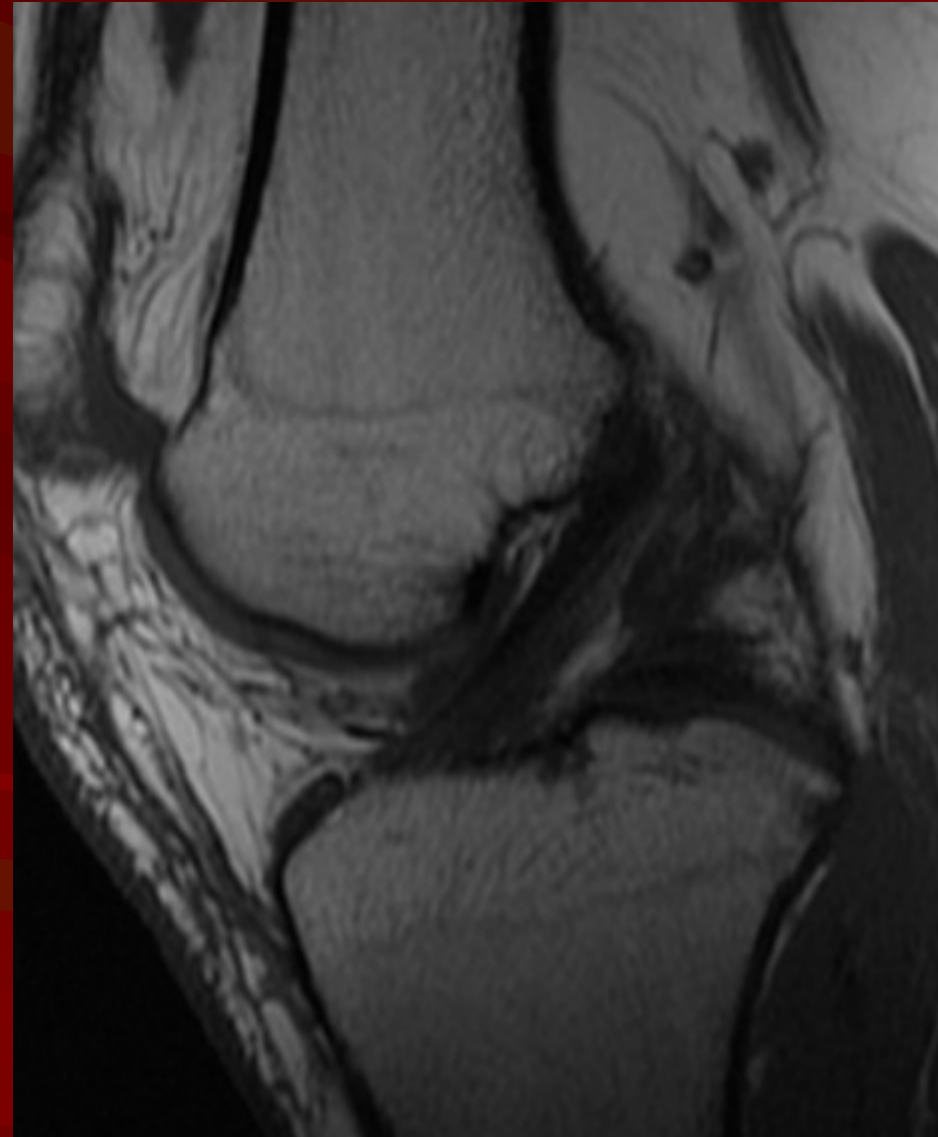
Rotational guide for condyles.



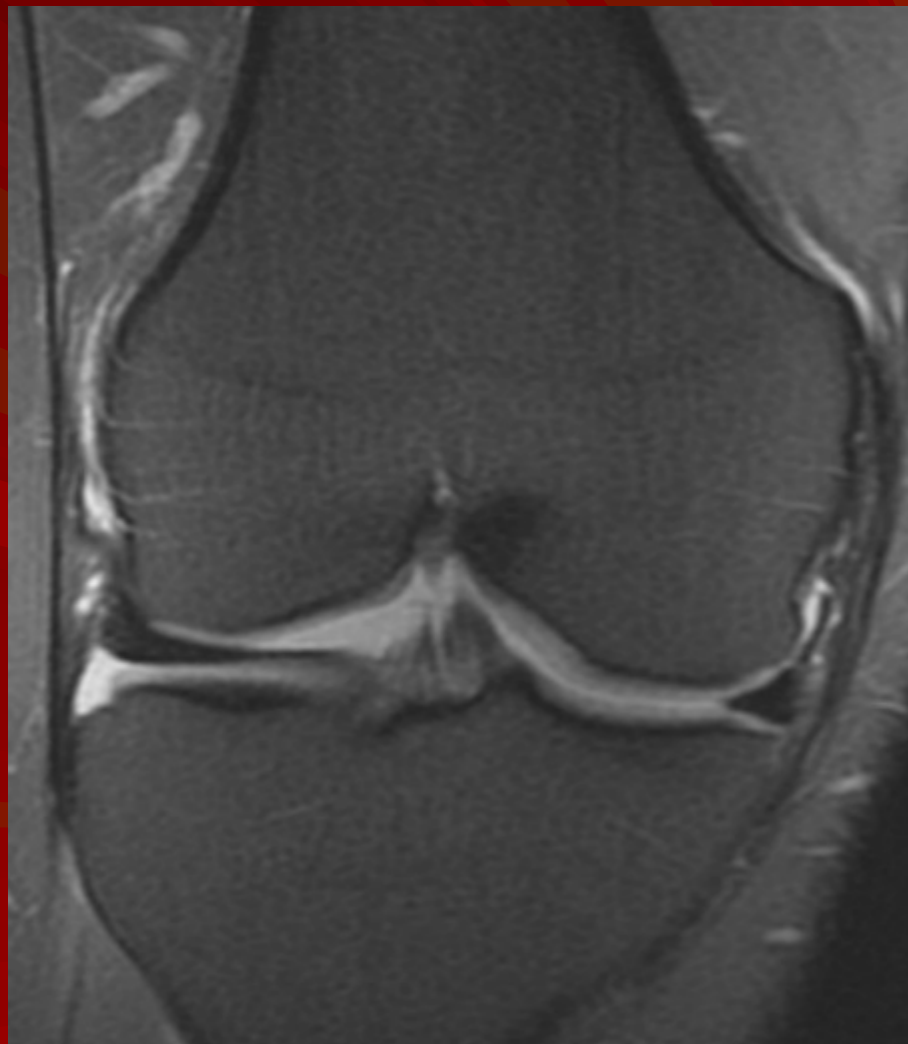
Extension – Posterolateral band is taut

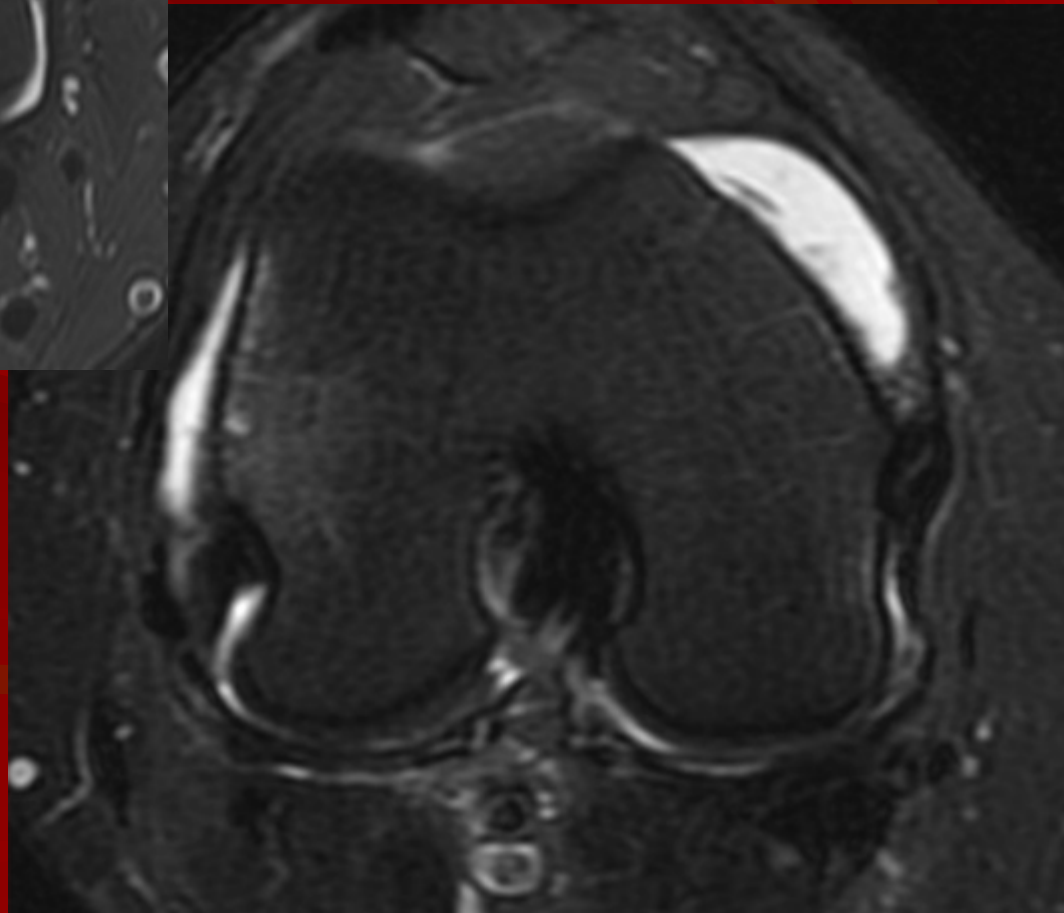
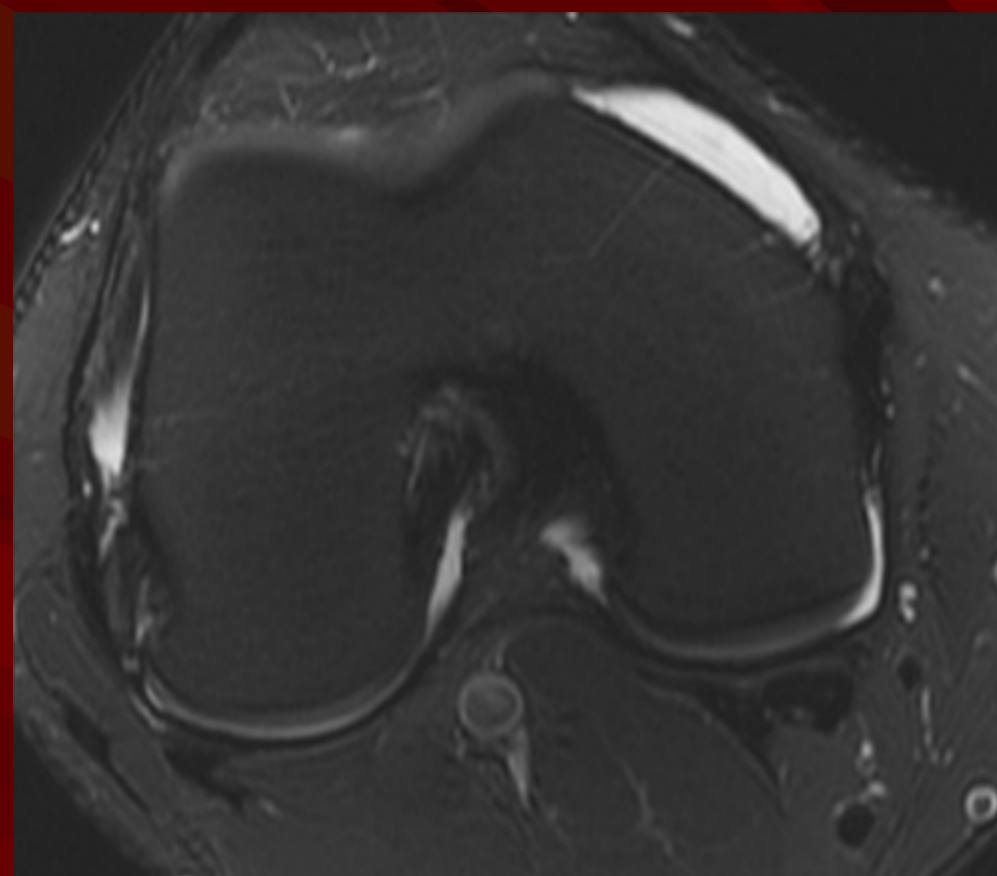
Flexion – anteromedial band is taut

# Normal ACL

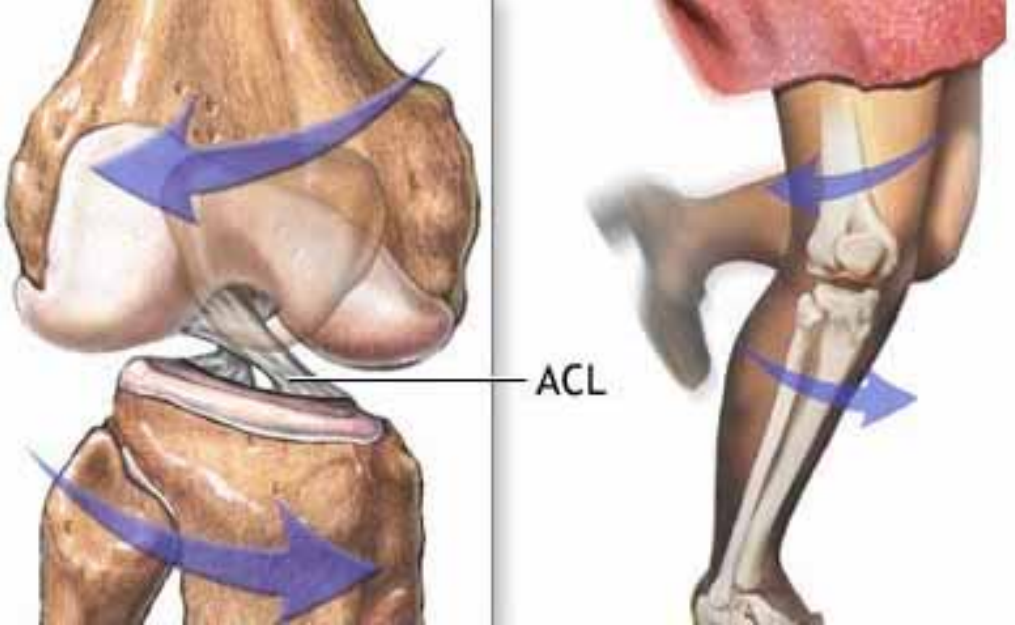


# Normal ACL



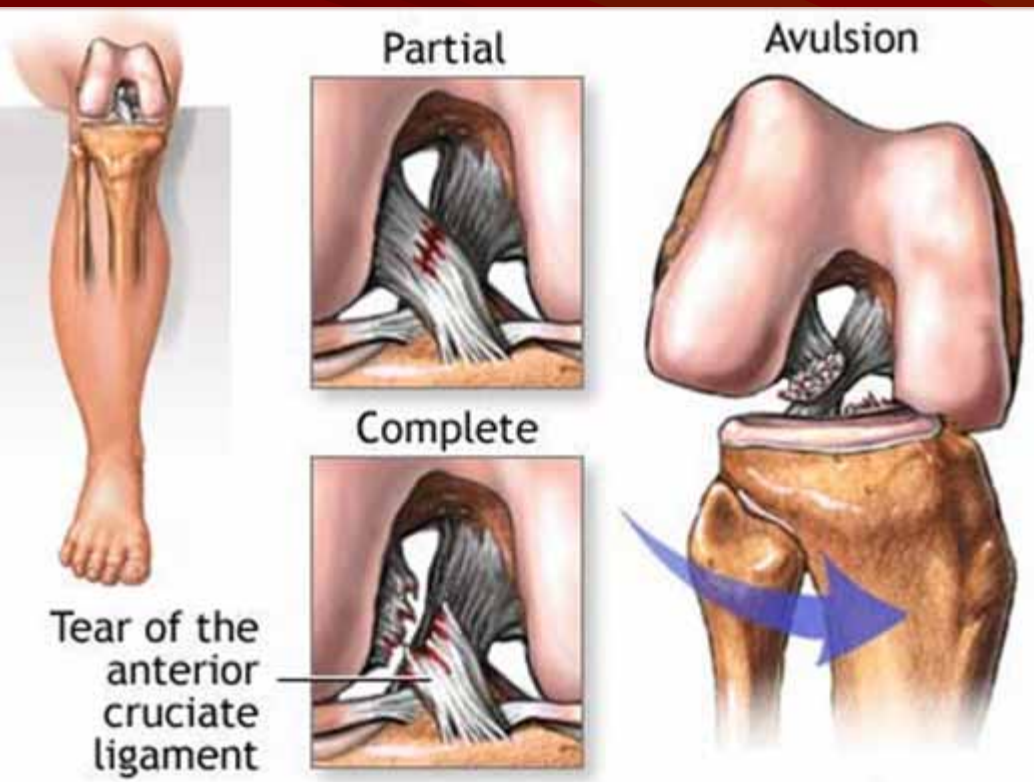


What is missing? →



## Mechanism of injury:

Anterior tibial translation



Types of ACL tear

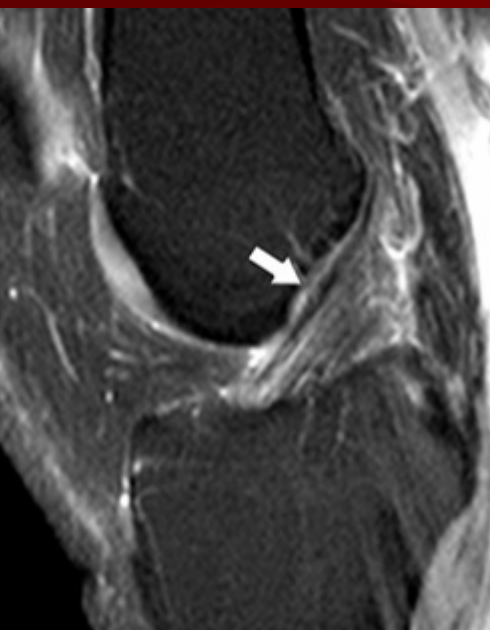
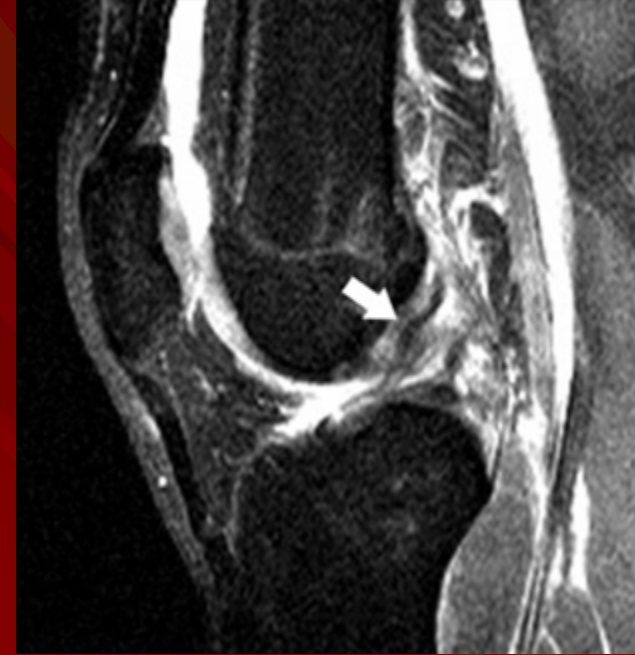




Normal ACL



**ACL Partial tear**

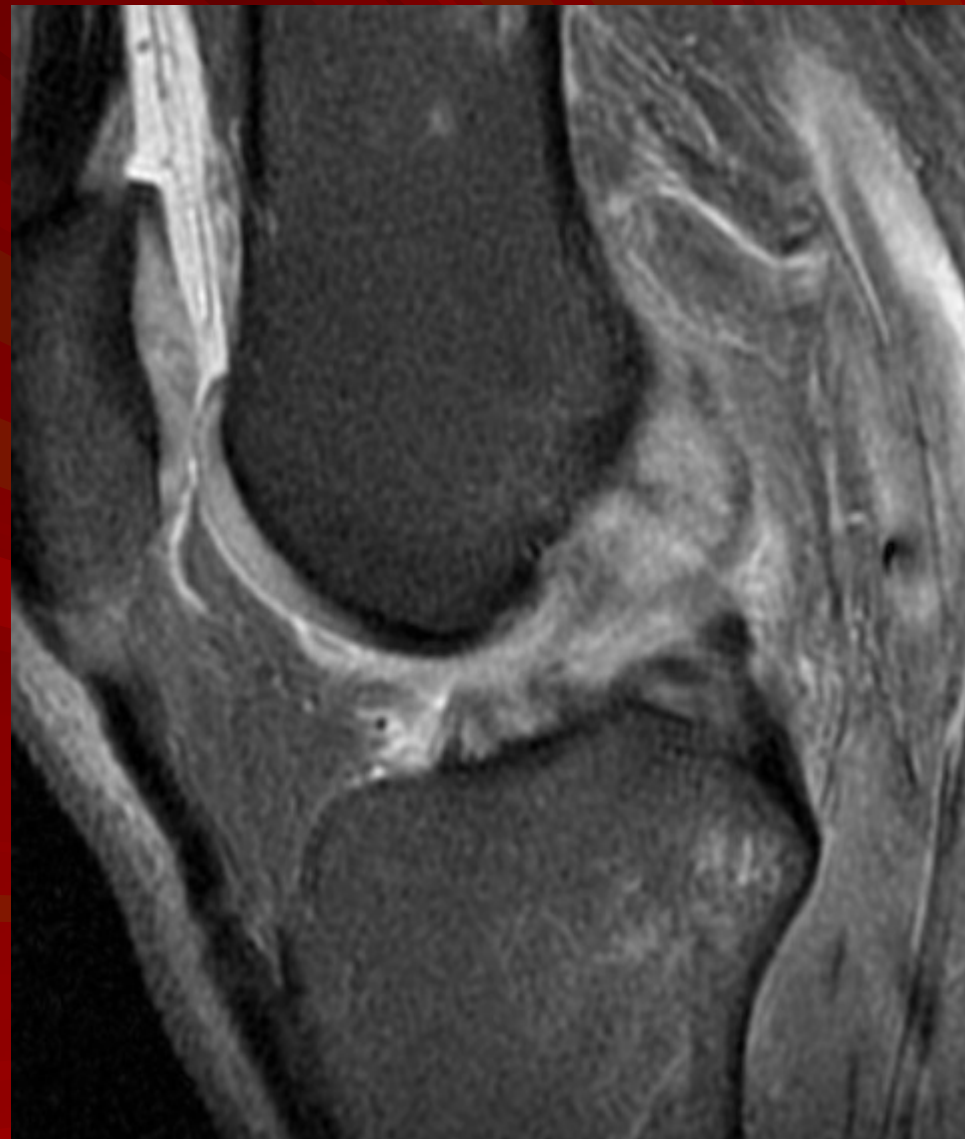
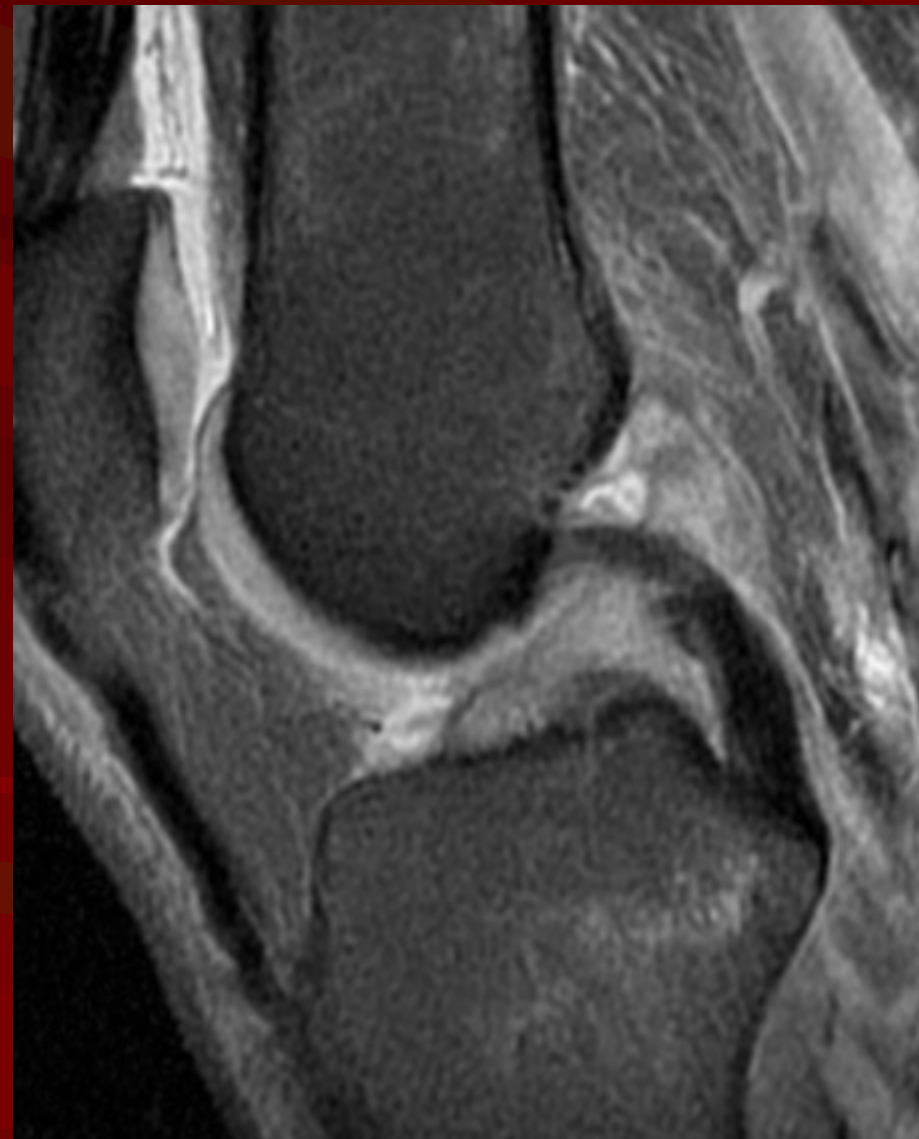


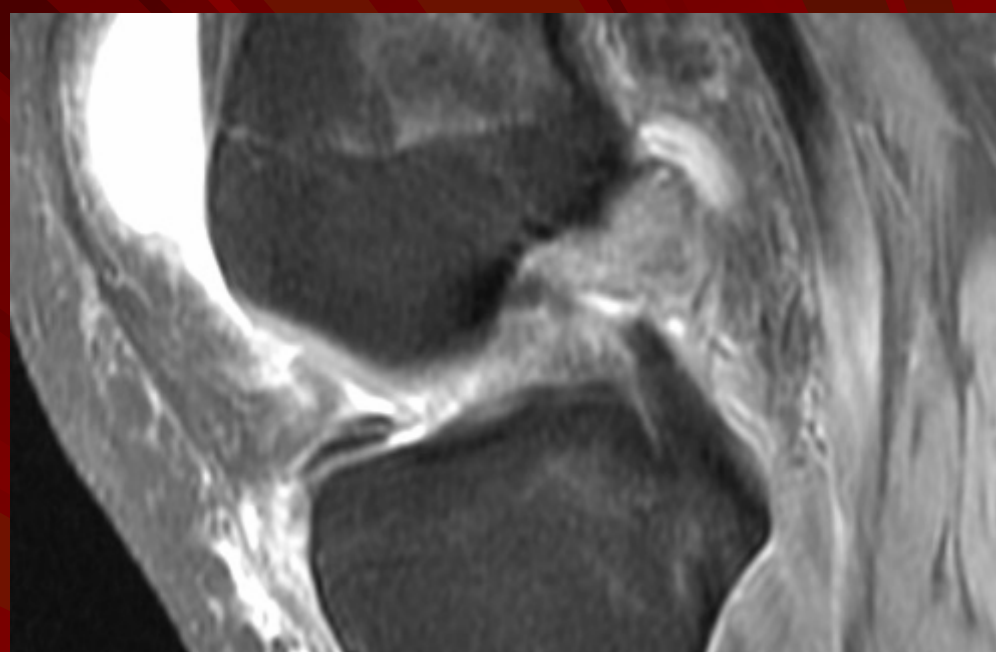
Direct signs-  
 Focal waviness  
 Focal bright signal

Indirect signs-  
 Pivot-shift bone bruises and fractures of  
 Lat.fem.condyle & posterolateral tibia

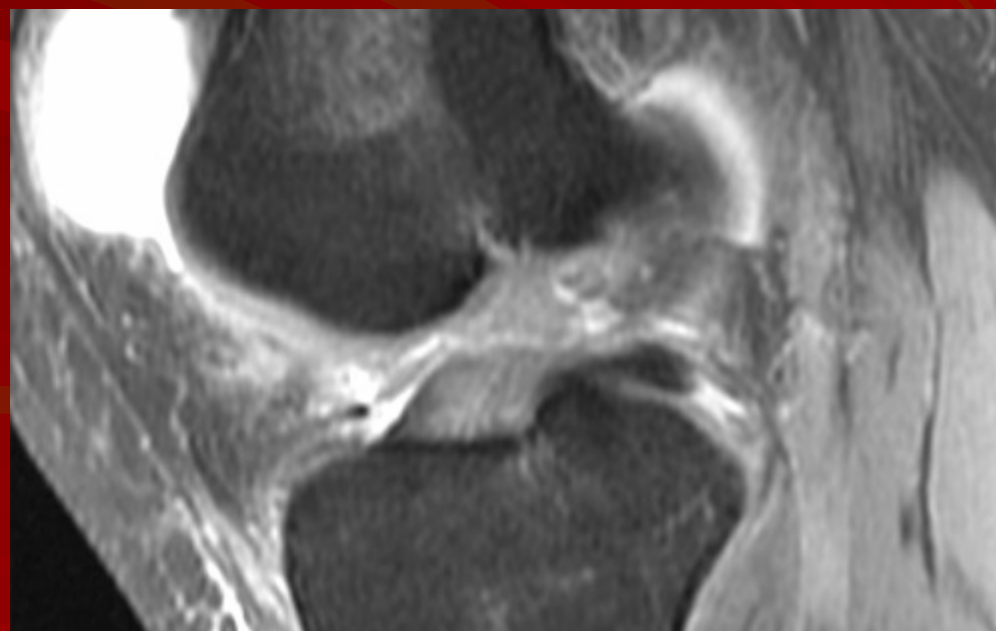
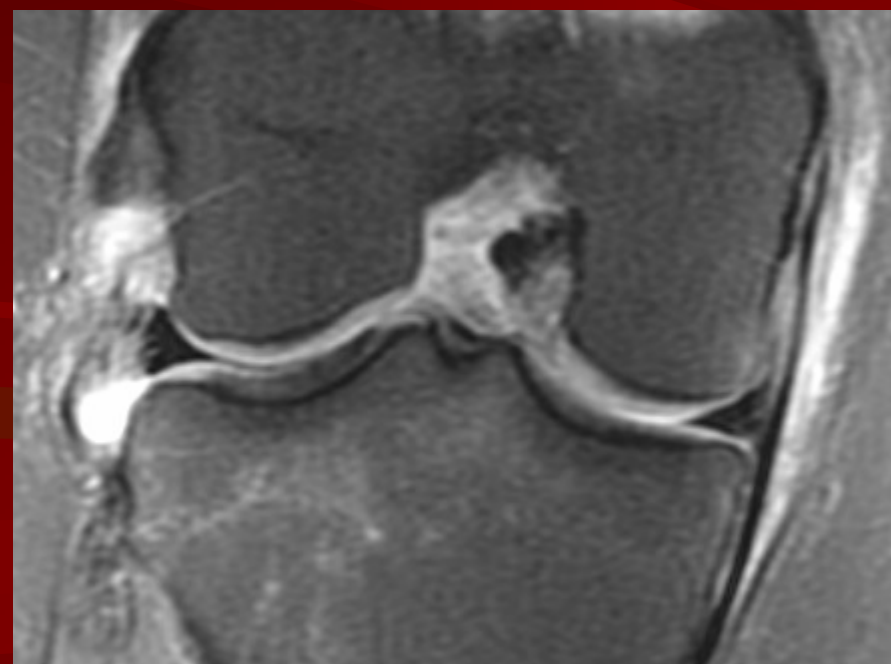
Ant.displacement of tibia  
 Segond fracture  
 Lateral meniscal tears  
 Buckling of PCL

# Complete ACL Tear



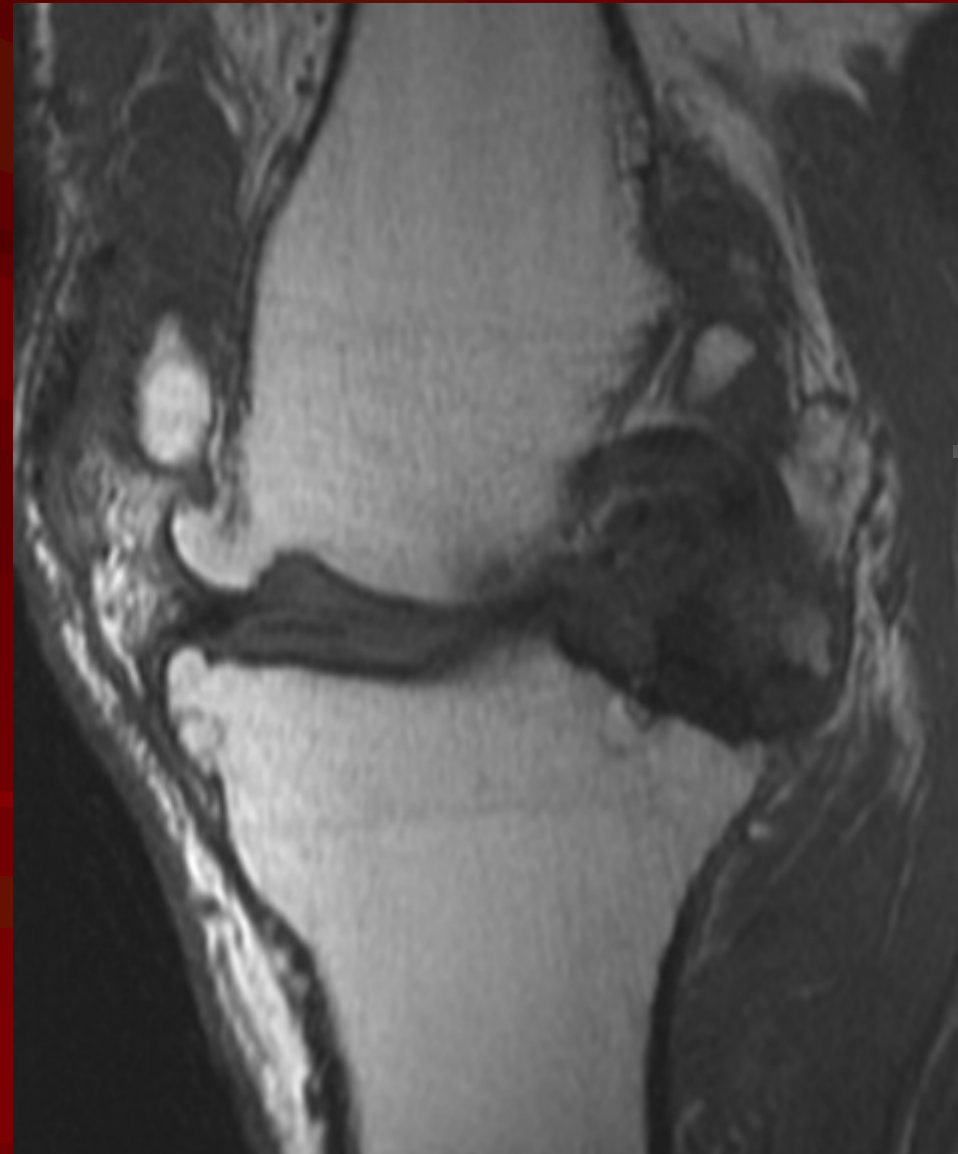


**ACL Complete Tear**

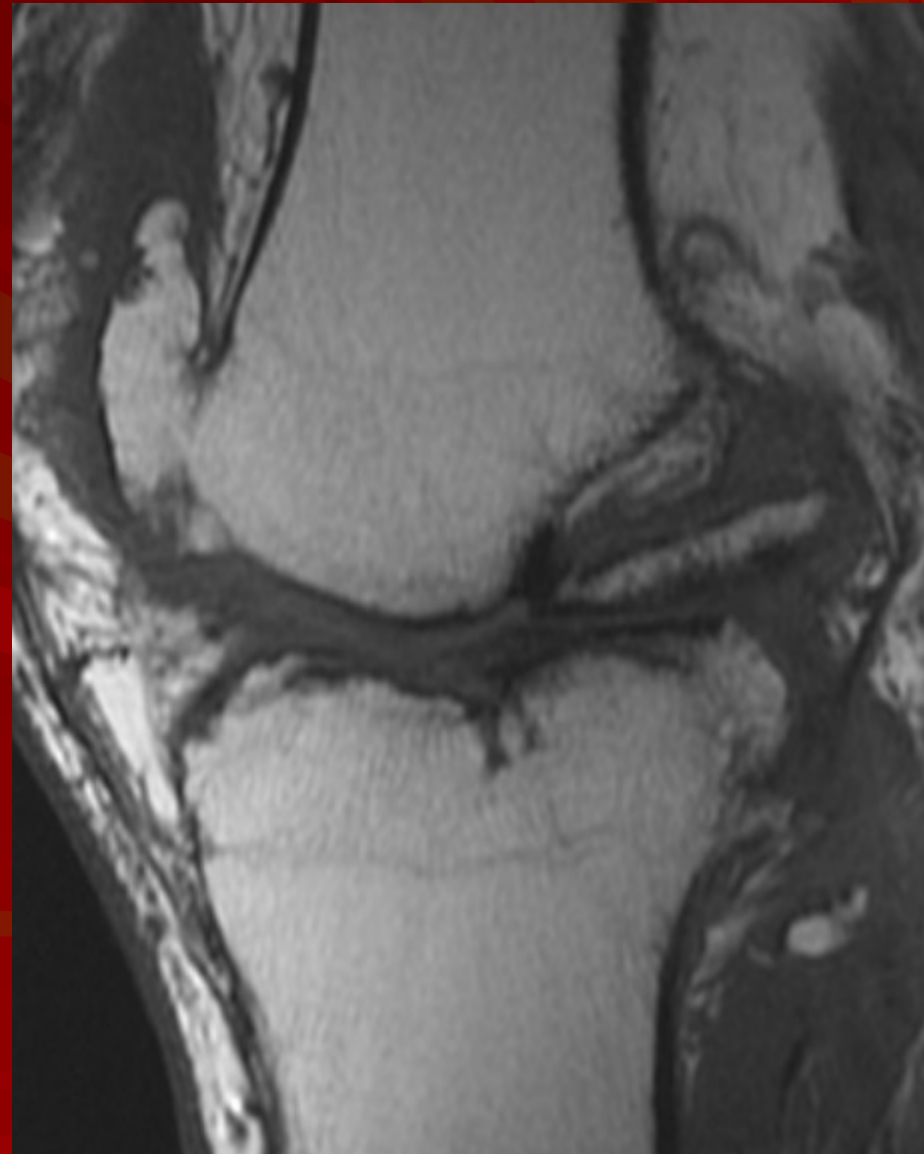




Buckled PCL



ACL Chronic tear

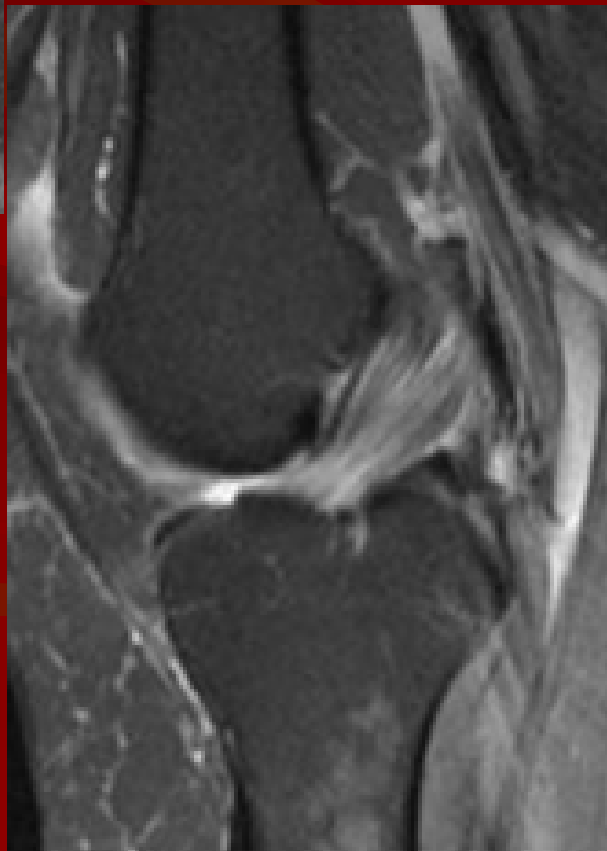




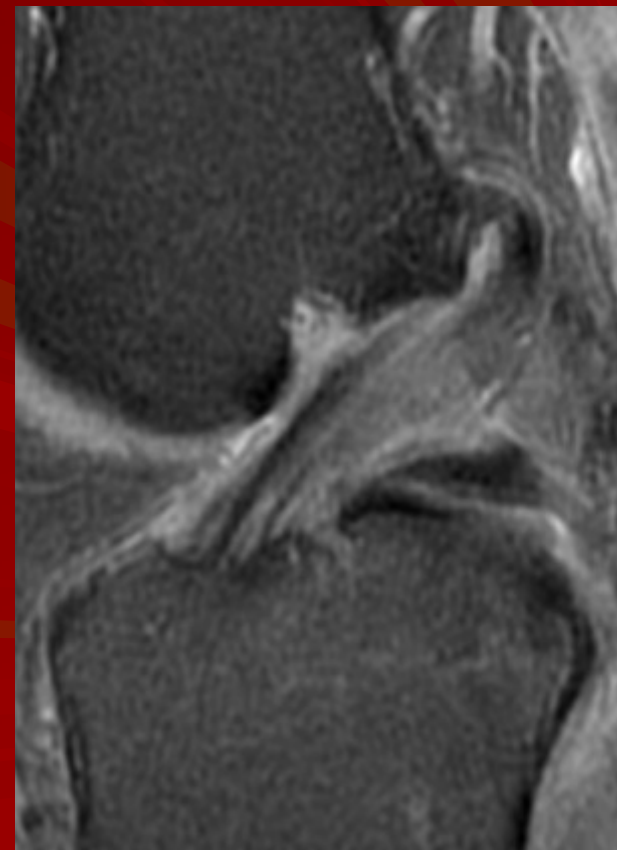
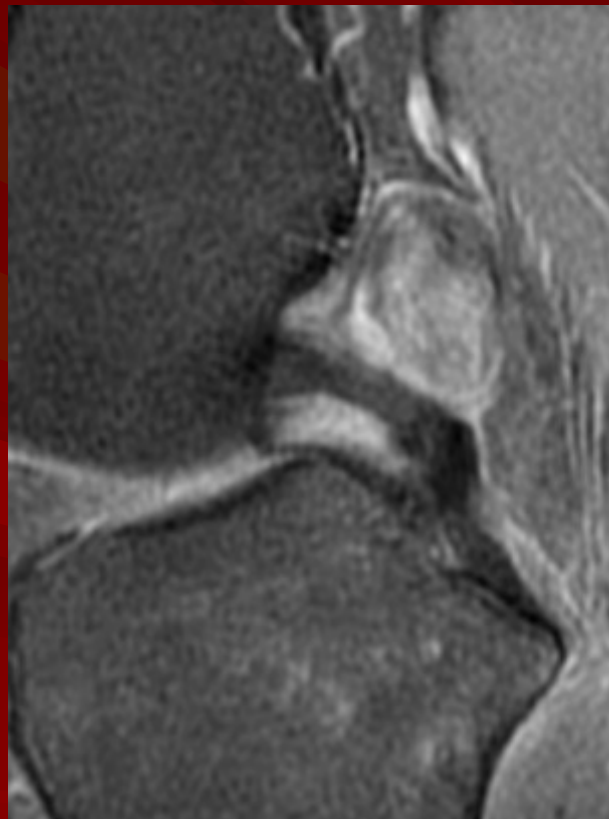
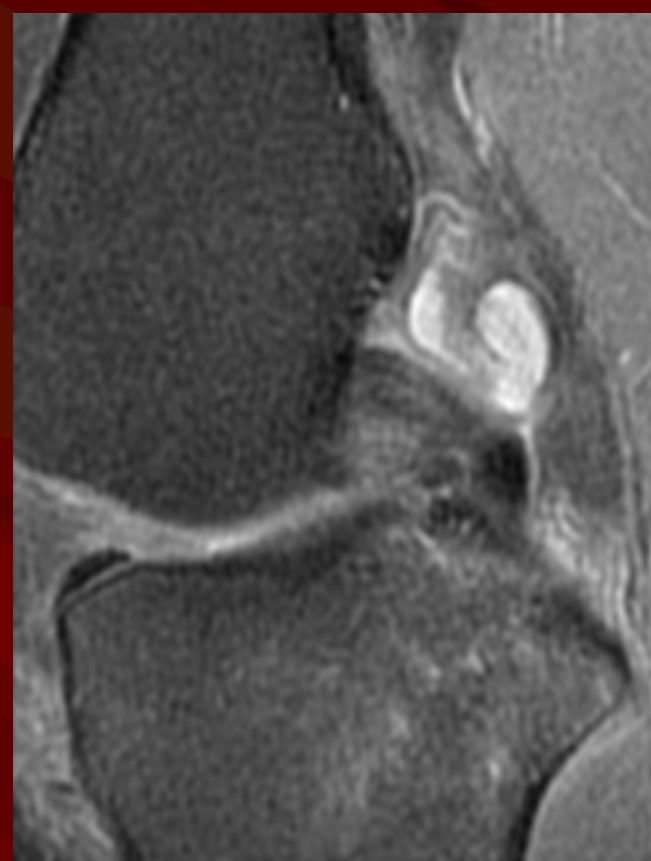
ACL Ganglion cyst-

'Celery stalk' appearance/  
Cystic form

Mucinous degeneration of ACL



# ACL ganglion cyst



## O'Donoghue's unhappy triad

- ACL tear
- Medial meniscus tear
- Medial collateral ligament tear

Classic triad  
ACL, MCL, MM - unusual

More common –  
ACL, MCL, LM



## PCL

- From medial femoral condyle to posterior aspect tibia 'L A M P'

PCL is 30% larger than ACL and twice as strong

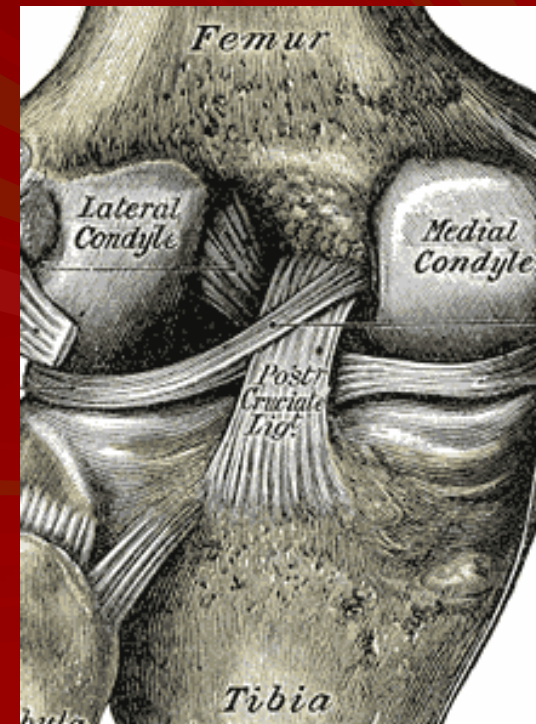
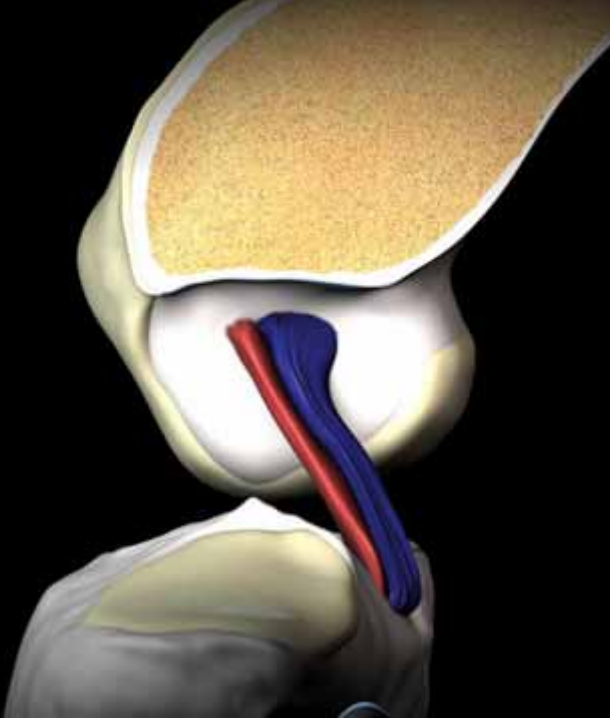
Anterolateral band – taut in flexion

Posteromedial band – taut in extension

Function

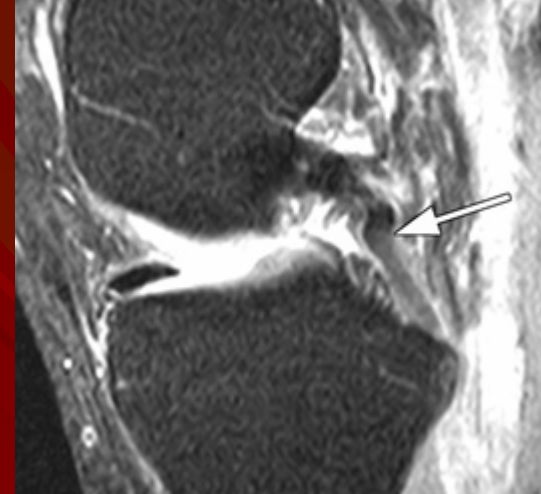
– prevent posterior tibial translation

-rotational stability to the knee



## PCL Tear

- Most often combined with other ligamentous injuries
- MC associated injury is to posterolateral corner – 60%
- Meniscal tear in up to 50% cases
- Mechanism of injury:
  - \* Direct blow to ant. tibia in flexion eg. Dashboard injury
  - \* Hyperextension injury causes avulsion
  - \* Severe abduction, adduction with rotational forces.



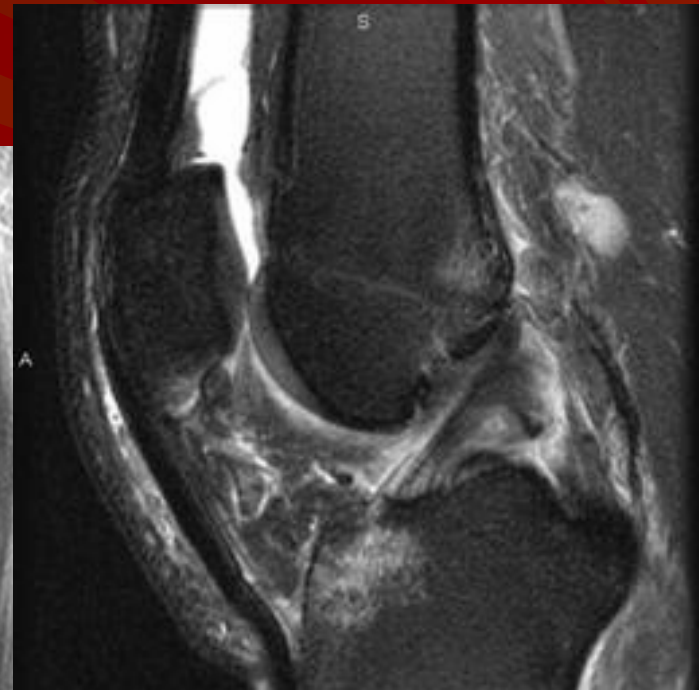
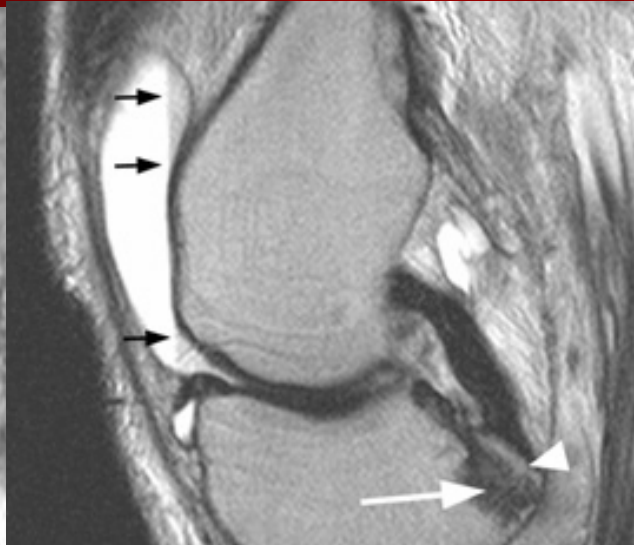
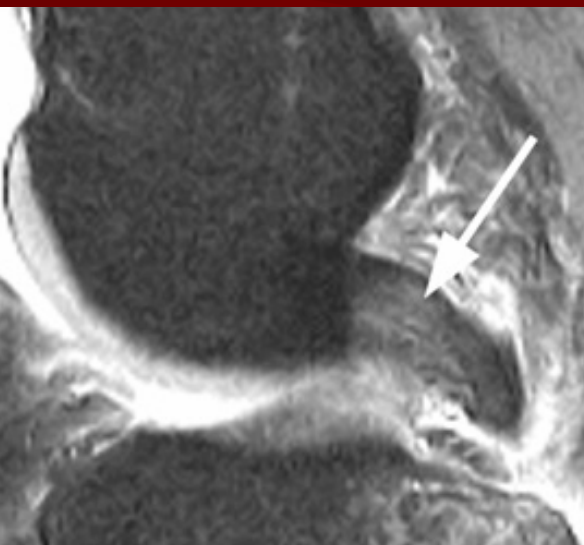
Normal PCL

Chronic  
tear

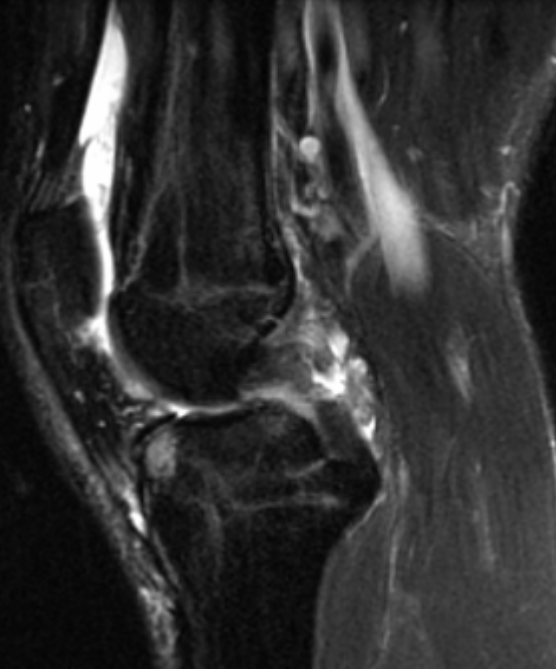
Complete tear PCL

Partial tear

Avulsion PCL



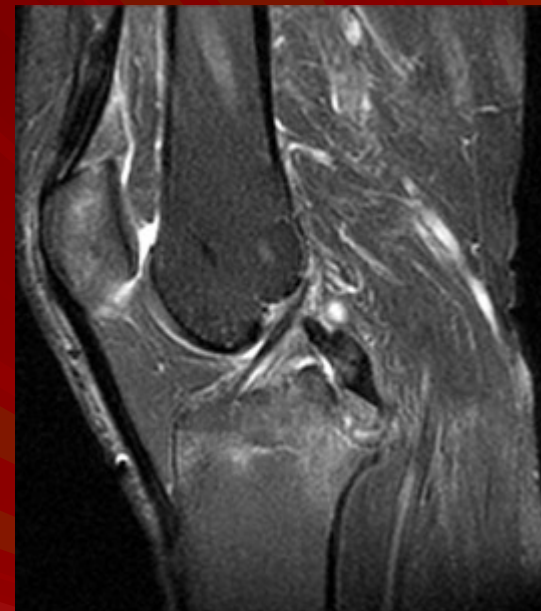




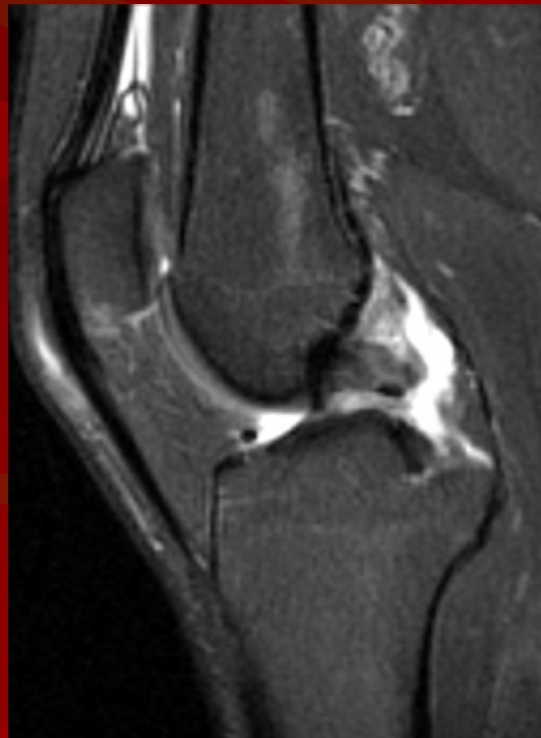
Complete tear PCL



PCL Avulsion



Midsubstance tear







## Medial Collateral Ligament

Superficial and deep portions

MCL bursa between the two layers

Function: provides primary restraint to valgus stress at knee

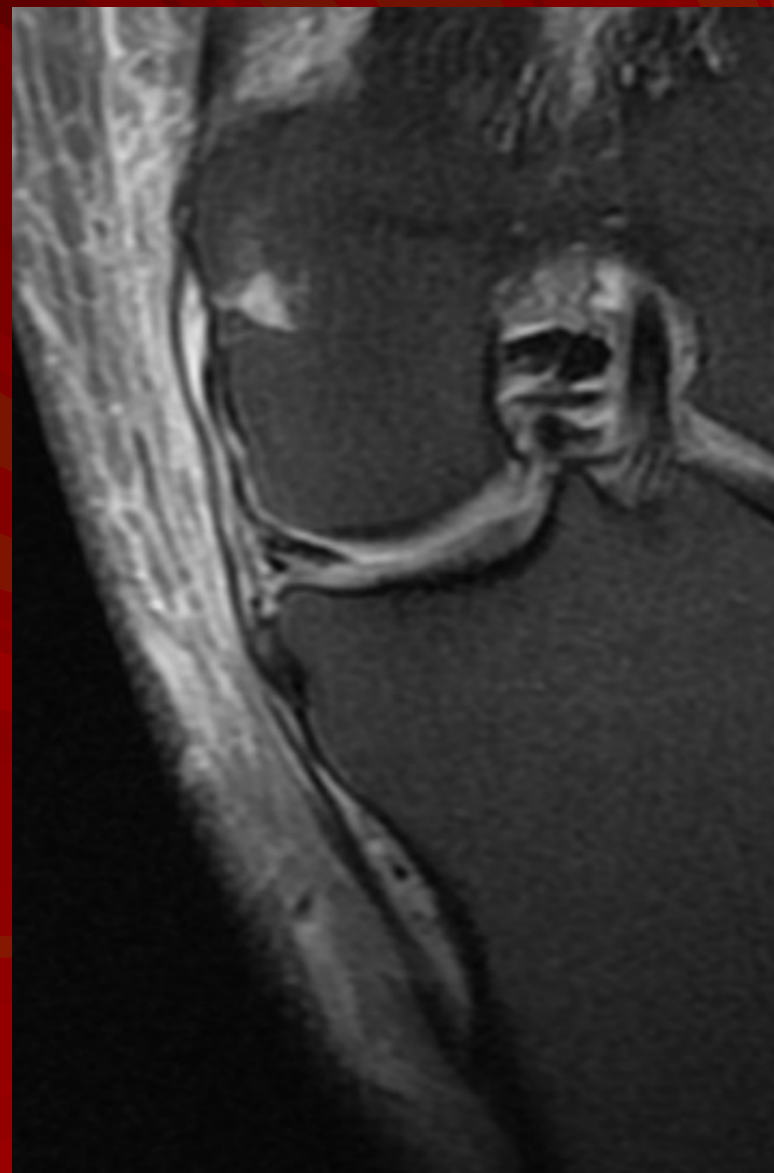
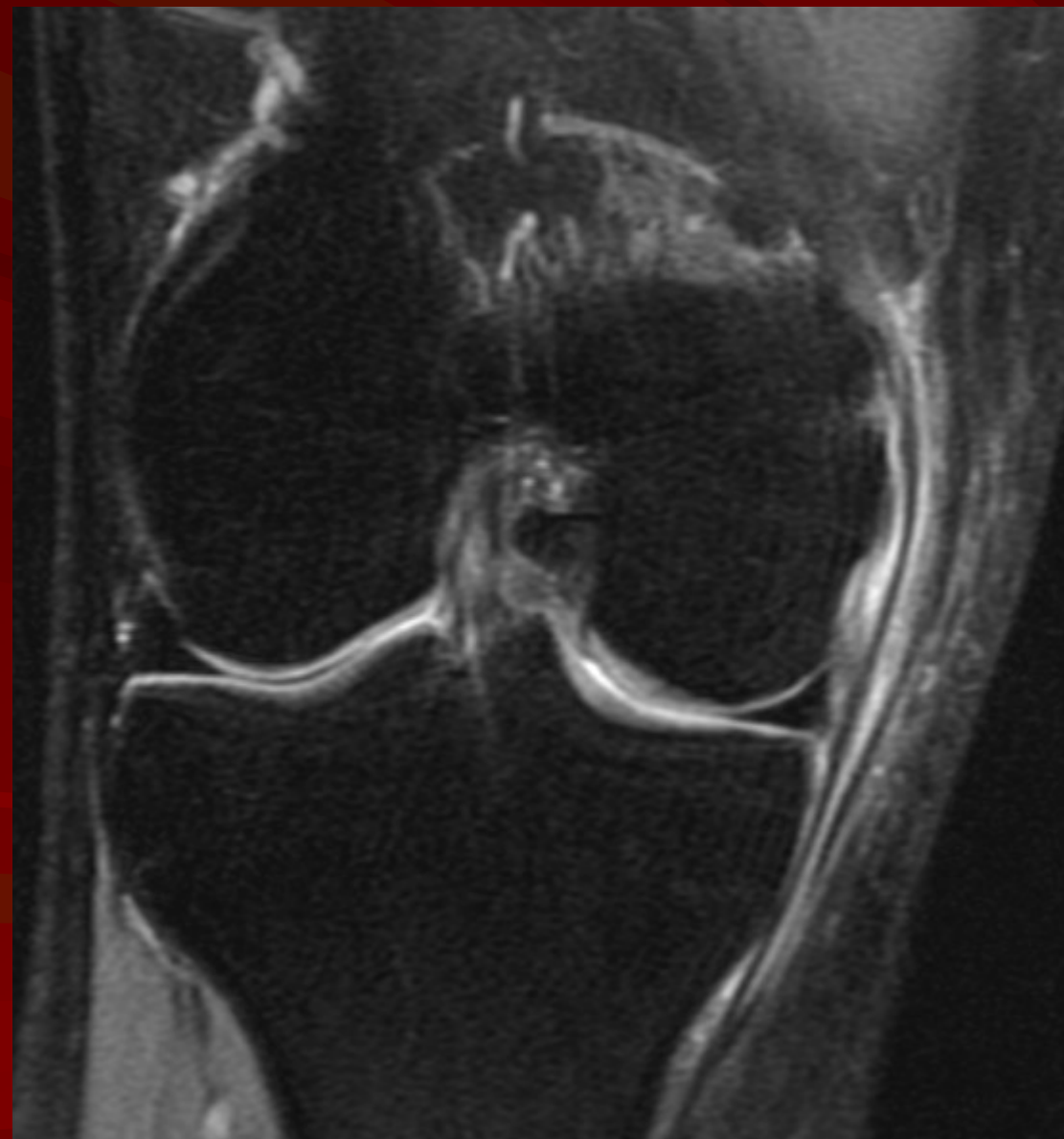


MCL bursitis

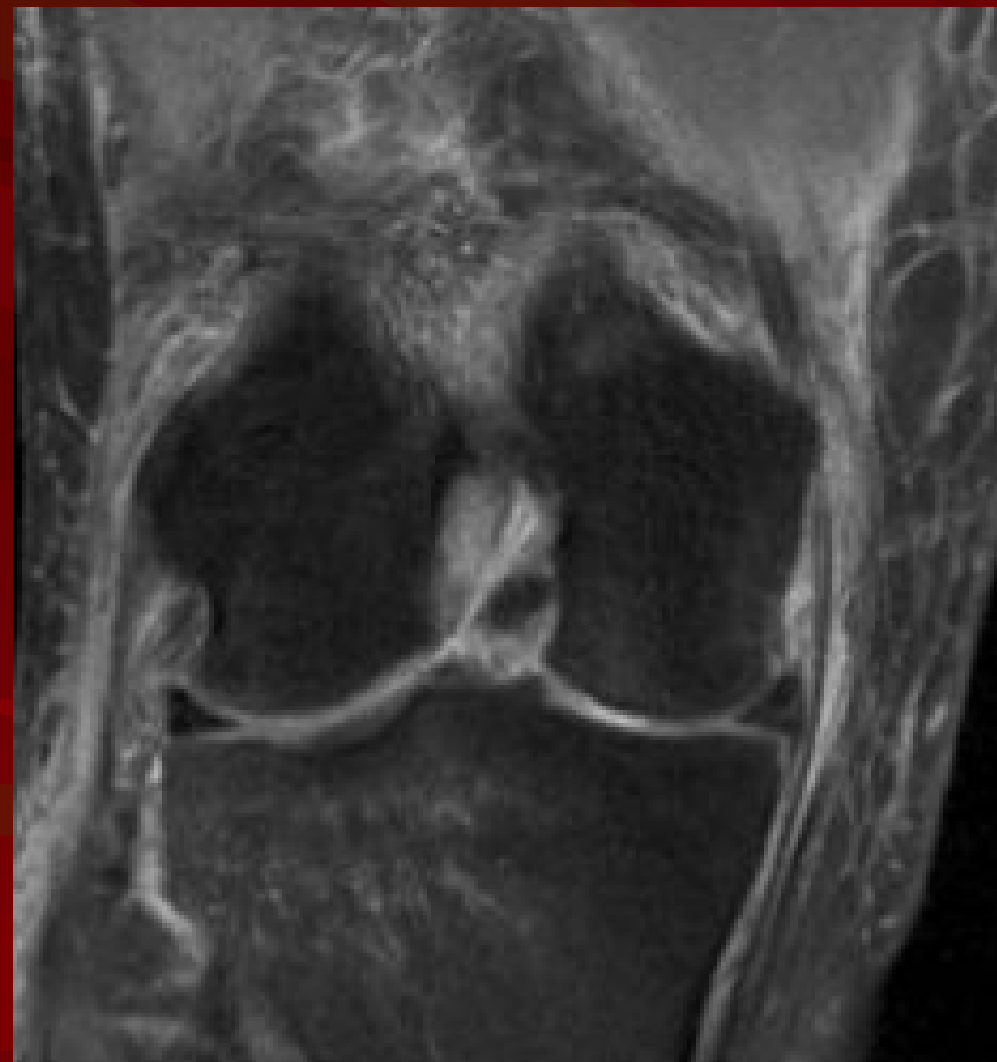
## MCL Injury Classification

- Grade 1 – Sprain
- Grade 2 – Partial tear
- Grade 3 – Complete rupture
- Meniscocapsular separation – Fluid between MCL and MM

## MCL Grade 1 sprain



Grade 2 MCL tear

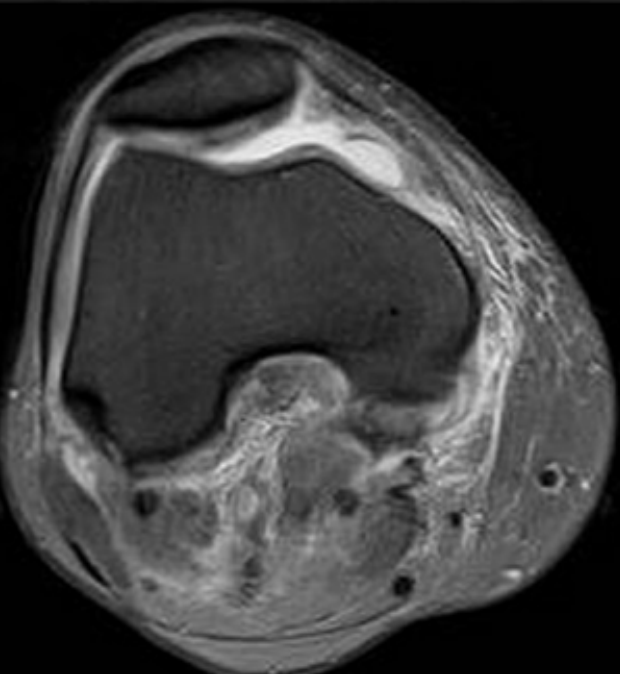


Isolated Grade 3 MCL tear





MCL Grade 3 tear

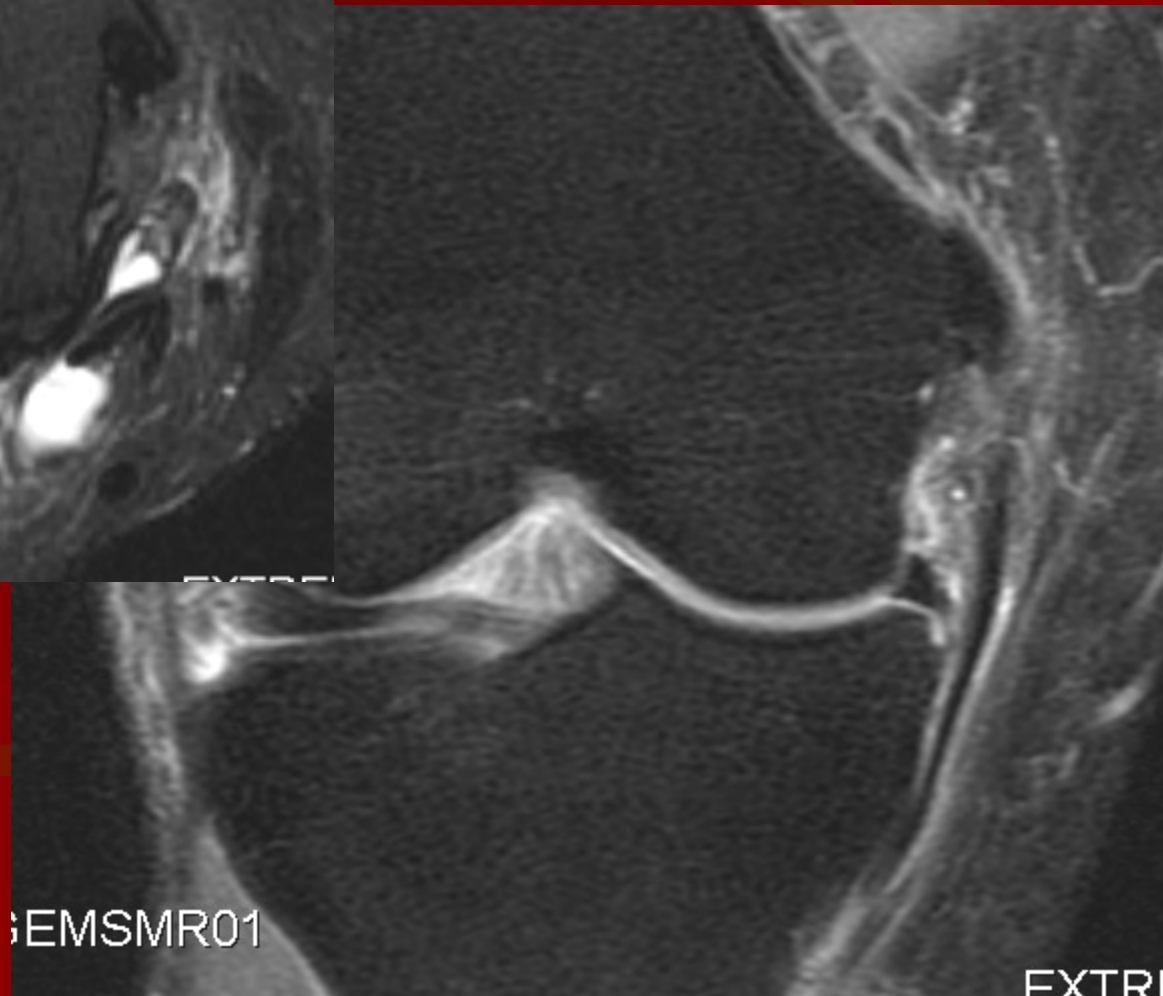
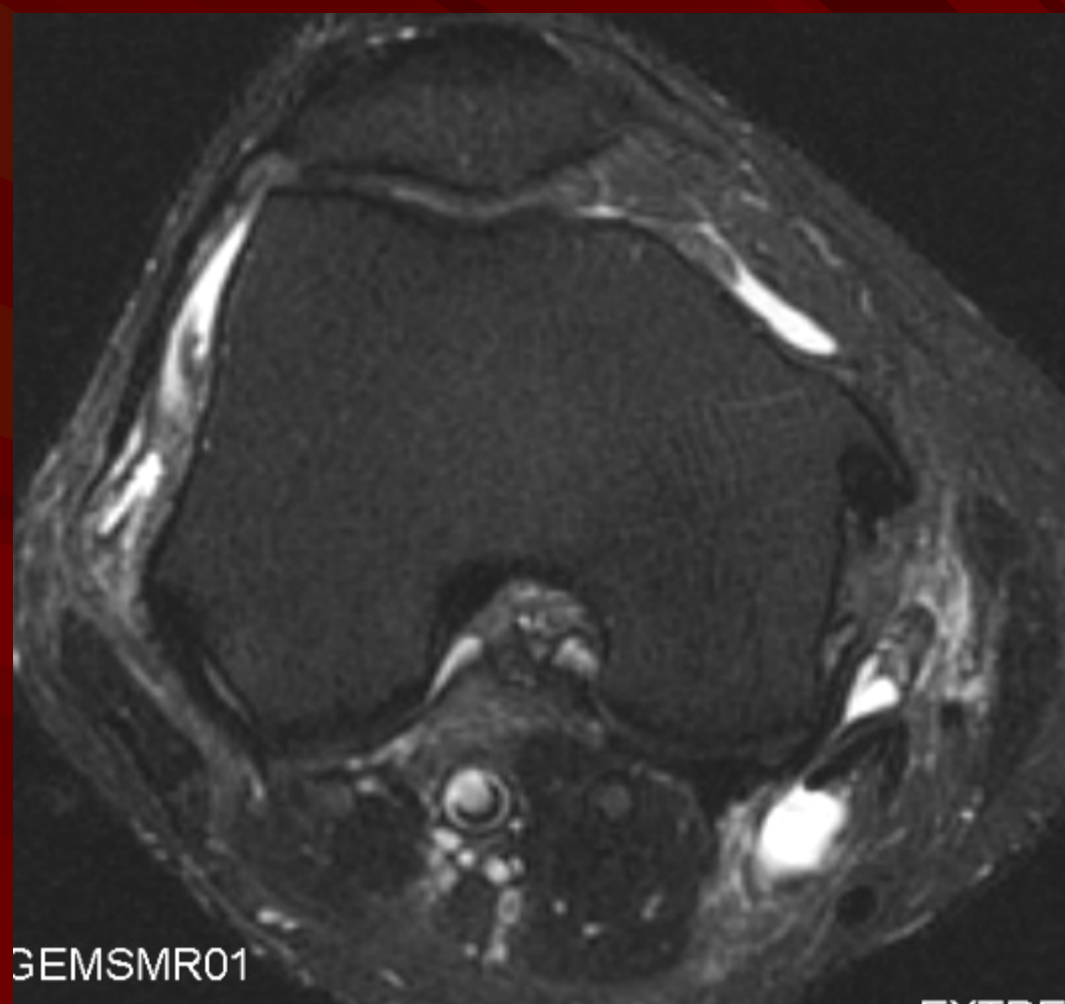


# Medial Second fracture injury

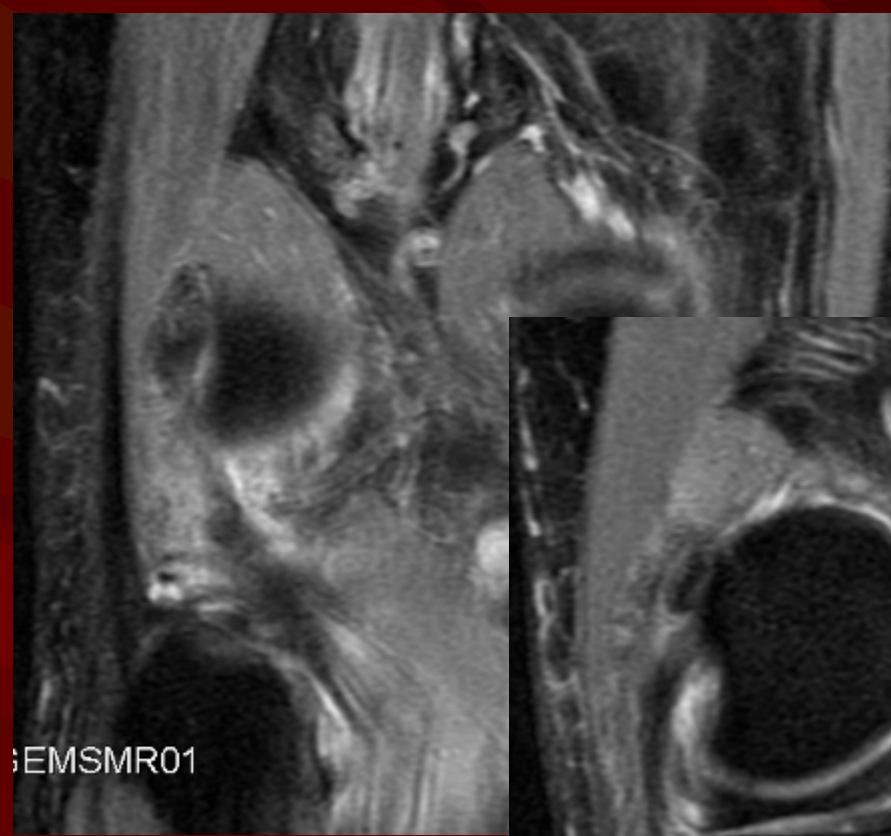




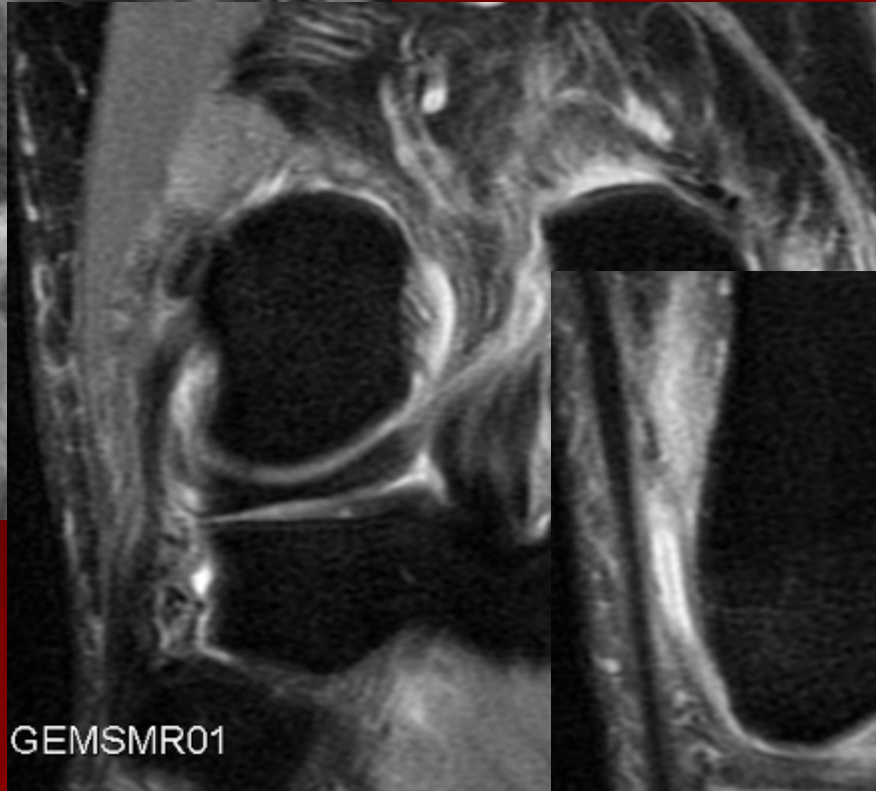
MM chronic injury



# LCL complex



Biceps femoris tendon

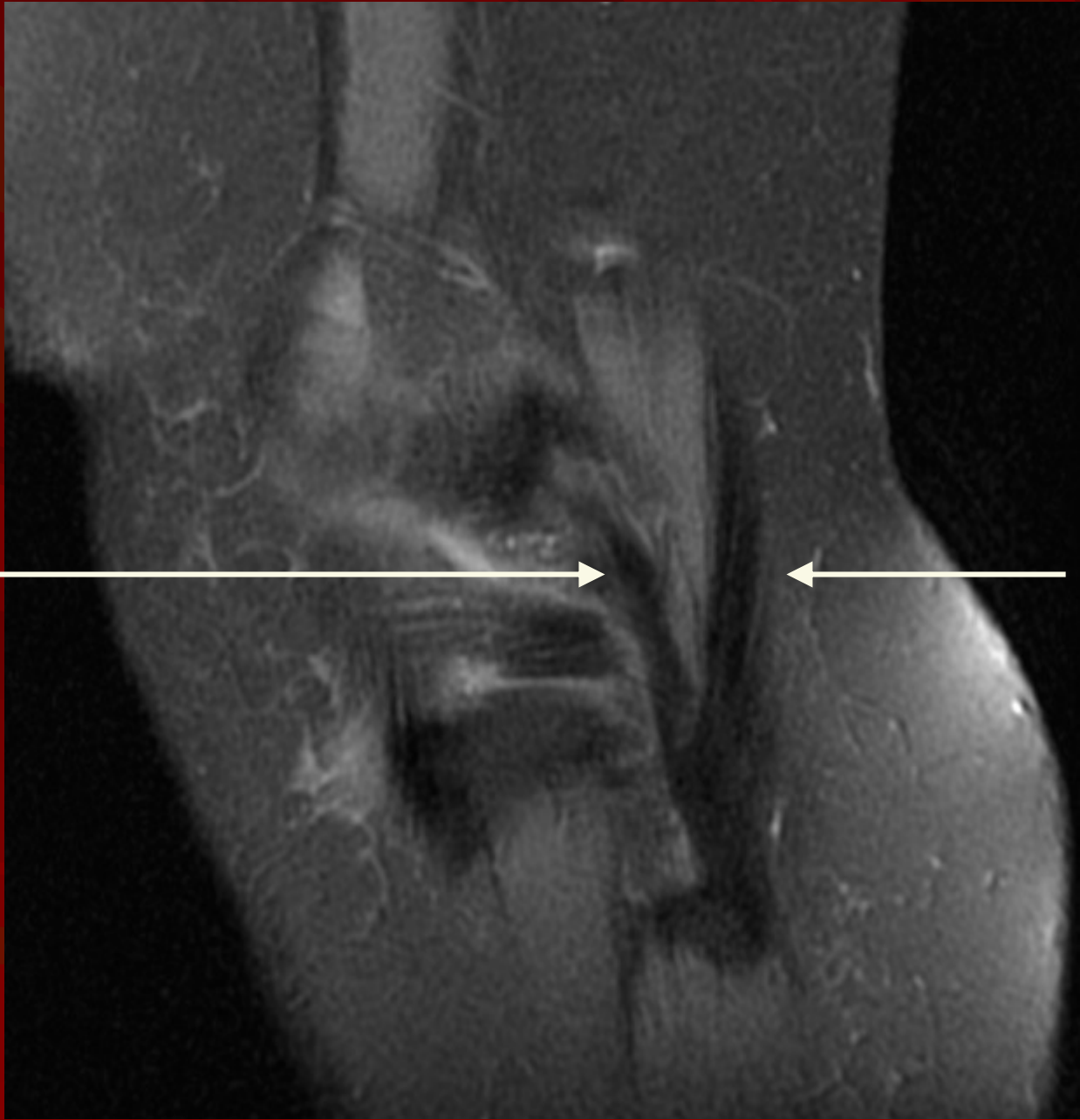


Fibular Collateral ligament



Iliotibial band



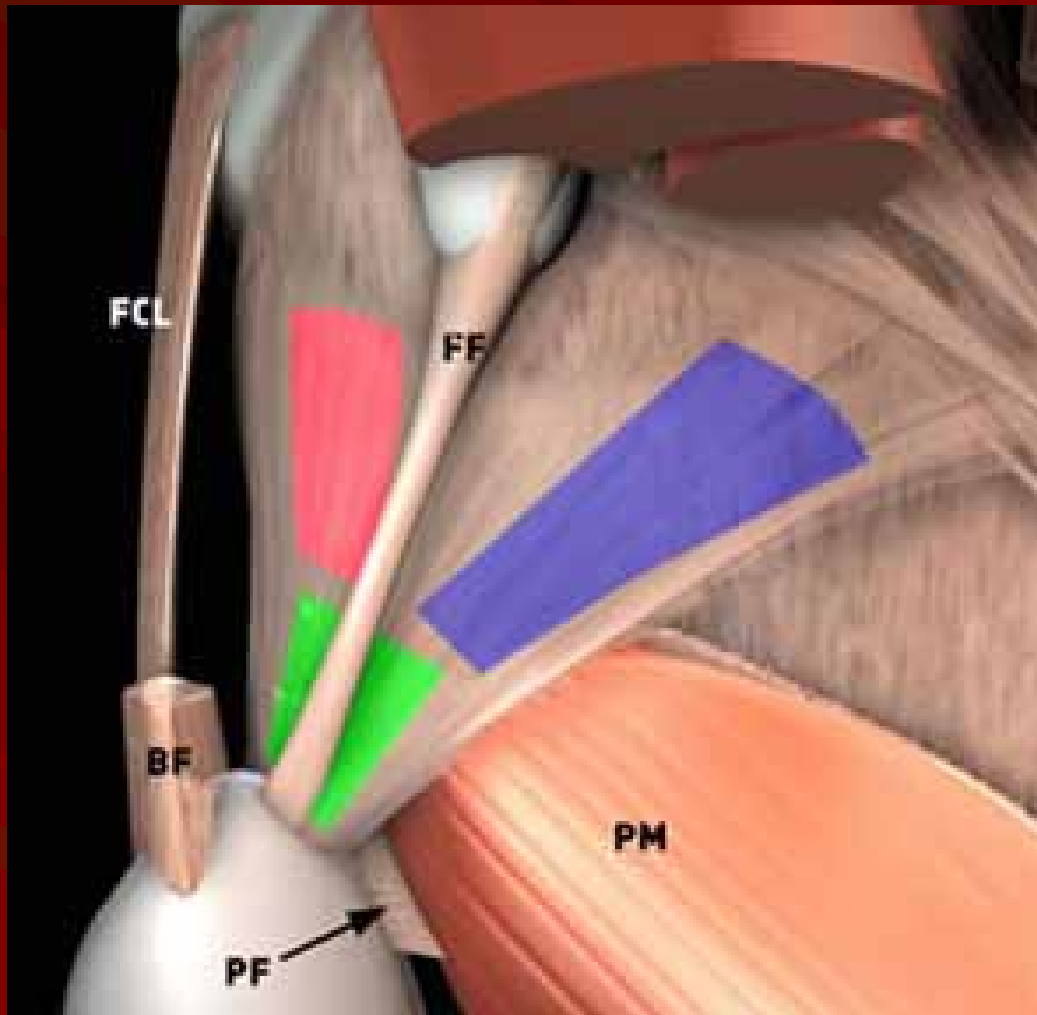


FCL

BF tendon

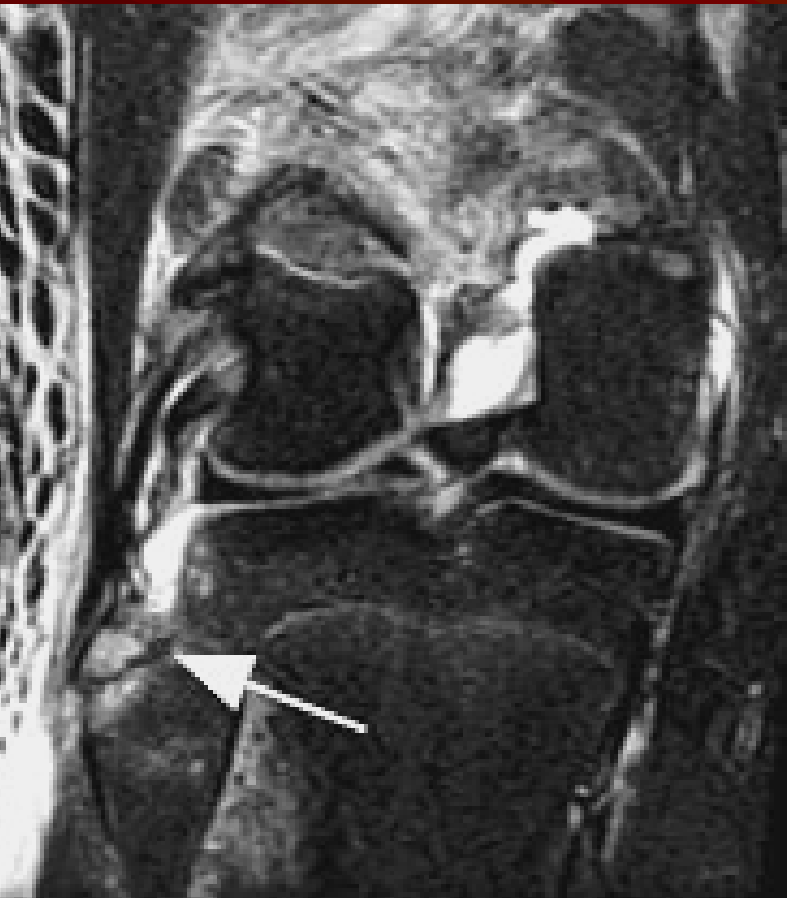
Arcuate complex – Arcuate ligament  
FCL  
Popliteus tendon

Additional components  
-Fabellofibular lig.  
-Popliteofibular lig.

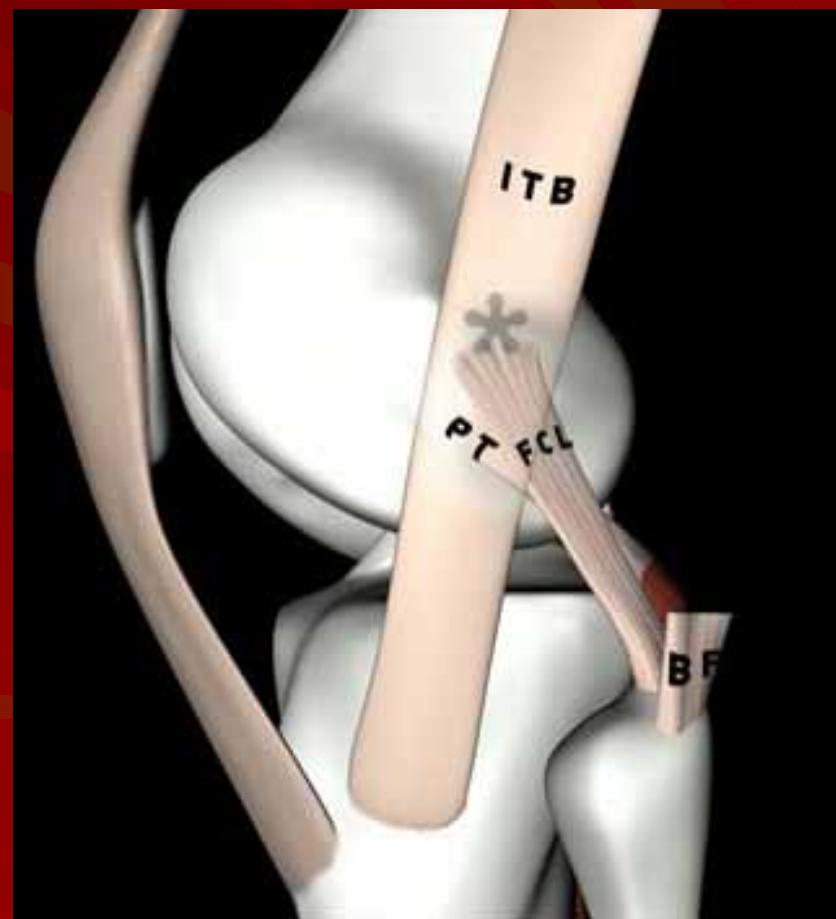
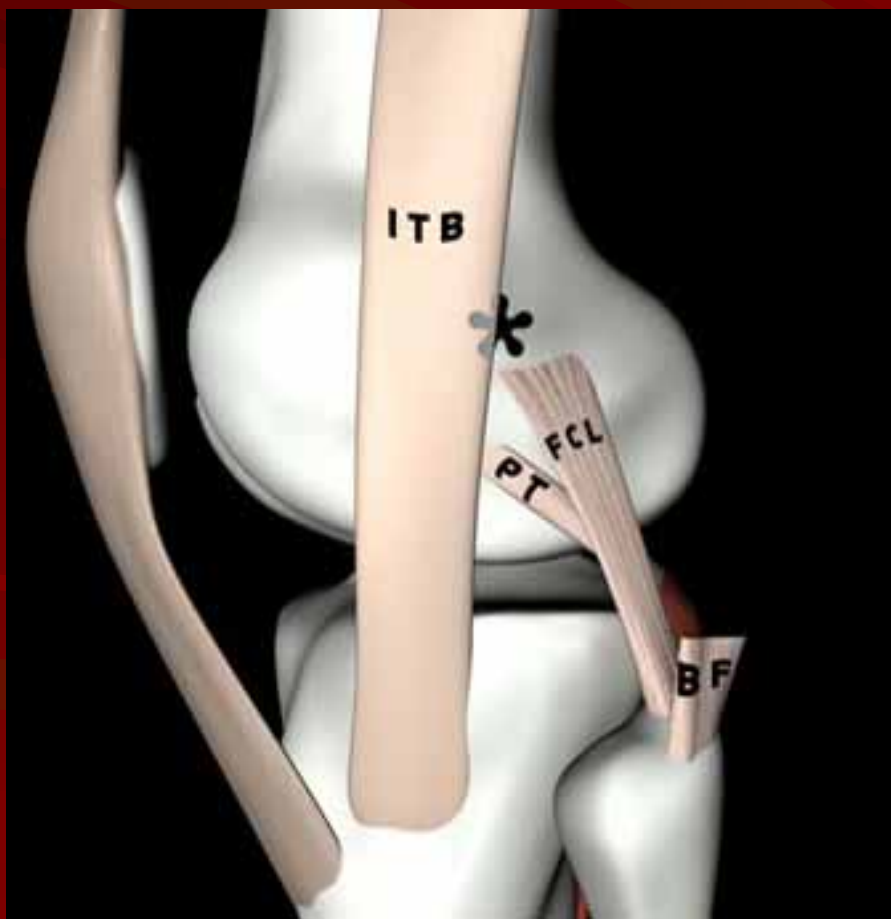


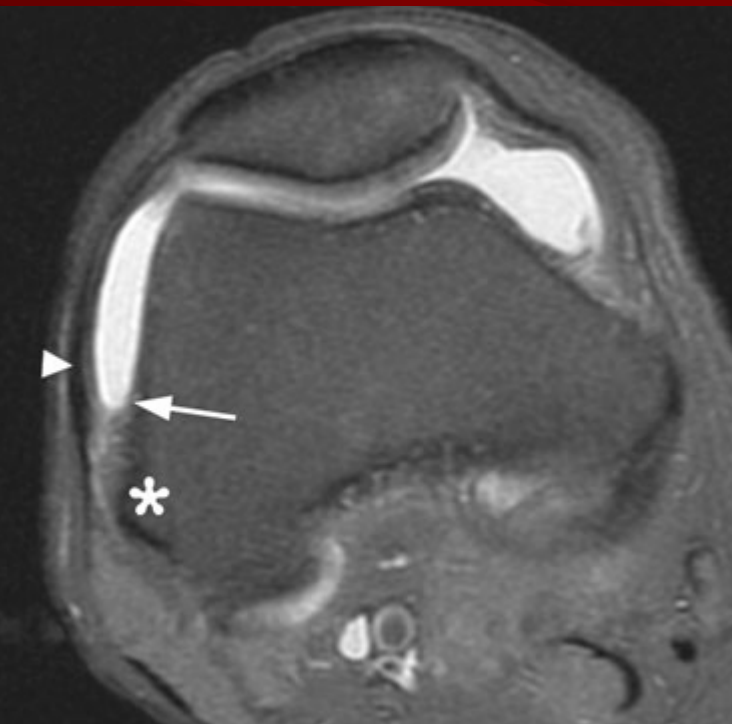
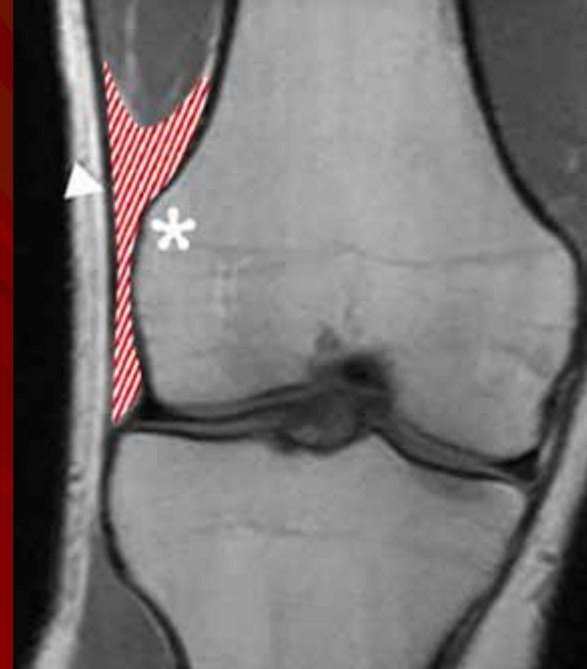
## Posterolateral corner injury

- LCL component injury
- Popliteus tendon tear
- Arcuate ligament injury
- ACL or PCL tear

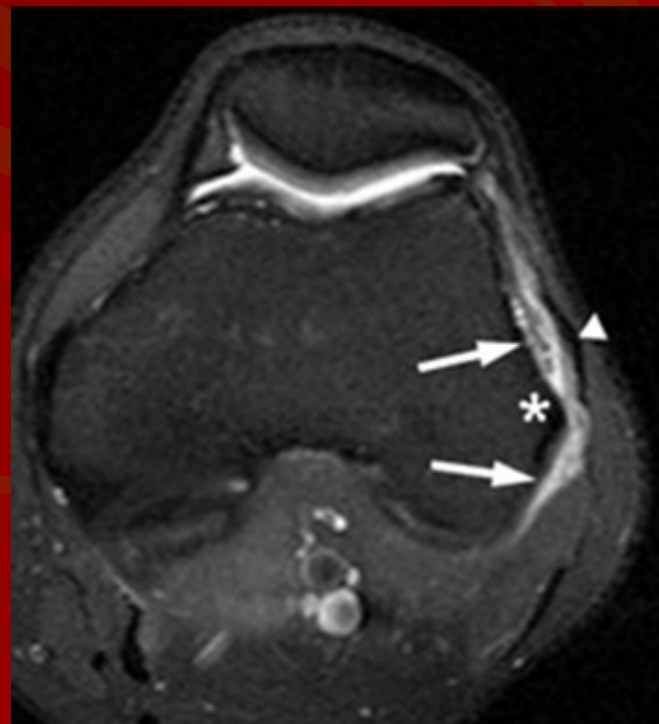


# Iliotibial band friction syndrome





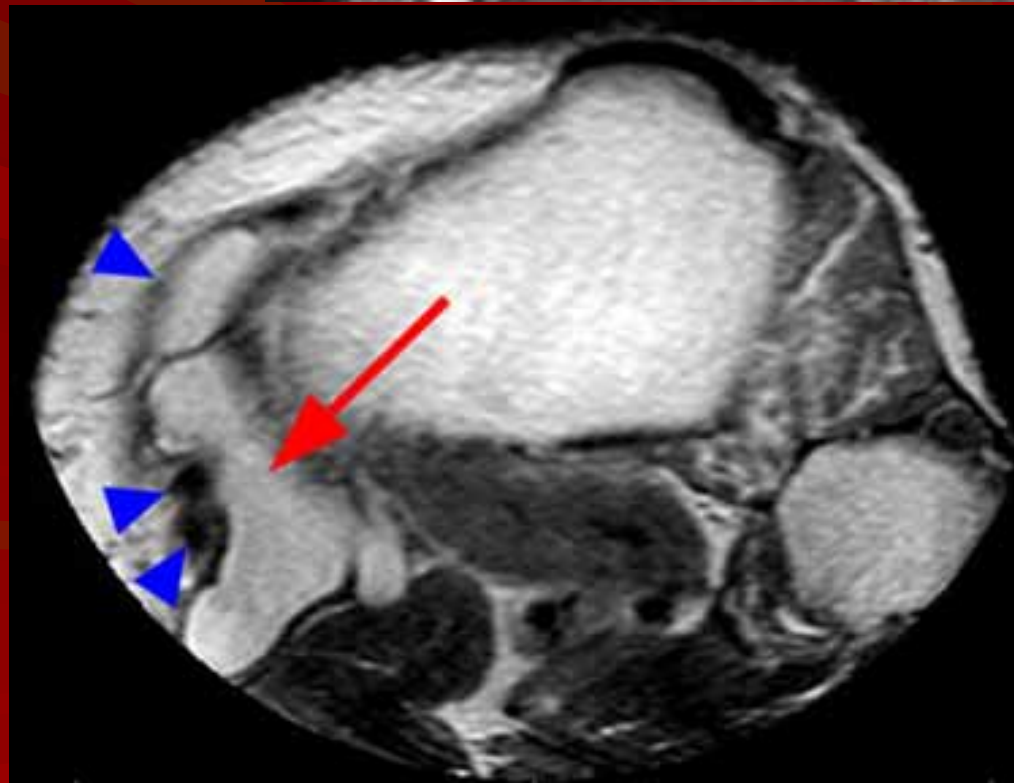
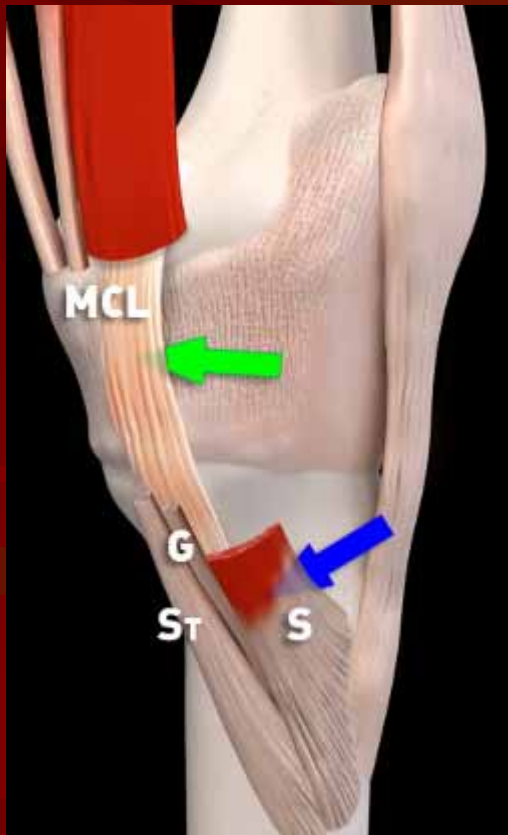
ITBS





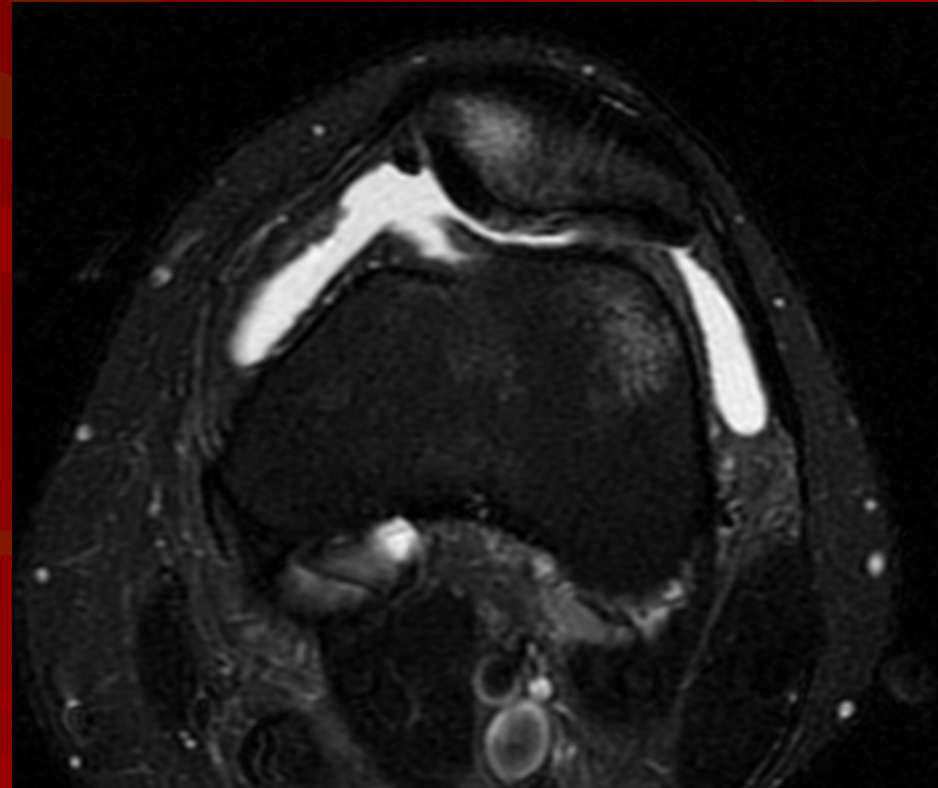
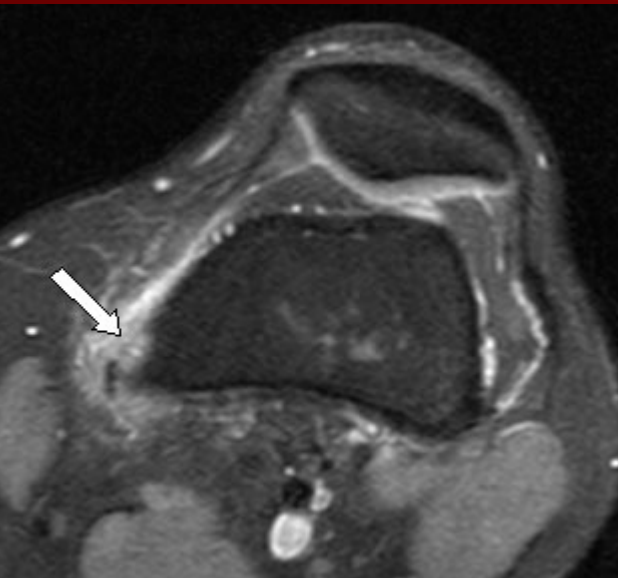
# Pes anserine bursitis

- Bursa lies deep to conjoint tendon of
- sartorius, gracilis, semitendinosus
- Lies superficial to MCL



## Lateral Patellar Dislocation

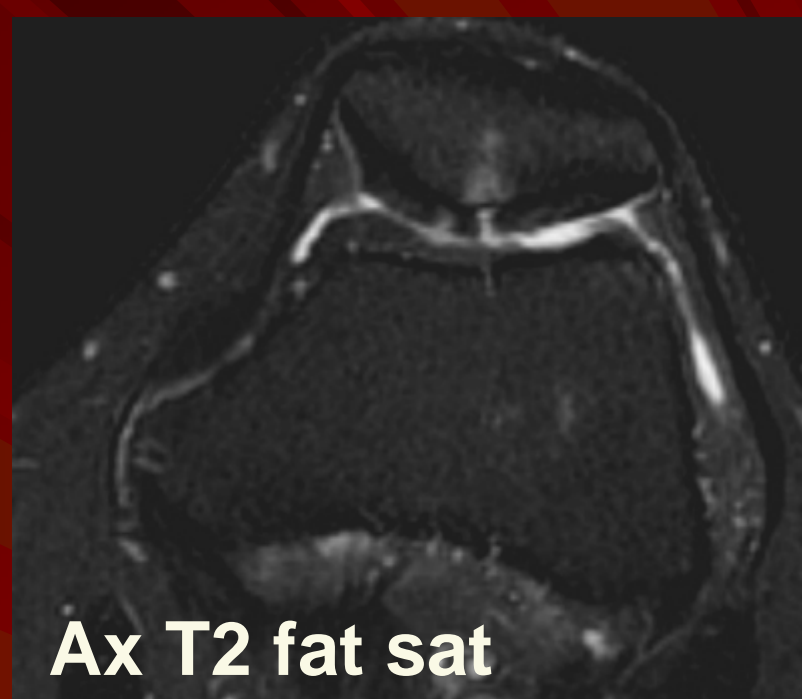
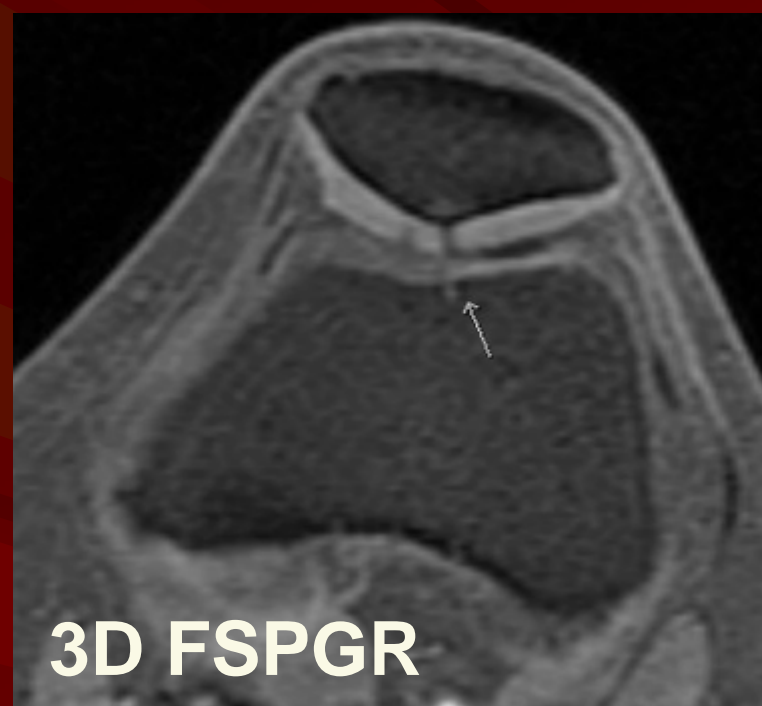
- Pattern of bone bruise : anterolateral femur and medial patella
- MPFL injury
- Patellar chondral injury



## Jumper's knee



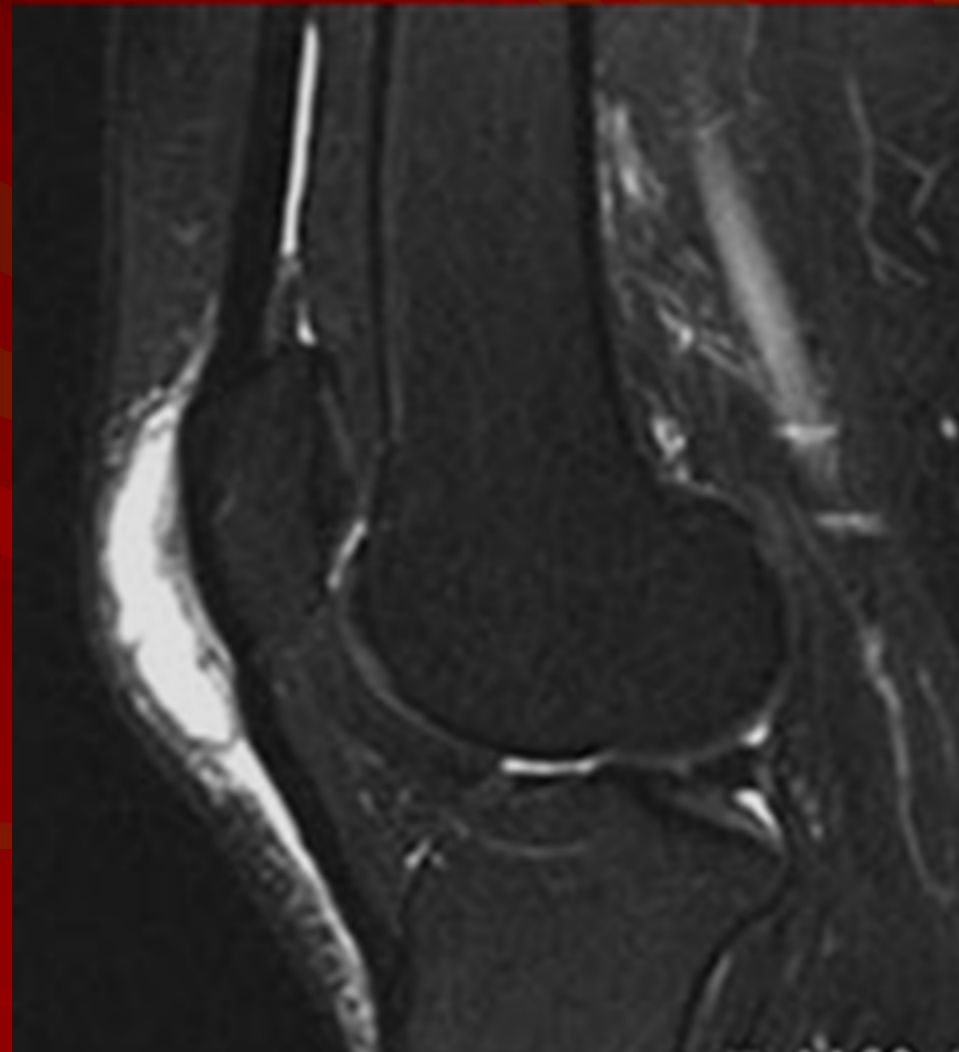
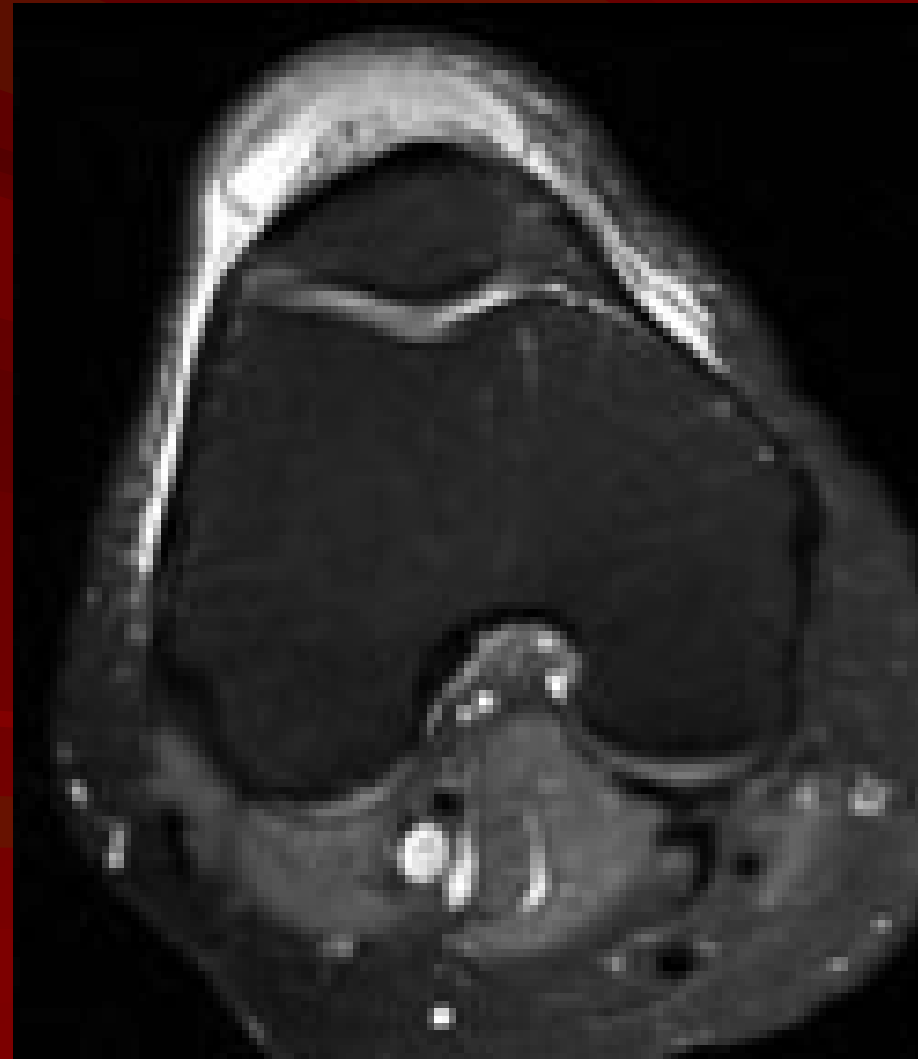


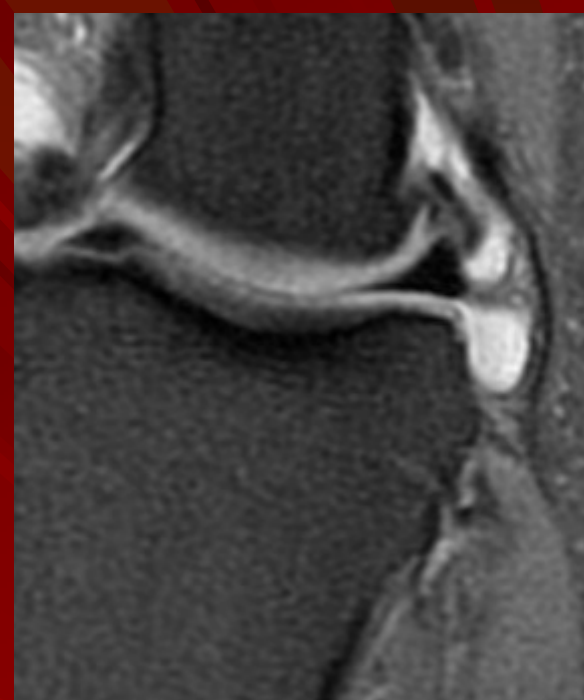
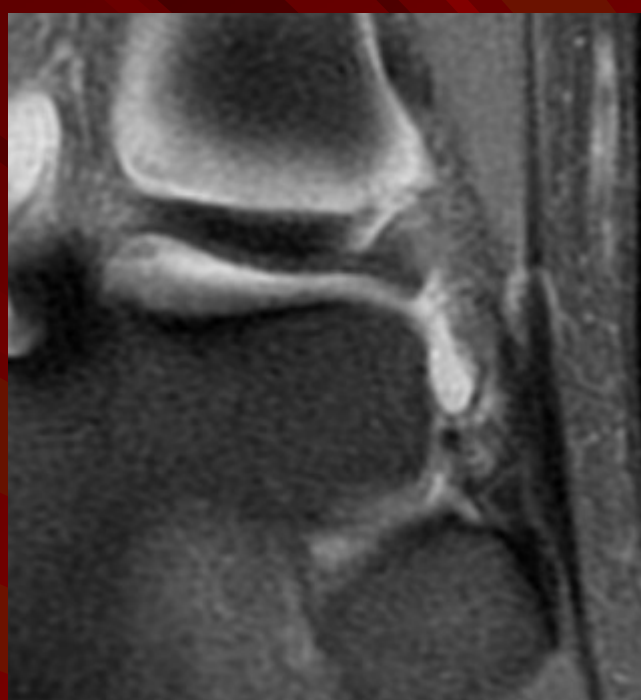
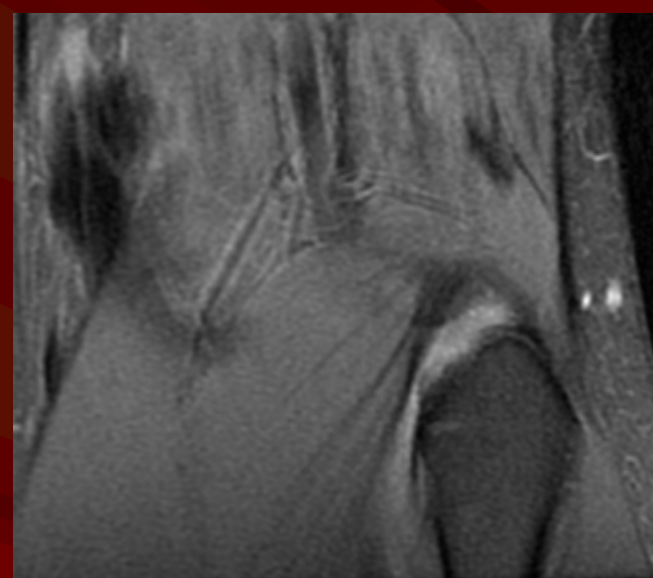


Flap tear-  
Patellar cartilage apex

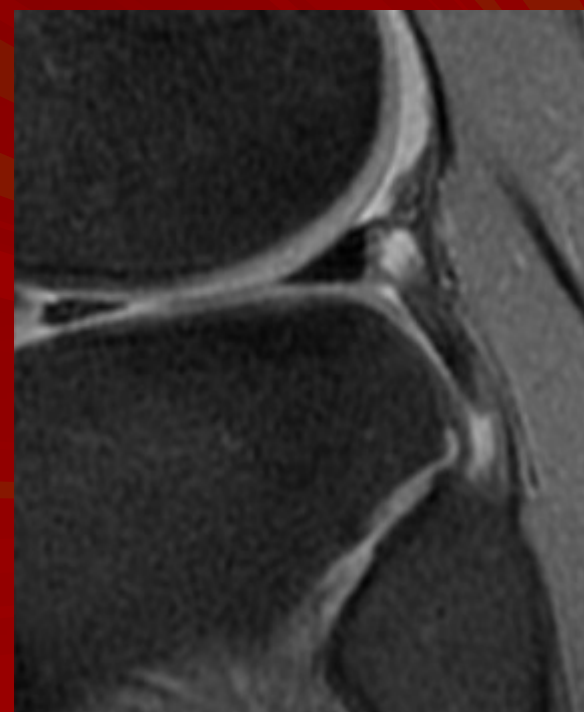
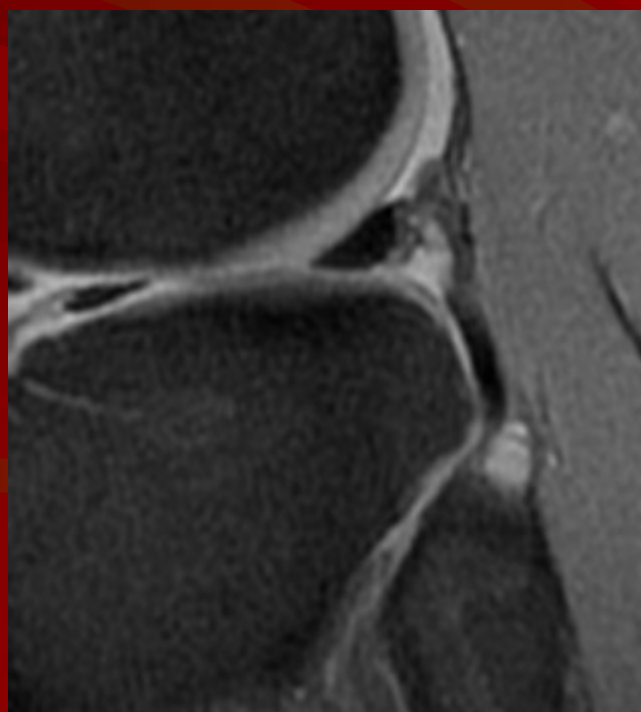


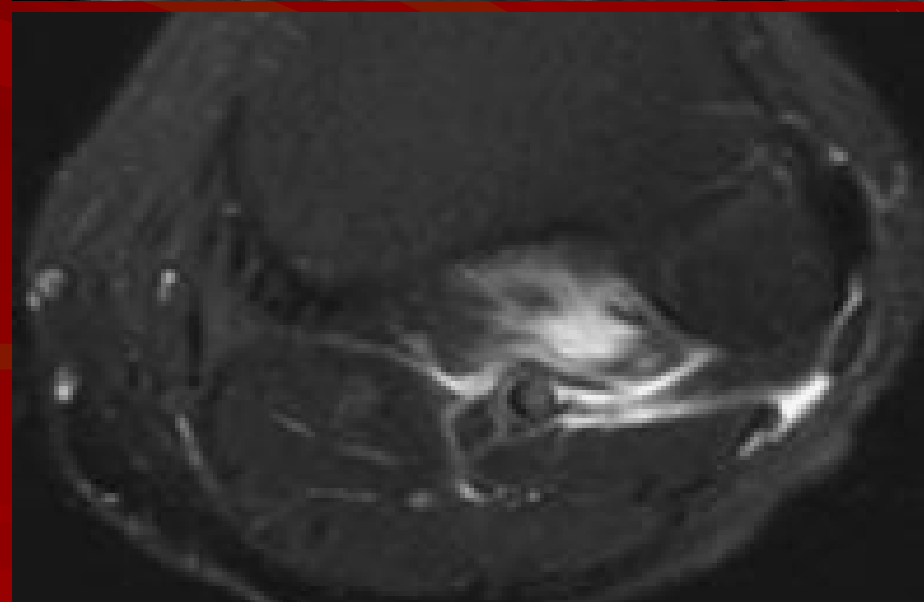
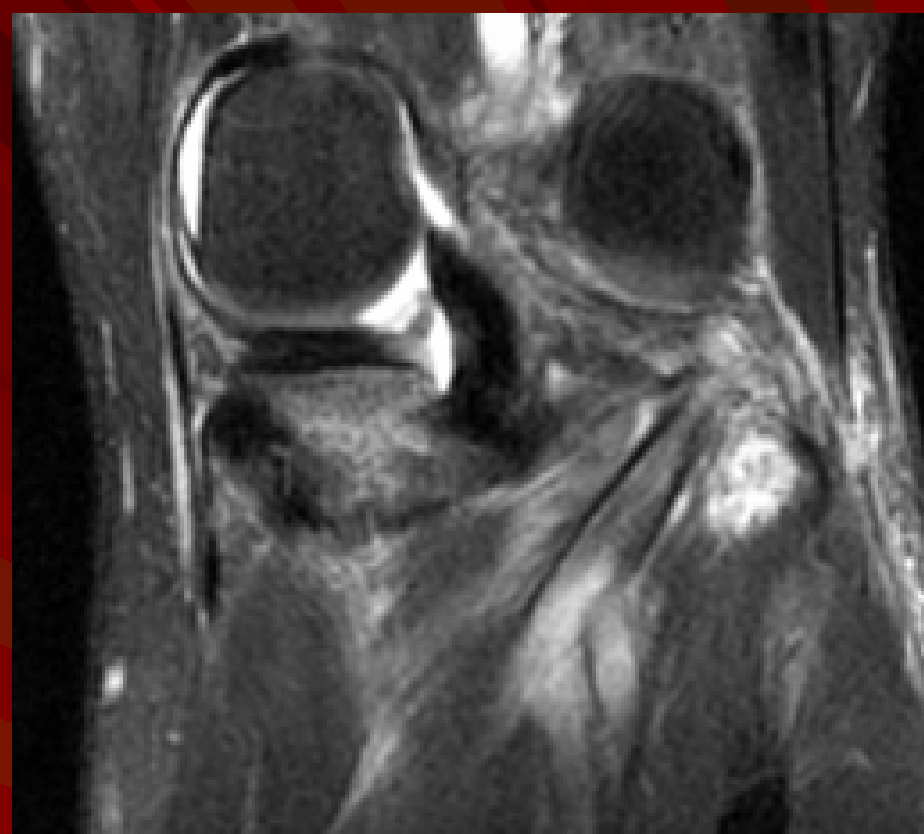
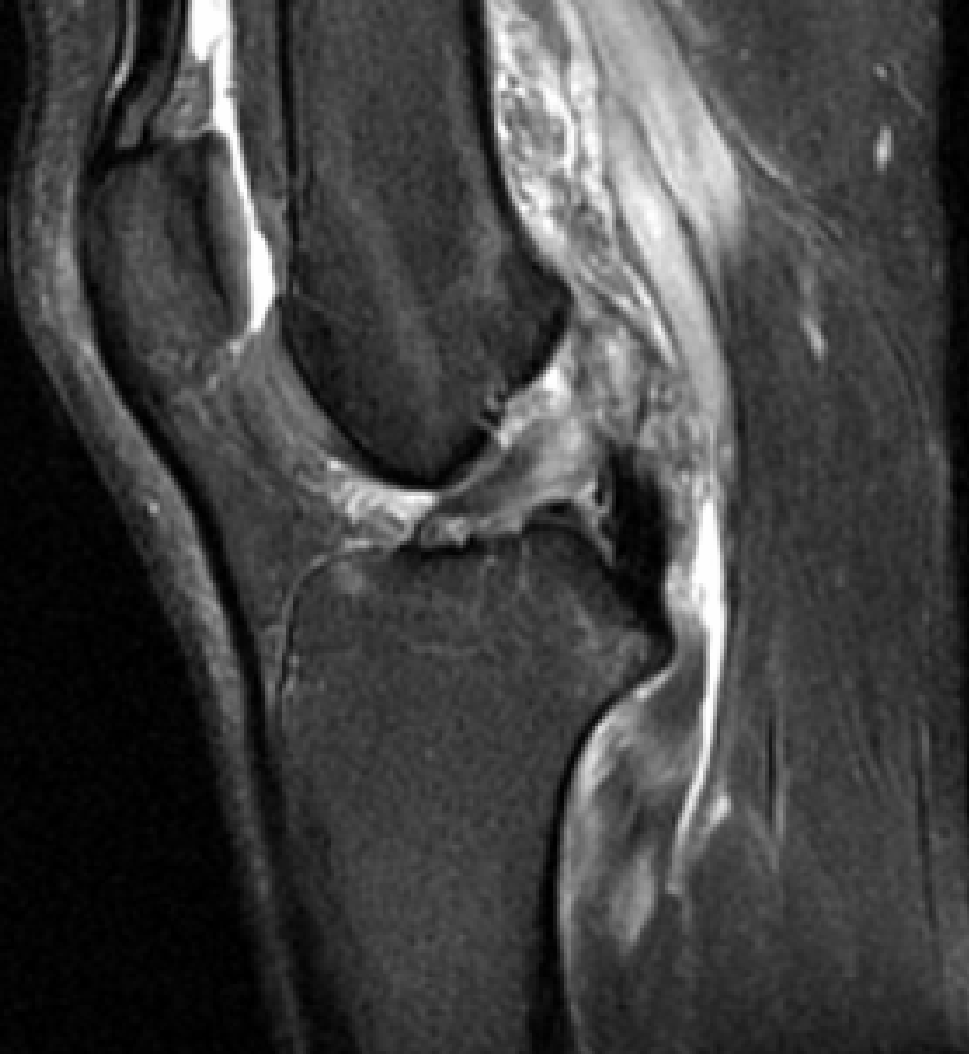
## Prepatellar bursitis



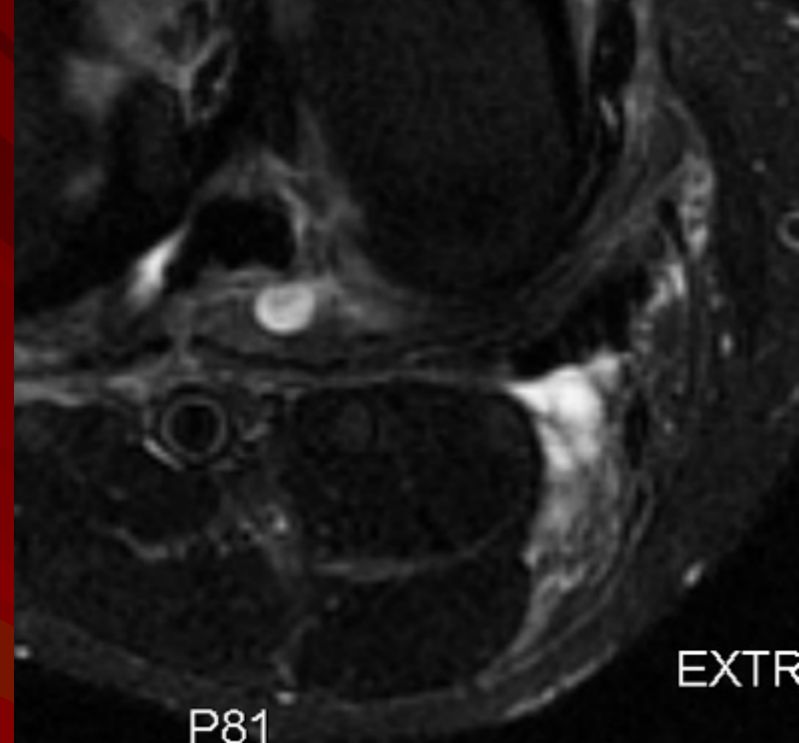
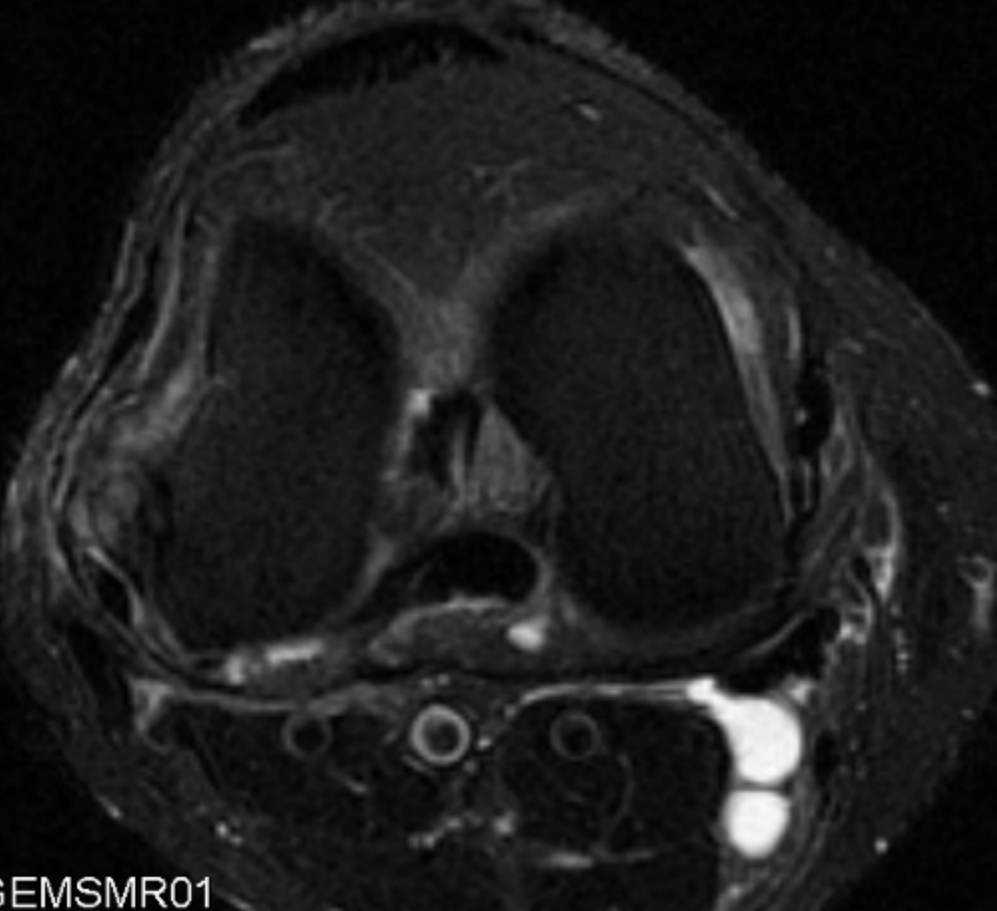


**Popliteus tendon**

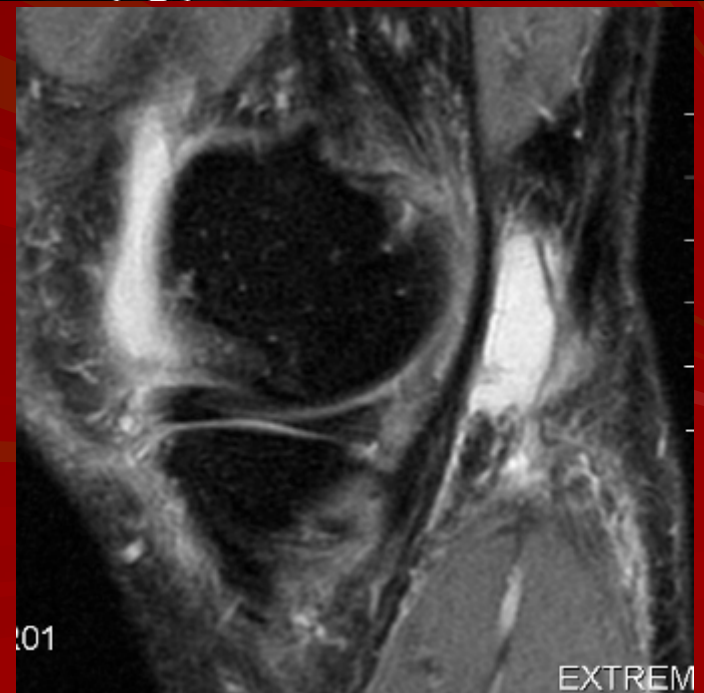


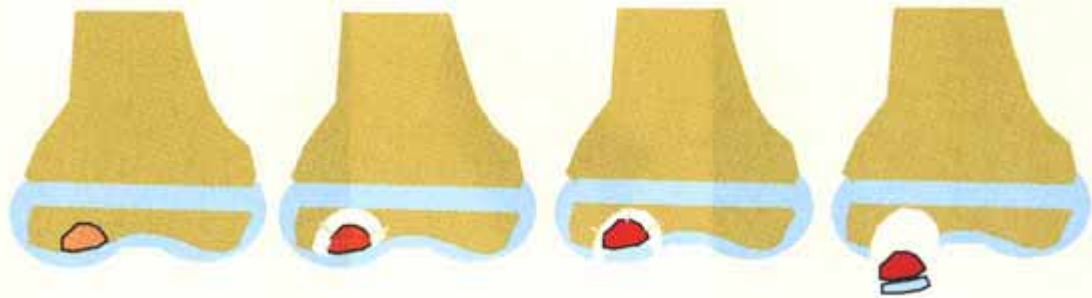


**Popliteus muscle injury**

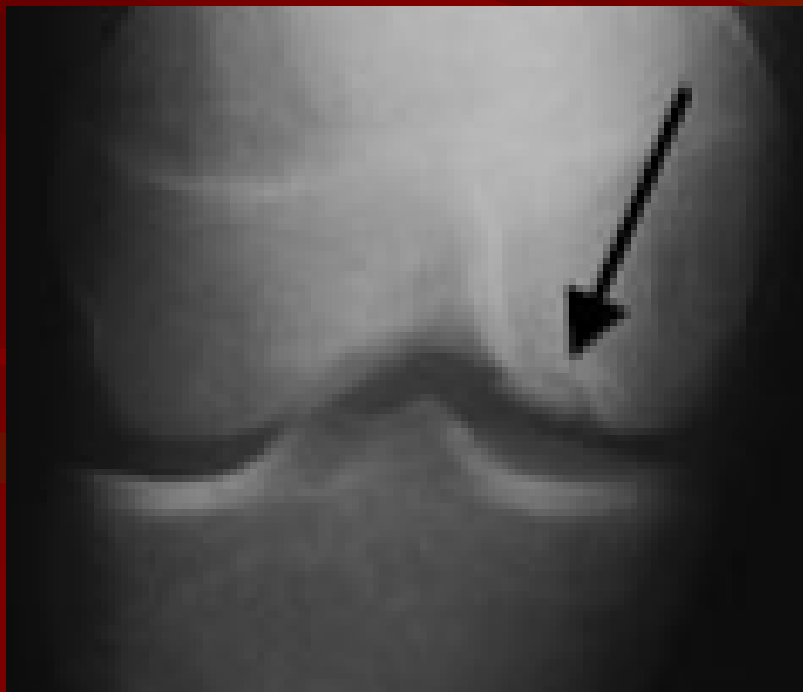


## Baker's Cyst





OCD





## **MRI classification of OCD:**

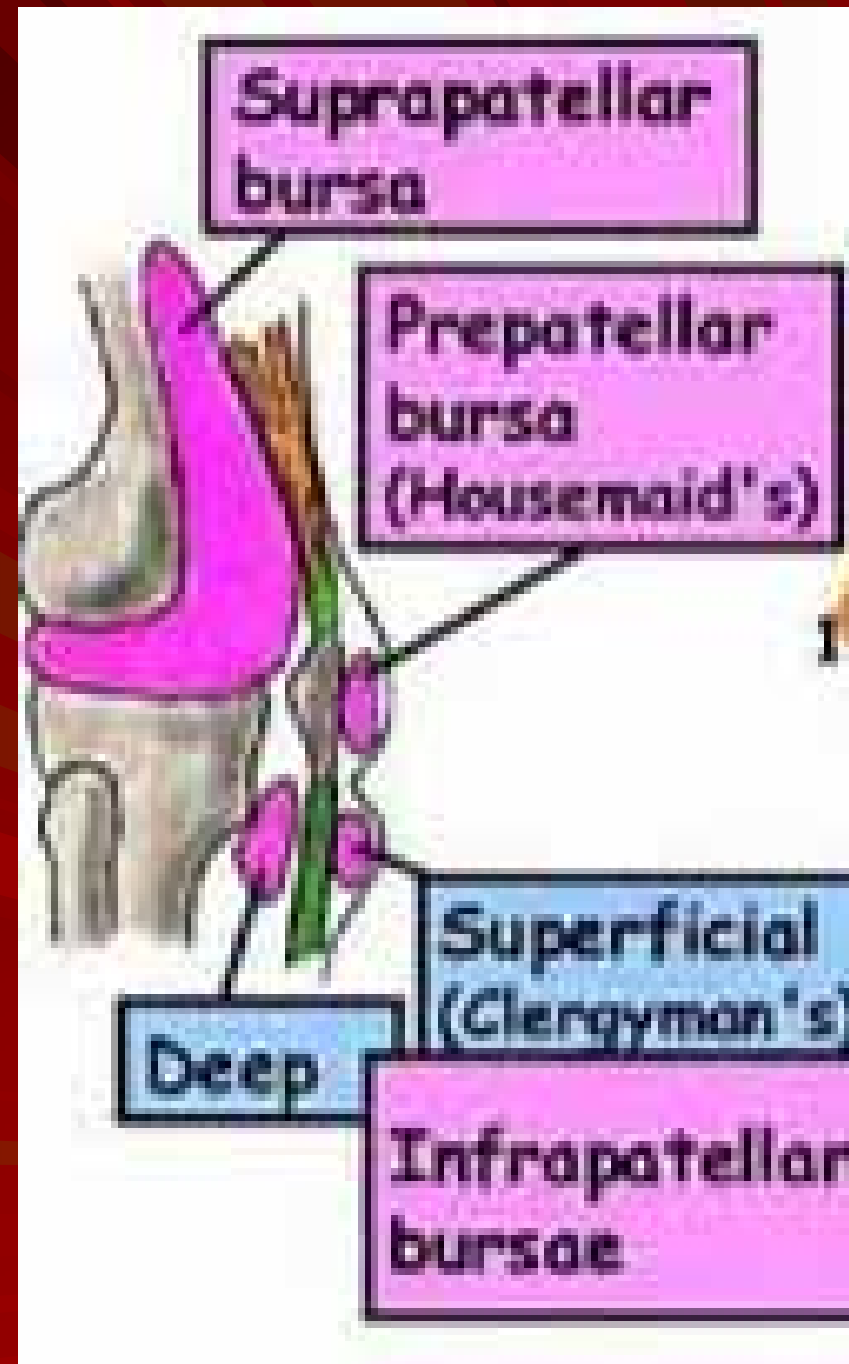
- I. Marrow edema (stable).
- II. Articular cartilage is breached. Low-signal rim surrounding fragment indicates fibrous attachment(stable).
- III. Pockets of fluid around undetached and undisplaced osteochondral fragment (unstable).
- IV. Displaced osteochondral fragment (unstable).

# Osgood-Schlatter's disease



## Knee Bursae

- Prepatellar
- Infrapatellar, deep & superficial
- Suprapatellar
- Pes anserine
- MCL
- SM-Gastroc.(Baker's)
- SM-TCL



## Summary:

- Evaluate menisci in at least 2 planes, be specific about location and type of tear, look for BHT in the notch.
- Know the anatomic pitfalls for meniscal tear
- Recognise signs of partial ACL tears. Do not miss PCL tears
- Remember to look for popliteus and PLC injuries.



...and the rewards!

BELIEVE IN YOURSELF!!





**Thank You**