

THE CRANIAL NERVES

5- Trigeminal n. V:

The largest cranial nerve, consists of three divisions designated as V_1 , V_2 , V_3 (or V_a , V_b , V_c).

V_a : the ophthalmic division.

V_b : the maxillary division.

V_c : the mandibular division.

The ophthalmic division V_a :

- Sensory function : conducts sensory impulses from the cornea, nose, forehead, and anterior scalp.

- Destiny : in the pons, through the sensory nucleus which extends through the whole length of the brainstem, and descends into 2-3 segments of the spinal cord.

- Pathway : the sensory fibres enter via the superior orbital fissure, and travel to the trigeminal ganglion, before entering the pons.

- Branches:

1- Lacrimal branch : sensory to the lateral part of the upper part of the eyelid, sensory to the palpebral and ocular surface of the eyelid (same area). It gives lacrimal gland secreto-motor branch (pick up this fiber from zygomatic branch of mandibular division)

2- Frontal branch : a large nerve, leaves the ophthalmic division at the lateral wall of the cavernous sinus. It enters the orbit through the superior orbital fissure, and divides into :

- **Supra-trochlear** : supplies the eyelid and conjunctiva (medial side of it), and the midline strip of the forehead skin till the hairline.

- **Supra-orbital** : sensory to the whole upper eyelid (all conjunctiva), frontal sinus, and supplies all forehead except the central strip, also supplies the frontal scalp till the vertex.

3- Naso-ciliary branch :- it is sensory to the whole eyeball, to the

paranasal sinuses along the medial wall of the orbit, some mucous membrane of the nasal cavity, and skin of the external nose. Its branches are :

- **The sensory root of the ciliary ganglion** : it enters the ganglion, then through it (the ganglion) the short ciliary nerves supply the whole eyeball (excluding the conjunctiva).
- **The long ciliary nerves** : 2¹-3 in number that enter the sclera, carrying sympathetic fibres from the cavernous plexus. Supplying the dilator papillae muscle.

The posterior ethmoidal nerve : it enters the posterior ethmoidal foramen supplying the posterior ethmoidal air sinus and the sphenoid sinus.

- The infra-trochlear nerve : supplies the medial skin and conjunctiva at the medial end of the upper eyelid, and ends on the skin over the nasal bridge.

- The **anterior ethmoidal nerve** : passes through the anterior ethmoidal foramen, then it supplies the middle and anterior ethmoidal air sinuses. It passes through the nasal slit along the crista galli, and enters the root of the nose. It straddles the nose, and supplies the antero-superior quadrant of the lateral wall of the nose, and the antero-superior half of the nasal septum, then it leaves the skin as **the external nasal nerve** supplying the skin over the nasal cartilage.

The maxillary division Vb: It is the 2nd branch of the trigeminal nerve. It leaves the middle part of the trigeminal ganglion. It passes through foramen rotundum to the upper part of the pterygo-palatine fossa, then short distance in the inferior orbital fissure. Here, it divides into 2 terminal branches. The branches of the maxillary nerve are : **1**- meningeal branch : supplies the dura mater of the anterior half of the middle cranial fossa and its called its called the middle meningeal nerve.

2- Ganglionic branches : are 2 in number that suspend the sphenopalatine ganglion, representing the sensory root of the ganglion. They mingle with the post-ganglionic fibres of the greater petrosal nerve, and the sympathetic fibres of the deep petrosal nerve.

By the way of the ganglion, 5 branches arise, carrying sensory, sympathetic, and secreto-motor (parasympathetic) fibres :

- Naso-palatine branch (long sphenopalatine n.). - Posterior superior lateral nasal branch.

- Anterior palatine branch (greater palatine n.).

- Middle and posterior palatine branches (lesser palatine nn.). - Pharyngeal branch.

3- Posterior superior alveolar branches : are 3 in number emerging through pterygo-maxillary fissure.

4- Zygomatic branch : which is the terminal branch of the maxillary division. It enters through the inferior orbital fissure to the orbit, and runs along the lower part of the lateral wall of the orbit. It carries secreto-motor fibres for the lacrimal gland. These secreto-motor fibres join the lacrimal nerve, then the zygomatic nerve divides into :

- Zygomatico-facial branch.

- Zygomatico-temporal branch.

5- infra-orbital n. : is the continuation of the maxillary n. after giving off the zygomatic branch. It passes in the infra-orbital groove (canal). During its passage in the groove, it gives the anterior and middle superior alveolar branches, then it emerges from the infra-orbital foramen.

The mandibular division V_c

It is a mixed nerve, mainly sensory, but also has a motor function. The mandibular nerve passes through foramen ovale (after emerging from the middle cranial fossa) with the small motor root.

Below foramen ovale they join together in the infra-temporal fossa, between the upper head of the lateral pterygoid muscle and tensor palati muscle, where the otic ganglion lies on the medial aspect of the nerve. Then the nerve divides into a small anterior branch, and a large posterior branch.

Clinical notes:

Trigeminal n, damage leads to:

V Trigeminal neuralgia due to inflammation of the sensory component of the nerve, resulting in intense, pulsating pain lasting for few minutes to several hours. 2- Loss of sensation of the skin of the face (according to the affected branches of the trigeminal nerve), beside loss of all sensations transmitted by the 3 branches of the nerve.

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6- Abducent n. VI:

Its nucleus is located in the lower part of the pons. It emerges between the pons and medulla oblongata (pyramid). It passes forward between the anterior inferior cerebellar artery and the pons, then it pierces the arachnoid and dura mater, passing upward over the apex of the petrous bone under the petrosphenoidal [lig. to](#) enter **the cavernous sinus**. Then it enters through the medial end of the superior orbital fissure. It enters through the tendinous ring to supply the lateral rectus muscle.

Clinical note : damage of the nerve disables the eye from rotating laterally, and in the rest, the eyeball is rotated medially.

7- Facial n. VII:

The main facial nerve emerges from the lower border of the pons, above the olive. The nervous intermedius emerges between the pons and the inferior cerebellar peduncle, near the Vestibulo-cochlear nerve.

The facial nerve, nervous intermedius, and vestibulo-cochlear nerve pass together laterally in the cerebello-pontine angle entering through the internal acoustic meatus. Above the vestibule of the inner ear, the two parts of the nerve share a common tube of arachnoid and dura mater. Near the middle ear, the nerve makes a sharp bend posteriorly, the geniculum, which is enlarged by the cell bodies of the afferent (taste) fibres to form the geniculate ganglion.

Just below the bulge of the lateral semi-circular canal, the nerve curves downwards behind the middle ear, then passes vertically down the facial canal.

After shedding the whole nervous intermedius fibres, the nerve

emerges from the stylo-mastoid foramen as a pure motor, and passes through the parotid gland.

- The intra-cranial branches of the facial nerve that arise within the petrous bone include the greater petrosal nerve, the nerve to stapedius muscle, and chorda tympani.

- The greater petrosal nerve consists of the nervous intermedius leaving the ganglion, and travels forward and medially through the petrous bone. Then the nerve passes beneath the trigeminal ganglion, and reaches foramen lacerum where it is joined by the deep petrosal nerve from the sympathetic plexus of the internal carotid artery. Together, they form the nerve of pterygoid canal (Vidian nerve), which passes through the canal to the pterygo-palatine fossa where it enters the pterygo-palatine foramen.

The post-ganglionic secreto-motor fibres are distributed with the branches of the ganglion to the nose, para-nasal sinuses, hard and soft palates, and nasopharynx.

The lacrimal post-ganglionic fibres join the maxillary nerve, and enter the orbit via its zygomatic branch.

- The nerve to stapedius muscle is given off in the facial canal.

- Chorda tympani consist of nervous intermedius fibres, and eaves the facial nerve in the facial canal 6 mm above the stylo-mastoid foramen, and passes through the posterior wall of the middle ear. Then it leaves through the anterior wall of the middle ear, grooving the spine of sphenoid, sloping downward to join the lingual nerve in the infra-temporal fossa. By the lingual nerve, its taste fibres are taken to the anterior 2/3 of the tongue. Its secreto-motor fibres relay in the submandibular ganglion for the submandibular gland; and the glands located in the floor of the mouth's cavity.

Clinical notes :

- 1- A lesion of the facial nerve intra-cranially will cause upper motor

neuron lesion, leading to the paralysis of the muscles of facial expression.

2- A lesion of the facial nerve in the facial canal causes lower motor neuron lesion, and is called Bell's palsy.

8- Vestibulo-cochlear n. VII :

- The cochlear n. :

The receptors for hearing are the hair cells of the spiral organ in the inner ear. The cell bodies of the 1st order neurons are located in the spiral ganglion.

Their central processes run along the cochlea, join together forming small nerves which pass in the internal acoustic meatus. In the pontine cistern, it combines the vestibular part (forming the vestibulo-cochlear nerve). Together with the trochlear nerve and the facial nerve, they pass through the cerebello-pontine angle, in front of the flocculus of the cerebellum. Then it enters (the VIII n.) the inferior peduncle at the lower border of the pons.

- **The vestibular n.:**

The receptors consist of hair cells in the maculae of the utricle, saccule and the ampulla of the semi-circular duct. Through the internal acoustic meatus, this nerve extends to form the vestibular ganglion, which represents the 1st order neuron. From the ganglion, the vestibular nerve joins the cochlear nerve forming the vestibulo-cochlear nerve, and completes its course as mentioned above.

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9- Glossopharyngeal n. IX:

This nerve emerges from the surface of medulla oblongata between the olive and the inferior cerebellar peduncle in a series of rootlets which join together forming a single nerve which runs laterally, and enters the anterior compartment of the jugular foramen. In the foramen, it is separated from the vagus and accessory nerves by a septum of dura mater.

The glossopharyngeal nerve has a small superior ganglion, and a large inferior ganglion. The cell bodies of the nerve's afferent fibres are in the ganglion.

Its tympanic branch passes into the middle ear through the tympanic canaliculus, which is present between the jugular fossa and the carotid canal, to form the tympanic plexus, from which, the lesser petrosal nerve emerges, which passes through foramen ovate to join the otic ganglion for the supplement of the parotid gland.

Outside the base of the skull, the glossopharyngeal nerve passes between the internal jugular vein and the internal carotid artery, then between the internal jugular vein and the external carotid artery.

The nerve to stylopharyngeus muscle is the only muscular branch

arising from the glossopharyngeal nerve.

The carotid branch runs to innervate the carotid sinus and carotid body.

Pharyngeal branches share the vagal pharyngeal branches to form the pharyngeal plexus; the fibres of these branches are afferent (sensory).

The glossopharyngeal nerve enters the pharynx between the superior and middle constrictor muscles.

The tonsillar branch provides afferent fibres for the tonsillar mucosa.

The lingual branch conveys common sensation and taste (special sensation) from the posterior 1/3 of the tongue; besides it's secreto-motor to the lingual glands.

10- Vagus n. X:

This nerve leaves the surface of medulla oblongata in a series of rootlets below the IX nerve, in a sulcus between the olive and the inferior cerebellar peduncle. These rootlets unite together forming a single nerve (vagus nerve) that enters the jugular foramen.

The vagus has a small superior ganglion just above, large inferior ganglion which lies in the jugular fossa below the base of the skull.

The superior ganglion has the cell bodies for the meningeal and auricular branches.

The inferior ganglion has the cell bodies of the all other sensory (and the post-ganglionic motor neurons) fibres in the vagus nerve.

The cranial root of the accessory nerve is attached to the inferior ganglion, and the accessory nerve gives its nucleus ambiguus fibres to the vagus below the ganglion.

In the neck, the vagus nerve lies vertical between the internal carotid artery/common carotid a. and the internal jugular vein within the carotid sheath. The small meningeal, auricular, and carotid body branches are all afferent.

The pharyngeal branch passes between the internal and external carotid arteries, and provides motor and sensory fibers for the pharyngeal plexus. The superior laryngeal nerve passes deep to the carotid arteries and divides into external and internal laryngeal nerves to supply the mucosa of the pharynx and larynx, and supply the cricothyroid muscle, respectively.

The cervical cardiac branches consist of the upper and lower branches of the right vagus nerve, and the upper branch of the left vagus nerve. These cervical cardiac branches join the deep part of the cardiac plexus, while the lower branch of the left vagus n. joins the superficial part of the cardiac plexus.

The vagus nerve has a recurrent laryngeal nerve which leaves the main trunk in different position for the right and left one. Also the 2 vagi nerves give branches to the anterior and posterior pulmonary plexuses (in the thorax).

Both vagi then break up forming the oesophageal plexus which forms the anterior and posterior vagal trunks, anterior and posterior to the oesophagus respectively. Then they enter the abdomen through the oesophageal opening of the diaphragm.

In the abdomen, the anterior vagal trunk gives a hepatic branch, and the posterior vagal trunk gives branches to coeliac ganglion through which the foregut, mid-gut, and their derivatives will be supplied.

11- Accessory n. XI :

The spinal root of the accessory nerve is formed by fibres from cell bodies (the spinal accessory nucleus) in the anterior horn of the upper five or six cervical segments (mainly 2, 3, and 4). These spinal roots ascend together as a single nerve, behind the denticulate ligament to join the cranial part.

The cranial part of accessory nerve arises as rootlets from medulla

oblongata, between the olive and the inferior cerebellar peduncle, just below to these of the vagus nerve.

It leaves the skull through the jugular foramen. Outside the skull, the accessory nerve gives its cranial root to the vagus nerve, when it will be distributed within the vagal branches to the striated muscles of the soft palate, pharynx, larynx, and oesophagus.

Then the accessory nerve (spinal component) will pass backward to supply sternocleidomastoid muscle, then crosses the posterior triangle of the neck to supply trapezius muscle.

12- Hypoglossal n. XII :

This nerve's fibres emerge the surface of the medulla oblongata between the olive and the pyramid. These fibres join together, and enter the hypoglossal canal. After emerging from the base of the skull, it descends downward between the internal jugular vein and internal carotid artery, then it crosses the occipital artery and its branch to sternocleidomastoid muscle, then the nerve crosses forward forming a loop around the carotid artery and lingual nerve, and passes deep to the hypoglossus muscle, and enters the tongue supplying all the muscles of the tongue except palatoglossus muscle.

The branches of hypoglossal nerve before it reaches the tongue, are all derived from C₁ nerve fibres which join the hypoglossal nerve at its exit from the skull.

The superior root of ansa cervicalis is given off from the hypoglossal nerve as it passes between the internal carotid artery and the internal jugular vein. Then it joins the C₂ and C₃ fibres (the inferior rami of ansa cervicalis) forming the ansa cervicalis which lies on the internal jugular vein.

