



**In The
Name Of
God**

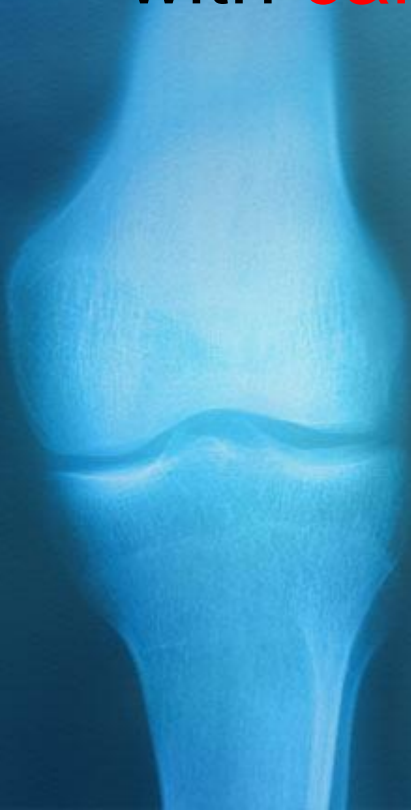
**Dr.R.jokar. MD- orthopaedics
surgeon
Knee and sport surgery
fellow**

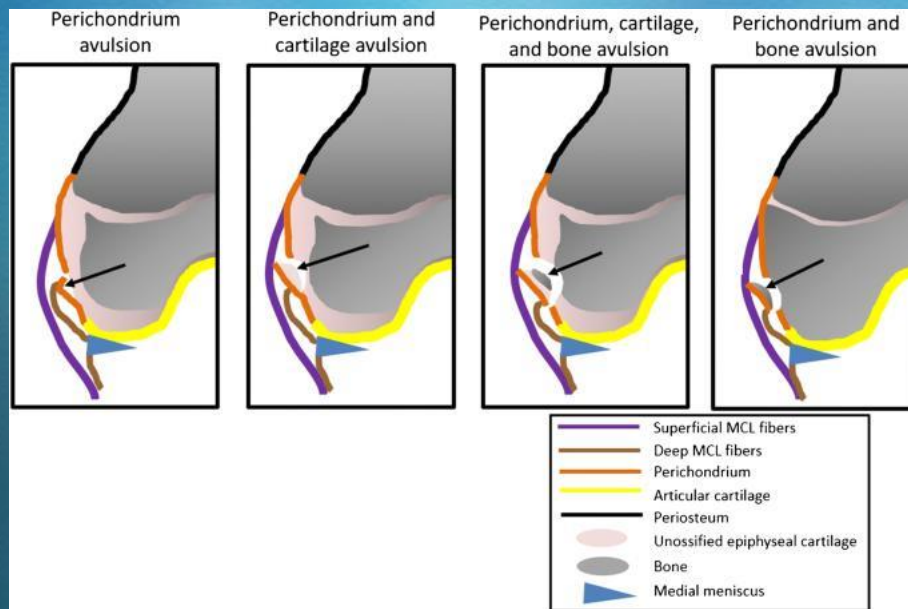
- **دکتر رحمت الله جوکار
متخصص ارتوپدی و فلوشیپ زانو
استادیار دانشگاه علوم پزشکی بابل**



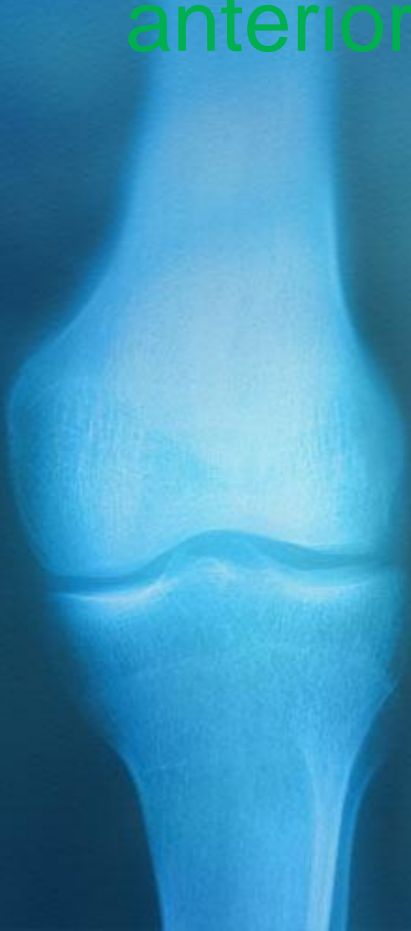
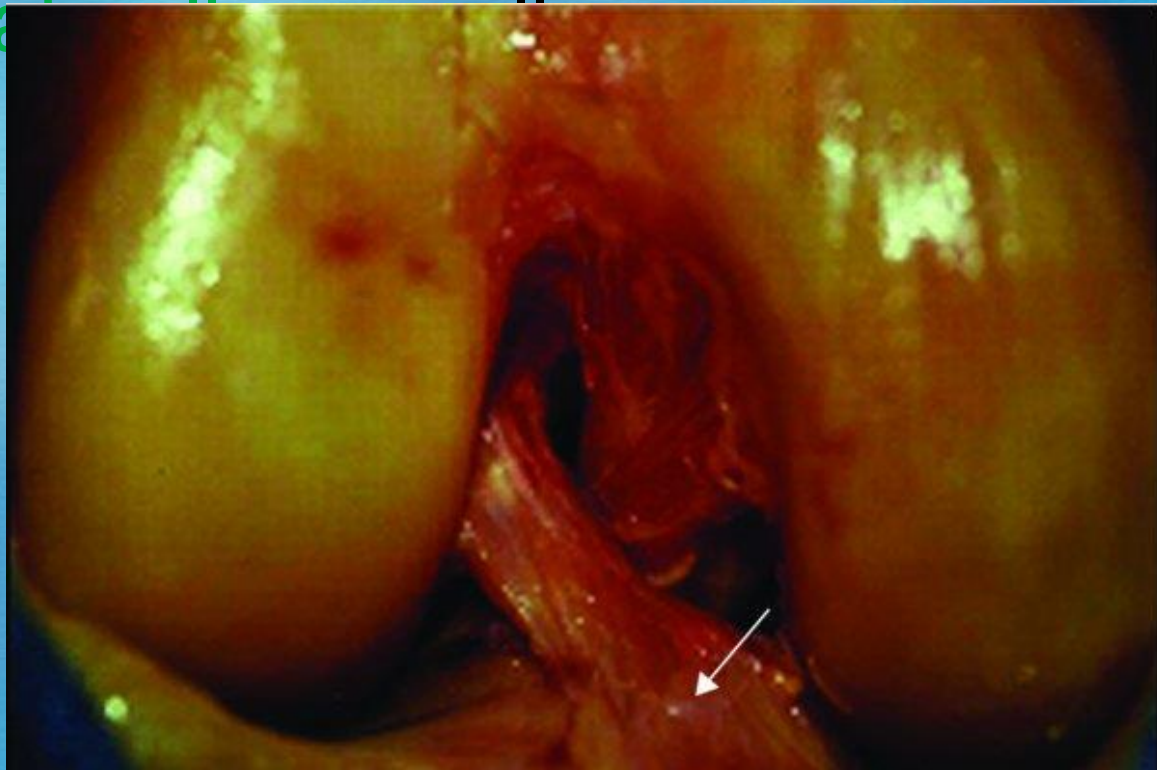
***Pathoanatomy and Applied
Anatomy***

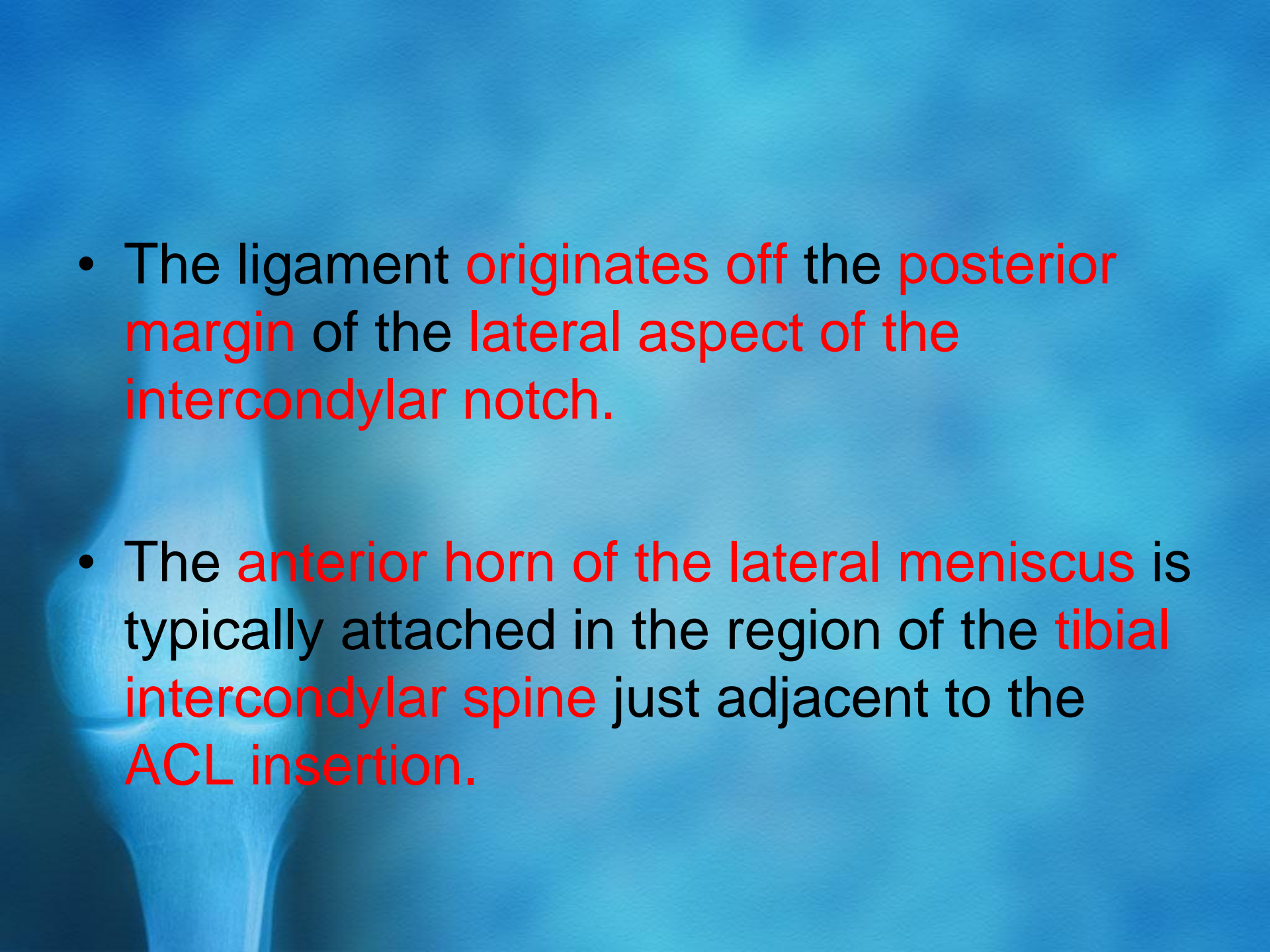
- In **the immature skeleton**, the proximal surface of the spine **is covered** entirely with **cartilage**.



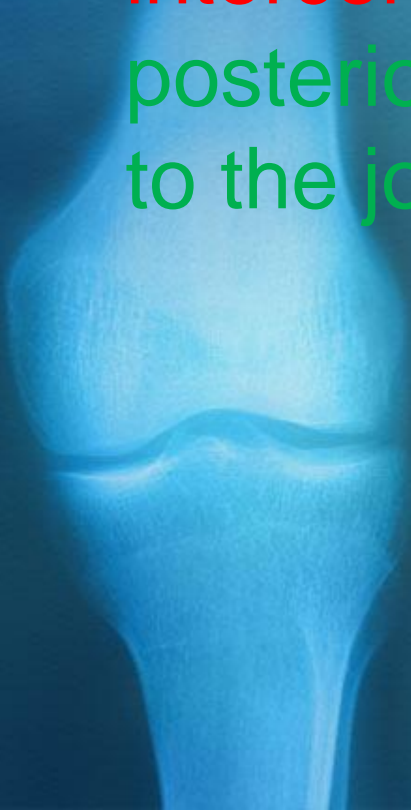


- The **ACL attaches** in the interspinous region of the **spine** and just anteriorly to the **tibial spines**, with **separate** slips anteriorly and laterally.



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- The ligament originates off the posterior margin of the lateral aspect of the intercondylar notch.
 - The anterior horn of the lateral meniscus is typically attached in the region of the tibial intercondylar spine just adjacent to the ACL insertion.

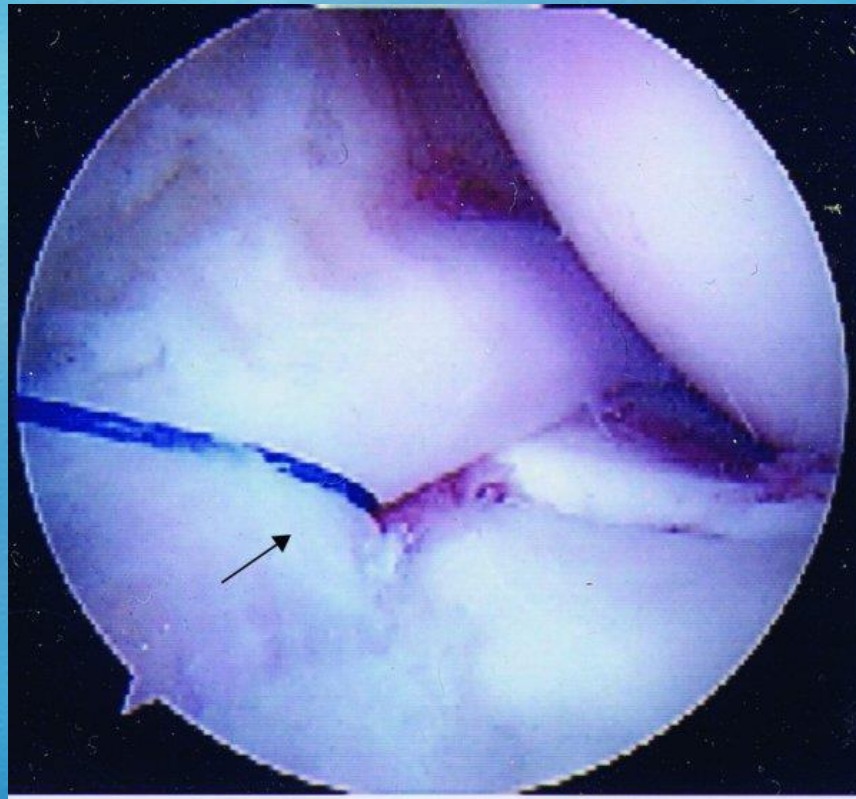
- The **posterior cruciate ligament (PCL)** originates off the **medial aspect of the intercondylar notch** and **inserts** on the **posterior aspect of the proximal tibia, distal to the joint line.**



- **Meniscal or intermeniscal ligament entrapment** under the **displaced tibial spine fragment** has been reported and may be a rationale for considering arthroscopic or open reduction in displaced



- Retraction of an entrapped anterior horn medial meniscus using a retaining suture (black arrow).



- The **menisci** become clearly defined by as early as **8 weeks of embryologic development**.
- The **medial meniscus** is **C shaped**.
- The **posterior horn** is larger in **anterior–posterior width** than the **anterior horn**.



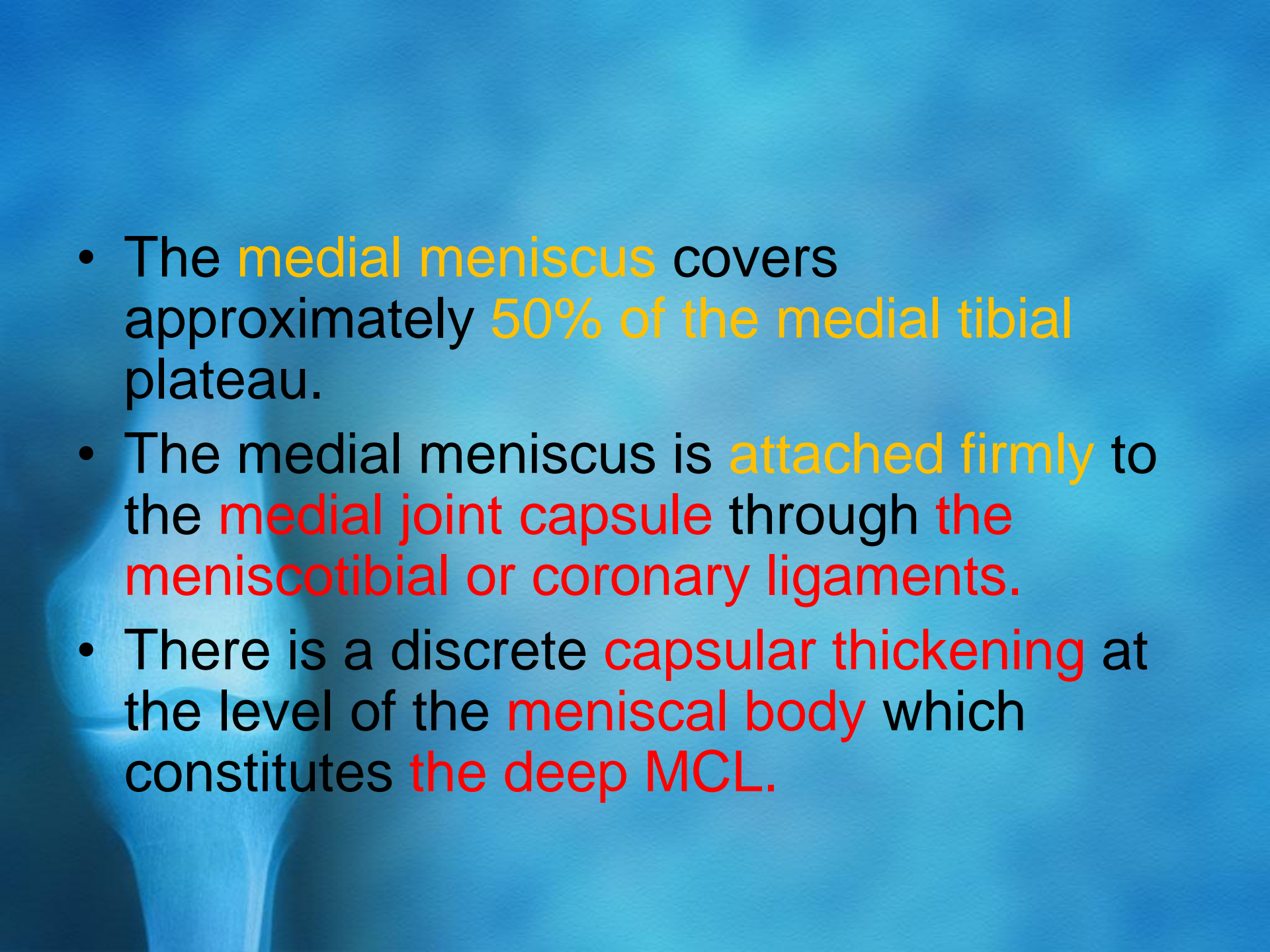
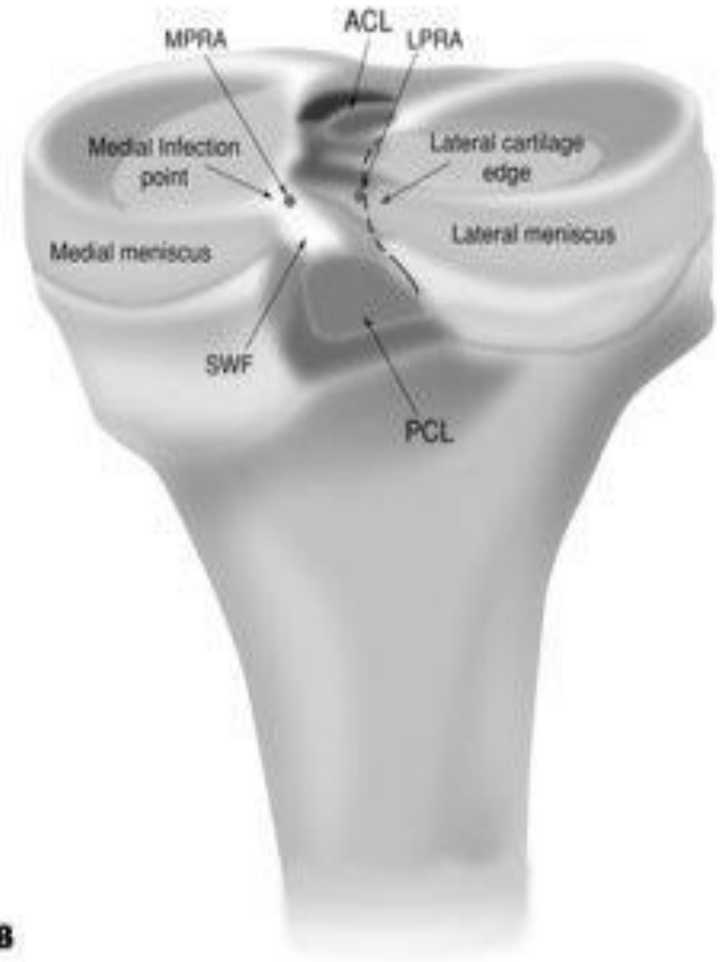
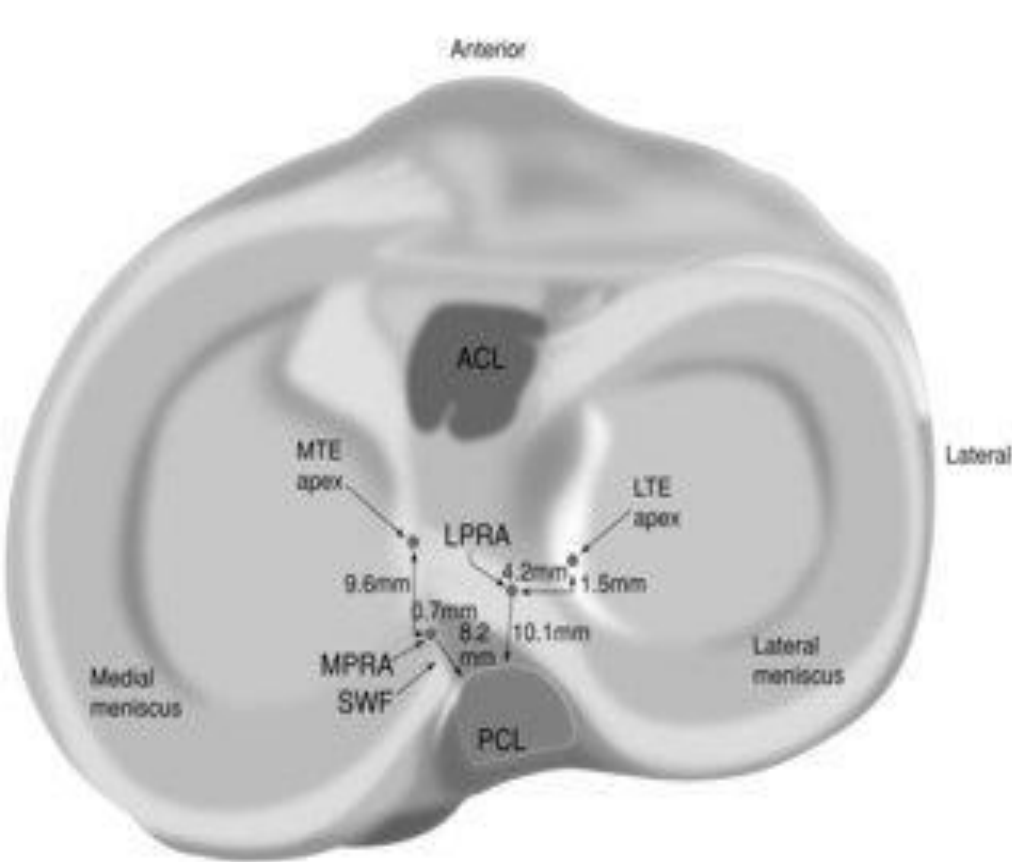
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- The **medial meniscus** covers approximately **50%** of the **medial tibial plateau**.
 - The medial meniscus is **attached firmly** to the **medial joint capsule** through the **meniscotibial or coronary ligaments**.
 - There is a discrete **capsular thickening** at the level of the **meniscal body** which constitutes **the deep MCL**.


Illustration demonstrating **the medial** and **lateral meniscal** posterior root attachments and relevant arthroscopically pertinent anatomy (right knee).



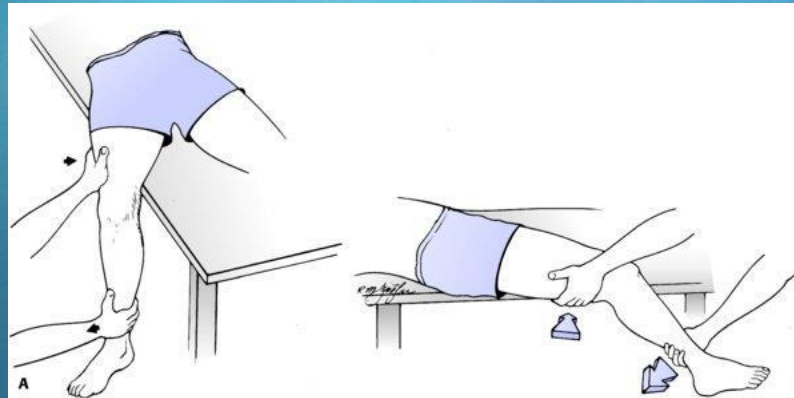
Signs and Symptoms of collateral Ligament Injuries

- Palpation of the collateral ligaments and their bony origins and insertions should locate tenderness at the site of the ligament injury.
- A defect in the collateral ligaments often can be felt if the MCL is avulsed from its insertion on the tibia or if the LCL is avulsed from the fibular head.



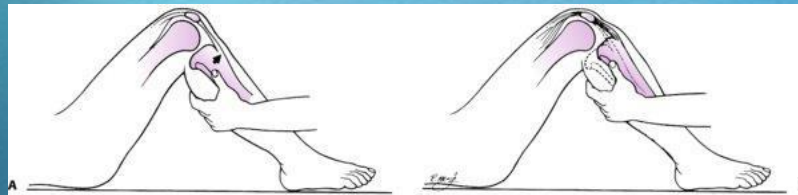
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- If the neurovascular status is normal, stability should be evaluated by **varus/valgus stress testing**, which may be done immediately after injury in cooperative adolescents but can be more difficult in younger ages or those with significant pain.

Valgus stress test of medial collateral ligament. Extremity is abducted off table, knee is flexed to 20 degrees, and valgus stress is applied. A: Frontal view. B: Lateral view.



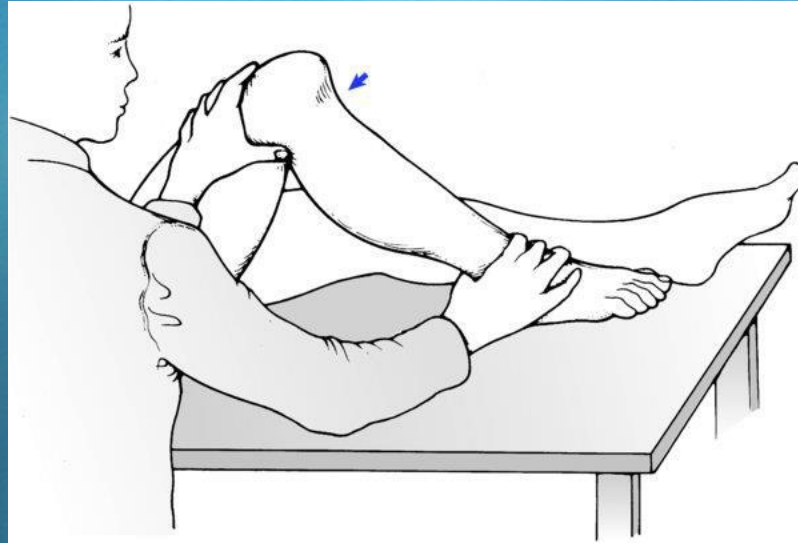
Anterior drawer test of anterior cruciate ligament.

Foot is positioned in internal, external, and neutral rotation during examination. With anterior cruciate insufficiency, an anterior force (A) displaces the tibia forward (B).



Posterior cruciate ligament injury.

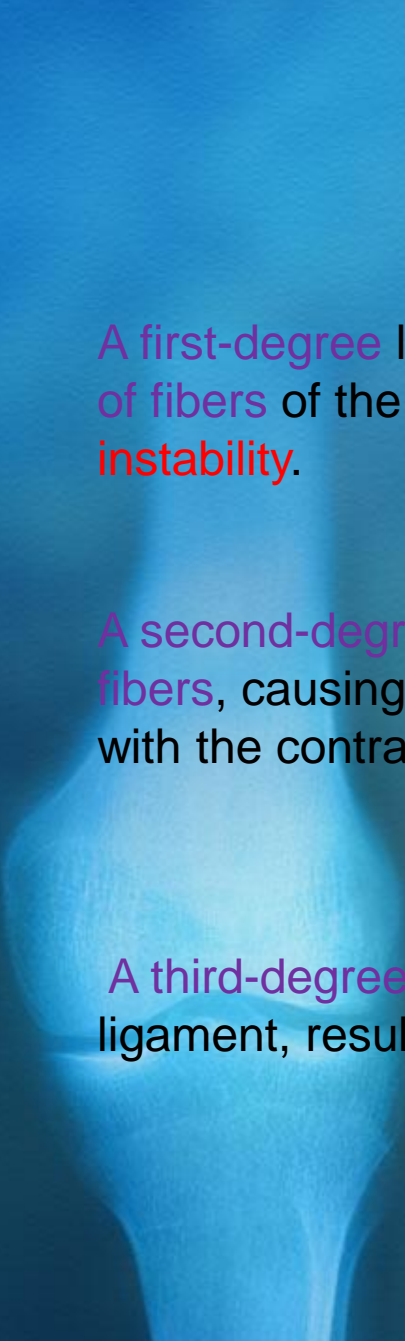
Note posterior sagging of the tibia with posterior cruciate injury.



Classification of Ligament Injuries

- Classification of knee ligament injuries is **based on** the **severity of the injury**, the specific **anatomic location** of the injury, and the **direction of the subsequent instability** caused by an isolated ligament injury or combination of ligament injuries.





A first-degree ligament sprain is a tear of a minimal number of fibers of the ligament with localized tenderness but no instability.

A second-degree sprain is disruption of more ligamentous fibers, causing asymmetry with stress testing, compared with the contralateral knee, but minimal or minor instability.

A third-degree sprain is complete disruption of the ligament, resulting in gross instability.

Although difficult to assess clinically, the degree of sprain also is determined with collateral ligaments during stress testing by the **amount of separation of the joint surfaces:**

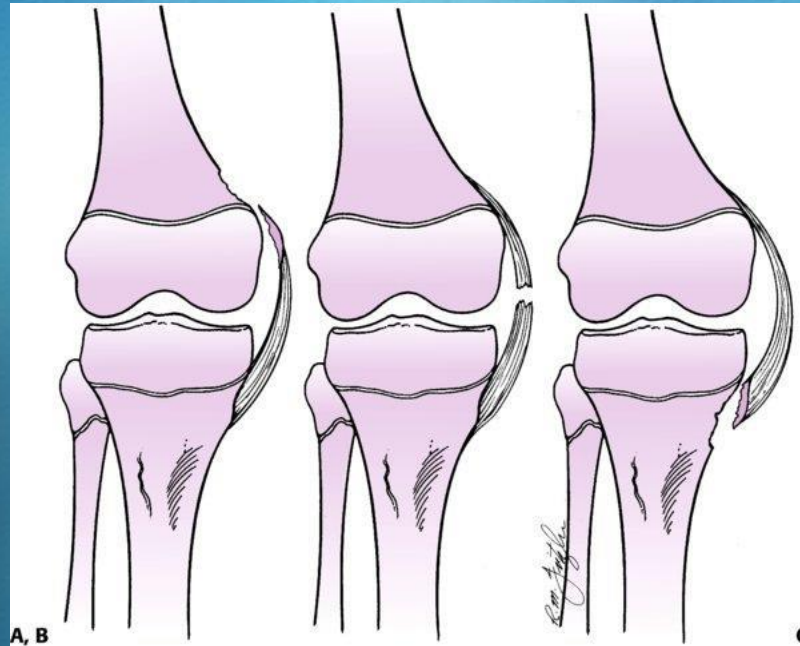
First-degree sprain, **5 mm or less (normal/baseline);**

second-degree sprain, **5 to 10 mm;**

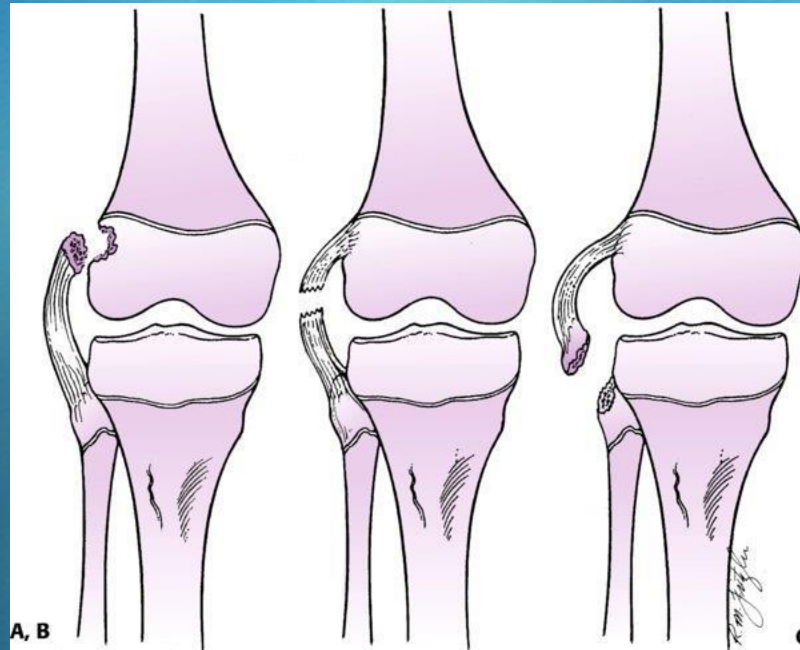
third-degree sprain, **more than 10 mm**



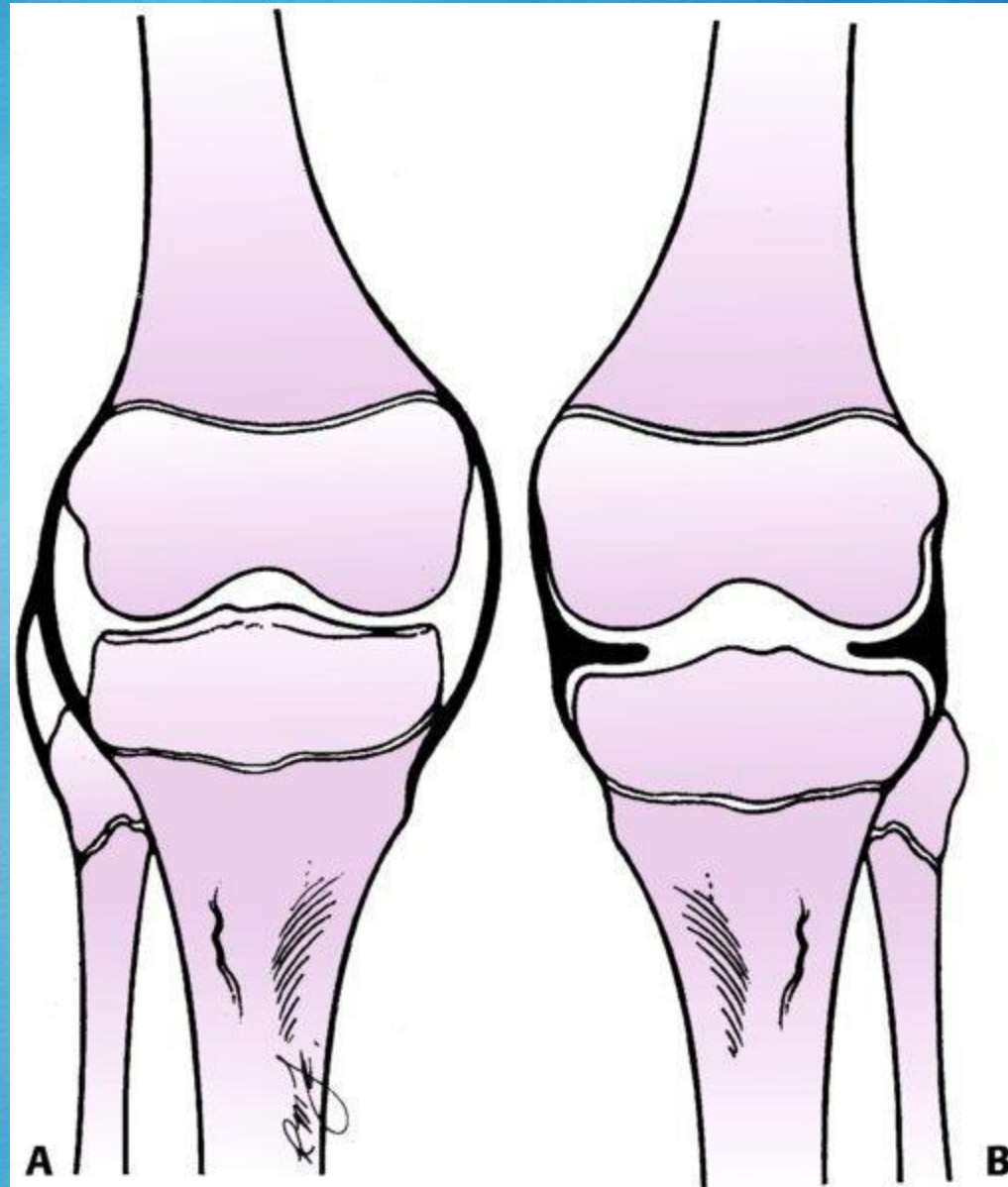
Medial collateral ligament injury.
A: Femoral origin. B: Middle
portion. C: Tibial insertion.



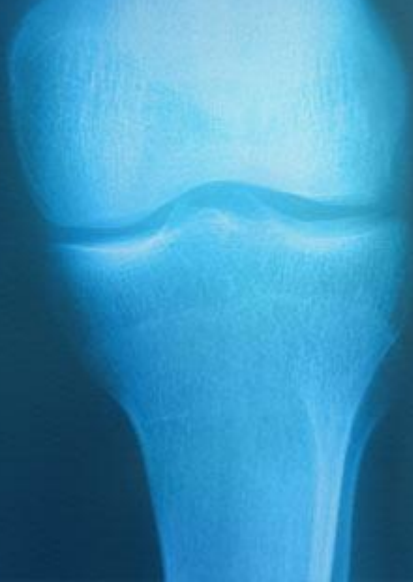
Lateral collateral ligament injury.
A: Femoral origin. B: Middle
portion. C: Fibular insertion.

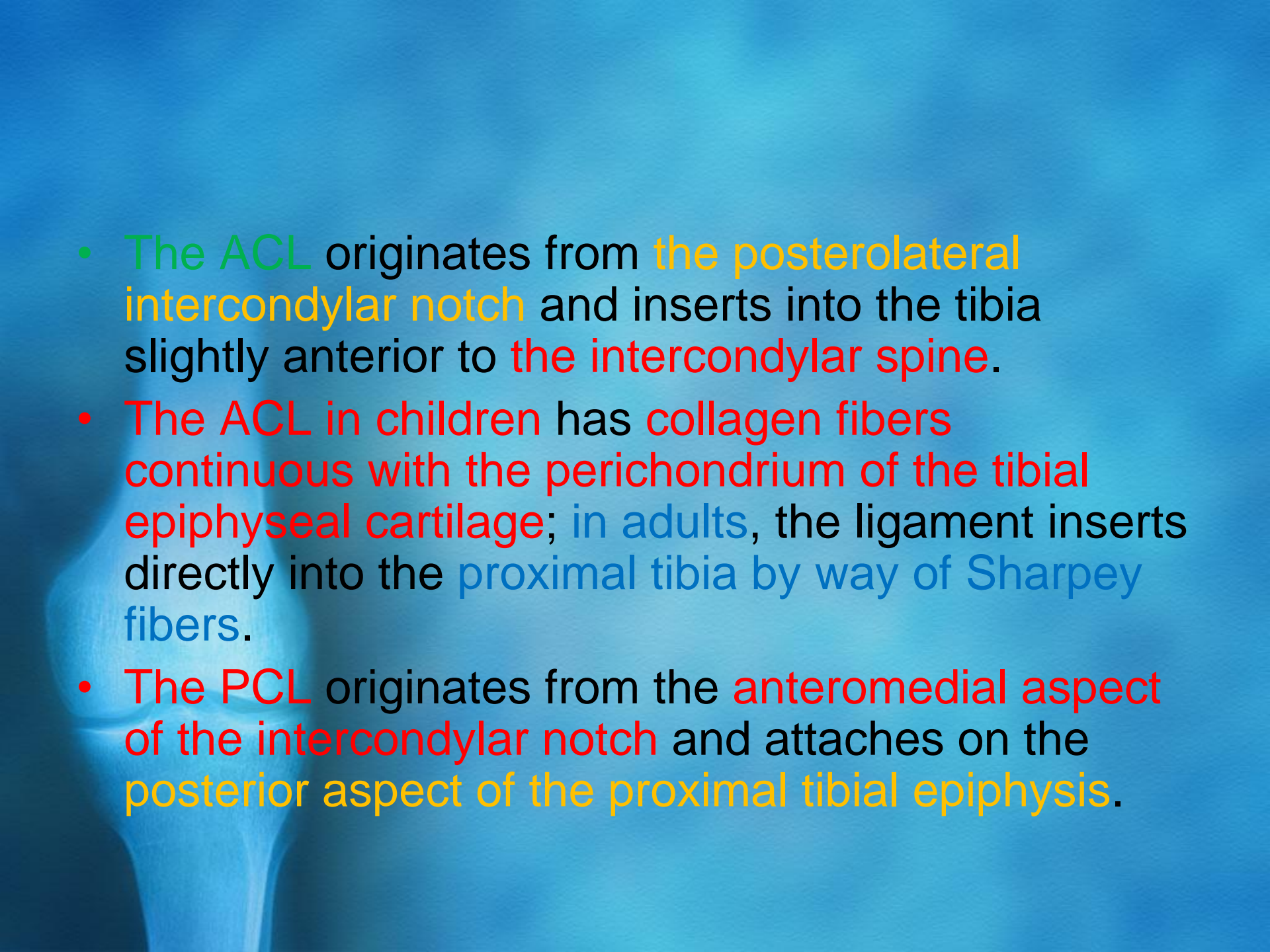


- The **MCL and LCL** of the knee originate from the distal femoral epiphysis and insert into the proximal tibial and fibular epiphyses, respectively, except for the **superficial portion of the MCL**, which inserts into the **proximal tibial metaphysis distal to the physis**



- In children, **these ligaments are generally stronger than the physes**, and significant **tensile stresses** usually produce **epiphyseal or physeal fractures** rather than ligamentous injury.



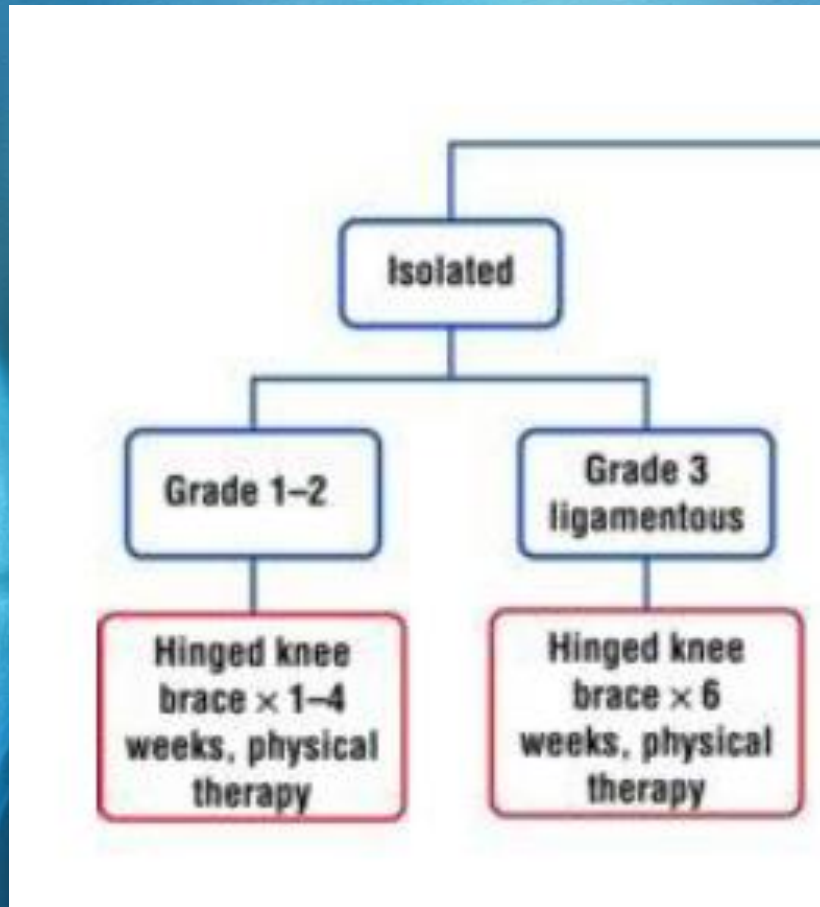
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- The ACL originates from the posterolateral intercondylar notch and inserts into the tibia slightly anterior to the intercondylar spine.
 - The ACL in children has collagen fibers continuous with the perichondrium of the tibial epiphyseal cartilage; in adults, the ligament inserts directly into the proximal tibia by way of Sharpey fibers.
 - The PCL originates from the anteromedial aspect of the intercondylar notch and attaches on the posterior aspect of the proximal tibial epiphysis.

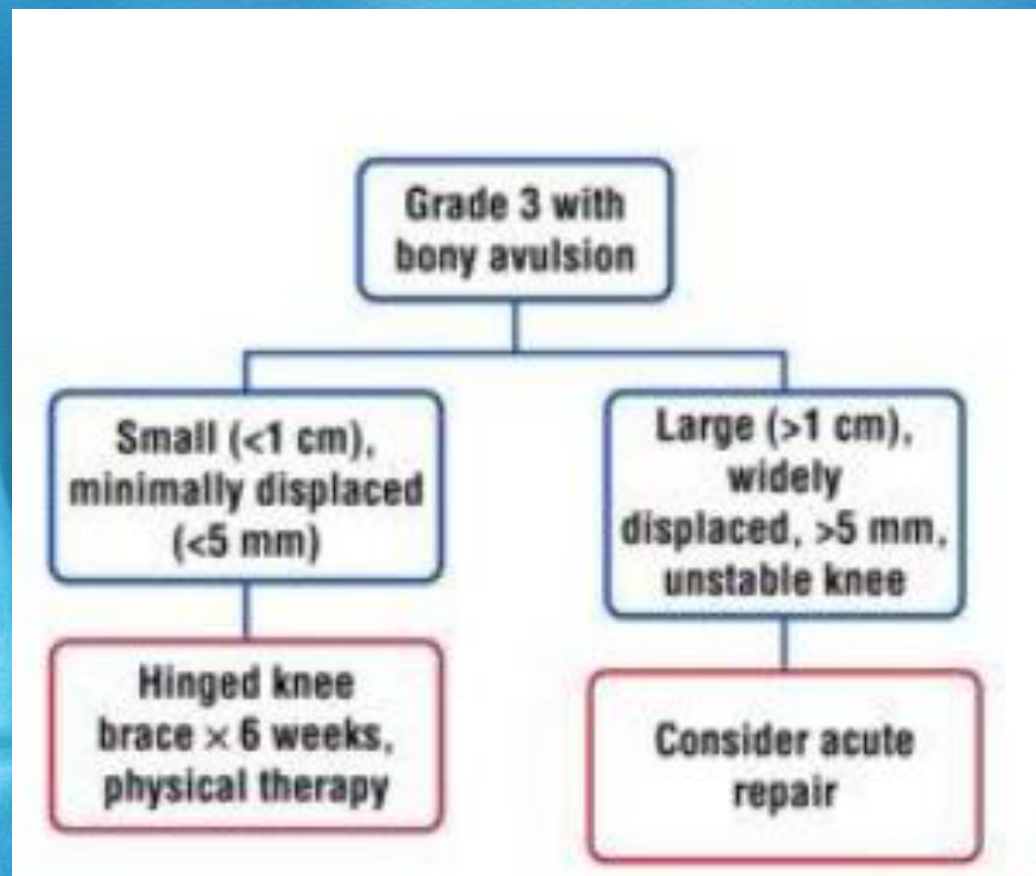
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- **Primary and secondary signs of ACL tears** in children have been described and are **similar to those seen in adults.**
 - **Primary signs** include **fiber discontinuity, altered course, and abnormal signal** of the ligament
 - **Secondary signs** include **increased angle and abnormally vertical orientation** of the **PCL**

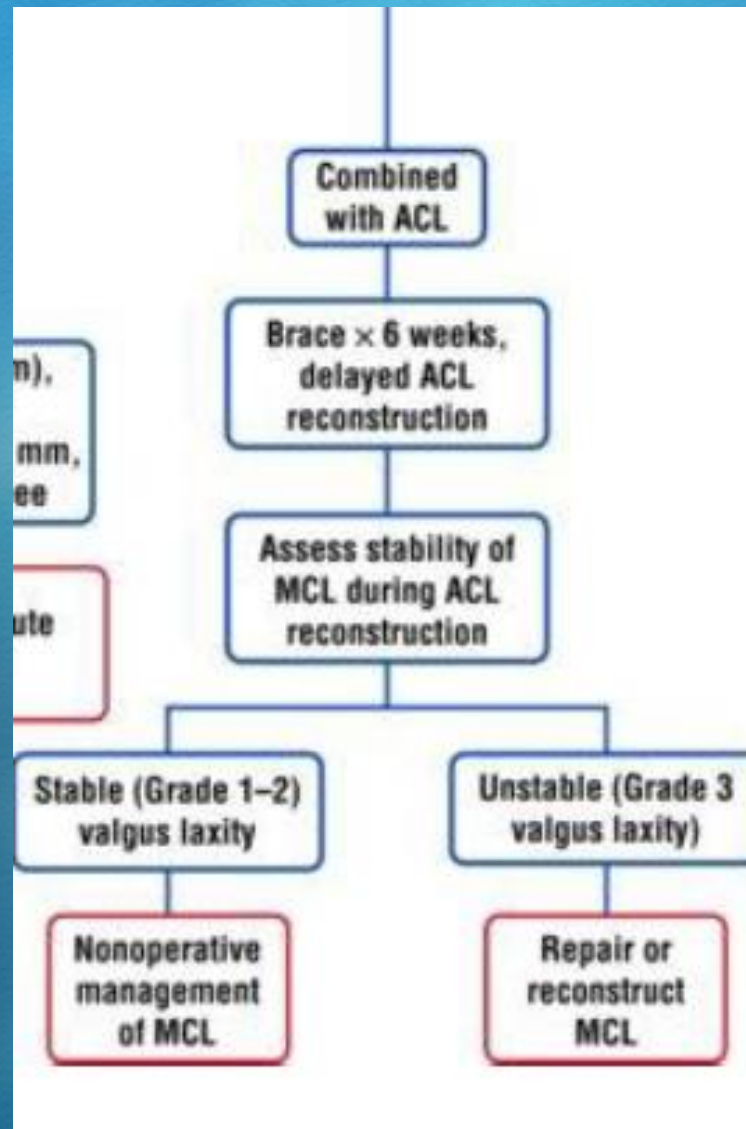
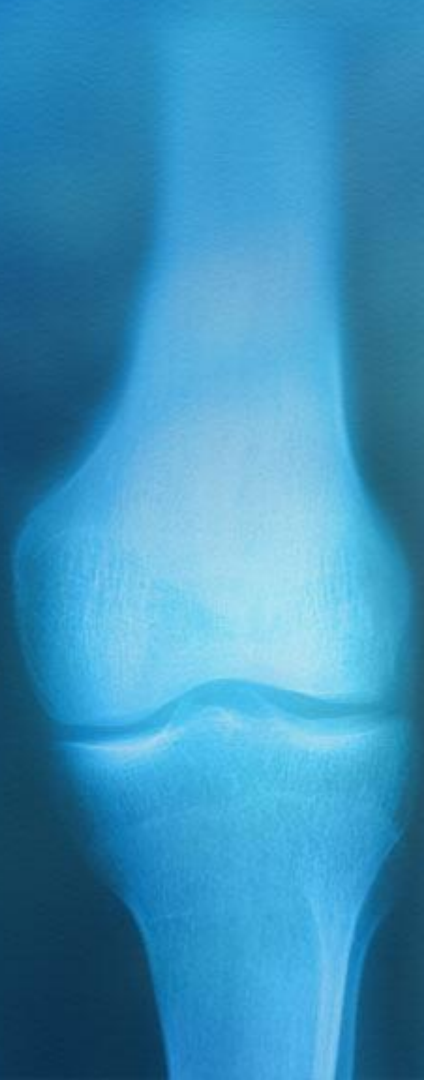
Nonoperative Treatment of Ligament Injuries

<i>Indications</i>	<i>Relative Contraindications</i>
Partial ACL tear (<50% fibers, negative pivot-shift test, younger child)	>50% tear, positive pivot shift, older adolescent Symptomatic instability Associated injury requiring operative treatment with prolonged rehabilitation regimen and maximum knee stability (e.g., meniscus repair)
Primary (midsubstance) PCL tear	Complete bony avulsion injury of footprint
Partial/incomplete LCL/PCL injury	Symptomatic instability despite prolonged PT regimen (quad strengthening)

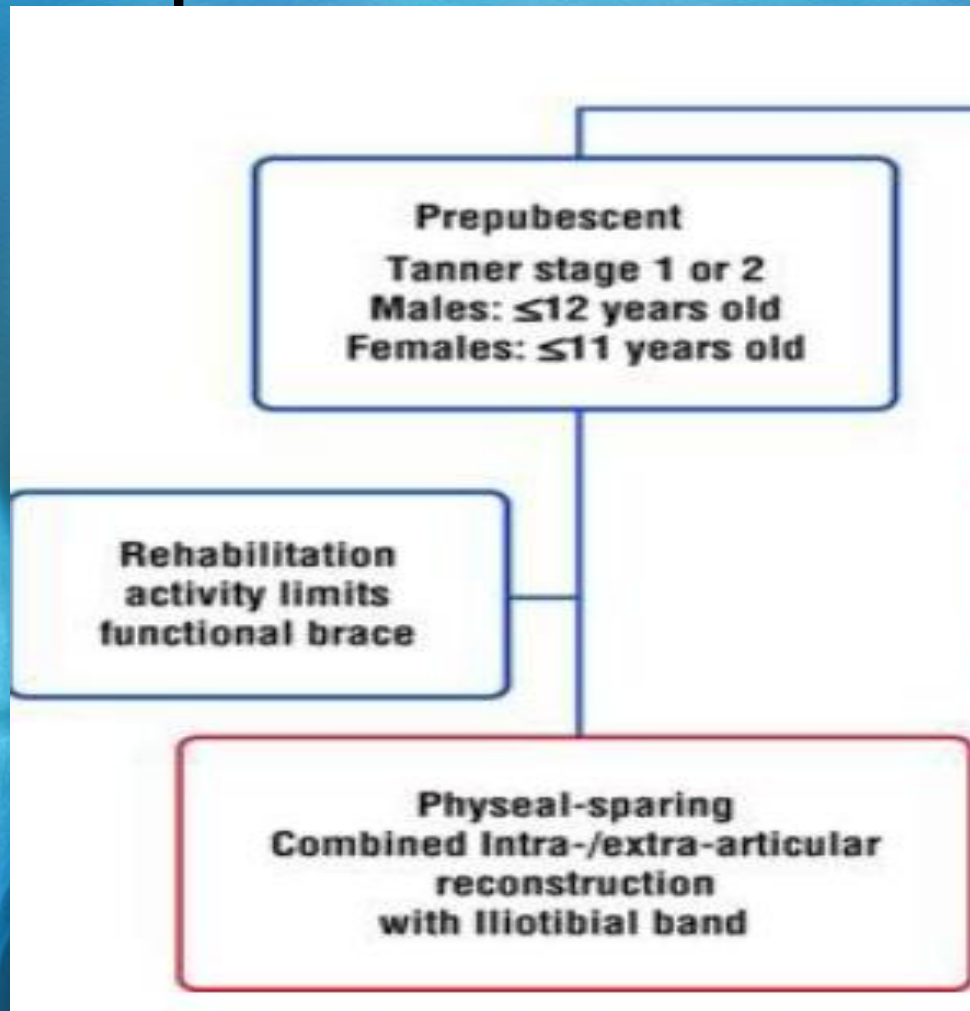
Authors' preferred treatment of medial cruciate ligament injuries.

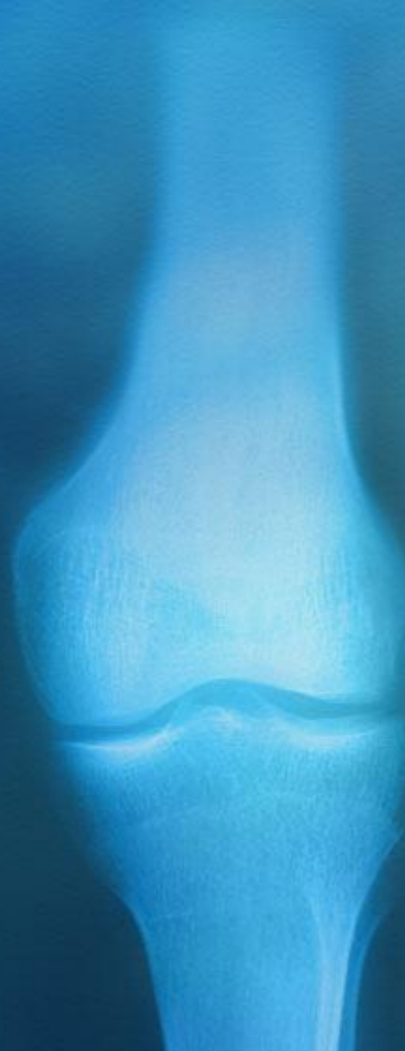







Authors' preferred treatment for ACL reconstruction in skeletally immature patients.





Adolescent with growth remaining
Tanner stage 2 or 3
Males: 13–16 years old
Females: 12–14 years old

Transphyseal reconstruction
with hamstrings and metaphyseal fixation

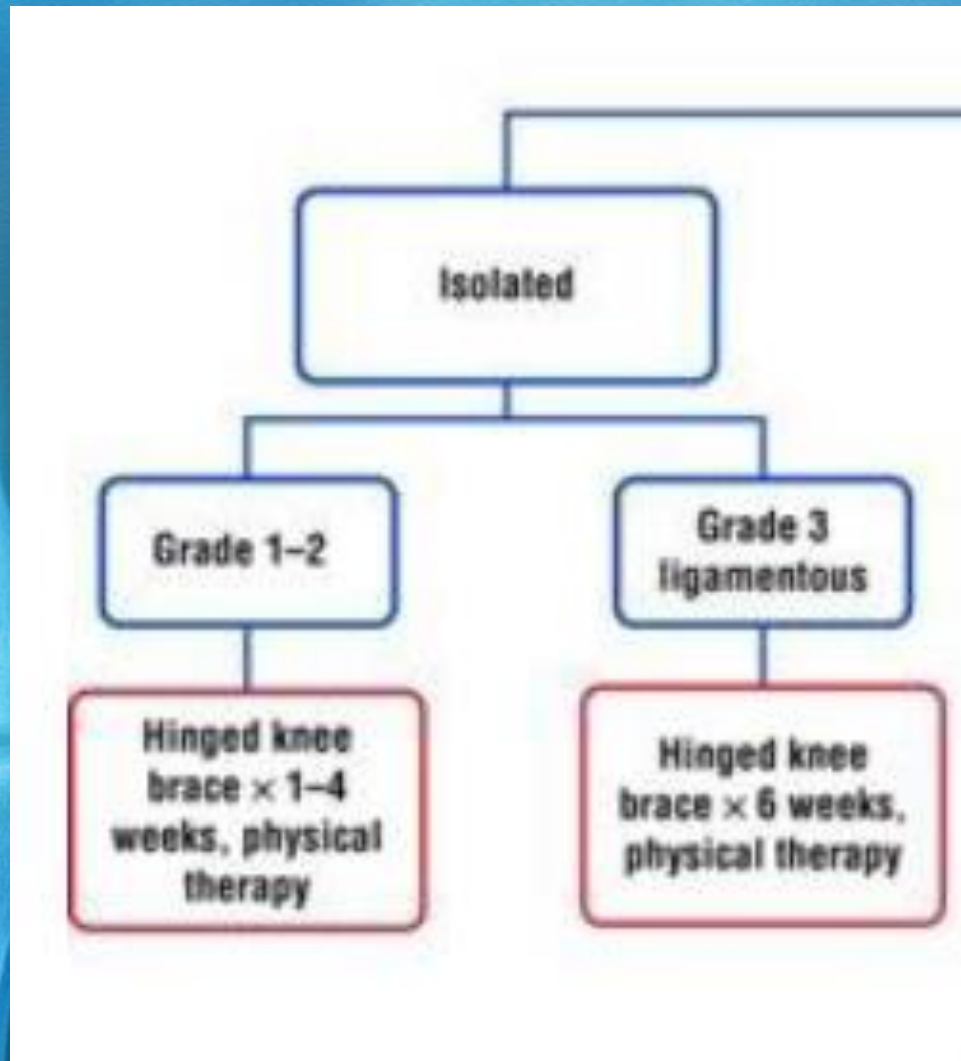


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graph TD; A[Older adolescent with closing physes  
Tanner stage 5  
Males: >16 years old  
Females: >14 years old] --- B[Adult ACL reconstruction with interference screw fixation (patellar tendon or hamstrings)]
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**Older adolescent with closing physes
Tanner stage 5
Males: >16 years old
Females: >14 years old**

Adult ACL reconstruction with interference screw fixation (patellar tendon or hamstrings)

Authors' preferred treatment of lateral cruciate ligament injuries.



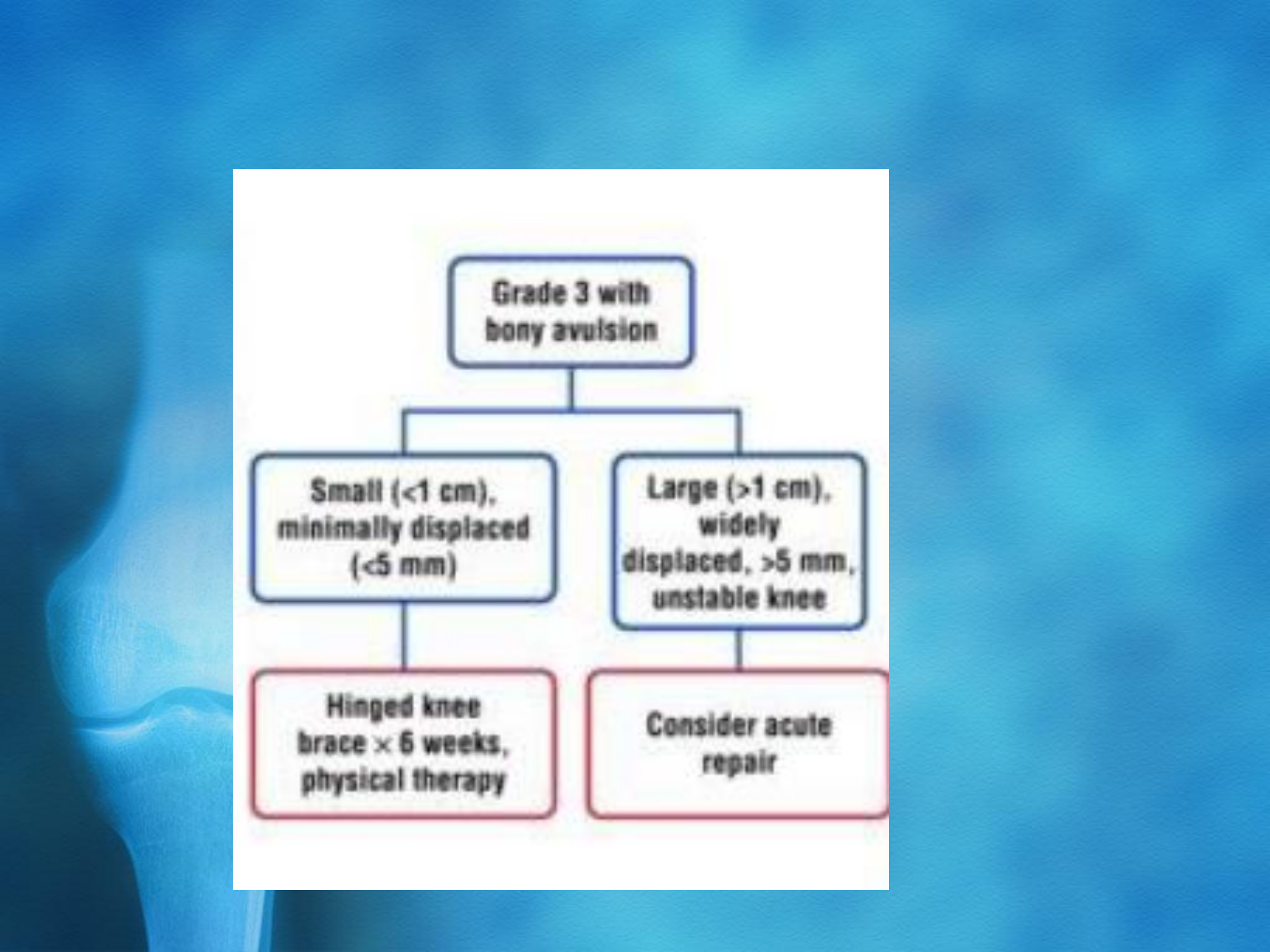
**Grade 3 with
bony avulsion**

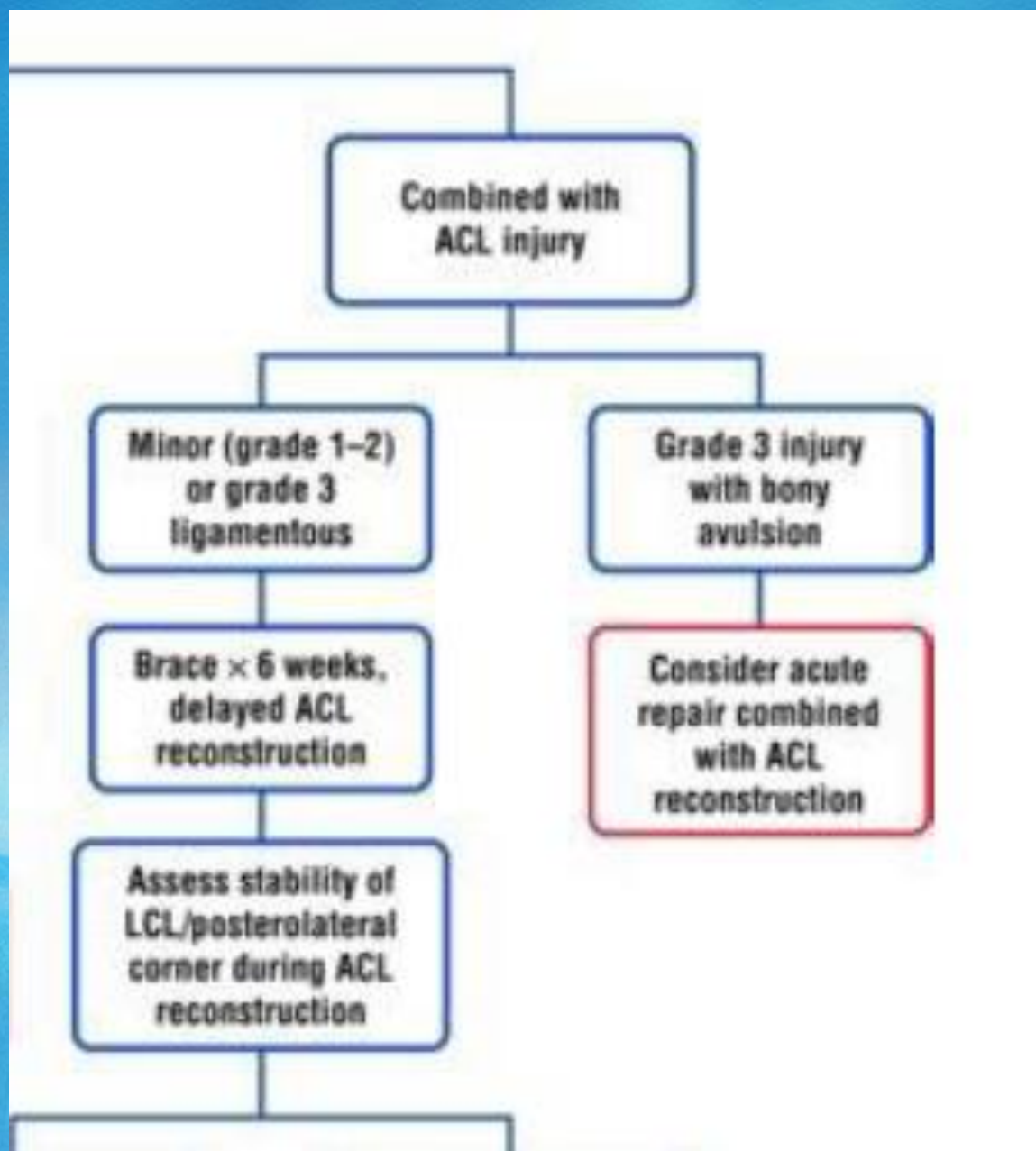
**Small (<1 cm),
minimally displaced
(<5 mm)**

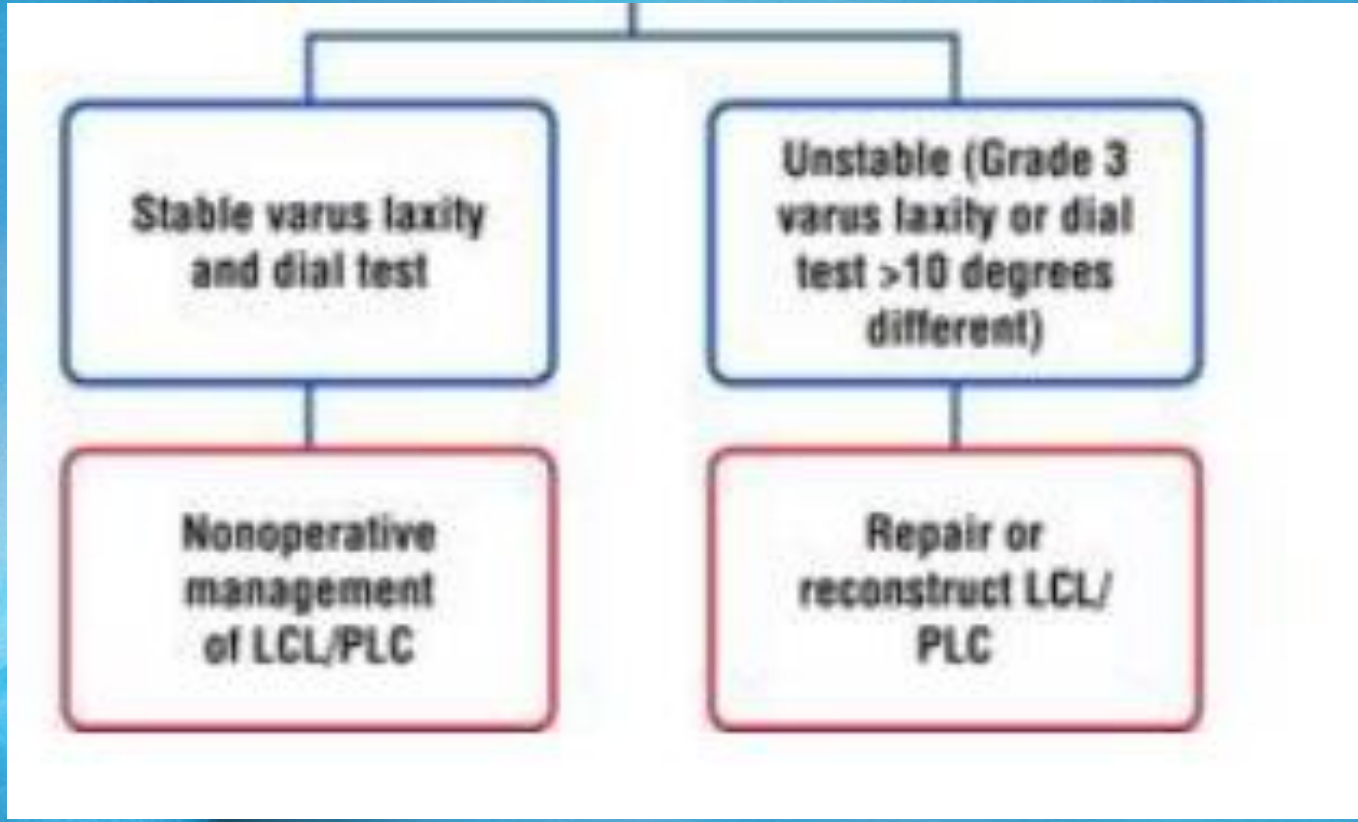
**Hinged knee
brace × 6 weeks,
physical therapy**

**Large (>1 cm),
widely
displaced, >5 mm,
unstable knee**

**Consider acute
repair**







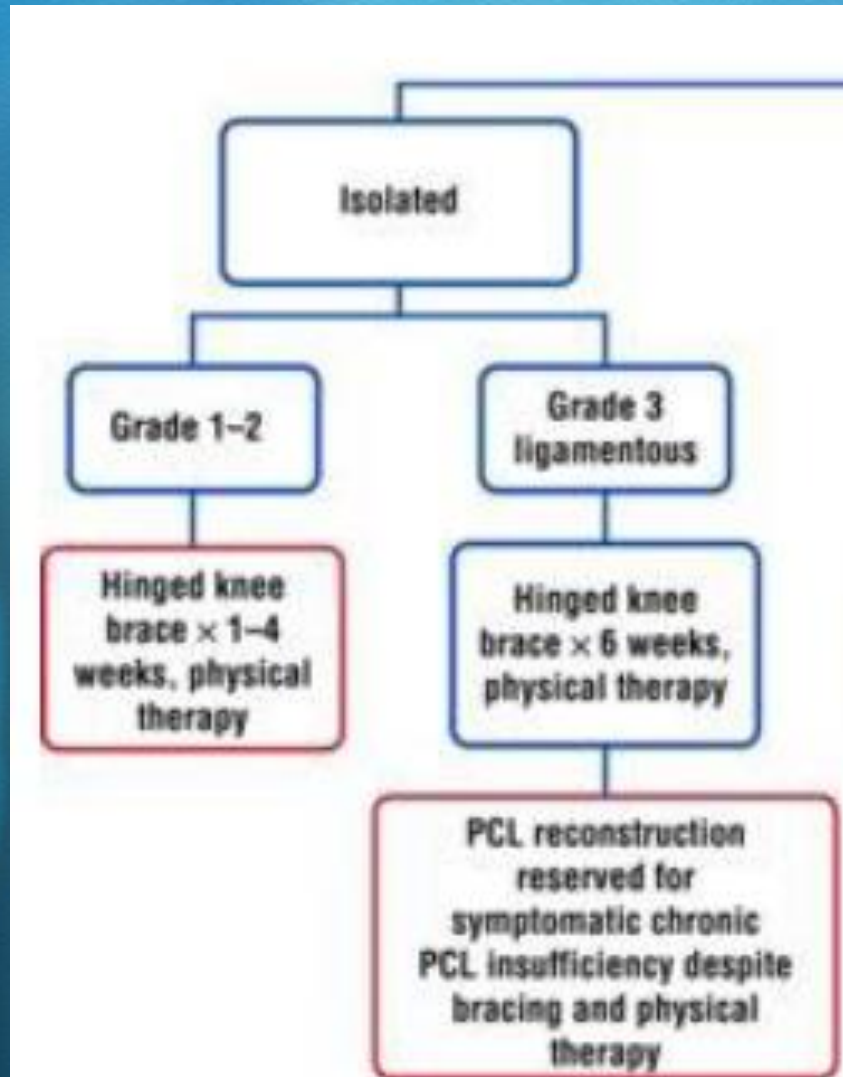
**Stable varus laxity
and dial test**

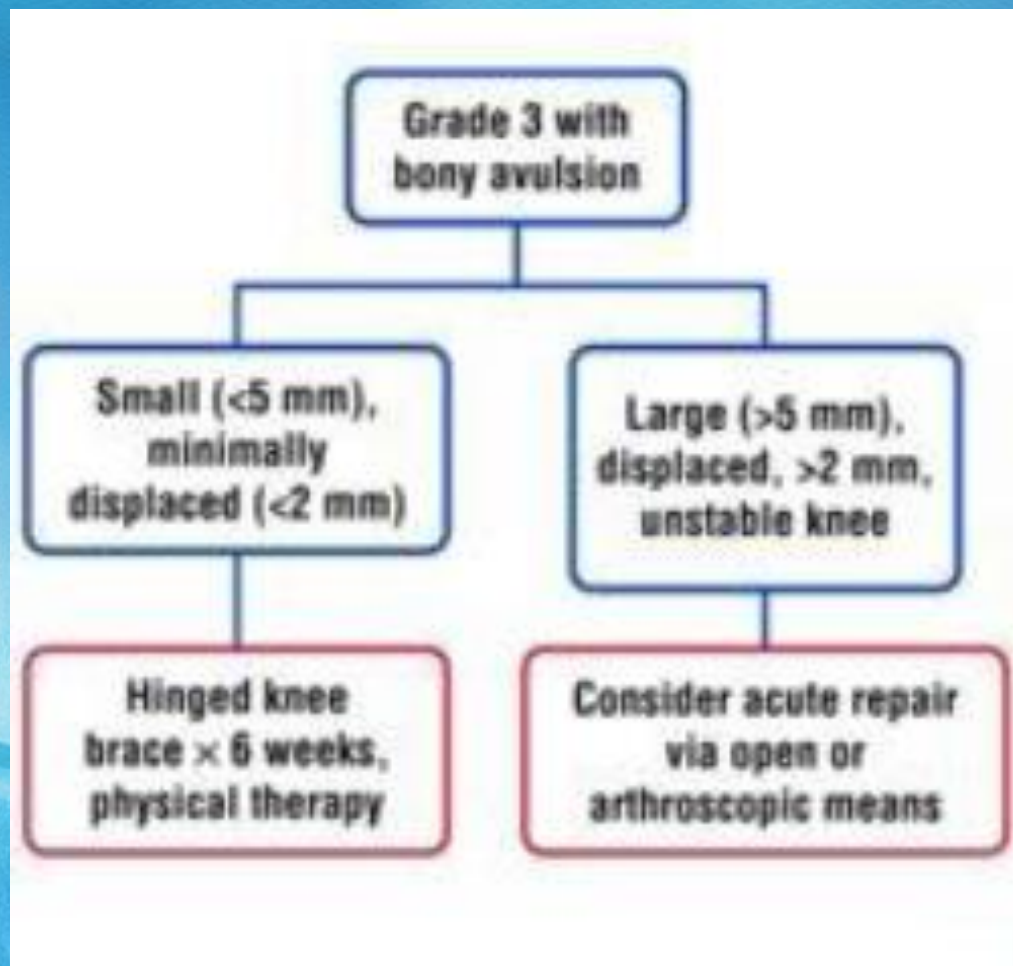
**Nonoperative
management
of LCL/PLC**

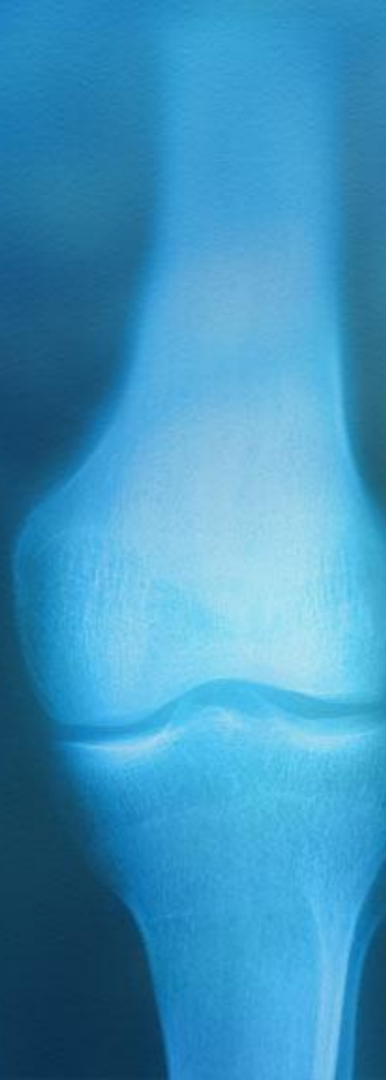
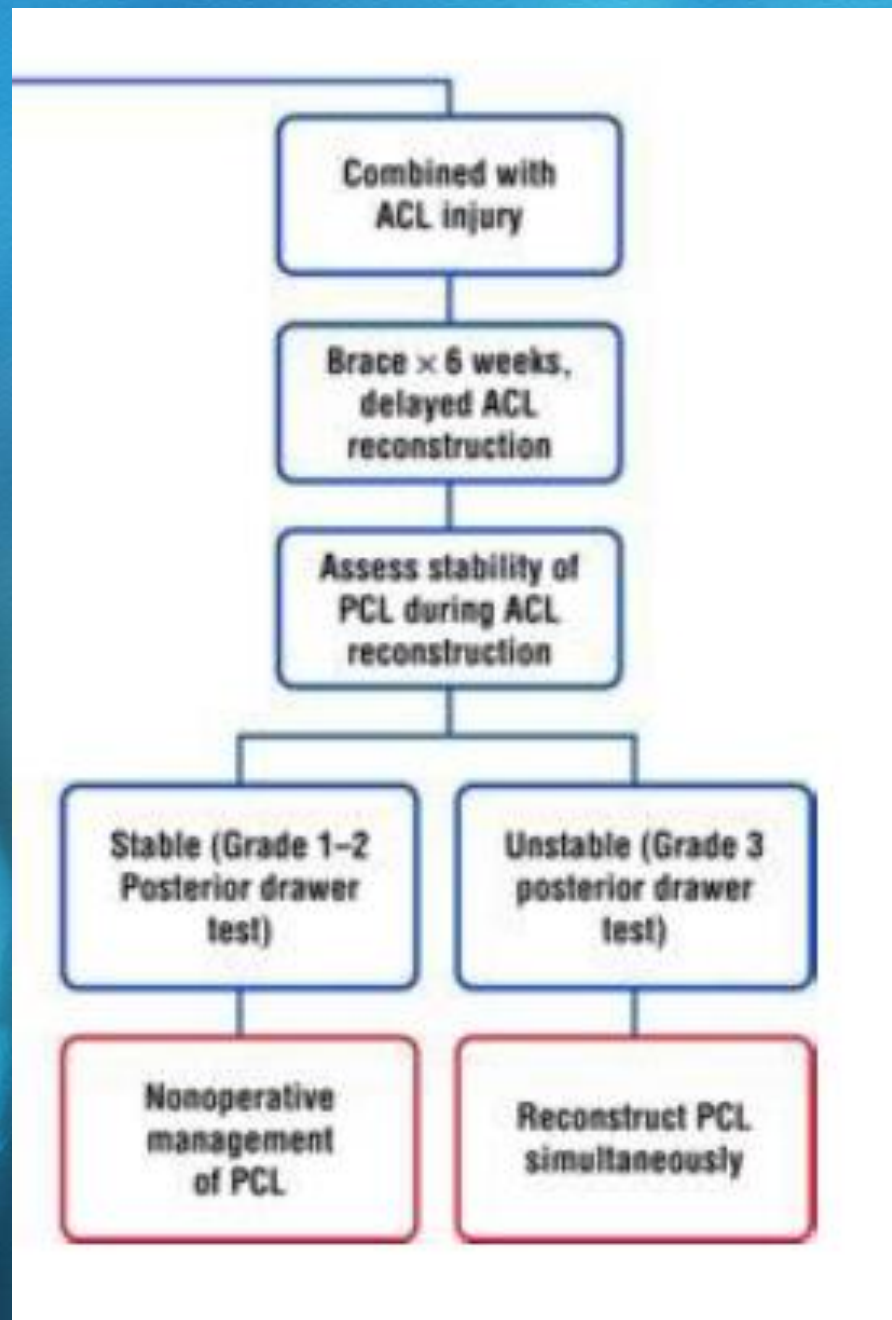
**Unstable (Grade 3
varus laxity or dial
test >10 degrees
different)**

**Repair or
reconstruct LCL/
PLC**

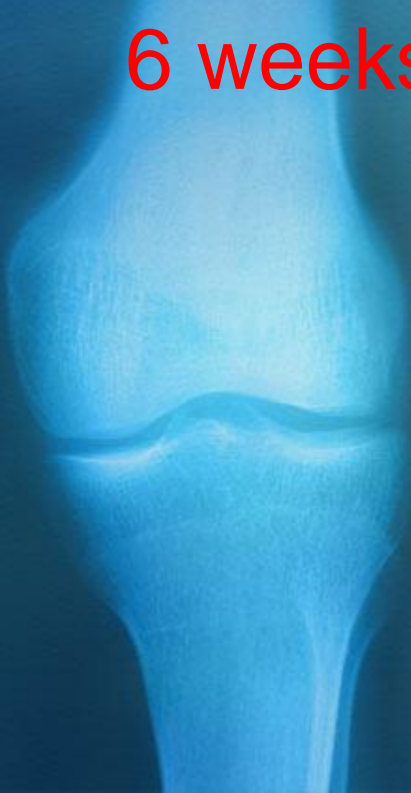
Authors' preferred treatment of posterior cruciate ligament injuries.





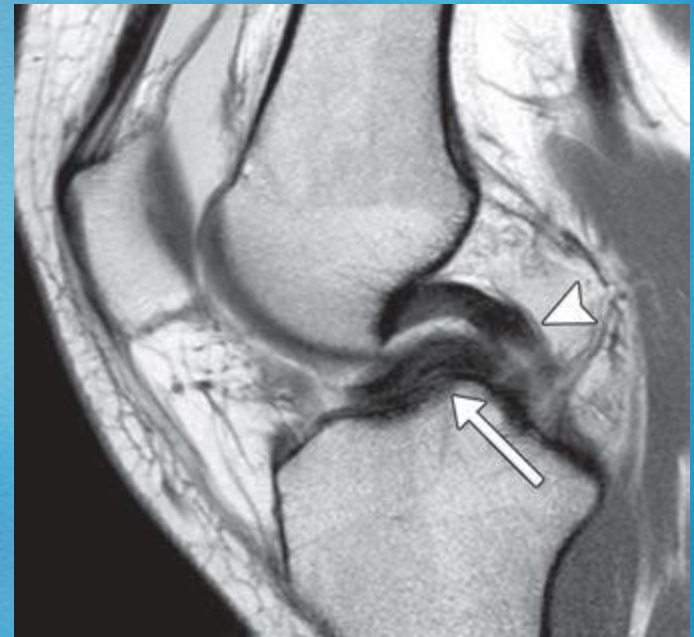


- Postoperatively, patients are placed in a postoperative **hinged knee brace** and **maintained touch-down weight bearing for 6 weeks**



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- Motion is restricted to 0 to 30 degrees for the first 2 weeks,
 - 0 to 60 degrees for the next 2 weeks,
 - then 0 to 90 for weeks 4 to 6,
 - with full ROM after 6 weeks,
 - The brace is kept locked in extension at night for the first 6 weeks to prevent a flexion contracture.

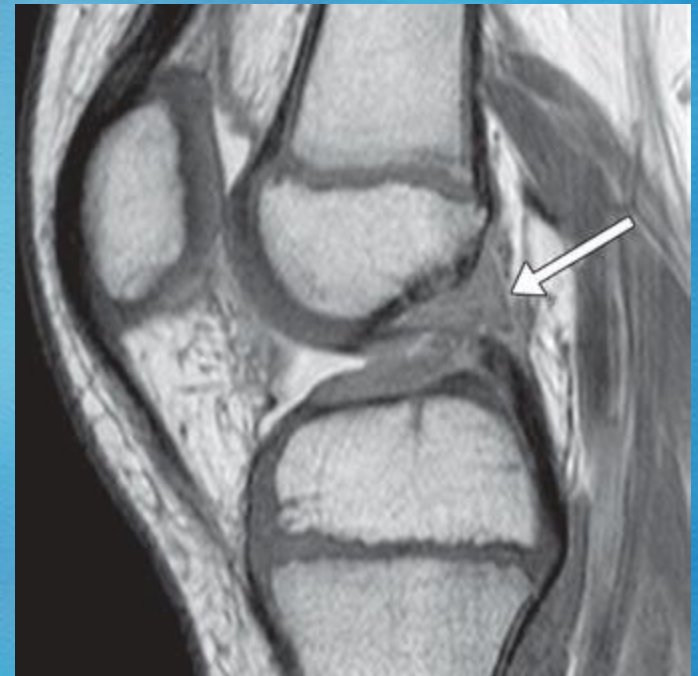
- 17-year-old soccer player who twisted his knee.
- **Sagittal** proton density–weighted image through knee at level of **posterior cruciate ligament (PCL)** shows abnormal tissue (*arrow*) just deep in relation to normal PCL (*arrowhead*).
- This is example of **double PCL sign** and signifies **bucket-handle tear of medial meniscus with flipped fragment**.



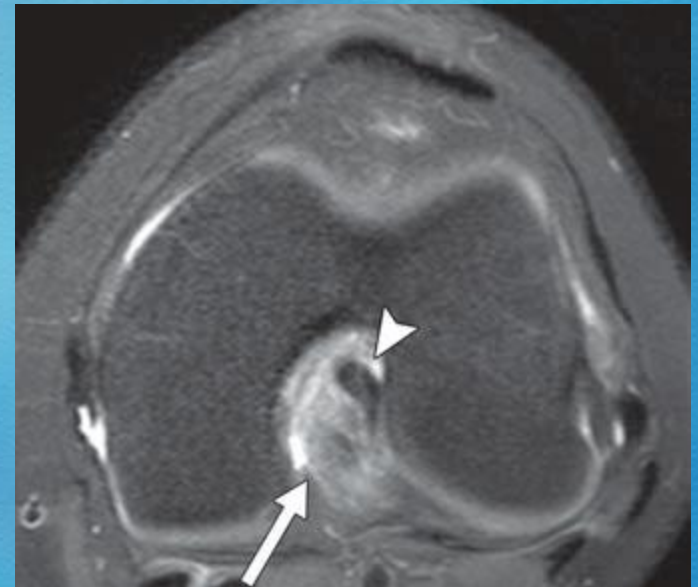
- 8-year-old boy with knee pain and no history of trauma.
- **Coronal** proton density–weighted image through knee **shows discoid lateral meniscus** with **abnormal intrameniscal signal**, compatible with degeneration (*arrow*).



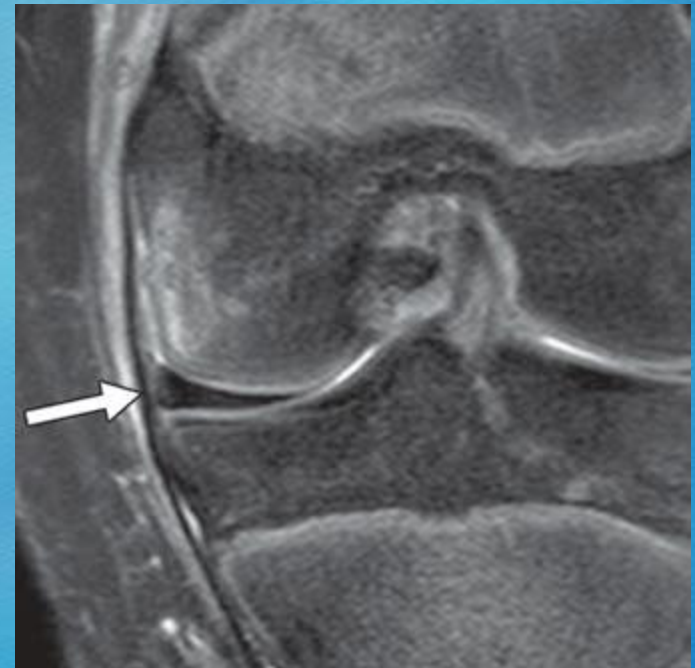
- 9-year-old boy who injured his knee while playing football.
- **Sagittal** proton density–weighted image through knee shows fiber disruption and abnormal signal of **anterior cruciate ligament, compatible with complete tear (arrow)**.



- 14-year-old girl who injured her knee while jumping on trampoline.
- **Axial** proton density–weighted image with fat saturation through knee shows **amorphous appearance and edema of posterior cruciate ligament**, compatible with tear (*arrow*). Notice normal configuration and signal of anterior cruciate ligament located anteriorly (*arrowhead*).



- 13-year-old boy who was injured playing football.
- **Coronal** proton density–weighted image through knee shows abnormal fluid adjacent to **intact medial collateral ligament (MCL)**, compatible with grade 1 injury (*arrow*).



- 13-year-old boy who was struck by car.
- **Coronal** proton density–weighted image through knee shows **disruption of lateral collateral ligament complex** (*arrow*), with extensive surrounding edema.
- Findings are compatible with grade 3 injury.



- 17-year-old football player who sustained direct trauma to lateral aspect of his knee.
- **Coronal proton** density-weighted image through knee shows **complete tear of MCL**, with wavy appearance of ligament distally and surrounding fluid (*arrow*).
- Associated **anterior cruciate ligament tear** was identified (*arrowhead*).
- *This patient also had bone marrow edema of lateral femoral condyle.*

