14 year-old female with recurrent patellar instability

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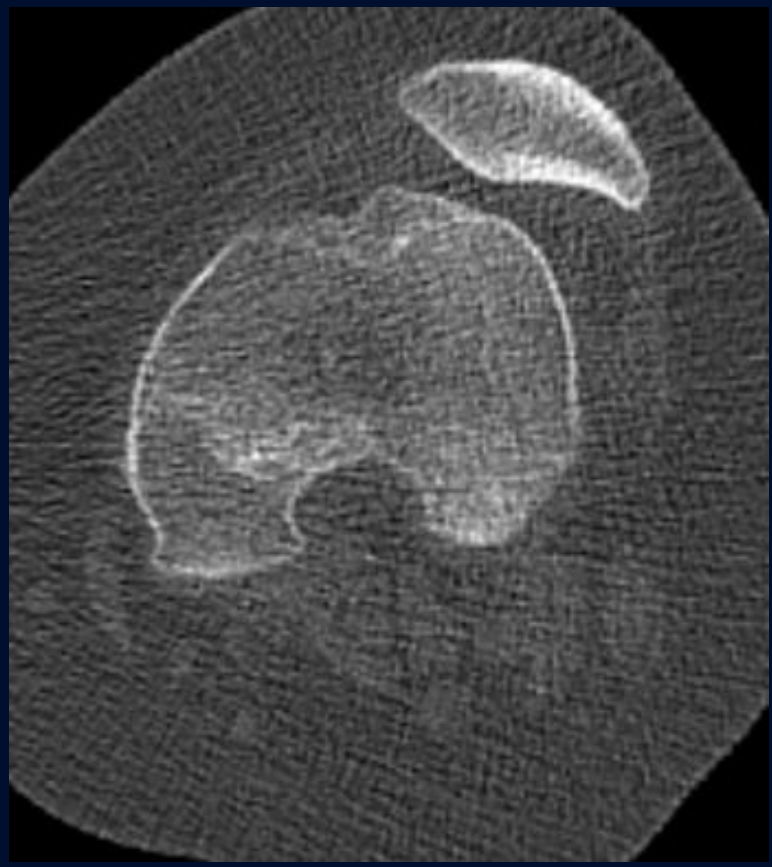
Right knee



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Right knee

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Patellar instability secondary to trochlear dysplasia and lateralized tibial tubercle

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Patellar instability 2/2 trochlear dysplasia and lateralized tibial tubercle

Patellar instability/maltracking and sometimes frank dislocation (as in this case) most frequently related to:

- Trochlear dysplasia
- Lateralization of the tibial tubercle
- Patella alta
- In this case, we see trochlear dysplasia and lateralization of the tibial tubercle.

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Trochlear dysplasia

Identified by:

- Flattening of trochlear joint surface proximally
- Concavity less pronounced distally
- Combination results in loss of lateral patellar tracking and lateral dislocation of the patella at the initiation of flexion
- Severe cases can have convexity of the trochlea (Dejour classification)

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Trochlear dysplasia

Measured on axial MR or CT by:

- Trochlear depth
- Lateral trochlear inclination
- Trochlear facet asymmetry
- Trochlear sulcus angle

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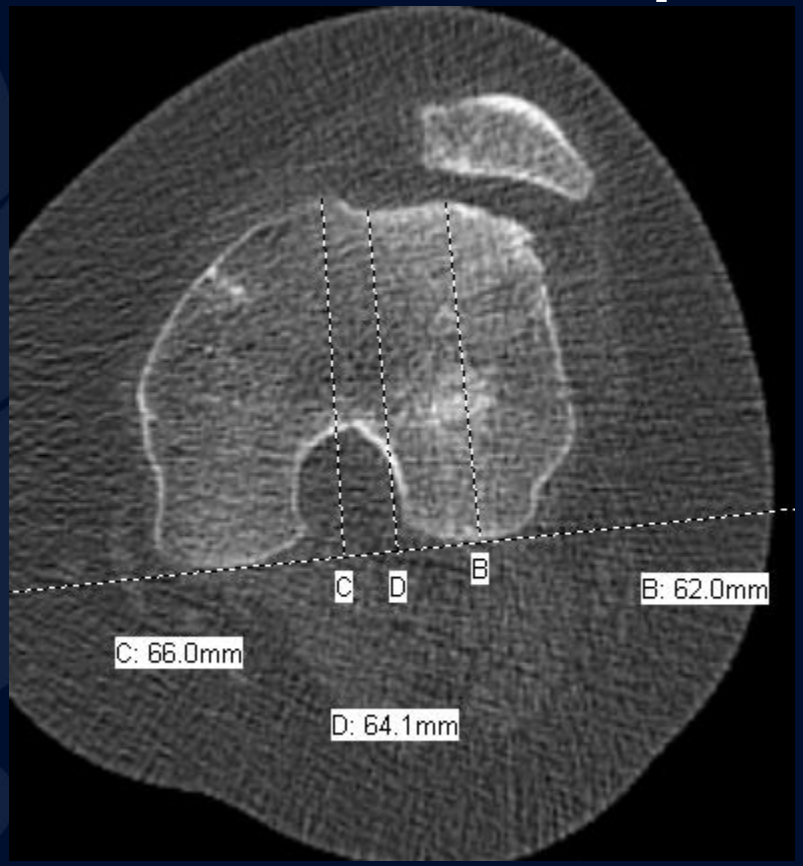
Trochlear depth



A line drawn parallel to the posterior aspect of the femoral condyles serves as a reference line. The lines drawn perpendicular to the reference line indicate the largest anteroposterior diameters of the lateral (line B) and medial (line C) trochlear facets and the deepest point of the sulcus (line D). Trochlear depth is calculated as follows: (B + C/2) − D. A trochlear depth of 3 mm or less is assumed to indicate dysplasia.

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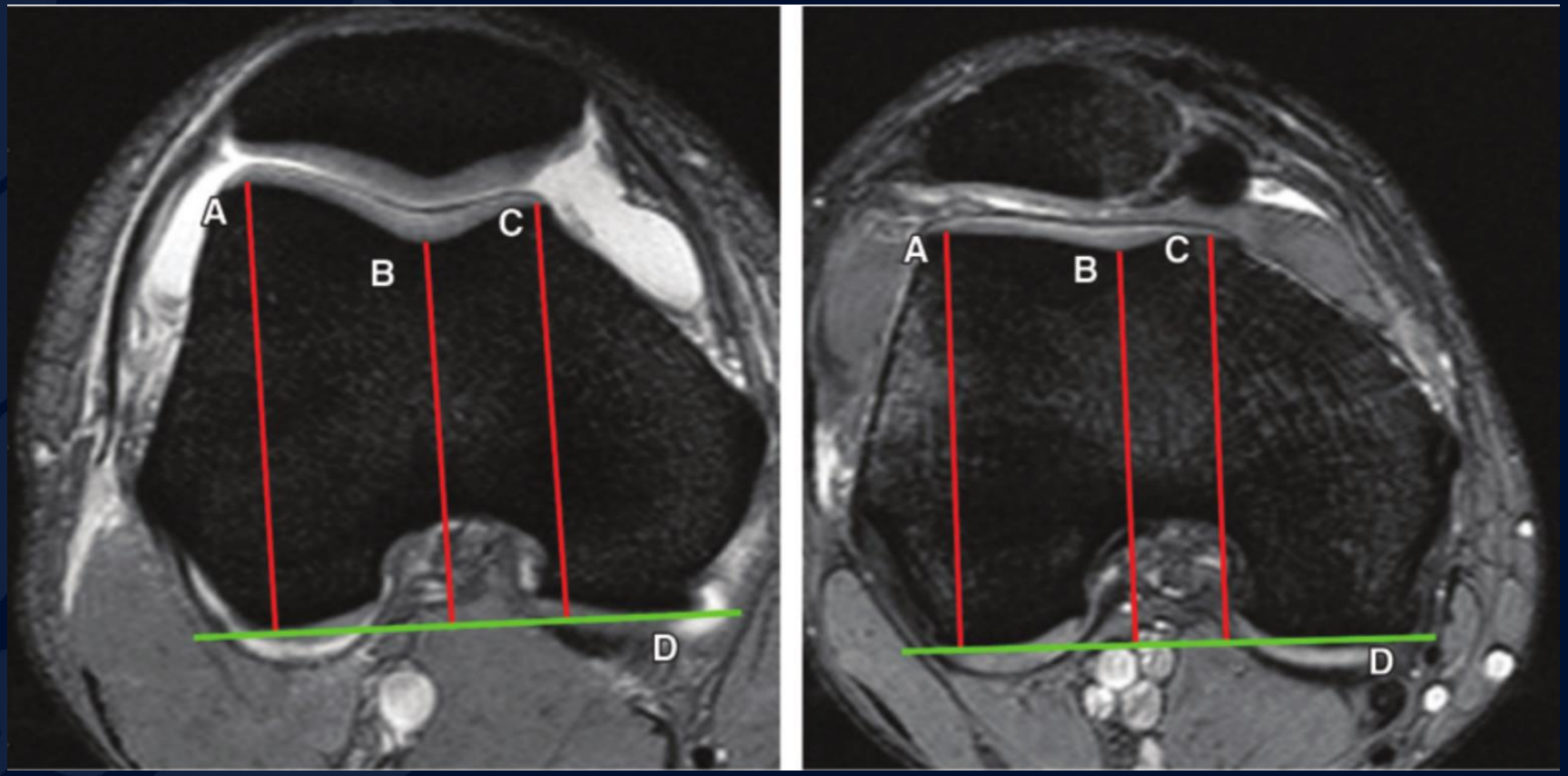
Trochlear depth



A line drawn parallel to the posterior aspect of the femoral condyles serves as a reference line (line D). The lines drawn perpendicular to the reference line indicate the largest anteroposterior diameters of the lateral (line A) and medial (line C) trochlear facets and the deepest point of the sulcus (line B). Trochlear depth is calculated as follows: (A + C/2) − B. A trochlear depth of 3 mm or less is assumed to indicate dysplasia.

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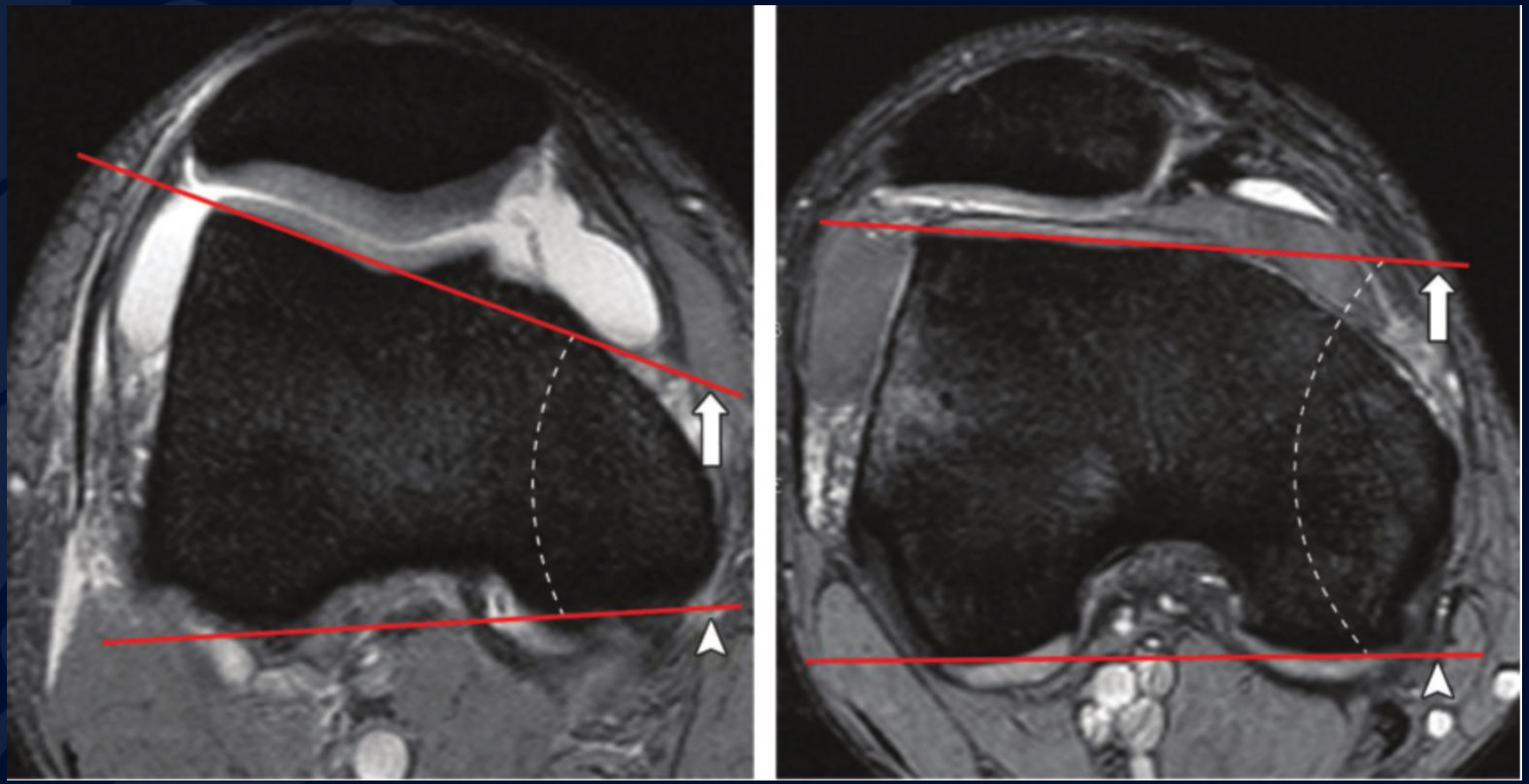
Lateral trochlear inclination



A line (arrow) is drawn along the subchondral bone of the lateral trochlear facet, and a second line (arrowhead) is drawn along the posterior aspect of the femoral condyles. The angle between the two lines is the inclination angle (dashed line). An inclination angle of less than 11° indicates trochlear dysplasia.

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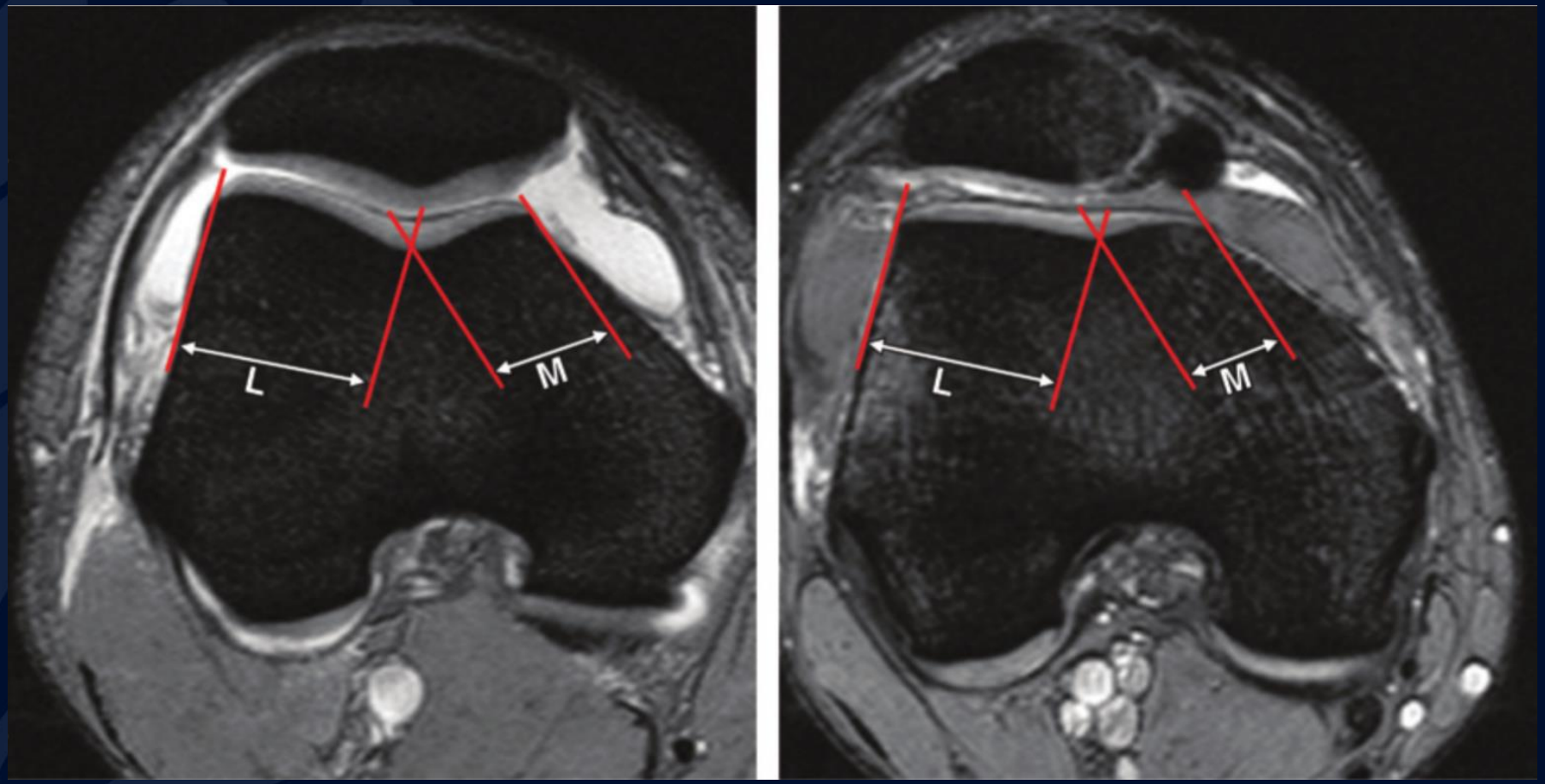
Trochlear facet asymmetry



Asymmetry of the medial facet length (M) and the lateral facet length (L) is calculated as the ratio of the medial facet length divided by the lateral facet length expressed as a percentage (M/L × 100%). A trochlear facet ratio of less than 40% indicates dysplasia.

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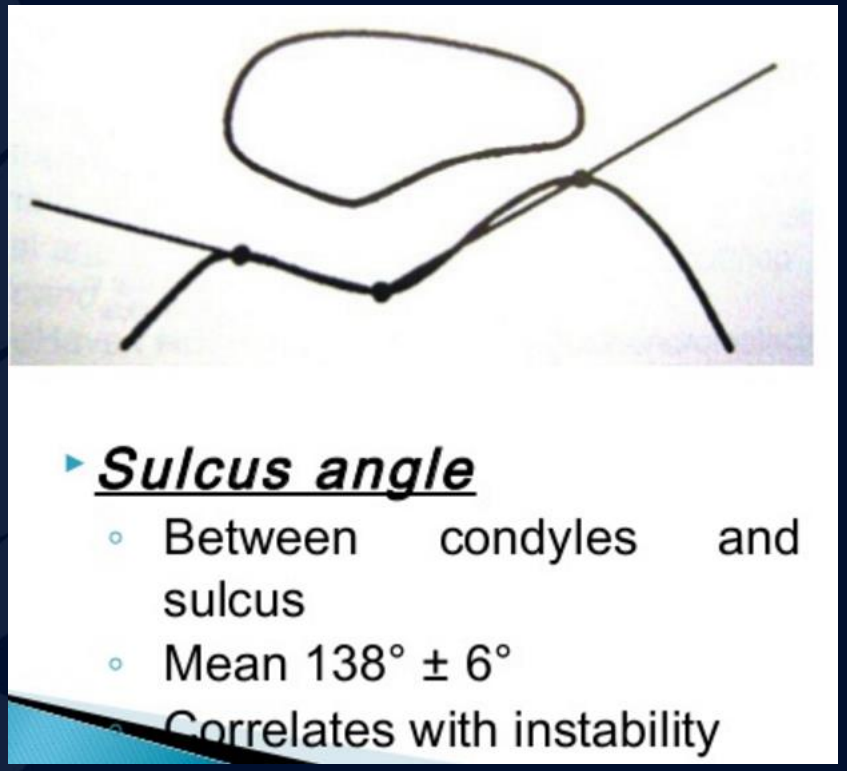
Trochlear sulcus angle



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Trochlear dysplasia

Surgically corrected with trochleoplasty.

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Lateralization of the Tibial Tubercle

Alters downward force vector on patella during flexion to a more lateral vector, predisposing to maltracking/dislocation.

Measured on axial MR or CT by:

- TT-TG distance
  - Horizontal distance in transverse-axial dimension from midpoint of tibial tubercle to deepest point of trochlear groove.
    - >20 mm diagnostic of abnormal lateralization
    - 15-20 mm considered borderline

Surgically corrected with tibial tubercle transfer osteotomy; basically moves tibial tubercle and patellar tendon attachment to a more medial/midline position.

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Lateralization of the Tibial Tubercle

Tibial tubercle – trochlear groove distance ~ 29

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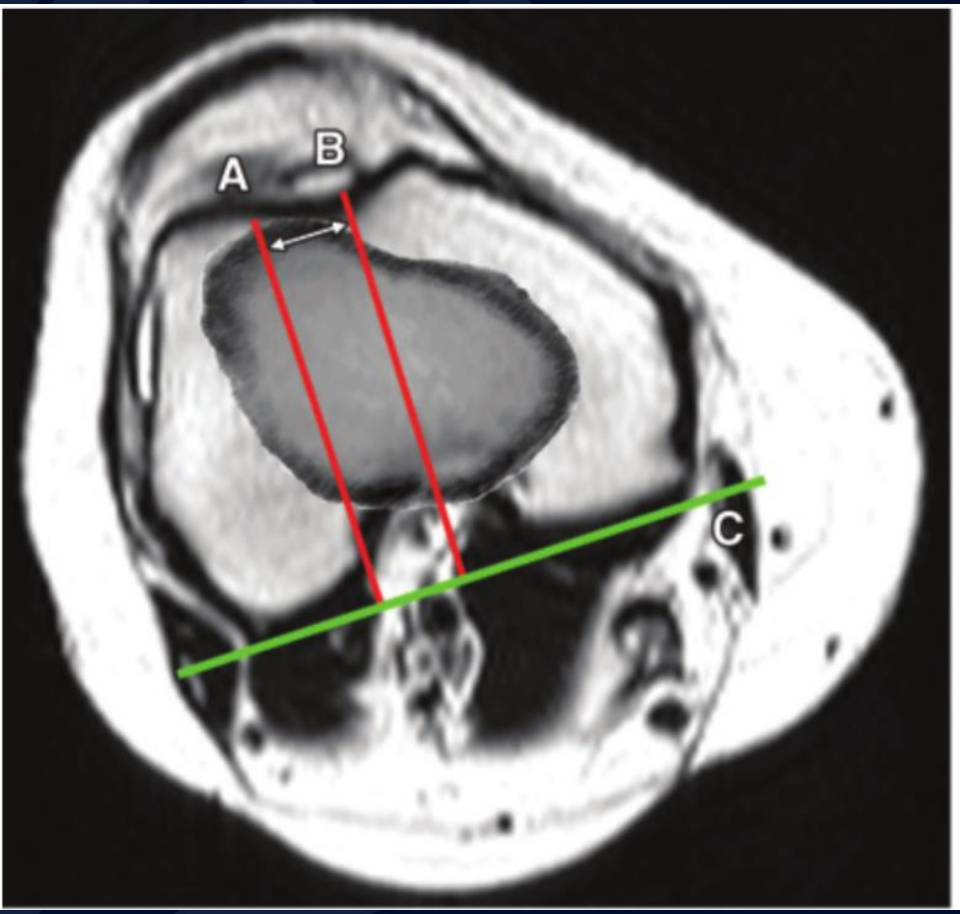
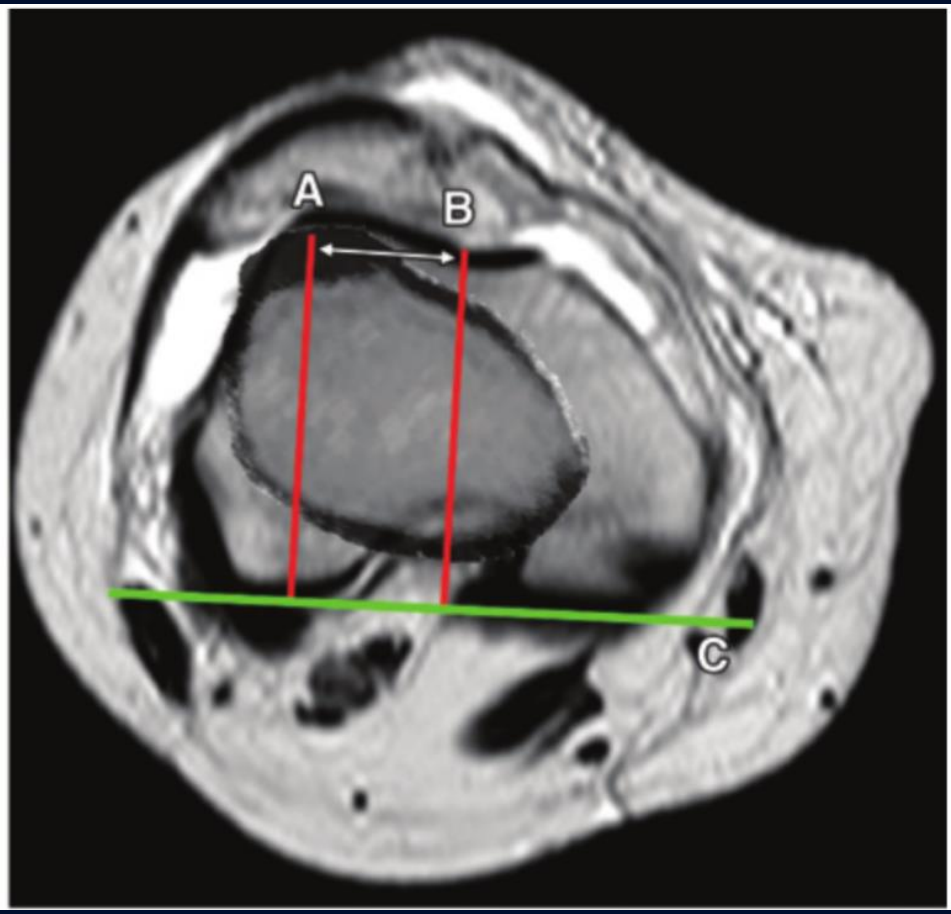
Lateralization of the Tibial Tubercle





The distance (double-headed arrow) from the deepest point of the trochlea (line B) to the middle of the tibial tubercle (line A) is measured, again by using the posterior plane of the condyles as the reference line (line C). A distance between the tibial tubercle and the trochlear groove of less than 15 mm is considered normal. Distances between 15 and 20 mm are borderline, and distances of more than 20 mm indicate marked lateralization of the tuberosity.

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Patella alta

- Defined by a high-positioned patella at 30 degrees knee flexion.
- Measured using the patellar height ratio on sagittal CT or MR. aka Insall-Salvati ratio on radiograph.
- (Patellar tendon length)/(longest CC dimension of patella)
- >1.3 = patella alta.
- Can also be surgically corrected with tibial tubercle transfer (downward transfer).

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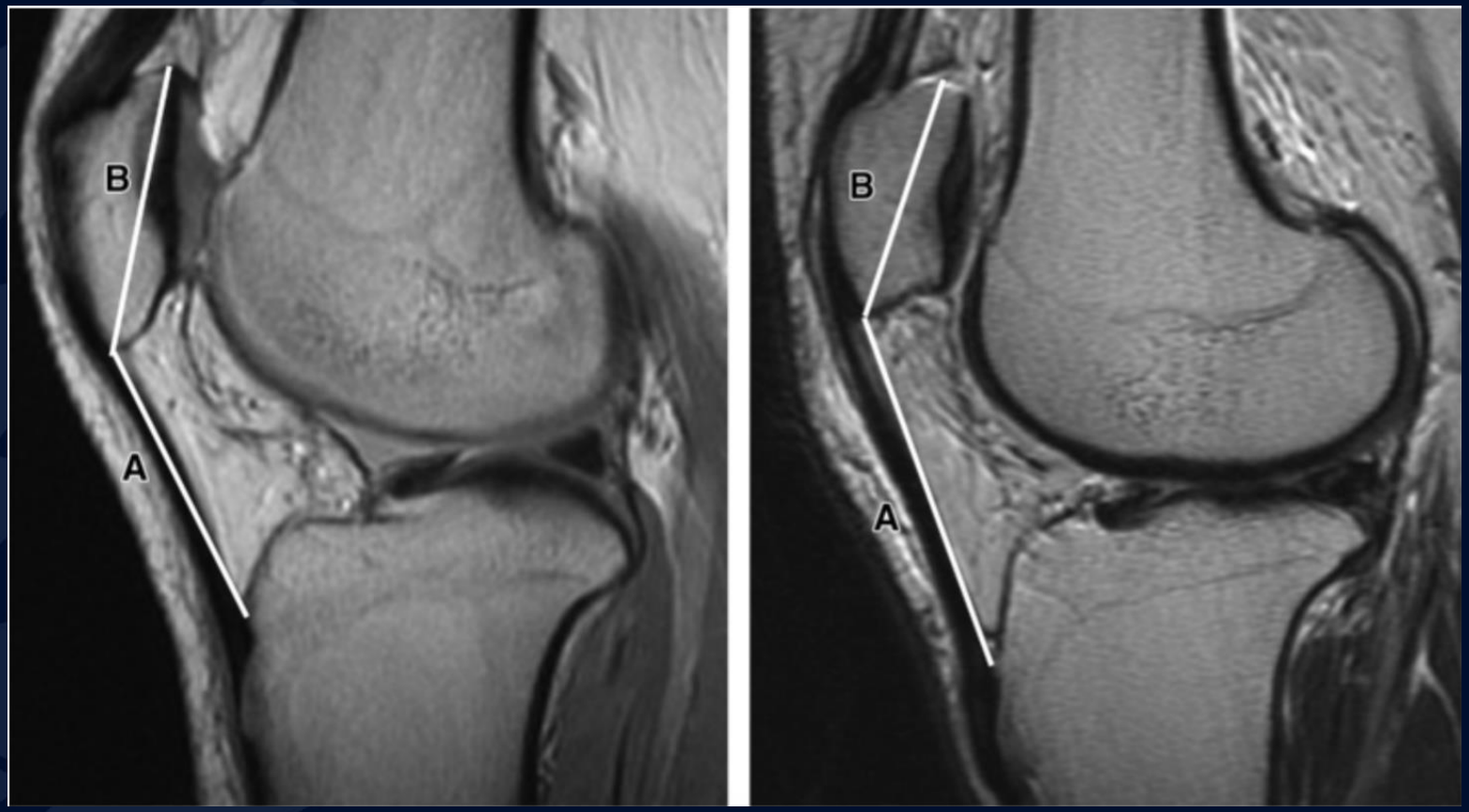
Patella alta



The length of the patellar tendon (line A) is measured posteriorly from the patellar apex to its attachment to the tibial tuberosity and is divided by the longest superoinferior diameter of the patella (line B) to obtain the patellar height ratio (PHR), as follows: PHR = A/B. A patellar height ratio of more than 1.3 indicates a high-riding patella (patella alta)

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Measurements in this case:

RIGHT KNEE:

Patellar height ratio: 1.4
TT-TG distance (mm): 20
Trochlear depth (mm): 2
Trochlear sulcus angle: 142

LEFT KNEE:

Patellar height ratio: 1.5
TT-TG distance (mm): 23
Trochlear depth (mm): 2
Trochlear sulcus angle: 146

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References

1. Diederichs G, Issever AS, Scheffler S. MR imaging of patellar instability: injury patterns and assessment of risk factors. Radiographics. 2010;30(4):961-981.
2. https://www.slideshare.net/lostpebble/anterior-knee-pain-28573987

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