HUMAN ANATOMY

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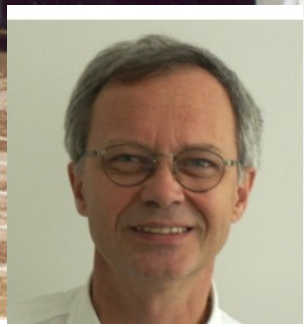


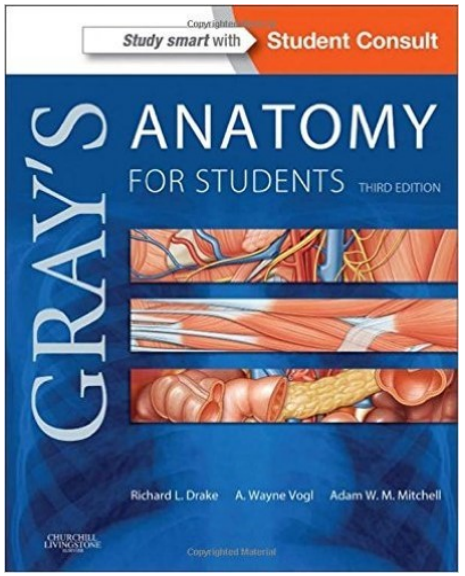
Lending of bones (1st – 5th week)

Monday	**10.00 – 16.00**
Tuesday	**8.00 – 16.00**
Wednesday	**10.00 – 17.00**
Thursday	**10.00 – 17.00**
Friday	**8.00 – 14.00**

Lending and returning of bones is held every single hour

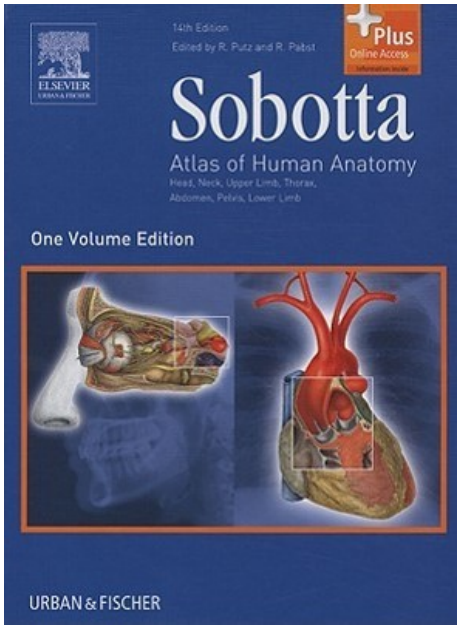
Textbooks

Drake, Richard L. (2010):
Gray´s Anatomy for Students.
Churchill Livingstone, Elsevier (second edition).



Anatomical atlases – for example:
Putz, R. (2008):
Atlas of Human Anatomy Sobotta.
Elsevier Books.

Netter, Frank H. (2006):
Atlas of Human Anatomy.
Philadelphia, Saunders Elsevier (4th edition).



Horáčková, L., Páč, L., Nechutová, H.:
Anatomy of Human Locomotor system.
MU Brno 2010.

For revision:
Hudák, R., Kachlík, D., Volný, O.:
Memorix Anatomy (Entire human anatomy in English and Latin), Triton, 2015.

Anatomy is the basis of the language of medicine

– The foundation of our knowledge of anatomy is cadaver anatomy.

– The aim of surface anatomy is the visualization in the „mind ´s eye“ of structures that lie beneath the skin and are hidden by it.

* to describe the relationship of one structure to another, the anatomical nomenclature should be used (it has at least 4600 words)

* anatomical terms are derived from Latin, Greek and Arabic

Descriptive terms

Must be clear what do you mean when you describe the body in patient histories, or your reports for medical journals.

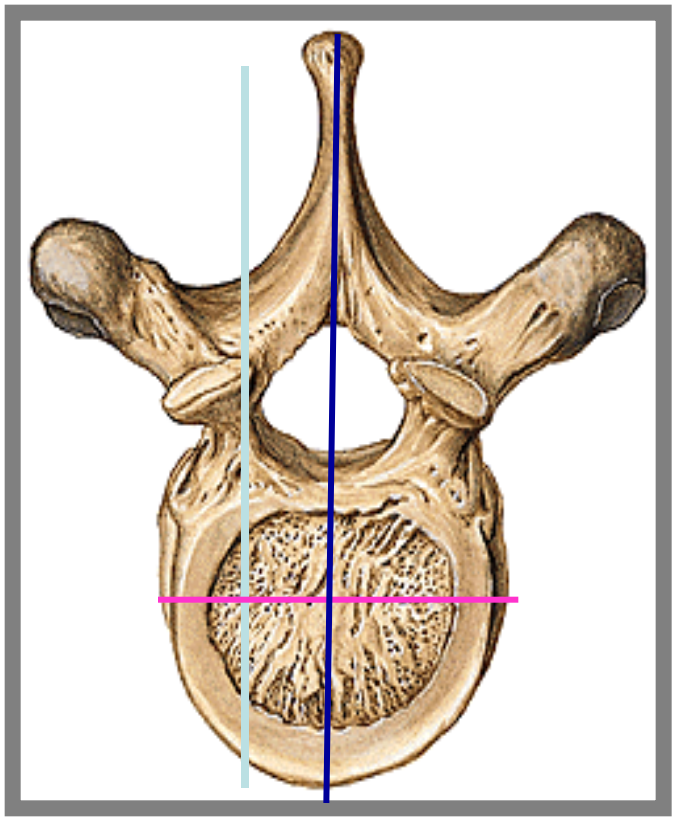
Anatomical position

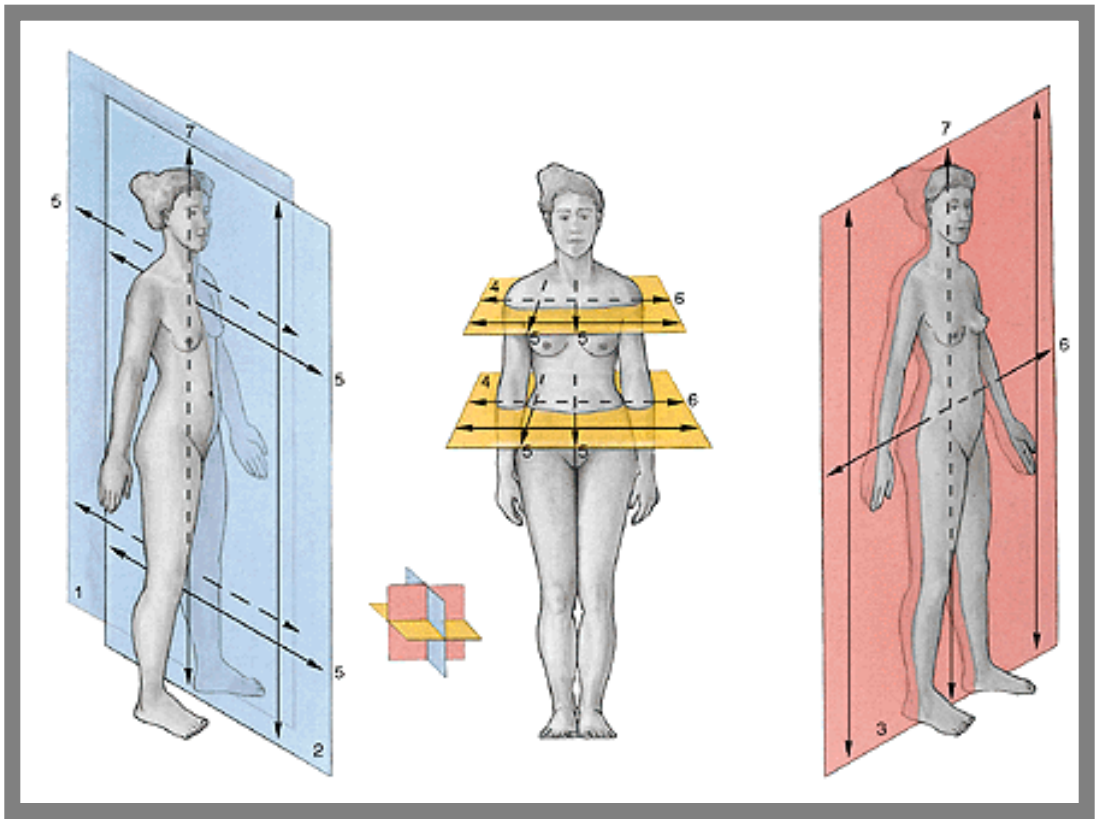
A person in the anatomical position is standing erect and facing forward. The palms of the hands facing forward (anteriorly).

No a military position!!!!

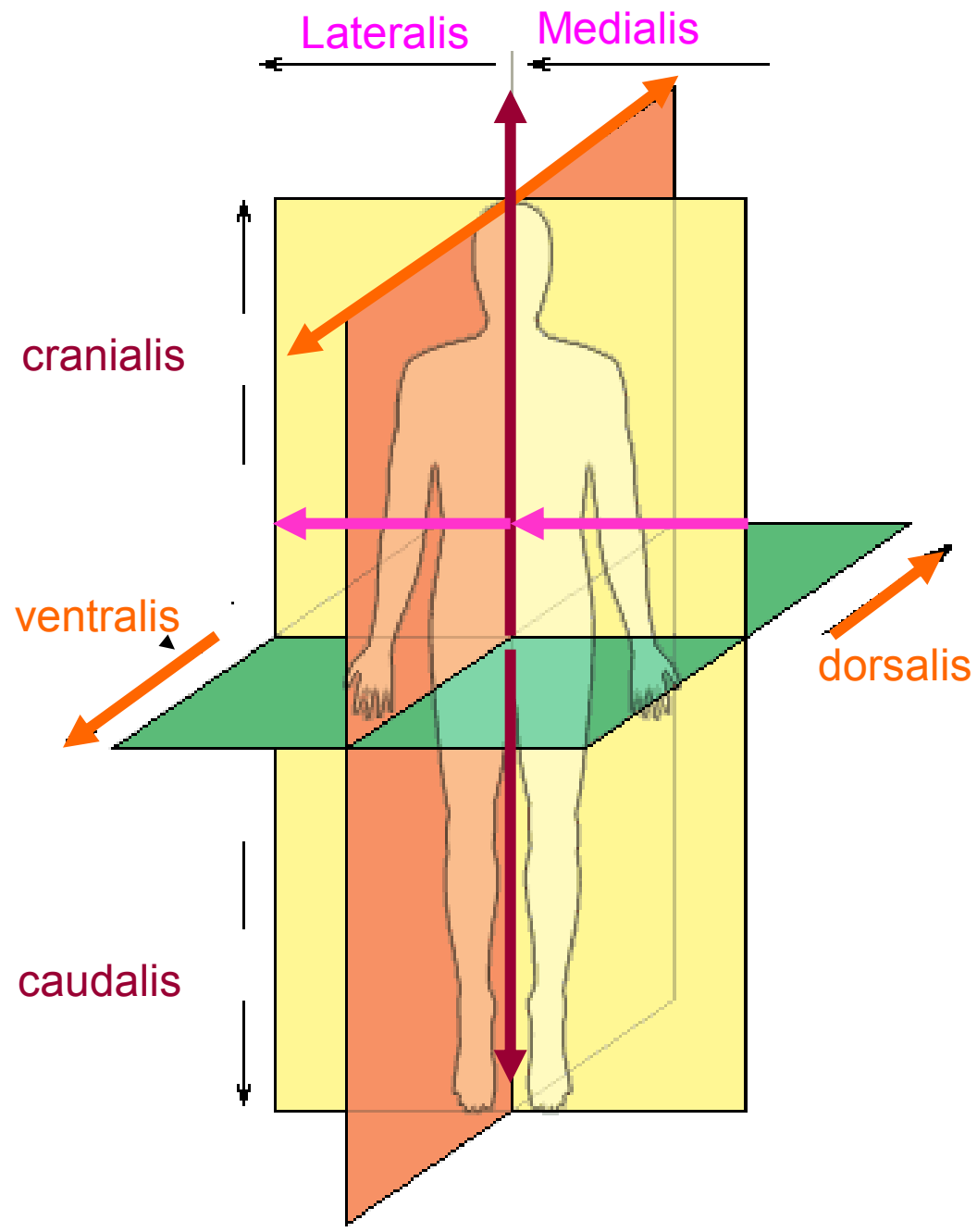
Planes of the body (or organs)

The sagittal planes (one median plane)
The frontal (coronal) planes
The transversal (horizontal) planes





Directions



Vertical axis:

Cranialis (superior, up)
– towards the head

Caudalis (inferior, down)
– towards the feet

Transversal axis:

Medialis towards the median plane

Lateralis further away from the median plane

Medianus within the median plane

Sagittal axis:

Ventralis (frontalis, anterior)
– towards the front of the body

Dorsalis (posterior)
– towards the back of the body

Limbs (extremities)

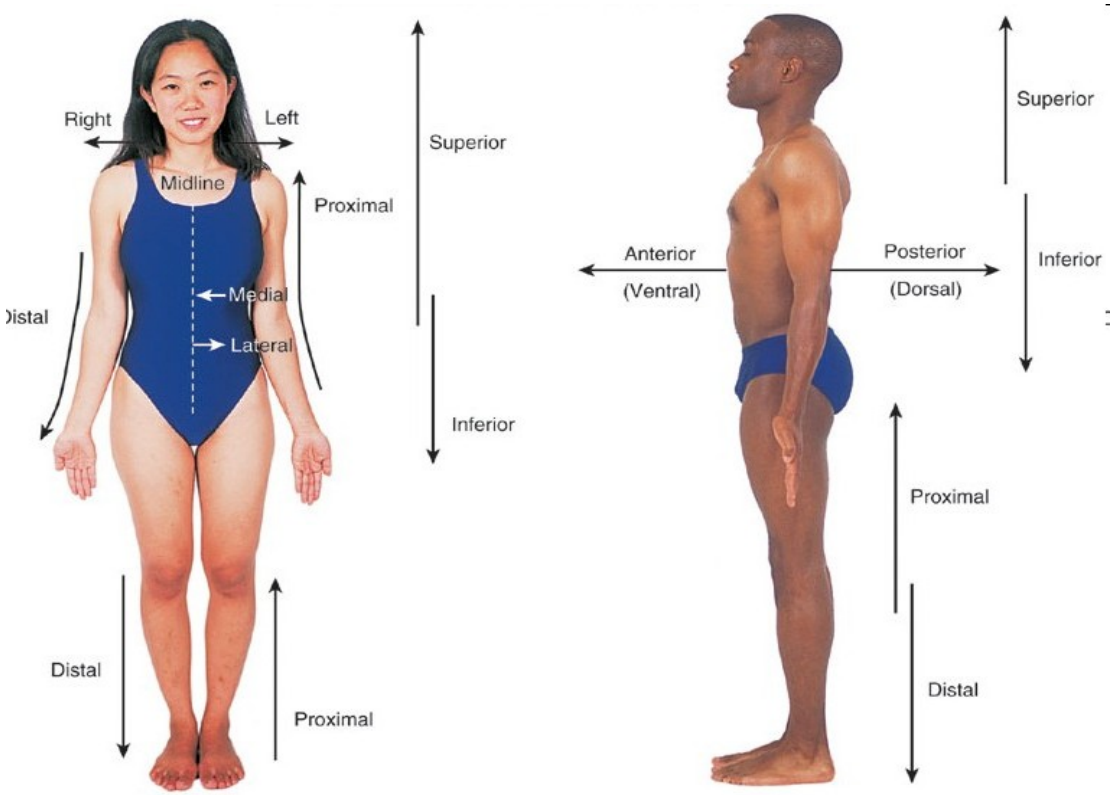
Proximalis – direction towards joining extremity to the trunk
Distalis – direction more distant from joining extremity to the trunk

Membrum superius (Upper limb):

Radialis (lateralis)
Medialis (ulnaris)
Palmaris
Dorsalis (dorsum=back)

Membrum inferius (Lower limb):

Tibialis (medialis)
Fibularis (lateralis)
Plantaris (planta=sole)
Dorsalis

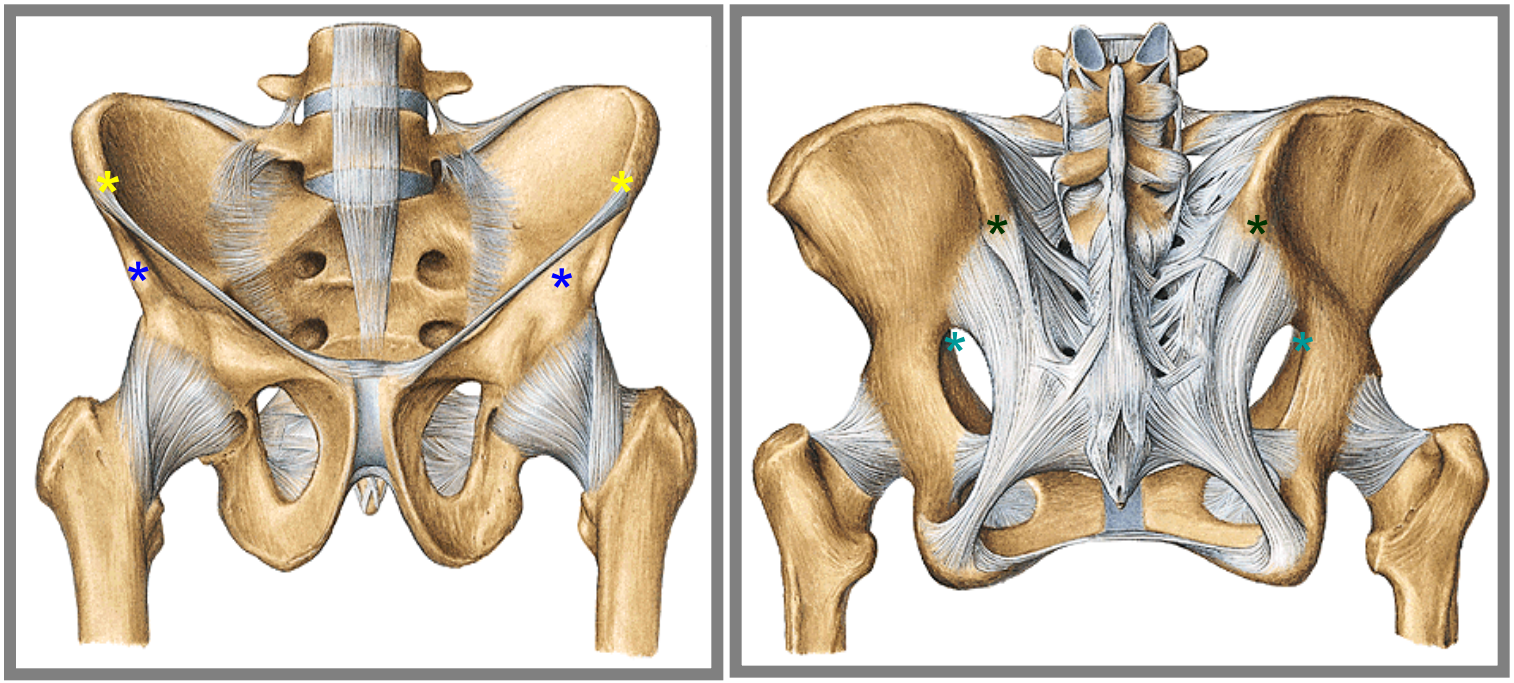


Anatomical nomenclature (Basel 1895 – BNA, Jena 1935 – INA, Paris 1955 - accepted 1960 – PNA, last corrections Japan)

The first word is noun (described formation), next adjectives specify it, and in the end a name of formation where the described formation is located.

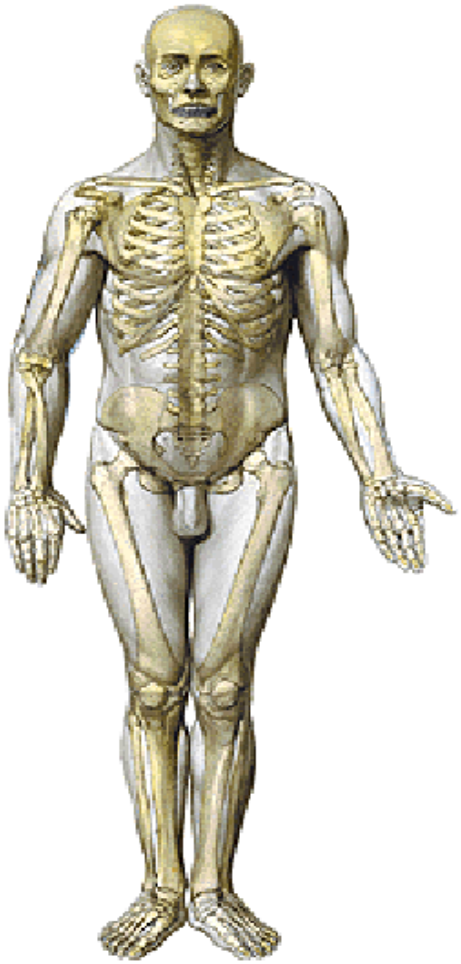
Examples:
Collum (a neck)
Collum (a neck) femoris (of the femur)
Collum (a neck) anatomicum (anatomical) humeri (of the humerus)
Collum (a neck) chirurgicum (surgical) humeri (of the humerus)

Epicondylus medialis humeri medial epicondyle of the humerus
Epicondylus medialis femoris medial epicondyle of the femur



Spina iliaca **anterior superior** ossis coxae *(anterior superior iliac spine of hip bone)*
Spina iliaca **anterior inferior** ossis coxae *(anterior inferior iliac spine of hip bone)*
Spina iliaca **posterior superior** ossis coxae *(posterior superior iliac spine of hip bone)*
Spina iliaca **posterior inferior** ossis coxae *(posterior superior iliac spine of hip bone)*

Parts of the human body



Caput - head
Collum (cervix) - neck

Truncus - trunk:
- **thorax** - chest
- **abdomen** - belly
- **pelvis** - basin
- **dorsum** - back

Membrum superius - upper limb
- **Brachium** - arm
- **Antebrachium** - forearm
- **Manus** - hand

Membrum inferius - lower limb
- **Femur** - thigh
- **Crus** - leg
- **Pes** - foot

GENERAL OSTEOLOGY

Bone = typical dense connective tissue

(cells = osteocytes, and fibers embedded in a calcified ground substance = bone matrix)

Two types of bone tissue:

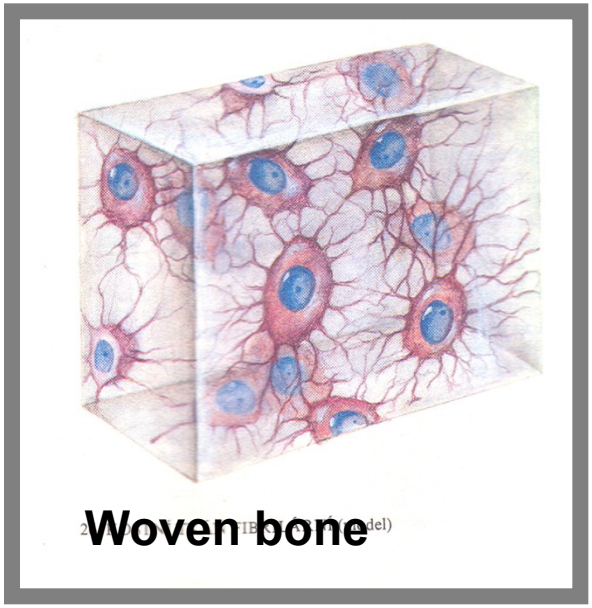
Woven bone (during development, inner ear..)

Lamellar bone

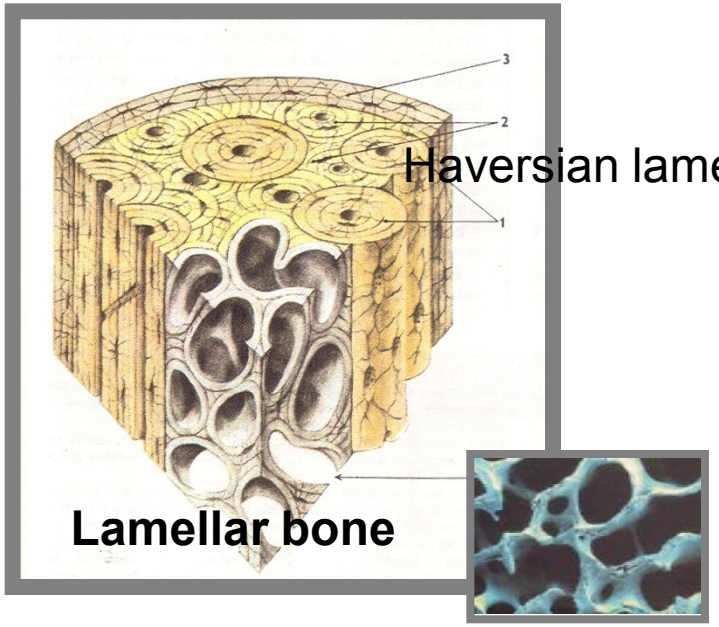
substantia compacta (compact bone – hard and dense)

substantia spongiosa (spongy / cancellous) bone

(spongework of trabeculae arranged in a very real pattern best adapted to resist the local strains and stresses – rearrangement of the trabeculae)



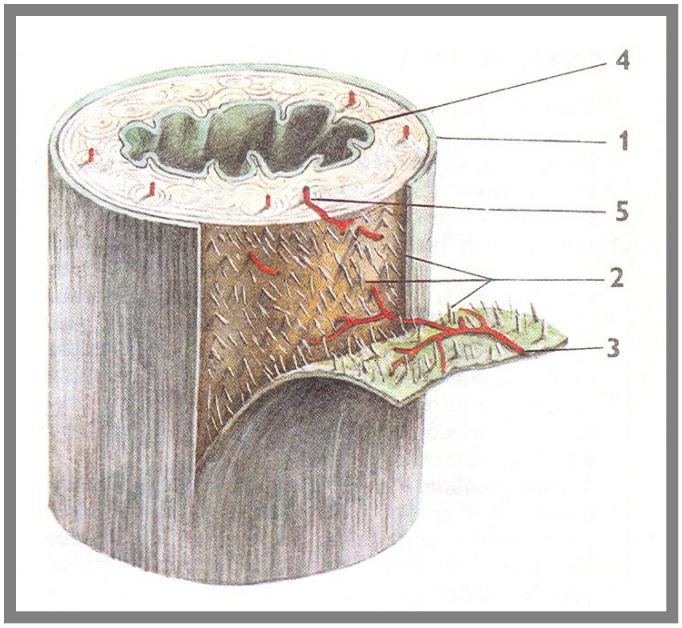
Woven bone

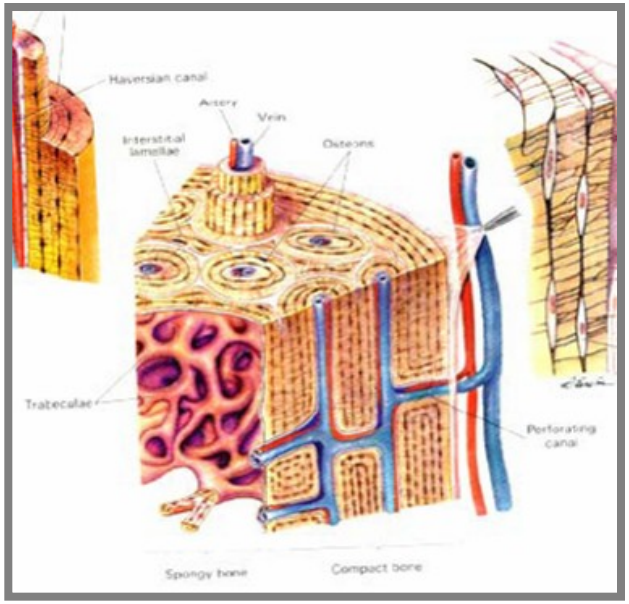


Haversian lamellae

Lamellar bone

Periosteum





a membrane which covers all parts of the bone surface except of joint surfaces; contains many vessels and nerves.

A bone from which the periosteum has been removed will die.

Periosteum consists of:

a) **a fibrous layer** (external)

b) **a cambious layer** (the site of osteoblasts – built up the thickness of bone and help of healing fractures)

Periosteum is attached by Sharpey´s fibers to the bone

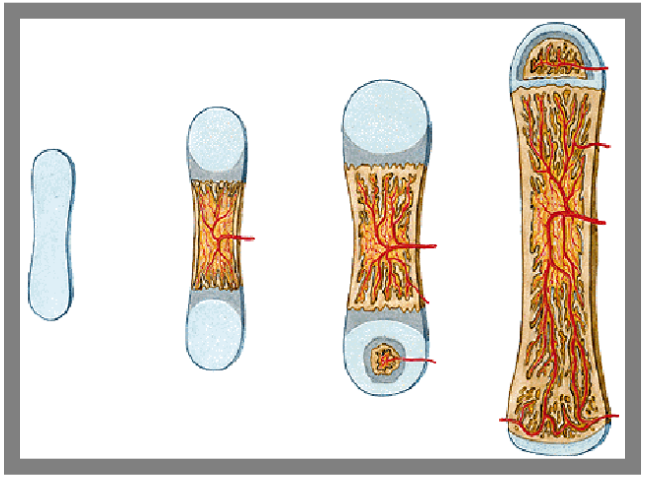
Endosteum (inner membrane, it cells can differentiate into osteoblasts or osteocytes)

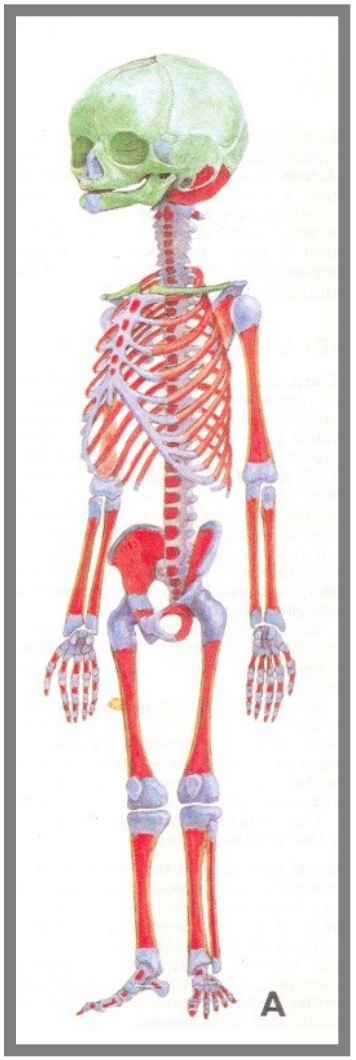
Intramembranous ossification

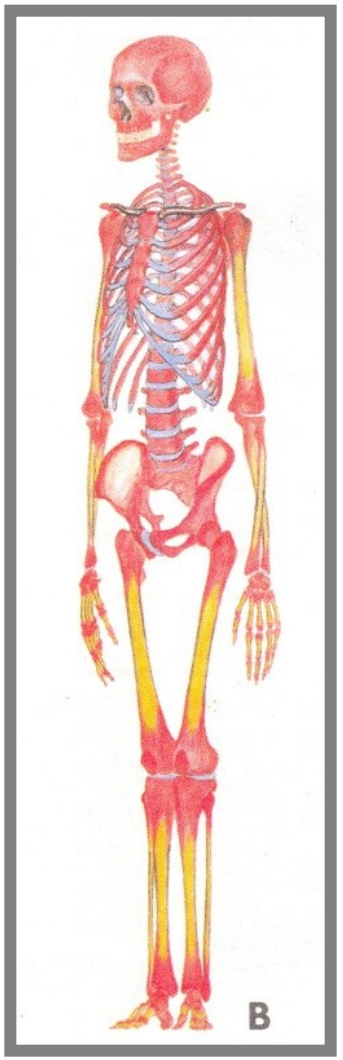
connective tissue is replaced by bone (flat bones, clavicle)

Chondral ossification

preformed cartilaginous (gristle) parts are replaced by bone







Function of skeleton

1) Protection – forming the rigid walls of cavities that contain vital structures.

2) Support (the rigid framework for the body). Forms a passive locomotor apparatus.

3) A mechanical basis for movement by providing attachments for muscles and serving as levers for ones that produce the movements permitted by joints.

4) Formation of blood cells in the red bone marrow.

5) Storage of salts – the calcium, phosphorus, and magnesium salts – mineral reservoir for the body.

Shape of bones

depends on their function and their position in the body. Compact bone is located on the surface of all bones, inside is spongy bone.

a) long bones *(ossa longa)*

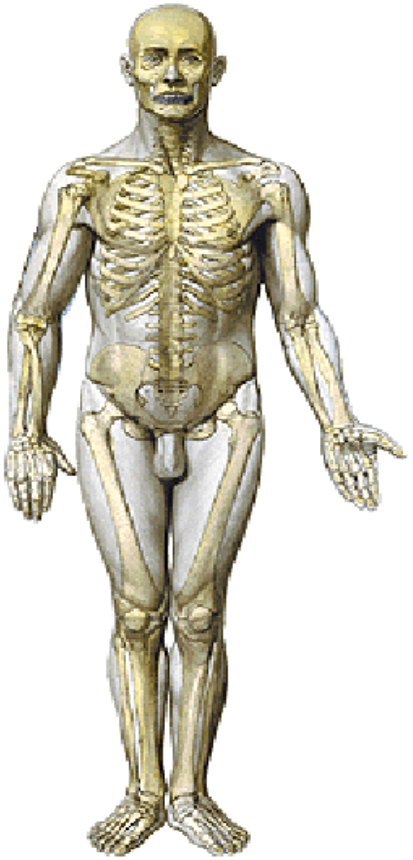
b) short bones *(ossa brevia)*

c) flat bones *(ossa plana)*

d) sesamoid bones *(ossa sesamoidea)*

e) pneumatic bones *(ossa pneumatica)*

f) irregular bones *(ossa irregularia)*



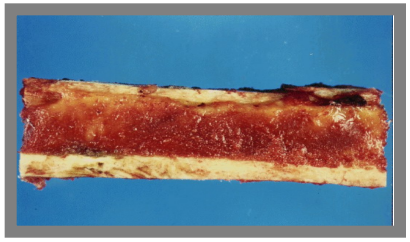
Long bones

Structure of long bone:

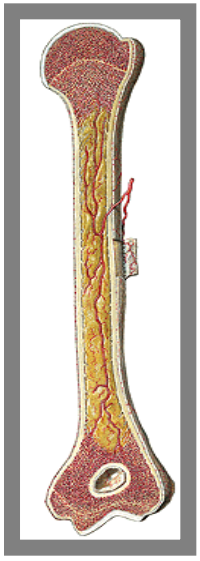
Diaphysis (or corpus) (body)
Two ends = proximal and distal - epiphysis

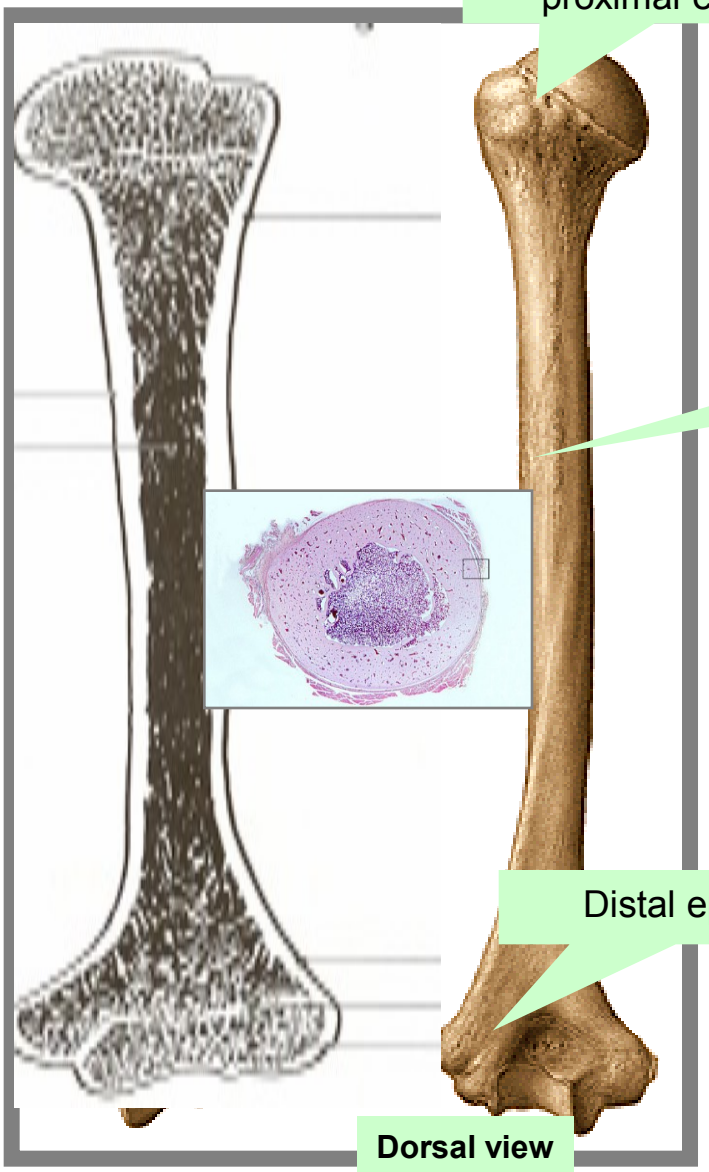
Cavum medullare (medullar cavity) a cavity inside of the diaphysis

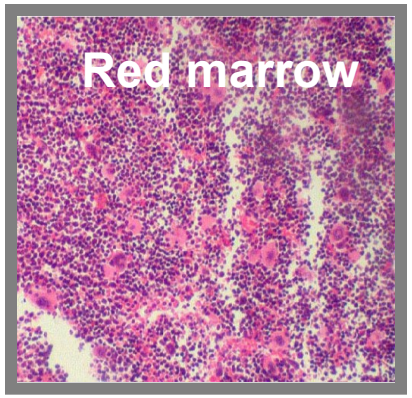
Medulla ossium rubra (flava, gelatinosa) – Red bone marrow (yellow, gray)

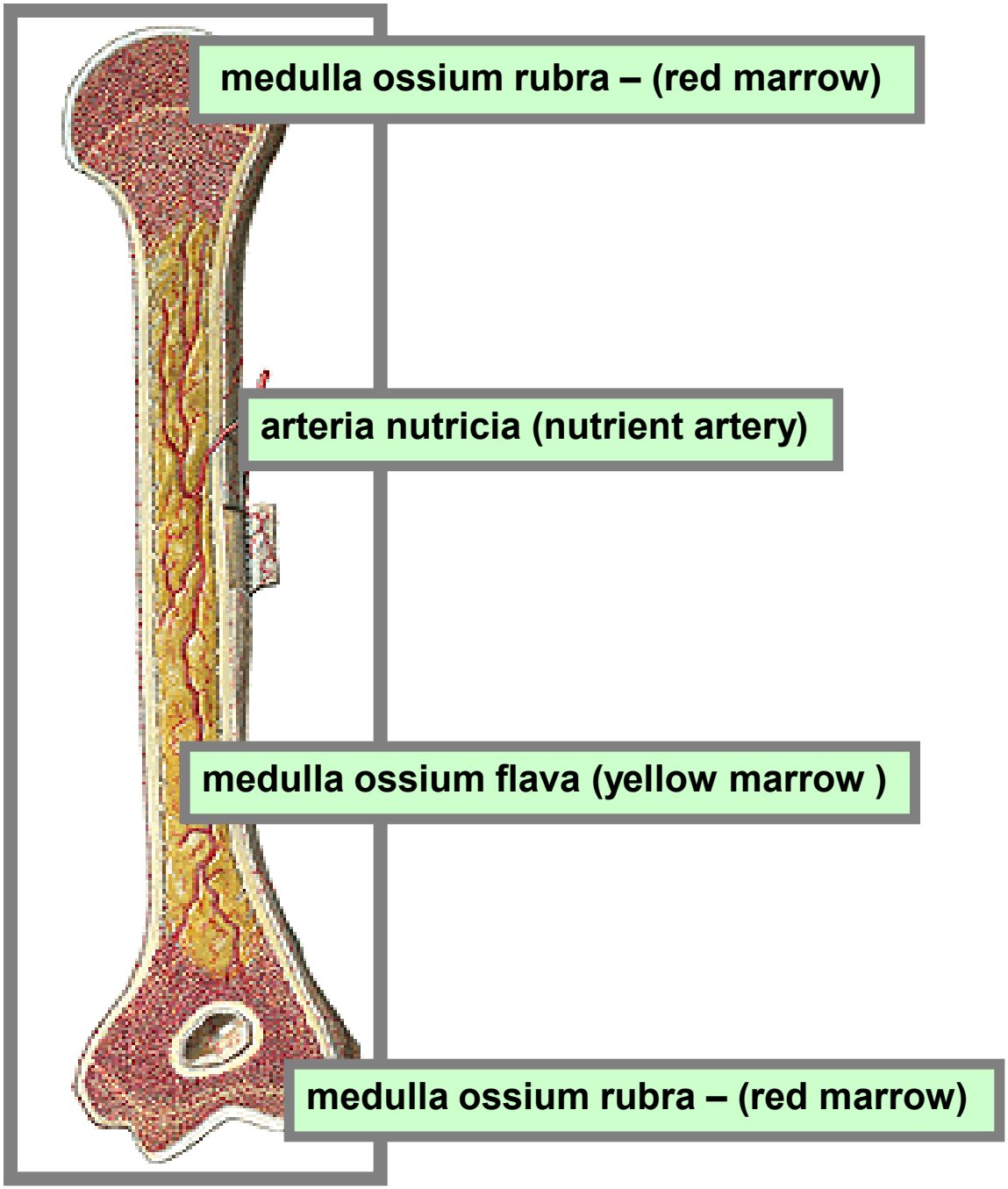


Surface of epiphyses is covered by thin layer of compact bone (corticalis)

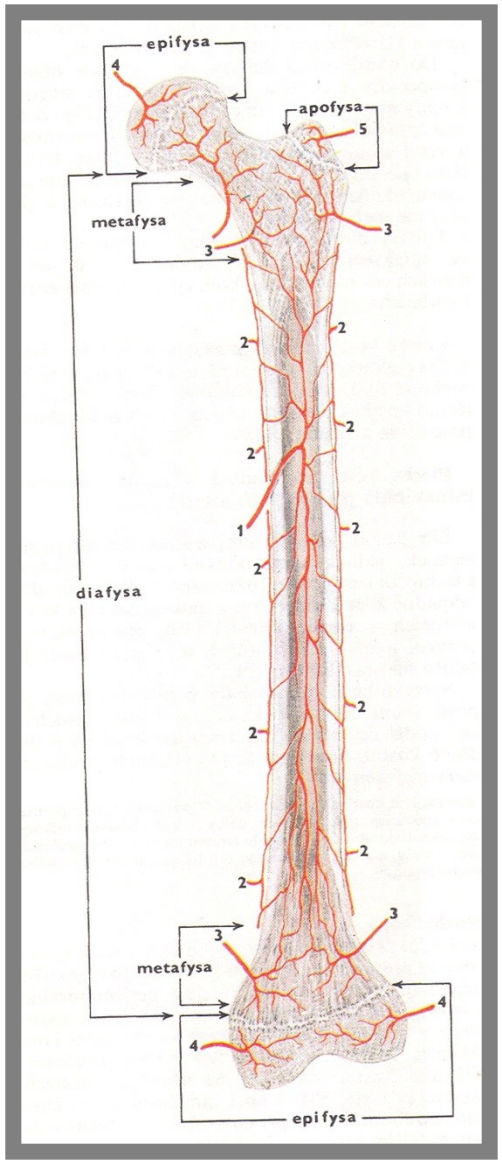




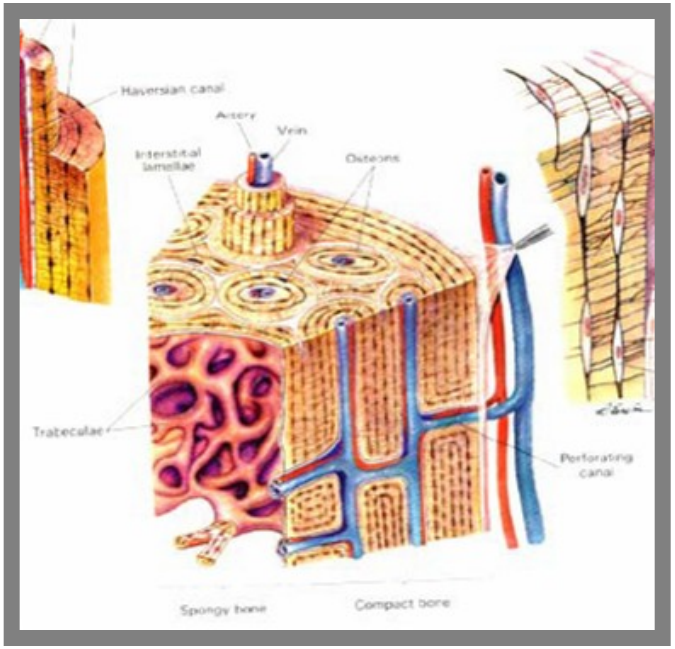

Red marrow


medulla ossium rubra – (red marrow)
arteria nutricia (nutrient artery)
medulla ossium flava (yellow marrow)
medulla ossium rubra – (red marrow)

Vessels of long bones

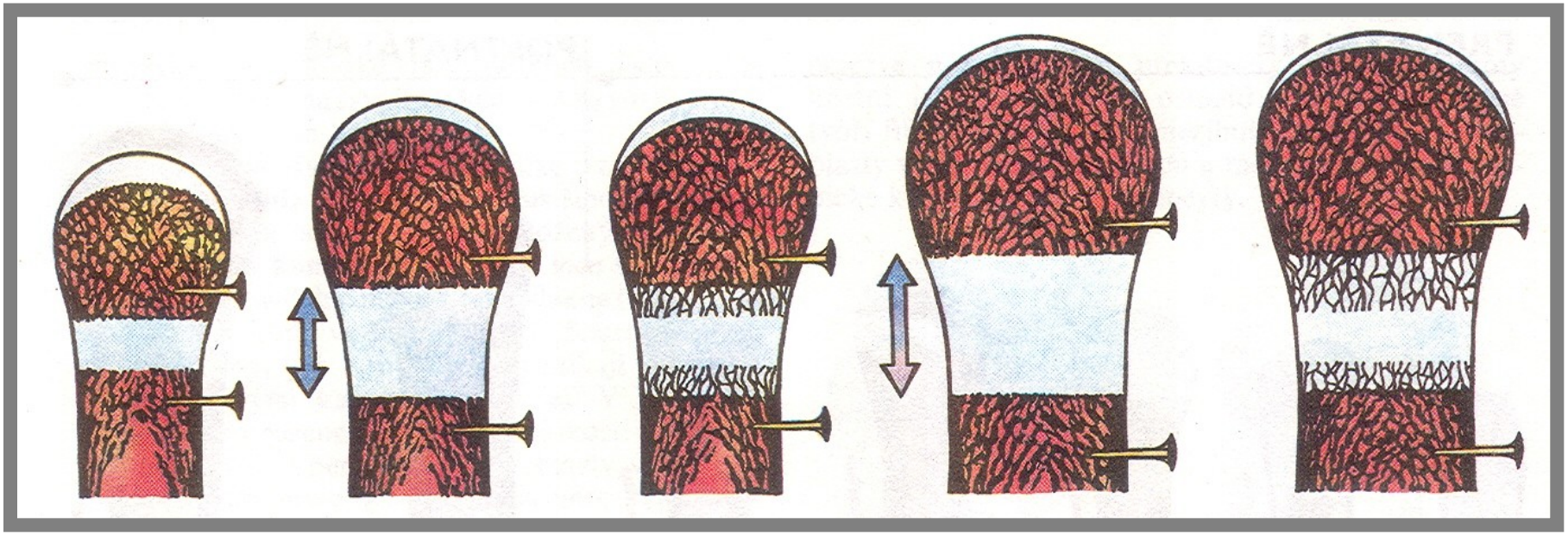


- Arteria nutricia (nutrient artery)
- Periostal vessels
- Arteriae metaphysariae – (metaphysary arteries)
- Arteriae epiphysariae – (epiphysary arteries)
- Vessels of apophysis



Growth plate = epiphysial disc

is necessary for growth in length, forms a layer between the epiphysis and the diaphysis of long bone.



Growth of epiphysial plate (ossification) – the growth of long bone to the length

Growth to the thickness – by cambious layer of periosteum !!!!!)

Ossa brevia (short bones)

structure:

1) **corticalis** (compact bone) **on the surface**

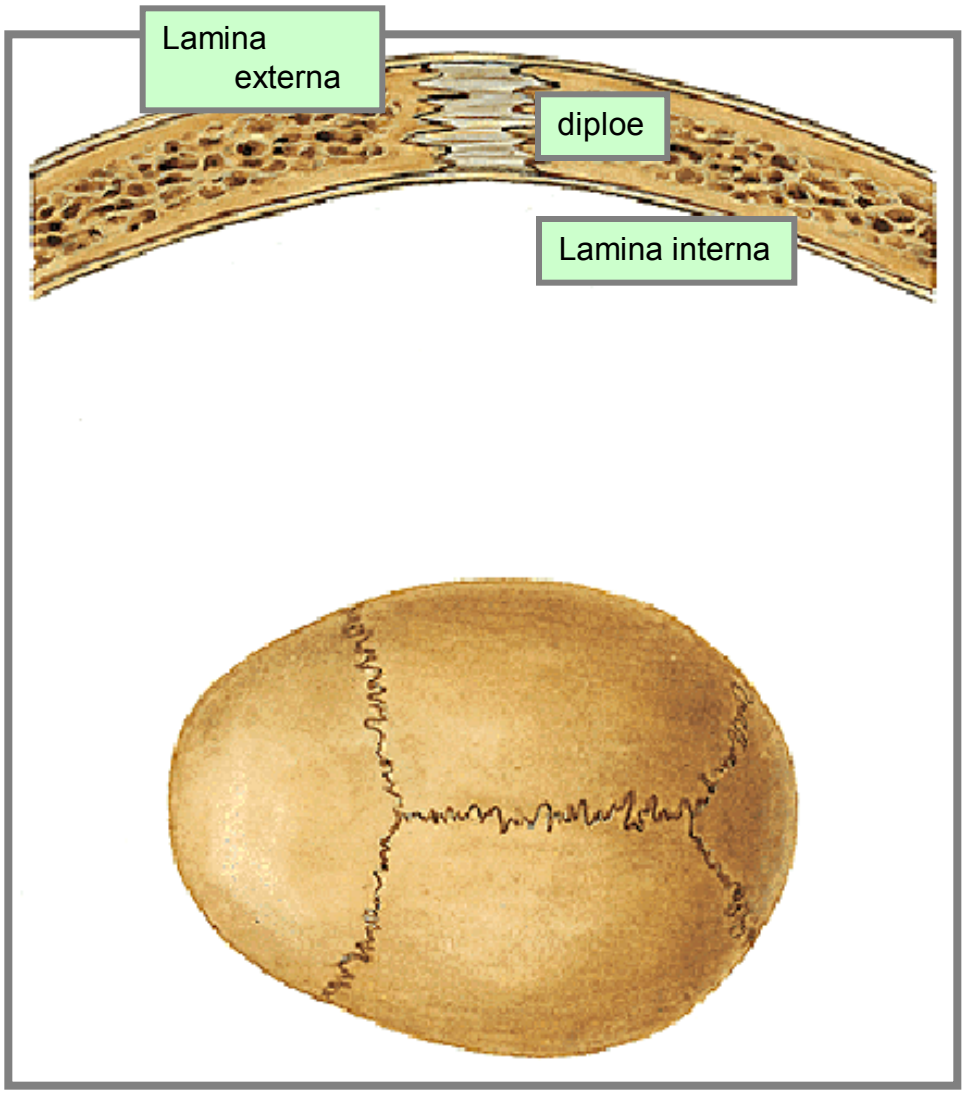
2) **inside – substantia spongiosa** (spongy bone)

Ossa plana (flat bones)

structure:

1) **Compact bone – lamina externa and lamina interna**

2) **Spongy bone between both laminae = diploe**

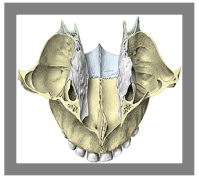


Ossa sesamoidea (sesamoid bones)

Inside of tendons of some muscles (patella = kneecap)

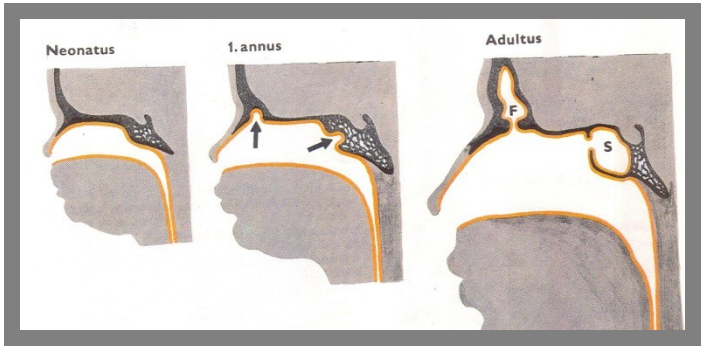
protection of tendon from excesive wear and change the angle of tendon

Ossa irregularia (irregular bones)



Ossa pneumatica (pneumatic bones) contain

air cells (sinuses). Development after birth (paranasal cavities)



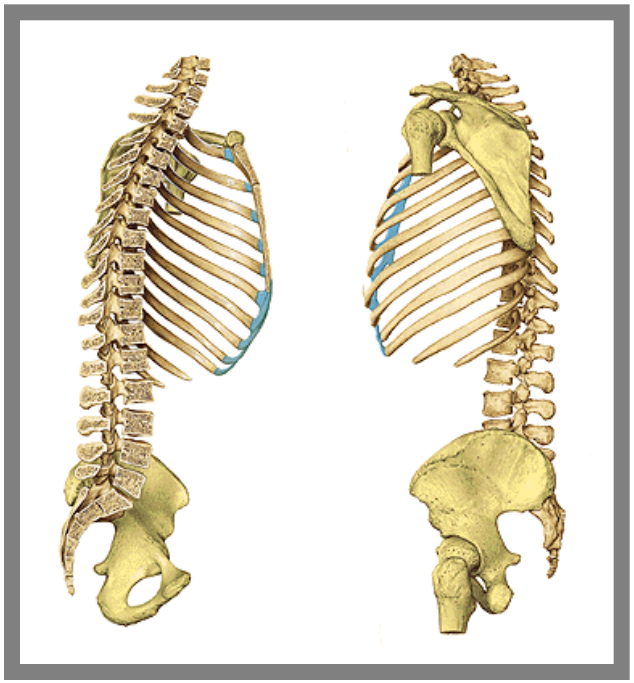
Systematic Anatomy
Locomotor Apparatus

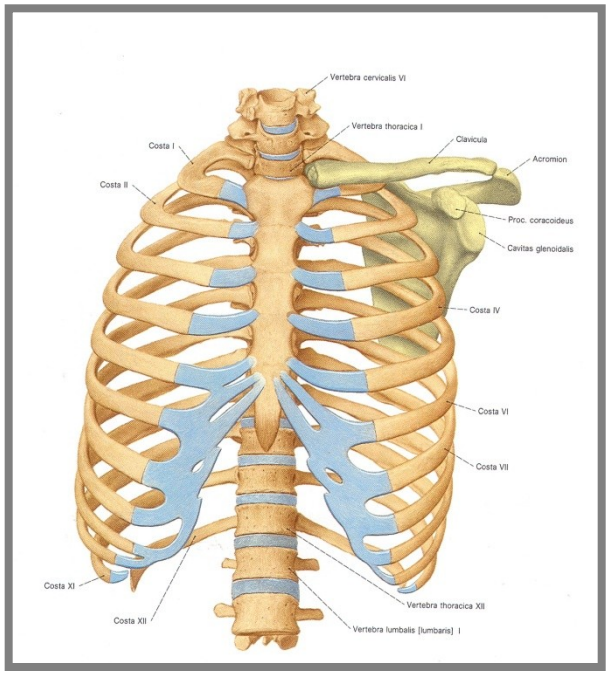
Specialized osteology

Trunk:

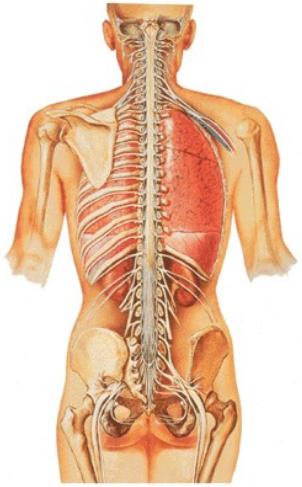
Columna vertebralis (vertebral column) + costae (ribs) + sternum (breast bone)

7 **vertebrae cervicales** (cervical vertebrae)
12 **vertebrae thoracicae** (thoracic vertebrae)
5 **vertebrae lumbales** (lumbar vertebrae)
5 **vertebrae sacrales** (sacral vertebrae) fuse into **os sacrum** (sacral bone)
4–5 **vertebrae coccygeae** (coccygeal vertebrae) fuse into **os coccygis** (coccyx)

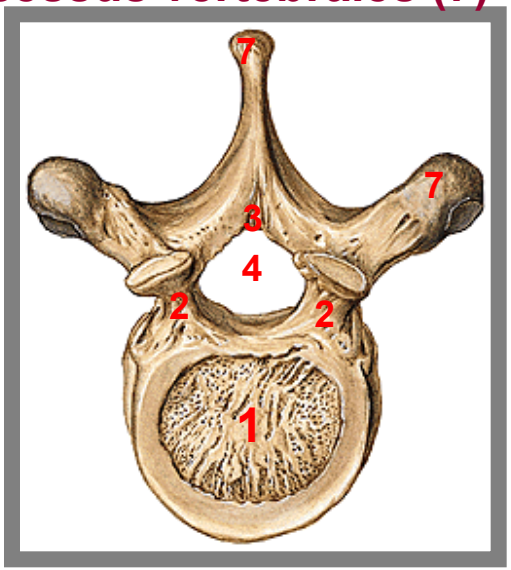


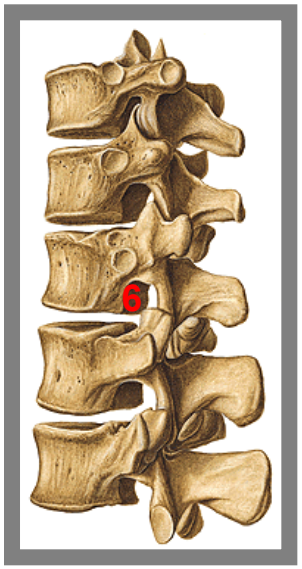


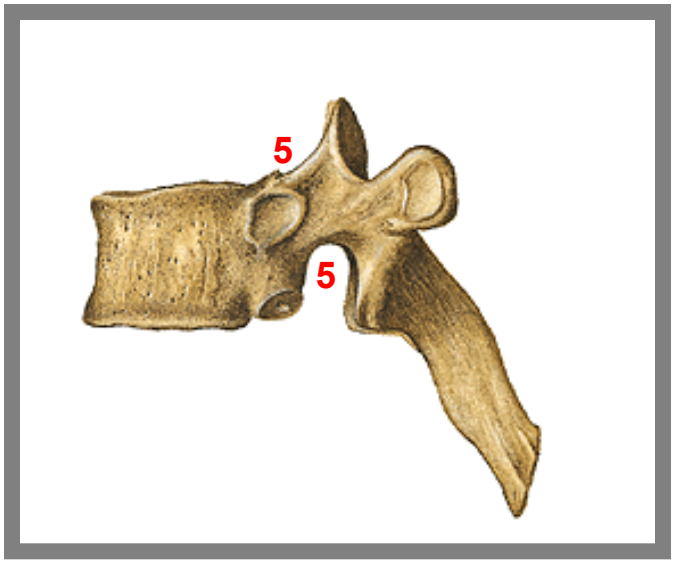
Vertebrae – general features



- 1) Corpus (body) – facies terminalis superior at inferior vertebrae
  (superior and inferior terminal facets of vertebrae)
- 2) Pediculus arcus vertebrae (pedicul of vertebral arch)
- 3) Arcus vertebrae (vertebral arch)
- 4) Foramen vertebrale (vertebral foramen)
- 5) Incisura vertebralis superior et inferior (superior and inferior vertebral notch)
- 5) Foramen intervertebrale (intervertebral foramen)
- 6) Processus vertebrales (7)



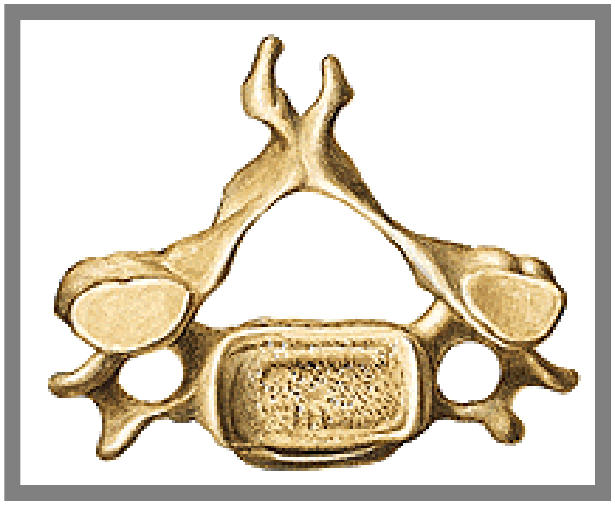


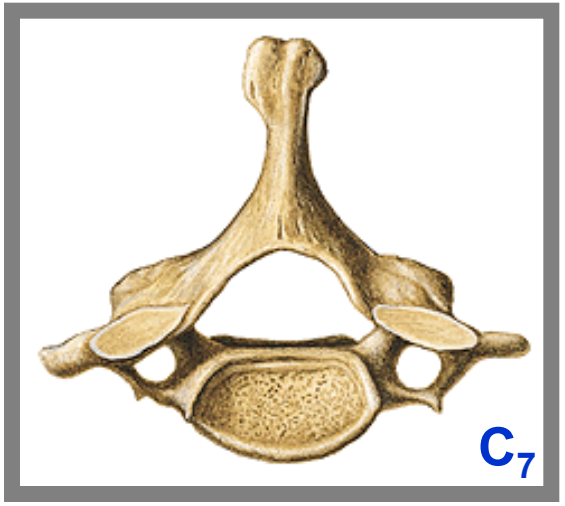


- **7 Processus vertebrales**

processus articularis (superior et inferior - dexter and sinister)
(superior and inferior articular processes – right and left)
processus transversus dexter and sinister (transversal process right and left)
processus spinosus (spinous process)

Vertebrae cervicales (cervical vertebrae) – (C1 – C7)

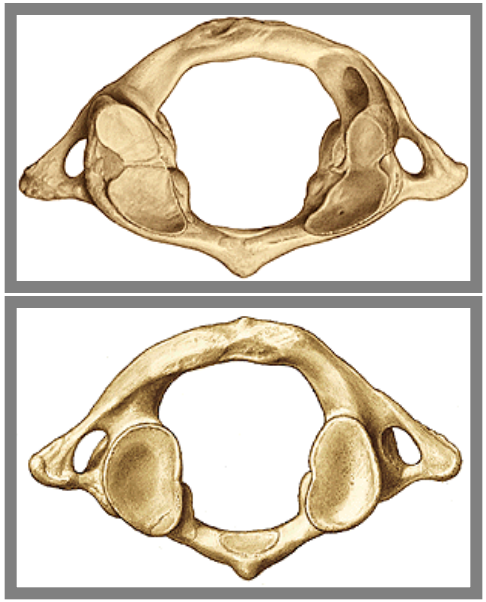




Foramen processus transversi (foramen of transverse process) !!!!!!
Sulcus nervi spinalis (groove for spinal nerve)
Position of articular processes
The uncus corporis
Bifurcation of spinous process (C2 – C6)
Tuberculum anterius et posterius processus transversi
(anterior and posterior tubercle of the transverse process)

C6 has tuberculum caroticum (carotic tubercle)
C3 – the smallest body, C7 = vertebra prominens*

C1 - Atlas



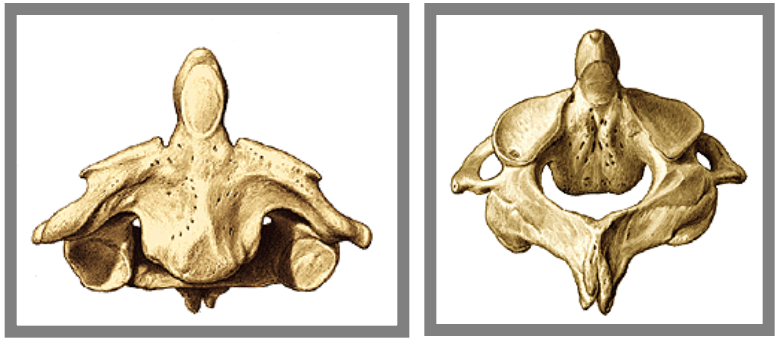
Arcus (an arch) **anterior and posterior atlantis**

(fovea dentis, tuberculum anterius and posterius atlantis)

Massae laterales (facies articularis superior and inferior, sulcus arteriae vertebralis)

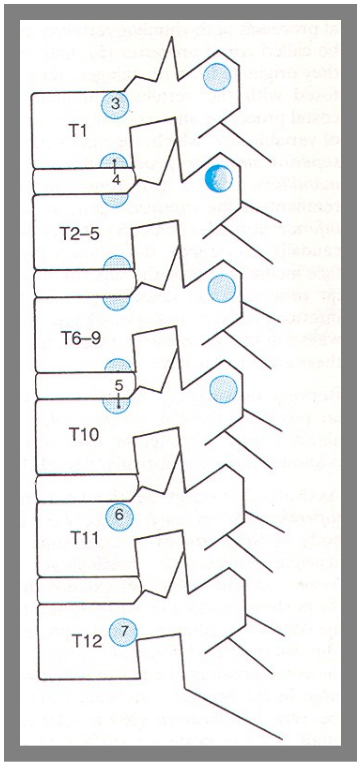
Processus transversi (foramen processus transversi)

C2 - Axis



Corpus vertebrae + dens axis (facies articularis anterior and posterior dentis, apex dentis)

Vertebrae thoracicae (thoracic vertebrae) (Th_1–Th_{12})

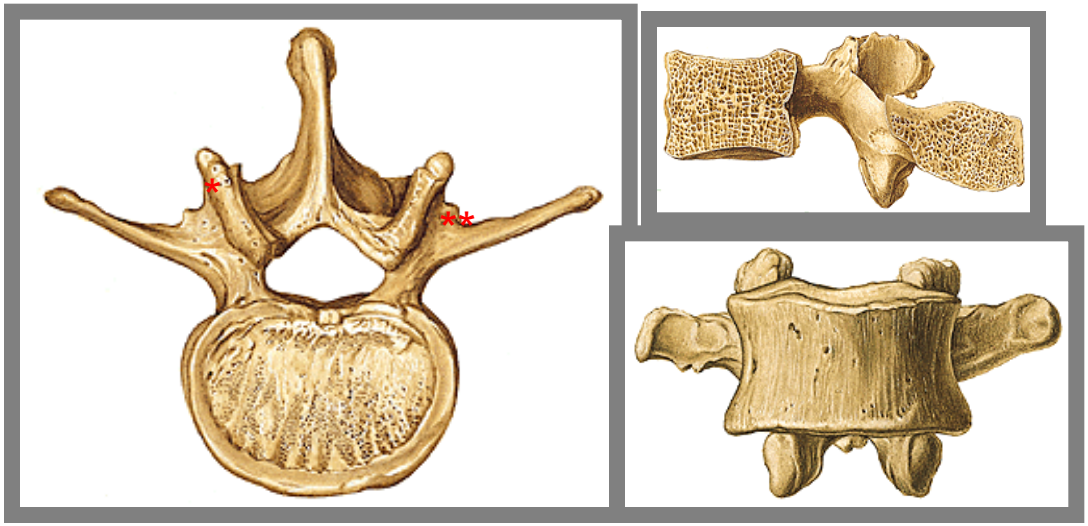


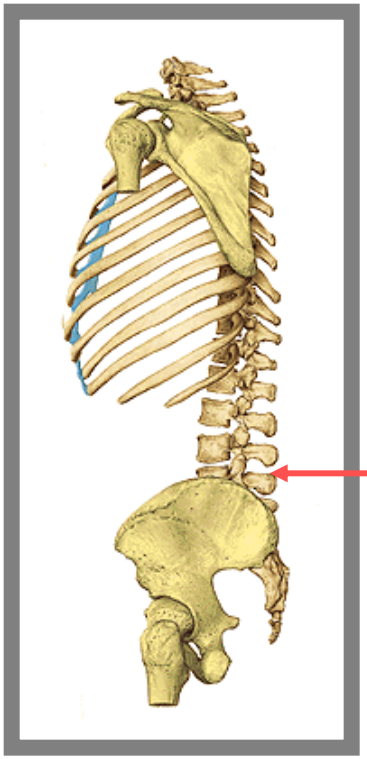
Foveae costales (costal facets)

Facies costales transversales (costal transversal facets)

Position of the articular processes – in the frontal plane

Vertebrae lumbales (lumbar vertebrae) – (L_1 – L_5)





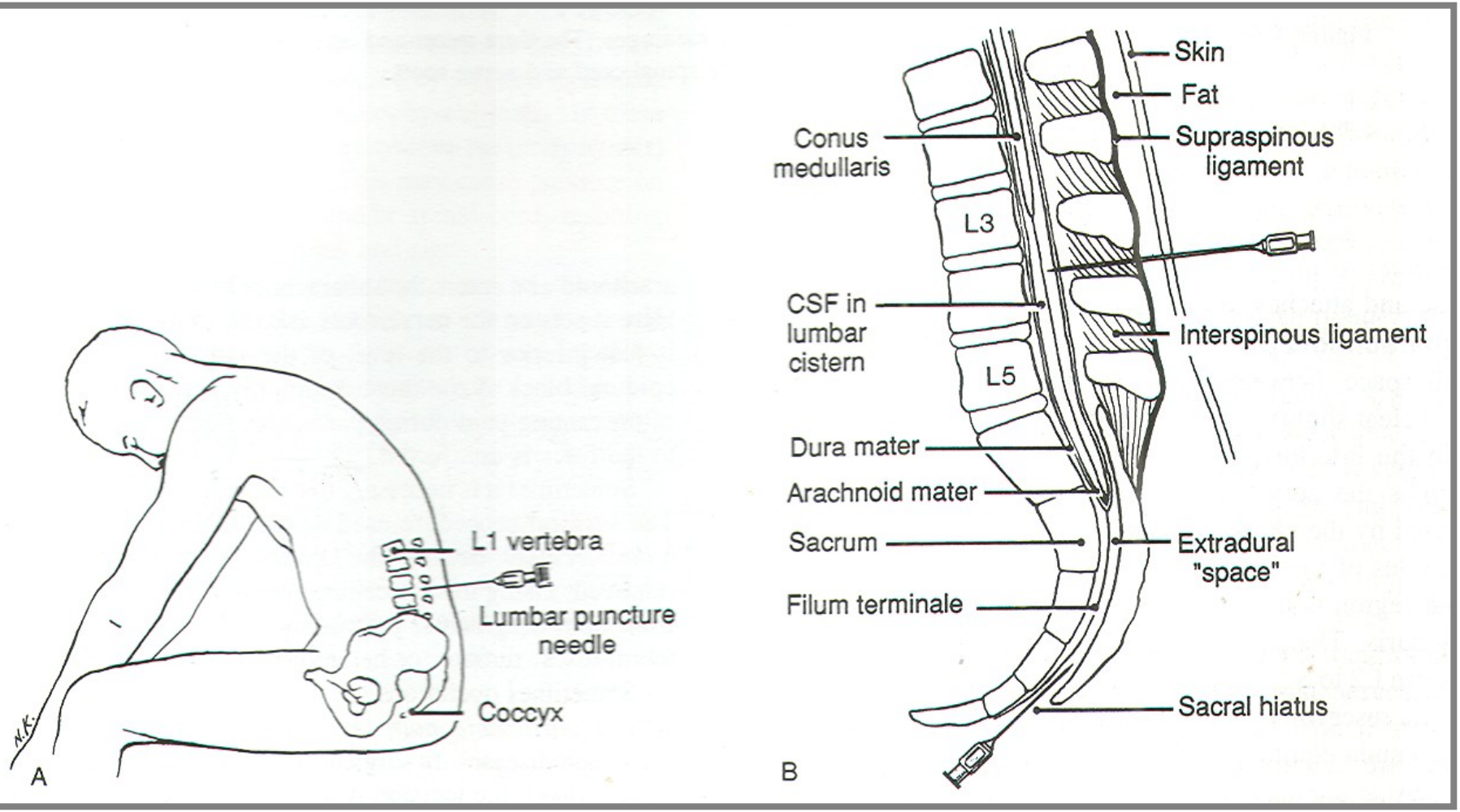
Processus costales (costal processes)

***Processus mammillares** (mammilar processes)

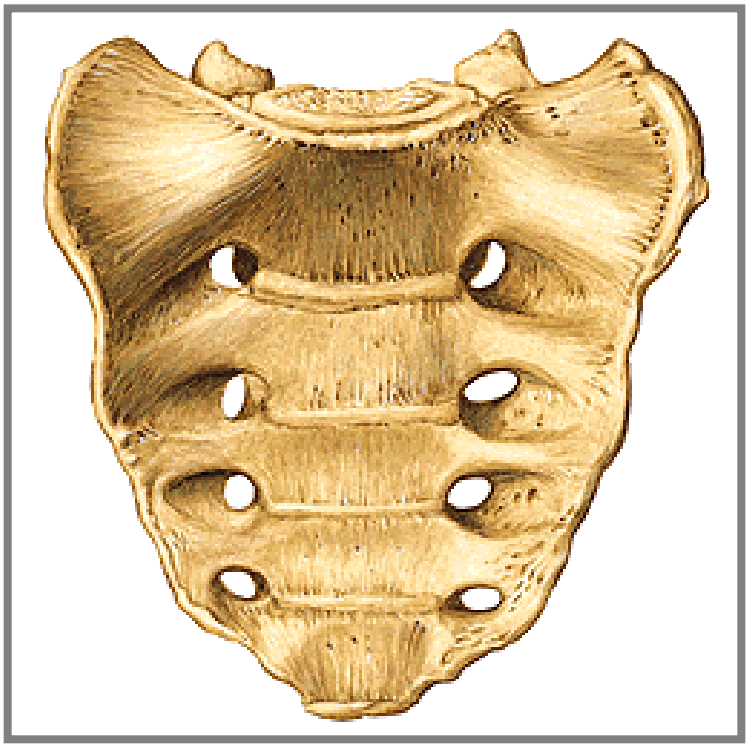
****Processus accessorii** (accessory processes)

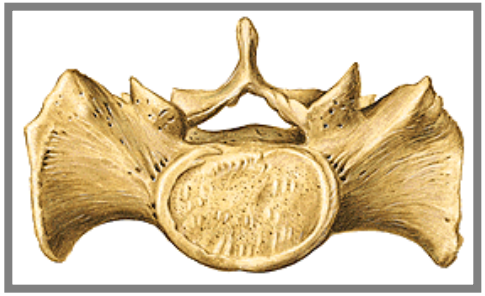
Position of **processus articulares** – in sagittal plane

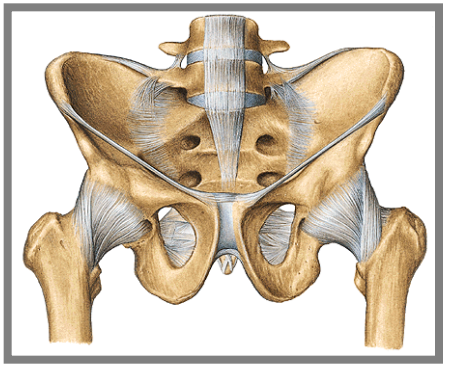
LUMBAR PUNCTURE



Vertebrae sacrales (sacral vertebrae), os sacrum (sacral bone), (S_1 – S_5)







basis – (with facies terminalis superior)

apex (with facies terminalis inferior)

facies pelvina (lineae transversales, foramina sacralia pelvina), promontorium

Os sacrum

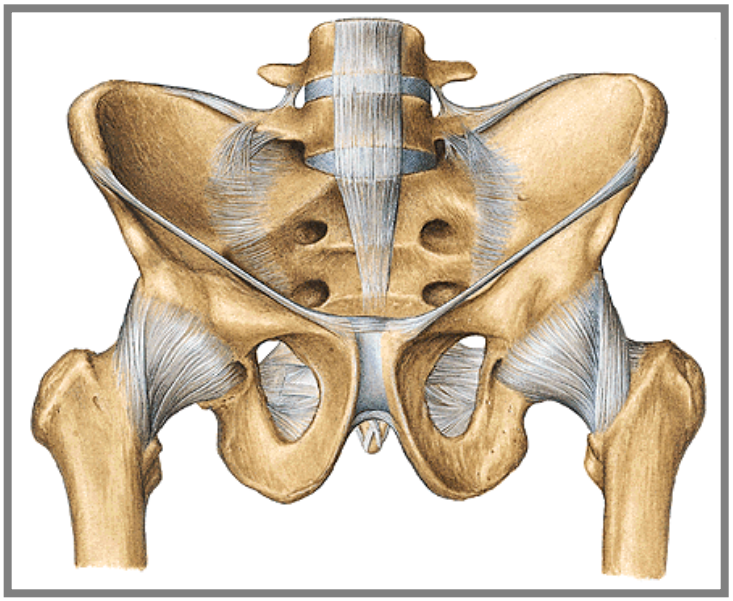
facies dorsalis
(crista sacralis mediana, cristae sacrales intermediae, cristae sacrales laterales, foramina sacralia dorsalia, tuberositas sacralis)

partes laterales (facies auriculares)

canalis sacralis (hiatus canalis sacralis, cornua sacralia)

Vertebrae coccygeae (coccygeal vertebrae)

Os coccygis (coccyx) – Co_1 – Co $_{4-5}$

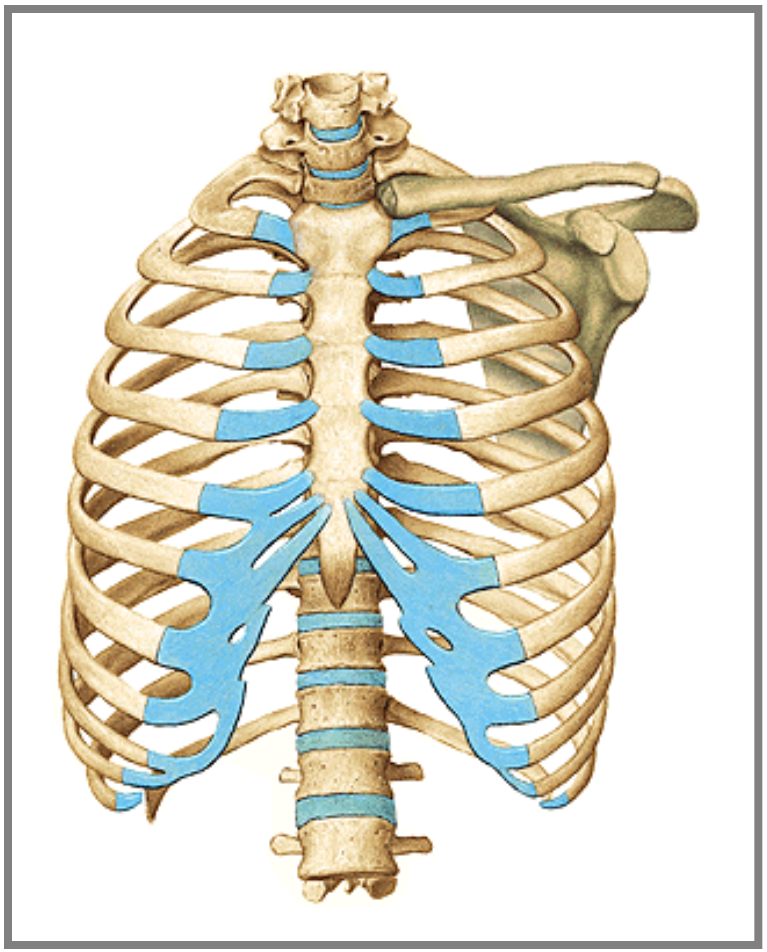


Basis (facies terminalis superior)

Cornua ossis coccygis

Apex ossis coccygis

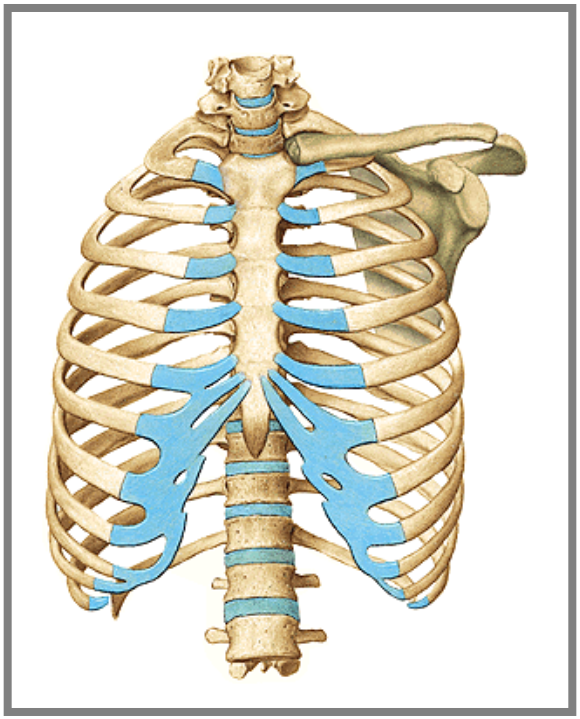
Costa (ribs) (11 – 12 – 13)

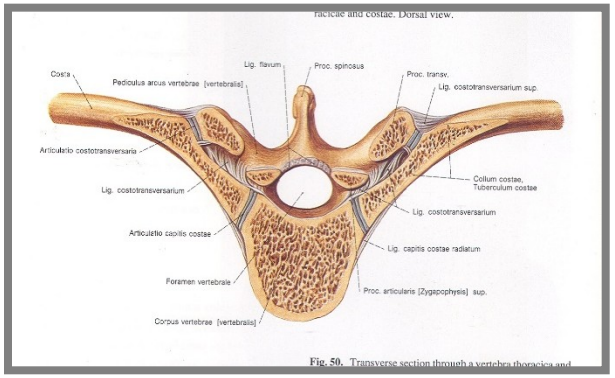


Costae verae (1-7) – true ribs

Costae spuriae (8-10) – false ribs

Costae fluctuantes (11, 12) – floating ribs





Os costae + cartilago costae (costal bone + costal cartilage)

Caput (head) with facies articularis

2nd – 10th rib with **crista capitis costae**

Collum costae (tuberculum costae + facies articularis tuberculi costae)

Corpus costae (angulus costae, crista costae, sulcus costae)

The 1st rib is small and flattened.

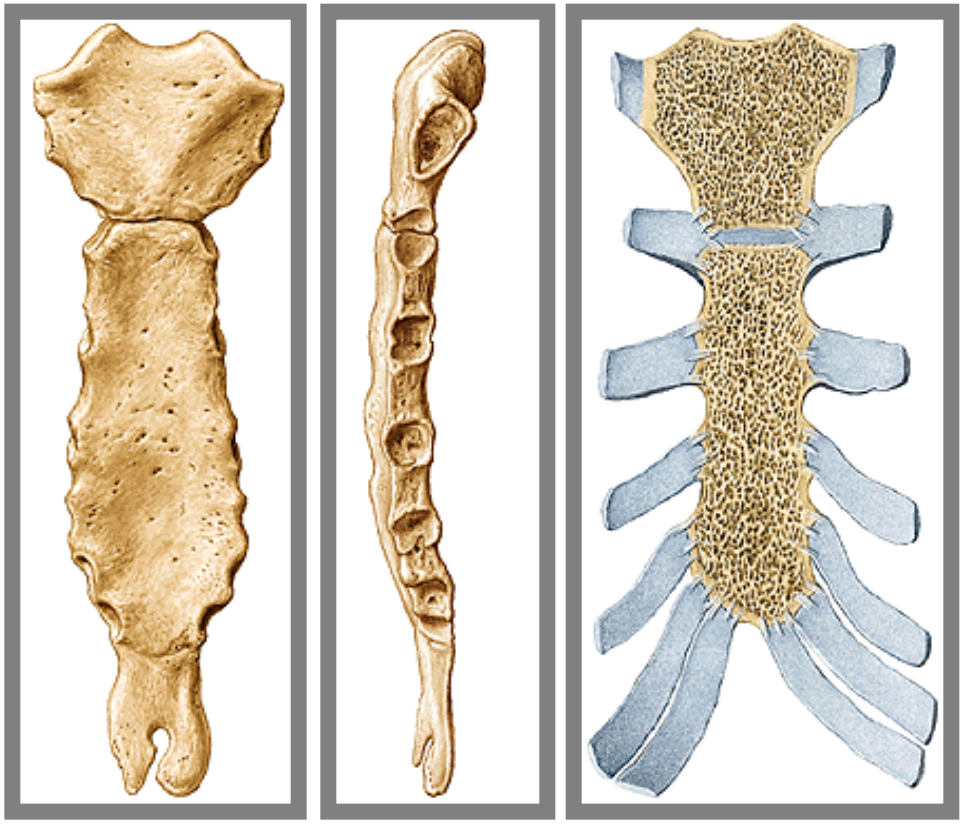
Cranial surface – tuberculum musculi scaleni (the scalene tubercle)
sulcus arteriae subclaviae (the sulcus of the subclavian artery)

The 2nd rib – cranial surface has tuberositas musculi scaleni posterioris and tuberositas musculi serrati anterioris

The 11th and 12th ribs – no the tuberculum costae and the sulcus costae

Variety:
Cervical rib - may cause a triad of disorders:
Pain due to distorsion of vessels, pain related to the brachial plexus, palpable abnormalities in the greater supraclavicular fossa
Lumbar rib (may cause pain – proximity to the kidney)

Sternum (breast bone)



Manubrium sterni (incisura (=notch) clavicularis, incisura jugularis, incisurae costales 1.,2.)

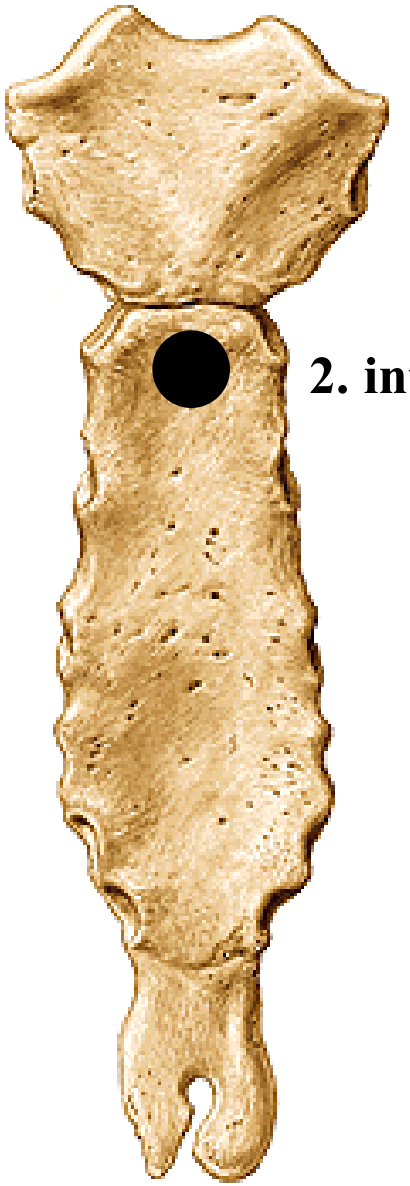
Angulus sterni (angle of sternum)

Corpus sterni (body with incisurae costales for the 3th-7th ribs)

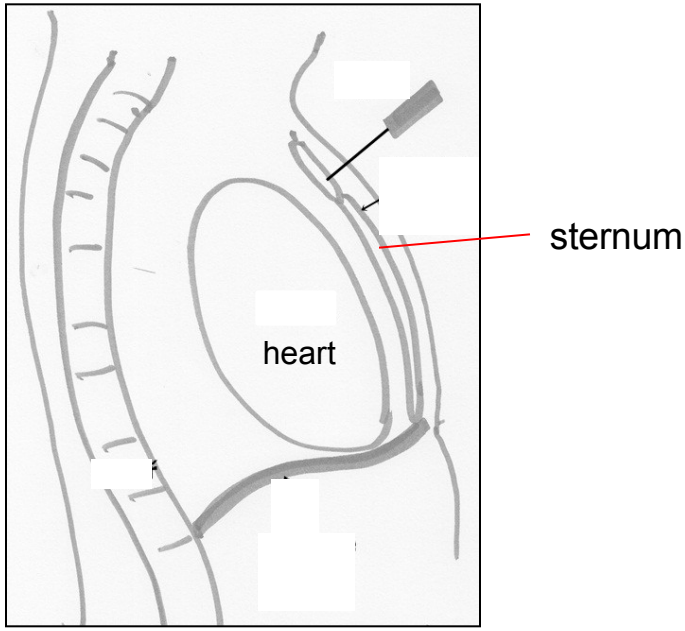
Processus xiphoideus

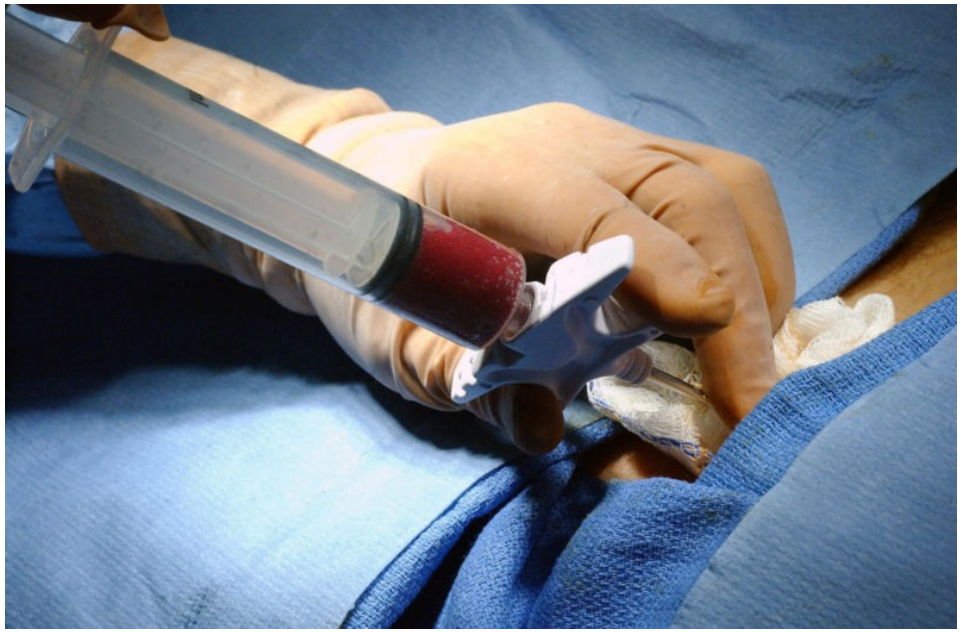
Sternal puncture

Sternal puncture



2. intercostal space





Used pictures come from:

Drake, Richard L. (2010):
Gray´s Anatomy for Students.
Churchill Livingstone, Elsevier (second edition).

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

Keith L. Moore, Arthur F. Dalley (2005):
Clinically Oriented Anatomy. Williams and Wilkins.

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

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

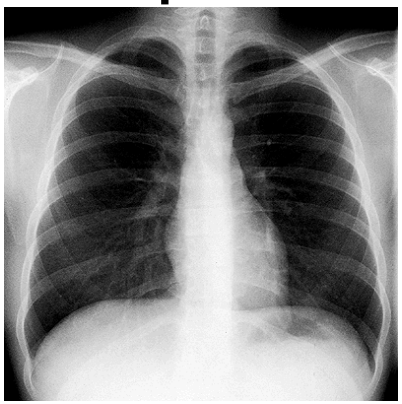
Radiology and anatomy

1. Anatomy is essential for understanding radiology.
2. You will see anatomical structures this way much more frequently than during operation or autopsy.

X–ray (K. Roentgen 1895 – awarded by Nobel price in physics)

A highly penetrating beam of x-rays „transluminates“ the pacient, showing tissues of differing densities on x-ray film.

A tissue or organ that is relatively dense absorbs (stops) more x-rays than a less dense tissue. Relatively fewer x-rays reach the silver emulsion in the film therefore only fewer grains of silver are developed at this area when the film is processed – „white area of bones“.



1. Simple X – ray

1. X– ray with contrast materials

   a) positive (iodide preparations, barium meal)

   b) negative (air, gases)

4. Projection according to the course of x-ray (anteroposterior, lateral)

5. New methods (sonografy, CT (computerized tomography – using CT scanners, shows sections of the body – a small beam of x-rays is passed through a plane of the body while the x-ray tube moves in an arch or a circle around the body), MRI