



# The Cranial Base

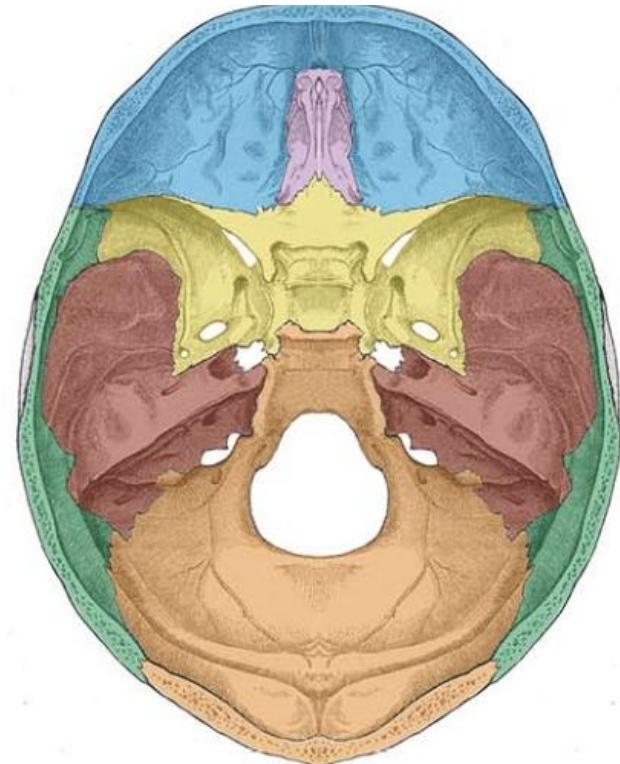
LEE ANN CUNY, DO

# Objectives – Base (Sphenoid and Temporal)

- ▶ Identify the individual bones of the cranial base, their developmental parts and origin (cartilage or membrane) and locations in the adult osteology
- ▶ Describe the physiologic motion of the individual bones with the primary respiratory mechanism (PRM) axis of motion
- ▶ Identify patient presentations that would indicate a need to evaluate and possibly treat the bones of the cranial base, including possible cranial nerve impingements
- ▶ List the foramen present in the bones of the cranial base and the relevant structures that traverse.

# Cranial Base

- ▶ Bone formed in cartilage secondary to compression
  - ▶ Ethmoid
  - ▶ Basi-Sphenoid, medial parts of greater and lesser wings
  - ▶ Basi-occiput, condylar parts, supraocciput
  - ▶ Temporal x 2
    - ▶ Petrous portion
    - ▶ Mastoid portion



Frontal
Sphenoid
Temporal
Parietal
Occipital
Ethmoid

# Sphenoid

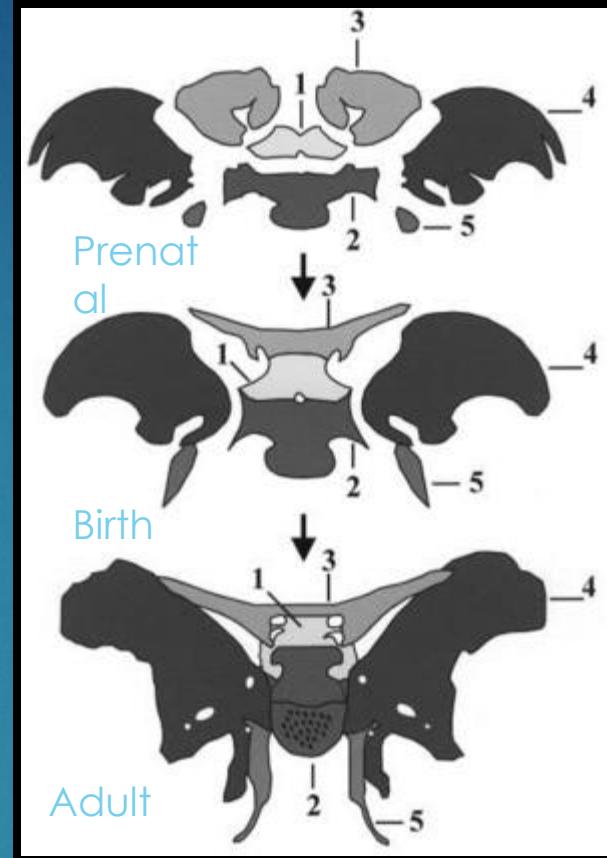


## ► Cartilaginous Ossification

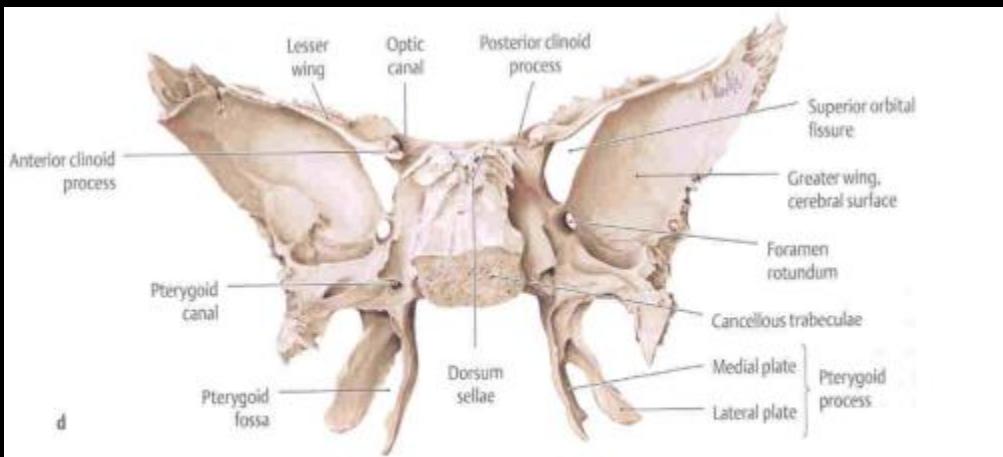
- Sphenoid Body- Develops in 2 parts
  - Presphenoid
    - Tuberculum Sellae with lesser wings
    - 2 ossification centers of the body 1 for each wing
  - Postsphenoid
    - Sella Tursica, Dorsum Sellae
    - 2 ossification centers for the body portion, 1 for each lingula
- The Lesser Wings
- Proximal aspects of the greater wings and pterygoid plates

## ► Membranous Ossification

- Distal aspects of the greater wings and pterygoid plates

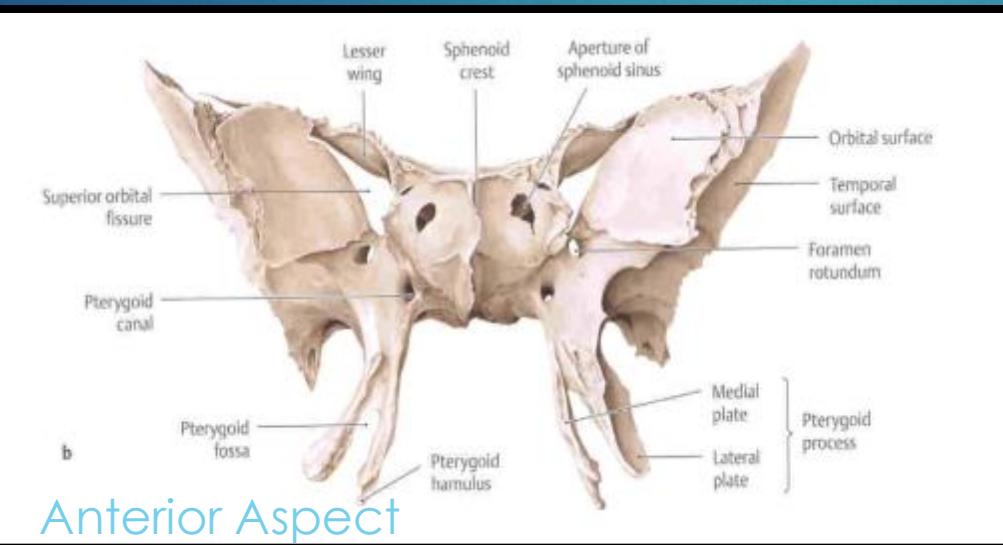


Embryologic Origin/Fetal Vs Adult Sphenoid

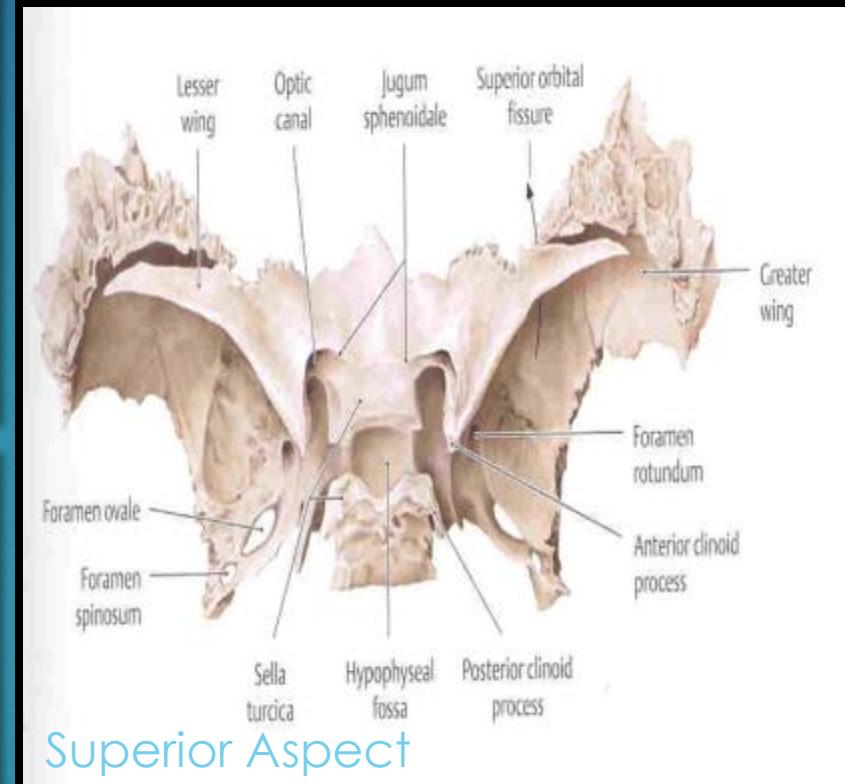


Posterior Aspect

25

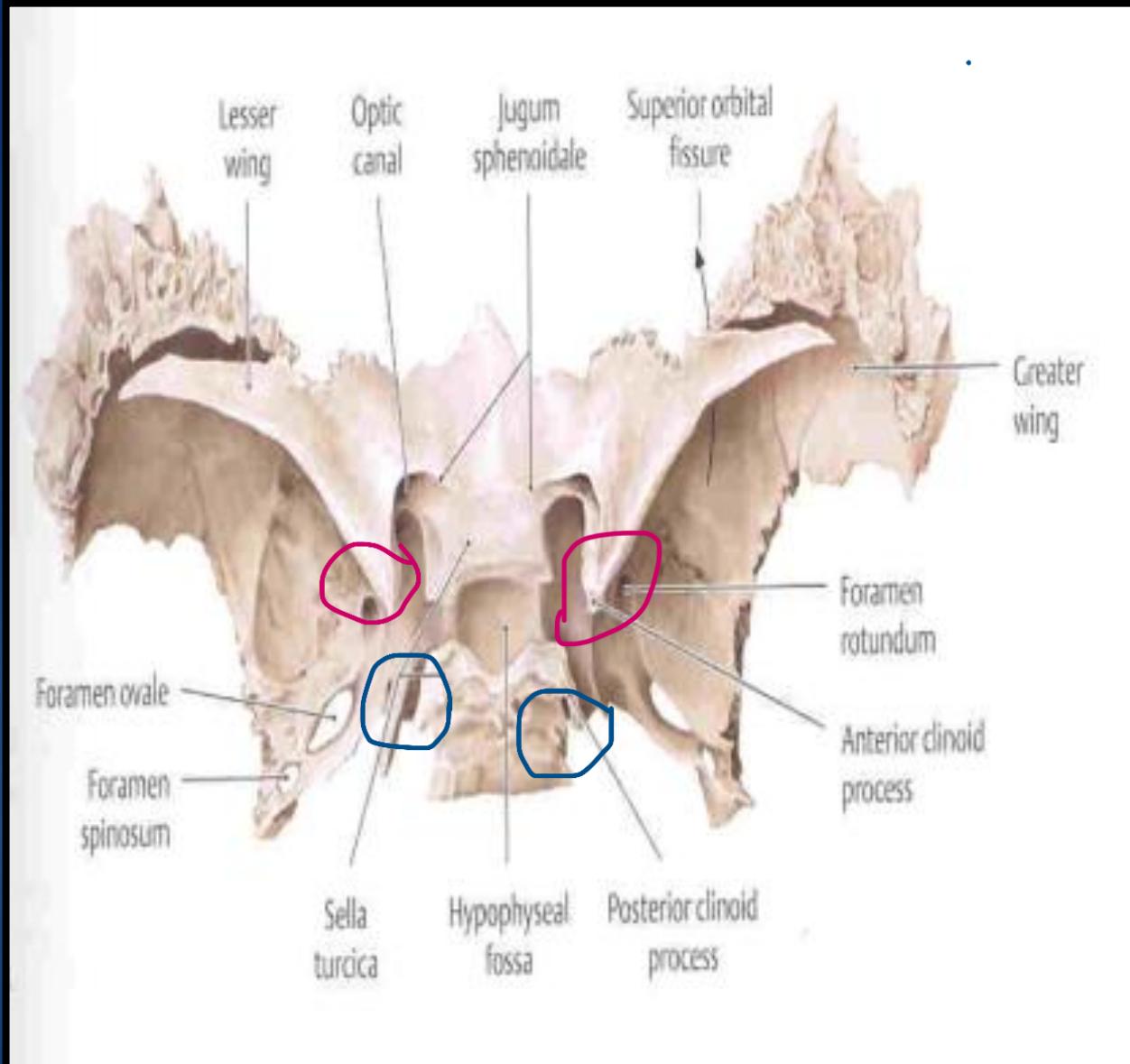


Anterior Aspect



Superior Aspect

# Parts of the Sphenoid



## ► Tentorium Cerebelli

### ► Free border

► Attaches to the anterior clinoid process

### ► Fixed border

► Attaches to the posterior clinoid process

# Attachment of the Falx Cerebelli

# Identification of the Sphenoid Parts & Articulations

## Parts of the Sphenoid

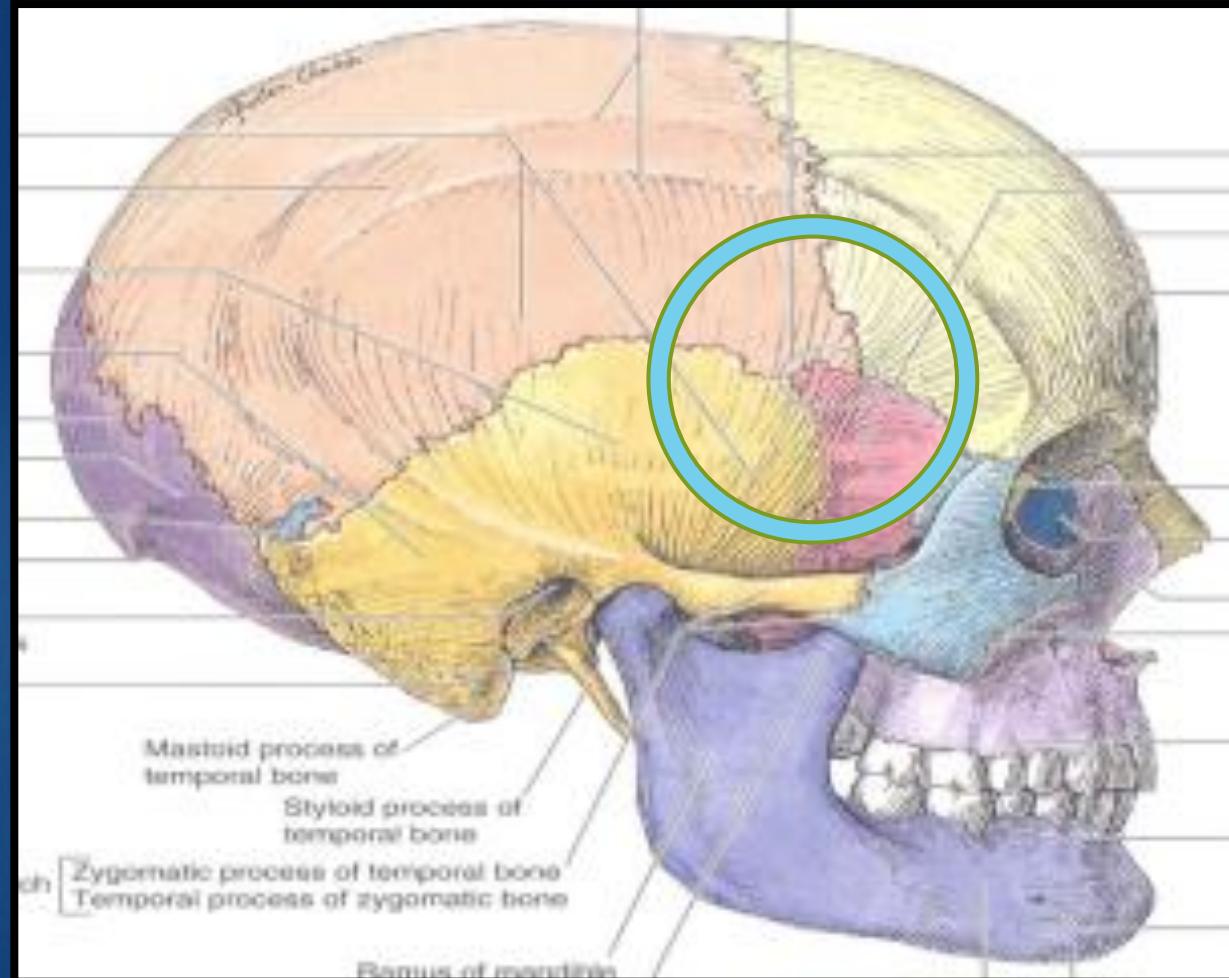
- Body-Sella Turcica
- Two lesser wings
- Two greater wings
- Two pterygoid processes

## Articulates with:

1. Occipital
2. Temporal
3. Parietal
4. Frontal
5. Zygoma
6. Palatine
7. Vomer
8. Ethmoid



# Identification of Sphenoid Parts & Articulations

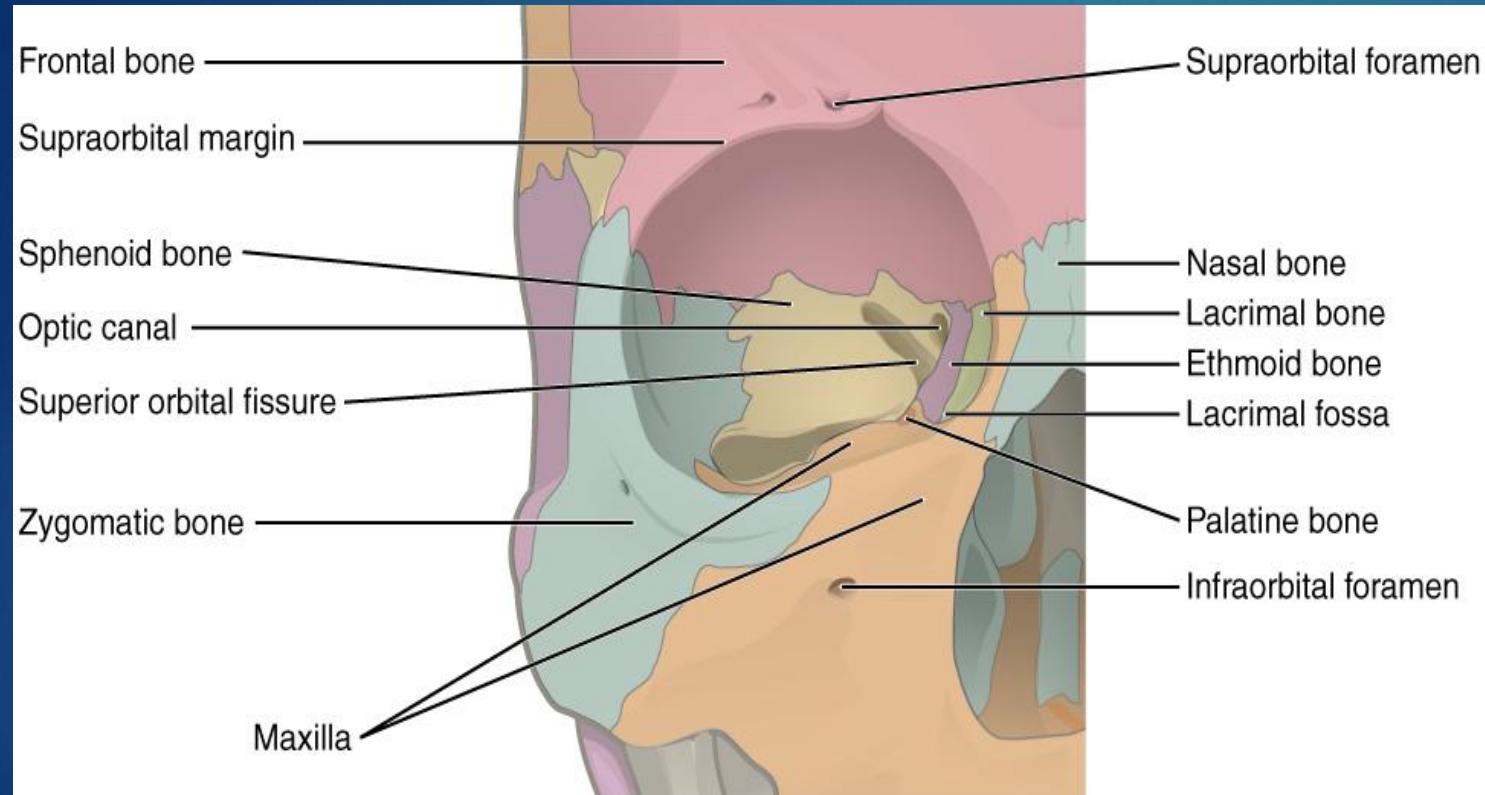


## Articulations at Pterion

- Temporal
- Parietal
- Frontal
- Sphenoid

Superficial → Deep  
Temporal, Sphenoid, Parietal, Frontal

# Identification of Sphenoid Parts & Articulations

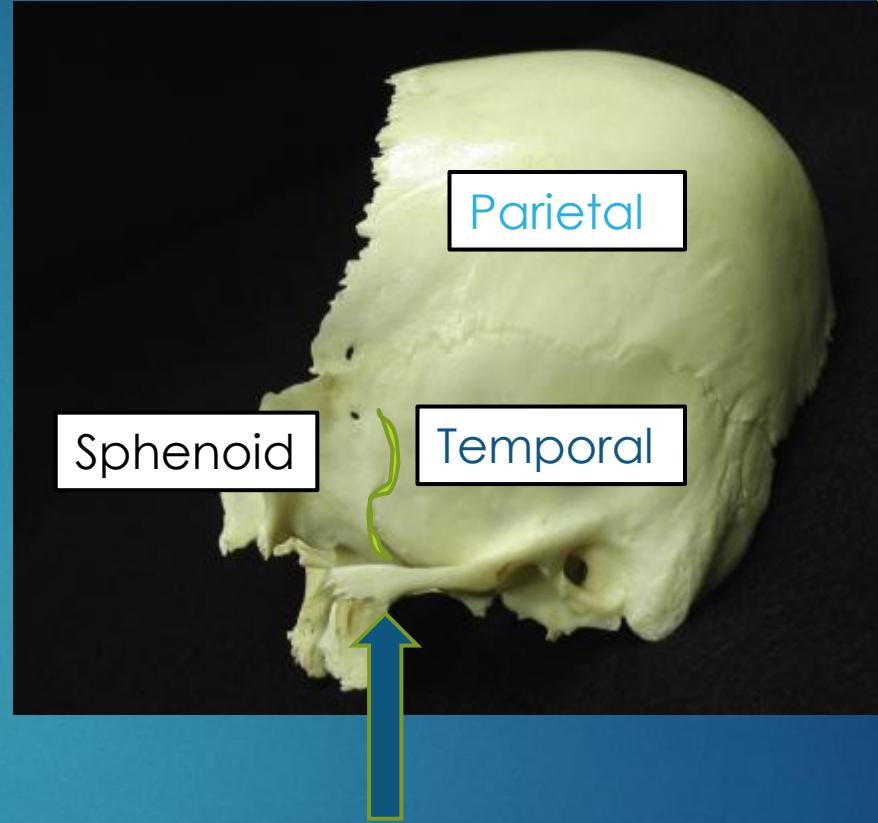
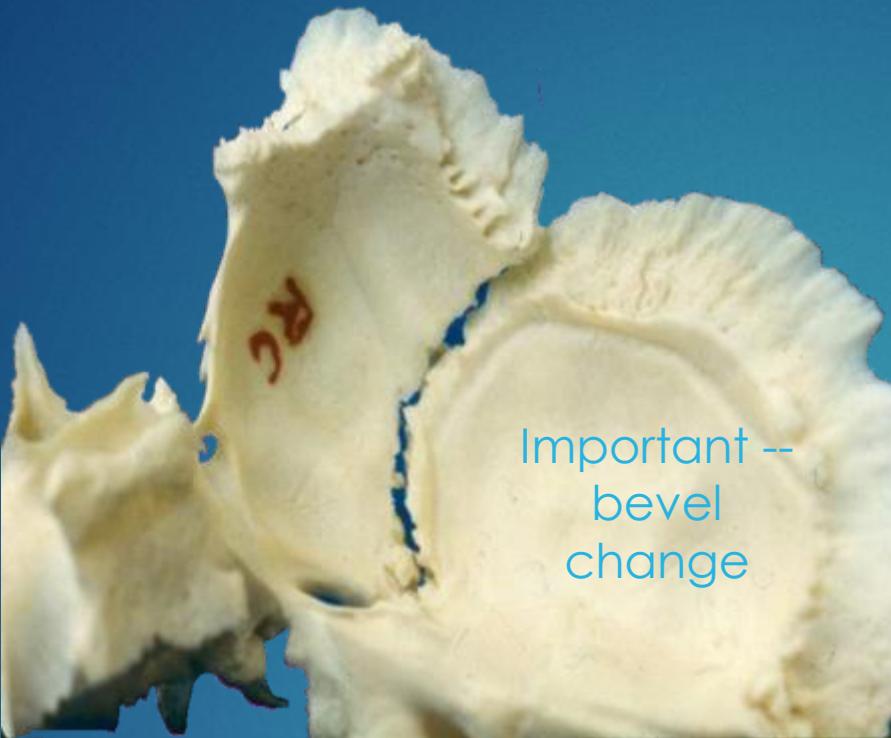


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Frontal (red)  
Maxilla (orange)  
Sphenoid (yellow)  
Zygoma (blue-green)  
Lacrimal (lime green)  
Palatine (barely visible red-orange)  
Ethmoid (purple)



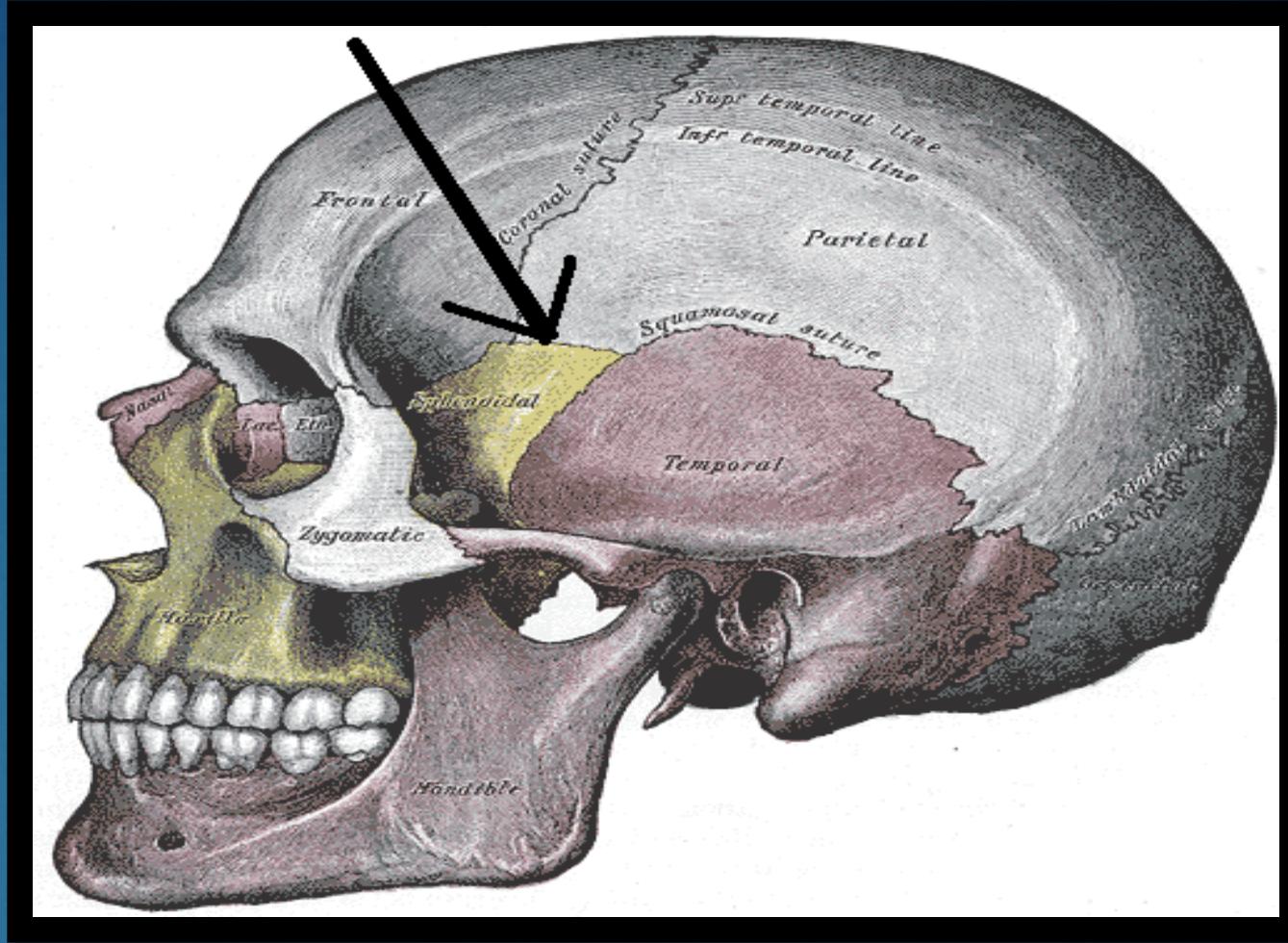
Sphenobasilar Synchondrosis (SBS)  
Between body of sphenoid and basilar portion of occiput



## Sphenosquamous Articulation

Between sphenoid and at squamous temporal

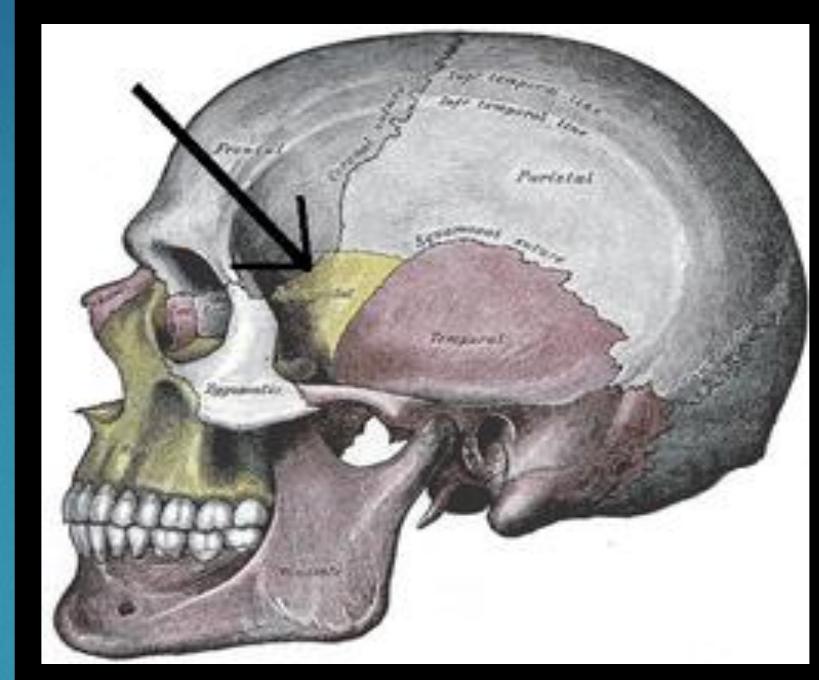
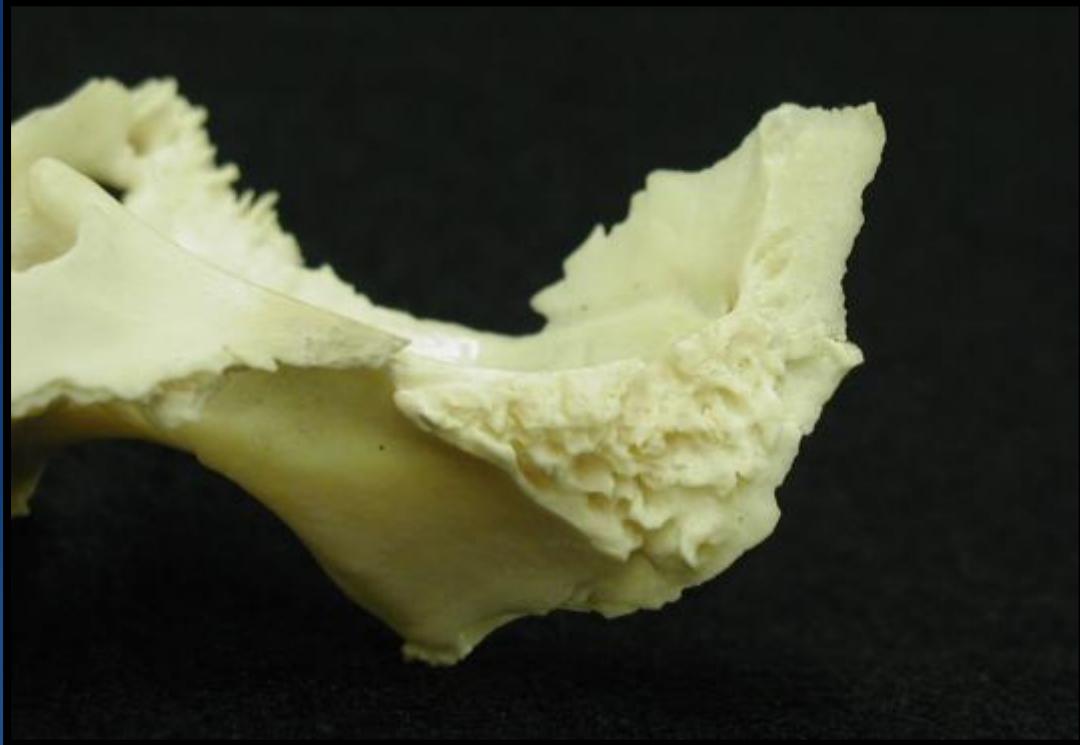
\*\* bevel change at the level of the zygomatic process



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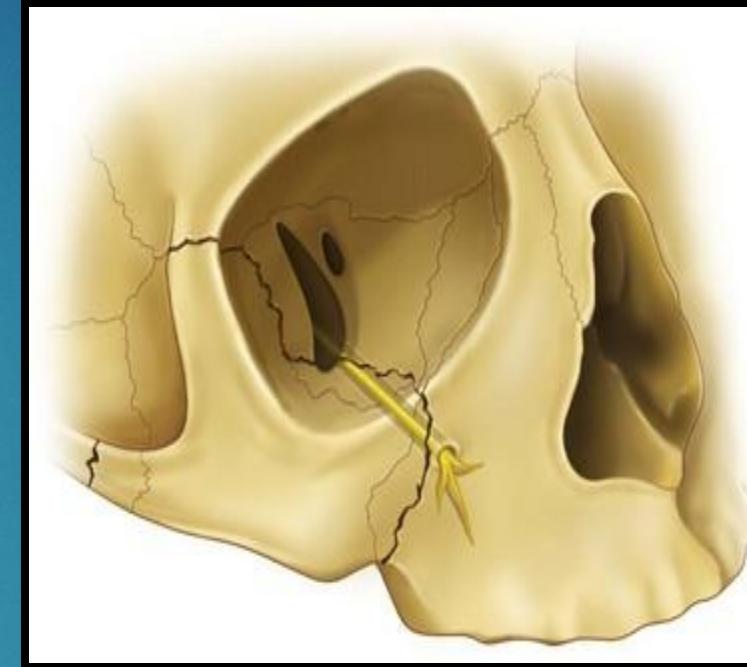
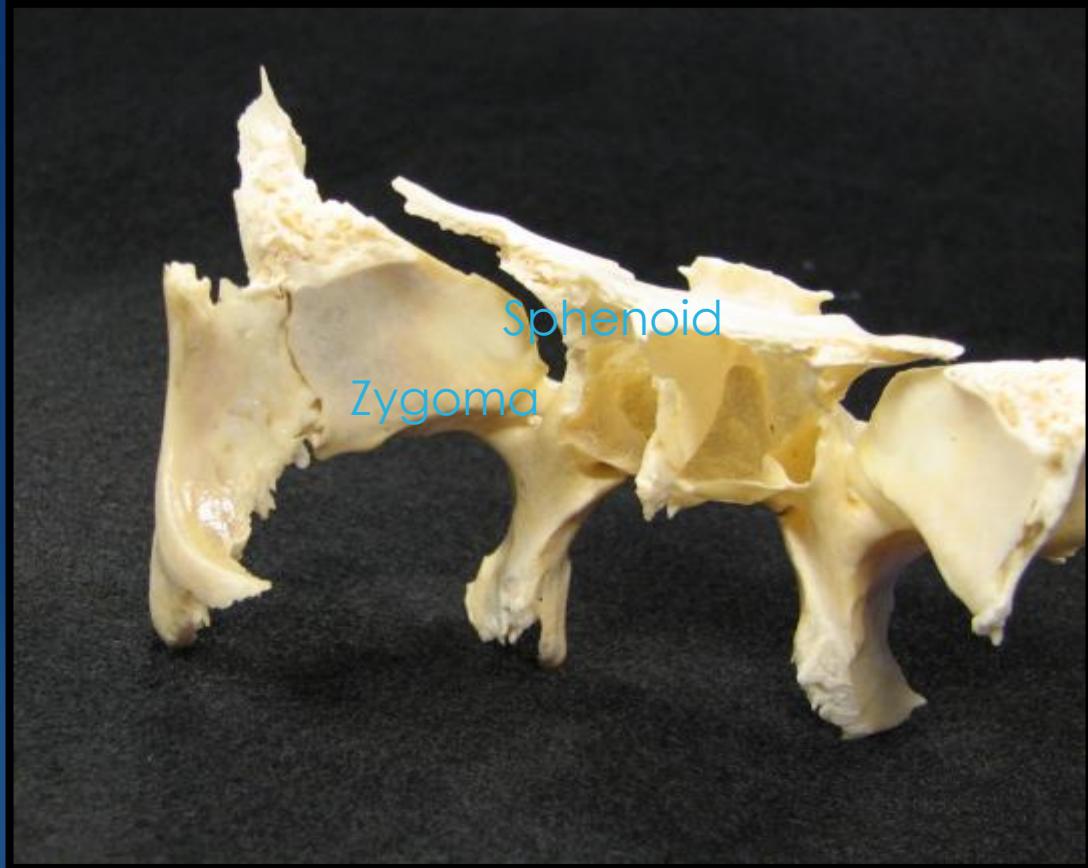
# Sphenoparietal Suture

## Articulation with the parietal bone



## Frontosphenoidal Articulation

Articulation with the frontal bone



<https://pocketdentistry.com/16-fractures-of-the-zygomatic-complex-and-arch/>

# Sphenozygomatic Articulation

## Articulation with the Zygoma

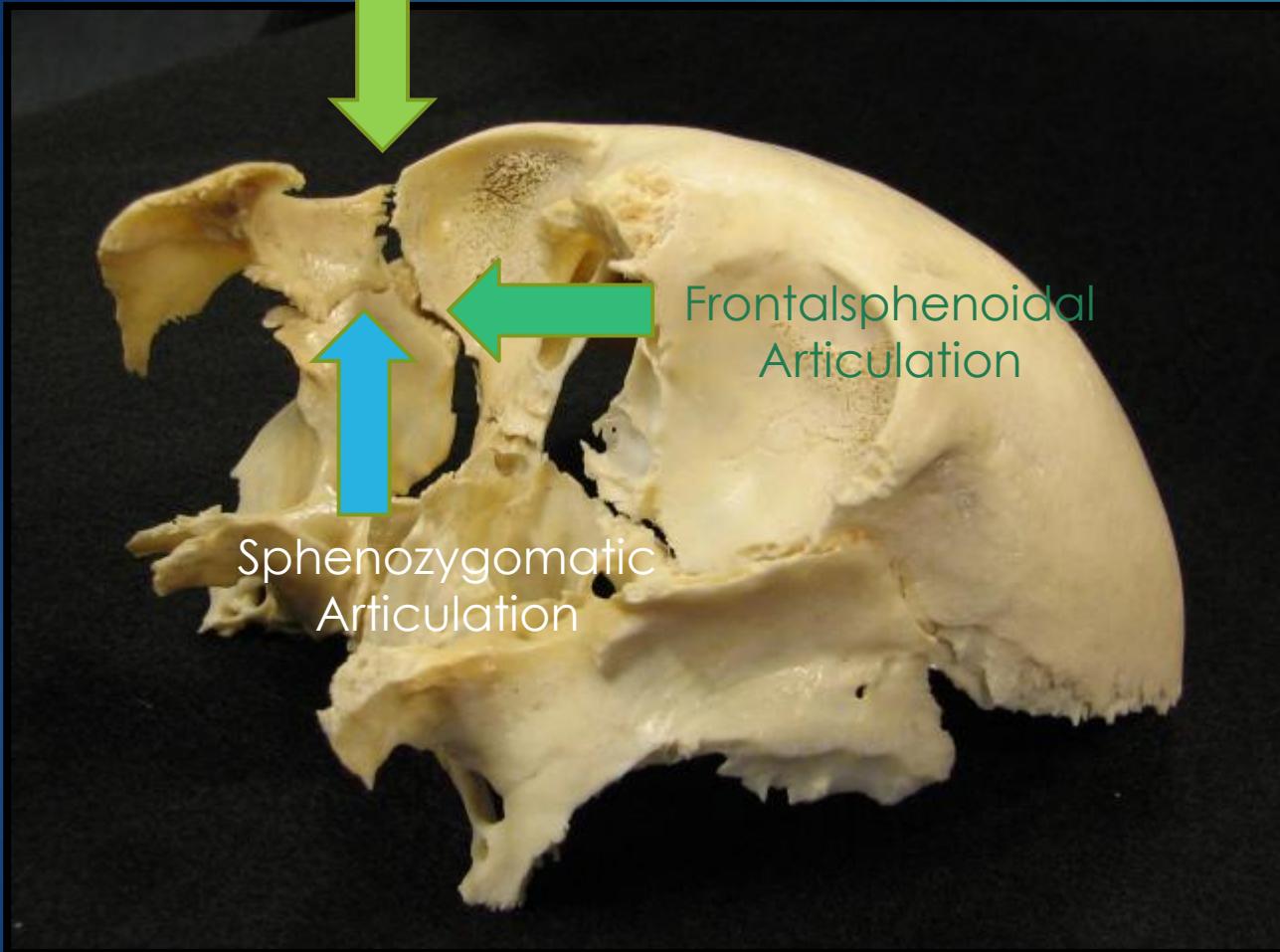
Frontozygomatic  
Articulation



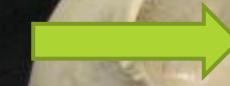
Frontalsphenoidal  
Articulation



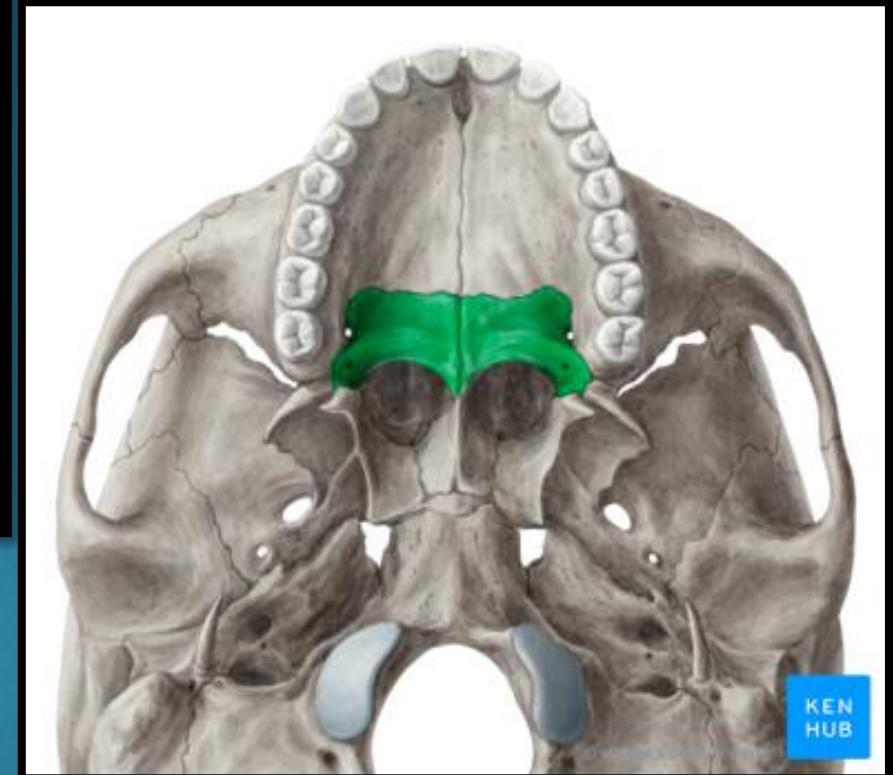
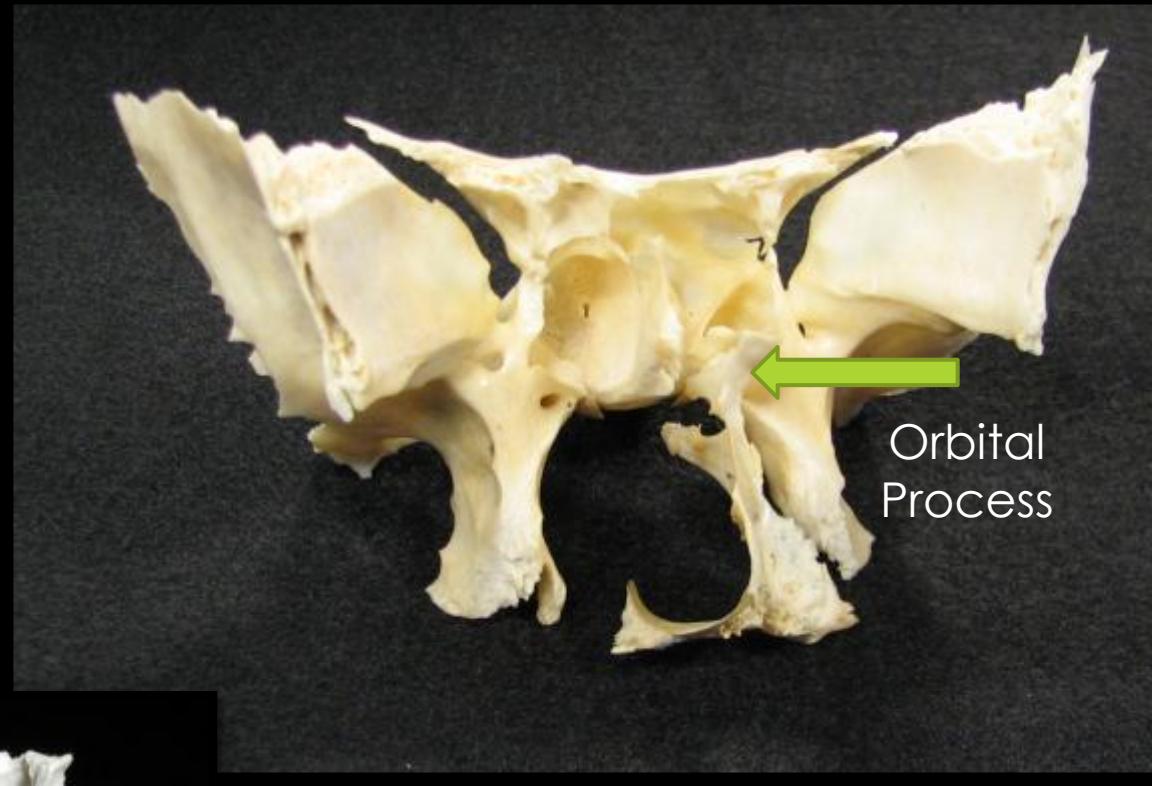
Sphenozygomatic  
Articulation



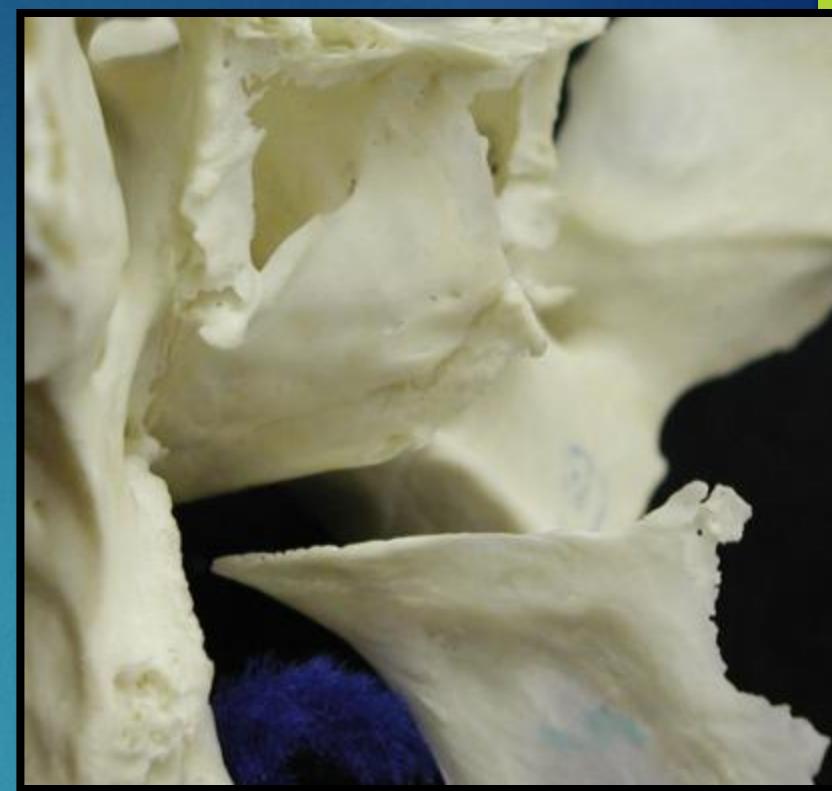
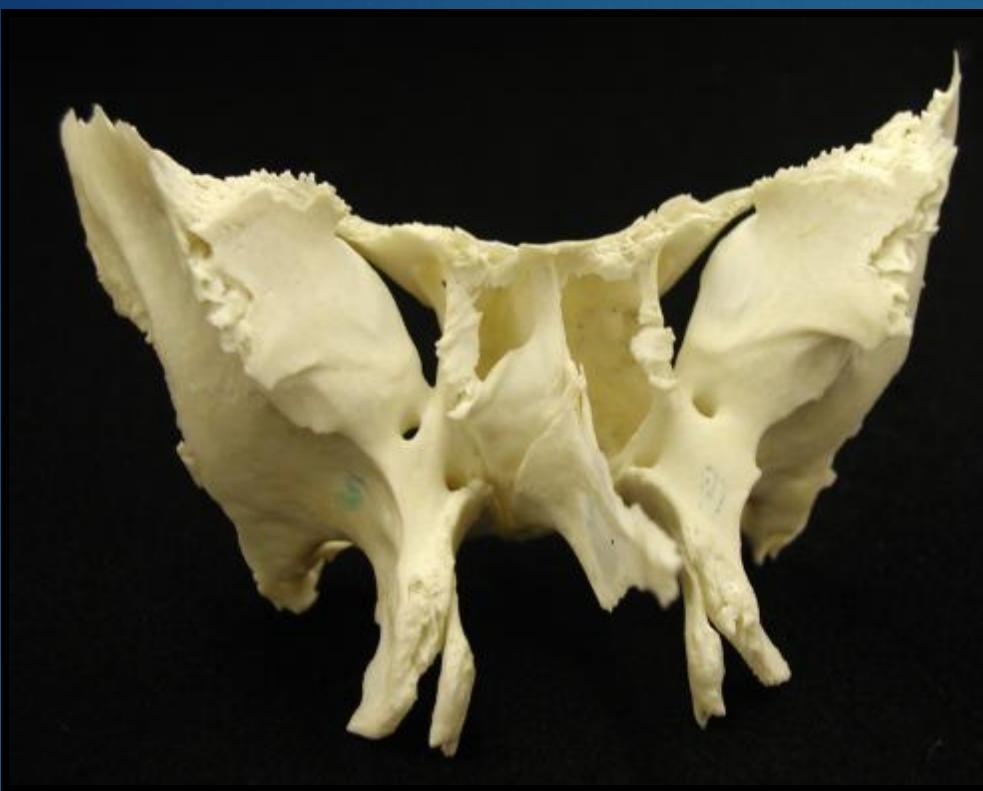
Ethmoid  
Notch



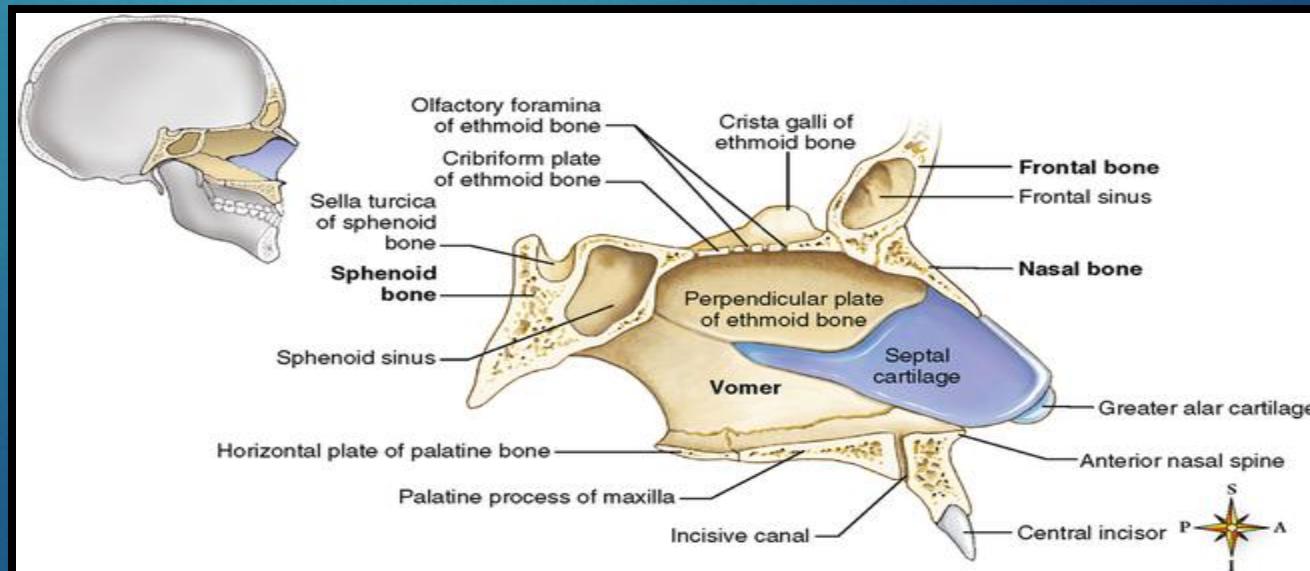
Putting the Articulations Together



Sphenoid and Palatines  
Articulation with the palatine bones



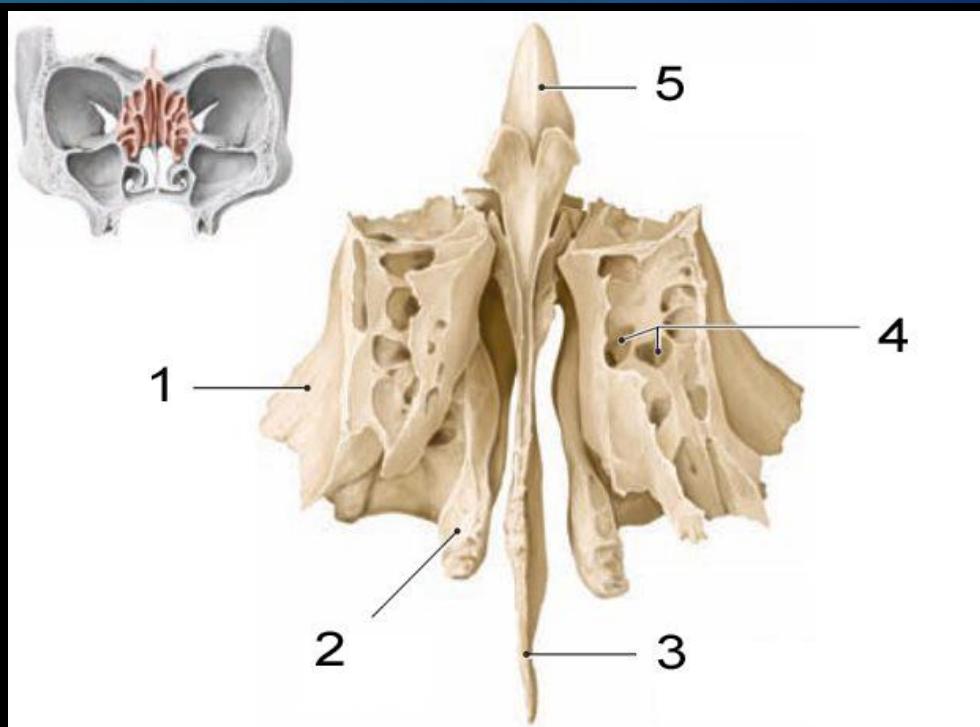
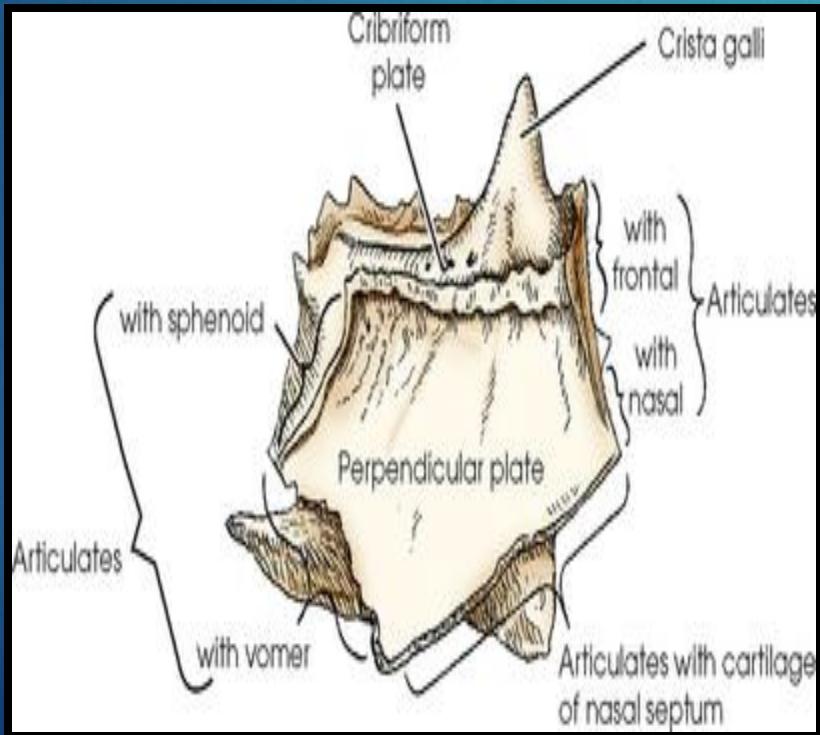
## Sphenoid-Vomer Articulation



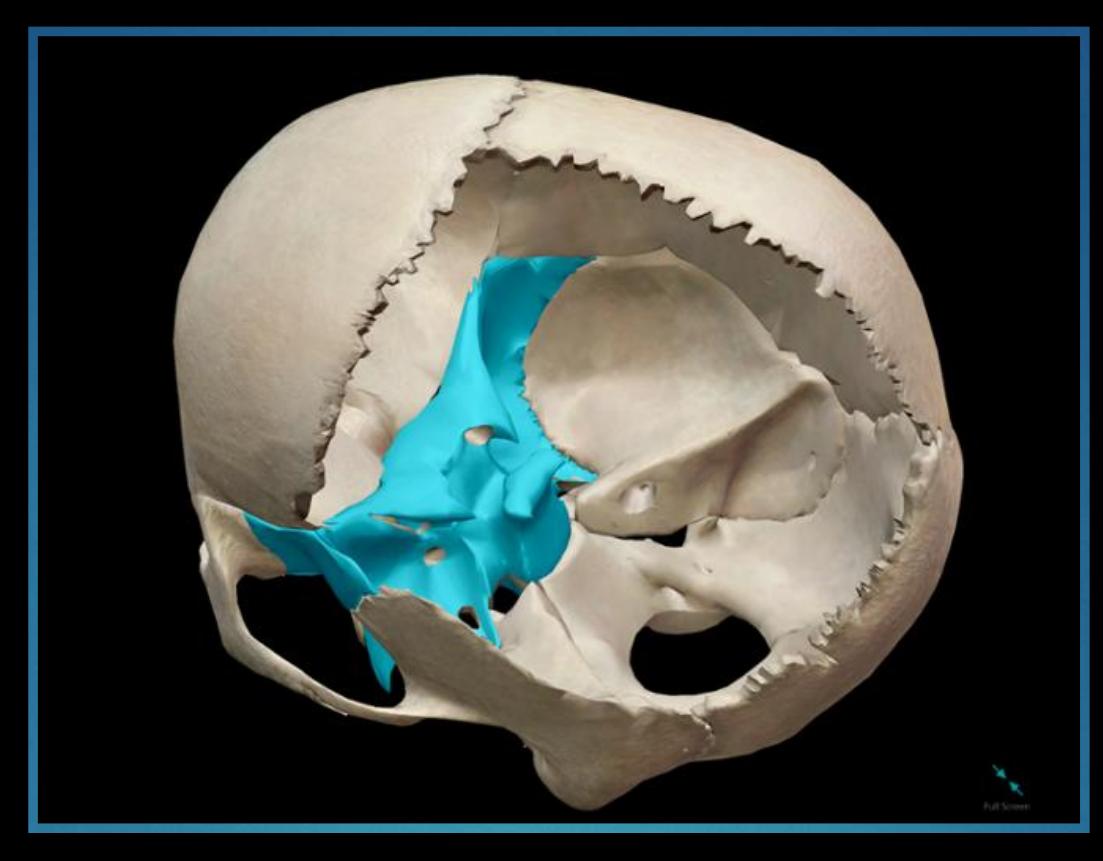
1. Orbital plate
2. Middle Concha
3. Perpendicular Plate
4. Ethmoid Air Cells
5. Crista Galli



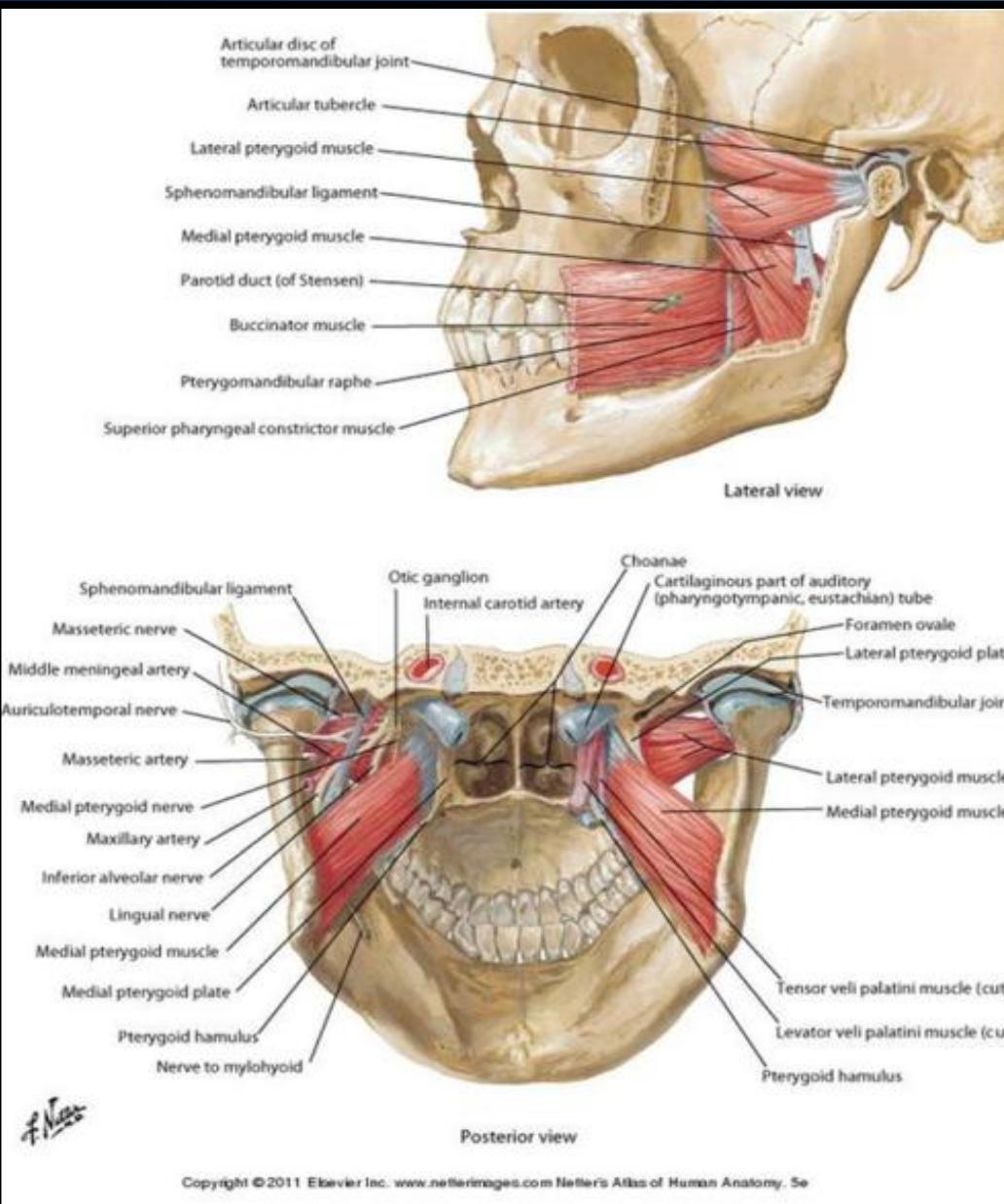
Lateral View Ethmoid



## Spheno-Ethmoid Articulation



Important Muscular &  
Ligamentous Attachments to  
the Sphenoid



## ► The Pterygoid Processes

- Separated by a fissure which articulates with the palatine bone
- Diverge posteriorly creating a fossa
- Attachment point for:

### 1. Lateral Pterygoid

- Origin- greater wing of sphenoid and lateral pterygoid plate
- Insertion- TMJ and mandible
- V3 innervation
- Jaw protrusion and closure

### 2. Medial Pterygoid

- Origin: medial surface of the lateral pterygoid plate and pterygoid fossa
- Insertion: mandibular angle
- V3 innervation
- Jaw closure

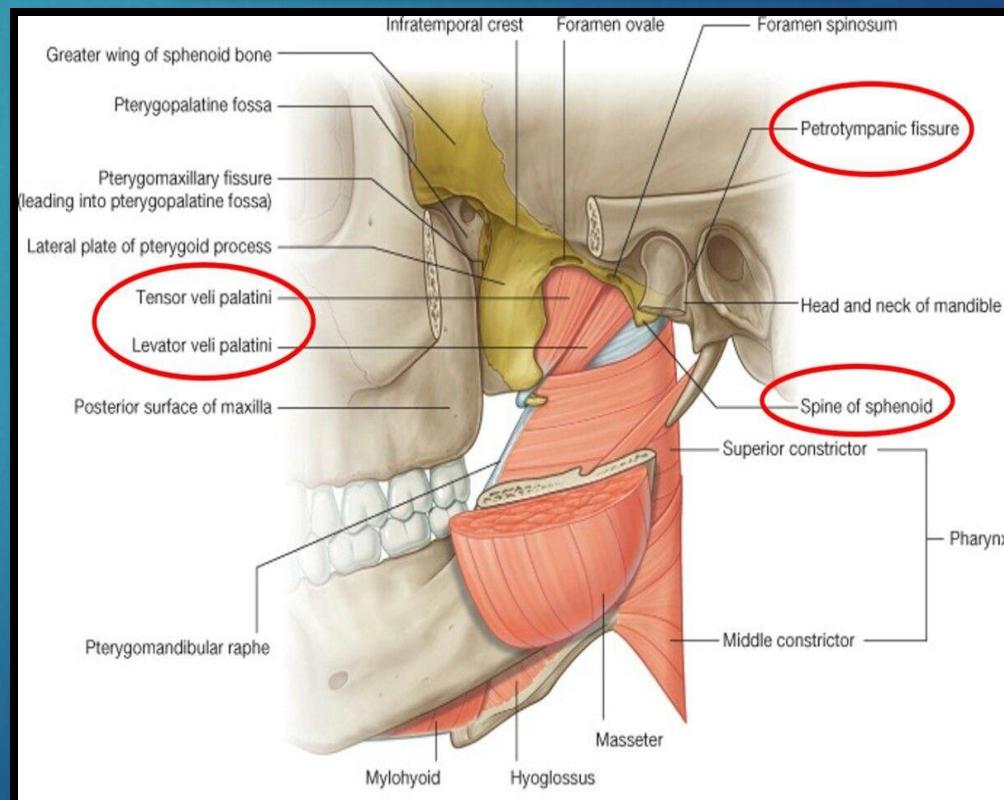
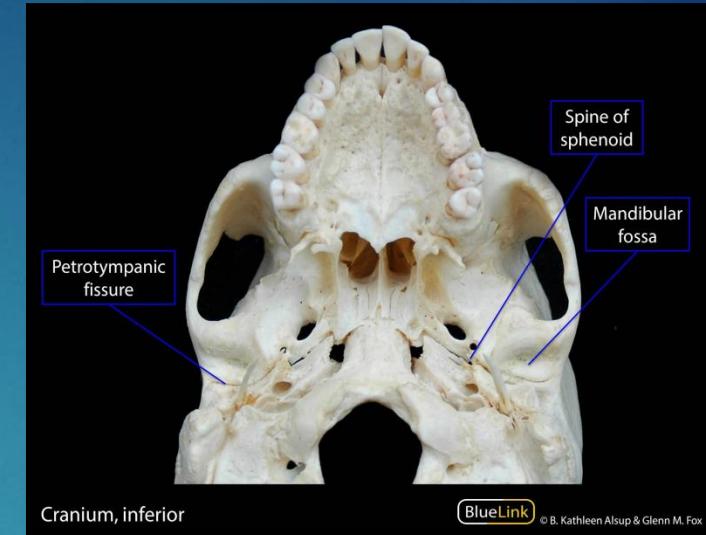
### 3. Tensor Veli Palatini

- Origin- medial pterygoid plate
- Insertion- palatine aponeurosis
- V3 innervation

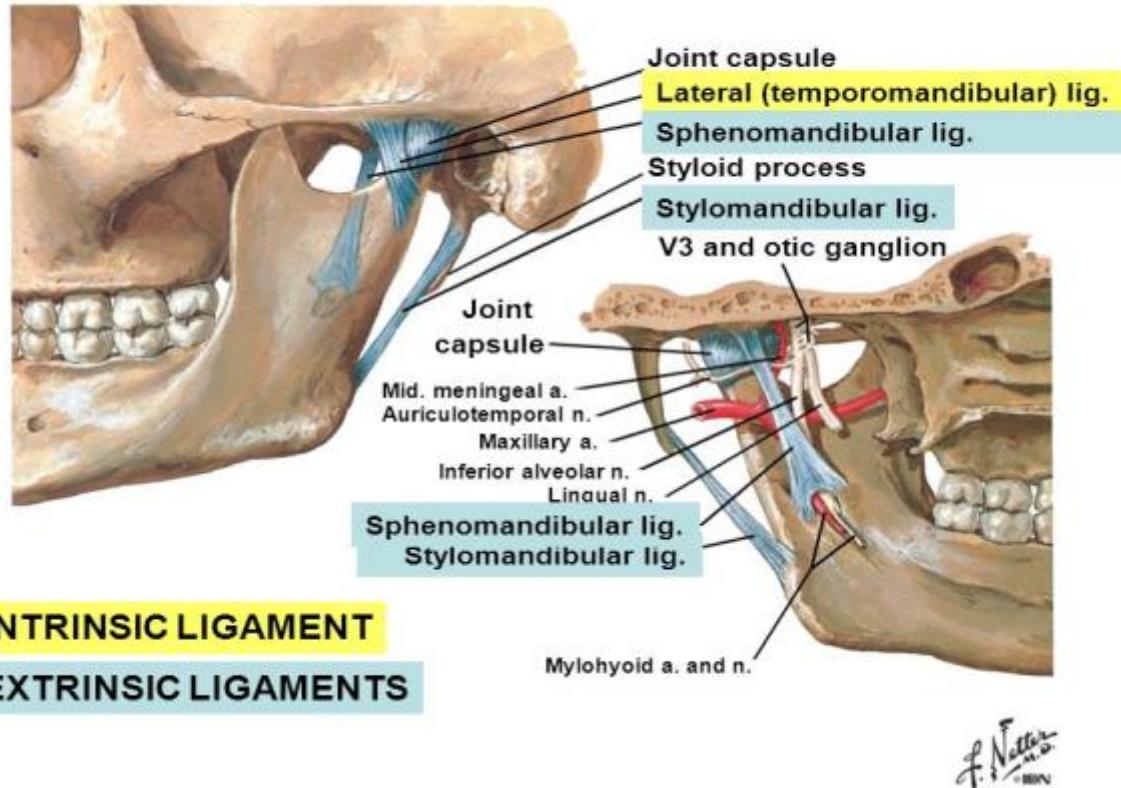
# Muscular Attachments at the Sphenoid

- Middle ear through the petrous portion of the temporal bone
- Across the articulation between the sphenoid and the petrous tip
  - The groove lies medial to the spine of the sphenoid
- Through pharyngeal musculature
  - Closely approximates tensor veli palatini and levator veli palatini and salpingopharyngeus
- Into the nasopharynx

## Pharyngotympanic (eustachian) tube

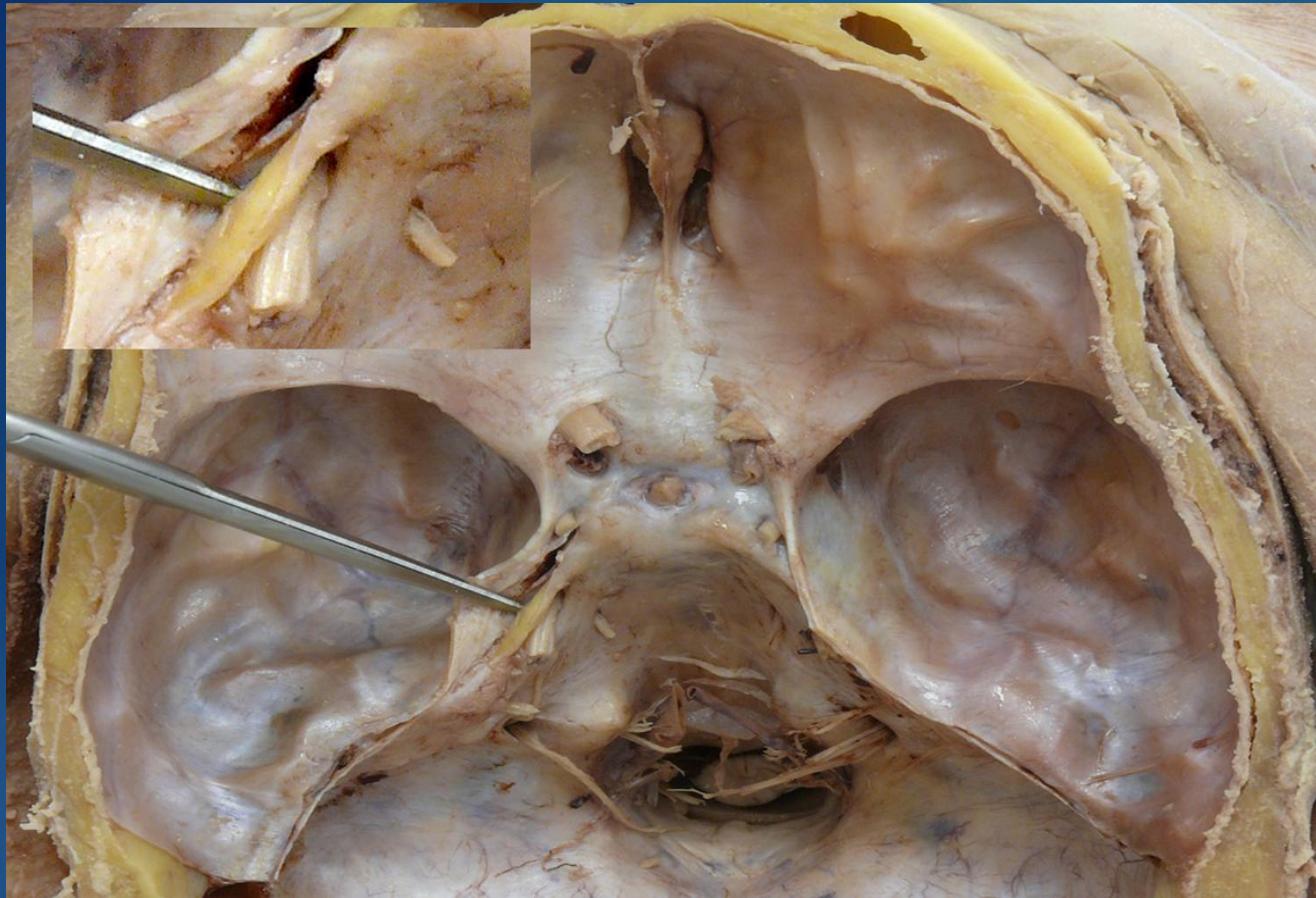


## LIGAMENTS, NERVES & BLOOD SUPPLY OF TMJ



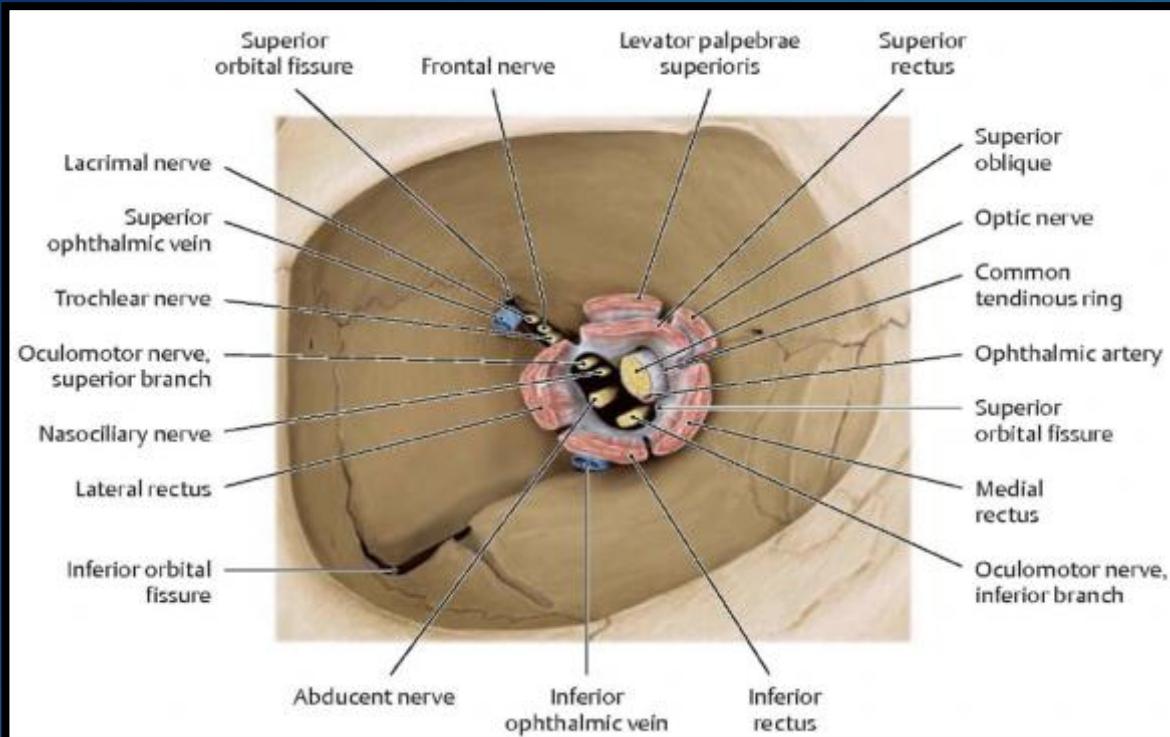
- Connects sphenoid to the lingula of the mandibular foramen
- Slackens when TMJ is closed, Taut when TMJ is open

# Sphenomandibular Ligament



# Petrosphenoidal Ligament (Gruber's Ligament)

- From the petrous ridge of the temporal bone to the posterior clinoid process
  - The Abducens Nerve Travels underneath it
  - Tension here could effect contents of the cavernous sinus
- 
- O TOM CAT
  - O: oculomotor
  - T: trochlear
  - O: ophthalmic branch of V
  - M: maxillary branch of V
  - C: Internal Carotid Artery
  - A: Abducent nerve
  - T: Trochlear Nerve



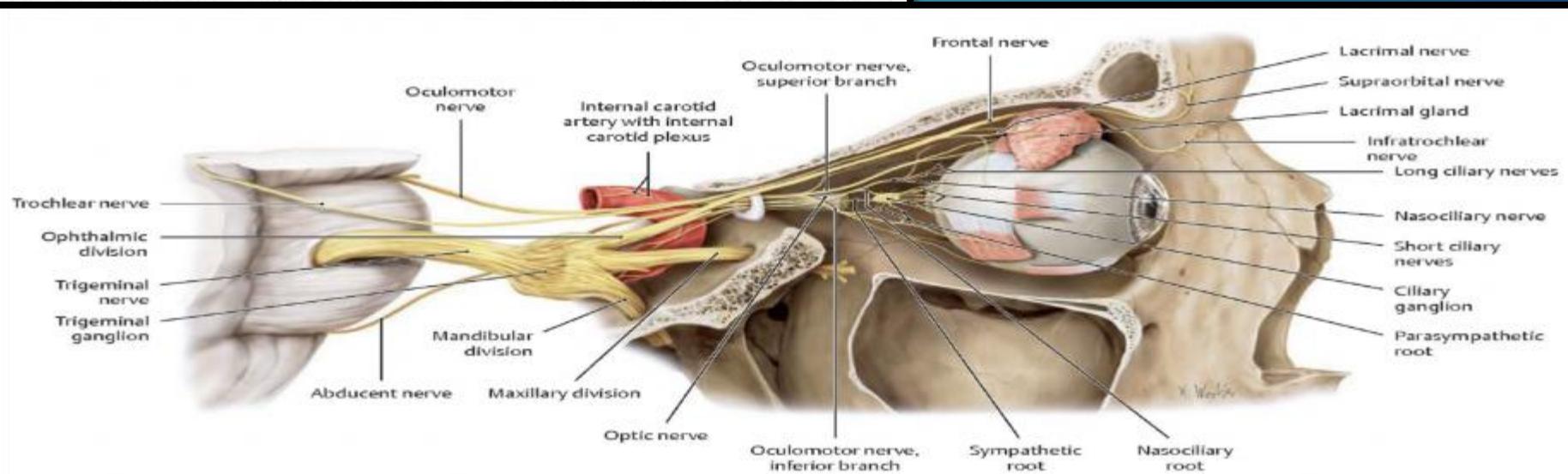
Illustrator: Karl Wesker

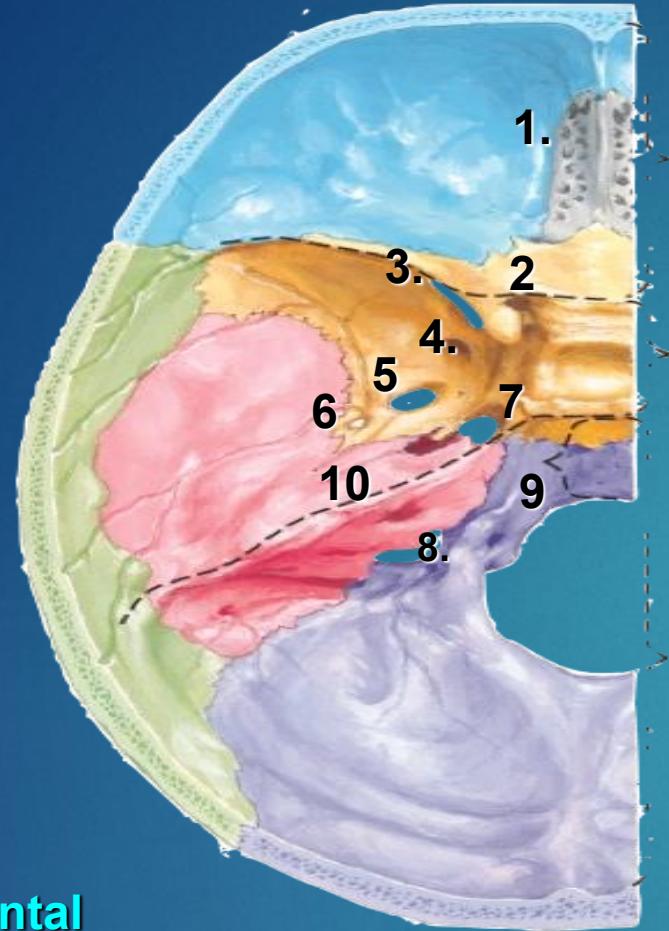
Schuenke et al. THIEME Atlas of Anatomy • Head and Neuroanatomy  
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pp. 138-139

Thieme

- ▶ Common Tendinous Ring (annulus of Zinn)
- ▶ Point of attachment of the four rectus muscles
- ▶ Ophthalmic artery
- ▶ Sheath of CN II
- ▶ CN III, VI & V1 (nasociliary nerve)
  - ▶ Moore pg 902
- ▶ Crosses the optic canal and the superior orbital fissure and then attaches to the greater wing of the sphenoid
  - ▶ "It will be influenced by the mechanics of the lesser wing, greater wing and body of the sphenoid"





Frontal

Ethmoid

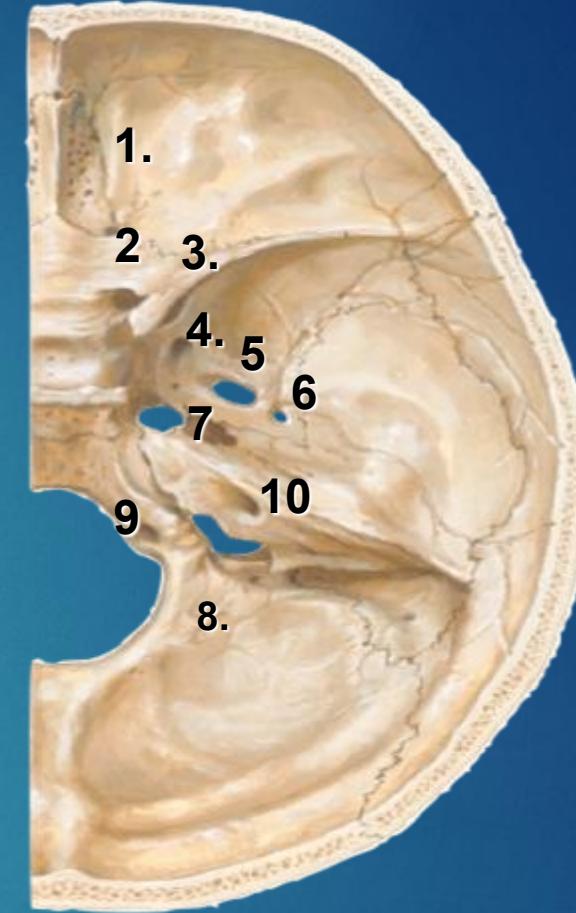
Sphenoid

Temporal

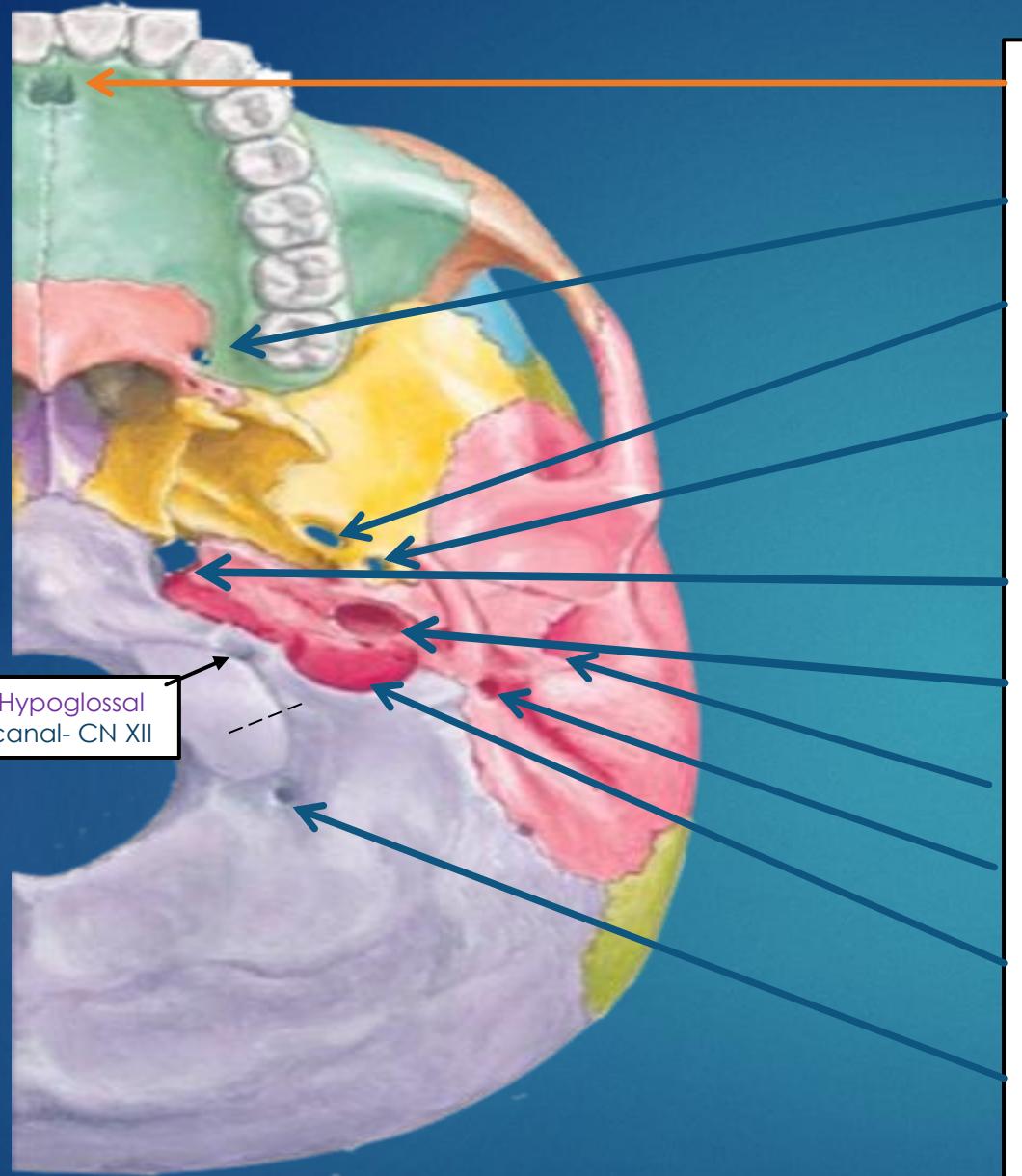
Parietal

Occipital

1. cribriform plate
2. optic canal
3. superior orbital fissure
4. foramen rotundum
5. foramen ovale
6. foramen spinosum
7. foramen lacerum
8. jugular foramen
9. condylar canal
10. internal auditory meatus

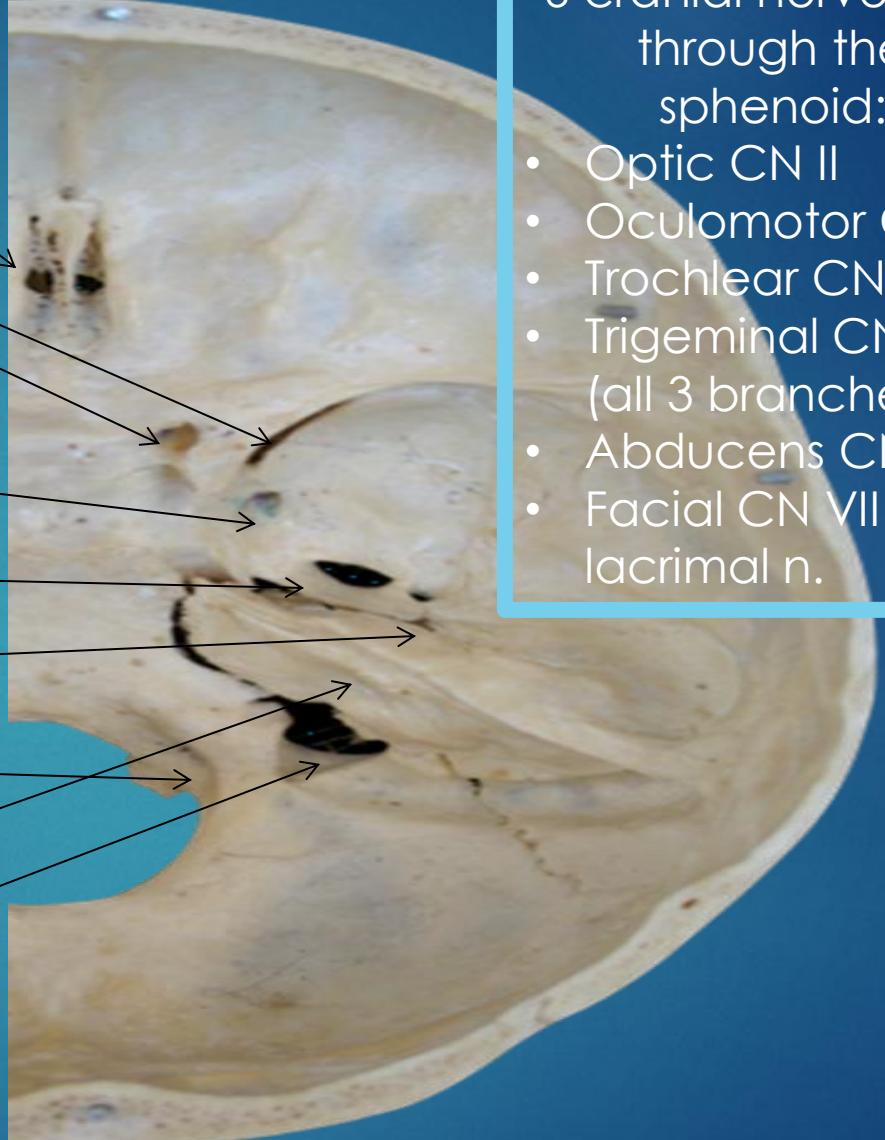


Foramina



- Incisive Canal
  - Emissary vein
- Greater Palatine Foramen
  - CN V Maxillary- greater palatine n
- Foramen Ovale
  - CN V mandibular
- Foramen Spinosum
  - Middle Meningeal A.
- Foramen Lacerum
  - Symp fibers for deep petrosal nerve
- Carotid Canal
  - Internal Carotid Artery
- External Auditory Meatus
- Stylomastoid Foramen
  - CN VII motor branch
- Jugular Foramen
  - CN IX, X, XI
- Condylar Foramen
  - Emissary vein

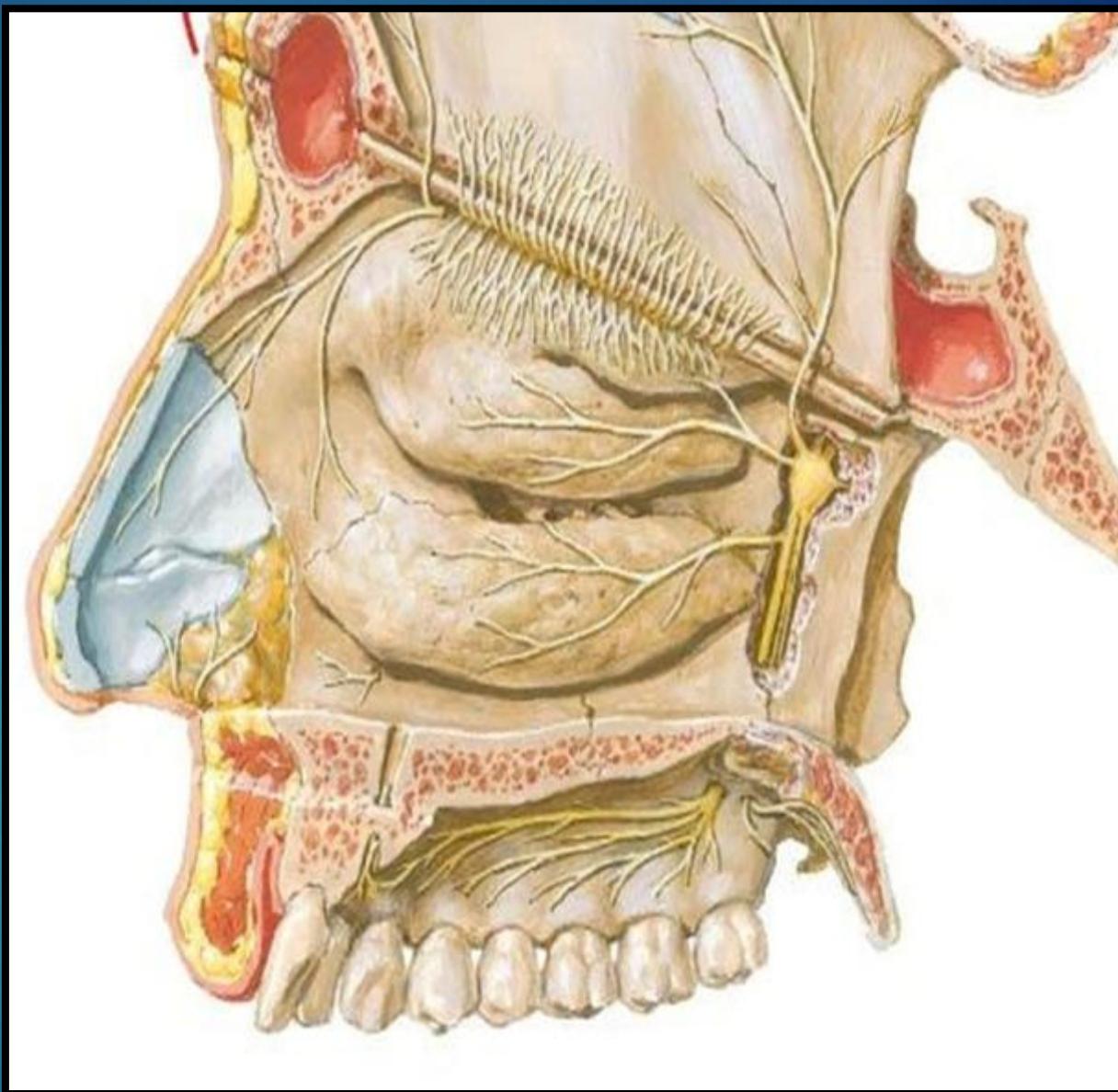
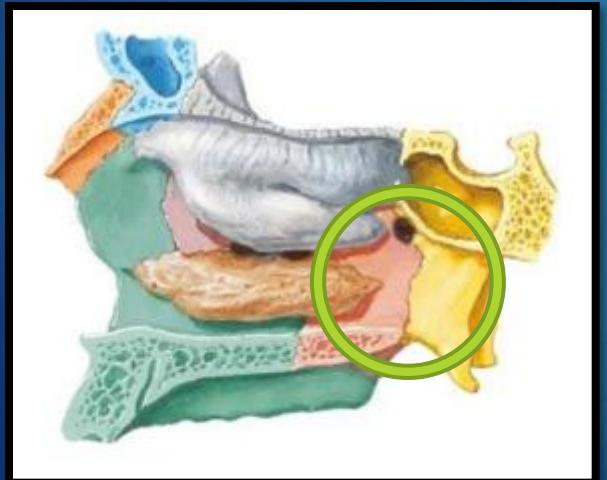
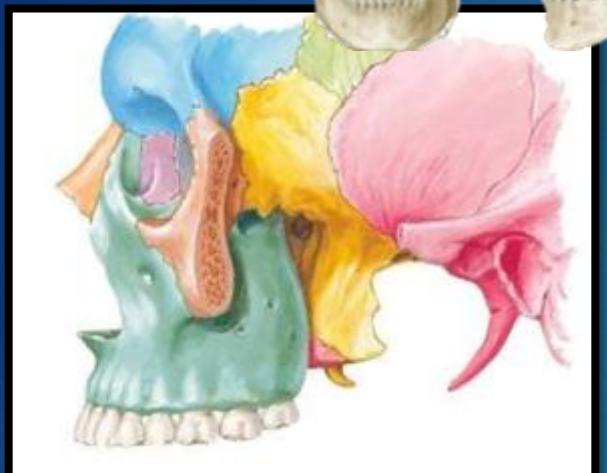
- ▶ Ethmoid Foramina
  - ▶ CNI- Olfactory
- ▶ Optic Canal
  - ▶ CNII- Optic
- ▶ Superior Orbital Fissure
  - ▶ CN III Ophthalmic N.
  - ▶ CN IV Trochlear N.
  - ▶ CN VI Abducens N.
  - ▶ CN V: ophthalmic N.
- ▶ Foramen Rotundum
  - ▶ CN V: maxillary division N.
- ▶ Foramen Ovale
  - ▶ CN V: mandibular division N.
- ▶ Foramen Spinosum
  - ▶ Middle meningeal artery
- ▶ Hypoglossal canal
  - ▶ CN XII: Hypoglossal N.
- ▶ Internal Auditory Meatus
  - ▶ VII: Facial N.
  - ▶ CN VIII: Vestibulocochlear
- ▶ Jugular Foramen
  - ▶ CN IX: Glossopharyngeal N.
  - ▶ CN X: Vagus N.
  - ▶ CN XI: Accessory N.



6 cranial nerves exit through the sphenoid:

- Optic CN II
- Oculomotor CN III
- Trochlear CN IV
- Trigeminal CN V (all 3 branches)
- Abducens CN VI
- Facial CN VII via lacrimal n.

## Cranial Nerves that Traverse the Foramina, Internal Cranial View



The Pterygopalatine Fossa



## Clinical Indications for Evaluating/Treating Sphenoid

- ▶ Vision problems
- ▶ Strabismus
- ▶ Balance issues/vertigo
- ▶ Hearing problems
- ▶ URI/sinus congestion
- ▶ Sinus headache
- ▶ Bell's palsy

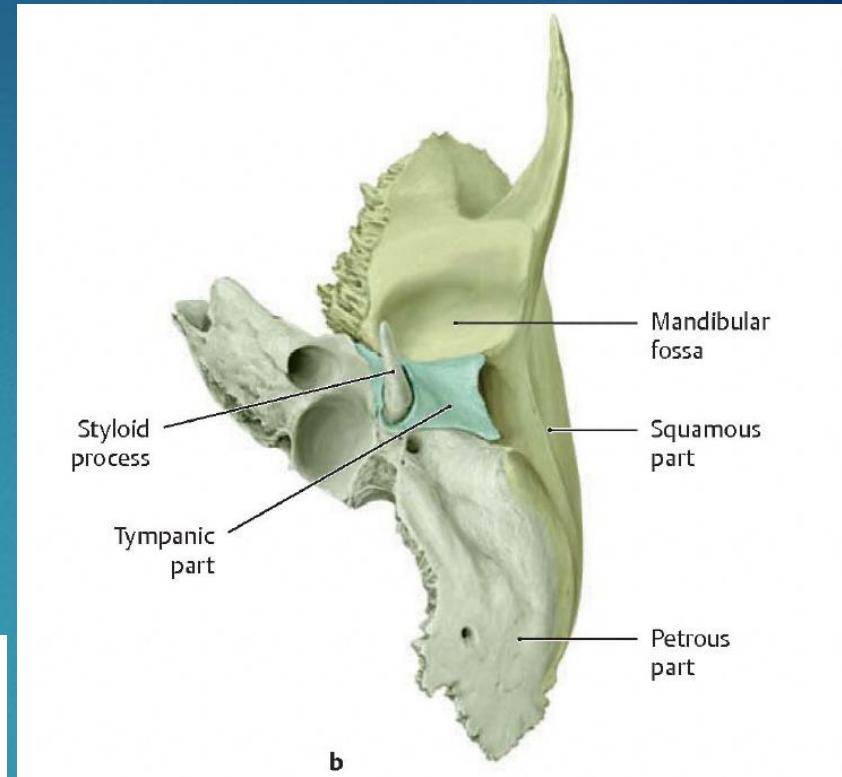
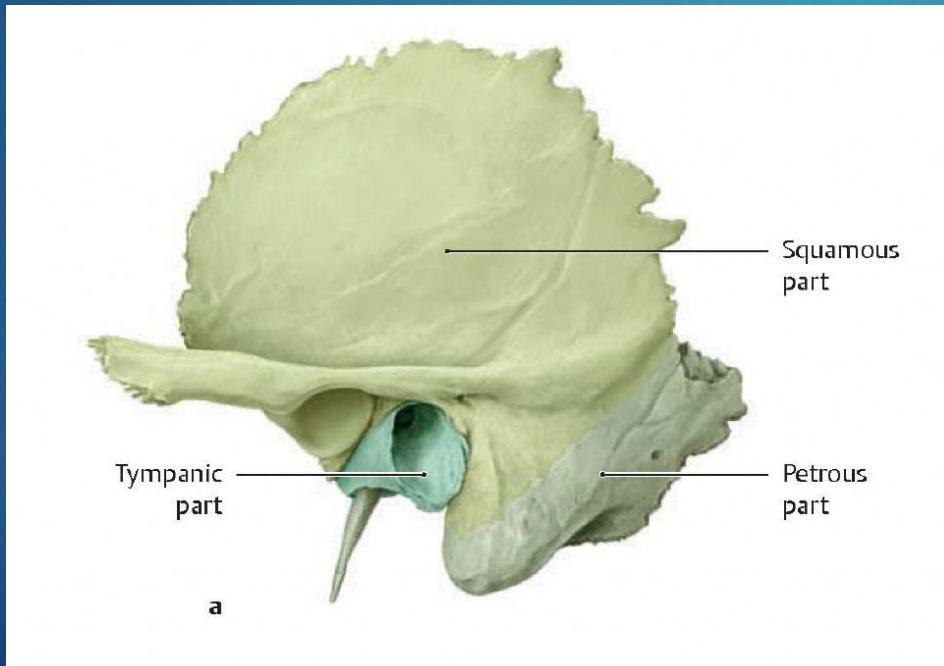
Temporal



# Origins

- ▶ Membranous origin
  - ▶ Squamous
  - ▶ Tympanic

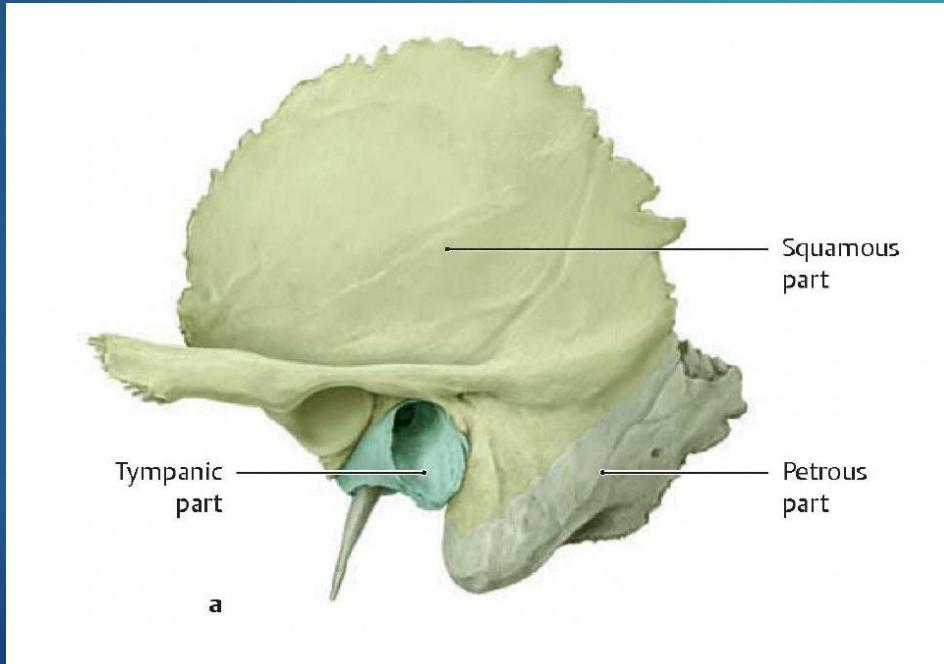
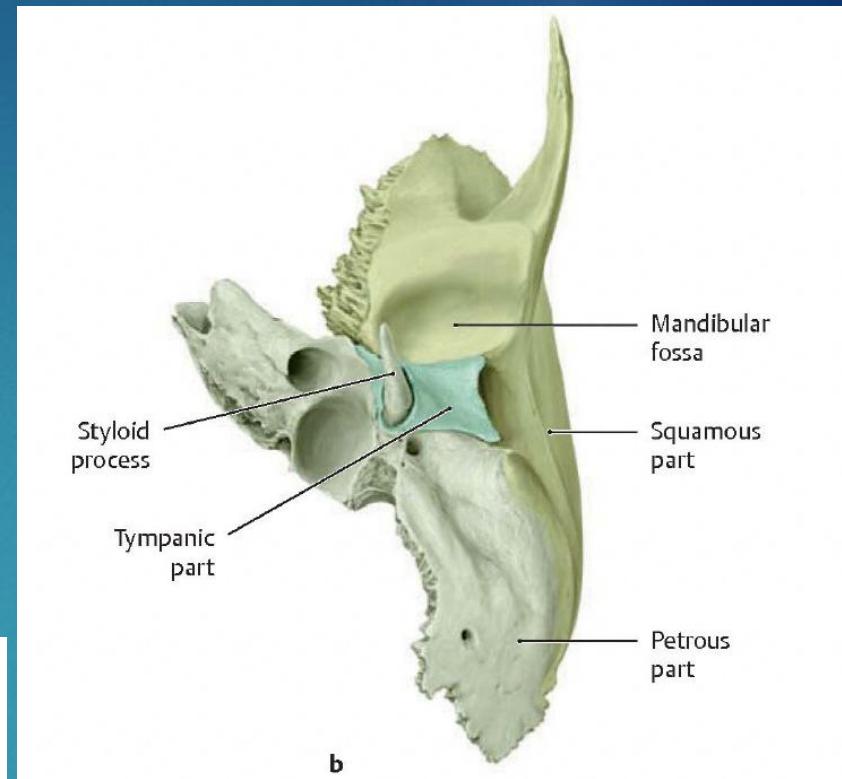
Lateral View

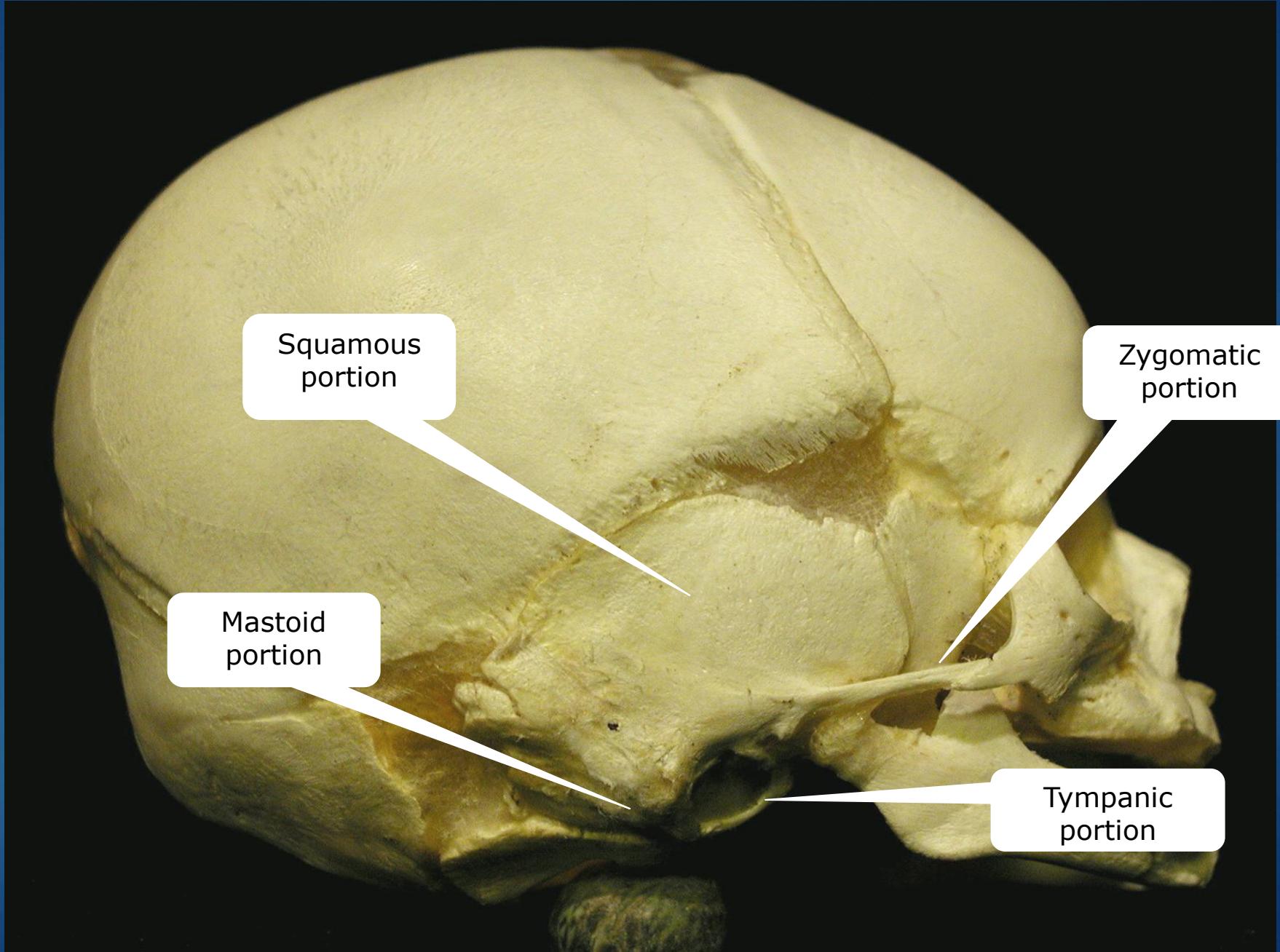


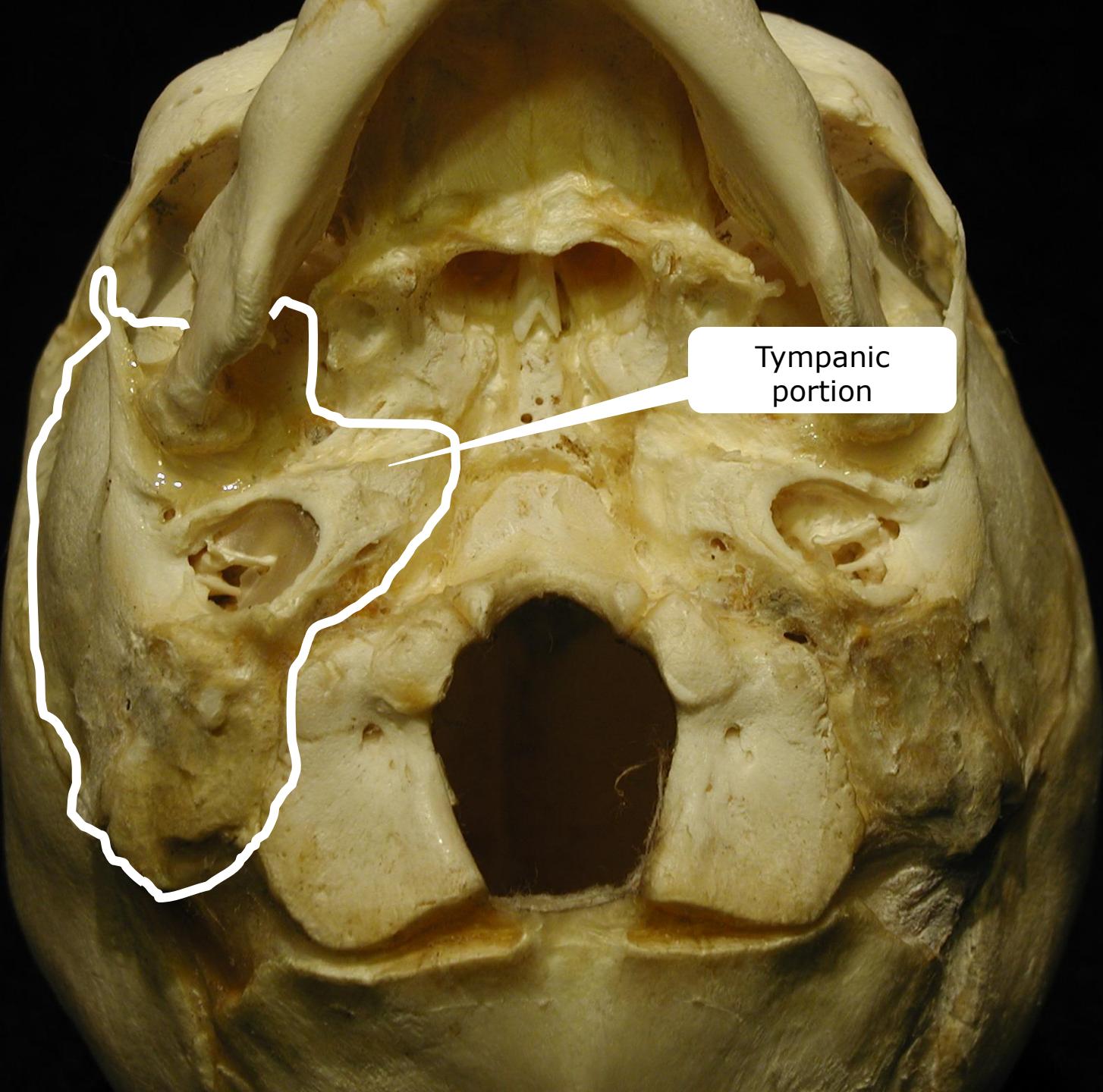
# Origins

- ▶ Cartilaginous origin
  - ▶ Petrous
  - ▶ Mastoid
  - ▶ Styloid

Lateral View

**a**





Tympanic  
portion

# Temporal Bone Articulations

- ▶ Occiput
- ▶ Parietal
- ▶ Sphenoid
- ▶ Zygoma
- ▶ Mandible

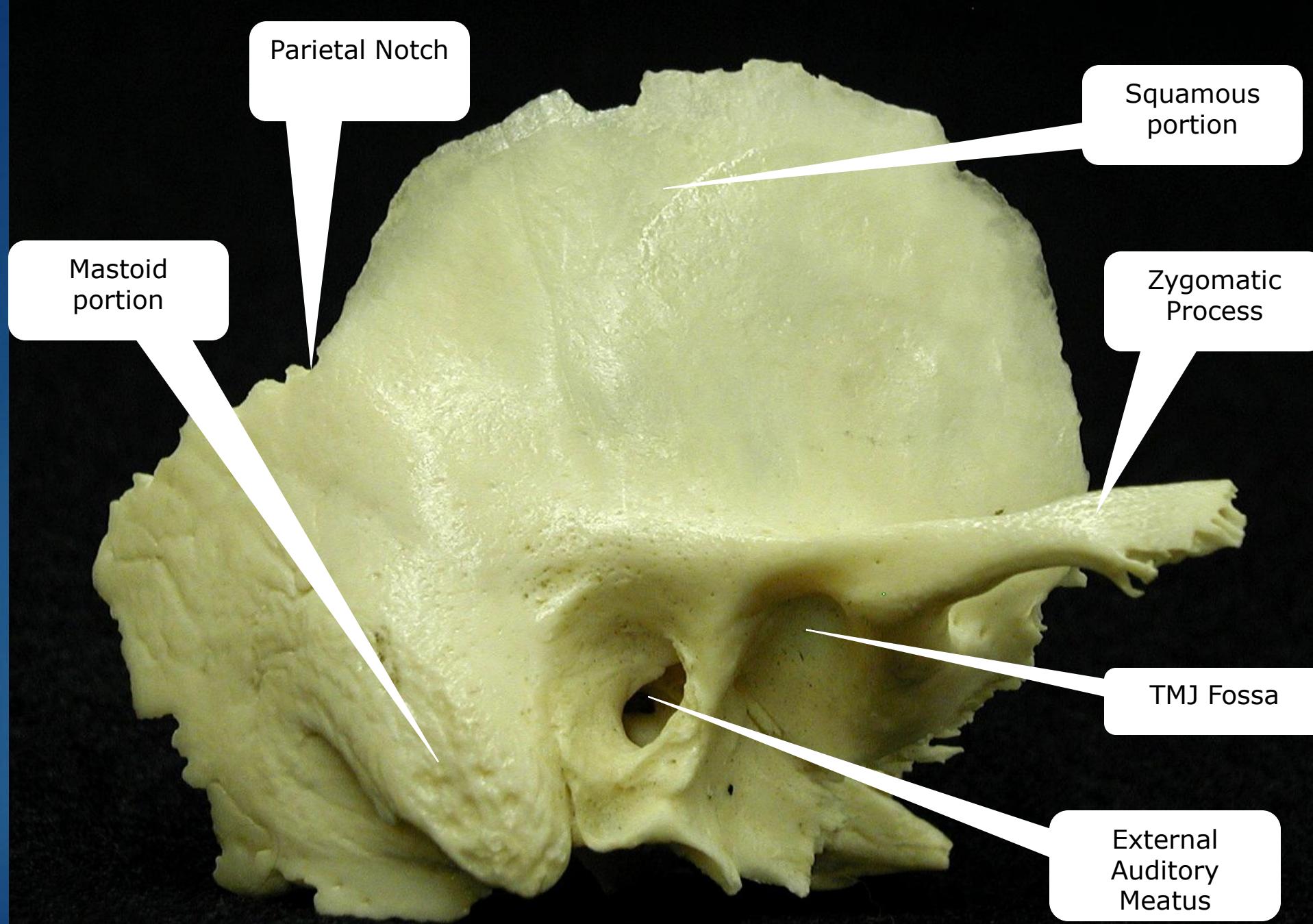






# Adult Temporal Bone – Posterior, Medial & Anterior Features

- ▶ Petrous Ridge
- ▶ Parieto-Squamous & Parieto-mastoid Articulations
- ▶ Sphenosquamous Pivot (SS Pivot)
- ▶ Hiatus Fallopii (Petrosal Canal)
- ▶ Bony Eustachian Tube
- ▶ Tensor Tympani Canal
- ▶ Trigeminal Impression (Meckels Cave)
- ▶ Carotid Canal
- ▶ Sigmoid Sinus Impression
- ▶ Superior Petrosal Sinus Impression
- ▶ Internal Auditory Meatus
- ▶ Vestibular Aqueduct



Parietosquamous  
Articulation

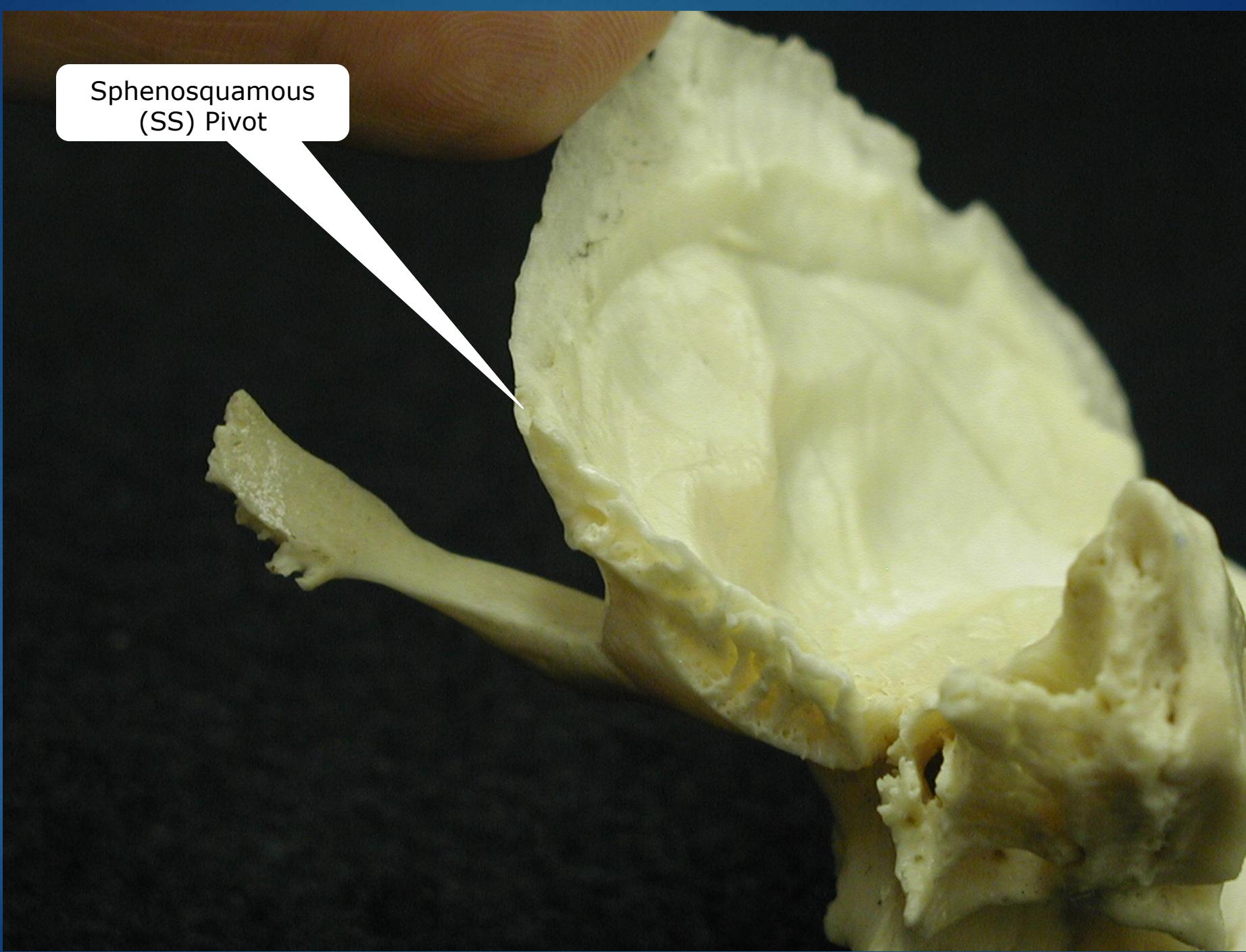
Parietomastoid  
Articulation

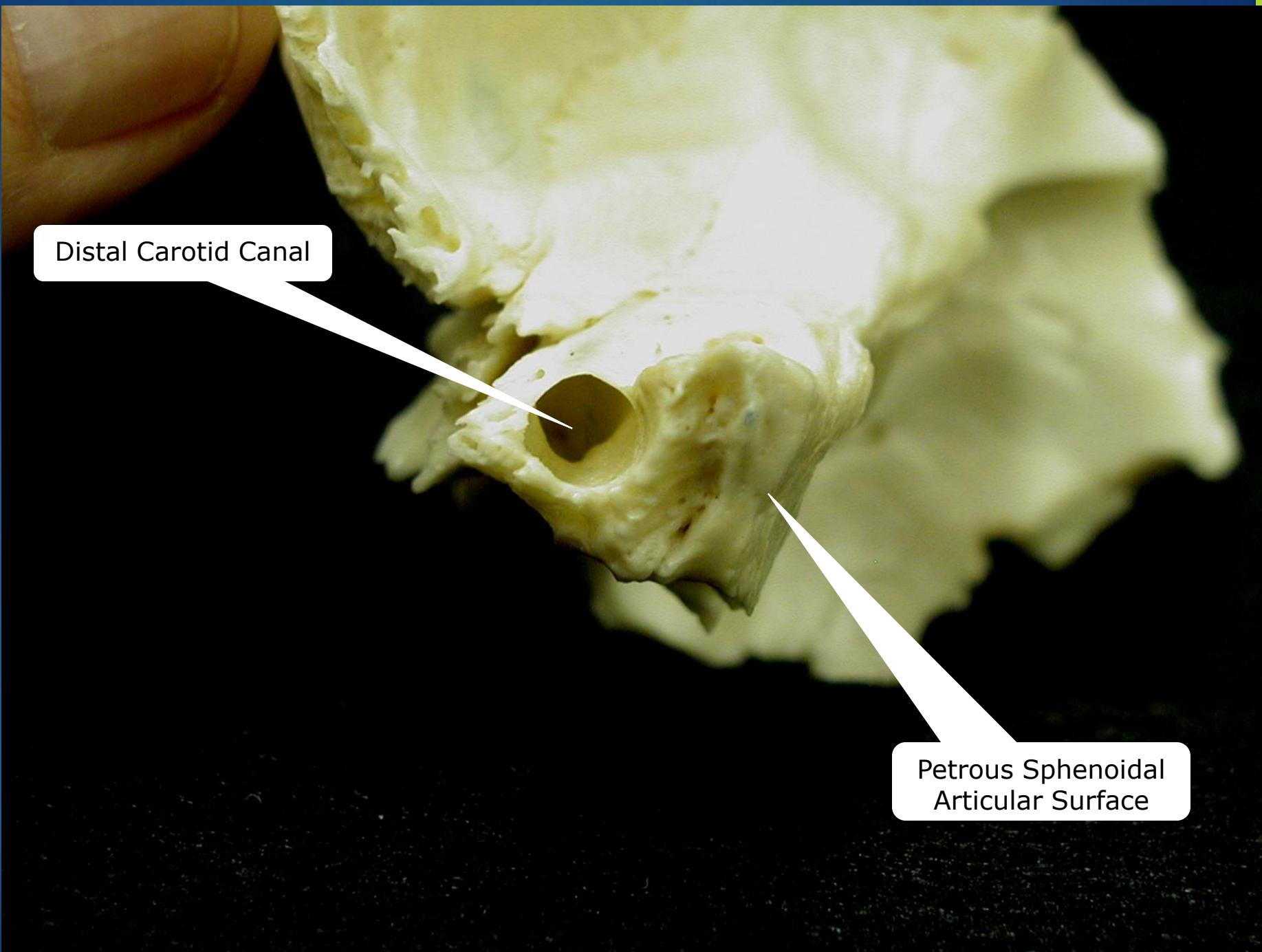
Petrosus Portion

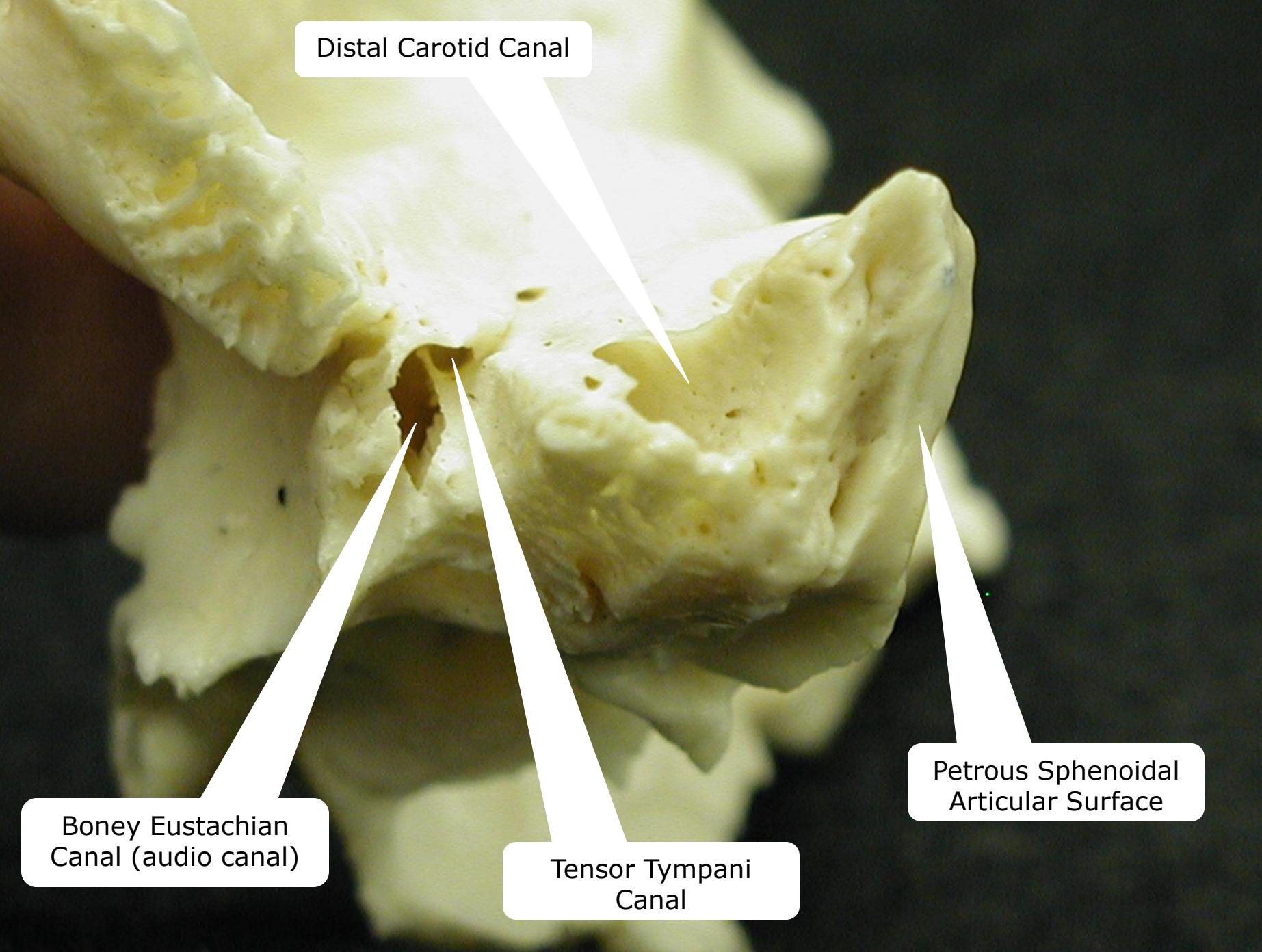
Vestibular  
Aqueduct

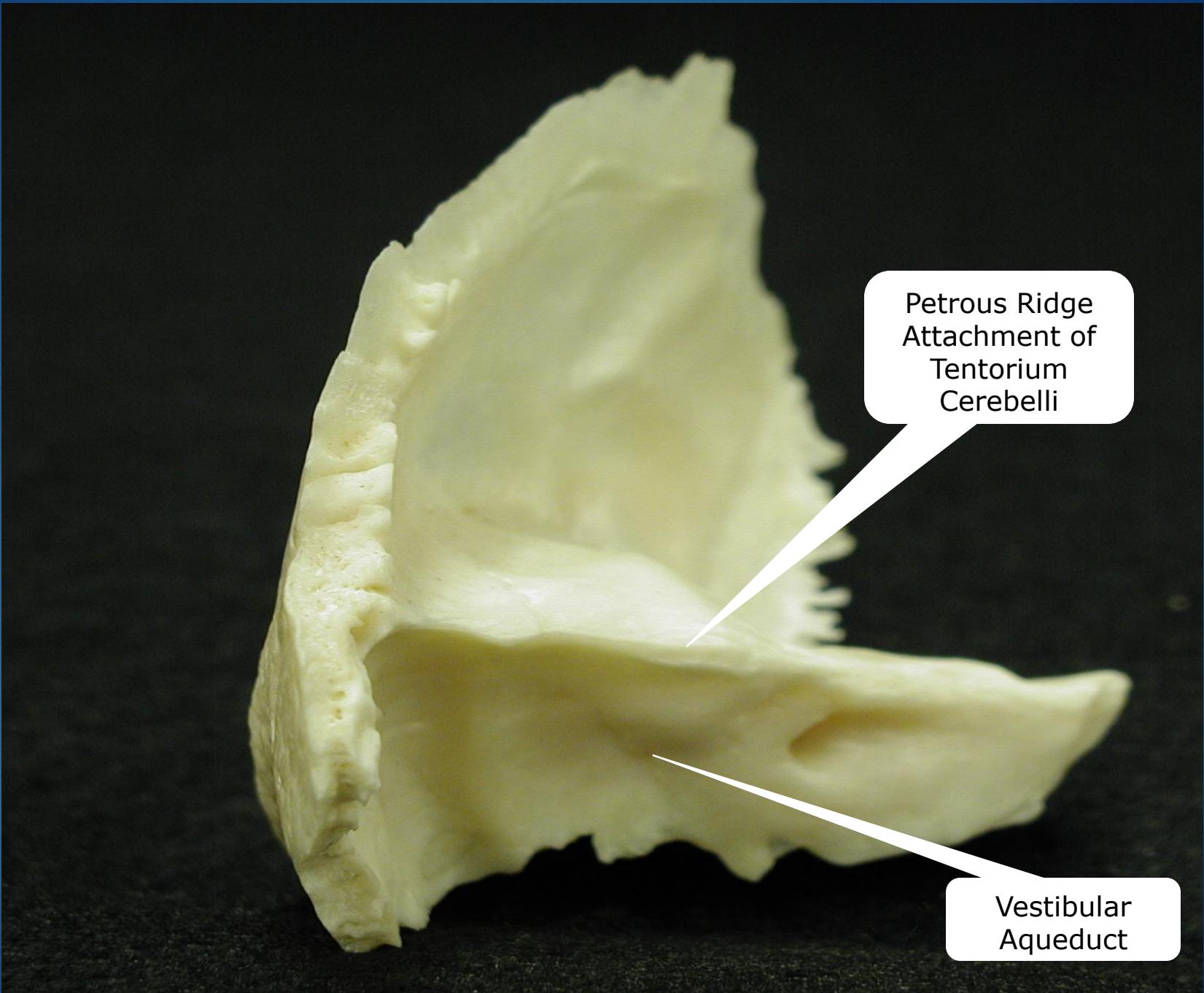
Sigmoid Sinus  
Impression

Sphenosquamous  
(SS) Pivot



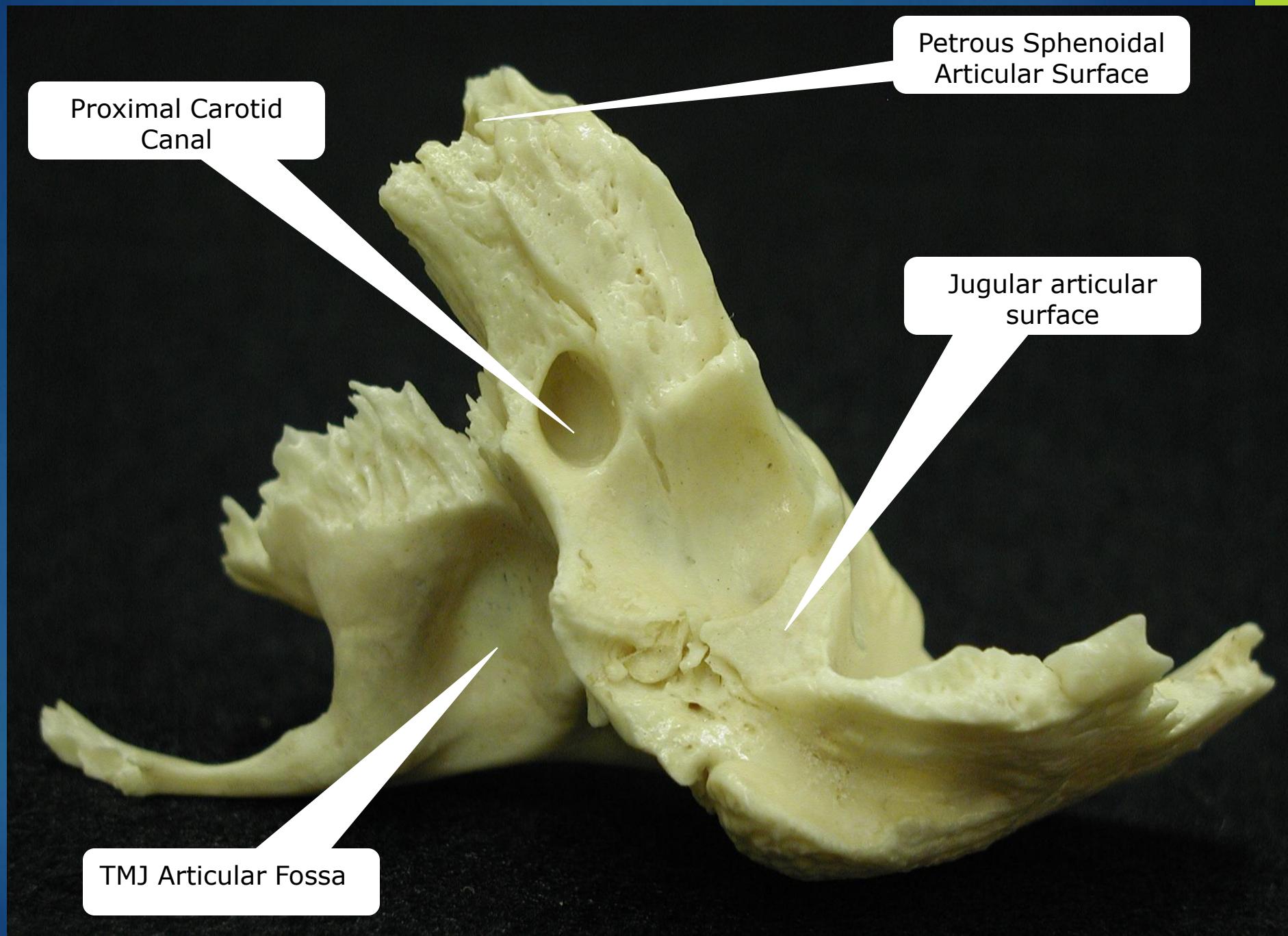


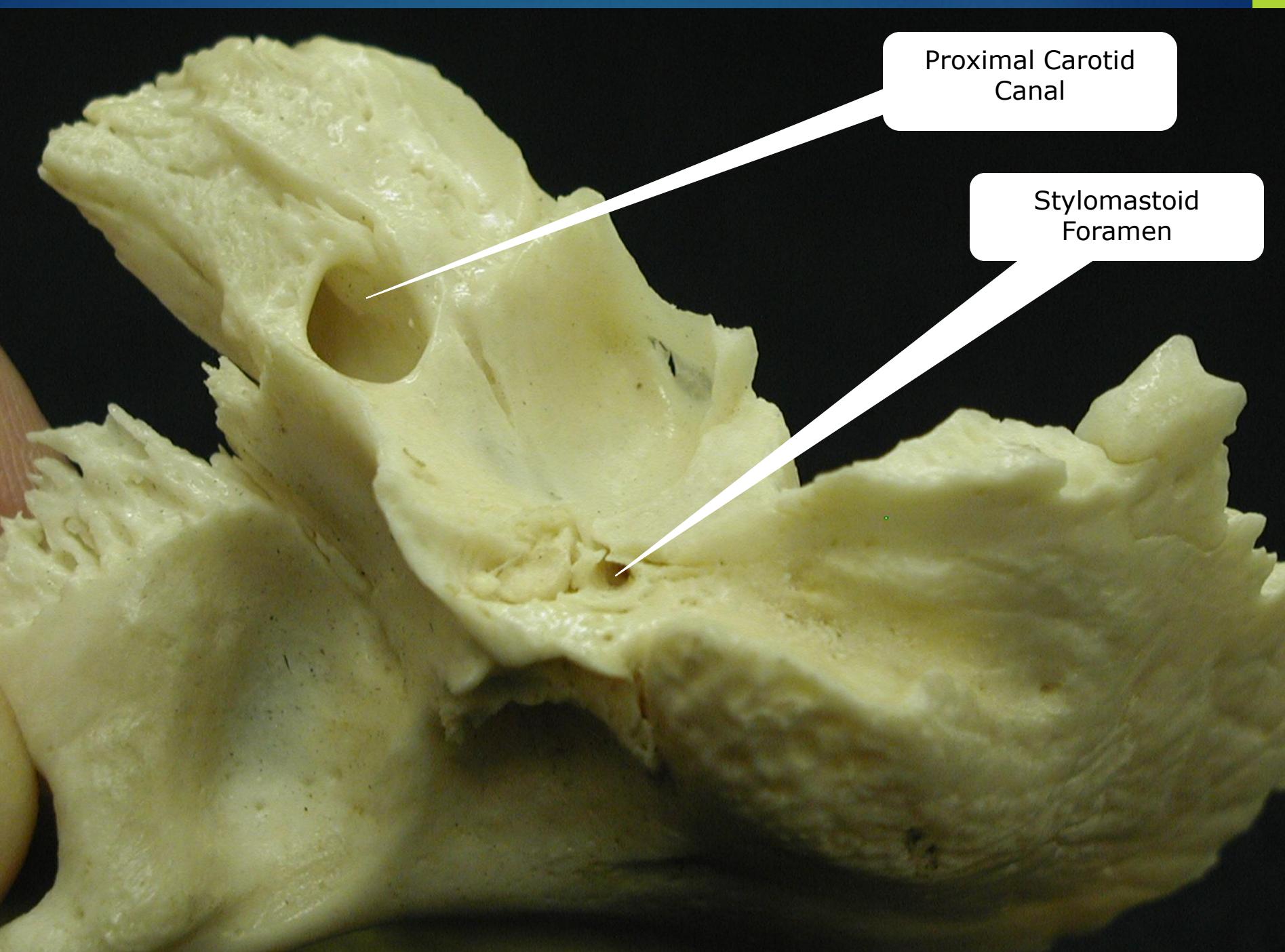




Petrosus Ridge  
Attachment of  
Tentorium  
Cerebelli

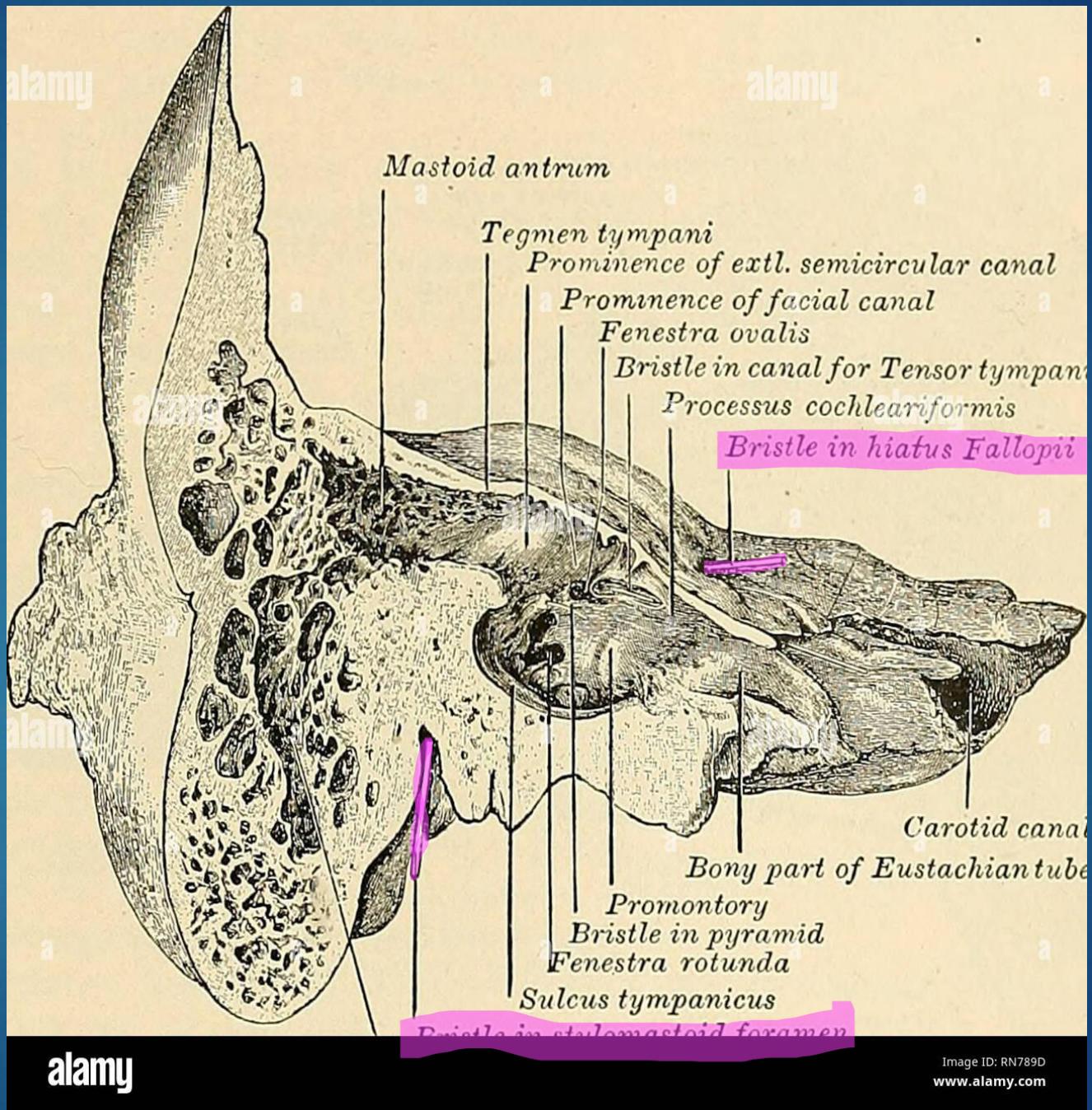
Vestibular  
Aqueduct





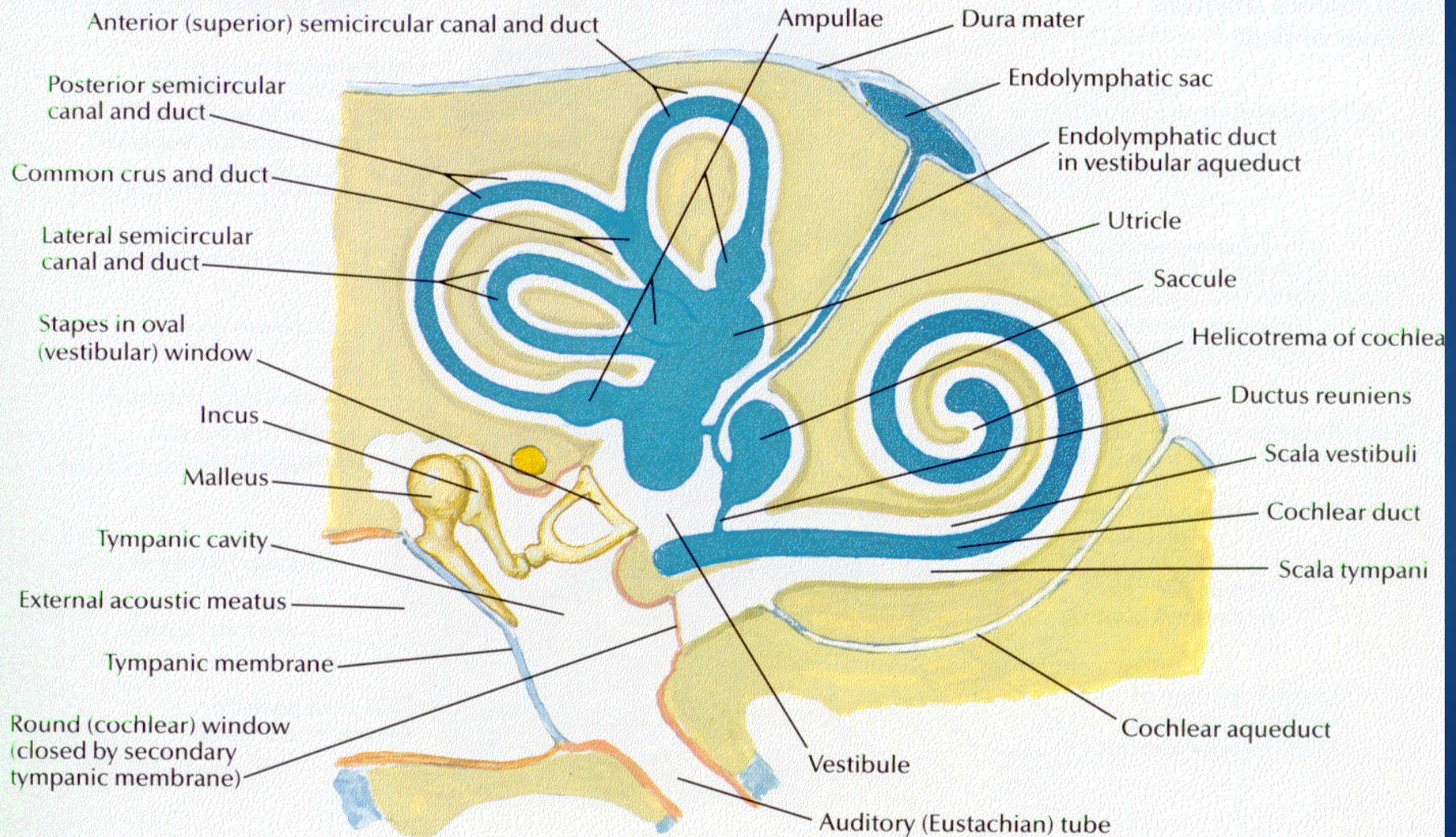
Proximal Carotid  
Canal

Stylomastoid  
Foramen



# Cross section of Petrous Portion of the Temporal Bone

## Osseous and membranous labyrinths: schema



Parietosquamous  
Articulation

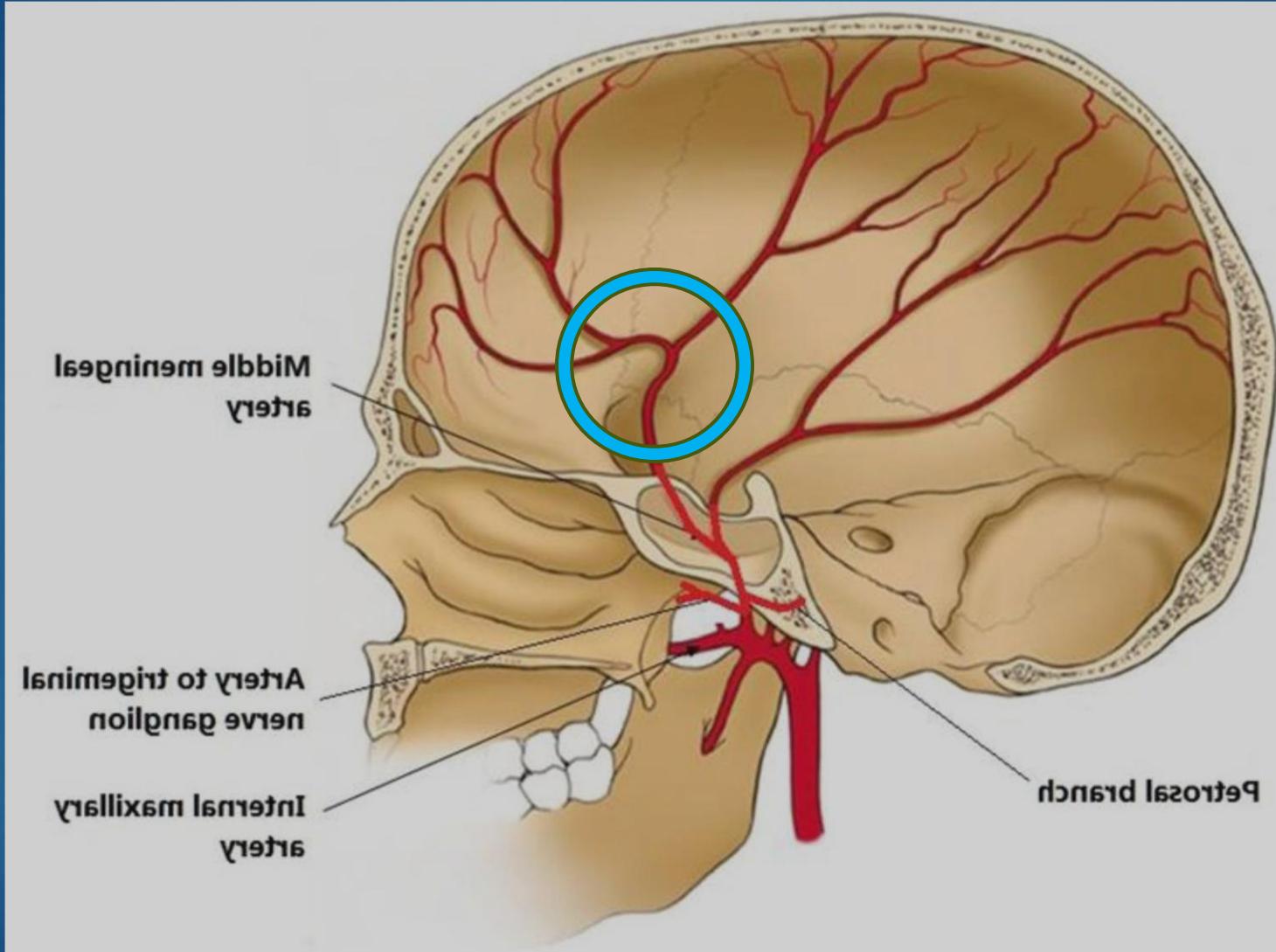
Parietomastoid  
Articulation

Petrosus Portion

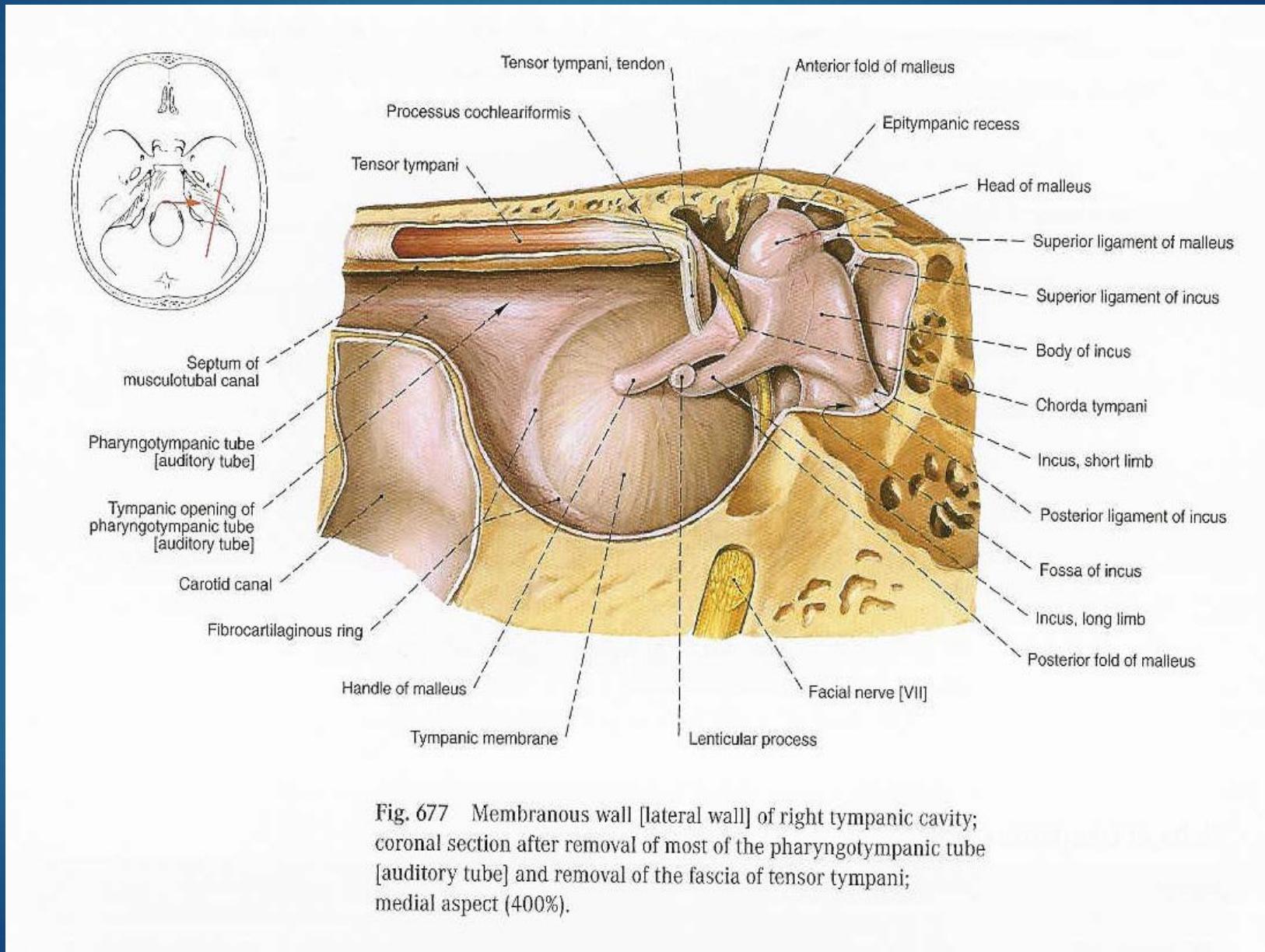
Vestibular  
Aqueduct

Sigmoid Sinus  
Impression

# Middle Meningeal Artery



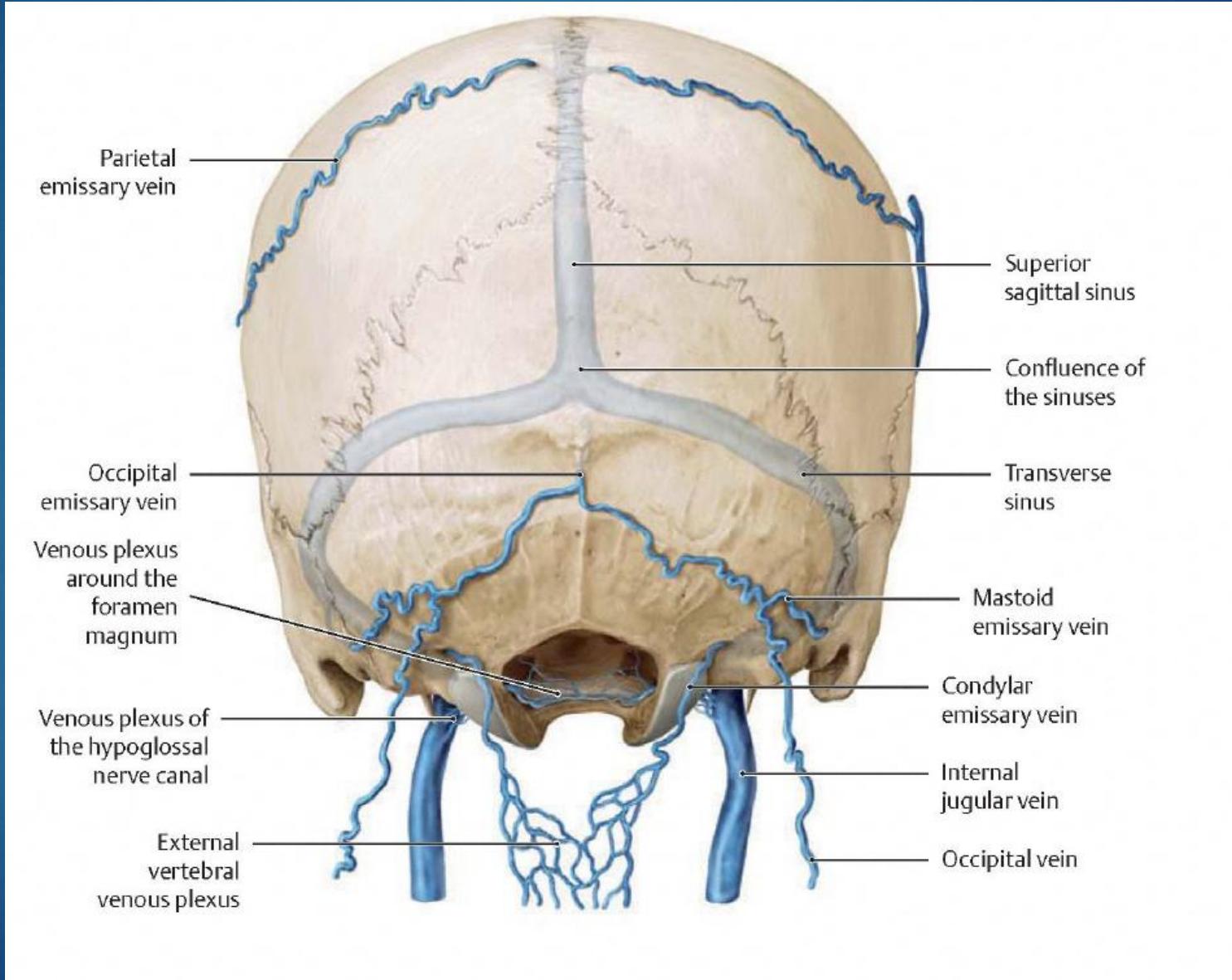
# Tensor Tympani Articular Relationship



# Temporal Bone Vascular Associations

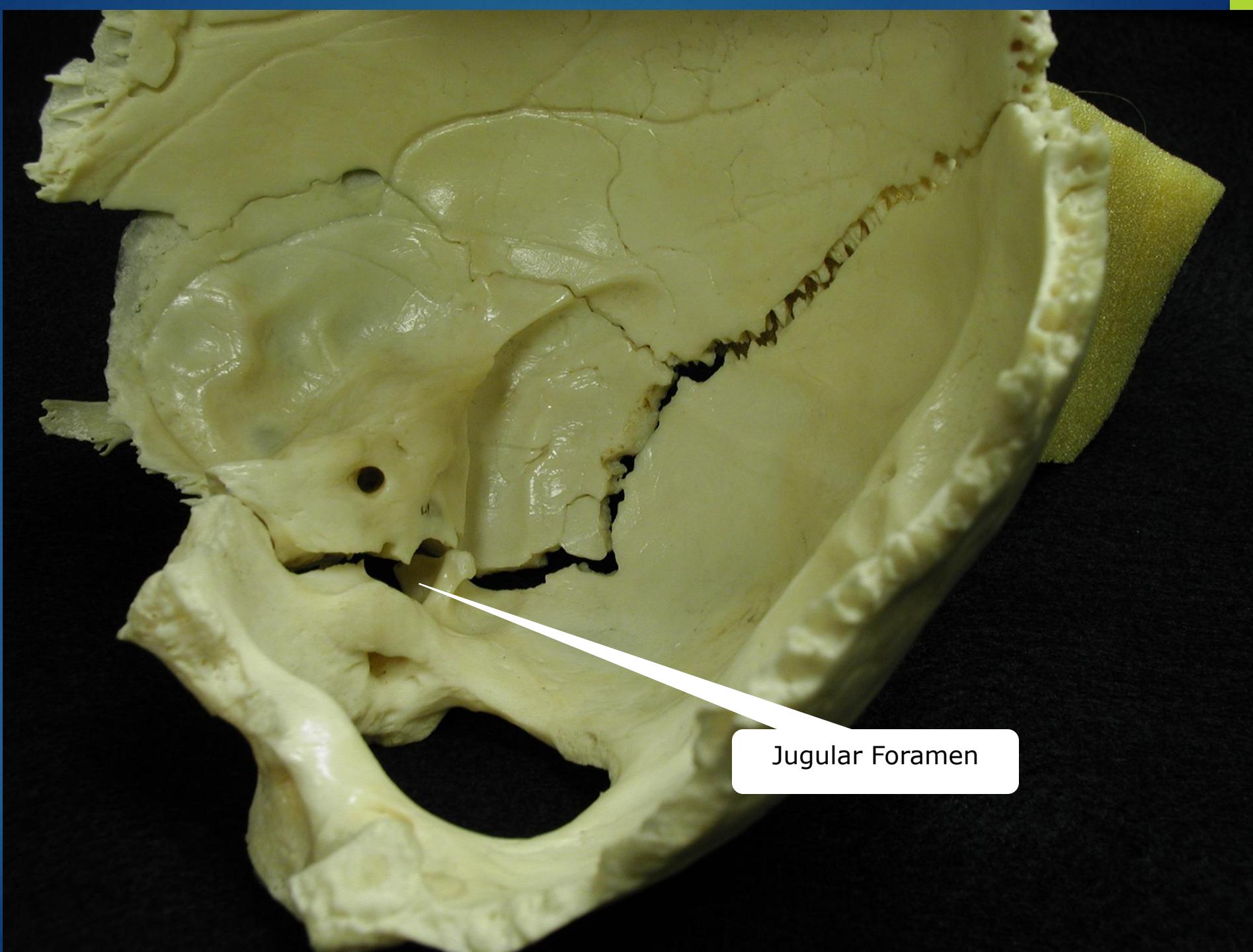
- ▶ Sigmoid Sinus
- ▶ Superior Petrosal Sinus
- ▶ Inferior Petrosal Sinus
- ▶ Jugular Vein (Occipital-Mastoid Foramen)
- ▶ Internal Carotid Artery

# Temporal Bone Venous Drainage Associations



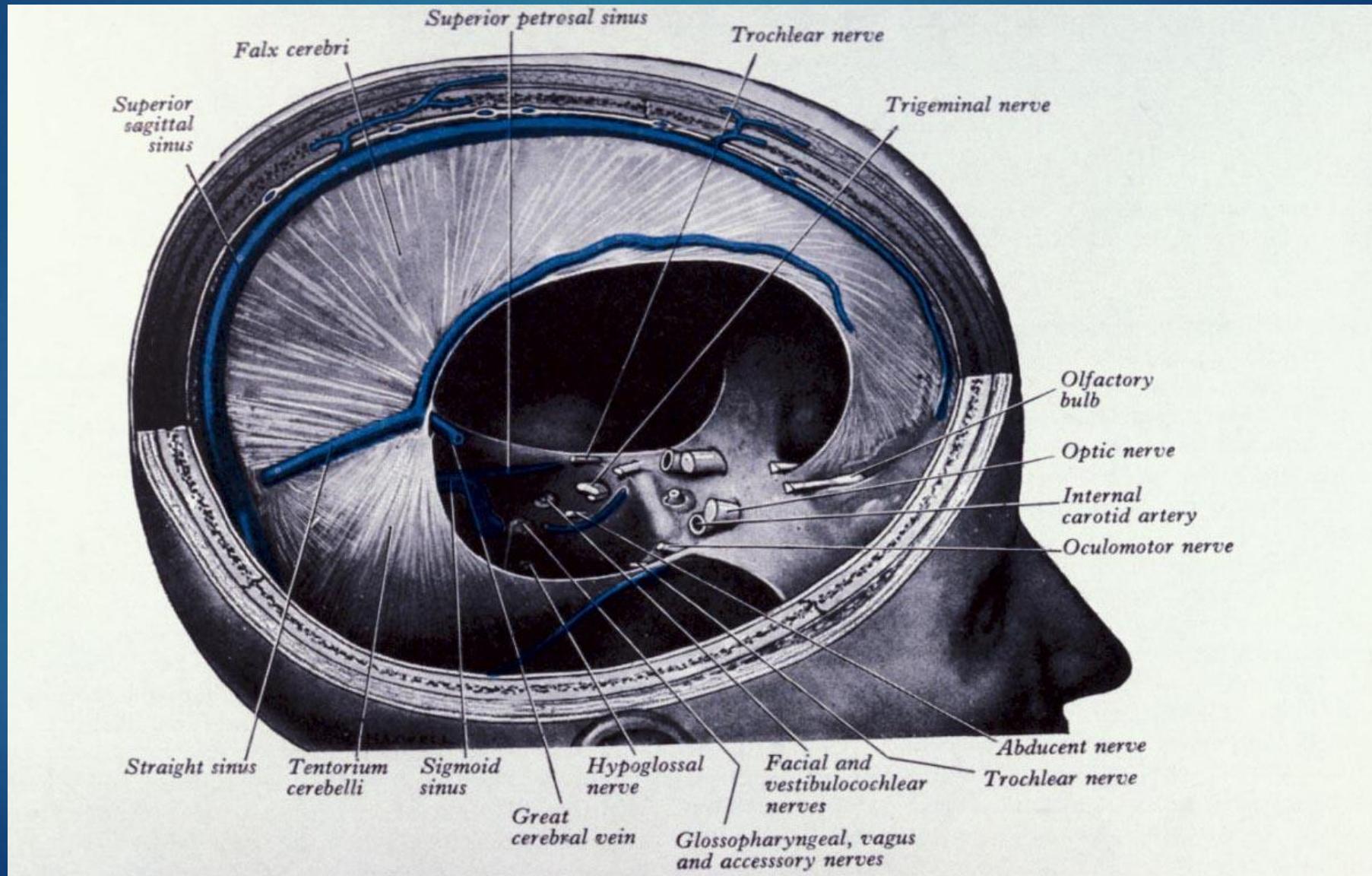


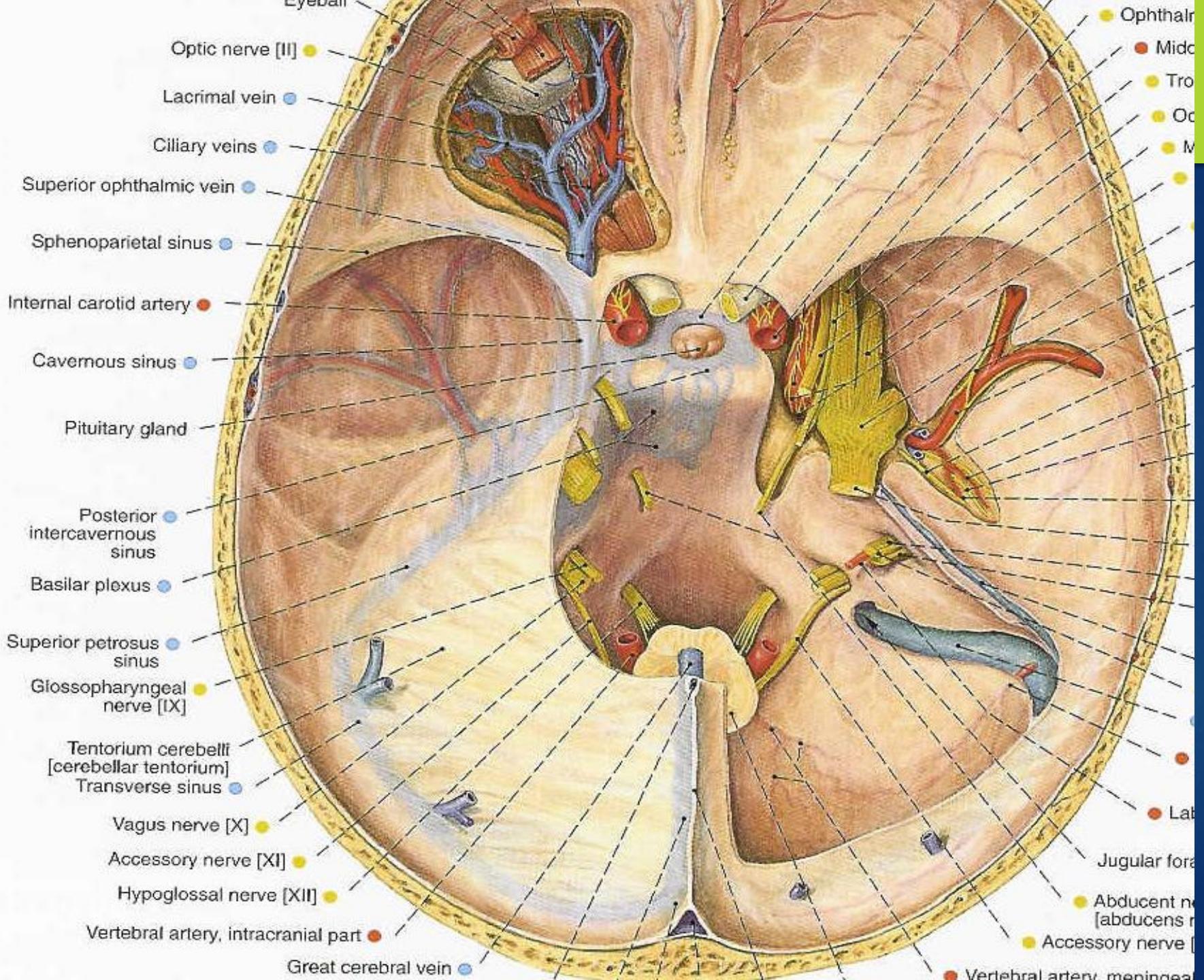


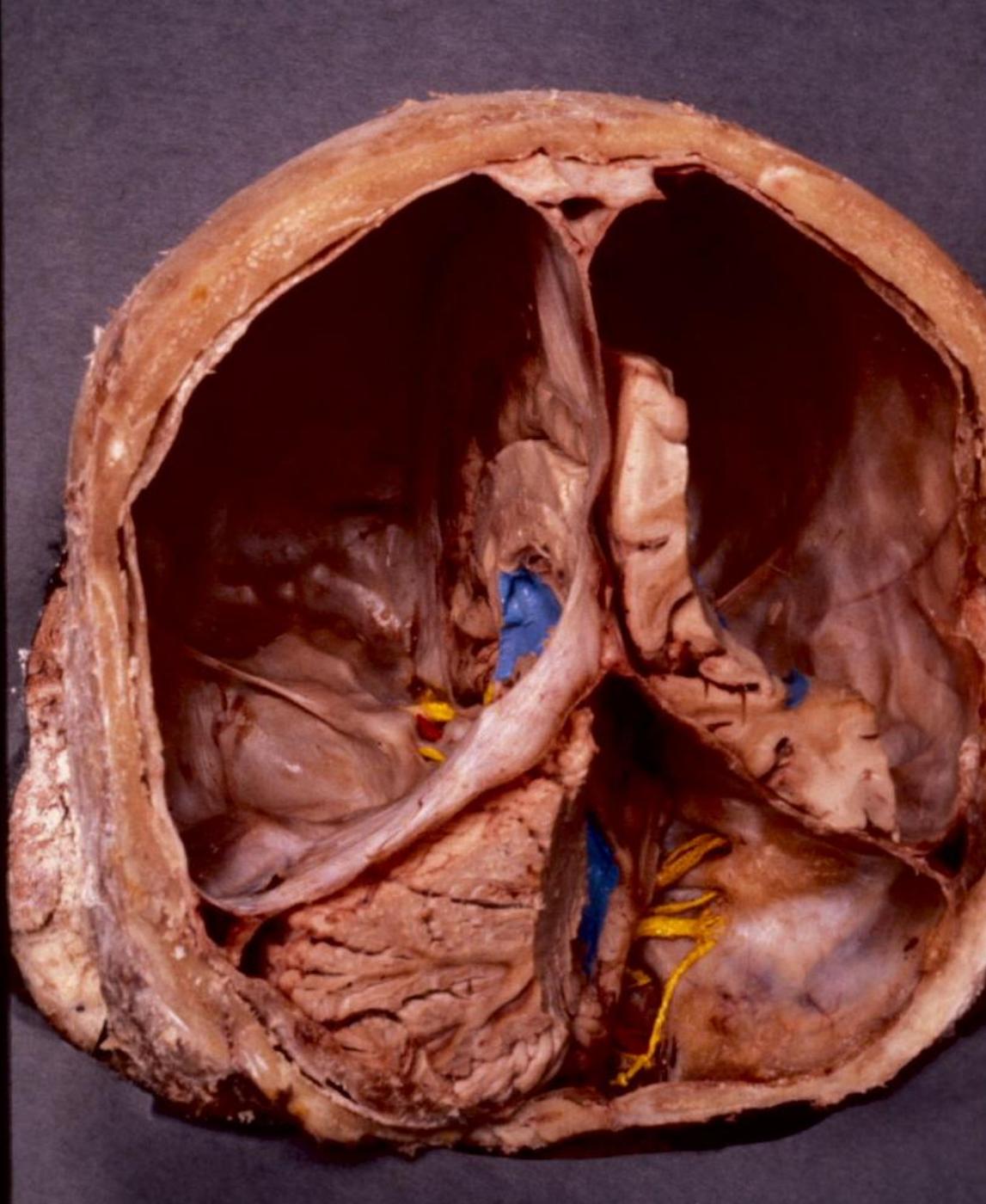


Jugular Foramen

# Temporal Bone Dural Associations







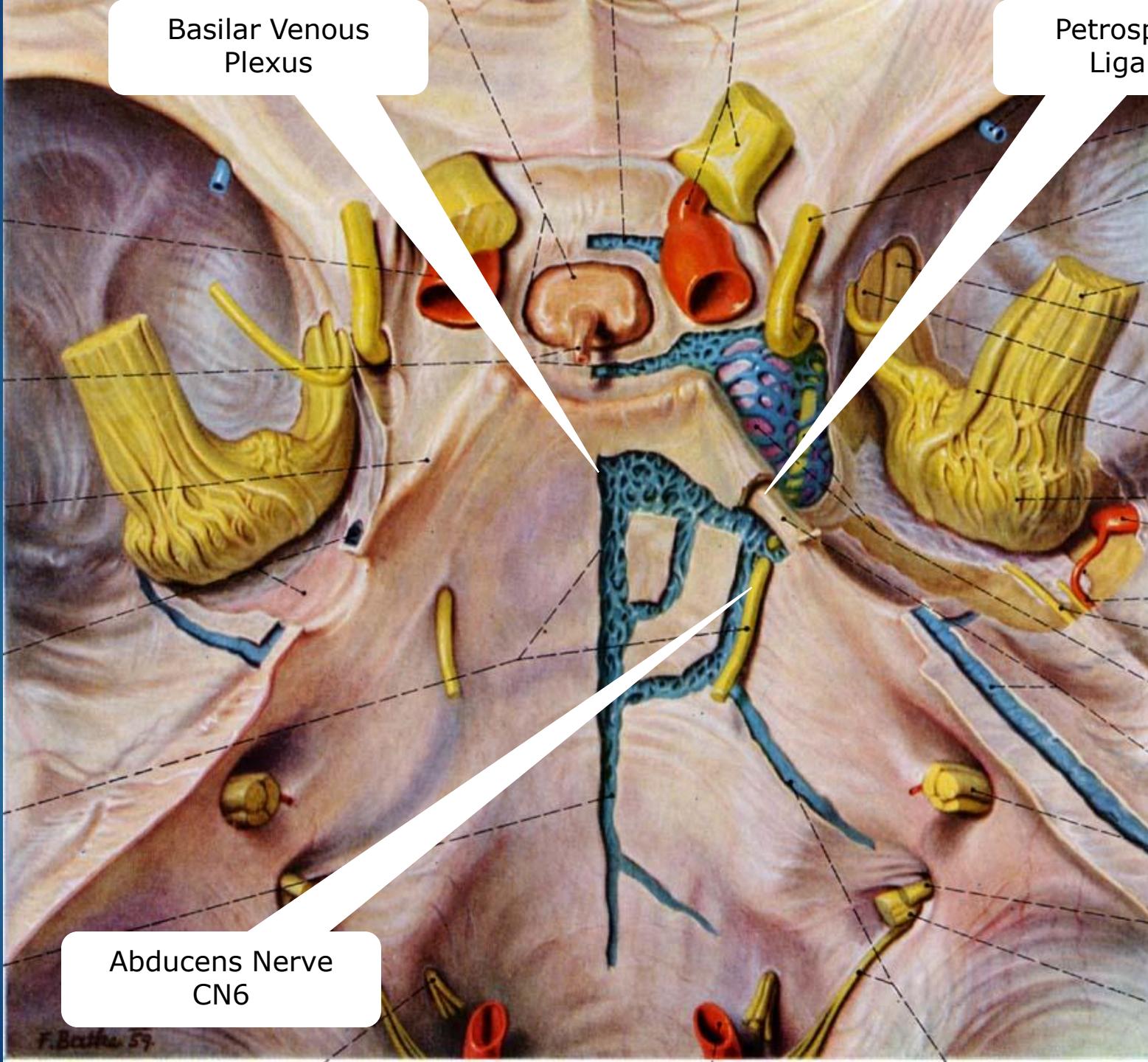
# Temporal Bone Neural Associations

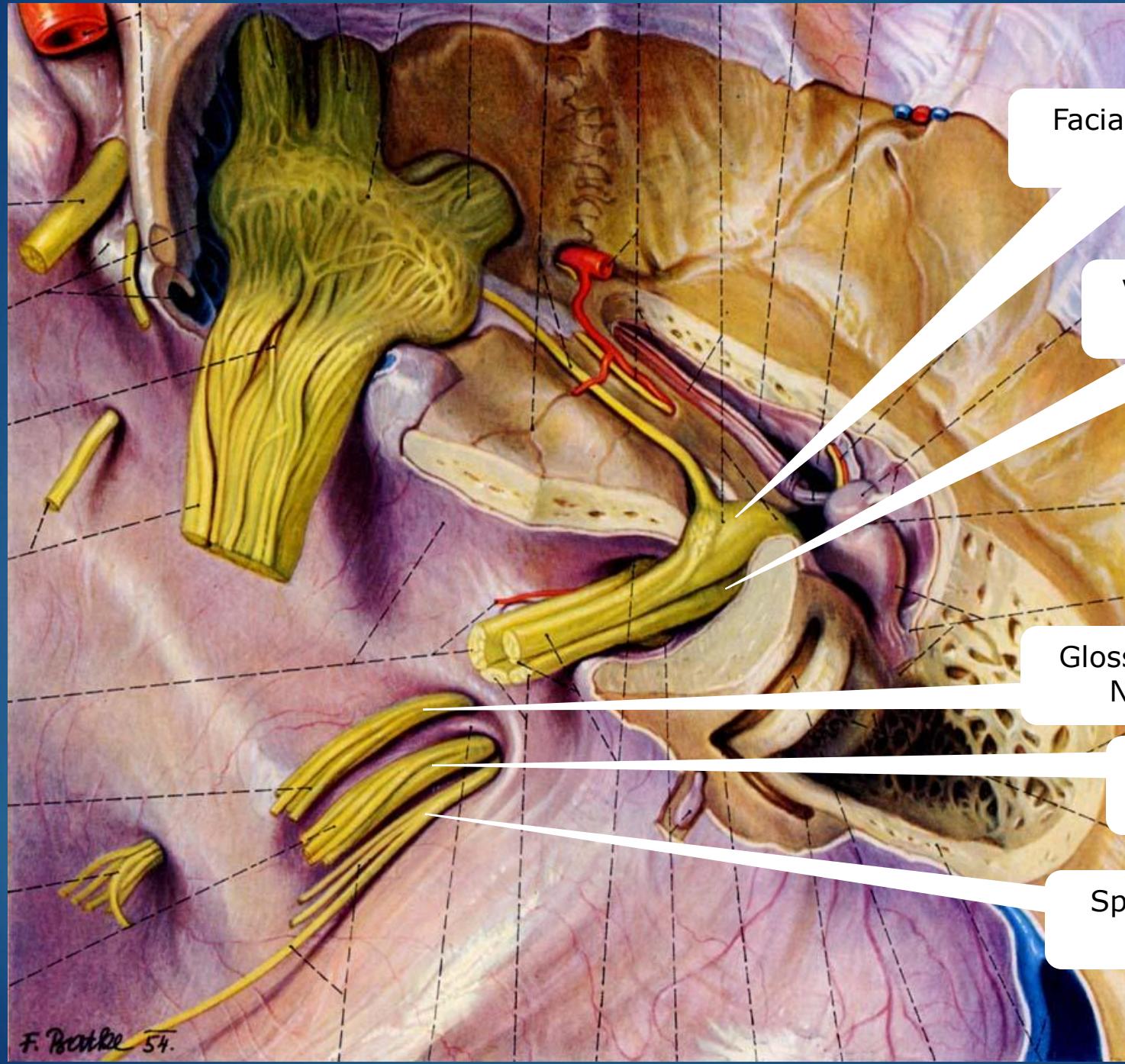
- ▶ V (Trigeminal-ganglion portion)
  - ▶ VI (Abducent)
  - ▶ VII (Facial)
  - ▶ VIII (Vestibulo-cochlear)
  - ▶ IX (Glossopharyngeal)
  - ▶ X (Vagus)
  - ▶ XI (Spinal Accessory)
  - ▶ Greater Petrosal
- 
- Occipital-  
Mastoid  
Foramen

Basilar Venous  
Plexus

Petrosphenoid  
Ligament

Abducens Nerve  
CN6





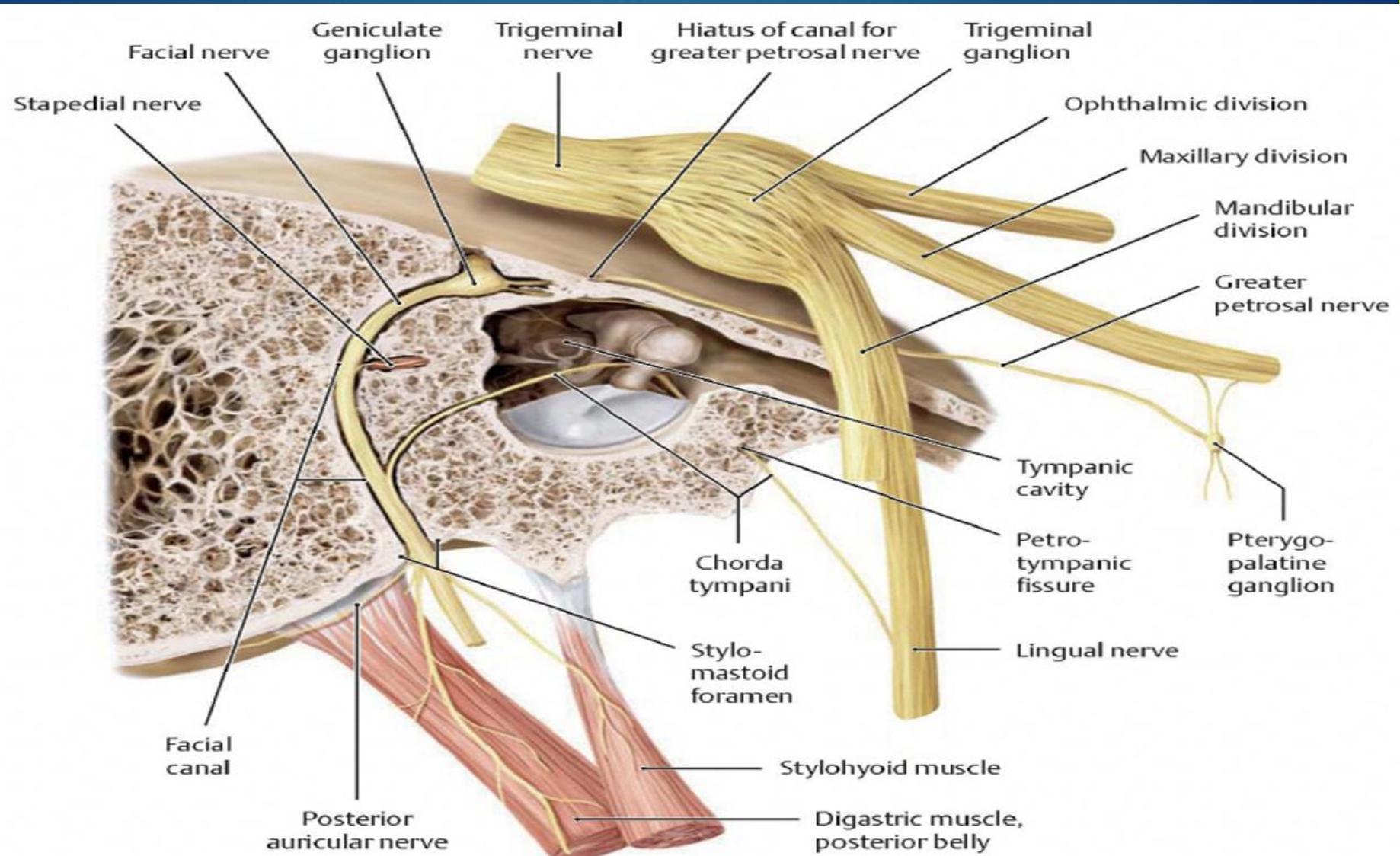
Facial Nerve CN7

Vestibulocochlear  
Nerve CN8

Glossopharyngeal  
Nerve CN9

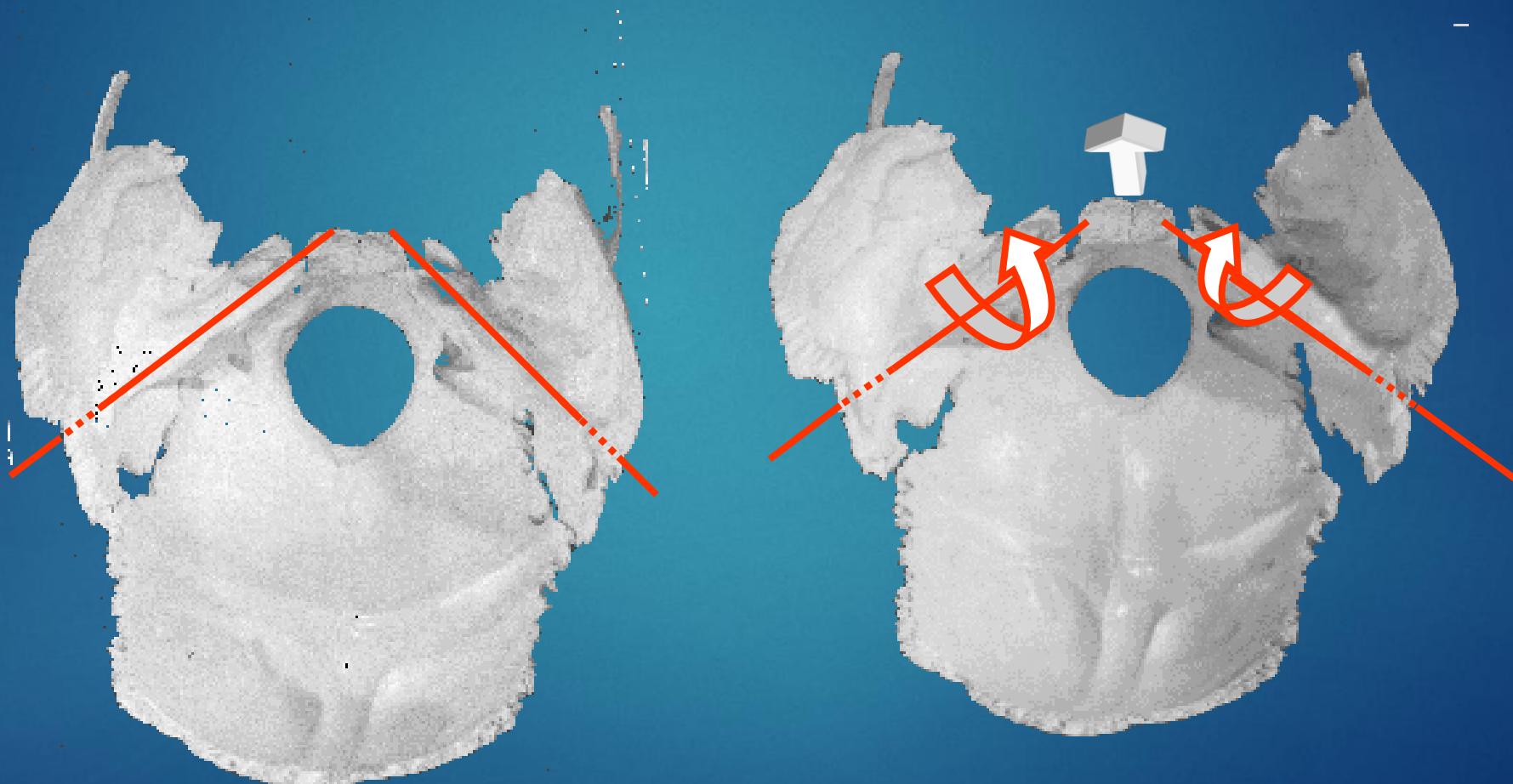
Vagus Nerve CN10

Spinal Accessory  
Nerve CN11



# Temporal Bone PRM Motion

Paired Bone Motion



# Clinical Indications for Temporal Bone Evaluation and/or Treatment

- ▶ Otitis (especially otitis media)
- ▶ Eustachian Tube Dysfunction
- ▶ Vertigo
- ▶ Tinnitus
- ▶ Hyper/Hypoacusis
- ▶ GI Autonomic Dysfunction
- ▶ CN7 palsy (Bell's Palsy)
- ▶ Migraine cephalgia
- ▶ Extraocular muscle dysfunction
- ▶ Secondary Respiratory Compromise
- ▶ TMJ Dysfunction

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