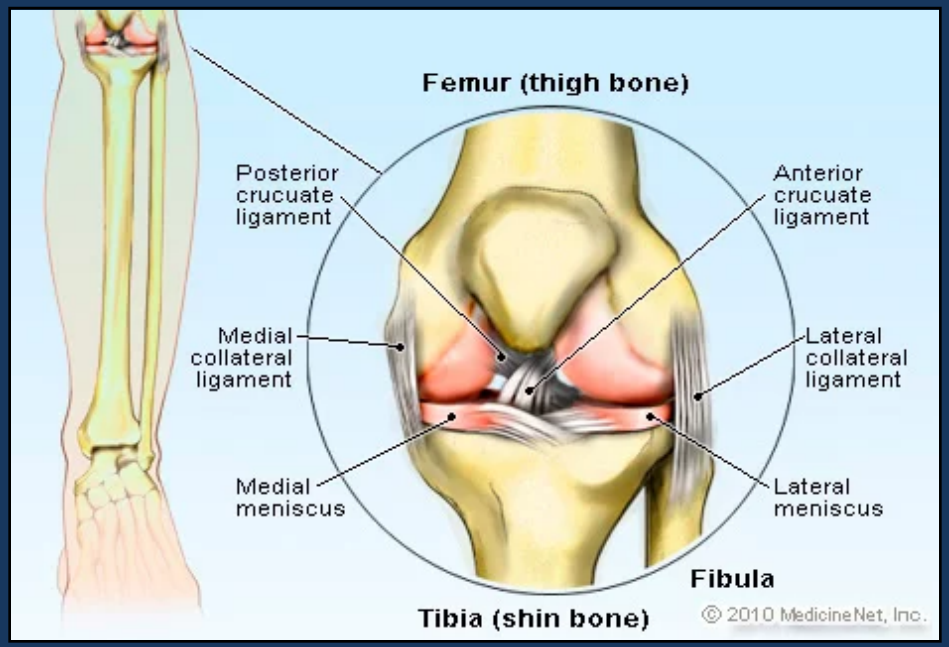
KNEE REGION



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Knee Region

OBJECTIVES

After the end of the lecture, the physiotherapy student will be able to:

- ✓ Demonstrate palpation of the palpable structures and motions of the knee.
- ✓ Describe motions of the knee joint (tibiofemoral joint).

Knee Region

Content

1. Introduction
2. Palpable Joint Structures
3. Non-palpable Structures
4. Knee Joint (tibiofemoral joint)
5. Questions and answer

1. Introduction

1. Introduction

- ✓ Largest & the most complex joint in the human body
- ✓ Three bones
- ✓ Two degrees of freedom of motion
- ✓ Three articulating surfaces: Medial tibiofemoral

  Lateral tibiofemoral

  Patellofemoral articulations

  Enclosed by a common joint capsule

Introduction(Cont.)

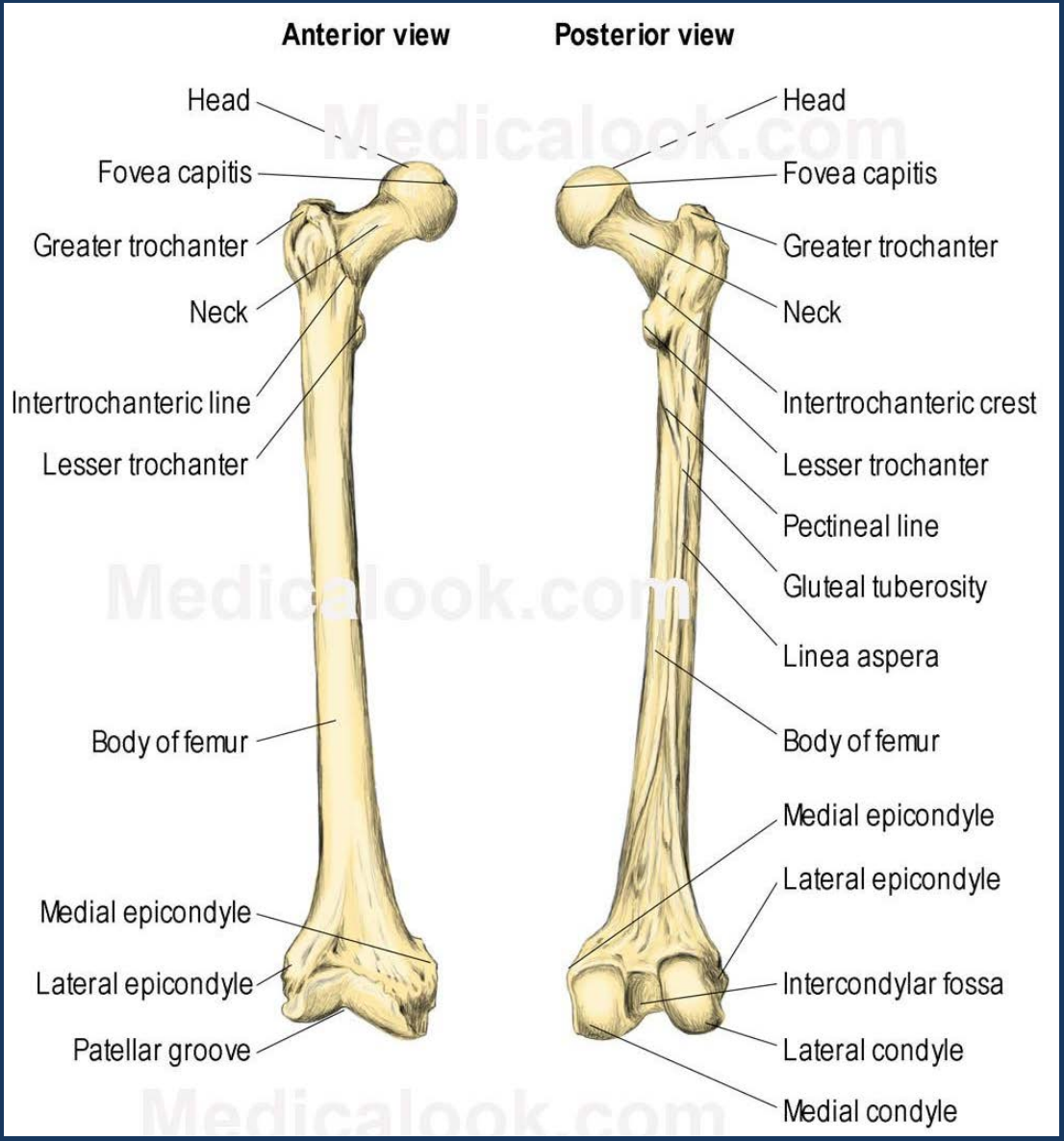


Fig. Right Femur

Introduction(Cont.)

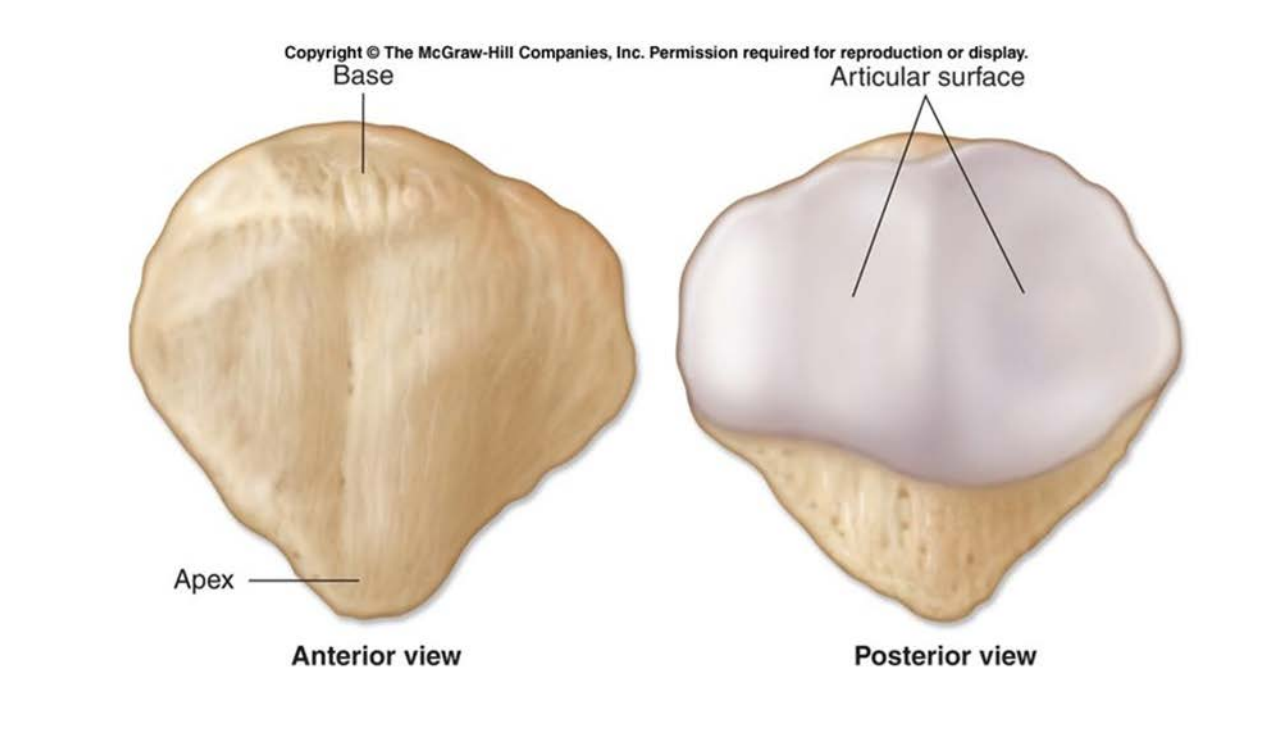


Fig. Patella - Body's largest sesamoid bone

Introduction(Cont.)

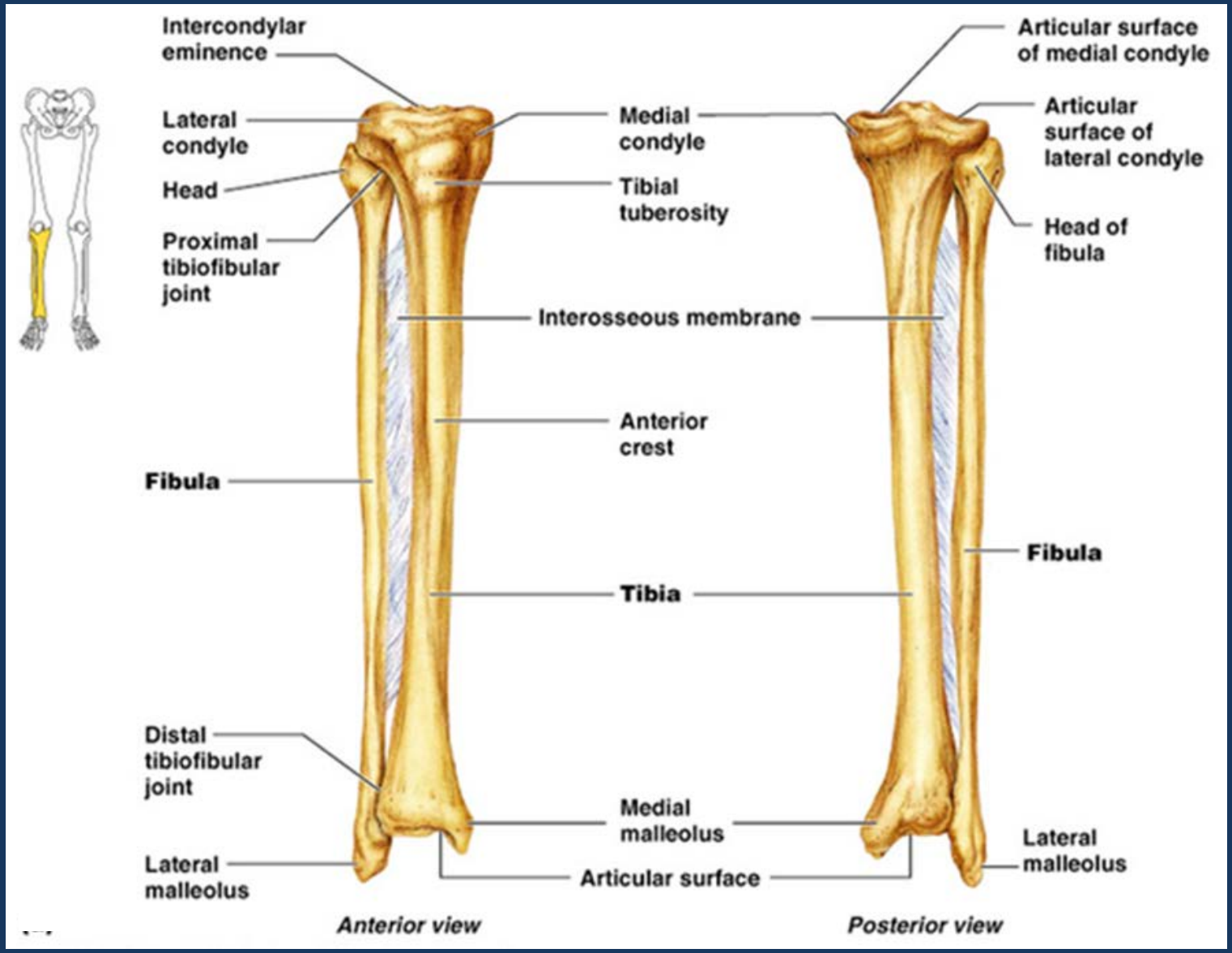
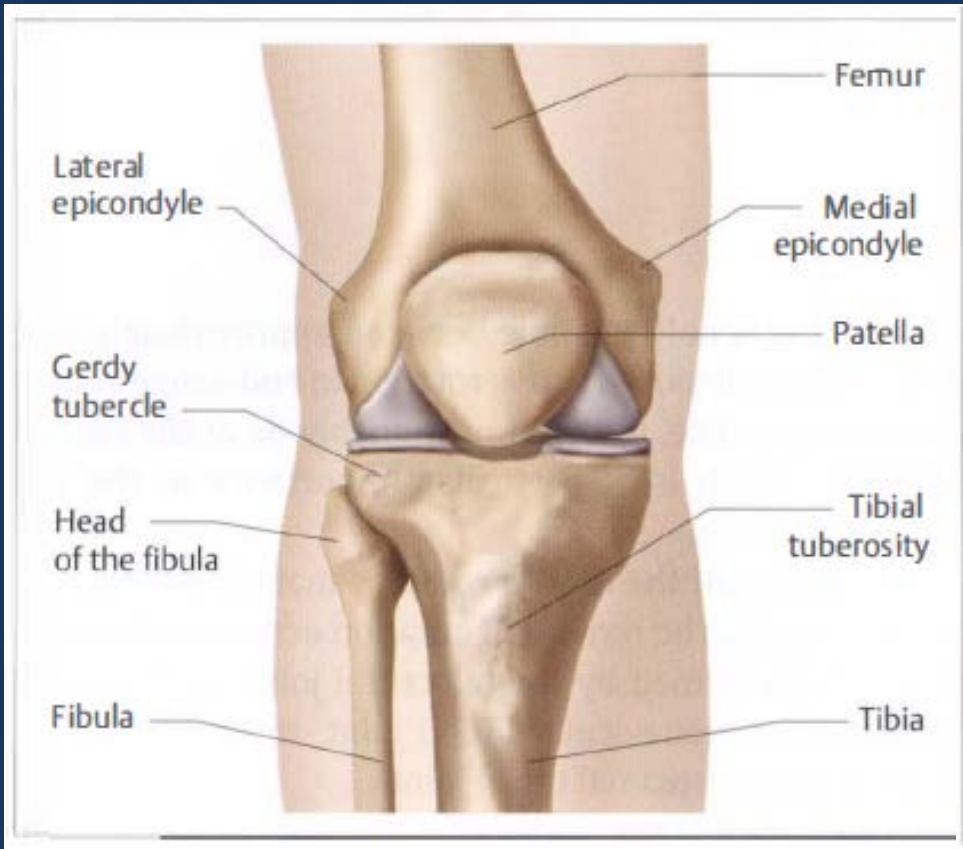
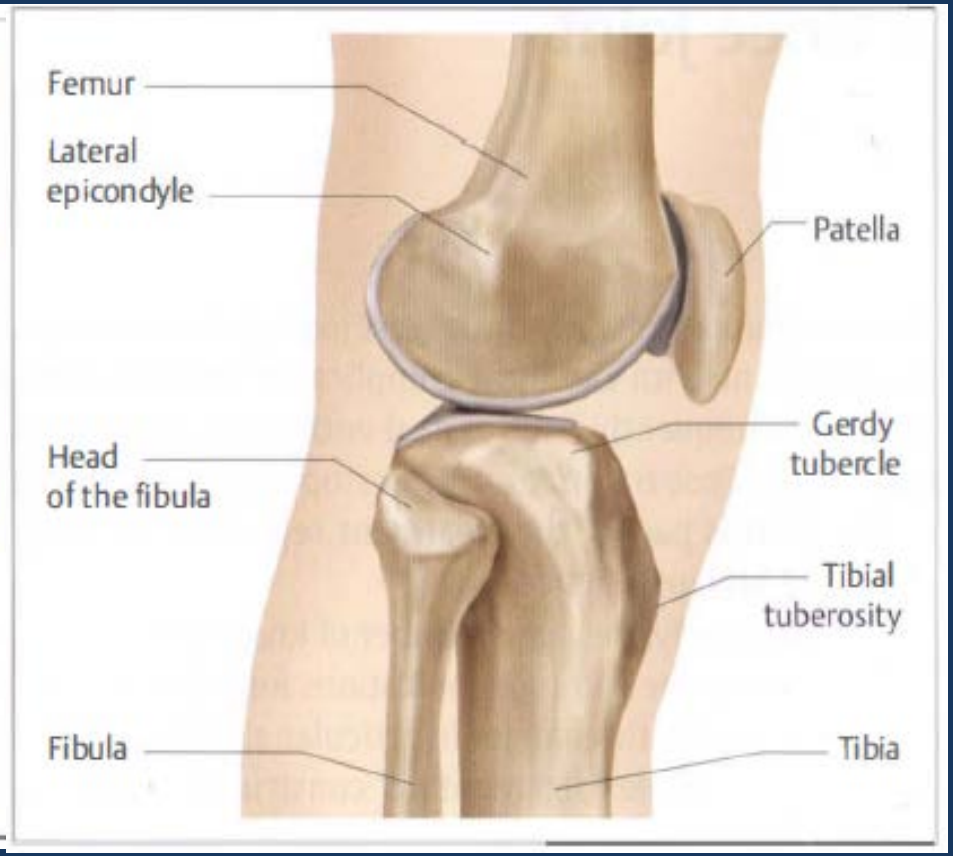


Fig. Right Tibia

Introduction(Cont.)



Topography of the osseous reference points: Anterior View



Topography of the osseous reference points: Lateral View

Fig. Knee joint

Introduction (Cont.)

- ✓ Support the body weight in the erect standing without muscle contraction
- ✓ Participates in lowering & elevating the body weight in sitting, squatting, or climbing
- ✓ Permits rotation of the body when turning on the planted foot
- ✓ Multiple functions of the normal knee are achieved in a unique way
    - To withstand large forces
    - To provide greater stability
    - To afford large range of motion

Introduction (Cont.)

- ✓ Mobility

  Bony structure

- ✓ Stability

  Soft tissues: ligaments, muscles, cartilage

- ✓ Athletic & industrial injuries to these stabilizing structures are common

  Caused by larger torques developed by forces acting on the long lever arms of the femur & tibia

2. Palpable Joint Structures

2. Palpable Joint Structures

Superficial structures of the knee

Subject sitting on a table with the knee relaxed in 90º of flexion

- ✓ **Femoral condyles**

  Anteriorly on both sides of patella

  Followed proximally to the epicondyles

- ✓ **Tibiofemoral joint line**

  Depression when the palpating fingers moved inferiorly to the femoral condyles

  Confirmed by passively rotating or extending the knee while feeling the motion of tibial condyles on the femur

Palpable Joint Structures (Cont.)

- ✓ **Tibial tuberosity**

  Anteriorly on the tibia & below the tibial condyles

  Large roughened area

  Distal attachment of the patellar tendon of the quadriceps femoris muscle

- ✓ **Crest of the tibia**

  Followed distally to the ankle

Palpable Joint Structures (Cont.)

- ✓ **Medial (tibial) collateral ligament**

  Spans the tibiofemoral joint on the medial side

  Along the joint line

  Obliterates the joint line as the ligament courses from the medial femoral epicondyle to the medial tibial condyle & shaft of the tibia

- ✓ **Edge of the medial meniscus**

  On the joint line at the anterior margin of the medial collateral ligament

  Medial edge

  More prominent on passive internal rotation the tibia

  Retract on passive external rotation of the tibia

Palpable Joint Structures (Cont.)

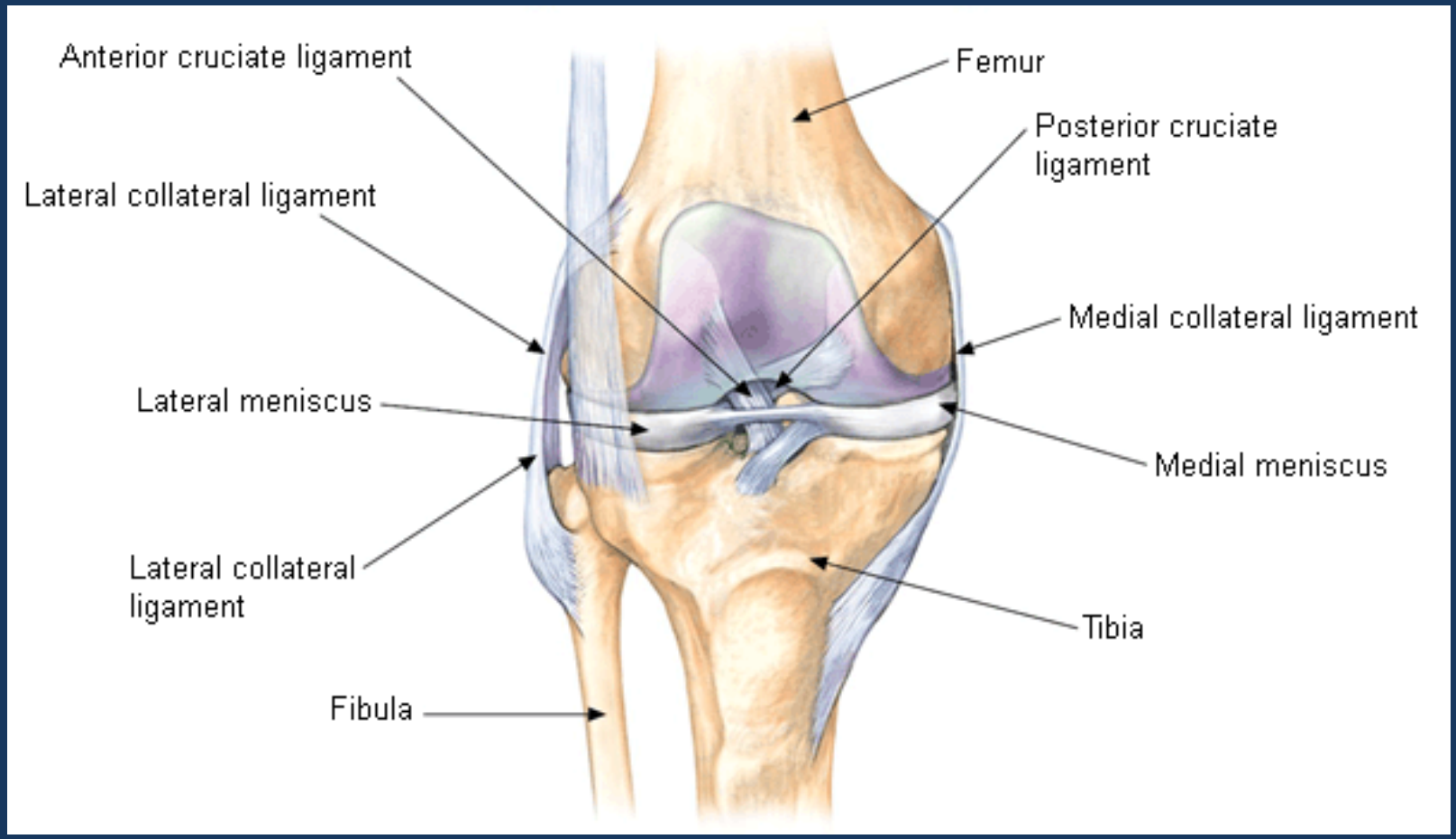


Fig. Ligaments of the knee joint

Palpable Joint Structures (Cont.)

- ✓ **Lateral (fibular) collateral ligament**

  Index finger on the lateral femoral epicondyle, middle finger on the fibular head

  Difficult to palpate as it crosses the joint line

  Readily palpate when the foot is placed on the opposite knee

- ✓ **Patella**

  Supine with knee extended & relaxed

- ✓ **Patellar ligament**

  Thick

  From tibial tuberosity to the apex of the triangular patella

Assignment

- Structure of the knee joint
- Functions of the knee joint
- Palpable structures of the knee joint

3. Non-palpable Structures

3. Nonpalpable Structures

- ✓ Articular surfaces & patellar surfaces on the femoral condyles
- ✓ Intercondyloid fossa of femur
- ✓ Lateral & medial supracondylar lines
- ✓ Articular surfaces of the tibial condyles
- ✓ Lateral meniscus
- ✓ Medial meniscus
- ✓ Cruciate ligaments
- ✓ Transverse ligament

4. Knee Joint

4. Knee Joint; Motions of the knee

- ✓ Two degrees of freedom

  Flexion & extension

  Axial rotation

- ✓ Flexion: 120° - 150°

  Depends on the size of muscle mass of the calf in contact with the posterior thigh

4. Knee Joint:; Motions of the knee (Cont.)

- ✓ With the hip in extension

  Decrease ROM of knee flexion because of limitation by two-joint rectus femoris muscle

- ✓ With the hip in 90° flexion

  Free or limit knee extension by the length of the hamstring muscles

- ✓ Hyperextension

  Not normally exceed 15°

✓**End feel**

Quality of m/m perceived by the practitioner at the very end of the available ROM

Reveal a great deal about the nature of various pathologies

Cyriax J, 1982

4. Knee Joint; Motions of the knee (Cont.)

- ✓ Normal Passive Motion End Feel

  Knee flexion: **Soft**

  Contact of the tissues of the posterior calf & thigh

  Shortened rectus femoris muscle if calf-thigh contact is not made

  Extension or hyperextension: **Firm**

  Tension on ligamentous & posterior capsular structures

4. Knee Joint; Motions of the knee (Cont.)

- Axes for flexion & extension
- Axial rotation
- Terminal rotation of the knee
- Accessory motions

Axes for Flexion & Extension

- ✓ Located a few centimeters above the joint line passing transversely through the femoral condyles

- ✓ Clinically, it is approximated as directed through the center of the lateral & medial condyles of the femur

Axes for Flexion & Extension

- ✓ Movement of the axis during joint motions occurs in most joints, but the magnitude is usually small

- ✓ Size of the knee joint causes considerable translation of the axis

Axes for Flexion & Extension

- ✓ Because of the shifting axis of motion of the human knee

  Problems occur when devices with mechanical hinge joints are applied to the knee

- ✓ When the knee joint is moved from extension to flexion

  Anatomic axis of the knee moves about 2 cm

  Mechanical axis of the attached device remains fixed

  Arms of the mechanical device cannot remain parallel to the thigh & leg, & motions or pressures between the mechanical & anatomic parts will occur

Axes for Flexion & Extension

- ✓ Compromise & careful alignment

  Prevent discomfort & abrasions

- ✓ Misalignment of an orthotic knee joint

  Can cause pressure of cuffs on the extremity during knee flexion

  & gapping during knee extension (or vice versa)

Axial Rotation

- ✓ Occurs in the **transverse plane** when **the knee is flexed**

  MCL & LCL slacken when the joint flexes

  More slack in the LCL than in the MCL

  M/m between the femoral & tibial condyles

  More extensive laterally than medially

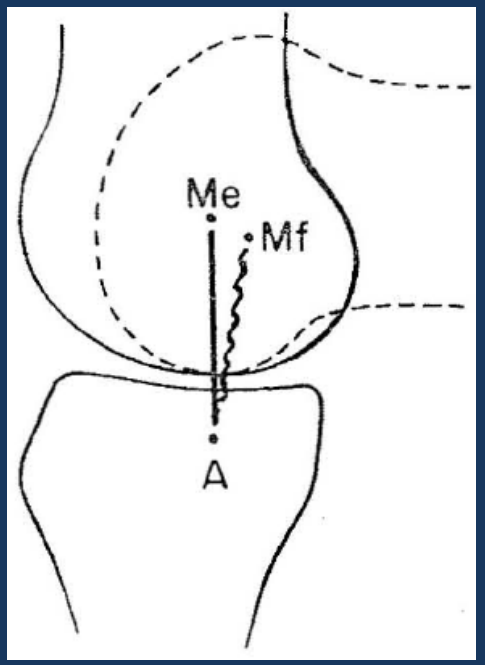


Fig. Slackening of the MCL in flexion of the knee

Axial Rotation

- ✓ Mean total rotation of 40° (SD = ± 8) at 90° of knee flexion

Mossberg and Smith, 1983

- ✓ ER was approximately twice as large as IR

- ✓ Decreases as the angle of knee flexion becomes smaller
- ✓ Cannot be performed as the knee approaches extension

Axial Rotation

- ✓ **Rotation of the tibia on the femur**

  Can be performed voluntarily in the sitting position

  Useful in placing & positioning the foot

- ✓ **Rotation of the femur on the fixed tibia**

  Major functional importance of the motion

  In closed-chain motion as in turning from kneeling, sitting, or squatting positions & in sudden changes in direction while running

Axial Rotation

- ✓ Normal end-feels for passive IR & ER are **firm**
- ✓ Motion is limited by capsular & ligamentous structures (CL, cruciate, oblique popliteal ligaments, the retinacula & the iliotibial tract)

Terminal Rotation of the Knee

Screw Home Mechanism

- ✓ When the knee moves into extension, the tibia externally rotates about 20° on the fixed femur

  Can be observed in the last 20° of KE

- ✓ In closed-chain motion as in rising from a chair

  Terminal rotation is seen as IR of the femur on the fixed tibia

- ✓ Purely a mechanical event that occurs with both passive & active KE & that **cannot be produced (or prevented) voluntarily**

Terminal Rotation of the Knee

Screw Home Mechanism

- ✓ Provides a mechanical stability to withstand forces occurring in the sagittal plane

- ✓ Permits humans to stand erect without quadriceps muscle contraction & to withstand anterior-posterior forces on the extended knee with reduced muscle force

Terminal Rotation of the Knee

- ✓ Although the amount of terminal rotation of the knee is modest, it is, like axial rotation, a requisite for normal knee function

- ✓ Both motions must be evaluated & regained for successful rehabilitation of the knee

Accessory Motions

- ✓ Closed-packed position of the knee

  Full extension

  Terminal rotation produces tightening of the ligamentous & capsular structures with strong stabilization of the joint

  Accessory motions normally cannot be produced in this position

Accessory Motions

- ✓ Knee is placed in 25° or more of f1exion & the femur is stabilized

  Tibia can be distracted several mm on the femur

  Tibia can be moved 1 to 3 mm in anterior or posterior glides & medial and lateral glides, as well as in abduction & adduction

  An excessive glide is a possible indication of laxity in soft tissue structures, i.e., ligaments, menisci, or the capsule

5. Questions and Answer

Questions

1. Two degrees of freedom motion occurred at the knee are ---------, and ---------.

2. With the hip in extension, ROM of knee flexion is decreased due to limitation of ----------.

3. With the hip in 90° flexion, free or limit knee extension depends on ----------.

Answer

1. Two degrees of freedom motion occurred at the knee are flexion and extension, and axial rotation.

2. With the hip in extension, ROM of knee flexion is decreased due to limitation of **two-joint rectus femoris muscle**.

3. With the hip in 90° flexion, free or limit knee extension depends on the **length of the hamstring muscles.**

Questions

4. Normal passive motion end feel for- knee flexion is -------- , and extension and rotation are ----------.

5. Because of ----------of MCL & LCL, axial rotation or ---------- rotation coccus when the knee is flexed.

6. Axial rotation decreases as the angle of knee flexion becomes ---------and cannot be performed as the knee approaches to ----------.

Answer

4. Normal passive motion end feel for- knee flexion is **soft** and extension and rotation are **firm**.

5. Because of **slackening** of MCL & LCL, axial rotation or **voluntary** rotation occurs when the knee is flexed.

6. Axial rotation decreases as the angle of knee flexion becomes **smaller** and cannot be performed as the knee approaches to **extension.**

Questions

7. When the knee moves into extension, the --------- externally rotates about 20° on the fixed femur.

8. In closed-chain motion as in rising from a chair, terminal rotation is seen as internal rotation of ---------- on the fixed ----------.

9. Screw home mechanism of the knee is purely a mechanical event that occurs with both passive & active knee ---------- & that cannot be produced or prevented ----------.

Answer

7. When the knee moves into extension, the **tibia** externally rotates about 20° on the fixed femur

8. In closed-chain motion as in rising from a chair, terminal rotation is seen as internal rotation of **femur** on the fixed **tibia.**

9. Screw home mechanism of the knee is purely a mechanical event that occurs with both passive & active knee **extension** & that cannot be produced or prevented **voluntarily.**

Questions

10. Screw home mechanism of knee permits humans to stand erect without ---------- & provides a ---------- to withstand forces occurring in the sagittal plane.

11. ---------- motions normally cannot be produced in closed-packed position, full extension, of the knee.

12. Knee accessory motions can be performed when the knee is placed in 25° or more of ---------- & the ----------is stabilized.

Answer

10. Screw home mechanism of knee permits humans to stand erect without **quadriceps muscle contraction** & provides a **mechanical stability** to withstand forces occurring in the sagittal plane.

11. **Accessory** motions normally cannot be produced in closed-packed position, full extension, of the knee.

12. Knee accessory motions can be performed when the knee is placed in 25° or more of **f1exion** & the **femur** is stabilized.

References

Smith, K. L, Weiss, E. L. and Lehmkuhl, L. D. (1996) Knee region. In *Brunnstrom's Clinical Kinesiology* , ed. K. L. Smith, E. L. Weiss and L. D. Lehmkuhl; p. 301- 304. 5th ed. Jaypee Brothers Medical Publishers in New Delhi, India.


THANK YOU