

BONES, ARTICULATIONS AND MUSCLES OF THE HUMAN BODY

1. Bones, articulations and muscles of the vertebral column – an overview
2. Bones, articulations and muscles of the thorax – an overview
3. Bones, articulations and muscles of the upper limb – an overview
4. Bones, articulations and muscles of the lower limb – an overview
5. Bones, articulations and muscles of the cranium – an overview



Human skeleton, *skeleton*

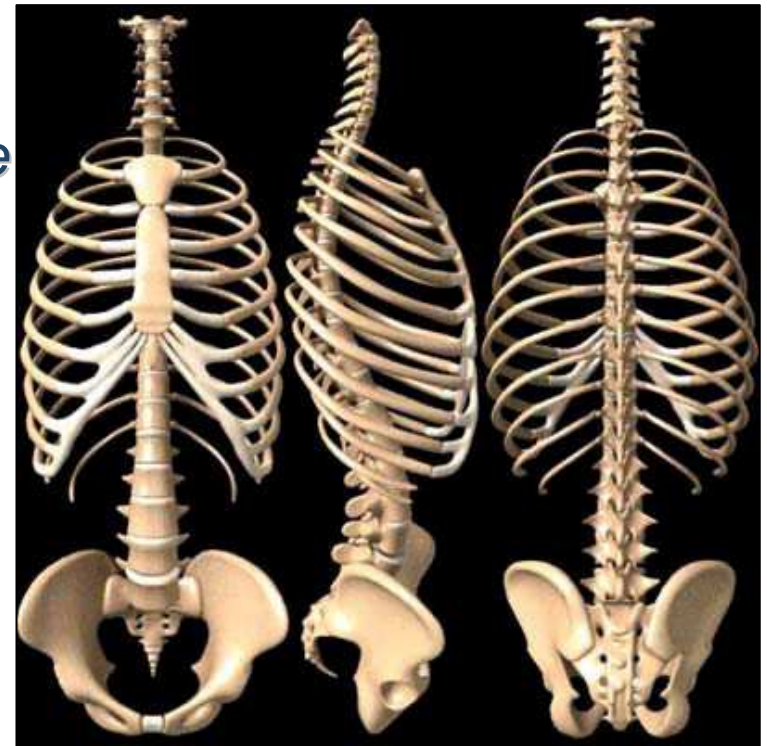
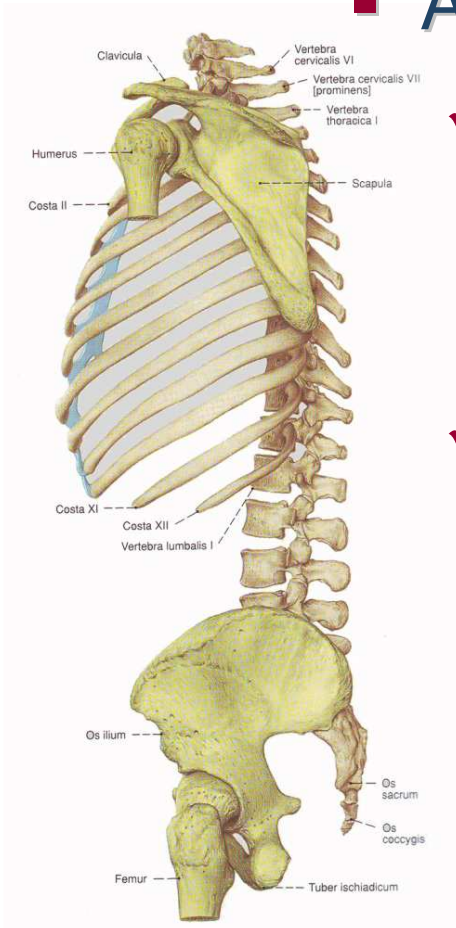
■ Axial skeleton:

✓ Vertebral column (spine),
columna vertebralis

- 33 vertebra, *vertebrae*

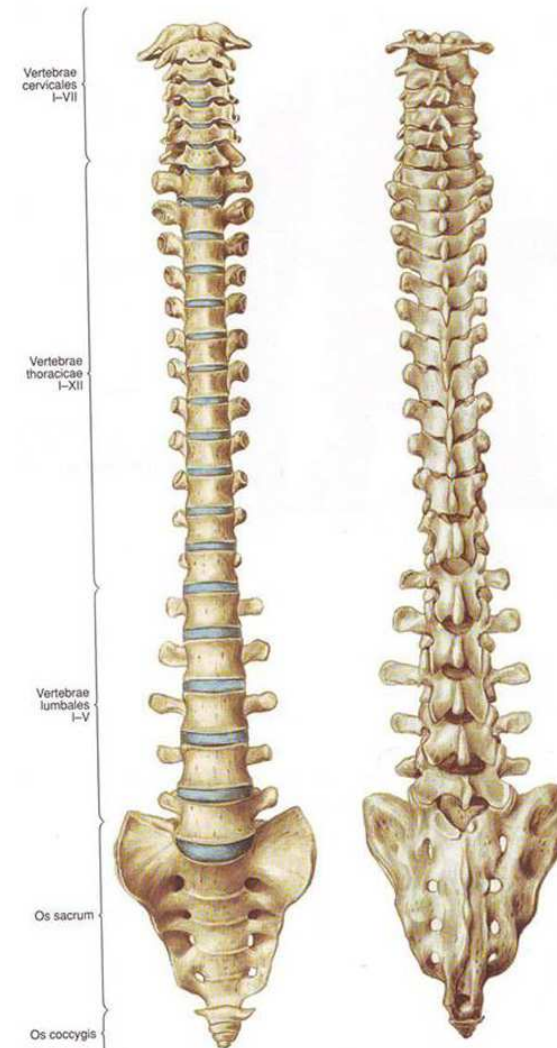
✓ Rib cage, *thorax*

- ribs, *costae*
- sternum, *sternum*
- thoracic vertebrae,
vertebrae thoracicae



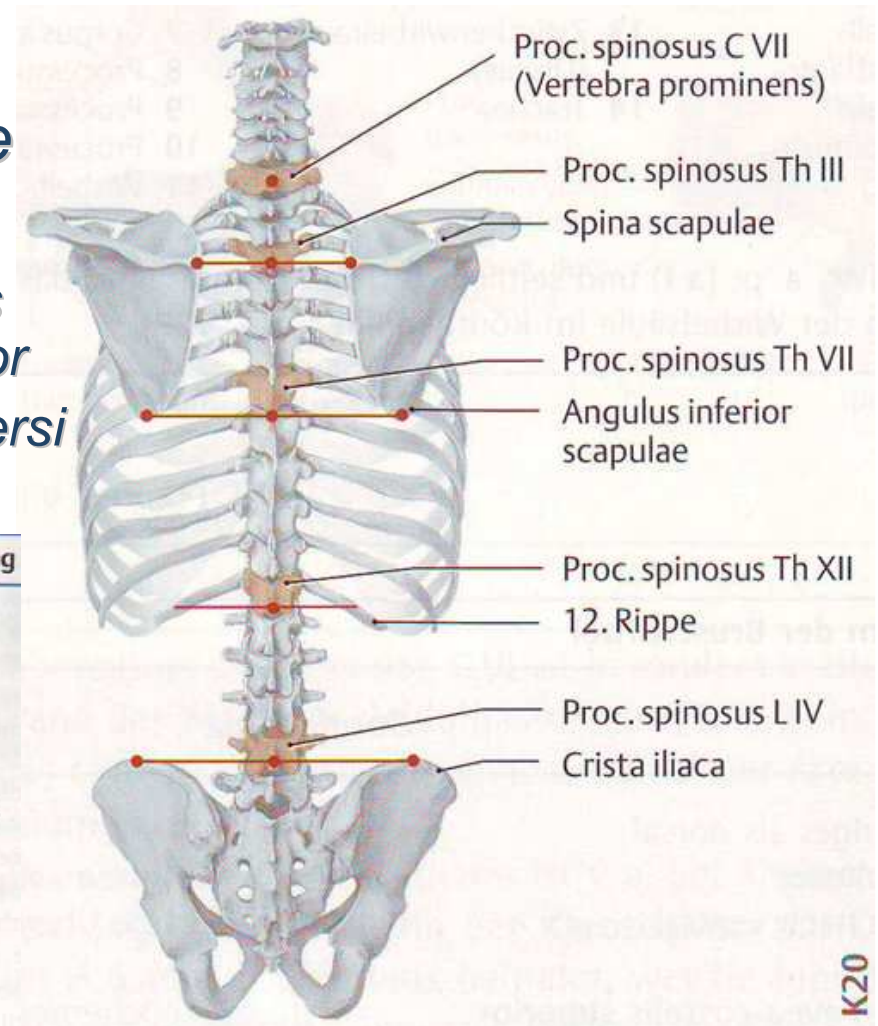
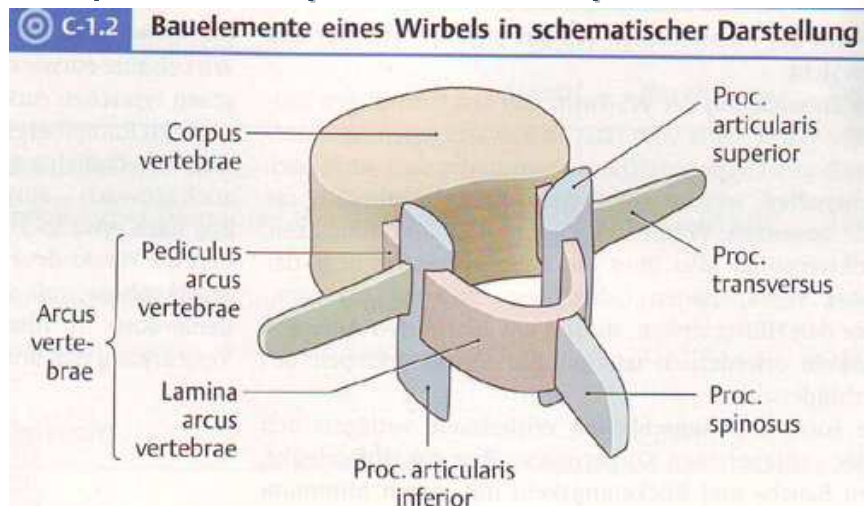
Vertebrae, *vertebrae* (Gr. *spondylos*)

- 32-34 vertebrae:
 - ✓ 24 articulating vertebrae, *vertebrae verae*:
 - cervical vertebrae – 7
 - thoracic vertebrae – 12
 - lumbar vertebrae – 5
 - ✓ 9 fused vertebrae, *vertebrae spuriae*:
 - sacrum, *os sacrum*
 - tailbone, coccyx, *os coccygis*



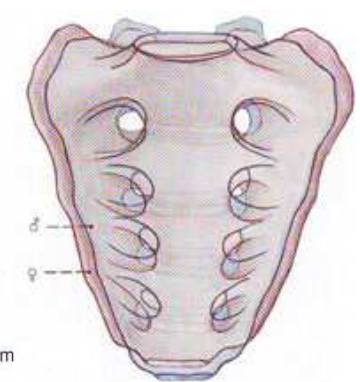
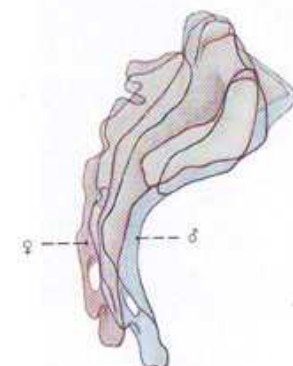
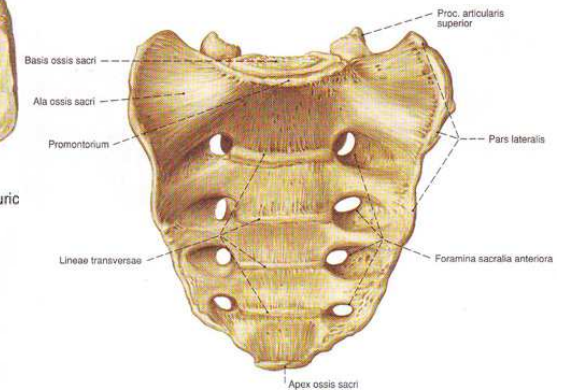
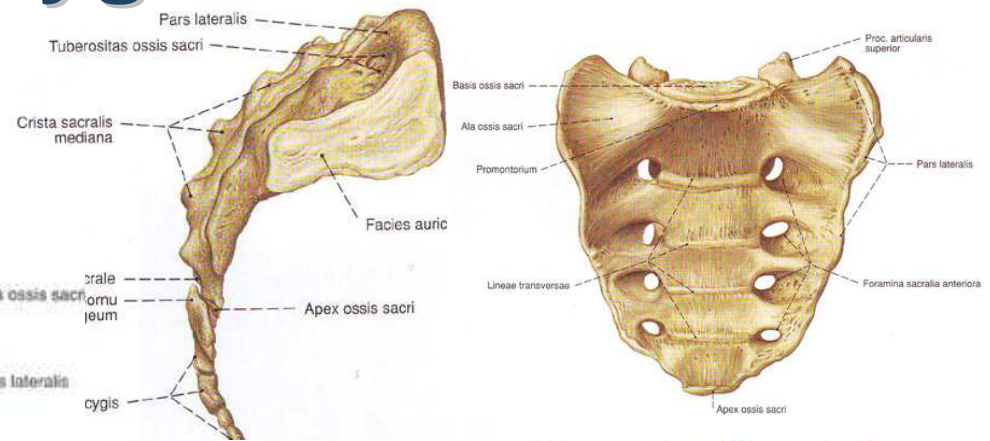
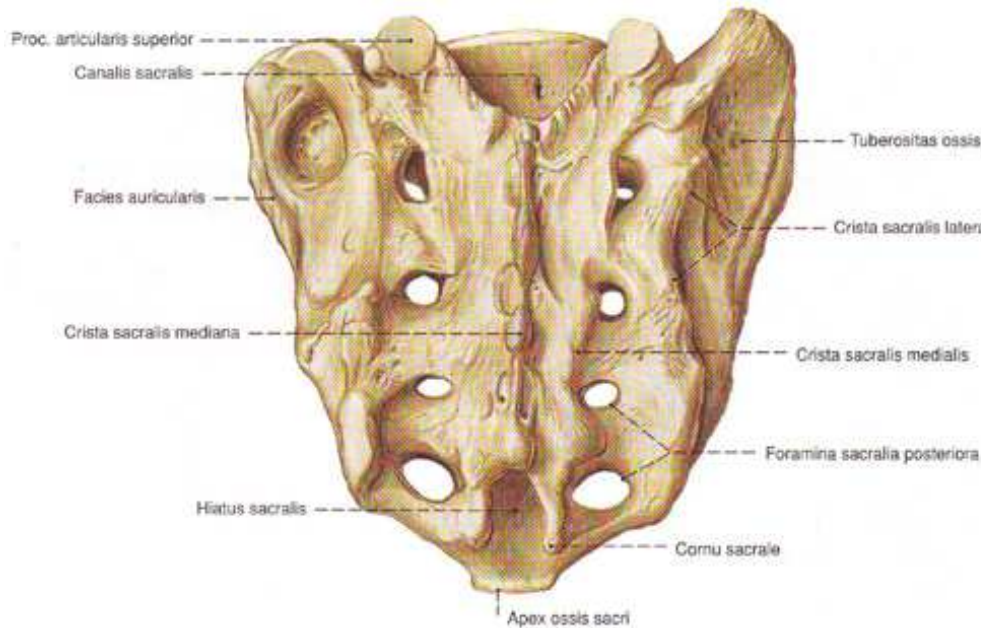
Structure of a typical vertebra

- Parts of the vertebra:
 - ✓ body, *corpus vertebrae*
 - ✓ vertebral arch, *arcus vertebrae*
 - ✓ 7 processes, *processus*:
 - 4 articular – *processus articularis (zygapophysis) superior et inferior*
 - 2 transverse – *processus transversi*
 - spinous – *processus spinosus*



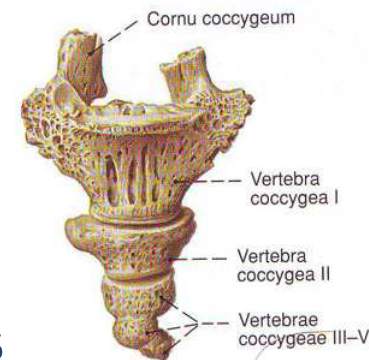
Sacral and coccygeal vertebrae

■ Sacrum, *os sacrum*



■ Tailbone, *os coccygis (coccyx)*

- ✓ formed of rudimentary vertebrae
- ✓ varying in number vertebrae – 3-5
- ✓ usually fused in middle age ~ 30 years



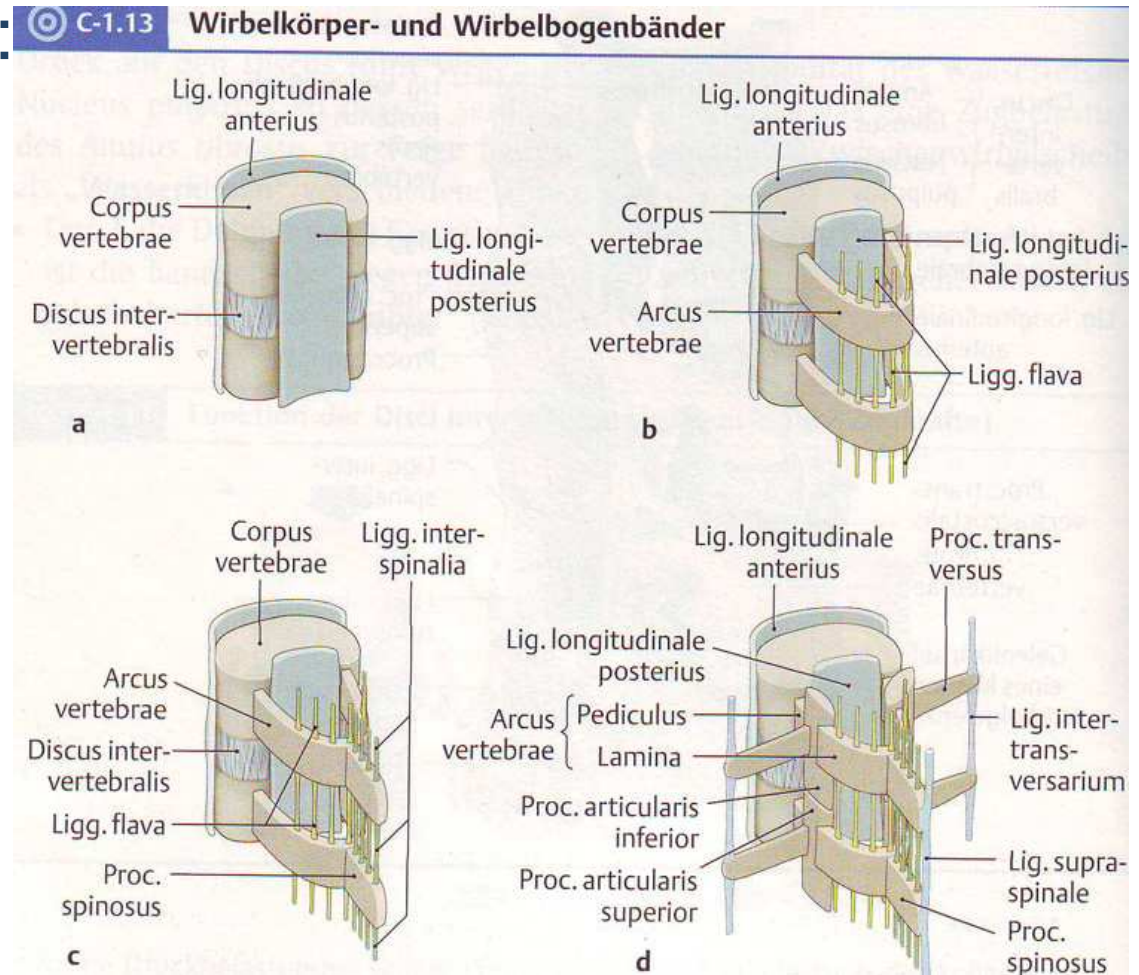
Articulations of the vertebral column, *articulationes vertebrales*

Types of articulations:

- ✓ syndesmoses
- ✓ syndchondroses
- ✓ synostoses
- ✓ articulations (synovial joints)

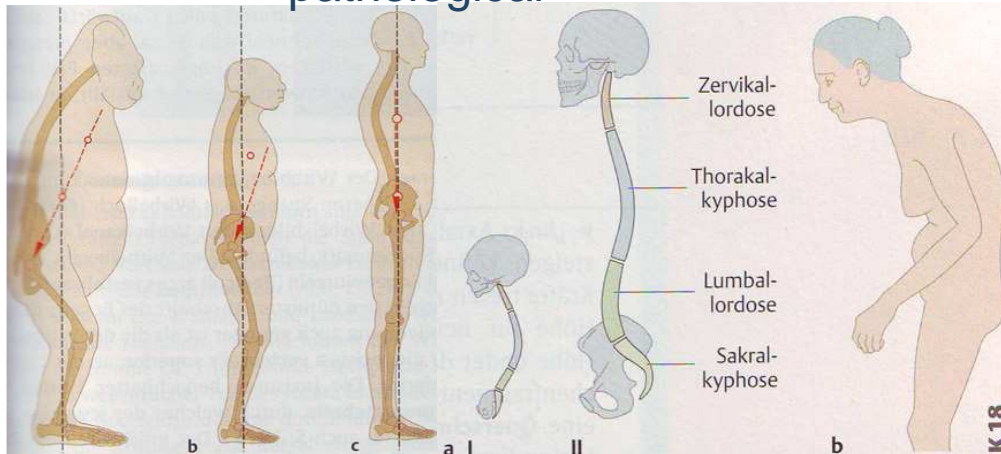
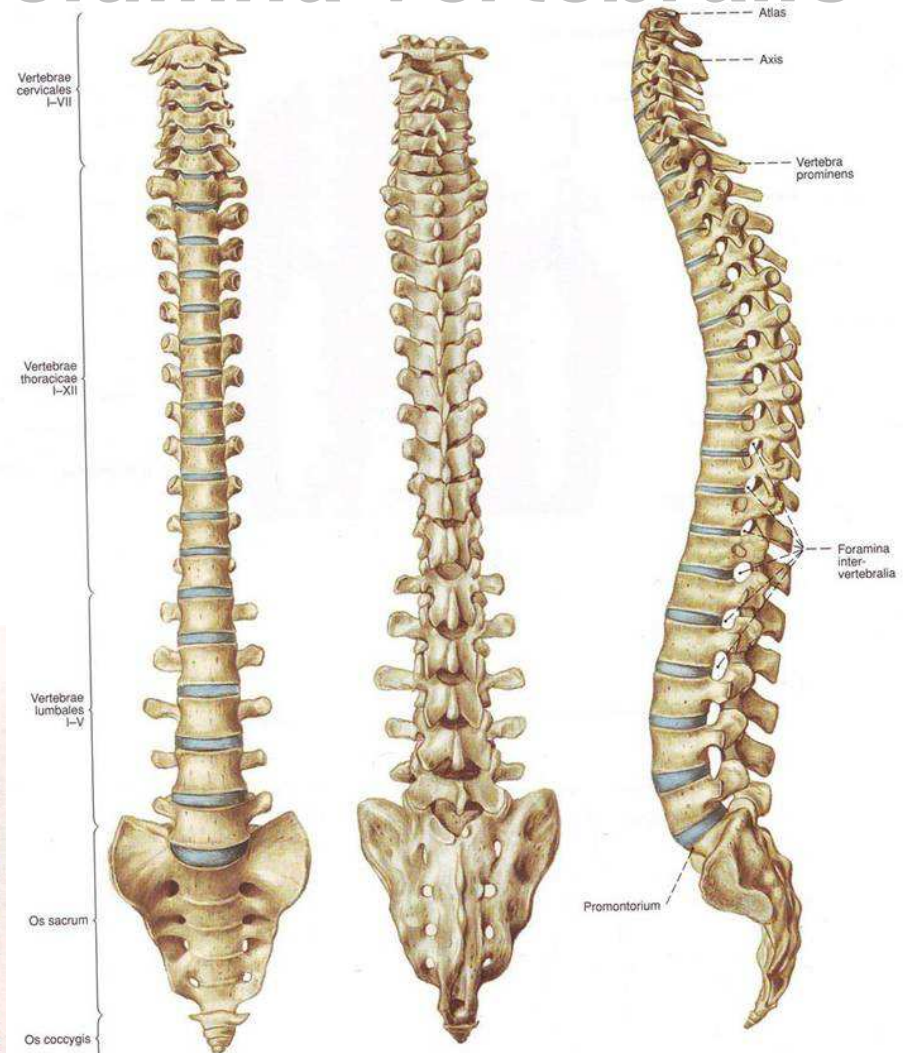
a series of joints between the:

- ✓ vertebral bodies
- ✓ vertebral arches
- ✓ vertebral processes

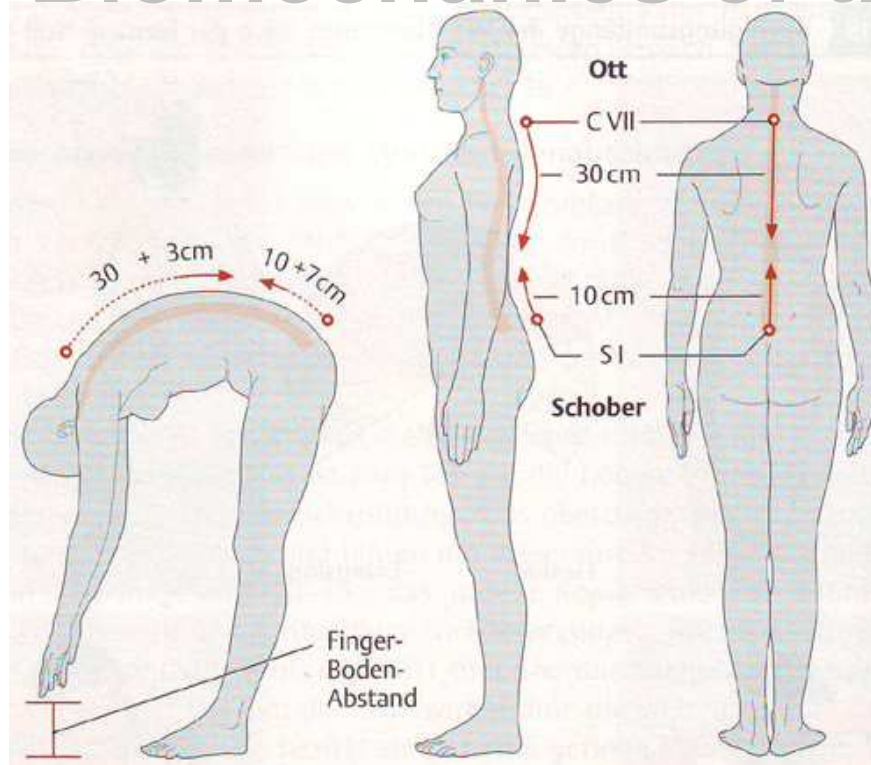


Vertebral column as a whole, *columna vertebralis*

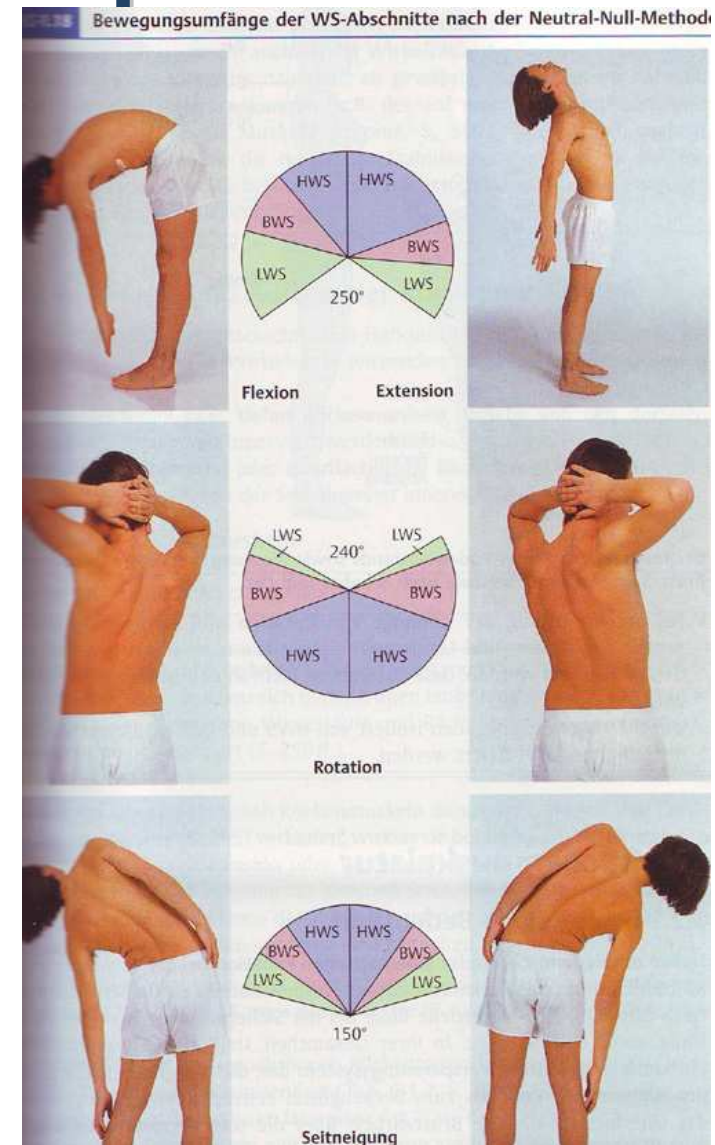
- average length – 60-70 cm, 2/5 of the human height
- double S-shape:
 - ✓ evolutionary trend, in primates – single S-shaped
 - ✓ *lordosis*, cervical and lumbar
 - ✓ *kyphosis* (Gr. *kyphos*, a hump) roundback, thoracic and sacral
 - ✓ *scoliosis* (Gr. σκολίωσις, obliquity)
 - physiological
 - pathological



Biomechanics of the spinal column

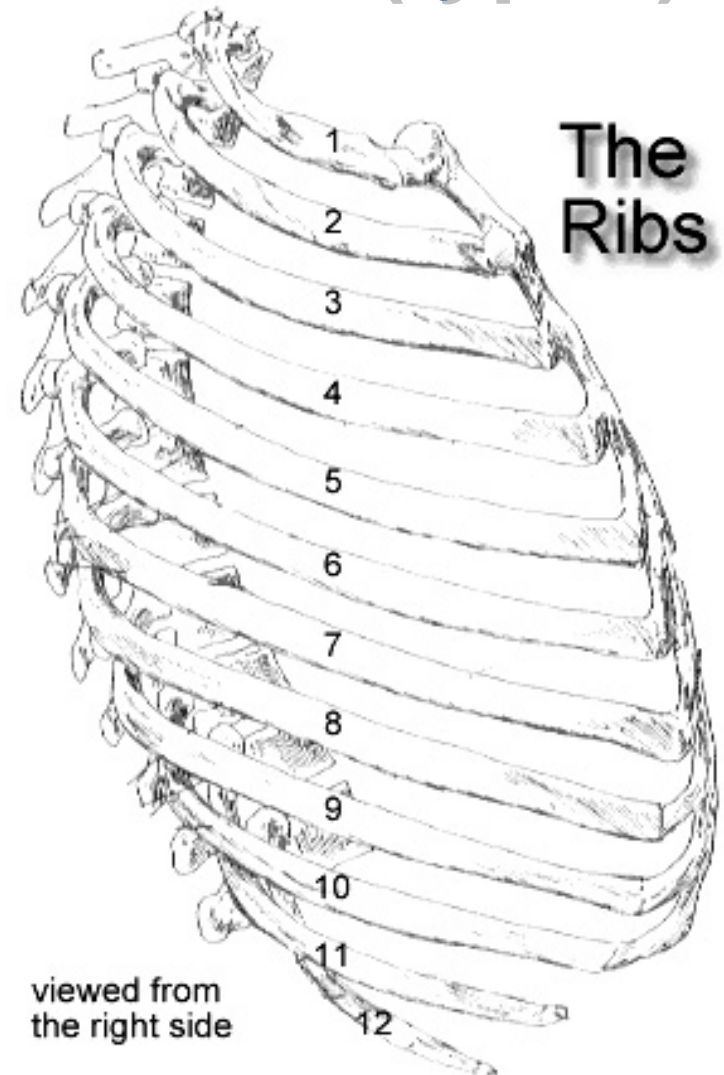
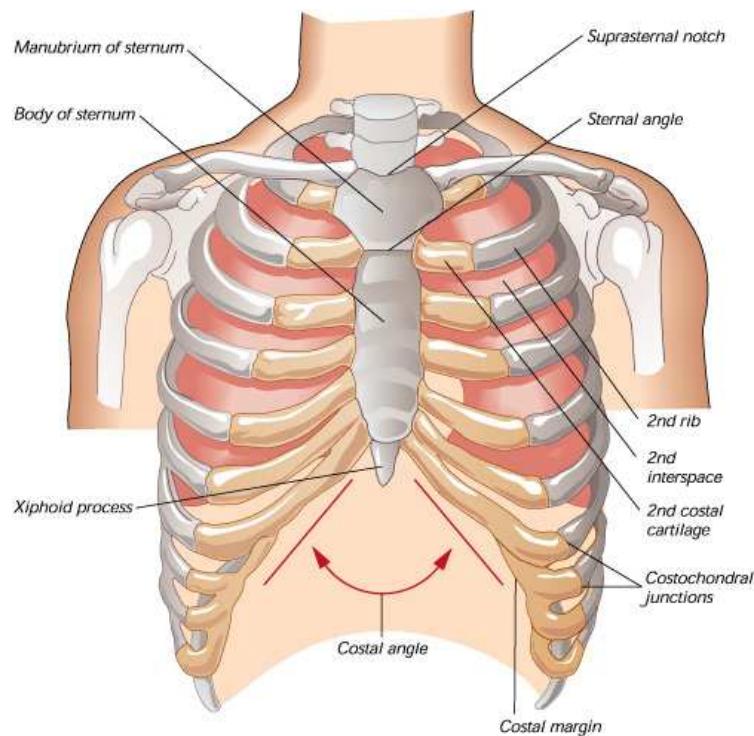


- three types of spinal movements:
 - ✓ in the sagittal plane:
 - flexion and extension $\sim 160^\circ$
 - ✓ in the frontal plane:
 - lateral bending $\sim 100^\circ$
 - ✓ along the longitudinal axis:
 - rotation up to 180°

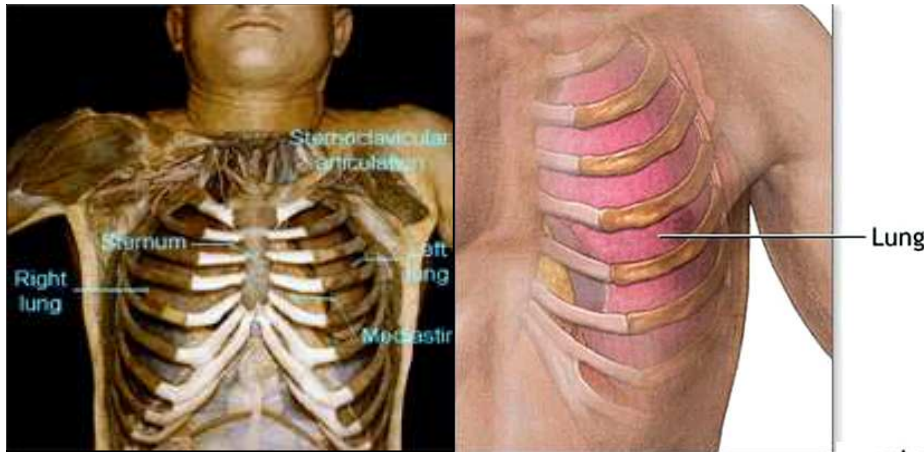


Ribs, *costae* (types)

- 12 pairs:
 - ✓ “true ribs”, *costae verae*
 - ✓ “false ribs”, *costae spuriae*
 - ✓ floating ribs, *costae fluctuantes*

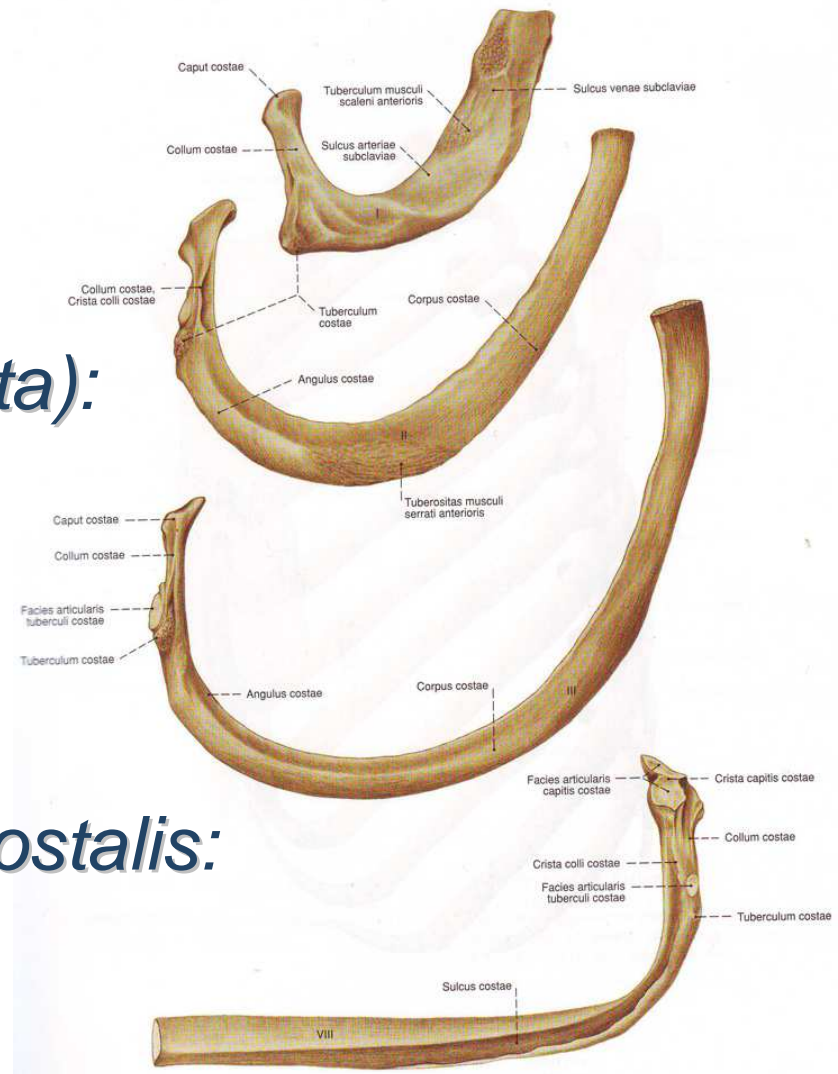


Ribs, *costae* (parts)



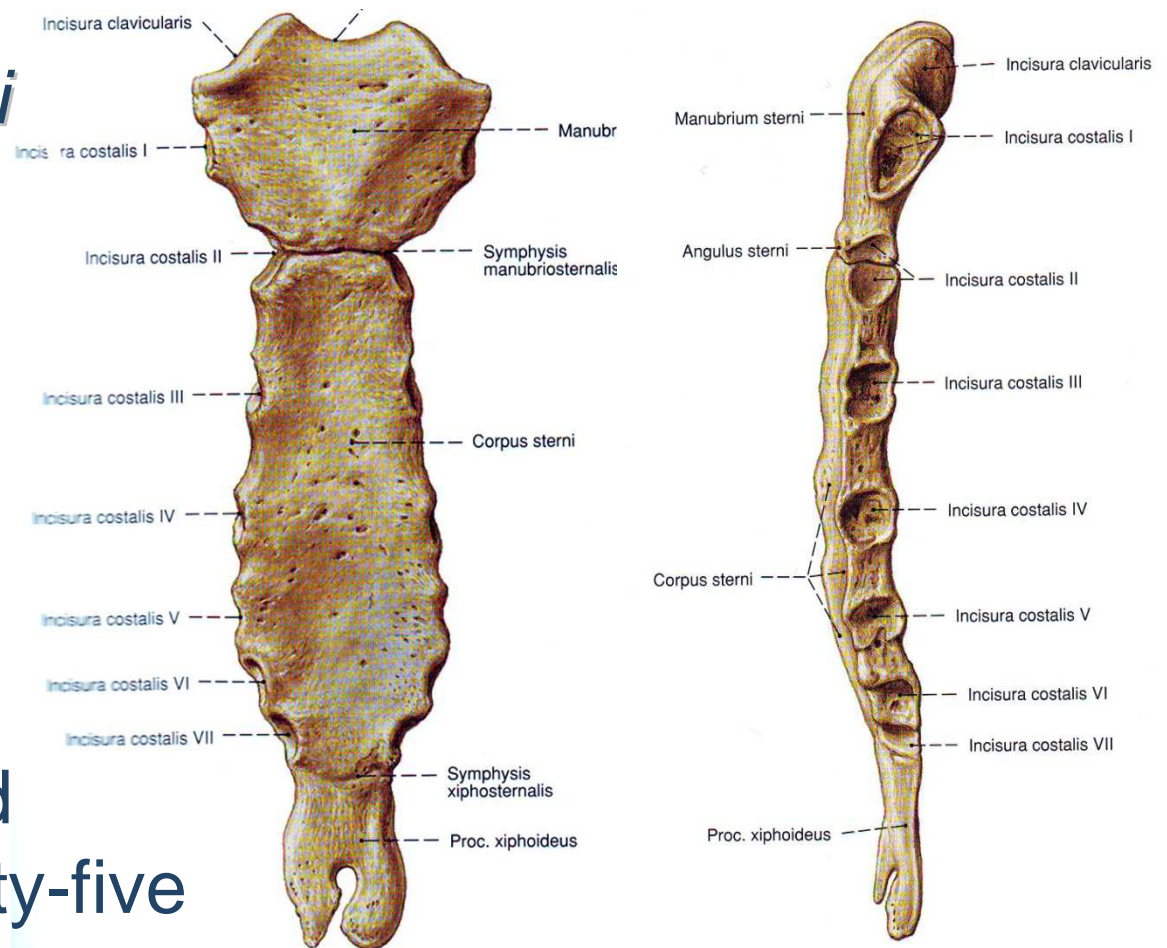
ADAM.

- Costal part, *os costale (costa)*:
 - ✓ head, *caput costae*
 - ✓ neck, *collum costae*
 - ✓ shaft or body, *corpus costae*
 - ⇒ angle, *angulus costae*
- Costal cartilage, *cartilago costalis*:
 - ✓ rib cartilage
 - ⇒ hyaline cartilage



Breastbone, *sternum* (parts)

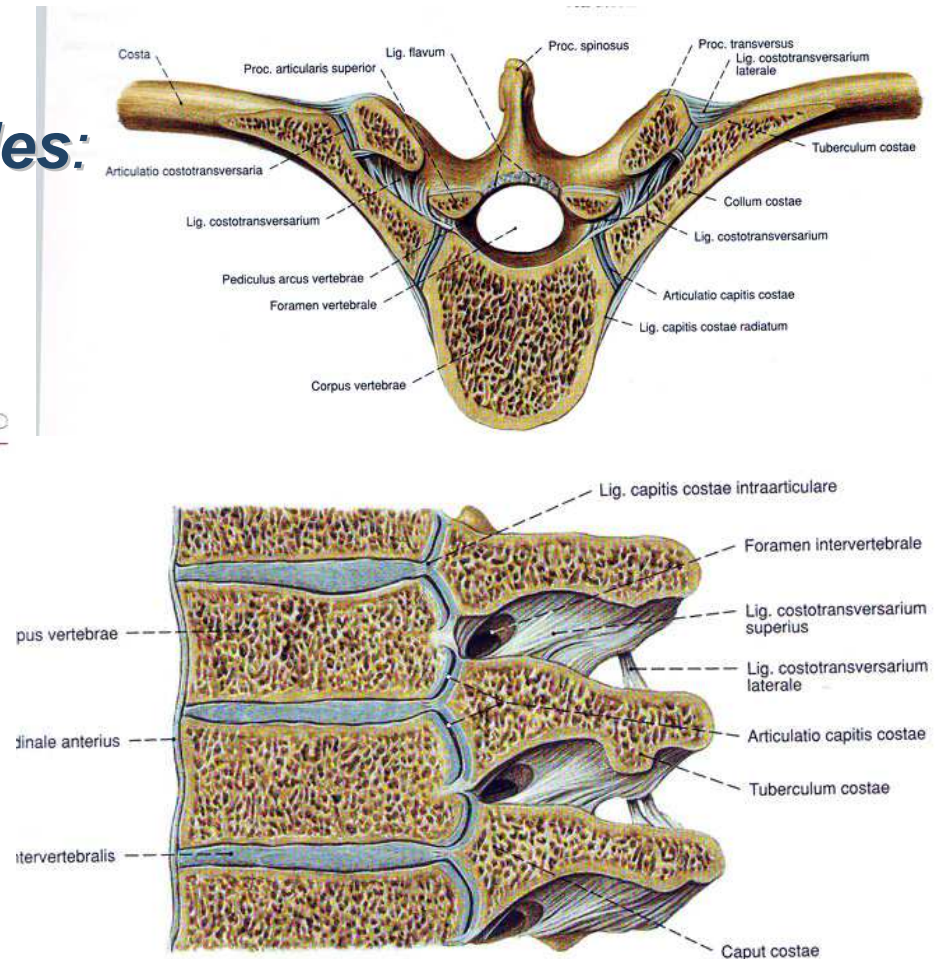
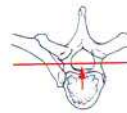
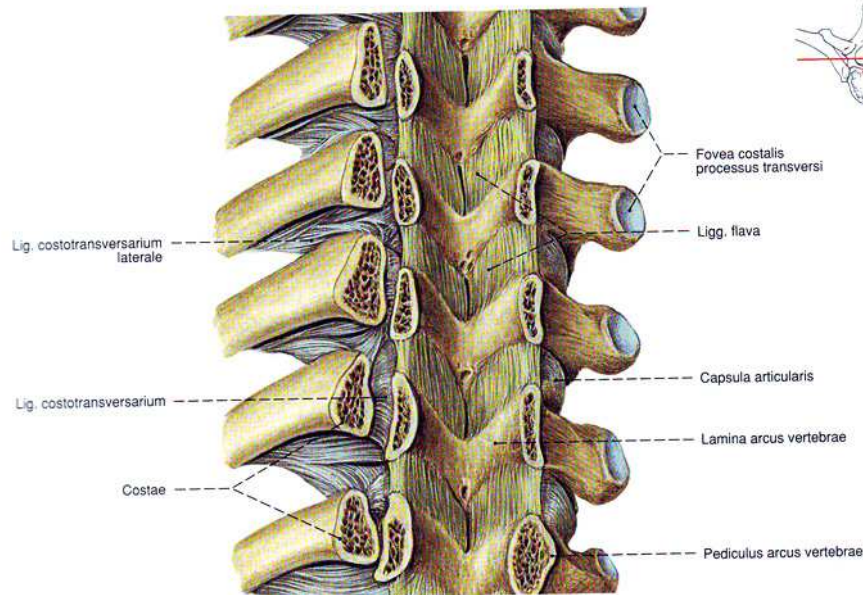
- manubrium, *manubrium sterni*
- body, *corpus sterni*
- xiphoid process, *proc. xiphoideus*
- *synchondrosis manubriosternalis*
- *synchondrosis xiphosternalis*
- *synostosis* – united by the age of twenty-five



Articulations of the thorax, *articulationes thoracis (1)*

■ Costovertebral joints, *Articulationes costovertebrales:*

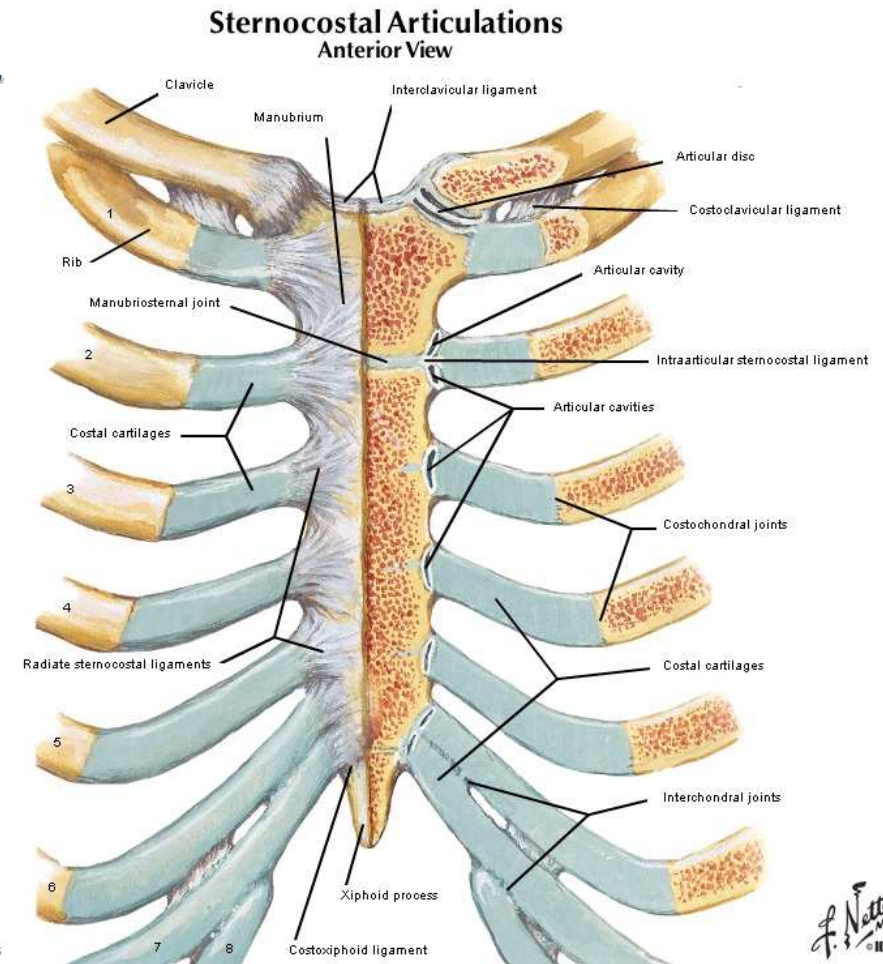
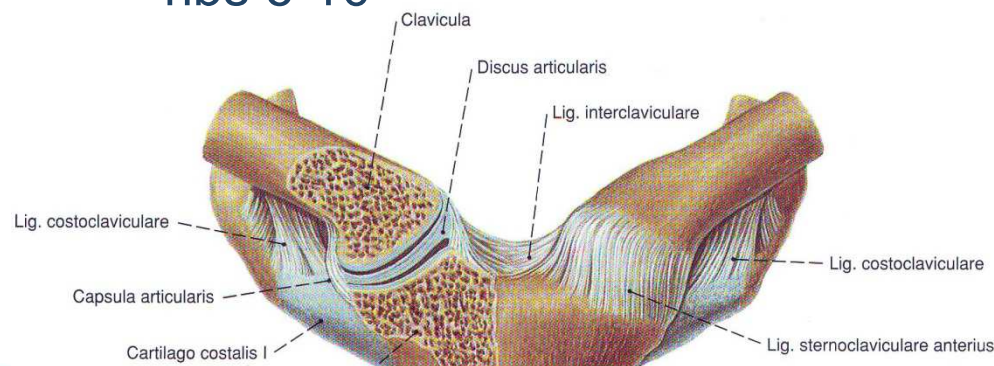
- ✓ *articulatio capitis costae*
- ✓ *articulatio costotransversaria*



Articulations of the thorax, *articulationes thoracis (2)*

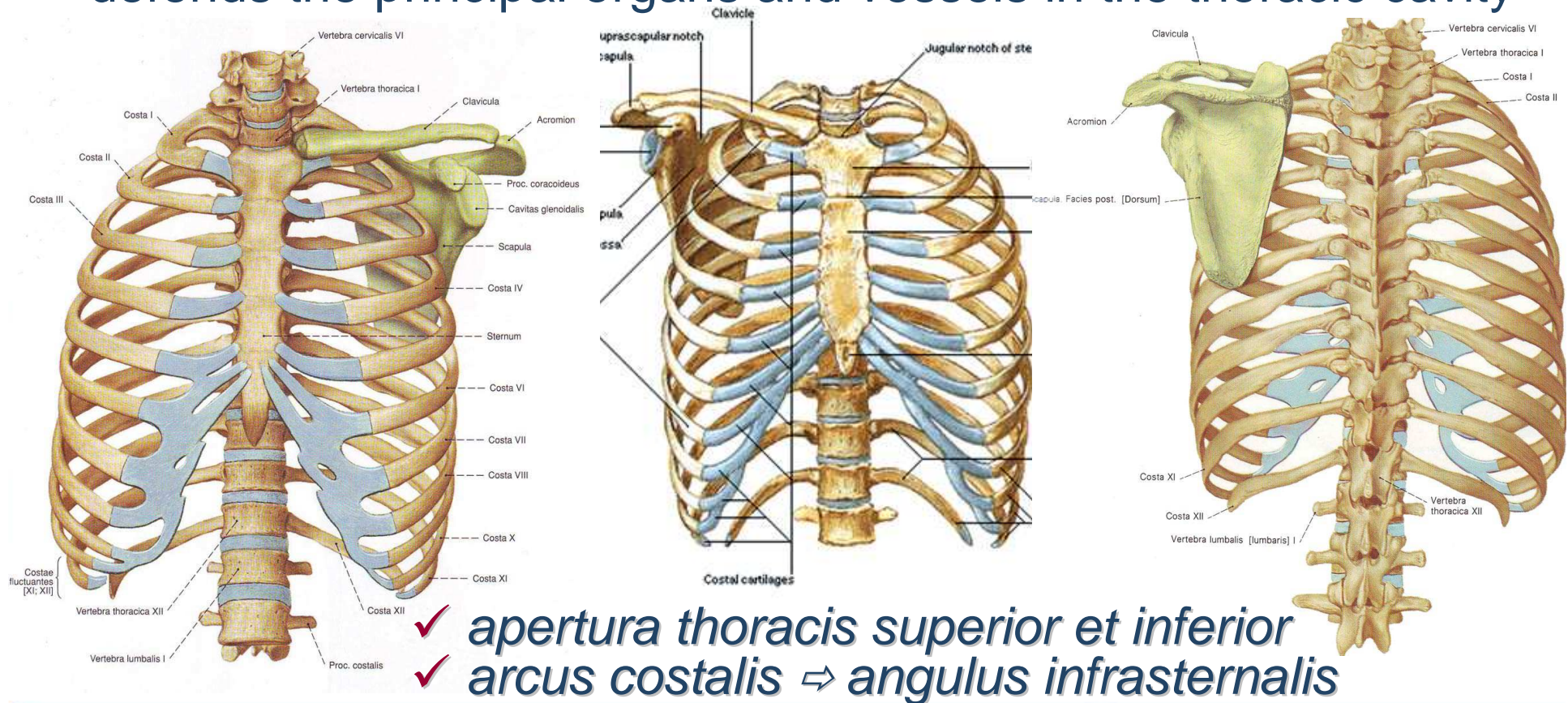
■ Sternocostal joints, *Articulationes sternocostales:*

- ✓ *synchondrosis costae I*
- ✓ *articulationes sternocostales* – ribs 2-5 (hemiarthroses)
- ✓ *synchondroses sternocostales* – ribs 6 and 7
- ✓ *articulationes interchondrales* – ribs 6-10

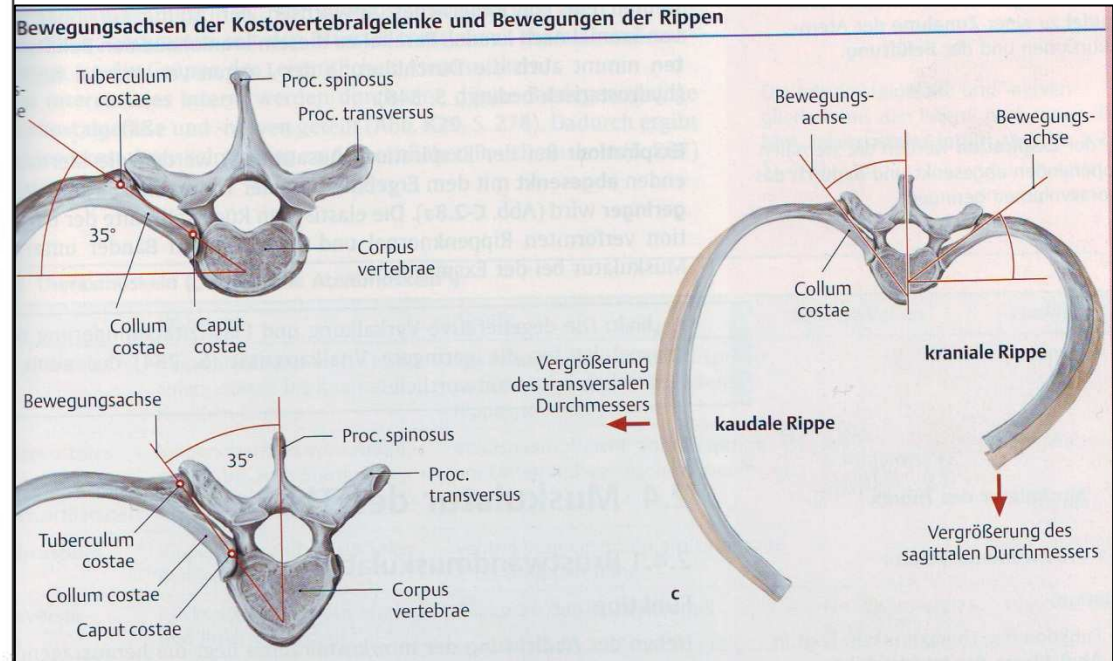
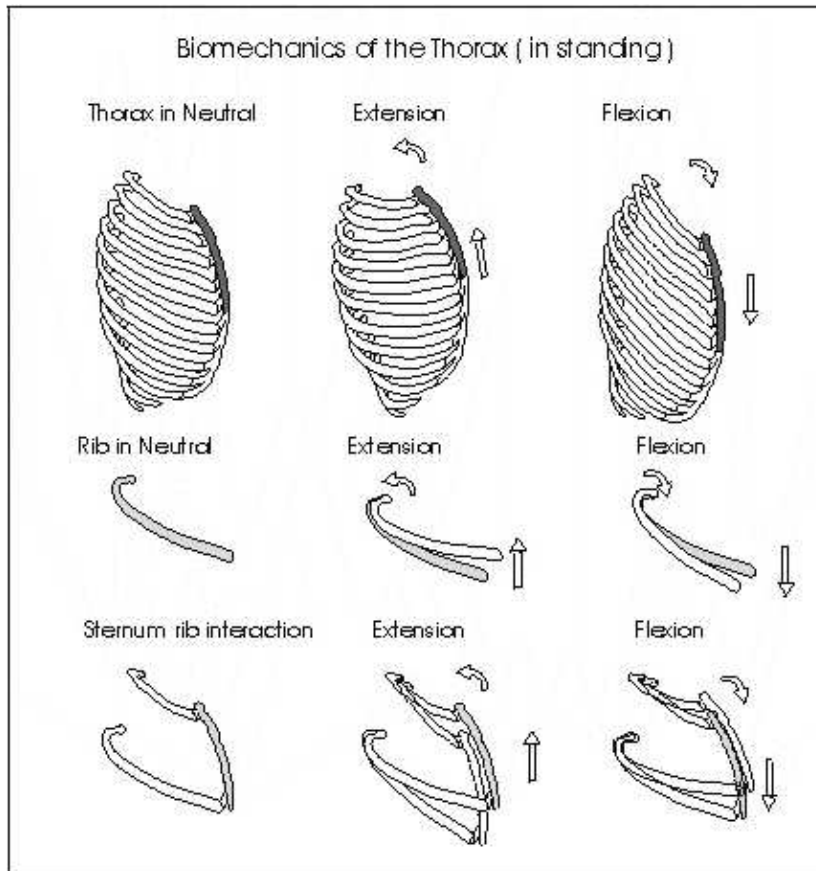


The thorax as a whole, *thorax* (*cavea, cavitas thoracis*)

- barrel-shaped
- narrower above than below, and compressed antero-posteriorly
- defends the principal organs and vessels in the thoracic cavity



Biomechanics of the thorax

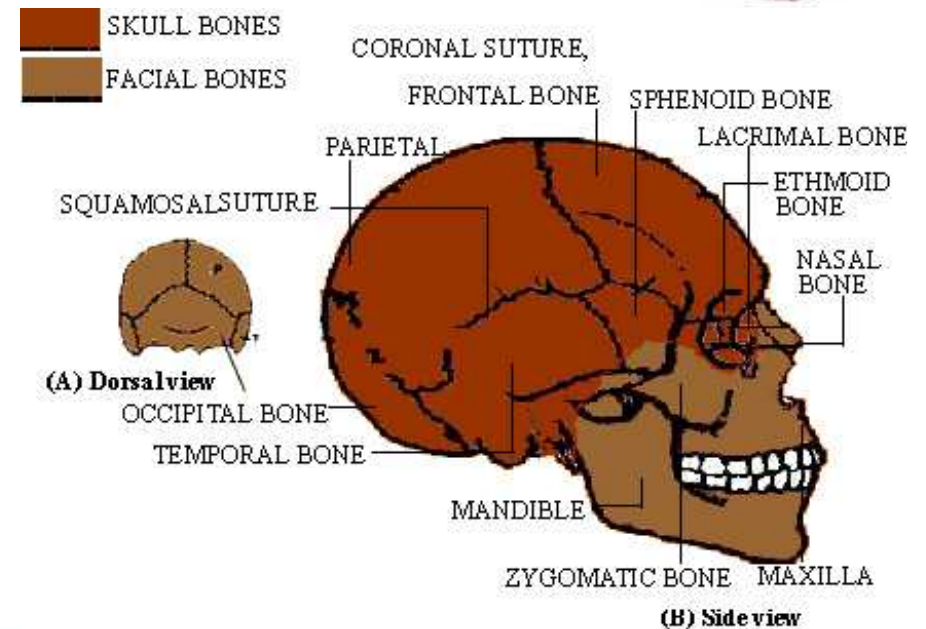


- combined joints
- common axis of motion:
 - ✓ upper ribs \Rightarrow anterior-posterior diameter
 - ✓ lower ribs \Rightarrow transverse diameter of the thorax



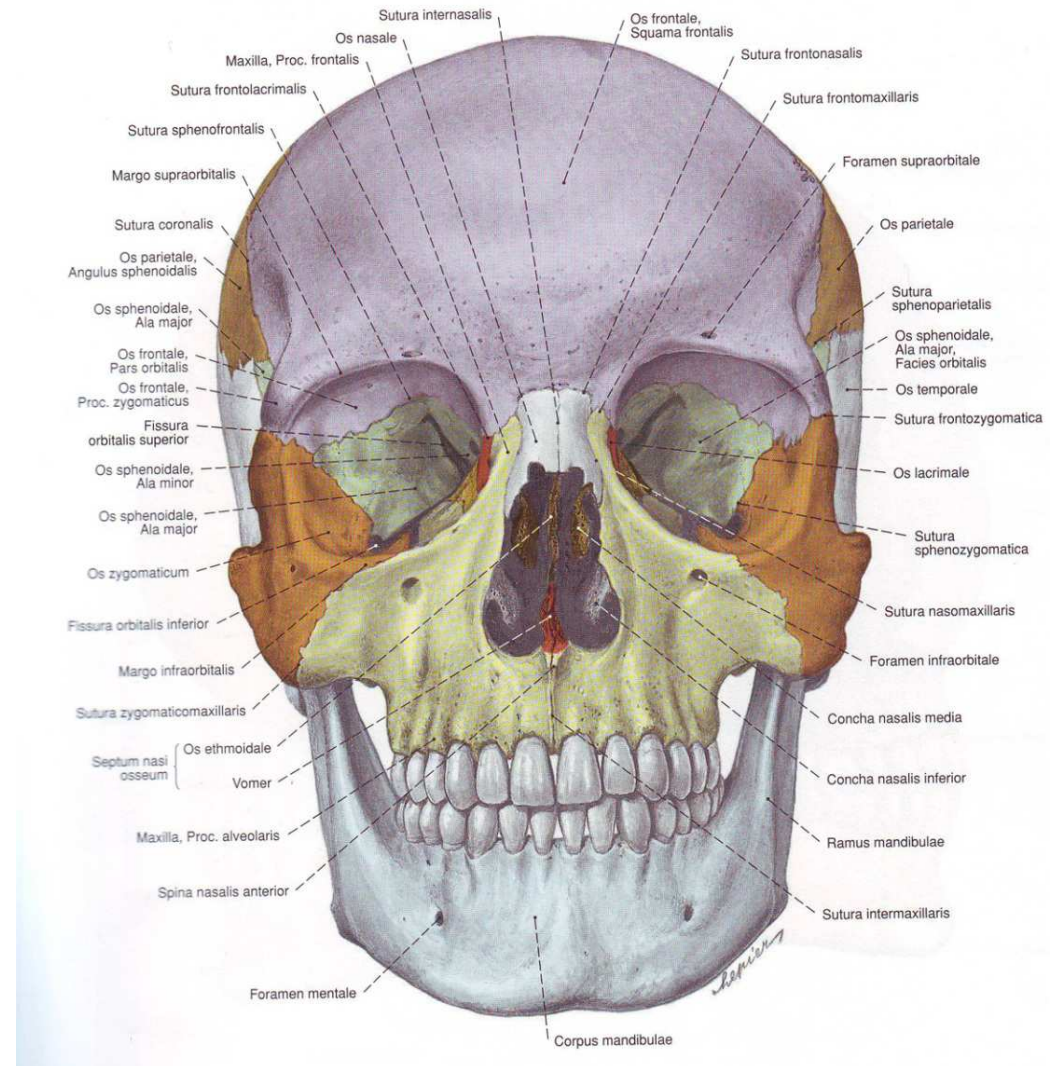
Bones of the head, skull, *cranium*

- Skull – 22 bones, *ossa cranii*:
 - ✓ braincase, *cranium cerebrale (neurocranium)*: twice larger
 - paired and unpaired bones
 - desmal, chondral and mixed ossification
 - ✓ facial skeleton, *cranium faciale (viscerocranium)*:
 - mostly paired bones
 - unpaired bones:
 - mandible and vomer
 - desmal ossification



Bones of the facial skeleton, *viscerocranium*

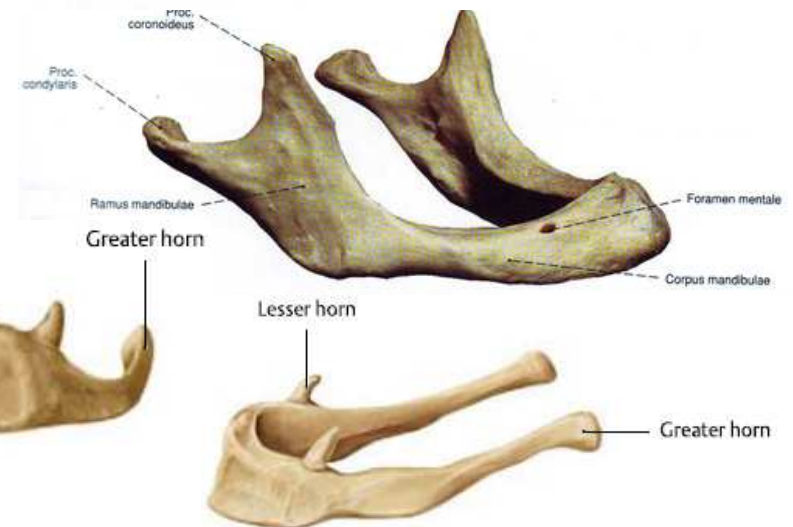
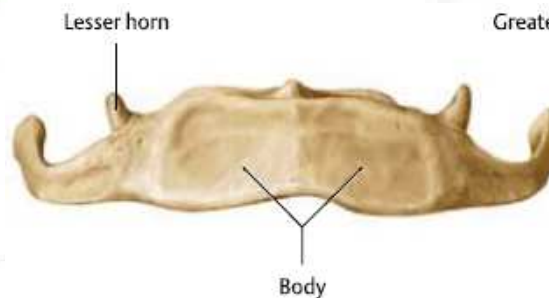
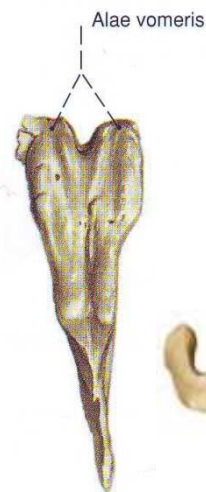
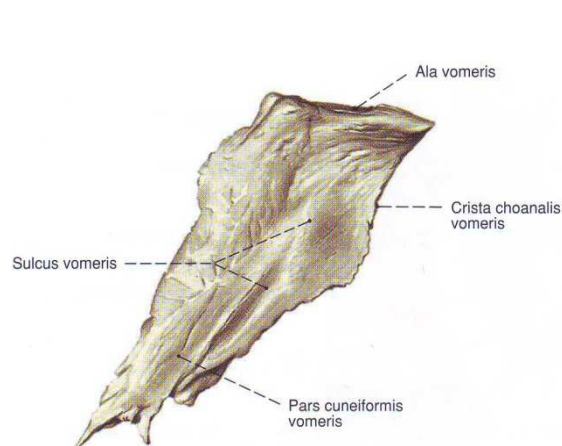
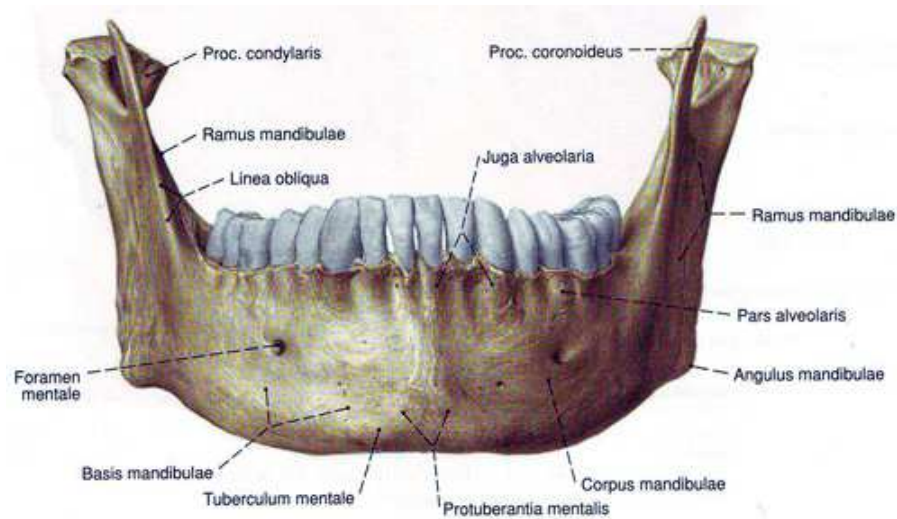
- Paired bones:
 - ✓ nasal bone, *os nasale*
 - ✓ lacrimal bone, *os lacrimale*
 - ✓ zygomatic bone, *os zygomaticum*
 - ✓ maxillary bone, *maxilla* ⇒ *os incisivum* (os 'Goethe')
 - ✓ palatine bone, *os palatinum*
 - ✓ inferior nasal concha, *concha nasalis inferior*



Bones of the facial skeleton, *viscerocranium*

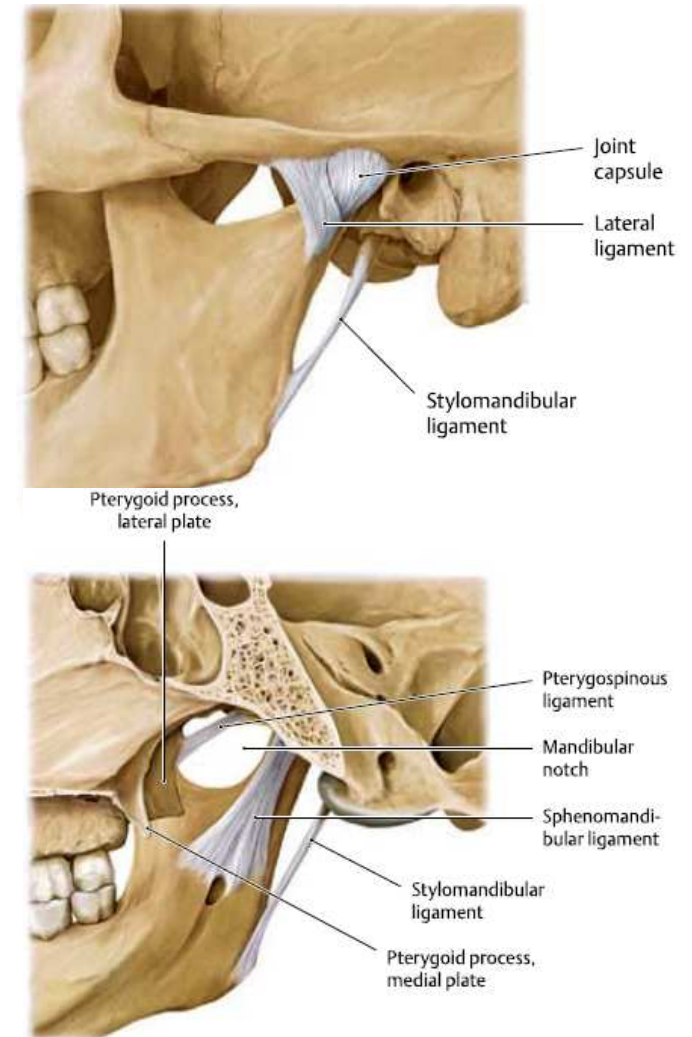
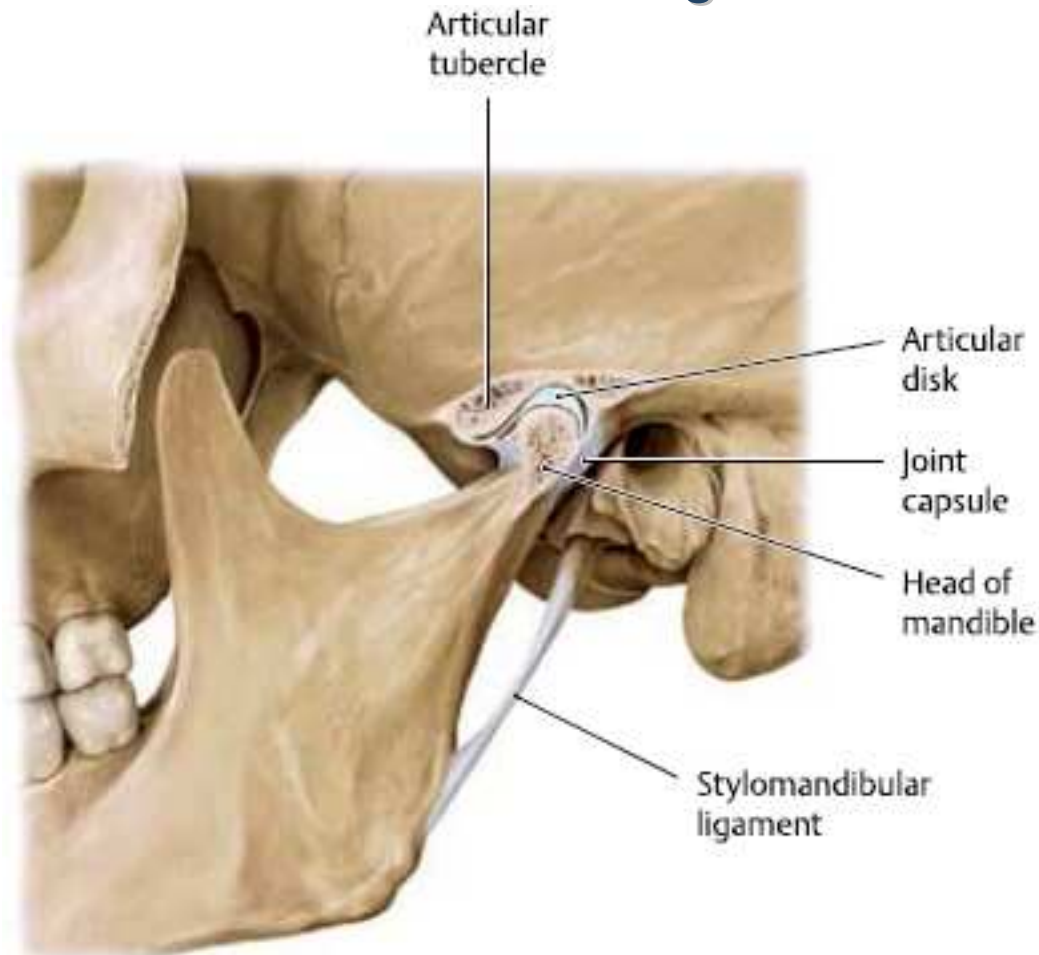
■ Unpaired bones:

- ✓ mandible, *mandibula*
- ✓ vomer, *vomer*
- ✓ hyoid bone, *os hyoideum*



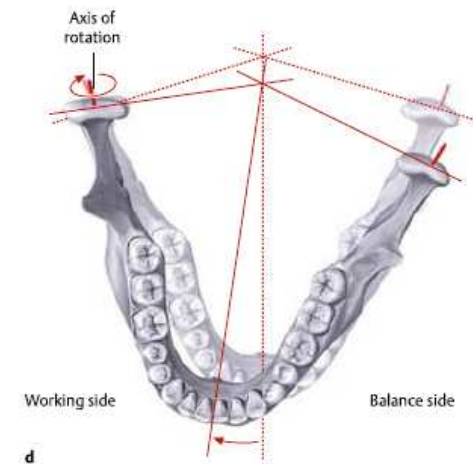
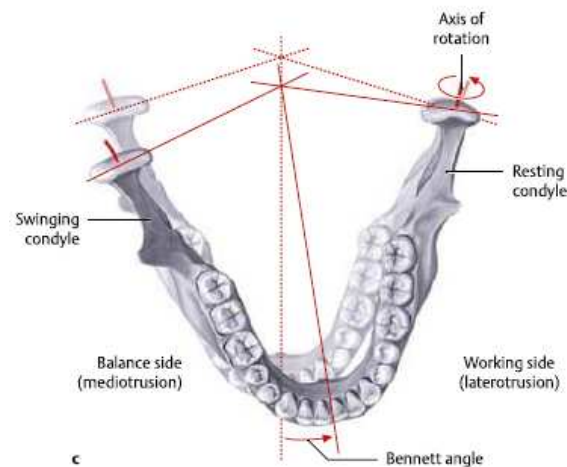
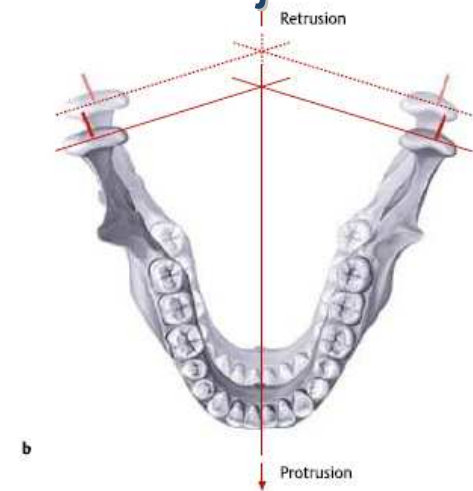
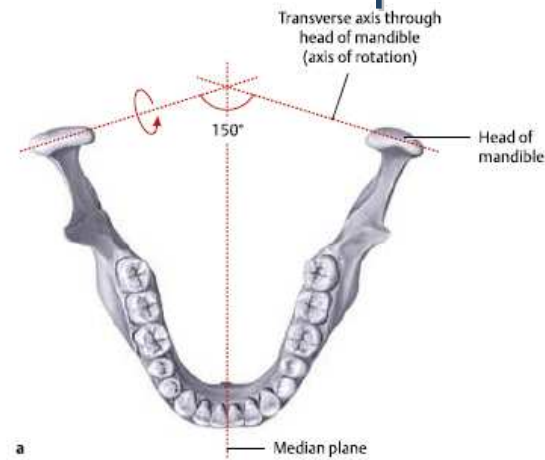
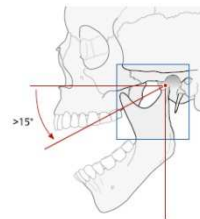
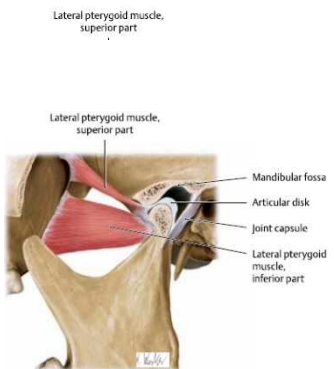
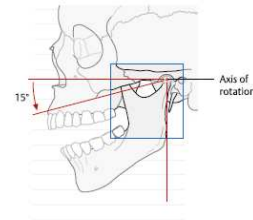
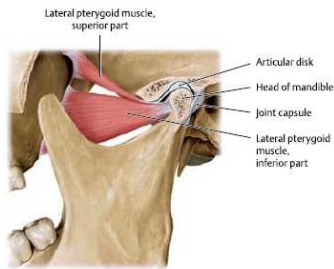
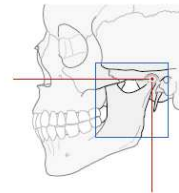
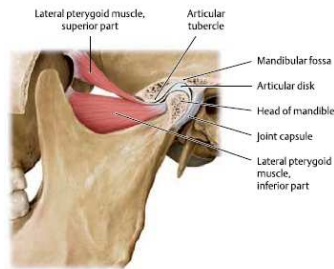
Temporomandibular joint, *articulatio temporomandibularis*

- Articular surfaces and ligaments

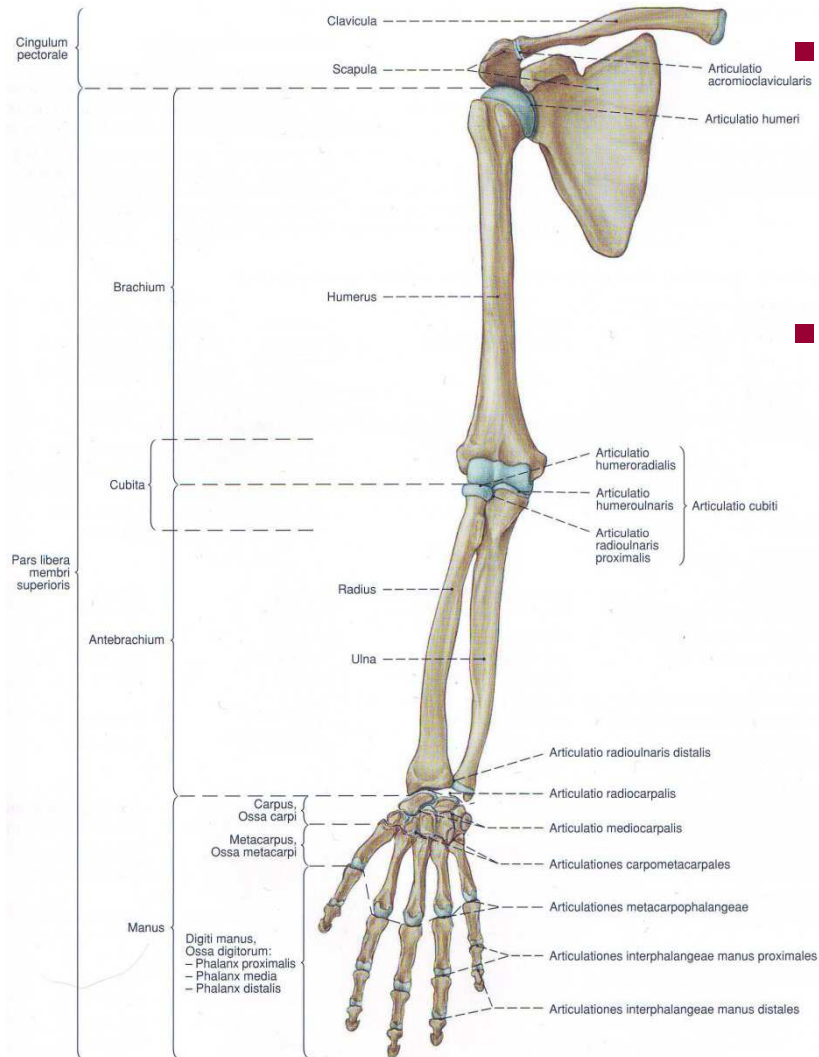


Biomechanics of the temporomandibular joint

■ Movements and dislocation of the temporomandibular joint



Bones of the upper limb, *ossa membri superioris*



■ Bones of the shoulder girdle, *cingulum pectorale*:

- ✓ clavicle, **clavicula**
- ✓ shoulder blade, **scapula**

■ Bones of the skeleton of upper limbs, *pars libera membri superioris*:

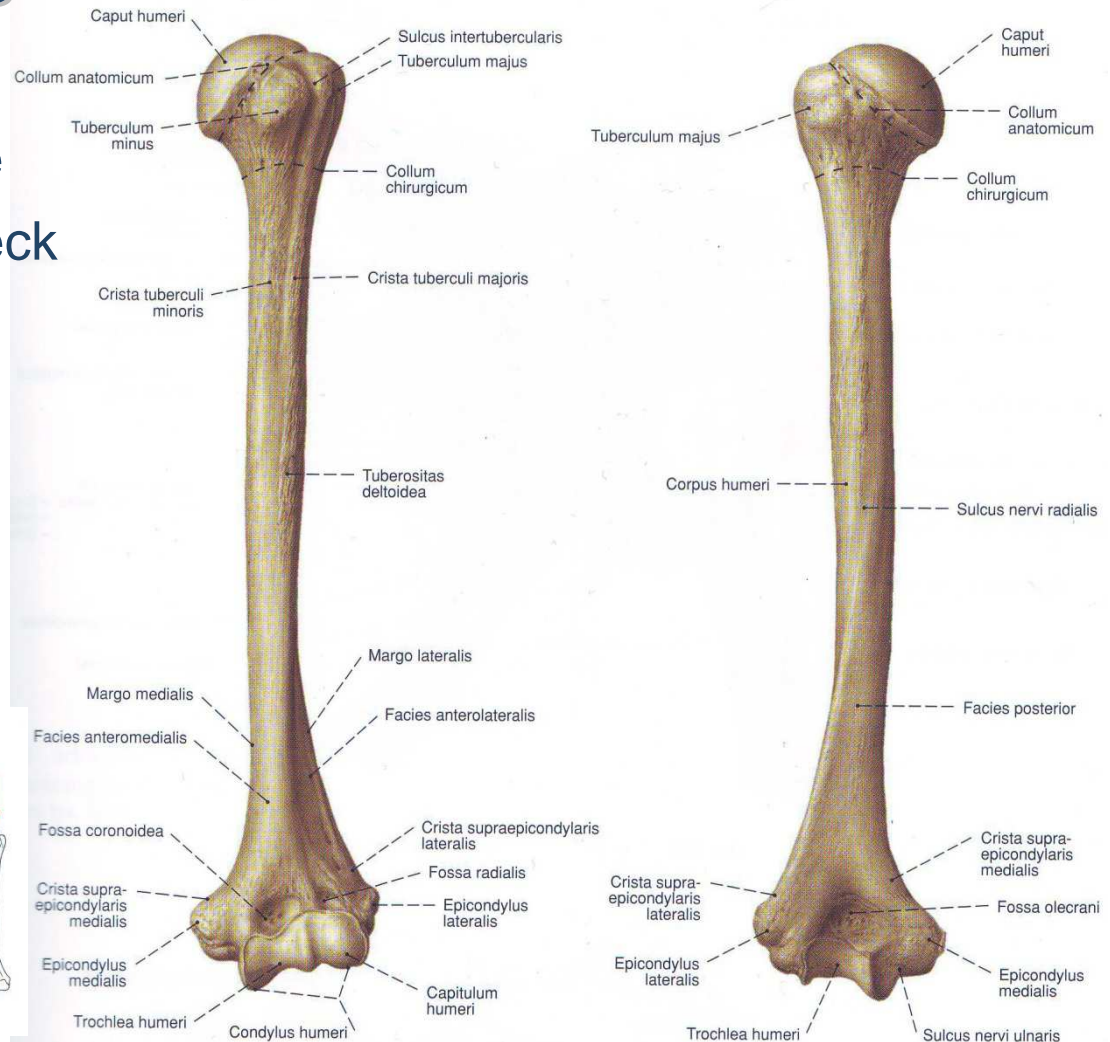
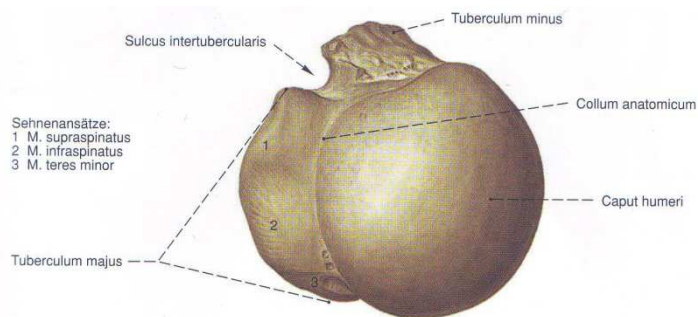
- ✓ arm, *brachium*:
 - humerus, **humerus**
- ✓ forearm, *antebrachium*:
 - elbow bone, **ulna**
 - radial bone, **radius**
- ✓ hand, *manus*:
 - carpal bones, **ossa carpi**
 - metacarpal bones, **ossa metacarpi**
 - finger bones, phalanges
ossa digitorum manus (phalanges)



Bones of the arm, *ossa brachii*

■ Humerus, *humerus*

- ✓ articular head
- ✓ greater and lesser tubercle
- ✓ anatomical and surgical neck
- ✓ *capitulum humeri*
- ✓ *trochlea*
- ✓ medial epycondyle
- ✓ lateral epycondyle
- ✓ olecranon fossa



Bones of the forearm, *ossa antebrachii*

■ Elbow bone, *ulna*

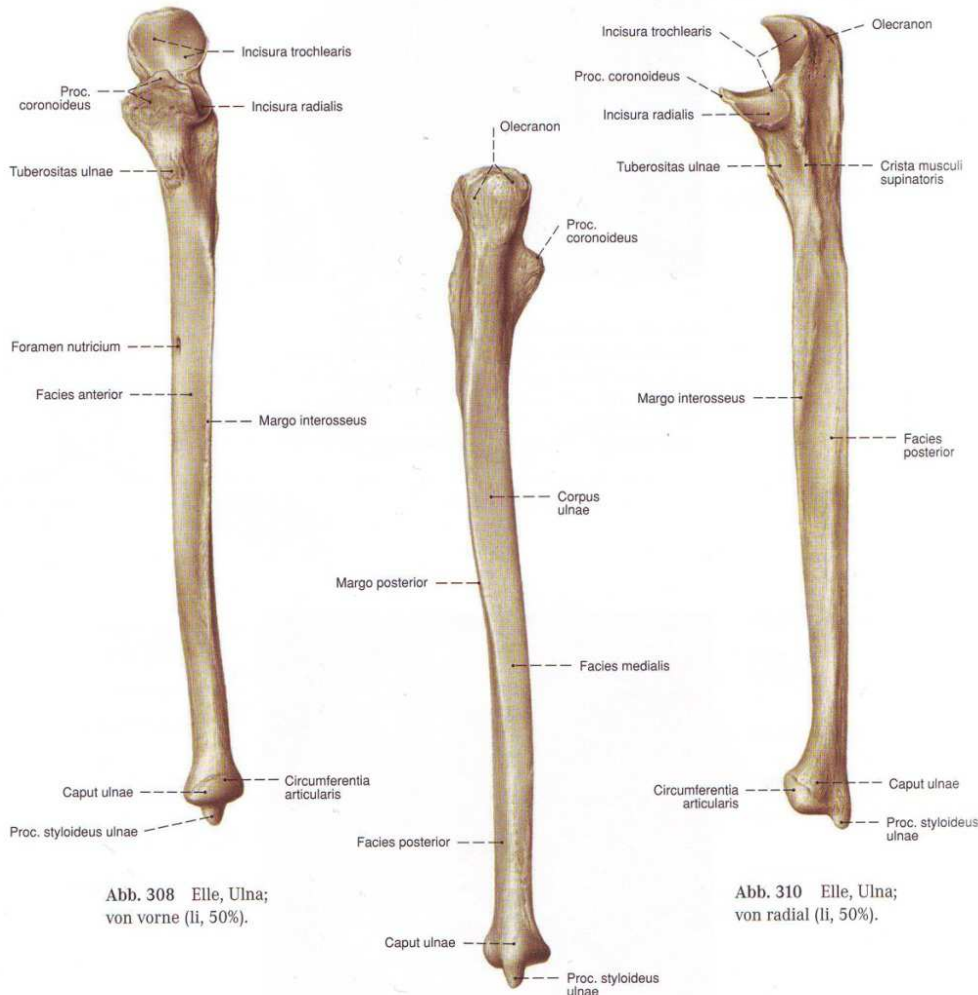


Abb. 308 Elle, Ulna; von vorne (li, 50%).

Abb. 310 Elle, Ulna; von radial (li, 50%).

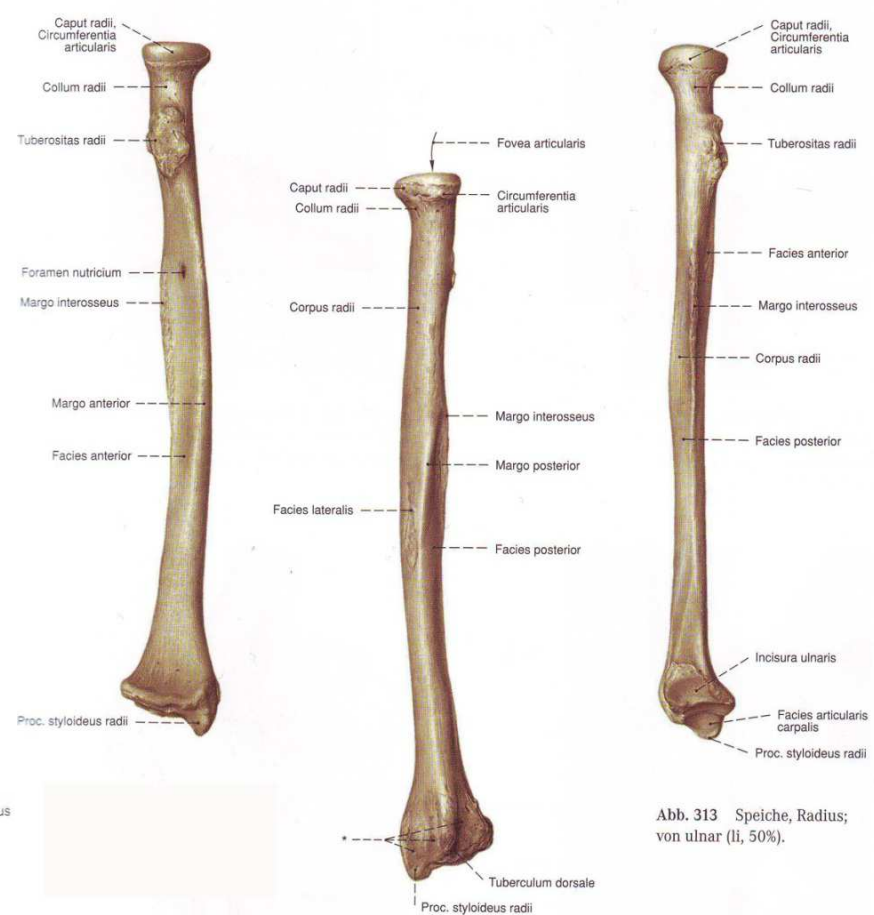


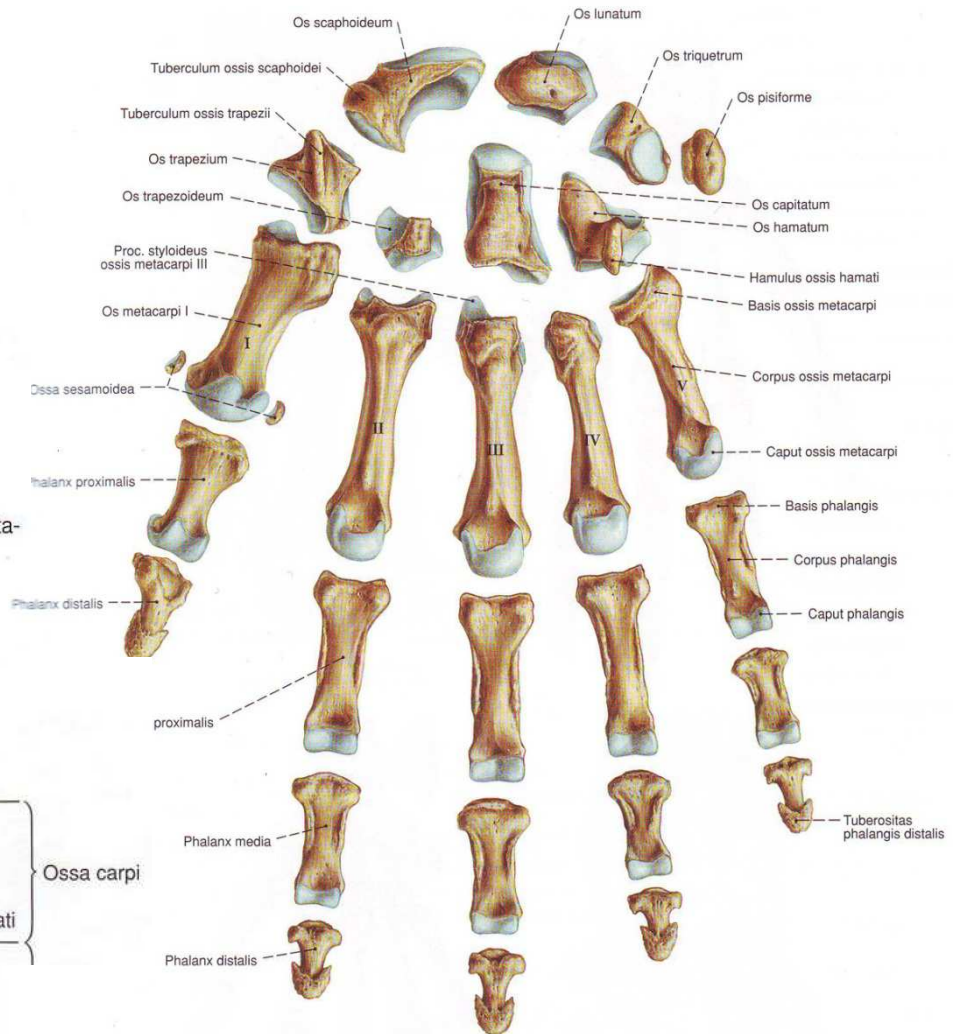
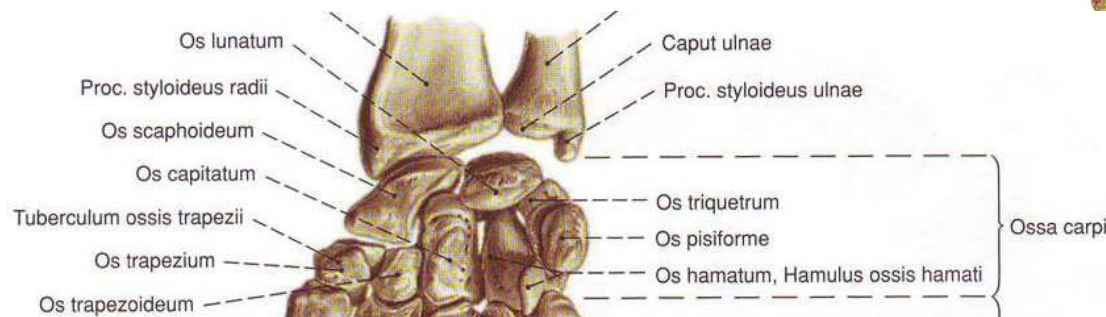
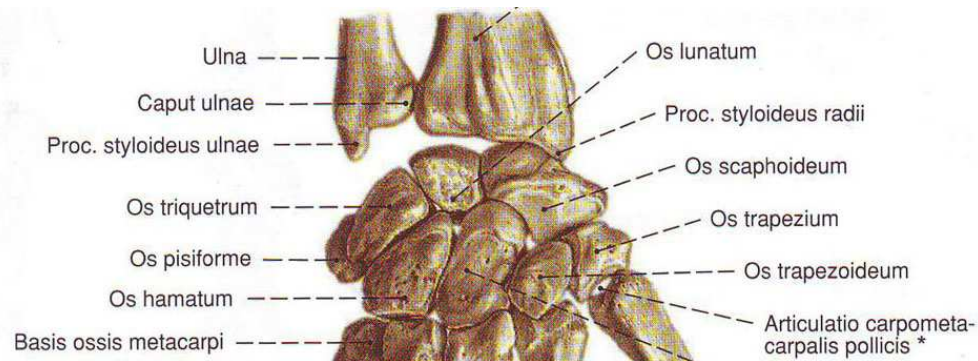
Abb. 313 Speiche, Radius; von ulnar (li, 50%).

■ Radial bone, *radius*



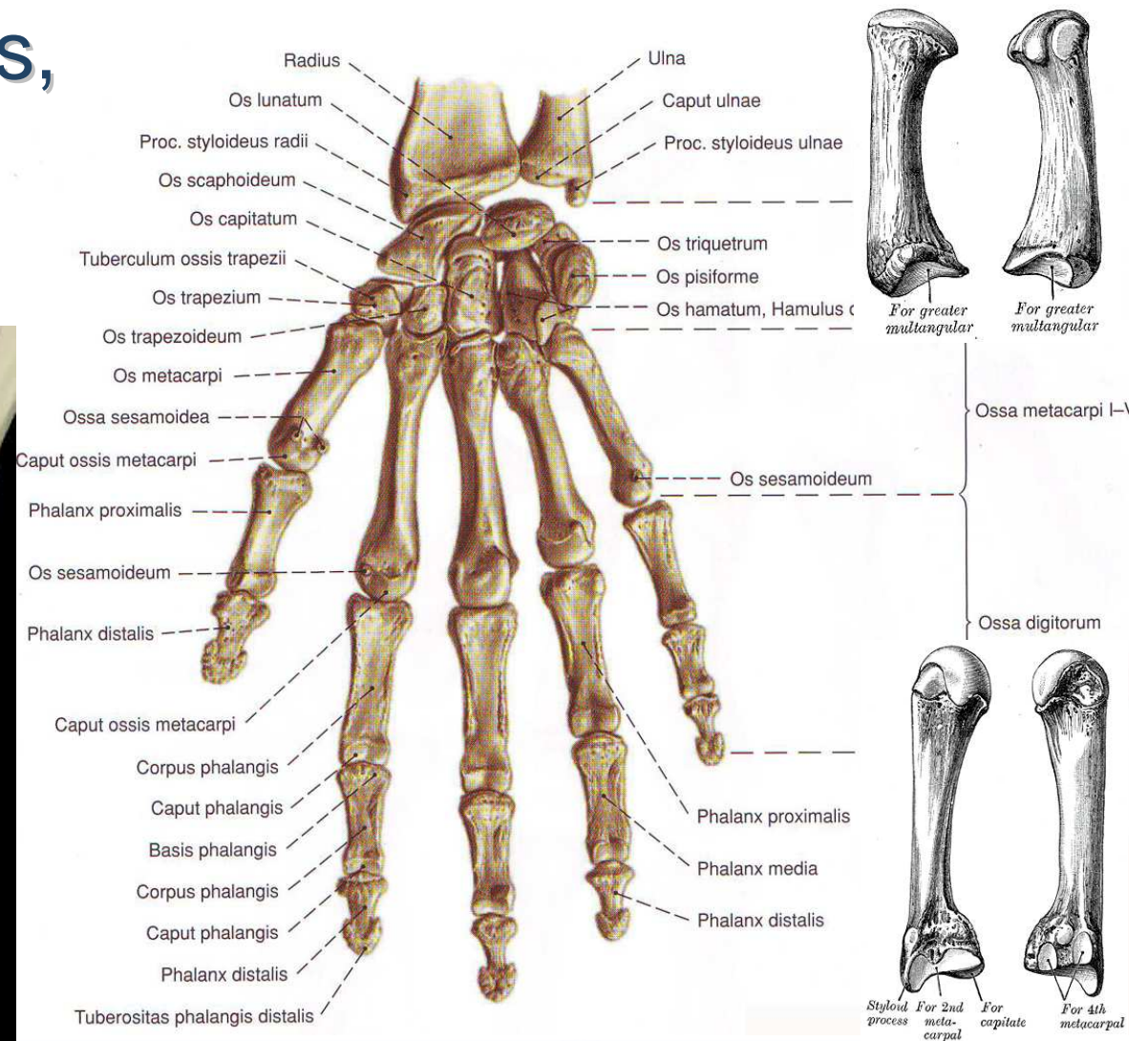
Bones of the hand, *ossa manus*

■ Carpal bones, *ossa carpi (carpalia)*



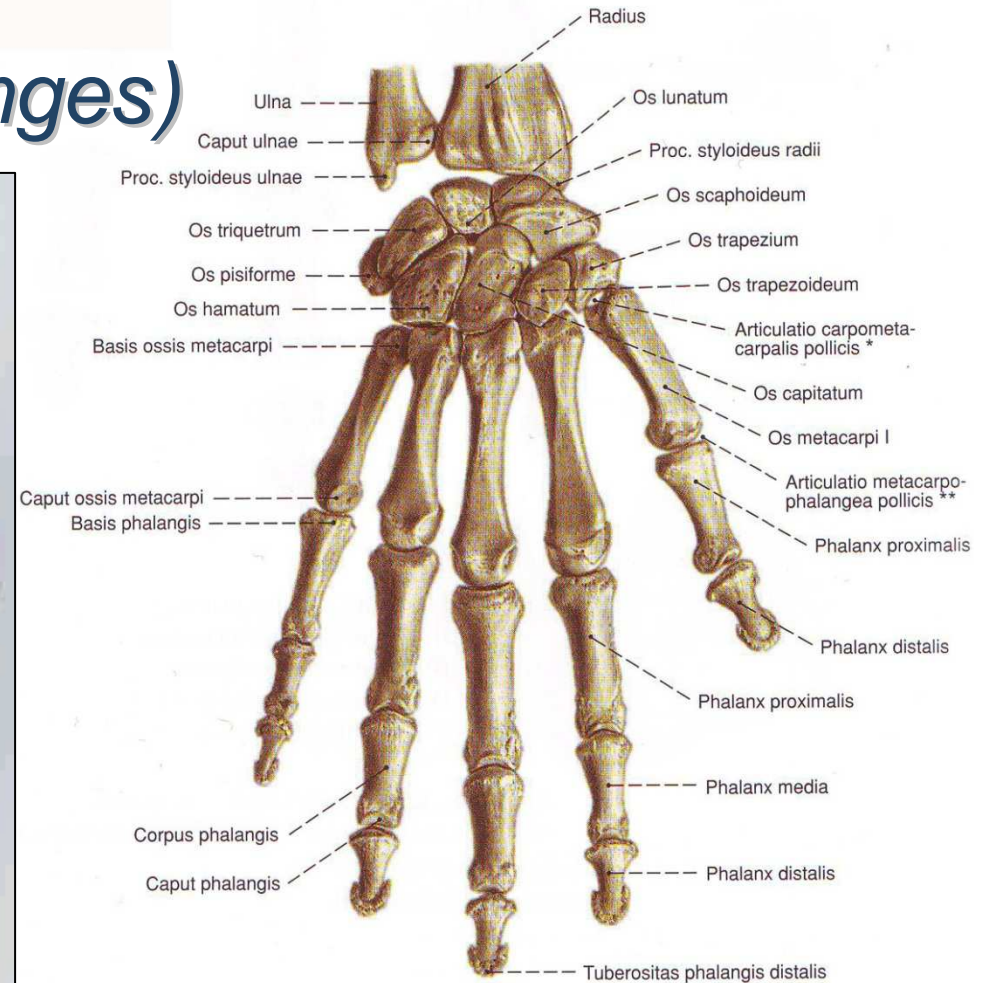
Bones of the hand, *ossa manus*

- Metacarpal bones, *ossa metacarpi* (*metacarpalia*)



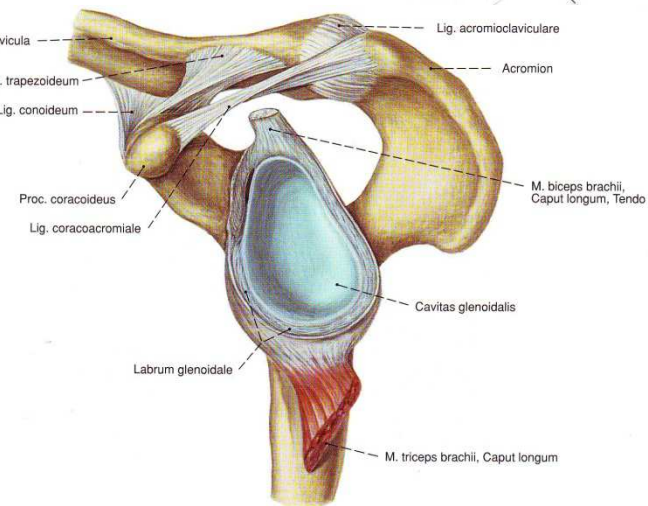
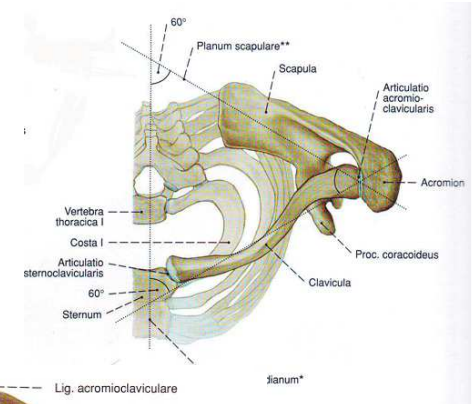
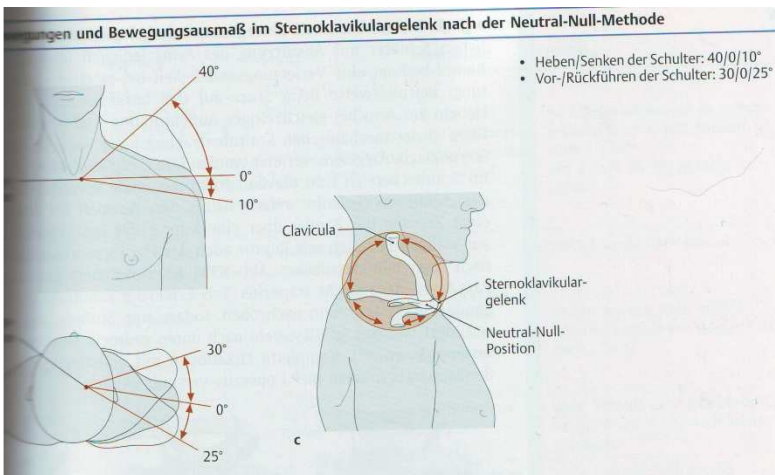
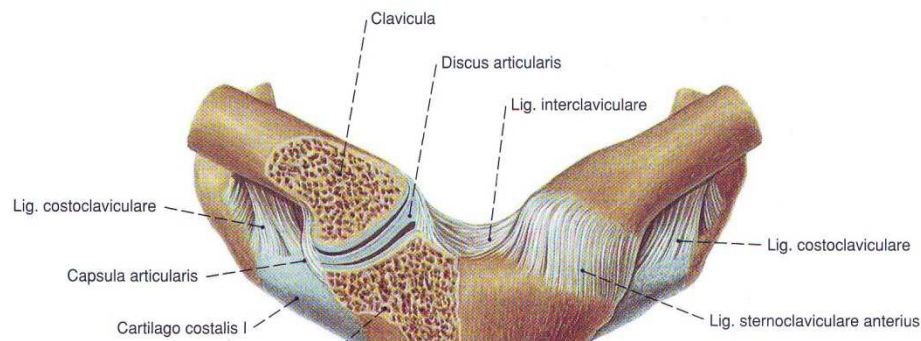
Bones of the hand, *ossa manus*

- Finger bones, *ossa digitorum (phalanges)*



Joints of the pectoral girdle, *articulationes cinguli pectoralis*

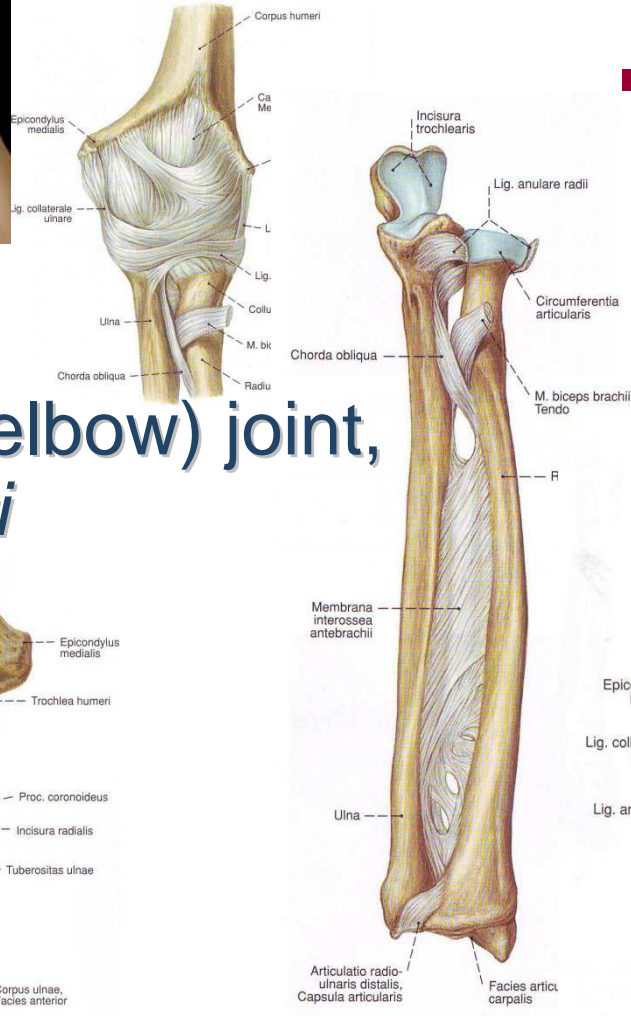
■ Sternoclavicular joint, *art. sternoclavicularis*



■ Acromioclavicular joint, *art. acromioclavicularis*

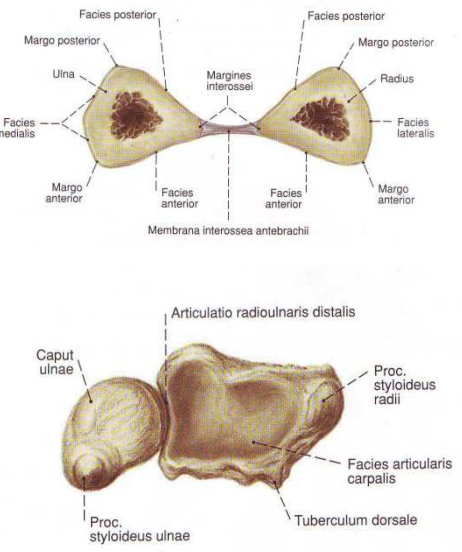
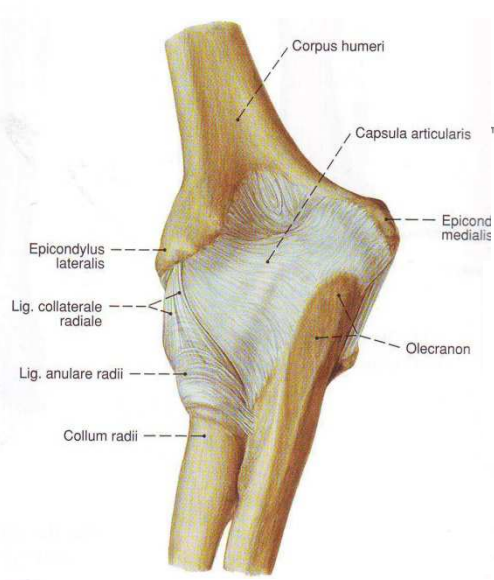
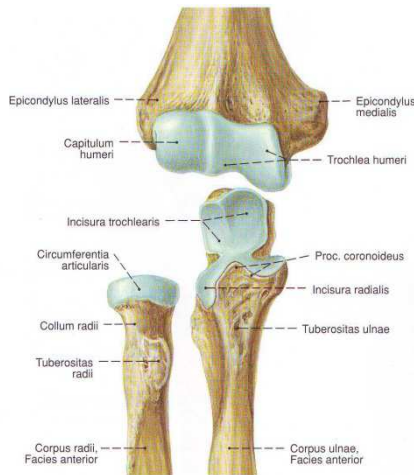


The radio-ulnar joints, *articulationes antebrachii*



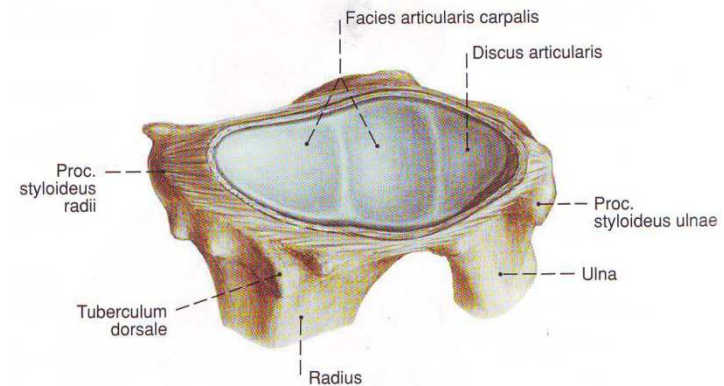
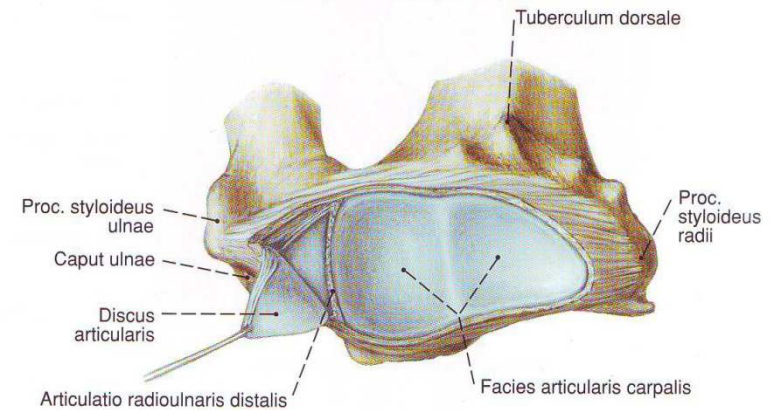
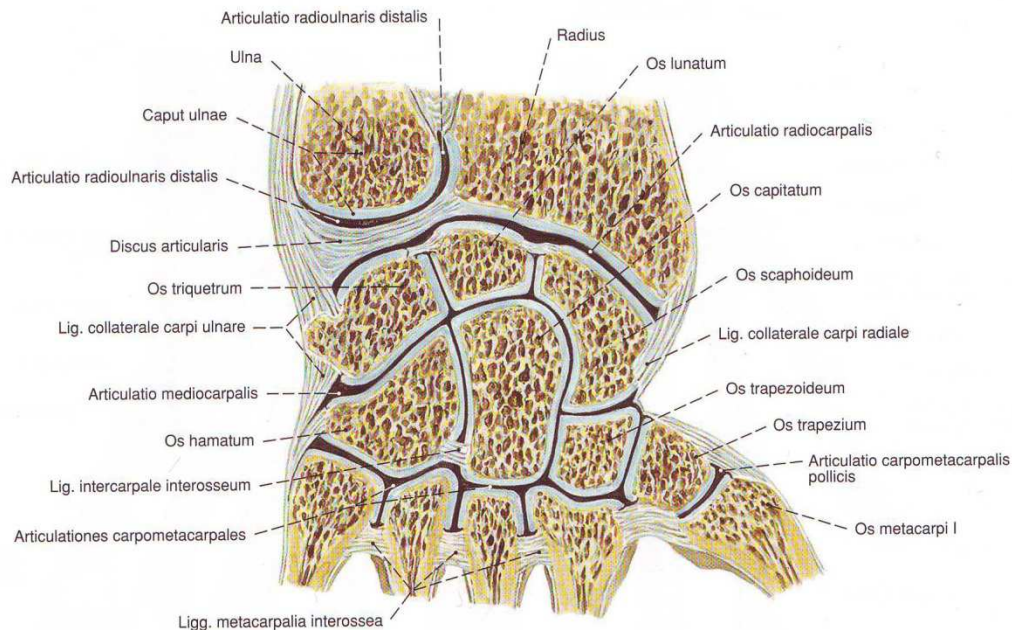
- Radio-ulnar joints:
 - ✓ proximal radio-ulnar joint
 - ✓ middle radio-ulnar joint
 - ✓ distal radio-ulnar joint

■ Cubital (elbow) joint, *art. cubiti*

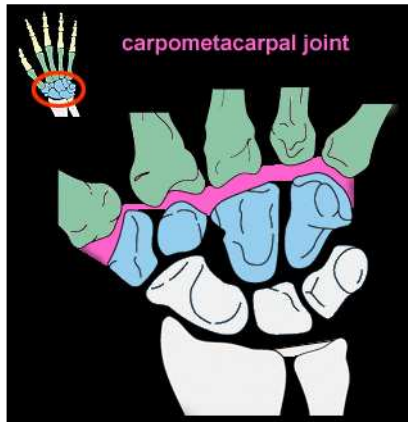


Joints of the hand, *articulationes manus*

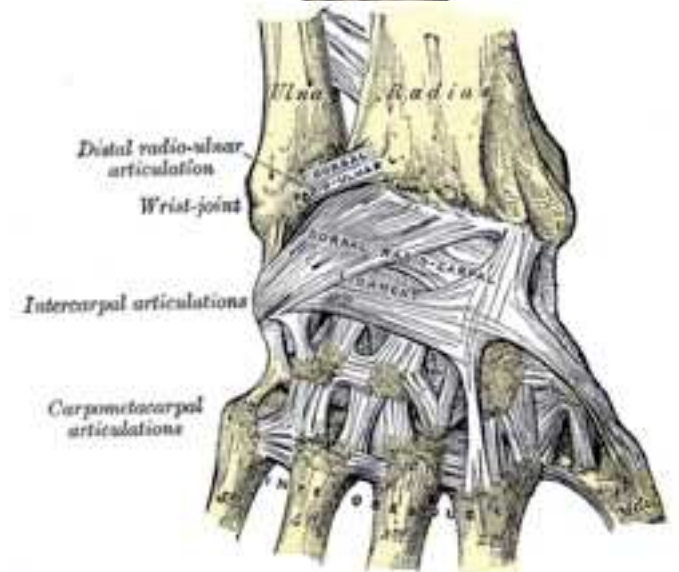
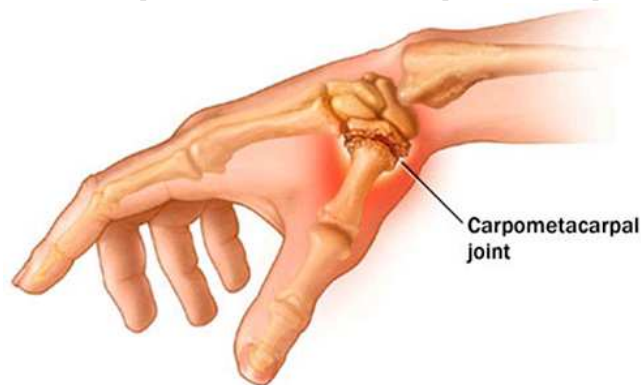
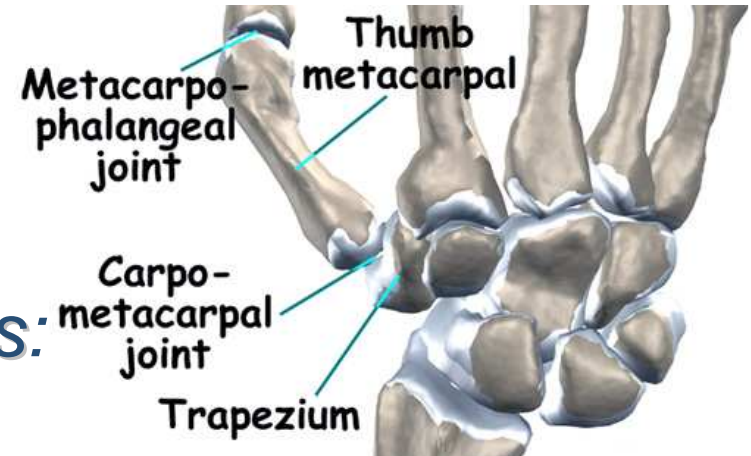
- Carpal joints,
articulationes carpi:
 - ✓ radiocarpal (wrist) joint,
art. radiocarpalis (radiocarpea)
 - ✓ intercarpal joints
 - ✓ midcarpal joint,
art. mediocarpalis (mediocarpea)



Joints of the hand, *articulationes manus*

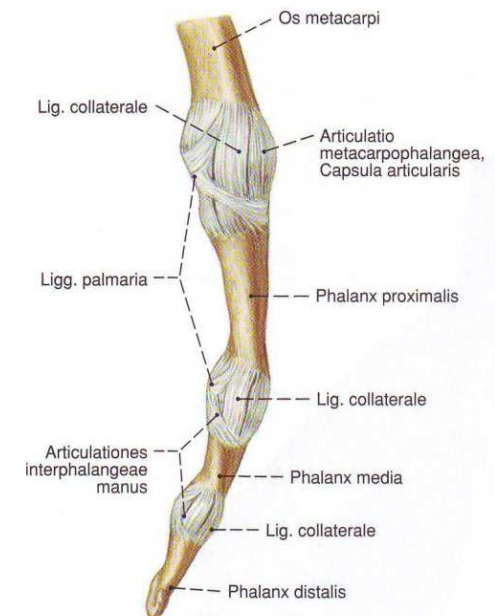
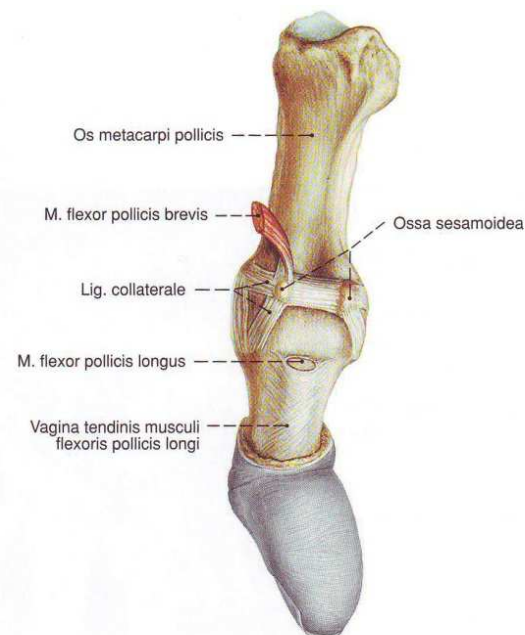
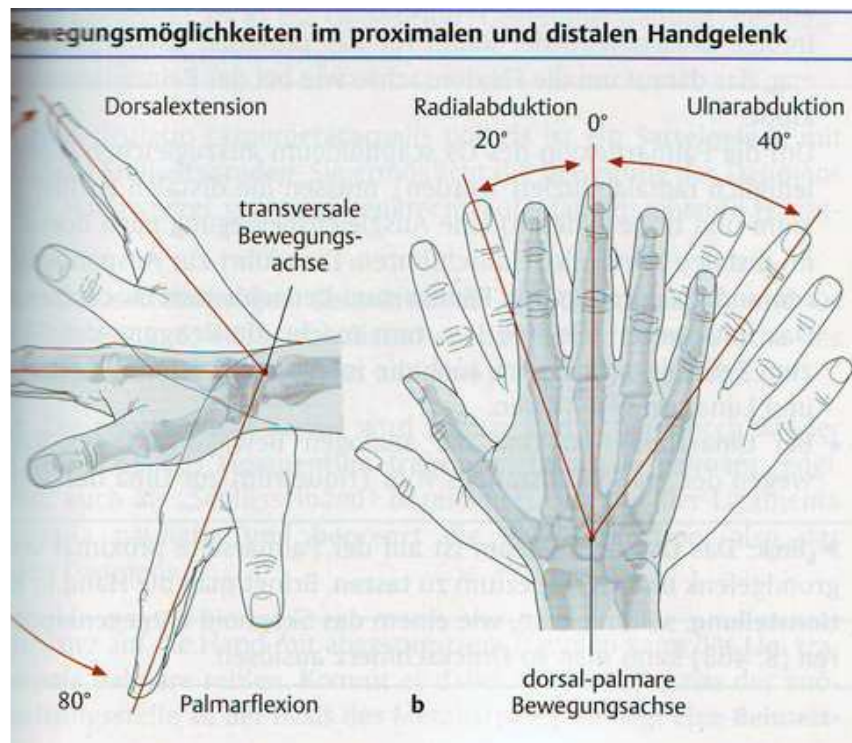


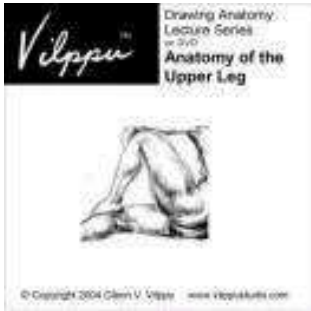
- Carpometacarpal joints,
articulationes carpometacarpales:
 - ✓ common carpometacarpal joint,
art. carpometacarpalis communis
 - ✓ carpometacarpal joint of the thumb,
art. carpometacarpalis pollicis



Joints of the fingers, *articulationes digitorum manus*

- ✓ metacarpophalangeal joints, *art. metacarpophalangeales*
- ✓ interphalangeal joints, *art. interphalangeales manus*





Bones of the lower limb, *ossa membri inferioris*

- Skeleton of the pelvic girdle, *cingulum pelvicum*:

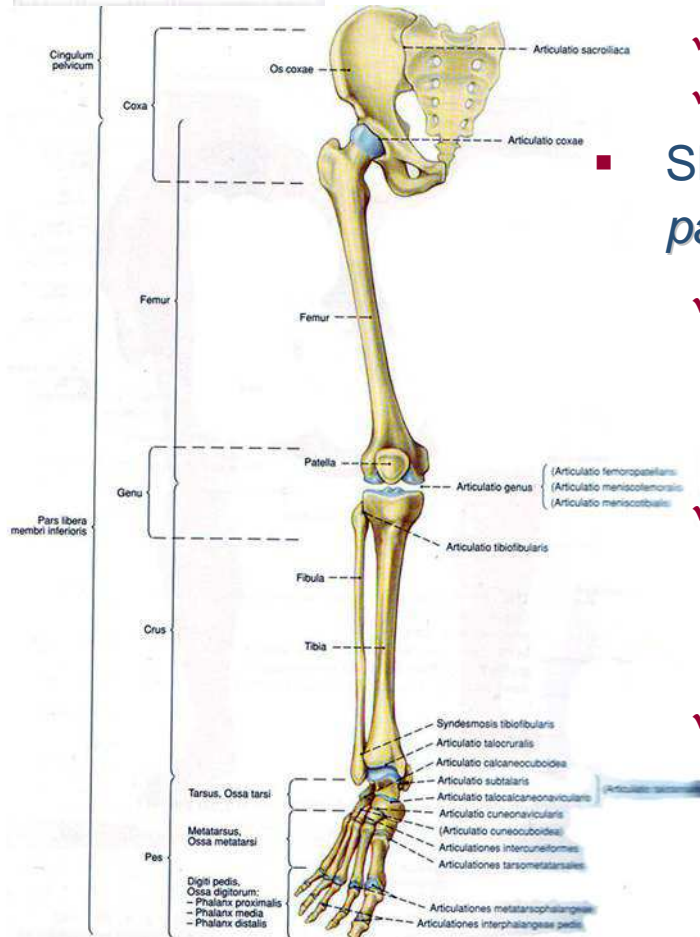
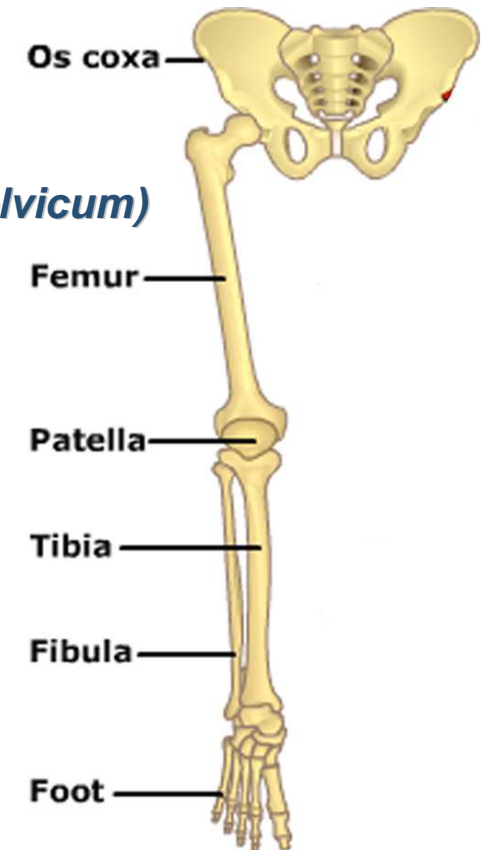
- ✓ sacrum, **os sacrum**
- ✓ innominate (hip) bone, **os coxae (pelvicum)**

- Skeleton of the free lower limb, *pars libera membri inferioris*:

- ✓ thigh, *femur*:
 - thigh bone, **femur (os femoris)**
 - kneecap, **patella**

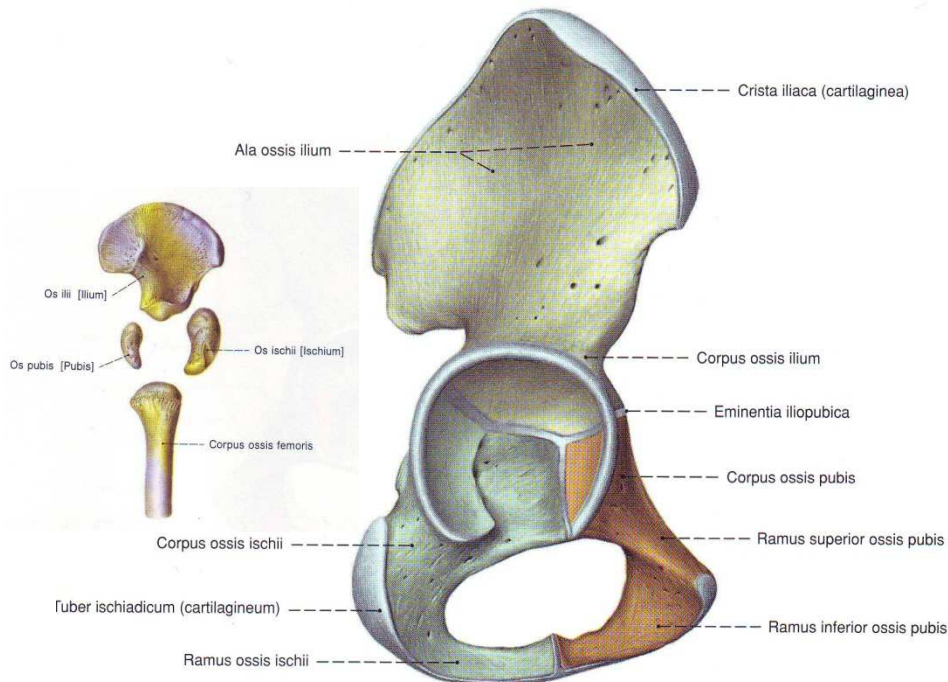
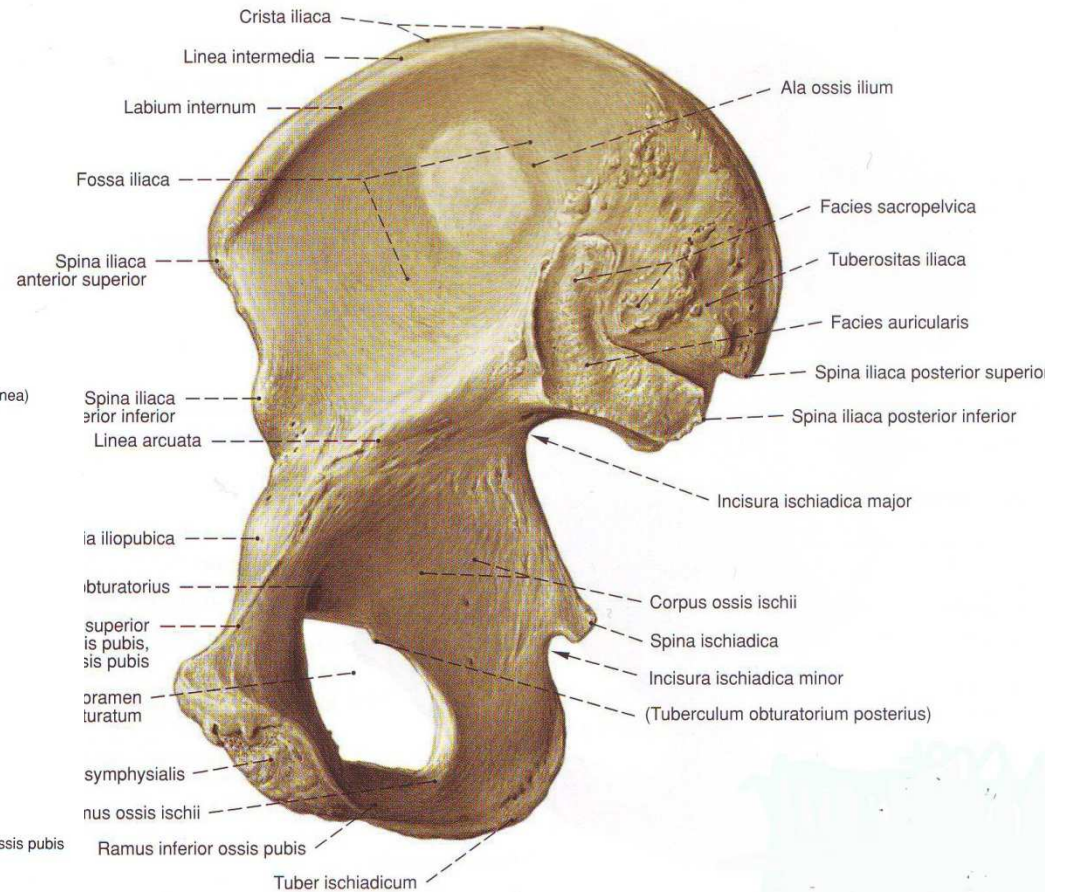
- ✓ leg, *crus*:
 - tibia, **tibia**
 - fibula, **fibula**

- ✓ foot, *pes*:
 - tarsal bones, **ossa tarsi (tarsalia)**
 - metatarsal bones, **ossa metatarsi (metatarsalia)**
 - phalanges of the foot, **ossa digitorum pedis, phalanges**



Bones of the pelvic girdle, *ossa cinguli pelvici*

- hip bone, *os coxae*
 - ✓ chondral osteogenesis: united by bone at 15-16 years
 - ✓ the ilium, *os ilii (ilium)*
 - ✓ the ischium, *os ischii (ischium)*
 - ✓ the pubis, *os pubis*

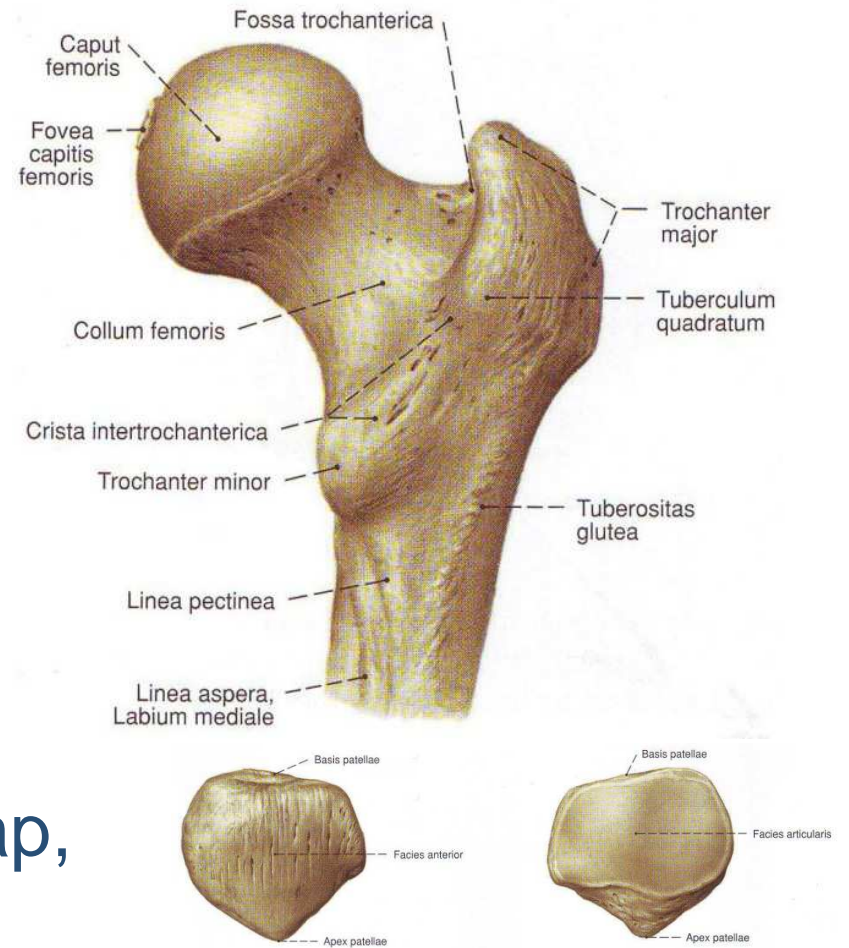
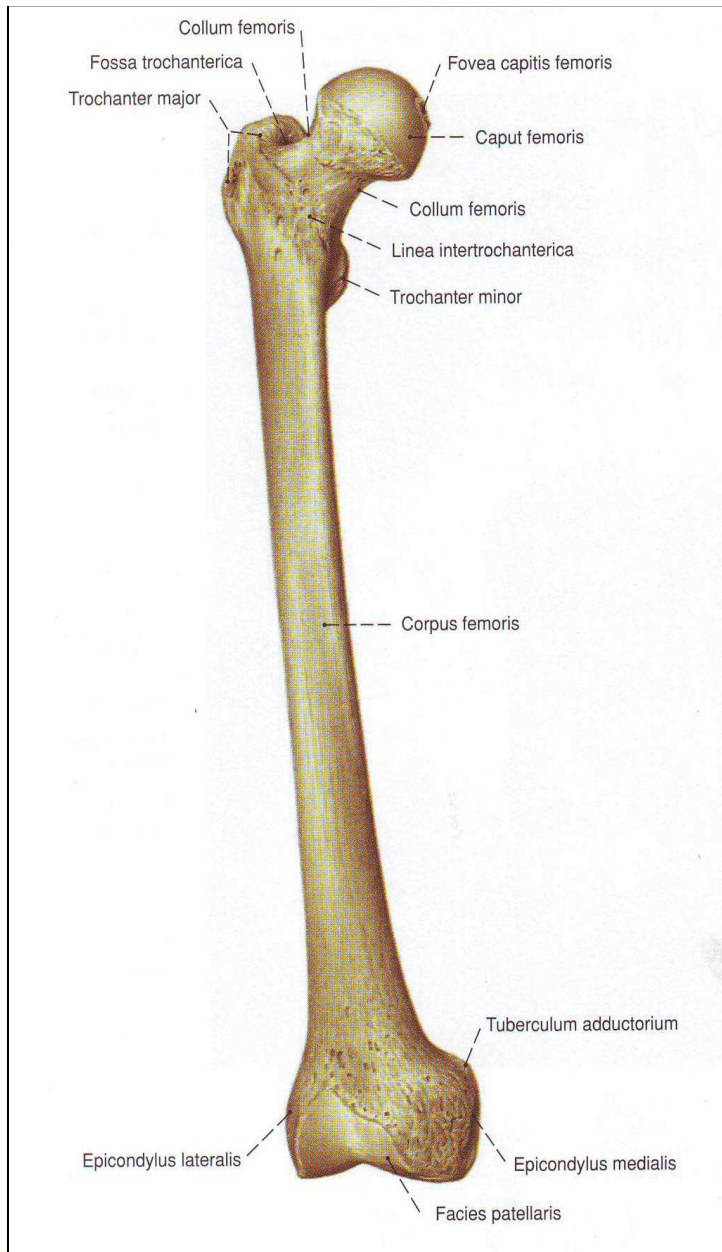


- the sacrum, *os sacrum*



Bones of the thigh, *ossa femoris*

■ Thigh bone, *femur*

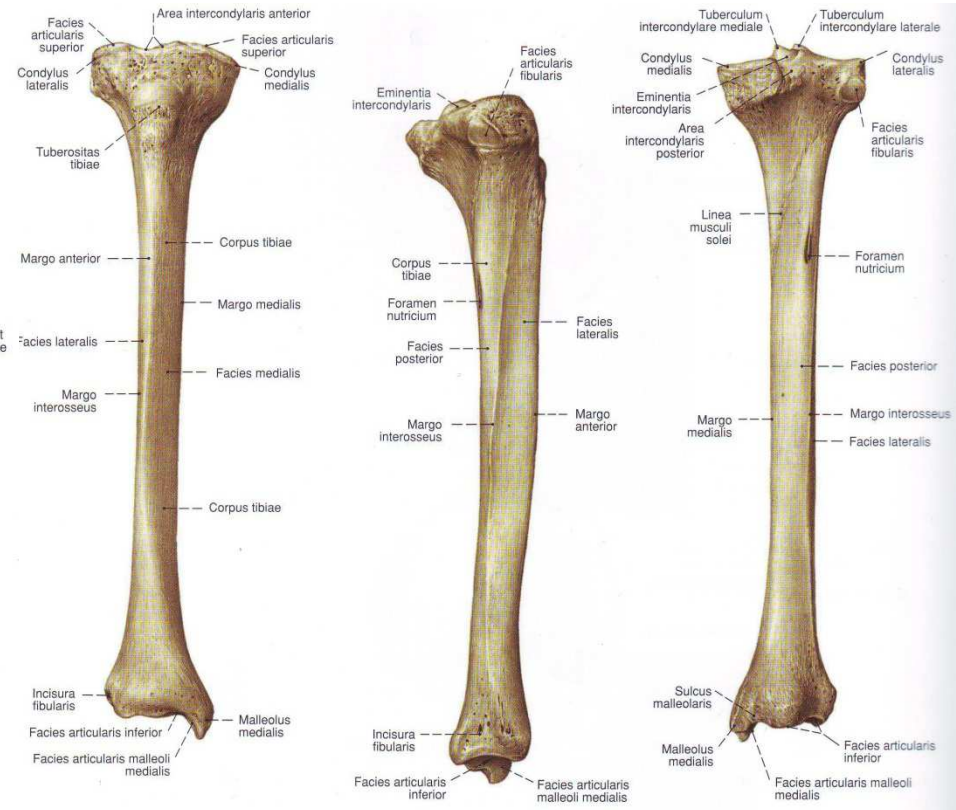
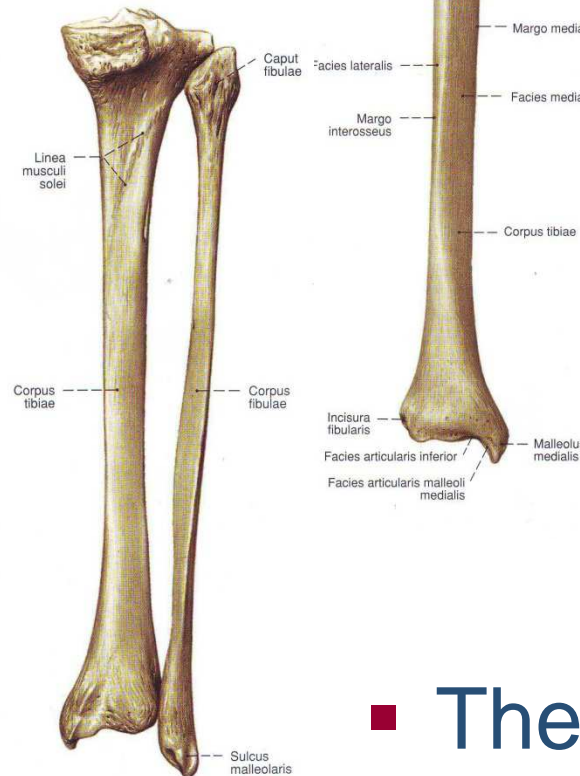
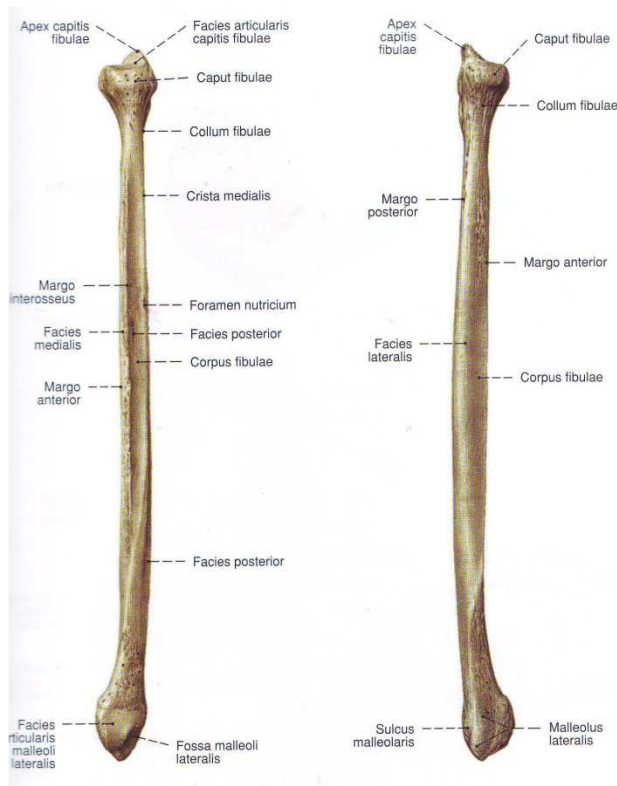


■ Kneecap, *patella*



Bones of the leg, *ossa cruris*

■ The tibia, *tibia*



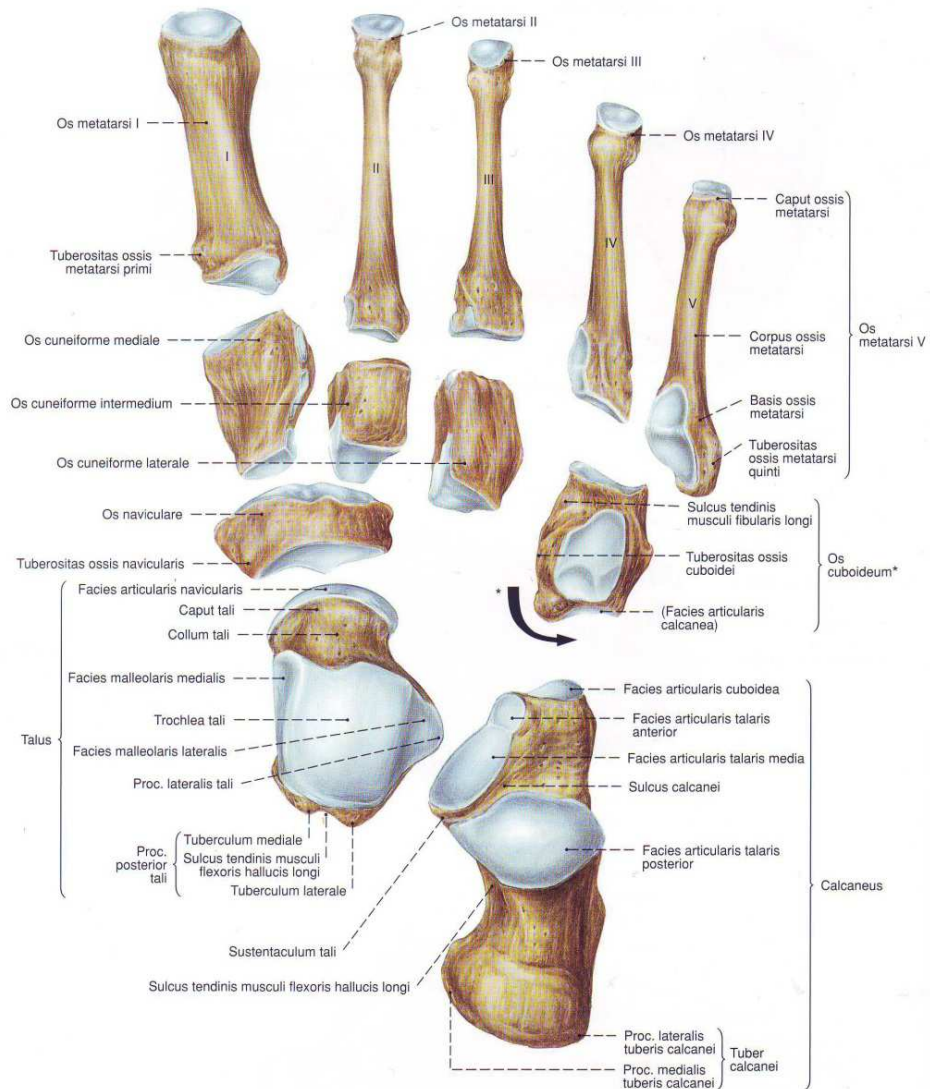
■ The fibula, *fibula*



Bones of the foot, *ossa pedis*

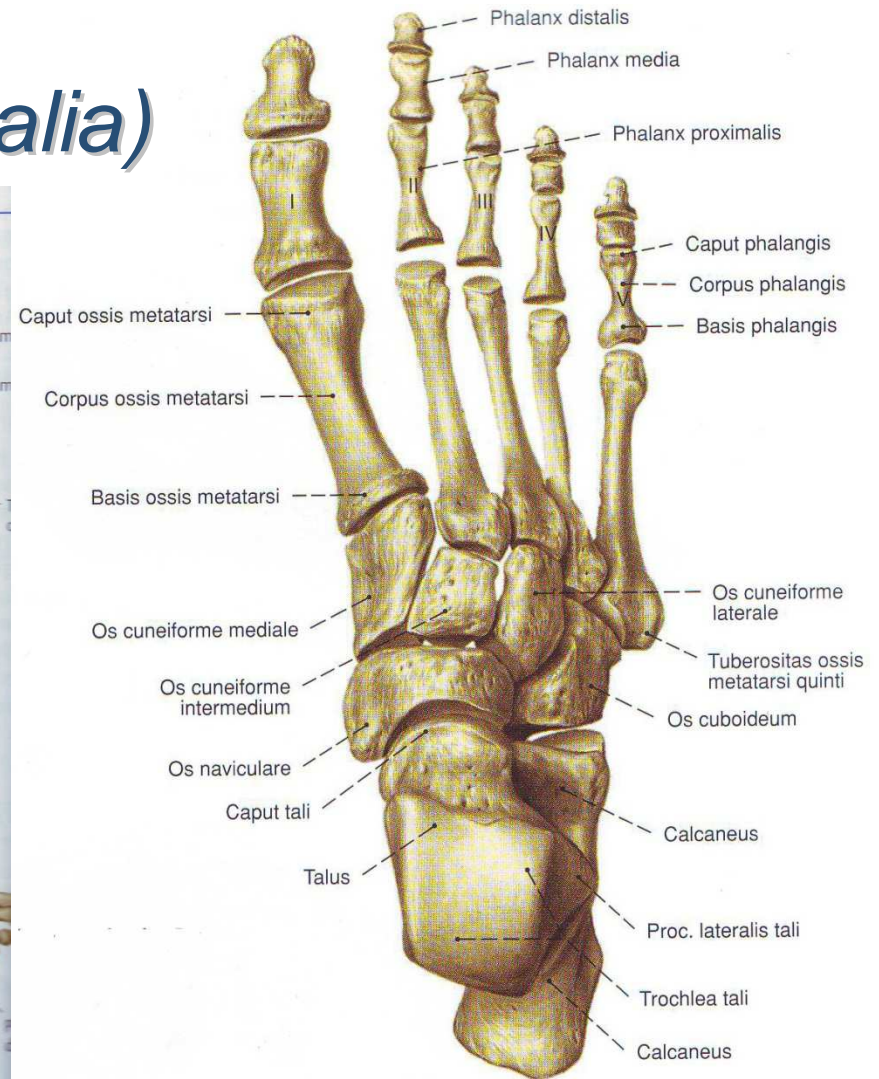
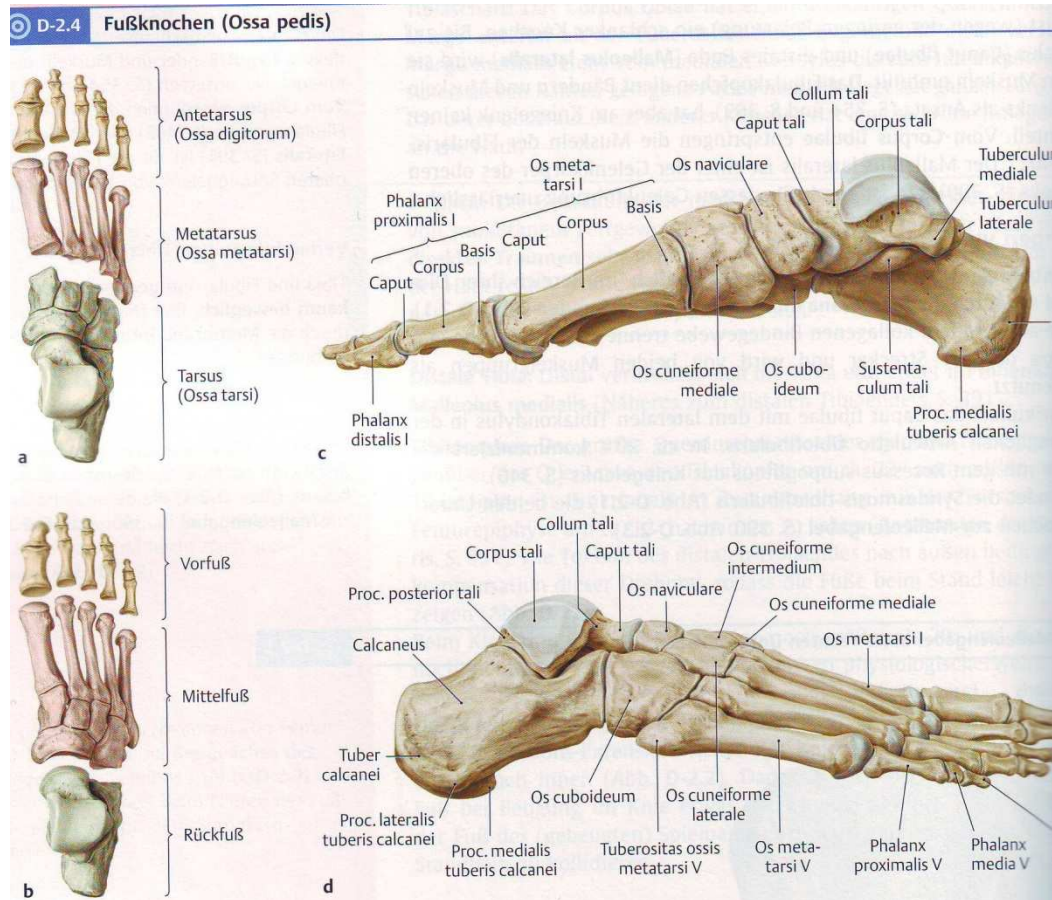
- Tarsal bones, *ossa tarsi (tarsalia)*:

- ✓ the talus, *talus*
- ✓ the calcaneus, *calcaneus*
- ✓ the navicular bone, *os naviculare*
- ✓ the cuneiform bones, *ossa cuneiformia*
- ✓ the cuboid bone, *os cuboideum*



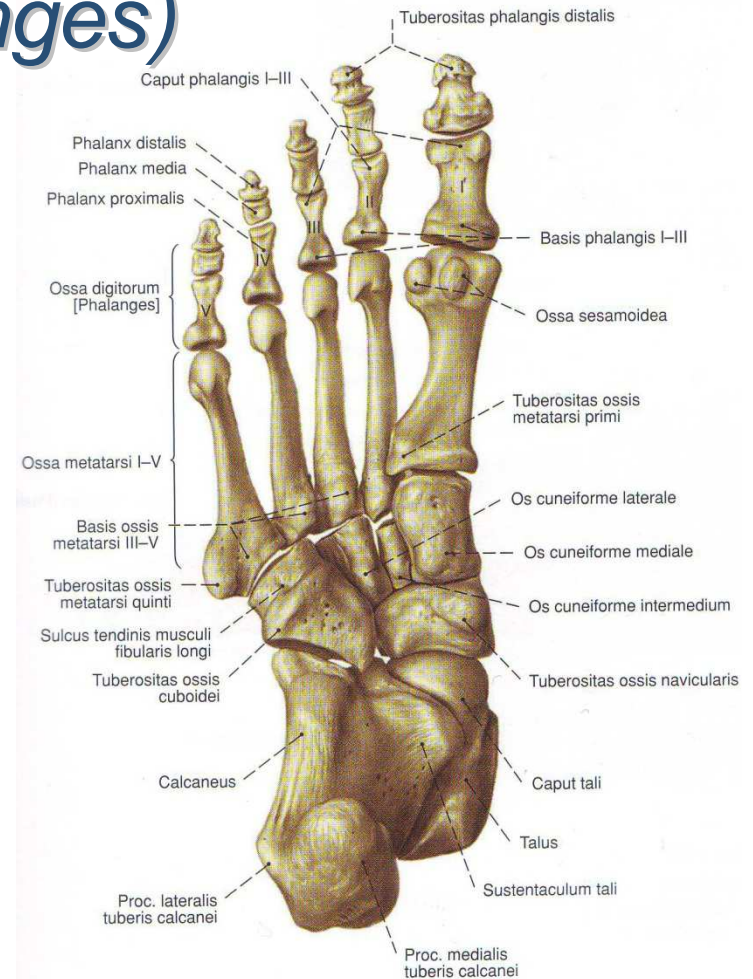
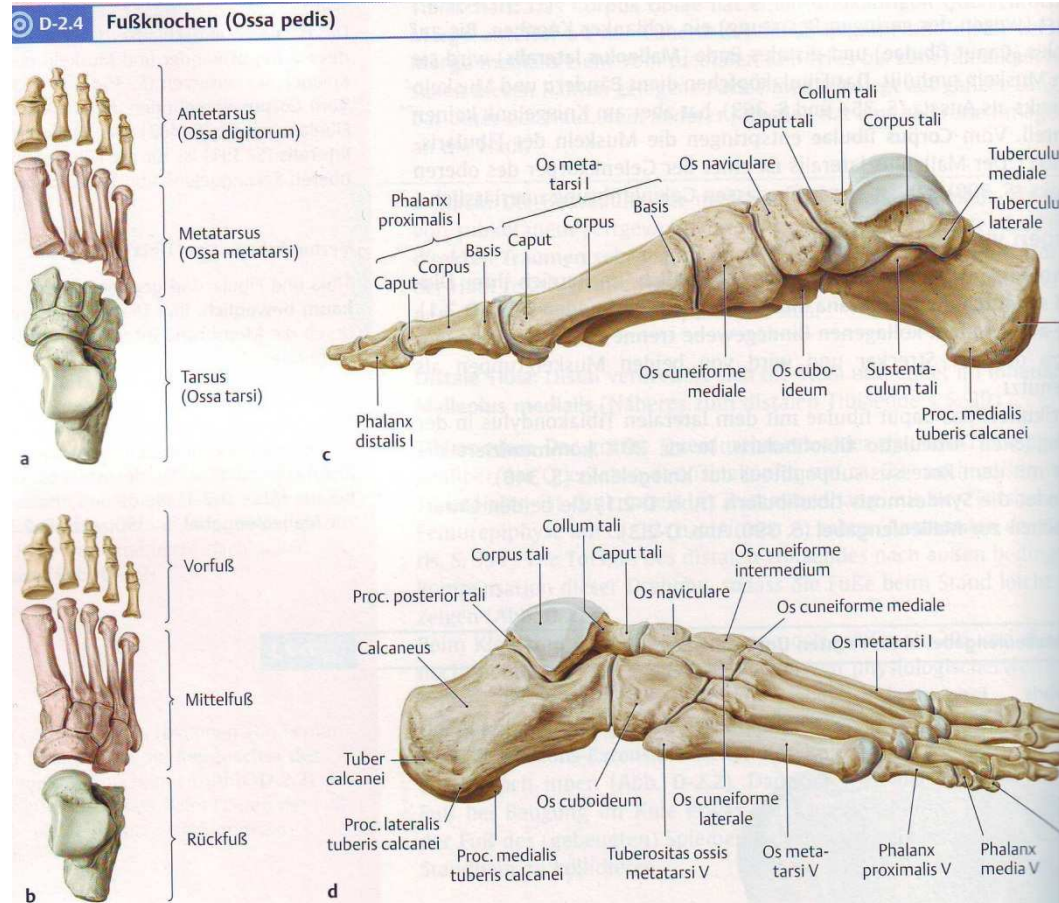
Bones of the foot, *ossa pedis*

- Metatarsal bones, *ossa metatarsi (metatarsalia)*



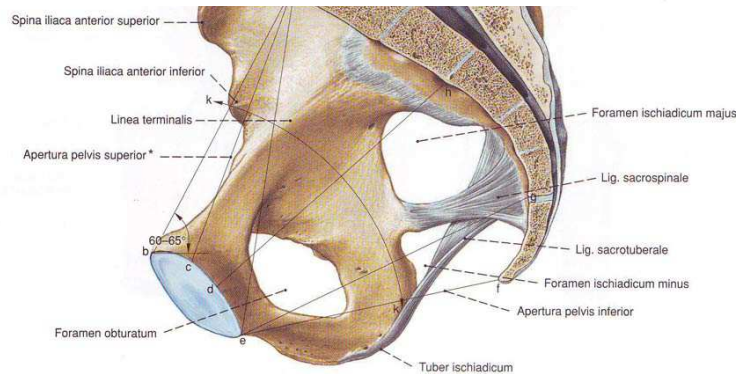
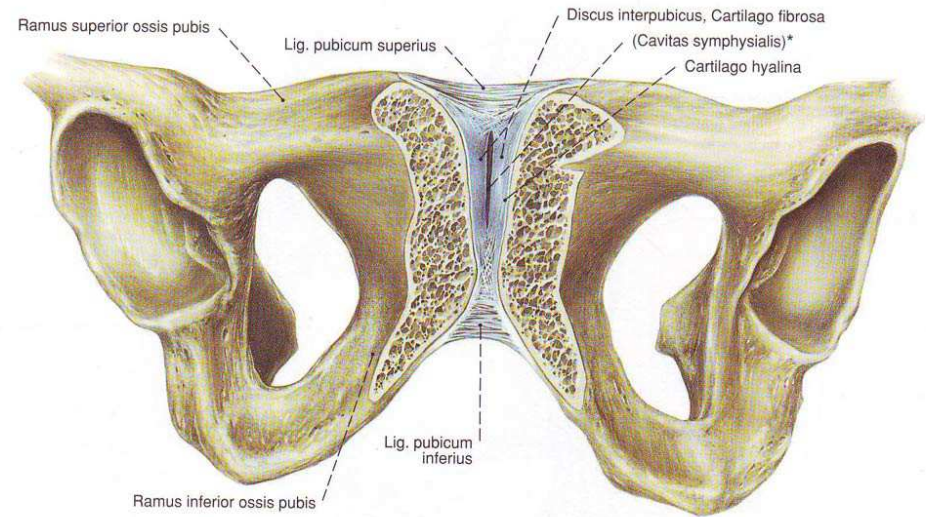
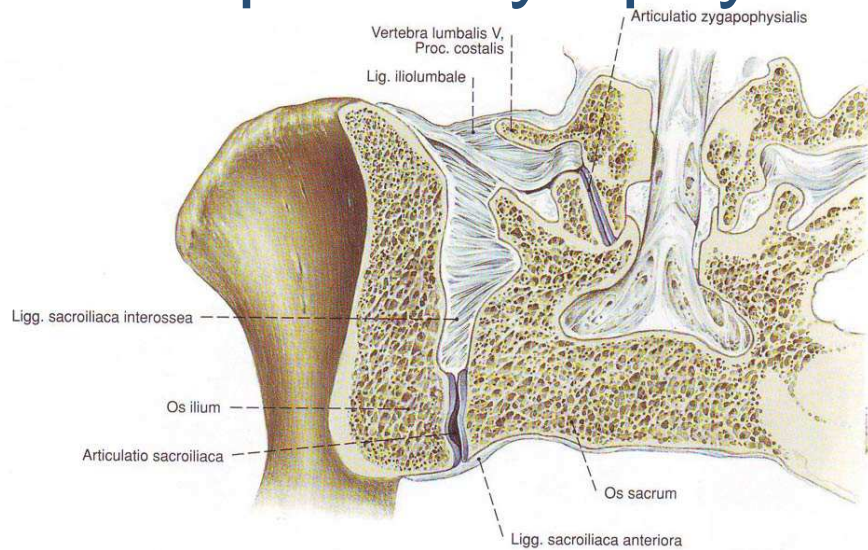
Bones of the foot, *ossa pedis*

- The phalanges of the foot, *ossa digitorum pedis (phalanges)*



Joints of the pelvic girdle, *articulationes cinguli pelvici*

- The pubic symphysis, *symphysis pubica*

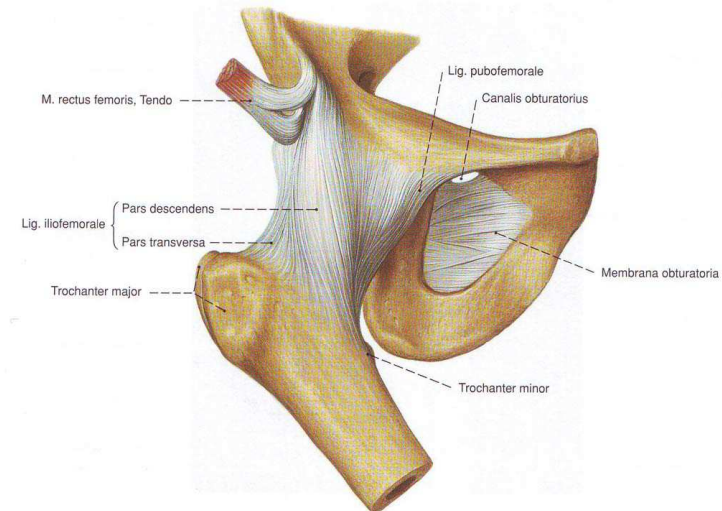
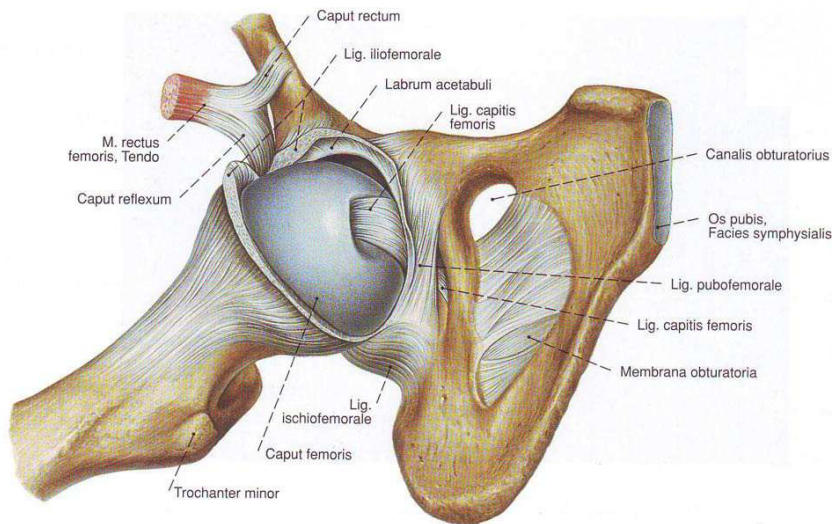
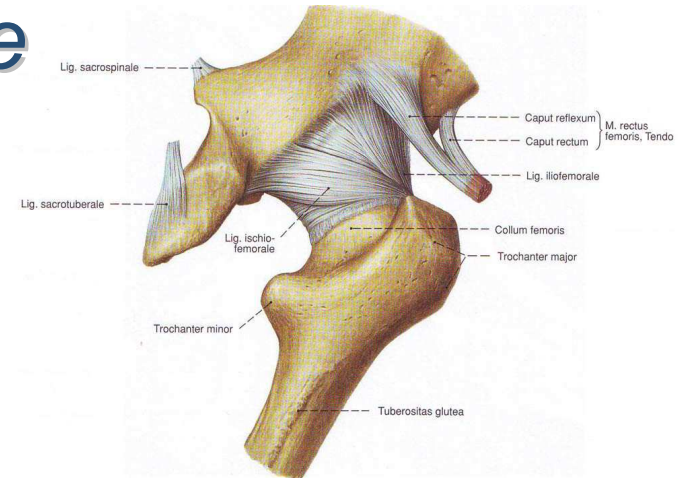
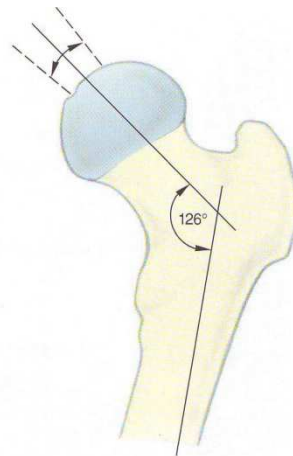
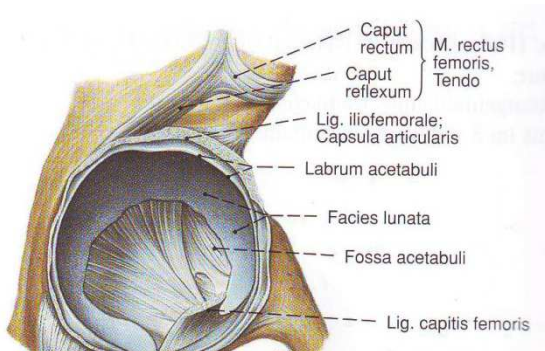


- The sacro-iliac joint, *art. sacroiliaca*
- The sacro-coccygeal joint, *articulatio sacrococcygea*



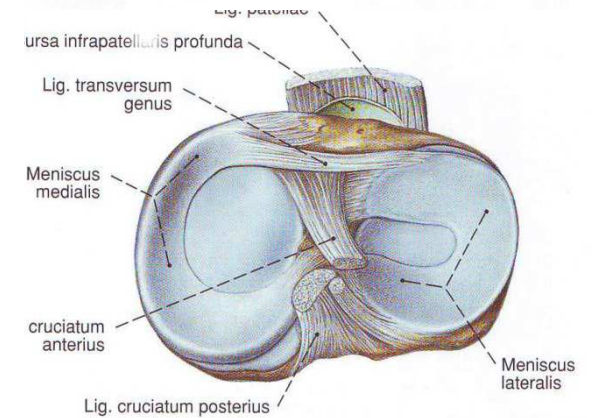
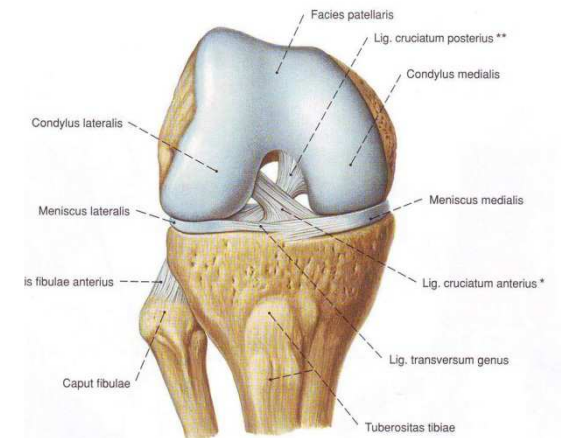
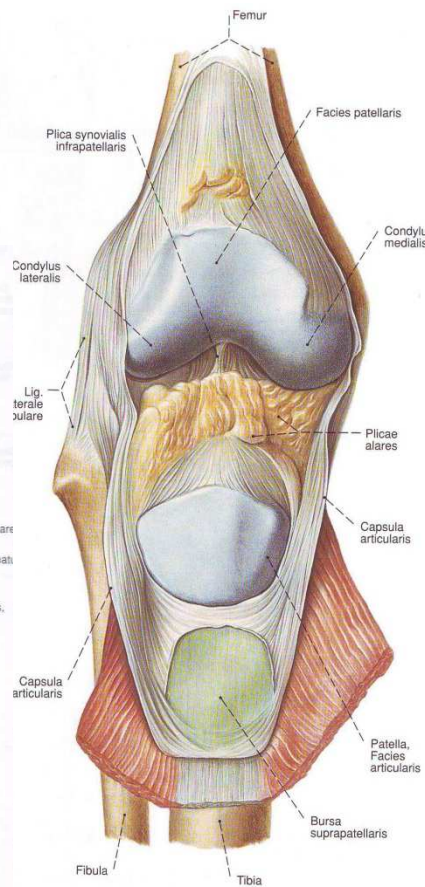
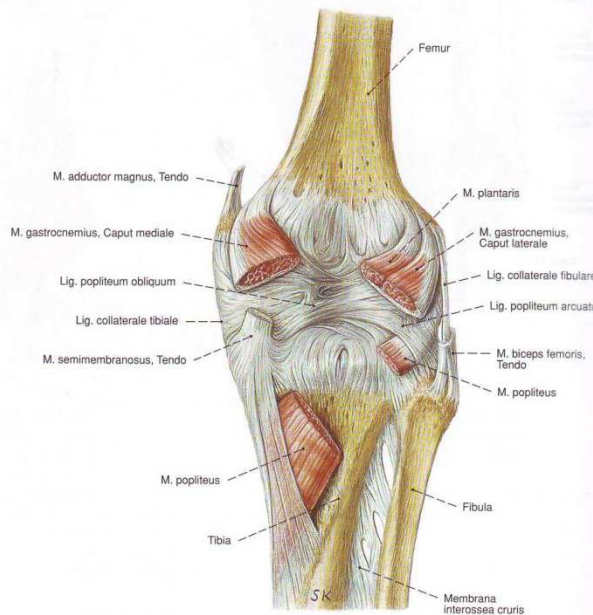
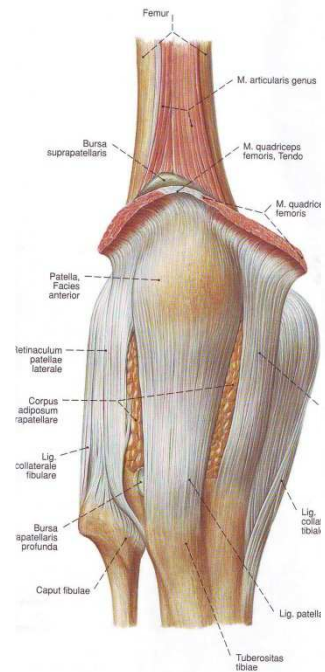
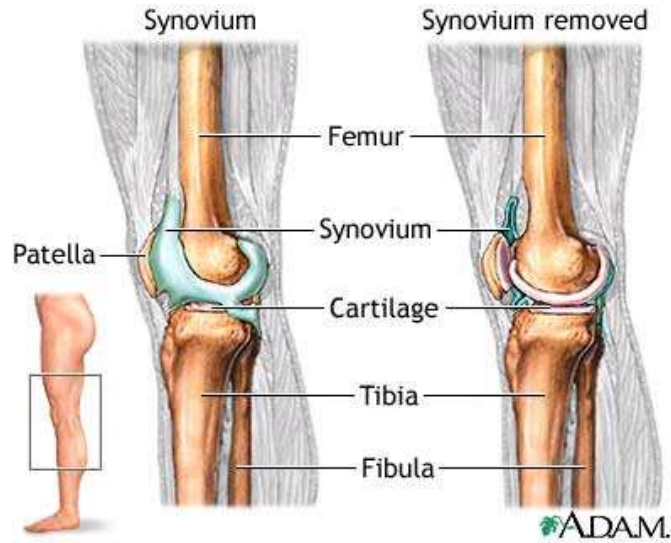
Joints of the free lower limb, *articulationes membri inferioris liberi*

- The hip (coxal) joint, *art. coxae*



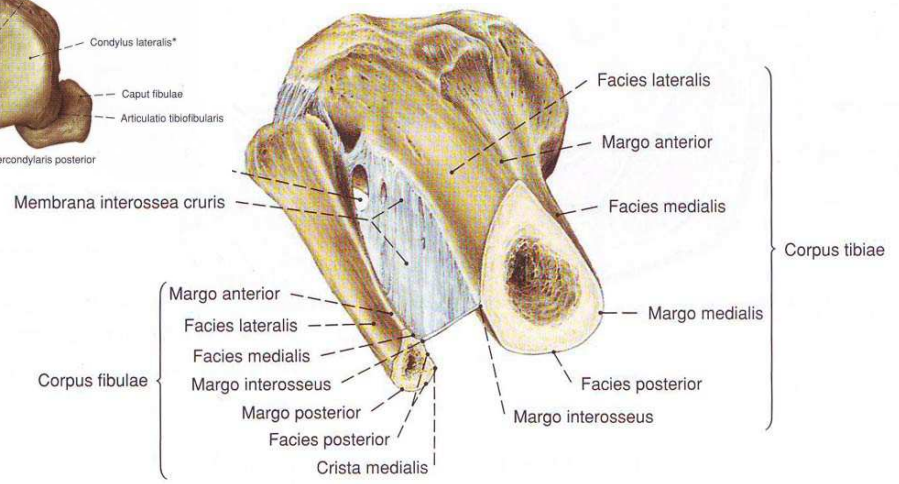
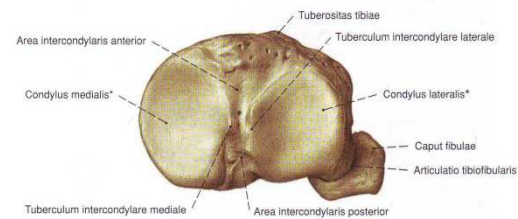
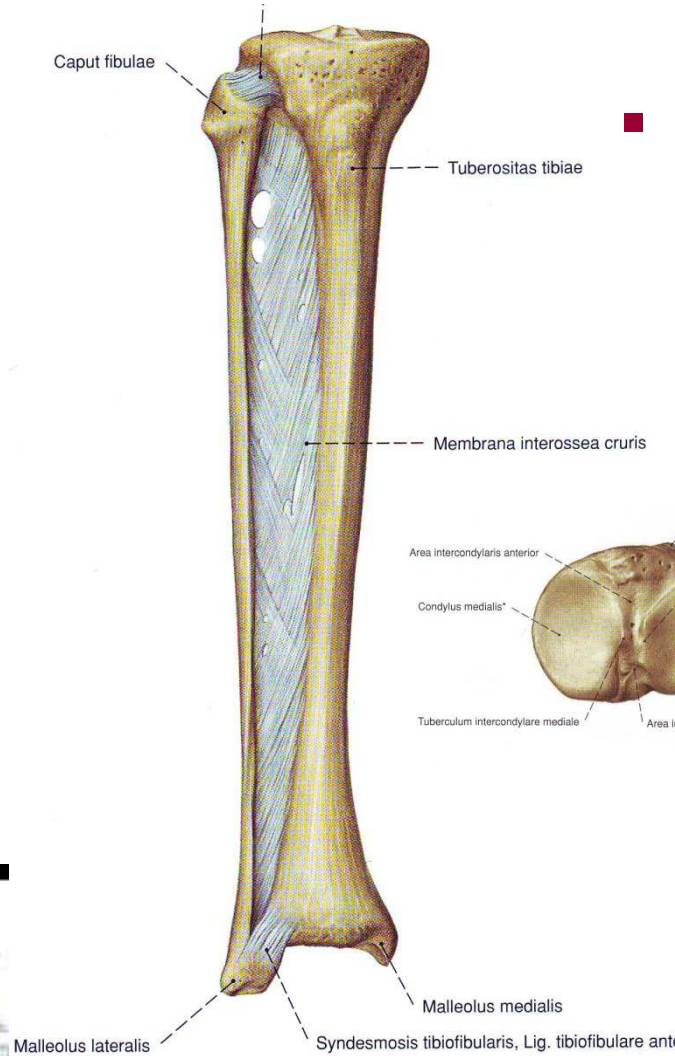
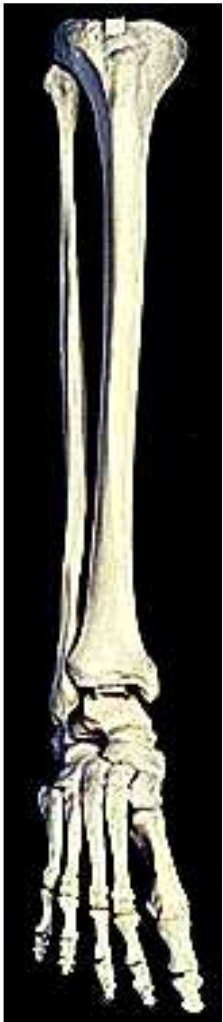
Joints of the leg, *articulationes cruris*

■ The knee (genual) joint, *art. genus*

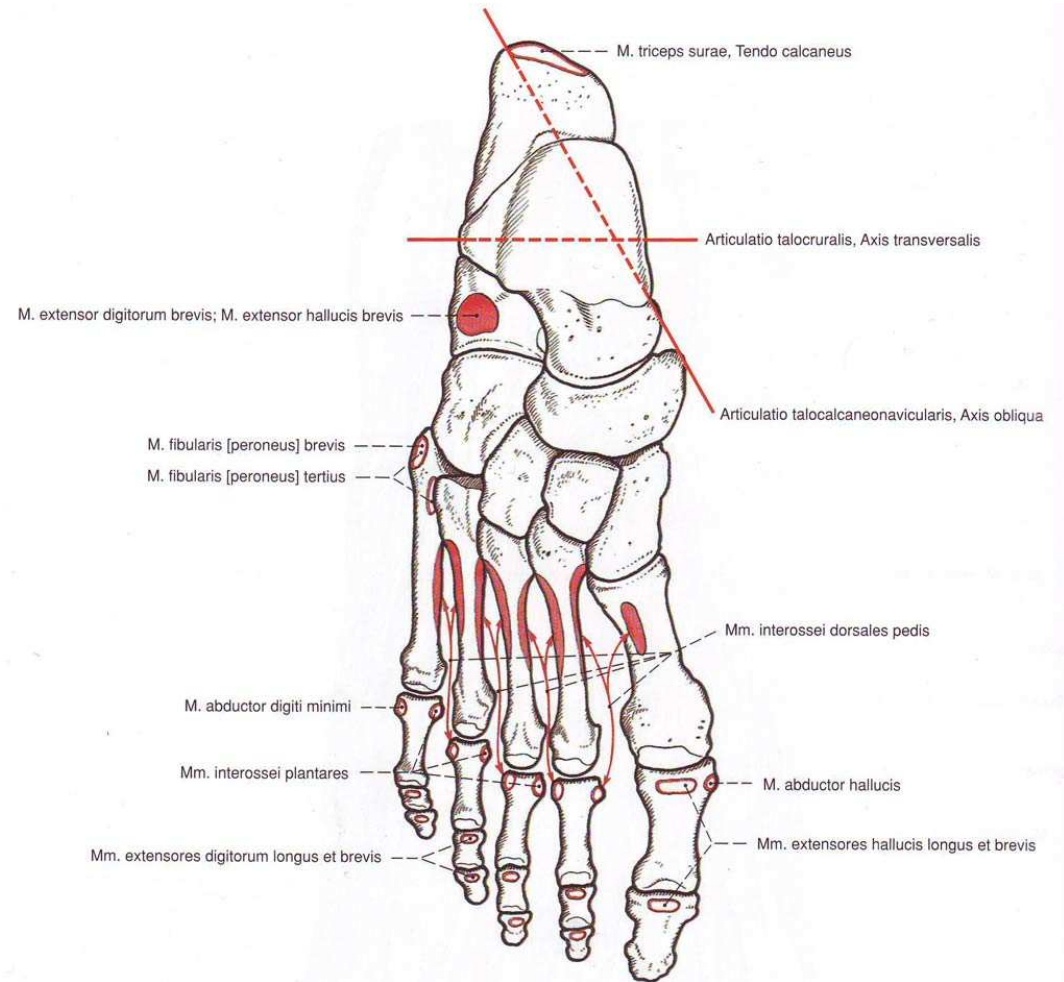
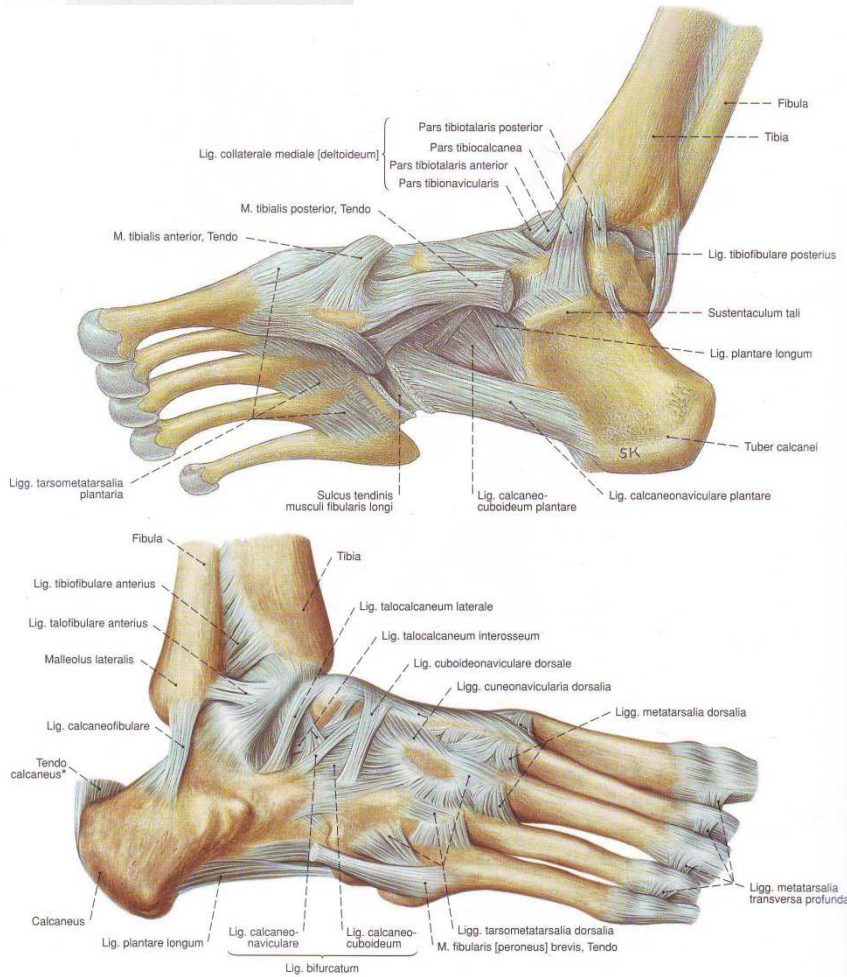
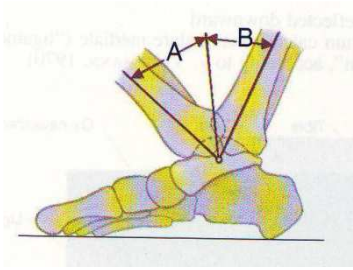


Tibiofibular articulations

- The tibiofibular articulations:
 - ✓ superior tibiofibular joint
 - ✓ crural interosseous membrane
 - ✓ inferior tibiofibular joint



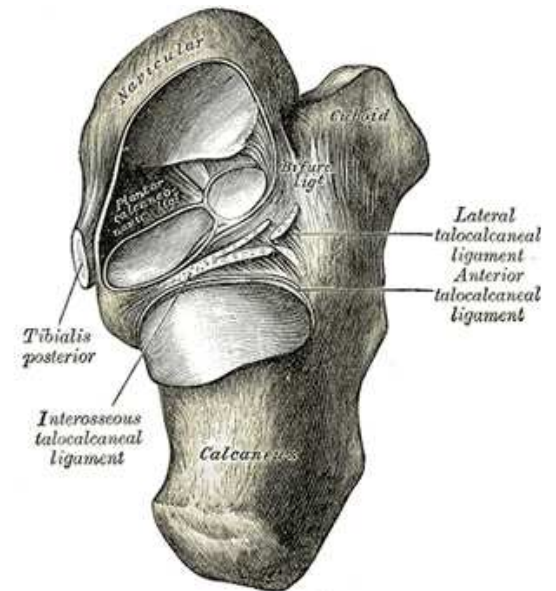
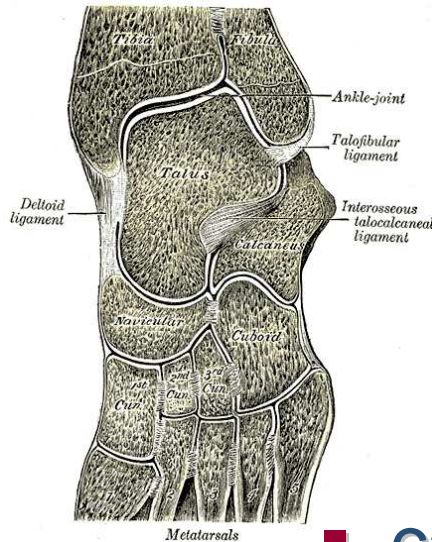
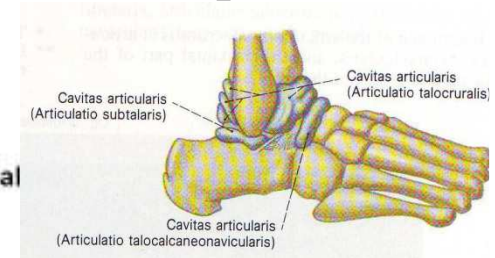
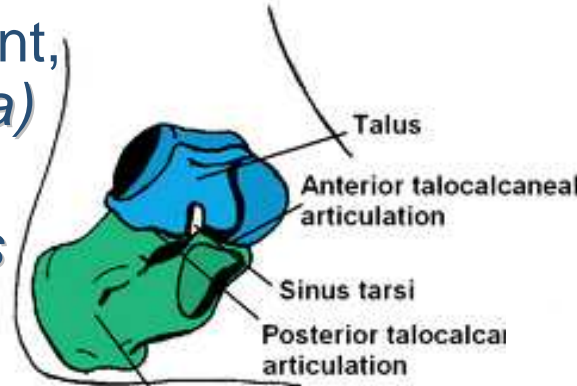
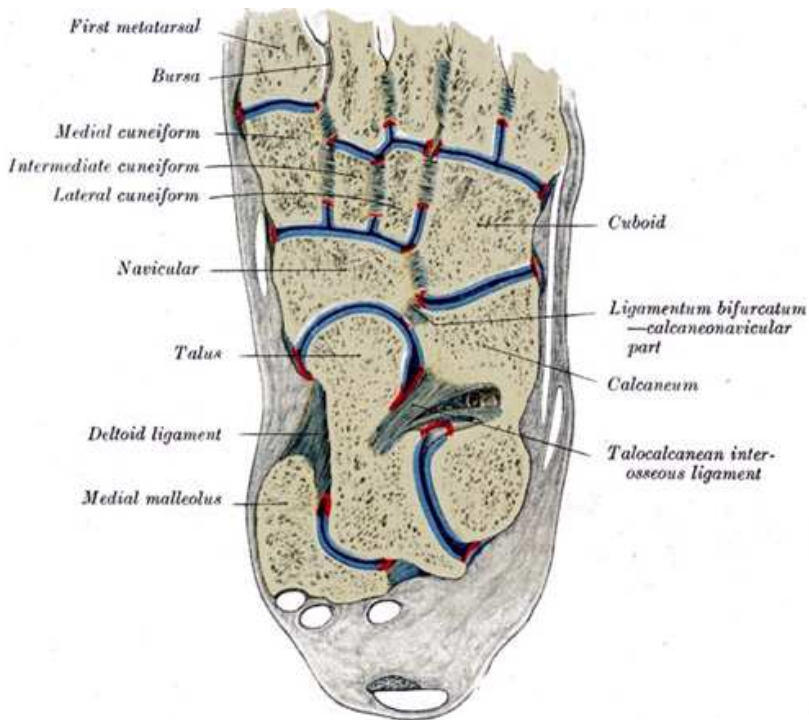
Talocrural (ankle) joint, *articulatio talocruralis*



Joints of the foot, *articulationes pedis*

- Intertarsal joints, *art. talocalcaneonavicularis*:

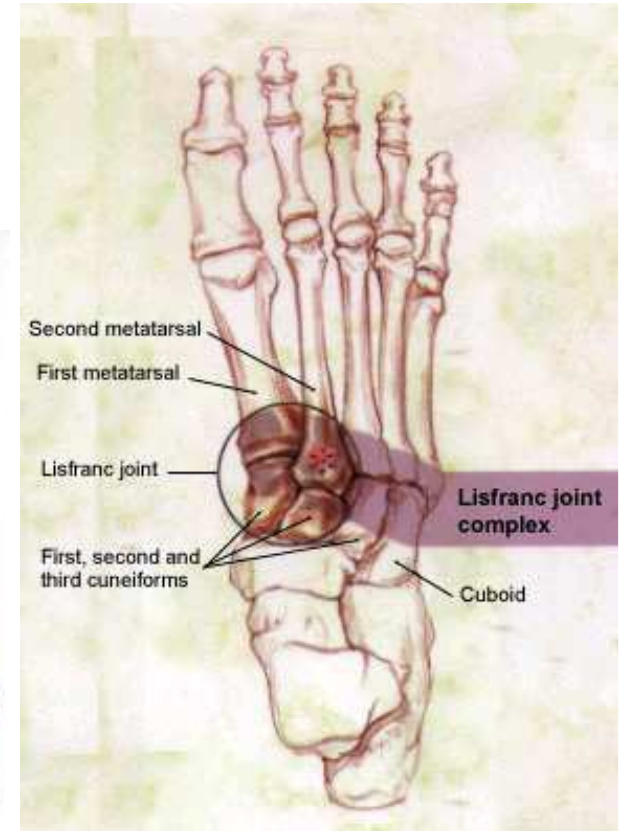
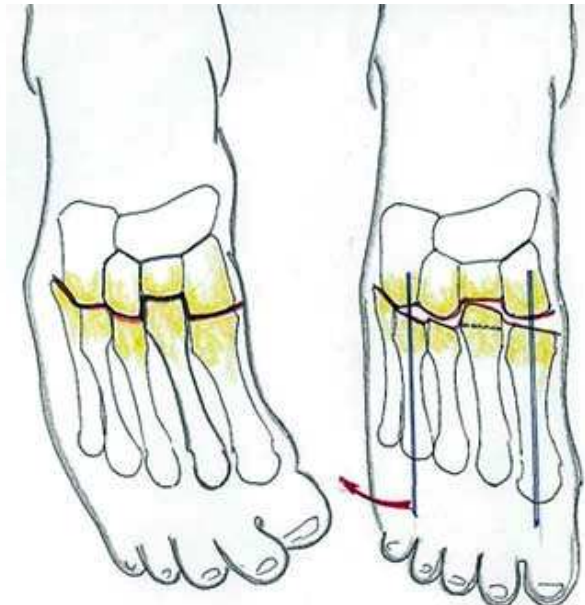
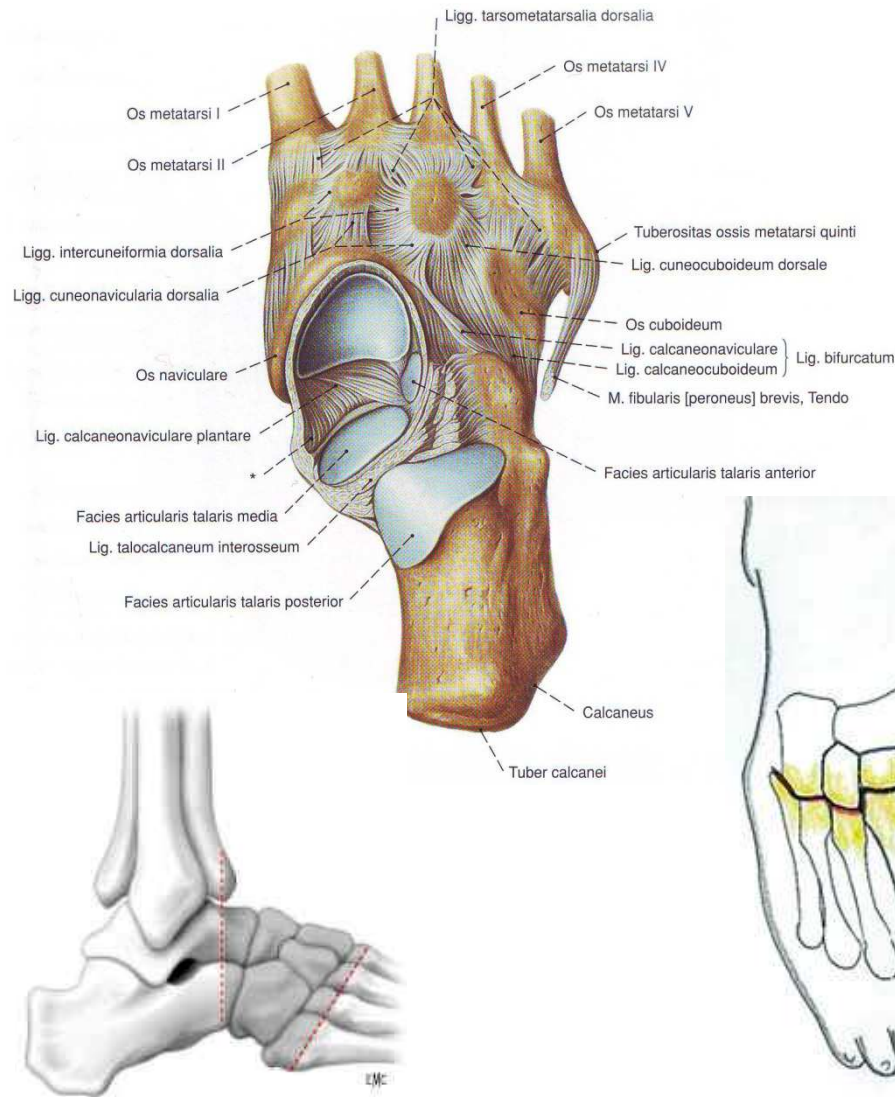
- ✓ subtalar (talocalcanean) joint, *art. subtalaris (talocalcanea)*
- ✓ talocalcaneonavicular joint, *art. talocalcaneonavicularis*



- calcaneocuboid joint
- cuneonavicular joint



Joints of the foot, *articulationes pedis*

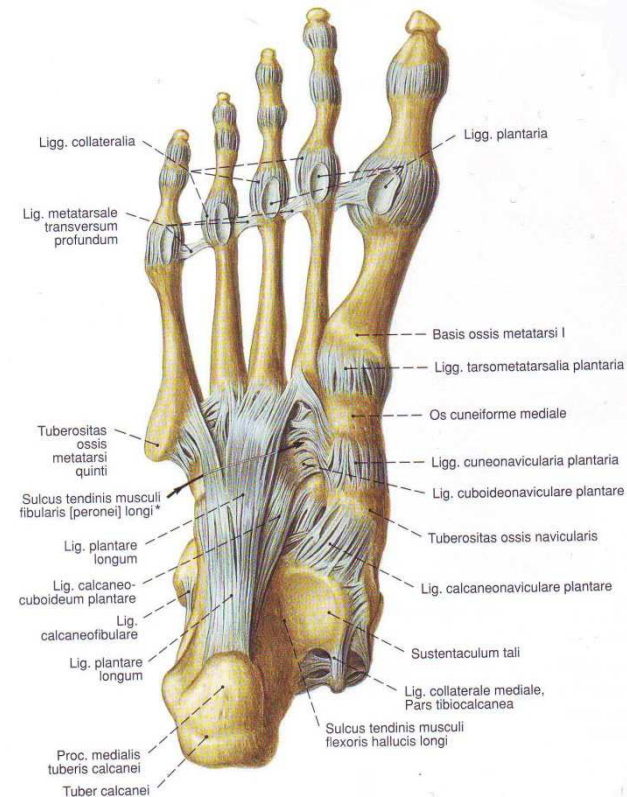
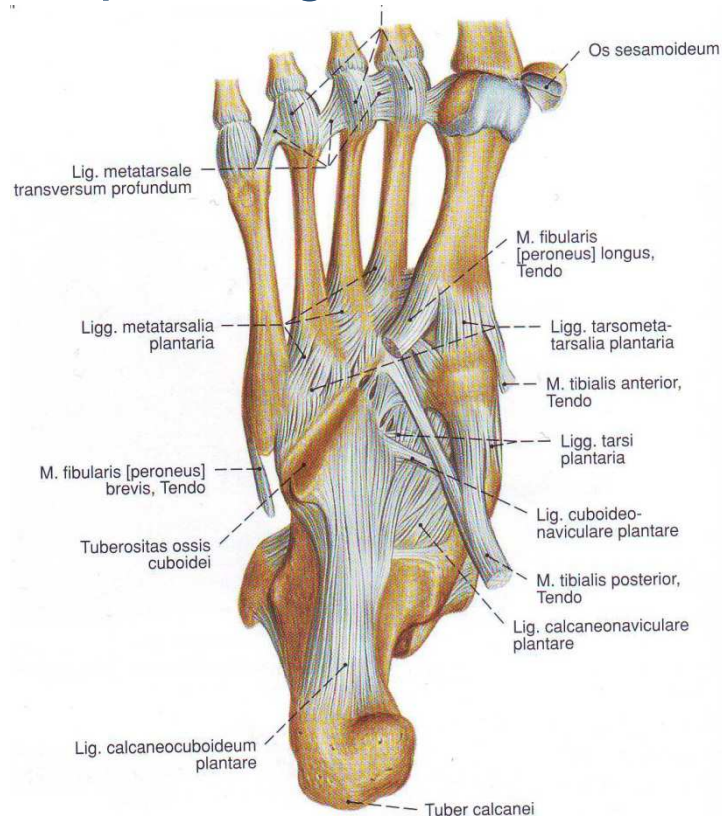


- The tarsometatarsal articulations,
articulationes tarsometatarsales

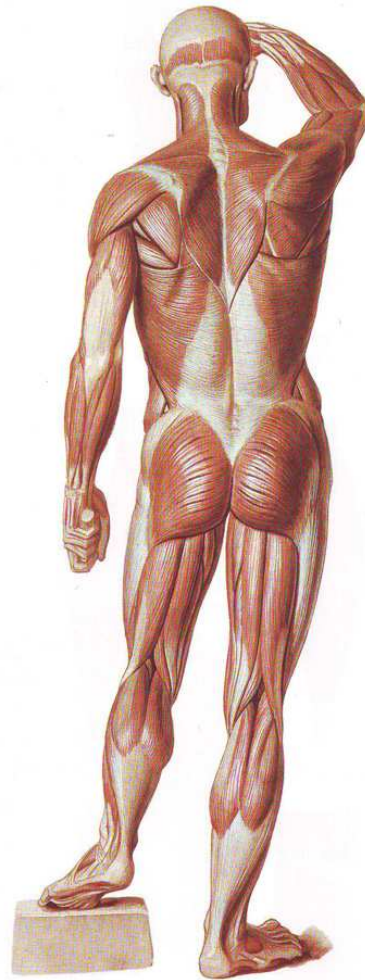
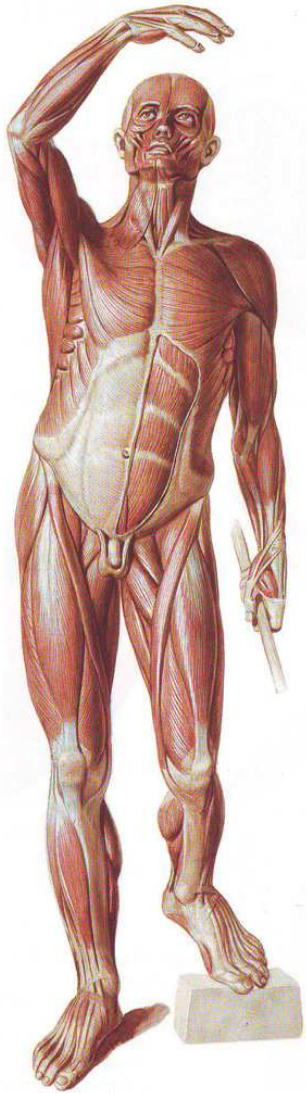


Joints of the phalanges of the foot, *articulationes digitorum pedis*

- ✓ metatarsophalangeal articulations, *art. metatarsophalangeales*
- ✓ interphalangeal articulations, *art. interphalangeales pedis*



Special myology



- Muscles of the trunk:
 - ✓ muscles of the back
 - ✓ muscles of the neck
 - ✓ muscles of the thorax
 - ✓ muscles of the abdomen
 - ✓ muscles of the pelvis and peritoneum
- Muscles of the head
- Muscles of the upper limb:
 - ✓ muscles of the shoulder girdle
 - ✓ muscles of the free upper limb
- Muscles of the lower limb:
 - ✓ muscles of the pelvic girdle
 - ✓ muscles of the free lower limb



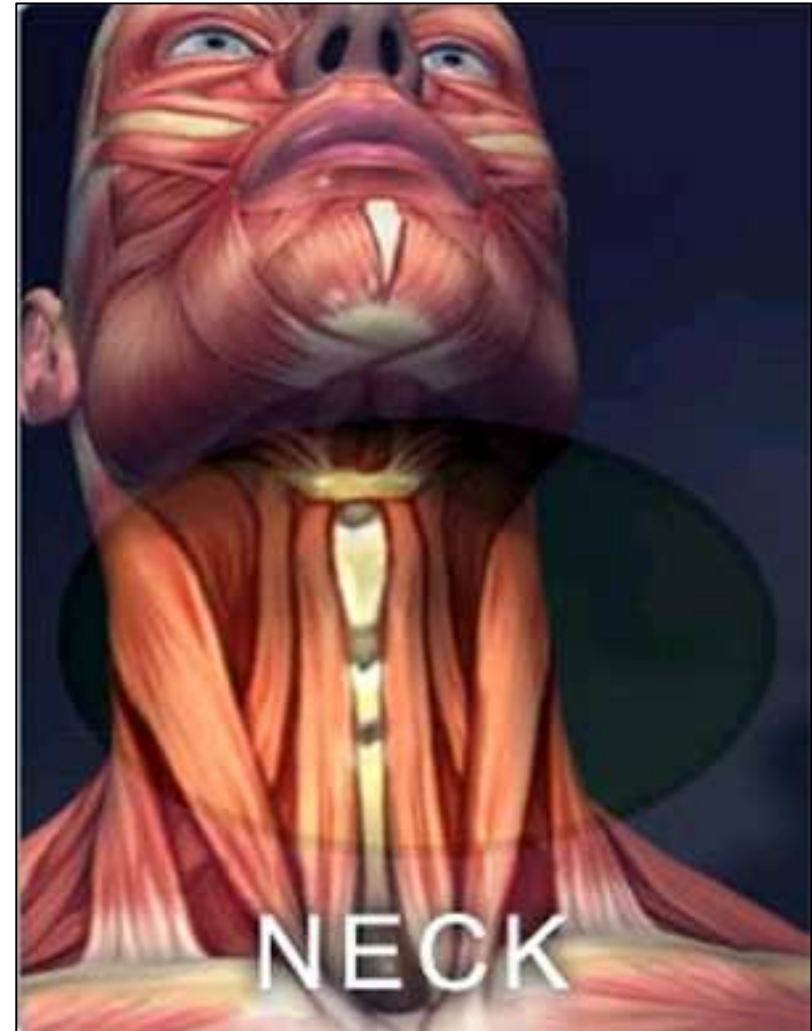
Muscles of the back, *musculi dorsi*

- superficial muscles of the back:
 - ✓ derived from ventral myotomes (hypomere)
 - ✓ no segmental arrangement
 - ✓ innervation from the ventral rami of the spinal nerves
- deep muscles of the back:
 - ✓ of ventral origin:
 - derived from ventral myotomes
 - innervation from ventral rami of the spinal nerves
 - ✓ of dorsal origin, true or autochthonous back muscles:
 - origin – dorsal myotomes (epimere)
 - innervation from dorsal rami of the spinal nerves



Muscles of the neck, *musculi colli*

- superficial muscles
- hyoid muscles:
 - ✓ suprahyoid muscles
 - ✓ infrahyoid muscles
(autochthonous neck muscles)
- deep muscles
(autochthonous muscles):
 - ✓ scaleni muscles
(modified intercostal muscles)
 - ✓ anterior vertebral muscles



Muscles of the thorax, *mm. thoracis*

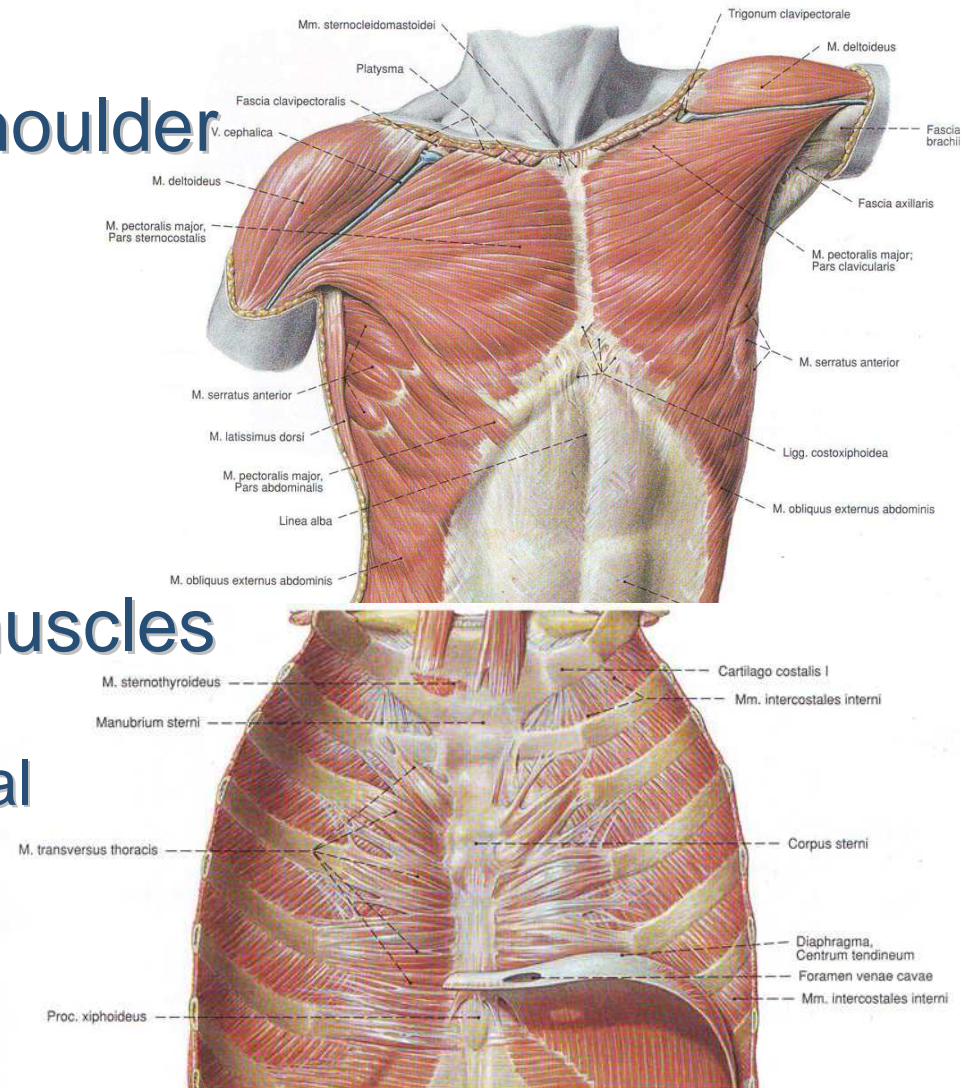
- Superficial group – thoracic muscles of the shoulder

- ✓ *m. pectoralis major*
- ✓ *m. pectoralis minor*
- ✓ *m. serratus anterior*
- ✓ *m. subclavius*

- Deep group – true, autochthonous thoracic muscles

- ✓ *mm. intercostales* – external, internal and intimal
- ✓ *m. transversus thoracis*
- ✓ *mm. subcostales*

- Diaphragm



Muscles of the abdomen, *mm. abdominis*

- Anterior abdominal muscles:

- ✓ *the rectus abdominis*

- ✓ *the pyramidalis*

- Lateral abdominal muscles:

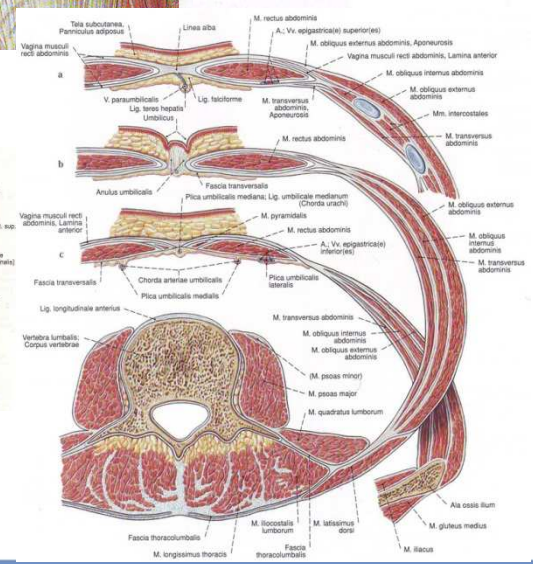
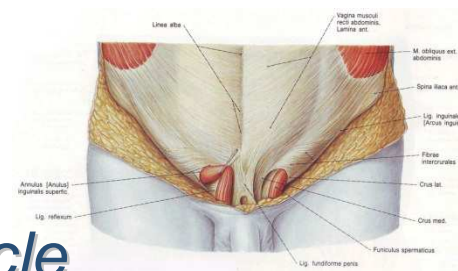
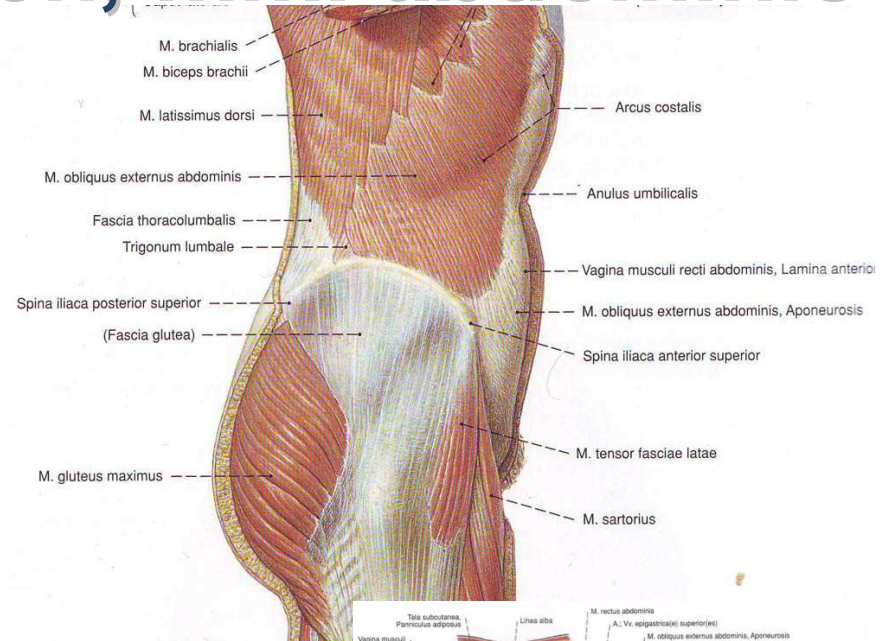
- ✓ *external abdominal oblique*

- ✓ *internal abdominal oblique*

- ✓ *transversus abdominis*

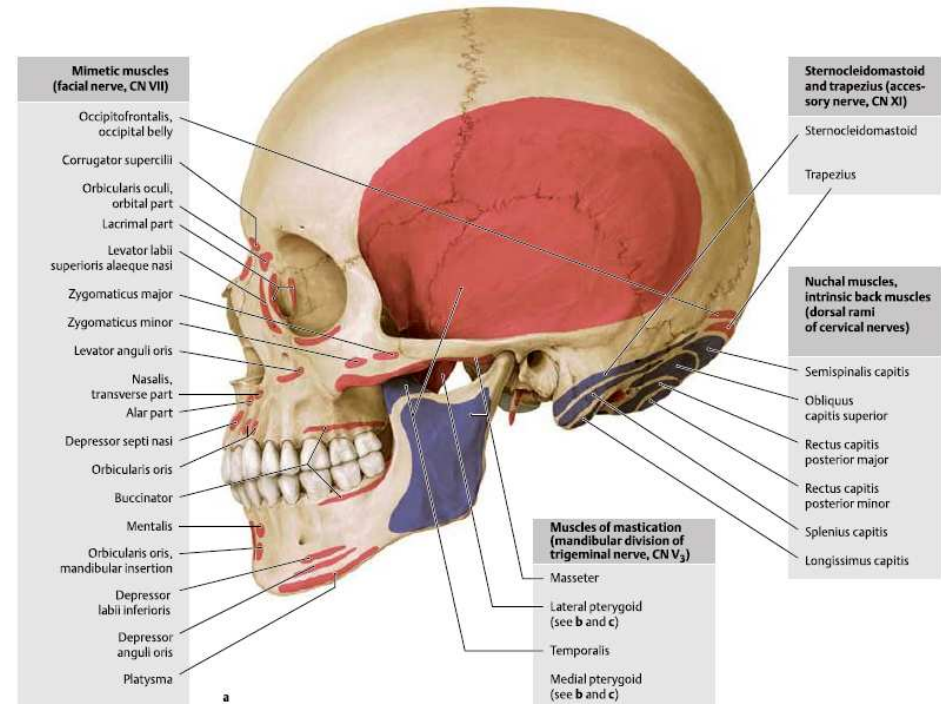
- Posterior abdominal muscles:

- ✓ *quadratus lumborum muscle*



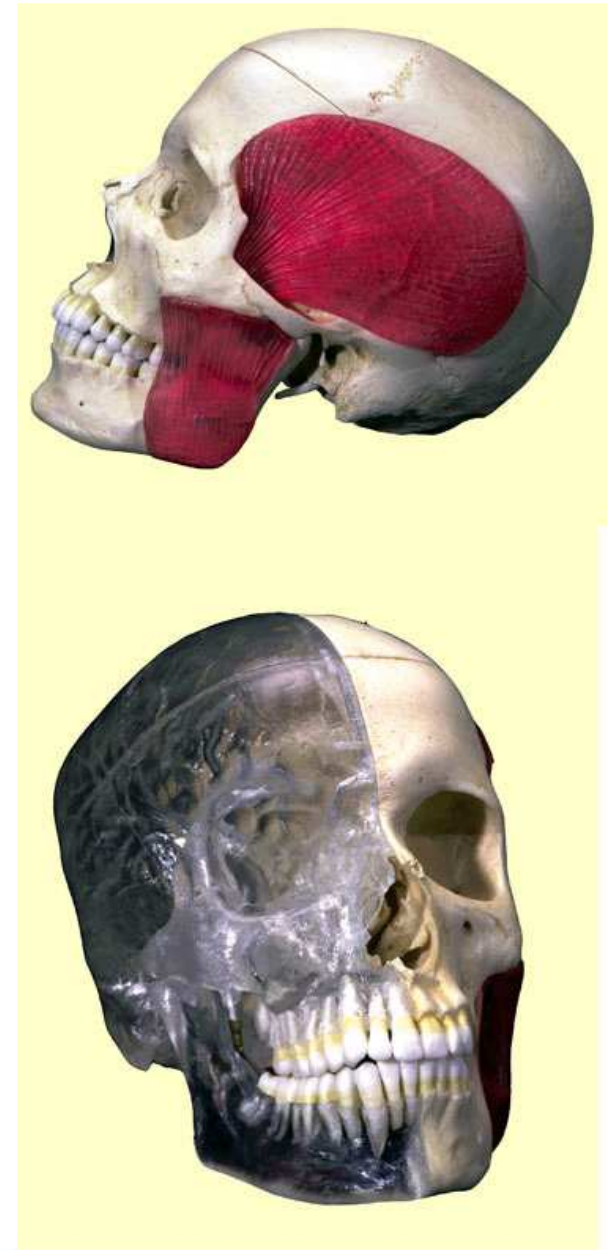
Muscles of the head, *musculi capitis*

- Masticatory muscles
- Mimic muscles – groups:
 - ✓ scalp and auricular groups
 - ✓ orbital group
 - ✓ oral and nasal groups
- Deep occipital muscles
- Muscles of the:
 - ✓ eye
 - ✓ middle ear
 - ✓ tongue
- Suprahyoid muscles



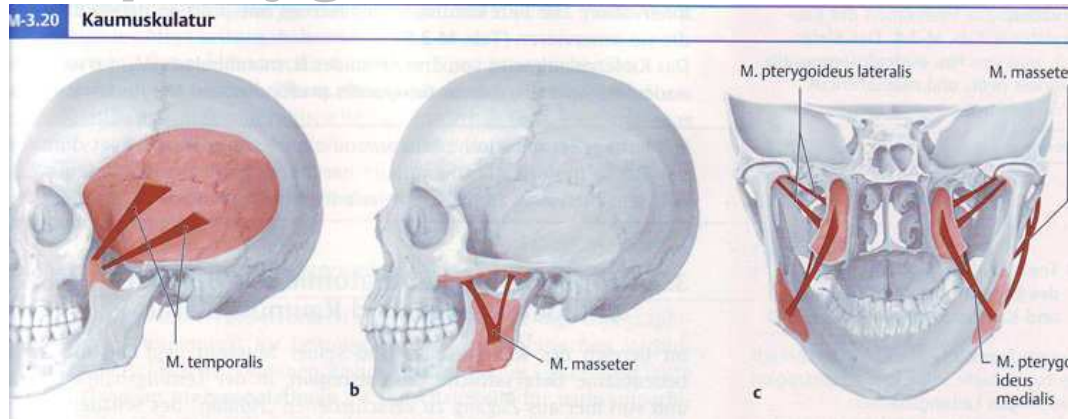
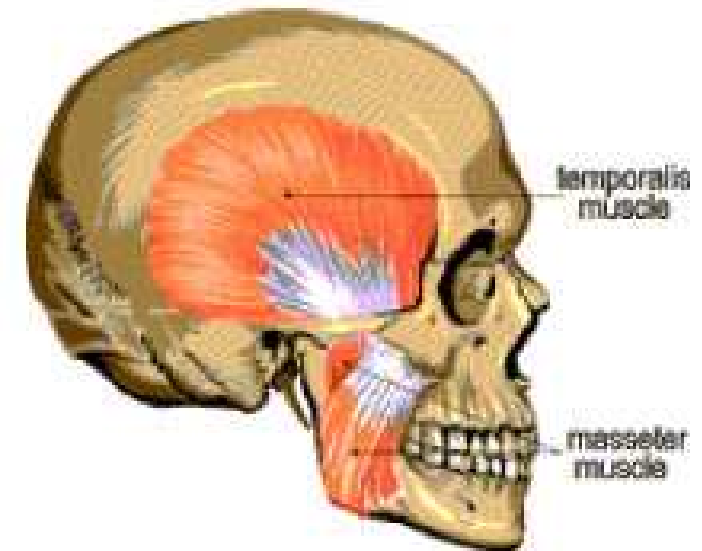
Muscles of mastication, *mm. masticatorii*

- Masticatory muscles:
 - ✓ origin from different parts of the skull
 - ✓ attached to the mandible
 - ✓ derived from the first branchial (pharyngeal) arch
 - ✓ nerve supply by the homonymous branches of the mandibular nerve (trigeminal nerve)
 - ✓ concerned with the movements of the mandible in mastication (and speech)
 - ⇒ jaw-closing muscles
 - ✓ primary and accessory muscles of mastication



Muscles of mastication, *mm. masticatorii*

- Masseter muscle, *m. masseter*
- Temporal muscle, *m. temporalis*
- Medial pterygoid muscle, *m. pterygoideus medialis*
- Lateral pterygoid muscle, *m. pterygoideus lateralis*



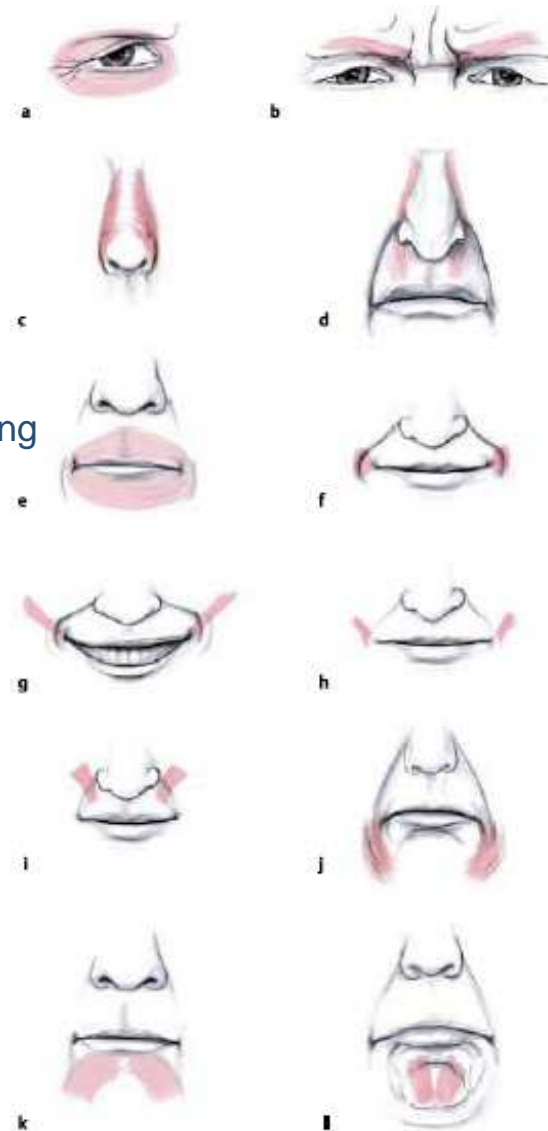
Facial muscles, *mm. faciales*

Mimic muscles:

- ✓ located on the skull vault and face
- ✓ surround the orifices of the face: the mouth, nostrils, eyes and ears
⇒ sphincters and dilators
- ✓ insert directly into the skin
- ✓ innervated by the facial nerve
- ✓ cause the skin to move
⇒ muscles of facial expression
- ✓ important role in eating and speaking



Frontalis
Corrugator
Orbicularis Oculi
Procerus
Nasalis Transversus
Nasalis Alaris
Nose Expander
Orbicularis Oris
Caninus
Quadratus Labii Superioris
Oris Elevator
Zygomaticus Min.
Zygomaticus Maj.
Risorius
Buccinatorius
Quadratus Labii Inferioris
Triangularis
Mentalis
MASTICATORS
Platysma



Region	Muscle	Remarks
Calvaria	Epicranial muscle, consisting of:	Muscle of the calvaria
	- Occipitofrontalis (frontal and occipital bellies)	Wrinkles the forehead
	- Temporoparietalis	Has no mimetic function
Palpebral fissure	Orbicularis oculi, consisting of:	Closes the eyelid (a)*
	- Orbital part	Tightly contracts the skin around the eye
	- Palpebral part	Palpebral reflex
	- Lacrimal part	Acts on the lacrimal sac
Nose	Corrugator supercilii	Wrinkles the eyebrow (b)
	Depressor supercilii	Lowers the eyebrow
	Procerus	Wrinkles the root of the nose
Mouth	Nasalis	Narrows the naris (c)
	Levator labii superioris alaeque nasi	Elevates the upper lip and nasal alae (d)
	Orbicularis oris	Closes the mouth (e)
Ear	Buccinator	Muscle of the cheek (important during eating and drinking) (f)
	Zygomaticus major	Large muscle of the zygomatic arch (g)
	Zygomaticus minor	Small muscle of the zygomatic arch
	Risorius	Muscle of laughter (h)
	Levator labii superioris	Elevates the upper lip
	Levator anguli oris	Pulls the corner of the mouth upward (i)
	Depressor anguli oris	Pulls the corner of the mouth downward (j)
	Depressor labii inferioris	Pulls the lower lip downward (k)
	Mentalis	Pulls the skin of the chin upward (l)
	Neck	Auricularis anterior
Auricularis superior		Superior muscle of the auricle
Auricularis posterior		Posterior muscle of the auricle
	Platysma	Cutaneous muscle of the neck



Muscles of the upper limb

- Innervation – brachial plexus (C_5 - Th_1)

- According to their position:

- ✓ muscles of the shoulder:

- deltoideus
- subscapularis
- supraspinatus and infraspinatus
- teres major and teres minor

- ✓ muscles of the arm – brachial muscles:

- anterior group – flexors
- posterior group – extensors

- ✓ muscles of the forearm:

- anterior (flexor/pronator) group
- lateral group
- posterior (extensor/pronator) group

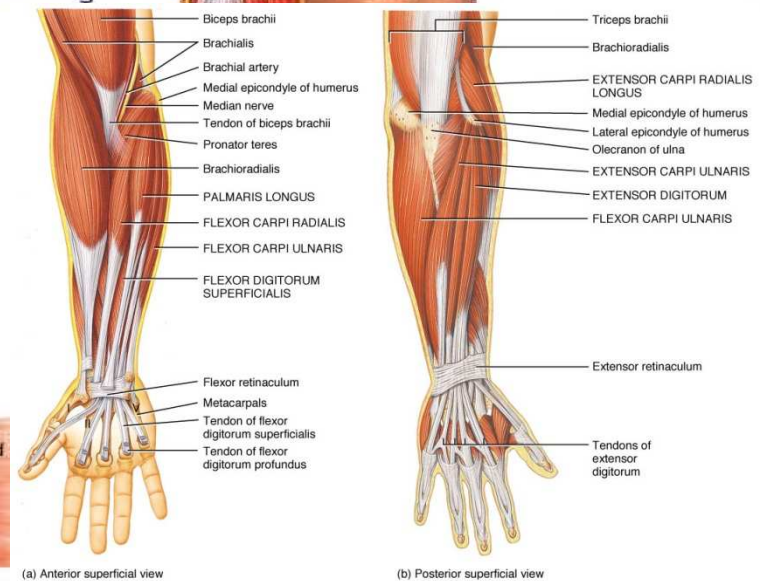
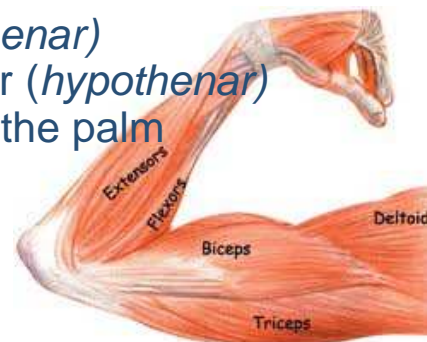
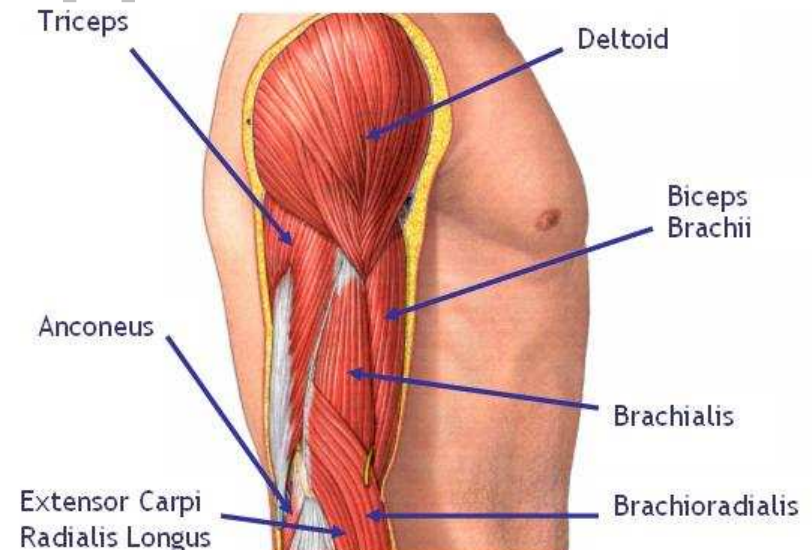
- ✓ muscles of the hand:

- muscles of the thumb (*thenar*)
- muscles of the little finger (*hypothelar*)
- muscles in the middle of the palm

- According to their function:

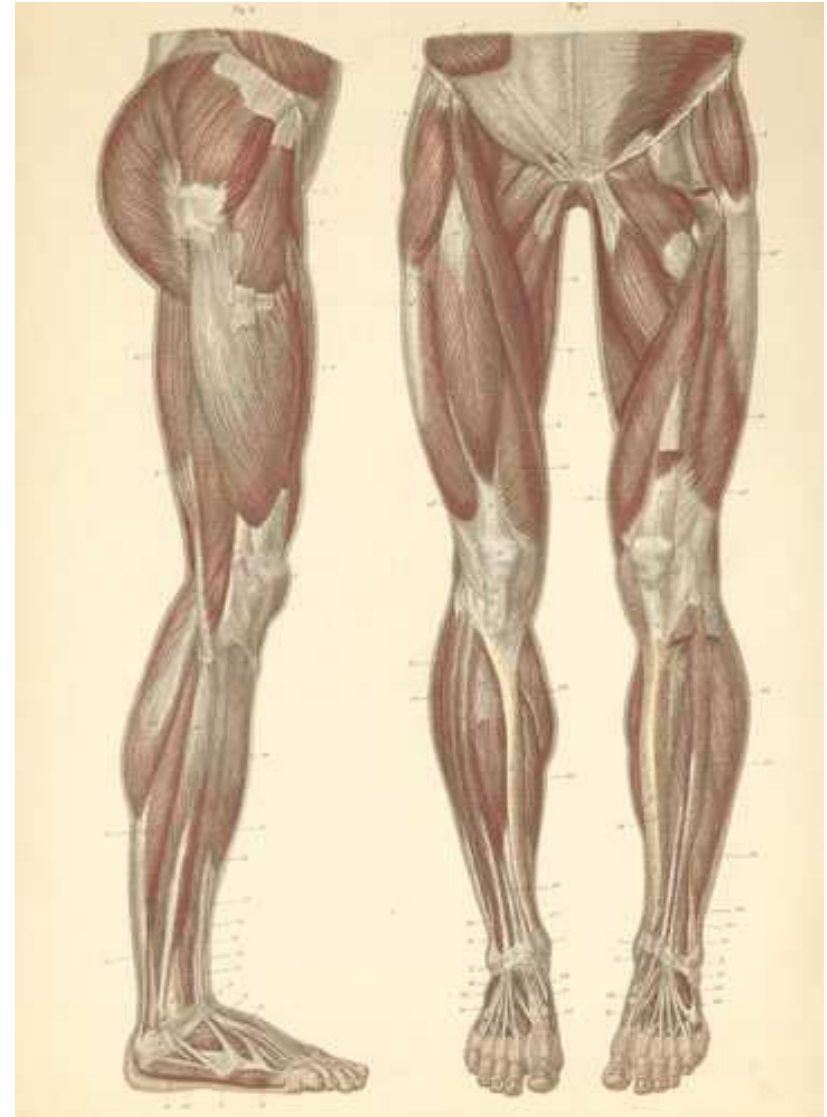
- ✓ ventral group – flexors

- ✓ dorsal group – extensors



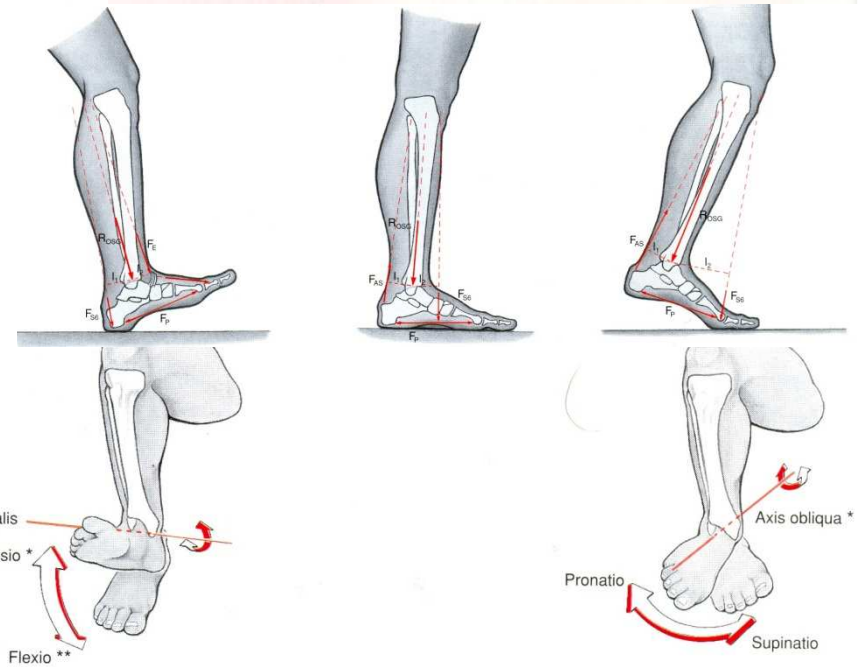
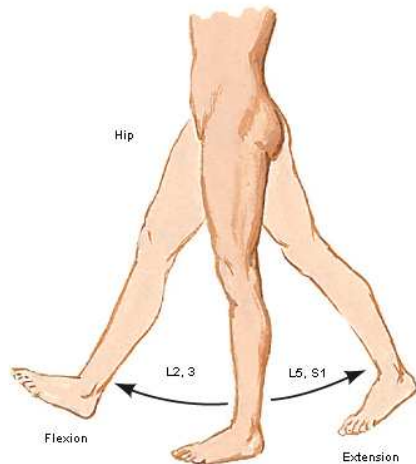
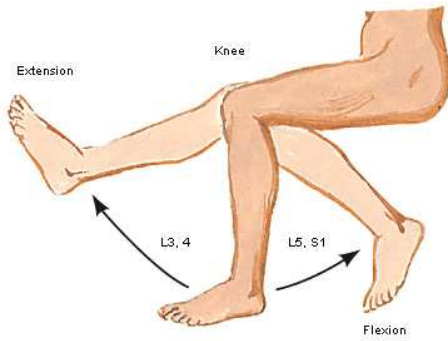
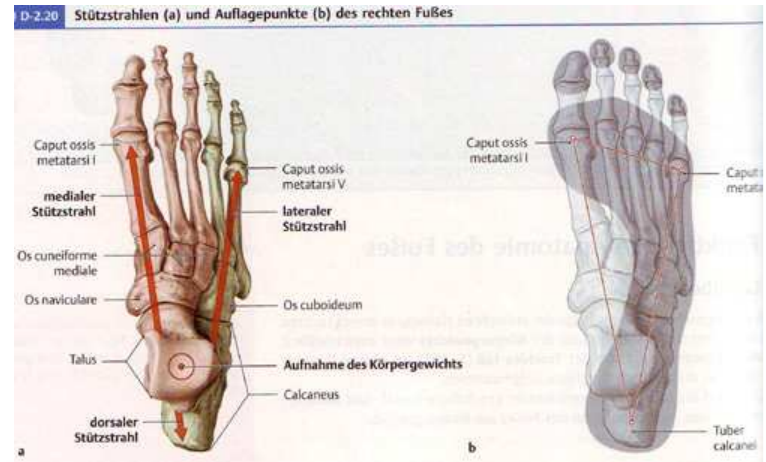
Muscles of the lower limb

- Innervation – lumbosacral plexus (L_1 - S_3)
- According to their position:
 - ✓ muscles around the hip joint:
 - internal and external pelvic muscles
 - anterior and posterior groups
 - ✓ muscles of the thigh:
 - anterior compartment
 - posterior compartment
 - medial compartment
 - ✓ muscles of the leg:
 - anterior compartment
 - lateral (peroneal) compartment
 - posterior compartment
 - ✓ muscles of the foot:
 - muscles on the dorsal side of the foot
 - plantar muscles
 - medial compartment
 - lateral compartment
 - middle compartment
- According to their function:
 - ✓ ventral group – flexors
 - ✓ dorsal group – extensors



Functional anatomy of the foot

- Arches of the foot:
 - ✓ transversal arch
 - ✓ longitudinal arch – medial and lateral



We're looking for medical students who like to solve difficult problems.

Why the wedding ring should be worn on the fourth finger?

Why the wedding ring should be worn on the fourth finger?

Why the wedding ring should be worn on the fourth finger?

Why the wedding ring should be worn on the fourth finger?

Why the wedding ring should be worn on the fourth finger?



Thank you...