SNS COLLEGE OF PHYSIOTHERAPY

AffiliatedToTheTamilNaduDr.MGRMedicalUniversity,Chennai
Coimbatore– 641035

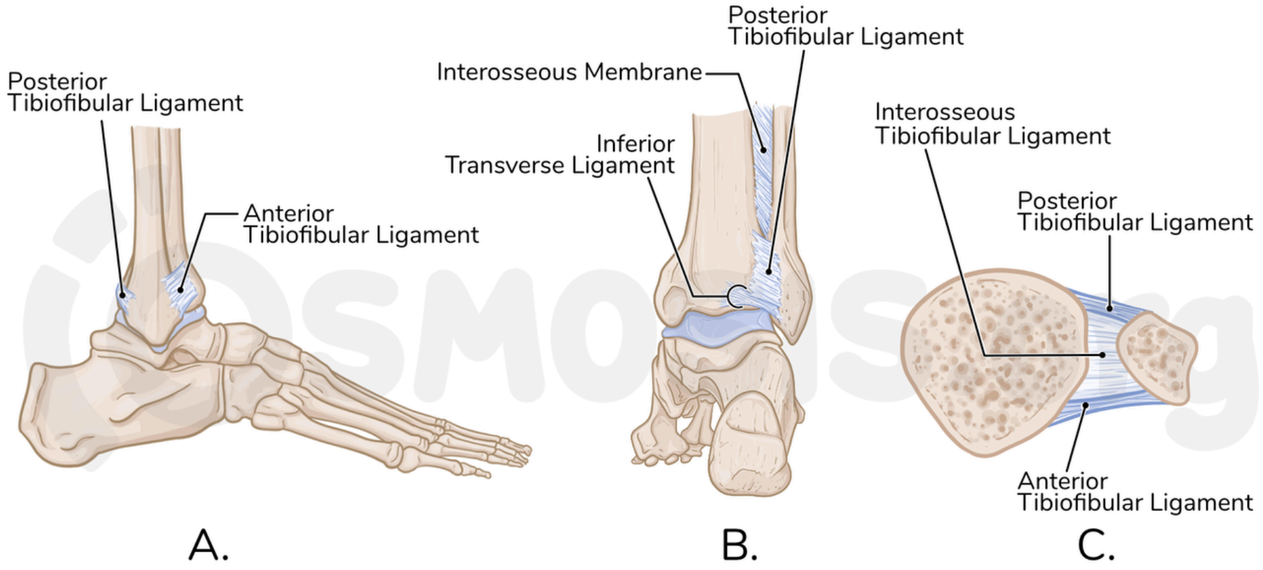
COURSE NAME : BIOMECHANICS

SUBJECT CODE : 6277

TOPIC :Biomechanics of Tibiofemoral Joint

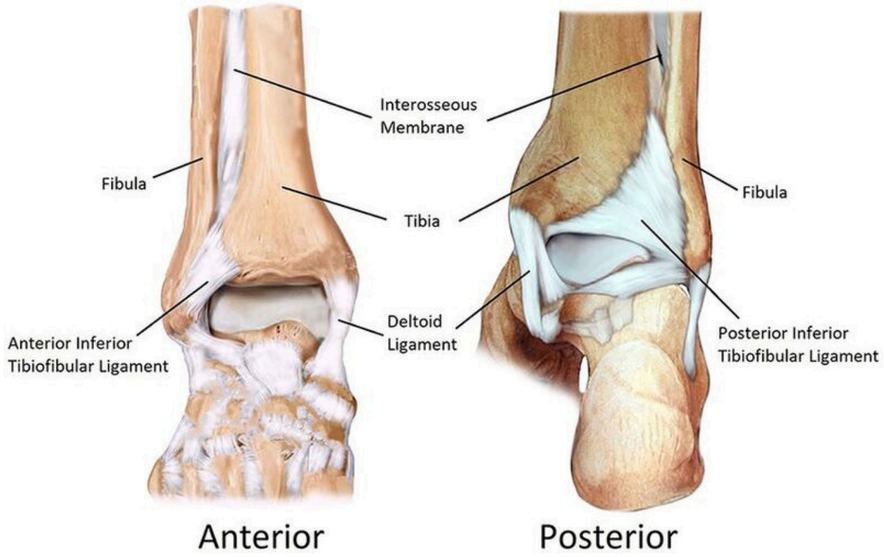
Biomechanics of Tibiofemoral Joint

- Tibiofemoral Osteokinematics
- Tibiofemoral Arthokinematics
- Automatic Locking/ Screw Home Phenomenon



Contents

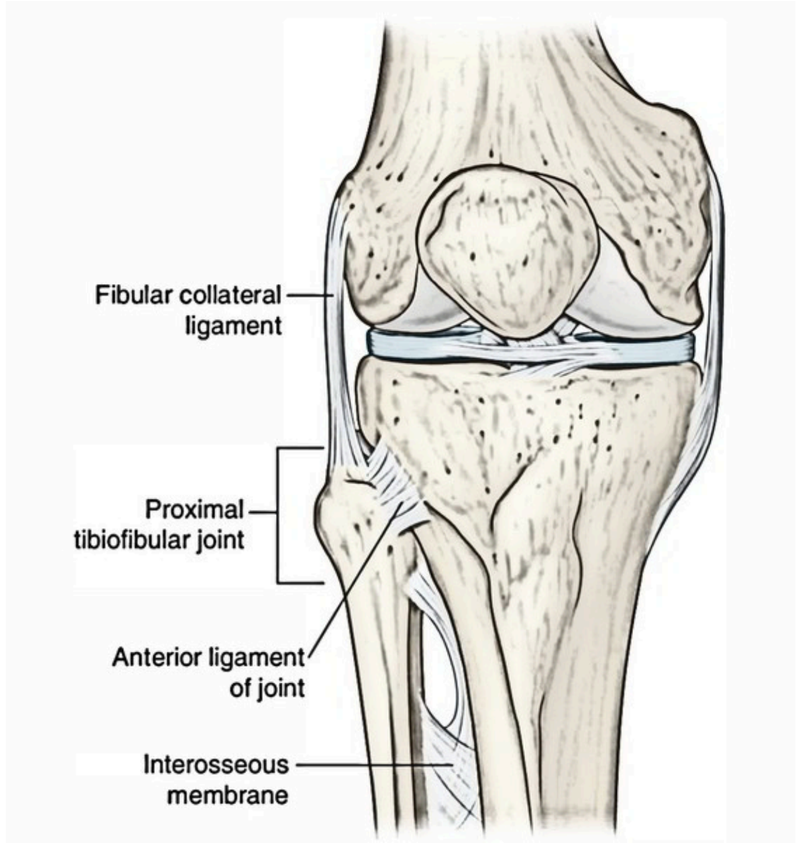
1. Tibiofemoral Arthokinematics
2. Tibiofemoral Osteokinematics
3. Automatic Locking/ screw home phenomenon



Osteokinematics of knee joint

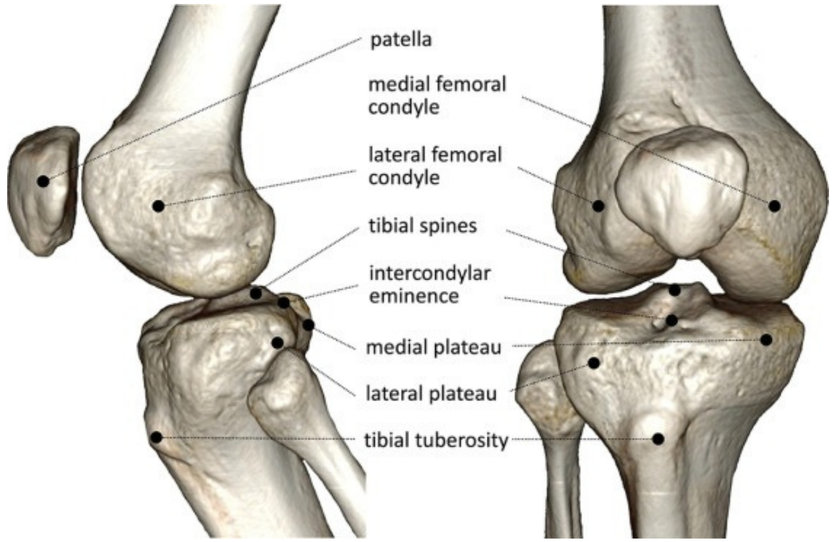
Two degree freedom of motion

- Flexion extension- coronal axis/ migrating medial lateral axis (the evolute)
- Internal/external rotation- vertical axis
- + Passive frontal plane motion

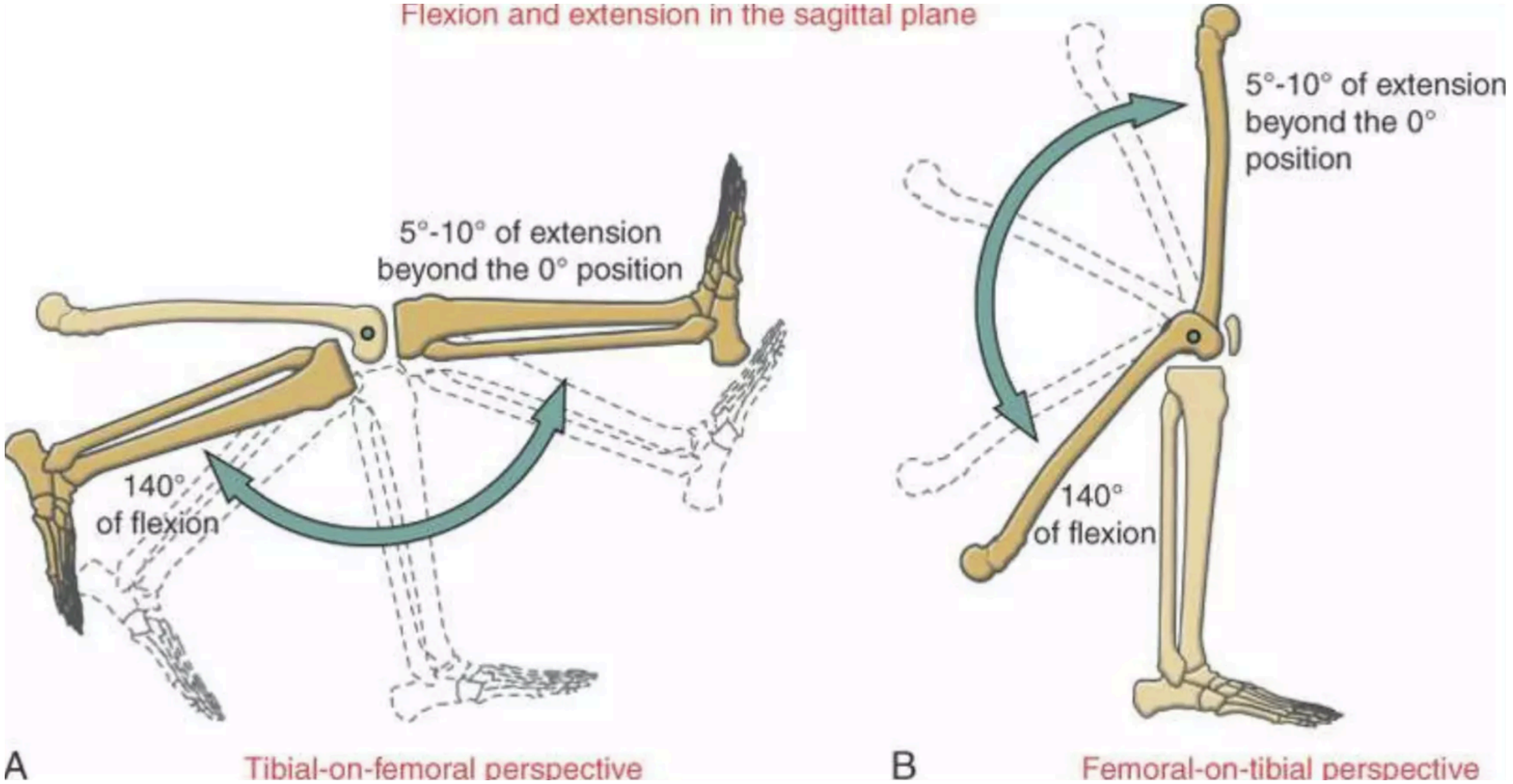


Osteokinematics

Flexion	Extension
In normal = 130°- 150°	Hyperextension= 5°-10°
In squatting = 160°	
Gait = 60°-70°	
Ascending stairs = 80°	

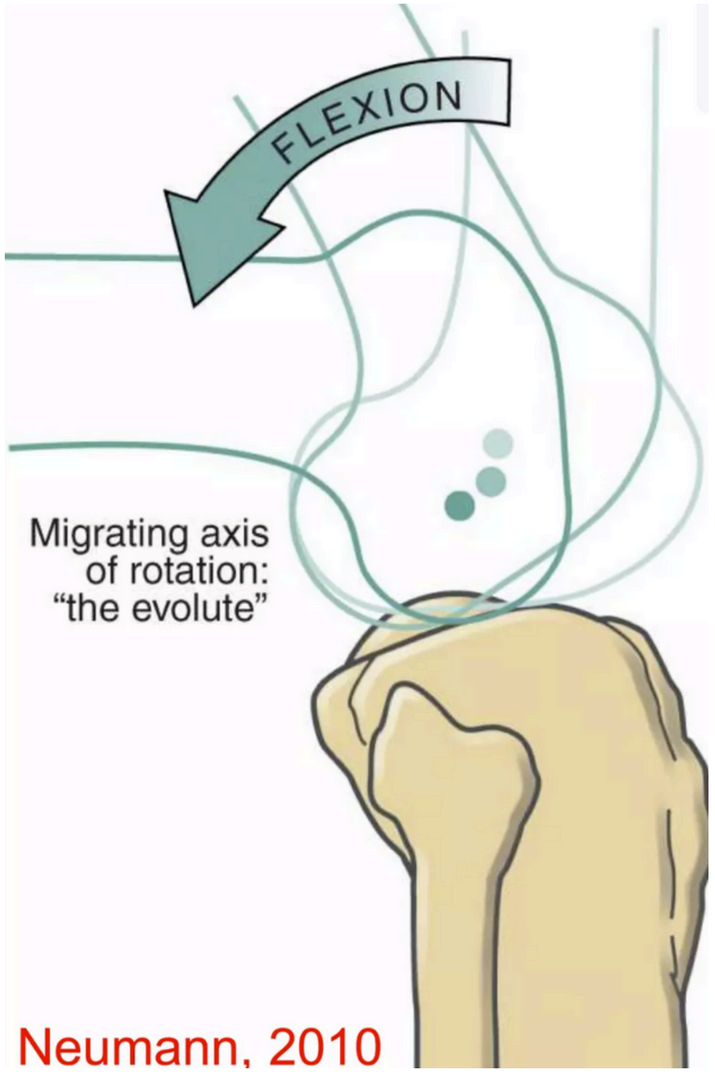


Osteokinematics - Flx/ Ext



“Evolute”

Migrating Axis



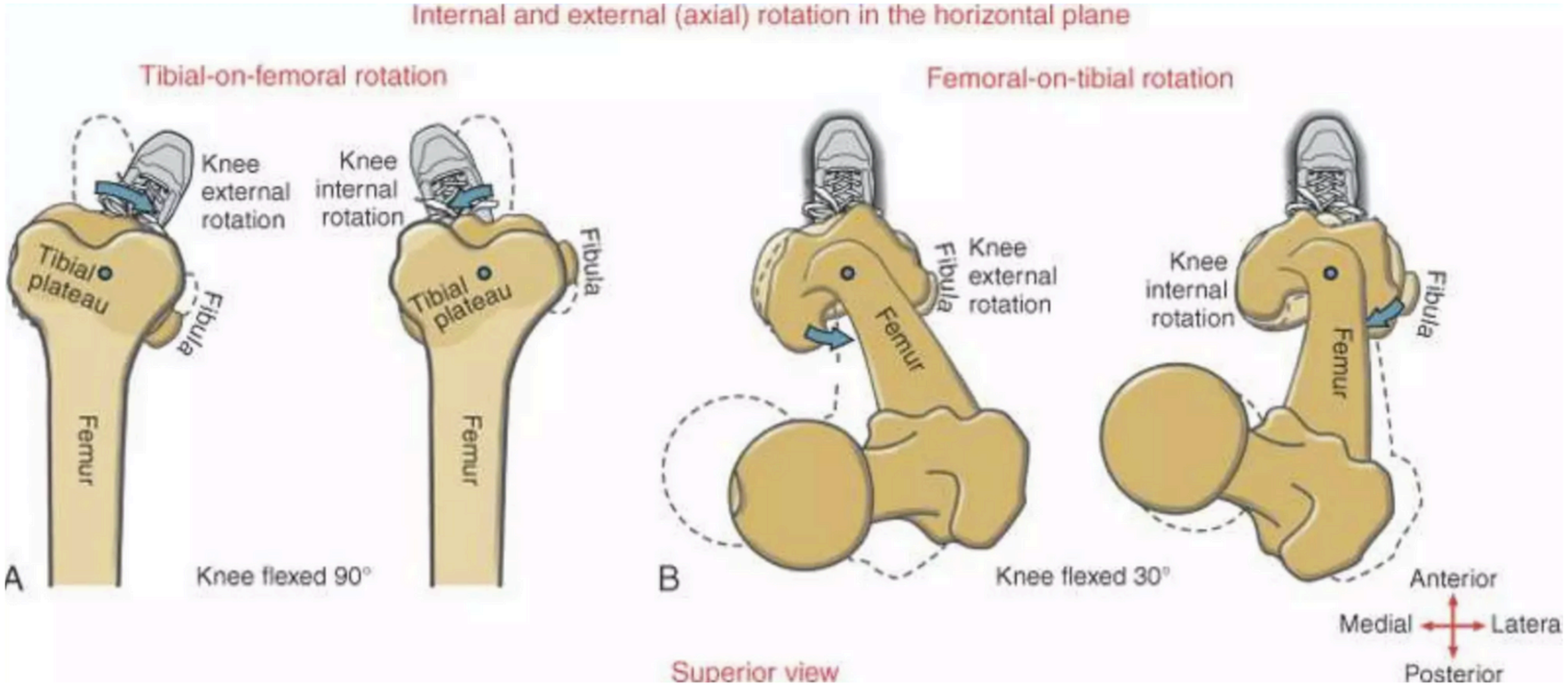
Osteokinematics

(Axial) Rotations	Valgus and varus
Medial Rotation= 0-15°	passive)

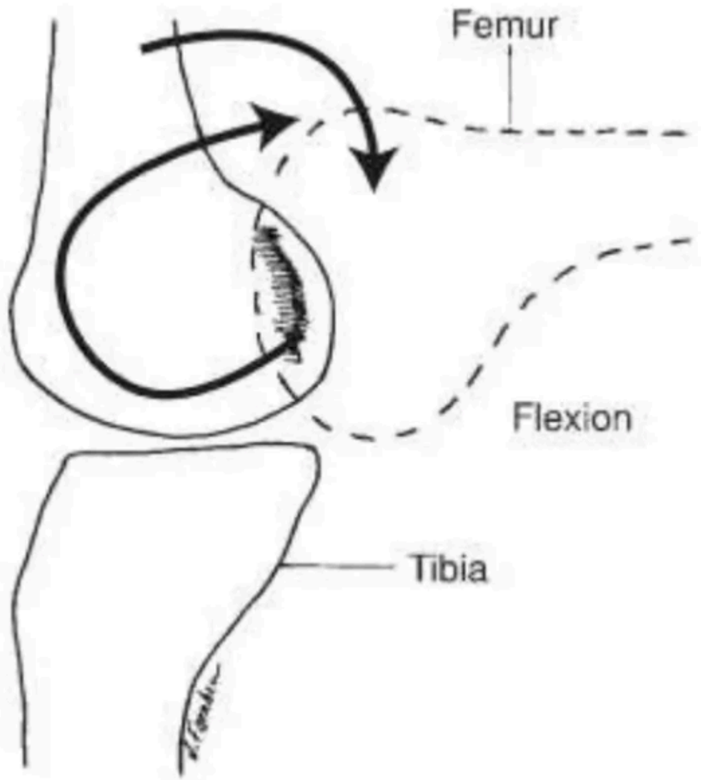
- Axial rotation increases with knee flexion.
- Total rotation in 90° flexion = 40-45°
- External rotation to internal rotation= 2:1
- Naming the rotation- based on orientation of tibial tuberosity

Osteokinematics

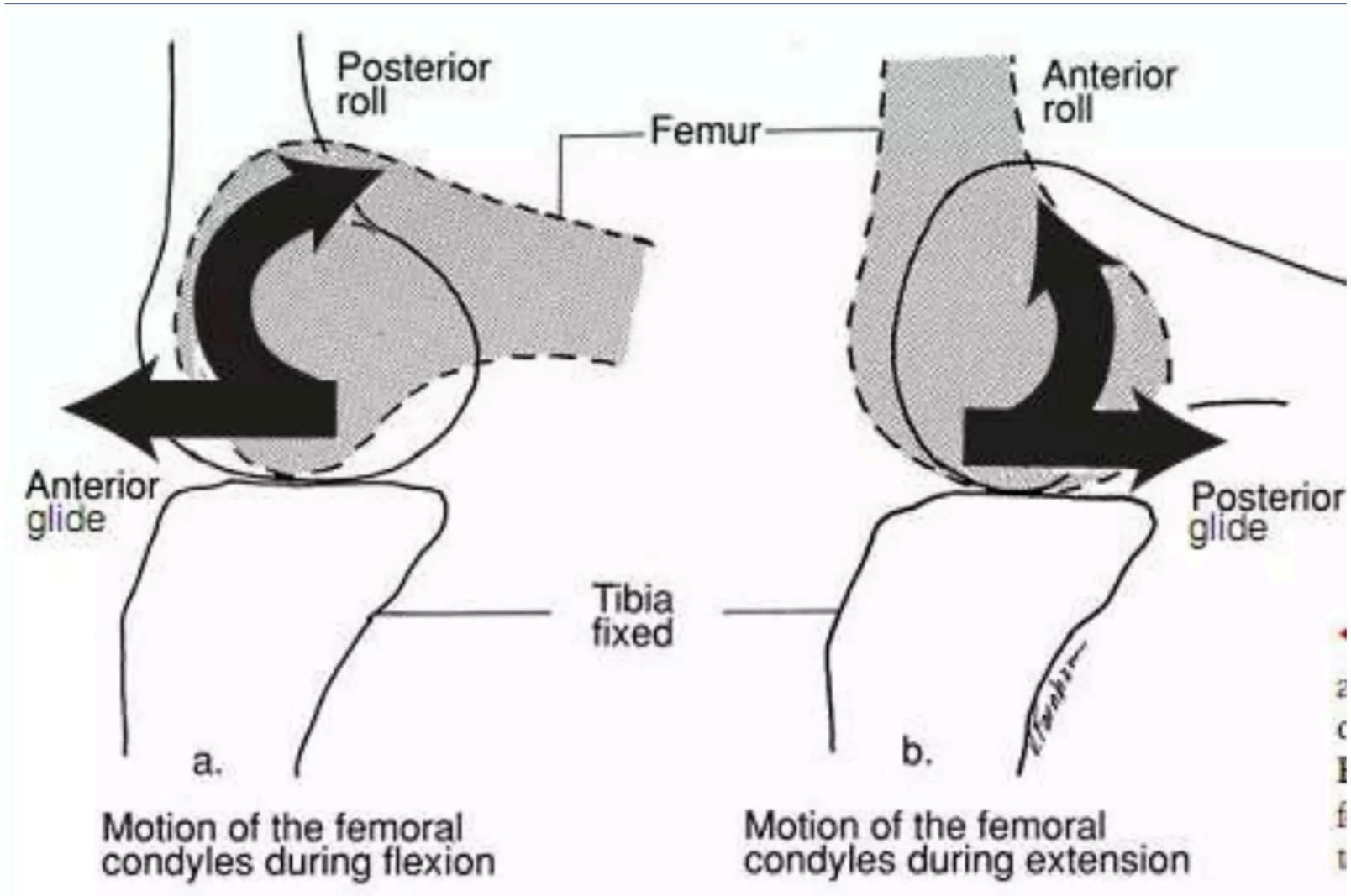
- Naming the rotation- based on orientation of tibial tuberosity with respect to distal anterior femur



Arthrokinematics: Knee Joint

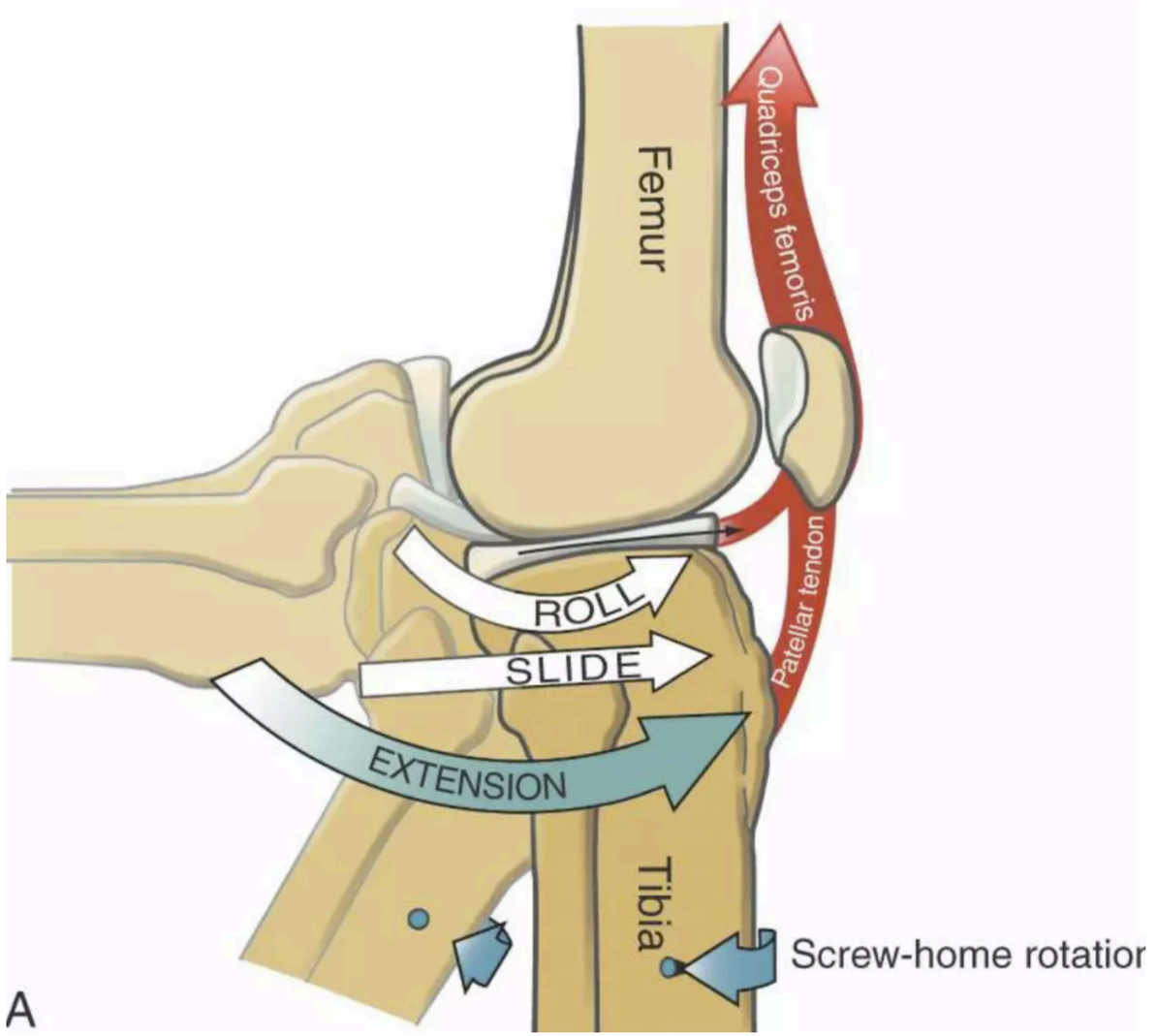


Arthrokinematics



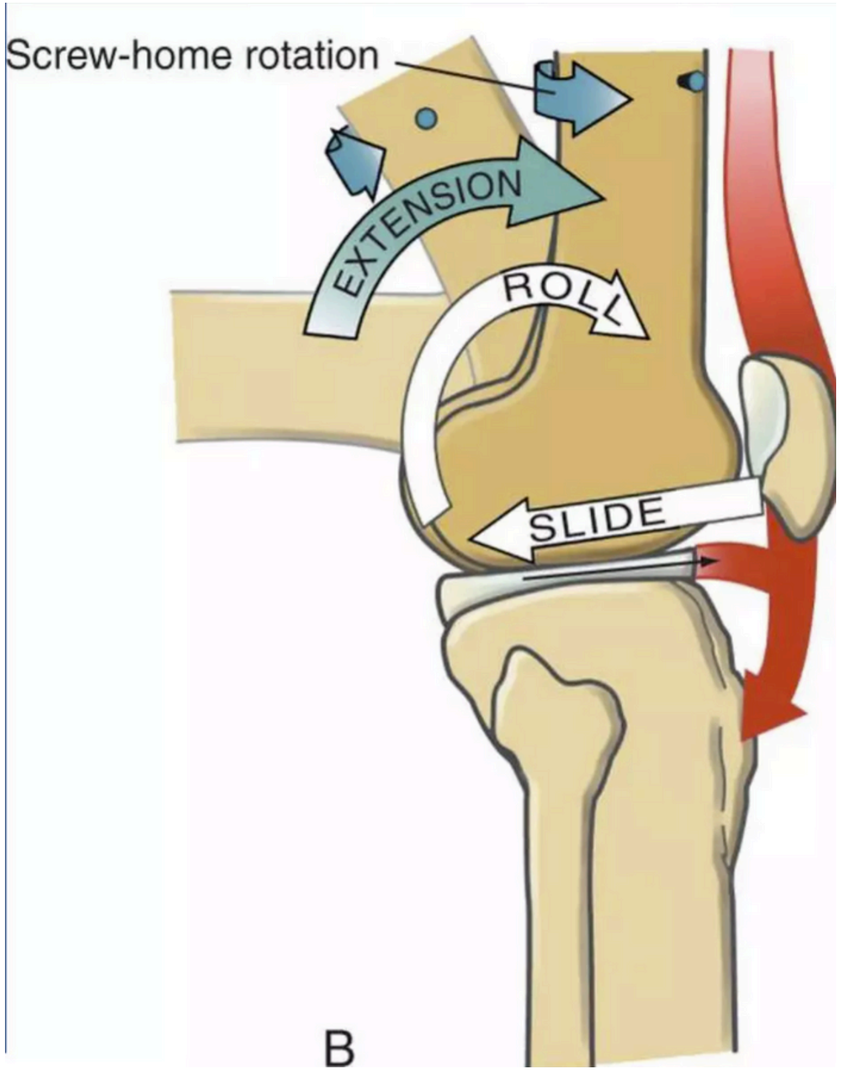
Arthrokinematics

Tibia on Femoral Extension



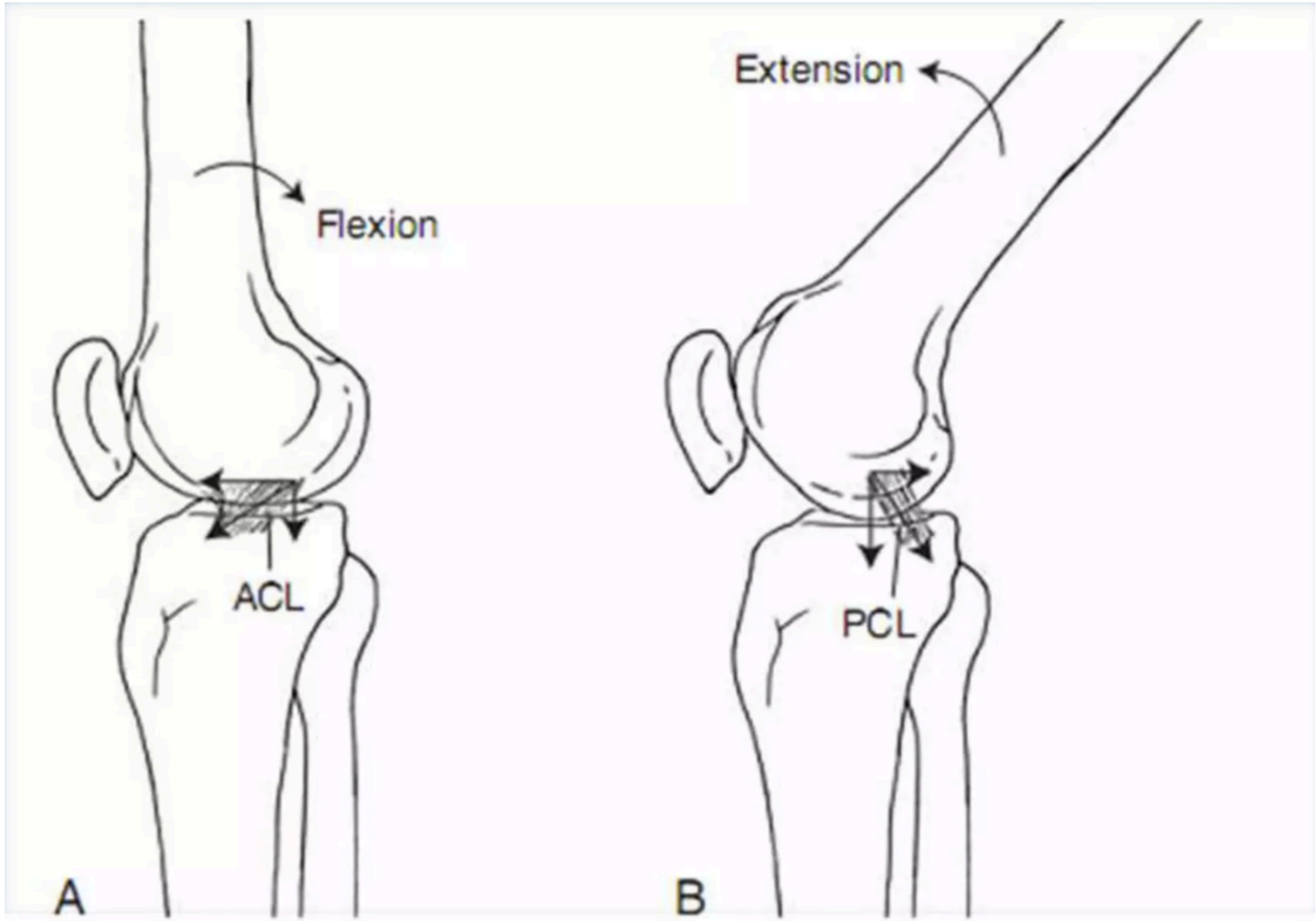
Arthrokinematics

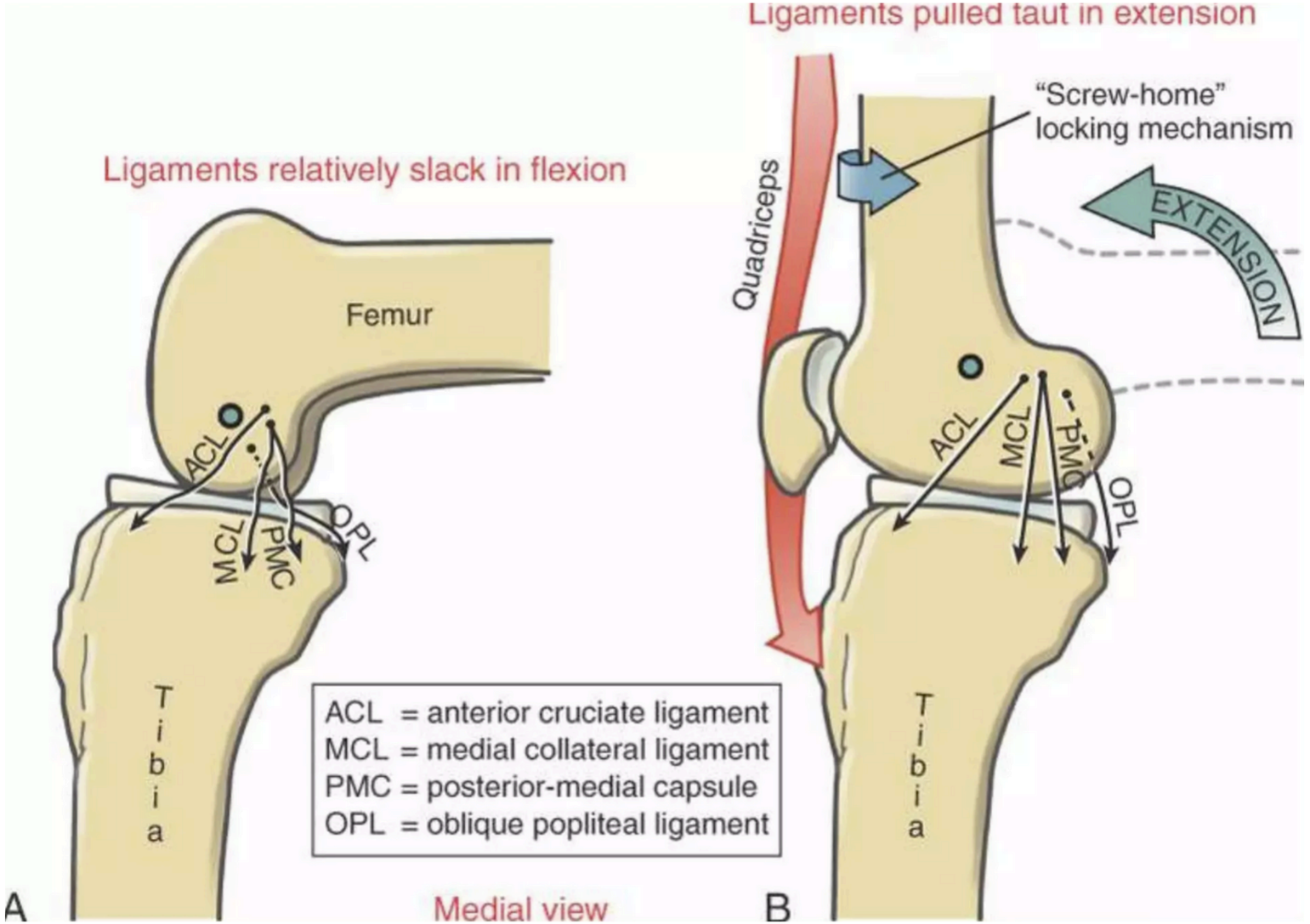
Tibia on Tibia Extension

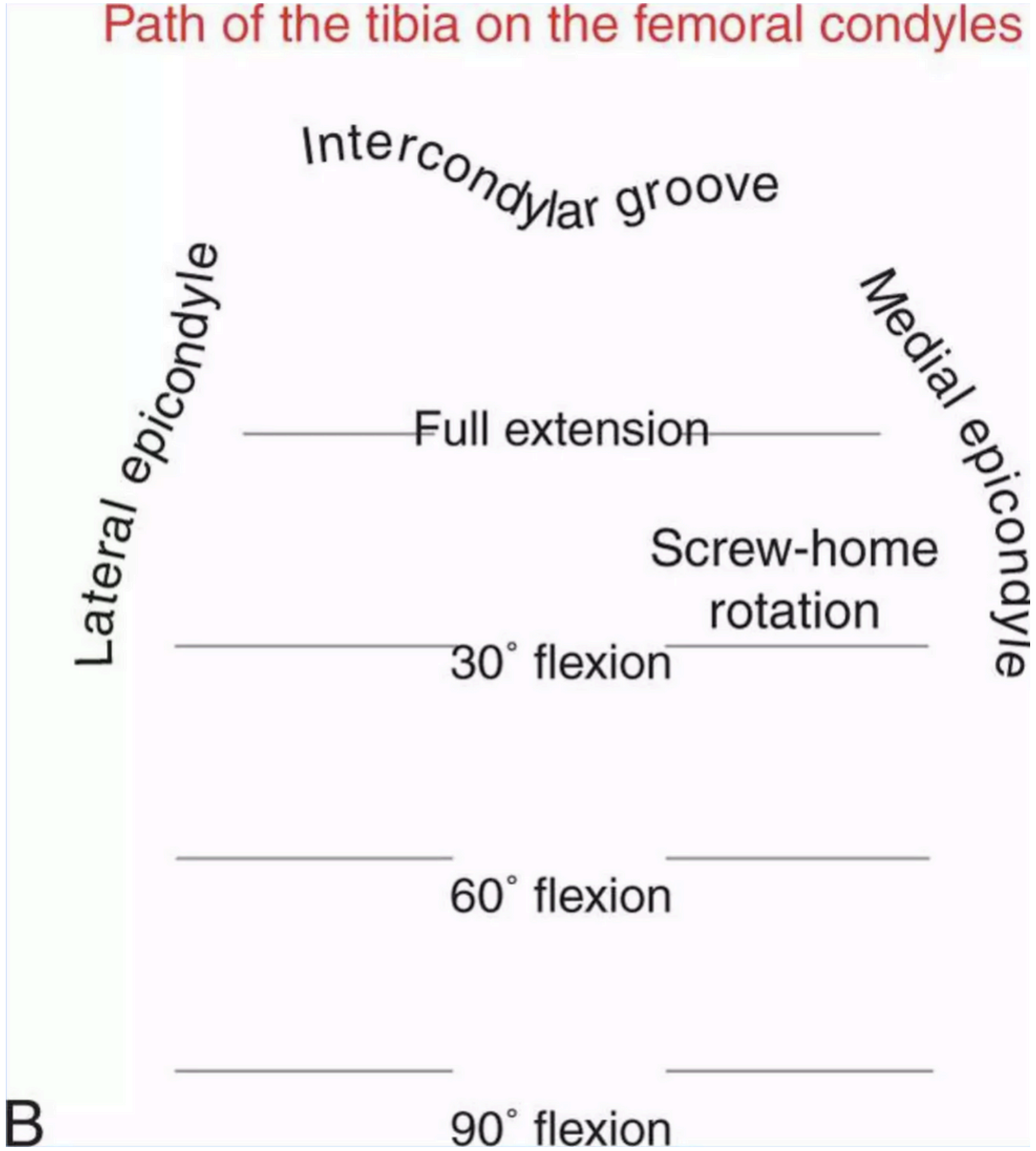


Arthrokinematics

Role of cruciate ligaments

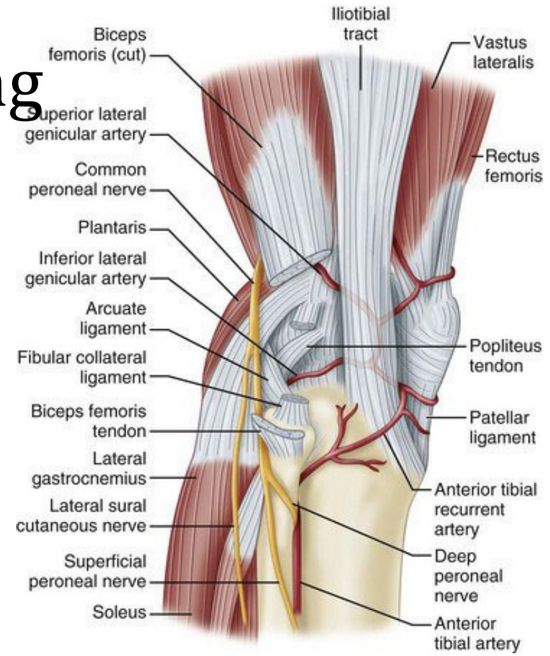



Ligaments relatively slack in flexion
Femur
ACL
MCL
PMC
OPL
Tibia
A
Ligaments pulled taut in extension
"Screw-home" locking mechanism
Quadriceps
EXTENSION
ACL
MCL
PMC
OPL
Tibia
B
ACL = anterior cruciate ligament
MCL = medial collateral ligament
PMC = posterior-medial capsule
OPL = oblique popliteal ligament
Medial view


Path of the tibia on the femoral condyles
Intercondylar groove
Lateral epicondyle
Medial epicondyle
Full extension
Screw-home rotation
30˚ flexion
60˚ flexion
90˚ flexion
B

Automatic or terminal rotation

- Coupled motion of lateral rotation and extension of knee
- Non-voluntary (Automatic)
- Locks the knee joint
- Keeps knee to remain in full extension in standing



Non weight bearing

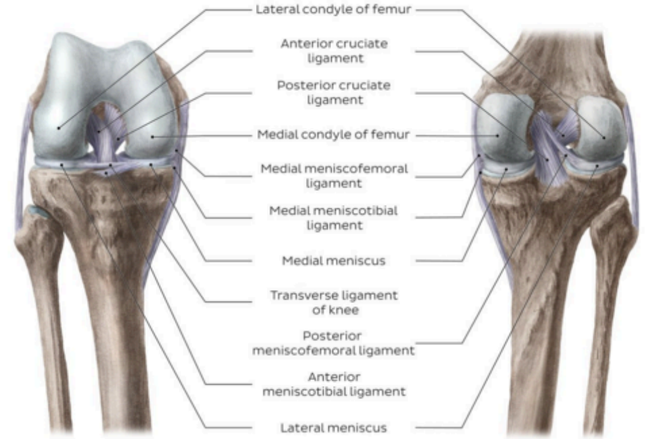
A-P diameter of Lat F condyle < Med F condyle

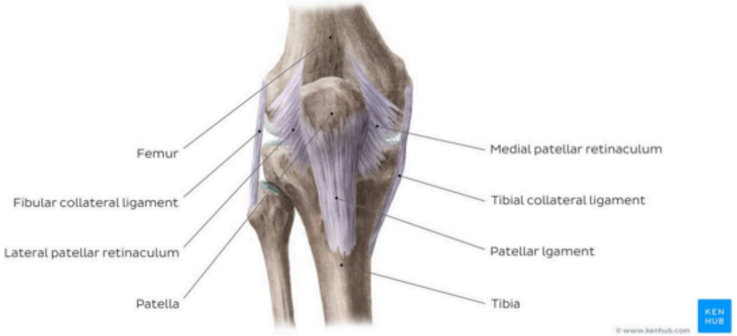
During last 30° of extension, glide and roll in Lateral condyle finishes but not in medial condyle

Lateral condyle serves as an axis for the medial condyle to rotate backwards i.e. Lateral rotation of tibia on femur occurs

Non weight bearing

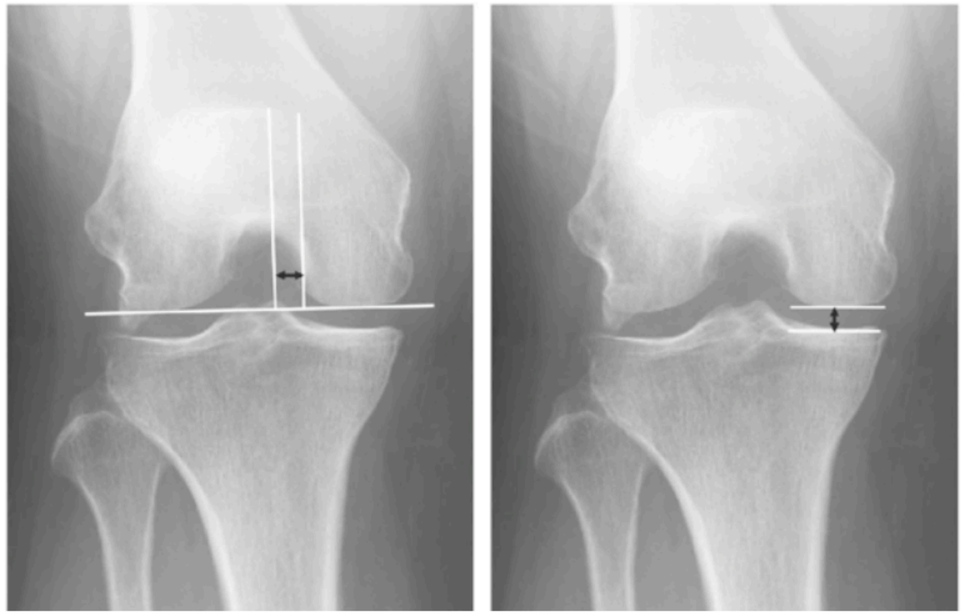
- This is locking of knee or Screw Home Phenomenon
- Locking makes all ligaments taut





Non weight bearing : Unlocking

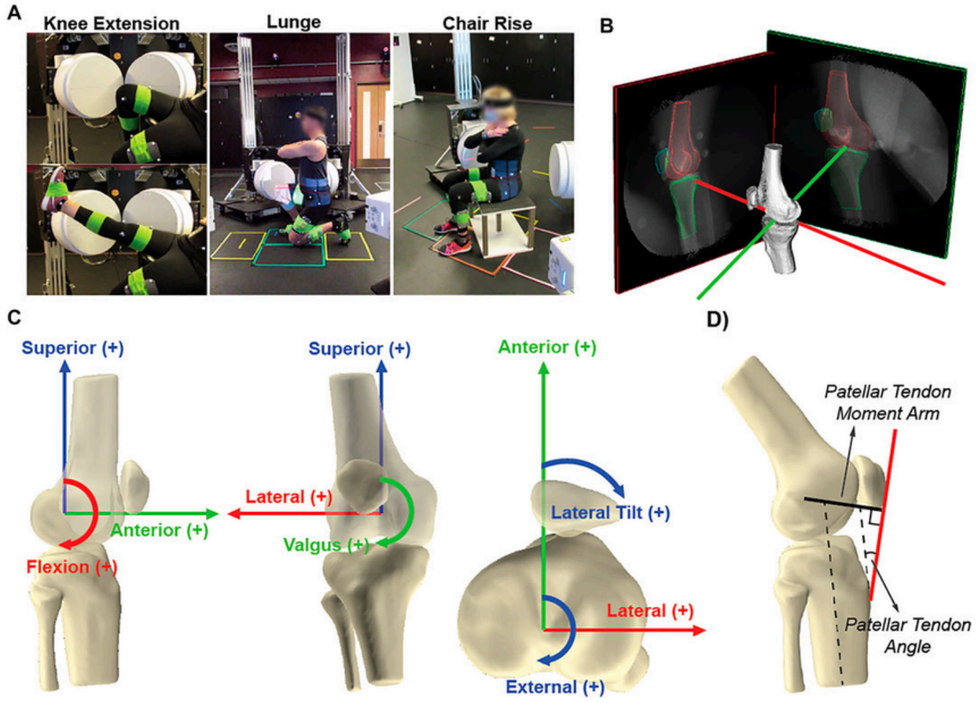
- Knee flexes only if unlocked
- It happens with medial rotation of tibia on femur
- Unlocking is brought about by Popliteus muscle



Weight bearing

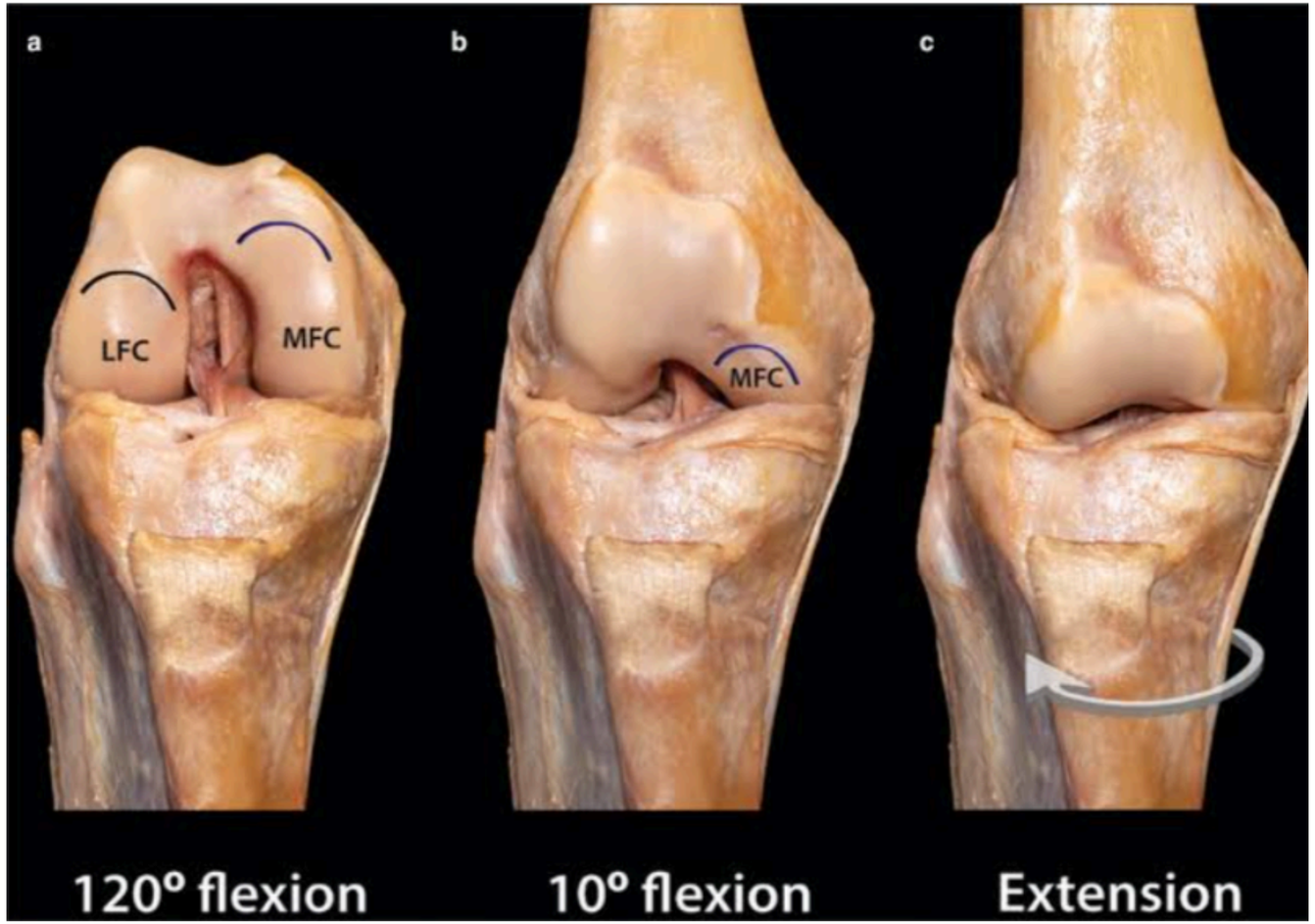
- Locking: femur rotates medially on relatively fixed tibia during last 30° of extension

- Unlocking: lateral rotation of femur on tibia before flexion proceeds



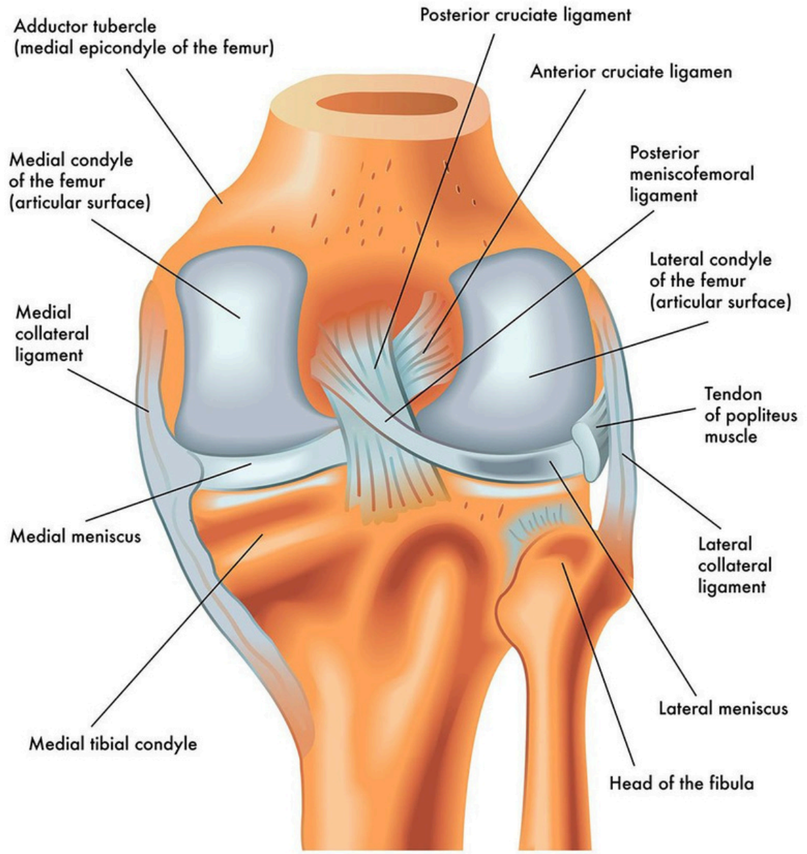
Factors guiding Screw home Rotation

- Shape of Medial femoral condyle
- Tension in ACL
- Lateral Pull of the Quadriceps

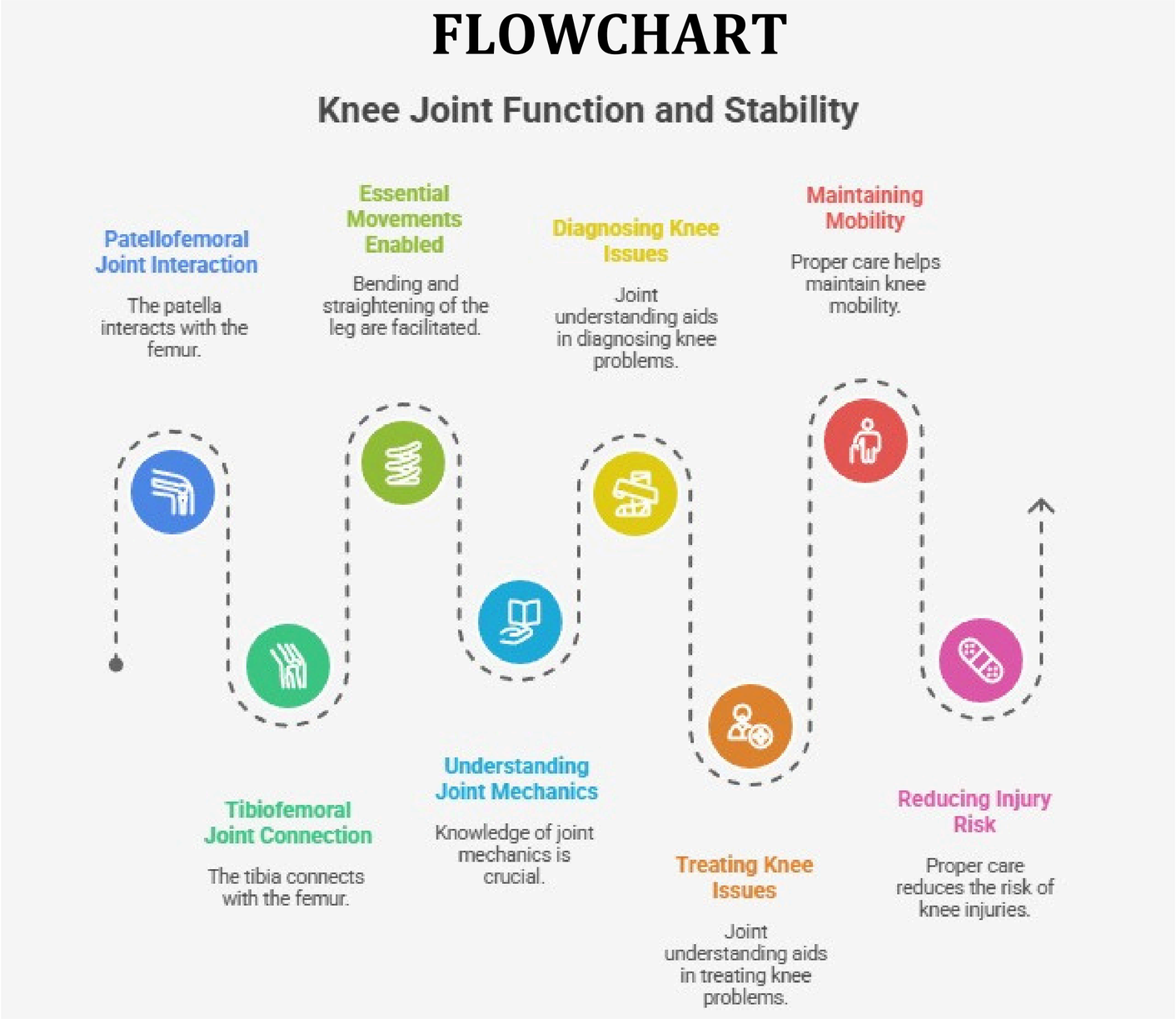


Summary

- Osteokinematics
- Arthrokinematics
- Screw home phenomenon



FLOWCHART


Knee Joint Function and Stability
Patellofemoral Joint Interaction
The patella interacts with the femur.
Essential Movements Enabled
Bending and straightening of the leg are facilitated.
Diagnosing Knee Issues
Joint understanding aids in diagnosing knee problems.
Maintaining Mobility
Proper care helps maintain knee mobility.
Tibiofemoral Joint Connection
The tibia connects with the femur.
Understanding Joint Mechanics
Knowledge of joint mechanics is crucial.
Treating Knee Issues
Joint understanding aids in treating knee problems.
Reducing Injury Risk
Proper care reduces the risk of knee injuries.

References

- Norkin C, Levengie P. Joint structure and function. 4th Edition
- Neumann DA. Kinesology of musculoskeletal system, Foundation for Physical Rehabilitation, 2nd Edition
- Kapandji IA. The Physiology of Joints. Volume 2, Lower Limb. 5th Edition

In class assessment

1. Define the tibiofemoral joint and classify it anatomically.
2. Describe the articular surfaces forming the tibiofemoral joint.
3. What are the functions of the menisci in the tibiofemoral joint?
4. Explain the screw-home mechanism of the knee joint.
5. Describe the movements possible at the tibiofemoral joint.

In class assessment

1. List the static and dynamic stabilizers of the tibiofemoral joint.
2. Explain the role of cruciate ligaments in knee stability.
3. Describe anteroposterior and rotational stability of the tibiofemoral joint.
4. What are the tibiofemoral joint reaction forces during weight-bearing activities?
5. Mention common clinical conditions affecting the tibiofemoral joint.

THANK YOU