

**General arthrology**  
**Joints of the spine, thorax,**  
**head and the hyoid bone**

# SKELETAL JUNCTIONS (juncturae ossium)

## 1. SYNARTHROSIS:

- The bones are connected using a layer of connective tissue
- The articulare surfaces are missing, minimal movements
- Differentiation according the type of connective tissue
  - a) **ART. FIBROSA- SYNDESMOSIS**
  - b) **ART. CARTILAGINEA – SYNCHONDROSIS (SYMPHYSIS)**
  - c) **SYNOSTOSIS**

## 2. DIARTHROSIS: articulatio synovialis

- Joint connection by touch

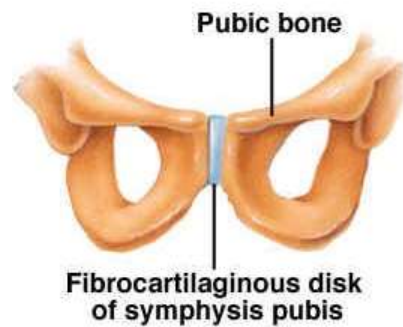
# 1) Synarthrosis

By connective tissue

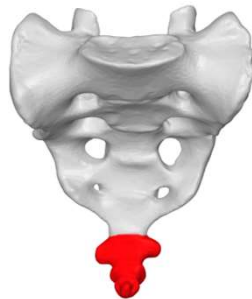
Syndesmosis



Synchondrosis

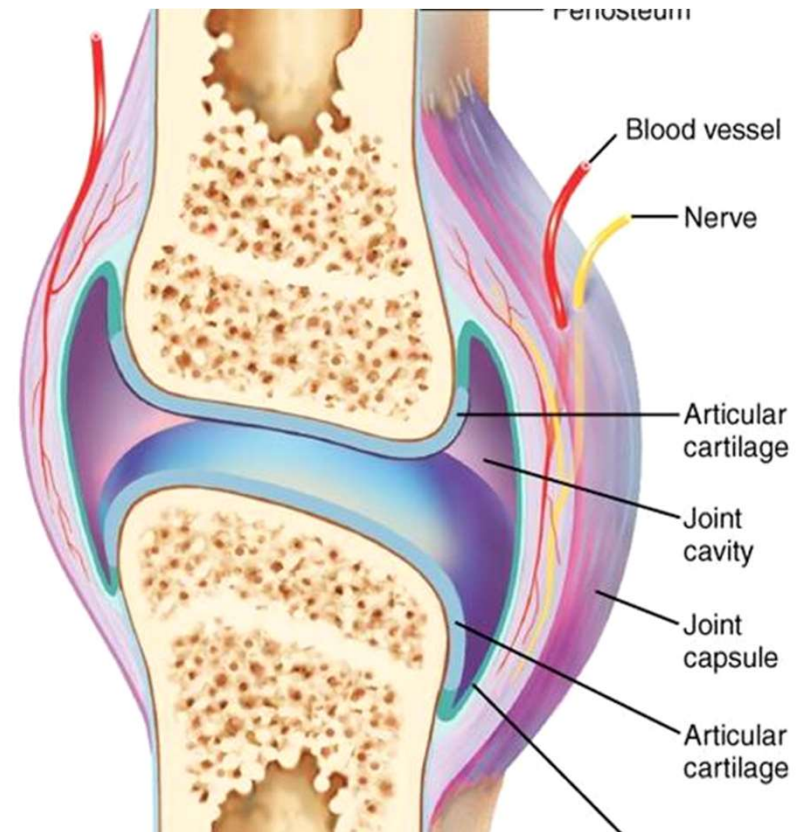


**Synostosis**



# 2) Diarthrosis

By touch

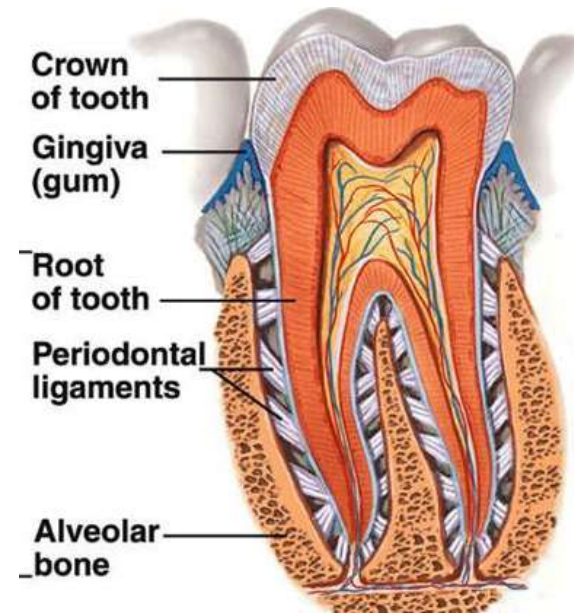


## **a) ART. FIBROSA- SYNDESMOSIS**

Connection using fibrous tissue

### **wedging (gomphosis):**

- it helps the tooth being inserted into dental alveolus of the jaw



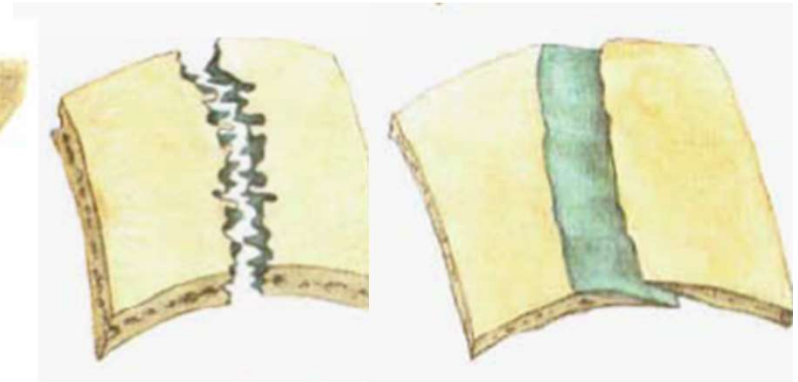
### **suture (sutura):**

- connection of skull bones

smooth- plana

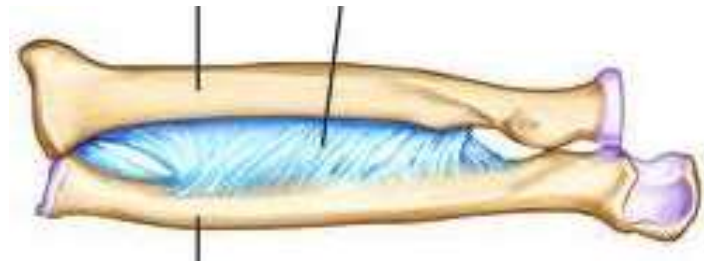
serrated- serrata

squamous- squamosa



### **ligament (ligamentum):**

- band of collagen fibrous tissue, (like a rope, ribbon or flat membrane)





## b) ART. CARTILAGINEA

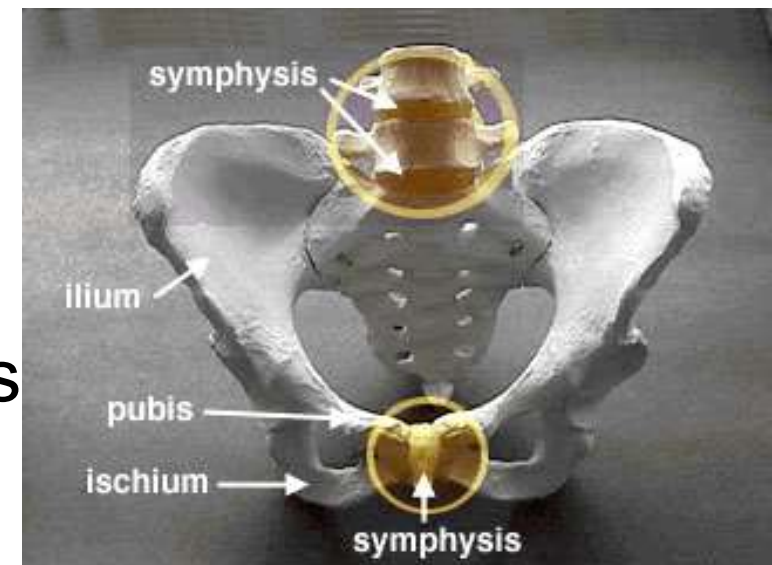
### SYNCHONDROSIS

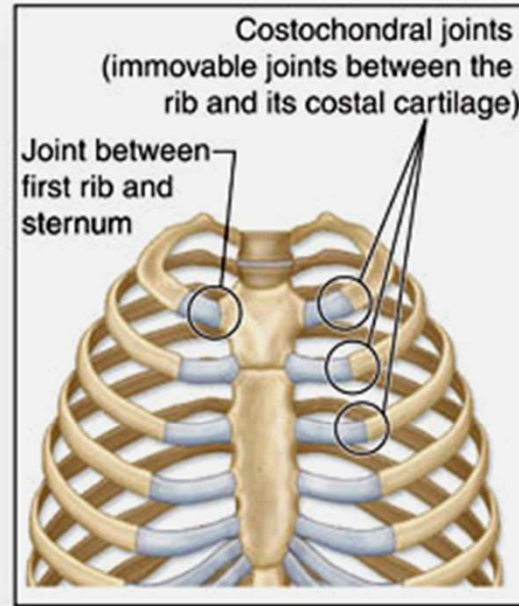
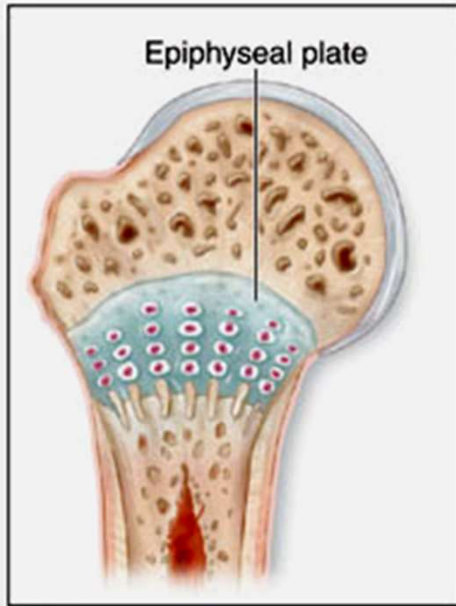
- Connection using hyaline cartilage  
(connection of ribs and sternum, between bones of the skull base- in child)



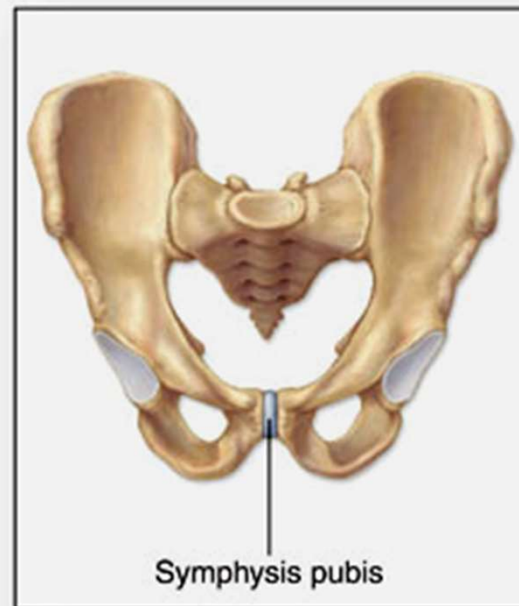
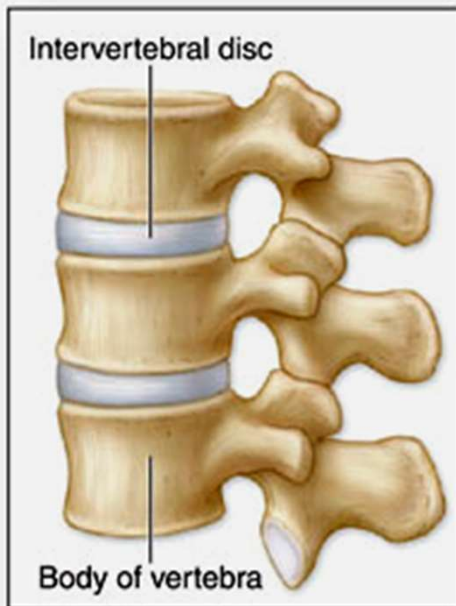
### SYMPHYSIS

- connection using fibrous cartilage  
(intervertebral discs, connection of the pubic bones by symphysis pubica)





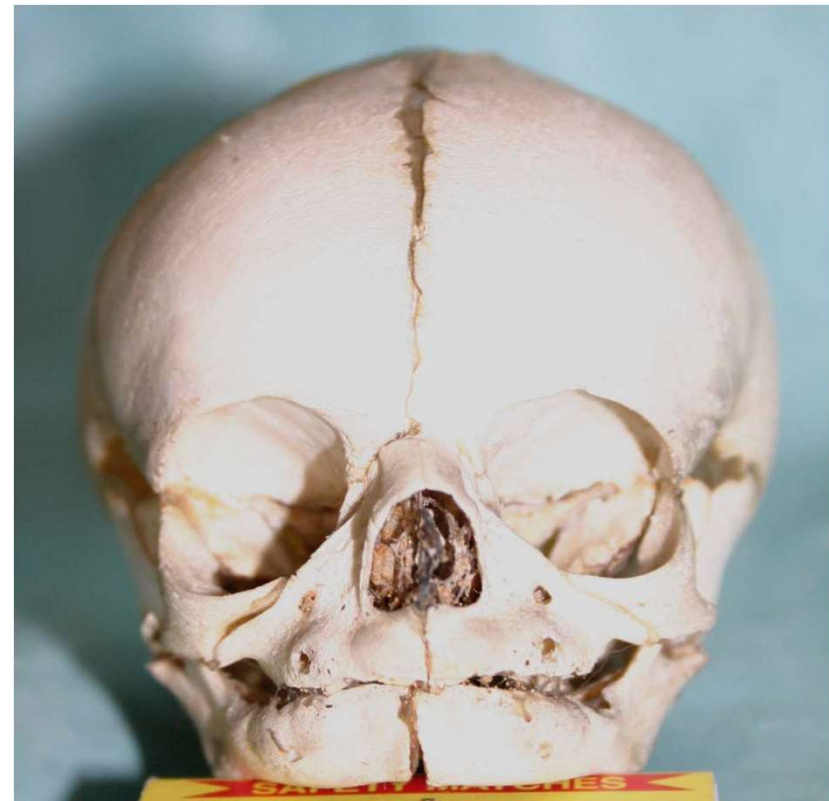
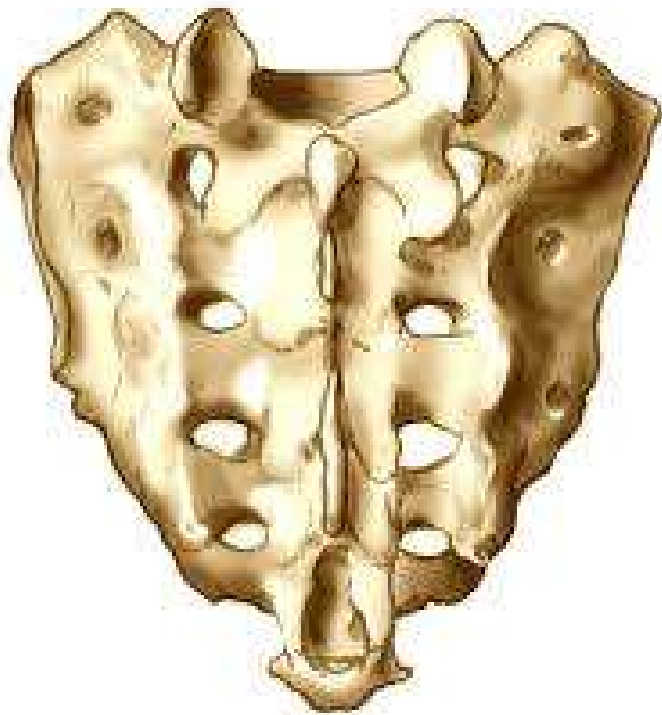
(a) **Symphondroses** (contain hyaline cartilage)



(b) **Symphyses** (contain fibrocartilage)

## **c) SYNOSTOSIS**

- Connection of the bones using the bone tissue, the result is growing of two or more bones
- Examples: sacral bone, coccygeal bone, coxal bone, some skull bones
- In adulthood: synostosis of skull sutures - physiological, pathological



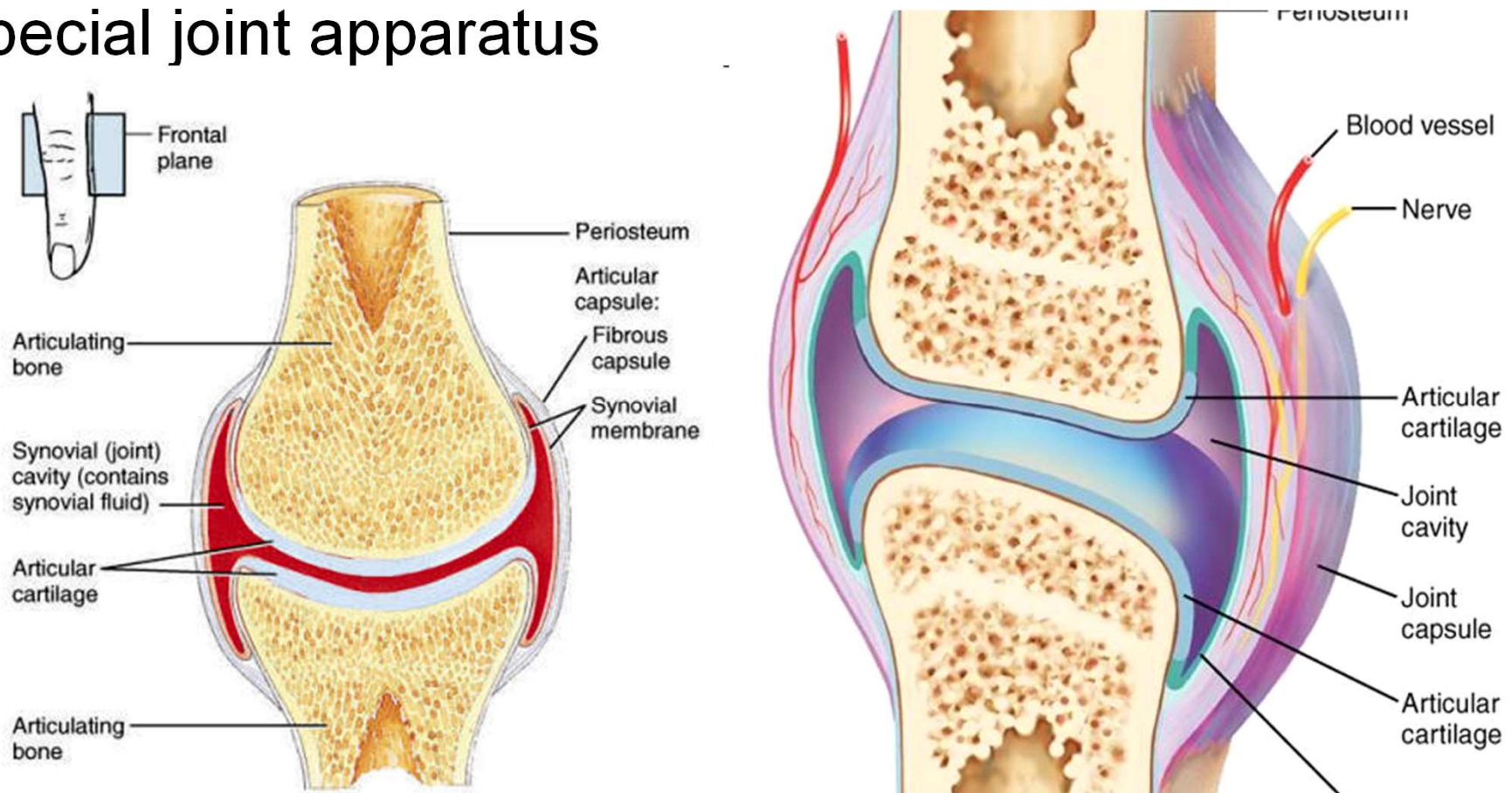


## 2. DIARTHROSIS

- Joint connection– **articulatio**, usually movable

### DESCRIPTION OF THE JOINT

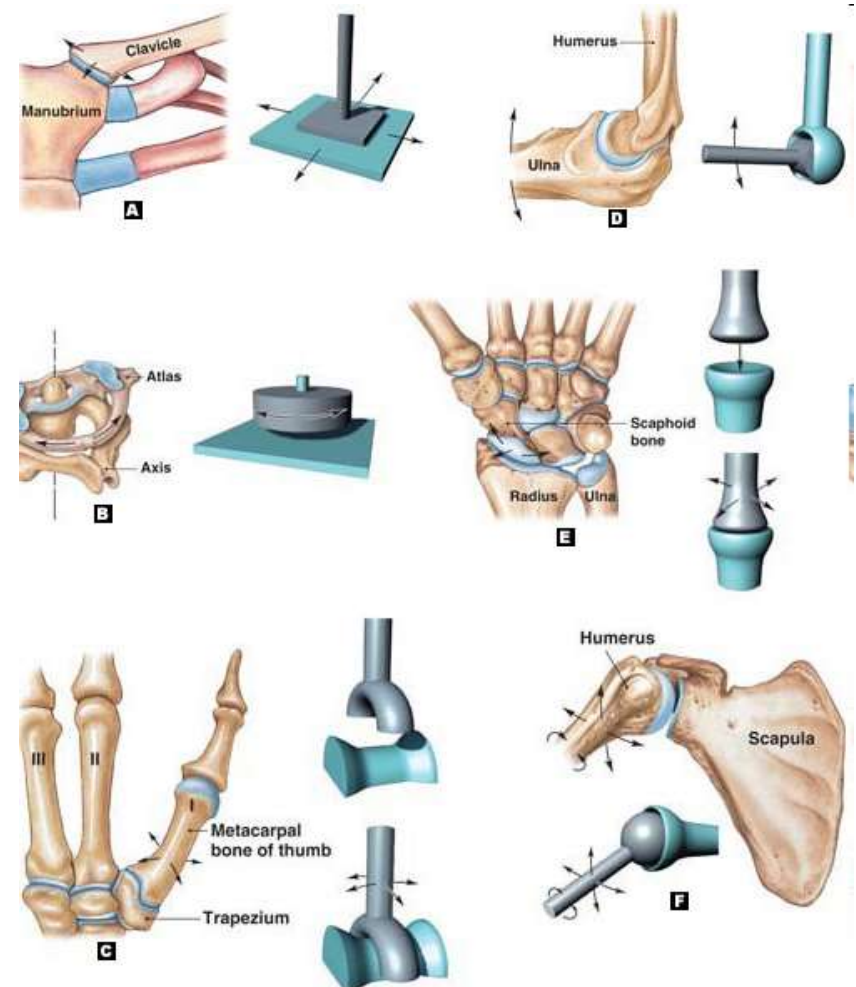
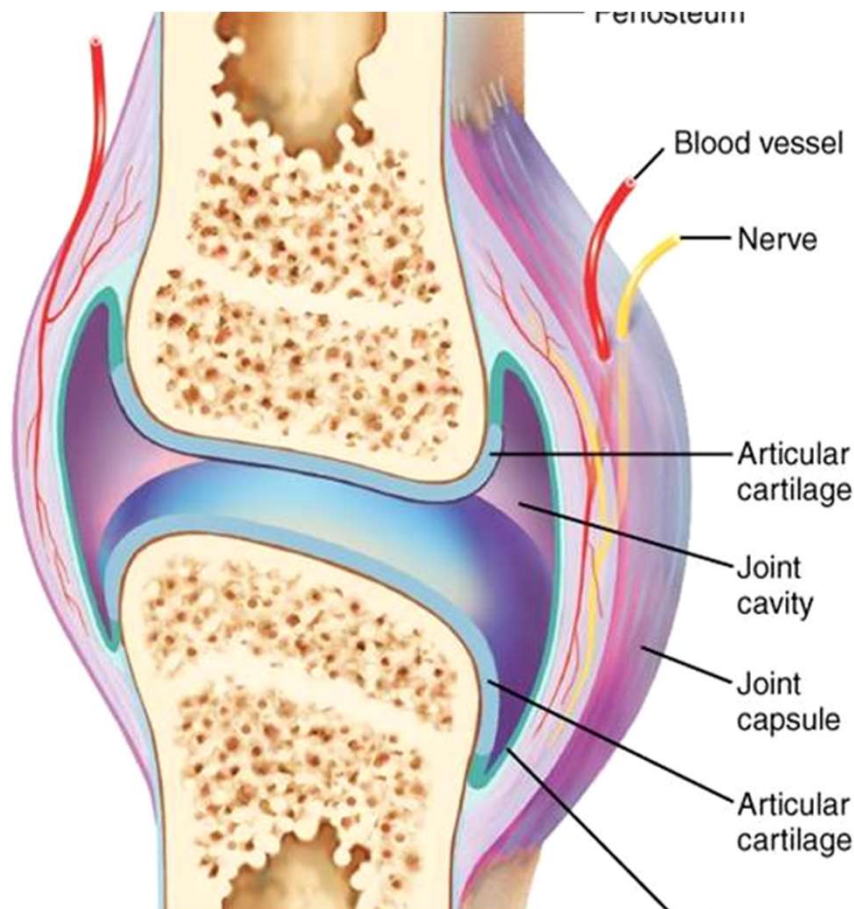
- Contact articular surfaces - **facies articulares**
- Joint cavity - **cavitas articularis**
- Joint capsule - **capsula articularis**
- Special joint apparatus





## a) Articular surface (facies articularis):

- surface, which is in connection with the other bone
- is covered by a layer of joint cartilage (hyaline)
- different shape, articular head (caput)- convex, articular fovea (fossa)- concave
- shape of the articular surfaces determines the possibility of movement in the joint

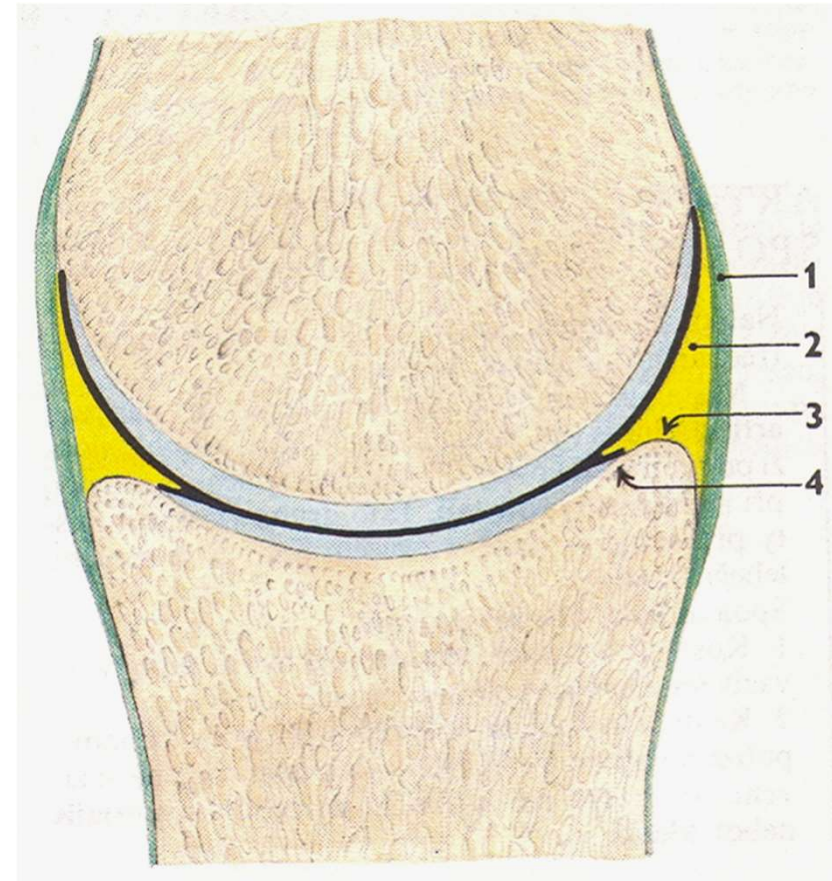
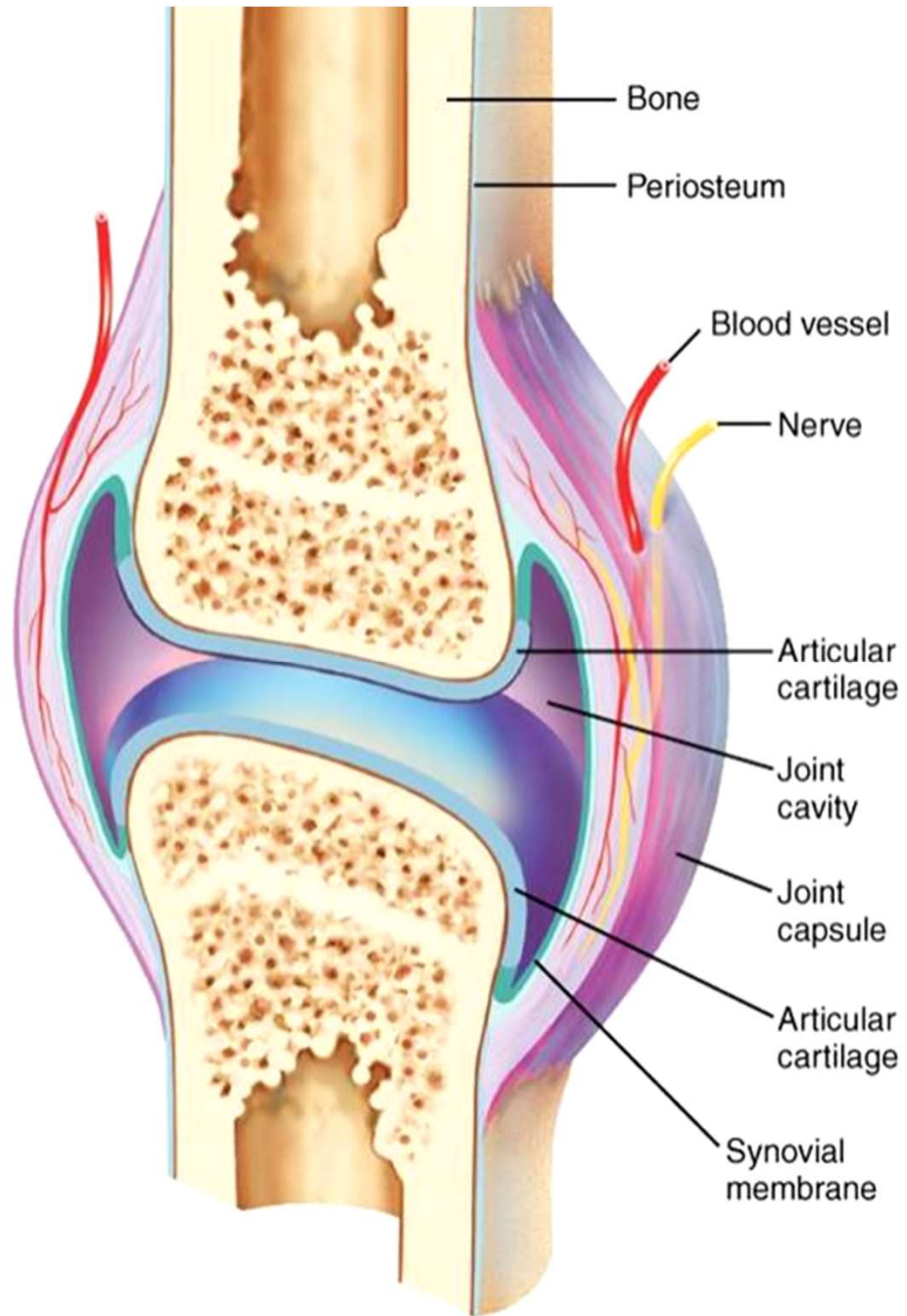


**b) Articular capsule (capsula articularis):**

- **fibrous covering** of the joint
- **stratum fibrosum**- external layer from firm collagenous fibrous tissue, it protects the joint
- **stratum synoviale**- thin internal layer from fine fibrous tissue with vessels and nerves, it forms folds - **plicae synoviales**, and villi- **villi synoviales**, it produces a synovium- **synovia** (it has nutritive and mechanical functions)

**c) Articular cavity (cavum articulare):**

- cavity (fissure) between articular surfaces and articular capsule, it is filled by synovia





## **d) Special joint apparatus:**

- Only in some joints
- It participates in providing of their better function

### **Joint ligaments (ligamenta articularia):**

- (intraarticular ligaments, extraarticular ligaments)

### **Cartilaginous plates (disci et menisci):**

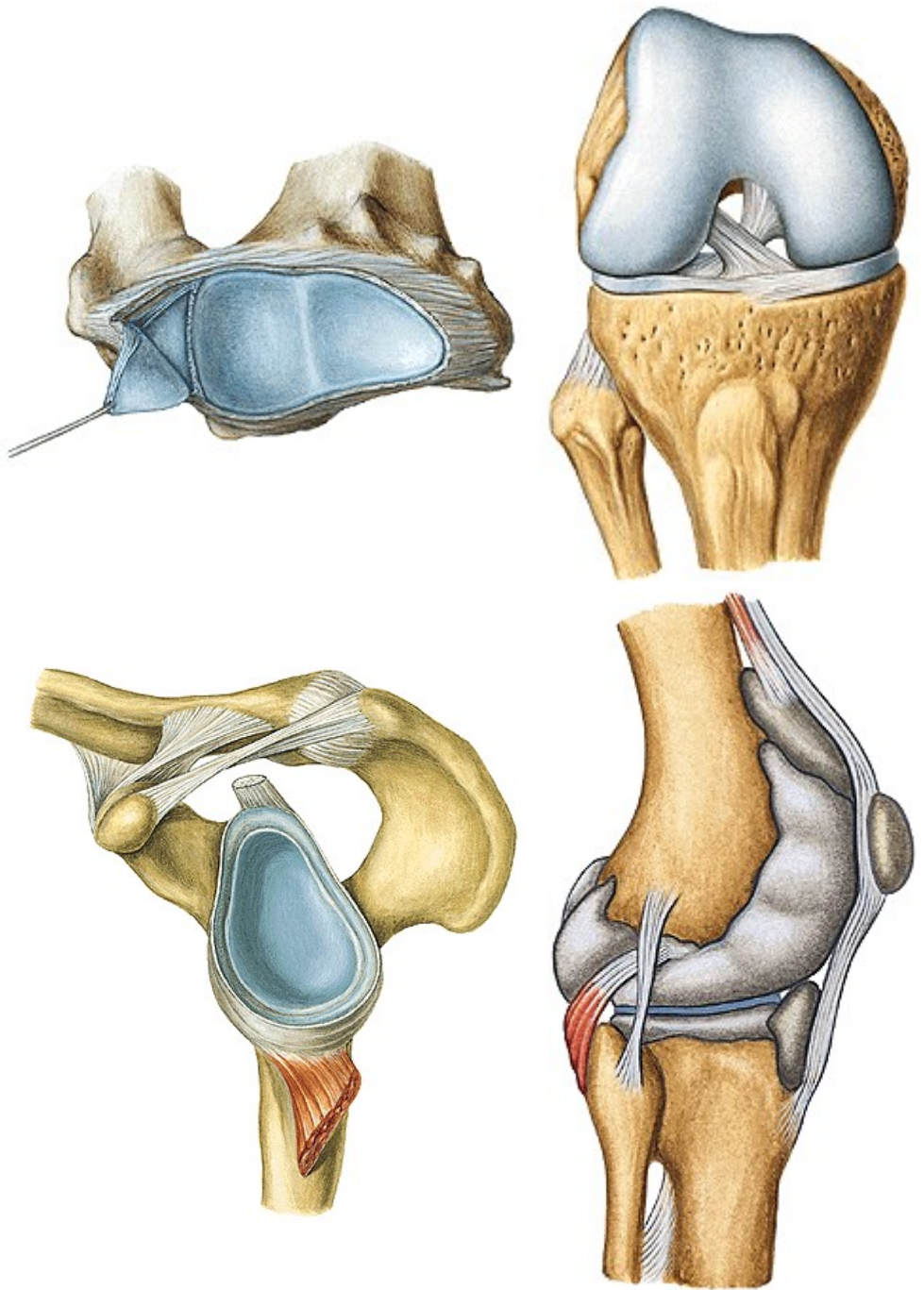
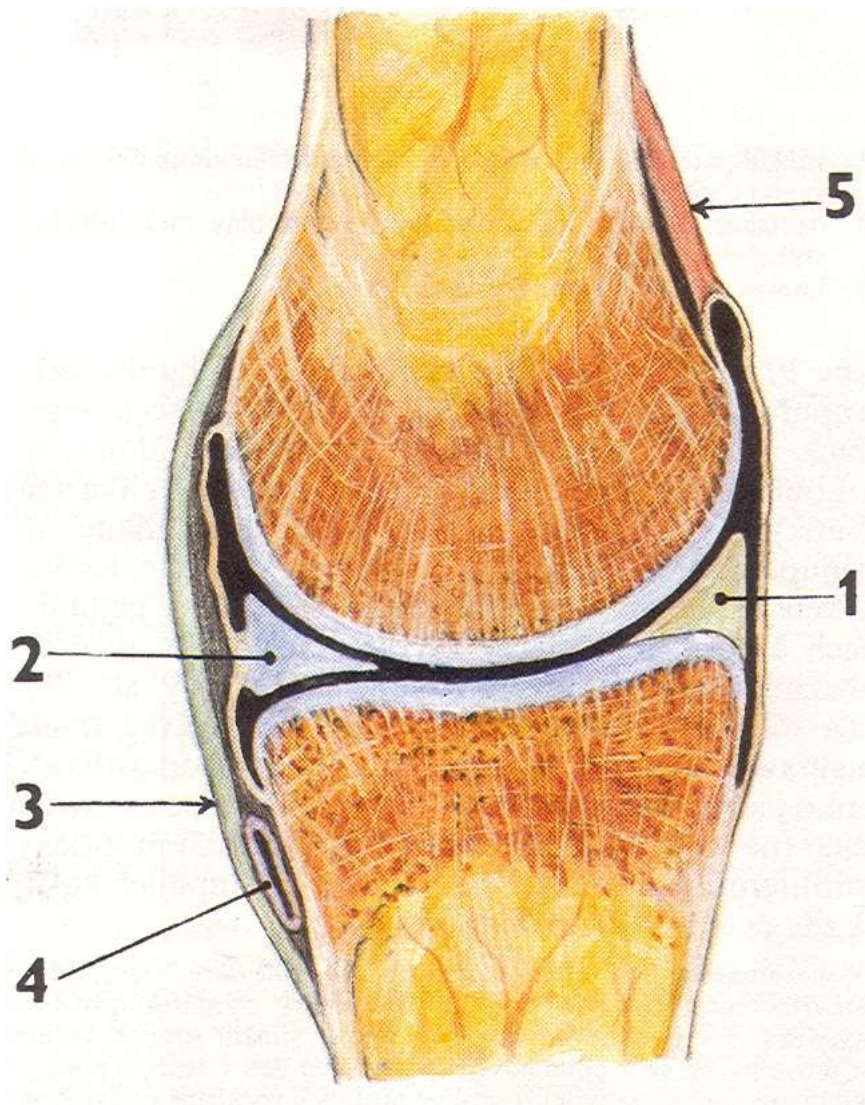
- Fibrous cartilage, intraarticular, in joints with incongruent joint surfaces
- discus articularis- completely septates the joint cavity and divides it into two separated cavities
- meniscus articularis- it septates incompletely the joint cavity

### **Articular labra(labra articularia):**

- Bands of cartilaginous tissue, they enlarge and deepen the joint pits

### **Synovial bursae (bursae synoviales):**

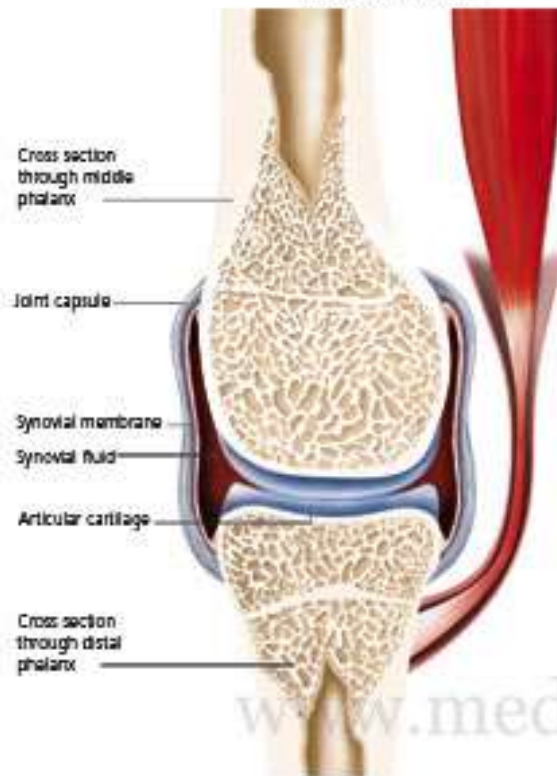
- pouches around the joint, derivatives of the joint capsule, in the places, where tendons and muscle lie directly on the joint



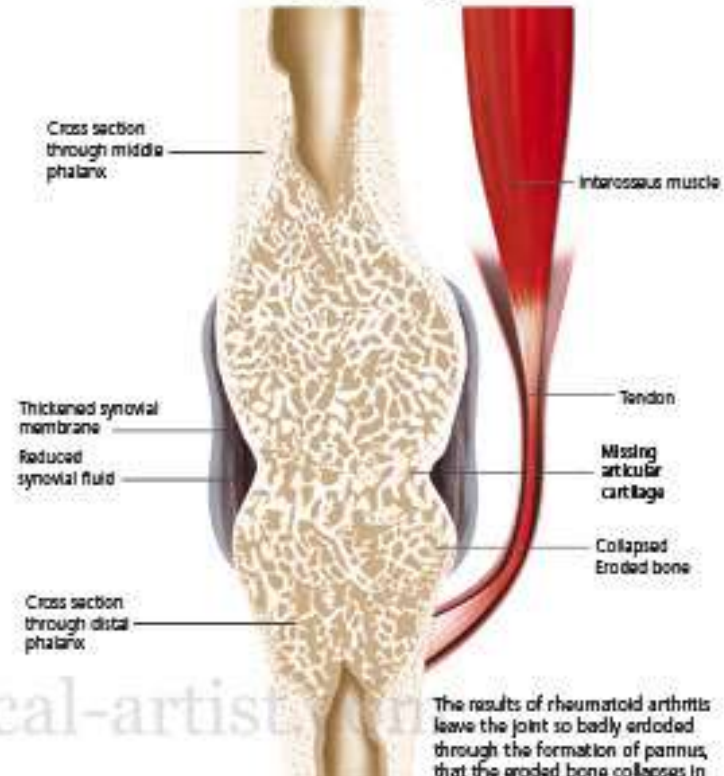
# Ankylosis

Cross Section through the Metacarpophalangeal and Proximal Phalanx of the Index Finger

Healthy Synovial Joint



Joint with Bony Ankylosis through Rheumatoid Arthritis



The results of rheumatoid arthritis leave the joint so badly eroded through the formation of pannus, that the eroded bone collapses in on itself called bony ankylosis





# **Types of the joints**

## A. Classification of joints according to the shape of articular surfaces:

Tough joint with irregular surfaces- **AMPHIARTROSIS**

Flat joint - **ART. PLANA**

Spherical joint - **ART. SPHAEROIDEA**

- Free - **ARTHRODIA**

- Restricted - **ENARTHROSIS**

Cylindrical joint - **ART. CYLINDROIDEA**

- **GINGLYMUS**- the axis of movement is in the right angle to the longitudinal axis of bone

- Wheel joint - **TROCHOIDEA**- the axis of movement is parallel with the longitudinal axis of bone

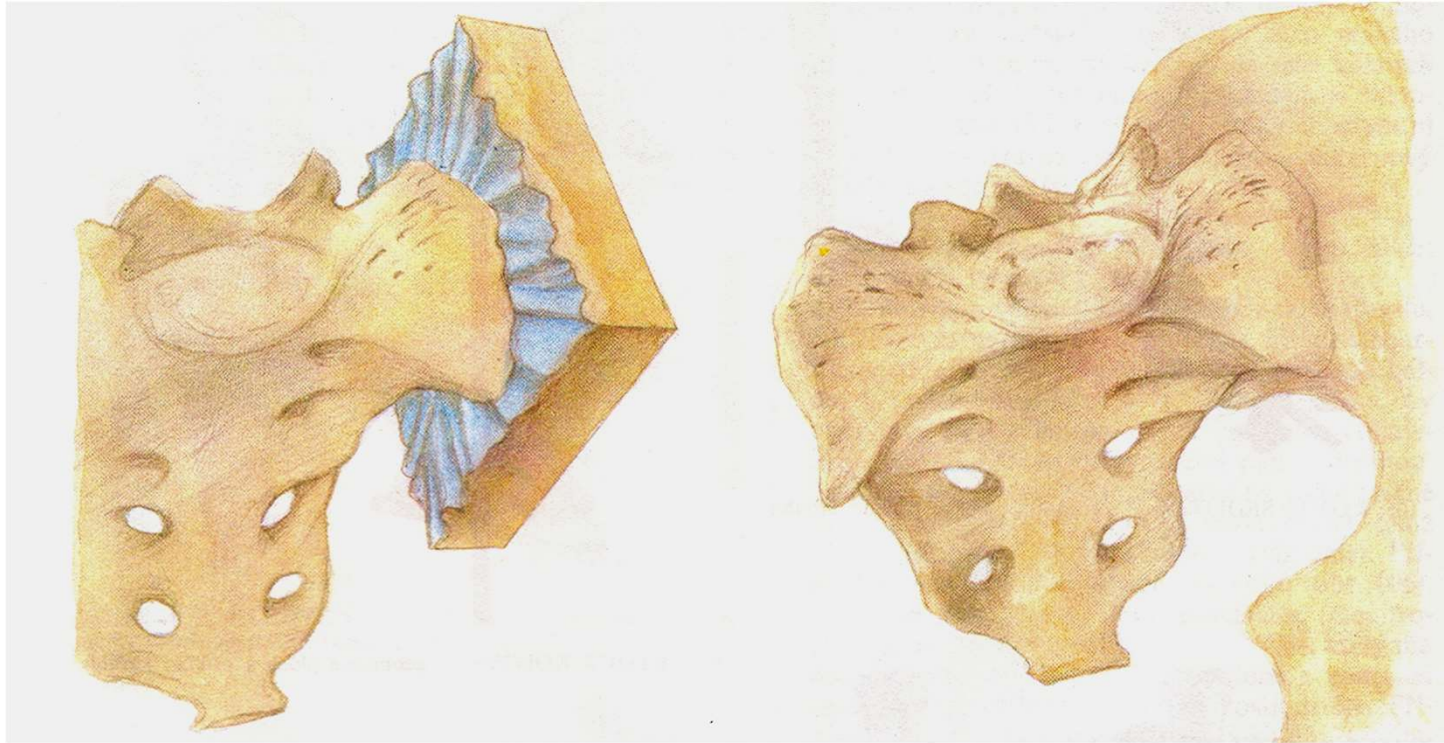
Elipsoidal joint- **ART. ELLIPSOIDEA**

Saddle joint - **ART. SELLARIS**

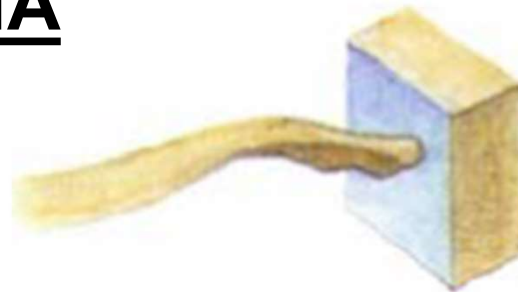
Trochlear joint- **ART. TROCHLEARIS**



# AMPHIARTROSIS

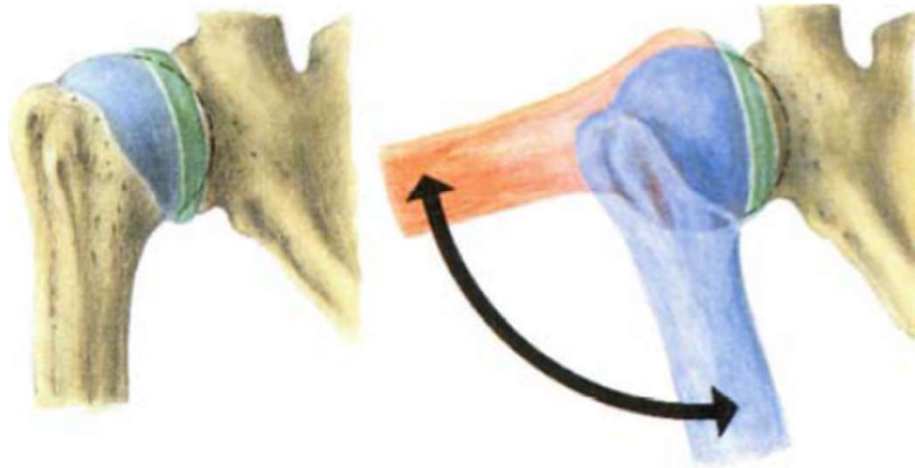


# ART. PLANA

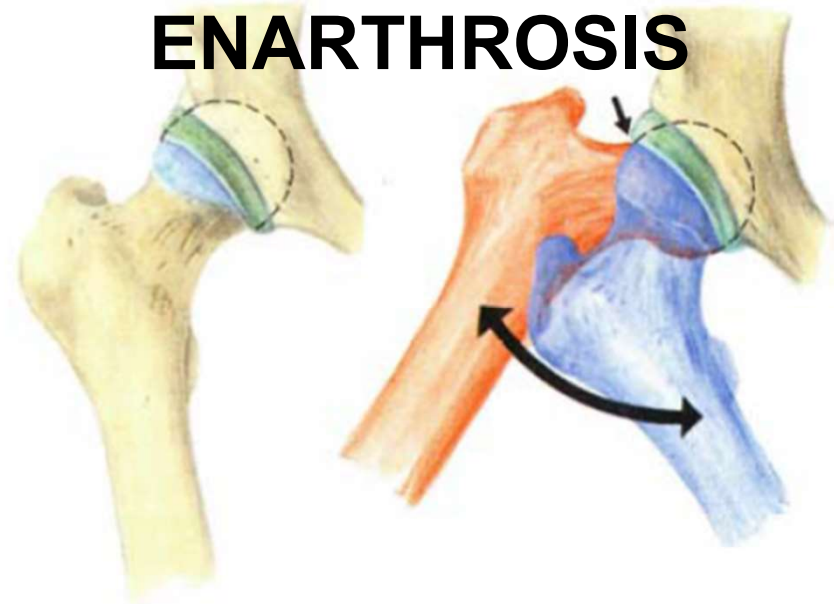


# ART. SPHAEROIDAE

**ARTHRODIA**

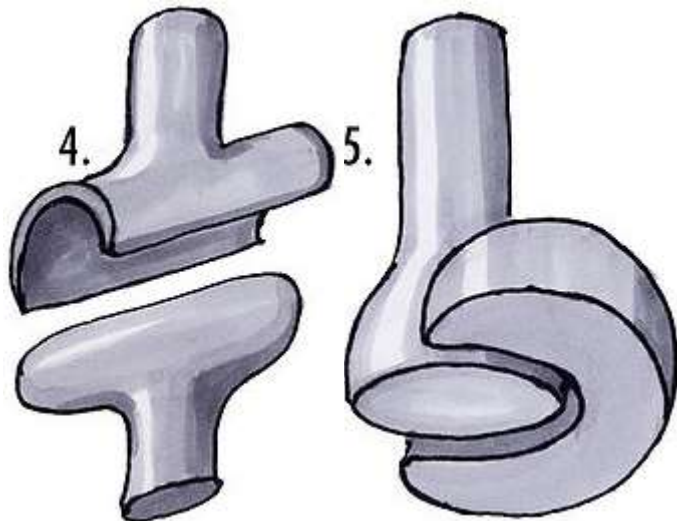


**ENARTHROSIS**

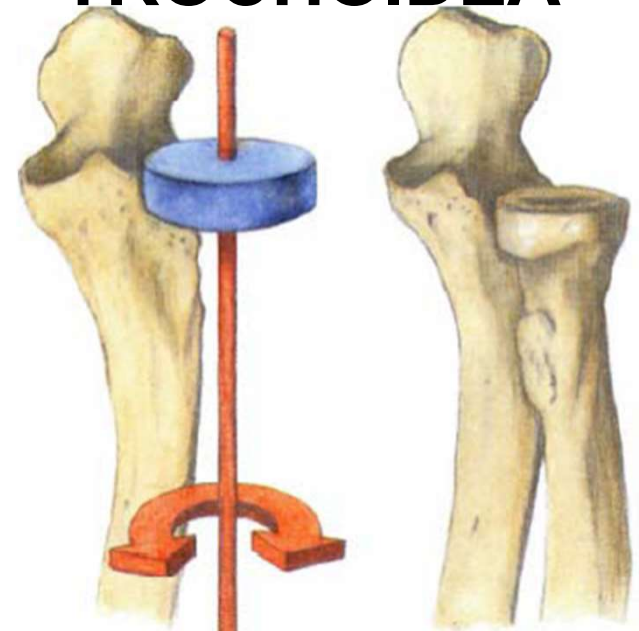


# ART. CYLINDROIDEA:

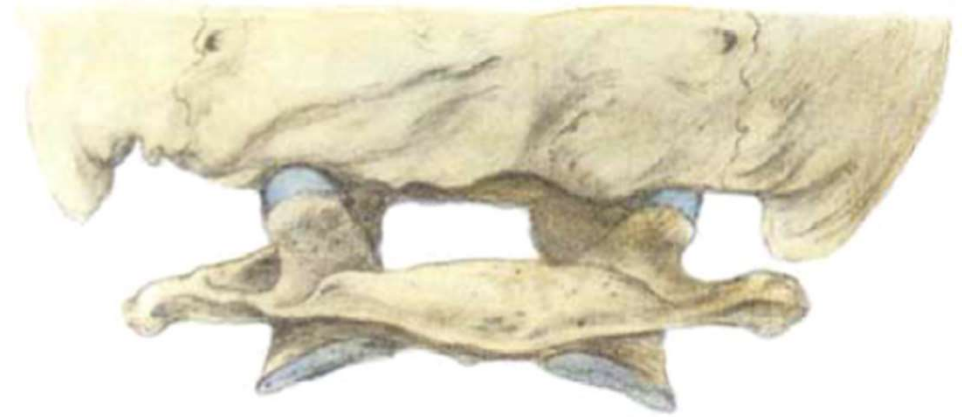
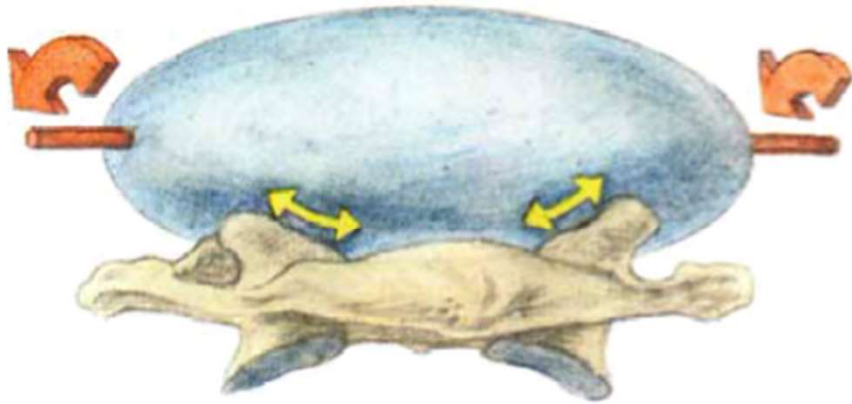
**GINGLYMUS**



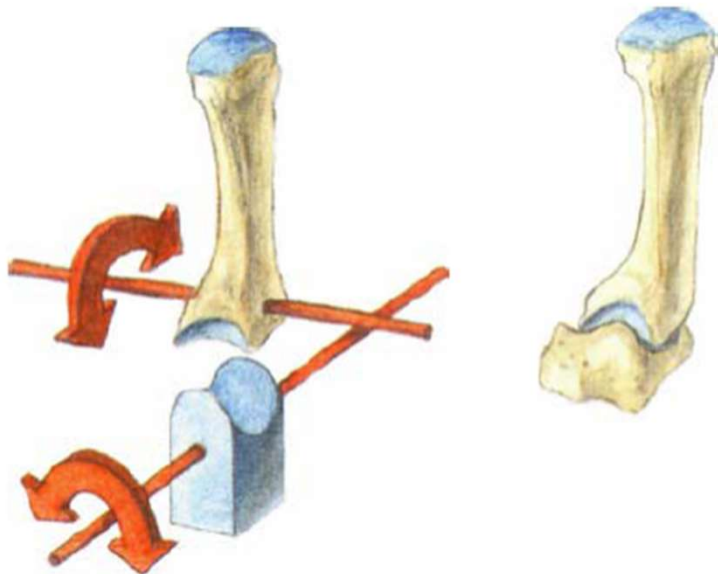
**TROCHOIDEA**



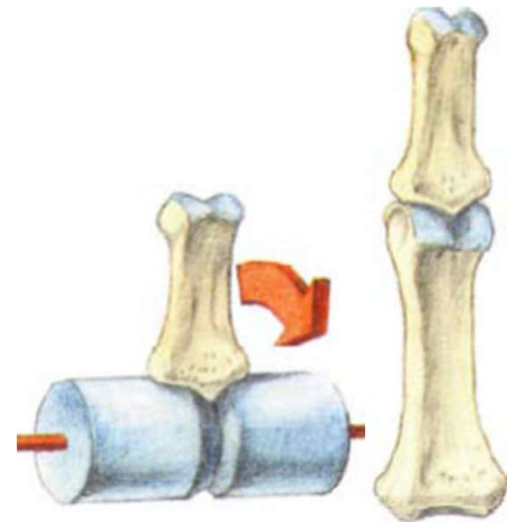
## ART. ELLIPSOIDEA



## ART. SELLARIS



## ART. TROCHLEARIS





## **B. Classification of joints according to the level of moveability and number of axis of movements.:**

### **Joints with minimal movement:**

- With irregular surfaces - **amphiartrrosis**

### **Joints with sliding movements:**

- Flat joints - **articulatio plana**

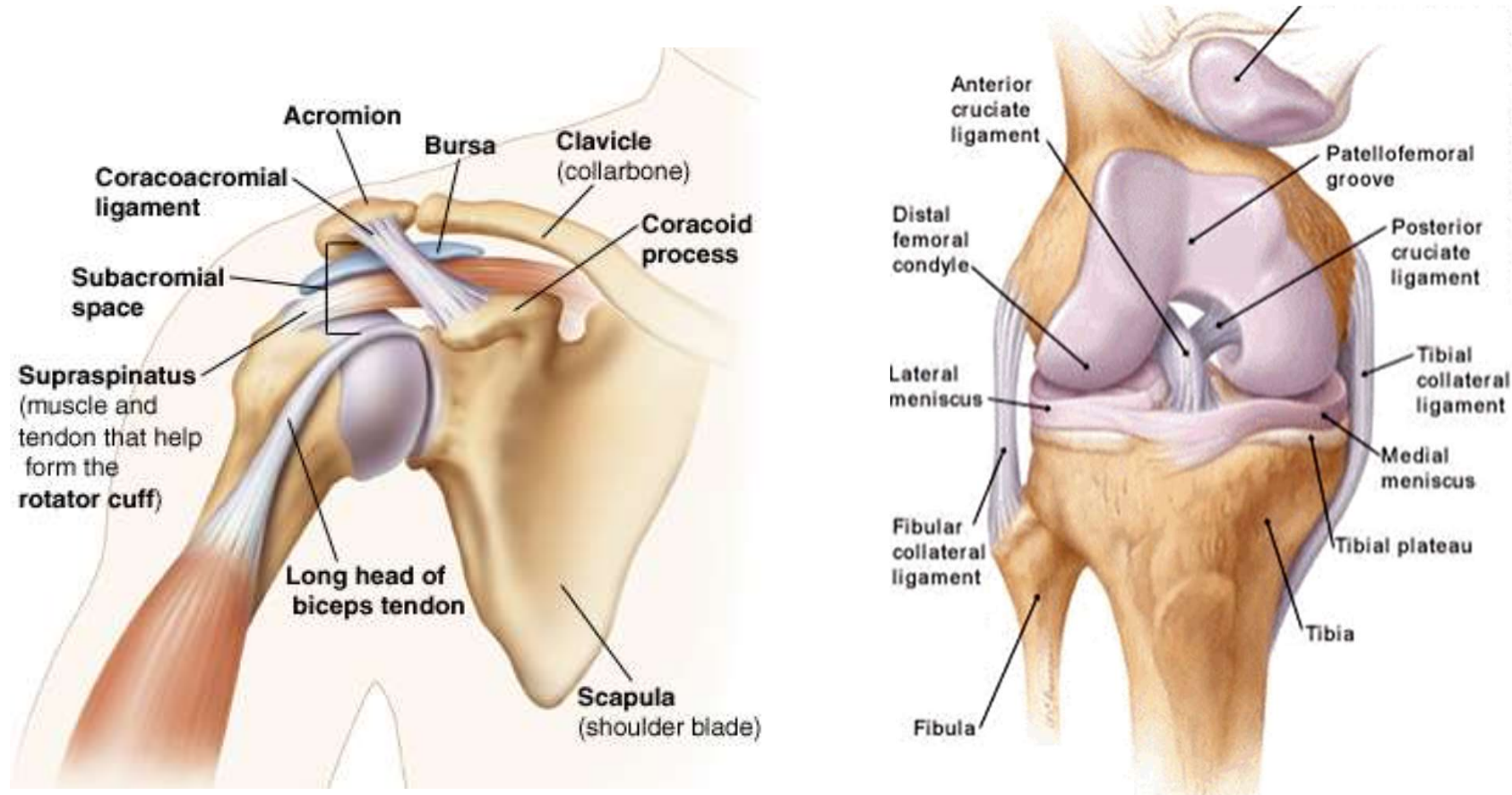
### **Joints with rotational movements:**

- Joint surfaces allow rotation along one to three axis
- **One-axis joints (art. cylindroidea and art. trochlearis)**
- **Two-axis joints (art. ellipsoidea and art. sellaris)**
- **Triaxial joints (art. sphaeroidea)**

## C. Classification of joints according to the number of connecting bones:

**Simple joint** - art. simplex- two bones are connecting

**Composed joint** - art. composita- two or more bone are connecting, or two bones with discus or meniscus



# **Junctions of the spine** **and thorax**

# Junctions of the spine

## Spine (columna vertebralis)

We can observe all types of junctiones on the spine

**Synartroses and diarthroses** as well

### Synarthrosis

- syndesmosis- ligaments
- synchondrosis- **disci intervertebrales**
  - synchondrosis **sacrococcygea**
- synostosis- **os sacrum, os coccygis**

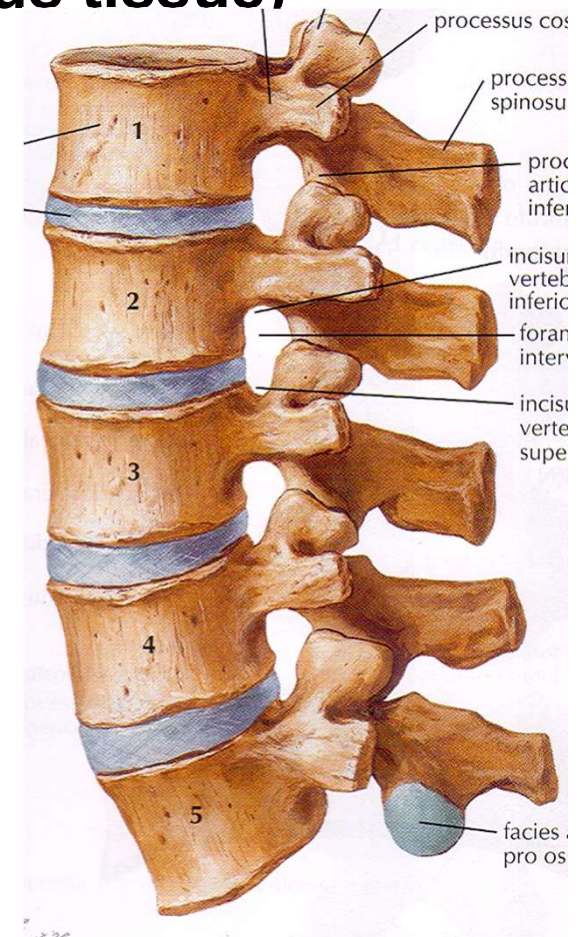
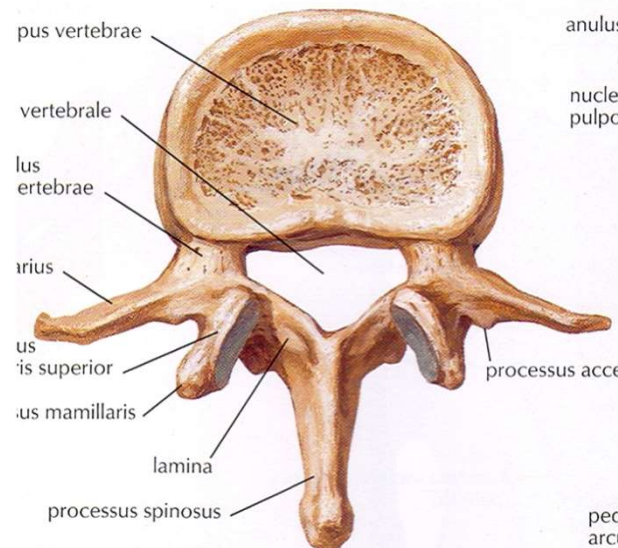
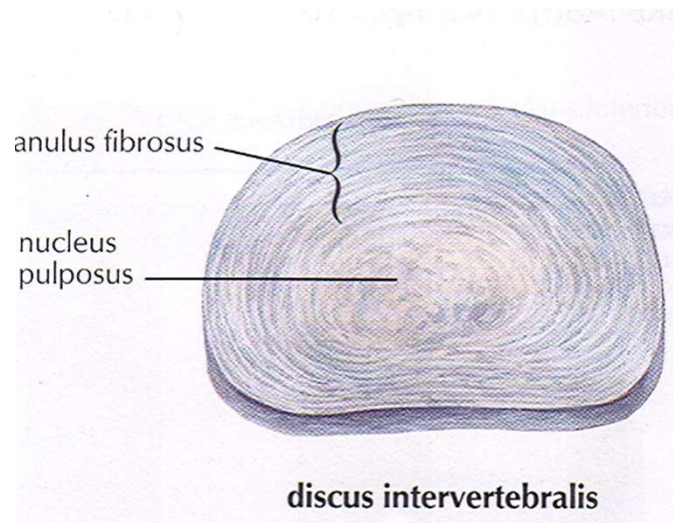
Diarthrosis- **articulationes intervertebrales**

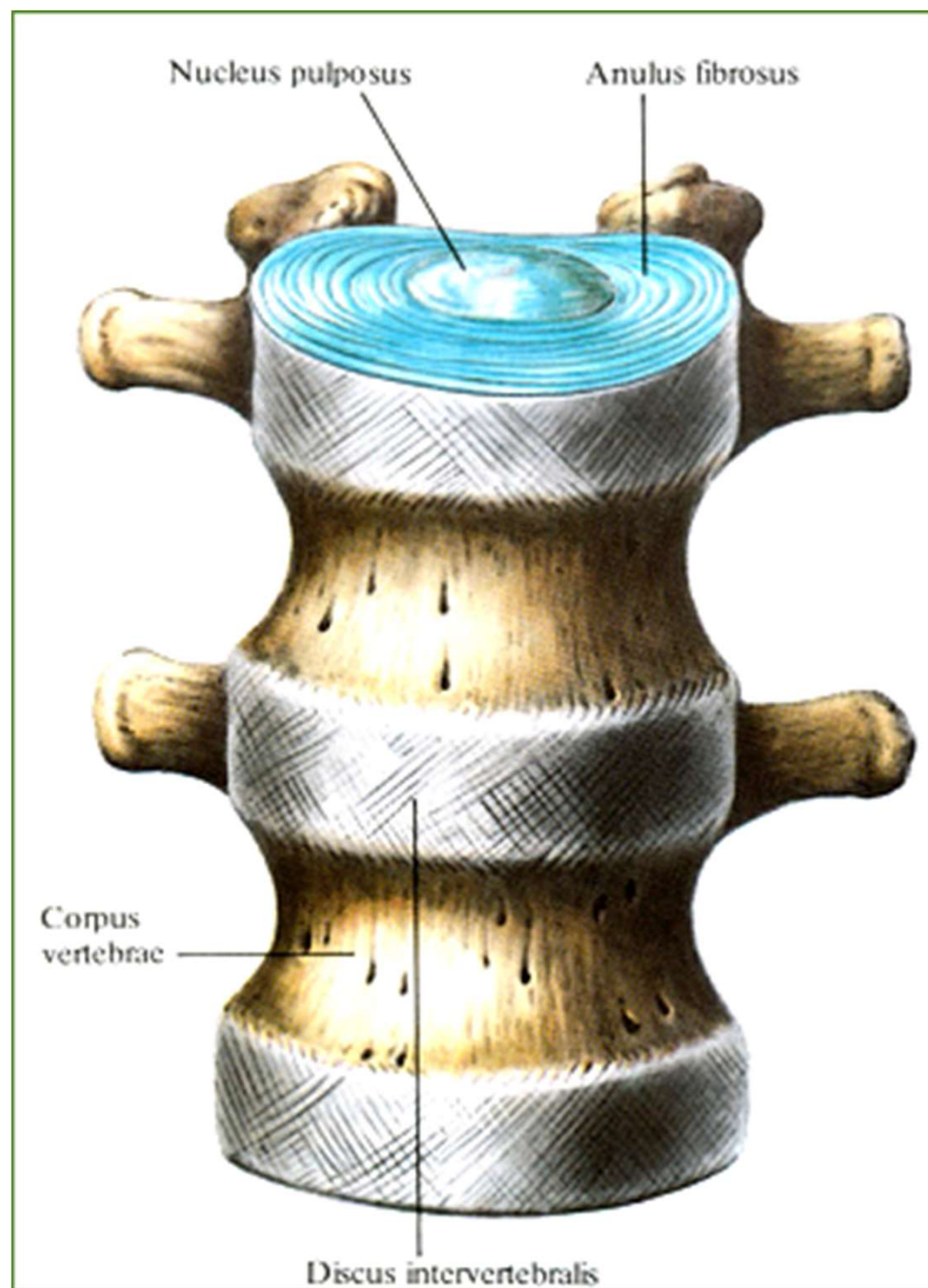


# Connection between vertebrae

## 1. Junctions of vertebral bodies

– **disci intervertebrales: altogether 23, cartilaginous (symphysis) connection (anulus fibrosus – hyaline and fibrous cartilae, nucleus pulposus – fibrous tissue)**







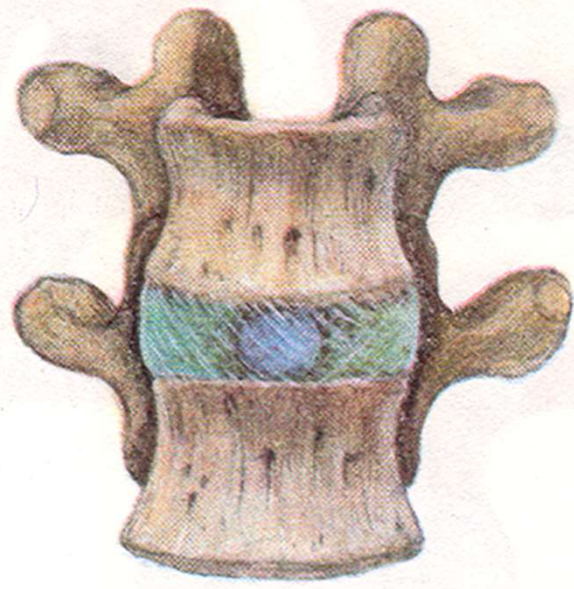


Diagram illustrating the position of the intervertebral disc in a normal, upright posture. The disc is shown as a horizontal band between the vertebral body and the vertebral arch.

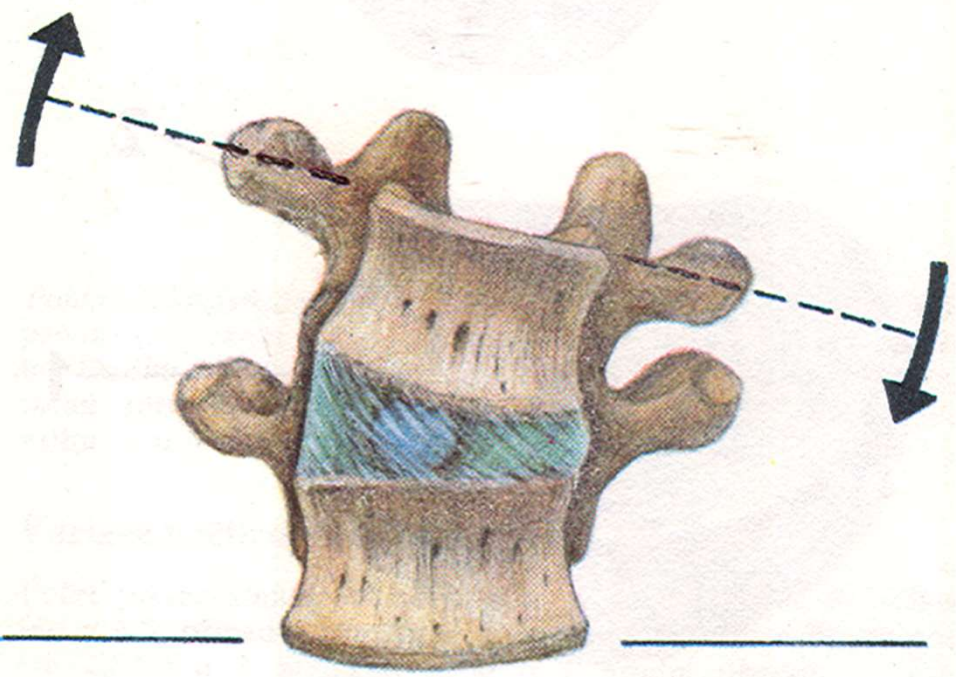
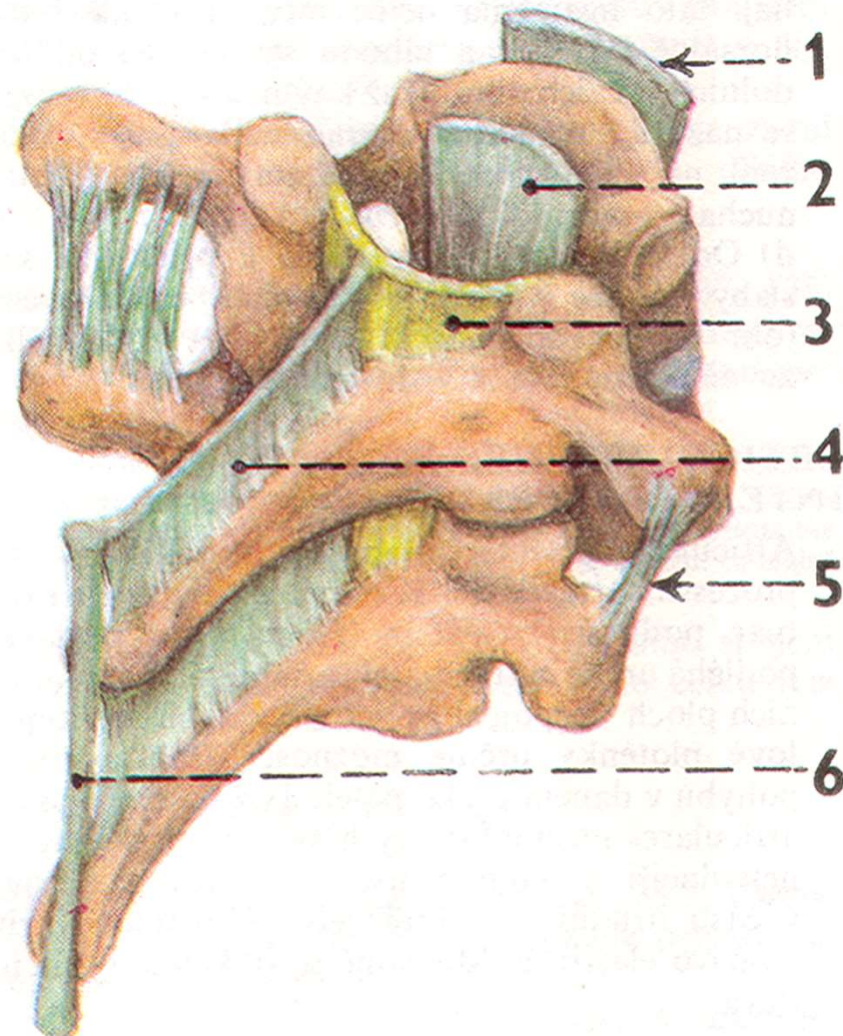


Diagram illustrating the position of the intervertebral disc during lateral bending. The disc is shown tilted, with the blue portion on the right and the green portion on the left. A dashed line indicates the axis of rotation, and curved arrows show the direction of movement.

## 2. Junctions of vertebral arches

- elastic ligaments– **ligamenta flava (interarcualia)**





### 3. Junctions of articular processes of vertebrae

- **articulationes intervertebrales**

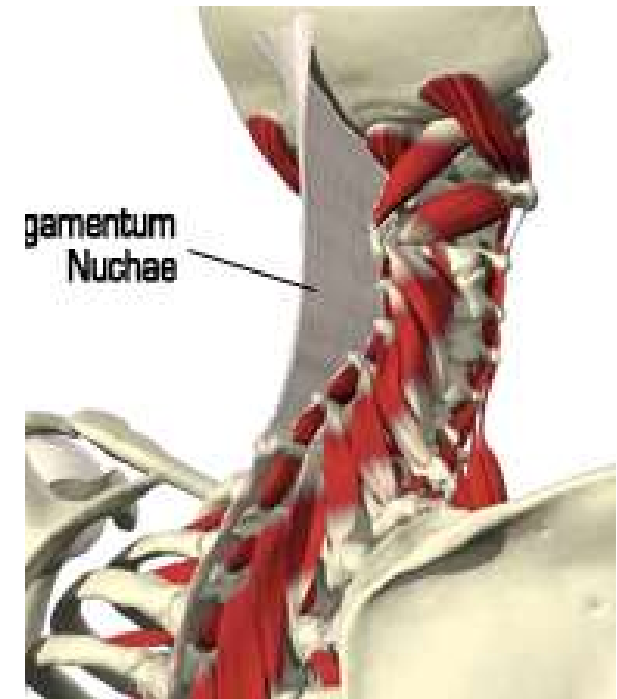
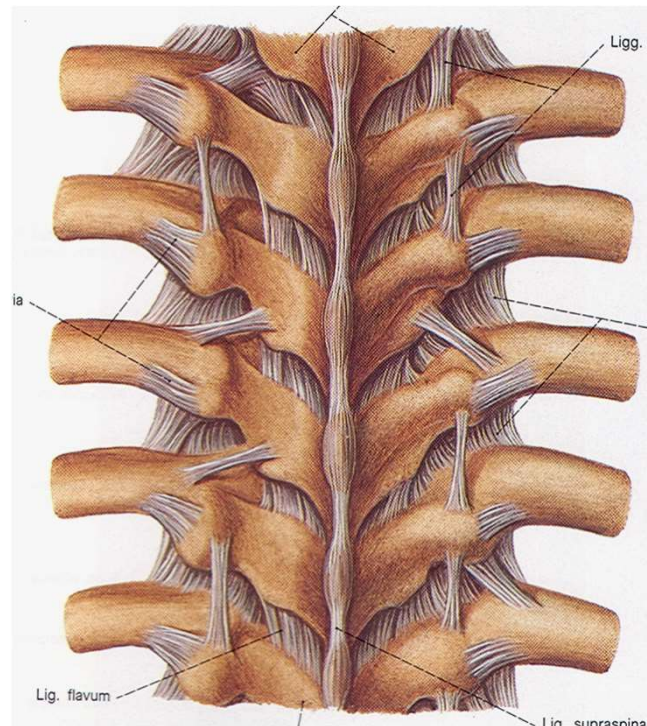
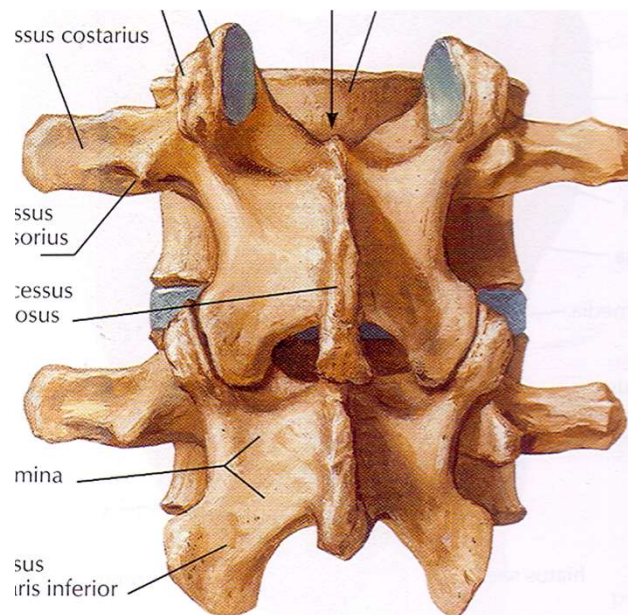
sliding movements

- short ligaments - **ligg. intertransversaria**

- **ligg. interspinalia**

- **lig. supraspinale** (cervical area) –

as sagittally oriented **ligamentum nuchae** which is going to the occipital bone

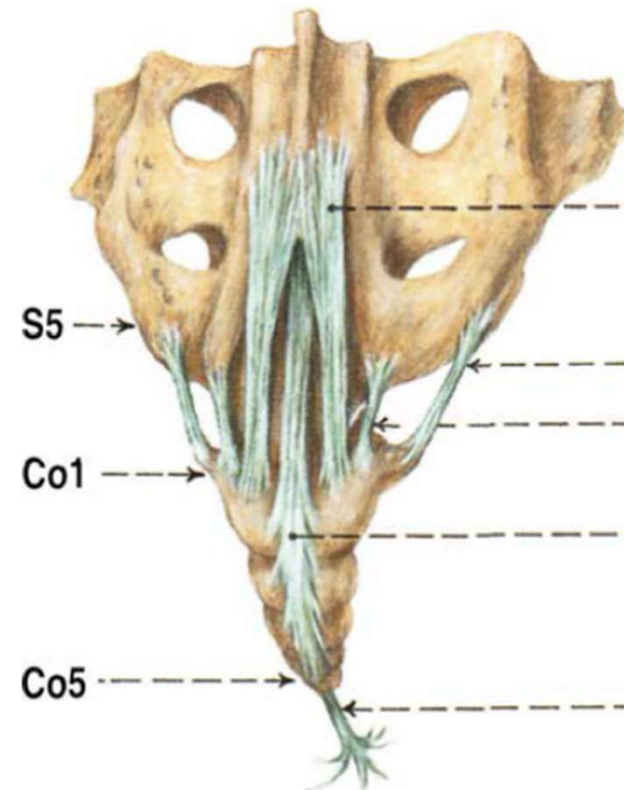
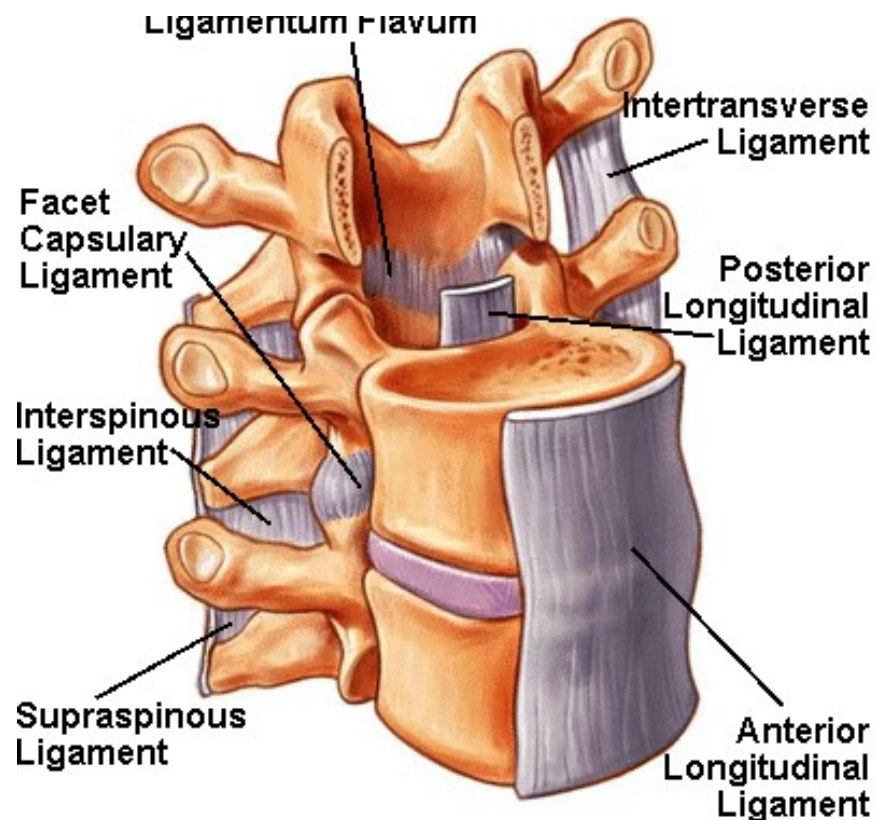


## 4. Junctions common for all vertebrae

a) lig. longitudinale anterius

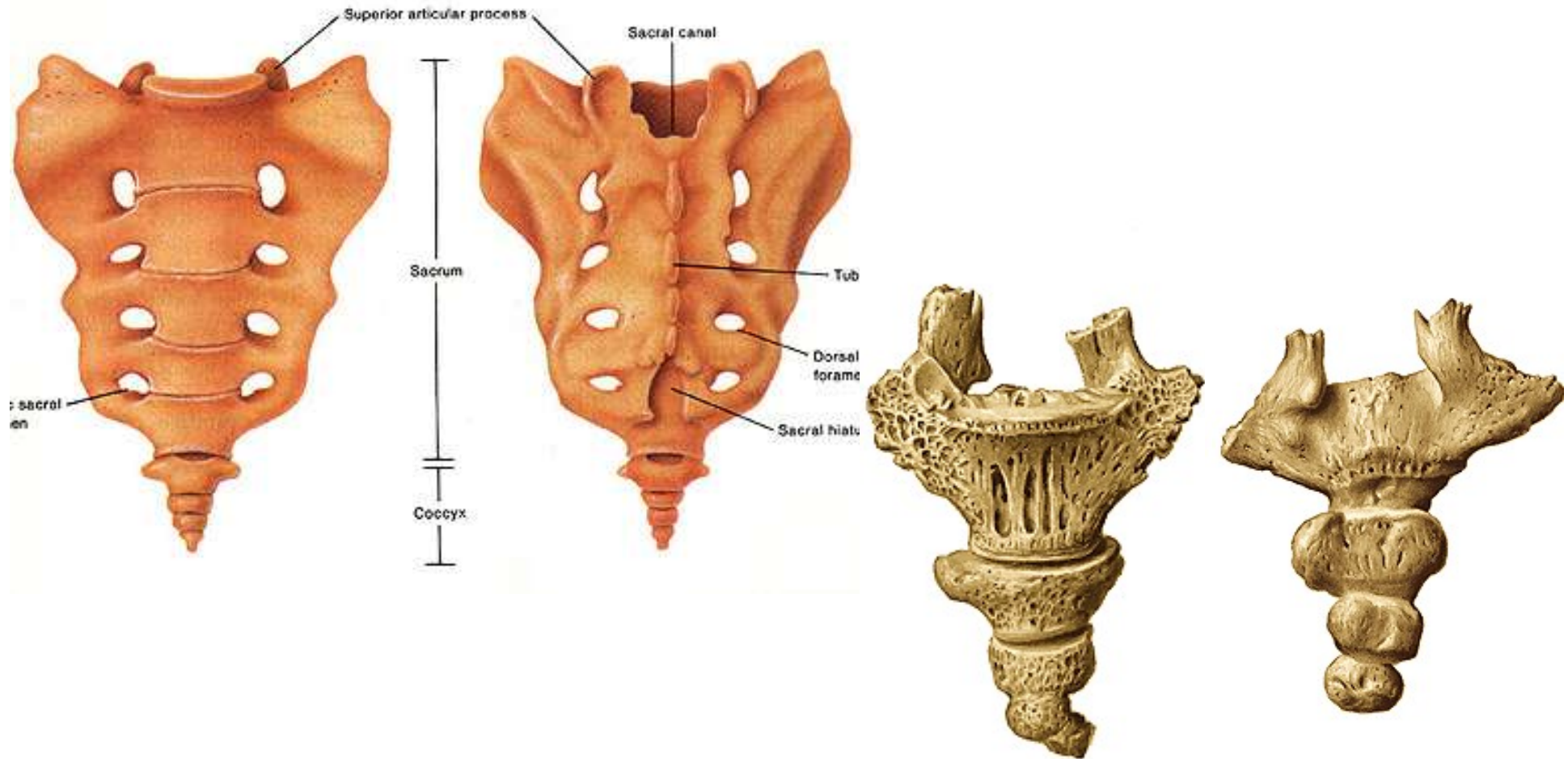
b) lig. longitudinale posterius

- They continue also to the sacral and coccygeal bone



# Synostosis

- Connection using the bone tissue
- Sacral bone: fusion of five sacral vertebrae
- Coccygeal bone: fusion of 3 - 5 coccygeal vertebrae





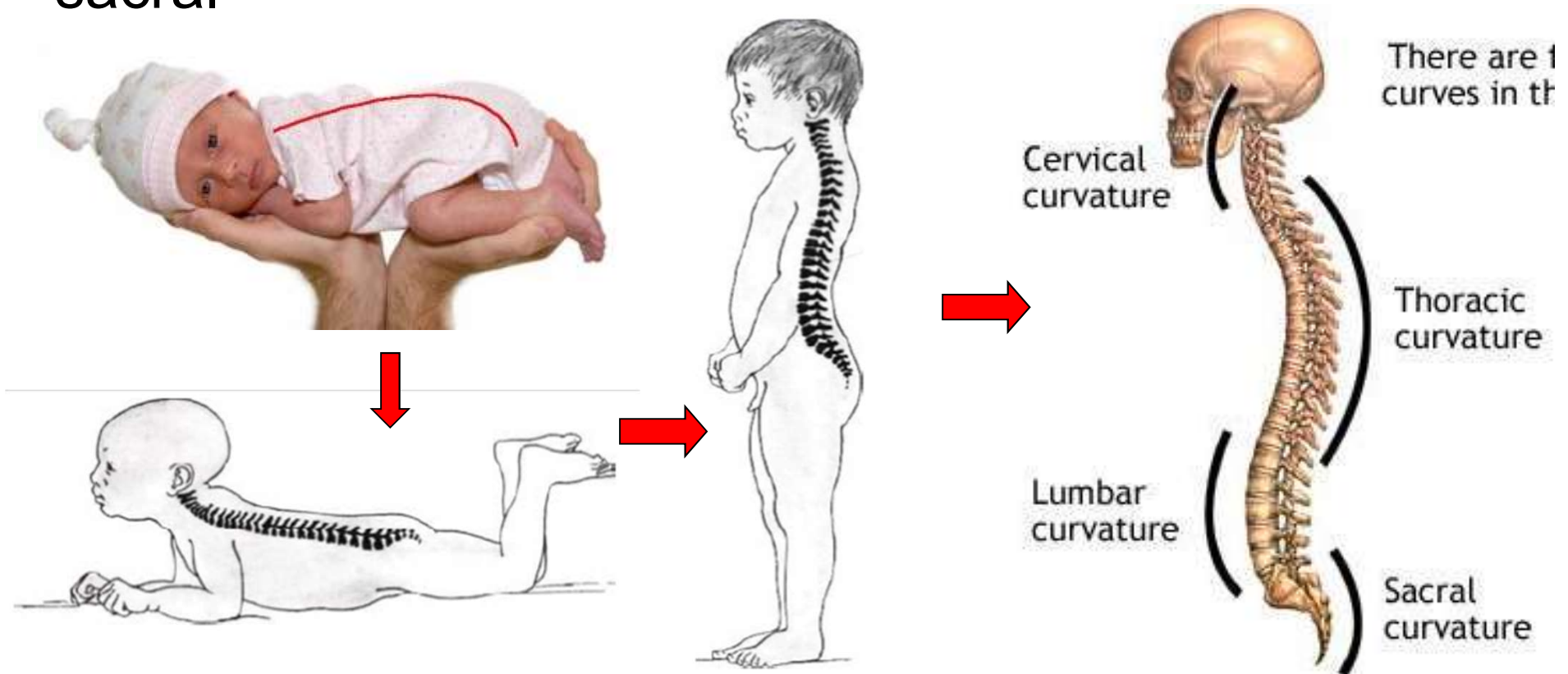
# Curvature of vertebral column

## 1. In the sagittal plane

- double S-shaped:

**lordosis**: curvature forwards, cervical C4-5 and lumbar L3-4

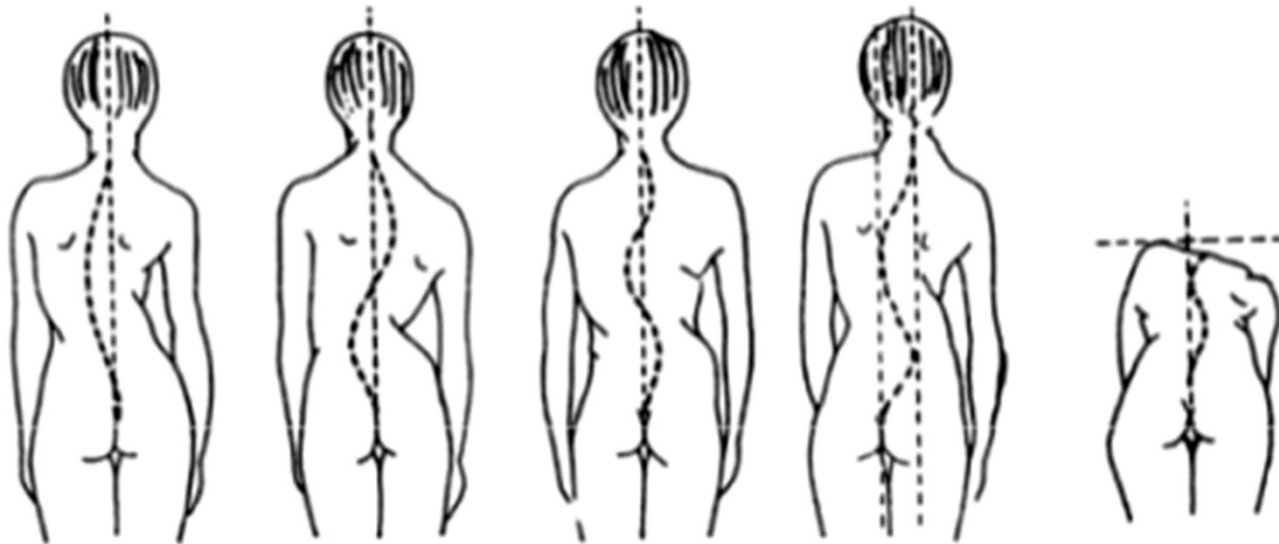
**kyphosis**: curvature backwards, thoracic Th6-7 and sacral





## 2. Curvature in frontal plane

- Skoliosis, mild skoliosis is physiological and it is present in all people – in most mild right, in some mild left (if you are right or left-handed)



# SHAPE AND MOVEMENTS OF THE SPINE

- 35% of body height

## Movements

- **anteflexion, retroflexion**, 90° cervical, 23° lumbar, most stressed and vulnerable is part of the lower cervical vertebrae, Th11-12, L4-S1
- **lateroflexion**, 30° cervical, 35° lumbar
- Rotation and torzion, 60-70° cervical, 25-35° thoracic
- Springing movements

## Mobility of the vertebral column

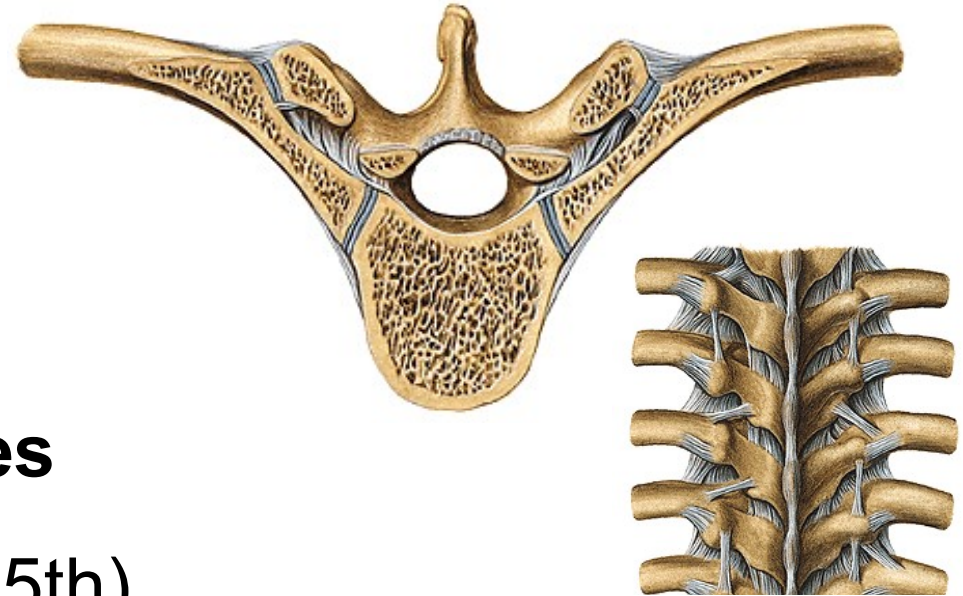
- depends on the size of intervertebral disc
- the mobility is restricted by: ligaments, articular capsules and muscles

# Junctiones of thoracic cage

## 1. Art. costovertebrales

a) art. capitis costae

b) art. costotransversarium



## 2. Juncturae sternocostales

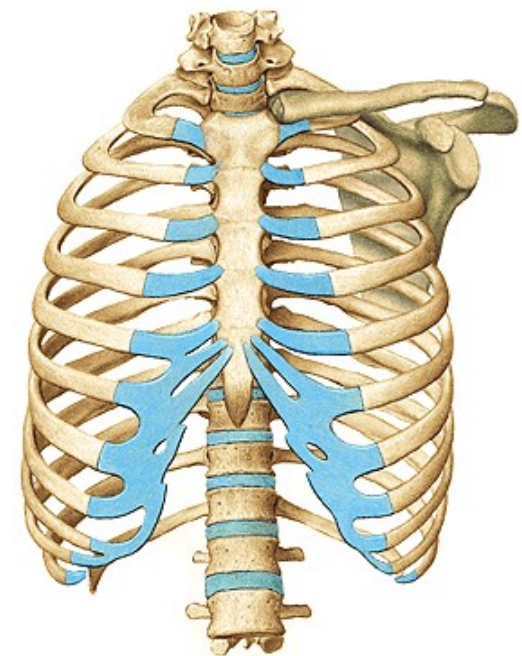
a) artt. sternocostales (2nd-5th)

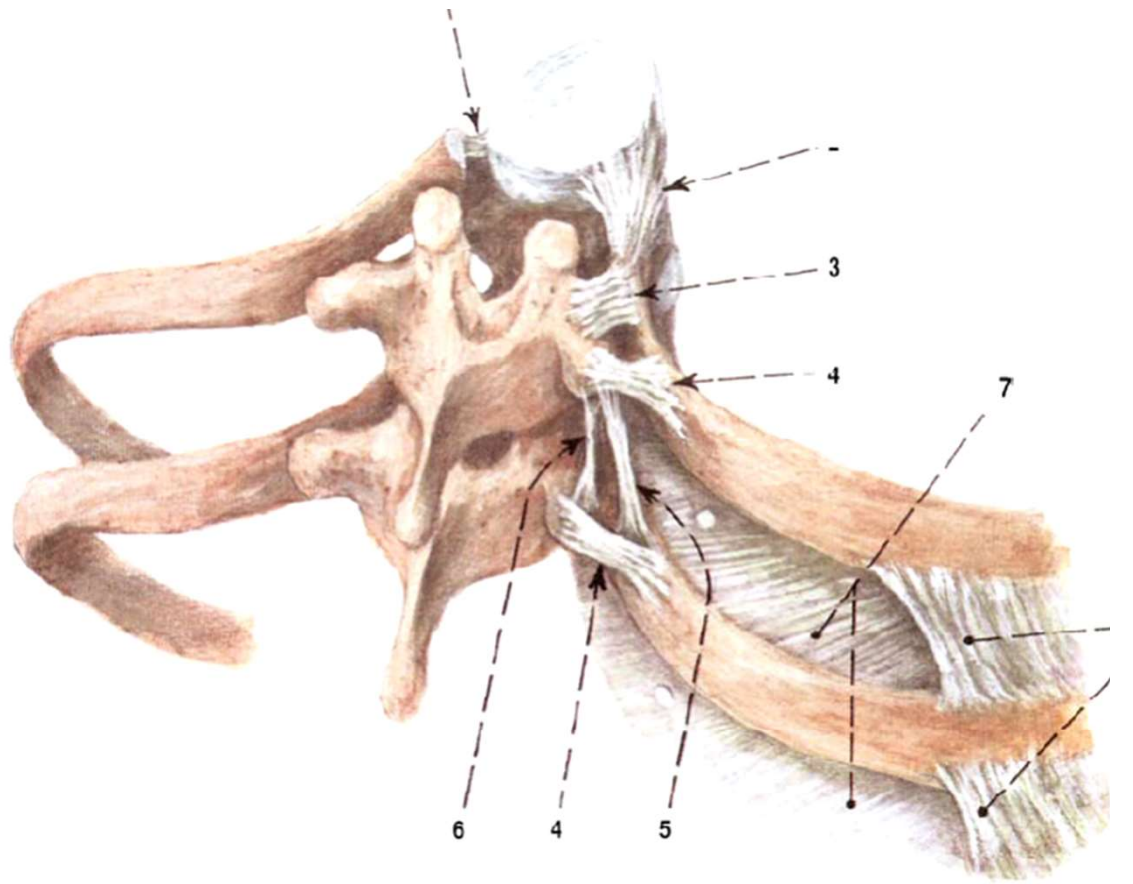
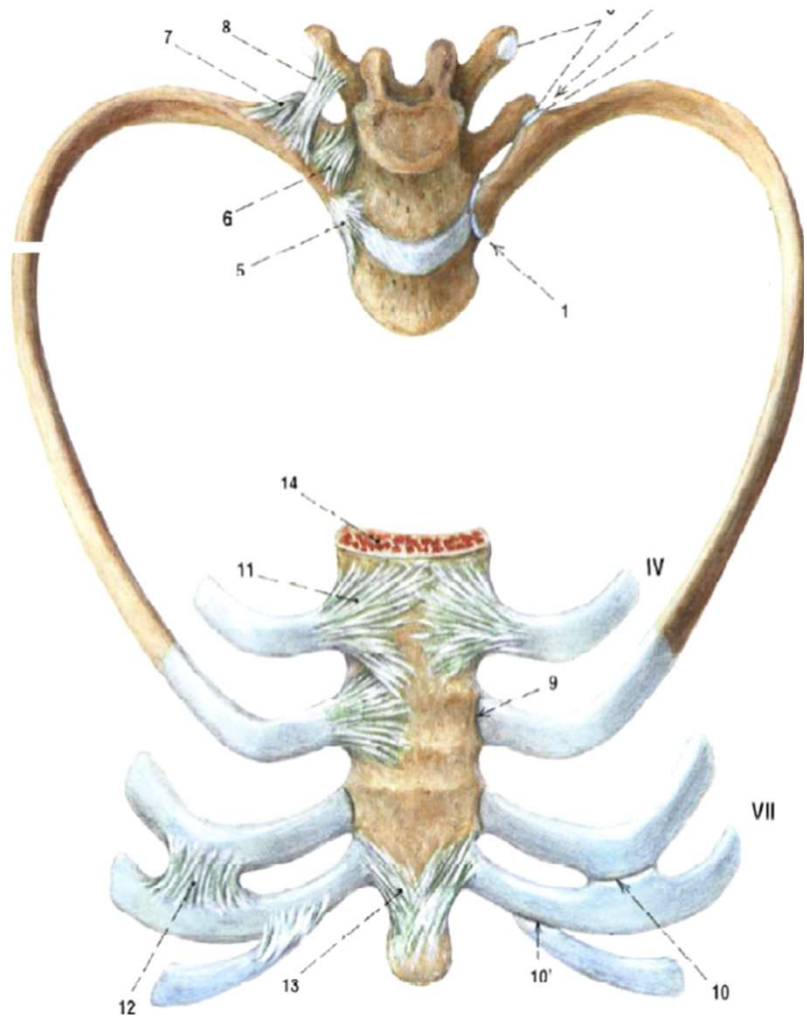
b) synchondrosis (1st, 6th, 7th)

## 3. Juncturae intercostales

a) artt. interchondrales (6th-9th)

b) membrana intercostalis externa,  
interna







# A. Articulationes costovertebrales

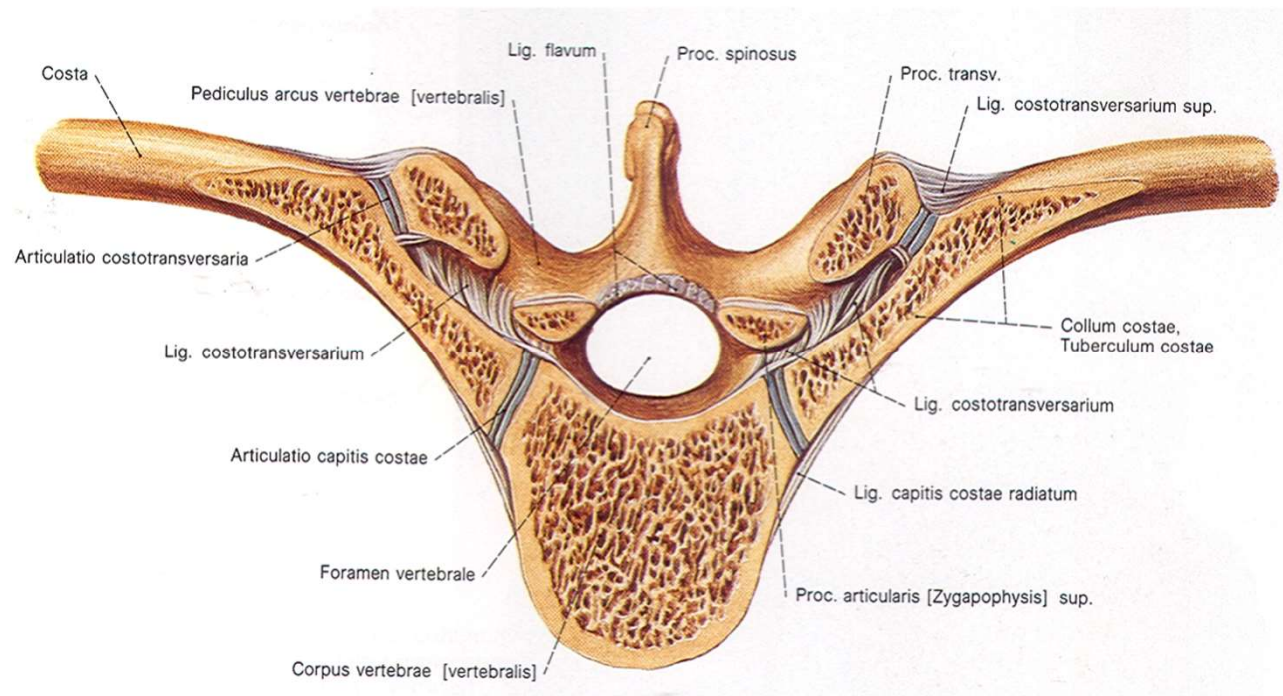
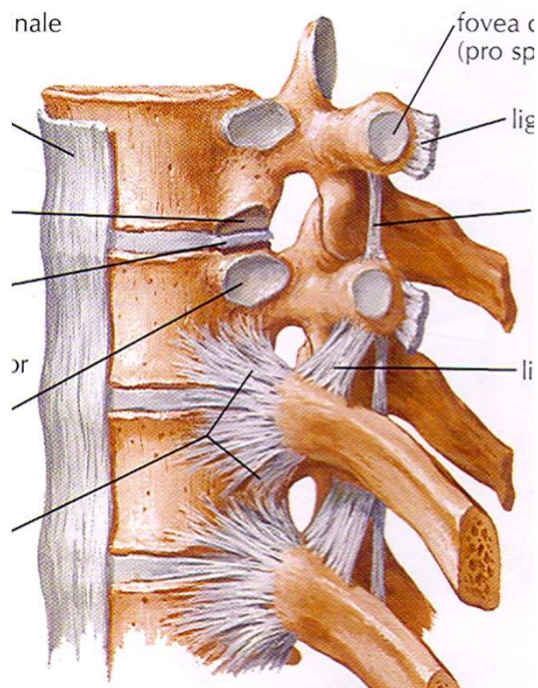
## 1. Articulationes capitis costae

**Articular surfaces:** facies articularis capitis costae and foveae costales on thoracic vertebrae

**articular capsule:** firm and it is attached to the margins of articular surfaces

**special apparatus:** lig. capitis costae radiatum, at 2nd – 10th rib: lig. capitis costae intraarticulare

**movements:** along axis parallel with the neck of the rib



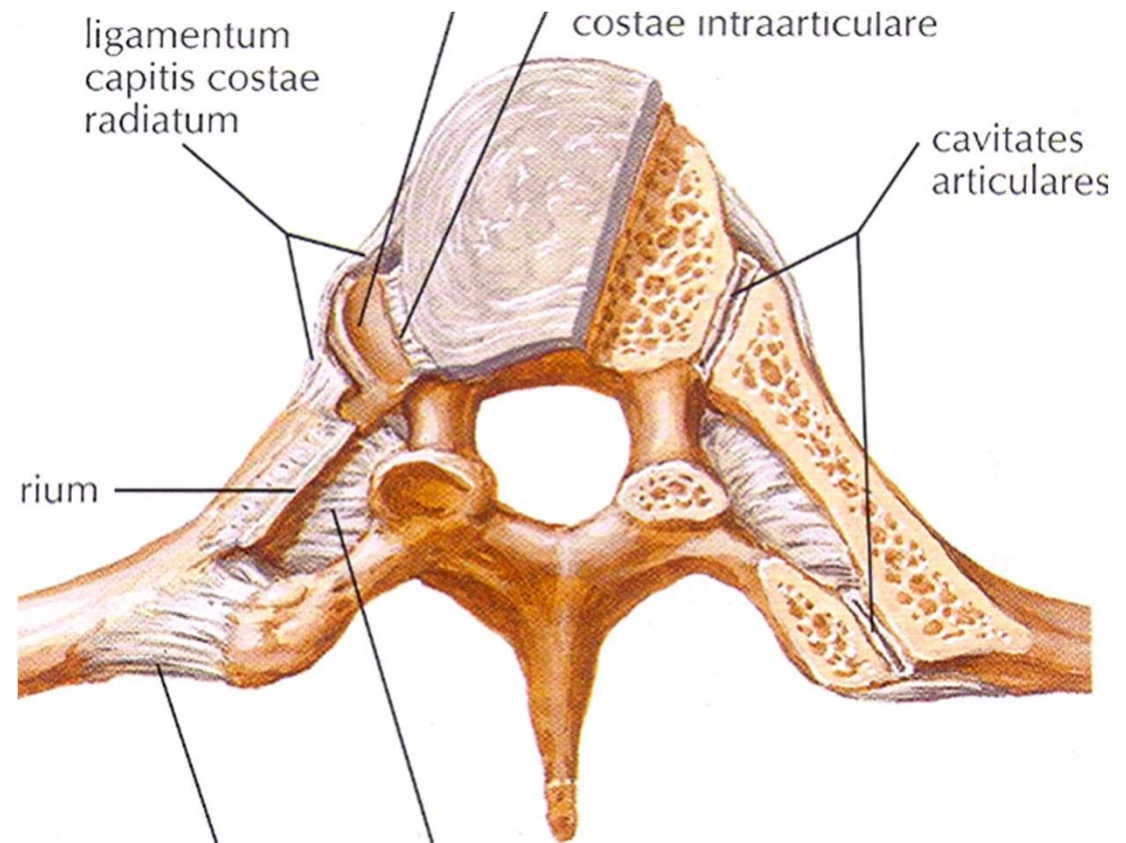
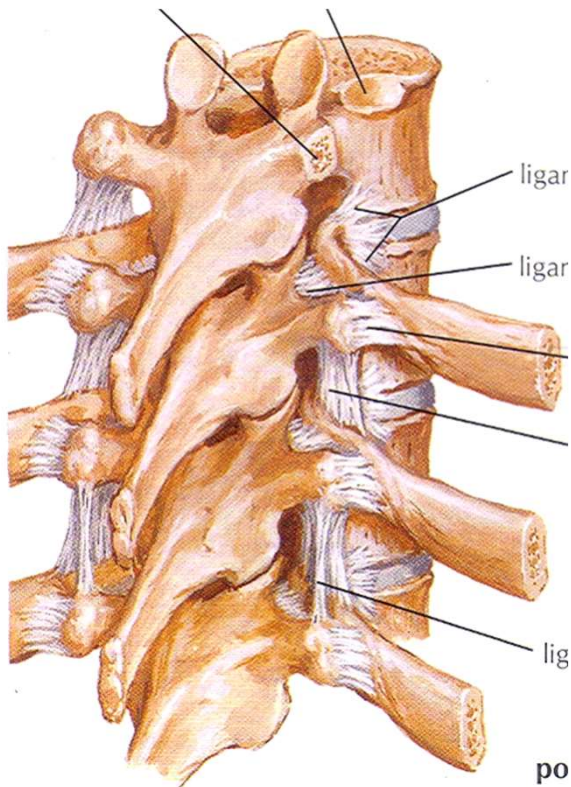
## 2. Articulationes costotransversariae

**articular surfaces:** foveae costales transversales and art. surface on tuberculum costae

**articular capsule:** margins of the articular surfaces

**special apparatus:** lig. costotransversaria, between collum costae and transversal process of the vertebra

**Movements:** along axis which is parallel with collum costae





## B. Juncturae sternocostales

- Connections between costal cartilages and sternum

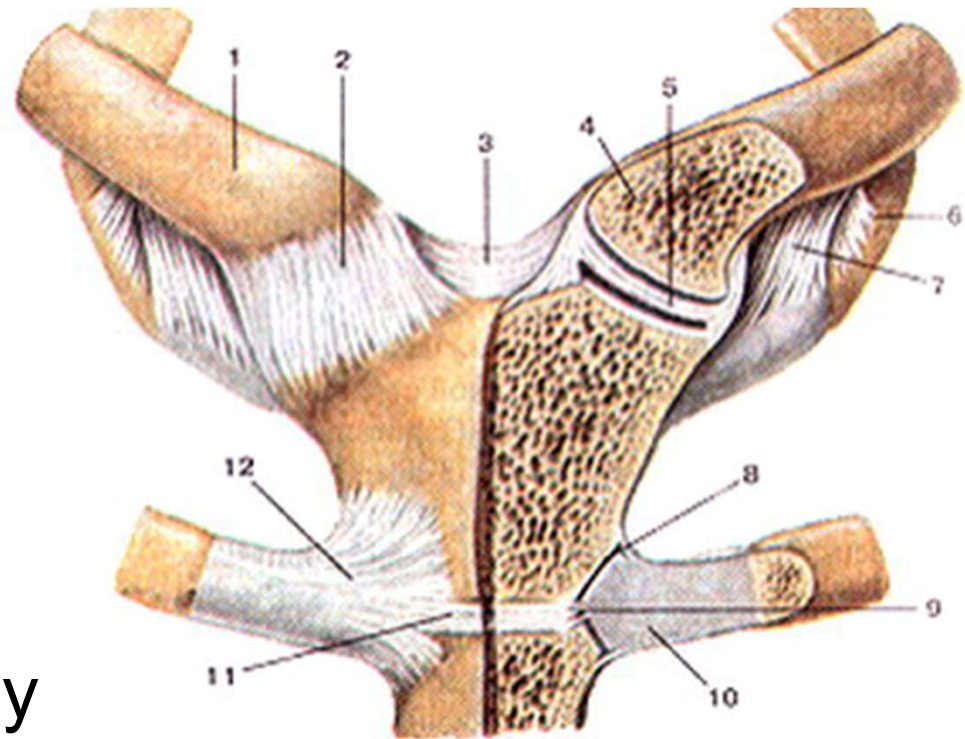
**1. Synchondrosis sternocostalis:** cartilaginous connection with incisura costalis sterni, regularly at 1st often at 6th and 7th rib

**2. Artt. sternocostales:** between 2nd to 5th rib and sternum

**Articular surfaces:** sternal end of costal cartilage, incisura costalis sterni

**Articular capsule:** to the margins of the articular surfaces

**Special apparatus:** ligg. sternocostalia radiata – they form membrana sterni externa and interna



## C. Junctions of adjacent ribs

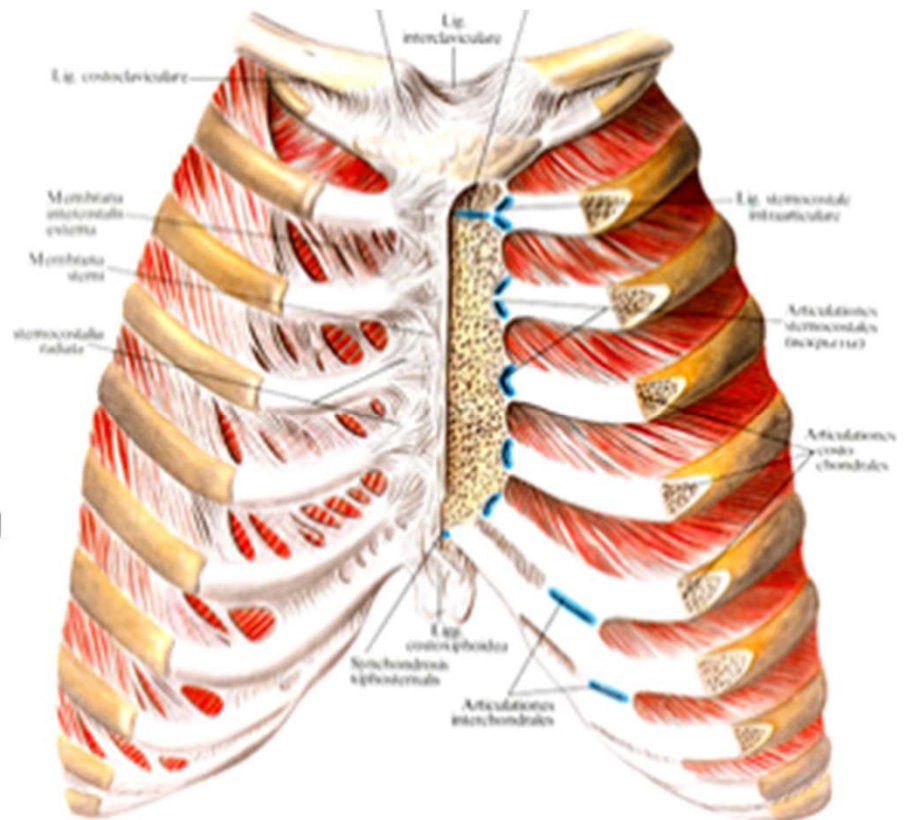
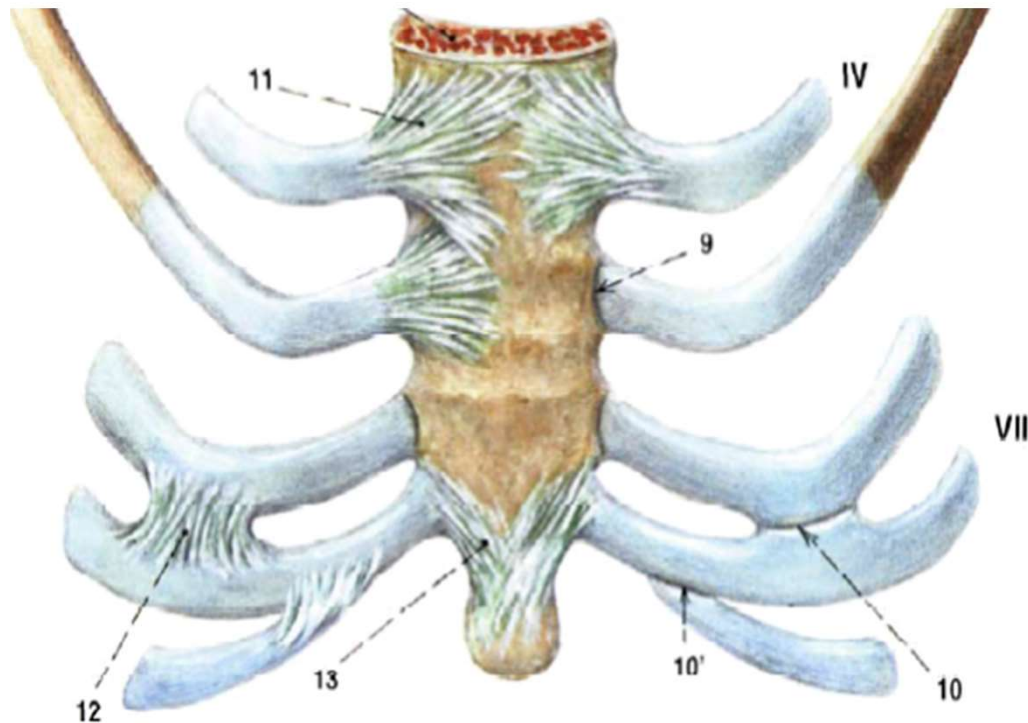
### 1. Articulationes interchondrales

joint connection between costal cartilages of 5th to 9th rib, covered by short articular capsule

### 2. Membranae intercostales – fibrous membranes connecting adjacent ribs

**Membrana intercostalis externa**

**Membrana intercostalis interna**

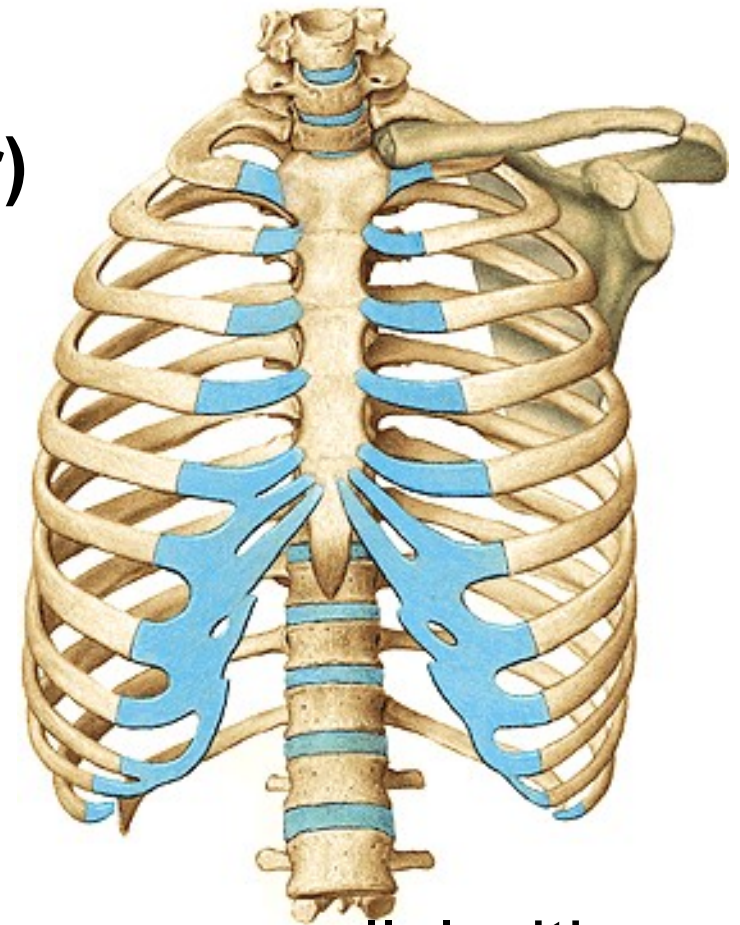






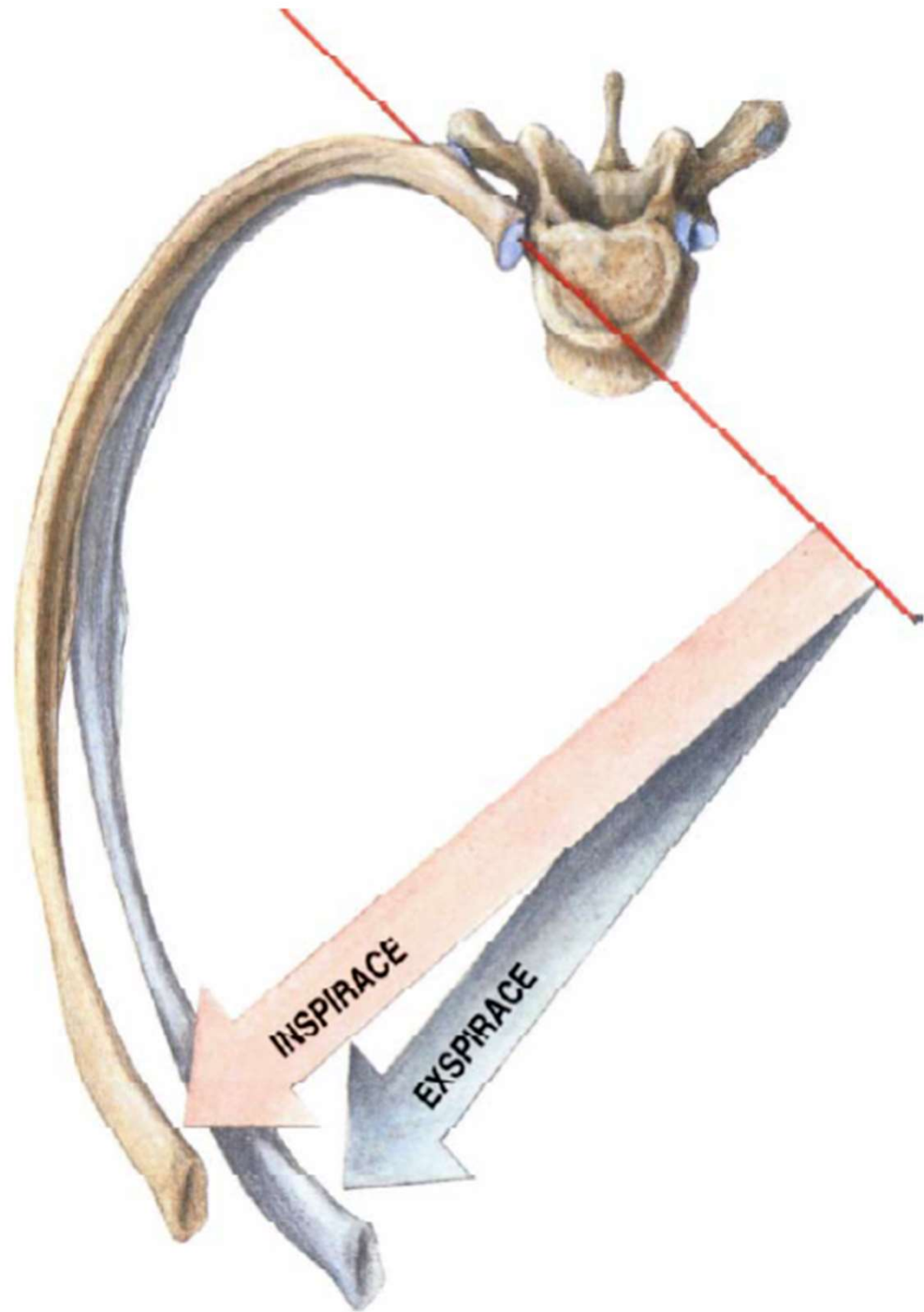
## Chest cage shape and movements

- Shape of truncated cone
  - base (apertura thoracis inferior)
  - apex (apertura thoracis superior)
  - walls – frontal, dorsal, lateral
- cavitas thoracis**  
**spatia intercostalia**  
**arcus costarum**  
**angulus infrasternalis**



### Movements

- in costovertebral connections, axis runs parallel with collum costae
- Upward rotation - inspirium  
downward rotation- expirium



## Junctions of skull

Craniovertebral junctions, syndesmoses, synchondroses, temporomandibular joint and hyoid junctions

### I. Craniovertebral junctiones

- Connection of the skull with the 1st and 2nd cervical vertebra

#### 1. *Articulatio atlantooccipitalis*

- Paired joint

#### Articular surfaces:

***condyli occipitales*** and  
***foveae articulares superiores***  
of atlas

#### Articular capsule:

Is attached to the margins of  
the articular surfaces





## Special apparatus:

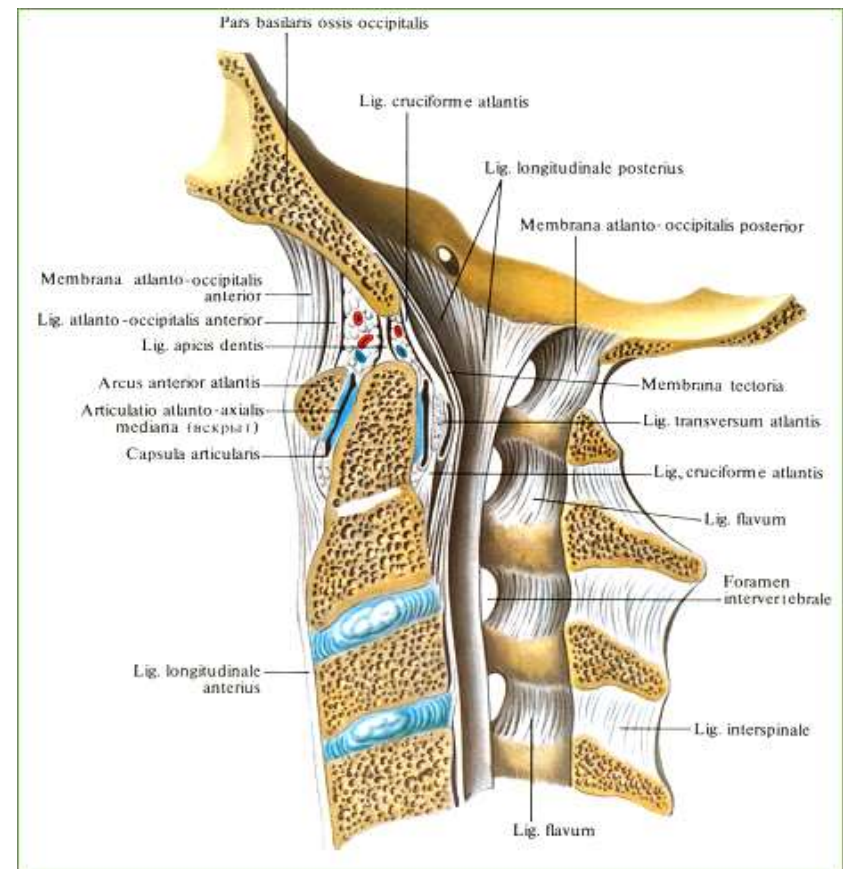
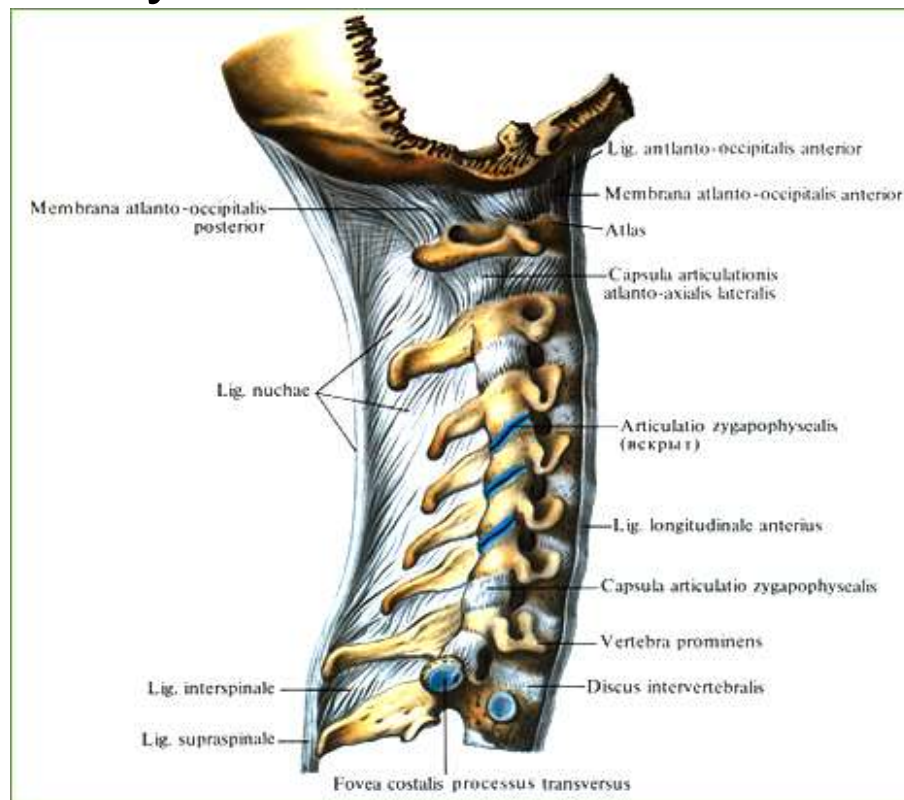
***membrana atlantooccipitalis anterior* and *posterior***

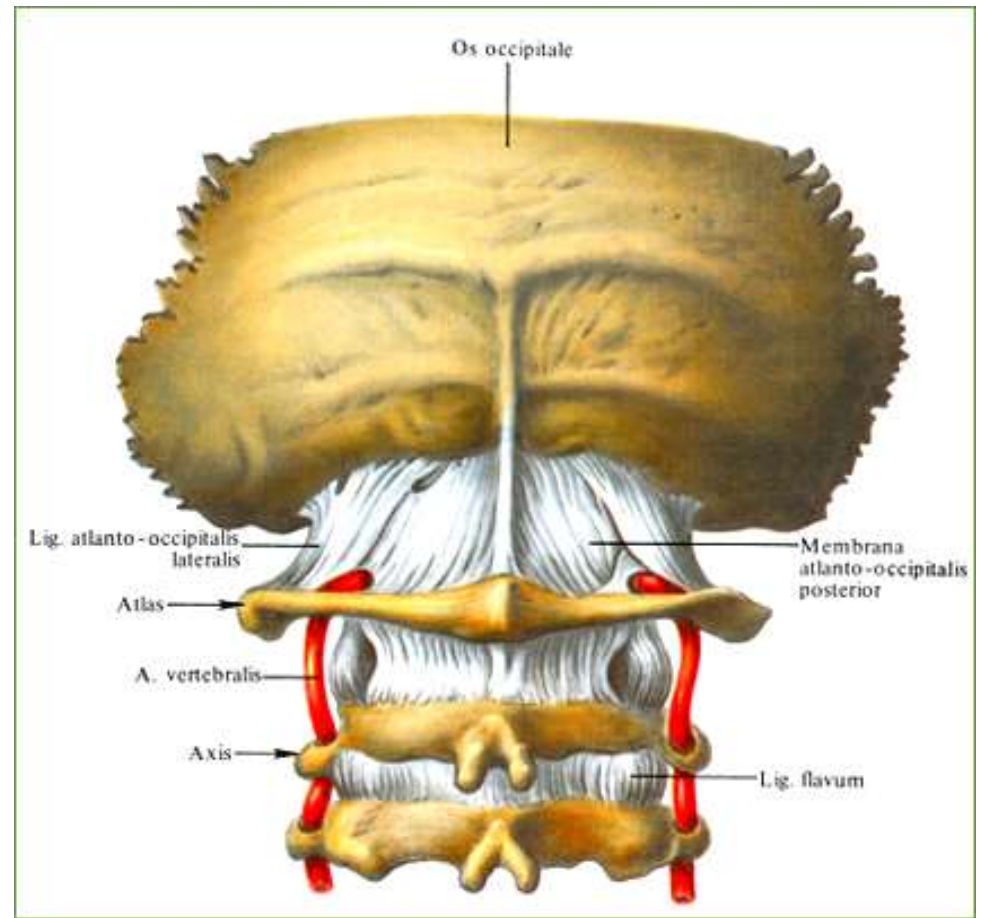
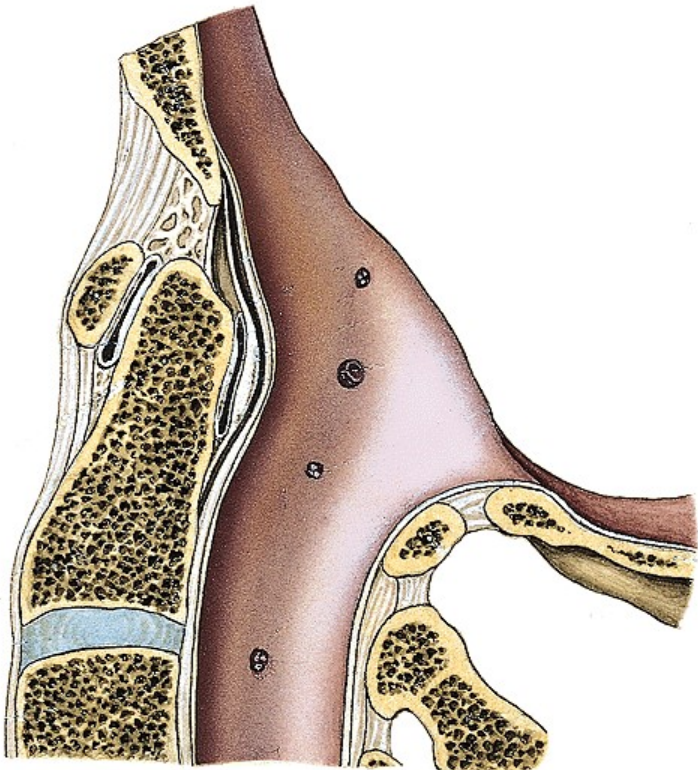
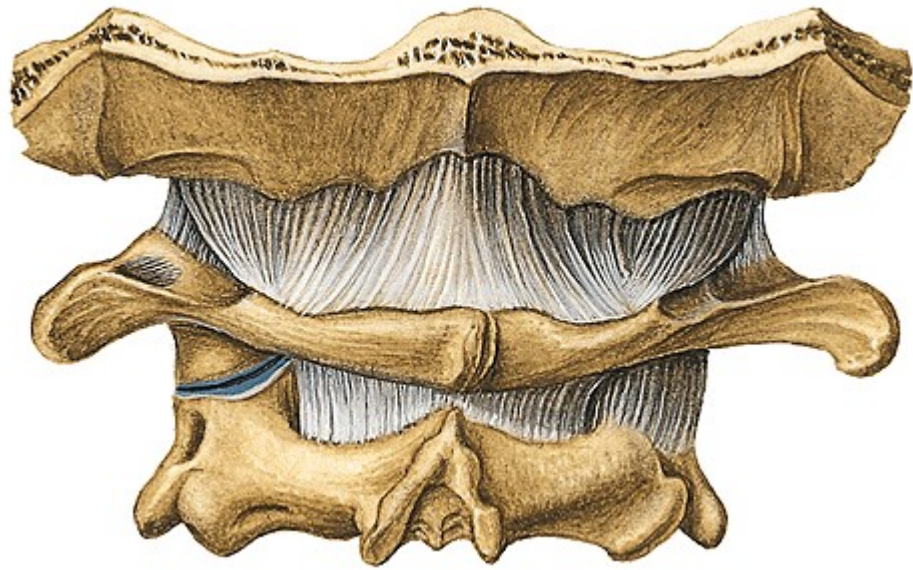
(between arches of atlas and occipital bone)

***membrana tectoria***

(cranial continuation of ***lig. longitudinale posterius***, it reaches to *clivus*)

**Type of joint: elipsoidal** with possibility of flexion and extension of the head and there are also possible smaller movements sideways







## 2. Articulatio atlantoaxialis

### a) articulatio atlantoaxialis lateralis

• Paired joint

#### Articular surfaces:

**facies articulares inferiores** of atlas

**facies articulares superiores** of axis

### b) articulatio atlantoaxialis mediana

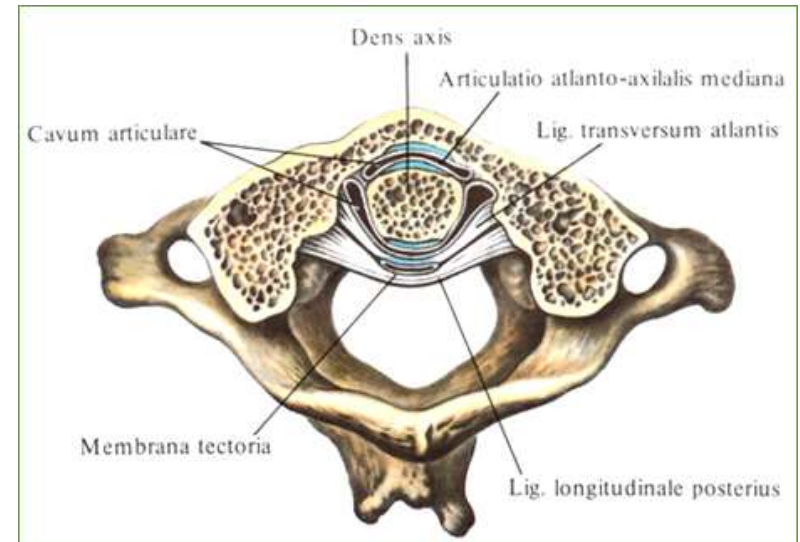
• Unpaired joint

#### Articular surfaces:

**facies articularis anterior** on frontal side of *dens axis* with **fovea dentis** of atlas and **facies articularis posterior** on dorsal side of *dens axis* with **lig.**

**transversum atlantis**

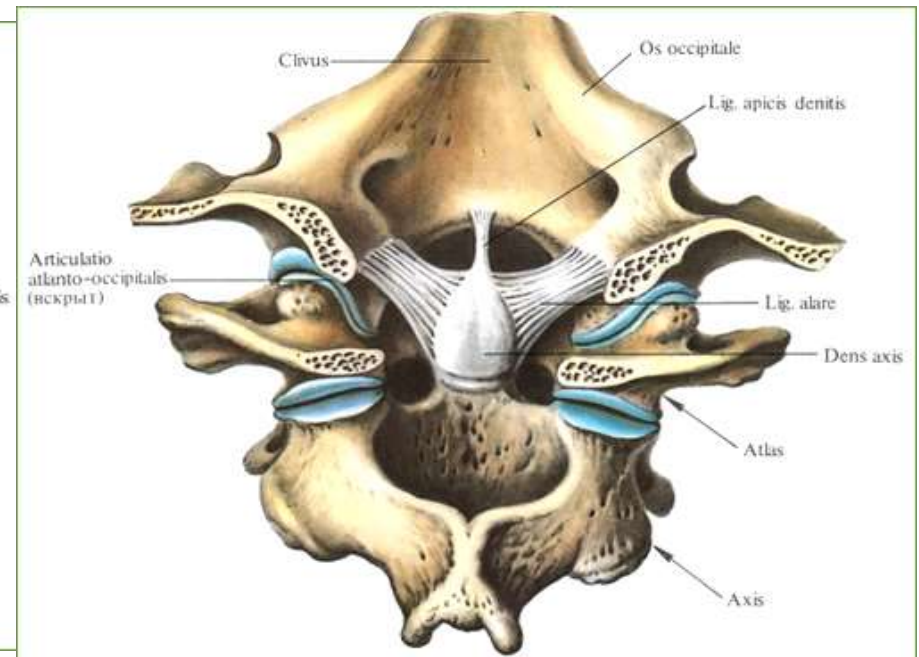
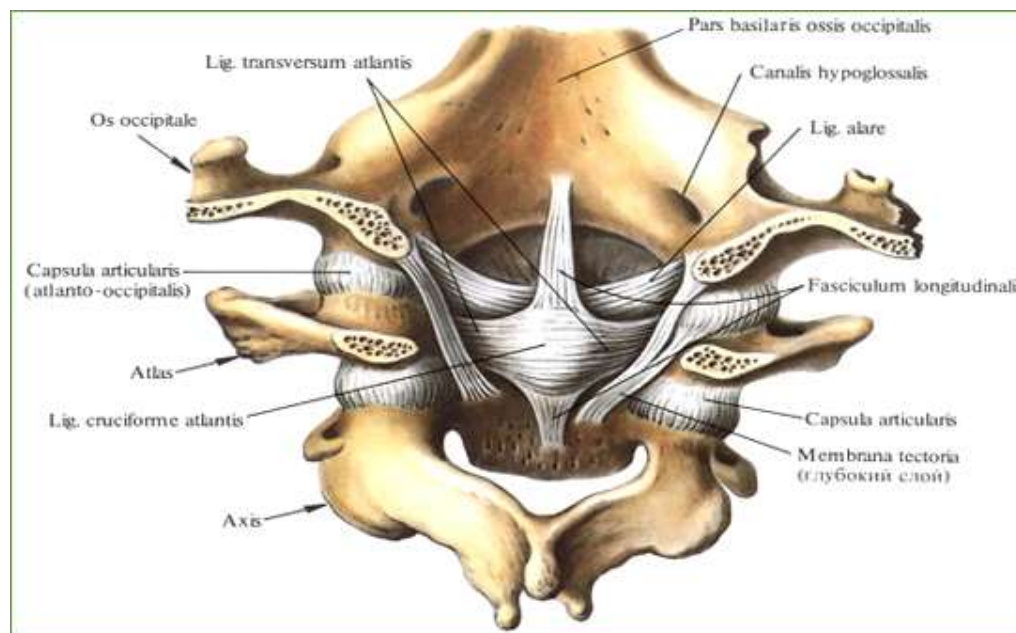
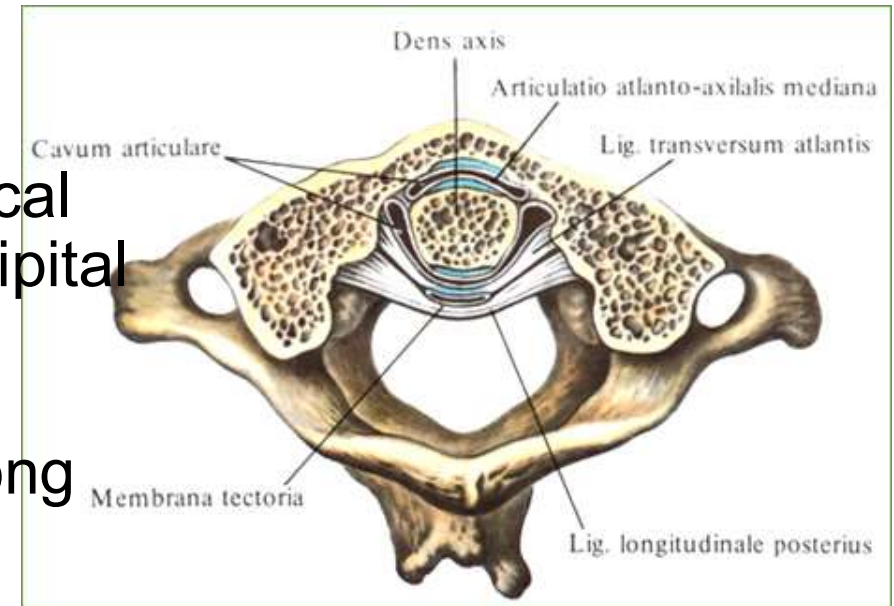
Articular capsule: is common and is attached to the margins of the articular surfaces



## Special apparatus:

***lig. apicis dentis, ligg. alaria, lig. cruciforme atlantis***, formed by ***lig. transversum atlantis*** and vertical fibrous bands going from axis to occipital bone (***fasciculi longitudinales***)

**Type of joint:** both joints form one mechanical unit, atlas is rotating along *dens axis* in range of 60°







## II. Skull syndesmoses

Present sutures (suturae), between the margins of the bones, there is a layer of fibrous tissue

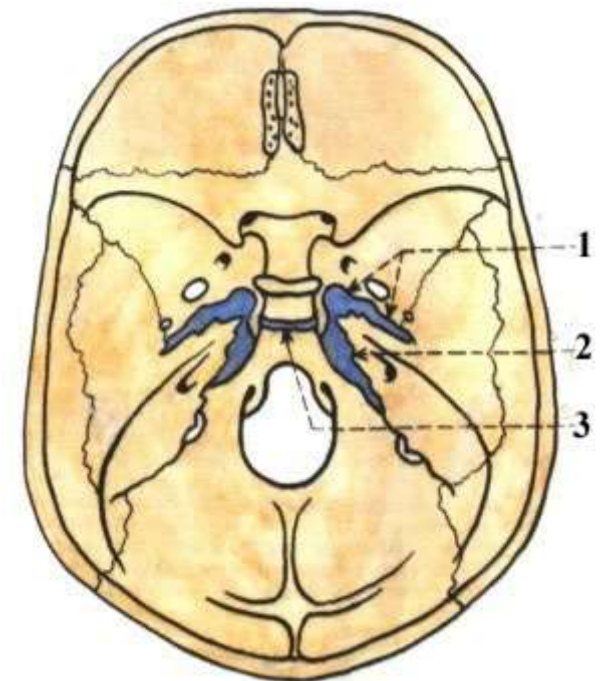
## III. Skull synchondroses

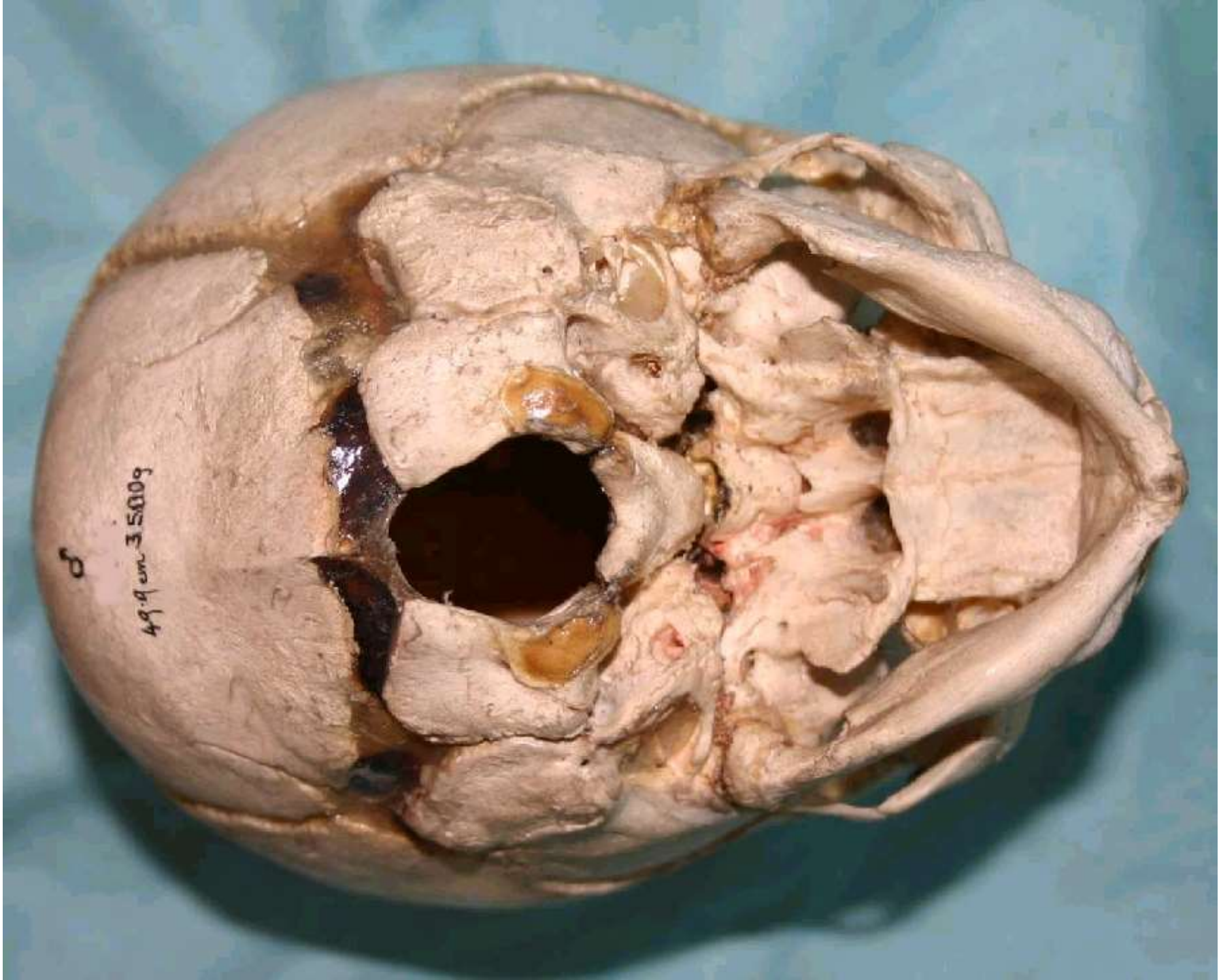
s. sphenopetrosa+s. petrooccipitalis

s.interoccipitalis- anterior et posterior

s.intersphenoidalis, s.sphenooccipitalis

synchondrosis sphenooccipitalis







## IV. Temporomandibular joint (*articulatio temporomandibularis*)

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

Articular capsule: is attached to the margins of the articular surfaces, its medial part is very strong, it rows together wit *discus articularis*

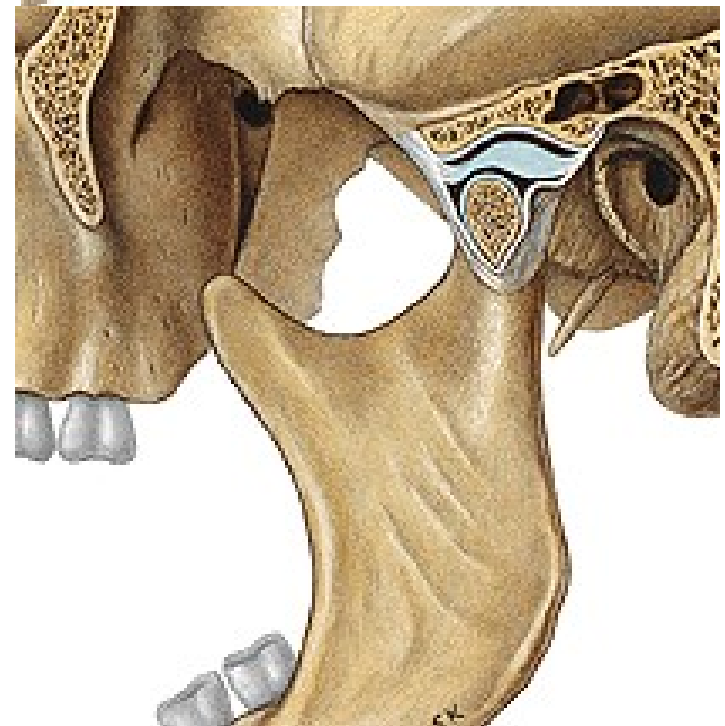
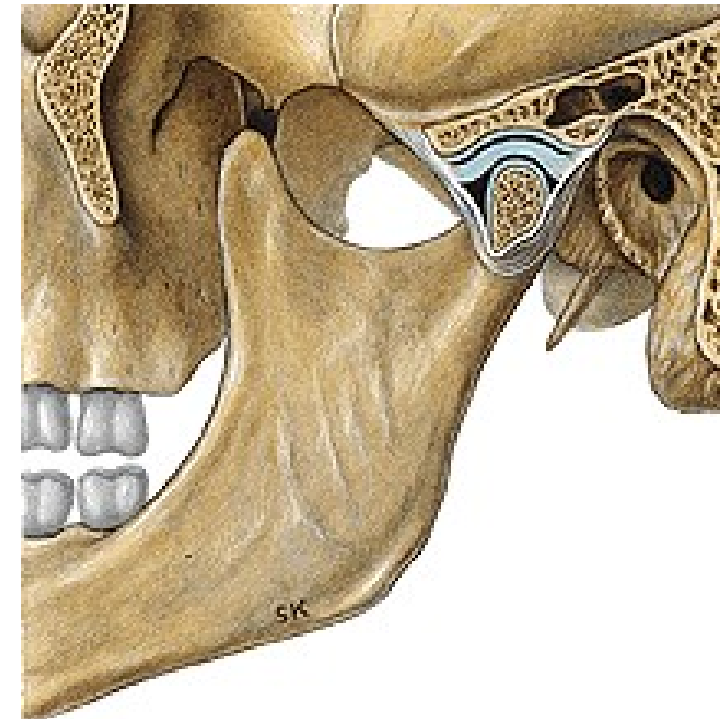
Type of joint: **gynglimus**

Elevation – closing of the mouth

Depresion – opening of the mouth

protraction - shifting od the chin forwards

Retraction - shifting od the chin backwards

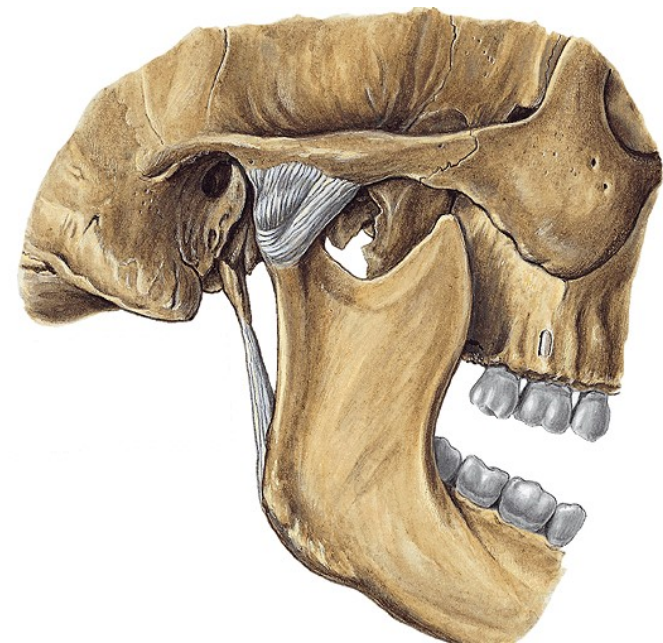
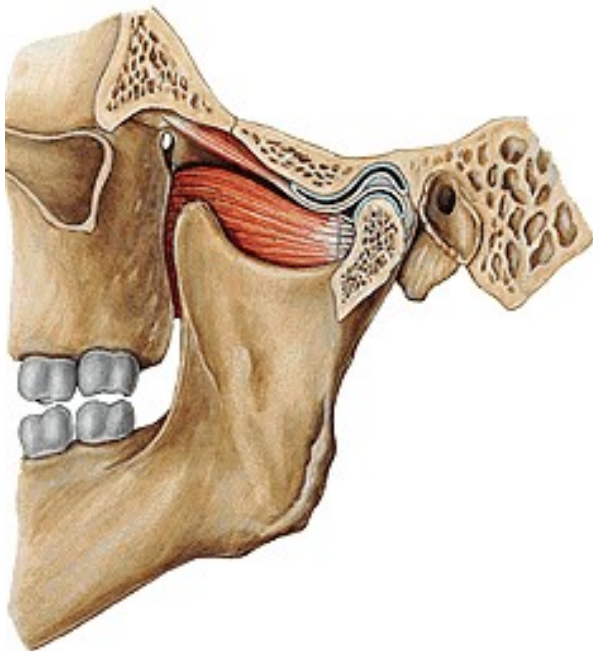


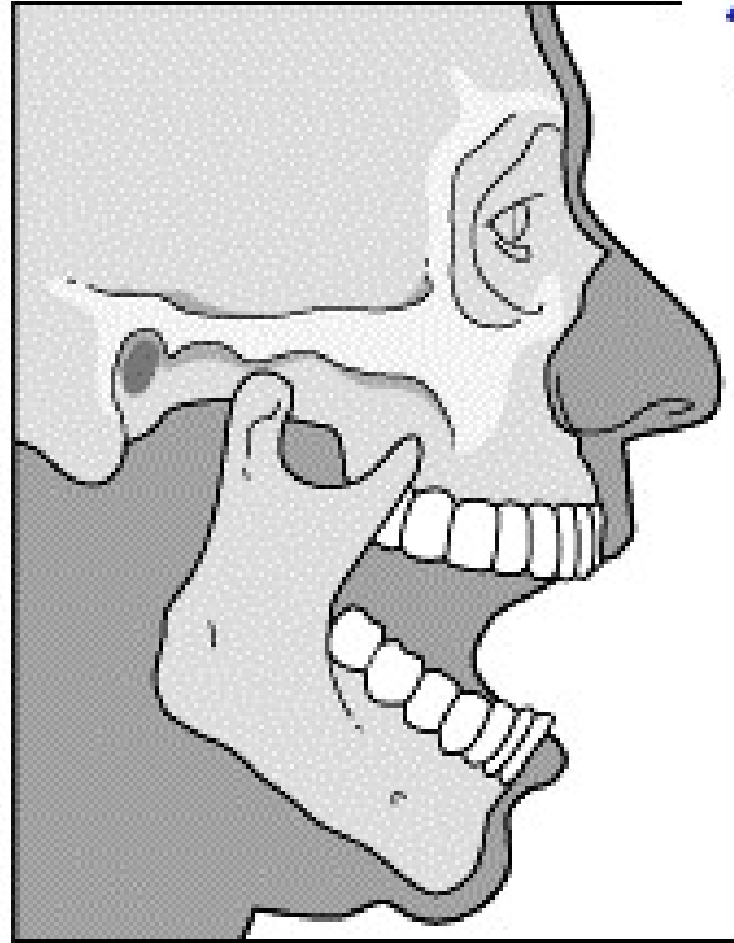
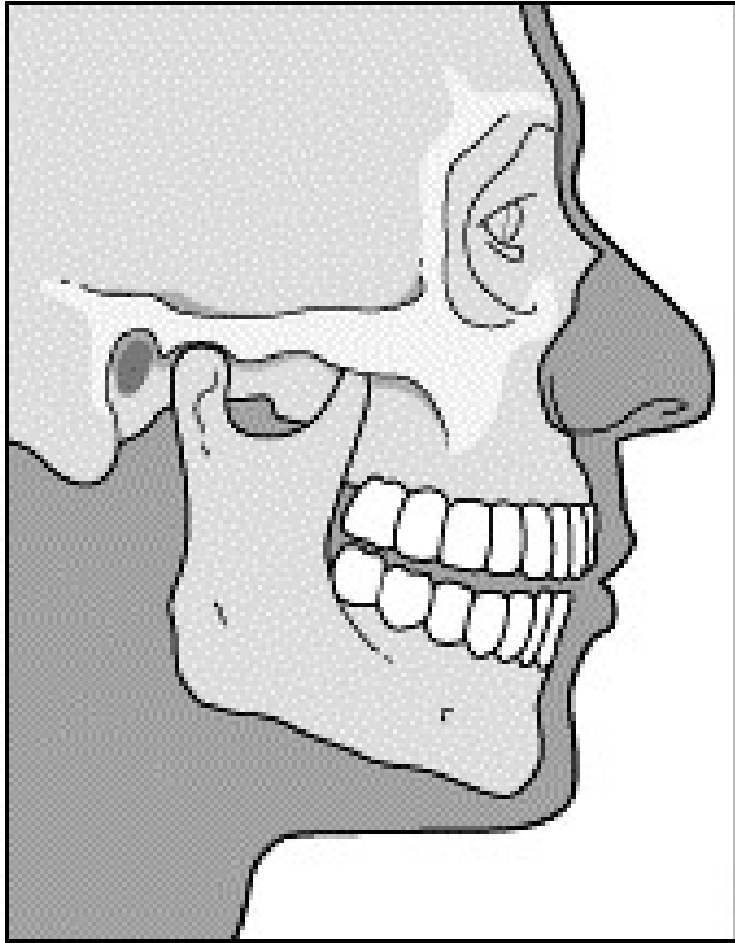


## Special apparatus:

**discus articularis** (fibrous cartilage) – its middle part is thinner and the margins are thicker, it grows together with articular capsule, it divides articular cavity into ***pars discotemporalis*** and ***discomandibularis***.

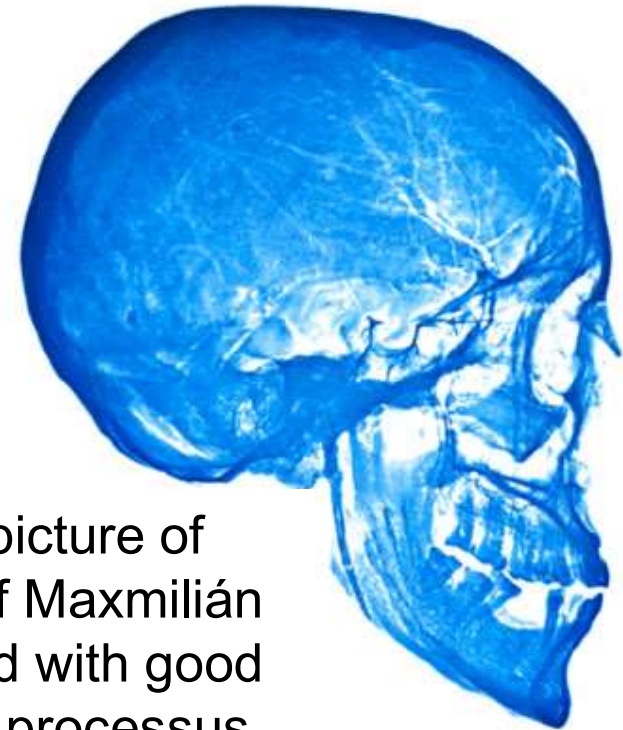
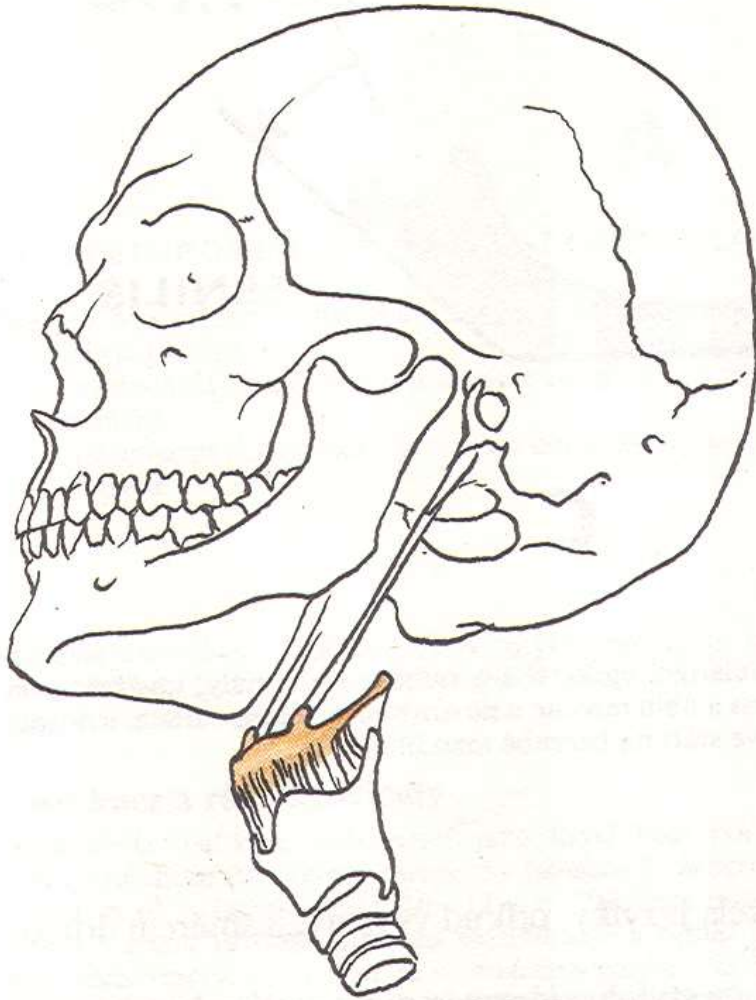
**Articular capsule:** on lateral side: ***lig. laterale***, around the joint: ***lig. sphenomandibulare*** and ***lig. stylomandibulare***





## V. Hyoid junctions

The skull and hyoid bone connects using muscle and *lig. stylohyoideum*



X-ray picture of skull of Maxmilián the 2nd with good visible processus styloideus elongatus, 7 cm long



# Thank you for your attention!!

## Obrázky:

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