

Change of bones lending from  
24th October till time of autopsies

Monday and Tuesday closed

Wednesday 9-14

Thursday 9-16

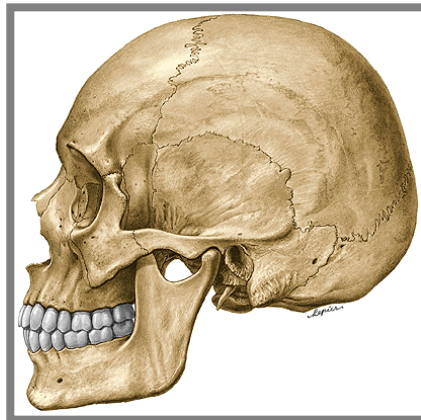
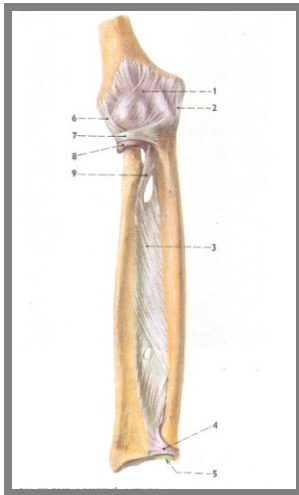
Friday 9-14

# Arthrology

**arthros (joint), logos (science)**

# Arthrology — study of joints (*articulatio*)

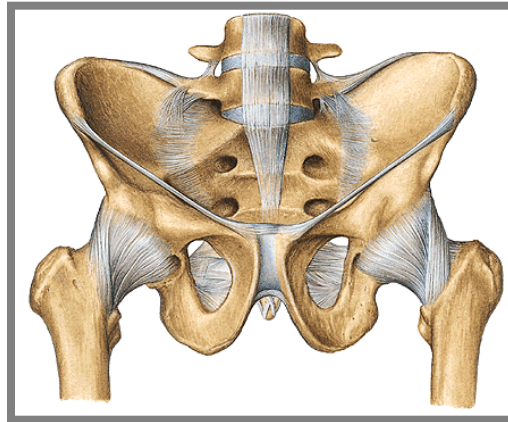
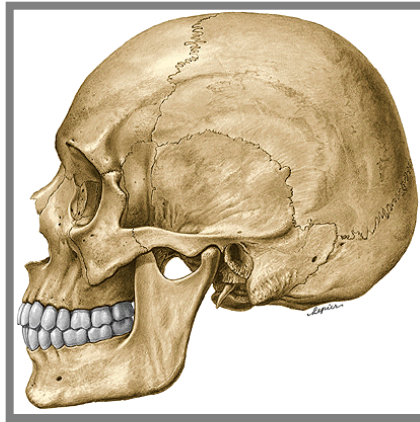
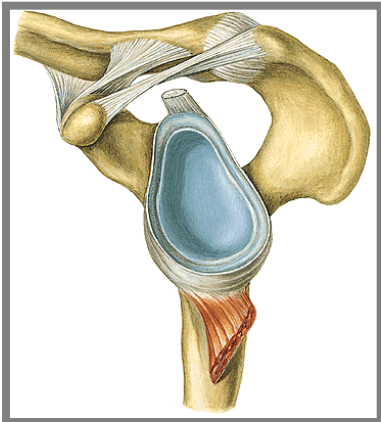
- 1) ***Synarthrosis*** (continuous/fibrous joint)— continuous connection of bones by connective tissue (fibrous tissue, cartilage, bone)
- 2) ***Diarthrosis (Synovial joint)*** — movable connection of bones by contact of articular surfaces covered by articular cartilage and with additional features



# ***Synarthrosis = continuous/fibrous joint***

(nearly immobile, continuous articulation of bones)

- 1) Syndesmosis** (*fibrous joint*) – bones are linked by connective tissue (collagenous or elastic) – ligaments, gomphosis (peg-and-socket joint) and sutures
- 2) Synchondrosis** (*cartilaginous joint*) – bones are linked by cartilage
- 3) Synostosis** – bones are linked by bone tissue





# ***I. Synarthrosis*** (continuous/fibrous joint)



1. syndesmosis

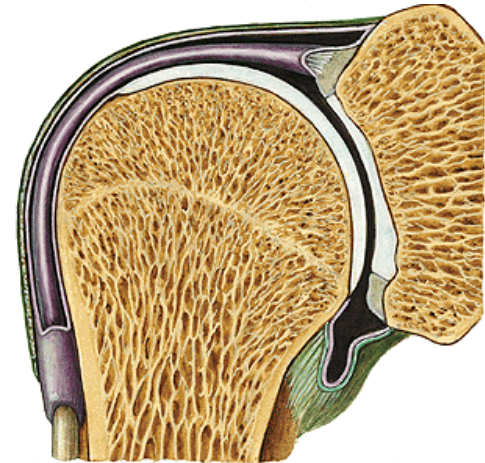


2. synchondrosis



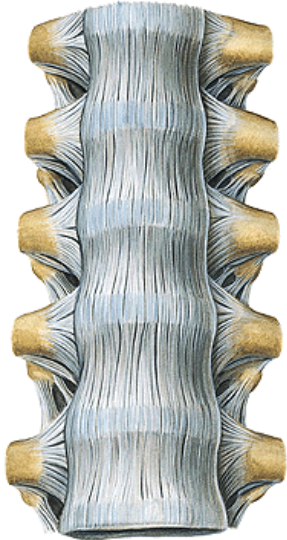
3. synostosis

# ***II. Diarthrosis*** (synovial joint)



# Ad 1. Syndesmosis (fibrous joint)

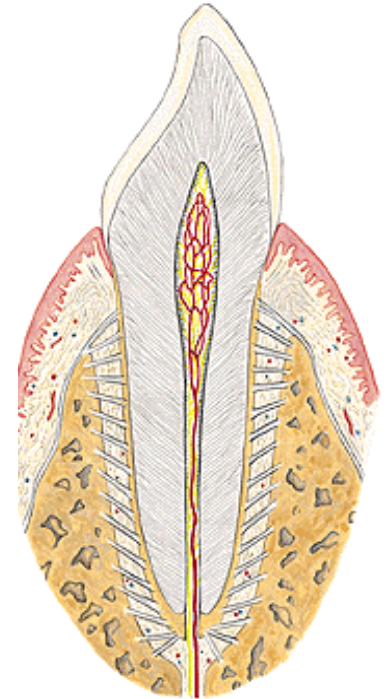
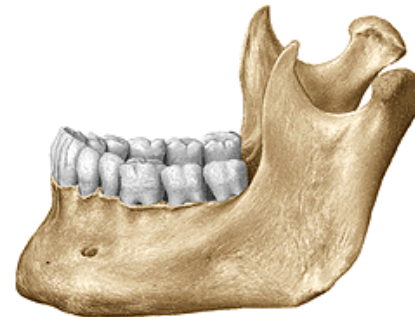
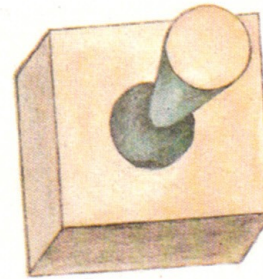
## 1. Ligaments



## 2. Membranes



## 3. Gomphosis (peg-and-socket joint)

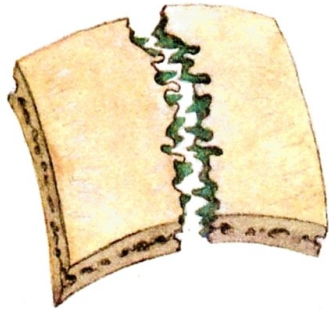
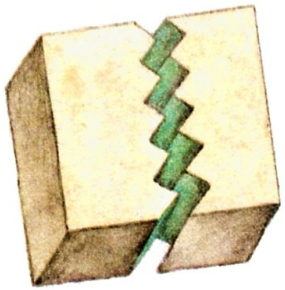


## 4. Sutures

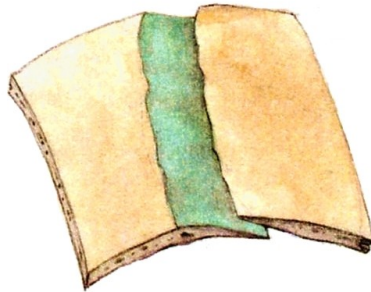
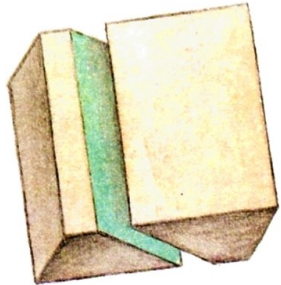
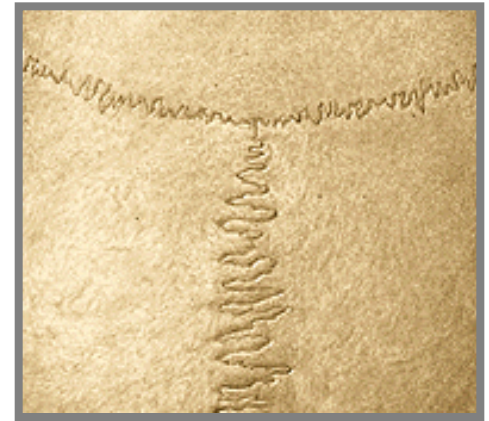




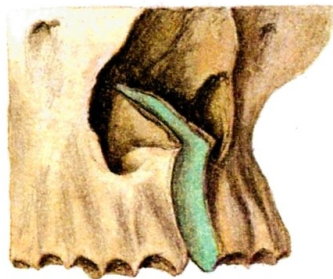
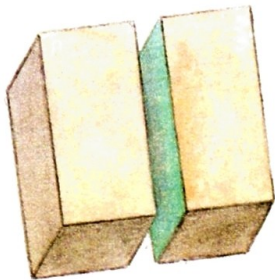
## 4. Sutures



**Sutura serrata**



**Sutura squamosa**  
(*Squamous suture*)



**Sutura plana**

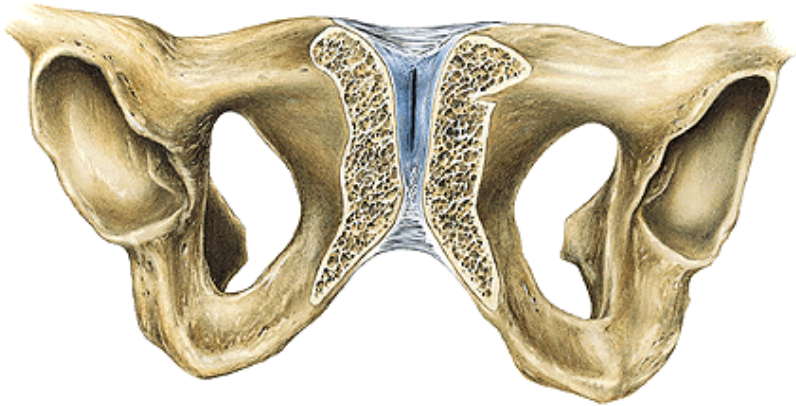


# Synarthrosis (continuation)

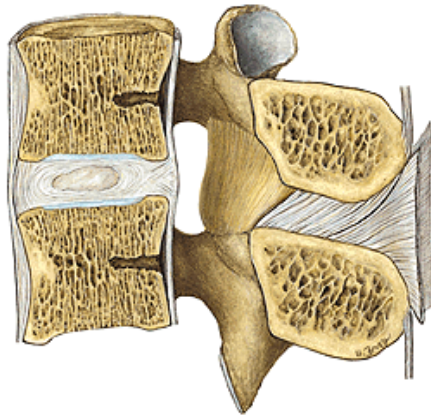
## 2. Synchondrosis

(cartilaginous joint)

Symphysis pubica

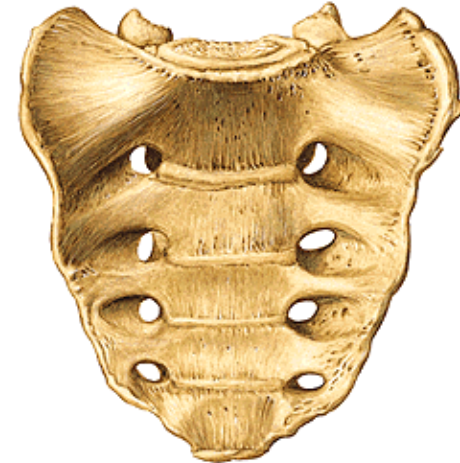


Discus intervertebralis (*intervertebral disc*)



## 3. Synostosis

Os sacrum



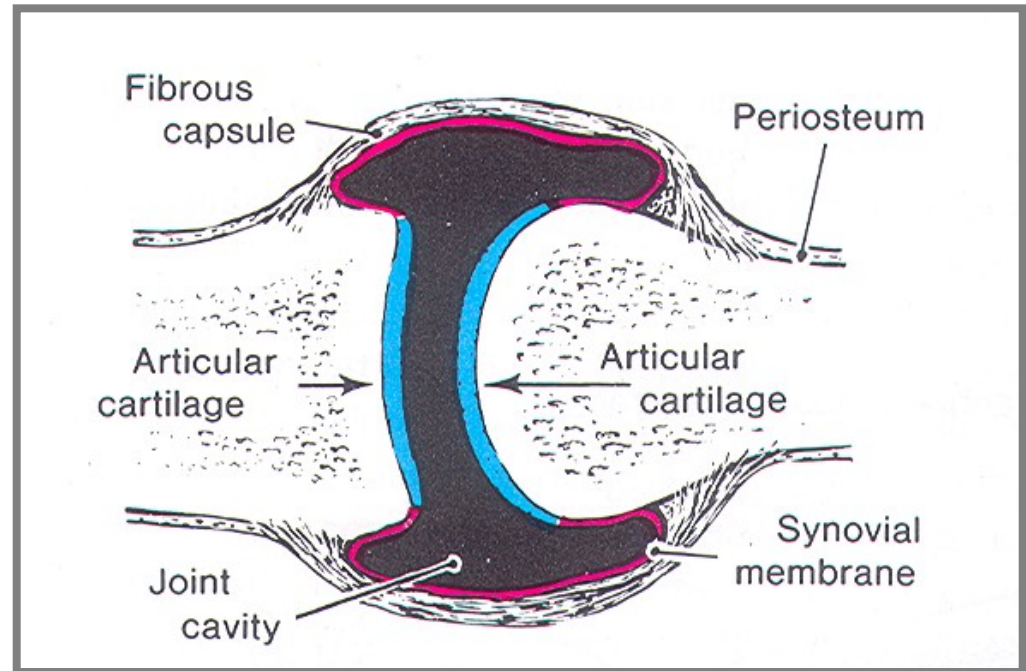
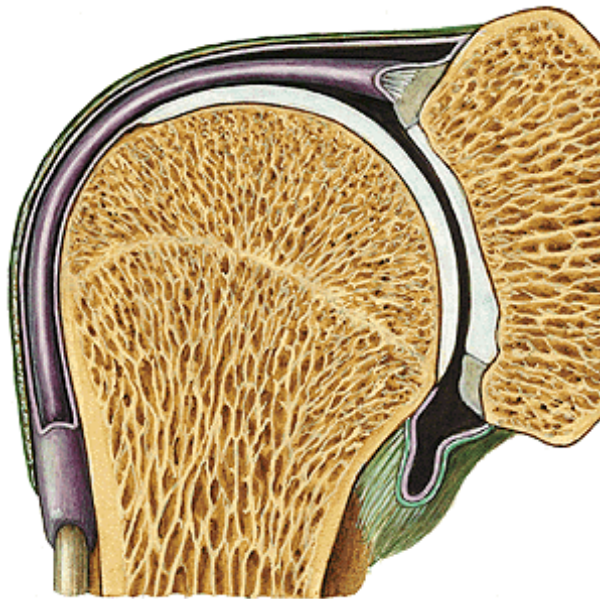
Os coccygis





## II. **Articulatio=synovial joint= *Diarthrosis***

movable connection of two or more bones by touch of contact  
articular surfaces covered by articular cartilage and with auxiliary  
facilities



# General features of a synovial joint (diarthrosis)

**Facies articulares** (*articular surfaces*) (fossa articularis, caput articulare)

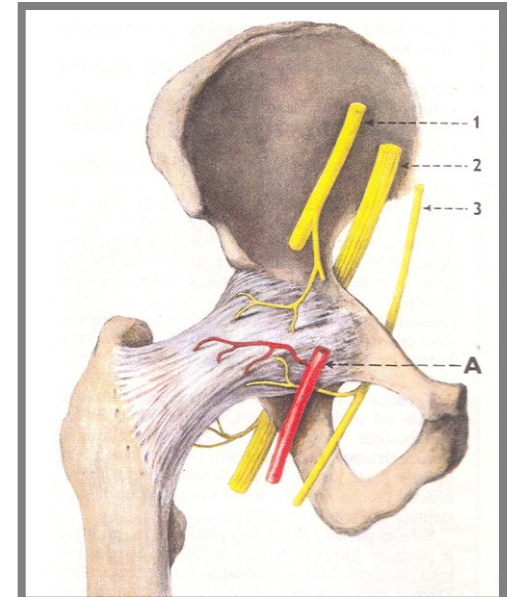
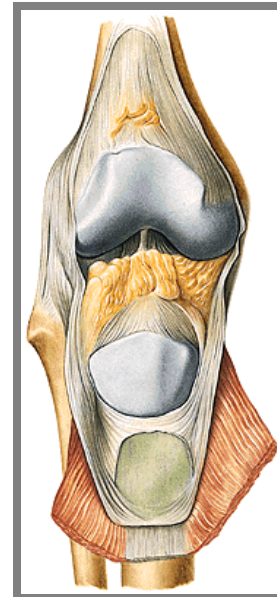
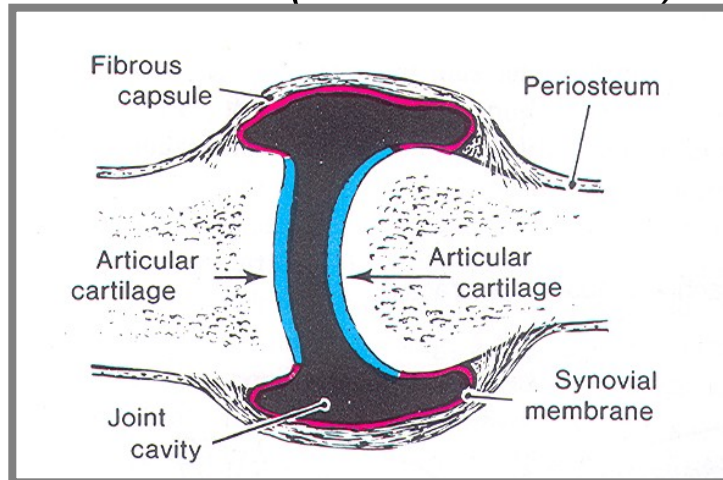
**Capsula articularis** (*joint capsule*) = (stratum fibrosum and stratum synoviale) – *fibrous and synovial layers*)

**Cavitas articularis** – capillary space filled by synovia (*synovial fluid*)

**Synovia** (*Synovial fluid*) – nourishes the articular cartilage, increases adhesion and decreases friction of contact surfaces (lubricant)

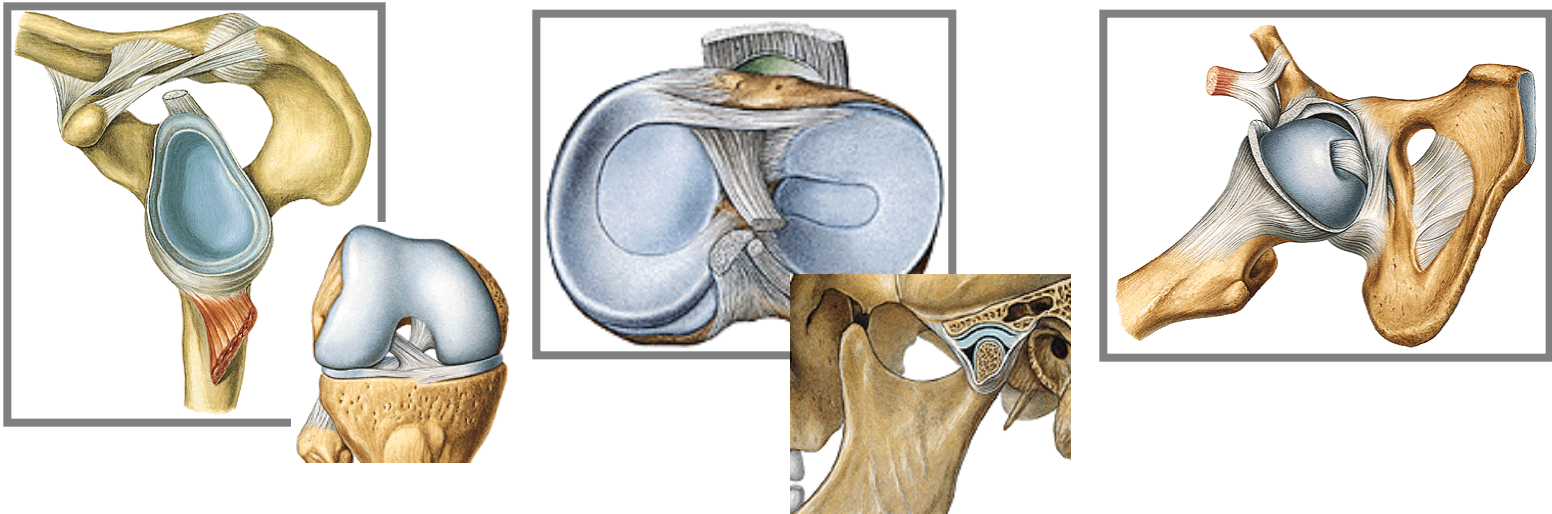
**Synovial plicae or synovial villi**

**Rete articulare** (*Articular network*)



# Auxiliary facilities of joints

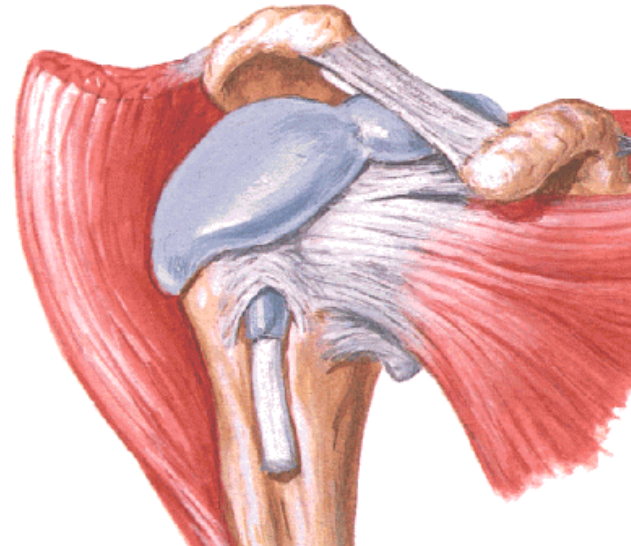
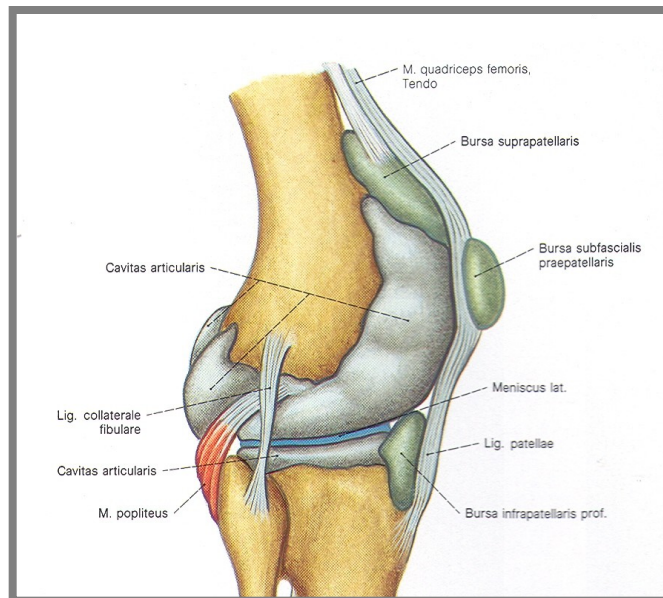
- a) **labrum articulare** – *fibrocartilaginous ring* – broadening of a shallow articular fossa by a strip of fibrous tissue and/or cartilage
- b) **disci and menisci articulares** – *plates of cartilage* - serves as elastic pad, discs divide the articular cavity into two parts, menisci only partly
- c) **ligamenta** are present in the most joints as ligamenta capsularia, extracapsularia or intracapsularia (*capsular, extracapsular or intracapsular ligaments*)





**d) muscoli articulares** (*articular muscles*) prevent joint capsule of a strangulation

**e) bursae synoviales** (*bursae and synovial pockets*) – small cavities close to the joint. They are constructed by synovial membrane and synovial fluid. They may communicate with the joint cavity. They decrease friction between tendons of muscles and bones.



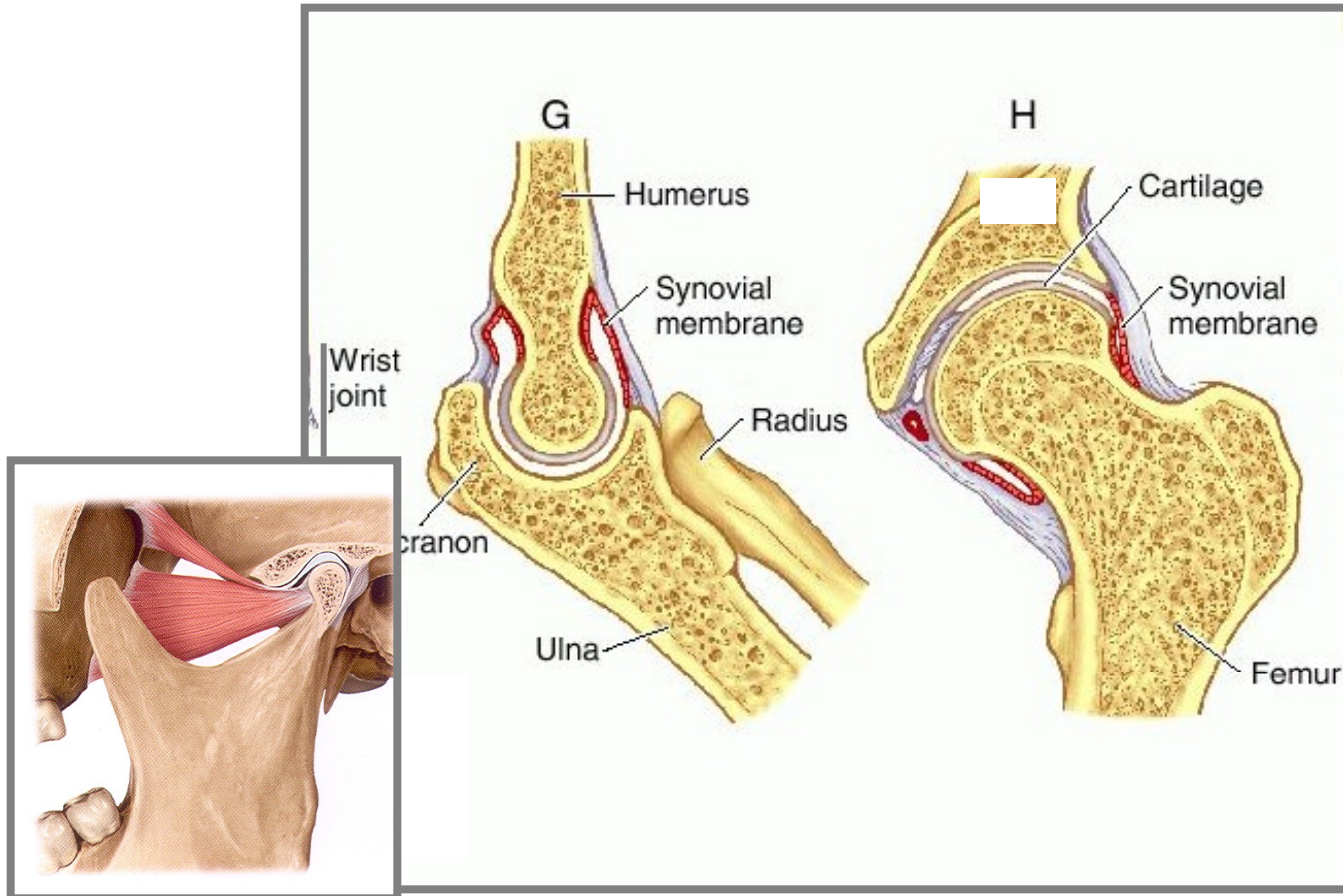


# Division of joints

A. According to a number of bone in contact:

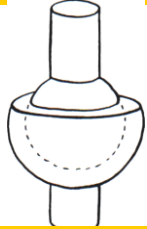
**Articulatio simplex** *Simple joint*

**Articulatio composita** *Compound joint*

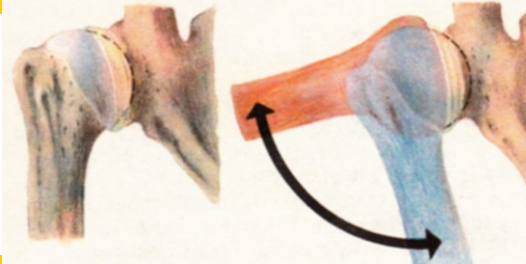


## B. Division of joints according to the shape of articular surfaces:

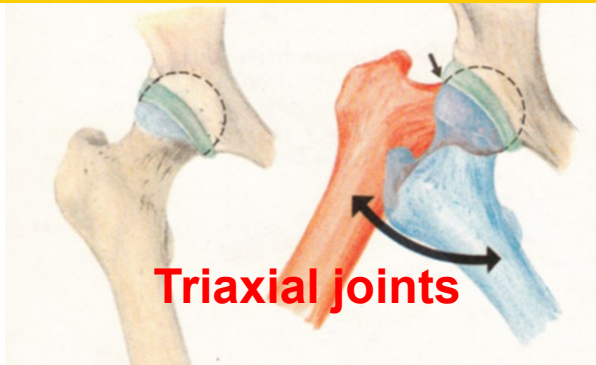
### 1. articulatio spherioidea *ball-and-socket joint*



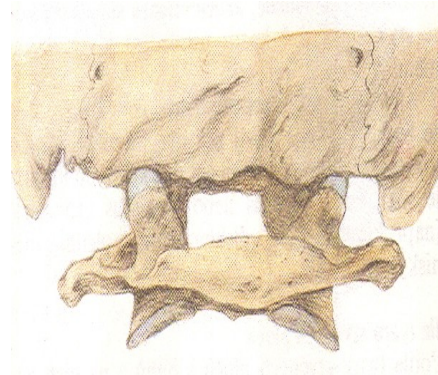
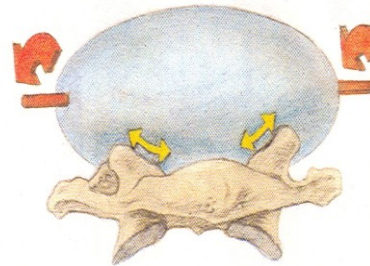
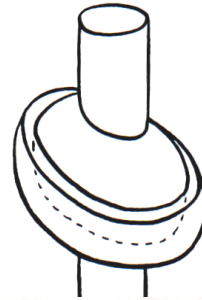
#### a) Arthrodia – free movements



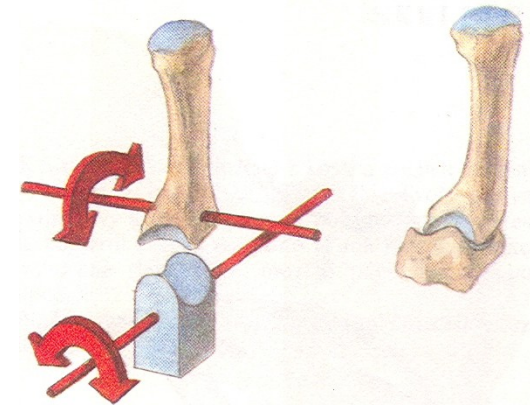
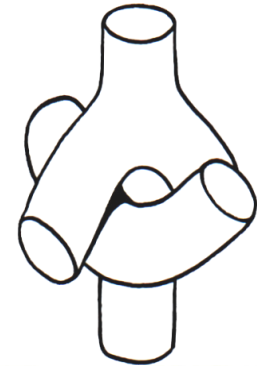
#### b) Enarthrosis – restricted movements



### 2. articulatio ellipsoidea *ellipsoidal (condyloid) joint*



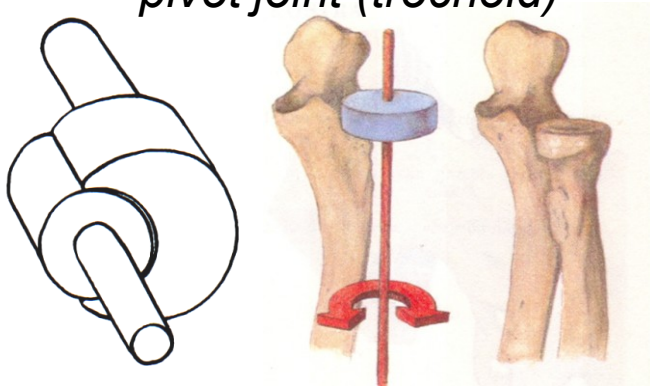
### 3. articulatio sellaris *saddle joint (sellar)*



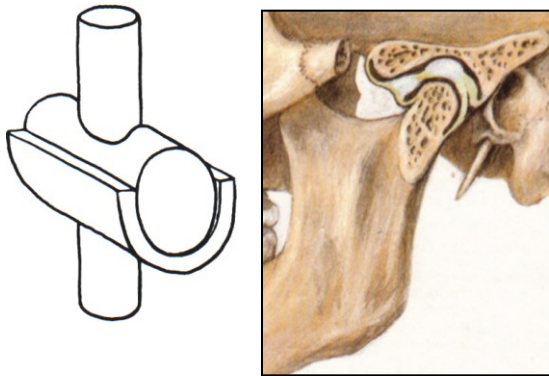
**Biaxial joints**

## 4. Articulatio cylindroidea cylindrical joint

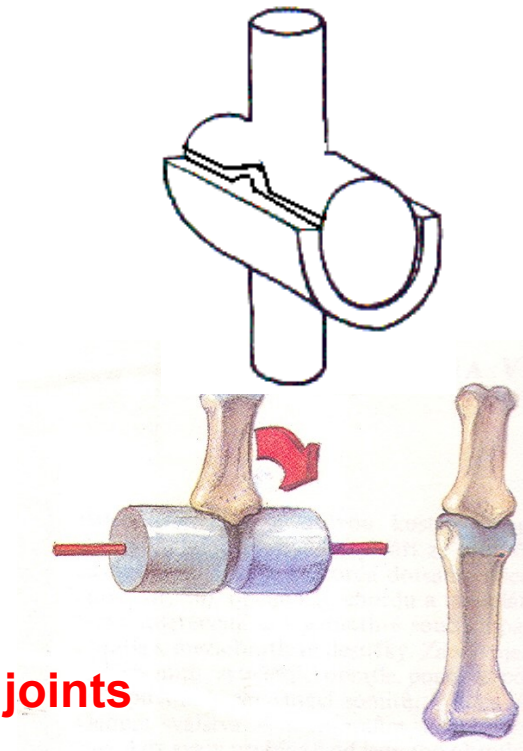
### 4a) Articulatio trochoidea *pivot joint (trochoid)*



### 4b) ginglymus

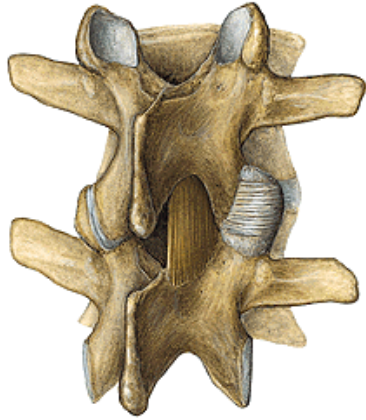


## 5) Articulatio trochlearis *hinge (trochlear) joint* (with ledge-shaped elevation)

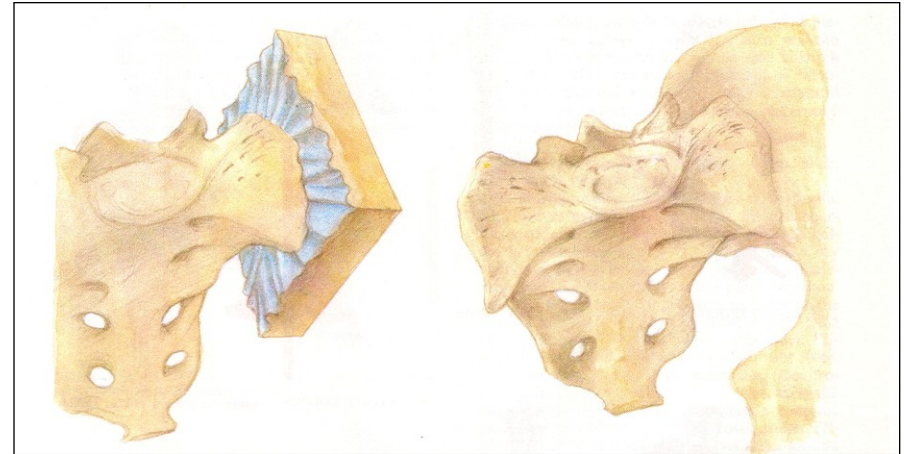


**Monoaxial joints**

**5. Articulatio plana**  
*Joint with sliding movements*



**6. Amfiartrosis**  
*Joint with minimal movements*



**Middle position of the joint** – position in which a joint capsule is evenly and maximum relaxed (the joint is the least loaded).



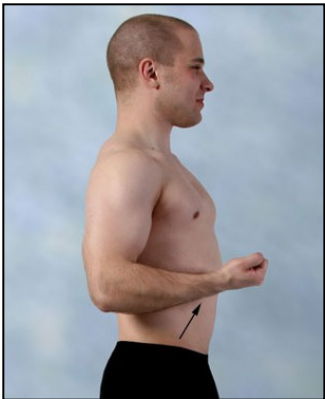
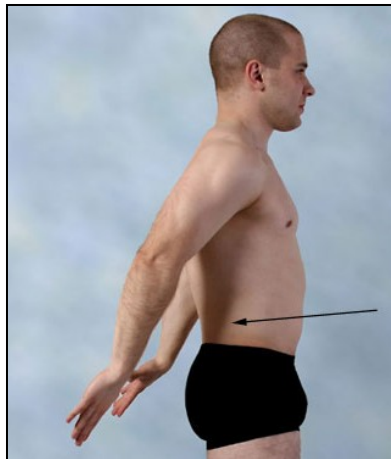
# Movements in joints

I.

**flexion**

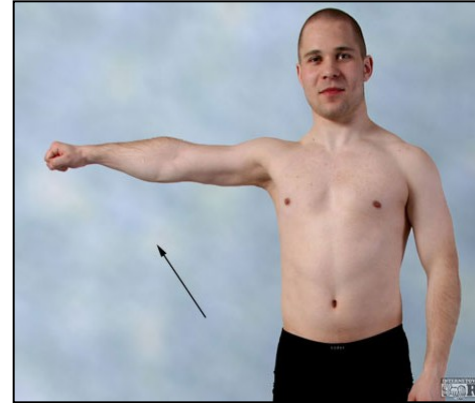


**extension**

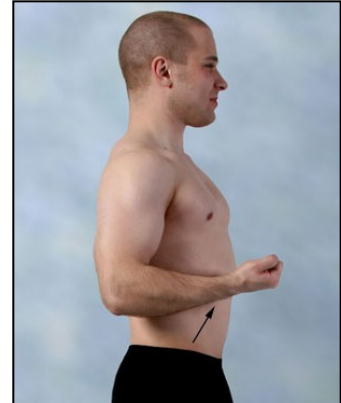


II.

**abduction**

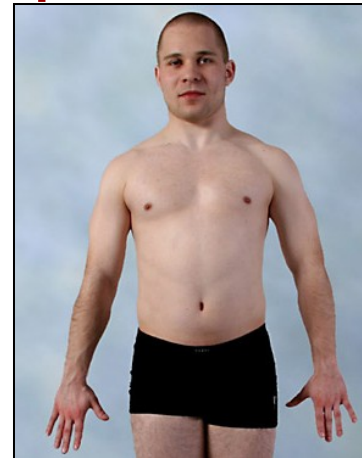


**adduction**



III.

**pronation**



**supination**



# Special arthrology

## Connection on the skull

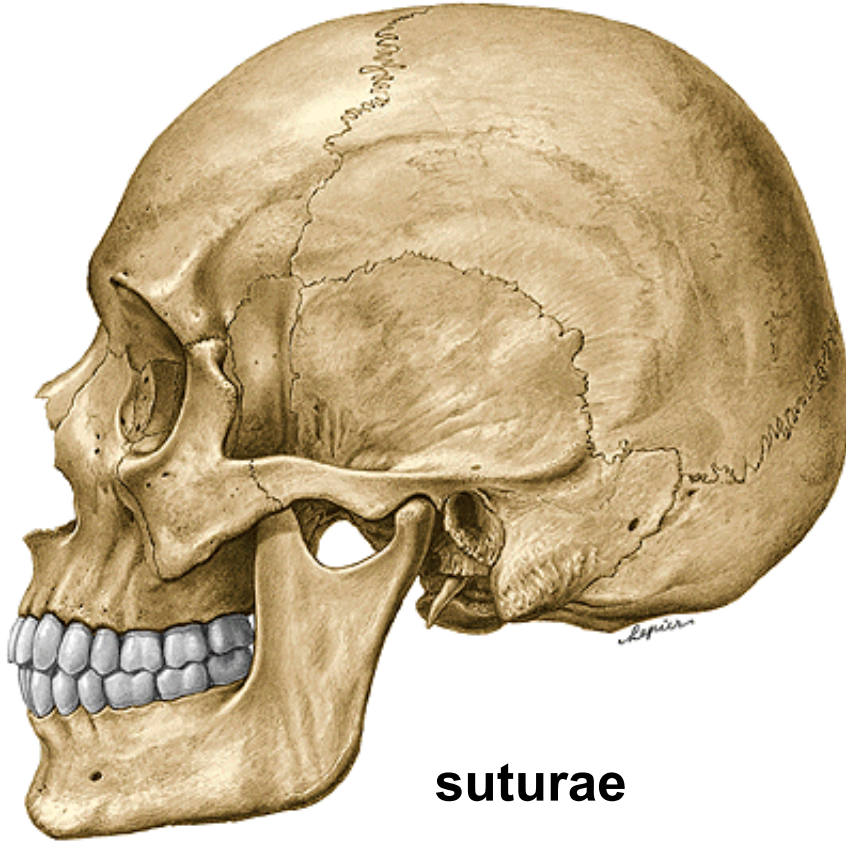
1. Craniovertebral connection
2. Skull syndesmoses and synchondroses
3. Temporomandibular joint
4. Connection of the hyoid bone (*os hyoideum*)

# 1. Connections of the skull

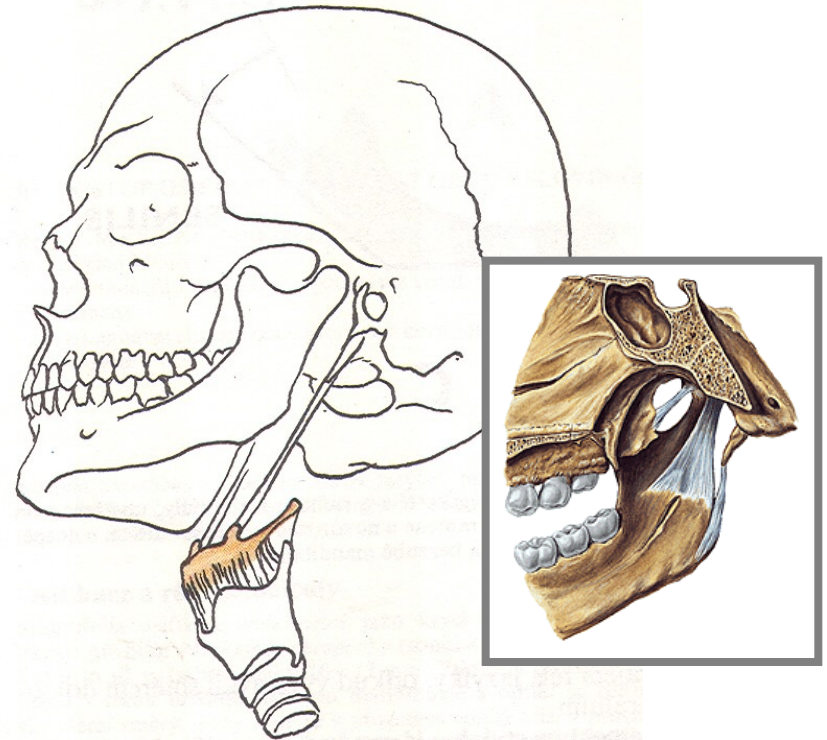
**A. Synarthrosis** (1. syndesmosis, 2. synchondrosis, 3. synostosis)

**B. Diarthrosis=synovial joint** (articulatio temporomandibularis)

## I.1. Syndesmosis cranii

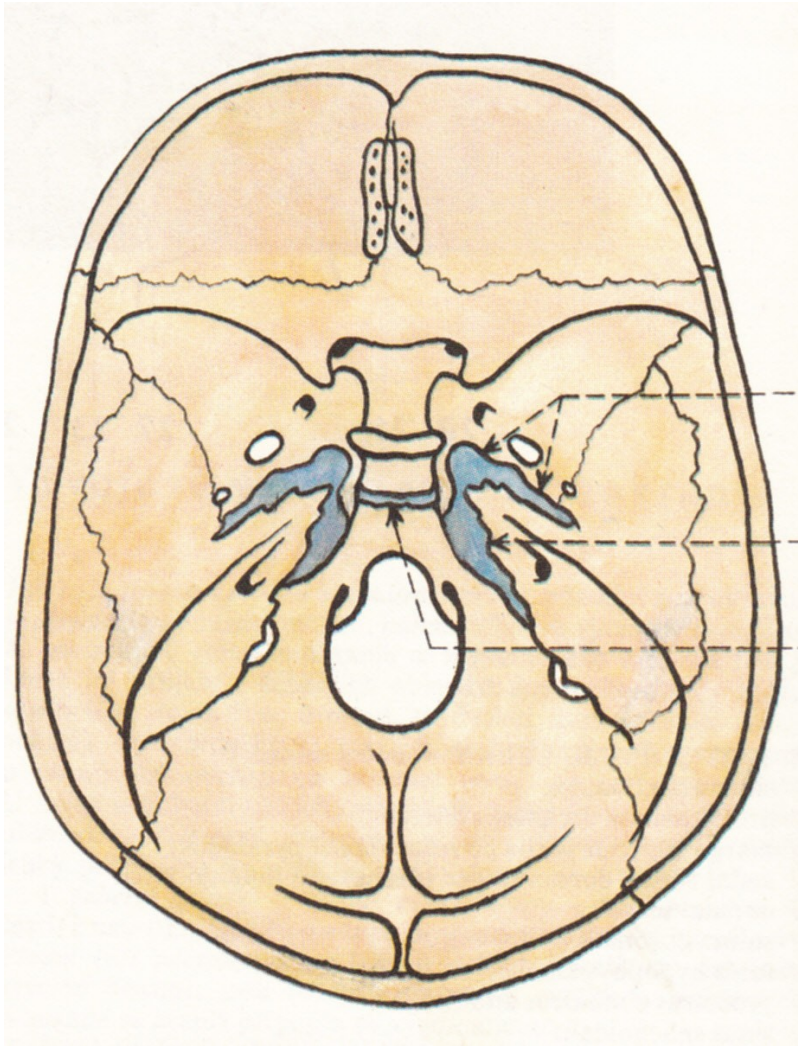


suturae



ligamentum stylohyoideum  
ligamentum stylomandibulare

## I. 2. Synchondrosis of the skull



synchondrosis sphenopetrosa

synchondrosis petrooccipitalis

synchondrosis sphenoccipitalis

## I. 3. Synostosis of the skull

synostosis sphenoccipitalis



# **Description (characterization) of synovial joints**

- 1. Name of a joint**
- 2. Articular surfaces**
- 3. Articular capsule**
- 4. Auxiliary facilities**
- 5. Type of joint**
- 6. Movements**

# Articulatio temporomandibularis

## *Temporomandibular joint*



Articular surfaces: caput mandibulae with fossa mandibularis and tuberculum articulare of the temporal bone

Articular capsule: is attached to the margins of contact articular surfaces, ventrally and dorsally is lax, its medial part is tense

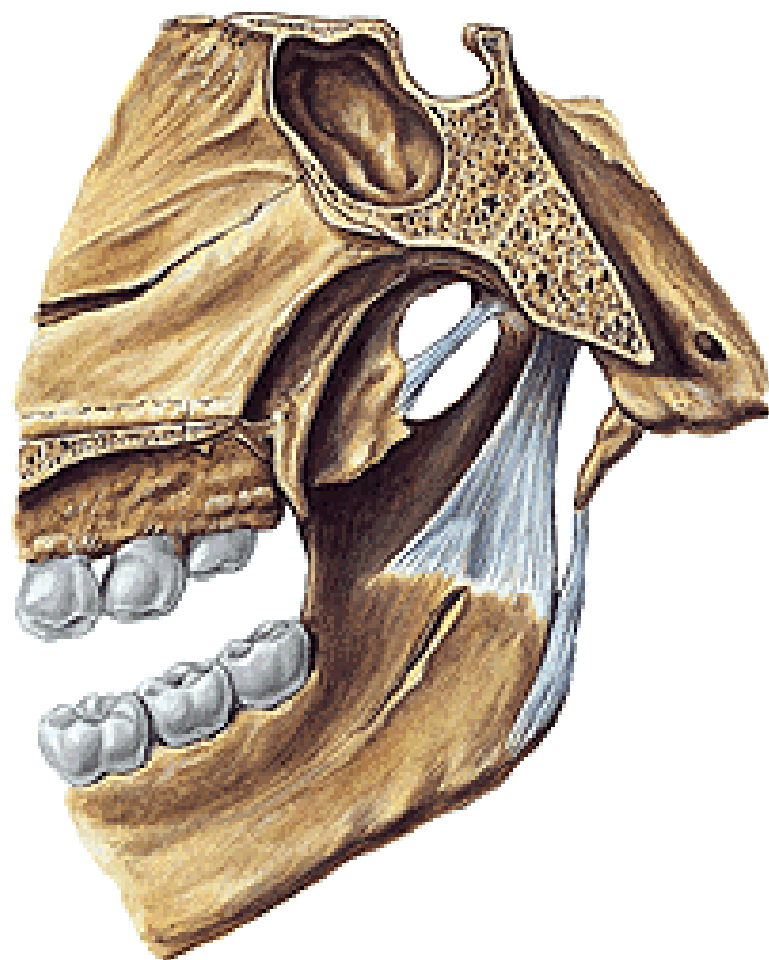
Auxiliary facilities: discus articularis – with a thin center and thicker margins. It divides joint cavity into the upper pars discotemporalis and lower pars discomandibularis. Lig. laterale.

Close to the joint are located lig. sphenomandibulare and lig. stylomandibulare

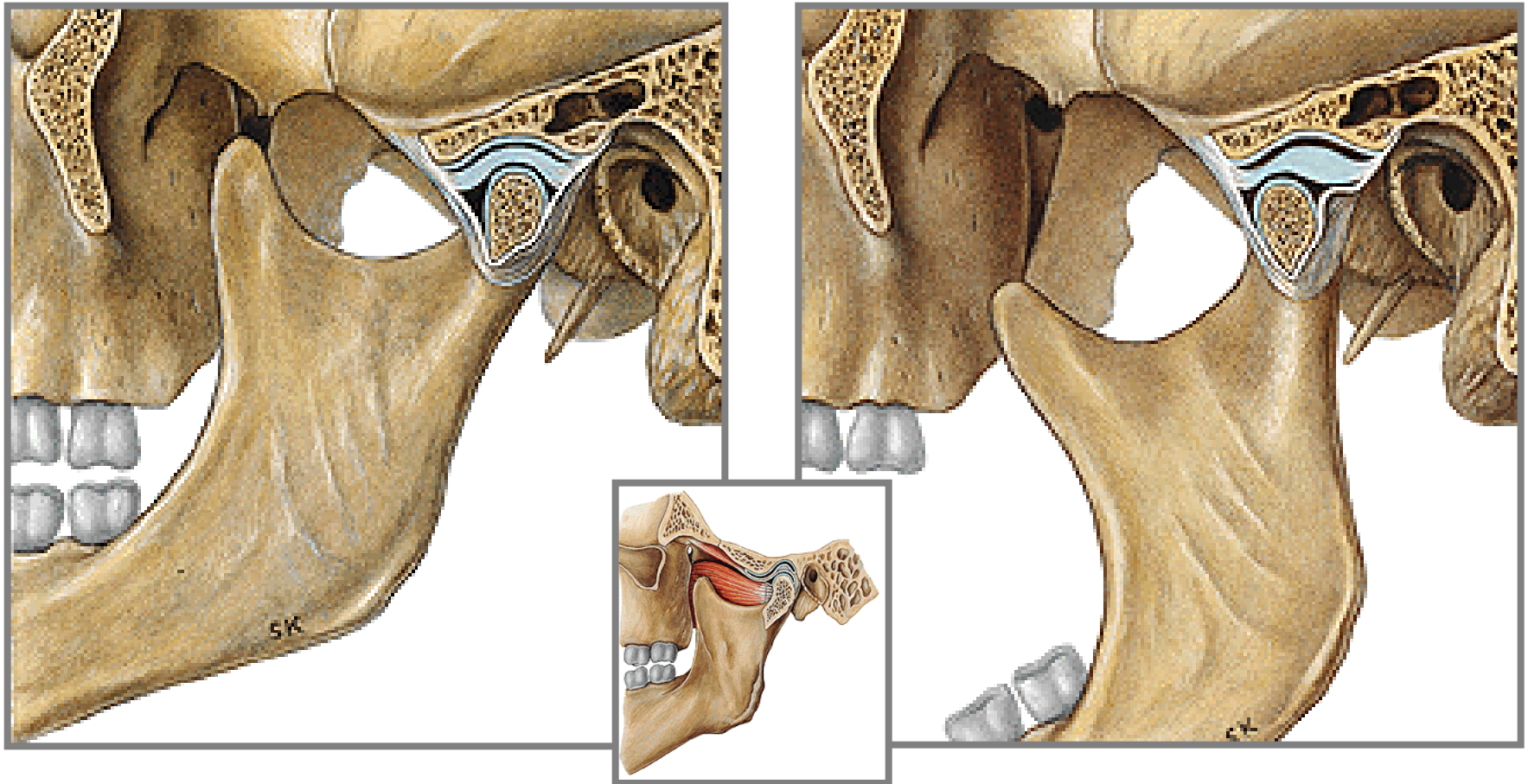
Type of joint: composite and paired joint (Gynglimus)

Movements: complicated (rotary, sliding, chewing movements)

..



**Movements:** opening (mandibular **depression** ) and closing mouth (**elevation**), rotary and sliding movements and chewing movements - mandibular **protraction** (movement of mandible ventrally) and **retraction** (movement of mandible dorsally)



# I. Craniovertebral joints

## 1. **Articulatio atlantooccipitalis** – (*atlanto-occipital joint*)

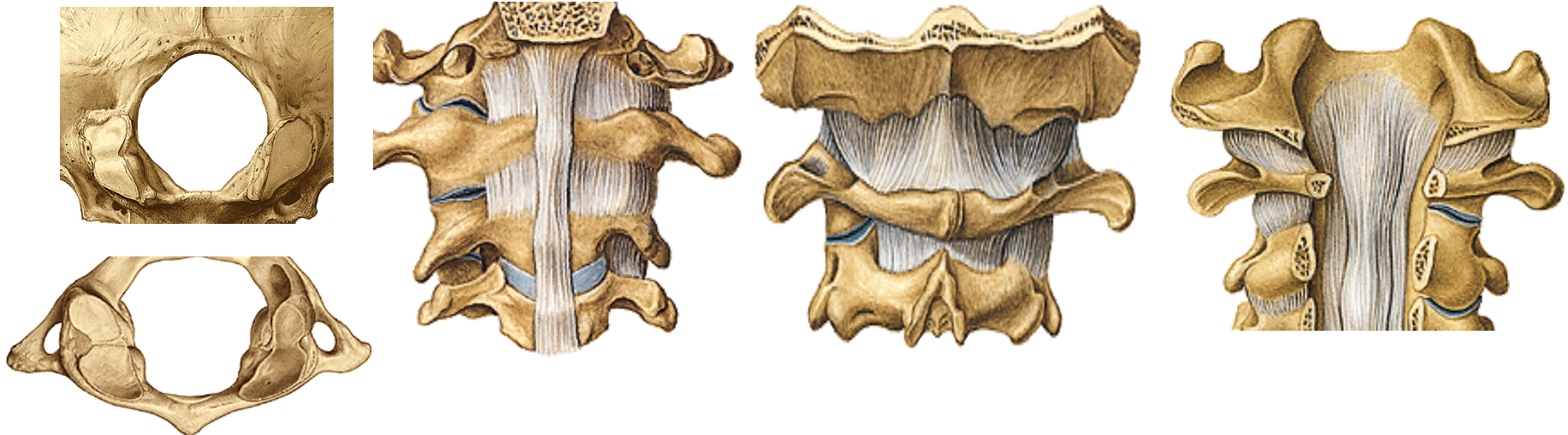
articular surfaces:.....

articular capsule: is attached to the margins of the articular surfaces

auxiliary facilities: **membrana atlantooccipitalis anterior and posterior**  
(anterior and posterior atlanto-occipital membranes)  
**membrana tectoria** (*tectorial membrane*)

type of joint: art. ellipsoidea (*ellipsoidal joint*)

movements: flexion and extension of the head and its minimal lateral motion



## 2. Articulatio atlantoaxialis – a compound joint

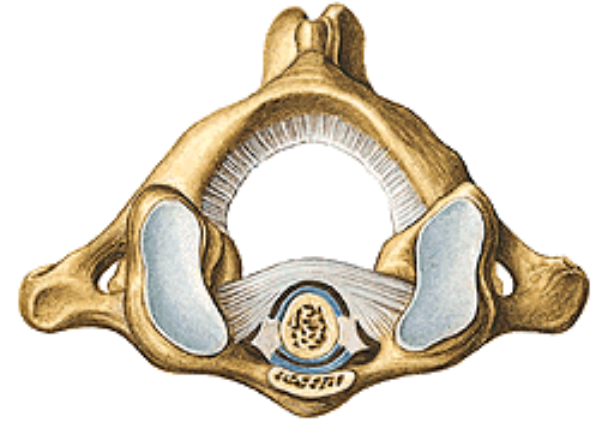
### Articular surfaces:

#### 2a. Articulatio atlantoaxialis mediana

facies articularis anterior dentis and fovea dentis

facies articularis posterior dentis

and lig. transversum atlantis



#### 2b. Articulatio atlantoaxialis lateralis

facies articulares inferiores atlantis

processus articulares superiores axis





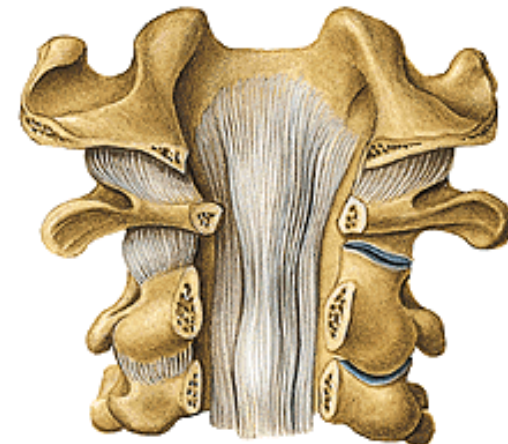
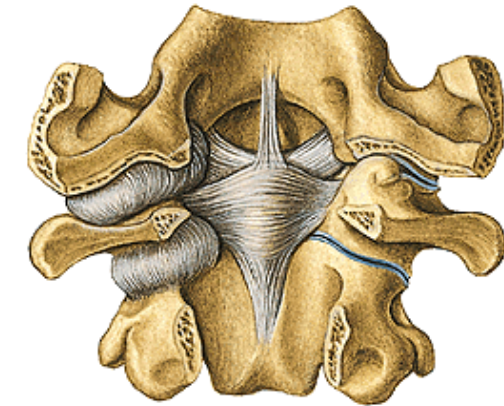
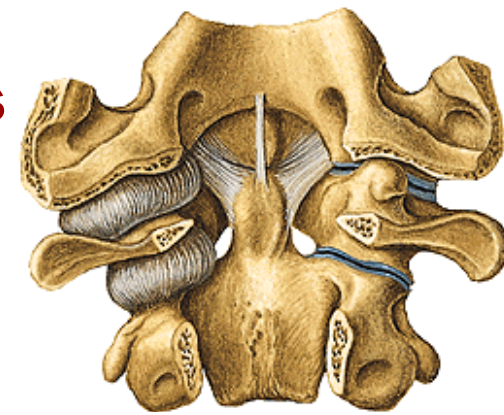
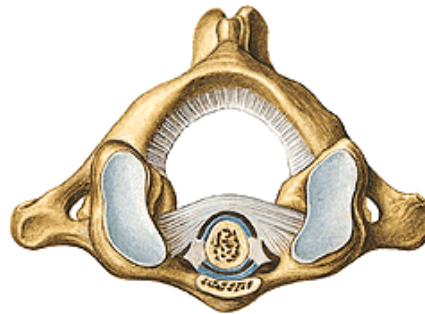
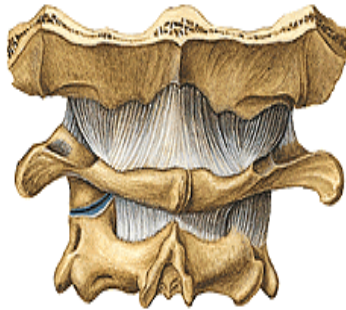
# Articulatio atlantoaxialis mediana et lateralis

**Articular capsule:** is common for both 1) and 2) joints and is attached to the margins of contact articular surfaces

**Auxiliary facilities:** **lig. apicis dentis**, **ligg. alaria**, **lig. transversum atlantis**, **lig. cruciforme atlantis** = **lig. transversum atlantis** and **fasciculi longitudinales** (*longitudinal bands*)

**membrana atlantooccipitalis anterior and posterior** (*Anterior and posterior atlantooccipital membranes*), **membrana tectoria**

**Type of joint:** functionally – the mechanical unit. **Atlas** rotates around **dens axis** in about 60°

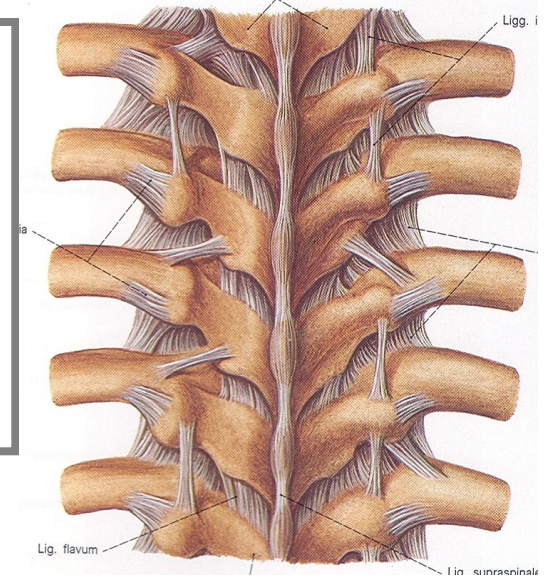
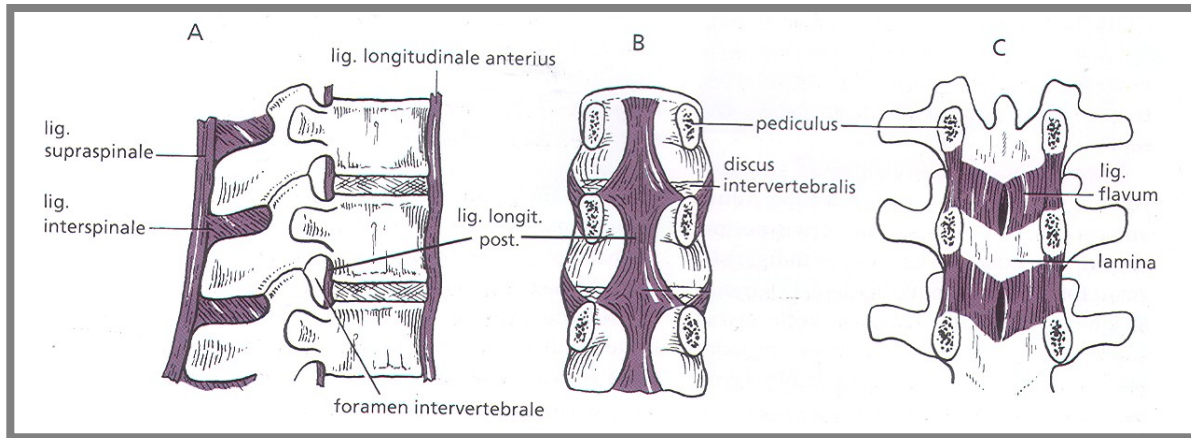


# Juncturae columnae vertebralis (*Junctions of the spine*)

There are both **synarthrosis** (*fibrous joints*) and **diarthrosis** (*synovial joints*) on the spine.

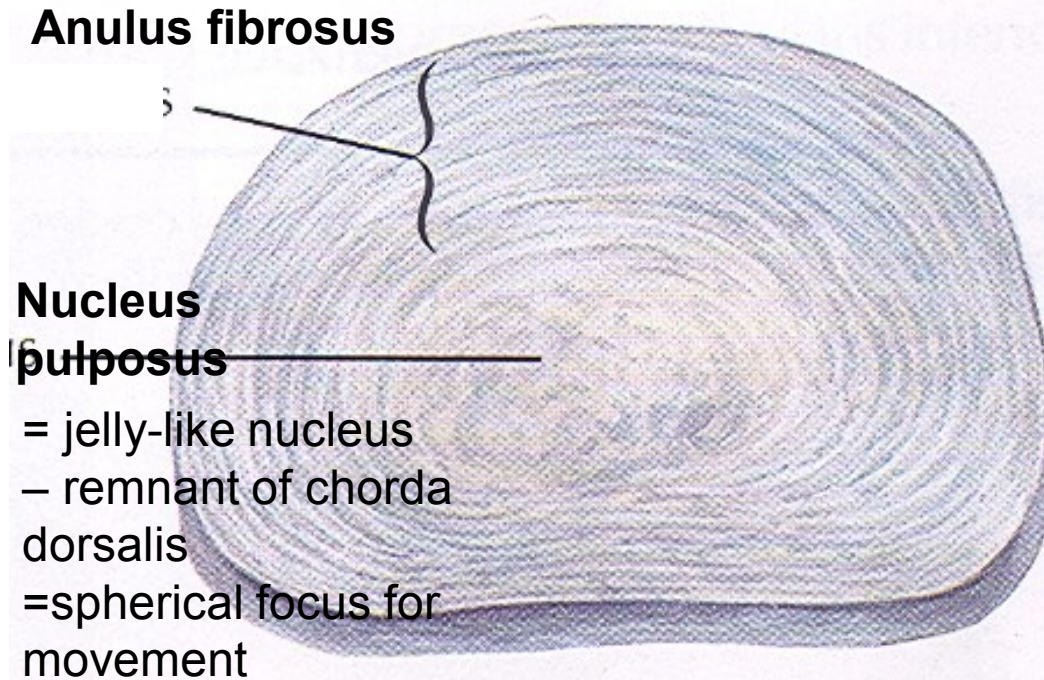
## Connections of adjacent vertebrae

1. between vertebral bodies – by **disci intervertebrales** (23)
2. between vertebral arches by **ligg. flava**
3. between vertebral processes by **ligg. intertransversaria, interspinalia** and **supraspinale (lig. nuchae)**
4. **Synovial joints** (diarthrosis) – **articulationes intervertebrales** (*intervertebral joints*)



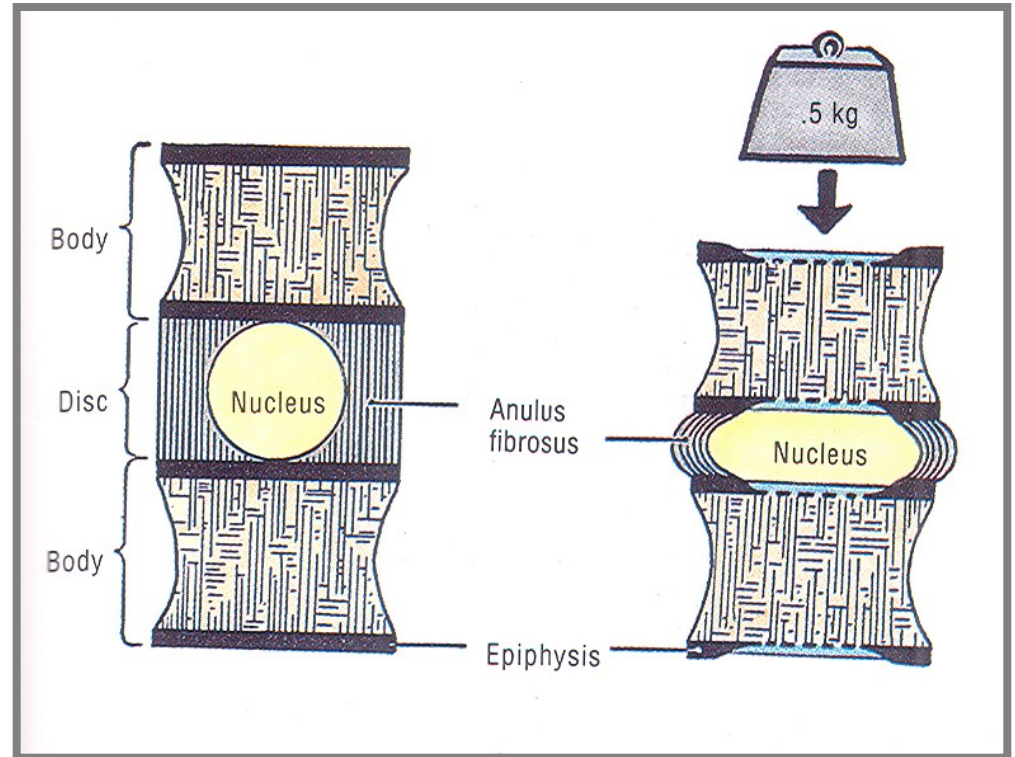
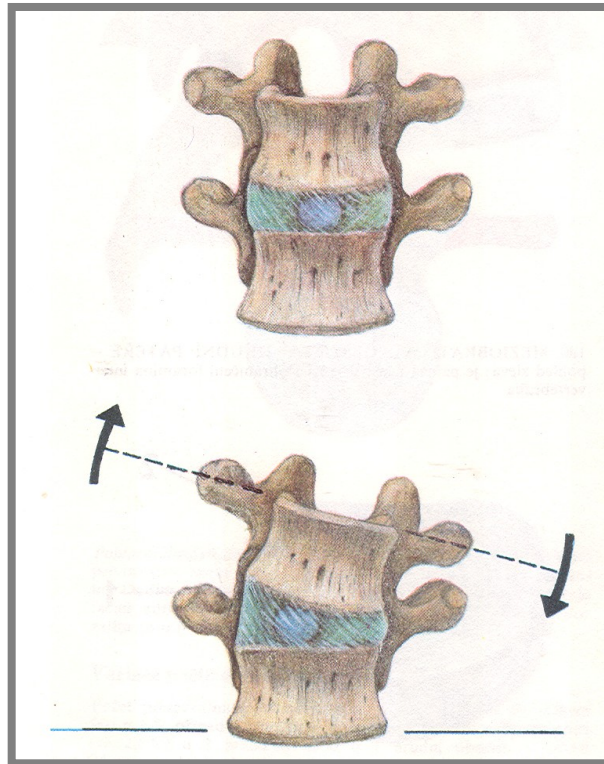


# 1. Connection between vertebral bodies

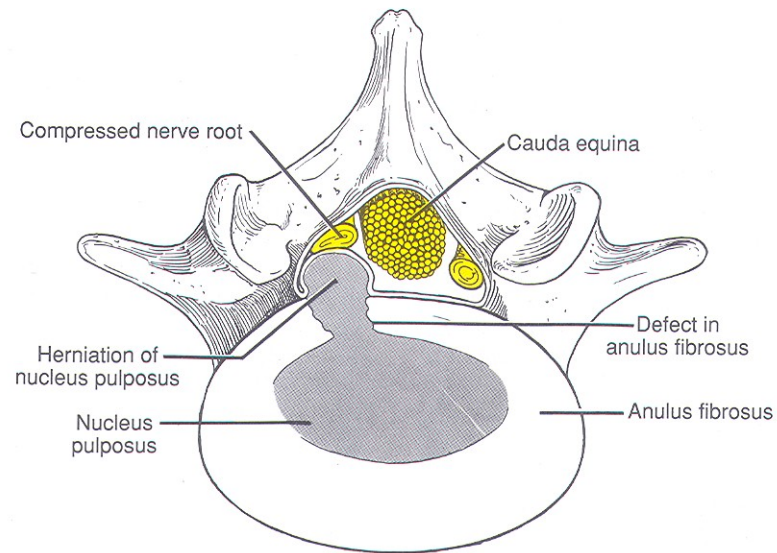


**discus intervertebralis**  
(*intervertebral disc*)

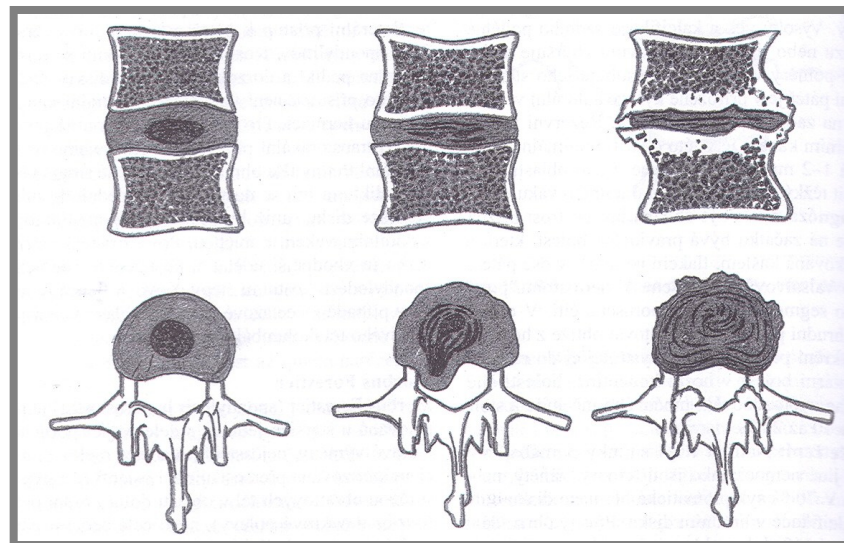
**23 discs, form about  $\frac{1}{4}$  of the spine length**  
**discs act as shock absorbers**



**Compression of disc (nucleus pulposus distributes the pressure)**



**Figure 4-32.** An illustration showing how an intervertebral disc protrusion may exert pressure on a spinal nerve root and/or the cauda equina.





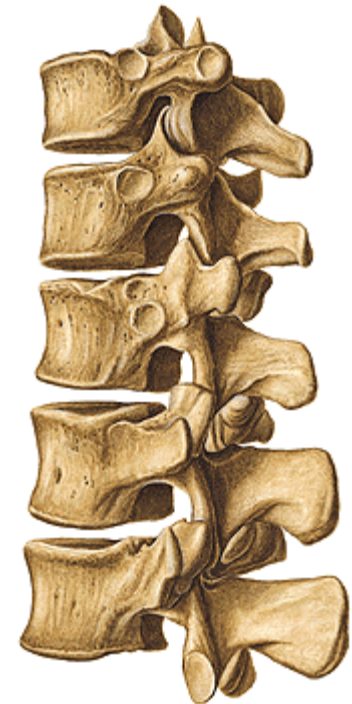
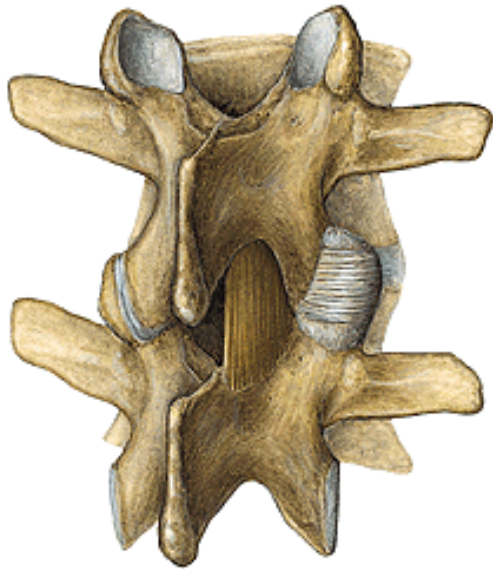
# Articulaciones intervertebrales (*intervertebral joints*)

**Articular surfaces:** processus art. sup. and inf. of adjacent vertebrae  
(position of articular surfaces - C oblique, Th frontal, L sagittal)

**Articular capsule:** is attached to the margins of contact articular surfaces

**Type of joints:** articulatio plana (*flat joints*)

**Movements:** sliding

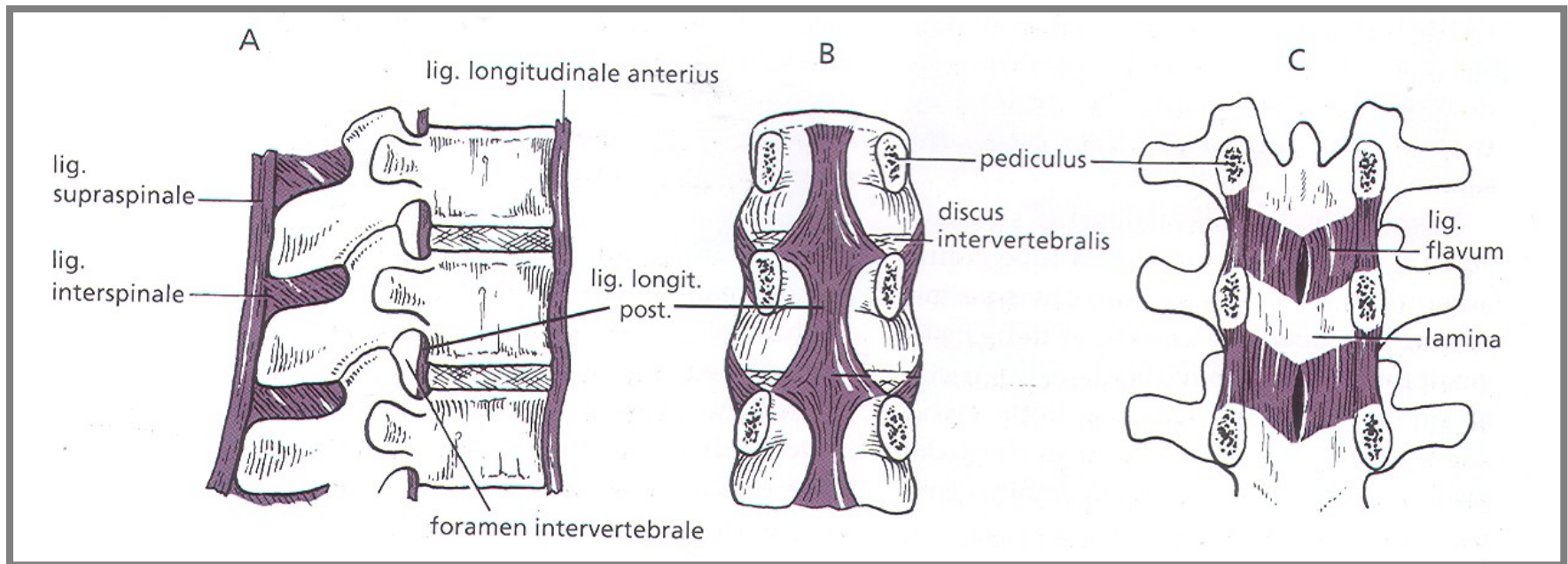


# Common connections for all vertebrae (tie vertebral column)

**Lig. longitudinale anterius** - anterior longitudinal ligament

**Lig. longitudinale posterius** – posterior longitudinal lig. continues cranially as **membrana tectoria**

caudal continuation of both – **ligg. sacrococcygea**

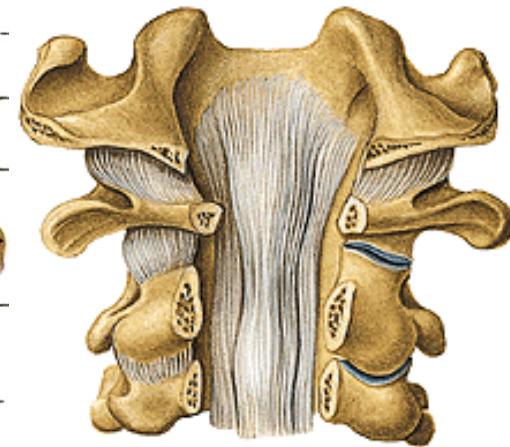
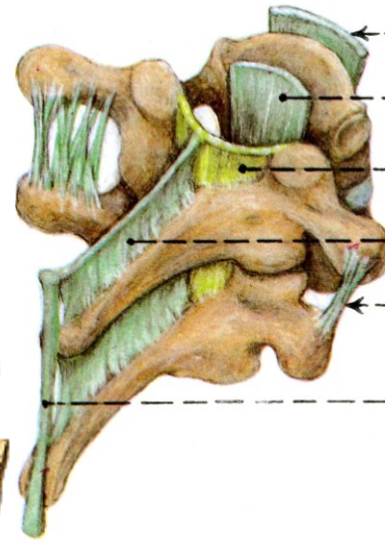
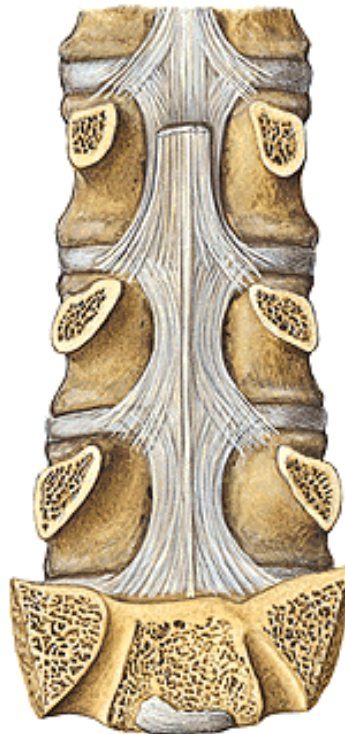
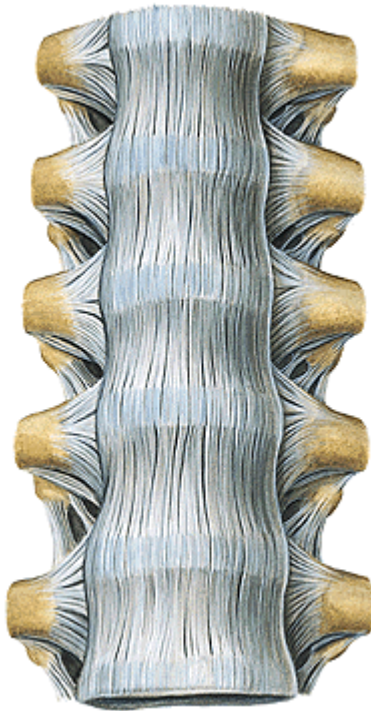
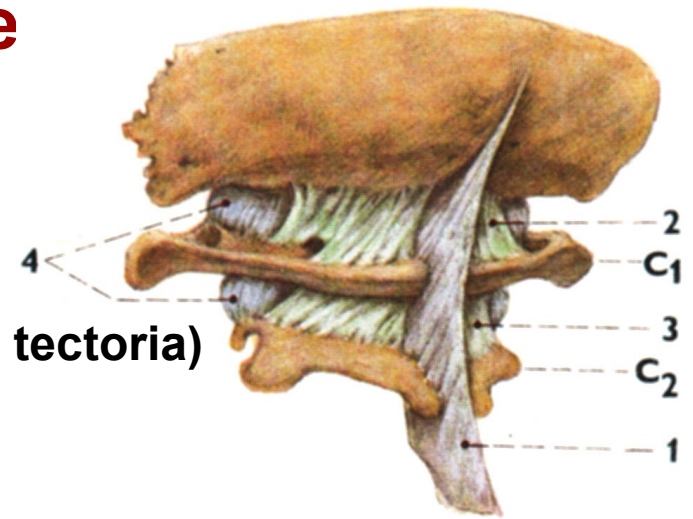


# Long ligaments of spine

Ligamentum supraspinale (ligamentum nuchae)

Ligamentum longitudinale anterius

Ligamentum longitudinale posterius (membrana tectoria)



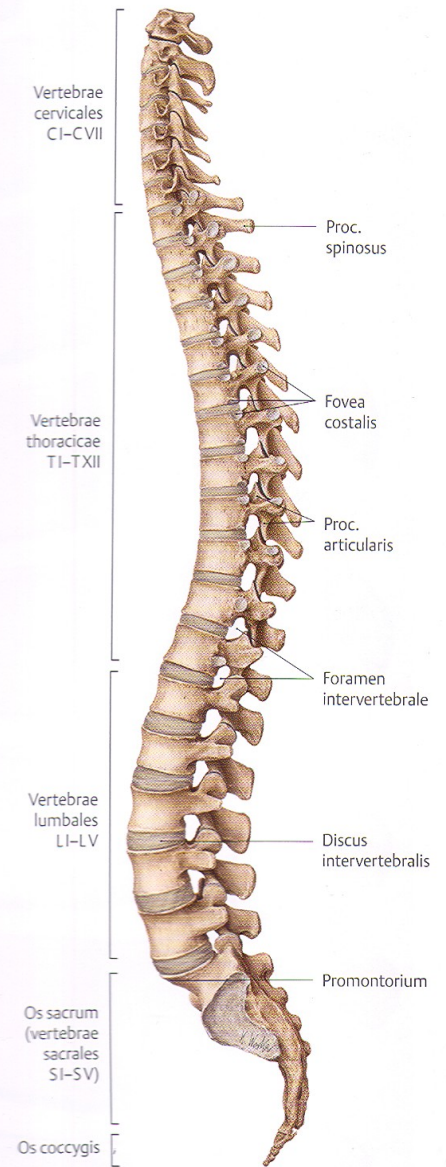
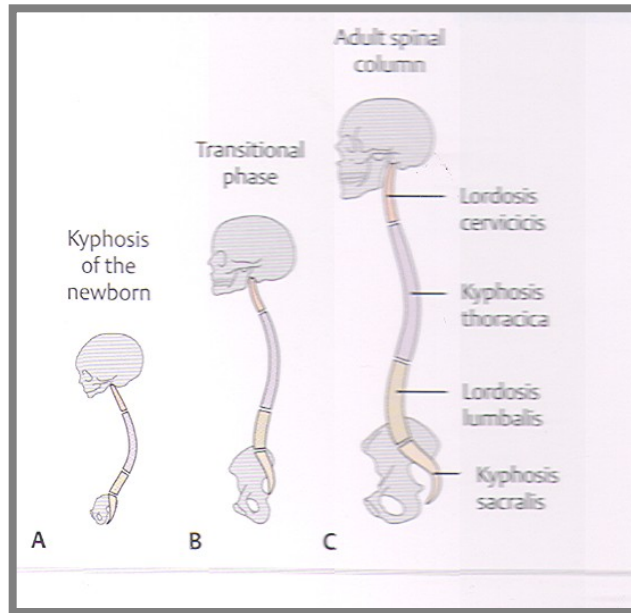


# Shape and curvature of spine

Spine has cervical and lumbar lordosis

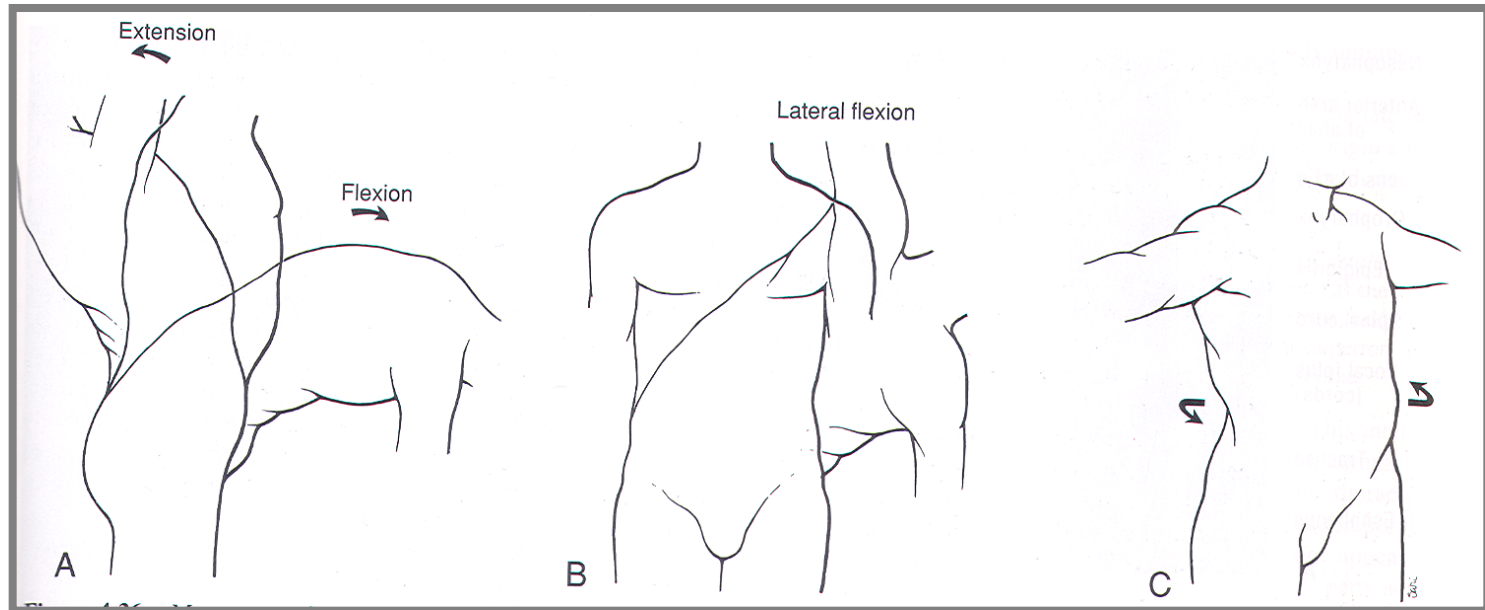
(C4-5, L3-4)

and thoracic and sacral kyphosis (Th6-7)



B Bony vertebral column.

# Movements of the spine



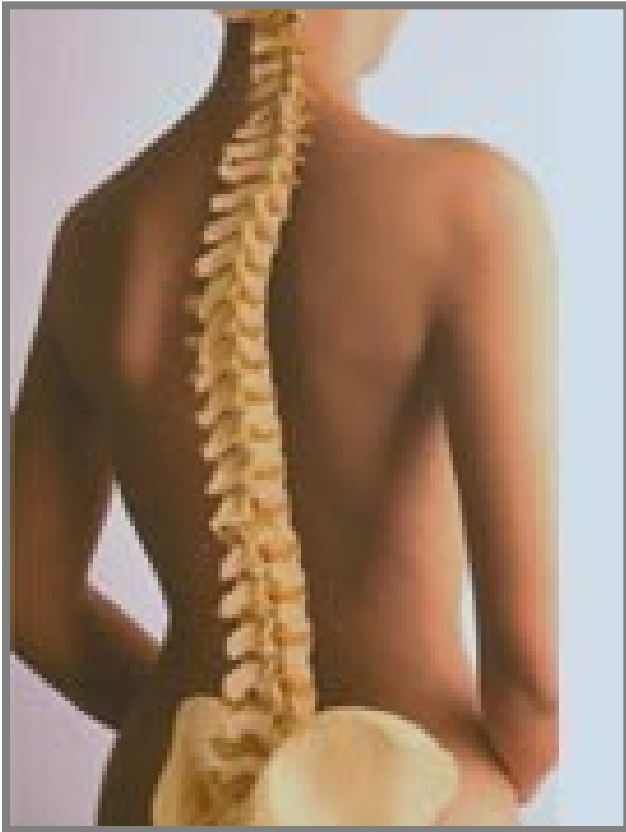
**Cervical spine** – anteflexion, retroflexion, lateral flexion, rotation

**Thoracic spine** – rotation

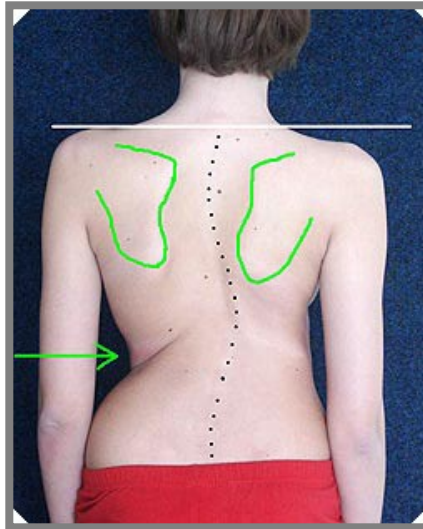
**Lumbar spine** – anteflexion, retroflexion, lateral flexion



## II. Curvature of the spine in frontal plane – *skoliosis*



Physiological skoliosis Th<sub>3-5</sub>



# Connections of the thorax

## I) Juncturae thoracis (*connections of thoracic cage*)

### A. *Articulationes costovertebrales* (*costovertebral joints*)

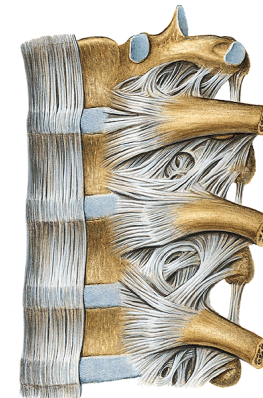
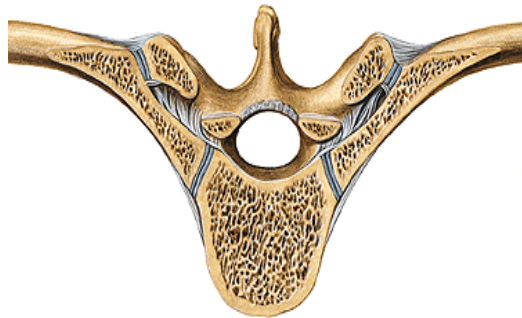
#### 1. *Articulationes capitis costae* (*joints of the rib head*)

Articular surfaces: **facies articularis capitis costae** and **foveae costales**  
of the thoracic vertebrae **bodies**

Articular capsule: is attached to the margins of contact articular surfaces.

Auxiliary facilities: **lig. capitis costae radiatum**  
**lig. capitis costae intraarticulare** 2. – 10. ribs

Movements: – around axis paralel to the collum costae (*neck of rib*)



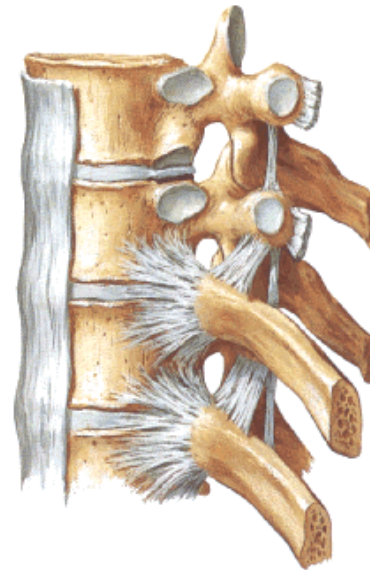
## 2. Articulationes costotransversariae

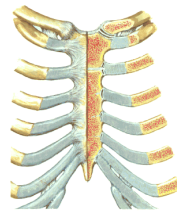
**Articular surfaces:** foveae costales transversales and facies articularis tuberculi costae.

**Articular capsule:** is attached to the margins of contact articular surfaces

**Auxiliary facilities** : **ligg. costotransversaria, ligg. costotransversaria lateralia and superiora**

**Movements:** – around axis paralel to the central line of the collum costae





## B. *Juncturae sternocostales* (*sternocostal articulations*)

1. **Synchondrosis sternocostalis** - connection of the **incisura costalis sterni** (*sternal costal notch*) and cartilage of the 1. and often the 6th and 7th ribs.
2. **Articulationes sternocostales** (*sternocostal synovial joints*) between 2.–5. ribs and sternum.

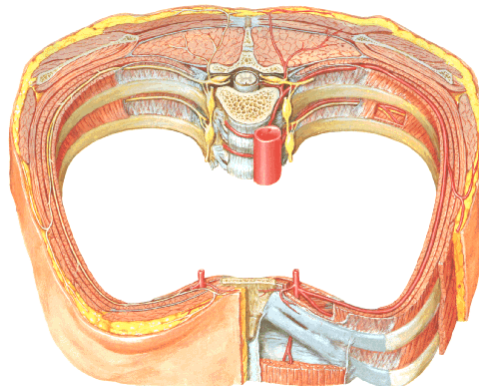
Auxiliary facilities: **ligg. sternocostalia radiata** form **membrana sterni externa and interna**

## C. Connection of 5th – 9th ribs

1. **Articulationes interchondrales** (*interchondral joints*)

Articular connection between **cartilagine costales 5.–9th** with short articular capsule.

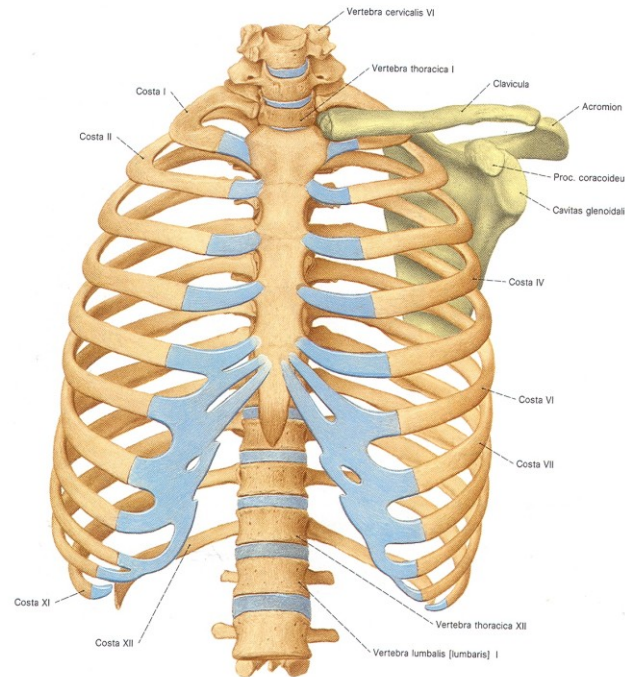
2. **Membranae intercostales** – **membranae intercostales externae** - between costal cartilages close to the sternum. **Membranae intercostales internae** are located near to the spine.





## II. Shape of thorax (*chest*)

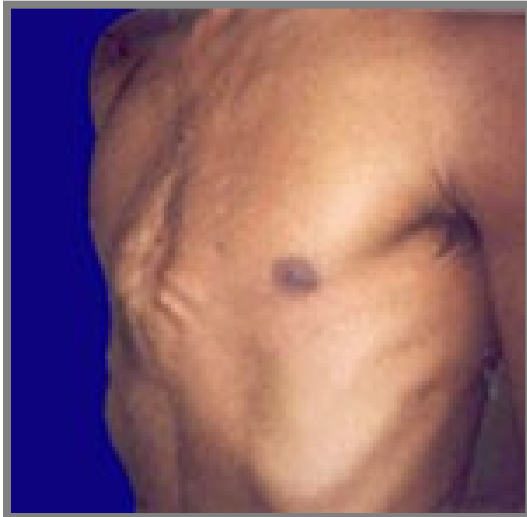
- a) Ventral wall – sternum, costal cartilages and ribs
- b) Lateral wall – anguli costae
- c) Dorsal wall – vertebrae thoracicae and bone parts of the ribs
- d) Entrance (**apertura thoracis superior**) is limited by the 1. thoracic vertebra, the 1. rib and cranial margin of sternum
- e) Exit (**apertura thoracis inferior**) is limited by 12. thoracic vertebra, 12. and 11. ribs and *arcus costarum*.



# Pathological shape of thorax

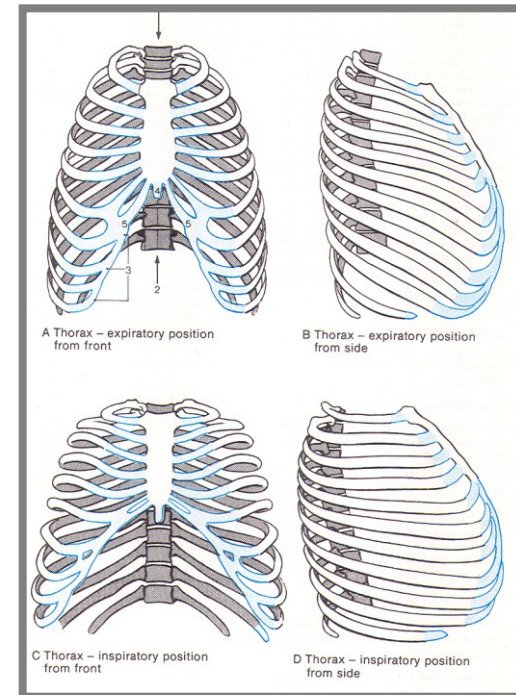
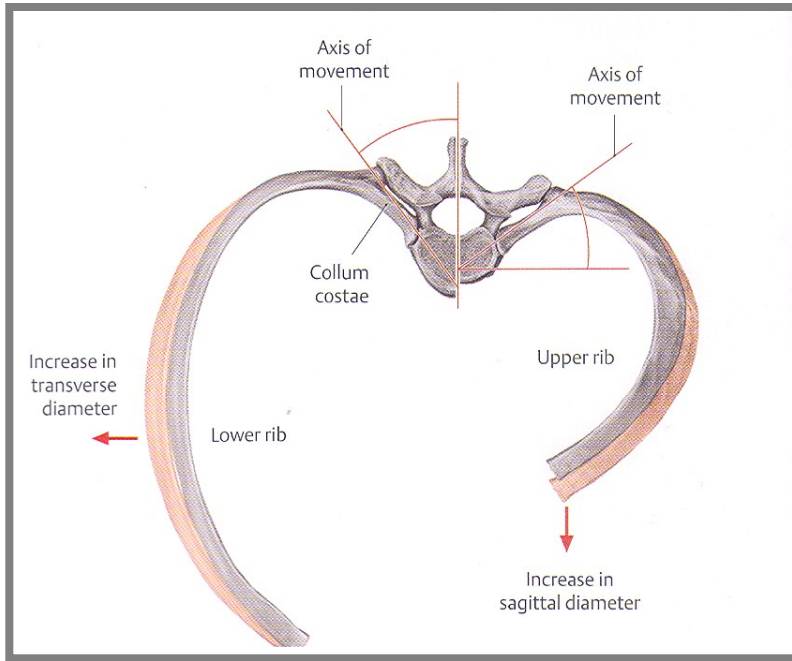


**Pectus excavatum**  
*(sunken)*



**Pectus carinatum**  
*(raised)*

### III. Movements of thorax (chest)



in costovertebral joints - **rotation along longitudinal axis** - runs through  
collum costae

increasing volume of the chest - inspiration (*inspire*)

decreasing volume of the chest - expiration (*expire*)

# Upper limb connections

*(juncturae ossium extremitatis superioris)*

## **1) Articulationes cinguli membri superioris**

*Connections of shoulder girdle*

## **2) Articulationes membri superioris liberi**

*Connections of the free part of the upper limb*

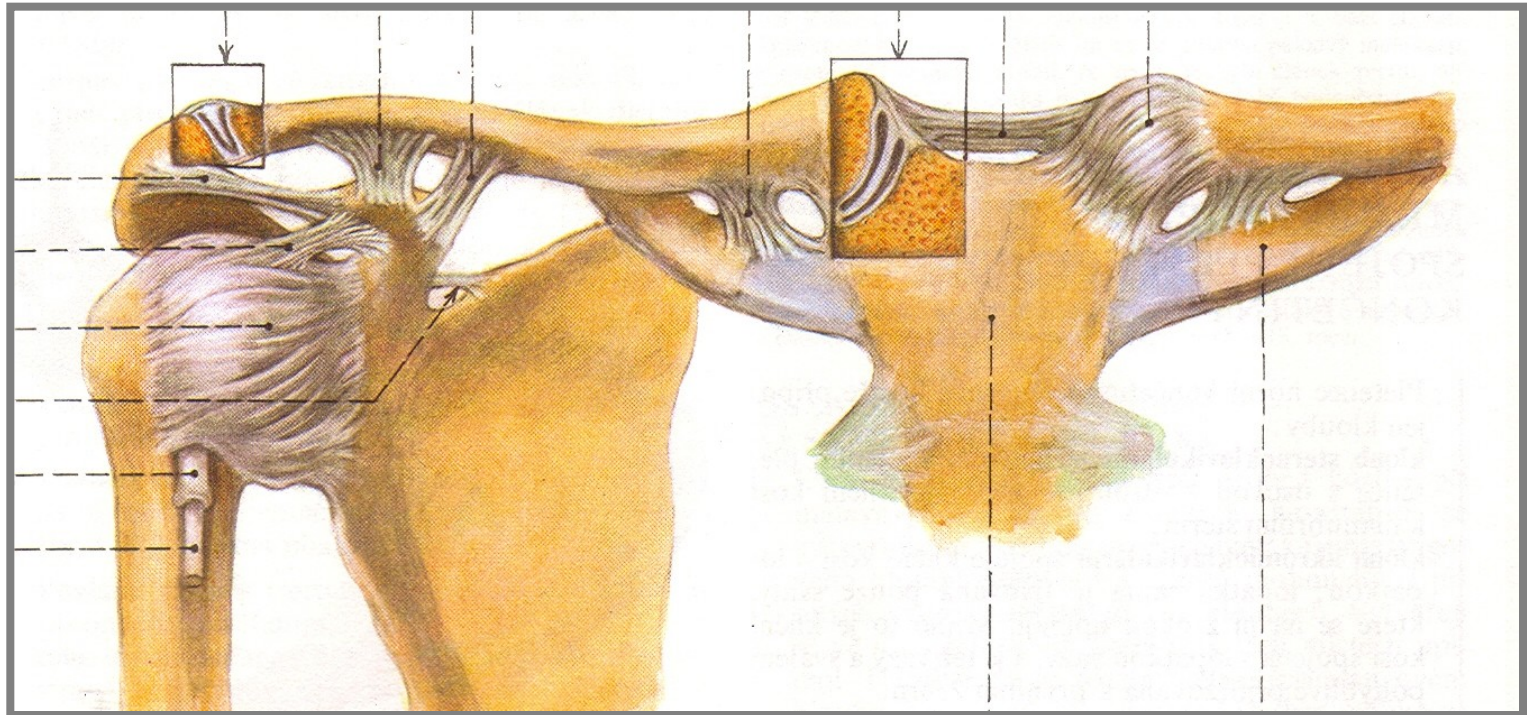


# **Articulationes cinguli membri superioris** (Connections of shoulder girdle)

**Articulatio sternoclavicularis** (sternoclavicular joint)

**Articulatio acromioclavicularis** (acromioclavicular joint)

**Syndesmosis scapulae** (ligaments of scapula)



# A) Connection of the shoulder girdle

## 1. **Articulatio sternoclavicularis** (*Sternoclavicular joint*)

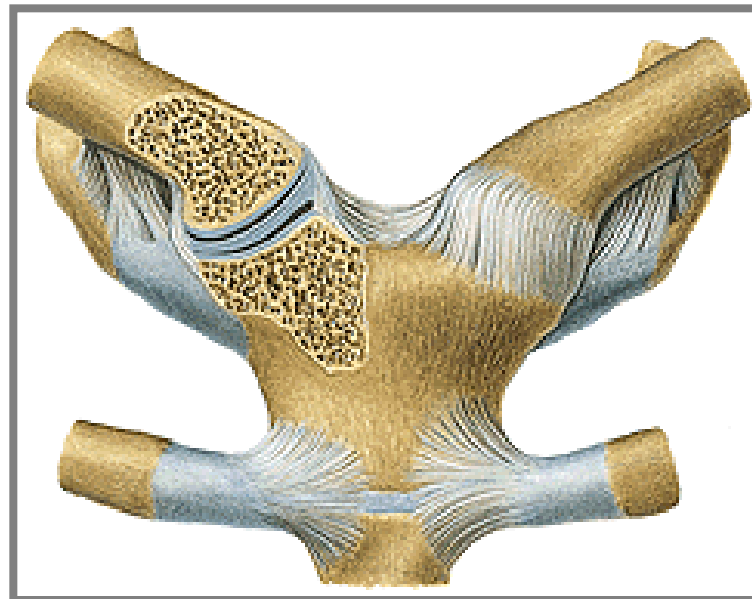
compound joint

**Articular surfaces:** .....

**Articular capsule:** is stiff and .....

**Auxiliary facilities:** discus articularis, lig. sternoclaviculare  
anterior and posterior., lig. interclaviculare, lig. costoclaviculare

**Type of joint:** art. **spheroidea** (*ball-and-socket joint*) with limited movements  
to all directions, a component of scapula and shoulder joint movements.



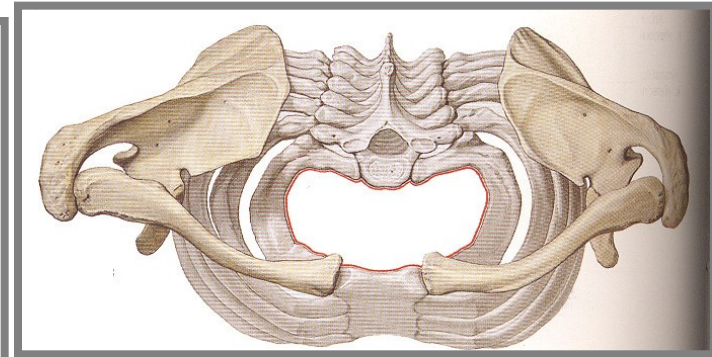
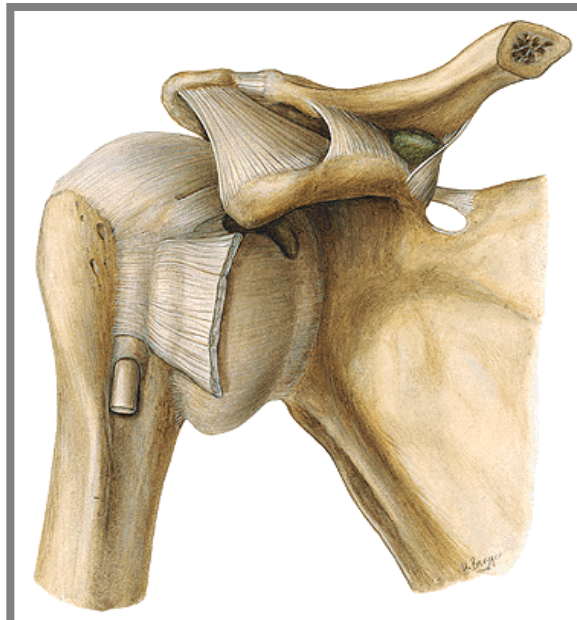
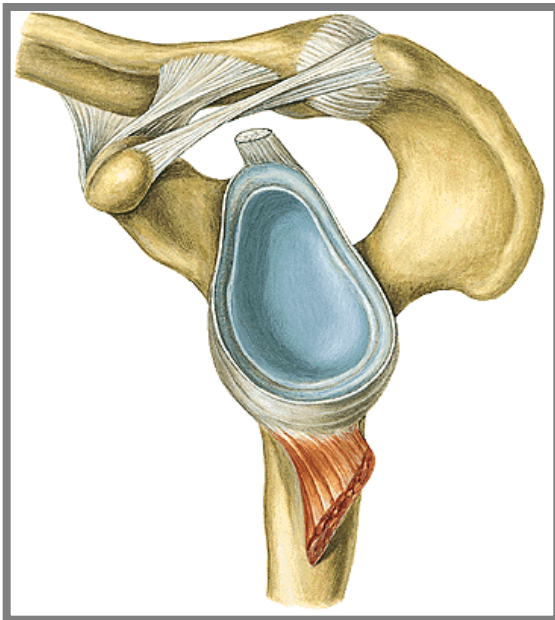
## 2. **Articulatio acromioclavicularis** (*Acromioclavicular joint*) (usually a compound joint)

**Articular surfaces** : .....

**Articular capsule** : is attached to.....

**Auxiliary facilities** : often is present discus articularis, **lig. acromioclaviculare**,  
**lig. coracoclaviculare**

**Type of joint**: spheroid or plane (*ball-and-socket/plane joint*) with limited movements - a component of scapula and shoulder joint movements.



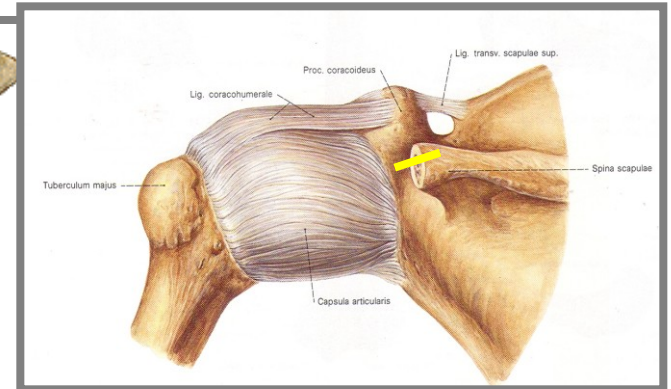
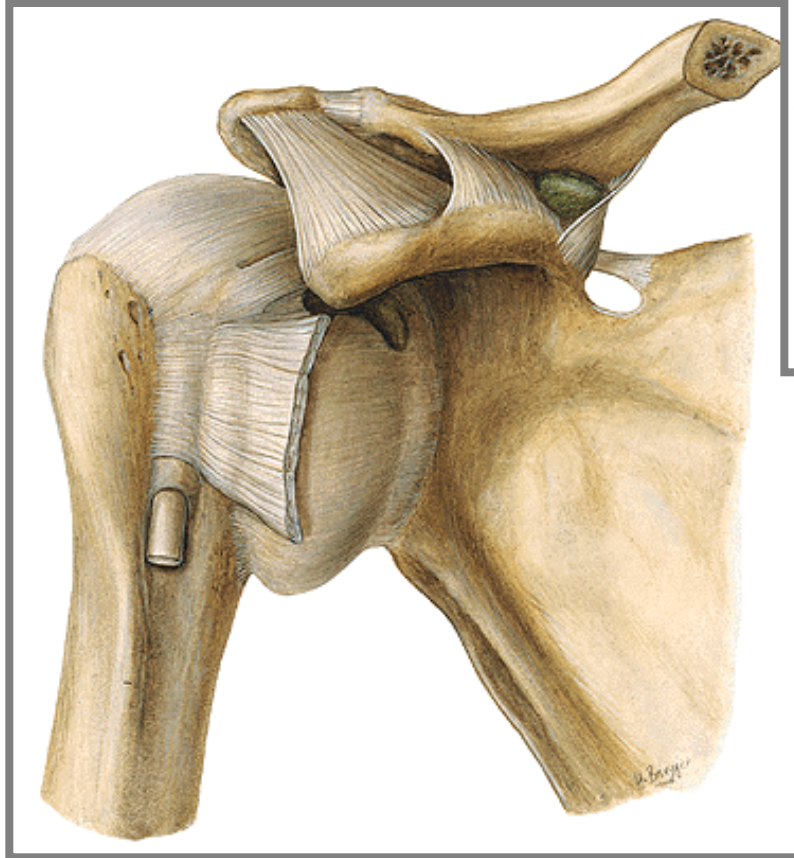


### 3. Syndesmosis (*Ligaments*) of the scapula

**Lig. transversum scapulae - superius and inferius** (*Superior and inferior transversal scapular ligament*)

**Lig. coracoacromiale** (*coracoacromial ligament*) - together with both bone processus forms **fornix humeri**

Abduction/elevation of the upper limb is always associated with movements of scapula!

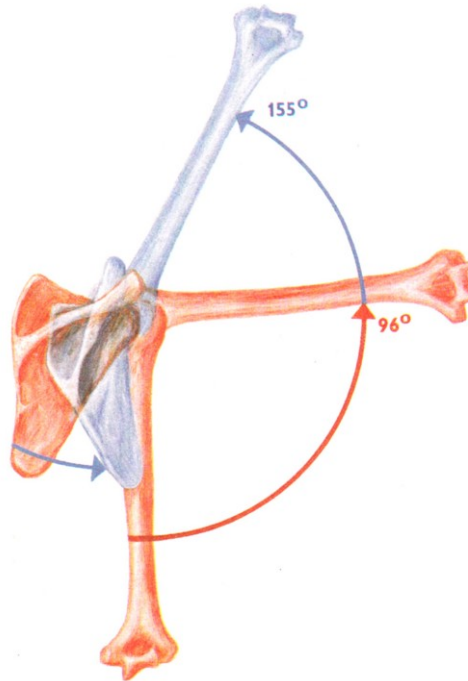




# Movements of scapula

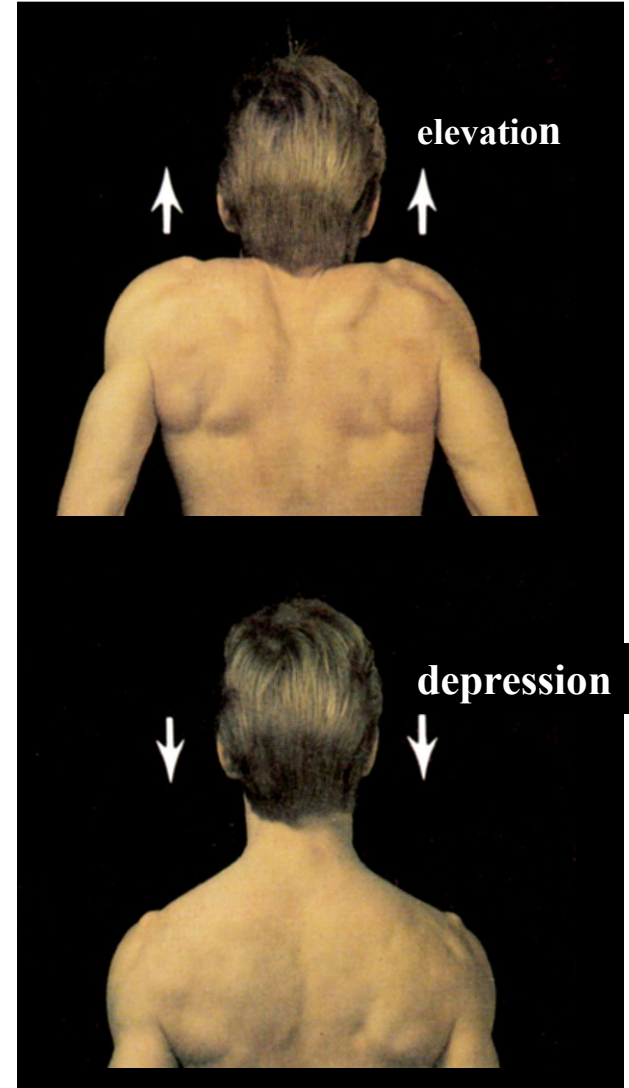
(lateroventrally,  
stretching arms forward)

(dorsomedially,  
stretching arms backward)



elevation

depression



# B) Articulationes membri superioris liberi

*Connections of the free part of the upper limb*

## 1. Articulatio humeri (Shoulder joint)

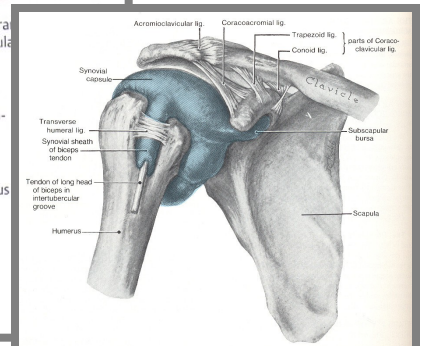
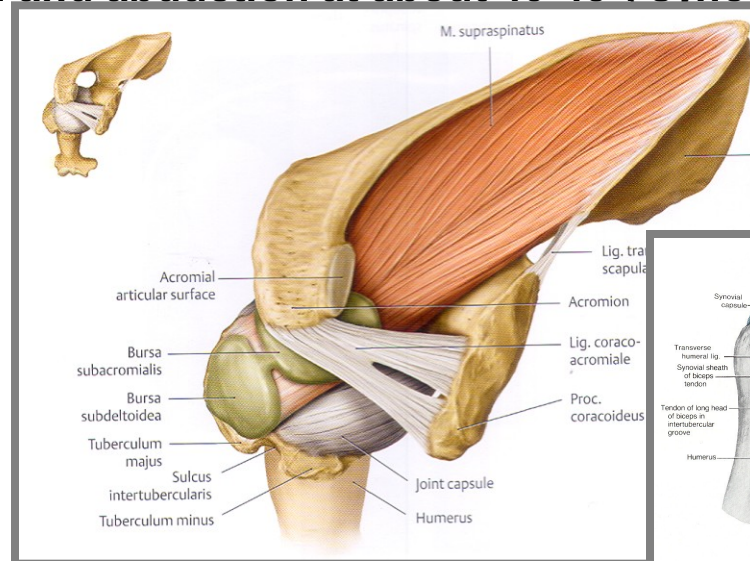
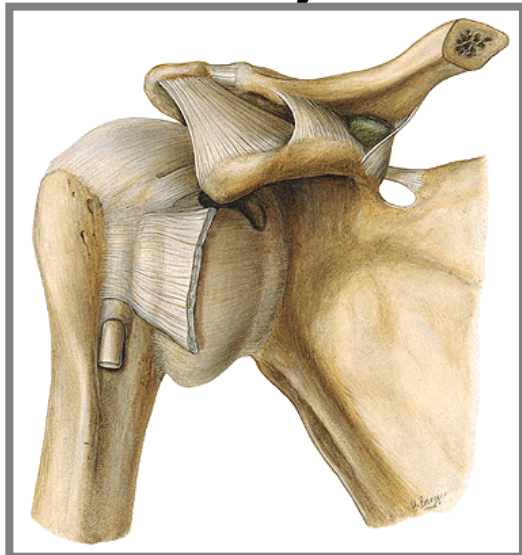
**Articular surfaces:**.....

**Articular capsule:** on the medial side of humerus runs more distally. Vagina synovialis intertubercularis.

**Auxiliary facilities:** labrum glenoidale, ligg. glenohumeralia, lig. coracohumerale. Articular capsule is reinforced by tendons of muscles (m. subscapularis, m. supraspinatus, m. infraspinatus, m. teres minor called **rotator cuff**).

**Type of joint:** arthrodia (*ball-and-socket*), three degrees of movements freedom).

**Middle position of the joint** - flexion and abduction at about 40-45°. synovial bursae





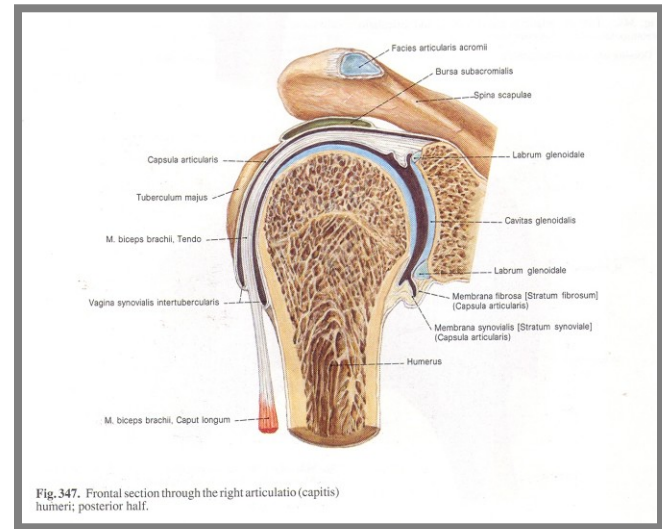
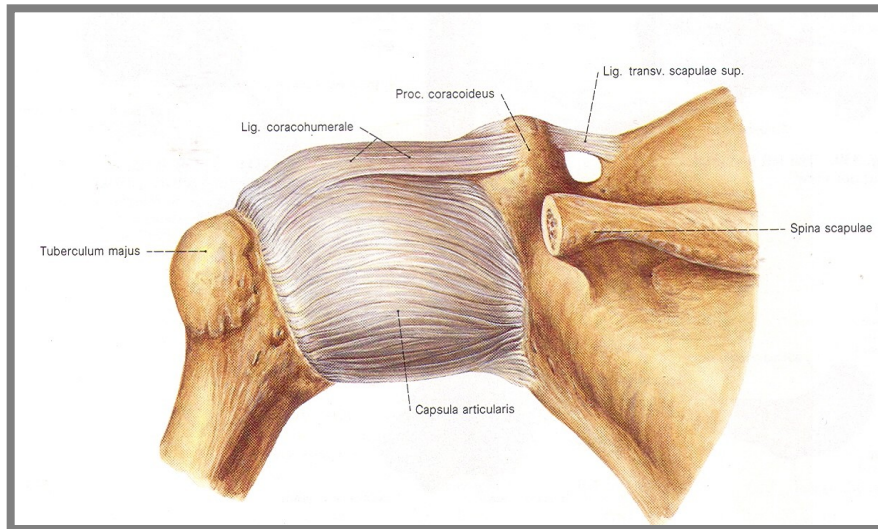


Fig. 347. Frontal section through the right articulation (capitis) humeri; posterior half.

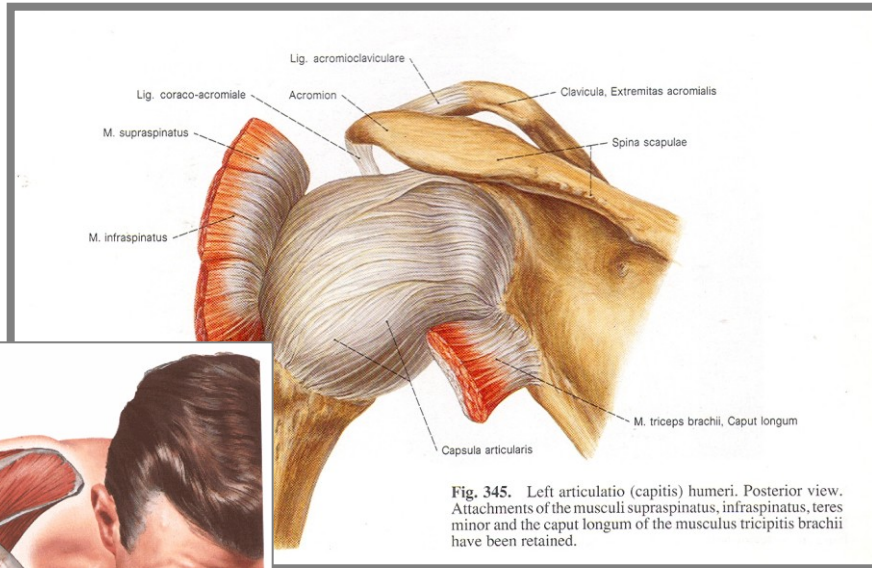
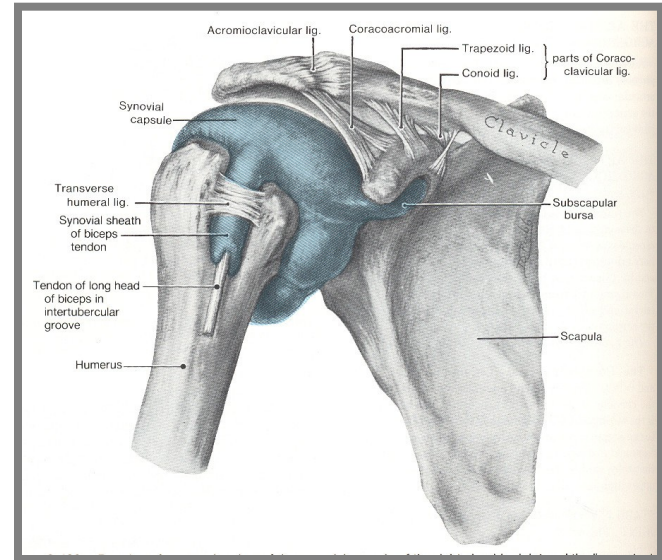


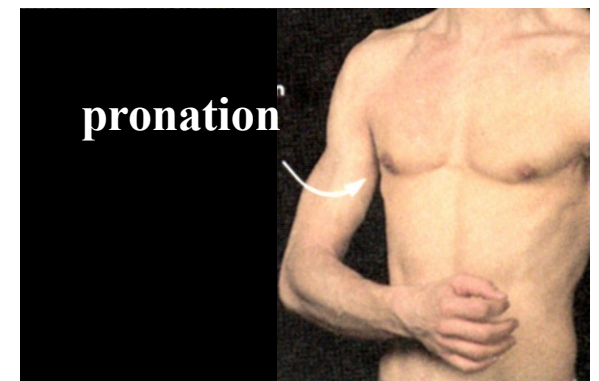
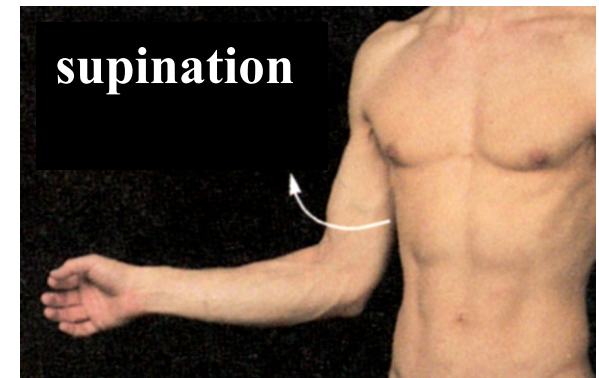
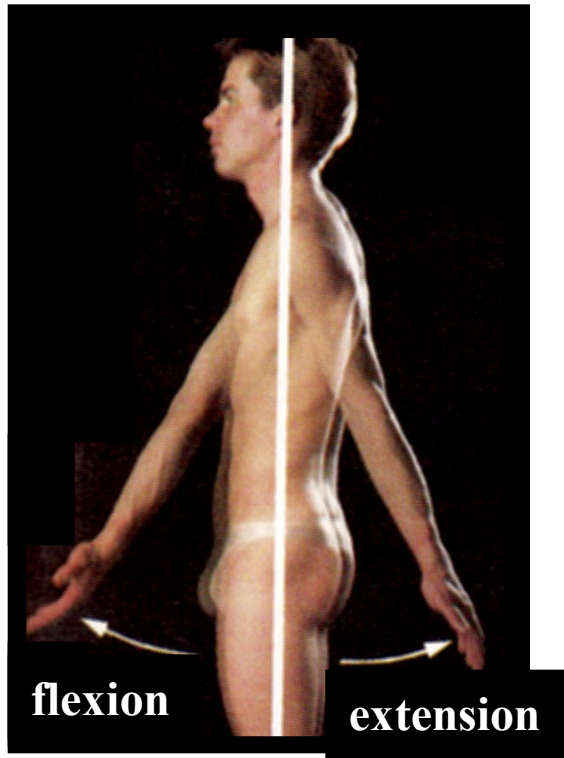
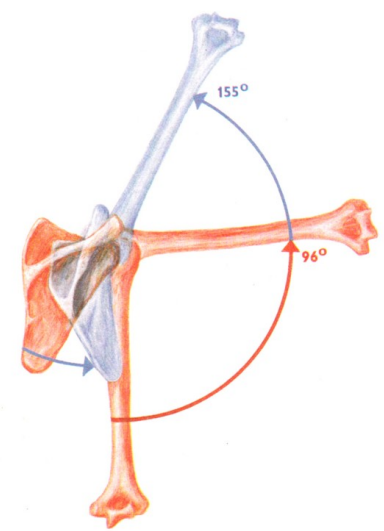
Fig. 345. Left articulation (capitis) humeri. Posterior view. Attachments of the musculus supraspinatus, infraspinatus, teres minor and the caput longum of the musculus tricipitis brachii have been retained.



# Articulatio humeri

Type of joint: spherioidea – ball and socket (arthrodia)

Movements: triaxial joint, to all directiones





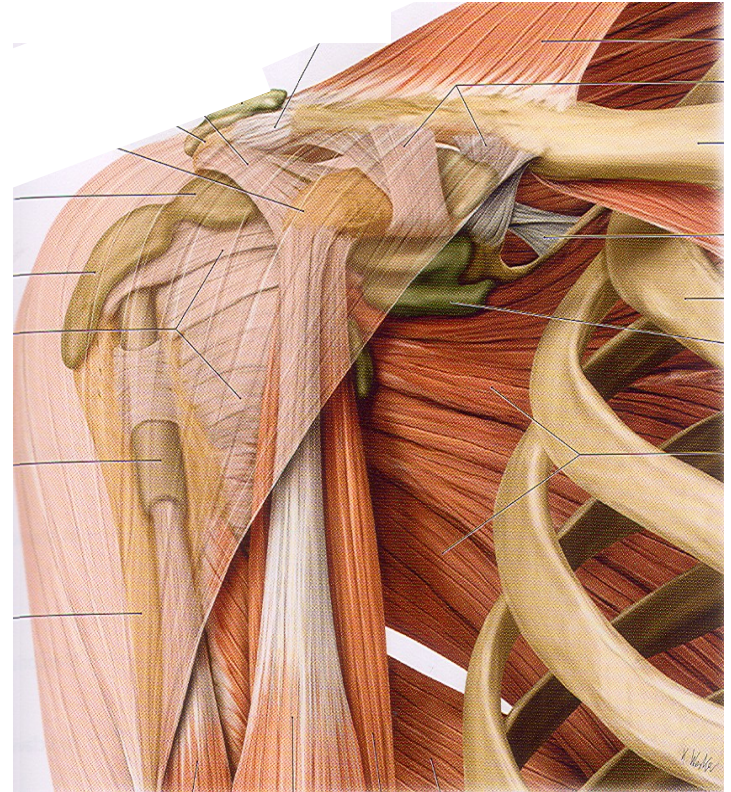
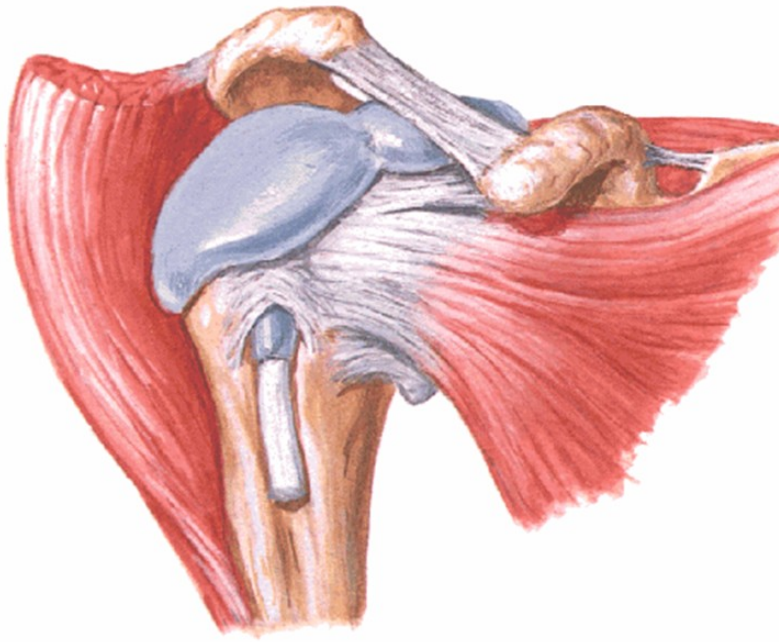
# Articulatio humeri - bursae synoviales

**Bursa subdeltoidea**

**Bursa subcoracoidea**

**Bursa subacromialis**

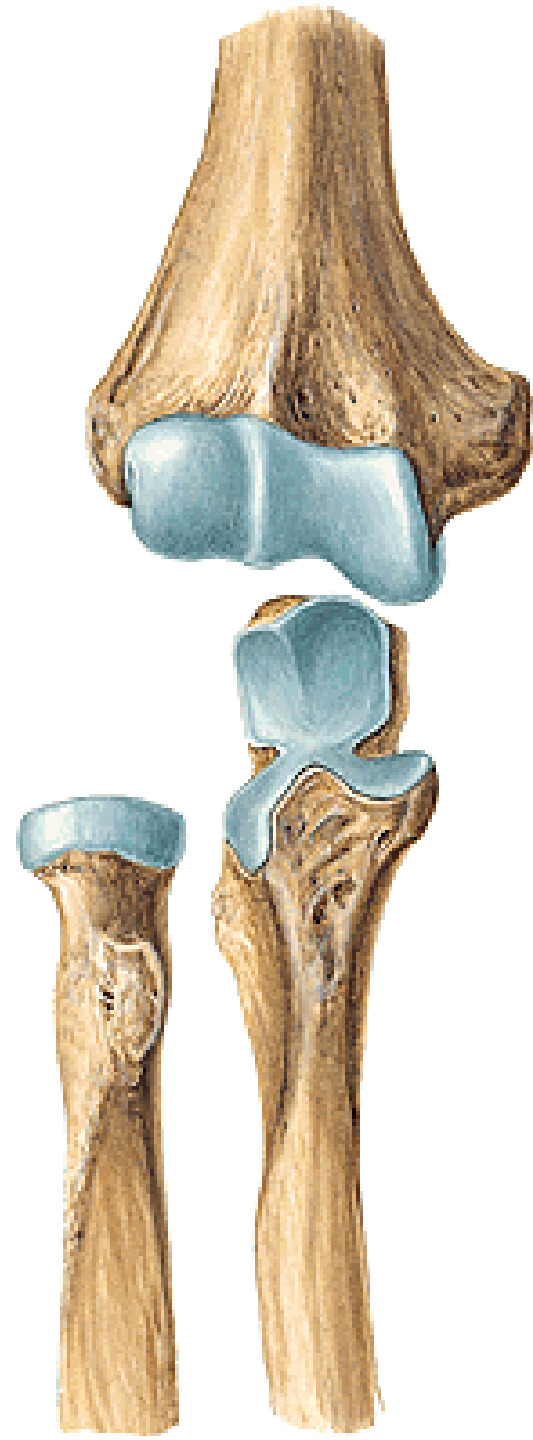
**Bursa m. subscapularis subtendinea**



# Articulatio cubiti (elbow joint)

**Articulatio composita:**

- 1. Articulatio humeroradialis**
- 2. Articulatio humeroulnaris**
- 3. Articulatio radioulnaris proximalis**



## 2. Articulario cubiti (*Elbow joint*) compound joint

**Articulatio humeroradialis** (*humeroradial joint*)

**Articulatio humeroulnaris** (*humeroulnar joint*)

**Articulatio radioulnaris proximalis** (*radioulnar proximal joint*)

**Articular surfaces** :.....

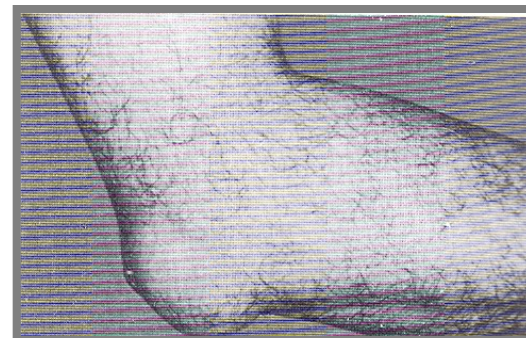
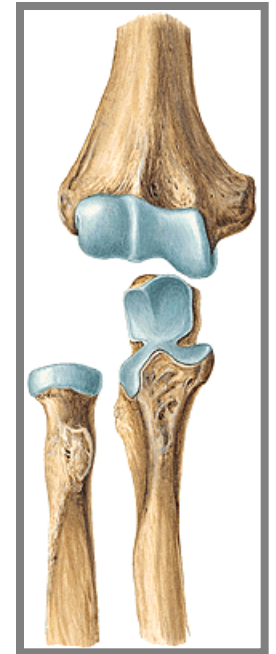
**Articular capsule** : both **epicondyli** of humerus are **free**, all fossae of humerus are located **intracapsularly**, on the radius runs to the collum radii – recessus sacciformis.

**Auxiliary facilities**: **ligg. collateralia rad. and uln.**, **anulare radii**

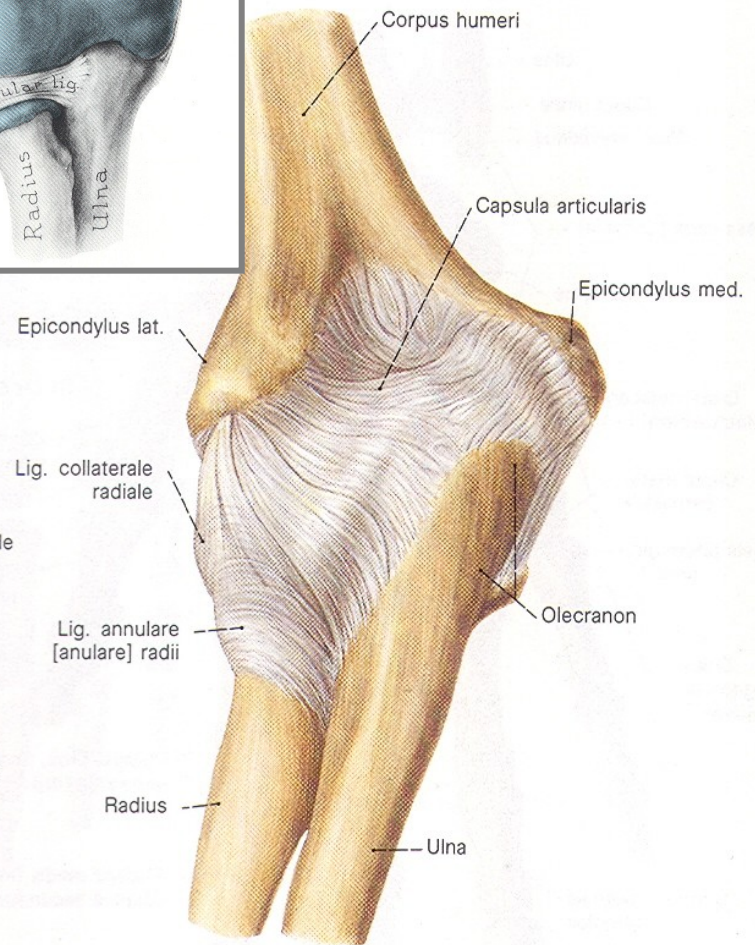
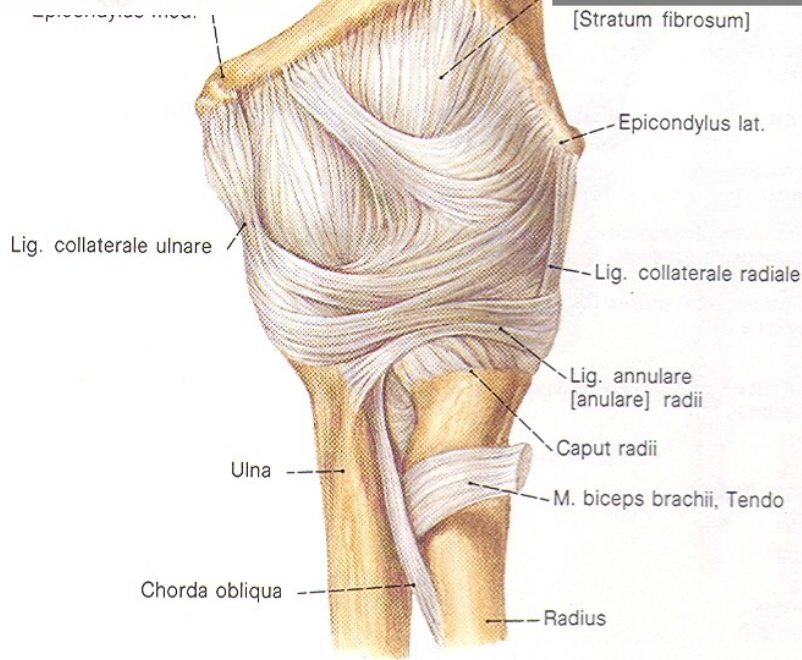
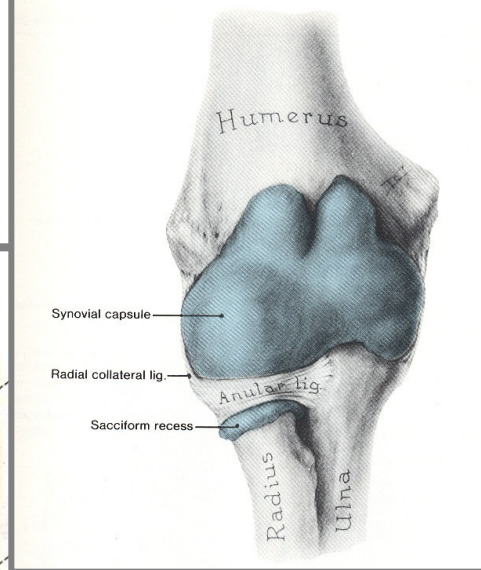
**Type of joints**:

**Movements**: flexion and extension, rotation (inner-pronation) and external rotation (supination).

Subcutaneous and subtendinous olecranon bursa.







**Fig. 358.** The left articulatio cubiti. Anterior view.

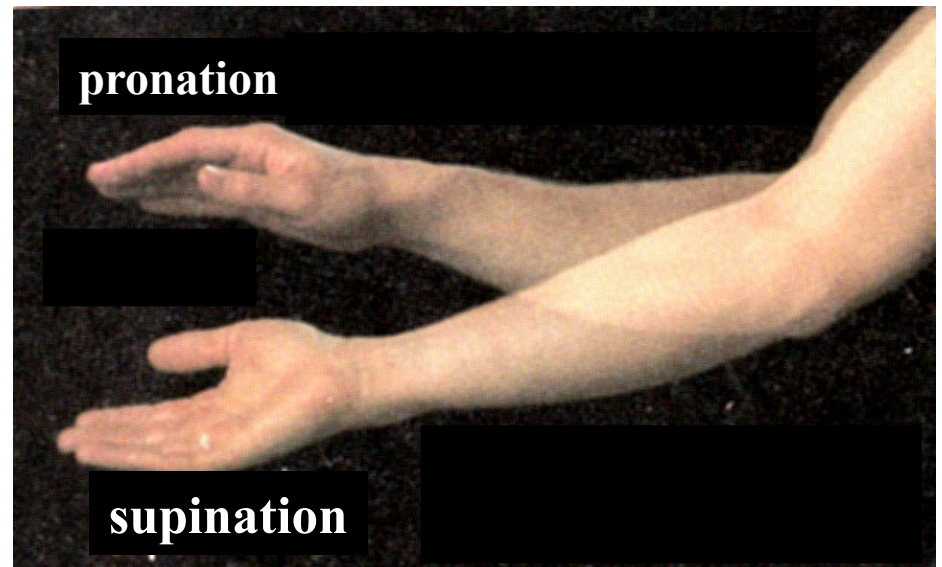
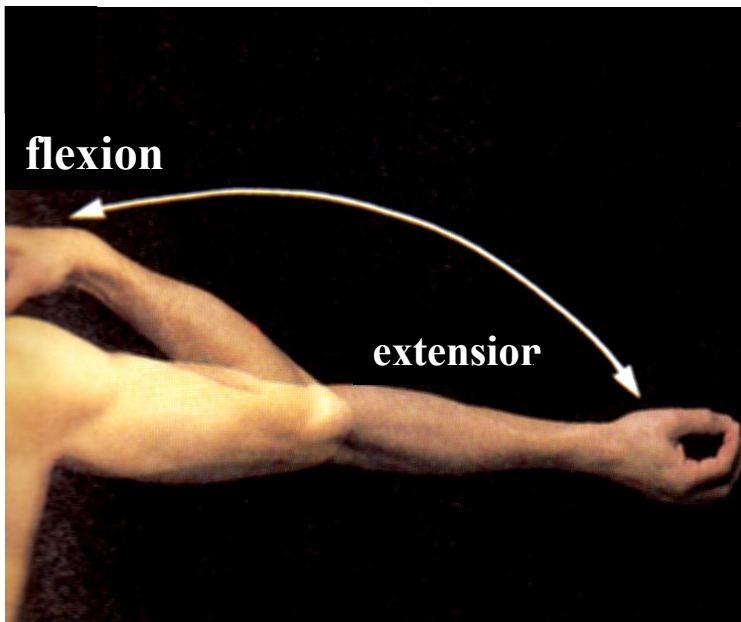
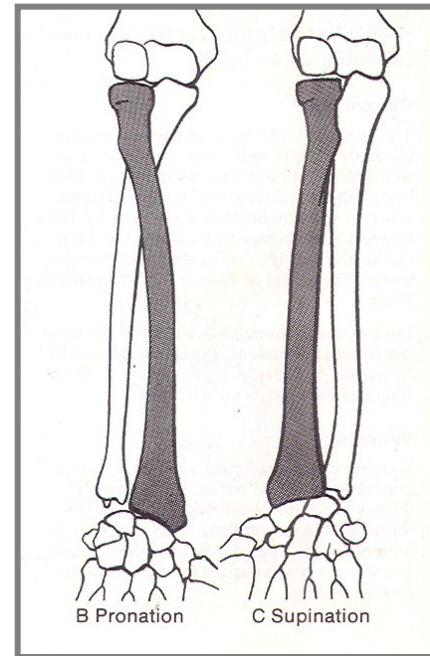
**Fig. 359.** The left articulatio cubiti. Posterolateral view.



# Articulatio cubiti - movements

**flexion and extension  
(hyperextension over 180°)**

**pronation and supination of forearm**



**Used pictures come from:**

**Moore, K. L. (1992):** Clinical oriented anatomy. Third edition.  
Williams&Wilkins, A Waverly Company.

**Gilroy, A. M. et al. (2009):** Atlas of Anatomy. Thieme New York, Stuttgart.

**Putz, R. (2008):**  
**Atlas of Human Anatomy Sobotta. Elsevier Books.**

**Platzer, W., Kahle, W., Leonhardt H. (1992):**  
**Locomotor system. Georg Thieme Verlag, Stuttgart,  
New York, 4th edition.**

**Čihák, R. (1987):** Anatomie 1. Avicenum, Zdravotnické nakladatelství.