

**The skull: principles of development and structure.**

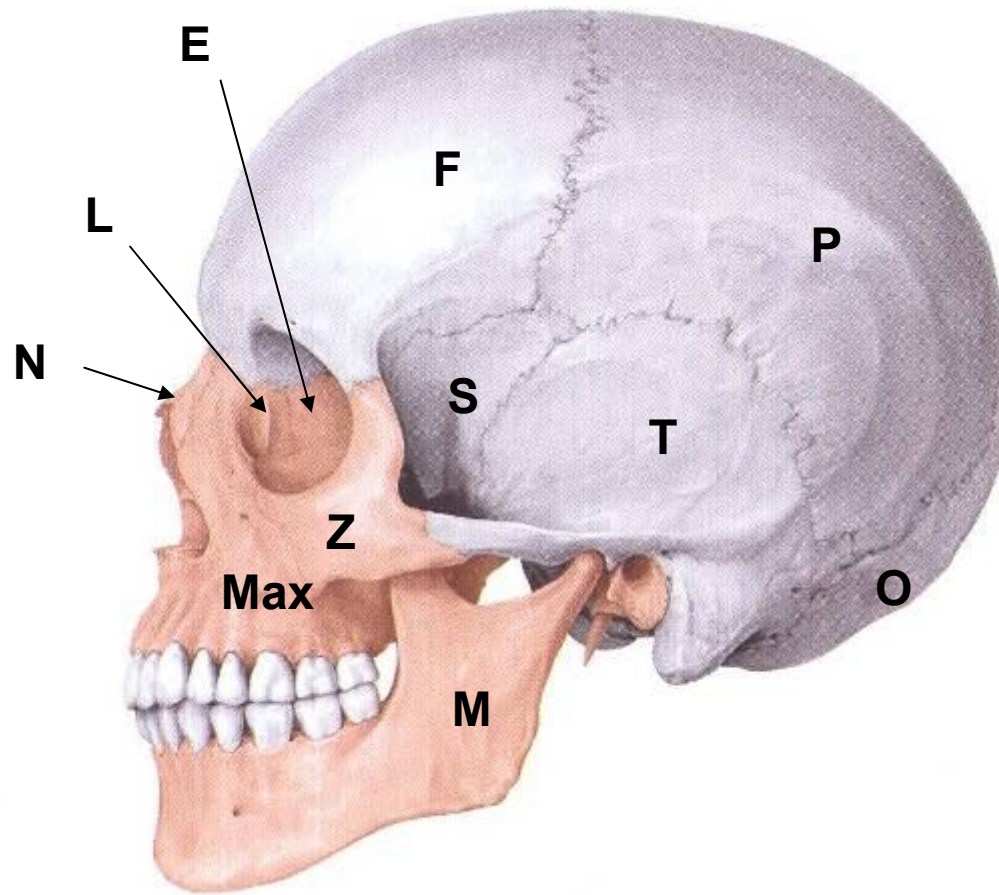
**The neurocranium and splanchnocranium bones – overview.**

**Skull of the newborn and its growth.**

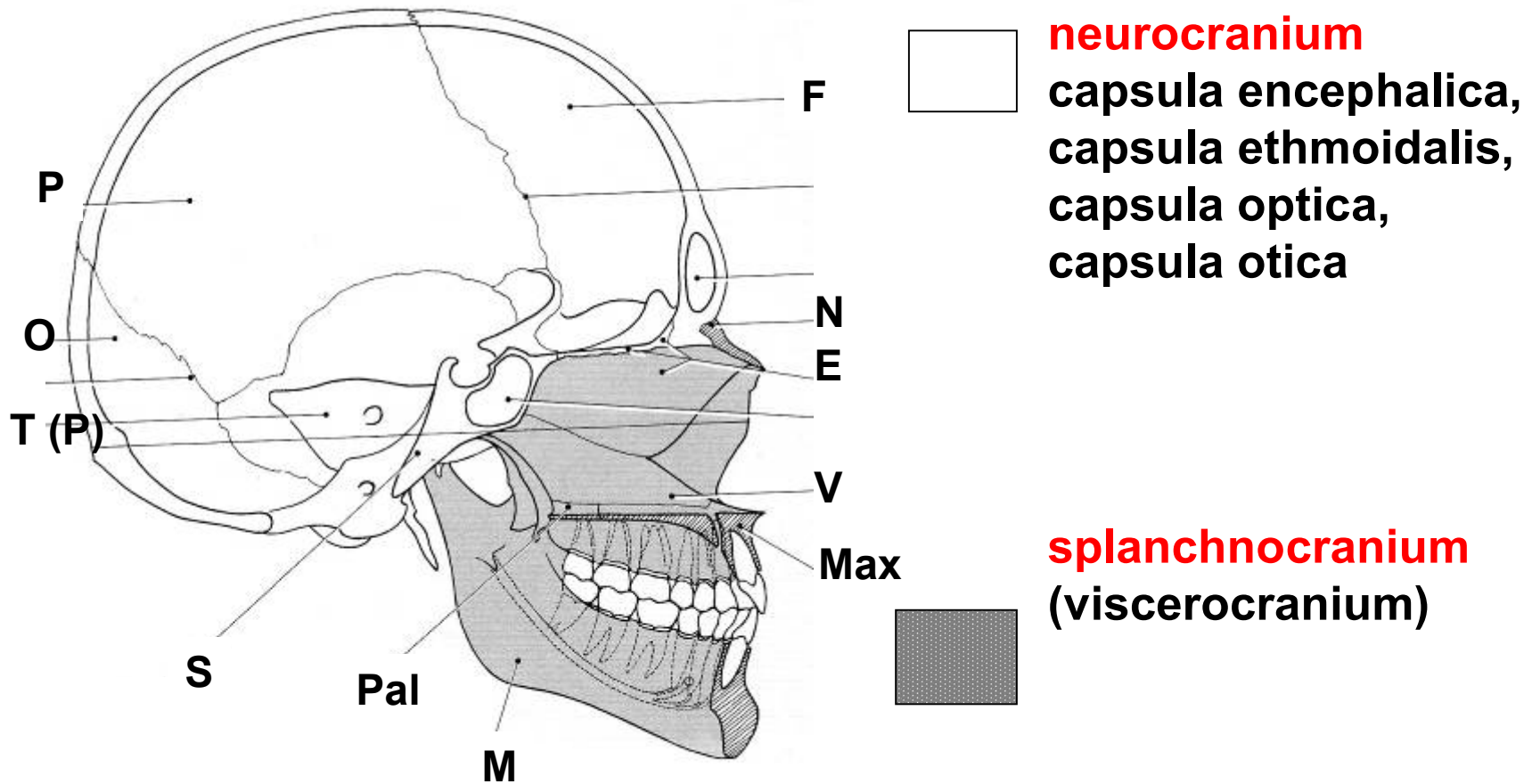
MUDr. Veronika Němcová, CSc.



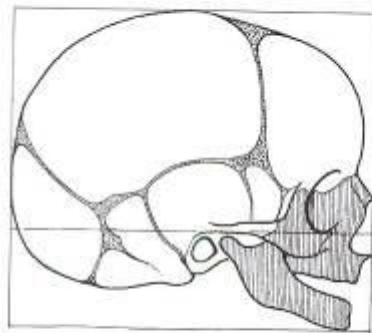
# Neurocranium + splanchnocranium



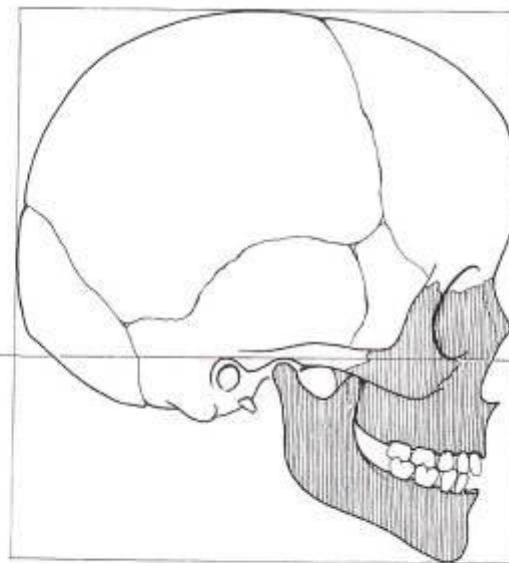
# Scull



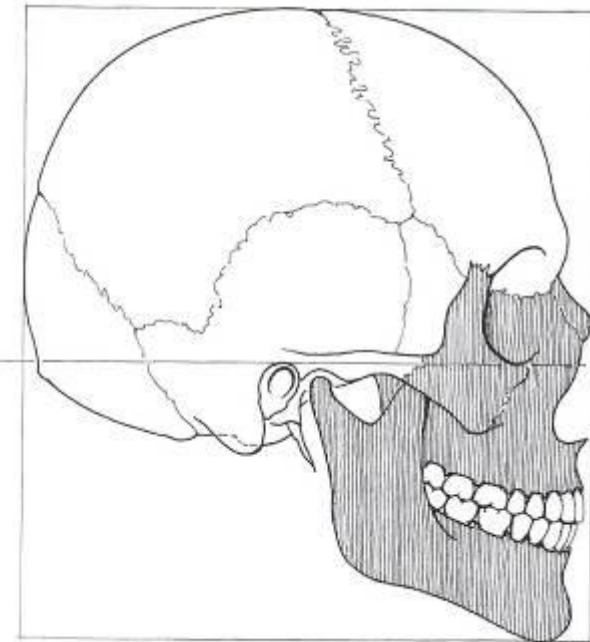
# Skull in the newborn, in 7 years and in adult proportions



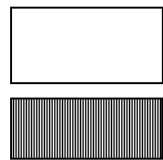
**newborn**



**7 years**



**adult**



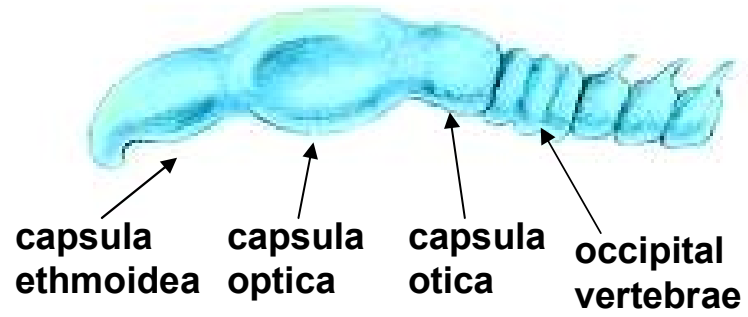
neurocranium

splanchnocranium

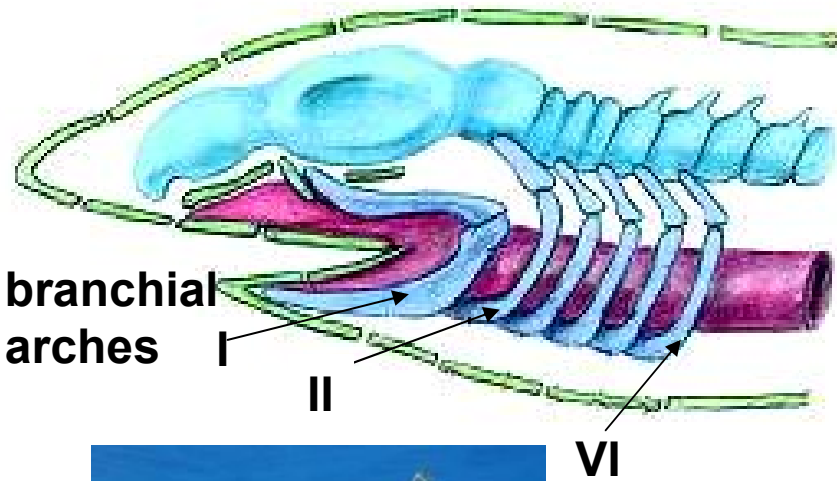
## Desmocranium and chondrocranium

- **intramembranous ossification** – directly from the mesenchymal connective tissue (most of the splanchnocranium and calvaria)
- **enchondral ossification** -ossification of the cartilaginous model (mainly bones of skull base)

**PRIMITIVE CHONDROCRANIUM**



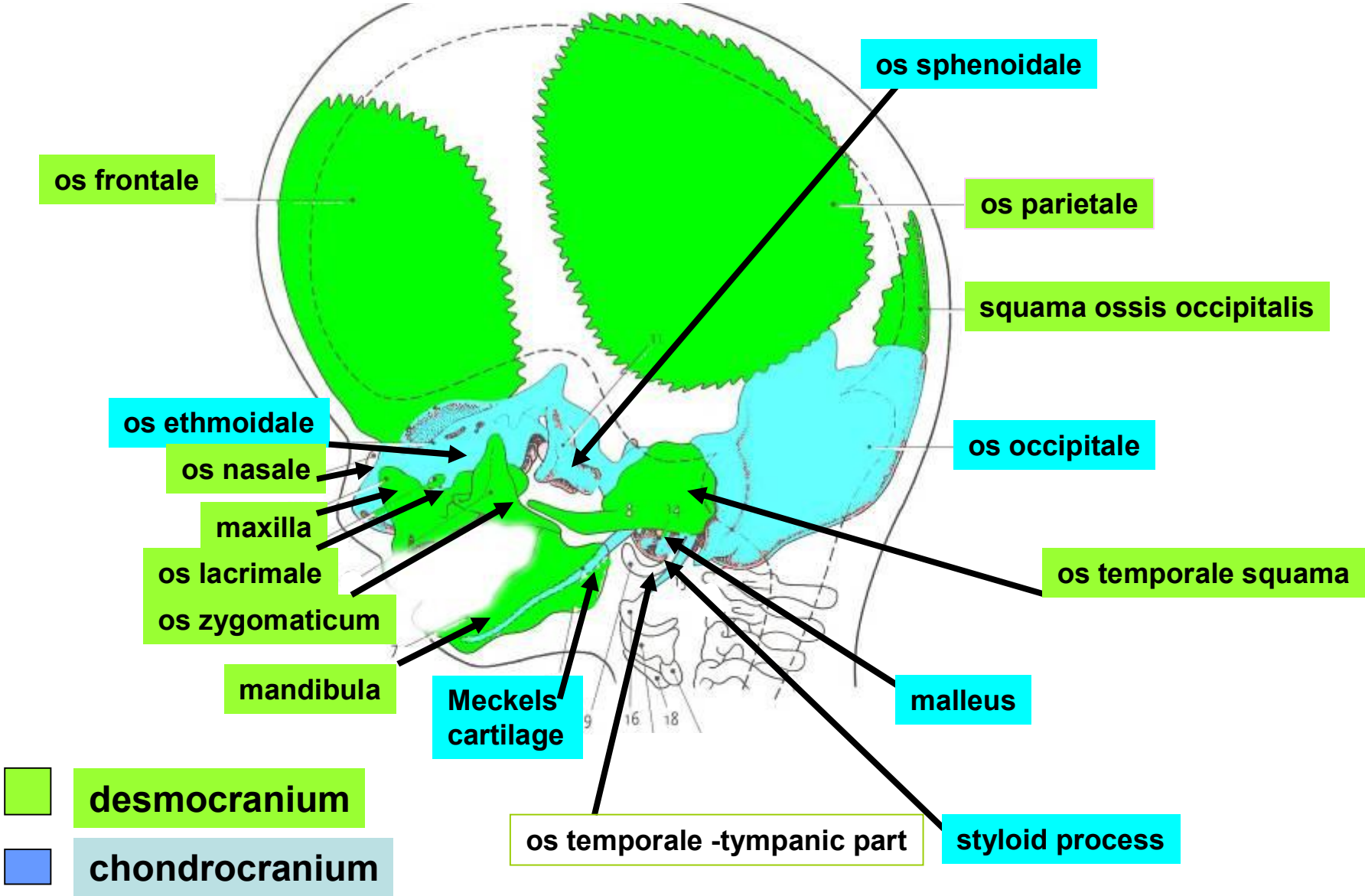
**CARTILAGINOUS CHONDROCRANIUM AND DESMOCRANIUM**



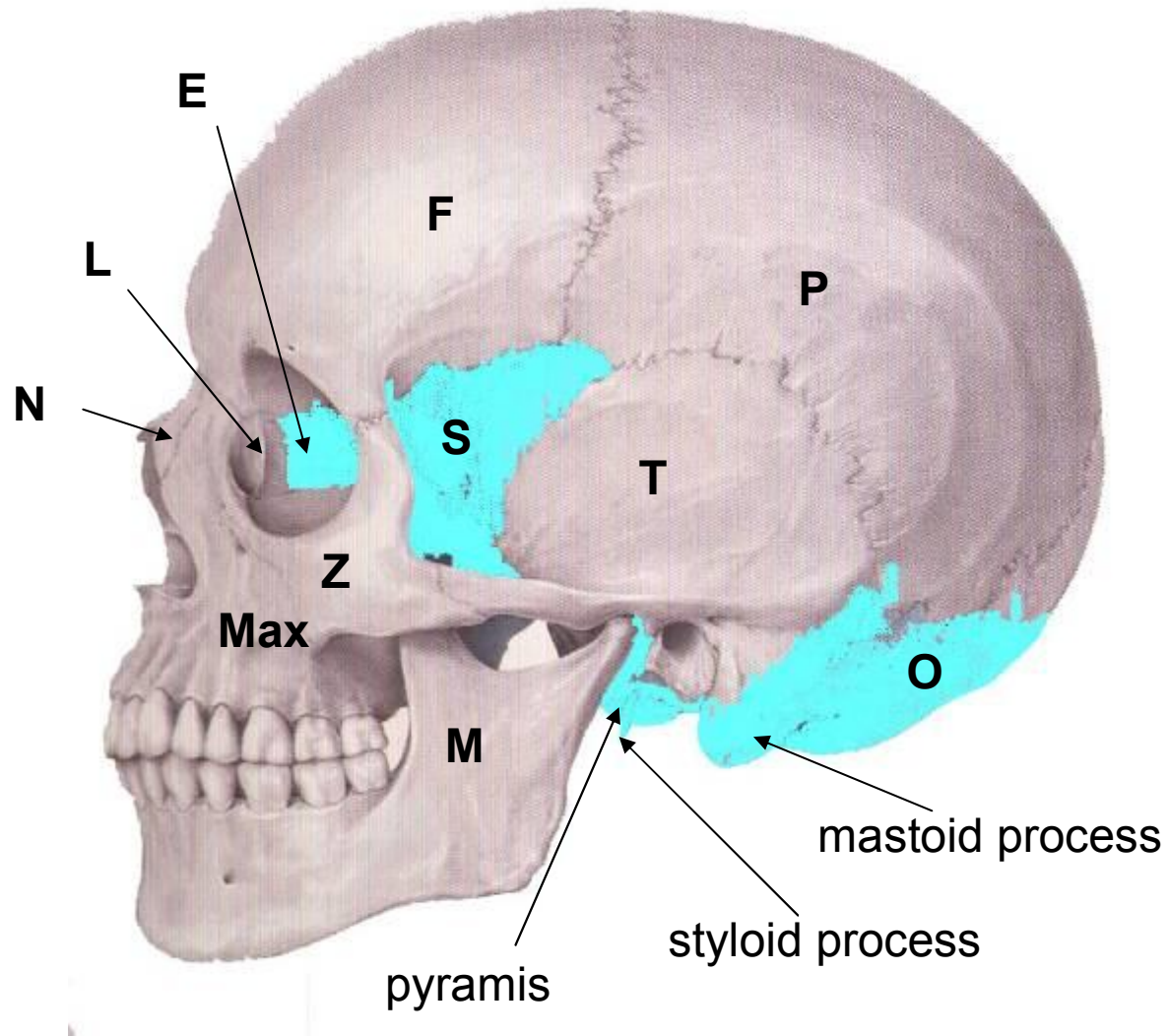
desmocranium  
chondrocranium



# Desmocranium and chondrocranium in the newborn



# Desmocranium and chondrocranium

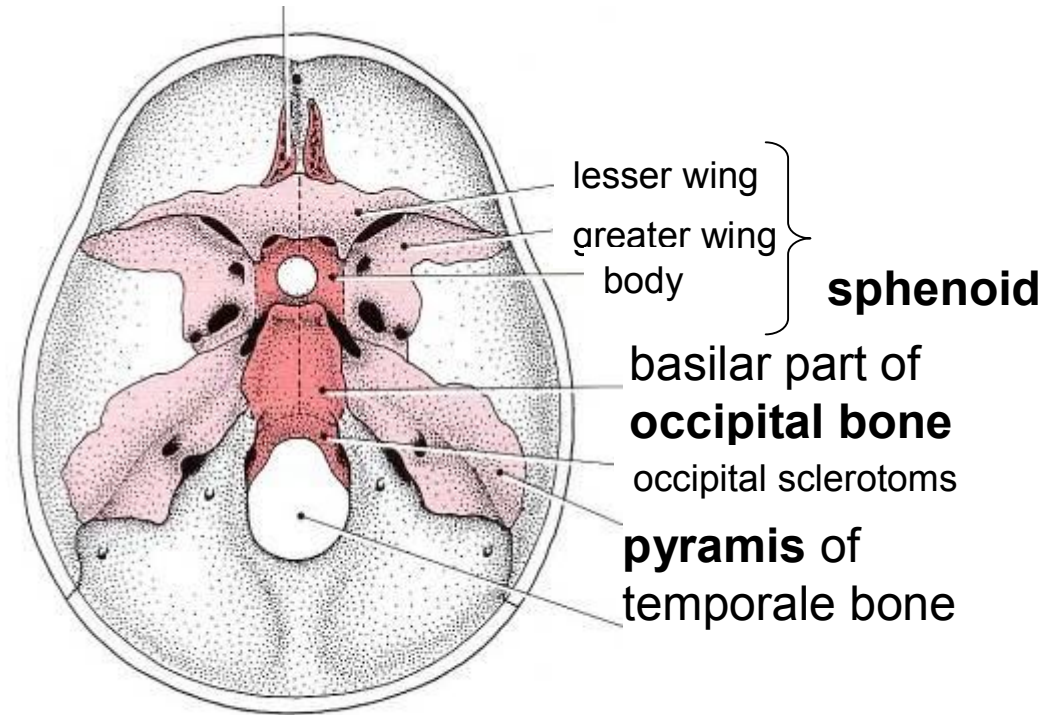
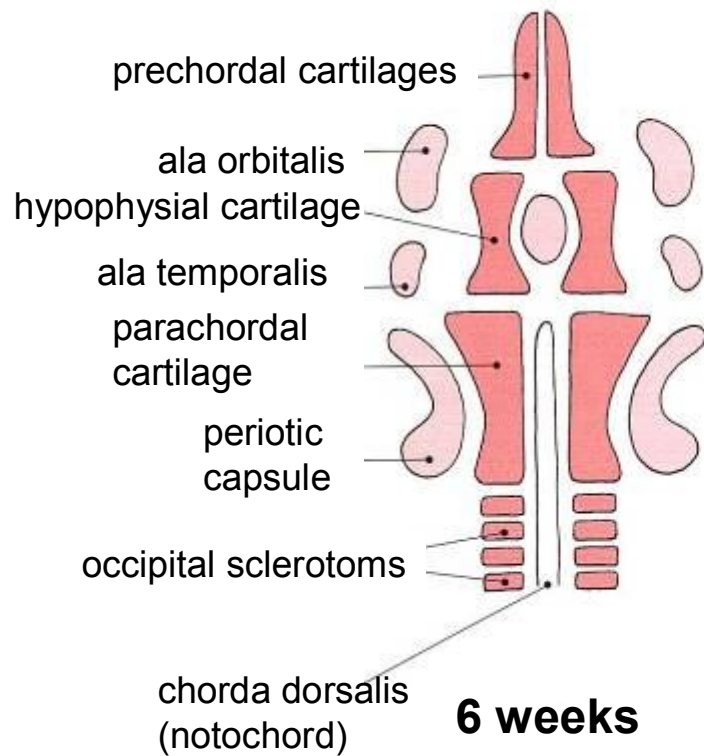




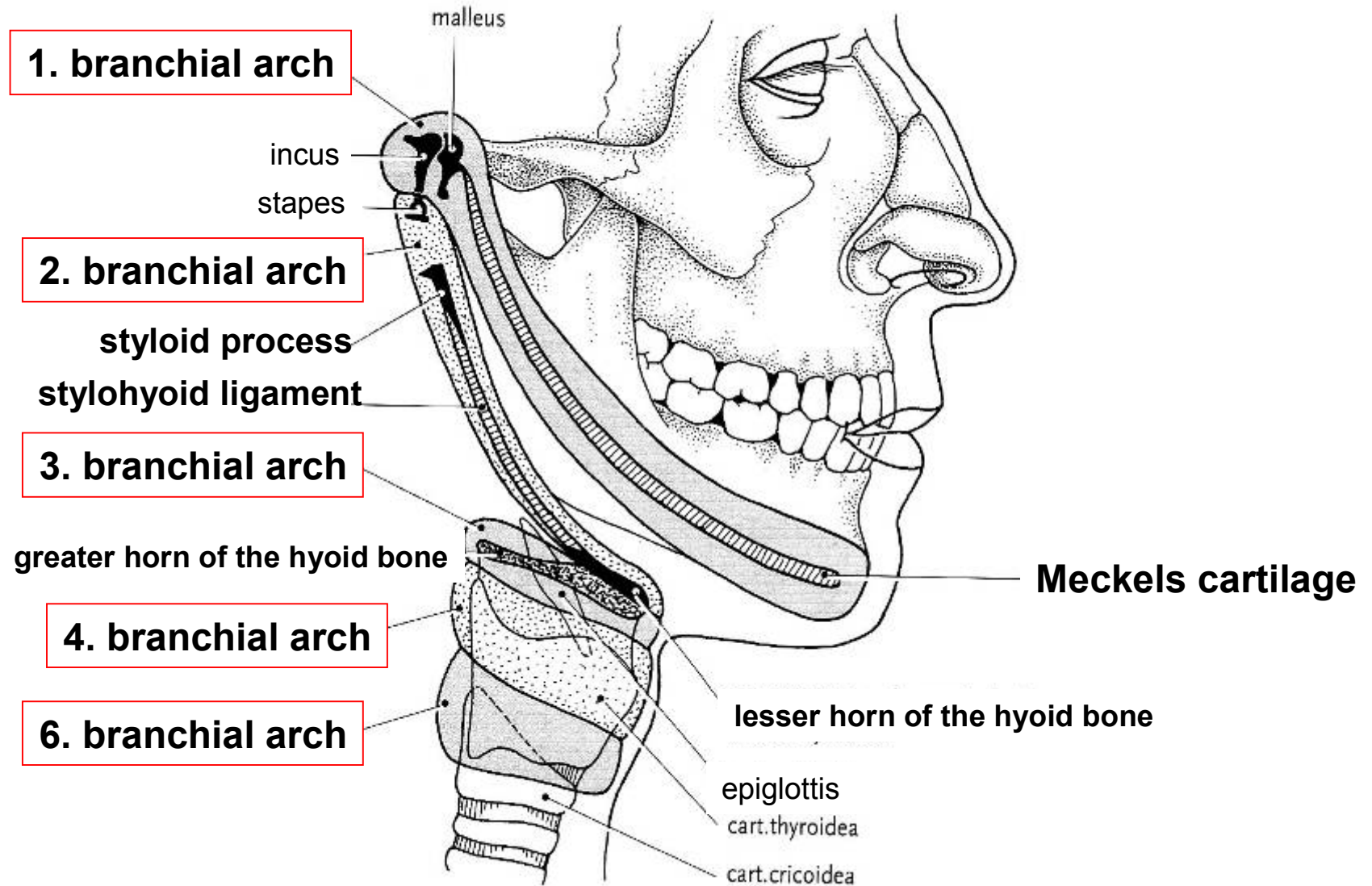
# Development of the skull base

**Chondrocranium**

**ethmoid bone**



# Development of the splanchnocranium – from branchial arches

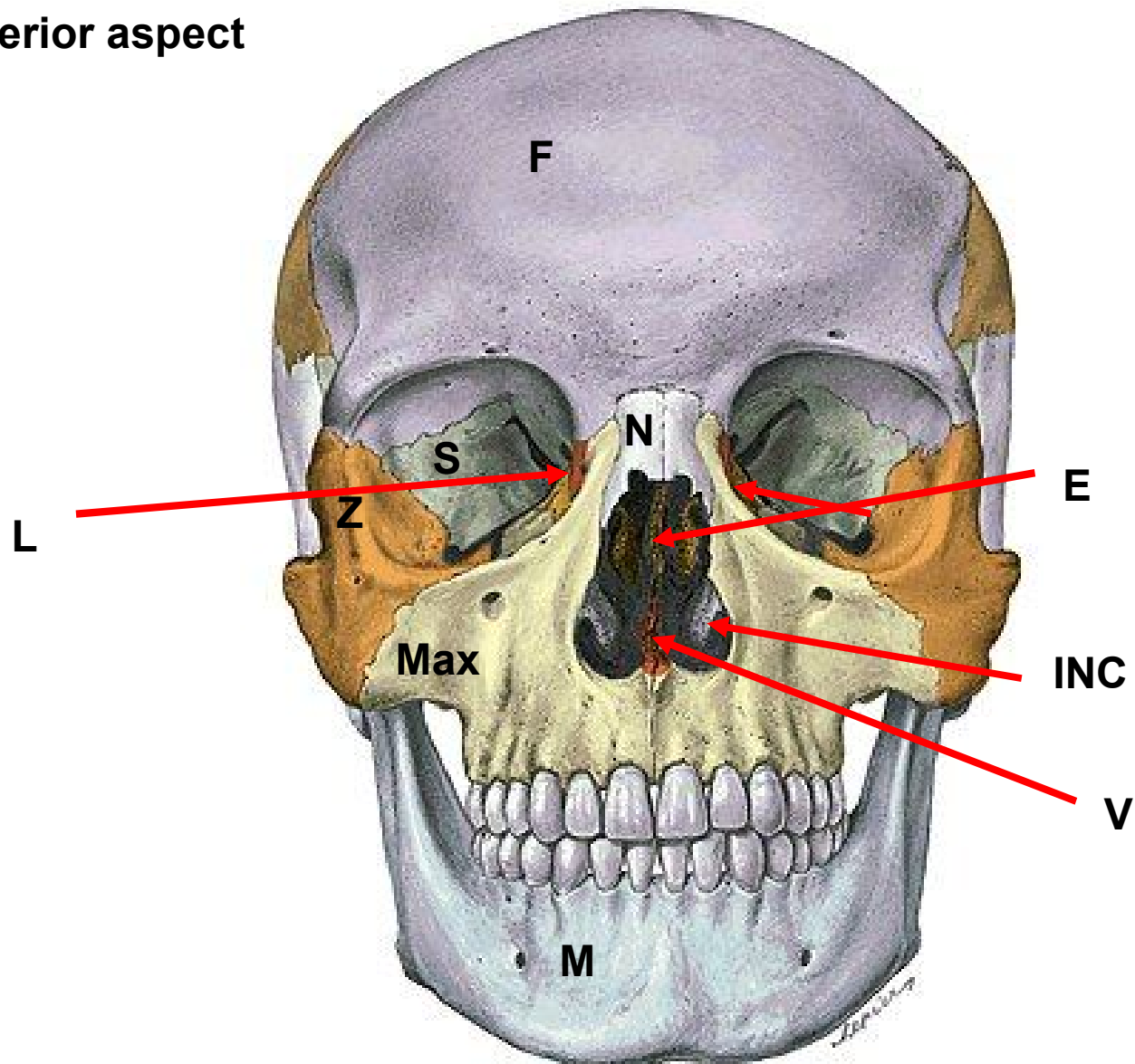


# Ossification

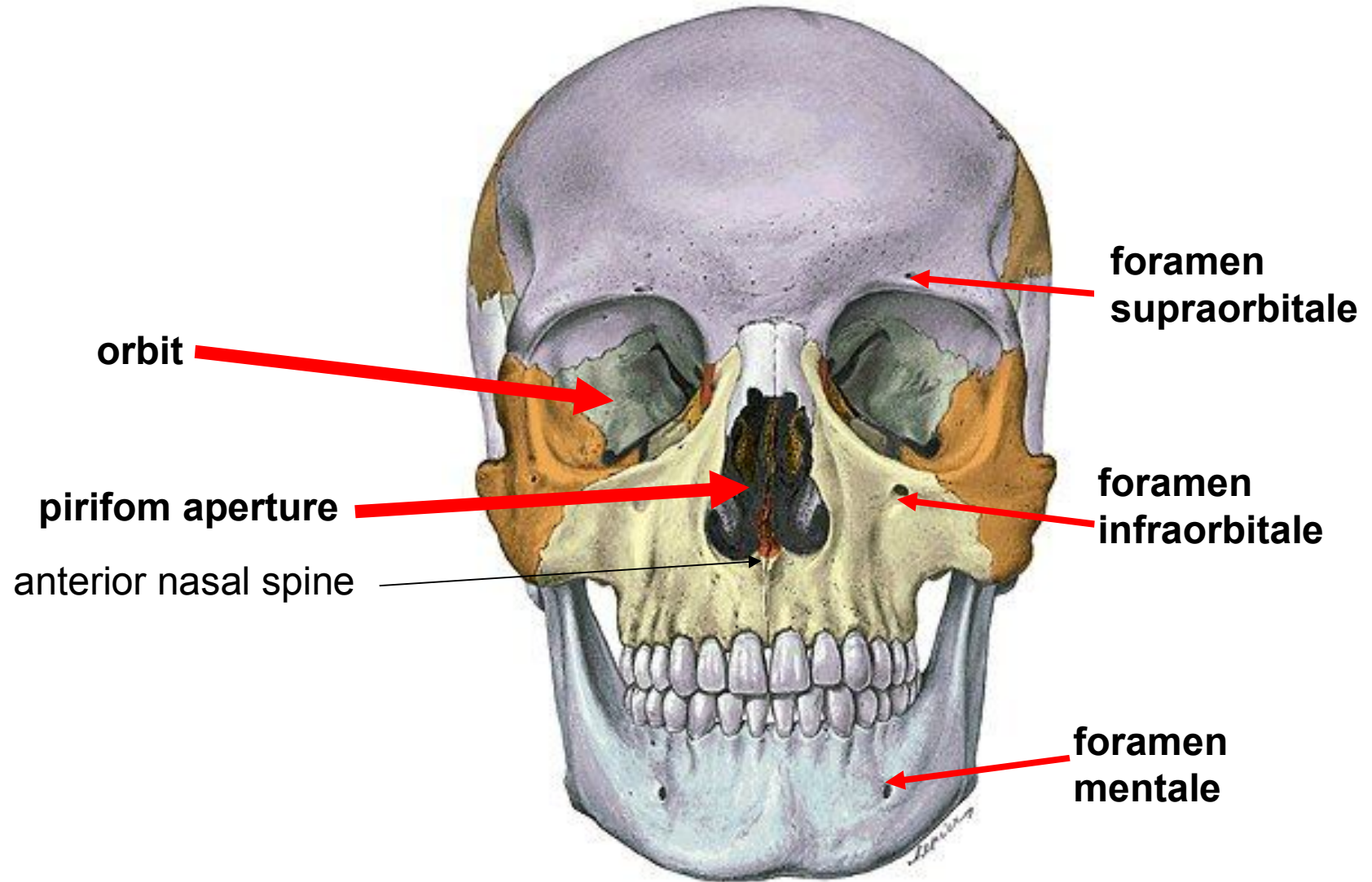
## Chondrocranium

- os occipitale –basis and lateral parts
  - os temporale – pyramis and mastoid process
  - os sphenoidale (without medial lamina of pterygoid process)
  - os ethmoidale
  - inferior nasal concha
  - malleus, incus stapes
  - styloid process
  - hyoid bone
- **Desmocranium**
  - os occipitale – squama
  - os parietale
  - os frontale
  - os temporale –squama
  - os tympanicum
  - os nasale
  - os lacrimale
  - vomer
  - medial lamina of pterygoid process
  - os palatinum
  - os zygomaticum
  - maxilla
  - mandibula (**Meckel cartilage**)

**Anterior aspect**



# Openings for trigeminal nerve branches and spaces



# Norma frontalis

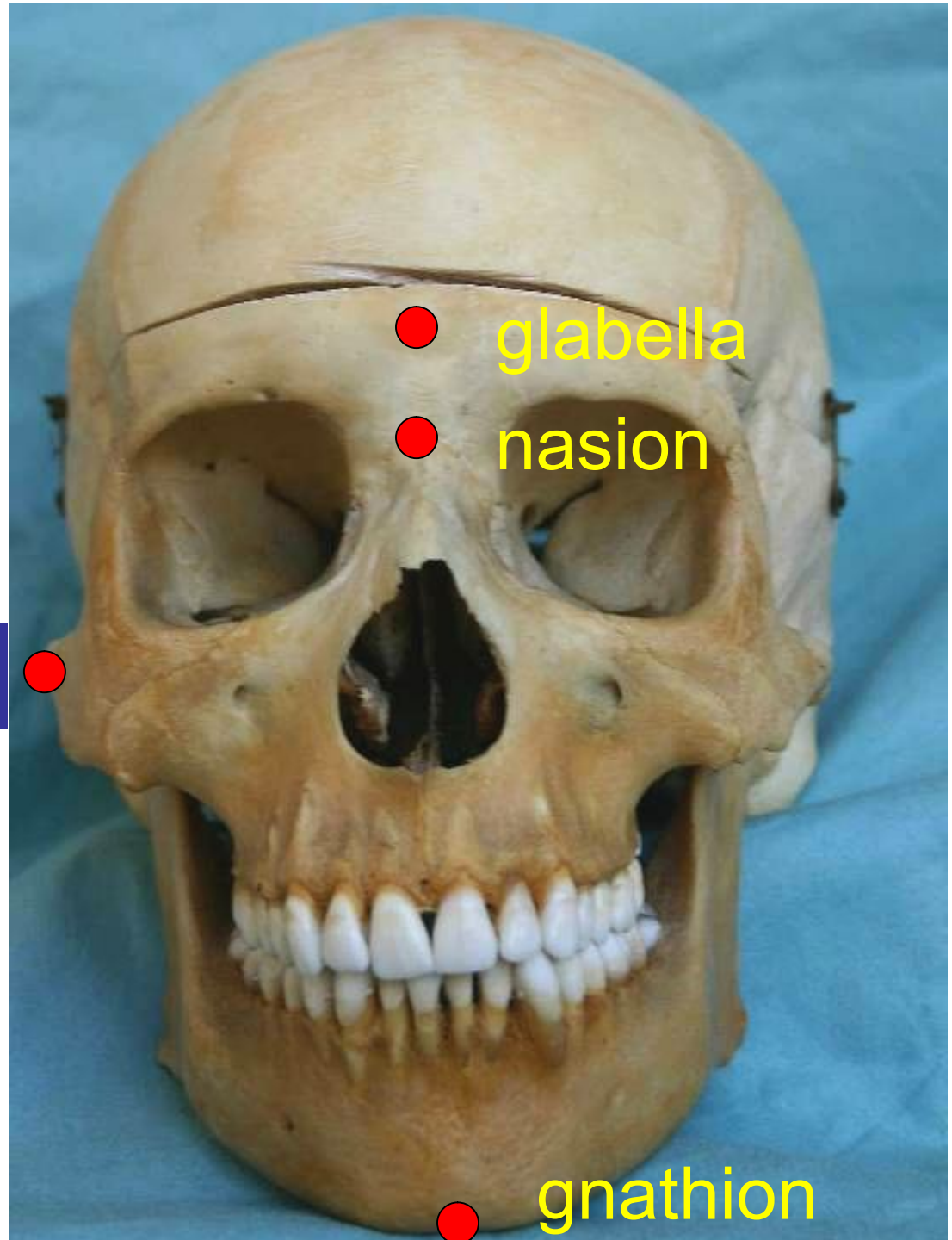
points for measurement

zygion

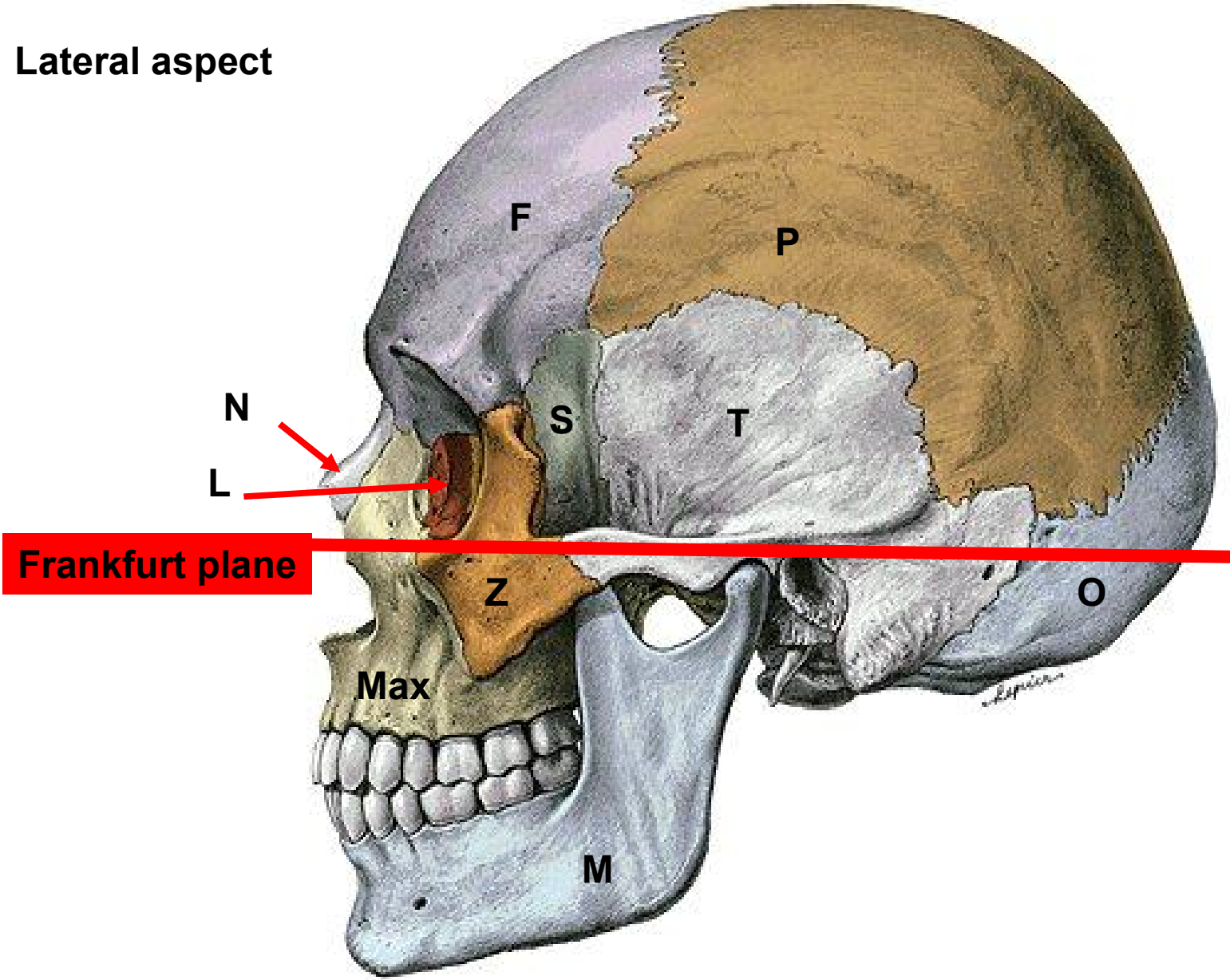
glabella

nasion

gnathion

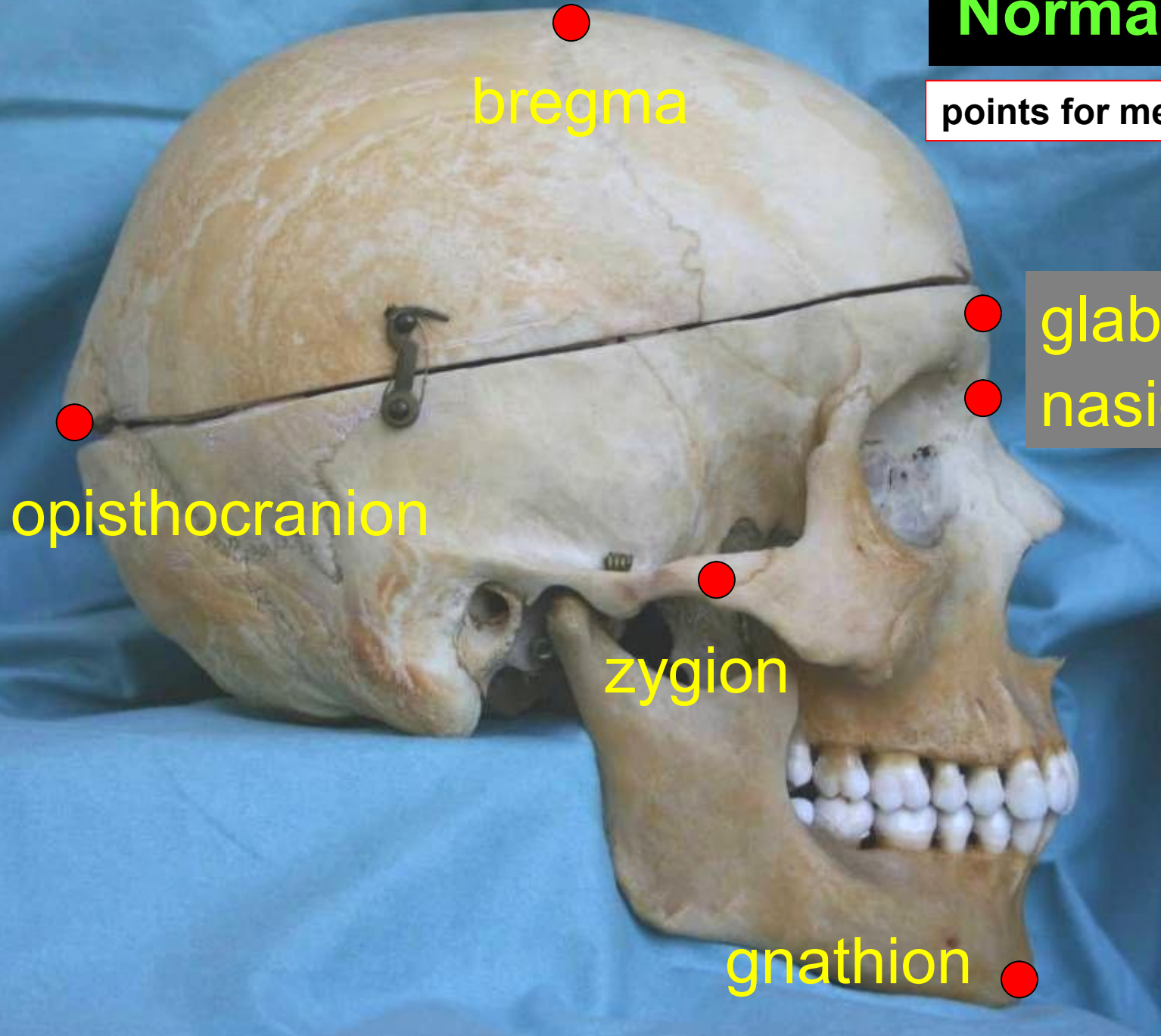


Lateral aspect



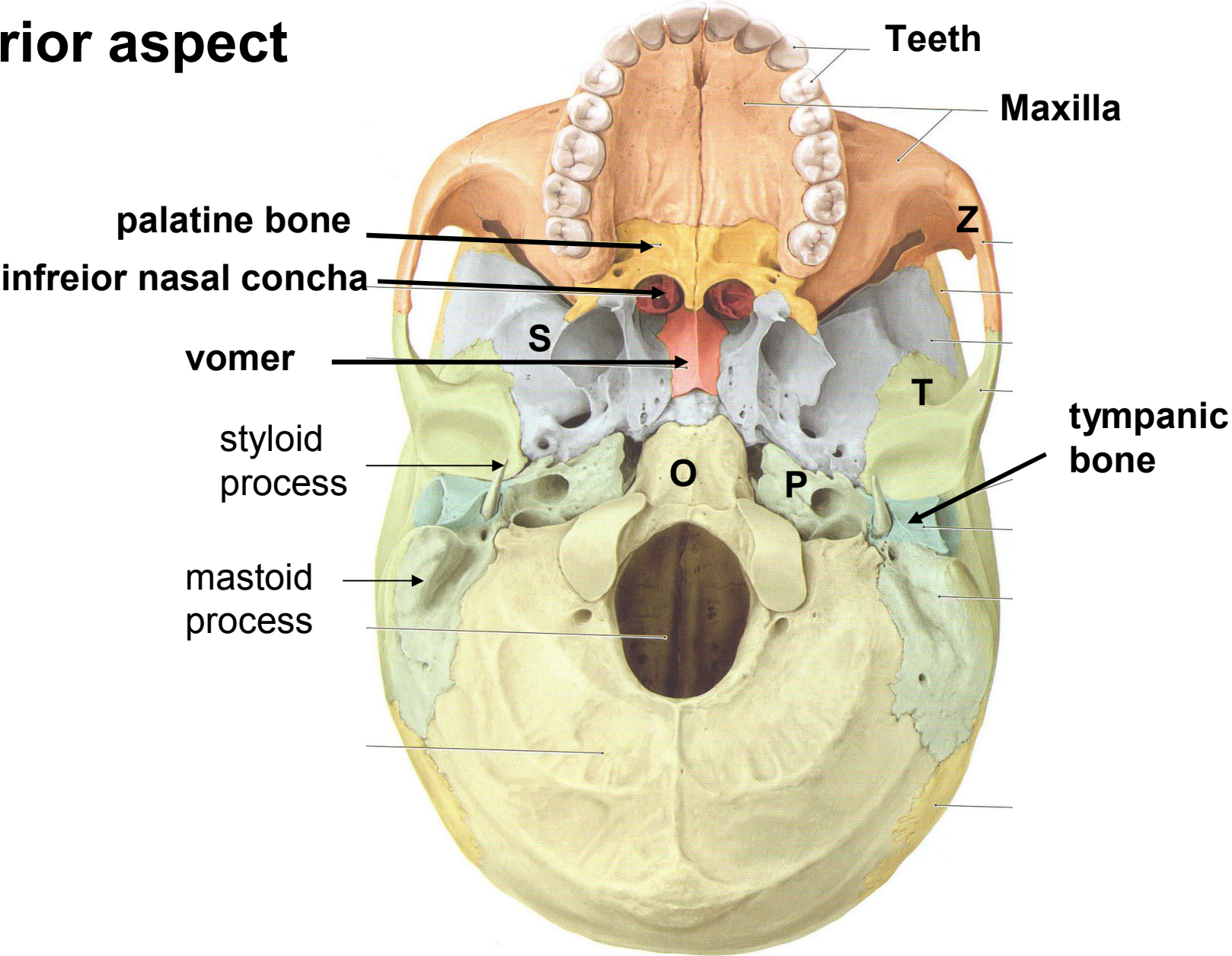
# Norma lateralis

points for measurement

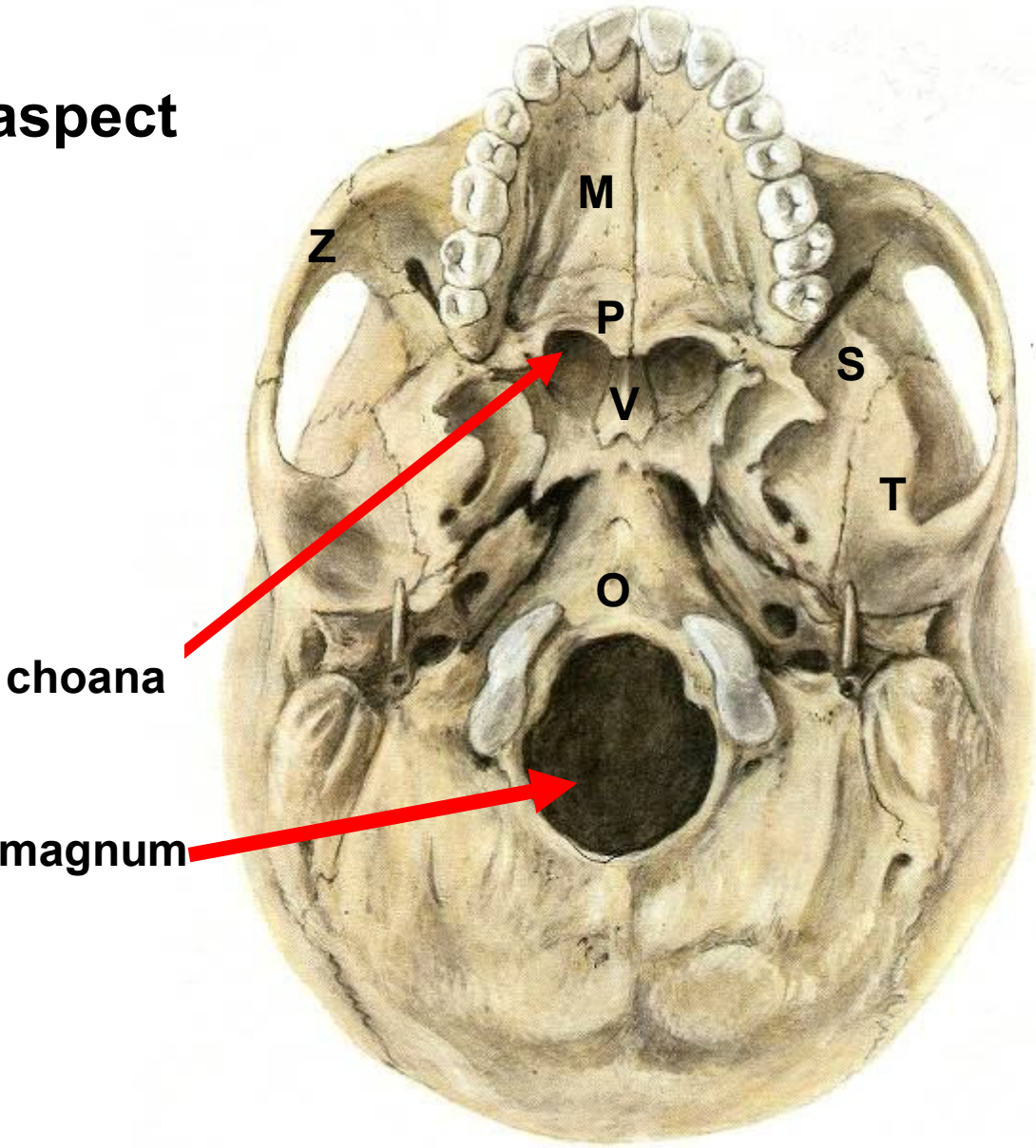




# Inferior aspect



**Inferior aspect**



**choana**

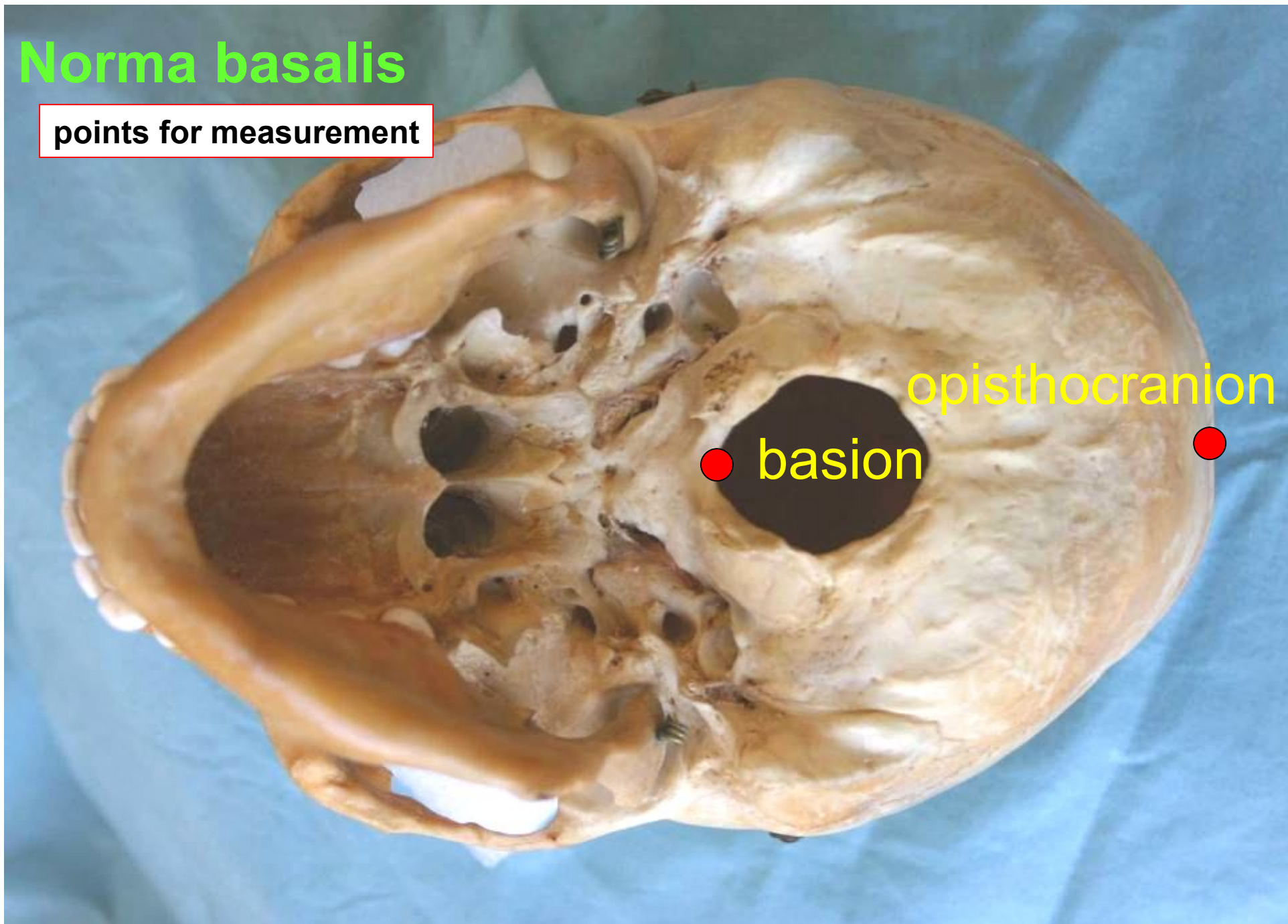
**foramen magnum**

# Norma basalis

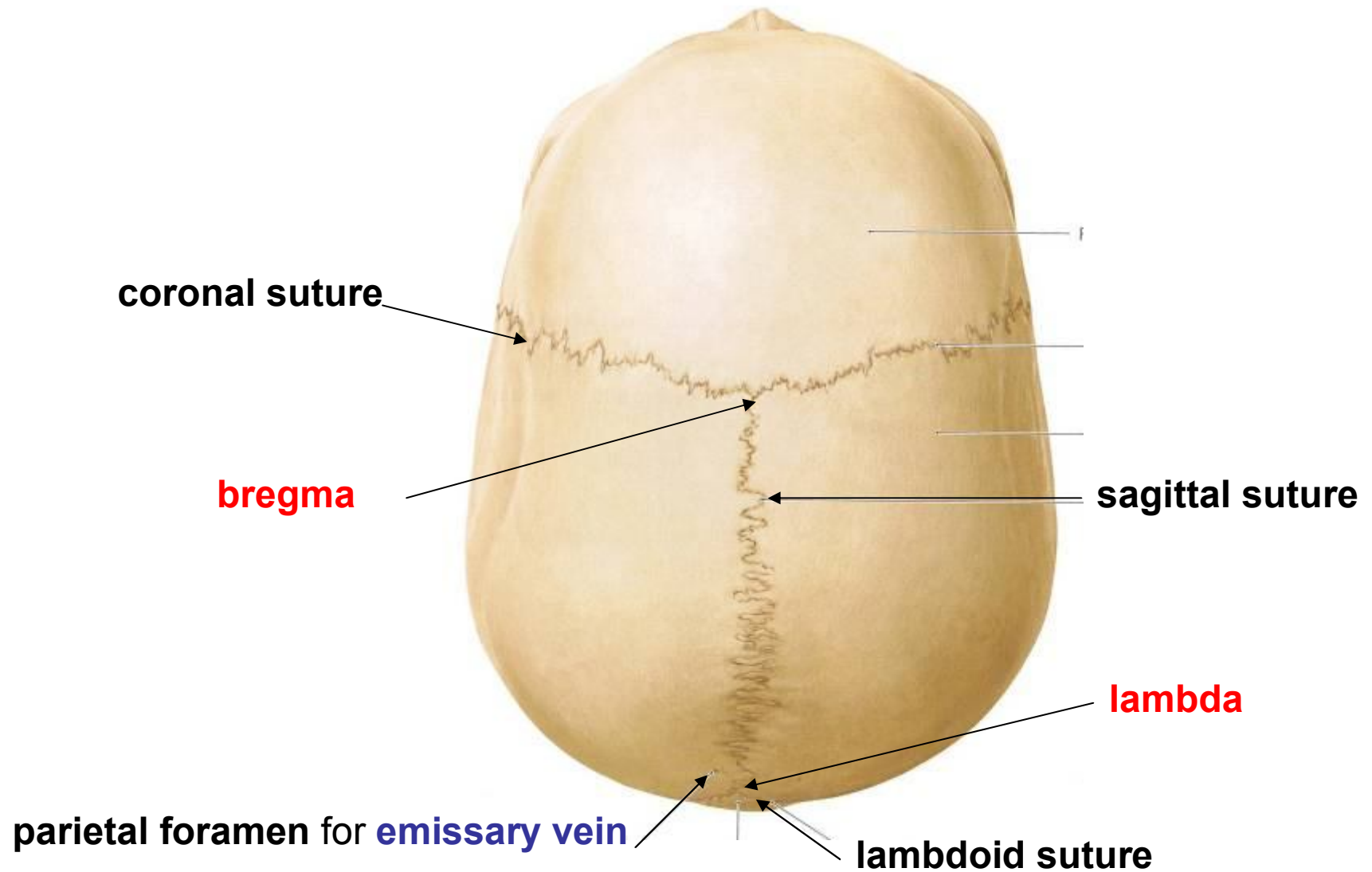
points for measurement

opisthocranion

• basion

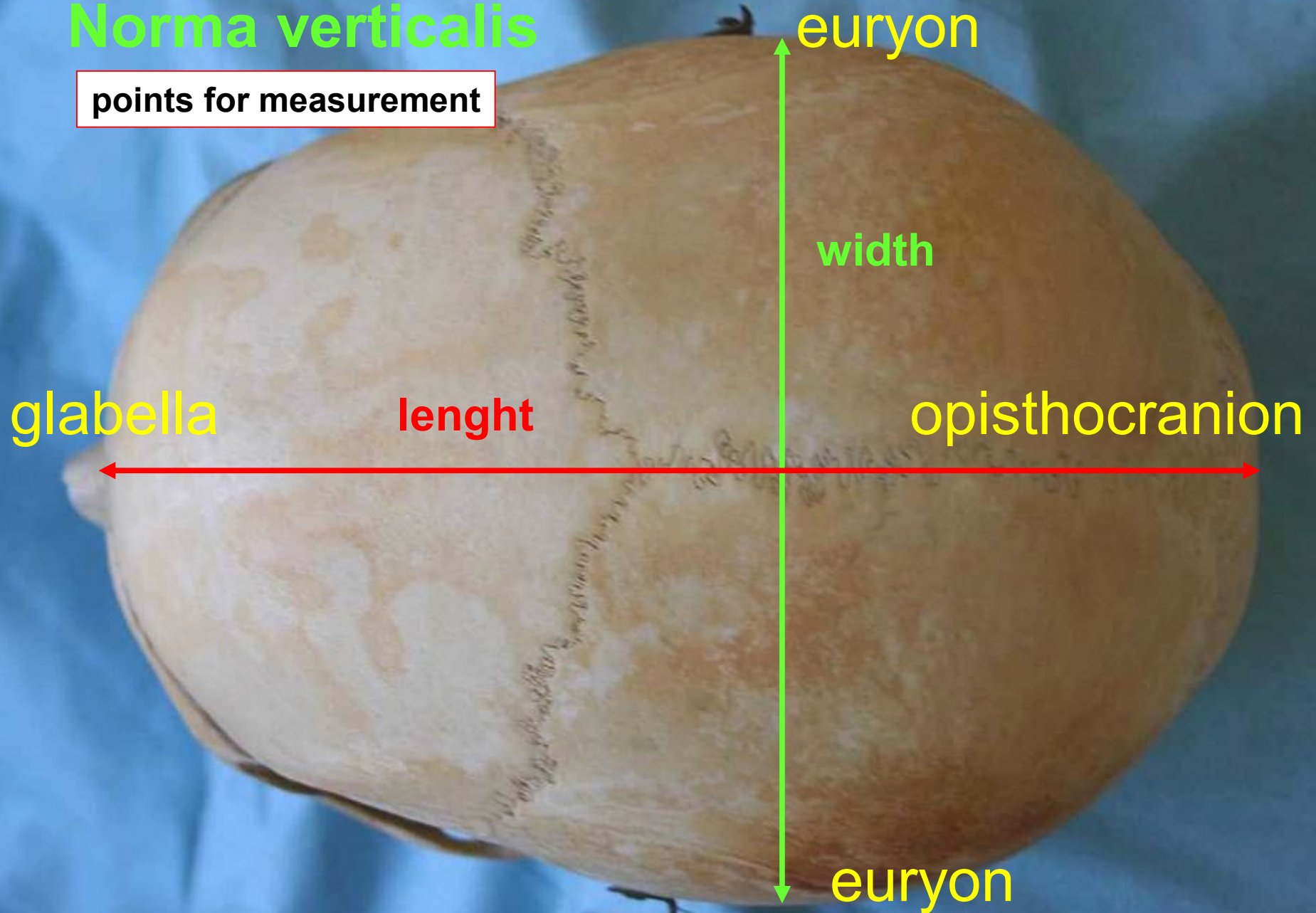


# Calvaria from outside

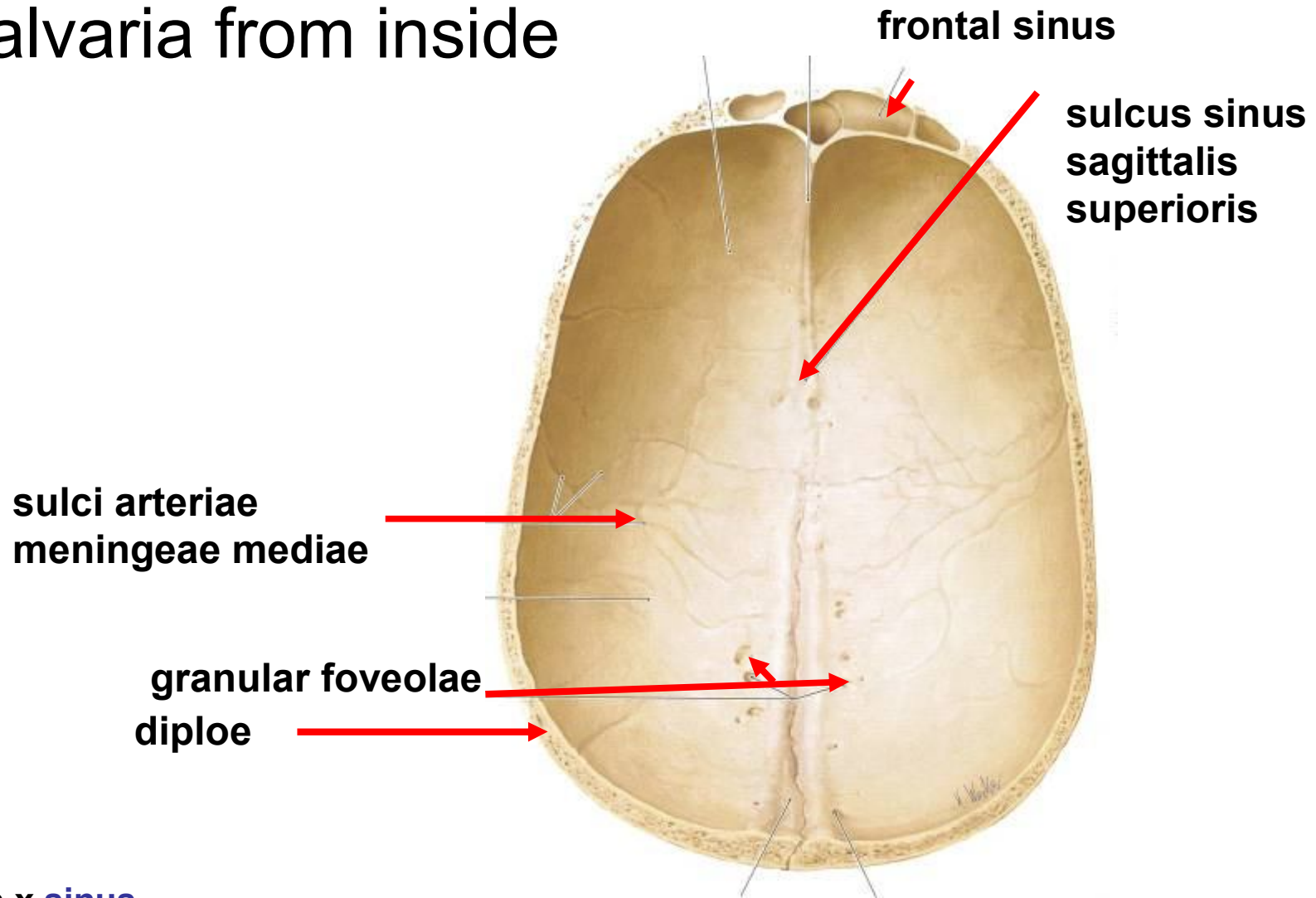


# Norma verticalis

points for measurement



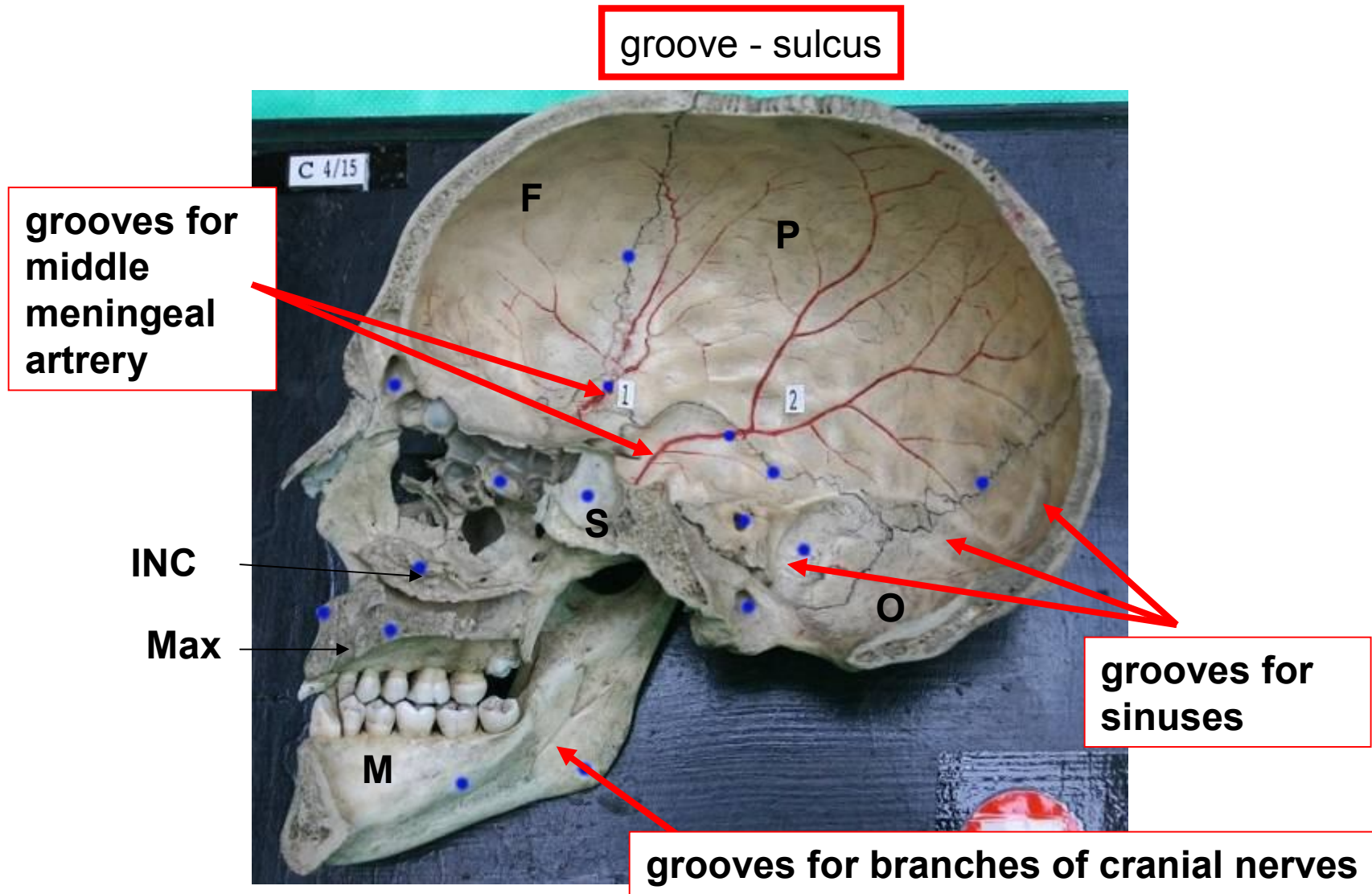
# Calvaria from inside



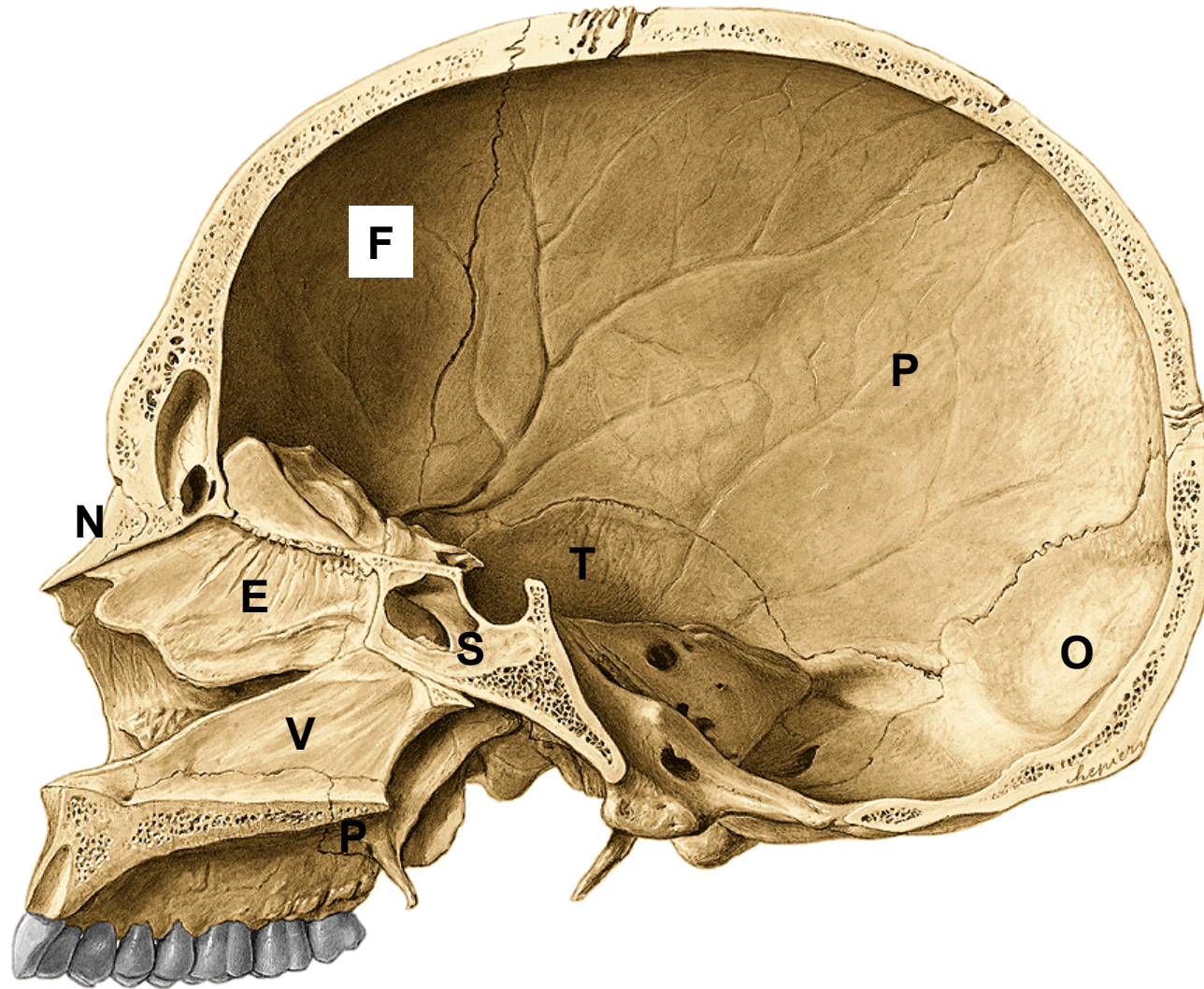
**sinus x sinus**

**air filled cavity x vein between dura mater and periosteum or only between dura mater**

# Skull – sagittal section - inner surface

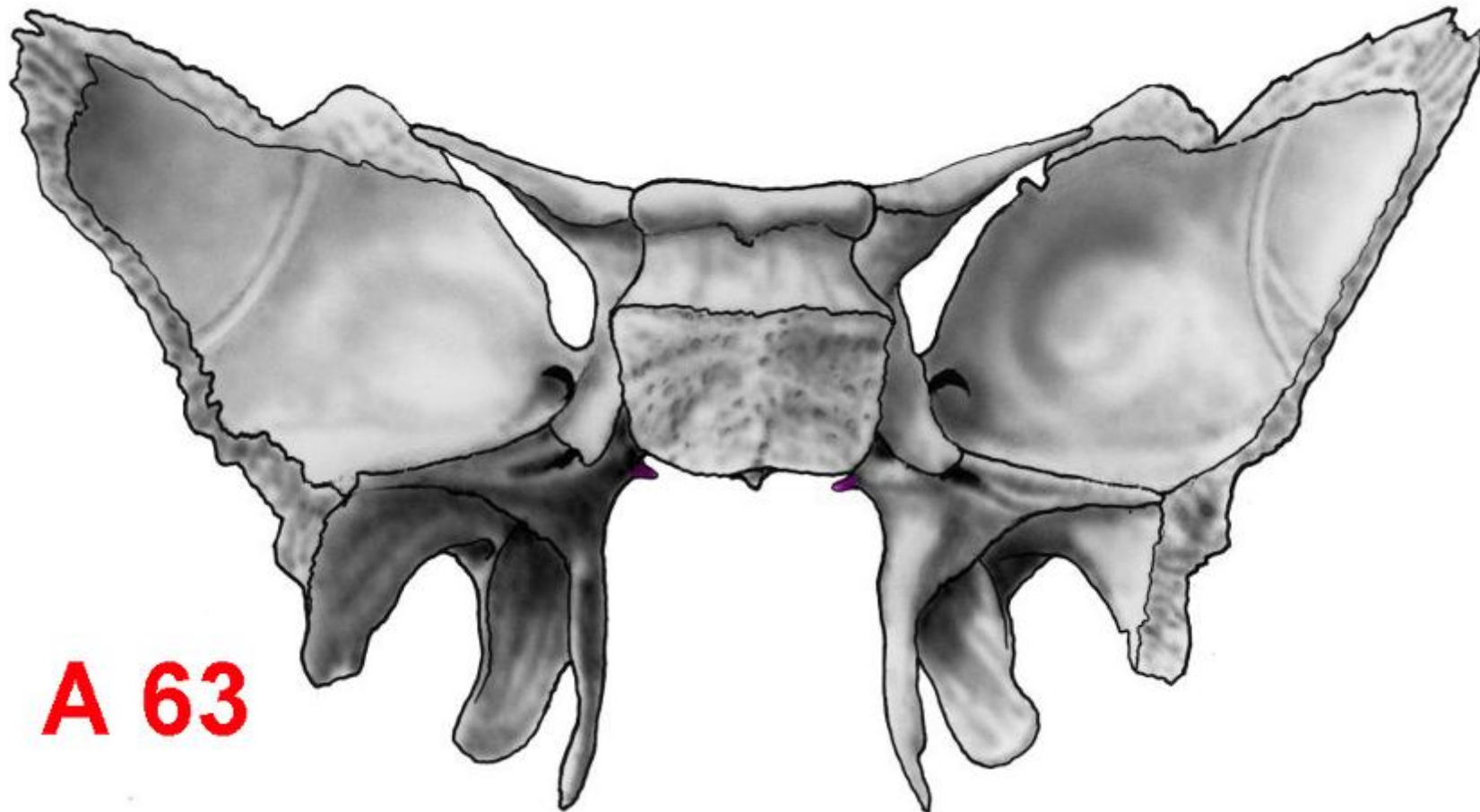
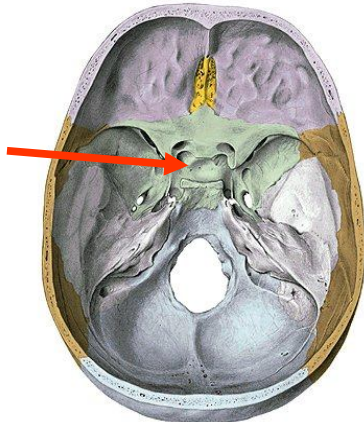


## Skull - midline section - inner surface





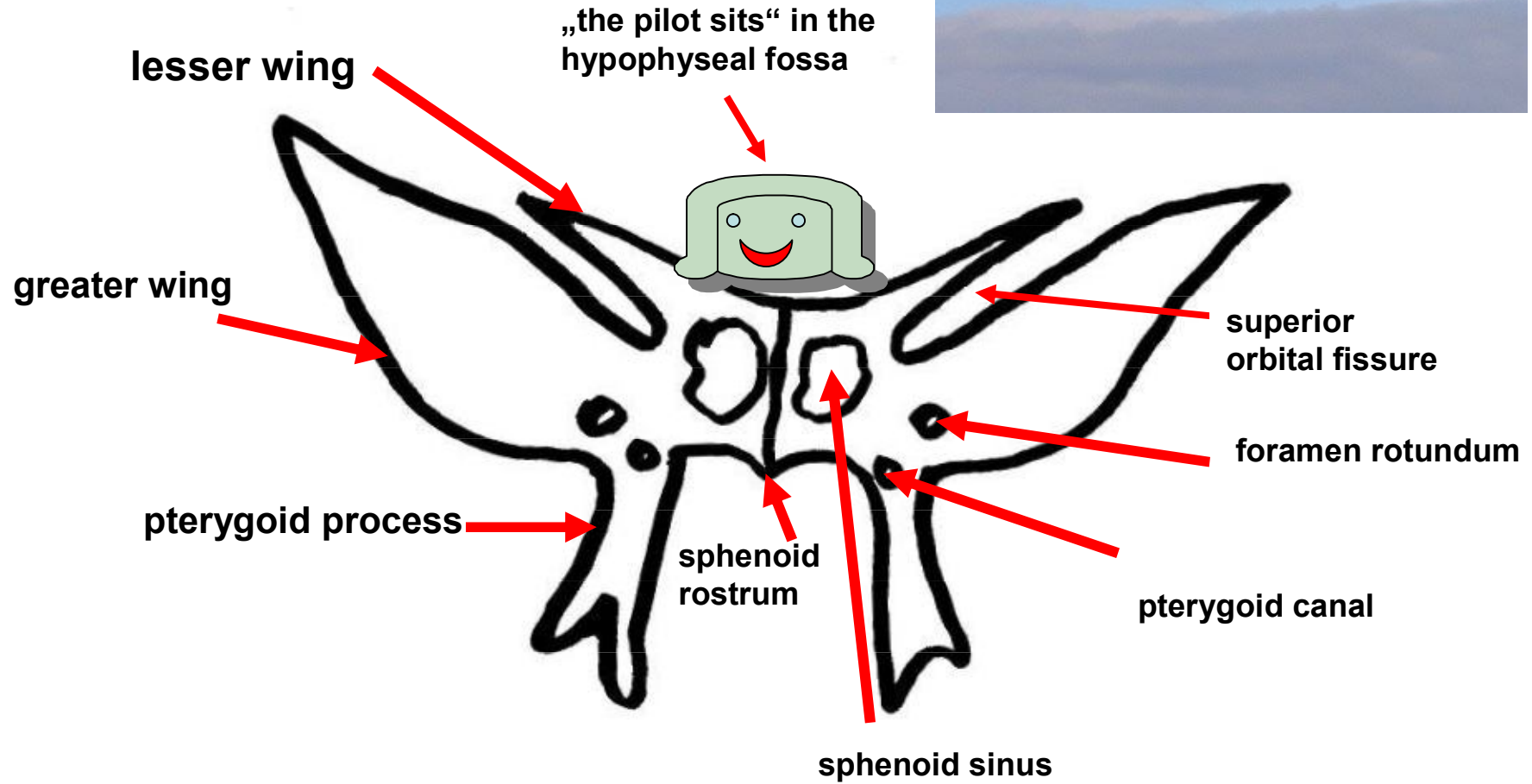
Os sphenoidale

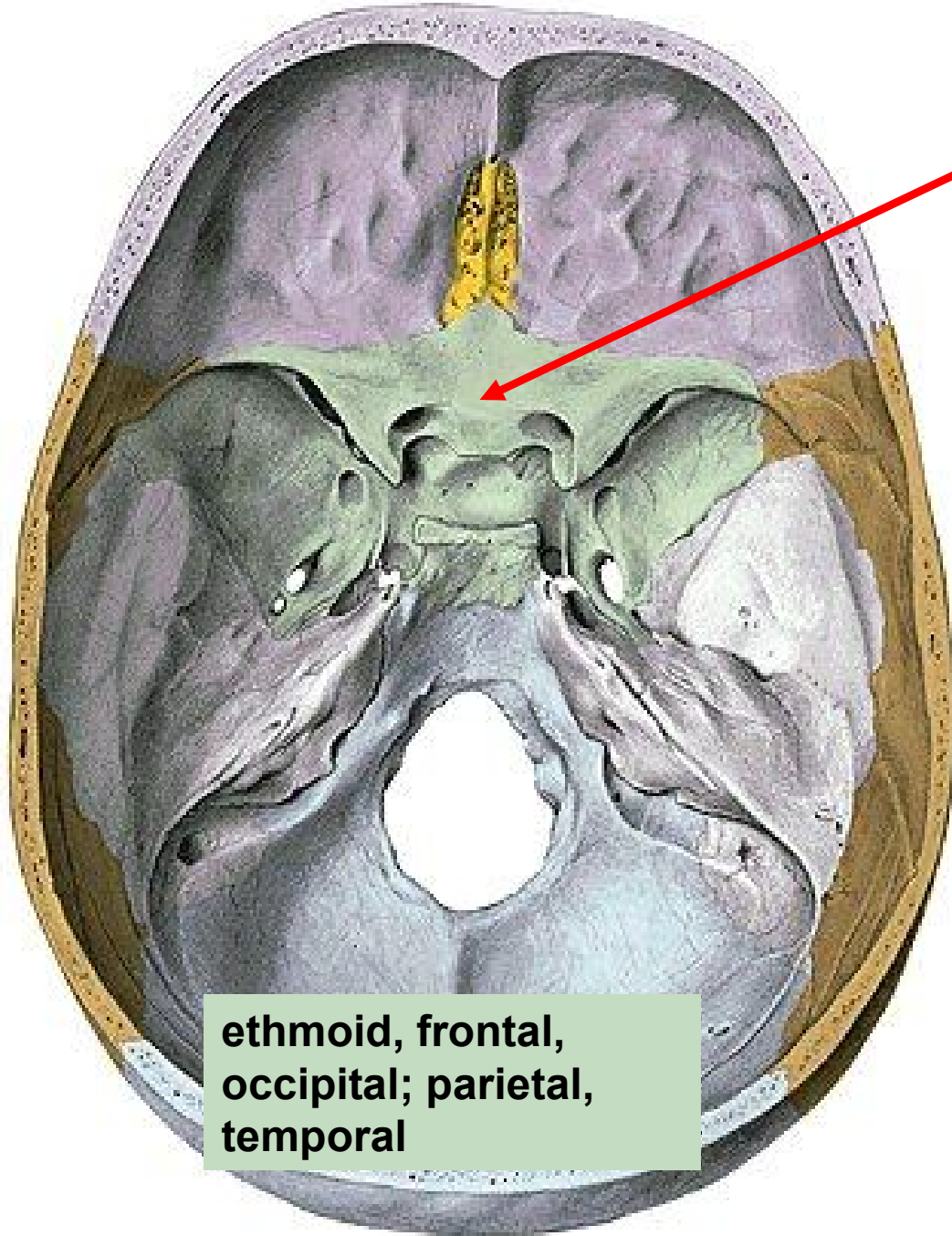


wing  
al  
al  
iporal  
omaxilar  
s)

**A 63**

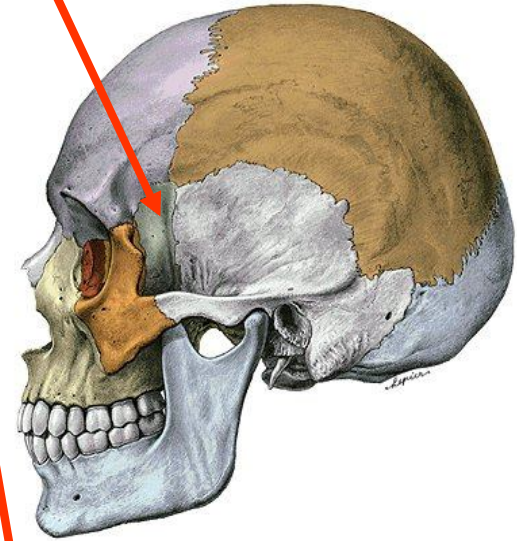
# Sphenoid bone anterior aspect - schema



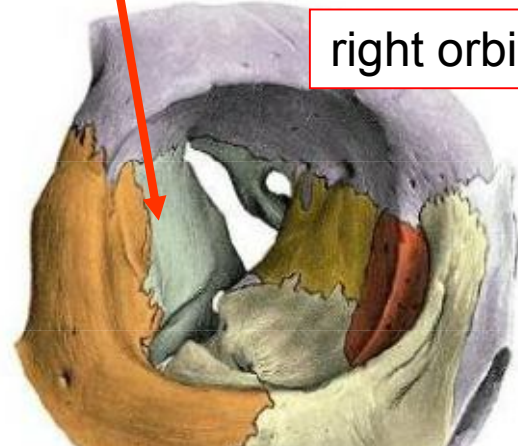


ethmoid, frontal,  
occipital; parietal,  
temporal

**Os sphenoidale - placement**

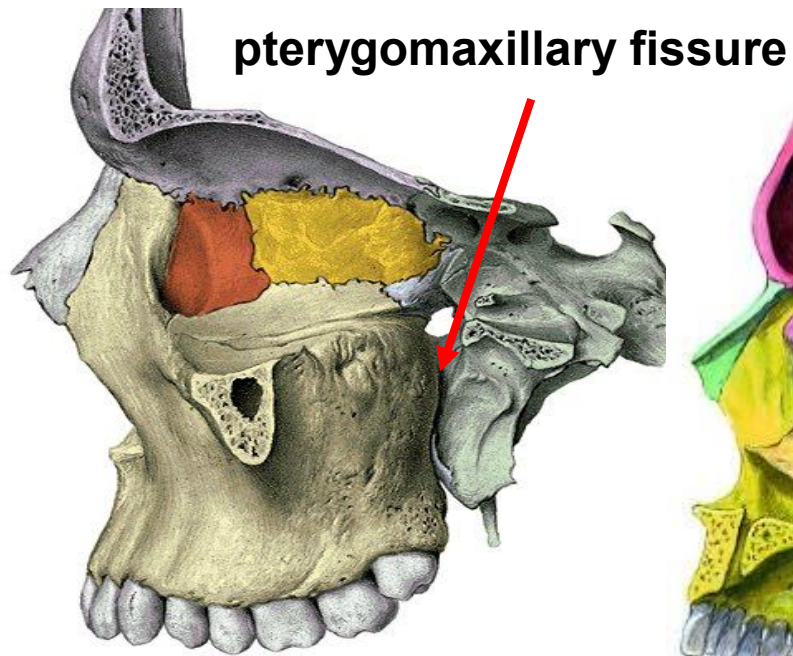


right orbit



ethmoid, frontal, zygomatic

# Os sphenoidale and maxilla, palatine bone and vomer



lateral aspect



lateral wall of the nasal cavity

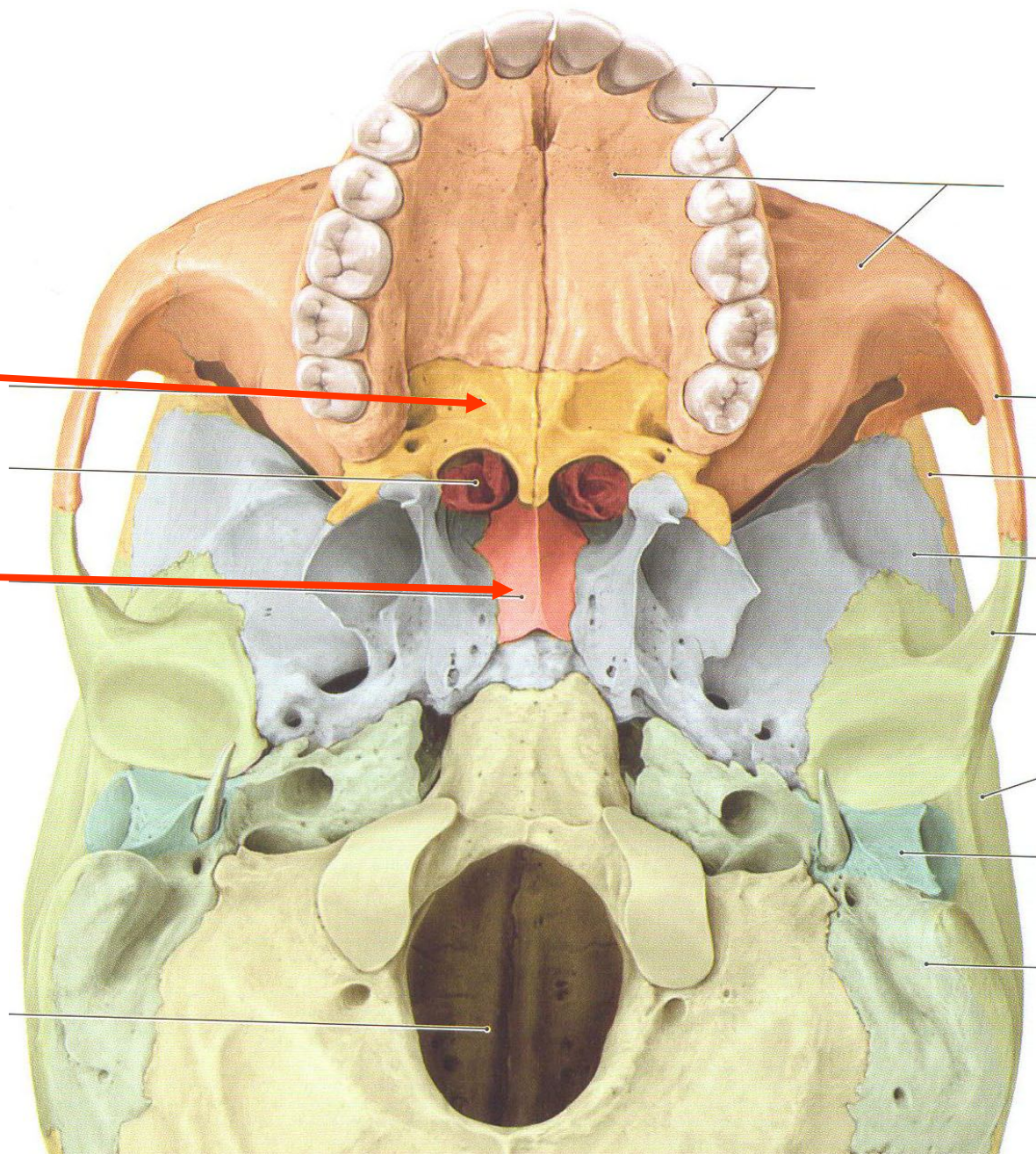


nasal septum

Os sphenoidale –  
inferior aspect

**Os palatinum**

**Vomer**



**Os sphenoidale openings and grooves  
aspect from superoposterior left side**

**sulcus prechiasmaticus**

**superior orbital fissure**

**optic canal**

**fossa hypophysialis**

**sulcus caroticus**

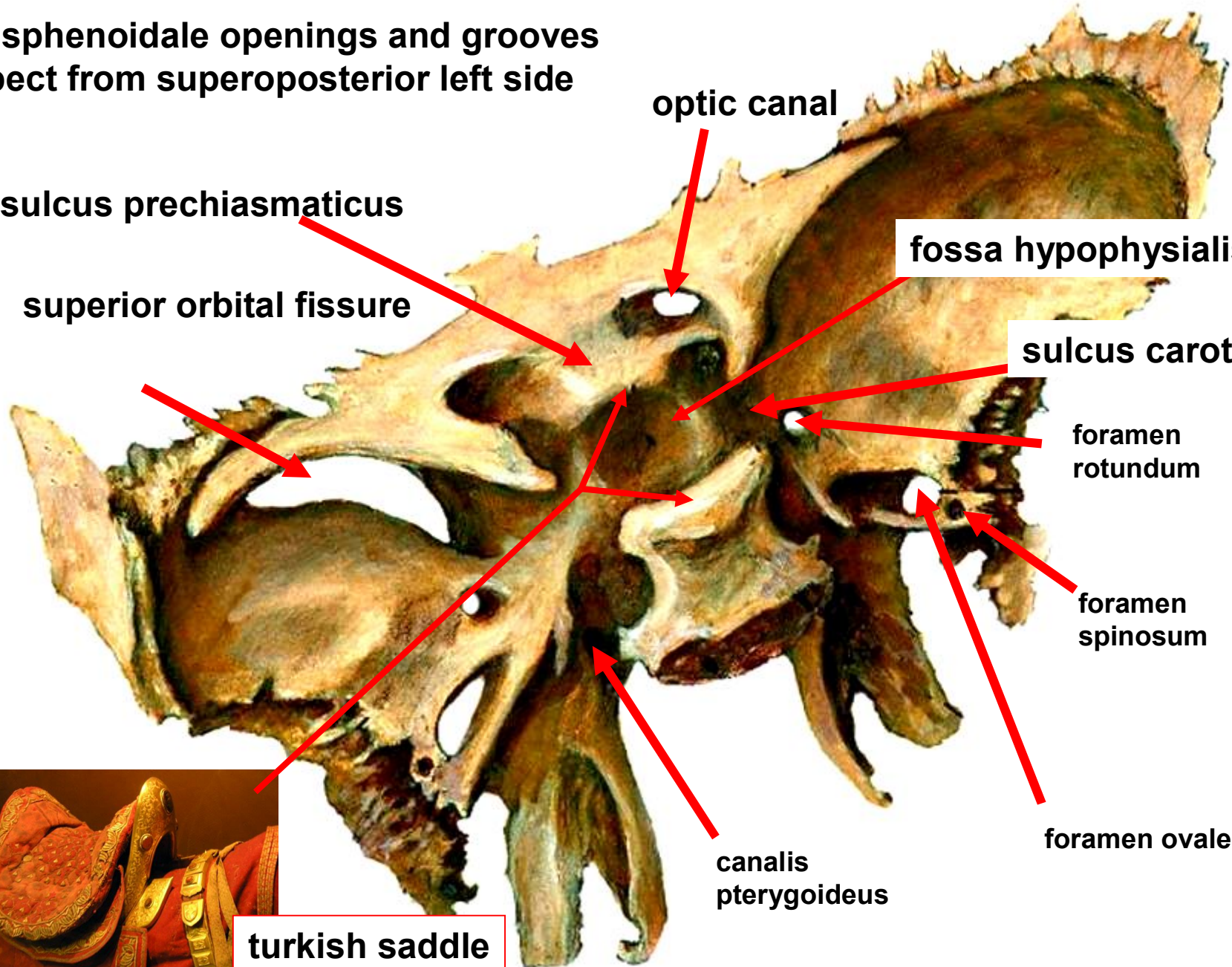
**foramen  
rotundum**

**foramen  
spinosum**

**foramen ovale**

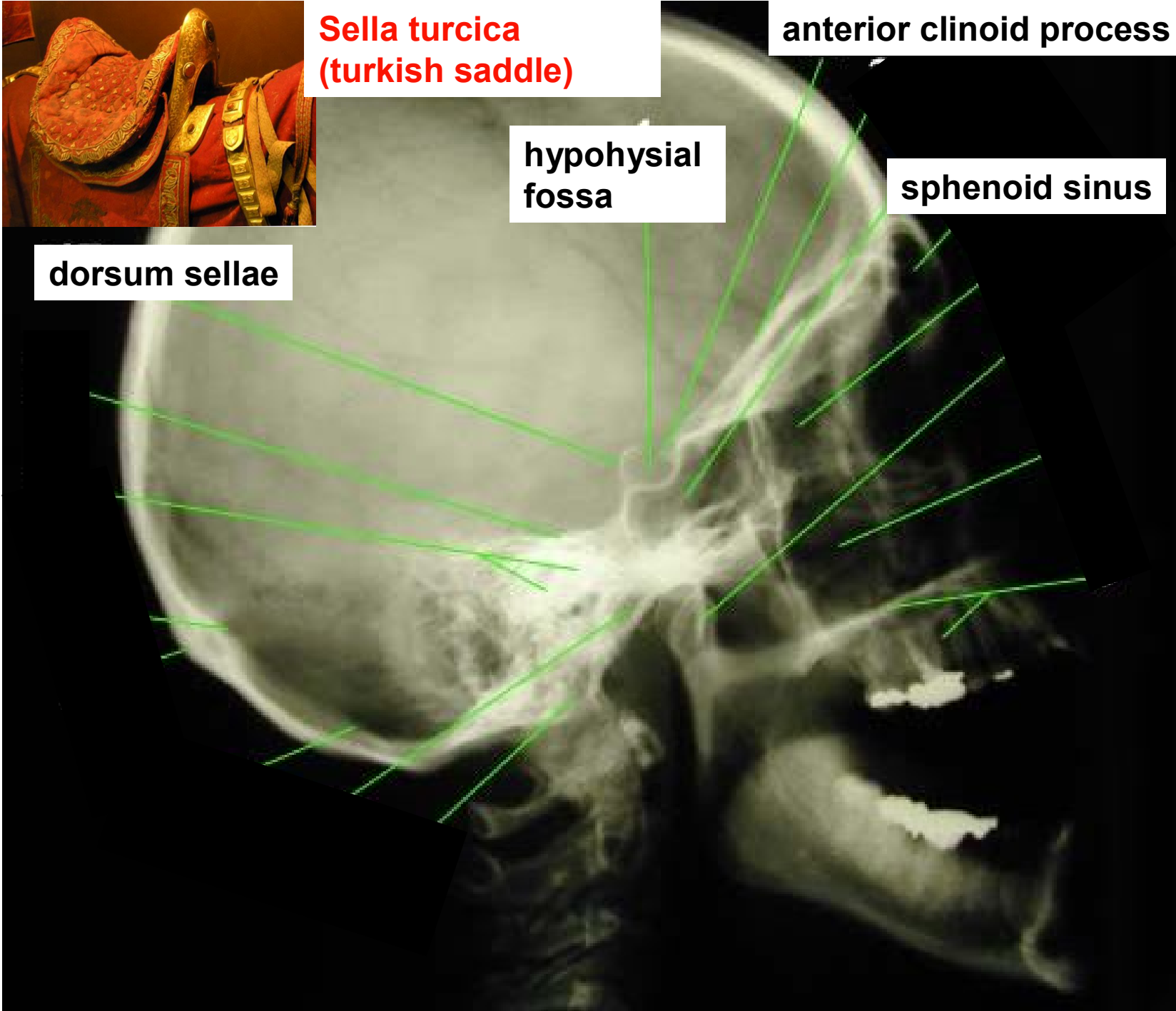
**canalis  
pterygoideus**

**turkish saddle**

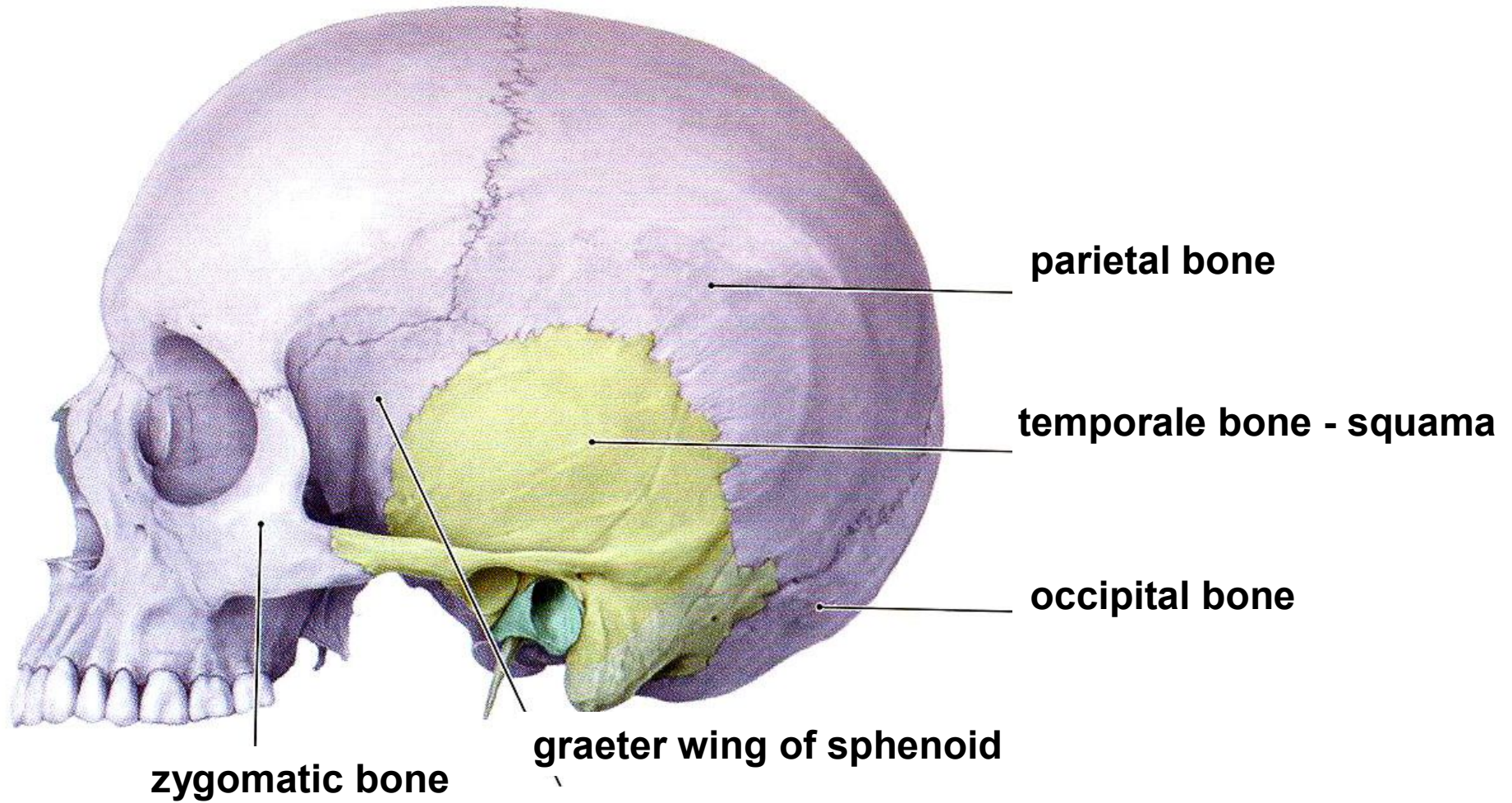




**Sella turcica  
(turkish saddle)**

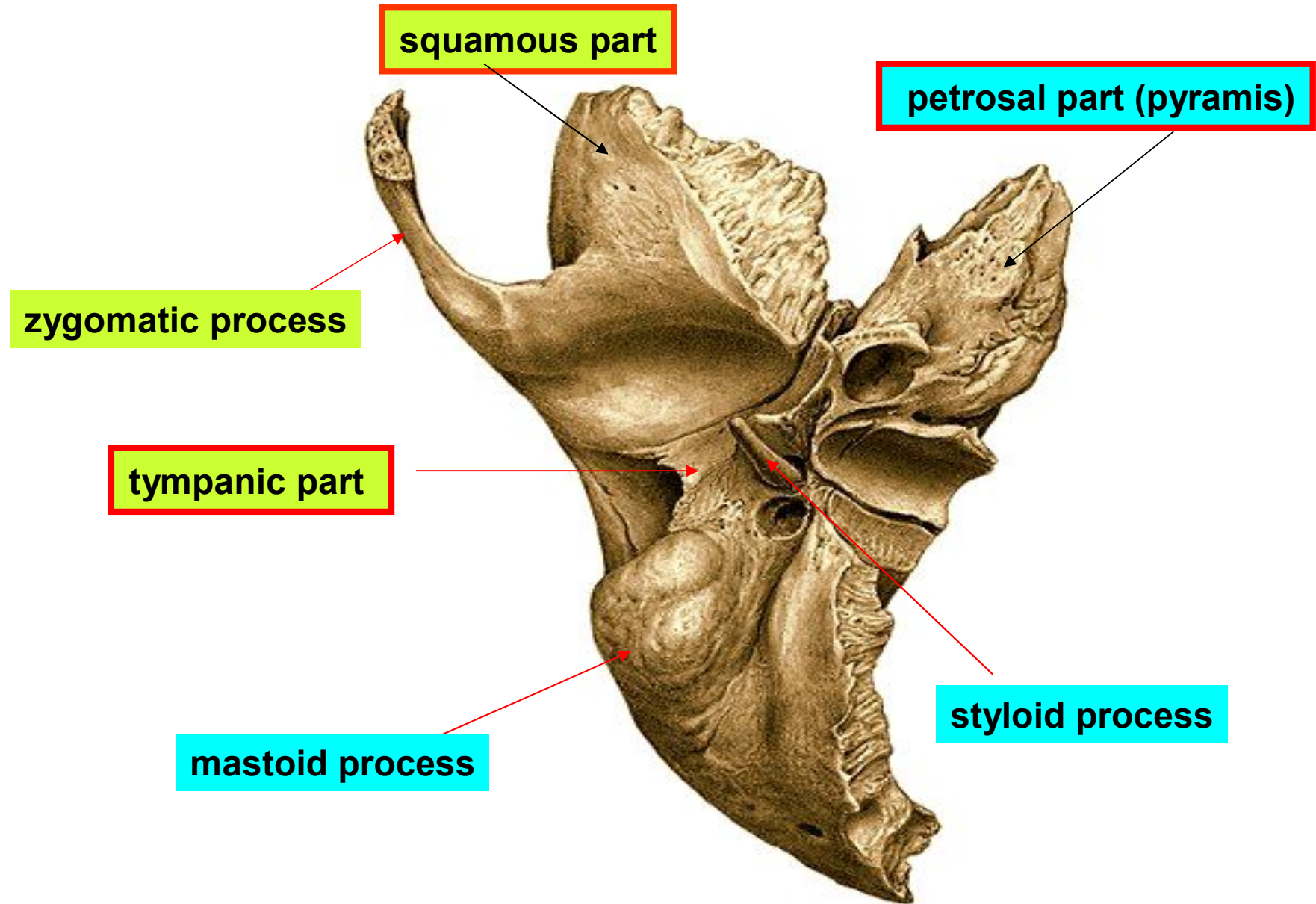


# Os temporale- lateral aspect



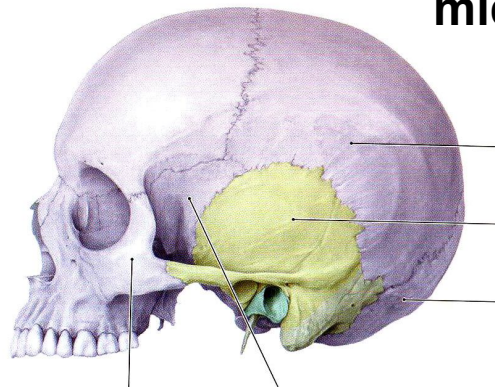


# Os temporale inferior aspect - parts

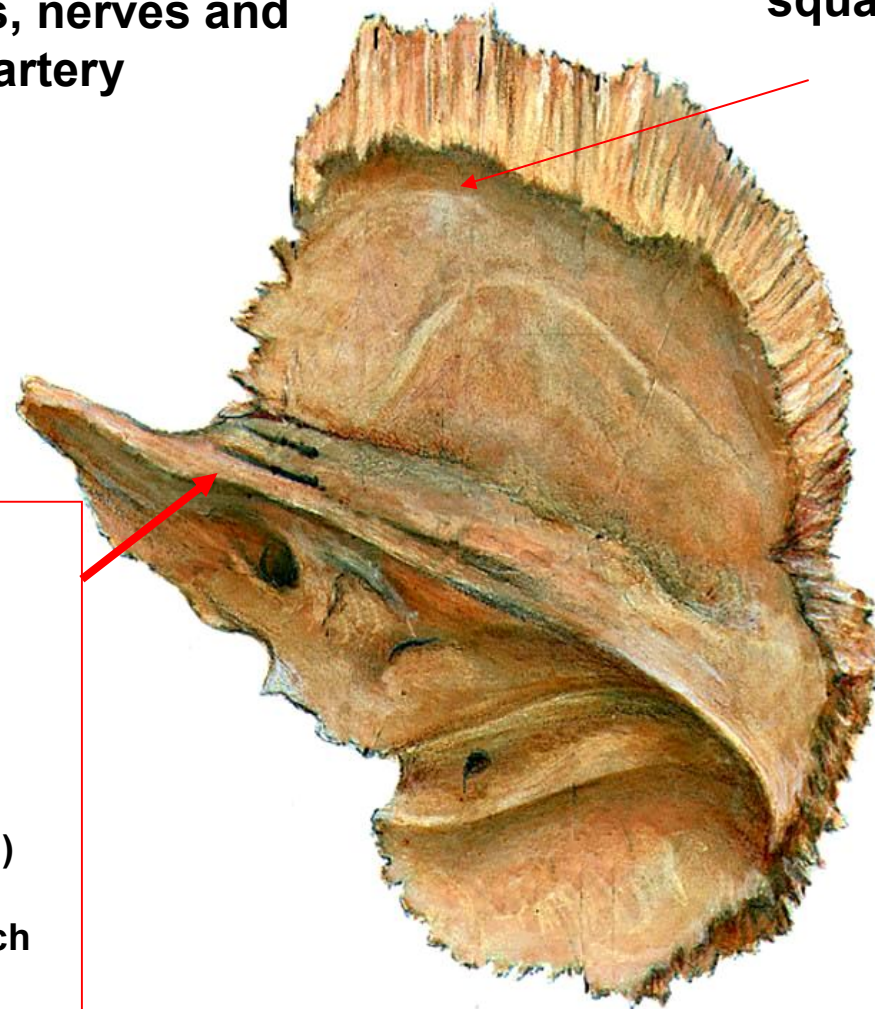


# Os temporale -superior aspect

anterior and posterior wall-  
grooves of sinuses, nerves and  
middle meningeal artery



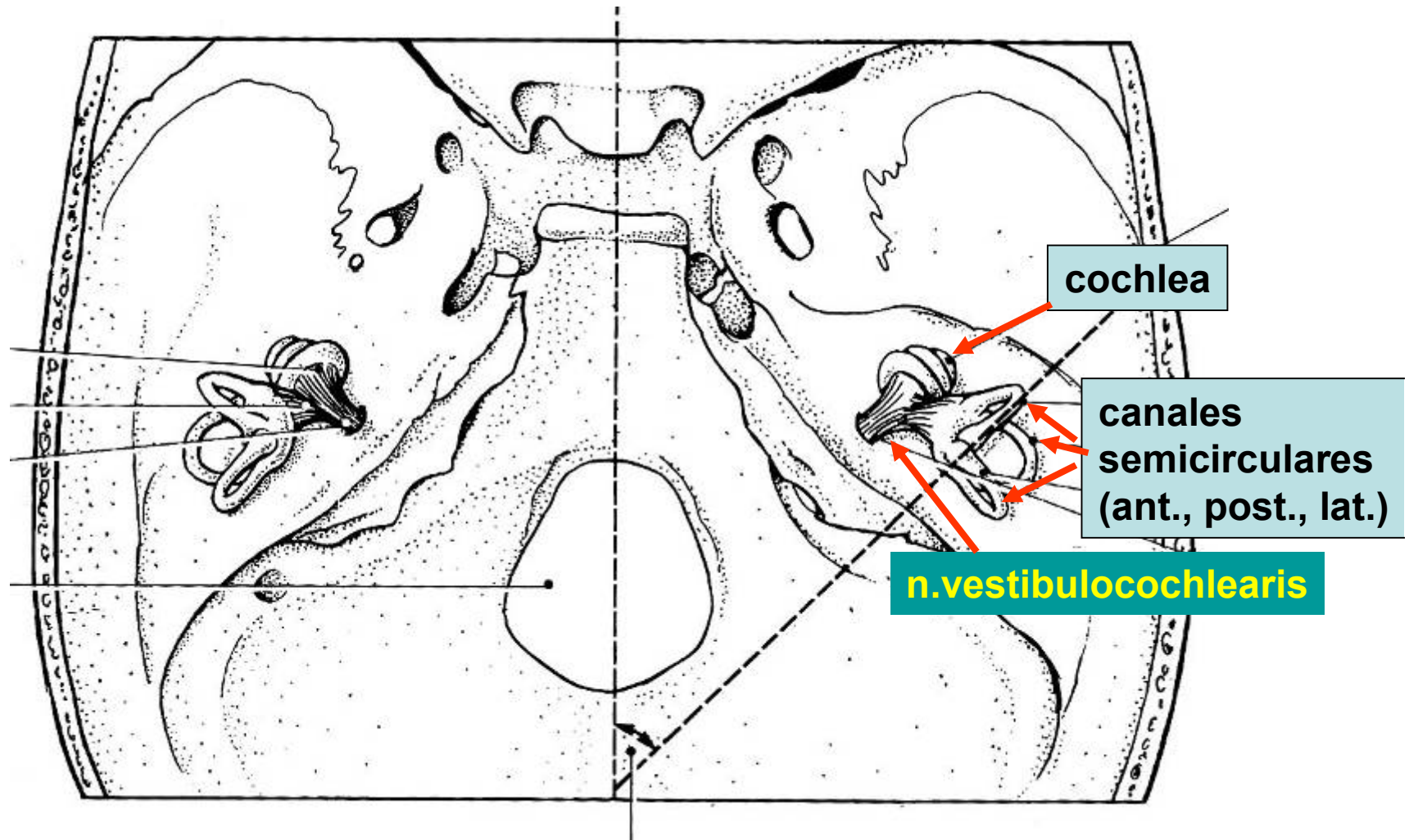
squama



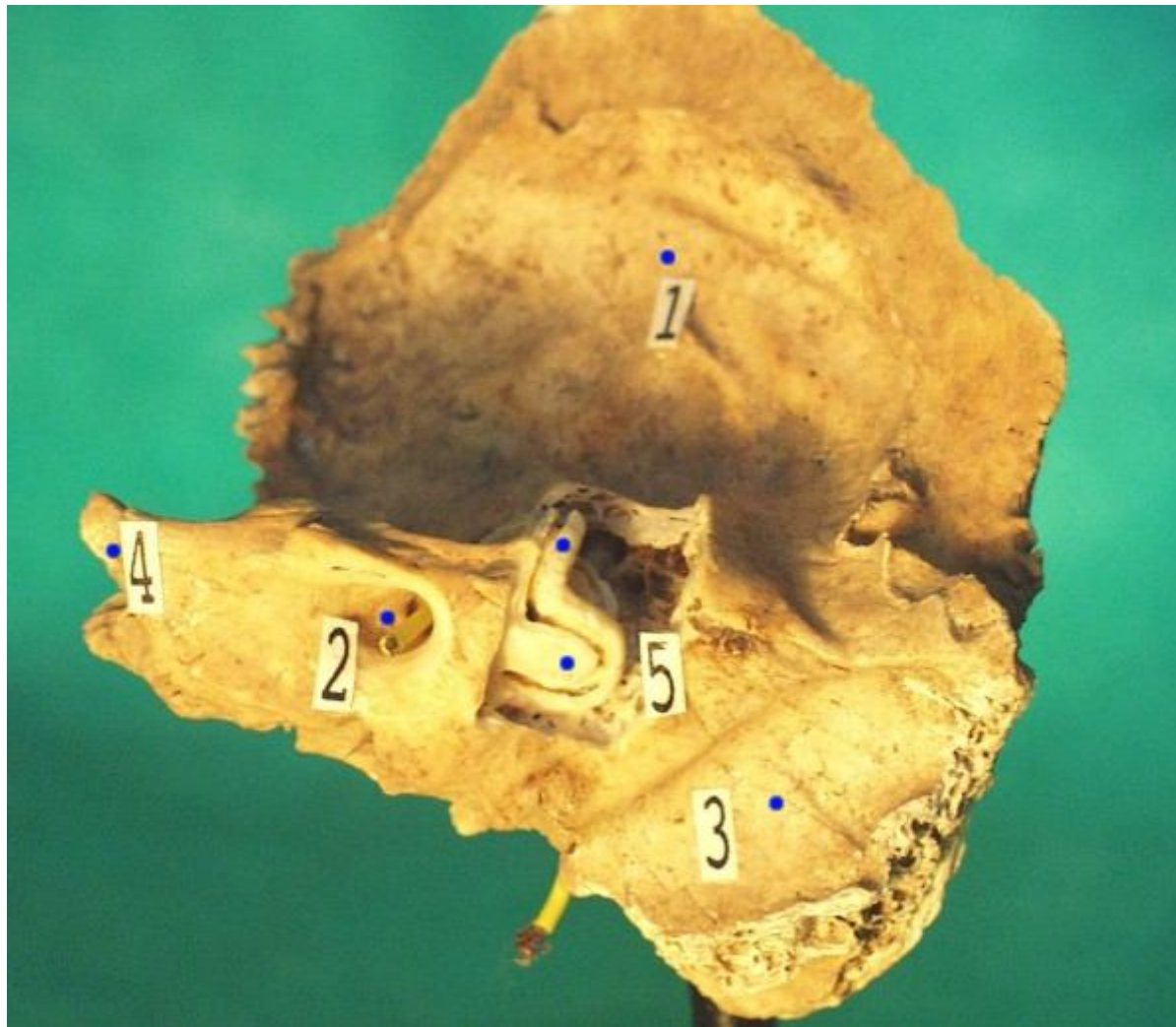
**os petrosum – pyramis**, inside are:

- 1) bony labyrinth
- 2) canalis caroticus
- 3) canalis nervi facialis
- 4) canalis musculotubarius
- 5) canaliculus cochlea
- 6) aquaeductus vestibuli
- 7) canaliculus tympanicus (for branch of IX.n)
- 8) canaliculus chordae tympani (from VII.n)
- 9) canaliculus mastoideus (for external branch of X.n.)

# Position of the inner ear in petrosal bone



# Os temporale labyrinthus osseus



1-squama

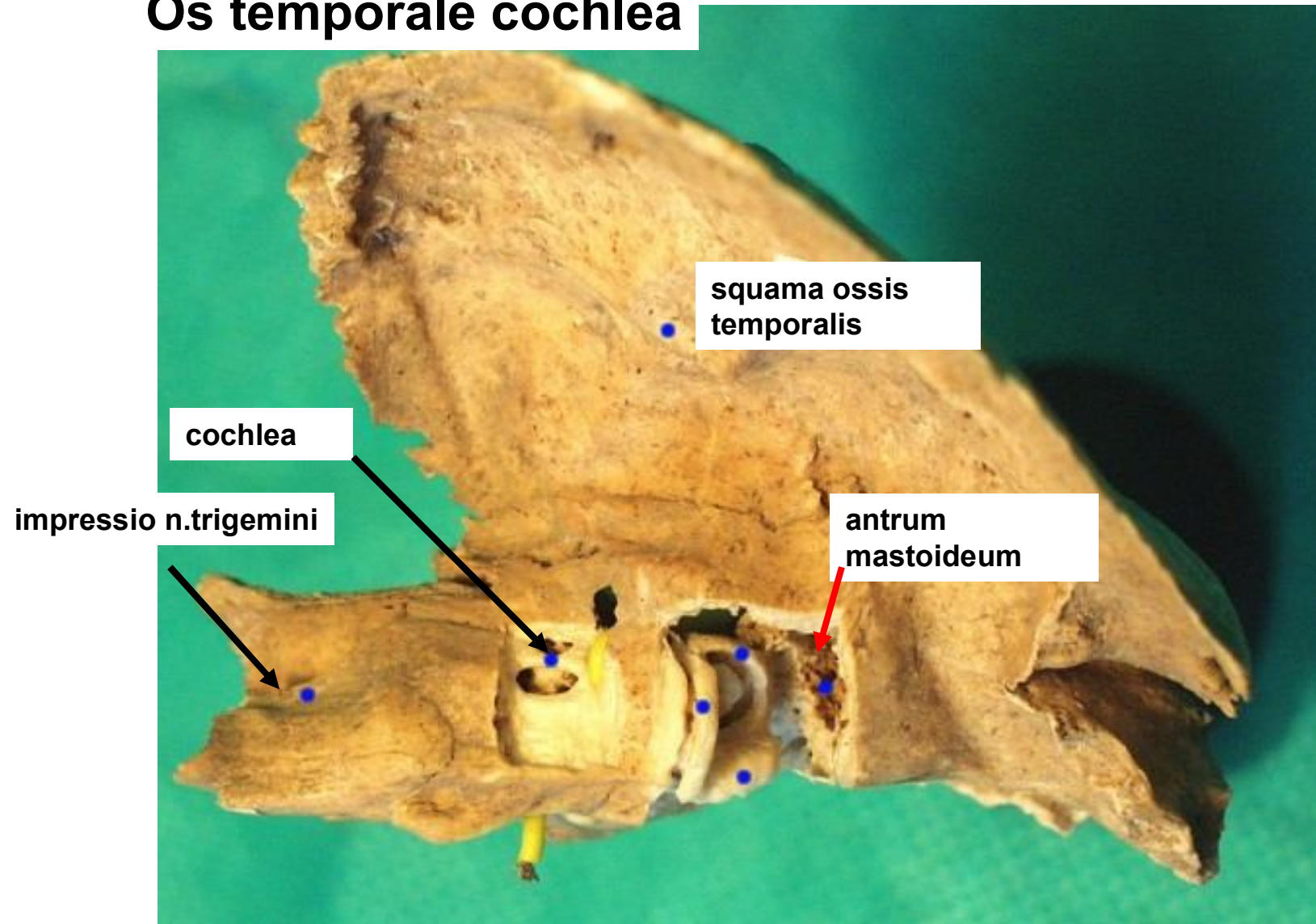
2-porus acusticus int.  
(n.VII +VIII)

3-sulcus sinus sigmoidei

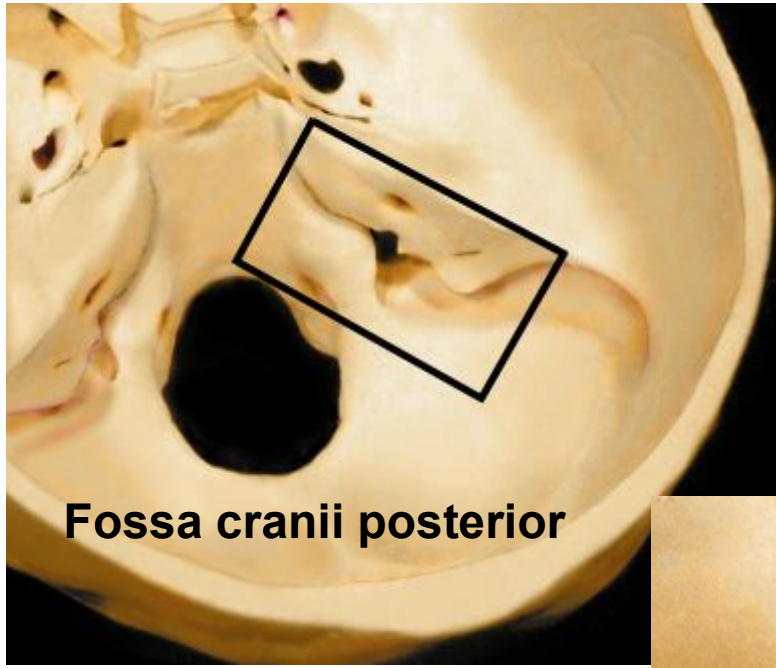
4-apex pyramidis

5-semicircular canals

# Os temporale cochlea

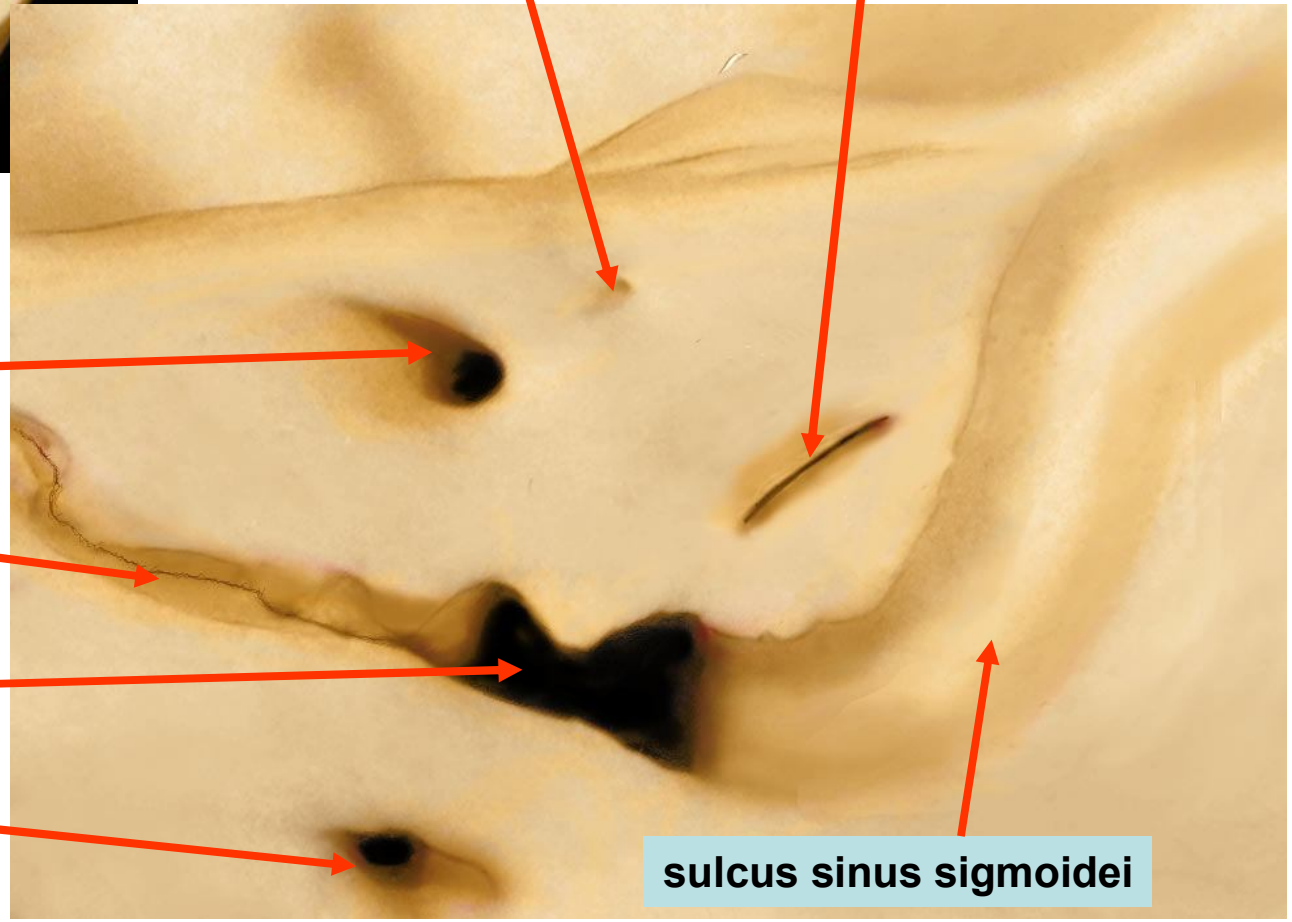


**Os petrosum (pyramis) - posterior wall**



**apertura externa  
aquaeductus vestibuli**

**fossa subarcuata**



# Os petrosum (pyramis) - posterior wall

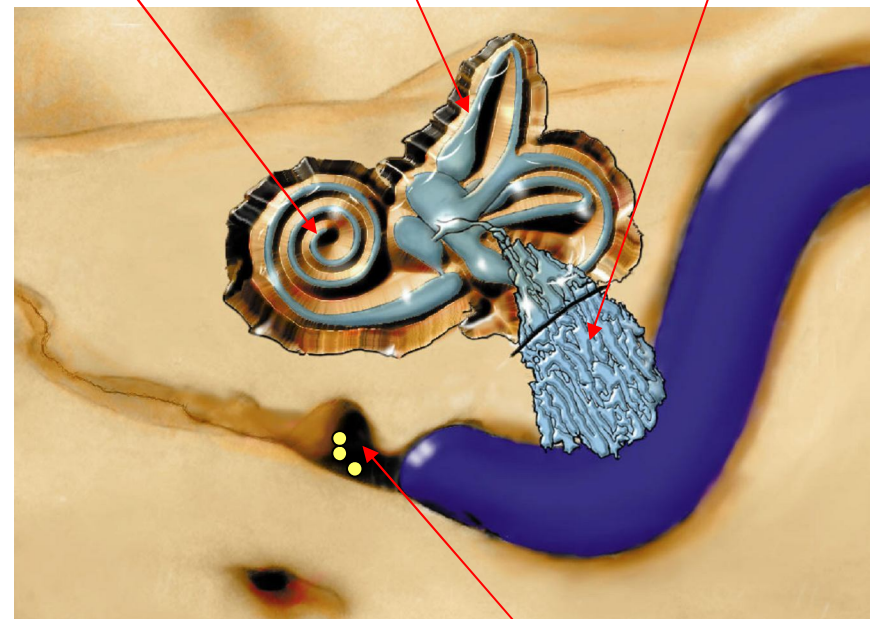
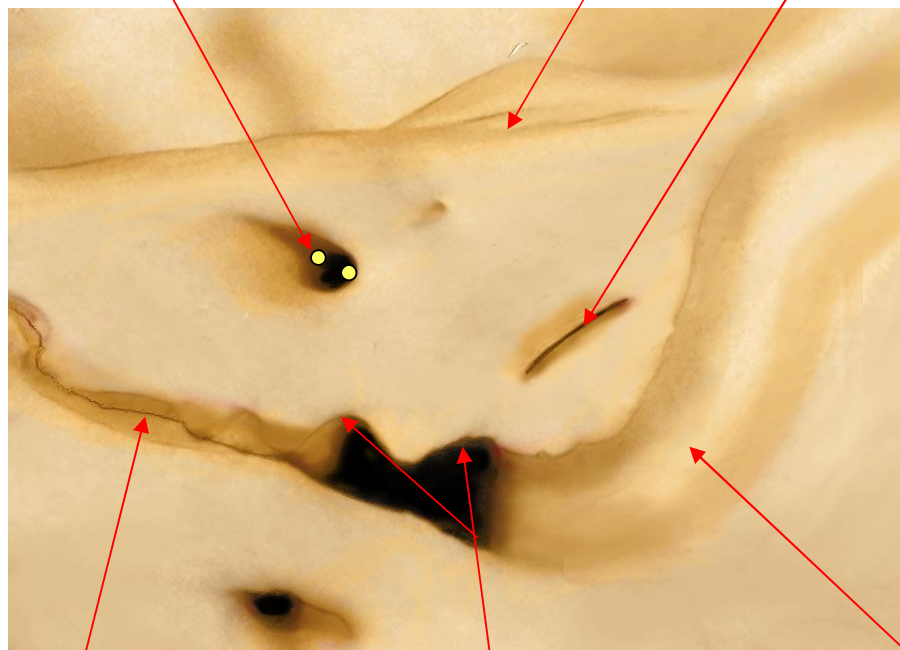
meatus acusticus internus

nerves VII, VIII

sulcus sinus petrosi superioris

apertura externa aquaeductus vestibuli

semicircular cochlea canals endolymphatic sac



sulcus sinus petrosi inferioris

incisura jugularis (jugular notch)

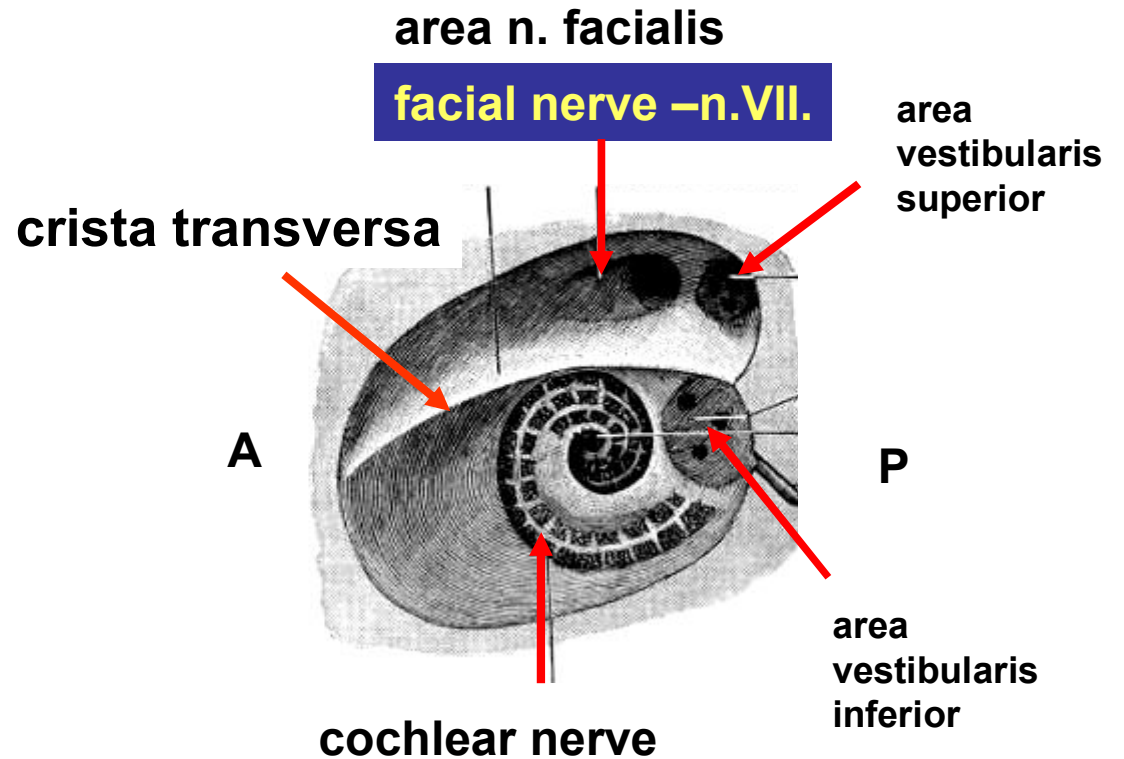
sulcus sinus sigmoidei

nerves IX, X, XI.

# Fundus meatus acustici interni – nerves VII. and VIII.



right pyramis posterior aspect





# Canalis nervi facialis

- 1) anterolaterally
- 2) posterolaterally
- 3) caudally

internal acoustic meatus

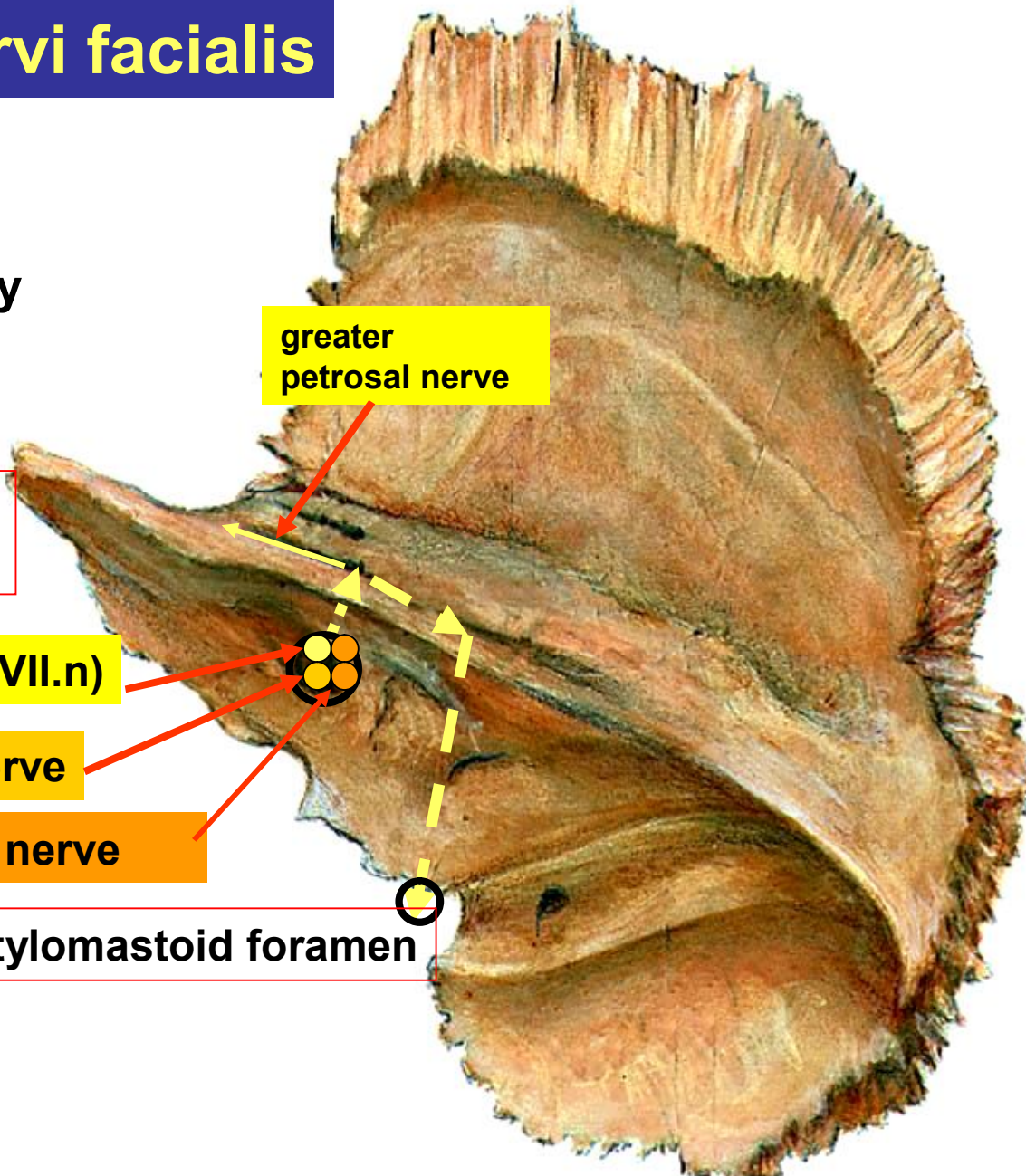
facial nerve (VII.n)

cochlear nerve

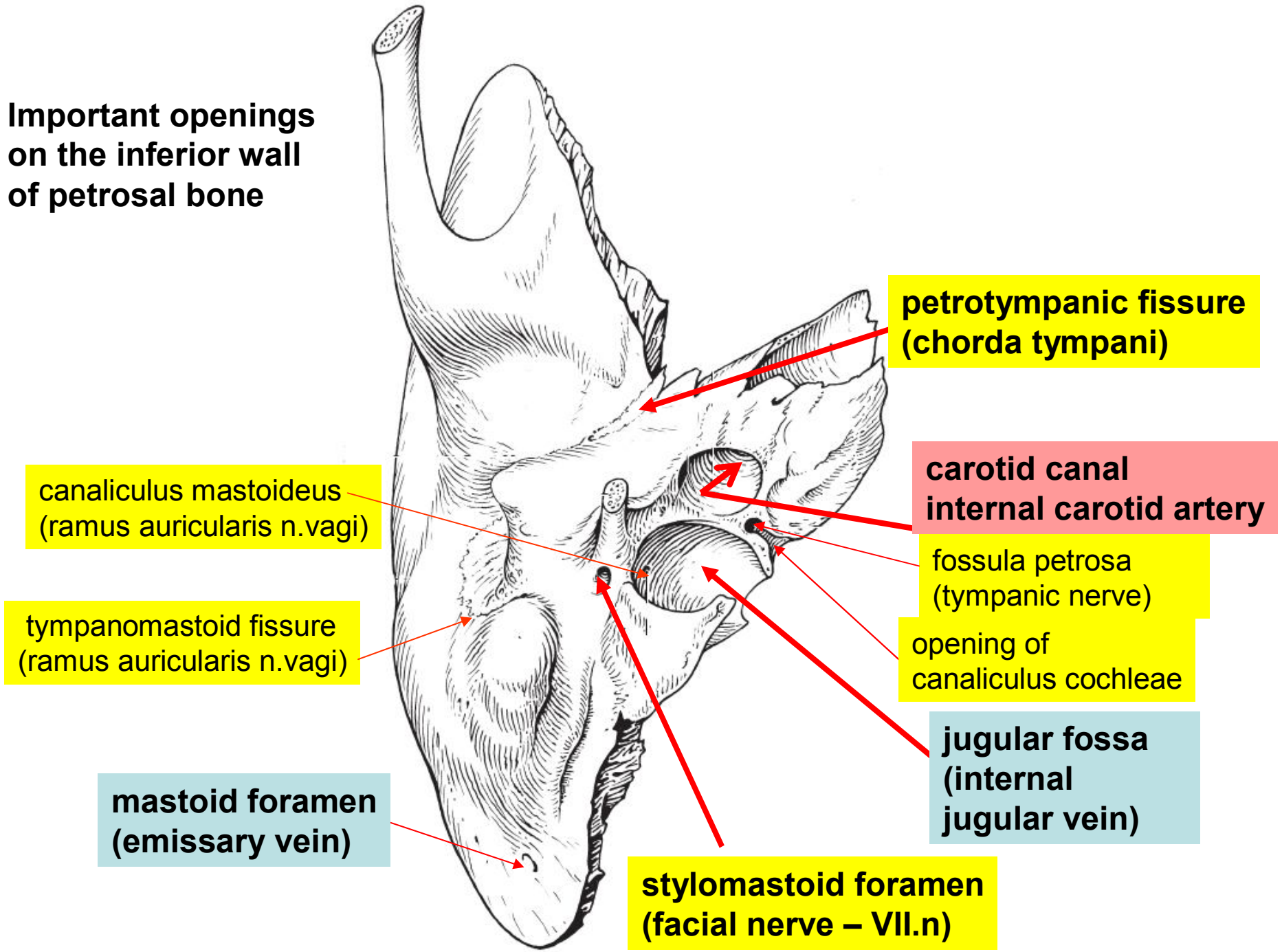
vestibular nerve

stylomastoid foramen

greater petrosal nerve

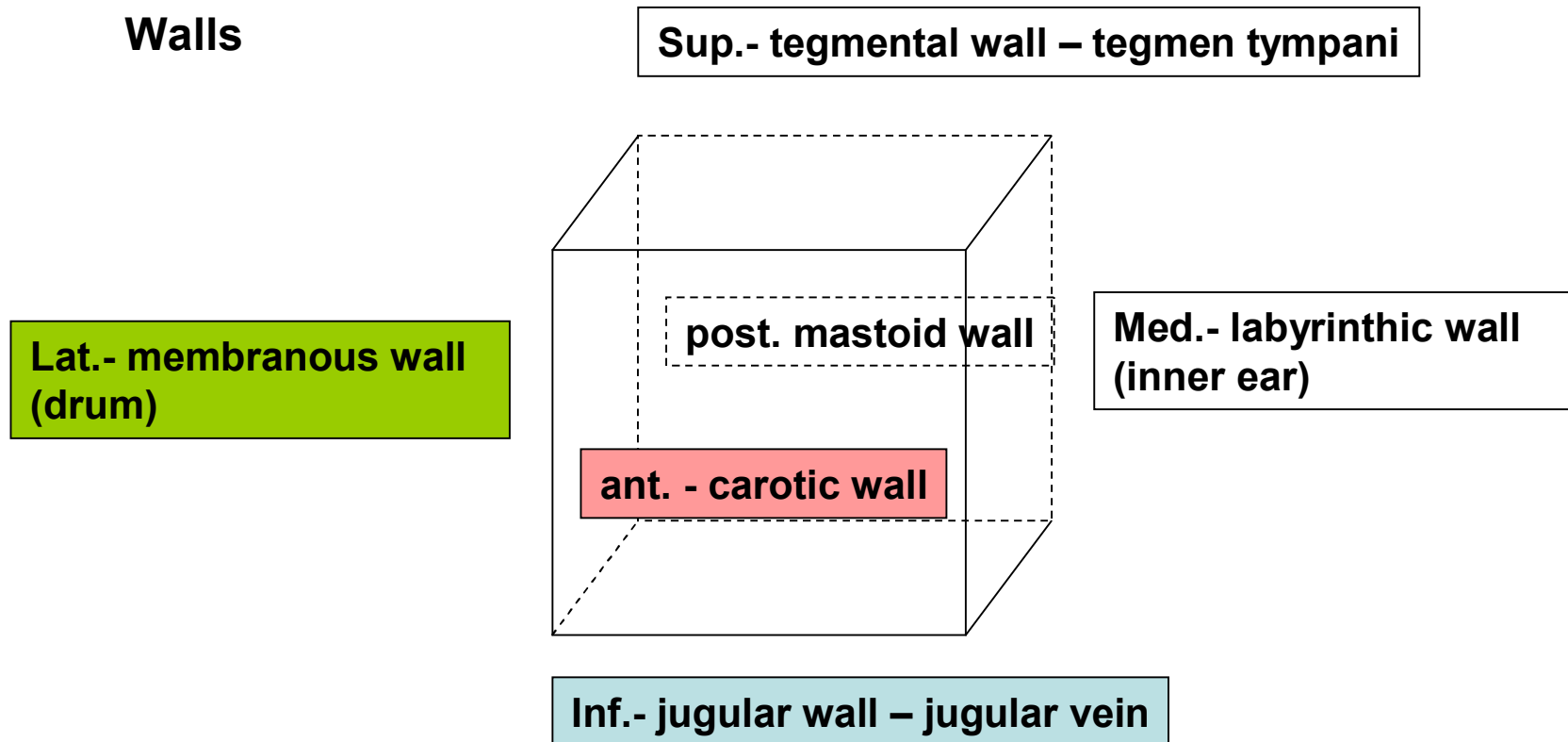


**Important openings  
on the inferior wall  
of petrosal bone**

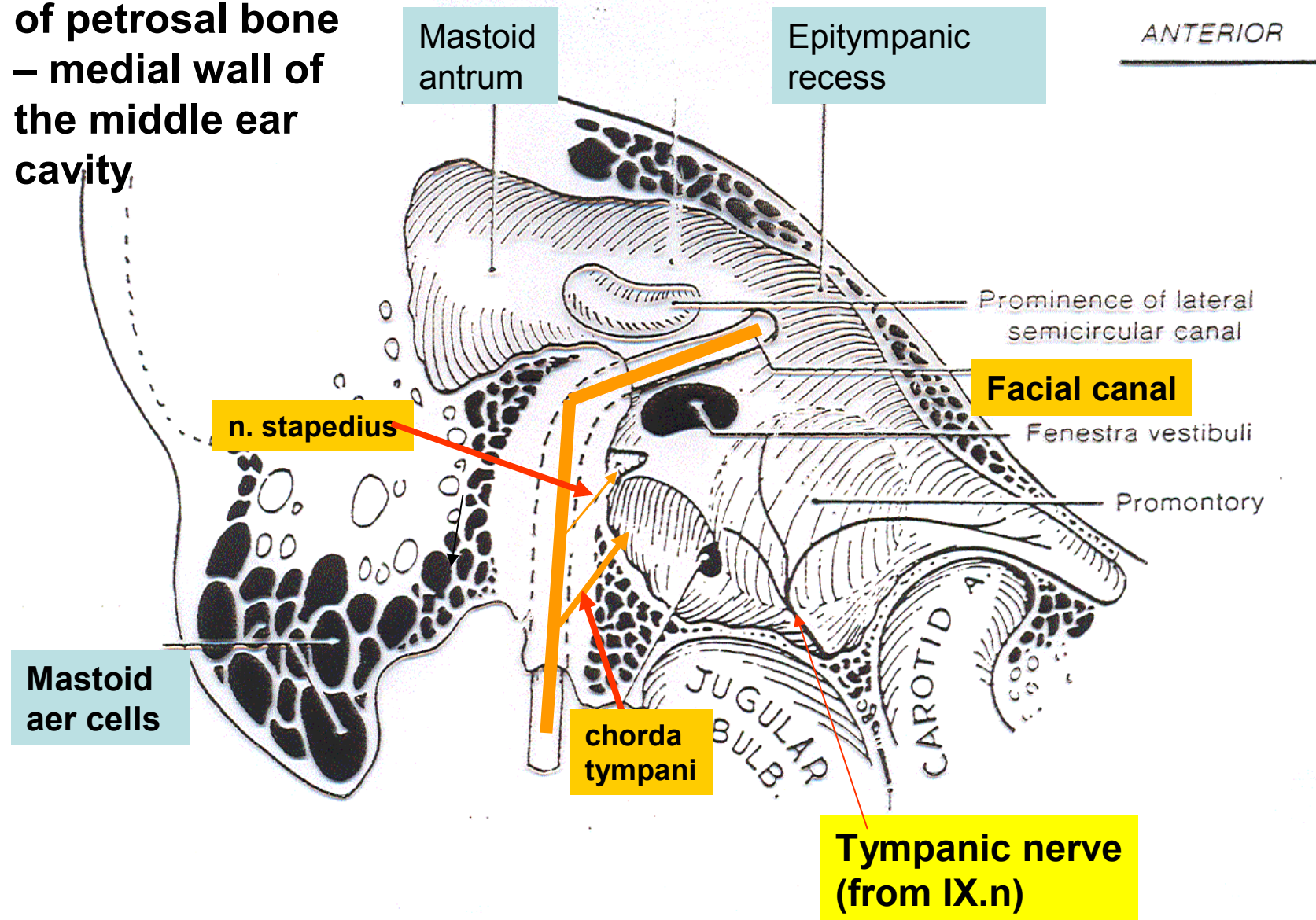


# Middle ear cavity (cavum tympani)

## Walls

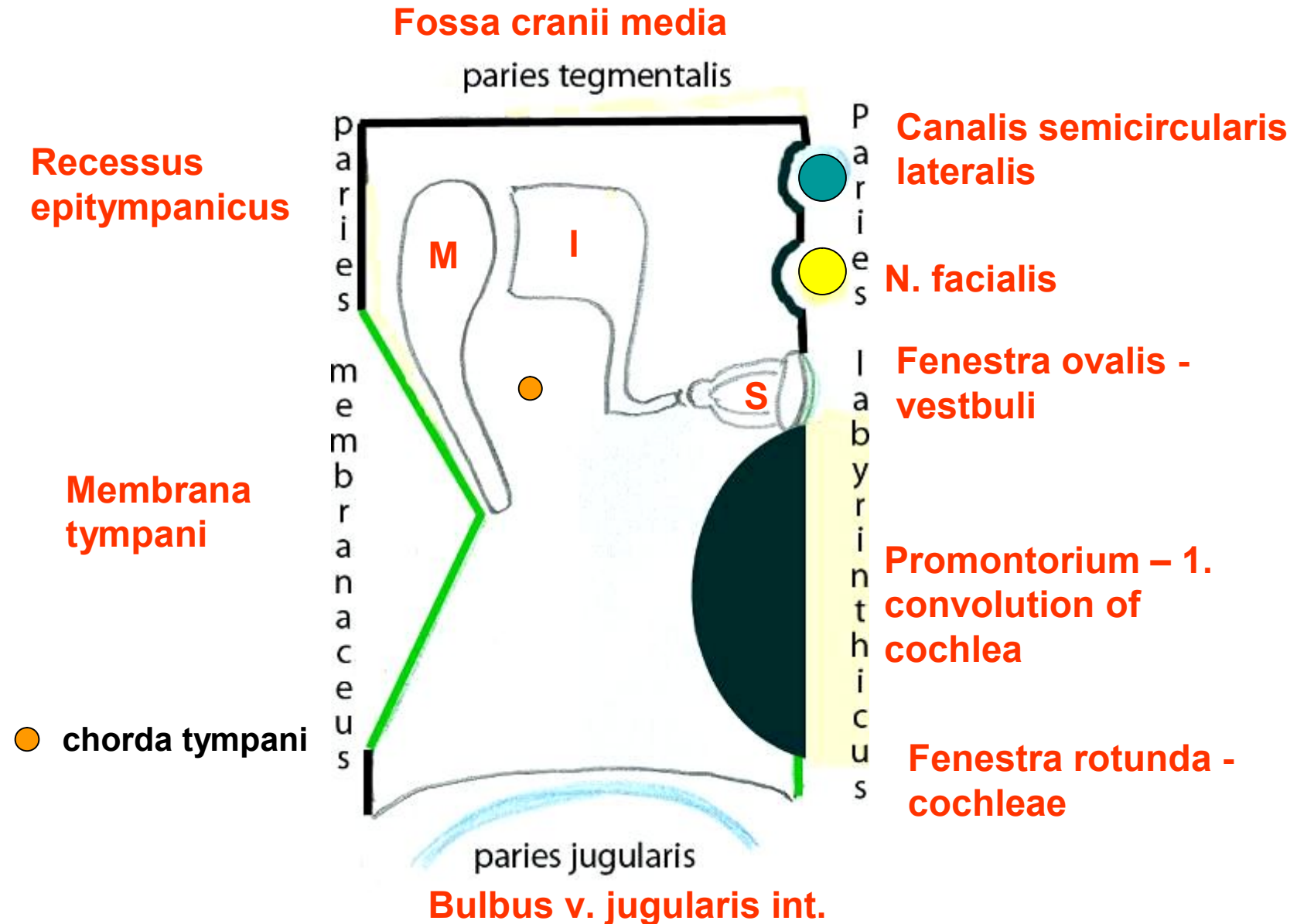


**Section -  
anterobasal wall  
of petrosal bone  
- medial wall of  
the middle ear  
cavity**

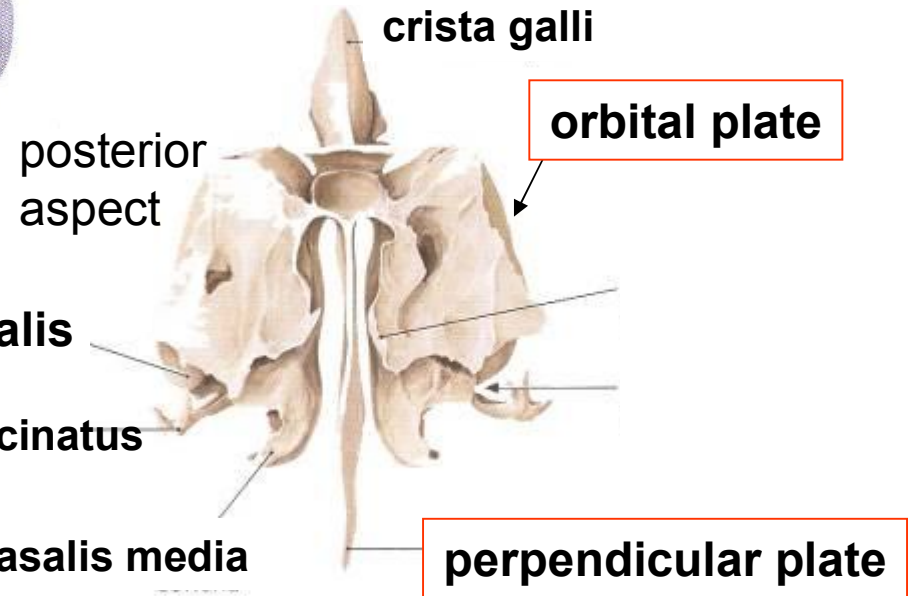
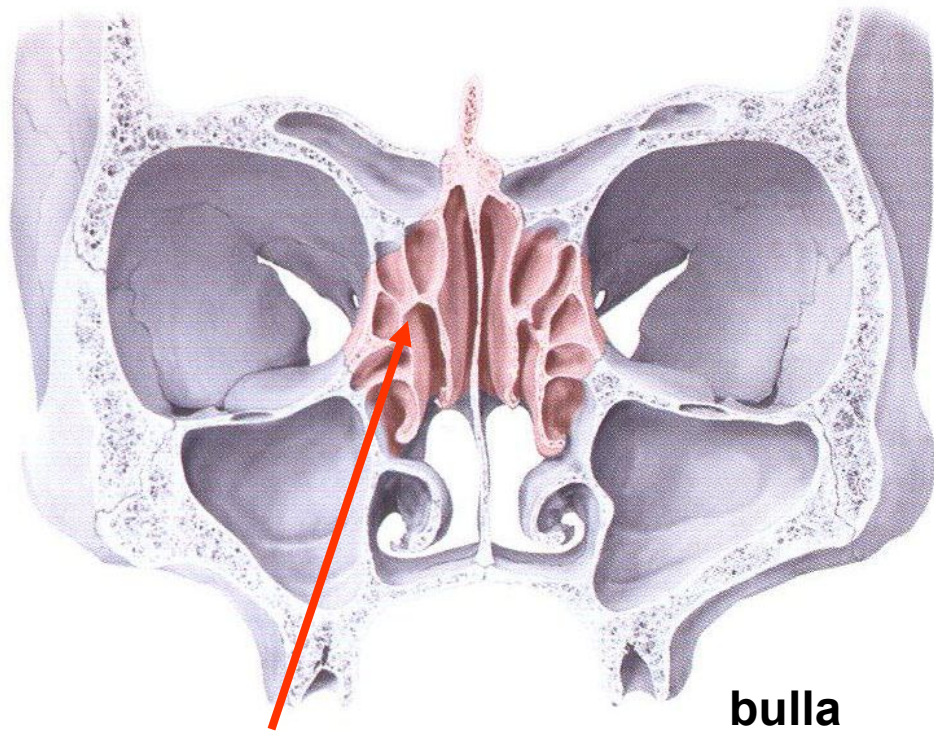
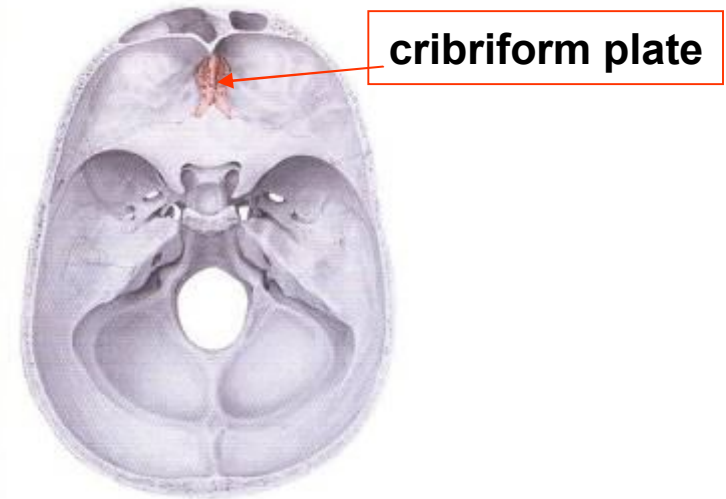


# Tympanic cavity – schematic frontal section

Paries labyrinthicus – anterobasal wall of petrosal bone



# Os ethmoidale

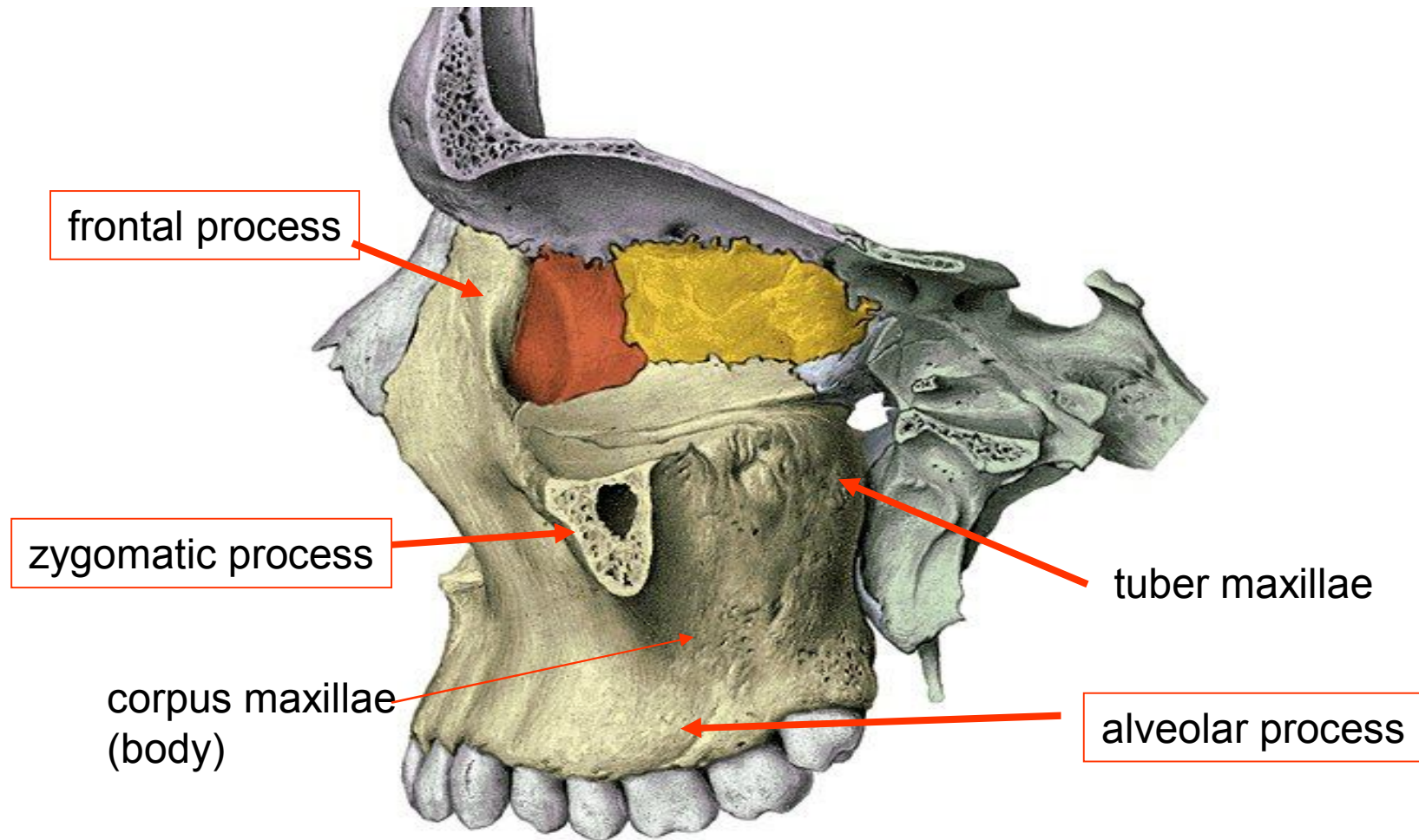


bulla ethmoidalis

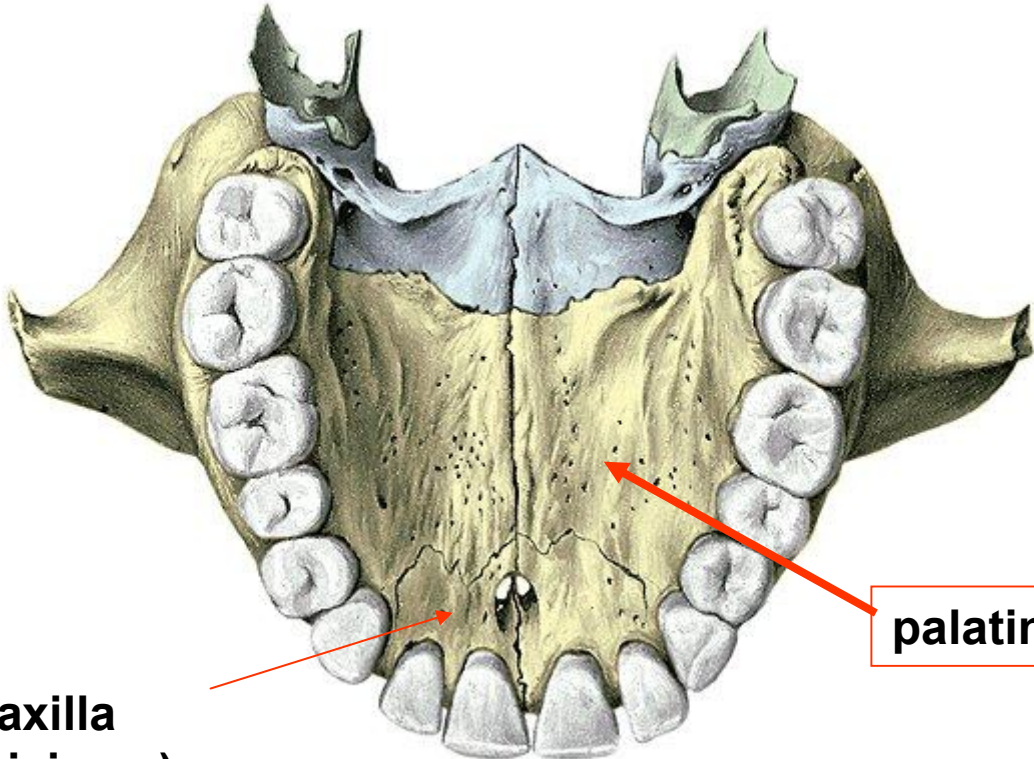
processus uncinatus

concha nasalis media

# Maxilla



# Maxilla

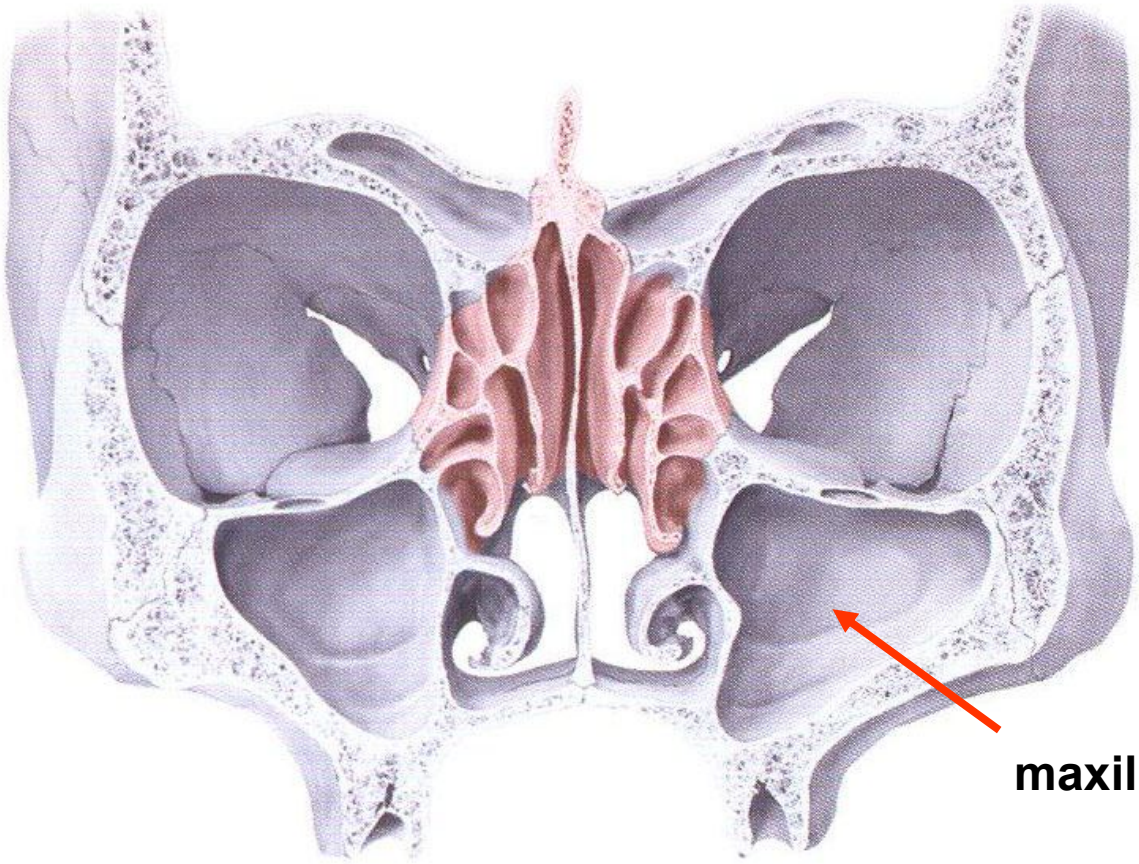


**praemaxilla  
(os incisivum)**

**palatine process**

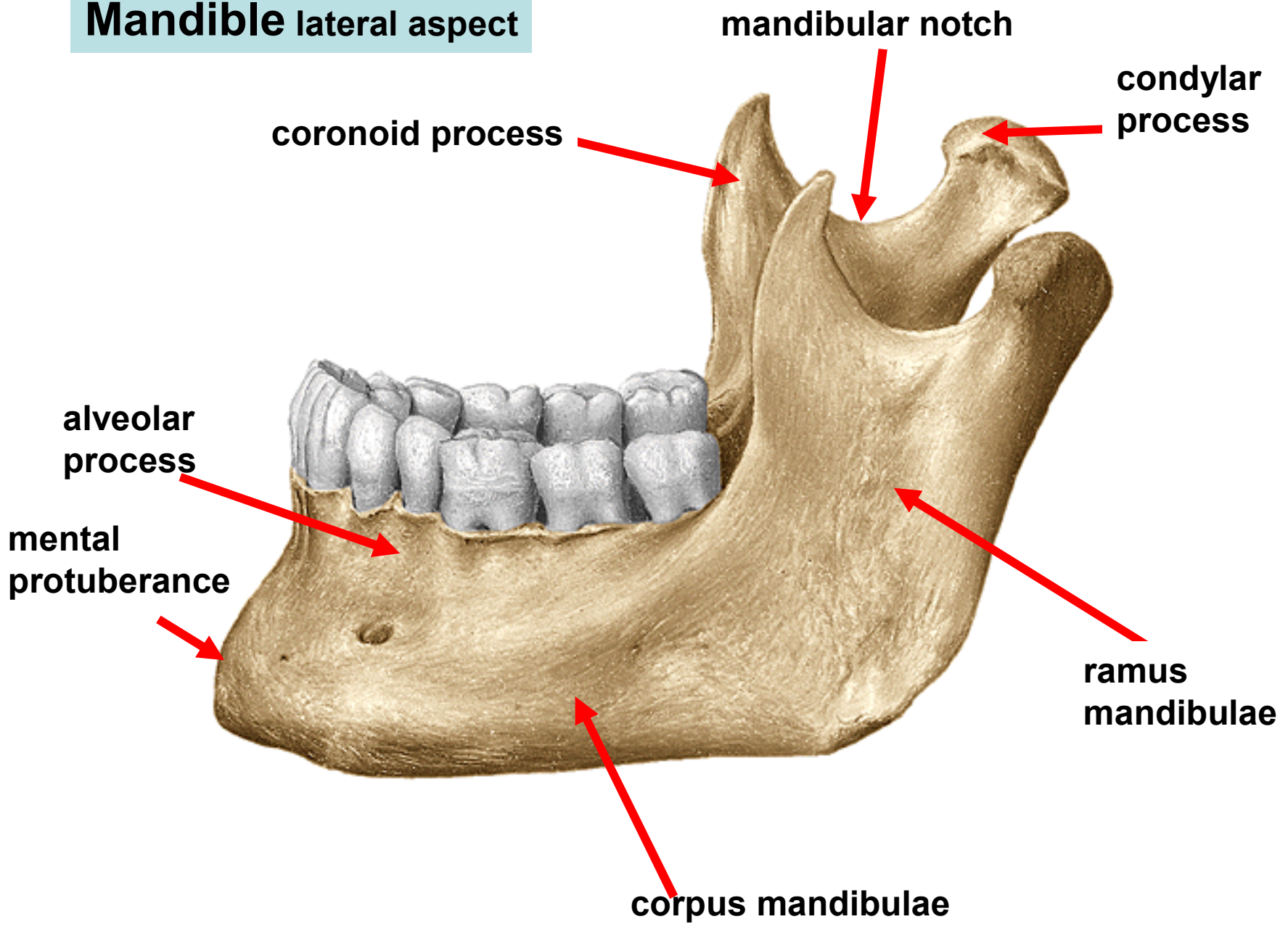


# Maxilla

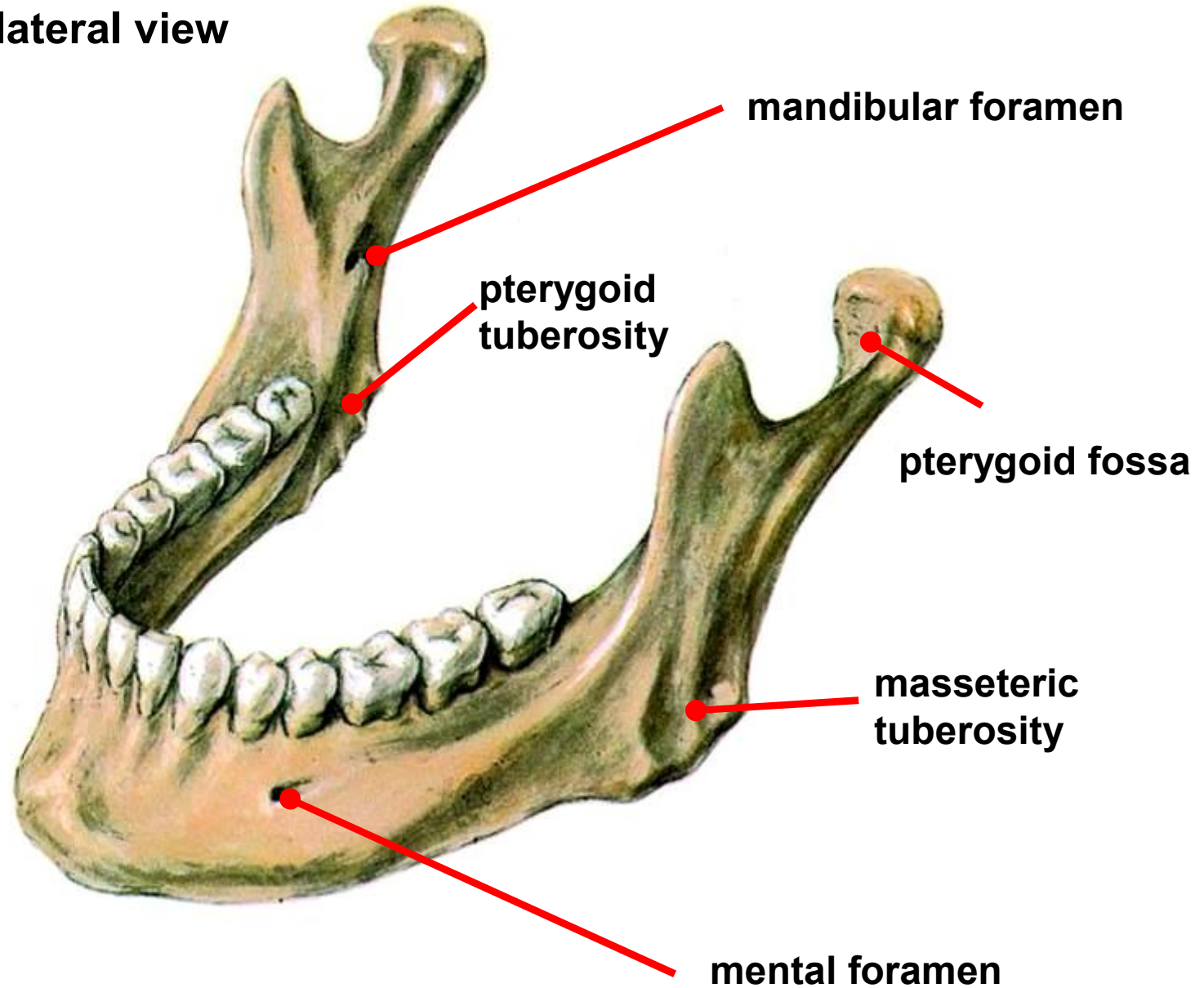


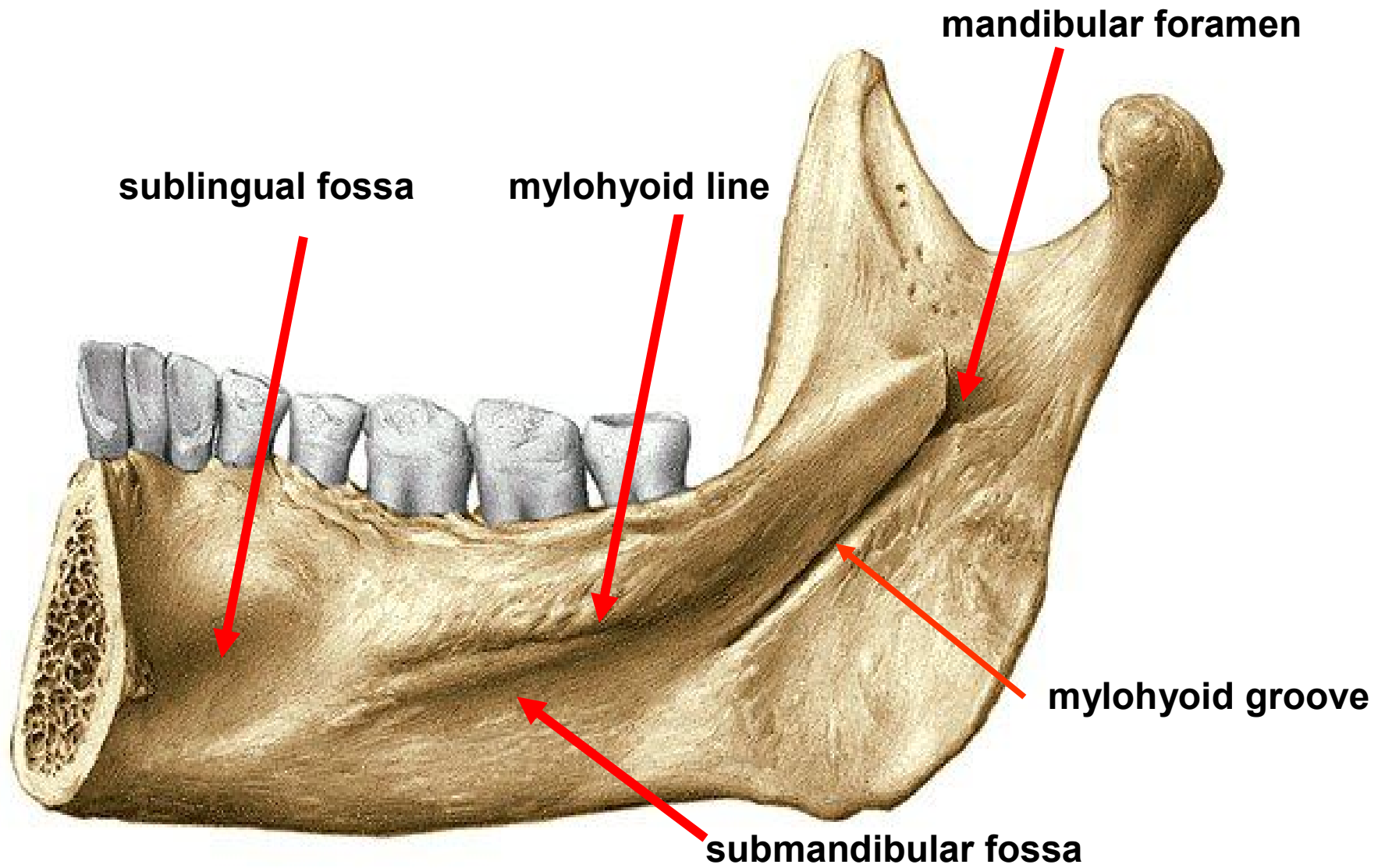
maxillary sinus

**Mandible lateral aspect**

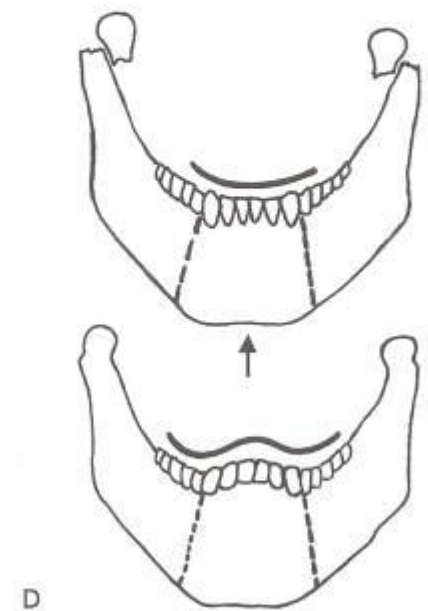
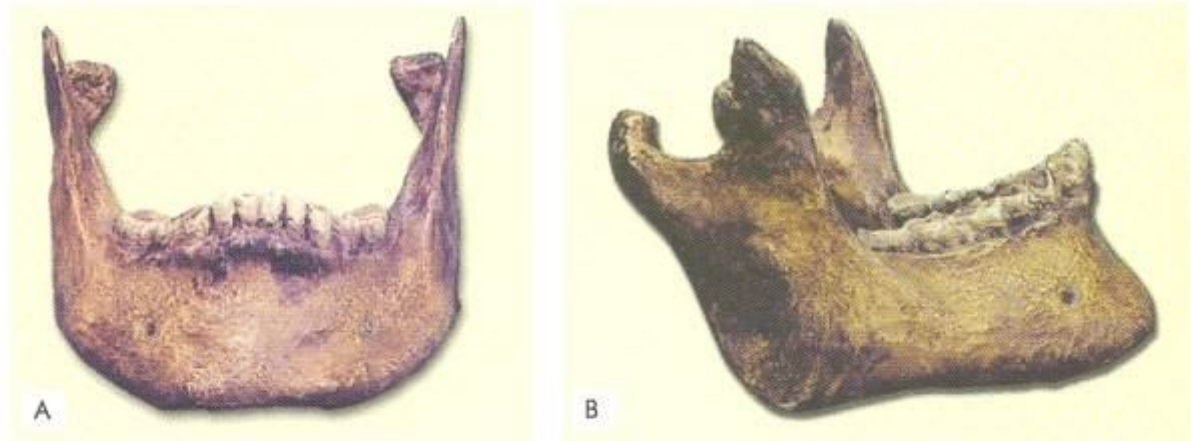


**Mandible**  
anterolateral view





# Mandible of Karel IV.



Post traumatic changes A-C  
Correction of the occlusion

# Skull of a newborn



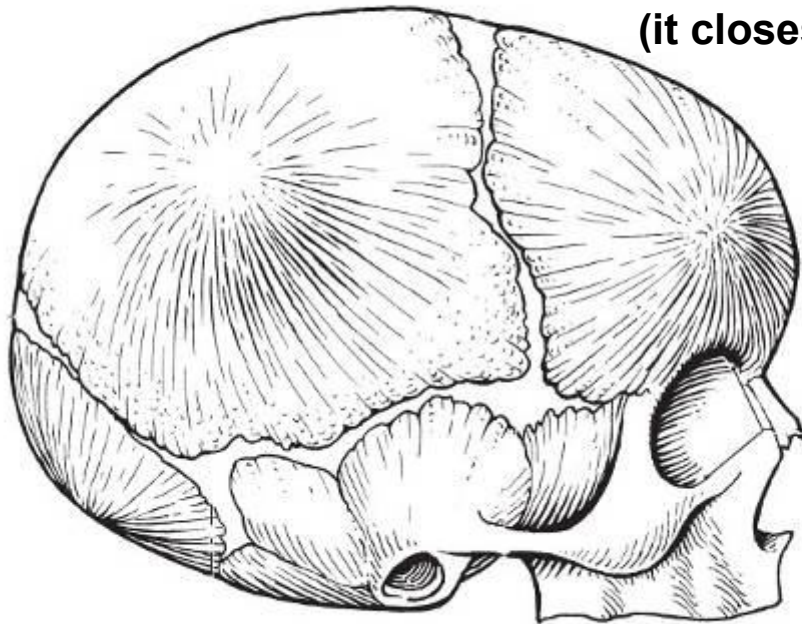
Lenght 11 cm

Circumference 34 cm

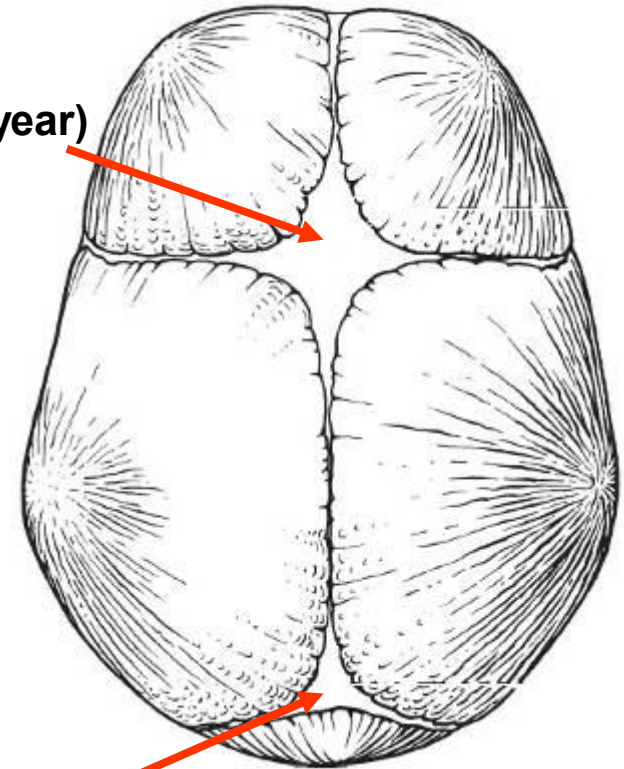
Fonticulus anterior  
it closes in 2-3 years

**Lenght 11 cm**  
**Circumference 34 cm**

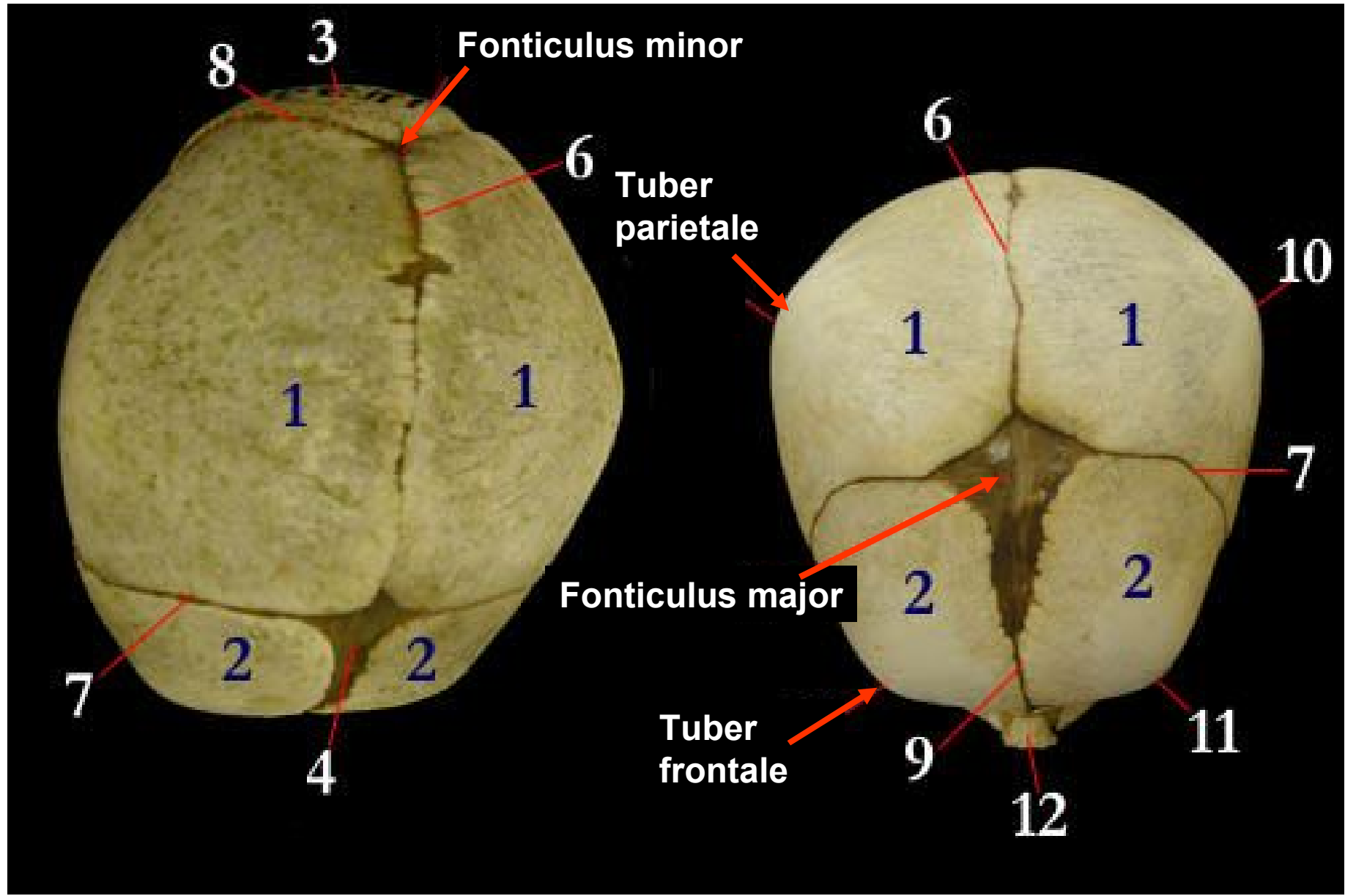
**fontanellae = fonticuli cranii**



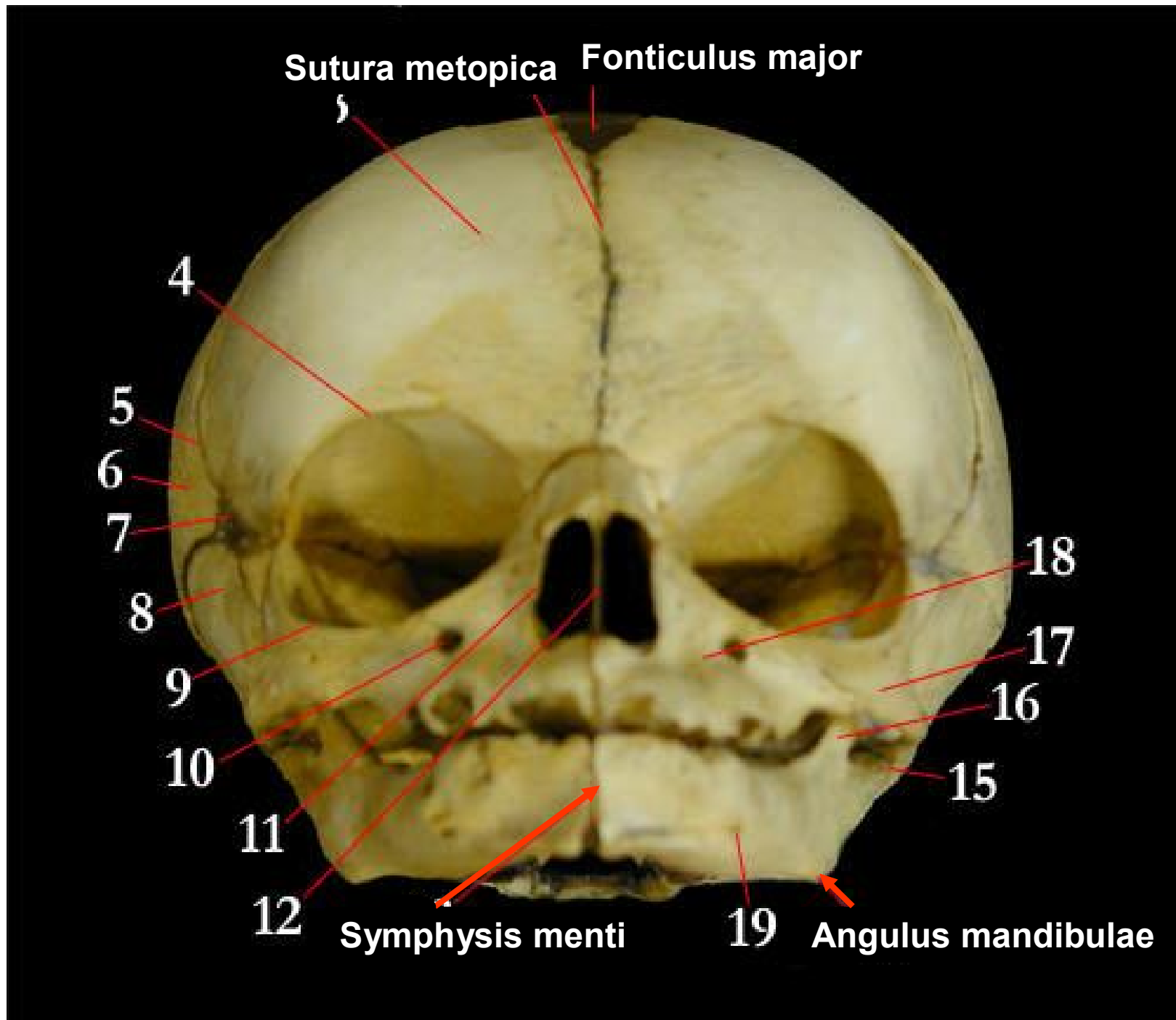
**Fontanella major**  
**(it closes in 2. or 3.year)**

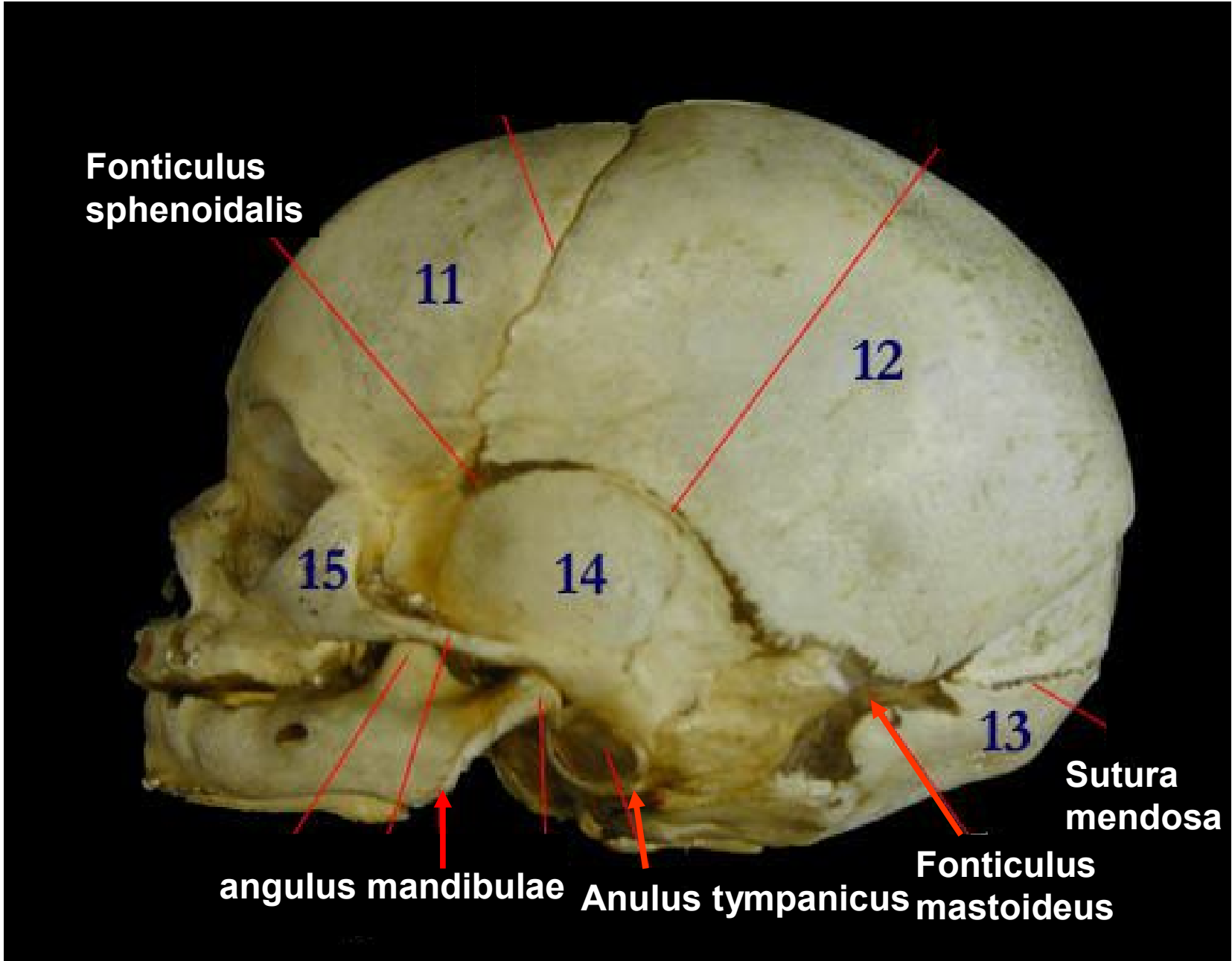


**Fontanella minor**  
**(it closes in 3.month)**









**Symphysis menti**

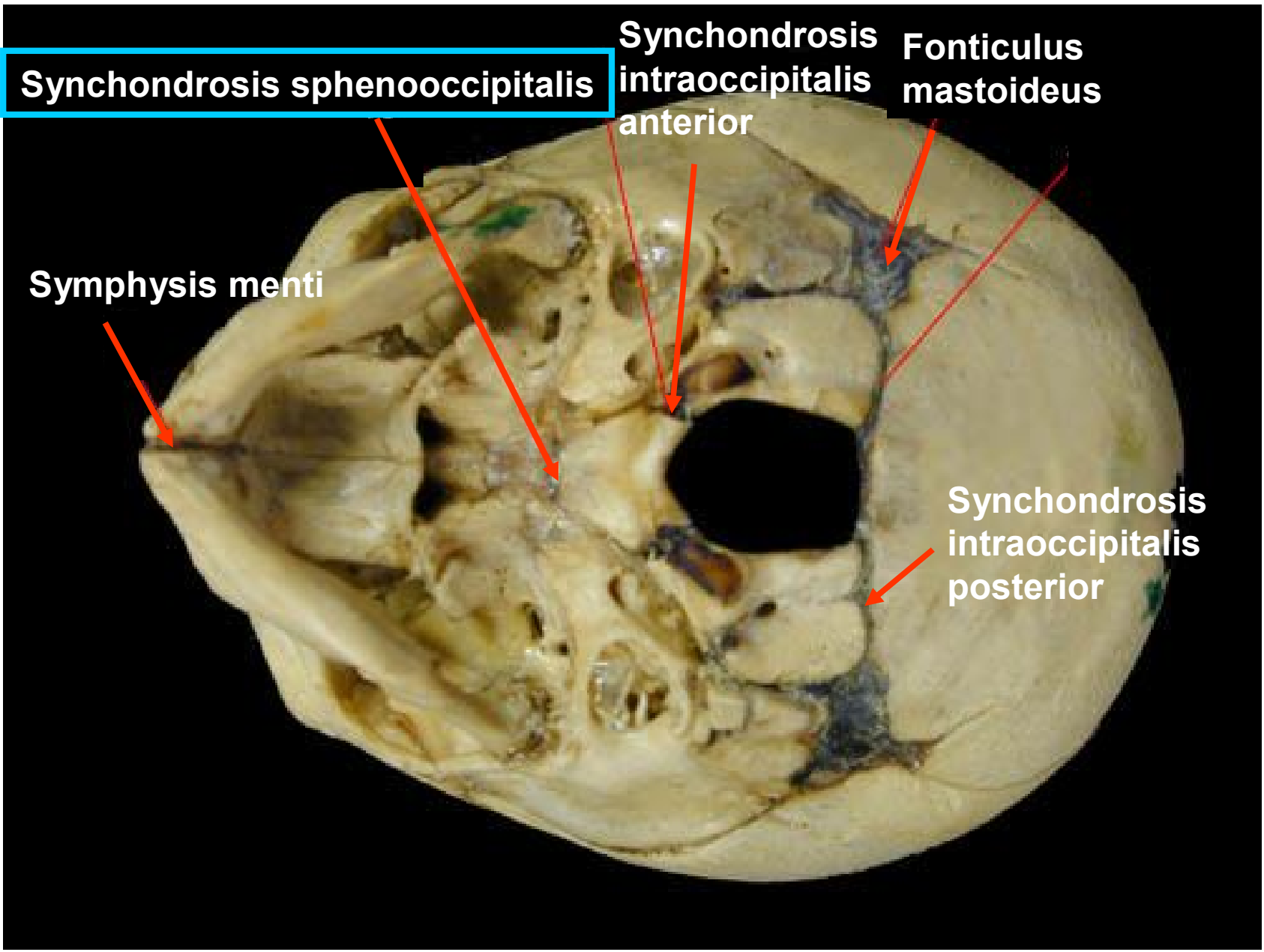
**Symphysis menti**

**Symphysis menti**

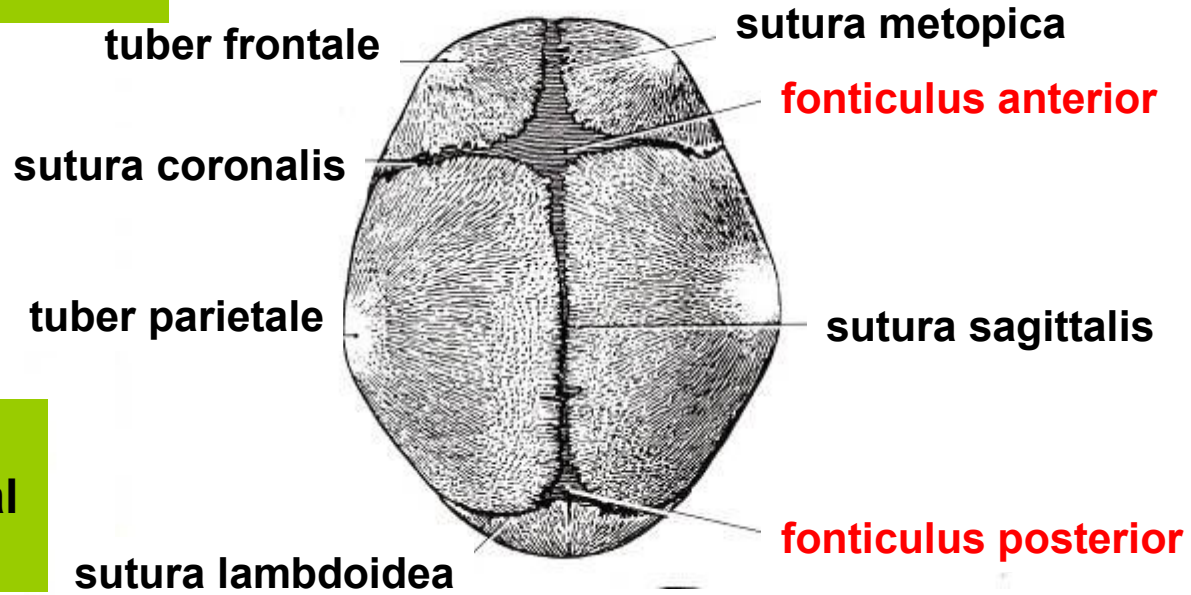
**Symphysis menti**

**Symphysis menti**

**Symphysis menti**

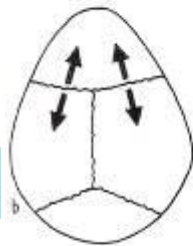


# Craniosynostoses

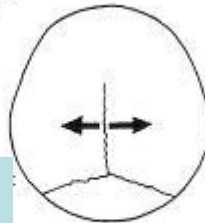


premature closure of cranial sutures

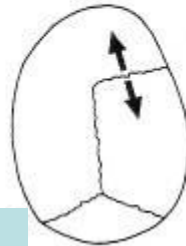
trigonocephaly



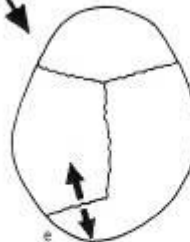
brachycephaly



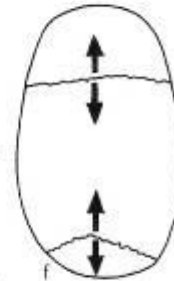
anterior plagiocephaly



posterior plagiocephaly



dolichocephaly (scaphocephaly)



# Skull of a newborn

**Big neurocranium**

**Small splanchnocranium**

**Prominent tubera frontalia et parietalia (centers of ossification)**

**Fonticuli cranii**

**Possible movement among bones of the calvaria**

**Paranasal sinuses are not fully developed**

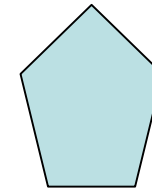
**Os frontale divided by a suture**

**Suture between maxilla and premaxilla**

**Symphysis menti**

**Angle of mandible -150-160 degree**

**Os tympanicum – anulus tympanicus**



# X-ray skull of a newborn



Lenticular left parietal calvarial mass-like lesion with peripheral sclerosis/calcification and central lucency. The lesion does not cross suture lines



**Subperiosteal cephalohematoma.**

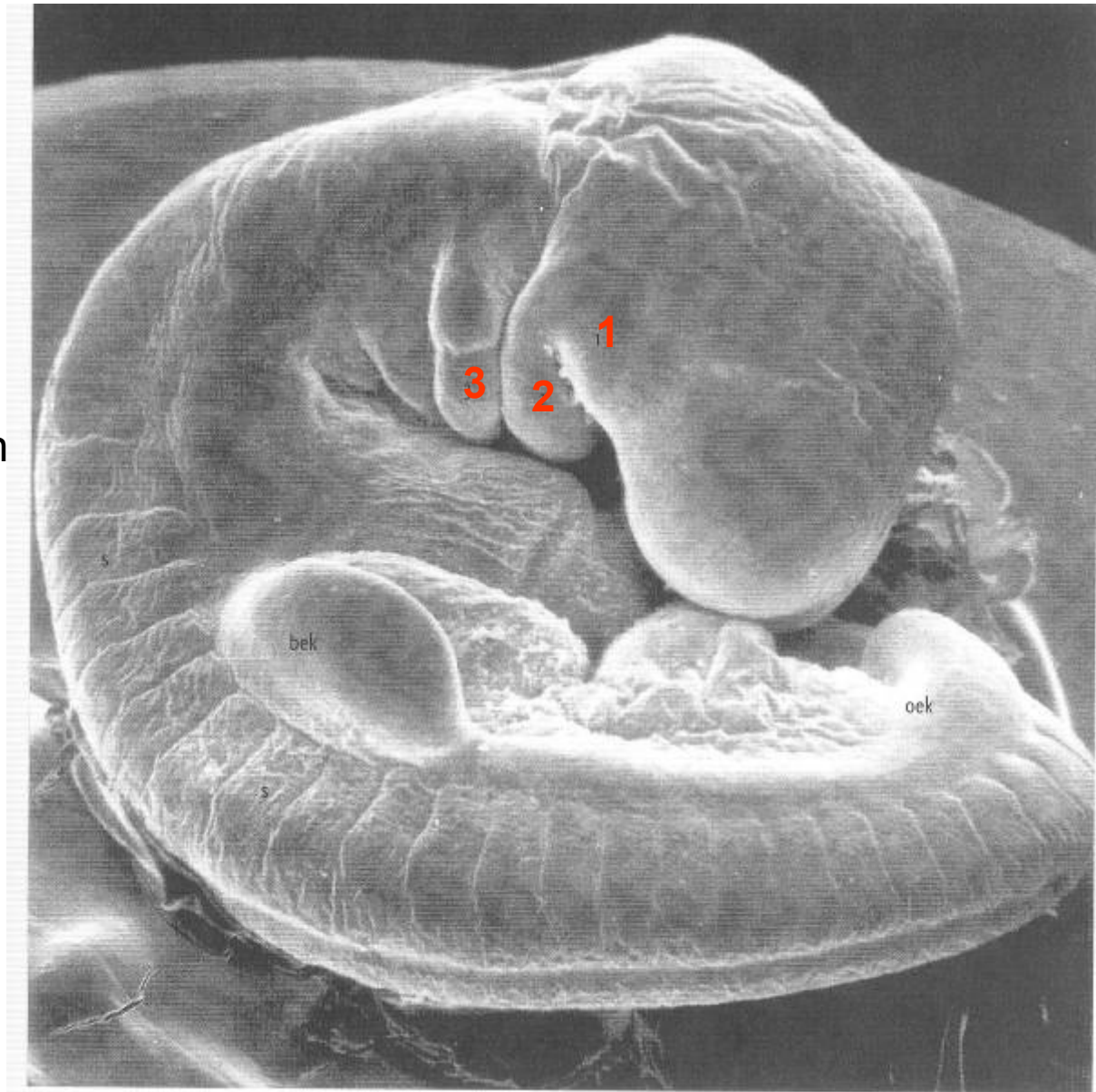
# Cranial nerves !!!

- **I. nn. olfactorii**
- **II. n. opticus**
- **III. n. oculomotorius**
- **IV. n. trochlearis**
- **V. n. trigeminus 1.ophthalmicus**
- **2.maxillaris**
- **3.mandibularis**
- **VI. n. abducens**
- **VII. n. facialis**
- **VIII. n. vestibulocochlearis**
- **IX. n. glossopharyngeus**
- **X. n. vagus**
- **XI. n. accessorius**
- **XII. n. hypoglossus**



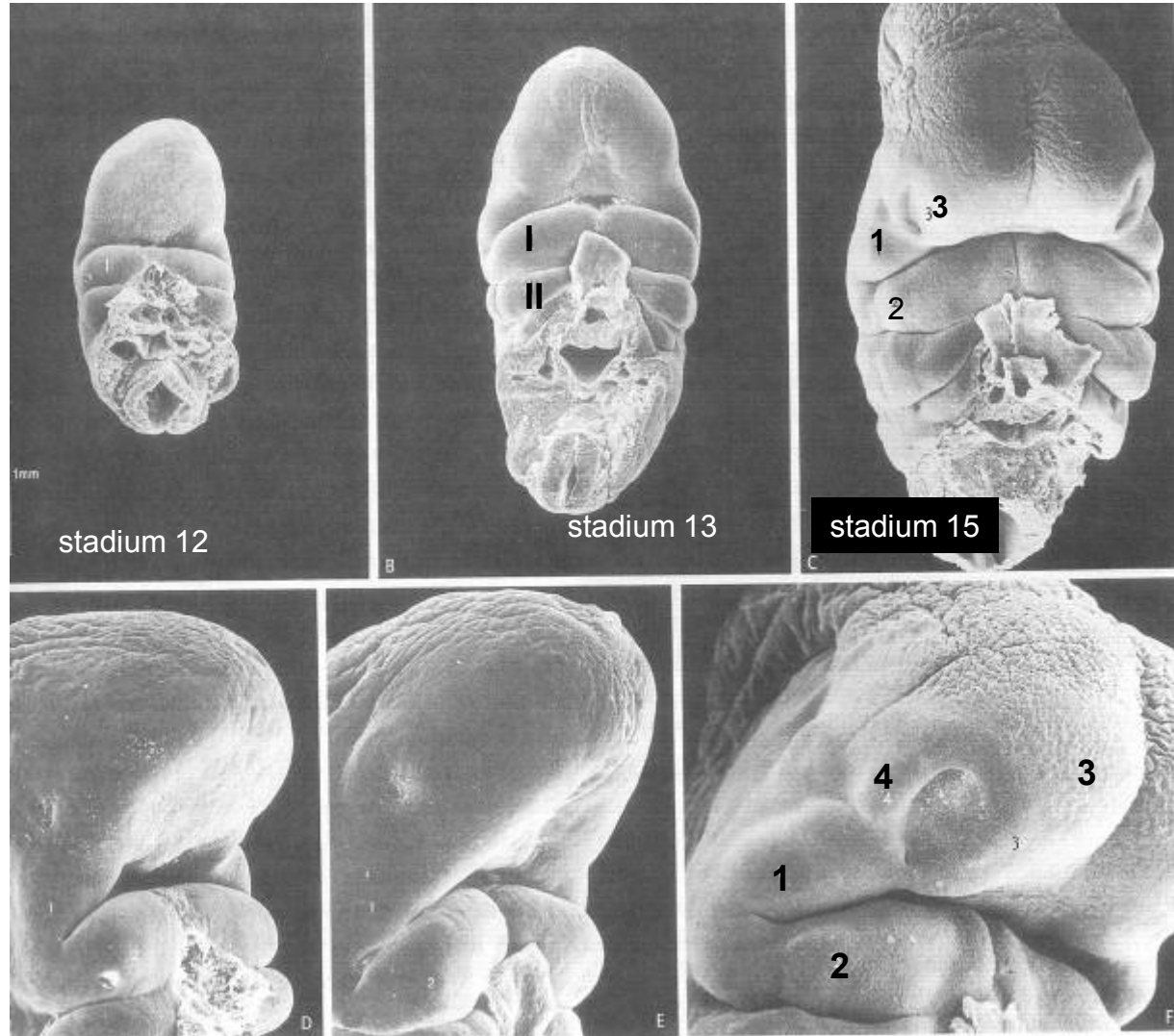
# Development of the face

- 1- maxillary process
- 2-mandibular process
- 3-second branchial arch

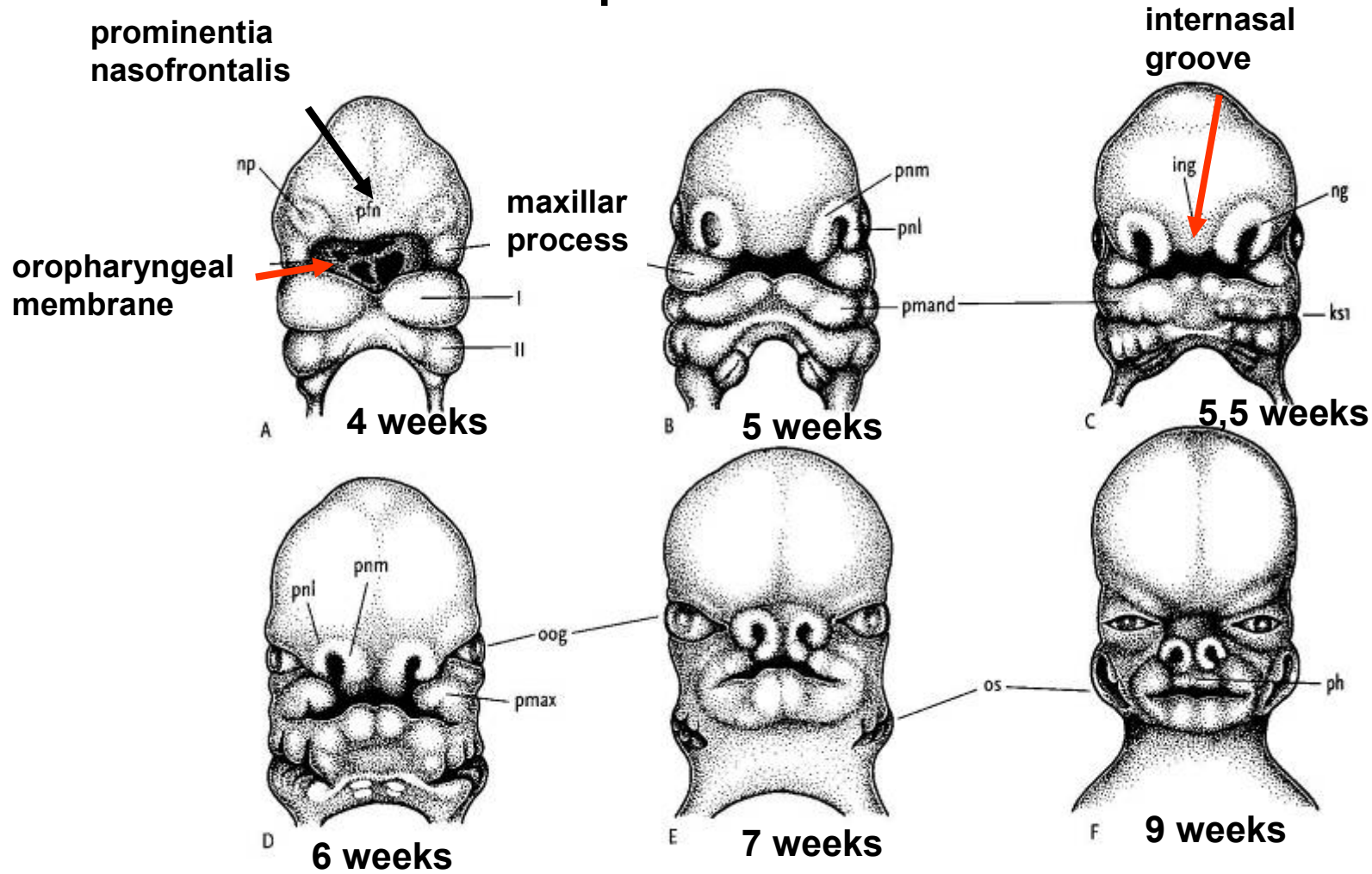


# Development of the face

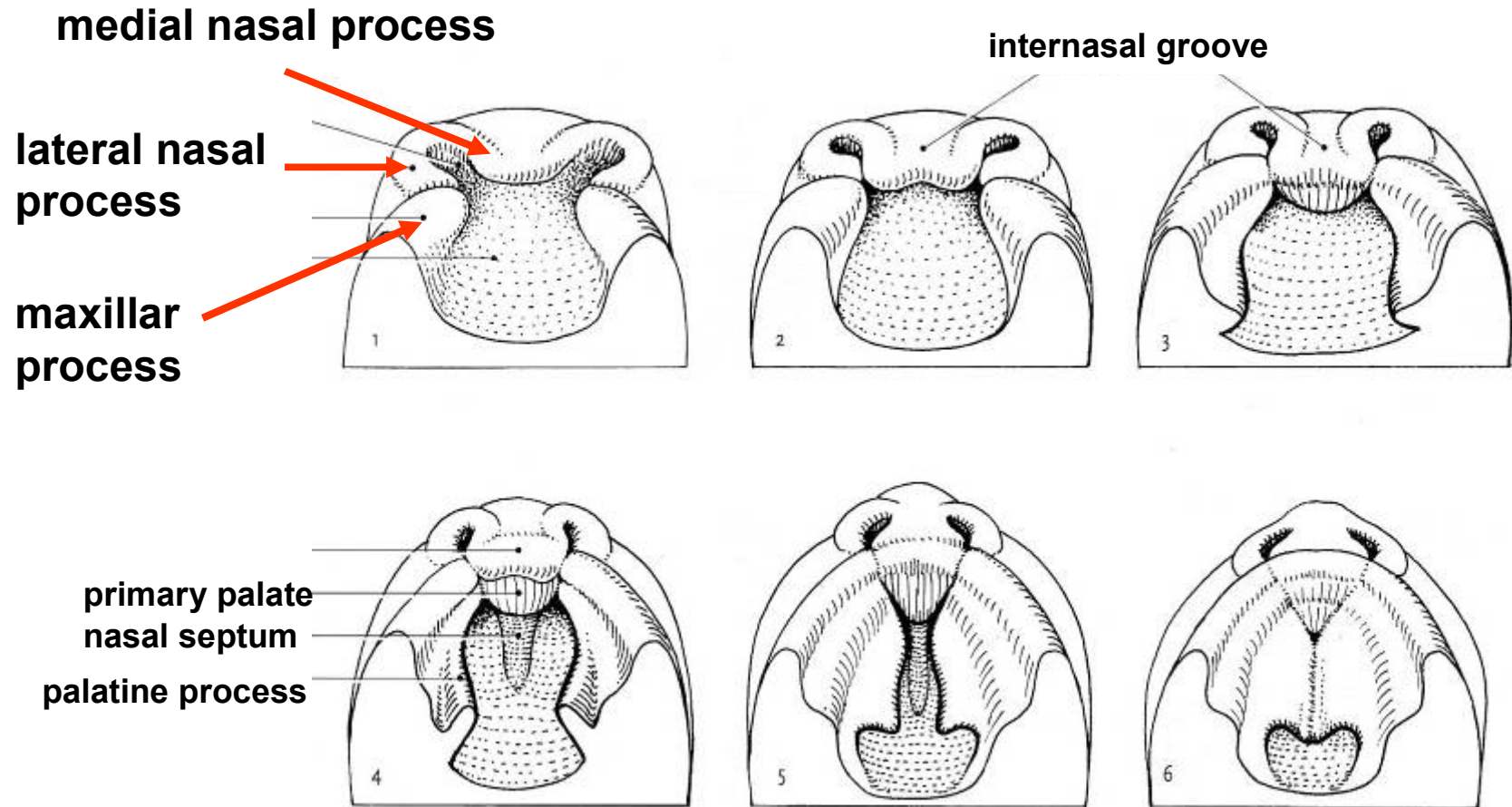
- 1-maxillary process
- 2- mandibular process
- 3-medial nasal process
- 4-lateral nasal process



# Development of the face

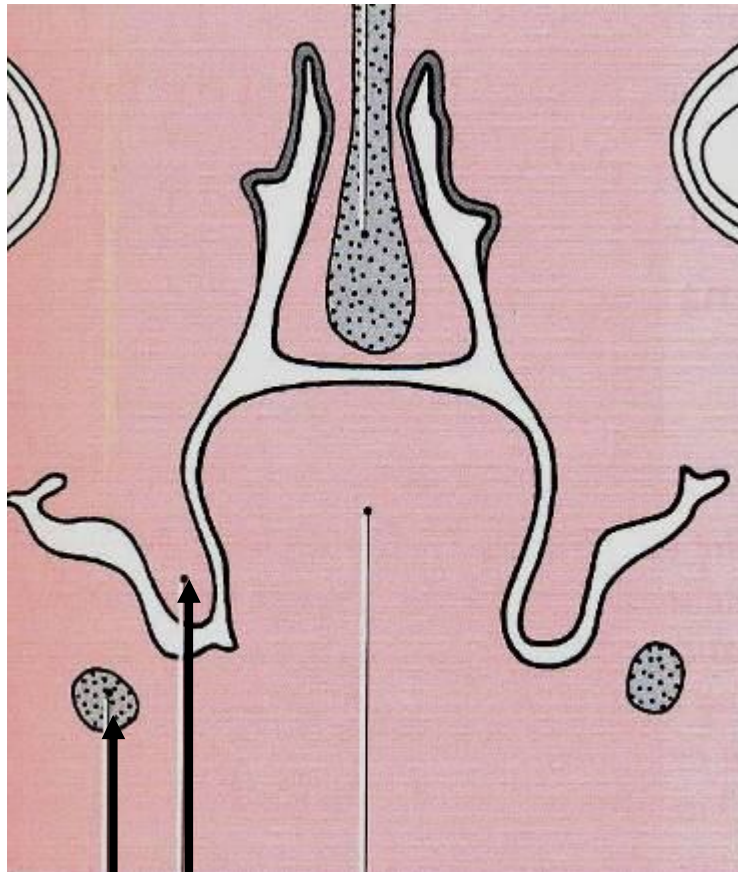


# Development of palate and nasal septum and nose



# Development of the palatine processes

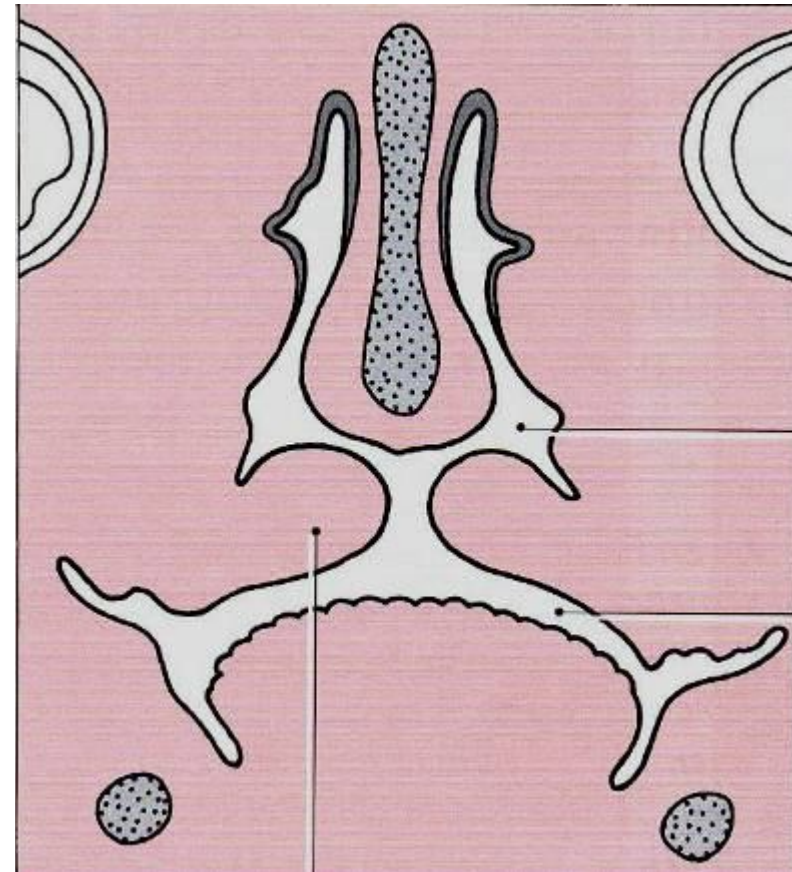
nasal septum



tongue

Meckel  
cartilage

palatine  
process



palatine process

# Sources

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- Petrovický a spol., Anatomie 1
- Sobotta , Atlas anatomie člověka
- Ten Donkelaar, Lohmann en Moorman, Klinische Anatomie en Embryologie
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- Personal archiv