



Imaging for patellofemoral instability

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Background



- ▶ **Patellofemoral instability** is the clinical syndrome due to morphologic abnormalities in the patellofemoral joint where the patella is prone to recurrent lateral dislocation.
- ▶ Most patients with patellar instability are young and active individuals, especially females in the 2nd decade.
- ▶ Prevalence is 6-77 per 100,000 population.



Background

- ▶ The normal patellofemoral joint has two kinds of stabilizers –
 - ▶ **active stabilizers** (extensor muscles)
 - ▶ **passive stabilizers** (bones and ligaments):
 - ▶ bone stabilizers: deep femoral sulcus, high lateral trochlea
 - ▶ ligament stabilizers: medial patellofemoral retinaculum, medial patellofemoral ligament
- ▶ The most common mechanism of first-time patellar dislocation is internal rotation of the femur relative to the knee (i.e. exorotation of the tibia relative to the femur) while the foot is planted and the knee is flexed.

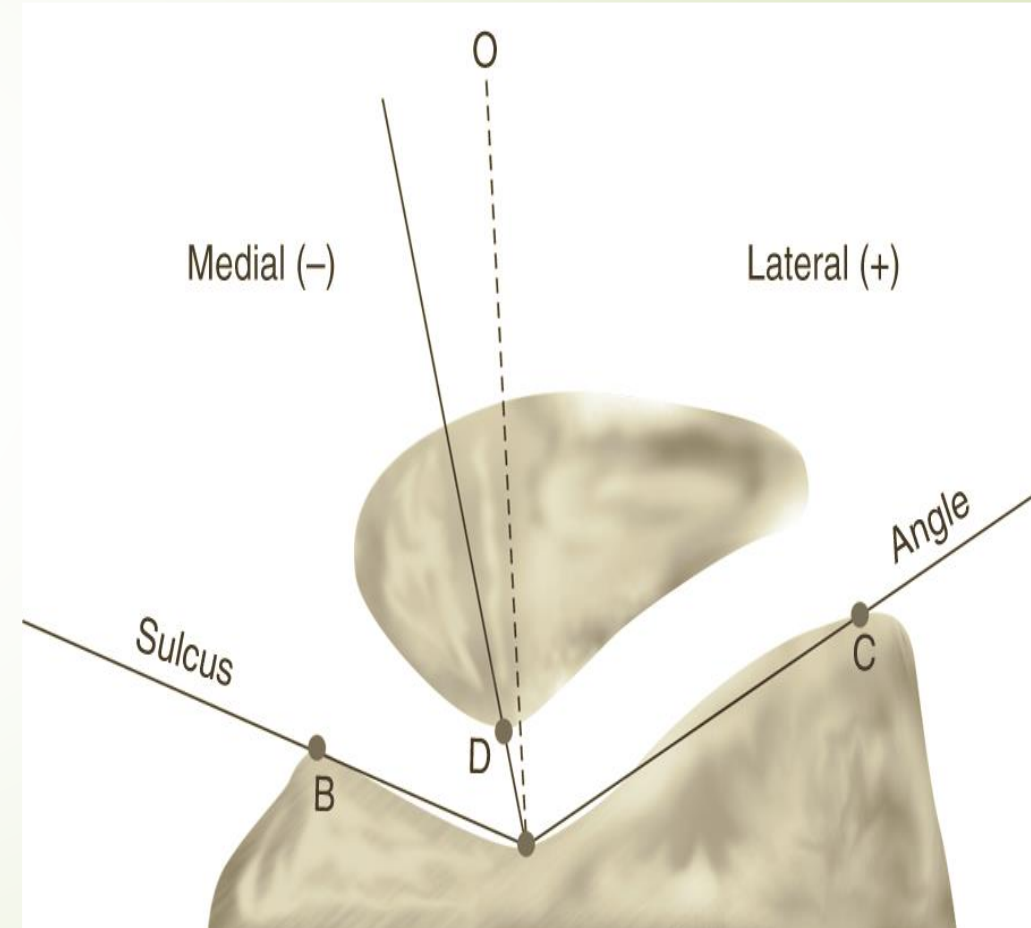


Background

- ▶ Three major morphologic abnormalities which predispose to patellar instability are:
 - ▶ trochlear dysplasia
 - ▶ patella alta
 - ▶ lateralization of the tibial tuberosity
- ▶ Other factors contributing to patellar instability are increased femoral anteversion, **ligament or retinaculum injury** or laxity (Ehler-Danlos syndrome, Marfan syndrome) or abnormal muscle tone.

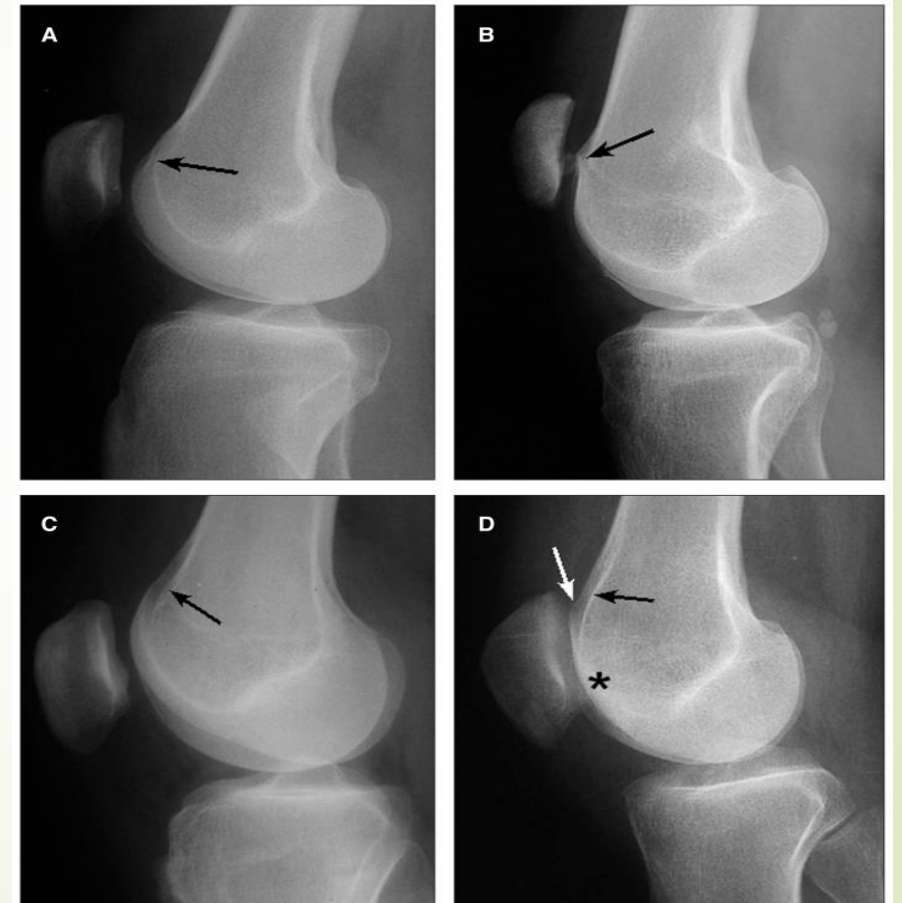
Plain radiographs

- ▶ AP views to assess alignment
- ▶ Lateral views
 - ▶ patellar height
 - ▶ Trochlear dysplasia
 - ▶ Loose bodies
- ▶ Axial views (20 degrees) to assess tilt or subluxation
- ▶ Sulcus angle (> 144)
- ▶ Congruence angle (-16)



Trochlear dysplasia

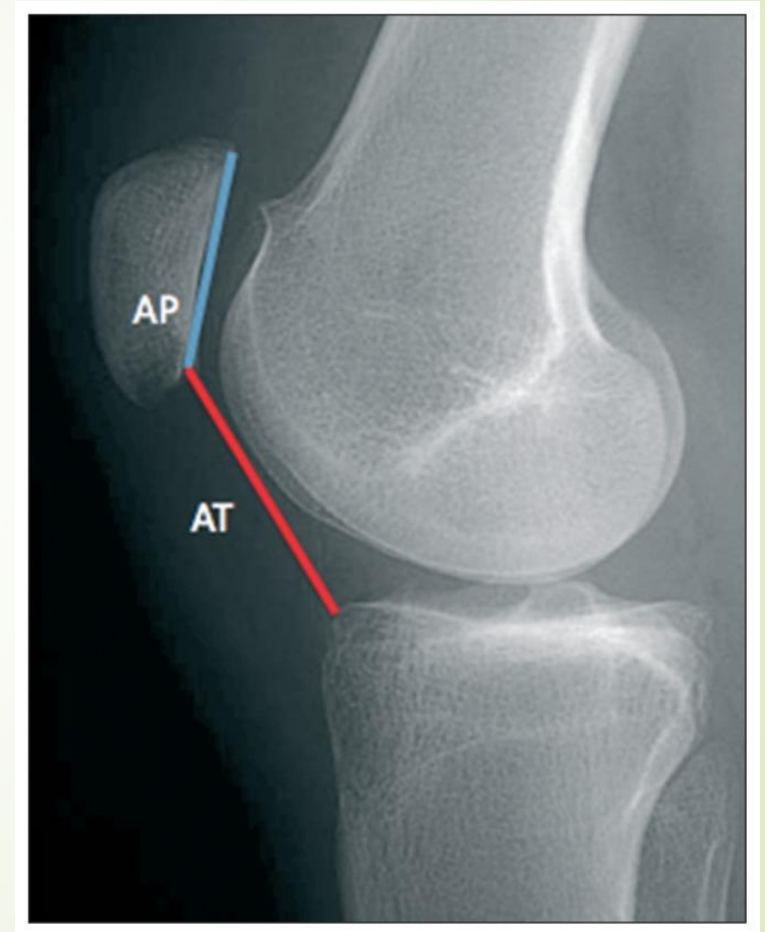
- ▶ **Radiographic classification of trochlear dysplasia**, according to the Lyonnaise School
- ▶ **Type A:** the line of the trochlear groove is seen to intersect the anterior border of one of the condyles (“crossing sign”)
- ▶ **Type B:** it is possible to see the so-called supratrochlear spur.
- ▶ **Type C:** it is possible to observe a “double contour” which represents a neo-articulation formed between the patella and a severely dysplastic trochlea.
- ▶ **Type D:** all three signs of dysplasia are present (“crossing sign”, double contour and spur), while on CT images the trochlea is shaped like a camel’s hump.



Patellar height

► The Caton-Deschamps index

- is the most reliable, as it is the one least influenced by the degree of knee flexion.
- represents the ratio of the distance between the lowest point of the articular surface of the patella and the tibial articular surface to the length of the entire articular surface of the patella (i.e. excluding the apex)
- Patella alta when this ratio is greater than 1.2.



CT scan

- ▶ **the TT-TG value (>20 mm)**
- ▶ **patellar tilt**
- ▶ **femoral and tibial torsion angles.**





CT scan

- ▶ **TT-TG**

- ▶ is the distance in mm between the tibial tuberosity and the deepest point of the trochlear groove
- ▶ > 20 mm is considered pathological

- ▶ **Patellar tilt,**

- ▶ which is calculated on an axial CT scan with the quadriceps relaxed and contracted
- ▶ is the measure of the angle formed at the intersection between the major axis of the patella and the line connecting the two most posterior points of the femoral condyles
- ▶ The mean of the values measured in the two conditions (relaxed and contracted) is considered pathological if it exceeds 20 degrees, as this is an indication of medial patellofemoral ligament insufficiency.



CT

► **Femoral torsion**

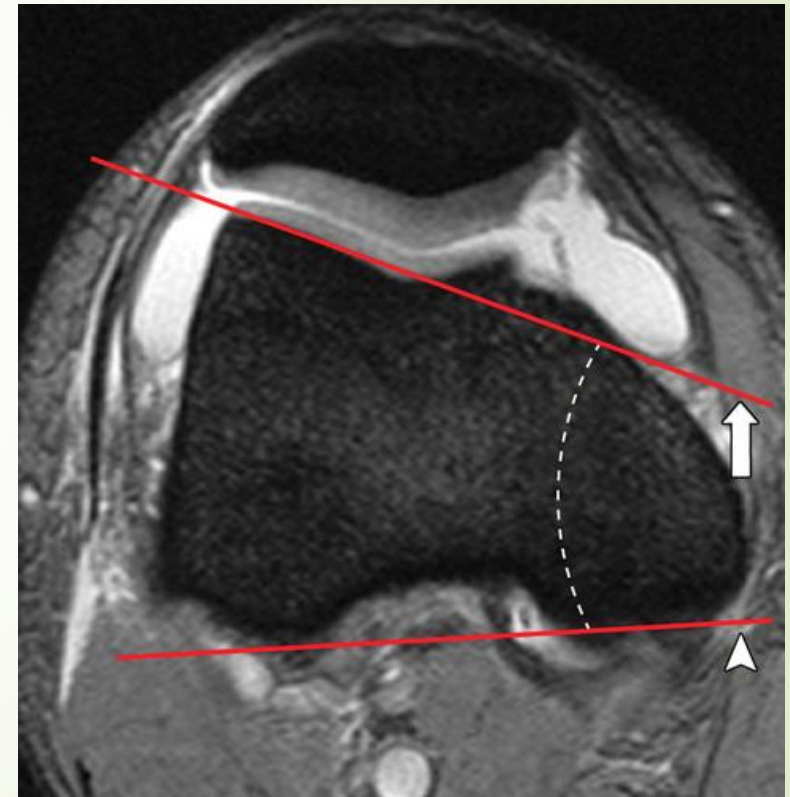
- is the measure of the angle formed between a line running through the center of the femoral head and the center of the femoral neck at its junction with the diaphysis and the posterior bicondylar line.
- The mean value of this angle measured using these landmarks is 13 degrees of femoral anteversion.

► **Tibial torsion**

- is measured between the knee flexion-extension axis and the ankle joint axis. Since the reproducibility of the measurement at tibial level is uncertain, femoral references, such as the transepicondylar axis or the posterior bicondylar line, are often used
- Mean values (30–35 degrees) show considerable gender- and ethnic-related variability.

MRI

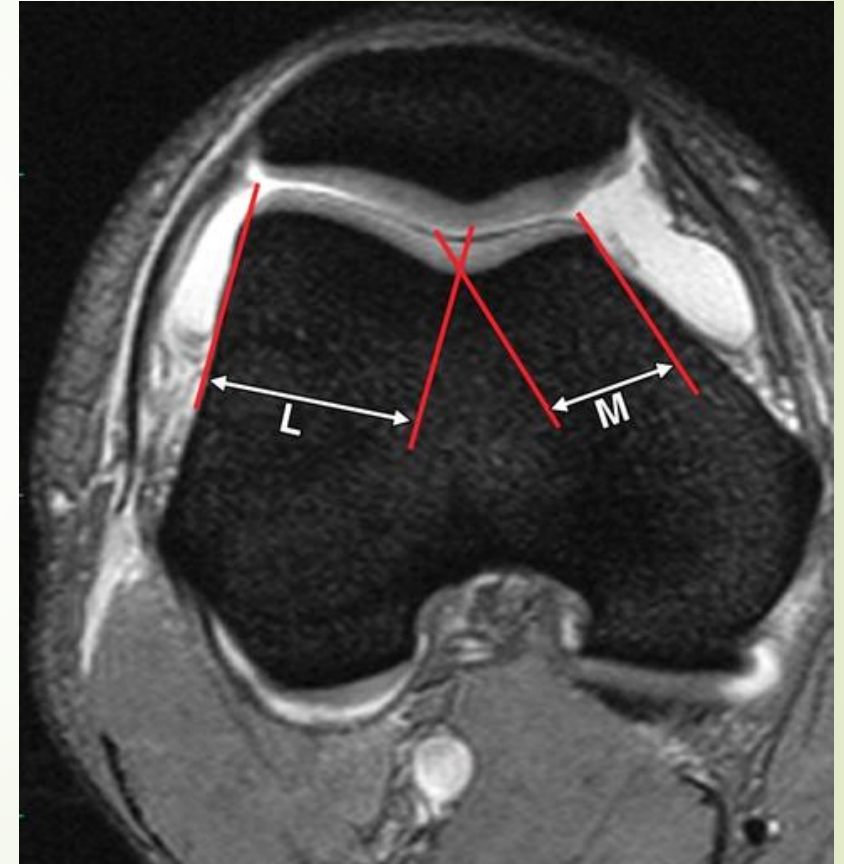
- ▶ **Lateral trochlear inclination**
 - ▶ is the angle formed between the plane of the lateral trochlear facet subchondral bone and a tangential line through posterior femoral condyles
 - ▶ An angle of $<11^\circ$ is considered abnormal



MRI

▶ Trochlear facet asymmetry

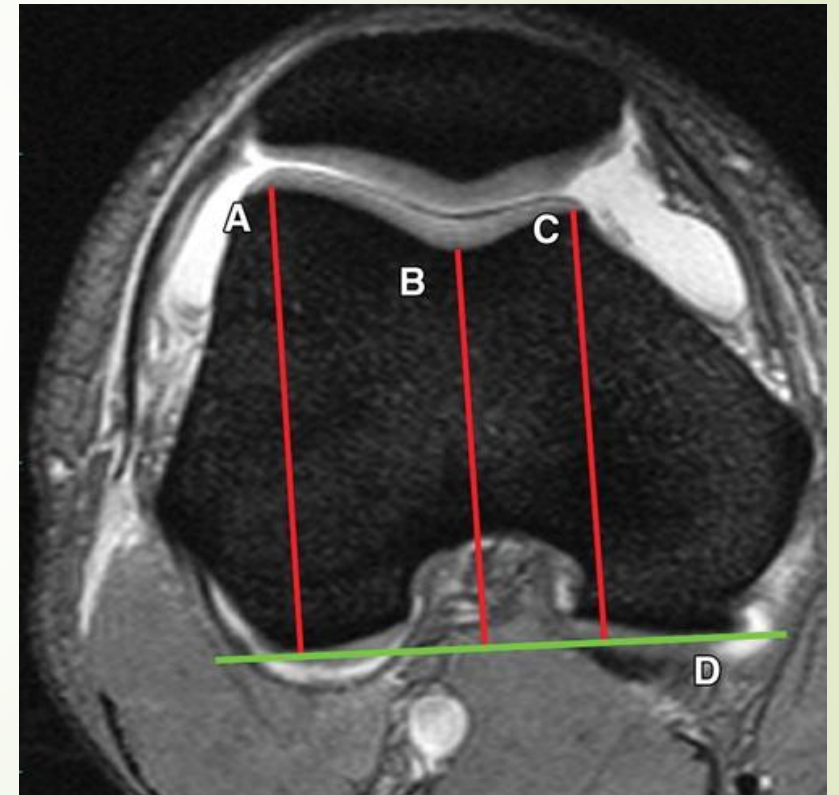
- ▶ This is the ratio of medial trochlear facet width to lateral trochlear facet width and measured in the axial plane.
- ▶ A ratio of **<0.4** is considered abnormal (i.e. it is abnormal if the medial facet is <40% the width of the lateral facet).



MRI

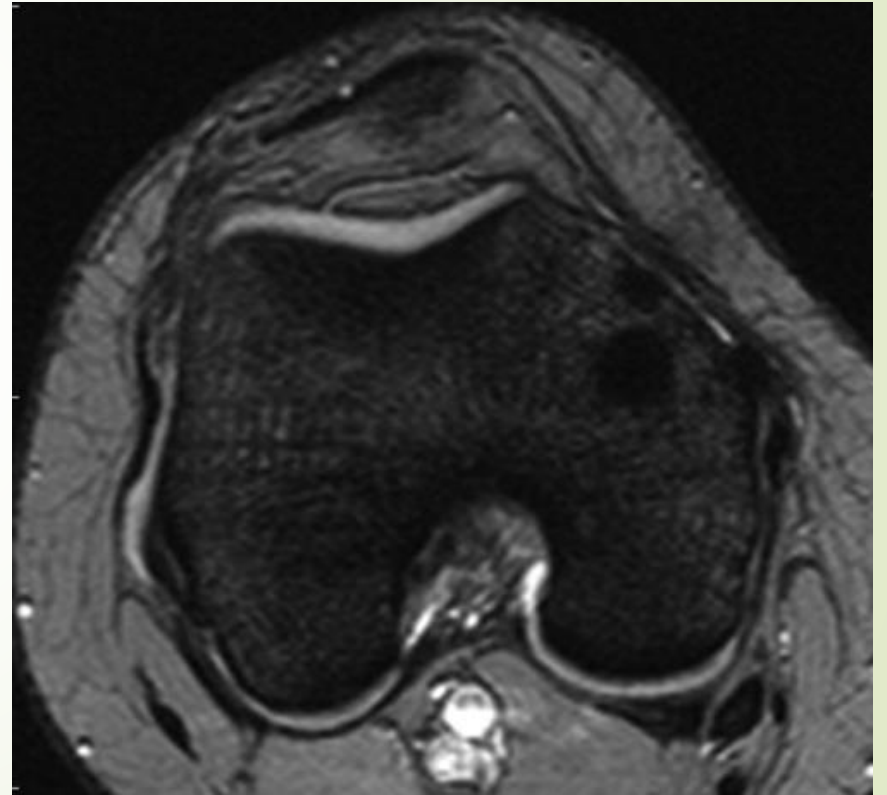
➤ Trochlear depth

- This measures the inset depth of the trochlear groove (sulcus) relative to the mean of the medial and lateral femoral condyle outlets.
- A trochlear depth of **<3 mm** is considered abnormal.



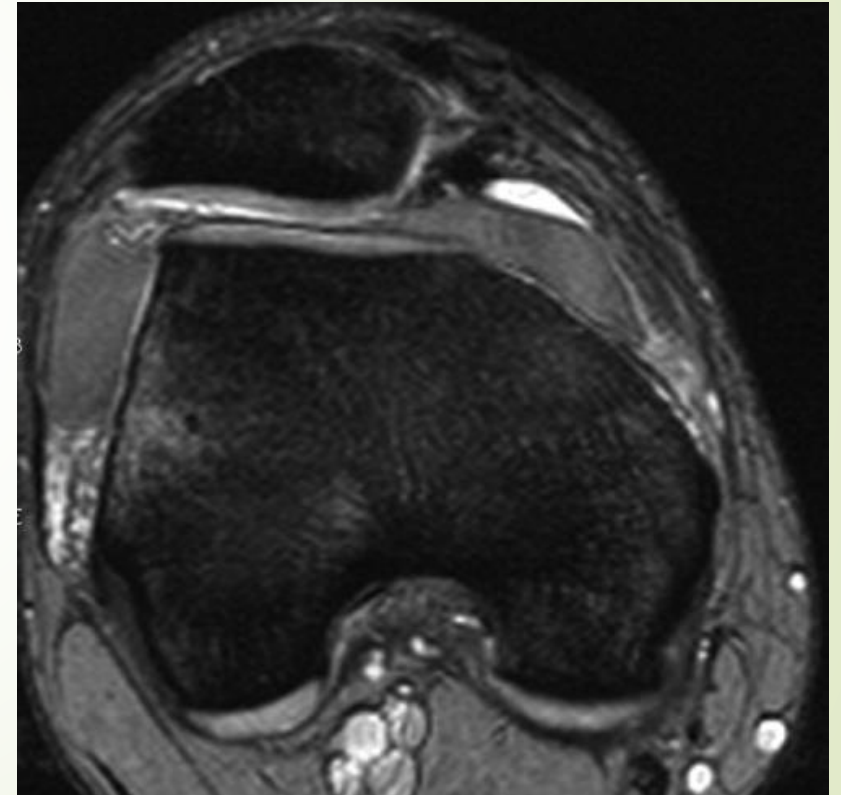
Dejour classification for trochlear dysplasia

- ▶ **type A dysplasia:** Trochlear morphologic structures are preserved, but the sulcus is shallow.



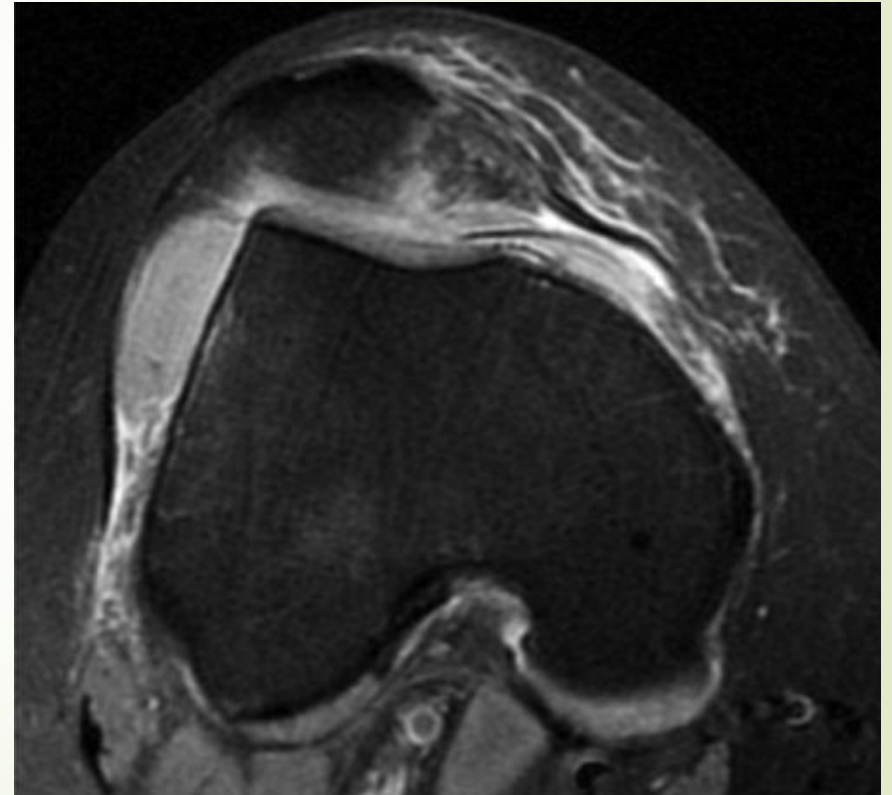
Dejour classification for trochlear dysplasia

- ▶ **type B dysplasia:** flat, horizontally oriented trochlear joint surface.



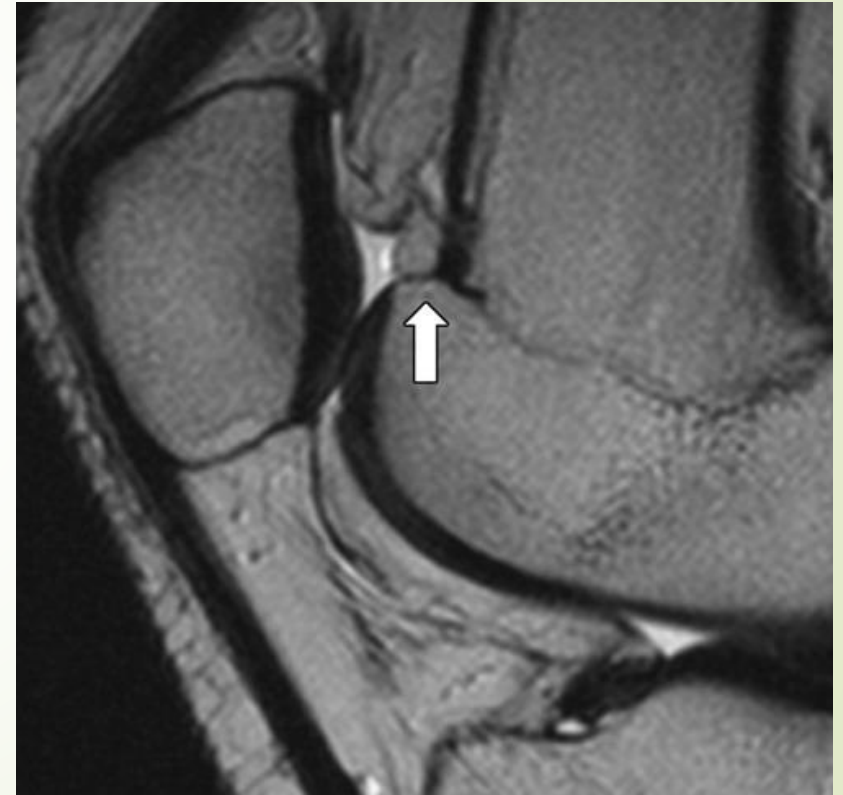
Dejour classification for trochlear dysplasia

- ▶ **type C dysplasia:** flat, obliquely oriented trochlear joint surface with facet asymmetry.



Dejour classification for trochlear dysplasia

- ▶ **type D dysplasia:** same as type C but with a prominent bone protrusion (arrow) on the parasagittal view (cliff pattern).



MRI

► Patella alta

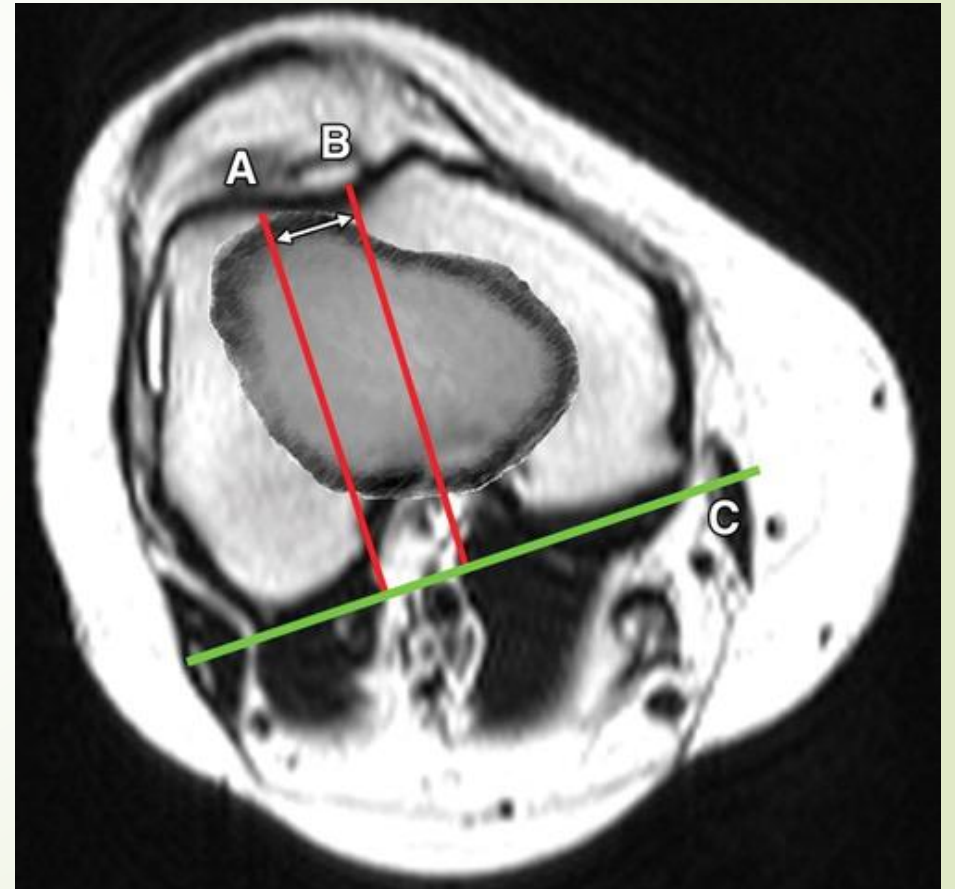
- Insall-salvati index (**>1.2**)
- Patellar tendon (46mm)



MRI

▶ TT-TG distance

- ▶ advocated as an accurate measure of patellar instability
- ▶ The distance from the tibial tuberosity to the trochlear groove is measured parallel to the tangential line through posterior femoral condyles.
- ▶ **>20 mm** is considered abnormal
- ▶ The distance has been shown to be slightly less when measured on MRI than CT.





MRI

- knee joint effusion
- medial patellofemoral ligament tear
- bone contusion in patella and lateral condyle
- osteochondral defects in patella
- edema/hemorrhage of vastus medialis
- intra-articular loose bodies
- internal derangement of knee



Conclusion

- Patellofemoral instability could be challenging
- Imaging plays important role
- MRI is the main and most accurate diagnostic modality
- Look for loose bodies
- Integrity of MPFL
- Assess anatomic **risk factors**
 - **Patella alta**
 - **TT-TG distance**
 - **Trochlear dysplasia**

THANK YOU

