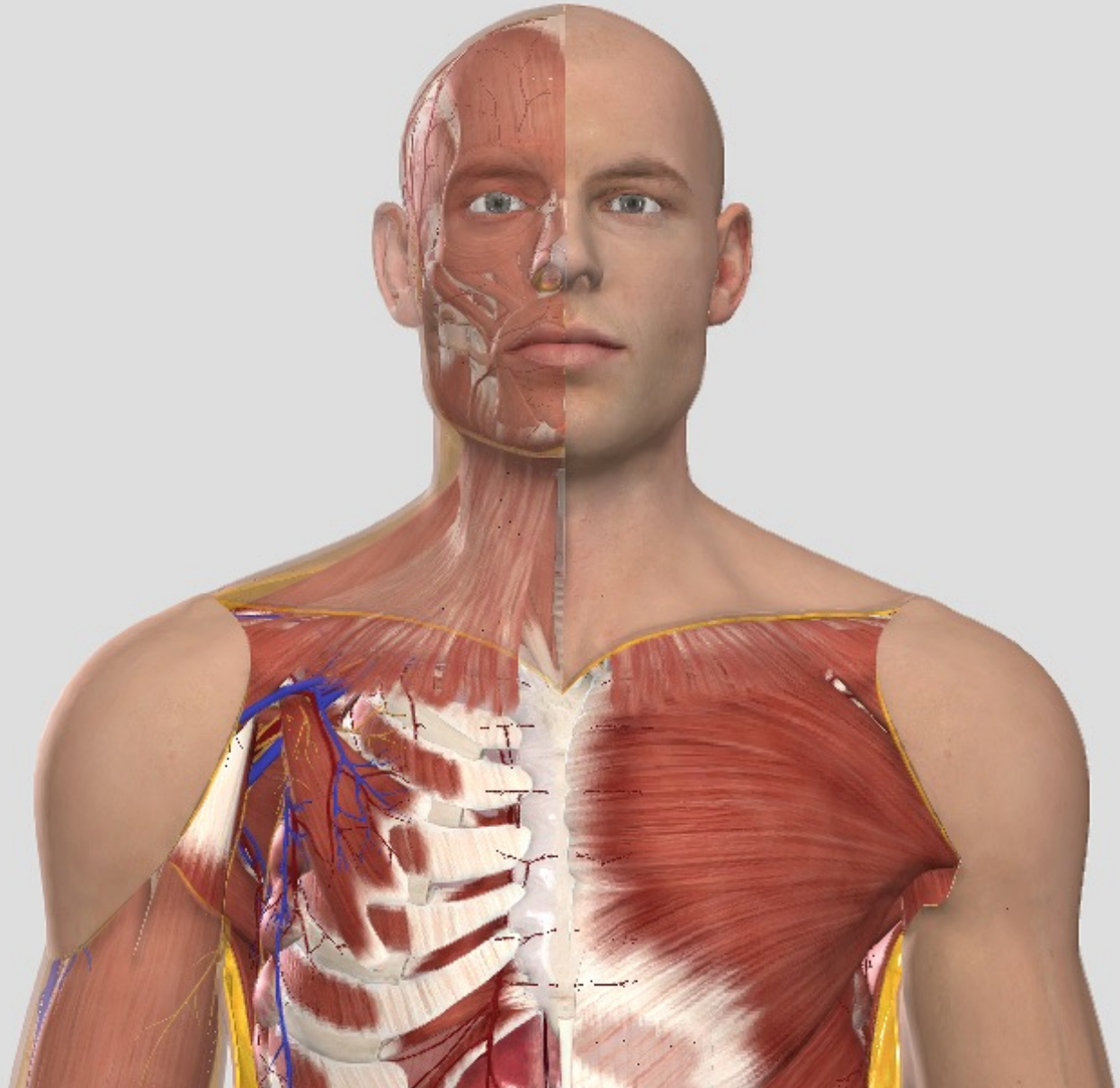
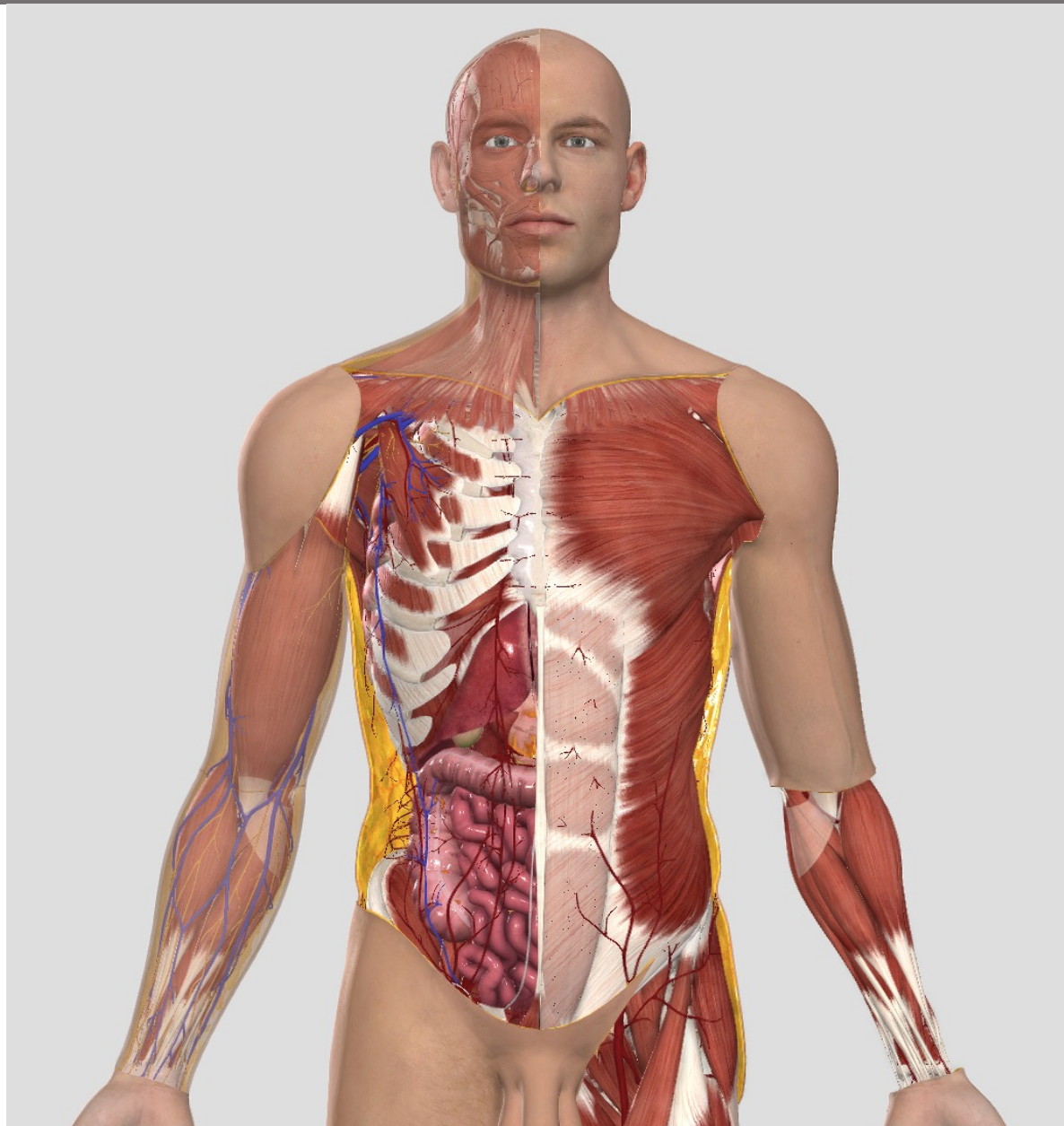
General anatomy 1.



Anatomia - Anatomy

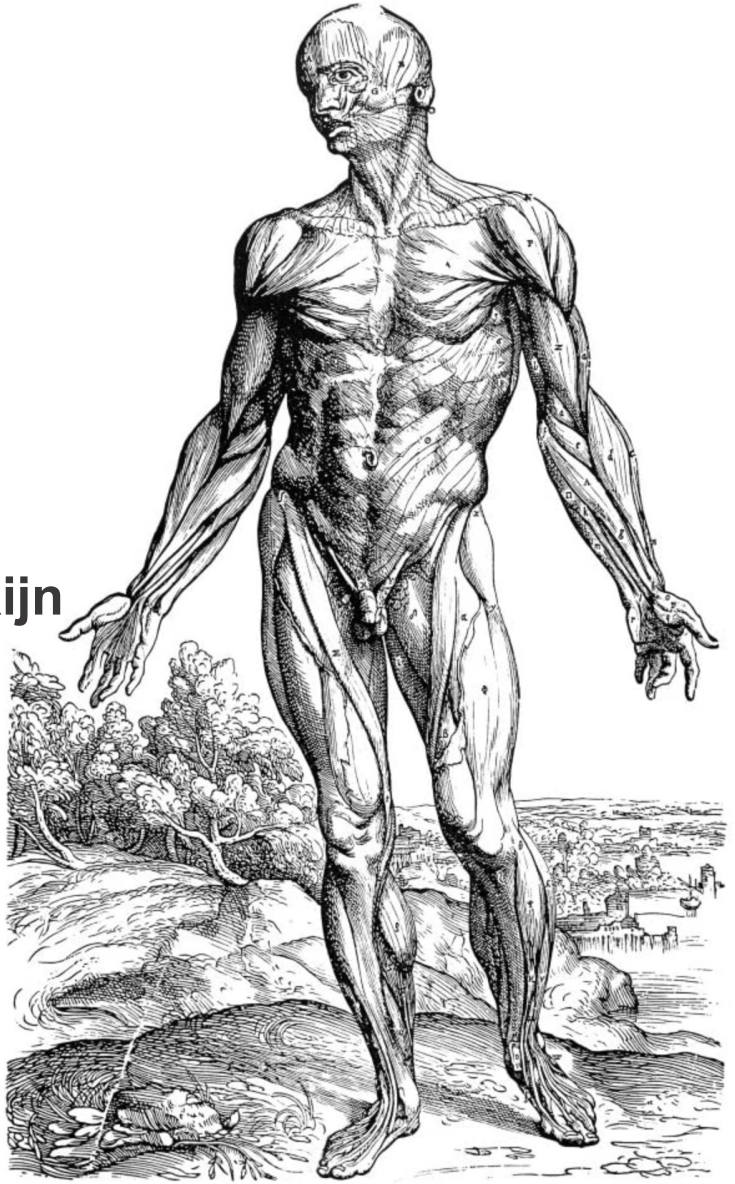
- tomos – knife
- anatemnein – cut

- *Systematic anatomy*
- *Topographic anatomy*
- *Evolutionary anatomy*
- *Surgical anatomy*
- *Radiological anatomy*
- *Microscopic anatomy – Histology*
- *Embrylology*
- *Experimental anatomy*



History of Anatomy

- **Antic**
  - ***Aristotelés, Hippokratés, Galénnos***
- **Medieval**
  - **Ibn Sinna (Avicenna)**
- **16. – 17. century**
  - **Andreas Vessalius, Johann Jessenius** – *public sections*
  - **Ambroas Parré** – *war surgery*
  - **Leonardo da Vinci, Michelangiolo Buonarroti, Rembrant van Rijn**
- **19. century**
  - **Surgery on the battl fields** – *Napoleon wars, Krym war*
  - **Surgery development –** *french and german school*
  - **Discovery of X- rays**
- **20. century**
  - **Wordl War I, and II., surgery development, imaging**



Organismus

- **Signs of the life**
  - Metabolism
  - Motion
  - Ritability, excitability
  - Reproduction *(as well as tissue)*
- **Cell – cellula**
  - Plasmalemma
  - Protoplasma
  - Nucleus
- Extracellular matrix
- Cellular shapes
  - Spheric, cylindric, flattened, multipolar, spermatozoa
- Size – mikrometers
  - Ovum 250, erythrocyt 7,2
  - Motoneurons of precentral gyrus – 70 cm

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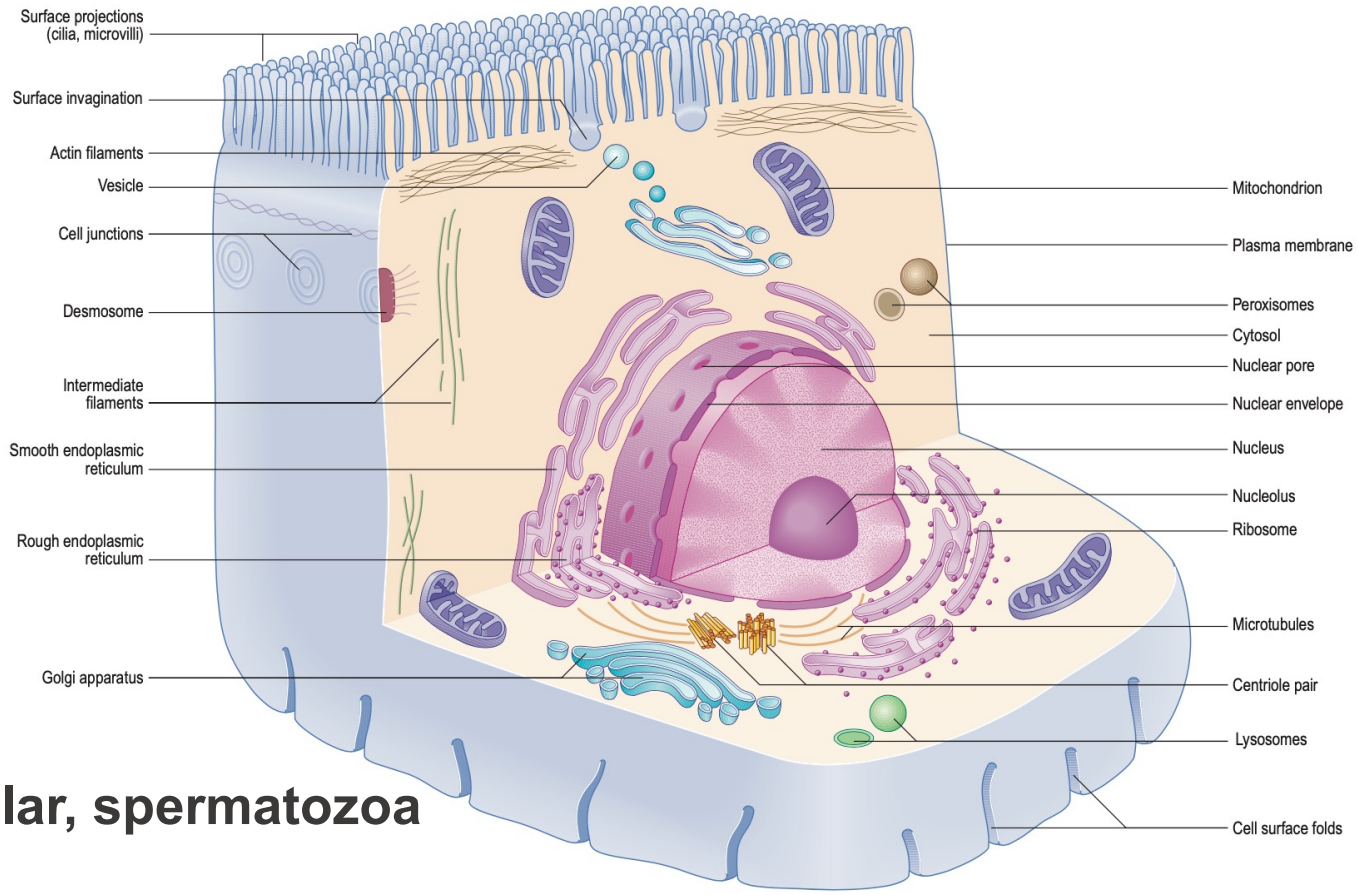

Tissues, organs, organ systems, organism

- Cells of hte same origin
  - Microekosystem
  - Microstrukture
- Epithelium
- Connective tissue
- Muscles
- Nervous tissue
- Functional assemble of tisses
- Organon
- Organ system
- Organismus

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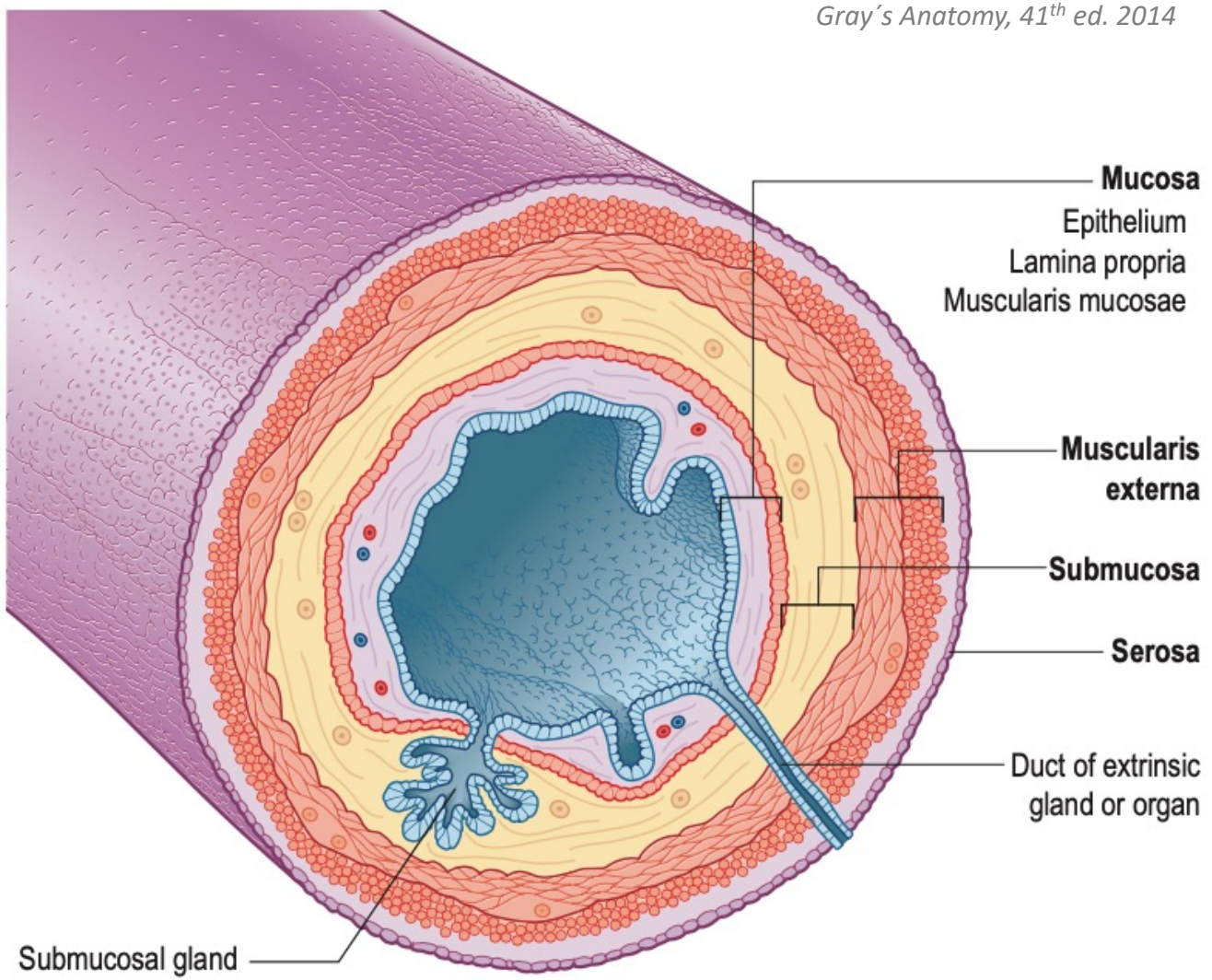
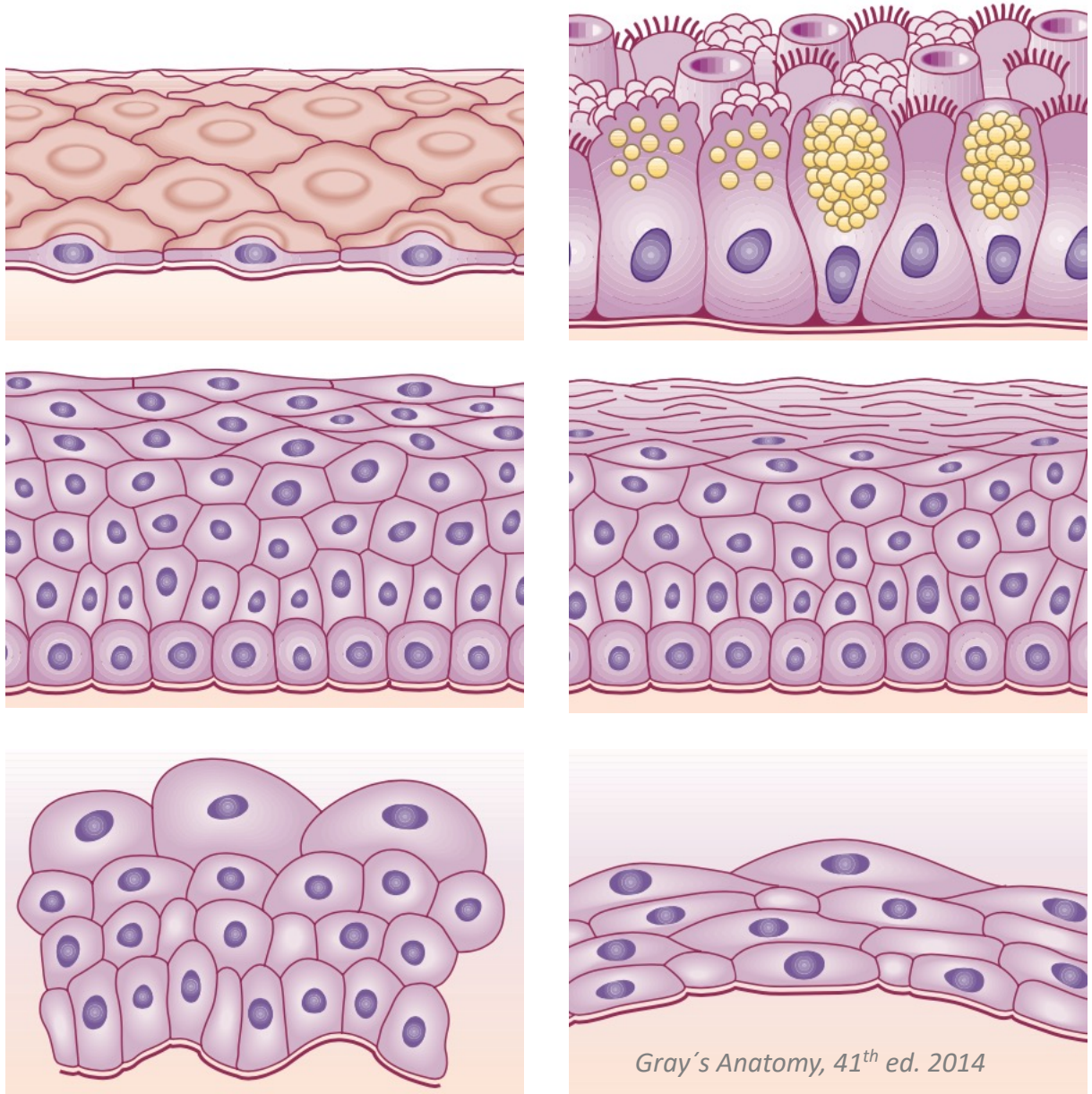


epithelium

- structure and function
- **Single layered**
  - flattened
  - Cubic
  - Cylindric
- **Multi-layered**
  - squamous
    - Non-keratinized
    - Keratinized
  - Transitional - urothelium
  - Cylindric multilayered
  - Pseudo-multil-ayered – GIT
  - Reticular - tyhmus
  - Trabecular - liver



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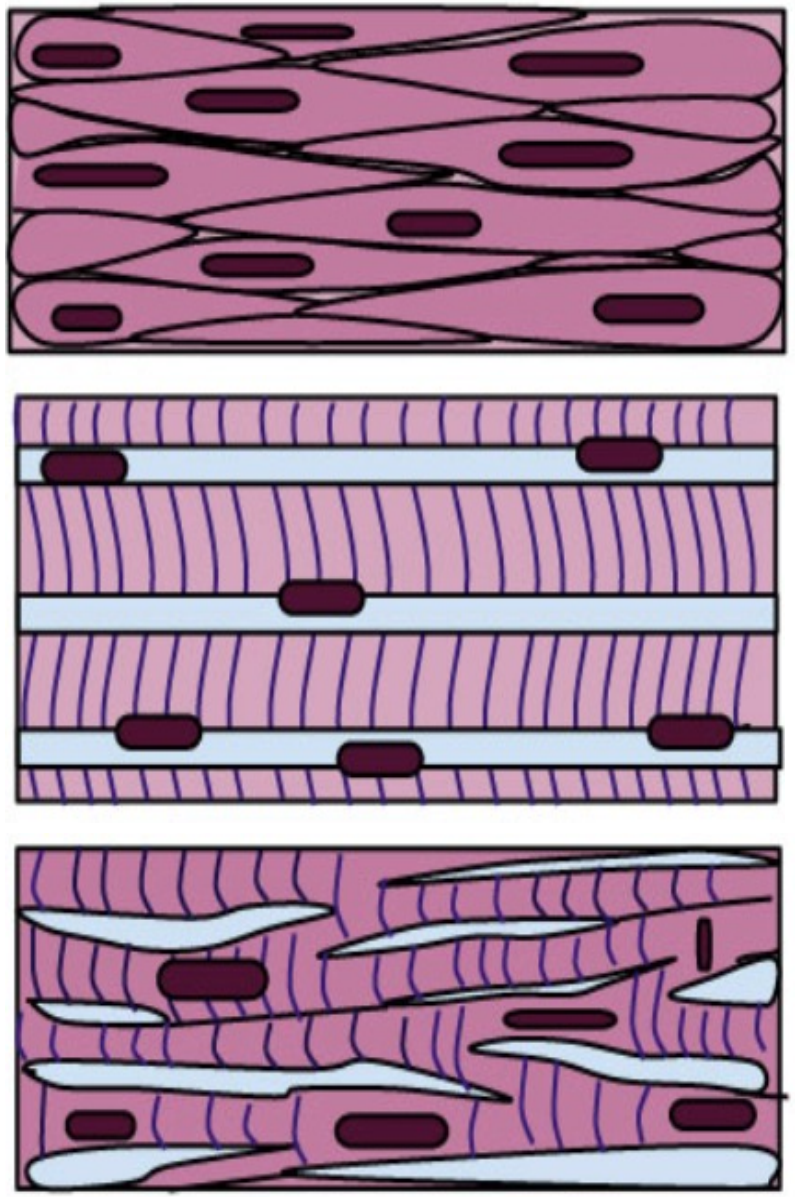
Muscles

- **Smooth muscles – single cells**
  - Sarkolemma
  - Sarkoplasma - myofibrils
  - Nucleus
  - Autonomous inervation
  - Slow but long-lasting contraction
- **Stripped muscles - syncytium**
  - Sarkoplasma
  - Myofibrils – isotropic/anisotropic stripes
  - Cerebrospinal inervation
  - Fast contraction fast tired
- **Myocardial muscle**
  - striped
  - Intercalar discs – intercellulari borderline
  - bridges
  - Continuous work, autonomous inervation



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Nervous tissue

- Neurones, supplemental cells
  - Neuron – base of the function
  - Neuron theory– Waldmayer 1891
- Neuron
  - body - soma
  - Centripetal processes - dendrits
  - centrifugal process - neurit,
    - longer neurit - axon
- Shapes
  - Bipolar, pseudounipolar
  - Pyramidal
  - Purkynje cells
- Glial cells
  - Makroglie (astrocytes)
  - Oligodendroglie
  - Mikroglie (makrophages)

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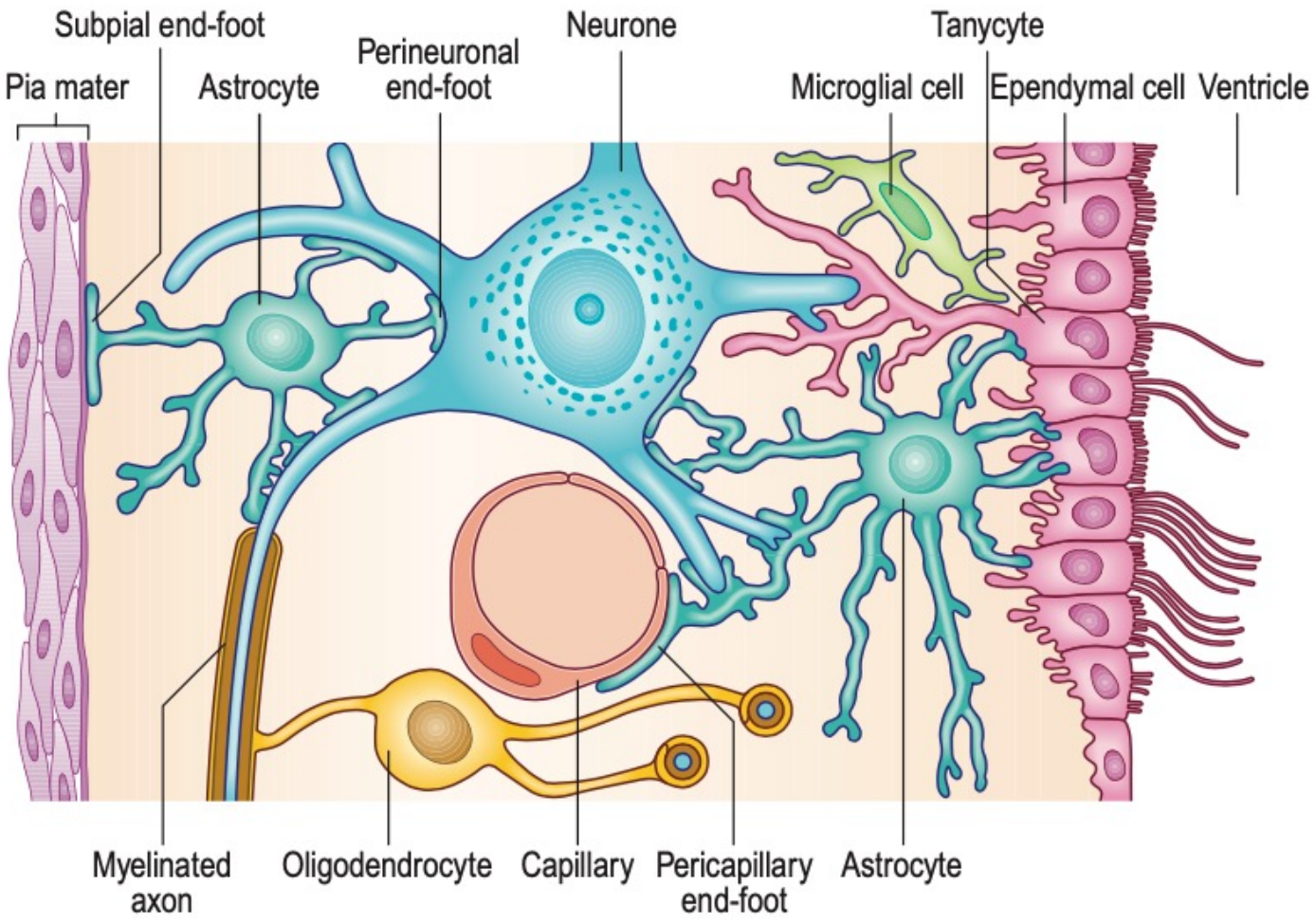
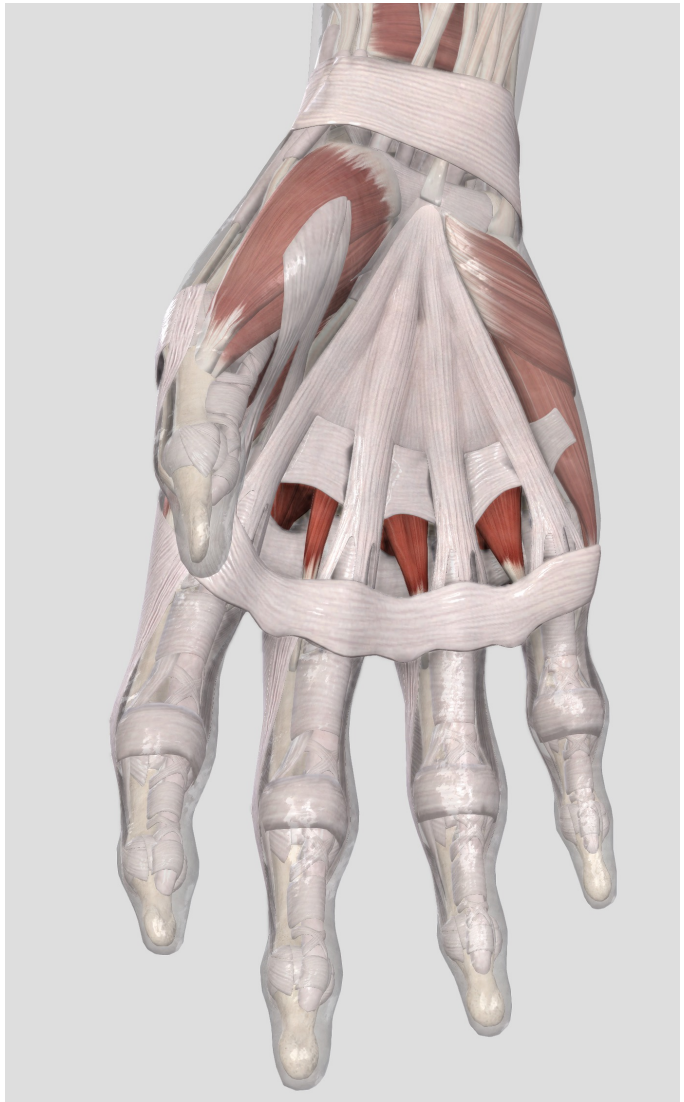


Connective tissue

- Cells and extracellualr matrix are causing character of tissue
- Connective tissue
- Cartilage
- Bone



Connective tissue

- Collagene and elastic fibres
- cells
  - fibrocytes, histiocytes, mastocytes, plasmatic cells
- **Mezenchyma**
  - *Primitive connective tissue*
- **Gelatinous**
  - *Umbilical cord*
- **Reticular**
  - *Bone marrow*
- **Collagenous**
  - Fibrillary – loose, insterstitial
  - Fibrose – stiff – ligamenta, tenda
- **Elastic**
  - Ligamenta flava
- **Fatty**

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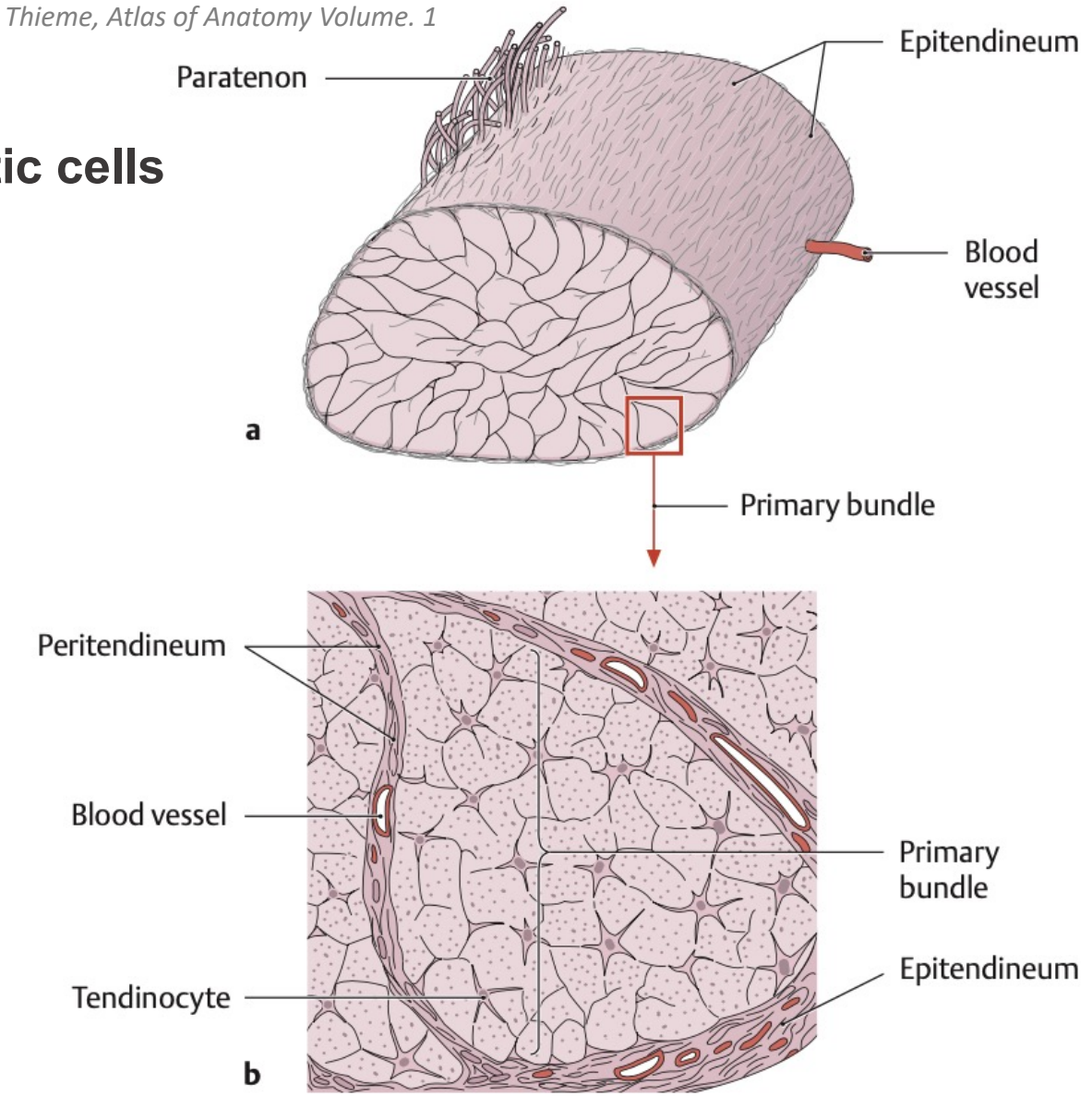

Cartilago

- **Perichondrium**
- **Fibrils**
- **Spindle fibrocytes**
- **Chondrocytes**

- **Cellular, parenchymatous**
  - *Embryonal, adult bat auricle*
- **Glass form – hyalinous**
  - *Masked fibrils, glossy surface*
- **Fibrous**
  - *Paltes, discs, meniscs*
- **Elastic**
  - *auricula, epiglottis*

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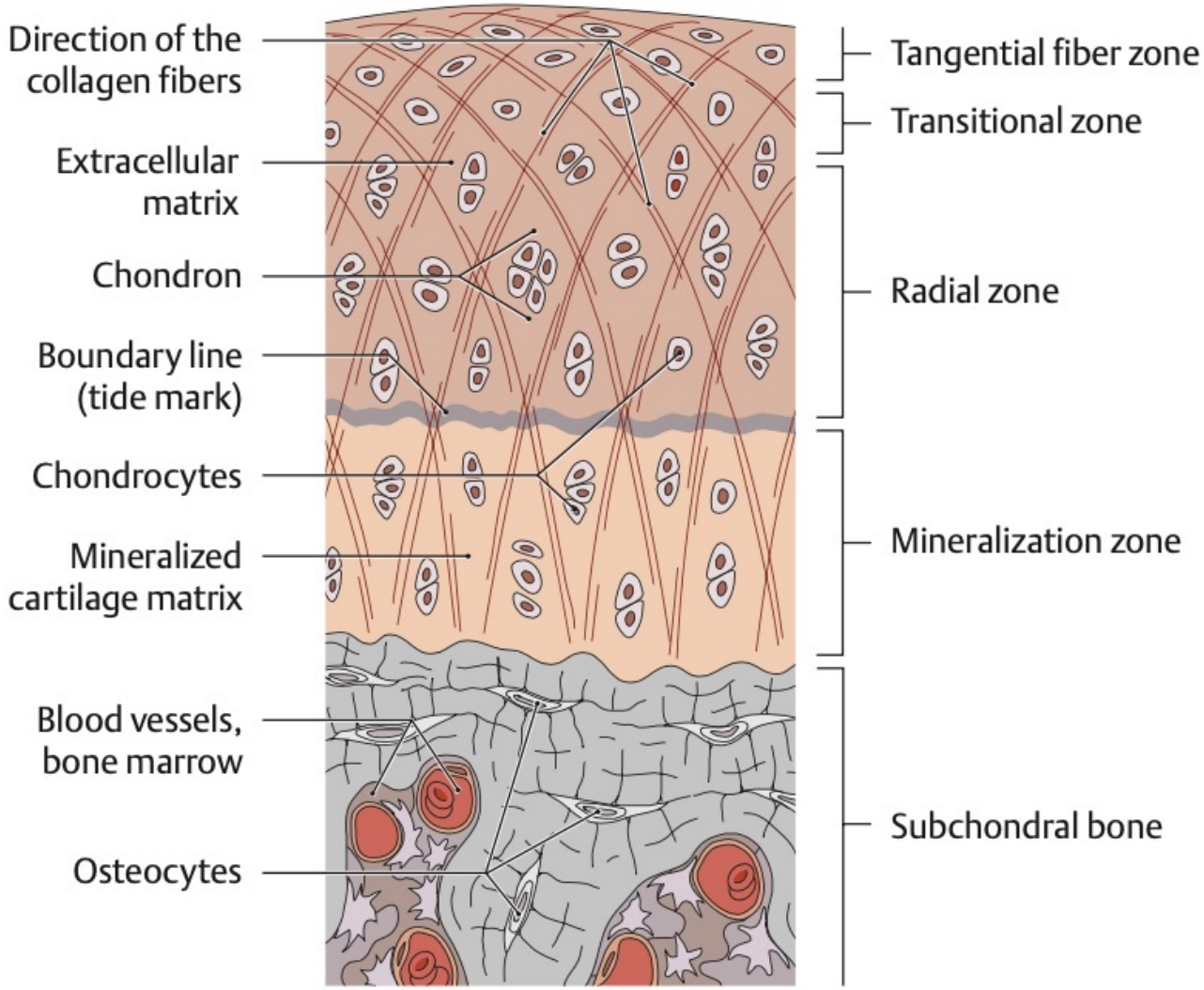
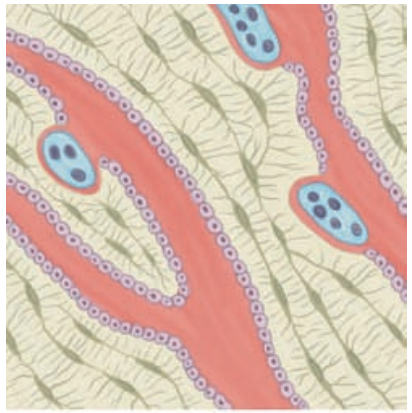


bone; os, ossium

- **Os, ossis**
- *Osteocytes, osteoblasts, osteoclasts*
- **Intercellular matrix**
- ***Anorganic part – hardness***
  - Removed by chemicals, acids, hydroxides
  - ***85% $Ca_3(HPO_4)_2$ – hydroxyapatite***
  - *10% $CaCO_3$ – calcit*
  - *5% other salts*
- ***Organic part – elasticity***
  - Removable by burning
  - ***Ossein***
  - *52% childhood*
  - *40% adulthood*
  - *30% senium*



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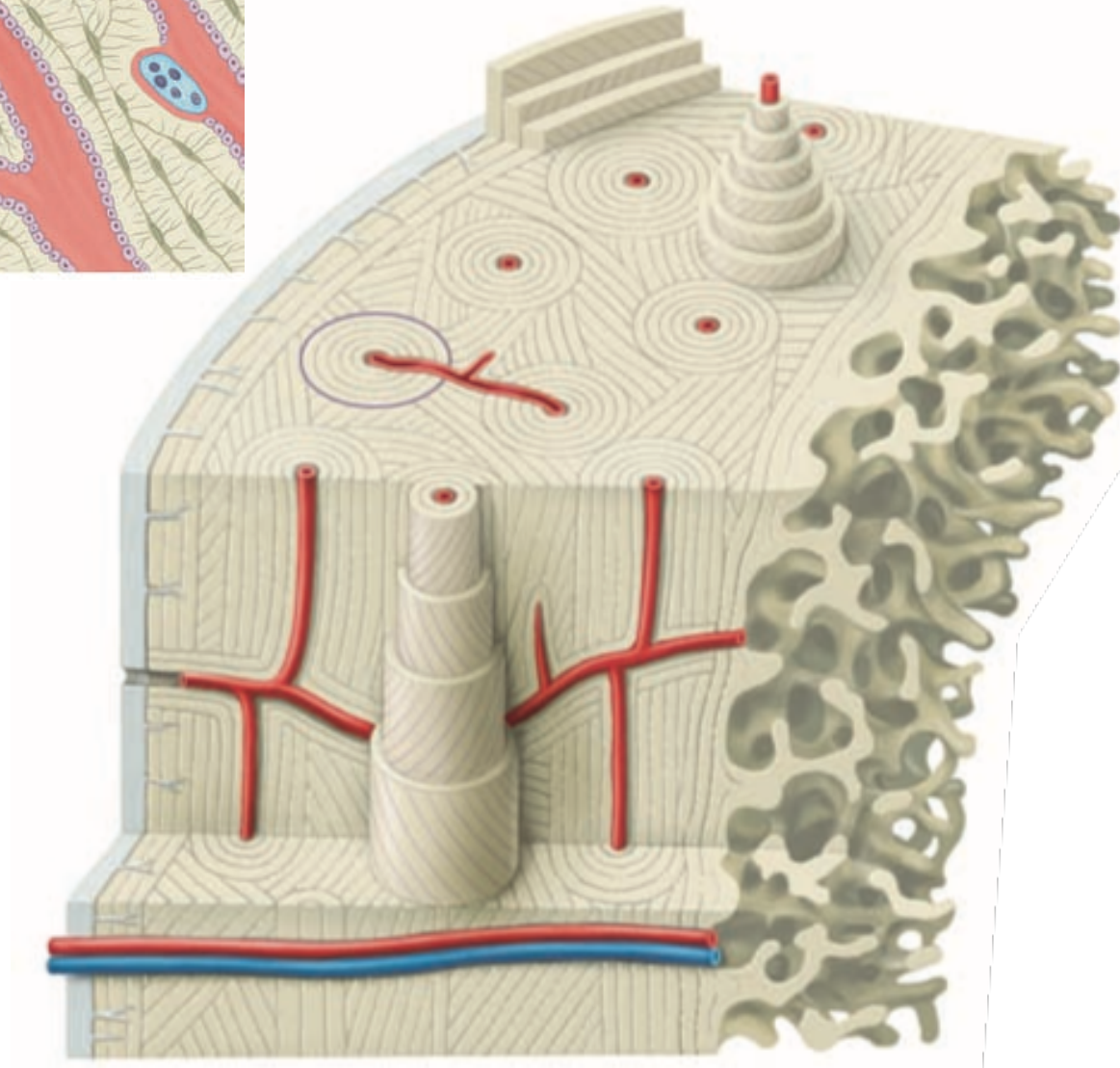

Bone structure

- Lamels
- Perpendicular orienttion
- Substantia compacta – compaq bone
- Substantia spongiosa – spongiform bone

- **Periosteum**

- **Osteon**
- Havers channel
- Volkmann channel
- Surface lamels – outer, inner
- Intersticial lamels

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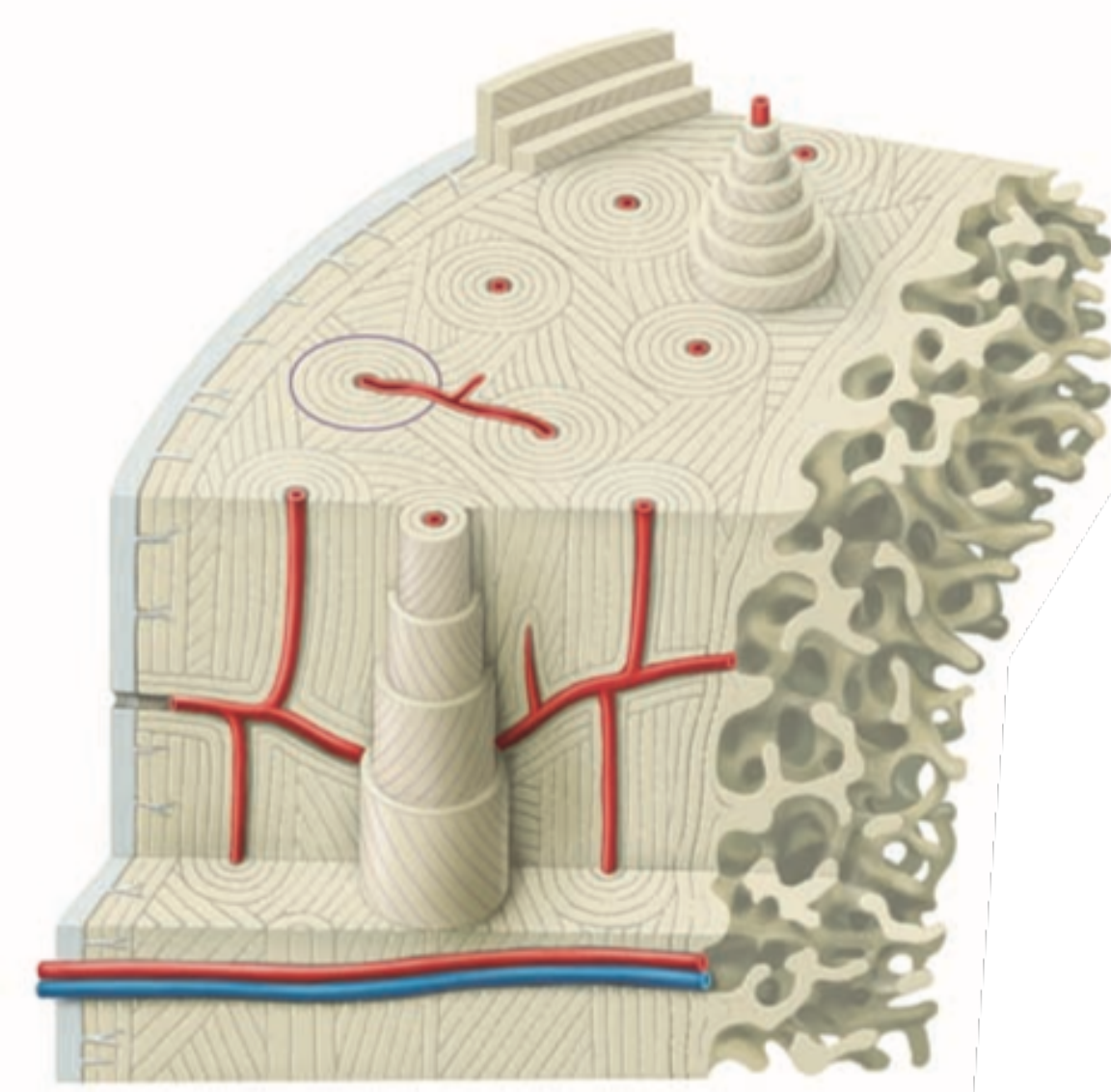


Bone structure

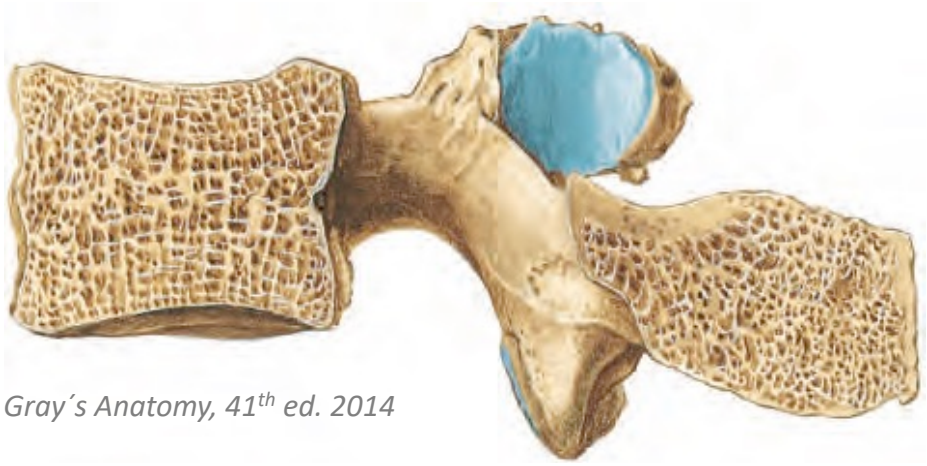
- **Substantia compacta**
- **Substantia spongiosa**
- **Cavum medullare**
- ***Medulla ossium***
  - ***rubra* – blood forming**
    - *Axial skeleton, sternum*
    - *STERNAL PUNCTURE*
  - ***lutea* – *fatty – tubular bones***
  - ***grissea* – *senile fibrous changes***
- **Periosteum**
  - **Suoerficial fibrous membrane**
  - **Stiff in childhood**
  - *Subperiostal fracture in children*

Bone parts

- **epiphysis proximalis, distalis**
  - *Joint ending*
- **physis proximalis, distalis**
  - *Growing plate*
- **metaphysis proximalis, distalis**
  - *Widening at the diapohysis ending*
- **diaphysis – corpus ossis**
  - *Bone body*
- **apophysis**
  - *Independently ossified processes*
- **physis apophyseos**
  - *Apophyseal growing plate*

Bone shapes

- Long bones
- Short bones – carpus, tarsus, vertebrae
- Flat bones– scapula, neurocranium
  - Skul – lamina externa, diploe, lamina interna
- Irregular bones– splanchnocranium
- Sesamoid bones – patella, os pisiforme
- Pneumatized bones



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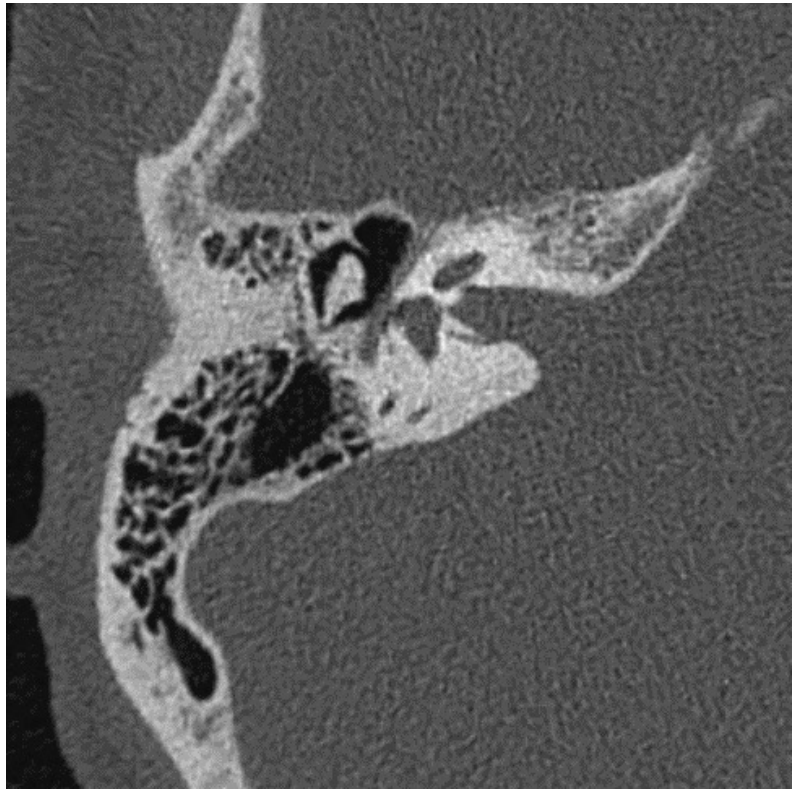
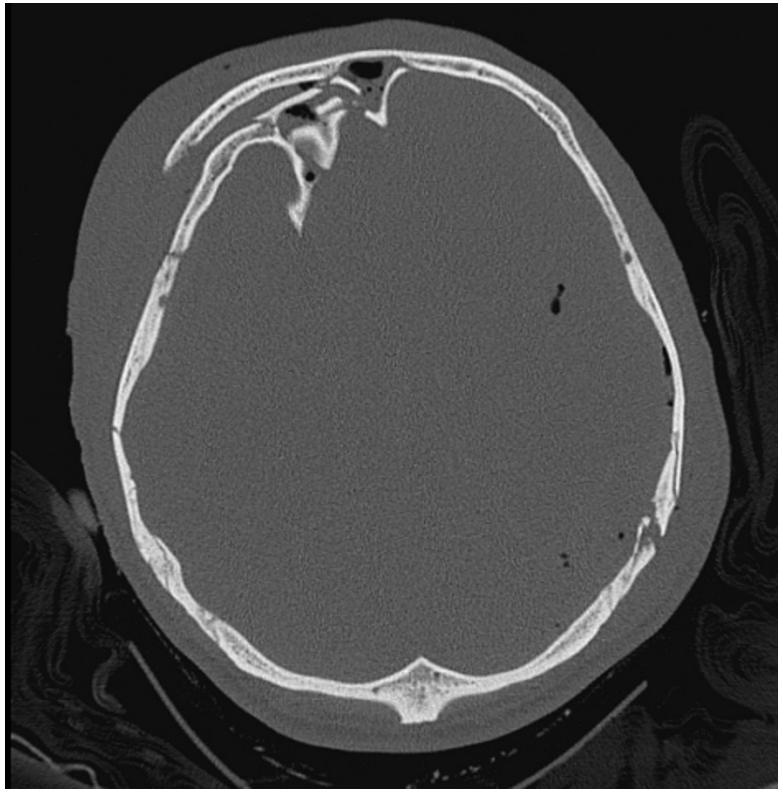
Ossa pneumatica

- Pneumatized bones
- The mucosa is growing into the bone and forming air-filled cavities
- Processus mastoideus, sphenoid, frontal, ethmoid bones, maxilla





Development and growth

- **Desmogenic ossification**
- *Fibrous model*
- *Flat skul bones of neurocranium*
- *Clavicula*

- **Chondrogenic ossification**
- *Cartiliginous model*
- *Perichondral – on surface*
- *Enchondral - inside*

Ossification 1. stage

- Thing ring is forming on the surface of the model
- Spreading to the epiphyses
- Perichondral bone
- Periost - next lamella
- Vessels growing into the cartiliginous model
- Vessels causing the cartilage widening
- Bone cavity is created

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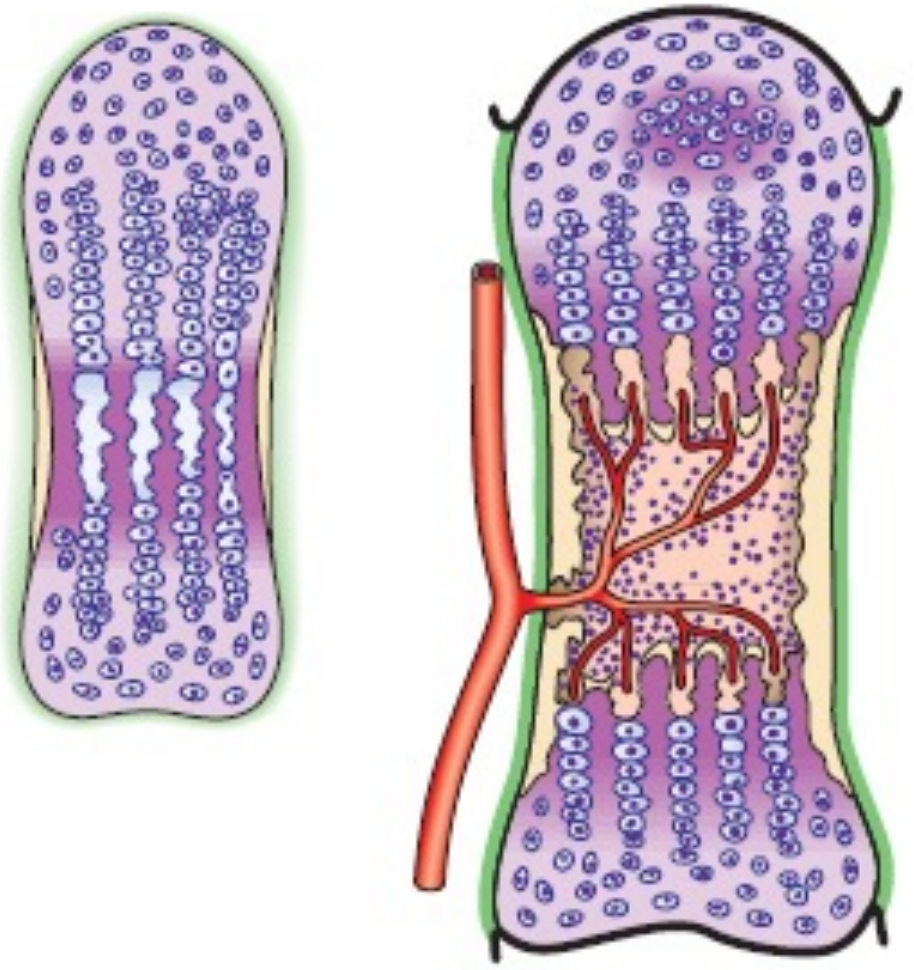
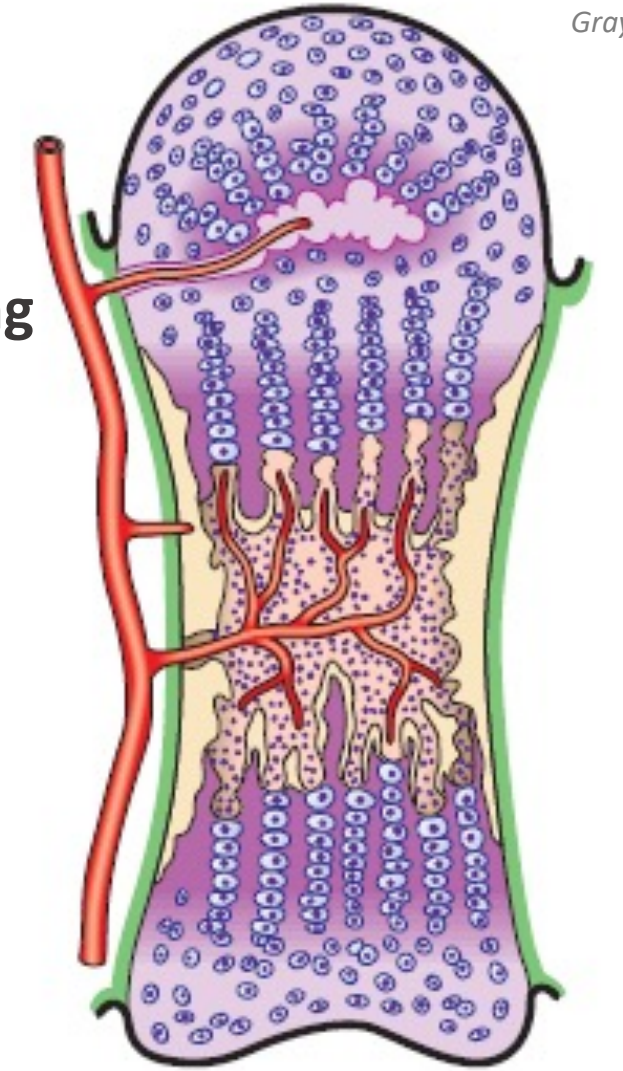


Ossification 2. stage

- The development of the diaphysis
- Periosteal bone
- From cavity enchondral ossification
- After creation of enchonral lamela endosteal forming

- epiphyses
- Ossification nucleus
- Further enchondral ossification



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Ossification 3. stage

- Joint cartilage
- Epiphyseal cartilage - growing plate
- Diaphysis
  - Enchondral bone
  - Endostal bone
  - Perichondral bone
  - Periosteal bone
- Epiphysis
  - Enchondral bone

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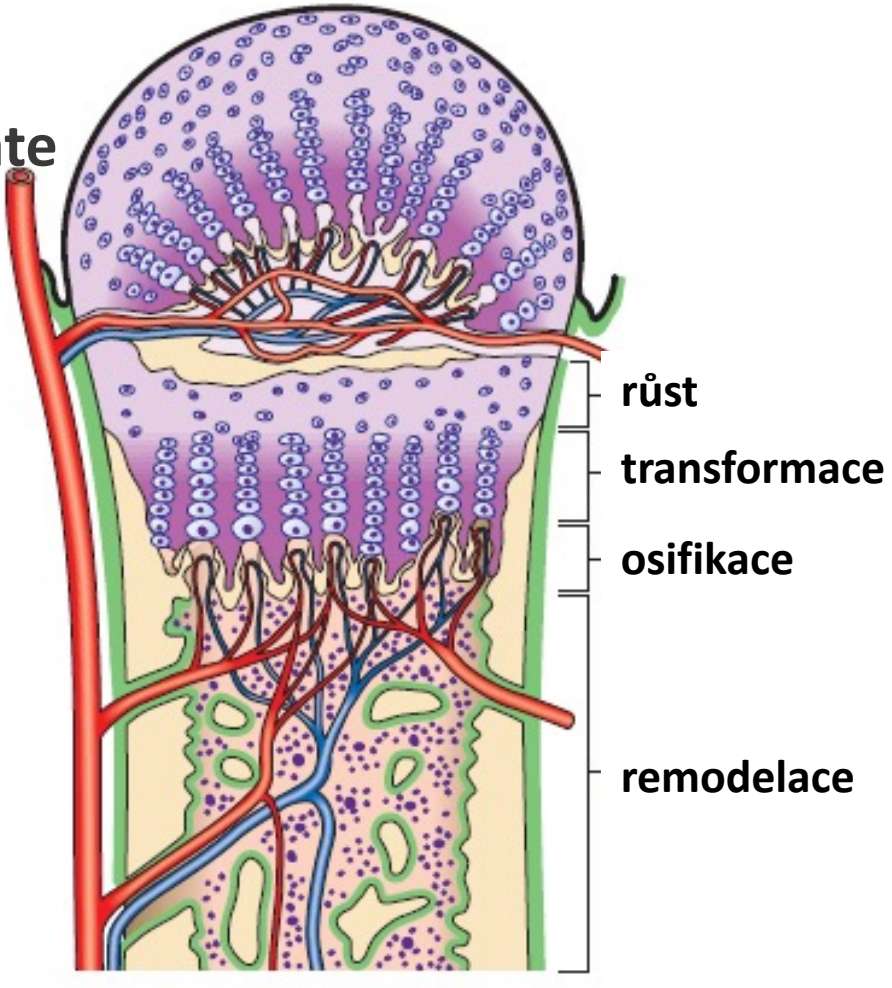

- Only joint and epiphyseal cartilage remained from cartilagenous model

Ossification

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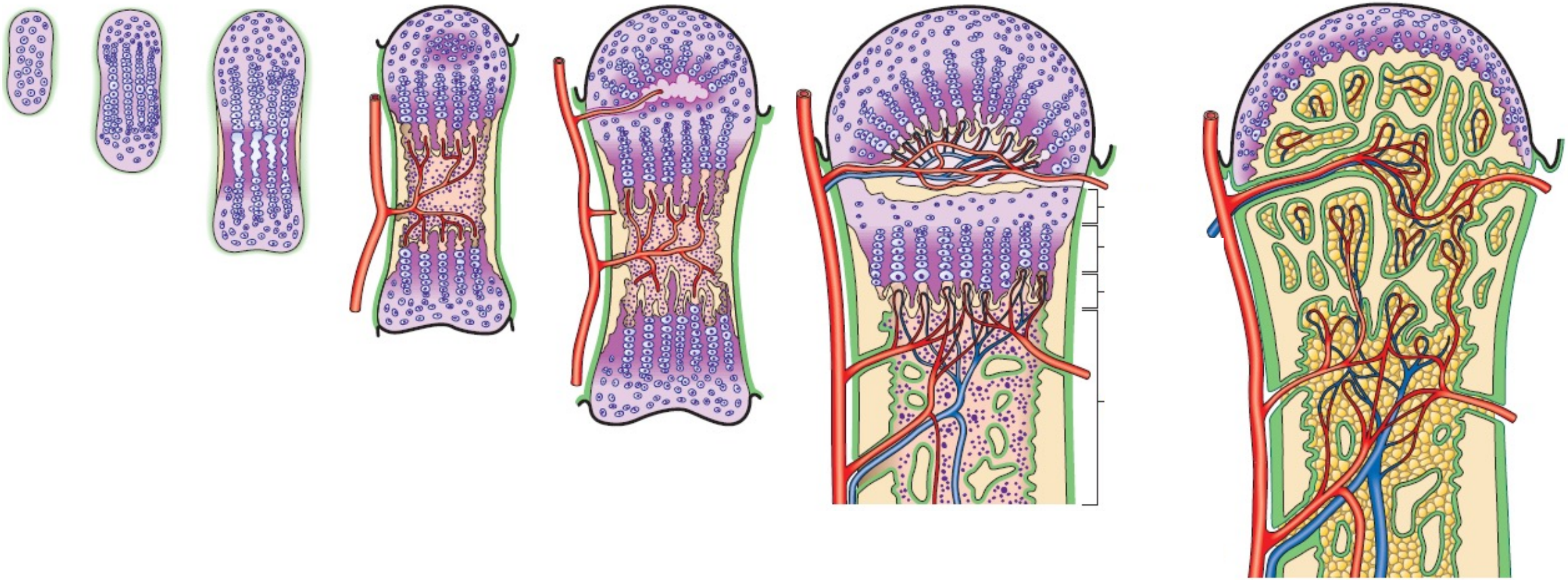
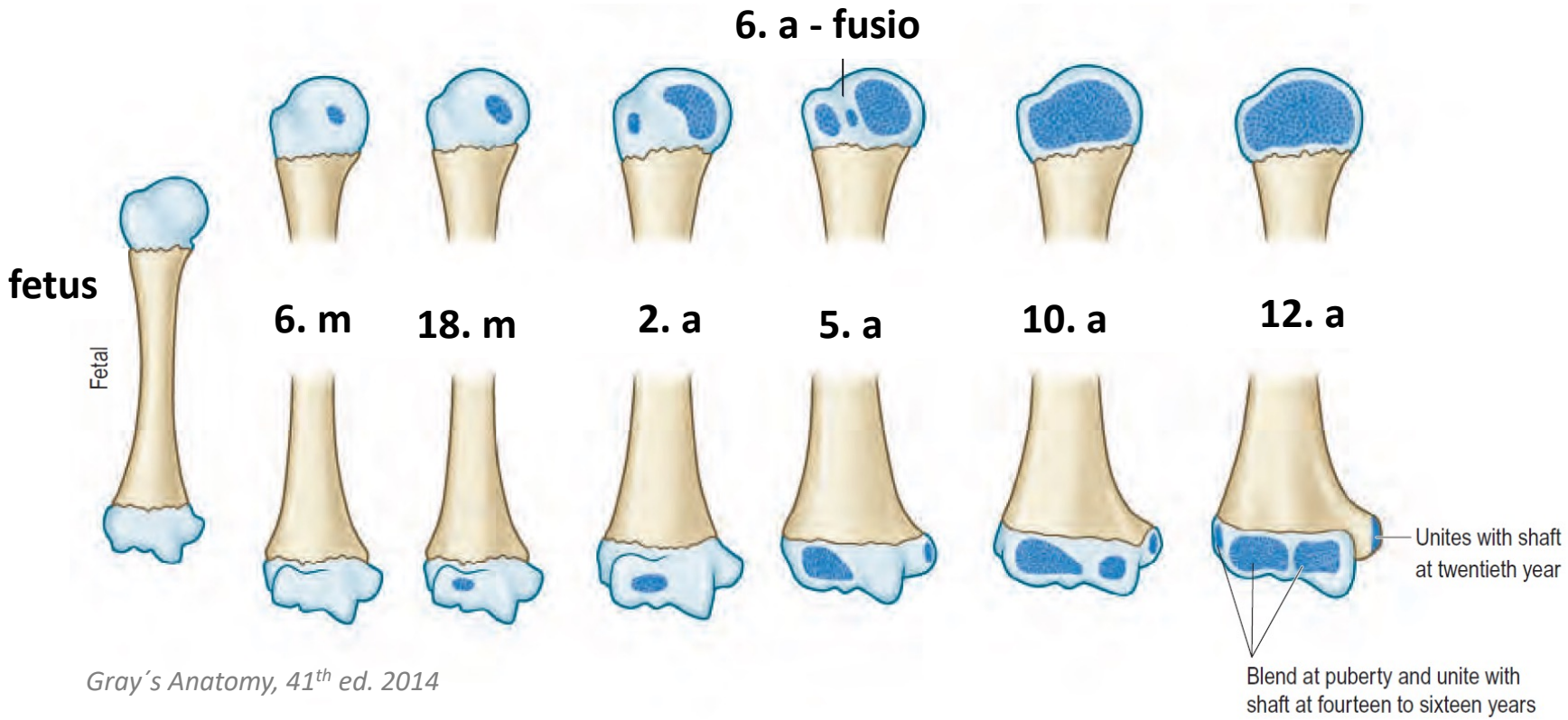


Ossification nuclei

- **Calendar age and hormonal status**
- **Bony age**
- *Adrenogenital sy - acceleration*
- *Hypogonadismus – slw-down*



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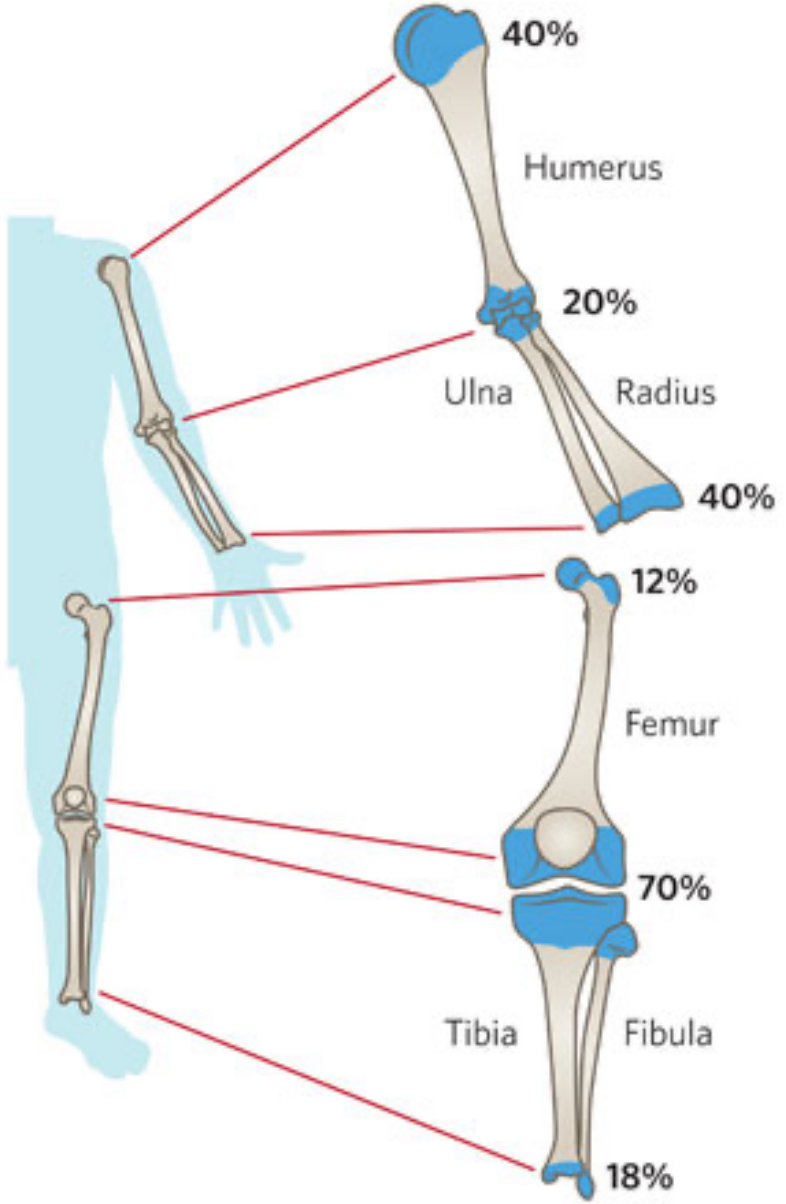
Growth and remodelling

- **Prolongation**
  - In growing plates
  - After occlusion - no prolongation
- **Widening**
  - On the surface – APOSITION
  - Removal in cavity – RESRPTION
- **Proximal and distal growing plates**
  - Not the same activity
  - Proximal more active in humerus
  - Distal more active in femur



Remodelling

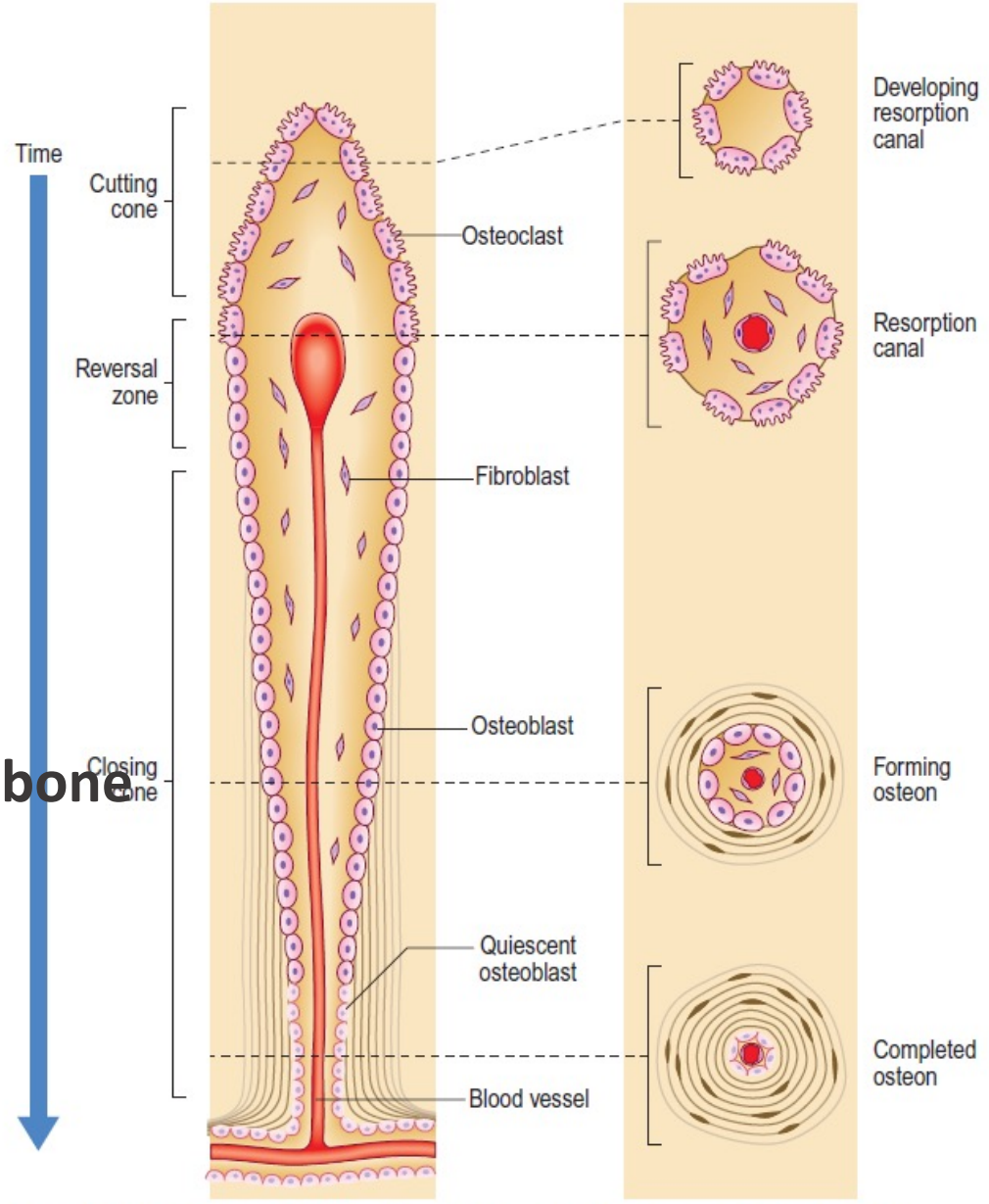
- **Remodellation of the bone tissue**

Under hormonal stimulation

Weight bearing stimulation

Physical activity stimulation

- **Never ending**
  - **Osteoclasts - bone removal**
  - *Fibroblasts - forming collagene fibers*
  - **Osteoblasts - forming osteoid non-mineralized bone**
  - **Mineralization**
  - **Completed osteon**



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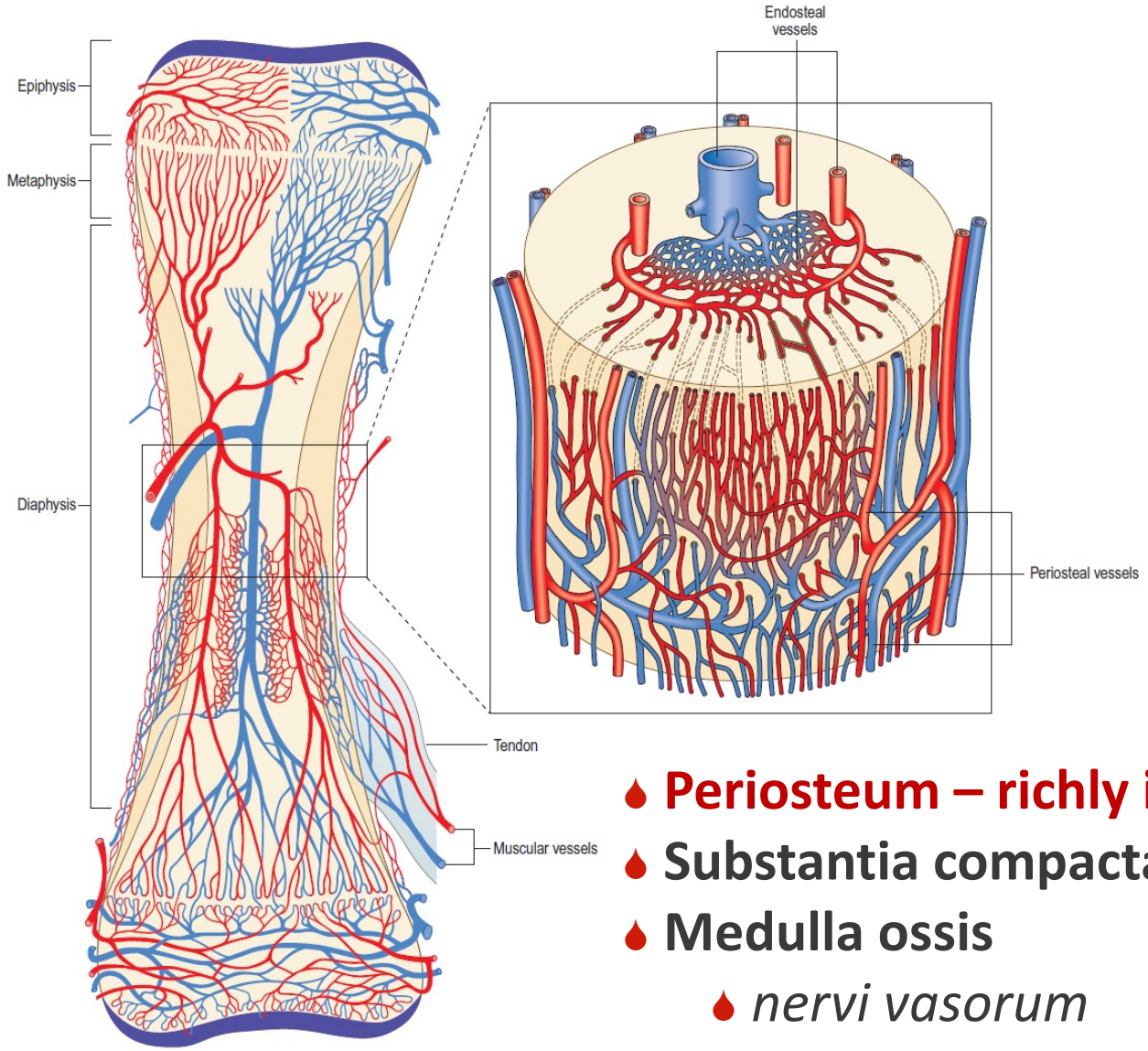
Vascular suply and inervation

- **Splitted teritoria during development, than fused**
- **A. nutricia**
- **Aa. corticales**
- **Aa metaphyseales**
- **Aa. apophyseales**
- **Aa. Epiphyseales**



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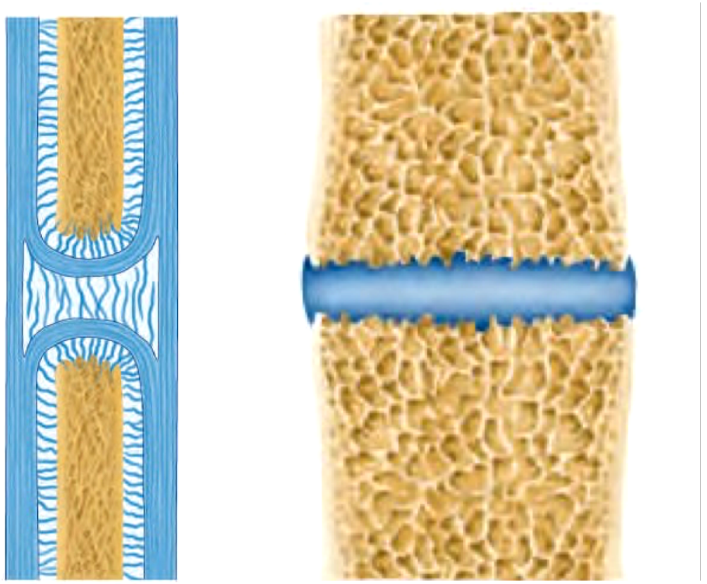
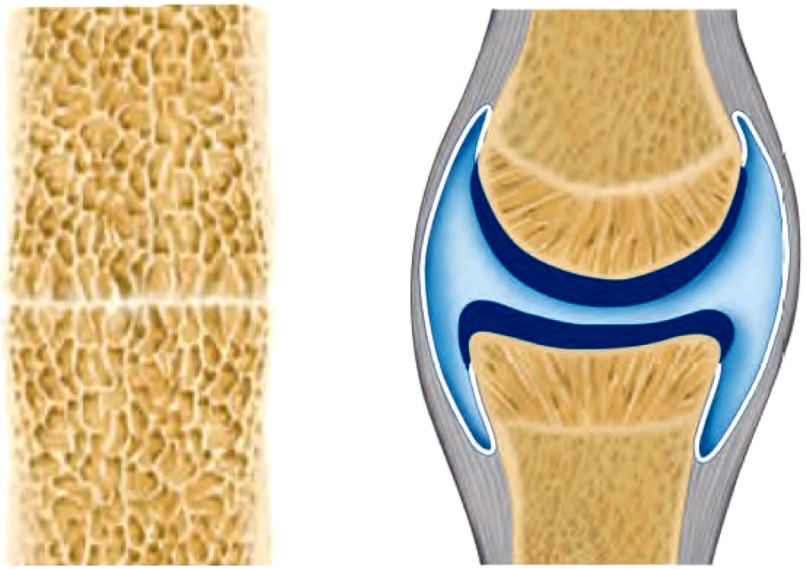
- **Periosteum – richly innervateed**
- **Substantia compacta**
- **Medulla ossis**
  - *nervi vasorum*

Bone junctures - connections

- **Continual – in continuitate – synarthrosis**
  - Fibrous connective tissue – SYNDESMOSIS – skull
  - Cartilage – SYNCHONDROSIS – symphysis pubis
  - Bone – SYNOSTOSIS – sacral bone
- **In touch – in contiquitate – diarthrosis**





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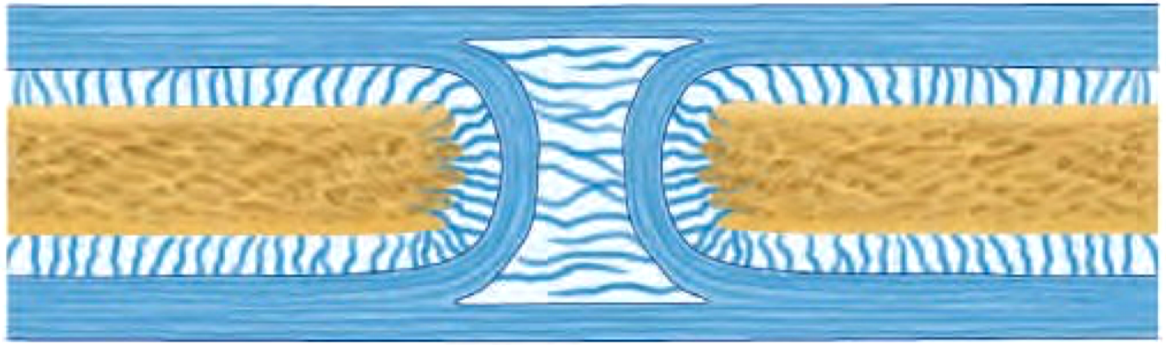
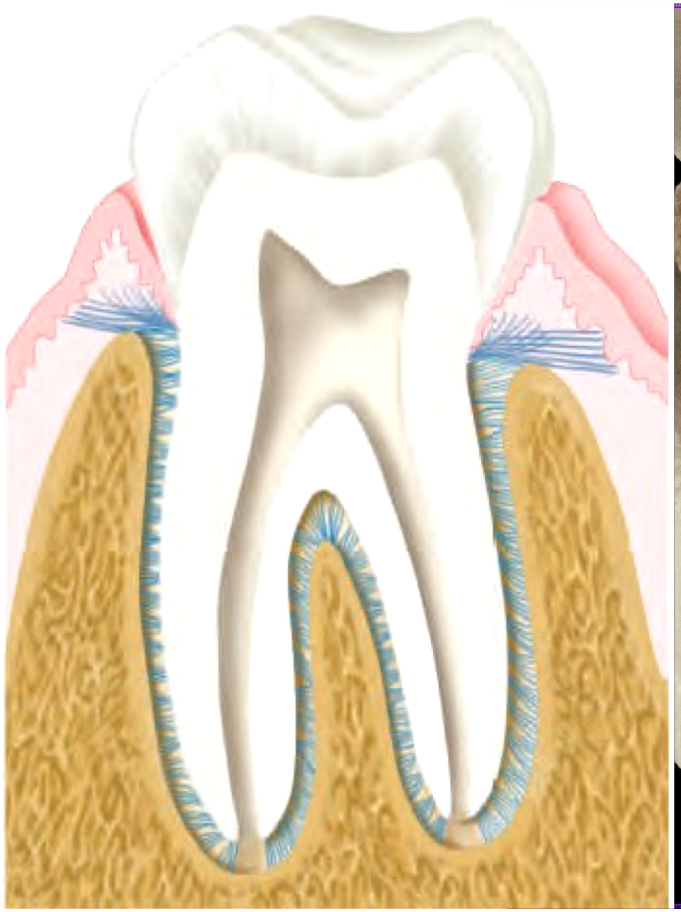
Sutures – sutura ossium

- **Sutura serrata – saw-toothed**
  - *Ossa suturarum Wormiana*
- **Sutura squamosa – squamous**
- **Sutura plana – flat**
- **Gomphosis**
  - **Wedged teeth in alveoli**



Gomphosis - inwedging

- Teeths in jaw alveoli



Articulation - joint

- **ball**
- **socket**
- **cartilage**
- **supplements**
  - *Labrum*
  - *Discus*
  - *Meniscus*
  - *Meniscoid*
  - *Intraarticular ligg.*
- **Capsula articularis**
  - *stratum fibrosum*
  - *stratum synoviale*

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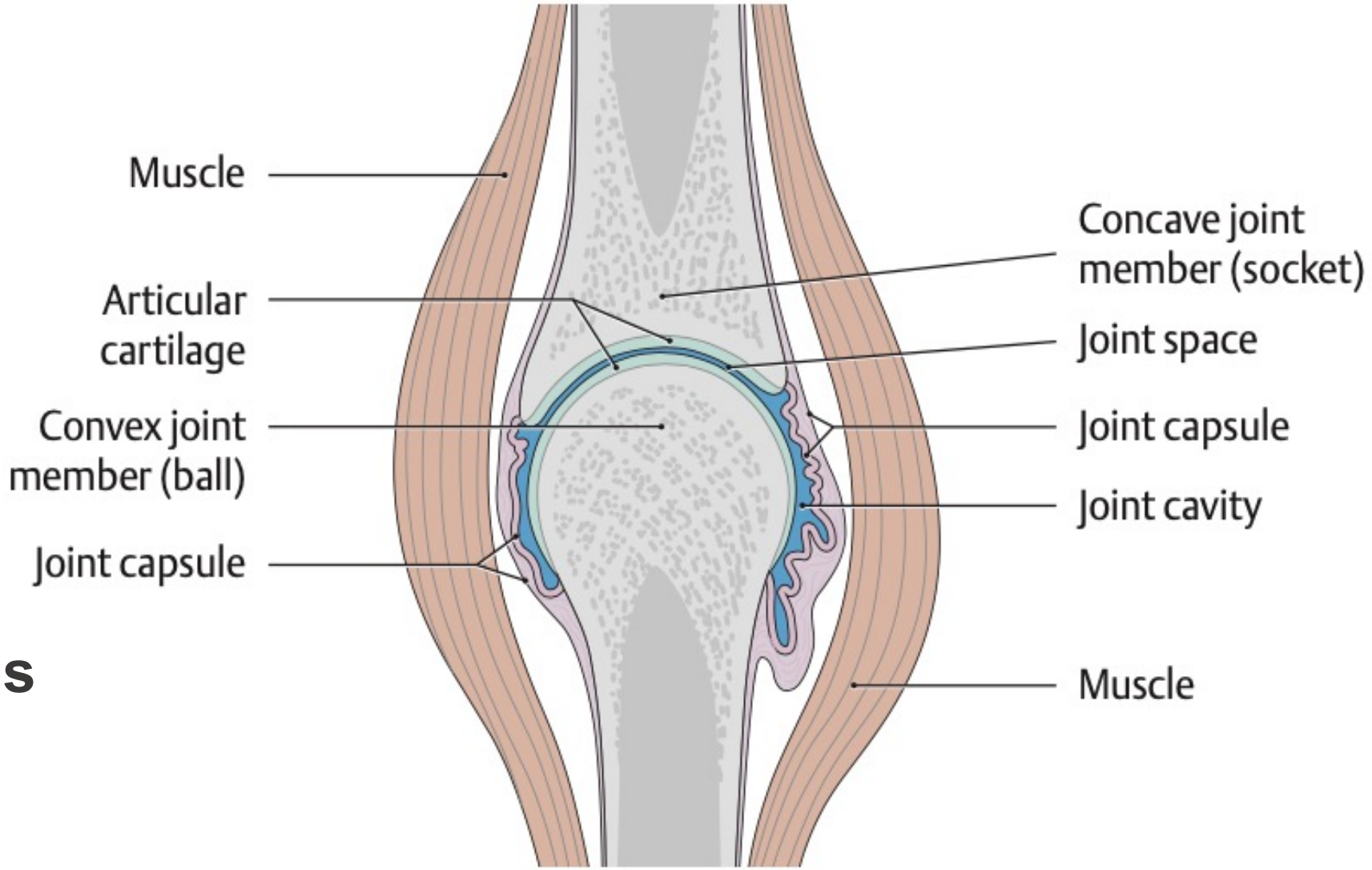

Joint description

1. Connecting surfaces
2. Capsule
3. Capsular enrichment
4. Basal position
5. Middle position
6. Mechanics

Connecting surfaces

- Different shapes
- Covered by hyaline cartilage
- exception temporomandibular (jaw) joint and clavicular joints - fibrous cartilage
- Supporting structures – labrum glenoidale

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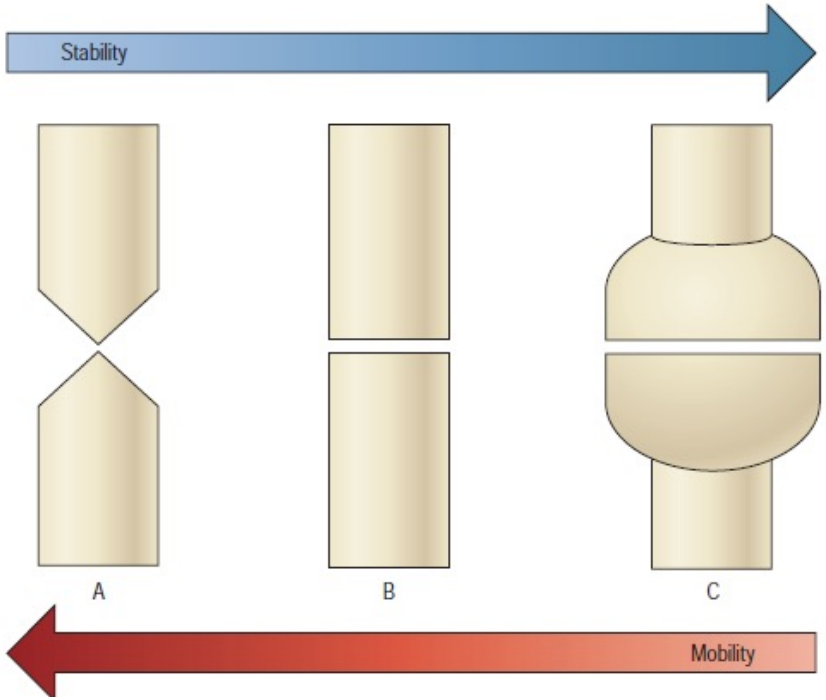
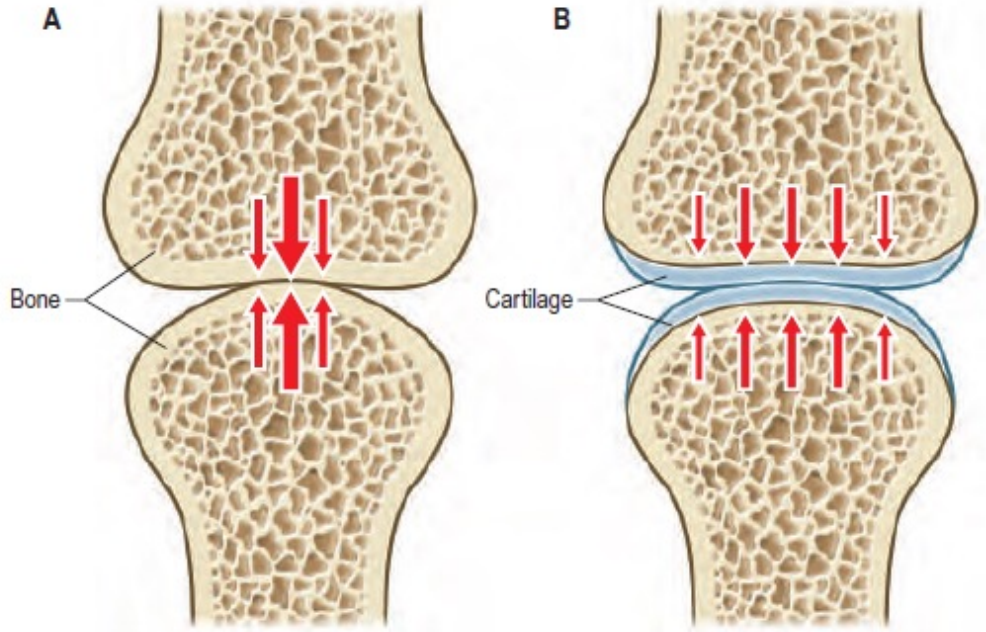




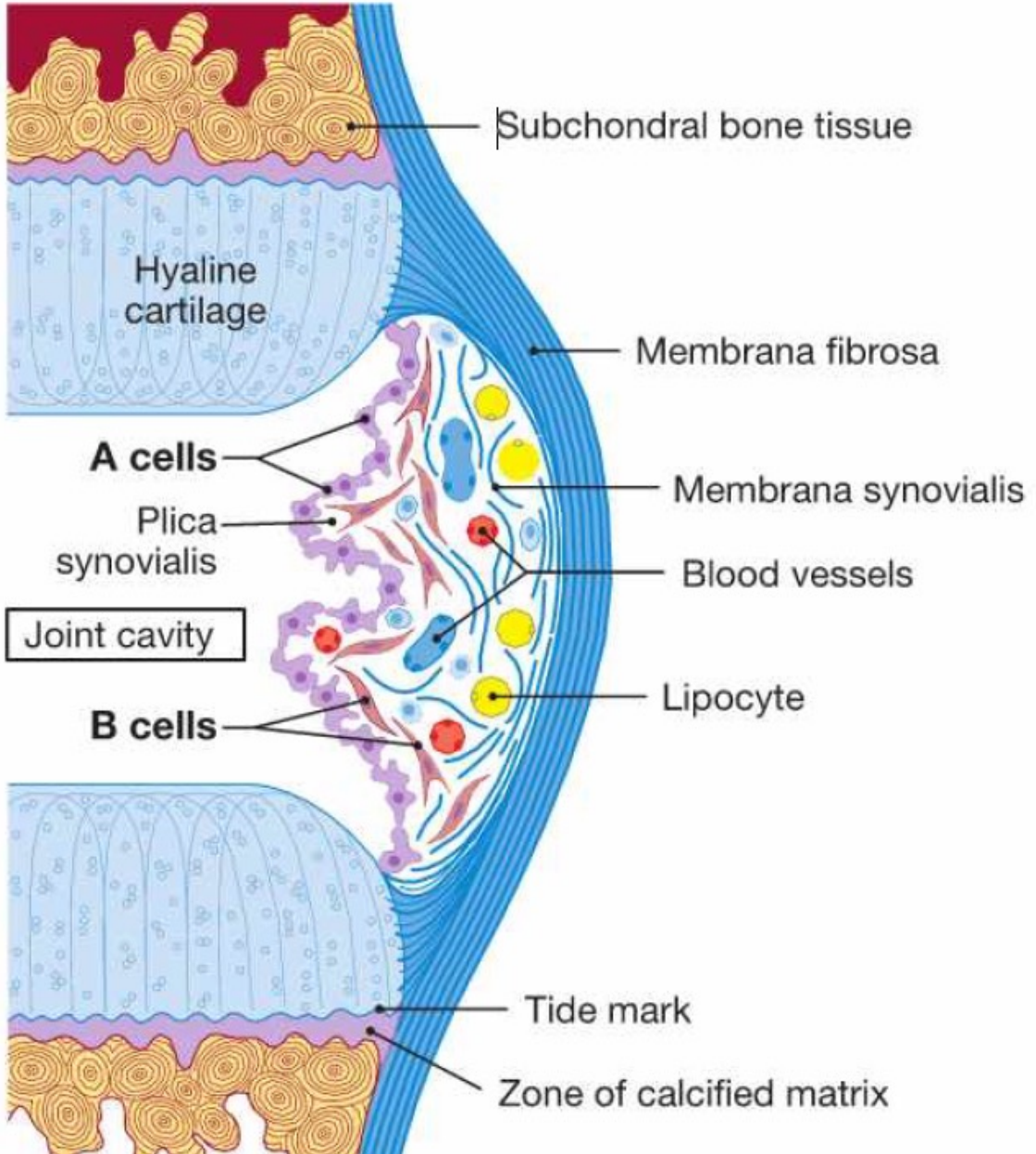
Joint cartilage

- Forces transmission
- Overloading - pathological inkongruency
- Cartilage´s destruction- osteoarthritis



Capsula articulationis – joint capsule

- Bound to the margins of connecting planes
- Outer fibrous layer
- Inner synovial layer
- Synovia



Capsullar accesories - enrichments

- ligaments
- Tendons
- muscles
- Cylindric joints
  - Collateral lig
  - ligg. Colateralia
  - Annular lig.

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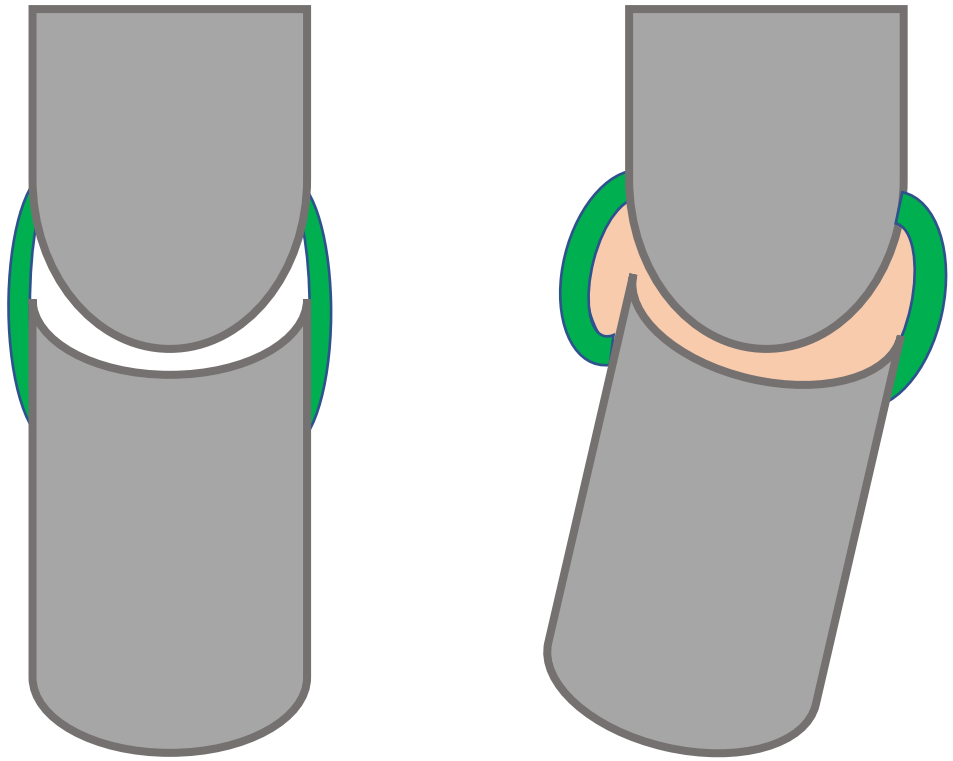
Base and middle position

- **basal**
  - *Upright position*
  - *Extremities down*
  - *Palms in supination*
- **Middle position**
  - *minimal capsular tension*
  - *Injuries, infection*



Joint mechanics

- FLEXION
- EXTENSION
  - HORIZONTAL AND FRONTAL AXES
- ABDUCTION
- ADDUCTION
  - HORIZONTAL, SAGITTAL
- INNER ROTATION
- OUTER ROTATION
  - AROUND LIMB AXIS
- CIRKUMDUCTION

Joints types

- **Number of bones or rotating axes**
- **Simple - articulationes simplices - only two bones**
- **Complex – articulationes compositae - more than two bones or discus or meniscus**

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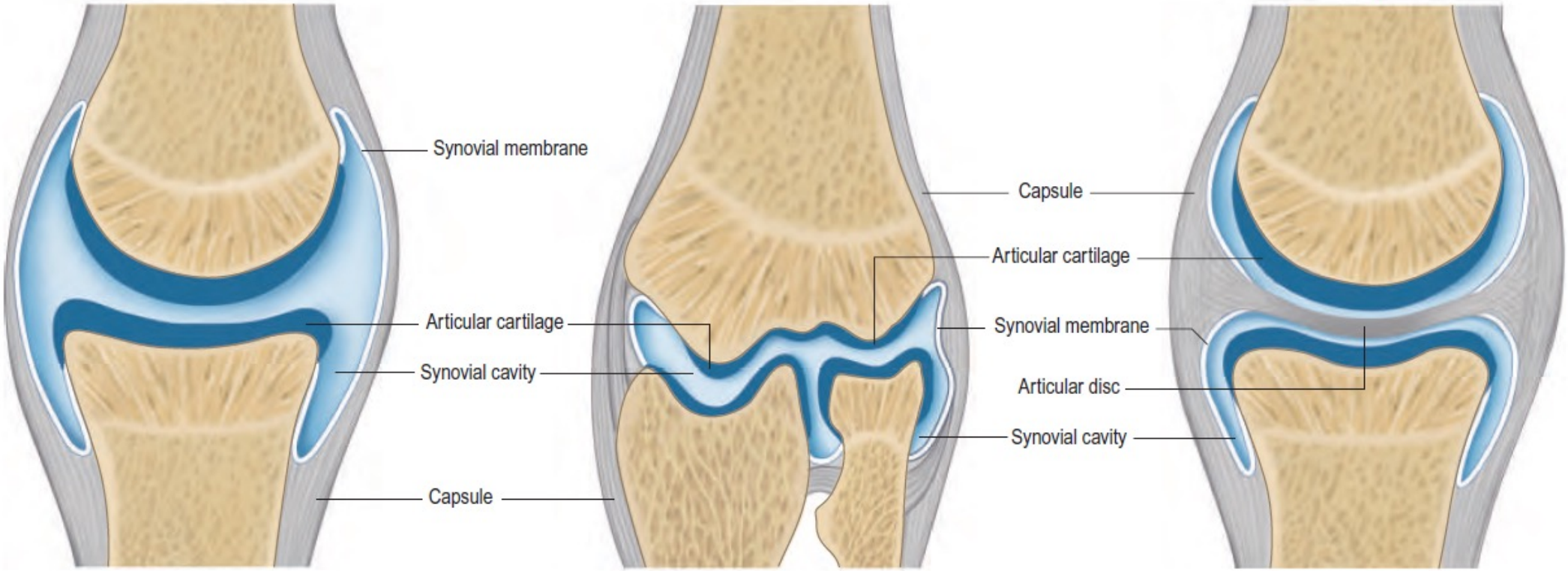

Degrees of freedom

- Three degrees of freedom – art. spheroidea
- Two degrees of freedom – art. sellaris, art. ellipsoidea
- One degree of freedom – art. trochoidea, art cylindrica

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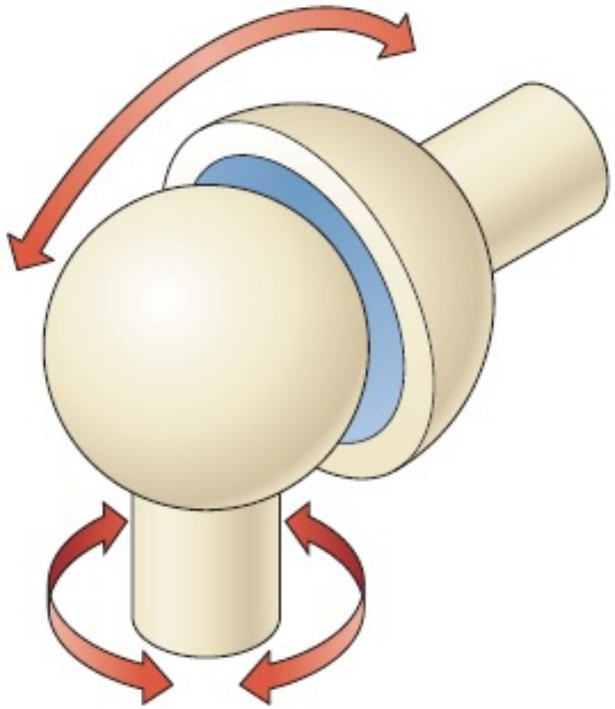
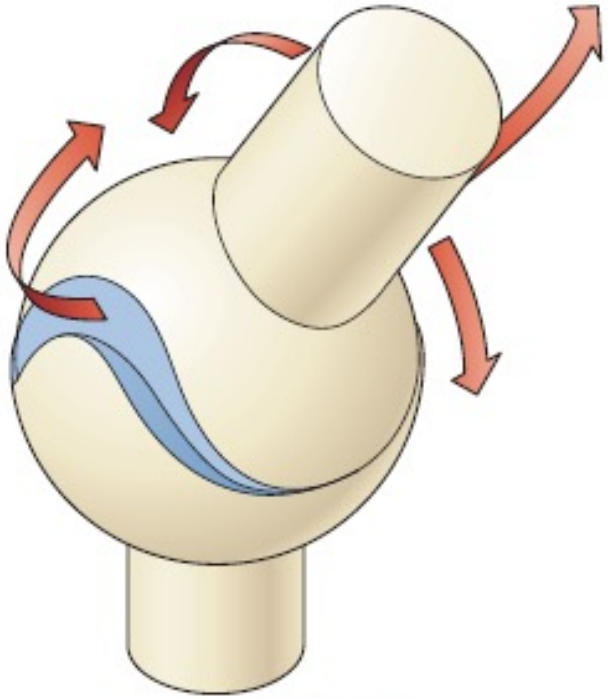
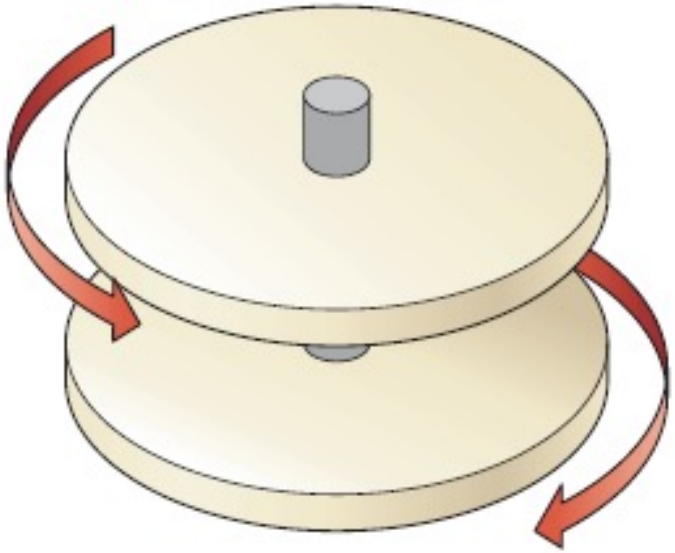
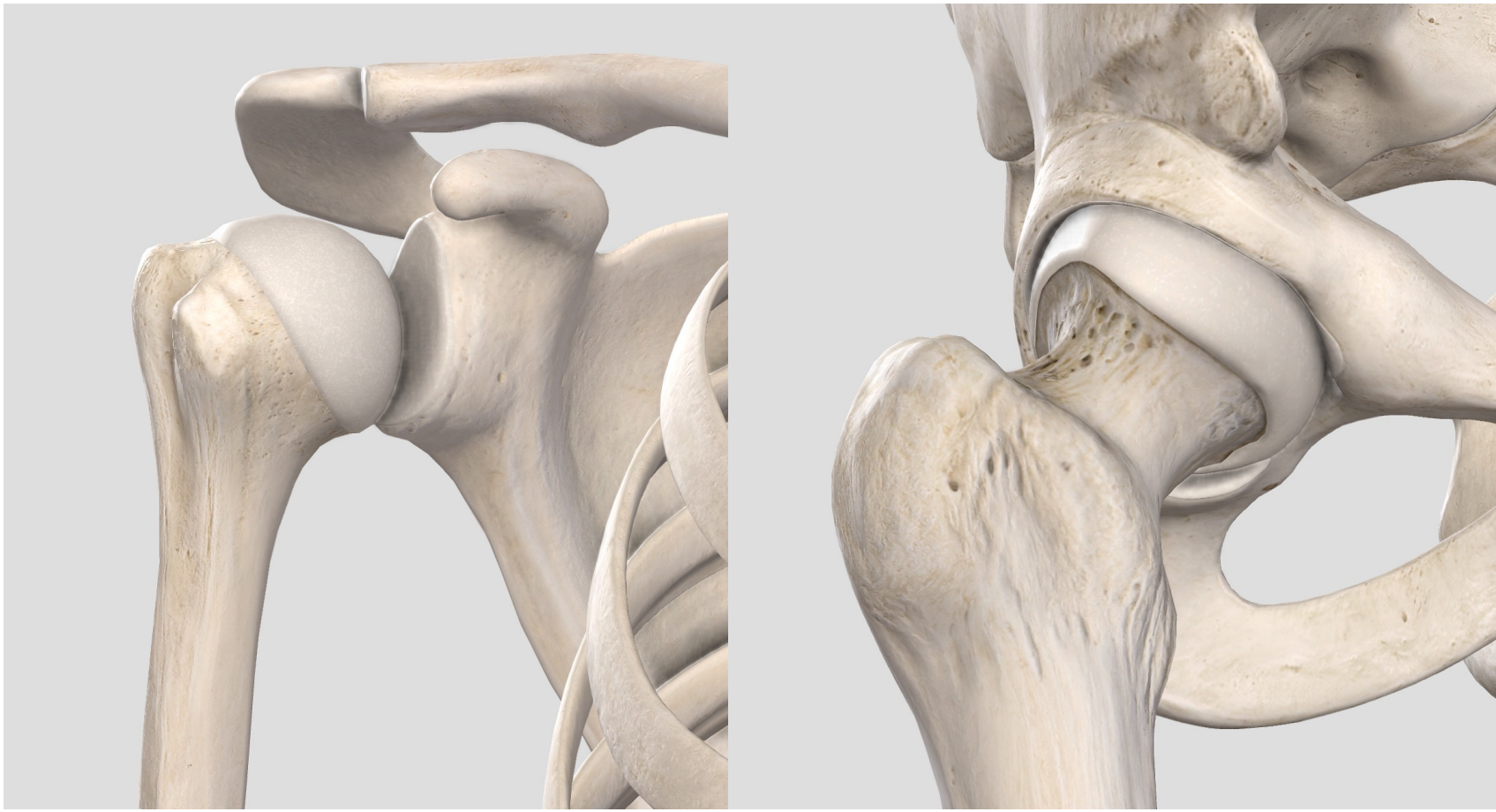






Art. sphaeroidea

- **Ball and socket**
- **Free – arthrodia**
  - **shoulder**
- **Limited – enarthrosis**
  - **hip**
- **3 degrees of freedom**
- *Transversal*
  - *flexion, extension*
- *Sagittal*
  - *abduction, adduction*
- *Rotation axis*
  - *outer, inner*



Art. cylindrica

- cylindric
- gynglymus – axis of rotation perpendicular to bone axis
  - Humeroulnar joint
- Hinge (pivotal) – art. trochoidea – axis of rotation parallel to bone axis
  - Prox. radioulnar joint

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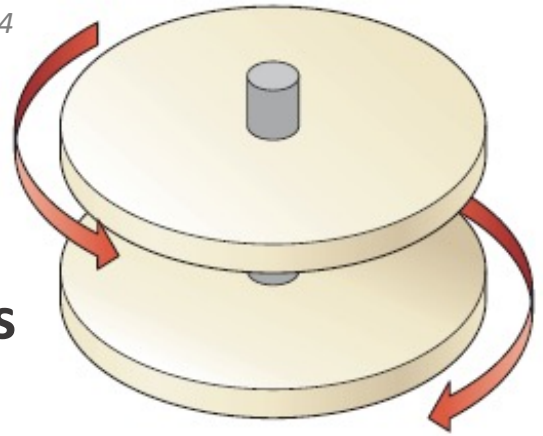
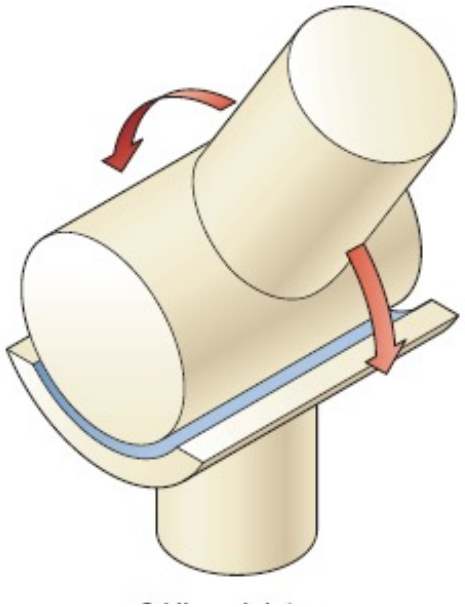
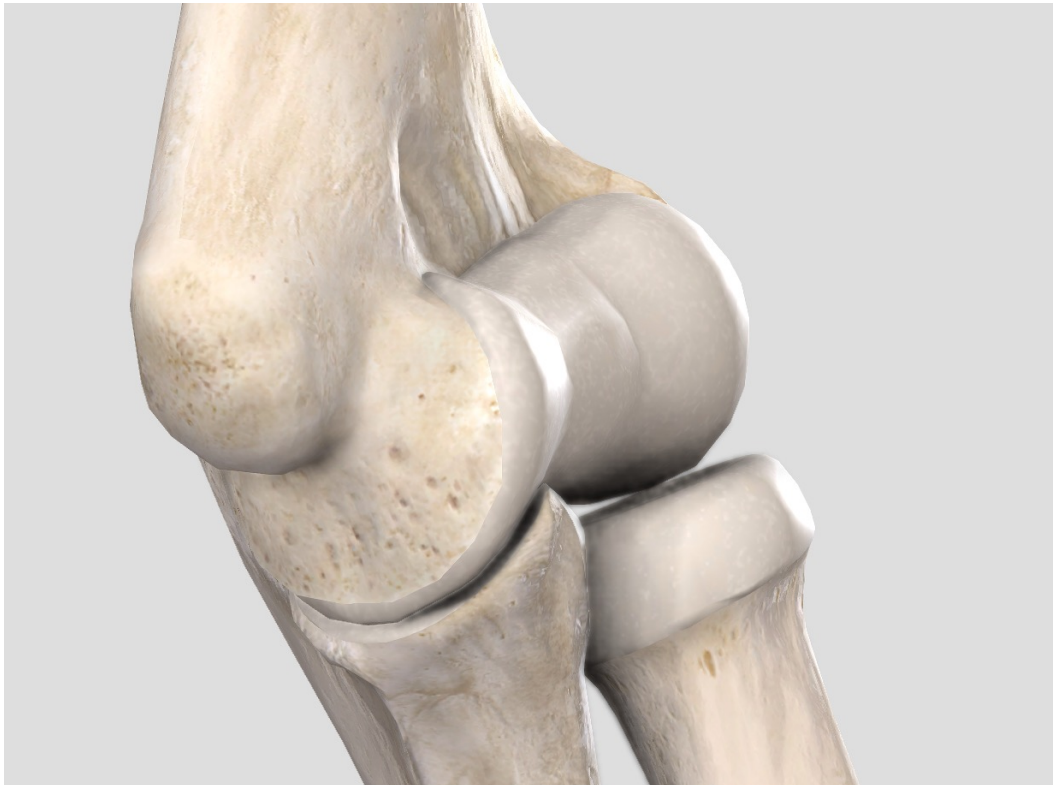
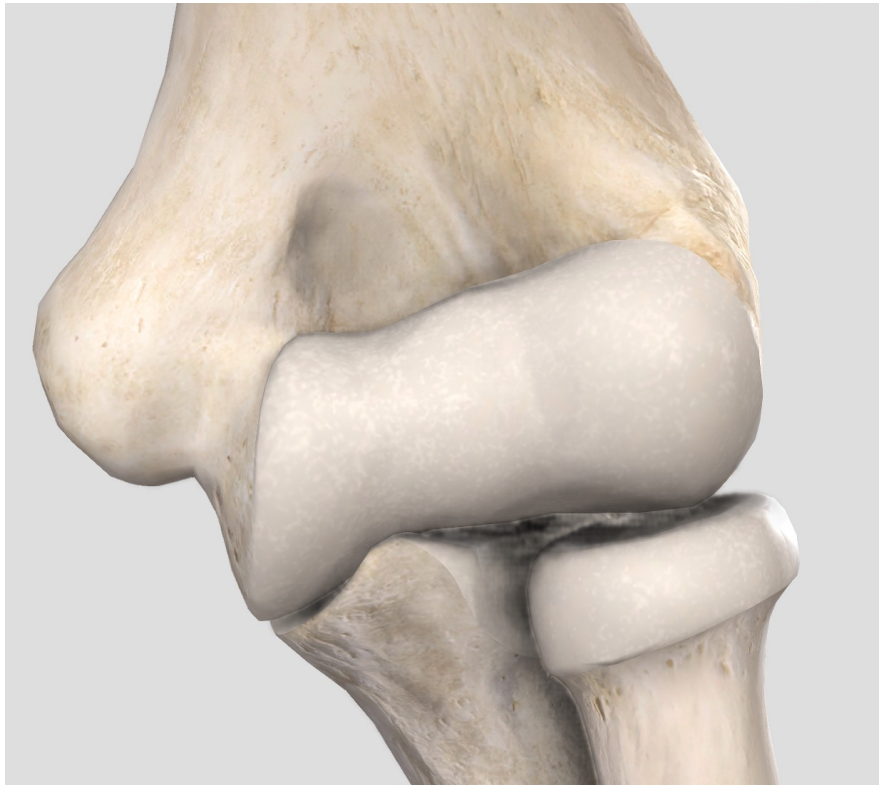






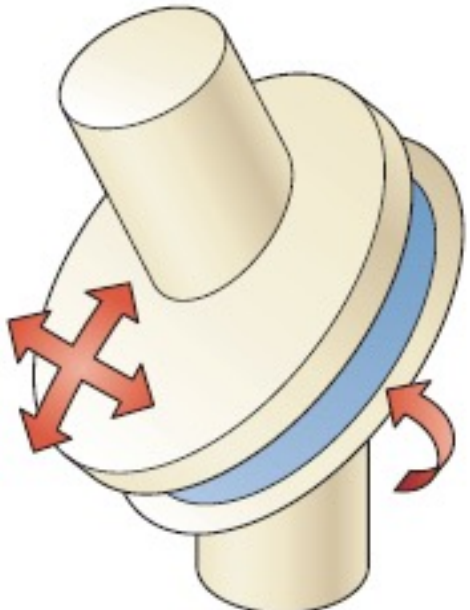


Art. trochlearis

- **tackle**
  - **Art. humeroulnaris**
  - **Art. interphalangealis**
  - **Art. genus**
- **axis of rotation perpendicular to bone axis**
  - *Flexion, extension*
  - *Leading roof and edge*

Art. elipsoidea

- **Ellipsoid - egg shaped**
- ***Atlantooccipital***
- *Transverse axis*
- *Flexion, extension*
- *Sagittal lateroflexion*



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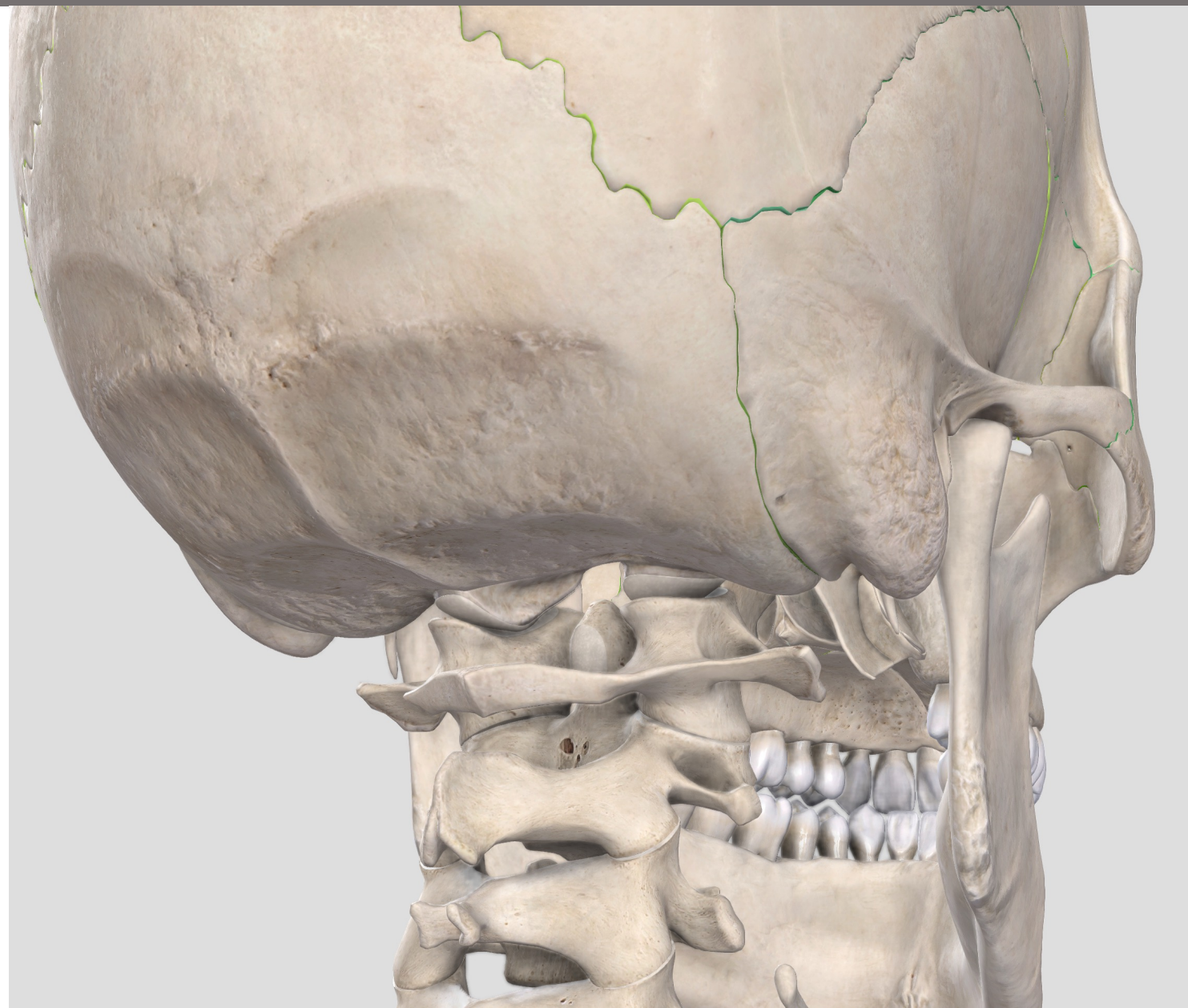

Art. sellaris

- **Saddle joint**
- **Os trapezium + I. metacarpus**

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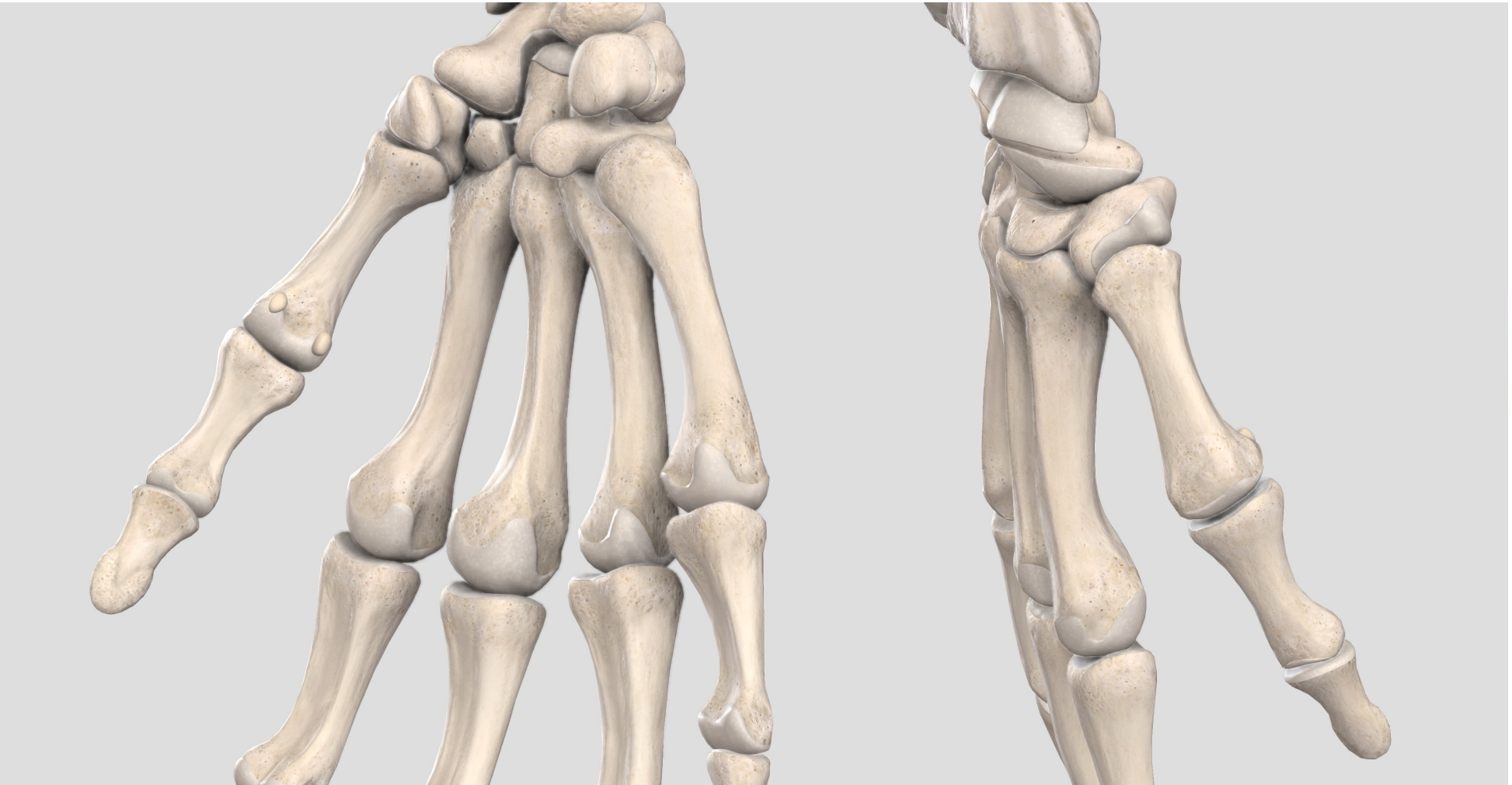
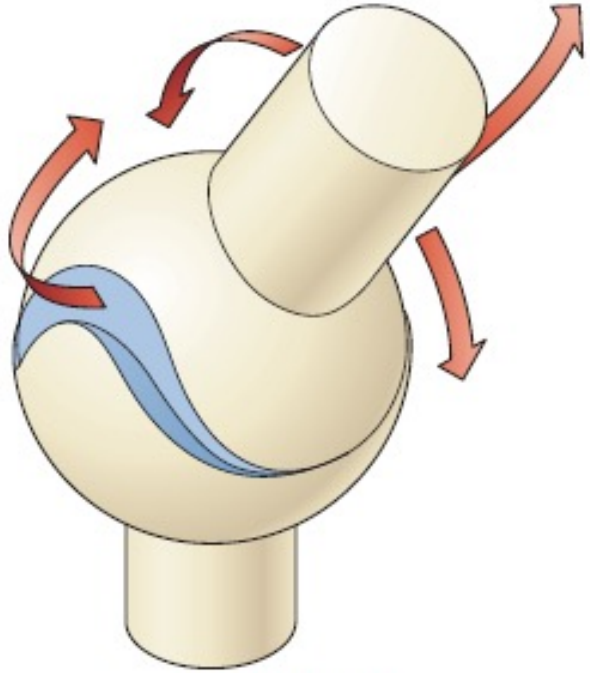
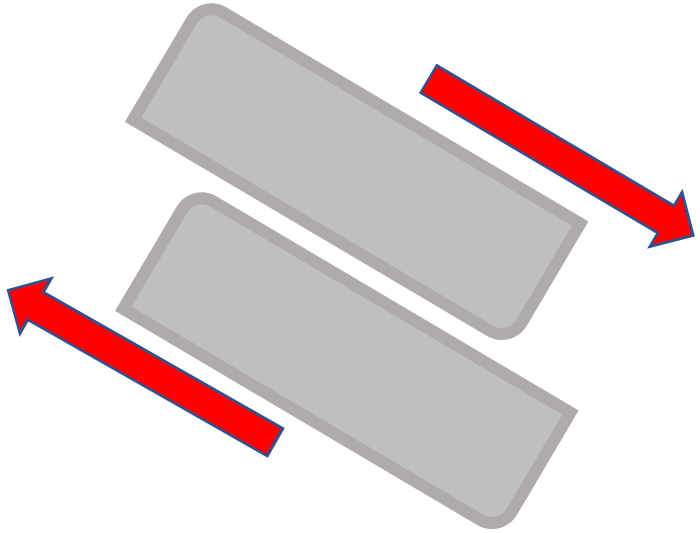




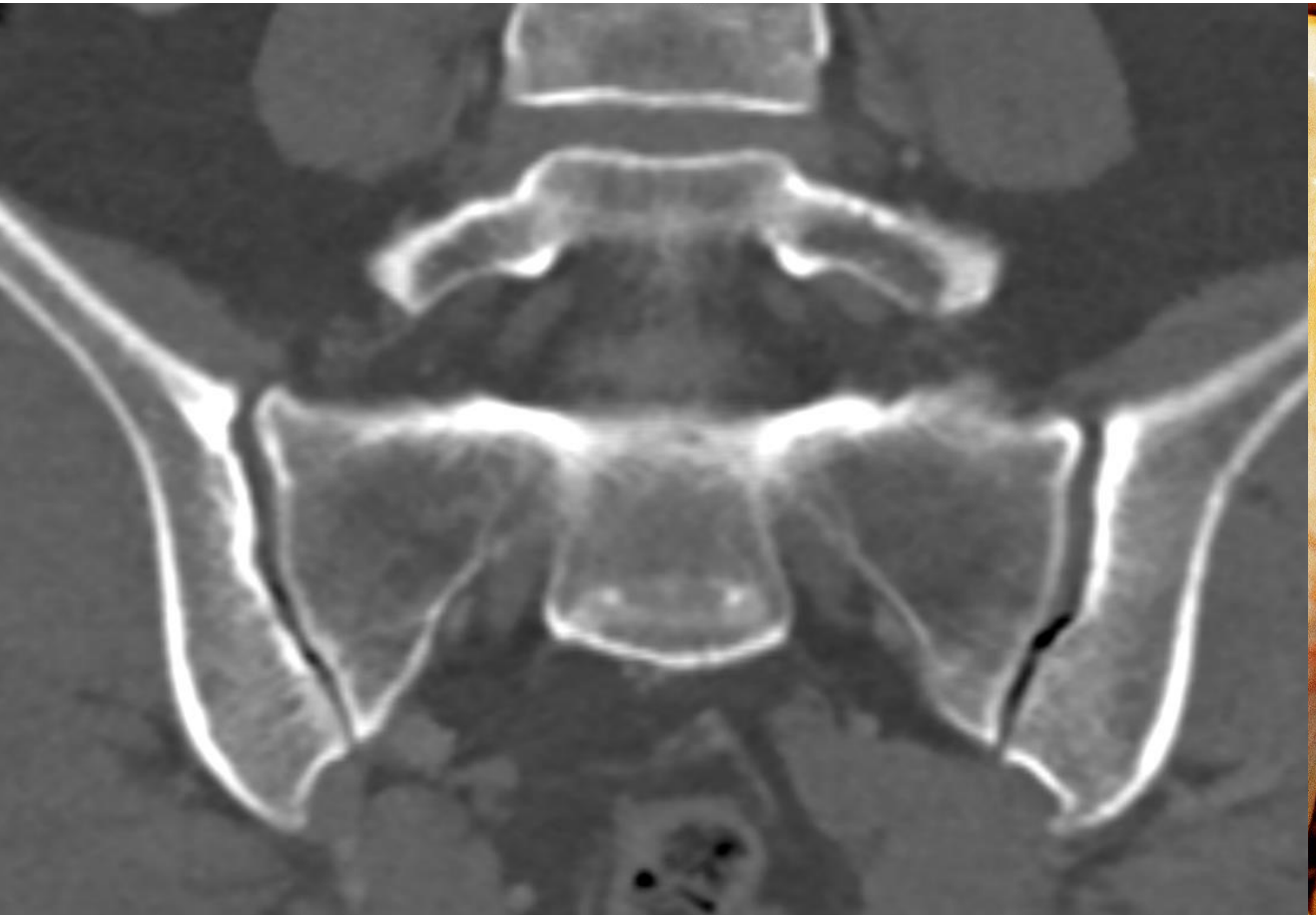
Art. plana

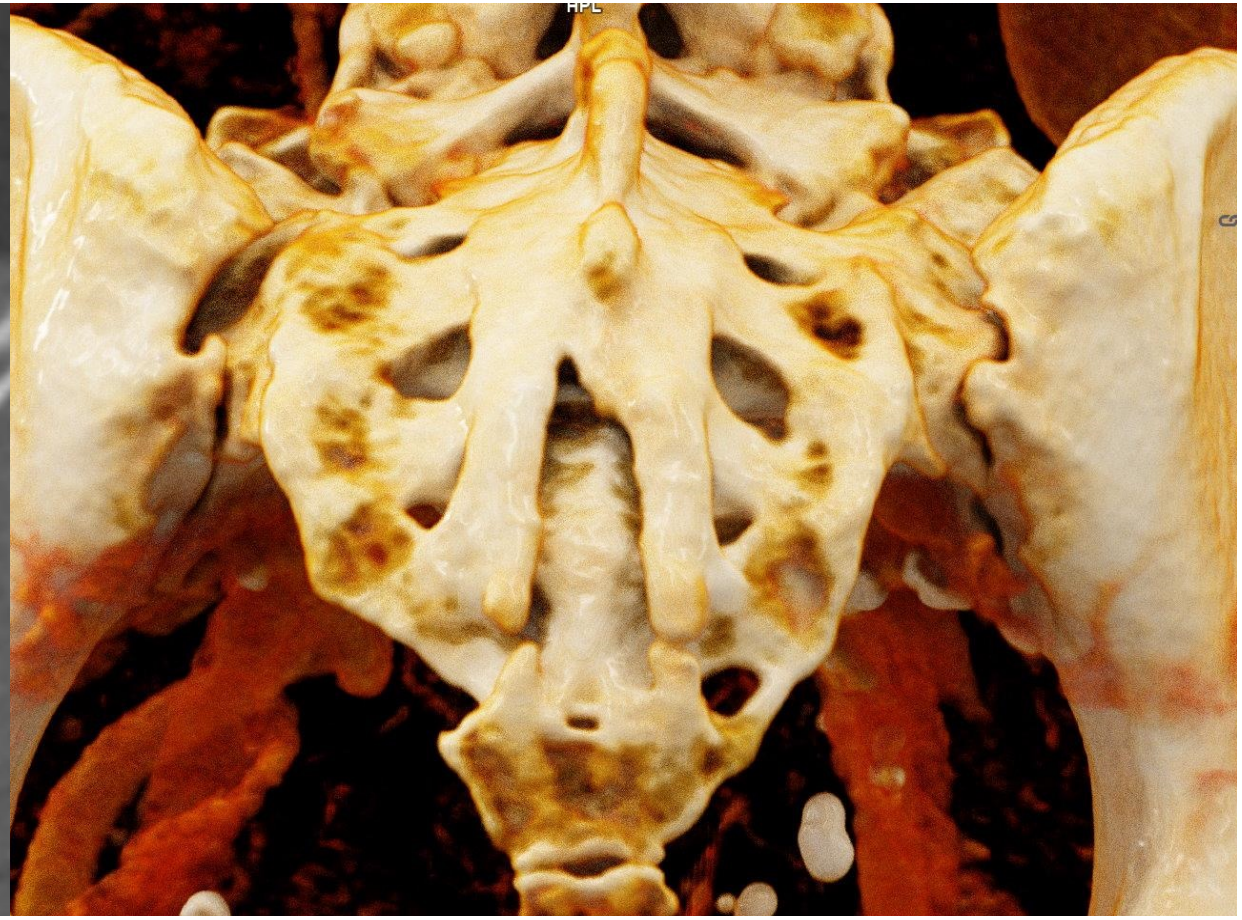
- Flat joint - sliding surfaces
- Os naviculare + ossa cuneiformia
- Art. Interverstebrales (zygophyseales)



Amphiarthrosis

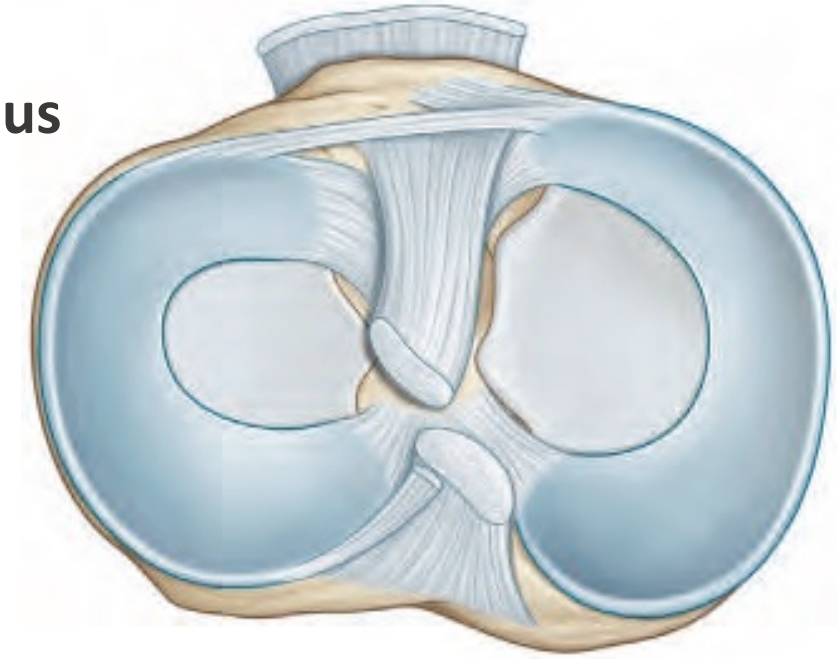
- **Stiff joint**
- *Art. sacroiliaca - minimal movements - irregular joint surfaces*





Art. composita

- **Complex joint**
- More bones
- Art. cubiti – humerus+ulna+radius
- **Interposition of**
  - **DISCUS**
  - art. sternoclaviculare, art. temporomandibularis
  - Coin shape
  - **MENISCUS** – art. genus
  - Halfmoon shape



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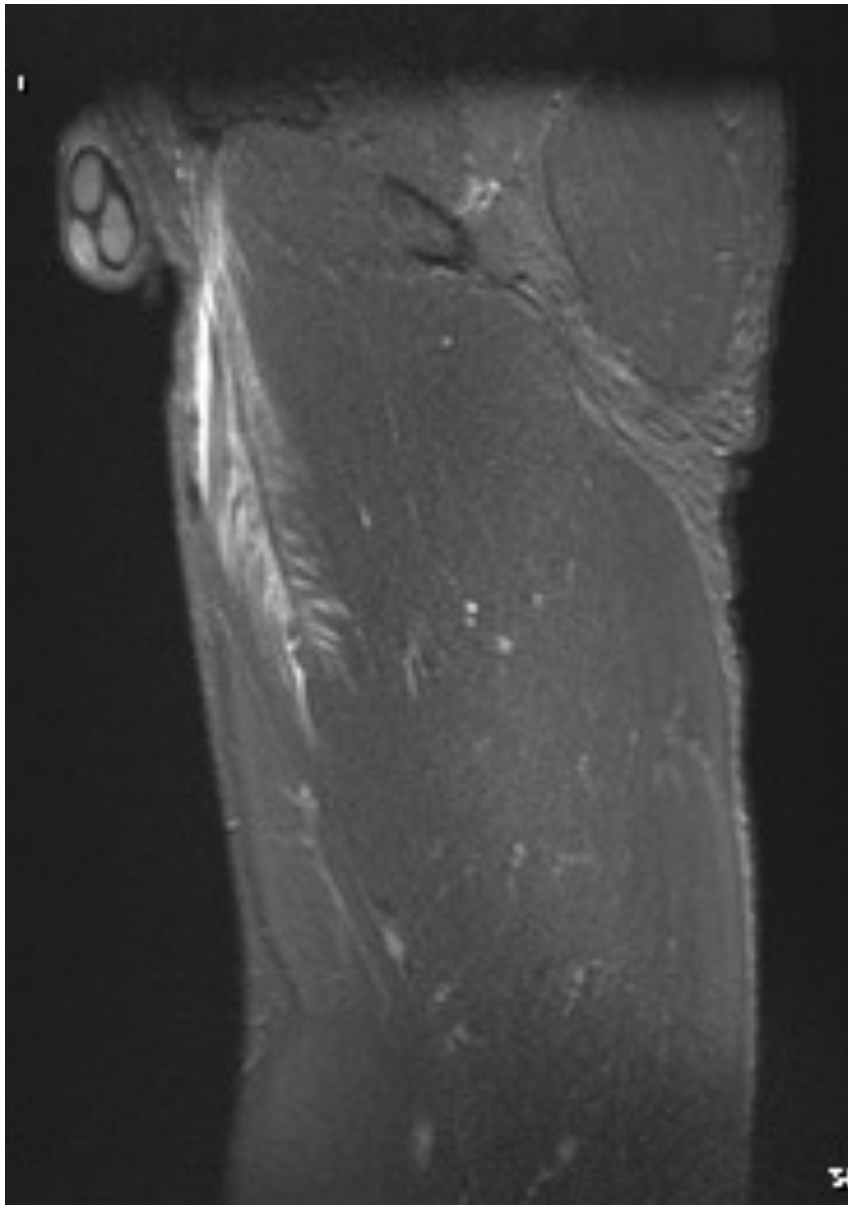
Myology

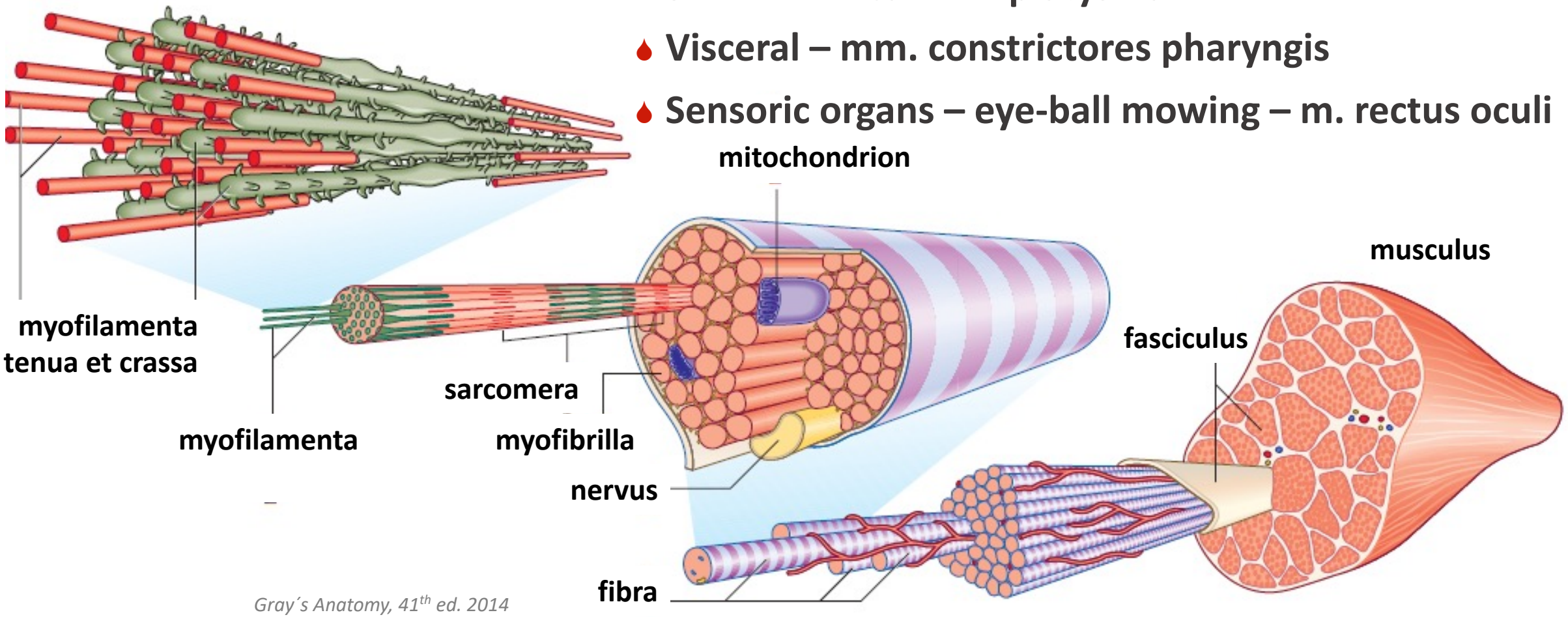
- Musculus
- Caput
- Venter
- Cauda
- Tendo

- 600 muscles *Gray´s Anatomy, 41th ed. 2014*
- Paired muscles
- 30 - 42% of body weight



Stripped muscles

- Skeletal – m. biceps brachii
- Skin - mimical – m. platysma
- Visceral – mm. constrictores pharyngis
- Sensoric organs – eye-ball mowing – m. rectus oculi



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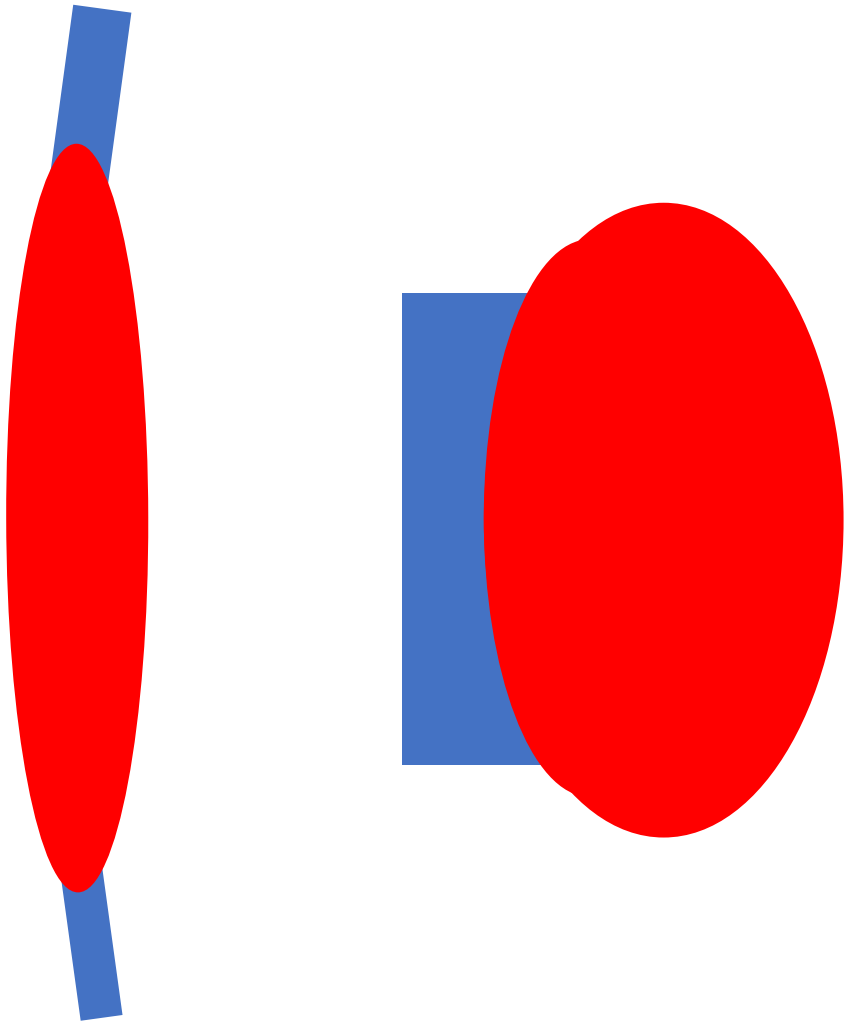
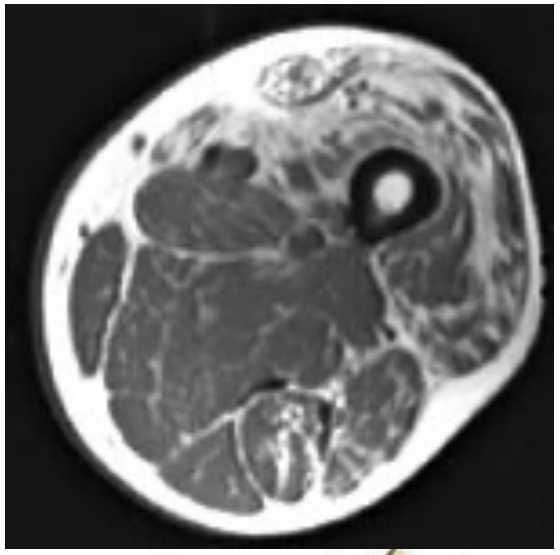
Tendons

- **Muscular tissue – active**
- **Fibrous connective tissue – passive**
- **tendon – tendo**
  - *Bound collagene fibers*
  - *Torsion of fibers*
  - *strength - 5 – 12 kg/m²*
- **Aponeurosis**
- **Wide tendineous attachment**



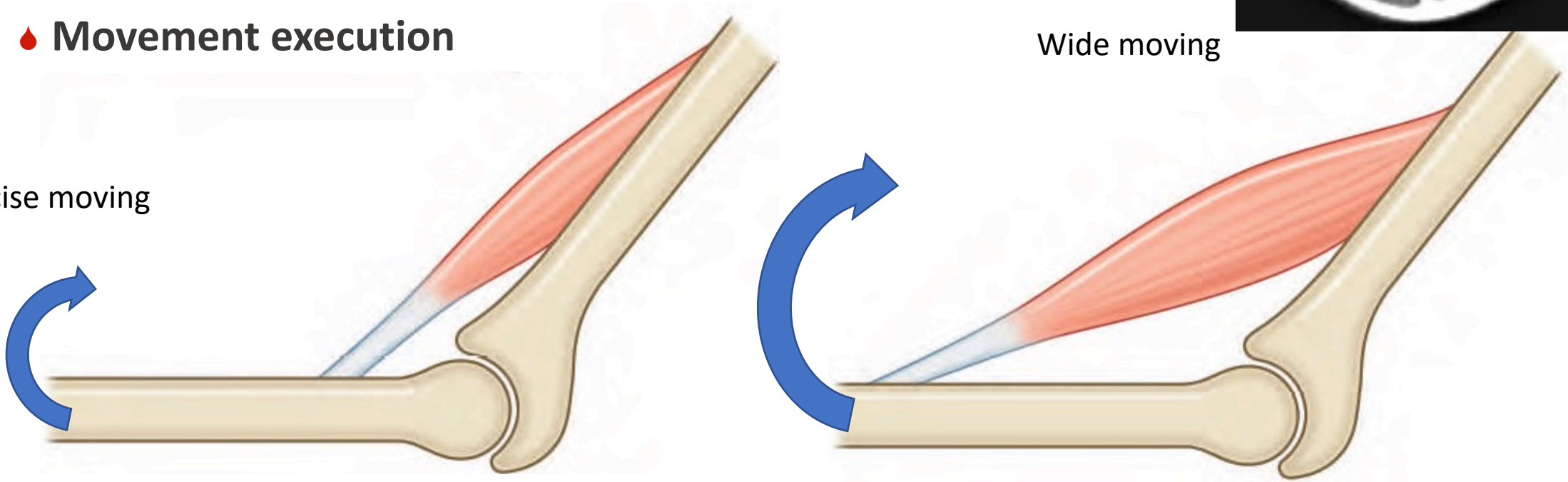
Funkce svalů

- **Static muscles**
  - Positioning
  - Increased fibrous connective tissue component
  - Postural muscles
- **Dynamic muscles**
  - Movement execution



Wide moving

Precise moving



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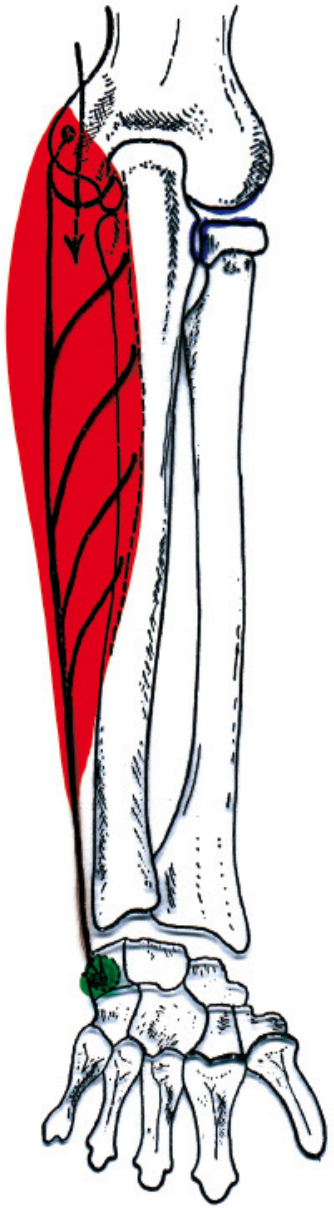
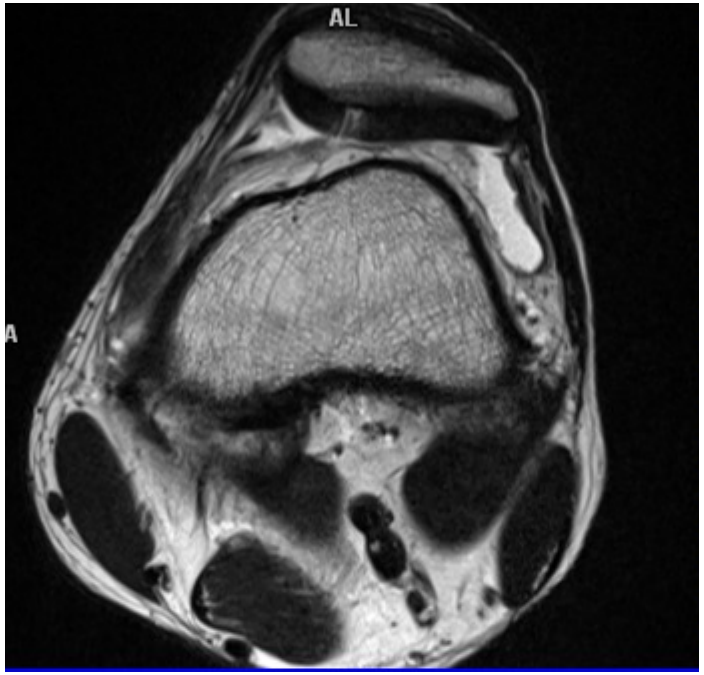
Ossa sesamoidea – sesam bones

- Traction and pressure
  - Sesamoid node
  - Metaplastic cartilage
  - Ossification
- Patella – genu – m. qudriceps femoris
- Os pisiforme – carpus – m. flexor carpi ulnaris
- Ossa sesamoidea pollicis – mm. flexores pollicis
- Ossa sesamoidea hallucis – mm. flexores hallucis





Musculo-tendineous junction

- **Tendon is not the direct following of venter**
- ***Angle less than 180°***
- **More smaller angle in**
  - *M. unipenatus - single-pennate*
  - *M. bipennatus - double-pennate*

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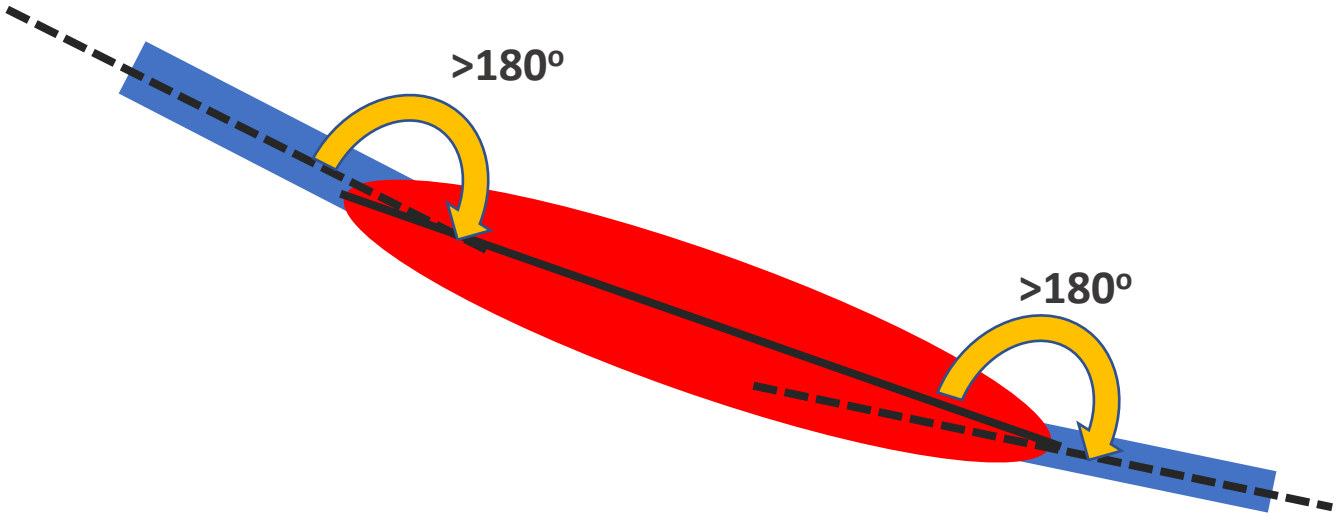
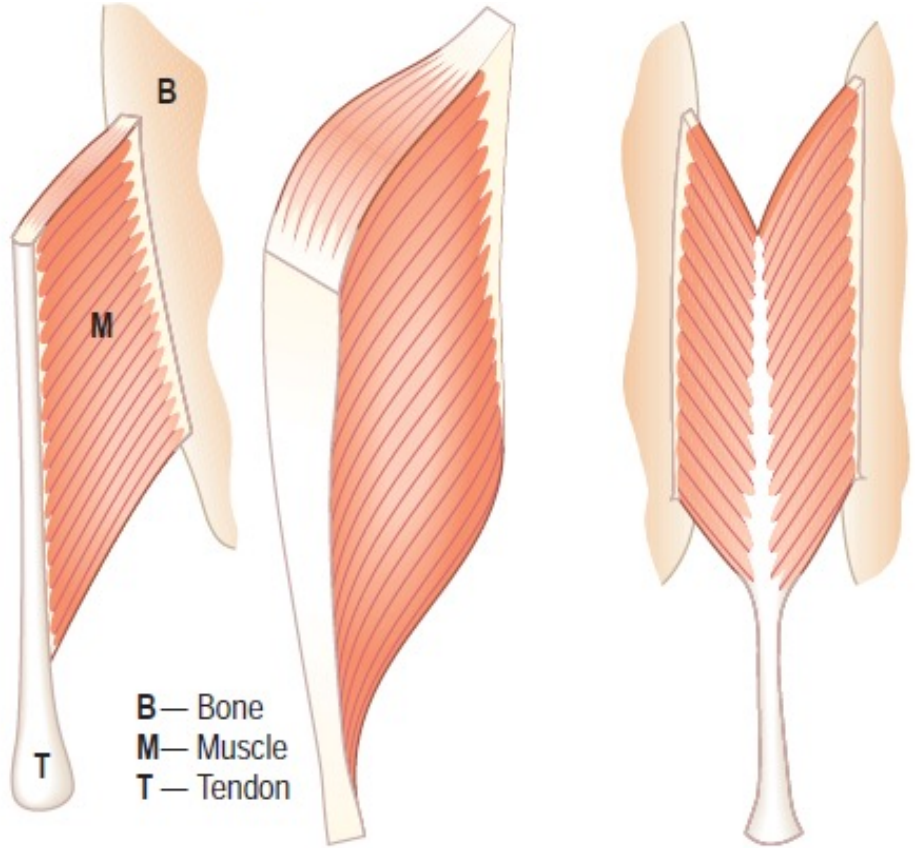




Bone-tendon junction

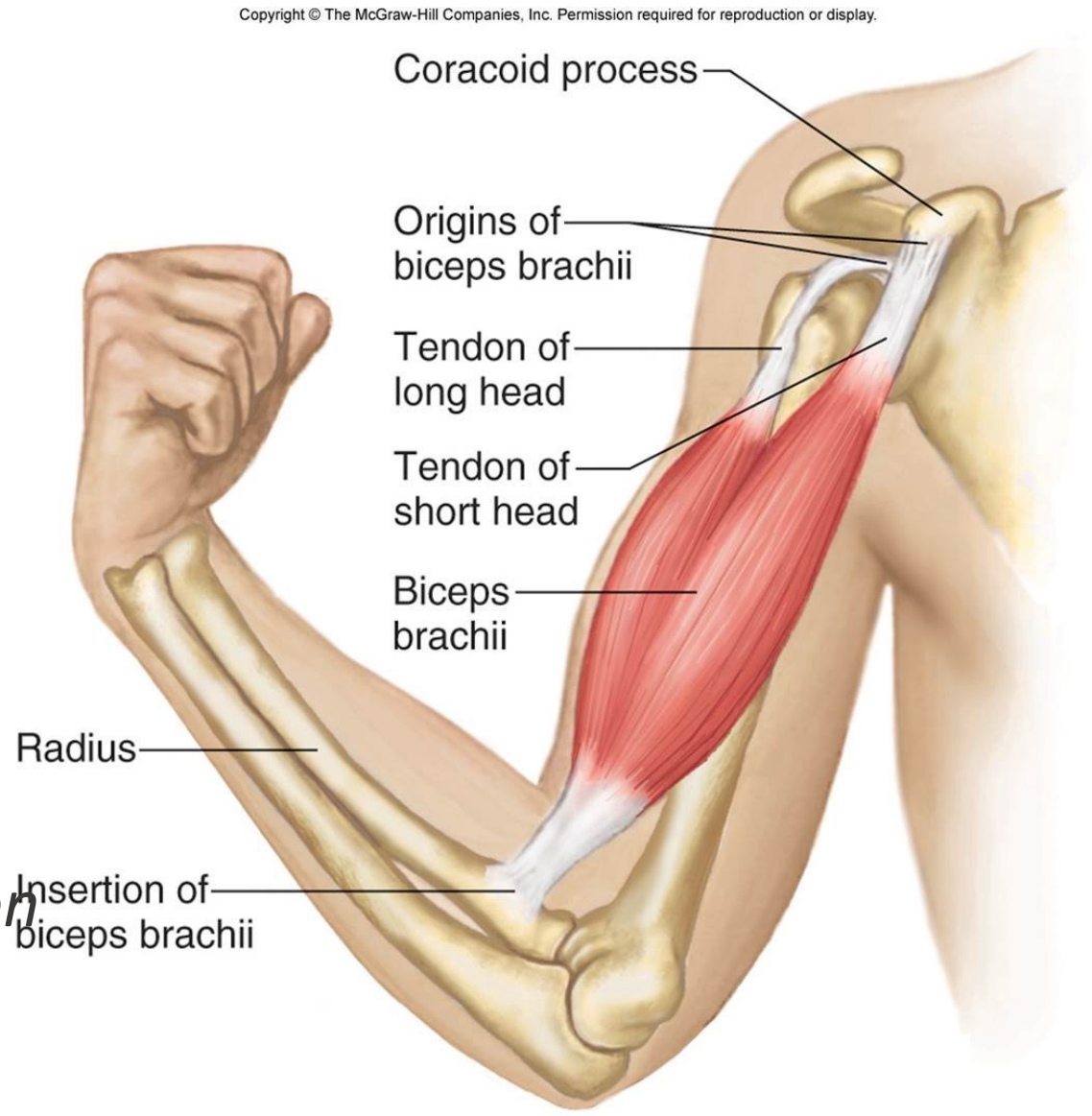
- **Tuber (tuber calcanei)**
  - *Acromion*
  - *Olecranon*
  - *trochanter*
- **Tuberculum (tuberculum maius humeri)**
- **Tuberositas (uberositas tibiae)**

- *Less frequent*

- **Fossa**
- **Fovea**

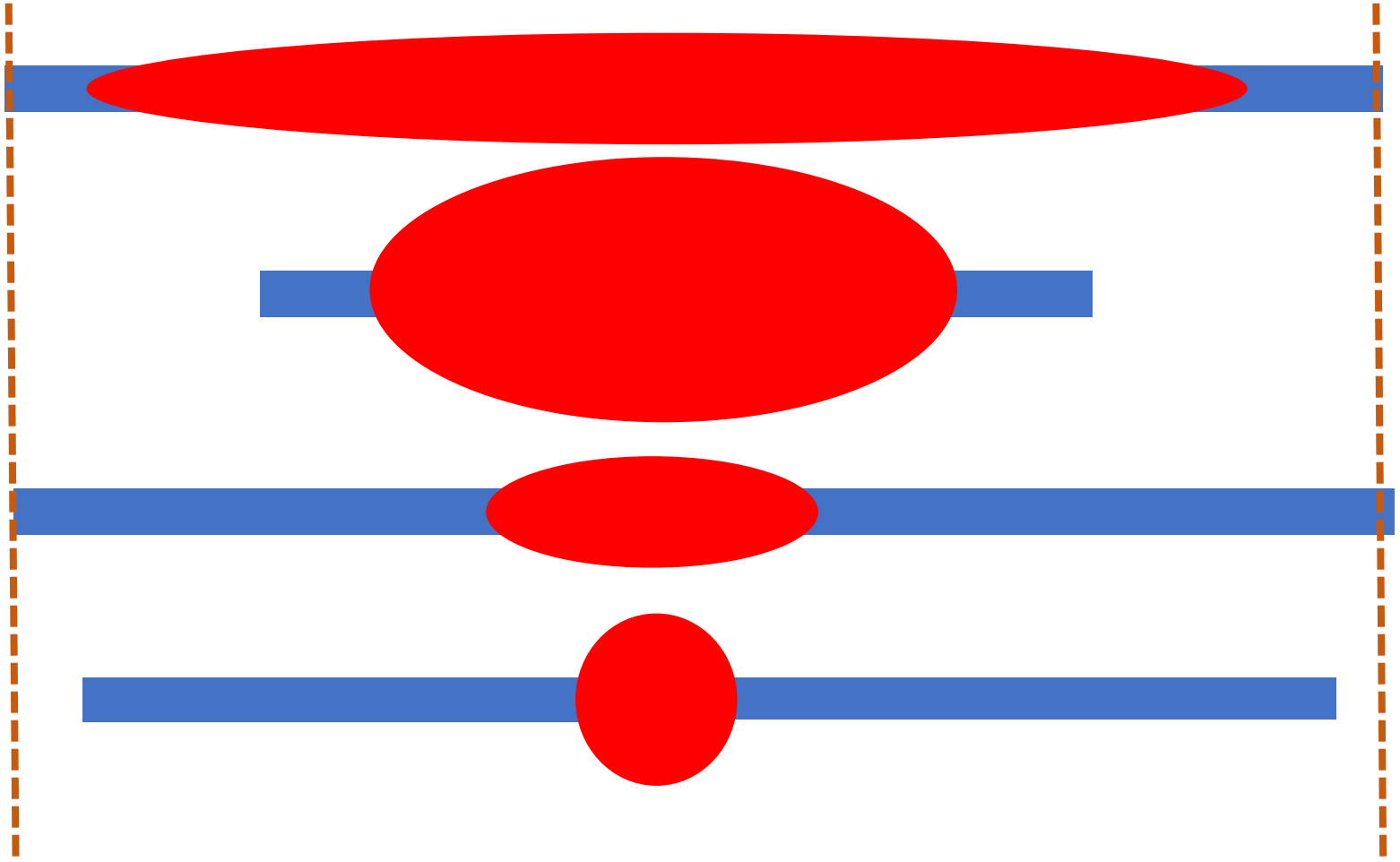
Origin and insertion

- **Origo - caput - starting point**
- **Punctum fixum**
  - *More cranial*
  - *Fixed during contraction*
- **Venter**
- **Insertio - cauda**
- **Punctum mobile**
  - *More caudal*
  - *More movable during contraction*



Weber – fick law

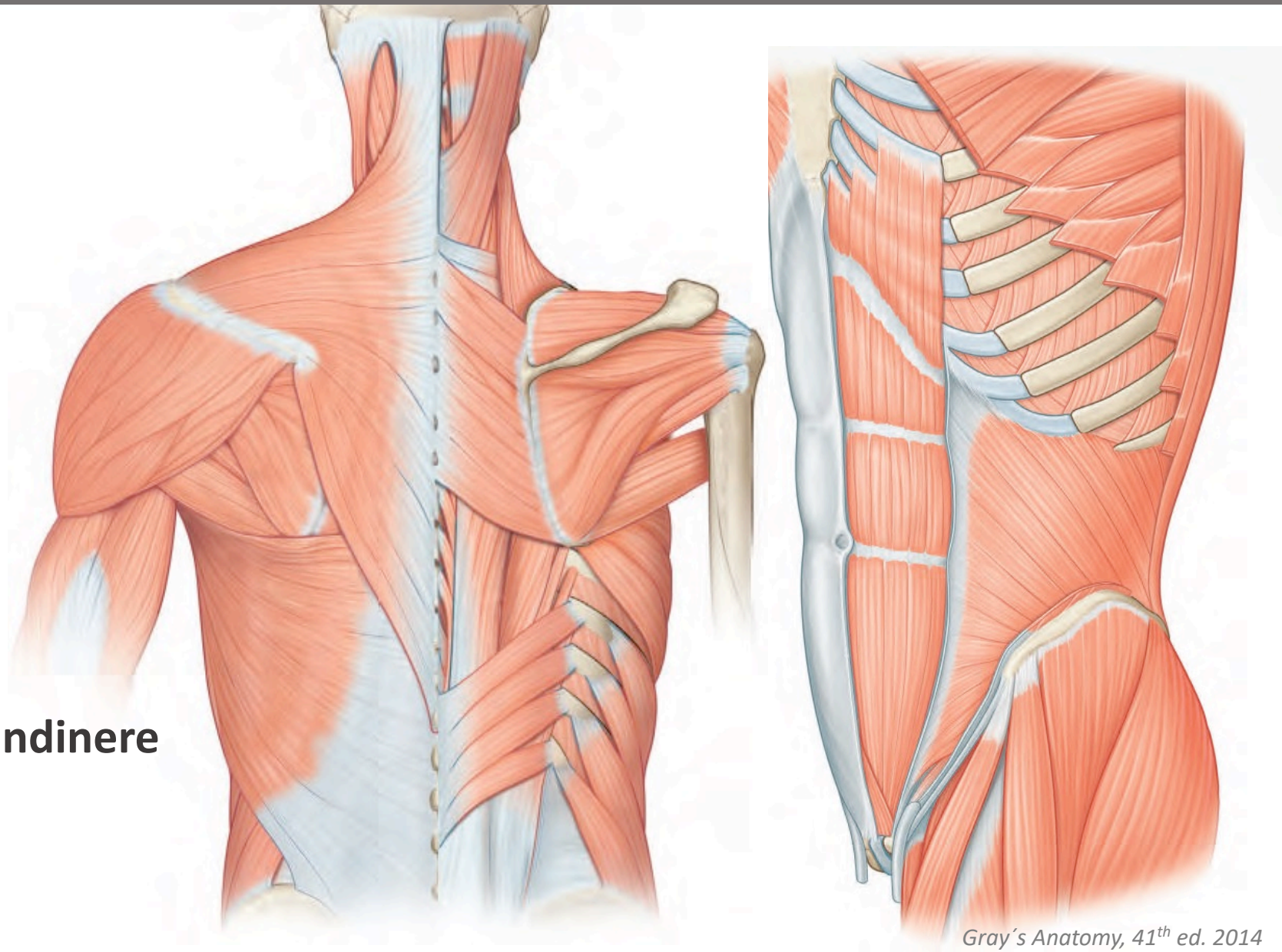
- Contraction of the muscle to ½ length of VENTER MUSCULI
- Working shortening is depending of the tendon lenght



Muscular types and shapes

- **Long**
- **Flat**
- **Short**

- **M. biceps**
- **M. triceps**
- **M. pennatus**
- **M. digastricus**
- **M. planus - intersectiones tendinere**
- *M. sphincter - circular fibres*
- *M. dilatator - radial fibres*



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Transsection of muscle

- **Anatomical - perpendicular**
- **Physiological - trough all fibers**

- **M. fusiformis - anatomical = physiological**
- **M. pennatus - anatomical << physiological**

- **Forces of the muscular contraction**
  - **Physiological transection area**

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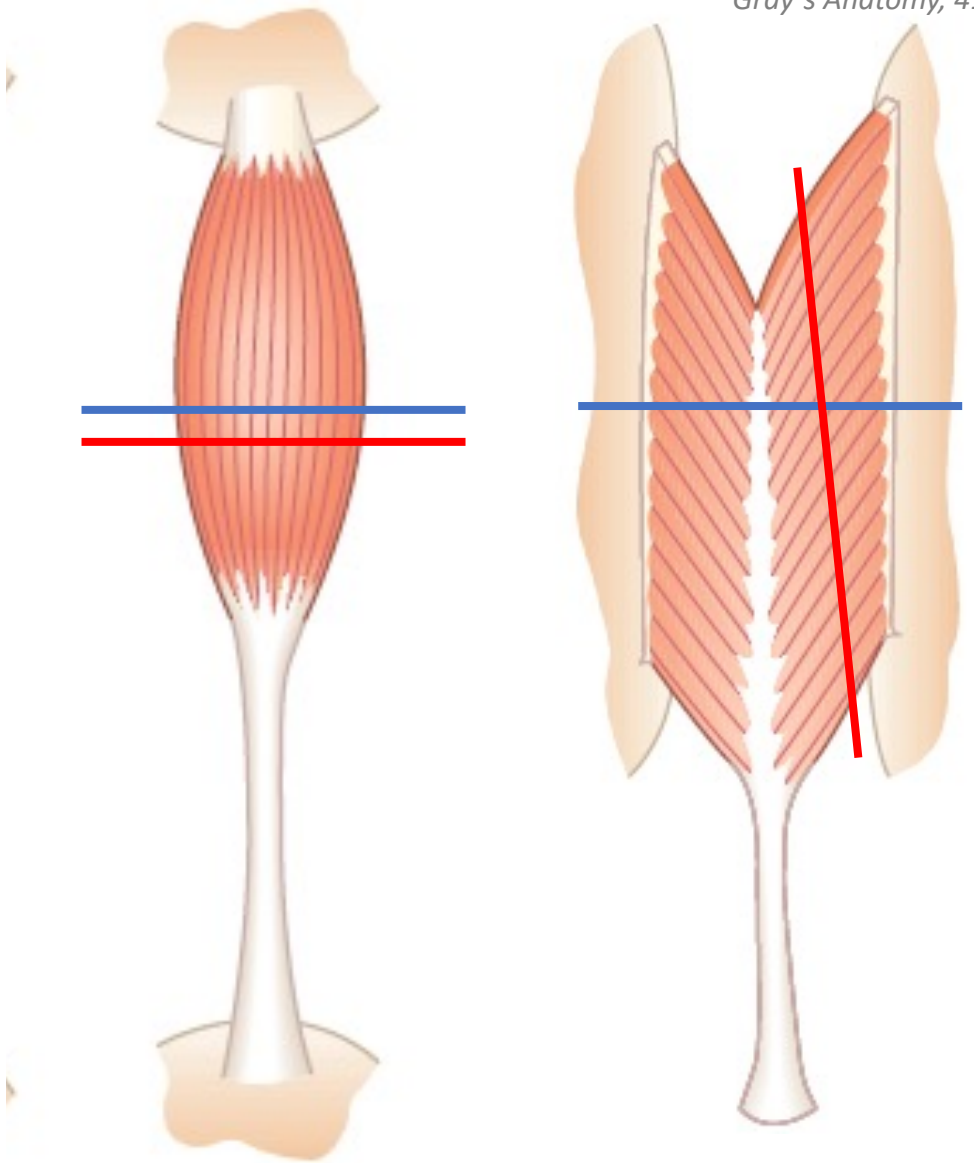
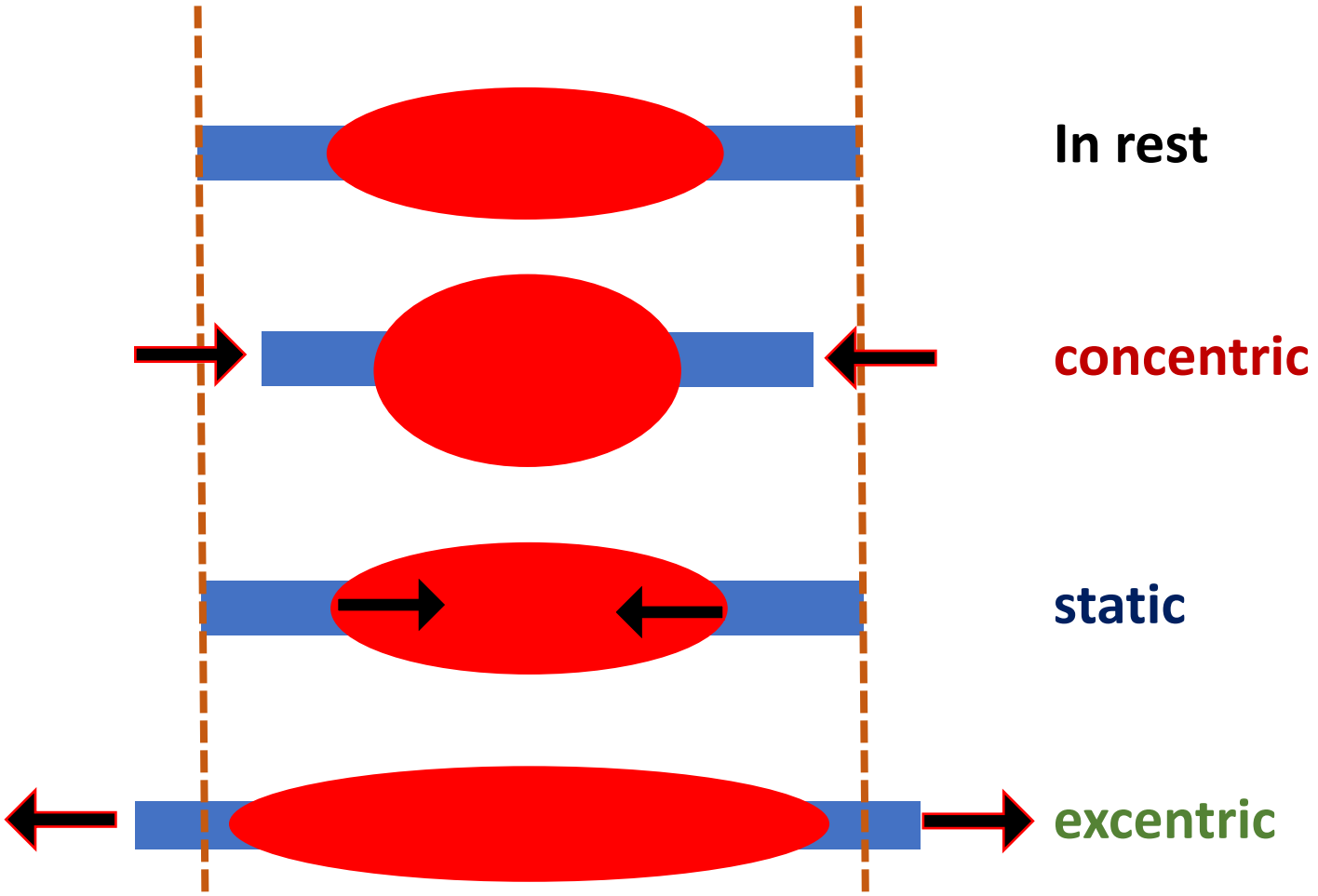


Muscular contraction

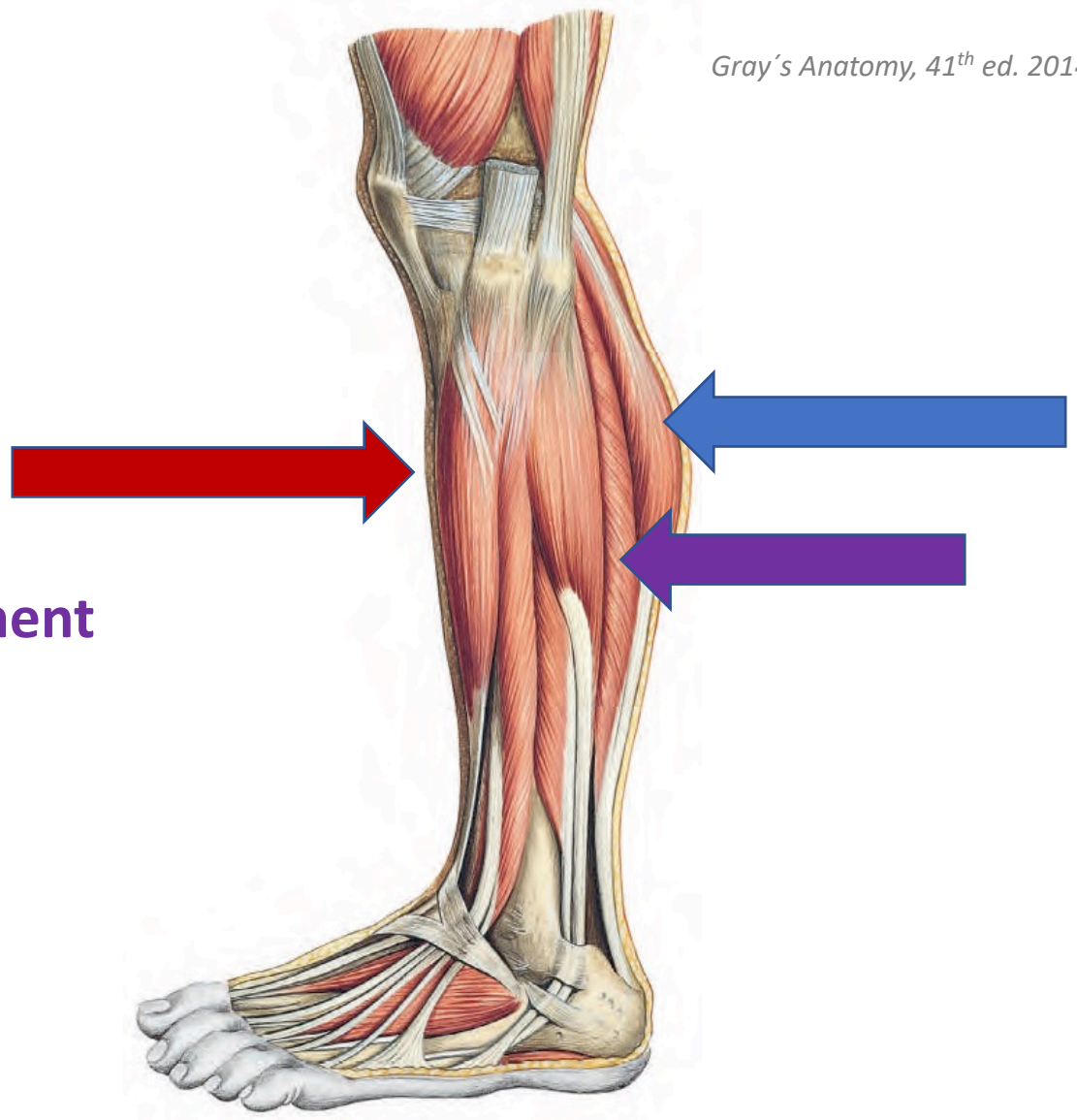
- concentric (isotonic)
  - Dynmical (phasic) muscles
- Static (isometric)
  - Static muscles - postural
- Excentric (braking)
  - Élongation is braking antagonst



Pairs of muscles

- FLEXOR
- ADDUCTOR
- INTERNAL ROTATOR
- EXTENSOR
- ABDUCTOR
- EXTERNAL ROTATOR

- Agonist - executing movement
- Antagonist - executing reverse movement
- Synergist - cooperation during certain movement



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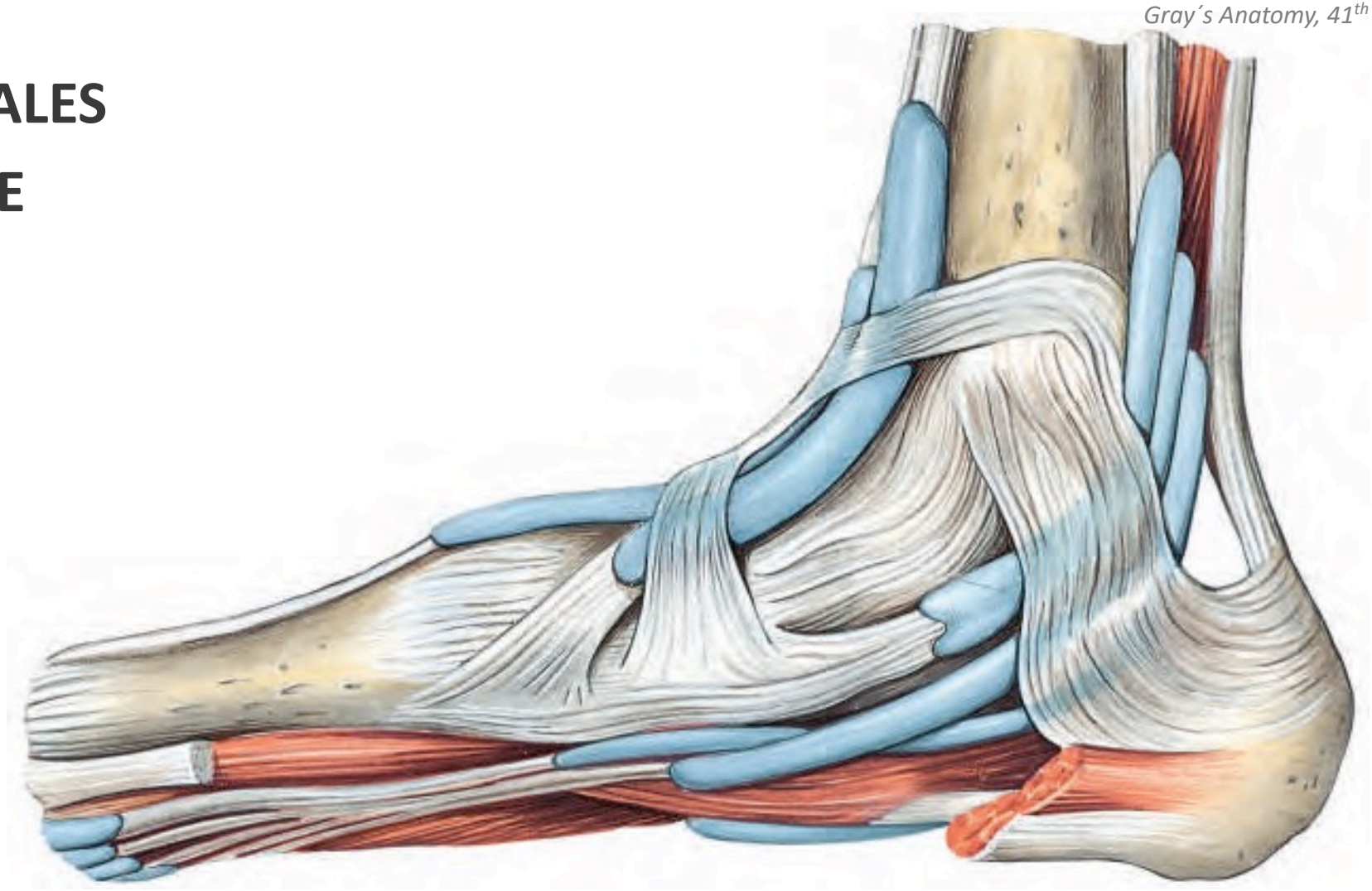
Muscular acceesories

- **FASCIAE**
- **VAGINAE SYNOVIALES**
- **BURSAE MUCOSAE**
- **TROCHLEAE**



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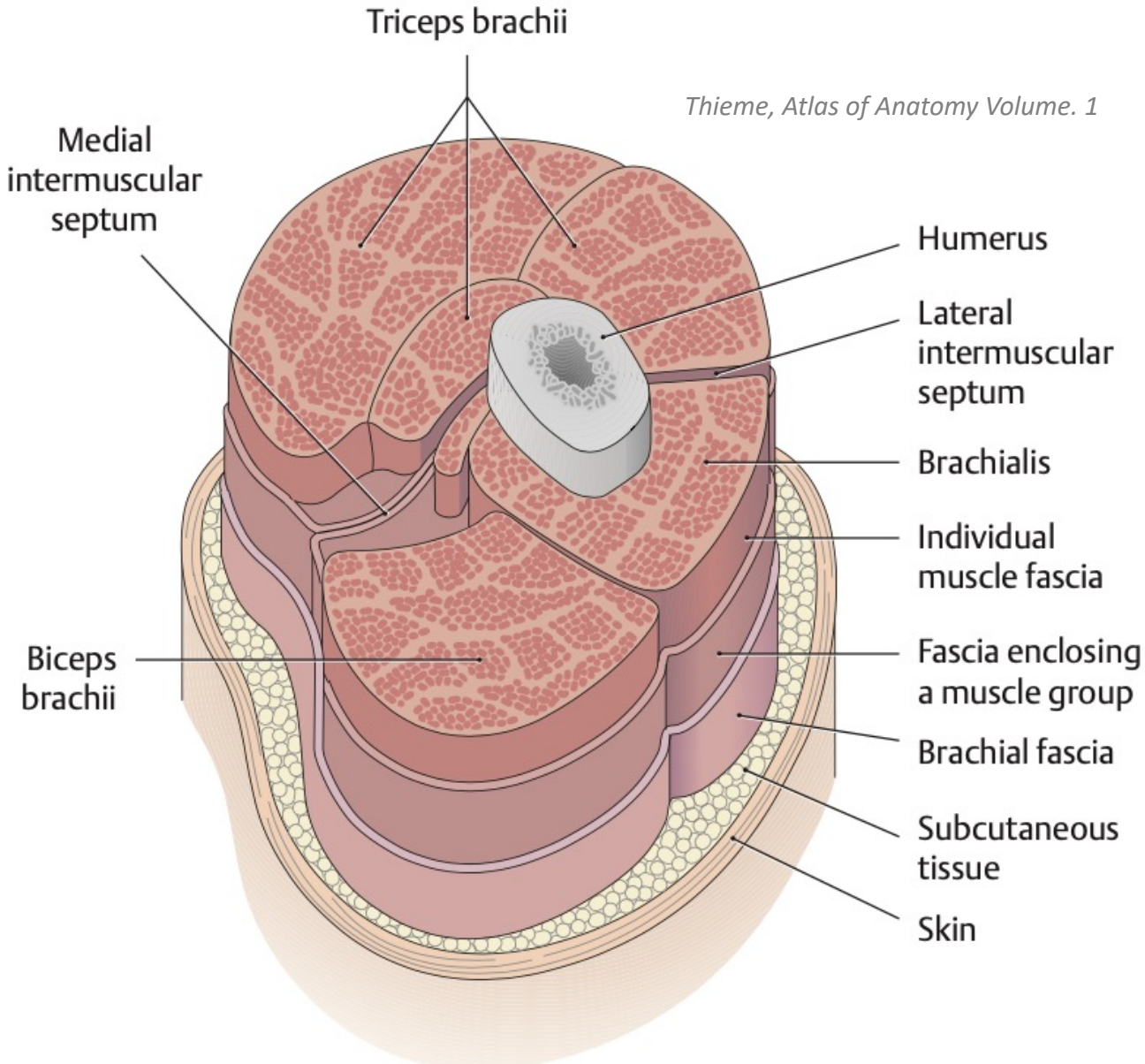
Fascia

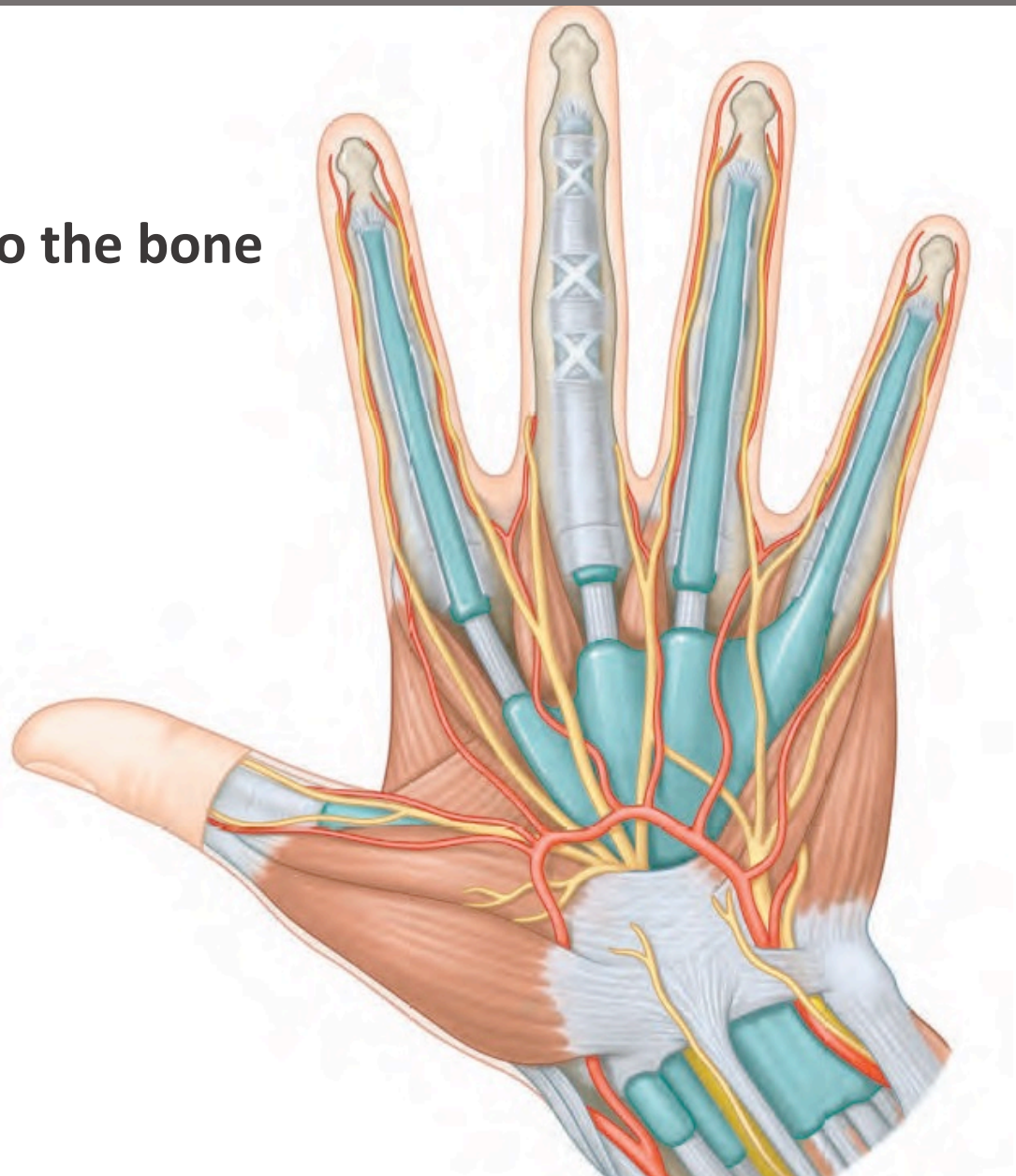
- **FASCIA muscular sheath**
  - Sliding of the muscle
  - Vascualr and neural supply
  - Creating spaces - compartements
  - Infection and tumorous spread
- **Fascia propria**
  - Ont he surface of a single muscle
  - Subfascial space
- **Fascia of the muscular group**
  - Muscular compartement
- **Osteofascial space**
  - Muscles with bone



Thieme, Atlas of Anatomy Volume. 1

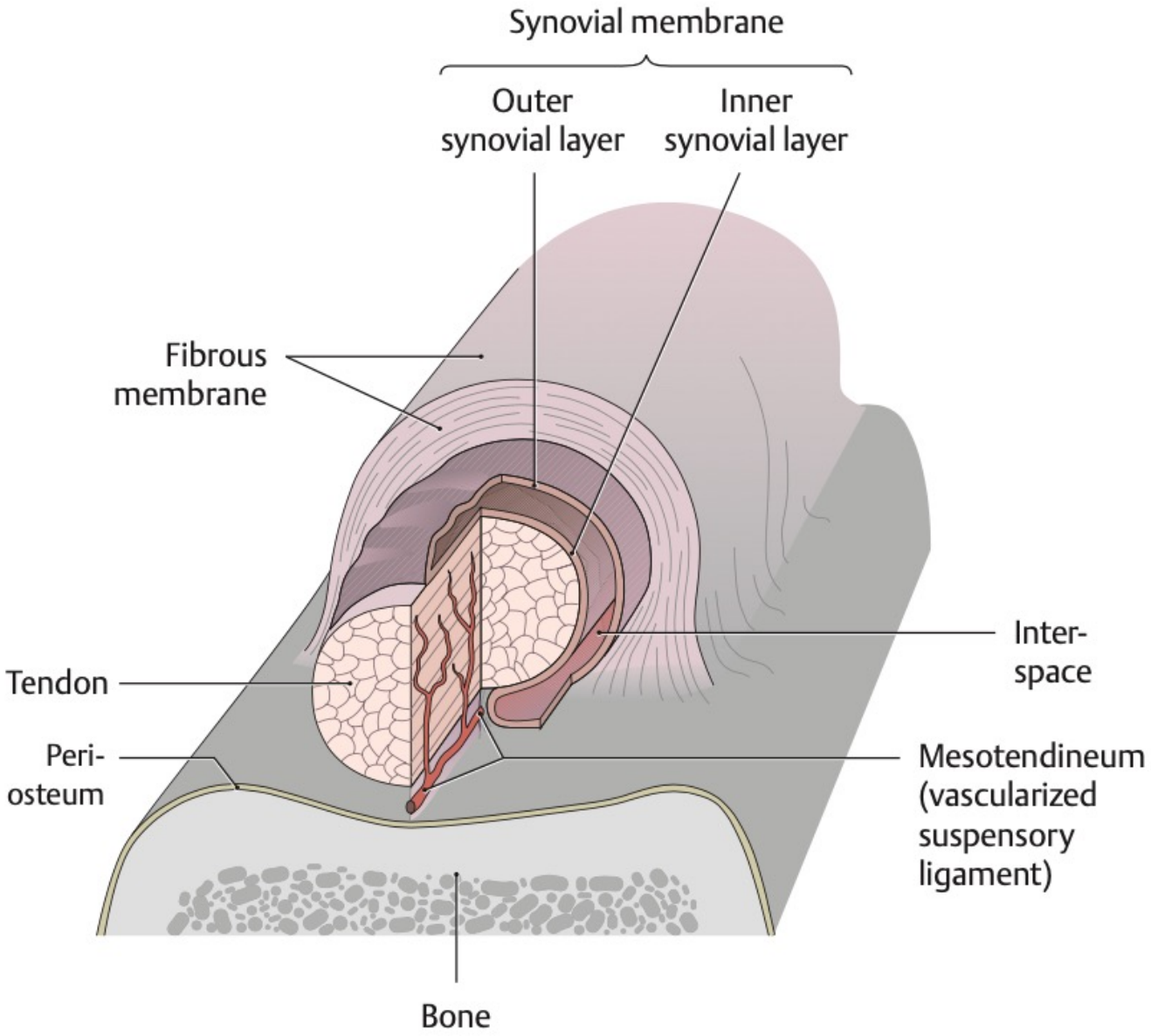
Synovial sheath

- **Synovial coverage of the tendon**
- **In osteofibrous space - holding the tendon to the bone**
- **vagina fibrosa**
- **vagina synovialis**
  - *Inside of v. fibrosa*



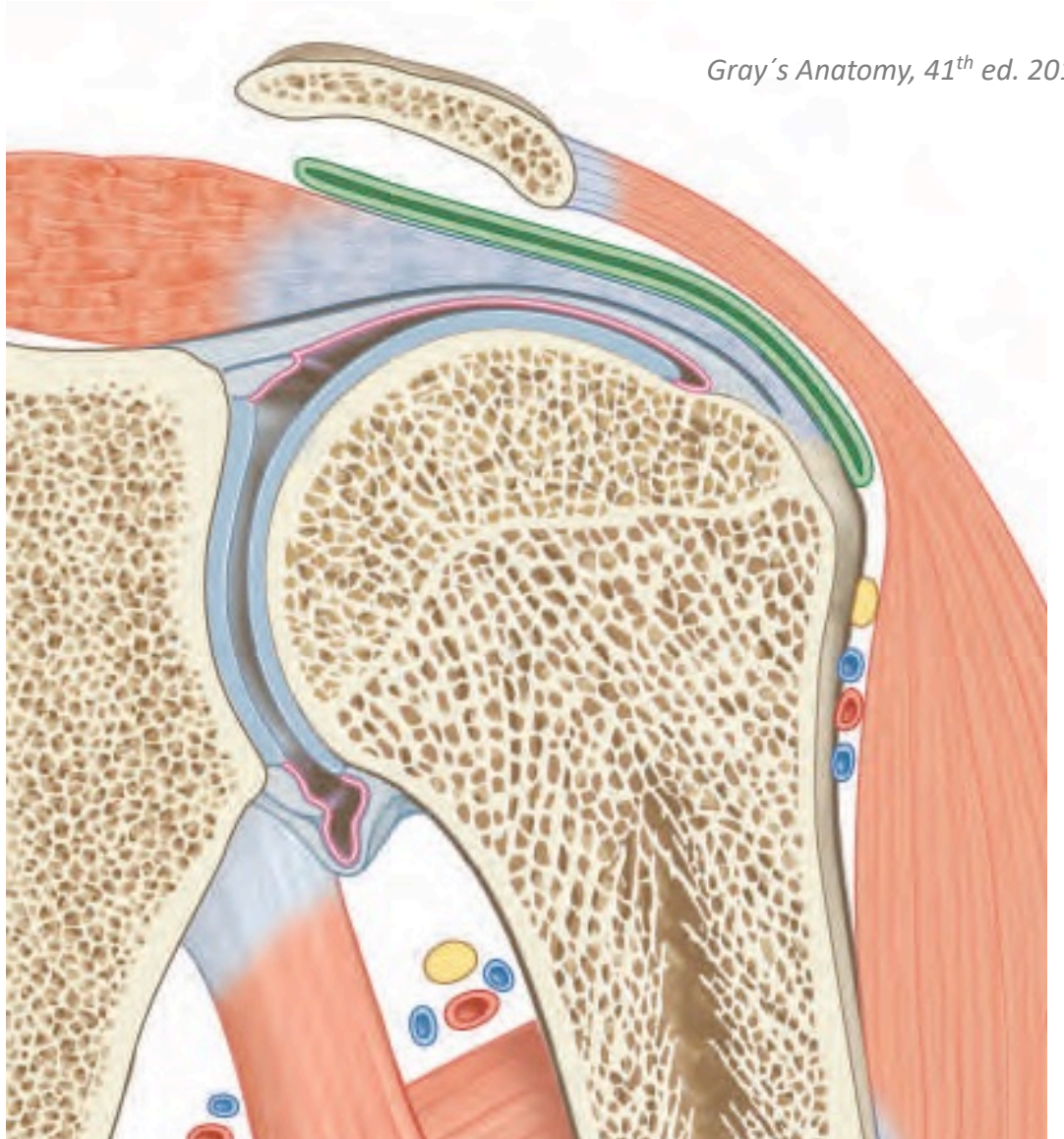
Tenonia

- Vagina fibrosa
- delineating osteofibrous space
- **EPITENONIUM**
  - Inner layer
  - On the surface of the tendon
- **PARATENONIUM**
  - outer layer
- **MESOTENONIUM**
  - „mesentery“ of the tendon
  - Connection between
    - epi- and paratenonium
  - Vascular gate to the tendon
  - Infection spread
  - disconnetion - necrosis of the tendon



Bubursae mucosae

- Gravity pouch
- Fibrous pouches
- Enlayered by synovial membrane
- Filled by synovial fluid
- In friction points with
  - muscle
  - tendon
  - Surrounding tissues



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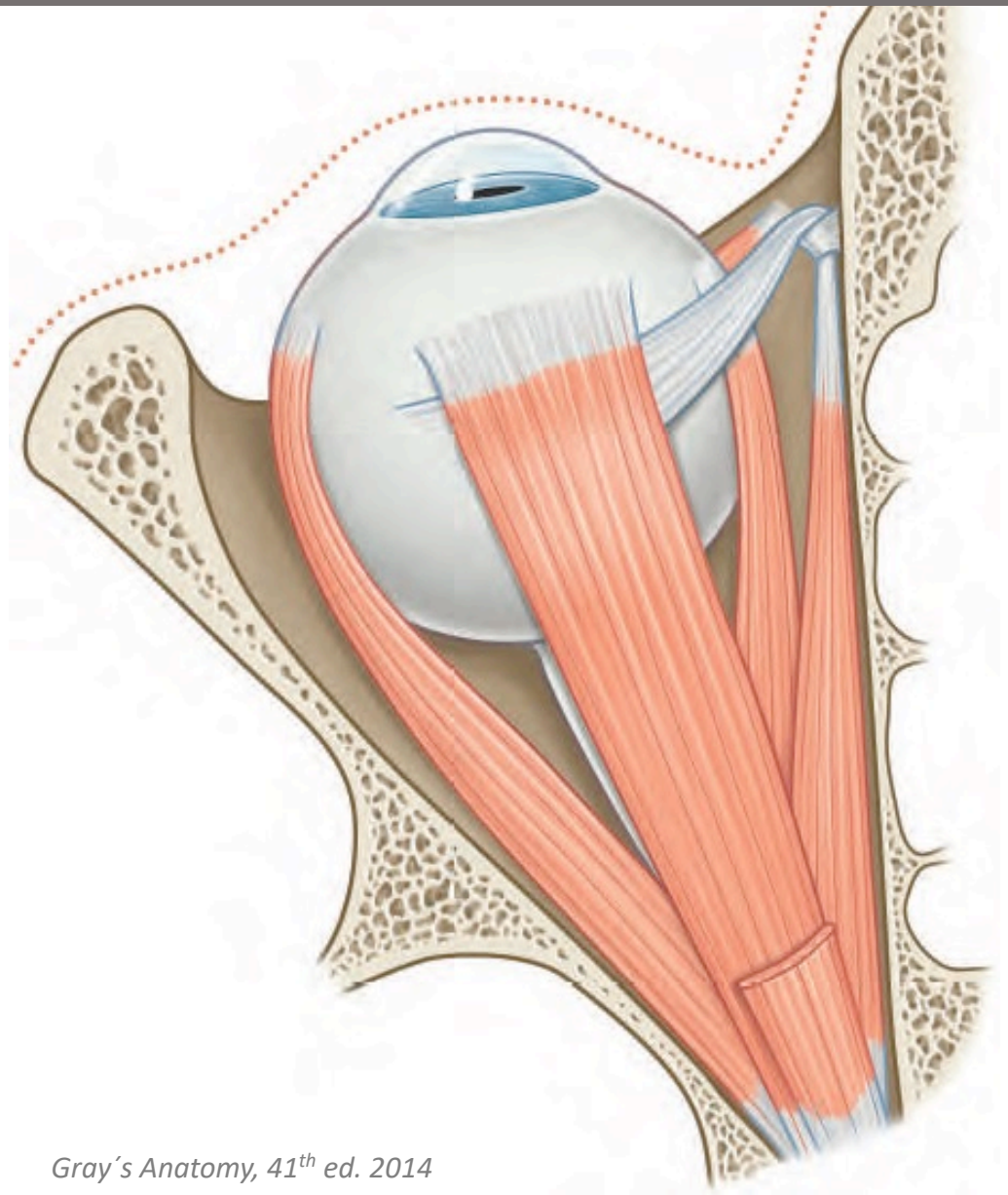
Trochlea

- **tackle**
- **Fibrous hook**
- *Angulation of a tendon*
- *Force acts in the direction of terminal tendon part*
- **M. obliquus superior - eye-ball movement**



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General anatomy 1.