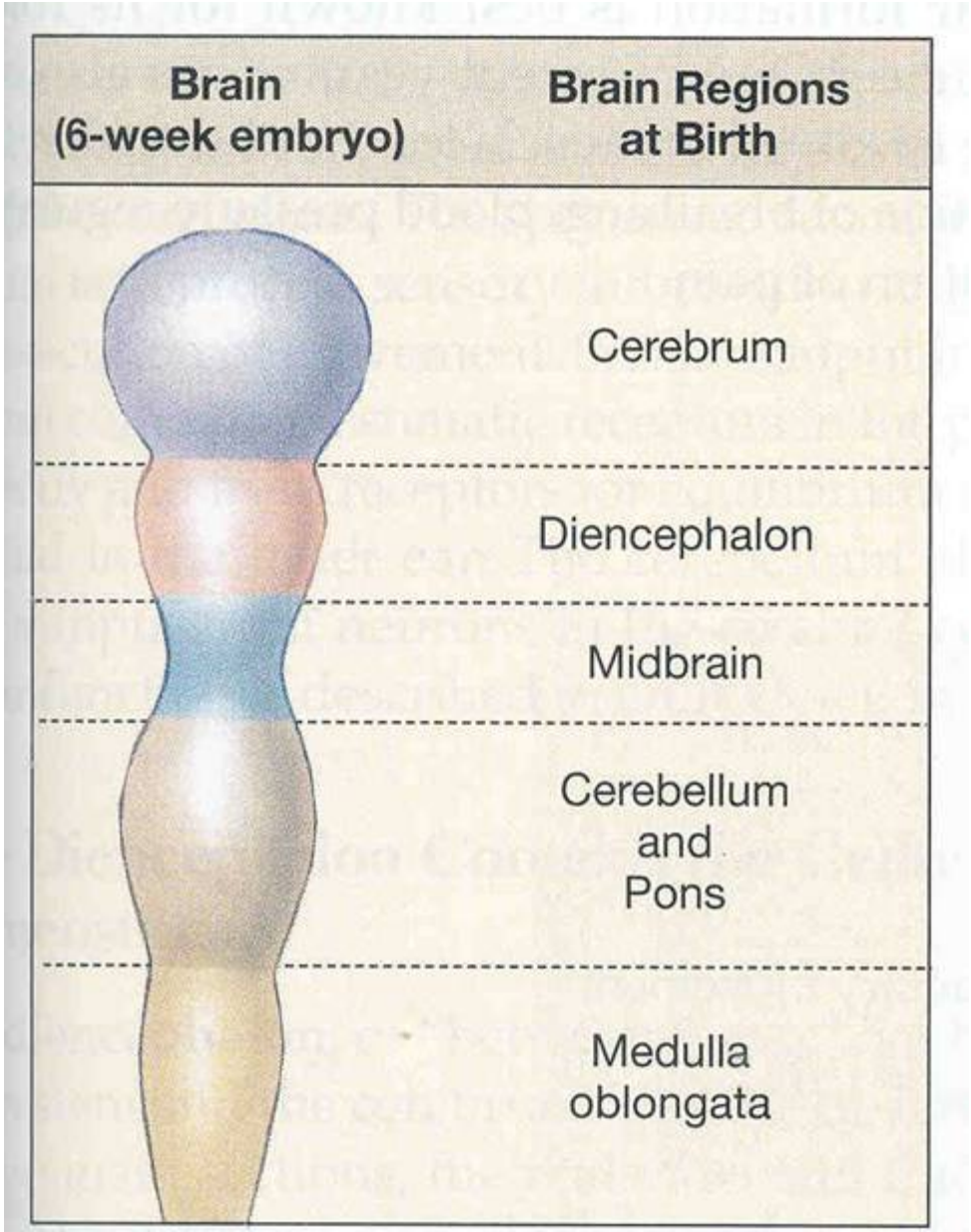
Biology 323
Human Anatomy for Biology Majors
Week 10; Lecture 1; Tuesday
Dr. Stuart S. Sumida

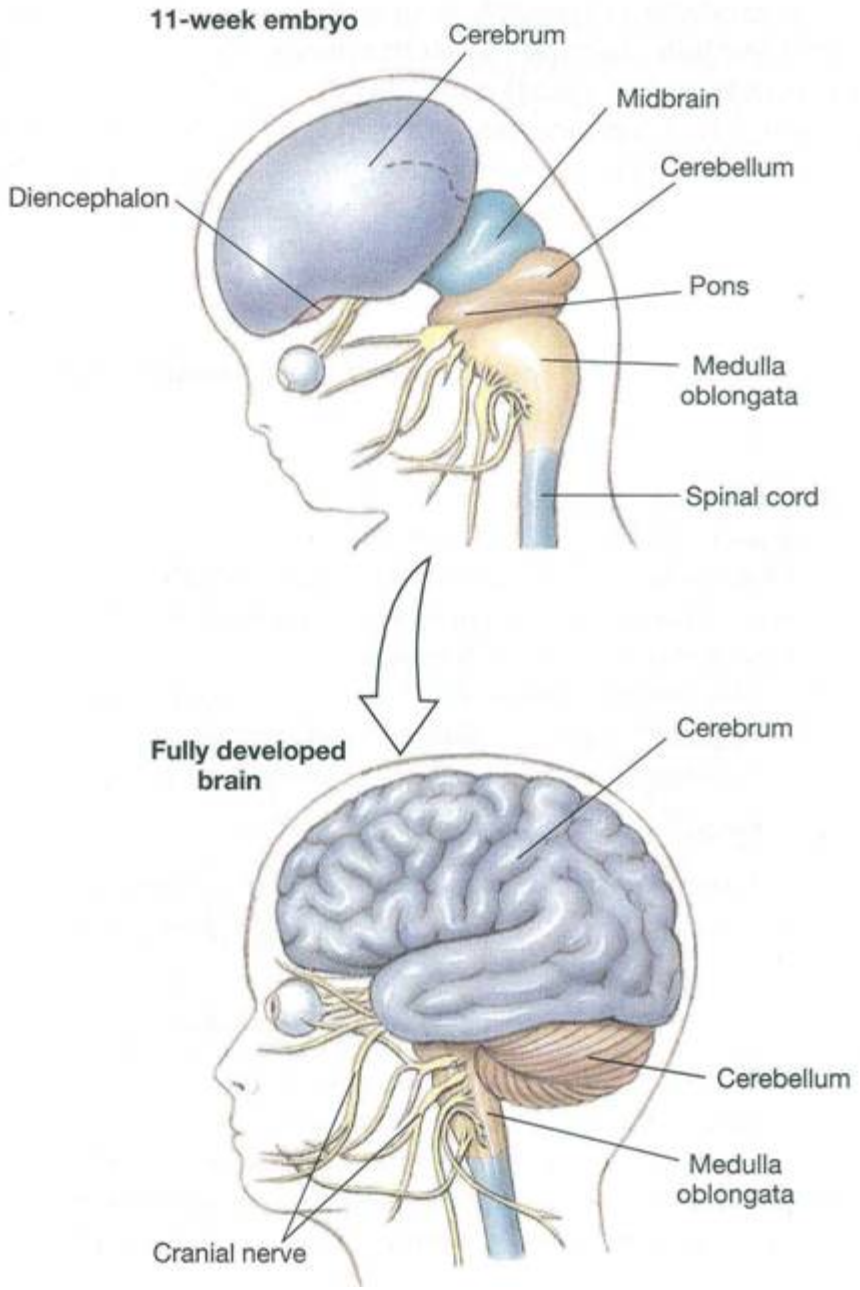
Cranial Nerves and Soft Tissues of the Skull



FOREBRAIN

MIDBRAIN

HINDBRAIN


11-week embryo
Cerebrum
Midbrain
Cerebellum
Diencephalon
Pons
Medulla oblongata
Spinal cord
Fully developed brain
Cerebrum
Cerebellum
Medulla oblongata
Cranial nerve

Forebrain:

Cerebrum – Perception, movement of somatopleure, sensoro-motor integration, emotion, memory, learning.
Diencephalon – Homeostasis, behavioral drives in hypothalamus; sensory relay and modification in thalamus; melatonin secretion in pineal gland.

Midbrain (Mesencephalon)

Control of eye movement.

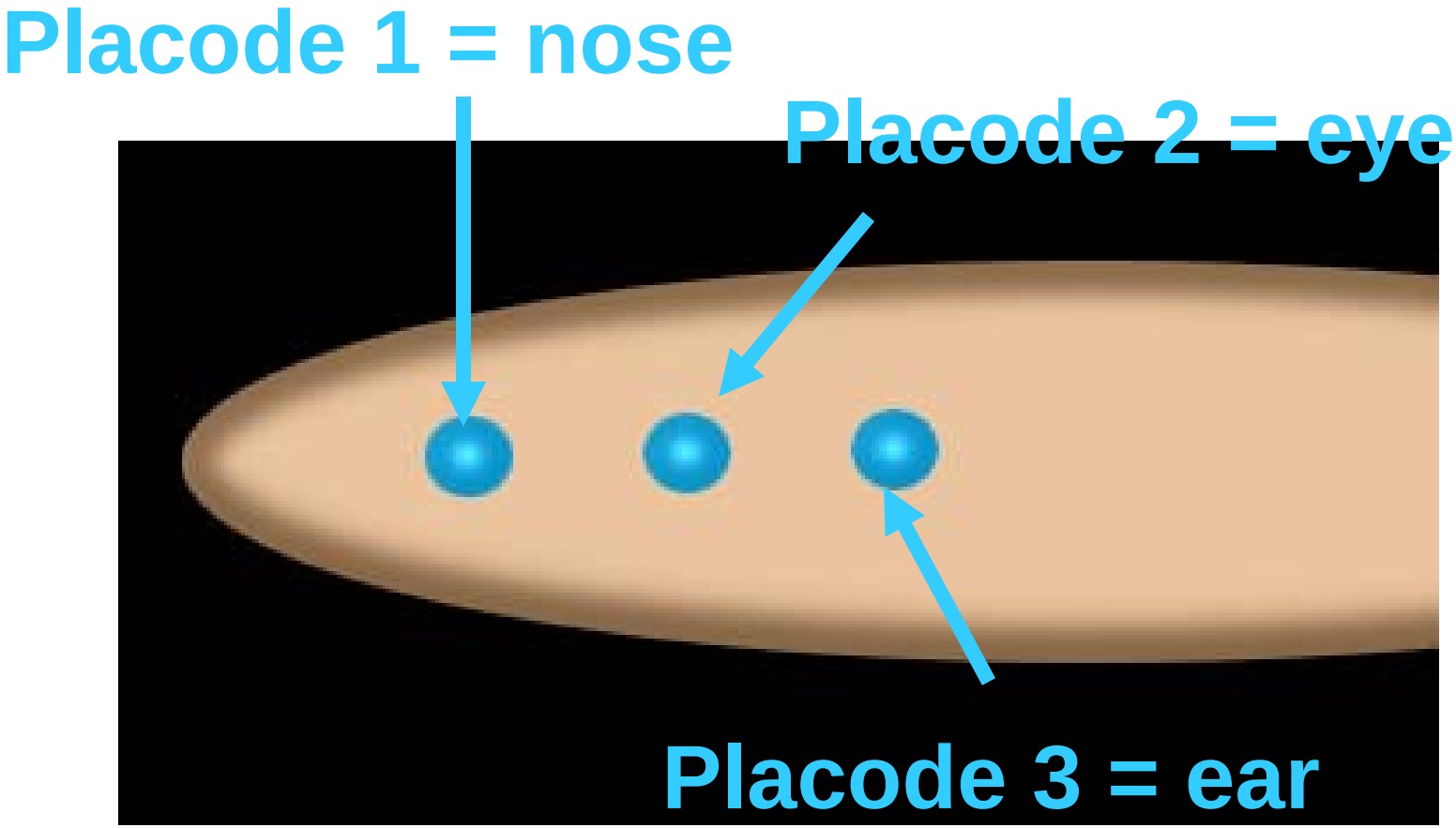
Hindbrain

Cerebellum and Pons – control of movement, proprioreceptive input; relays visual and auditory reflexes in pons.
Medulla Oblongata – Involuntry functions: blood pressure, sleep, breathing, vomiting.

Development

- Special Sense organs = nose, eyes and ears, begin as small outcrops of ectoderm called placodes

Development

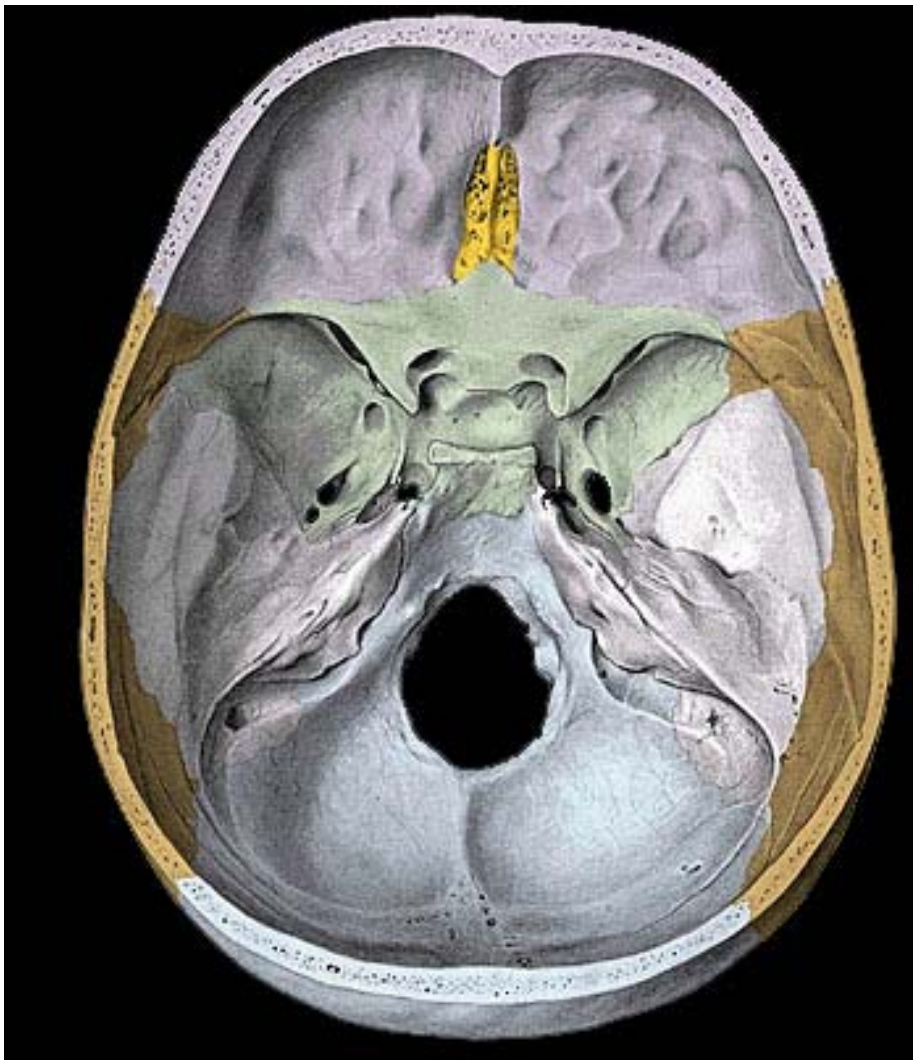


Development

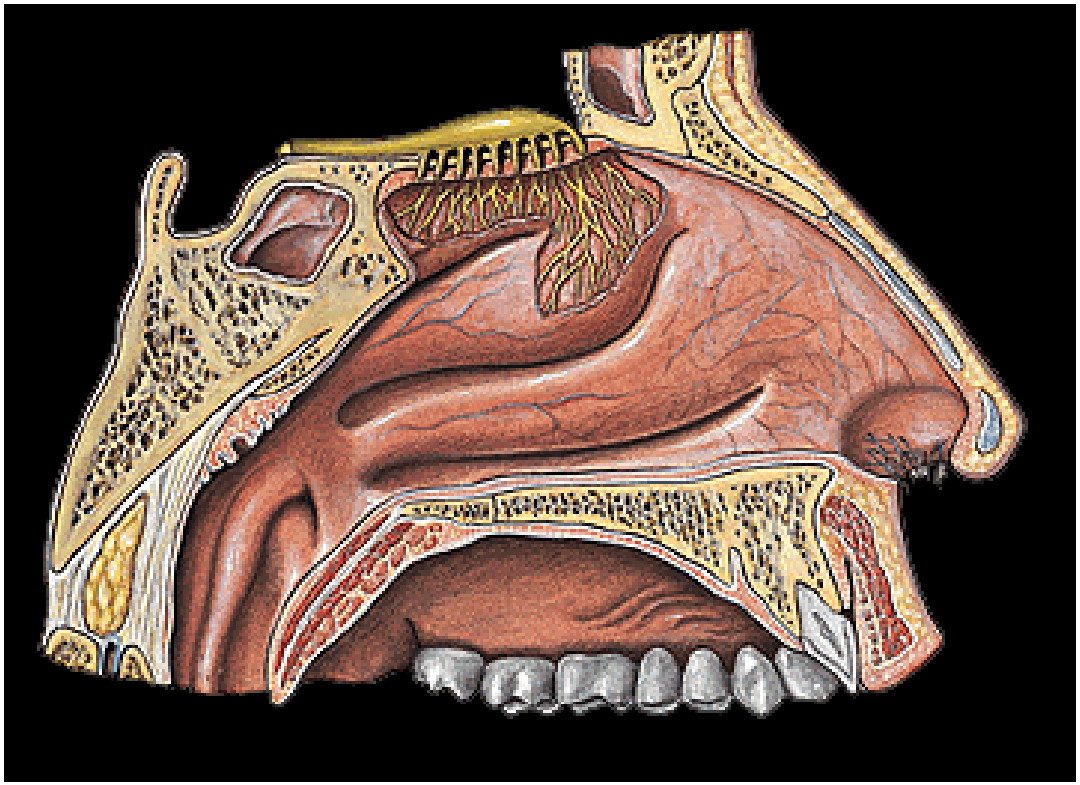
- In the nose, the ectoderm become nerve cells that send their fibres through the cribriform plate of the ethmoid, back to the brain

- This is Cranial Nerve I = the Olfactory Nerve

Development



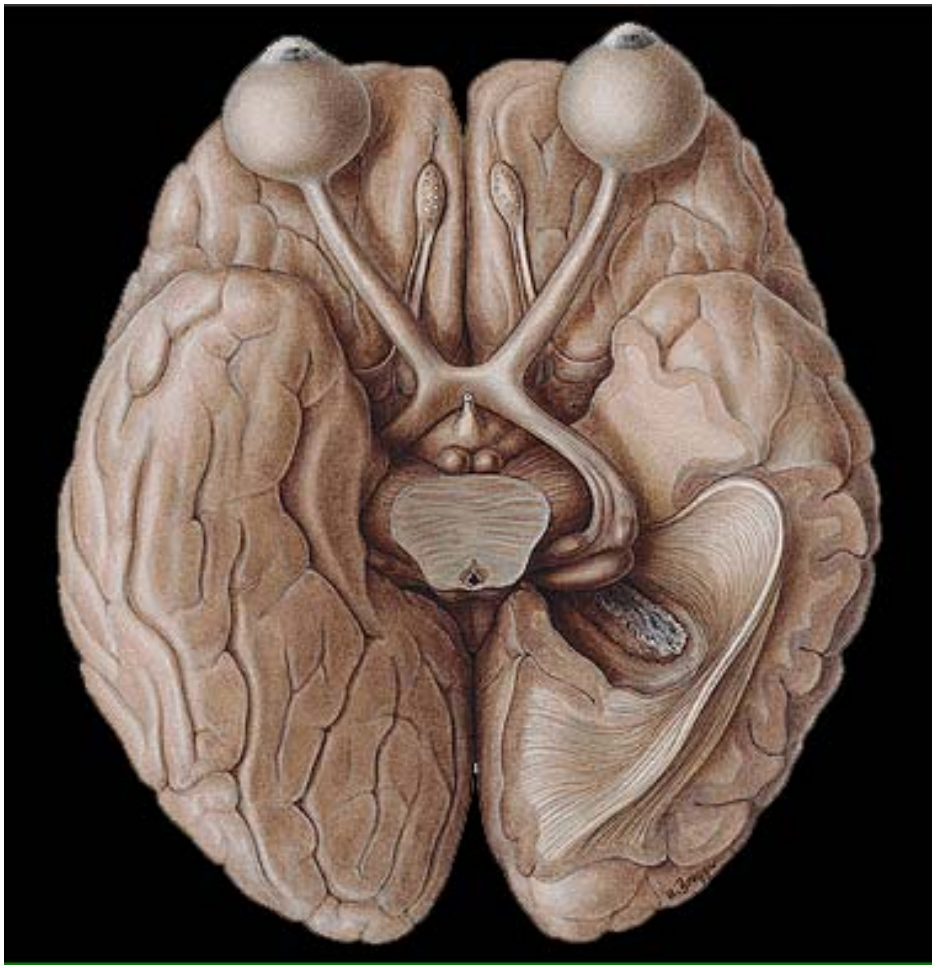
Development



Development

- The second placode becomes the lens of the eye.
- It sinks below the surface of the skin, and an outgrowth of the brain wraps around it.
- The outgrowth is the retina, and the stalk connecting it is Cranial Nerve II = The Optic Nerve

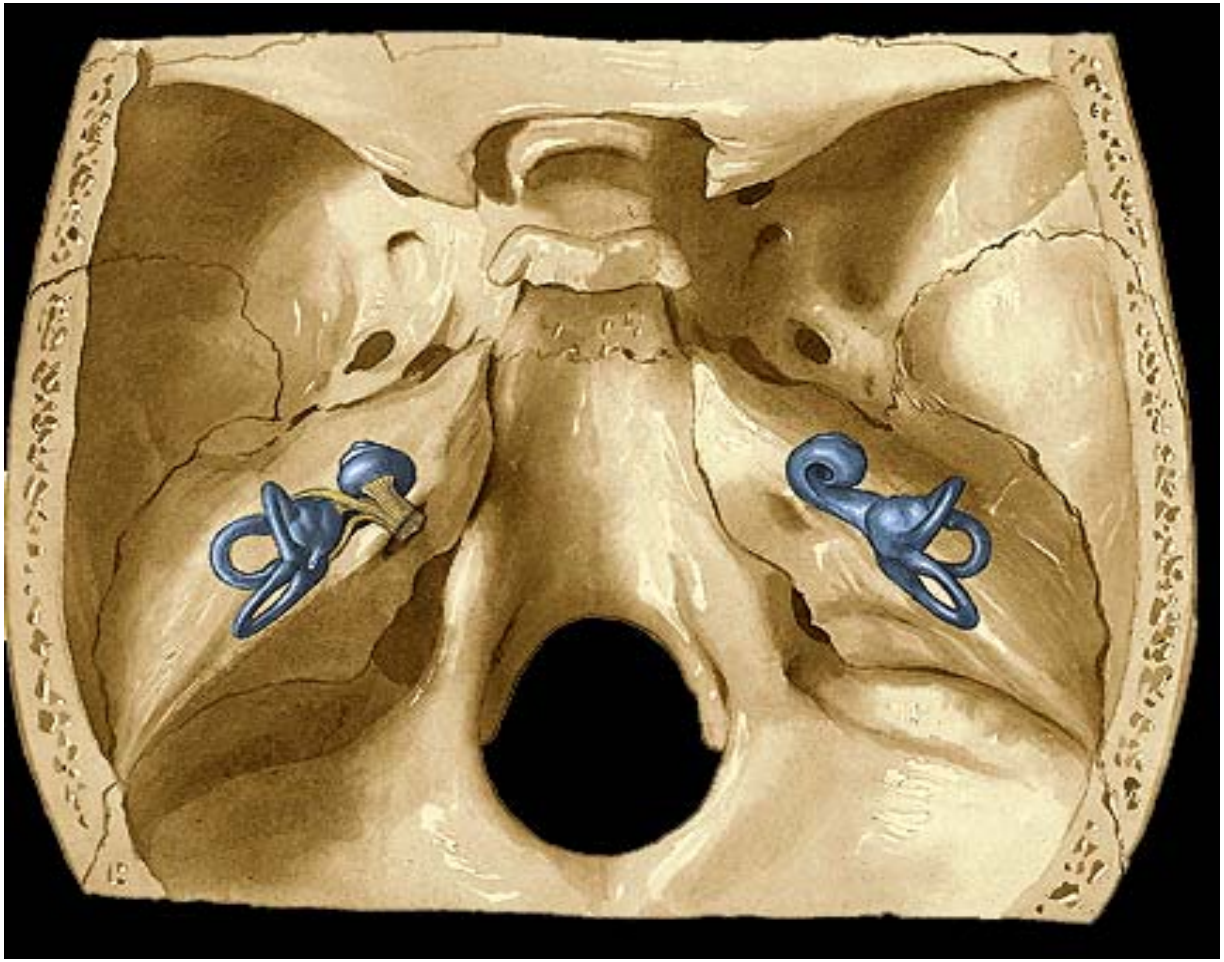
Development



Development

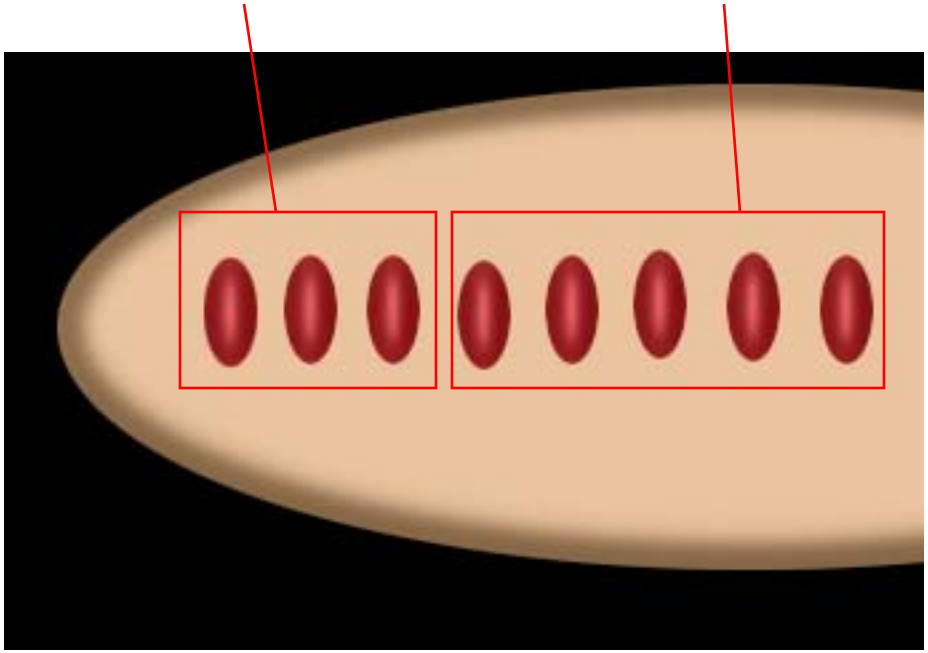
- **The Inner ear starts out as a lens, but turns into a fluid filled sac**
- **Receptor organs of hearing and balance.**
- **Cranial Nerve VIII = Auditory or Vestibulocochlear Nerve**

Development



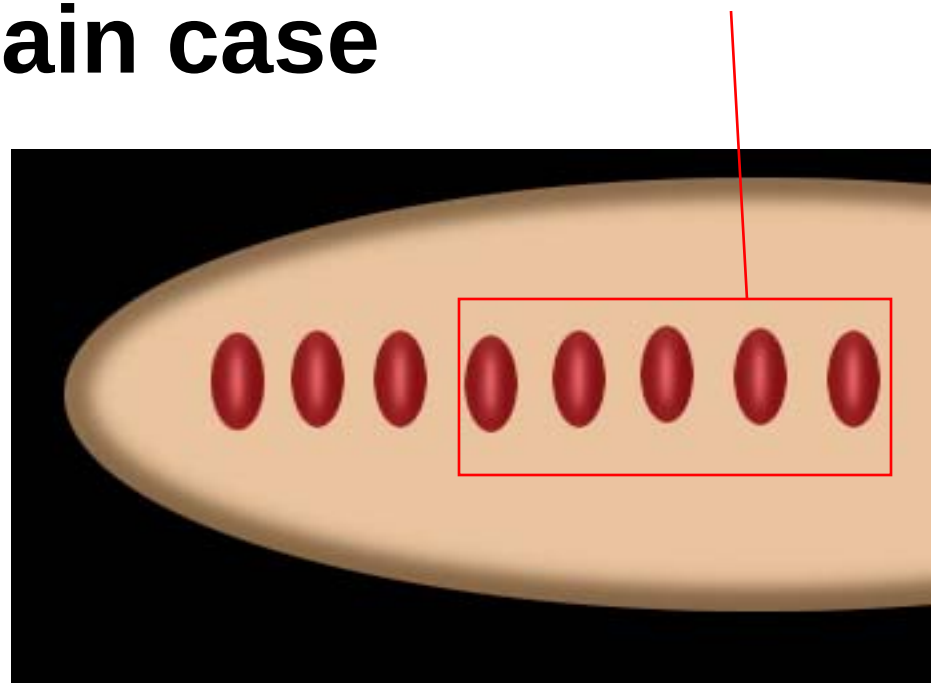
Development

- **Head somites can be divided into 2 sets. Pre-otic and post-otic**



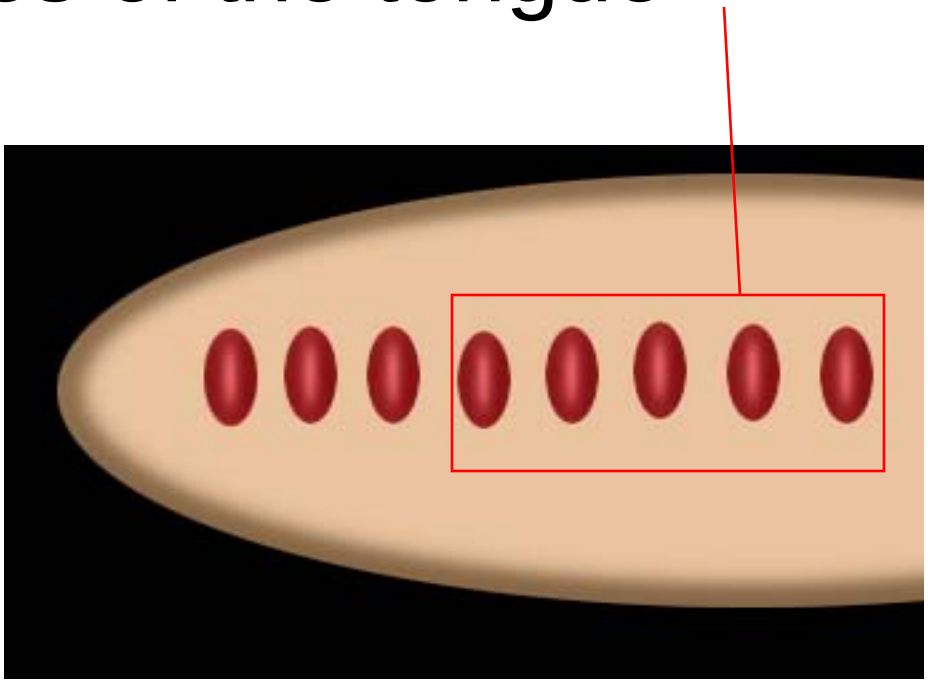
Development

- **The sklerotomes of the post otic somites help form the floor of the brain case**



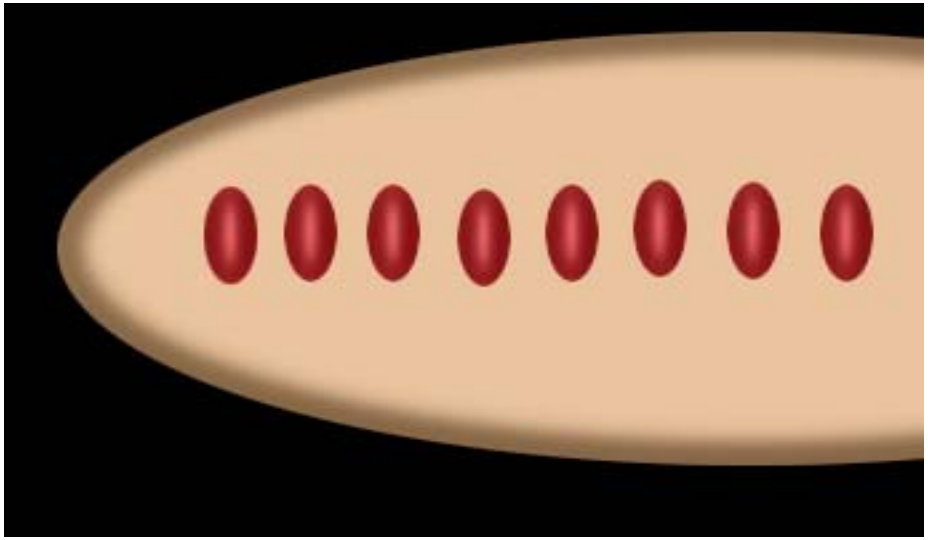
Development

….and their myotomes develop into muscles of the tongue



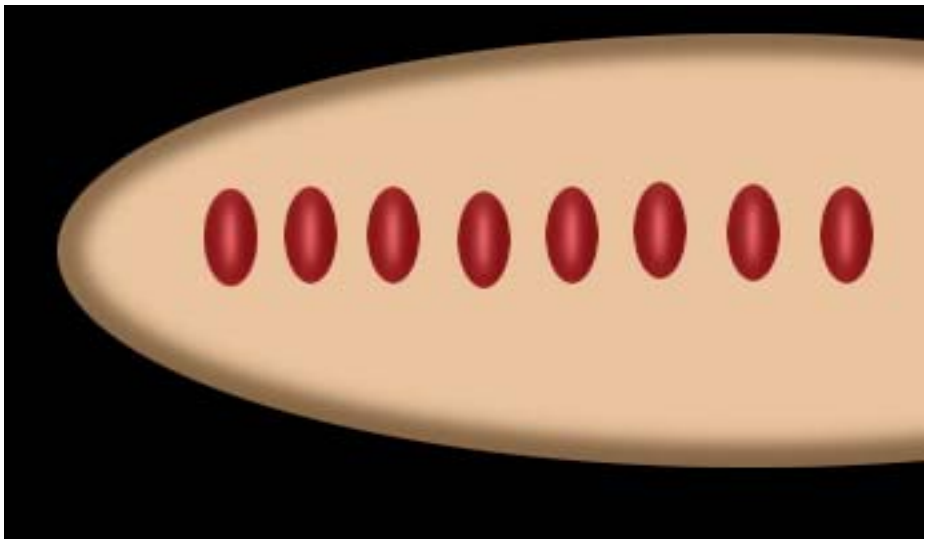
Development

The myotomes of the pre-otic somites form the muscles that move the eyeballs.



Development

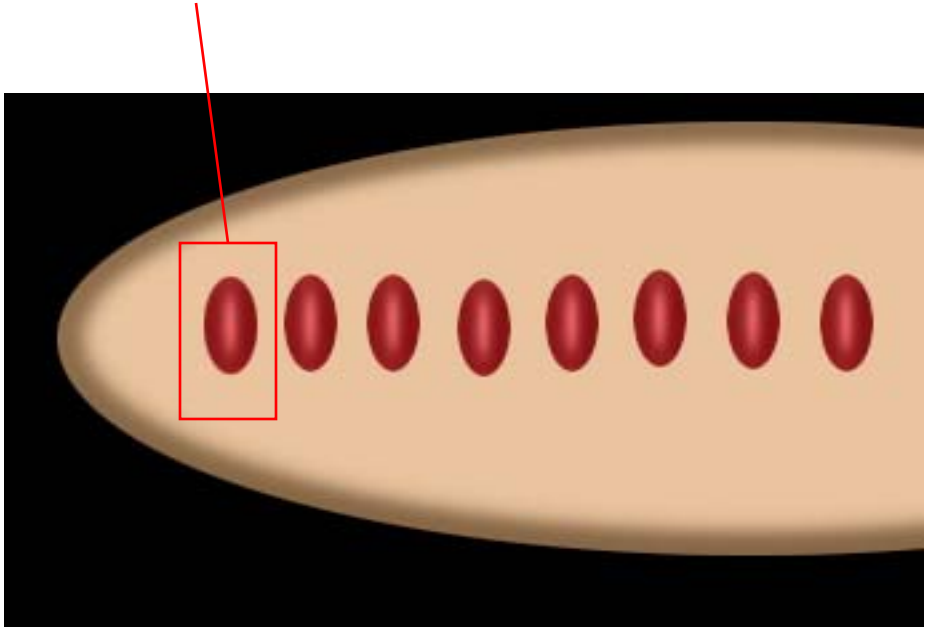
Each is supplied by a different cranial nerve:



Development

Cranial Nerve III =

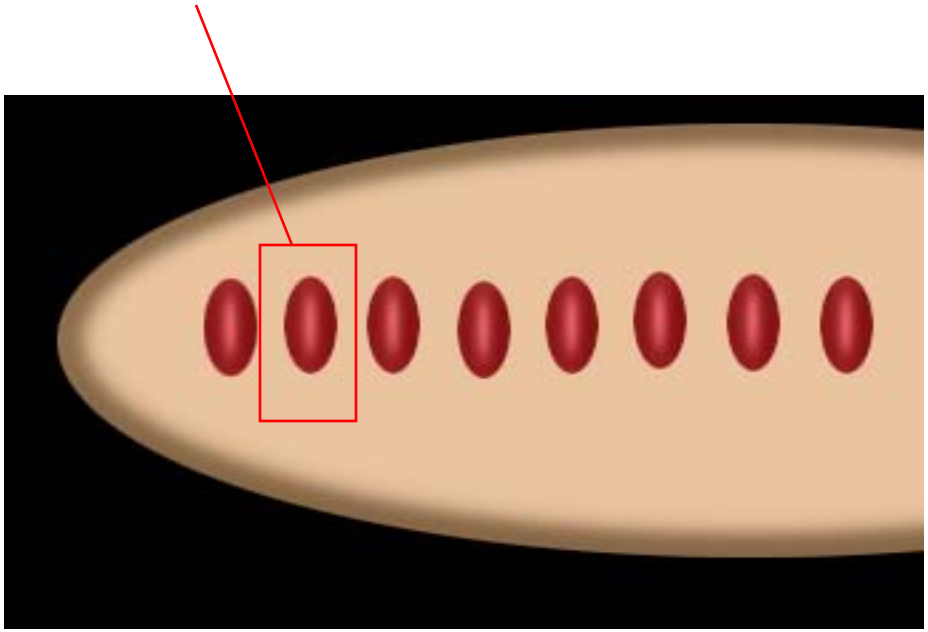
Occulomotor Nerve



Development

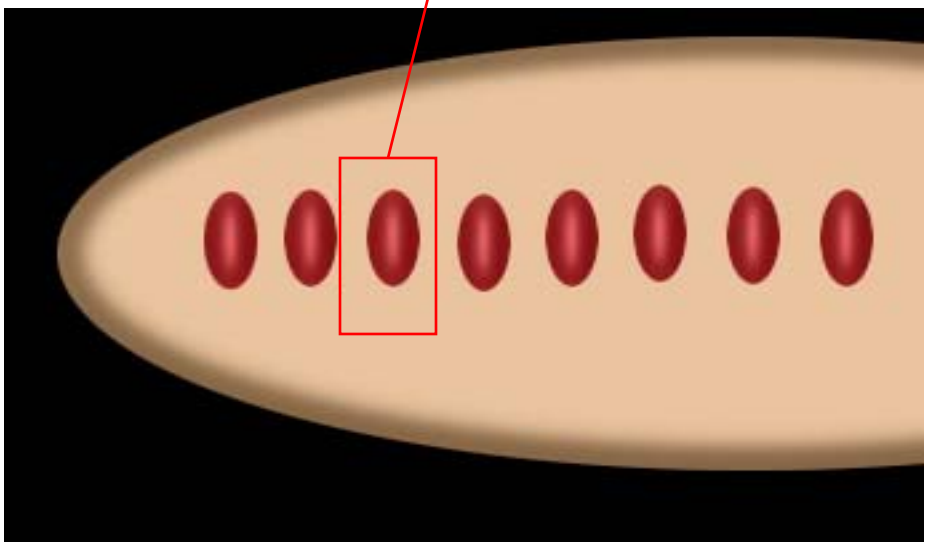
Cranial Nerve IV =

Trochlear Nerve



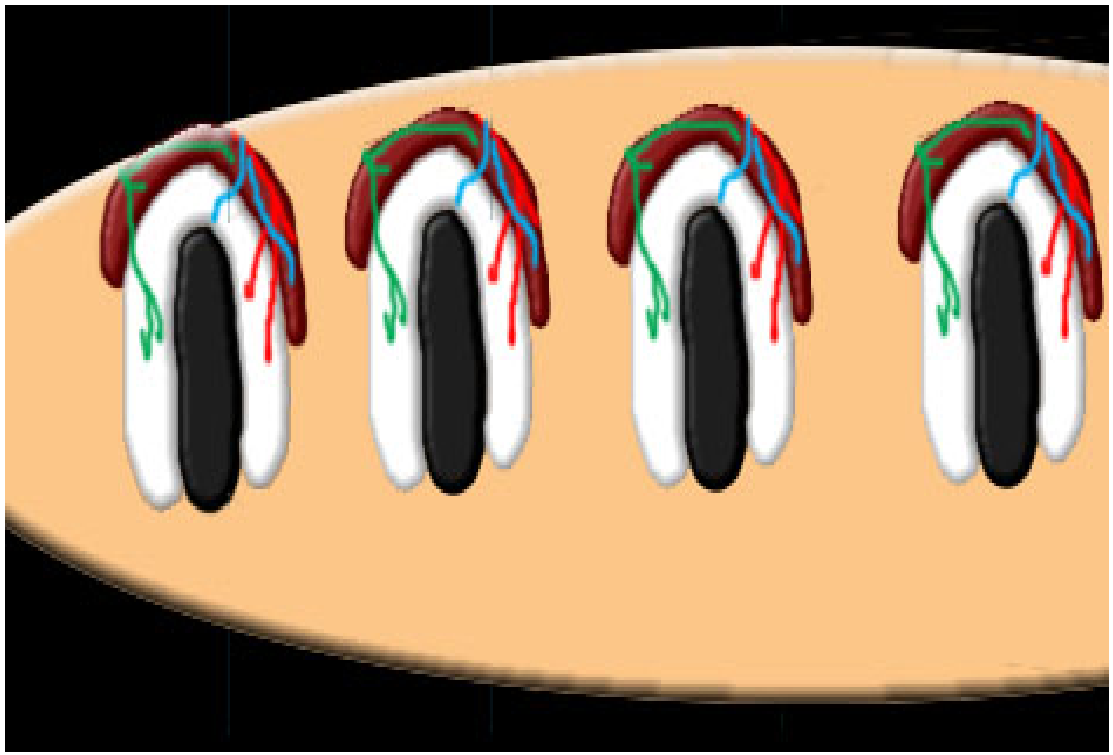
Development

Cranial Nerve VI = Abducens Nerve



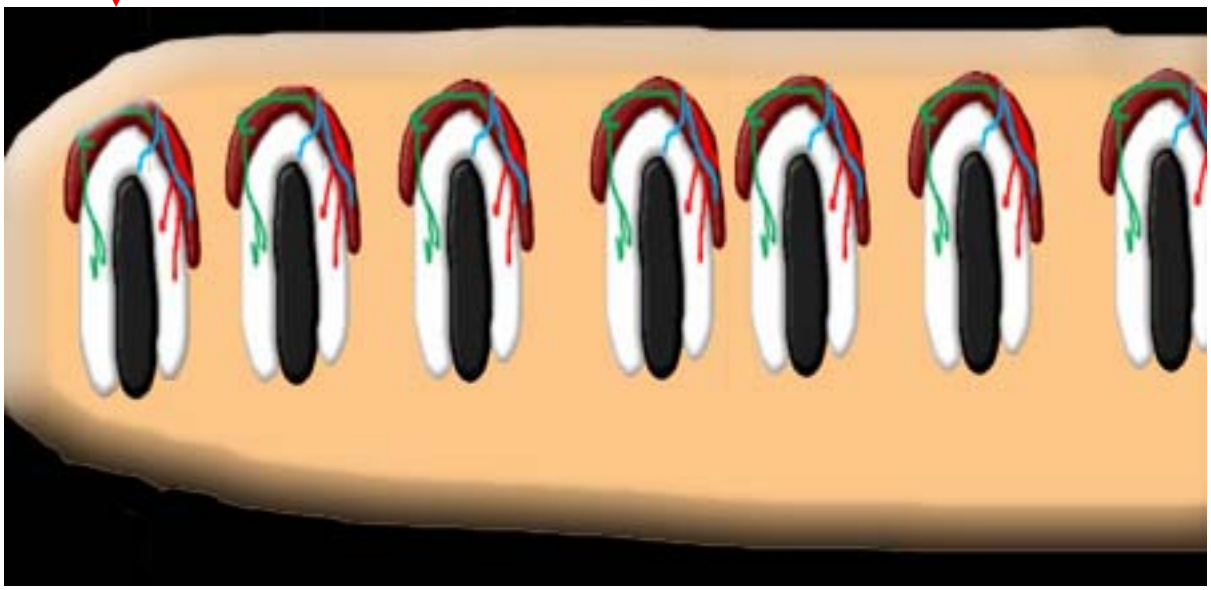
Development

Gill Arch Derivatives



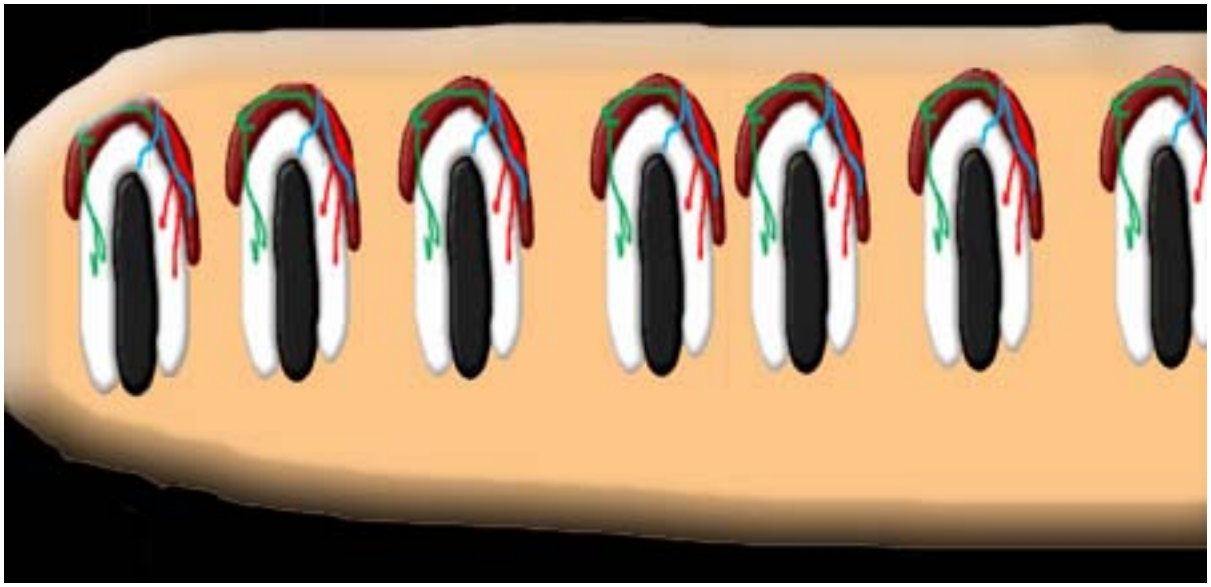
Development

Mandibular arch



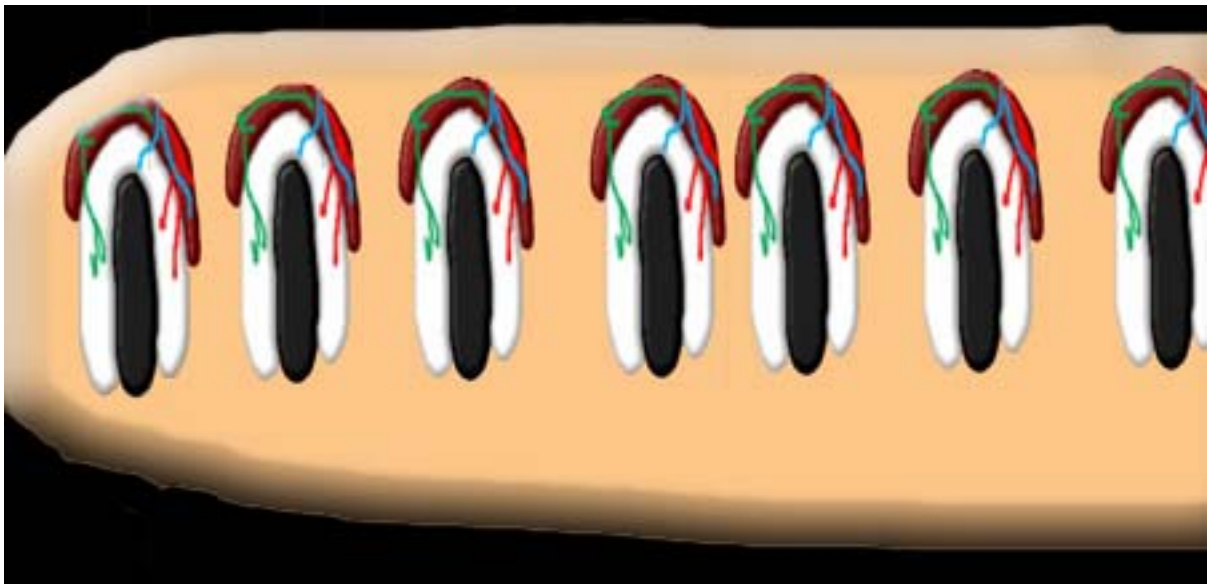
Cranial Nerve V: The Trigeminal Nerve (3 branches)

- V1 Opthalmic ,
- V2 Maxillary,
- V3 Mandibular



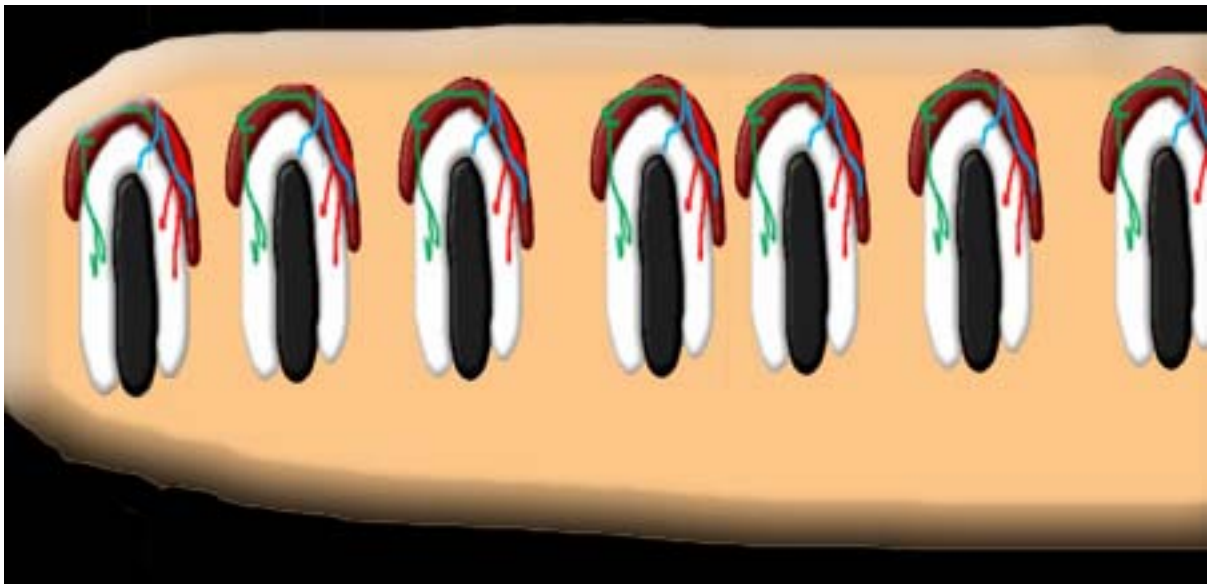
Development

Hyoid arch



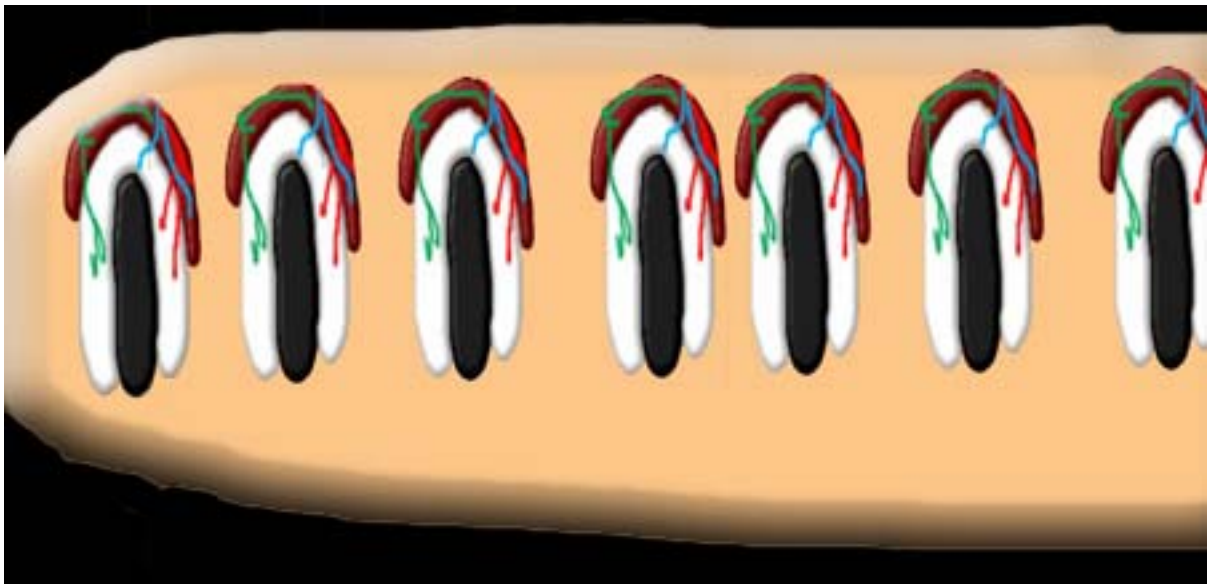
Cranial Nerve VII:

Facial nerve



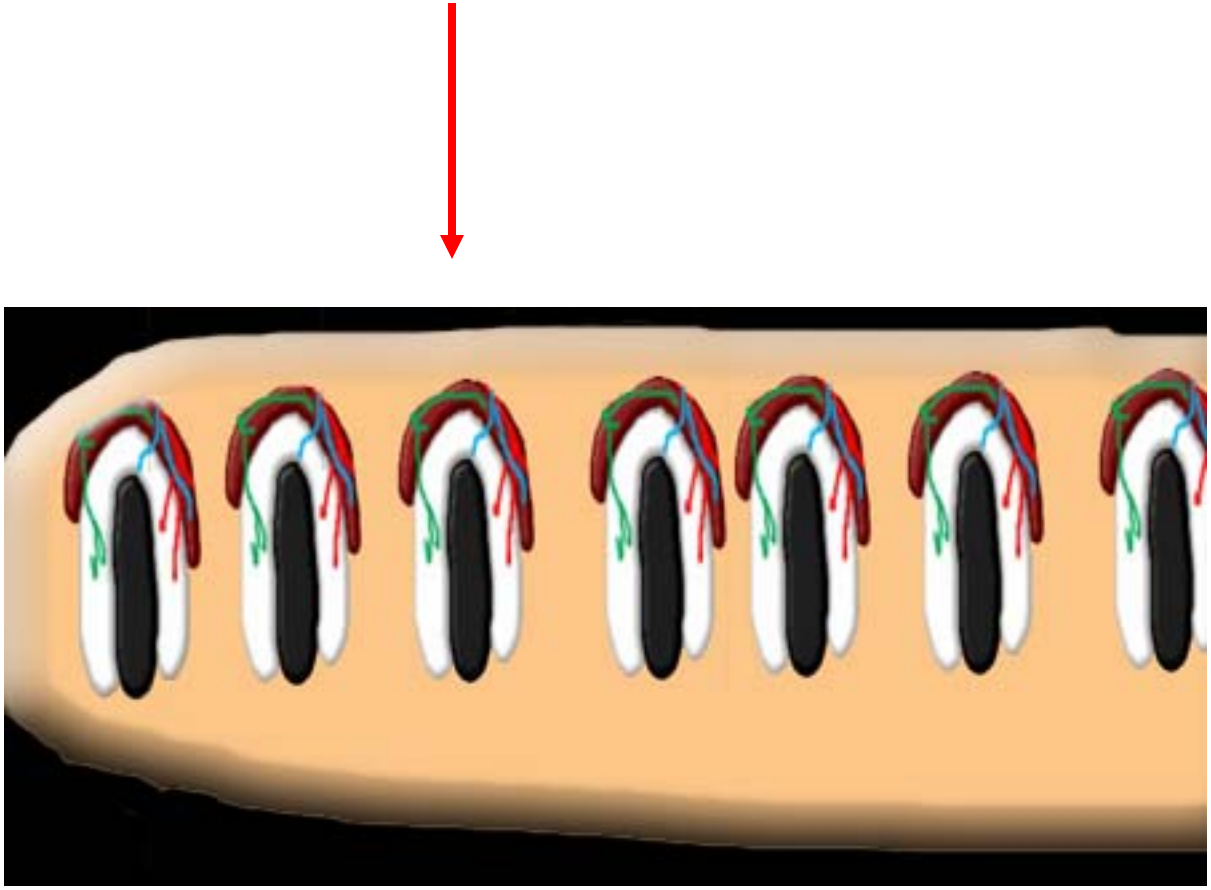
Development

Next arch



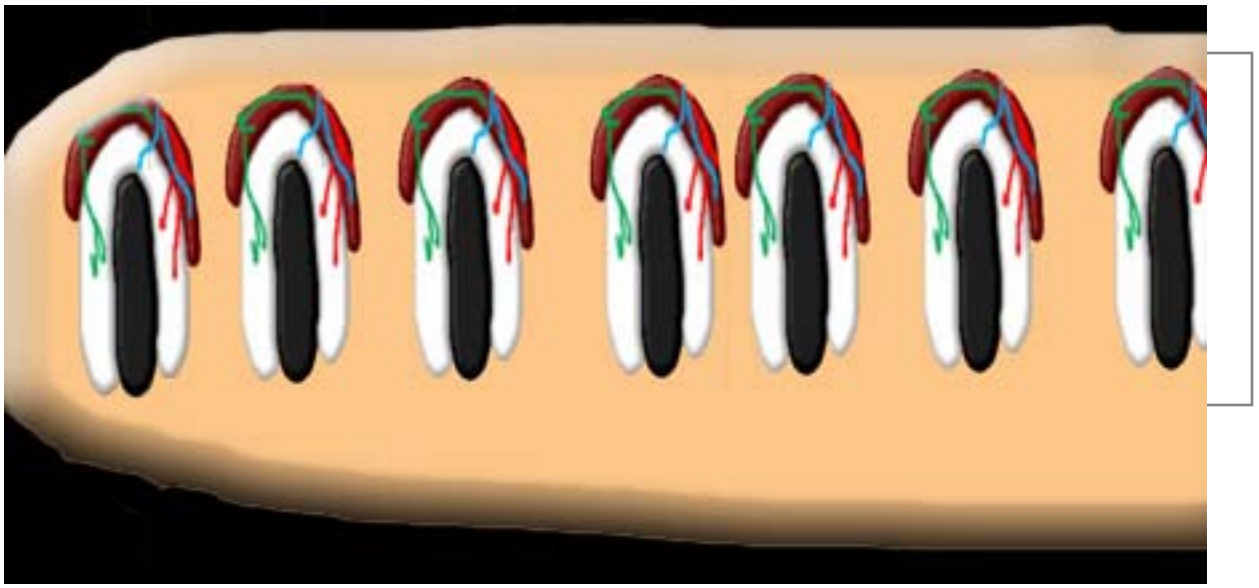
Cranial nerve IX:

Glossopharyngeal Nerve



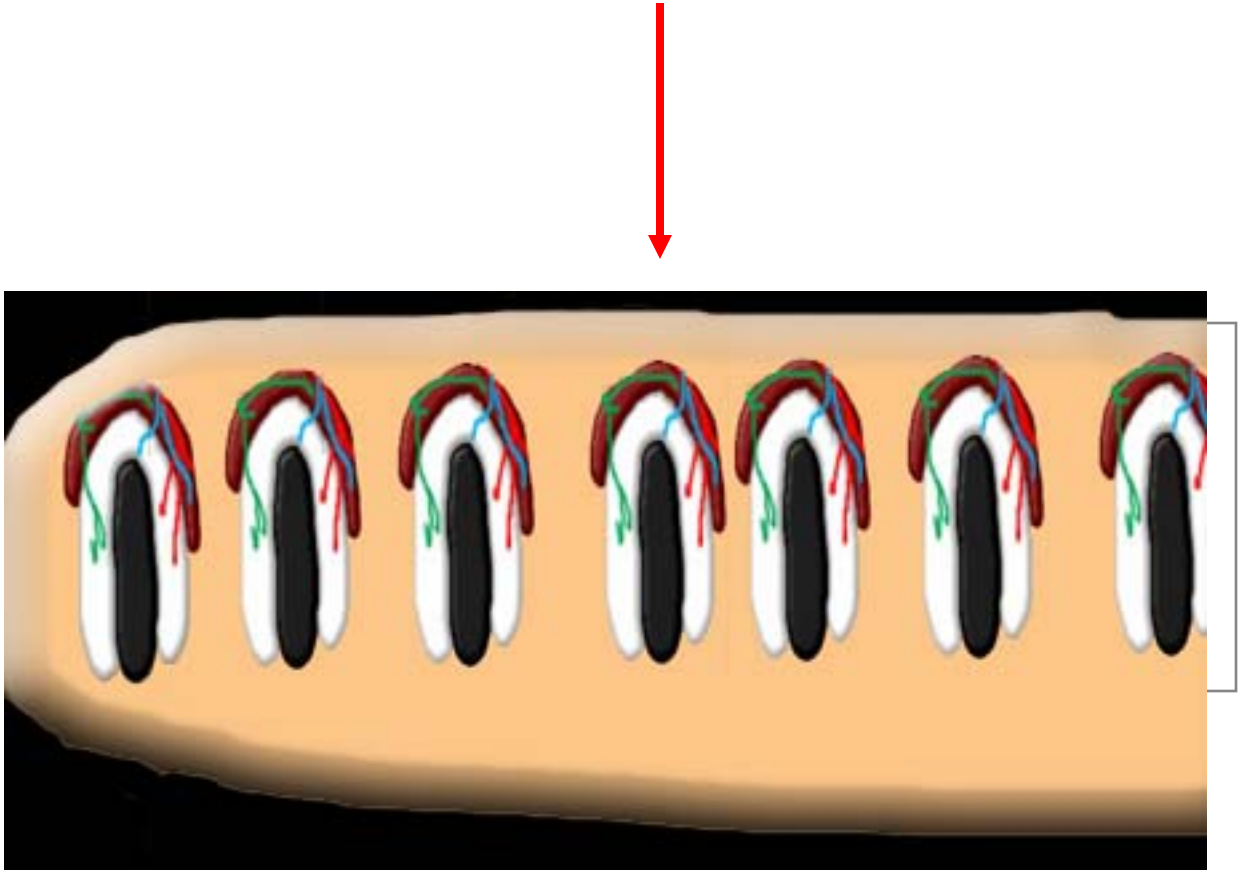
Development

Remaining arches



Cranial nerve X:

The Vagus Nerve



The Cranial Nerves

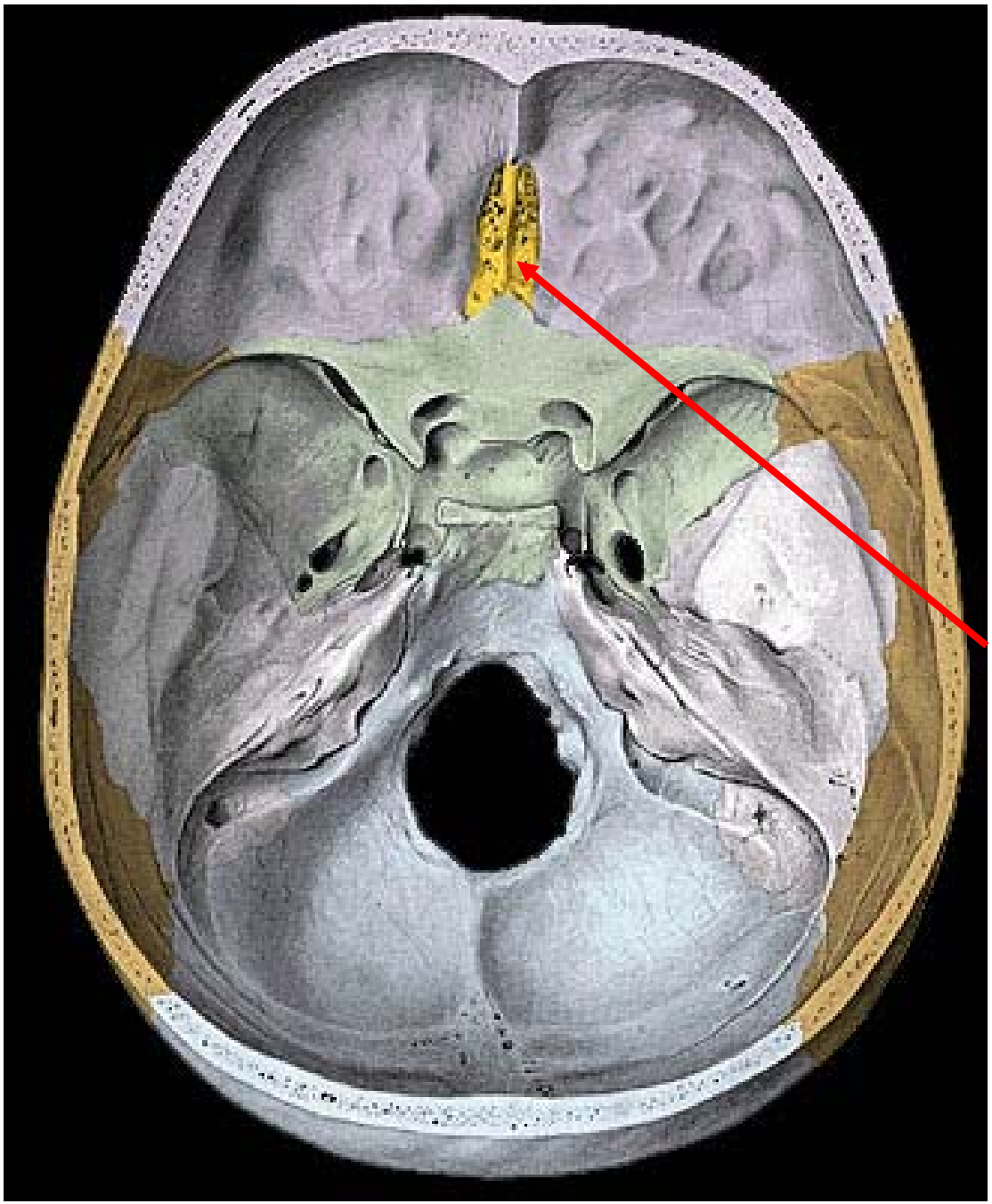
Summary of Cranial Nerves

Is there a "#0" nerve?

The *Nervus Terminalis* (Nerve Zero) has been suggested as a primitive vertebrate structure serving the vomeraonasal organ.

Special Sensory Nerves

I



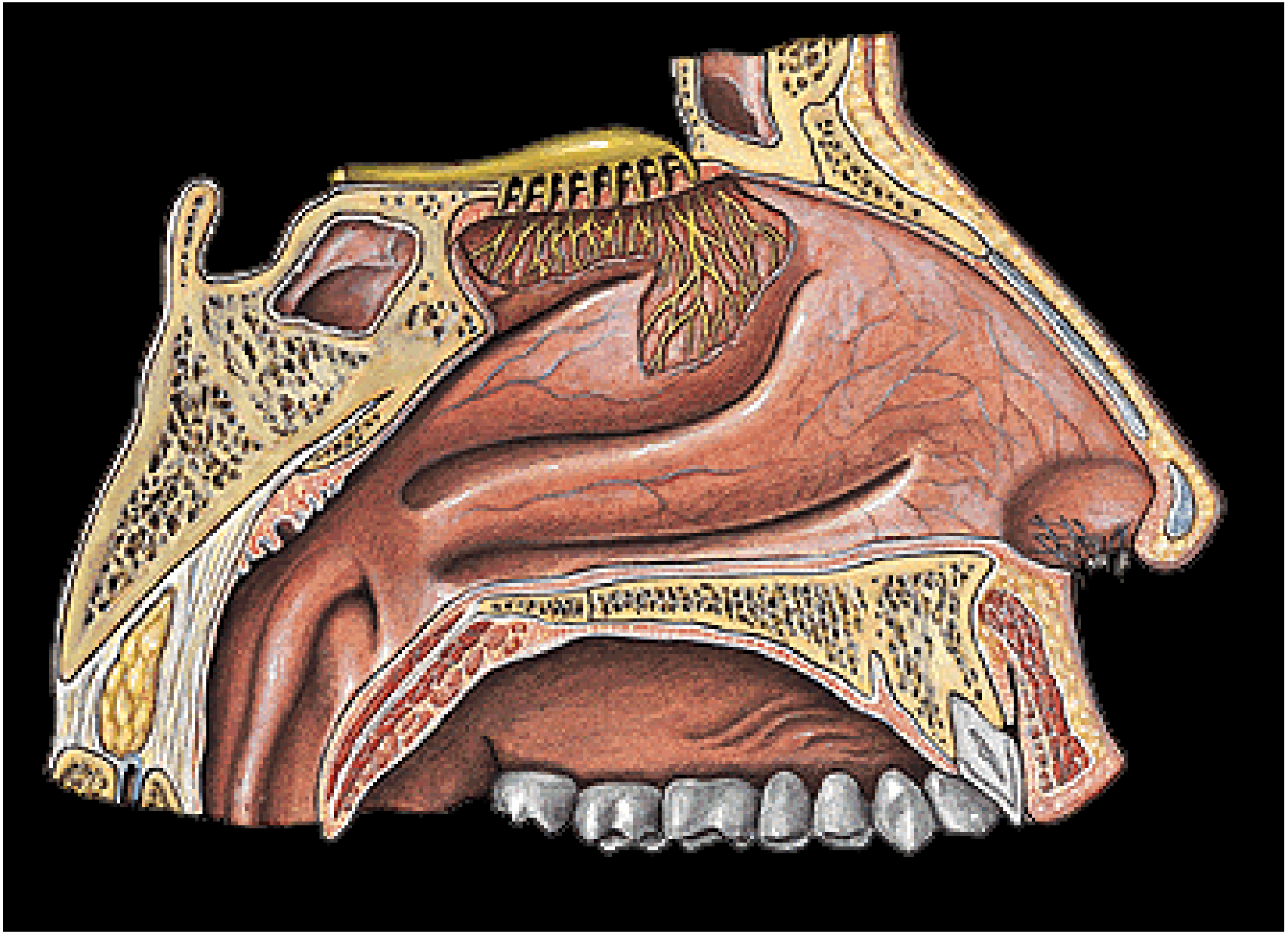
Cranial Nerve I

The Olfactory Nerve

Sensory

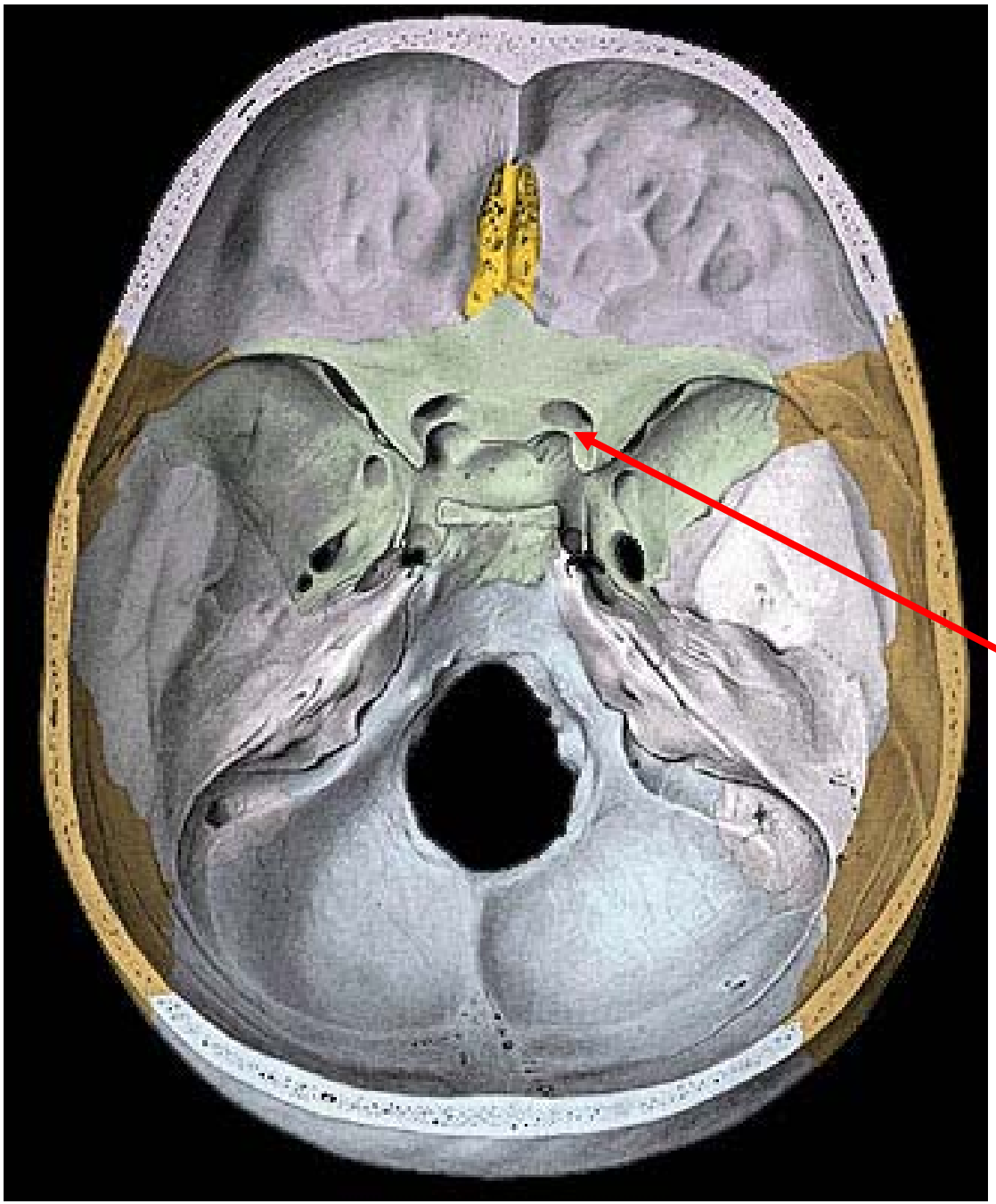
Smell

Cribriform plate of ethmoid



II


8
7
2
3
3
5



Cranial Nerve II

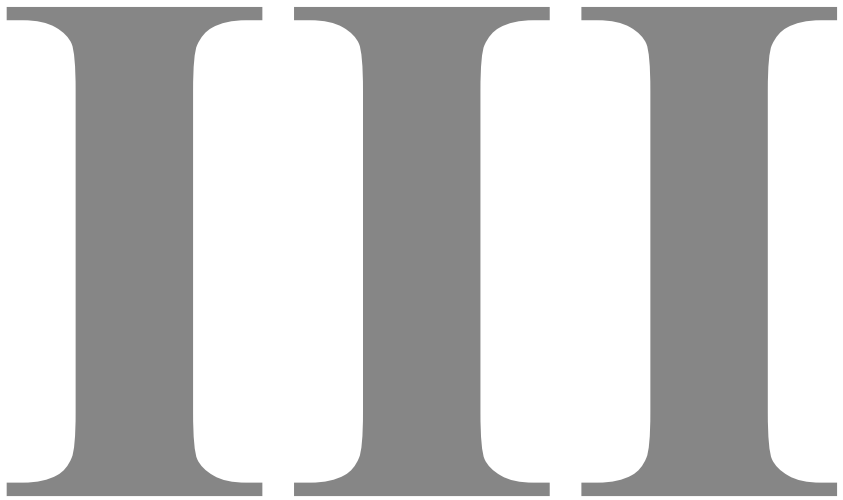
The Optic Nerve

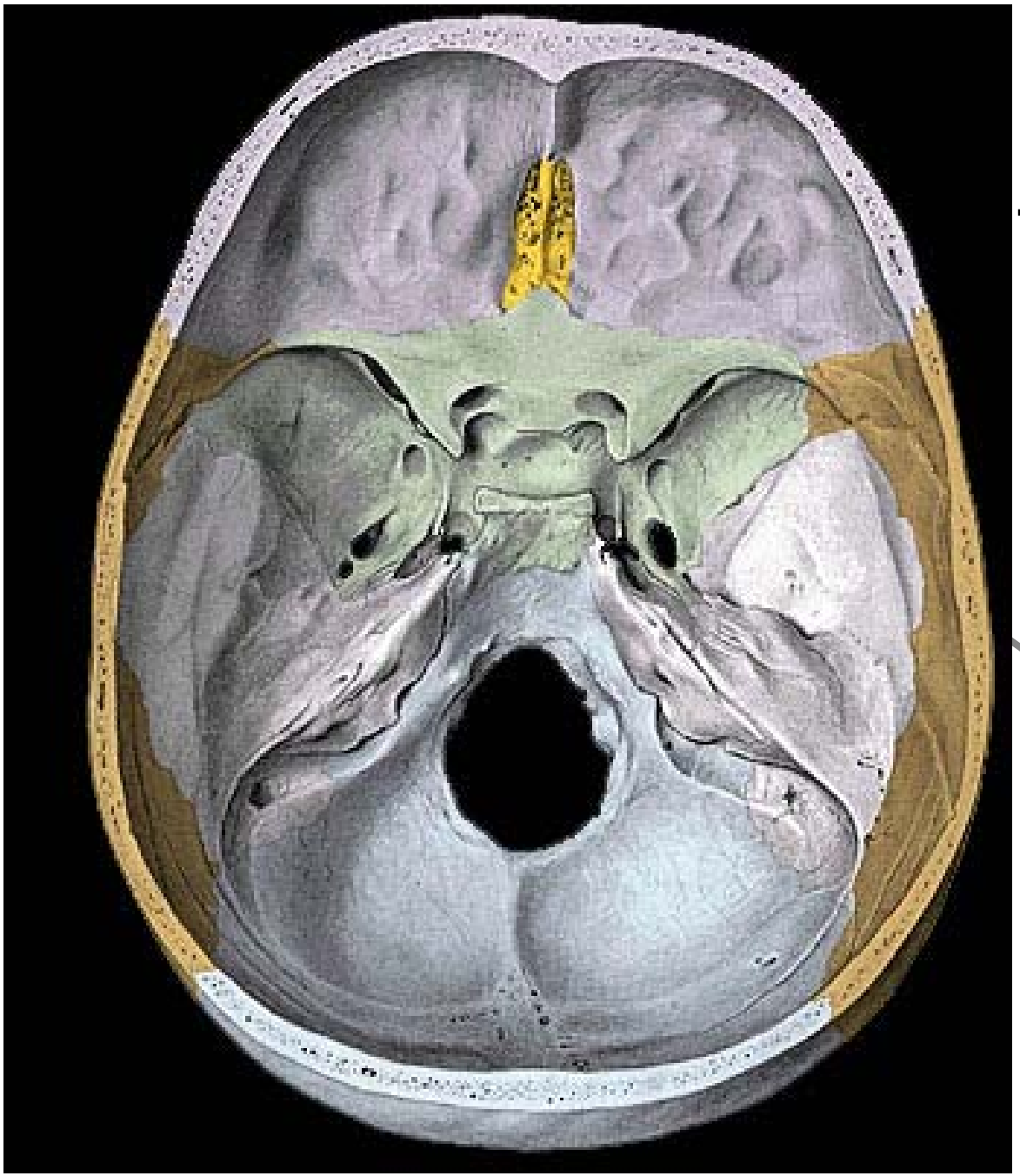
Sensory

Vision

Optic foramen

Ventral Root Cranial Nerves





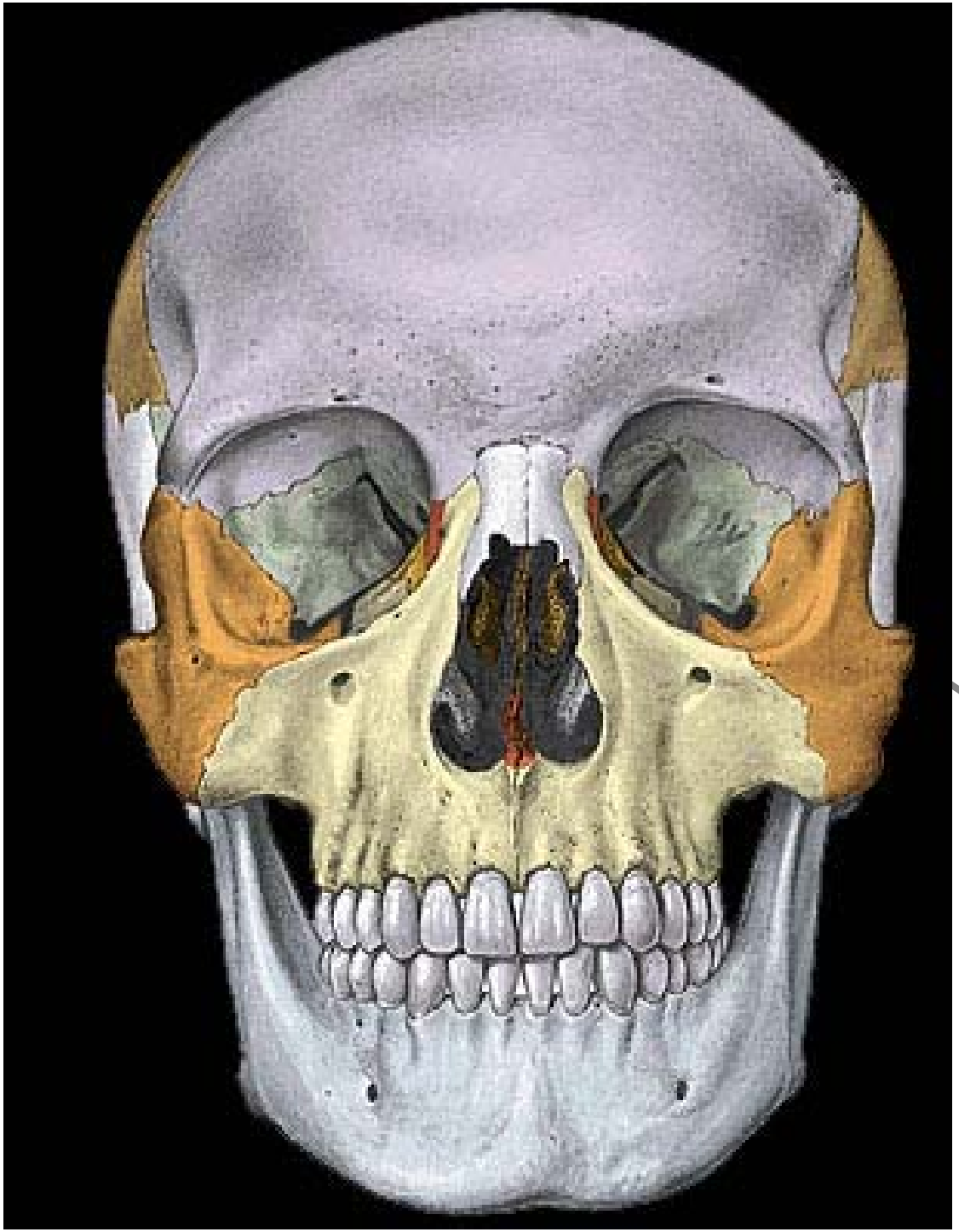
Cranial Nerve III

The Occulomotor Nerve

Mainly motor

Eye Movement

Superior orbital fissure



Cranial Nerve III

The Occulomotor Nerve

Mainly motor

Eye Movement

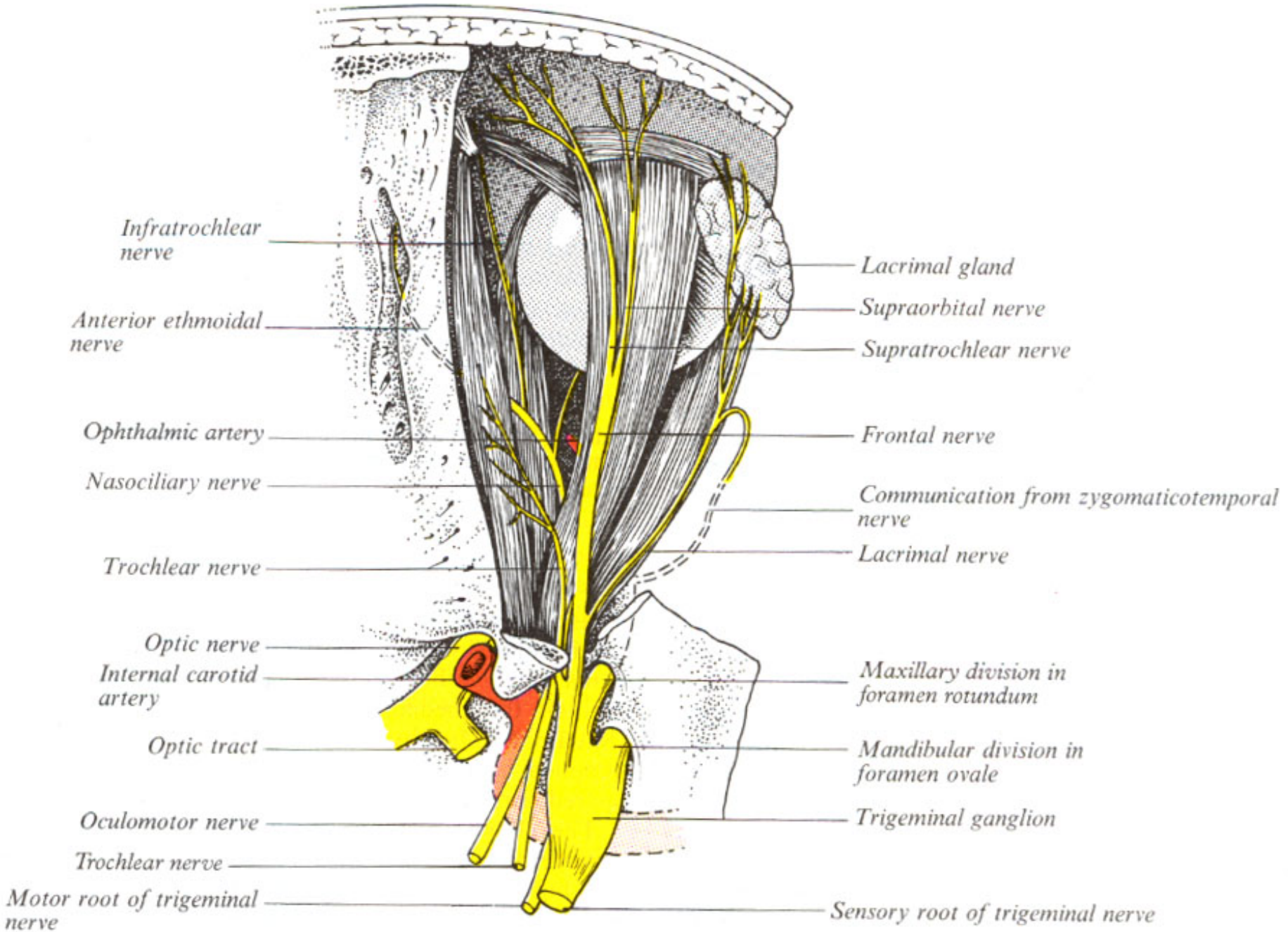
Superior orbital fissure

Detail on Occulomotor (III) Function:

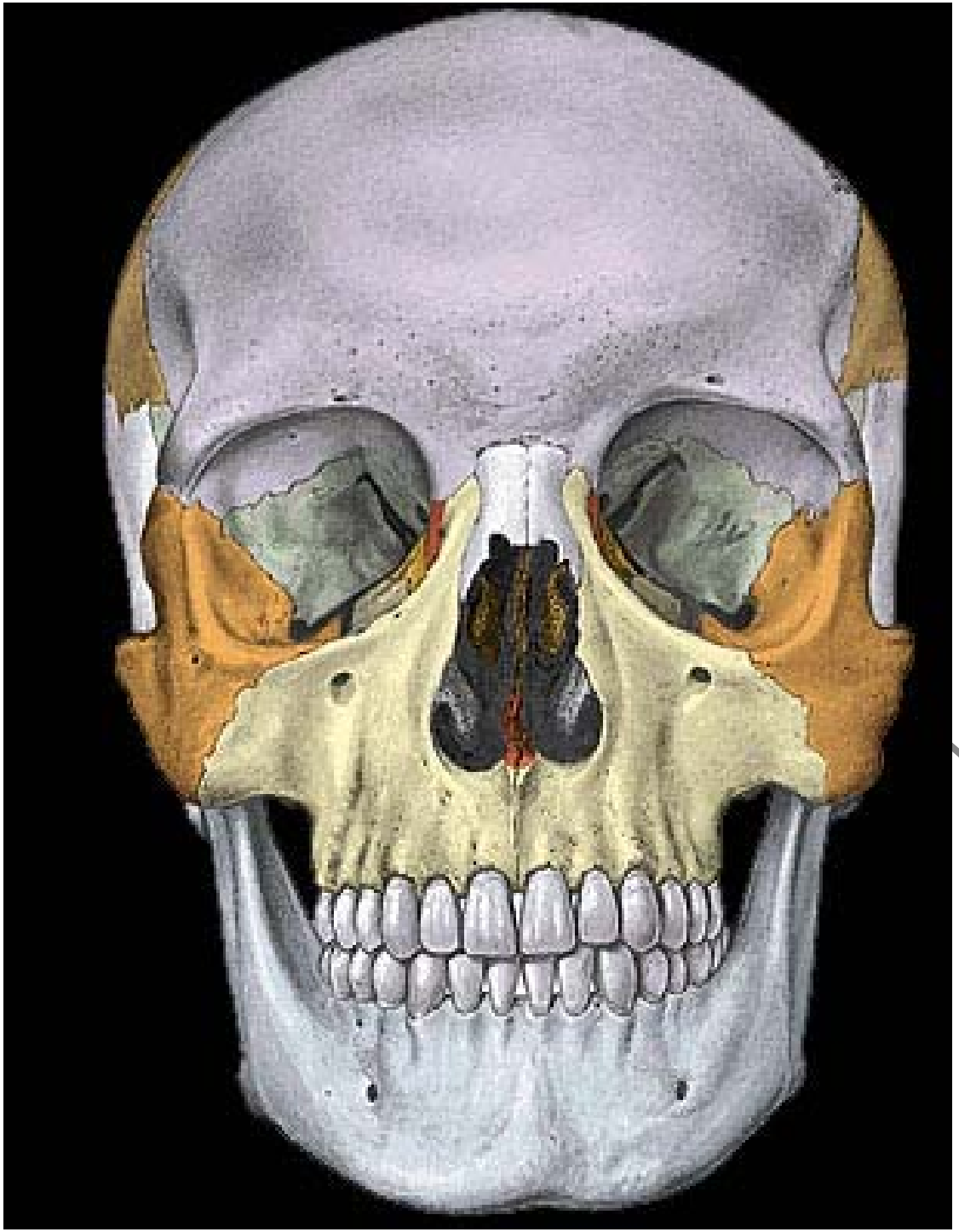
- Motor to all extra-ocular muscles except lateral rectus and superior oblique.

- Parasympathetic innervation to sphincter pupillae and ciliaris muscles (synapse in ciliary ganglion).

- Sympathetic innervation to sphincter pupillae and ciliaris muscles. Fibers originate in upper thoracic levels, synapse in cervical ganglia, get to orbit via associated arteries.


Infratrochlear nerve
Anterior ethmoidal nerve
Ophthalmic artery
Nasociliary nerve
Trochlear nerve
Optic nerve
Internal carotid artery
Optic tract
Oculomotor nerve
Trochlear nerve
Motor root of trigeminal nerve
Lacrimal gland
Supraorbital nerve
Supratrochlear nerve
Frontal nerve
Communication from zygomaticotemporal nerve
Lacrimal nerve
Maxillary division in foramen rotundum
Mandibular division in foramen ovale
Trigeminal ganglion
Sensory root of trigeminal nerve

IV



Cranial Nerve IV

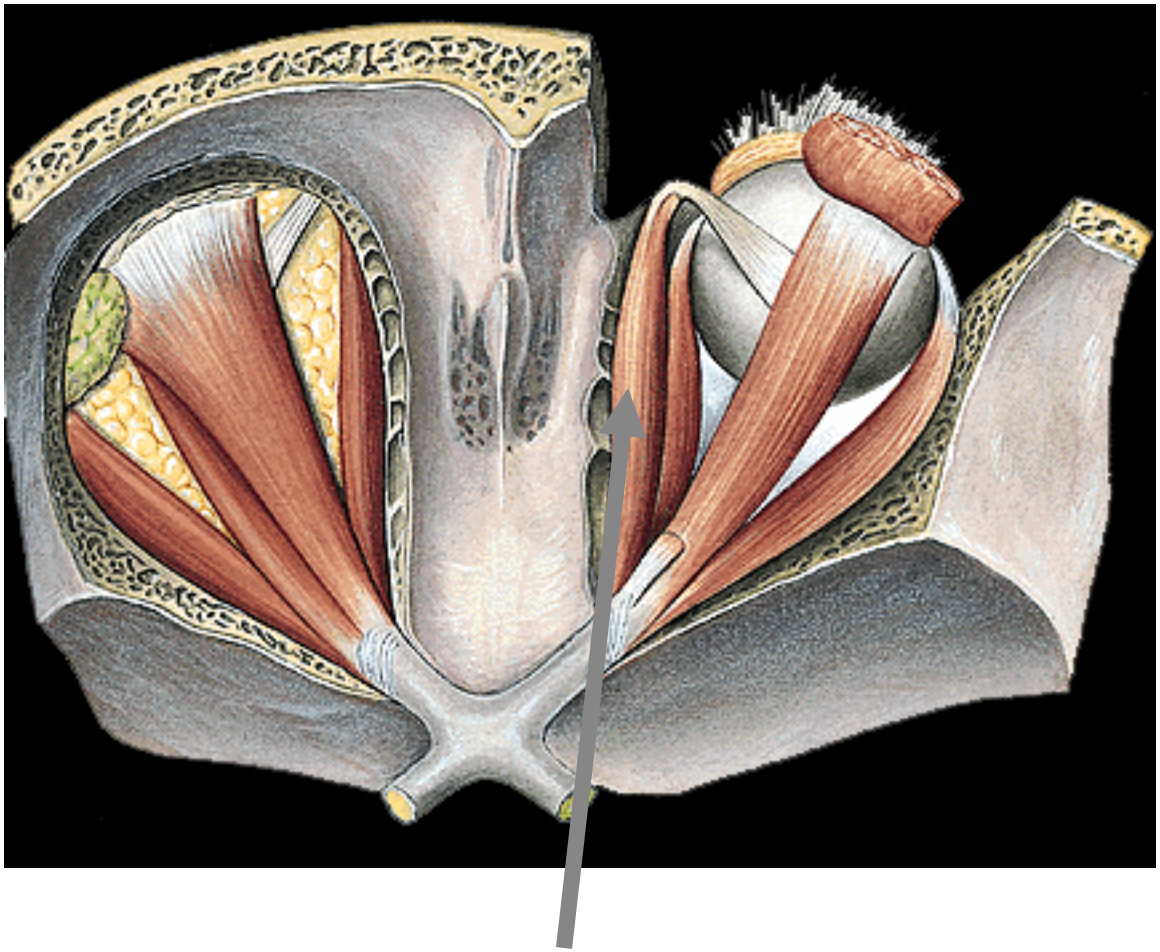
The Trochlear Nerve

Mainly motor

Superior oblique

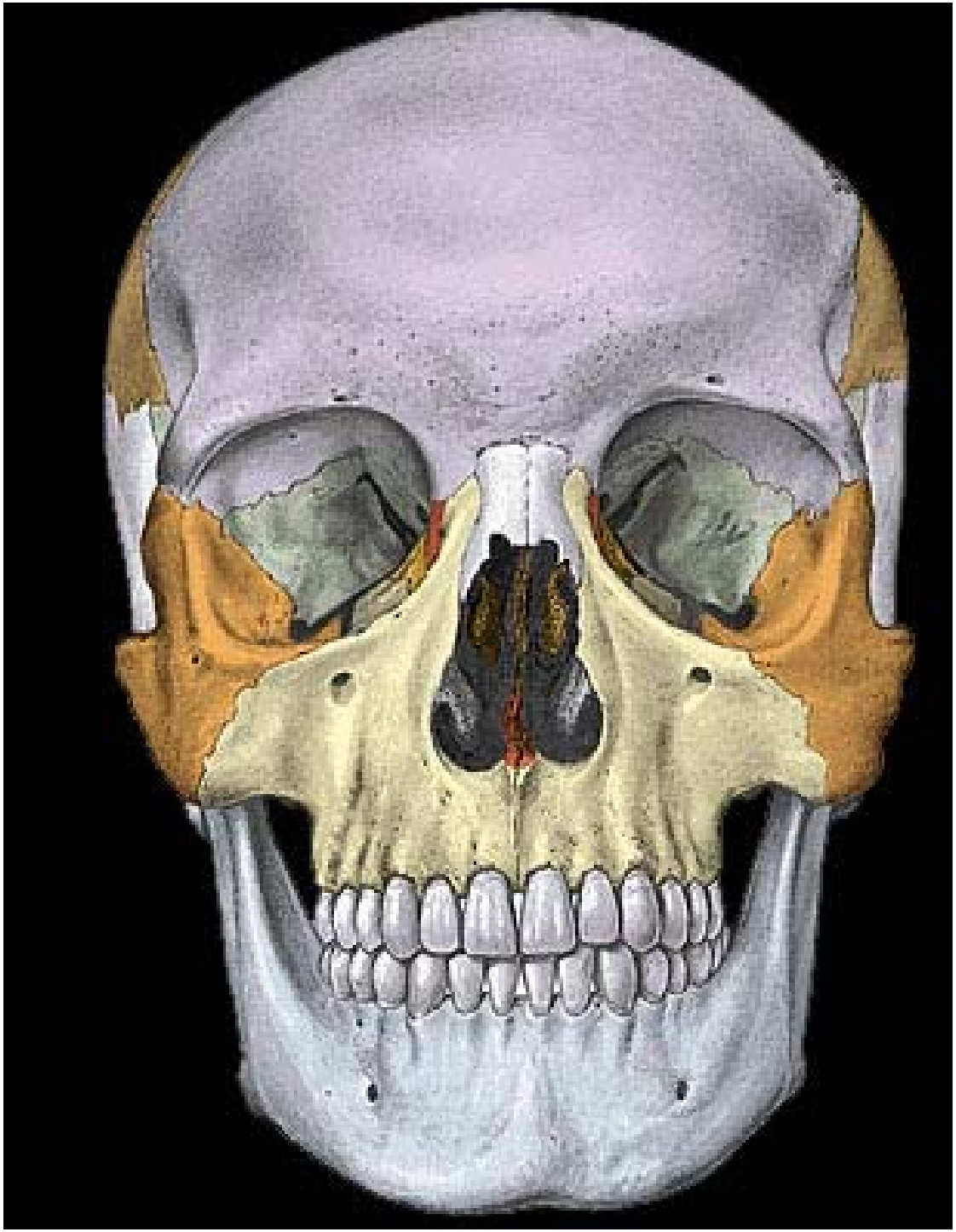
Superior orbital fissure

Cranial Nerve IV



Superior oblique

VI



Cranial Nerve VI

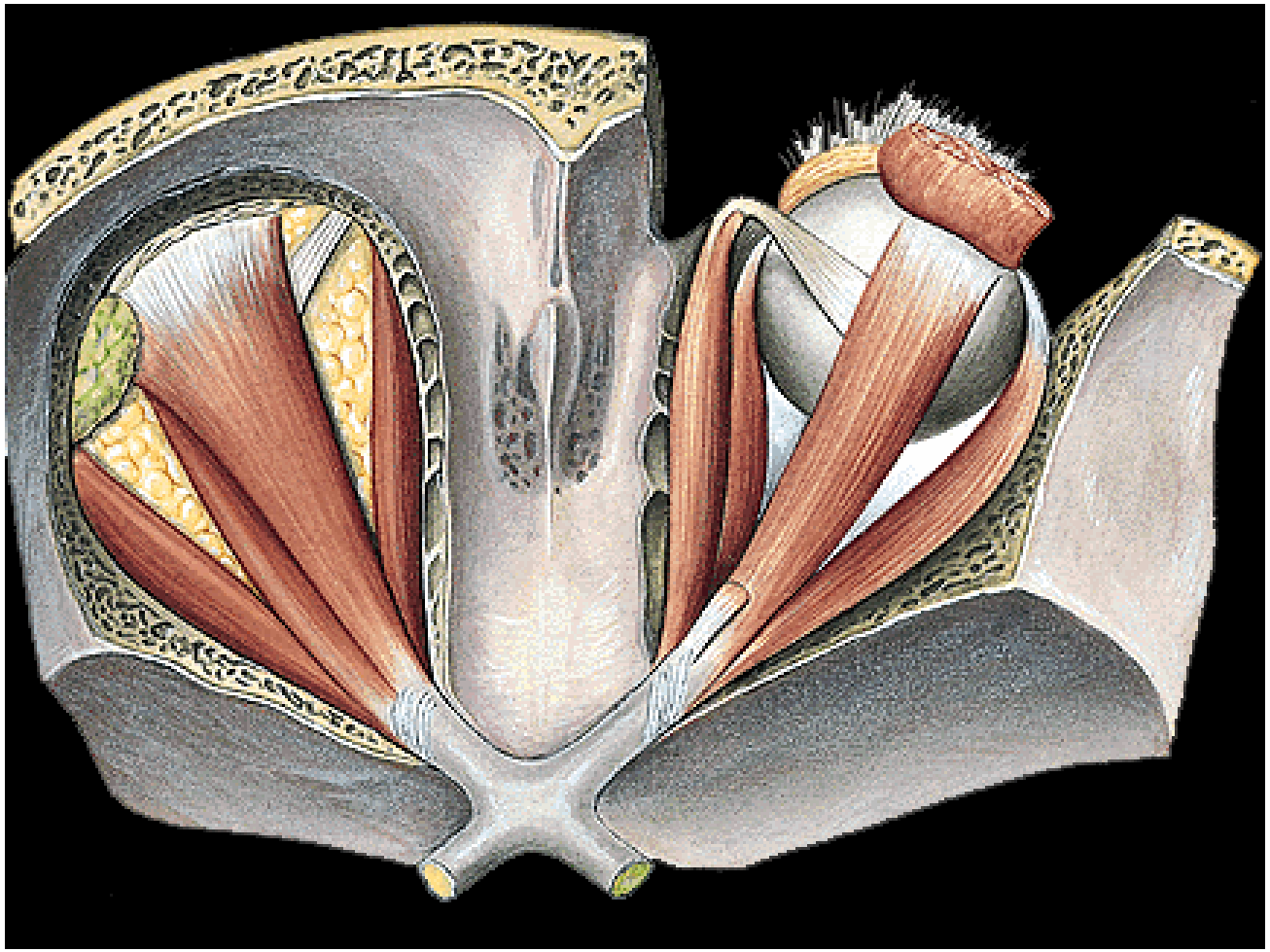
The Abducens Nerve

Mainly motor

Lateral rectus

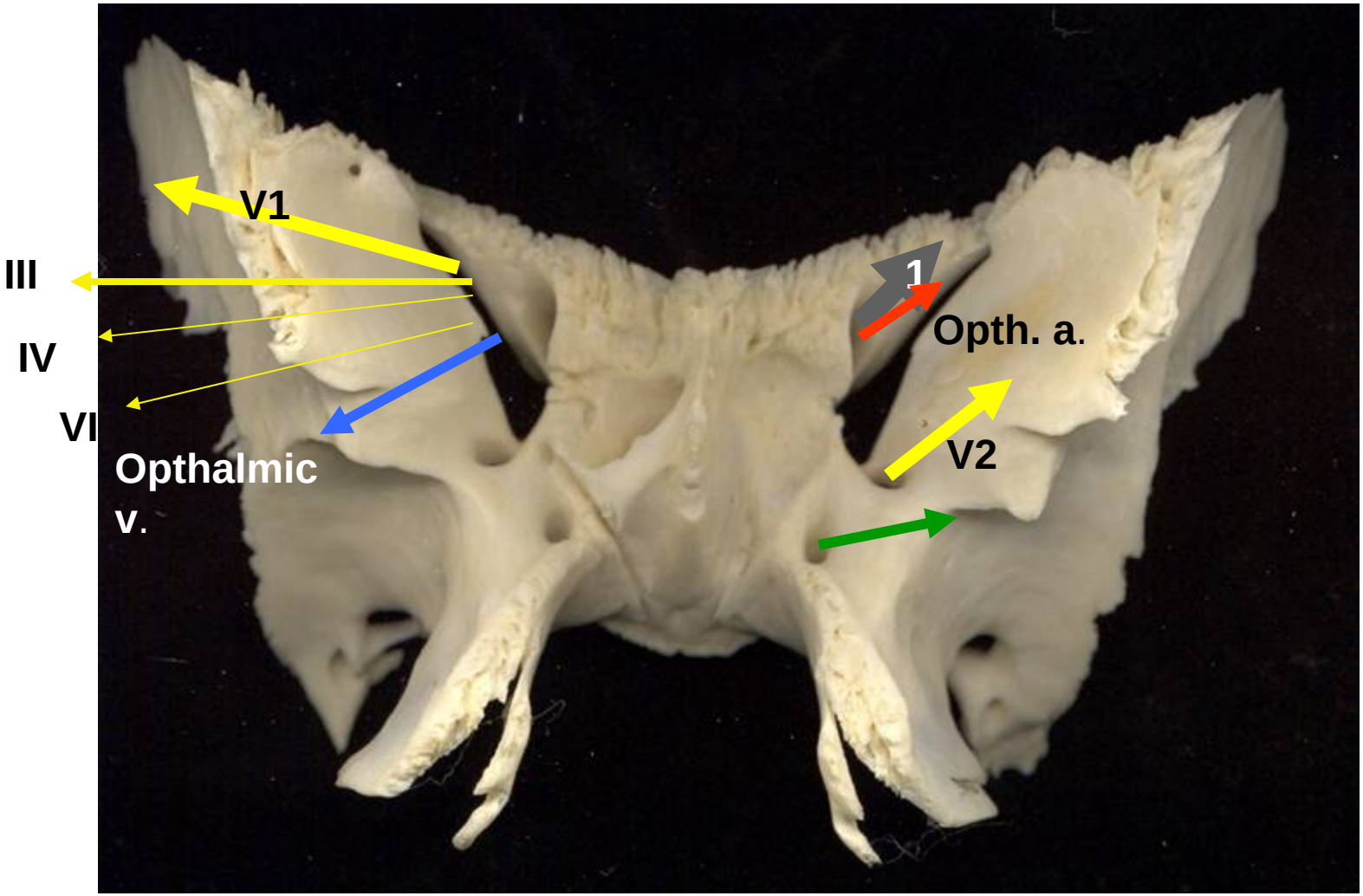
Superior orbital fissure

Cranial Nerve VI



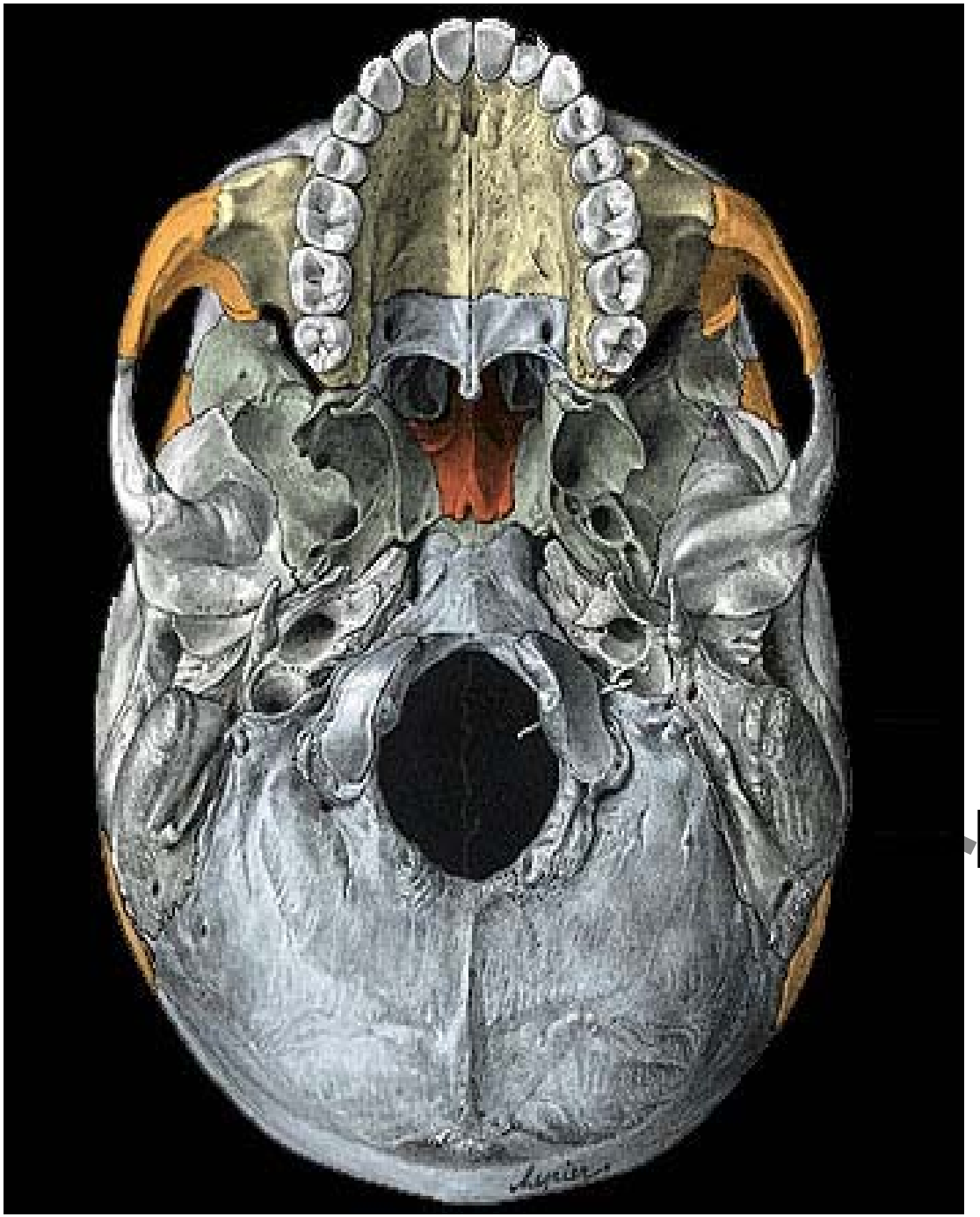
Lateral rectus

SUPERIOR ORBITAL FISSURE AND STRUCTURES PASSING THROUGH IT.



Sphenoid/ anterior view of orbital surface and sutures with frontal, ethmoid and palatine bones/ cranial nerves indicated

XII



Cranial Nerve XII

The Hypoglossal Nerve

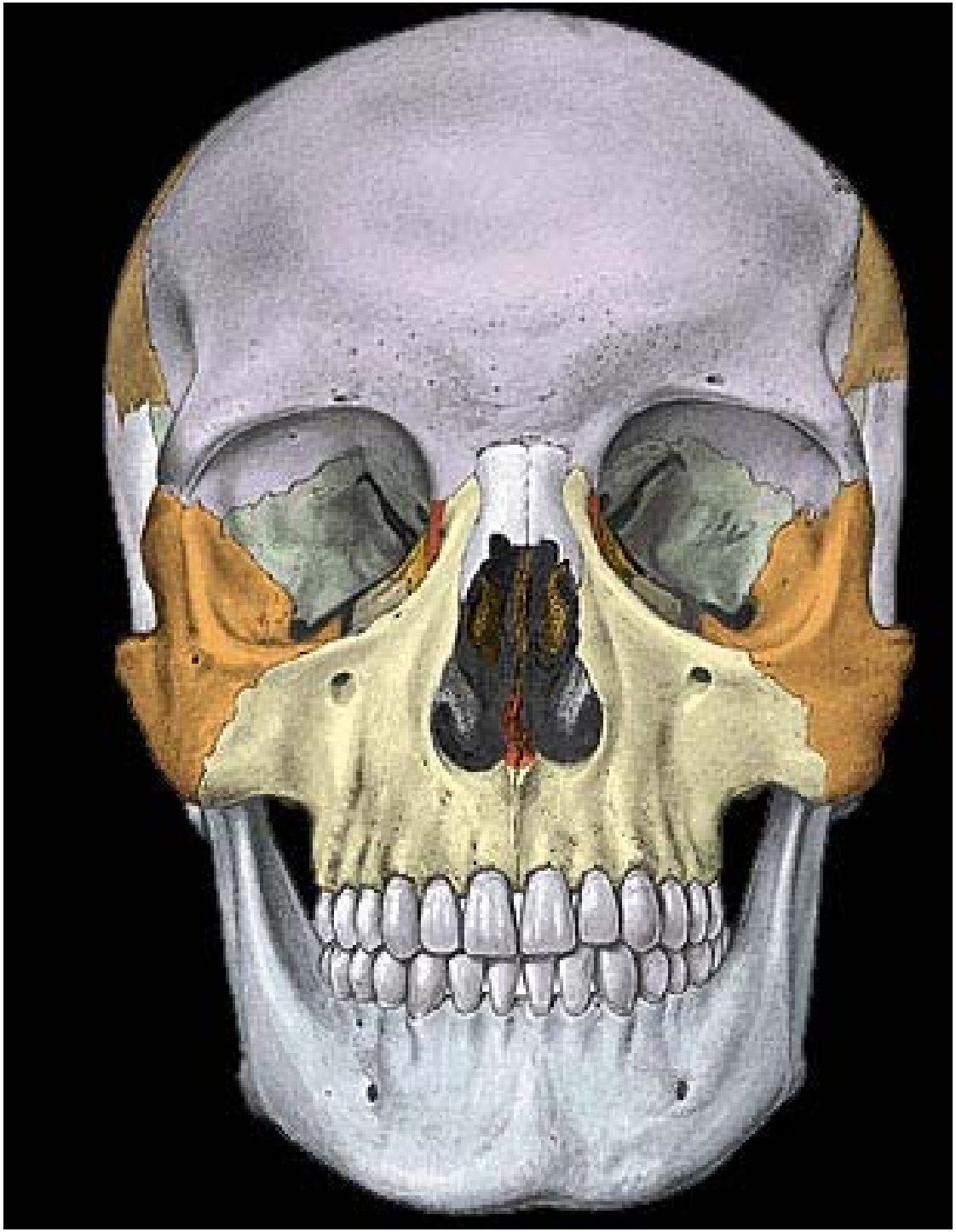
Mainly Motor

Tongue

Hypoglossal Canal

Dorsal Root Cranial Nerves

V



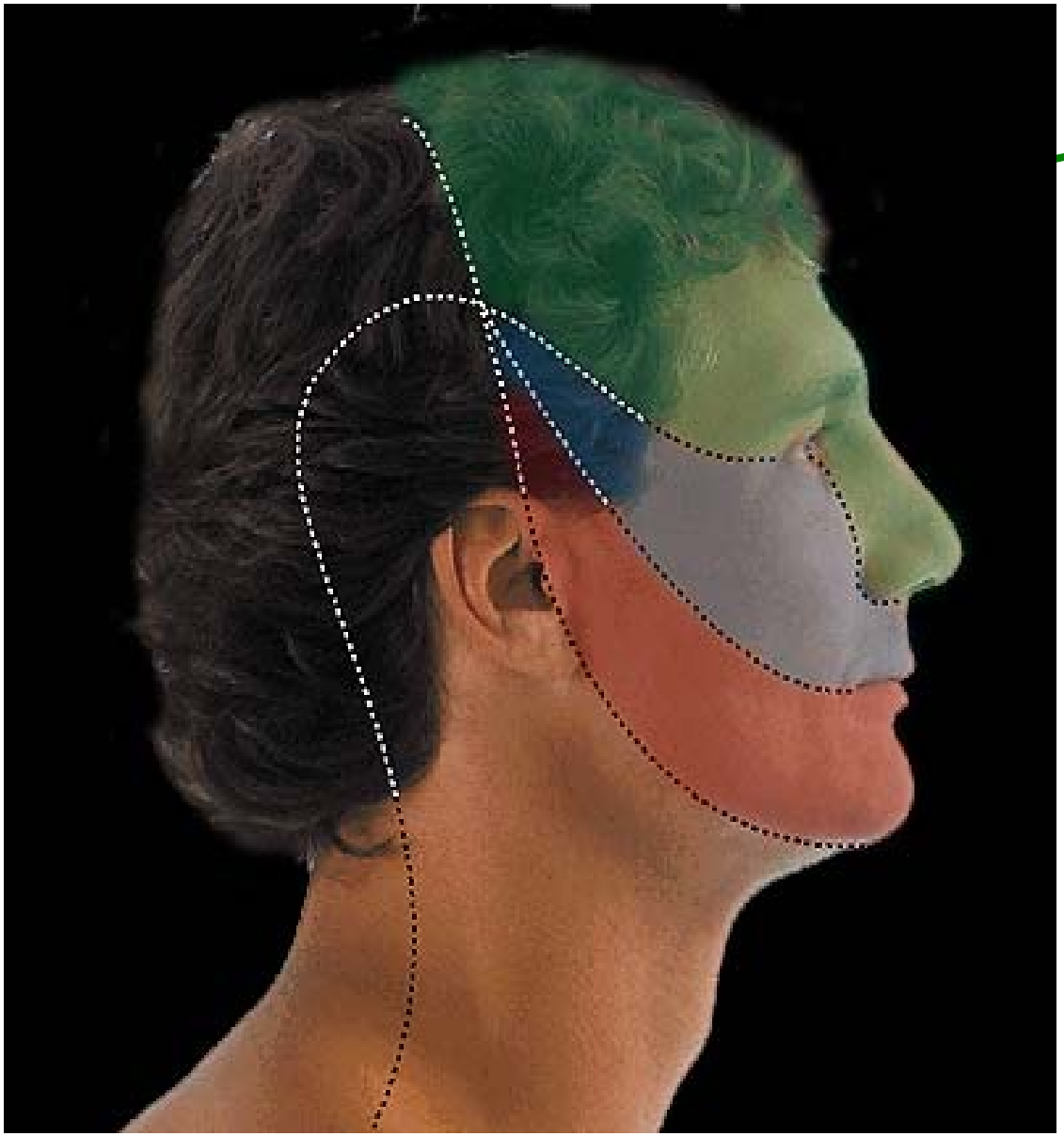
Cranial Nerve V

The Trigeminal Nerve

Both

V_1= ophthalmic
V_2 = maxillary
V_3 = mandibular

Cranial Nerve V_1

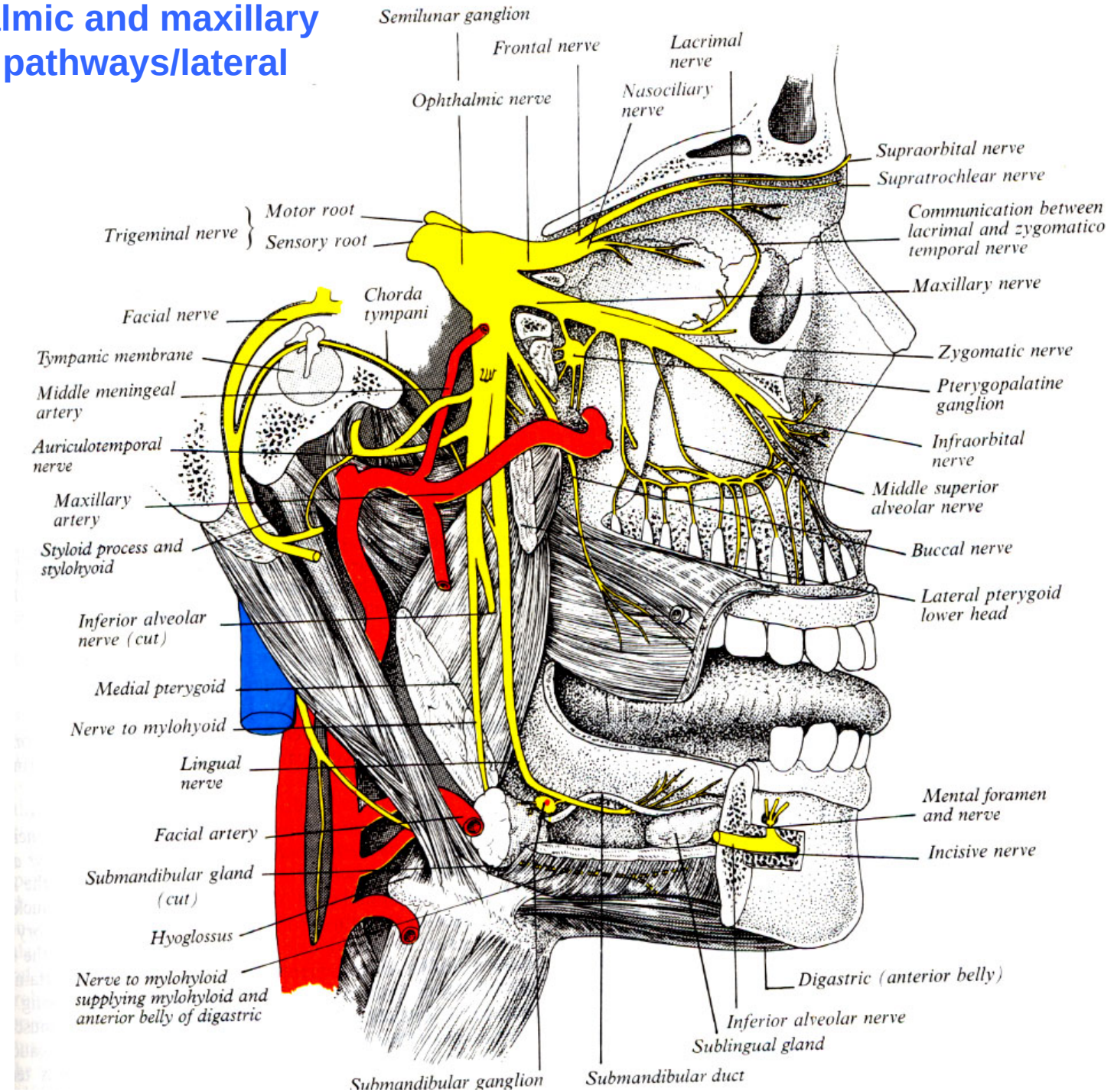


Ophthalmic division

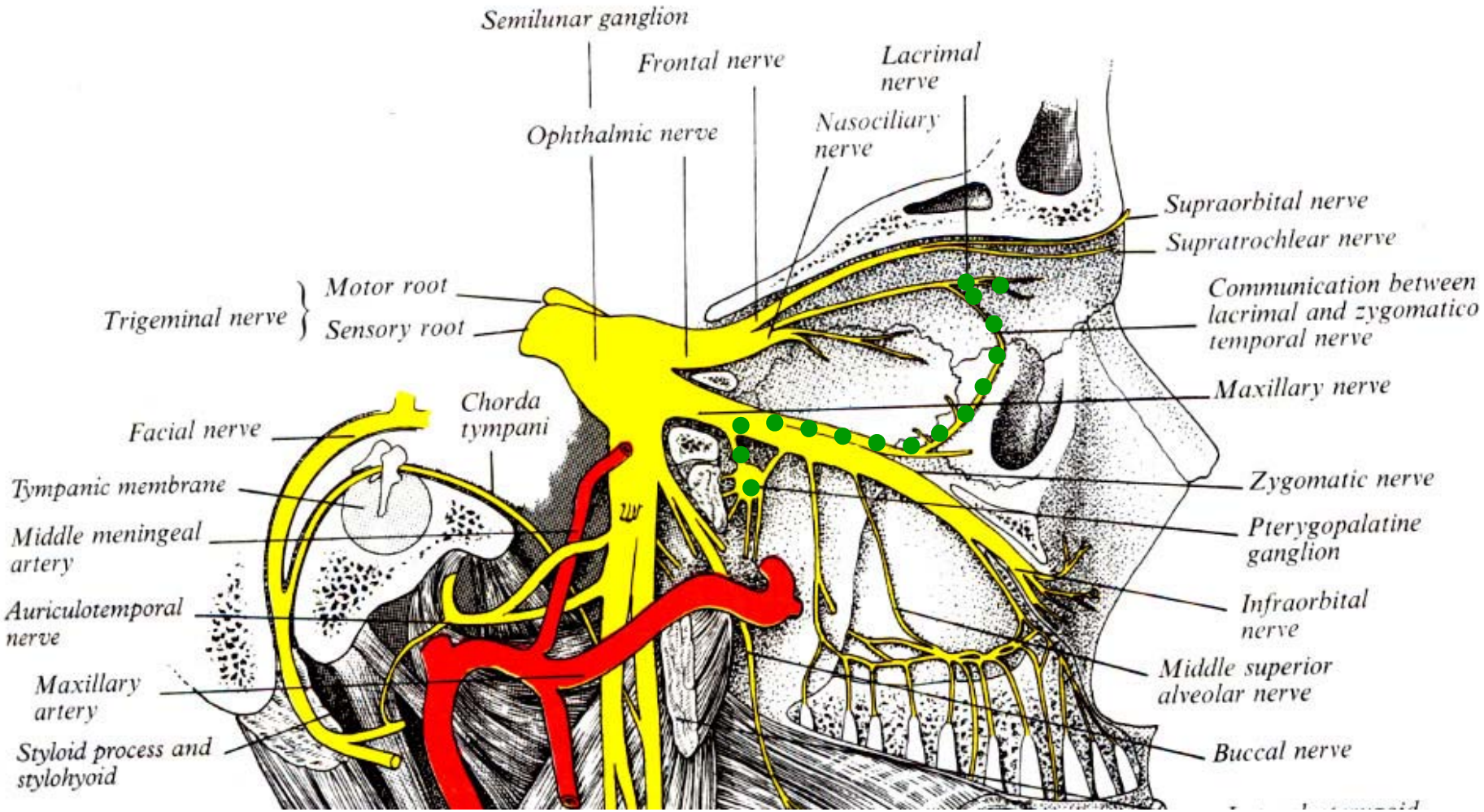
Sensory

Superior orbital fissure

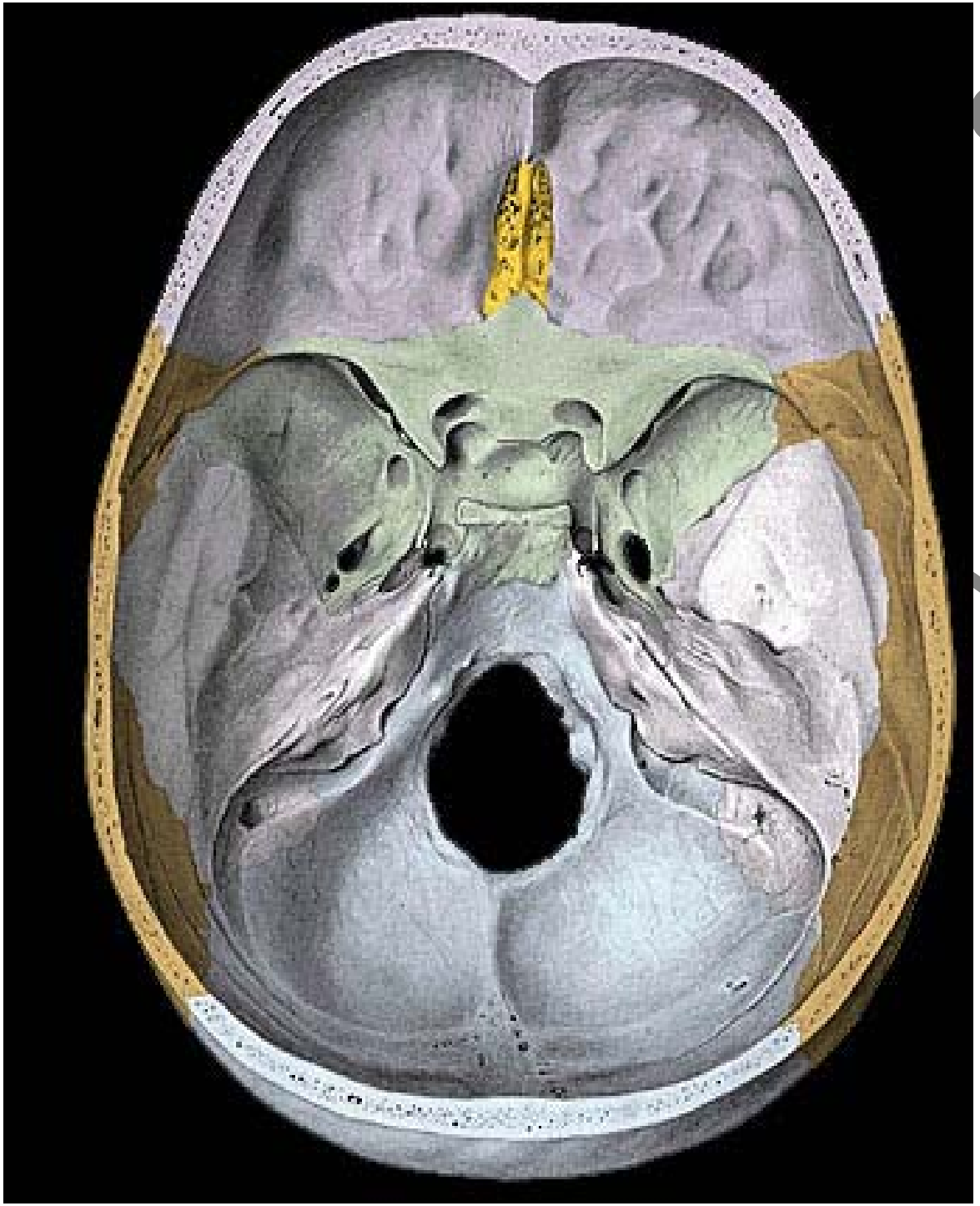
Opthalmic and maxillary nerve pathways/lateral view



Opthalmic and maxillary nerve pathways/medial view of lateral cut away orbit



Lateral path of efferent parsympathetics from VII to lacrimal gland following zygomatico-temporal n. V2 to lacrimal n. V3



Cranial Nerve V_1

Ophthalmic division

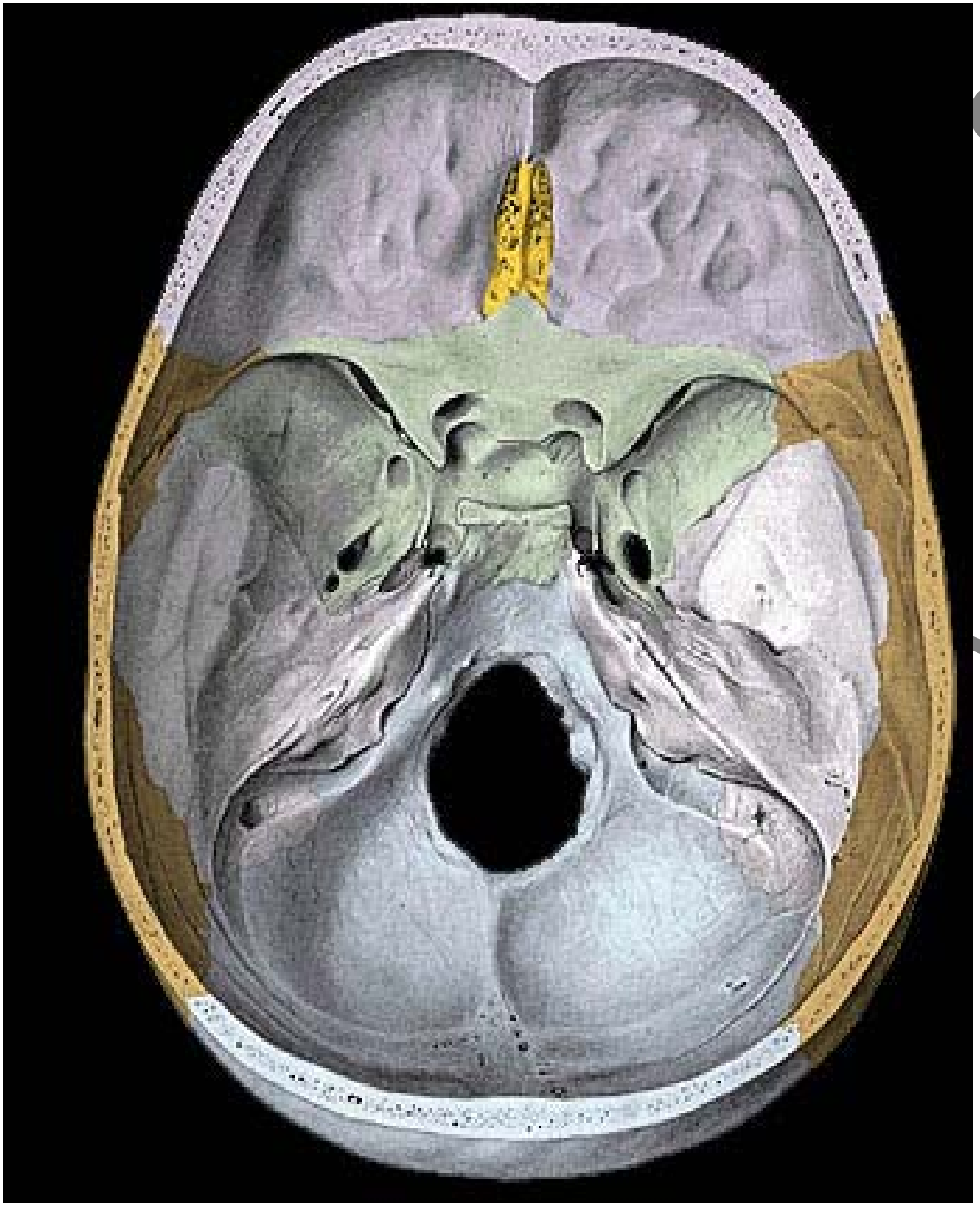
Sensory

Superior orbital fissure

Detail on Ophthalmic (V-1) Function:

• Almost wholly sensory: eyeball, lacrimal gland, conjunctiva, part of nasal mucosa, from brow ridge superiorly.

•Carrys a bit of sympathetic fibers for dilator pupillae. From upper thoracic levels, synapsing in in upper cervical ganglion. Reaches via branches of internal carotid artery.



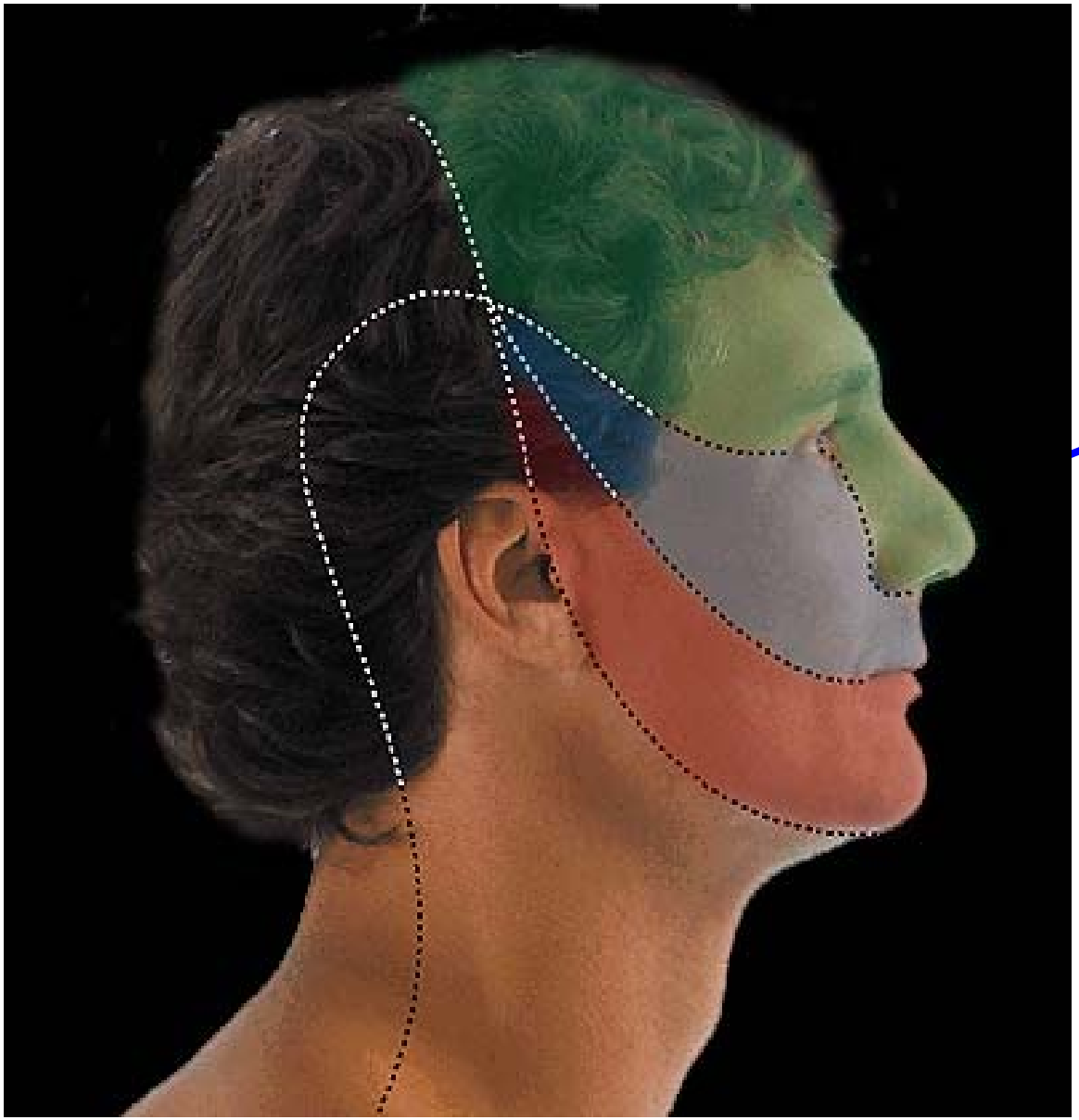
Cranial Nerve V_2

Maxillary division

Sensory

Foramen rotundum

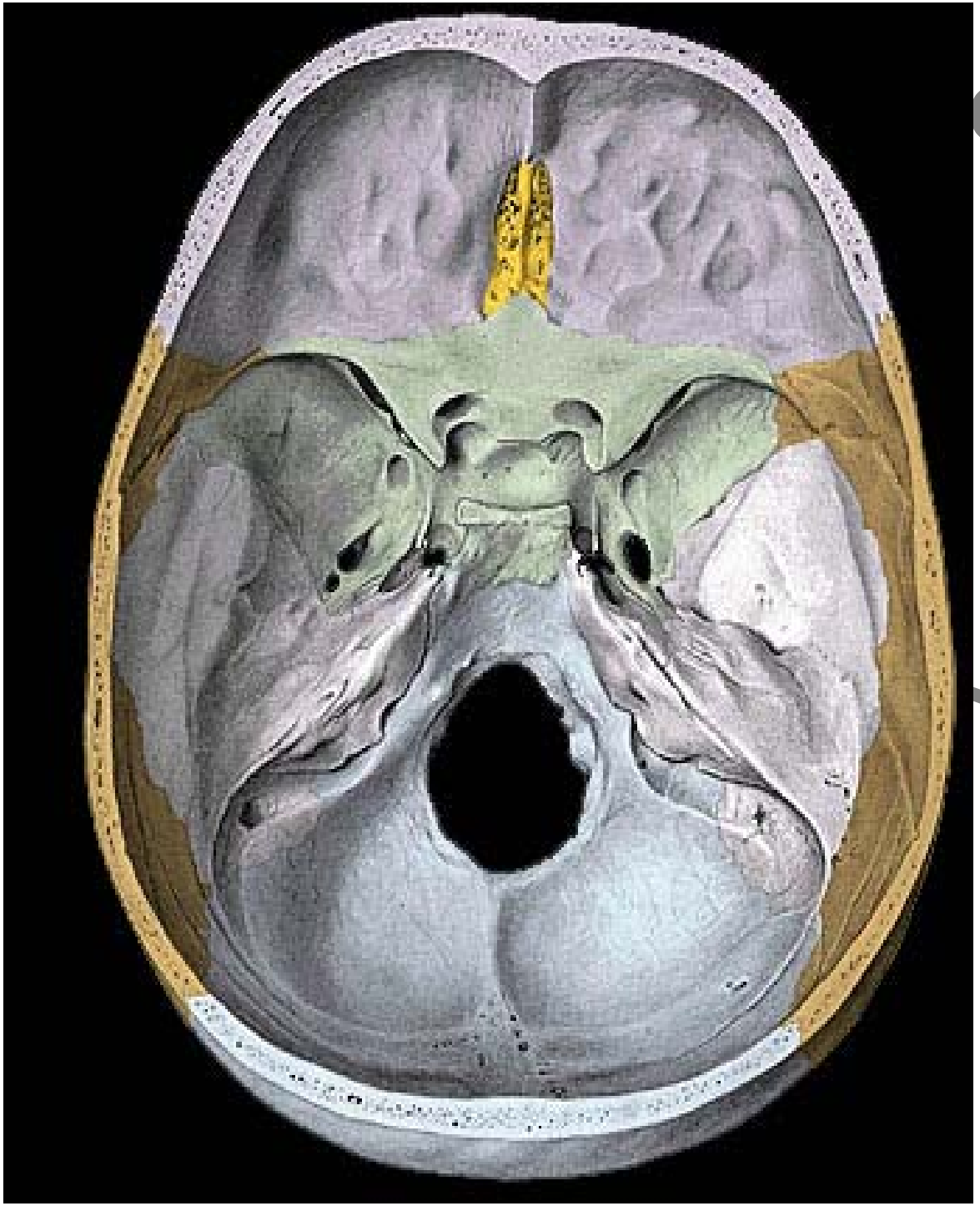
Cranial Nerve V_2



Maxillary division

Sensory

Foramen rotundum



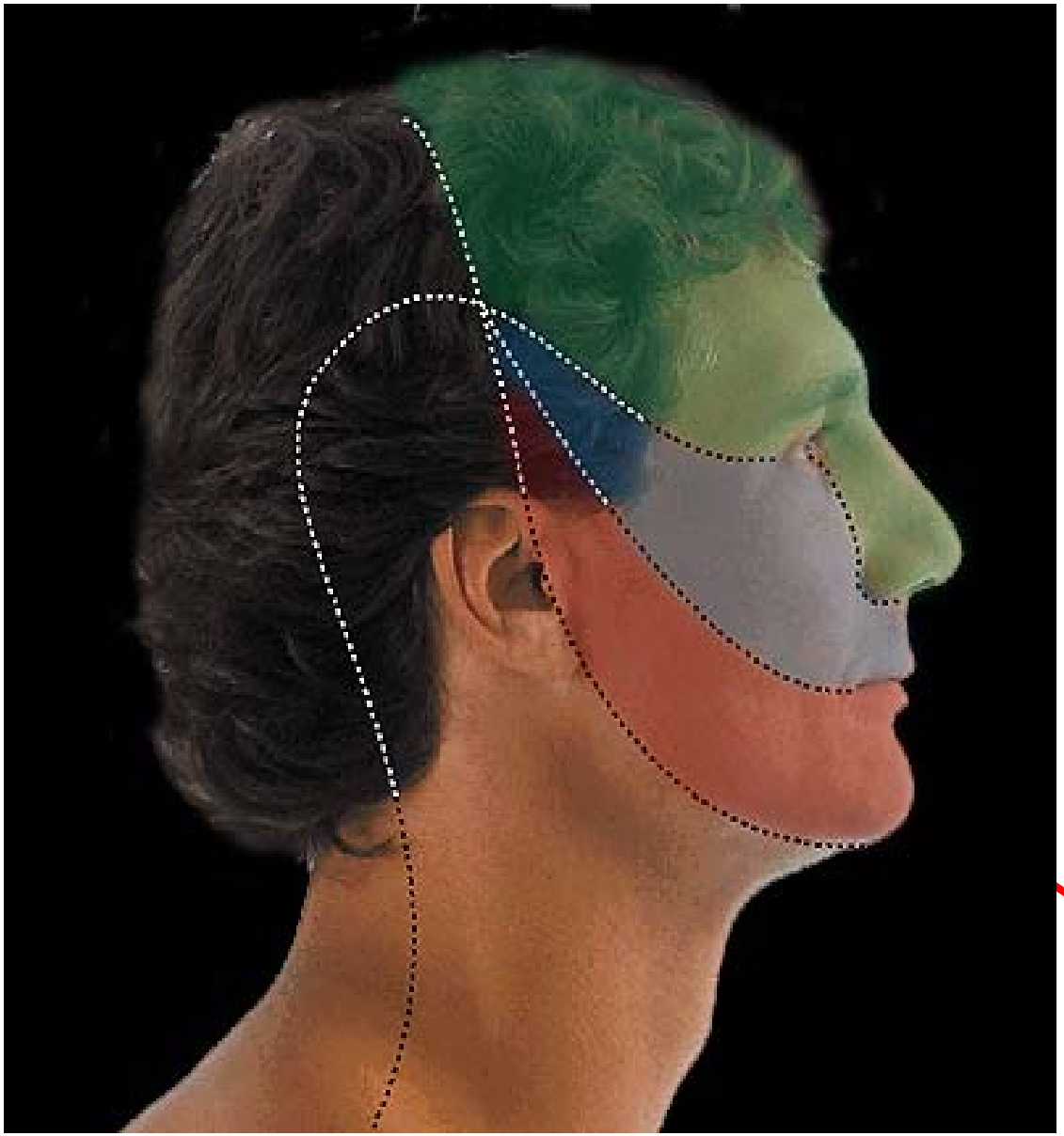
Cranial Nerve V_3

Mandibular division

Both

Foramen ovale

Cranial Nerve V_3



Mandibular division

Both

Foramen ovale

Sensory Component

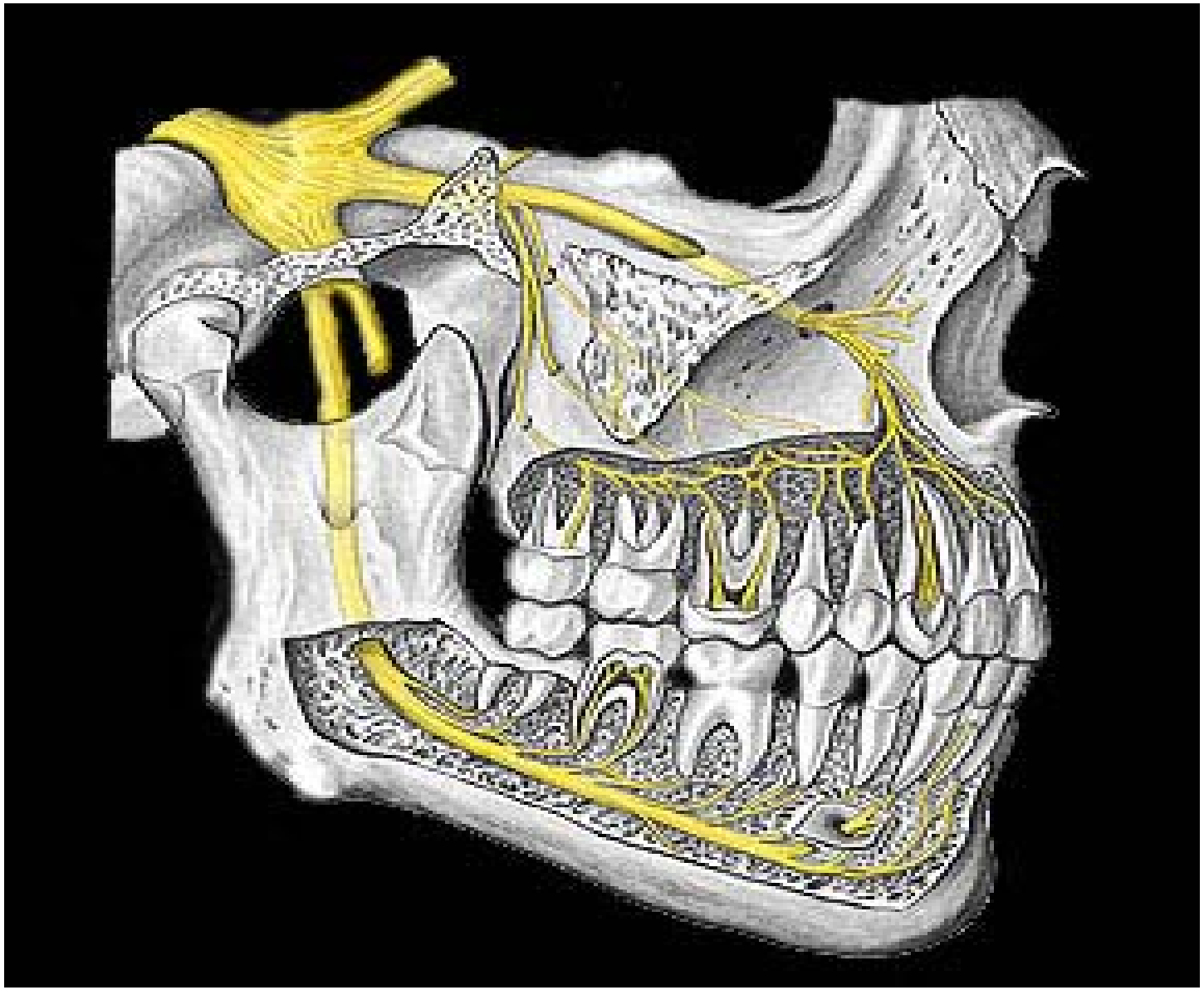
Detail on Mandibular (V-3) Function:

- Sensory to lower jaw region, including teeth.

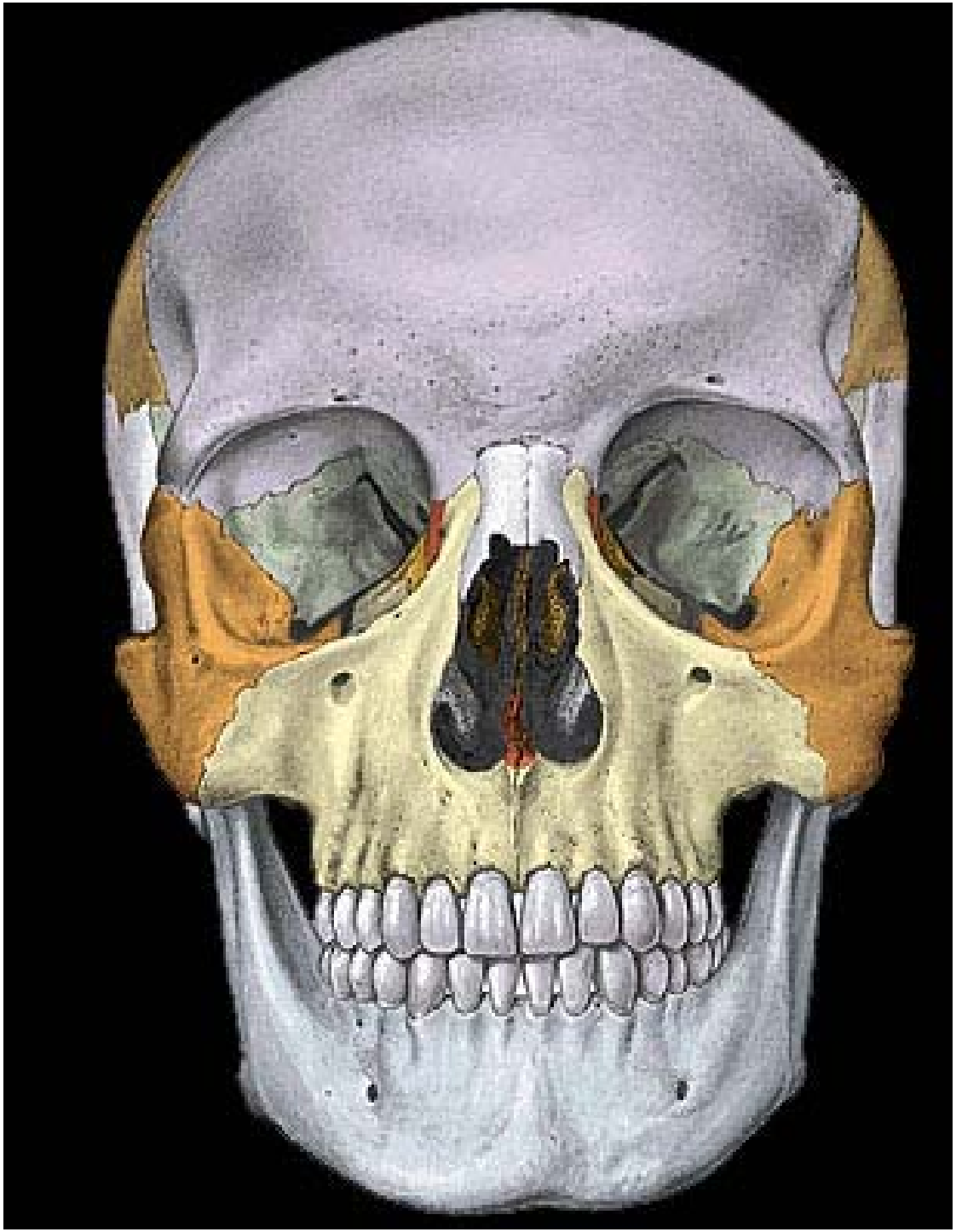
- Motor nerve to muscles of the mandibular arch: masseter, temporalis, anterior and posterior pterygoids, mylohyoid, tensor tympani, anterior digastric, and tensor veli palatini.

- The auriculotemporal branch contains secretomotor fibers to the parotid gland via the parotid branches.

Cranial Nerve V



VII



Cranial Nerve VII

The Facial Nerve

Both

Motor and sensory

Cranial Nerve VII

The Facial Nerve

Both motor and sensory

Muscles of facial expression

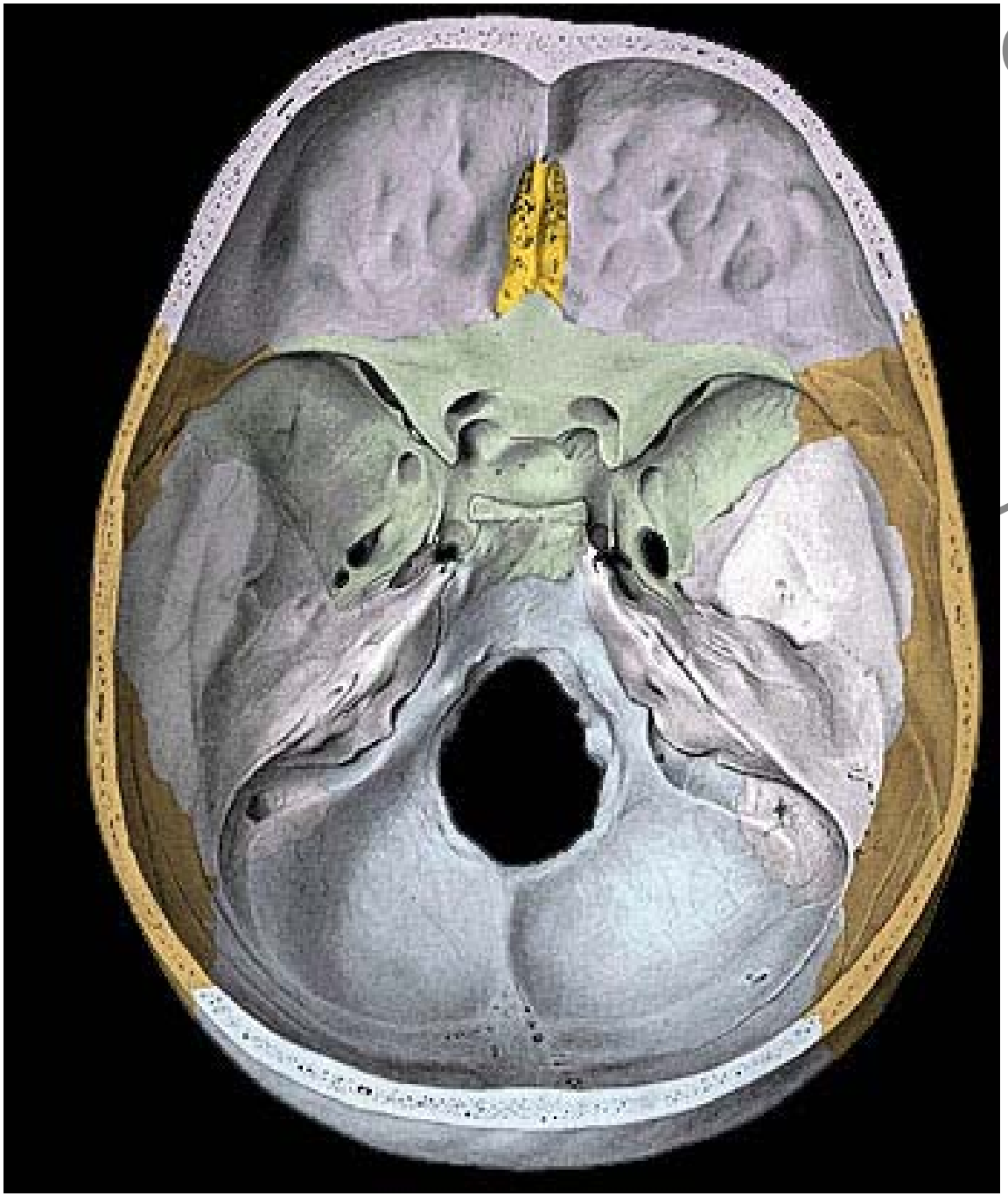
Parasympathetic:

Lacrimal ducts, taste, salivary glands

Cranial Nerve VII

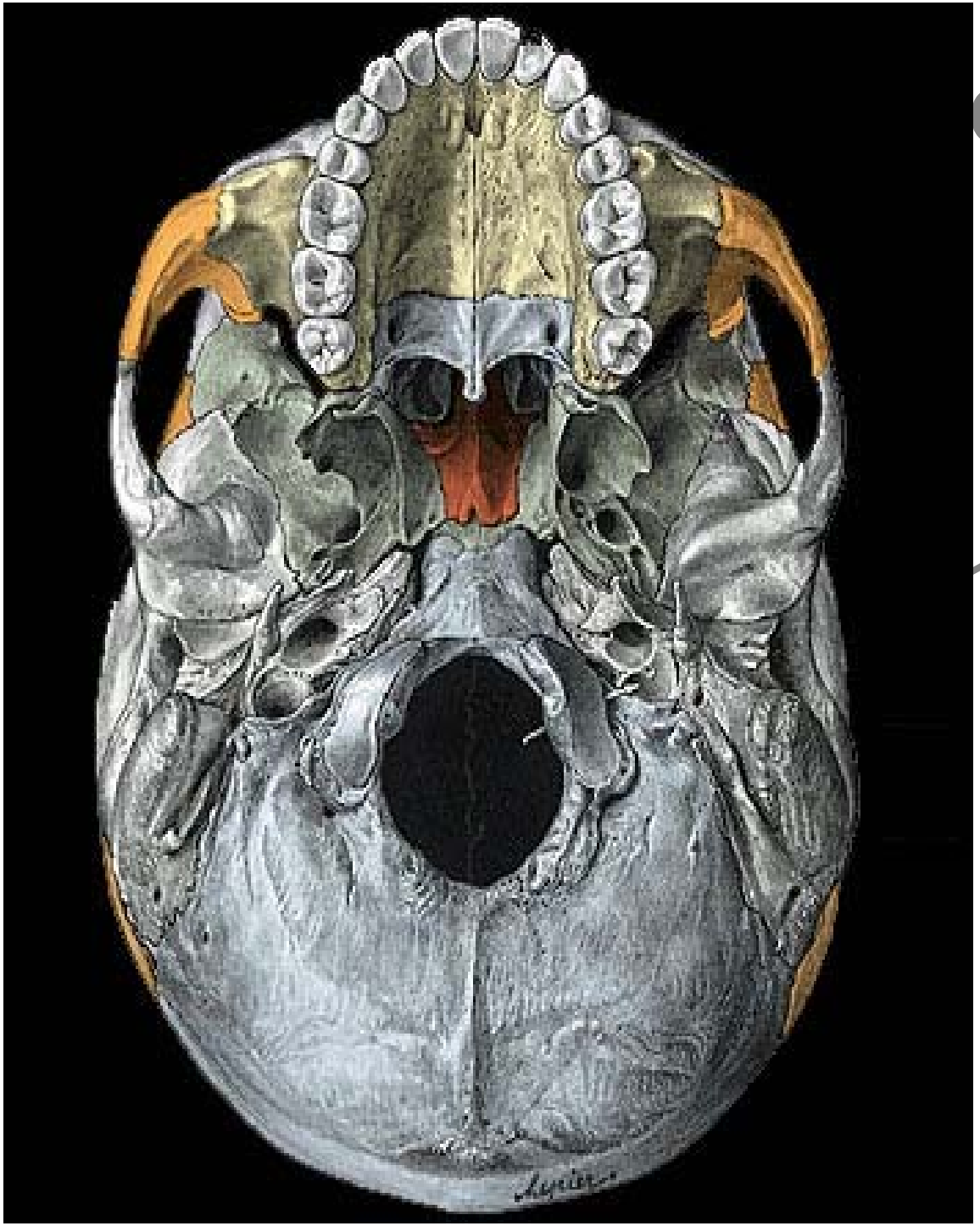
The Facial Nerve

VII_a Temporal
VII_b Zygomatic
VII_c Buccal
VII_d Mandibular
VII_e Cervical



Cranial Nerve VII

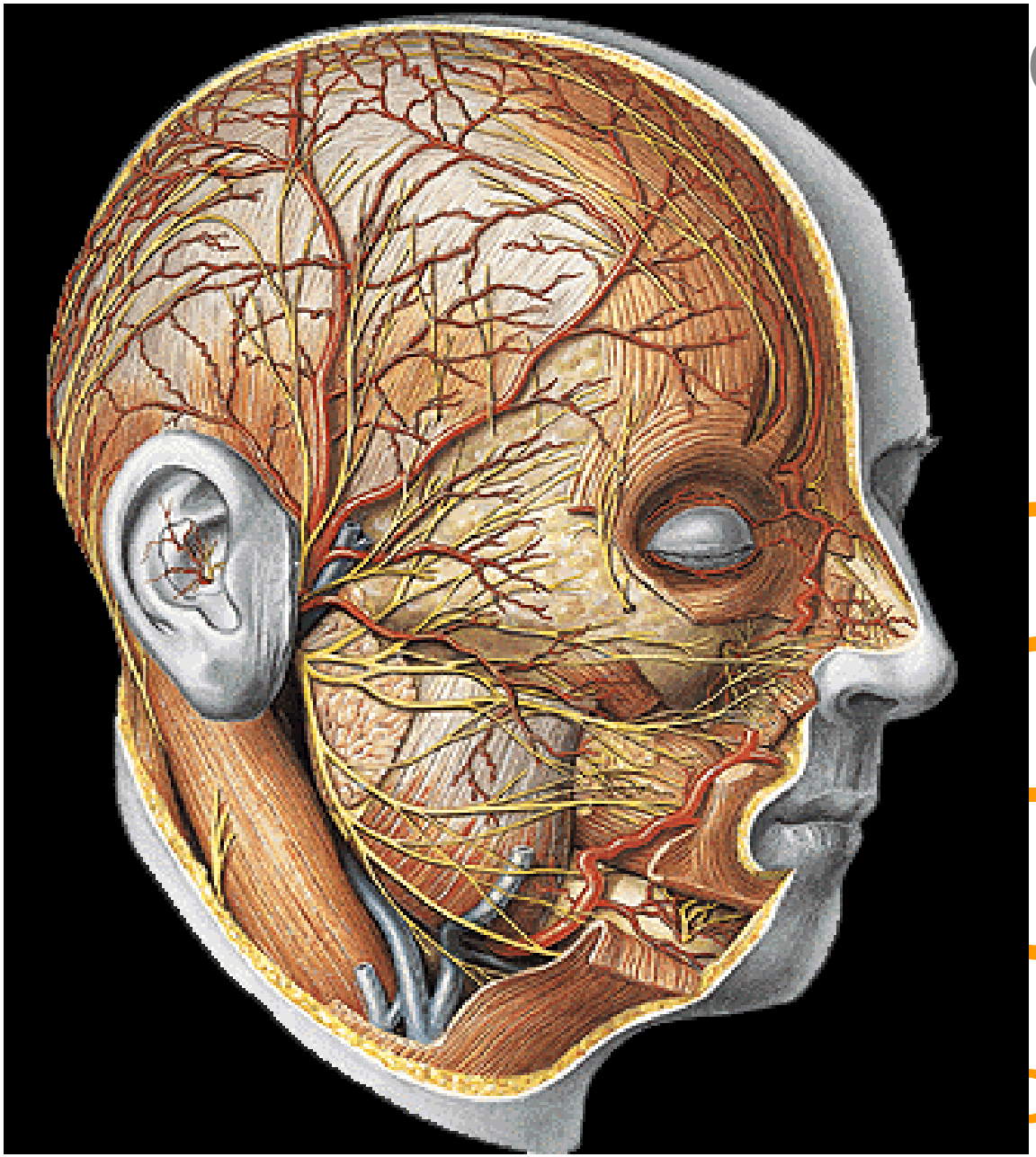
Enter skull via internal auditory meatus



Cranial Nerve VII

Exit skull via stylomastoid foramen

Cranial Nerve VII



a Temporal

b Zygomatic

c Buccal

d Mandibular

Cervical

Detail on Facial (VII) Function:

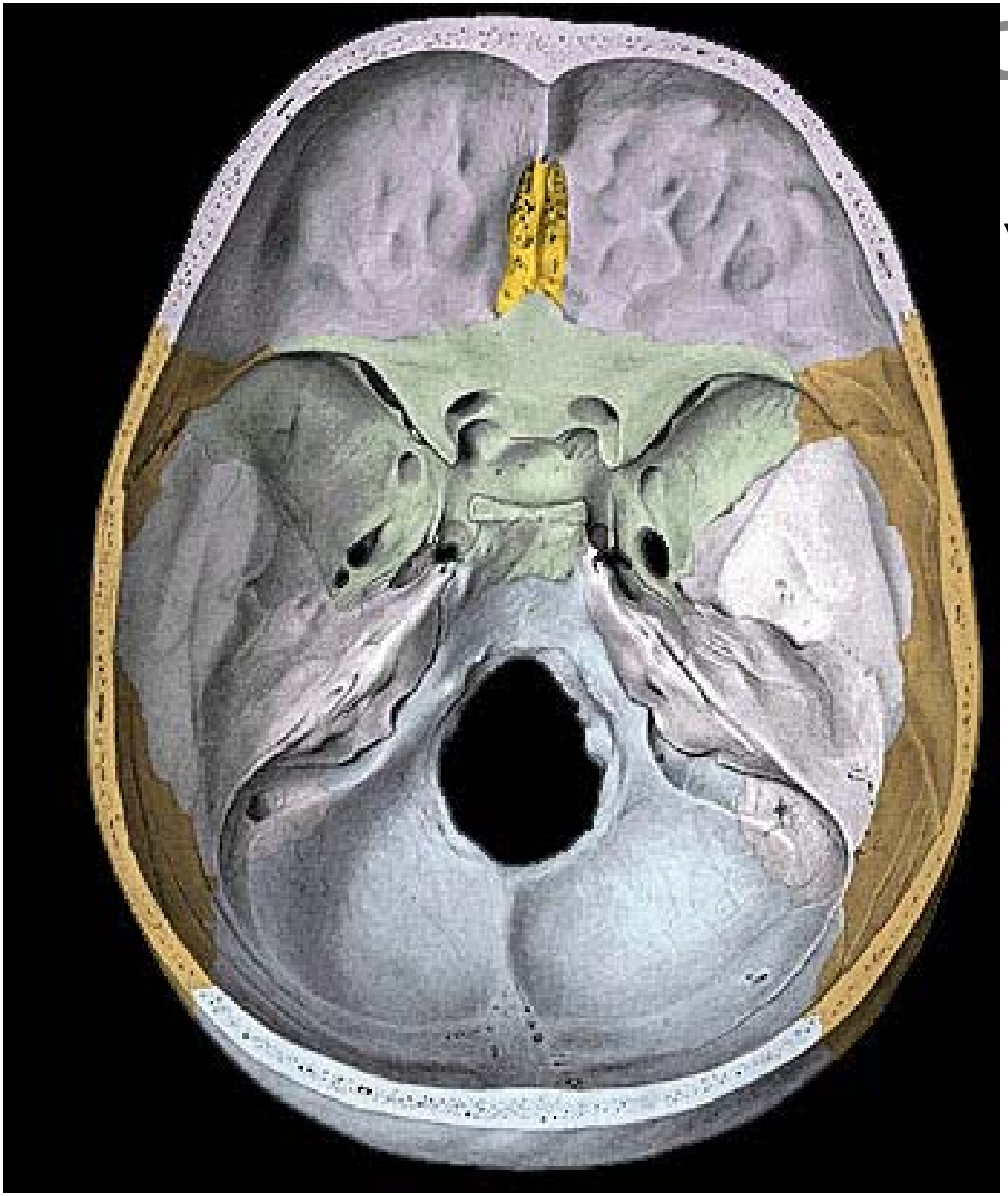
- Motor to muscles of the hyoid arch: posterior digastric, mm. of facial expression.

- Sends parasympathetic fibers via greater petrosal branch and pterygopalatine ganglion to lacrimal gland (secretomotor fibers).

- It may also supply parasympathetic innervation to palatine, pharyngeal, and nasal glands.

VIII

An Evolutionary Branch of VII



Cranial Nerve VIII

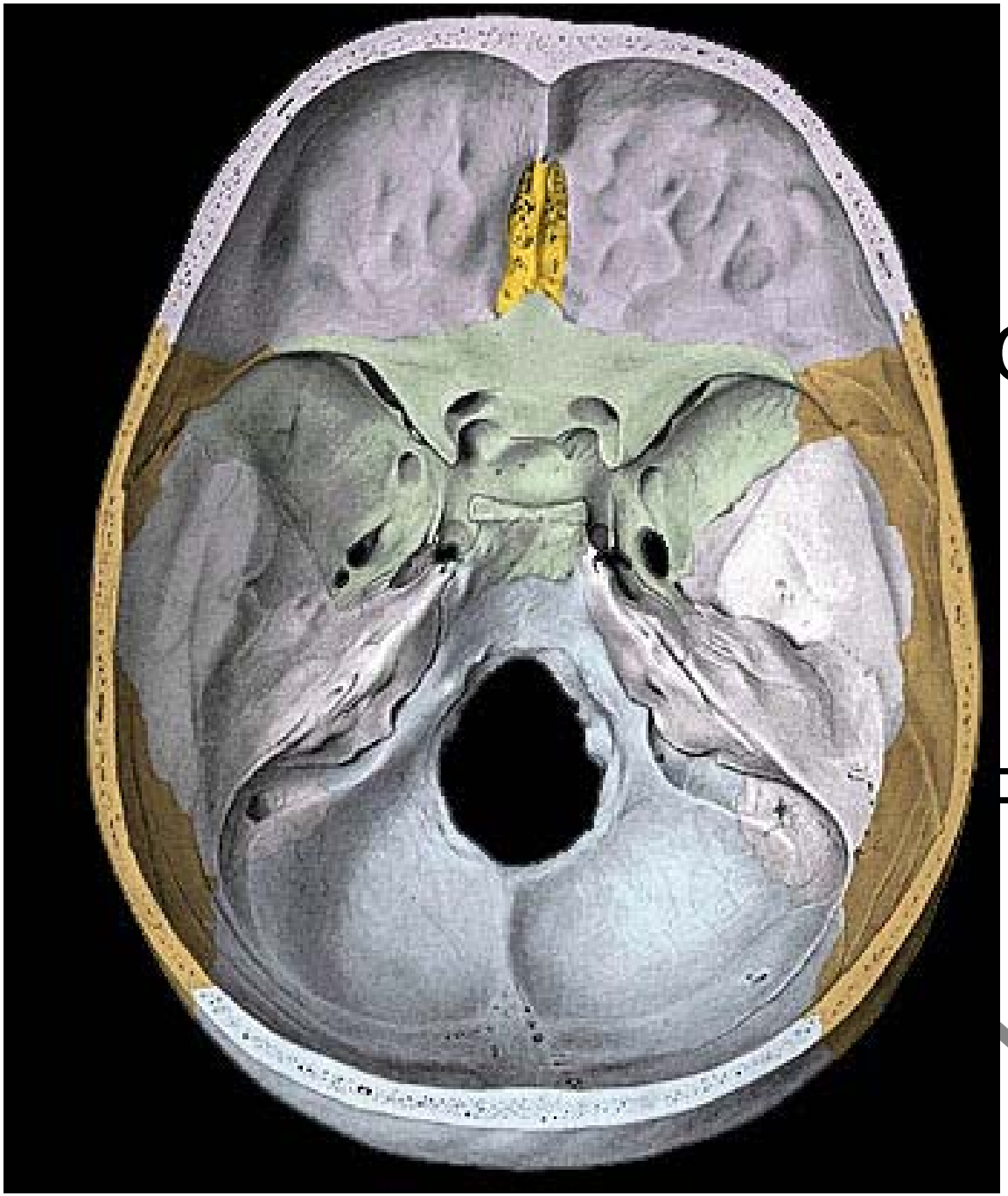
Vestibulocochlear Nerve

Sensory

Hearing

Internal Auditory Meatus

IX



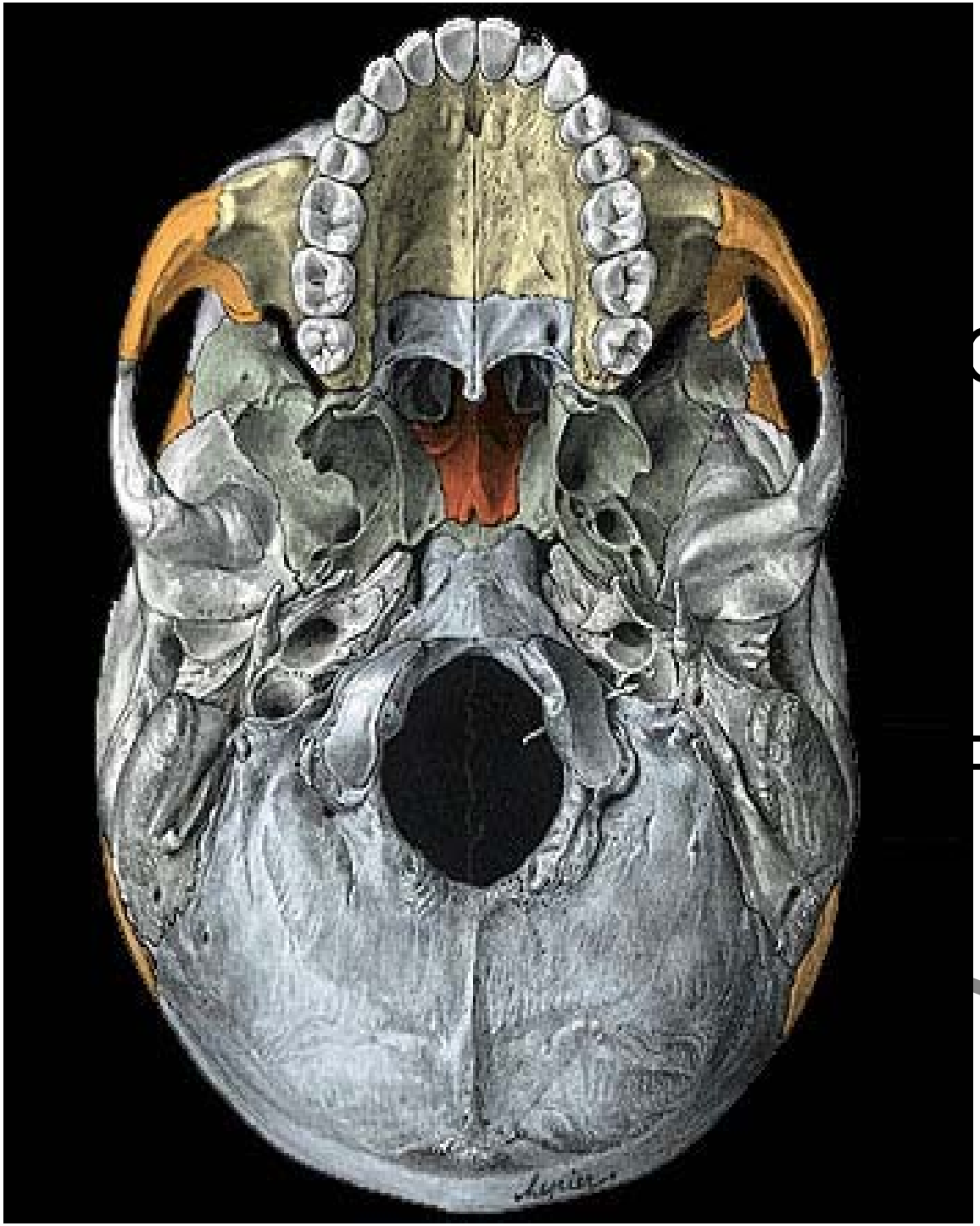
Cranial Nerve IX

The Glossopharyngeal Nerve

Both

Pharynx, posterior tongue

Jugular foramen



Cranial Nerve IX

The Glossopharyngeal Nerve

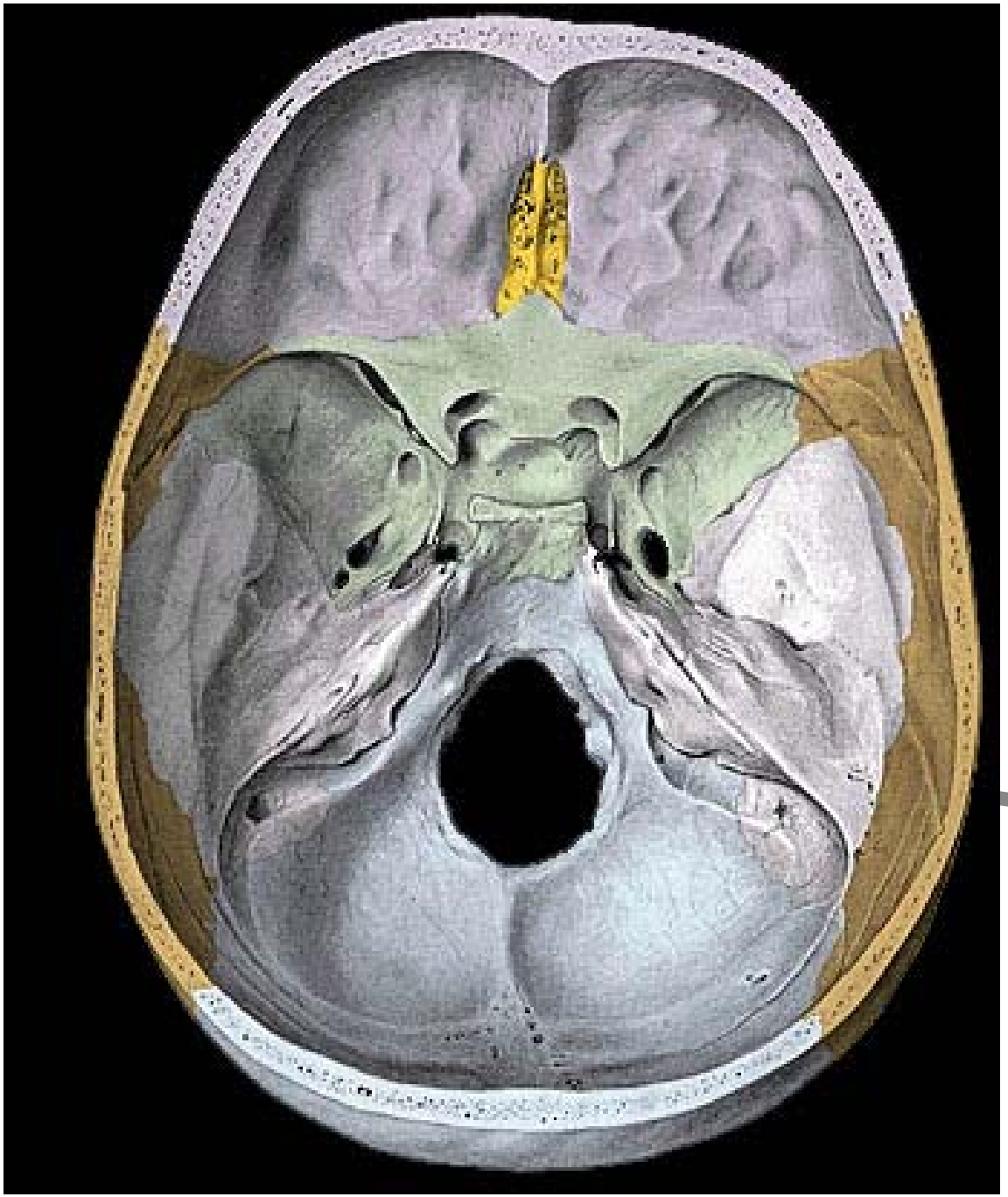
Both

Pharynx, posterior tongue

Jugular foramen

Detail on Glossopharyngeal (IX) Function:

- Motor to stylopharyngeus muscle.
- Parasympathetic secretomotor fibers to parotid gland.
- Sensory to pharynx, tonsils, and posterior 1/3 of tongue.
- Taste fibers for posterior 1/3 of tongue.



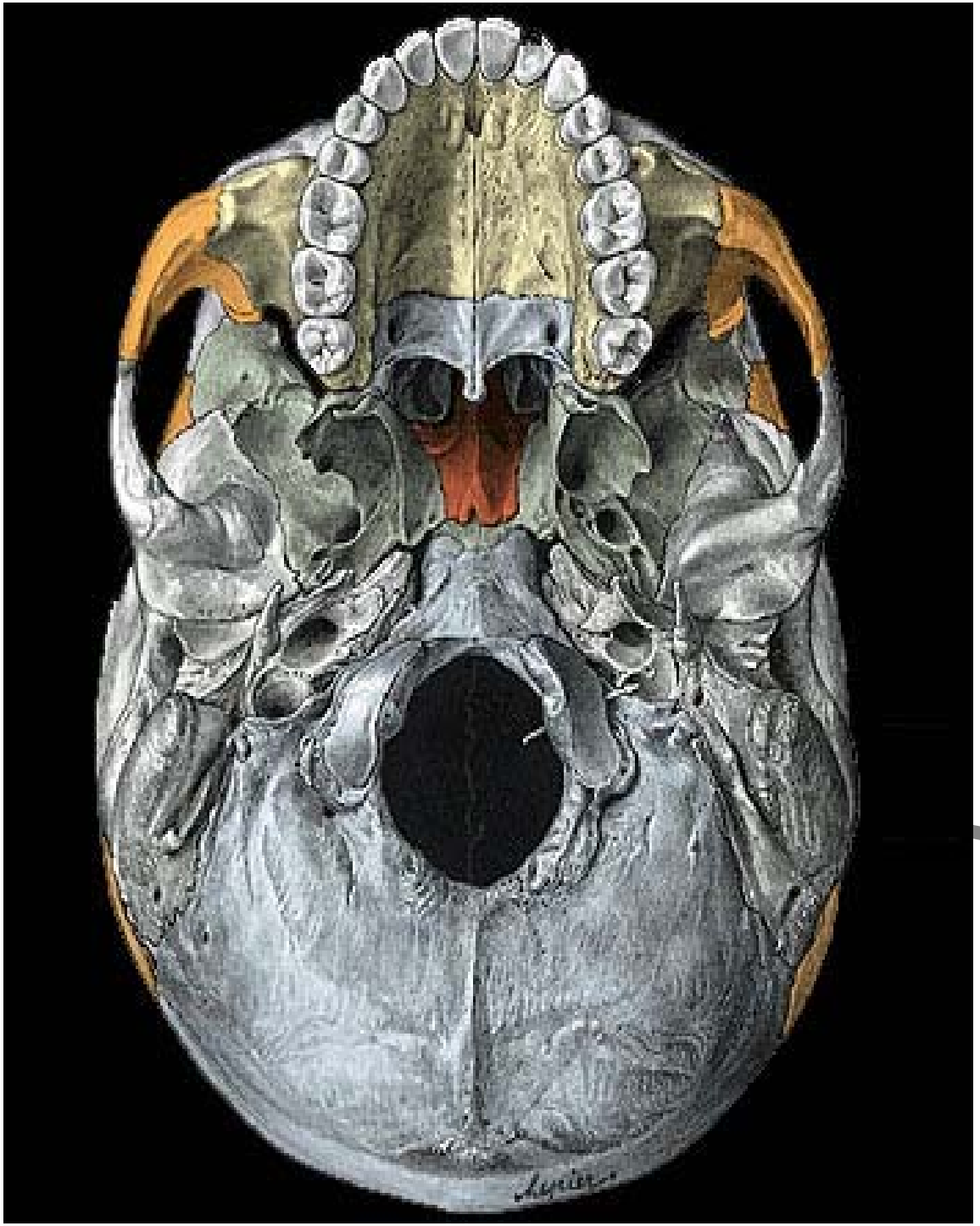
Cranial Nerve X

The Vagus Nerve

Both

Throat to end of midgut

Jugular foramen



Cranial Nerve X

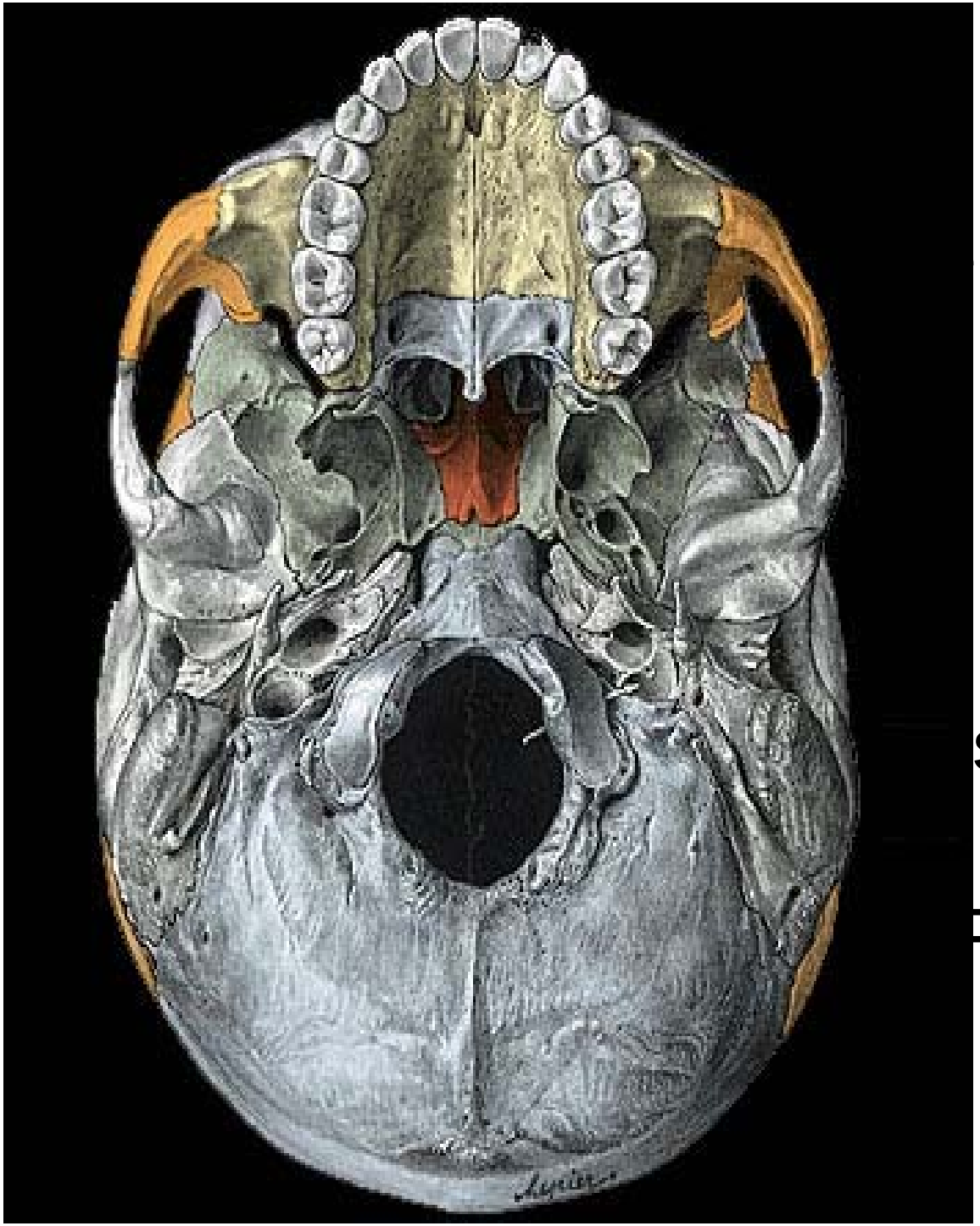
The Vagus Nerve

Both

Throat to end of midgut

Jugular foramen

An Evolutionary Branch of X



Cranial Nerve XI

Accessory Nerve

Mainly Motor

larynx, pharynx, trapezius and sternocleidomastoid

Foramen Magnum

Names

I	Olfactory			
II	Optic			
III	Occulomotor			
IV	Trochlear			
V	Trigeminal			
VI	Abducens			
VII	Facial			
VIII	Vestibulochochlar			
IX	Glossopharyngeal			
X	Vagus			
XI	Accessory			
XII	Hypoglossal			

Motor, sensory, or both

I	Sp. Sense	Sensory		
II	Sp. Sense	Sensory		
III	Ventral Rt.	Mainly motor		
IV	Ventral Rt.	Mainly motor		
V	Dorsal Rt.	Both		
VI	Ventral Rt.	Mainly motor		
VII	Dorsal Rt.	Both		
VIII	Sp. Sense	Sensory		
IX	Dorsal Rt.	Both		
X	Dorsal Rt.	Both		
XI	Dorsal Rt.	Mainly motor		
XII	Ventral Rt.	Mainly motor		

Route

I		**SENSORY**	**Cribriform plate**	
II		**SENSORY**	**Optic Canal**	

III		MAINLY MOTOR	Superior orbital fissure	
IV		MAINLY MOTOR	Superior orbital fissure	
V		BOTH	Superior orbital fissure	
VI		MAINLY MOTOR	Superior orbital fissure	

III		MAINLY MOTOR	Superior orbital fissure	
IV		MAINLY MOTOR	Superior orbital fissure	
V		BOTH	Superior orbital fissure	
VI		MAINLY MOTOR	Superior orbital fissure	

III		MAINLY MOTOR	Superior orbital fissure	
IV		MAINLY MOTOR	Superior orbital fissure	
V		BOTH V1 V2 V3	•Superior orbital fissure •Foramen Rotundum •Foramen Ovale	
VI		MAINLY MOTOR	Superior orbital fissure	

VII		**BOTH**	**Internal Auditory meatus**	
VIII		**SENSORY**	**Internal Auditory meatus**	

VII		**B**	**•Internal Auditory meatus** **•Exits through stylomastoid foramen**	
VIII		**SENSORY**	**Internal Auditory meatus**	

IX		BOTH	Jugular foramen	
X		BOTH	Jugular foramen	

XI		**MAINLY MOTOR**	**Foramen Magnum**	
XII		**MAINLY MOTOR**	**Hypoglossal Canal**	

Functional Summary

(Note other details)

I	**OLFACTORY**	**SENSORY**	**CRIBRIFORM PLATE**	**SMELL**

II	OPTIC	SENSORY	OPTIC CANAL	Vision

III	**OCCULOMOTOR**	**MAINLY MOTOR**	**SUPERIOR ORBITAL FISSURE**	**Focusing**

IV	**TROCHLEAR**	**MAINLY MOTOR**	**SUPERIOR ORBITAL FISSURE**	**Superior obliques**

V	TRIGEMINAL	BOTH	SUPERIOR ORBITAL FISSURE FORAMEN OVALE FORAMEN ROTUNDUM	Ophthalmic, maxillary, mandibular

VI	**ABDUCENS**	**MAINLY MOTOR**	**SUPERIOR ORBITAL FISSURE**	**Lateral rectus**

VII	**FACIAL**	**BOTH**	**INTERNAL AUDITORY MEATUS** **EXITS THROUGH STYLO-MASTOID FORAMEN**	**Temporal** **Zygomatic** **Buccal** **Mandibular** **Cervical**

VIII	**AUDITORY**	**SENSORY**	**INTERNAL AUDITORY MEATUS**	**Hearing**

IX	**GLOSSO PHARYNGEAL**	**BOTH**	**JUGULAR FORAMEN**	**Taste, saliva, throat**

X	**VAGUS**	**BOTH**	**JUGULAR FORAMEN**	**Motor and Sensory. Parasympathetic from throat to end of midgut**

XI	**ACCESSORY**	**MAINLY MOTOR**	**FORAMEN MAGNUM**	**Trapezius, sterno-cleidomastoid, throat**

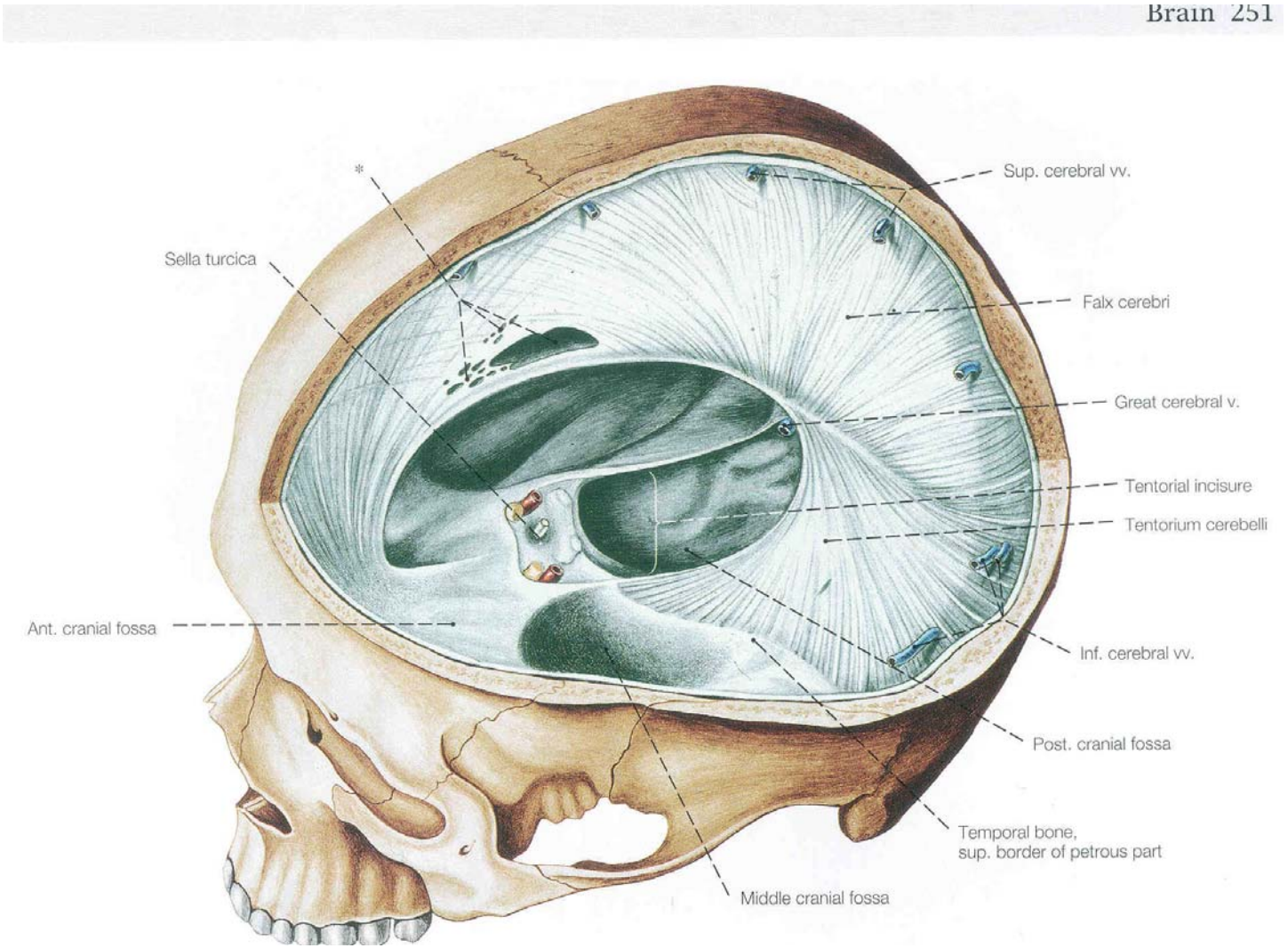
XII	**HYPOGLOSSAL**	**MAINLY MOTOR**	**HYPOGLOSSAL CANAL**	**Tongue and throat**

Meninges (All from Neural Crest)

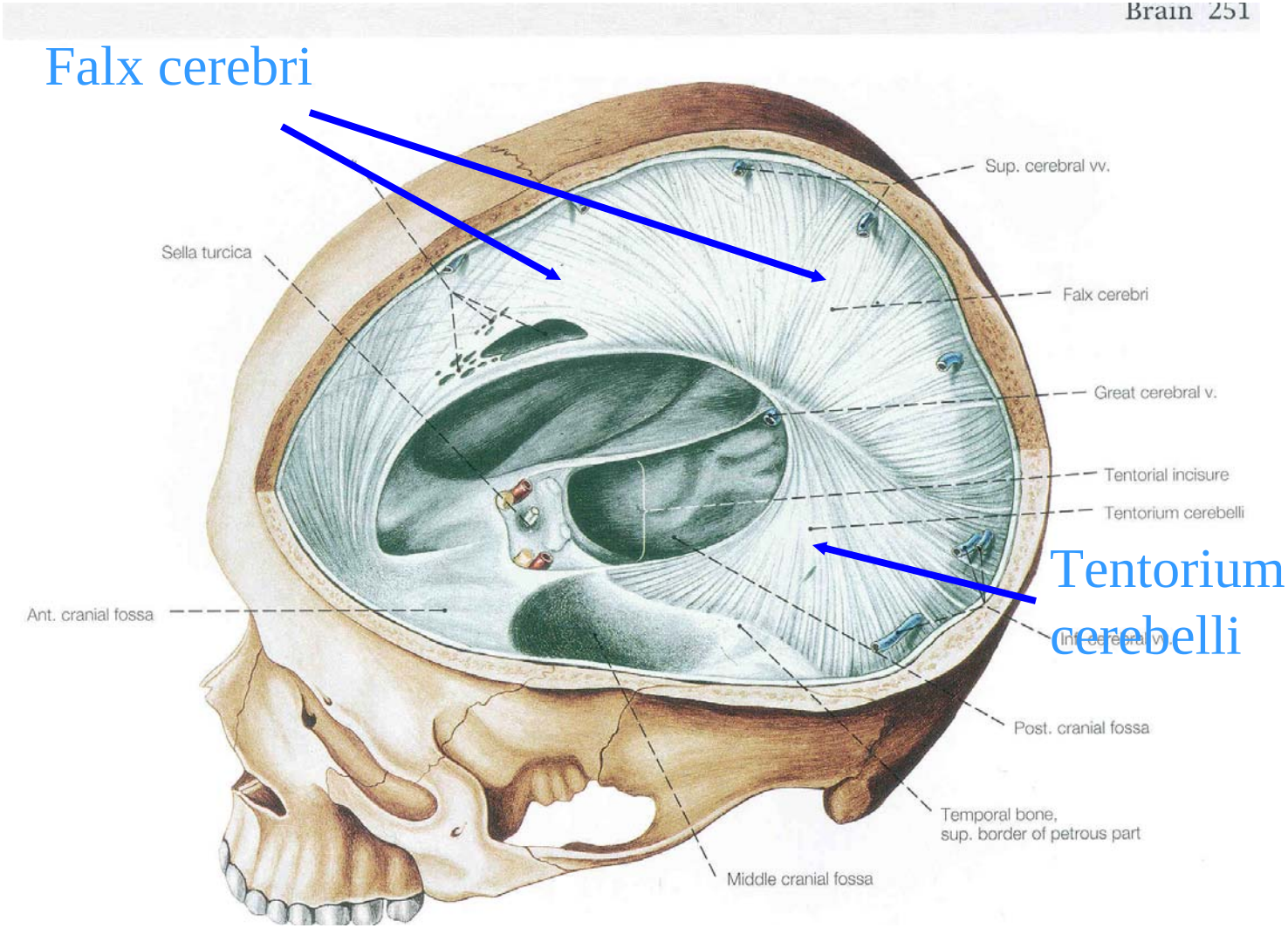
Outermost: *Dura mater*
Middle: *Arachnoid mater*
Deepest: *Pia mater*

Cerebrospinal fluid between Arachnoid and Pia mater

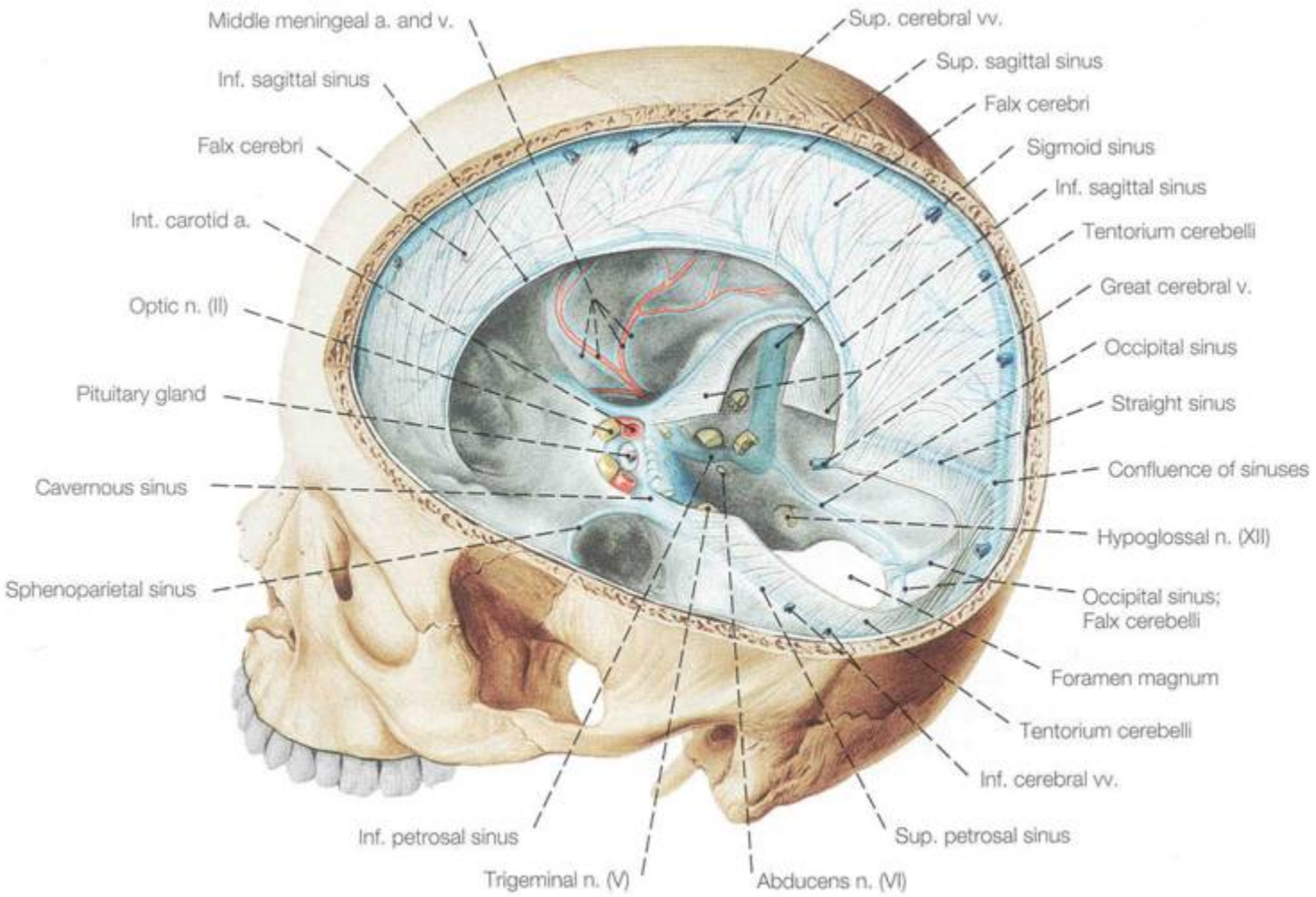
Meninges: *Dura mater*



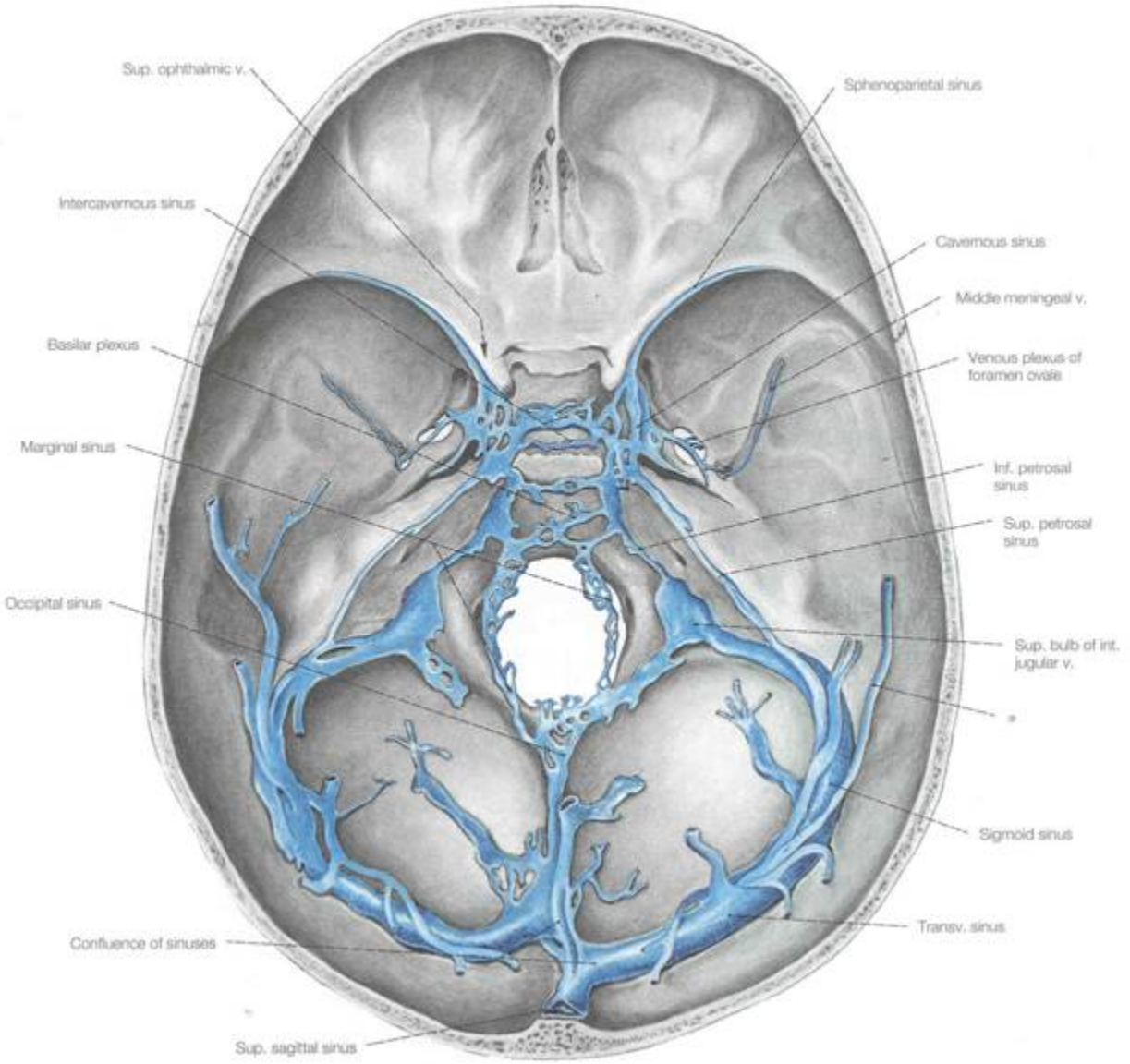
Dural Reflections



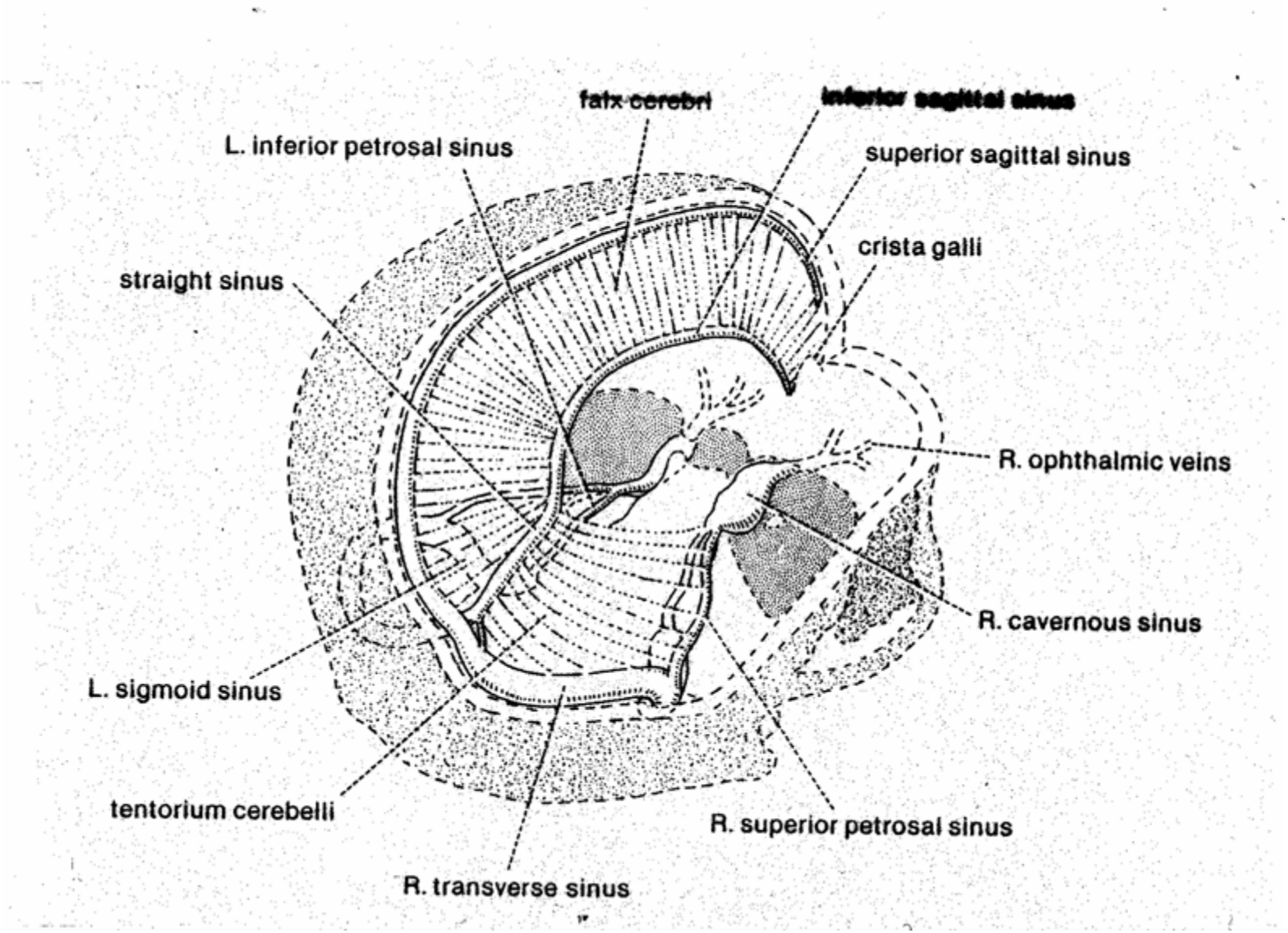
Vasculature: Venus Sinuses



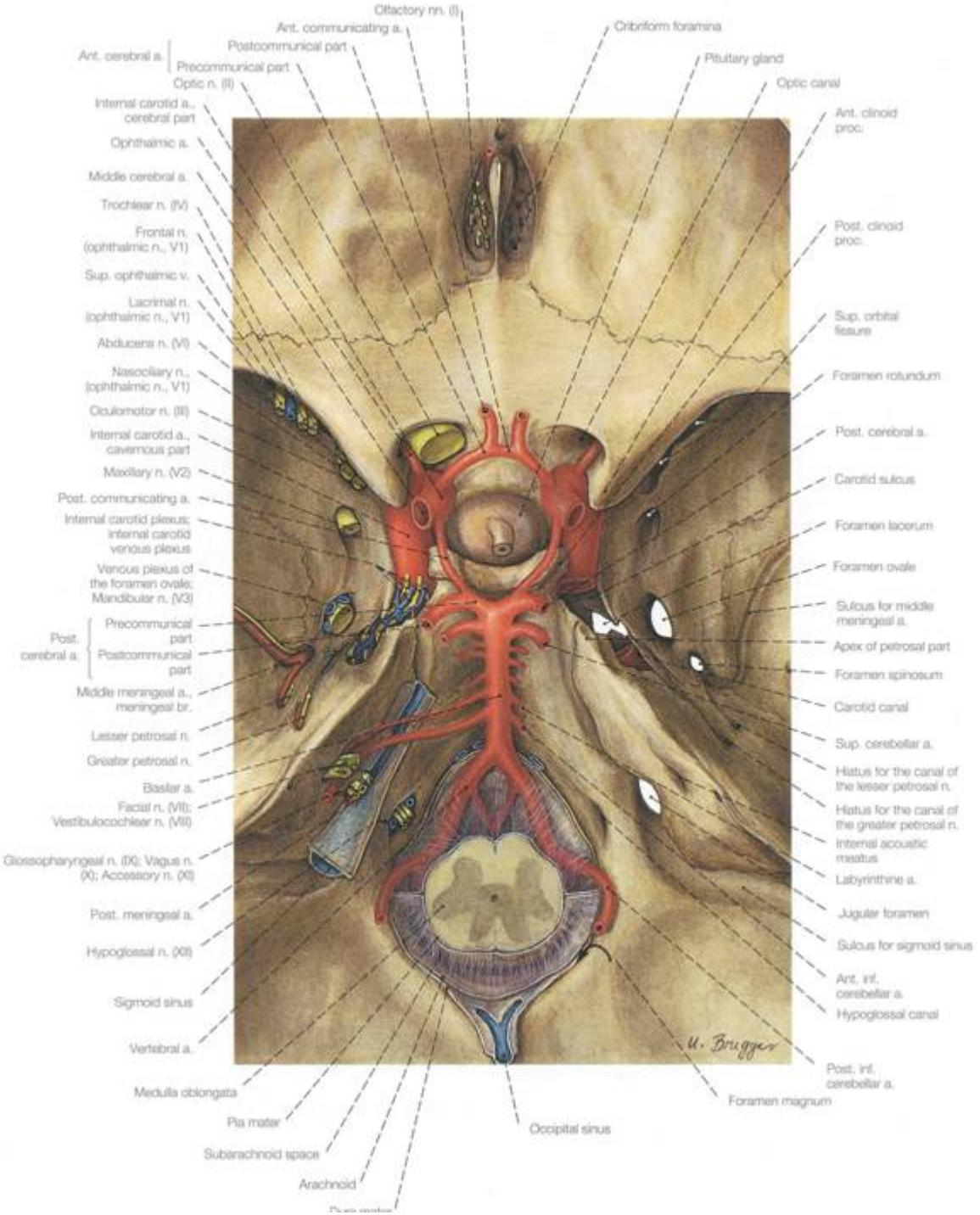
Vasculature: Venus Sinuses



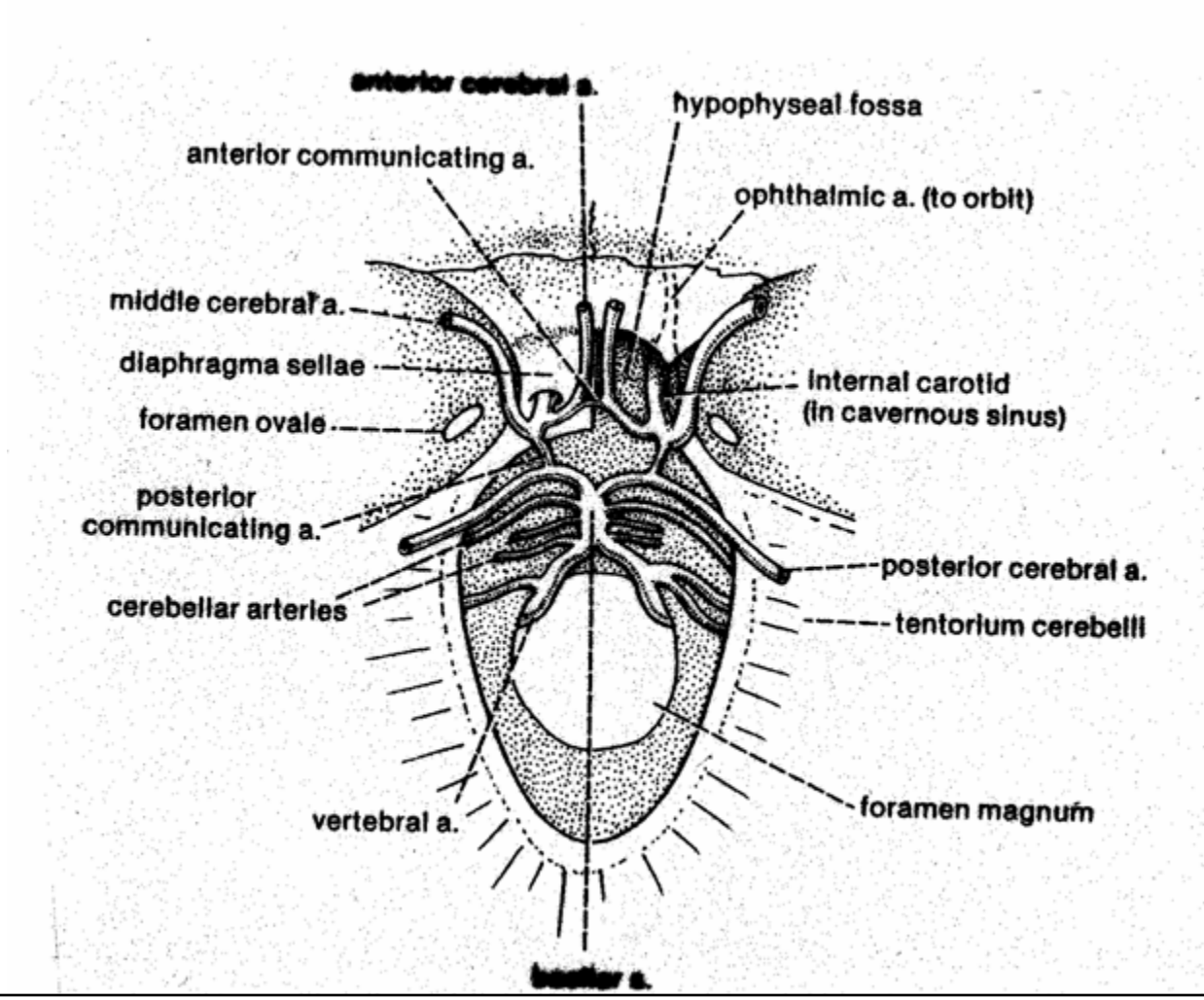
Vasculature: Venus Sinuses



Vasculature: Arterial Supply

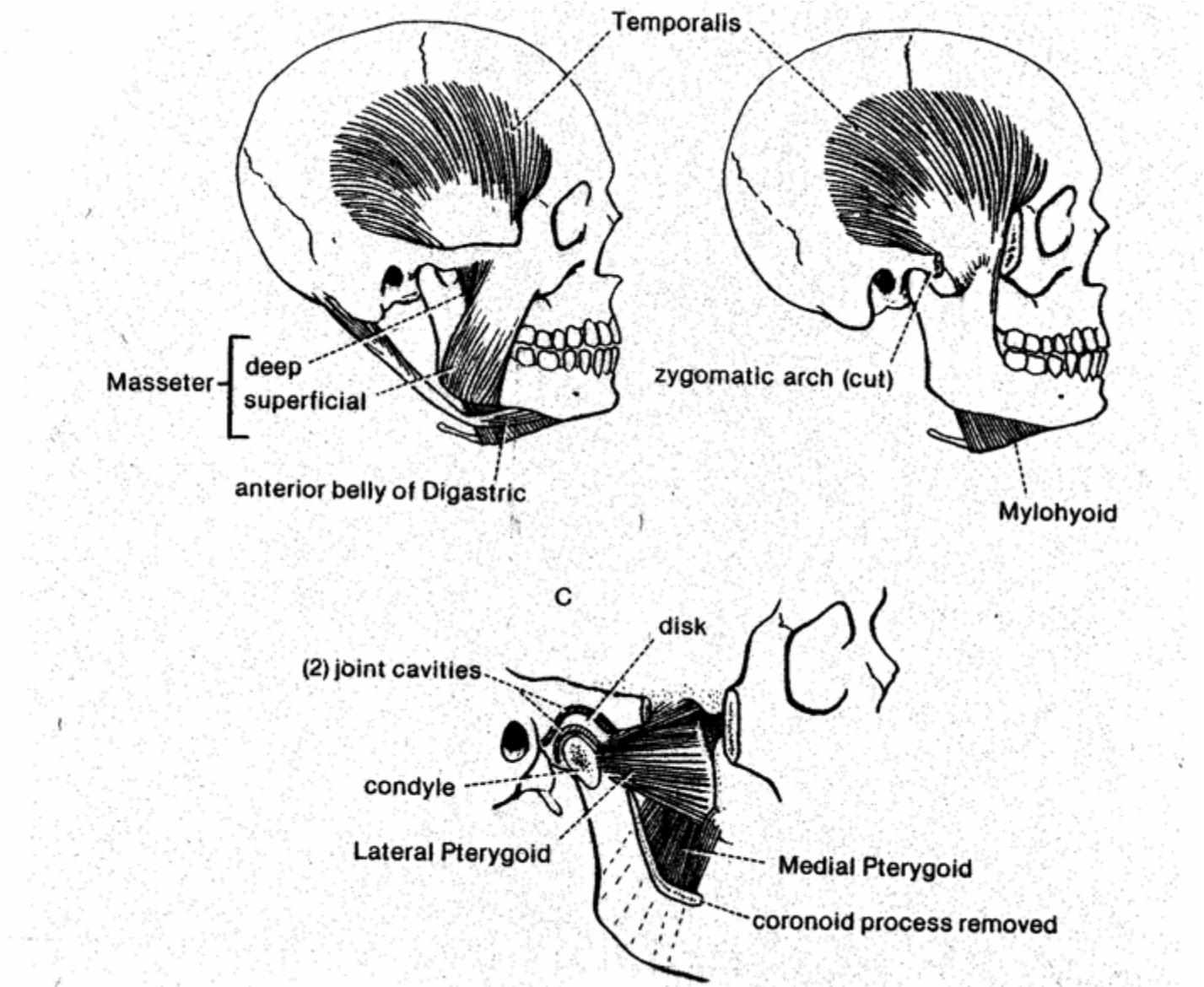


Vasculature: Arterial Supply



Muscle and Nerve Stuff…

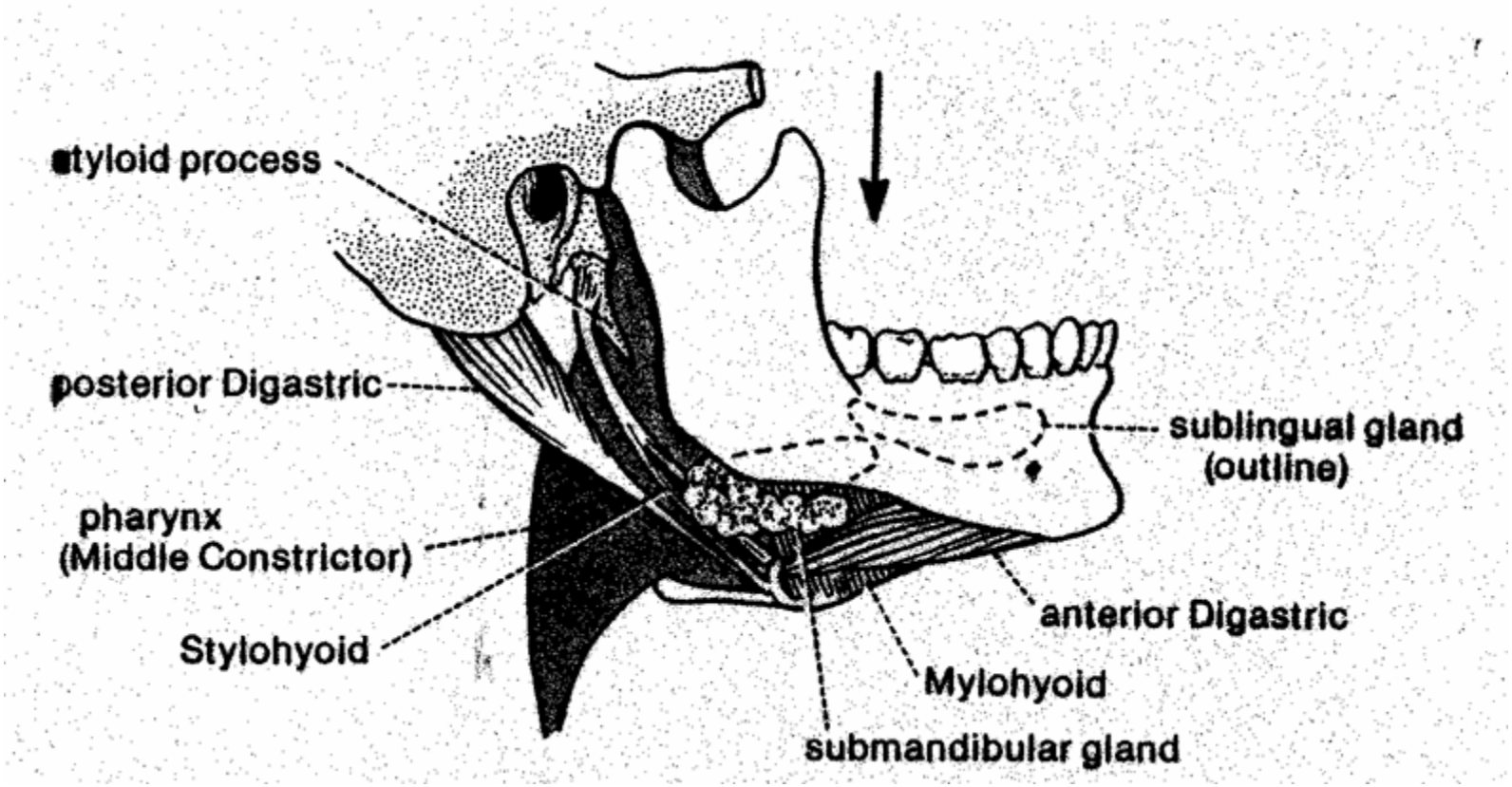
Jaw Moving Musculature:



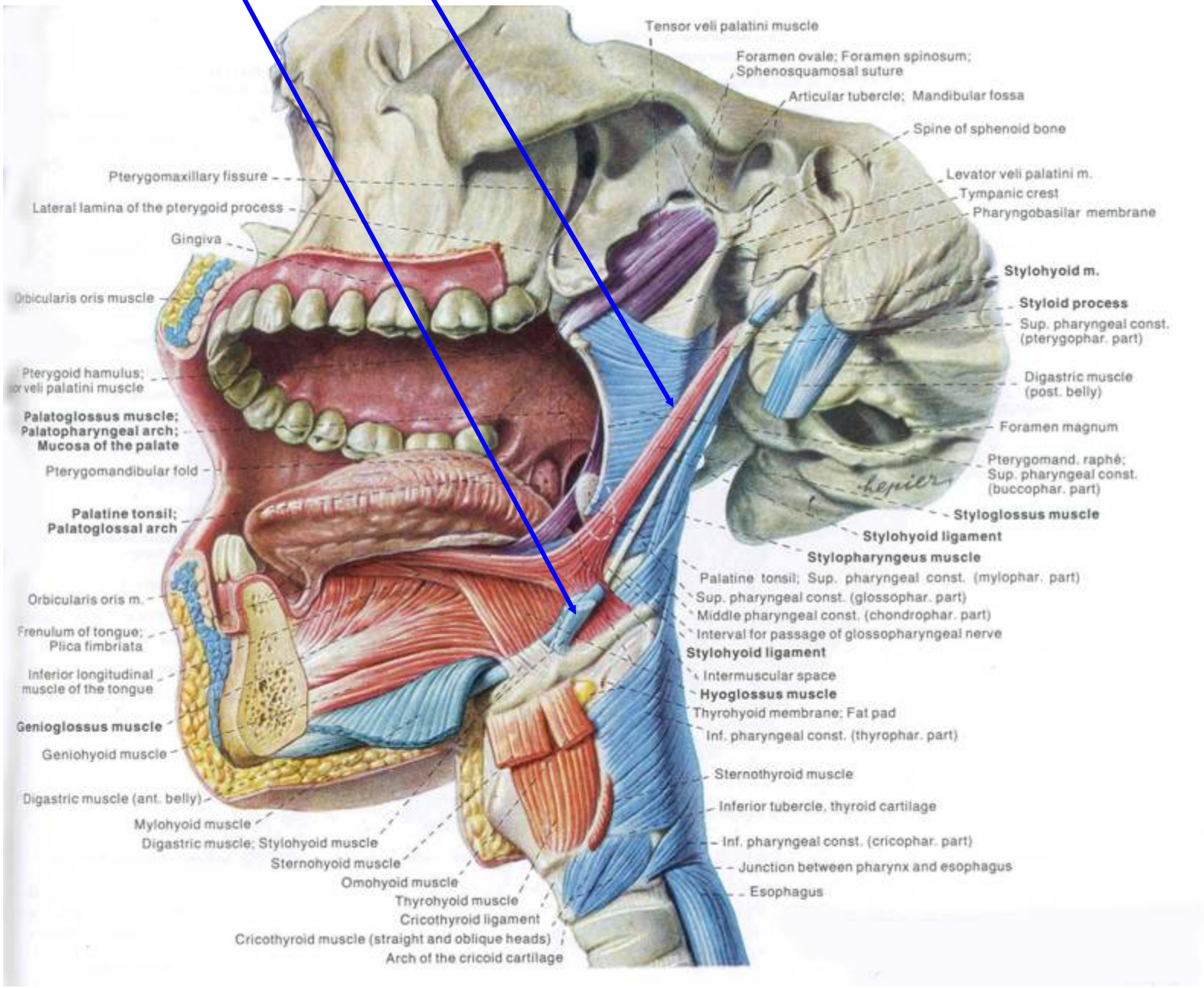
Jaw Opening Musculature: Diagastric Muscle

Anterior belly – innervated by Mandibular (V_3) nerve

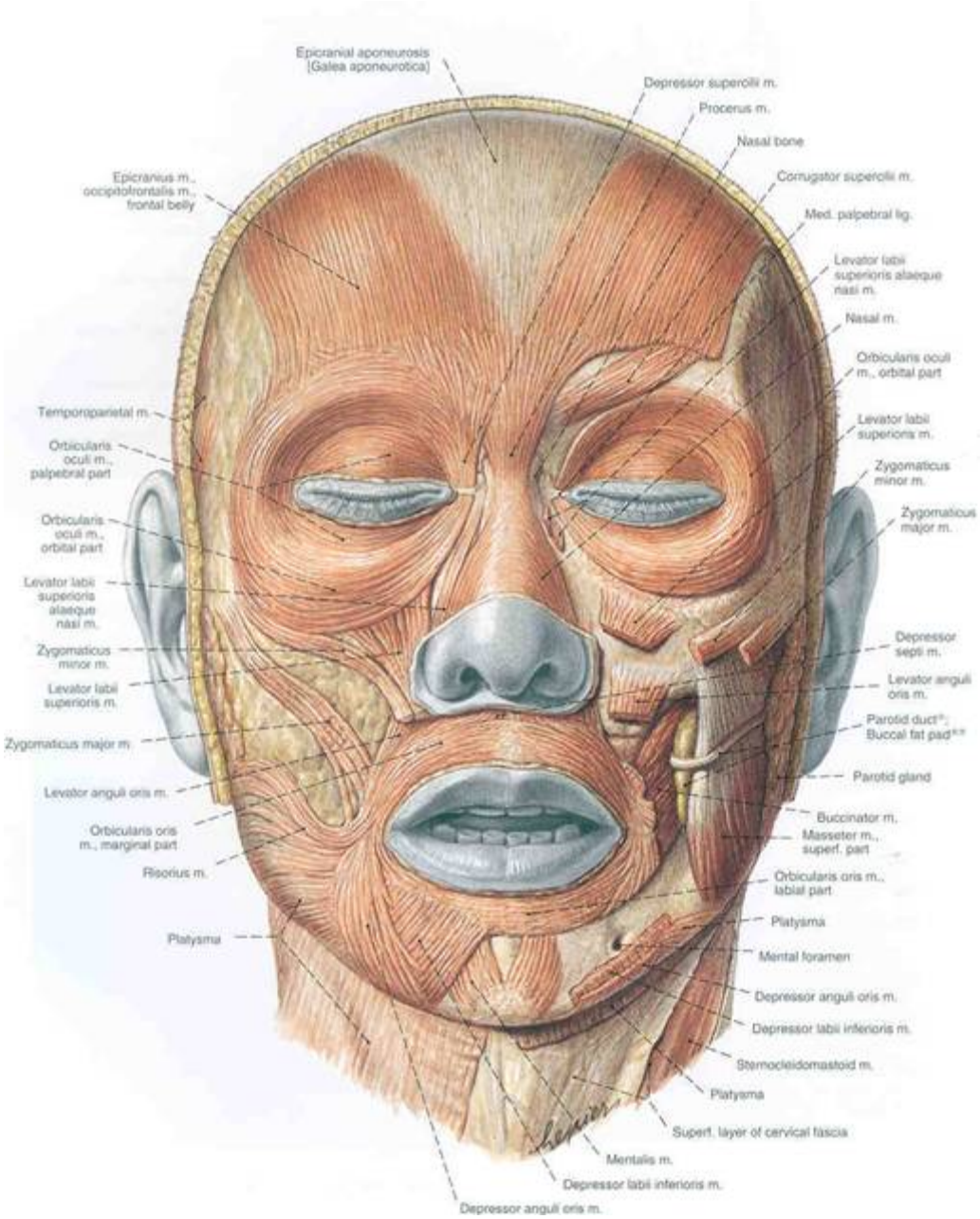
Posterior belly – innervated by Facial (VII) nerve



Note! Stylohyoid, styloglossus, tongue muscles in general.

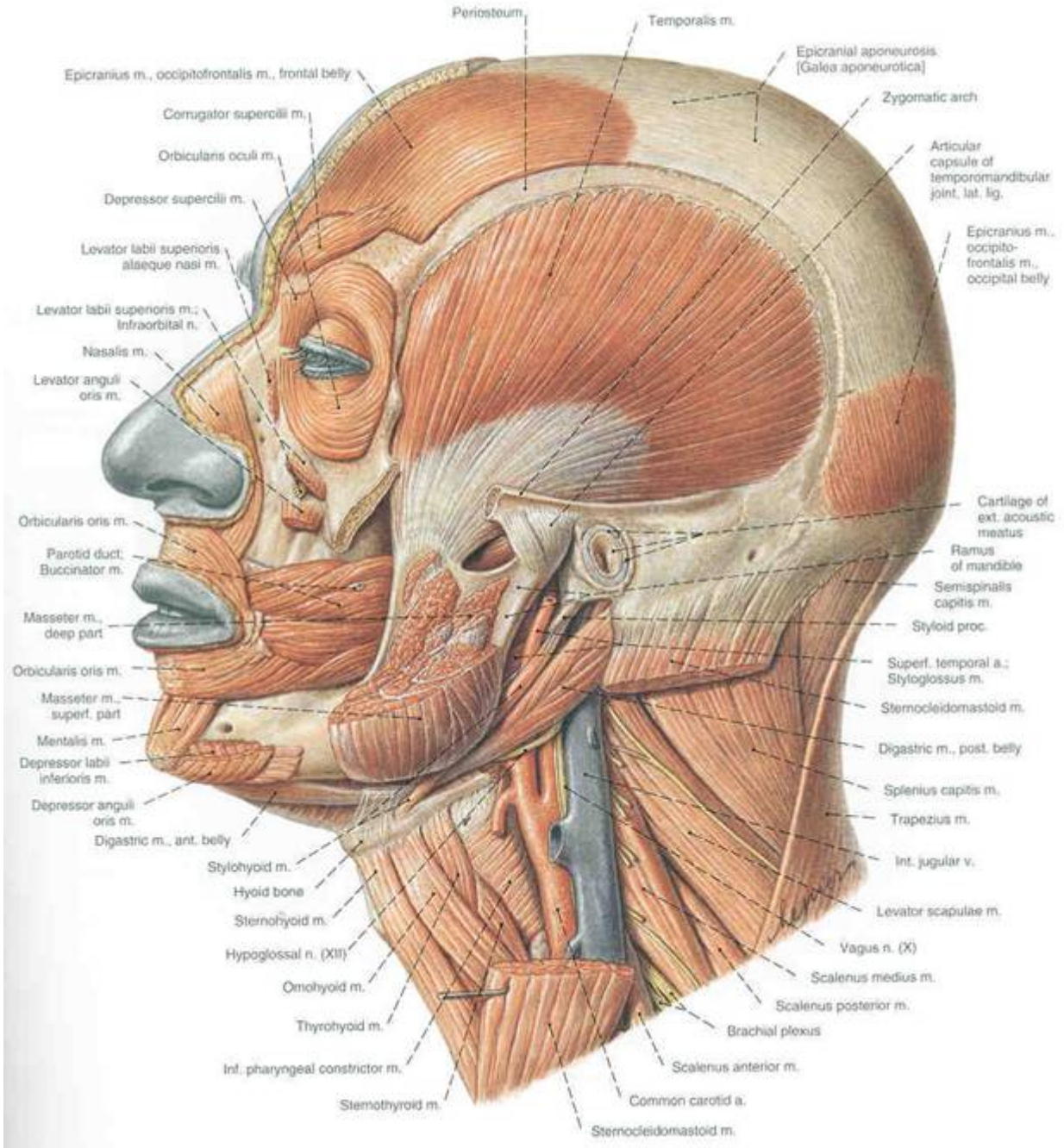


Superficial Facial Muscles (all innervated by VII)

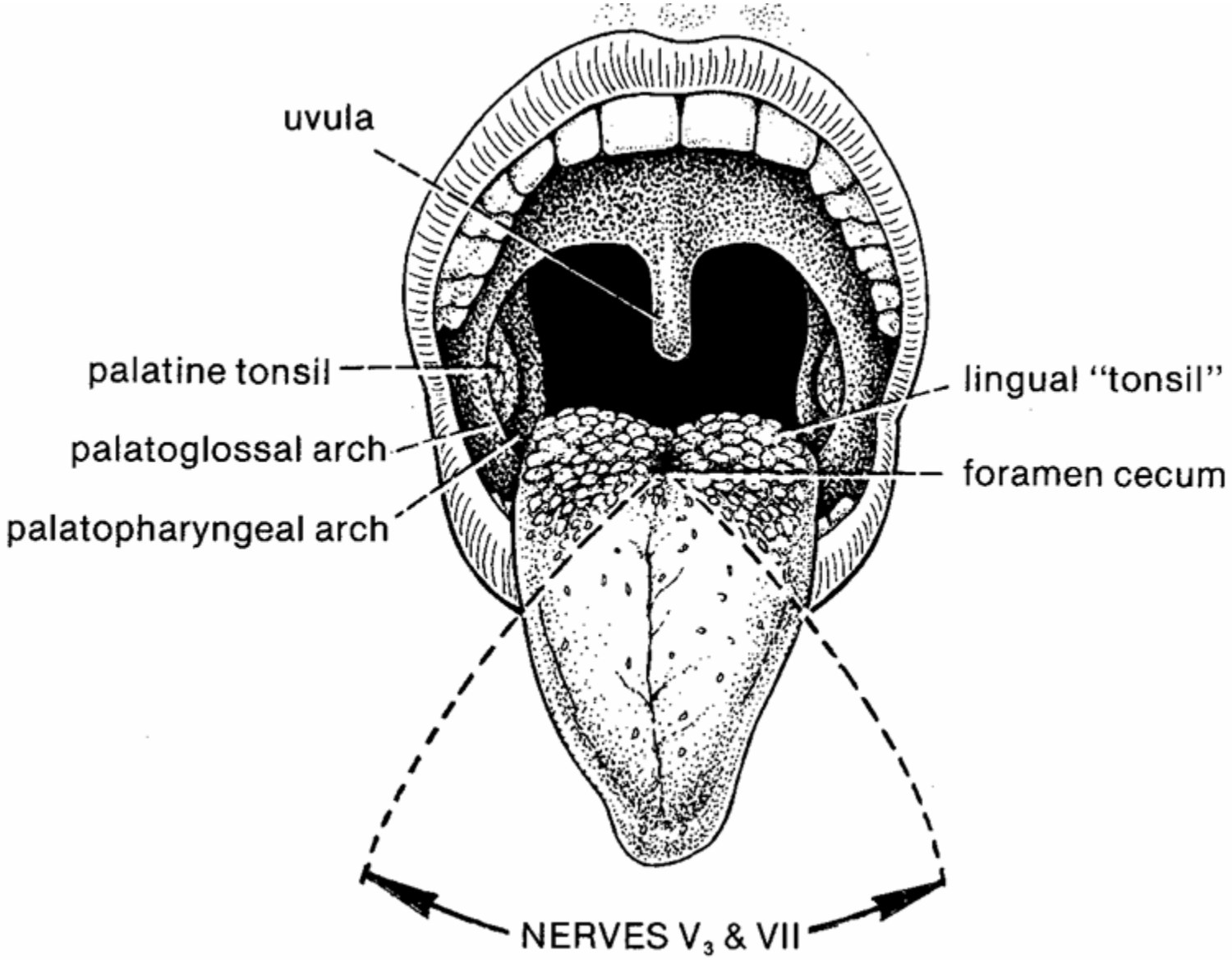


Some muscles of mastication (Innervated by V_3)

Deeper Facial Muscles (All innervated by VII)



Tongue: Surface



Extrenisc and Intrensic Tongue Muscles