

Lecture: 10

Anatomy and Physiology of the Facial and Vestibulo-Cochlear Nerves

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الرجاء تحويل الجوال إلى وضع
الصامت مع
الشكر



The Facial Nerve (VII)

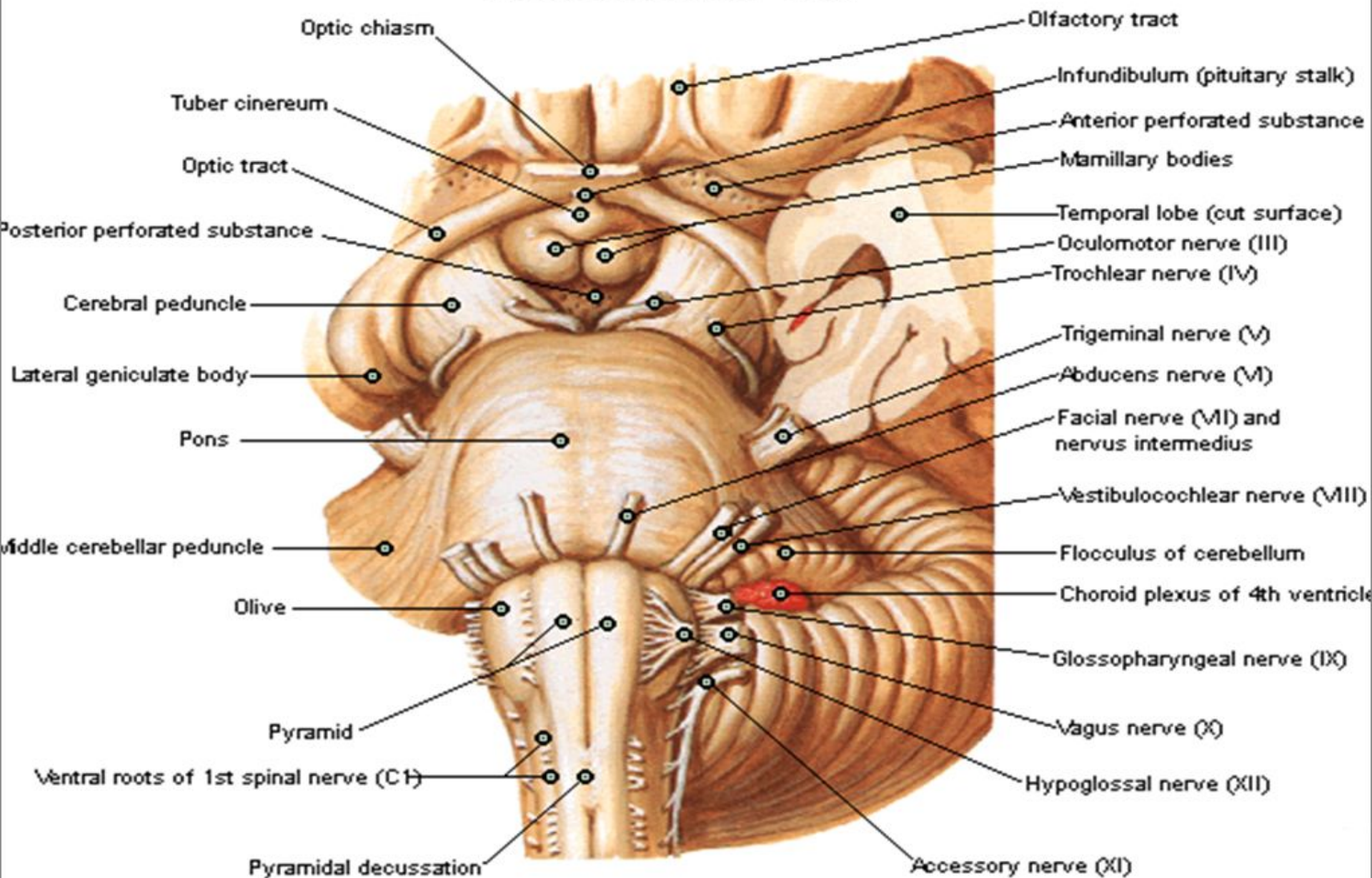
1. It is a mixed nerve which contains motor, sensory and parasympathetic fibers.
2. It is more important as **a motor** than as a sensory nerve.
3. It is **a mixed nerve** only while it is found inside the skull, but after leaves the skull it becomes **a purely motor nerve** and supplies muscles of facial expression.

Roots of the Facial Nerve

- **Facial Nerve (motor nerve):** is a purely motor nerve supplies all the muscles of face expression.
- **Nerve Intermedius:** consists of sensory and parasympathetic fibers.

Brainstem

Anterioinferior View



Nuclei of the Facial Nerve

1. **Facial motor nucleus (Motor):** lies in **the pons** and supplies the facial muscles.
2. **Superior salivary nucleus (Parasympathetic):** lies in **the pons** for:
 - a. Submandibular and sublingual salivary glands (**Chorda tympani nerve**).
 - b. Glands of the palate, nose, lacrimal glands and nasopharynx (**Greater superficial petrosal nerve**).
3. **Solitary nucleus:** lies in **the medulla oblongata** for:
 - General sensation from the skin of the external auricle and tympanic membrane.
 - Taste sensations from the anterior 2/3 of the tongue.

Function of the Facial Nerve

1. Motor function to muscles of facial expression.
2. Parasympathetic to all glands of head
(submandibular, sublingual and lacrimal glands)
except **the parotid gland** (glossopharyngeal nerve).
3. Sensory for skin of the external auricle and tympanic membrane.
4. Taste for anterior 2/3 of the tongue.

Parts of the Facial Nerve

1. **Intracranial Part:** the part which starts from the brain stem and ends at the internal auditory meatus.
2. **Intracanal (petrosal) Part:** the part which lies inside the petrous part (Facial canal or Fallopiian canal) of the temporal bone.
3. **Extracranial Part:** the part of the nerve after it comes out from the stylomastoid foramen.



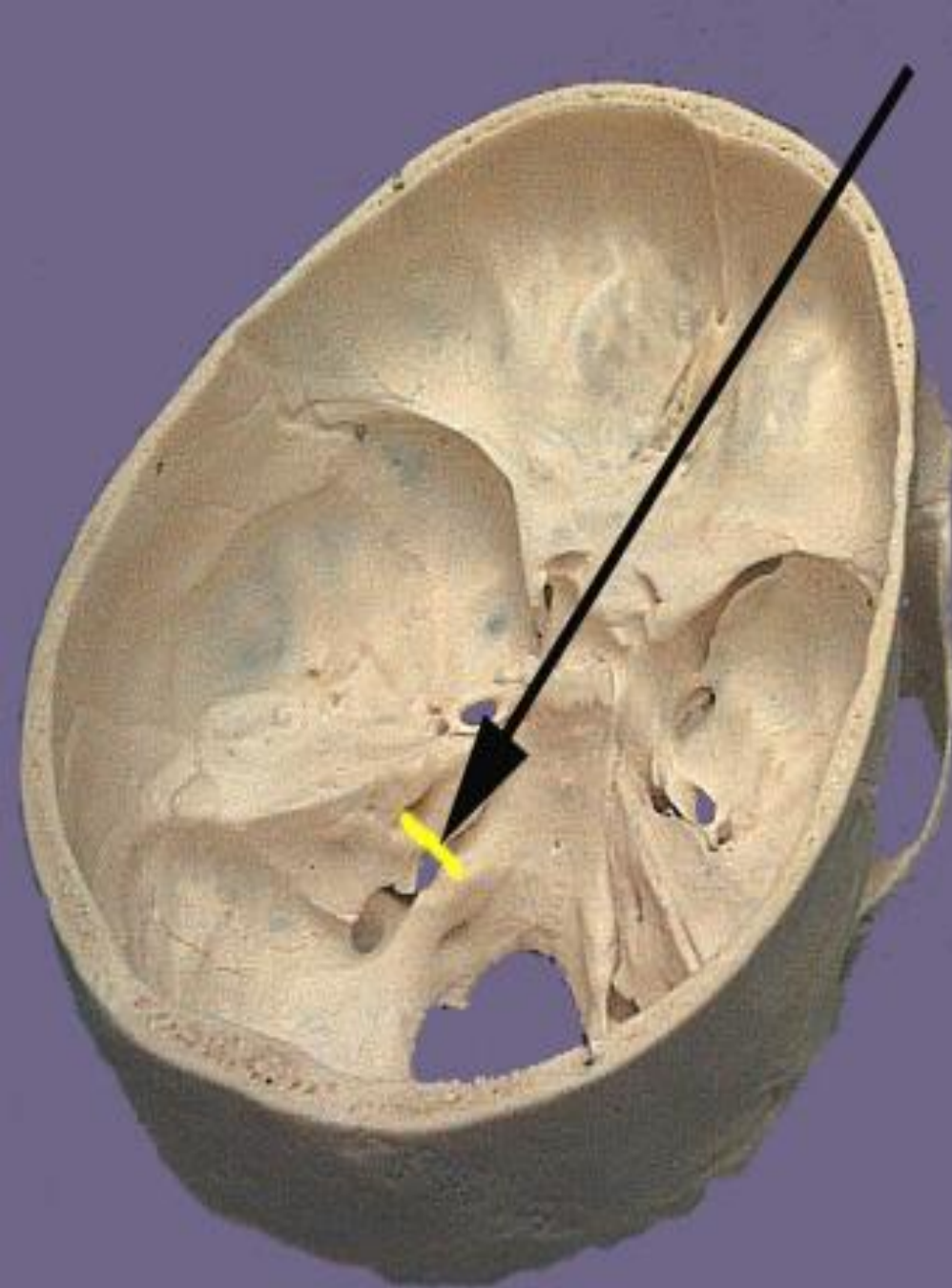
Course and Relations of the Facial Nerve

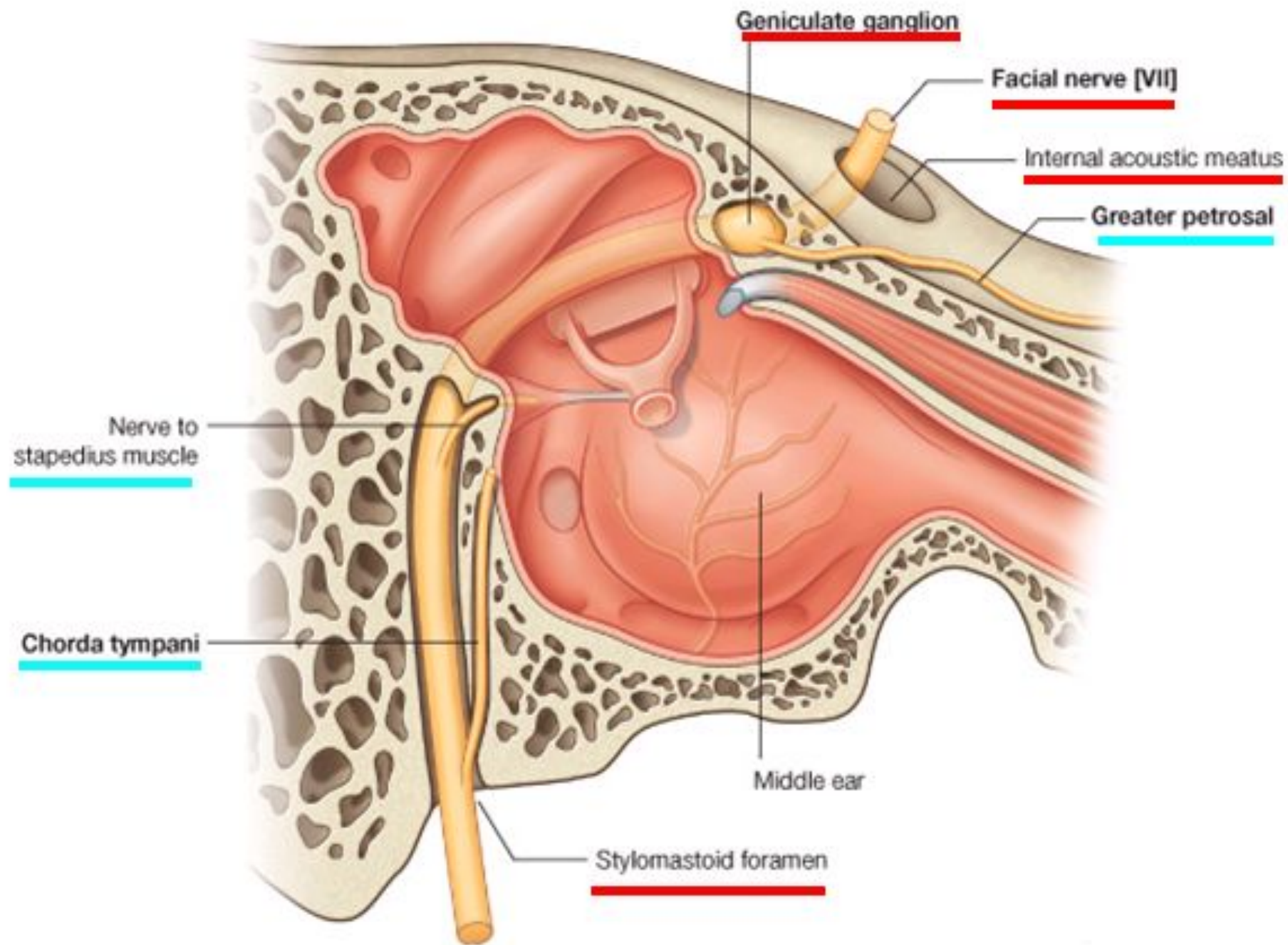
A. Intracranial course of the facial nerve.

B. Extracranial course of the facial nerve.

A. Intracranial Course of the Facial Nerve

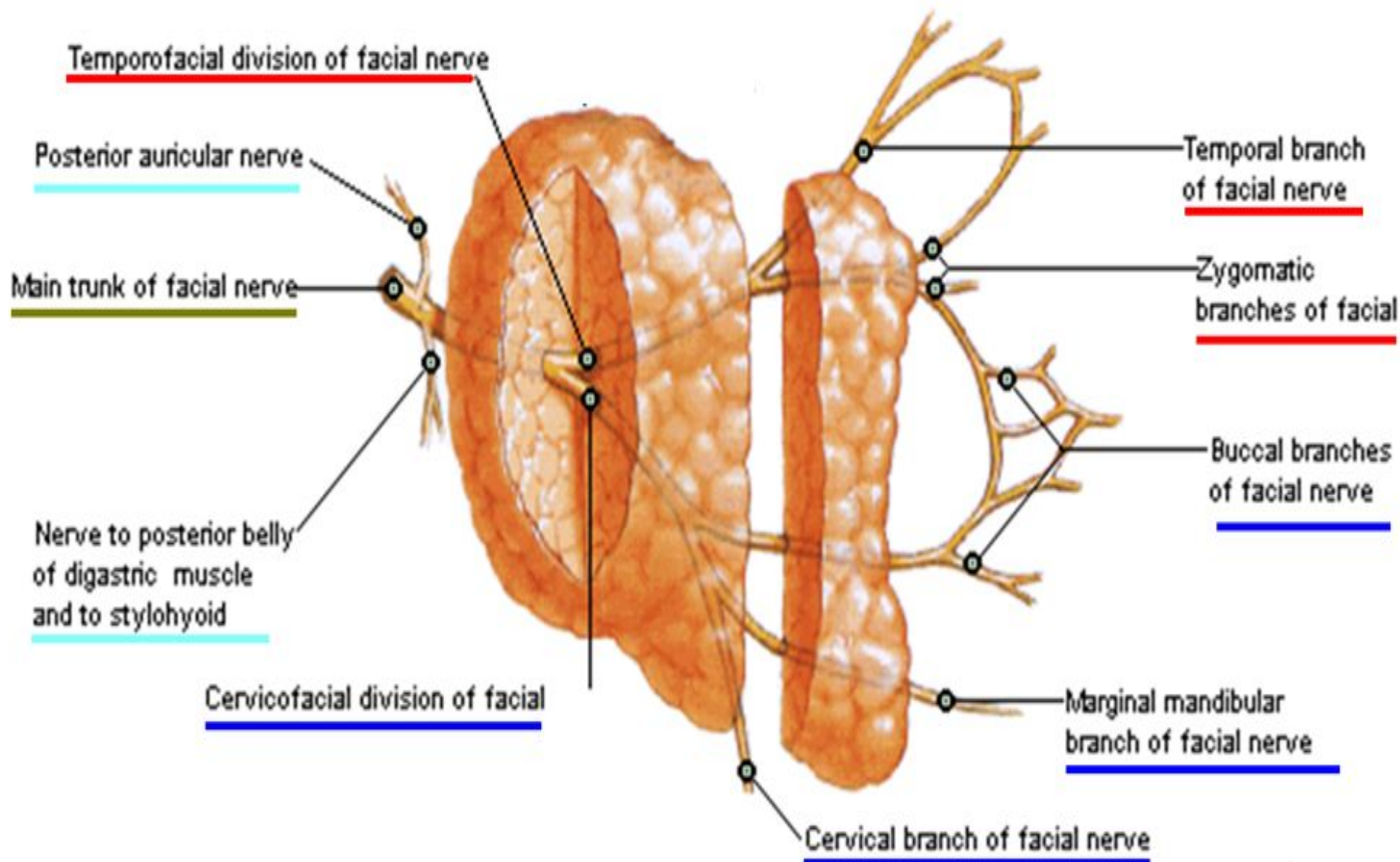
- ❑ The facial nerve emerges from the lower border of the pons at **cerebello-pontine angle**.
- ❑ It leaves the cranial cavity by entering **the internal auditory meatus**.
- ❑ It runs through a facial canal (Fallopian canal) inside petrous temporal bone.
- ❑ In the facial canal gives **three branches**.
- ❑ Finally it passes to reach **the stylomastoid foramen**.

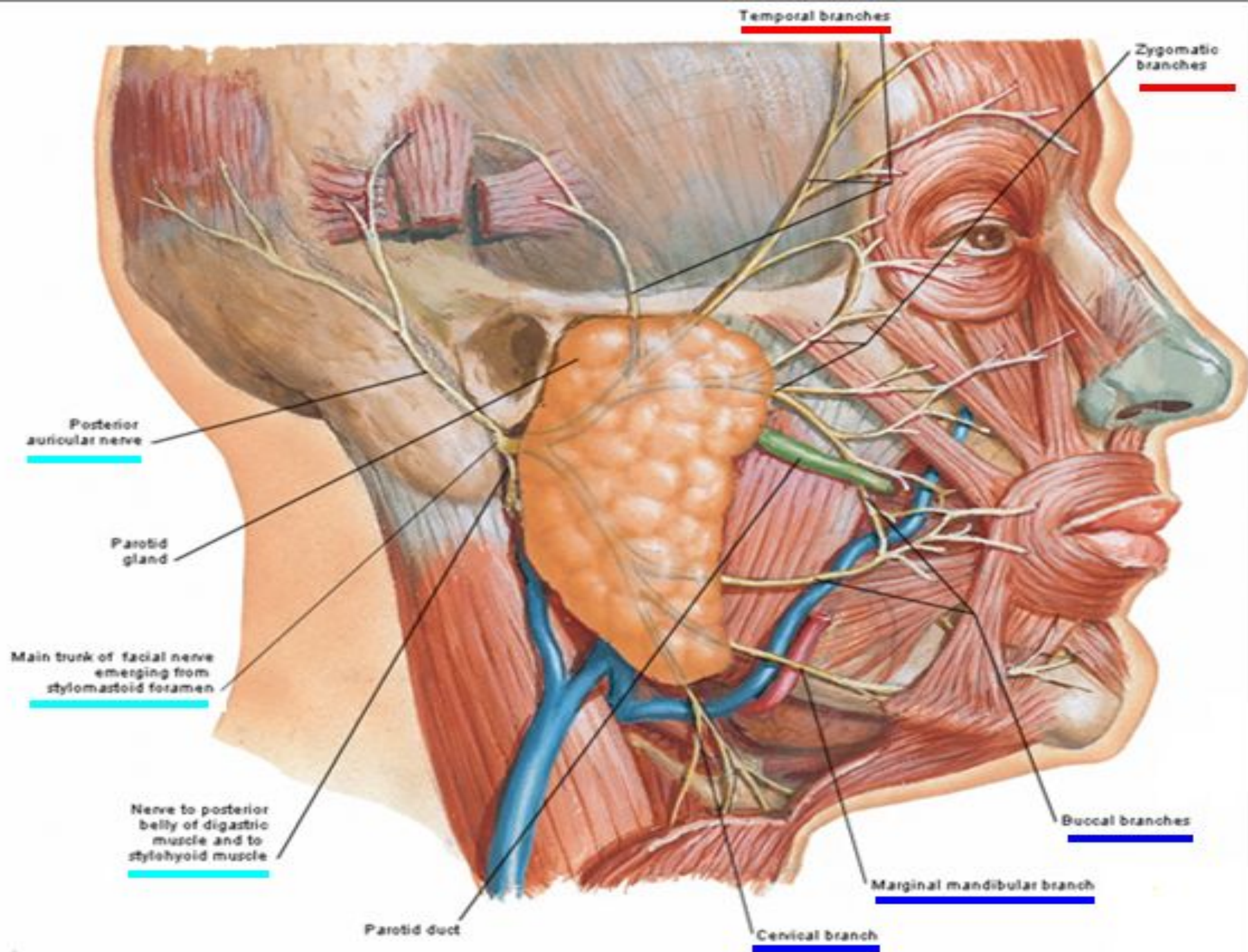


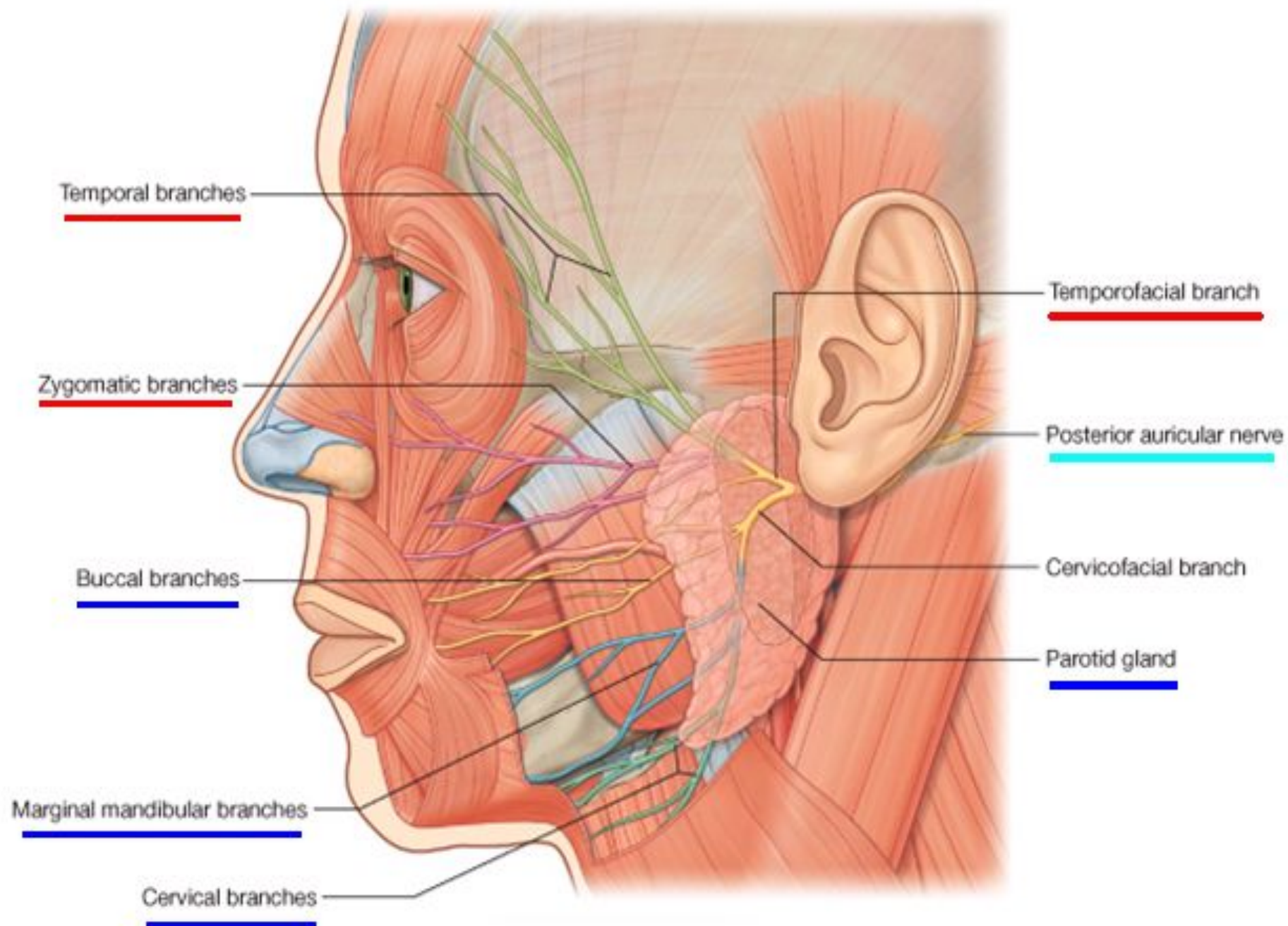


B. Extracranial Course of the Facial Nerve

1. It leaves the facial canal through the stylomastoid foramen.
2. Immediately after exit of the skull it gives 2 branches.
3. It turns forwards making a curve around the lateral side of base of styloid process.
4. It enters the posteromedial surface of parotid gland (lying superficial to ECA).
5. It ends inside the substance of the parotid gland by dividing into **two roots** and then into **five terminal branches**.

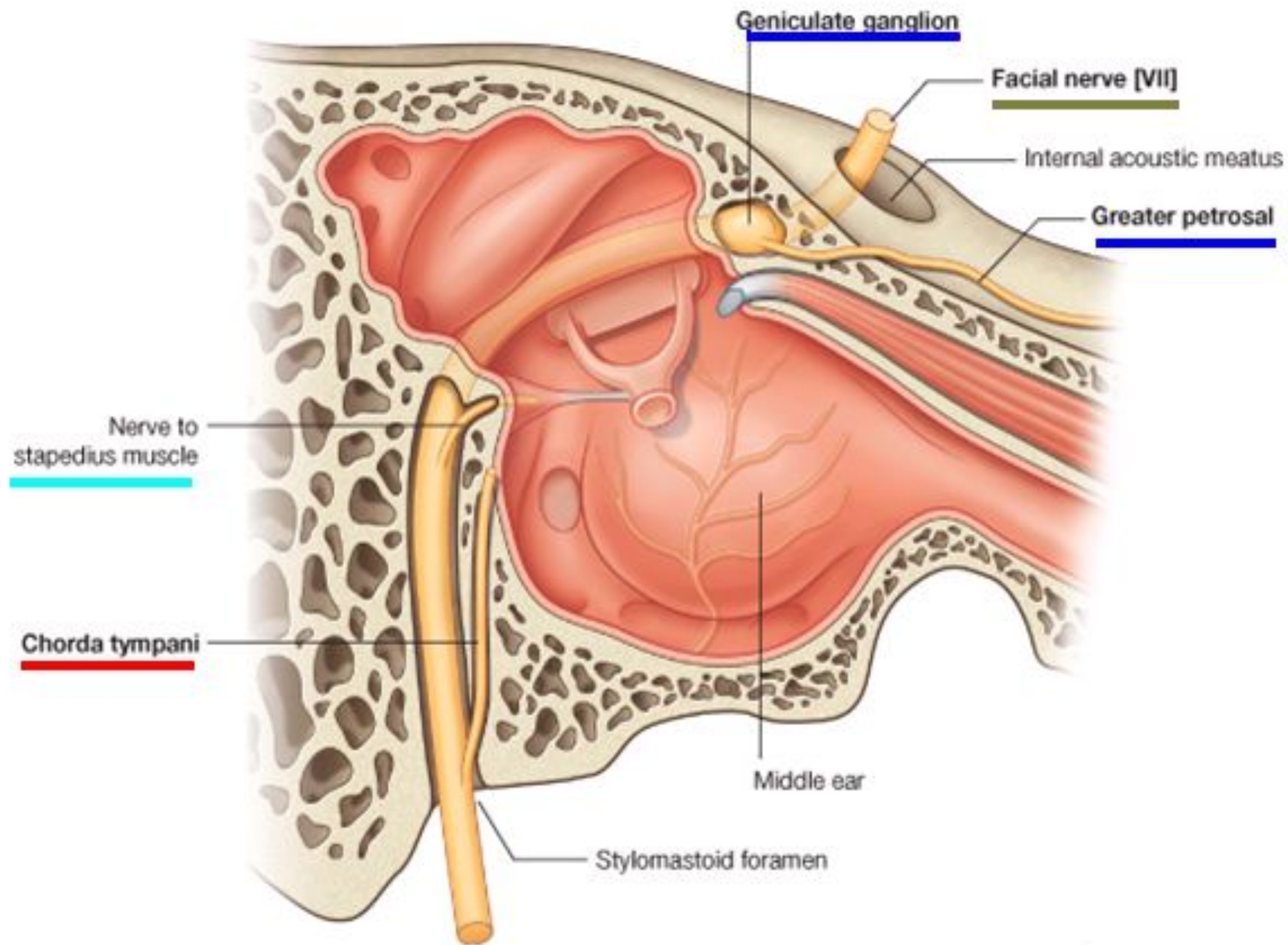






Branches of the Facial Nerve Inside the Fallopian Canal

- 1. The greater superficial petrosal nerve “GSPN”.**
- 2. Small branch to the stapedius muscle.**
- 3. The chorda tympani.**



Branches of the Facial Nerve

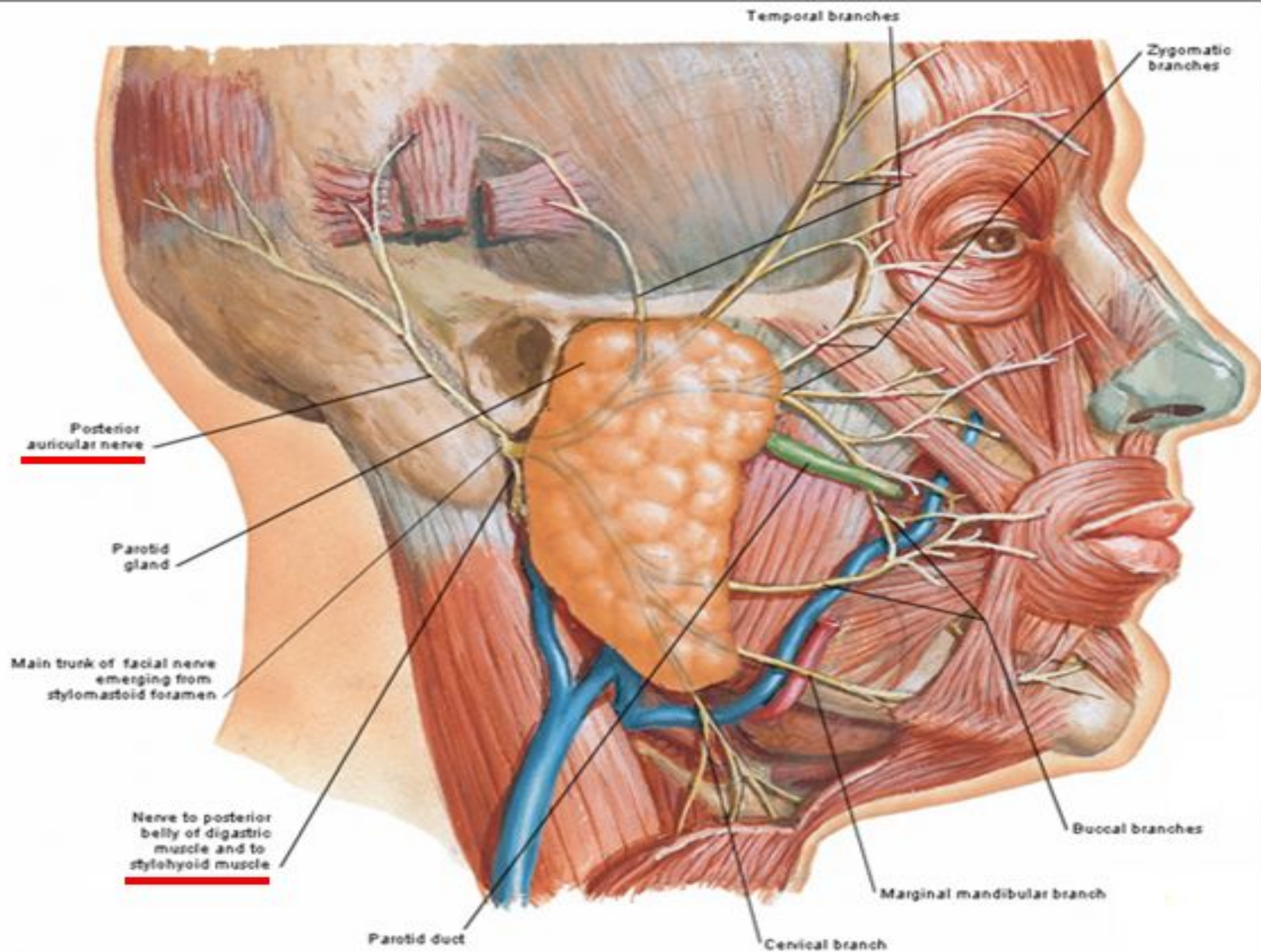
After it Leaves the Skull

◆ Immediately after it leaves the skull “2 branches”:

1. The posterior auricular nerve.
2. The nerve to the posterior belly of the digastric muscle and to the stylohyoid muscle.

◆ Terminal branches of the facial nerve “5 branches”:

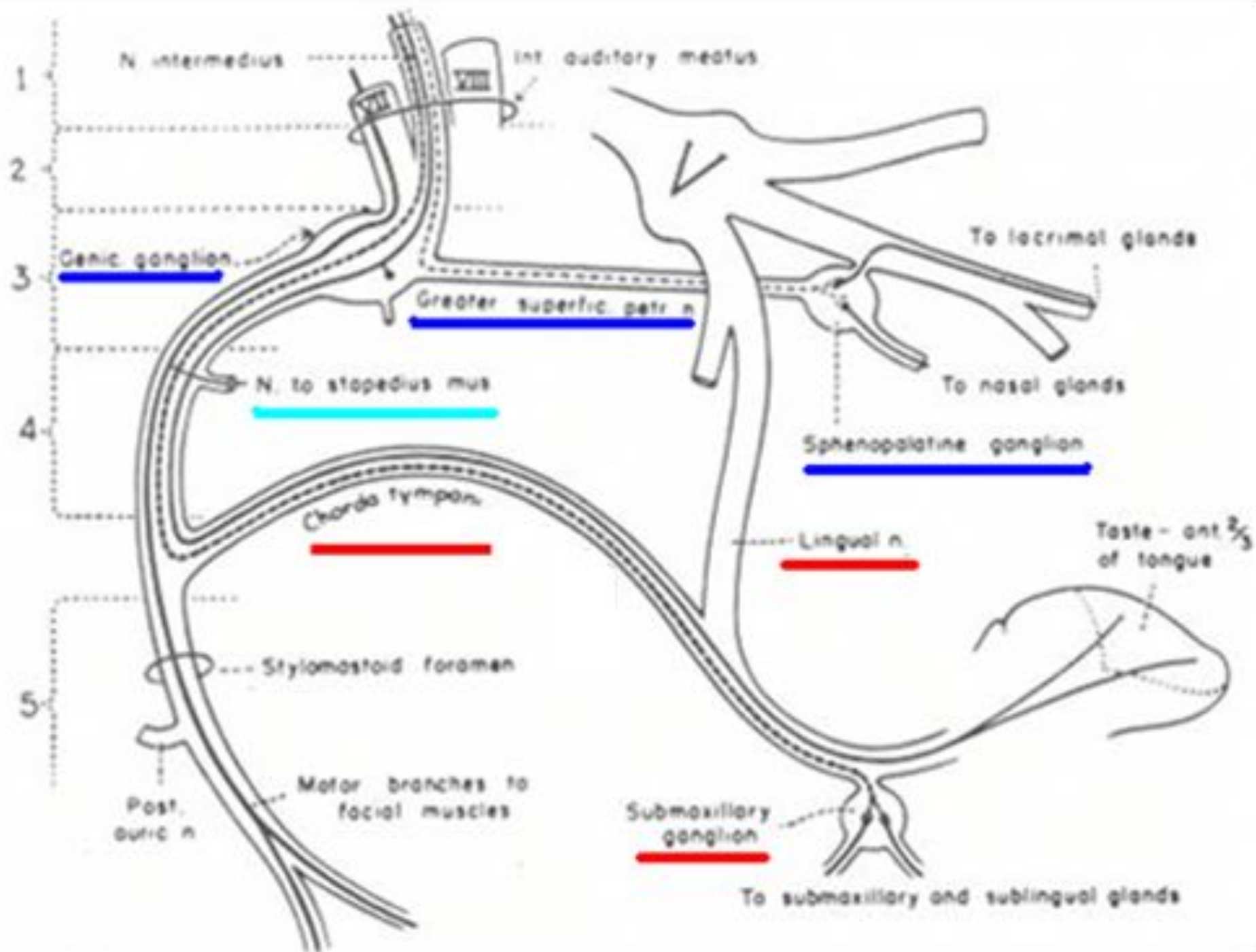
1. Temporal nerve (from temporofacial branch).
2. Zygomatic nerve (from temporofacial branch).
3. Buccal nerve (from cervicofacial branch).
4. Marginal mandibular nerve (from cervicofacial branch).
5. Cervical nerve (from cervicofacial branch).

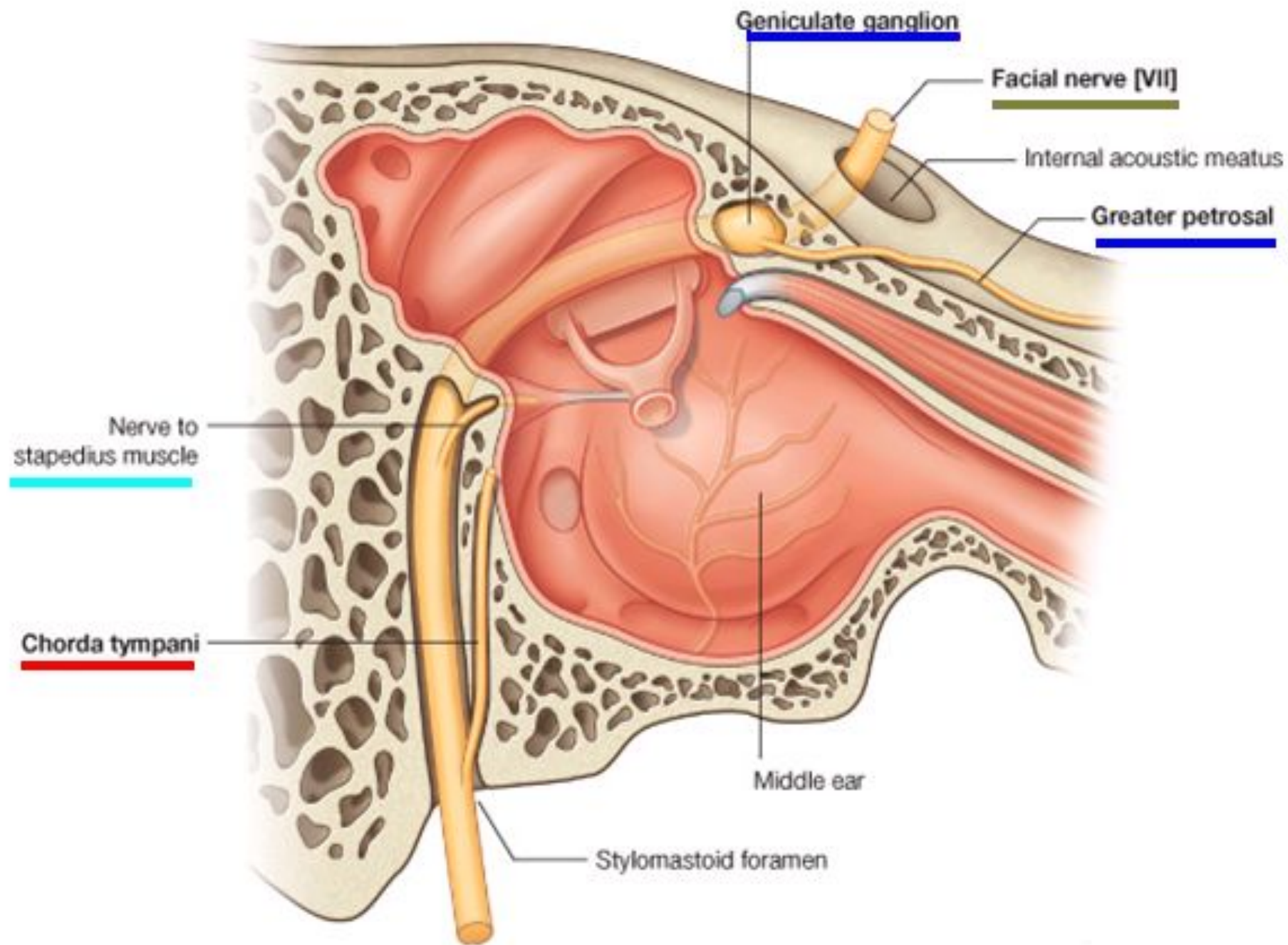


Branches of the Facial Nerve Inside the Fallopian Canal

- I. **The greater superficial petrosal nerve (Parasympathetic):**
 - Arises from the facial nerve at the geniculate ganglion.
 - It passes through anterior surface of the petrous temporal bone and runs in a groove to the foramen lacerum, where it unites with the deep petrosal nerve (sympathetic) to form **the nerve of pterygoid canal**.
 - This nerve carries preganglionic parasympathetic fibers to the lacrimal, nasal and palatine glands (**relay in the sphenopalatine ganglion**).

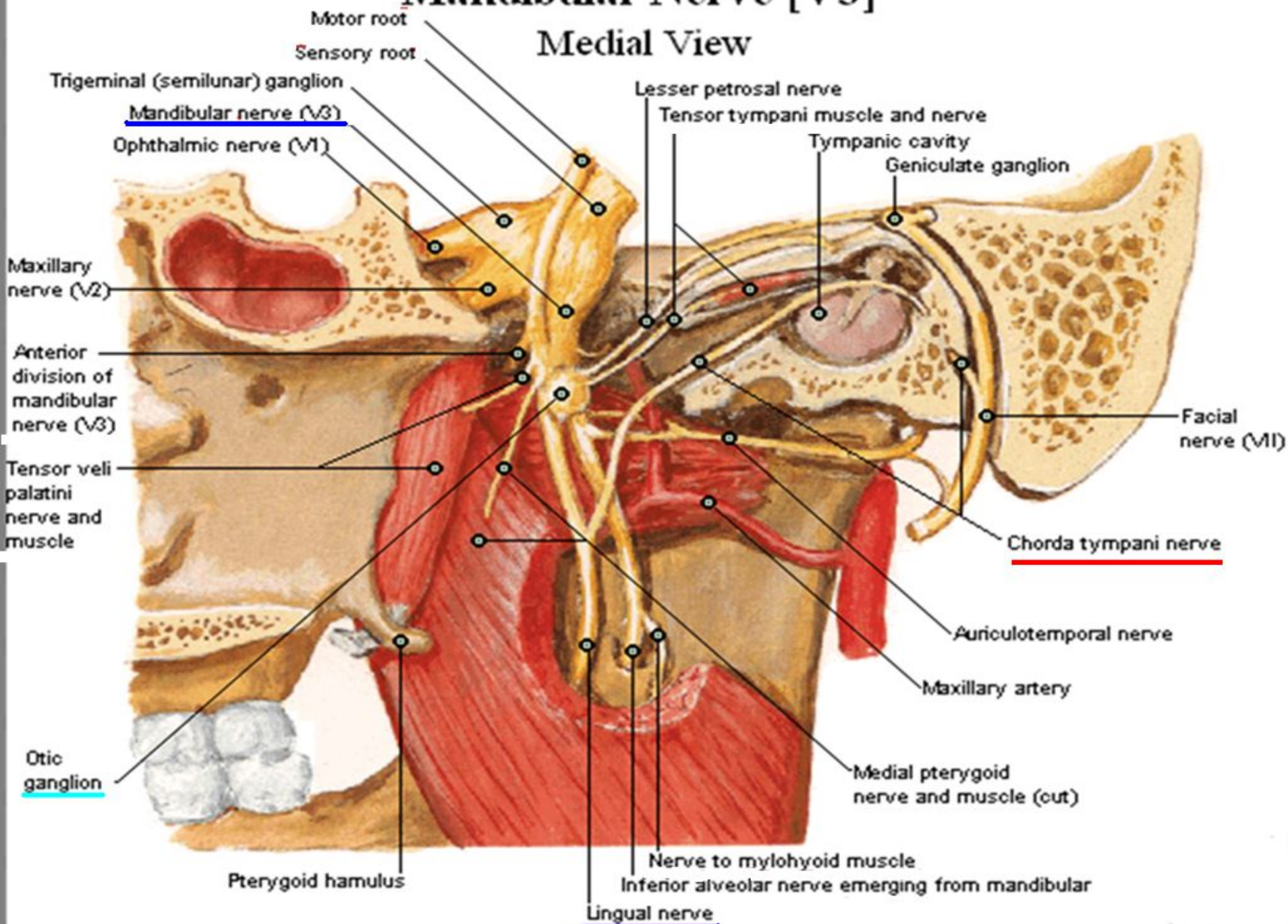
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2. **Small branch to the stapedius muscle (motor nerve):** reduce excessive vibration and sound transmission to the inner ear.
 3. **The chorda tympani (Taste sensation and parasympathetic):**
 - Leaves the facial canal through a tunnel in the posterior wall of the middle ear.
 - It runs to the medial side of sphenoid and joins the lingual nerve in the infratemporal fossa.
 - Gives preganglionic parasympathetic fibers to the submandibular and sublingual glands **(relay in submandibular ganglion)**.
 - Receives the taste from anterior 2/3 of the tongue.





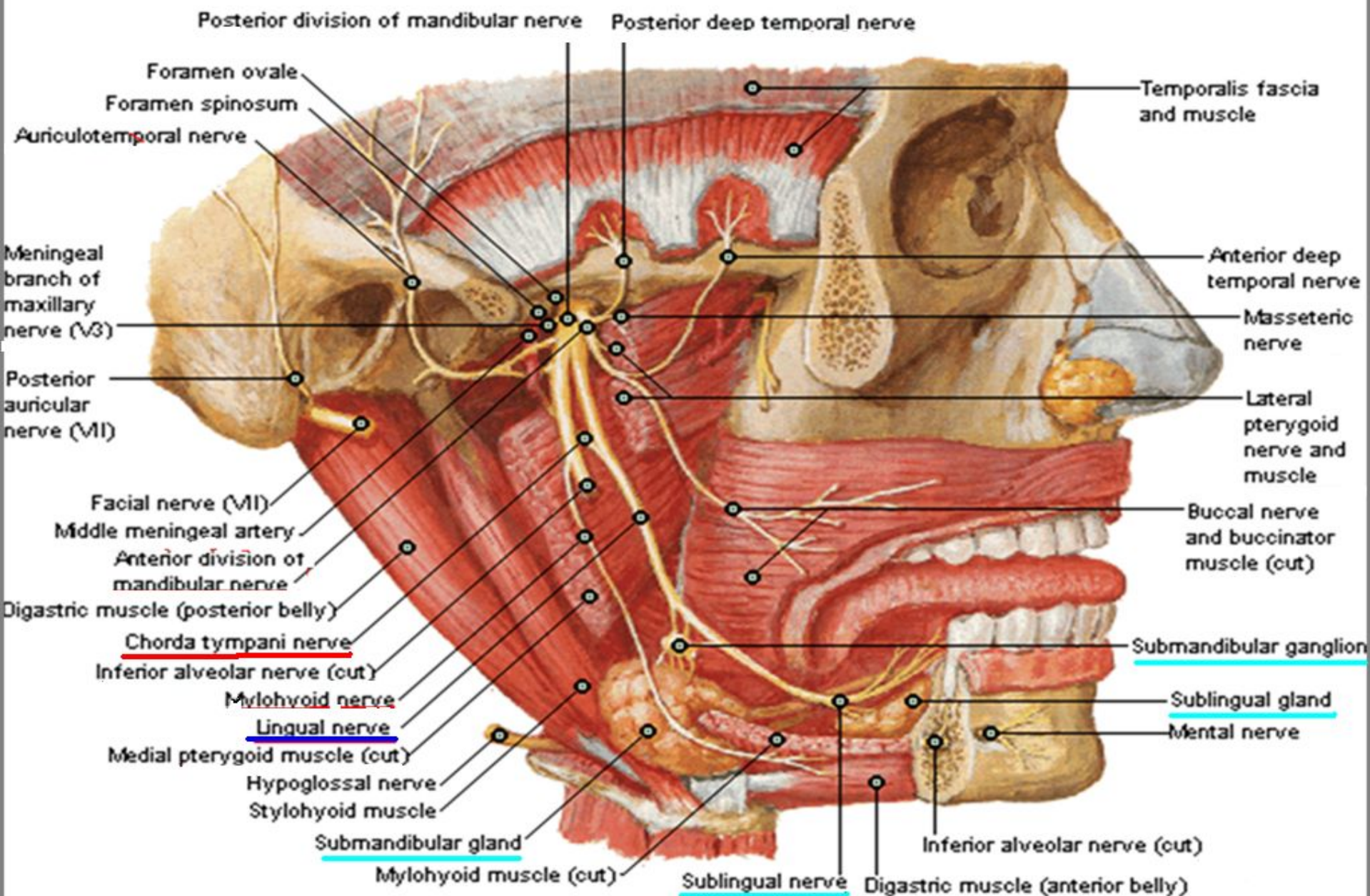
Mandibular Nerve [V3]

Medial View



Mandibular Nerve [V3]

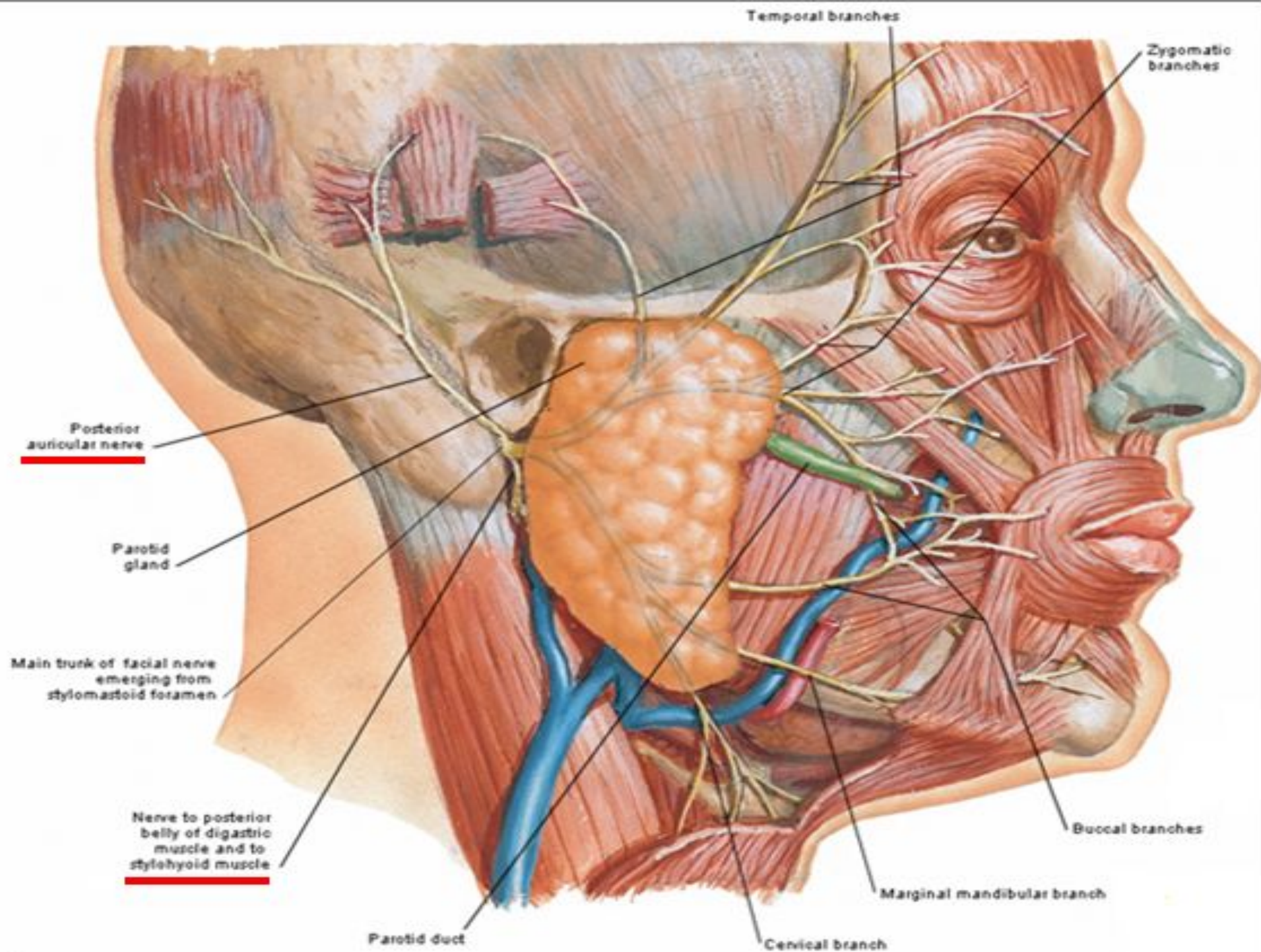
Lateral View

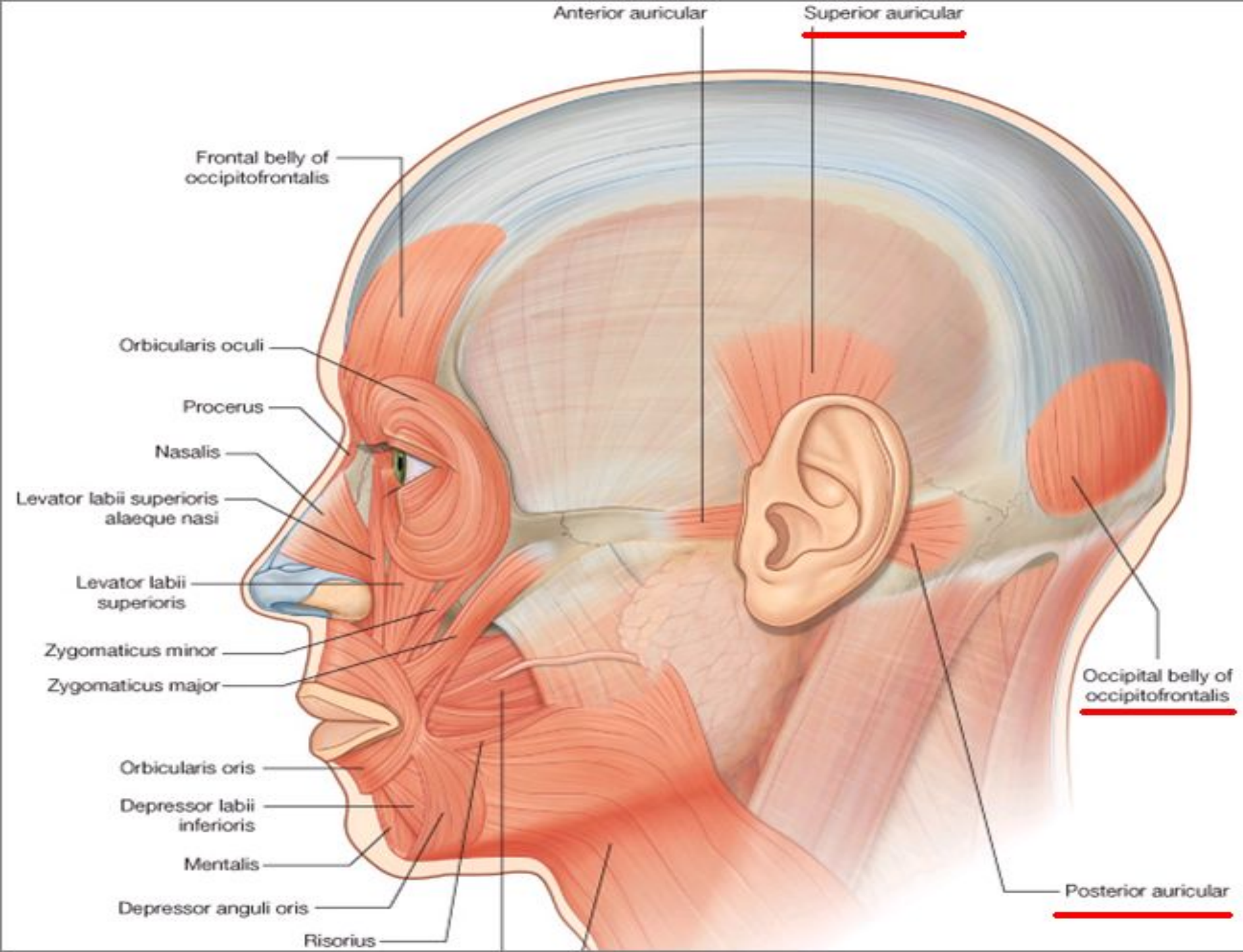


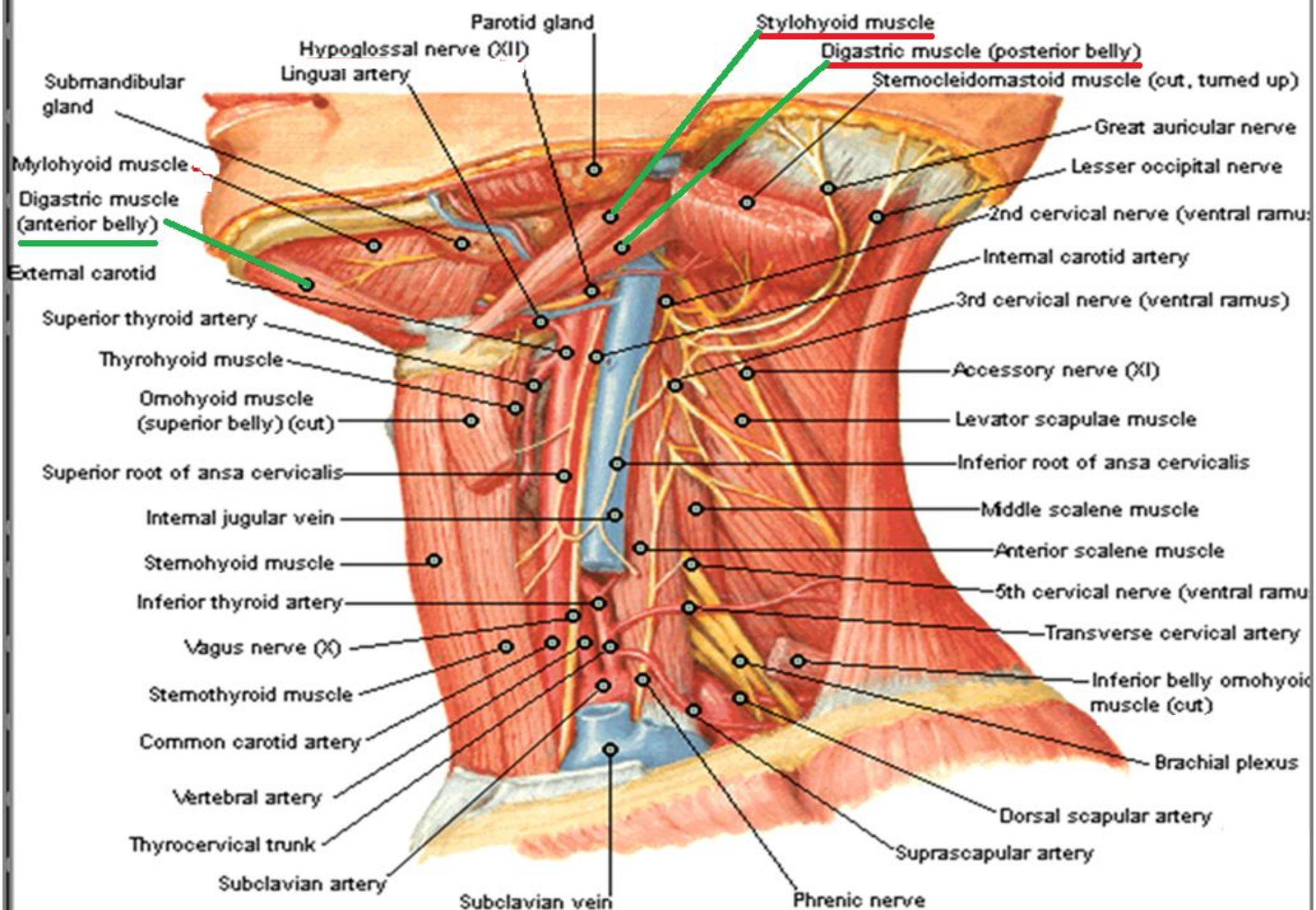
Branches of the Facial Nerve Immediately After it Leaves the Skull

It gives two branches:

- 1. The posterior auricular nerve:** supplies the occipital belly of occipitofrontalis, superior and posterior auriculares muscles. Receives sensation from the skin of the external auricle and tympanic membrane.
- 2. The nerve to:** the posterior belly of the digastric muscle and to the stylohyoid muscle.







Terminal Branches of the Facial Nerve

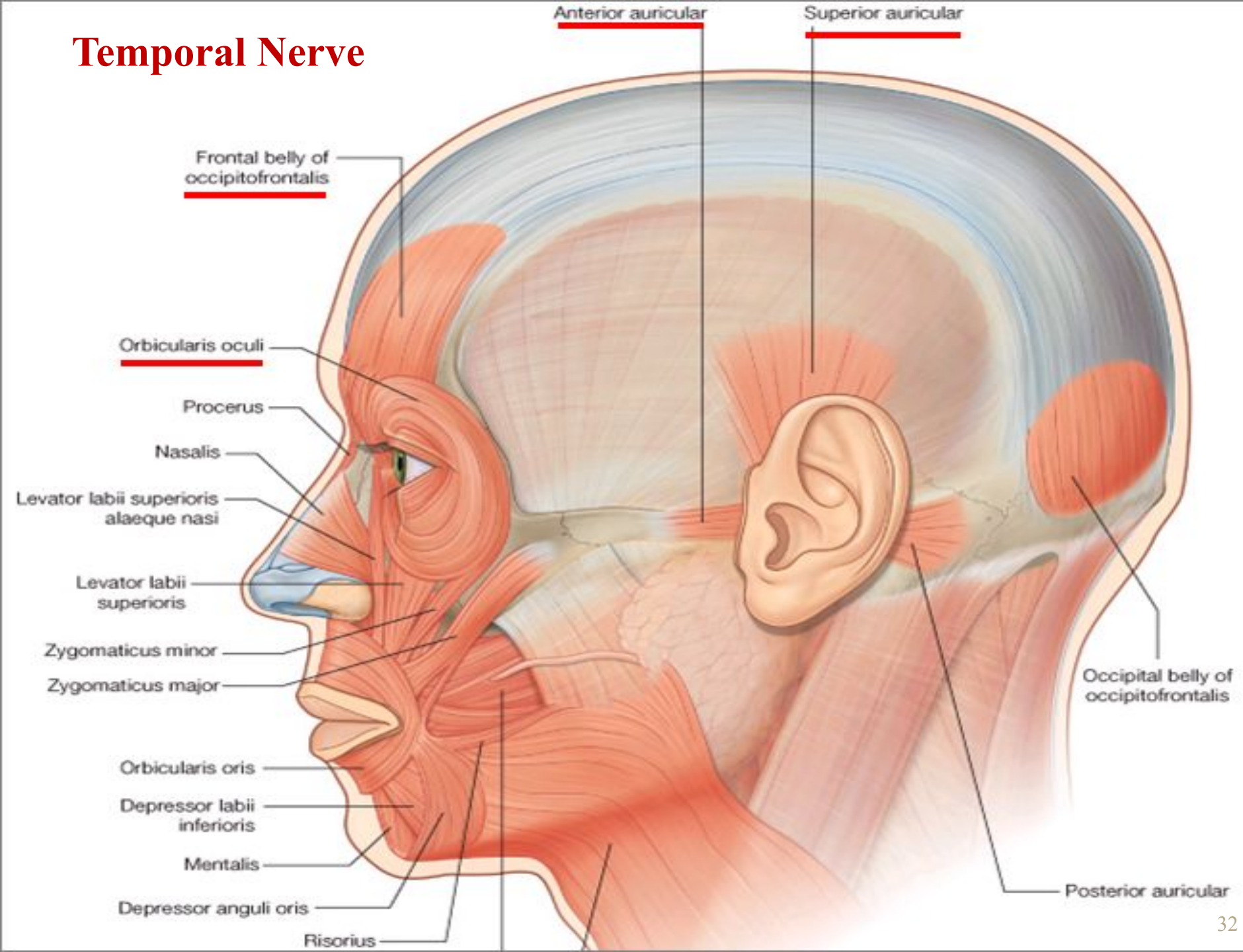
1. The Temporal Nerve

□ Emerges from **temporofacial division** of the facial nerve at the upper pole of the parotid gland.

□ **It runs upwards and forwards to supply:**

1. Frontal belly of occipitofrontales muscle.
2. Upper part of the orbicularis oculi muscle.
3. Superior and anterior auriculares muscle.

Temporal Nerve

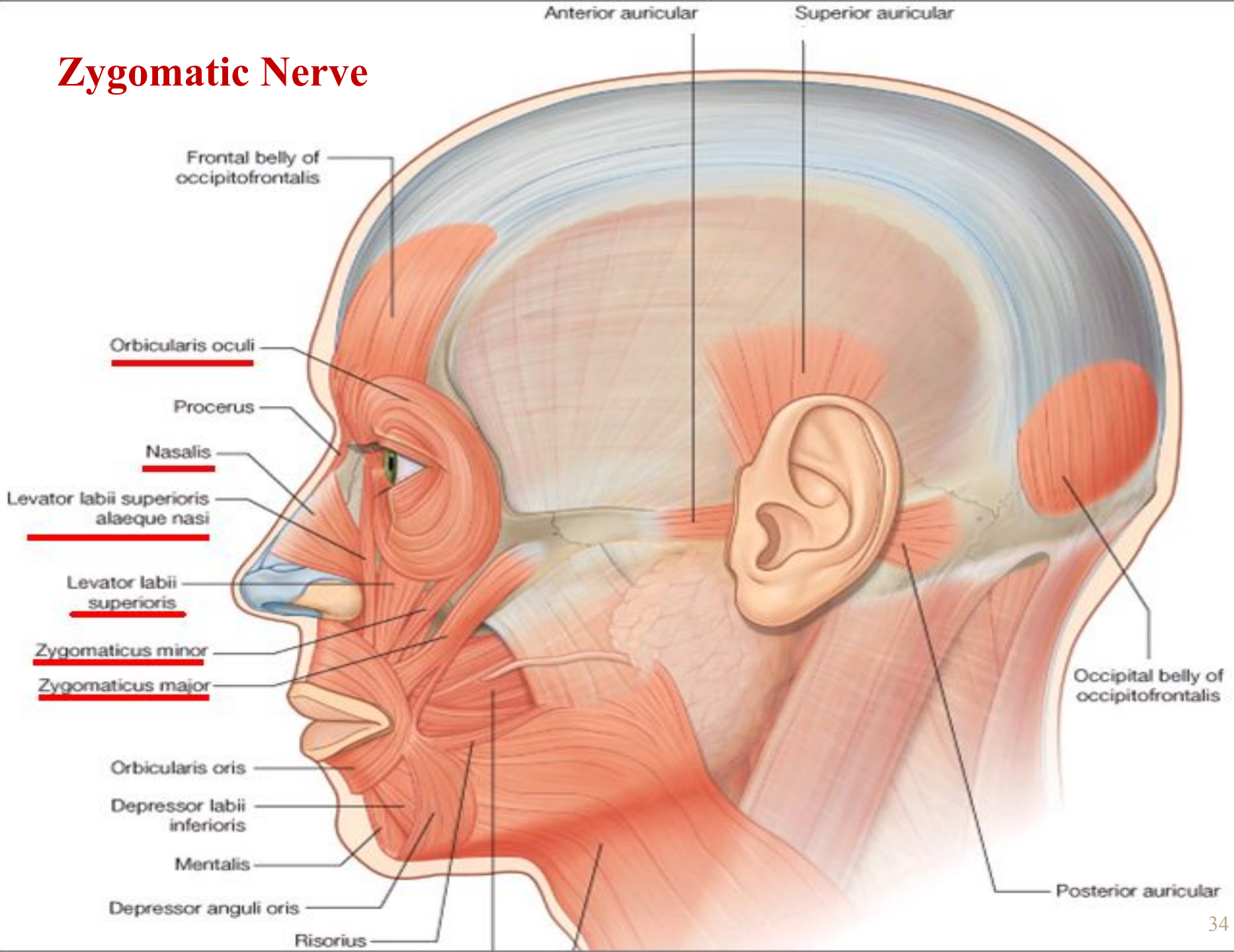


2. The Zygomatic Nerve

□ Emerges from **temporofacial division** of the facial nerve at the anterior border of the parotid gland, and it divided into:

- a. **The upper zygomatic branch:** supplies the **orbicularis oculi.**
- b. **The lower zygomatic branch:** supplies the **muscle between the eye and mouth including the muscle of the nose.**

Zygomatic Nerve



3. The Buccal Nerve

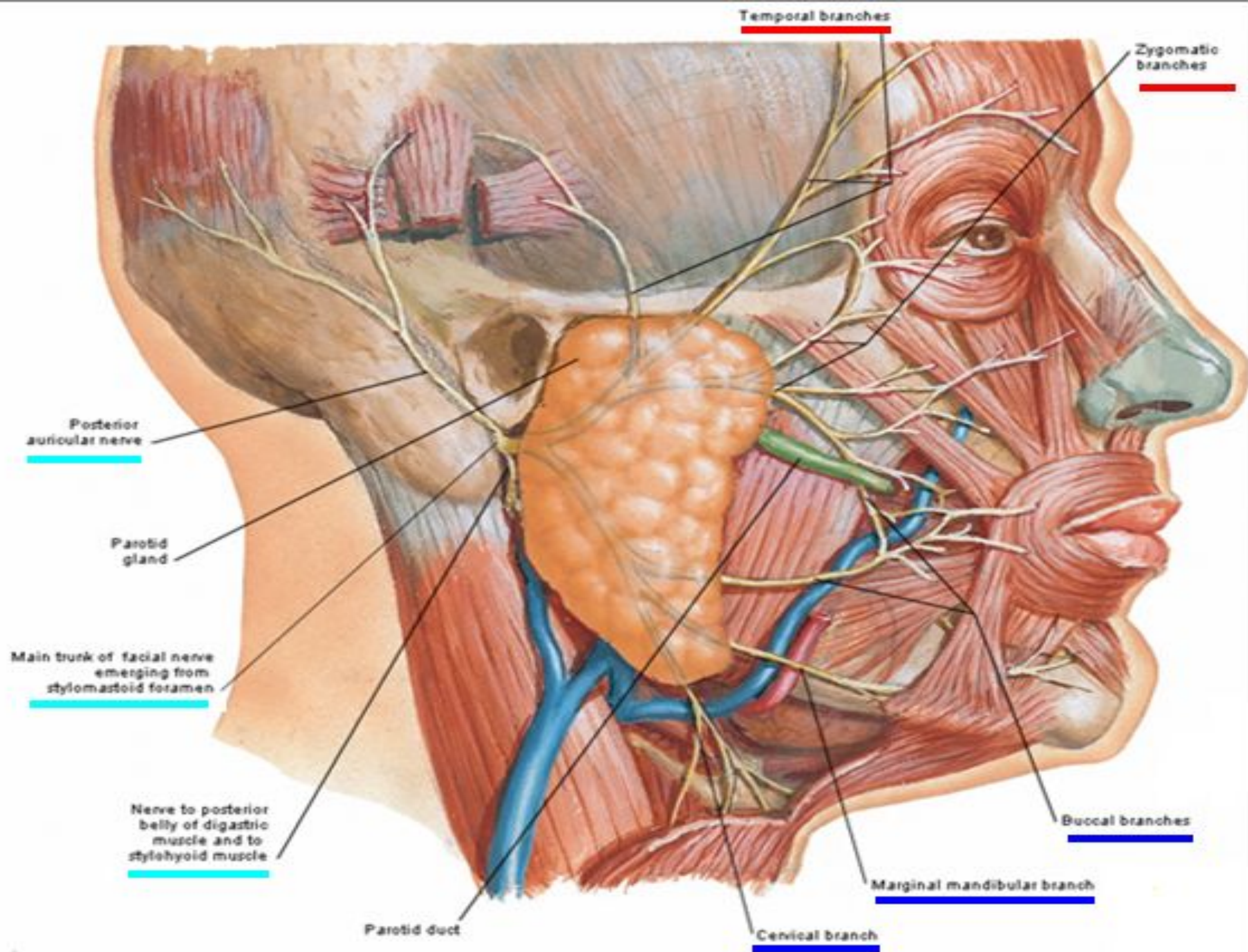
- Emerges from **cervicofacial division** of the facial nerve at the anterior border of the parotid gland.
- Runs forward towards the angle of the mouth to supply **the buccinator and orbicularis oris muscles.**

4. The Marginal Mandibular Nerve

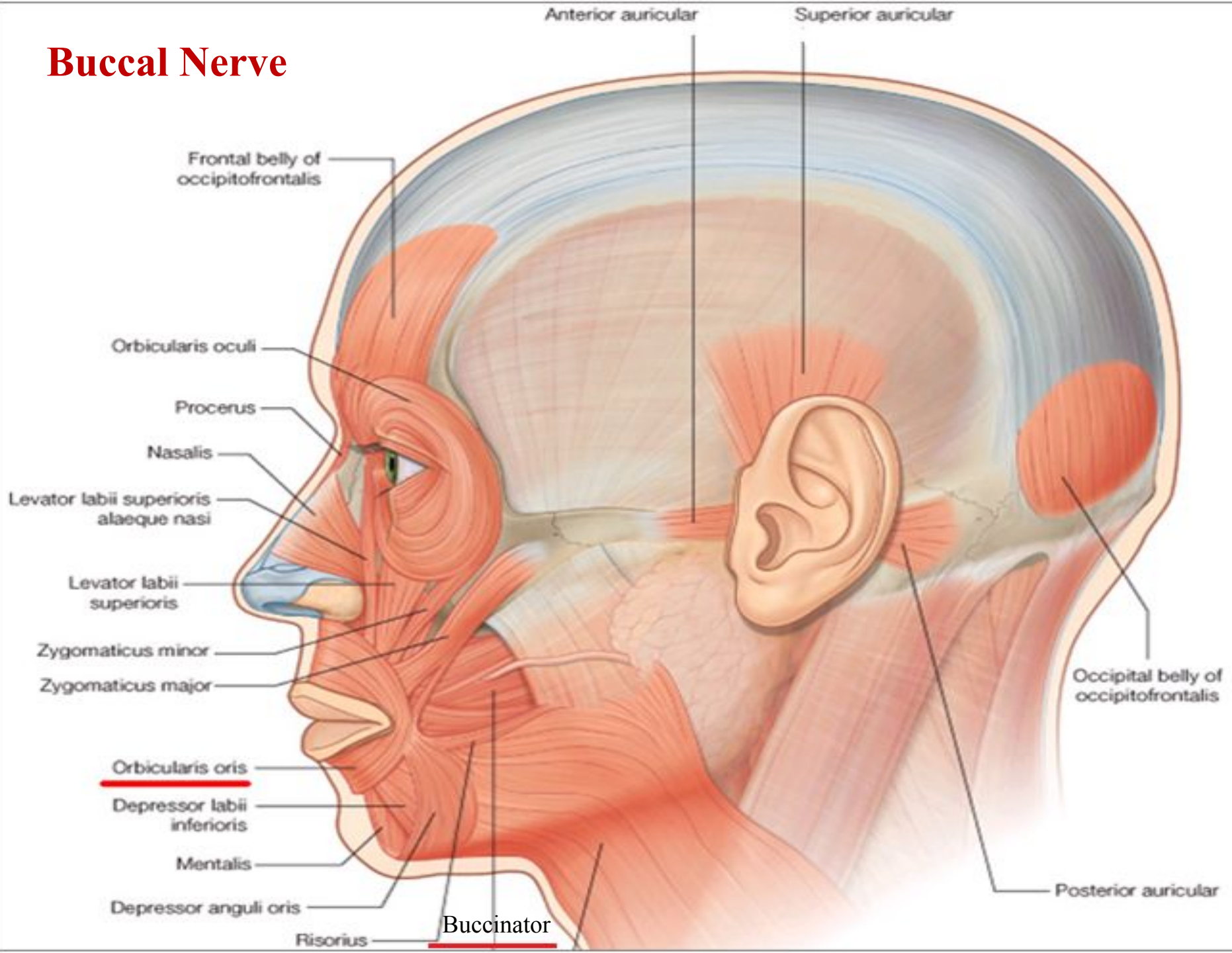
- Emerges from **cervicofacial division** of the facial nerve at the anterior border of the parotid gland.
- Runs forwards along the mandible to supply **the muscles in the region of the mandible.**

5. The Cervical Nerve

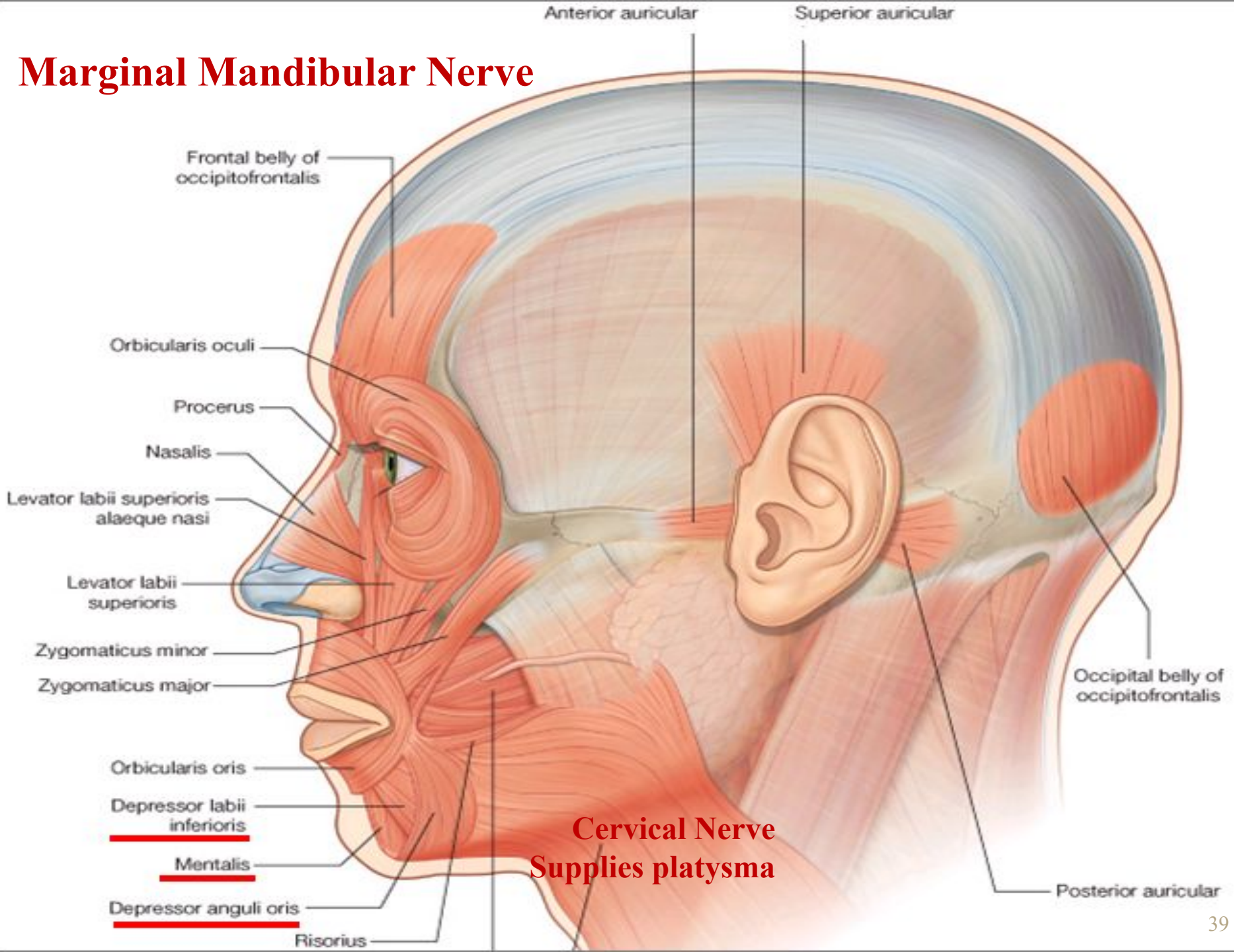
- Emerges from **cervicofacial division** of the facial nerve at the lower end of the parotid gland.
- Runs downwards and forwards below the mandible to supply **the platysma muscle.**



Buccal Nerve



Marginal Mandibular Nerve



Bell's Palsy

- ❖ **Sir Charles Bell “Scottish Surgeon”**
first described the anatomy and function of the facial nerve in the **1800**.
- ❖ **Bell's palsy:** defined as an acute peripheral facial nerve palsy of unknown cause.
- ❖ The annual incidence rate is between 13-34 cases per 100,000 population.
- ❖ **Etiology:** Herpes simplex virus reactivation.



(November 1774 – 28 April 1842 12)

Clinical Features of Bell's Palsy

Patients with Bell's palsy typically present with sudden onset (usually over hours) of unilateral facial paralysis, common findings include:

- Absent of forehead wrinkles “more by looking upwards”.
- Inability to close the eye.
- Absent nasolabial fold.
- Drop (asymmetrical) of mouth angle.
- Deviation the mouth to the non affected side.

Ramsay-Hunt Syndrome

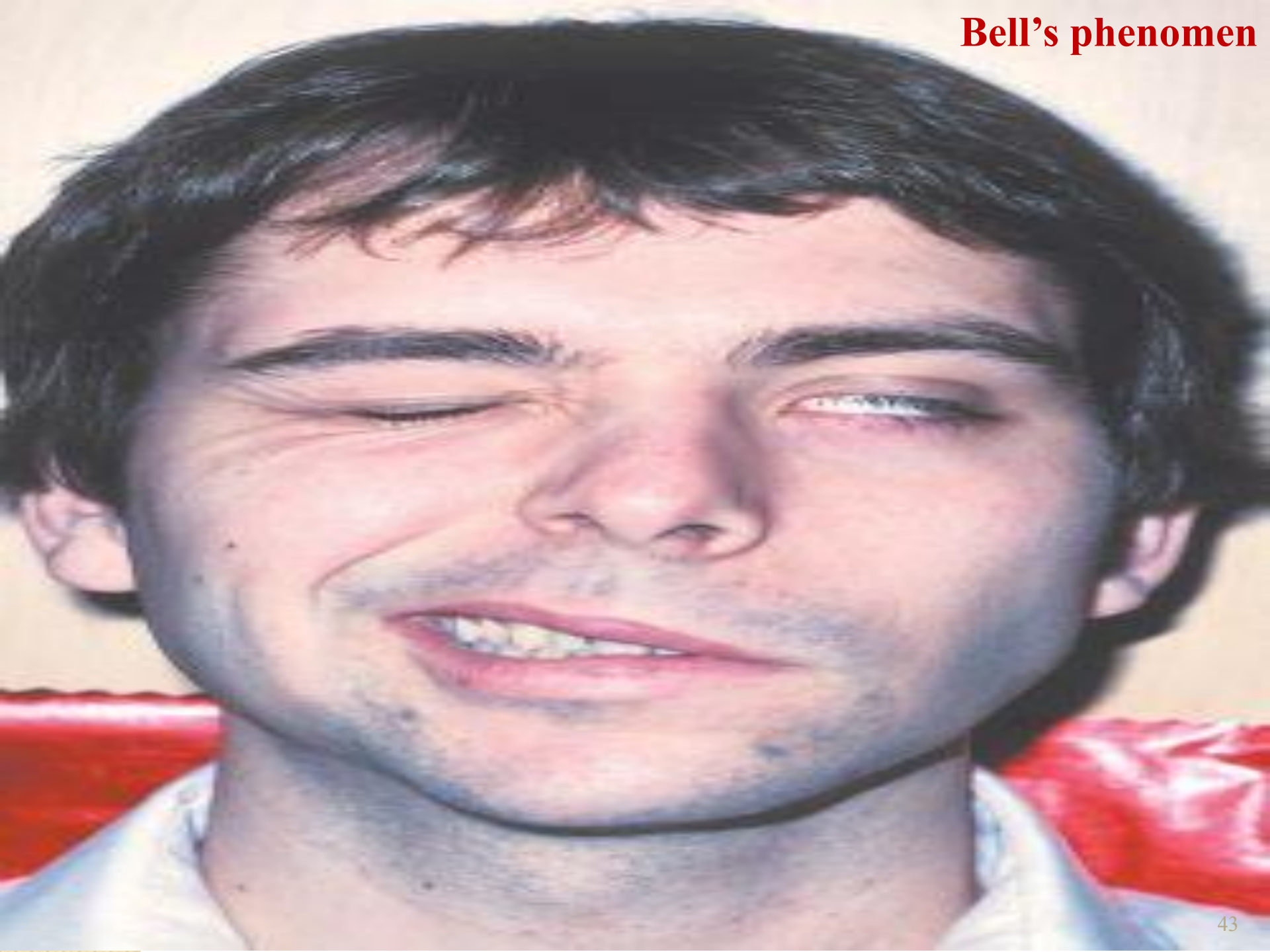
Ramsay Hunt syndrome: acute peripheral facial neuropathy associated with erythematous vesicular rash of the skin of the ear canal.

Etiology: varicella-zoster reactivation.

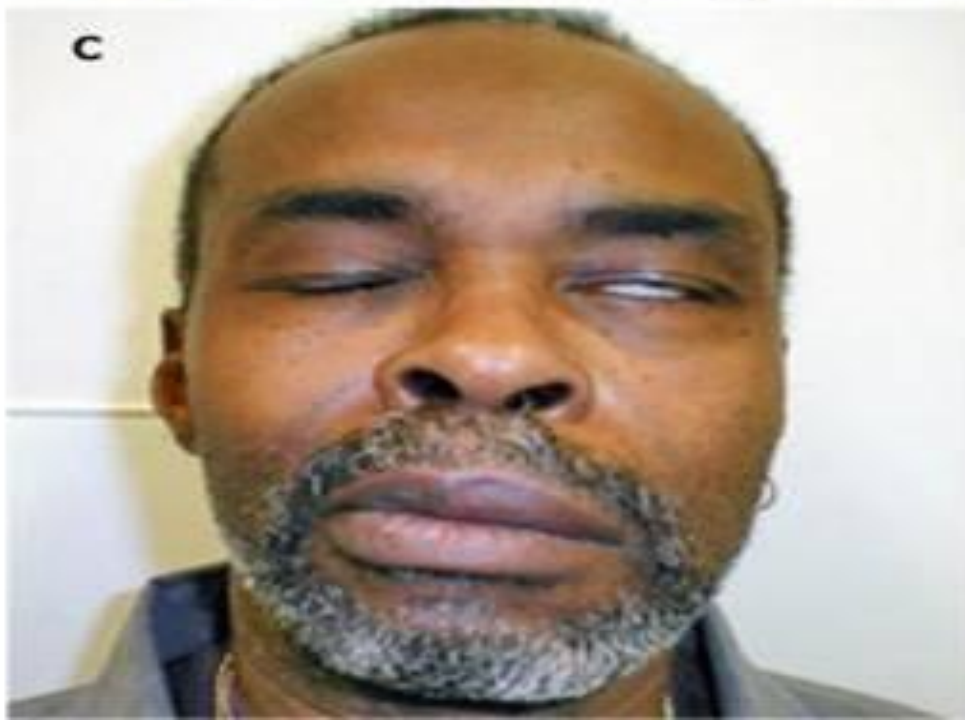
Clinical picture:

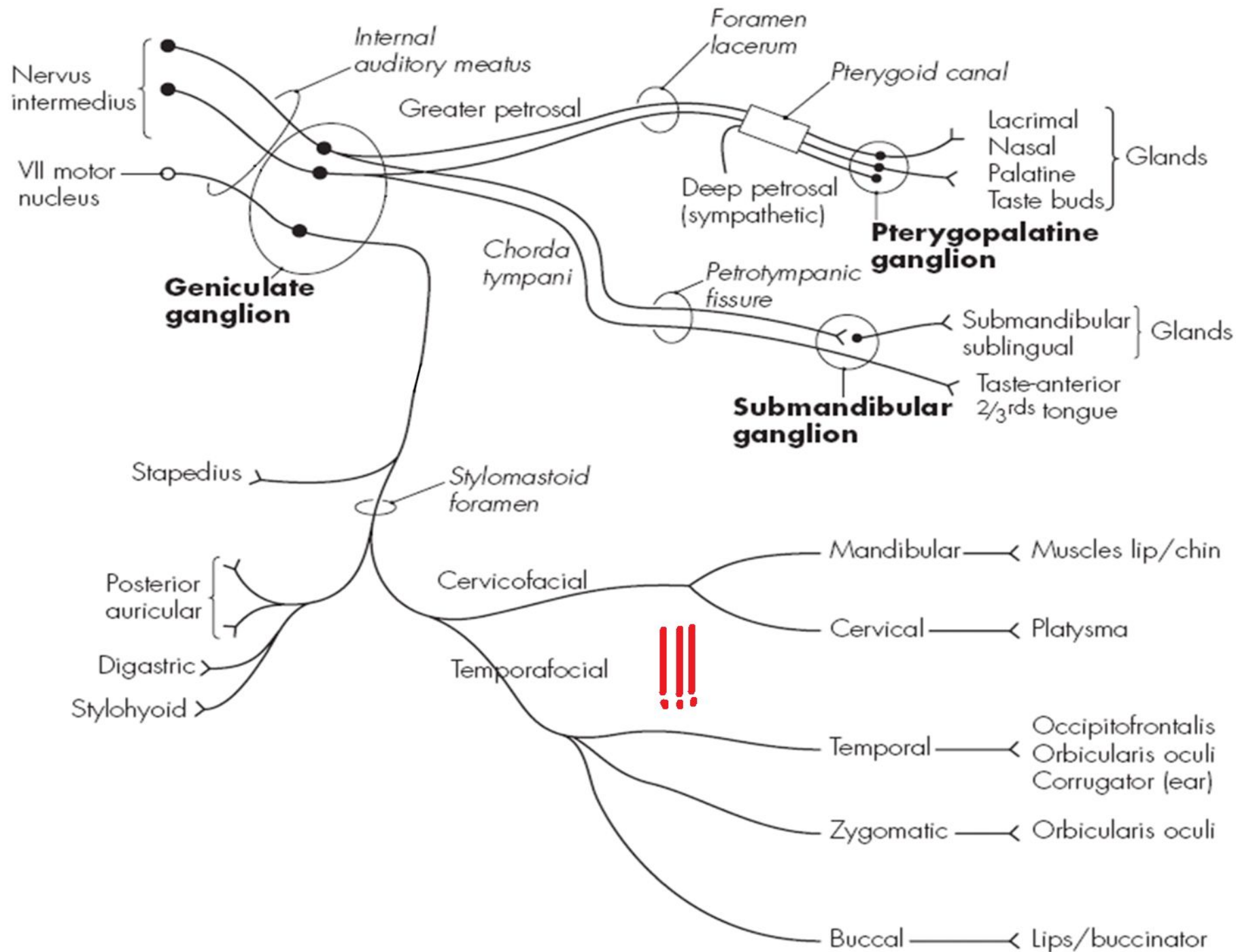
- Vesicular rash of the ear or mouth.
- Ipsilateral peripheral facial palsy.
- Vertigo and ipsilateral hearing loss.
- Tinnitus.
- Otalgia: ear pain.
- Headaches.
- Fever.







A**B****C**

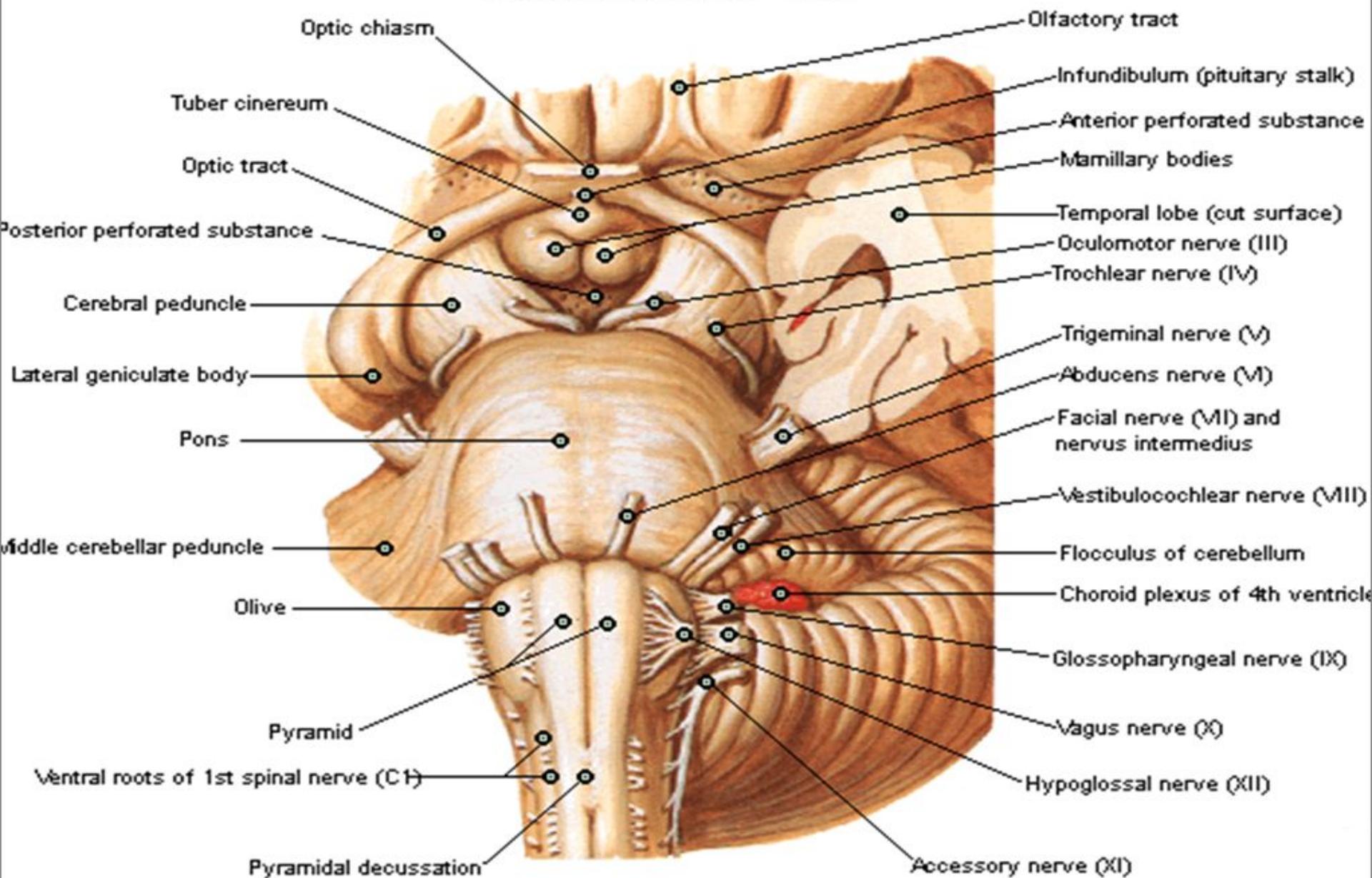


The Vestibulo-Cochlear Nerve (VIII) (Auditory or Stato-Acoustic nerve)

- It is a special sensory (hearing and balance) nerve.
- It emerges from the anterolateral surface between the pons and medulla oblongata with the facial nerve.
- It has two divisions:
 - 1. Cochlear division.**
 - 2. Vestibular division.**

Brainstem

Anterioinferior View

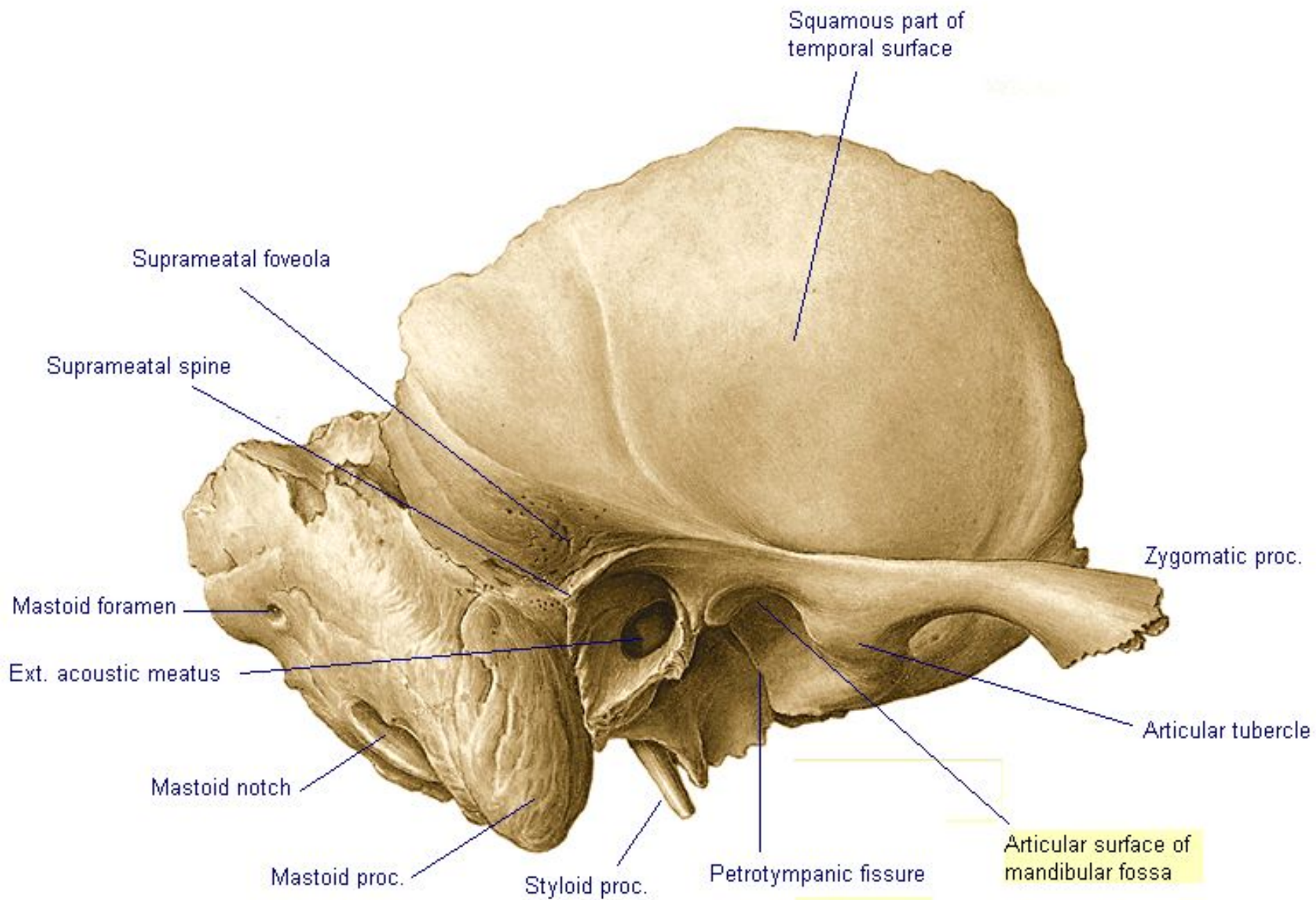


Is Hearing Important?

1. **Communication:** hearing is essential to
Language.
2. **Localization:** determining the location of unseen
sound sources.

The Sense of Hearing

- It is the ability to detect sounds.
- The most important function of hearing is involved in language and social communications.
- Sound is a stimulus (energy) for hearing.
- In **air** sound travels at about 330 m/sec. While in **water** sound travels at about 1500 m/sec.
- The ear with all its parts is located in **the temporal bone**.



What Needed for Normal Hearing?

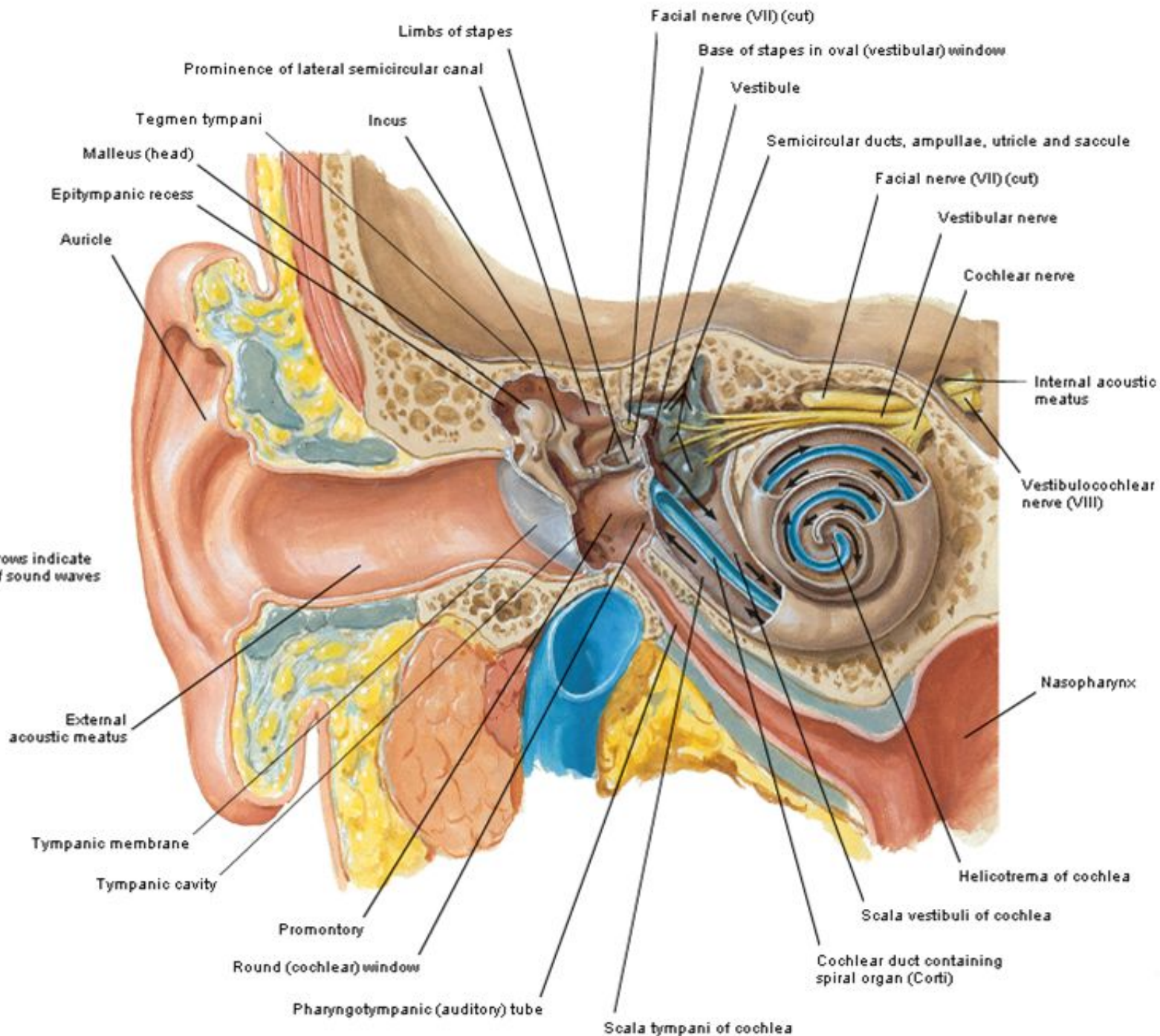
1. Adequate stimulus (Sound).
2. Conduction of stimulus to sensory organs of hearing.
3. Sensory transduction of stimulus.
4. Neural transmission of the signal.
5. Central auditory processing of the signal.

The Peripheral Organ of Hearing

The peripheral organ of hearing is **the ear**, which has three divisions:

- 1. The external ear.**
- 2. The middle ear.**
- 3. The inner ear.**

Note: Arrows indicate course of sound waves



Functions of the External Ear

1. **Collection of sound stimuli.**
2. **Increase the sound pressure at the tympanic membrane.**
3. **Sound localization.**
4. **Protective function:** skin of the auditory canal secretes wax (a bactericidal effect).

Function of Middle Ear

1. Conduct sound from the tympanic membrane through the middle ear to the cochlea.
2. Physical protection of the cochlea.
3. The malleus with tensor tympani muscle keeps the tympanic membrane tensed.
4. The stapedius muscle reduce excessive vibration and sound transmission to the inner ear.

The Pathway of Hearing

Receptors: the organ of the corti in the cochlea of inner ear.

1. First order neuron: cells of the spiral (cochlear) ganglion.

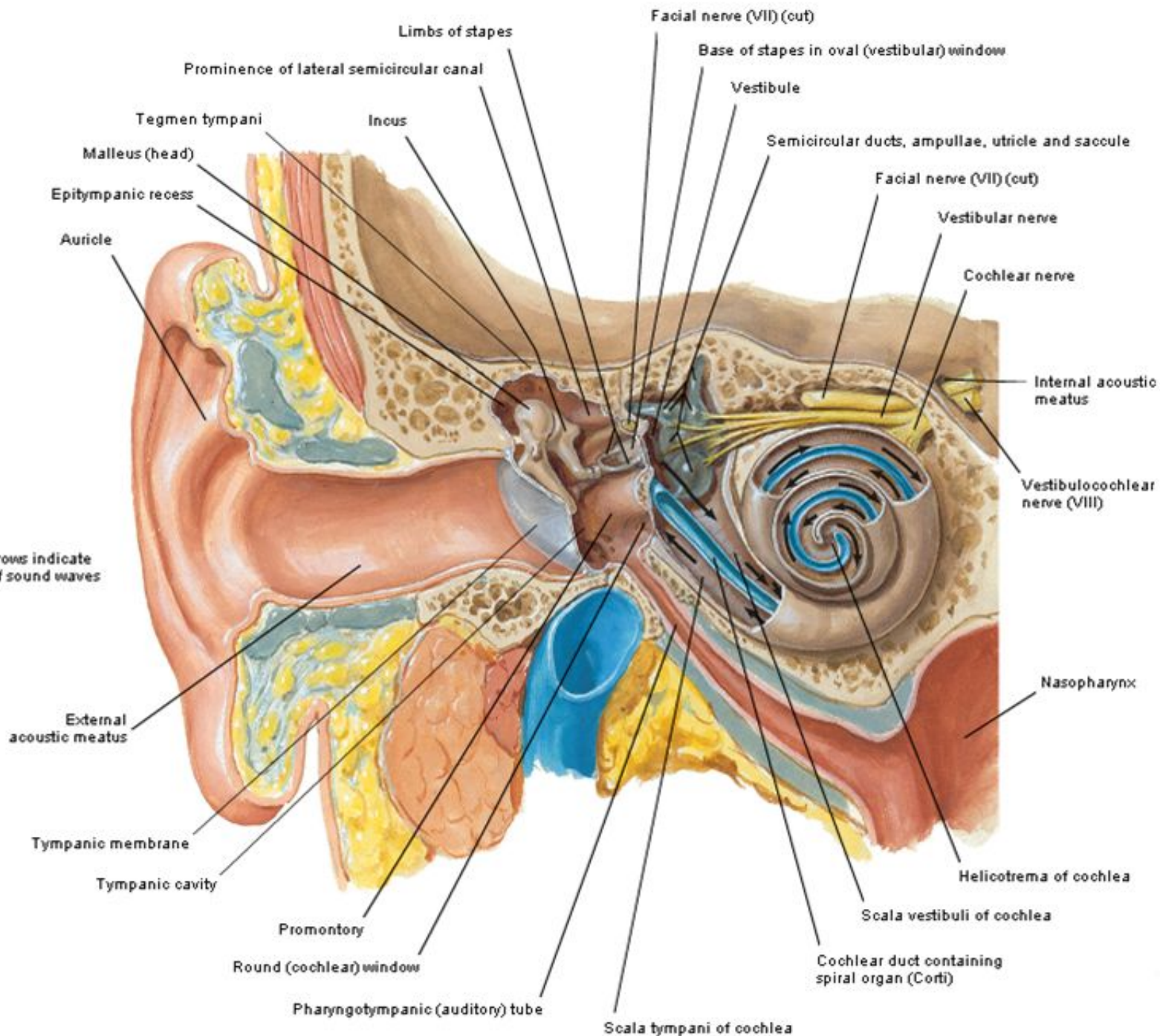
Carry hearing sensation from the corti in the cochlea of inner ear → cochlear nerve enters the brain stem between the pons and medulla oblongata → cochlear nuclei of the pons and upper medulla.

2. Second order neuron: “Cells of cochlear nuclei”

Few axons ascend in the lateral lemniscus of the same side. Most of the axons decussate to opposite side and ascends as lateral lemniscus → inferior colliculus → medial geniculate body.

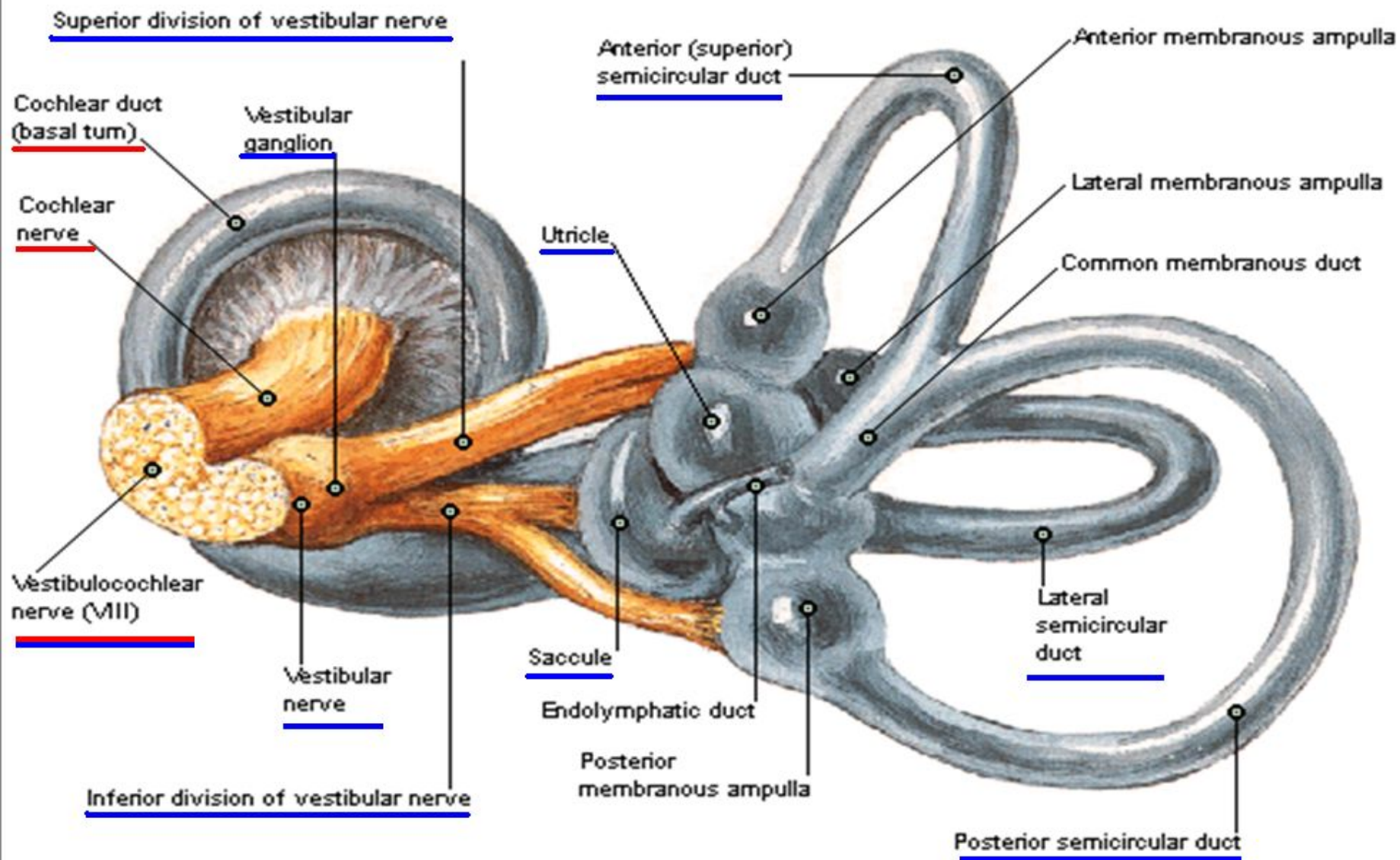
3. Third order neuron: “Cells of medial geniculate body” → posterior limb of internal capsule → auditory sensory area in superior temporal gyrus (area 41 & 42) where hearing is bilaterally represented.

Note: Arrows indicate course of sound waves

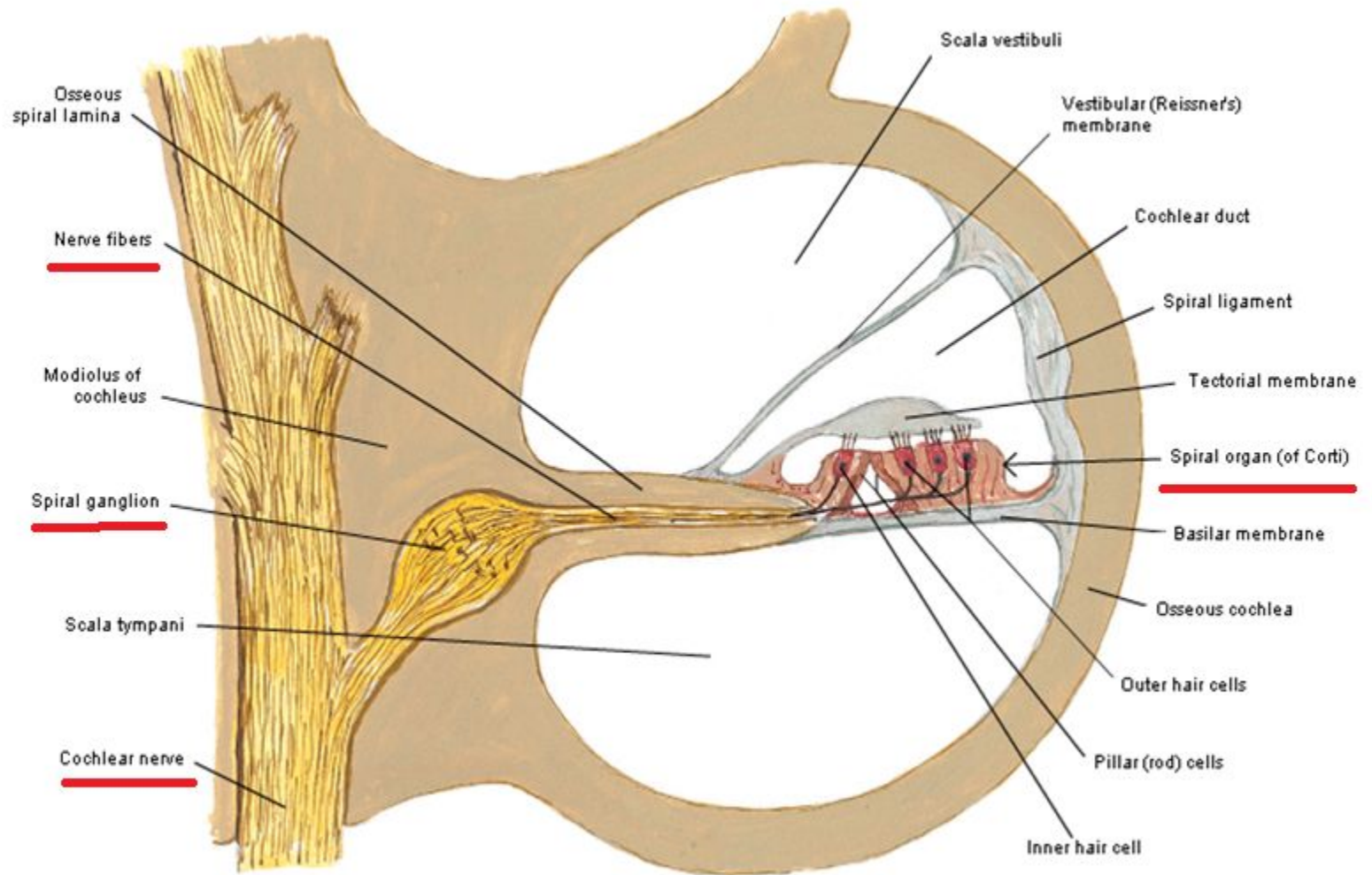


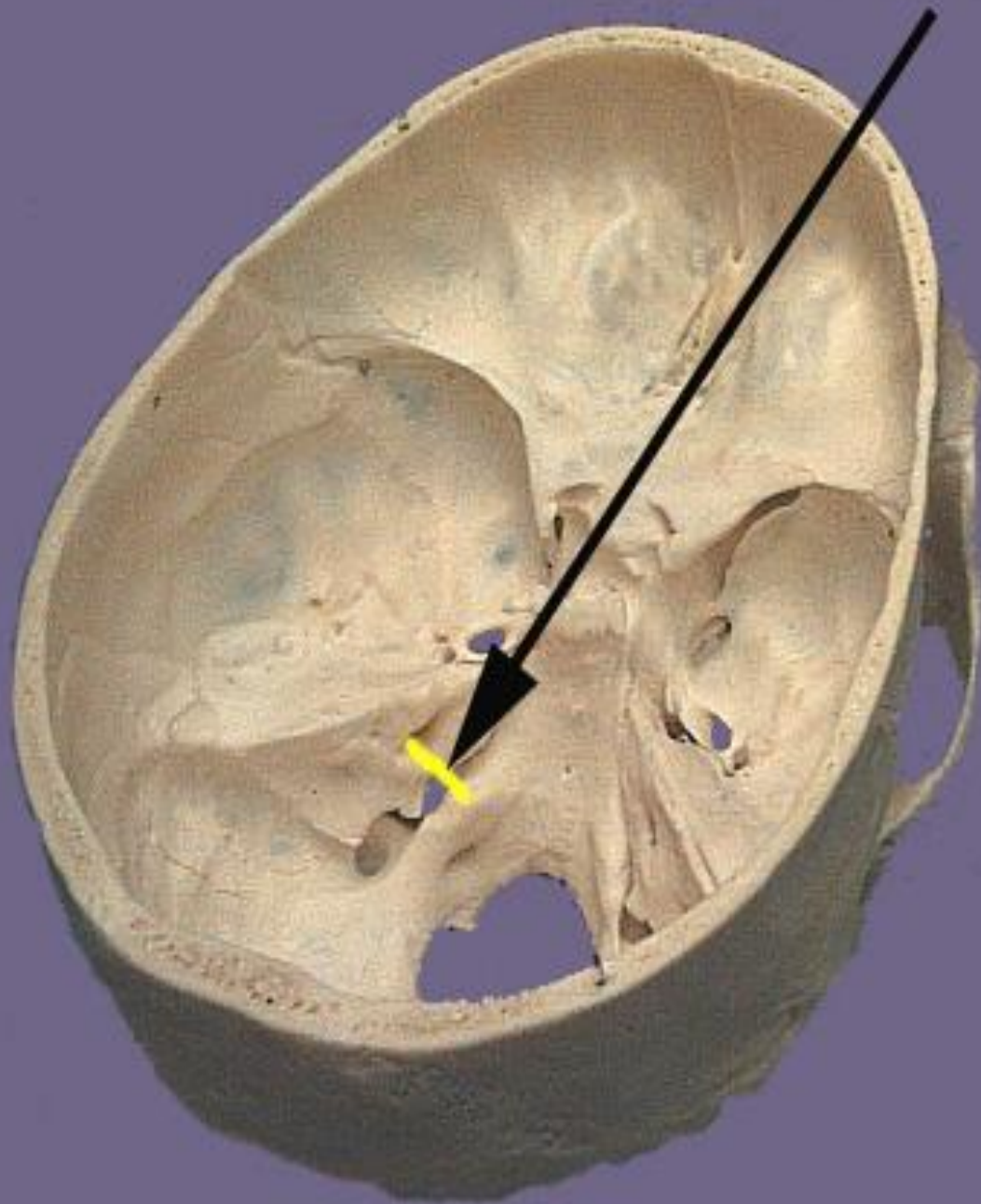
Right Membranous Labyrinth with Nerves

Posteromedial View



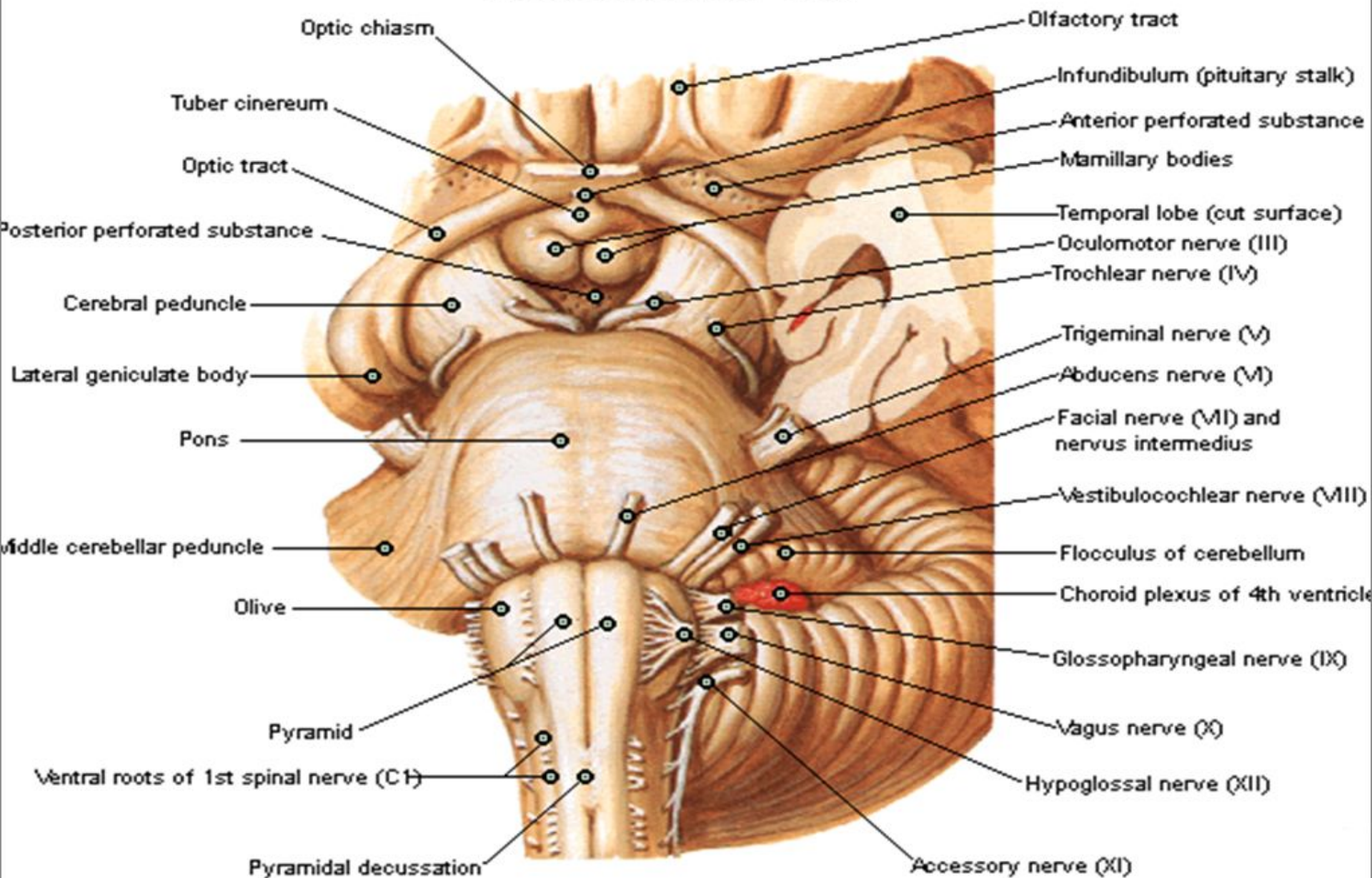
Cross Section Through Cochlea





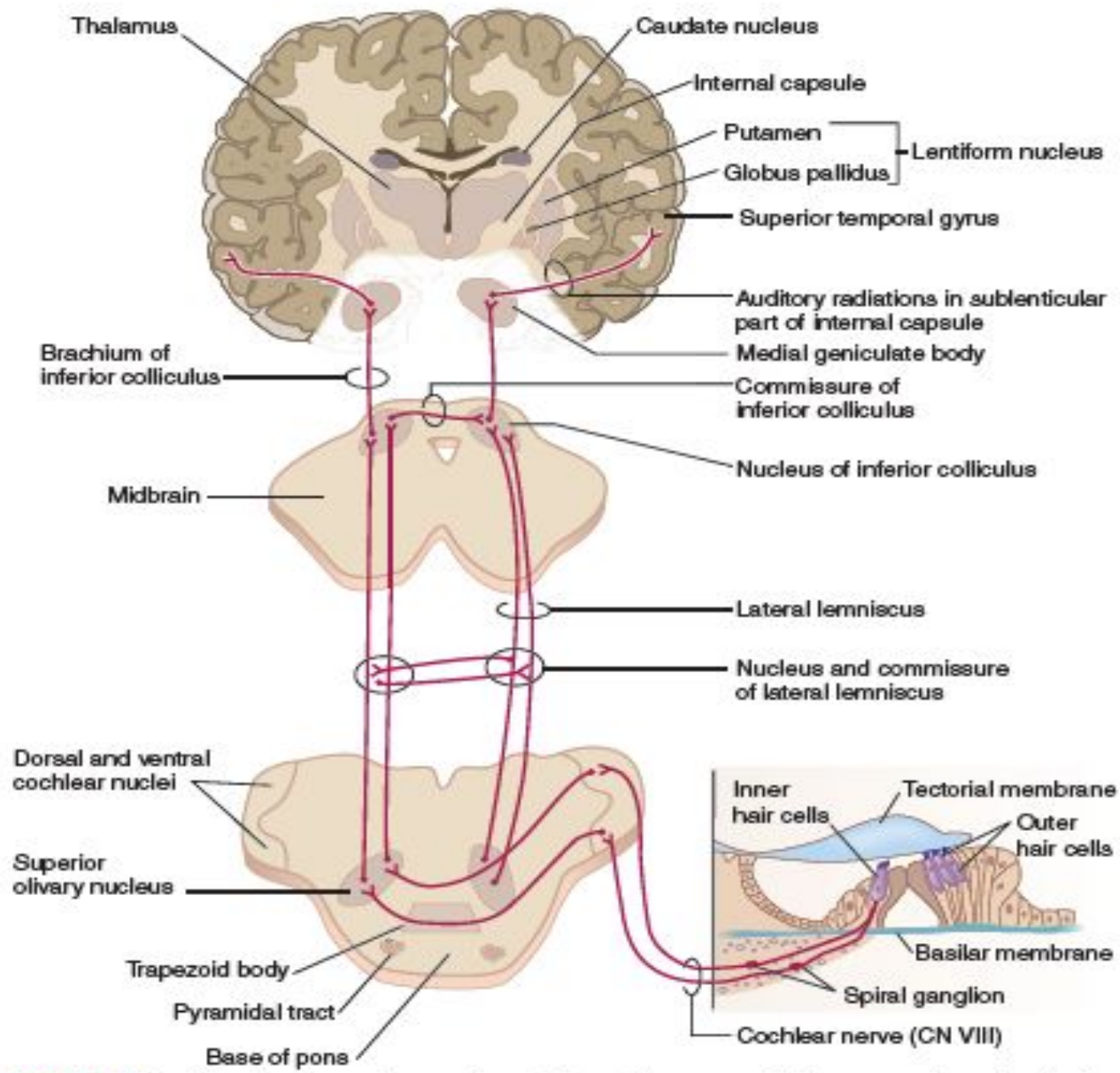
Brainstem

Anterioinferior View



Steps in Hearing

- ❖ The auricle → the external auditory meatus → vibration of the tympanic membrane → vibration of the malleus → incus → stapes → inner ear.
- ❖ Vibration of the perilymph of the inner ear → vibration of the endolymph causes → vibration of the basilar membrane → hair cells in the organ of Corti → cochlear nerve.
- ❖ Cochlear nerve → cochlear nuclei in the brain stem → lateral lemniscus → inferior colliculus → medial geniculate body → auditory cortical center (area 41 & 42 in the superior temporal lobe).

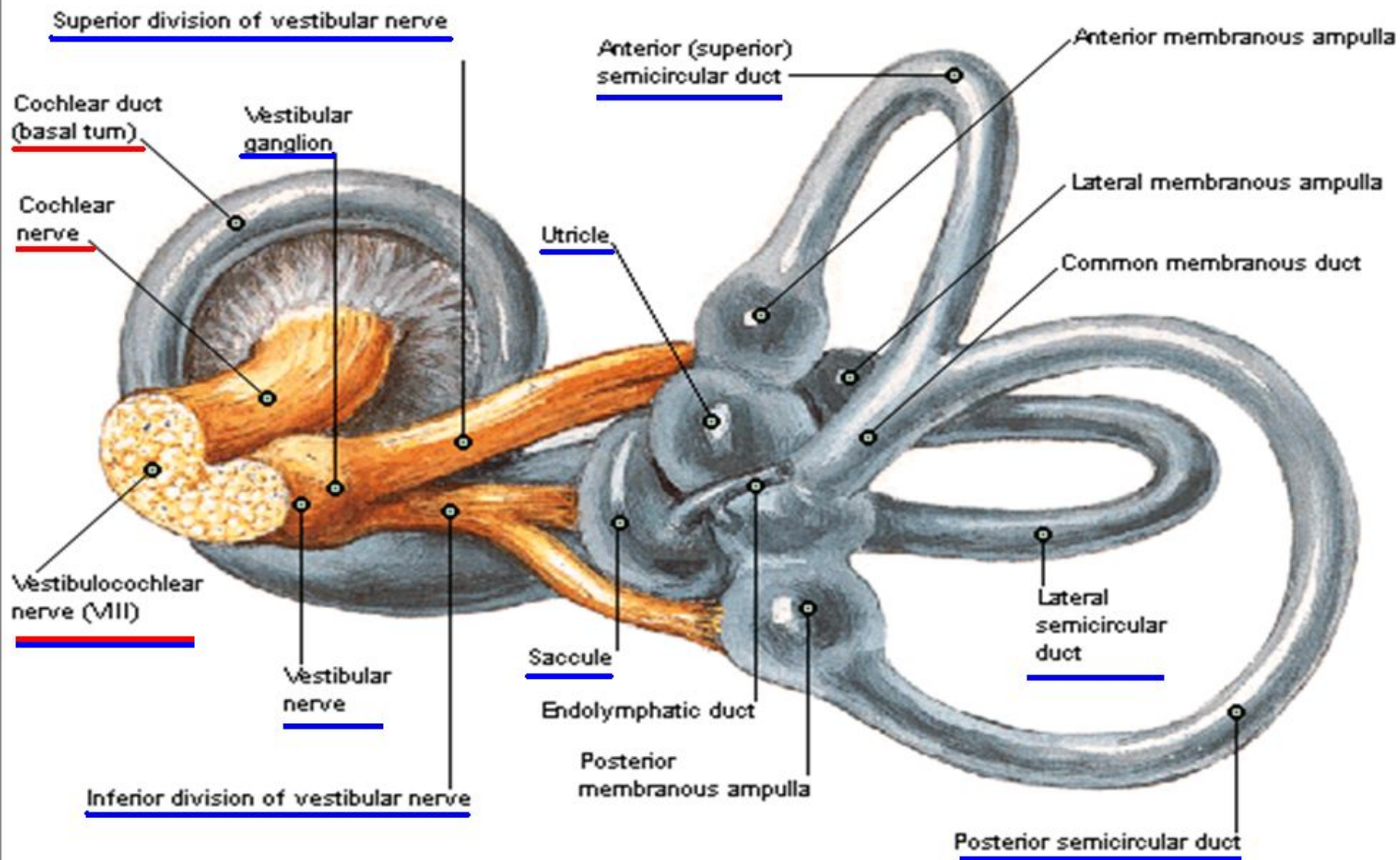


The Vestibular Division

- ❖ Its fibers carry equilibrium impulses from the internal ear via the vestibular nerve.
- ❖ **Pathway:** From the inner ear “**three semicircular canals, utricle and saccule**” → Internal auditory canal → joint cochlear division → lower border of the cerebello-pontine angle → to enter pons and medulla where they relay in the vestibular nuclei.

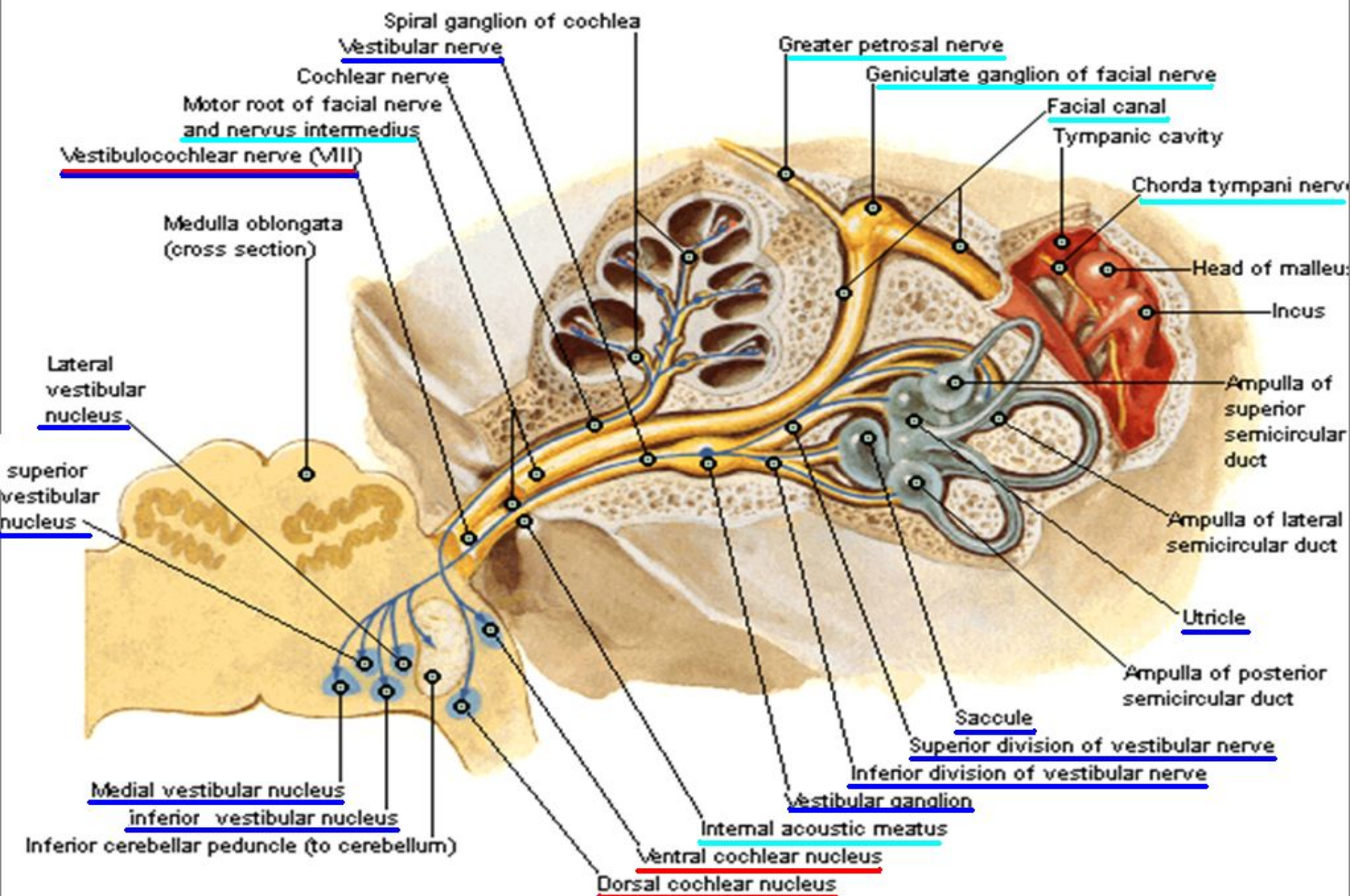
Right Membranous Labyrinth with Nerves

Posteromedial View



Vestibulocochlear Nerve

Schema





Thank You