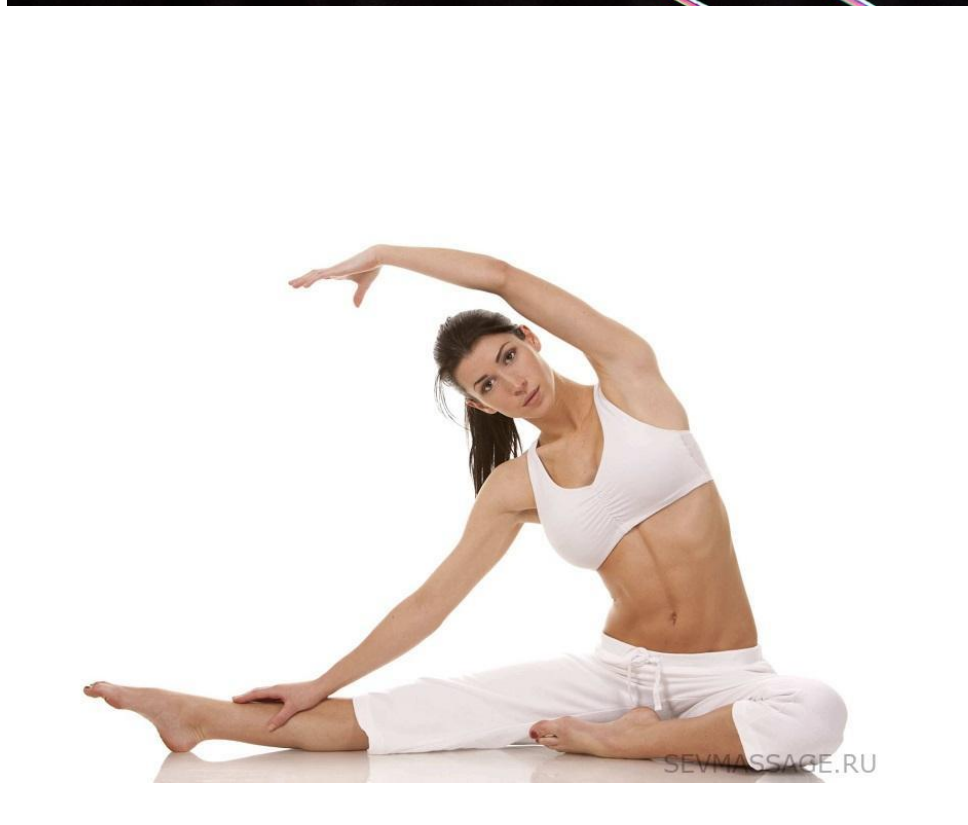


Kazan Federal (Volga Region) University
Institute of Fundamental Medicine and Biology
Department of Morphology and General Pathology

Articular system I



Zaikina Elvira Ildarovna,
MD, PhD, Senior lecturer



Articular system = Syndesmology (Systema articulare)

- System of joints
- Joint occurs, where 2 bones meet
- Combine bones of skeleton into a single unit
- Provide mobility

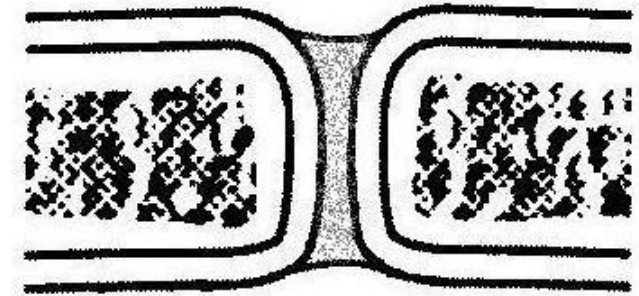


Classification of the joints

1. Synarthrosis

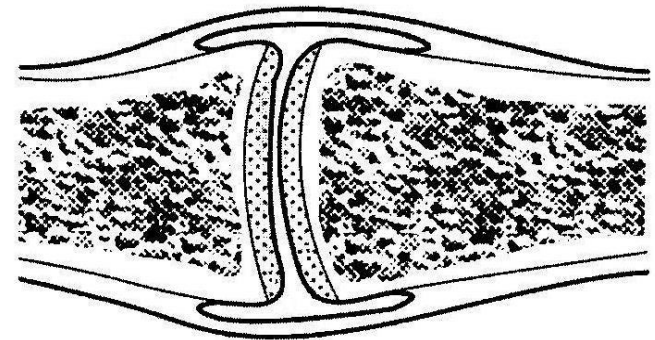
(immovable joint):

- 1) Syndesmosis
- 2) Synchondrosis
- 3) Synostosis



2. Diarthrosis

(synovial joint, joint)

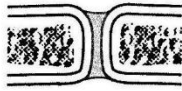


Classification of the joints

1. Synarthrosis

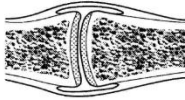
(immovable joint):

- 1) Syndesmosis
- 2) Synchondrosis
- 3) Synostosis



2. Diarthrosis

(synovial joint, joint)



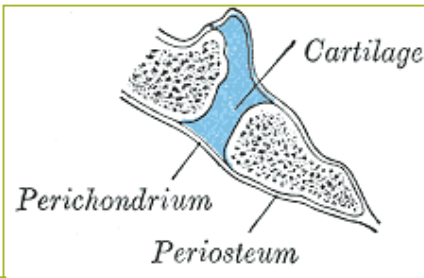
SYNARTHROSIS

- *Immovable and strong connection*
- *No cavity*
- *Space between bones is filled with different types of connective tissue*

1) Syndesmosis – solid connective tissue

2) Synchondrosis - cartilage

3) Synostosis - bone



Types of *Syndesmosis*

1. Sutures

2. Fontanelle

3. Interosseus membrane

4. Ligament

5. Dento-alveolar syndesmosis (Gomphosis)

Classification of the joints

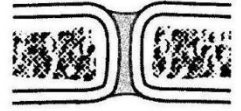
1. Synarthrosis

(immovable joint):

1) *Syndesmosis*

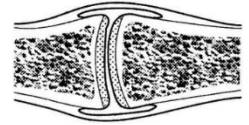
2) *Synchondrosis*

3) *Synostosis*



2. Diarthrosis

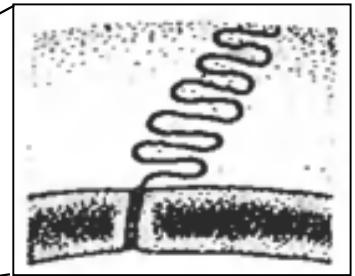
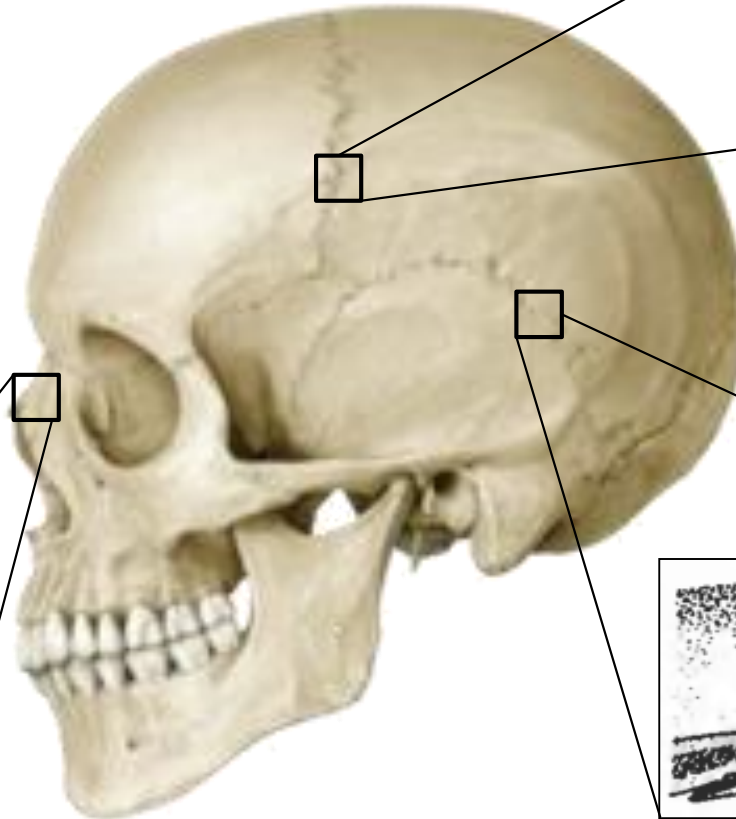
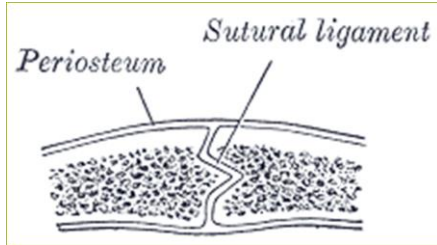
(synovial joint, joint)



Synarthrosis > syndesmosis > 1. sutures

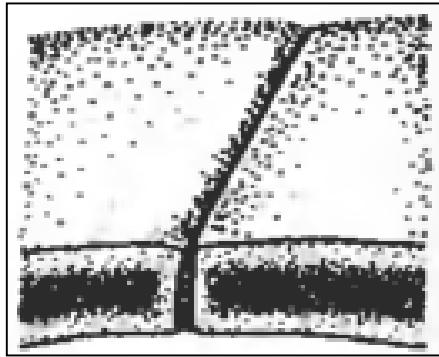
Sutures

bone - collagenous sutural ligament – bone



Serrate suture
(*Sutura serrata*):

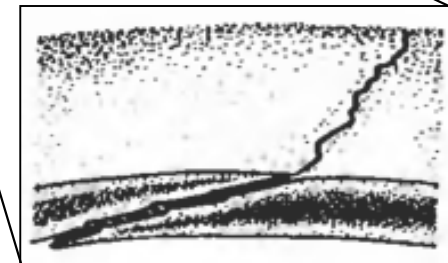
- Lambdoid suture
- Sagittal suture
- Coronal suture



Plane suture

(*Sutura plana*)

- sutures between the bones of the facial skull



Squamous suture

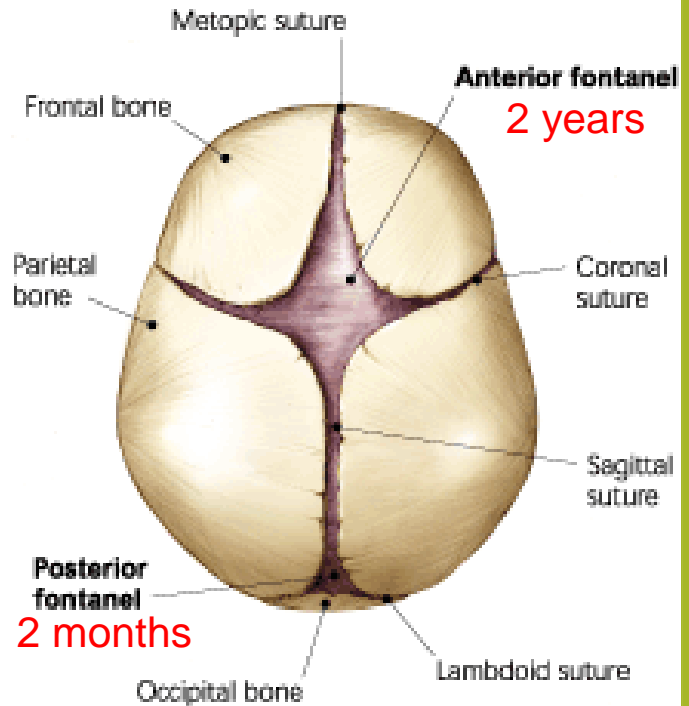
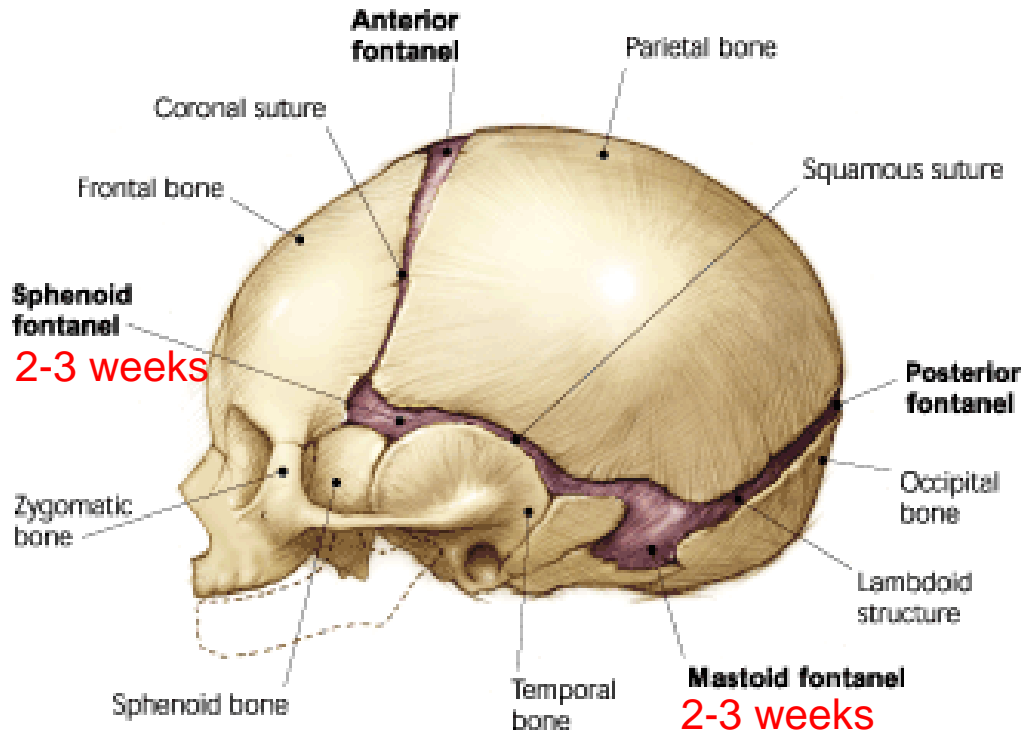
(*Sutura squamosa*)

- Temporo-parietal suture

Synarthrosis > syndesmosis > 2. fontanelle

Fontanelles

(Fonticuli cranii)



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Functions:

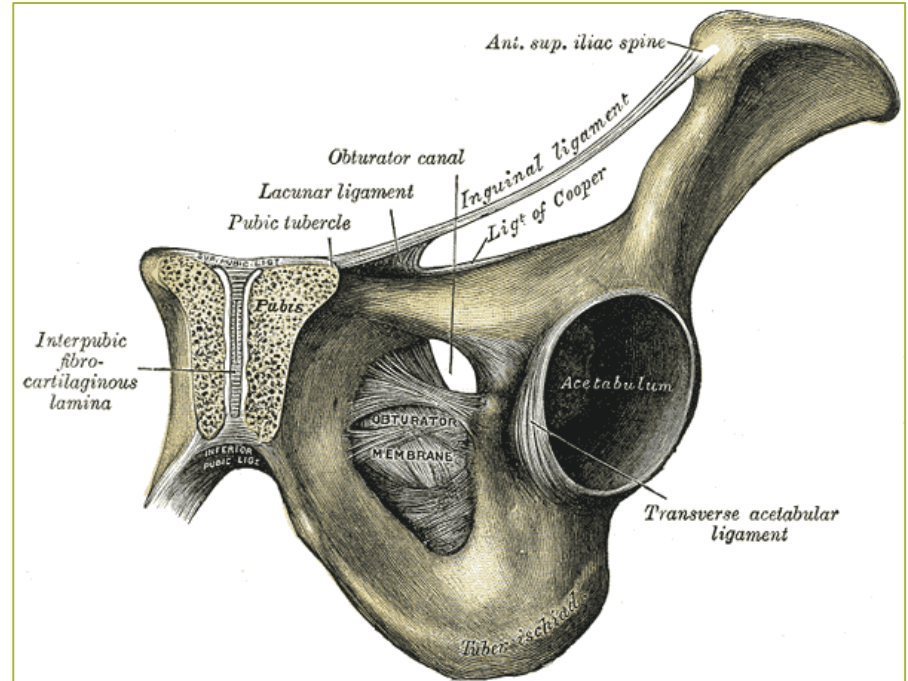
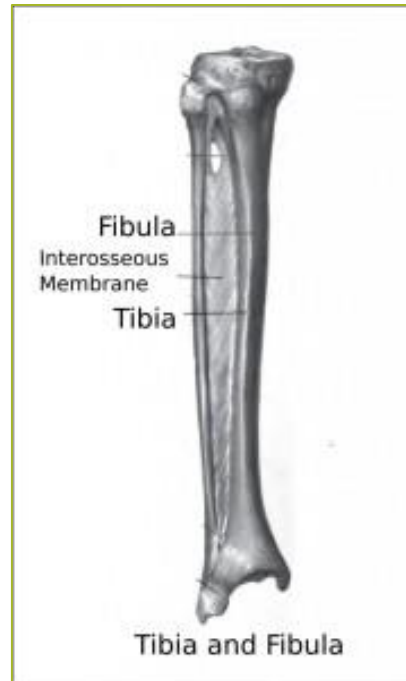
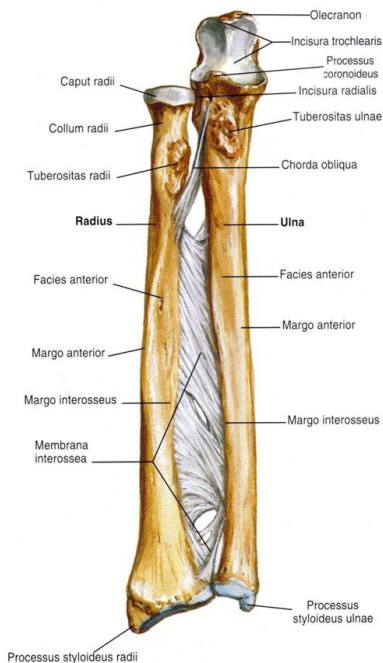
- the possibility of displacement of the skull bones during birth,
- the possibility of bone growth of the skull after birth



Synarthrosis > syndesmosis > 3. interosseous membranes

Interosseus membranes

= bone – layers of parallel collagen fibers – bone



Functions:

- hold the bone adjacent to each other
- serve as an attachment site for muscles
- forming holes to vessels and nerves

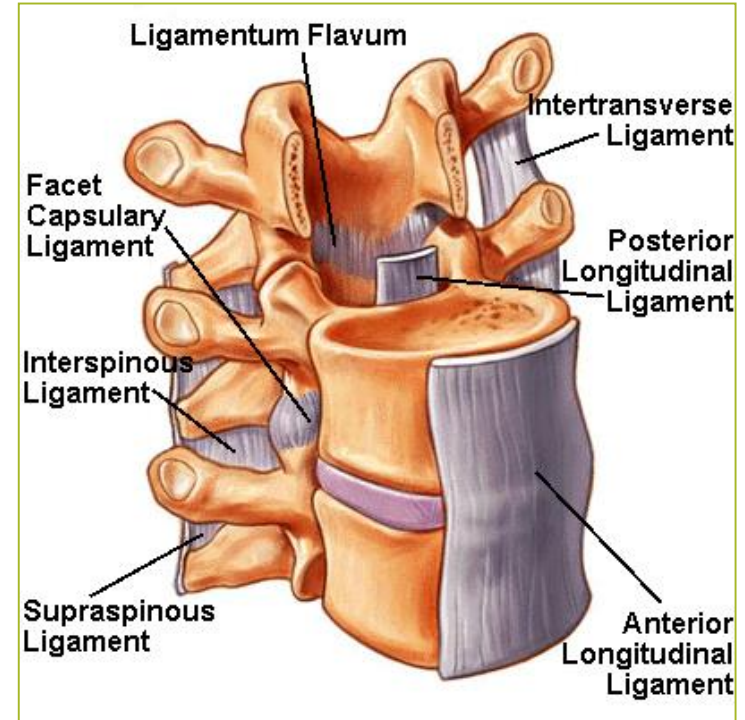
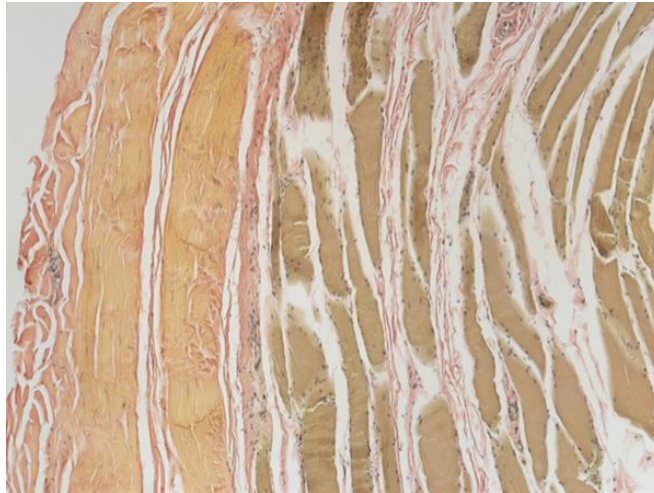
Synarthrosis > syndesmosis > 4. ligament

Ligament

(*Ligamentum*)

Fibers of the ligaments:

- a) Fibrous
- b) Elastic (*Ligamentum flavum*)

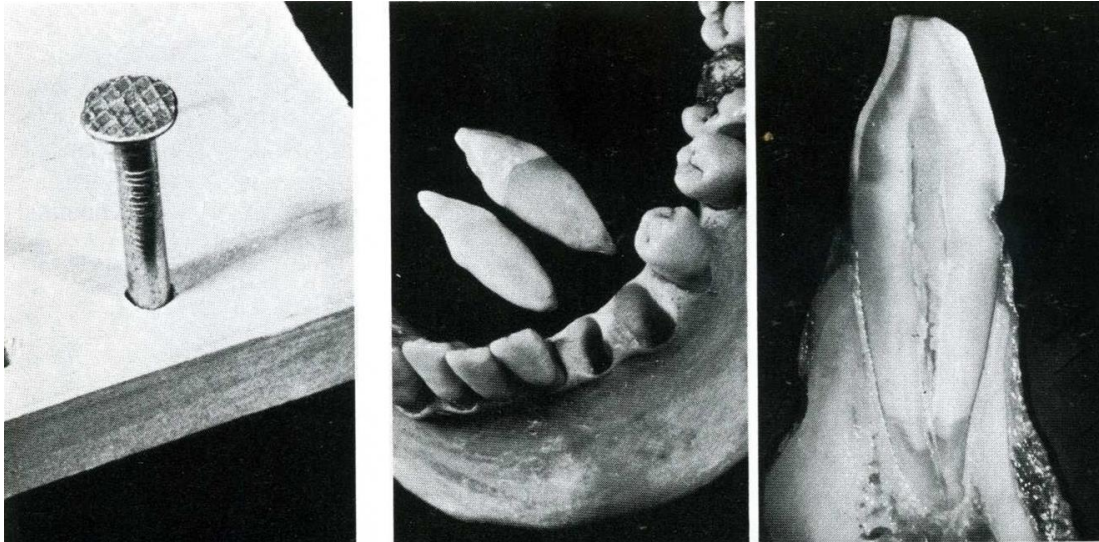
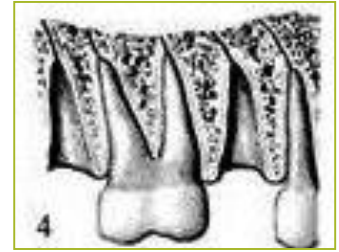


Functions:

- a) hold the bone adjacent to each other
- b) serve as an attachment site for muscles
- c) form holes for vessels and nerves

Synarthrosis > syndesmosis > 4. dento-alveolar syndesmosis

Dento-alveolar syndesmosis (Gomphosis)



- Fix the teeth in the alveolar sockets of mandible and maxillae with the help of specific connective tissue called the periodontium

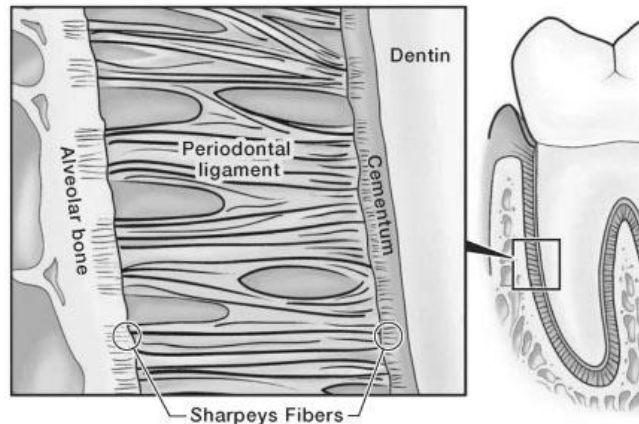


Figure 2.18. Sharpey Fibers. The ends of the periodontal ligament fibers that are embedded in the alveolar bone and the cementum are known as Sharpey Fibers.

Synchondrosis

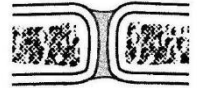
= bone – hyaline/fibrous cartilage - bone

Classification of the joints

1. Synarthrosis

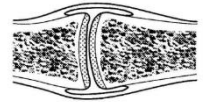
(immovable joint):

- 1) *Syndesmosis*
- 2) *Synchondrosis*
- 3) *Synostosis*



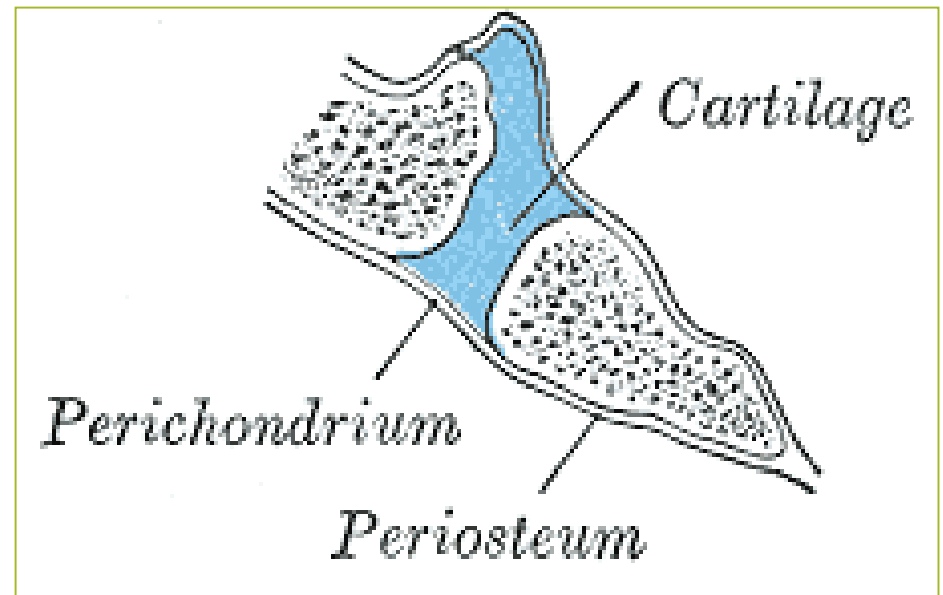
2. Diarthrosis

(synovial joint, joint)



Types of Synchondrosis

- a) Permanent
- b) Temporary
- c) Symphysis



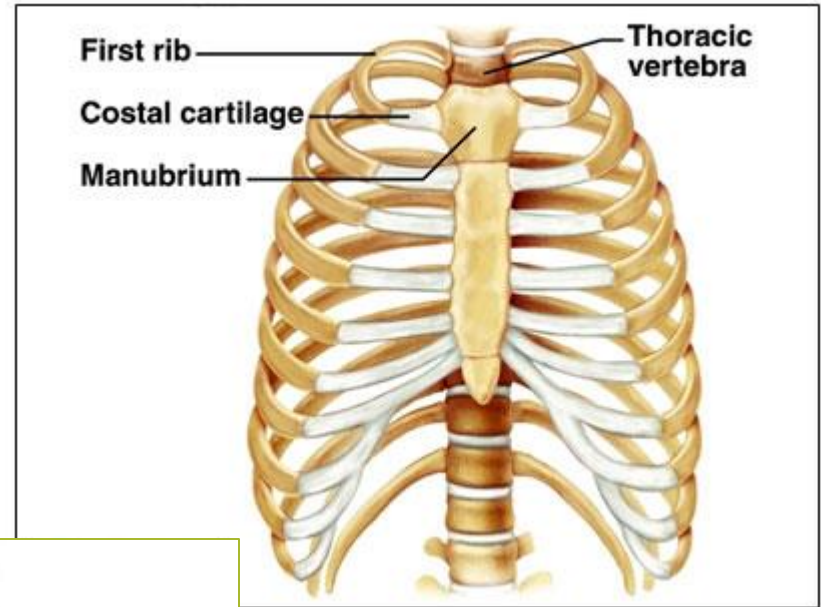
Functions:

- a) Connection of the bones
- b) Amortization (distribute and reduce the pressure, shock absorber)

Synarthrosis > synchondrosis > 1. permanent synchondrosis

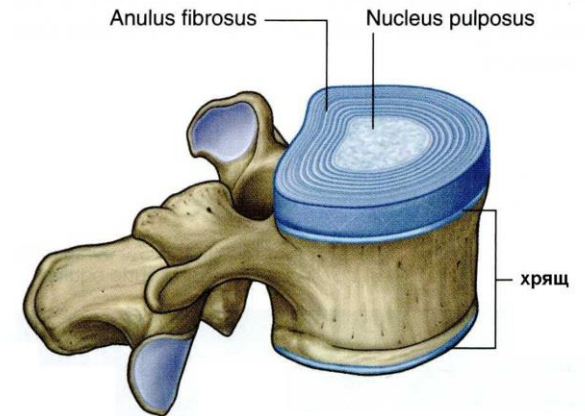
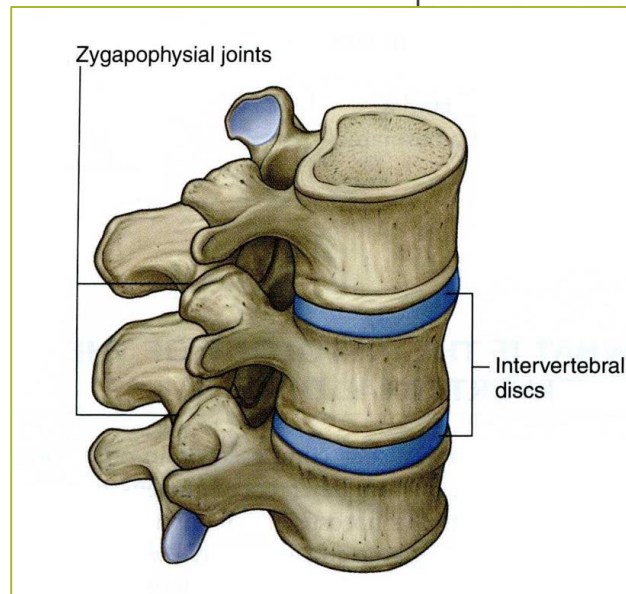
Permanent Synchondrosis

- Permanent during the whole life
- Fibrous cartilage (stronger)



Samples:

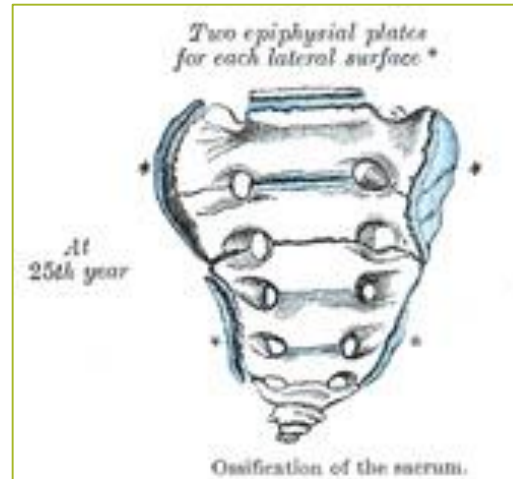
- Intervertebral discs
- Cartilage of the ribs



Synarthrosis > synchondrosis > 2. temporary synchondrosis

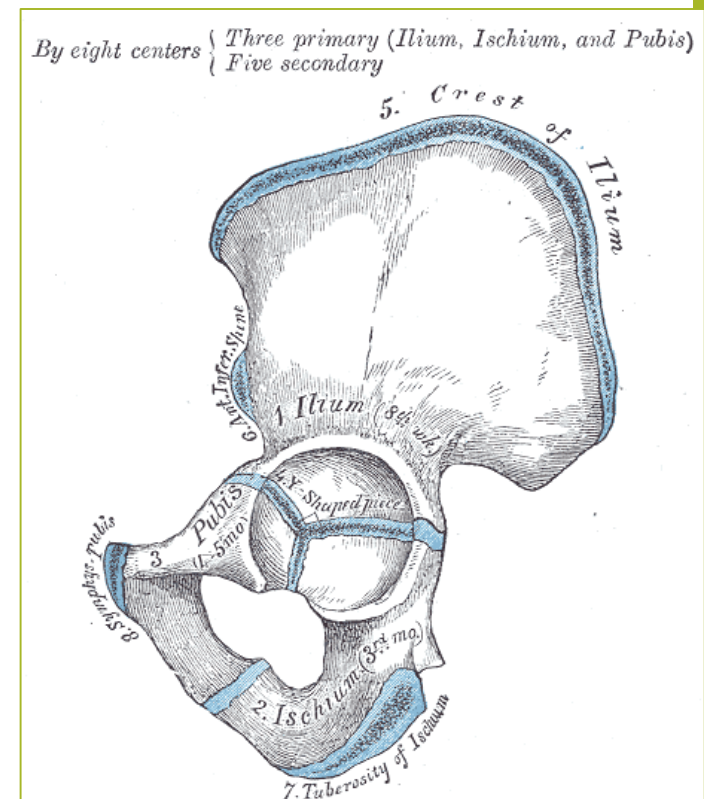
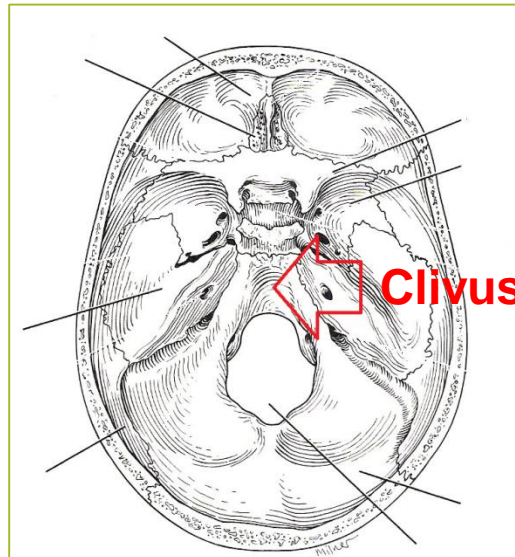
Temporary Synchondrosis

- Hyaline cartilage (more elastic)
- Provides growth of bones
- Later will be ossified

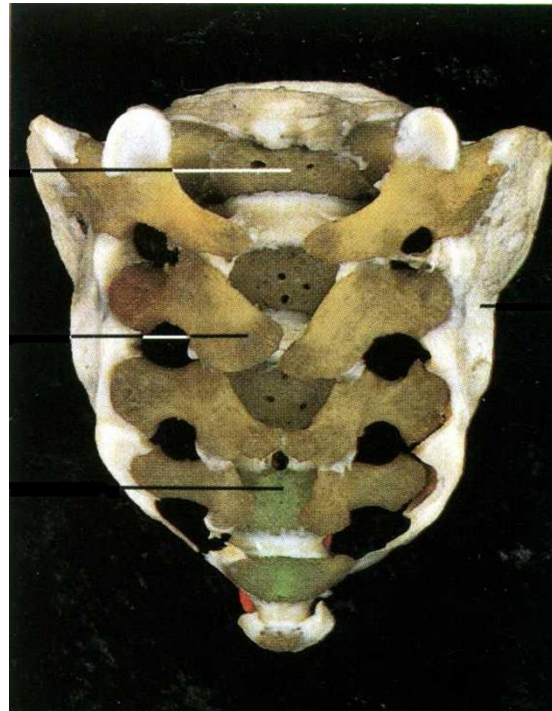
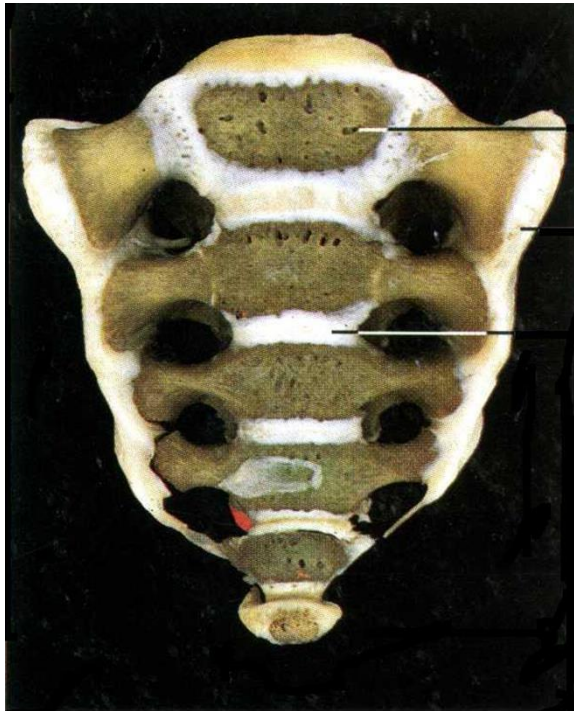
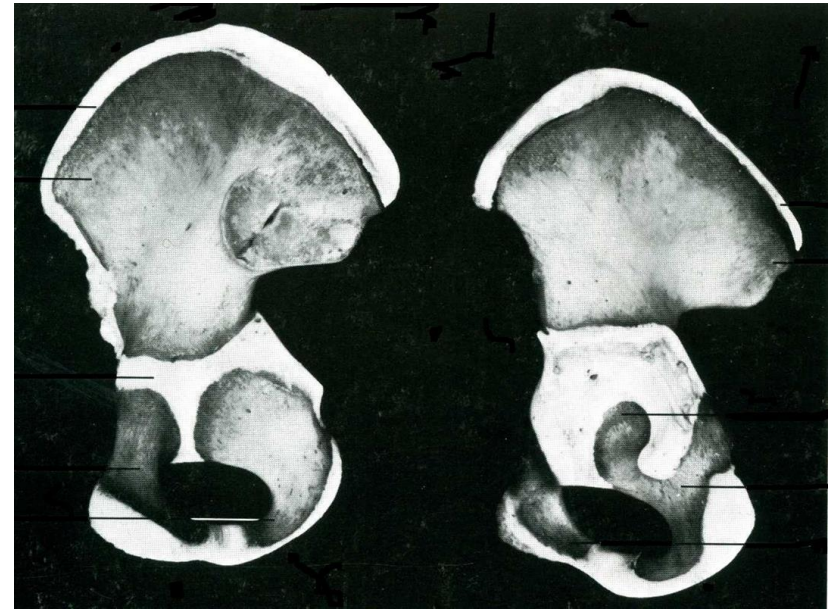


Samples:

- Sphenooccipital synchondrosis
- Sacrum
- Hip bone
- Metaphysis (growth plate of long bones)

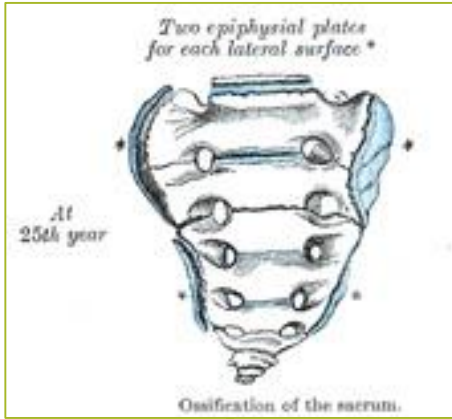


Temporary Synchondrosis

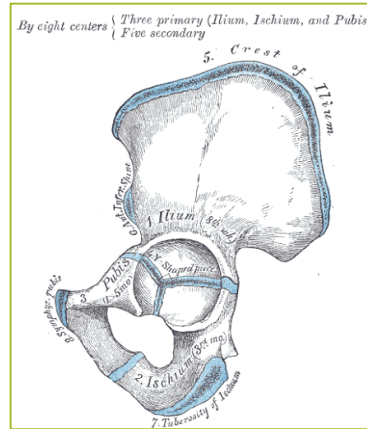


Synostosis

= rigid bony union



Temporary
spondylosis



Synostosis

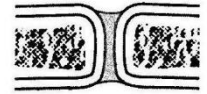


Classification of the joints

1. Synarthrosis

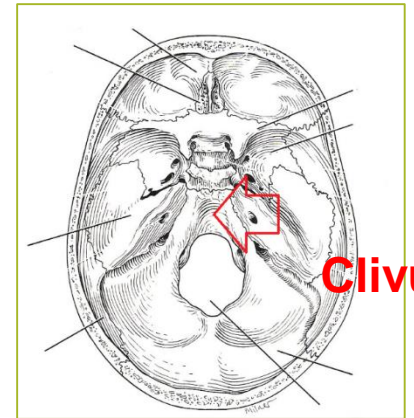
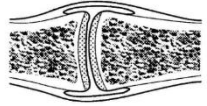
(immovable joint):

- 1) Syndesmosis
- 2) Synchondrosis
- 3) Synostosis

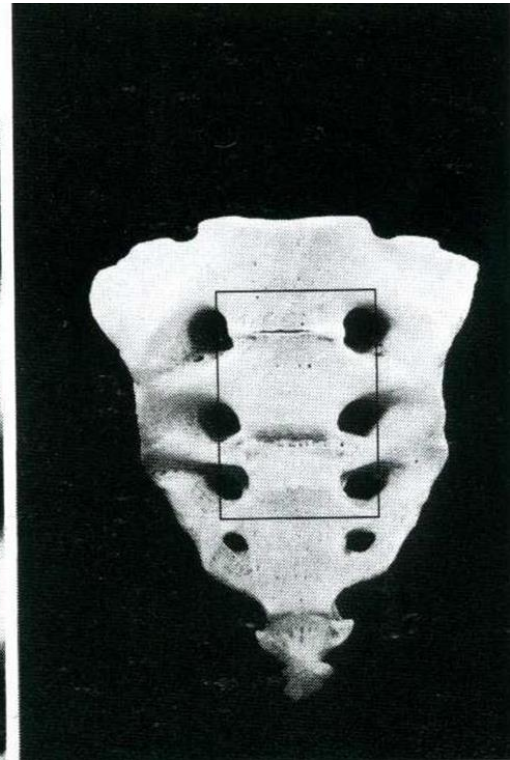
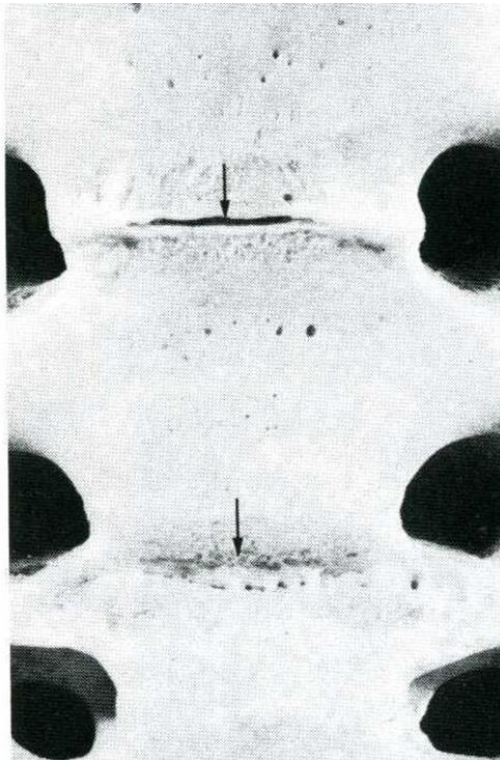
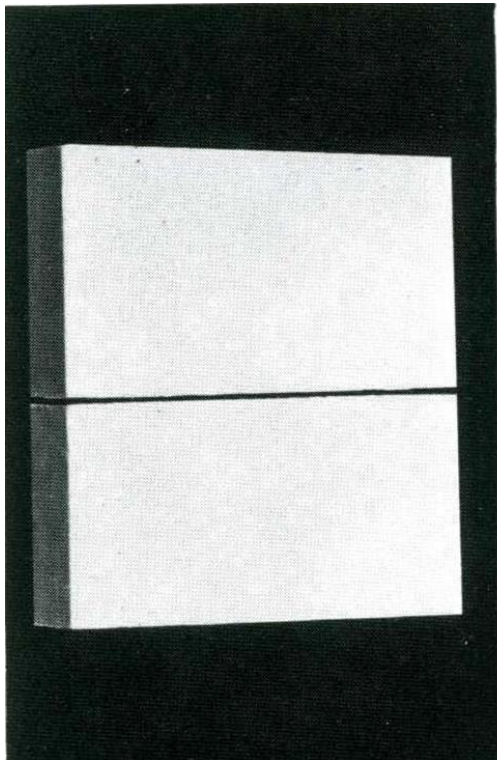


2. Diarthrosis

(synovial joint, joint)



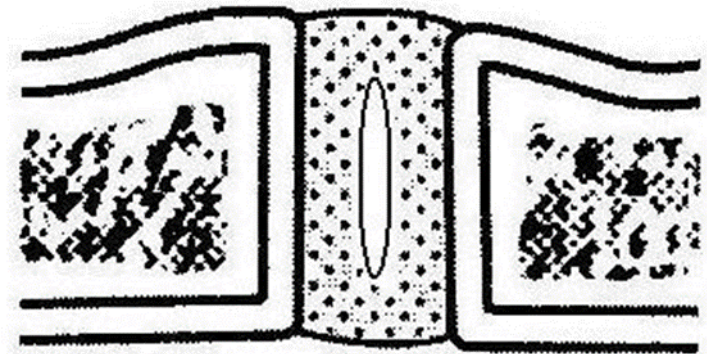
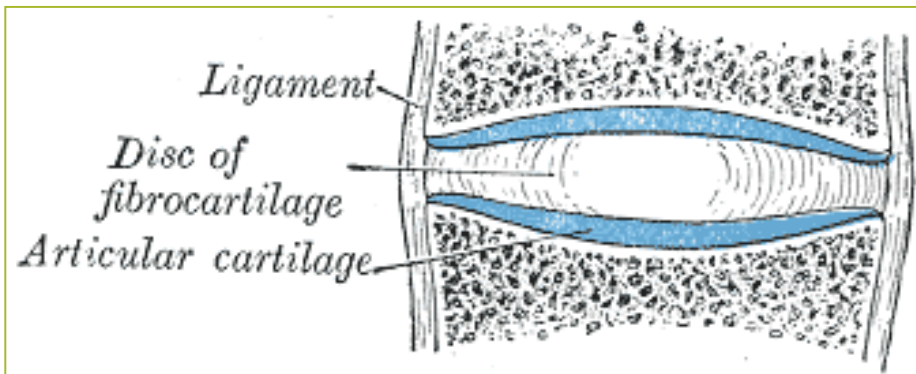
Synostosis



Symphysis

(semi-mobile joint)

= bone - hyaline cartilage - fibrocartilage disc with **slit-like cavity** filled with synovial fluid- hyaline cartilage – bone



Classification of the joints

1. Synarthrosis

(immovable joint):

1) Syndesmosis

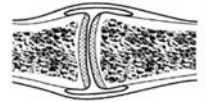
2) Synchondrosis

3) Synostosis



2. Diarthrosis

(synovial joint, joint)



Symphysis

Classification of the joints

1. Synarthrosis

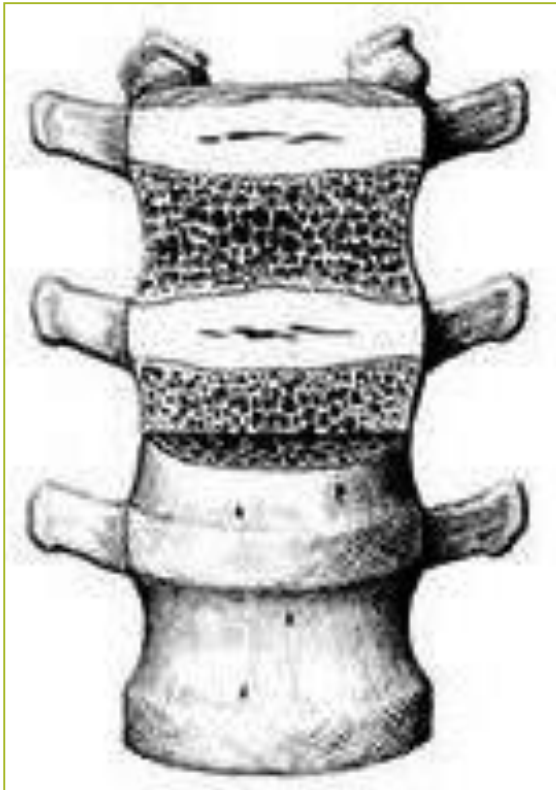
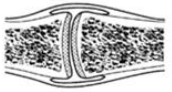
(immovable joint):

- 1) *Syndesmosis*
- 2) *Synchondrosis*
- 3) *Synostosis*

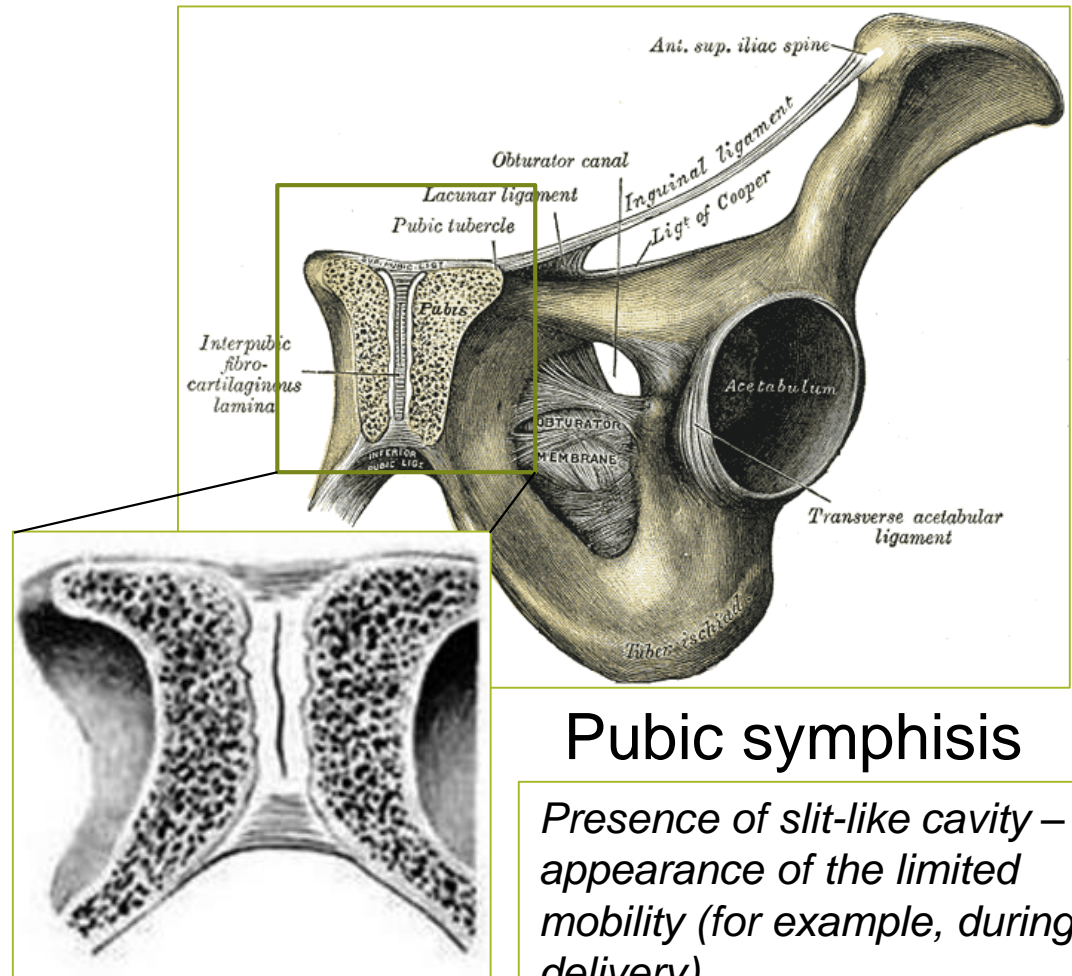


2. Diarthrosis

(synovial joint, joint)



Intervertebral
symphysis



Pubic symphysis

Presence of slit-like cavity – appearance of the limited mobility (for example, during delivery)

Classification of the joints

1. Synarthrosis

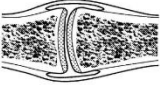
(immovable joint):

- 1) *Syndesmosis*
- 2) *Synchondrosis*
- 3) *Synostosis*



2. Diarthrosis

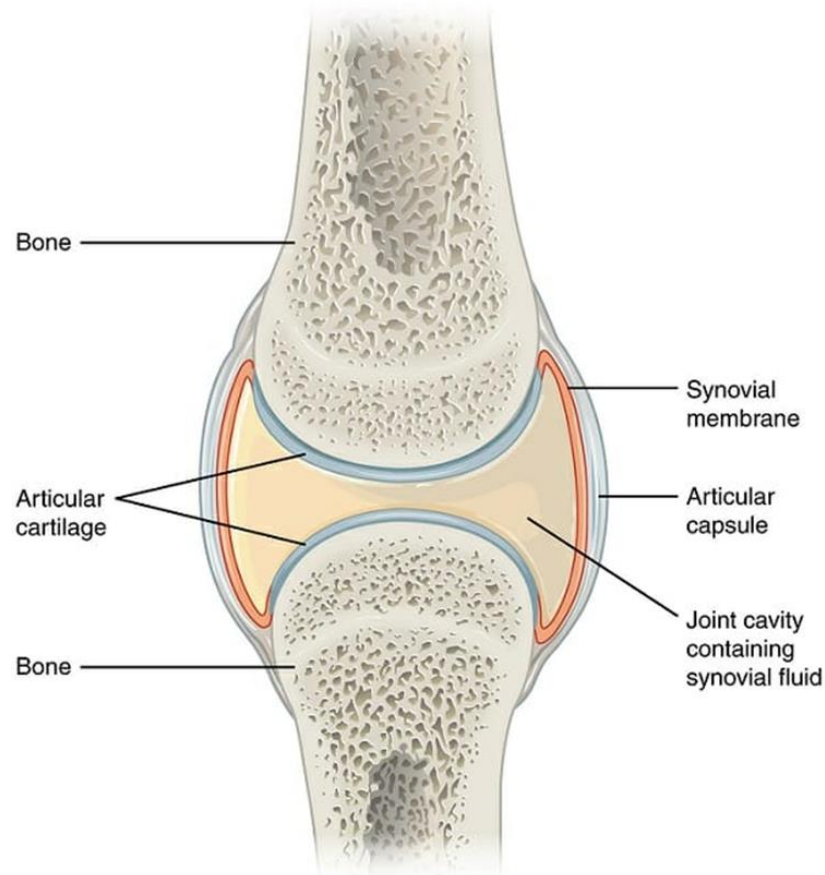
(synovial joint, joint)



DIARTHROSIS

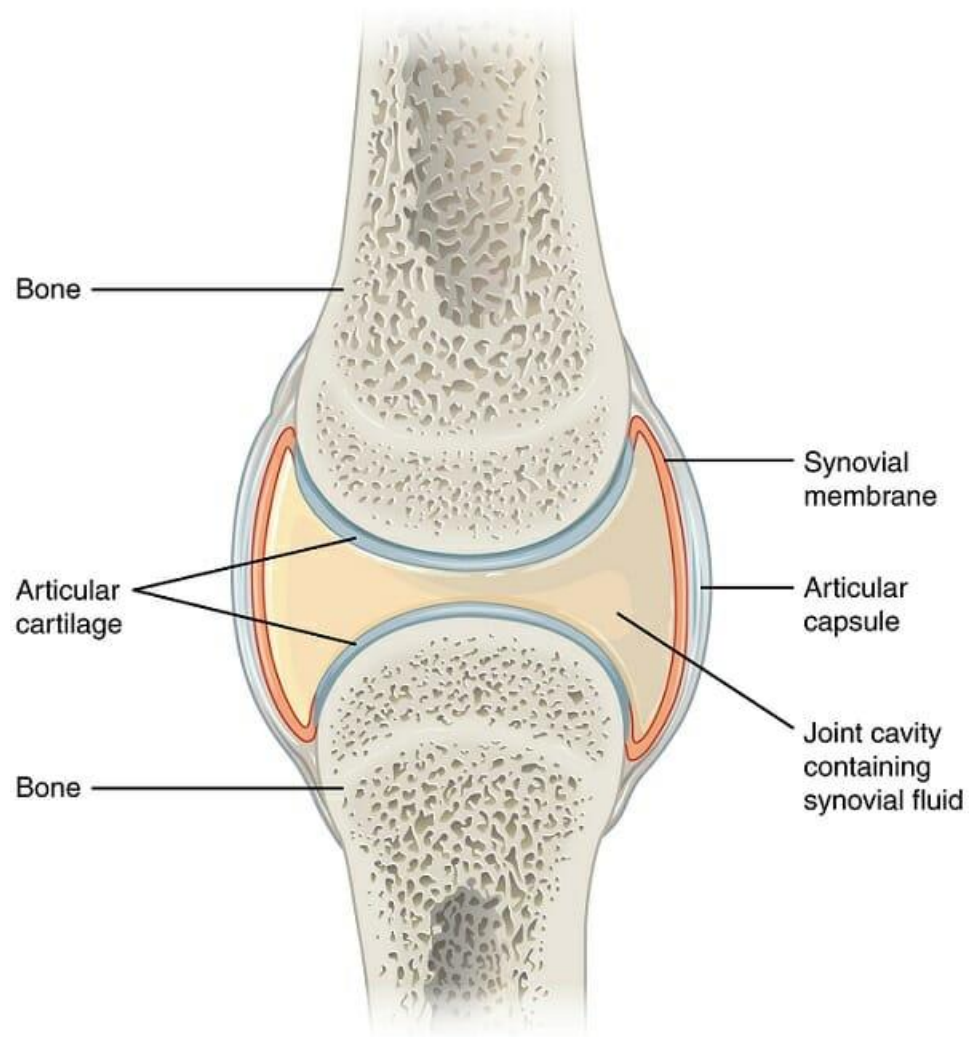
(Synovial joint)

= bone – articular cartilage - fluid
in cavity - articular cartilage - bone



Essential elements of Diarthrosis

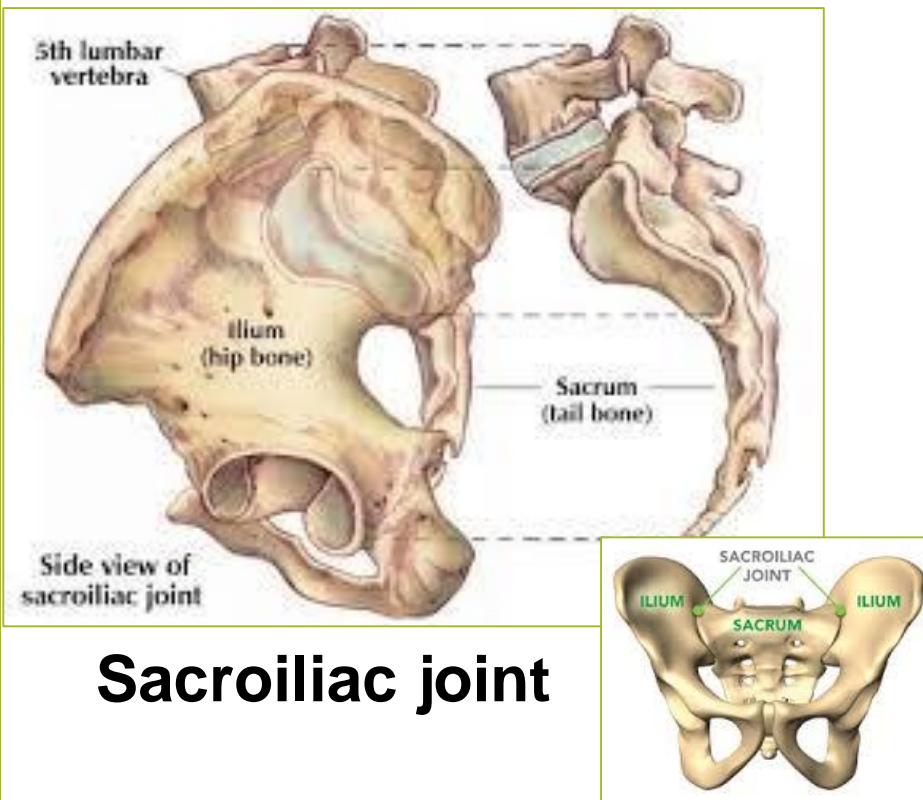
- 1. Articular surfaces of the bones**
 - covered with cartilage
- 2. Articular cavity** containing synovial fluid
- 3. Articular capsule**



Articular surface of Diarthrosis

Congruence – similarity between articular surfaces.

Less congruence - more mobility of the joint

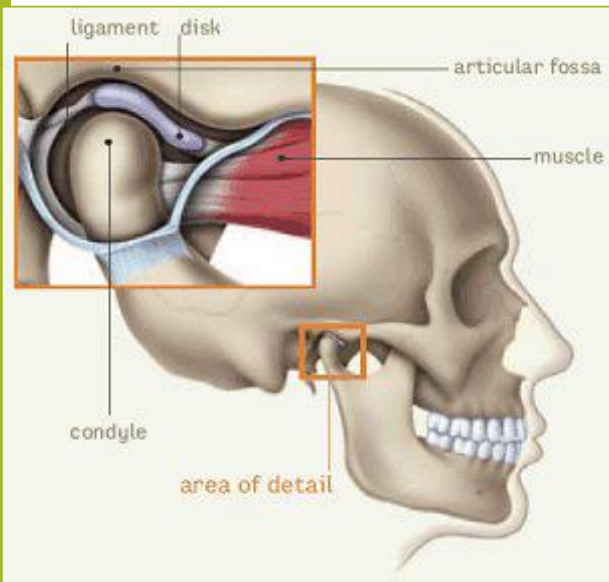


Sacroiliac joint



Shoulder joint

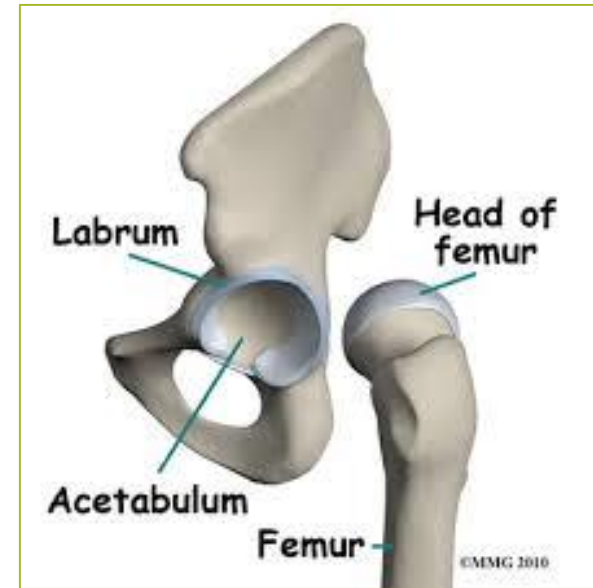
Articular Discs, Meniscus and Labrum



Articular disc



Articular meniscus



Articular labrum

Articular cartilage

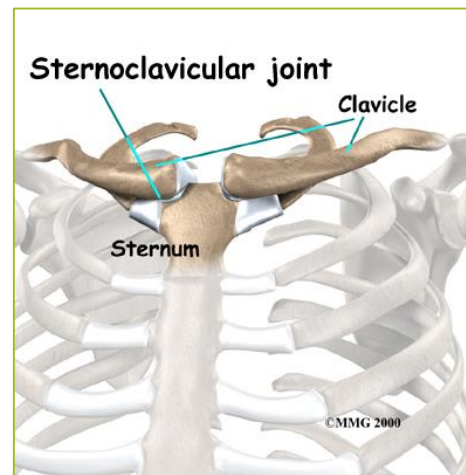
Hyaline cartilage

- covers articular surfaces most of the joints

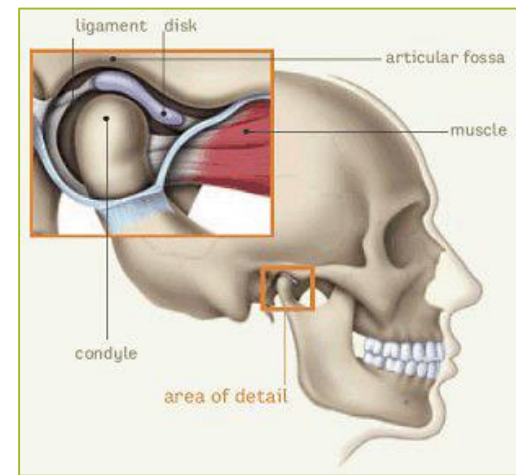


Fibrous cartilage

- covers articular surfaces of two joints



Sternoclavicular joint

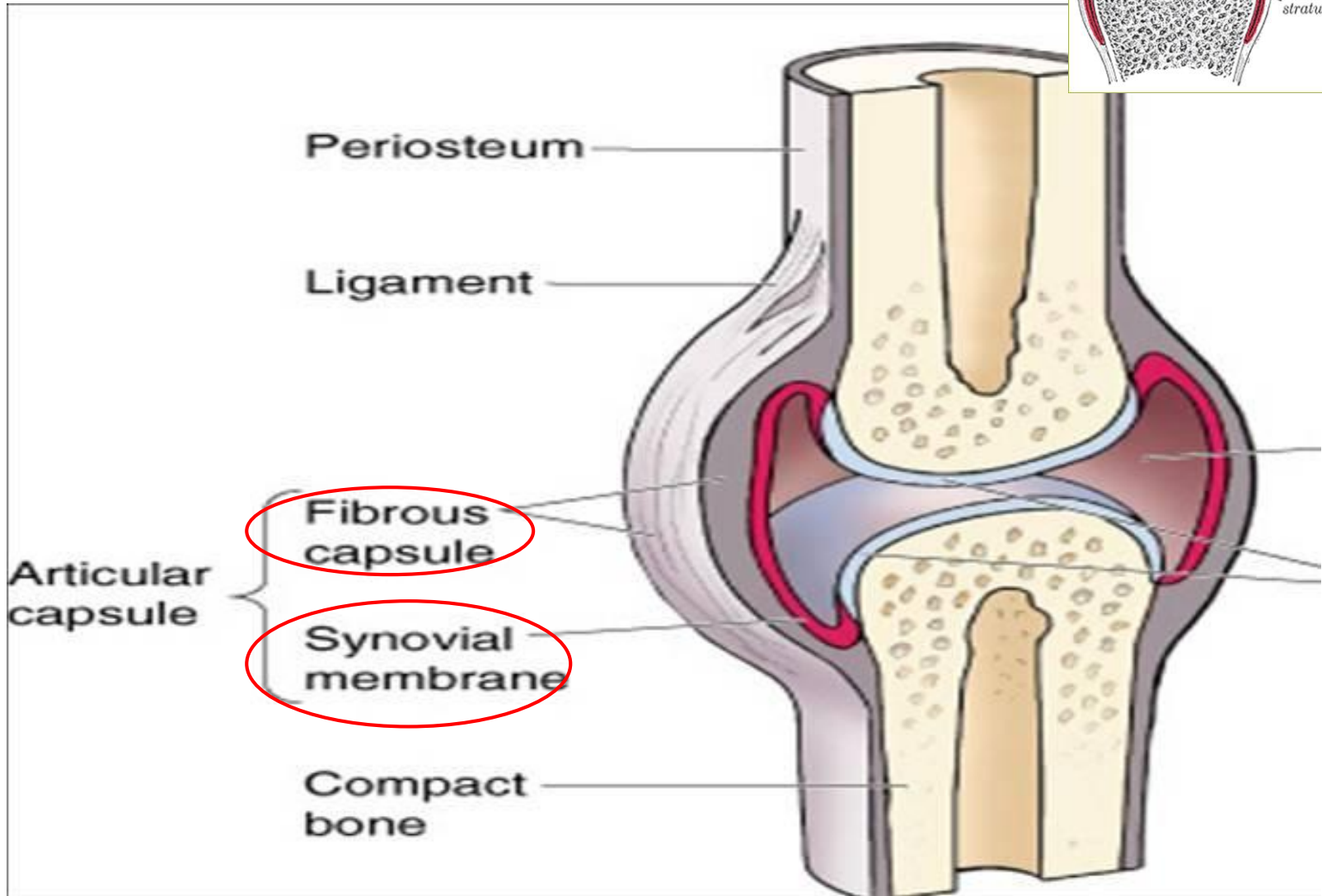
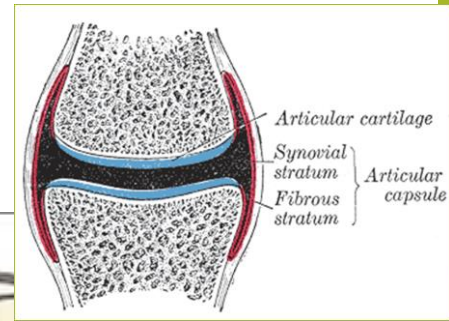


Temporomandibular joint

Articular cartilage has:

- no pain receptors
- no blood vessels
- very low coefficient of friction

Articular capsule

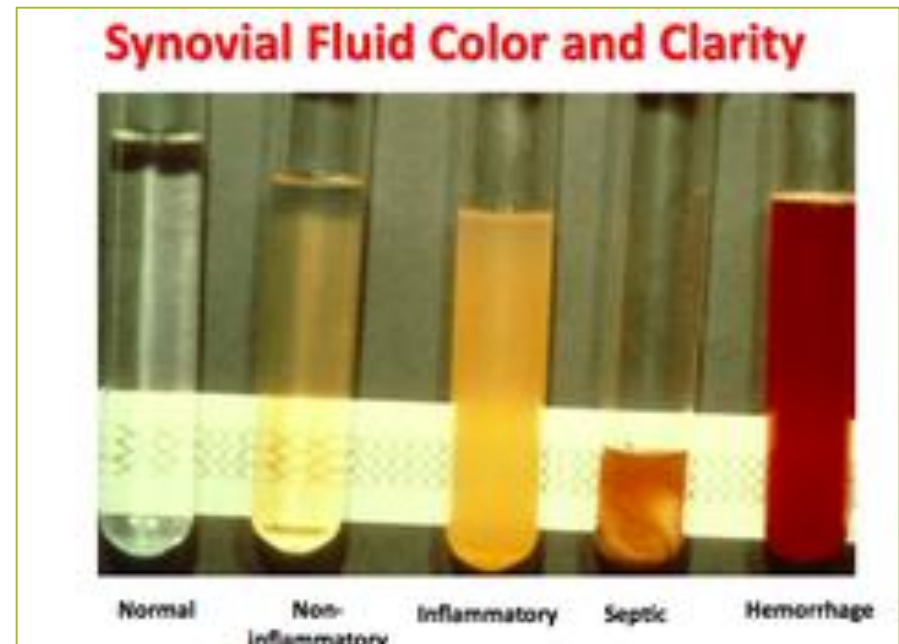


Synovial membrane functions:

- 1) lines the joint and seals it into a joint capsule.
- 2) secretes synovial fluid (a clear, sticky fluid) around the joint to lubricate it.

Synovial fluid functions:

- 1) Lubricate the articular surfaces
- 2) Feed the articular surfaces (the cartilage has no blood vessels)
- 3) Combine the articular surfaces into a single unit
- 4) Moderate the pressure (shock absorber)



Support (accessory) elements of the joints

1. Intraarticular ligaments

- fibrous ligaments covered with synovial membrane

2. Intraarticular cartilage (discus/meniscus)

- increase the congruence of the articular surfaces

3. Articular labrum (“lips”)

- fibrous cartilages surrounding the articular surface

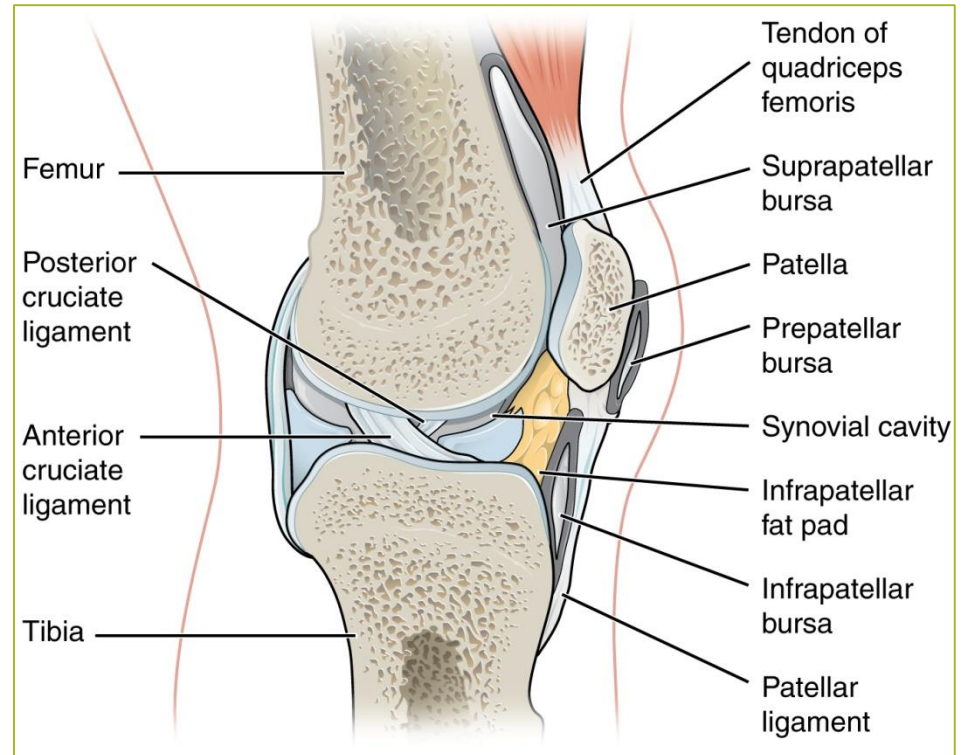
4. Articular folds

- derivative of synovial membrane

5. Articular bursa (“sacs”)

- cavities, lined with synovial membrane, that help cushion the friction in a joint

6. Fat pads

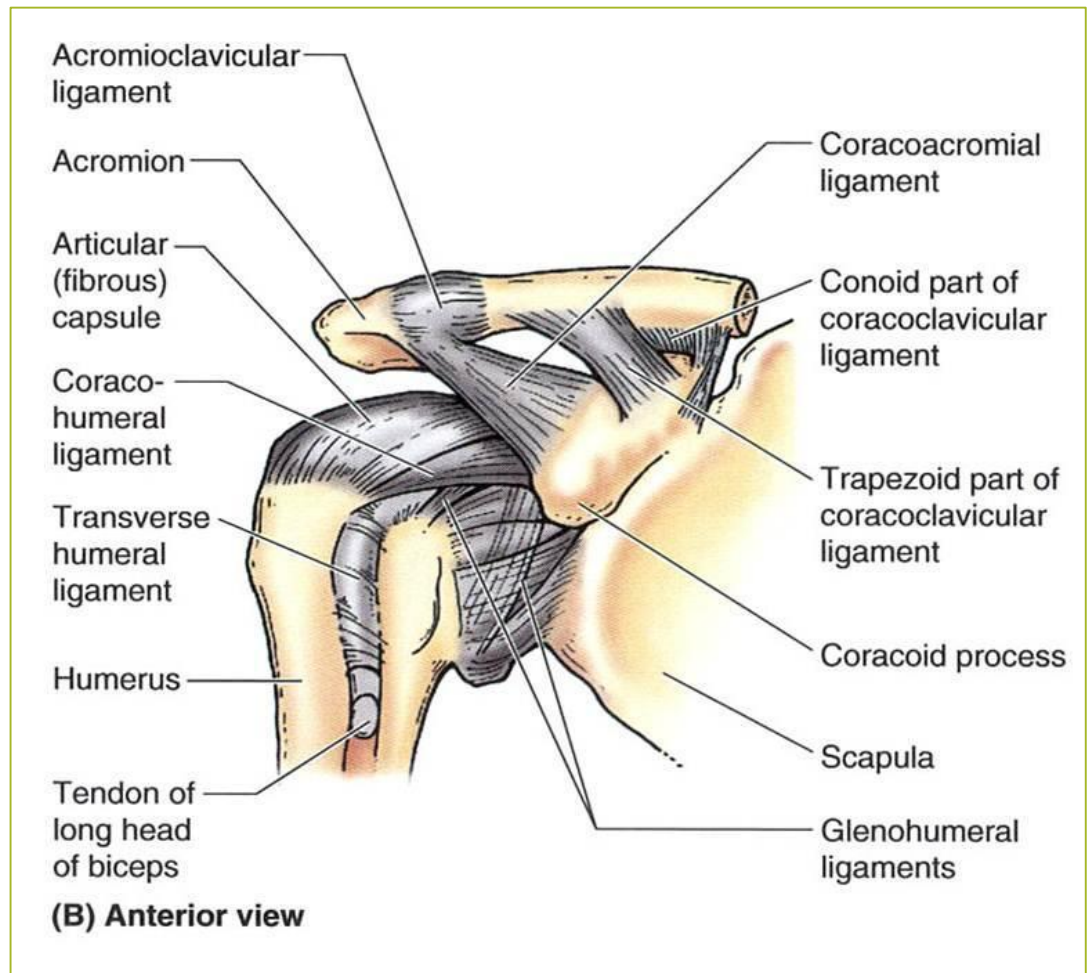


Ligaments of the joints

- strong ligaments (tough, elastic bands of connective tissue)

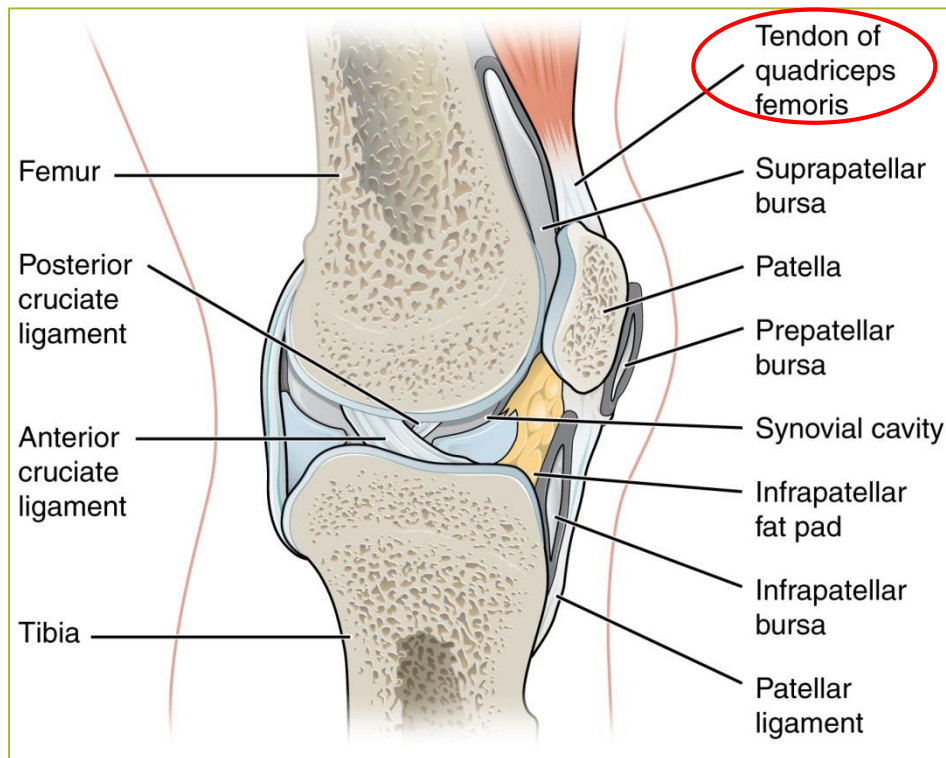
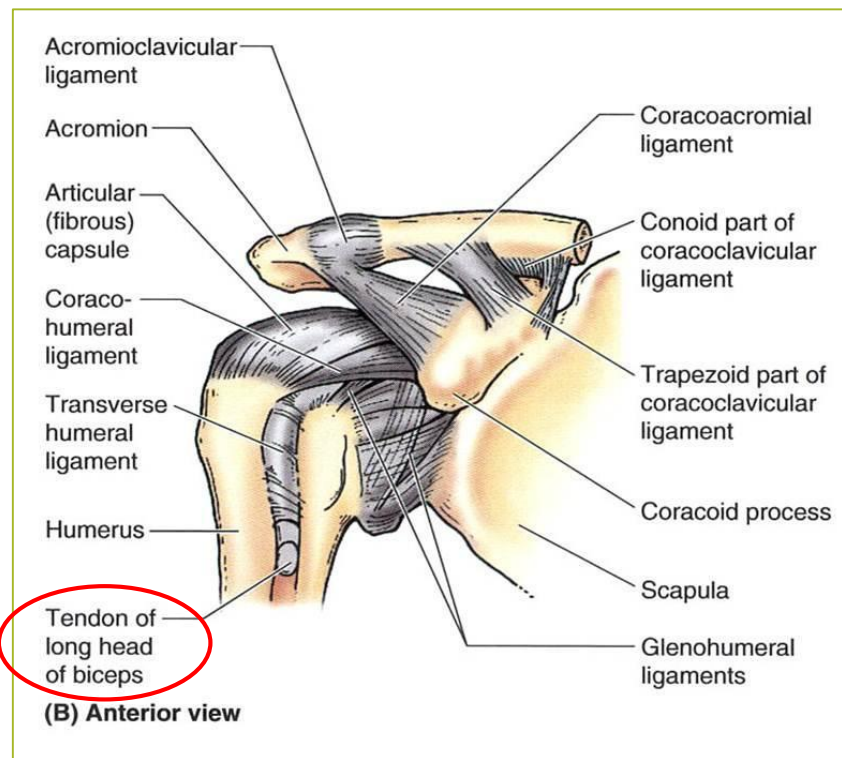
Functions:

- 1) surround the joint to give support and stability
- 2) connect the bones
- 3) limit the joint's movement
- 4) reinforce the articulations
- 5) frequently form an articular capsule about the joint



Tendons of the joints

- another type of tough connective tissue on each side of a joint
- attach to muscles that control movement of the joint.



Similarity of the articular surfaces is called:

- a) Syndesmosis
- b) Congruence
- c) Diarthrosis
- d) Symphysis

Connection of the bones through fibrous connective tissue is called:

- a) Syndesmosis
- b) Synchondrosis
- c) Diarthrosis
- d) Symphysis
- e) Synostosis

Samples of permanent synchondrosis:

- a) Sacroiliac joint
- b) Pubic symphysis
- c) Sternocostal junction
- d) Sacral vertebrae junction
- e) Intervertebral disc

Essential elements of the diarthrosis:

- a) Articular disc
- b) Articular surface
- c) Articular notch
- d) Articular condyle
- e) Articular capsule
- f) Articular ligaments
- g) Articular space/cavity

Gomphosis is a sample of:

- a) Syndesmosis
- b) Synchondrosis
- c) Diarthrosis
- d) Symphysis
- e) Synostosis

CLASSIFICATION OF SYNOVIAL JOINTS

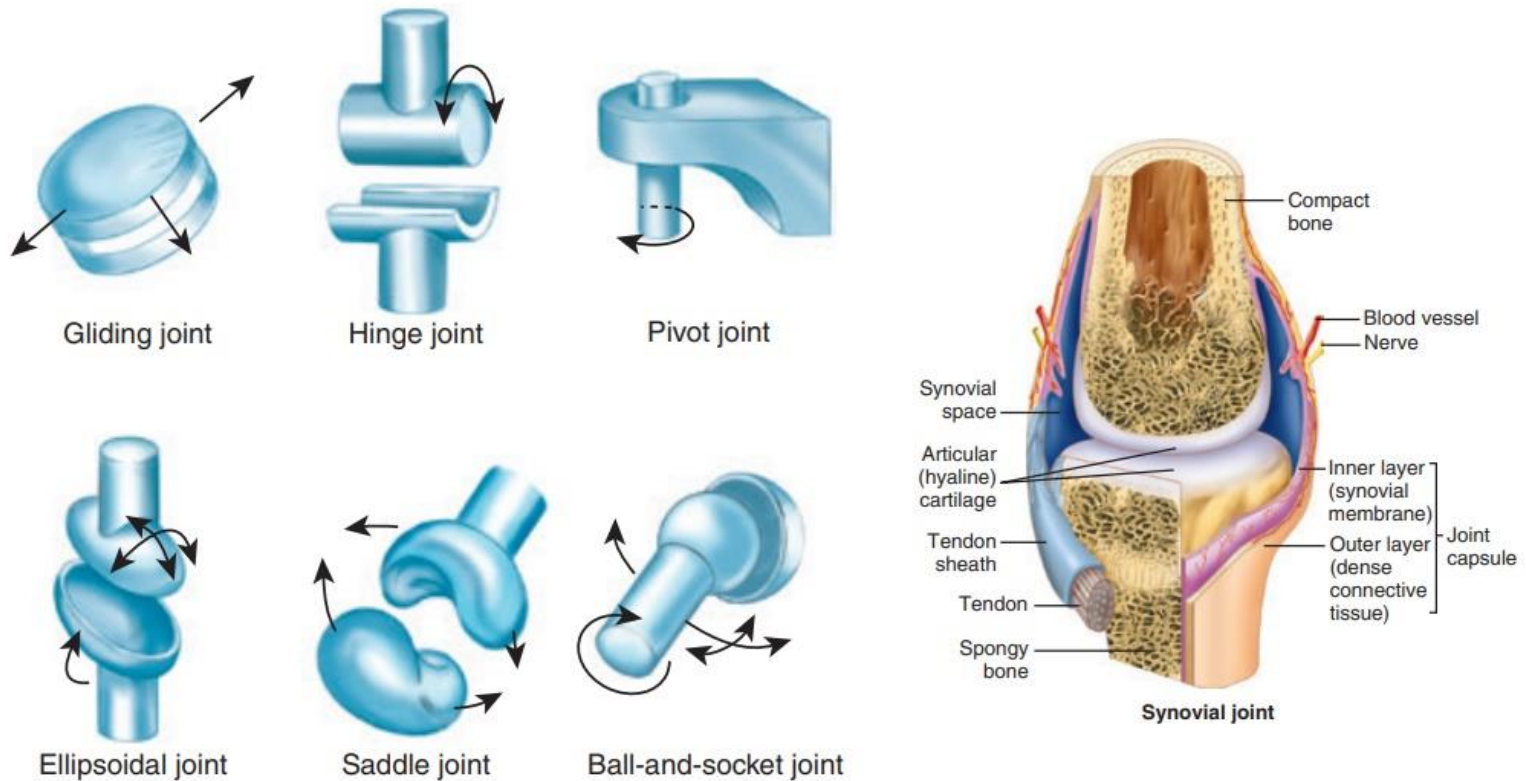


FIGURE 1 Types of synovial joints.

Complexity of the joints

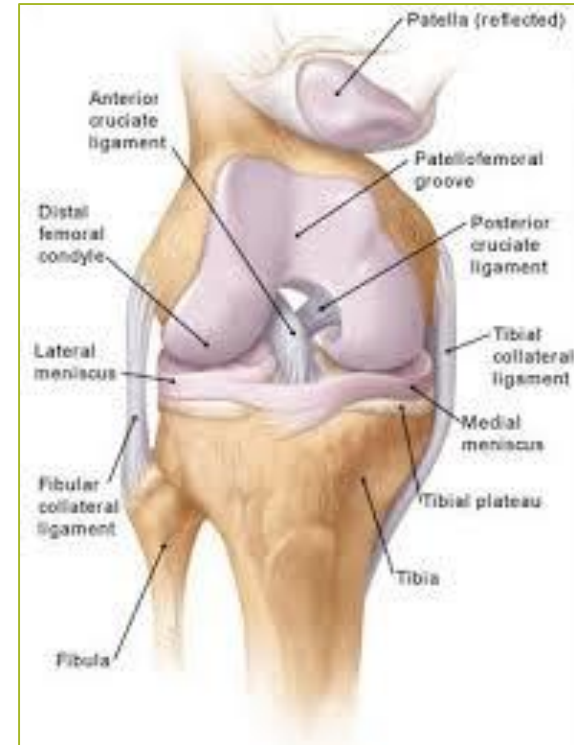
Simple joint

- two articular surfaces
- Usually: one convex, male & one concave, female



Complex joint

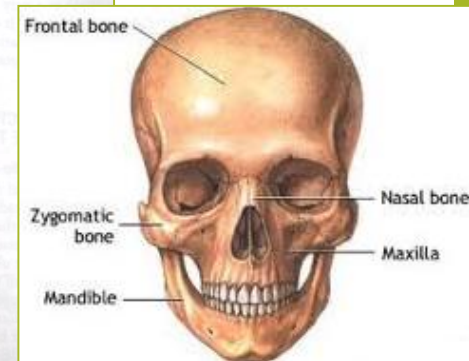
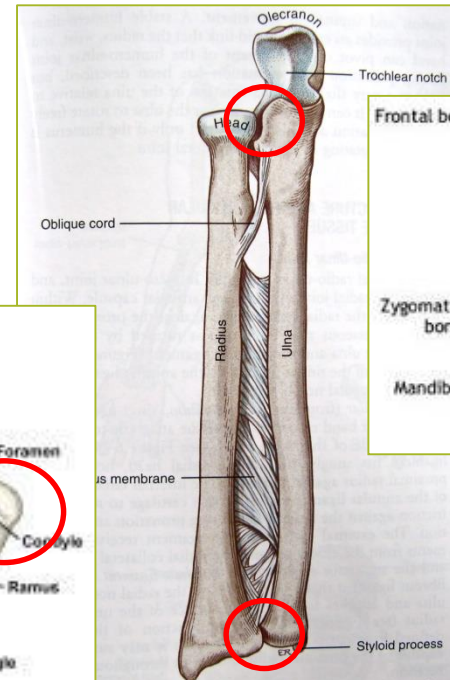
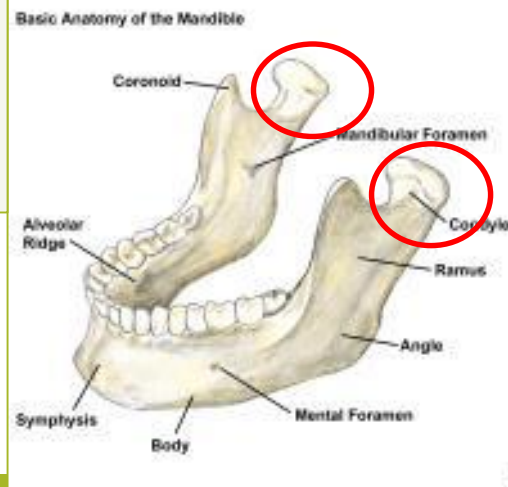
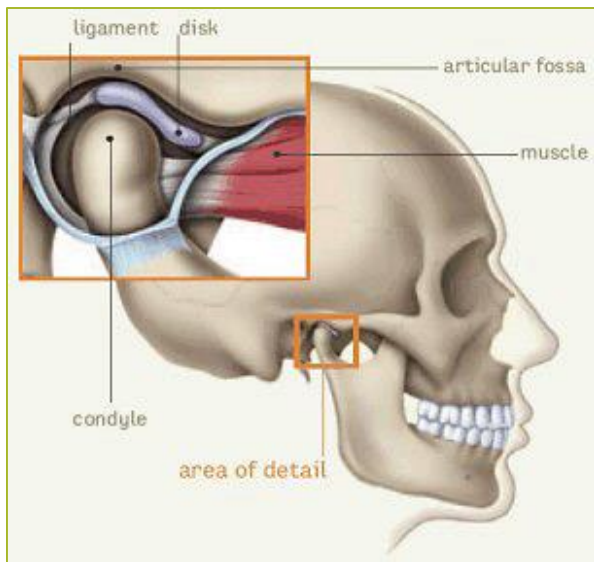
- more than two articular surfaces
- Presence of disc or meniscus



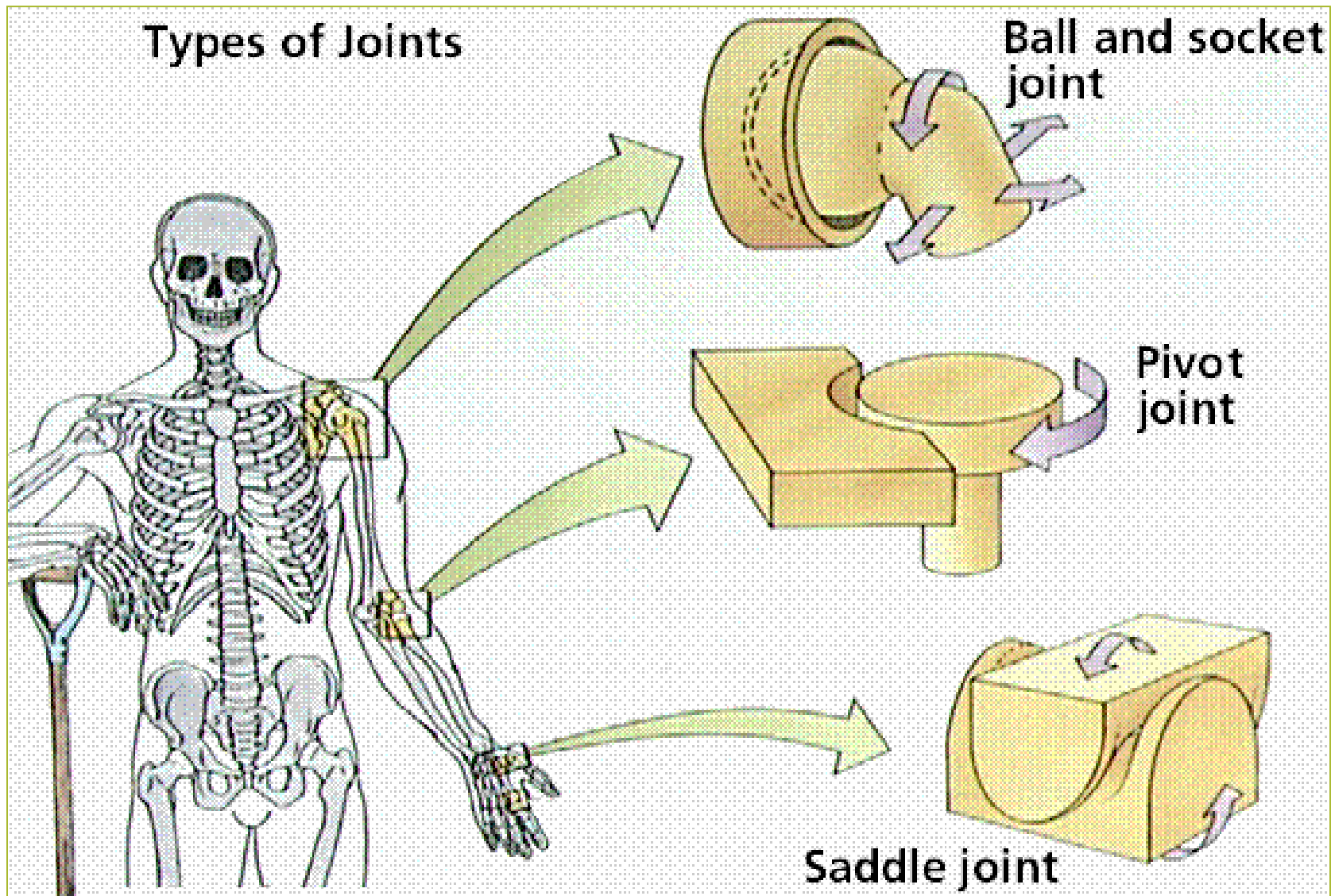
Synovial joints

Combined joint

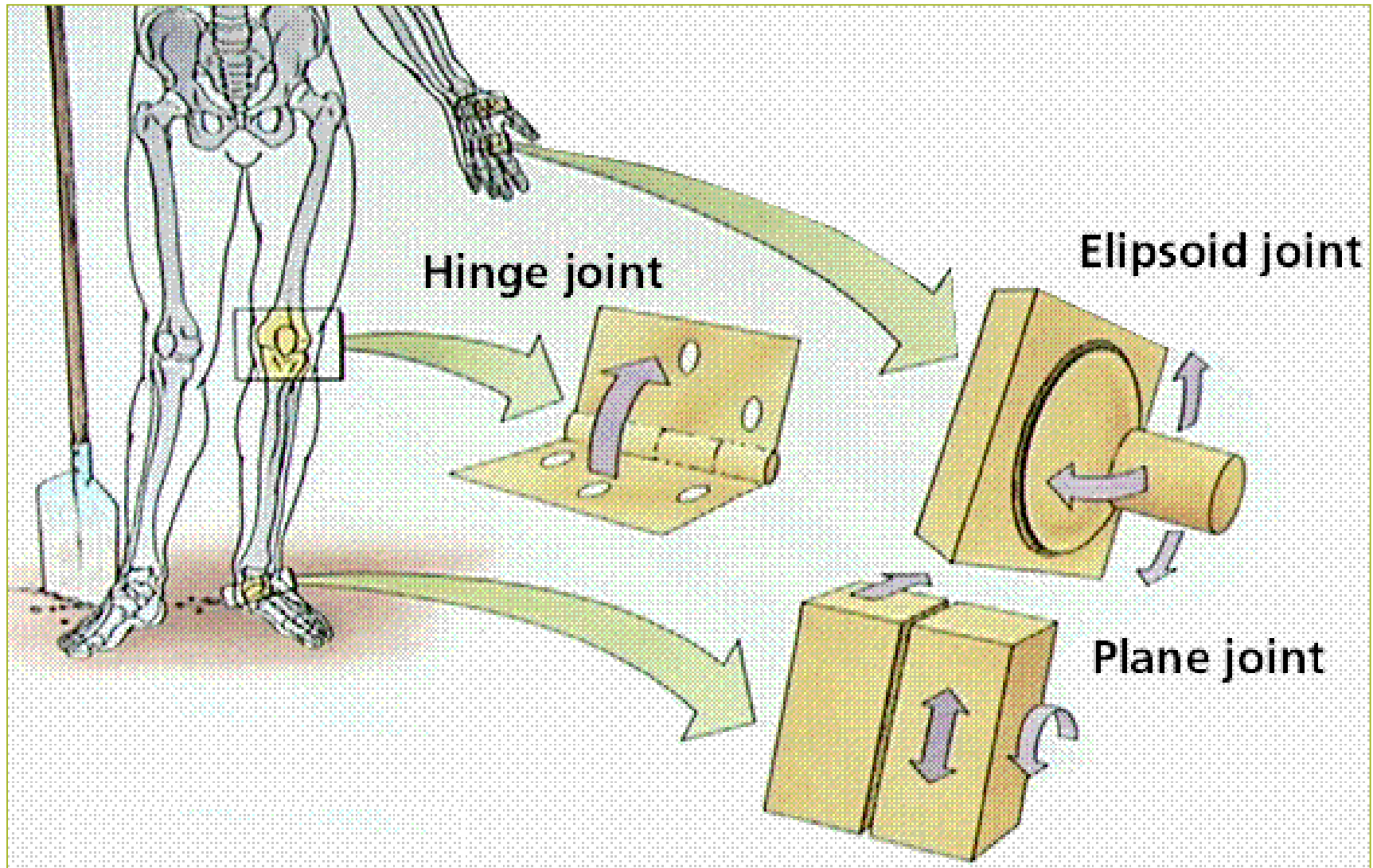
- Two anatomically isolated joints move together at the same time



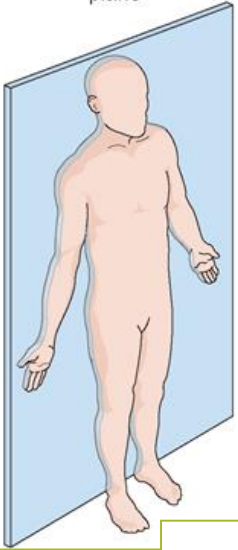
Shape of articular surfaces



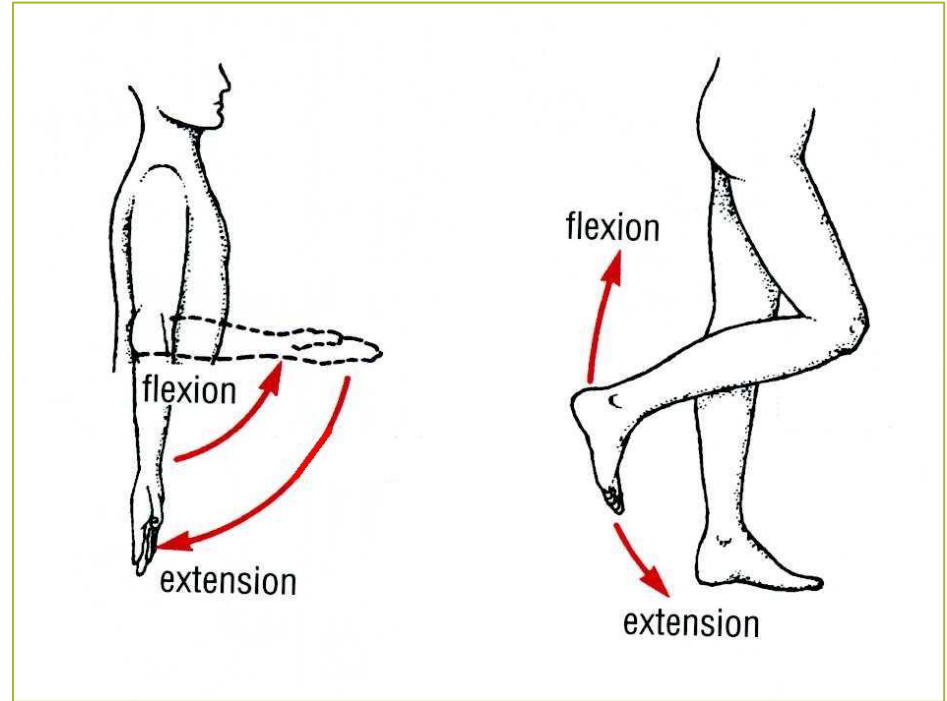
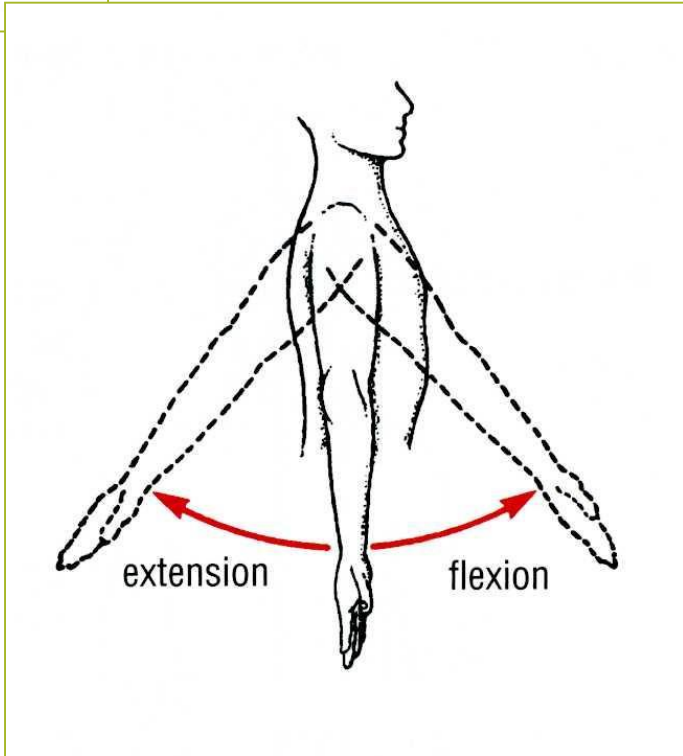
Shape of articular surfaces



Frontal
(coronal)
plane

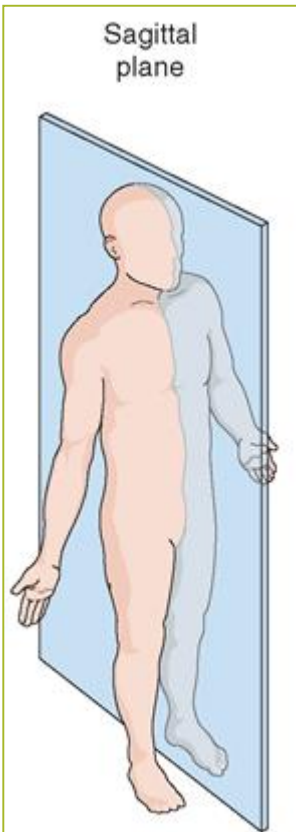


Frontal axis

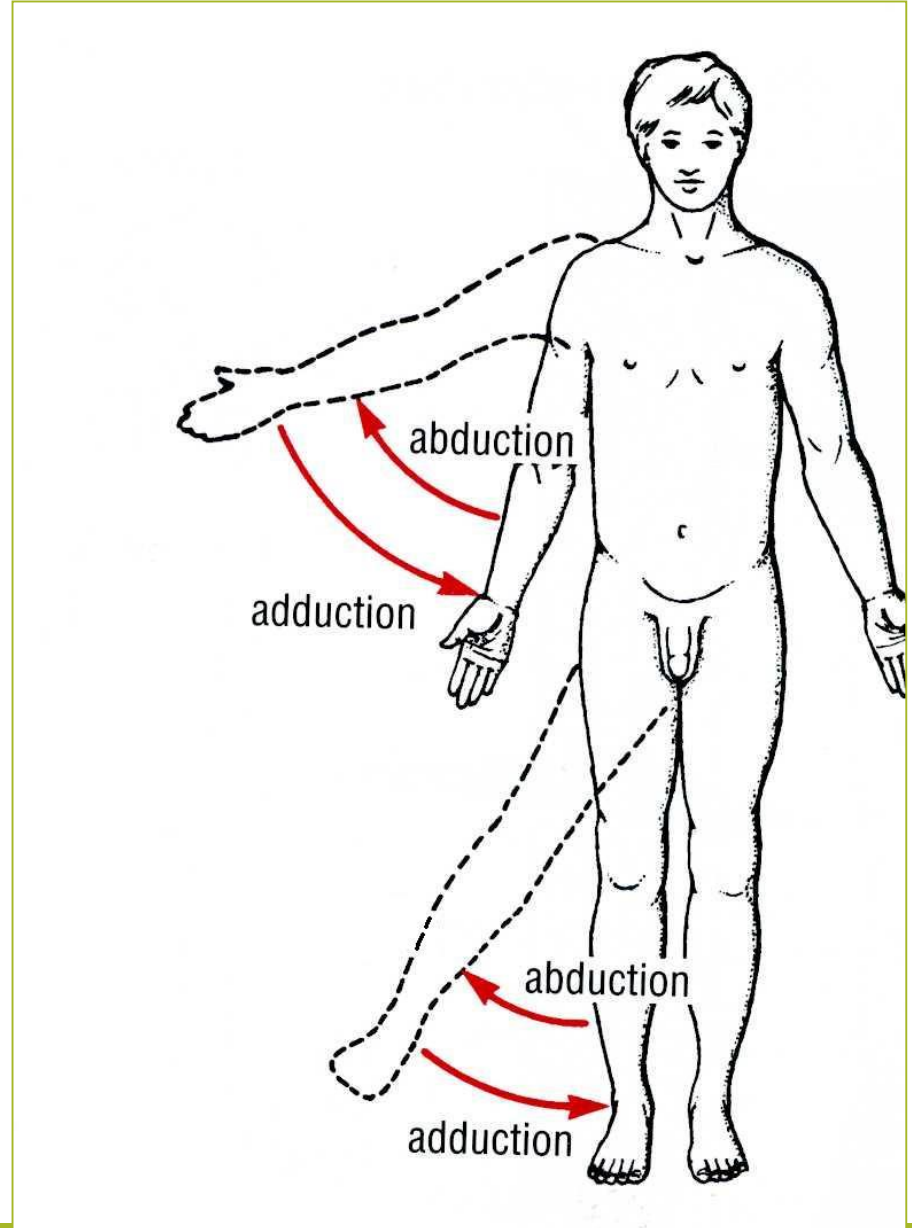


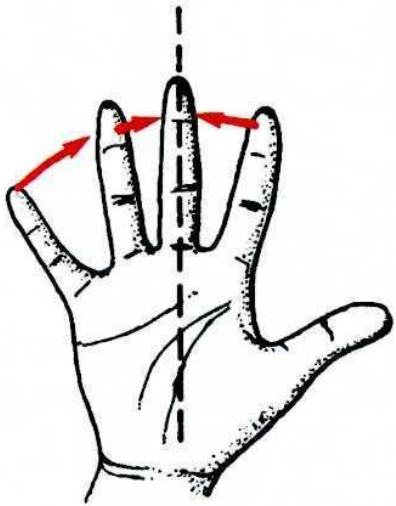
Flexion-extension

Sagittal axis

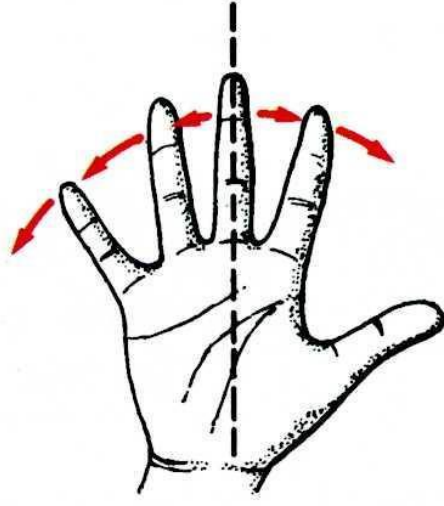


**Abduction-
adduction**

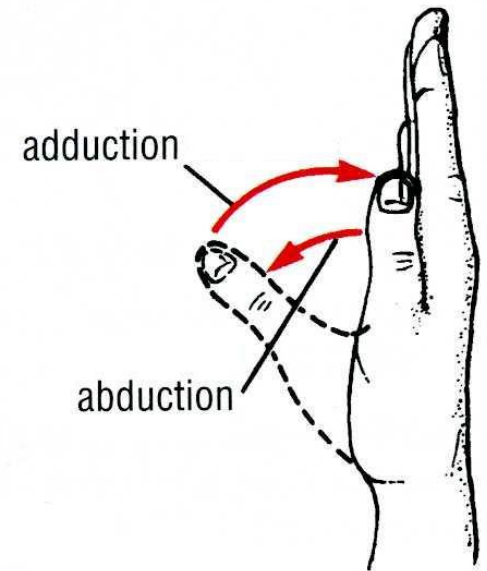
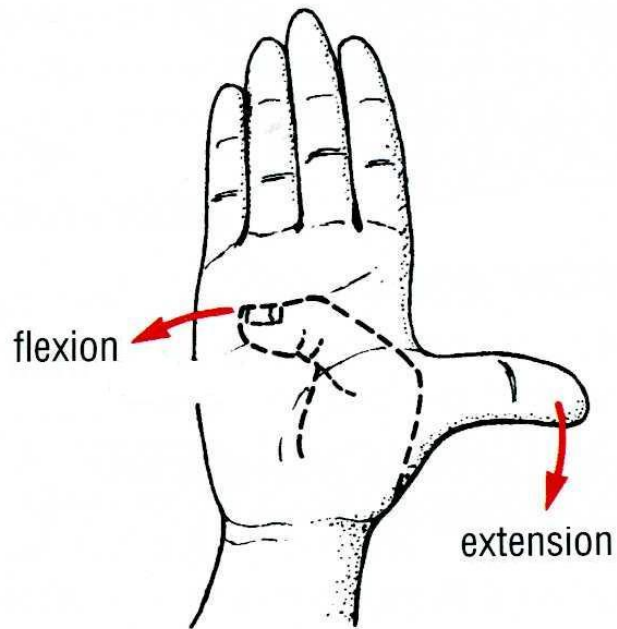




adduction



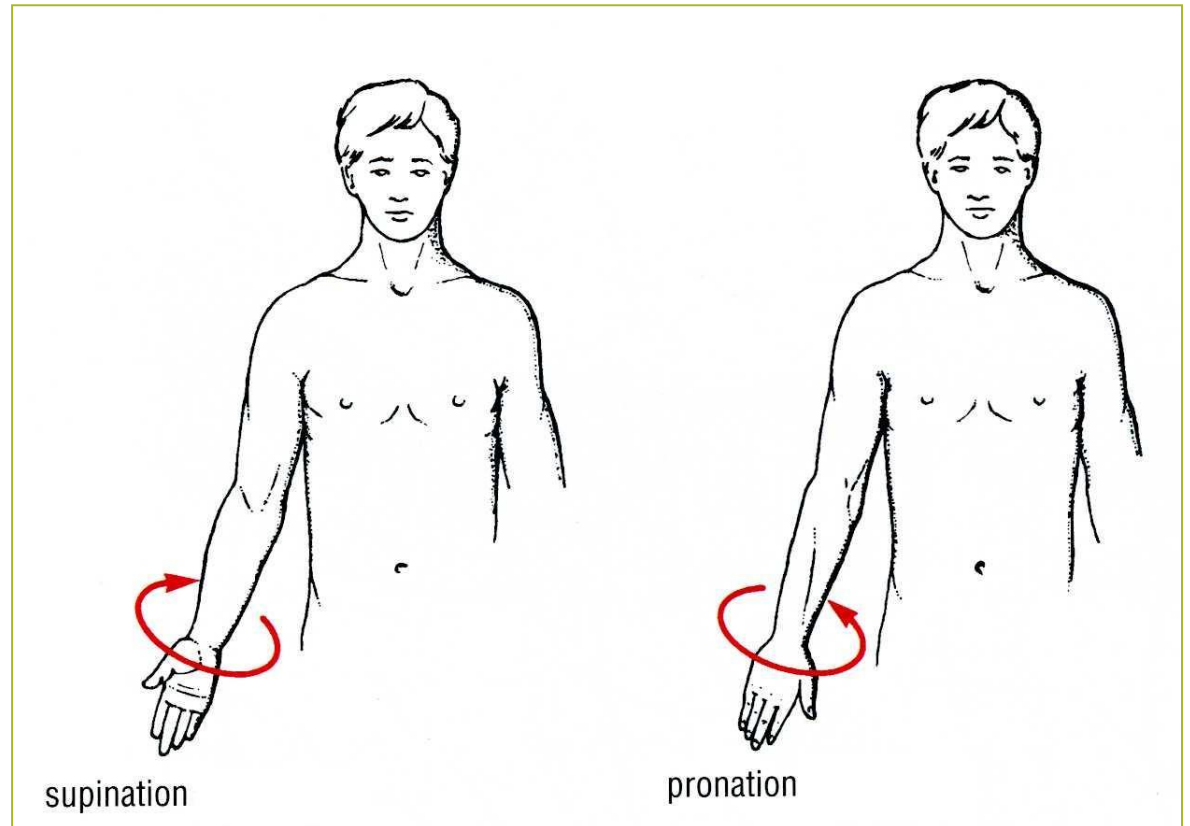
abduction



Vertical axis

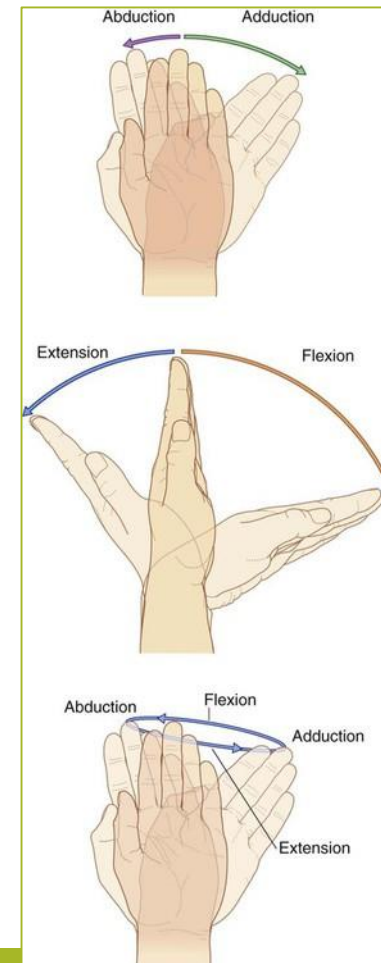
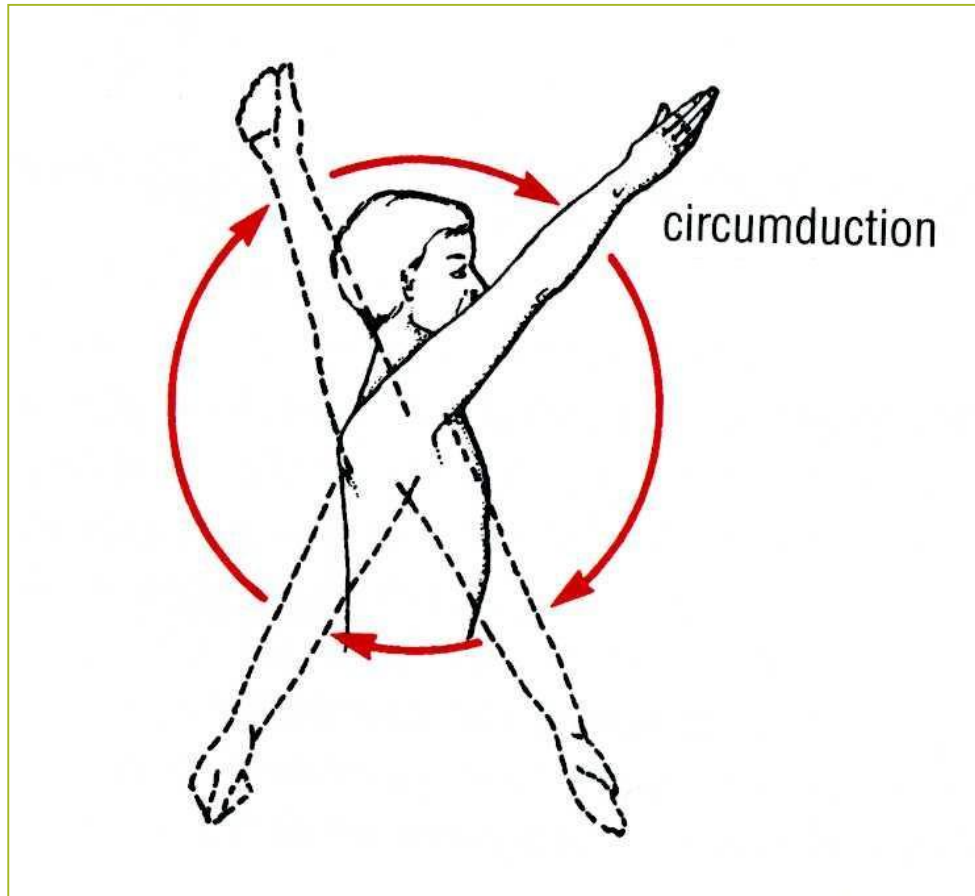
Rotation

- * outward (supinatio)
- * inward (pronatio)



Movements in all axes

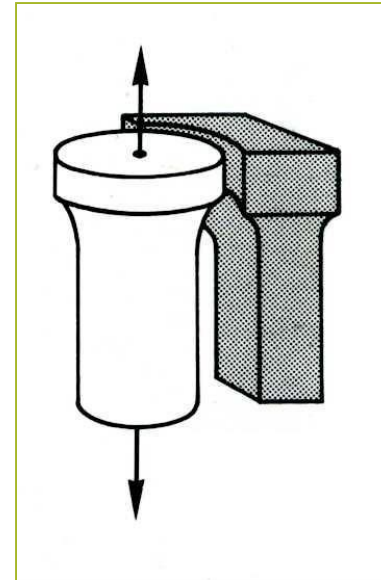
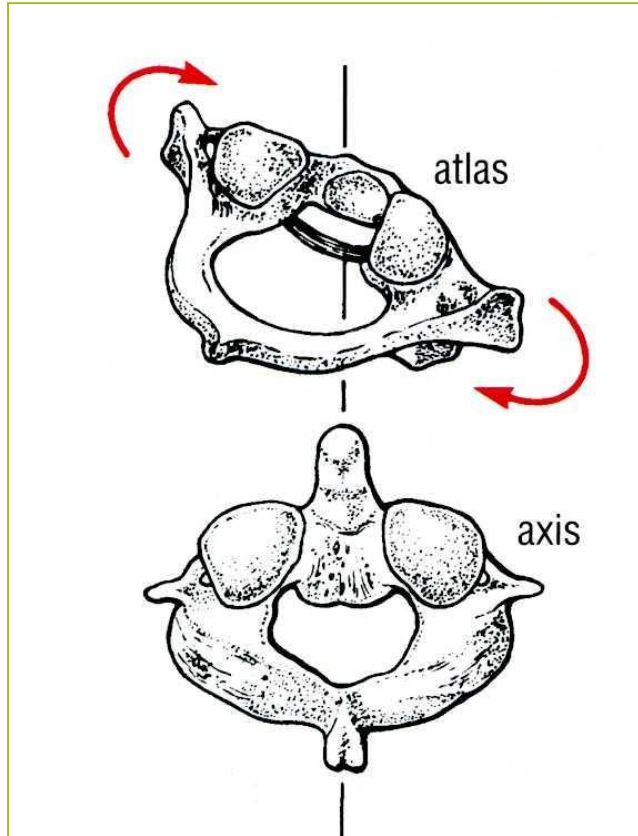
Circular movement = combination of flexion+abduction+adduction+extension



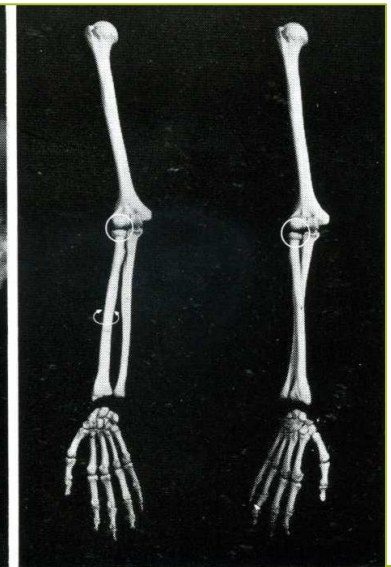
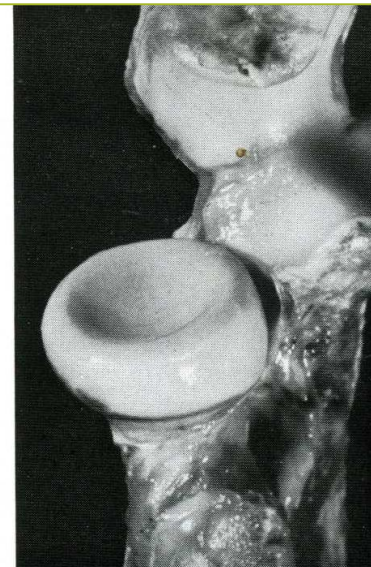
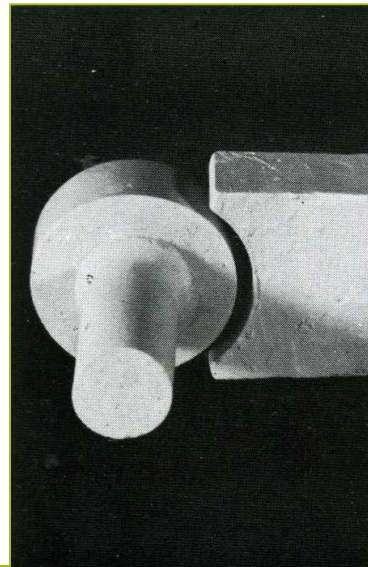
Degrees of freedom

- Moves in one plane **uniaxial** (elbow)
- Moves in two planes **biaxial** (wrist)
- Moves in three planes **multiaxial** (shoulder joint)

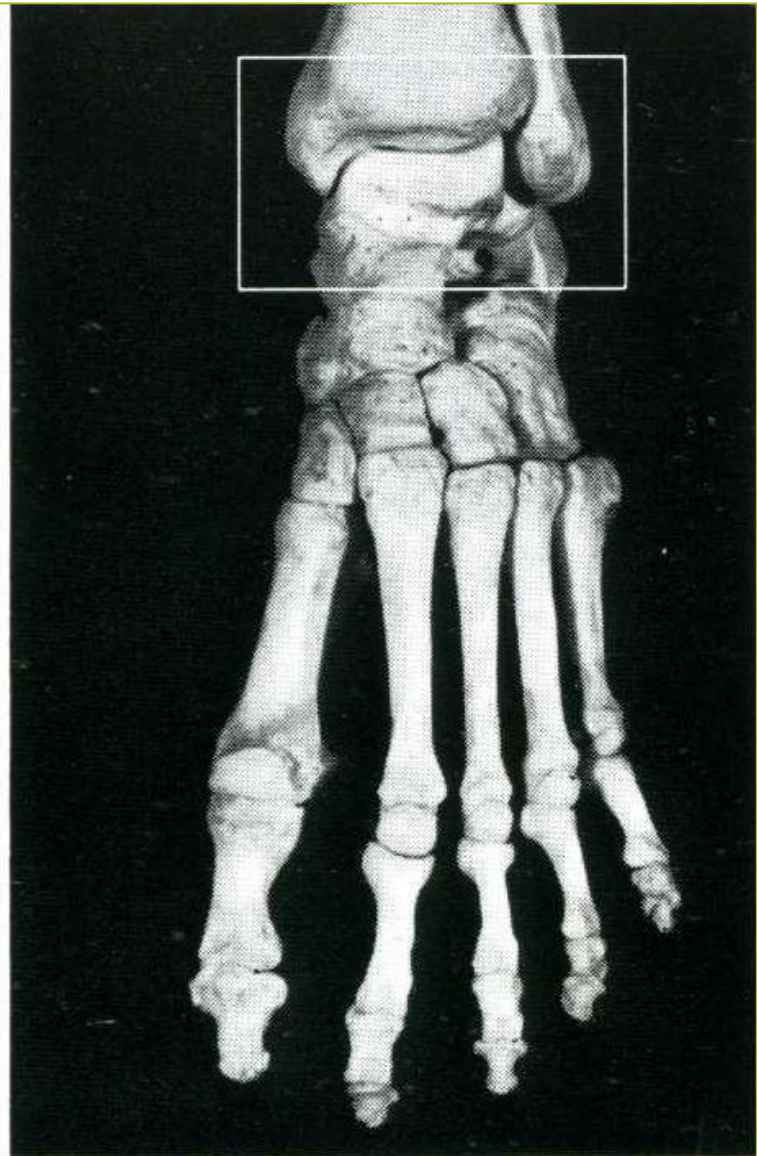
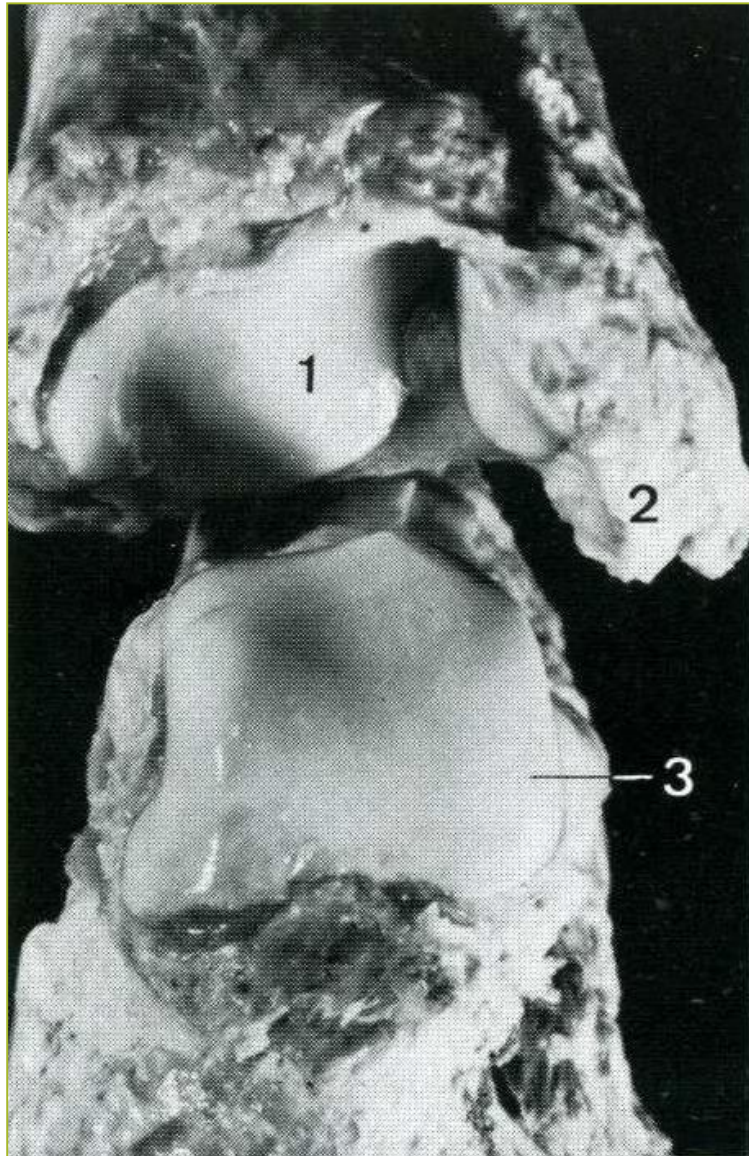
Uniaxial joints



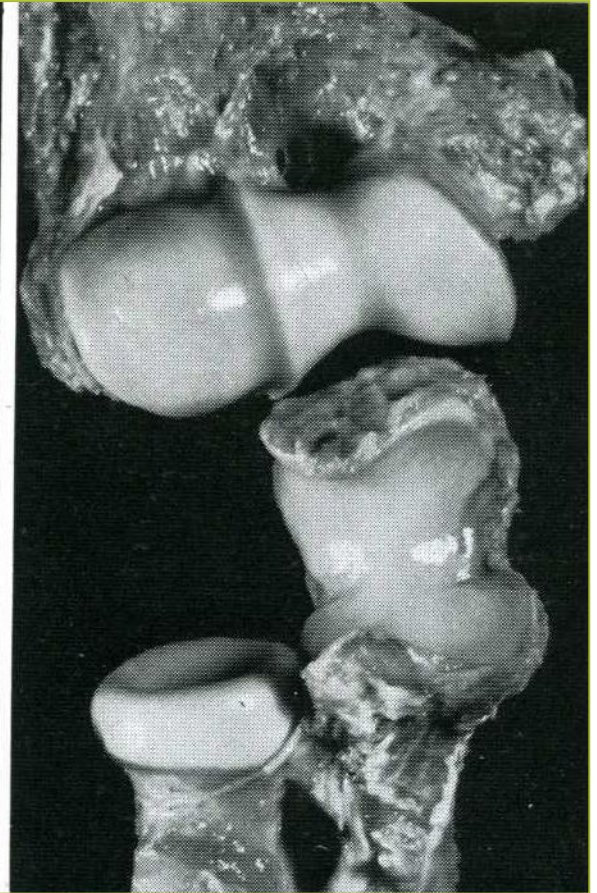
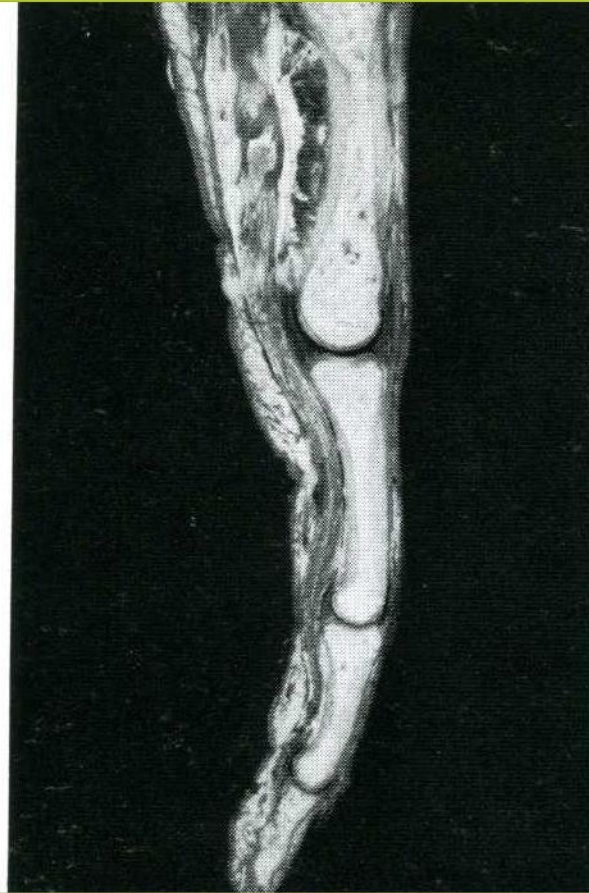
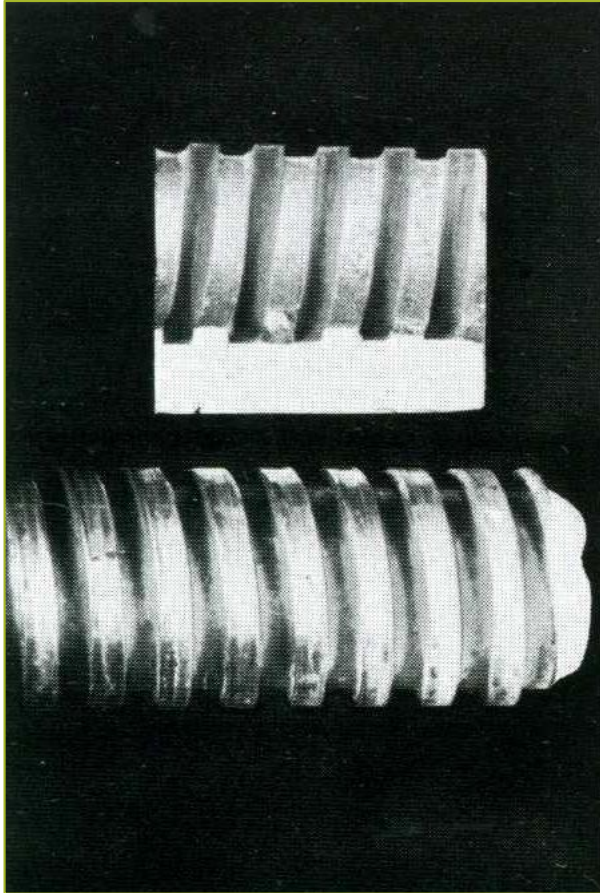
- cylindrical
- trochlear
- hinge



Uniaxial joints

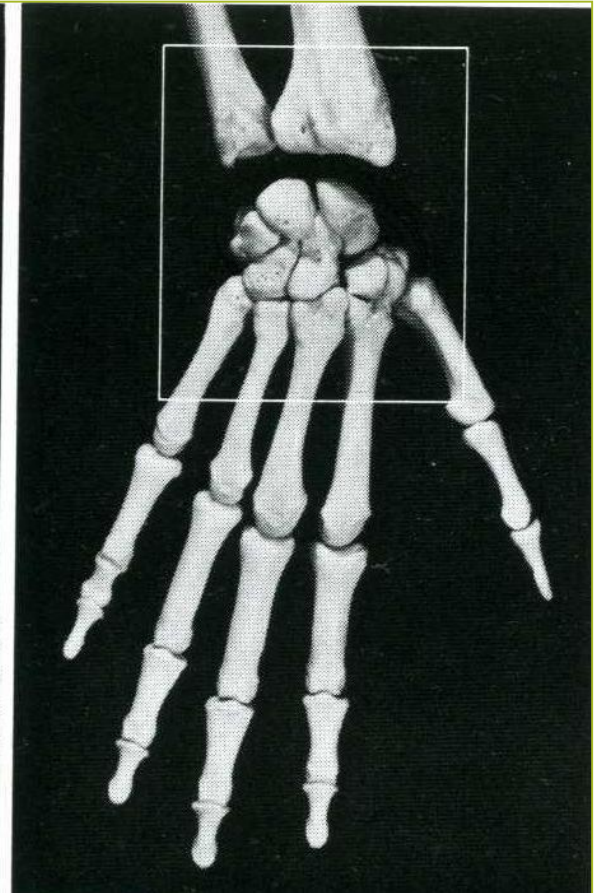
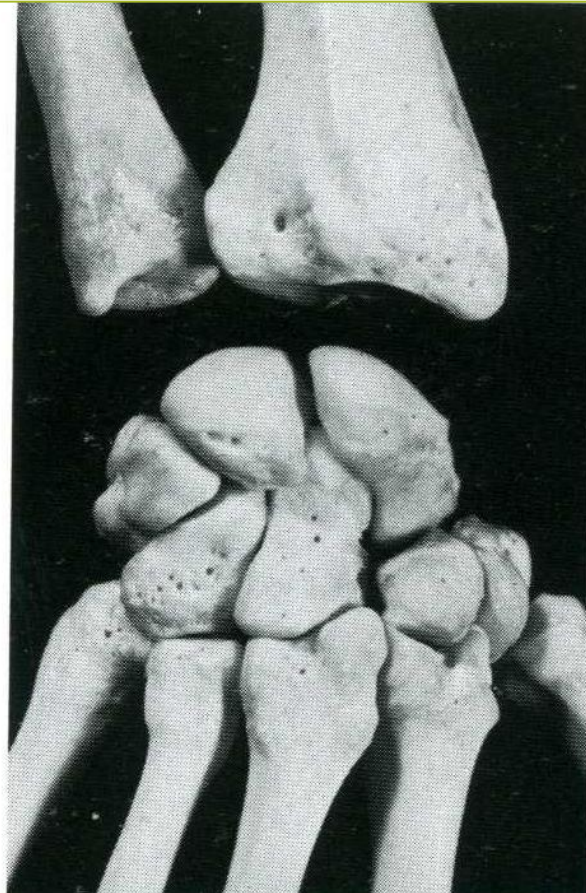
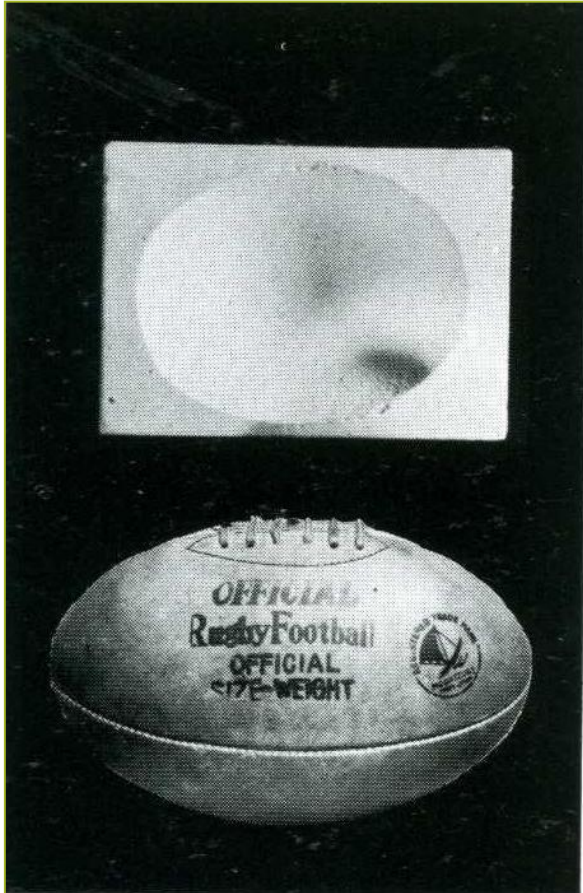


Uniaxial hinge



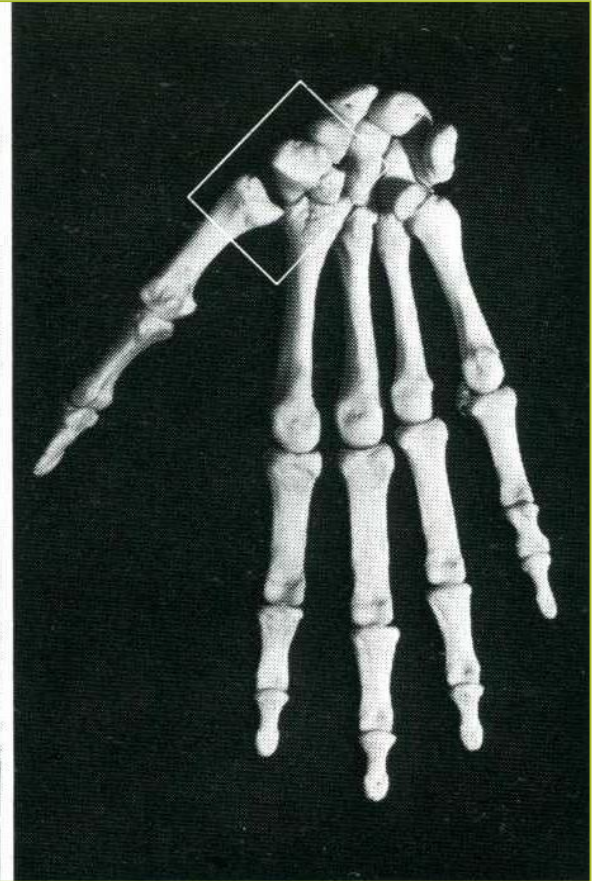
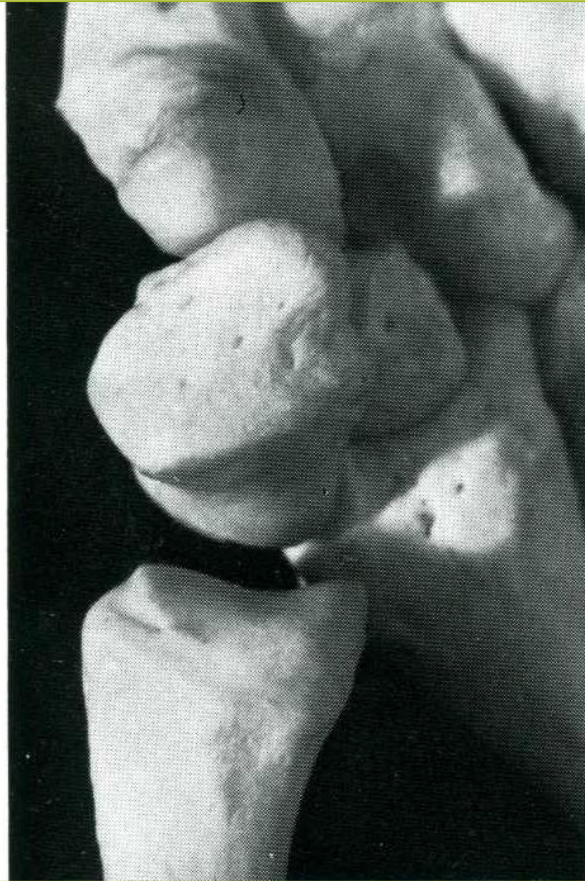
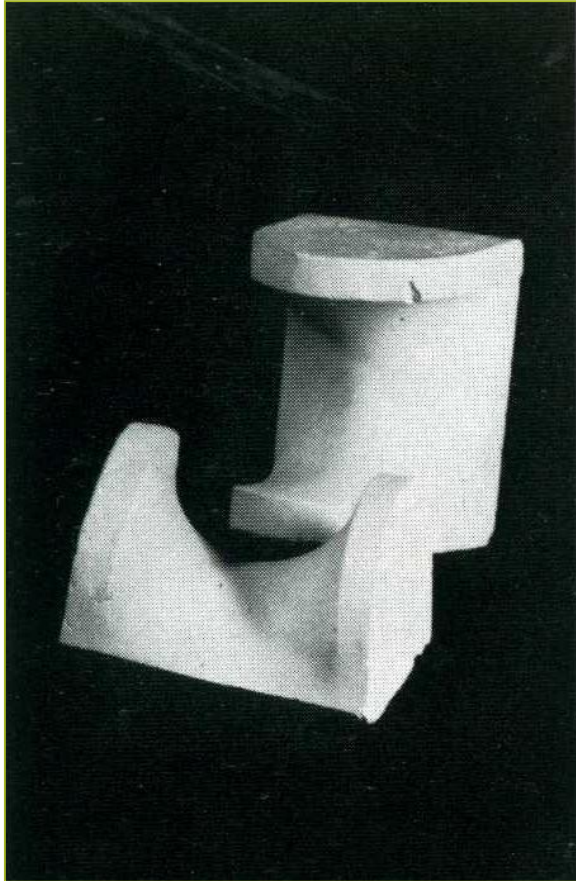
Biaxial joints

Biaxial ellipsoid



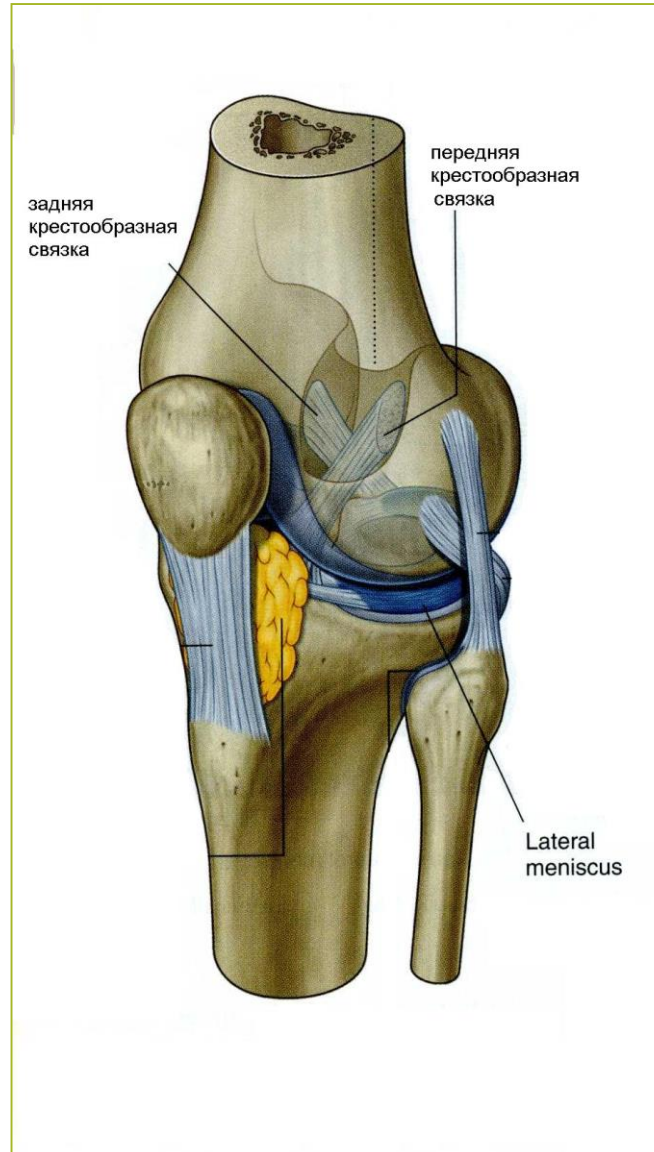
Biaxial joints

Biaxial saddle



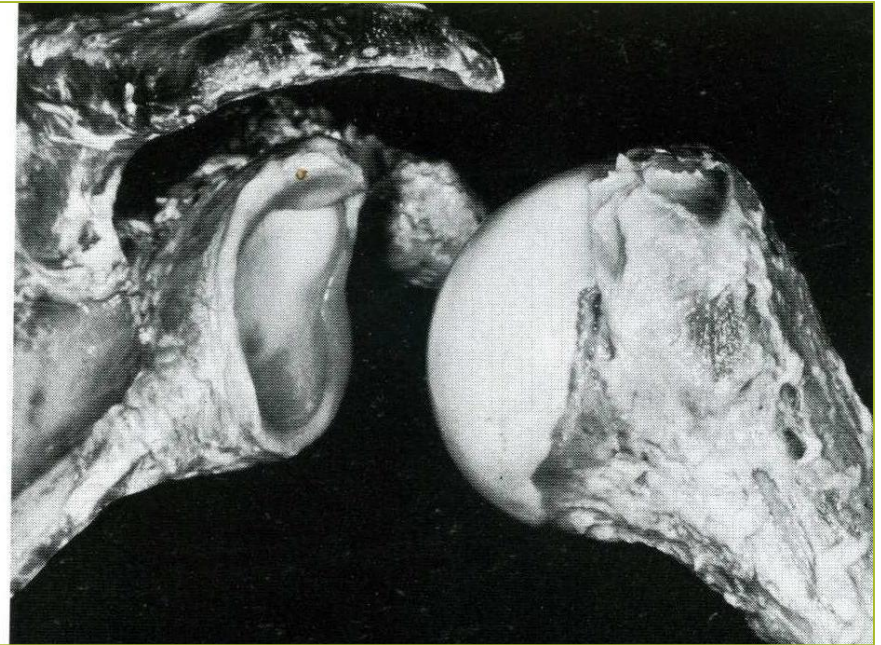
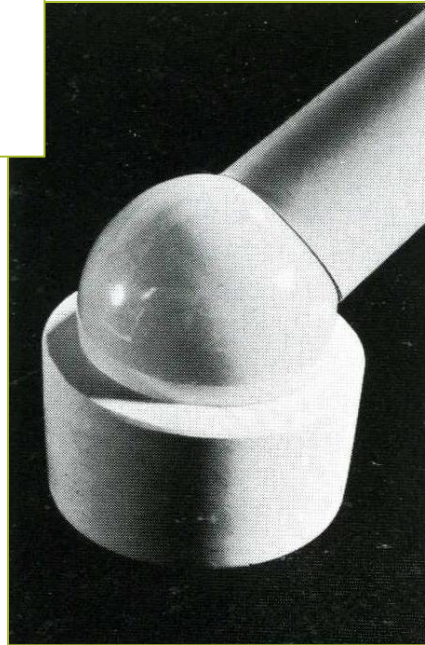
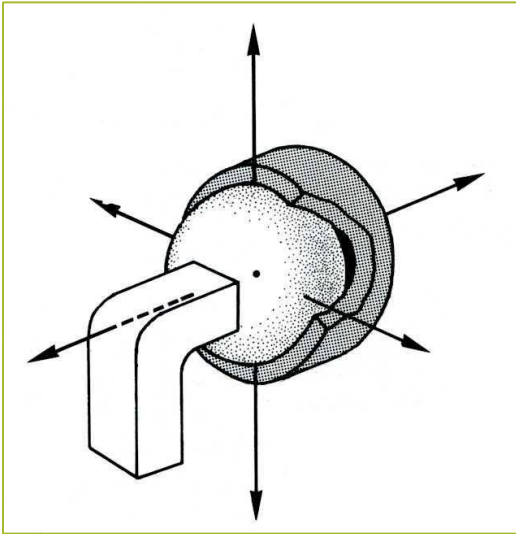
Biaxial joints

Biaxial condylar



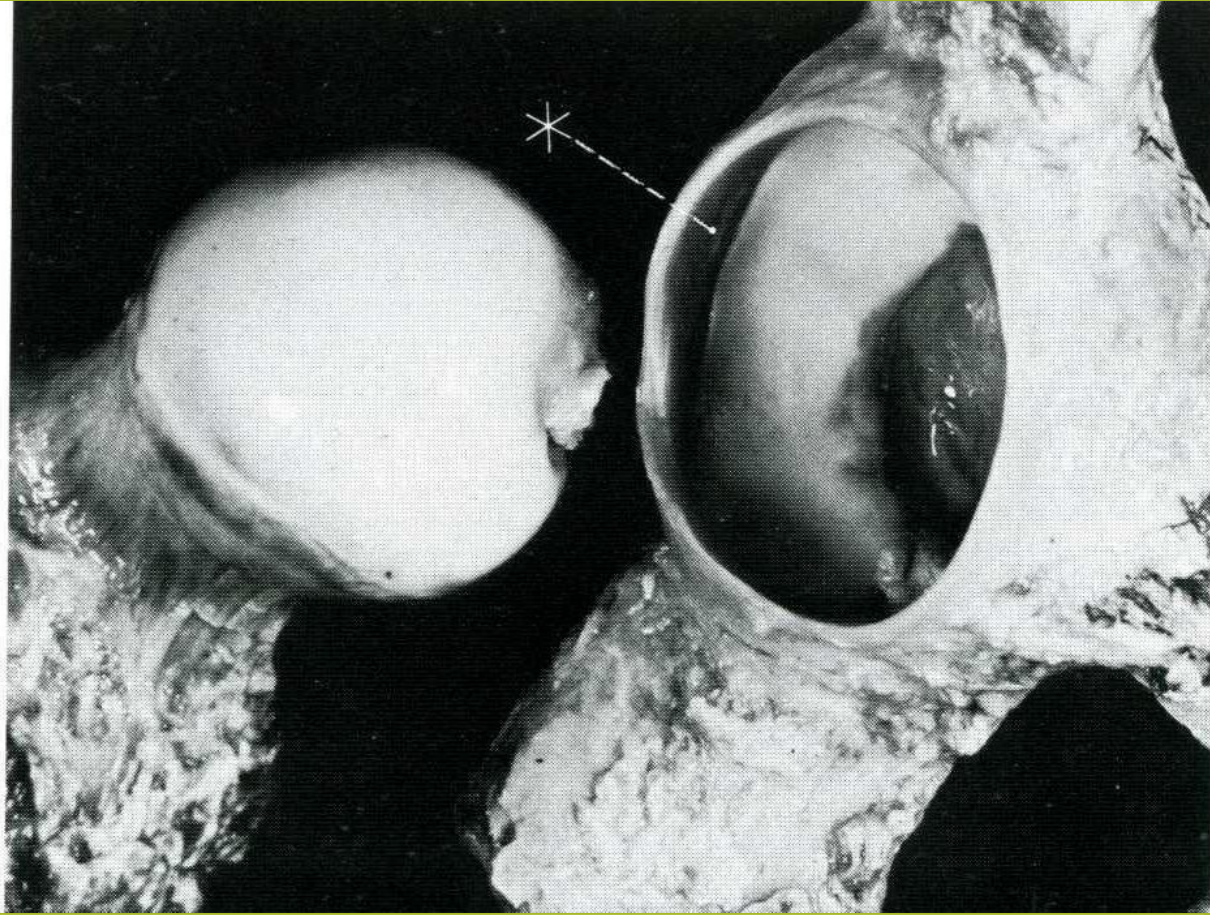
Multiaxial joints

Multiaxial ball-and-socket



Multiaxial joints

Multiaxial scyphiform



Multiaxial joints

Multiaxial plane

