

# **BASES OF ANATOMY**

**Marek Joukal, M.D., Ph.D.**

**[mjoukal@med.muni.cz](mailto:mjoukal@med.muni.cz)**

**Department of Anatomy, Faculty of Medicine  
Masaryk University**



# Recommended literature

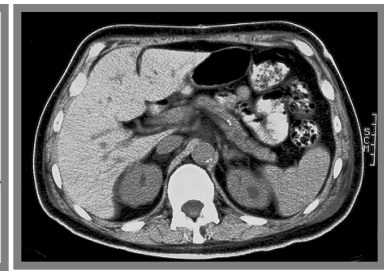
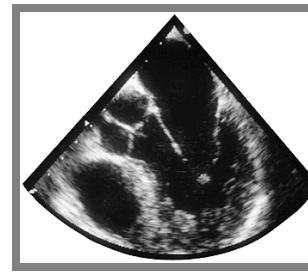
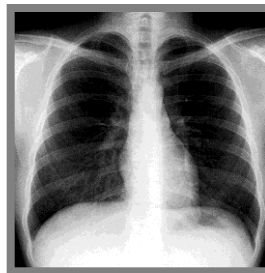
- **LECTURES**
- **Gray's Basic Anatomy, Churchill Livingstone, 2013**
- **Instant Anatomy, Wiley-Blackwell, 2010**
- **Anatomy atlases: Netter, Sobotta, Pocket atlas etc.**
- **<http://www.dartmouth.edu/~humananatomy/>**

# **INTRODUCTION INTO** **ANATOMY**

**History, surface planes and directions on human  
body, tissues**

# Anatomy

- **Science of form, organisation, structure and posture of human body and its parts**
- **Macroscopic anatomy (systemic, general anatomy, special, topographical)**
- **Comparative anatomy, experimental anatomy, applied anatomy**
- **„Anatemnein“= to cut, dissection**



# History

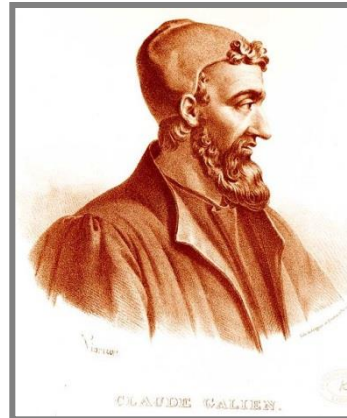
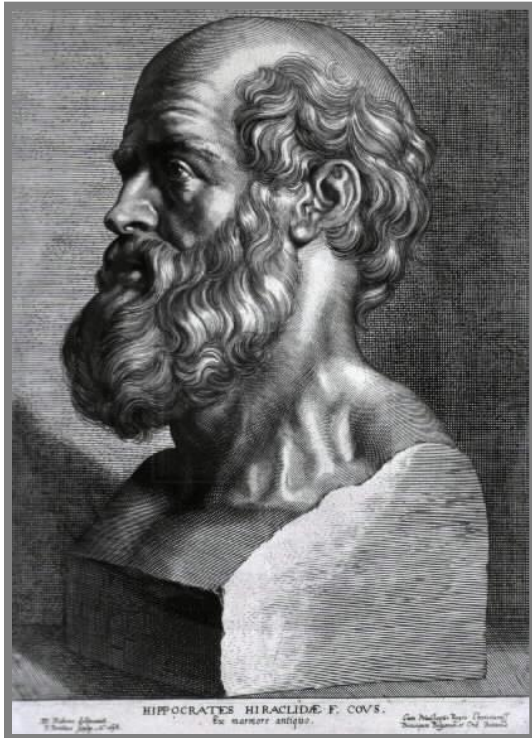
Egypt – mummification

Greece – **Hippocrates** (460 B.C.) and his disciples – „*Corpus Hippocraticum*“

**Aristoteles** (384 B.C.) – tendons, nerves, joints

**Hérofilos** (335 B.C.) – dissection of human body (several terms, e.g. duodenum)

**Galen of Pergamon** (2nd century) – anatomy is a basic, dissection of animals

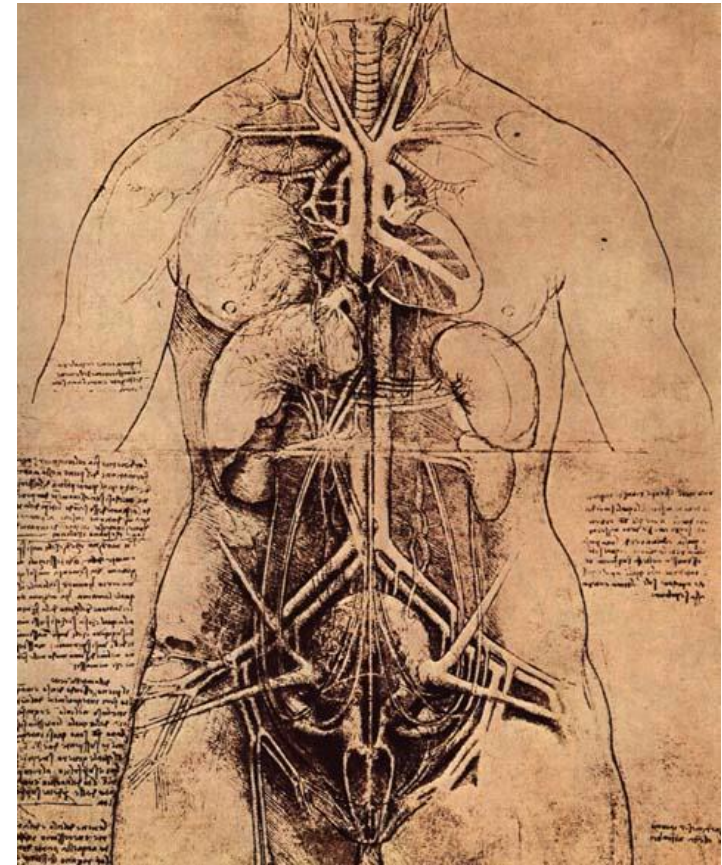
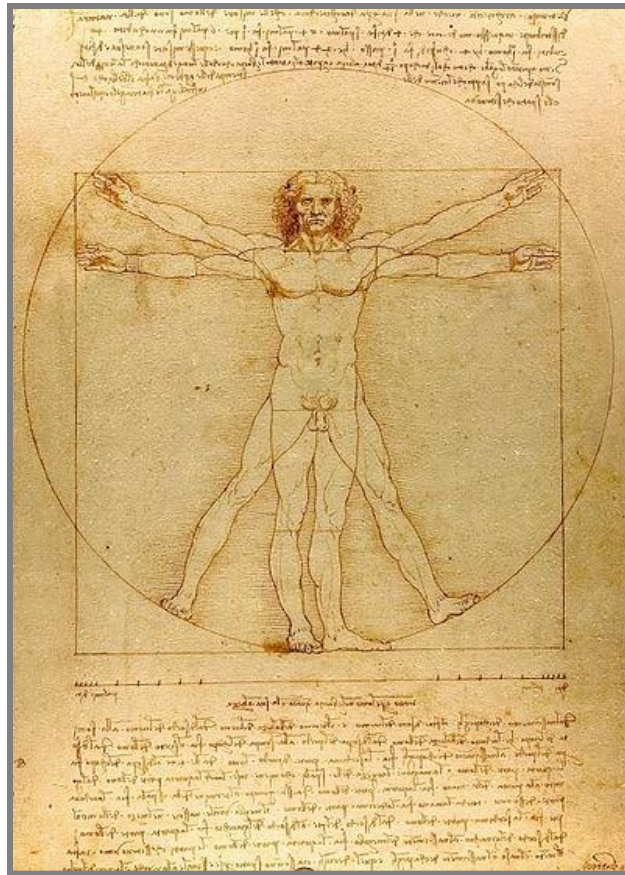




**Middle Ages** – stagnation, dissection is prohibited, Galen's medicine

**Rennaisance** – letterpress, dissections in faculties of medicine

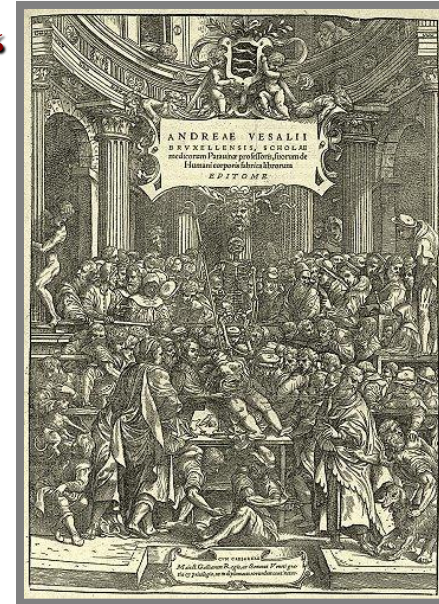
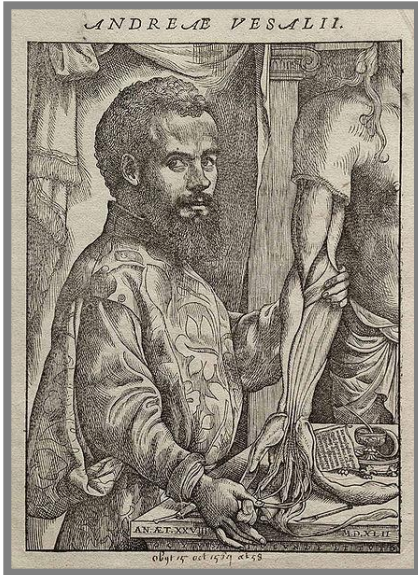
**Leonardo da Vinci (1452)** – dissection, locomotor system, cardiovascular system





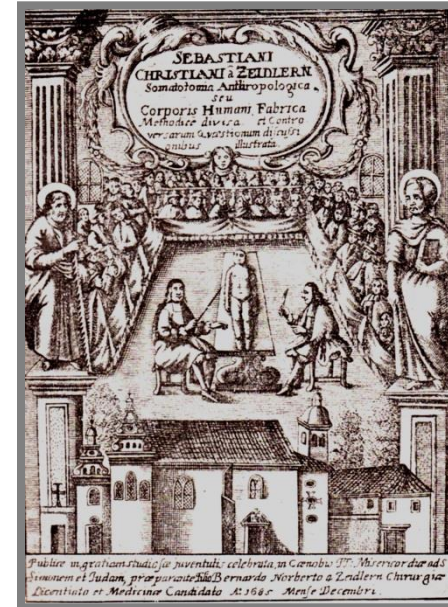
## Andreas Vesalius (1514 – 1564)

*„De humanis corporis fabrica libri septem“  
- The first public dissection  
„Tabulae anatomicae sex“*



## Ján Jesenský (1655 – 1621)

1600 the first **public** dissection in Prague





**William Harvey (1578) – Blood circulation**



**Jan Evangelista Purkyně (1787) – Purkyně's fibres, cells**

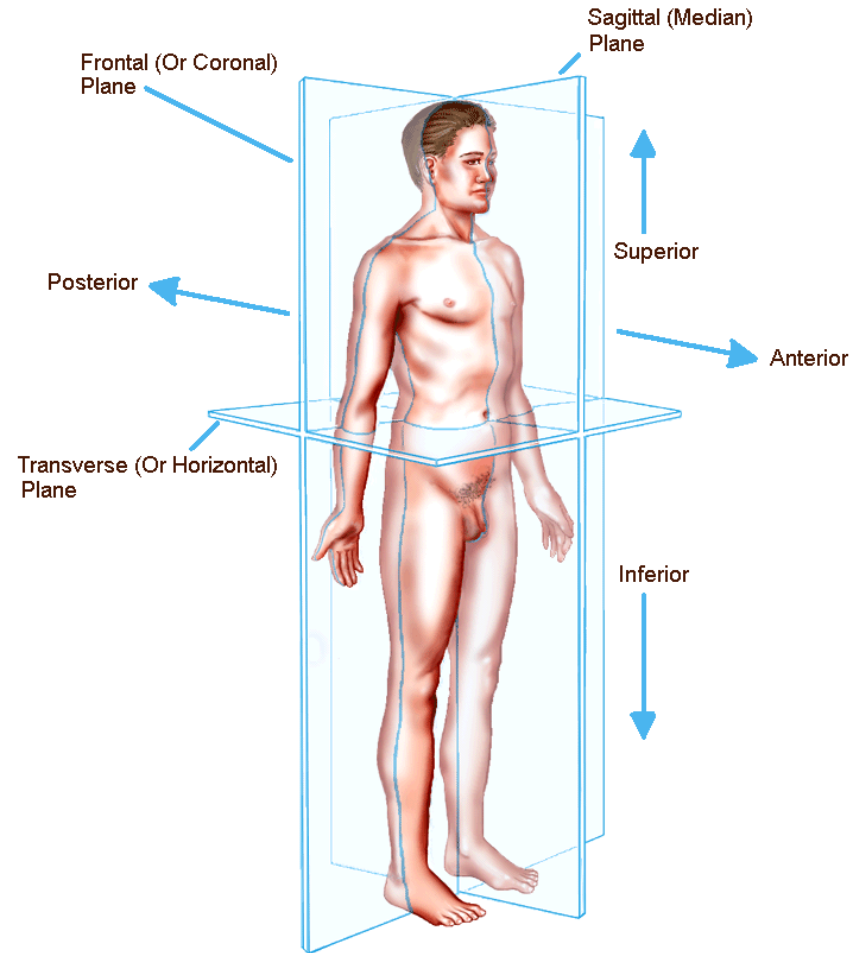


# Anatomical orientation

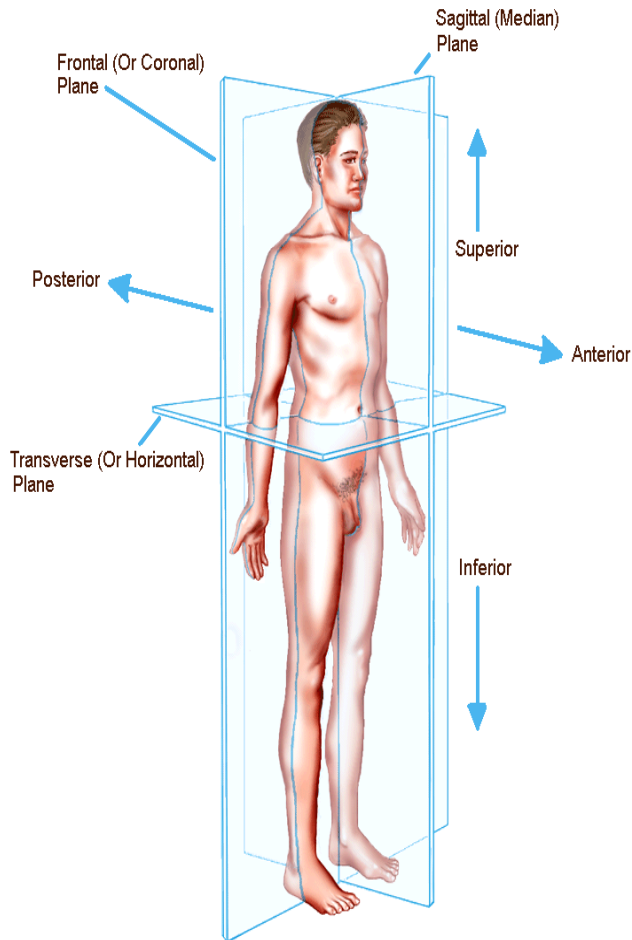
## Anatomical position



## Surface planes



# Directions:



## Longitudinal axis:

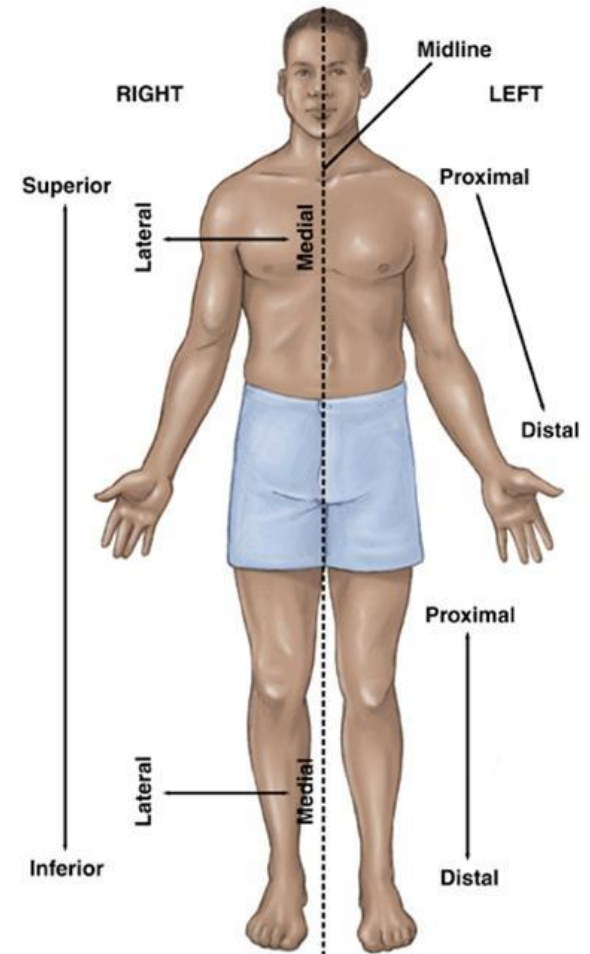
- ***Cranial (superior)***
- ***Caudal (inferior)***

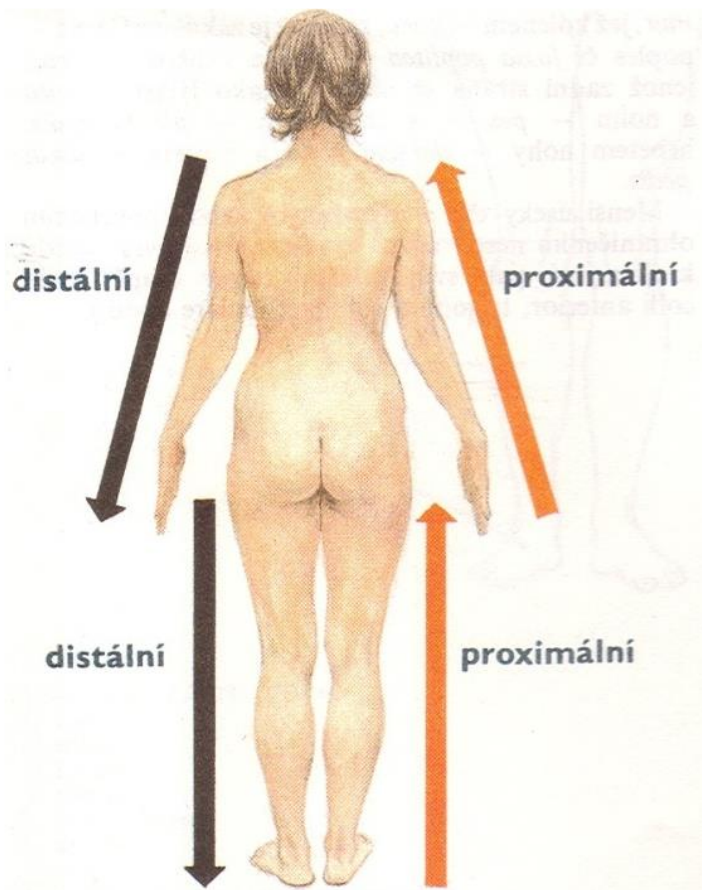
## Transverse axis:

- ***Medial***
- ***Lateral***
- ***Medius***
- ***Medianus***
- ***Dexter***
- ***Sinister***

## Sagittal axis:

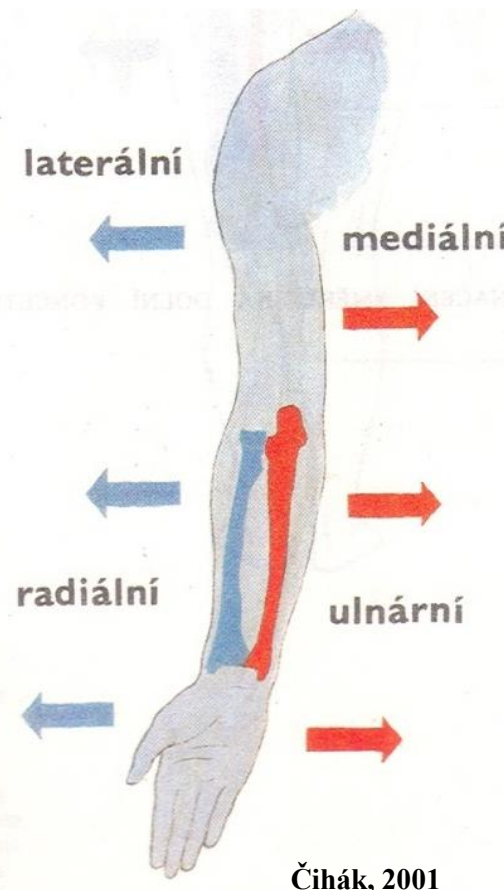
- ***Ventral (anterior)***
- ***Dorsal (posterior)***
- ***Internus (profundus)***
- ***Externus (superficial)***





**Extremities**

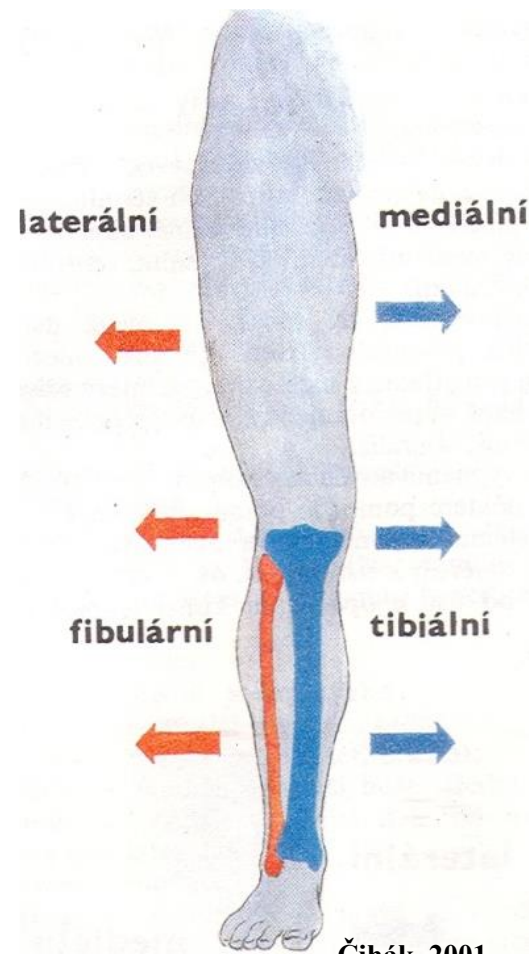
**Proximal**  
**Distal**



Čihák, 2001

**Upper limb:**

**Radial (lateral)**  
**Ulnar (medial)**  
**Palmar**  
**Dorsal**



Čihák, 2001

**Lower limb:**

**Tibial (medial)**  
**Fibular (lateral)**  
**Plantar**  
**Dorsal**

# Parts of body

head – *caput*

neck – *collum (cervix)*

trunk – *truncus*

*thorax*

*abdomen*

back – *dorsum*

*pelvis*

Upper extremity – *membrum superius*

arm – *brachium*

forearm – *antebrachium*

hand – *manus*

Lower extremity – *membrum inferius*

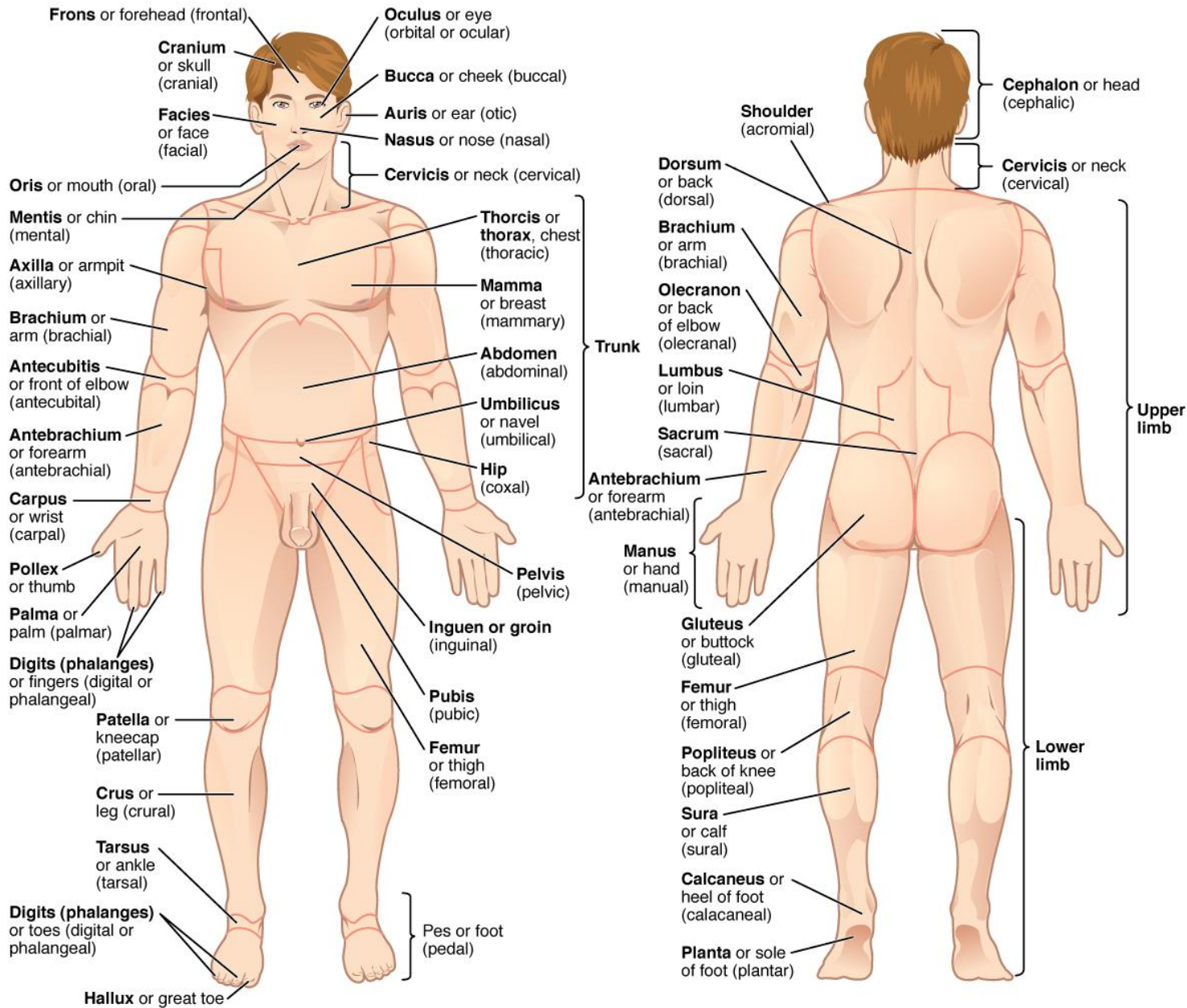
thigh – *femur*

*crus*

Foot - *pes*







(a) Anterior view

(b) Posterior view

# **Tissue**

**A part of an organism consisting of a large number of cells having a similar structure and function.**

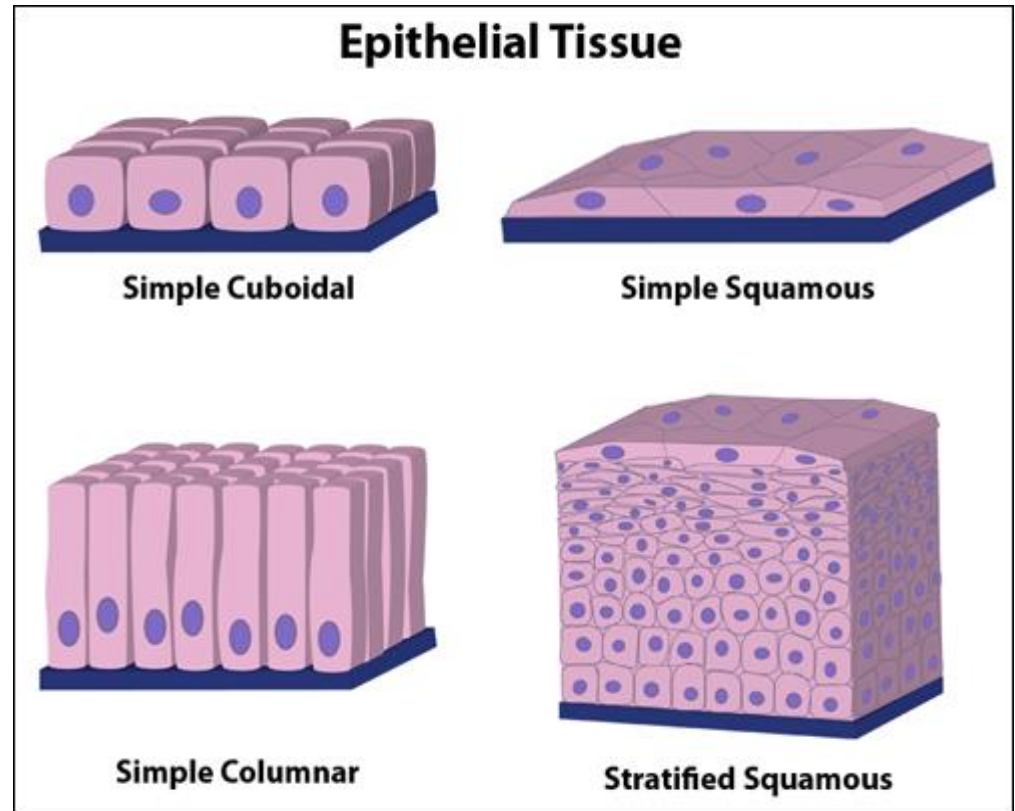
- 1. Epithelial tissue**
- 2. Connective tissue**
- 3. Muscular tissue**
- 4. Nervous tissue**

## Epithelial tissue

Covers the body, lines the cavities of the body and composes the glands

**Simple epithelium:** single layer of cells

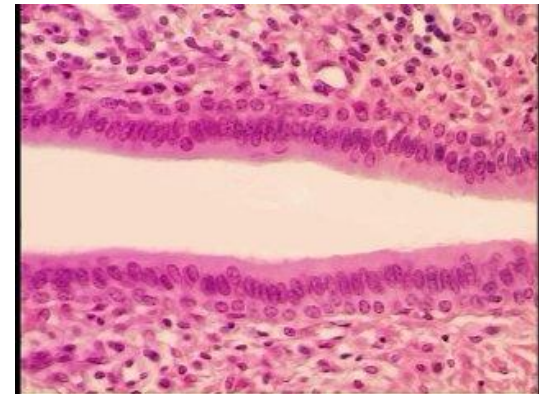
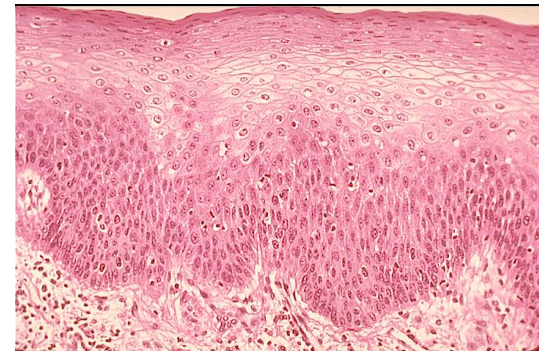
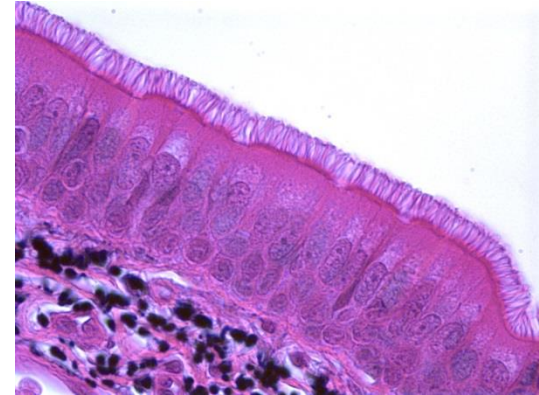
- **Simple squamous:** thin squamous cells, lining of cavities (the mouth, blood vessels and lungs)
- **Simple cuboidal:** cuboidal cells, found in glands, duct and portions of the kidney tubules.
- **Simple columnar:** A single layer of tall, skinny cells (column shaped), found in places like the lining of the intestine and gallbladder



<http://www.hartnell.edu/tutorials/biology/tissues.html>

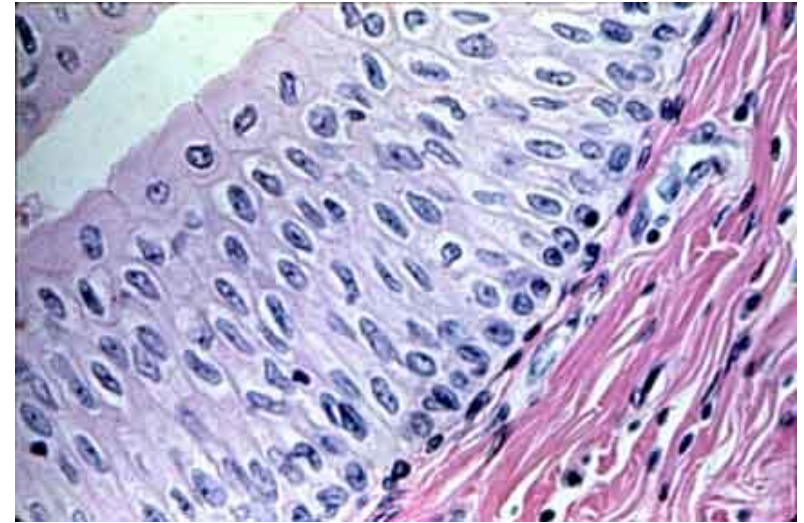
## **Stratified epithelium:** the tissue is two or more cells thick

- **Pseudostratified columnar:** appears to be composed of layers of cells, but is in fact composed of just a single layer of cells, as each cell touches the basement membrane, line the nasal cavity, bronchi and trachea.
- **Stratified squamous:** Many layers of cells are present, the topmost layer is made up of squamous cells, makes up the skin surface and lining of the mouth, through and esophagus.
- **Stratified columnar:** Many layers of cells, the topmost layer is made up of columnar cells, found in the mammary ducts and epididymis.



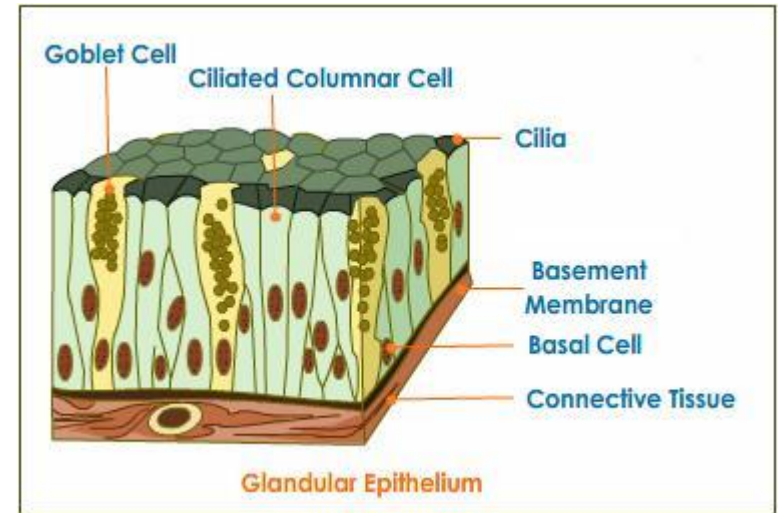


- **Transitional:** Multiple layers of cells, but surface cells change from rounded to flat to permit expansion when needed, found in the urinary bladder, renal pelvis and ureters.



<http://www.hartnell.edu/tutorials/biology/tissues.html>

- **Glandular:** Columnar and cuboidal cells often become specialized as gland cells which are capable of secreting substances such as enzymes, hormones, mucus, sweat and saliva; e.g. salivary, sweat and adrenal glands.



<http://www.tutorvista.com/content/science/science-i/tissues/epithelial-tissue.php>

## Connective tissue

**Connects and supports the structures of the body, providing structural support and binding organs together.**

**Loose connective tissue – fibrocytes, skin**

**Dense connective tissue – regular (tendons), irregular (dermis)**

**Cartilage – chondrocytes, extracellular matrix, collagen and elastic fibres**

- 1. hyaline cartilage – the most common type of cartilage, contains many collagen fibers; joints**
- 2. elastic cartilage - many elastic fibers in the matrix; auricular cartilage**
- 3. fibrocartilage - tough and contains many collagen fibers; intervertebral disc**

**Bone**

# Bone

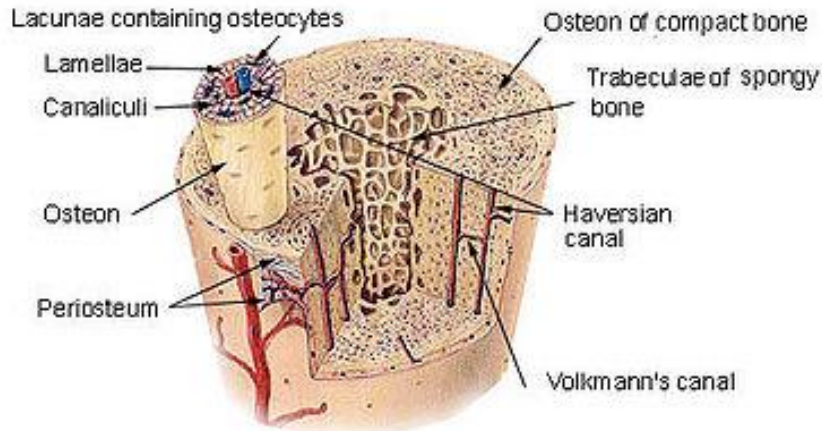
1. Osteocytes
2. Bone matrix – organic substances (osein), 20-40%  
anorganic substances (Ca, P, F...), 60-75%

**Lamellar organization – Havers canals**

**Spongy bone – trajectories, arcitecture**

**Compact bone**

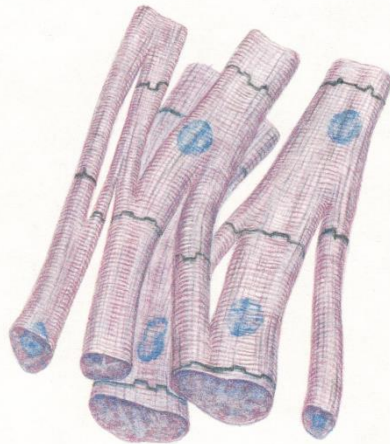
## Compact Bone & Spongy (Cancellous Bone)



# Muscle tissue

**Muscle tissue is characterized by the ability to contract when stimulated.**

- 1. Skeletal muscle: long, multinucleate cells with visible striations, voluntary muscle**
- 2. Smooth muscle: short, cylindrical cells, involuntary muscle; e.g. digestive tract, walls of blood vessels**
- 3. Cardiac (heart) muscle: short, branched, striated cells, with one nucleus at the center of each cell, joined to their neighbors by intercalated discs, involuntary muscle**





# Nervous tissue

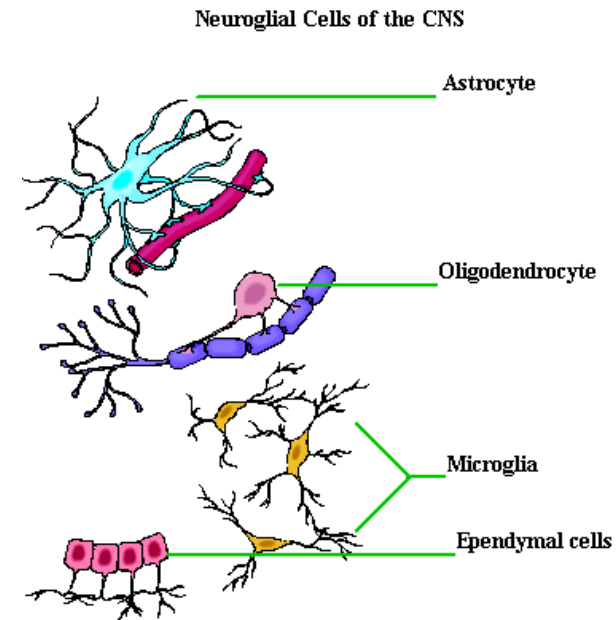
**Highly specialized tissue, characterized by irritation, conduction and integration.**

**Neuroglia - do not send or receive electrical impulses, but support neurons (physical support, providing nutrients, removing debris and providing electrical insulation)**

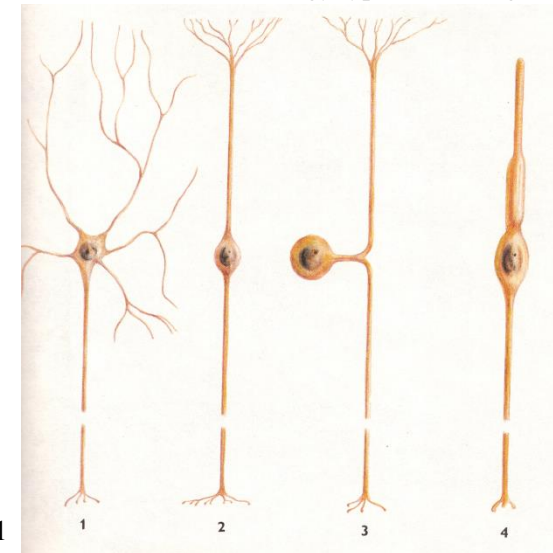
**Neurons: carry electrical impulses.**

**Three main types of neurons:**

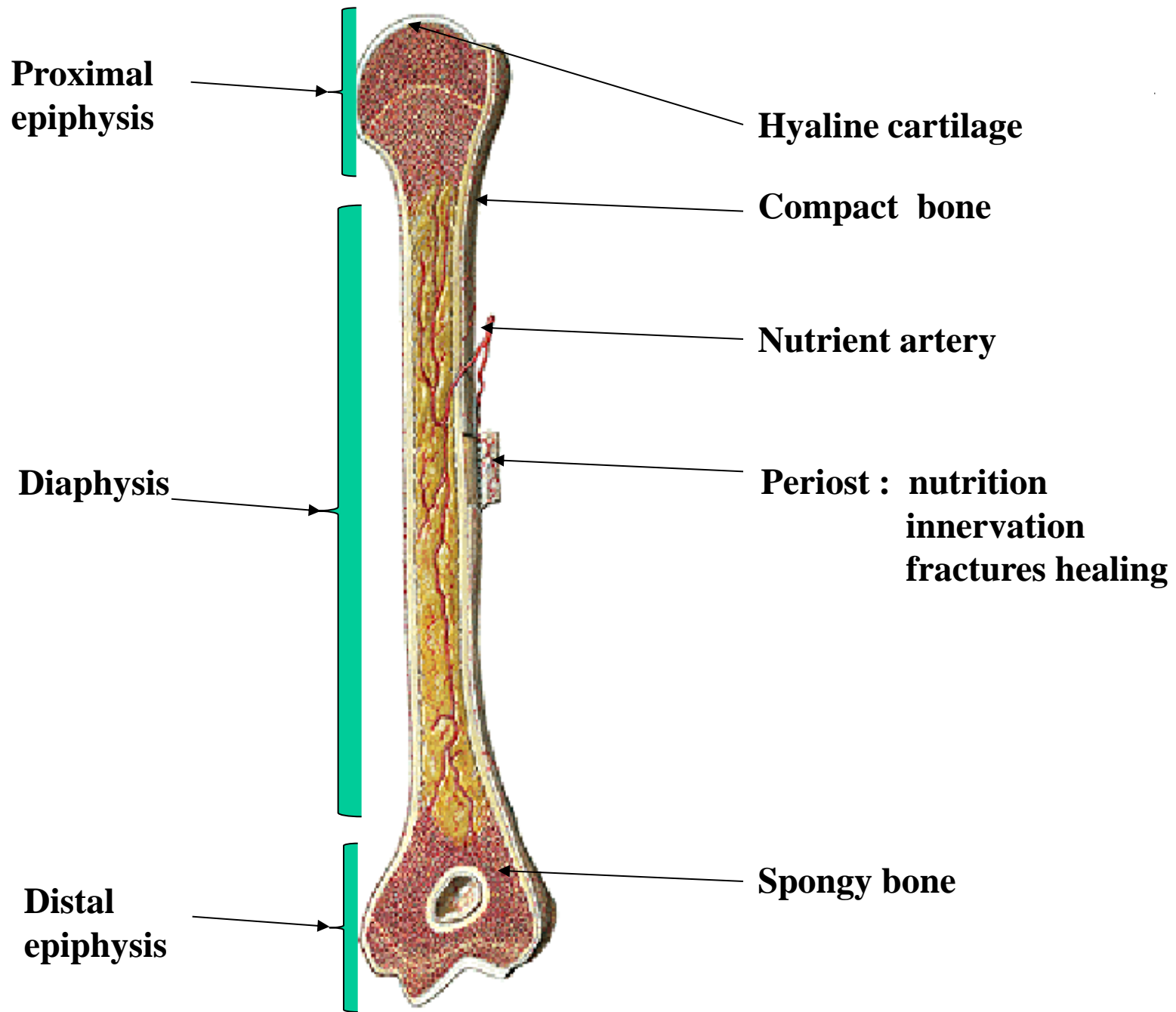
1. **Sensory neurons** - conduct impulses from the sensory organs (eyes, nose, ears, etc) to the central nervous system (brain and spinal cord).
2. **Motor neurons** - responsible for conducting impulses from the central nervous system to the effector organs (muscles and glands)
3. **Interneurons** are those neurons that connect sensory neurons to motor neurons.



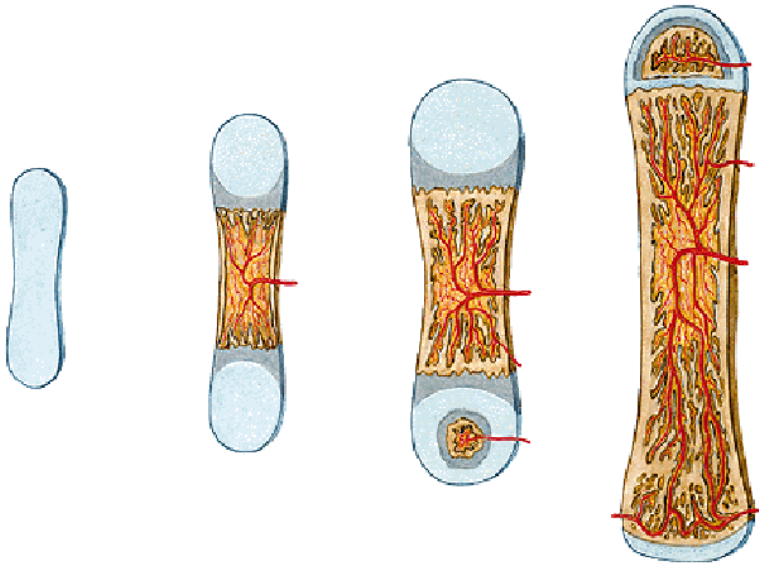
<http://www.tutorvista.com/biology/types-of-neuroglial-cells>



# **OSTEOLOGY AND ARTHROLOGY**

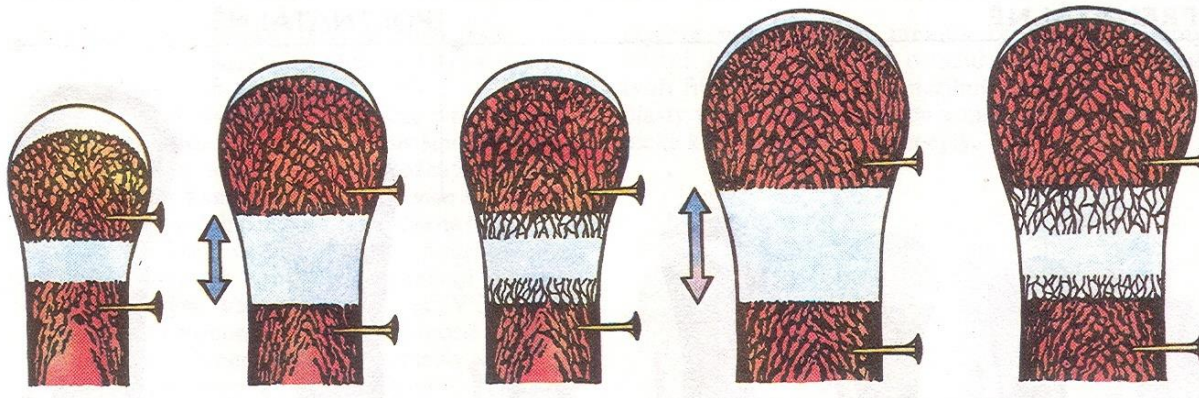


# Ossification and bone growth



**Chondral ossification – long bones**  
**perichondral ossification**  
**enchondral ossification**  
**ossification centre**

**Desmogenous ossification – bone of skull**



**Growth plate – longitudinal growth**

**Periosteum – width growth**

Čihák, 2001

**STH – hypofýza – nanism – gigantism**

**thyroid gland, parathyroid gland, calcium, sexual hormones etc.**



**X-ray picture of 4  
year old children**



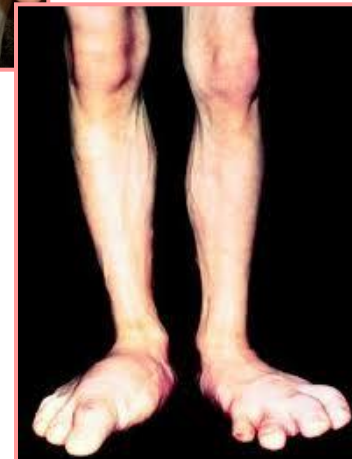
**Ossification centres**

# Adenohypophysis dysfunction

*(higher or lower hormon production or cell receptors miss)*

STH

a) gigantism



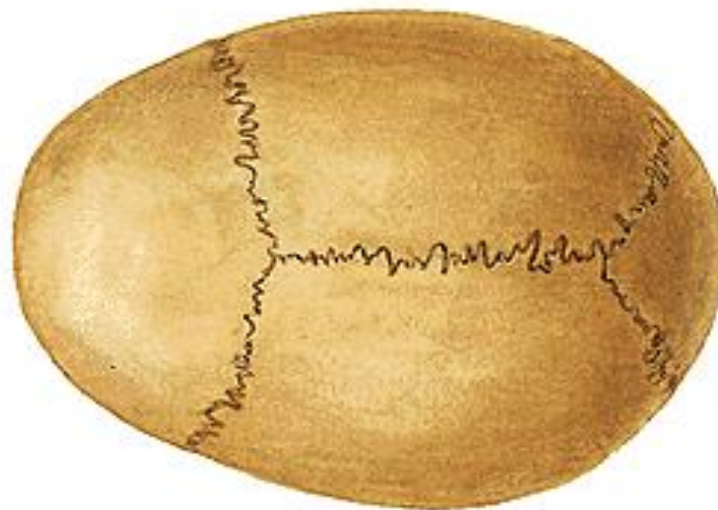
b) Nanism

## Bone connections

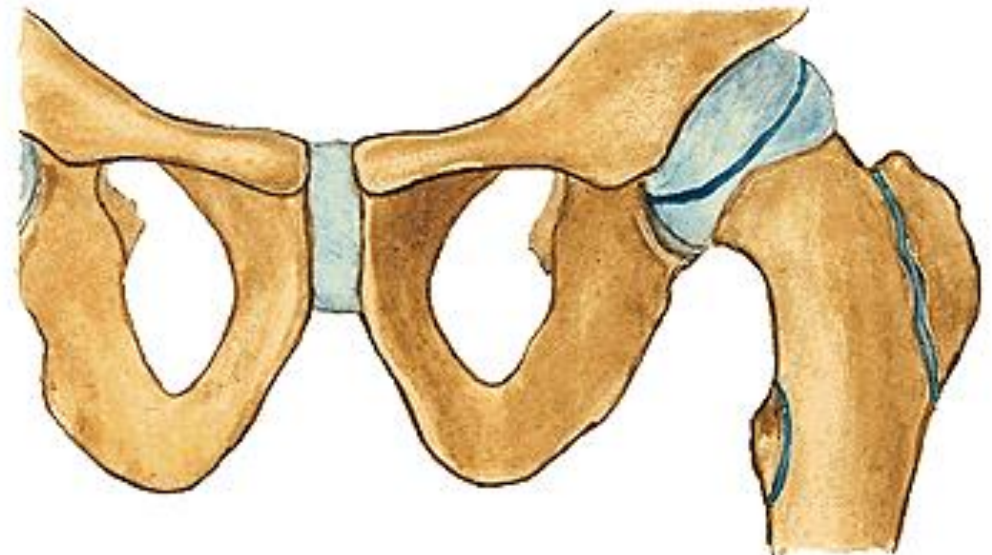
### A) Synarthroses

(connective tissue, unmoveable)

#### 1) Syndesmosis - suture

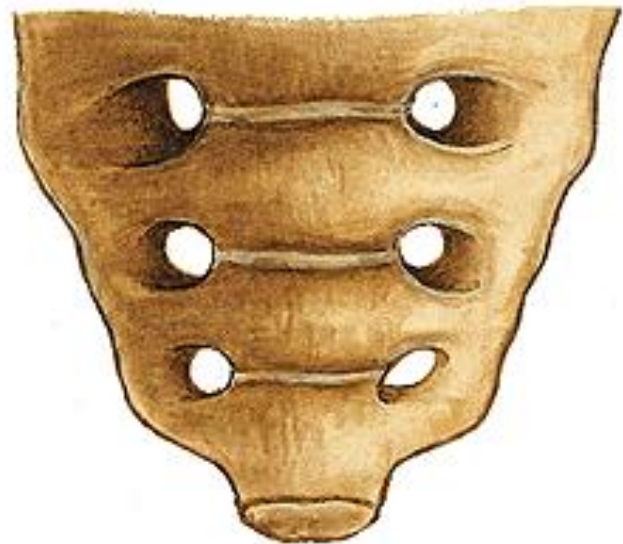


2) Synchondrosis: cartilage, *symphysis pubica*





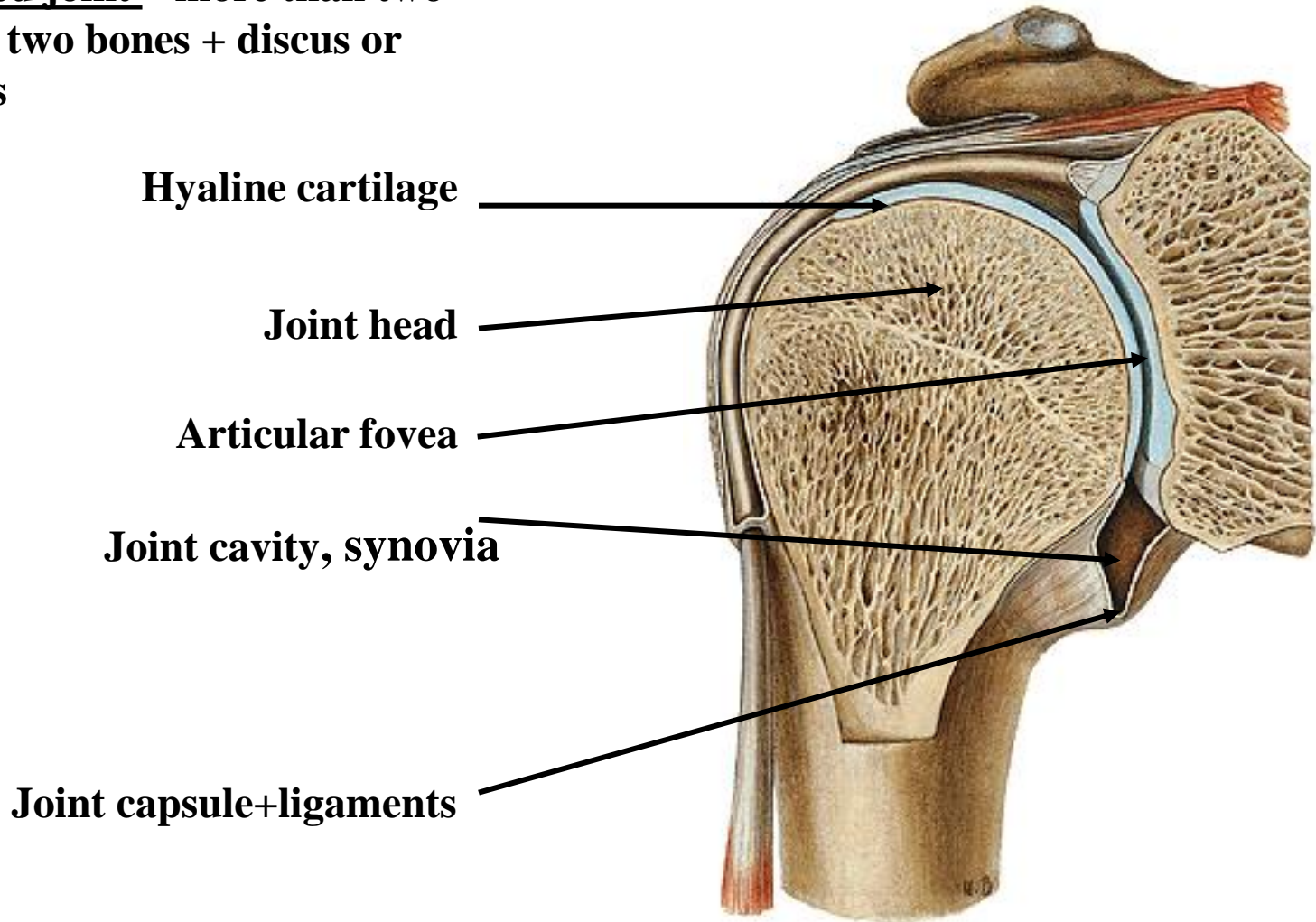
### 3) Synostosis – bone, e.g. sacral bone



## **B) Diarthroses**

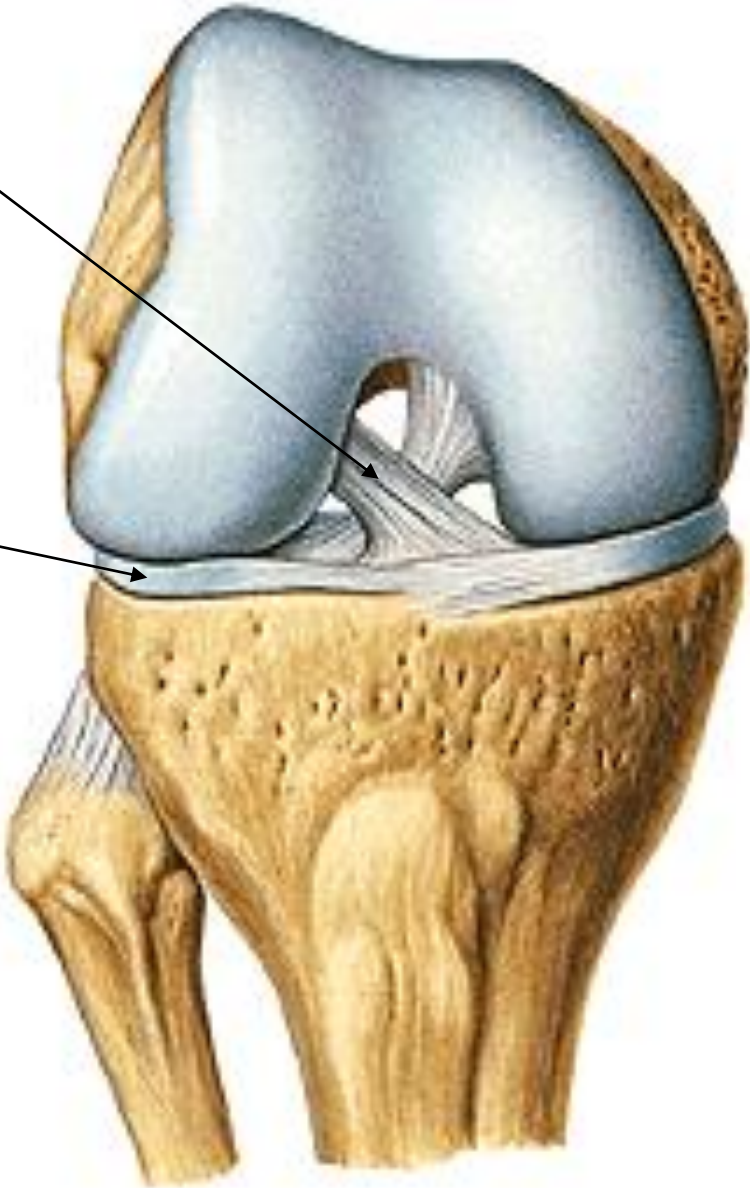
**(joint connection with contact, moveable)**

1. **Simple joint** – two bones
2. **Composed joint** – more than two bones or two bones + discus or meniscus



**Cruciate ligaments**

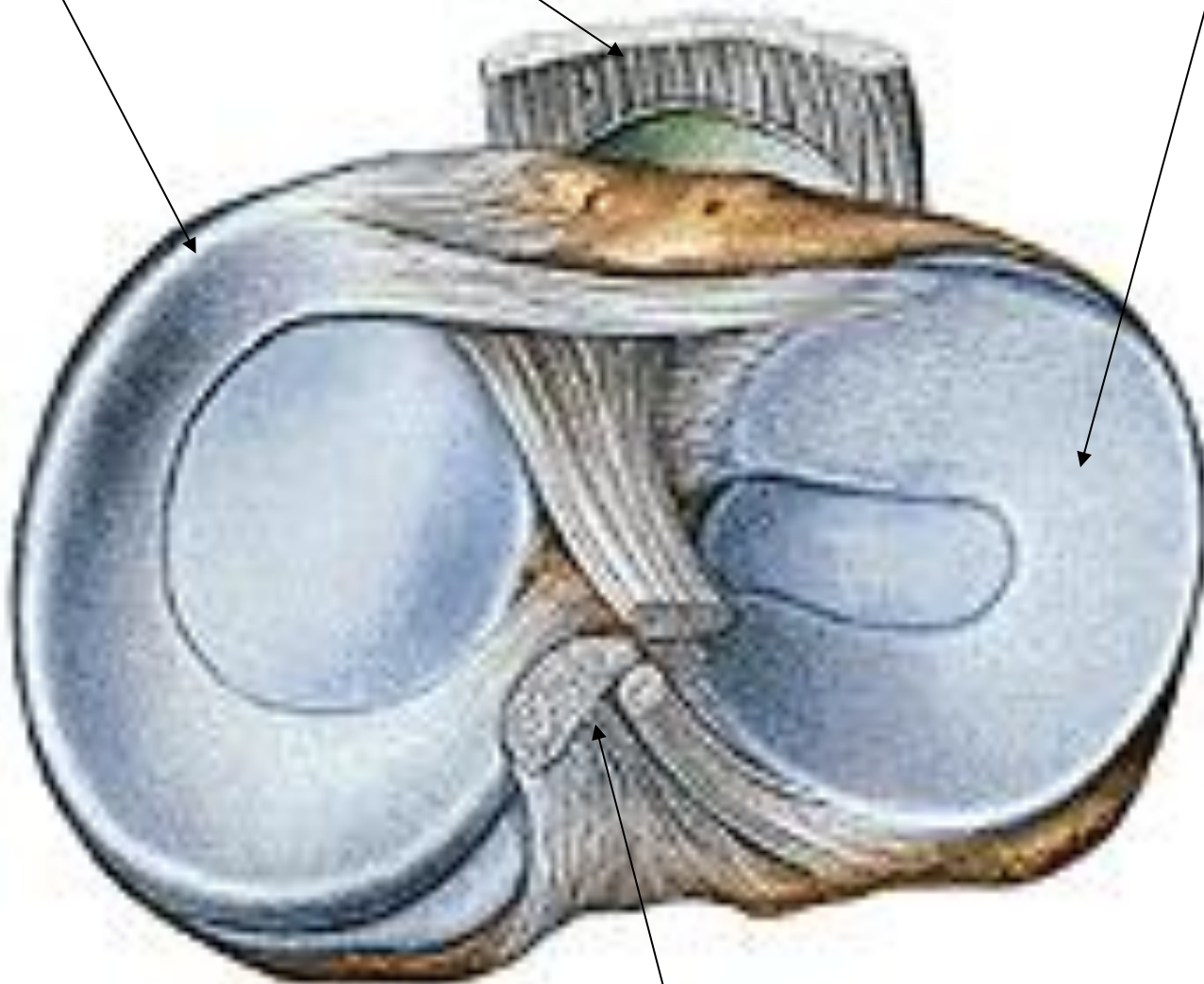
**Meniscus lateralis**



**Meniscus med.**

**Tendo m.  
quadricip.**

**Meniscus  
lat.**



Sobotta, 2007

**Lig. cruciata, cruciformia**





# **AXIAL SKELETON**

# **Columna vertebralis** (vertebral column)

**Costae** (ribs)

**Sternum**

33-34 originally, 24 free

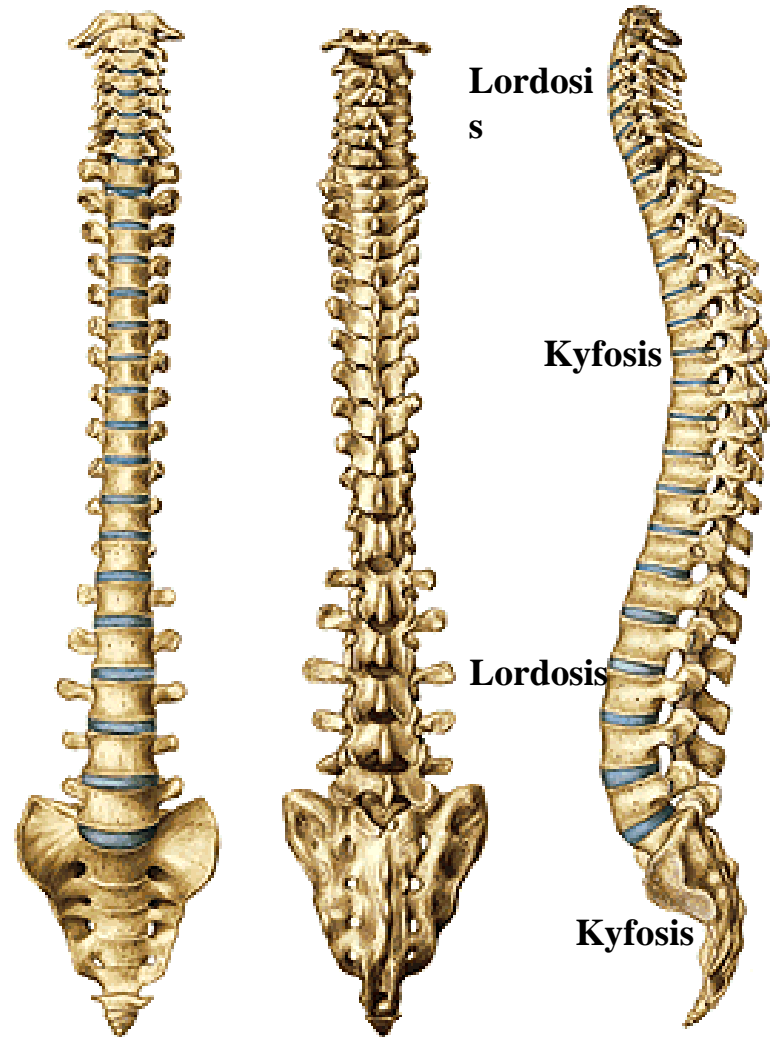
7 vertebrae **cervicales**

12 vertebrae **thoracicae**

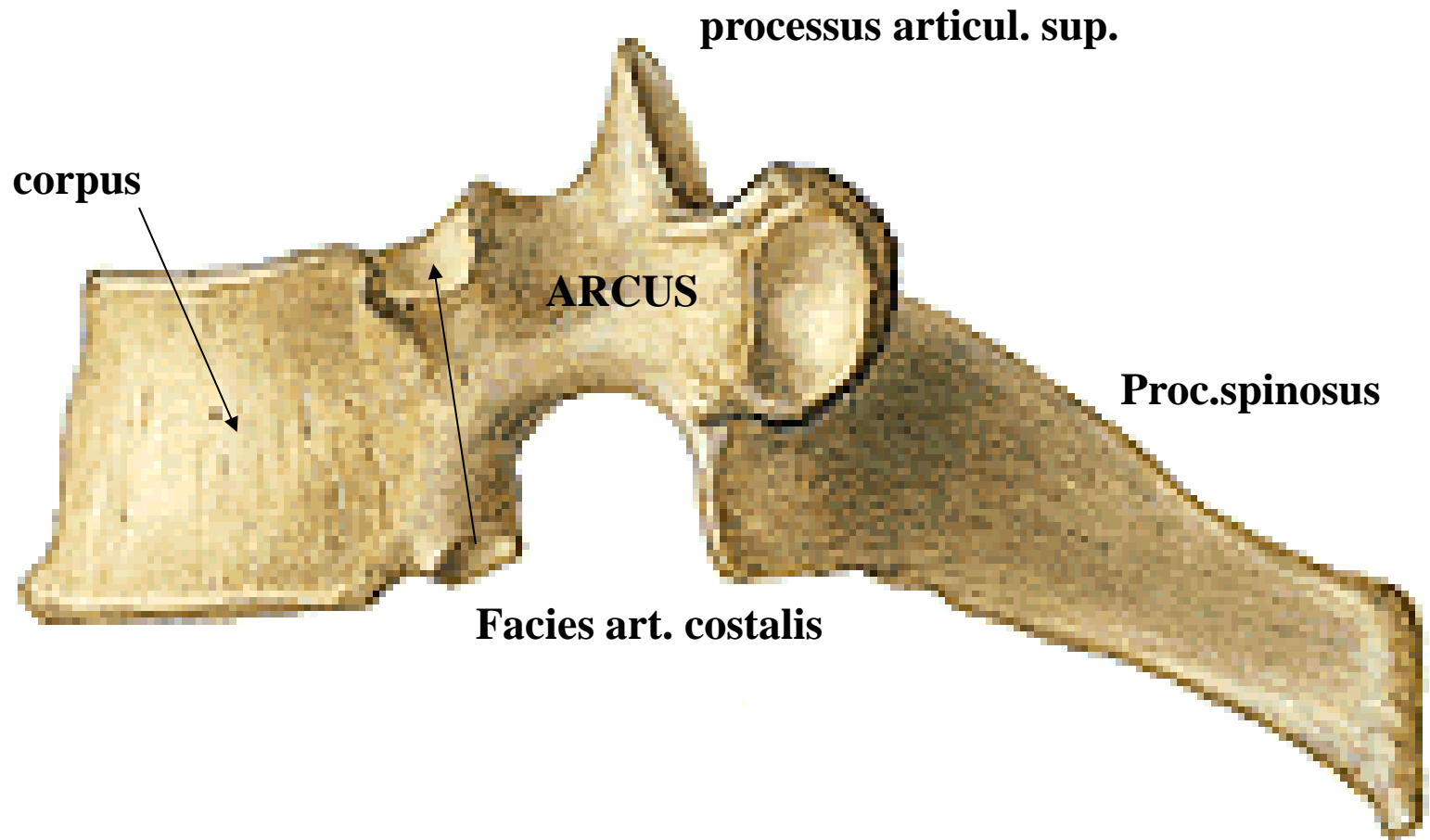
5 vertebrae **lumbales**

5 vertebrae sacrales – **os sacrum**

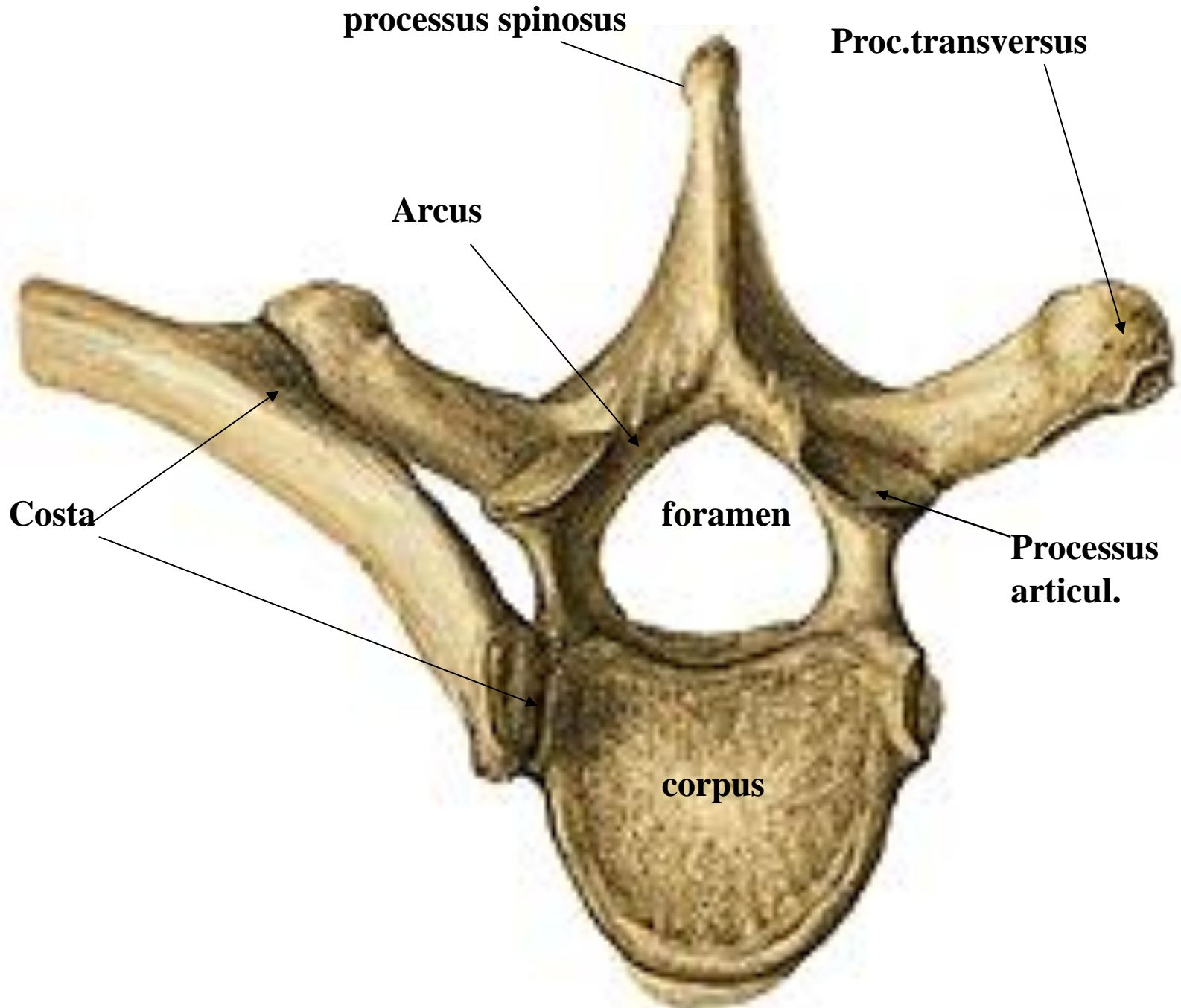
4–5 vertebrae coccygeae – **os coccygis**



# VERTEBRA







**processus spinosus**

**Proc.transversus**

**Arcus**

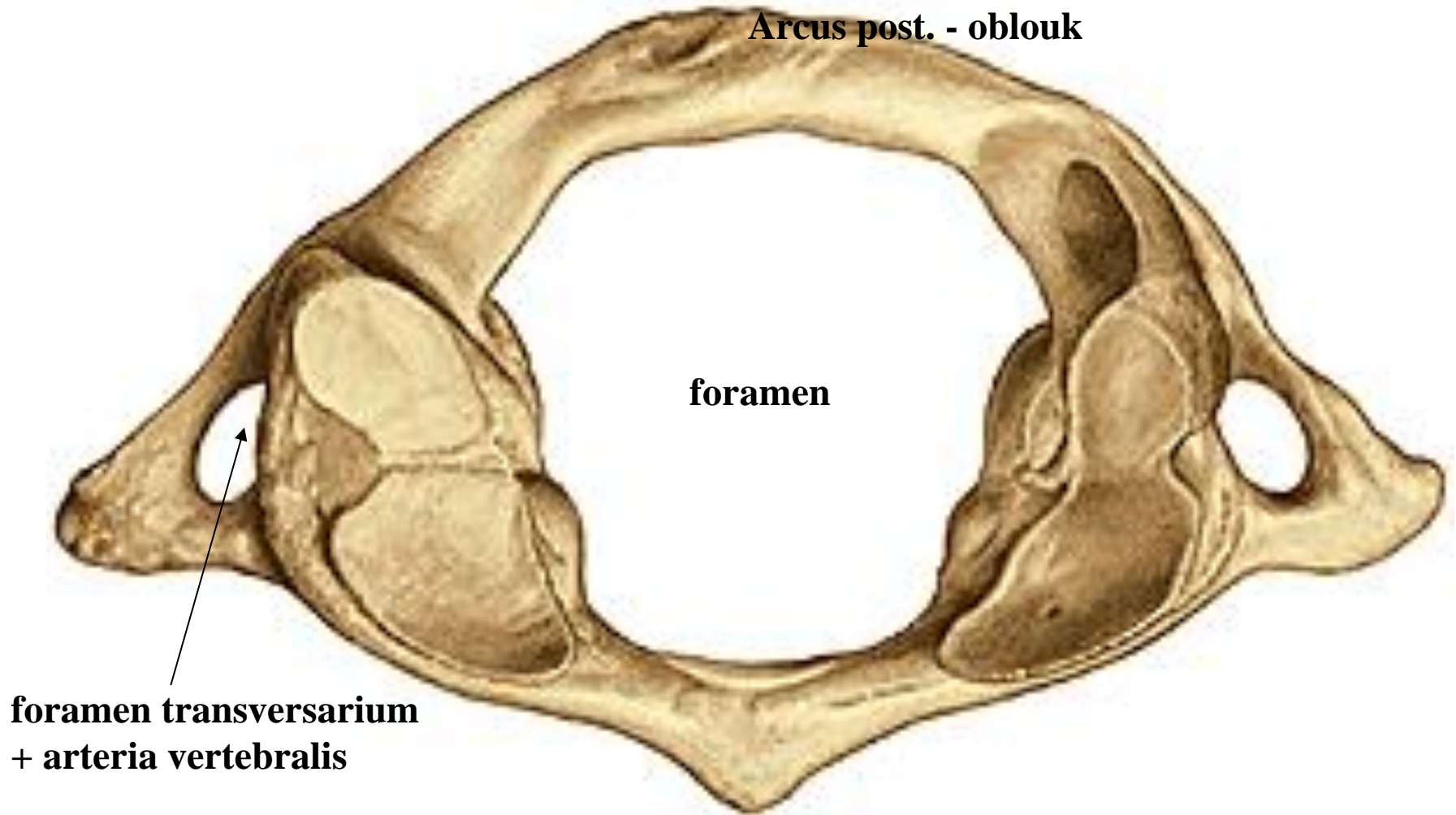
**Costa**

**foramen**

**Processus  
articul.**

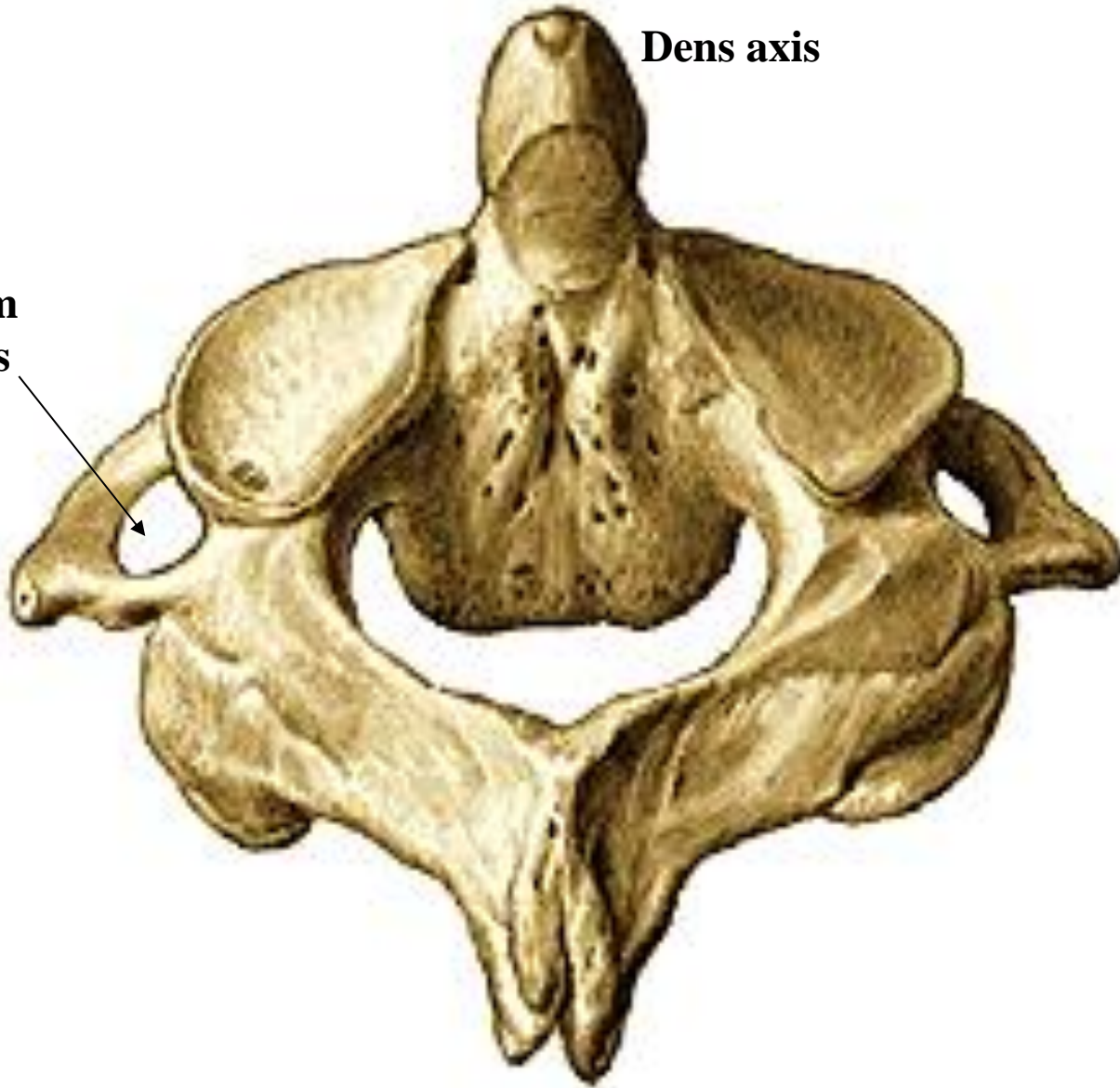
**corpus**

# ATLAS – C1



## AXIS – C2

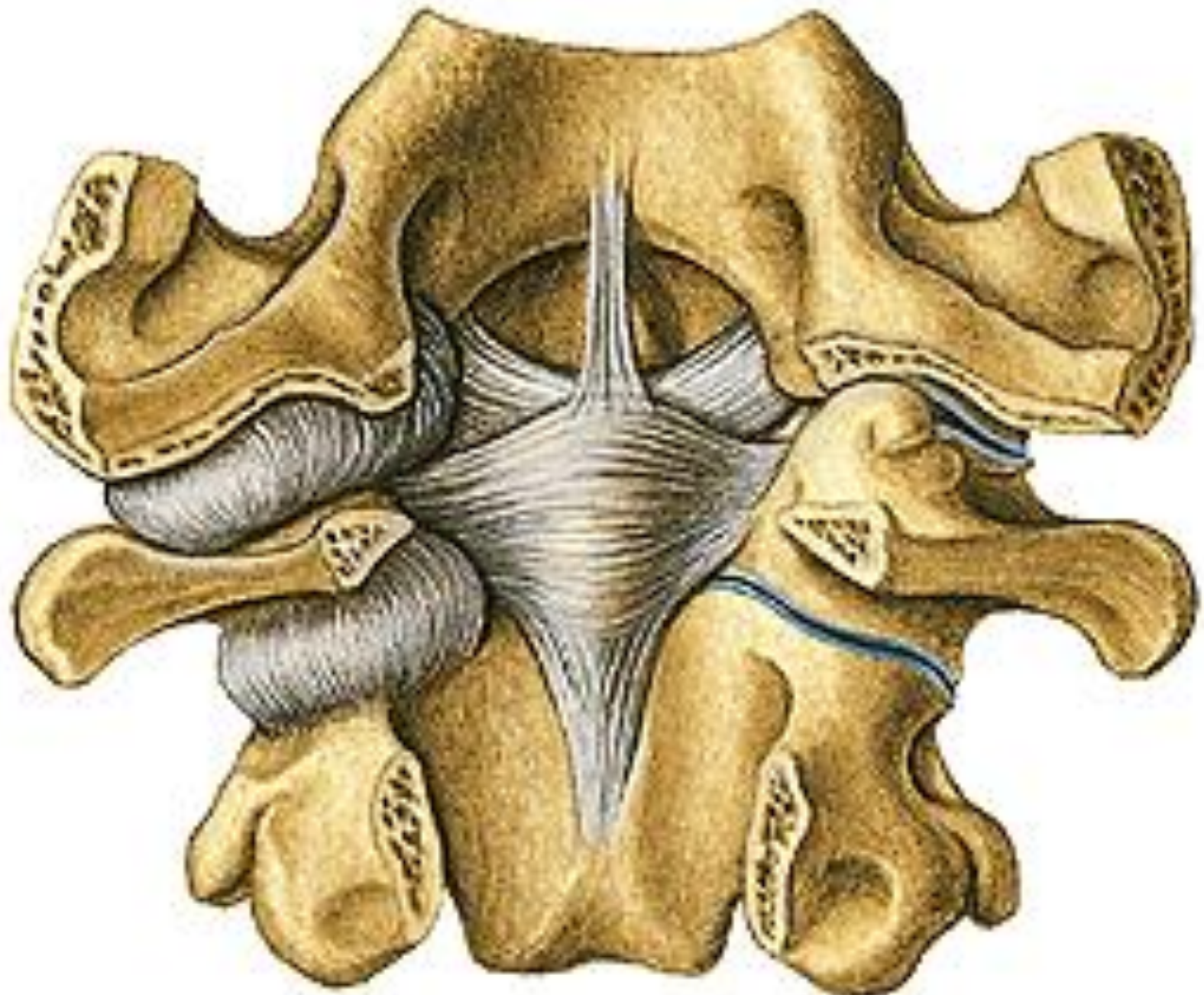
**Foramen  
transversarium  
+ a. vertebralis**



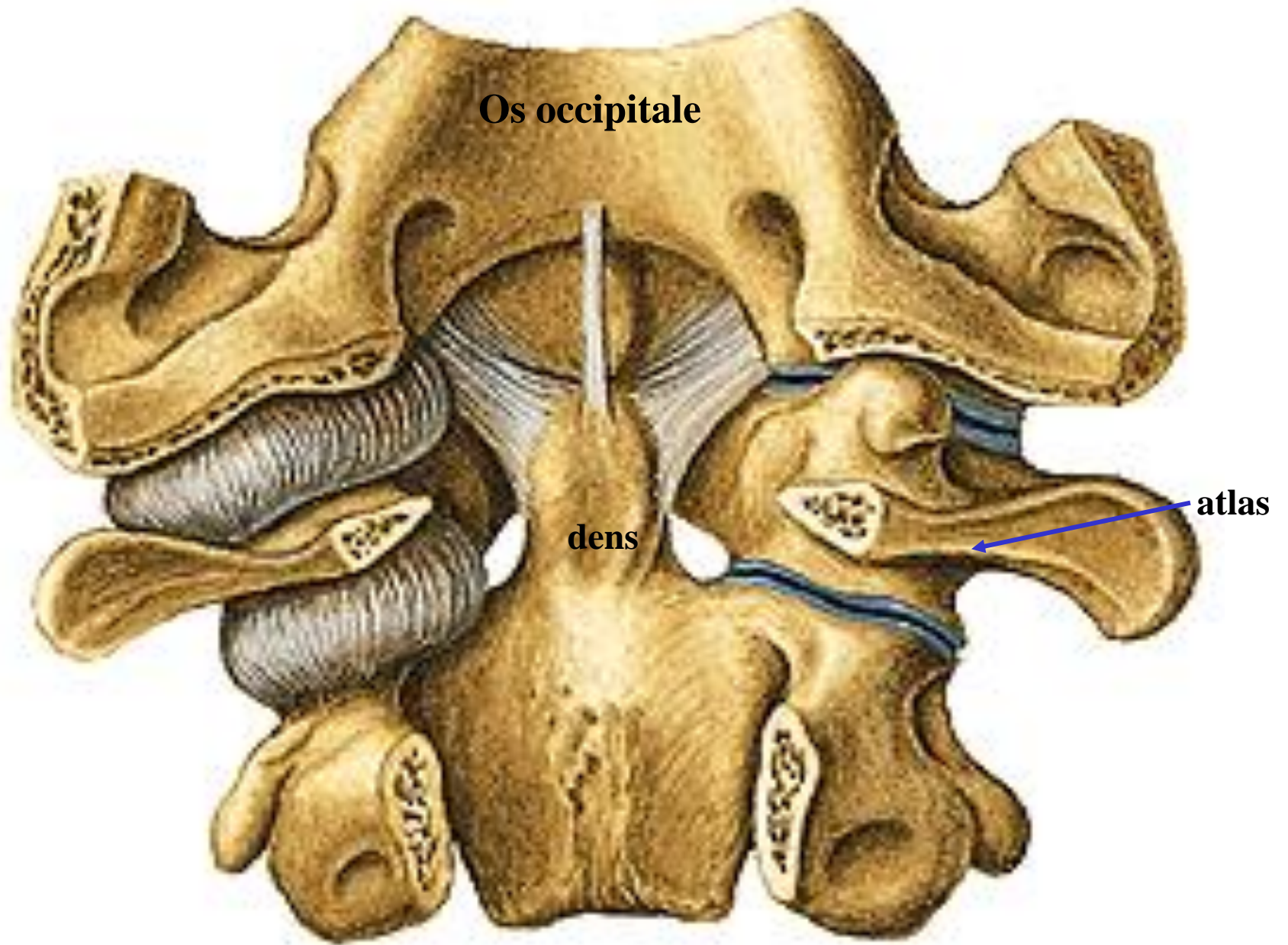




Dens



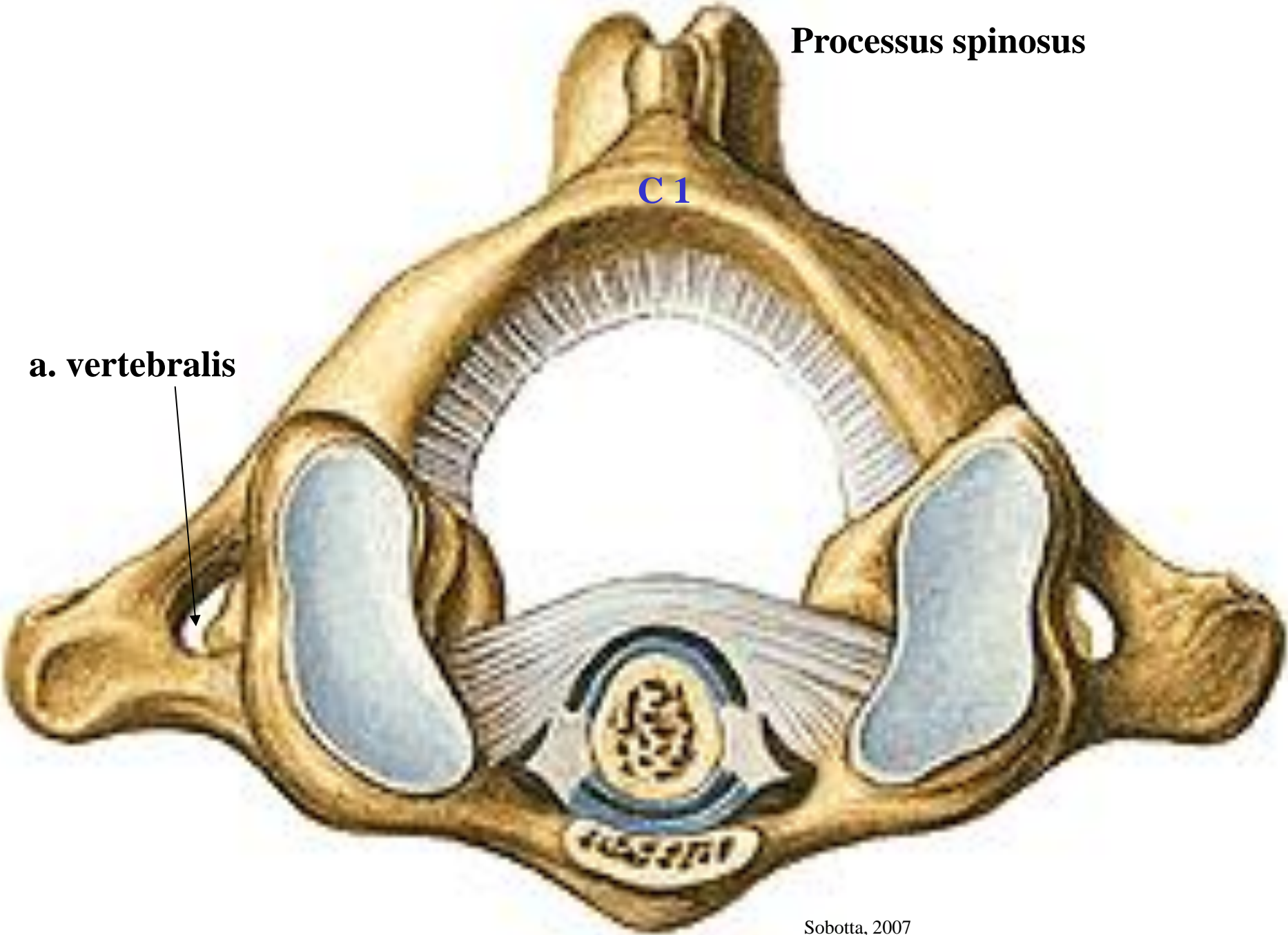




**Processus spinosus**

**C1**

**a. vertebralis**

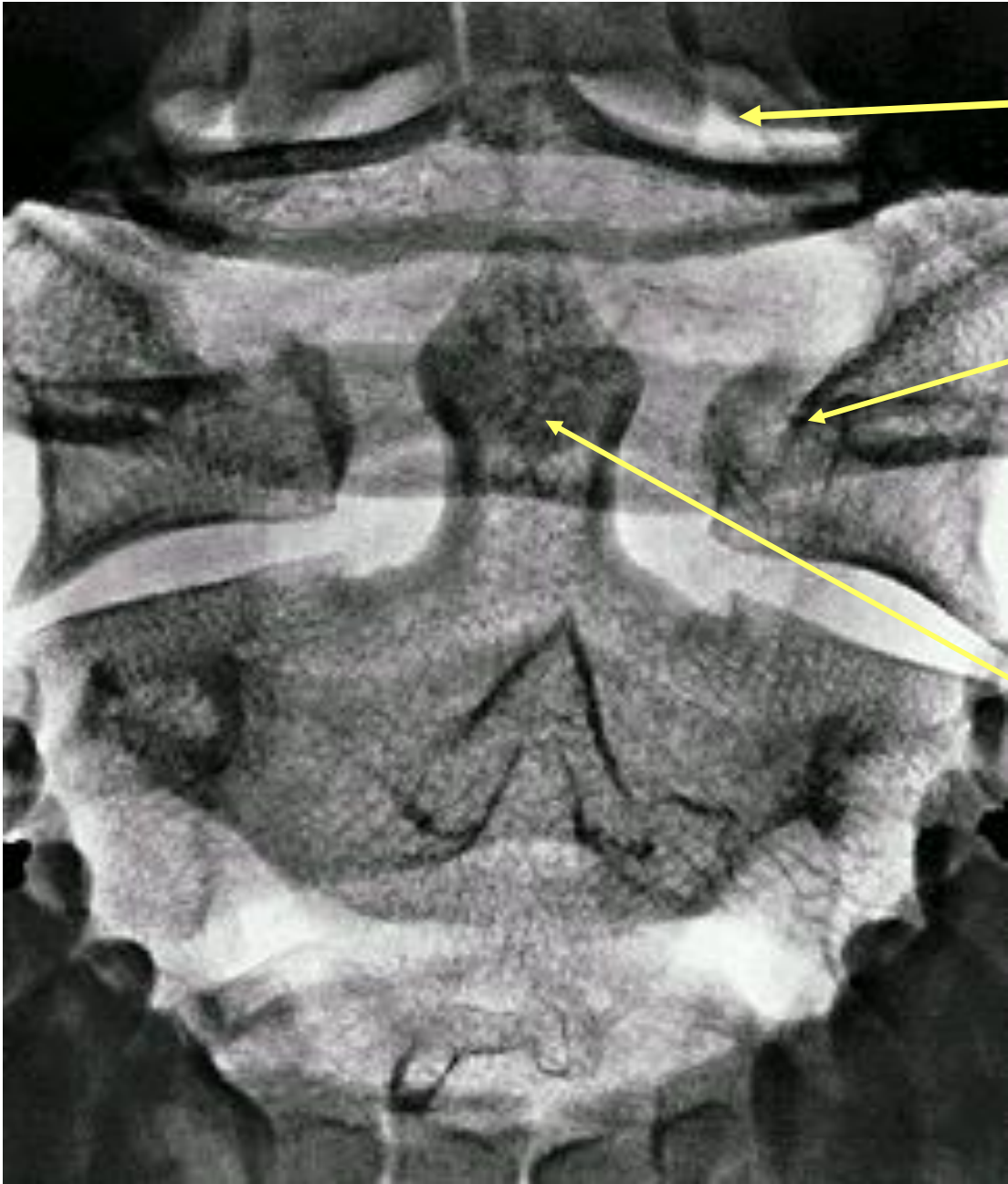






**C1 – C7**

**Cervical part of  
vertebral column**



**Os occipitale**

**C 1 - arcus**

**C 2 -dens**

**Os hyoideum**



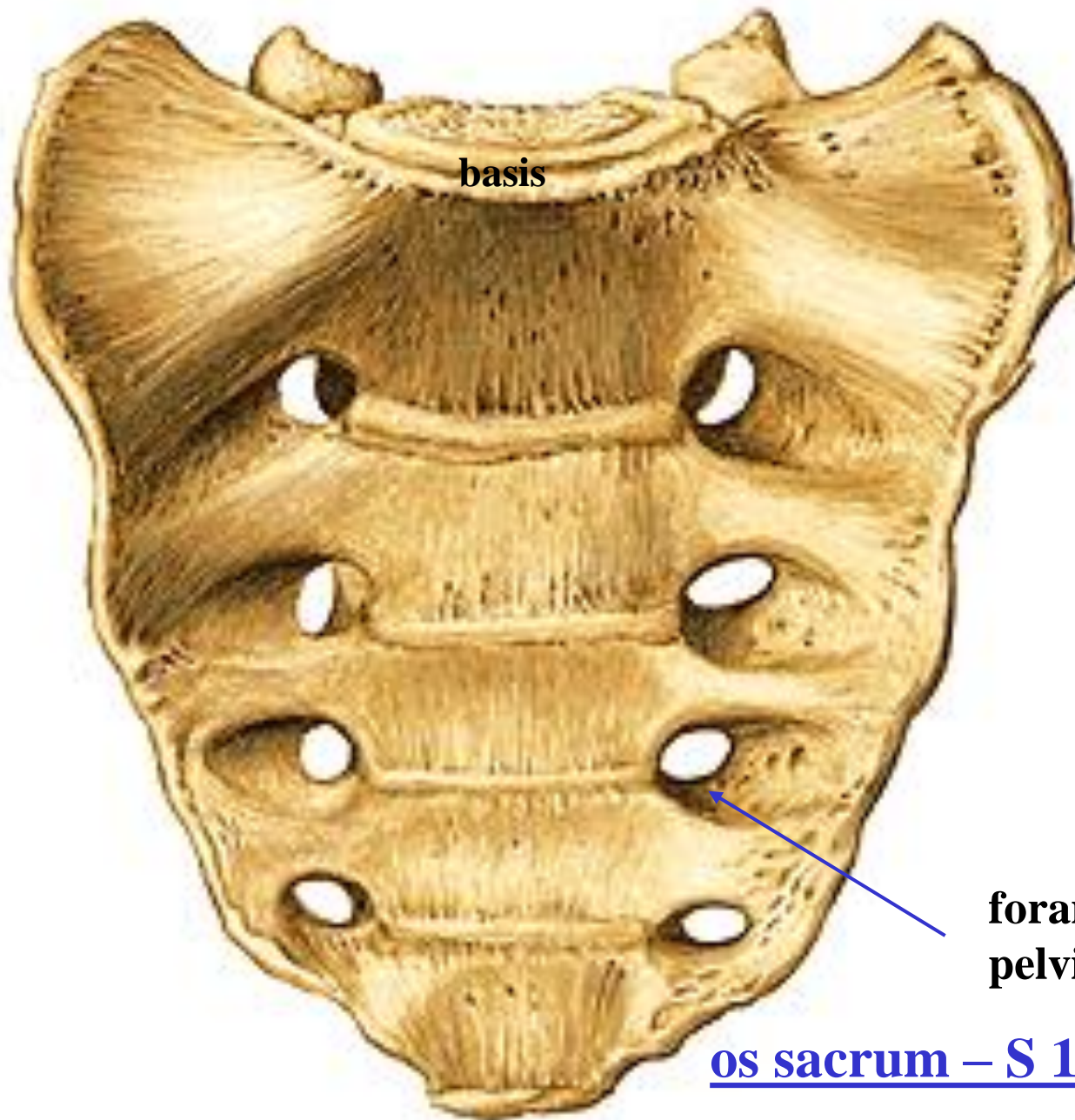




**vertebrae lumbales**  
**L1 - 5**



**Promontorium**  
**( L5 – S1 )**

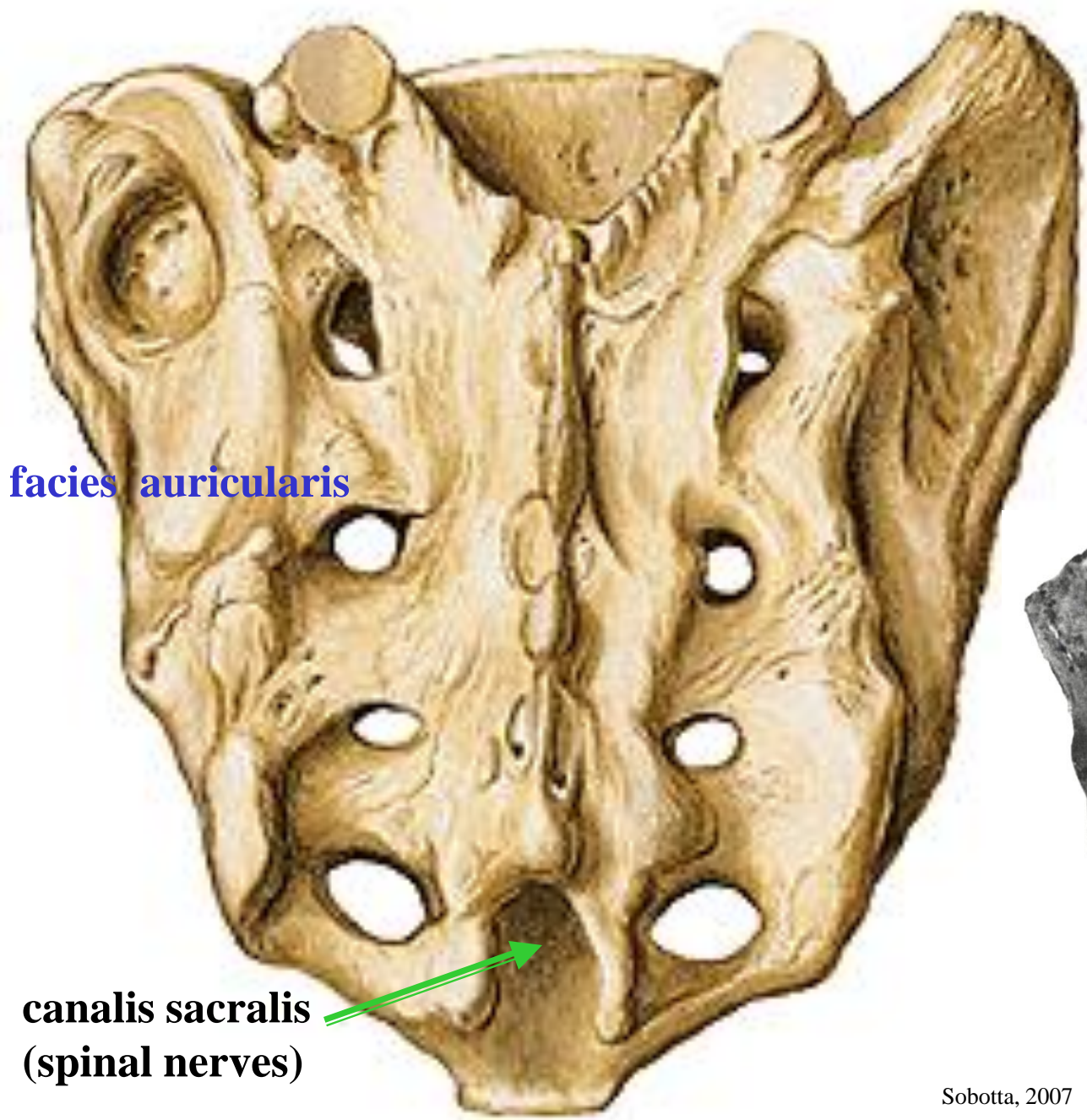


**basis**

**foramina sacralia  
pelvina**

**os sacrum – S 1 – 5**



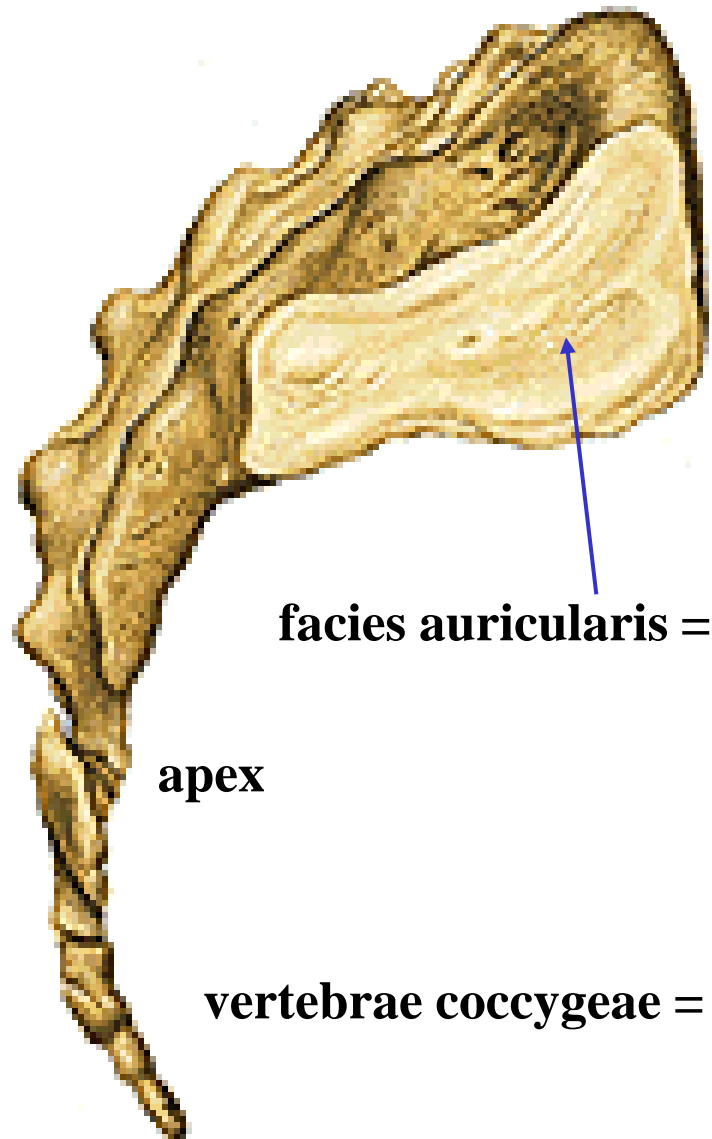


**facies auricularis**

**canalis sacralis  
(spinal nerves)**



SBO de



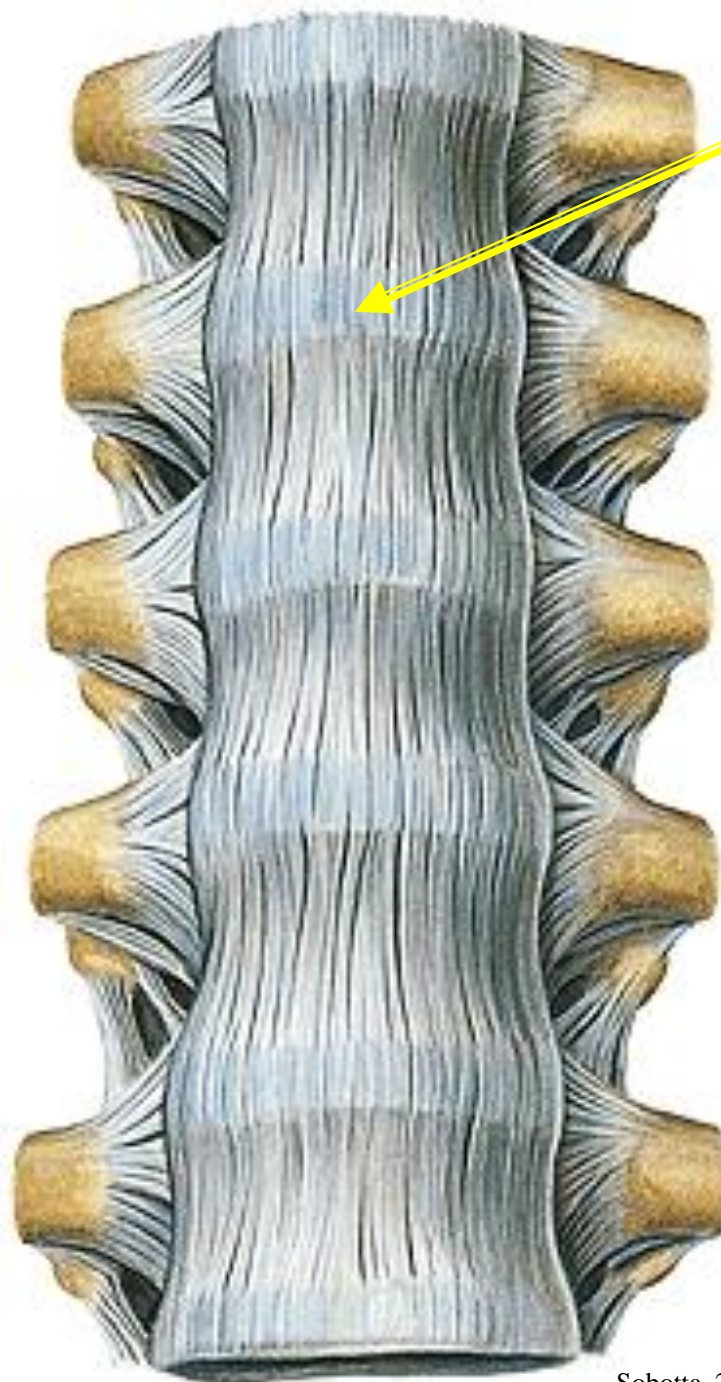
**facies auricularis = S-I**

**apex**

**vertebrae coccygeae = Co 1-3**



## Connections of the vertebrae



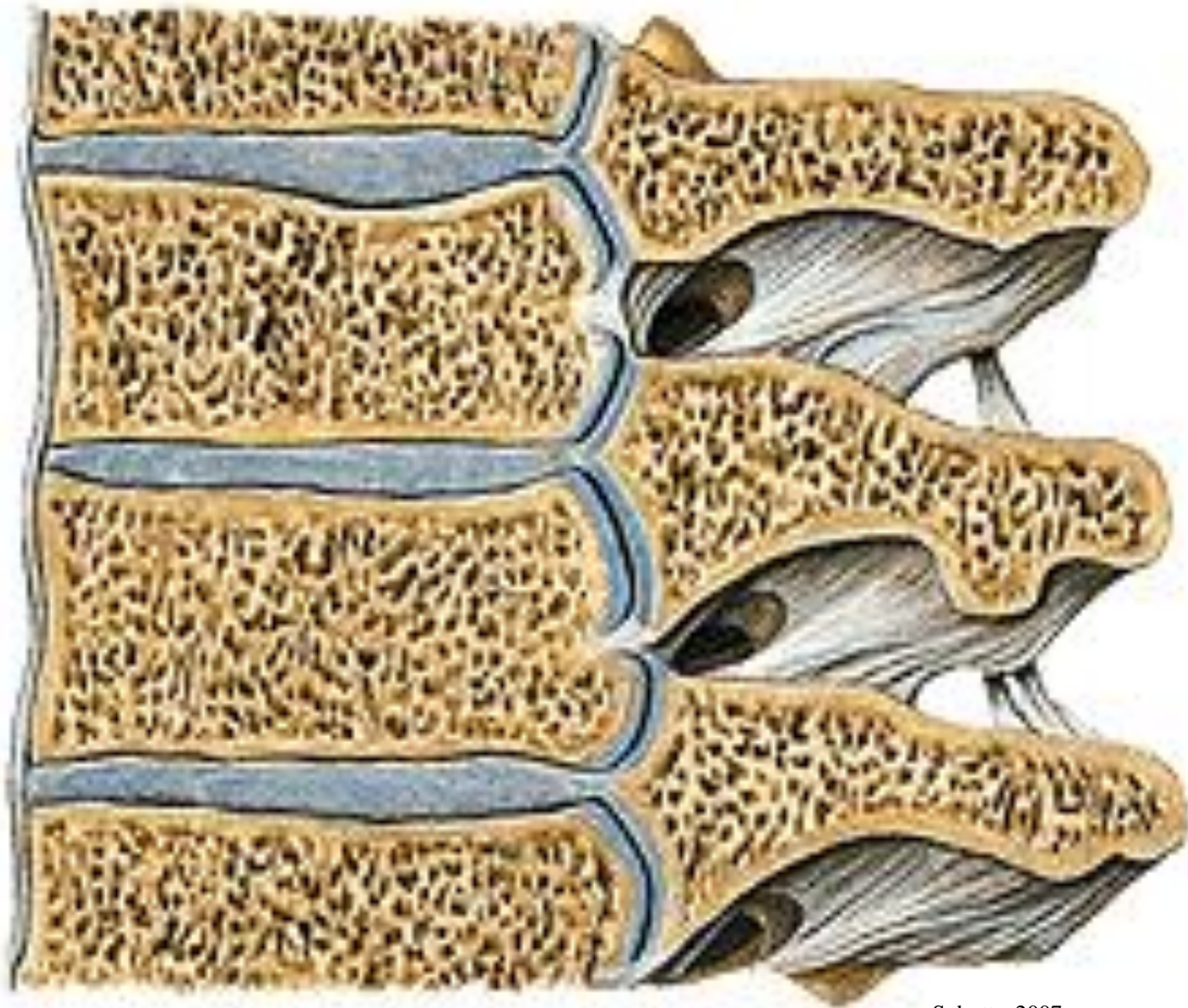
**ligamentum longitudinale  
anterius**



**Ligaments of vertebral column—  
spinal, transverse**

Sobotta, 2007





Sobotta, 2007

## Disci intervertebrales

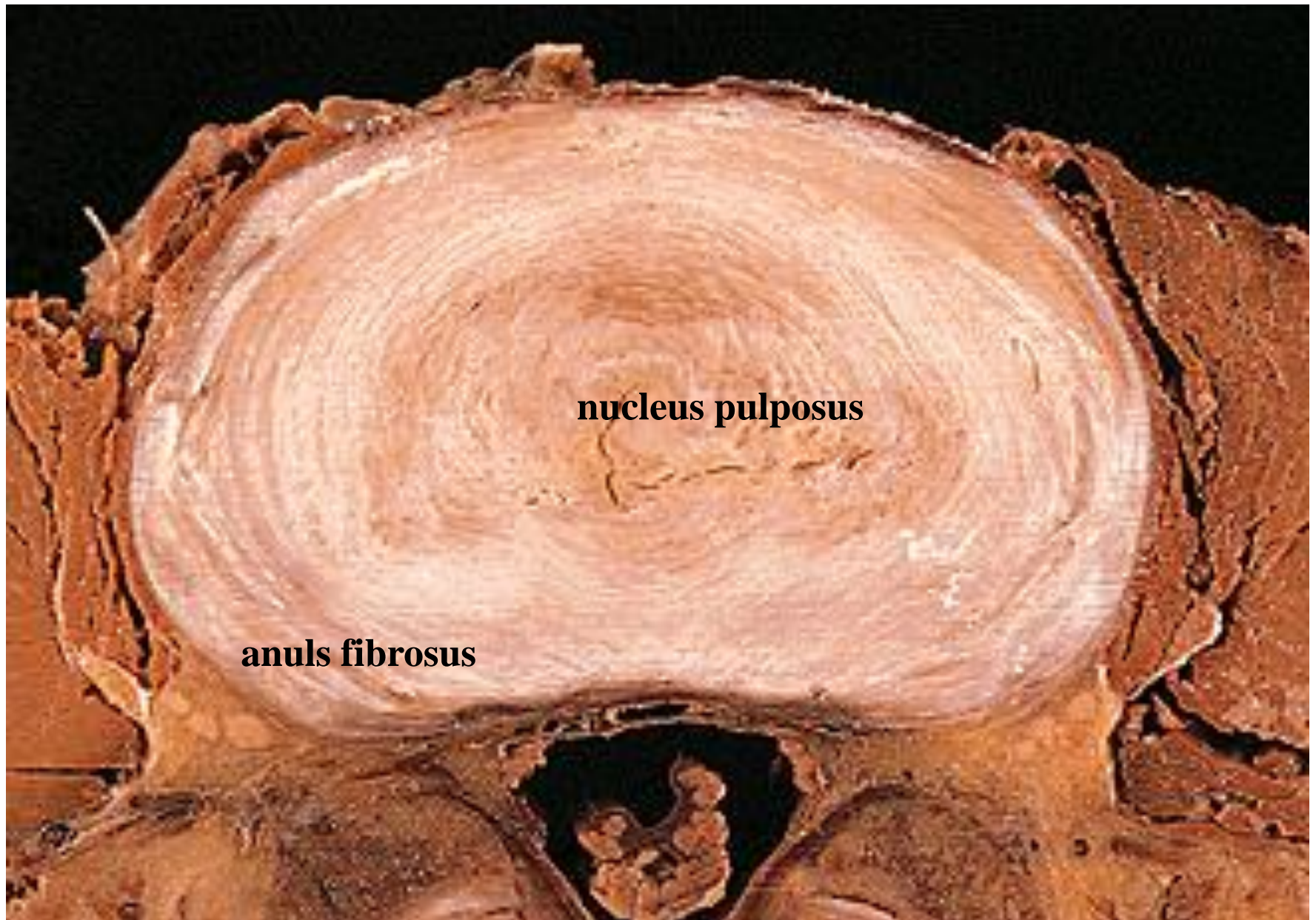


**nucleus pulposus**

**annulus fibrosus**

**Discus intervertebralis**





**nucleus pulposus**

**anuls fibrosus**

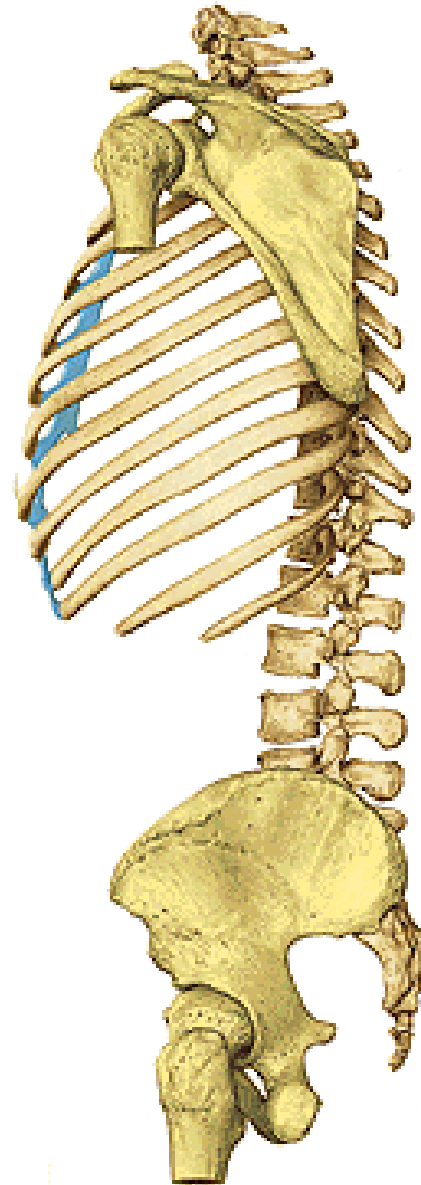
**foramen vertebrale + spinal cord**



**MRI + perimyelography**

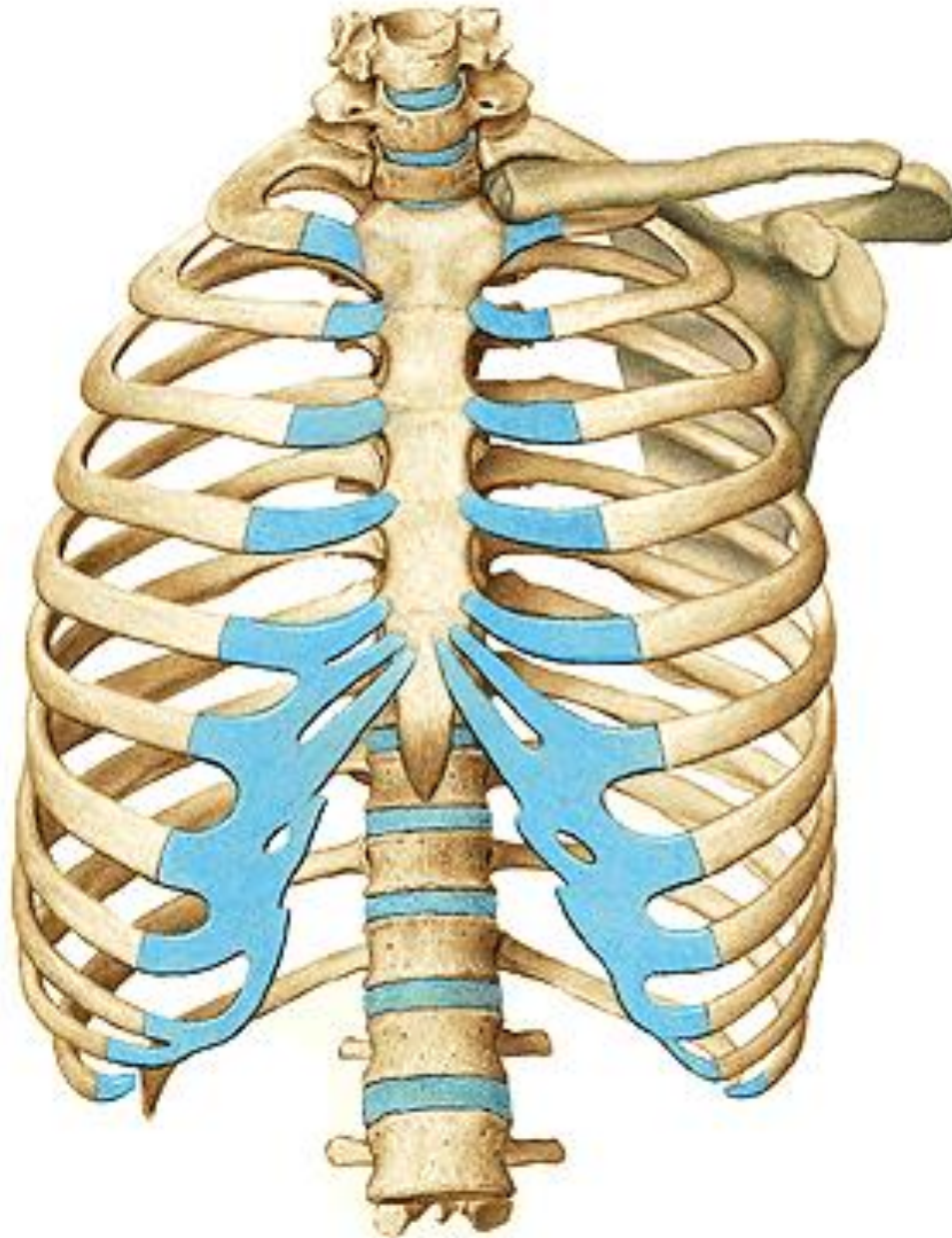


# Thorax



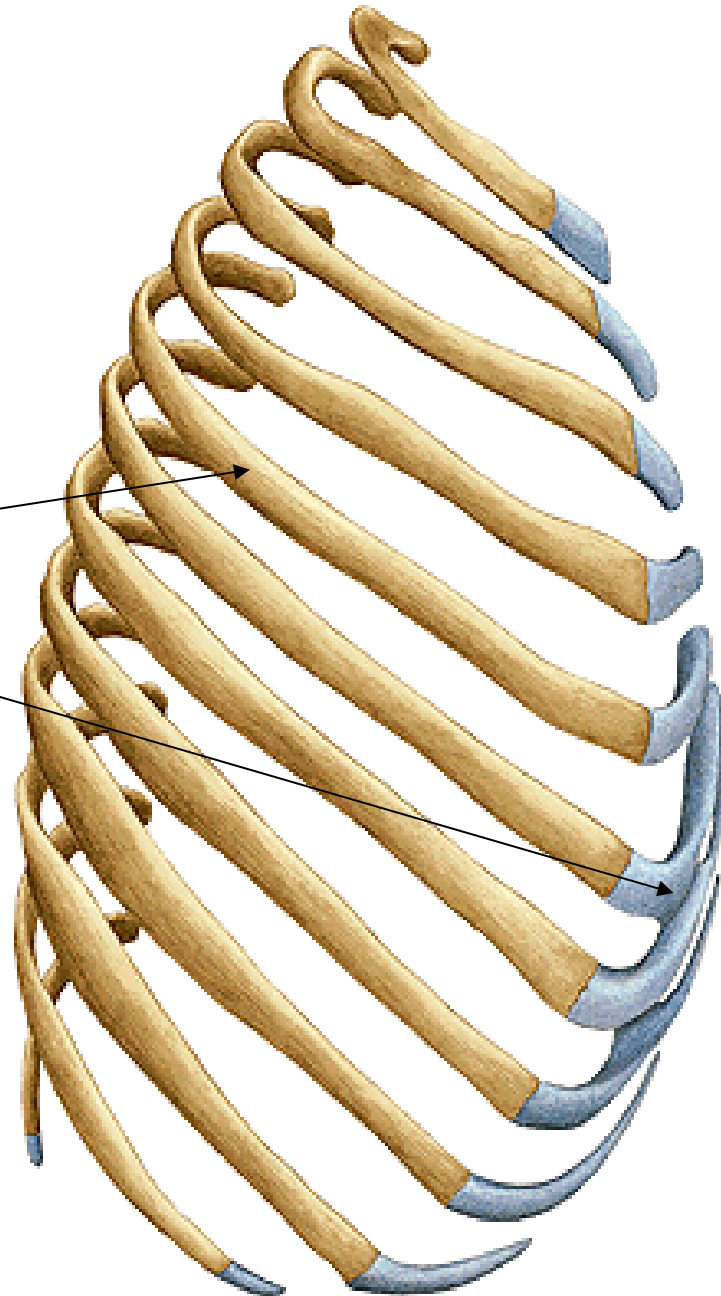
## RIBS:

- real 1-7
- false 8-10
- improper 11,12



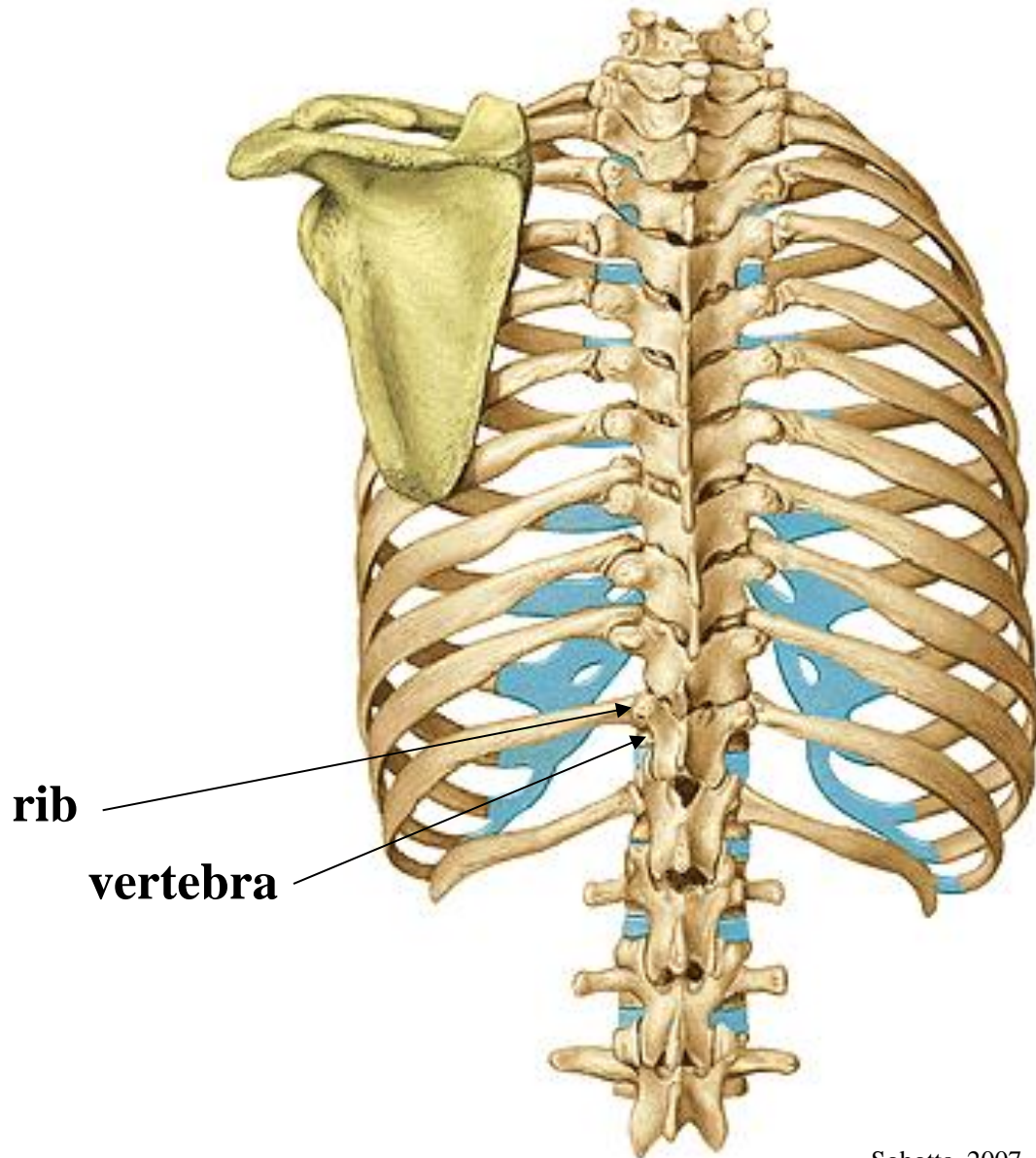
*Costae (ribs):*

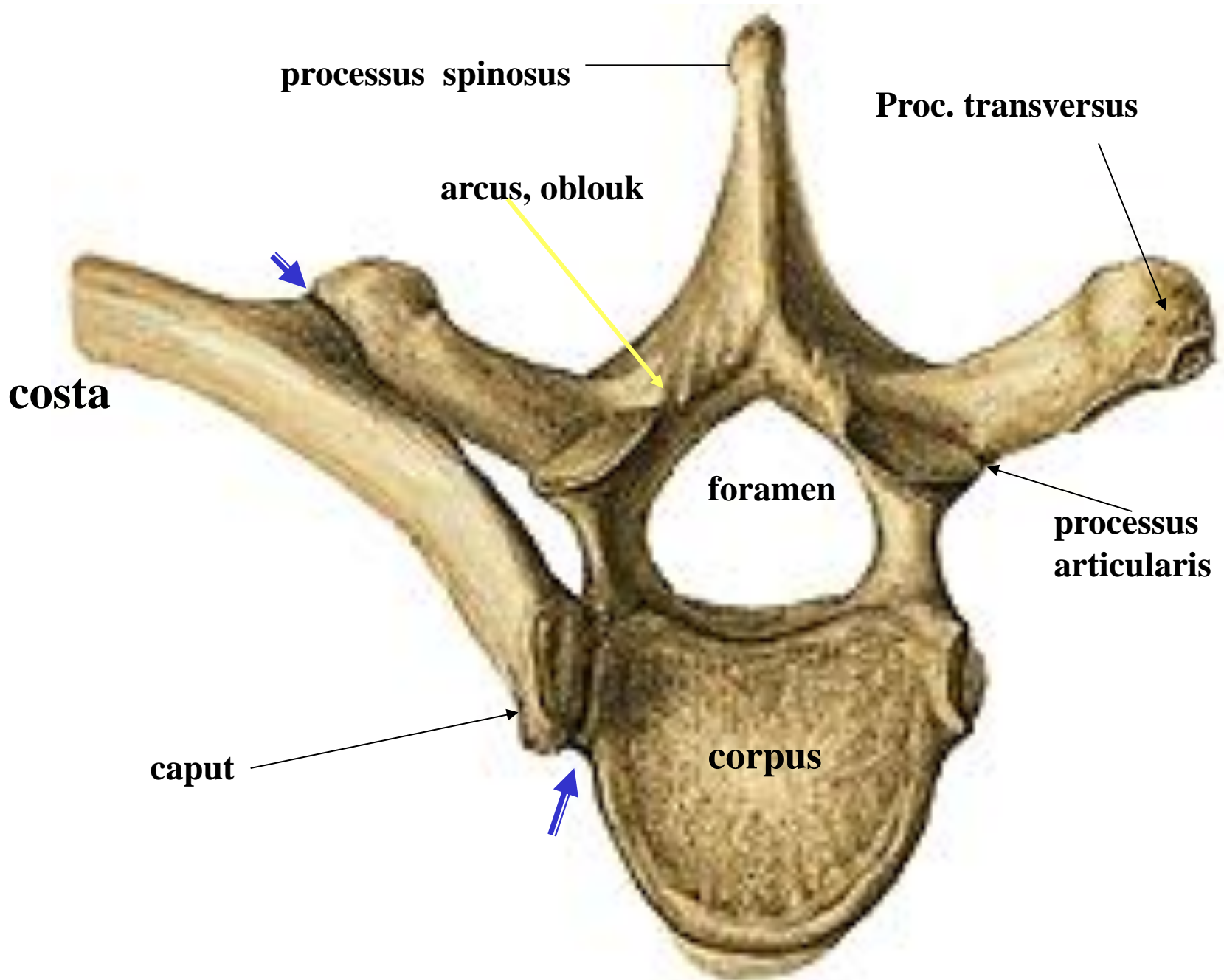
**pars ossea**  
**cartilaginea**





# Costovertebral connections (on the body and transverse processes)





# Sternocostal connections (on the body and transverse processes)

**Artt. sternocostales**

**Artt. interchondrales**

