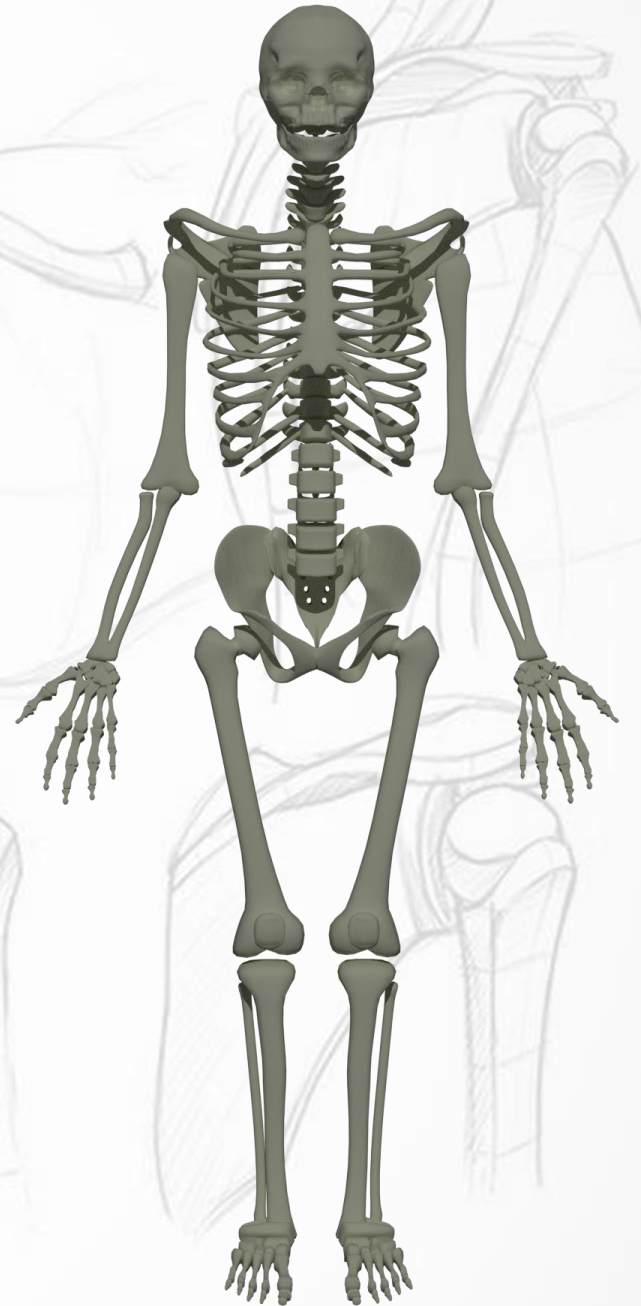


# Arthrology

Objective of the lecture

- Definition of arthrology and joints
- Classifications of joints
- Synovial joint - elements and types
- Types of movements
- Joint markings

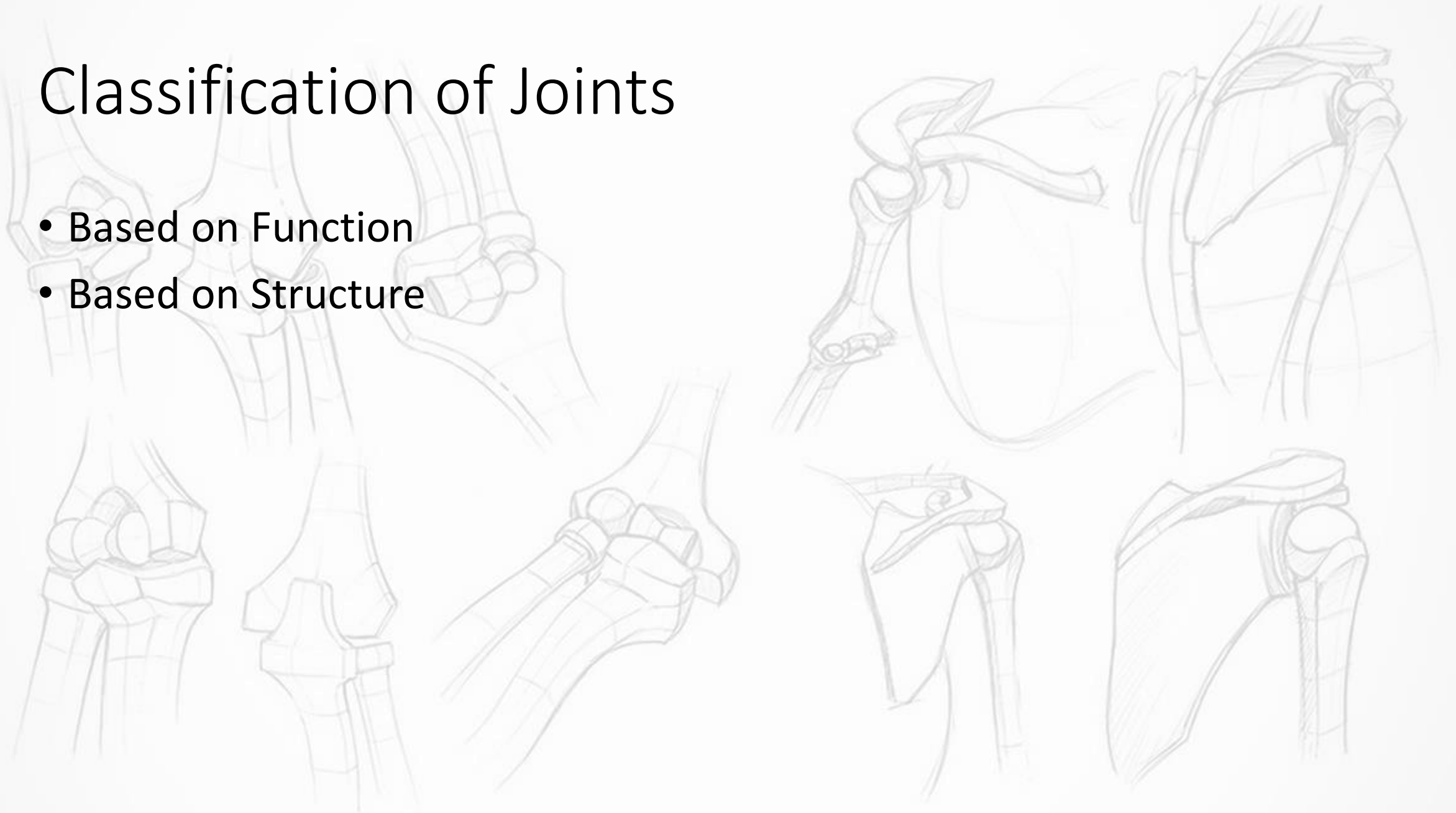


# Definition

- **Arthrology** is the science concerned with the study of anatomy, function, dysfunction and treatment of joints.
- Greek root “arthro” means joint.
- **Kinesiology** The study of the motion of human body.
- **Joint**, also called **articulation** is point of contact between rigid elements of the skeleton, *bones*.
- Usually, but not always allow for movements.

# Classification of Joints

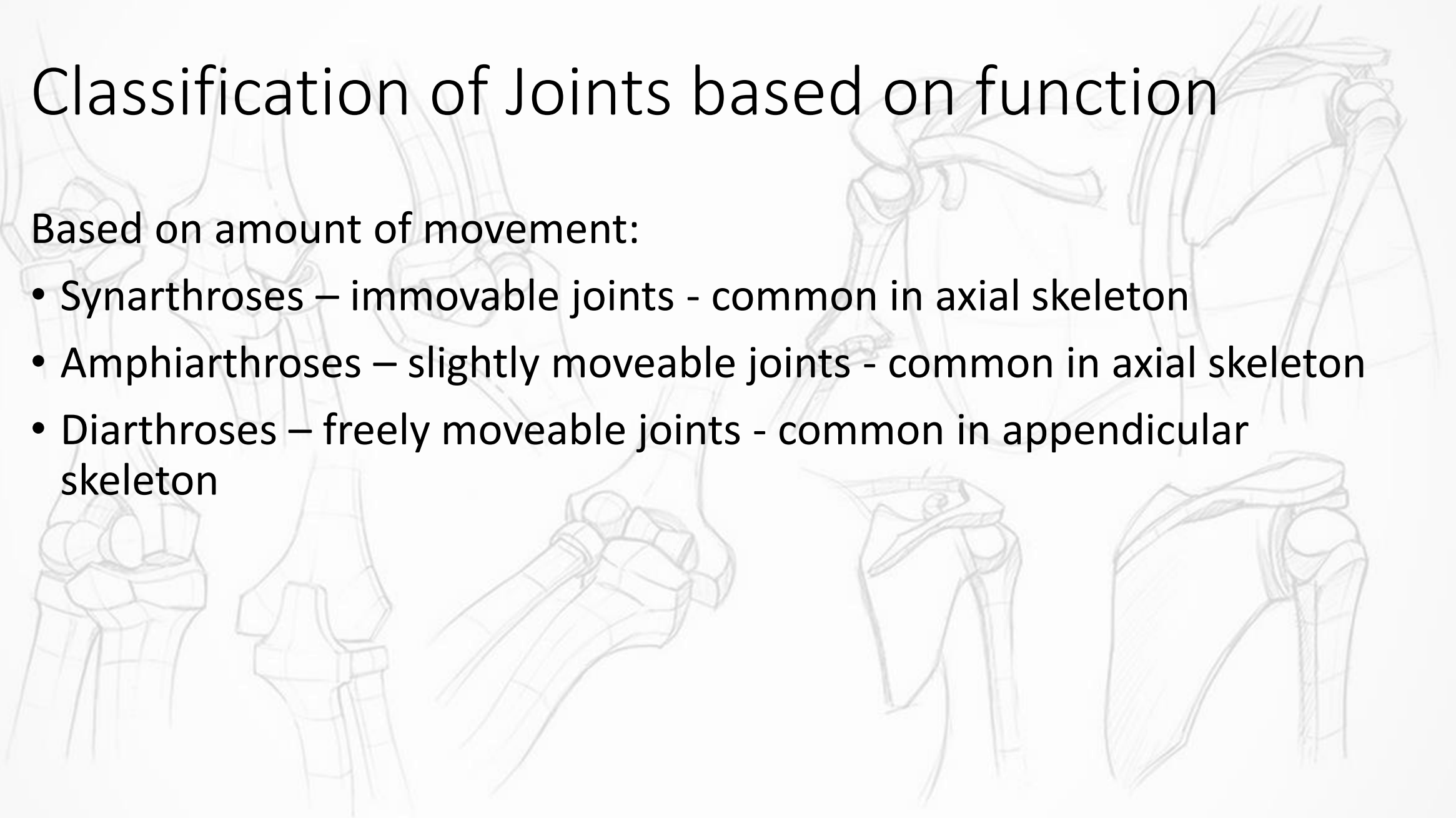
- Based on Function
- Based on Structure



# Classification of Joints based on function

Based on amount of movement:

- Synarthroses – immovable joints - common in axial skeleton
- Amphiarthroses – slightly moveable joints - common in axial skeleton
- Diarthroses – freely moveable joints - common in appendicular skeleton



# Joints by Functional Classification

Type

Movement

Example

- **Synarthrosis**

**None (minimal)**

**Sutures, Teeth,  
Epiphyseal plates,  
1st rib and costal cart.**

- **Amphiarthrosis**

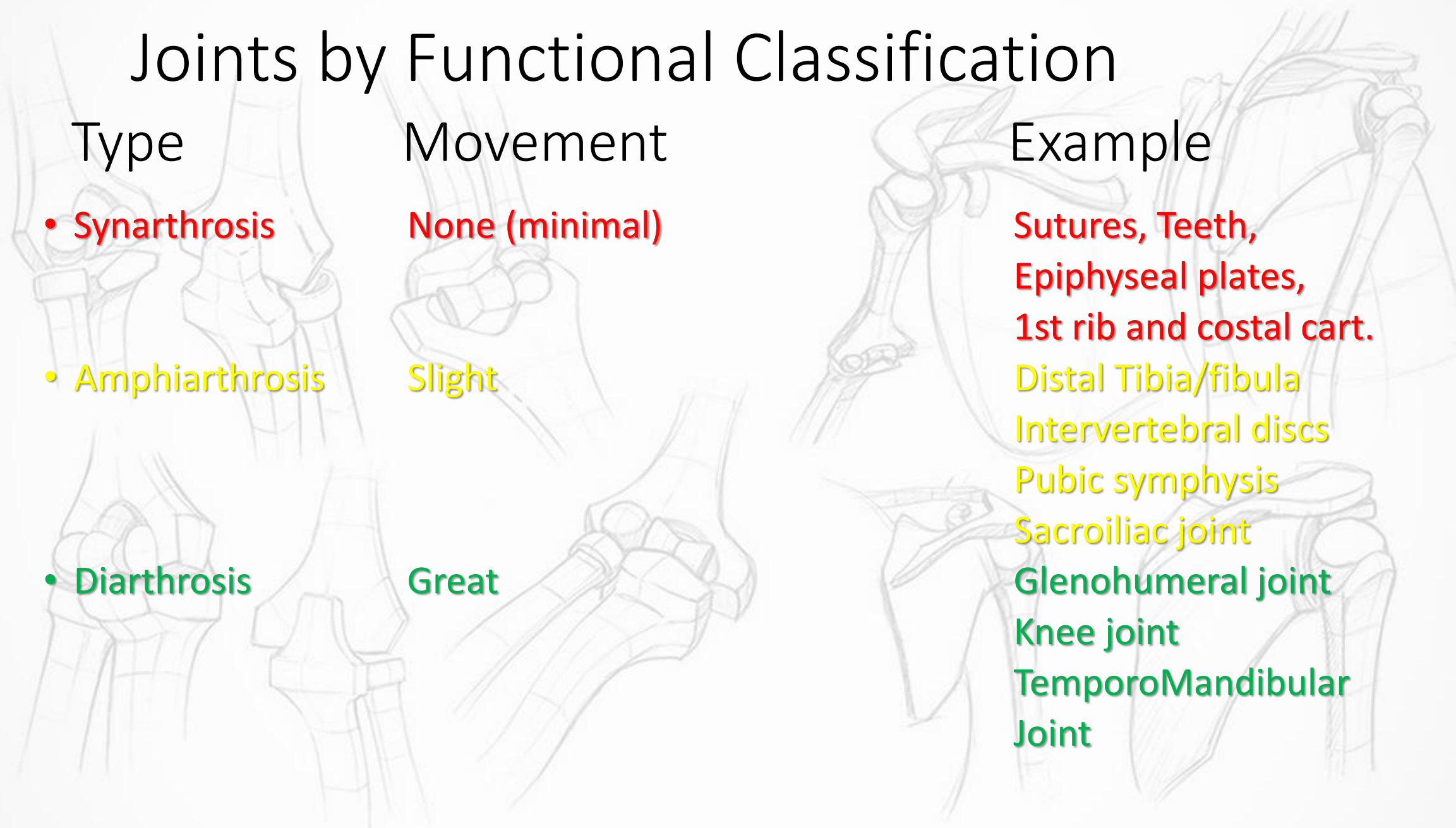
**Slight**

**Distal Tibia/fibula  
Intervertebral discs  
Pubic symphysis**

- **Diarthrosis**

**Great**

**Sacroiliac joint  
Glenohumeral joint  
Knee joint  
TemporoMandibular  
Joint**



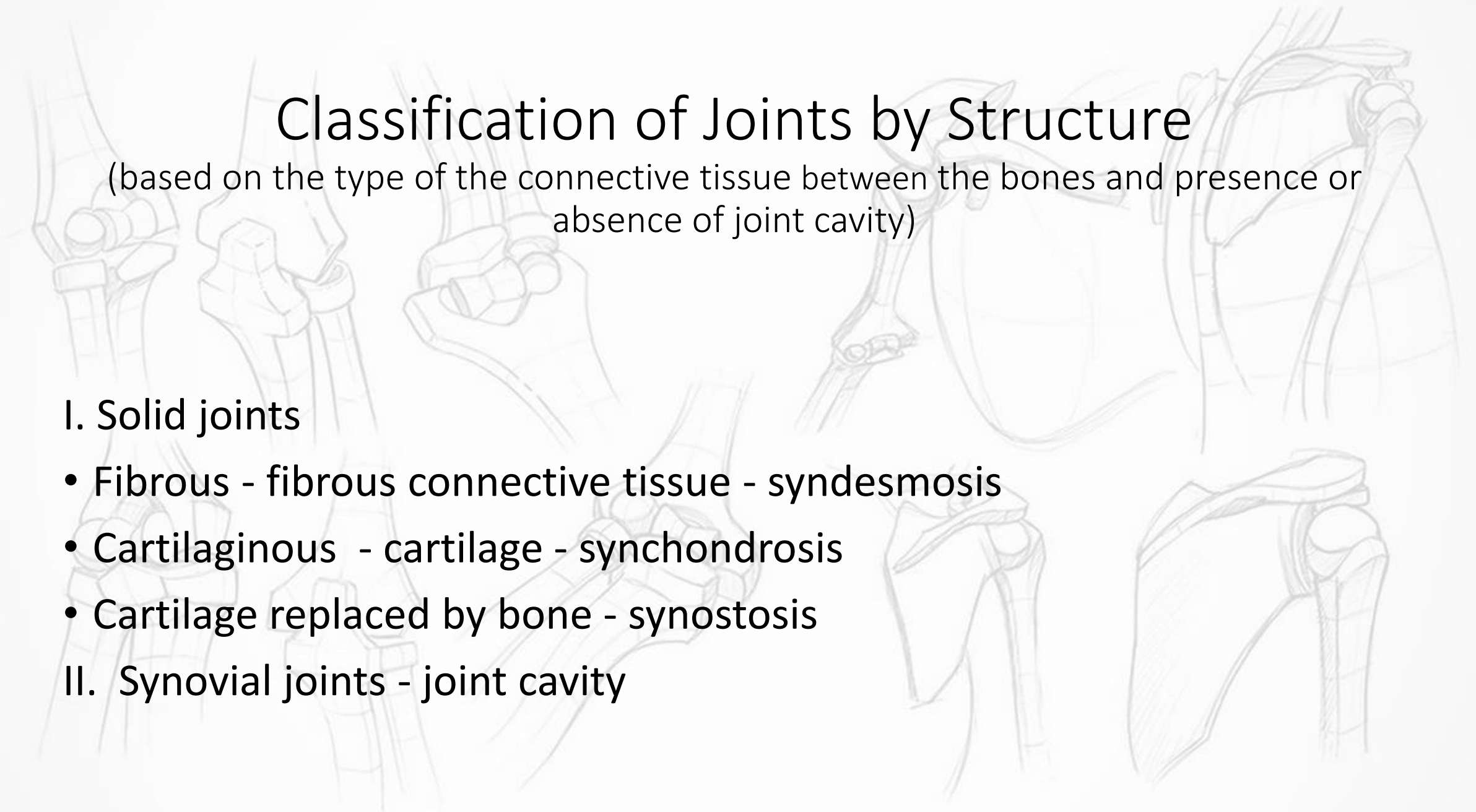
# Classification of Joints by Structure

(based on the type of the connective tissue between the bones and presence or absence of joint cavity)

## I. Solid joints

- Fibrous - fibrous connective tissue - syndesmosis
- Cartilaginous - cartilage - synchondrosis
- Cartilage replaced by bone - synostosis

## II. Synovial joints - joint cavity

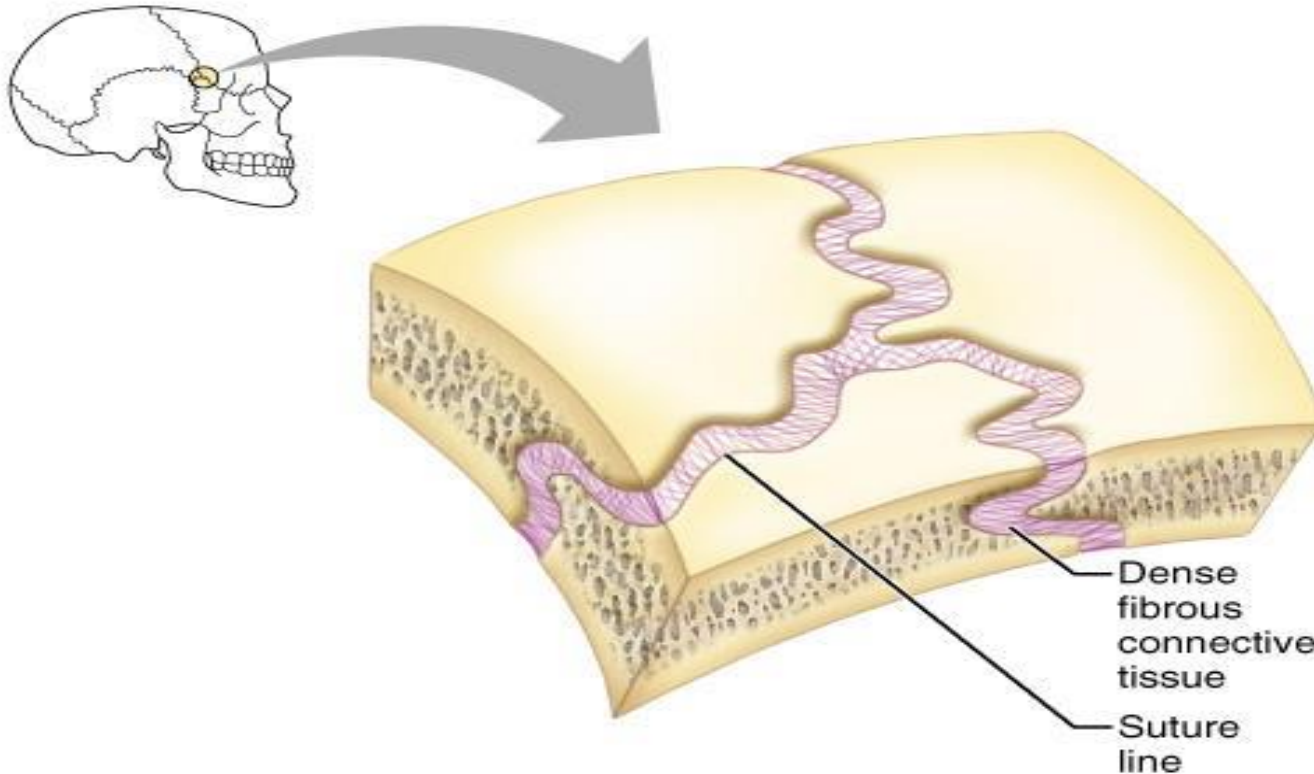




# Fibrous joints

- **Suture**

- Bones tightly bound by minimal fiber
- Only found in skull



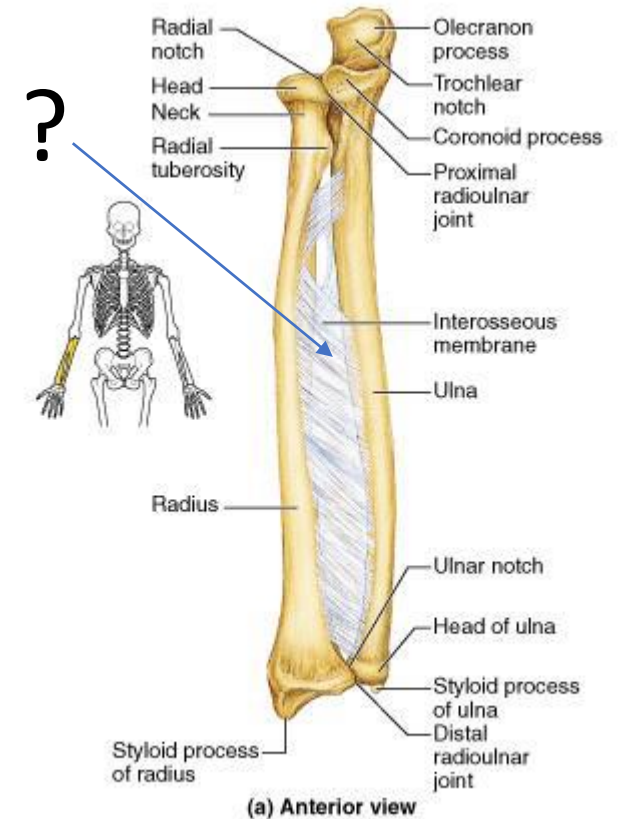
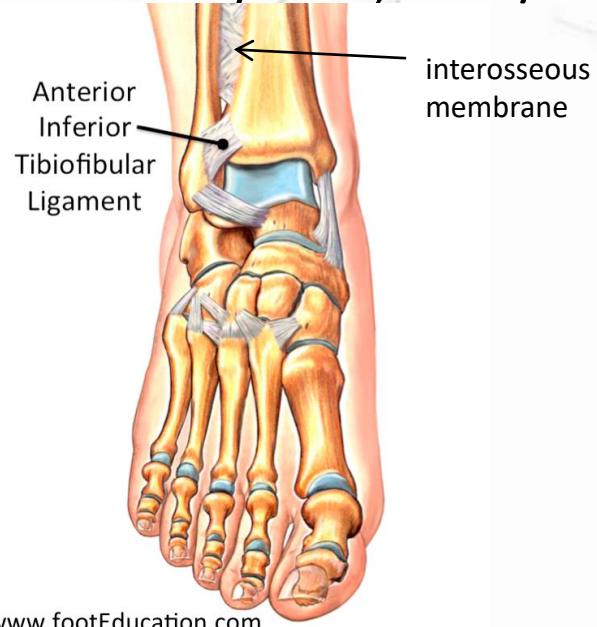
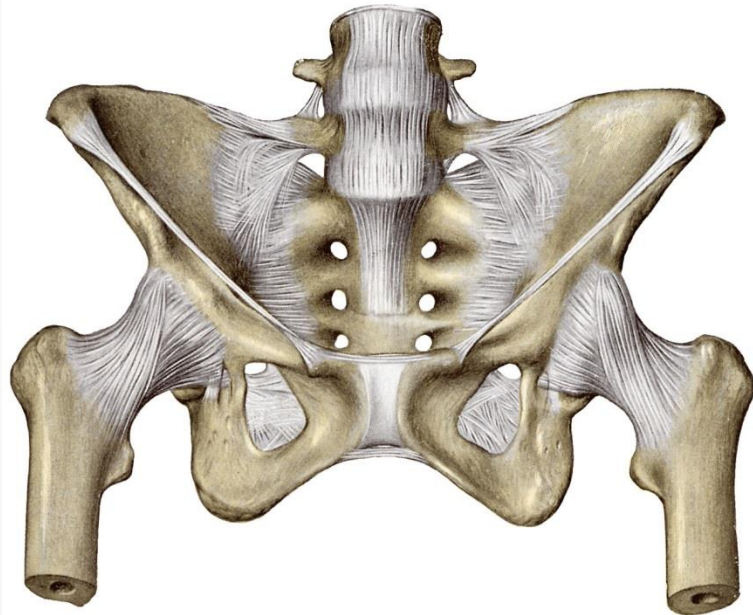
**(a) Suture**

Fibrous joints are mostly non-movable joints, but some are slightly movable.  
Synovial joints are mostly movable, but some are slightly movable.



# Fibrous joints

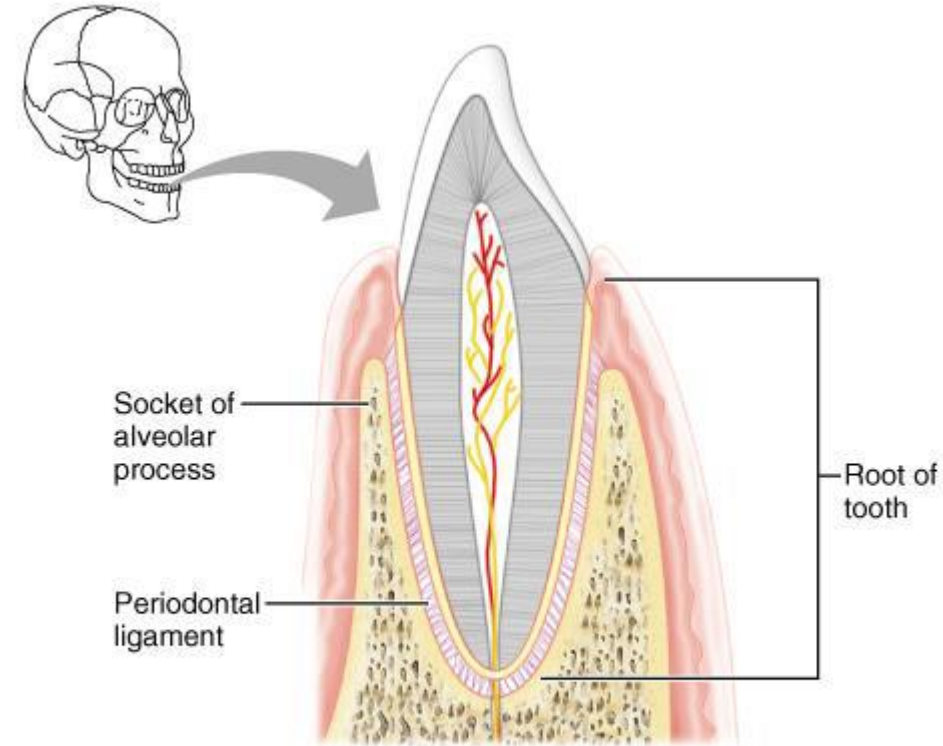
- Suture
  - Bones tightly bound by minimal fiber
  - Only found in skull
- Syndesmoses
  - Bones connected by ligaments E.g. tibiofibular ligament,
  - interosseous membrane of radius/ulna; tibia/fibula





# Fibrous joints

- Suture
  - Bones tightly bound by minimal fiber
  - Only found in skull
- Syndesmoses
  - Bones connected by ligaments E.g. tibiofibular ligament,
  - interosseous membrane of radius/ulna; tibia/fibula
- **Gomphoses**
  - Peg in socket joint
  - Only found in teeth/alveoli



(c) Gomphosis

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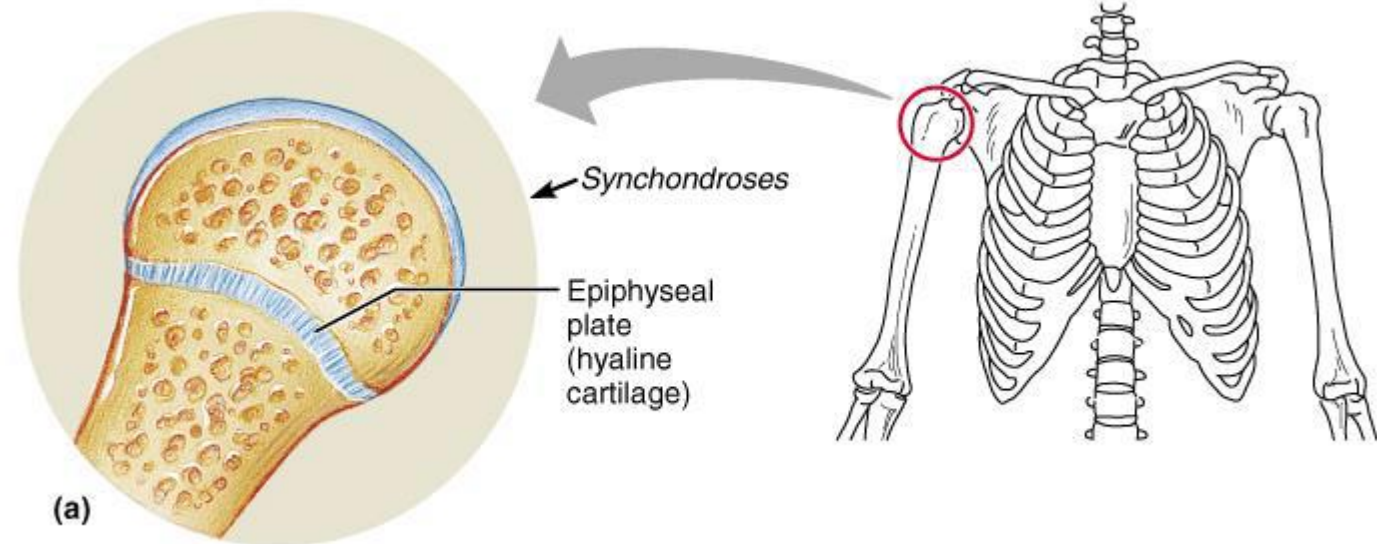
# Cartilaginous Joints

- **Symphondrosis**

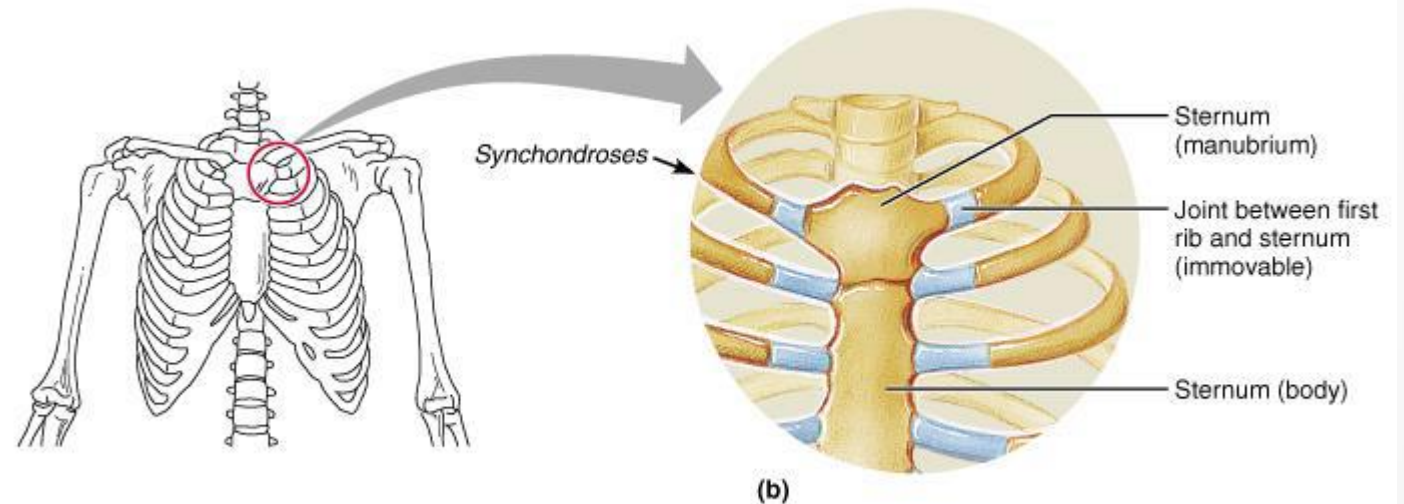
- Hyaline cartilage unites bones
- Epiphyseal growth plates
- Costal cartilage-sternum

- **Symphysis**

- Fibrocartilage unites bones
- Pubic symphysis
- Intervertebral disc



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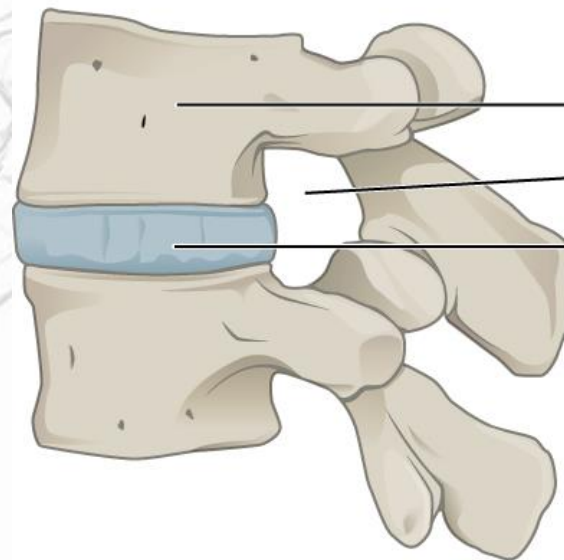
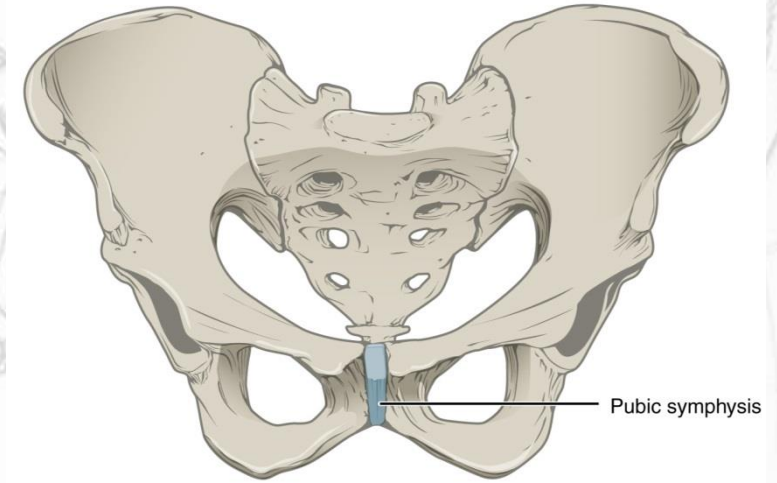
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# Cartilaginous Joints

- Synchondrosis
  - Hyaline cartilage unites bones
  - Epiphyseal growth plates
  - Costal cartilage-sternum

- **Symphysis**

- Fibrocartilage unites bones
- Pubic symphysis
- Intervertebral disc



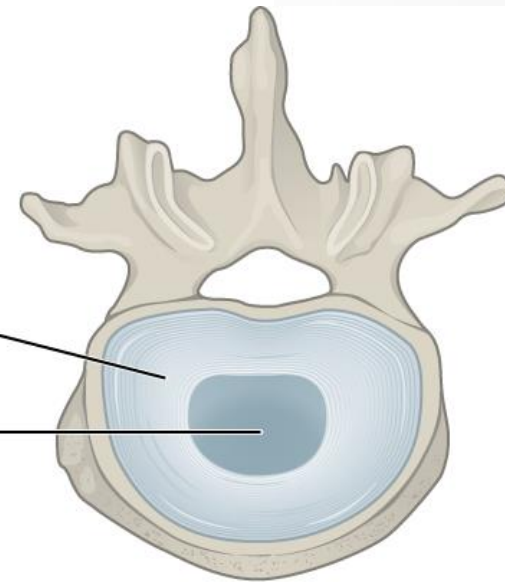
Lateral view

Vertebral body

Intervertebral foramen

Anulus fibrosus

Nucleus pulposus

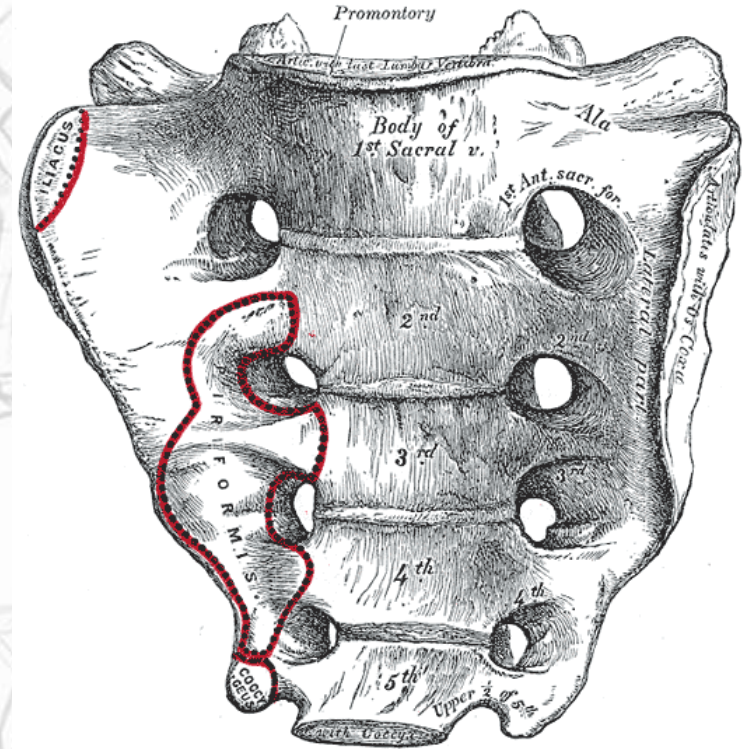
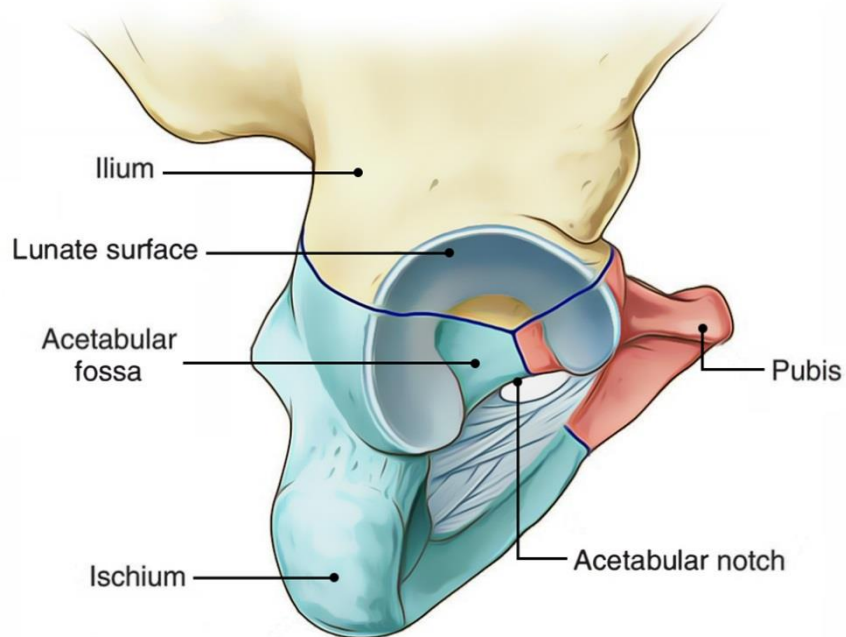


Superior view



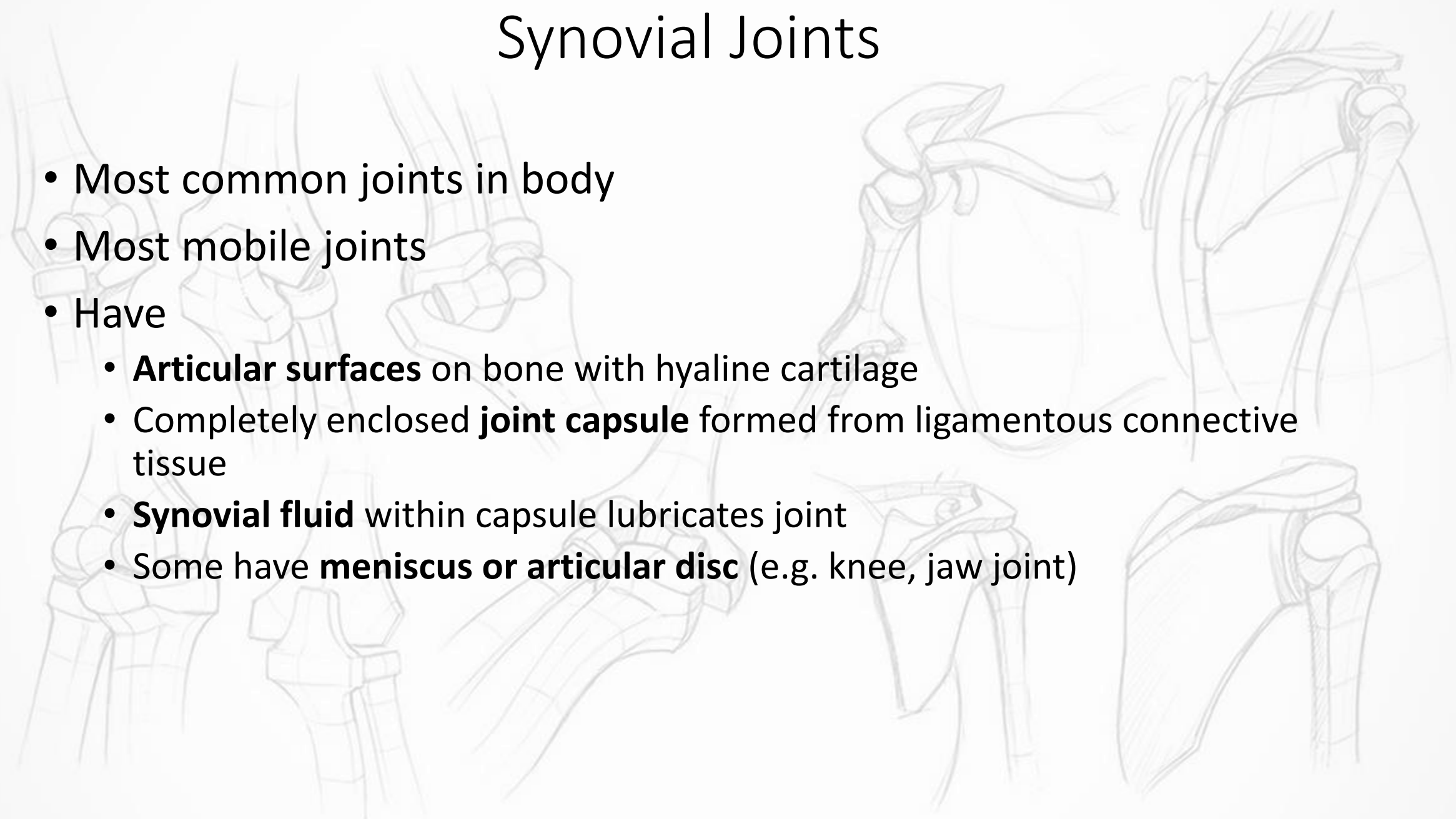
# Synostosis

- Bone between bones
  - Temporary synchondroses
    - E.g. Epiphyseal growth plates
  - Sacrum, Hip bone



# Synovial Joints

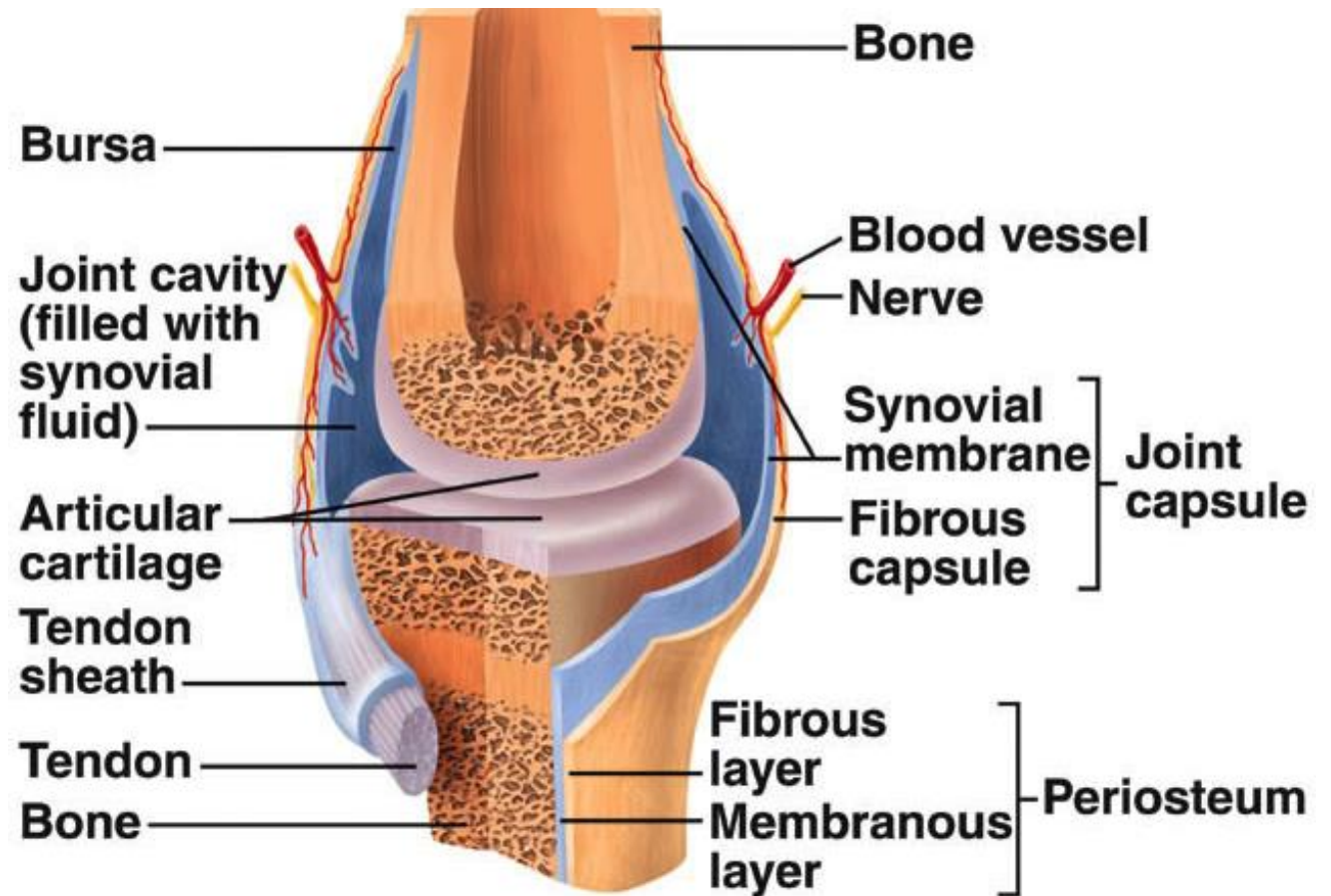
- Most common joints in body
- Most mobile joints
- Have
  - **Articular surfaces** on bone with hyaline cartilage
  - Completely enclosed **joint capsule** formed from ligamentous connective tissue
  - **Synovial fluid** within capsule lubricates joint
  - Some have **meniscus or articular disc** (e.g. knee, jaw joint)





# Synovial Joints

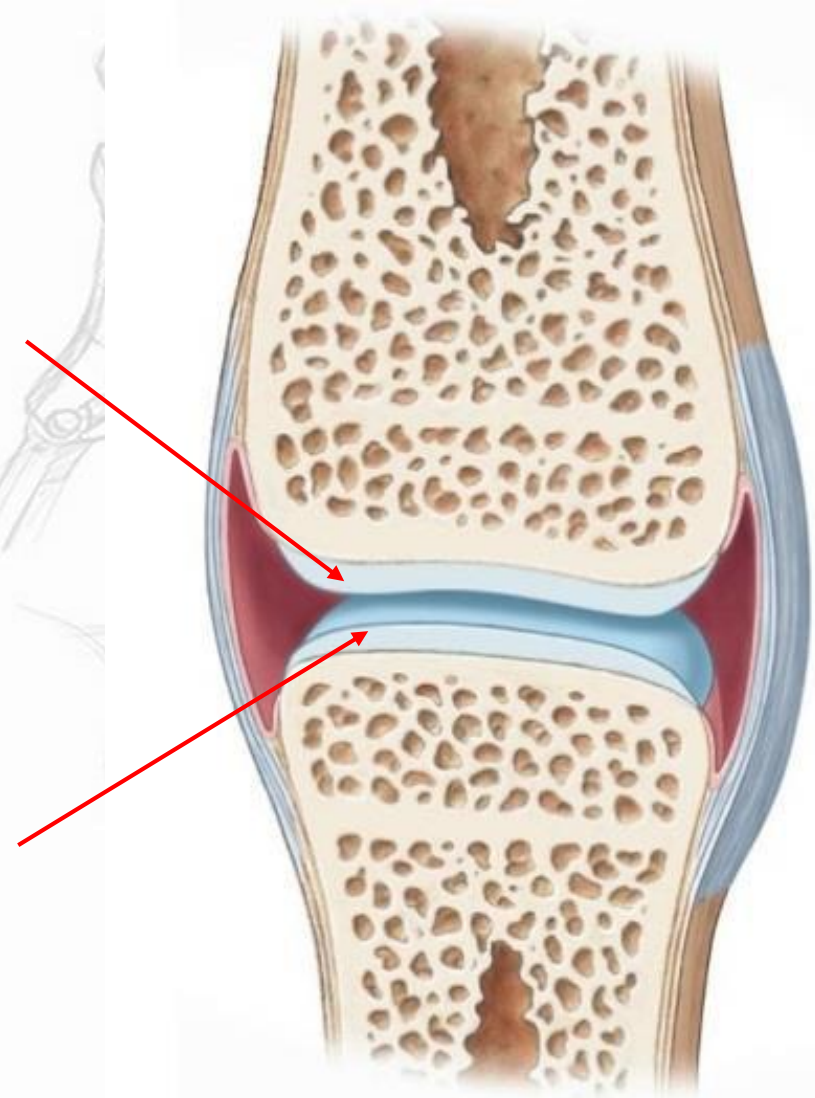
- Components of synovial joints
  - Articular cartilage
  - Joint cavity and capsule
  - Synovial membrane and fluid



# Synovial joints -Components of synovial joints

## Articular cartilage

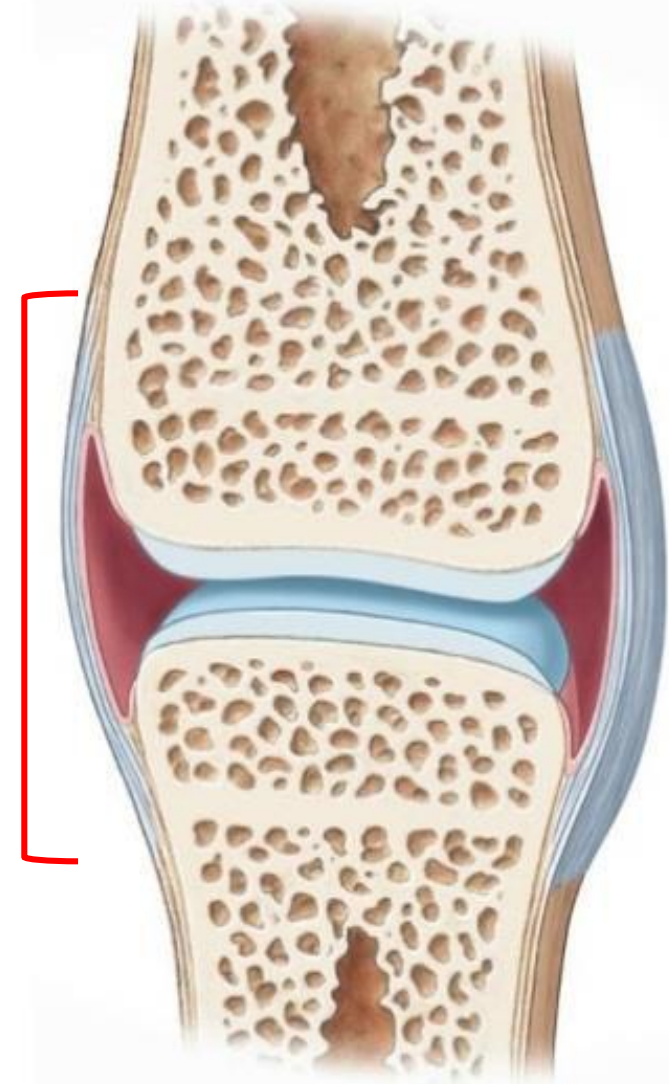
- Resemble hyaline cartilage
  - Matrix contains more water comparatively
- Has no perichondrium
- Slick and smooth, so reduce friction
- Separated by thin film of synovial fluid



# Synovial joints -Components of synovial joints

## Joint capsule

- Dense and fibrous
- May be reinforced with accessory structures (tendons and ligaments)
- Continuous with periosteum of each bone

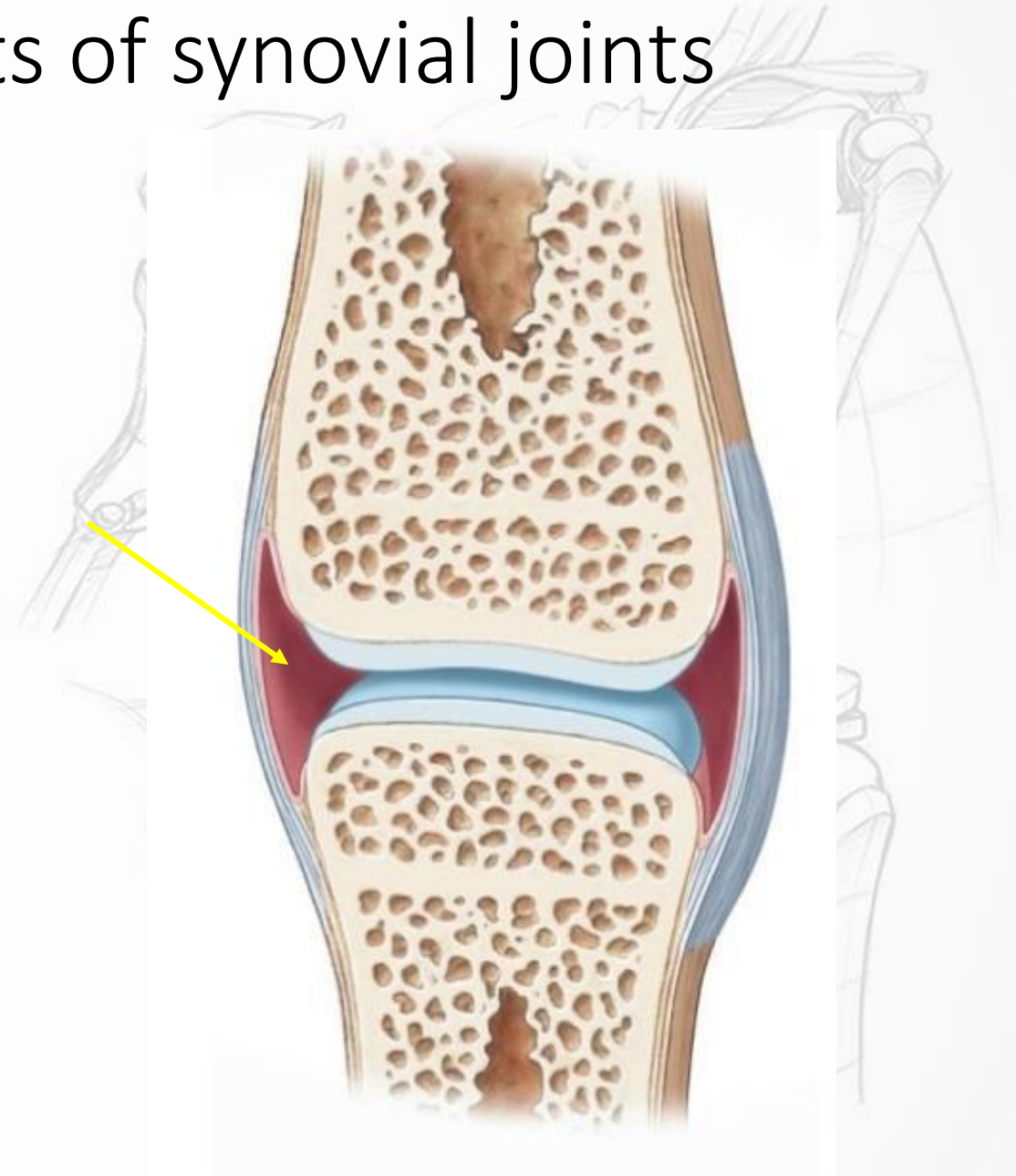




# Synovial joints -Components of synovial joints

## **Synovial fluid**

- Similar in texture to egg whites
- Produced at the synovial membrane
- Circulates from areolar tissue to joint cavity
- Percolates through articular cartilages
- Total quantity is less than 3 ml



# Functions of synovial fluid



## –Lubrication

- With articular cartilage compression, synovial fluid is squeezed out and reduces friction between moving surfaces

## –Synovial fluid distribution

- Provide nutrients and oxygen, as well as waste disposal for the chondrocytes of articular cartilages
- Compression and reexpansion of articular cartilages pump synovial fluid in and out of cartilage matrix

## –Synovial fluid absorption

- Distributes compression forces across articular surfaces and outward to joint capsule



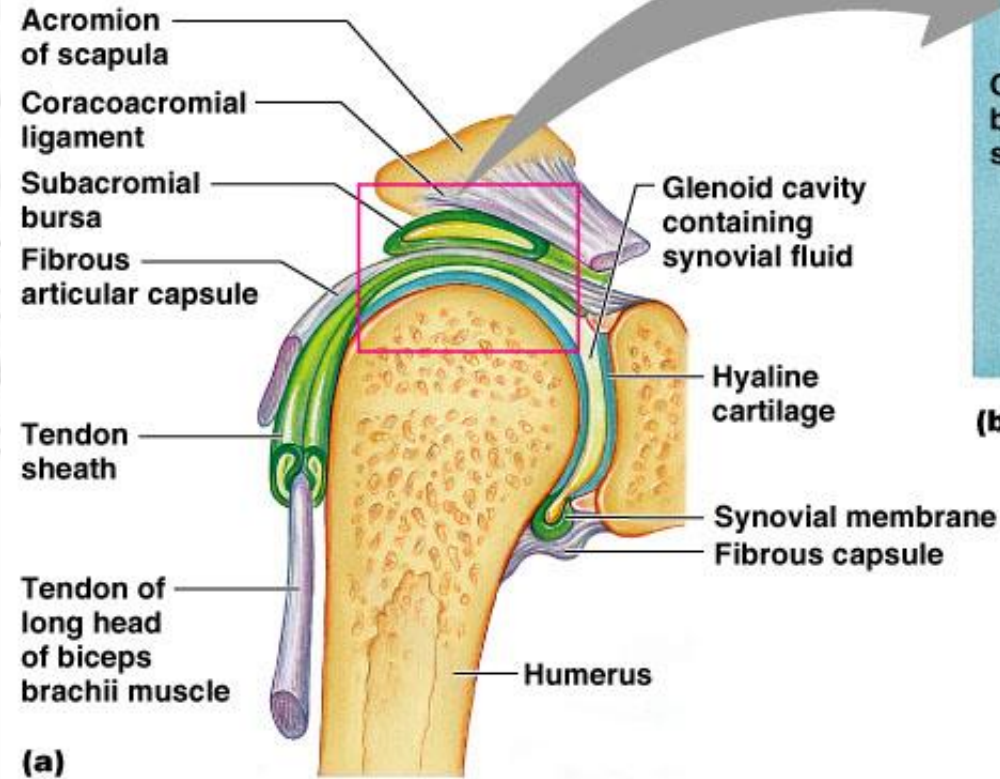
Joint Accessory - Friction  
Reducing Structures:  
Bursae and Tendon Sheaths

- **Bursa** (a pouch)

- Small pocket filled with synovial fluid
- Often form in areas where tendon or ligament rubs against other tissues
- Reduce friction and act as shock absorbers

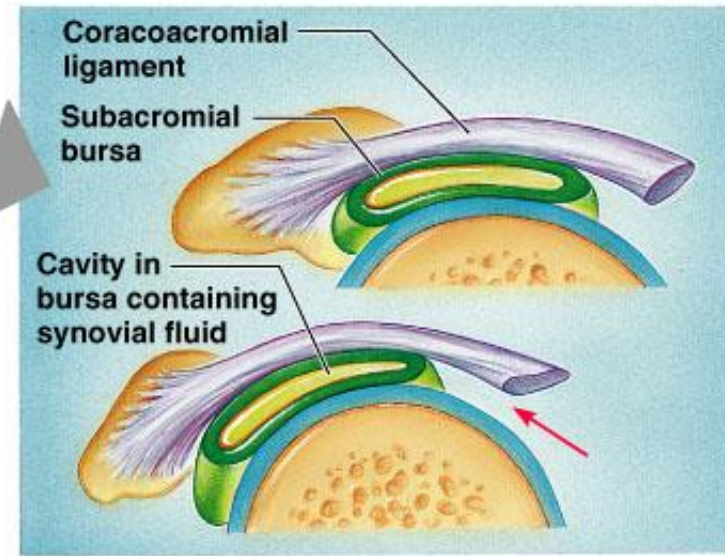
- **Tendon sheath**

- a layer of synovial membrane around a **tendon**.
- It permits the **tendon** to stretch and not adhere to the surrounding fascia.
- It has two layers: synovial **sheath**. fibrous **tendon sheath**.



(a)

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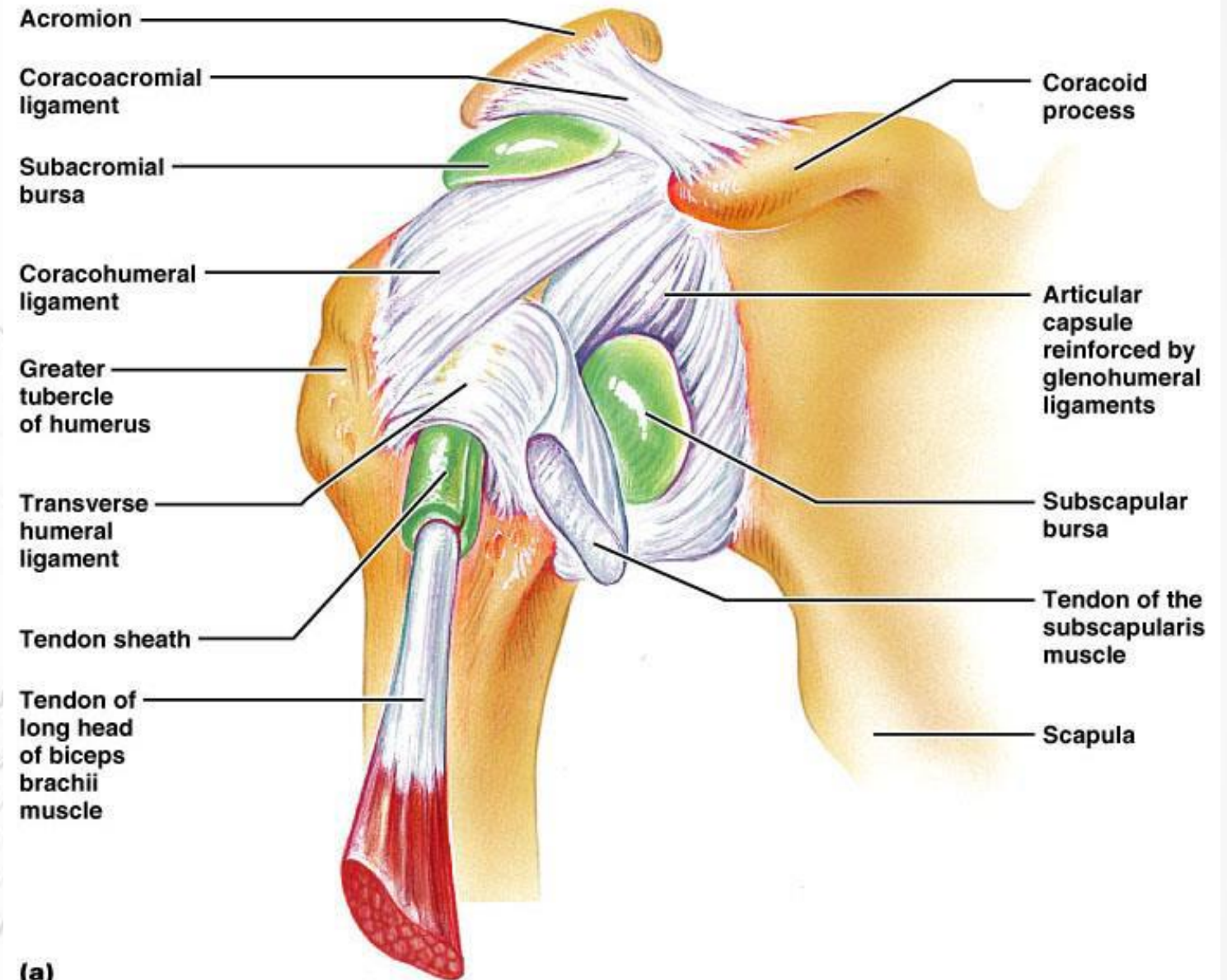


(b)

## Joint Accessory - Friction Reducing Structures: Bursae and Tendon Sheaths

Bursae and tendon sheaths are synovial sacks located *outside* the joint.

They lubricate the movement of ligaments and tendons allowing them to slide against other structures without tearing.





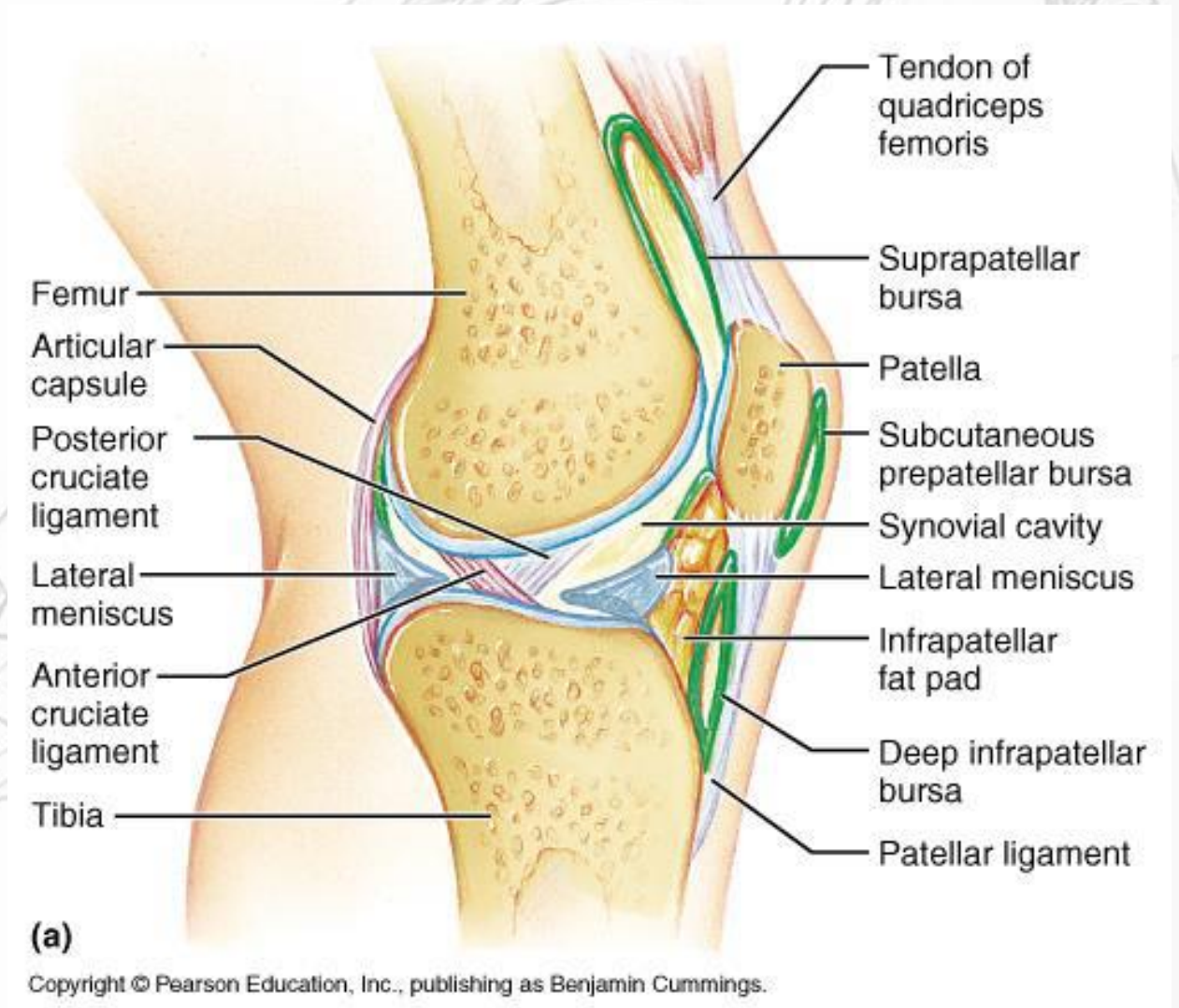
# Accessory structures in knee

## –Fat pads

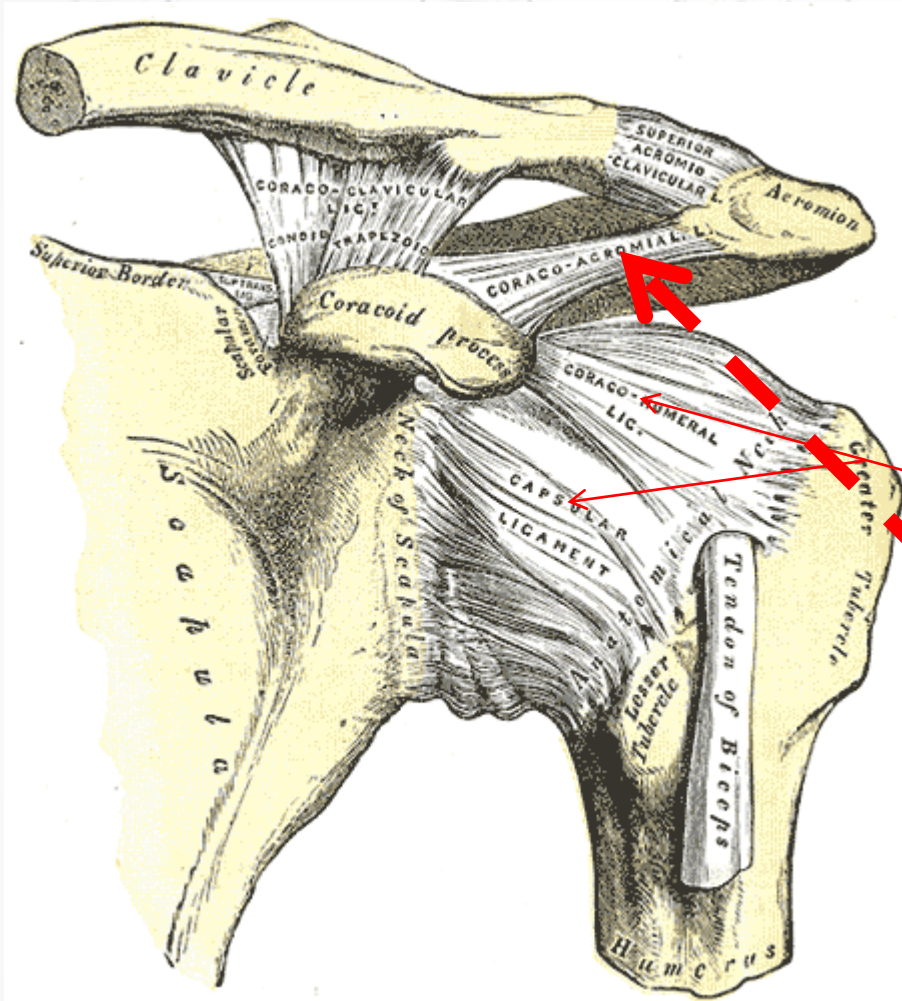
- Adipose tissue covered by synovial membrane
- Protect articular cartilages
- Act as packing material for joint

## –Meniscus (a crescent)

- Pad of fibrous cartilage between bones of synovial joint
- May subdivide joint cavity and affect fluid flow or allow variations in shapes of articular surfaces



# Accessory structures of joints



– Tendons of quadriceps

- Pass across joint

1. Limit movement

2. Provide mechanical support

– Accessory ligaments

Strengthen, and reinforce joint

- Capsular ligaments

– Localized thickening of joint capsule

– Example: glenohumeral ligaments of shoulder

- Intracapsular ligaments

– Inside the joint capsules. Reinforce the connections of the articulating surfaces

– Cruciate ligaments of the knee

- Extracapsular ligaments

– Separate from joint capsule

– Example: coracoacromial ligament



# Accessory structures in knee

– Tendons of quadriceps

• Pass across joint

1. Limit movement

2. Provide mechanical support

– Accessory ligaments

Strengthen, and reinforce joint

• Capsular ligaments serve to enhance the strength of the articular capsule.

• Intracapsular ligaments

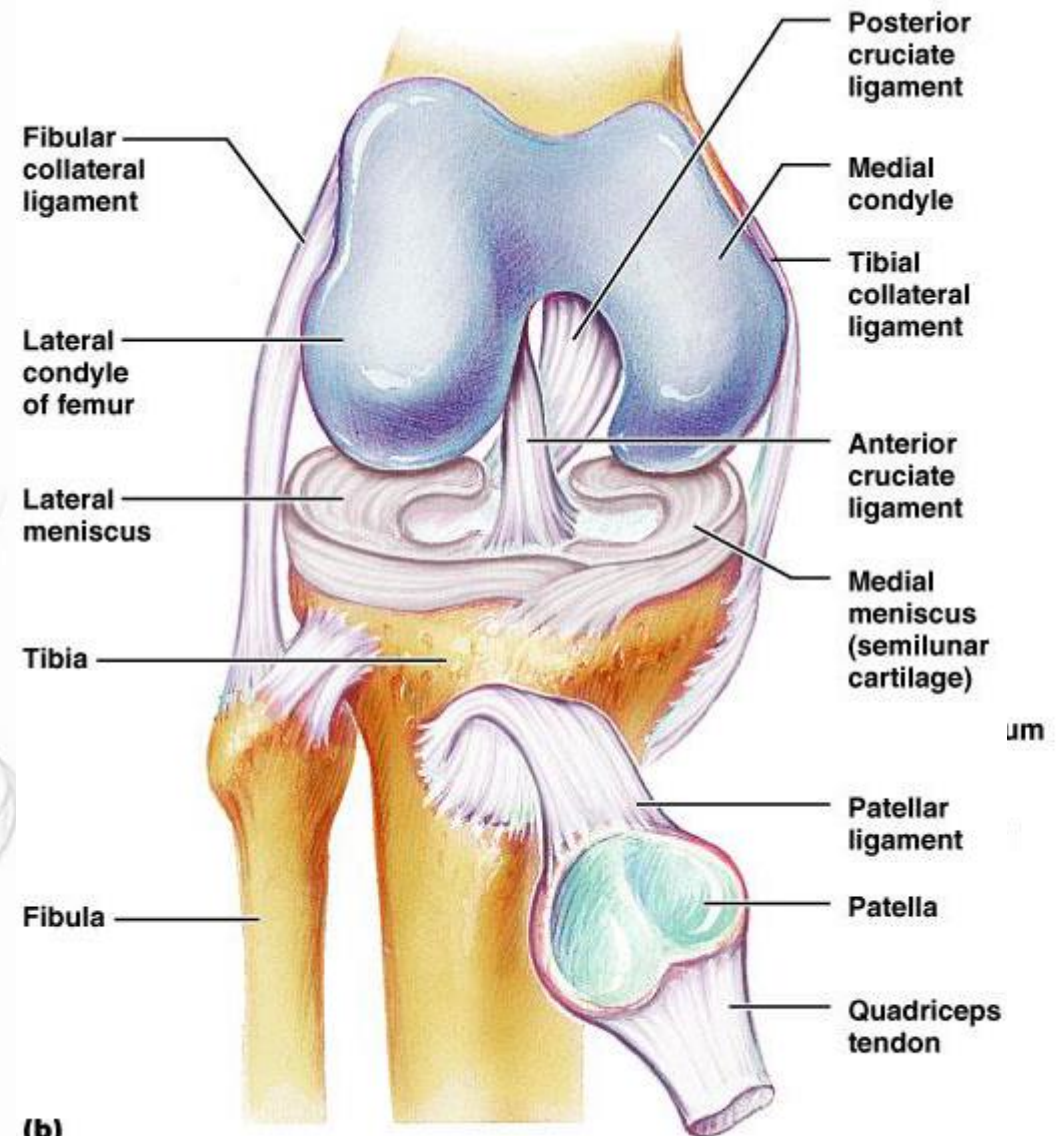
– Localized thickening of joint capsule

– Example: cruciate ligaments of knee

• Extracapsular ligaments

– Separate from joint capsule

– Extracapsular example: patellar ligament



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**Lateral**

**Hockey puck**

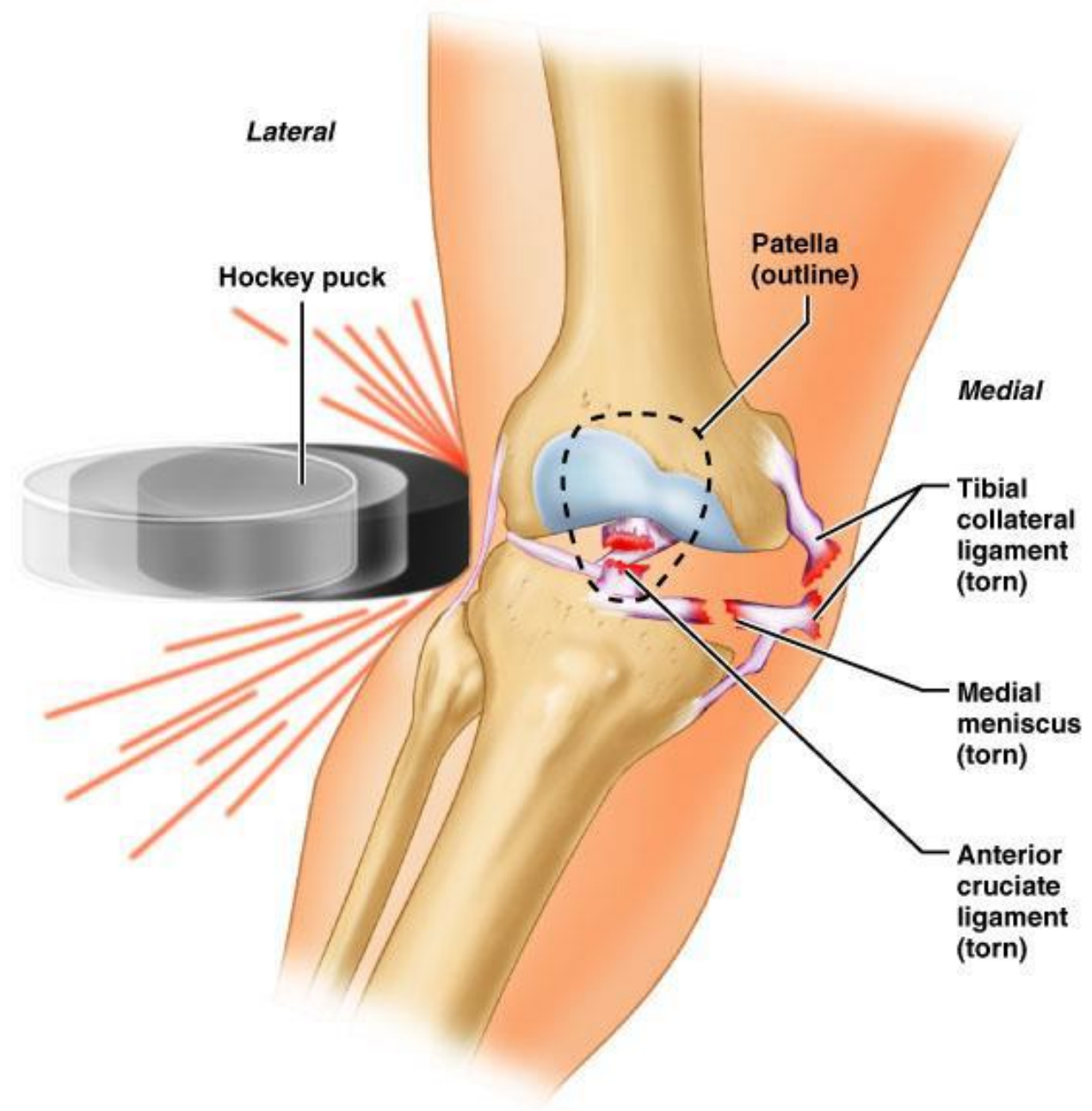
**Patella  
(outline)**

**Medial**

**Tibial  
collateral  
ligament  
(torn)**

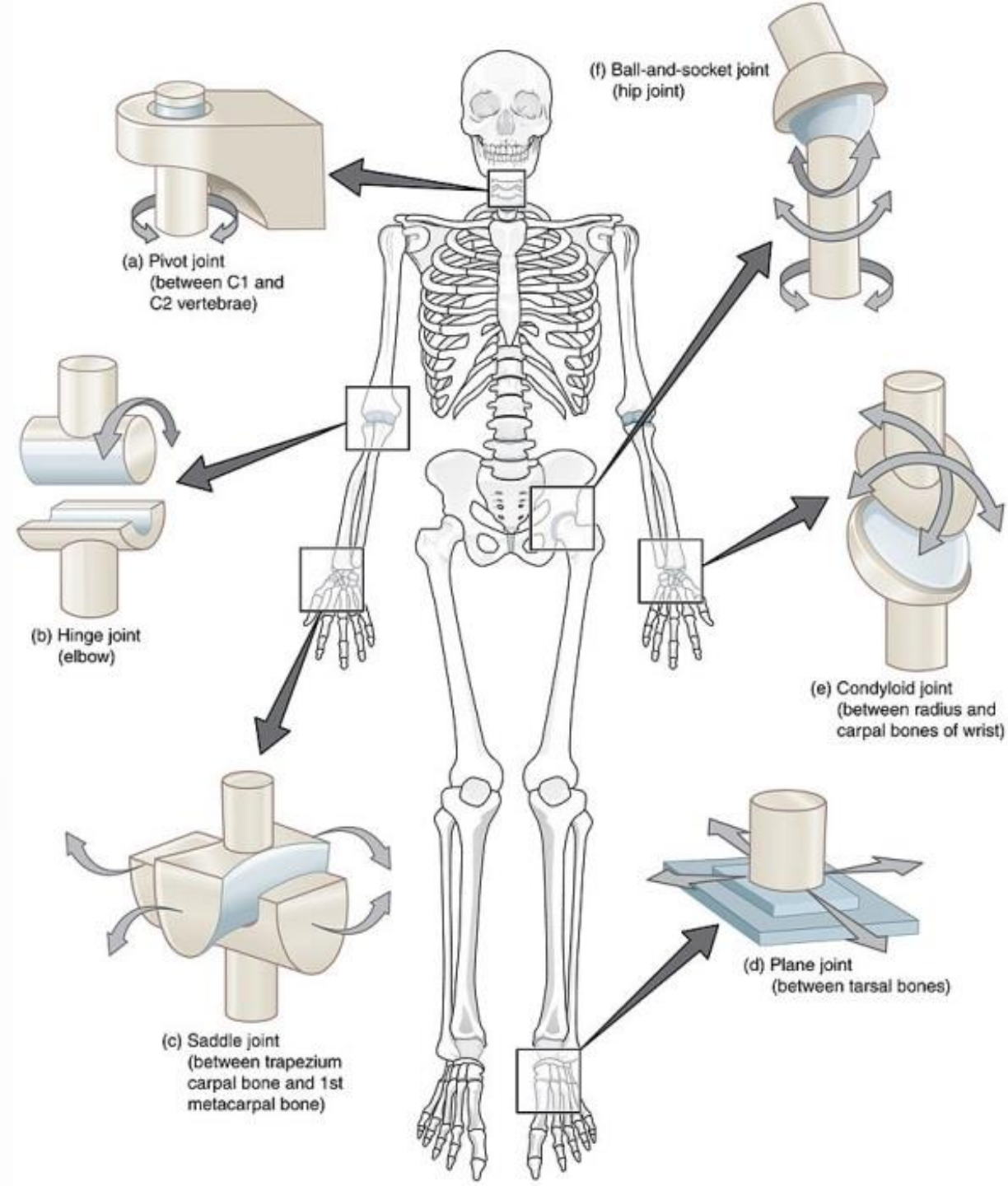
**Medial  
meniscus  
(torn)**

**Anterior  
cruciate  
ligament  
(torn)**



# Types of synovial joints

- Plane or gliding
- Saddle
- Hinge
- Pivot
- Ball-and-socket
- Ellipsoid



# Types of synovial joints

- Non axial
- Uniaxial
- Biaxial
- Multiaxial

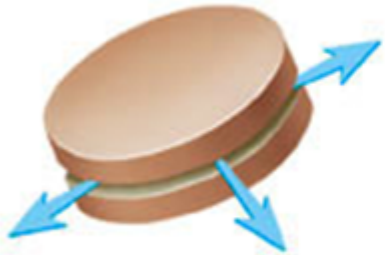


- Nonaxial
- Uniaxial
- Biaxial
- Multiaxial



# Plane and Pivot Joints

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**Plane Joint**



**Pivot Joint**



**Hinge Joint**



- Plane or Gliding joints
  - Non axial
  - Example : Articular processes between vertebrae
- Pivot joints
  - Monoaxial
  - Example: Articulation between dens of axis and atlas
- Hinge Joints
  - Monoaxial
  - Example: elbow, knee

# Saddle and Ellipsoid Joints

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**Saddle Joint**

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**Ellipsoid Joint**

- **Saddle Joints**

- Biaxial
- Example: Thumb

- **Ellipsoid**

- Biaxial
- Modified ball-and-socket
- Example: Atlantooccipital joint

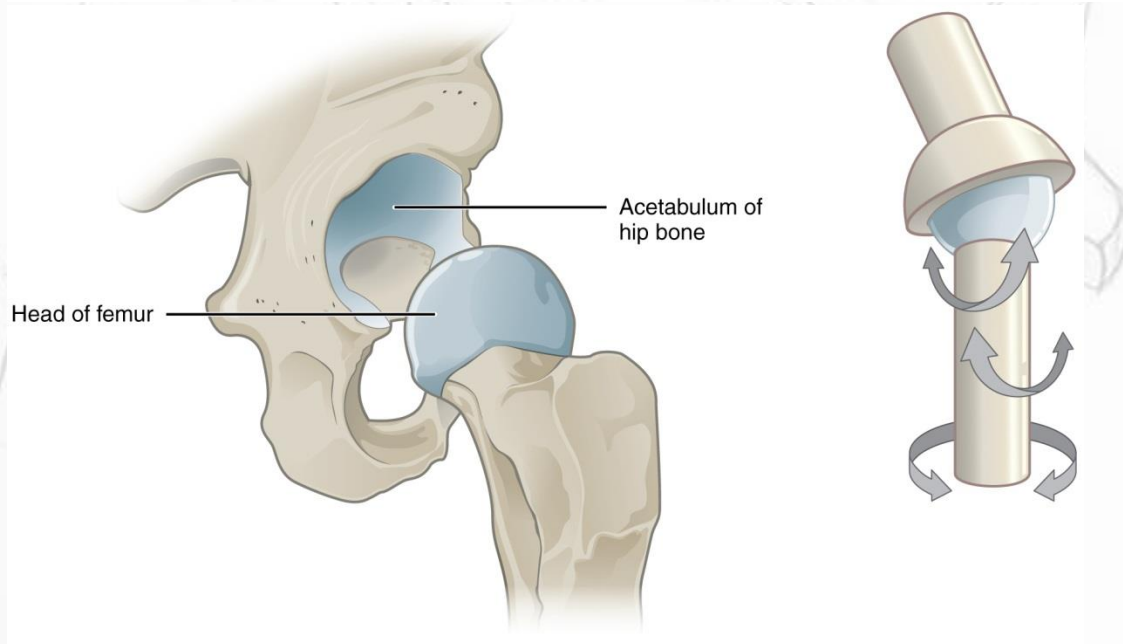


# Ball-and-Socket Joints

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## Ball-and-Socket Joint

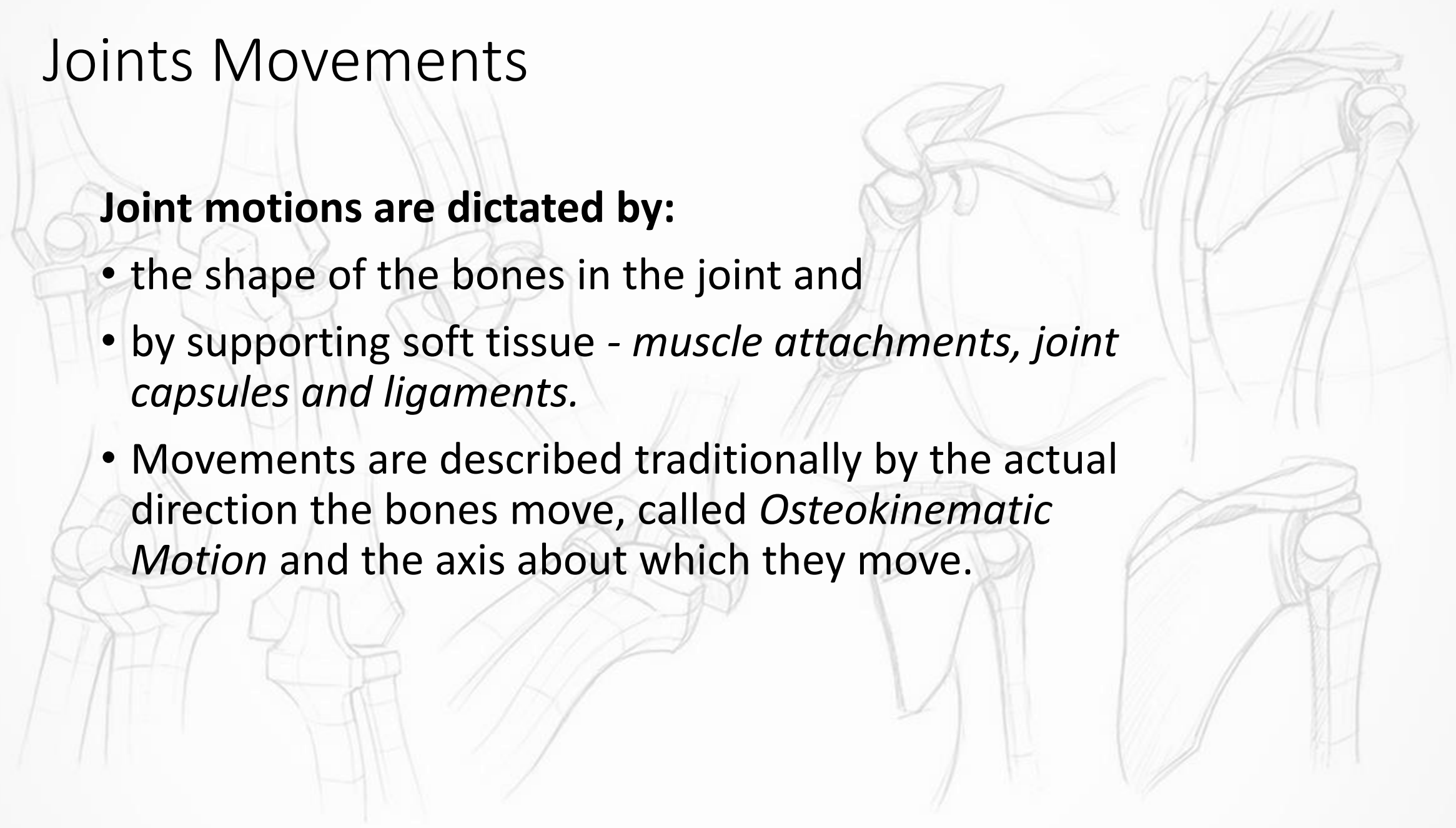


- Ball-and-socket
  - Multiaxial
  - Examples: shoulder and hip joints

# Joints Movements

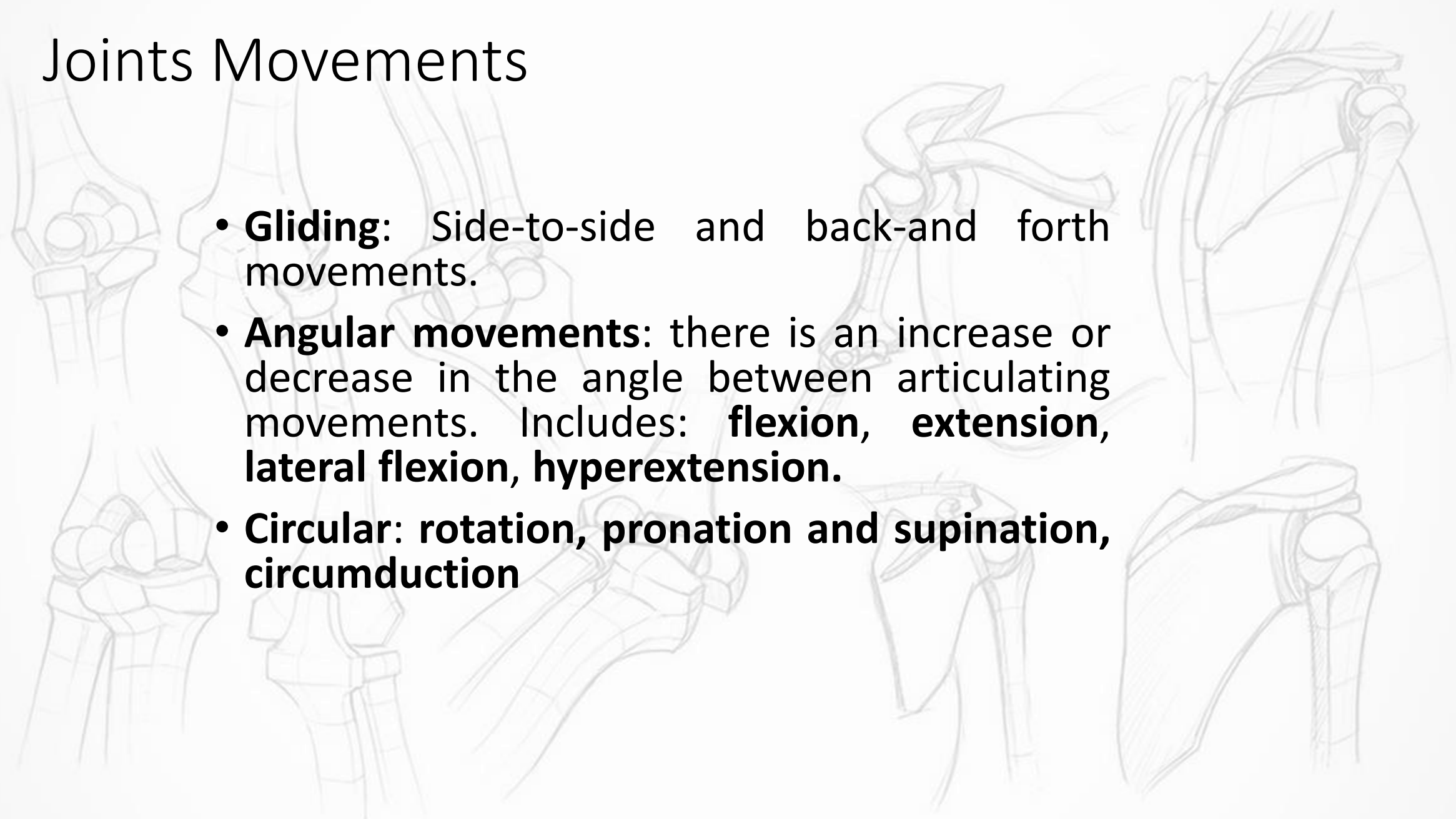
## **Joint motions are dictated by:**

- the shape of the bones in the joint and
- by supporting soft tissue - *muscle attachments, joint capsules and ligaments.*
- Movements are described traditionally by the actual direction the bones move, called *Osteokinematic Motion* and the axis about which they move.



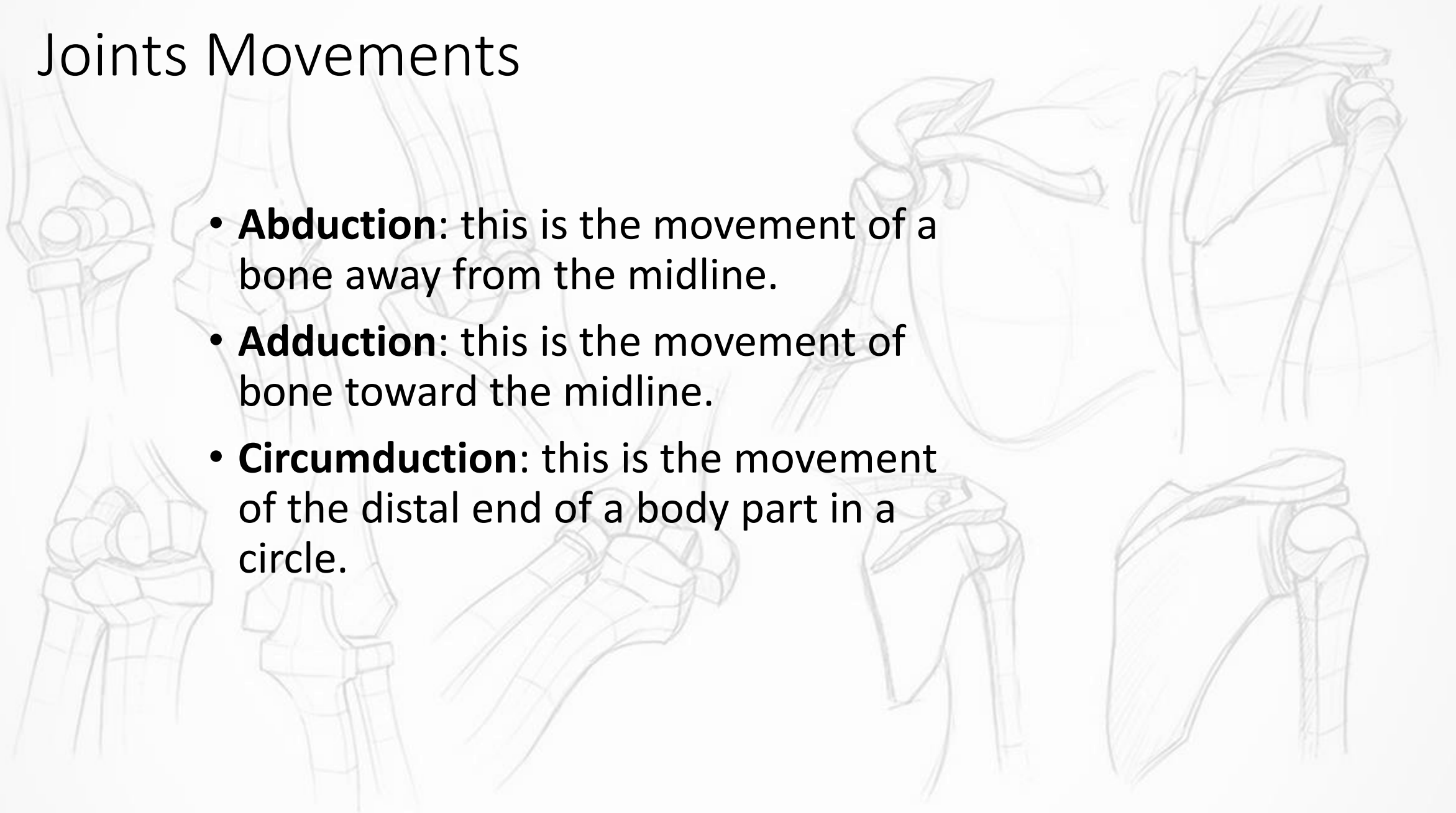
# Joints Movements

- **Gliding:** Side-to-side and back-and forth movements.
- **Angular movements:** there is an increase or decrease in the angle between articulating movements. Includes: **flexion, extension, lateral flexion, hyperextension.**
- **Circular: rotation, pronation and supination, circumduction**



# Joints Movements

- **Abduction:** this is the movement of a bone away from the midline.
- **Adduction:** this is the movement of bone toward the midline.
- **Circumduction:** this is the movement of the distal end of a body part in a circle.





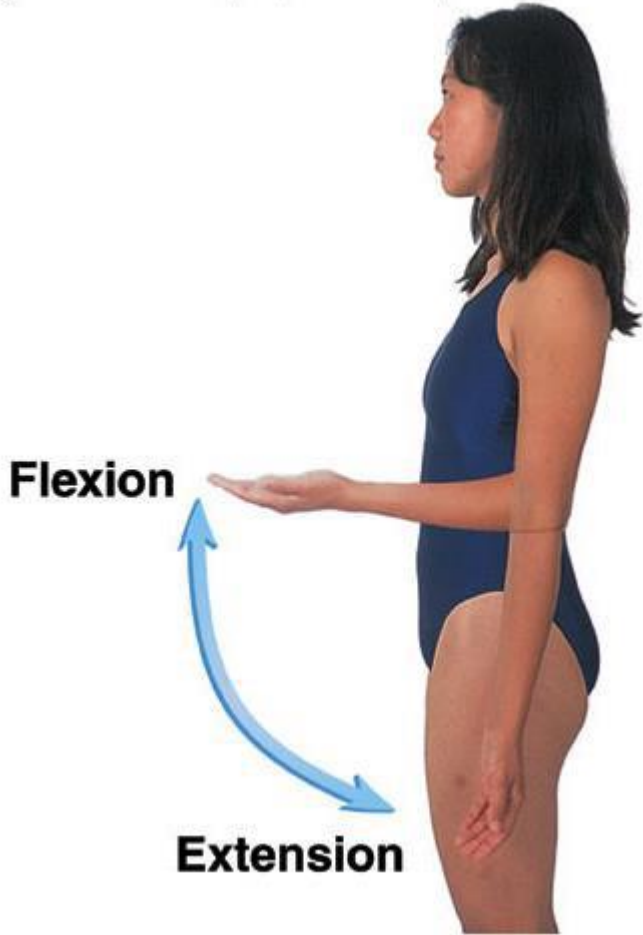
# Joints Movements



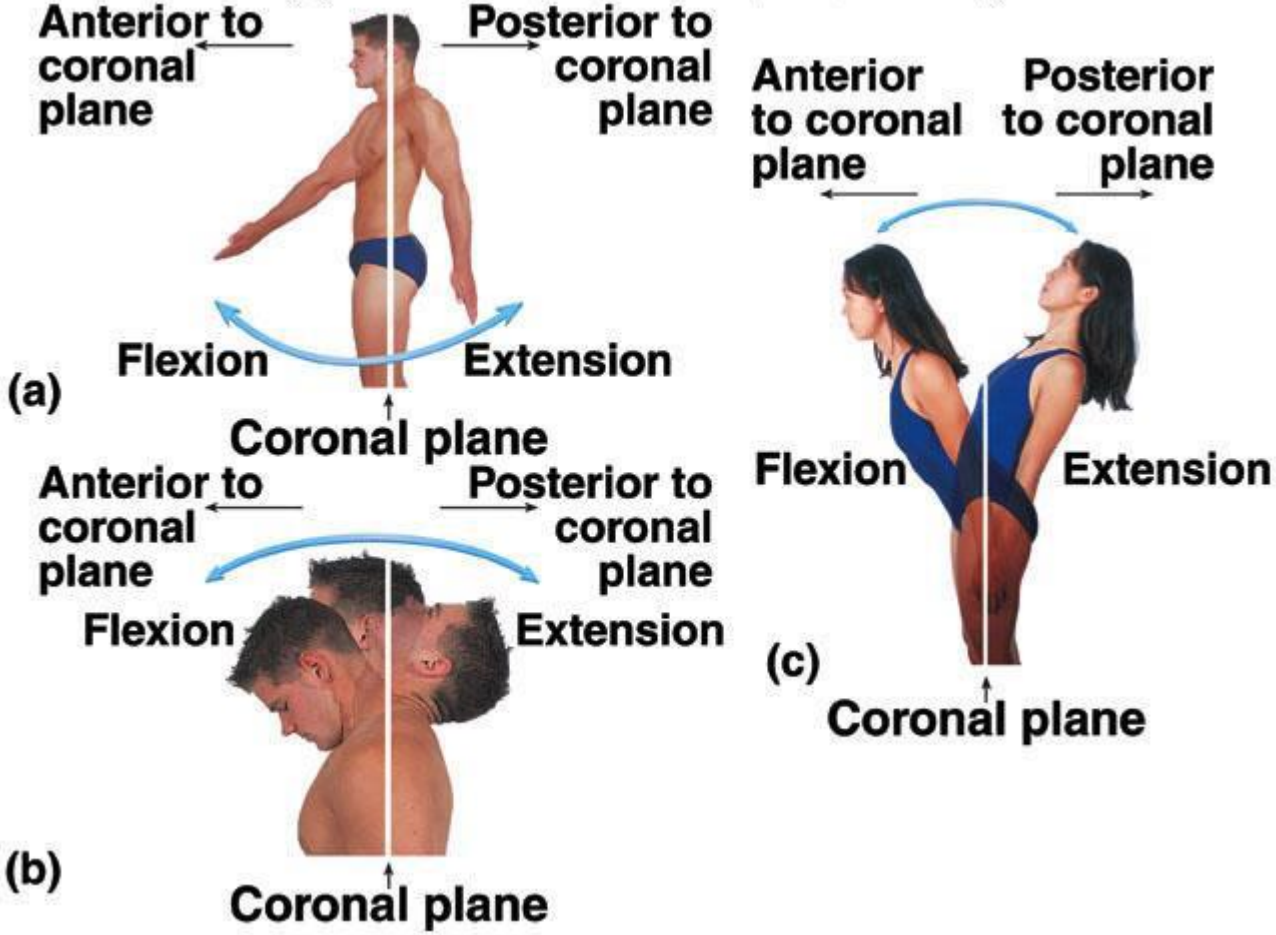
- **Rotation:** a bone revolves around its own longitudinal axis. Pivot and ball-and-socket joints permit rotation. *Medial (internal) rotation and lateral (external) rotation.*
- **Special movements** - Unique to only one or two joints: *elevation - depression; protraction - retraction; inversion - eversion; dorsiflexion - plantar flexion; supination - pronation; opposition - reposition.*

# Flexion and Extension

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# Dorsiflexion and Plantar Flexion

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# Abduction and Adduction

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**Abduction**

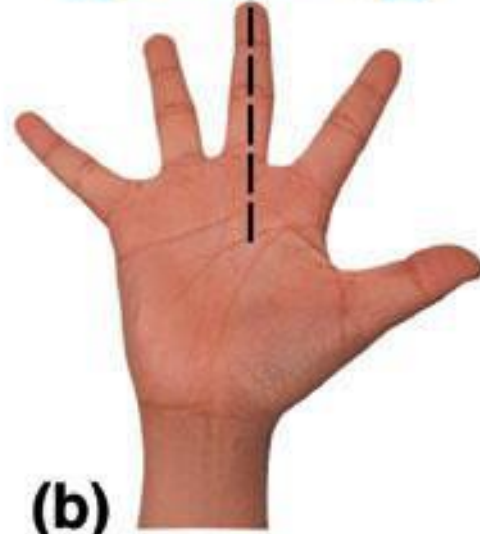


**Adduction**



**(a)**

**Abduction**



**(b)**

**Adduction**





# Rotation and Pronation and Supination

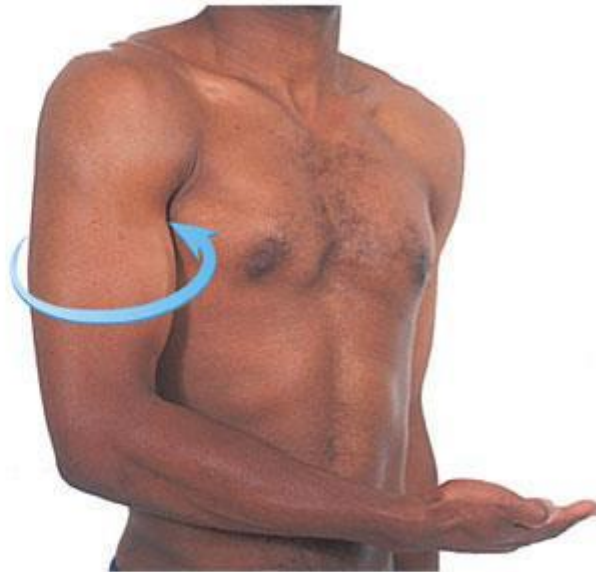
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**Lateral rotation**



**Medial rotation**



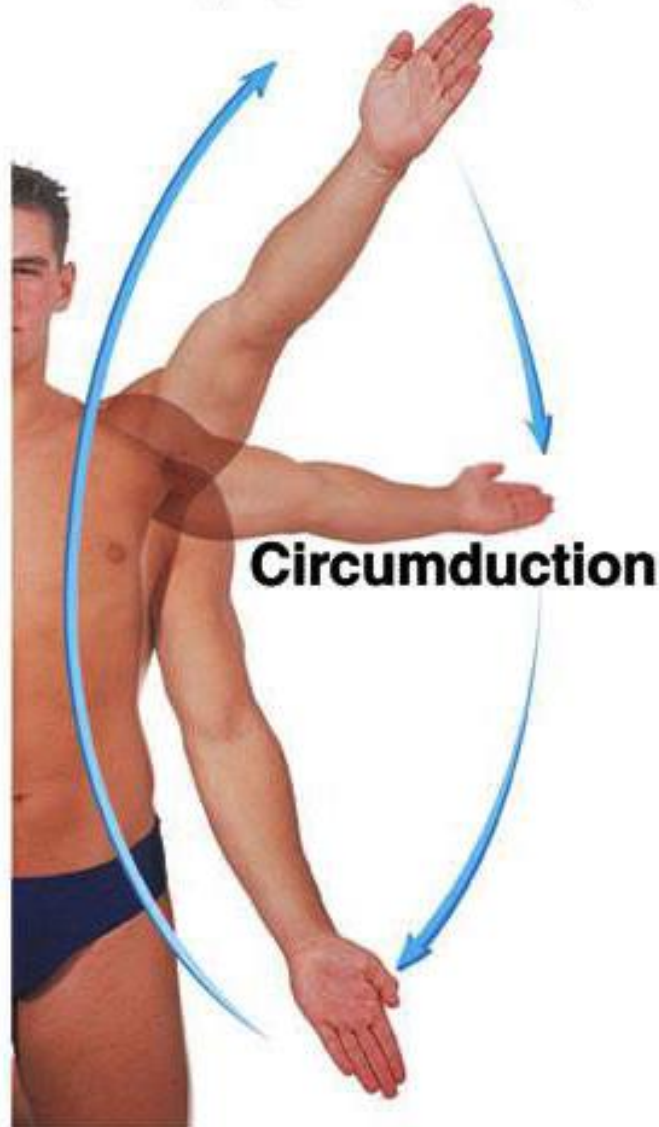
**Pronation**



**Supination**

# Circumduction

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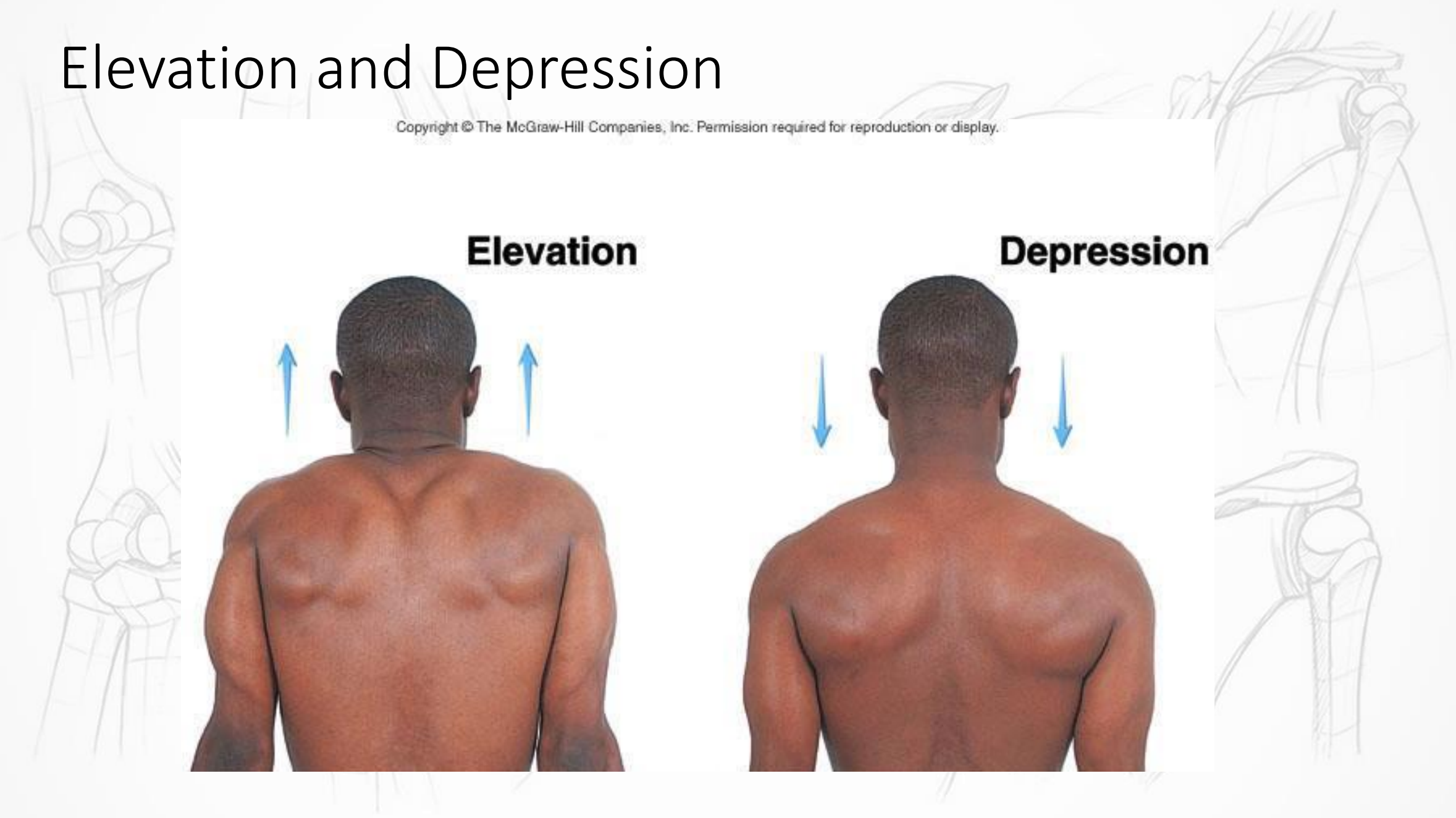
# Elevation and Depression

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**Elevation**



**Depression**



# Protraction and Retraction

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**Protraction**



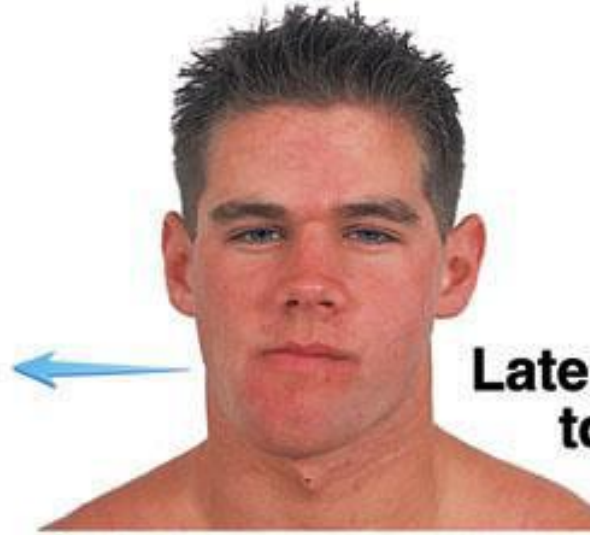
**Retraction**



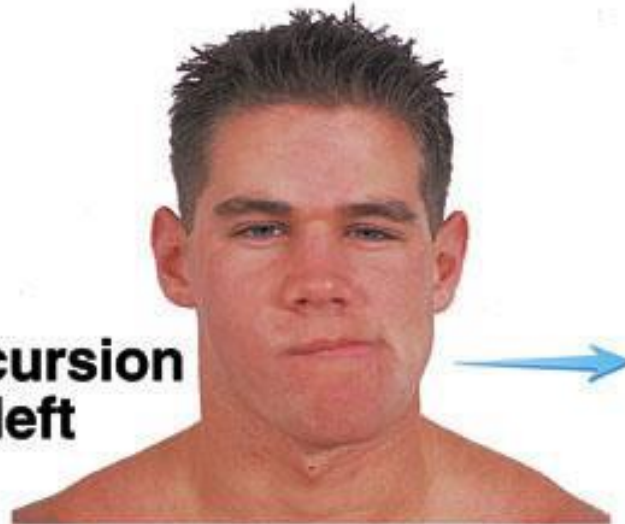


# Excursion

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**Lateral excursion  
to the right**



**Lateral excursion  
to the left**



# Opposition and Reposition

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**Opposition**



**Reposition**



# Inversion and Eversion

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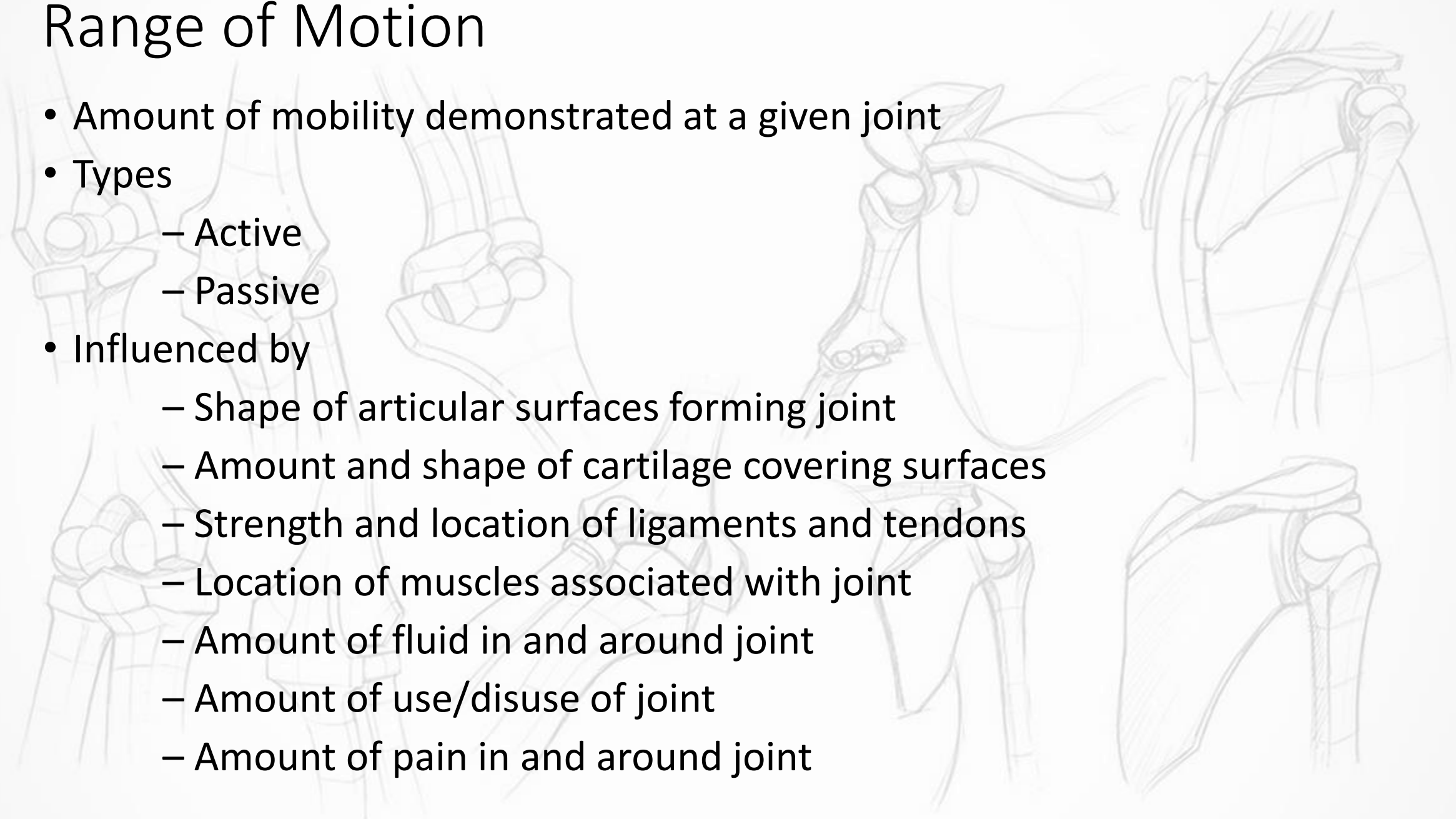
**Eversion**

**Inversion**



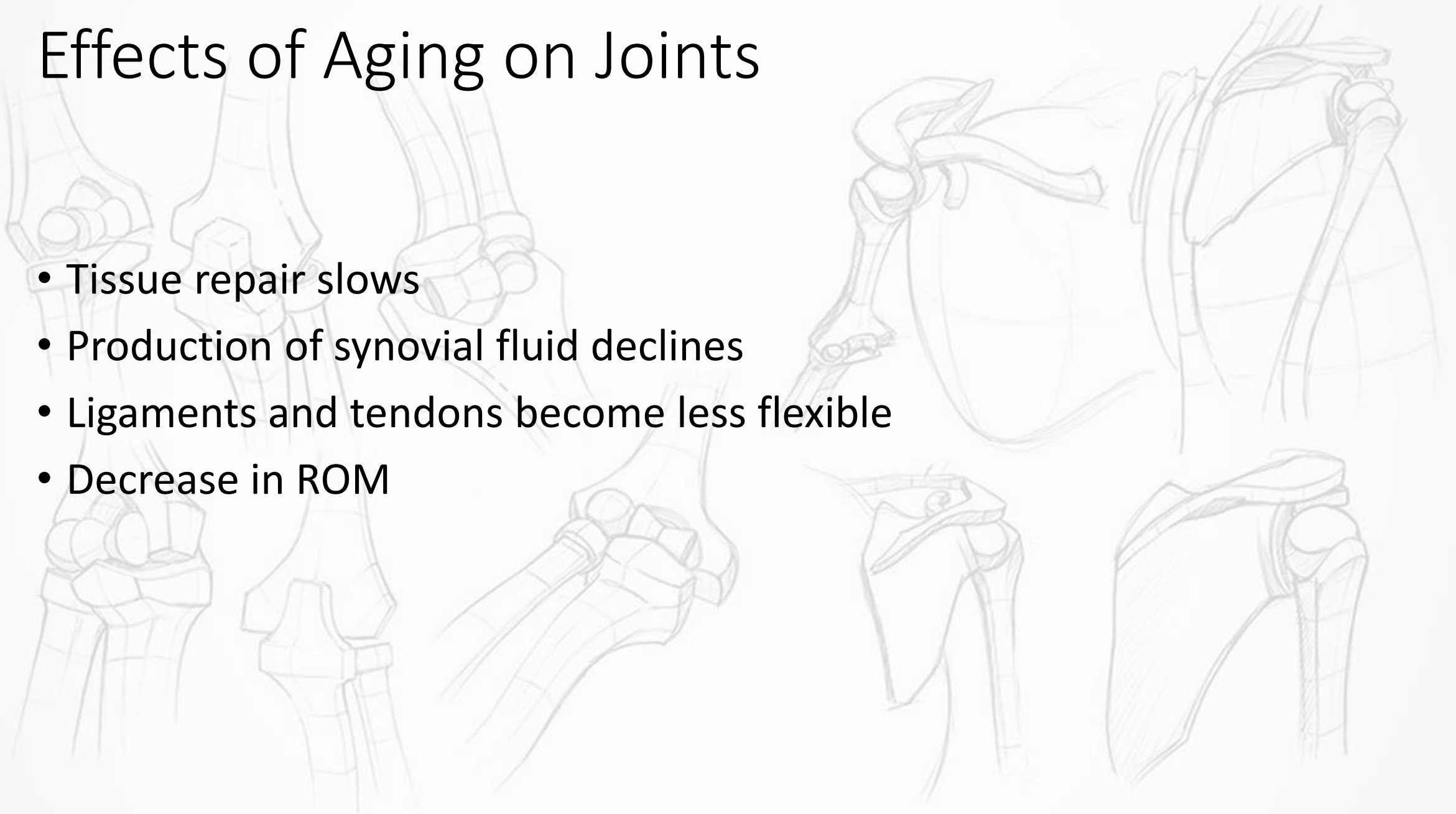
# Range of Motion

- Amount of mobility demonstrated at a given joint
- Types
  - Active
  - Passive
- Influenced by
  - Shape of articular surfaces forming joint
  - Amount and shape of cartilage covering surfaces
  - Strength and location of ligaments and tendons
  - Location of muscles associated with joint
  - Amount of fluid in and around joint
  - Amount of use/disuse of joint
  - Amount of pain in and around joint



# Effects of Aging on Joints

- Tissue repair slows
- Production of synovial fluid declines
- Ligaments and tendons become less flexible
- Decrease in ROM

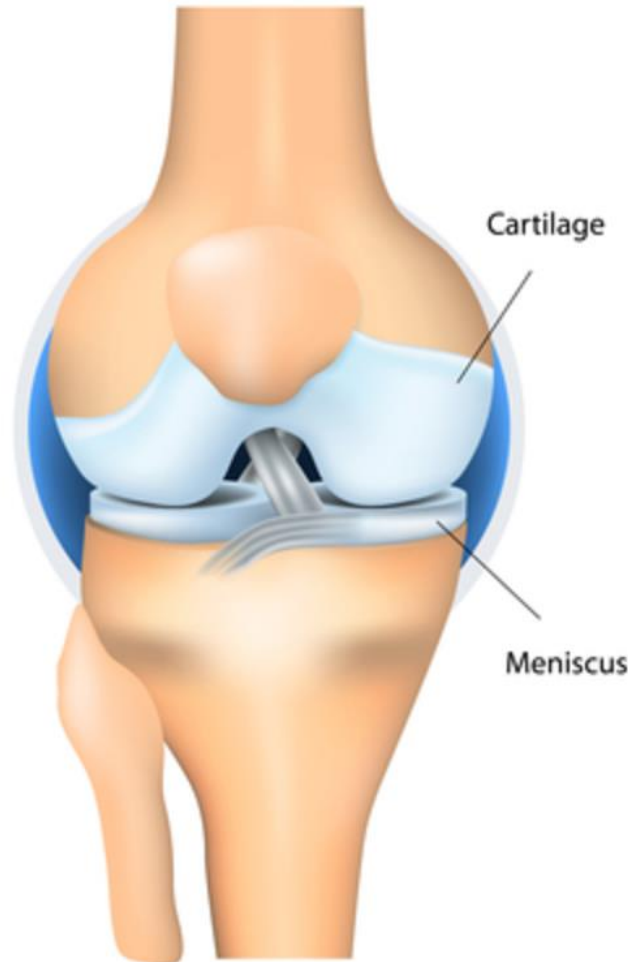
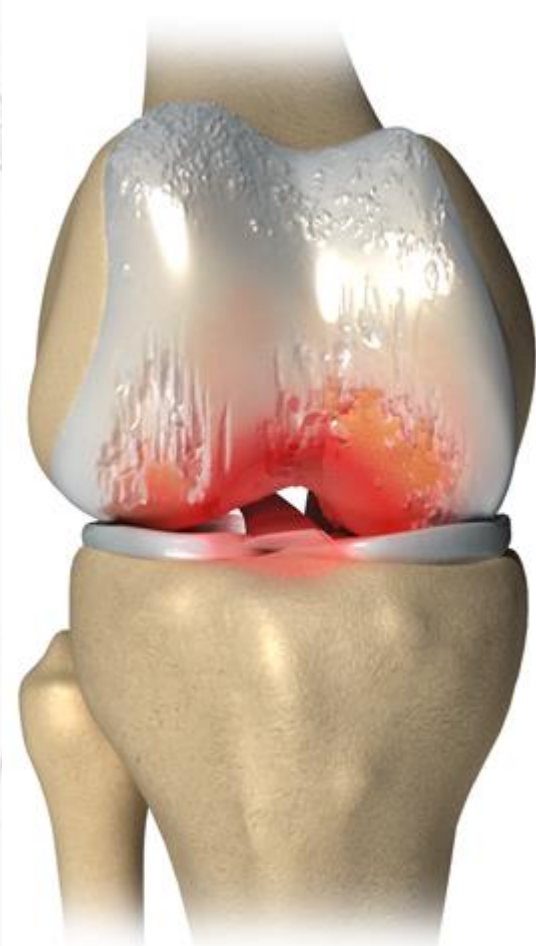


# Joint Disorders

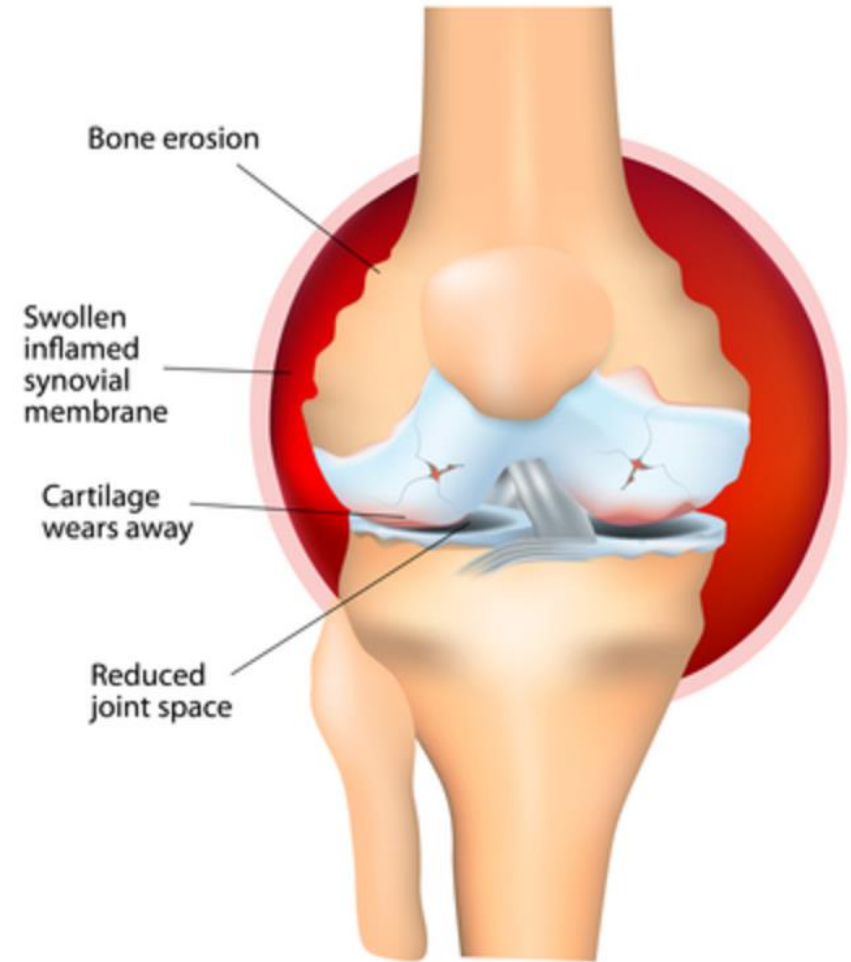


- Arthritis
  - Osteoarthritis: Wear and tear
  - Rheumatoid: Caused by transient infection or autoimmune disease
- Joint infections
  - Lyme disease: Tick vector
- Gout
  - Metabolic disorders of unknown cause (idiopathic)

# Osteoarthritis vs Rheumatoid arthritis



**Healthy joint**



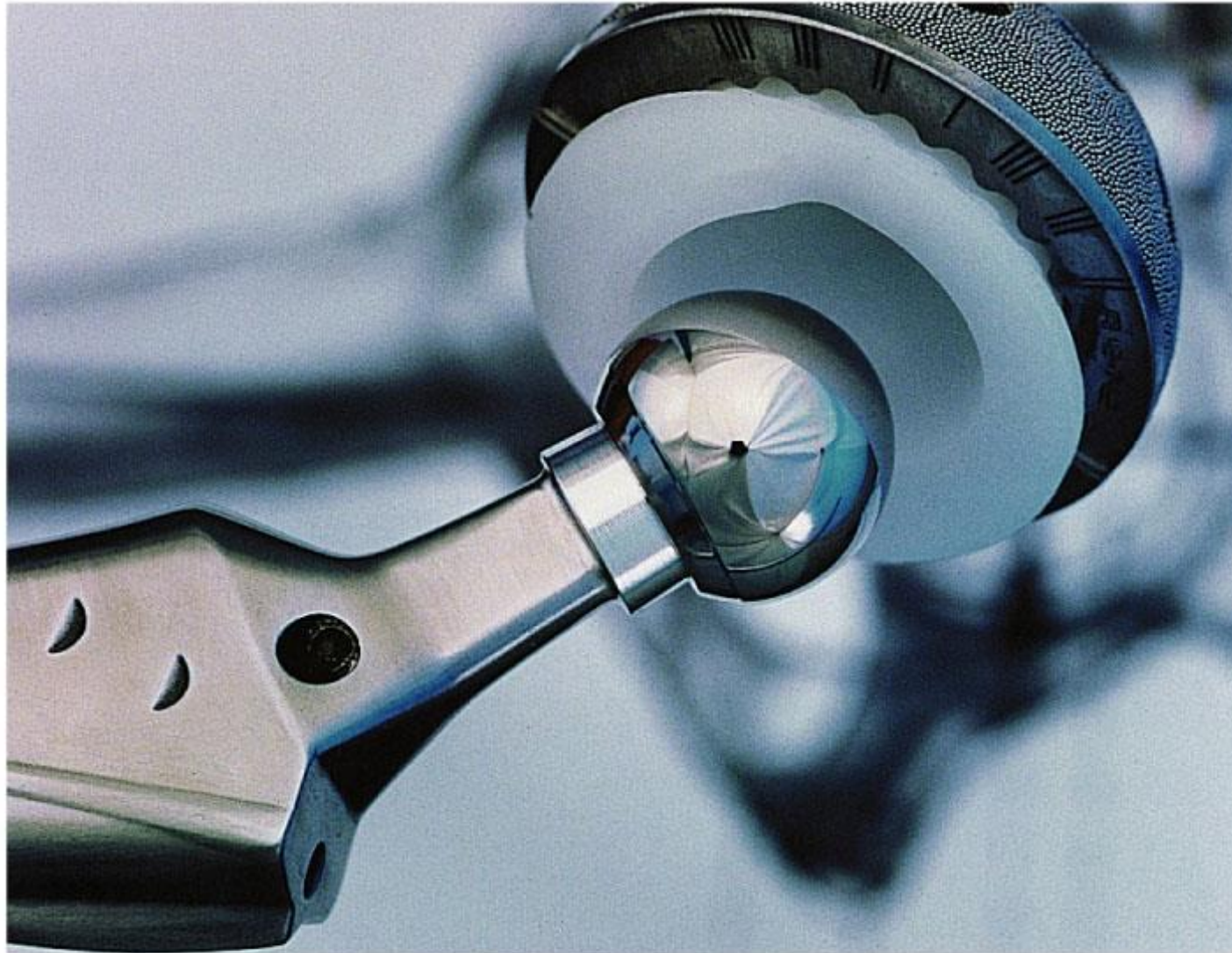
**Rheumatoid arthritis**



# Gout

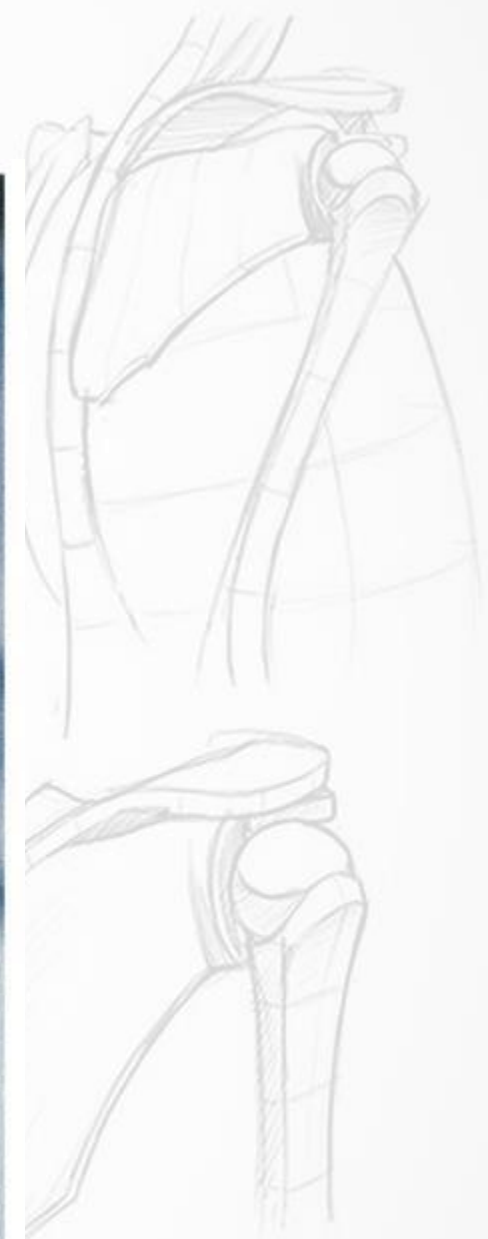


# Artificial Hip Joint

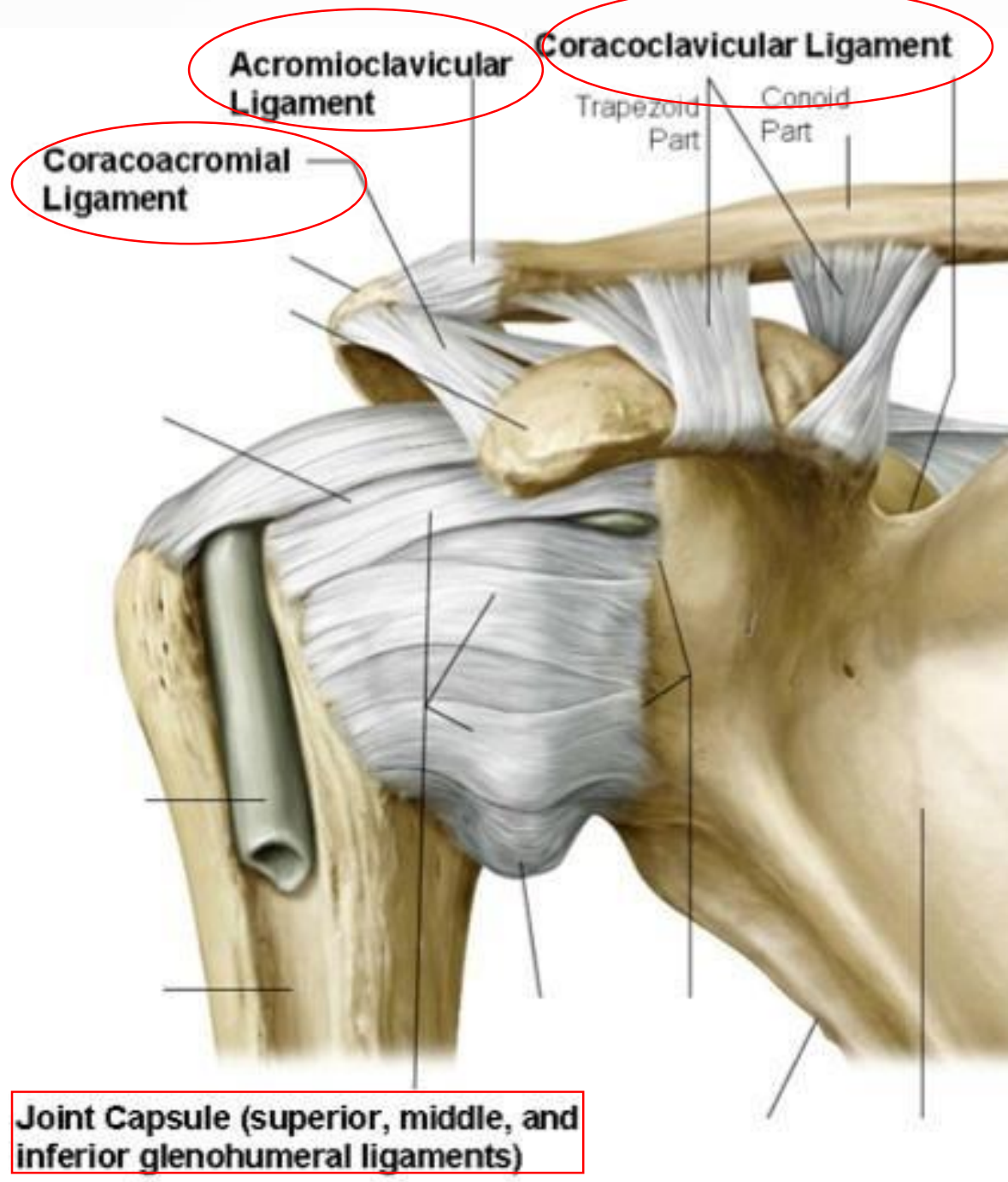


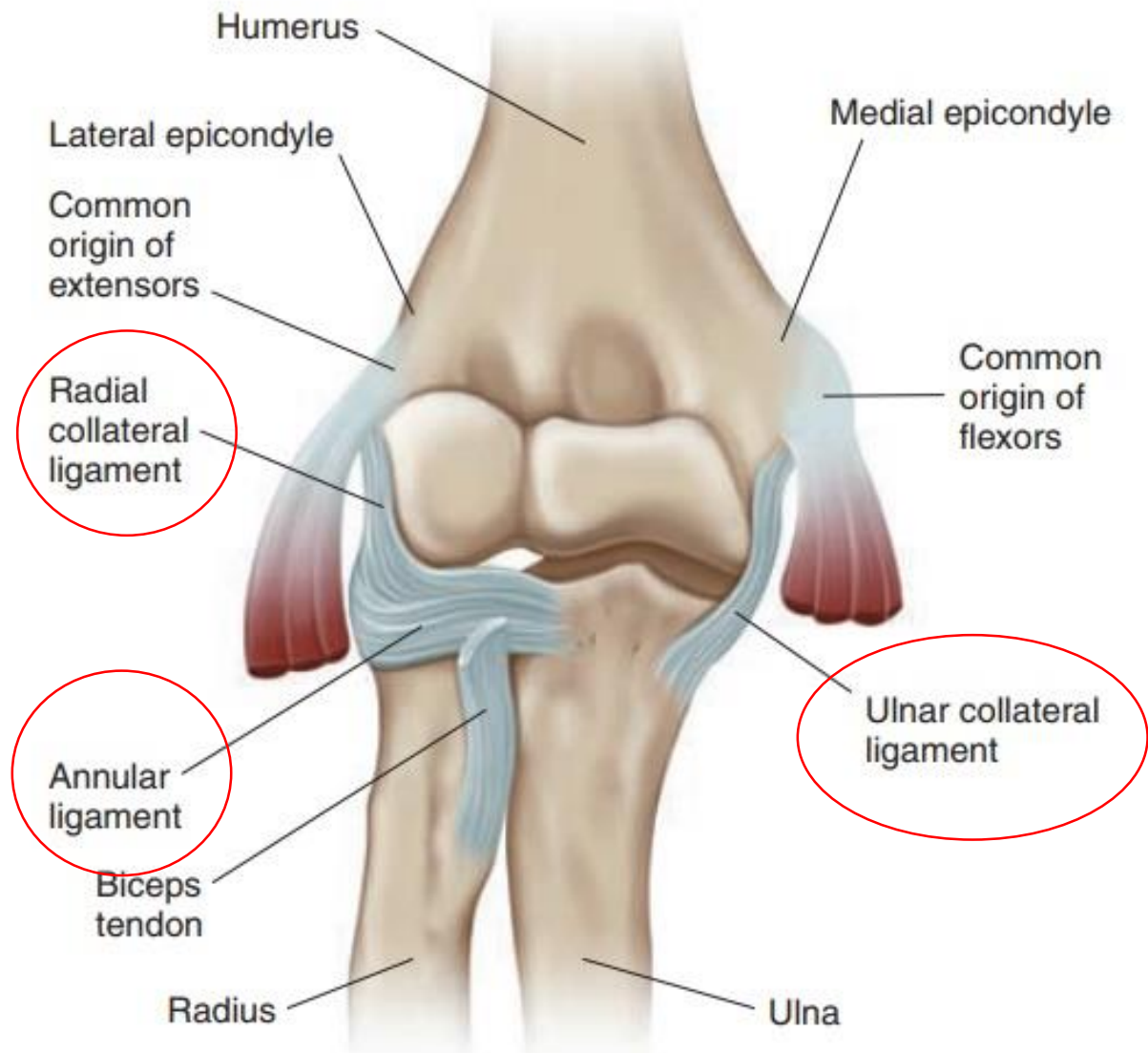
**Photograph of a hip prosthesis.**

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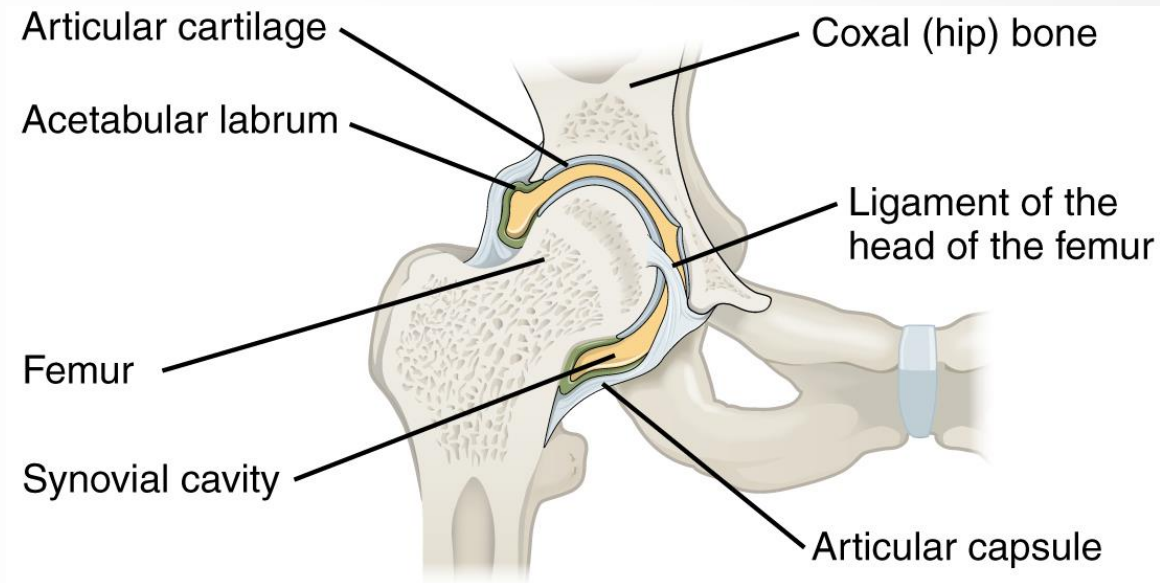




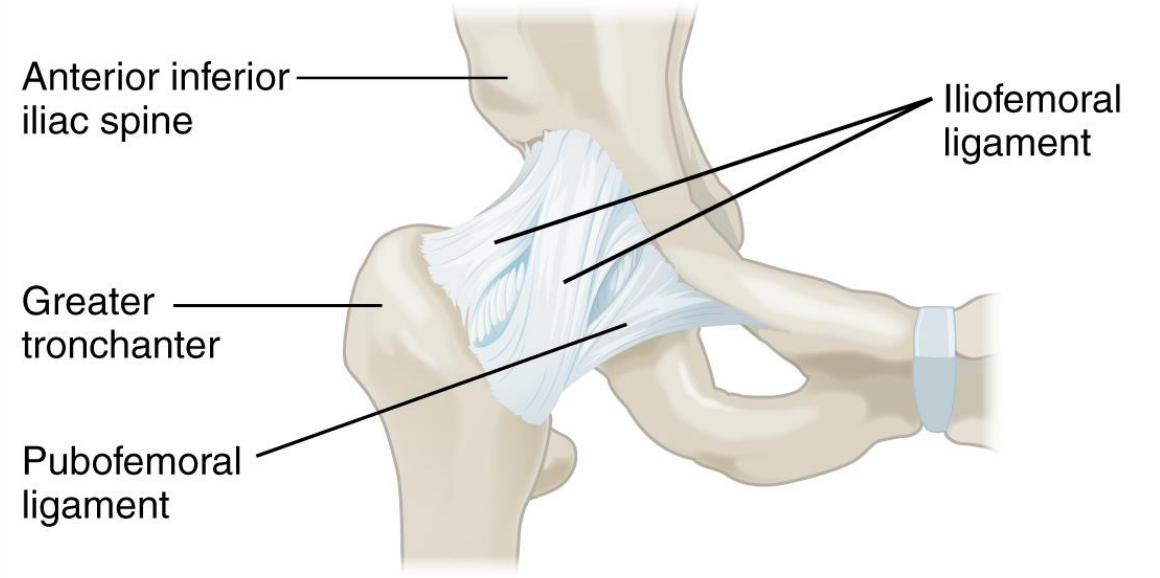


**FIGURE 3.41.** Right Elbow Joint, Radius, and Ulna—Anterior View, Showing the Ligaments

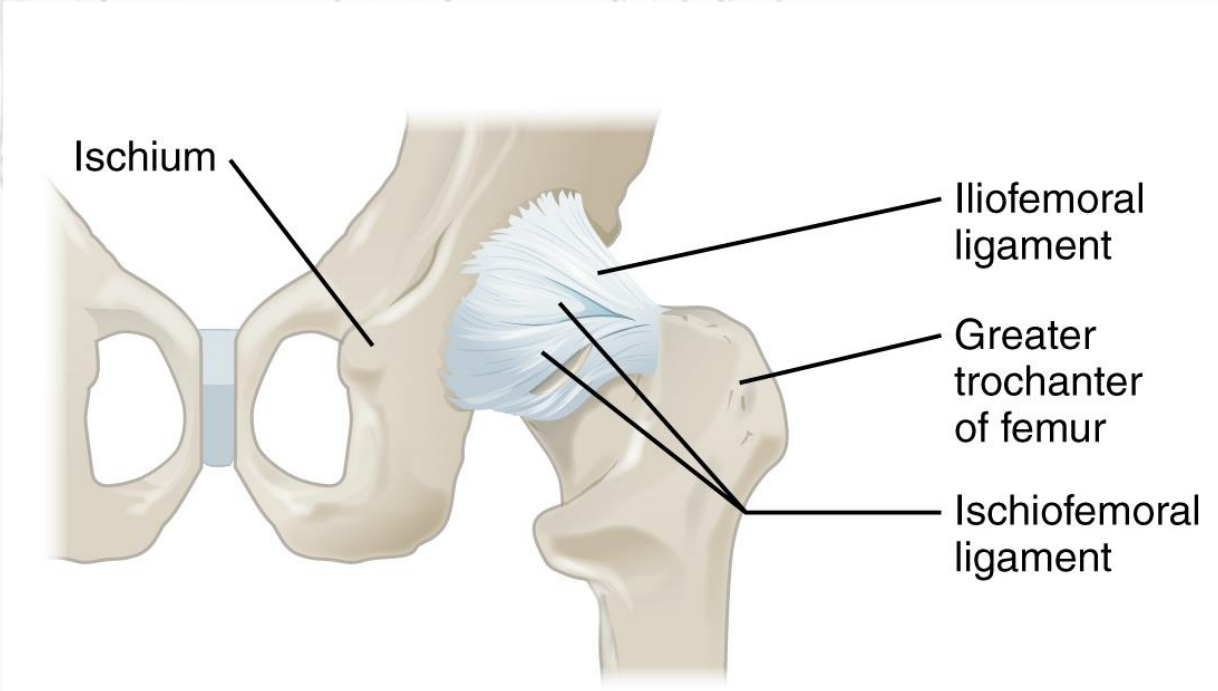




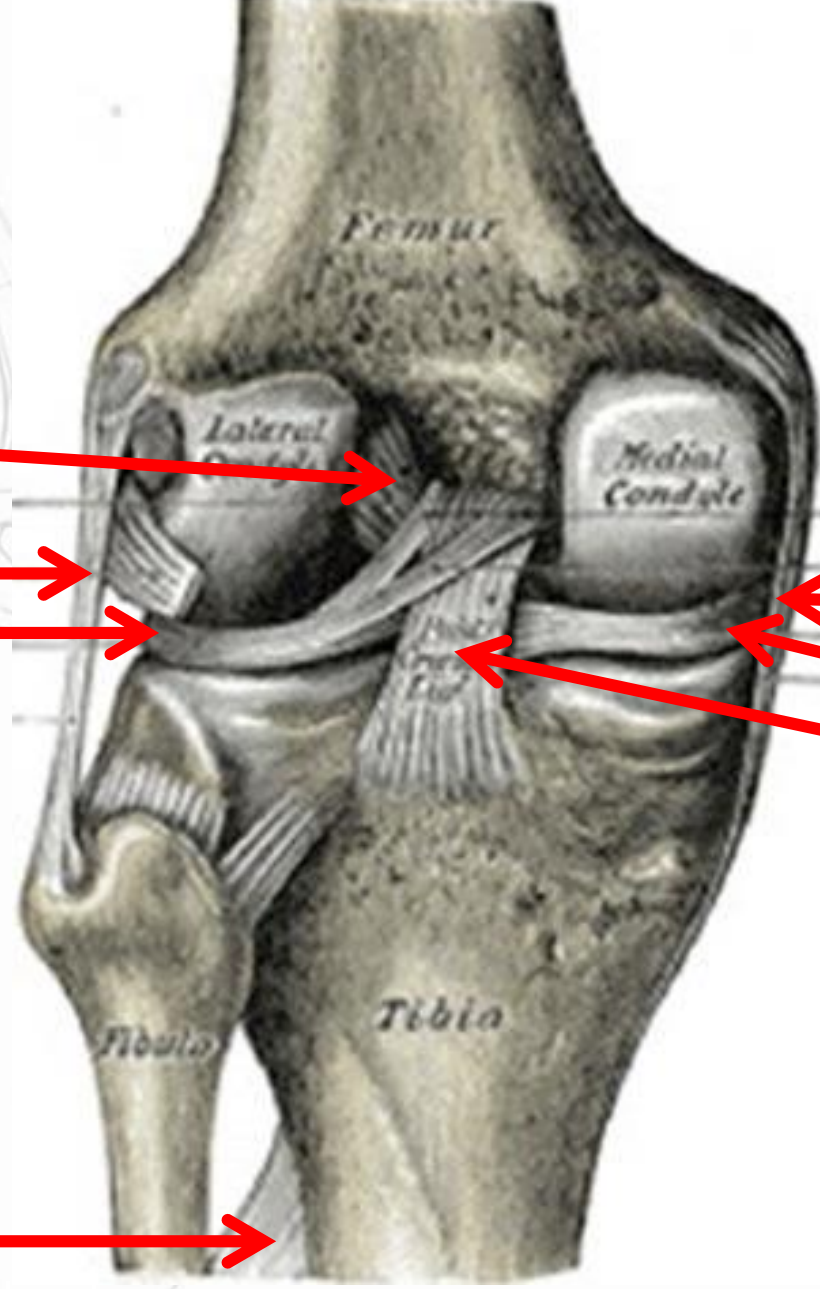
(a) Frontal section through the right hip joint



(b) Anterior view of right hip joint, capsule in place



(c) Posterior view of right hip joint, capsule in place



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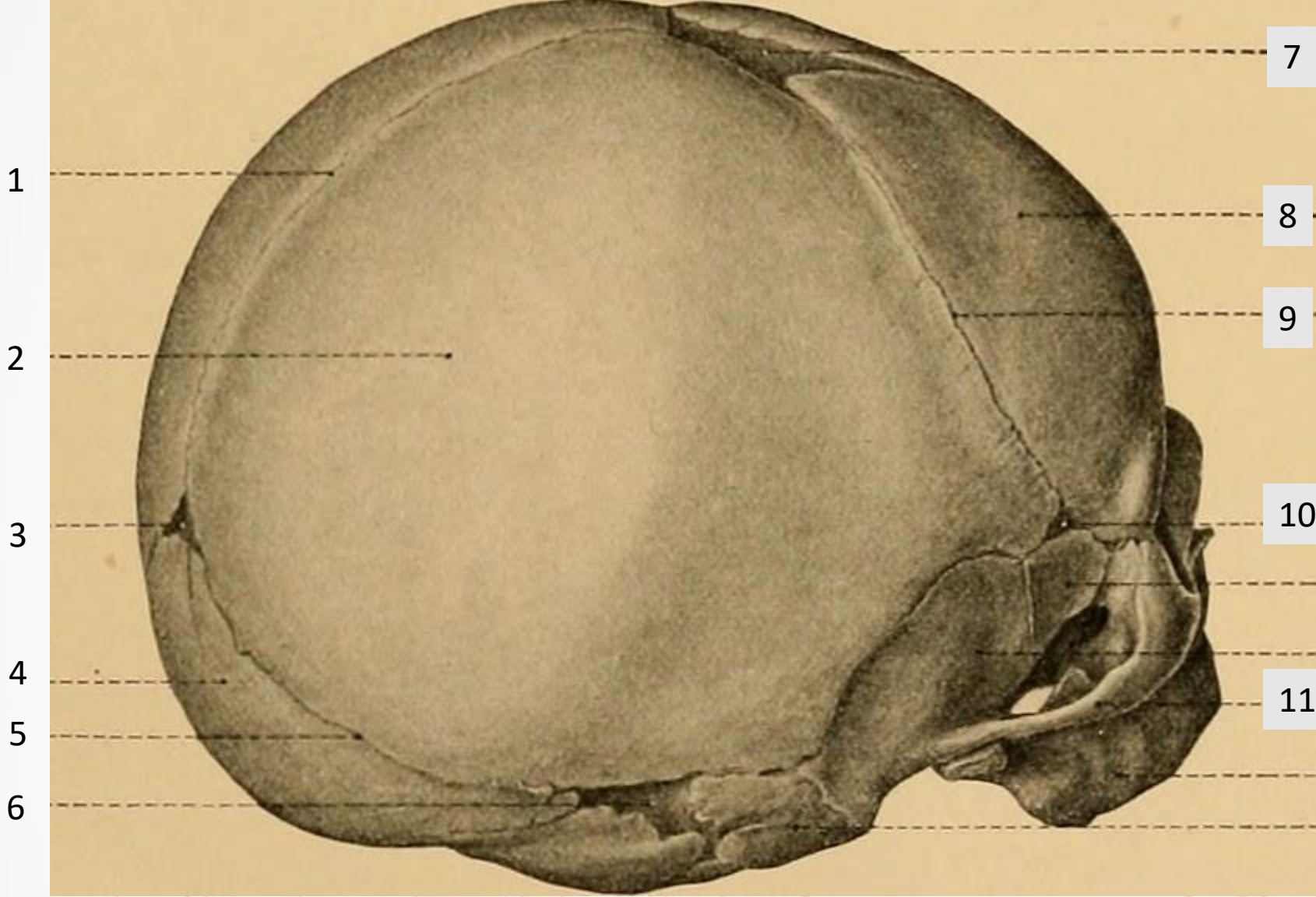


3



7





1. sagittal suture
2. parietal bone
3. posterior fontanelle
4. occipital bone
5. lambdoid suture
6. posterolateral suture
7. anterior (frontal) suture
8. frontal bone
9. coronal suture
10. anterolateral suture
11. zygomatic arch

7

8

9

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11

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