GENERAL ARTHROLOGY

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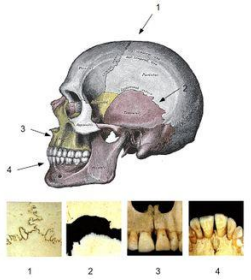
Lecture 7 – DENTISTRY – Autumn 2016

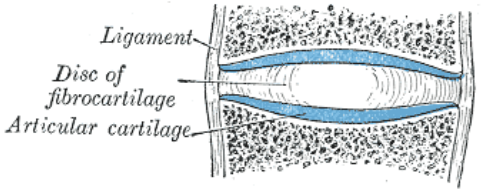
Skeletal junctions
Juncturae *seu* Systema articulare

Two main types of connections:

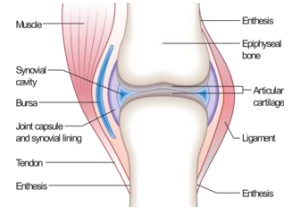
1. Synathrosis /fibrous joint, fluent connection/ - union by some kind of the connective tissue

(fibrous tissue, cartilage, bone)





2. Diarthrosis /synovial joint, connection by touch/ - union by touch (by articular surfaces and another additional features)



Source of the pictures: http://www.wikiskripta.eu/index.php/Spojen%C3%AD_kost%C3%AD

Fibrous joint (synarthrosis)

- Continuous connections by a layer of connective tissue between bones nearly immobile
- The articulare surface are missing!
- Differentiation according the type of connective tissue

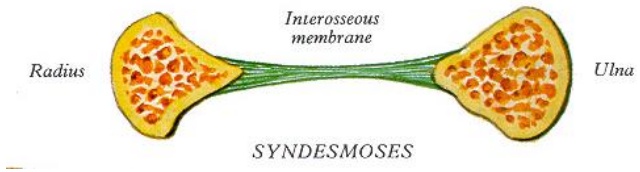
1) **Syndesmosis** – *articulatio fibrosa*, bones are joined by fibrous tissue

2) **Synchondrosis** – *articulatio cartilaginea,* bones are joined by cartilage

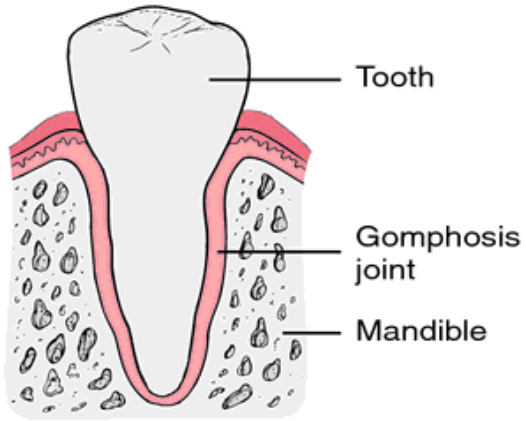
3) **Synostosis** – *articulatio ossea*, bones are joined by bone tissue

Syndesmosis (*art. fibrosa*)

1) **connective tissue *(ligaments),*** band of collagen fibrous tissue, (like a rope, ribbon or flat membrane)



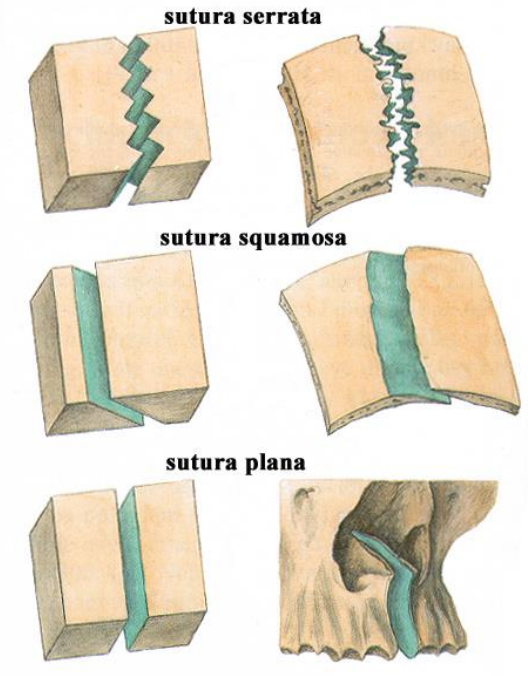
2) **wedging (gomphosis):** fixation of tooth to the alveolus



Source: http://medical-dictionary.thefreedictionary.com/gomphosis

3) **sutures** between flat skull bones *(suturae)*.
The main types of sutures:

- **serrated suture** *(sutura serrata)*
- **squamous suture** (*sutura squamosa*),
- **flat suture** (*sutura plana*)



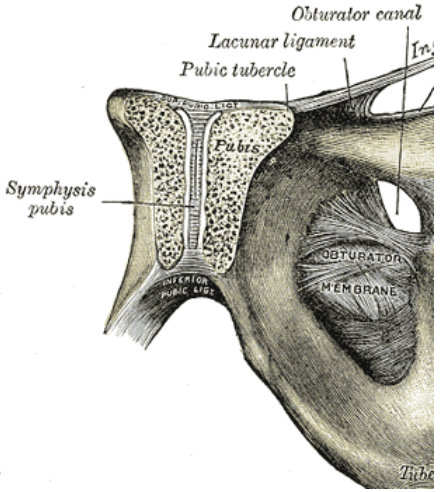
Source: anatomie Čihák

Synchondrosis (*art. cartilaginea*)

bones are joined by cartilage

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

- connection using **fibrous** cartilage (**SYMPHYSIS)** (intervertebral discs, pubic symphysis (*symphysis pubica)* between both pelvic bones



Source:http://www.wikiskripta.eu/index.php/Soubor:Gray394.png

Synostosis (*art. ossea*)

- bones are joined by bone tissue, for example *synostosis sphenooccipitalis*

Connection of the bones using the bone tissue, the result is growing of two or more bones

- Exapmles: sacral bone, coccygeal bone, coxal bone, some skull bones
- In adulthood: synostosis of skull sutures - physiological, pathological

DIARTHROSIS (junctura synovialis, articulatio)

Articulation (joint) **is movable union** of two or more bones by touch of contact articular surfaces covered by the articular cartilage.

General features of a joint

- **Articular surfaces=*facies articulares***

*(*articular fossa=*fossa articularis,* articular head=*caput articulare)*

- **Joint capsule=*capsula articularis***

(stratum fibrosum and *stratum synoviale)*

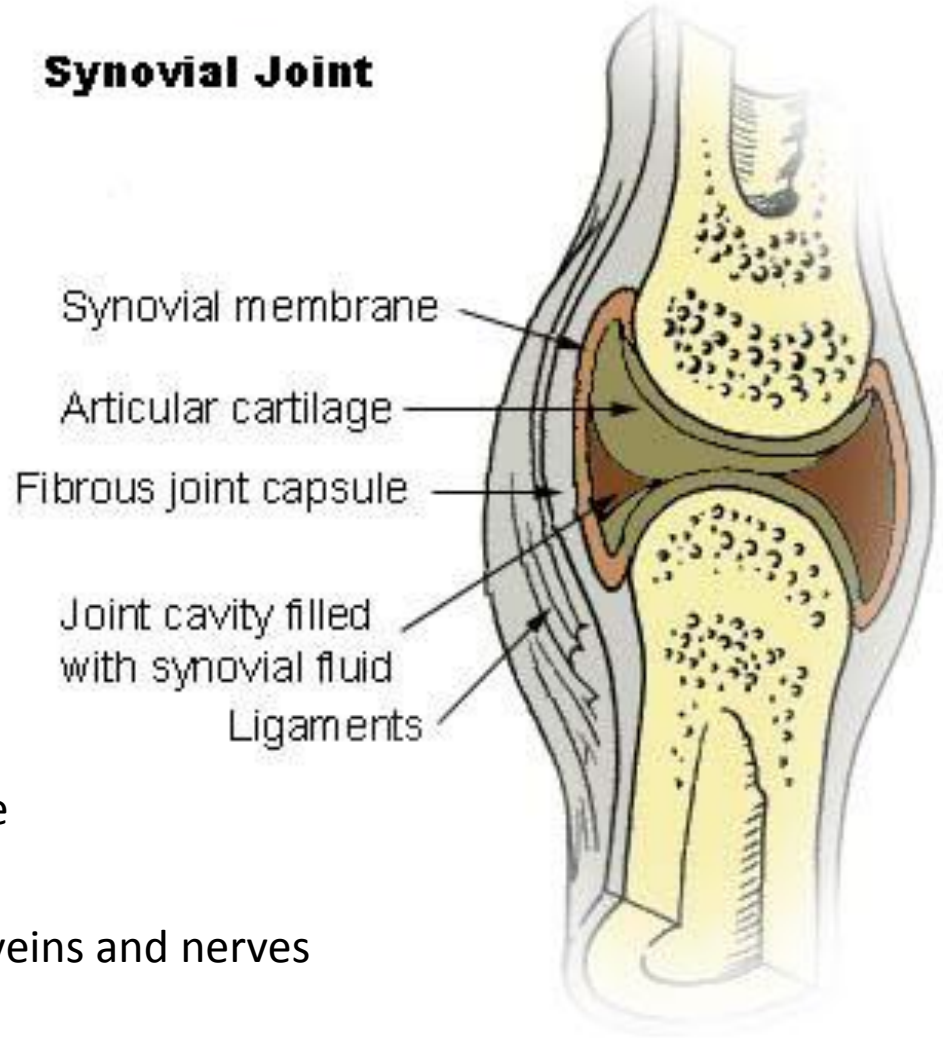
- **Joint cavity=*cavitas articularis***

articular fissure filled by synovial fluid (*synovia*)

Synovial fluid *(synovia)* – nourishes an articular cartilage, increases adhesion and decreases friction of contact surfaces

(plicae) or (villi) – are folds of the synovial layer of the articular capsule and increase inner surface of articular capsule *(capsula articularis)*

- **Articular network (*rete articulare*)** – supplying of joint by arteries, veins and nerves
- **Special joint apparatus**



Additional features of the joints

a) ***labrum articulare*** – fibrocartilaginous ring - broadening of a shallow articular fossa by a strip of cartilage

b) articular discs and meniscs ***(disci*** **and** ***menisci articulares)*** – plates of cartilage, which serves as elastic pads, discs divid the articular cavity into two parts, *menisci* only partly

c) ligaments (ligamenta) are present in the most joints as extracapsular, capsular or intracapsular ligaments

d) articular muscles (*musculi articulares*) – prevent of a strangulation of articular capsules

e) bursae and synovial pockets (*bursae synoviales*) – are small cavities close to the joint. They are constructed by synovial membrane and synovial fluid. Usually may communicate with the joint cavity.

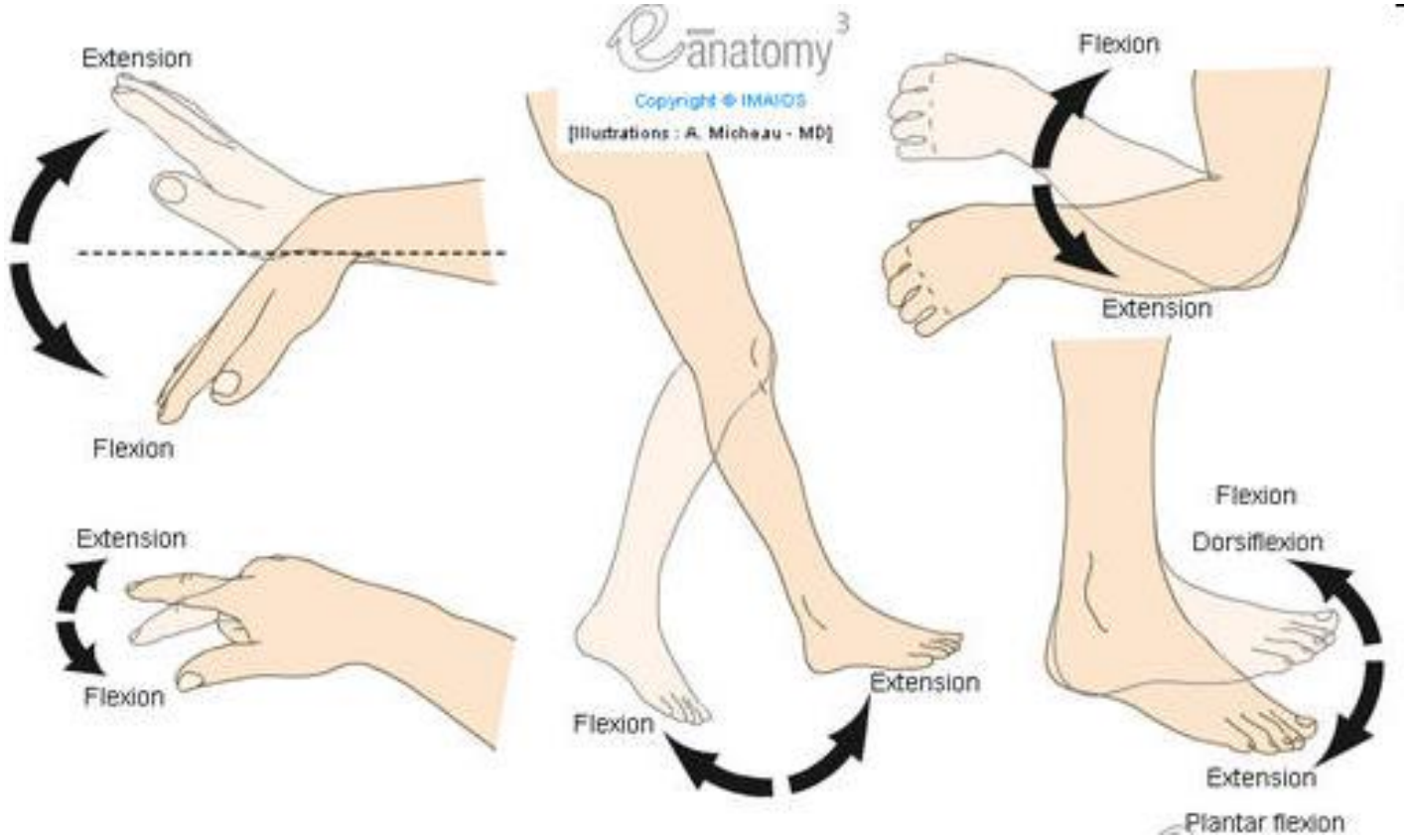
Movements in joints

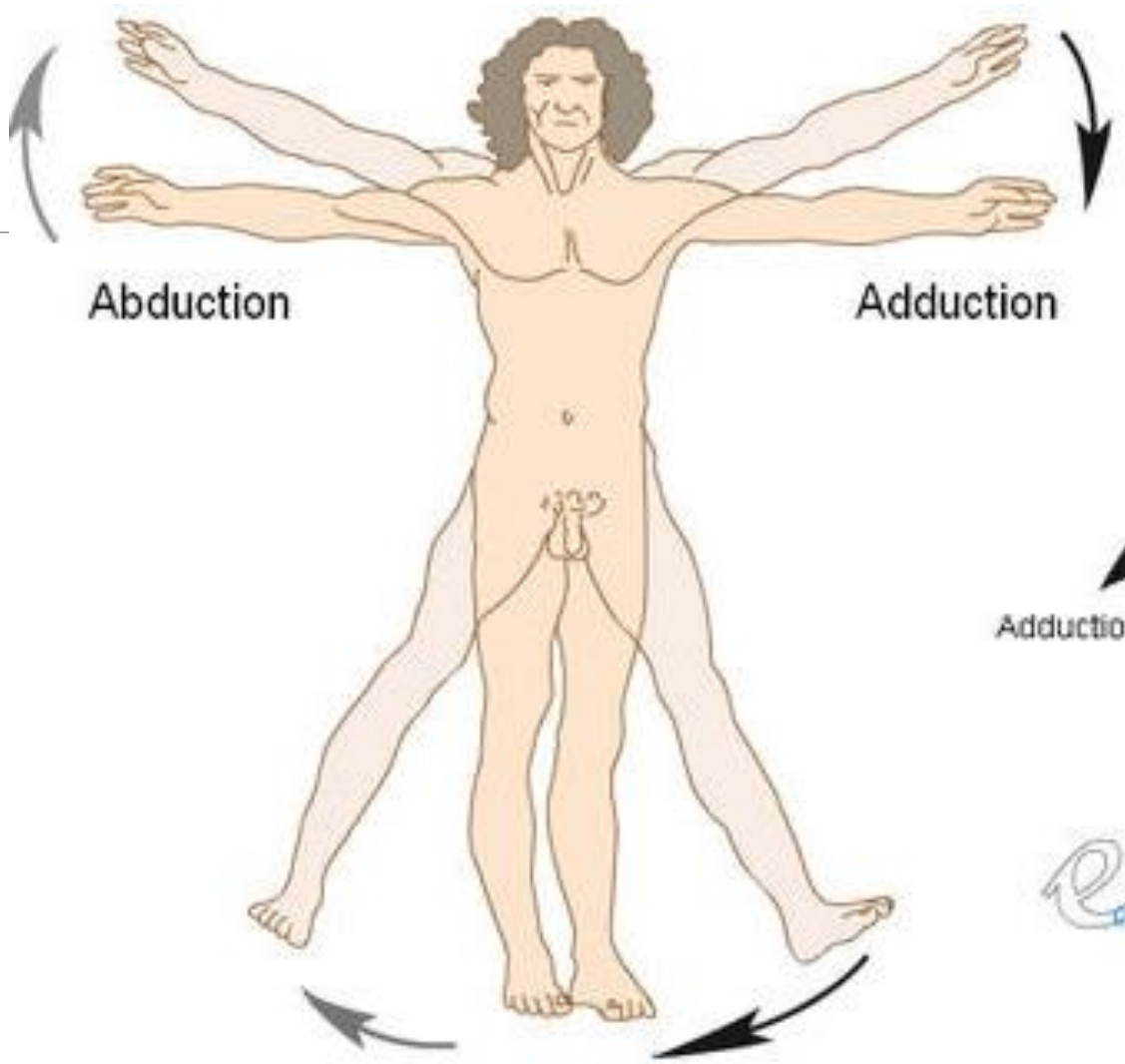
- Possible according to the shape of articulation surfaces and on position of muscles attachments around the joints
- Joints monoaxial, biaxial, multiaxial

Basic position of the joint - basic anatomical position

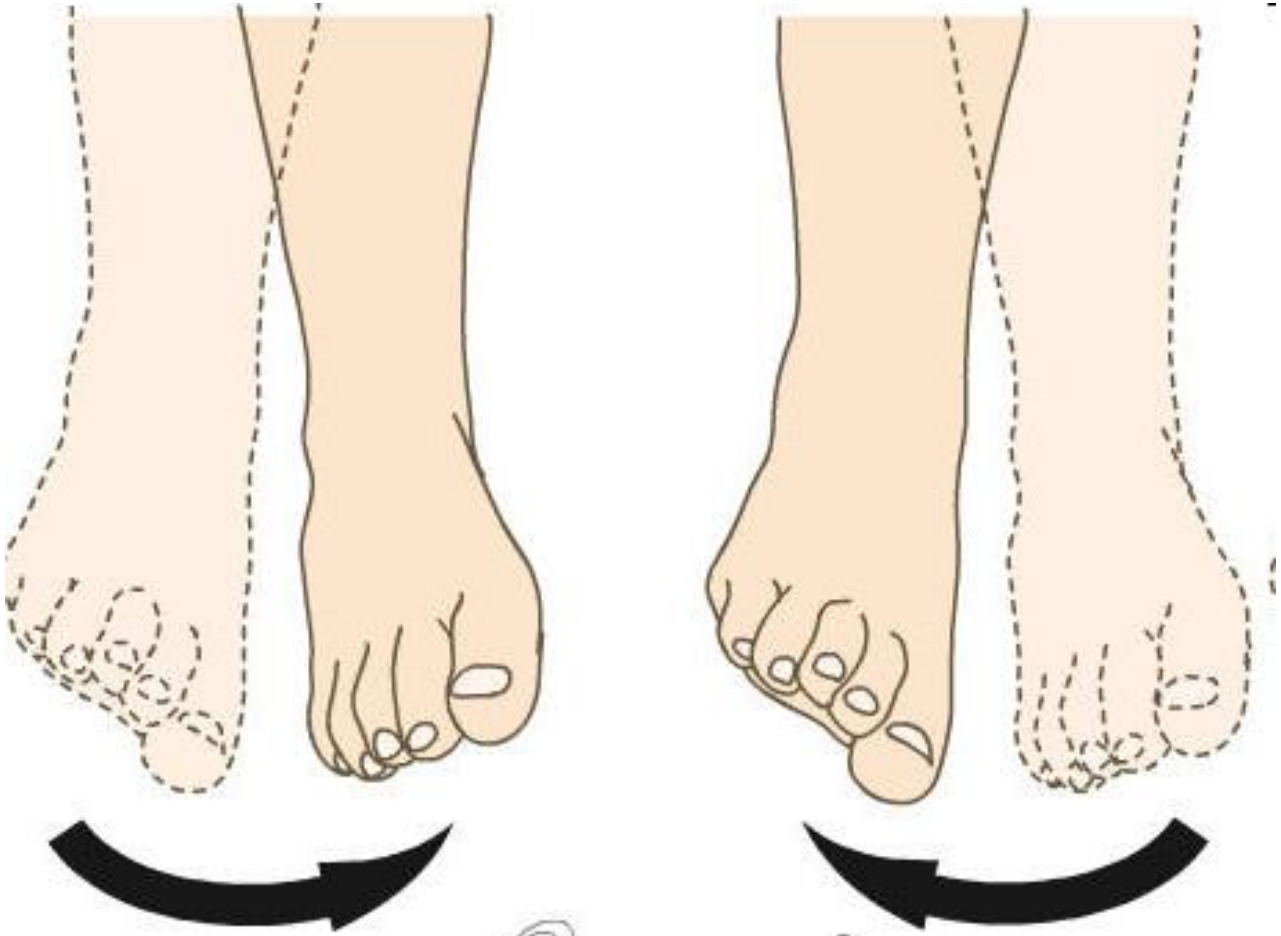
Middle position of the joint - most relaxed joint capsule

Movements in joints




Abduction
Adduction


Abduction
Adduction


Inversion
Eversion
anatomy 3
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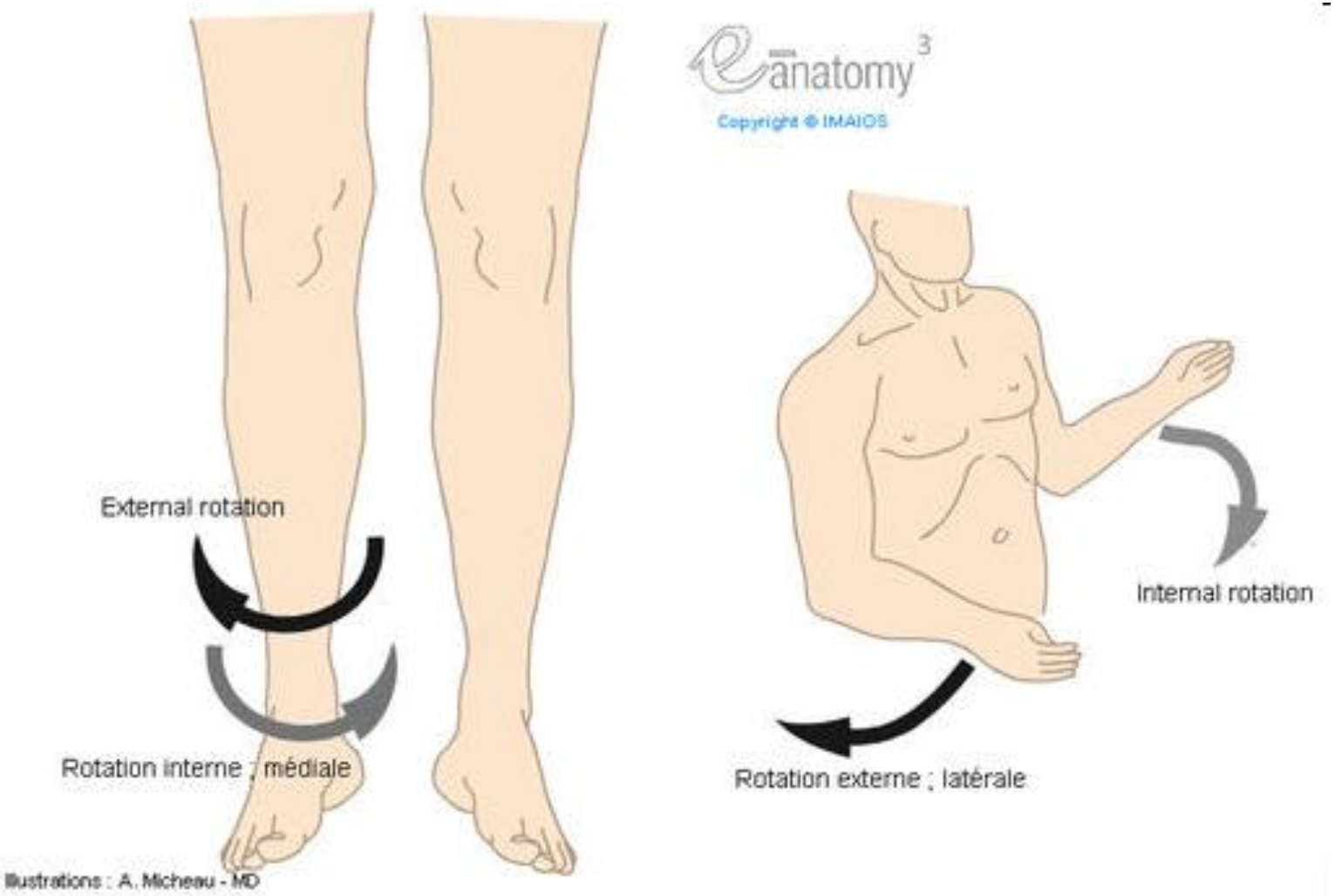
External rotation
Rotation interne ; médiale
Illustrations : A. Micheau - MD
anatomy 3
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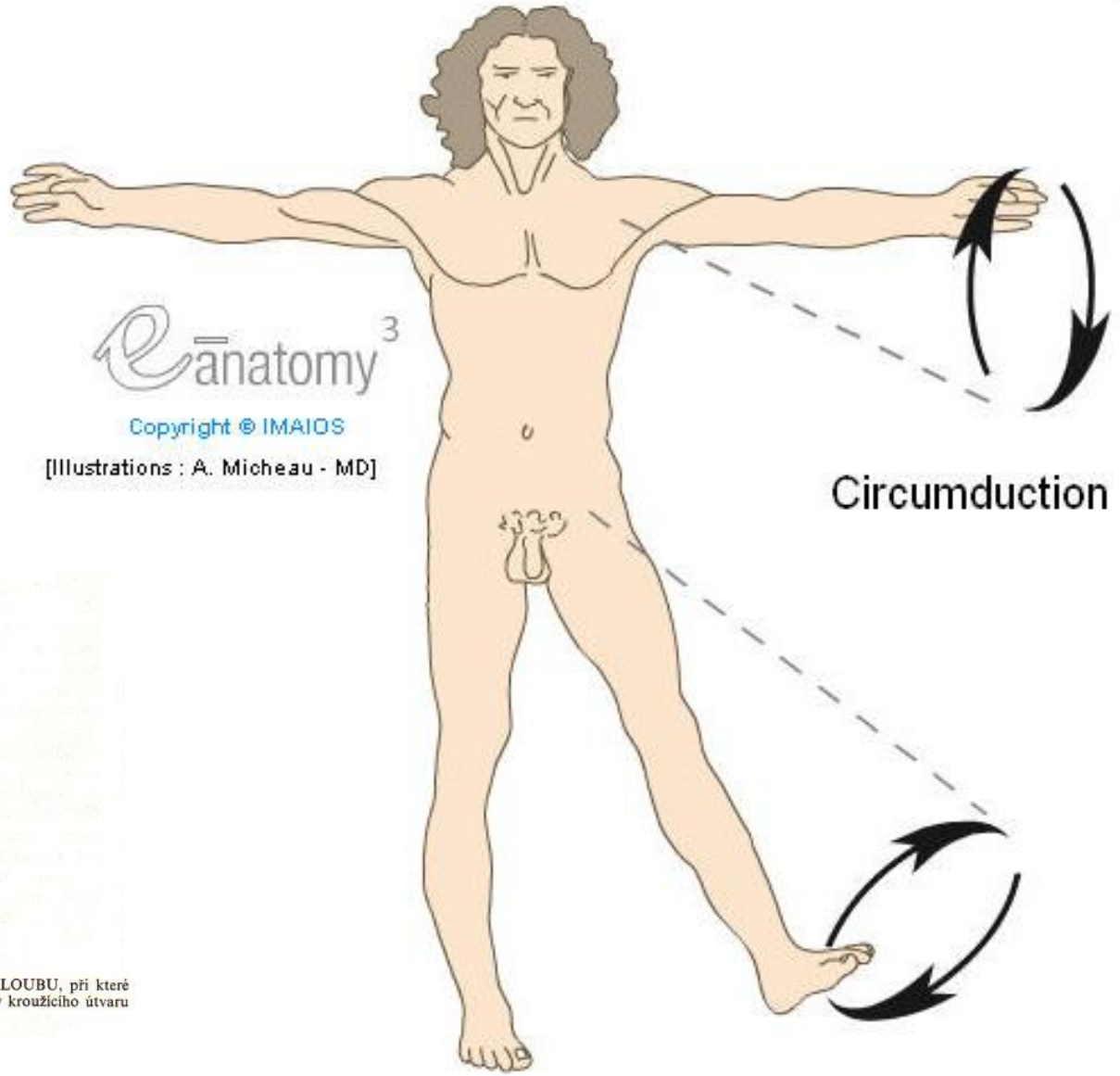
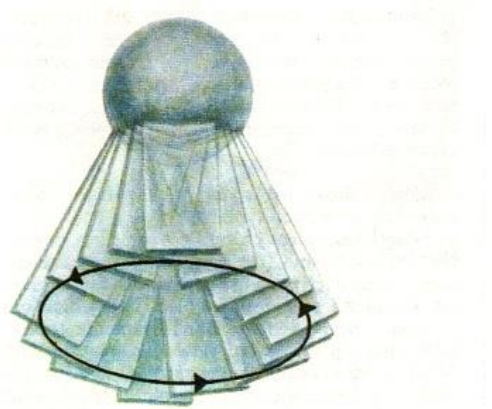
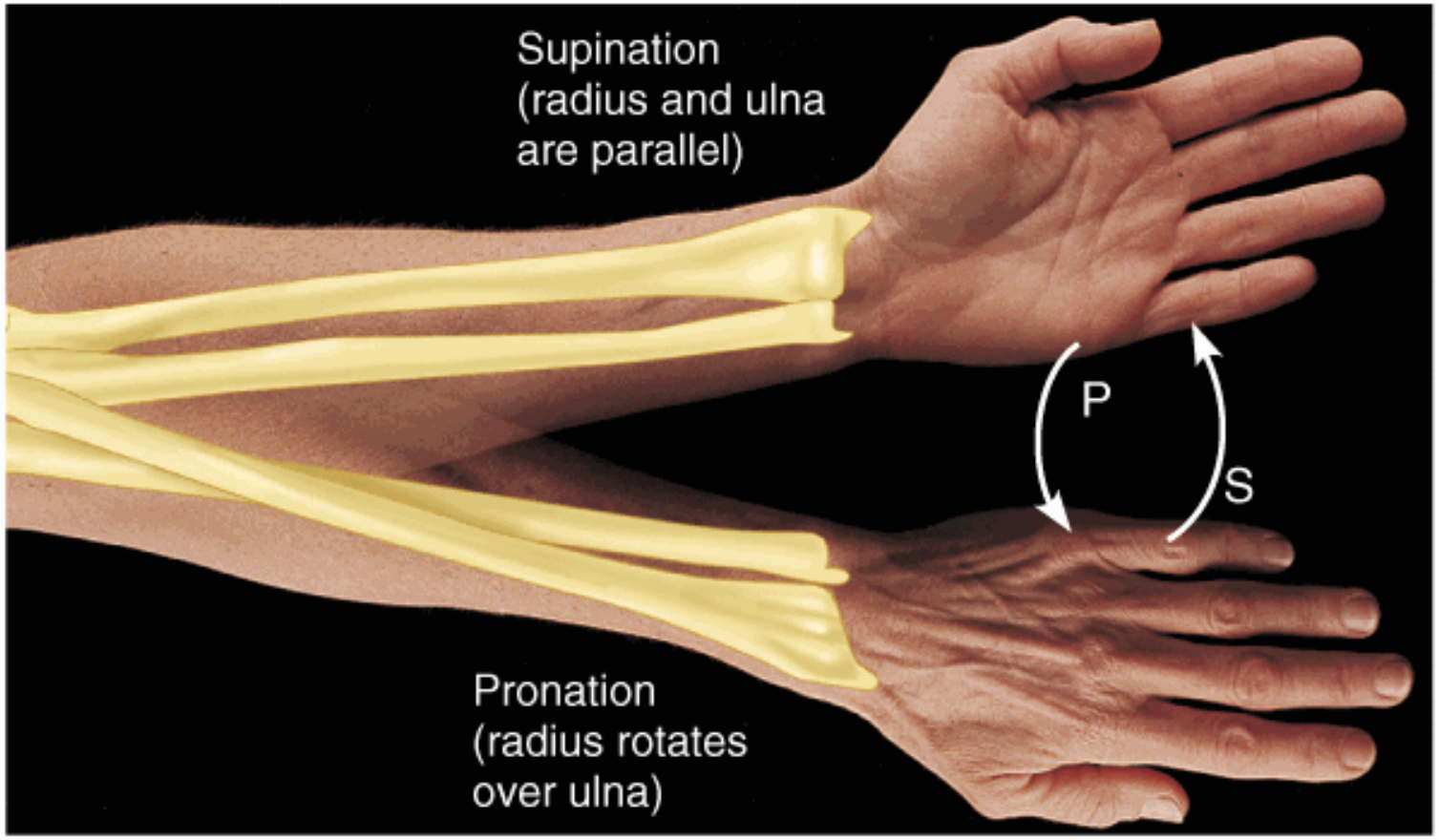
Internal rotation
Rotation externe ; latérale





100. CIRKUMDUKCE KULOVITÉHO KLOUBU, při které chybí rotace (srov. obr. 101); jednotlivé strany kroužícího útvaru jsou obráceny stále stejným směrem



(a) Supination (S) and pronation (P)

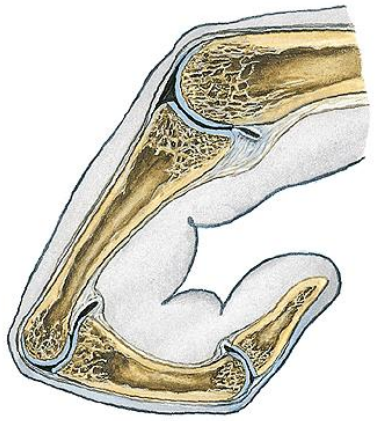
Types of joints

Joints may be classified from various points of view.

According to a number of articular surfaces:

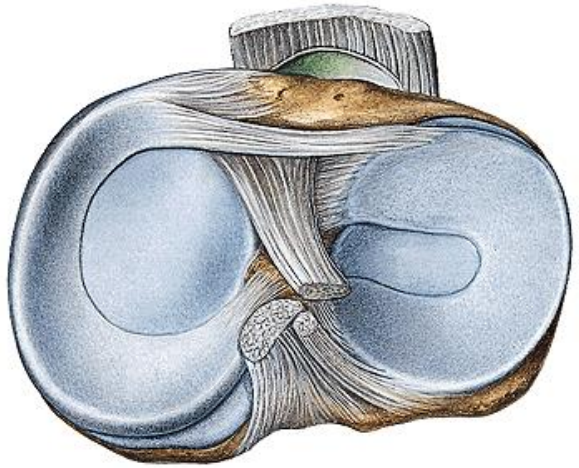
a) Simple joints

- only two bones are in contact



b) Compound joints

- more than two bones are in contact
- two bones and between them is located **disk (*discus*)** or **menisk (*meniscus articularis*).**



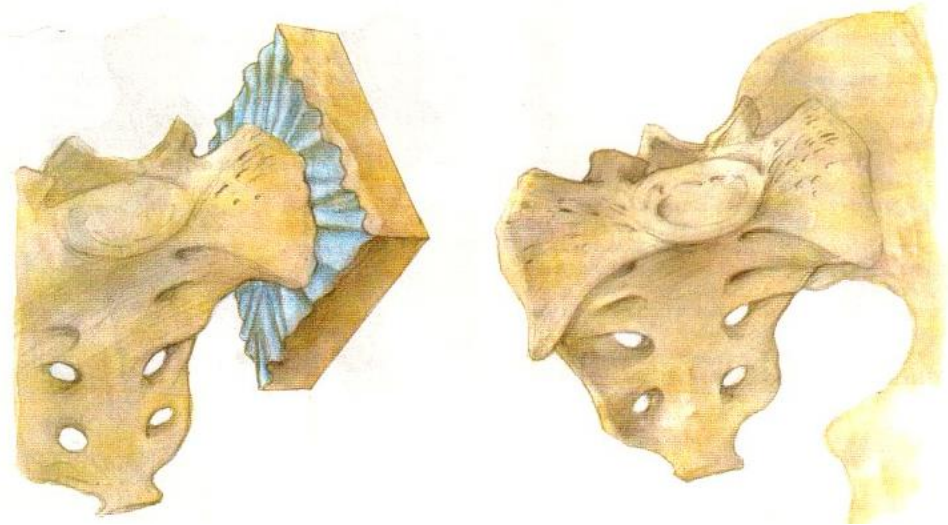
Classification of joints according to the shape of articular surfaces:

- **spheroidal joint (ball-and-socket joint)** *(articulatio spheroidea)* – head has shape like a sphere or its part,
  free spheroid joint *(arthrodia*)
  spheroid joint with restricted movements *(enarthrosis)*
- **ellipsoidal (condyloid) joint** (*articulatio ellipsoidea*)
- **cylindrical joint:**

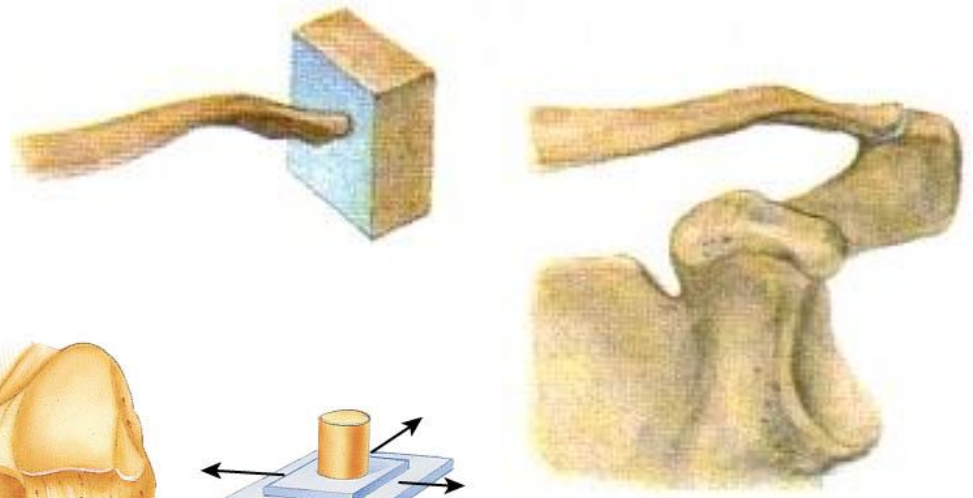
  pivot joint (trochoid) (*articulatio trochoidea*), wheel joint - the axe of movement is parallel with the longitudinal axe of bone

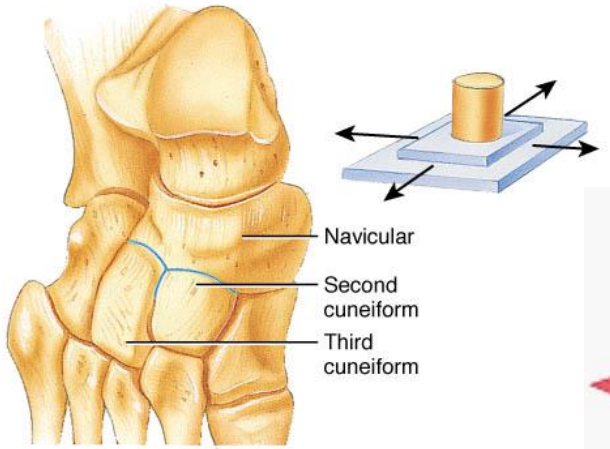
  hinge joint *(articulatio trochlearis); ginglymus* - the axe of movement is in the right angle to the longitudinal axe of bone
- **saddle joint (sellar)** *(articulatio sellaris)*
- **plane joint** *(articulatio plana)*
- **amphiartrosis**

AMPHIARTROSIS

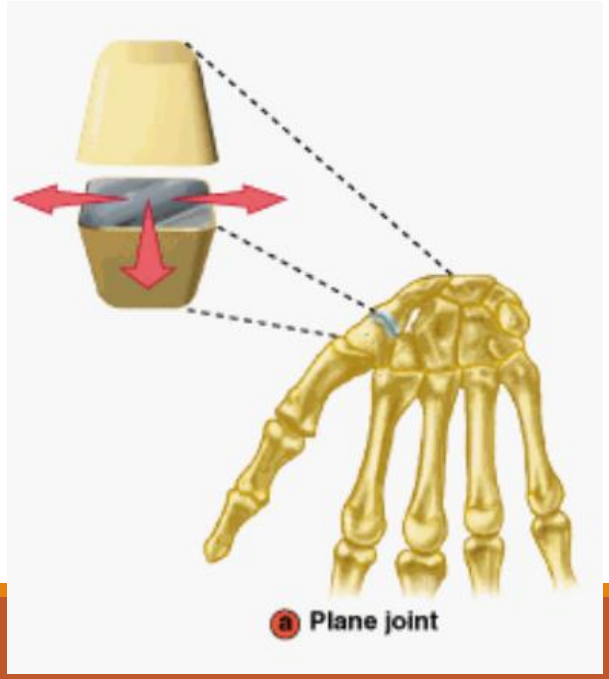


ART. PLANA



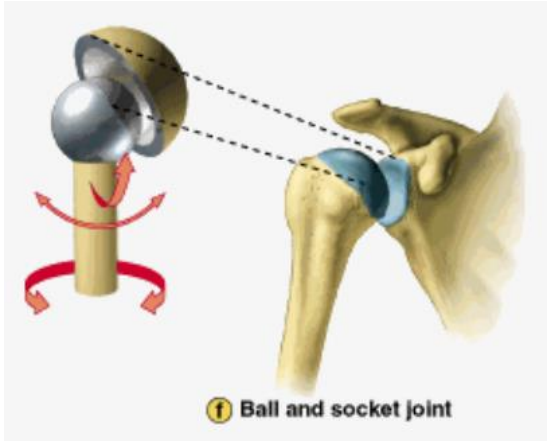


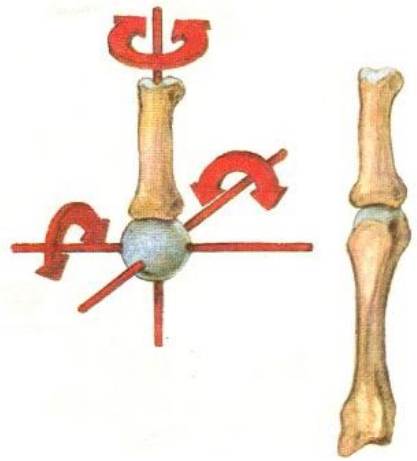
(a) Planar joint between the navicular and second and third cuneiforms of the tarsus in the foot



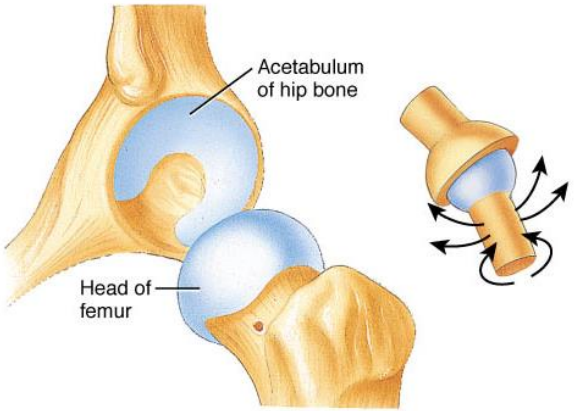
BALL AND SOCKET

ARTHRODIA





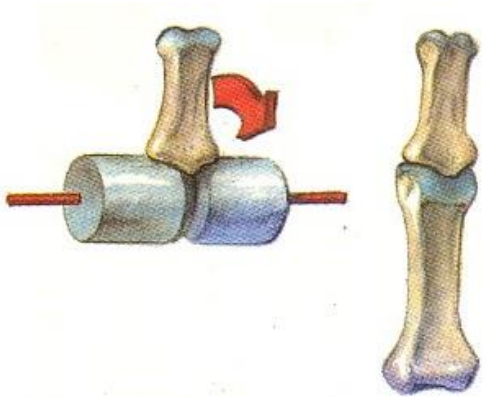
ENARTHROSIS

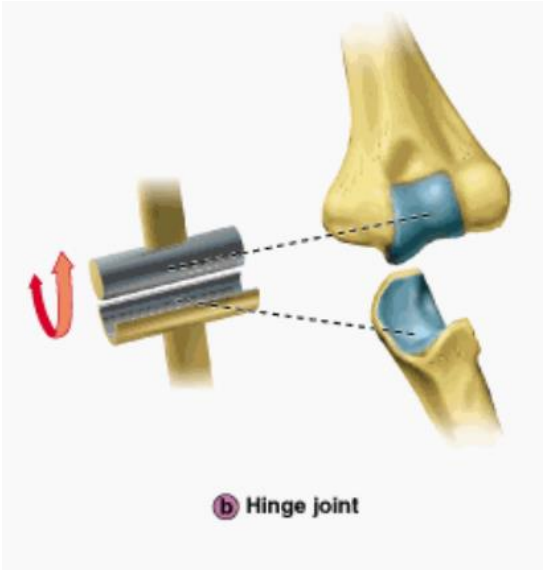


(f) Ball-and-socket joint between head of the femur and acetabulum of the hip bone

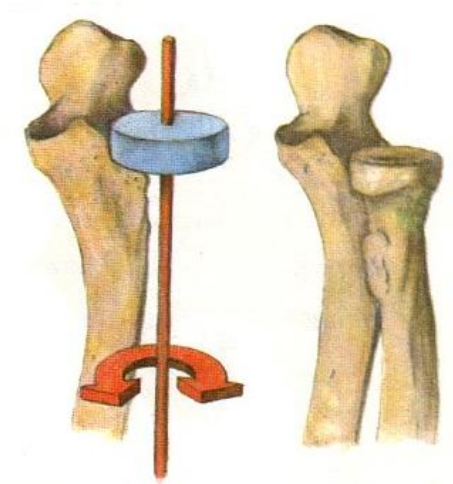
CYLINDRICAL JOINT:

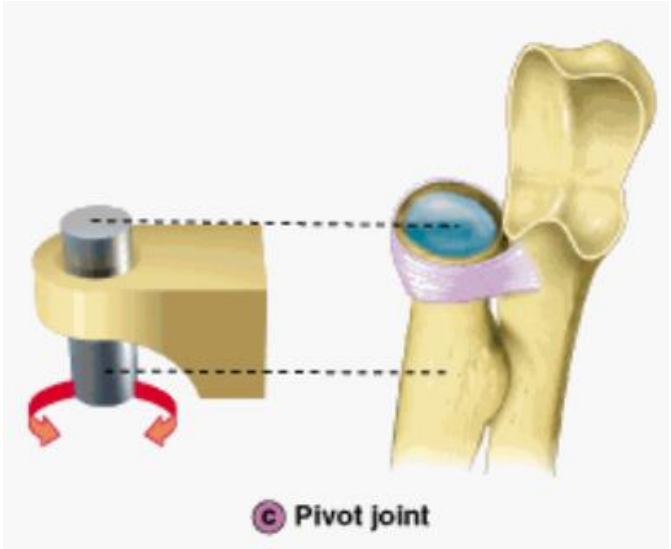
HINGE JOINT



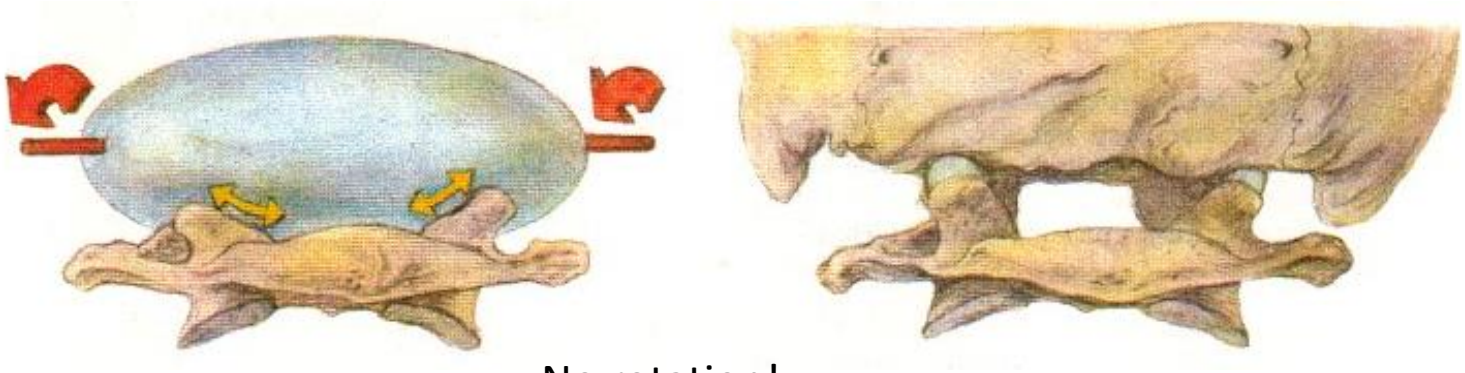


PIVOT JOINT

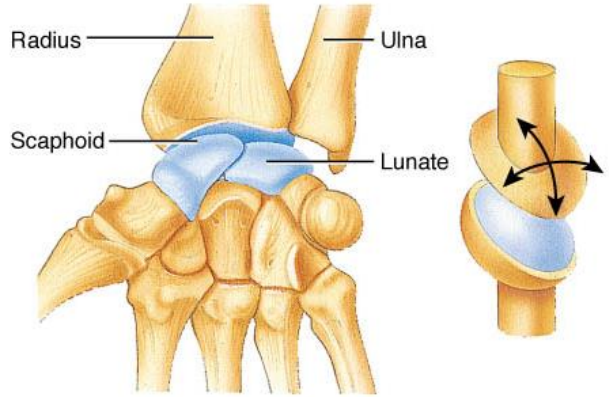




ART. ELLIPSOIDEA (CONDYLOID)

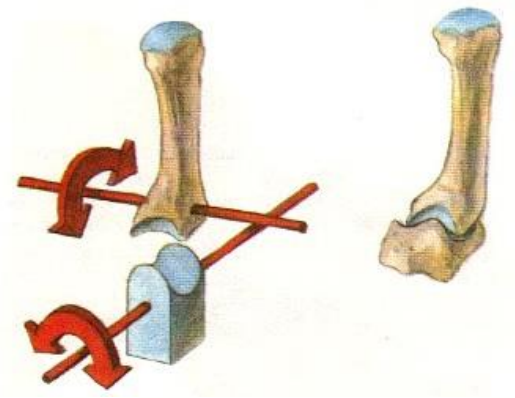


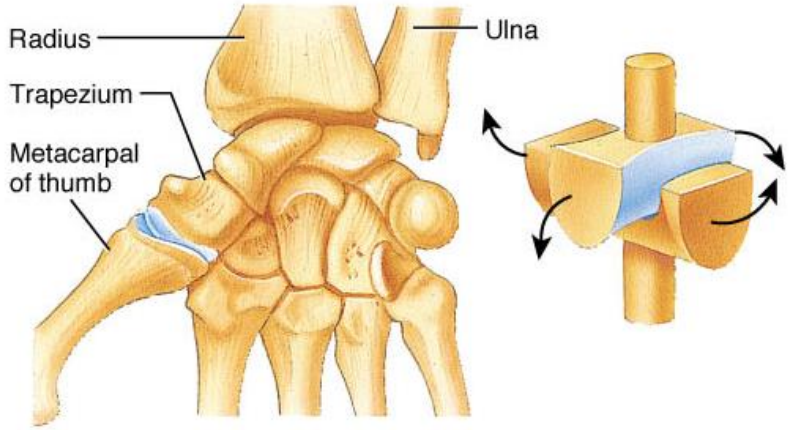
No rotation!
Movements according to the long axis



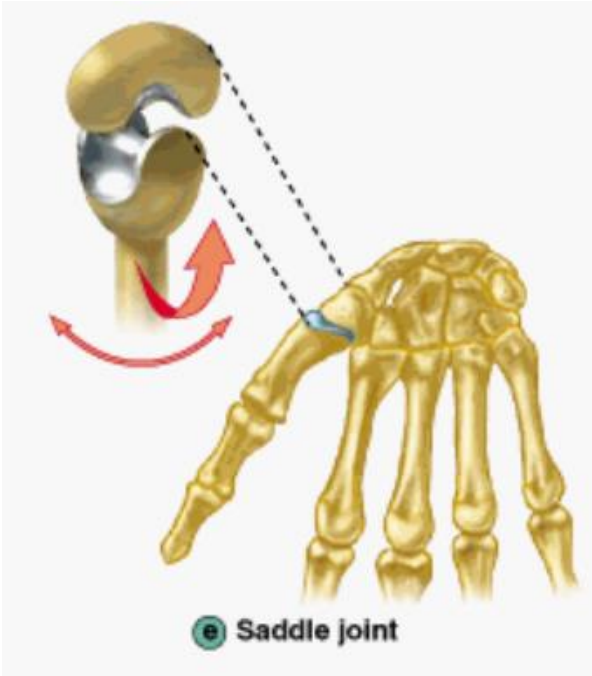
(d) Condyloid joint between radius and scaphoid and lunate bones of the carpus (wrist)

SADDLE JOINT





(e) Saddle joint between trapezium of carpus (wrist) and metacarpal of thumb



Classification of joints according to the level of moveability and number of axis of movements:

Joints with minimal movement:

With irregular surfaces – **amphiarthrosis**

Joints with sliding movements:

- Flat joints - **articulatio plana**

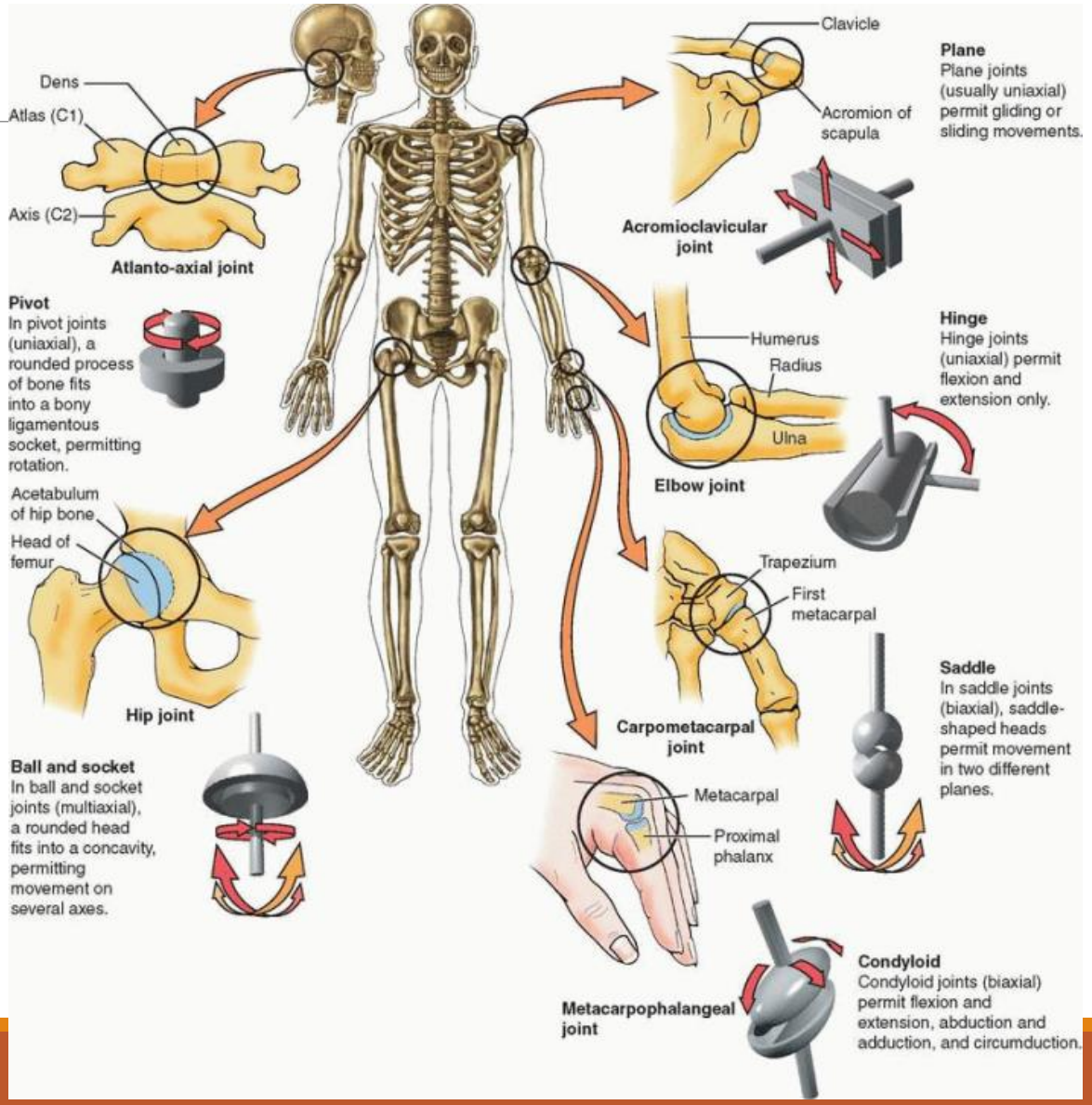
Joints with rotational movements:

- 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)



How to describe joints

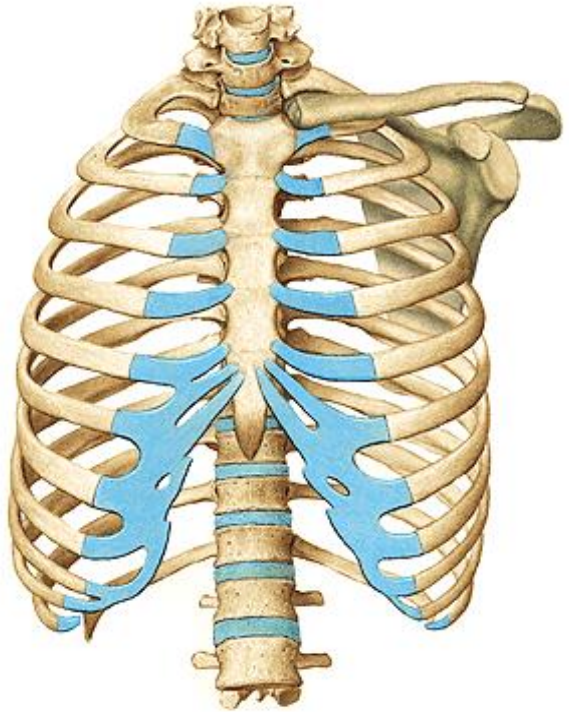
Obvious are theoretical knowledges of the general arthrology, the knowledges of the special osteology is obvious.

We are following this outline :

1. **Name** of the joint,
2. Names of the **articular surfaces**,
3. Characteristic of the **joint capsule**
4. Joint **auxiliary equipmnet**,
5. **Type of the joint**,
6. **Movements** in the joint.

An integral part is the description of the joints at the plain x-rays in sagittal and lateral projection

Special arthrology
Connections of the spine and thorax



Spine (columna vertebralis)

We can observe all types of junctiones on the spine

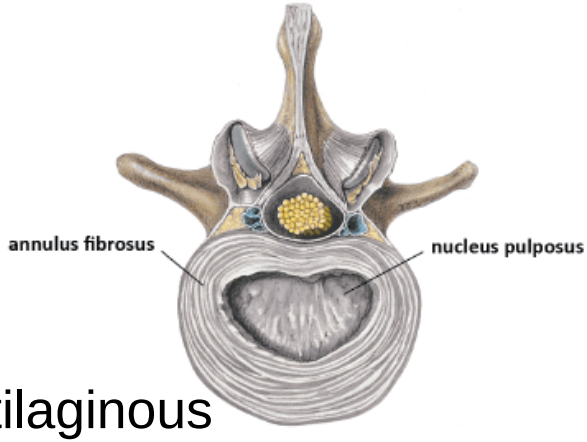
Synartroses and diarthroses as well

Synarthrosis

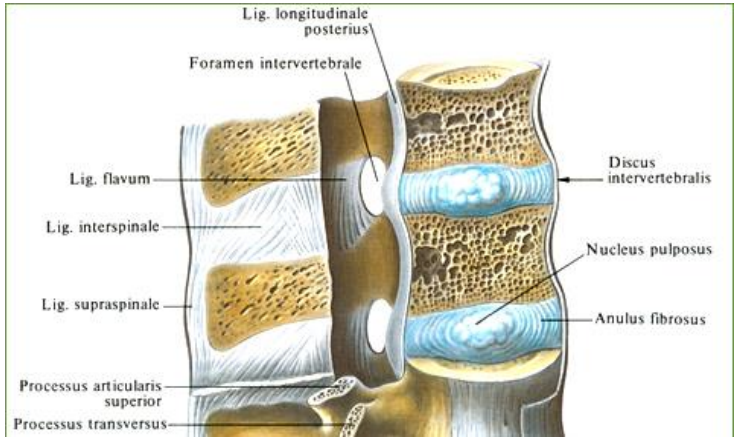
- syndesmosis- ligaments
- synchondrosis- disci intervertebrales
  - synchondrosis sacrococcygea
- synostosis- os sacrum, os coccygis

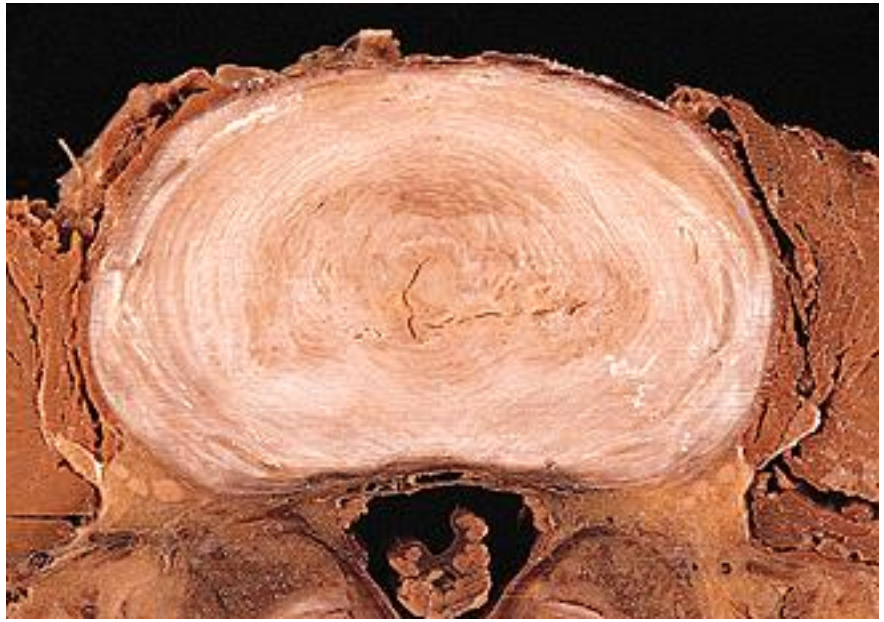
Diarthrosis- articulationes intervertebrales

Joints of the Vertebral Bodies



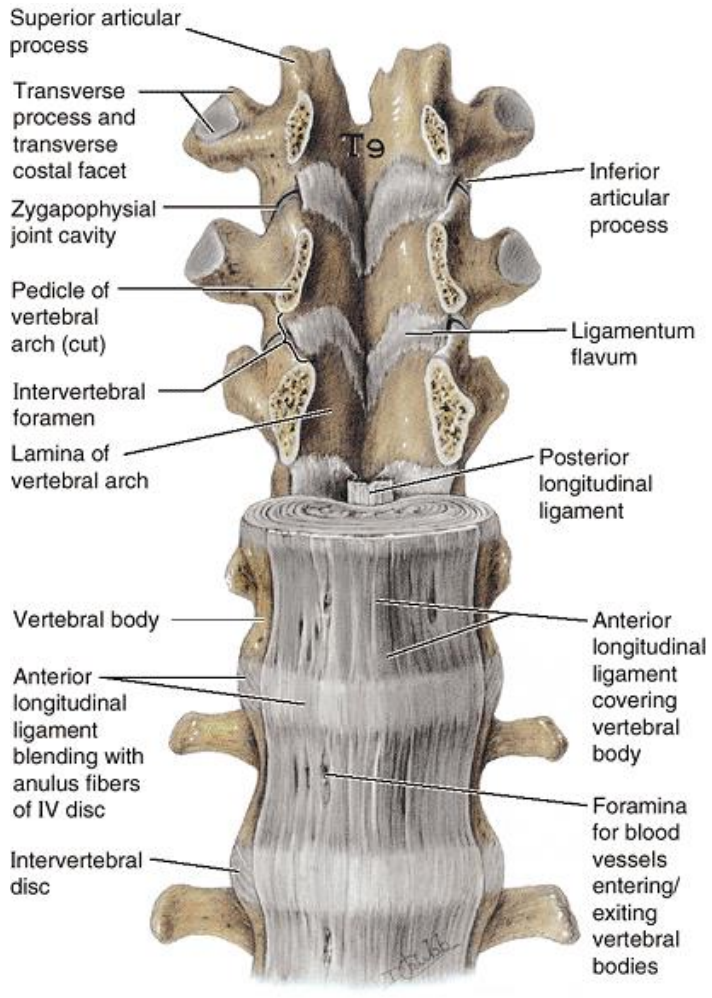
- disci intervertebrales: altogether 23,
- cartilaginous (symphysis) connection, discus
- (anulus fibrosus – hyaline and fibrous cartilage - Concentric layers of fibrocartilaginous fibers, nucleus pulposus – fibrous tissue)





Junctions of vertebral arches

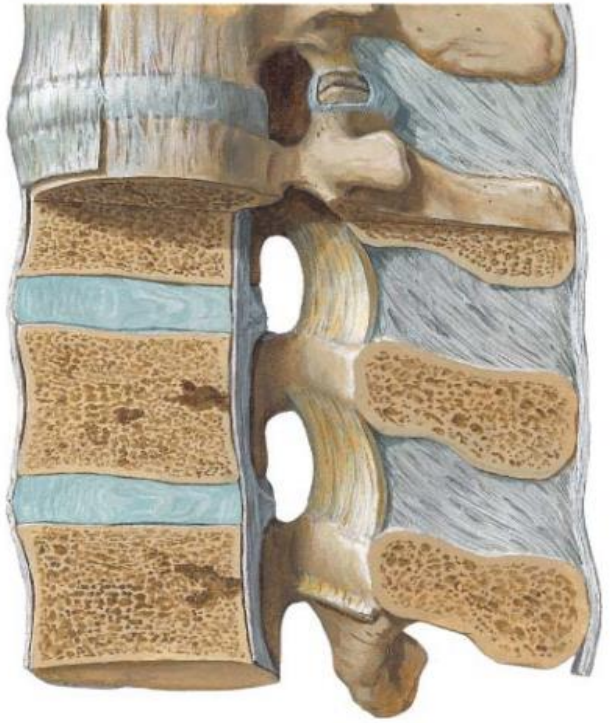
- elastic ligaments – ligamenta flava (interarcualia)



Anterior view

Junctions of articular processes of vertebrae

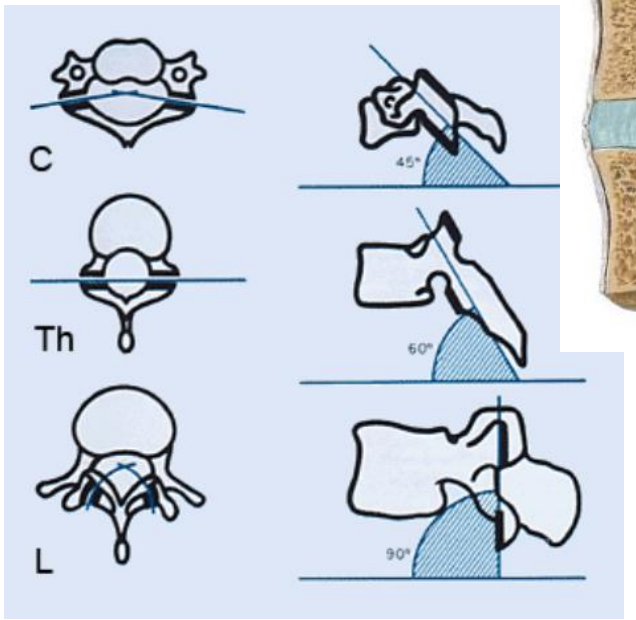
- articulationes intervertebrales



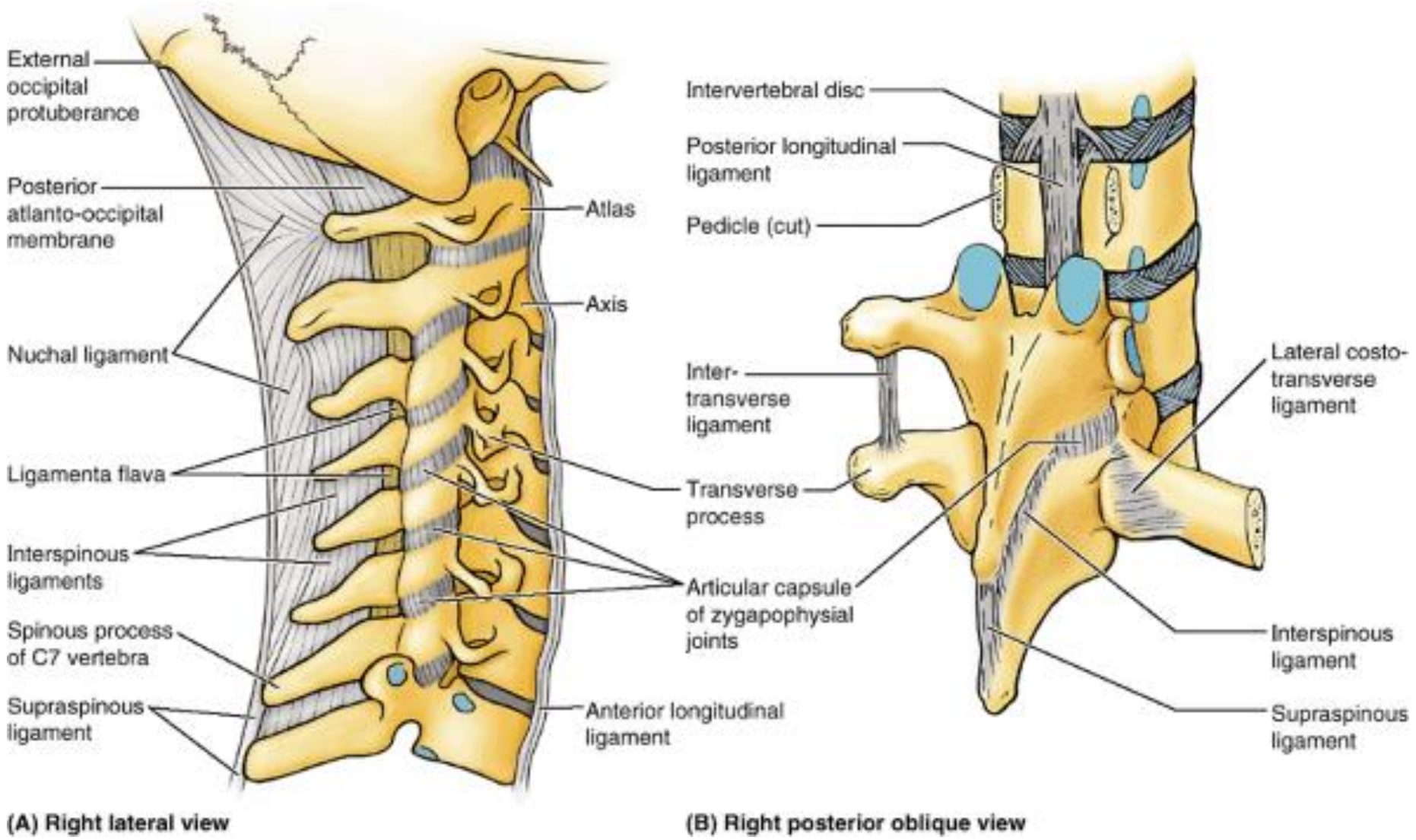
between the superior and inferior articular processes of adjacent vertebrae - zygapophysial/facet joints

sliding movements

angulations of the articular facets determine types of movements



- short ligaments:
  - **ligg. intertransversaria**
  - **ligg. interspinalia**
- **lig. supraspinale** (cervical area) – as sagitally oriented **ligamentum nuchae** which is going to the occipital bone

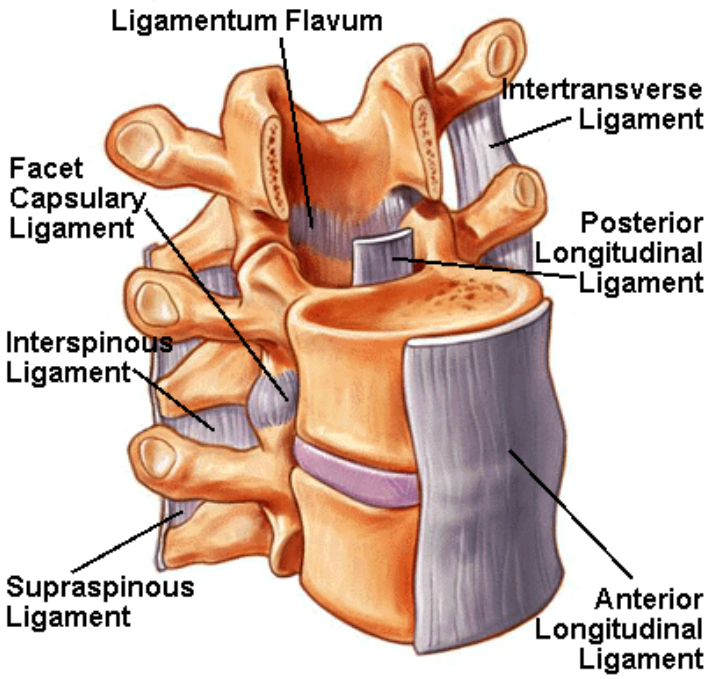

External occipital protuberance
Posterior atlanto-occipital membrane
Nuchal ligament
Ligamenta flava
Interspinous ligaments
Spinous process of C7 vertebra
Supraspinous ligament
Atlas
Axis
Anterior longitudinal ligament
(A) Right lateral view
Intervertebral disc
Posterior longitudinal ligament
Pedicle (cut)
Inter-transverse ligament
Transverse process
Articular capsule of zygapophysial joints
Lateral costo-transverse ligament
Interspinous ligament
Supraspinous ligament
(B) Right posterior oblique view

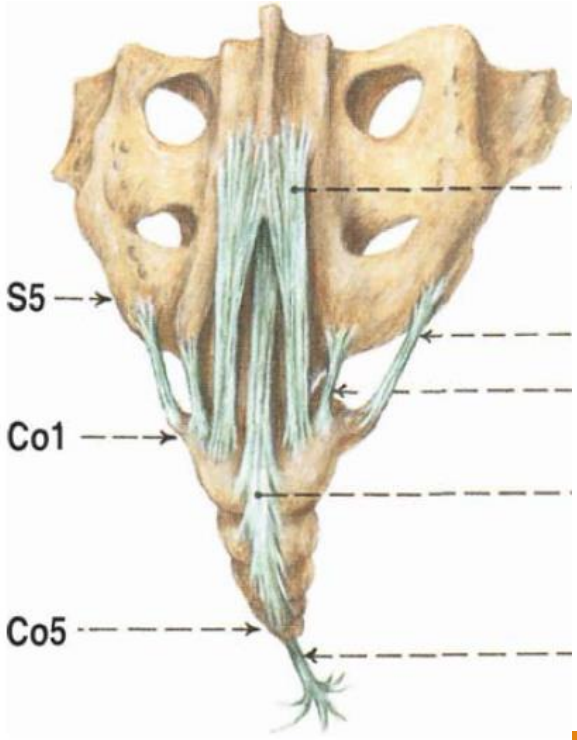
Junctions common for all vertebrae

a) lig. longitudinale anterius

b) lig. longitudinale posterius

- They continue also to the sacral and coccygeal bone





Synostosis

- Conection 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 the 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

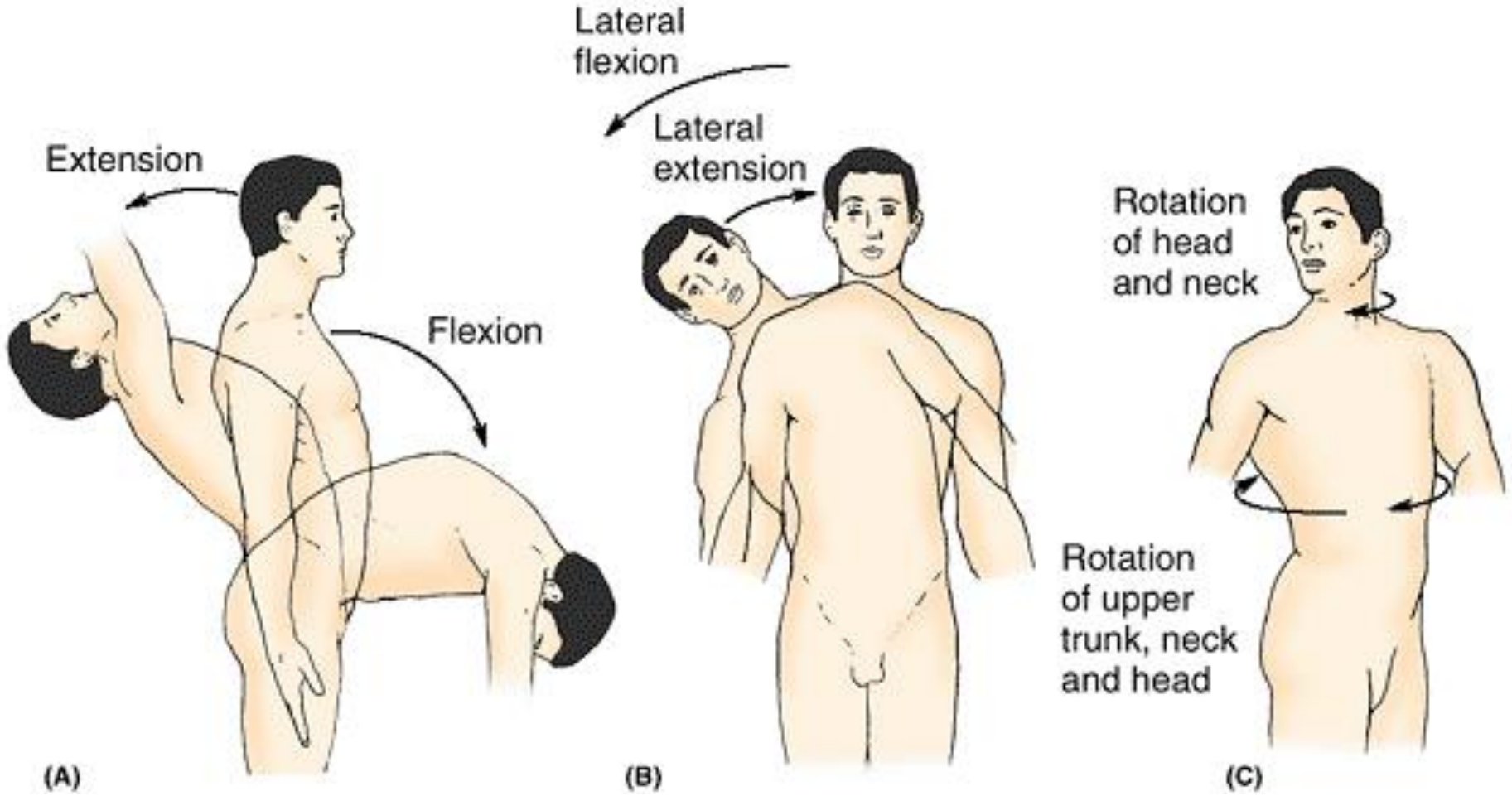
- **anteflexion, retroflexion,** 90° cervical, 23° lumbar, most stressed and vulnerable is part of the lower cervical vertebrae, Th11-12, L4-S1
- **lateroflexion**, 30° cervical, 35° lumbar
- Rotation and torsion, 60-70° cervical, 25-35° thoracic
- Springing movements

Mobility of the vertebral column

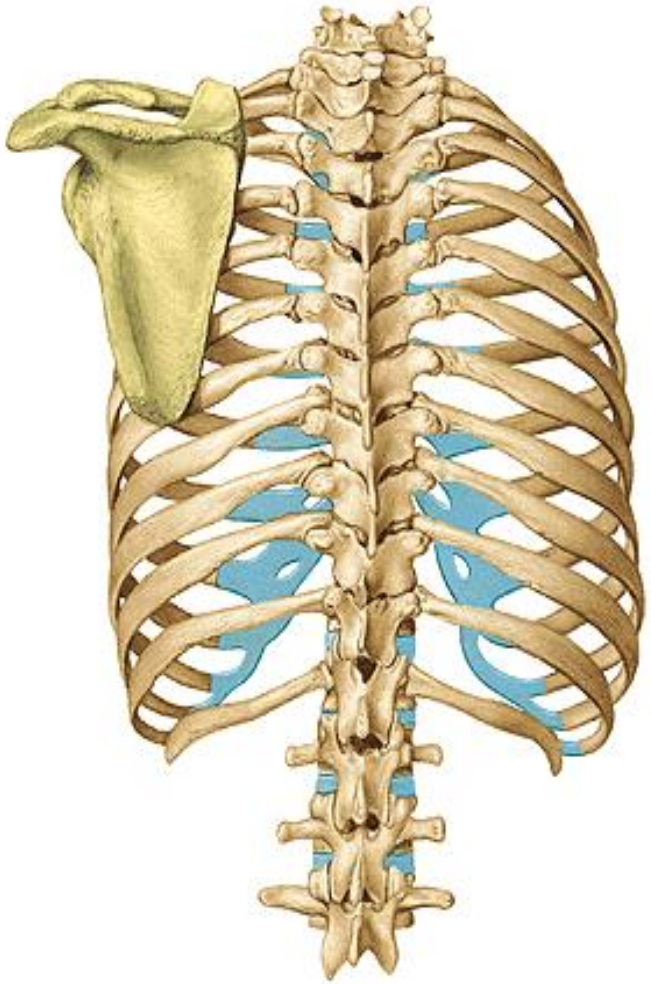
– depends on the size of intervertebral disc

– the mobility is rectricted by: ligaments, articular capsules and muscles

- the cervical vertebrae allow a range of flexion, lateroflexion and rotation coupled with lateroflexion
- the thoracic should be particularly mobile in rotation (is limited by the attachment of ribs)
- in the lumbar region - anteflexion, retroflexion, lateral flexion



Junctions of the thorax



- **costovertebral joints**

art. capitis costae

art. costotransversarium

- **costochondral joints and interchondral joints**

artt. interchondrales (6th-9th)

membrana intercostalis externa, interna

- **sternocostal joints**

artt. sternocostales (2nd-5th)

synchondrosis (1st, 6th, 7th)

Costovertebral Joints

Articulationes capitis costae

- AF: head of the rib articulates with the inferior and

superior costal facets of two adjacent thoracic vertebral bodies and the intervening intervertebral disc

- **AC:** firm and it is attached to the margins of AF
- **special apparatus:** lig. capitis costae radiatum, at 2nd – 10th rib: capitis costae intraarticulare
- m**ovements:** along axis parallel with the neck of the rib
- allow elevation and depression of the ribs

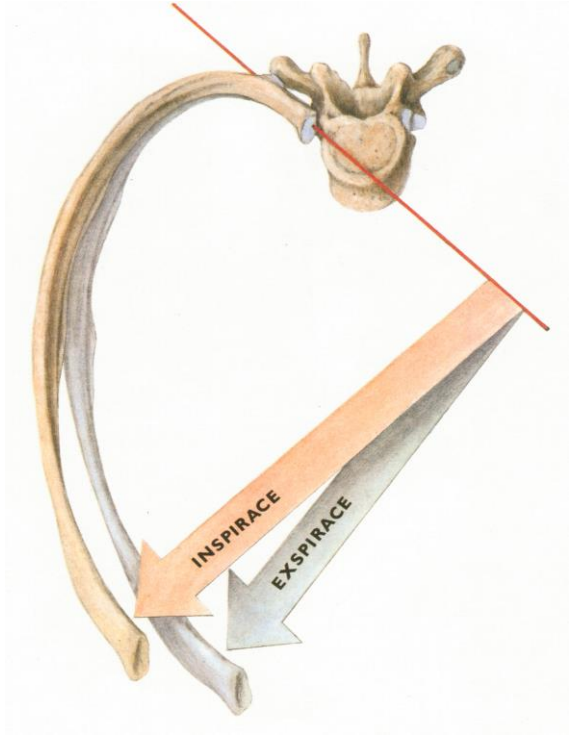
Articulationes costotransversariae

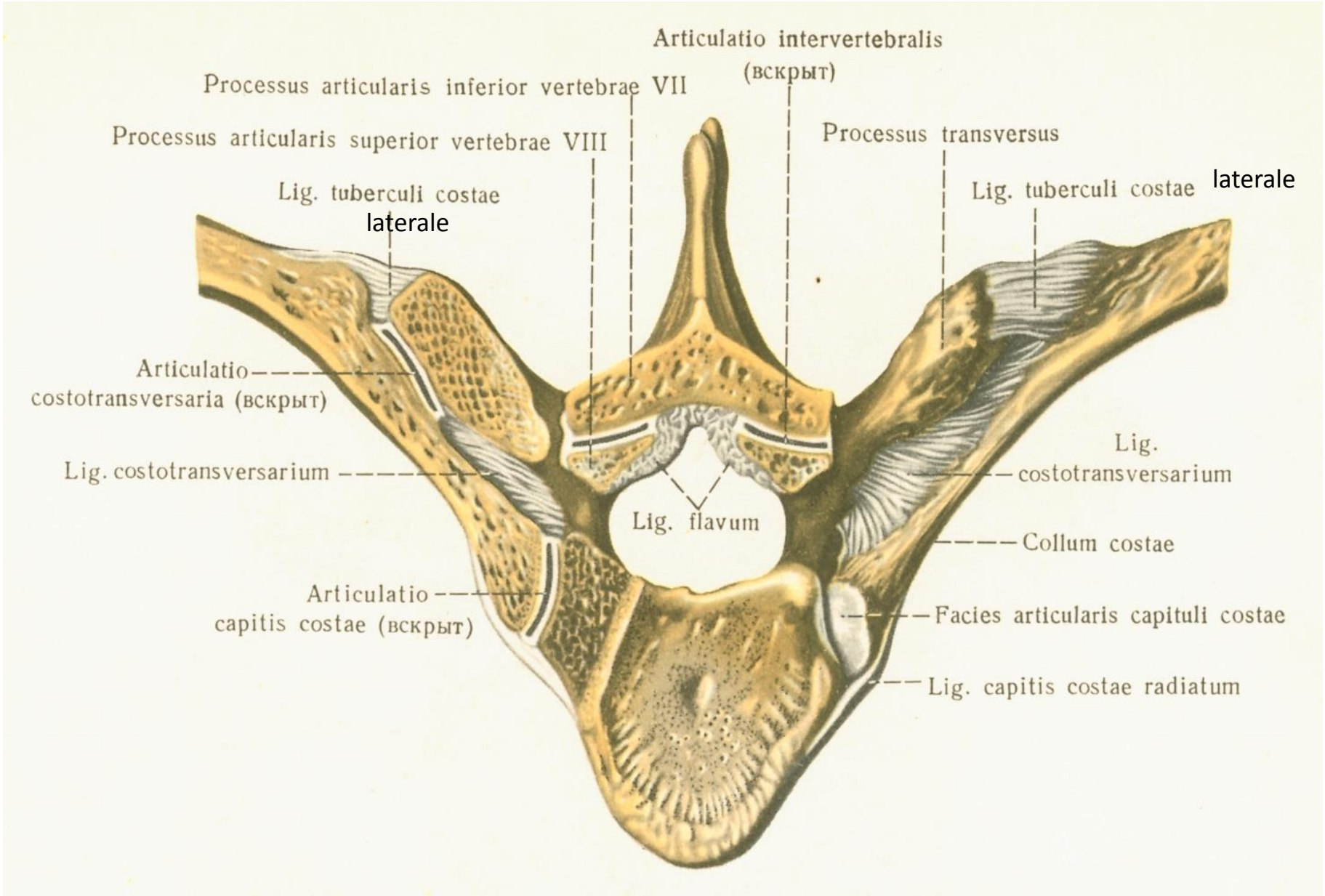
AS: foveae costales transversales and art. surface on tuberculum costae

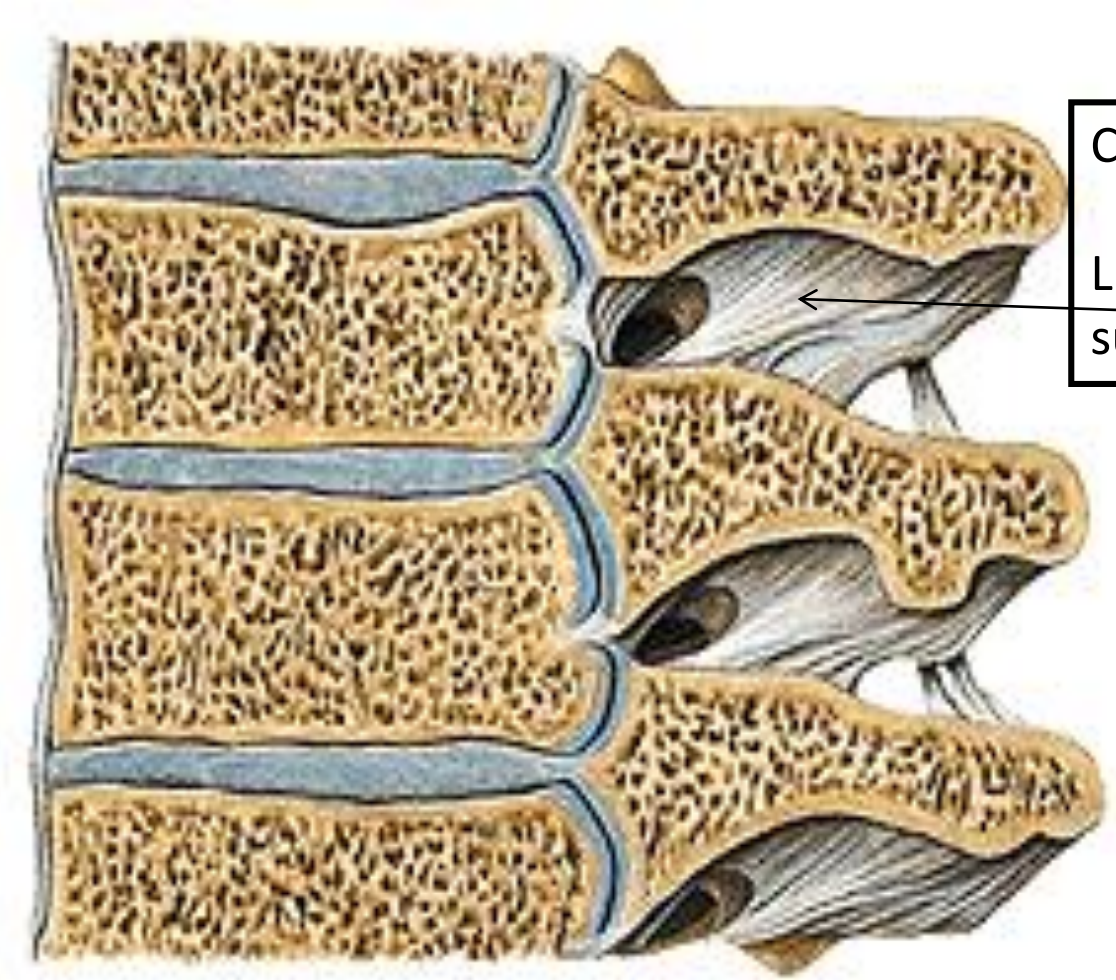
AC: margins of the articular surfaces

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

Movements: along axis which is parallel with collum costae

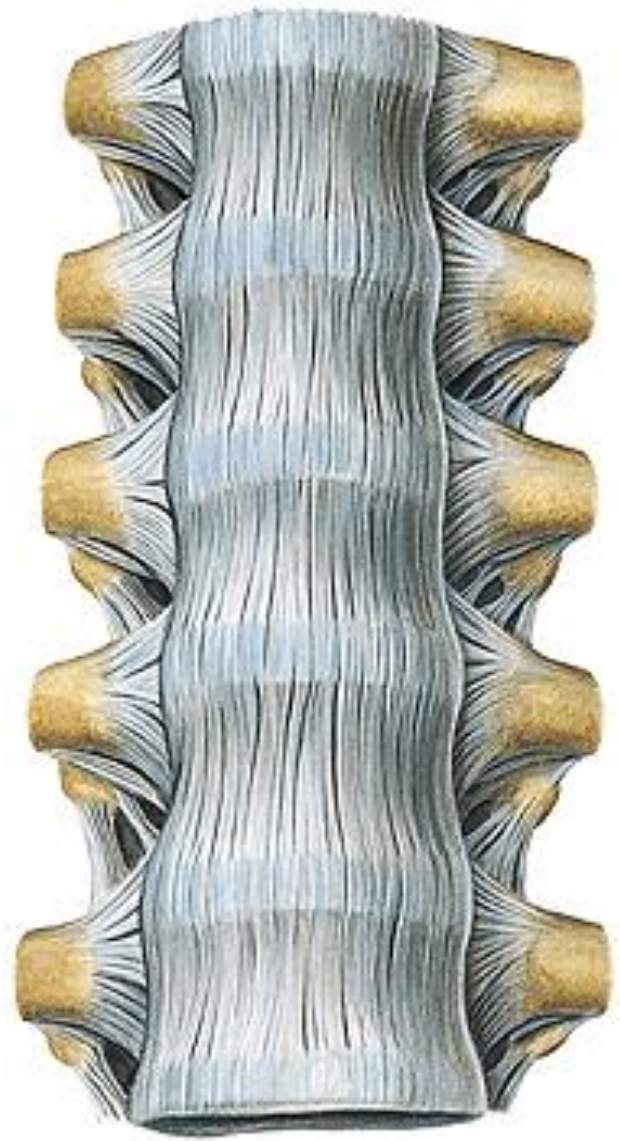



Articulatio intervertebralis
(вскрыт)
Processus articularis inferior vertebrae VII
Processus articularis superior vertebrae VIII
Processus transversus
Lig. tuberculi costae
laterale
Lig. tuberculi costae
laterale
Articulatio
costotransversaria (вскрыт)
Lig. costotransversarium
Lig. flavum
Lig.
costotransversarium
Collum costae
Articulatio
capitis costae (вскрыт)
Facies articularis capituli costae
Lig. capitis costae radiatum



Caput costae + lig.radiatum

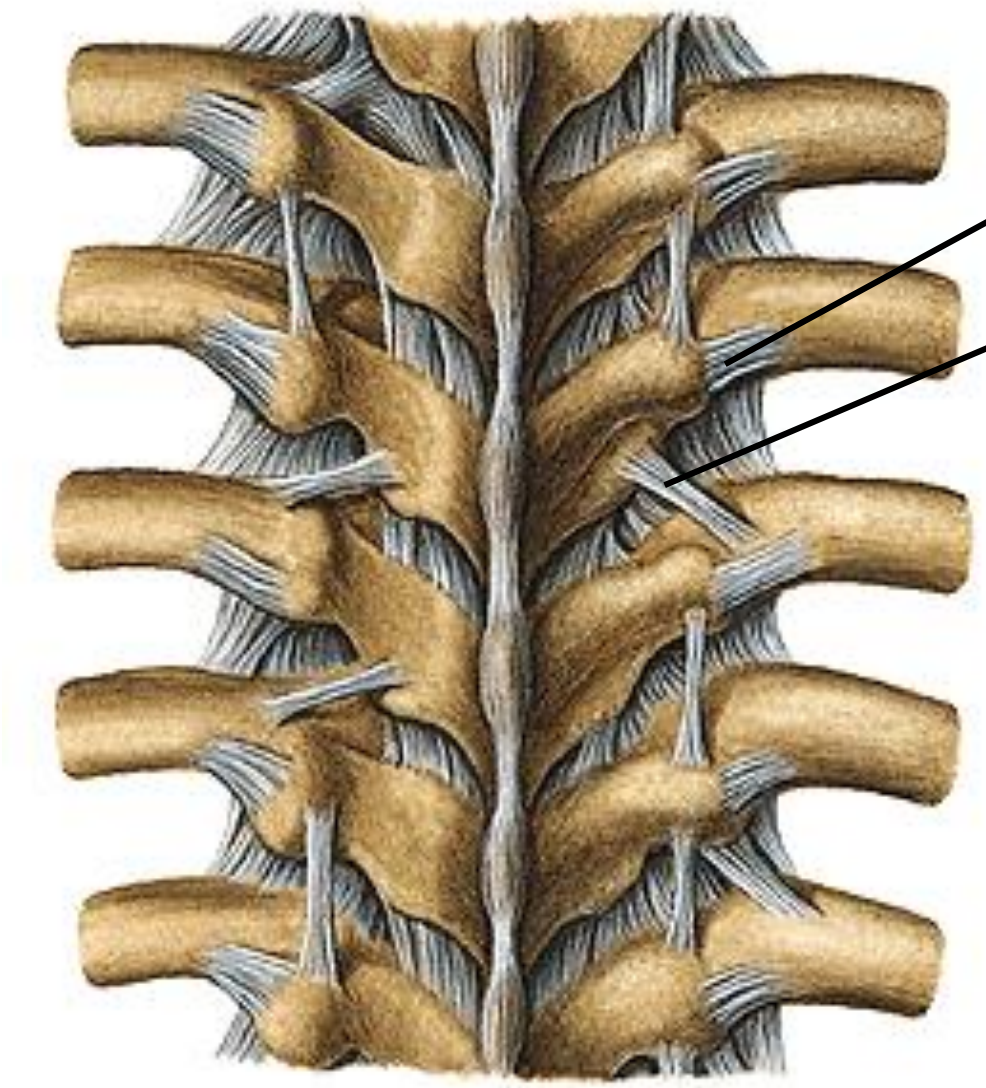
Lig.costotransversarium superius



Lig.capitis costae radiatum

Lig. costotransv. sup.

Lig. longitudin. ant.



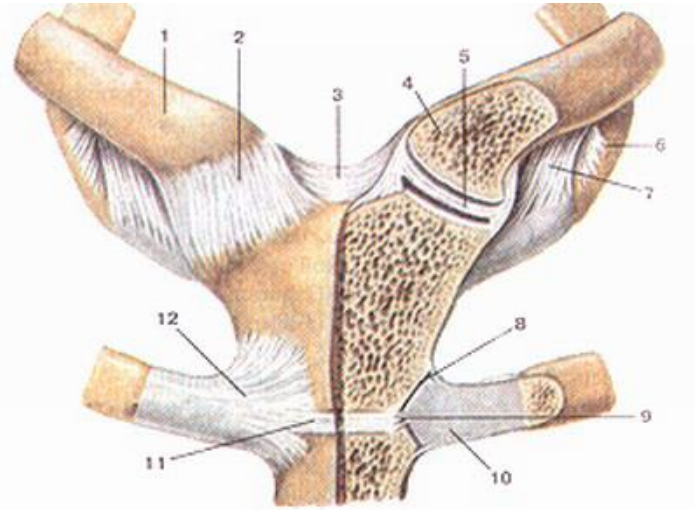
Lig. intertransversaria
interspinale (nuchae)

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
AS: sternal end of costal cartilage, incisura costalis sterni
AC: to the margins of the articular surfaces
Special apparatus: ligg. sternocostalia radiata – they form membrana sterni externa and interna



Junctions of adjacent ribs

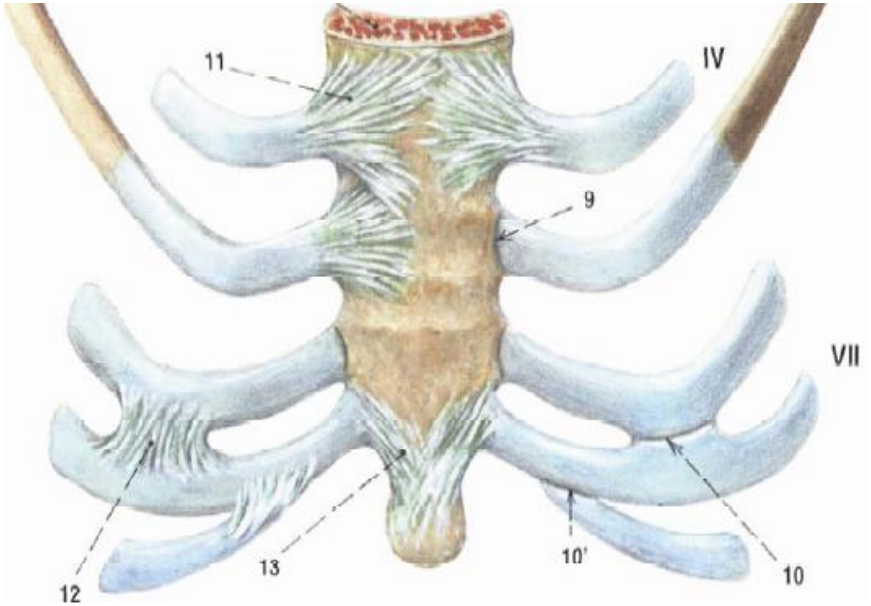
1. Articulationes interchondrales

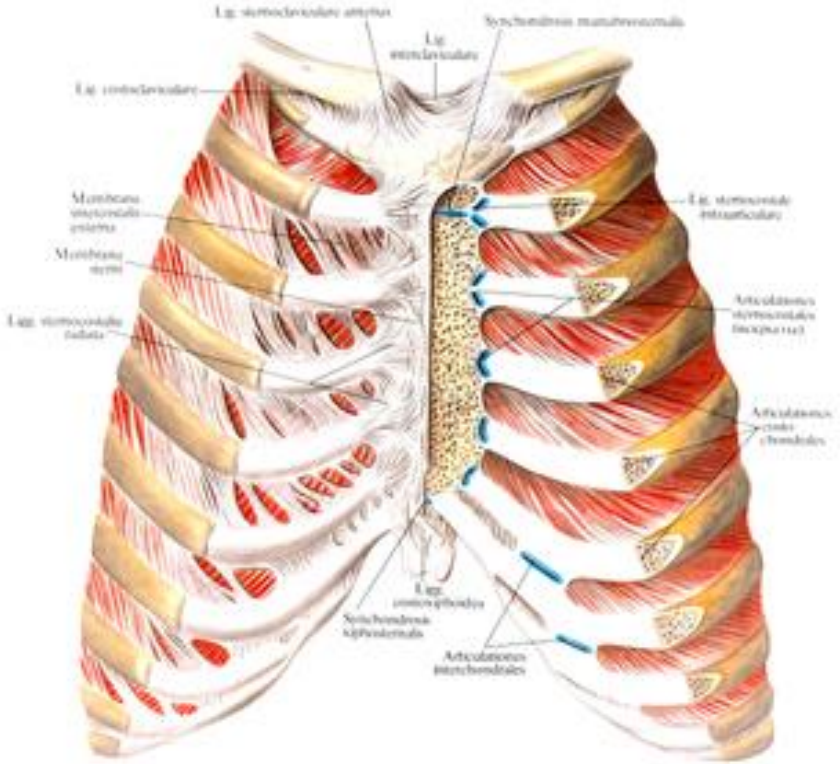
joint connection between costal cartilages of 5th to 9th rib, covered by short articular capsule

2. Membranae intercostales – fibrous membranes connecting adjacent ribs

Membrana intercostalis externa

Membrana intercostalis interna





Chest cage shape and movements

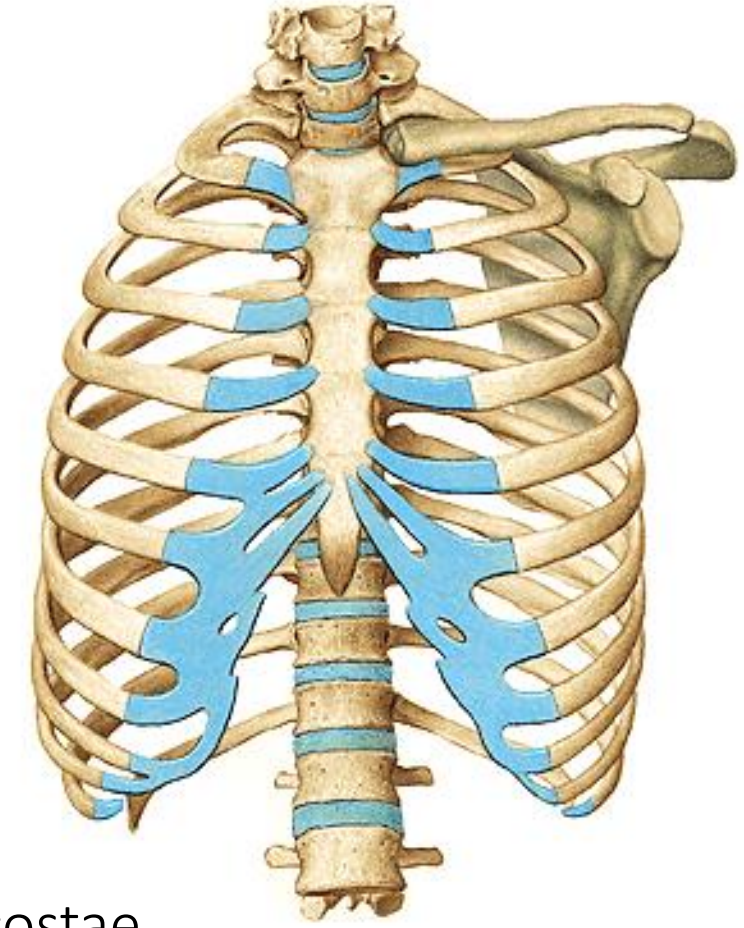
- Shape of truncated cone
- base (apertura thoracis inferior)
- apex (apertura thoracis superior)
- walls – frontal, dorsal, lateral

cavitas thoracis

spatia intercostalia

arcus costarum

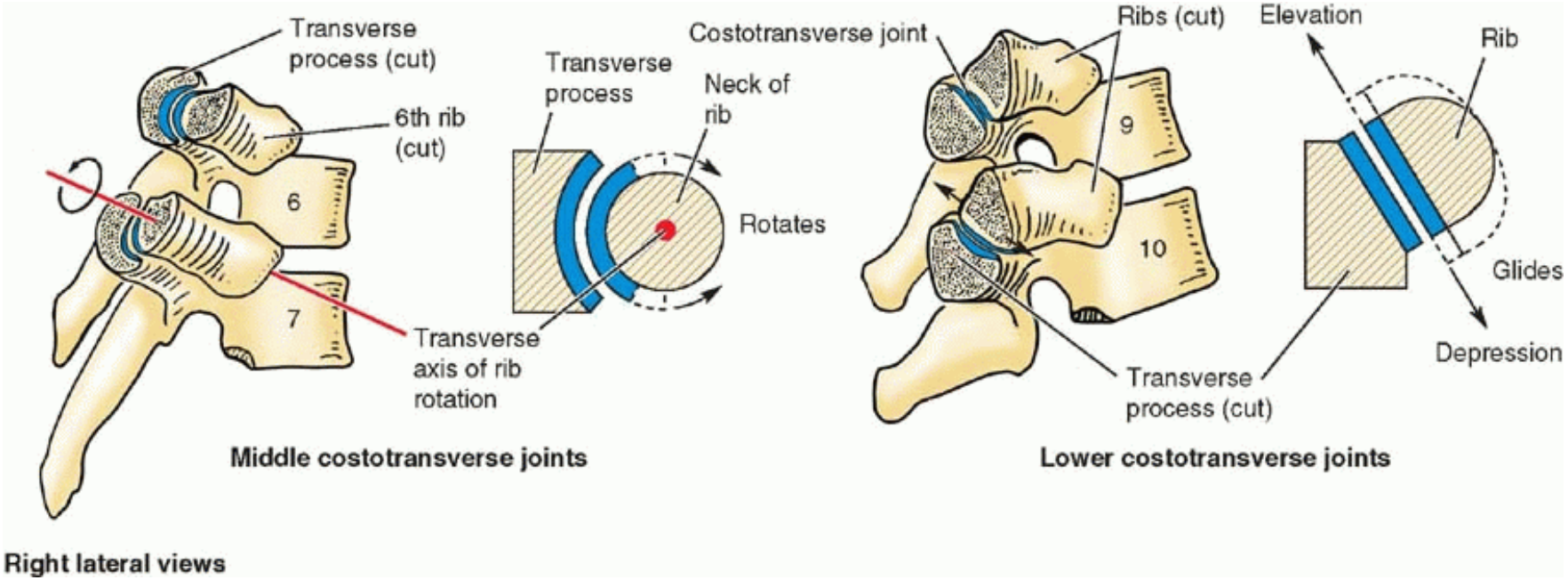
angulus infrasternalis

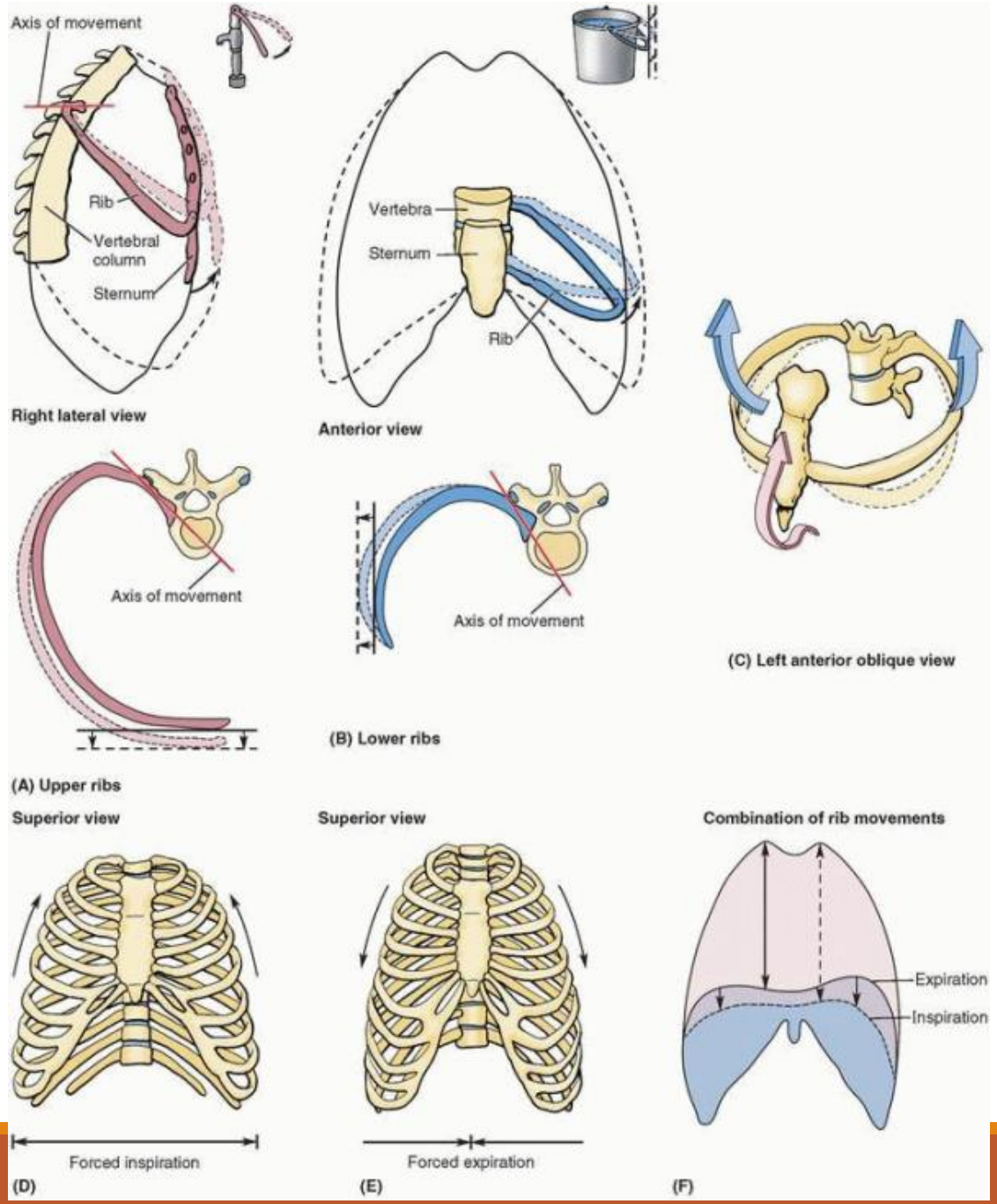


Movements

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

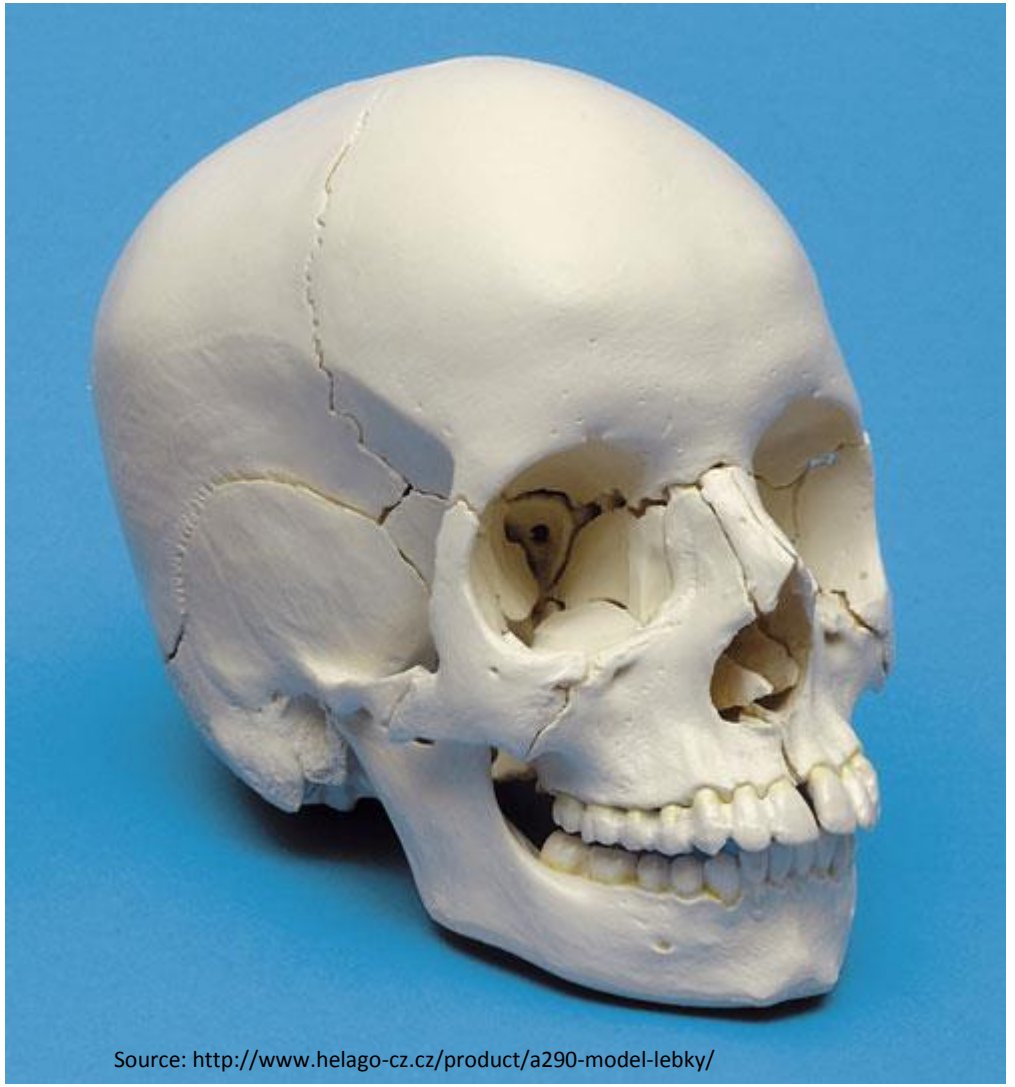
Movements of the thoracic wall during inspiration produce increases in the intrathoracic volume and diameters of the thorax




Axis of movement
Rib
Vertebral column
Sternum
Right lateral view
Vertebra
Sternum
Rib
Anterior view
Axis of movement
Axis of movement
(A) Upper ribs
(B) Lower ribs
(C) Left anterior oblique view
Superior view
Forced inspiration
(D)
Superior view
Forced expiration
(E)
Combination of rib movements
Expiration
Inspiration
(F)

Connections of the skull
(juncturae cranii)

- craniovetebral junctions
- syndesmoses
- synchondroses
- temporomandibular joint
- hyoid junctions



Source: http://www.helago-cz.cz/product/a290-model-lebky/

Craniovertebral junctiones

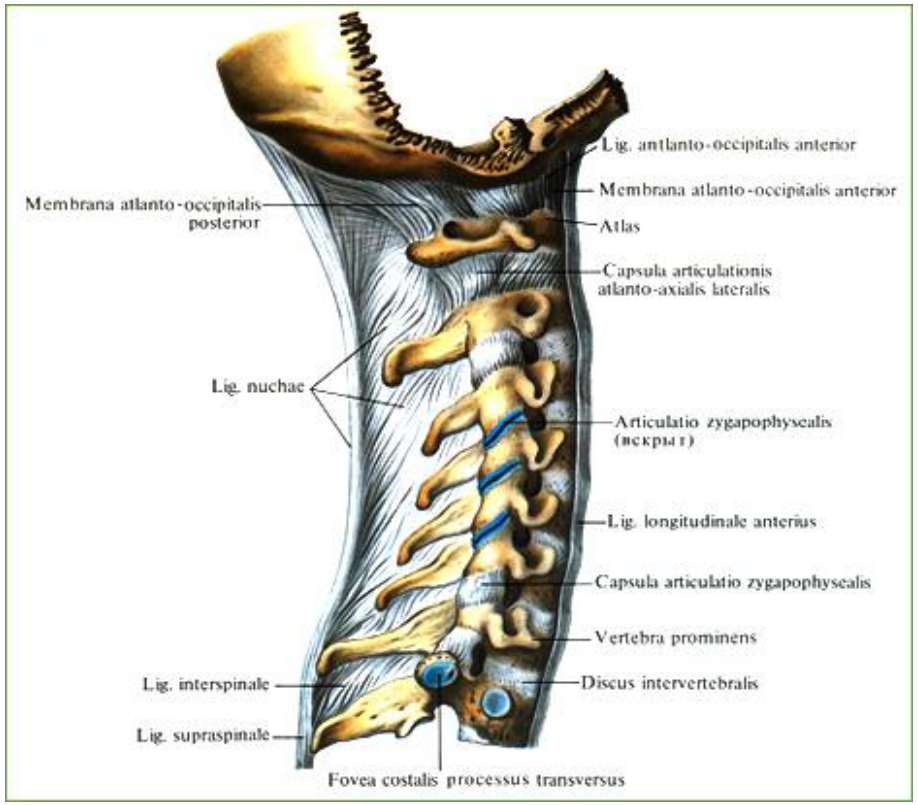
- Connection of the skull with the C1 and C2

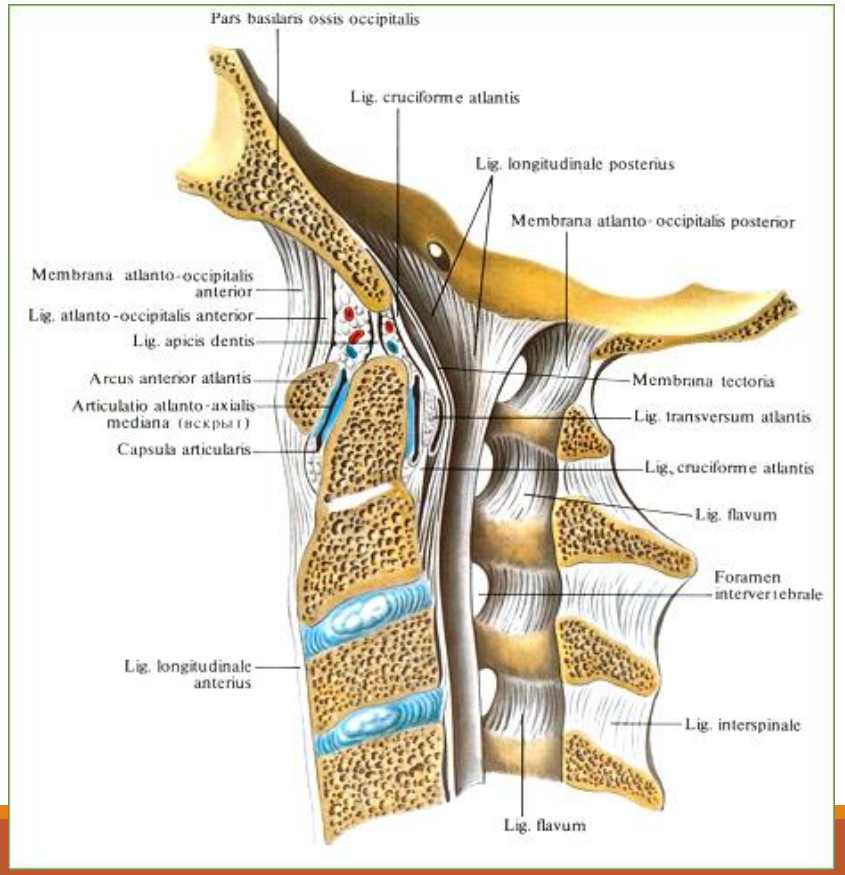
1. *Articulatio atlantooccipitalis*

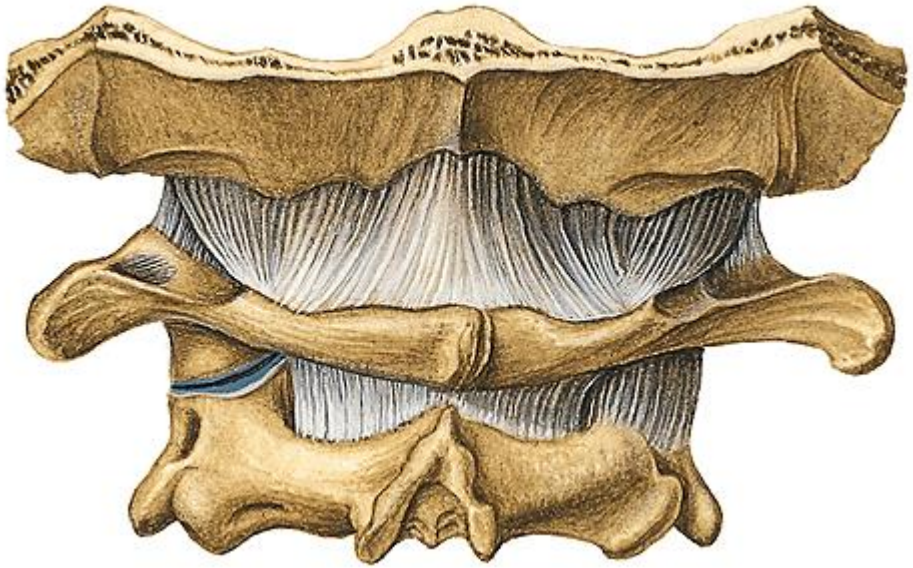
Paired joint

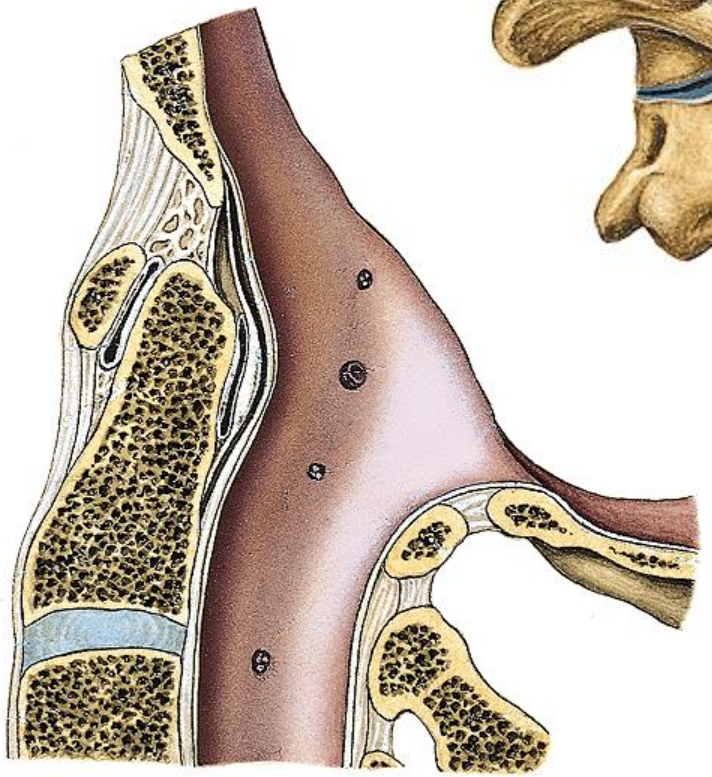
AS:
condyli occipitales and
foveae articulares superiores
of atlas
AS:
Is attached to the margins of the articular surfaces

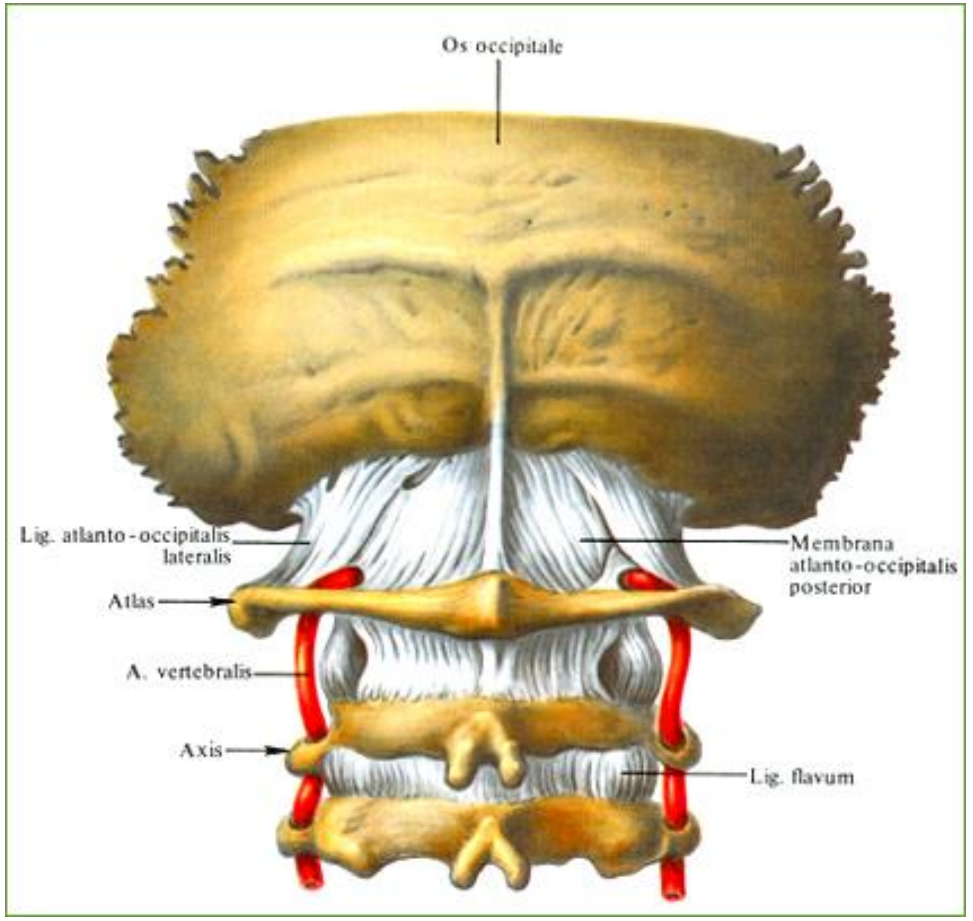
Special apparatus:
membrana atlantooccipitalis anterior and ***posterior***
(between arches of atlas and occipital bone)
membrana tectoria
(cranial continuation of ***lig. longitudinale posterius,*** it reaches to *clivus)*
Type of joint: **elipsoidal** with possibility of flexion and extension of the head and there are also possible smaller movements sideways










Os occipitale
Lig. atlanto-occipitalis lateralis
Membrana atlanto-occipitalis posterior
Atlas
A. vertebralis
Axis
Lig. flavum

2. *Articulatio atlantoaxialis*

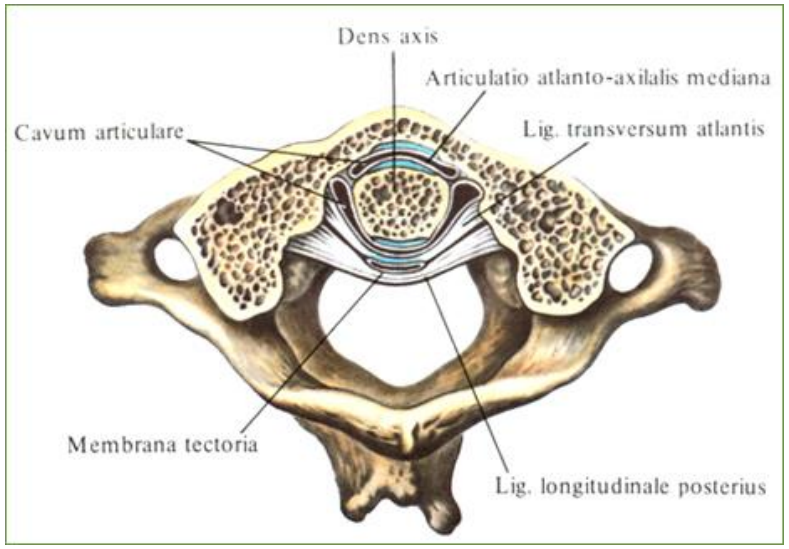
a) articulatio atlantoaxialis lateralis

- Paired joint

AS:

facies articulares inferiores of atlas

facies articulares superiores of axis



b) *articulatio atlantoaxialis mediana*

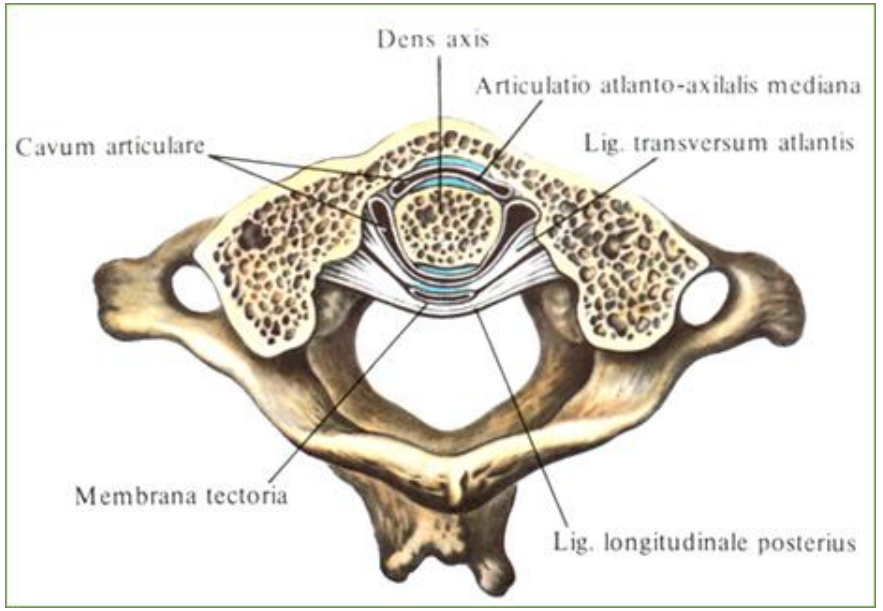
- Unpaired joint

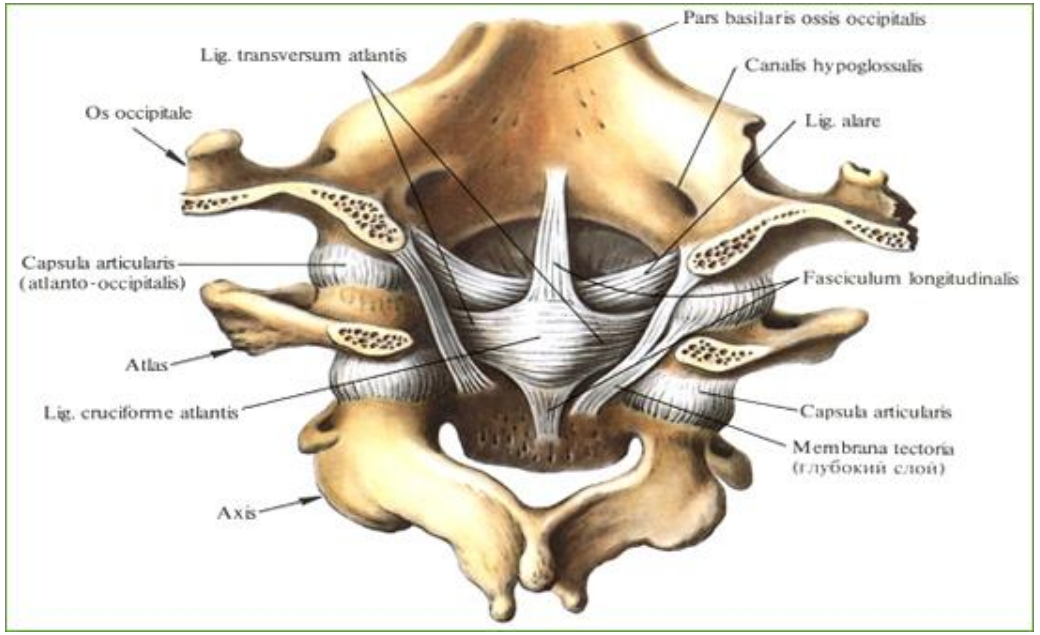
AS:

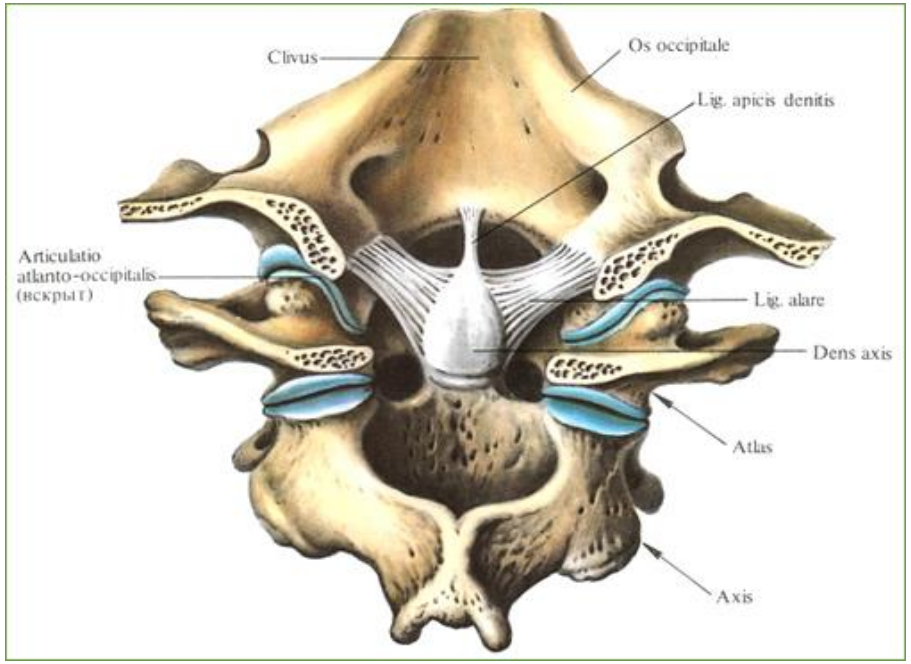
facies articularis anterior on frontal side of *dens axis* with ***fovea dentis*** of atlas and ***facies articularis posterior*** on dorsal side of *dens axis* with ***lig. transversum atlantis***

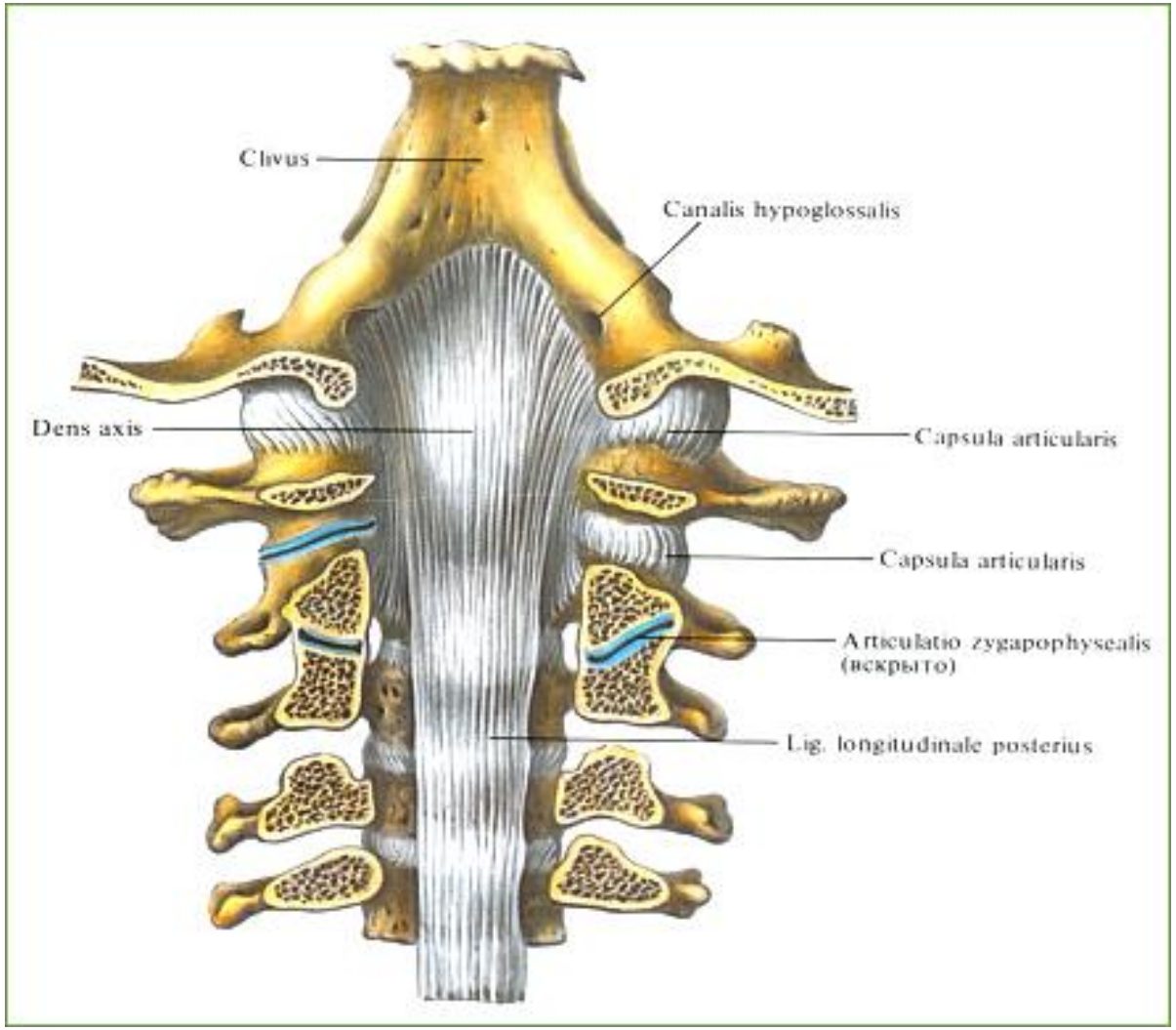
AC: is common and is attached to the margins of the articular surfaces

Special apparatus:
lig. apicis dentis, ligg. alaria,
lig. cruciforme atlantis, formed by
lig. transversum atlantis and *fasciculi longitudinales (*vertical fibrous bands going from axis to occipital bone*)*
Type of joint: both joints form one mechanical unit, atlas is rotating along *dens axis* in range of 60°







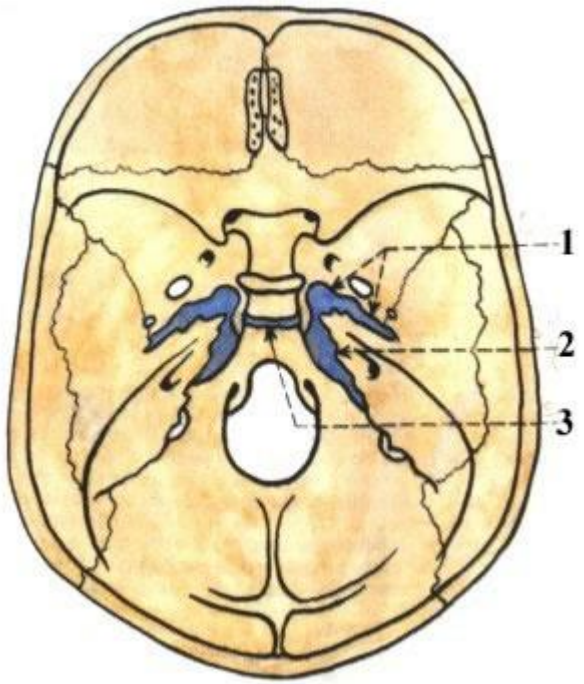

Clivus
Canalis hypoglossalis
Dens axis
Capsula articularis
Capsula articularis
Articulatio zygapophysealis
(вскрыто)
Lig. longitudinale posterius

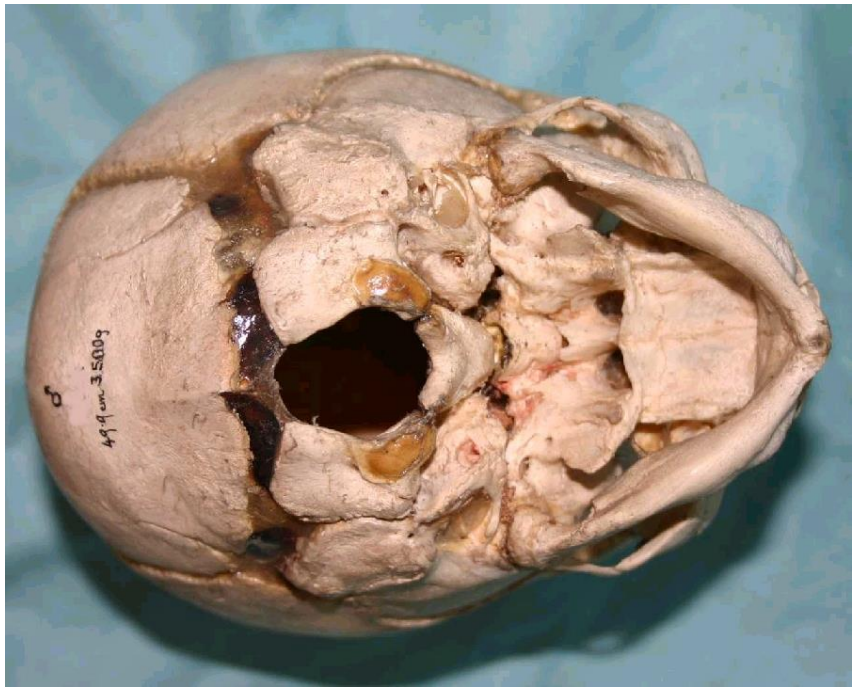
Skull syndesmoses

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

Skull synchondroses

s. sphenopetrosa
s. petrooccipitalis
s.Interoccipitalis - anterior et posterior
s. intersphenoidalis,
s. sphenooccipitalis
synchrondrosis sphenooccipitalis

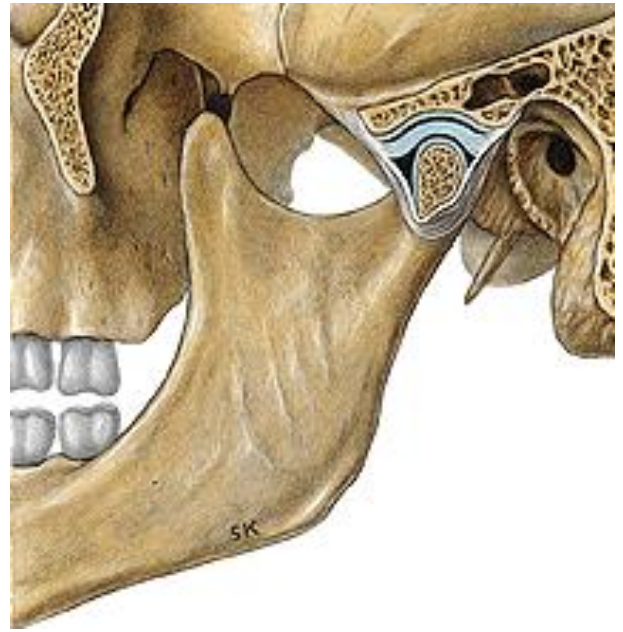




Temporomandibular joint
(articulatio temporomandibularis)

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

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



Type of joint: gynglimus (hinge)

Elevation – closing of the mouth
Depresion – opening of the mouth
Protraction – shifting od the chin forwards
Retraction – shifting od the chin backwards

Special apparatus:

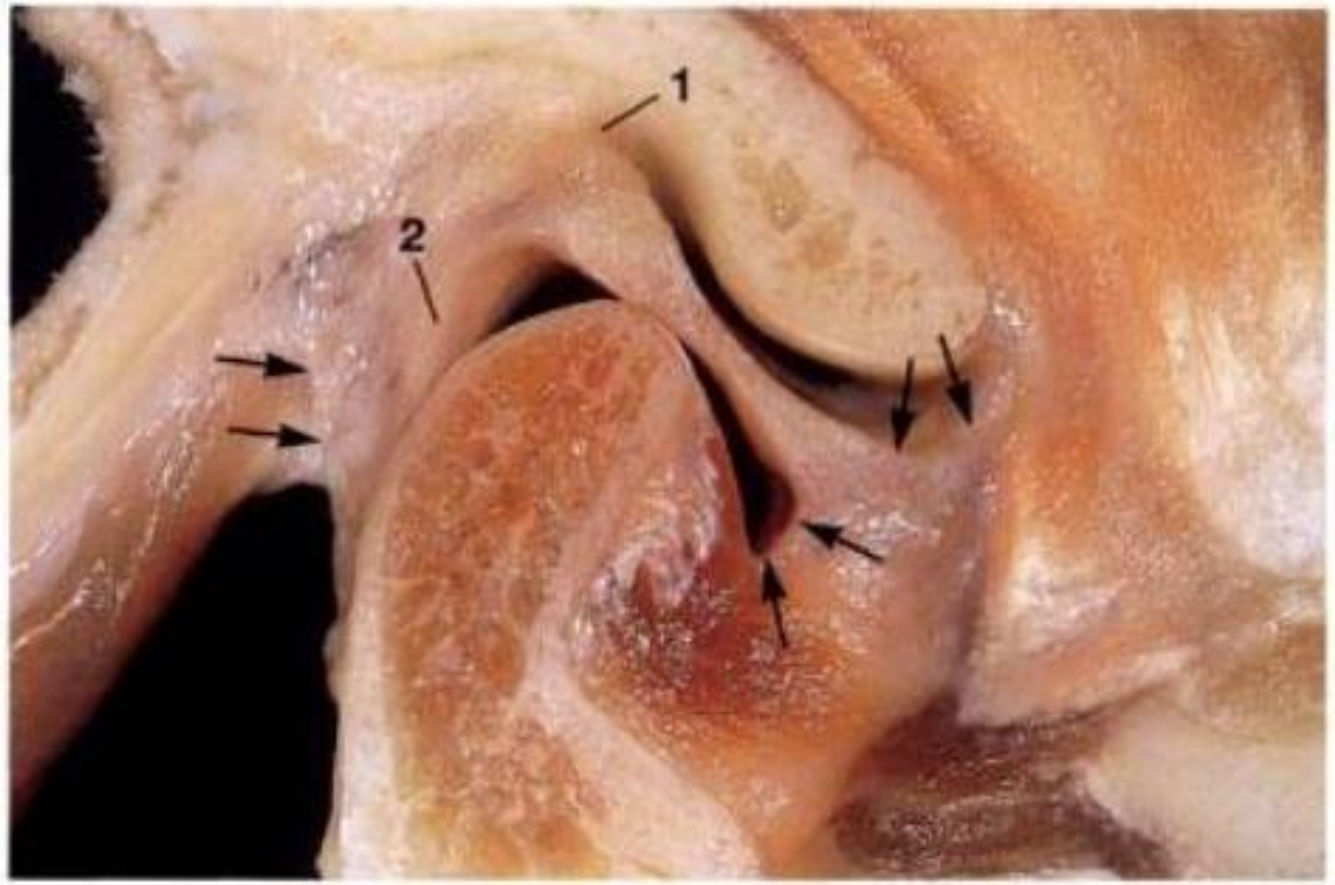
discus articularis (fibrous cartilage):

- its middle part is thiner and the margins are thicker,
- it grows together with articular capsule,
- It reduce sliding friction
- allow the mouth open and close
- it divides articular cavity into:
- ***pars discotemporalis*** –

between the mand.fossa and disc (1,2ml)

- - ***discomandibularis -***

between the disc and condyle (0,9ml)

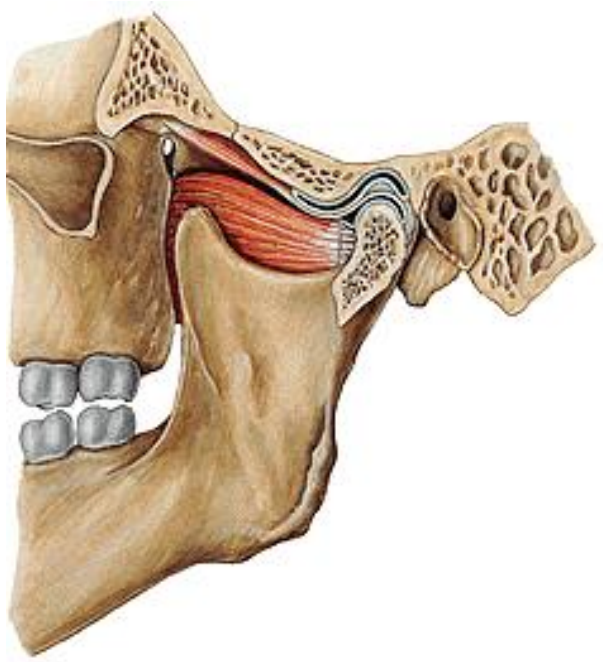


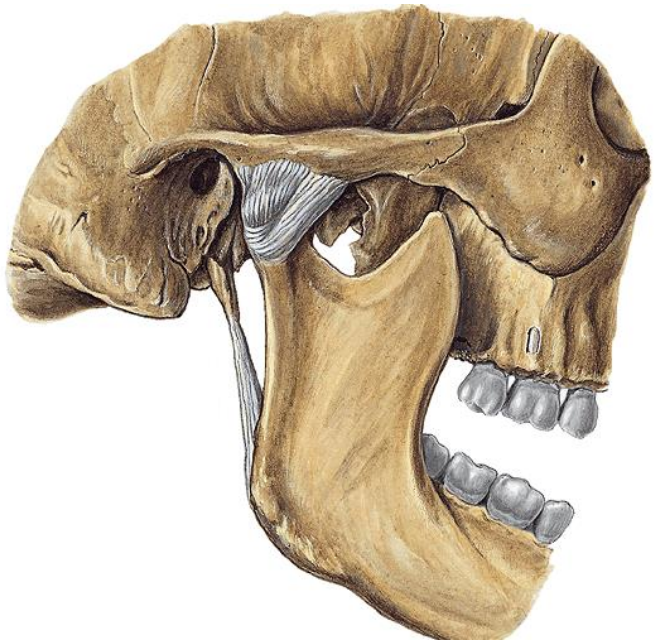
Ligaments - extraarticular

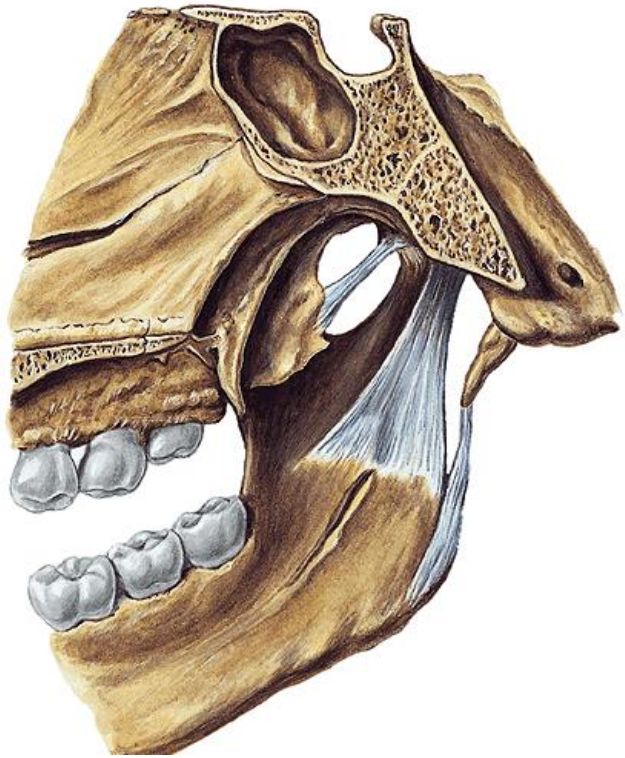
on lateral side: ***lig. laterale***

around the joint: ***lig. sphenomandibulare*** *(runs from the spina ossis sphenoidalis to the mandible)*

lig. stylomandibulare (runs from the styloid process → the posterio edge of the angle of the mandible)







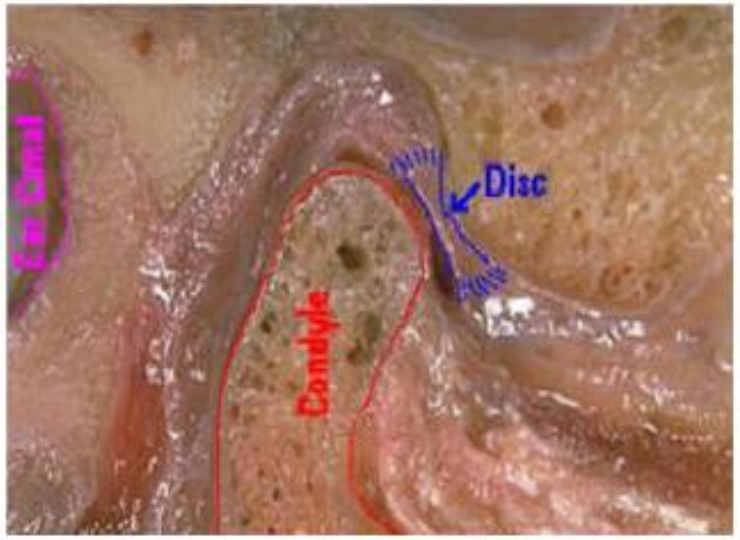
Movements at the TMJ

Hinge movement

- type of rotation takes place in the lower compartment between the stationary disc and the moving condyle

Gliding movement

- takes place in the upper compartment between the superior surface of the disc, which is moving, and mandibular fossa



Depression - the opening

- with simple rotation at the joint can be achieved 15 - 20mm intericisor distance
- during translation, the disc and condyle move under the articular eminence

Elevation – the closing

- translation - the condyles move backward and upward along the articular eminence
- rotation upward to attain final position

Protrusion

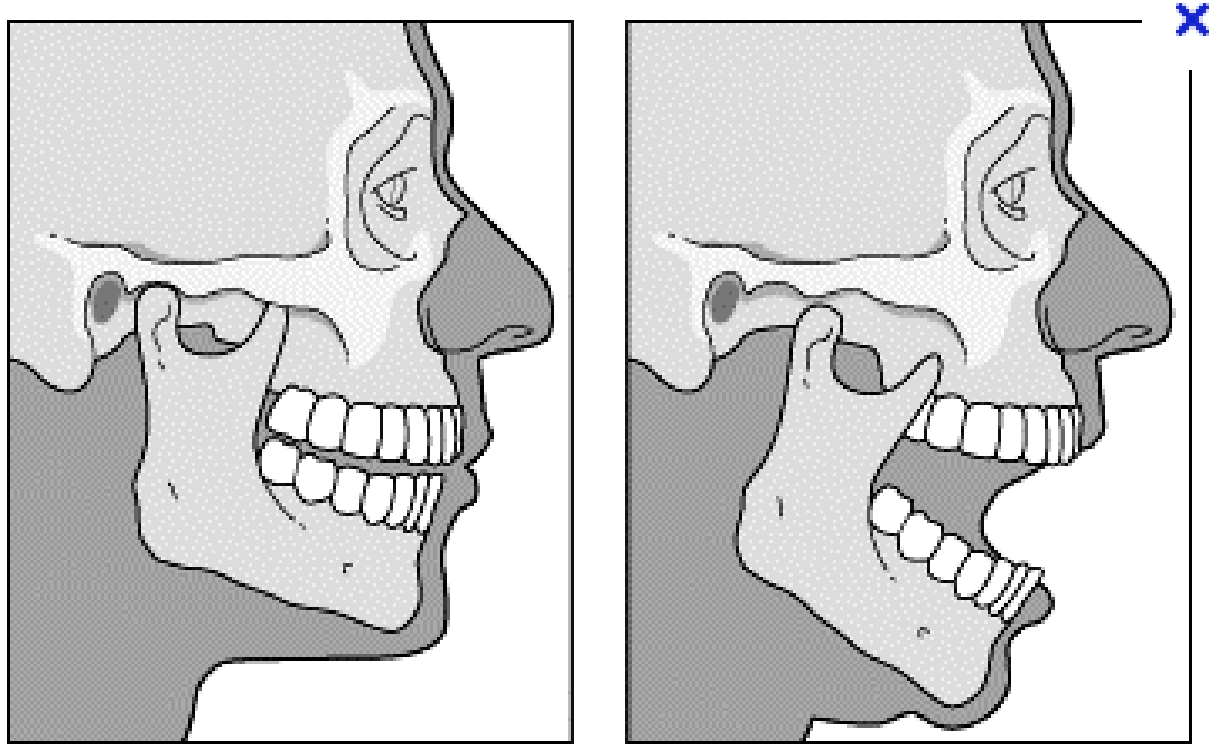
- slide the mandible forward
- maximal protrusion results in the lower incisors being a few mm anterior to the maxillary incisors

Retrusion

- move the mandible posteriorly
- condyles move backward and upward and reoccupy the mandibular fossa

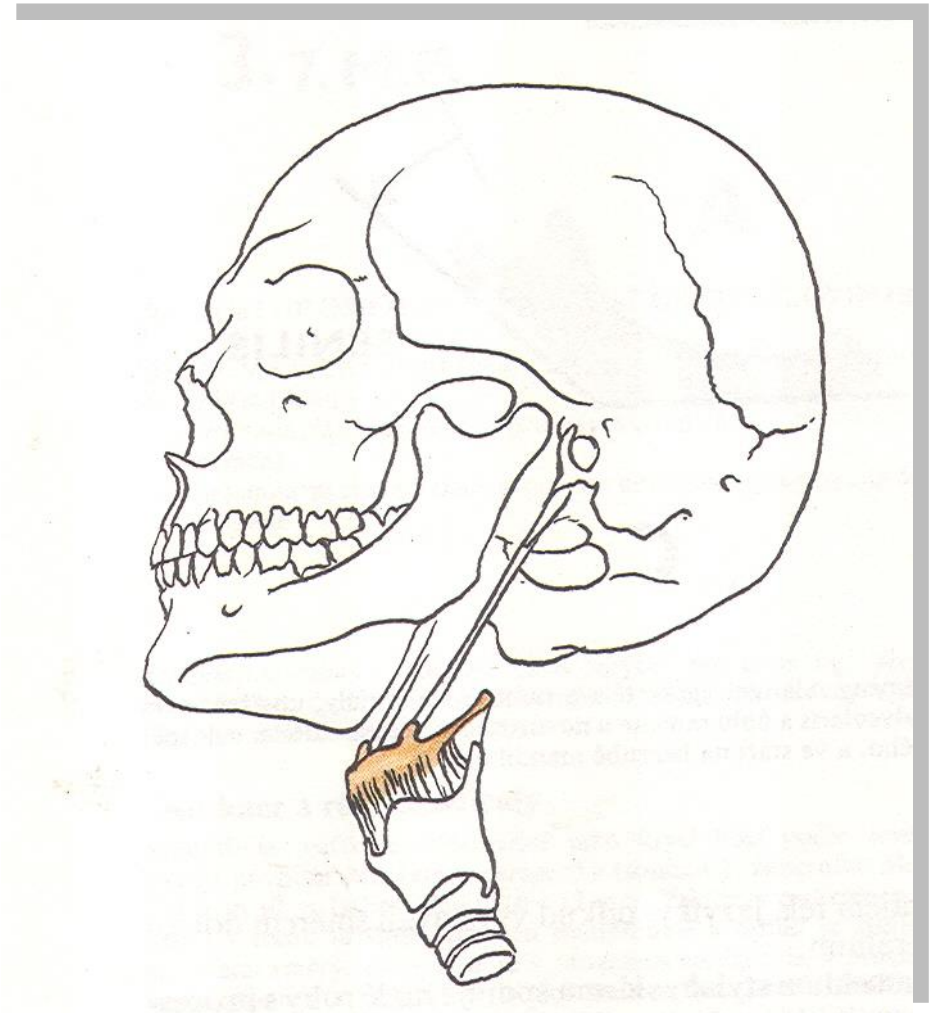
Laterotrusion

- the condyle move to the right or to the left side



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

Illustrations were copied from:

Atlas der Anatomie des Menschen/Sobotta. Putz,R., und Pabst,R. 20. Auflage. München: Urban & Schwarzenberg, 1993)

Netter: Interactive Atlas of Human Anatomy. Windows Version 2.0

Čihák R: Anatomie 2 (Splanchnologia). Avicenum, zdravotnické nakladatelství, Praha, 1988.

Drake et al: Gray´s Anatomy for Students. 2010

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