Cranial Nerves

(1,5,7,8,9,10,11 and 12)

Slides not included				
9th and 10th Cranial Nerves	11th and 12th Cranial Nerves	8th Cranial Nerve	5th and 7th Cranial Nerves	1st Cranial Nerve
(3,7,11,12,13,21,23,24)	-	(10,16)	(12,23)	Slides included: (14 to 17)

*Slides that are not included **mostly** are slides of summaries or pictures.

Nouf Alabdulkarim.
Med 435

Olfactory Nerve [The 1st Cranial Nerve] Special Sensory

Olfactory pathway

1st order neuron

Receptors	Axons of 1st order Neurons
Olfactory receptors are specialized, ciliated nerve cells that lie in the olfactory epithelium.	The axons of these bipolar cells 12 -20 fibers form the true olfactory nerve fibers. Which passes through the cribriform plate of ethmoid → They join the olfactory bulb

Preliminary processing of olfactory information

It is within the olfactory bulb, which contains interneurones and large Mitral cells; axons from the latter leave the bulb to form the olfactory tract.

2nd order neuron

- It is formed by the Mitral cells of olfactory bulb.
- The axons of these cells form the olfactory tract.
- Each tract divides into 2 roots at the anterior perforated substance:

Lateral root	Medial root
Carries olfactory fibers to end in cortex of the Uncus & adjacent part of Hippocampal gyrus (center of smell).	• crosses midline through anterior commissure and joins the uncrossed lateral root of opposite side. • It connects olfactory centers of 2 cerebral hemispheres. • So each olfactory center receives smell sensation from both halves of nasal cavity.

NB. Olfactory pathway is the only sensory pathway which reaches the cerebral cortex without passing through the Thalamus .

Trigeminal Nerve [The 5th Cranial Nerve] Mixed

<table>
<tr><th colspan="4">Nuclei</th><th>Trigeminal Ganglion</th><th colspan="6">Branches</th></tr>
<tr><td rowspan="2">Mesencephalic nucleus</td><td rowspan="2">Principal (main) sensory nucleus</td><td rowspan="2">Spinal nucleus</td><td rowspan="2">Motor nucleus</td><td rowspan="2">Site:
-Occupies a depression in the middle cranial fossa.
-Importance:
Contains cell bodies: 1. Whose dendrites carry sensations from the face.
2. Whose axons form the sensory root of trigeminal nerve.</td><td colspan="6">The 5th nerve emerges from <u>the middle of the ventral surface of the pons</u> by 2 roots
(Large Lateral sensory root & small medial motor root).
Divides into 3 divisions (dendrites of trigeminal ganglion):</td></tr>
<tr><td colspan="3">1. Ophthalmic
<u>(Pure Sensory)</u>
Axons of cells of motor nucleus join only the mandibular division.</td><td colspan="2">2. Maxillary
<u>(Pure Sensory)</u>
Supplies:</td><td colspan="2">3. Mandibular
<u>(Mixed)</u></td></tr>
<tr><td rowspan="2">(midbrain &pons): receives propriocepti ve fibers from muscles of mastication.</td><td rowspan="2">(pons): receives touch fibers from face & scalp</td><td rowspan="2">(pons, medulla & upper 2-3 cervical segments of spinal cord): receives pain & temperatur e sensations from face & scalp.</td><td rowspan="2">(pons): supplies:
-Four Muscles of mastication (temporalis, masseter, medial & lateral pterygoid).
-Other four muscles (Anterior belly of digastric, mylohyoid, tensor palati &</td><td>1. Frontal: supplies skin of face & scalp.</td><td>2. Lacrimal: supplies skin of face & lacrimal gland.</td><td>3. Nasociliary: supplies skin of face, nasal cavity & eyeball.</td><td rowspan="2">1. Upper teeth, gums & maxillary air sinus: (posterior, middle & anterior superior alveolar nerves).</td><td rowspan="2">2. Face: (zygomaticofacial & infraorbital nerves).</td><td>Sensory Branches:</td><td>Motor Branches:</td></tr>
<tr><td colspan="3">They pass through superior orbital fissure to the orbit</td><td>1. Lingual: receives General sensations from anterior 2/3 the of tongue.
2. Inferior alveolar: supplies Lower teeth, gums & face.
3. Buccal: supplies Face (cheek on upper jaw)
4. Auriculotemporal: supplies auricle, temple, parotid gland & TMJ.</td><td>to 8 muscles (4 muscles of mastication & other 4 muscles).</td></tr>
</table>

Facial Nerve [The 7th Cranial Nerve] Mixed

Nuclei

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

Fibers

Special visceral afferent	Special visceral efferent	General visceral efferent
carrying taste sensation from anterior 2/3 of the tongue.	supplying muscles developed from the 2nd pharyngeal arch.	supplying parasympathetic secretory fibers to submandibular, sublingual, lacrimal, nasal & palatine glands

Course

-Emerges from the cerebellopontine angle by 2 roots:
1. Medial motor root: contains motor fibers.
2. Lateral root (nervous intermedius): contains parasympathetic & taste fibers.
-Passes through internal auditory meatus to inner ear where it runs in facial canal.
Then emerges from the stylomastoid foramen & enters the parotid gland where it ends.

Branches

In facial canal:

1.Greater petrosal nerve	2.Chorda tympani	3.Nerve to stapedius
carries preganglionic parasympathetic fibers to lacrimal, nasal & palatine glands.	carries: a) preganglionic parasympathetic fibers to submandibular & sublingual glands. b) taste fibers from anterior 2/3 of tongue.	control the amplitude of sound waves from the external environment to the inner ear.

Geniculate ganglion: contains cell bodies of neurones; its fibres carrying taste sensations from anterior 2/3 of tongue; ending in solitary nucleus in M.O.
Lies in internal acoustic meatus.

Just as it emerges from the stylomastoid foramen it gives:

1.Posterior auricular	2.Muscular branches
to occipitofrontalis muscle.	to posterior belly of digastric & stylohyoid.

Inside parotid gland:
gives 5 terminal motor branches: Temporal, Zygomatic, Buccal, Mandibular & Cervical
To the muscles of the face.

Nerve Lesions

Damage of the facial nerve results in paralysis of muscles of facial expressions:
Facial (Bell's) palsy; lower motor neuron lesion (whole face affected)

• NB. In upper motor neuron lesion (upper face is intact).

-Face is distorted:
- Drooping of lower eyelid,
- Sagging of mouth angle,
- Dribbling of saliva,
- Loss of facial expressions,
- Loss of chewing,
- Loss of blowing,
- Loss of sucking,
- Unable to show teeth or close the eye on that side.

Vestibulo-Cochlear [The 8th Cranial Nerve] Special sensory

Vestibular Nerve

Cochlear Nerve

Vestibular & cochlear parts leave the ventral surface of brain stem through the ponto-medullary sulcus 'at crebello-pontine angle' (lateral to facial nerve), run laterally in posterior cranial fossa and enter the internal acoustic meatus along with 7th nerve.

Vestibular nuclei belong to special somatic afferent column in brain stem.

Cochlear nuclei belong to special somatic afferent column in brain stem.

Afferent

The cell bodies (1st order neurons) are located in the vestibular ganglion within the internal auditory meatus.

1-**The Peripheral processes**: (vestibular nerve fibers) make dendritic contact with hair cells of the membranous labyrinth (inner ear).

2- **The central processes:** (form the vestibular nerve): A. Mostly end up in the lateral, medial, inferior and superior vestibular nuclei (2nd order

Efferent

Function:

1. control of posture
2. maintenance of equilibrium
3. co-ordination of head
4. eye movements
5. the conscious awareness of vestibular stimulation.

They Are:

1. To ipsilateral flocculonodular lobe of cerebellum (vestibulocerebellar tract) through inferior cerebellar peduncle
2. Bilaterally to ventral posterior nucleus of thalamus, which in turn project to

Medial Longitudinal Fasciculus

Extends through out the brain stem and formed of both descending & ascending fibers • Projects bilaterally

• **Has two components:**

1-The ascending component (vestibulo-ocular): establishes connections with the nuclei of the Occulomotor, Trochlear & Abducent nerves (motor nuclei for extraoccular muscles) for coordination of head & eye movements.

2-The descending component:

Vestibulospinal Tracts

•Vestibulospinal fibers influence the activity of spinal motor neurons concerned with the control of body posture and balance

• **Two tracts:**

-**Lateral** arises from lateral vestibular (Deiter's) nucleus, descends ipsilaterally

-**Medial** is the descending part of the medial longitudinal fasciculus, projects bilaterally.

Vestibular Cortex

Located in the lower part of postcentral gyrus (head area).

Responsible for conscious awareness of vestibular sensation.

Afferent

The cell bodies (1st order neurons) are located in the spiral ganglion within the cochlea (organ of Corti in inner ear).

1-The Peripheral processes: make dendritic contact with hair cells of the organ of Corti within the cochlear duct of the inner ear.

2-The central processes: (cochlear nerve fibers) terminate in the dorsal and ventral cochlear nuclei (2nd order neurons), which lie close to the inferior cerebellar peduncle (ICP) in open rostral medulla.

Auditory Pathway

*Check the picture in the slides it helps.

From the cochlear nuclei, 2nd order neurons, fibers ascend into the pons, where:

1- Most fibers cross the midline in trapezoid body and terminate in the nucleus of trapezoid body or in the contralateral superior olivary nucleus.

2- Some fibers run ipsilaterally and terminate in the superior olivary nucleus

• From the superior olivary nuclei, ascending fibers comprise the lateral lemniscus. containg both crossed (mainly) and direct (few) cochlear fibres, which runs through tegmentum of pons and terminate in the inferior colliculus of the mdibrain (3rd order neurones).

• Some axons within lateral lemniscus terminate in small nucleus of the lateral lemniscus • The inferior colliculi project to medial geniculate nuclei (4th order neurones) of thalamus

• The axons originating from the medial geniculate nucleus (auditory radiation) pass through sublenticular part of the internal capsule to the primary auditory cortex (Brodmann's areas 41, 42) located in the dorsal surface of the superior temporal gyrus (Heschl's gyrus)

• The region surrounding the primary auditory cortex is known as the auditory

Other Functions of some nuclei

• **Superior olivary nucleus** sends olivocochlear fibers to end in organ of Corti through the vestibulocochlear nerve. These fibers are inhibitory in function and serve to modulate transmission of sound to the cochlear nerve

• **Superior olivary nucleus & the nucleus of the lateral lemniscus** establish reflex connections with motor neurons of trigeminal and facial motor nuclei mediating contraction of tensor tympani and stapedius muscles as They reduce the amount of sound that gets into the inner ear in response to loud noise

• **Inferior colliculi** establish reflex connections with motor neurons in the cervical spinal segments (tectospinal tract) for the movement of head and neck

neurons) of the rostral medulla, located beneath the lateral part of the floor of 4th ventricle. B. Some fibers go to the cerebellum through the inferior cerebellar peduncle	the cerebral cortex. 3. Bilaterally to motor nuclei of cranial nerves (vestibuloocular tract) through medial longitudinal fasciculus. 4. To Motor neurons of the spinal cord as lateral (ipsilateral) directly & medial vestibulospinal (bilateral) tracts through MLF, for control the posture.	extends into the spinal cord as the medial vestibulospinal tract, for control the posture.				association cortex or Wernick's area (Brodmann's areas 22) • Wernick's area is related to recognition and processing of language by the brain.	in response to auditory stimulation.

Glossopharyngeal [The 9th Cranial Nerve] Mixed

Superficial attachment	Course	Component of Fibers & Deep Origin				Ganglia & Communications	Branches	Nerve Lesions
		SVE fibers	GVE fibers	SVA fibers	GVA fibers			
1. It arises from the ventral aspect of the medulla by a linear series of small rootlets, in groove between olive and inferior cerebellar peduncle. 2. It leaves the cranial cavity by passing through the jugular foramen in company with: a. the Vagus b. Acessory nerves c. the Internal jugular vein.	1. It Passes forwards between Internal jugular vein and External carotid artery. 2. Lies Deep to Styloid process. 3. Passes between external and internal carotid arteries at the posterior border of Stylopharyngeus then lateral to it. 4. It reaches the pharynx by passing between middle and inferior constrictors, deep to Hyoglossus, where it breaks into terminal branches.	originate from nucleus ambiguus (NA), and supply stylopharyngeusmuscle.	arise from inferior salivatory nucleus (ISN), relay in otic ganglion, the postganglionic fibers supply parotid gland.	arise from the cells of inferior ganglion, their central processes terminate in nucleus of solitary tract (NST), the peripheral processes supply the taste buds on posterior third of tongue.	visceral sensation from mucosa of posterior third of tongue, pharynx, auditory tube and tympanic cavity, carotid sinus, end in nucleus of solitary tract (NST).	It has two ganglia: 1. **Superior ganglion**: Small, with no branches. It is connected to the Superior Cervical sympathetic ganglion. 2. **Inferior ganglion**: Large and carries general sensations from pharynx, soft palate and tonsil. It is connected to Auricular Branch of Vagus. The Trunk of the nerve is connected to the Facial nerve at the stylomastoid foramen.	1. **Tympanic**: relays in the otic ganglion and gives secretomotor to the parotid gland 2. **Nerve to Stylopharyngeus muscle.** 3. **Pharyngeal**: to the mucosa of pharynx. 4. **Tonsillar**. 5. **Lingual:** carries sensory branches, general and special (taste) from the posterior third of the tongue. - Sensory branches from the carotid sinus and body (pressoreceptors and chemoreceptors).	**It produces:** • Difficulty of swallowing; Impairment of taste and sensation over the posterior one-third of the tongue, palate and pharynx. • Absent gag reflex. Dysfunction of the parotid gland.

Vagus [The 10th Cranial Nerve] Mixed

Superficial attachment	Course	Component of Fibers & Deep Origin				Ganglia & Communications	Branches	Nerve Lesions
		SVE fibers	GVE fibers	SVA fibers	GVA fibers			
1. Its rootlets exit from medulla between olive and inferior cerebellar peduncle. 2. Leaves the skull through jugular foramen. 3. It occupies the posterior aspect of the carotid sheath between the internal jugular vein laterally and the internal and common carotid arteries medially. jugular foramen	1. The vagus runs down the neck on the prevertebral muscles and fascia. 2. The internal jugular vein lies behind it, and the internal and common carotid arteries are in front of it, all the way down to the superior thoracic aperture. -It lies on the prevertebral muscles and fascia. -Enters thorax through its inlet: A. Right Vagus descends in front of the subclavian artery. B. Left Vagus descends between the left common carotid and subclavian arteries.	originate from Nucleus Ambiguus, to muscles of pharynx and larynx.	originate from Dorsal Nucleus of Vagus synapses in parasympathetic ganglia, short postganglionic fibers innervate cardiac muscle, smooth muscles and glands of viscera.	sensation from auricle, external acoustic meatus and cerebral dura mater, to Spinal Tract & Nucleus of Trigeminal.	carry impulse from viscera in neck, thoracic and abdominal cavities to Nucleus of Solitary Tract.	1. **Superior ganglion (in the jugular foramen) with:** • Inferior ganglion of glossopharyngeal nerve, • Superior cervical sympathetic ganglion • Facial nerve. 2. **Inferior ganglion (just below the jugular foramen) with:** • Cranial part of accessory nerve, • Hypoglossal nerve, • Superior cervical sympathetic ganglion. • 1st cervical nerve.	• **Meningeal**: to the dura • Auricular nerve: to the external acoustic meatus and tympanic membrane. • **Pharyngeal**: it enters the wall of the pharynx. It supplies the mucous membrane of the pharynx, superior and middle constictor muscles, and all the muscles of the palate except the tensor palati. • **To carotid body**. • **Superior Laryngeal**: It divides into: (1) Internal Laryngeal: It provides sensation to the hypopharynx, the epiglottis, and the part of the larynx that lies above the vocal folds. • (2) External Laryngeal: supplies the cricothyroid muscle. • **Recurrent Laryngeal**: -it goes round the subclavian artery on the right, and round the arch of the aorta on the left. -It runs upwards and medially alongside the trachea, and passes behind the lower pole of the thyroid gland. -The recurrent laryngeal nerve gives motor supply to all the muscles of the larynx, except the cricothyroid. It also provides sensation to the larynx below the vocal folds.	**Vagus nerve lesions produce**: -palatal and pharyngeal and laryngeal paralysis. -Abnormalities of esophageal motility, gastric acid secretion, gallbladder emptying, and heart rate; and other autonomic dysfunction.

Accessory [The 11th Cranial Nerve] Motor

Cranial Part	Spinal Part	CorticoNuclear fibers		Function	Injury of the Spinal Root	Manifestations of Injury
		Nucleus Ambiguus	Spinal Nucleus			
-Carries fibers that **originate** in the caudal part of nucleus ambiguous -Foramen of **exit** from skull: Jugular foramen 1.Emerges from lateral aspect of the medulla as a linear series of rootlets caudal to rootlets of the vagus nerve. 2.At the side of medulla it joins the spinal root briefly 3.It separates once again as the nerve leaves the cranial cavity through the Jugular foramen. 4.At the level of jugular foramen these fibers join the valgus nerve and distribute with it to: - muscles of the soft plate -esophagus -pharynx -larynx	- **Arises** from motor neurones in ventral horn of the spinal gray matter at levels C1-C5 (spinal nucleus) -Foramen of **exit** from skull: Jugular foramen. -The axons leave the cord via series of rootlets, emerge laterally midway between the dorsal and ventral roots of the spinal nerves. -Courses rostrally and enter the cranial cavity through the foramen magnum, and joins the cranial root briefly. -Separates once again as the nerve leaves the cranial cavity through the Jugular foramen. Supplies: the sternomastoid and trapezius muscles.	Receive bilateral corticonuclear fibers (from both cerebral hemispheres).		1. Movements of the soft palate, larynx, pharynx. 2. Controls the movements of neck.	**Causes:** -Because of the relatively superficial position of the nerve in the posterior triangle, it may be damaged by penetrating trauma as stab wounds[1]. -It is considered the most commonly iatrgenically (Induced unintentionally in a patient by a physician.) injured nerve as during removal of malignant lymph nodes in the posterior triangle.	-It produces atrophy and weakness of trapezius. -Unilateral paralysis of trapezius is evident by: 1. inability to elevate & retract the shoulder 2.difficulty in elevating the arm 3.Winging of scapula -Dropping of the shoulder is an obvious sign of injury of the nerve. -The lesion also causes: difficulty in swallowing and speech. -Inability to turn the head.

Hypoglossal [The 12th Cranial Nerve] Motor

Origin & Exit	CorticoNuclear	Course	Function	Manifestations of Lesion of the nerve (LMN)
-Origin: Hypoglossal nucleus of the medulla (in the floor of 4th ventricle) - The fibers emerge from the anterior surface of the medulla oblongata through the sulcus between the pyramid and the olive. **-Foramen of exit** from skull: Hypoglossal canal.	-The hypoglossal nucleus receives corticonuclear fibers from both cerebral hemispheres. EXCEPT the region that supplies genioglossus muscle (receives contralateral supply only) -Also receives afferent fibers from nucleus solitarius and trigeminal sensory nucleus.	-The nerve courses downward with cervical neurovascular bundle: (internal carotid artery, internal Jugular vein, vagus nerve) -Then curves forward behind mandible to supply the tongue. -During its initial course, it carries C1 fibers which leave in a branch to take part in the formation of ansa cervicalis (a loop of nerves supplying neck muscles).	1. Supplies motor innervation to all of the muscles of the tongue Except the palatoglossus (which is supplied by the vagus nerve). It Controls the movements and shape of the tongue during speech and swallowing 2. Carries proprioceptive afferents from the tongue muscles.	1.Loss of tongue movements 2.Difficulty in chewing and speech 3.The tongue paralyses, atrophies, becomes shrunken and furrowed on the affected side (LMN paralysis). 4.On protrusion, tongue **deviates to the affected side** -If both nerves are damaged, person can't protrude tongue.