Al-Farabi Kazakh National University
Higher School of Medicine

Joint

LEARNING OUTCOMES

As a result of the lesson you will be able to:

- *identify the major anatomical features of the jaw, shoulder joints*
- *explain how mechanical advantage relates to the power and speed of the jaw, shoulder joints movement;*
- *discuss the factors that determine the jaw, shoulder joint range of motion*
- *describe the primary axes of rotation that a bone can have and relate this to a joint's degrees of freedom*

The Coxal (Hip) Joint

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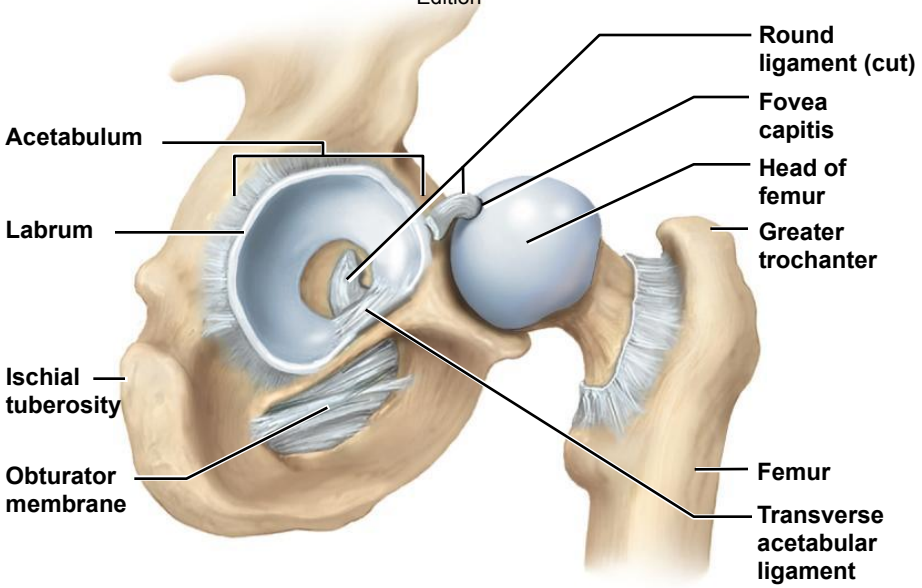

(b) Lateral view, femur retracted

Figure 9.26b

- **coxal (hip) joint** – point at which the head of femur inserts into the acetabulum of the hip bone
- bears much more weight, have deeper sockets, more stable than shoulder
- **acetabular labrum** – horseshoe-shaped ring of fibrocartilage that deepens socket
  - dislocations rare: congenital dislocations in infants
- **ligaments** supporting hip joint
  - **iliofemoral** and **pubofemoral** – on anterior
  - **ischiofemoral** ligament – on posterior
  - when standing, the ligaments become twisted

Hip (Coxal) Joint

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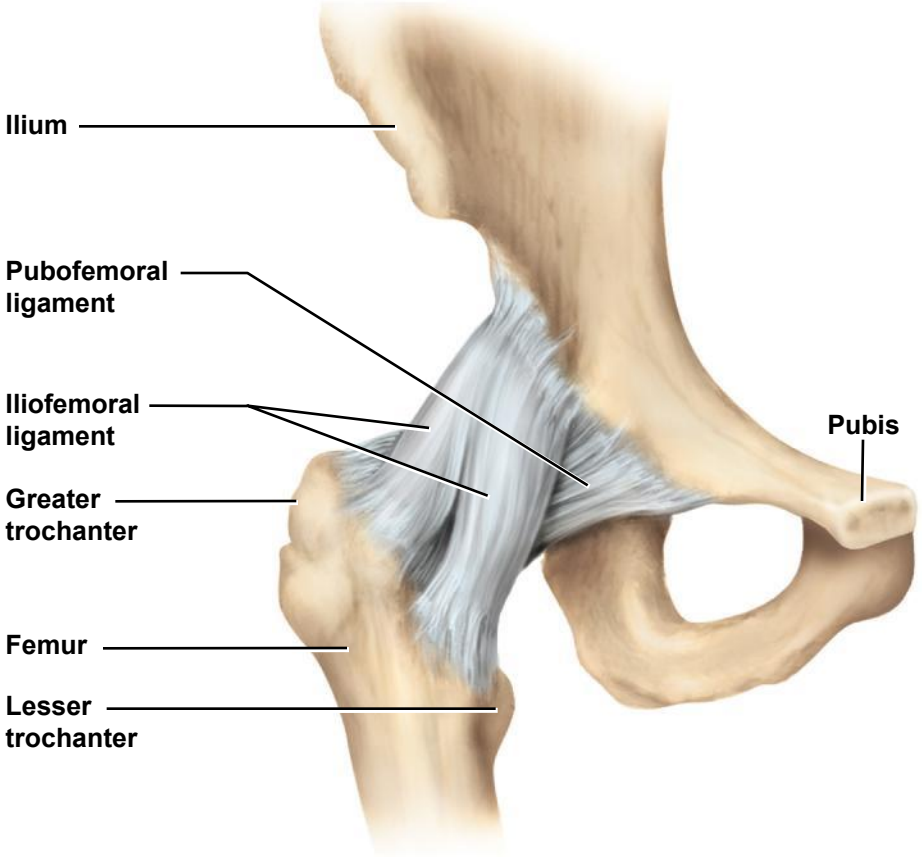

(c) Anterior view

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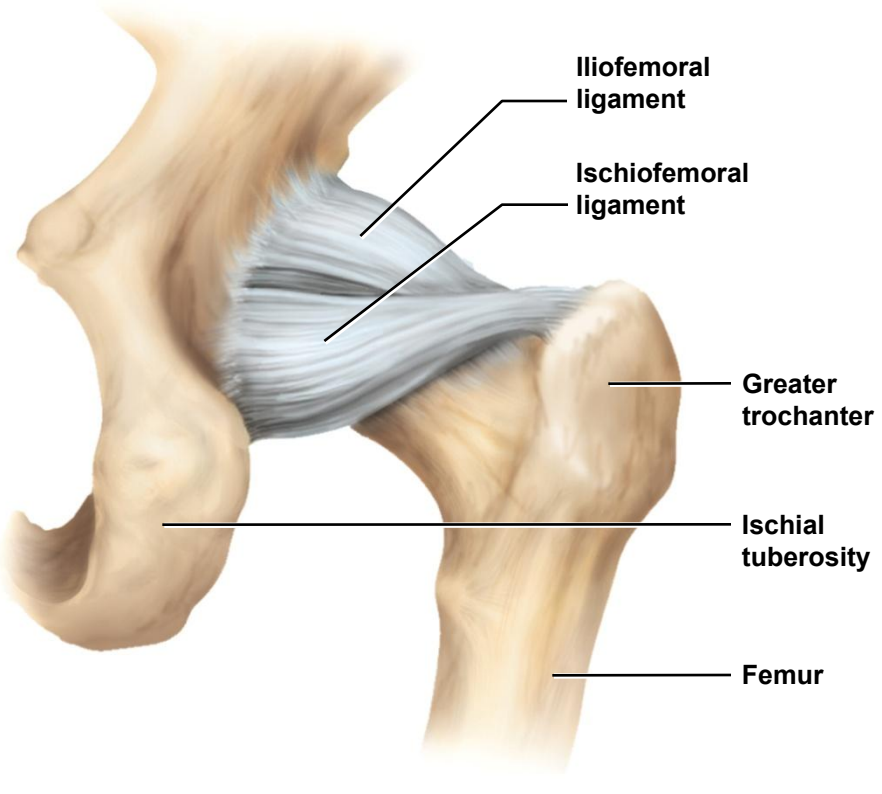


(d) Posterior view

Figure 9.26c,d

Coxal (Hip) Joint

Coxal (Hip) Joint

Anterior

Posterior

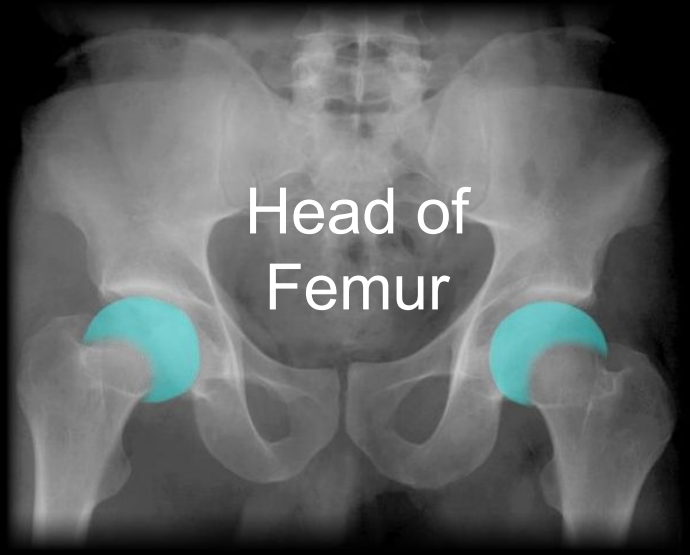
Ball and Socket Joint

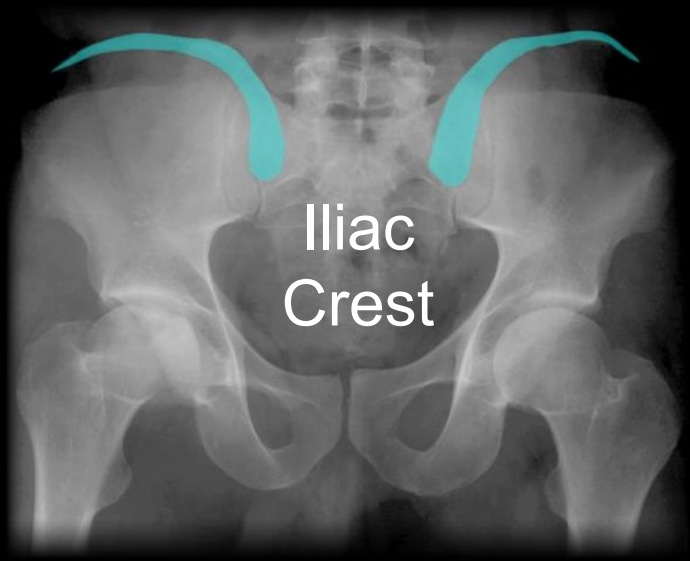
Coxal (Hip) Joint

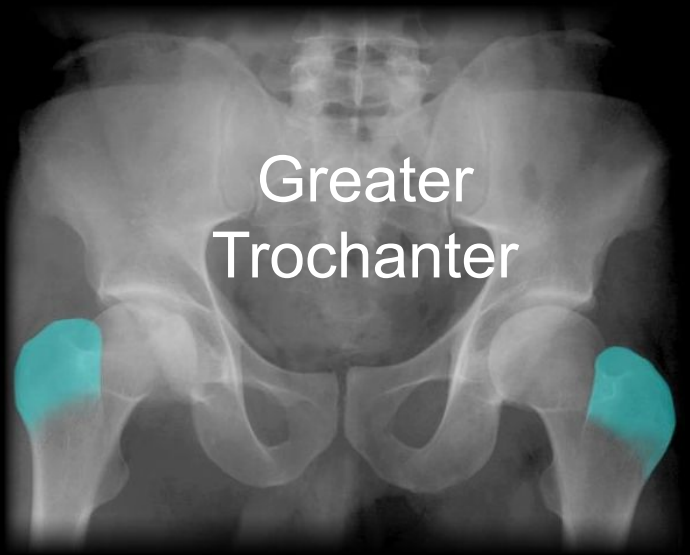
Coxal (Hip) Joint

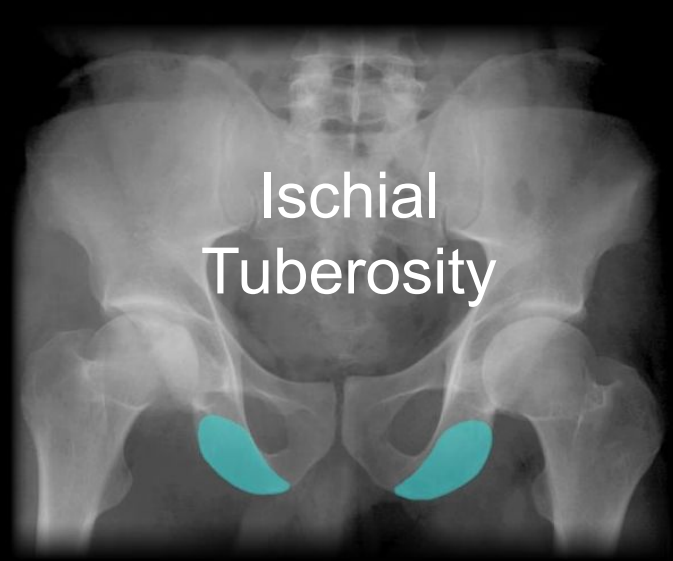
Hip
Fracture

Coxal (Hip) Joint









Coxal (Hip) Joint

Coxal (Hip) Joint

Coxal (Hip) Joint

Coxal (Hip) Joint

Coxal (Hip) Joint

Coxal (Hip) Joint

Coxal (Hip) Joint

Coxal (Hip) Joint

Coxal (Hip) Joint

Head of
Femur

Acetabulum

Coxal (Hip) Joint

Female

Male

Hip Region

Congenital Hip Dislocation Treatment

Dissection of Hip Joint

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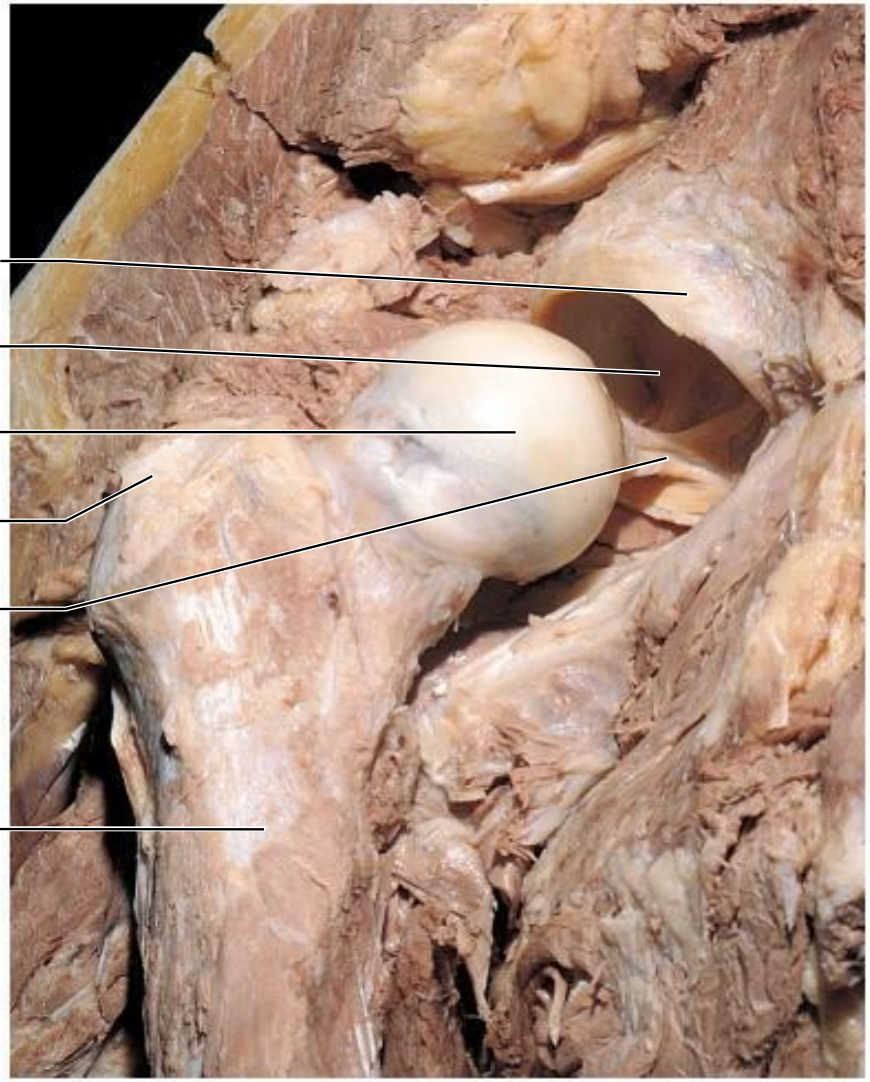

Figure 9.26a

(a) Anterior dissection

A Spill at Parsenn Bowl: Knee Injury and Recovery

by

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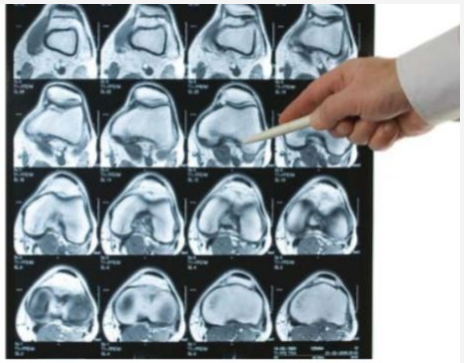
Department of Biology
Illinois College, Jacksonville, IL



1.What mechanisms did Elaine's body employ to maintain homeostasis?

A.What is the sensor for cold

B.Where is the "thermostat" of the body located?

C. What is the effector (i.e., what tissues are involved) for the blood vessel constriction? For the shivering?

2. What areas of the body are the most vulnerable to frostbite?

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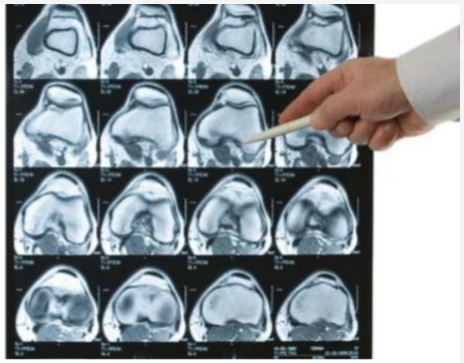

1. Why was Elaine instructed to remove her parka?
2. Why was she shivering?
3. Why was the knee swollen?
4. Where would the dorsalis pedis pulse be taken? Why?

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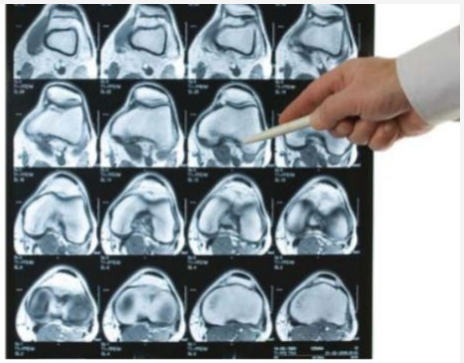
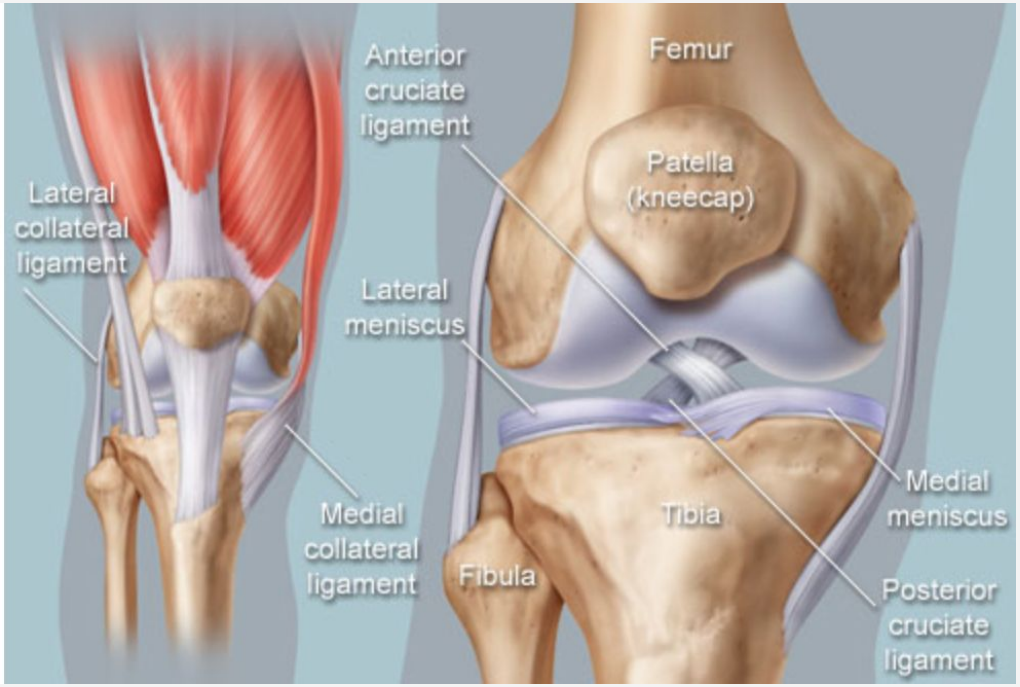


5. How do the bones that comprise the knee joint fit together?

four bones are the Femur (thigh bone), Tibia (shin bone), Patella (knee cap), and fibula.



Knee Joint – Anterior and Posterior Views

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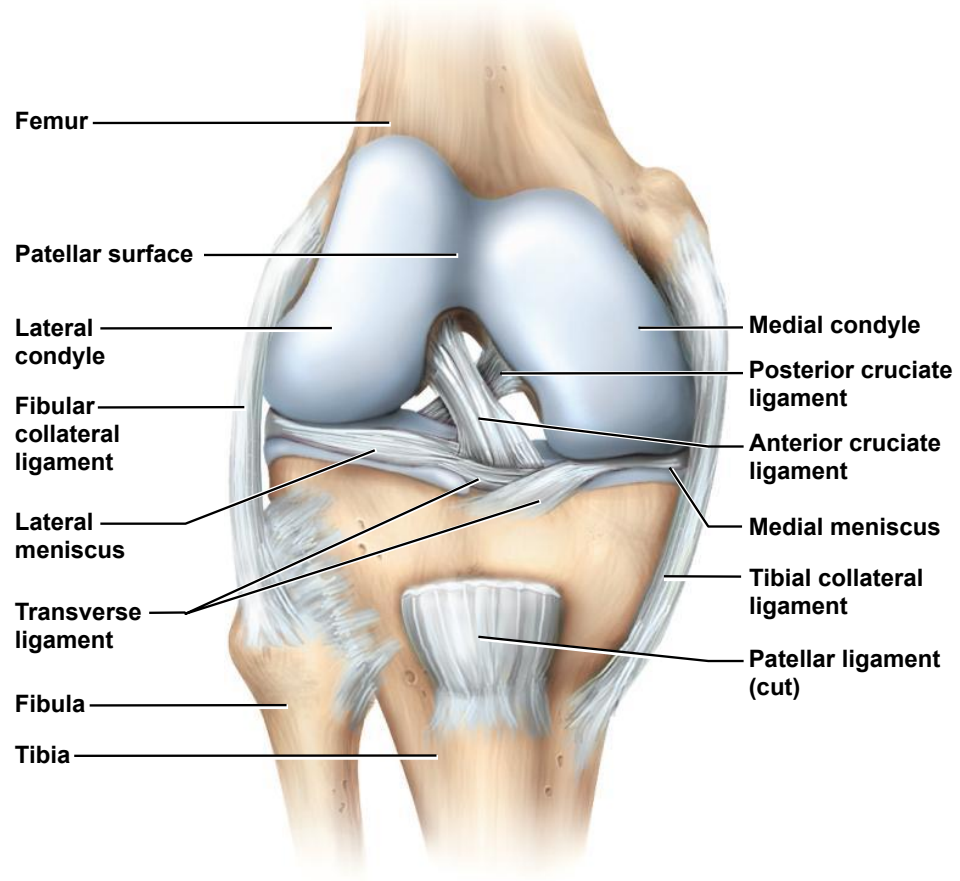

(a) Anterior view

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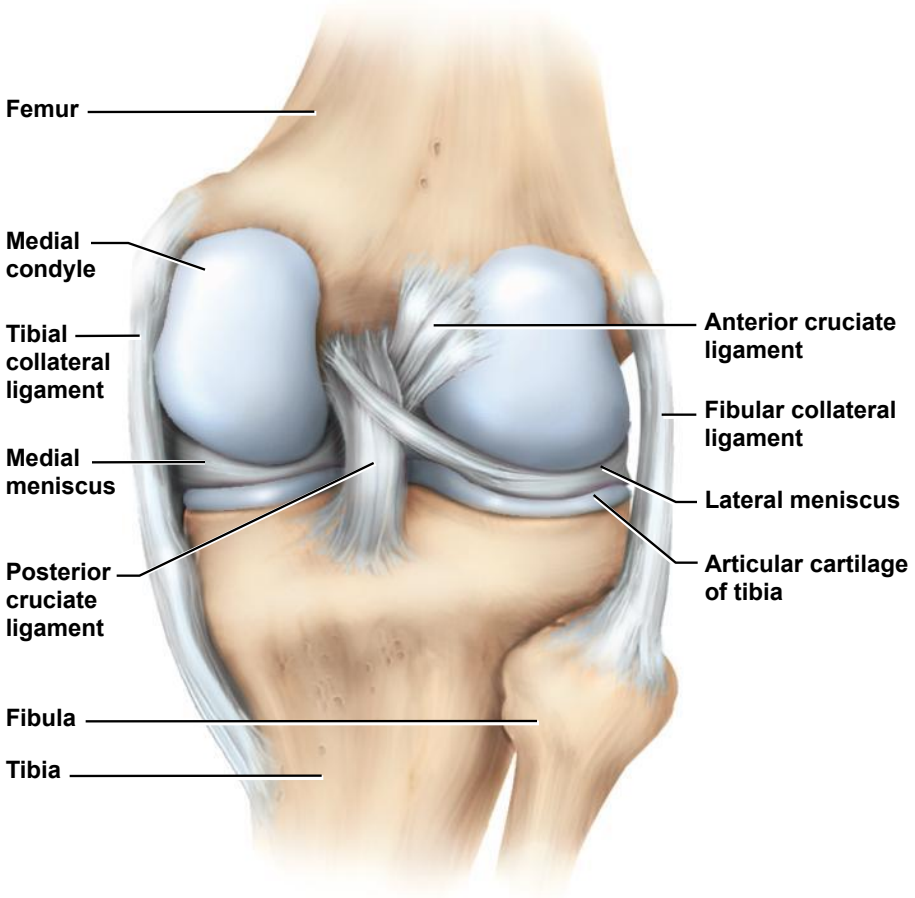

(b) Posterior view

Figure 9.29a,b

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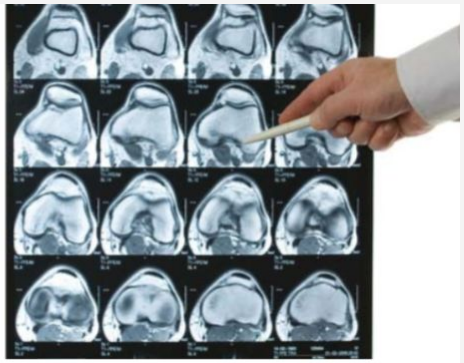
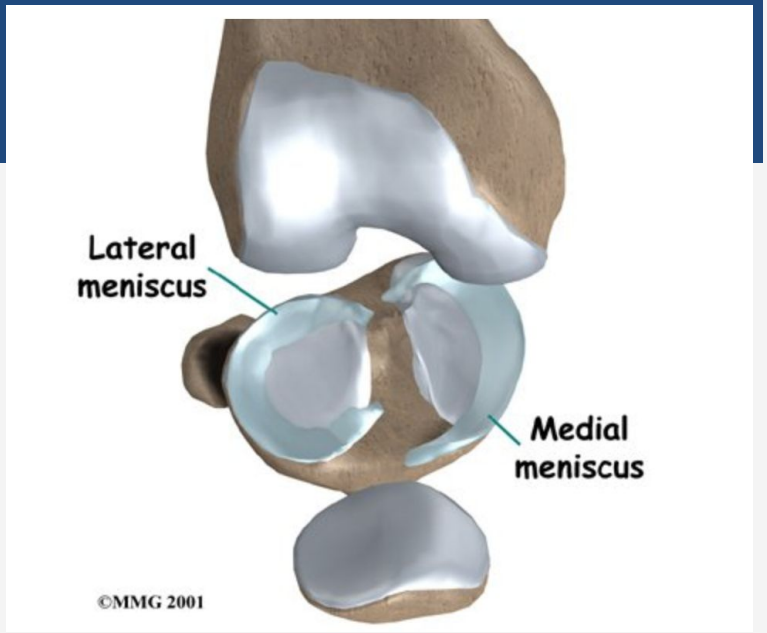
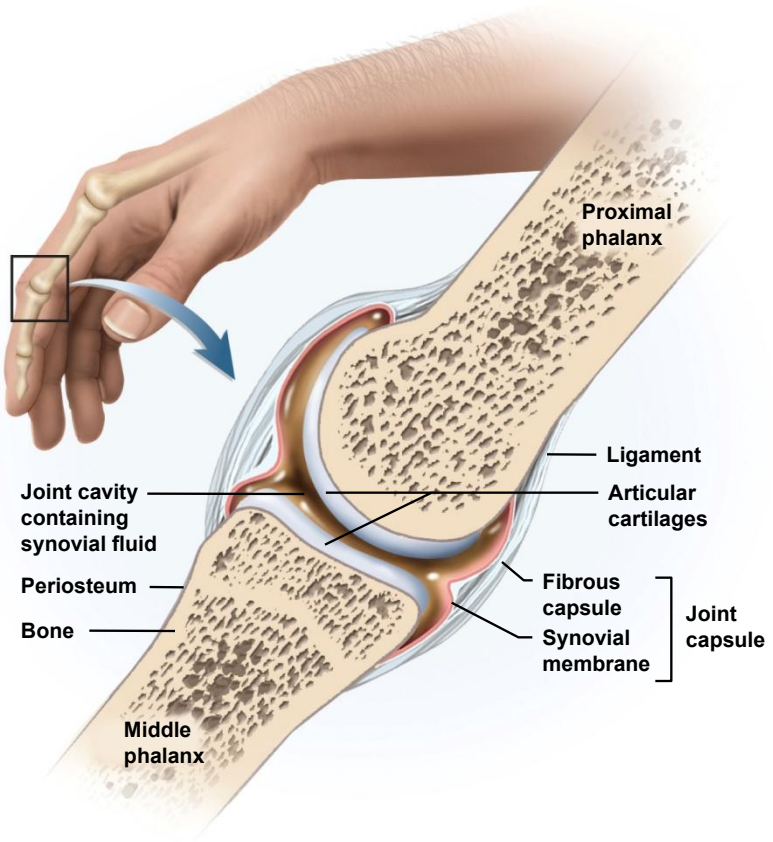


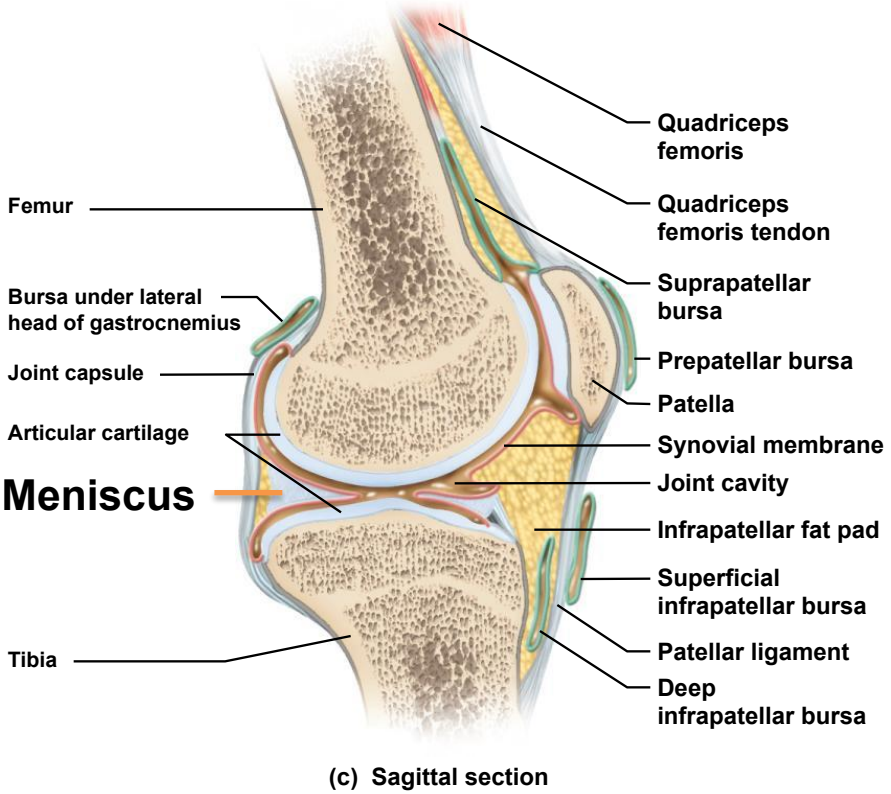
The menisci (plural of meniscus) are fibrocartilage rings that sit on top of the tibia, and stabilize the knee as well as act to cushion the knee from the forces placed upon it and through it while dancing. The medial meniscus is "C" shaped, and solidly attached to the tibia, while the lateral meniscus is "O" shaped, and is slightly more mobile.

- joint cavity contains **two C-shaped cartilages**
  - **lateral meniscus** and **medial meniscus**
  - joined by **transverse ligament**
    - absorbs shock on the knee
    - prevents femur from rocking side-to-side on the tibia



Why is a meniscus unnecessary in an interphalangeal joint?





(c) Sagittal section

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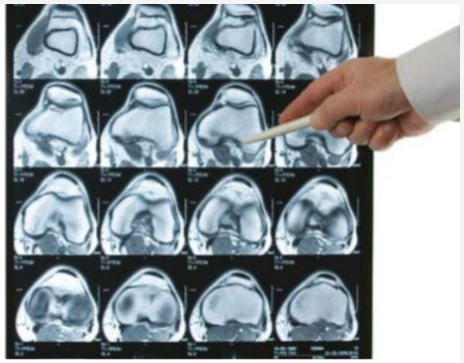

6. What structures are associated specifically with the medial surface of the knee?

The Knee Joint

- **Tibiofemoral (knee) joint** – largest and most complex diarthrosis of the body
- **primarily a hinge joint**
  - capable of **slight rotation** and lateral **gliding** when knee flexed
  - **patellofemoral joint** – gliding joint
    - **joint capsule** encloses only the lateral and posterior aspects of the knee, not the anterior
  - anterior covered by **patellar ligament** and **lateral** and **medial retinacula**
    - all are extensions of **the tendon of quadriceps femoris** muscle

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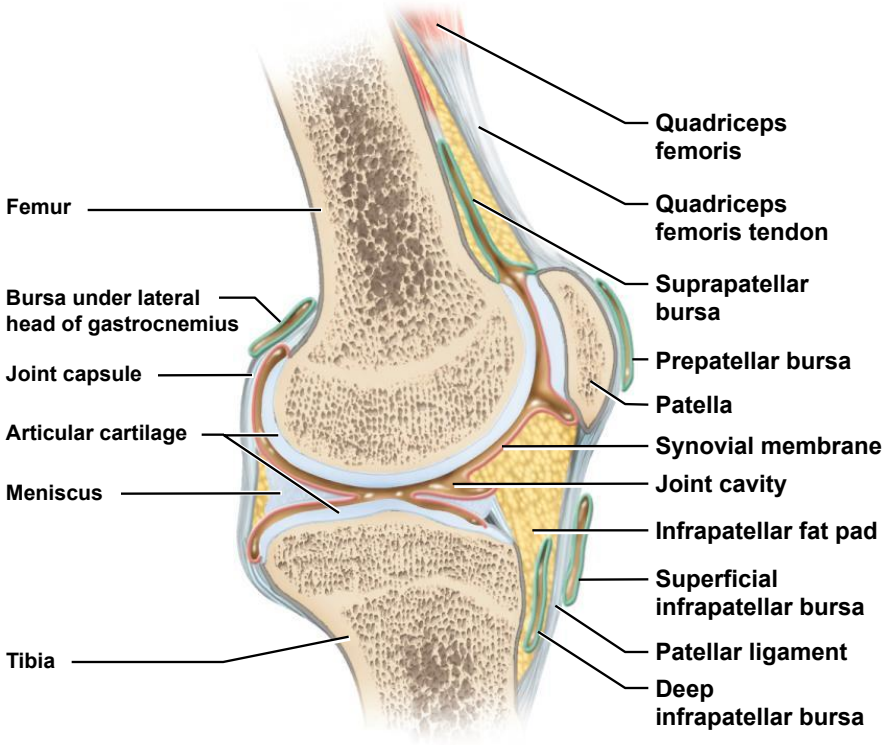

(c) Sagittal section

- knee stabilized:
  - **quadriceps tendon** in front
  - **tendon of semimembranosus muscle** on rear side of thigh

The Knee Joint

- **popliteal region of knee**
  - supported by a complex array of:
  - **extracapsular ligaments** – external to joint capsule
    - prevent knee from rotating when joint is extended
    - **fibular (lateral) collateral ligament**
    - **tibial (medial) collateral ligament**
  - two **intracapsular ligaments** deep within joint capsule
    - synovial membrane folds around them, so they are excluded from the fluid filled synovial cavity
    - ligaments cross each other to form an X
    - **anterior cruciate ligament (ACL)**
      - prevents hyperextension of knee when ACL is pulled tight
      - one of the most common sites of knee injury
    - **posterior cruciate ligament (PCL)**
      - prevents femur from sliding off tibia
      - prevents the tibia from being displaced backward

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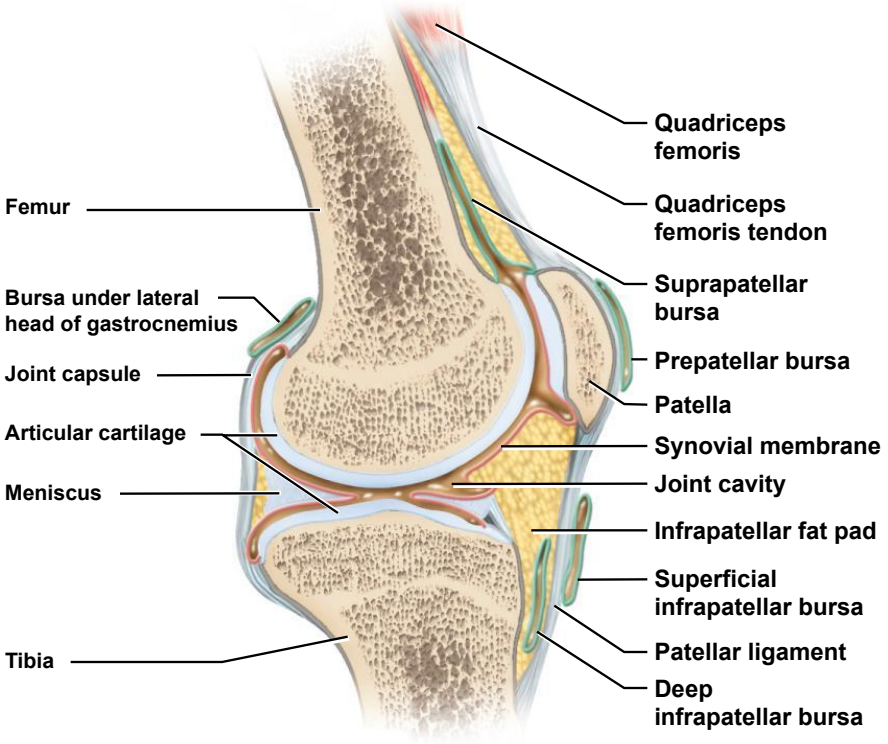

(c) Sagittal section

Figure 9.29c

The Knee Joint

- ability to **“lock” the knees**
  - important aspect of **human bipedalism**
  - **when knee is extended to the fullest degree allowed by ACL**
    - femur rotates medially on the tibia
    - locks the knee, and all major knee ligaments are twisted and taut
  - **“unlock” knee** – *popliteus* muscle rotates the femur laterally and untwists the ligaments

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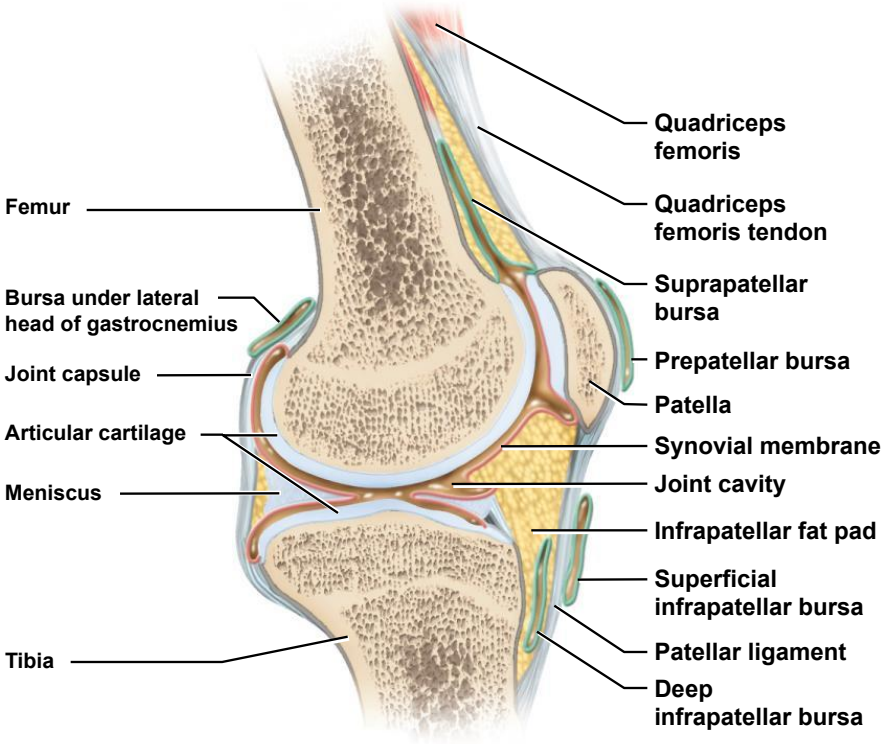

(c) Sagittal section

Figure 9.29c

Knee Joint – Anterior and Posterior Views

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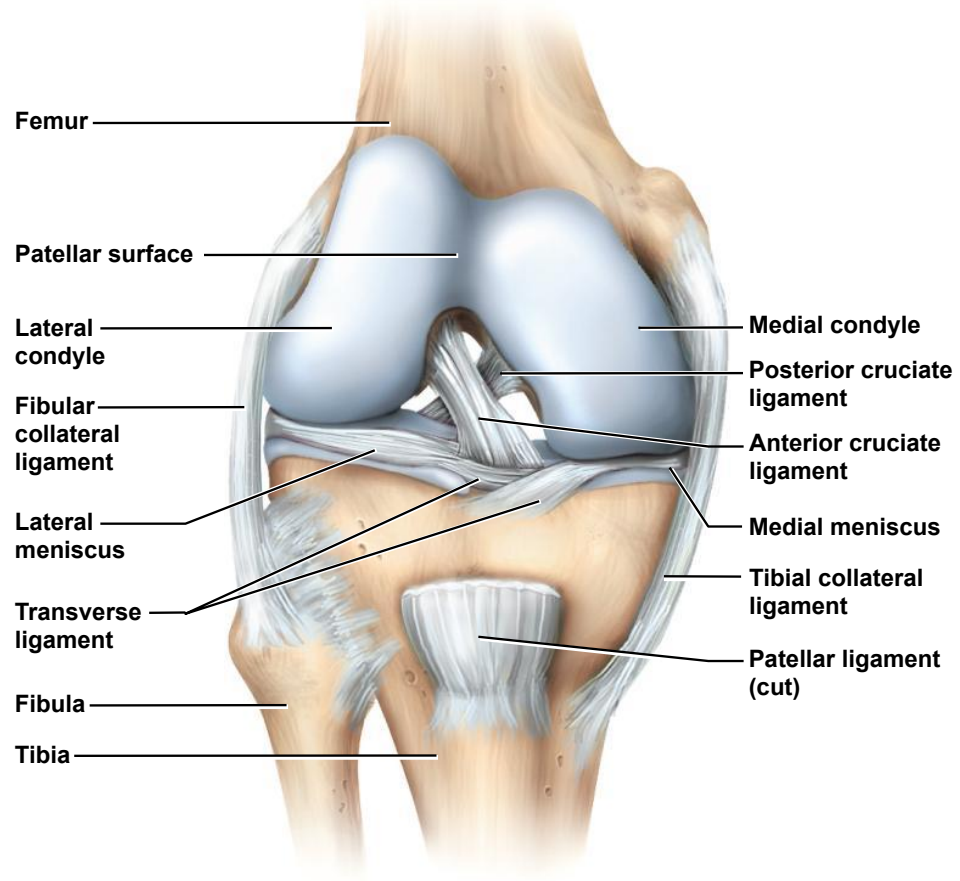

(a) Anterior view

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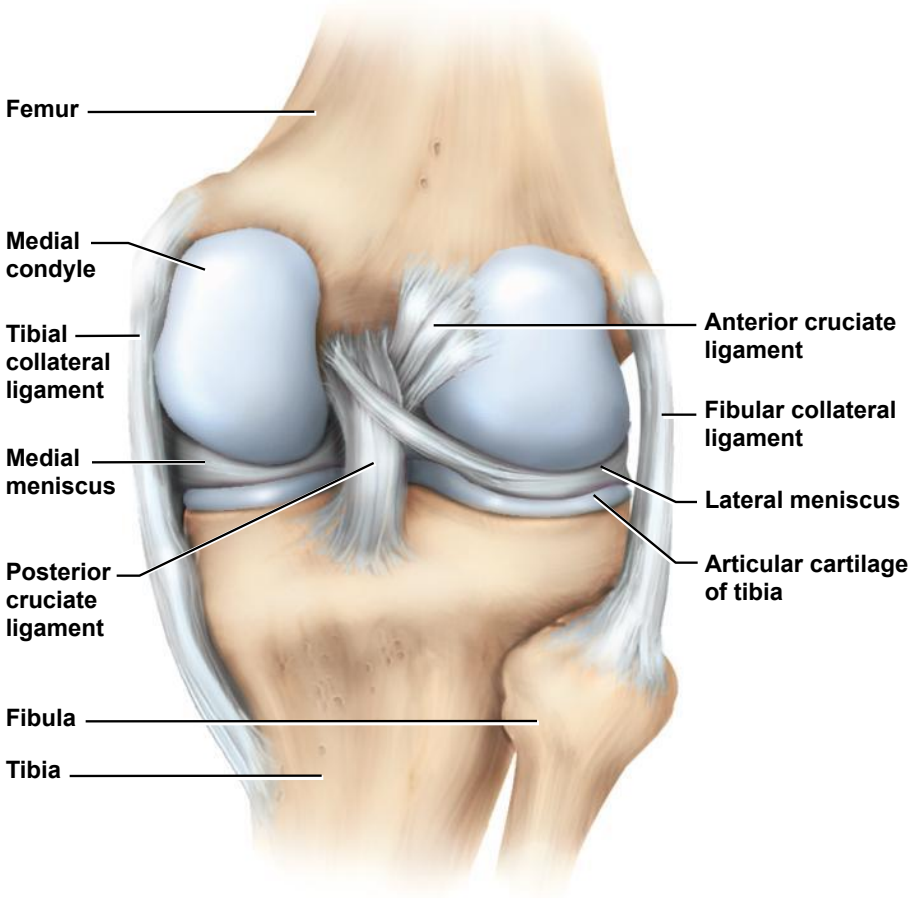

(b) Posterior view

Figure 9.29a,b

Dissection of Knee Joint

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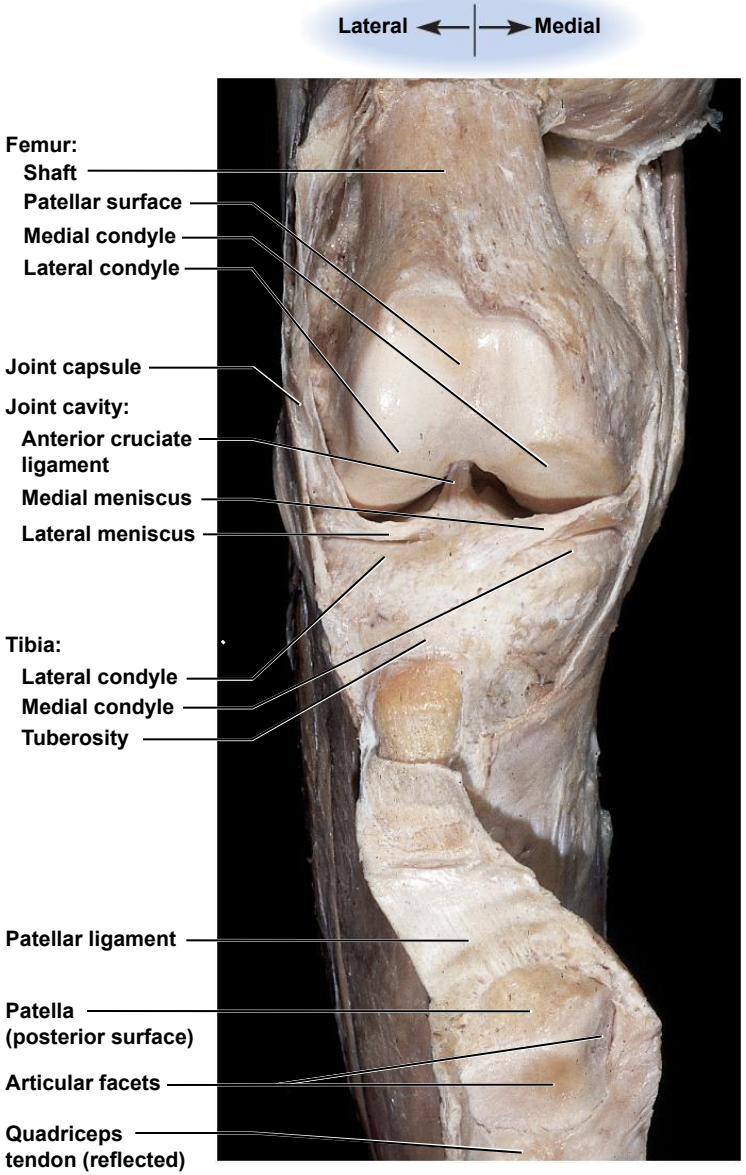

Knee Joint – Anterior and Posterior Views

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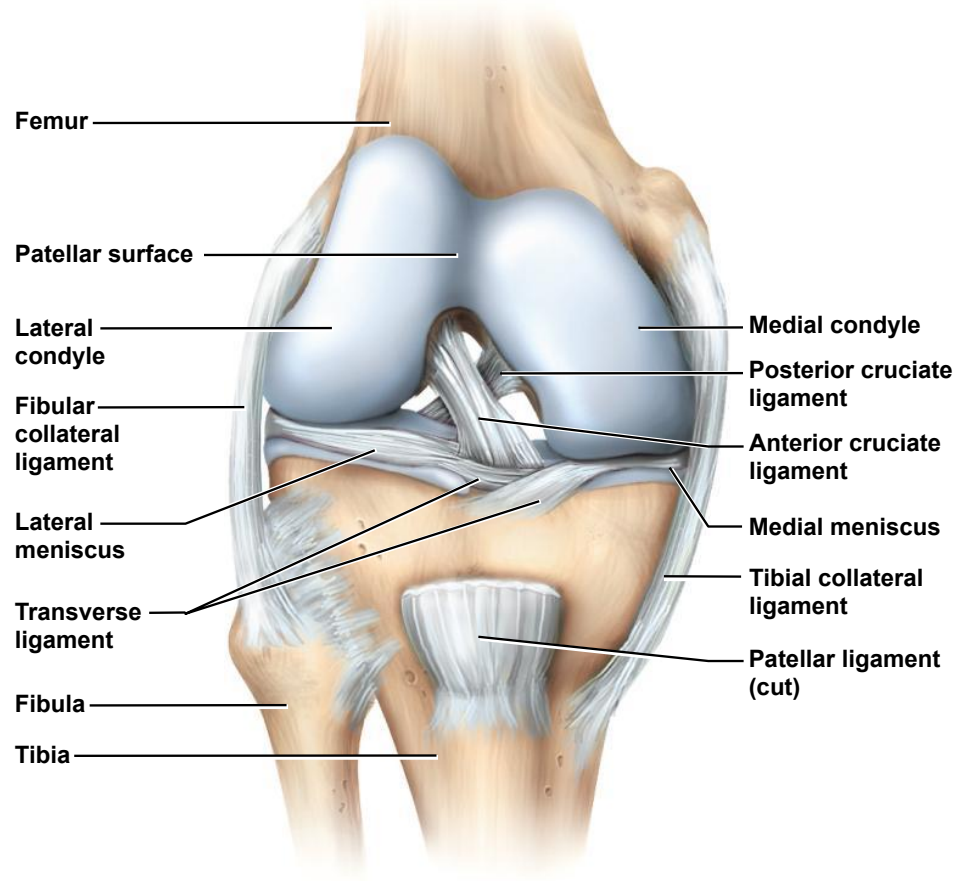

(a) Anterior view

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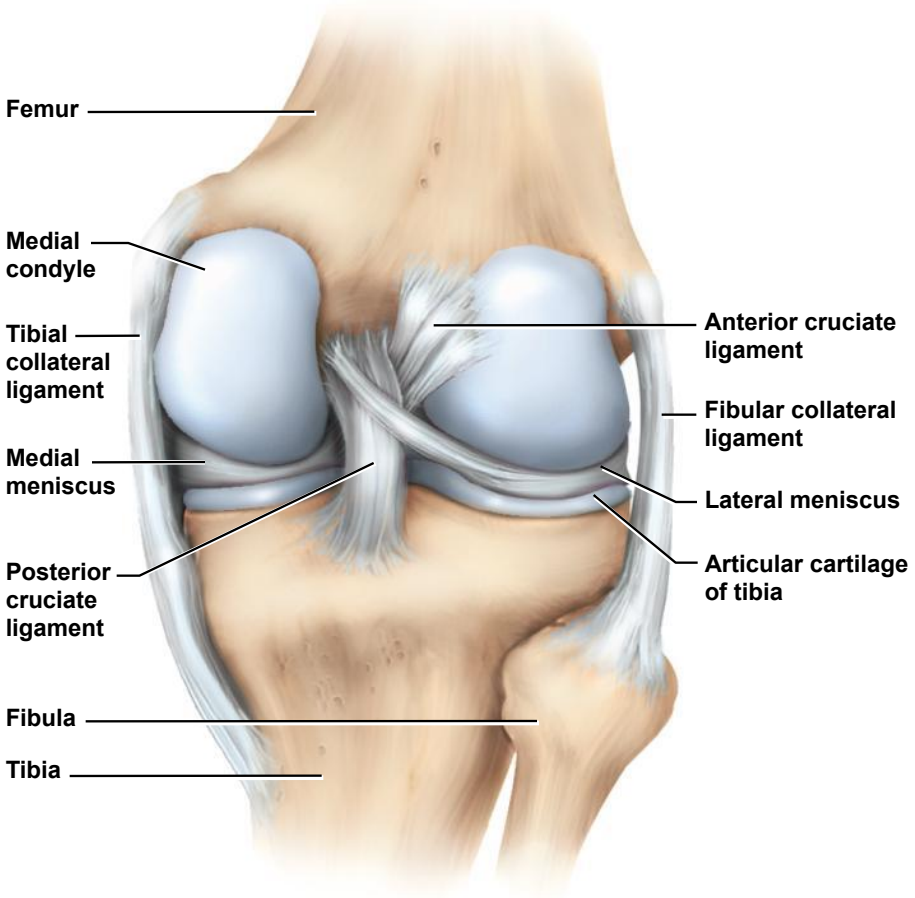

(b) Posterior view

Figure 9.29a,b

A Spill at Parsenn Bowl: Knee Injury and Recovery

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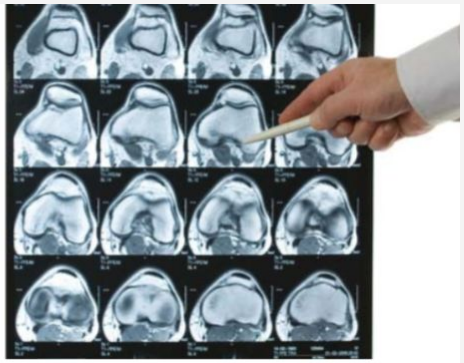

6. What type of injuries would be identified most clearly on an X-Ray? Why?

Knee

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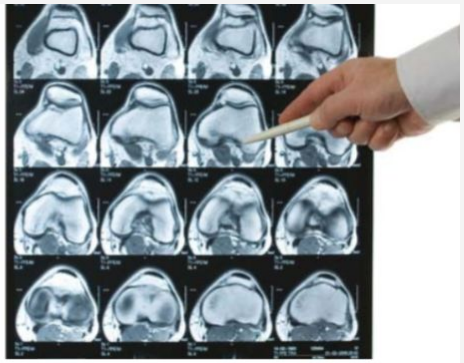

7. What is a positive Lachman maneuver/test?

- **anterior cruciate ligament (ACL)**
  - prevents hyperextension of knee when ACL is pulled tight
  - one of the most common sites of knee injury
- **posterior cruciate ligament (PCL)**
  - prevents femur from sliding off tibia
  - prevents the tibia from being displaced backward

Knee Joint – Anterior and Posterior Views

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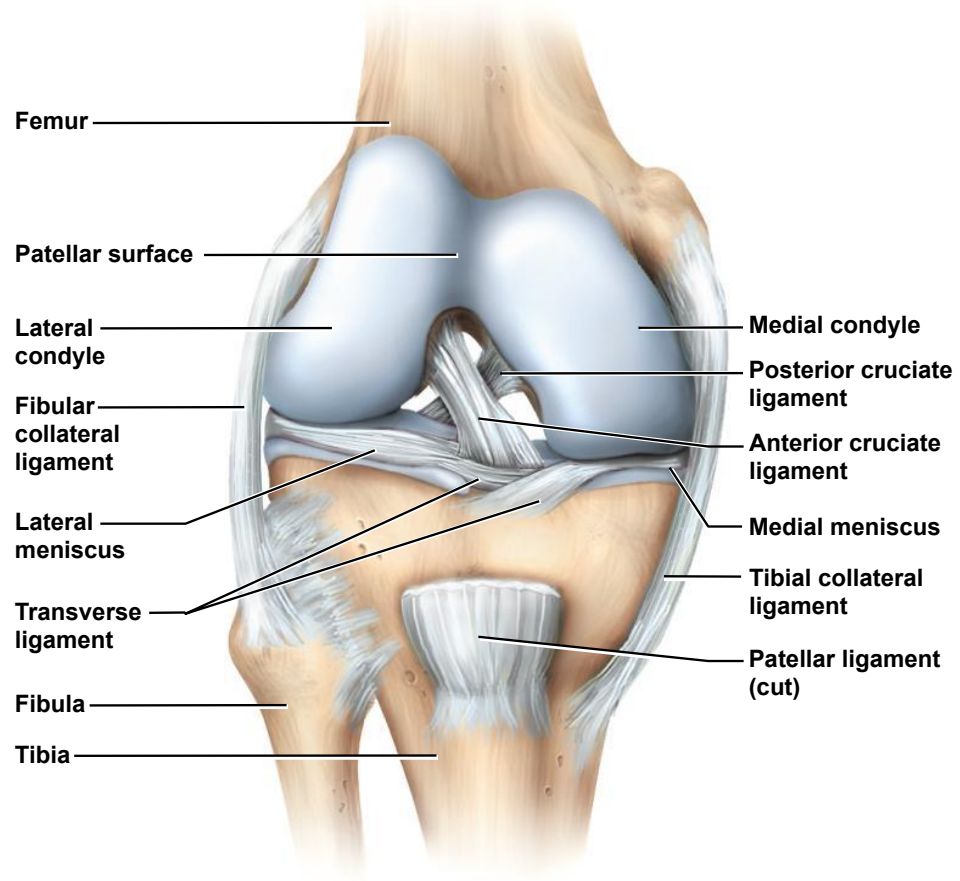

(a) Anterior view

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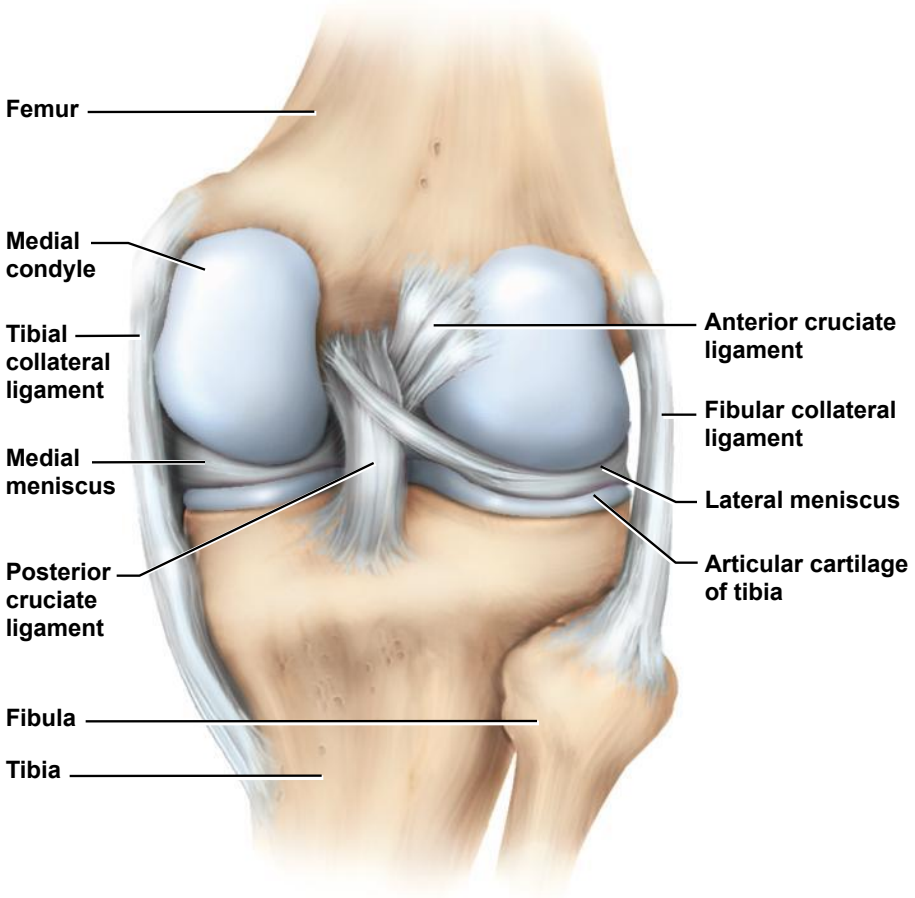

(b) Posterior view

Figure 9.29a,b

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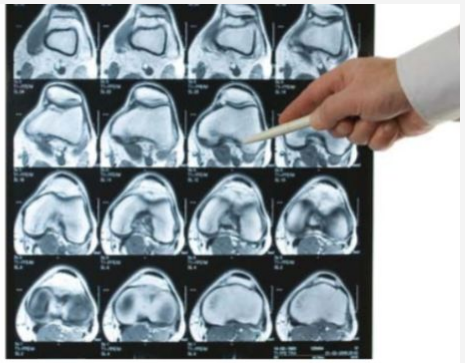

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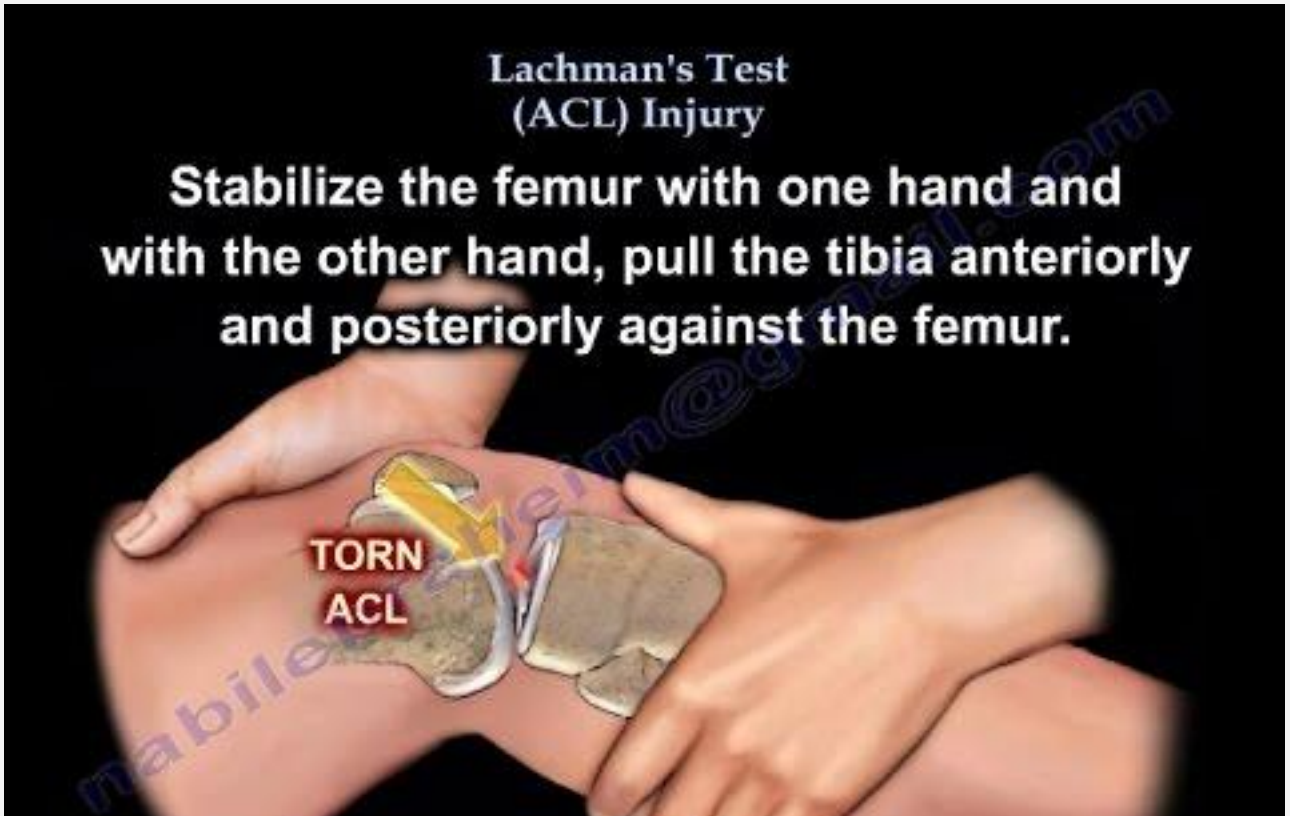

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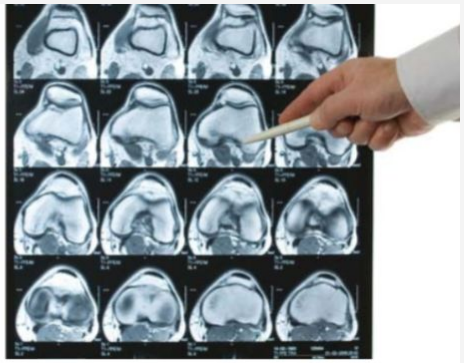

7.What is the purpose of the leg elevation and ice? (Wasn't she already high enough and cold enough?)

8.Why was she instructed *not* to use the hot tub?

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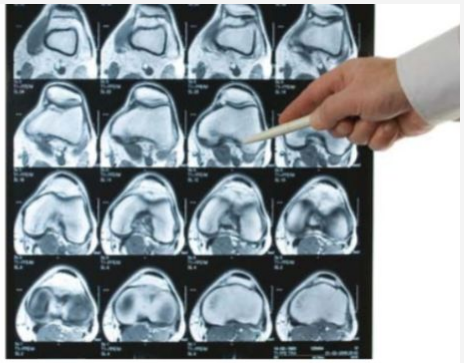

7.Why did Dr. Scott order an MRI?

Knee MRI

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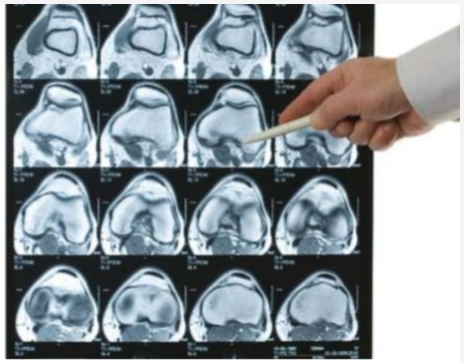

8.What difference does age make in terms of the healing process?

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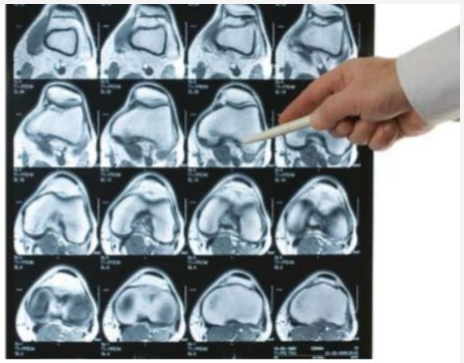

9. What is osteoarthritis?

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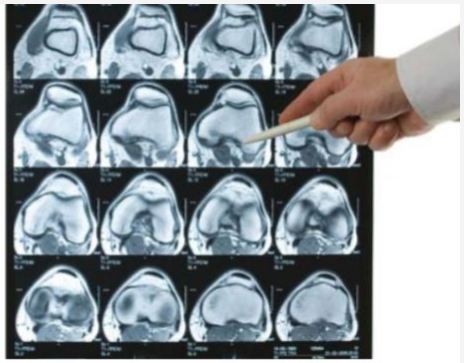

Osteoarthritis, also known as "wear and tear" arthritis, occurs when the cartilage that cushions and protects the ends of your bones gradually wears away. This leads to pain and stiffness that worsens over time, making it difficult to do daily activities.

Arthritis

- **arthritis** - a broad term for pain and inflammation of a joint
- most common crippling disease in the United States
- **rheumatologists** – physicians who treat arthritis and other joint disorders
- **osteoarthritis** (OA) – most common form of arthritis
  - 'wear-and-tear arthritis'
  - results from years of joint wear
  - articular cartilage softens and degenerates
  - accompanied by crackling sounds called **crepitus**
  - bone spurs develop on exposed bone tissue causing pain

Arthritis and Artificial Joints

- **rheumatoid arthritis (RA)** - autoimmune attack against the joint tissues
  - misguided antibodies (**rheumatoid factor**) attack synovial membrane, enzymes in synovial fluid degrade the articular cartilage, joint begins to ossify
  - **ankylosis** – solidly fused, immobilized joint
  - remissions occur, steroids and aspirin control inflammation

- **arthroplasty** - the replacement of diseased joint with artificial device called **prosthesis**

Rheumatoid Arthritis

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(b)

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Figure 9.32b

Joint Prostheses

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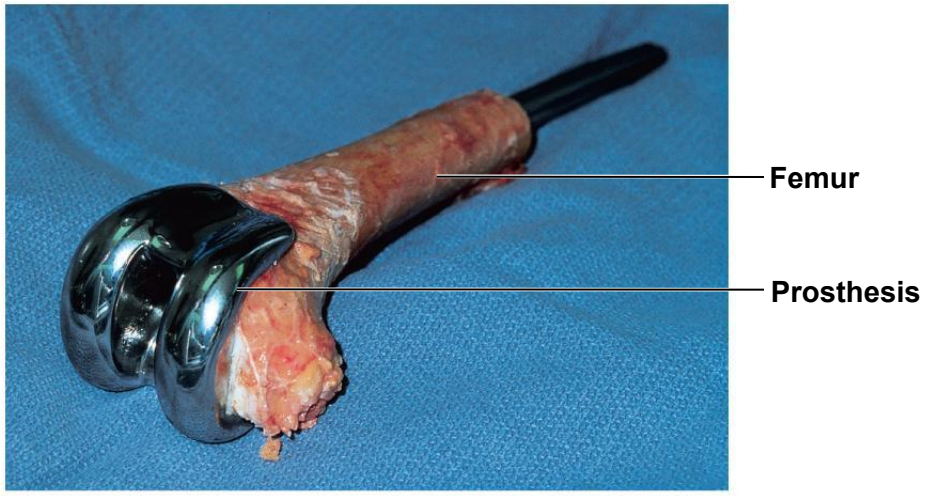
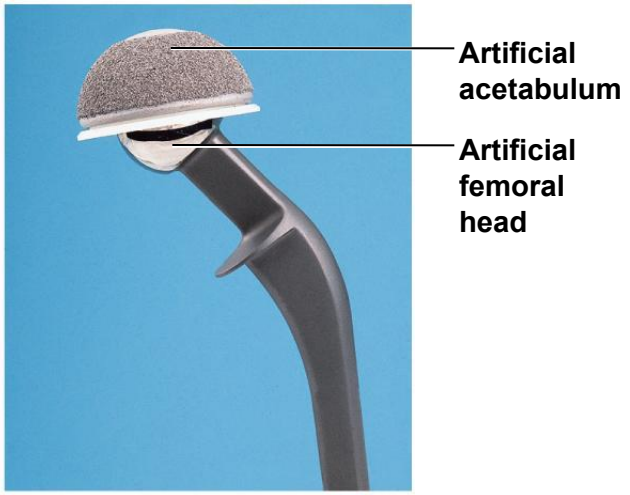


(a)



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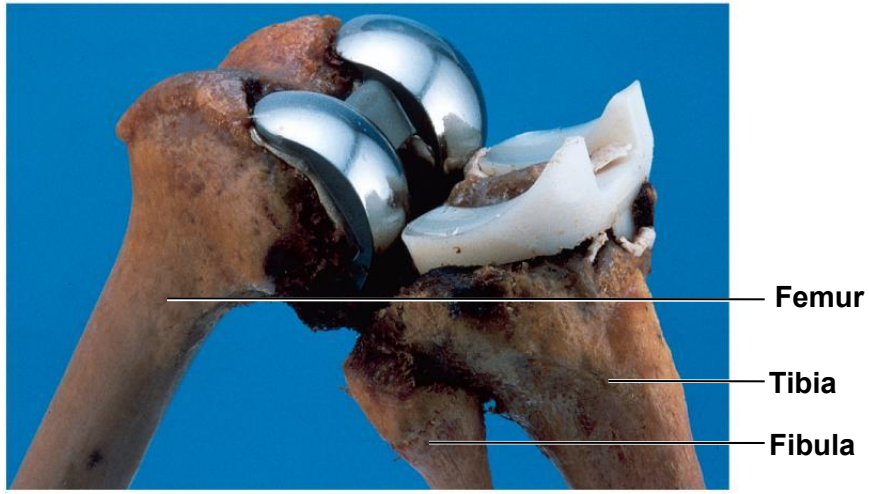

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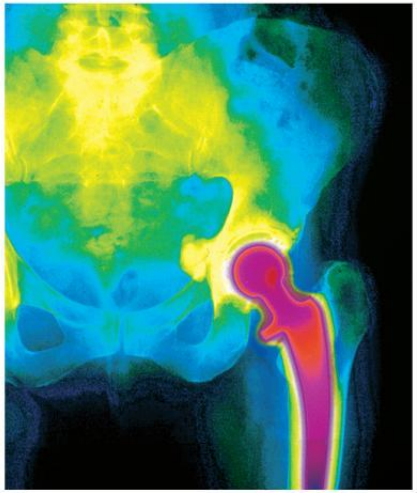


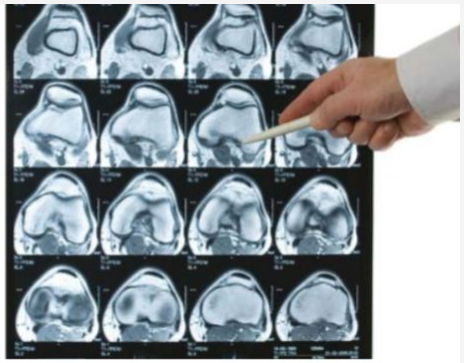
(d)

Figure 9.33a,b

Figure 9.33c,d

A Spill at Parsenn Bowl: Knee Injury and Recovery

by
Elaine S. Chapman
Department of Biology
Illinois College, Jacksonville, IL



What are the primary movements of the knee joint?

What muscle groups are the most important in flexion and extension of the knee?

What happens to muscle and bone tissue when they are not used?

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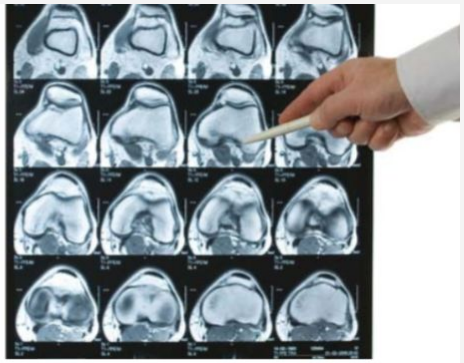

Why could a tendon be used to replace a ligament?

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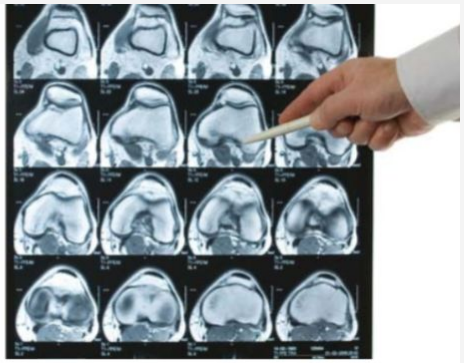
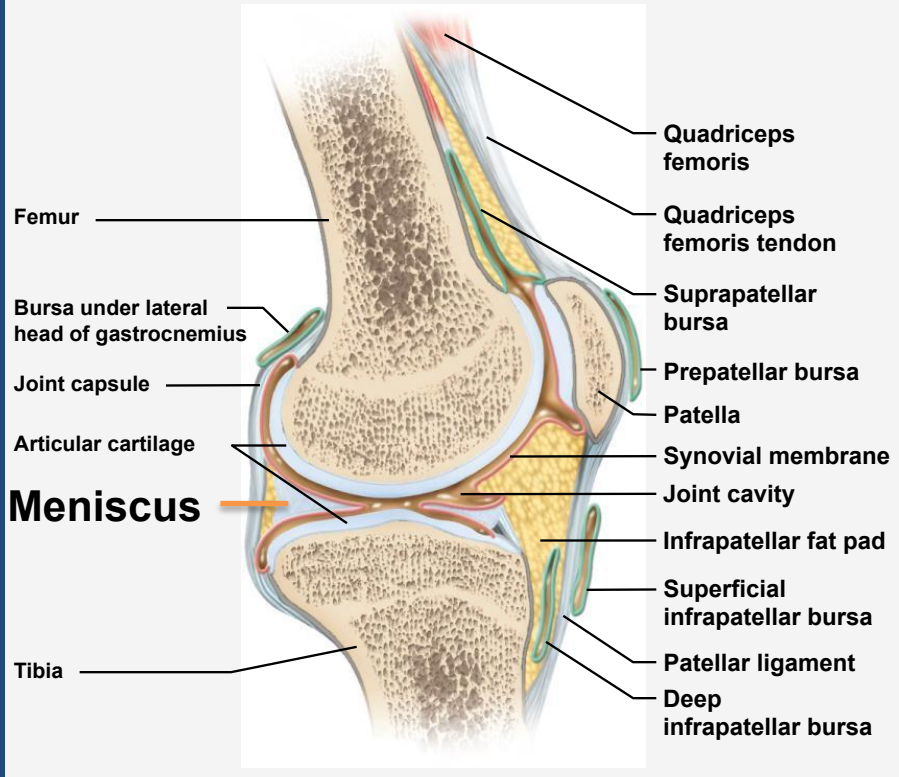


Consider the overall structure of the knee joint. (You may wish to draw a picture or label a diagram.) What type of membrane lines the joint? What is its function? Was it cut in any way during the surgery?



(c) Sagittal section

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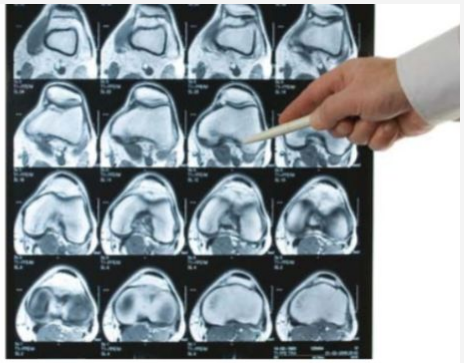

Of the structures injured (patella, MCL, ACL, menisci), which will heal the fastest? Why?

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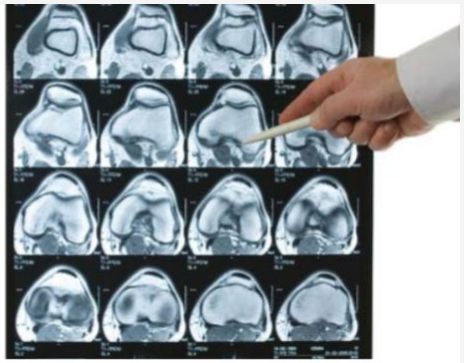


Every incision will form some sort of scar. What is the term for scarring of a tissue? What cell type is most important for scar formation?

Knee – most complex

Knee

Knee Story

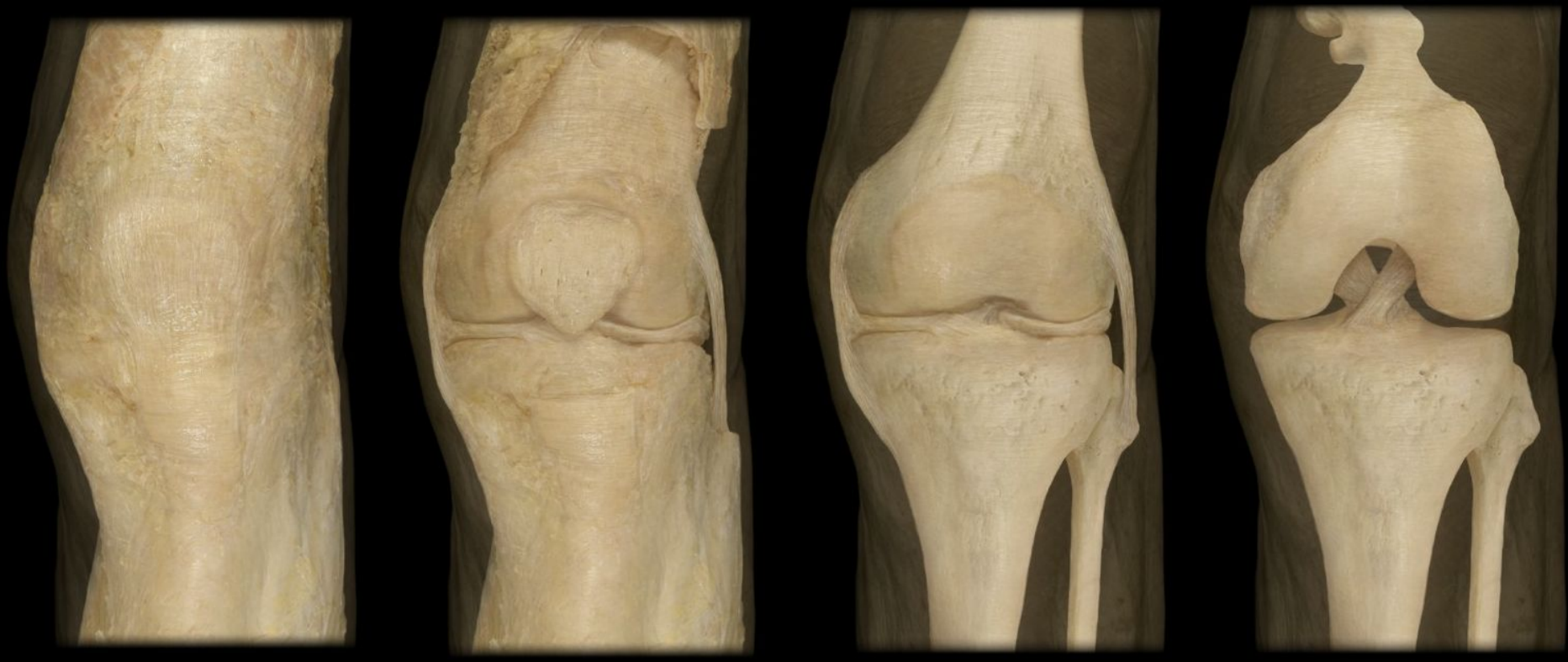
Surface projection of patella

Surface projection of patella ligament

Surface projection of tibial tuberosity

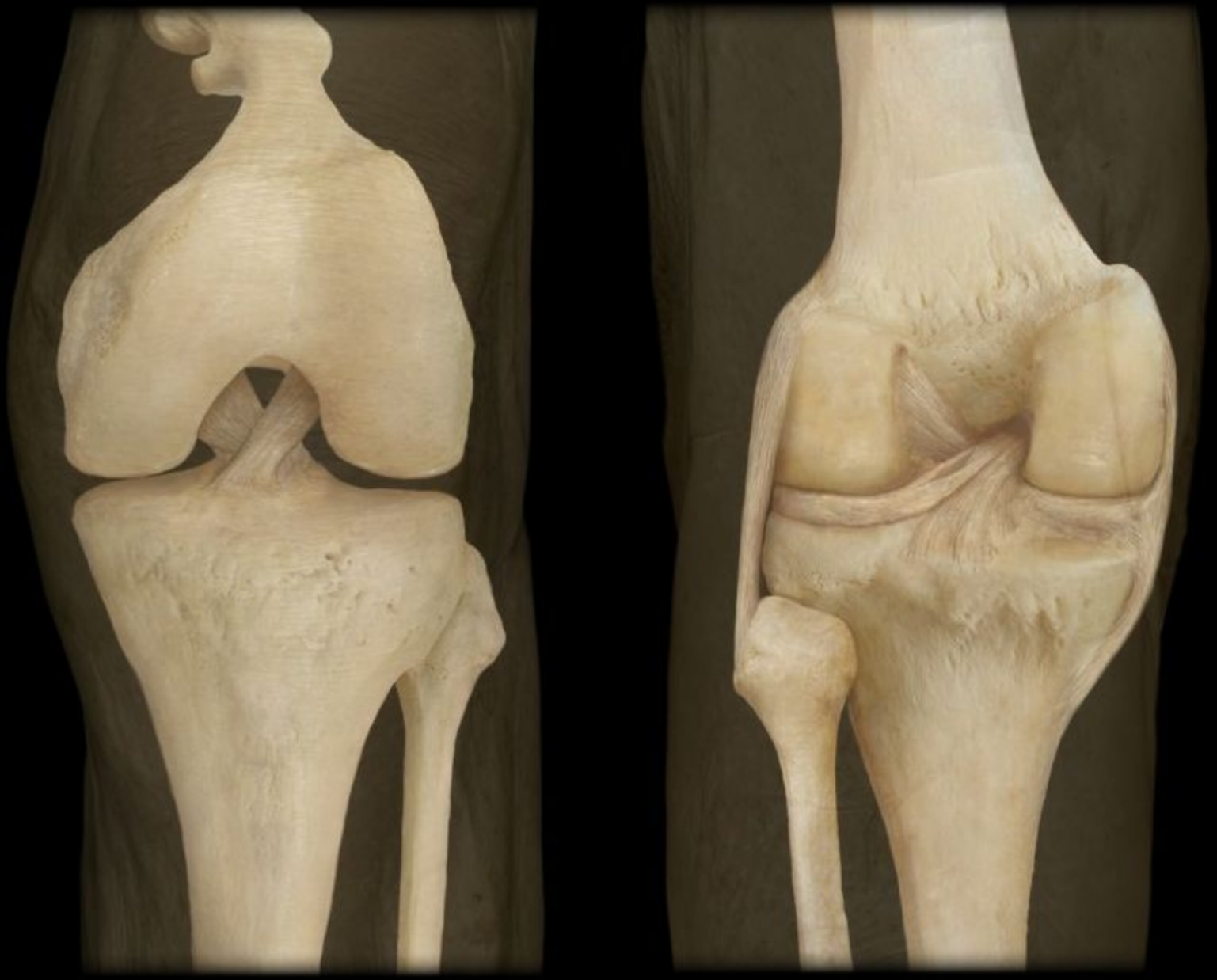
Knee

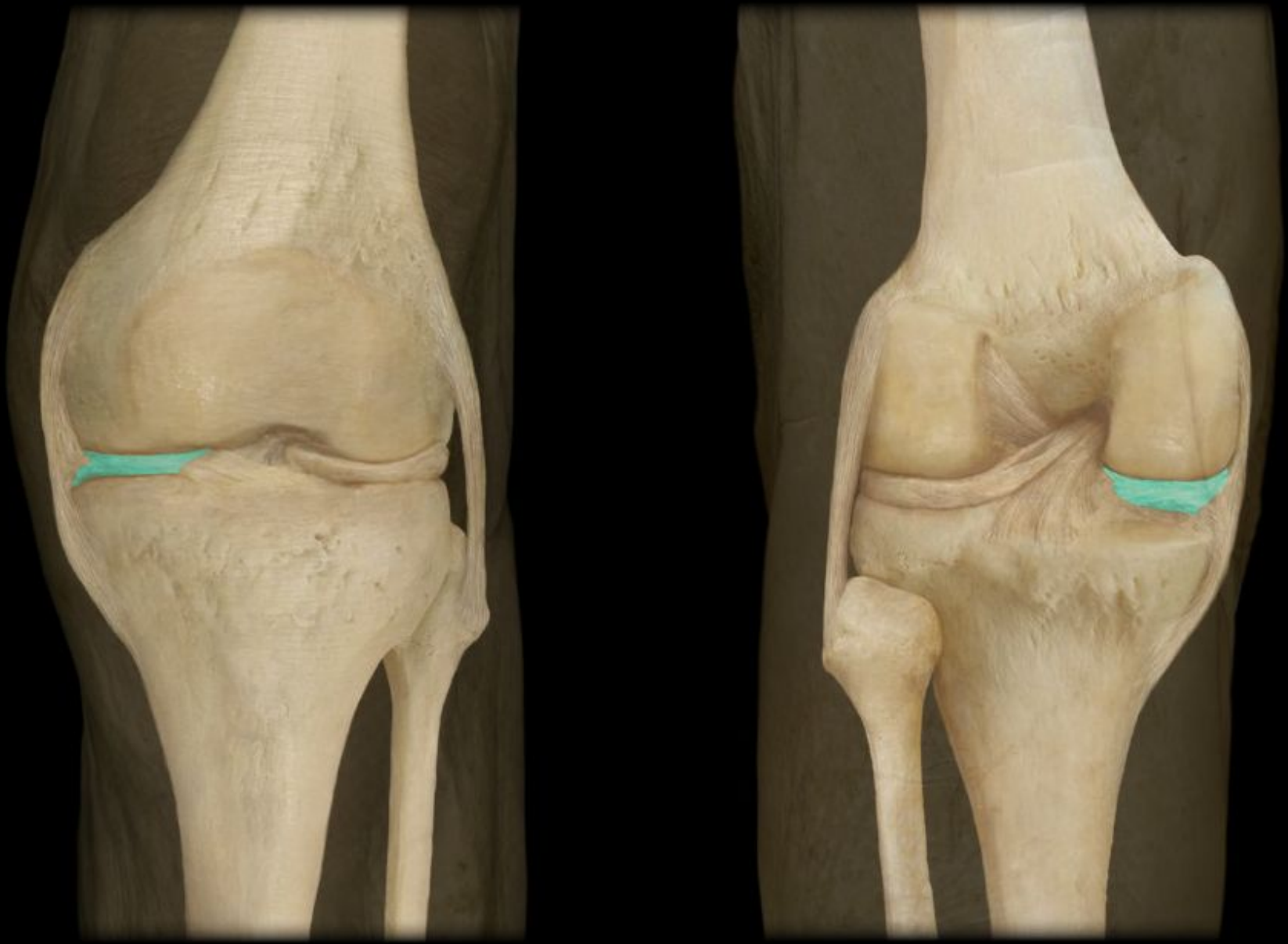
Anterior Knee

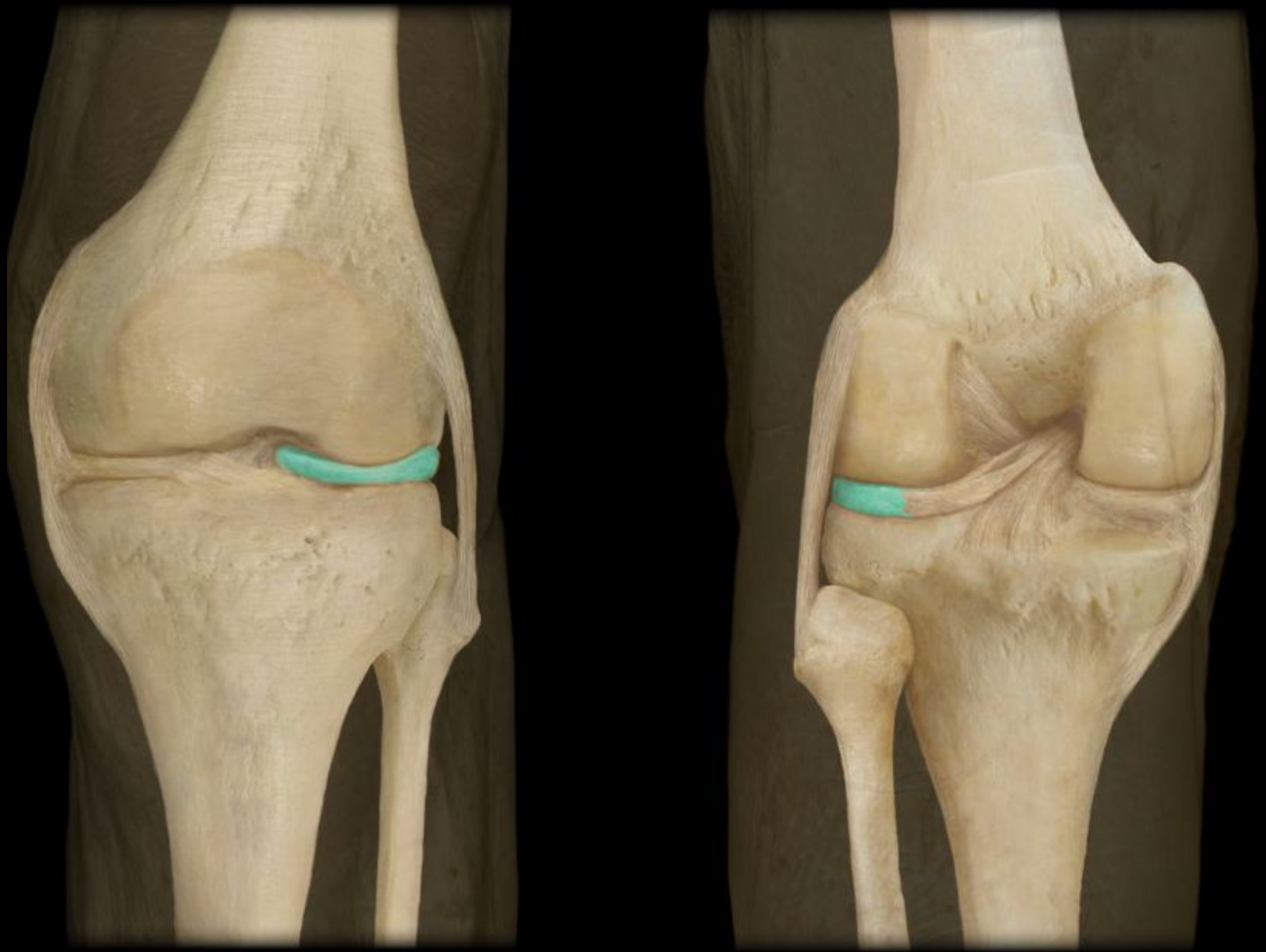


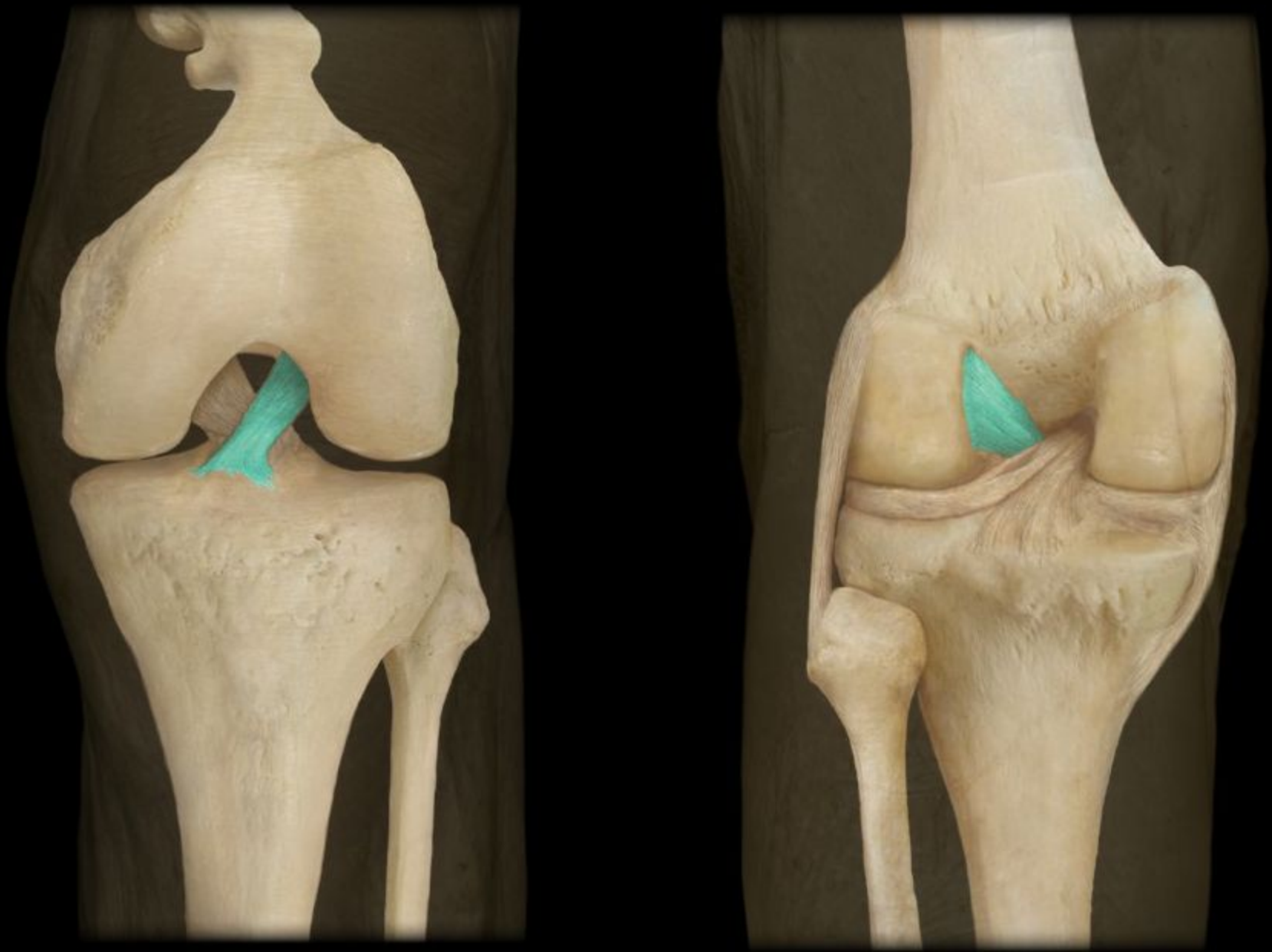
Posterior Knee

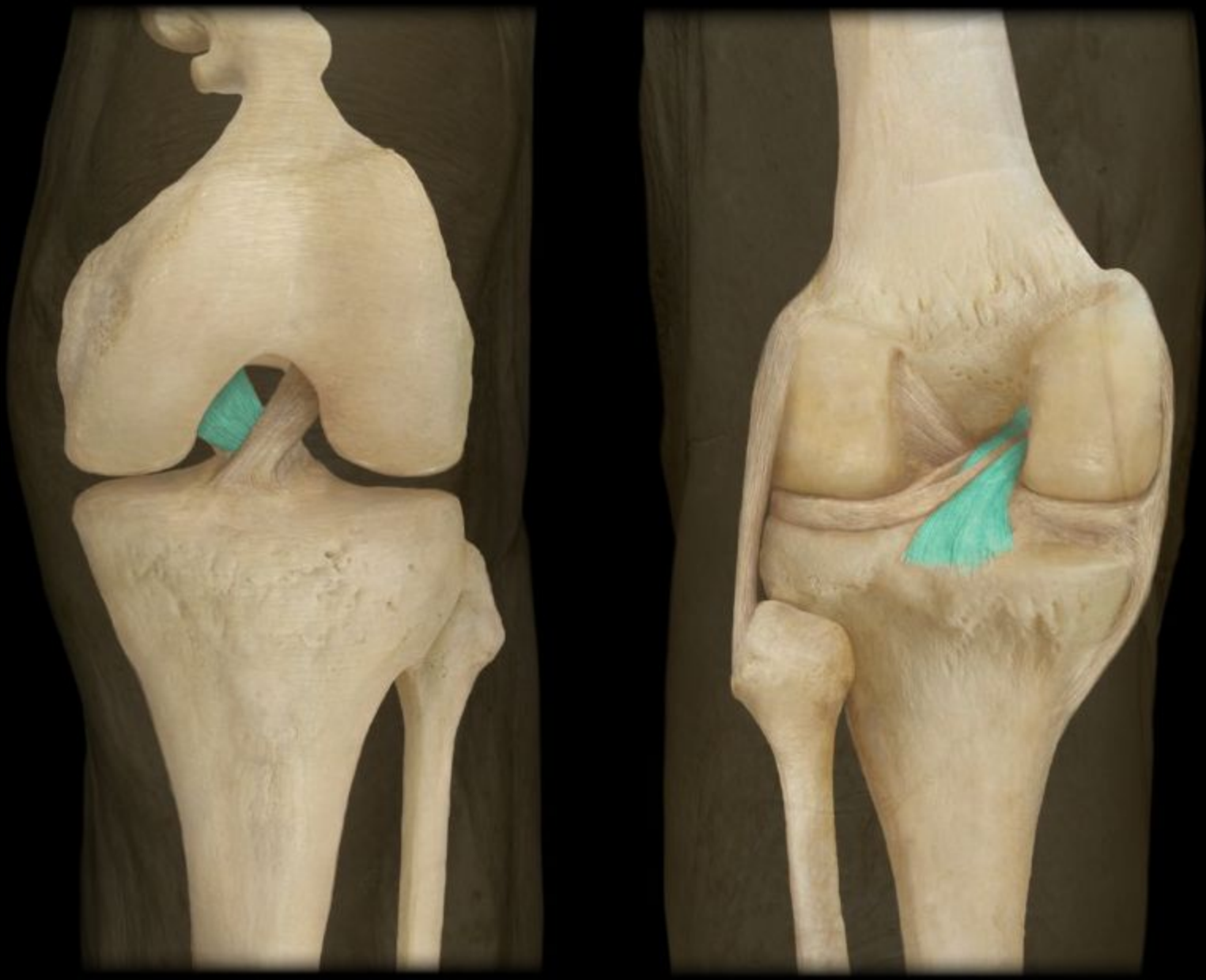
Anterior Posterior











Knee Joint – Sagittal Section

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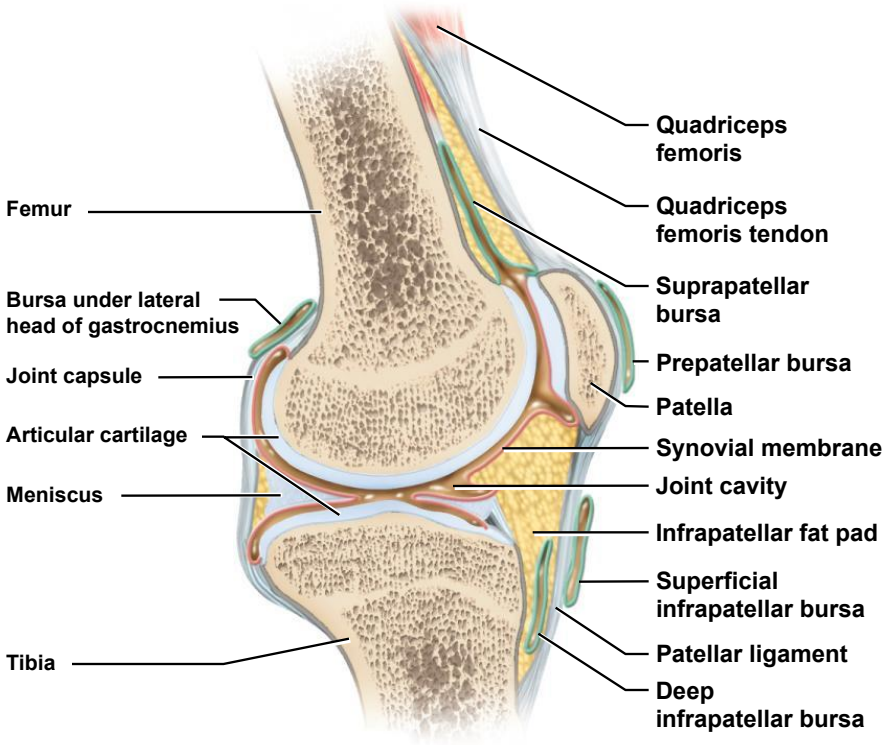

(c) Sagittal section

- A **synovial bursa** (plural **bursae** or **bursas**) is a small fluid-filled sac lined by synovial membrane with an inner capillary layer of viscous synovial fluid (similar in consistency to that of a raw egg white). It provides a cushion between bones and tendons and/or muscles around a joint. This helps to reduce friction between the bones and allows free movement. Bursae are found around most major joints of the body.

Knee Joint – Sagittal Section

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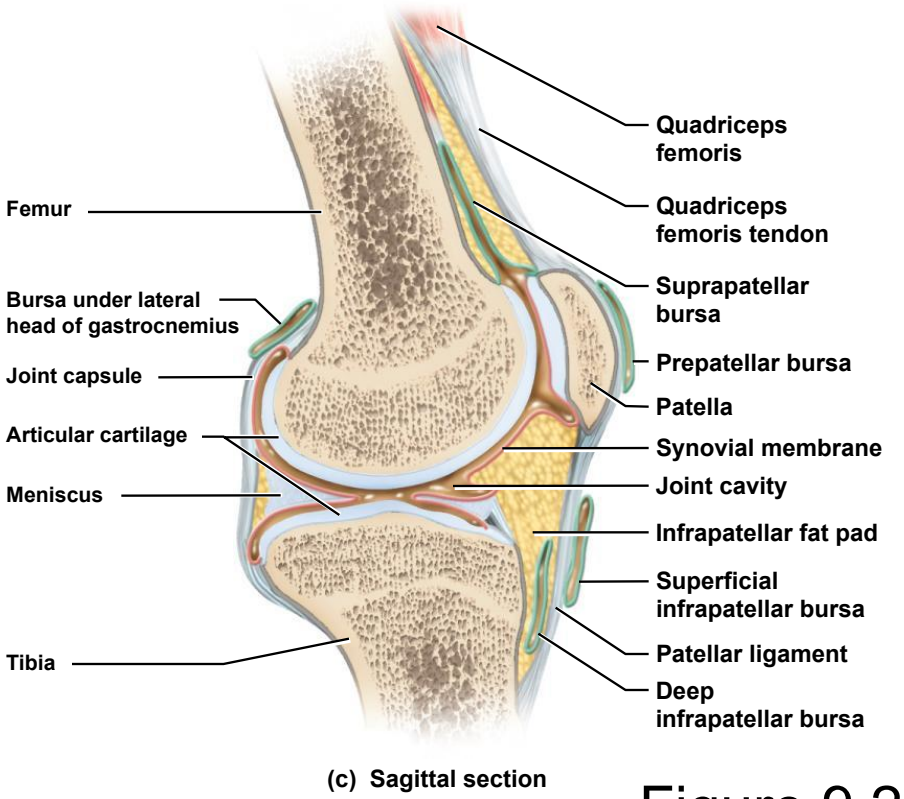

(c) Sagittal section

Figure 9.29c

- knee joint has at least **13 bursae**
- four anterior: superficial infrapatellar, suprapatellar, prepatellar, and deep infrapatellar
- popliteal region: popliteal bursa and semimembranosus bursa
- seven more bursae on lateral and medial sides of knee joint

Knee Joint – Superior View

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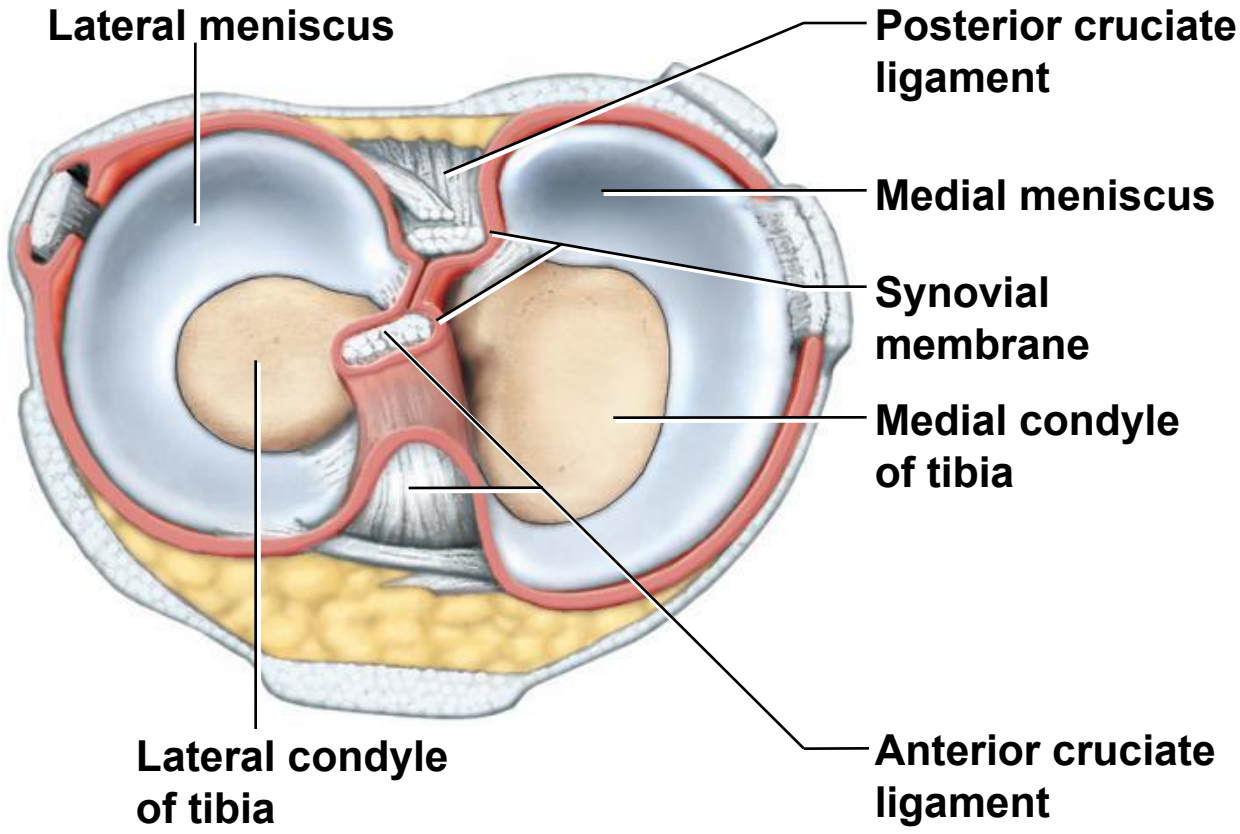

Figure 9.29d

(d) Superior view of tibia and menisci

- medial and lateral meniscus absorb shock and shape joint

Knee Injuries

- highly vulnerable to rotational and horizontal stress
- most common injuries are to the **meniscus** and **anterior cruciate ligament (ACL)**
- heal slowly due to scanty blood flow
- **arthroscopy** – procedure in which the interior of the joint is viewed with a pencil-thin **arthroscope** inserted through a small incision
  - less tissue damage than conventional surgery

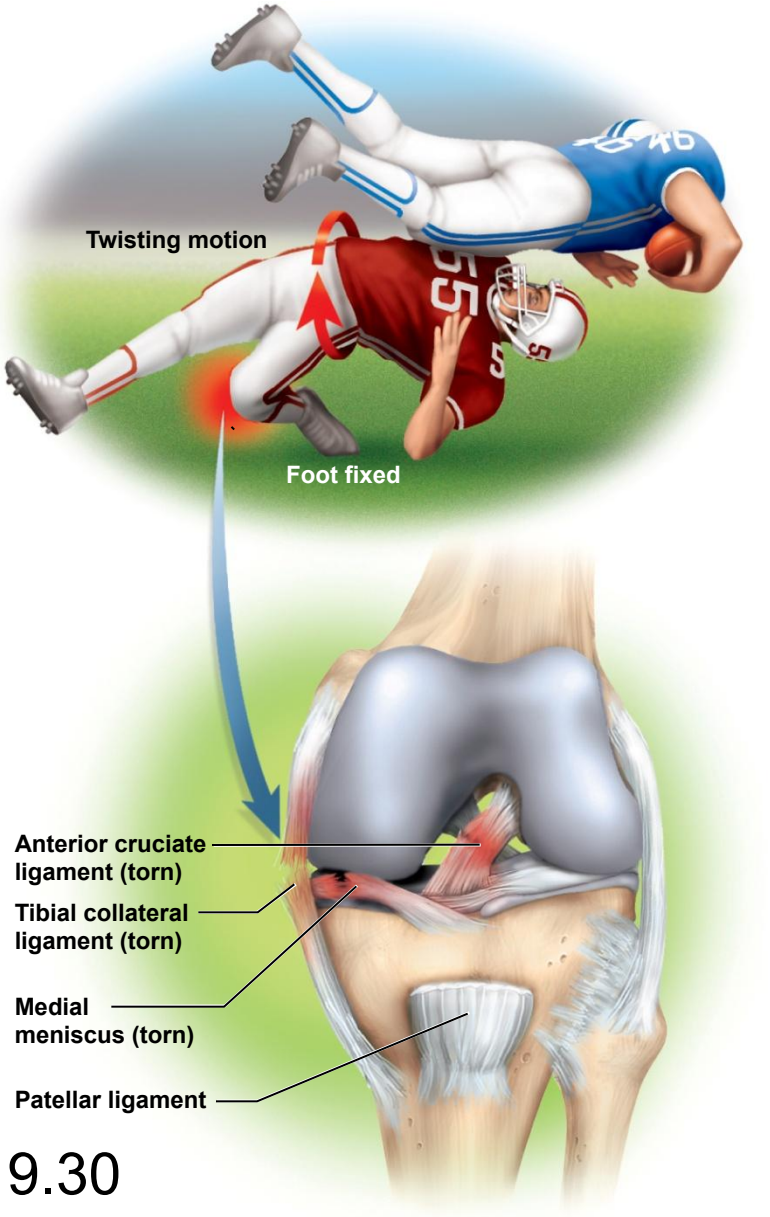

Figure 9.30

LEARNING OUTCOMES

As a result of the lesson you will be able to:

- *identify the major anatomical features of the elbow and ankle joints*
- *classify the elbow and ankle joints action as a first-, second-, or third- class lever;*
- *explain how mechanical advantage relates to the power and speed of the elbow and ankle joints movement;*
- *discuss the factors that determine the elbow and ankle joints range of motion*
- *describe the primary axes of rotation that a bone can have and relate this to a joints degrees of freedom*

The Elbow Joint

- **elbow** is a hinge joint composed of **two articulations**:
  - **humeroulnar joint** – where the trochlea of the humerus joins the trochlear notch of the ulna
    - hinge joint
  - **humeroradial joint** – where the capitulum of the humerus meets the head of the radius
    - pivot joint
    - edge of the disc-like head of the radius fits into the **radial notch** of the ulna
    - **anular ligament** holds the head in place
    - radial head rotates like a wheel against the ulna as the forearm is **supinated** and **pronated**
- both enclosed in a single joint capsule
- **olecranon bursa** – on posterior side of the elbow

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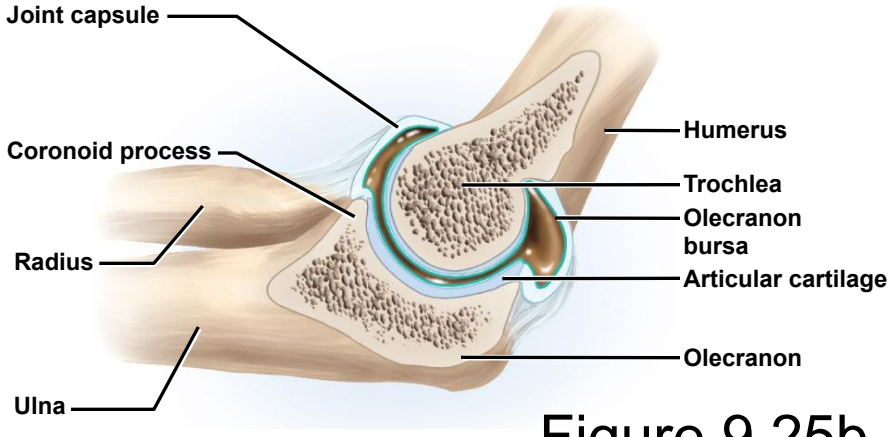
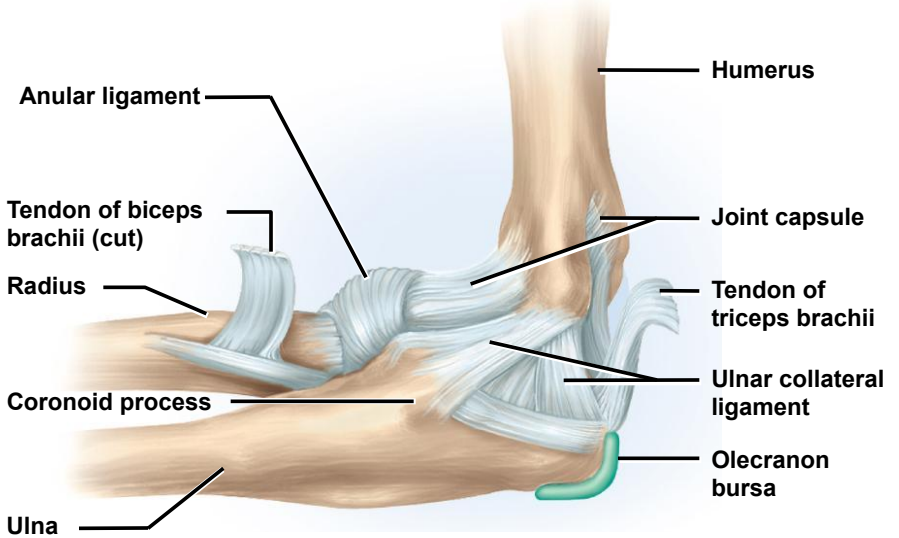


(b) Sagittal section

Figure 9.25b



(c) Medial view

Figure 9.25c

Elbow Joint

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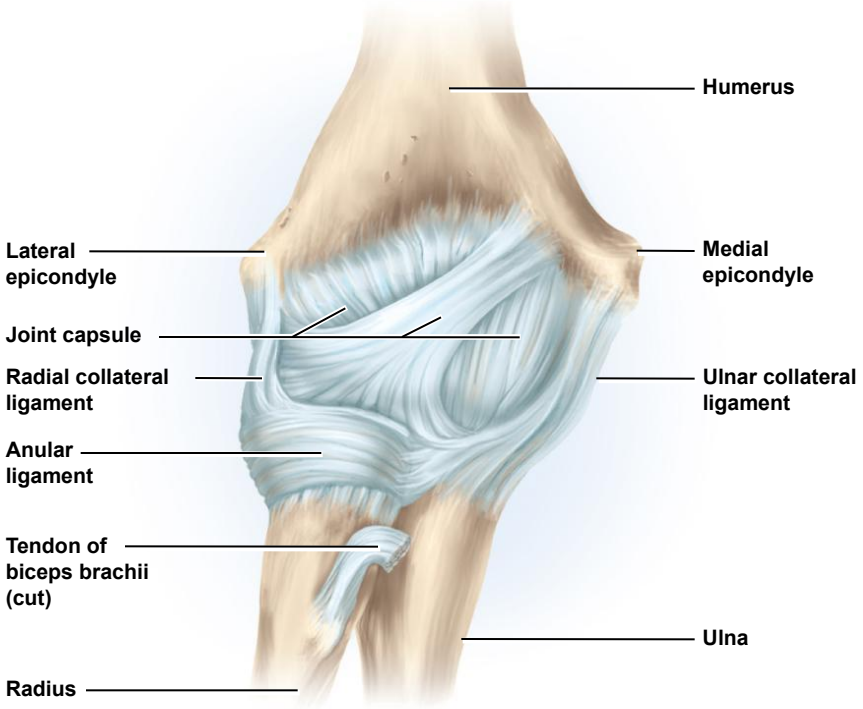
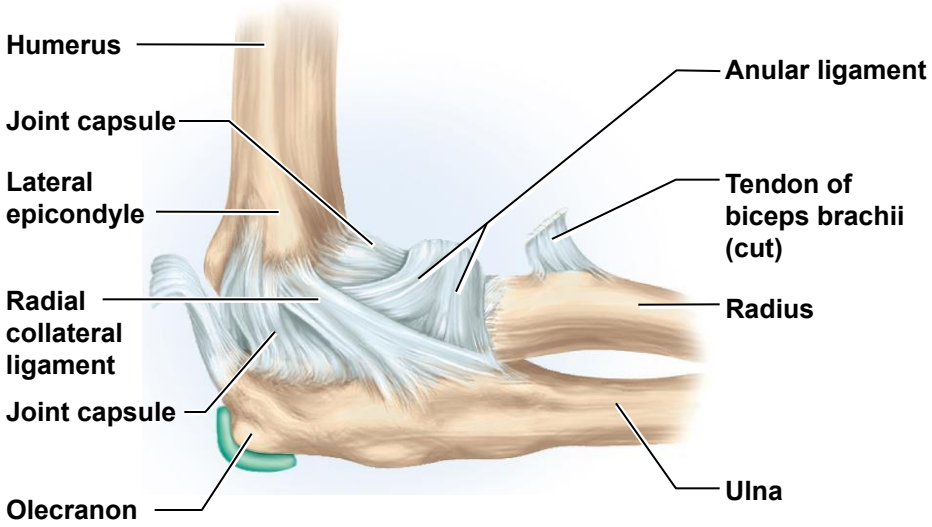


(a) Anterior view

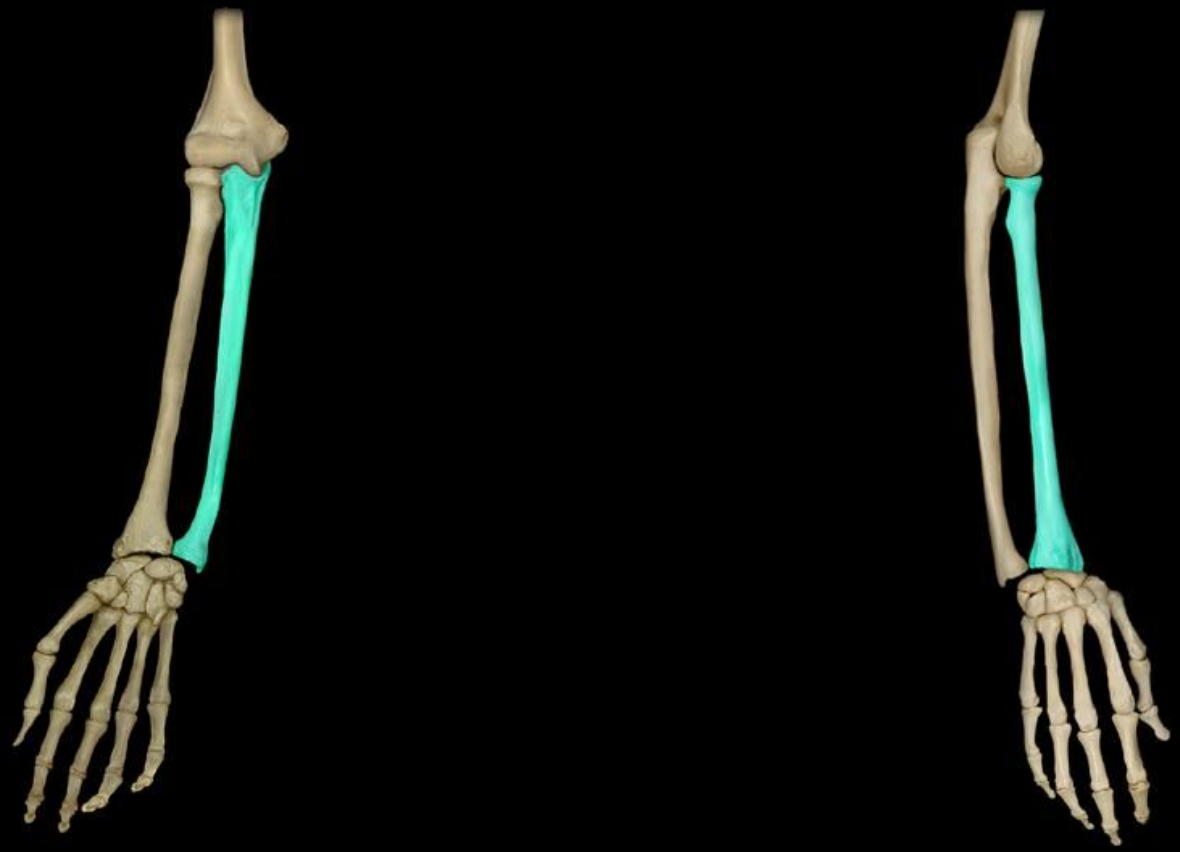
Figure 9.25a



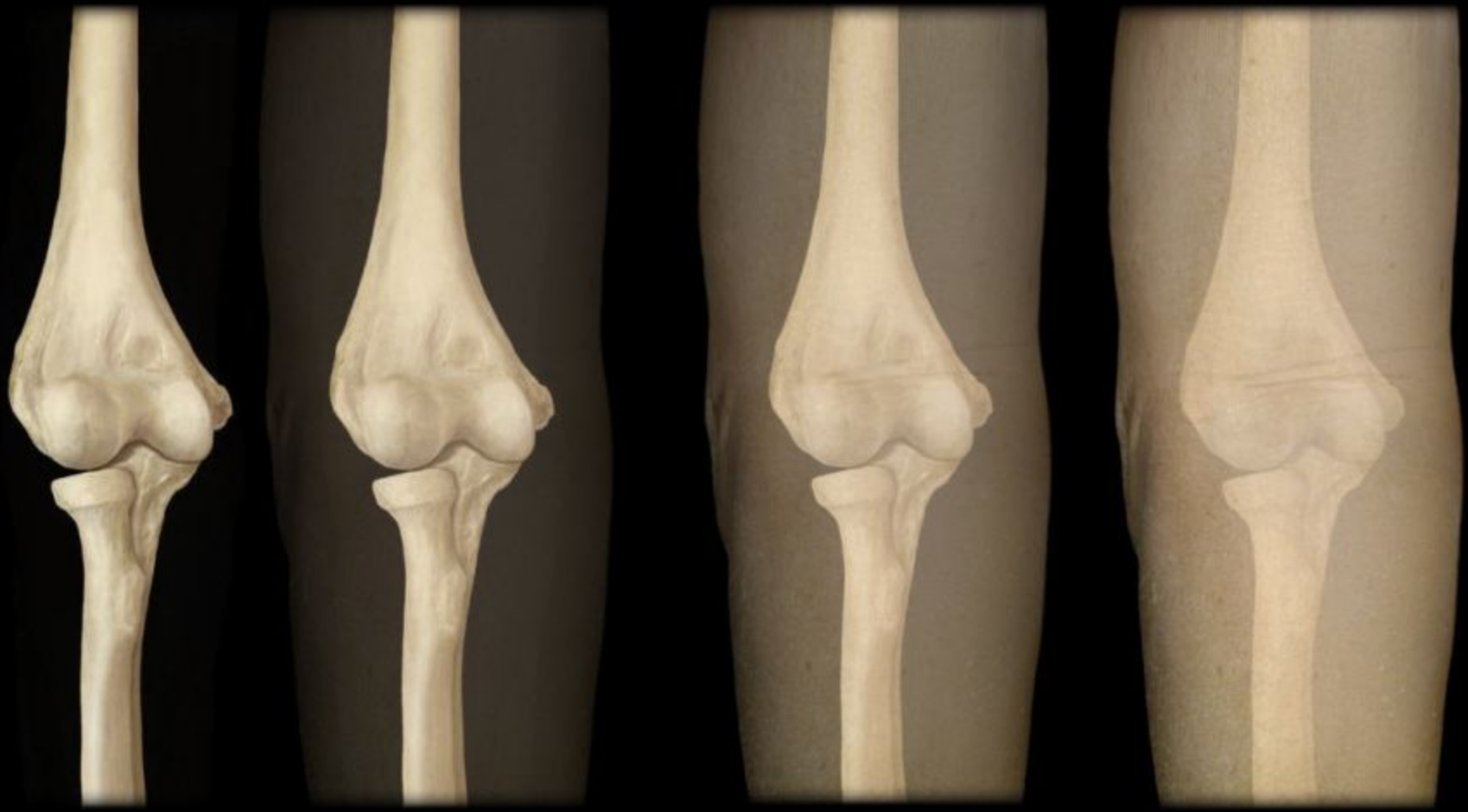
(d) Lateral view

Figure 9.25d

Elbow - 2 joints in one
Humeroulnar & Humeroradial



Elbow



Elbow Joints

Humeroradial Joint

Humeroulnar Joint

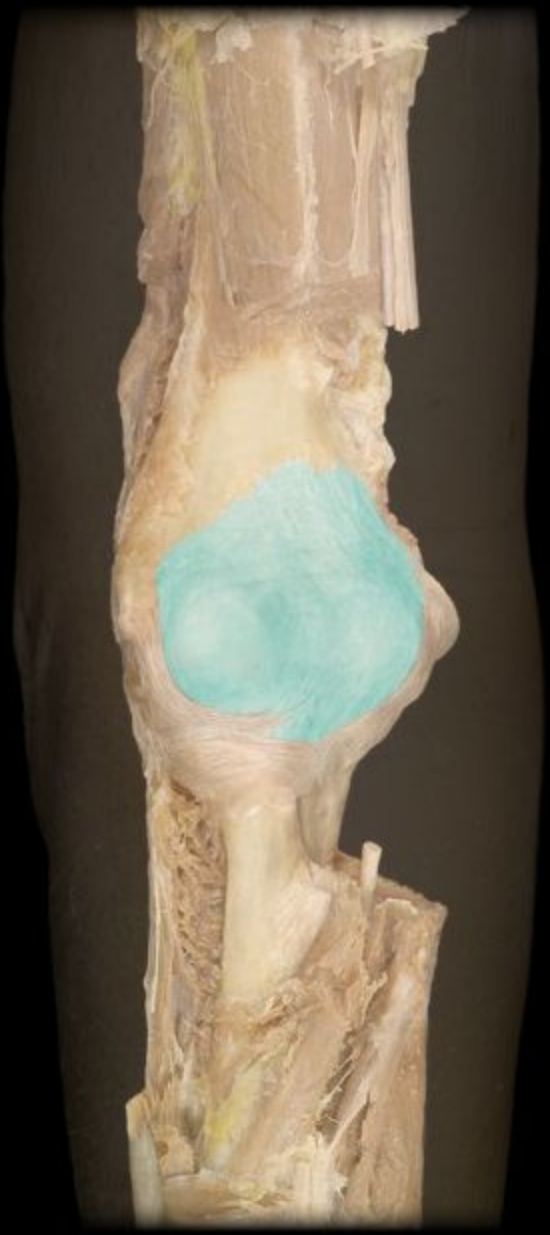
Elbow Joints

Elbow Joints

Elbow Joints

Elbow Joints

Fibrous Capsule of Elbow



Elbow Joints

Anular Ligament

Elbow Joints

Radial Collateral Ligament

Elbow Joints

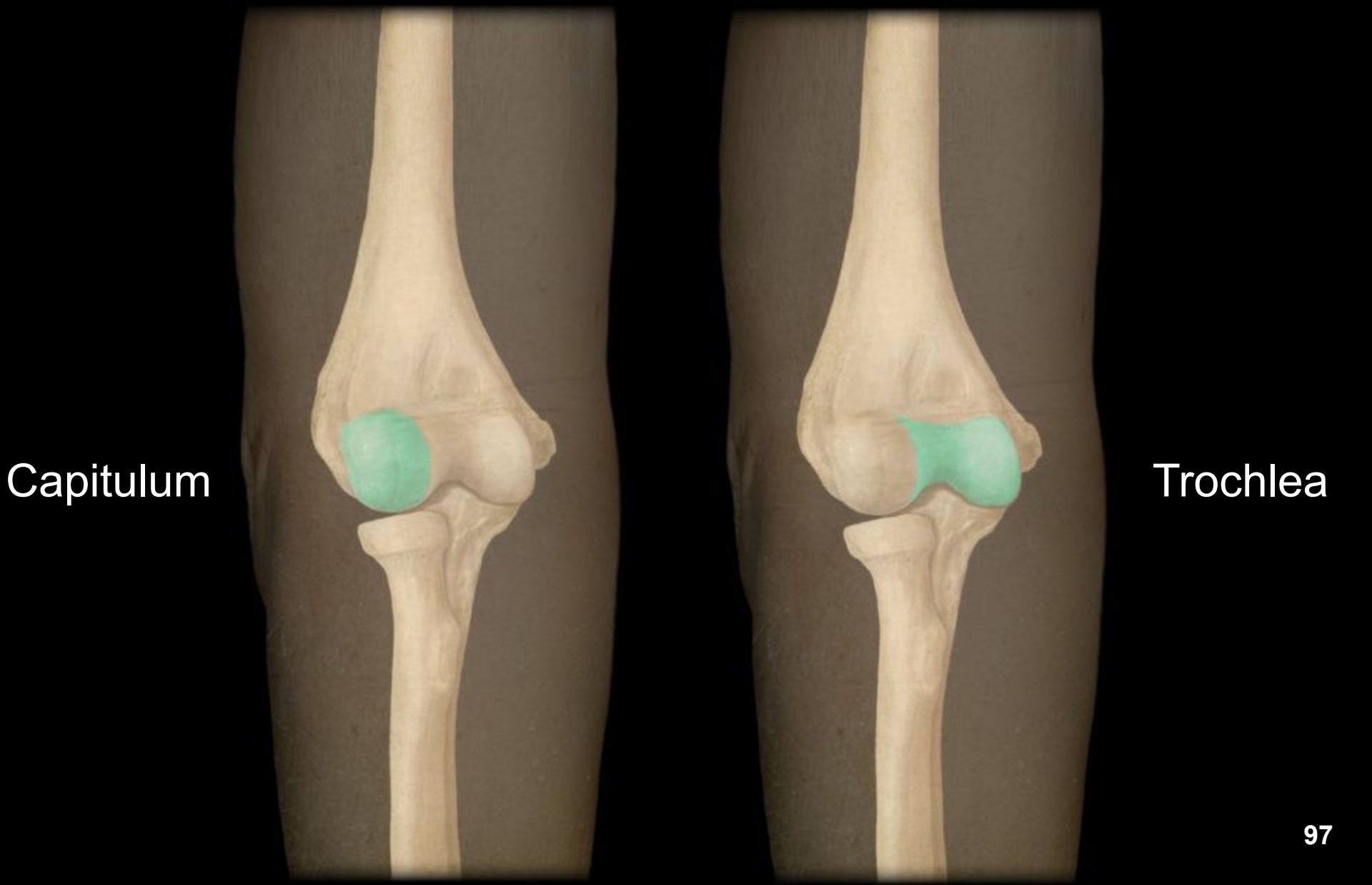
Ulnar Collateral Ligament

Elbow Joints

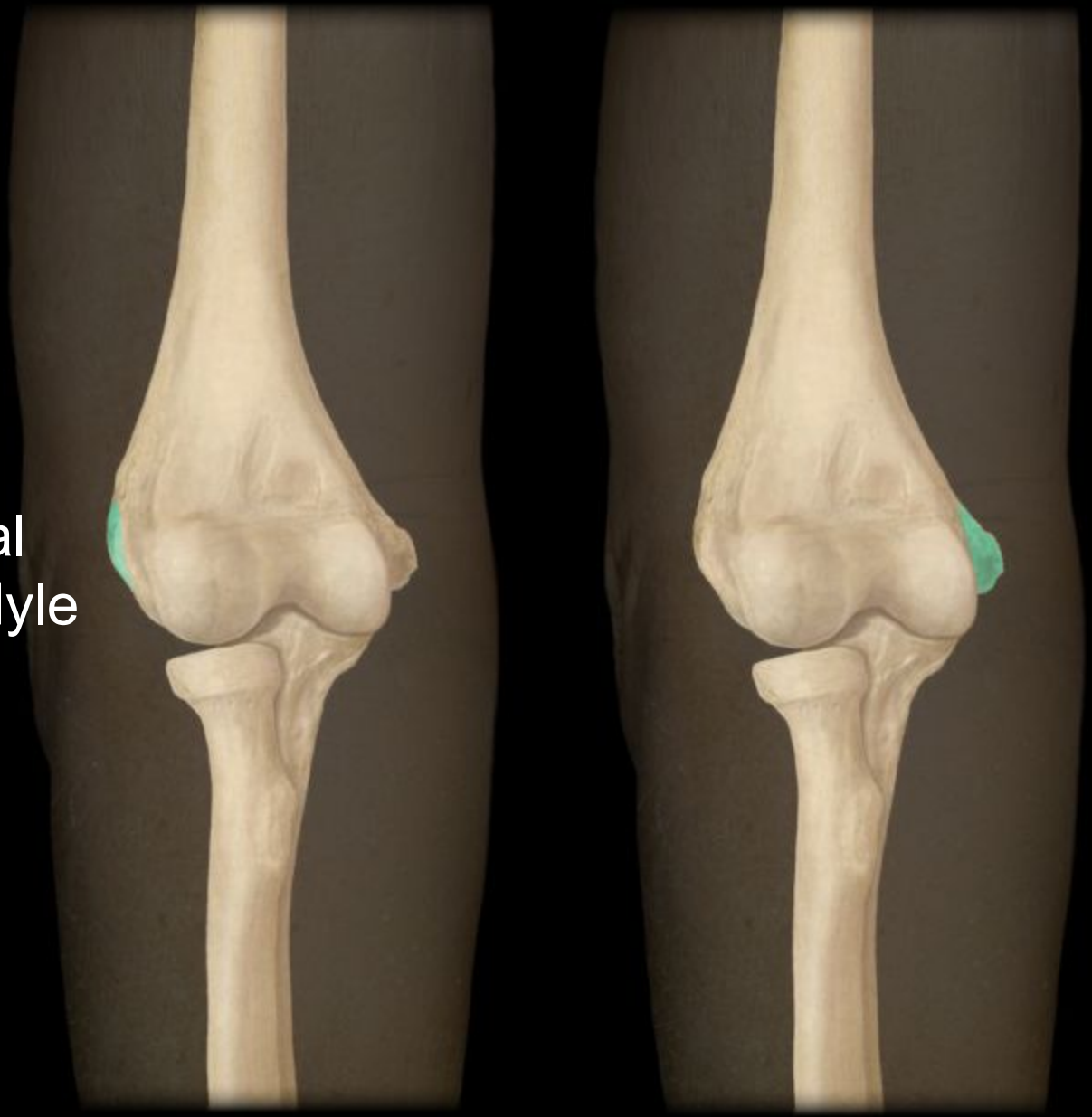
Elbow Joints

Humerus

Elbow Joints



Elbow Joints



Lateral Epicondyle

Medial Epicondyle

Elbow Joints

Head of Radius

Radius

Radial Tuberosity

Elbow Joints

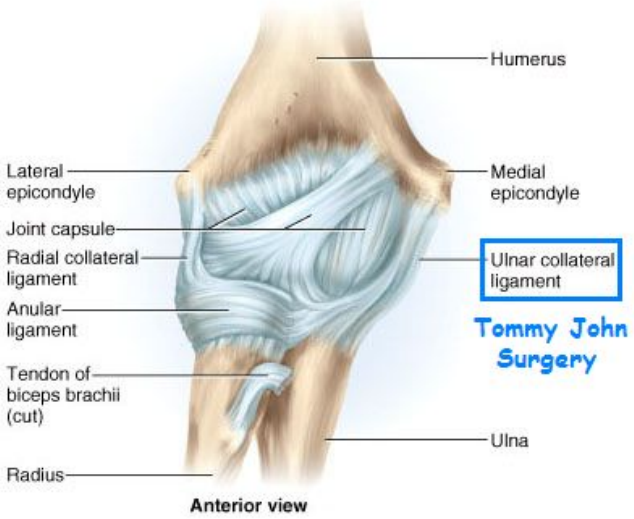
Ulna

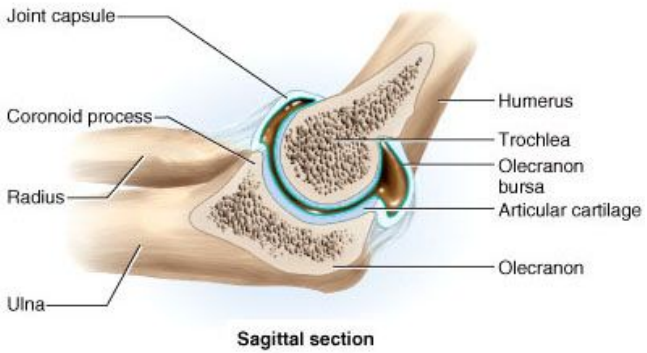
Elbow Joints

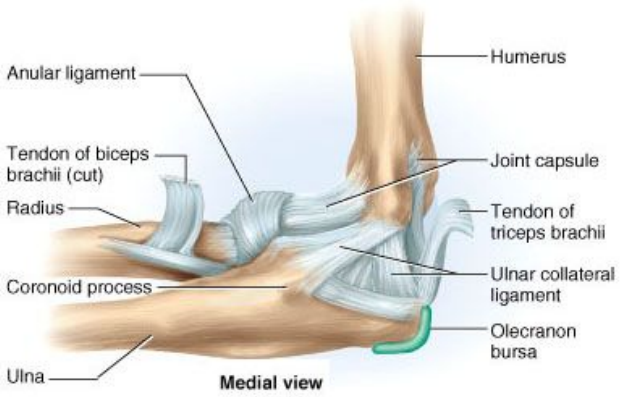
Humeroradial Joint

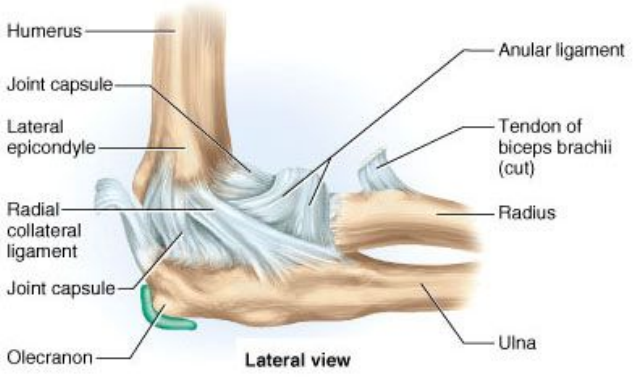
Humeroulnar Joint

Elbow -2 joints in one Humeroulnar & Humeroradial









Elbow Joint

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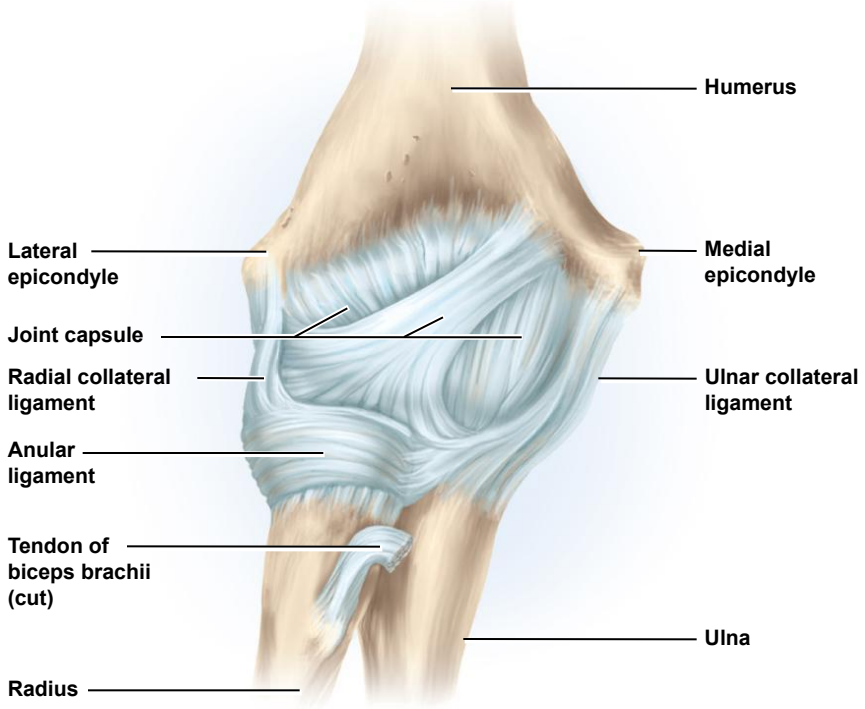
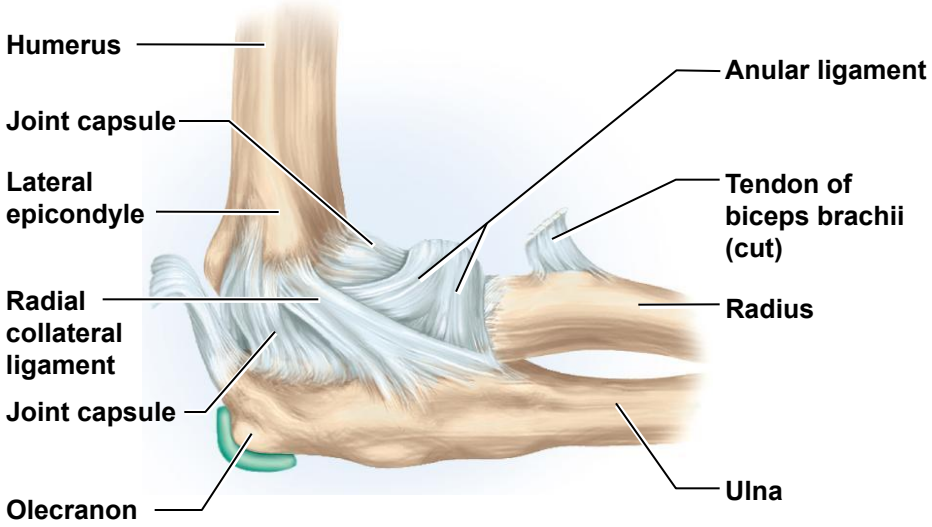


(a) Anterior view

Figure 9.25a



(d) Lateral view

Figure 9.25d

The Ankle Joint

- **talocrural (ankle) joint** – includes two articulations:
  - **medial joint** – between tibia and talus
  - **lateral joint** – between fibula and talus
  - both enclosed by one joint capsule
  - **malleoli** of tibia and fibula overhang the talus on either side and prevent side-to-side motion
  - more restricted range of motion than the wrist

- **ankle ligaments**
  - **anterior** and **posterior tibiofibular ligaments** – bind the tibia to fibula
  - **multipart medial (deltoid) ligament** – binds the tibia to the foot on the medial side
  - **multipart lateral (collateral) ligament** – binds fibula to the foot on the lateral side
  - **calcaneal (Achilles) tendon** – extends from the calf muscle to the calcaneus
    - plantarflexes the foot and limits dorsiflexion
  - **sprains** (torn ligaments and tendons) are common at the ankle
    - pain and immediate swelling

Ankle Joint and Foot Ligaments

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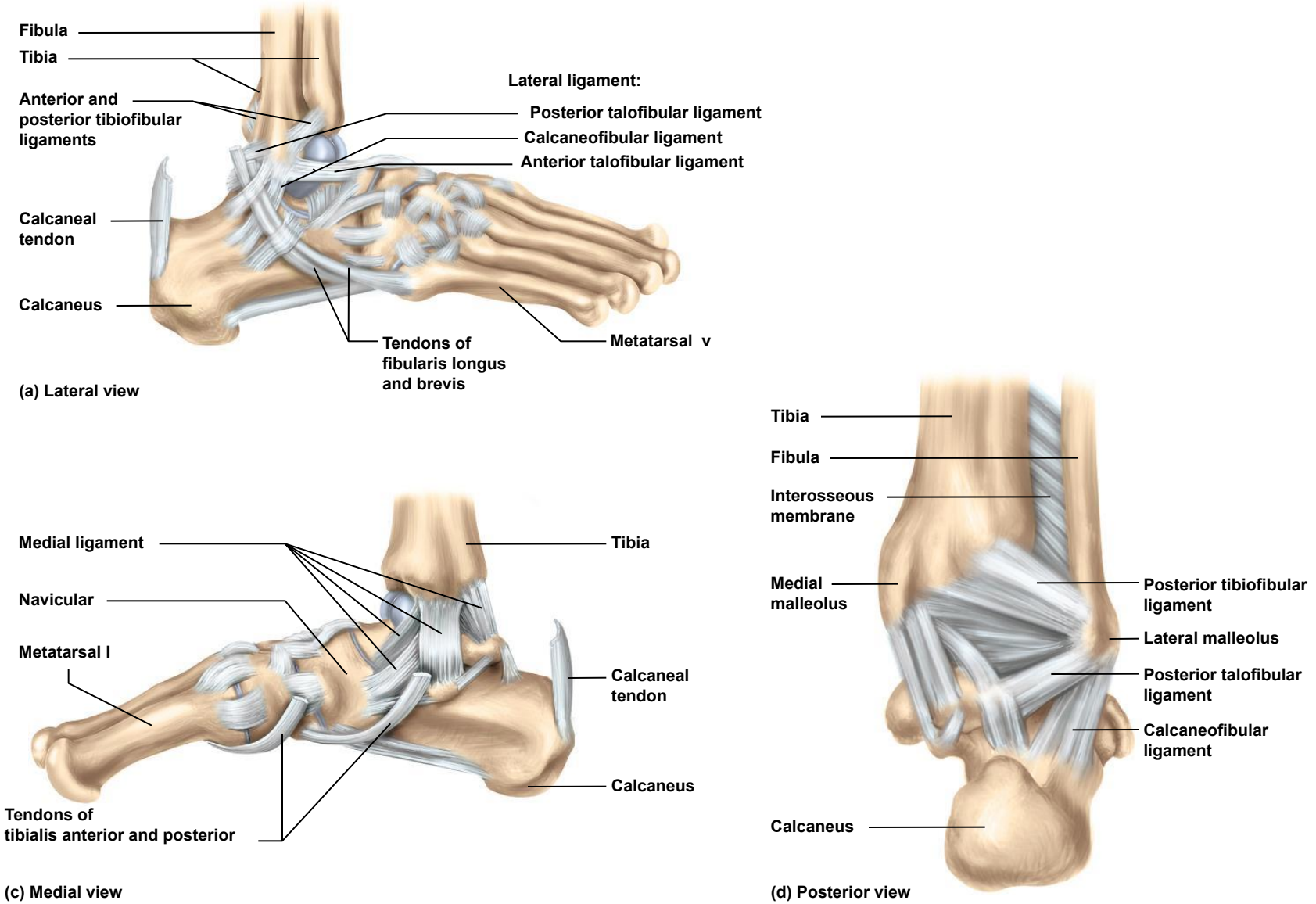

Figure 9.31a,c,d

Dissection of the Foot

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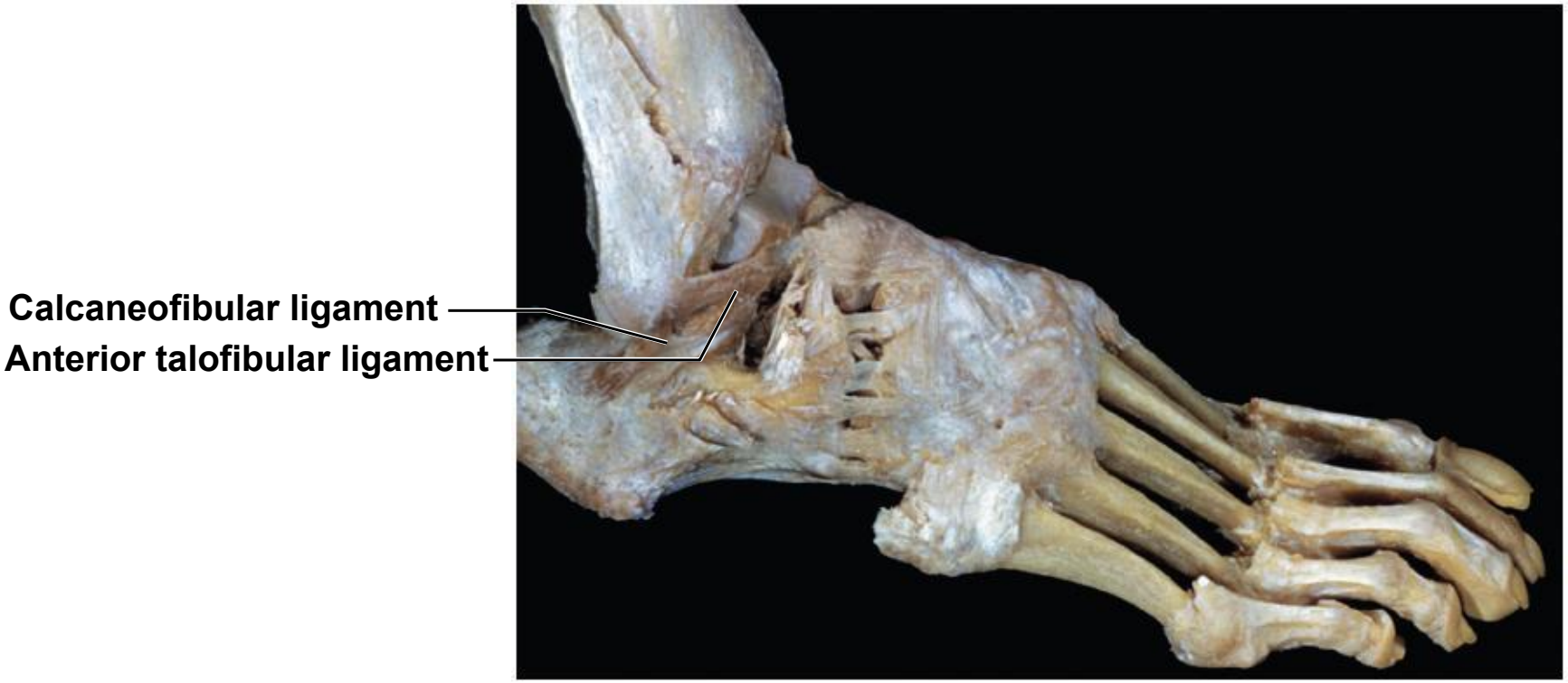

(b) Lateral dissection

Figure 9.31b

Ankle Joint

Lateral Aspect

Medial Aspect

Ankle Joint

Lateral Aspect

Ankle Joint

Lateral Aspect

Ankle Joint

Lateral Aspect

Ankle Joint

Lateral Aspect

Ankle Joint

Lateral Aspect

Ankle Joint

Lateral Aspect

Ankle Joint

Lateral Aspect

Ankle Joint

Lateral Aspect

Ankle Joint

Fibular Retinaculum of Ankle

Ankle Joint

Extensor Retinaculum of Ankle

Ankle Joint

Calcaneal (Achilles) Tendon

Ankle Joint

Tendon of Fibularis Longus Muscle

Ankle Joint

Tendon of Fibularis Brevis Muscle

Ankle Joint

Tendon of Fibularis Tertius Muscle

Bones of Ankle Joint

Ankle Joint

Fibula

Ankle Joint

Lateral Malleolus of Fibula

Ankle Joint

Tibia

Ankle Joint

Talus

Ankle Joint

Calcaneus

Ankle Joint

Lateral
Aspect

Ankle Joint

Medial Aspect

Ankle Joint

Medial Aspect

Ankle Joint

Medial Aspect

Ankle Joint

Medial Aspect

Ankle Joint

Medial Aspect

Ankle Joint

Medial Aspect

Ankle Joint

Medial Aspect

Ankle Joint

Medial Aspect

Ankle Joint

Flexor Retinaculum of Ankle

Ankle Joint

Median Ligament of Ankle

Ankle Joint

Calcaneal (Achilles)
Tendon

Ankle Joint

Tendon of Flexor Digitorum Longus Muscle

Ankle Joint

Tendon of Tibialis Posterior Muscle

Ankle Joint

Tendon of Tibialis Anterior Muscle

Ankle Joint

Tibia

Ankle Joint

Median Malleolus of Tibia

Ankle Joint

Lateral Malleolus of Fibula

Ankle Joint

Talus

Ankle Joint

Calcaneus

Ankle Joint

Ankle Joint

Ankle Joint

Ankle Joint

Talus

Ankle Joint

Calcaneus