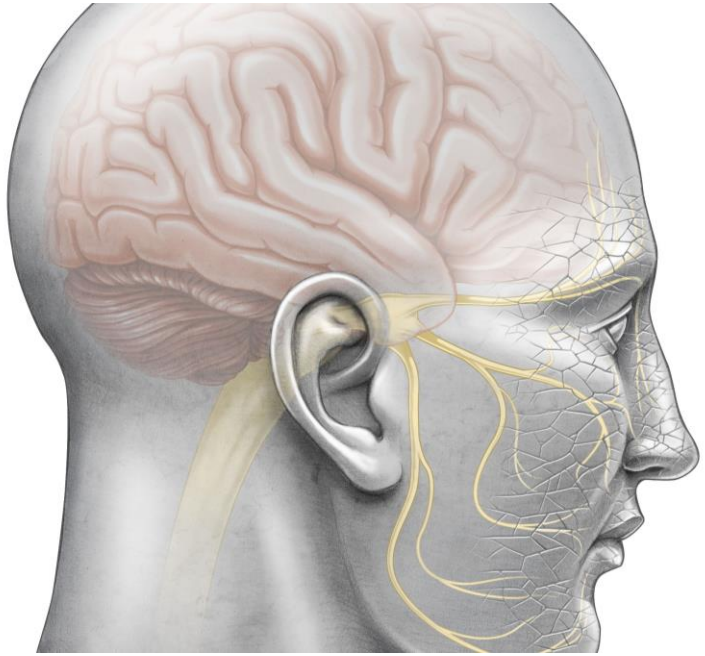
NERVE SUPPLY OF THE FACE

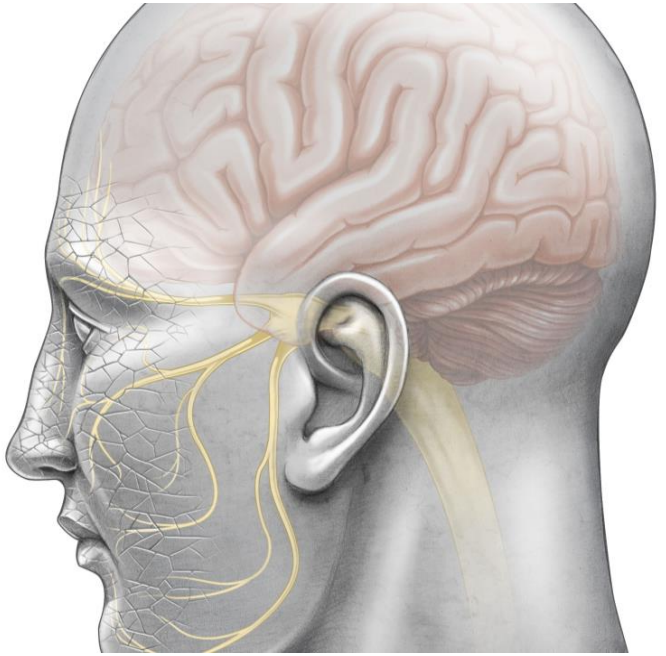
Khaleel Alyahya, PhD, MSc, MEd

www.khaleelalyahya.com

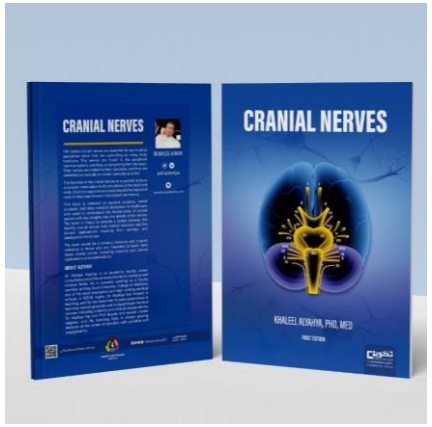


OBJECTIVES

- Describe the importance of trigeminal and facial nerves in the face.
- List the nuclei of the deep origin of the trigeminal and facial nerves in the brain stem.
- Describe the type and site of each nucleus.
- Describe the superficial attachment of trigeminal and facial nerves to the brain stem.
- Describe the main course and distribution of trigeminal and facial nerves in the face.
- Describe the main motor & sensory manifestation in case of lesion of the trigeminal & facial nerves including assessment.

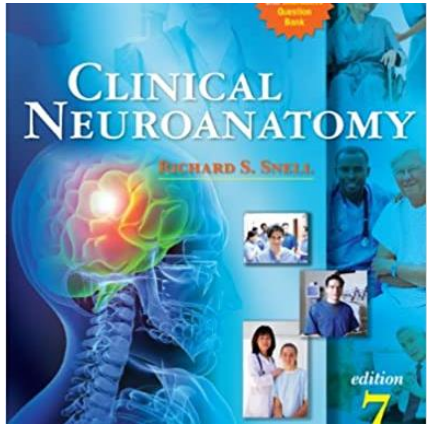


RESOURCES



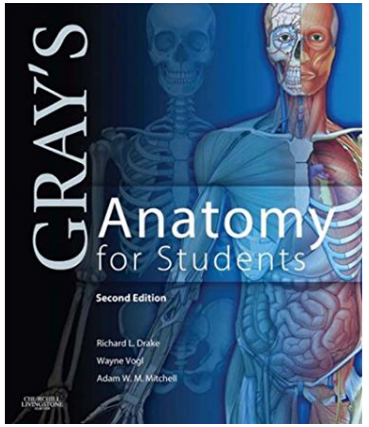
Cranial Nerves

By Khaleel Alyahya



Clinical Anatomy

By Richard Snell



Gray's Anatomy

By Richard Drake, Wayne Vogl &Adam Mitchell

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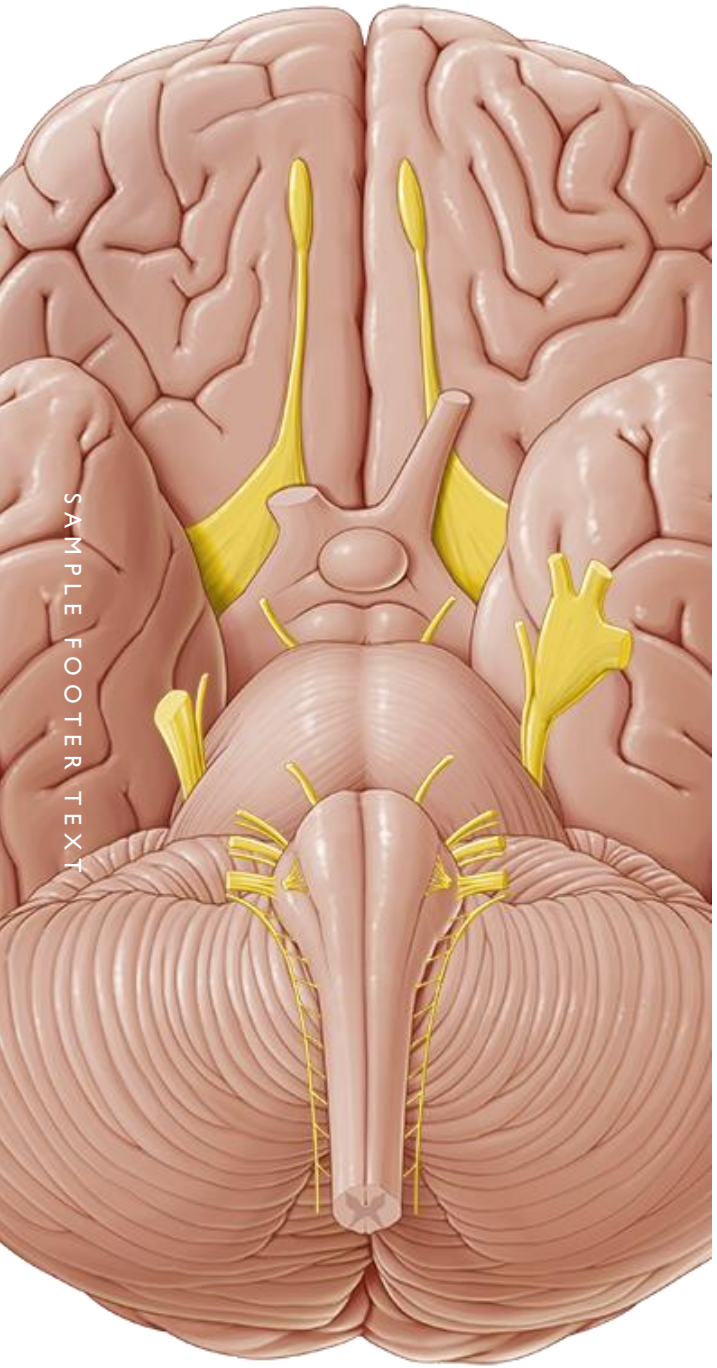
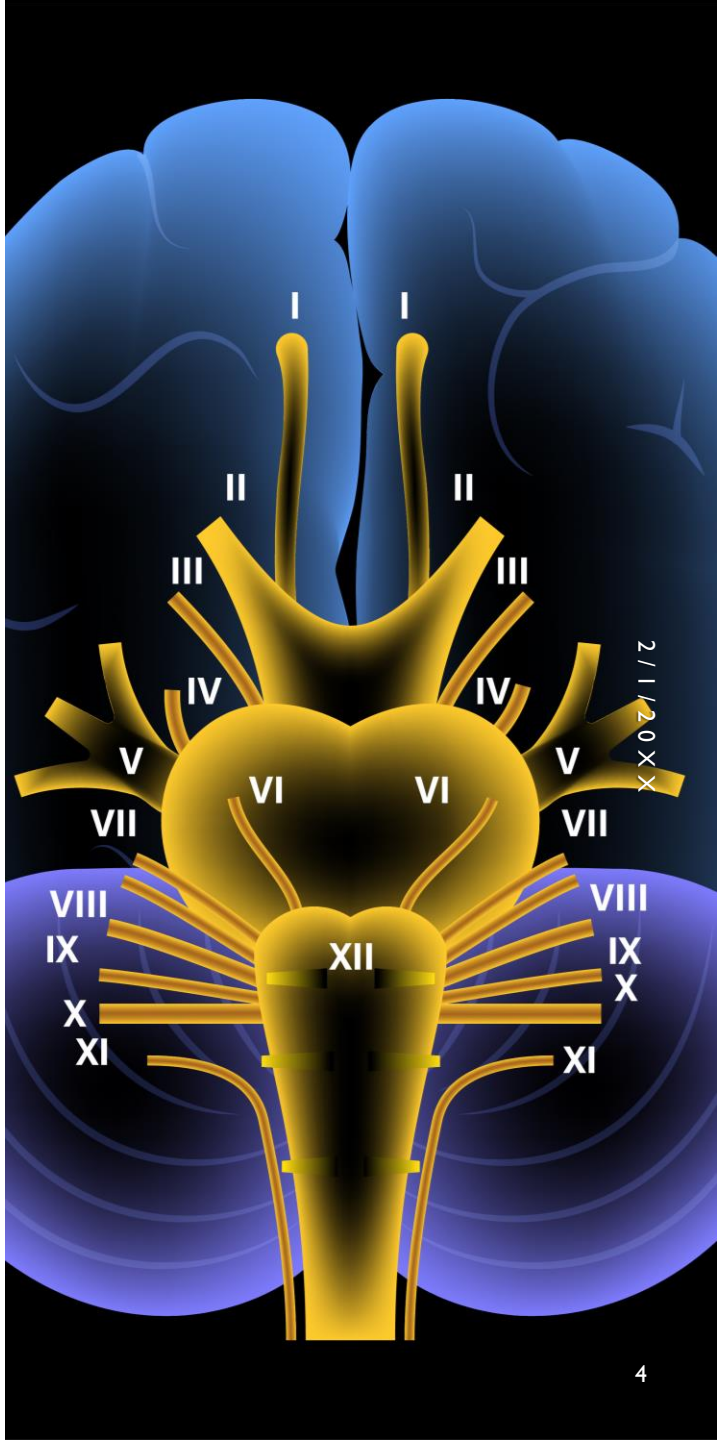


INTRODUCTION

- There are close functional and anatomical relationships between cranial nerves that supply the face (trigeminal and facial) in both their sensory and motor divisions.
- Sensation on the face is innervated by the trigeminal nerves (V) as are the muscles of mastication, but the muscles of facial expression are innervated mainly by the facial nerve (VII) as is the sensation of taste.
- This lecture describe the anatomy of these two cranial nerves with clinical cases and notes.



OVERVIEW

TRIGEMINAL

- The fifth cranial nerve
- Mixed
- Three main branches
- Important in chewing food and dental work

FACIAL

- The seventh cranial nerve
- Mixed
- Five terminal branches
- Important in facial expression

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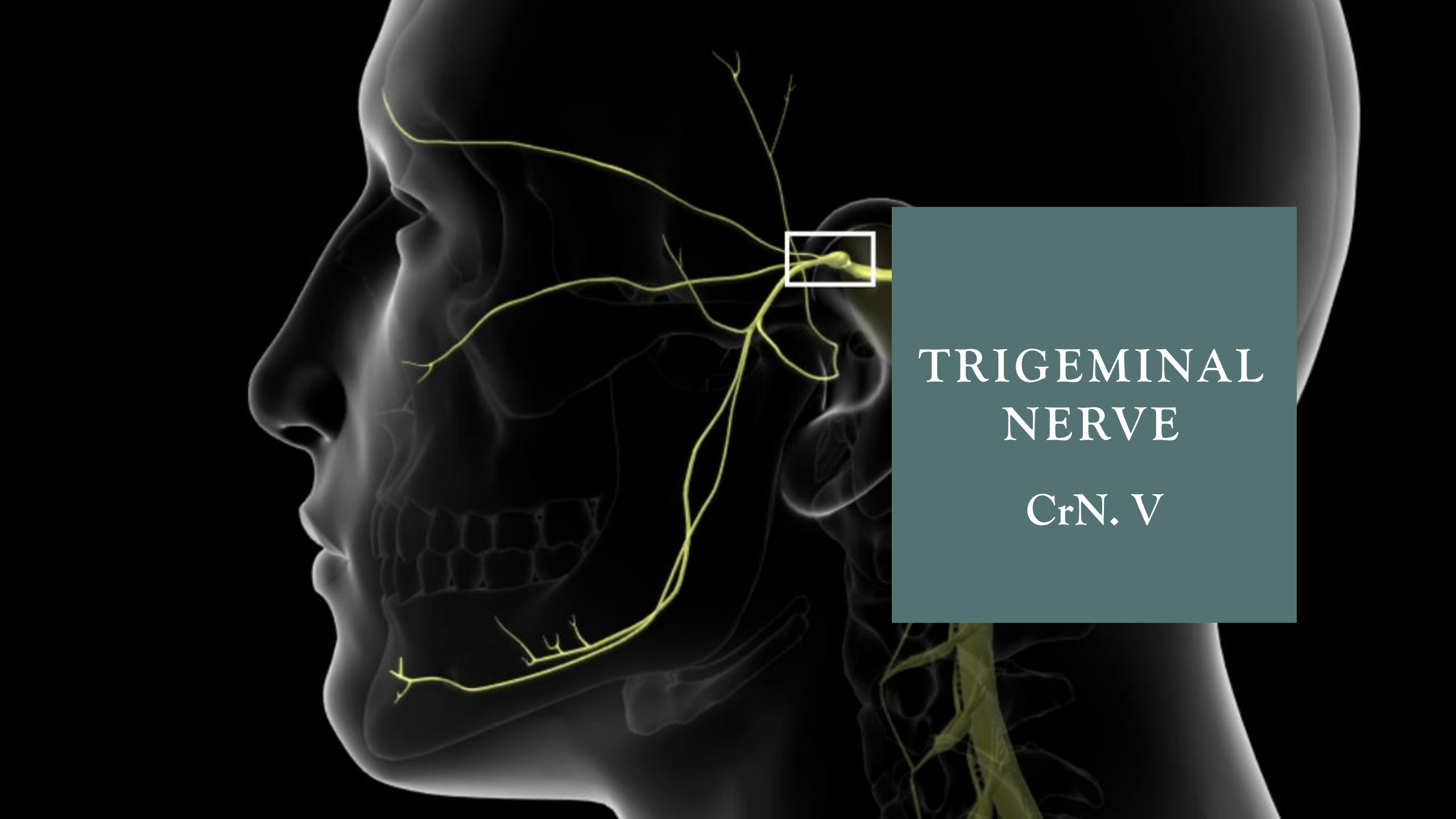
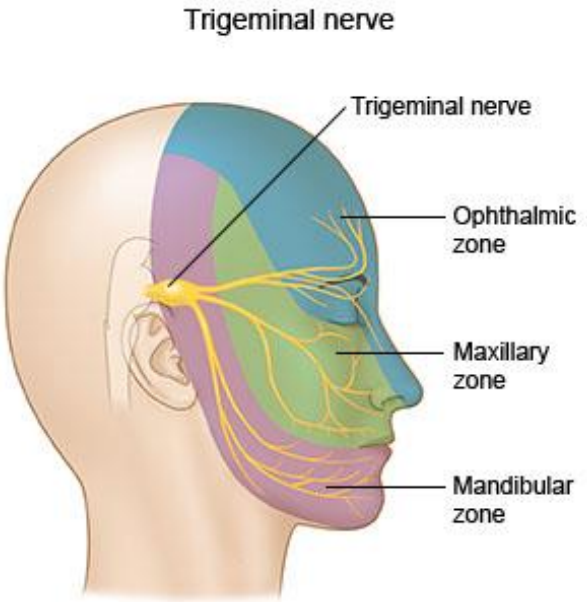


TRIGEMINAL NERVE

CrN. V

INTRODUCTION

- It is the 5th and the largest nerve among the twelve pairs of cranial nerves.
- It has multiple functions including motor, sensory and parasympathetic innervations.
- The motor fibers are found only in the mandibular branch of trigeminal nerve to provide innervation to eight muscles of the first pharyngeal arch including muscles of mastication, anterior belly of digastric, tensor veli palatine, mylohyoid and tensor tympani.
- The sensory fibers are found in all three branches of trigeminal nerve to innervate skin, mucous membranes, and sinuses of the face.



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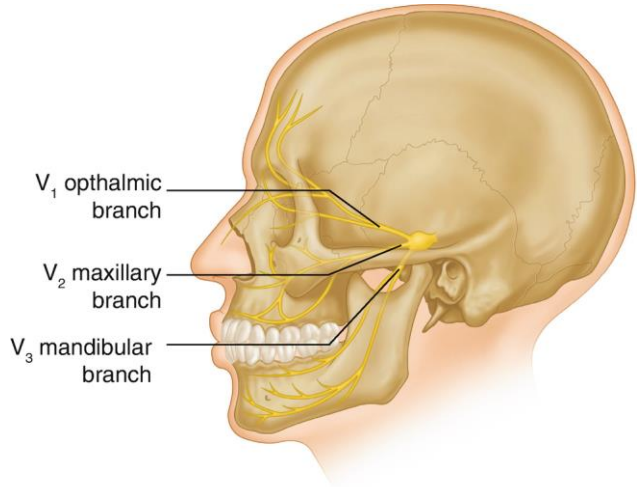
IMPORTANCE

- Every time we enjoy food, the gratitude should be delivered to the trigeminal nerve as one of the most important cranial nerves that maintain the function of mouth for eating and chewing.
- It helps us feel the sensations including temperature and pain.
- It also maintains the function of speaking and breathing via the mandibular nerve, which is the third division of trigeminal nerve.
- It plays also an importnat role when we visit the dentist to do some dental works, especially in the lower part of our mouth.



Trigeminal nerve

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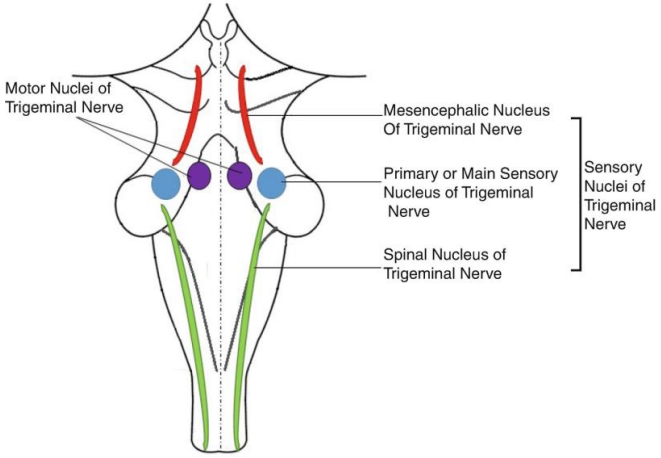
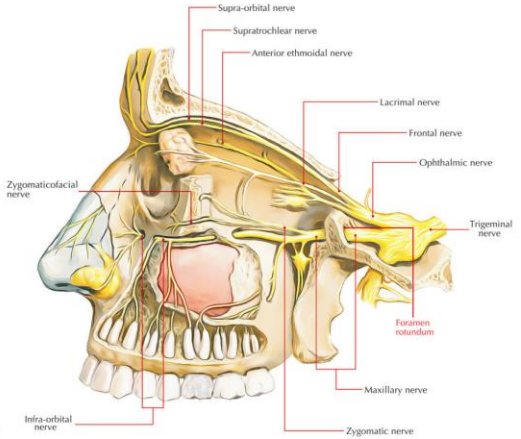
COURSE

- The trigeminal nerve arises from four nuclei, **one motor nucleus** (motor nucleus of the trigeminal nerve) and **three sensory nuclei** (primary sensory, mesencephalic and spinal nuclei of trigeminal nerve) which extend from the midbrain to the medulla oblongata.
- The trigeminal ganglion is situated laterally to the cavernous sinus, in a depression of the temporal bone known as the **trigeminal cave**.
- The peripheral aspect of the trigeminal ganglion is divided into three segments: ophthalmic (V1), maxillary (V2) and mandibular (V3).
- The ophthalmic and maxillary nerves run laterally to the cavernous sinus to leave the cranium through the superior orbital fissure and foramen rotundum, respectively.
- The mandibular nerve leaves the cranium through the foramen ovale to access the infratemporal fossa.





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NUCLEI

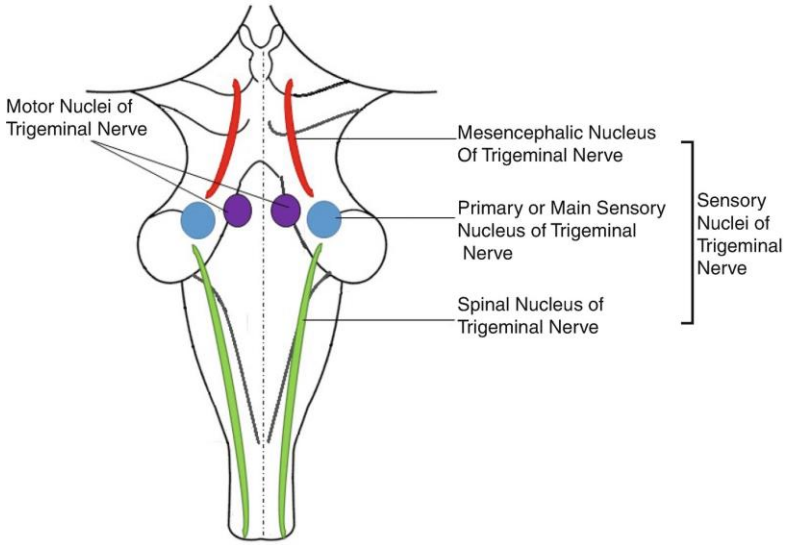
Four nuclei: (3 **sensory** + 1 **motor**)

General somatic afferent

1. **Mesencephalic nucleus** (midbrain & pons): receives proprioceptive fibers from muscles of mastication.
2. **Principal** (main) **sensory nucleus** (pons): receives touch fibers from face & scalp.
3. **Spinal nucleus** (pons, medulla & upper 2-3 cervical segments of spinal cord): receives pain & temperature sensations from face & scalp.

Special visceral efferent

1. **Motor nucleus** (pons): supplies:
   - Four Muscles of mastication (temporalis, masseter, medial & lateral pterygoid).
   - Other four muscles (Anterior belly of digastric, mylohyoid, tensor palati & tensor tympani).



NUCLEI

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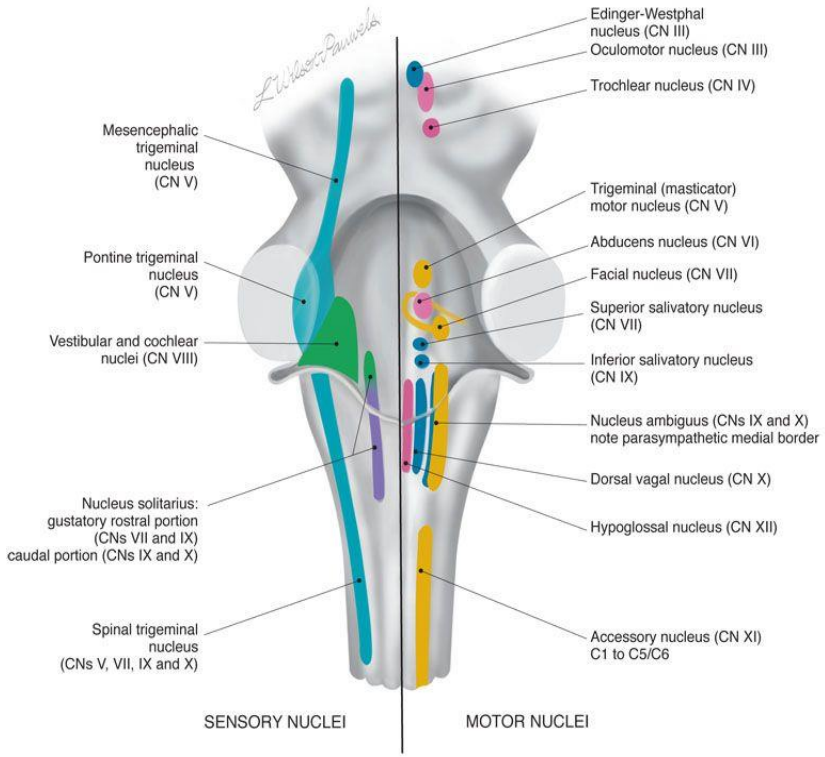


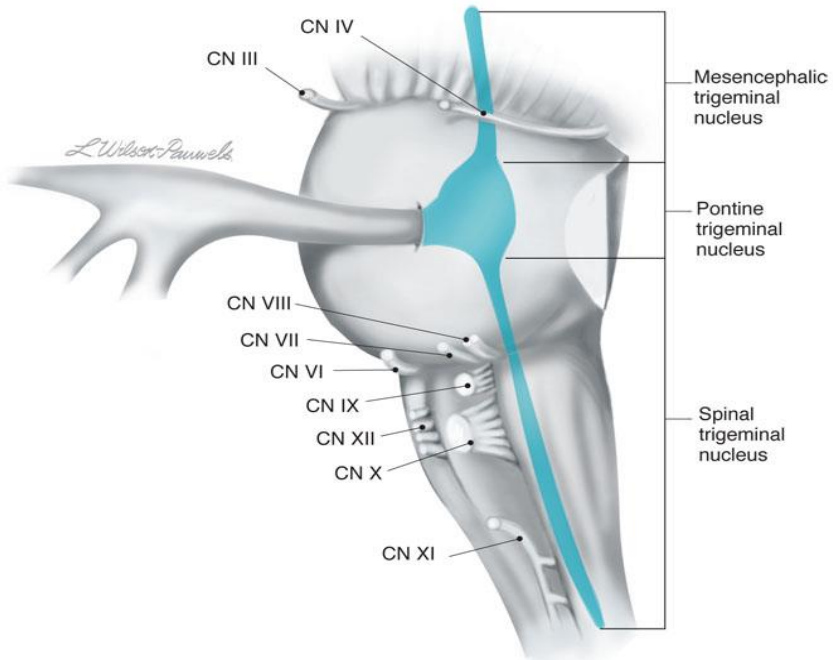
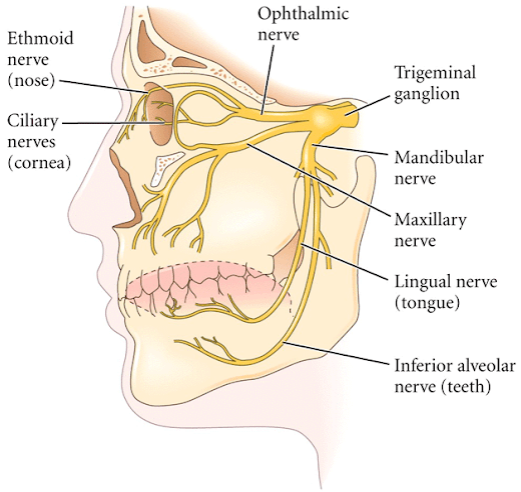
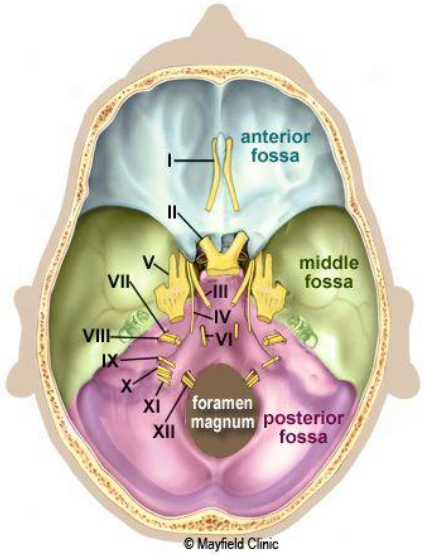


Figure V–9 Trigeminal sensory nucleus (lateral view of the brain stem).

GANGLION

- It occupies a depression in the middle cranial fossa (temporal bone) known as **trigeminal cave**.
- It contains cell bodies:
  - Whose dendrites carry sensations from the face.
  - Whose axons form the sensory root of trigeminal nerve.





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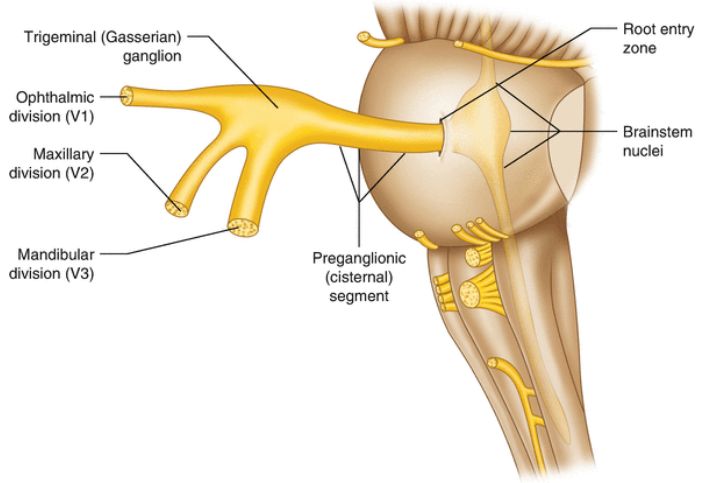
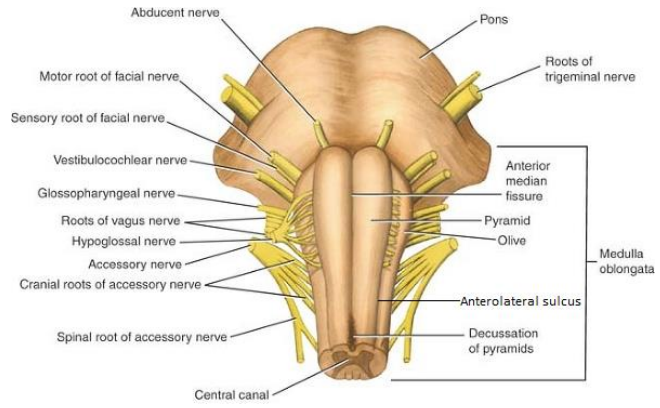
TRIGEMINAL NERVE

- Emerges from the middle of the ventral surface of the pons by two roots
  - Large lateral sensory root & small medial motor root.
- Divides into 3 divisions (dendrites of trigeminal ganglion):
  - Ophthalmic.
  - Maxillary.
  - Mandibular.
- Axons of cells of motor nucleus join only the mandibular division.





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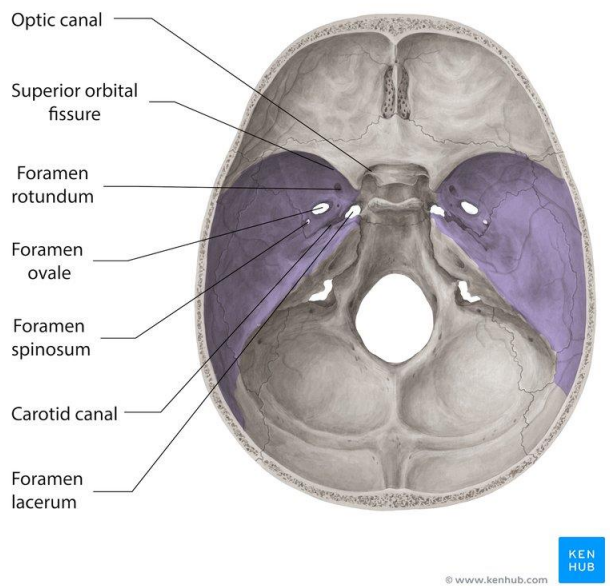
FORAMINA

- Ophthalmic Branch
  - Pass through **superior orbital fissure**
- Maxillary Branch
  - Pass through **foramen rotundum**
- Mandibular Branch
  - Pass through **foramen ovale**



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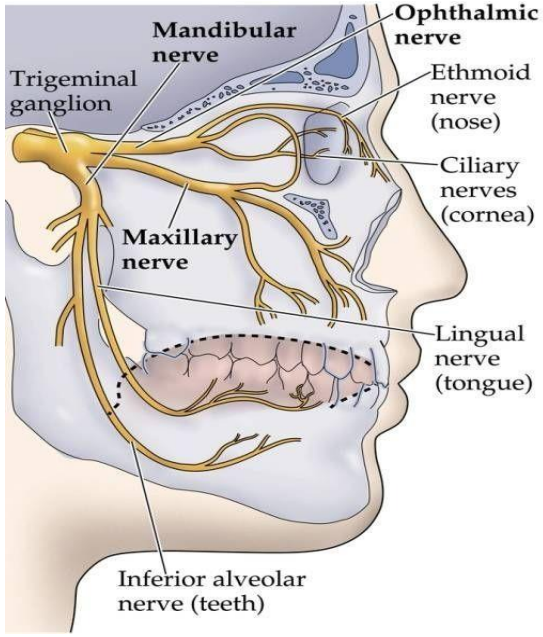
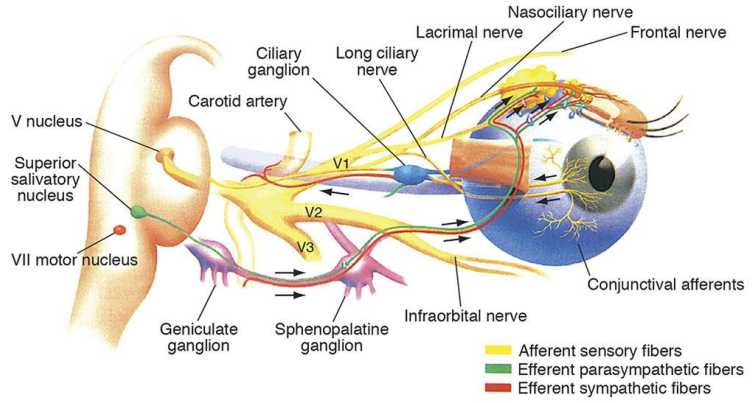
OPTHALAMIC BRANCH

- Pure sensory
- Divided into three branches
- Frontal, Lacrimal and Nasociliary which pass through superior orbital fissure to the orbit.
  - **Frontal** supplies skin of face and scalp.
  - **Lacrimal** supplies skin of face and **lacrimal gland**.
  - **Nasociliary** supplies skin of face, nasal cavity and eyeball.





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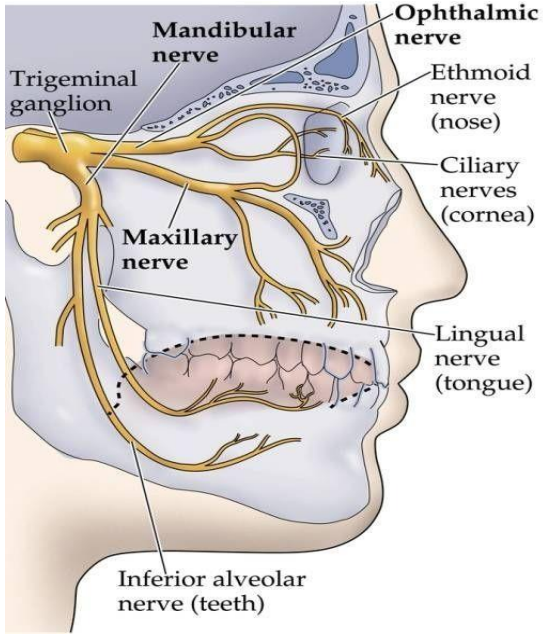
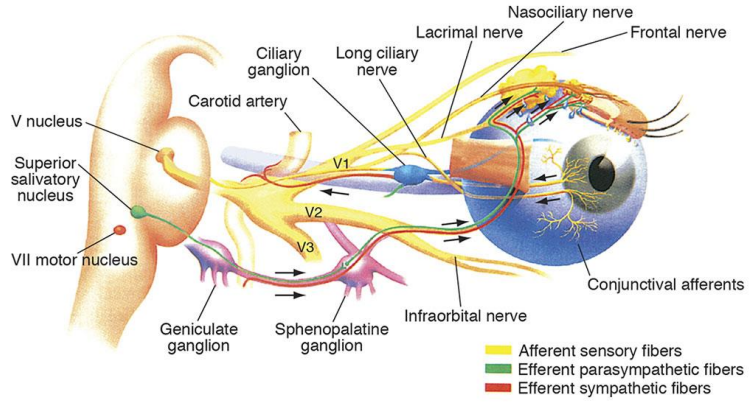
MAXILLARY BRANCH

- Pure sensory
- It provided innervation to the following:
  - Upper teeth, gums and maxillary air sinus (posterior, middle and anterior superior alveolar nerves).
  - Face: zygomaticofacial and infraorbital nerves.





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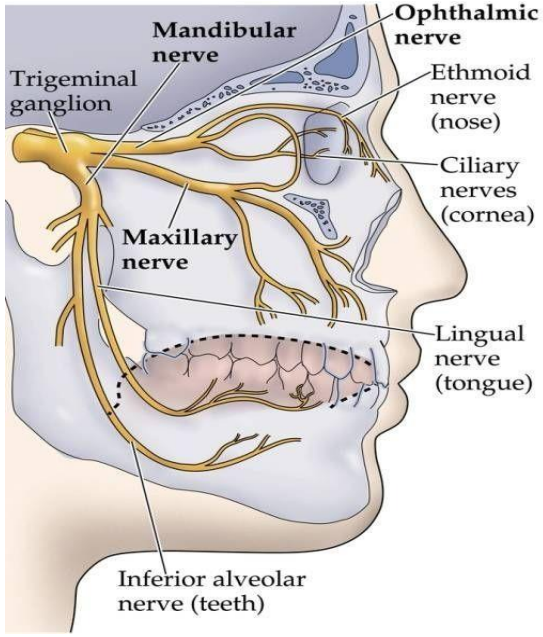
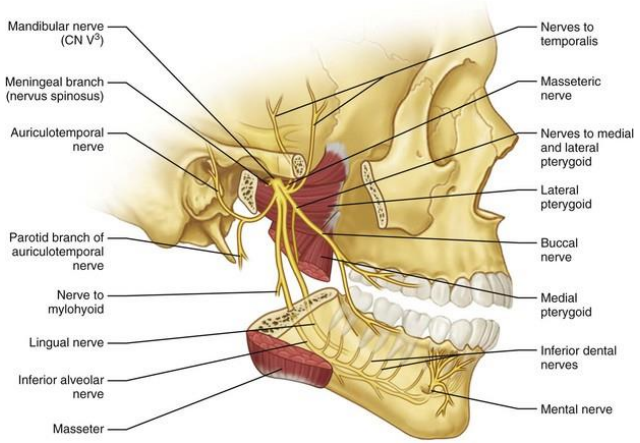
MANDIBULAR BRANCH

- Mixed (sensory and motor)
- Sensory branches supplies several regions including:
  - **Lingual:** receives general sensations from anterior 2/3 the of tongue.
  - **Inferior alveolar:** supplies lower teeth, gums and face (over mandible).
  - **Buccal:** supplies face (cheek on upper jaw)
  - **Auriculotemporal:** supplies auricle, temple, **parotid gland** and TMJ.
- Motor branches supplies the followings:
  - **Eight Muscles** (four of muscles of mastication and other four muscles).





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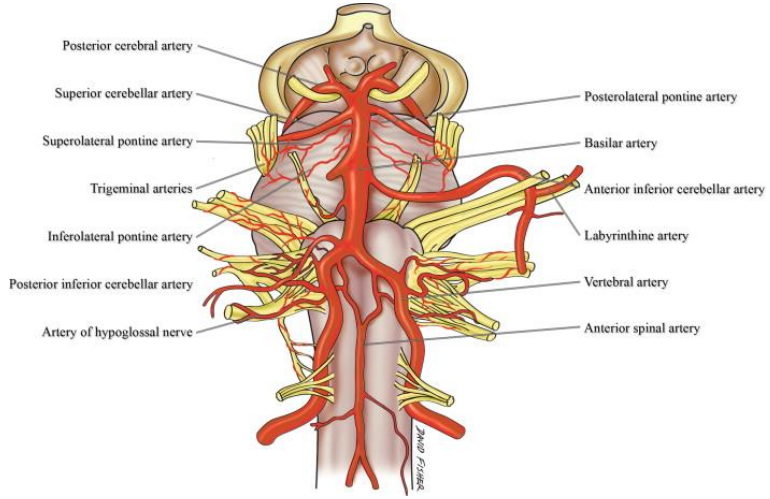
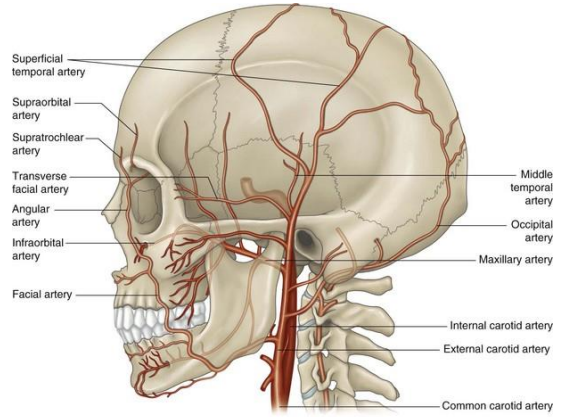
BLOOD SUPPLY

- The trigeminal nerve receives blood supply from three major arteries includes the **superolateral branch** of the basilar artery, the **peduncular cerebellar branch** of the anterior inferior cerebellar artery and the **trigeminocerebellar artery**.
- The **trigeminal artery** originates from the superolateral pontine branch of the basilar artery and from the peduncular cerebellar branch of the anterior inferior cerebellar artery.
- The **trigeminal artery** is considered an important channel that connect the basilar and carotid arteries and it follows the same course of the trigeminal nerve.





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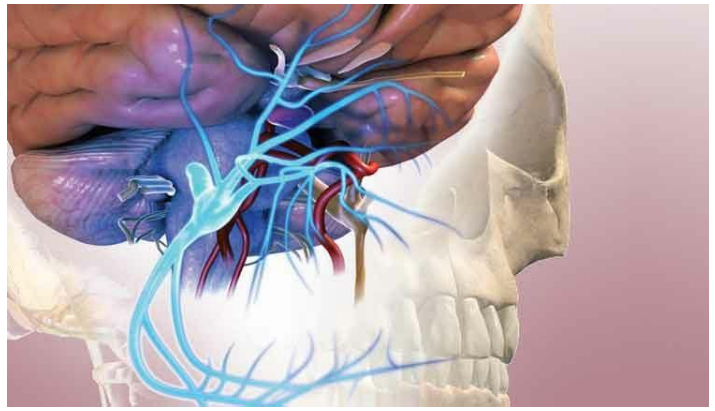
TRIGEMINAL AND DENTAL WORK

- The mandibular nerve plays a role just about every time you get dental work done, especially in the lower part of your mouth.
- Anytime you have dental work done, you will face a small risk of permanent nerve damage.
- Wisdom tooth extraction is a common case in which patients face this risk.
- In any dental surgery, you will need local anaesthesia, so your mandibular nerve will not transmit pain messages during the surgery.
- Local anaesthetics block the part of the nerve that is affected.
- However, nerve damage also makes a rare complication for procedures like dental implants and other dental surgeries.
- That is why you should always work with an experienced, responsible dentist who can minimize your risk.



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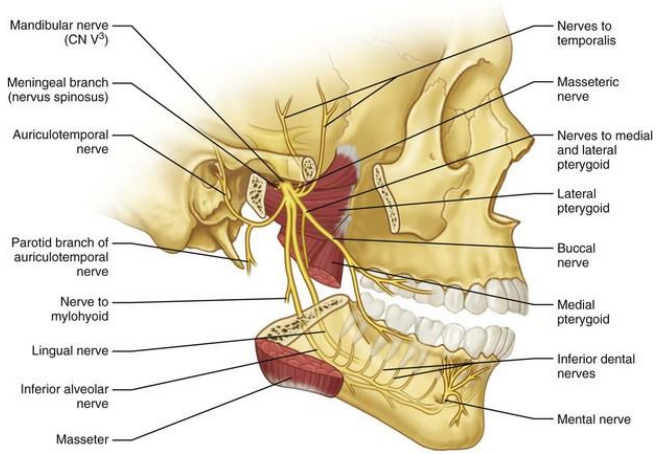
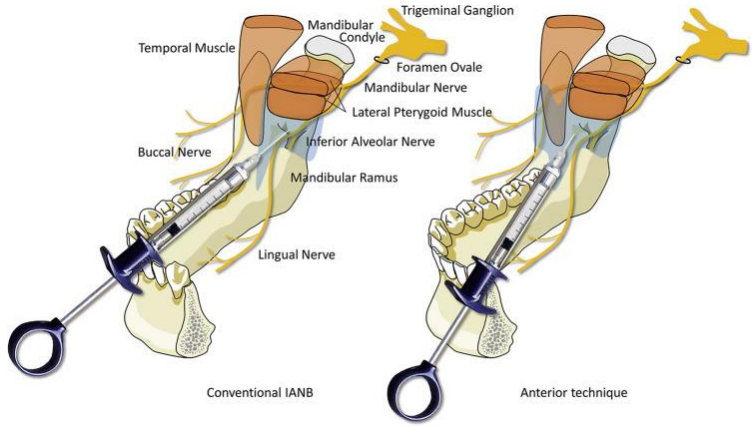
INFERIOR ALVEOLAR NERVE BLOCK

- It is the most common procedure used in dentistry to get some dental works done.
- The **inferior alveolar nerve** supplies the lower teeth including molars and second premolar with sensory innervation that is formed into inferior dental plexus and give off small dental nerves to the teeth.
- Also, the **mental nerve** is the major branch of this plexus, therefore, the inferior alveolar nerve is blocked by inserting a needle close to the mandibular foramen to release a local anaesthesia near to the nerve before it enters the foramen.
- The anaesthesia causes numbness of area innervated by the inferior alveolar nerve and it managed at the mandibular foramen.
- The anaesthesia also reaches the **lingual nerve** arising near the inferior alveolar branch and leading to numbness of the anterior 2/3 of the tongue.





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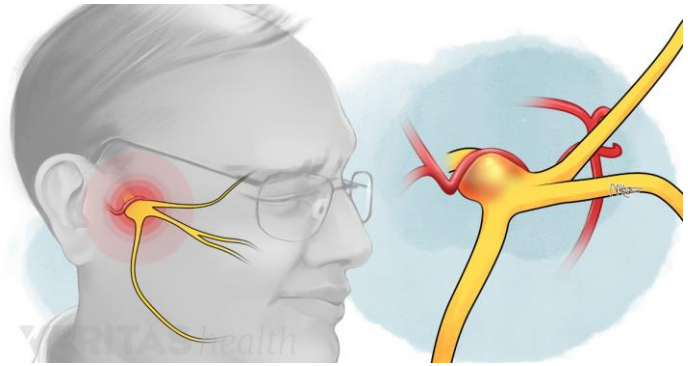
TRIGEMINAL NEURALGIA

- It is a facial pain syndrome characterised by recurring unilateral episodes (recurrent attacks) of intense stabbing pain spreading from the angle of the jaw along a branch of the trigeminal nerve.
- The pain usually extends to the mandibular or maxillary regions, but rarely to the ophthalmic branch.
- Trigeminal neuralgia may also transfer the sensation from the face to the brain.
- Several causes may lead to this condition including compression, degeneration or inflammation of the trigeminal nerve.
- This condition generated by direct contact between trigeminal nerve and a normal blood vessel at the base of the brain.
- This contact applies pressure on the nerve and causes it to malfunction.



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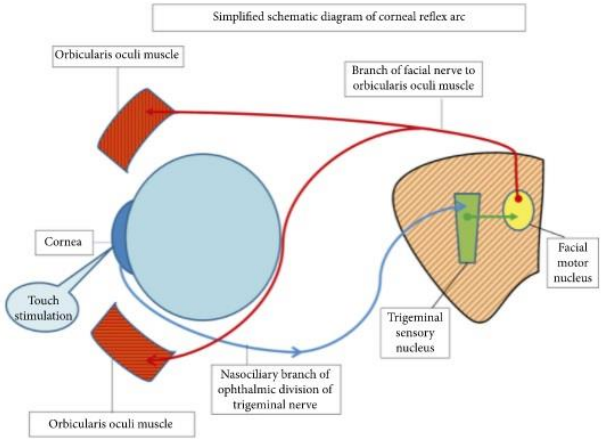
CORNEAL REFLEX

- The corneal reflex is defined as the involuntary blinking of the eyelids, in which it is triggered by thermal, tactile or painful stimulation of the cornea.
- During corneal reflex, the **ophthalmic nerve** functions as the afferent limb to detect the stimuli while the **facial nerve** functions as the efferent limb, resulting in constriction of the orbicularis oculi muscle.
- The damage to the facial nerve or the ophthalmic branch of trigeminal nerve can be observed by the absence of corneal reflex.



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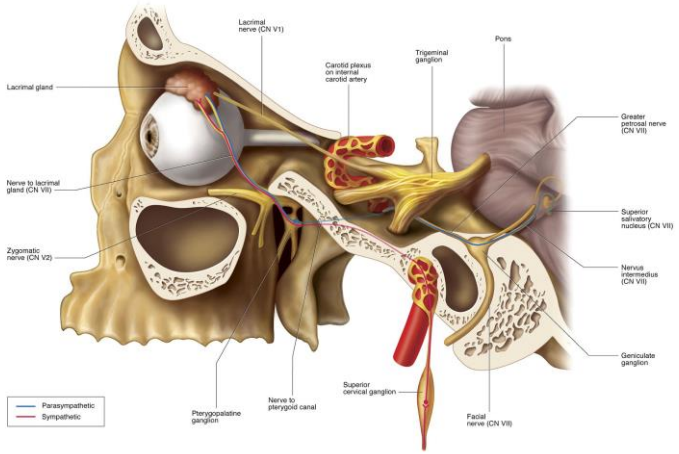
NERVE ASSESSMENT

- The sensory division of the trigeminal nerve provides touch, pain and temperature sensation to the face.
- The innervation includes the cornea of the eye, mucosa of sinuses, oral and nasal cavities and dura of the cranial fossae.
- To examine the sensory innervation of the trigeminal nerve, a cotton wisp should be applied to the facial areas that are innervated by the three divisions of trigeminal nerve after asking the patients to close their eyes in order to evaluate the quality of palpable sensory.
- Meanwhile, to examine the motor innervation, the zygomatic area can be palpated when patients clench the jaw and by the contraction of the temporalis.
- The same procedure can be applied to the masseter muscles that can be palpated when the patient clenches the jaw and then by asking the patient to open the mouth against resistance.
- When medial and lateral pterygoid muscles are planned to be checked, patients should be asked to open their mouths and deviate the mandibles to the right and left.
- If pterygoid muscles do not contract properly, the jaw will be deviated to that side when the mouth is opened.



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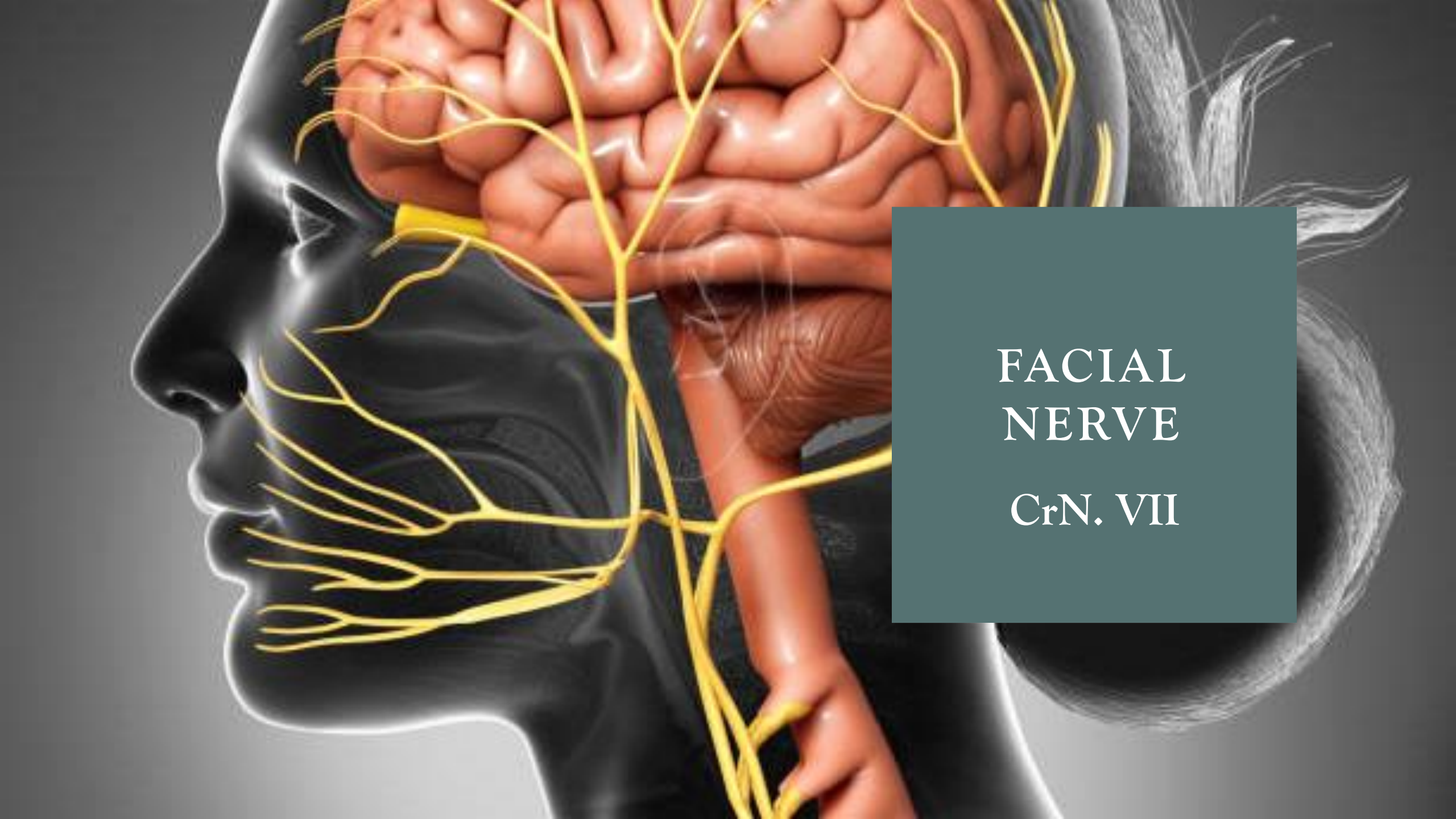
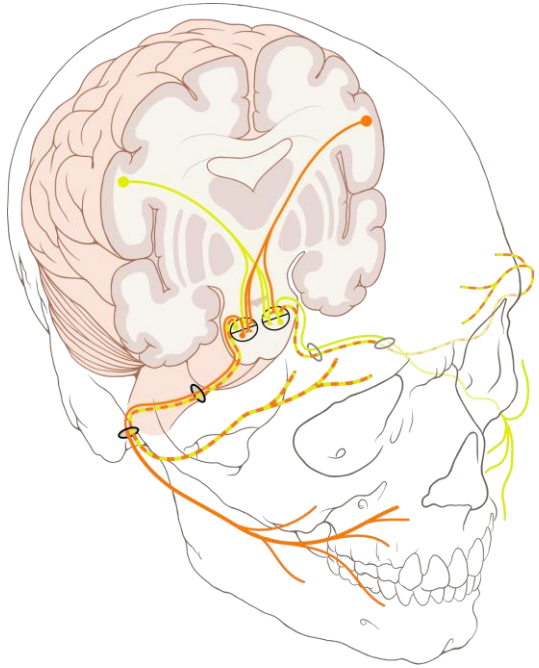


FACIAL NERVE

CrN. VII

INTRODUCTION

- It is the 7th paired cranial nerve, and it is involved in our facial expression.
- Type: Mixed nerve (motor, special sensory, parasympathetic).
- Fibers:
  - Special visceral afferent: carrying taste sensation from anterior 2/3 of the tongue.
  - Special visceral efferent: supplying muscles developed from the 2nd pharyngeal arch.
    - The muscles of facial expression.
    - The posterior belly of the digastric.
    - The stylohyoid muscle.
    - The auricular muscle.
    - The stapedius muscle of the middle ear.
  - General visceral efferent: supplying parasympathetic secretory fibers to submandibular, sublingual, lacrimal, nasal and palatine glands.

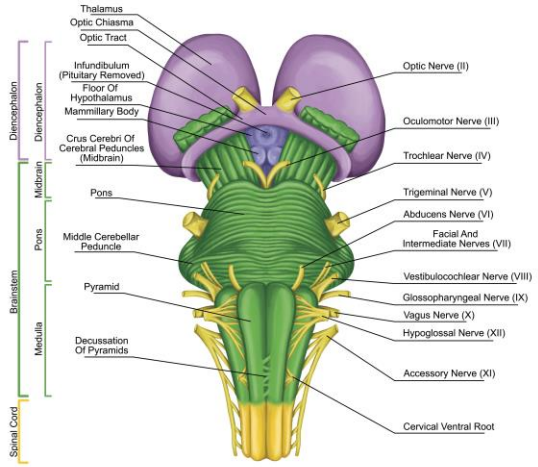


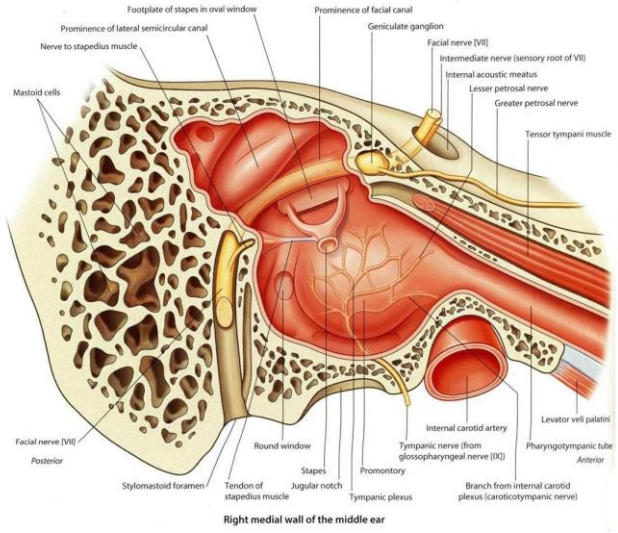
IMPORTANCE

- Muscles of facial expression are critical and most important for non-verbal communication, where lifting our eyebrows, wrinkling our nose, and slightly twinging the corner of our mouth indicate the level of our attention during communicating with others.
- Those small non-verbal signs interpret not only what they tell about the people we are interacting with, but also, they indicate our behaviour towards others when we all engaged in communication.
- Damage to facial nerve will reduce the ability of non-verbal communication, and the face will lose its symmetry and beauty.

COURSE

- The facial nerve has a long course with many branches that carry a combination of sensory, motor, and parasympathetic fibres.
- The nerve can be split into two portions: **intracranial** which refers to the course of the nerve inside the cranium and **extracranial** which refers to the course of the nerve outside the cranium, where it is running through the face and neck.
- The intracranial course starts in the pons where the nerve originates in two roots: a small sensory root and a large motor root (Unlike trigeminal nerve).
- Both roots (sensory and motor) run through the **internal auditory** to run within the **facial canal**.
- The posterior auricular nerve is the first extracranial branch to arise through which motor innervation is provided to some muscles around the ear.
- The facial nerve pierces parotid gland where it divided into five terminal branches to innervate the muscles of facial expression. These branches are temporal, zygomatic, mandibular, buccal and cervical.

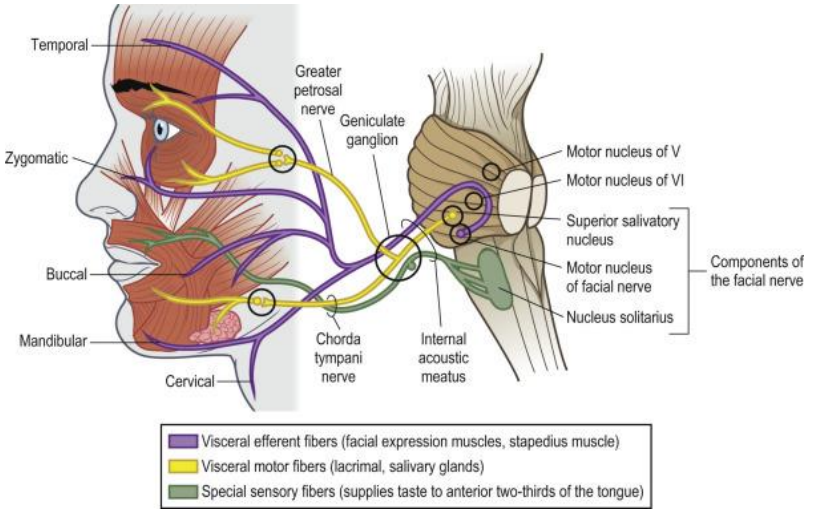




Right medial wall of the middle ear

NUCLEI

- **Special visceral afferent:** nucleus solitarius: receives taste from the anterior 2/3 of tongue.
- **Special visceral efferent:** motor nucleus of facial nerve supplies: muscles of facial expression, posterior belly of digastric, stylohyoid, platysma, stapedius, and occipitofrontalis.
- **General visceral efferent:** superior salivatory nucleus sends preganglionic parasympathetic secretory fibers to sublingual, submandibular, lacrimal, nasal and palatine glands.



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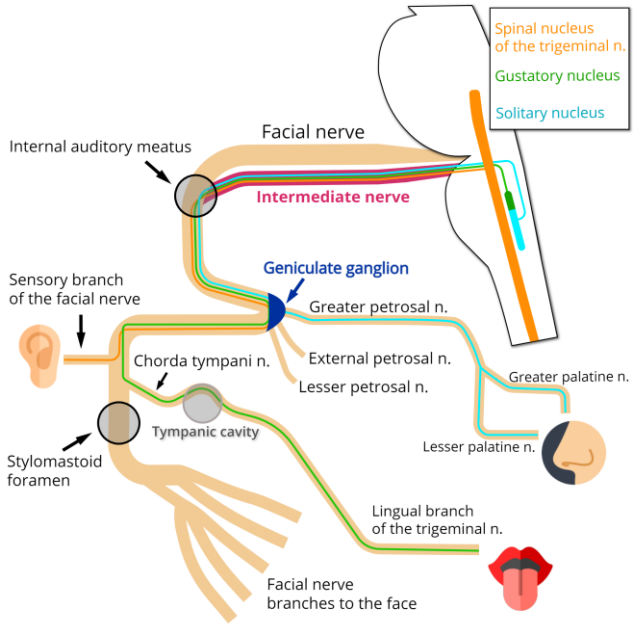
BRANCHES WITHIN FACIAL CANAL

- **Greater petrosal nerve** carries preganglionic parasympathetic fibers to lacrimal, nasal and palatine glands.
- **Chorda tympani carries** both:
  - Preganglionic parasympathetic fibers to submandibular and sublingual glands.
  - Taste fibers from anterior 2/3 of tongue.
- Nerve to **stapedius muscle** to control the amplitude of sound waves from the external environment to the inner ear.



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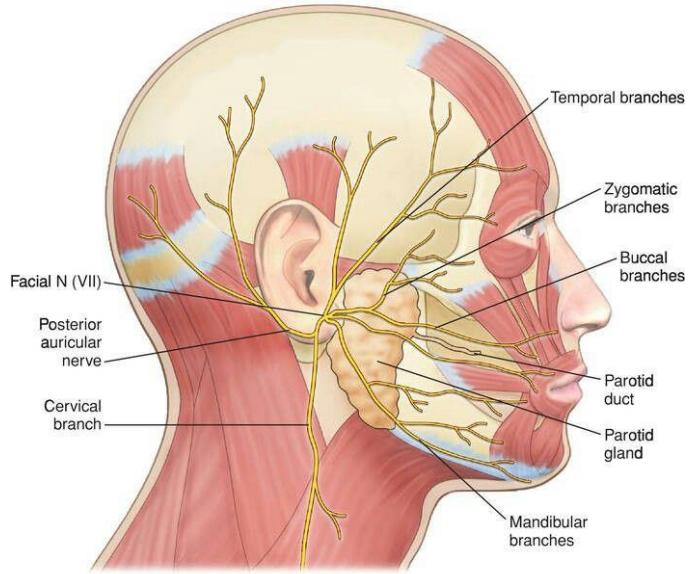
ONCE EXITS STYLOMASTOID FORAMEN

- **Posterior auricular innervates** occipitofrontalis muscle.
- **Muscular branches** innervate posterior belly of digastric and stylohyoid.



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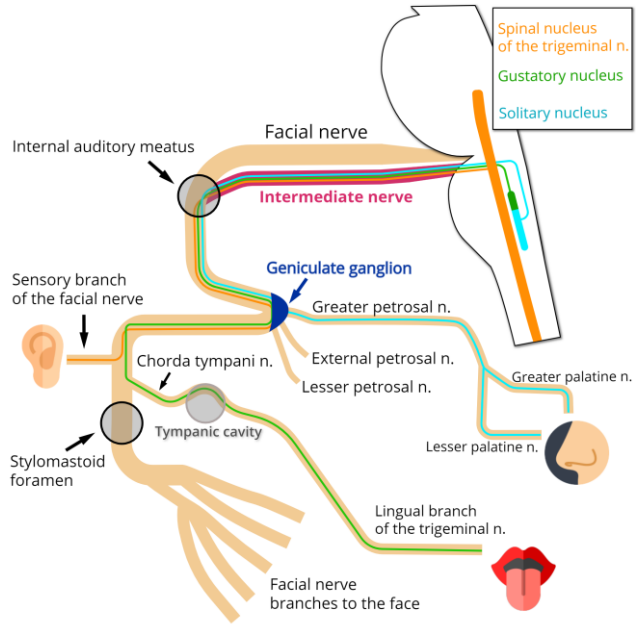
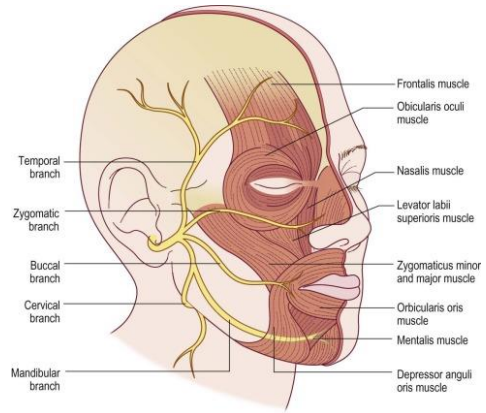
INSIDE PAROTID GLAND

- Temporal branch
- Zygomatic branch
- Buccal branch
- Mandibular branch
- Cervical branch
- All innervate muscles of facial expression.





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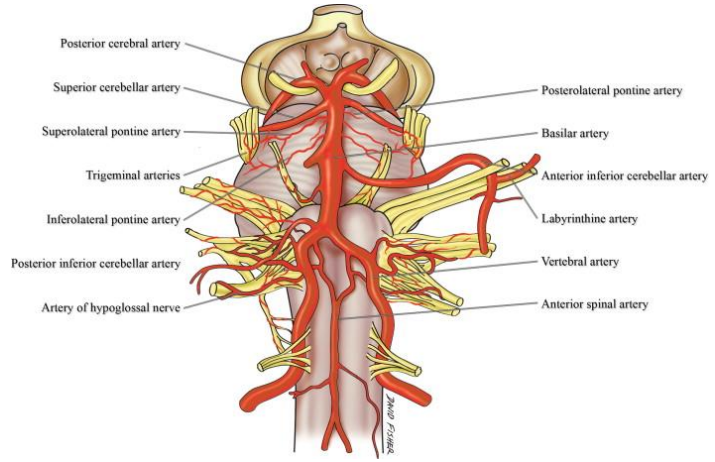
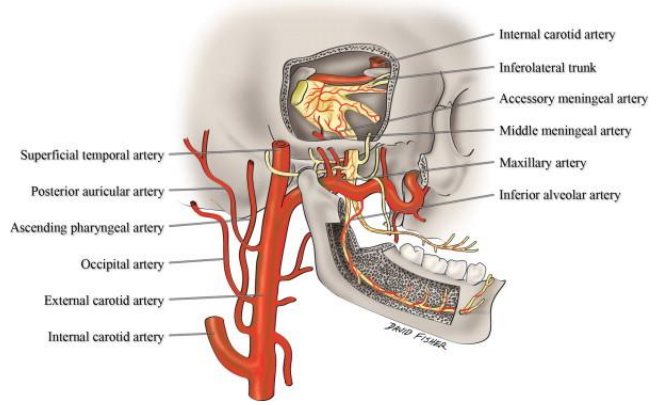
BLOOD SUPPLY

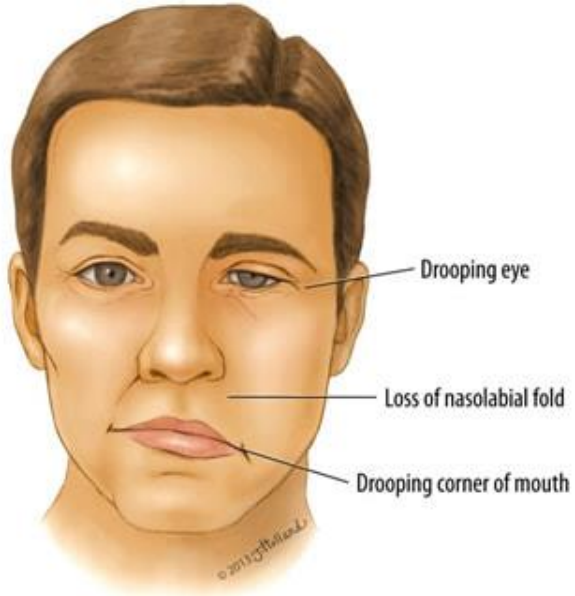
- Within the pons, the facial nucleus receives the blood supply mainly from the **anterior inferior cerebellar artery**, which is a branch of basilar artery.
- This artery enters the internal meatus (acoustic) accompanying the facial nerve, and then it splits into the **labyrinthine** and **cochlear** arteries.
- The **superficial petrosal** branch of the middle meningeal artery is the second arterial blood supply to the extramedullary facial nerve.
- The **posterior auricular artery** supplies the facial nerve at and distal to the stylomastoid foramen





BELL'S PALSY

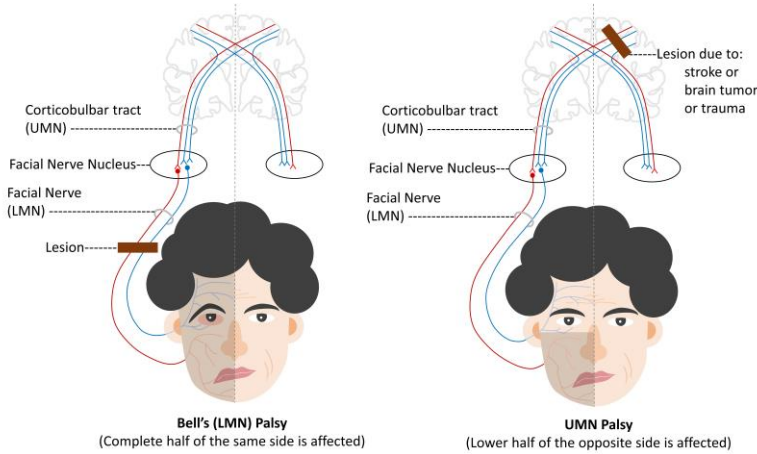
- Bell's palsy is one of the most common diseases of facial nerve that lead to the paralysis of facial muscle because of the damage to the facial nerve.
- This condition is named after Scottish surgeon Charles Bell who was the first to discover the involvement of facial nerve to it.
- It can attack anyone suddenly at different ages including diabetic people, people with cold and pregnant women.
- Bell's palsy can be temporary or permanent based on the cause, but in rare cases, it does not disappear completely.
- The cause of Bell's palsy is fully unknown, but it may be due to an inflammation to the nerve controlling movement of the face.
- The most obvious symptoms of this condition include disabling the movement of the muscles of facial expressions that will affect the smiling, blinking, or closing the eyelid.
- Loss of feeling in the face and loss of the sense of taste on the front 1/2 of the tongue are within the common symptoms



MOTOR NEURON LESION

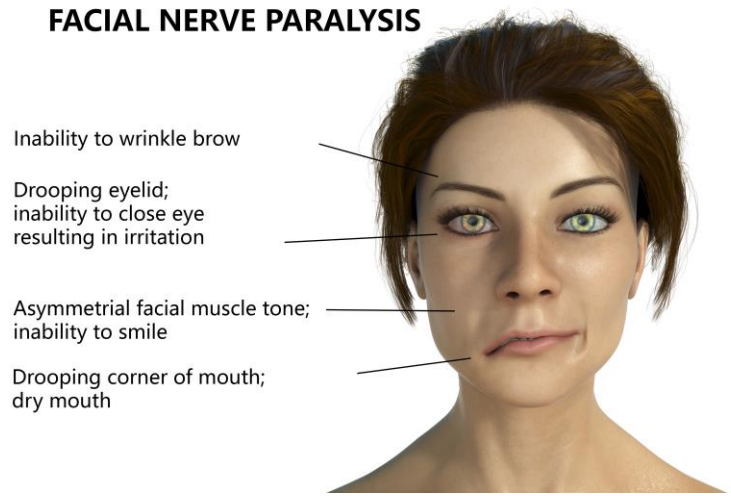
- **Lower Motor Neuron Lesion**
- Results from injury of facial nerve fibers **below** facial nucleus in internal acoustic meatus in the middle ear in the facial canal or in parotid gland.
- Manifested by complete paralysis of facial muscles on the same side of lesion.

- **Upper Motor Neuron Lesion**
- This occurs after injury to the pyramidal tract (corticonuclear) **above** facial nucleus.
- Leads to paralysis of facial muscles of lower ½ of face of opposite side but the upper ½ of the face intact because:
  - Muscles of lower ½ of face receive pyramidal fibers from opposite cerebral cortex only.
  - While Muscles of upper ½ of face receive pyramidal fibers from both cerebral hemispheres (Bilateral represented).



NERVE ASSESSMENT

- The assessment of facial nerve could be performed by examining the quality of facial expression to observe any asymmetry.
- Doctors may ask patients to carry out a sequence of facial expressions to assess the muscles of the face that are responsible for facial expression.
- If there is any damage to the motor functions of facial nerve, patients cannot perform good facial expressions.
- Also, to assess if there is paralysis to the stapedius muscle, doctors may ask patients if they have noticed any recent changes to their hearing.
- Sensory assessment of facial nerve could be done by noticing any changes in the sense of taste since the facial nerve is carrying the innervation of the anterior 2/3 of the tongue with the special sense of taste .



KHALEEL ALYAHYA, PHD, MED

QUESTIONS?

alkhaleel@ksu.edu.sa

www.khaleelalyahya.com

@khaleelya