MBB Lab 6: PowerPoint Handout
Anatomy of the Face and Ear

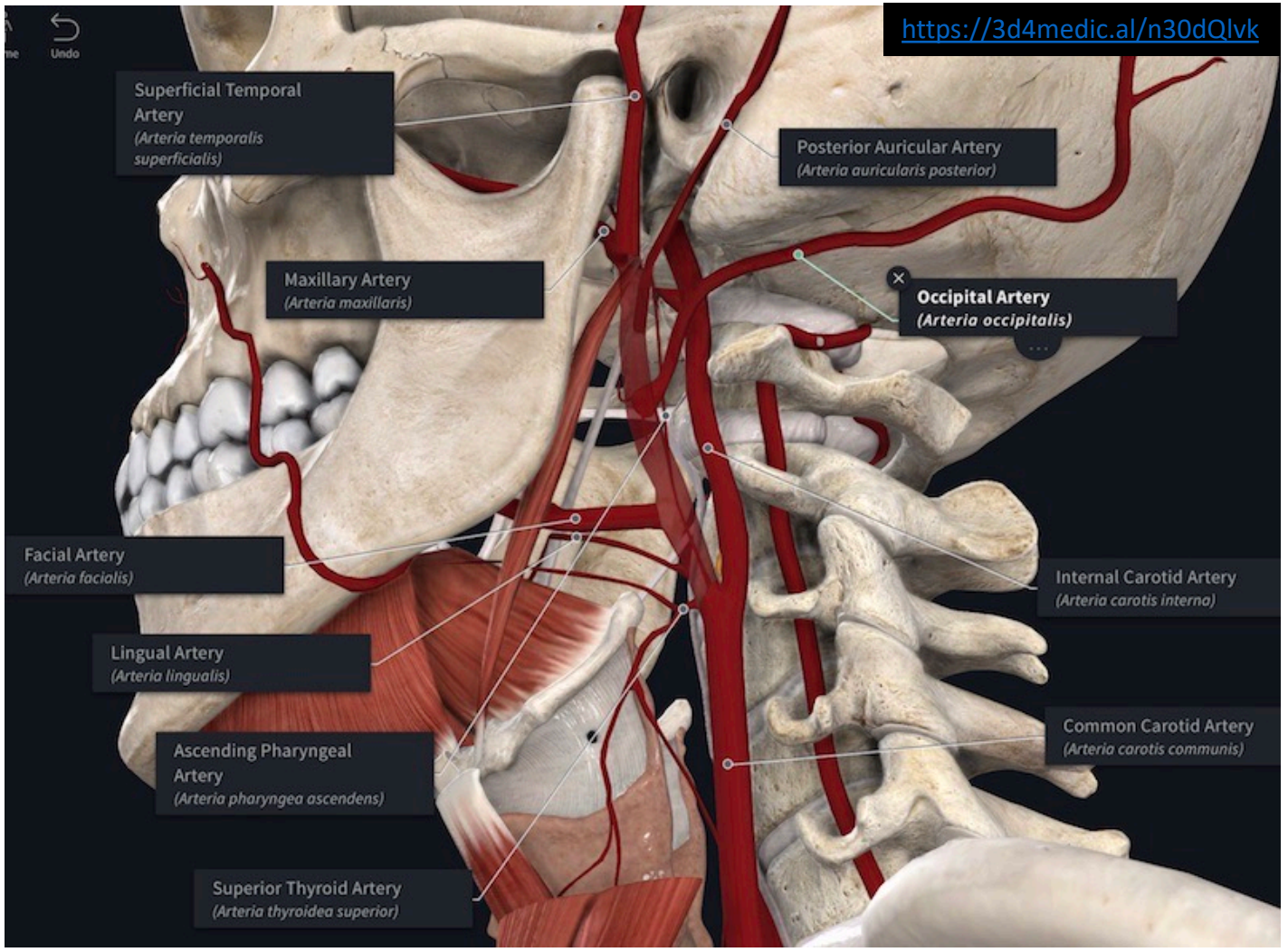
Review ”The Basics” and ”The Details” for the following cranial nerves in the Cranial Nerve PowerPoint Handout.

- Mandibular division trigeminal (CN V3)
- Facial nerve (CN VII)

Blood Supply to Neck, Face, and Scalp: External Carotid Artery

The common carotid artery branches into the internal and external carotid arteries at the level of the superior edge of the thyroid cartilage. The external carotid artery supplies the neck and face with the following branches. From inferior to superior, the following mnemonic can be helpful: *Some Anatomists Like Freaking Out Poor Medical Students*

- **Superior thyroid a.** branches at the level of the hyoid bone and supplies the larynx and thyroid gland.
- Ascending pharyngeal a. is the smallest branch and is the only branch we won't attempt to identify in the lab. It supplies the pharynx.
- The **lingual a.** passes deep to the hyoglossus muscle and is the primary blood supply to the tongue.
- The **facial a.** ascends after branching to pass deep to the posterior belly of the digastric m, stylohyoid m., and the submandibular gland. It then hooks around the inferior border of the mandible to enter the face along the anterior border of the masseter muscle. It ascends the face across the cheek and along the lateral aspect of the nose to terminate as the angular artery at the medial canthus of the eye.
- After branching, the **occipital a.** courses in a posterior direction to pass through the apex region of the posterior triangle to enter the occipital region of the scalp, which it supplies.
- The **posterior auricular a.** branches in a posterior direction from the external carotid artery to pass posterior to the auricle of the ear to supply the scalp in that region.
- The **maxillary a.** is the largest of the two terminal branches. After its formation, it passes through the parotid gland to course medial to the neck of the mandible. It then passes through the infratemporal fossa to enter the pterygopalatine fossa. Its many branches supply deep structures of the face along its path.
- The **superficial temporal a.** is the smaller of the two terminal branches. Within the parotid gland, it is formed where the maxillary artery branches from the external carotid artery. It ascends anterior to the auricle of the ear over the zygomatic arch to supply structures in the temporal region.

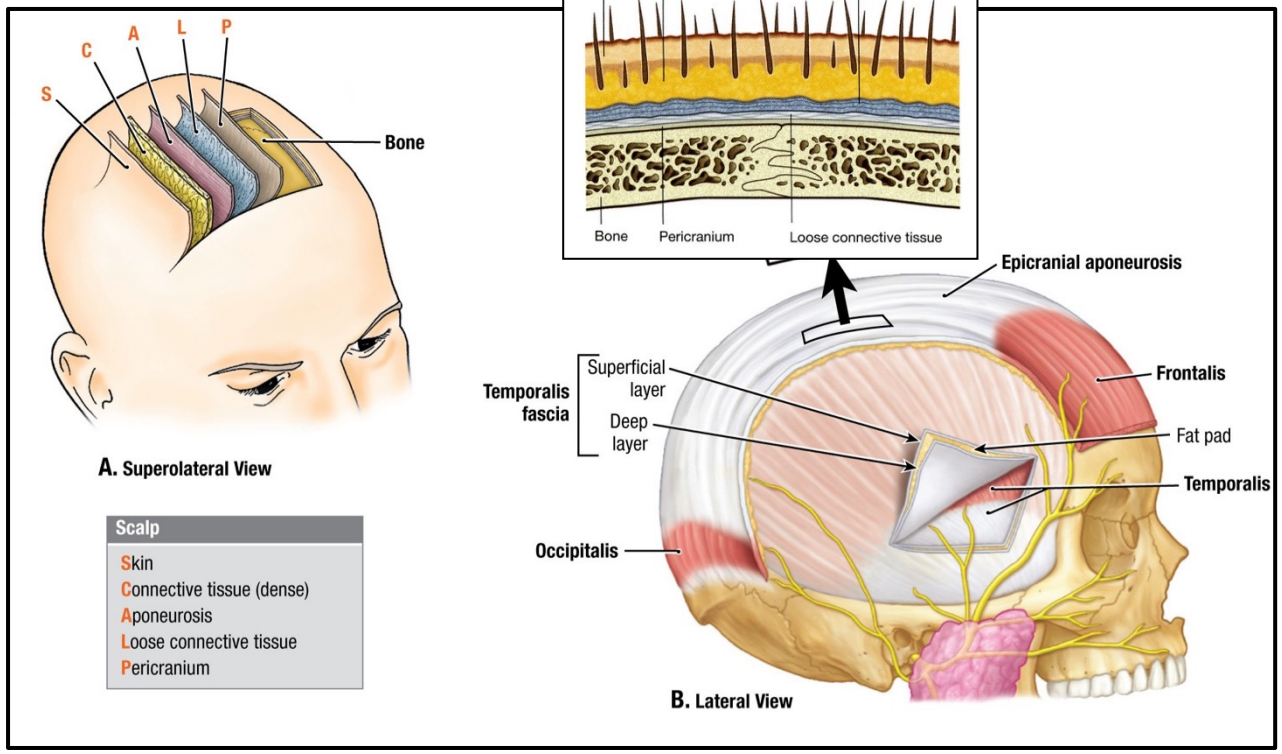


Scalp: Layers

The scalp consists of 5 layers, which are listed below from superficial to deep. Note that combining the first letter of each layer spells the word SCALP, which is a great mnemonic!

- **Skin proper**: This layer is consists of epidermis and dermis.
- **Connective tissue**: This layer is the scalp's superficial fascia (subcutaneous layer) consisting of adipose and fibrous connective tissue. The fibrous connective tissue is organize into fibrous bands that connect the skin proper to the underlying aponeurosis, which makes the connective tissue layer firm and resists stretching. The space between the fibrous bands is occupied occupied by adipose tissue. In addition, **this layer contains an extensive network of vessels and nerves that supply the skin.**

CLINICAL ANATOMY: The blood vessels coursing through the connective tissue layer are attached to the fibrous portion of the connective tissue, which prevents them from vasoconstricting when they are lacerated. This lack of vasospasm can result in profuse bleeding upon injury.



- **(Epicranial) Aponeurosis**: The aponeurosis layer is the sheet-like tendon of the occipitofrontalis (epicranius) muscle. This layer is sometimes referred to as the galea aponeurotica.
- **Loose connective tissue**: This layer consists of areolar connective tissue that allows the 3 superficial layers to glide over the deepest layer (pericranium).

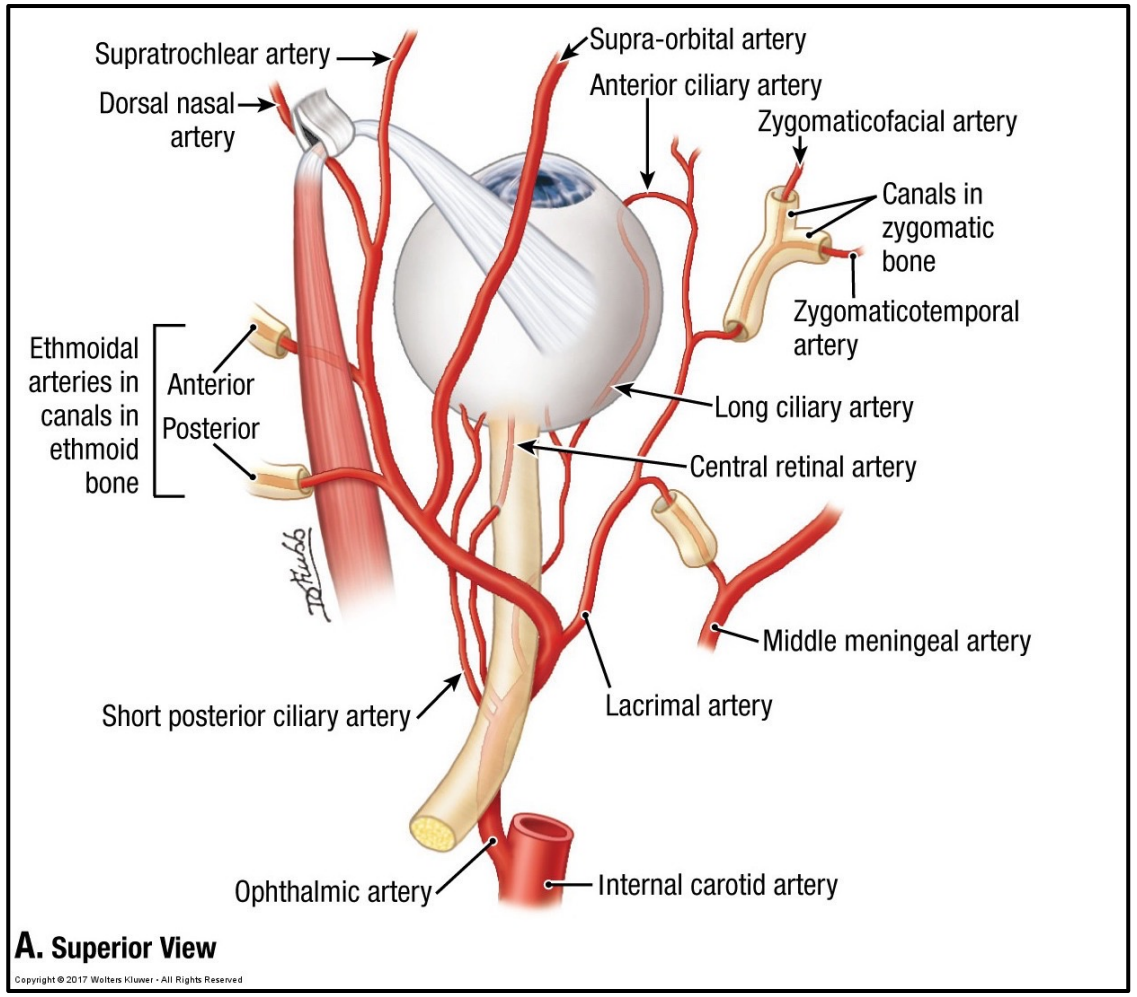
CLINICAL ANATOMY: Infections in the loose connective tissue layer can also spread to the cranial cavity via emissary veins. Because the occipital belly of the occipitofrontalis muscle attaches firmly to the occipital bone, and the epicranial aponeurosis attaches firmly to the zygomatic arches, infections or blood in the "danger space" cannot spread into the neck. However, because the frontal belly of the occipitofrontalis muscle inserts into skin, infections and blood in the "danger space" can spread to the eyelids and bridge of the nose. Since this layer is drained by emissary veins, infection can spread into the cranial cavity, leading to meningitis.

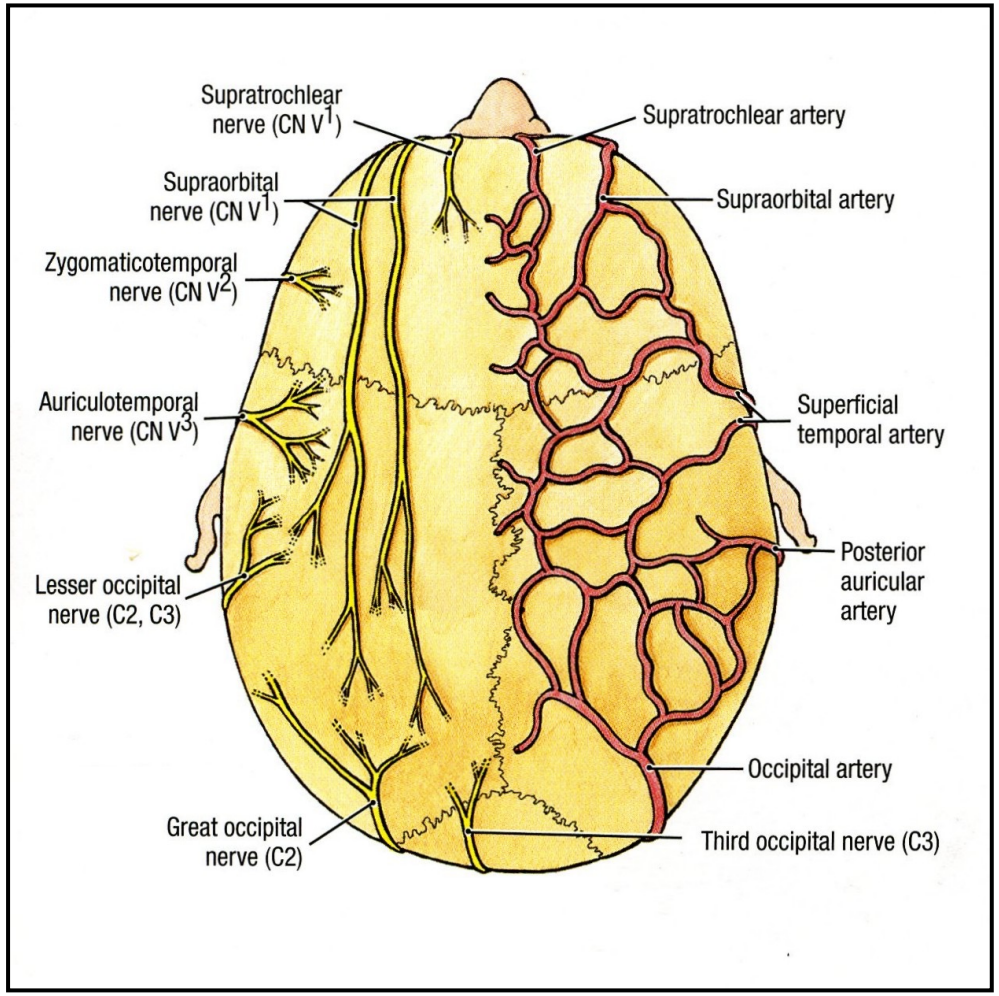
- **Pericranium**: The pericranium is the periosteum covering the external surface of the skull (neurocranium).

Scalp: Blood Supply

The scalp receives arterial blood from branches of both the **internal** and **external carotid arteries** (Figure Scalp Vessels).

- Internal carotid artery: Branches of the the ophthalmic artery (supratrochlear and supraorbital) pass through the orbit to supply the anteriosuperior portion of the scalp. Recall that the ophthalmic artery is the first intracranial branch of the internal carotid artery.
- External carotid artery
  - The **superficial temporal artery** supplies the frontal and temporal regions of the scalp
  - The **posterior auricular artery** supplies the superior scalp and region posterior to auricle,
  - The **occipital artery** supplies the posterior scalp.

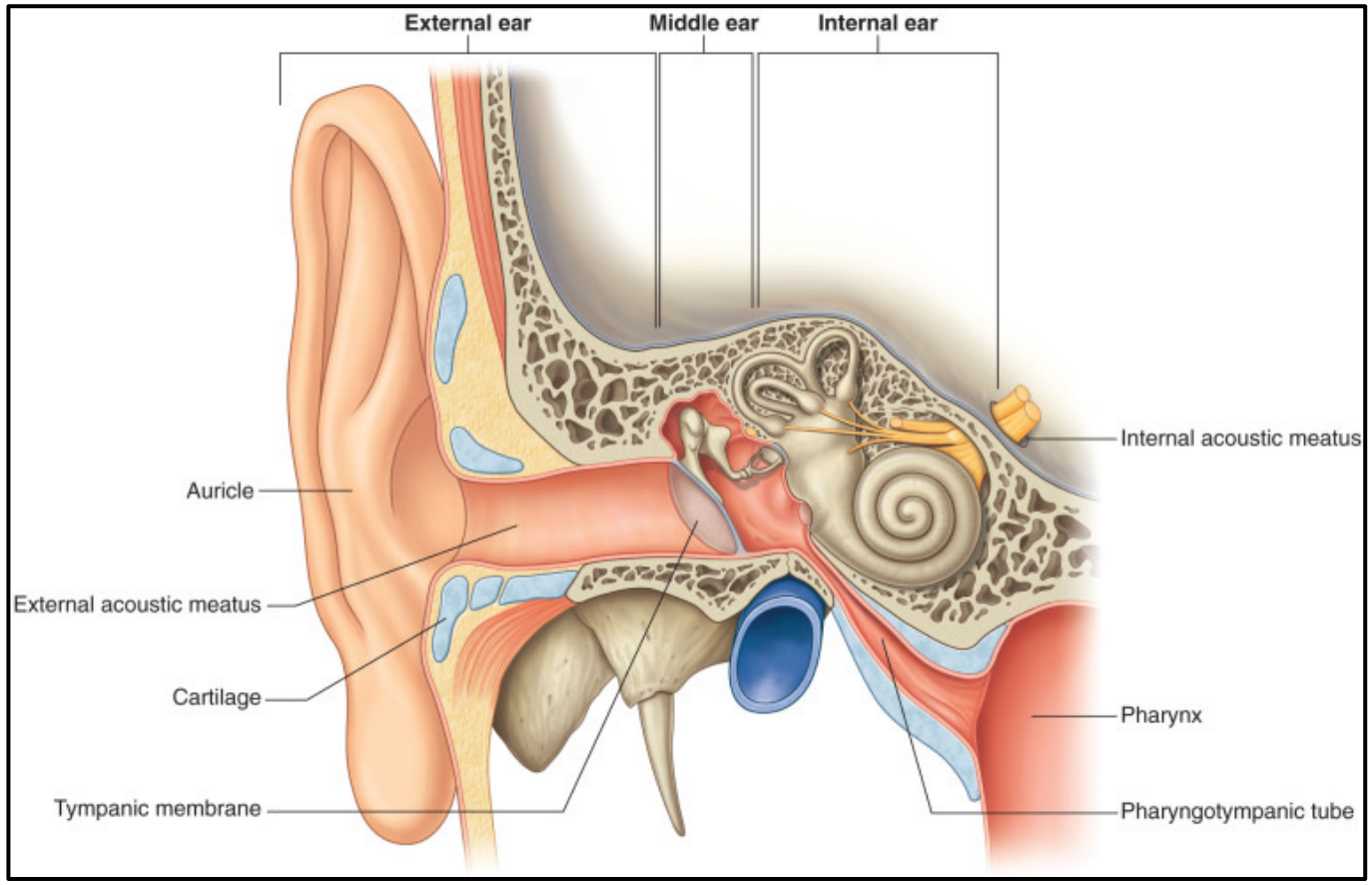




Regions of the Ear

The ear is divided into the following three parts.

- The **external ear** includes the tympanic membrane and all ear structures external to it.
- The **middle ear** consists of an air-filled cavity medial to the tympanic membrane within the petrous portion of the temporal bone. The mucosa lining the middle ear is continuous with the mastoid antrum and the pharyngotympanic (Eustachian) tube.
- The **inner ear** consists of structures embedded within the petrous portion of the temporal bone. **The organs of the inner ear** contain receptors involved in the special sense of hearing and and also “vestibular sense,” which is the recognition of head/body position relative to gravity. The anatomy and function of the inner ear will be covered later in Mind, Brain and Behavior.

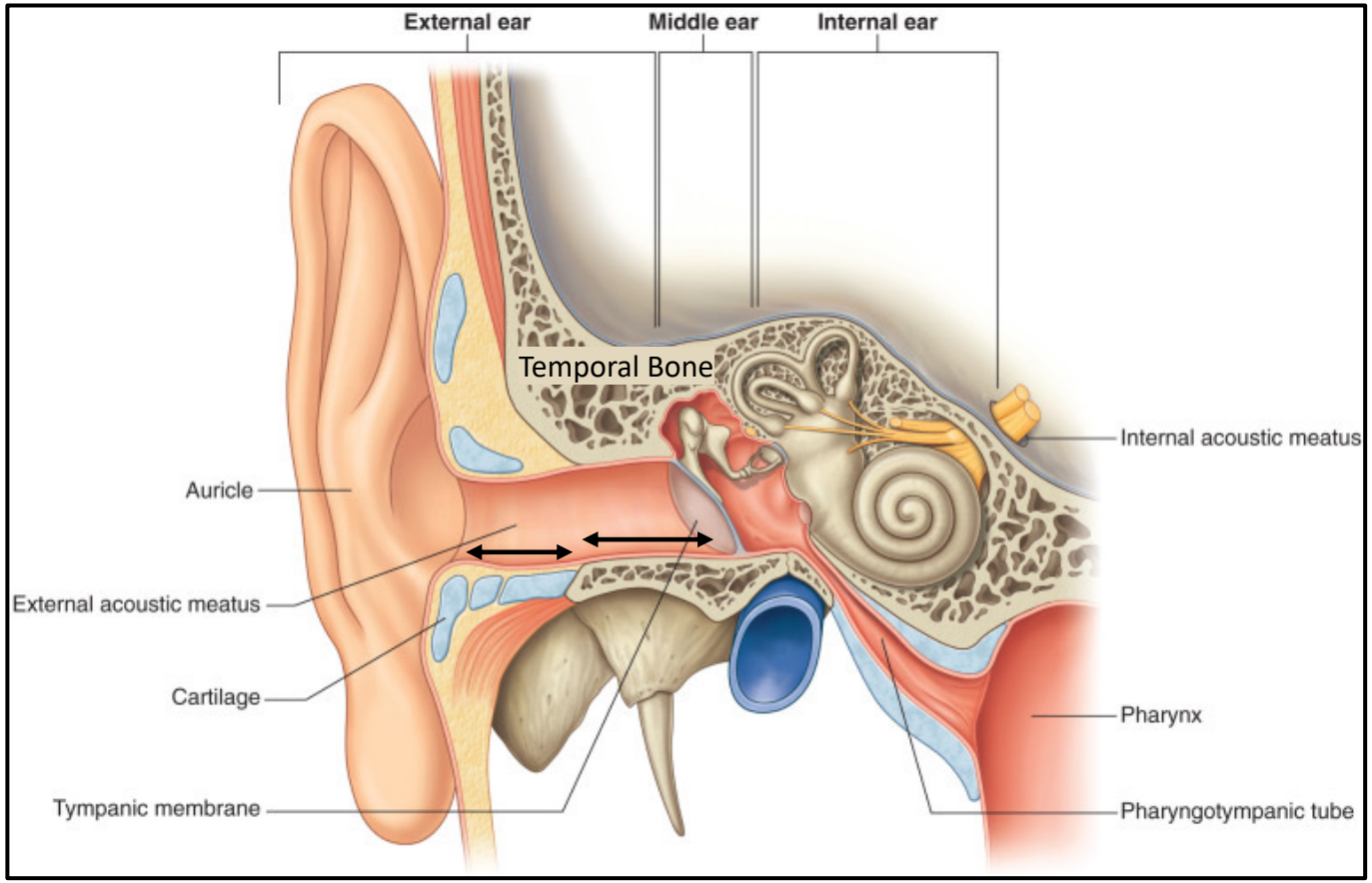


External Ear: Anatomy

The external ear consists of the following structures.

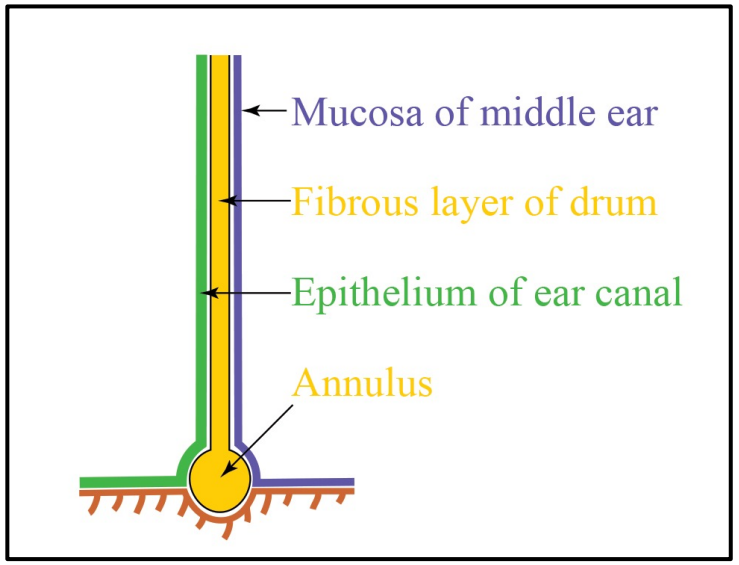
- The **auricle (pinna)** is an irregular-shaped flap of elastic cartilage that is covered with skin. The cartilage of the external acoustic meatus is continuous with the cartilage of the external auditory canal. The auricle's function is to concentrate sound waves and direct them to the opening of the external auditory canal.

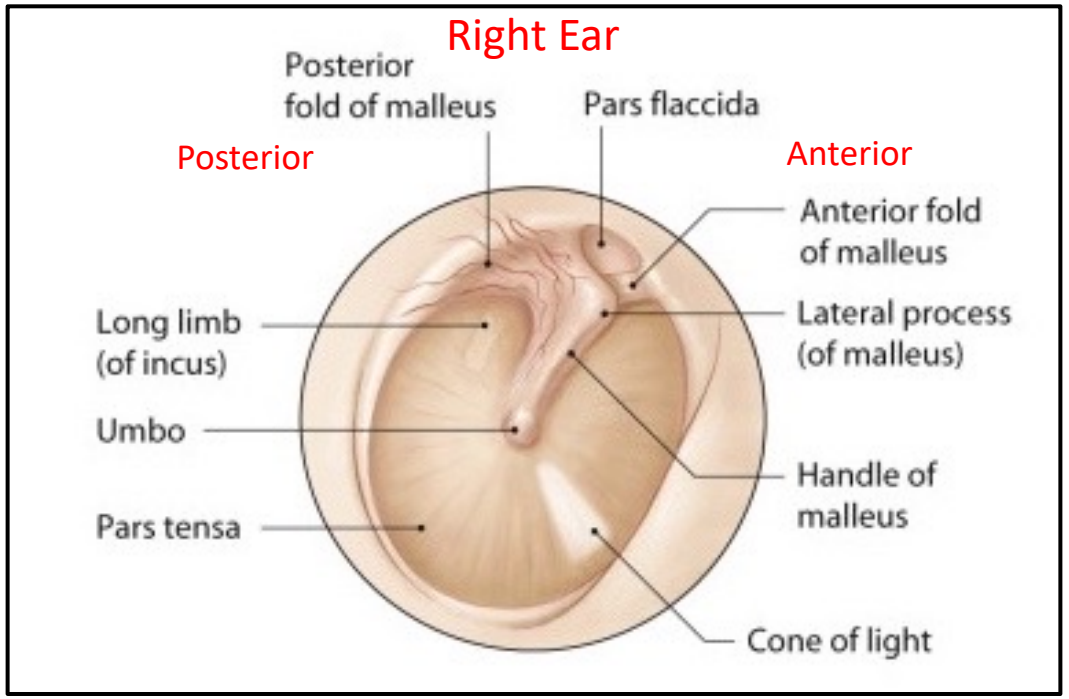
- **The external auditory canal (meatus)** conducts sound waves from the auricle to the **tympanic membrane.** The tympanic membrane is the boundary between the external ear and the tympanic cavity. The region of the tympanic membrane that faces the external auditory canal is lined with skin.
  - The lateral one-third of the canal is cartilaginous.
  - The medial two-thirds of the canal consists of thin bone (part of the temporal bone). The skin of the external auditory canal contains sebaceous glands, ceruminous glands that secrete a waxy substance (cerumen), and hair follicles. However, the hair follicles lack arrector pili muscles.



Tympanic Membrane

- The **tympanic membrane** forms the boundary between the external ear and tympanic cavity of the middle ear.
  - The tympanic membrane is a semitransparent oval that is approximately 1 cm in diameter. Its position is oblique in orientation facing downward, forward, and lateral. Its outer margin is oval in shape, and its central region is pulled toward the middle ear by its attachment to the manubrium, which pulls it into the shape of a cone.
  - It consists of three layers.
    - The external external surface (side facing external auditory canal) is covered with skin.
    - The middle layer consists of connective tissue layer.
    - The inner surface (side facing tympanic cavity) is covered with mucous membrane.
  - When viewing the external surface tympanic membrane, a central depression can be identified. This depression is the apex of the cone-shape tympanic membrane where tip of the malleus is attached to the tympanic membrane forming a central concavity called the **umbo**.
  - The **pars flaccida** is a small superior region of the tympanic membrane that is triangular in shape and is slack relative to the pars tensa.
  - The **pars tensa** is the large inferior region of the tympanic membrane that is pulled tense by its attachment of the manubrium. The pars tensa is attached at its periphery by a thickened ring of collagen called the **annulus**.

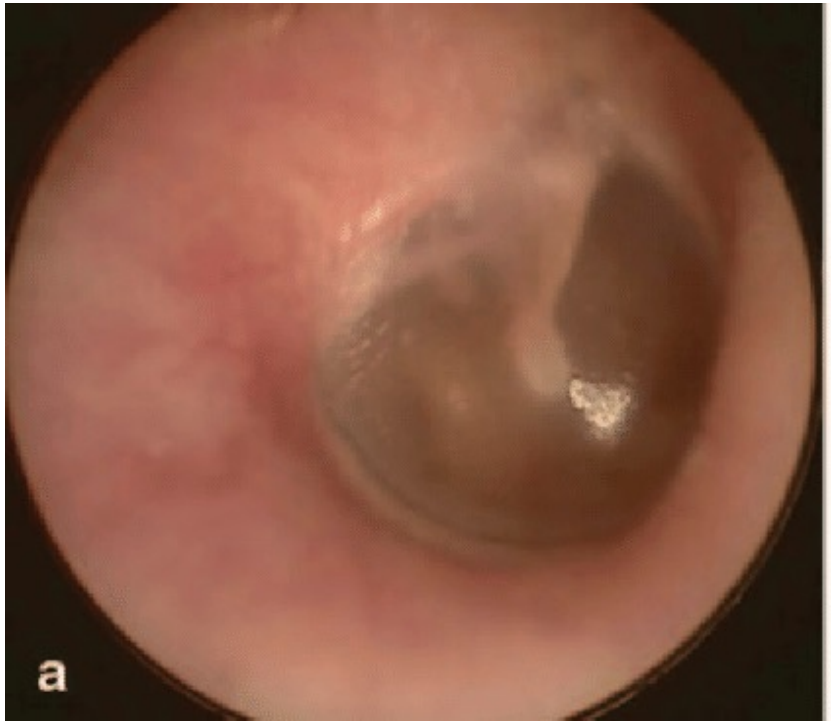


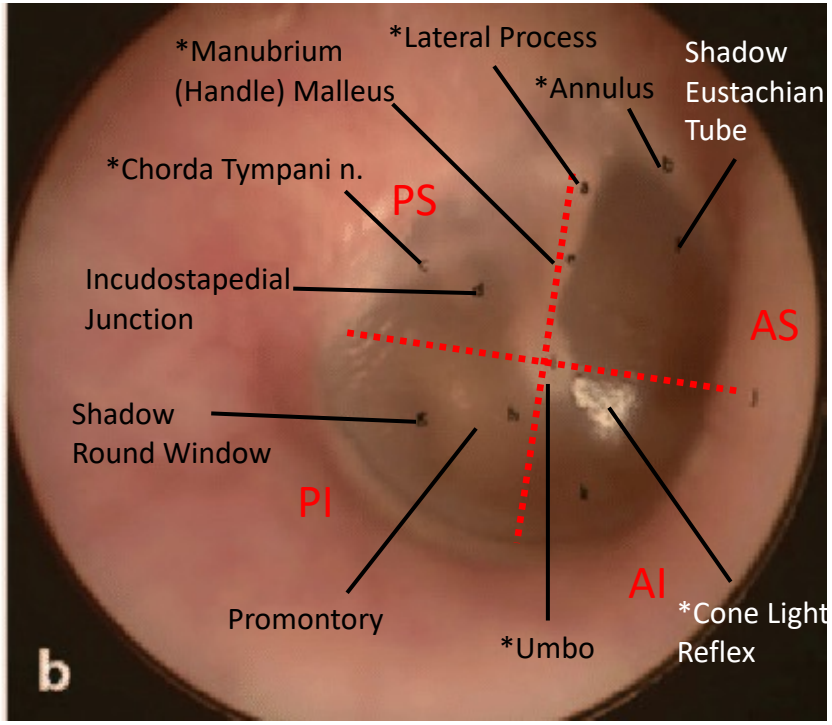


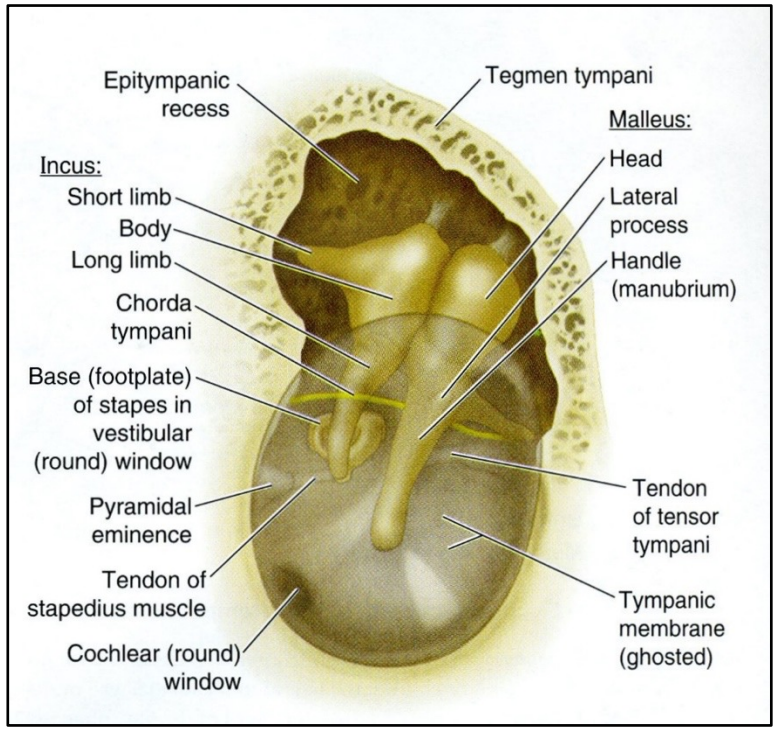
Tympanic Membrane (Continued)

The tympanic membrane is divided into four quadrants. You should be aware of the four quadrants and the tilt of the vertical axis that allows you to determine which ear you are viewing. However, you **won't be tested** on the the structures visible in each quadrant, but seeing them labeled can help with understanding the anatomical relationships of structures within the middle ear. The structures you need to identify are labeled by an asterisk.

Quadrant	Structures Visible Within Each Quadrant
Anterior superior quadrant	Shadow of opening for eustachian tube
Anterior inferior quadrant	Cone of light reflex (The reflex can be used to determine the anterior portion of the tympanic membrane, which in turn can be used to determine whether you are viewing a left or right tympanic membrane.)
Posterior superior quadrant	• Chorda tympani nerve • Incudostapedial joint
Posterior inferior quadrant	• Promontory • Shadow of round window







Sensory Innervation: Auricle, EAC, and Tympanic Membrane

•Sensory innervation of the auricle includes the following nerves. (Figure 1)

- •Great auricular nerve (cervical plexus)
- •Lesser occipital nerve (cervical plexus)
- •Auriculotemporal nerve (branch of V3)

•Sensory innervation to the external auditory canal (meatus) and LATERAL (EXTERNAL) surface of the tympanic membrane is via branches from the following three nerves. (Figure 2)

- •CN VII (Facial n.)
- •Auriculotemporal n. (branch of V3)
- •CN X (Vagus n.)

•Sensory innervation to the MEDIAL (INTERNAL) surface (side facing the middle ear cavity) is innervated by CN IX (glossopharyngeal n.)

Figure 1

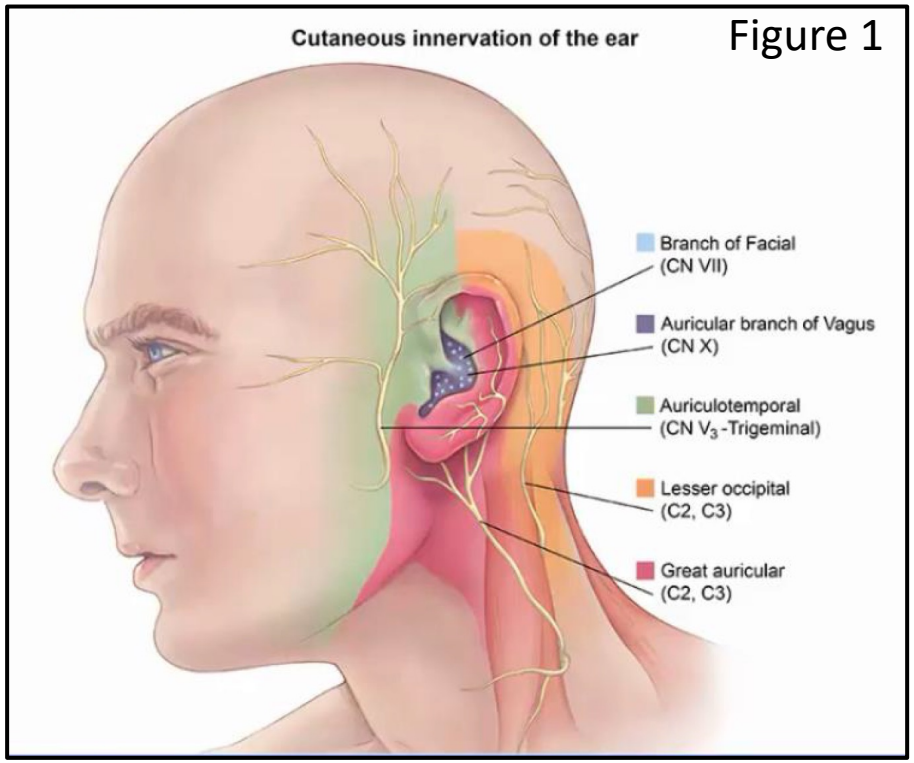
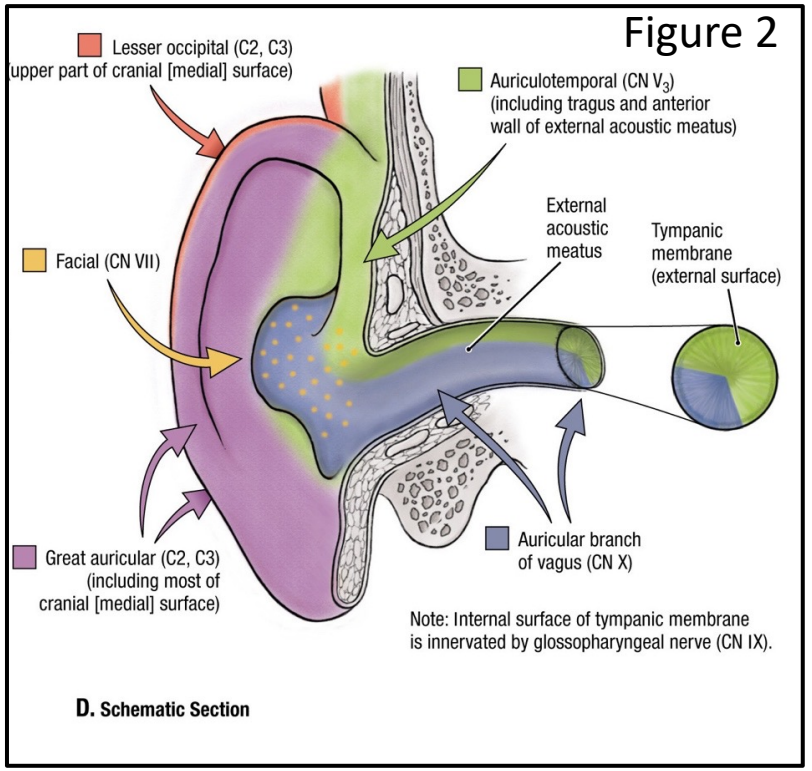


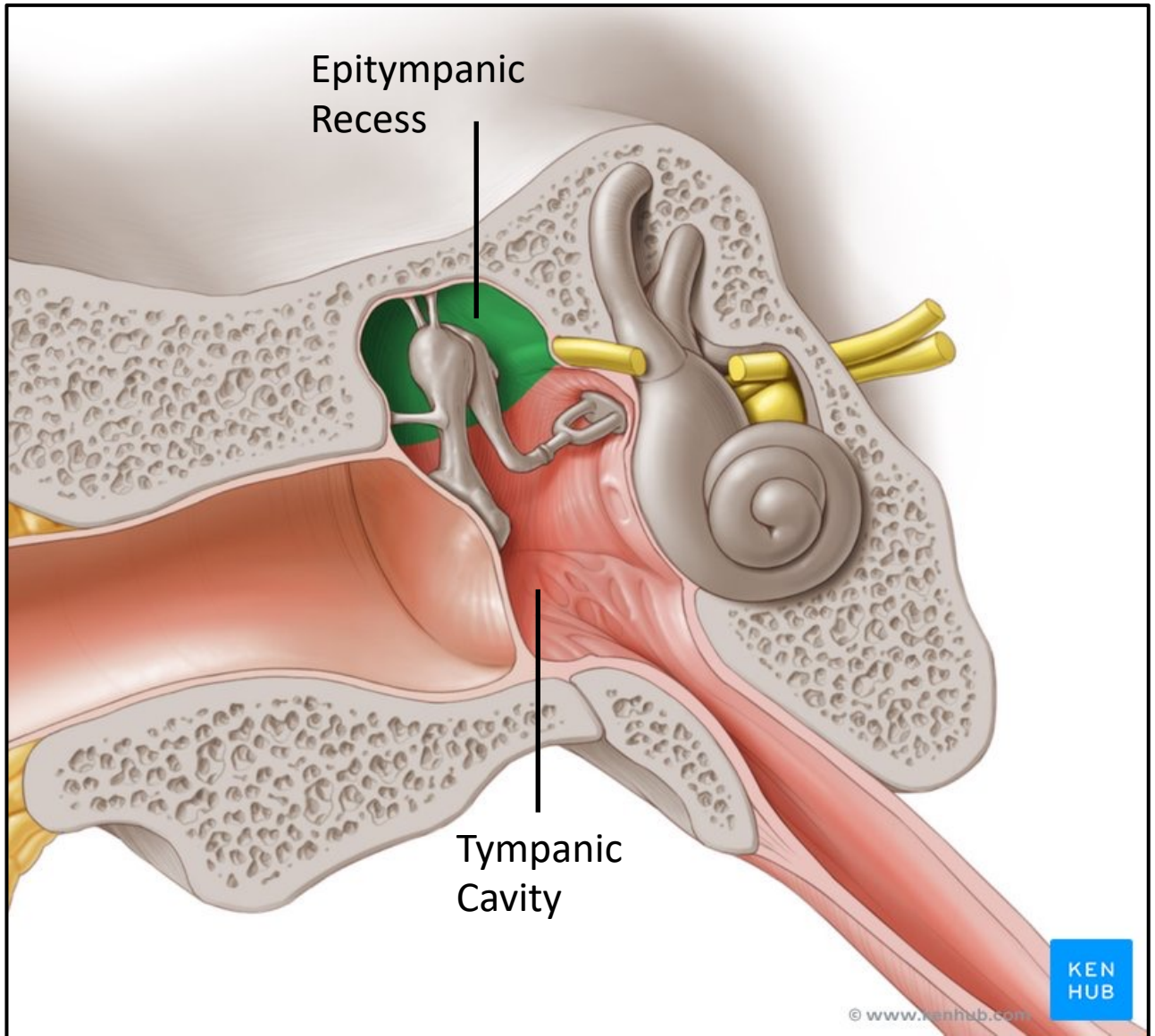
Figure 2

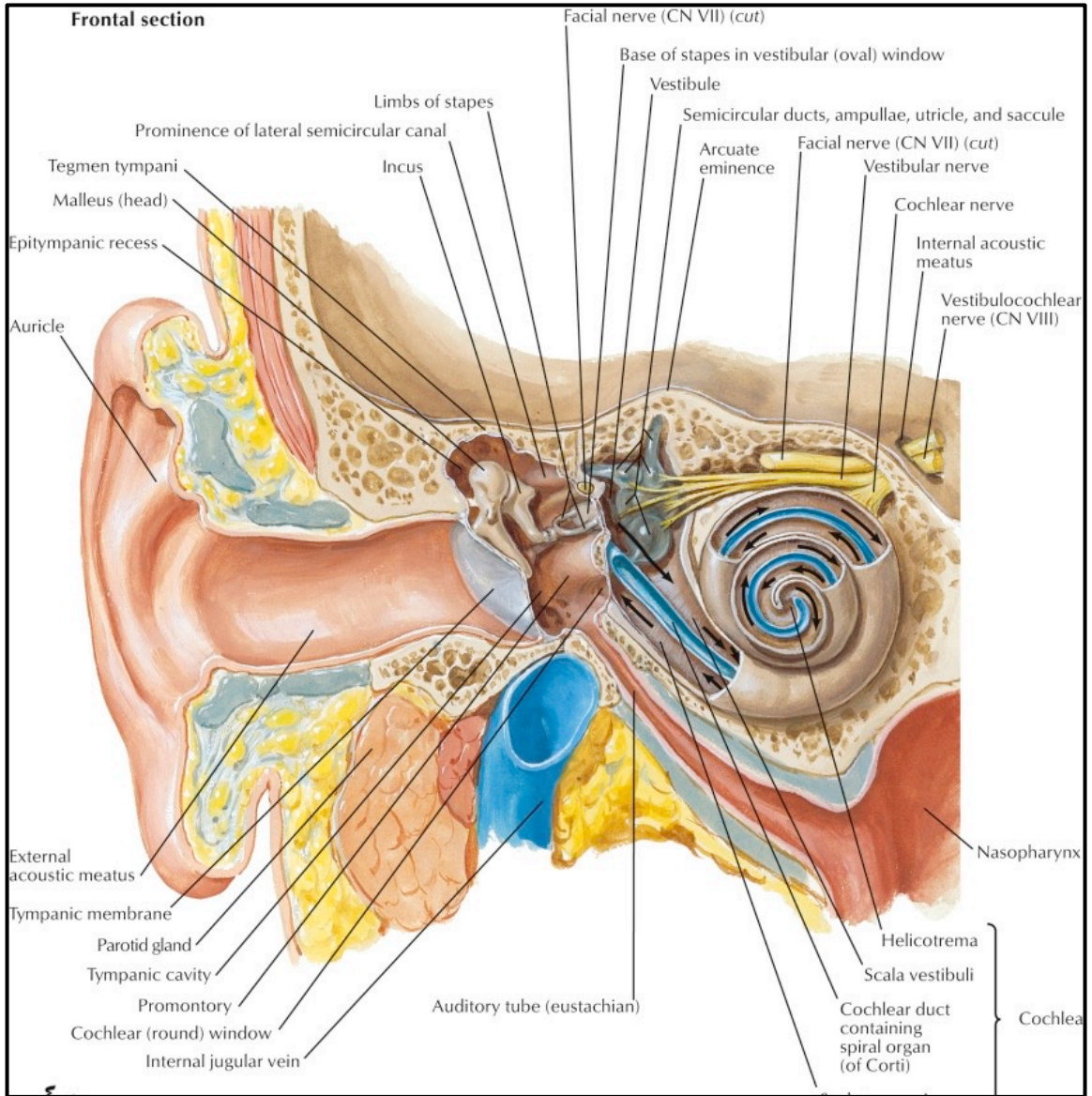


Middle Ear Cavity

The middle ear is an air-filled cavity located within the temporal bone that contains the auditory ossicles. It can be divided into two regions.

- The **tympanic cavity** is the region of the middle ear directly medial to the tympanic membrane.
- The **epitympanic recess** is the portion of the middle ear superior to the tympanic cavity.





Middle Ear Cavity (Continued)

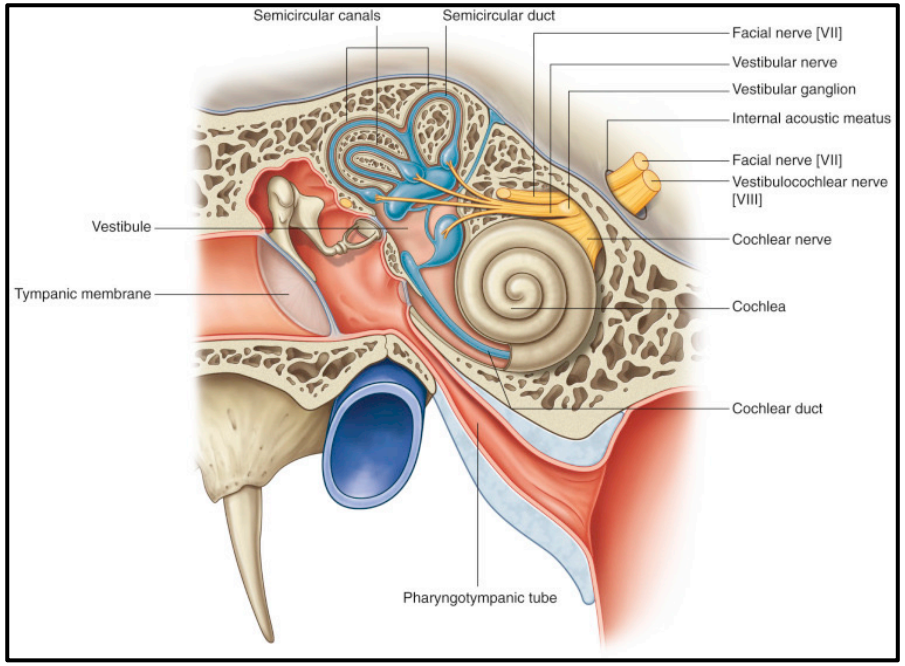
Moyer PRL Middle Ear Cavity: Panopto

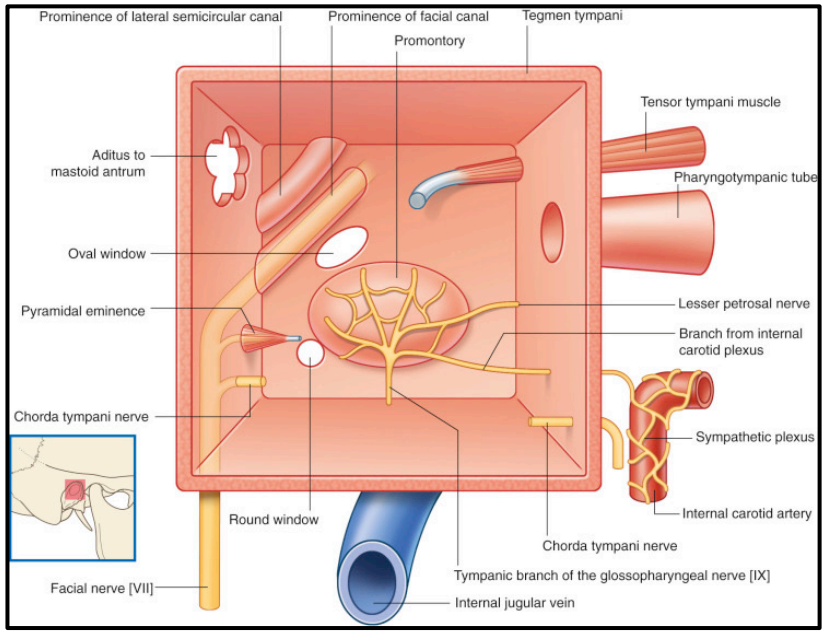
To understand the middle ear as a space, it is often described as a rectangular box consisting of a roof, floor, medial wall, posterior wall, and a lateral wall. The structures forming each wall, and the landmarks associated with each wall are described below.

- The roof is formed by thin bone called the **tegmen tympani** of the petrous portion of the temporal bone, which is also the floor of the middle cranial fossa
- The floor is formed by the bone separating the middle ear from the jugular fossa. The jugular fossa is a depression on the inferior side of the skull that communicates with the posterior cranial fossa via the jugular foramen. The jugular fossa contains the jugular bulb portion of the internal jugular vein and CNs IX, X, and XI after they pass through the jugular foramen.
- The lateral wall consists of the **tympanic membrane** and the bone forming lateral wall of the epitympanic recess.
- The medial wall is associated with the following structures.
    - The proximal part of cochlea forms a bulge in the medial wall called the **promontory**.
    - The oval and round windows are located along the medial wall.
    - A ridge of bone called the prominence of facial canal is where the facial canal forms a bony protrusion into the middle ear cavity
    - The lateral semicircular canal also forms a ridge-like bony protrusion into the middle ear cavity superior to the prominence of the facial canal.

- The anterior wall is a thin plate of bone that separates the middle ear from the **carotid canal** containing internal carotid artery. It contains two openings.
    - Opening for the tensor tympani muscle
    - Opening for the Eustachian tube

- The posterior wall (mastoid wall) consists of a bony partition between the tympanic cavity and the mastoid air cells. It contains an opening called the **mastoid aditus** that communicates with the mastoid antrum.





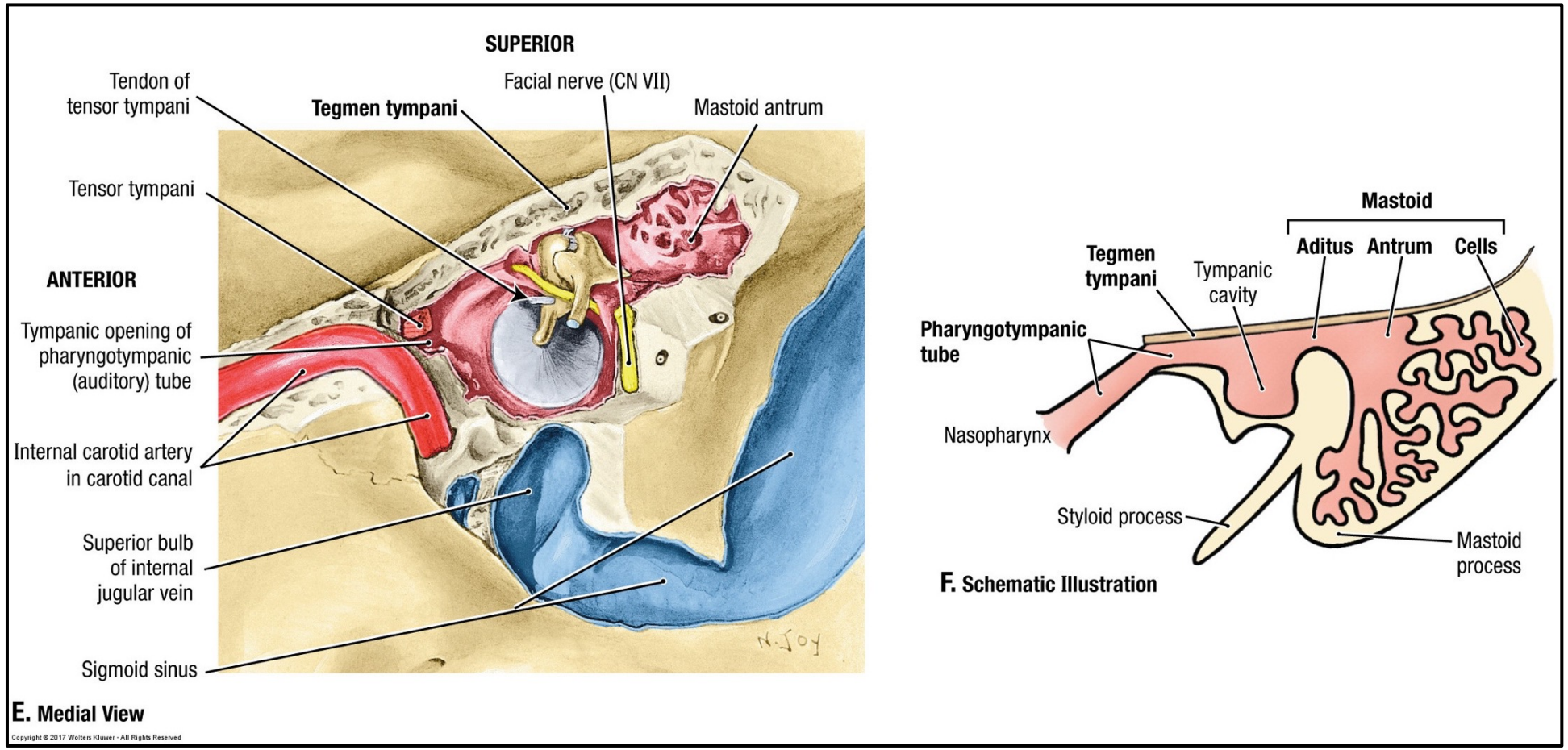
The tympanic membrane (lateral wall) is removed in this picture

Mastoid Antrum

The **mastoid antrum** is the space inside the the **mastoid process** of the temporal bone containing small **mastoid air cells**.

- The **mastoid antrum** is located posterior to the **tympanic cavity** and communicates with it through an opening referred to as the **additus** of the **mastoid antrum**.
- The roof of the **mastoid antrum** is formed by the **tegmen mastoideum**, which is a thin sheet of bone forming the floor of the *middle cranial fossa*. The tegmen mastoideum and the tegmen tympani are continuous with each other.

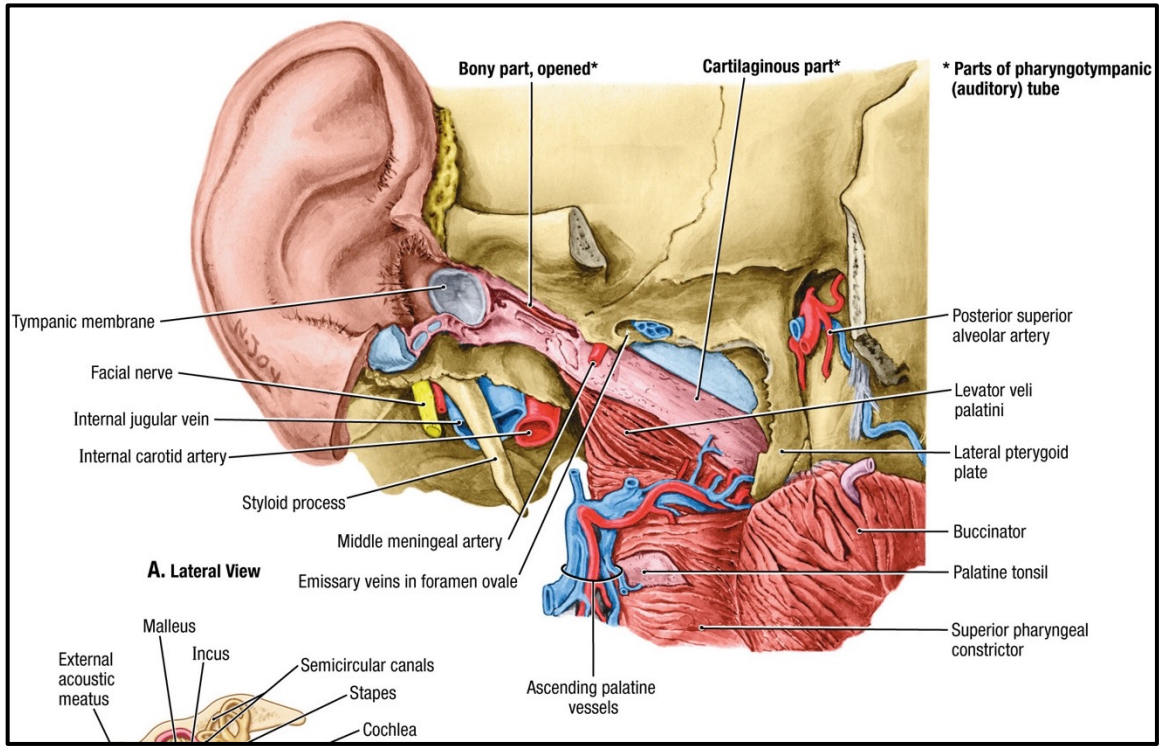
CLINICAL ANATOMY: Mastoiditis is infection of the mastoid antrum and mastoid air cells secondary to middle ear infection. Because of the thinness of the tegmen mastoideum, these infections can spread superiorly into the middle cranial fossa.

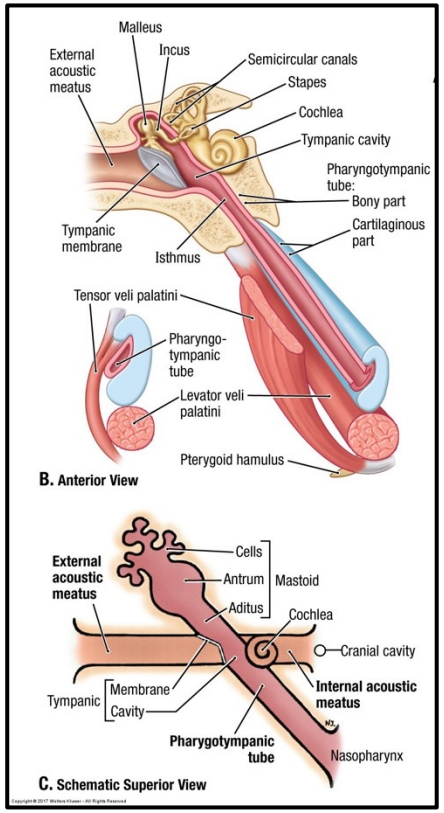


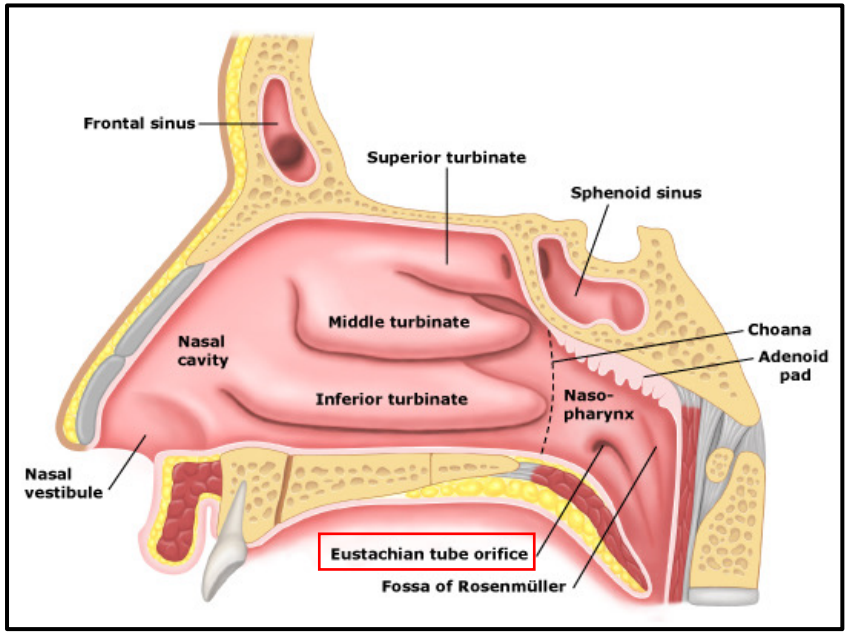
Eustachian (Pharyngotympanic or Auditory) Tube

The auditory (Eustachian or pharyngotympanic) tube connects the **tympanic cavity** to the **nasopharynx**.

- The portion of the tube in direct communication with the middle ear (posterolateral third) consists of bone, while the remainder of the tube is cartilaginous.
- The **Eustachian tube provides** a passage for air to enter and leave the tympanic cavity, which allows for the equalization of pressure between the middle ear and atmospheric air. This equalization of pressure across the tympanic membrane influences the tension on the tympanic membrane and the attached ossicles, which indirectly impacts the efficiency of sound wave transmission.
- A secondary function of the Eustachian tube is to be a pathway for drainage of secretions, infection, or debris from the middle ear.
- Normally the connection point of the Eustachian tube with the nasopharynx is “closed” due to the collapse of its cartilaginous walls. However, it can be opened by by air moving along a pressure gradient or by contraction the **soft palate** muscles. This explains why “popping the eardrums” is associated with yawning and swallowing.







Otitis Media

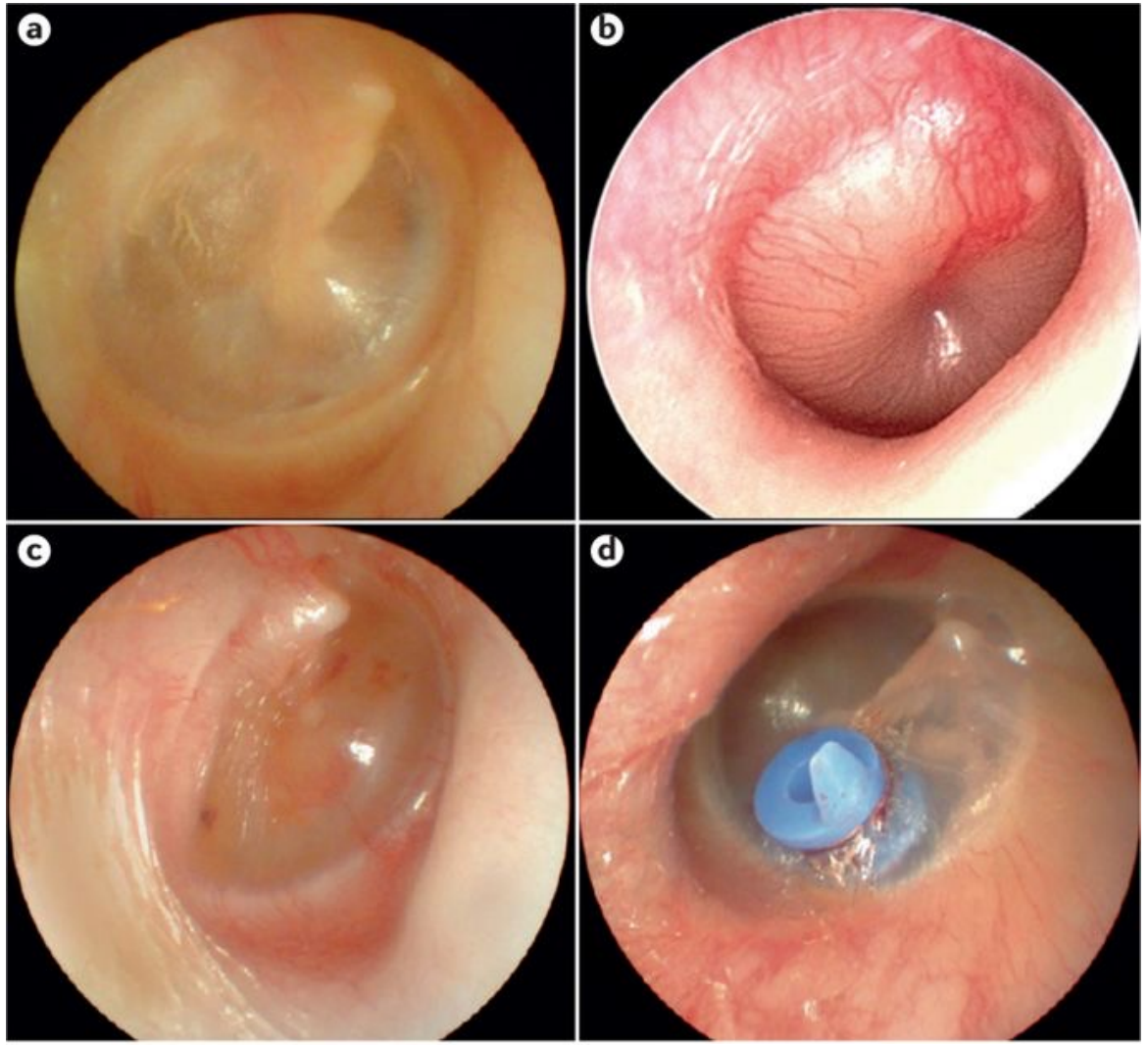
CLINICAL ANATOMY: Otitis media refers to inflammation of the mucosa lining the middle ear cavity. Two main types of otitis media are described below.

- **Acute otitis media** (AOM) is the term used to describe middle ear inflammation occurring due to a viral or bacterial infection. In acute otitis media, the tympanic membrane appears red and bulges toward the external auditory canal because of fluid and mucus buildup within the middle ear cavity. The inflammation is often the result of a pharyngeal infection transmitted to the the middle ear via the auditory tube. Because the auditory tube is shorter, more narrow, more horizontally oriented, and less rigid in a children compared to adults. These anatomical differences of a child's Eustachian tube make it is easier for infections to spread from the nasopharynx to the middle ear and make it more susceptible to collapse and blockage.
- **Otitis media with effusion**, or better termed **serous otitis media**, occurs when there is fluid in the middle ear space, but lacks an active infection. This condition is often the result of a previous infection in which fluid still remains in the middle ear cavity. Some children develop it as a result of a blocked eustachian tube.
- It is important to note that infections from the middle ear can spread to the mastoid air cells via the mastoid antrum, leading to **mastoiditis**.
- In cases of repeated infections or chronic fluid accumulation of the middle ear, a tympanostomy tube can be placed through the tympanic membrane to facilitate drainage.

Nice video on tympanostomy tube placement:
https://www.merckmanuals.com/home/children-s-health-issues/ear,-nose,-and-throat-disorders-in-children/secretory-otitis-media-in-children

Normal

AOM: Red, Bulging TM



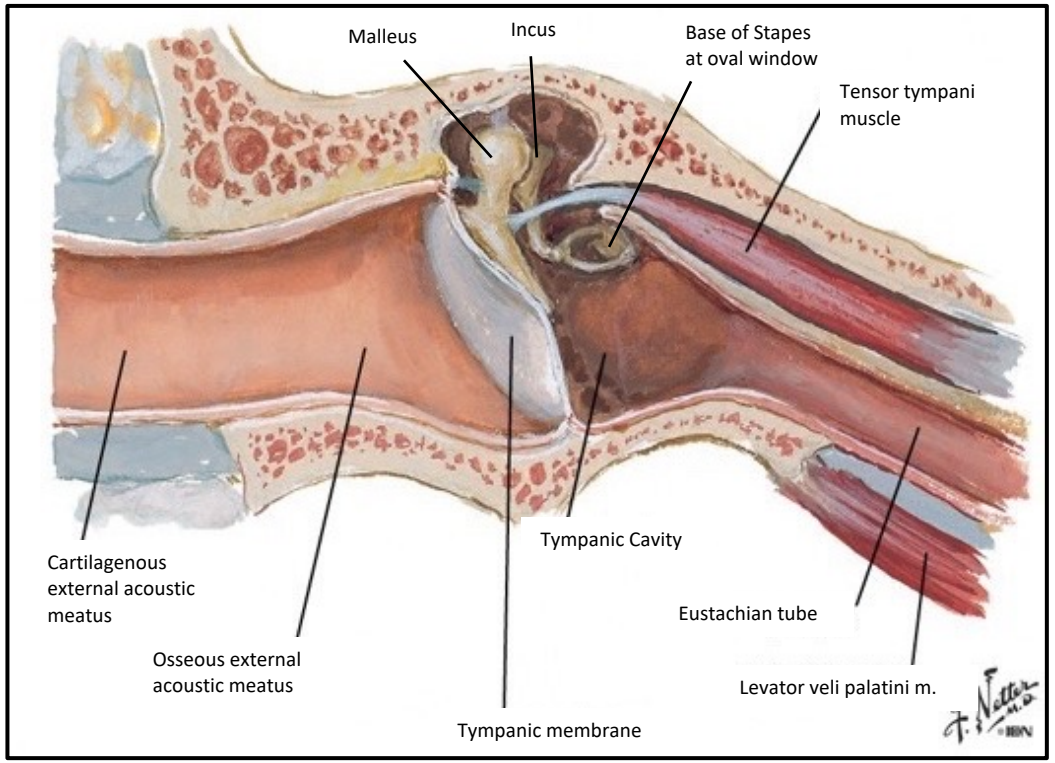
OM with Effusion

Tube Placed in TM

Auditory Ossicles

The **auditory ossicles** are a mobile chain of small bones connected by synovial joints that span the middle ear cavity from the tympanic membrane to the oval window. The ossicular chain functions to to increase the force and decrease the amplitude of the vibrations being transmitted from the tympanic membrane to the inner ear. The three auditory ossicles are listed below.

- The **malleus** (commonly known as the hammer) is the ossicle attached to the tympanic membrane on one end and forms a joint with the incus bone at its other end.
  - The manubrium (handle) is the portion of the the malleus embedded in the **tympanic membrane.**
  - The tip of the malleus' manubrium is the umbo, which forms the apex of the conical tympanic membrane.
  - The **tensor tympani** muscle (innervated by V3) inserts into its handle and functions to tighten the **tympanic membrane** (**tensor tympani**) during loud noises.
- The **incus** intervenes between the malleus and stapes**,** articulating with the other two ossicles at each of its ends by synovial joints.
- The stapes (stirrup) is the auditory ossicle in contact with the inner ear.
  - The footplate of the **stapes** articulates with the **oval window** of the **inner ear**.
  - The **stapedius** muscle (innervated by the facial nerve – "motor" portion) inserts on its neck and functions reduce the vibrations of the **stapes** (**stapedius**) during loud noises



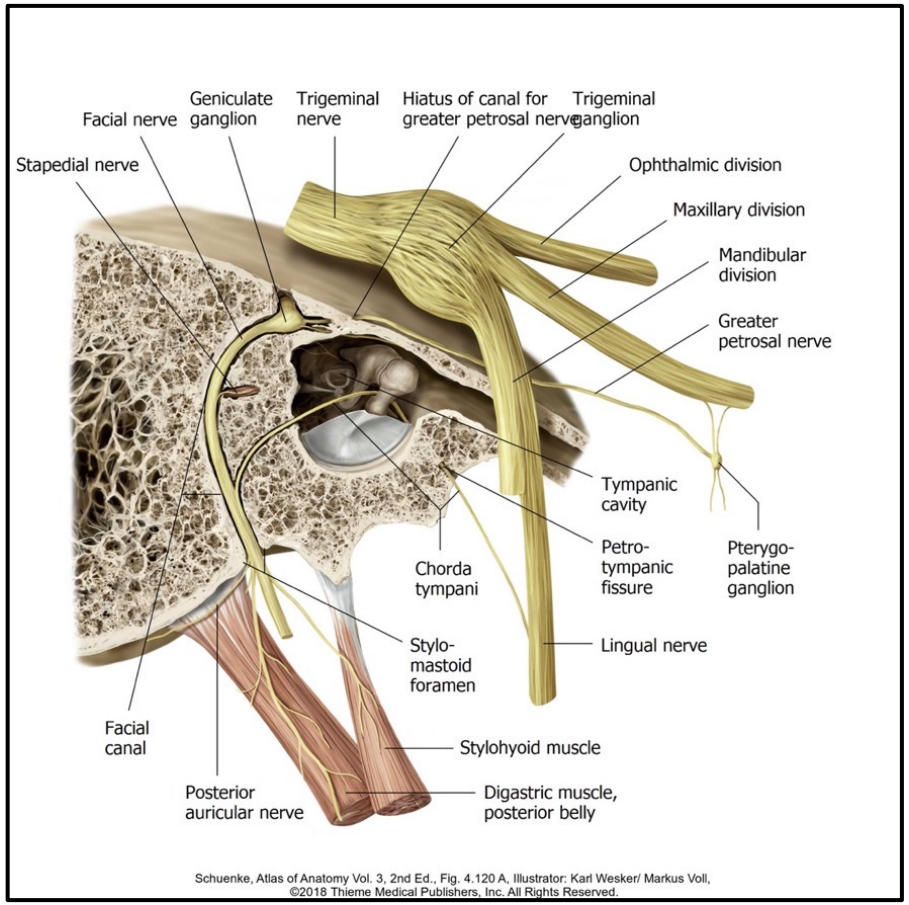
CLINICAL ANATOMY: Hyperacusis refers to an increased sensitivity to loud sounds. In some cases this condition is due to loss of function of the stapedius muscle due to lesion of the facial nerve.

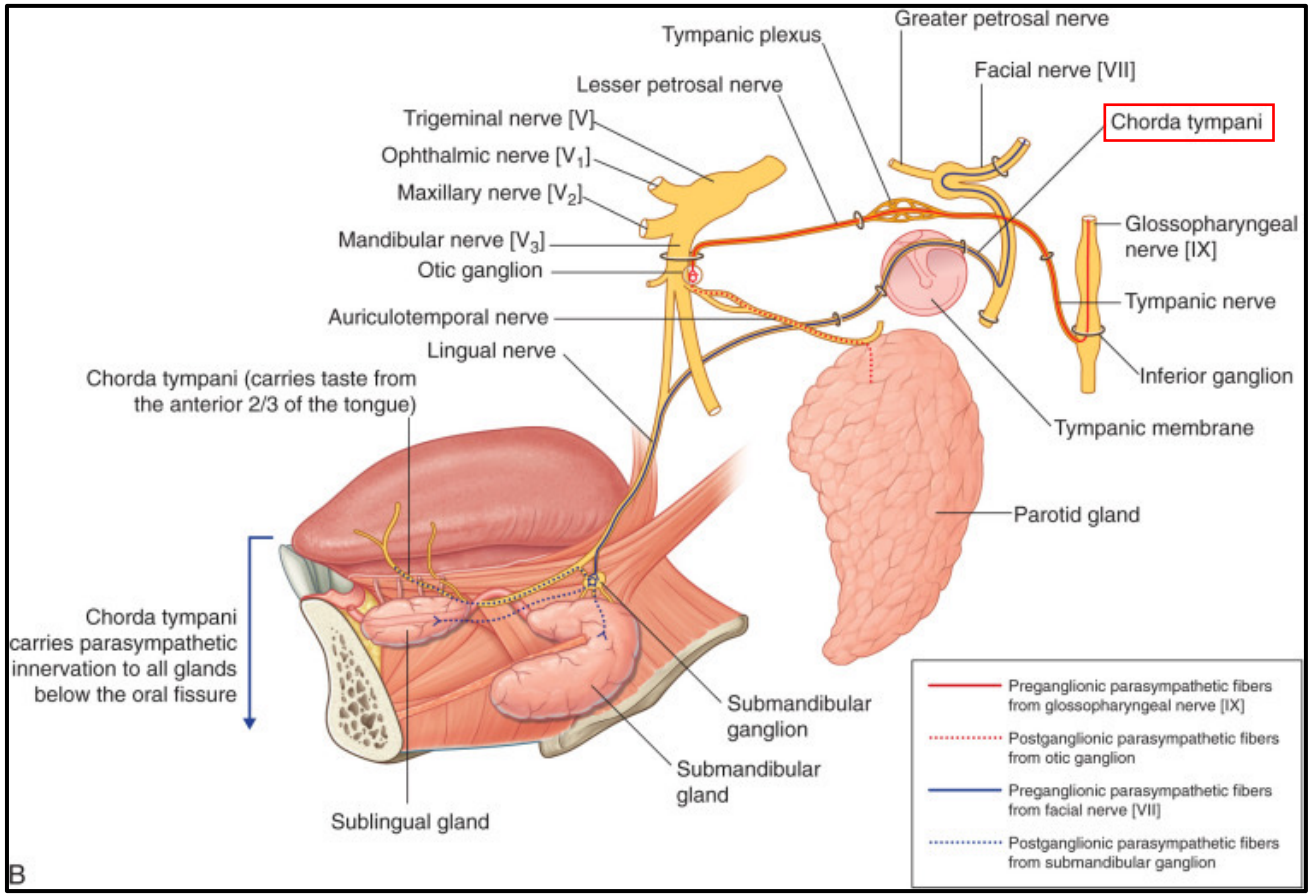
Tinnitus is the perception of sound in the absence of corresponding external noise (*i.e.*, "ringing" in the ears). Tinnitus is not a disease but a symptom resulting from a range of underlying causes that can include ear infections, foreign objects or wax in the ear, nose allergies that prevent (or induce) fluid drainage and cause wax build-up. Tinnitus can also be caused by natural hearing impairment (as in aging), as a side-effect of some medications, and as a side-effect of genetic (congenital) hearing loss. However, the most common cause for tinnitus is noise-induced hearing loss.

Chorda Tympani Nerve and Middle Ear

Chorda tympani

- The chorda tympani nerve branches from the facial nerve (CN VII).
- It exits the the **facial canal** to to traverse the **tympanic cavity** from posterior to anterior between the **malleus** and **incus** near the inner surface of the **tympanic membrane**.
- It exits the **tympanic cavity** through a small fissure (*petrotympanic fissure*) and joins the **lingual nerve** high in the *infratemporal fossa* of the deep face.
- Details about the chorda tympani nerve are in the cranial nerve PowerPoint handout.

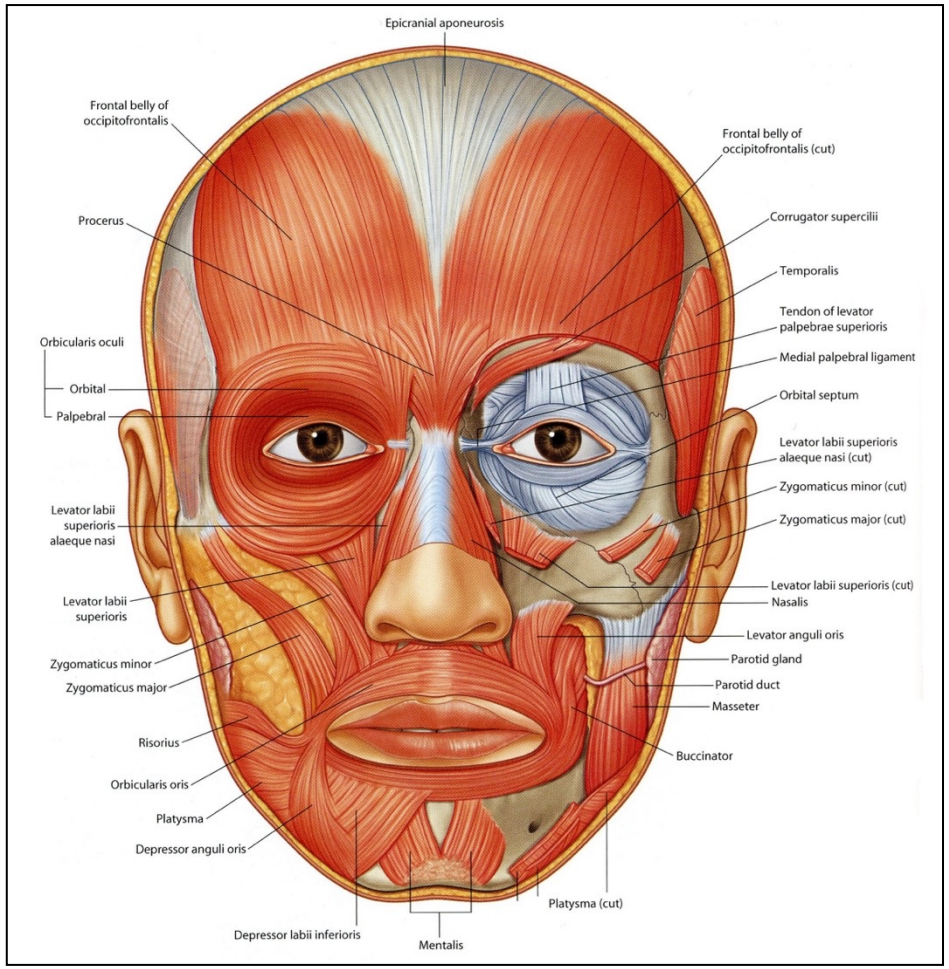


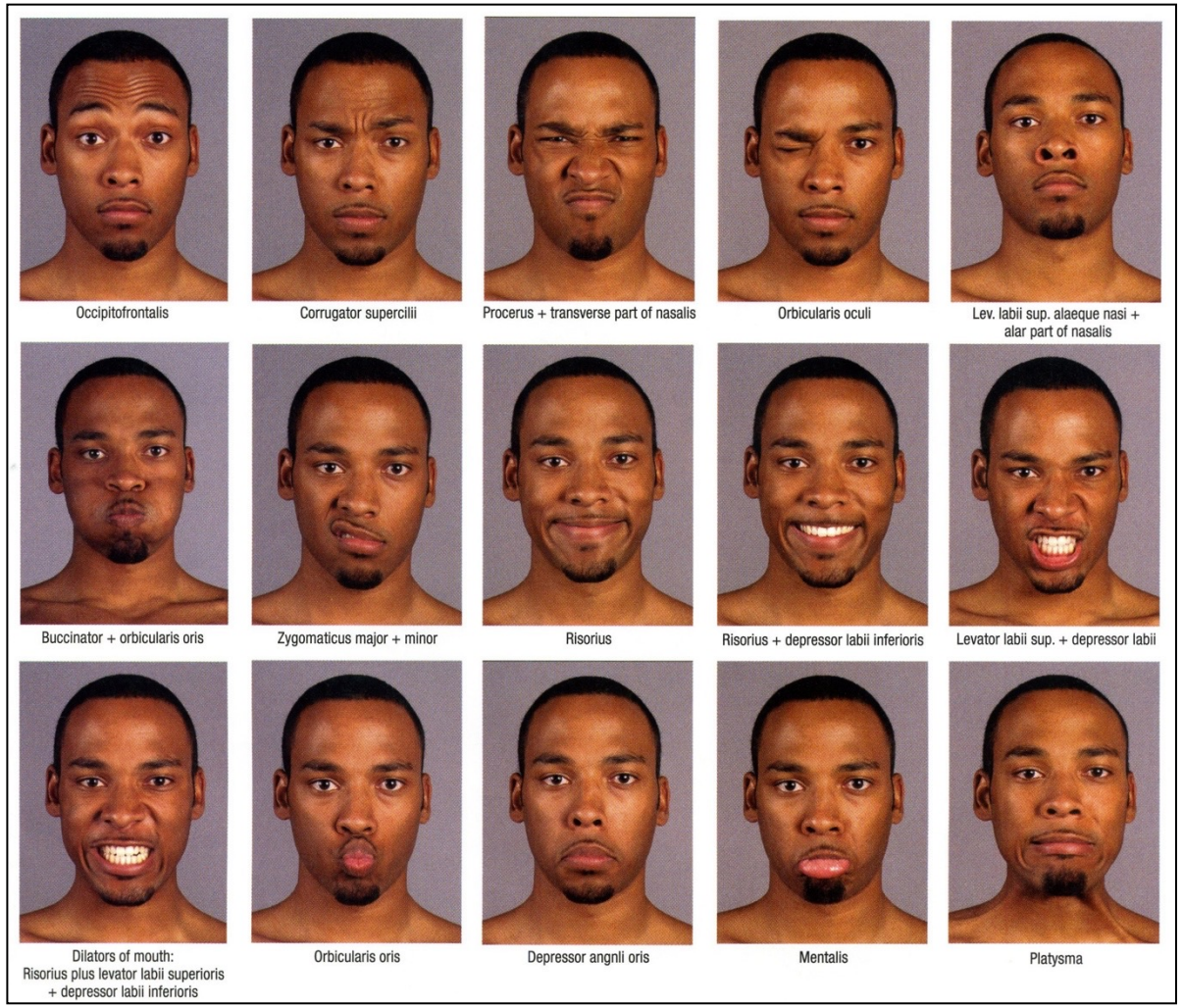


Superficial Facial Muscles: Muscles of Facial Expression

Muscles of facial expression

- They consist of skeletal muscles located in the superficial fascia of the neck, face and scalp.
- In general, they are attached to bones or fascia of the skull and insert into the skin.
- They develop embryologically from a single sheet of muscle derived from the 2nd branchial arch.
- As the name implies, they are principally involved in movements of the skin that lead to changes in facial expression.
- All muscles of facial expression are innervated by branchial efferent neurons of the **facial nerve.** All of the facial nerve's branchial efferent fibers innervating muscles of facial expression enter the face by exiting the **facial canal** at the **stylomastoid foramen**.



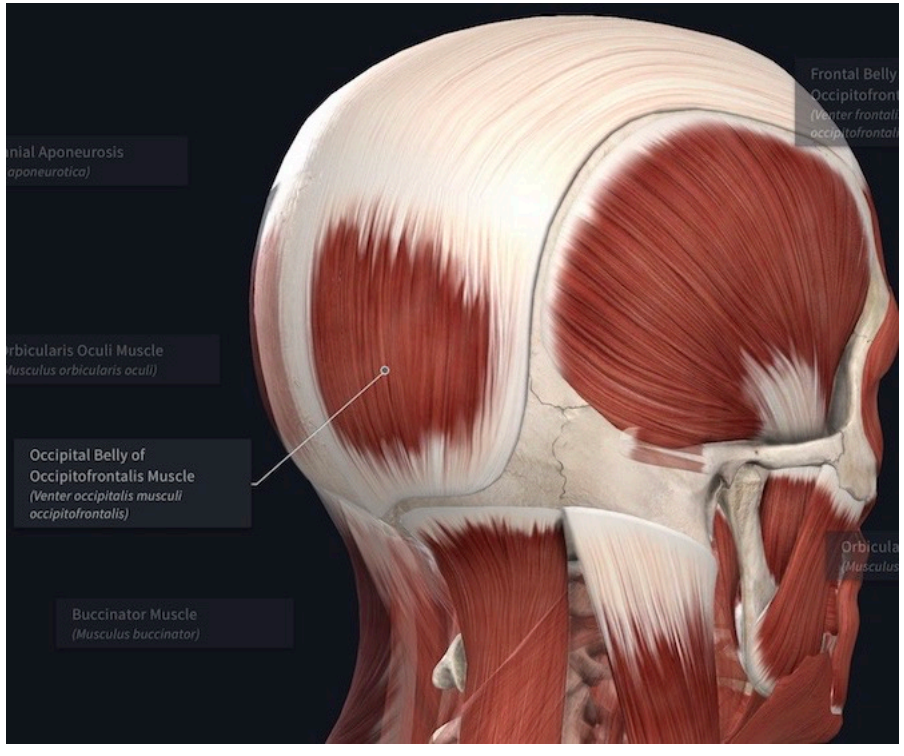


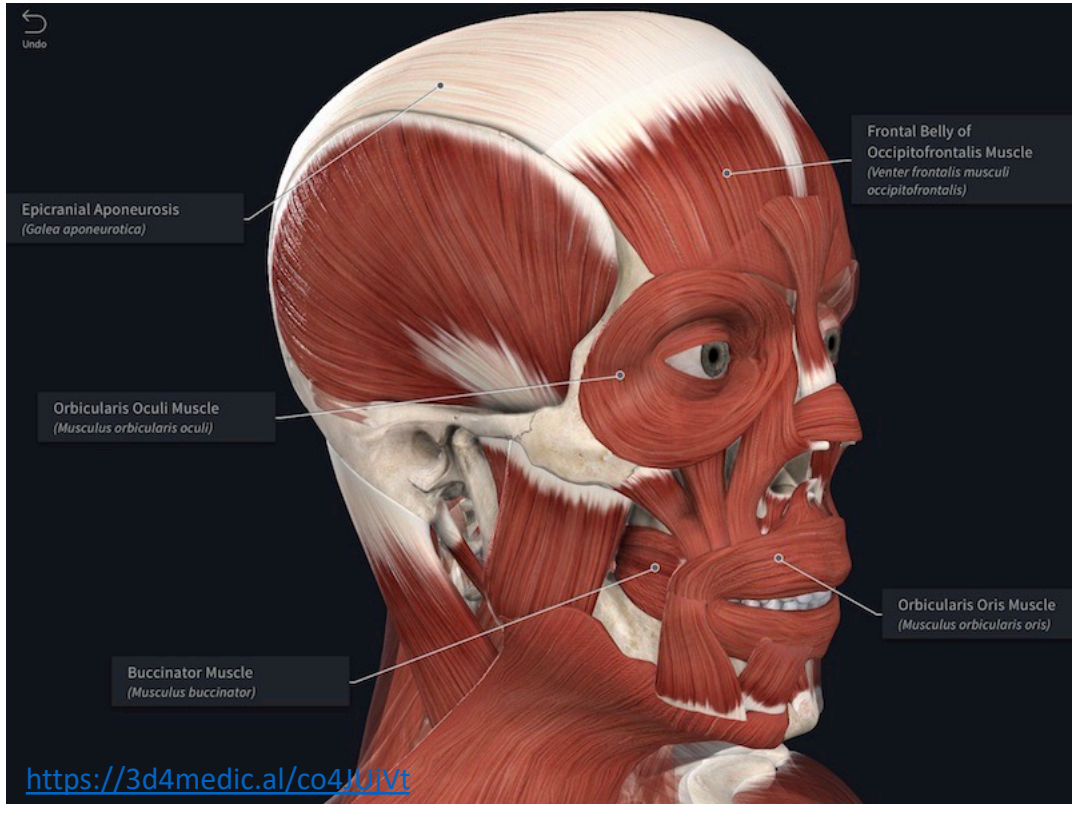
Superficial Facial Muscles: Muscles of Facial Expression (Continued)

Identify the following muscles of facial expression and state their action(s).

- The **orbicularis oculi** muscle **(orbital part and palpebral part)** forms a sphincter the functions to close the eyelids and assists with spreading **lacrimal fluid** across the c**ornea** and **sclera**.
- The **orbicularis oris** forms a sphincter around the opening to the oral cavity that seals the lips & prevents drooling.
- The **buccinator** muscle functions to compress the cheek against the buccal (cheek) surface of the teeth. It assists during chewing to keep food on the occlusal surfaces of the teeth, thereby preventing food from falling into the oral vestibule (space between cheek and teeth). It sometimes is considered an accessory muscle of mastication, BUT ISN'T a muscle of mastication.
- The **occipitofrontalis muscle** (aka: epicranius m.), consists of two bellies: the **frontal belly** (frontalis) and the **occipital belly** (occipitalis). The two bellies are joined by the epicranial aponeurosis (galea aponeurotica). This muscle functions to move the scalp, elevate the eyebrows, and wrinkle the skin of the forehead.

CLINICAL ANATOMY: Functional testing of the frontal belly of occipitofrontalis is often used to test the integrity of the facial nerve by asking a patient to raise eyebrows. An intact facial nerve results in both sides to winkle/raise equally.





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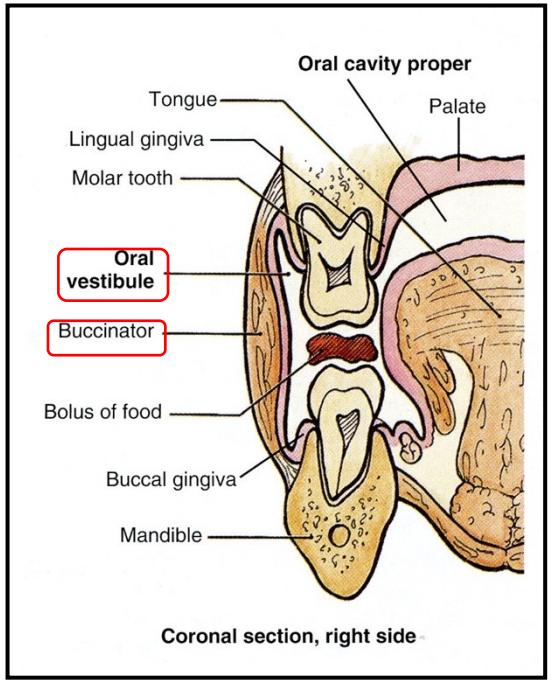
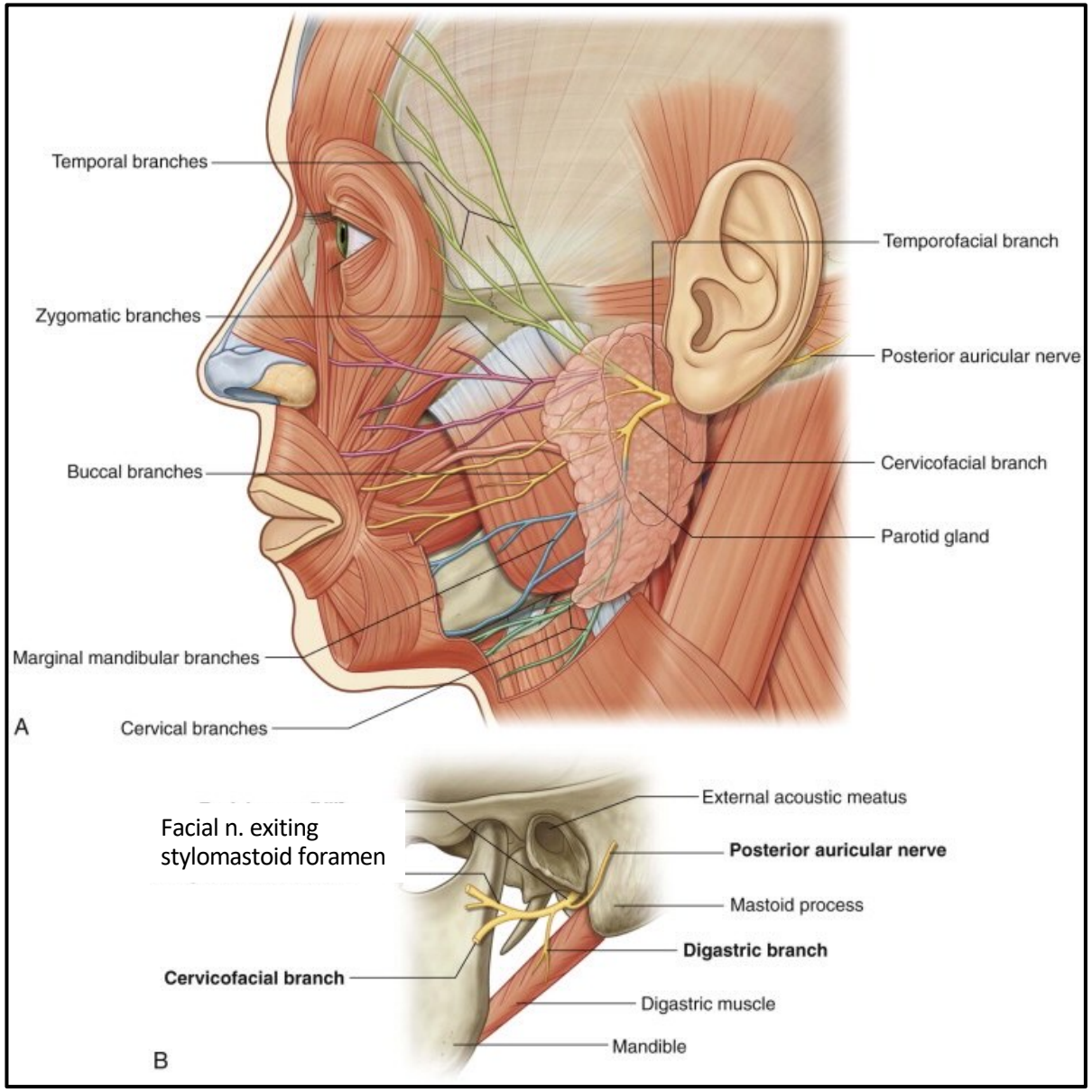


Superficial Facial Muscles: Innervation

Recall that the branchial motor portion of the facial nerve branches after exiting the facial canal at the stylomastoid foramen.

- The **posterior auricular nerve** branches from the facial nerve before it enters the parotid gland. This nerve innervates the occipitalis muscle.
- Five nerve branches are formed after the facial nerve enters the parotid gland. These branches supply the muscles of facial expression
    - **The temporal nerve** supplies the frontalis muscle and upper ½ of orbicularis oculi.
    - The **zygomatic nerve** supplies the lower ½ of orbicularis oculi.
    - The **buccal nerve** supplies the buccinator and orbicularis oris muscles.
    - The **mandibular nerve** supplies the orbicularis oris muscle.
    - The **cervical nerve** supplies the platysma muscle.

CLINICAL ANATOMY: Because of their superficial location in the face, branches of the **facial nerve** (along with the **parotid duct**) can be injured in superficial lacerations of the face. They can also be easily numbed on cold days. These types of injuries to the facial nerve from a know cause, should not be confused with Bell (Bell's) Palsy, which is defined as an idiopathic injury of the facial nerve affecting all or some of its branches.

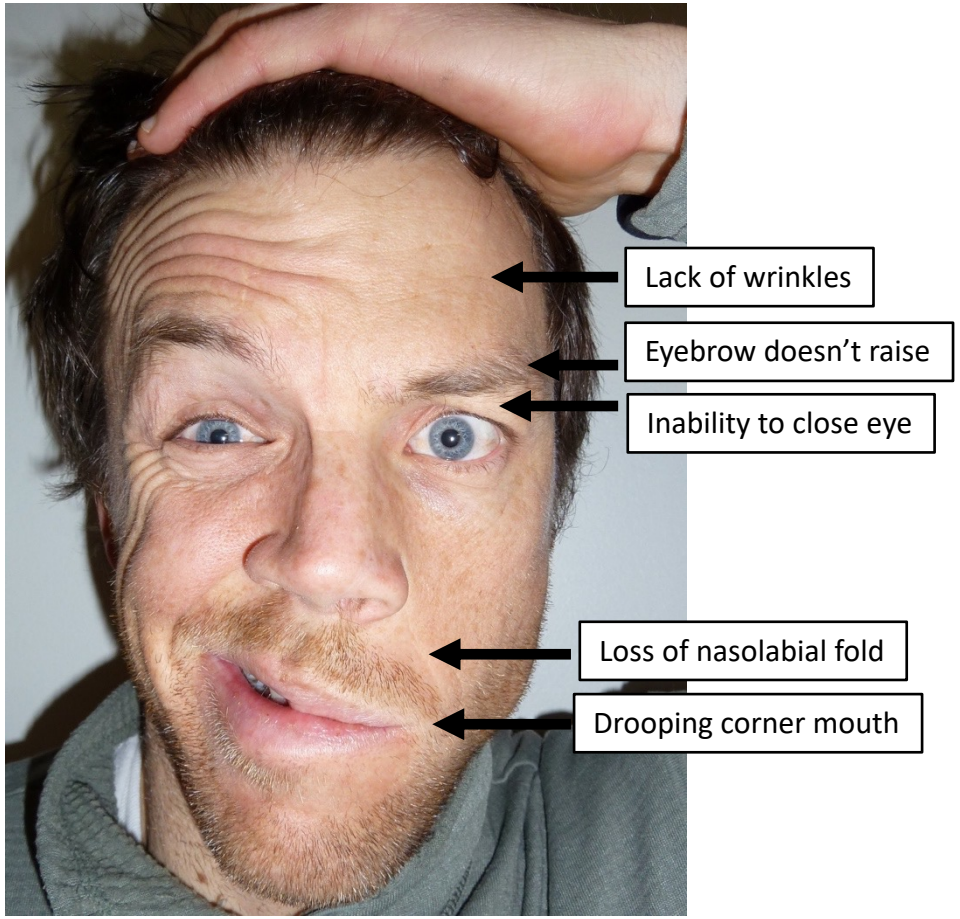


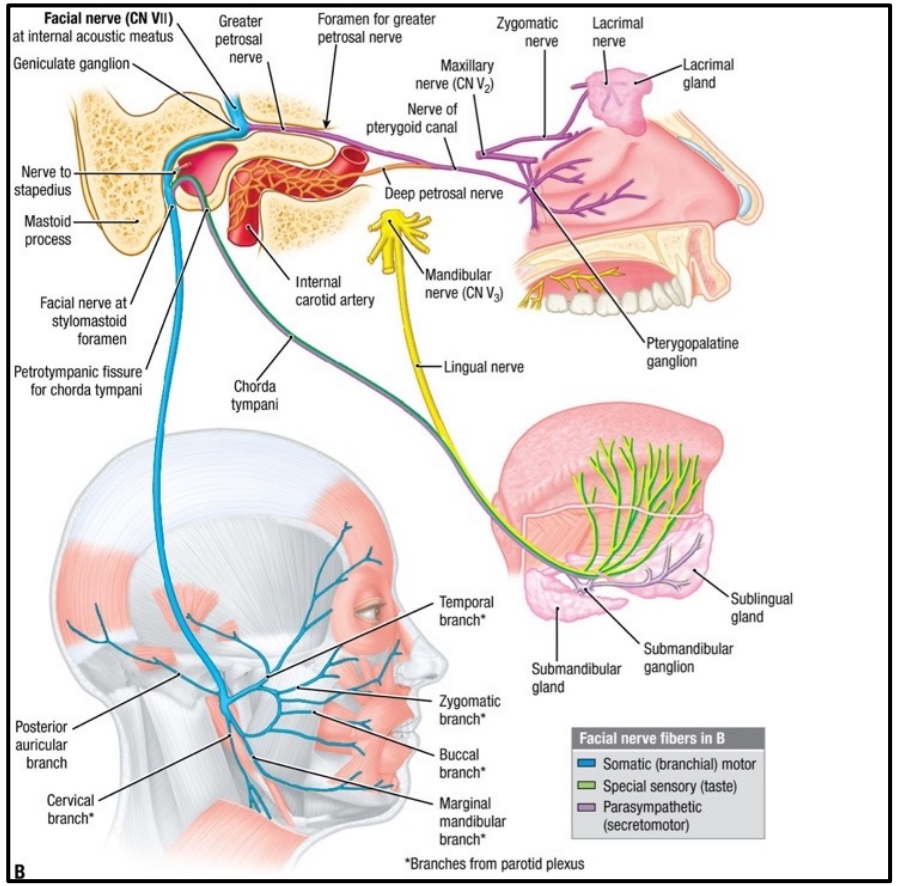
Superficial Facial Muscles: Innervation (Continued)

CLINICAL ANATOMY: Bell's palsy, also termed idiopathic facial paralysis (IFP), is the most common cause of unilateral facial paralysis and the most common cause of facial paralysis worldwide. The precise pathophysiology of Bell's palsy remains an area of debate. A popular theory proposes that edema and ischemia result in compression of the facial nerve within the facial canal. The cause is unknown, although viral or inflammatory mechanisms have been suggested. In the majority of cases, the symptoms gradually resolve over time. Injury to the facial nerve in Bell's palsy is peripheral to the nerve's nucleus within the brainstem. The injury usually occurs near, or at, the geniculate ganglion. If the lesion is proximal to the geniculate ganglion, the motor paralysis is accompanied by gustatory and autonomic abnormalities. Lesions between the geniculate ganglion and the origin of the chorda tympani produce the same effect, except lacrimation is spared. If the lesion is at the stylomastoid foramen, it may result in facial muscle paralysis only.

CLINICAL ANATOMY:
Due to an inability to close the with Bell's palsy, eye care to prevent drying, corneal abrasion, and corneal ulcers is imperative. In most cases, topical ocular lubrication and/or artificial tear eye drops are sufficient to prevent the complications of corneal dryness. In addition, an eye patch or tape can be used to cover the eye during sleep. Permanent eyelid weakness may require tarsorrhaphy or implantation of gold weights in the upper lid.

Patient attempting to smile and raise eyebrows



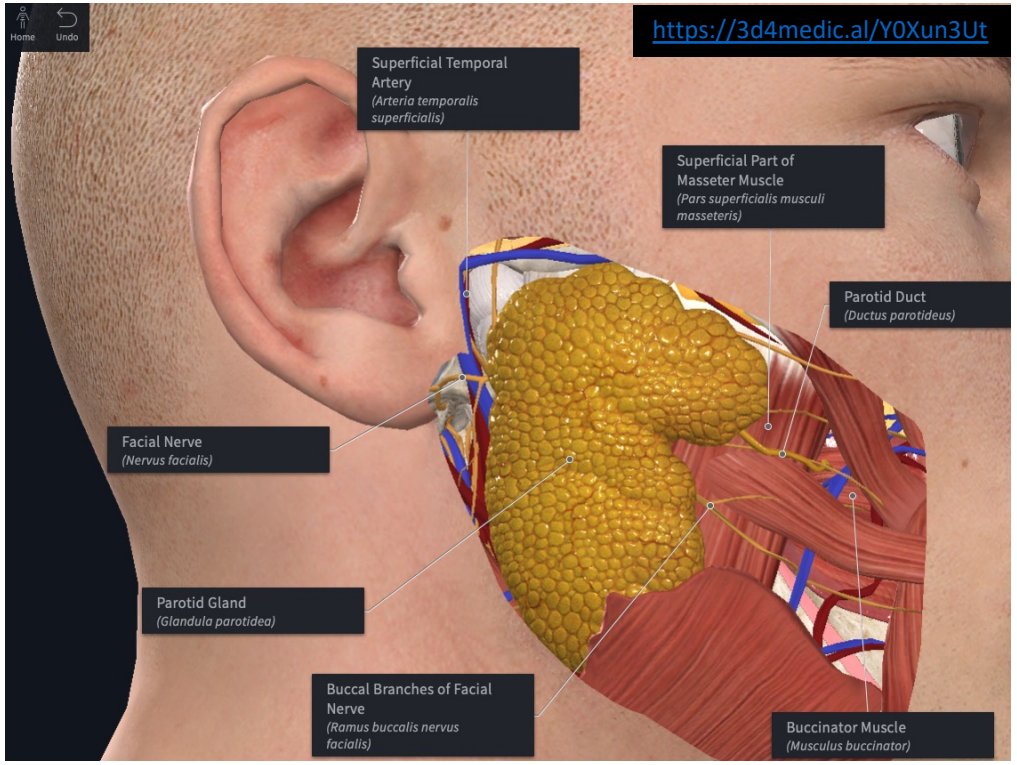


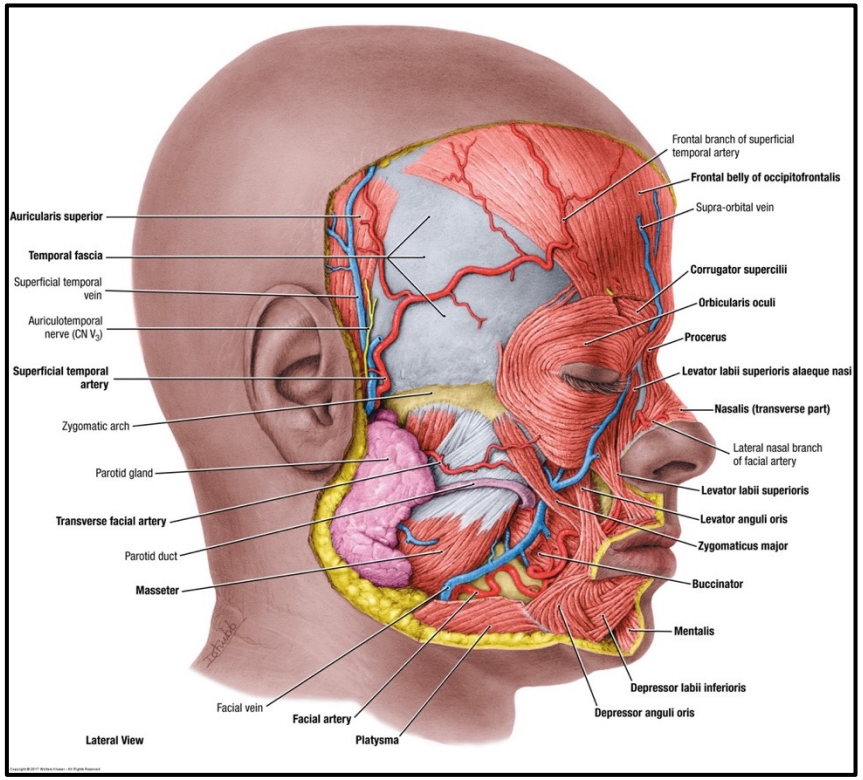
Parotid Gland

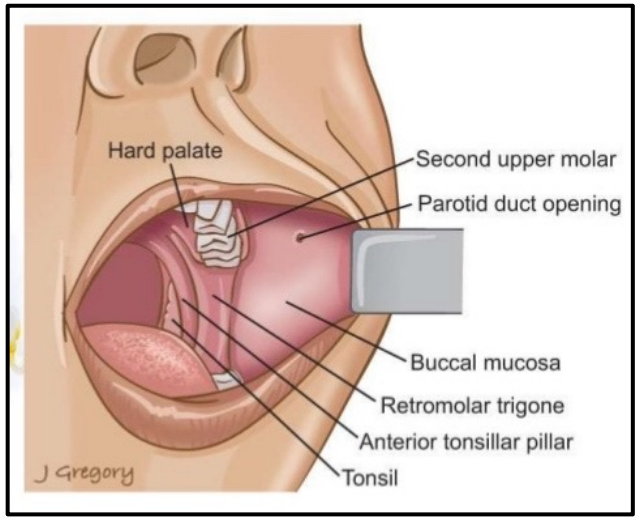
- The paired **parotid glands** are the largest of the salivary glands and are located just anterior and inferior to the pinna (auricle) of the ear.
- The **duct of the parotid gland (Stenson duct)** pierces the **buccinator muscle** and opens into the *oral vestibule* lateral to the maxillary (upper) second molar.

CLINICAL ANATOMY: The parotid gland is surrounded by the investing layer of deep cervical fascia that extends from the neck region to the zygomatic arch. This is the most superficial of three deep cervical fascial layers that enclose structures of the neck. The investing layer of deep fascia surrounds the parotid and submandibular glands. Due to the inflexibility of the deep fascia surrounding the parotid gland, parotid infections can lead to severe pain.

CLINICAL ANATOMY: The facial nerve courses within the substance of the parotid gland, which complicates parotidectomy surgeries. Approximately 2/3 of the parotid gland is superficial to the nerve. Knowledge of the surgical anatomy and landmarks to find the facial nerve are the key to preserving facial nerve function. In addition, electrophysiological nerve monitoring of the facial nerve during surgery is useful in nerve preservation.



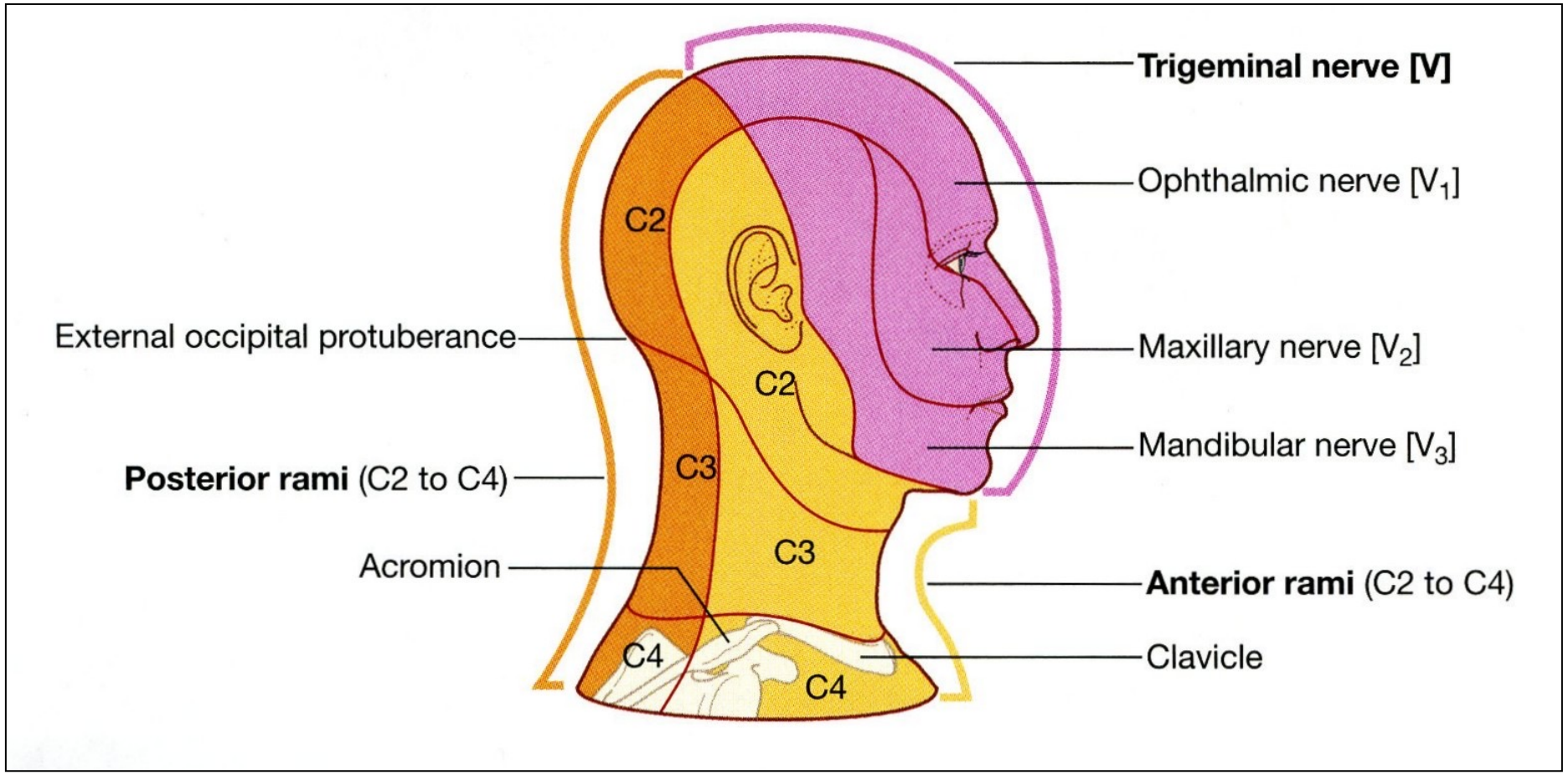




Scalp and Face: Sensory Innervation

The face and scalp are innervated by cervical nerves and branches of the trigeminal nerve.

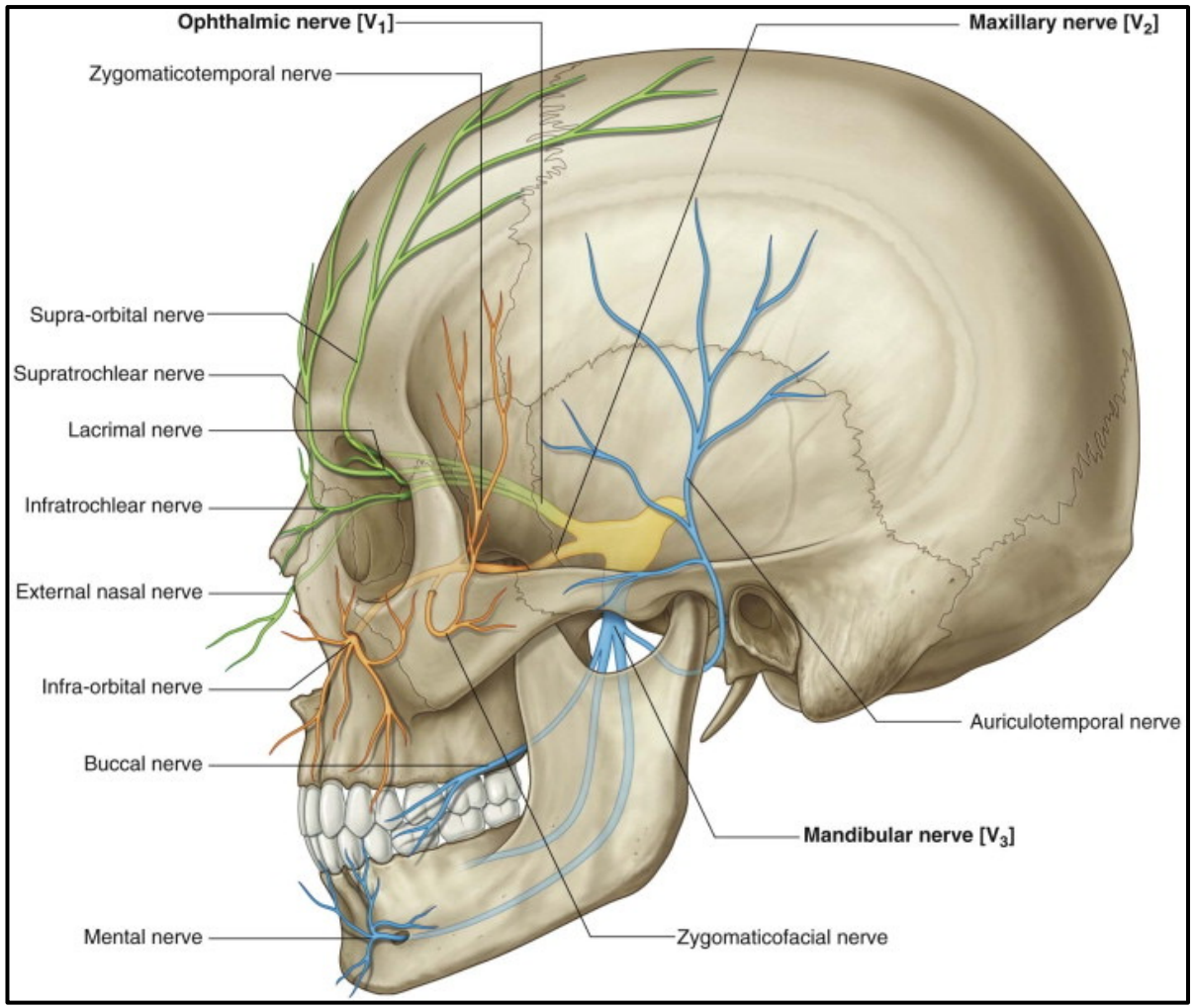
- Cervical spinal nerves innervate the posterior and lateral aspects of the face and scalp.
- The **trigeminal nerve** innervates the anterior face.

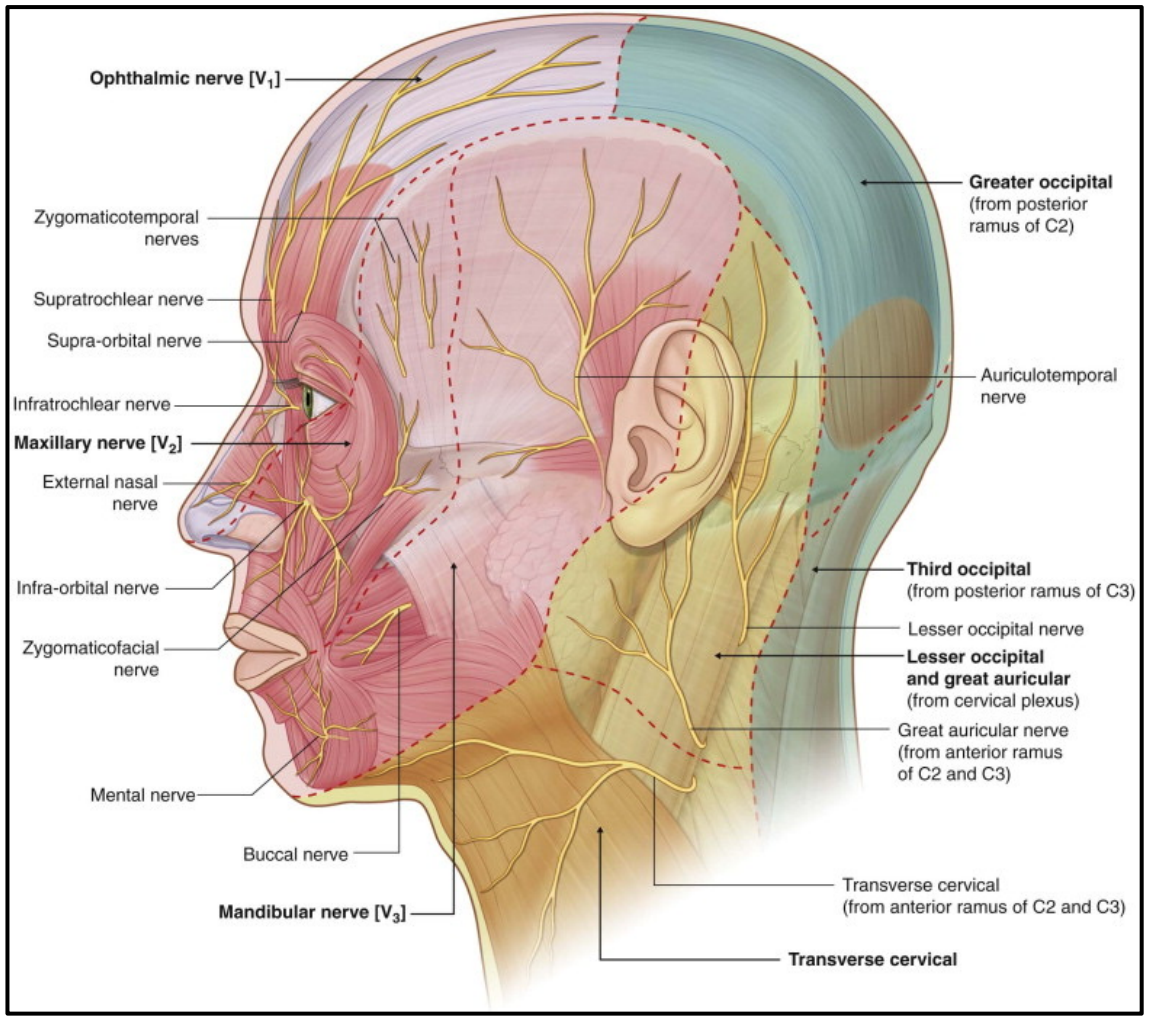


Scalp and Face: Sensory Innervation (Continued)

Review the sensory distribution of the trigeminal nerve's three divisions and their branches supplying the skin of the face. More detailed descriptions of the following nerves can be found in the Lab 2 Cranial Nerve PowerPoint Handout.

- **Ophthalmic division**: **supratrochlear n.**, **supraorbital n.**
- **Maxillary division**: **infraorbital n.**, **zygomatic n.**
- **Mandibular division**: **mental n.**, **buccal n.**, **auricolotemporal n.**

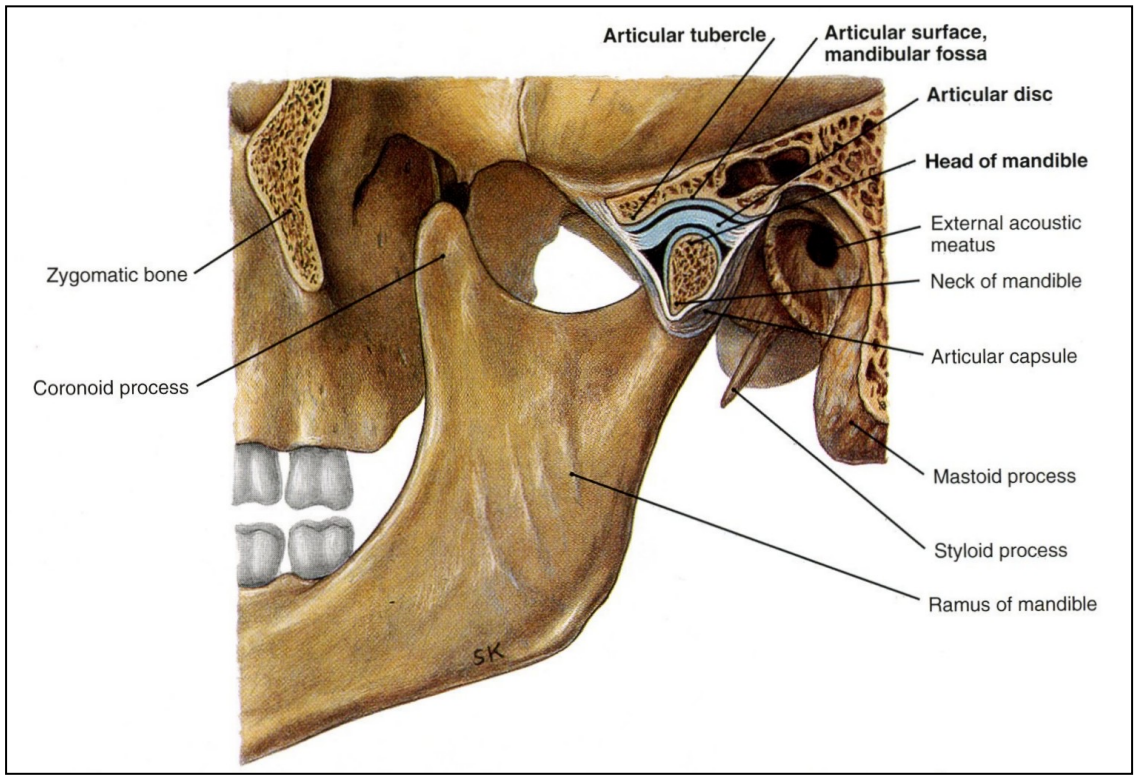


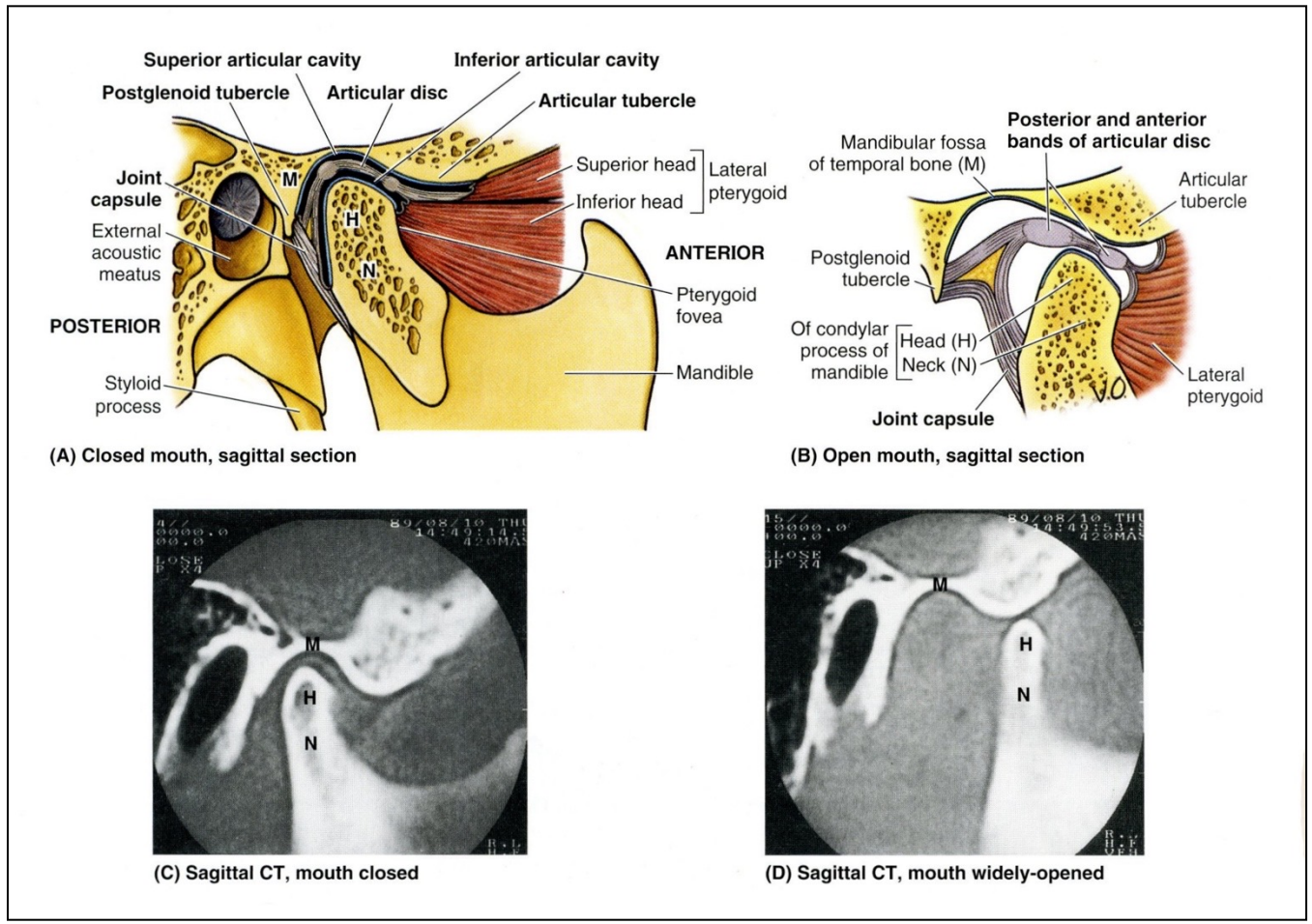


Temporomandibular joint

- The **temporomandibular joint (TMJ**) is formed by the **mandibular condyle (head of condyle)** articulating with the **mandibular (glenoid) fossa** of the temporal bone.

- The articular tubercle of the temporal bone is located at the anterior-most aspect of the mandibular fossa. Realize that the articular surfaces of the TMJ are covered by fibrocartilage and not hyaline cartilage like a typical synovial joint. In addition, a fibrocartilaginous articular disc divides the TMJ into two separate synovial capsules and two *different* parts that have *different* functions.
  - A sliding motion of the articular disc occurs at the superior superior part of the joint. Anterior sliding of the articular disc causes the mandibular head to glide forward onto the anterior tubercle. Posterior sliding of the articular disc results in the mandibular head gliding posterior into the mandibular fossa.
  - A hinge-like motion occurs at the inferior part of the joint, which results in elevation and depression of the mandible.



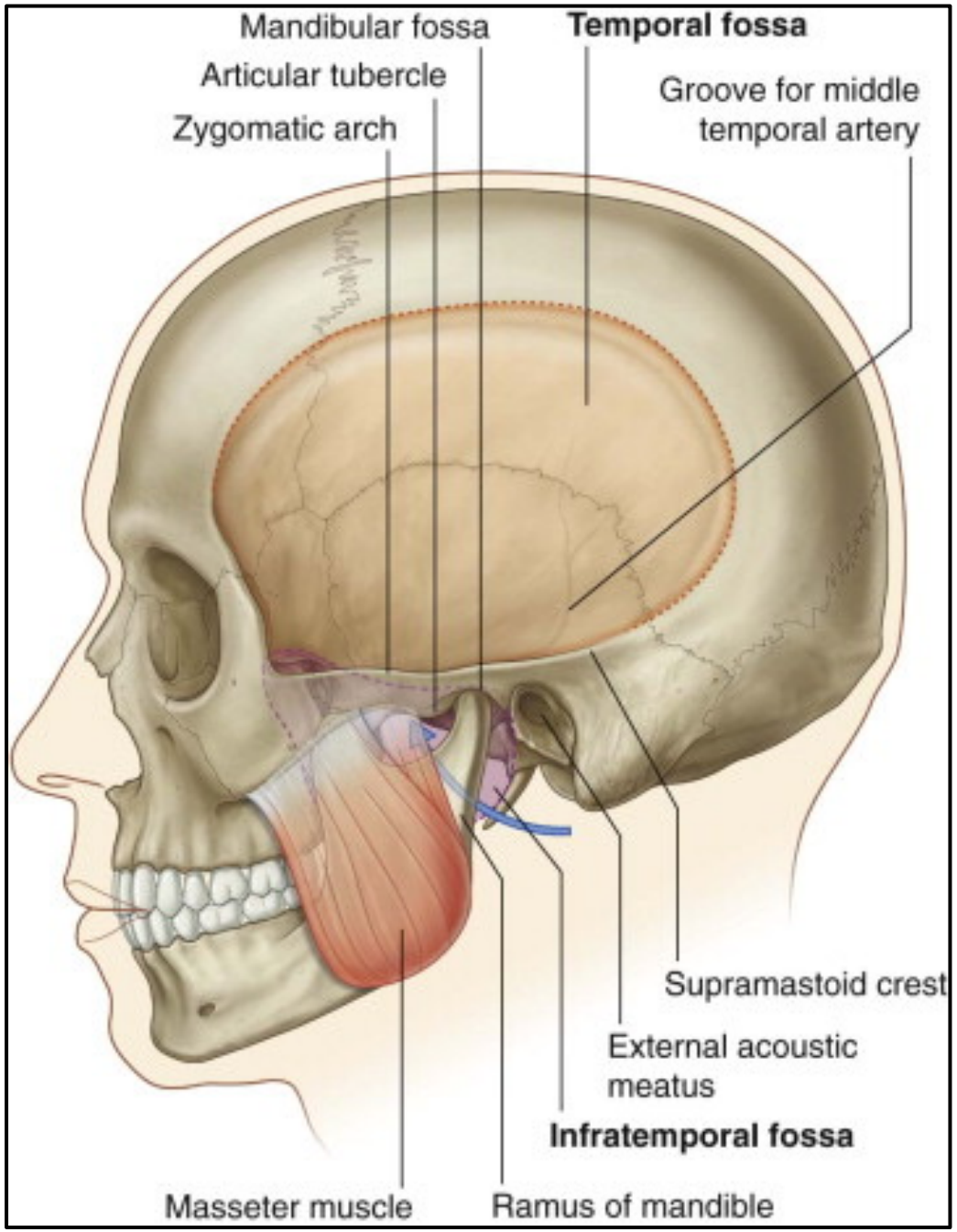


Temporal and Infratemporal Fossae: Introduction

The **temporal fossa** and **infratemporal fossa** are interconnected spaces on the lateral side of the head.

- The **temporal fossa** is a fan-shaped region of the lateral skull superior to the zygomatic arch.
- The **temporal fossa** communicates with the **infratemporal fossa** by the space medial to the zygomatic arch. It is a wedge-shaped region medial to the ramus of the mandible.
    - To help you understand the location, listed below are the boundaries. However, you don't need to memorize the boundaries.
        - Lateral border: ramus of the mandible
        - Medial border: lateral pterygoid plate of the sphenoid
        - Anterior border: posterior surface of the maxilla
        - Posterior border: mastoid and styloid processes of temporal bone

    - It contains the following structures: insertion **temporalis m.**, **medial and lateral pterygoid mm.**, **mandibular division trigeminal and branches**, **otic ganglion**, **chorda tympani nerve**, **maxillary a.**, and **pterygoid plexus of veins**.



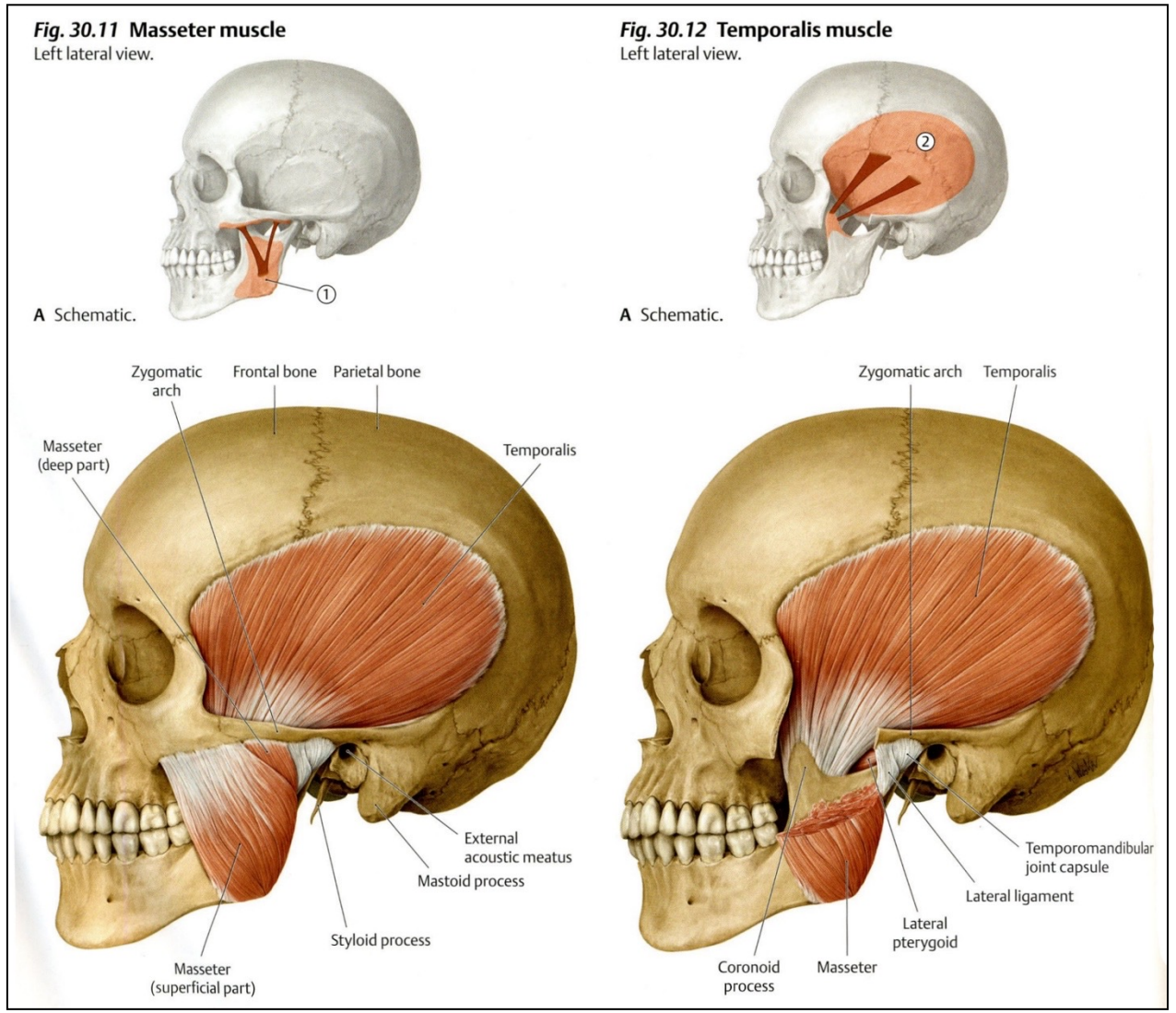
Temporal and Infratemporal Fossae: Muscles of Mastication

The muscles that function to move the temporomandibular joint are called the muscles of mastication. They are all innervated by the mandibular division of the trigeminal nerve (V3). Two of the muscles of mastication are easily seen when the skin is removed, but the two located within the infratemporal fossa are hidden from view.

Two muscles of mastication are easily viewed when the skin is removed.

- **Masseter:**
  - Location: The masseter muscle is the only muscle in the group *not* located in the temporal fossa or infratemporal fossa. It spans the space between the zygomatic arch and the lateral surface of the mandible's ramus.
  - Function: Elevates the mandible and contributes to protrusion

- **Temporalis:**
  - Location: The temporalis muscle is a fan-shaped muscle that originates in the temporal fossa. The distal portion of the muscle courses deep to zygomatic arch to enter the infratemporal fossa where it inserts on the coronoid process of the mandible.
  - Function: Elevates the mandible and contributes to retraction

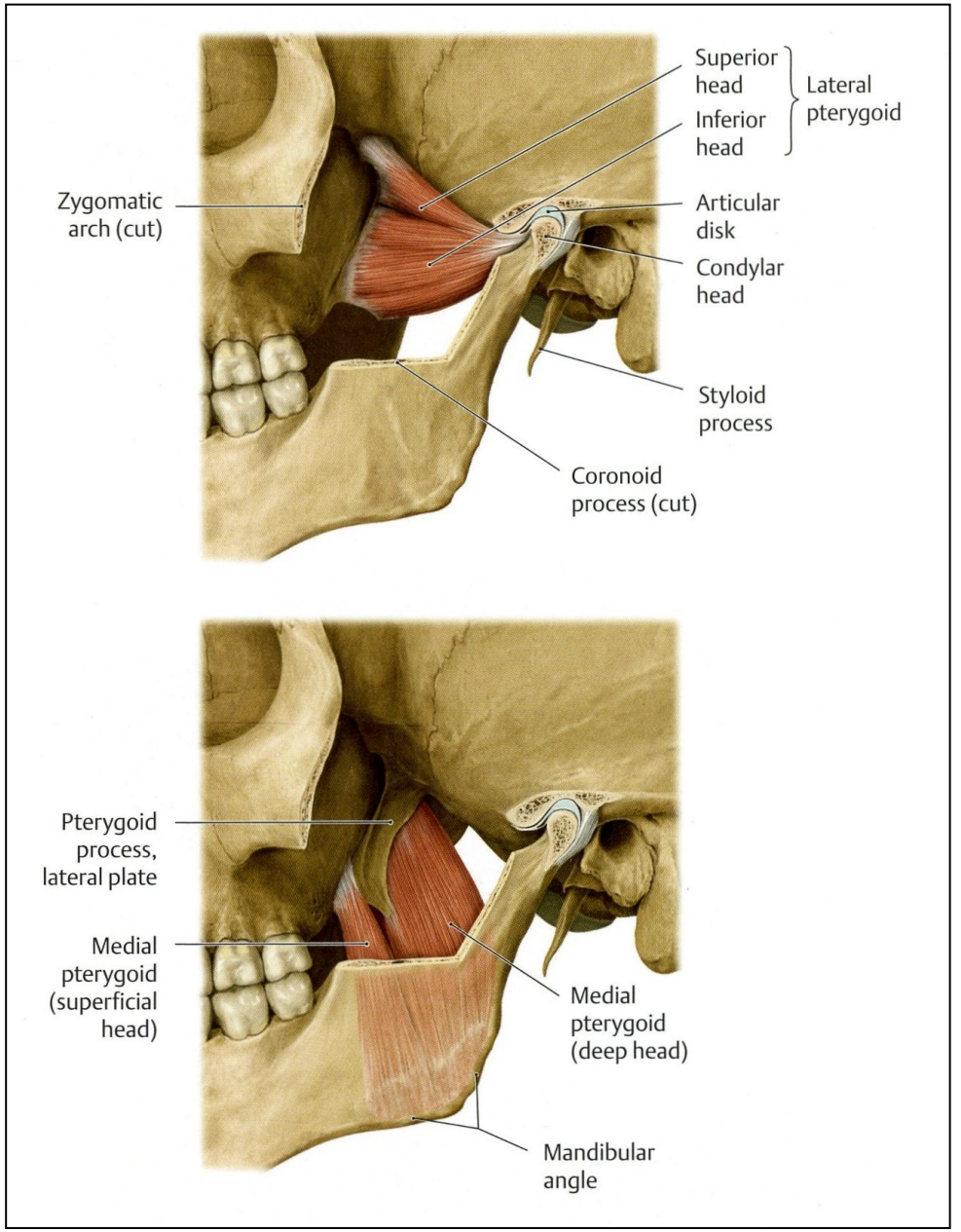


Temporal and Infratemporal Fossae: Muscles of Mastication (Continued)

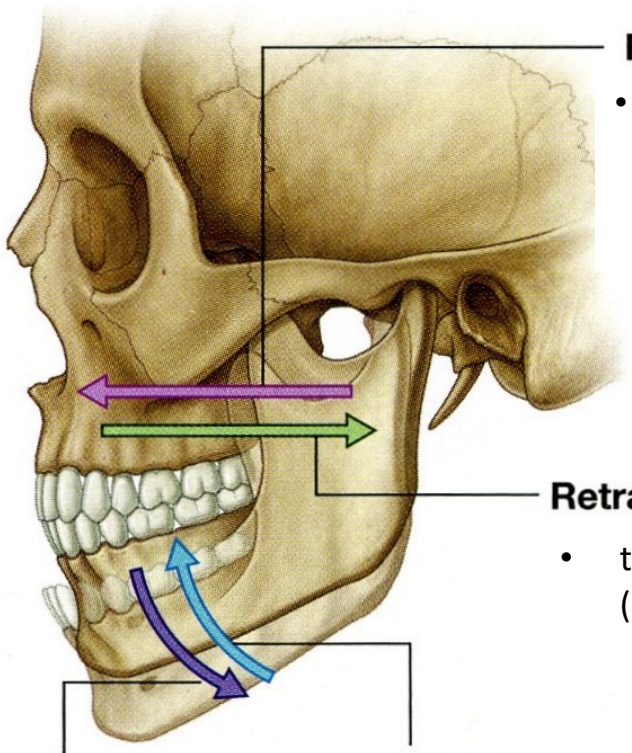
Two muscles of mastication are located entirely within the infratemporal fossa, which means they are not visible when the skin is removed.

- The **lateral pterygoid muscle**
  - Location: It originates on the lateral surface (this is why it is named lateral) of the lateral pterygoid plate of the sphenoid bone (inferior head) and the greater wing of sphenoid (superior head). It inserts on the coronoid of the mandible (inferior head) and the joint capsule/articular disc (superior head).
  - Function: **Protrusion** and contributes to side-to-side movement (inferior). In addition, the superior portion stabilizes the condyle and disc during chewing.

- The **medial pterygoid muscle**
  - Location: It originates on the medial surface (this is why it is named medial) of the lateral pterygoid plate (deep head) and the tuberosity of maxilla (superficial head). It inserts onto the medial surface of the mandibular ramus and mandibular angle (both heads).
  - Function: It **elevates the mandible** and contributes to protrusion and side to side movement .



Summary of Muscles of Mastication Actions



Protrusion

- lateral pterygoid (inferior), medial pterygoid, masseter

Retraction

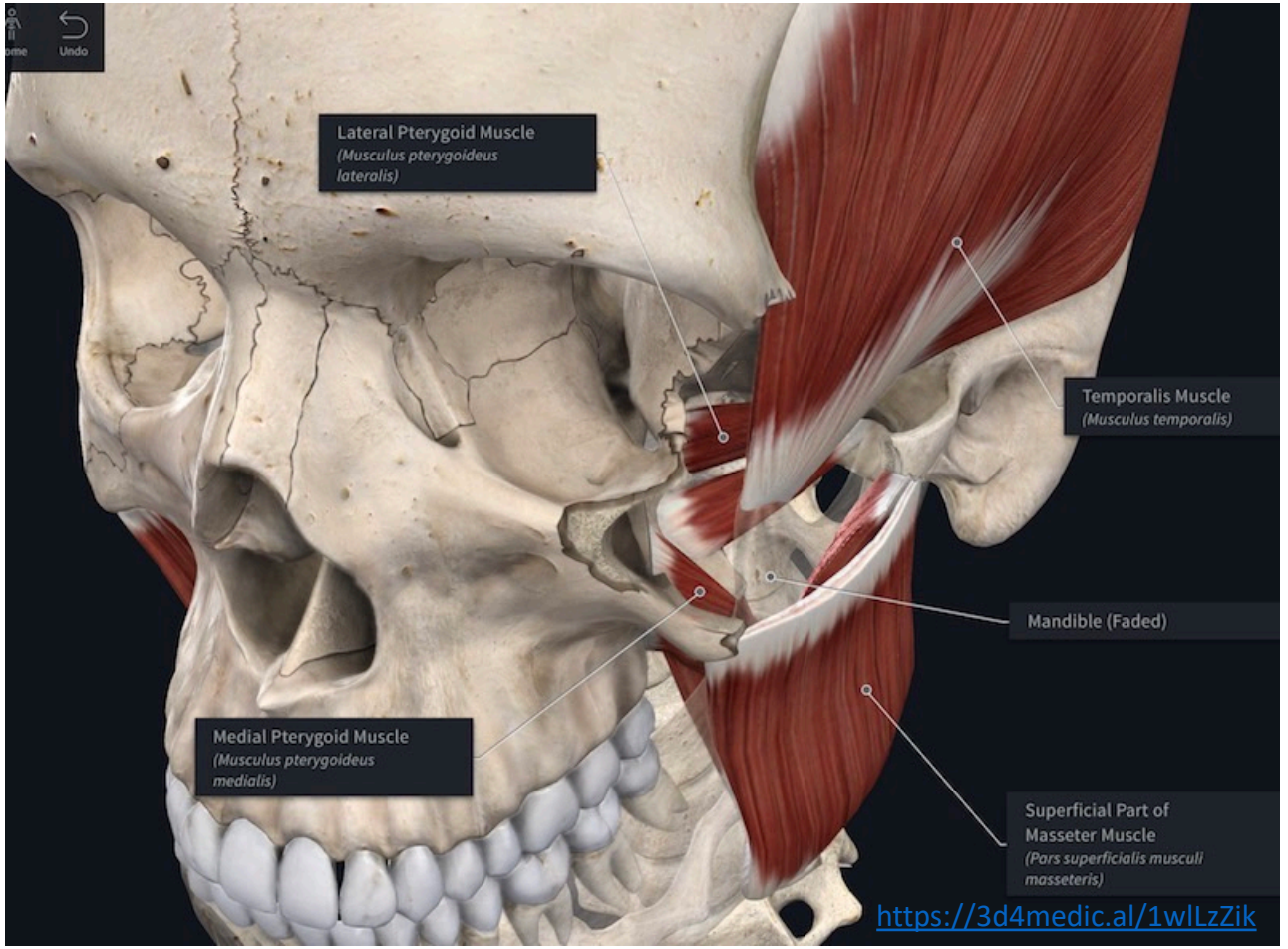
- temporalis and (geniohyoid, digastric)

Elevation

- temporalis, masseter, medial pterygoid

Depression

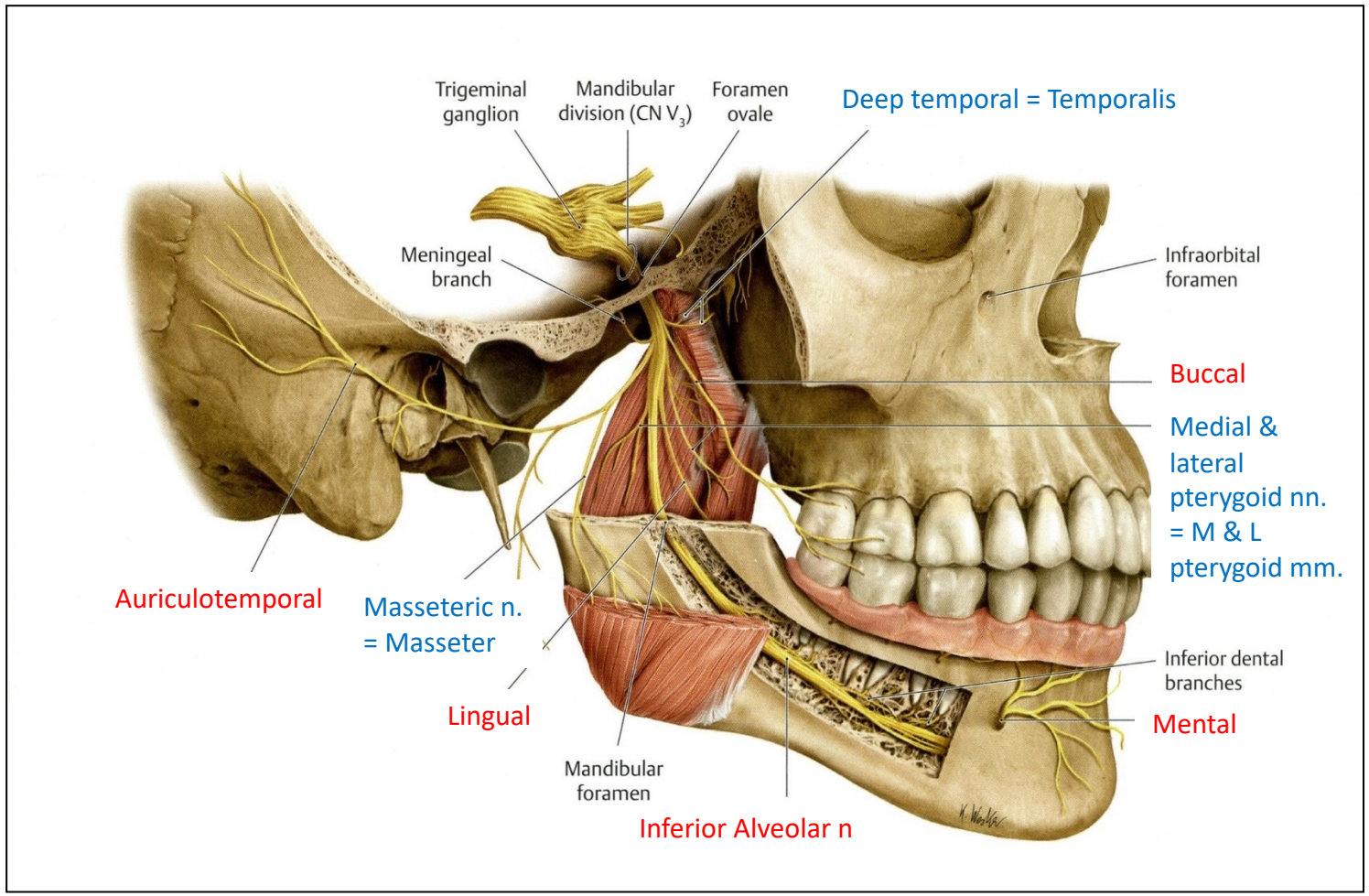
- gravity
- digastric, geniohyoid, and mylohyoid muscles



Infratemporal Fossae: Mandibular Nerve

Moyer PRL Demonstrating Infratemporal Fossa on (Deep) Face Anatomical Model: Panopto

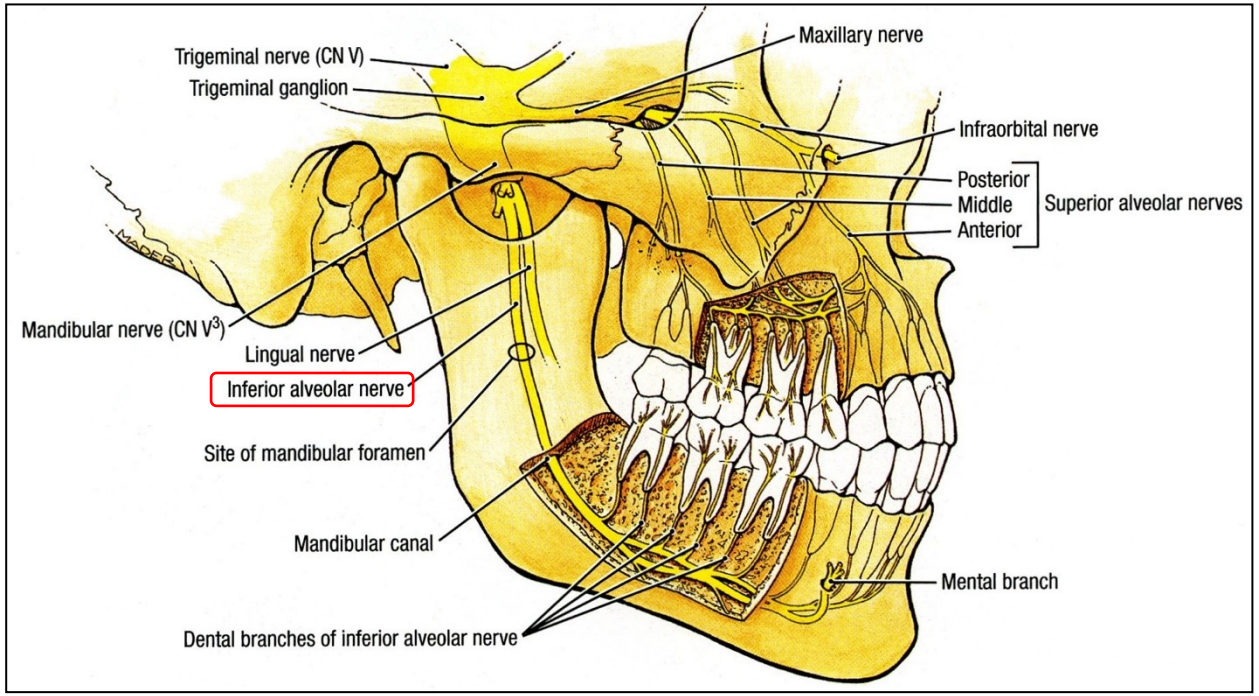
- The mandibular nerve, located in the infratemporal fossa, provides branchial efferent fibers to the muscles of mastication.
- In addition, the mandibular nerve forms several branches that contain general somatic sensory (afferent) fibers (GSA).
  - **Buccal n.**: The nerve provides general sensory innervation to the buccal (cheek) region, including the buccal mucous membranes of the mouth. It also branches to supply the second and third mandibular molar teeth.
  - **Mental n.**: It provides general sensation to the skin over the chin and skin of lower lip.
  - **Auriculotemporal n.**: It provides general sensory innervation to the temporal region, external ear, and outer surface of tympanic membrane. In addition, the auricolotemporal nerve delivers postganglionic parasympathetic fibers from the otic ganglion to the parotid gland. (Preganglionic fibers are brought to otic ganglion by the glossopharyngeal nerve).
  - **Inferior alveolar n.**: it provides general sensation to the mandibular teeth and gums. In addition, prior to entering the mandibular foramen, it forms a branch that provides branchial motor innervation to the mylohyoid muscle and the anterior belly of the digastric muscle.

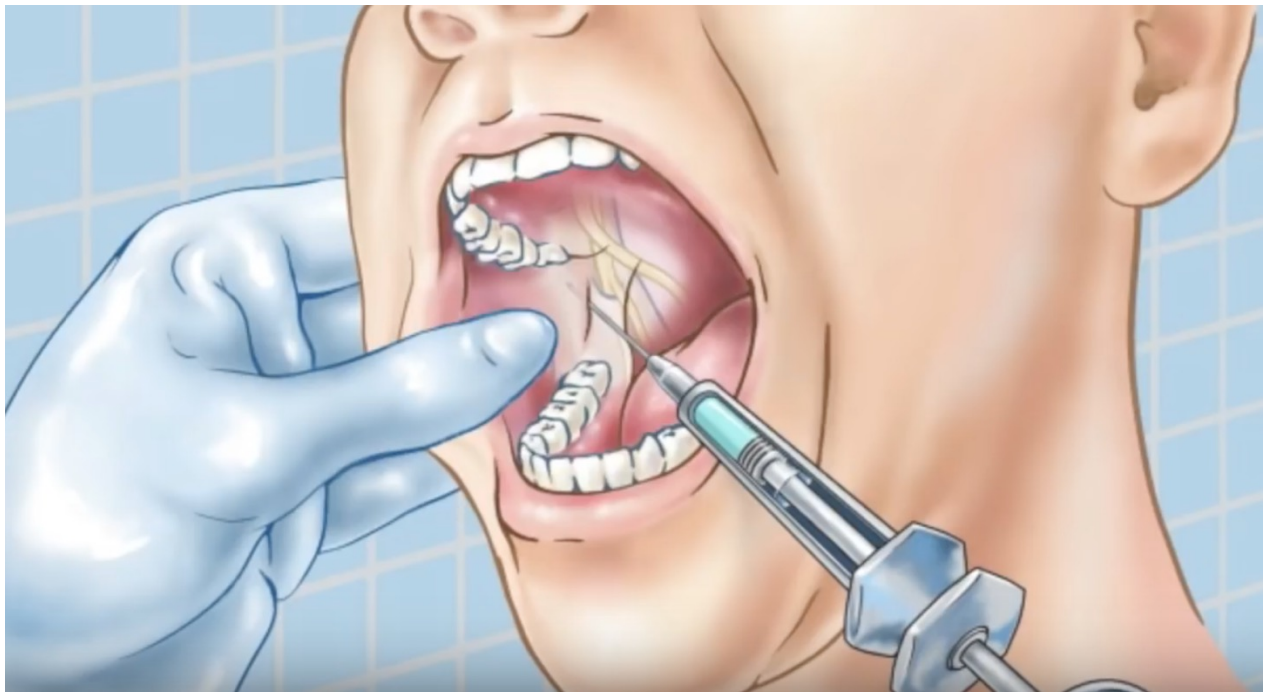


- **Lingual n.**: It provides sensory innervation to the anterior two-thirds of the tongue. In addition, preganglionic parasympathetic fibers from the facial nerve (chorda tympani) course along with the lingual nerve (see Facial Nerve, CN VII).

Inferior Alveolar Nerve Block

CLNICAL ANATOMY: An **inferior alveolar nerve block** is when anesthetic is injected in the mouth near the *mandibular foramen*, which is the location where the *inferior alveolar nerve* enters the mandible via the **mandibular foramen**. This single injection anesthetizes all of the mandibular teeth on one side.





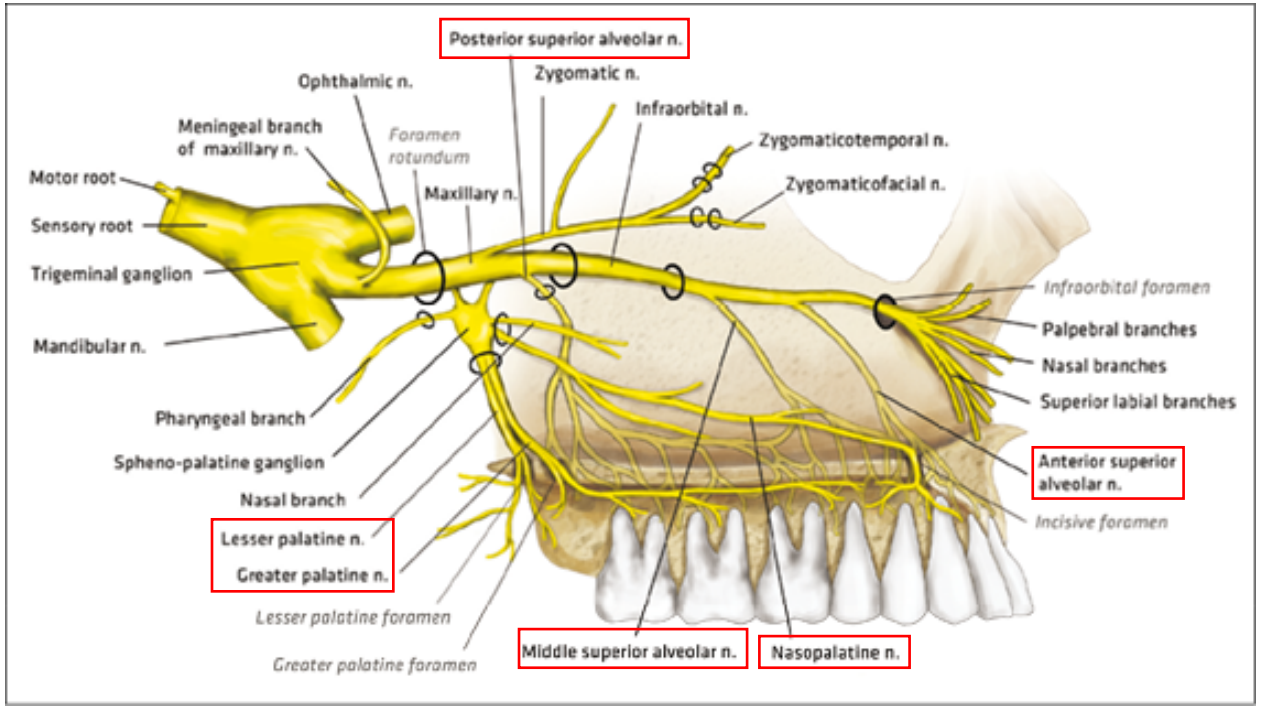
Palatine Nerve Block

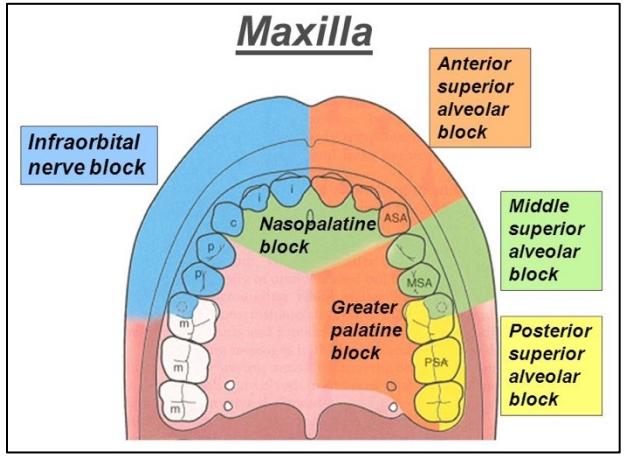
CLNICAL ANATOMY: A **palatine nerve block** can refer to one of the following injection sites.

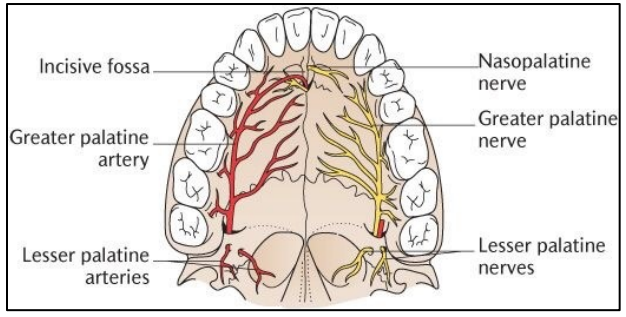
- Greater palatine nerve block is an injection of local anesthesia into the site where the greater palatine nerve enters the hard palate. Anesthesia in this area anaesthetizes the soft tissues of the posterior palate (posterior to canine teeth).
- Nasopalatine nerve block is an injection of local anesthesia into the site where the nasopalatine nerve enters the palate via the nasopalatine (incisive) foramen. A nasopalatine nerve block anesthetizes the palatal tissues of the six anterior teeth (incisors). If the needle is inserted into the canal from which the nerve emerges, it is possible to anesthetize the six anterior teeth completely. However, this is uncommon due to the painful nature of the procedure.

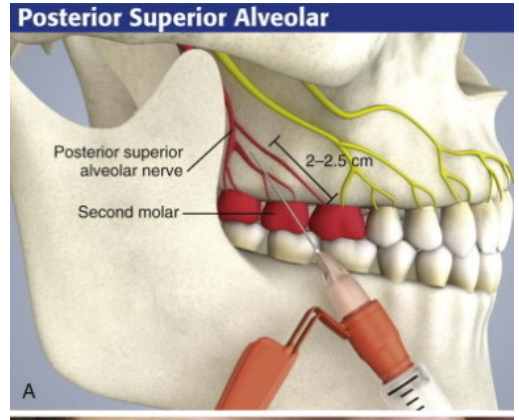
Anesthetizing the upper dentition requires specific injections for the teeth that need to be anaesthetized. The following three nerves are typically involved

- Posterior superior alveolar nerve: 1st, 2nd , 3rd molars
- Middle superior alveolar nerve: maxillary premolars
- Anterior superior alveolar nerve: canines, lateral, incisors, and central incisors



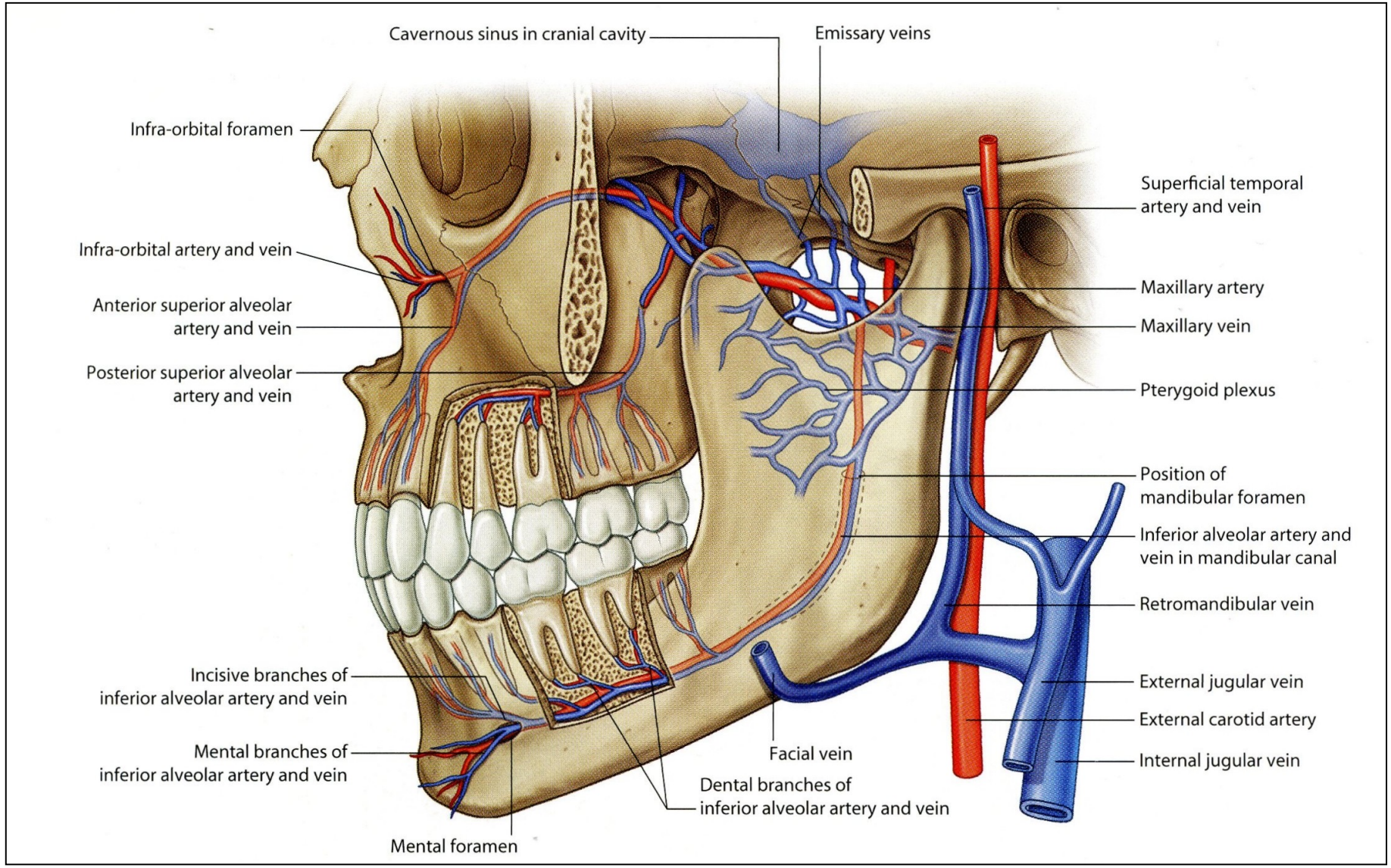






Infratemporal Fossae: Maxillary Artery & Pterygoid Plexus

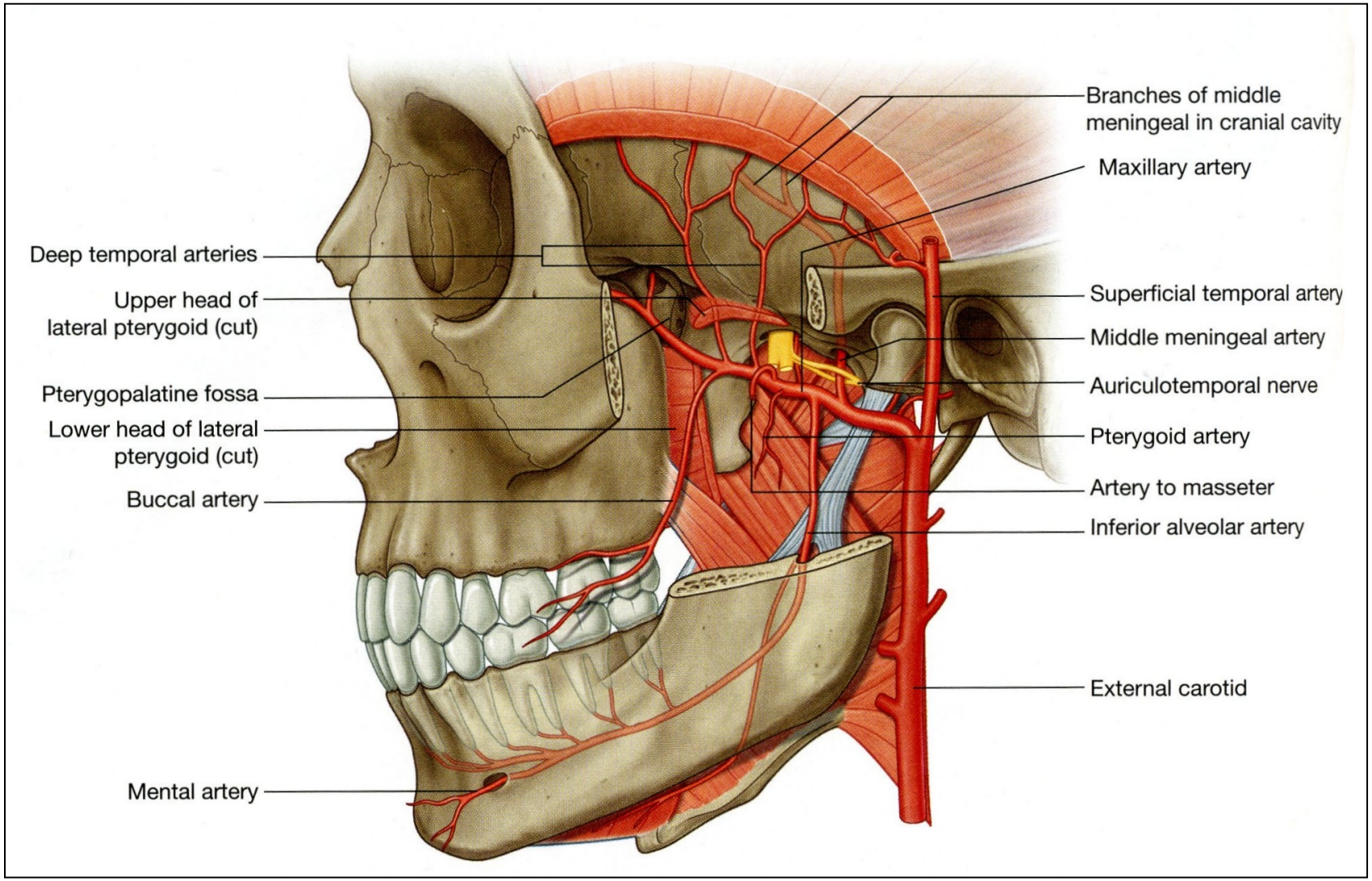
The maxillary artery and pterygoid venous plexus are located within the infratemporal fossa.



Infratemporal Fossa: Maxillary Artery

The **maxillary artery** is the largest branch of the two terminal branches of the **external carotid artery**. After branching from the external carotid artery, it passes through the infratemporal fossa where a number of vessels branch from it. It then courses between the heads of the lateral pterygoid muscle to enter the pterygopalatine fossa. In the pterygopalatine fossa, it forms a number of branches, including its terminal branches. The maxillary artery supplies the following structures/regions.

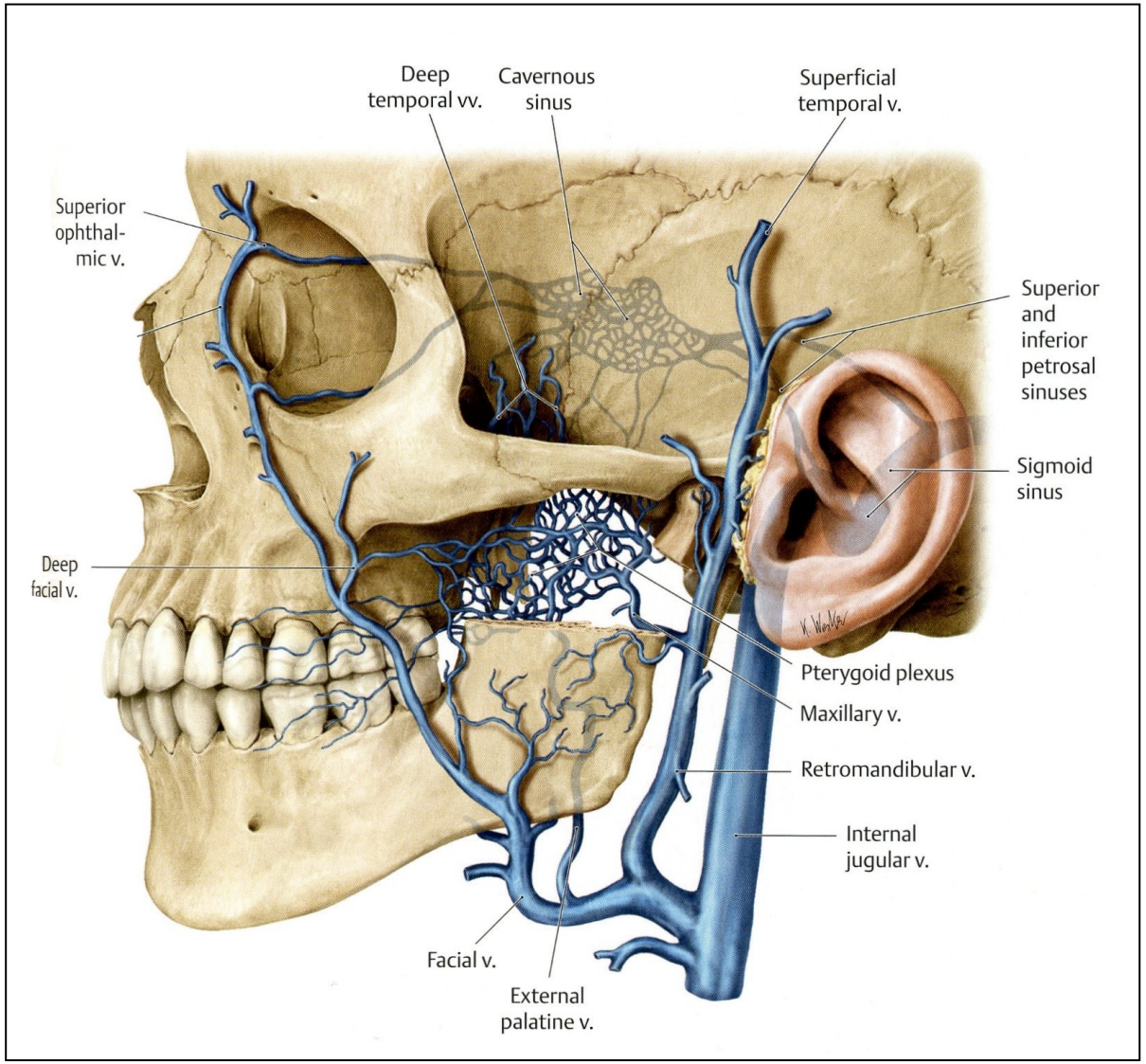
- Maxillary and mandibular dentitions
- Gingivae
- Oral mucosa of the cheek and palate
- Nasal mucosa
- Muscles of mastication
- Cranial dura via its **middle meningeal** a. branch.



Infratemporal Fossa: Pterygoid Plexus

- The **pterygoid plexus** is a network of veins between the medial and lateral pterygoid muscles, and between the lateral pterygoid and temporalis muscles.
- The **pterygoid plexus** of veins receives venous blood from the areas supplied by branches of the maxillary artery that branch within the infratemporal fossa and pterygopalatine fossa.
- The **pterygoid plexus** connects with the following vessels
  - Anterior/Superior: inferior ophthalmic vein → pterygoid plexus
  - Anterior/Inferior: deep facial vein → facial vein → pterygoid plexus
  - Posterior: maxillary vein → retromandibular → facial v. → internal jugular
  - Superior: cavernous sinus via emissary veins

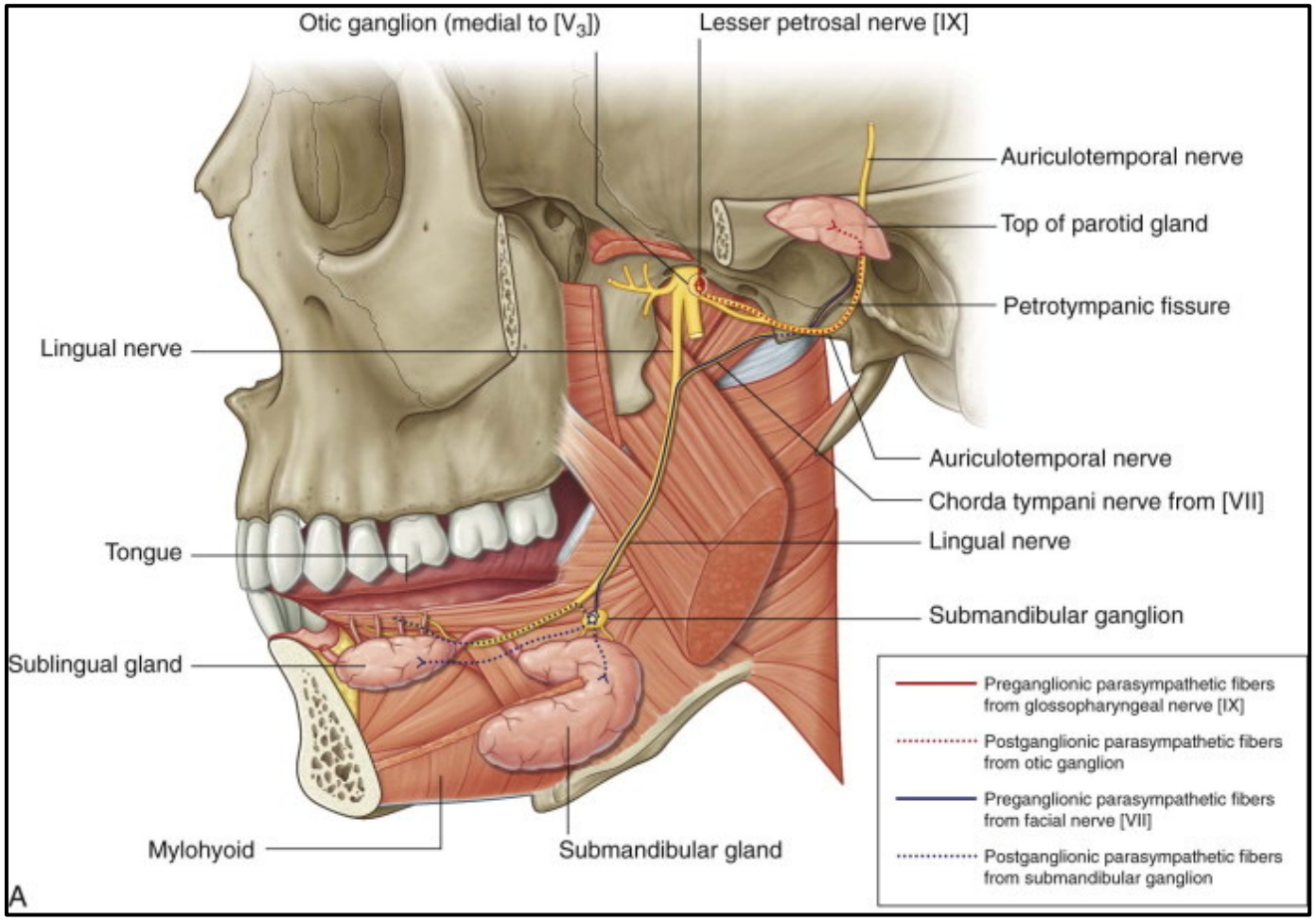
Recall that the communication of the **facial vein** with the **cavernous sinus** via the **superior and inferior ophthalmic veins**. This connection can provide a route for passage of an infection from areas drained by the the **facial vein** (danger triangle of the face) to the cranial dural sinuses. An infection can result from lacerations of the nose or the squeezing of pustules (pimples) on the side of the nose and upper lip.

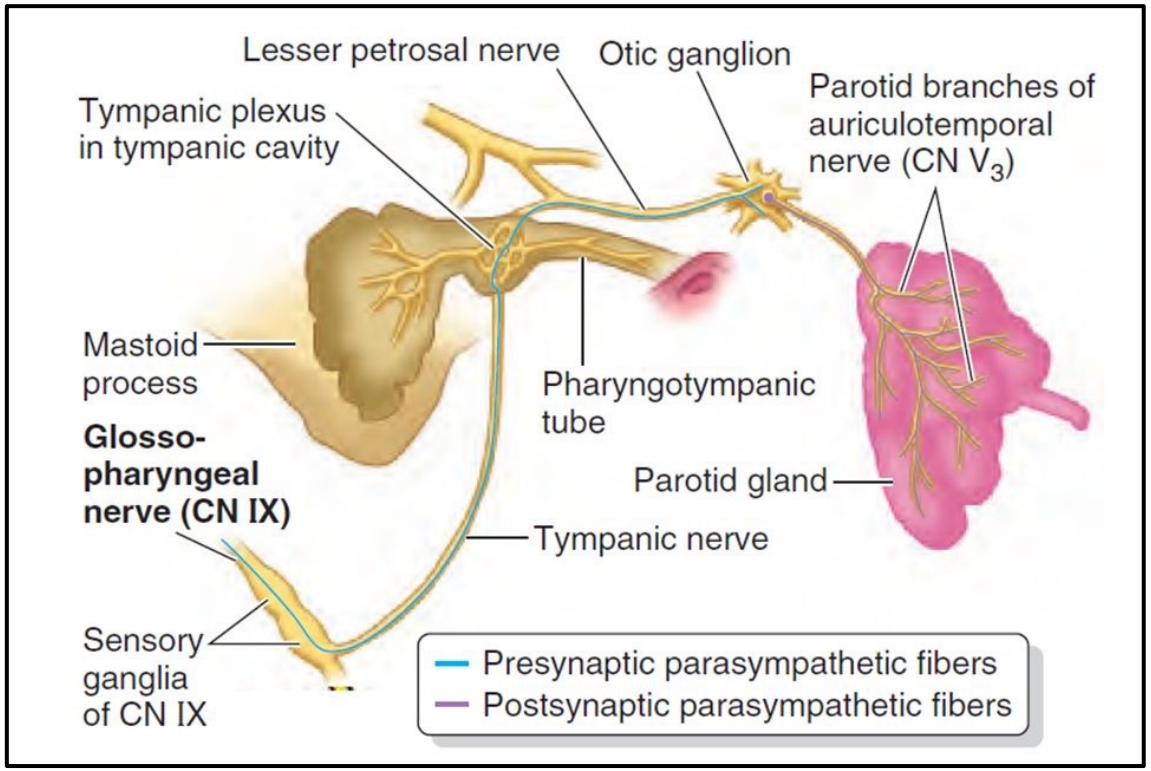


Infratemporal Fossa: Otic Ganglion

The **otic ganglion**, in association with the **mandibular nerve**, is located in the infratemporal fossa.

- More detailed descriptions of the following nerves can be found in the Pre-Lab Lab 2, Cranial Nerve PowerPoint Handout: Glossopharyngeal nerve (CN IX).
- Preganglionic parasympathetic fibers are brought to the **otic ganglion** via branches of the **glossopharyngeal nerve**.
- Postganglionic fibers then travel with the **auriculotemporal nerve** branch of the **mandibular nerve** to reach the parotid.





Infratemporal Fossa: Chorda Tympani Nerve

The **chorda tympani nerve**, which is a branch of the **facial nerve**, passes through the infratemporal fossa.

- More detailed descriptions of the following nerves can be found in the, Cranial Nerve PowerPoint Handout: Facial Nerve (CN VII).

- The **chorda tympani n**. contains the following fiber types.
  - Preganglionic fibers branching from the facial nerve and sensory
  - Special sensory fibers (taste) from the anterior 2/3 of the tongue

- Fibers of **chorda tympani** join with the **lingual n**.
  - The **chorda tympani** nerve's preganglionic parasympathetic fibers join with the the **lingual nerve** in the infratemporal fossa to ultimately reach the submandibular ganglion in the floor of the oral cavity.
  - Special sensory taste fibers from the anterior 2/3 of the tongue travel with the lingual nerve to exit the floor of the oral cavity. The taste fibers then branch from the **lingual nerve** within the infratemporal fossa to join the **chorda tympani** nerve.