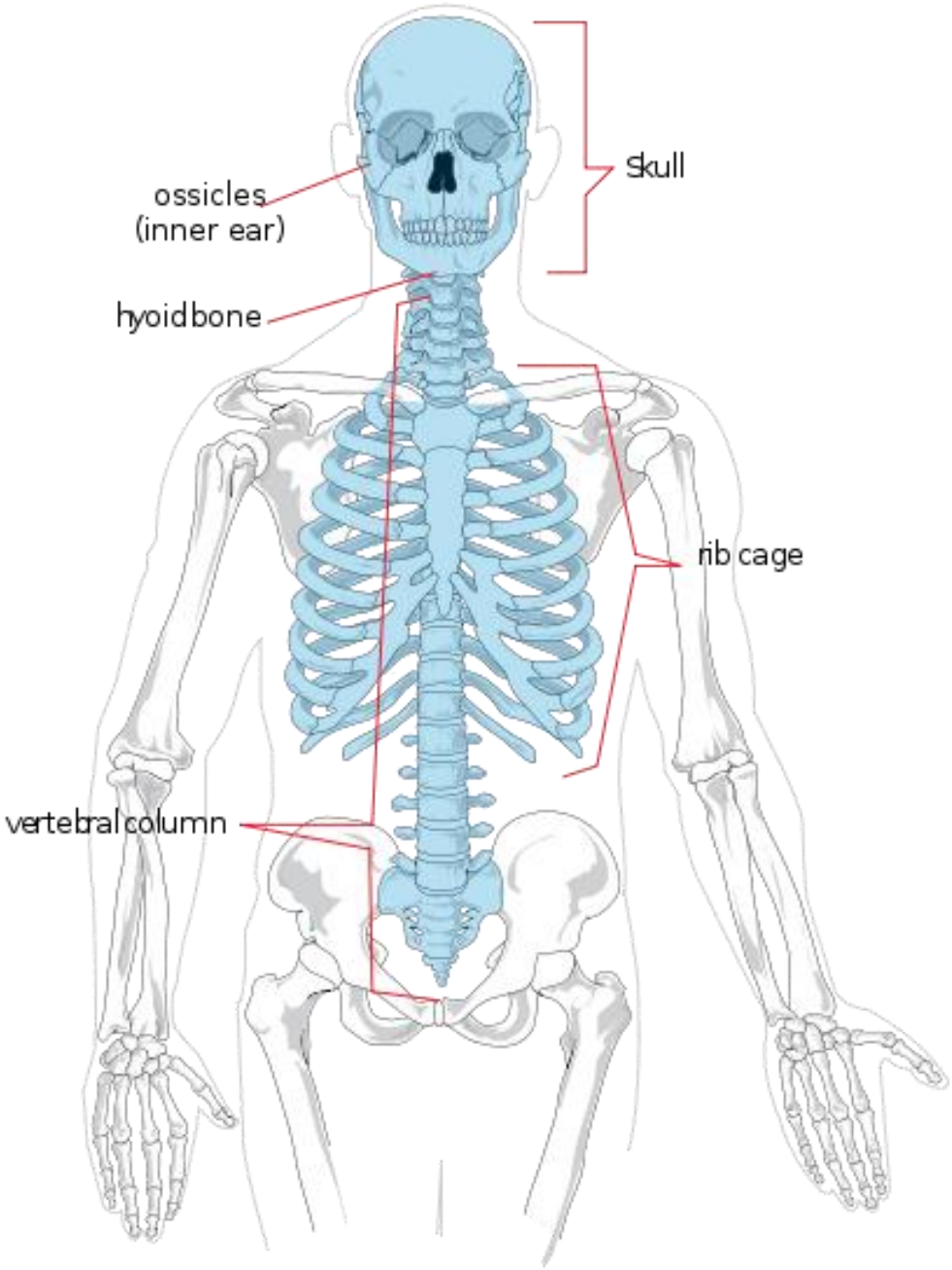
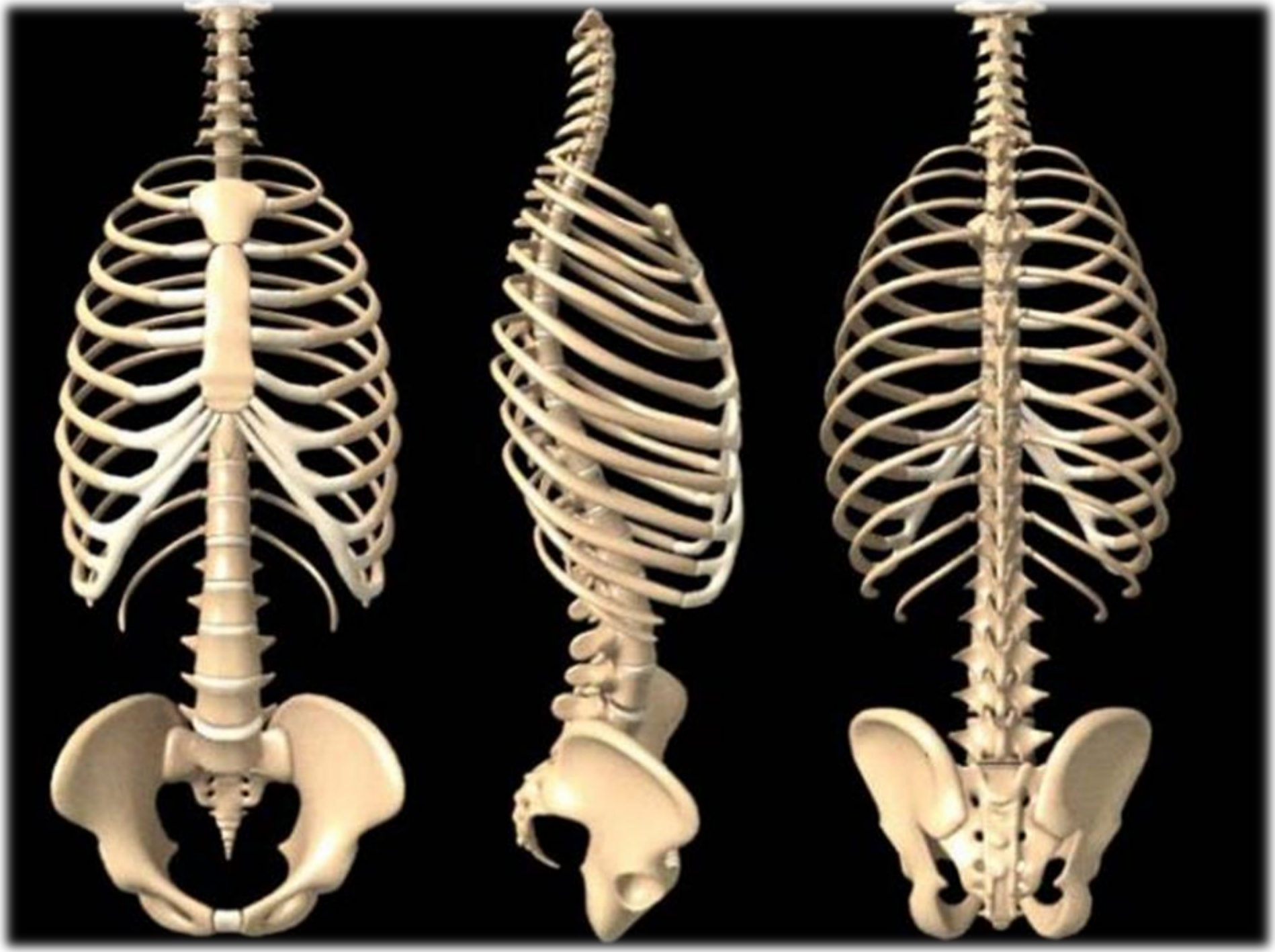
Vertebral column Thorax Pelvis as a whole

Columna vertebralis
Skeleton thoracis
Pelvis

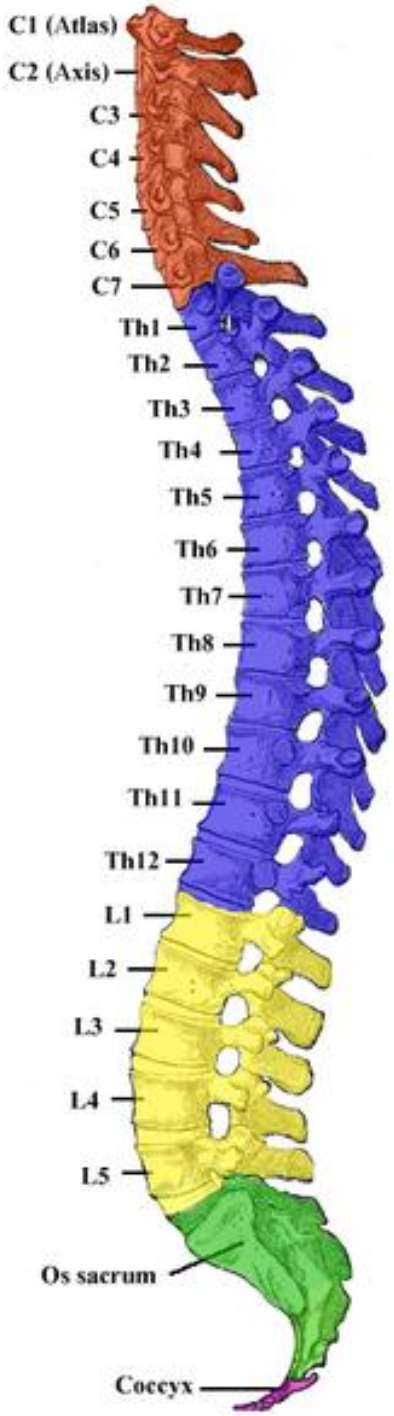




Vertebral column
columna vertebralis

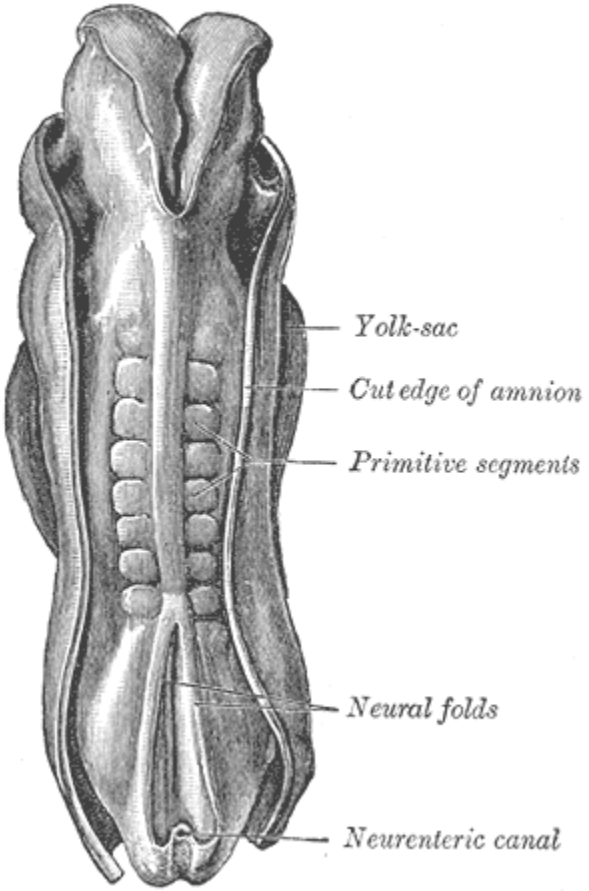
composed of vertebrae:

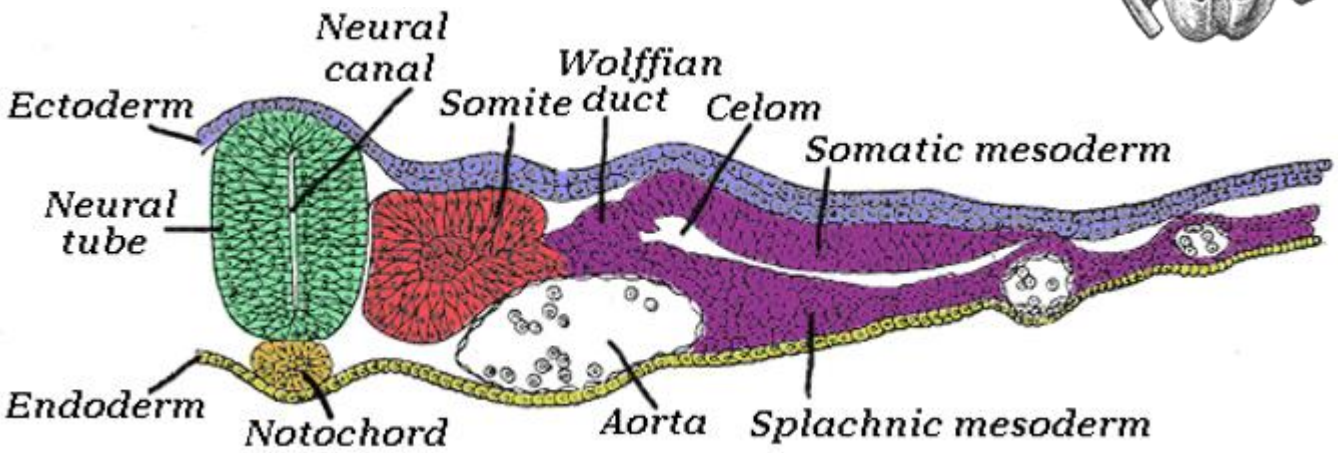
- 7 cervical
- 12 thoracic
- 5 lumbar
- 5 sacral (fused into sacral bone)
- 4-5 coccygeal (atretic, fused into coccyx)



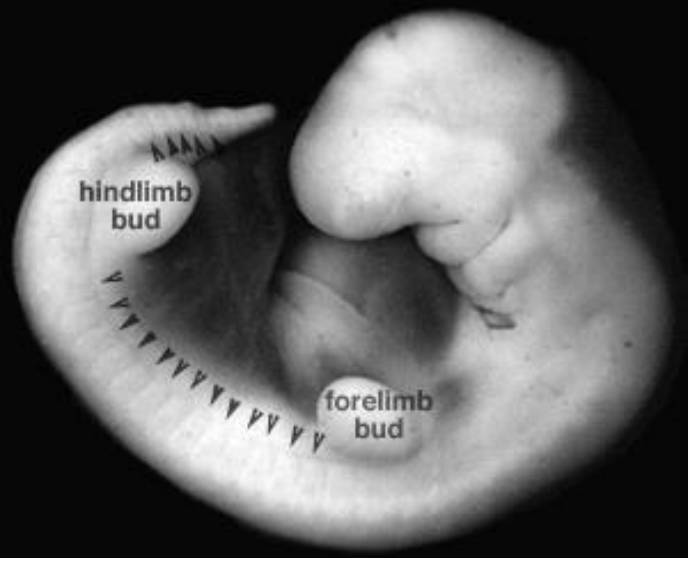
Vertebral column development

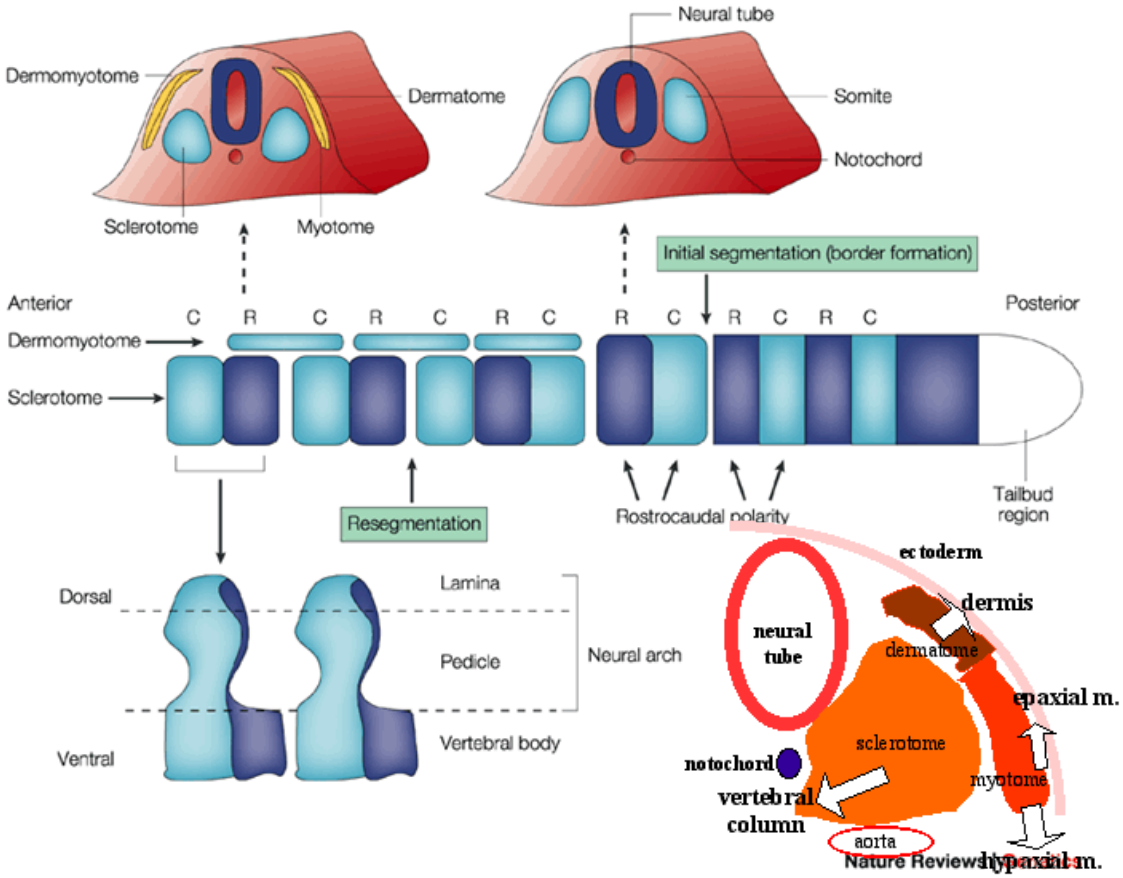
- somites
- exits of spinal nerves
- „occipital vertebra“
- notochord (dorsal string)

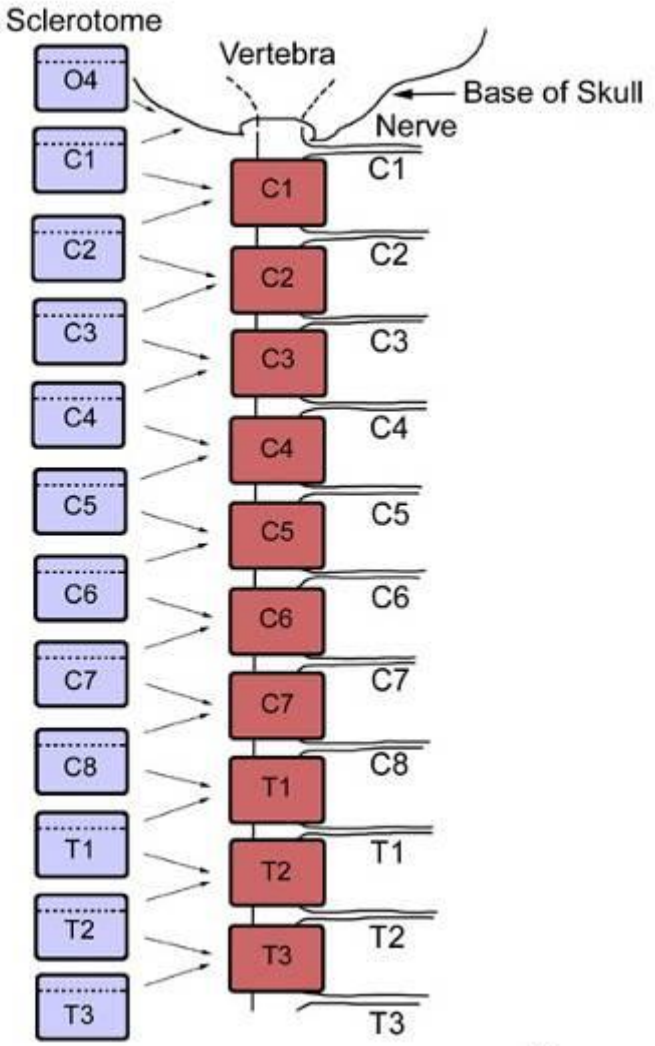




Somites


hindlimb bud
forelimb bud


Neural tube
Dermomyotome
Dermatome
Somite
Notochord
Sclerotome
Myotome
Initial segmentation (border formation)
Anterior
Posterior
Dermomyotome
Sclerotome
C R C R C R C R C R C R C
Resegmentation
Rostrocaudal polarity
Tailbud region
Dorsal
Lamina
Pedicle
Neural arch
Ventral
Vertebral body
ectoderm
dermis
neural tube
dermatome
epaxial m.
sclerotome
notochord
myotome
vertebral column
aorta
hypaxial m.
Nature Reviews


Sclerotome
Vertebra
Base of Skull
Nerve
O4
C1
C2
C3
C4
C5
C6
C7
C8
T1
T2
T3

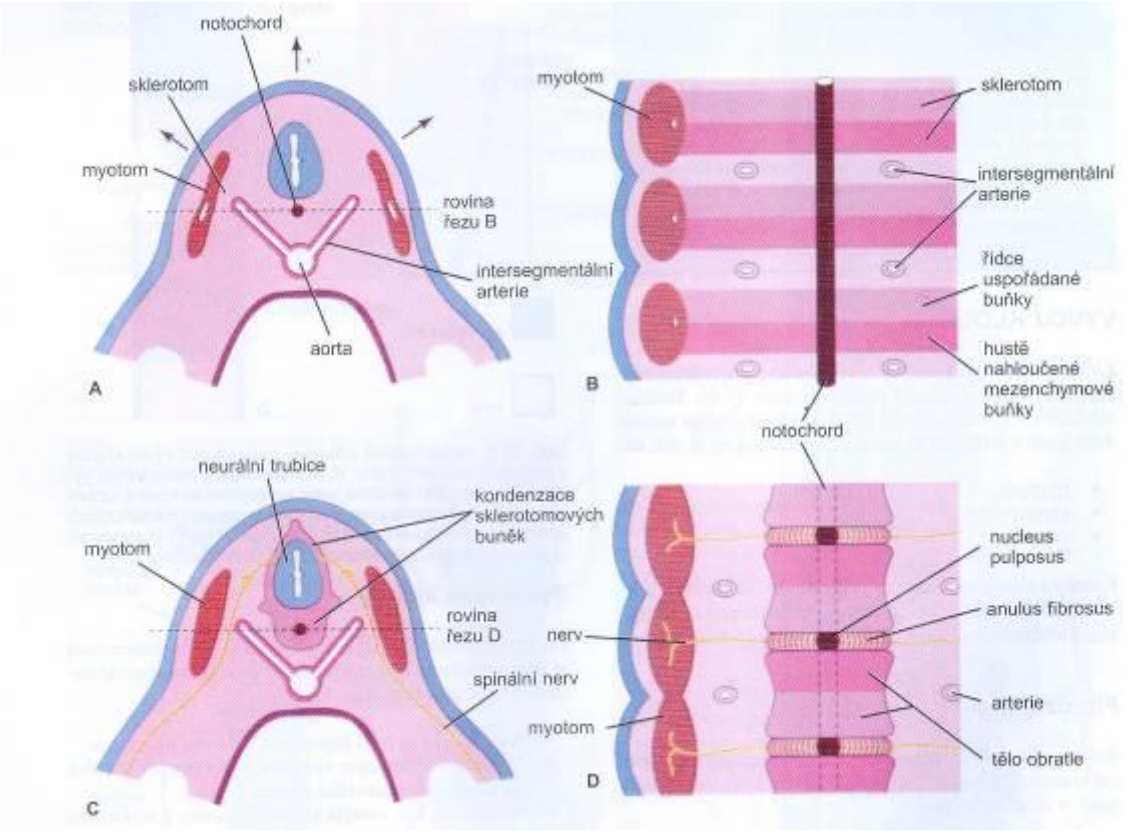
SOMITE

↓

- dermatome
- myotome
- sclerotome

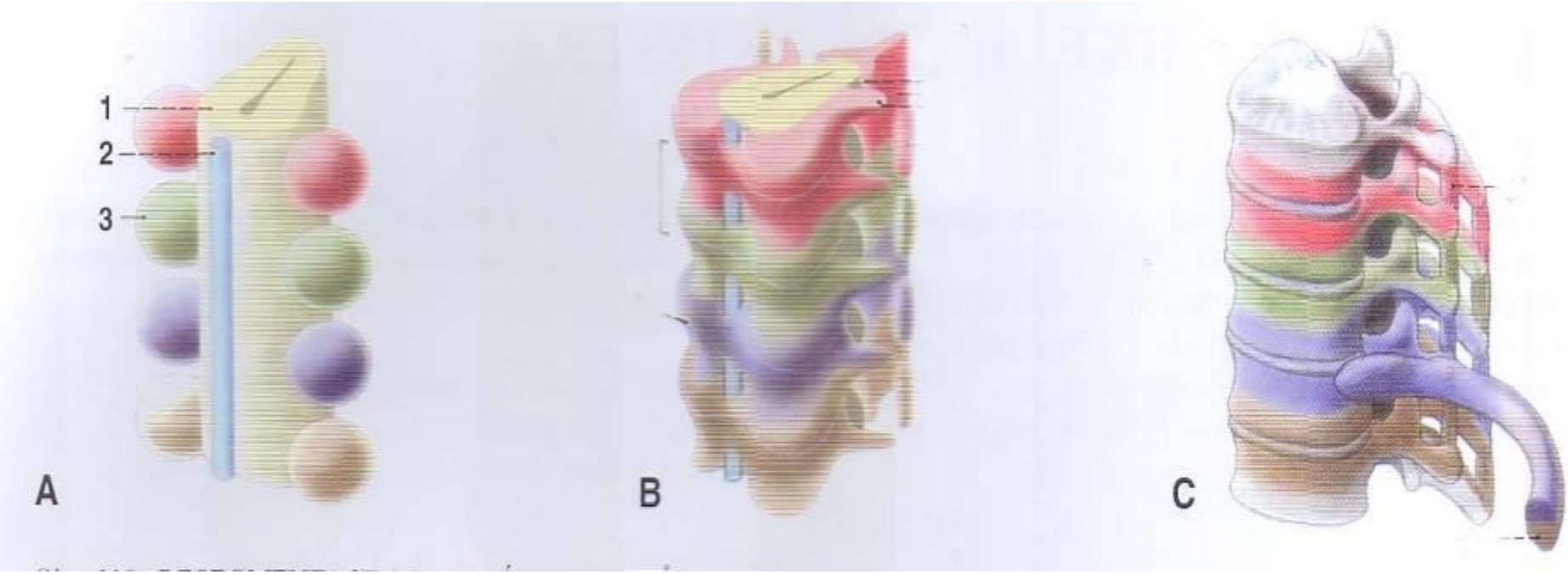
Development of vertebral column

- notochord
- myotome
- intersegmental arteries
- sclerotome
  - loosely structured part
  - densely structured part



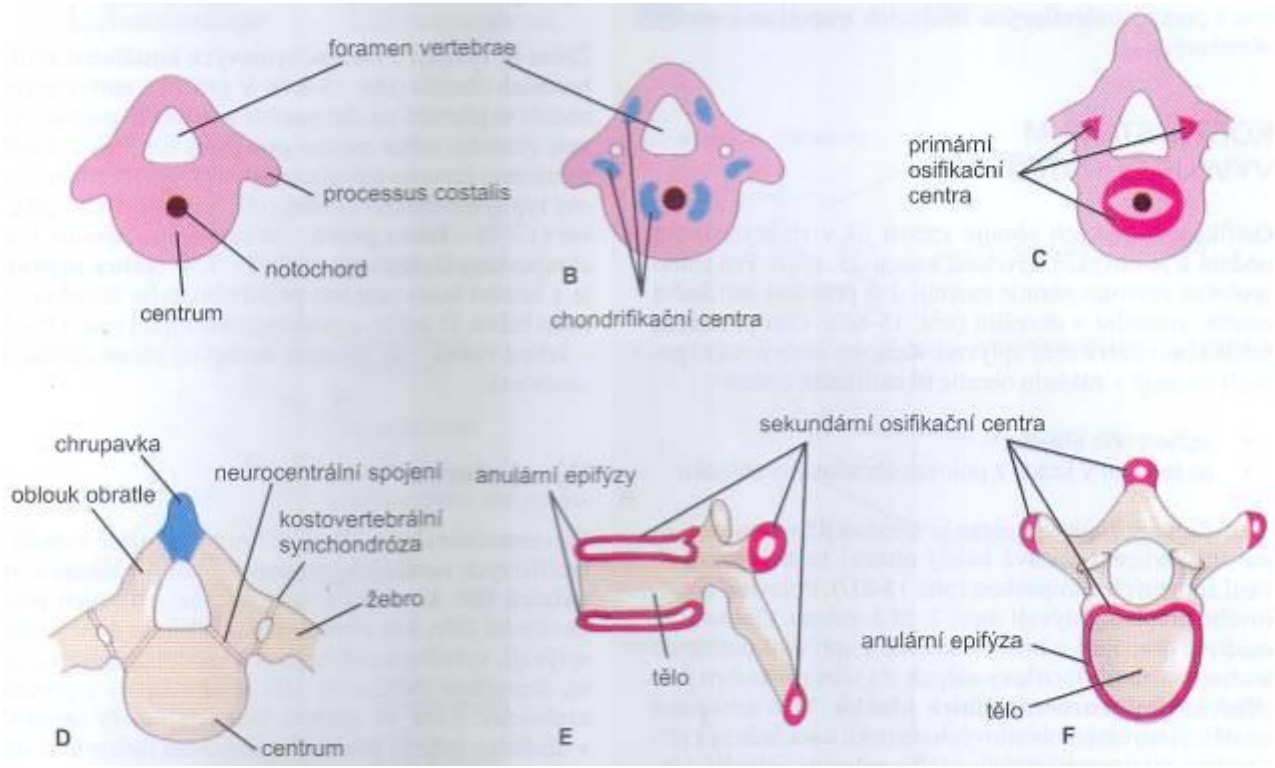
Development of vertebrae

- sclerotome
- resegmentation



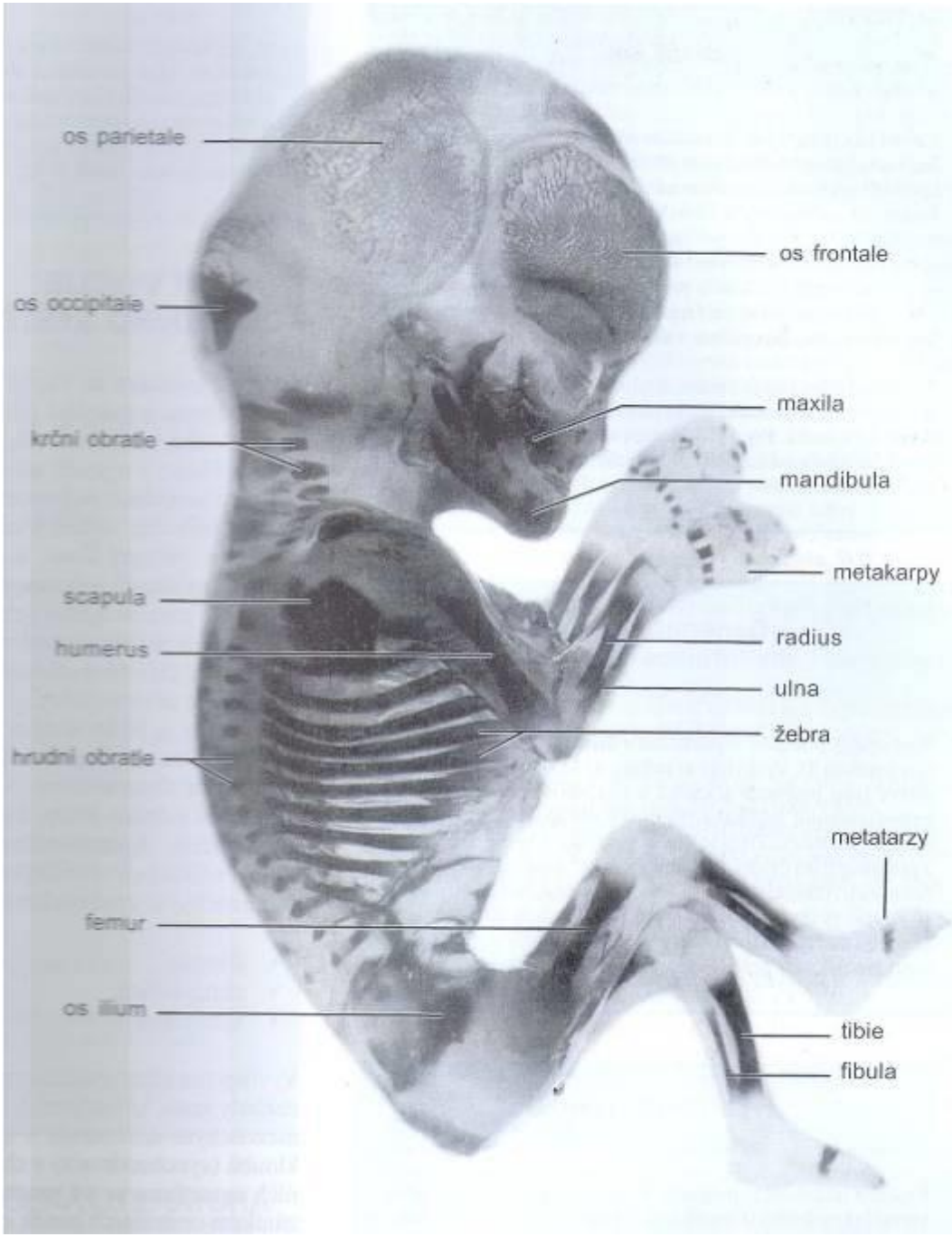
Development of vertebral column

- stages of development:
  - primary chord
  - mesenchymal
  - cartilagineous
  - ossification
- centers of ossification:
  - primary
  - secondary

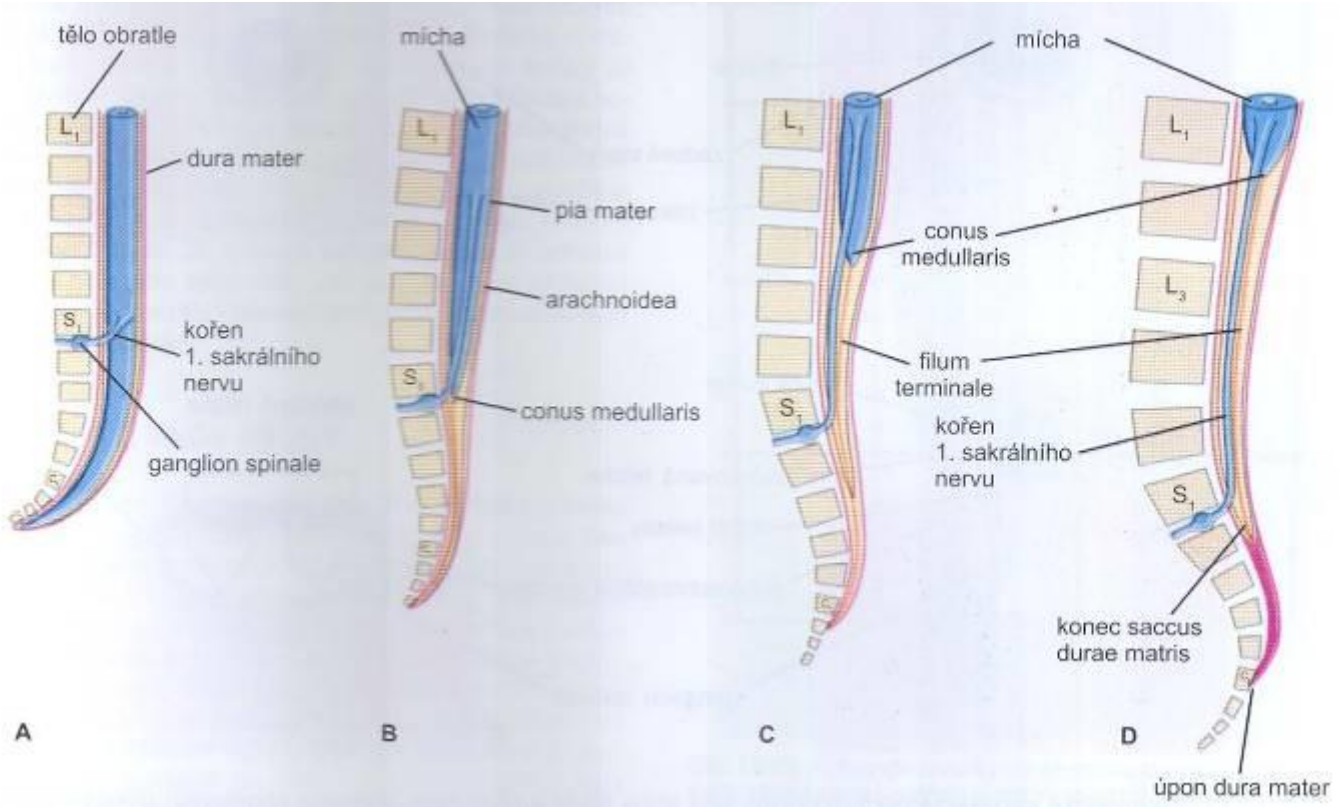


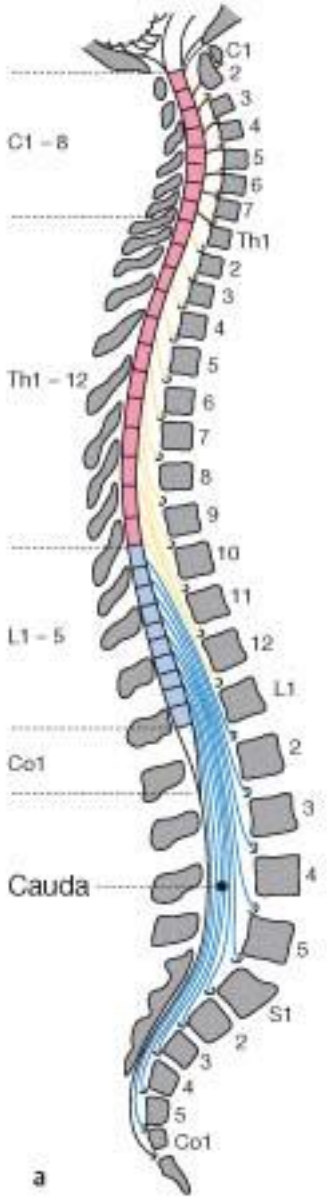
Ossification

12 weeks old fetus



Development of vertebral canal

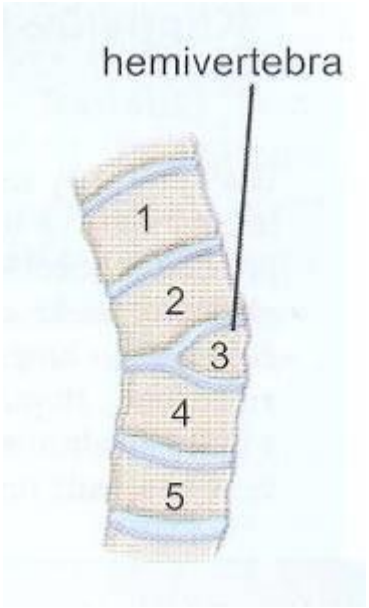


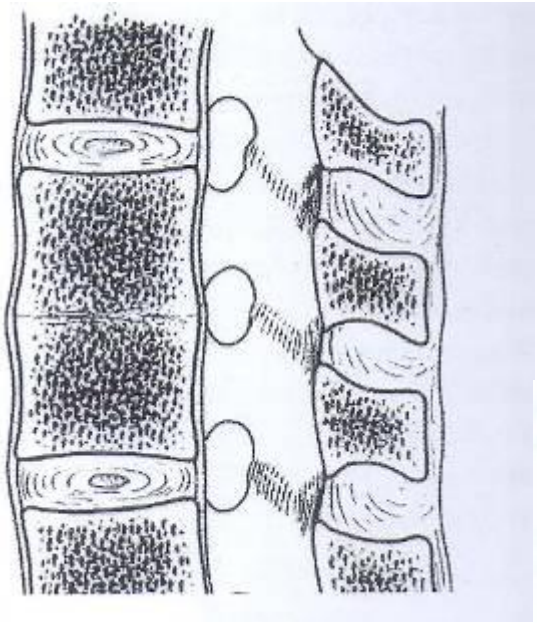


Development defects

basic abnormalities in segmentation:

- hemivertebra
- congenital block
- sacralization x lumbalization

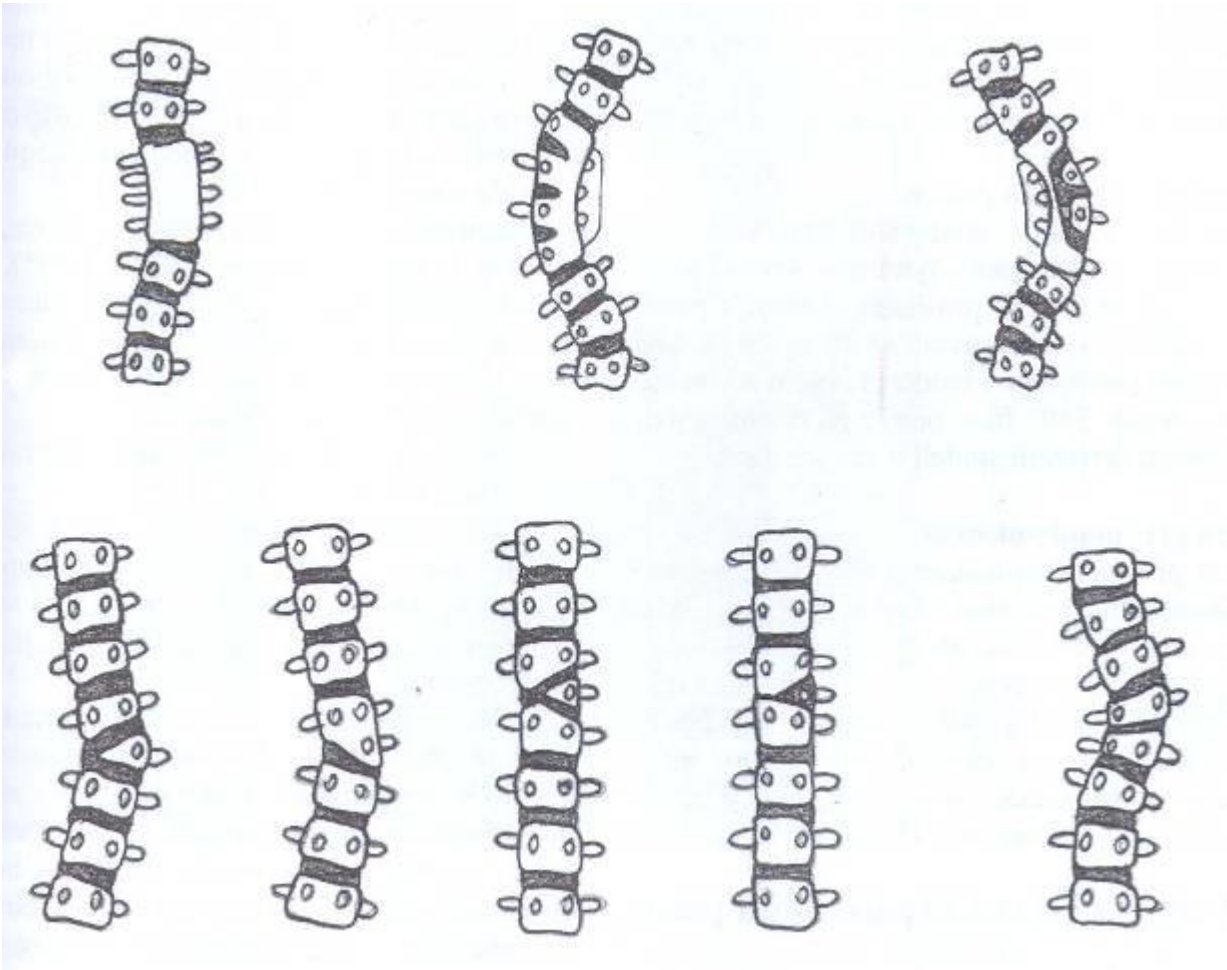




Development defects

abnormalities in segmentation and formation

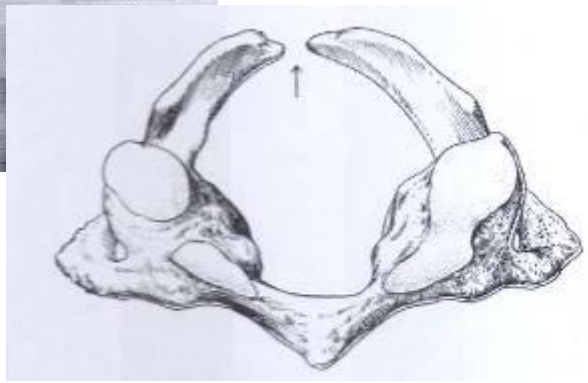
- non-segmented ridge
- wedge-shaped vertebra
- hemivertebra
- quartervertebra
- corner vertebra



Development defects

abnormalities in vertebral arch closure:

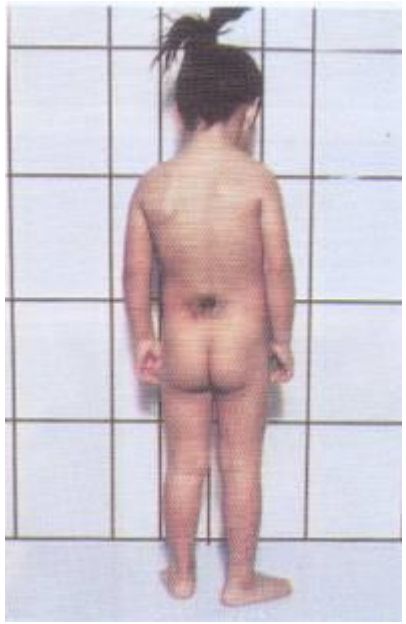
- majority in lumbar and sacral parts
- frequently accompanying with abnormalities of neural tube

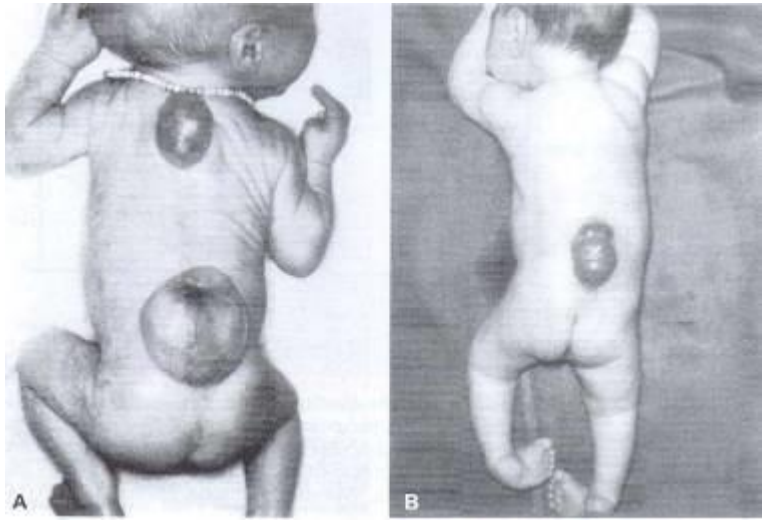


Development defects

spina bifida:

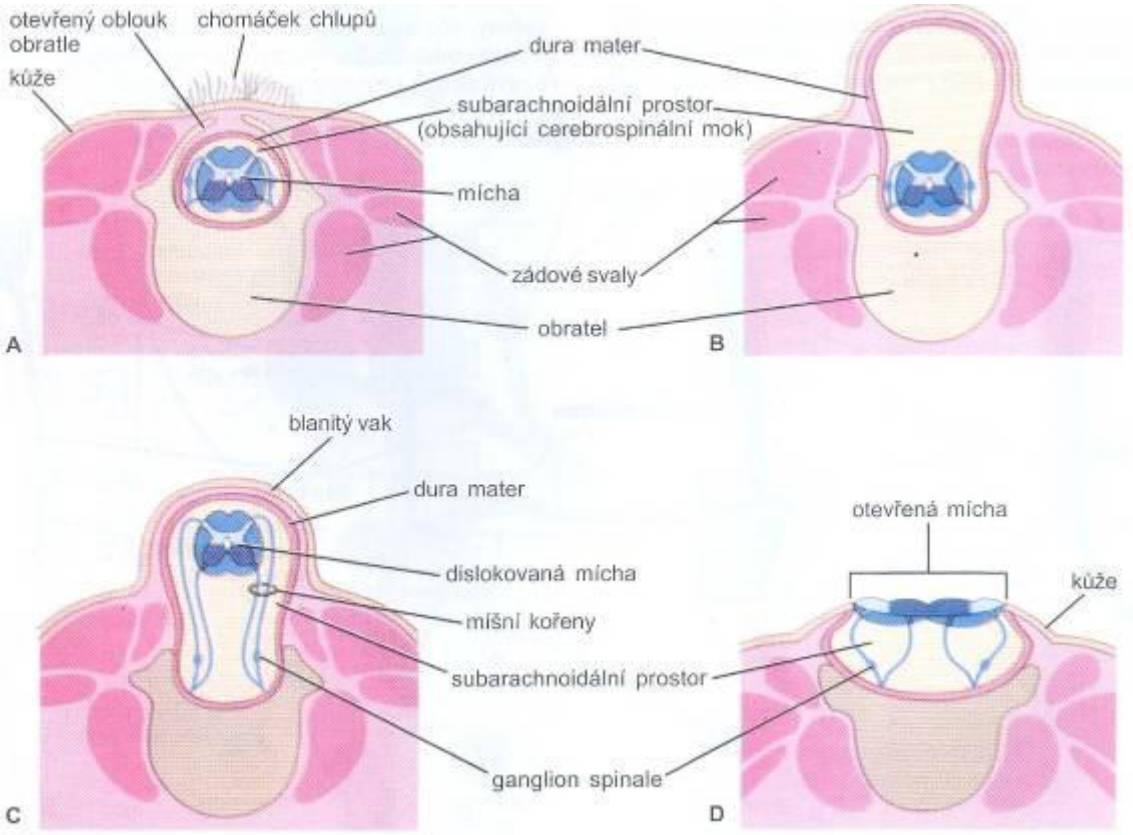
- occulta
- dermal sinus
- cystica





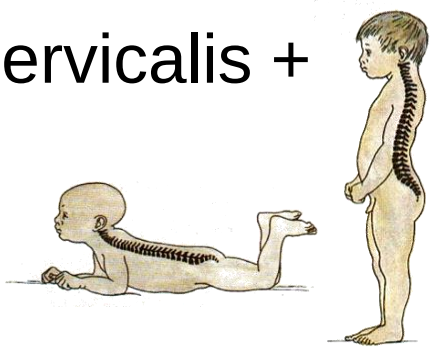
Development defects

- meningomyelocele
- meningocele
- myeloschisis

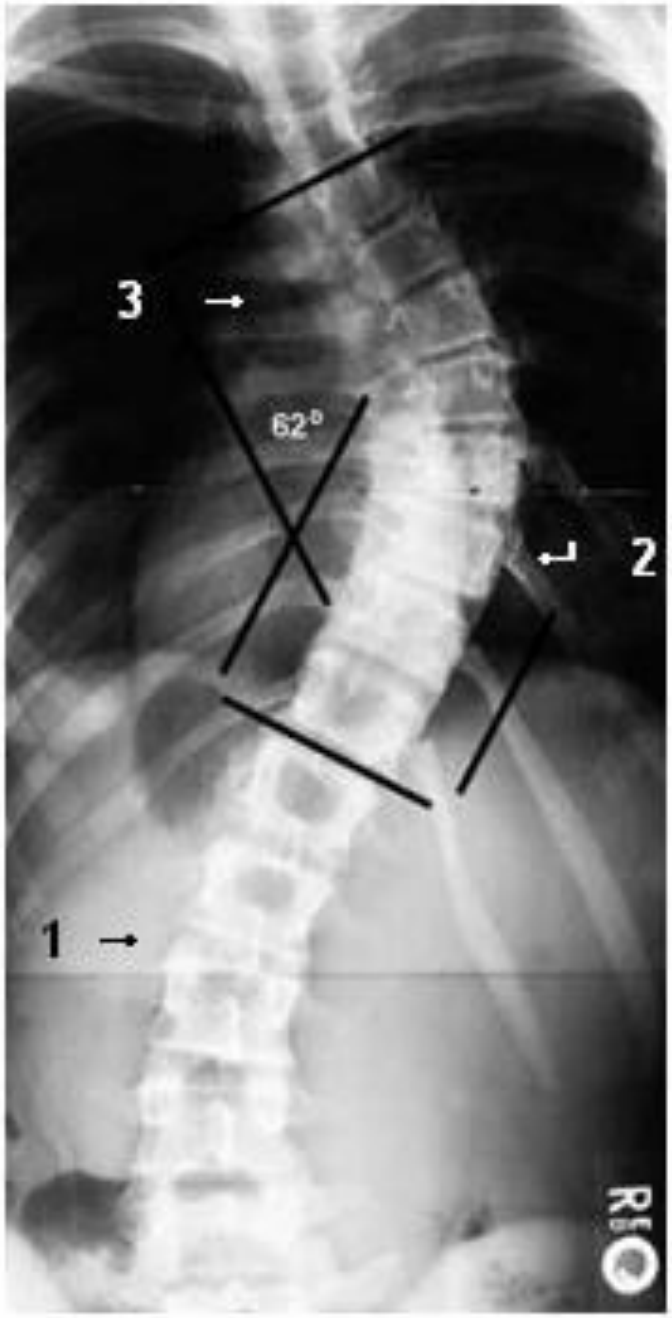


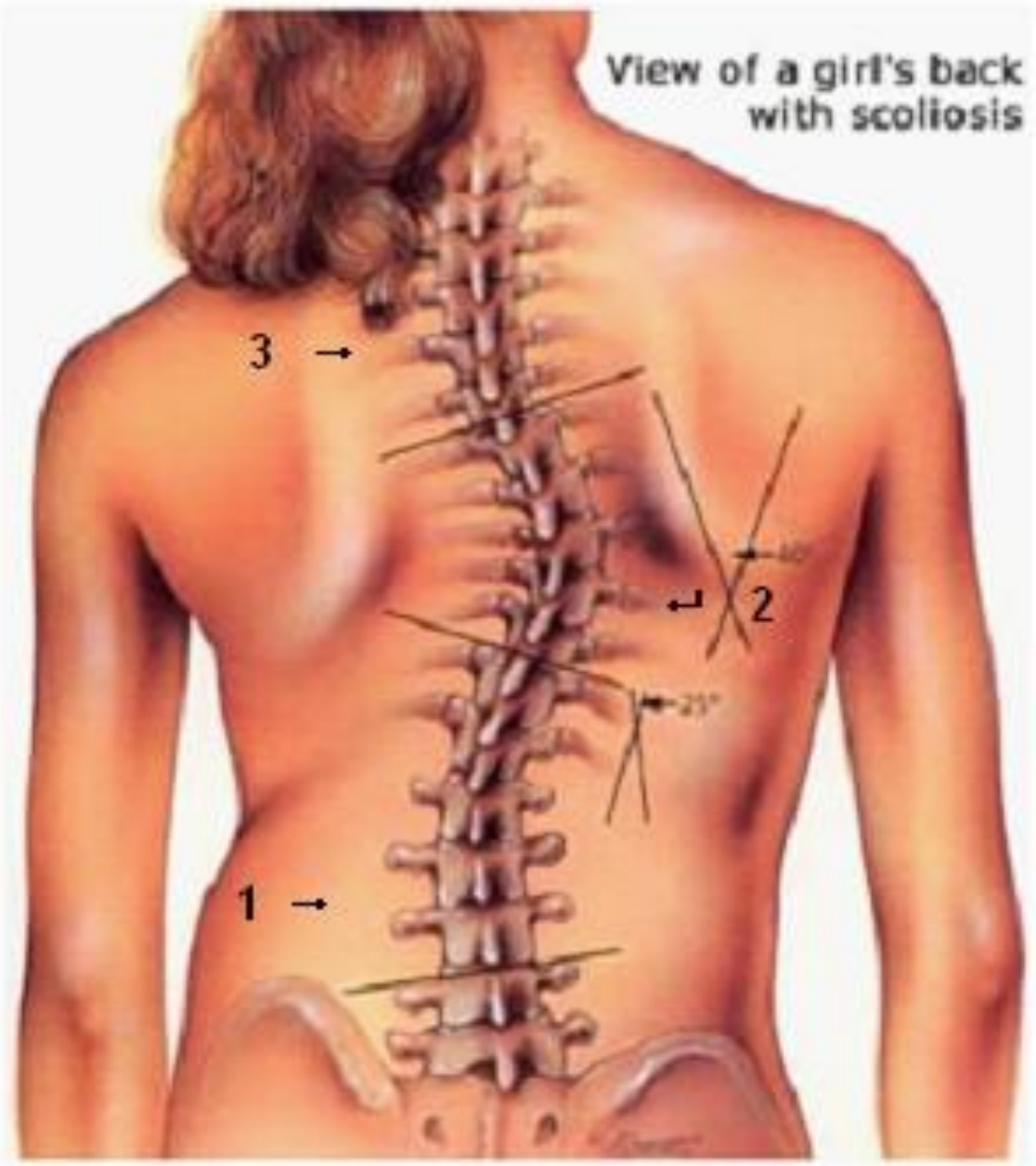
Vertebral column

- column length – 35% of body height
- 1/5 to 1/4 length is formed by intervertebral discs
- kyphosis thoracica + sacralis
- lordosis cervicalis + lumbalis
- scoliosis



- canalis vertebralis
- foramen intervertebrale

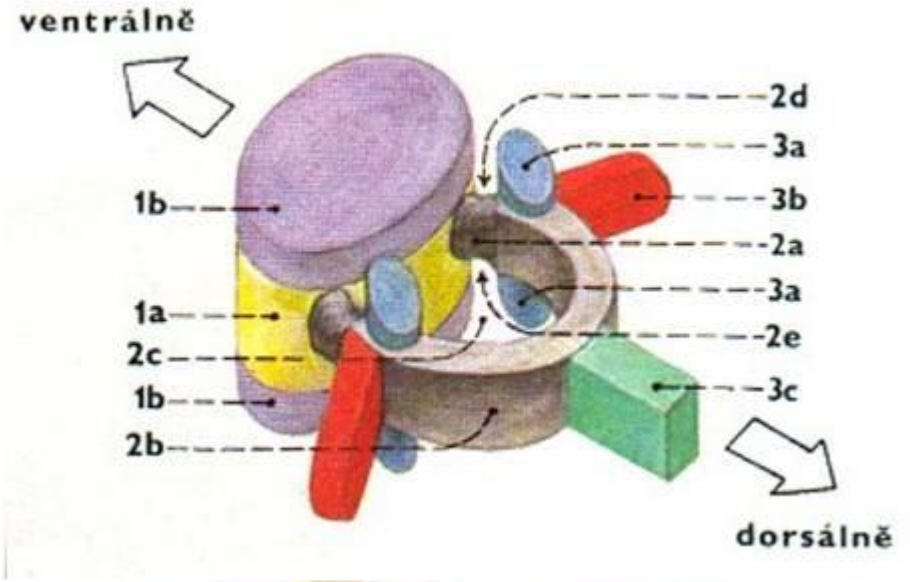

3
62°
2
1
R

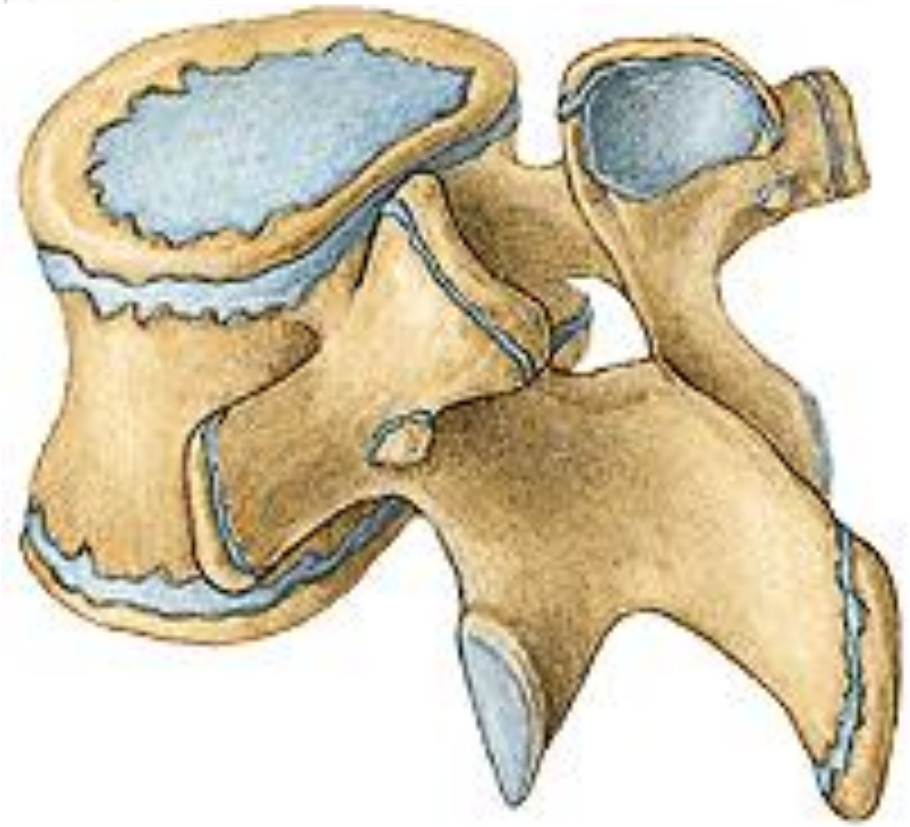

View of a girl's back with scoliosis
3
2
1

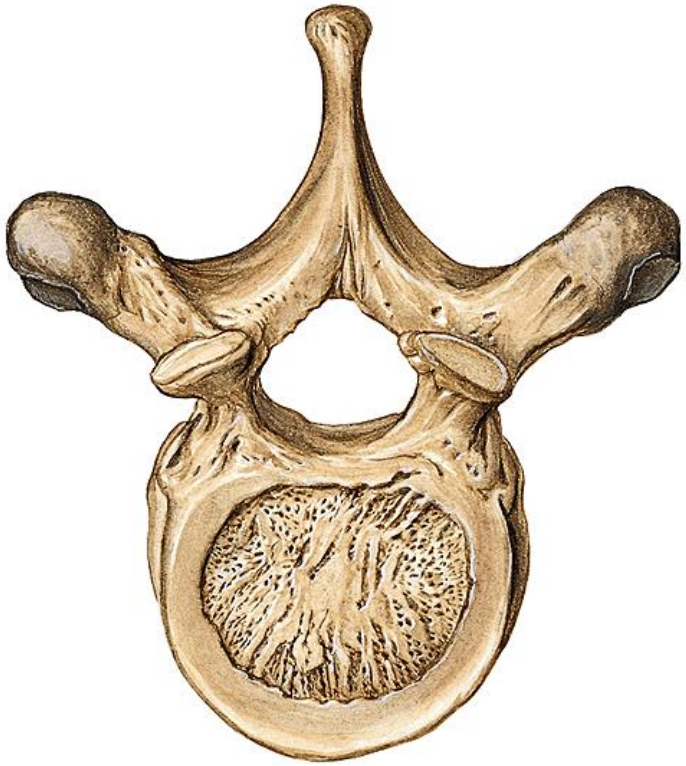
Vertebra (*Vertebra*)

- corpus vertebrae
- arcus vertebrae
  - pediculus
  - lamina
- foramen vertebrale
- processus spinosus
- processus transversus
- processus articularis

- *epiphysis anularis*



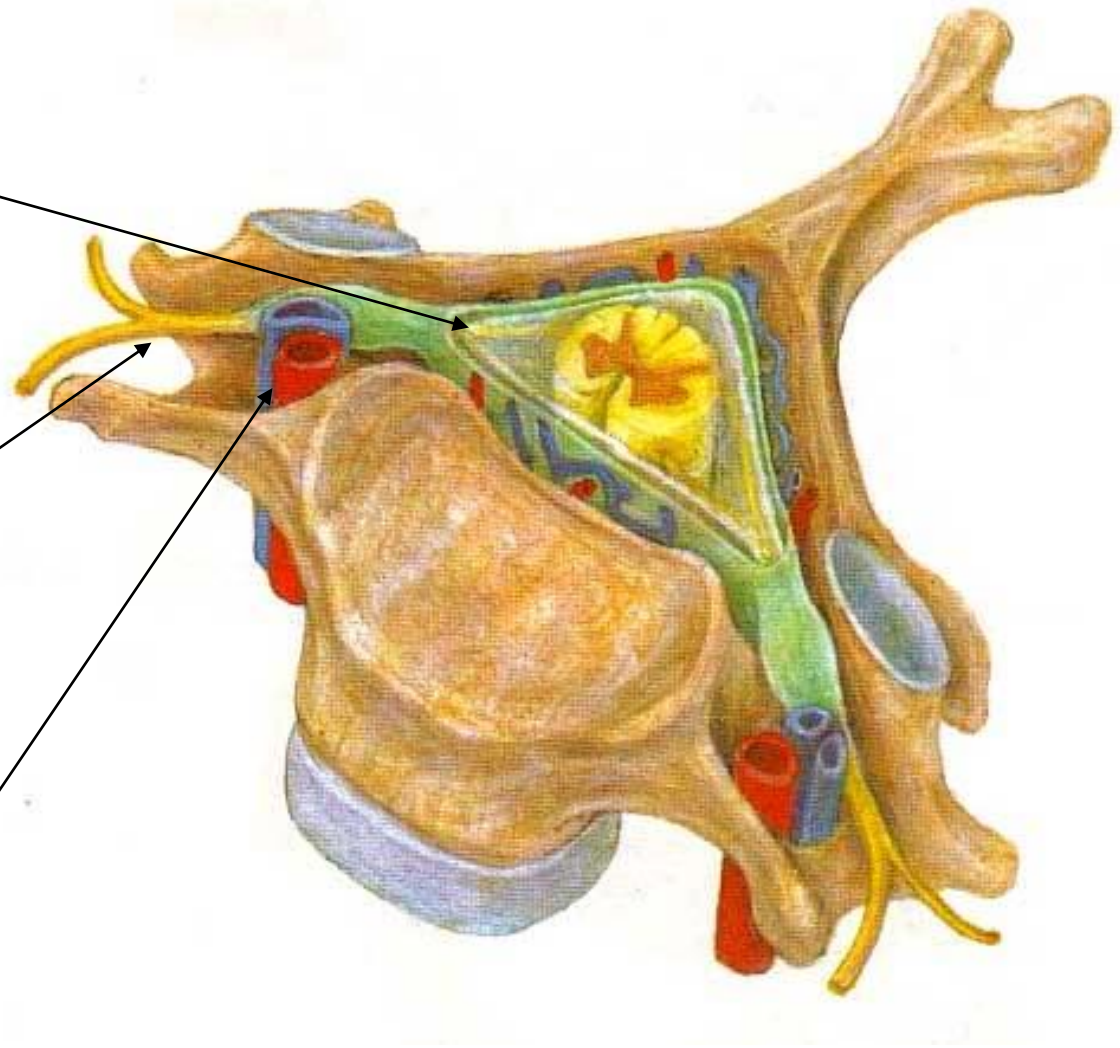




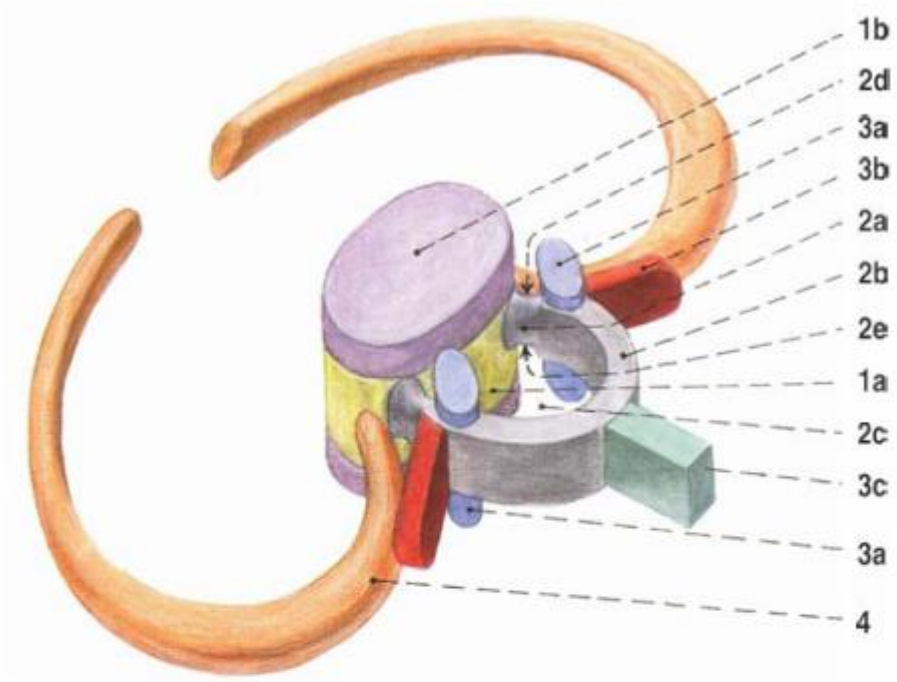
Vertebra
Corpus vertebrae
Facies intervertebralis
Arcus vertebrae
Pediculus arcus vertebrae
Lamina arcus vertebrae
Foramen intervertebrale
Incisura vertebralis superior
Incisura vertebralis inferior
Foramen vertebrale
Processus spinosus
Processus transversus
Processus articularis superior; Zygapophysis superior
Facies articularis superior
Processus articularis inferior; Zygapophysis inferior
Facies articularis inferior

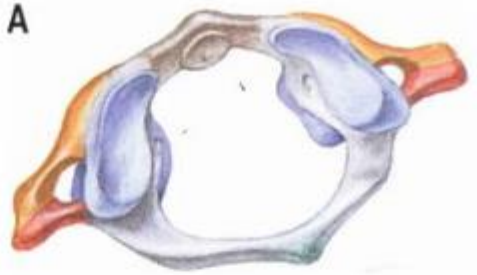
Vertebrae
topographical site

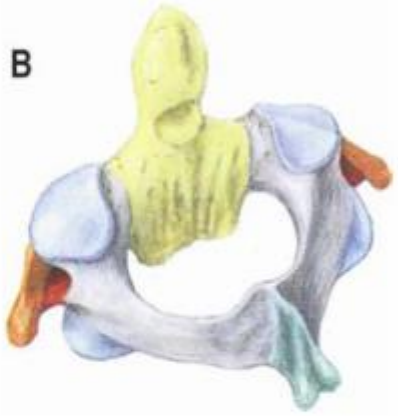
- canalis vertebralis
- foramen intevertebrale
- foramen transversarium

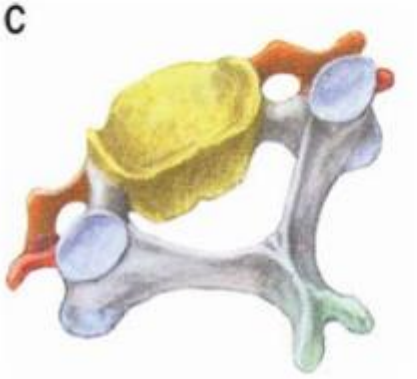


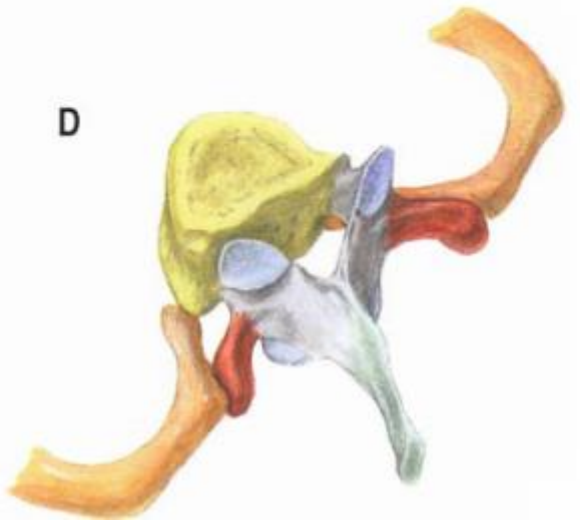
Local differences between vertebrae



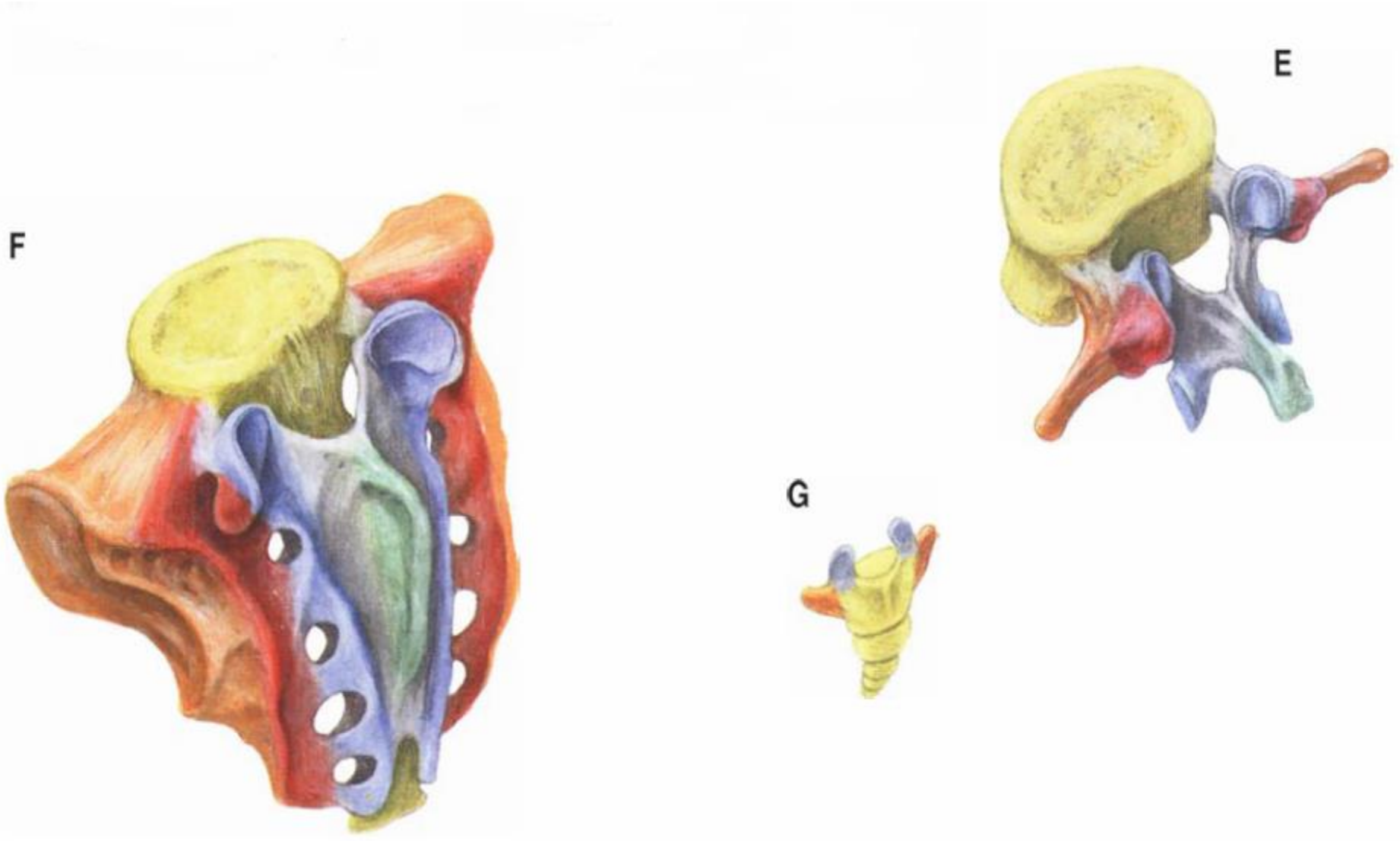






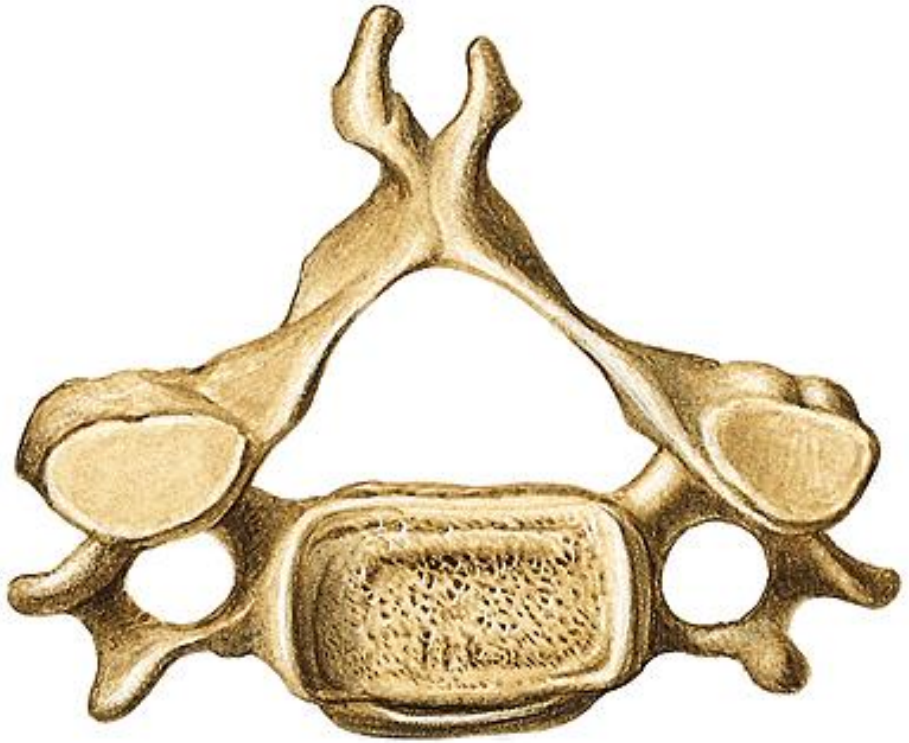


Local differences between vertebrae



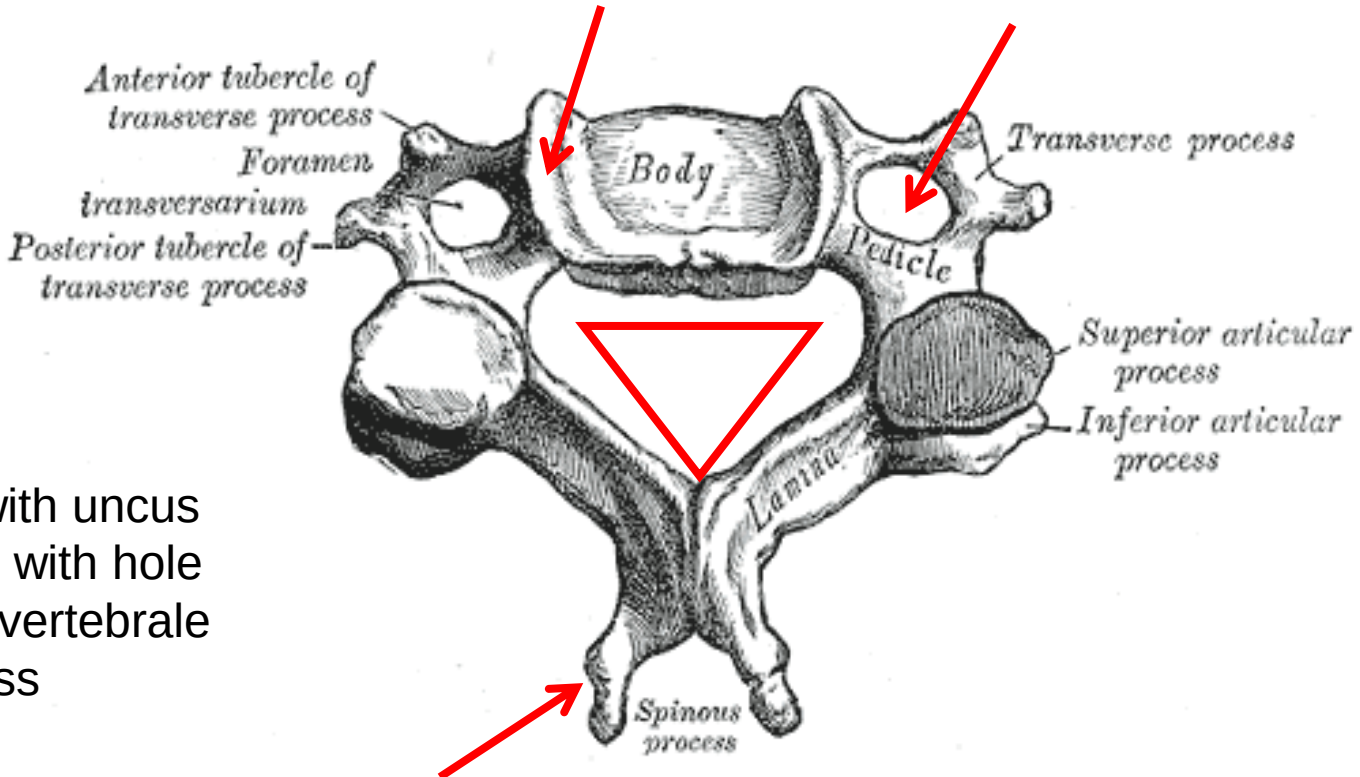
Cervical vertebrae (*Vertebrae cervicales*) CI – CVII

Uncus corporis; Processus uncinatus
Foramen transversarium
Tuberculum anterius
Tuberculum caroticum
Tuberculum posterius
Sulcus nervi spinalis



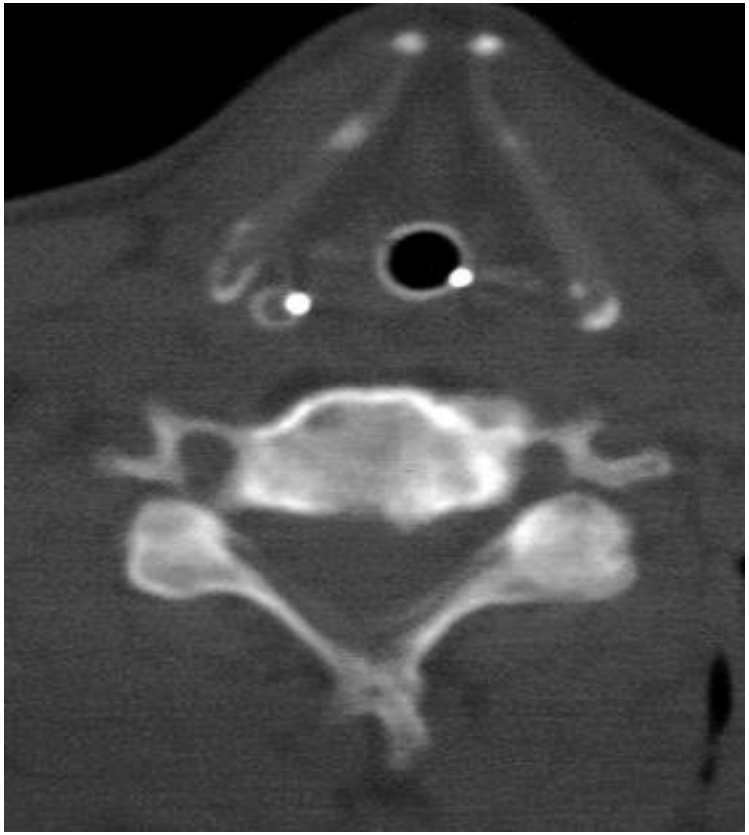
Cervical vertebrae

- ! difference in numbering of vertebrae and spinal nerves !
  - vertebrae CI-C**VII**
  - spinal nerves C1-C**8**

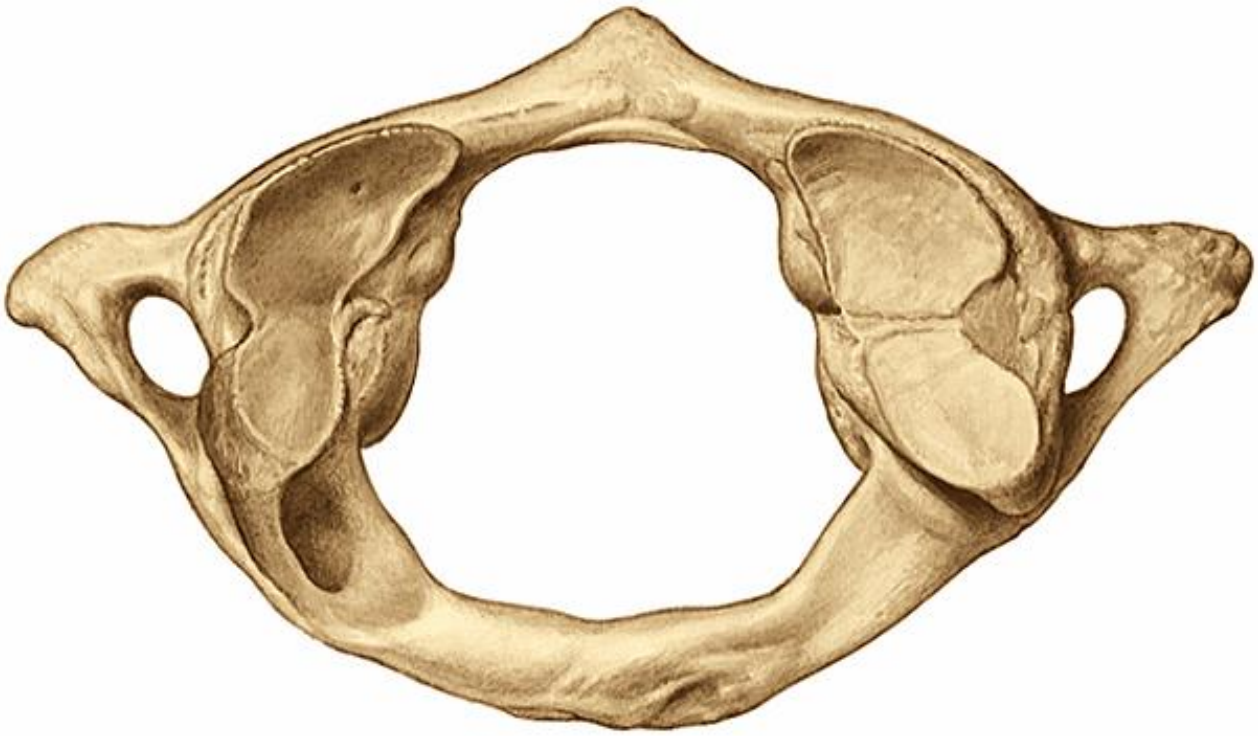


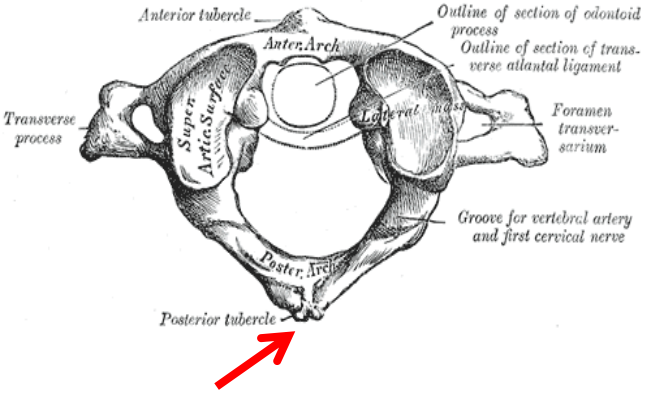
- small round body with uncus
- transverse process with hole
- triangular foramen vertebrale
- split spinous process

Vertebra cervicalis



Atlas = *Atlas* (CI)

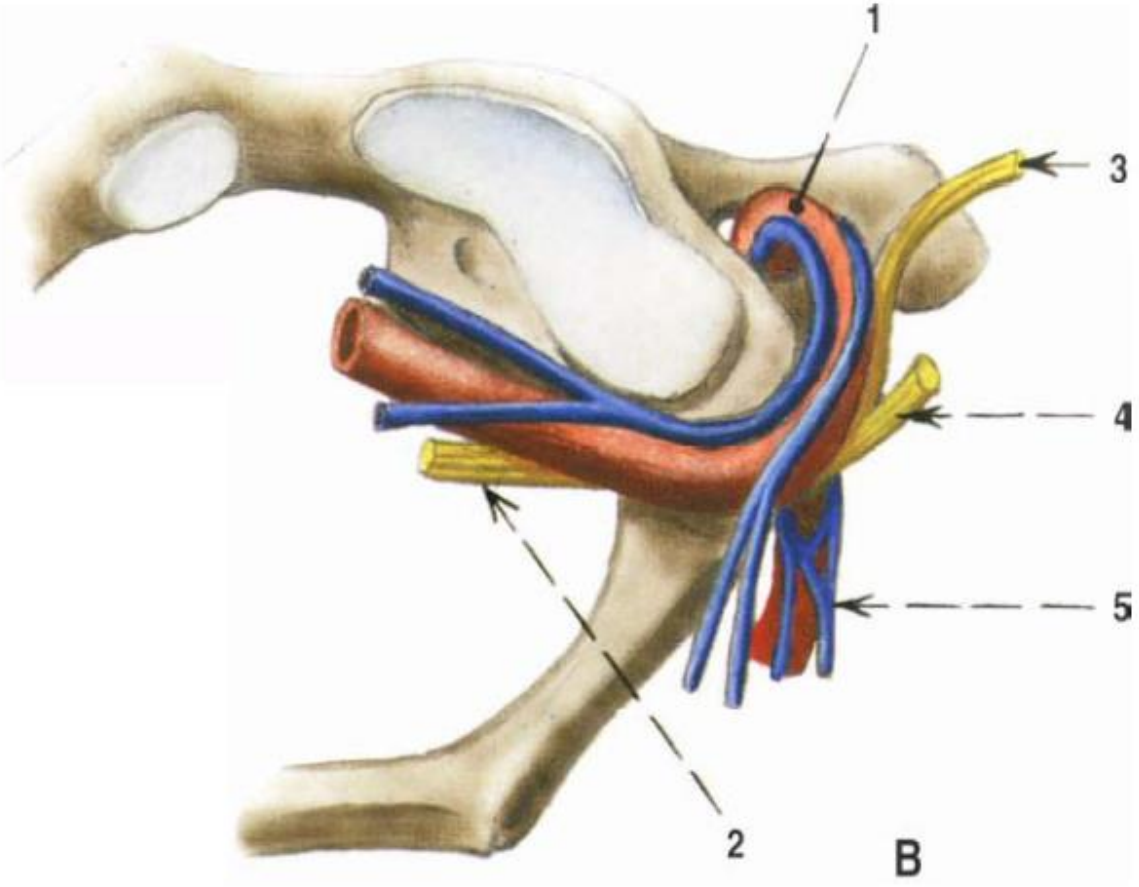




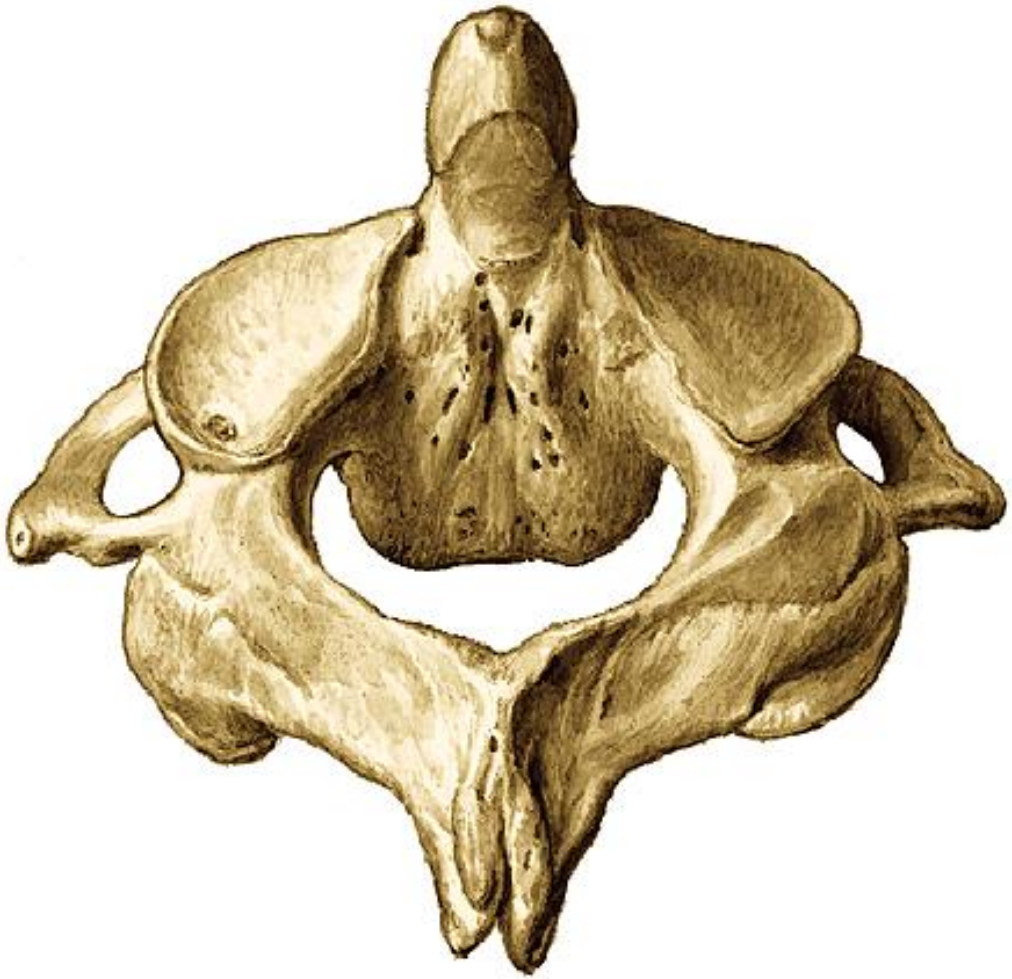
Massa lateralis atlantis
Facies articularis superior
Facies articularis inferior
Arcus anterior atlantis
Fovea dentis
Tuberculum anterius
Arcus posterior atlantis
Sulcus arteriae vertebralis
(Canalis arteriae vertebralis)
Tuberculum posterius

Atlas

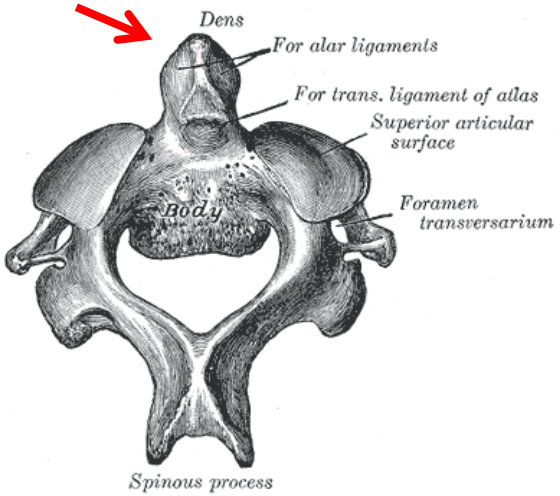
- course of a. vertebralis



Axis = *Axis* (CII)
formerly „epistropheus“

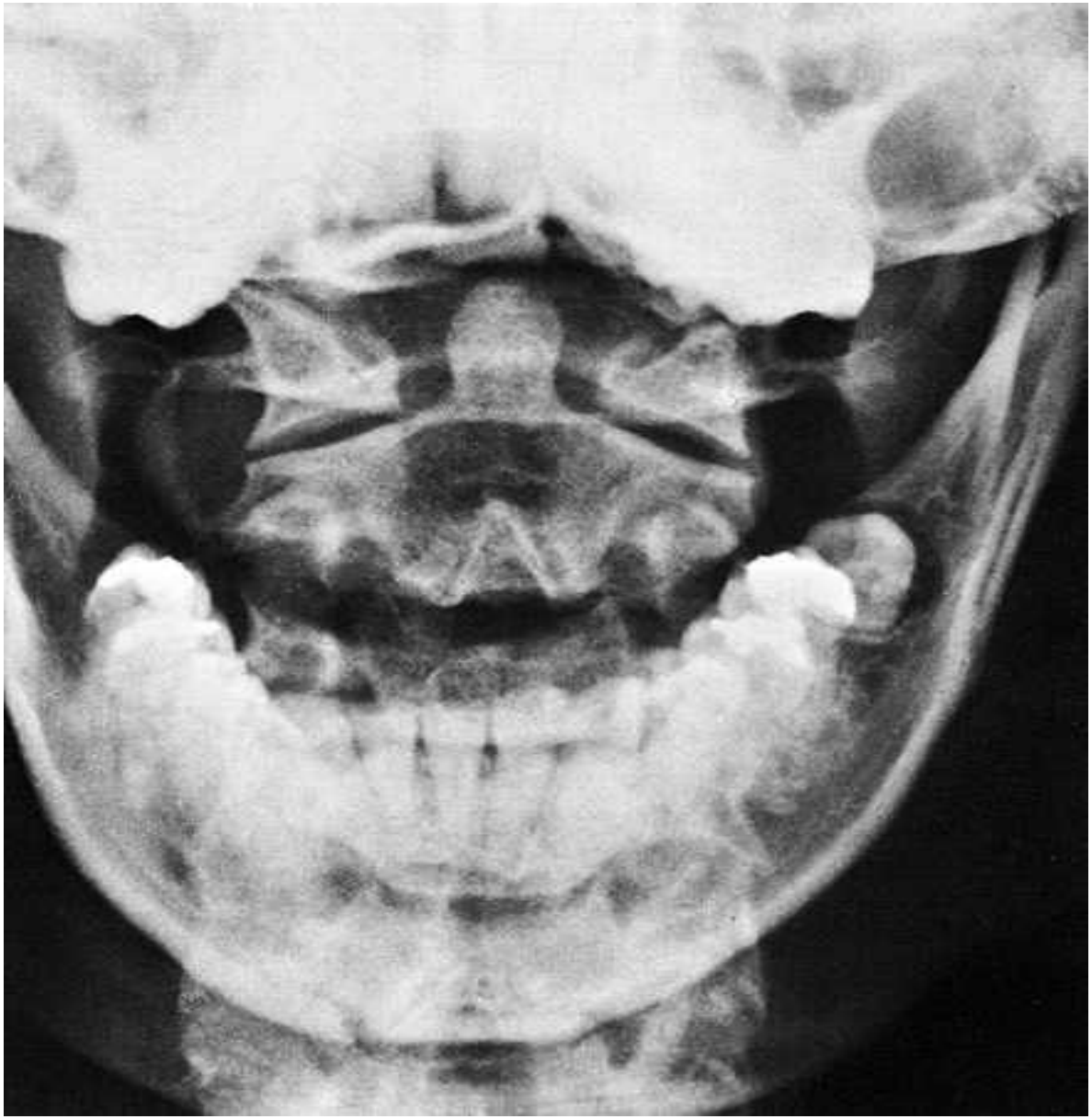


Dens axis
Apex dentis
Facies articularis anterior
Facies articularis posterior



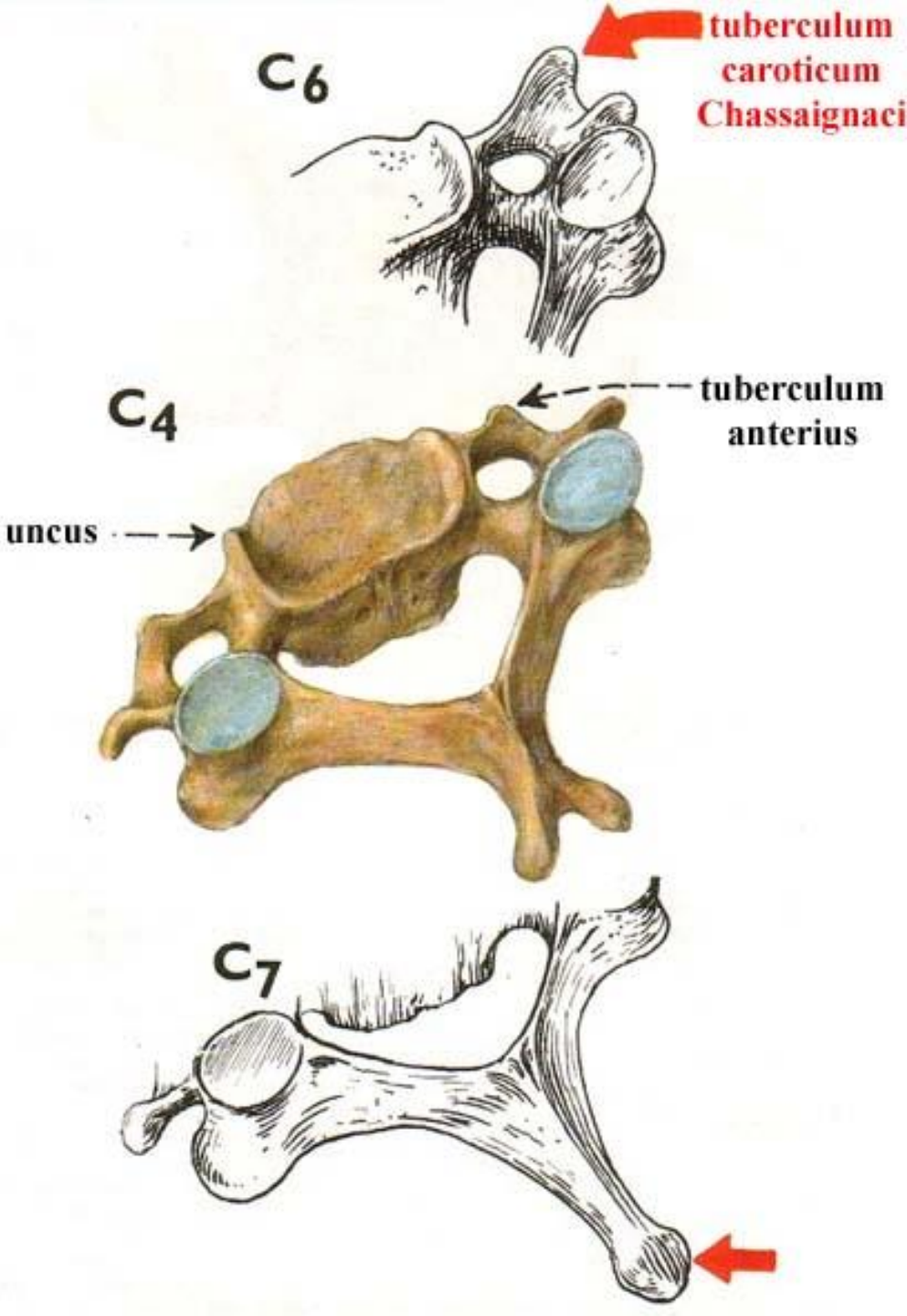
X-ray picture of the skull, frontal view

Sandberg‘s projection with opened mouth to show dens axis



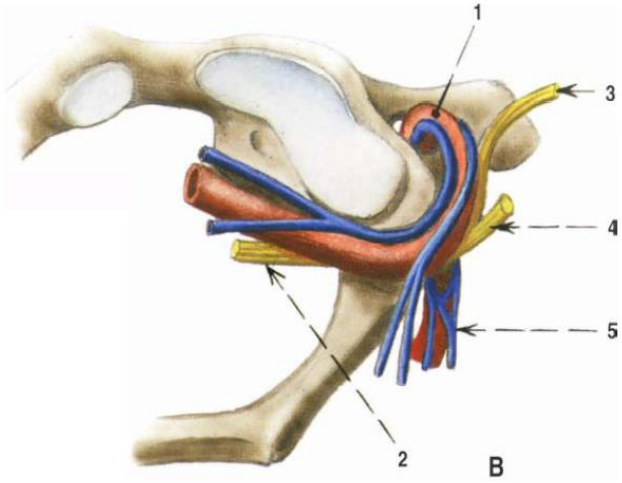
Other vertebrae

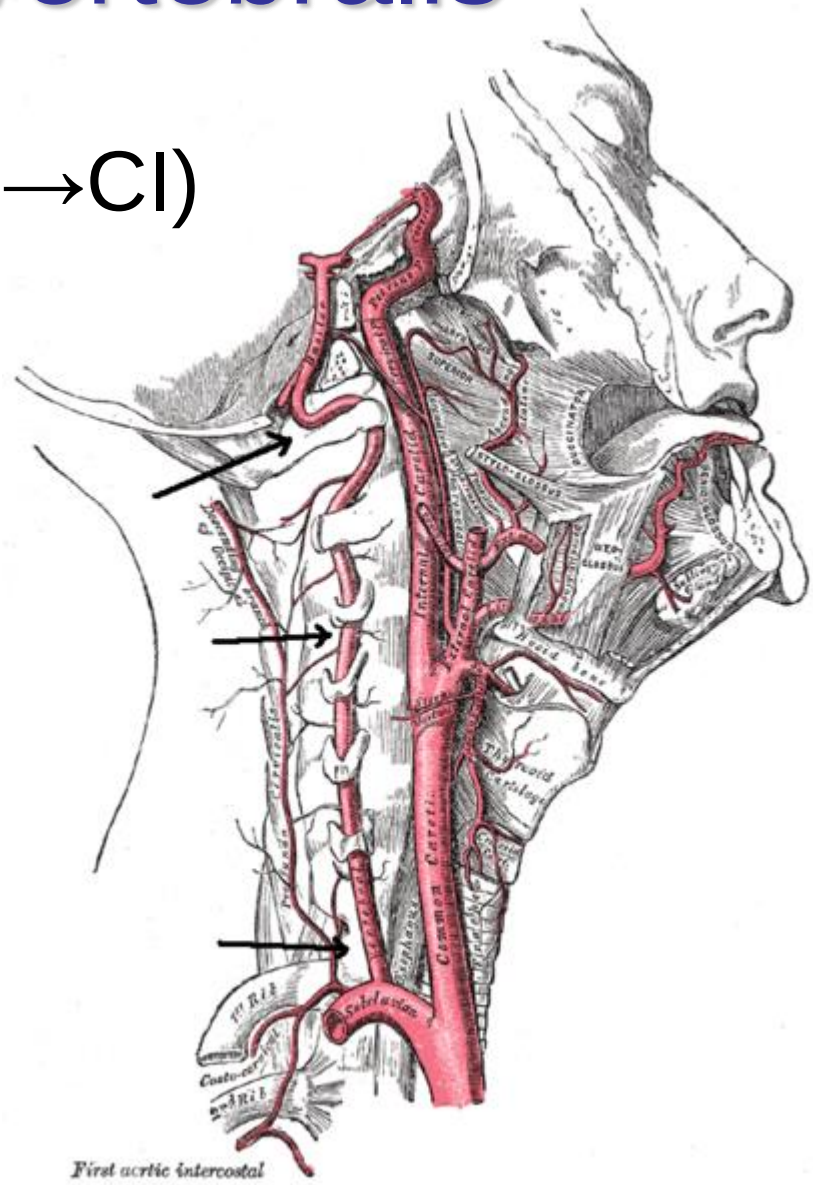
- **C VI**
  - prominent tuberculum anterius = t. caroticum *Chassaignaci*
- **C VII**
  - prominent hammer-like processus spinosus



Course of a. vertebralis

- pars transversaria (CVI→CI)
- pars atlantica (CI)
- „viewing cathedrals“ syndrome





Arteriogram of arteriae vertebrales

X-ray of cervical vertebrae


28. Halswirbelsäule, seitlich


A
P

Developmental defects of cervical vertebral column

spina bifida posterior

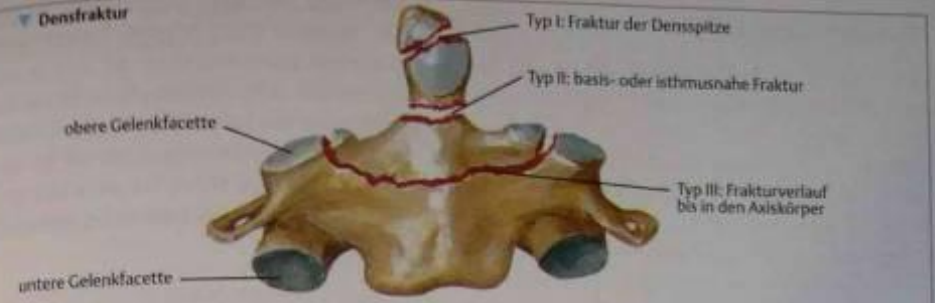
spina bifida anterior

http://esbirky.netadmin.cz/cz/instituce/narodni-muzeum/prirodovedecke-muzeum/antropologicka-sbirka/sbirka-minulych-populaci/prvni-krcni-obratel-atlas-5/

Clinical notes

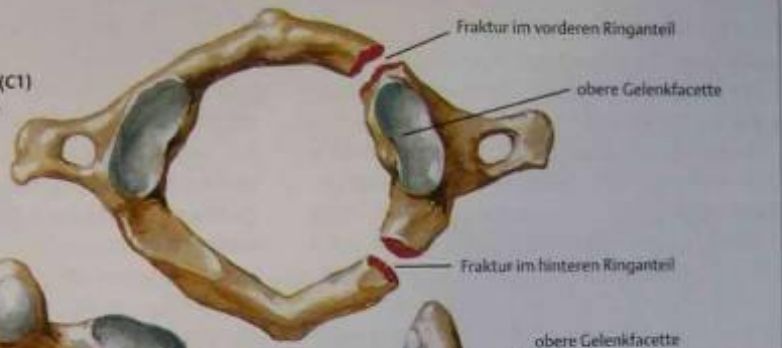
- **fracture of C1** (Jefferson‘s fracture)
  - reposition from posterior approach
- **fracture of *dens axis***
  - anterior transoral approach (compressive osteosynthesis by two screws)
- *cave:* surrounding structures (cervical neurovascular bundle, *arteria vertebralis,* spinal cord)
- **cervical rib**
  - *variations*, most common in C7 – pressure on surroundings
- cervical segment of vertebral column: upper part C1+2, lower part C3-7

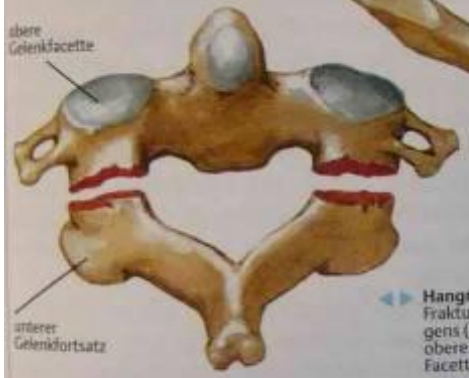
Densfraktur



Jefferson-Fraktur des Atlas (C1)

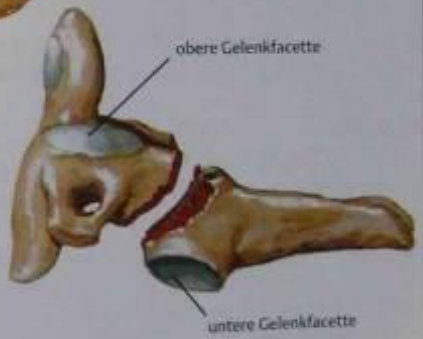
Atlasringsprengung an einer oder an mehreren Stellen





Hangman-Fraktur

Fraktur des Axisbogens (C2) zwischen oberer und unterer Facette



a

b

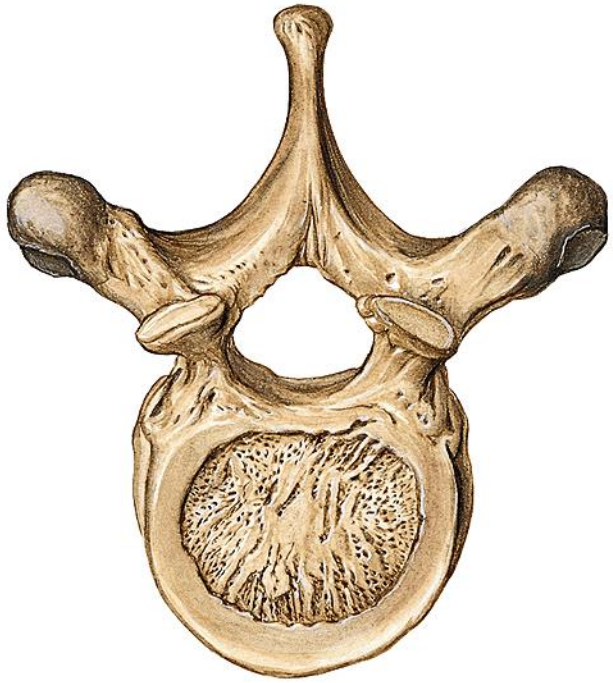
c

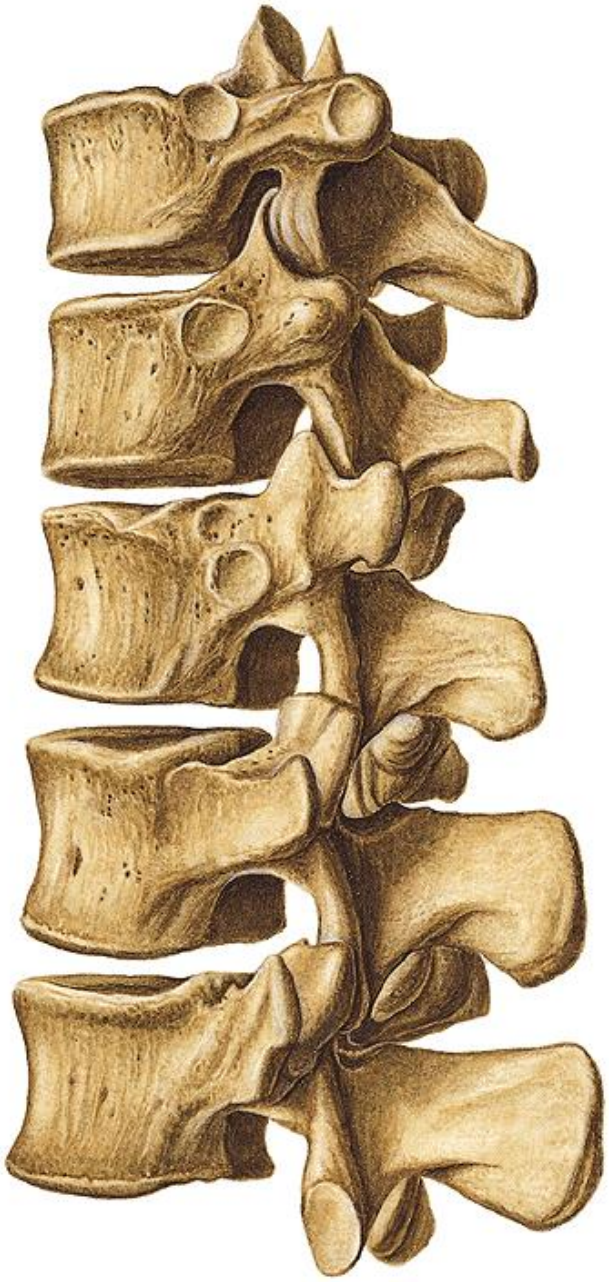
Fracture of dens axis

Berchtold/Bruch/Trentz: Chirurgie, 5.A. © Elsevier GmbH. www.studentconsult.de

Vertebrae thoracicae

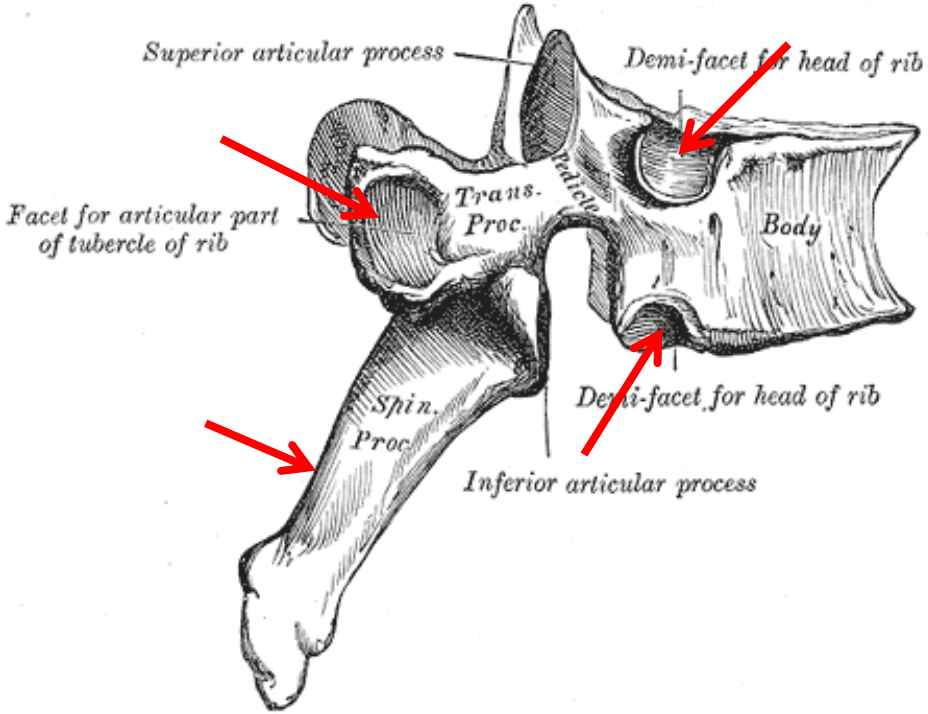
Thoracic vertebra [T I – T XII]
Fovea costalis superior
Fovea costalis inferior
Fovea costalis processus transversi





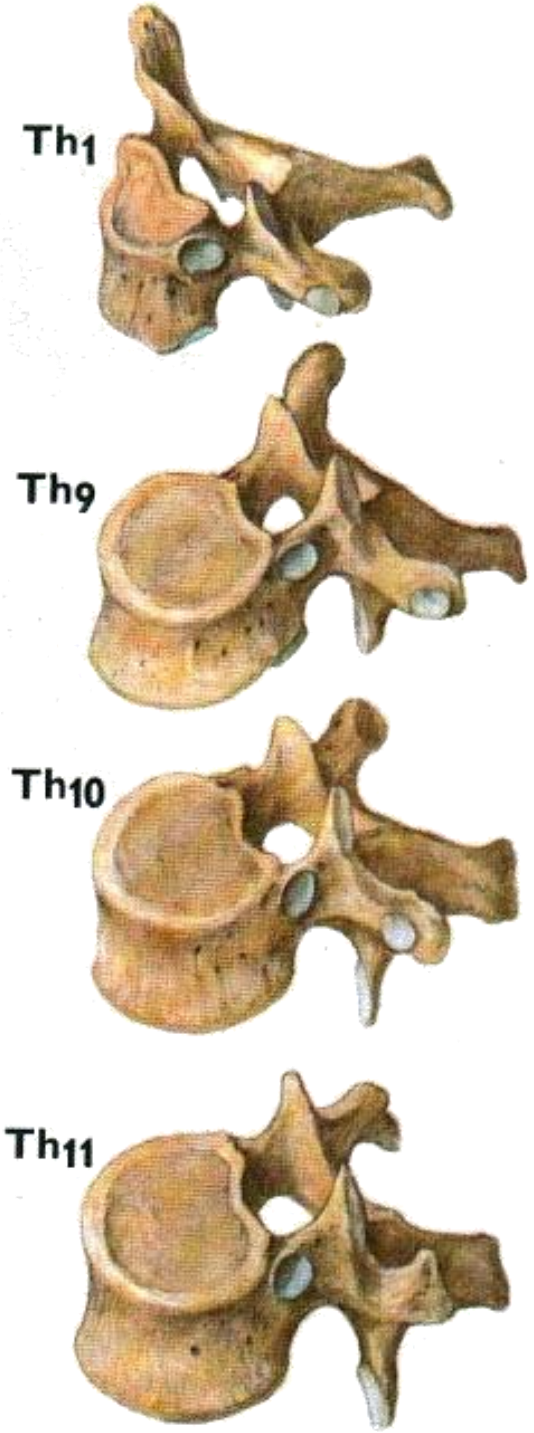
Thoracic vertebra

- TI – TXII
- articular facets for ribs
- „diagonal“ spinous process

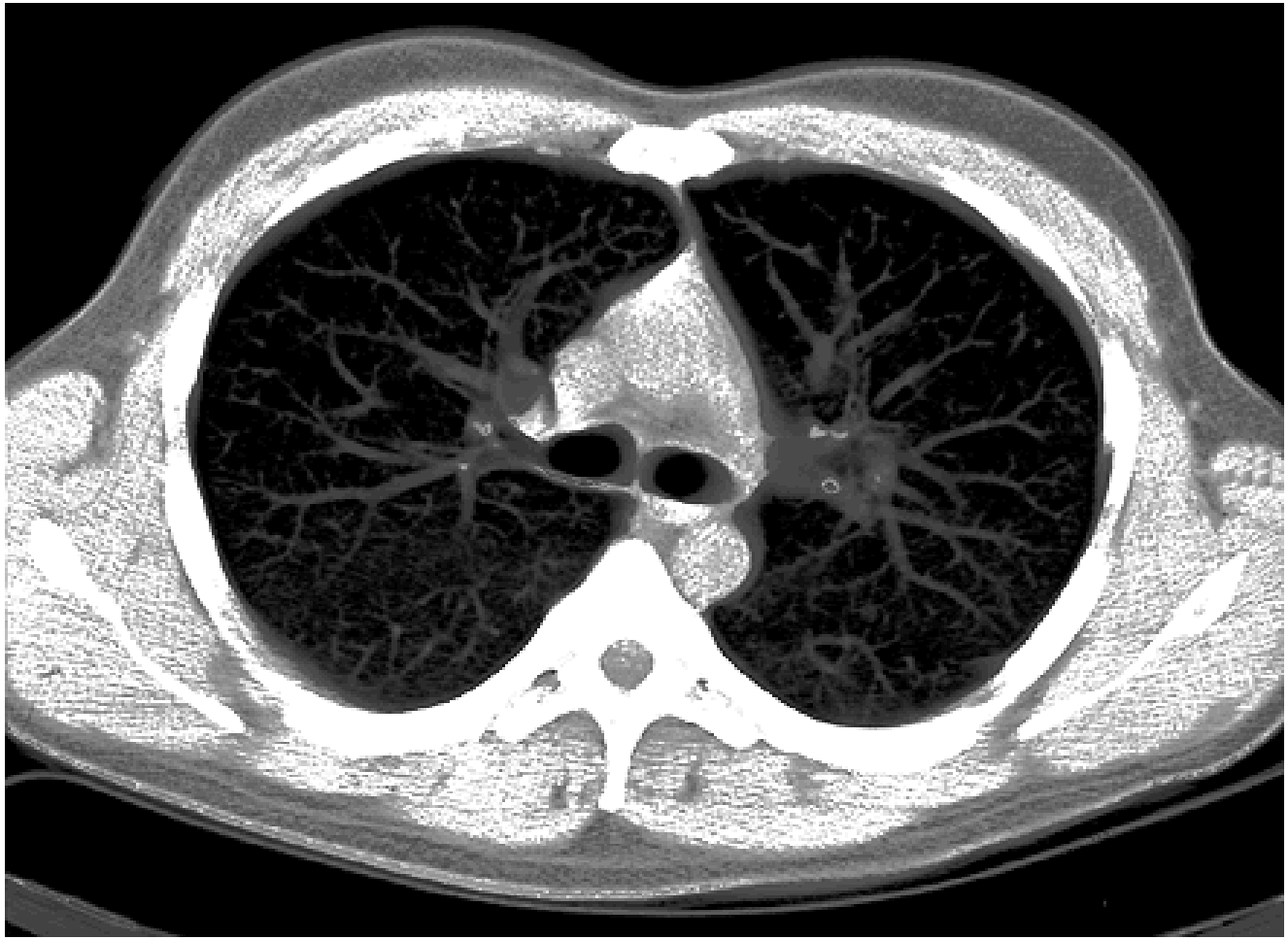


Thoracic vertebra

T12



CT of thoracic vertebra



X-ray of thoracic vertebrae

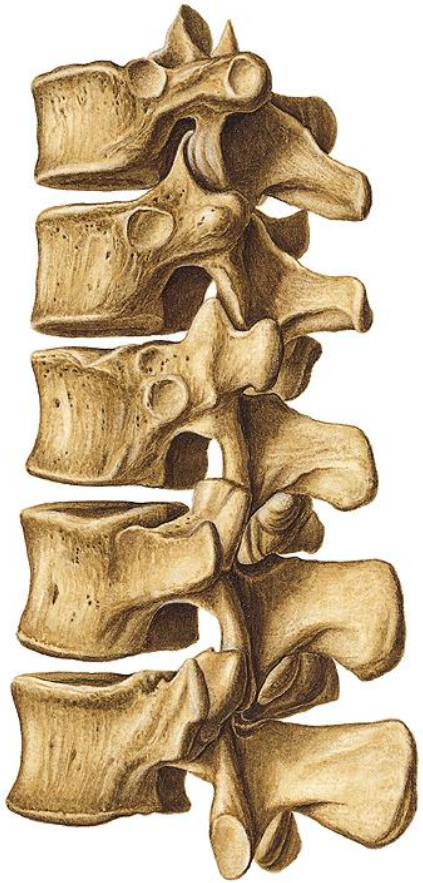
Abb. 32. Brustwirbelsäule a.p.

Abb. 33. Brustwirbelsäule, seitlich

Fused thoracic vertebrae

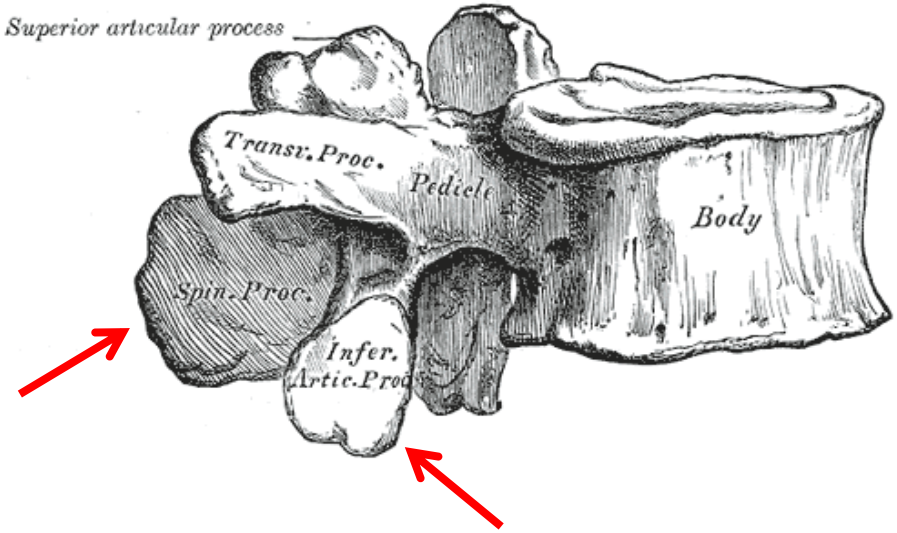
Vertebrae lumbales

Lumbal vertebra [L I - L V]
Processus accessorius (caudally)
Processus costalis (formerly costarius)
Processus mammillaris (cranially)

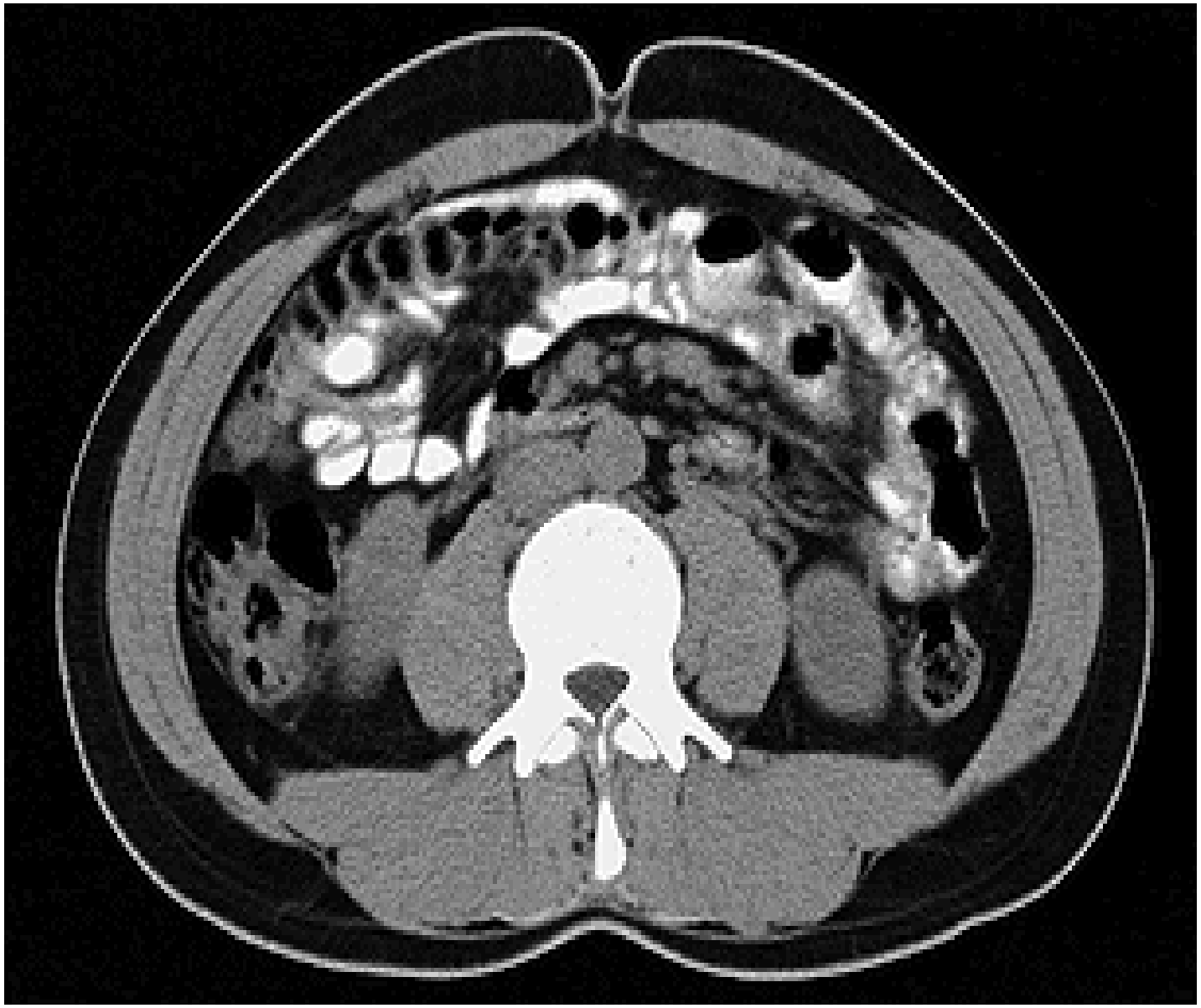


Lumbar vertebra

- LI – LV
- flat, wide, quadrangular spinous process
- rather sagitally oriented articulation facets
- triangular vertebral foramen
- big high round body



CT of lumbar vertebra



X-ray of lumbar vertebra

Abb. 34. Lendenwirbelsäule a.p.

säule seitlich

Developmental defects of lumbar vertebrae

http://esbirky.netadmin.cz/cz/instituce/narodni-muzeum/prirodovedecke-muzeum/antropologicka-sbirka/sbirka-minulych-populaci/dva-bederni-obratle-3/

Spondylolysis

= non-closed posterior arch
- 4th and 5th lumbar vertebra

http://esbirky.netadmin.cz/cz/instituce/narodni-muzeum/prirodovedecke-muzeum/antropologicka-sbirka/sbirka-minulych-populaci/bederni-obratle-l4-l5/

Patological states in lumbar vertebrae

Spondylarthritis of lumbar vertebra L1-L4

http://esbirky.netadmin.cz/cz/instituce/narodni-muzeum/prirodovedecke-muzeum/antropologicka-sbirka/sbirka-minulych-populaci/bederni-obratle-l1-4/

Fusion of two thoracic vertebrae

Patological states in lumbar spine

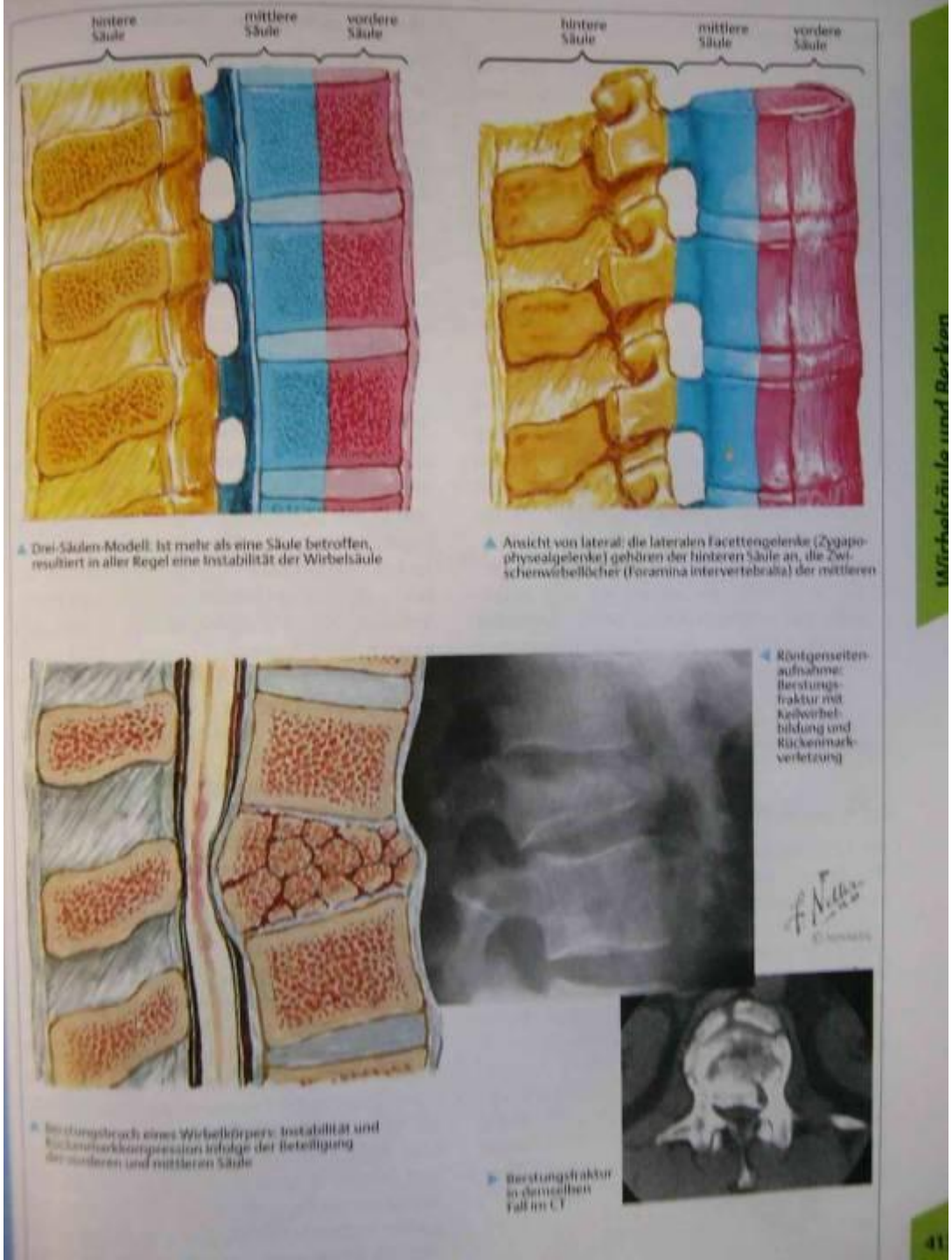
Clinical notes

- most frequent fracture of vertebrae in transition of T and L (T12–L2)
- fracture classification – 3 columns following Denis
- compressive fractures (osteoporosis, metastasis of tumors), splinter fractures, (Chance‘s fracture)
- surgical treatment only in case of non-stabile fractures (posterior approach)
- damage to nervous structures !
  - (Brown-Séquard‘s syndrome)
- later consequences

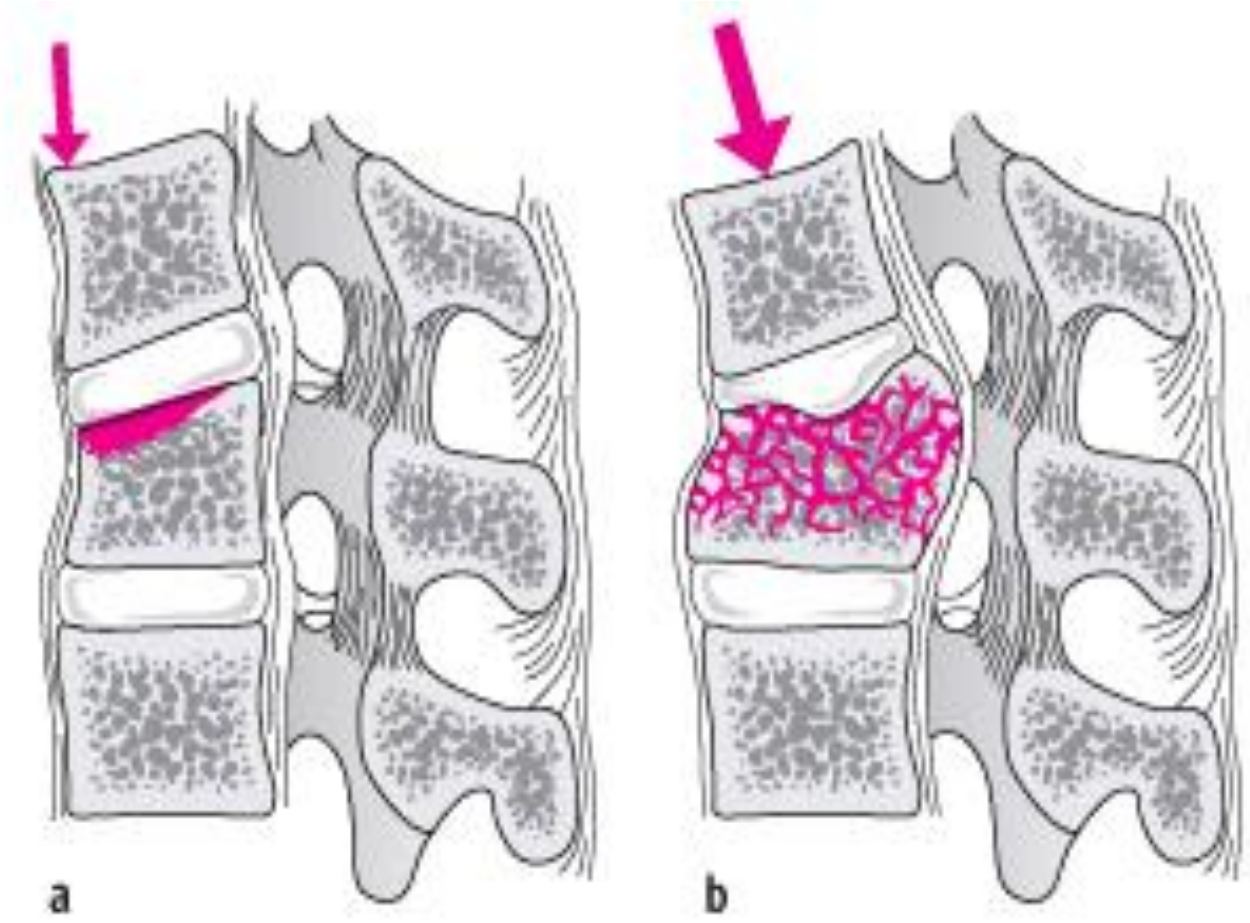
- fracture classification

3 columns following Denis

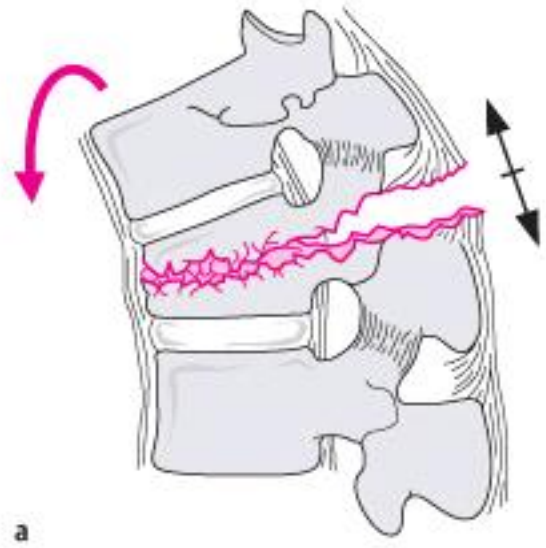
- compressive fracture



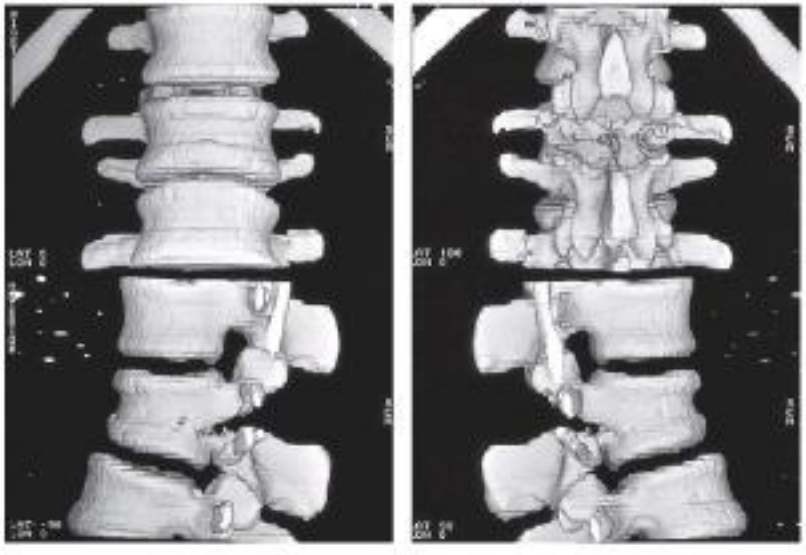
Stabile and non-stabile fracture



Chance‘s fracture

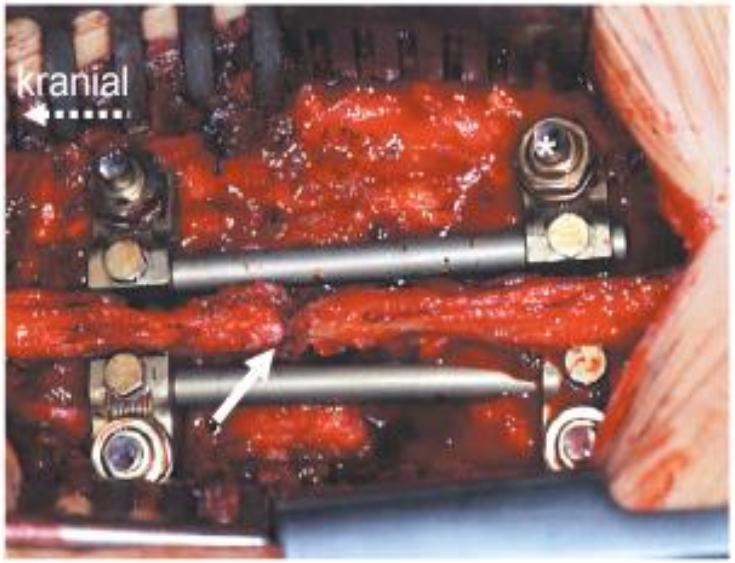


a



b

Fracture treatment



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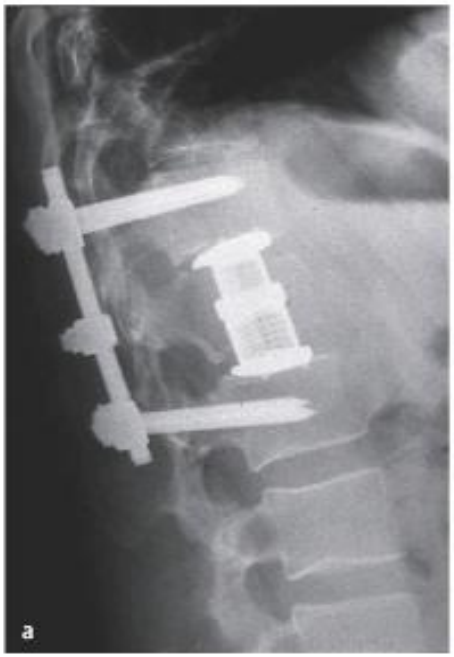

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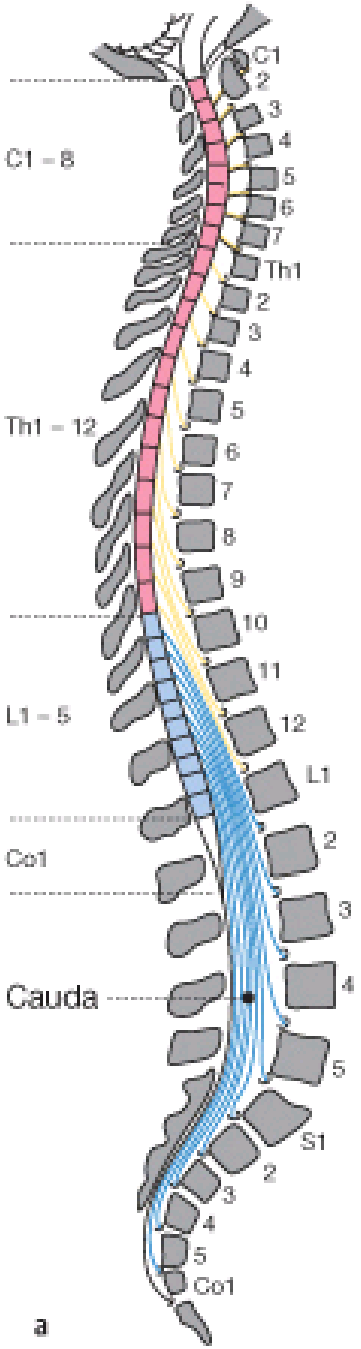
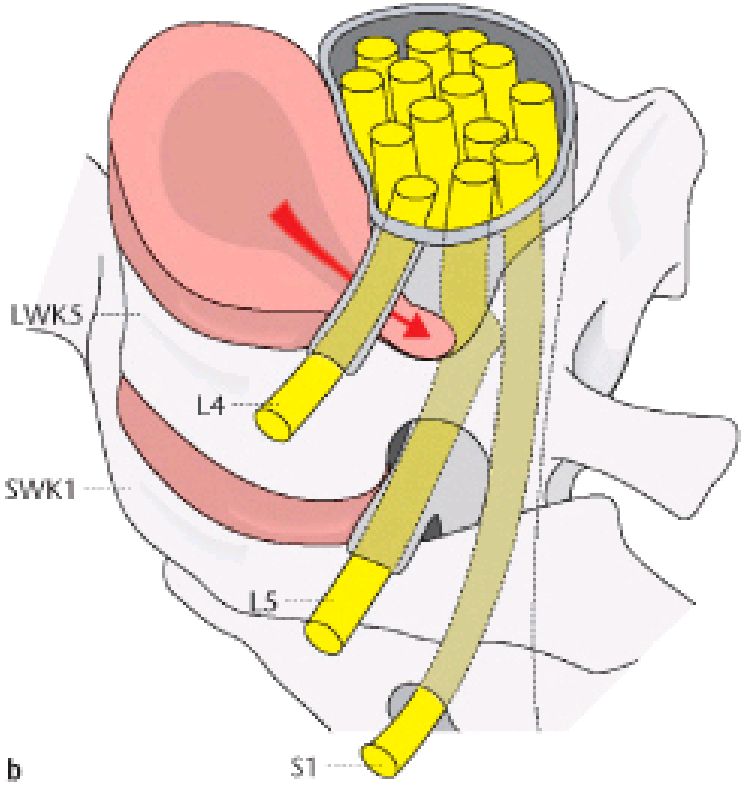
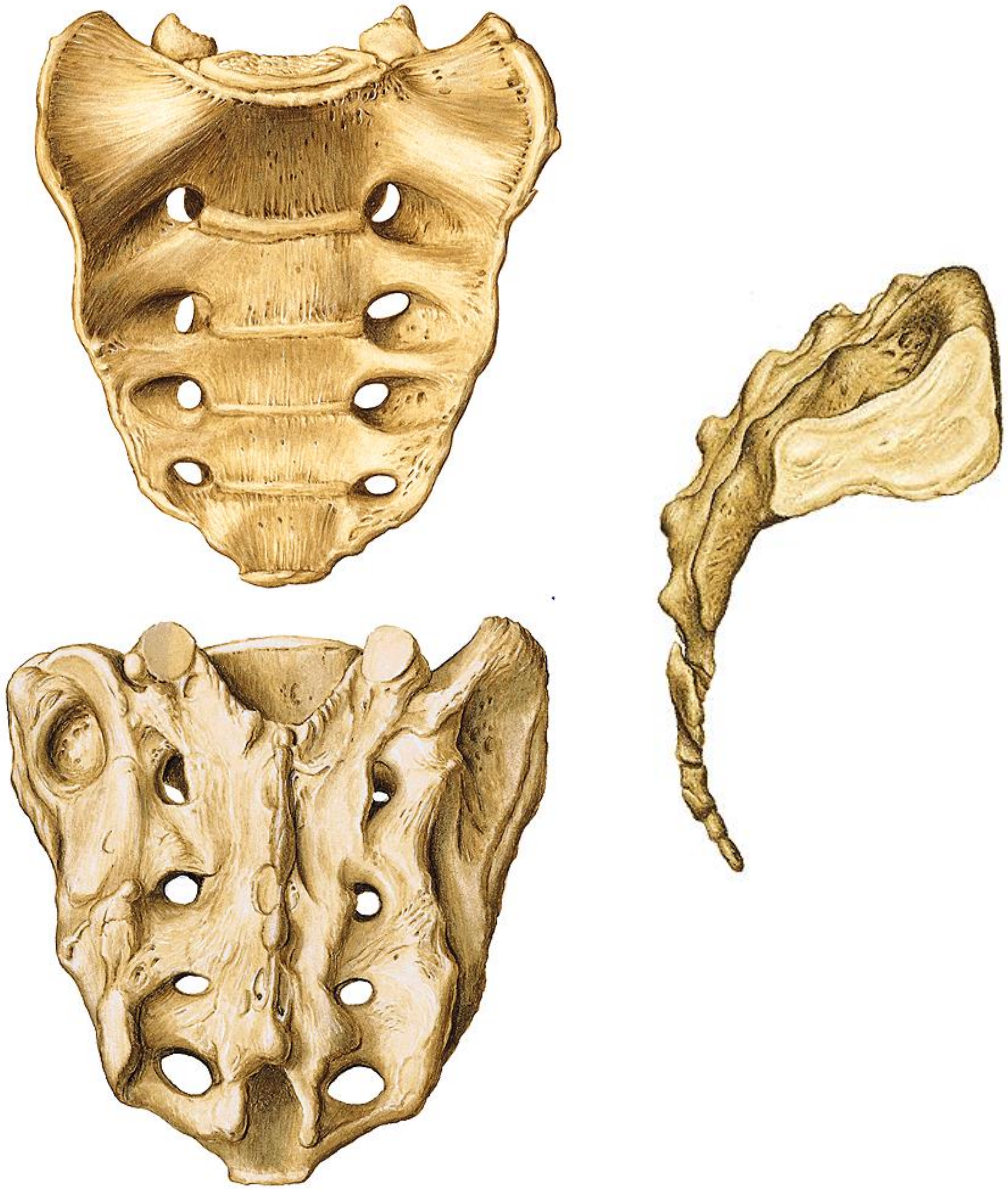
Disc protrusion





Os sacrum

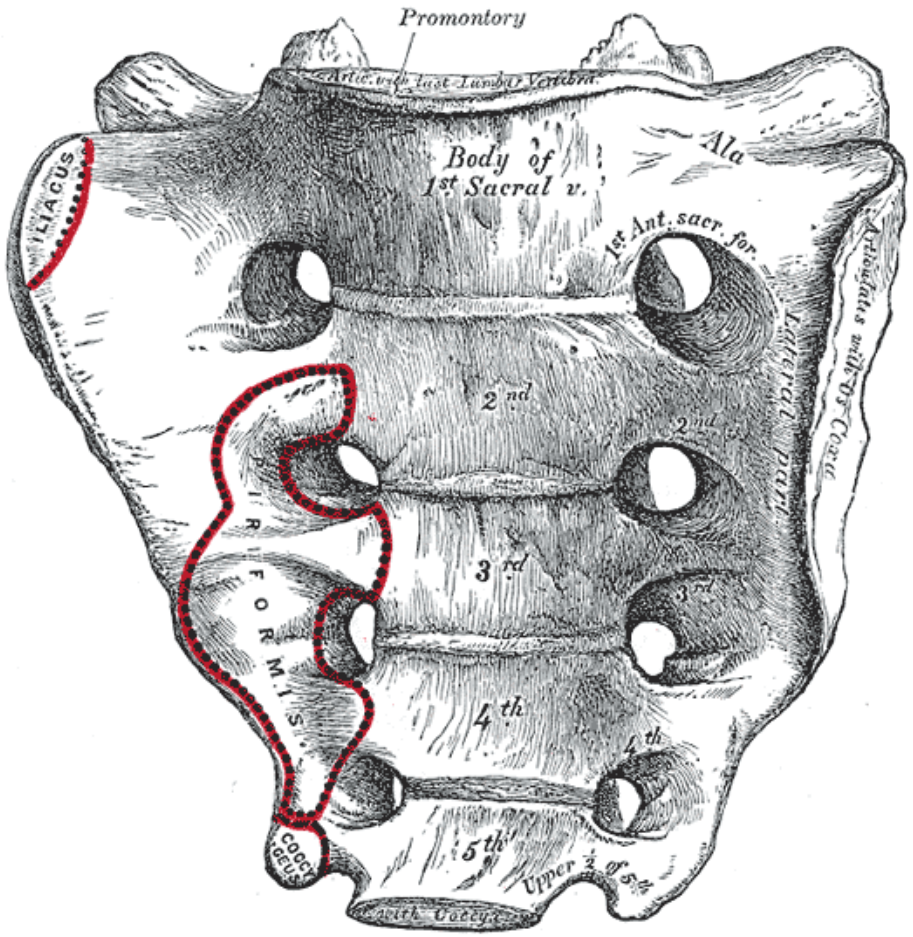
vertebrae sacrales SI - SV



Sacral bone
Basis ossis sacri
Promontorium
Ala ossis sacri
Processus articularis superior
Pars lateralis
Facies auricularis
Tuberositas ossis sacri
Facies pelvica
Lineae transversae
Foramina intervertebralia
Foramina sacralia anteriora
Facies dorsalis
Crista sacralis mediana
Foramina sacralia posteriora
Crista sacralis medialis
Crista sacralis lateralis
Cornu sacrale
Canalis sacralis
Hiatus sacralis
Apex ossis sacri

Os sacrum

- 5 fused sacral vertebrae
- developmental origin of its parts



- sacralization of lumbar vertebrae
- lumbalization of sacral vertebrae

Coccyx (Os coccygis)

- cornua coccygea
- 3-5 fused vertebrae (Co)
- rudimentary part of vertebral column
- 1 pair of spinal nerves

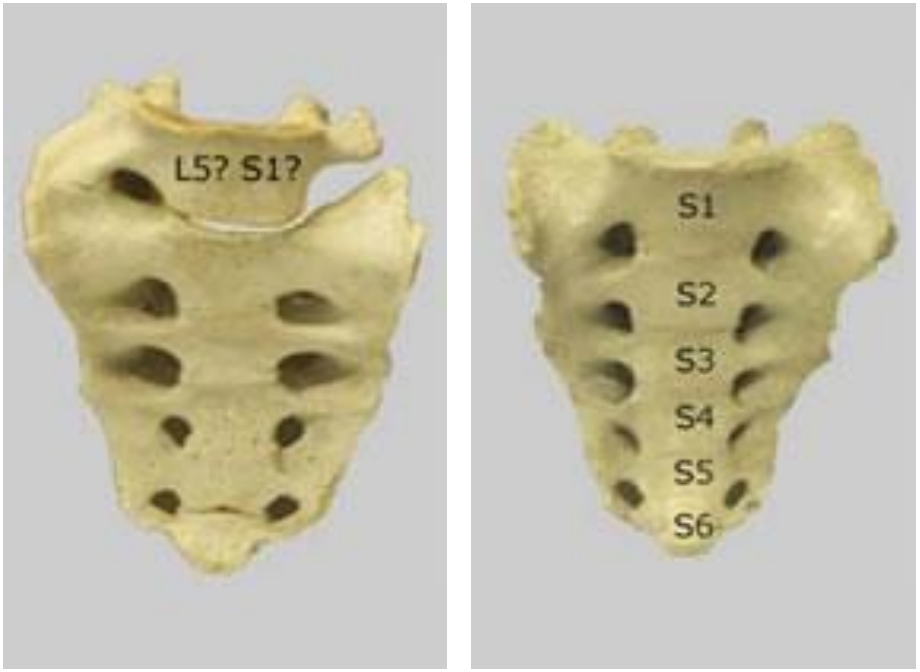
- *examination per rectum*

Developmental defects of sacral bone and coccyx

synostosis sacrococcygea

Developmental defects of sacral bone and coccyx

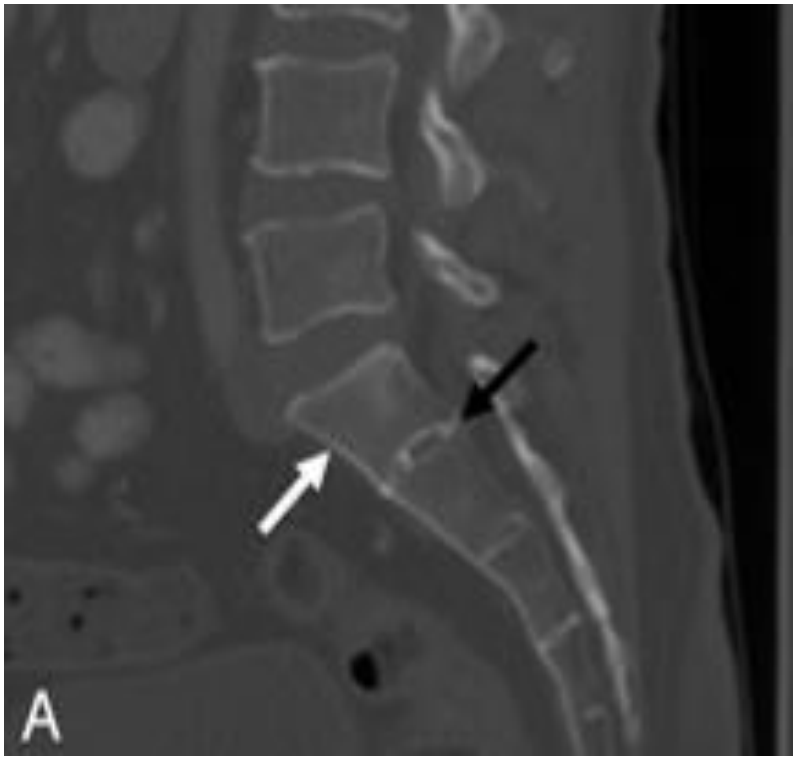
lumbalization / sacralization



http://sympol3.charite.de/docent/cds/ANA_wirbelbauplan/eee/wirbel.htm

canalis sacralis apertus opened vertebral canal

Sacralization of L5



Sacralization of L5 – white arrow
Disappeared intervertebral disc – black arrow

http://esbirky.netadmin.cz/cz/materialu/antropologicky-material/kost-krizova-4/

http://www.ajnr.org/content/31/10/1778/F8.expansion.html

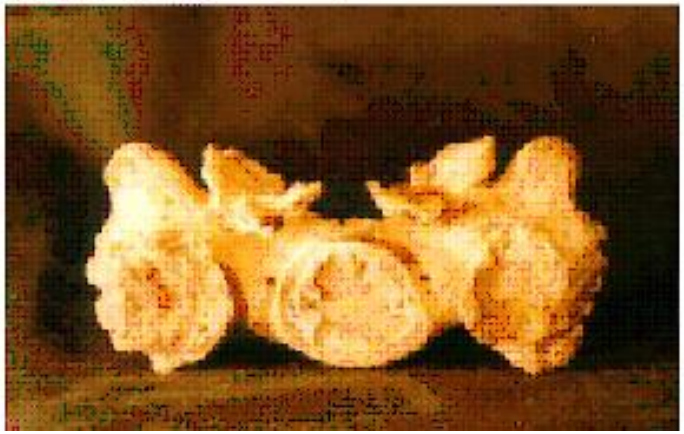
Lumbalization of S1

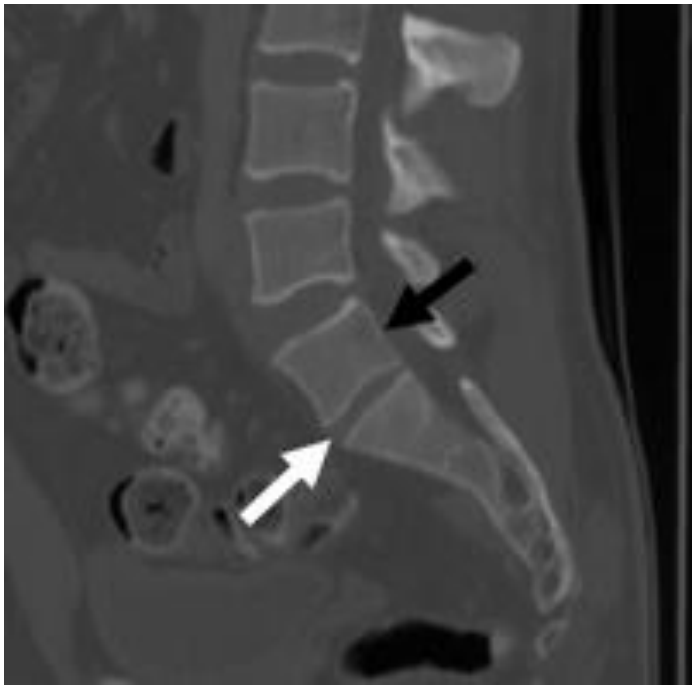
Complete lumbalization of S1

+

Spina bifida lateralis (spondylolysis) S_1

Numerous osteophytes as a mark of originating spondylolysis



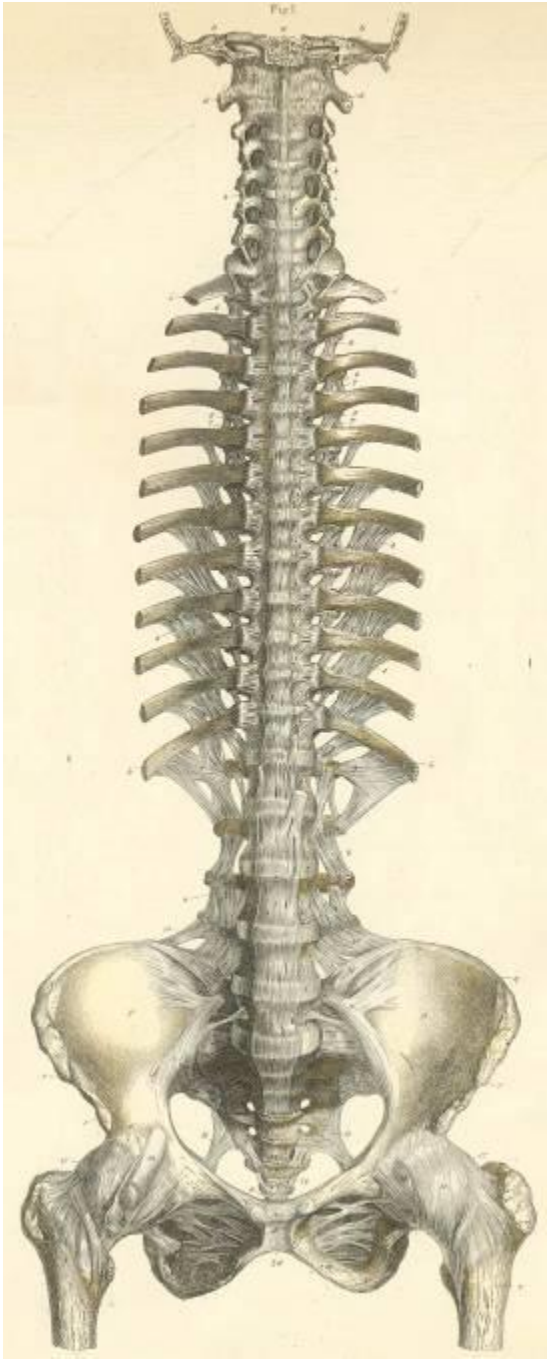


Lumbalizstion of S1 – black arrow
Well developed intervertebral disc – white arrow

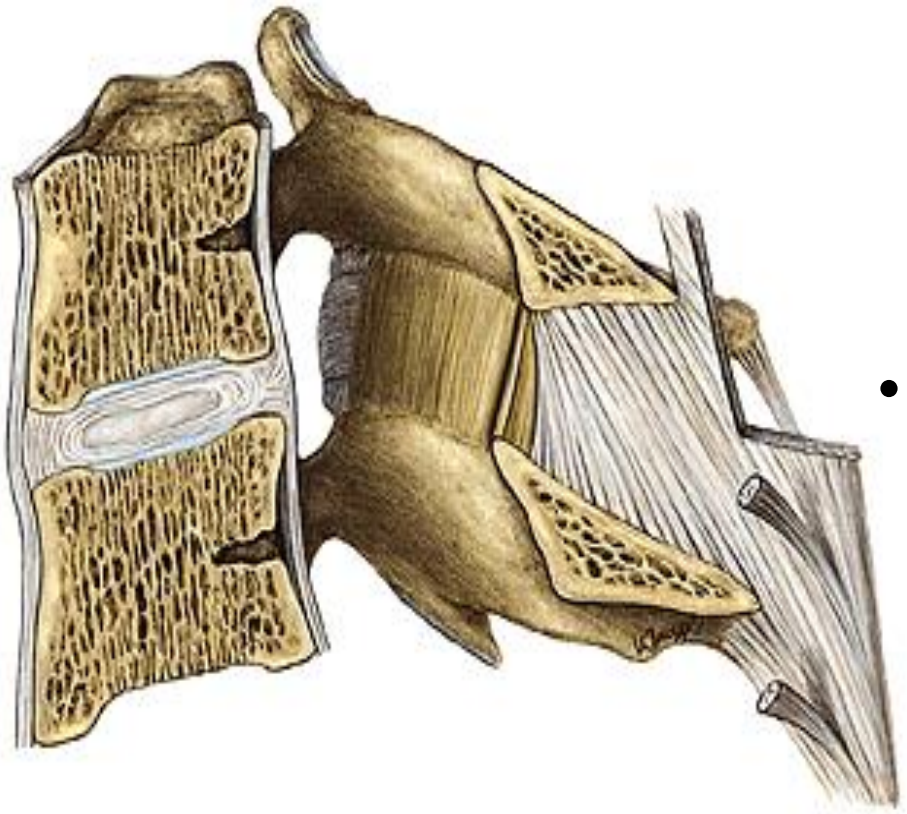
http://www.docstoc.com/docs/57155513/Variety_-anom%E9%86%A0ie-a-patologie-kos#

http://www.ajnr.org/content/31/10/1778.full

Vertebral joints



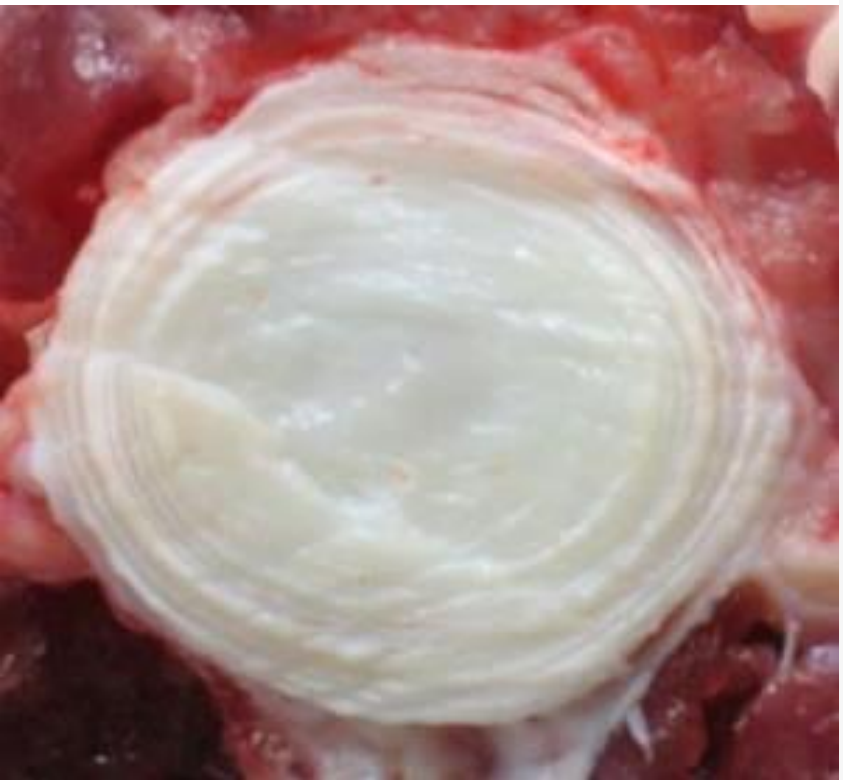
Vertebral joints

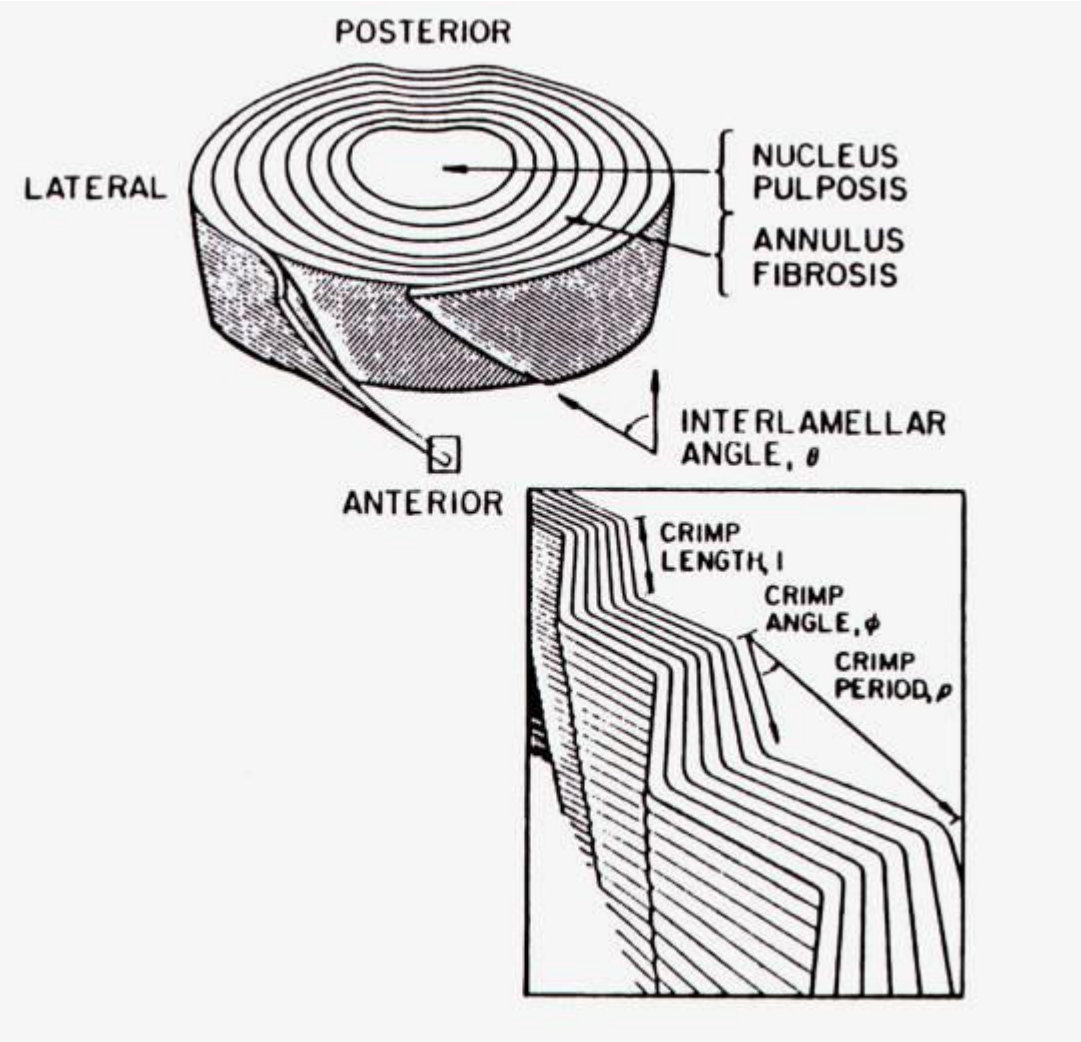


- **Synarthroses**
  - syndesmoses = ligaments
    - long
    - short
  - symphyses (disci intervertebrales)
    - symphysis intervetebralis
    - symphysis sacrocyoccygea
- **Diarthroses** = joints
  - artt. atlantoaxiales
  - artt. zygapophysiales
  - art. lumbosacralis

Symphyses intervertebrales

- discus intervertebralis = intervertebral disc
- anulus fibrosus
- nucleus pulposus



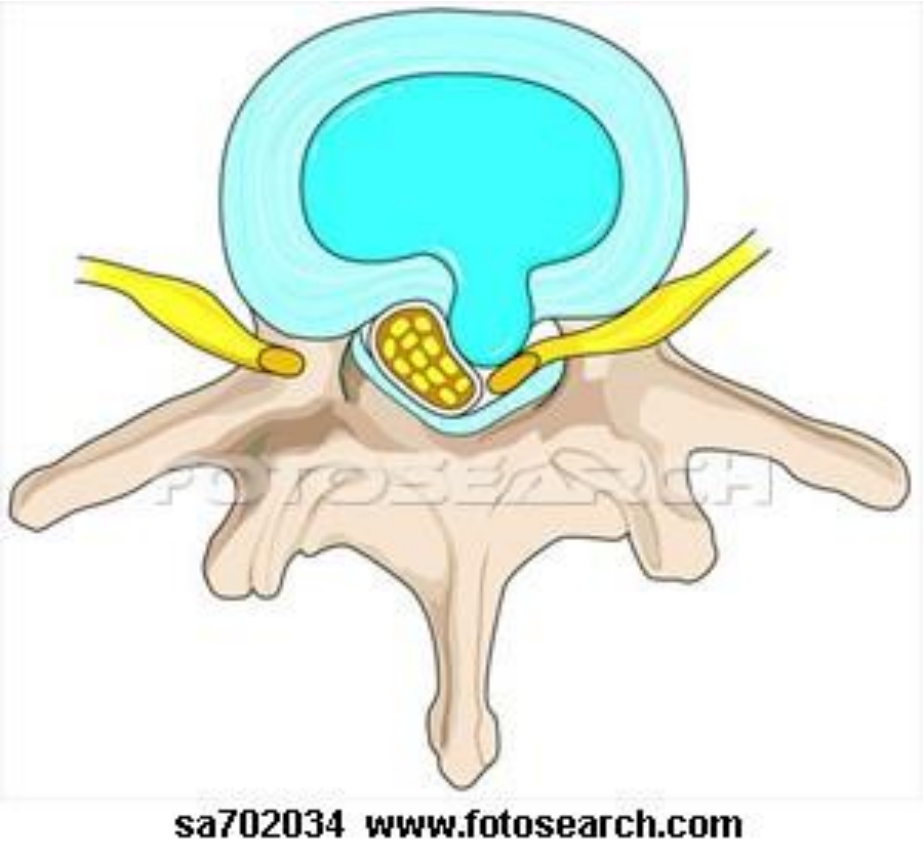


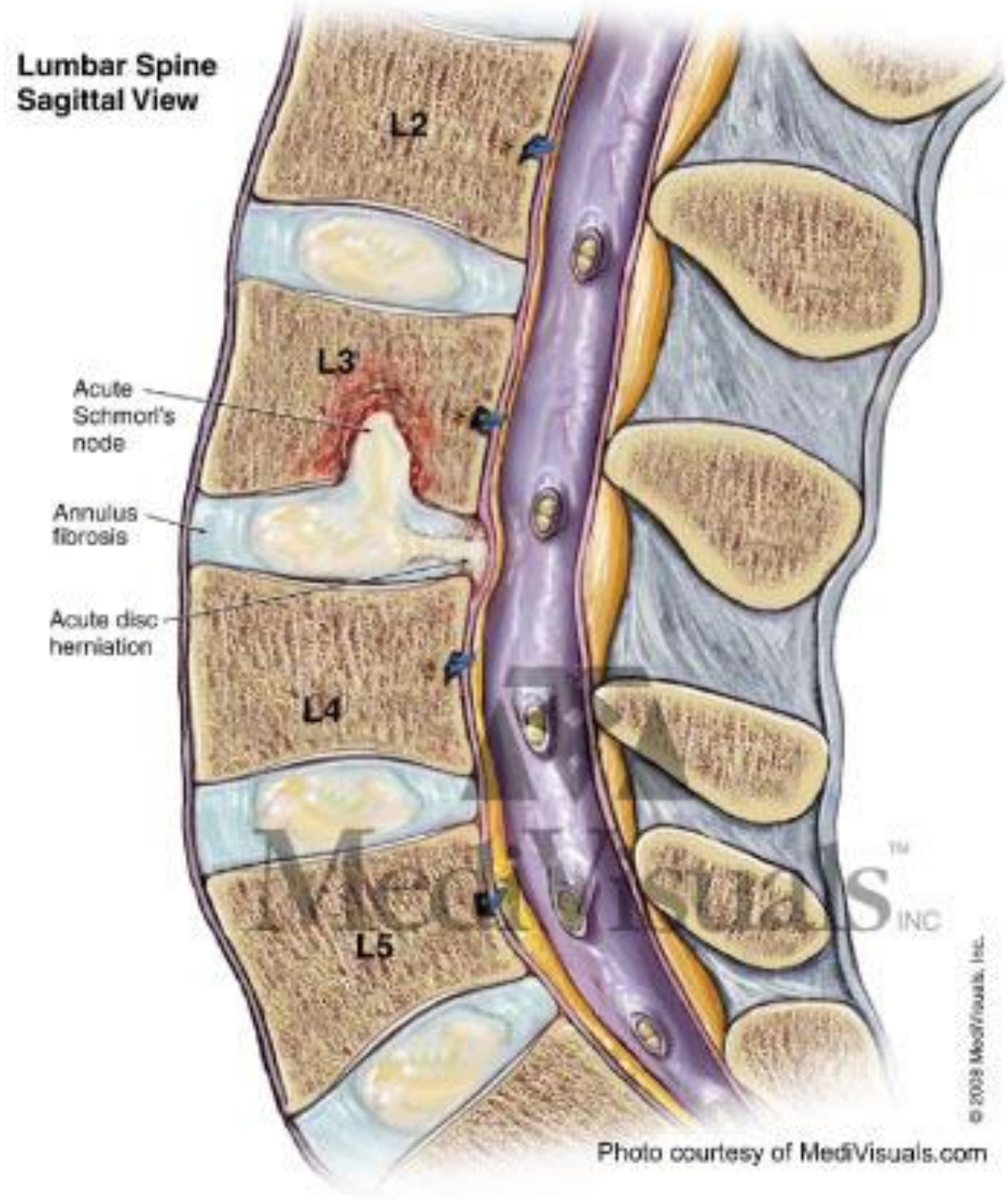
Symphyses intervertebrales
Intervertebral joints

- interconnect movable part of vertebral column
- 23 discs
- first between C2 and C3, pre-last between L5 and S1, last between S5 and Co1
- craniocaudally increase in size
- **anulus fibrosus** – external part of discus formed by elastic cartilage, on the surface hyaline cartilage
- **nucleus pulposus** – fluidy nucleus of round shape approximately in the middle
  - due to impossibility of fluid compression, vertebrae move around this nucleus
- note:
  - in the later age body has less fluid → decrease of the discus size → column decreases size and bends
  - disci decrease in size proportionally to load → in the morning we are taller then in the evening

Prolapsus of disc

- Schmorl‘s node (morbus Scheuermann)
- inside vertebral canal (compression of spinal cord)




Lumbar Spine
Sagittal View
L2
L3
Acute
Schmorl's
node
Annulus
fibrosis
Acute disc
herniation
L4
L5
MediVisuals INC
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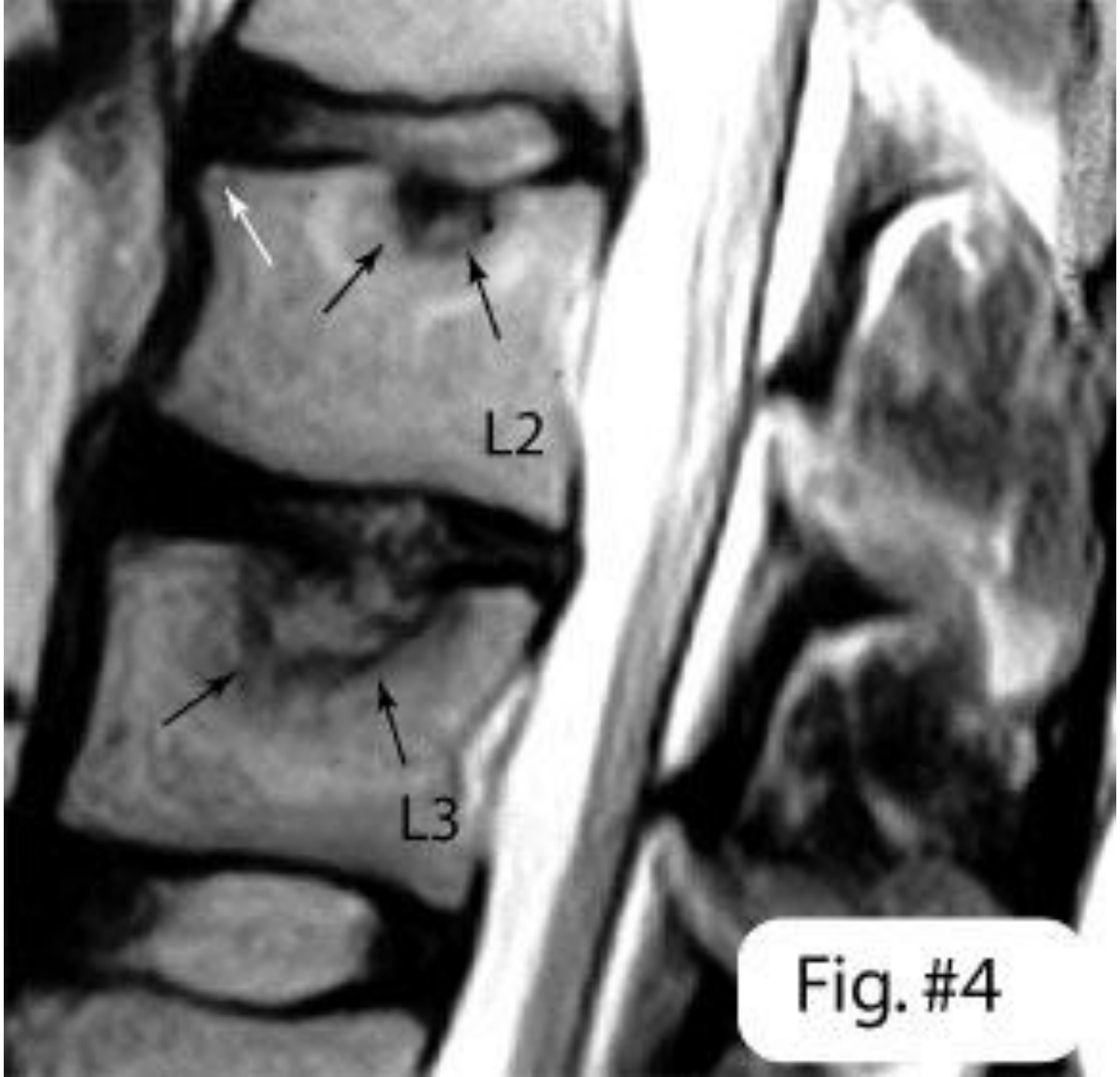
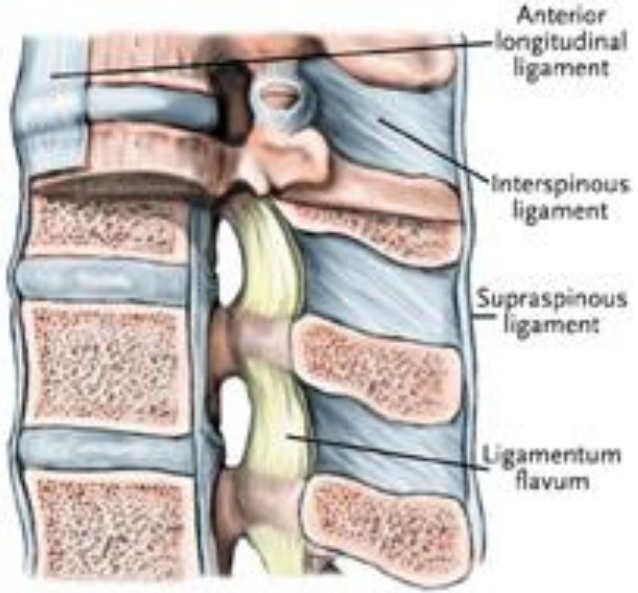
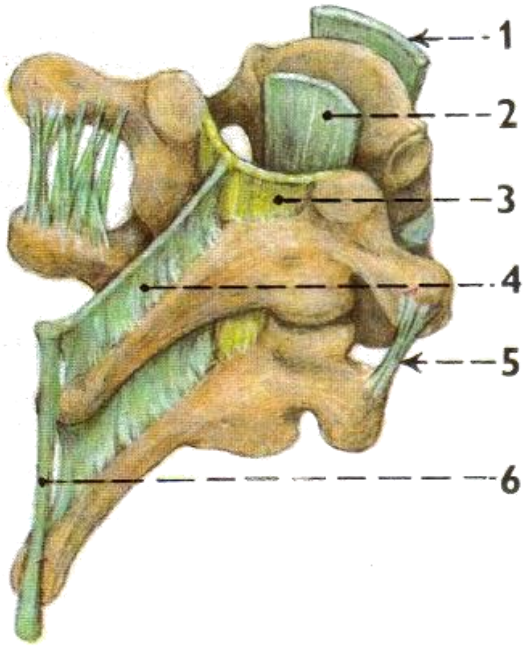


Fig. #4

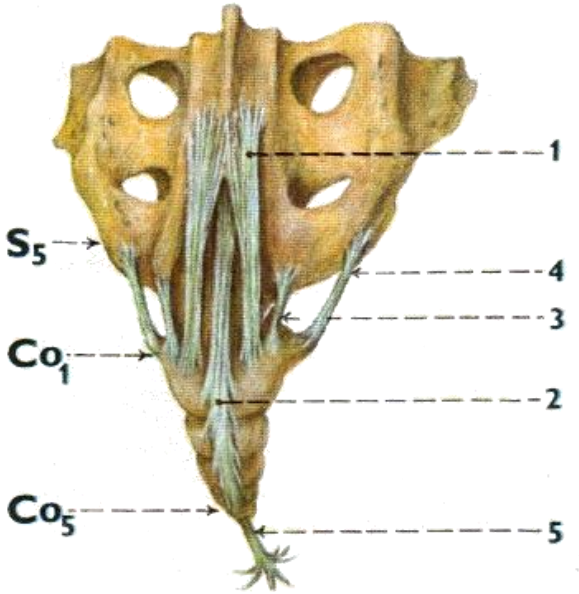
Long ligaments of vertebral column

- lig. longitudinale anterius
- lig. longitudinale posterius
- lig. sacrococcygeum posterius superficiale





135. LIGAMENTA PÁTEŘE v úseku hrudní páteře – pohled zprava zezadu
1/ ligamentum longitudinale anterius
2/ ligamentum longitudinale posterius
3/ ligamenta interarcualia
4/ ligamenta interspinalia
5/ ligamenta intertransversaria
6/ ligamenta supraspinalia



136. LIGAMENTA KŘÍŽOVÉ KOSTI A KOSTRČE – pohled zezadu
1/ ligamentum sacrococcygeum dorsale superficiale (uprostřed vyříznuté, aby bylo vidět do hiatus sacralis)
2/ ligamentum sacrococcygeum dorsale profundum
3/ vazivové přemostění mezi cornu sacrale a cornu coccygeum
4/ ligamentum sacrococcygeum laterale
5/ retinaculum caudale cutis

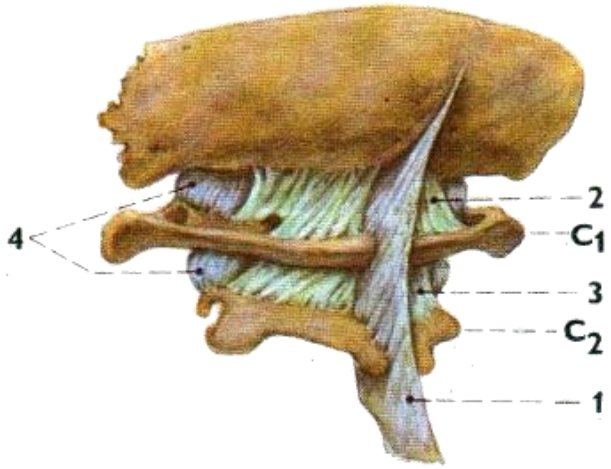
Morbus Bechterevi

- ankylotic spondylitis, morbus of Bechterew
- hereditary inflammatory chronic disease of vertebrae
- 1% of population, males 2-3x more often
- onset often between 18th and 30th year of age
- antigen HLA-B27 (7% of inhabitants of Czech Republic)
- in ill people in 90% cases
- in people with antigen HLA-B27 is the disease probability 300x higher
- chronic pain and **stiffness** in caudal part of column
- syndesmophytes → ankylosis of column („bambus column“)
- *treatment: regular exercise*

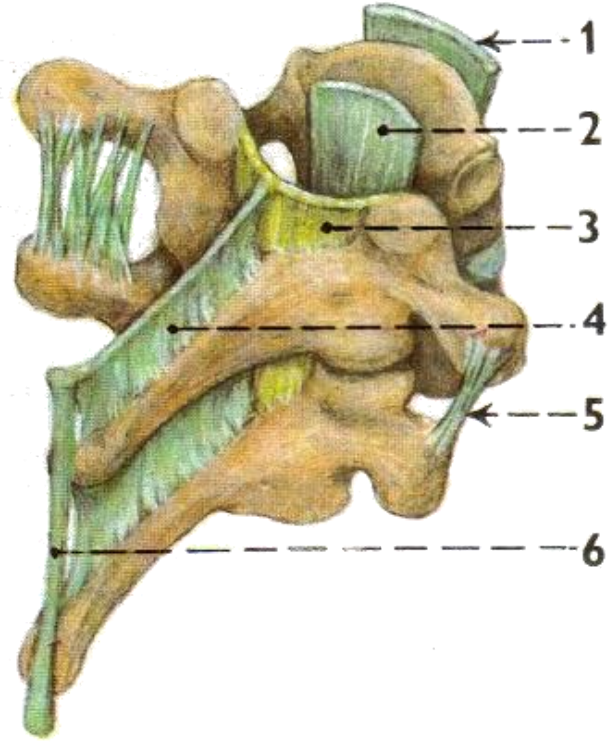
Morbus Bechterevi

Short ligaments of column

- ligamenta flava – *elastic*, between arches
- ligg. intertransversaria
- ligg. interspinalia



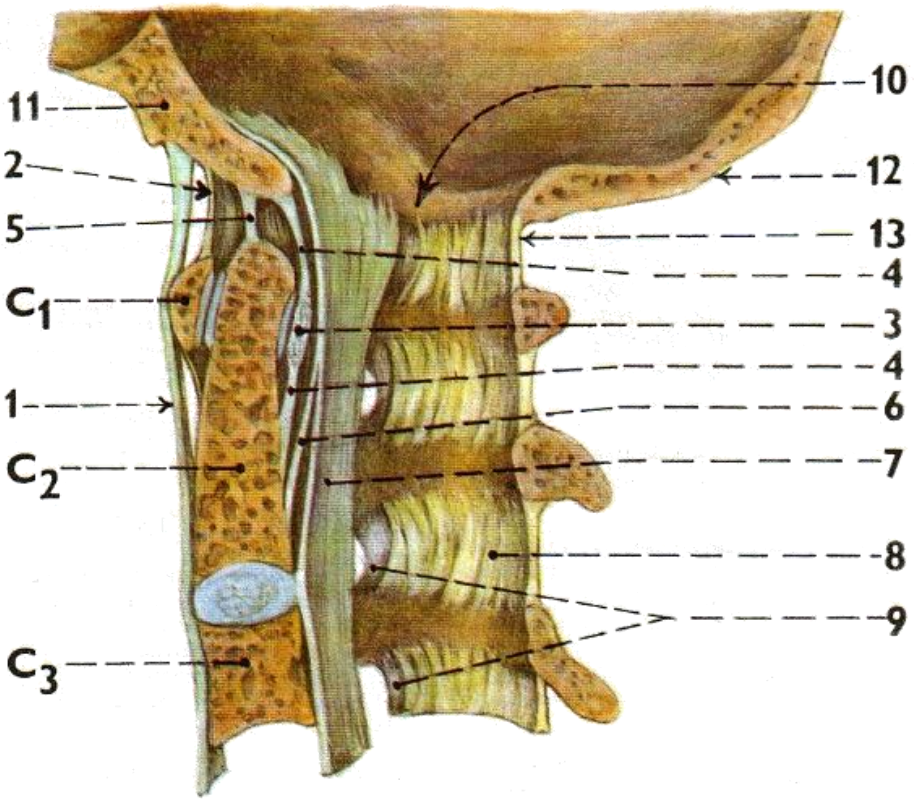
137. SPOJENÍ NA PÁTEŘI od týlní kosti po obratel C_2 (dorsální strana) – pohled zleva zezadu
1/ ligamenta supraspinalia a lig. nuchae
2/ membrana atlantooccipitalis posterior
3/ ligamenta interarcualia mezi zadním obloukem atlasu a obloukem axis
4/ kloubní pouzdra atlantookcipitálního a postranního atlantoaxiálního kloubu



135. LIGAMENTA PÁTEŘE v úseku hrudní páteře – pohled zprava zezadu
1/ ligamentum longitudinale anterius
2/ ligamentum longitudinale posterius
3/ ligamenta interarcualia
4/ ligamenta interspinalia
5/ ligamenta intertransversaria
6/ ligamenta supraspinalia

Articulatio atlantooccipitalis

- elipsoid joint
- condyli occipitales
- facies articularis superior atlantis
- membrana atlantooccipitalis ant. + post.
- lig. atlantooccipitale lat.

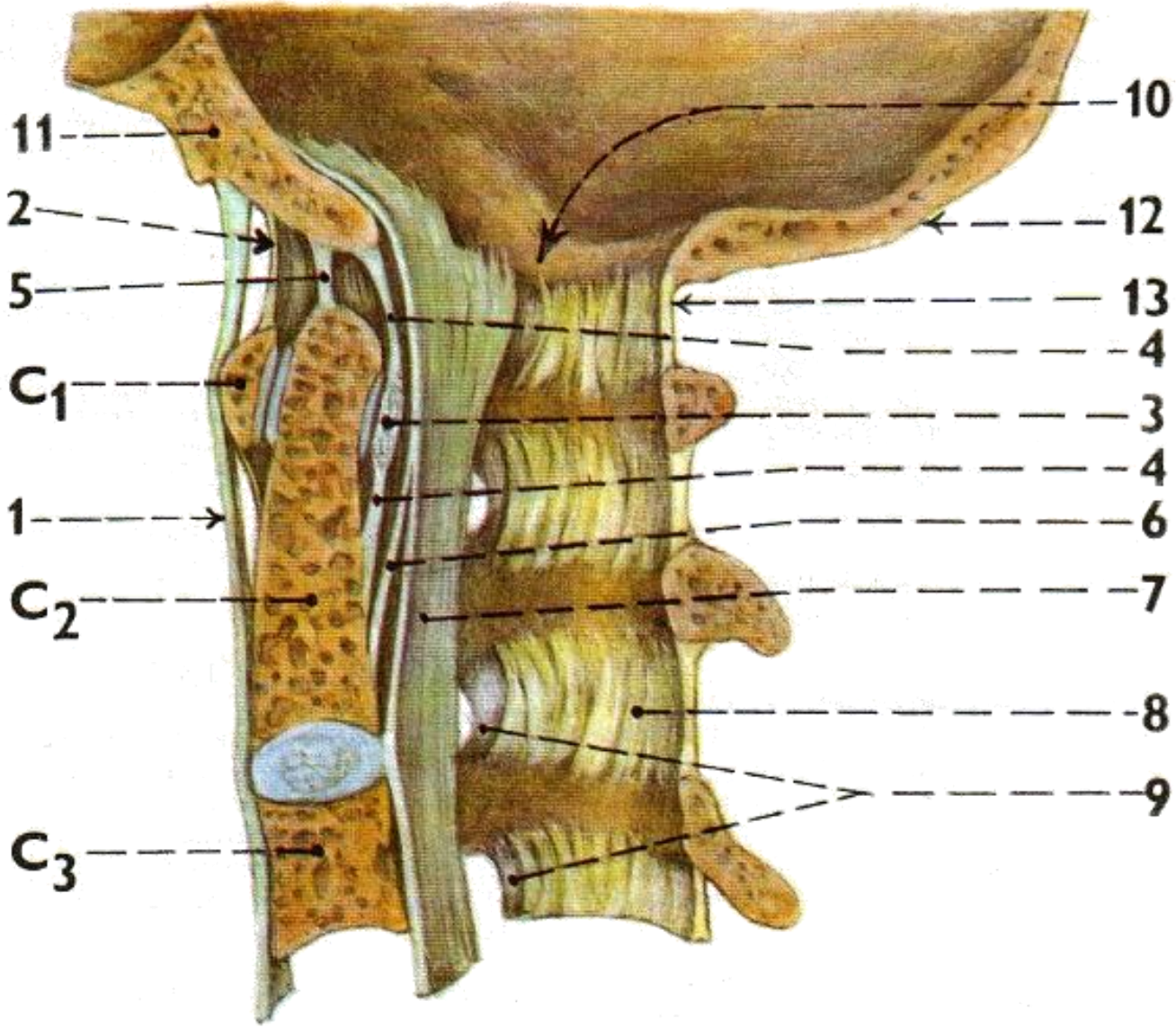


140. PODÉLNÝ ŘEZ KRANIOVERTEBRÁLNÍM SPOJENÍM (až po obratel C_3) – pohled zleva; (mírně zvětšeno)

1/ ligamentum longitudinale anterius
2/ membrana atlantooccipitalis anterior
3/ ligamentum transversum atlantis
4/ podélné snopce ligamentum cruciforme
5/ ligamentum apicis dentis
6/ membrana tectoria
7/ ligamentum longitudinale posterius
8/ ligamenta interarcualia
9/ pouzdra meziobratlových kloubů
10/ okraj foramen magnum
11/ tělo kosti týlní
12/ šupina kosti týlní
13/ membrana atlantooccipitalis posterior

Articulatio atlantooccipitalis (atlantooccipital joint)

Joint type	Simple, biaxial, elipsoid, mobile
Head	Condyli occipitales
Cavity	Facies articulares superiores (massae lateralis) atlantis
Articular capsule and its ligaments	Membrana atlantooccipitalis an. et post., lig. atlantooccipitale lat.
Movements	Anteflexion+retroflexion (pendular movements – head and neck as a whole up to 90°), lateroflexion (small interval)
Middle position	= basic position



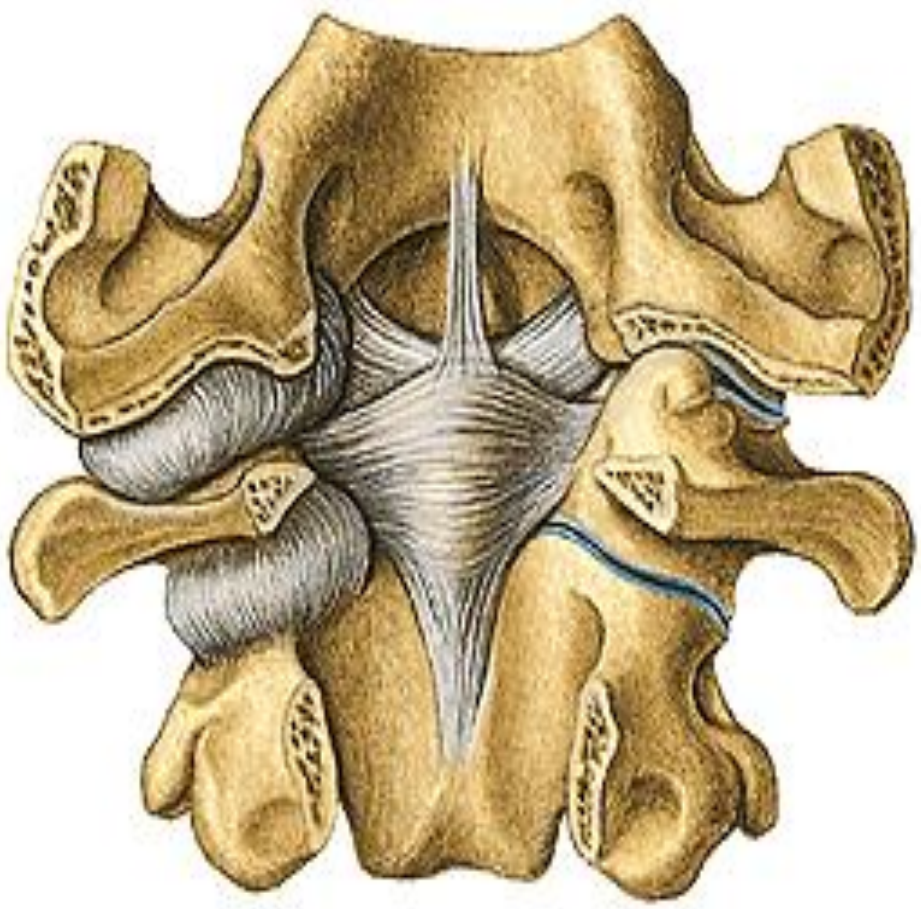
140. PODÉLNÝ ŘEZ KRANIOVERTEBRÁLNÍM SPOJENÍM (až po obratel C_3) – pohled zleva; (mírně zvětšeno)

1/ ligamentum longitudinale anterius
2/ membrana atlantooccipitalis anterior
3/ ligamentum transversum atlantis
4/ podélné snopce ligamentum cruciforme
5/ ligamentum apicis dentis
6/ membrana tectoria
7/ ligamentum longitudinale posterius
8/ ligamenta interarcualia
9/ pouzdra meziobratlových kloubů
10/ okraj foramen magnum
11/ tělo kosti týlní
12/ šupina kosti týlní
13/ membrana atlantooccipitalis posterior

Articulatio atlantoaxialis mediana + lateralis

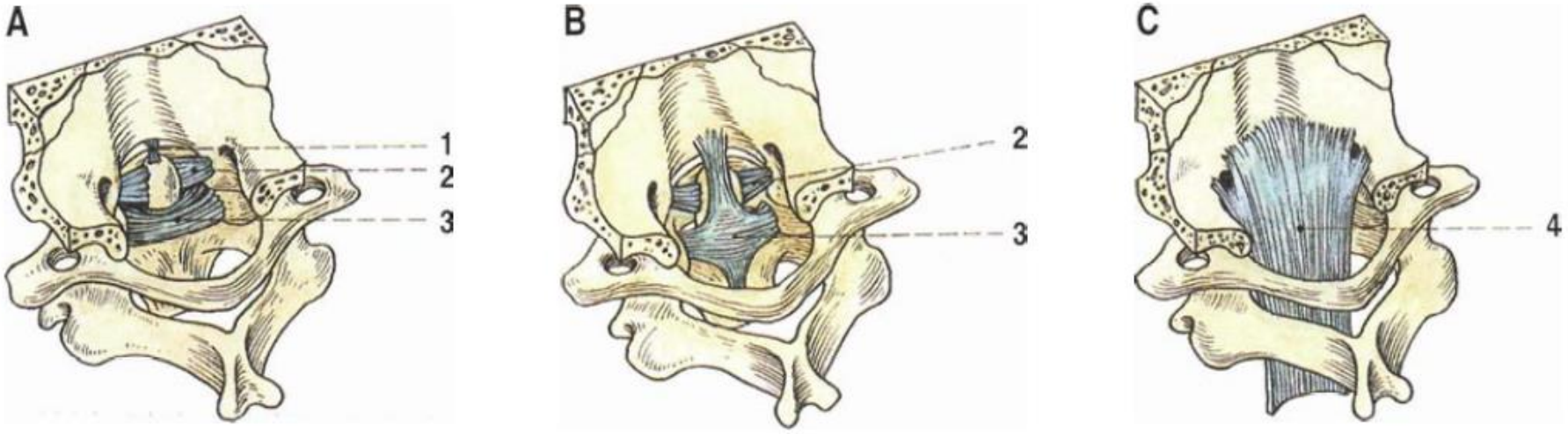
AAAM – pivot joint

- ligg. alaria
- lig. apicis dentis
- lig. cruciforme atlantis
- lig. transversum atlantis
- fasciculi longitudinales
- membrana tectoria

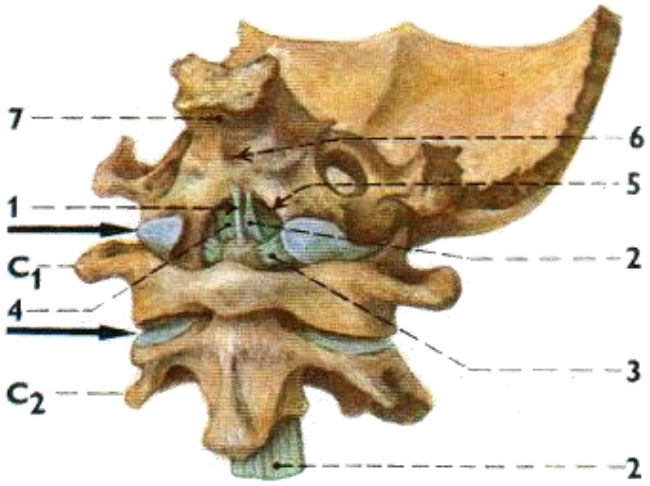


AAAL – plane joint

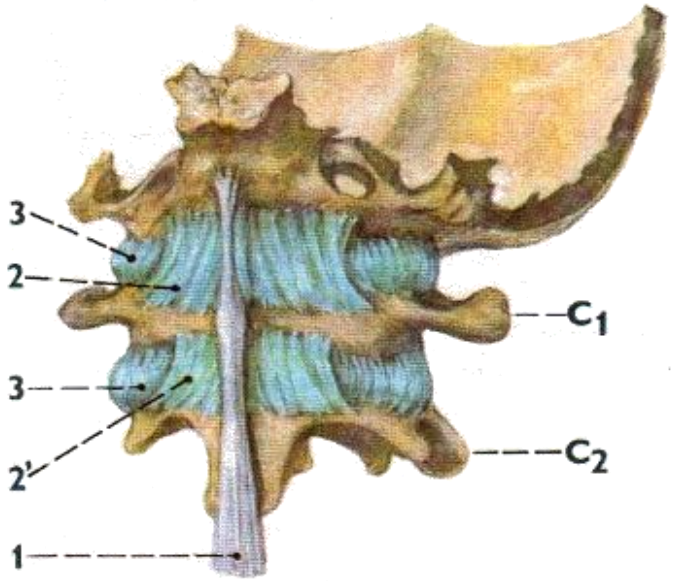
Articulatio atlantoaxialis mediana (Median atlantoaxial joint)	
Joint type	Simple, 1-axial, pivot, mobile
Head	Dens axis
Cavity	Fovea dentis (arcus anterioris) atlantis
Articular capsule and its ligaments	Ligg. alaria, lig. apicis dentis, lig. cruciforme atlantis (fasciculi longitudinales + lig. transversum atlantis), membrana tectoria
Movements	Rotation (up to 30° on both sides)
Middle position	= basic position
Note	*Fractures of dens axis – danger of infraction to medulla oblongata*
Articulatio atlantoaxialis lateralis (Lateral atlantoaxial joint)	
Joint type	Simple, three-axial, flat, movable
(Head)	Facies articularis inferior axis
(Cavity)	Facies articularis inferior atlantis
Articular capsule and its ligaments	Ligg. alaria, lig. apicis dentis, lig. cruciforme atlantis (fasciculi longitudinales + lig. transversum atlantis), membrana tectoria
Notes	Anteflexion+retroflexion (head and neck as a whole up to 90°), lateroflexion (head and neck as a whole up to 30°), rotation (a+a up to 30°; head and neck as a whole 60-70°)



A. ventrální vrstva, B. střední vrstva, ligamentum transversum atlantis doplněné podélnými snopci v lig. cruciforme atlantis, C. dorsální vrstva oddělující skloubení od páteřního kanálu
1/ ligamentum apicis dentis
2/ lig. alare
3/ lig. transversum atlantis (na obr. A bez podélných pruhů, na obr. B jako lig. cruciforme)
4/ membrana tectoria (splývající s lig. longitudinale posterius)



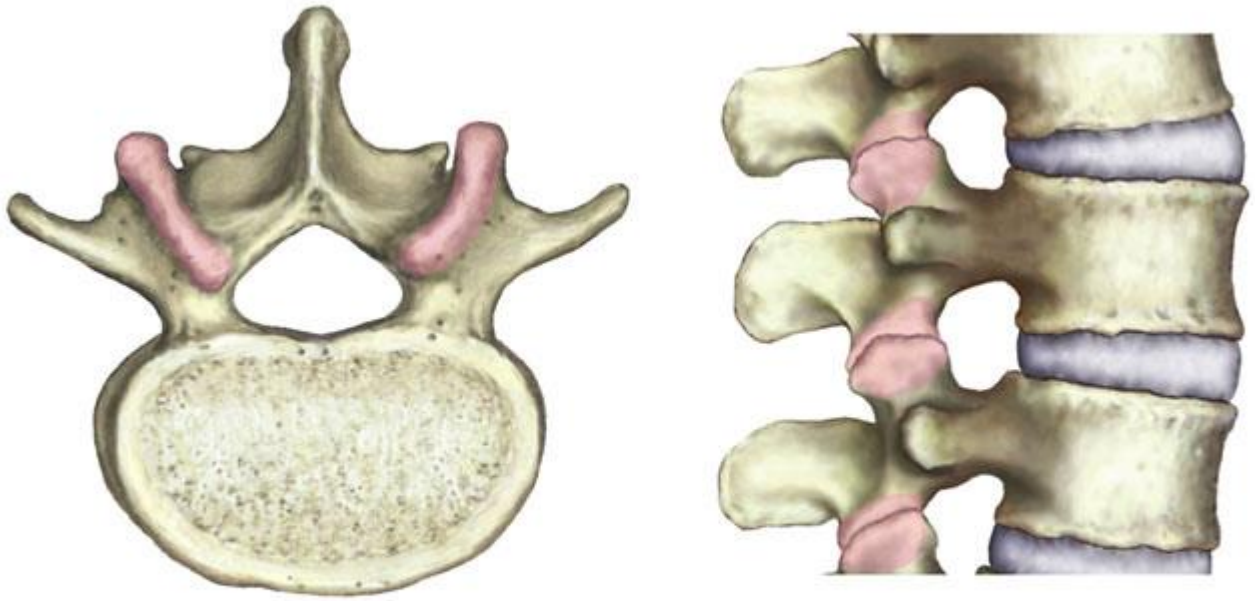
138. KRANIOVERTEBRÁLNÍ SPOJENÍ – pohled zpředu po odstranění části vazů, membrán a kloubních pouzder; articulatio atlantooccipitalis a articulatio atlantoaxialis lateralis (šipky)
1/ ligamentum apicis dentis
2/ ligamentum cruciforme atlantis, podélné pruhy (fasciculi longitudinales)
3/ ligamentum alare
4/ membrana tectoria
5/ okraj otvoru týlního
6/ tuberculum pharyngeum kosti týlní
7/ tělo kosti týlní



134. SPOJENÍ NA PÁTEŘI od týlní kosti po obratel C_2 – pohled z ventrální strany.
1/ ligamentum longitudinale anterius
2/ membrana atlantooccipitalis anterior
2'/ obdoba předchozí membrány mezi atlasem a tělem axis
3/ kloubní pouzdro articulatio atlantooccipitalis a articulatio atlantoaxialis lateralis

Articulationes zygapophysiales
Zygapophysial joints

- plane
- in between processus articulares

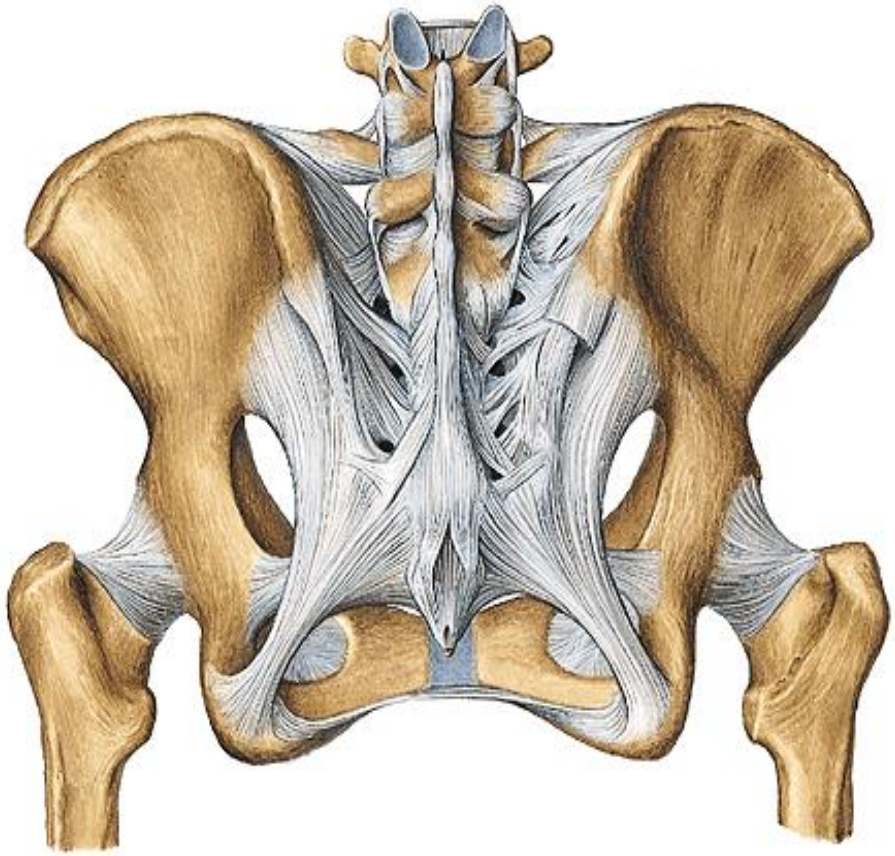


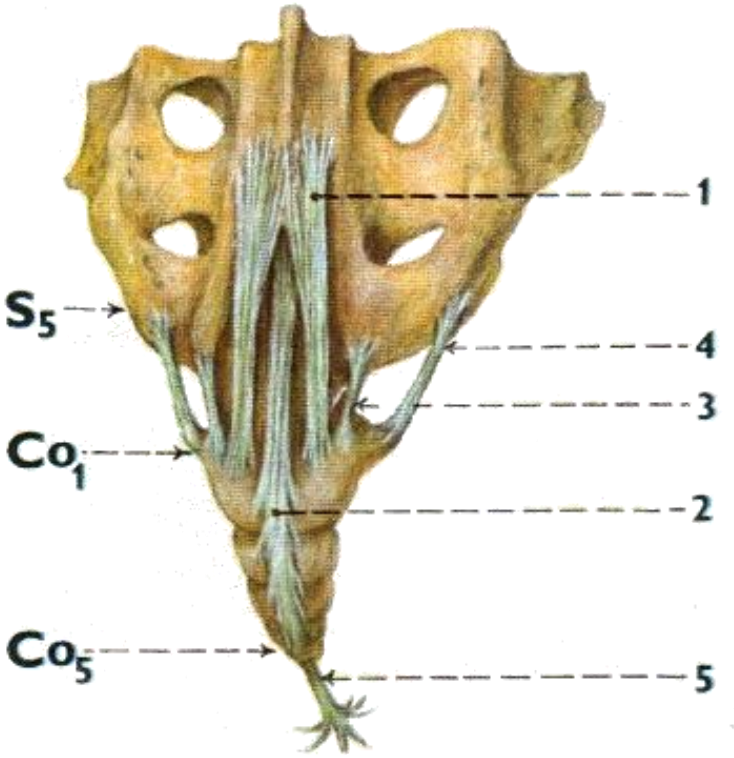
Facet Joints

Articulationes zygapophysiales

Joint type	Simple, three-axial, plane, mobile
(Head)	Processus articularis superior
(Cavity)	Processus articularis inferior
Articular capsule and its ligaments	Ligg. interspinalia, ligg. flava, lig. supraspinale, lig. longitudinale anterius, lig. longitudinale posterius (reinforcing syndesmoses in vicinity); lig. iliolumbale
Movements	Anteflexion+retroflexion (head and neck as a whole up to 90°; thorax, especially last vertebrae 90°/45°, lumbar 90°/23°) lateroflexion (head and neck as a whole up to 30°; thorax limited by ribs, lumbar up to 35°) rotation (a+a up to 30°; head and neck as a whole 60-70°, thorax up to 30°, lumbar 5-10°) spring movements
Middle position	= basic position
Note	*Meniscoid shapes* (special structure of joint) – extensions of synovial membrane (vasculated and innervated)

- Articulatio lumbosacralis (lumbosacral joint)
- Symphysis sacrococcygea (sacrococcygeal joint)





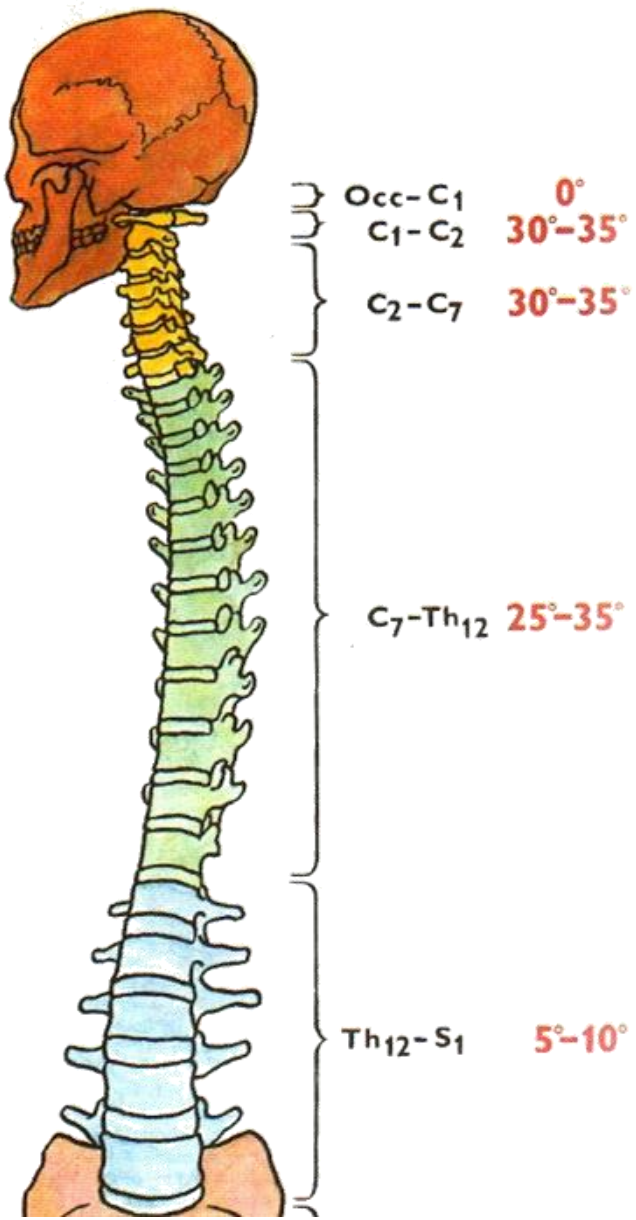
136. LIGAMENTA KŘÍŽOVÉ KOSTI A KOSTRČE – pohled zezadu
1/ ligamentum sacrococcygeum dorsale superficiale (uprostřed vyříznuté, aby bylo vidět do hiatus sacralis)
2/ ligamentum sacrococcygeum dorsale profundum
3/ vazivové přemostění mezi cornu sacrale a cornu coccygeum
4/ ligamentum sacrococcygeum laterale
5/ retinaculum caudale cutis

Articulatio lumbosacralis (lumbosacral joint)	
Joint type	Simple, three-axial, plane, mobile
Head	Facies articularis superior vertebrae (on processus articularis superior)
Cavity	Facies articularis inferior vertebrae (on processus articularis inferior)
Articular capsule and its ligaments	Ligg. interspinalia, ligg. flava, ligg. intertransversaria, lig. supraspinale, lig. longitudinale anterius, lig. longitudinale posterius (reinforcing syndesmoses in vicinity)
Movements	Minimal in all directions
Middle position	= basic position

Symphysis sacrococcygea (sacrococcygeal joint)	
Joint type	Usually junctura cartilaginea - **symphysis**
Head	Apex ossis sacri
Cavity	Os coccygis (cranial end)
Ligaments	Lig. sacrococcygeum posterius superficiale et profundum, lig. sacrococygeum anterius, lig. sacrococcygeum laterale
Movements	Minimal in all directions
Notes	Dissolves during pregnancy and delivery by relaxin May be replaced by synostosis or synovial joint

Movements of column as a whole

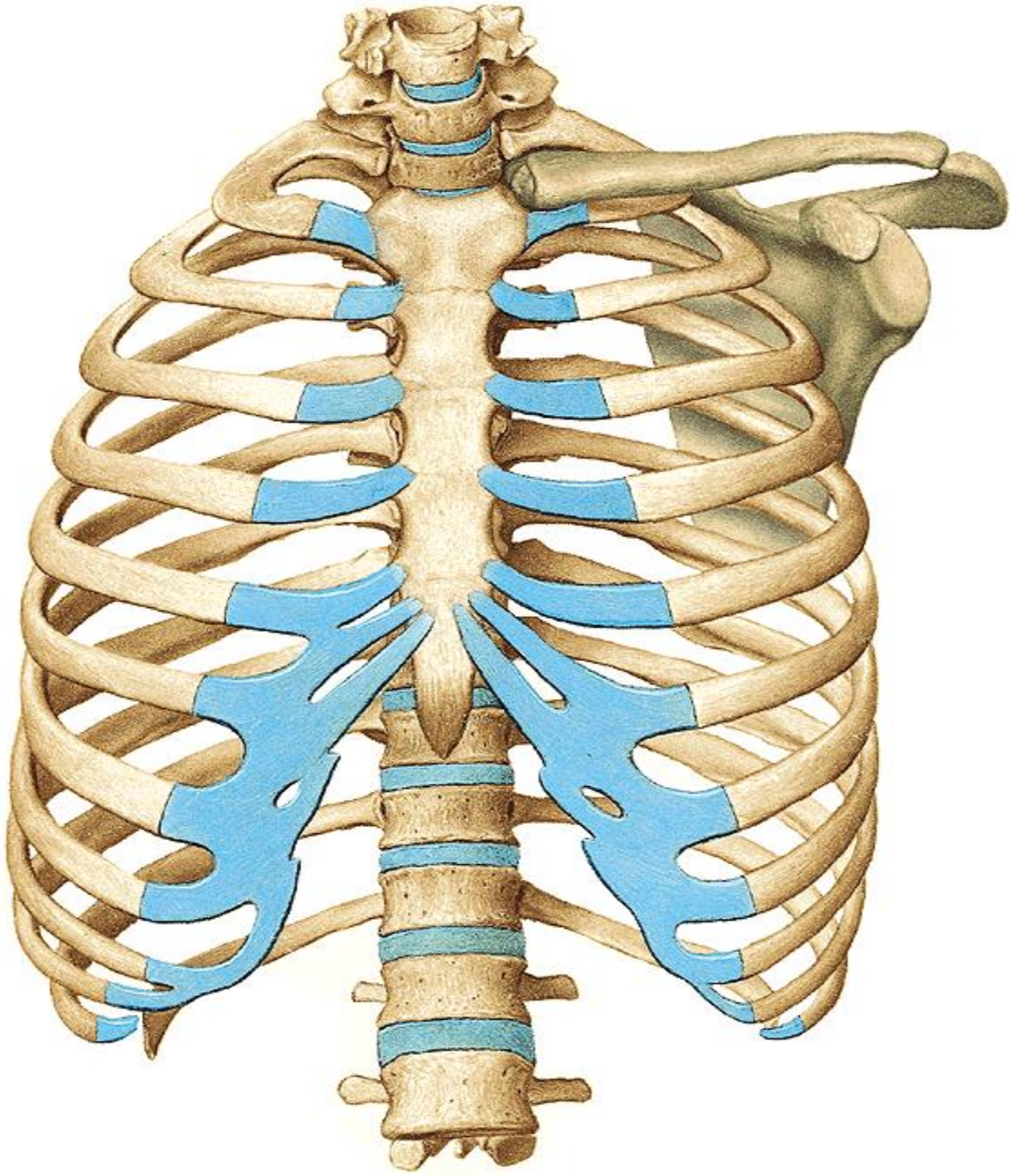
- **anteflexion/retroflexion** = bend forward/backward
  - C – 60° ventrally and dorsally
  - T – minimal (ribs)
  - L – 25° ventrally, 90° dorsally
- **lateroflexion** = side bend
  - C – 80°
  - T – minimal (due to ribs)
  - L – 35°
- **rotation**
  - mostly in C and T region, in L region minimal
- **spring movements**



Thorax
Thorax

- true ribs (I-VI)
- false ribs (VII-X)
- free ribs (XI, XII)

- cartilago costalis

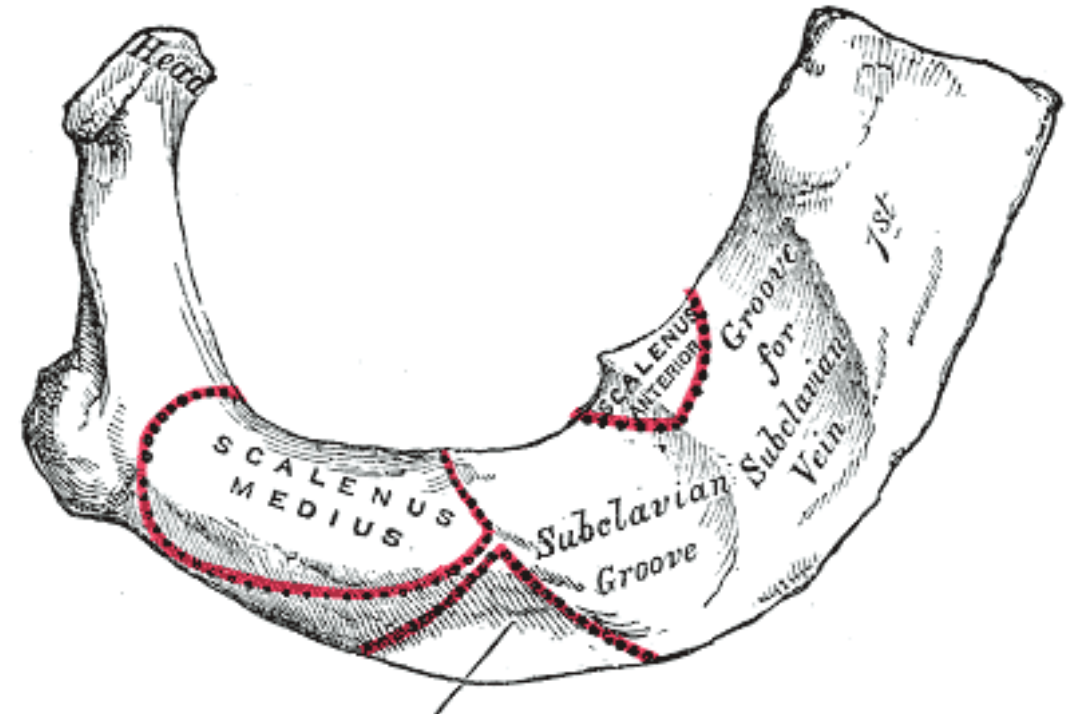


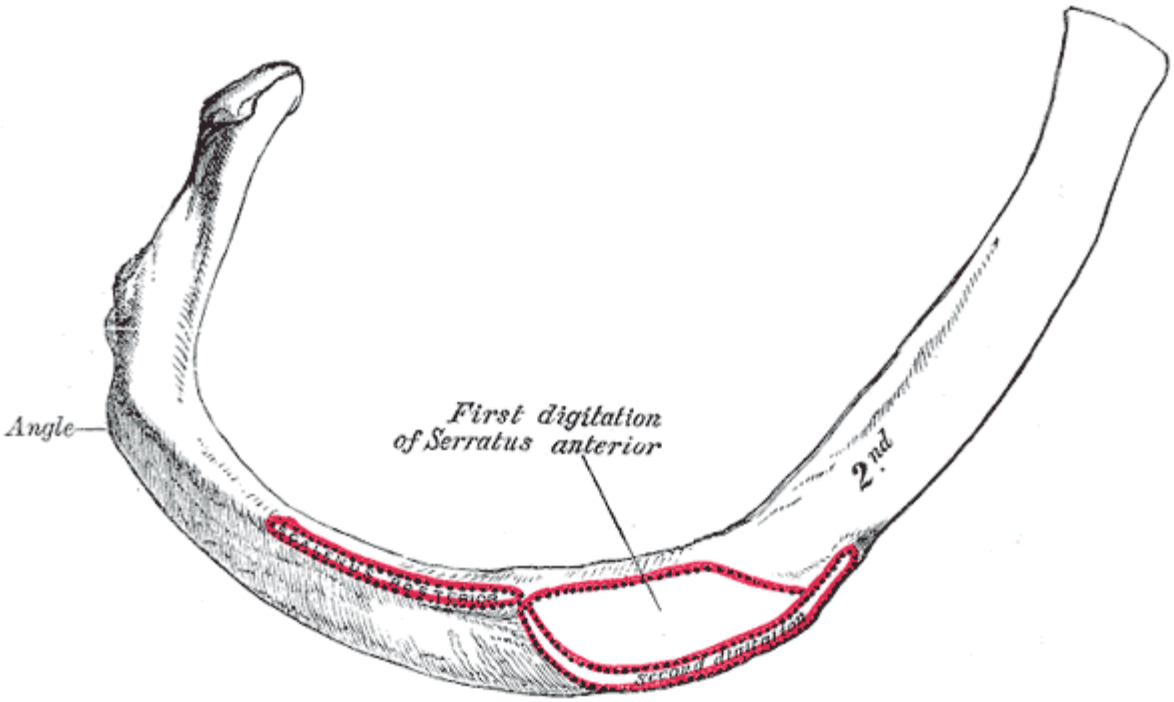
Rib = *Costa*

Caput costae
Facies articularis capitis costae
Cristae capitis costae
Collum costae
Crista colli costae
Corpus costae
Tuberculum costae
Facies articularis tuberculi costae
Angulus costae
Sulcus costae
Crista costae
(Costa cervicalis)

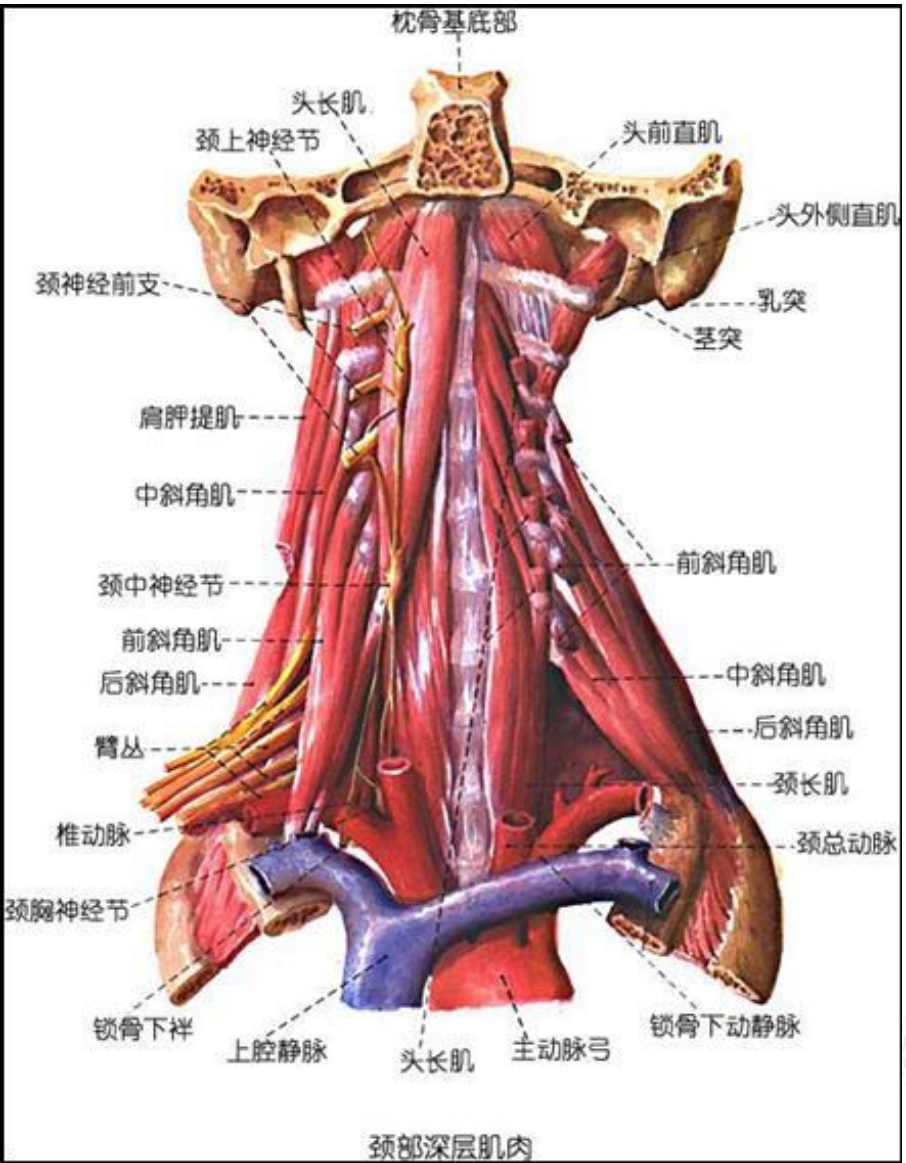
Different ribs

Costa prima [I]
Tuberculum musculi scaleni anterioris
Tuberculum musculi scaleni medii
Sulcus arteriae subclaviae
Sulcus venae subclaviae
Costa secunda [II]
Tuberositas musculi serrati anterioris

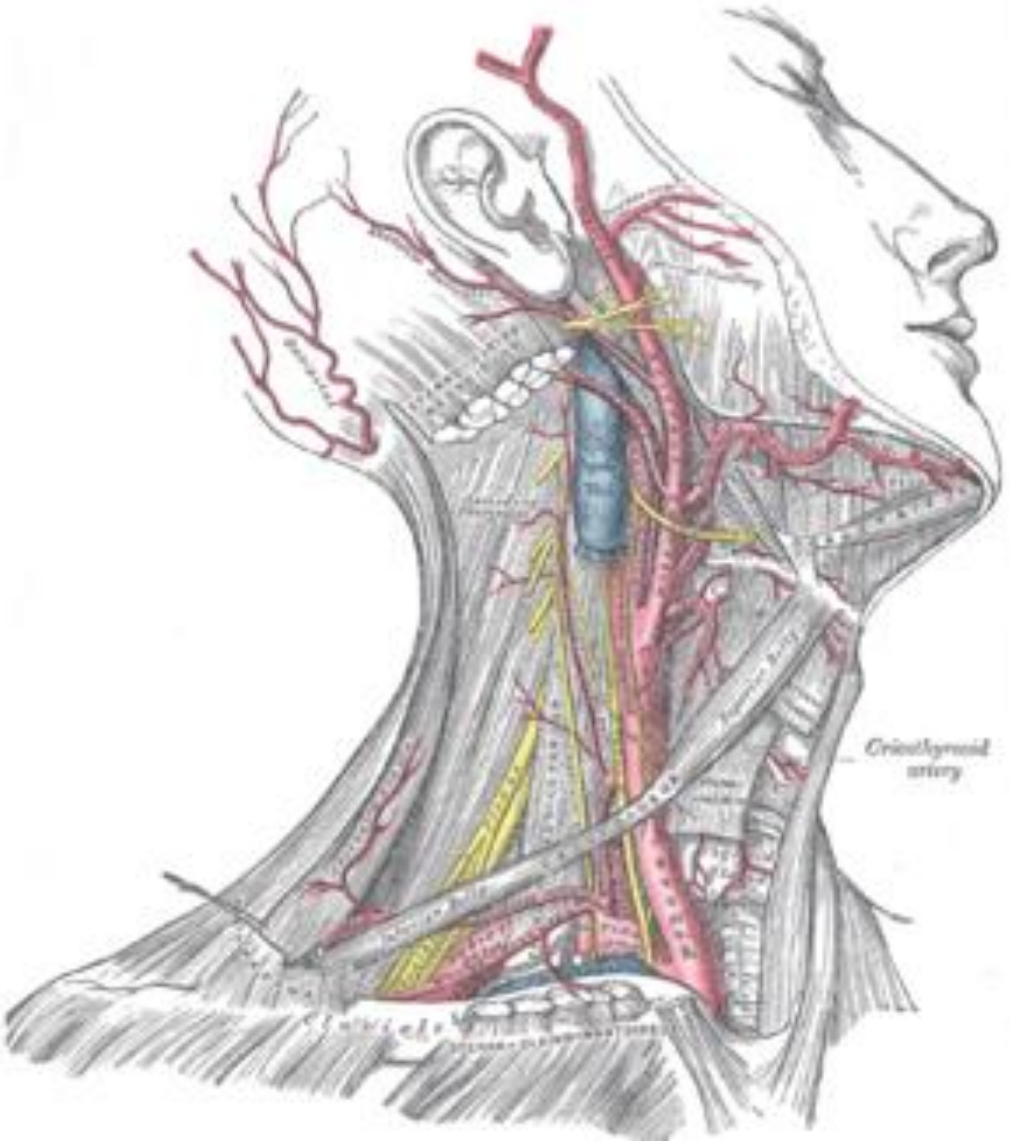




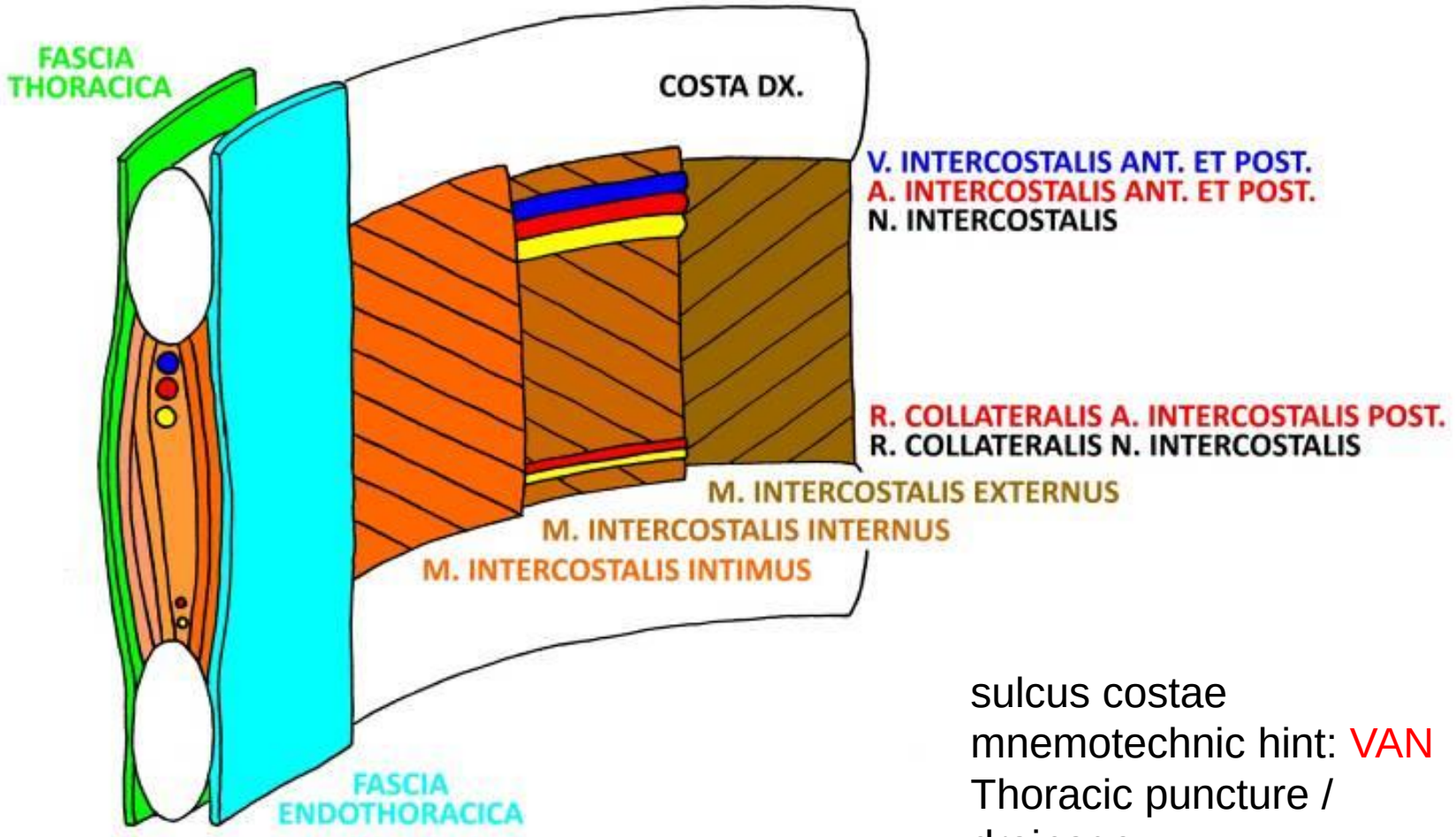
Fissura scalenorum



颈部深层肌肉



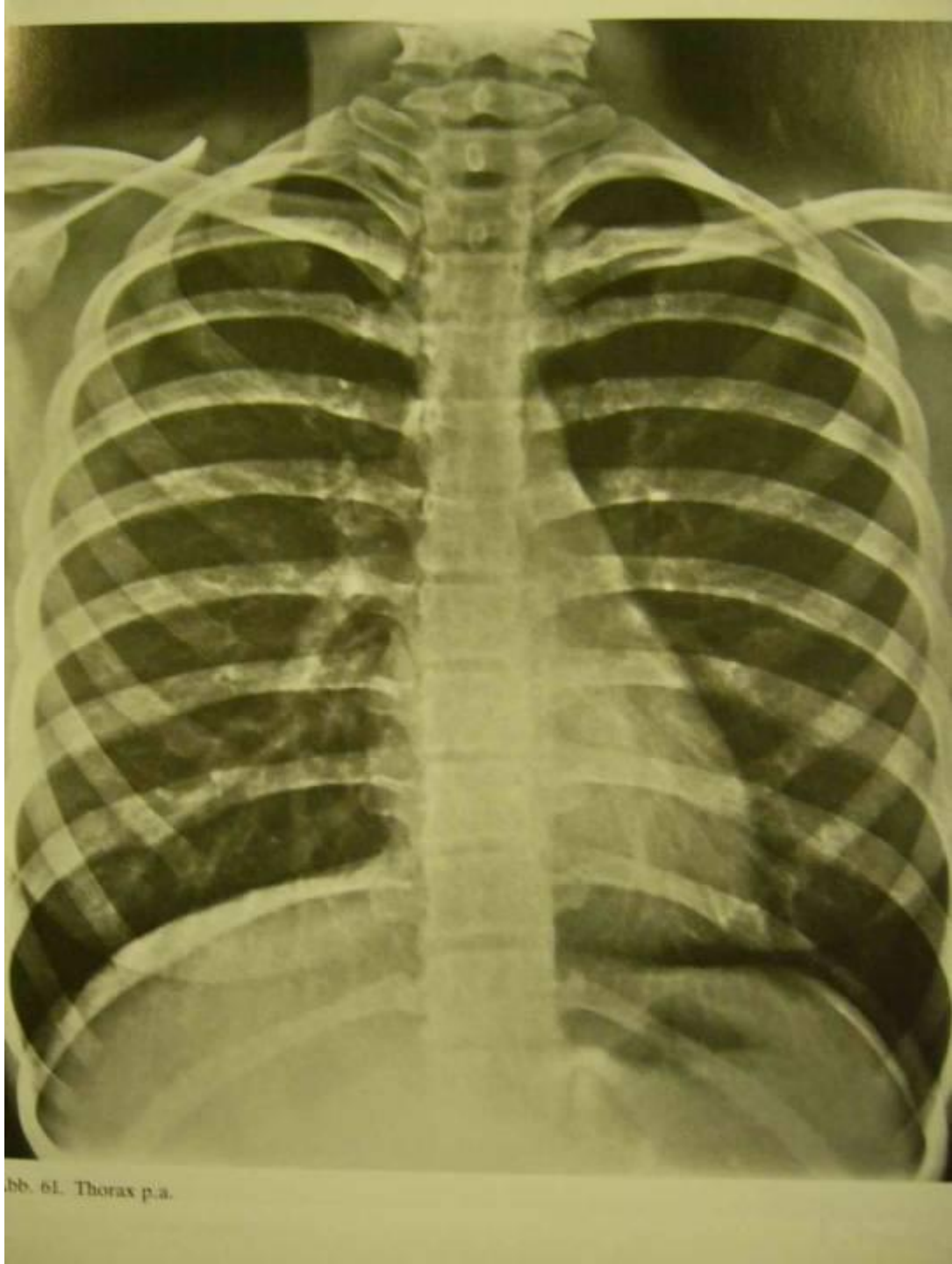
Spatium intercostale
Intercostal space



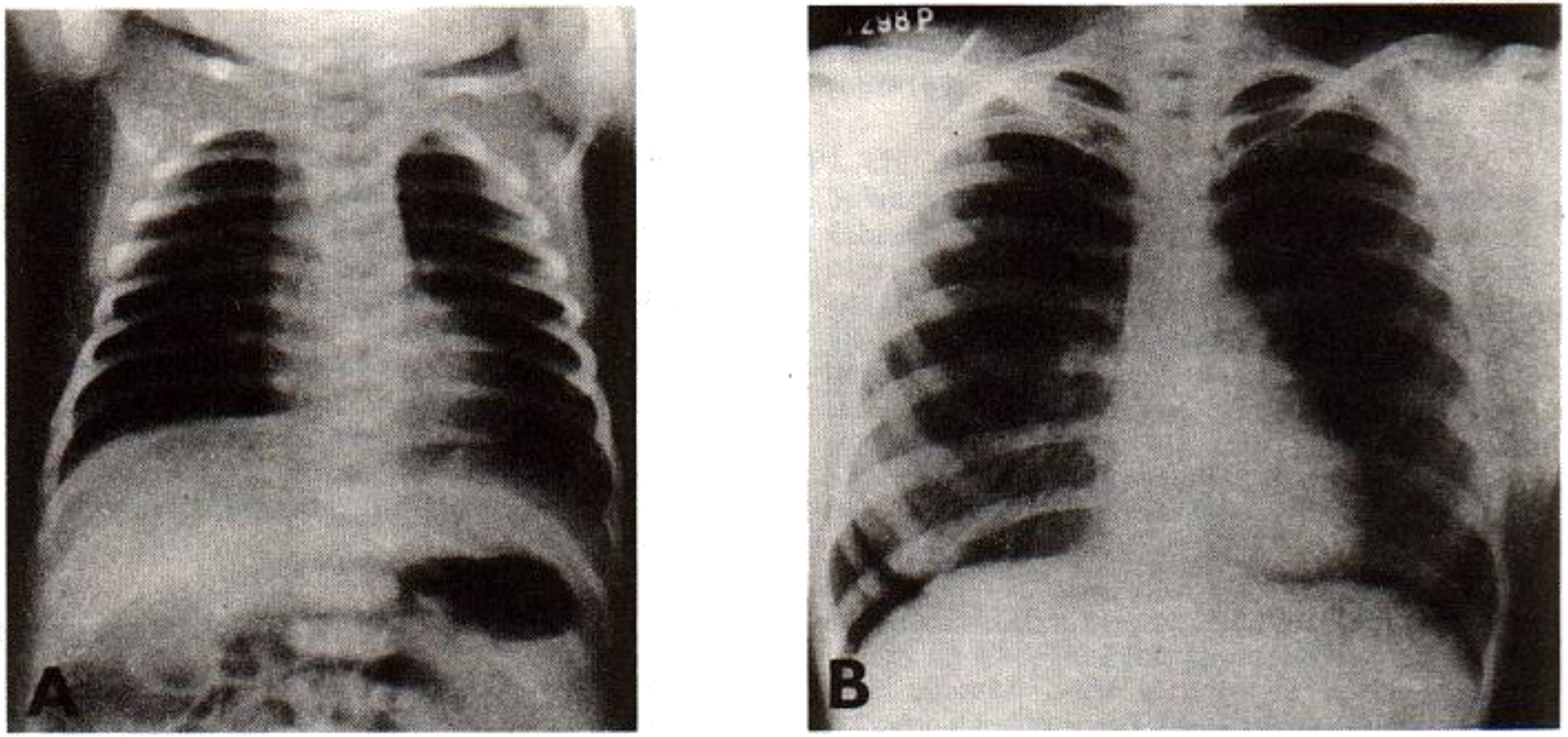
sulcus costae
mnemotechnic hint: VAN
Thoracic puncture / drainage

Thorax as a whole

- cavitas thoracis
- apertura thoracis superior + inferior
- arcus costalis
- angulus infrasternalis
- spatium intercostale



X-ray of thorax

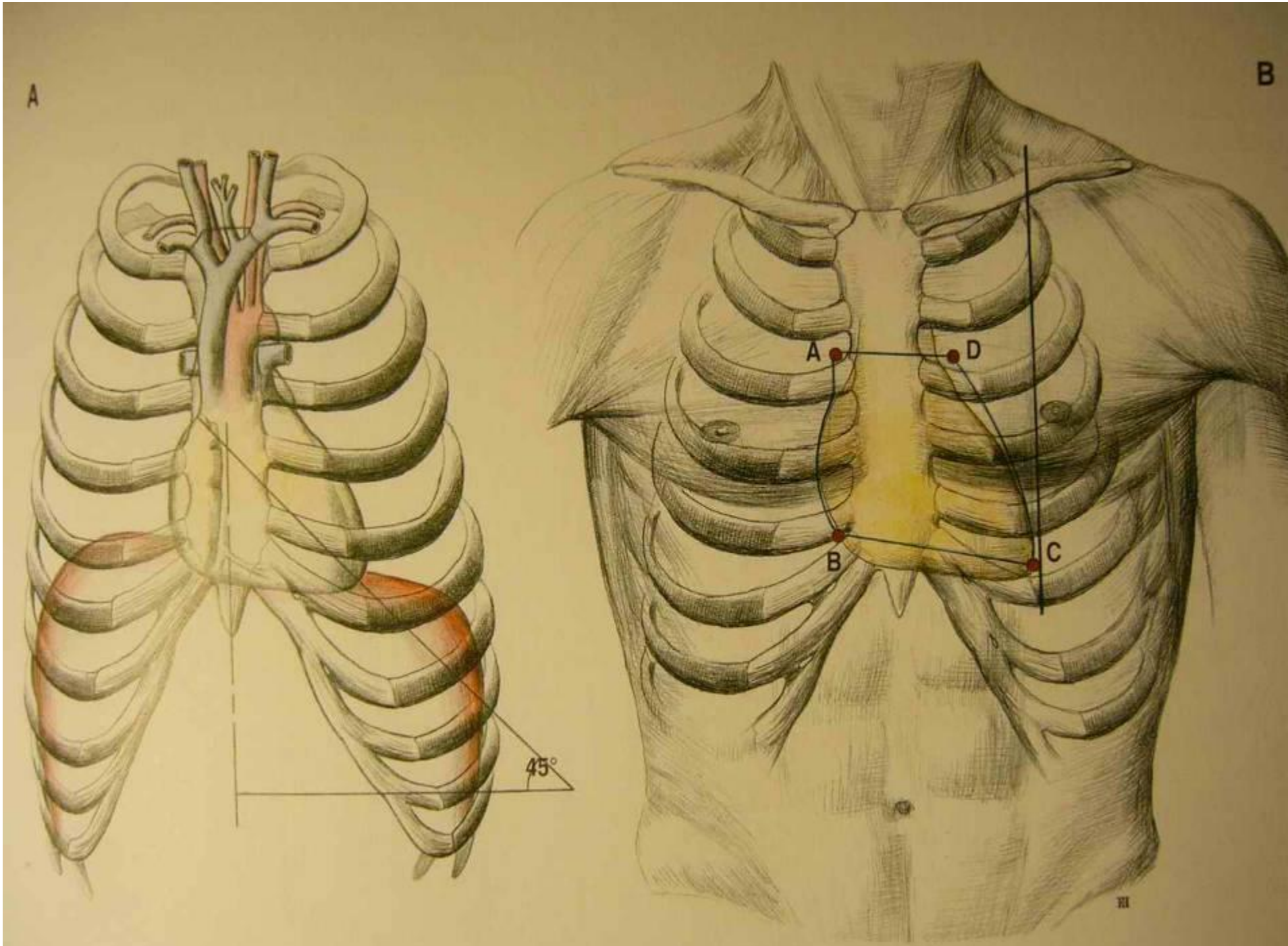


167. ROZDÍL TVARU HRUDNÍKU NOVOROZENCE A HRUDNÍKU DOSPĚLÉHO na rtg snímku (předozadní projekce): A. novorozenec, B. dospělý

X-ray of thorax

Anteroposterior x-ray of idiopathic thoracic scoliosis before operation – thoracic curve 60°

Anteroposterior x-ray of idiopathic thoracic scoliosis after operation from ventral approach with instrumentation – correction on 13°


A
B
A
D
B
C
45°

Pectus excavatum
Inward chest

Clinical notes

- individual ribs cross each other on X-ray
- isolated injury of the 1st rib is frequent, treatment usually conservative
- *cave:* pneumothorax, haemothorax, rupture of pericardium
- segmental fracture, serial fracture, door fracture (non-stabile thorax → life danger)
- fractures by CPR

A. Vor der Mund-zu Mund-Beatmung wird der Kopf überstreckt, die Nase zugehalten und das Kinn nach vorne gezogen. Zum Schutz vor Infektionen sollten Handschuhe getragen und ein Gazestück auf den Mund gelegt werden; wenn vorhanden, Beatmungshilfe benutzen

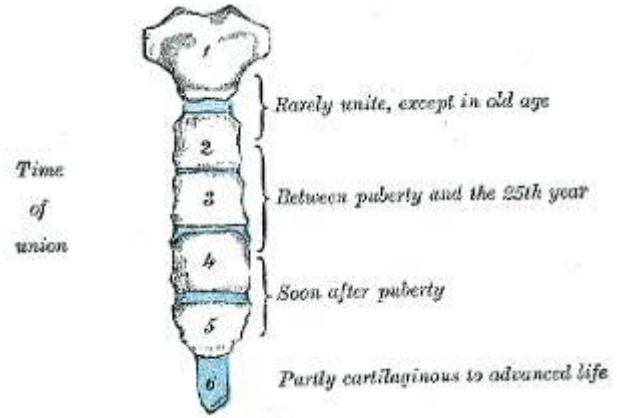
B. Intermittierend wird mit dem Handballen Druck auf das untere Sternumdrittel ausgeübt; Druckpunkt: 2 Querfinger oberhalb des unteren Sternumrandes

C. Das Herz wird intermittierend zwischen Brustbein und Wirbelsäule komprimiert

Sternum (*Sternum*)

Manubrium sterni
Incisura clavicularis
Incisura jugularis
Angulus sterni *Ludovici*
Corpus sterni
Processus xiphoideus
Incisurae costales

Clinical notes

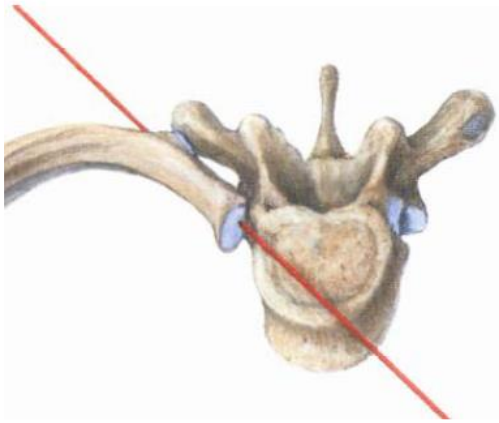


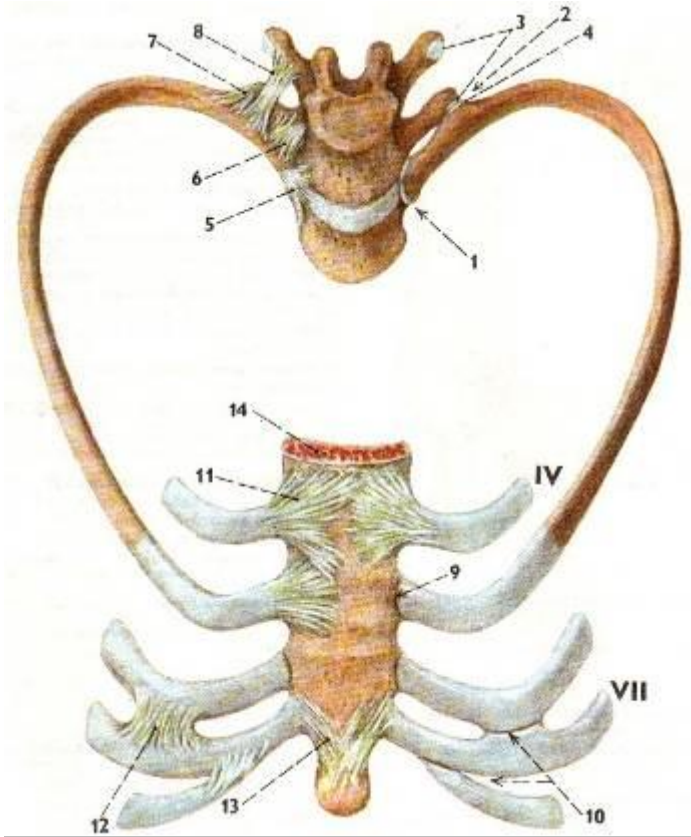
- a hole in the sternum as a result of impaired fusion of sternal segments = *sternebrae*
- fractures of sternum are not common
  - only in case of great violence (contusion S+P, fractures of T column)
- sternotomy – cardiosurgery (rigid fixation)
- puncture of bone marrow
- CPR

Synarthorses of thorax

- membrana intercostalis interna + externa
- synchondroses costosternales
- synchondrosis costae primae
- symphysis xiphosternalis + manubriosternalis

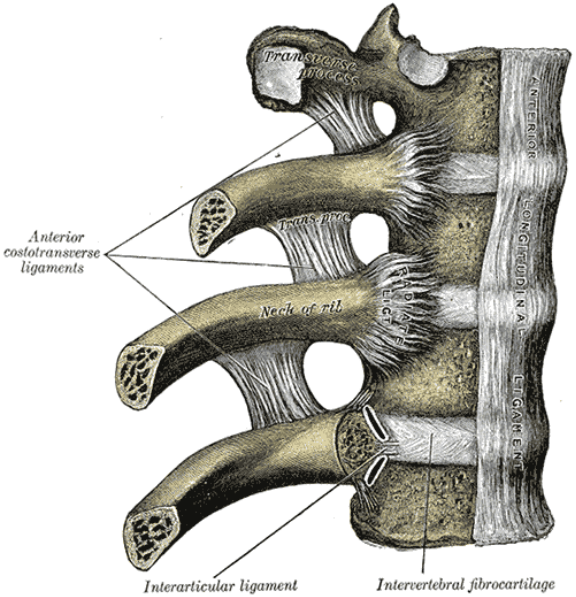
- 4 joints

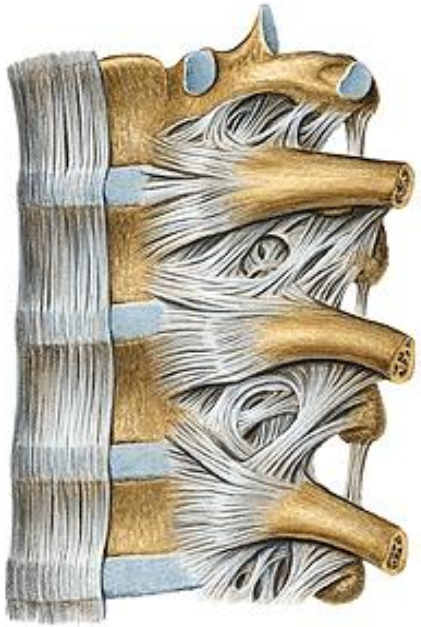




Articulationes costovertebrales

- Articulatio capitis costae
  - lig. capitis costae radiatum
  - lig. capitis costae intraarticulare
- Articulatio costotransversaria
  - ligg. costotransversaria





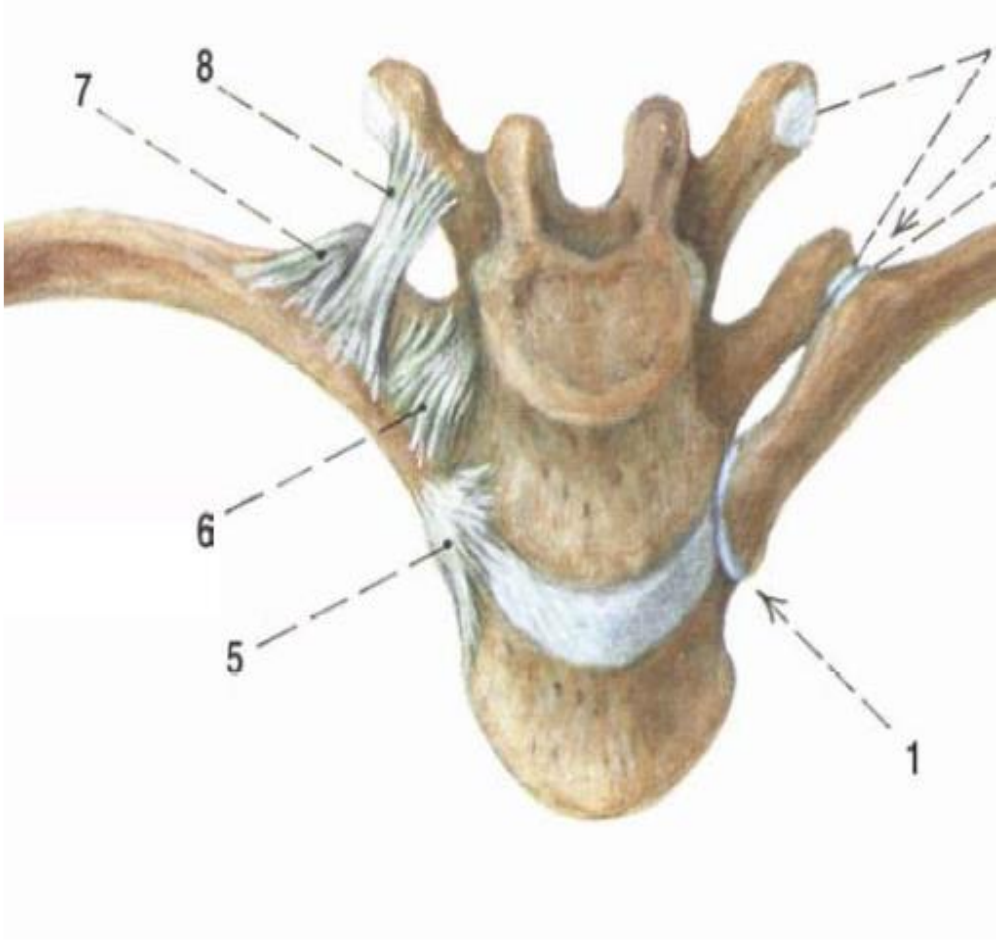
Articulatio capitis costae (joint of head of head)

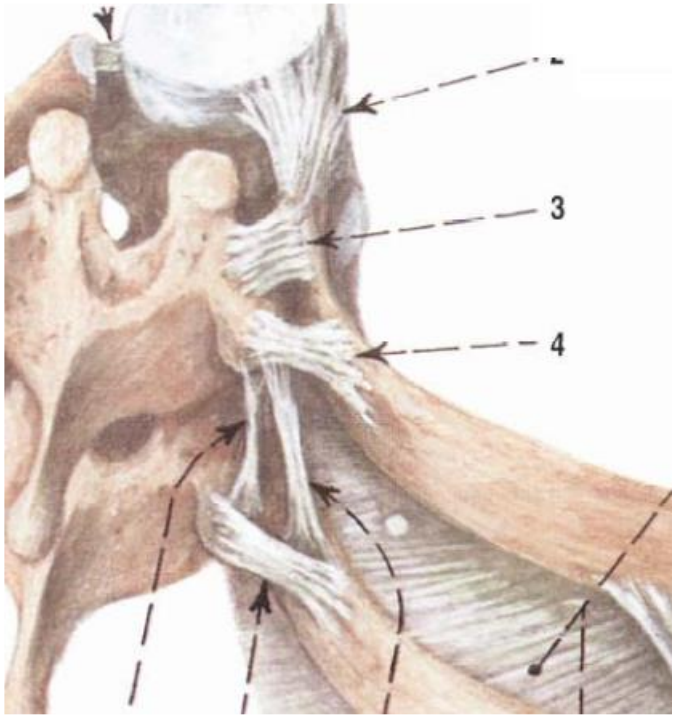
Joint type	Compound, mobile, rather elipsoid then plane – 2 facets (forming blunt angle)
Head	Facies articularis capitis costae (2 facets – crista capitis costae) 1st, (10th),11th,12th have one facet w/o margin
Cavity	Fovea costalis corporis vertebrae (usually composed of two cavities of neighbouring vertebrae and from the margin of intervertebral disc) T1, (T10),T11,T12 have simple cavity
Articular capsule and its ligaments	Lig. capitis costae radiatum, lig. capitis costae intraarticulare (divide joint into two cavities in 2nd-10th ribs)
Movements	Rotation of rib (prominent in 1st-6th rib, minimal in 7th-12th rib), elevation-depression of rib (minimal in 1st-6th rib, prominent in 7th-12th rib)
Middle position	= basic position

Articulatio costotransversaria (costotransversal joint)

Joint type	Simple, movable (approx. flat)
Head	Facies articularis tuberculi costae (1.-10.)
Cavity	Fovea costalis processus transversi vertebrae (T1-T10)
Articular capsule and its ligaments	Lig. costotransversarium, Lig. costotransversarium superius et laterale Lig. lumbocostale
Movements	Rotation of rib (prominent in 1st-6th rib, minimal in 7th-12th rib), elevation-depression of rib (minimal in 1st-6th rib, prominent in 7th-12th rib)
Middle position	= basic position
Joint type	Foramen costotransversarium (w/o content)

Articulationes costovertebrales

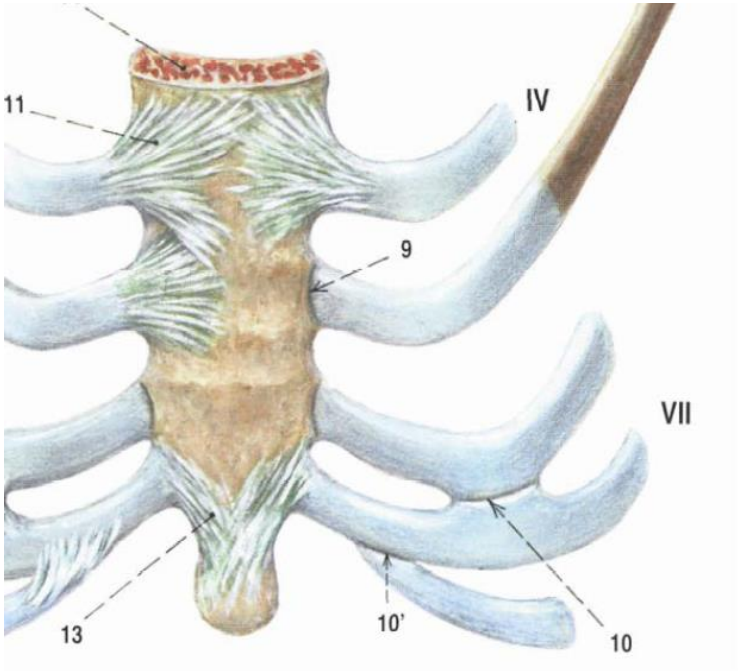




Articulationes sternocostales

- lig. sternocostale radiatum
- membrana sterni
- lig. sternocostale intraarticulare
- ligg. costoxiphoidea

- Articulationes interchondrales

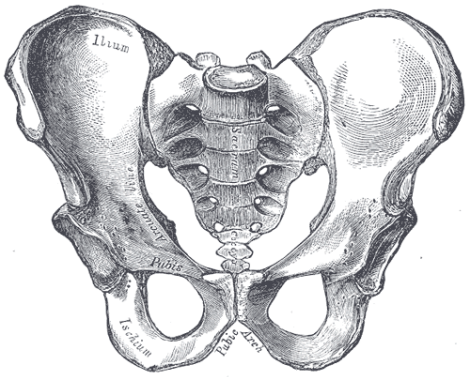


Articulatio sternocostalis (sternocostal joint)	
Joint type	Compound, mobile
Head	Cartilago costalis costae 2nd-7th (2 facets on ventral end)
Cavity	Incisurae costales sterni
Articular capsule and its ligaments	Lig. sternocostale radiatum, lig. sternocostale intraarticulare (in 2nd and 3rd joint), ligg. costoxiphoidea
Movements	Small in all directions
Middle position	= basic position
Note	Sliding movements for breathing Missing cavity always in 1st joint and especially in caudal ones – here a fibrocartilago connects continuously both bones

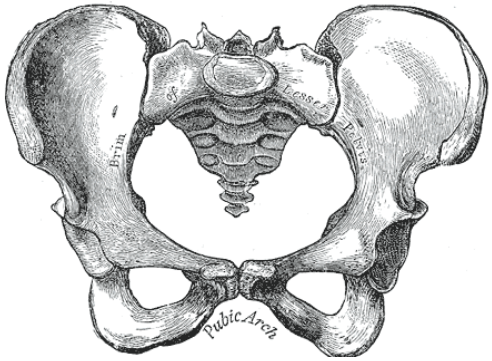
Articulatio interchondralis (interchondral joint)	
Joint type	Simple, mobile
Head	Cartilago costalis costae 8th-10th
Cavity	Cartilago costalis costae 7th-9th
Articular capsule and its ligaments	Ligg. interchondralia
Movements	Small in all directions
Middle position	= basic position
Note	Joints often missing articulation cavity, between 9th and 10th rib always missing

Pelvis as a whole

Pelvis

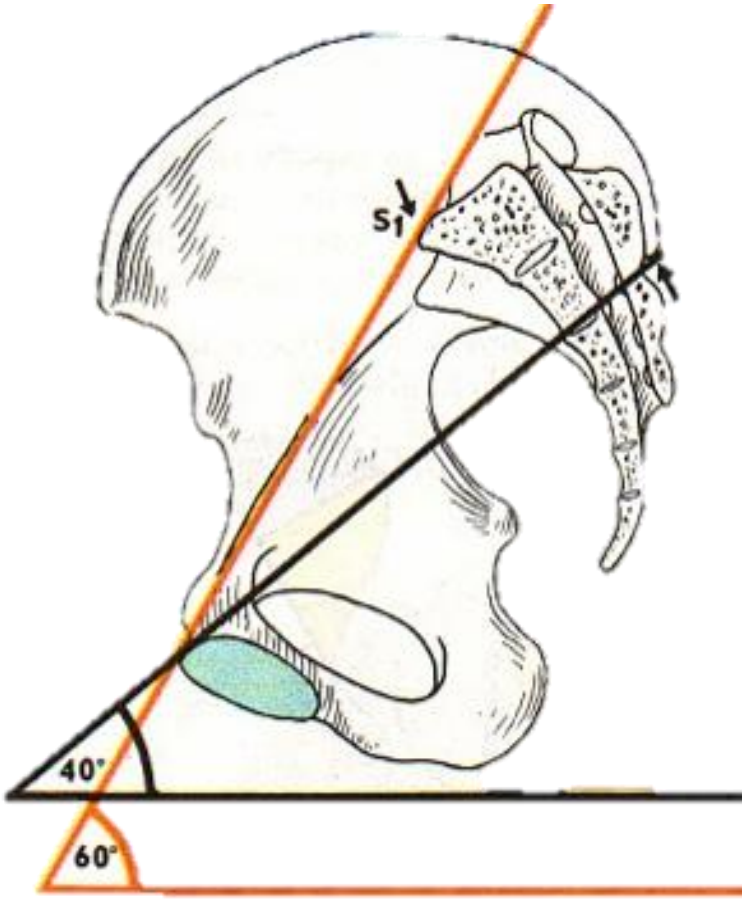


- sexual dimorphism
- linea terminalis
- greater pelvis:
  - ala ossis ilii above lineae terminales
  - basis ossis sacri
- lesser pelvis:
  - os sacrum and coccyx
  - os ischii and os pubis with membrana obturatoria
  - symphysis pubica

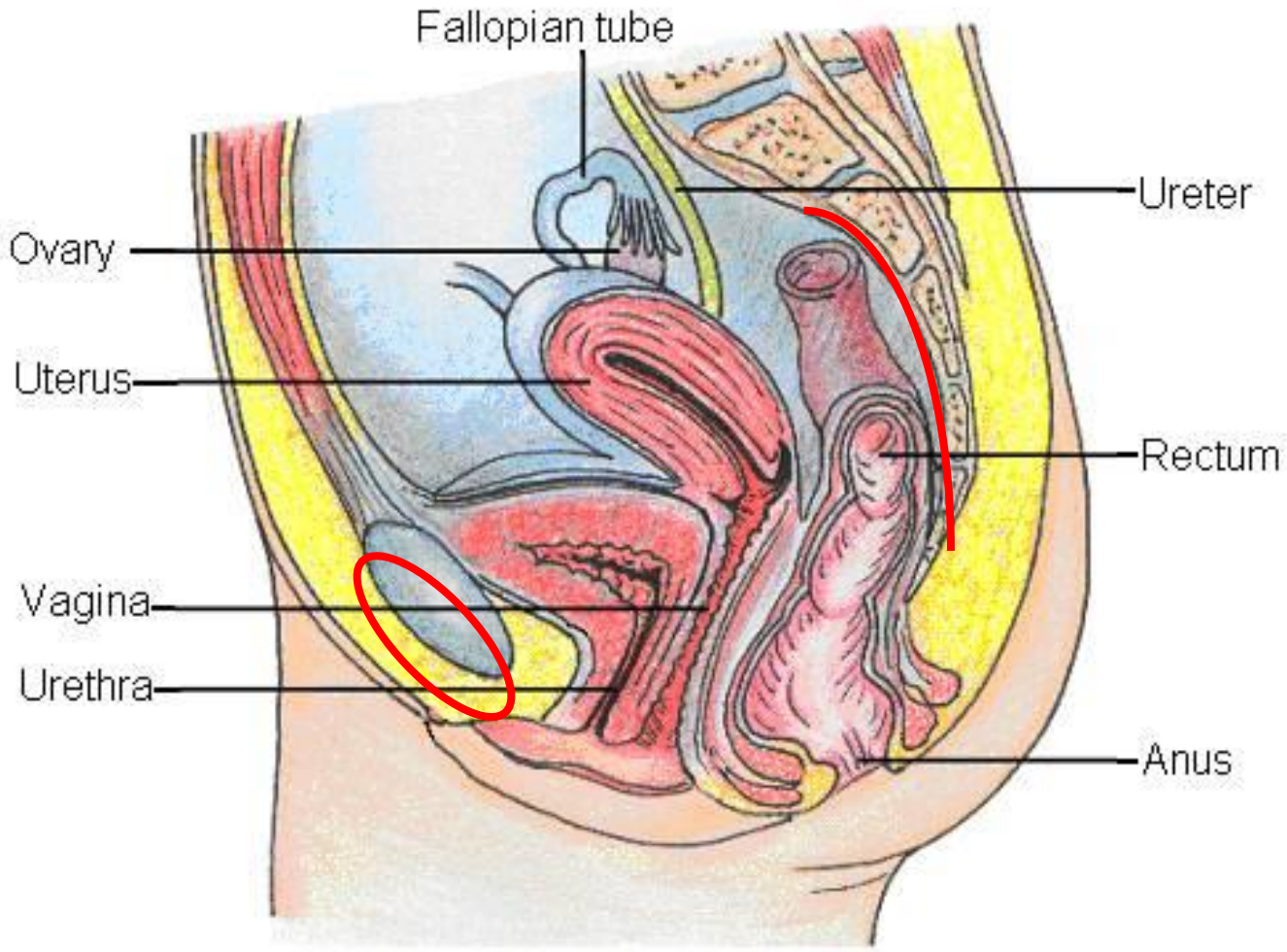


Pelvic declination

- **<u>inclinatio pelvis normalis</u>** (red angle):
  - plane via: promontorium + lineae terminales + upper margin of pubic bone
  - horizontal plane
  - **60°** – only on X-ray
- **<u>inclinatio coxae</u>** (black angle):
  - plane via: spina iliaca posterior superior + upper margin of pubic bone
  - horizontal plane
  - **40°**



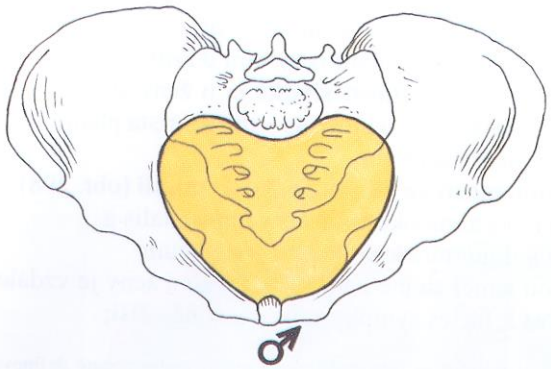
Syntopy to organs

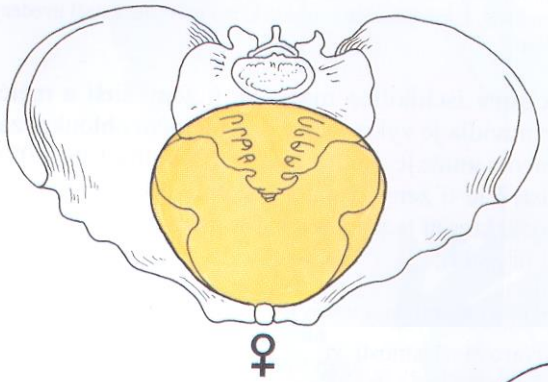


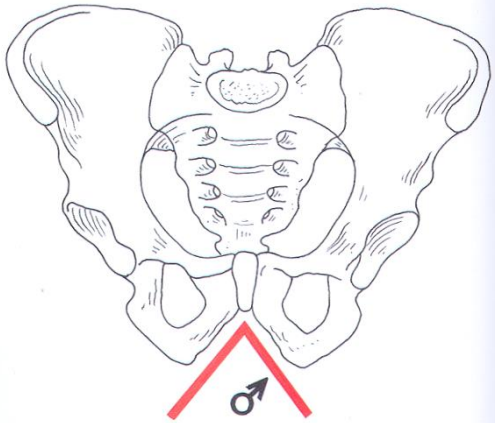
Sexual dimporhism on pelvis

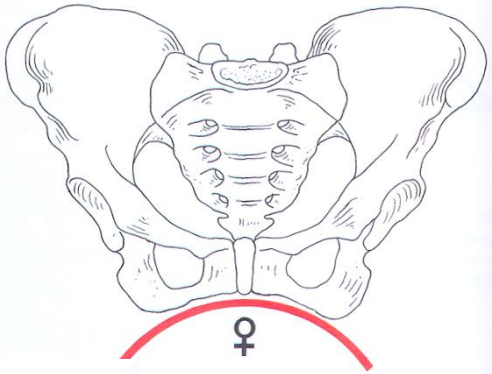
- promontorium – round♀ x ♂hearty
- symphysis pubica – lower in females (♀4,5 cm x ♂5,5 cm)
- rami inferiores ossis pubis – different angles
  - arcus pubicus ♀
  - angulus pubicus ♂
- incisura ischiadica major – larger and flatter in females♀
- coccyx – shorter and more movable in females♀
- foramen obturatorium – triangular♀ x round ♂
- alae ossis ilii – more open in females ♀

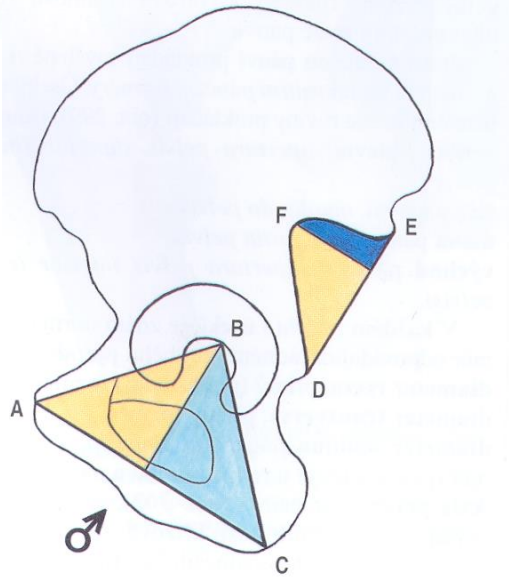
Sexual dimorphism on pelvis

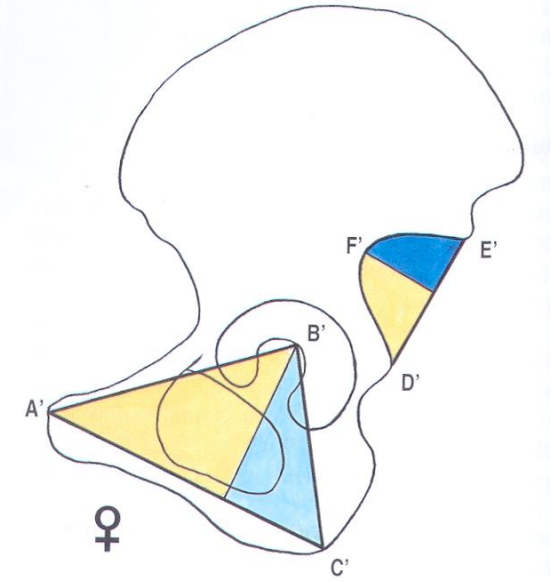






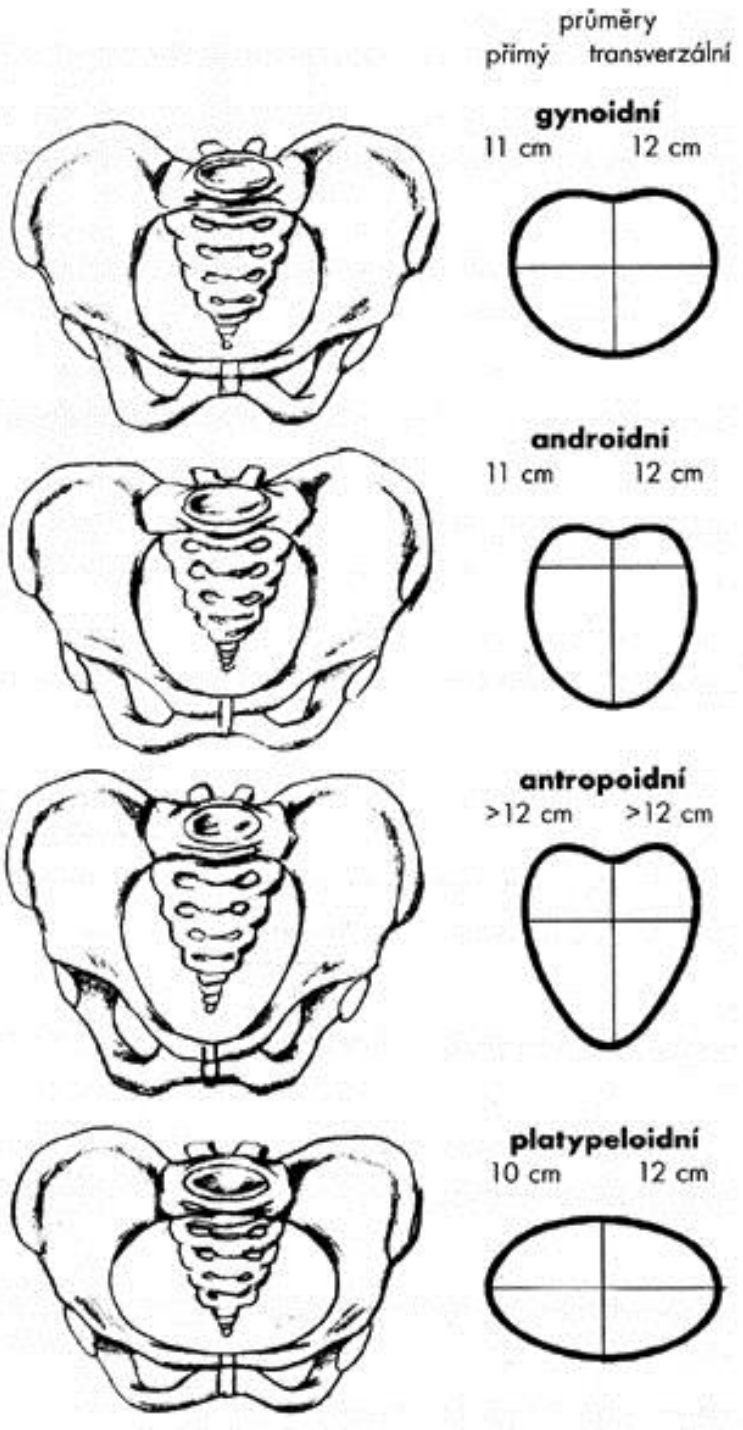






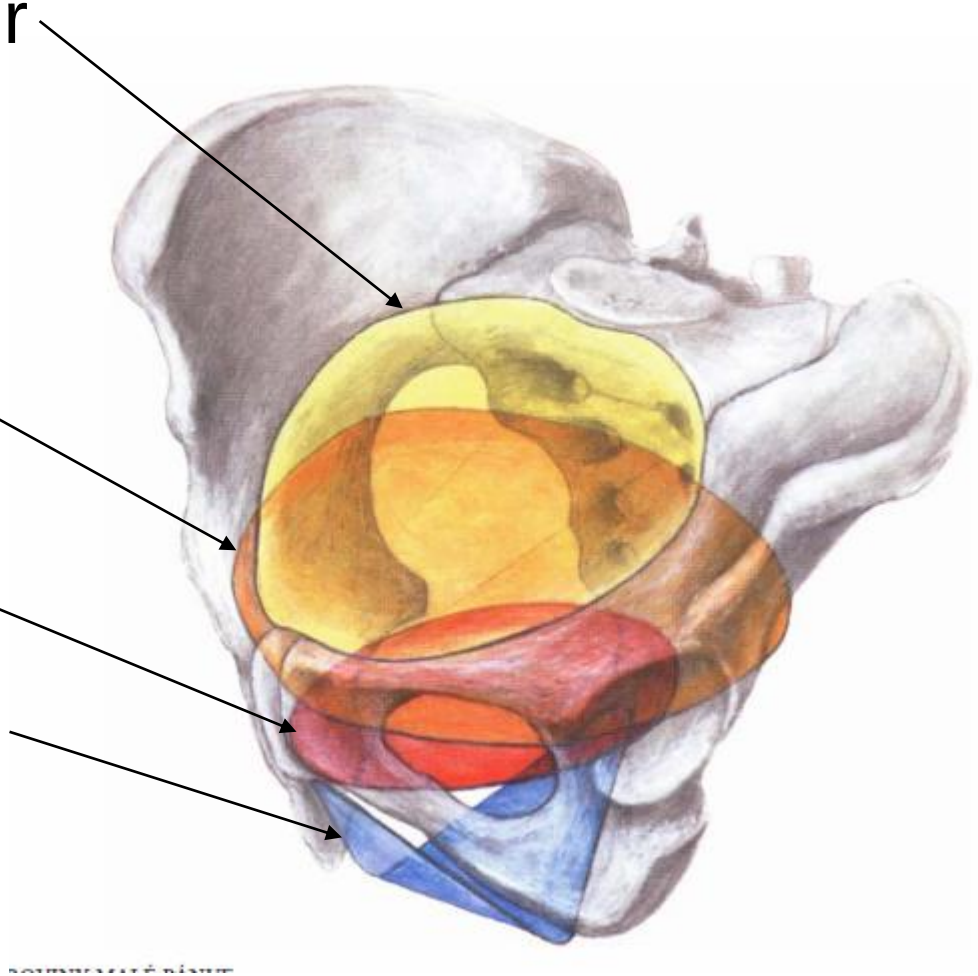
Types of pelvis

- gynoid – cicular aditus
- android – heart-shaped aditus
- anthropoid – oval aditus, long os sacrum with 6 vertebrae
- platypeloid – transversally oval aditus, wide arcus pubicus



Pelvic planes

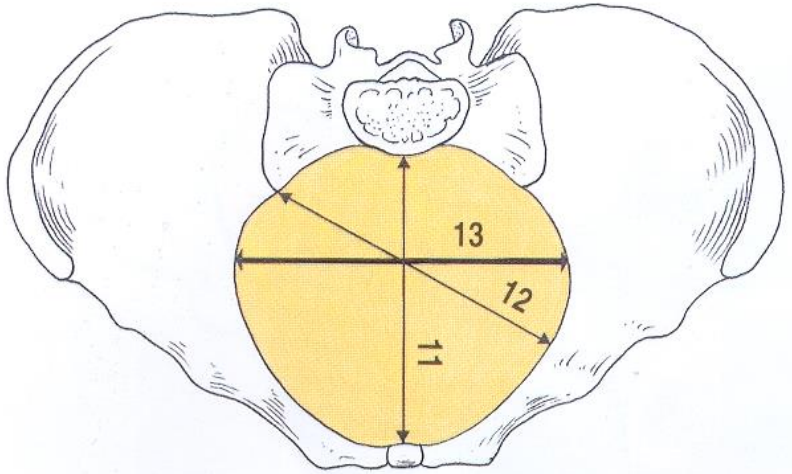
- Apertura pelvis superior (aditus pelvis)
  - plane of pelvic inlet
- Amplitudo pelvis
  - plane of pelvic width
- Angustia pelvis
  - plane of pelvic isthmus
- Apertura pelvis inferior (exitus pelvis)
  - plane of pelvic oulet



Pelvic inlet

= linea terminalis

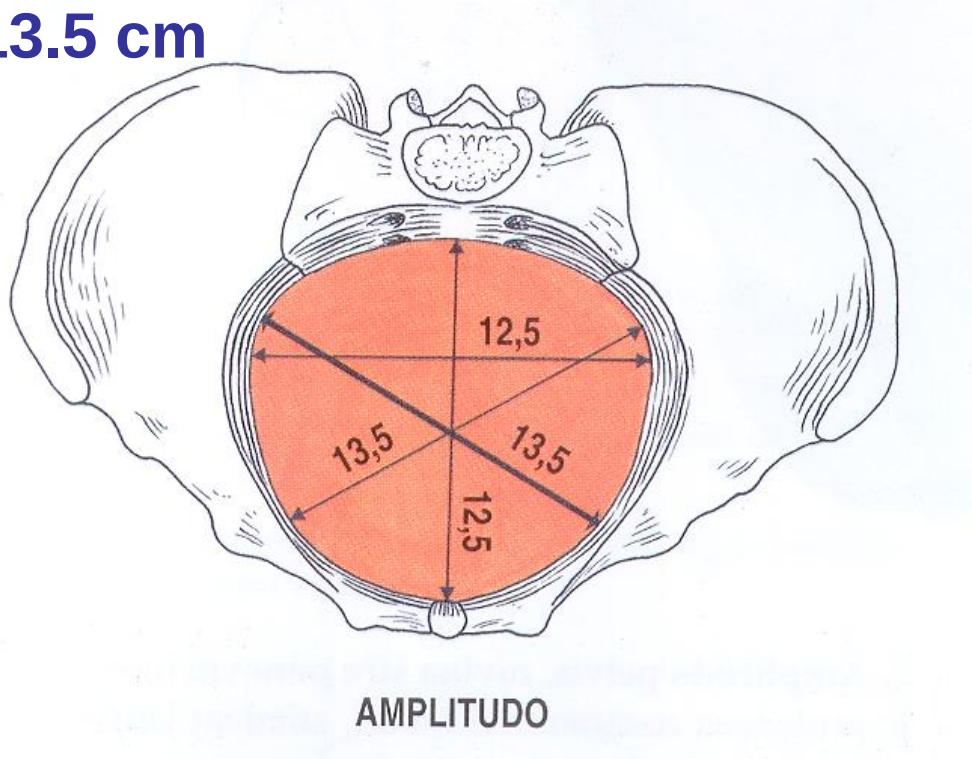
- diameter recta (conjugata anatomica): *promontorium – upper margin of symphysis pubica* = minimally 11 cm
- diameter obliqua: *articulatio sacroiliaca – eminentia iliopubica* = minimally 12 cm
- **diameter transversa: *across between linea arcuata (part of linea terminalis)* = minimally 13 cm**



Pelvic width

= S2-S3 → middle of acetabulum → middle (posterior margin) of symphysis pubica

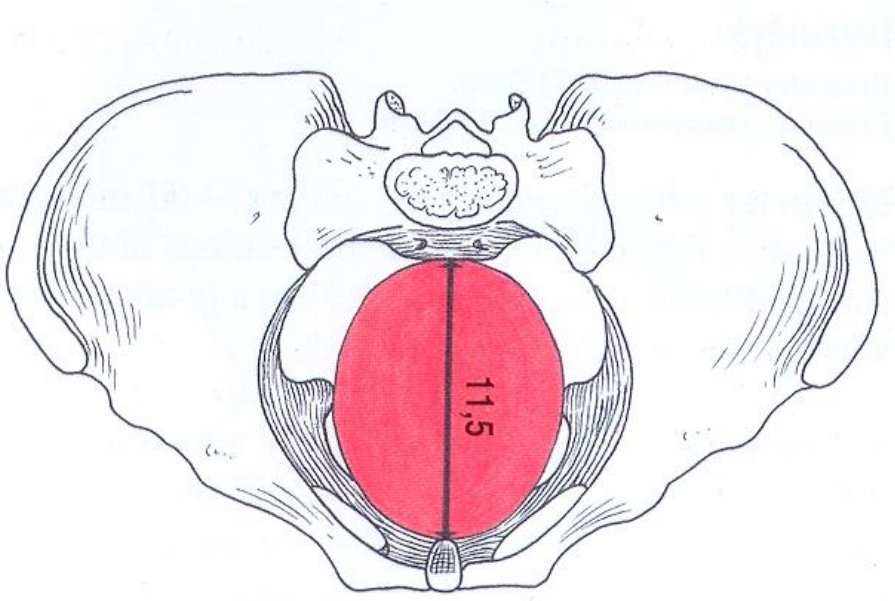
- diameter recta*:* 12.5 cm
- diameter transversa*:* 12.5 cm
- **diameter obliqua: insicura ischiadica major → sulcus obturatorius = minimally 13.5 cm**



Pelvic isthmus

= apex ossis sacri → spina ischiadica → lower margin of symphysis pubica

- narrowest part of small pelvis
- diameter transversa: 10 cm
- **<u>diameter recta</u>: 11.5 cm**



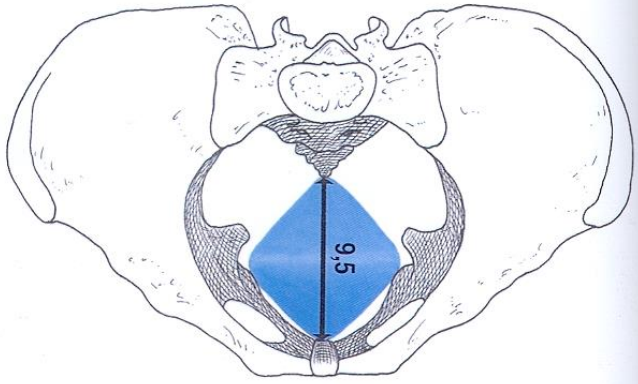
Pelvic oulet

= two triangular planes (trigonum urogenitale et anale)

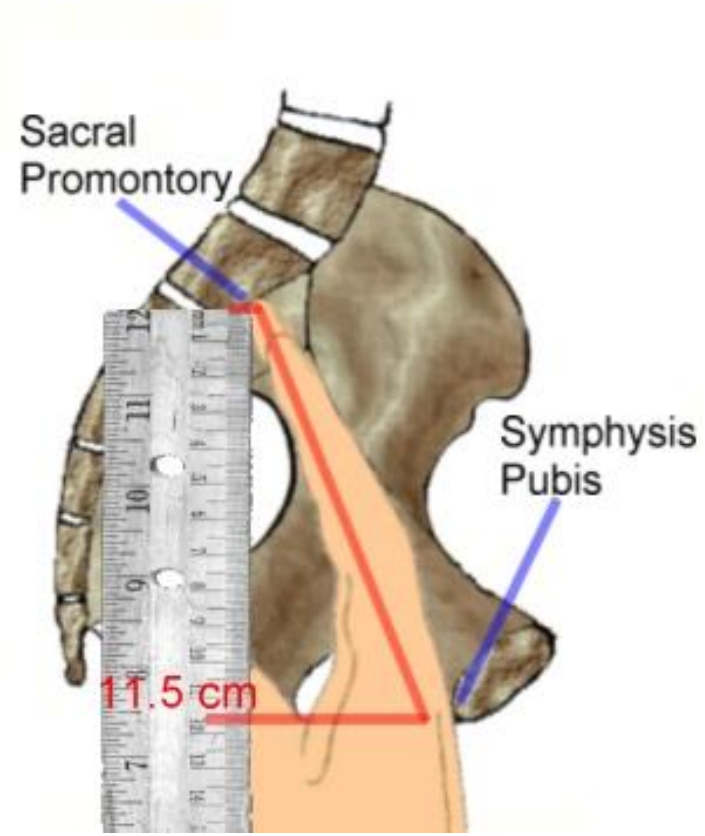
Lower margin of symphysis pubica → tubera ischiadica → os coccygis

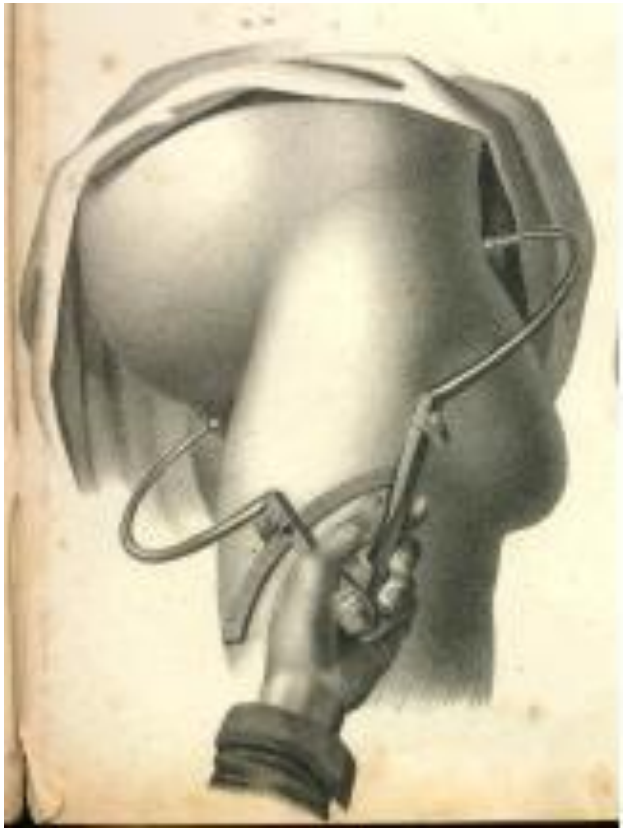
- diameter transversa: *between tubera ischiadica* = minimally 11 cm
- **diameter recta: *apex ossis coccygis → posterior margin of symphysis pubica***

= minimally 9.5 cm, during delivery coccyx bends dorsally due to releasing of connection with sacral bone = minimally 11.5 cm



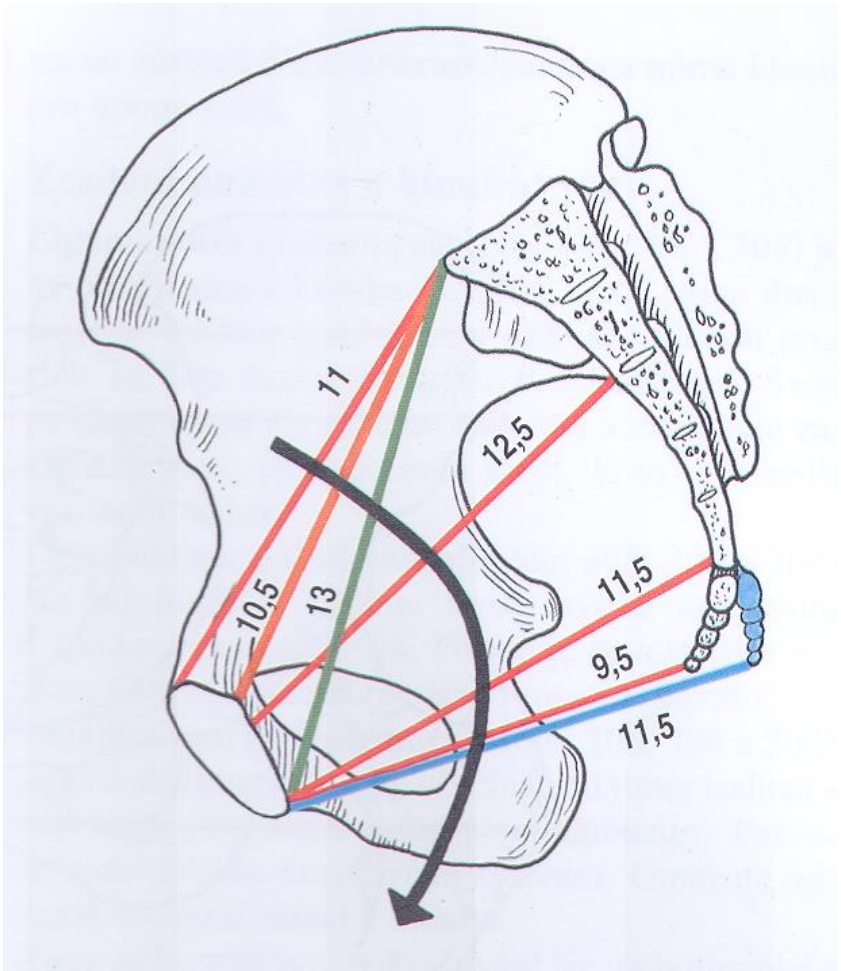
EXITUS

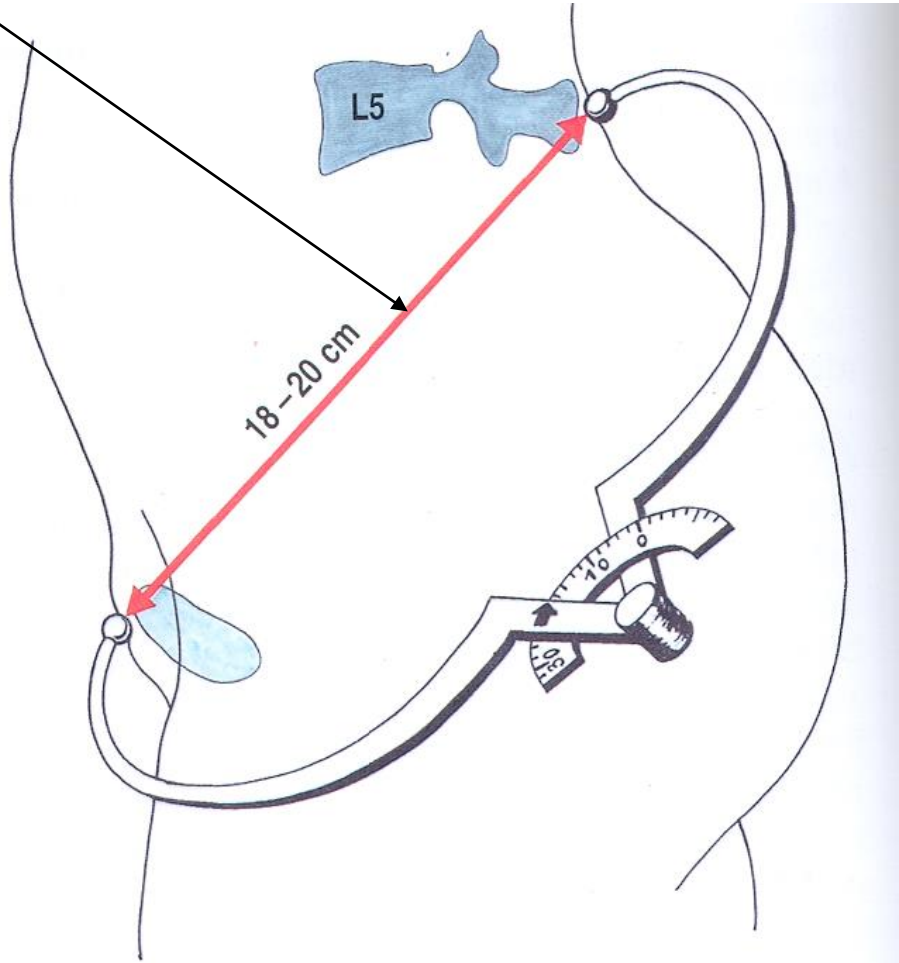

Sacral
Promontory
Symphysis
Pubis
11.5 cm



Delivery pelvic diameters - *internal*

- conjugata obstetrica (orange) = minimally 10,5 cm
- conjugata diagonalis (green) = minimally 12 cm
- conjugata externa *Baudelocqui* = minimally 18 cm, better 20 cm – *external diameter !!!*





Delivery pelvic diameters - *external*

- conjugata obstetrica (vera):

promontorium → eminetia retropubica

  – real anteroposterior diameter of pelvic entrance

  – shorter then diameter recta (conjugata anatomica) – minimally 10.5 cm

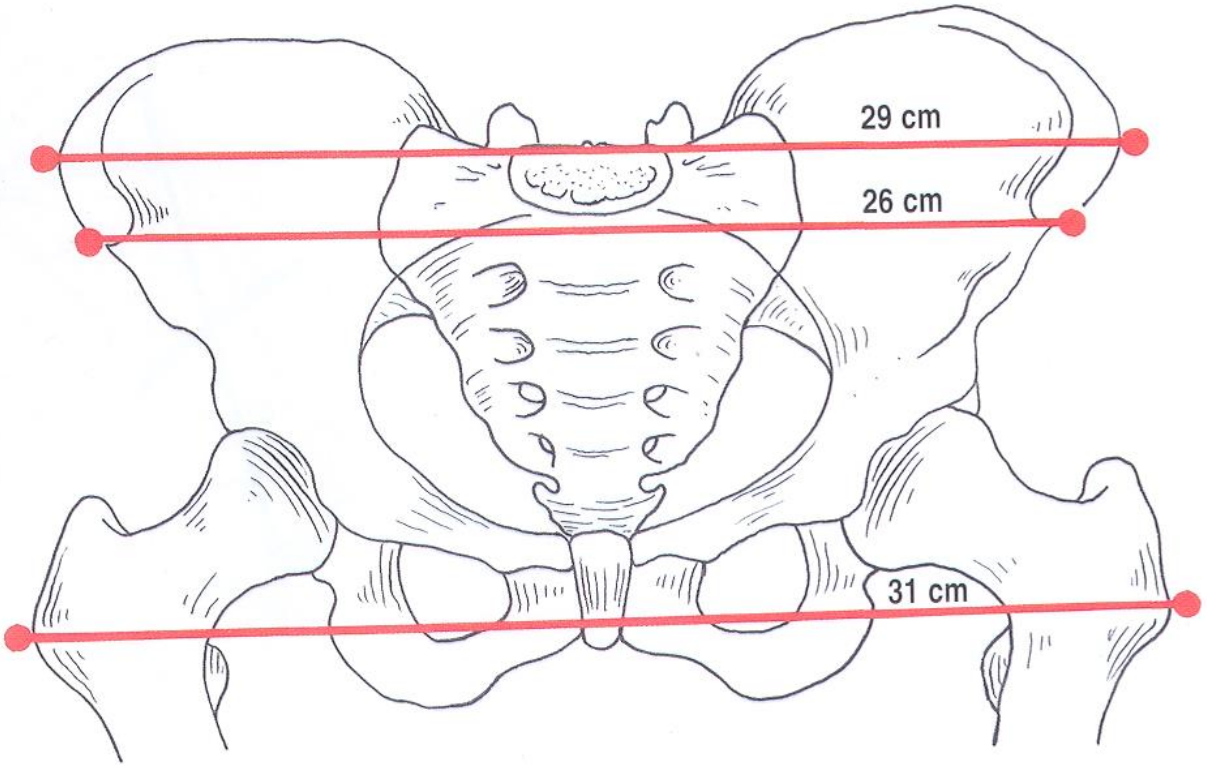
- conjugata diagonalis:

promontorium → lower margin of symphysis pubica (lig. pubicum inf.)

  – minimally 13 cm for normal passage of head

Delivery pelvic diameters - *external*

- distantia interspinosa = minimally 26 cm
- distantia intercristalis = minimally 29 cm
- distantia intertrochanterica = minimally 31 cm



Delivery pelvic diameters - *external*

- distantia interspinosa:

between spinae iliacae ant. sup. (SIAS) = minimally 26 cm

- distantia intercristalis:

between most distant margins of cristae iliacae = minimally 29 cm

- distantia intertrochanterica:

between most distant margins of trochanteres majores = minimally 31 cm

- conjugata externa (diameter Baudelocquei):

between processus spinosus L5 and upper margin of symphysis pubica = minimally 18 cm (better 20 cm)

Hard delivery canal

- delivery canal – 16 cm
- Michaelis‘ rhomboid:
  - L5 → symphysis sacrococcygea: 11 cm
  - spinae iliacae posteriores superiores: 10 cm

- fetus weight: 3400 g