

THE CRANIAL NERVES

- **12** pairs, (two are attached to the cerebrum and **10** are attached to the brain stem).
- Nine are attached to the ventral surface of the brain stem, while one is attached to the back of the midbrain.
- They leave the cranial cavity by passing through small foramina in the skull bones.
- Both 'names' and 'numbers' are used to identify them.
- Their names indicate either their distribution or their function.
- Their numbers (**ROMAN numerals**) indicate the order in which the nerves arise from the brain (front to back).
- Like all nerves, cranial nerves are made up of bundles of axons.
- Cranial nerves may be sensory, or motor, or mixed, and may contain somatic and/or autonomic fibers.

Numbers & Names :

I - 1st : Olfactory

V - 5th : Trigeminal

IX - 9th : Glossopharyngeal

II - 2nd : Optic

VI - 6th : Abducent

X - 10th : Vagus

III - 3rd : Oculomotor

VII - 7th : Facial

XI - 11th : Accessory

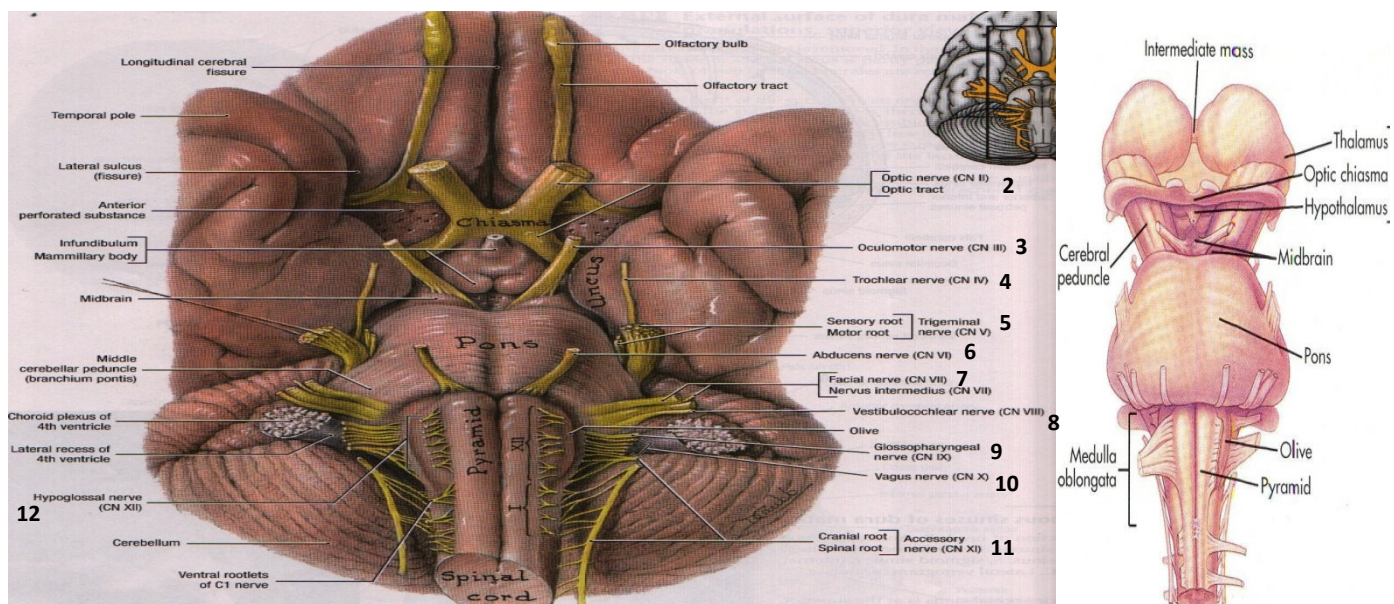
IV - 4th : Trochlear

VIII - 8th : Vestibulocochlear
(statoacoustic) or (auditory)

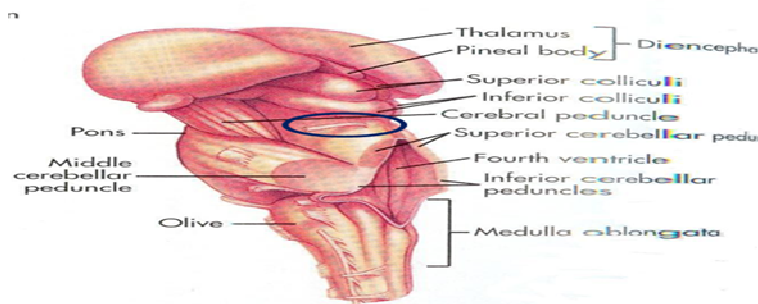
XII - 12th : Hypoglossal

Attachment Of The Cranial Nerves :

- Ventral surface of brainstem showing attachment of the cranial nerves :

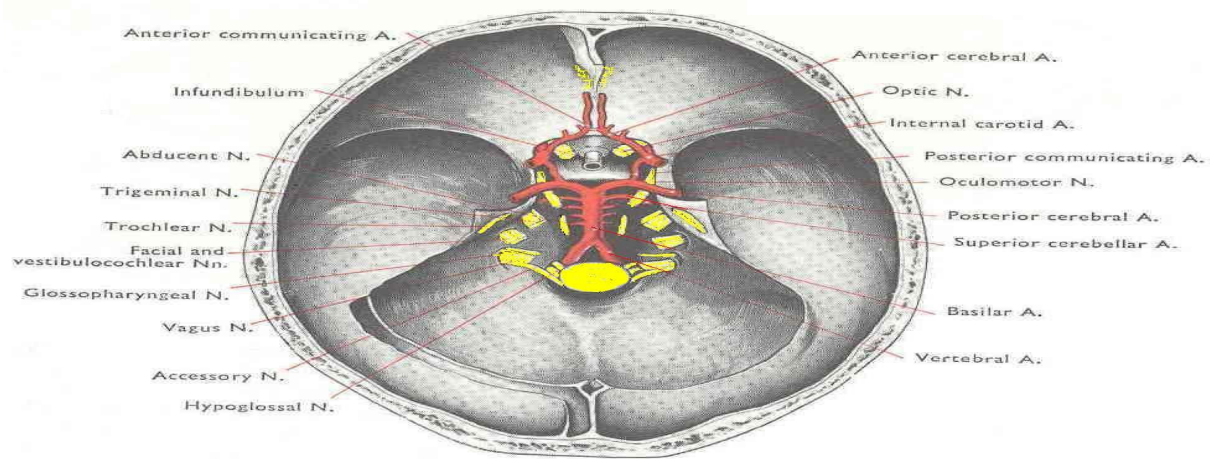
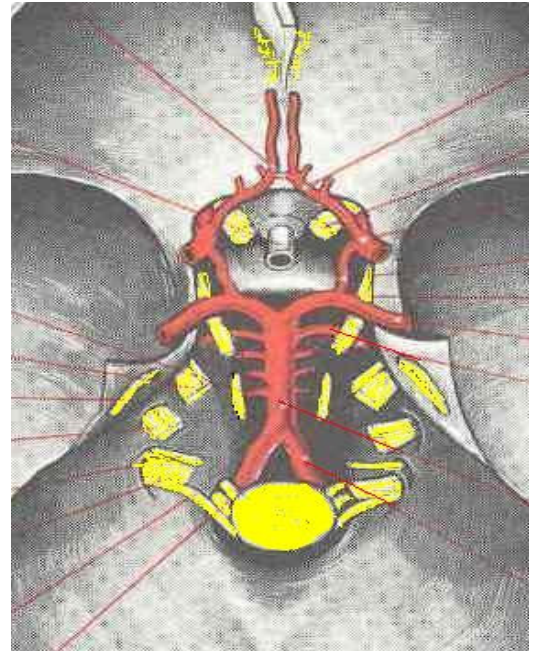


- Trochlear nerve is the only nerve that rise from the *dorsal* surface of the midbrain :



Foramina of Exit :

- 1st : Cribriform plate of ethmoid.
- 2nd : Optic canal.
- 3rd : **Superior orbital fissure.**
- 4th : **Superior orbital fissure.**
- 5th :
 - Ophthalmic division : **Superior orbital fissure.**
 - Maxillary division : Foramen rotundum.
 - Mandibular division : Foramen ovale.
- 6th : **Superior orbital fissure.**
- 7th : **Internal acoustic meatus; Stylomastoid foramen.**
- 8th : **Internal acoustic meatus.**
- 9th : **Jugular foramen.**
- 10th : **Jugular foramen.**
- 11th : **Jugular foramen.**
- 12th : Hypoglossal canal.



Spinal Nerves Functional Components :

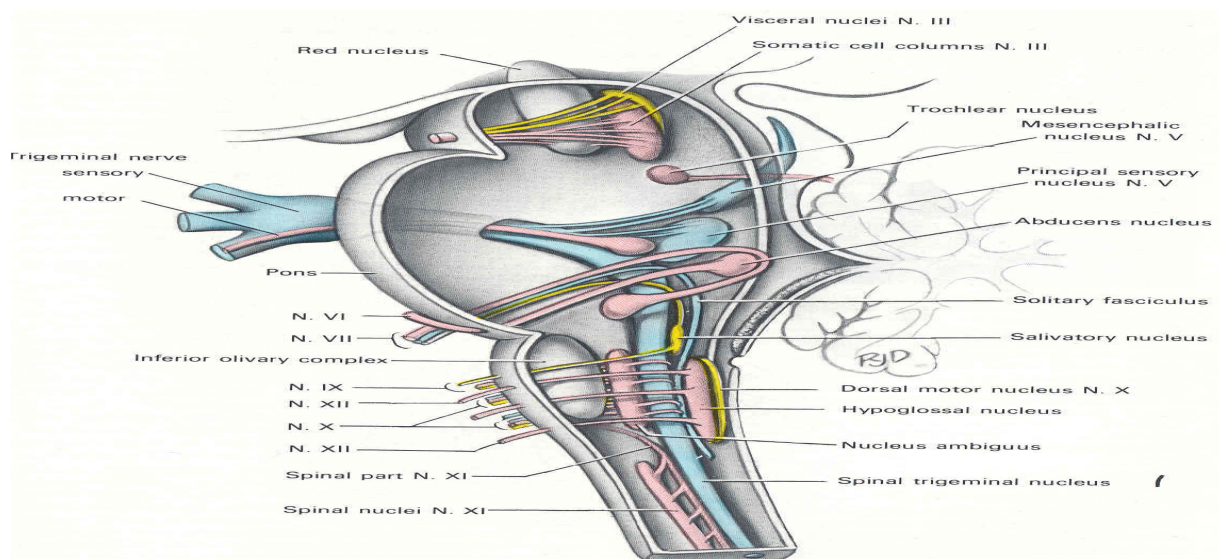
- General somatic afferent (GSA).
- General somatic efferent (GSE).
- General visceral afferent (GVA).
- General visceral efferent (GVE).
- **N.B. : All the spinal nerves carry all the four components.**

Cranial Nerves Functional Components :

- **Four like the spinal nerves :**
 - General somatic afferent (GSA).
 - General somatic efferent (GSE).
 - General visceral afferent (GVA).
 - General visceral efferent (GVE).
- **Three additional: (for special senses & pharyngeal arch muscles) :**
 - Special somatic afferents (SSA) : **vision & hearing.**
 - Special visceral afferents (SVA) : **taste & olfaction.**
 - Special visceral efferent (SVE) : supplying muscles derived from pharyngeal arches.
- **N.B. : Not all the cranial nerves carry all the components.**

Type	Distribution
Efferent	
General Somatic Efferent (GSE)	Skeletal muscles from Somites
General Visceral Efferent (GVE) – Autonomic efferent	Smooth muscles and glands
Special Visceral efferent (SVE)	Skeletal muscles from pharyngeal arches
Afferent	
General Somatic Afferent (GSA)	Skin, skeletal muscles, joints and bone
General Visceral Afferent (GVA) – Autonomic afferent	Visceral organs
Special Somatic Afferent (SSA)	Retina, auditory and vestibular organs
Special Visceral afferent (SVA)	Gustatory and olfactory receptors

Cranial Nerves Nuclei :



Sensory Pathway :

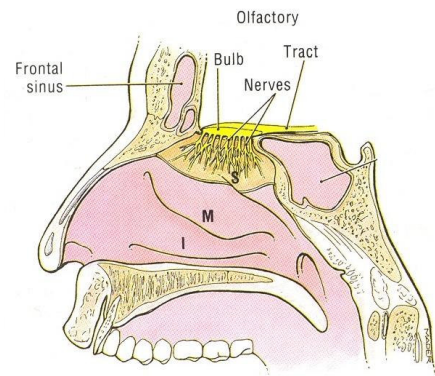
- **Three Neurons :**
 - **First order neuron** : from receptors to **sensory nucleus**. *The cell bodies lie in the sensory ganglia.*
 - **Second order neurons** : from sensory nucleus to the **contralateral thalamus**.
 - **Third order neurons** : from thalamus to **cerebral cortex**.

Motor Pathway :

- **Two neurons**
 - **Upper motor neuron** : from cerebral cortex to the **motor nucleus**, mostly bilateral projection *except part of 7th and 12th nerves*.
 - **Lower motor neurons** : from the motor nucleus to the **muscles**.

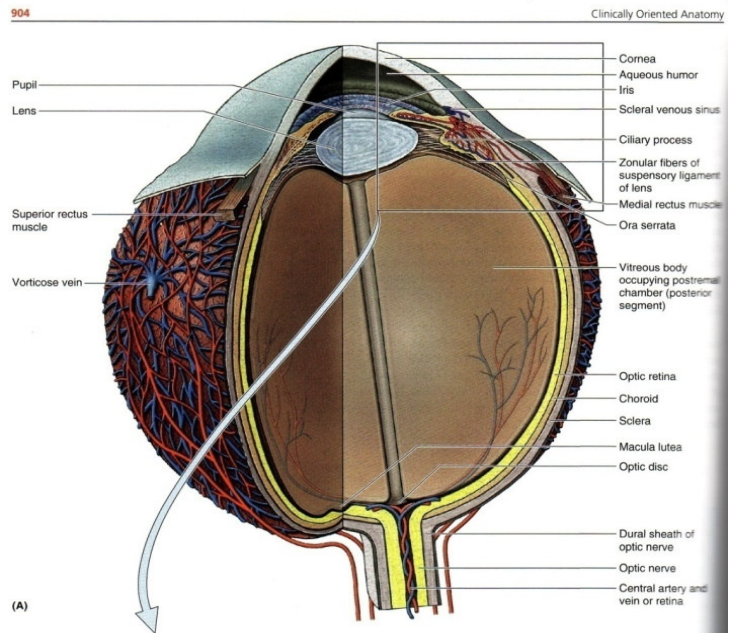
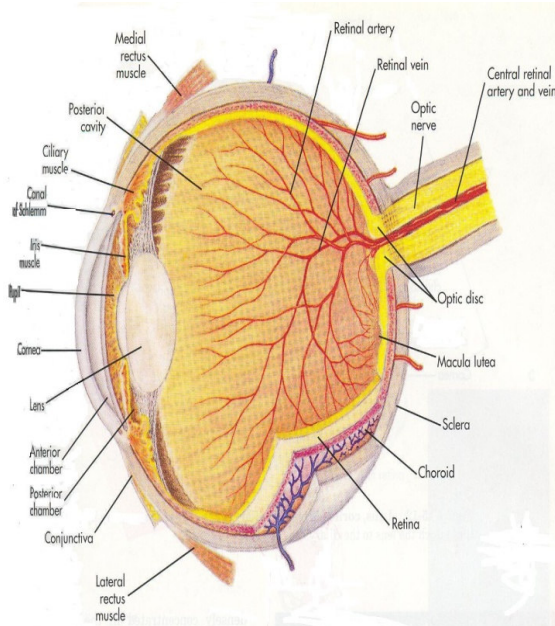
Olfactory Nerve :

- **Type : Special sensory.**
- **Function : Smell.**
- **Lesion :** results in loss of sense of smell, called **anosmia**.



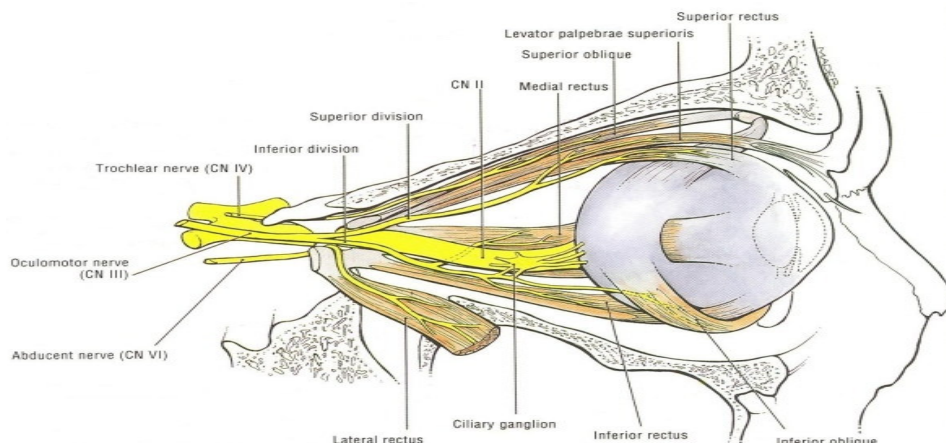
Optic Nerve :

- **Type : Special sensory.**
- **Function : Vision.**
- **Lesion :** results in visual field defects and loss of visual acuity.
 - A defect of vision is called **anopsia**.



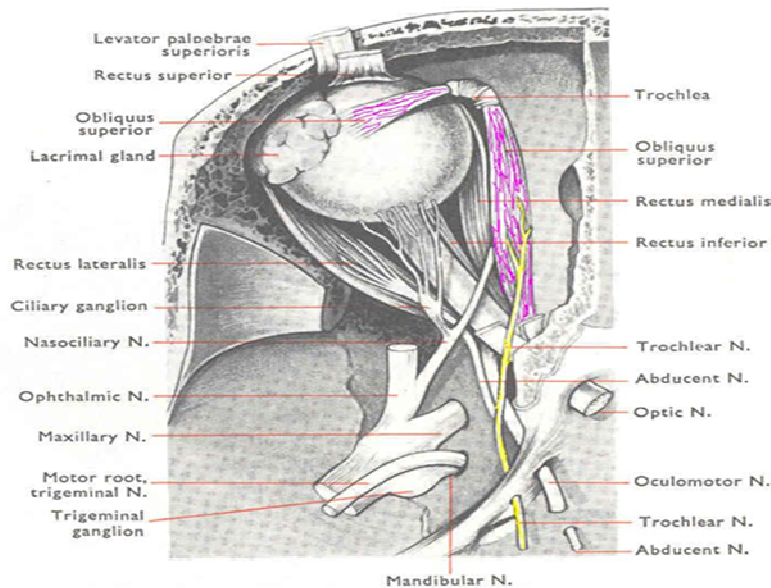
Oculomotor Nerve :

- **Type : Motor & Parasympathetic.**
- Supplies all the extraocular muscles except **SO4 & LR6**.
 - Also it supplies **LPS** muscle.
- **Function :** Elevation of the upper eyelid, movements of eyeball, constriction of pupil and **accommodation** of the lens for near vision.
- **Lesion :** Squint, **Ptosis**, diplopia, pupillary dilatation, **loss of accommodation**, and downward & outward movement of the eye ball on the side of the lesion.



Trochlear Nerve :

- **Type : Motor.**
- **Supplies : Superior oblique muscle.**
- **Function :** Rotates the eye ball downwards and outwards.
- **Lesion :** diplopia, and **difficulty in walking downstairs.**



Trigeminal Nerve :

- **Type : Mixed.**
- **Three divisions :**
 - Ophthalmic (sensory).
 - Maxillary (sensory).
 - Mandibular (**mixed**).
- **Function :**
 - **Sensory :** Conveys general sensations (pain, touch, temperature, pressure, vibration) from the face and anterior scalp, orbit, nasal and oral cavity, and anterior 2/3 of tongue.
 - **Motor :** supplies 4 muscles of **mastication** & other 4 muscles.
- **Lesion :** loss of general sensations in the area of distribution, paralysis of the muscles of **mastication**.

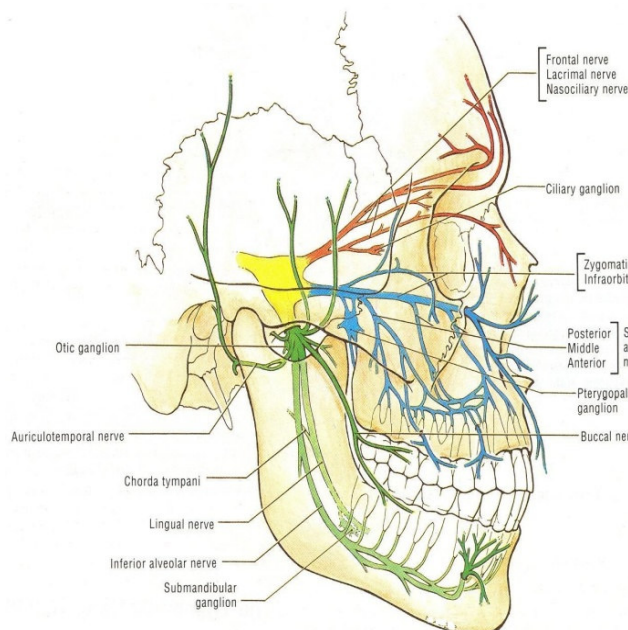
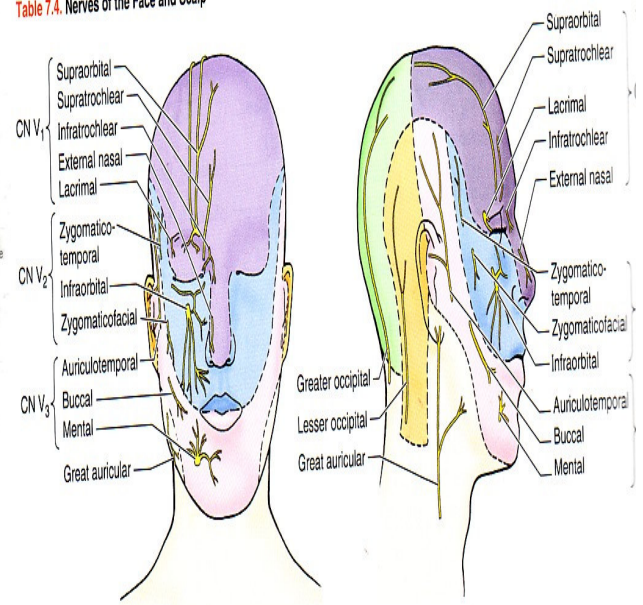


Table 7.4. Nerves of the Face and Scalp

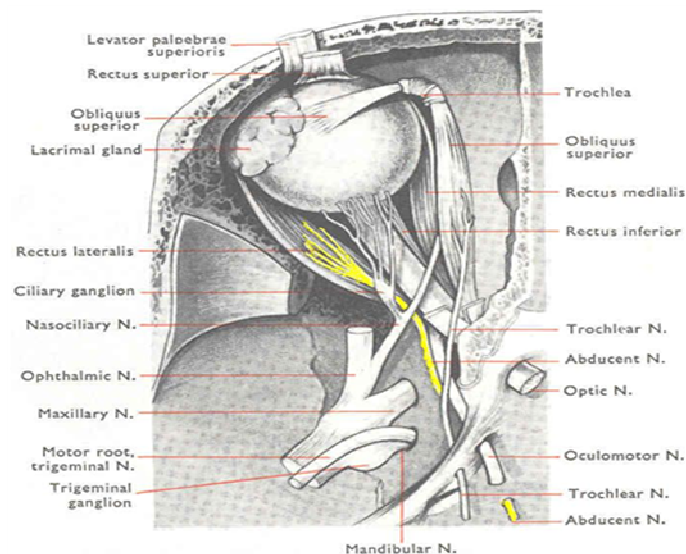


- **Trigeminal Neuralgia :**

- Compression, inflammation or degeneration of the 5th cranial nerve may result in a condition called trigeminal neuralgia or **tic douloureux**.
- This condition is characterized by recurring episodes of **intense stabbing pain**, radiating from the angle of the jaw along a branch of trigeminal nerve.
- Usually involves the **maxillary & mandibular** nerves, sparing the ophthalmic division.

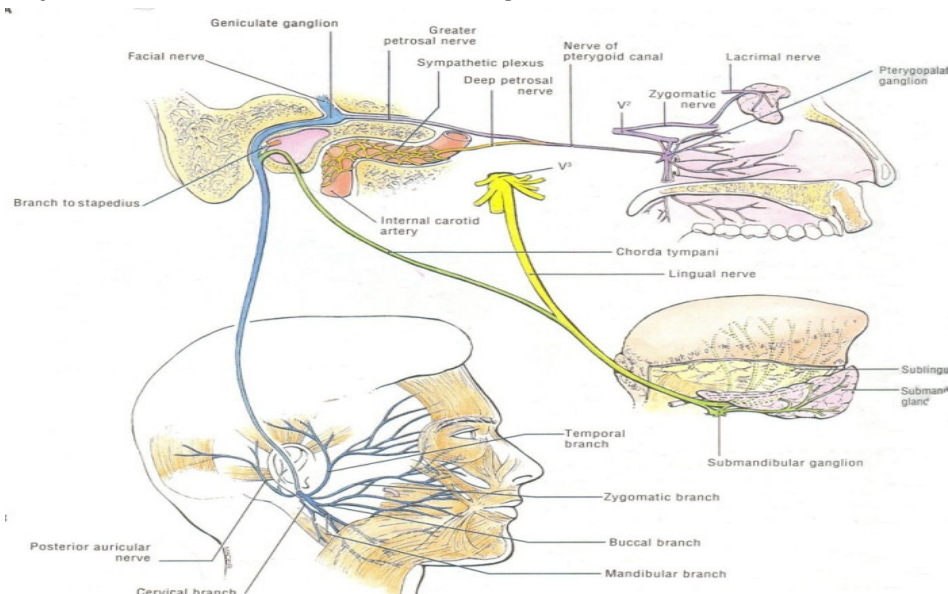
Abducent Nerve :

- **Type : Motor.**
- **Supplies : Lateral rectus.**
- **Function :** moves the eyeball laterally.
- **Lesion : Medial squint, diplopia, loss of movement of the eyeball laterally beyond the midpoint.**



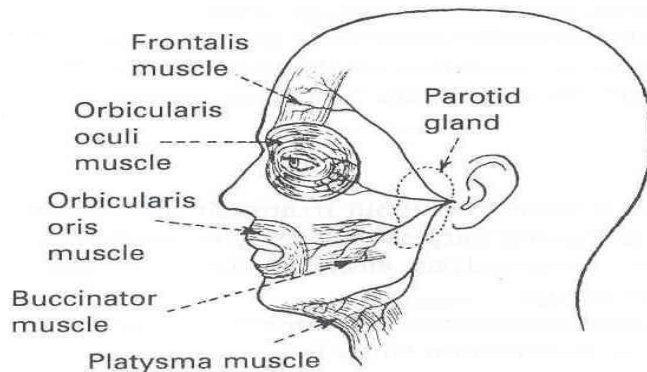
Facial Nerve :

- **Type : Motor, special sensory, parasympathetic.**
- **Function :** Motor to muscles of facial **expression** (2nd pharyngeal arch, **lacrimal gland**, nasal and oral mucous membrane submandibular and sublingual **salivary glands**, taste fibers to **anterior 2/3** of tongue).
- **Lesion : Bell's palsy**, loss of taste from **anterior 2/3** of tongue, **loss of Lacrimation and salivation.**



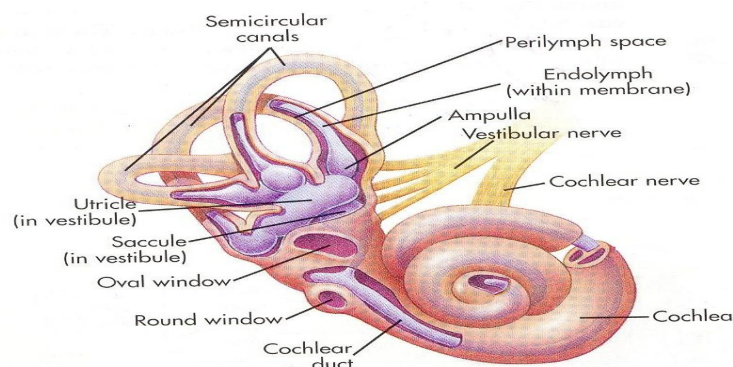
- **Bell's palsy :**

- Damage to facial nerve results in paralysis of facial muscles : Facial palsy (Bell's palsy); **lower motor neuron lesion** (whole face affected).
 - **N.B. : In upper motor neuron lesion (upper face is intact).**
- Face is distorted : drooping of lower eyelid, sagging of the angle of the mouth, dribbling of saliva, loss of facial expressions, loss of chewing, blowing, sucking, unable to show teeth or close the eye on affected side.



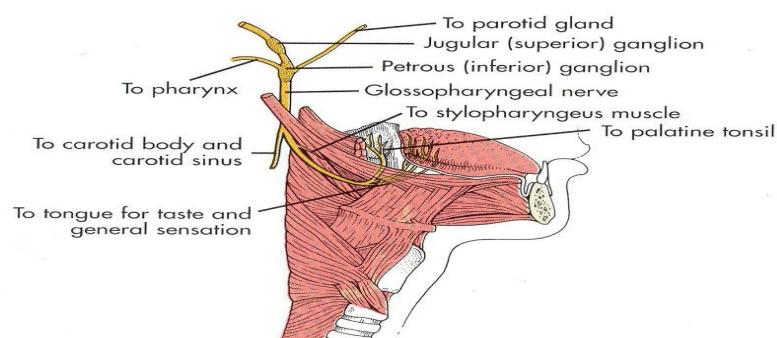
Vestibulo-cochlear Nerve :

- **Type : Special sensory.**
- **Function :**
 - **Vestibular part** : conveys impulses associated with **balance of body.**
 - **Cochlear part** : conveys impulses associated with **hearing.**
- **Lesion : loss of hearing, tinnitus, vertigo, dizziness, ataxia.**



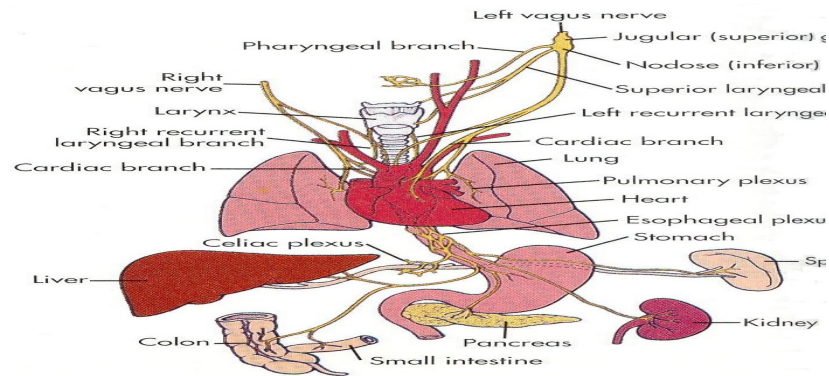
Glossopharyngeal Nerve :

- **Type : Motor, Sensory (general & special)parasympathetic.**
- **Function :** supplies one muscle of pharynx (Stylopharyngeus), & parotid gland, carries taste fibers from **posterior 1/3** of tongue, general sensations from pharynx & palate.
- **Lesion : Dysphagia** (difficult swallowing), loss of sensation from throat, loss of parotid secretion and loss of taste from **posterior 1/3** of the tongue.



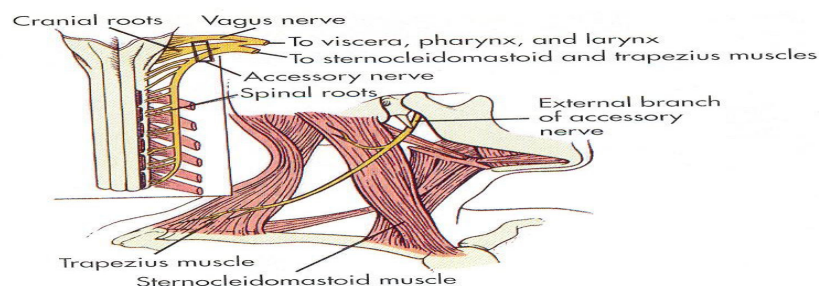
Vagus Nerve :

- **Type :** Motor (+cranial part of accessory nerve), Sensory (general & special), Parasympathetic.
- **Function :** supplies visceral muscles, glands of GIT, muscles of the larynx and pharynx, **taste buds** on the base of tongue, sensations from the viscera.
- **Lesion :** **difficulty in swallowing & speech**, loss of sensations from the organs, and taste from the base of the tongue.



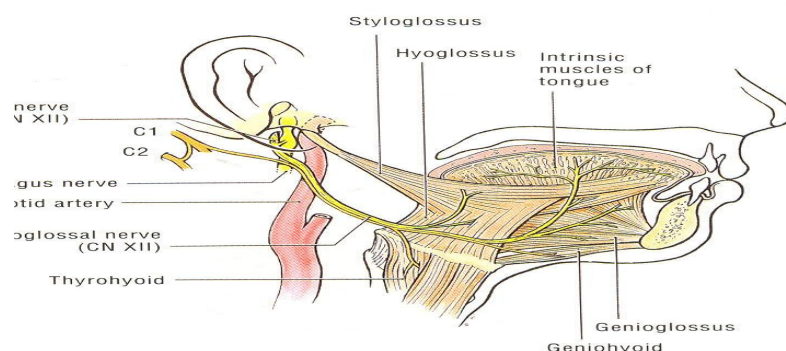
Accessory Nerve :

- **Type :** Motor.
- It has two parts : cranial & spinal.
- **Function :**
 - **Cranial part :** unites with the vagus and supplies voluntary muscles of larynx, pharynx and esophagus.
 - **Spinal part :** supplies **Sternomastoid & Trapezius**.
- **Lesion :** **Difficulty in swallowing & speech. Inability to turn the head and raise the shoulder.**



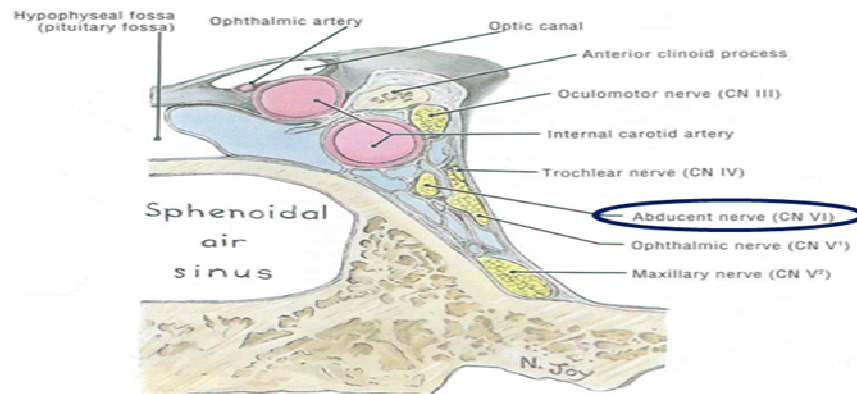
Hypoglossal Nerve :

- **Type :** Motor.
- **Function :** Motor to all muscles of the tongue *except palatoglossus*.
 - Allows movements of tongue during speech and swallowing.
- **Lesion :** **Difficulty in chewing & speech.**
 - The tongue paralyses, atrophies, becomes shrunken and furrowed on the affected side, and on protrusion deviates to the affected side.



Lesion of Cranial Nerves :

- **Causes :**
 - Severe head injuries, skull bone fractures or penetrating wounds.
 - Brain lesions.
 - Compression due to raised intracranial pressure (due to any space occupying lesion, e.g. tumor, hematoma, or CSF obstruction).
 - Cavernous sinus thrombosis.
- **Cavernous Sinus Thrombosis :** Compression of abducent nerve and internal carotid artery.



Reflexes Related to Cranial Nerves :

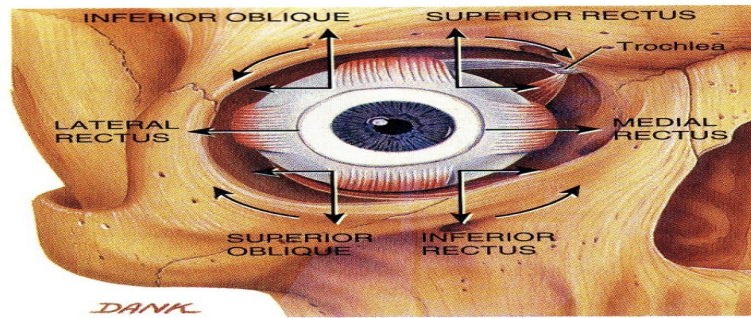
- Pupillary (light) CN 2,3.
- Accommodation CN 2,3.
- Corneal (Blinking) CN 5,7.
- Lacrimation CN 5,7 (stimulus may be visual or even thought or emotions).
- Salivation CN 5,7,9 (stimulus may be olfactory, visual, taste, or even thought of food).
- Sneezing CN 5,9,10,11, phrenic, intercostals.
- Vomiting CN 5,7,9 (stimulus may be olfactory, visual, taste, or even thought).
- Yawning CN 5,7, phrenic, intercostal.
- Swallowing CN 5,7,9,10,11,12.
- Jaw jerk CN 5.
- Stapedial CN 8,7.
- Cough CN 9,10,11, phrenic, intercostals.
- Gag CN 9,10.
- Carotid sinus reflex CN 9,10.

Clinical tests for Cranial Nerves :

- The integrity of nerves is assessed by examining the :
 - **Sensations** in the area of distribution.
 - **Action** of muscles.
 - **Integrity** of reflexes.
 - **Secretory** activity of glands.
- ❖ **Olfactory nerve** : Ask the patient to identify items with very specific odors (e.g. coffee, alcohol), placed under the nose. *Each nostril is tested separately.*
- ❖ **Optic nerve** :
 - Ask the patient to read an eye chart.
 - Peripheral vision is tested *by detecting object or movement from corners of the eyes.*

❖ **Oculomotor nerve :**

- Note the ability to move each eye upward, downward and inward by asking the person to follow a target moved by the examiner.
- Also examine the constriction of pupil & accommodation.



(b) Movements of right eyeball in response to contraction of extrinsic muscles

❖ **Trochlear :** Note the ability to move each eye downward and inward.

❖ **Trigeminal nerve :**

- General sensations on face are tested by using a pin and a wisp of cotton.
- Blink reflex is tested by touching the cornea of the eye with a cotton wisp.
- Strength and action of muscles of mastication are tested by asking the person to clench the teeth and open the jaw against resistance.

❖ **Abducent nerve :** Note the ability to move each eye outward beyond the midline.

❖ **Facial nerve :**

- The action of muscles of face is tested by asking the person to SMILE, to open the mouth, to show the teeth, and to close the eyes tightly.
- Taste sensations from anterior 2/3 tongue is tested using substances that are sweet, sour, salty & bitter.

❖ **Vestibulocochlear nerve :**

- Hearing is tested with a tuning fork.
- Balance is tested by asking the person to walk on a straight line.

❖ **Glossopharyngeal & Vagus nerves :** (cranial part of Accessory nerve) :

- The person is asked to swallow.
- The person is asked to say 'ah-h-h' to check the movements of palate and uvula.
- The 'gag reflex' is tested by touching the back of the throat by the tongue blade.
- The person is asked to speak to check the voice for hoarseness.

❖ **Spinal part of Accessory nerve :** The person is asked to turn the head and to shrug the shoulders against resistance provided by the examiner.

❖ **Hypoglossal nerve :** The person is asked to stick out the tongue, to observe the deviation to one side or the other.



THE END

LoveTomy Team 426

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SELF QUIZ

1- All of the following nerves have parasympathetic activity EXCEPT :

- a. III.
- b. VII.
- c. IX.
- d. X.
- e. II.

2- All of the following have motor activity EXCEPT :

- a. III.
- b. IV.
- c. VI.
- d. VII.
- e. I.

3- All of the following statements regarding sensory and motor pathway are true EXCEPT :

- a. First order neuron is from receptors to sensory nucleus.
- b. In first order neuron the cell bodies lie in the sensory ganglia.
- c. Third order neurons is from thalamus to cerebral cortex.
- d. Lower motor neurons is from the motor nucleus to the cerebral cortex.
- e. In Upper motor neuron there is usually bilateral projection except part of 7th and 12th nerves.

4- Regarding the cranial nerves , all of the following statements are true EXCEPT :

- a. A lesion in the Olfactory nerve results in loss of sense of smell, called anosmia.
- b. The function of the oculomotor nerve is elevation of the upper eyelid.
- c. Abducent nerve is a motor nerve.
- d. Lesion of the trigeminal nerve will cause Bell's palsy.
- e. Trigeminal neuralgia usually involves the maxillary & mandibular nerves, sparing the ophthalmic division.

5- Which of these cranial nerves are related to the Gag reflex :

- a. CN 8,7.
- b. CN 9,10.
- c. CN 3.
- d. CN 7.
- e. CN 2,5,8.

6- Choose the CORRECT Statement :

- a. While testing the facial nerve, the action of muscles of face is tested by asking the person to smile.
- b. While testing the vestibulocochlear nerve, the balance is tested by a tuning fork.
- c. In cavernous sinus thrombosis there might be a compression for the oculomotor nerve.
- d. The glossopharyngeal nerve supply the styloglossus muscle.
- e. In upper motor neuron lesion, upper face is effected.

1. e	2. e	3. d	4. d	5. b	6. a
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