

Review File

Mid lectures

وَمَنْ يَتَوَكَّلْ عَلَى اللَّهِ فَهُوَ حَسْبُهُ

L1: Organization of the nervous system

- Most of the CSF drains from the 4th ventricle to distribute in the subarachnoid space around the brain and **returns to the dural sinuses through the arachnoid villi.**
- Tract: A group of **nerve fibers** (axons) **within** the CNS
- Ganglion: A group of **neurons outside** the CNS
- Plexuses are formed from **ventral remi.**
- CSF is formed from **Choroid plexus.**
- One of the sites forming the CSF is **lateral ventricles .**
- 3rd Ventricle lie in the **Diencephalon.**
- Spinal cord Gives rise to **31 pairs** of spinal nerves:
8 Cervical | 12 Thoracic | 5 Lumbar | 5 Sacral | **ONE** Coccygeal
- There is no Subpia Space
- Sympathetic is Thoracolumbar , parasympathetic is craniosacral

L2: Anatomy of the spinal cord

- The **lateral horn** is characteristics of **thoracic and upper lumbar segments.**
- The lateral group of anterior horn cells innervate the **limbs**
- Nucleus proprius is found in rexed laminae **IV**
- Nucleus Dorsalis (Clark's column, Nucleus thoracis) Extend from **C8 to L3-4**
- Spinal cord Extends from foramen magnum to **L1-L2**

Marginal zone (posterior marginals)				
Rexed Laminae	Location	Composed of	Extends	Afferents
I (1)	At the tip of dorsal horn	-	-	Important for relaying pain and temperature sensation to the brain.
Substantia Gelatinosa				
Rexed Laminae	Location	Composed of	Extends	Afferents
II (2)	apex of the posterior/dorsal horn	<u>large</u> neurons	throughout the length of spinal cord	<u>dorsal</u> root fibers concerned with pain, temperature and crude touch
Nucleus Proprius				
Rexed Laminae	Location	Composed of	Extends	Afferents
IV (4)	anterior to substantia gelatinosa/ located in the neck of dorsal horn	<u>large</u> neurons	throughout the length of spinal cord	<u>dorsal</u> root fibers concerned with half crude touch
Nucleus Dorsalis (Clark's column, Nucleus thoracis)				
Rexed Laminae	Location	Composed of	Extends	Afferents
VII (7)	base of dorsal horn/ the most dorso-medial nuclei	mostly <u>large</u> neurons	from C8 to L3-4 segments	<u>dorsal</u> root fibers concerned with information from muscle spindles and tendon organs.

*Associated with **proprioceptive endings**

*Relays unconscious proprioceptive information to brain

Visceral Afferent Nucleus				
Rexed Laminae	Location	Composed of	Extends	Afferents
VII (7)	lateral to nucleus dorsalis	mostly of <u>medium</u> size neurons	from T1 to L3 segments	Visceral afferents

L3: Sensory Tracts

- Dorsal column (fasciculus Gracilis and cuneatus) carry impulses concerned with **proprioception (movement and joint position)** , **discriminative touch (fine touch)** from **ipsilateral* side** of the body.
- Tabes dorsalis affect the lumbosacral dorsal spinal roots and **dorsal columns of the spinal cord**.
- The second order neuron of the dorsal column is **nucleus gracilis(for lower limb)**and **cuneatus (for upper limbs)**.
- In syringomyelia the first tract affected is **lateral spinothalamic**.

Lateral Spinothalamic Tract		Anterior Spinothalamic Tract
Carries pain & Temperature to thalamus and sensory area of the cerebral cortex.	Function	Carries crude touch (non discriminative) & pressure to thalamus and sensory cortex.
Neurone I: Small cells in the dorsal root ganglia.	Neurons: 3 Neurones	Neurone I: Medium sized cells in the dorsal root ganglia.
Neurone II: Cells of substantia gelatinosa of Rolandi in the posterior horn.		Neurone II: Cells of main sensory nucleus or (nucleus proprius) .
Neurone III: Cells of (VP*) nucleus of the thalamus.		Neurone III: Cells of VP* nucleus of thalamus.

L4: Brachial & Lumbosacral Plexus

- **Site of formation:**
Brachial plexus: In the **posterior triangle**
Lumbar plexus: In the substance of **psoas major muscle**.
Sacral plexus: In front of **piriformis muscle**
- **Upper Lesions** of the Brachial Plexus **Upper Trunk C5,6 (Erb-Duchenne Palsy)** "waiter's tip position", the arm hangs by the side and is **rotated medially**.
 The forearm is **extended** and **pronated**.
- **Lower Lesions** of the Brachial Plexus (**Klumpke Palsy**) / **Lower Trunk (C8,T1) Lesion**.
Hand of Benediction or Pope's Blessings (APE HAND) will result from **median nerve injury**. **clawed hand** due to **ulnar nerve injury**, and drop wrist due to radial nerve injury.
- **Injury of femoral nerve:**
 - Wasting of **quadriceps femoris***
 - Weak flexion** of hip
 - Loss of extension** of knee
 - loss of sensation over areas supplied
 antero-medial aspect of thigh & medial side of leg & foot.
- **Injury of sciatic nerve:**
 Injury will affect the *flexion of knee, extension of hip, all movements of leg & foot, as well as loss of sensation of skin of leg and foot* (except areas supplied by saphenous branch of femoral nerve).
- **Common Peroneal Nerve:** **injury to the nick of fibula** will affect this nerve. Which functions in the lateral and anterior compartments of the leg

L5&6: Brain stem (External & Internal)

- The brainstem is the region of the brain that **connects** the **cerebrum** with the **spinal cord**
- Each part of brain stem is **connected** to **cerebellum** by **cerebellar peduncles**:
Superior peduncle connects **midbrain** with cerebellum
Middle peduncle connects **pons** with cerebellum
Inferior peduncle connects **medulla oblongata** with cerebellum
- **Open/Dorsal Medulla**: On either side, an inverted V-shaped sulcus divides the area into 3 parts (**from medial to lateral**):
 1. **Hypoglossal triangle**: overlies hypoglossal nucleus (**medial**)
 2. **Vagal triangle**: overlies dorsal vagal nucleus
 3. **Vestibular area**: overlies vestibular nuclei
- **Vestibular area in dorsal surface of open medulla & pons**
- **Pyramidal decussation** is **Motor Decussation** Formed by **pyramidal fibers** descend in the lateral white column of the spinal cord as the **lateral corticospinal tract**.
- **Motor decussation (pyramids)**: **Closed/Caudal Medulla**
- **Sensory decussation (internal arcuate fibers)**: **Mid Medulla**
- **The trapezoid body** consists of **acoustic fibres from cochlear nuclei** to ascend into midbrain as lateral lemniscus and terminate in inferior colliculus.
- Nerves emerging from **Medulla (Ventral Surface)** (4 nerves):
 1. **Hypoglossal (12th) (most medial)**
 2. Glossopharyngeal (9th)
 3. Vagus (10th)
 4. Cranial part of accessory (11th)
- Nerves emerging from **Pons (Ventral Surface)**(4 nerves):
 1. Trigeminal (5th)
 2. Abducent (6th)
 3. Facial (7th)
 4. Vestibulocochlear (8th)
- Nerve emerging from **Midbrain (Ventral Surface)**(ONE nerve):
 1. Oculomotor (3rd)
- Nerve emerging from **Midbrain (Dorsal Surface)**(ONE nerve):
 1. Trochlear (4th)

**The trochlear nerve is the only cranial nerve that emerges from the dorsal surface.*

L5&6: Brain stem (External & Internal)

- **Open/Rostral Medulla:** Beneath the **floor of 4th ventricle** lie :
 1. Hypoglossal Nucleus.
 2. Dorsal Nucleus of Vagus
 3. Medial longitudinal fasciculus (**Function: links the vestibular nuclei with nuclei of extraocular muscles**)
 4. Vestibular nuclei complex
 5. Nucleus Ambiguus
 6. Solitary nucleus
 7. Tectospinal tract
- We have 4 lemniscus (**lemniscus is group of tracts larger than fasciculus**)
 - Spinal: lateral & medial spinothalamic (first seen in medulla)
 - Medial: gracile & cuneate (after sensory decussation)
 - Lateral: fibers of ventral & dorsal cochlear nucleus in both sides (Caudal pons)
 - Trigeminal: axons of sensory & spinal nucleus of trigeminal (Mid pons)

*All of them you can see at the level of mid pons

*All of them end in the thalamus EXCEPT the lateral lemniscus (end at the level of inferior colliculus)

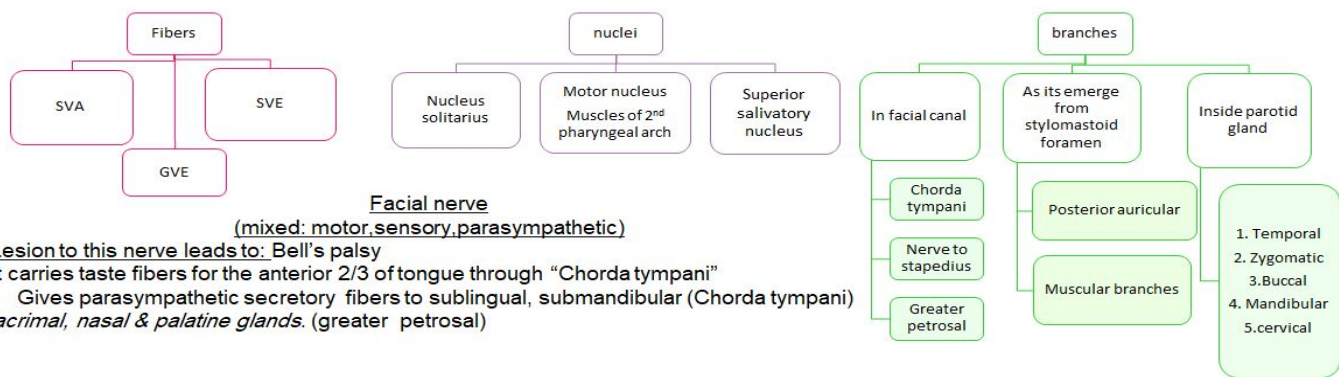
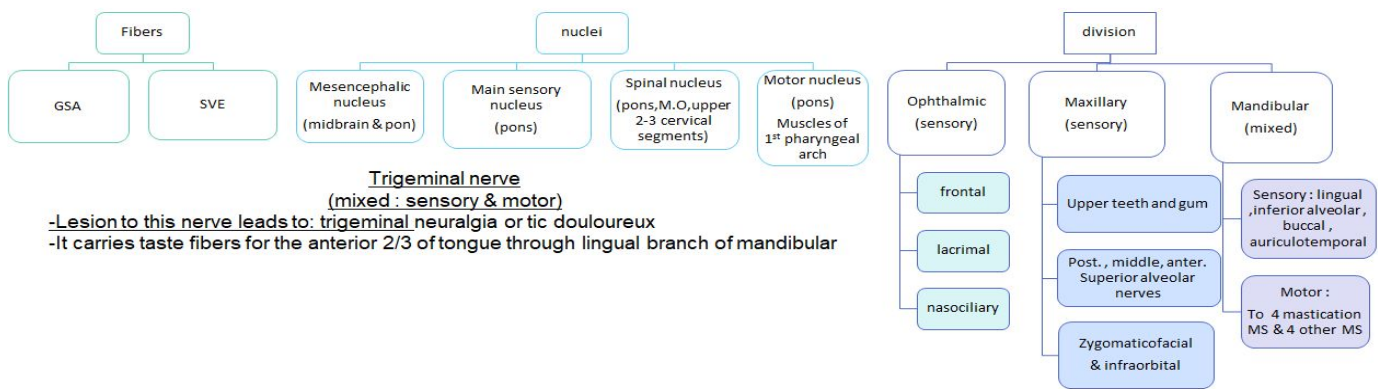
Medial lemniscus	Lateral lemniscus
Ascending internal arcuate fibers	Acoustic fibres from cochlear nuclei
Terminates in <u>thalamus</u>	Terminate in <u>inferior colliculus</u>

- **Pons:** Caudal part:
 1. Pontine Nuclei
 2. Bundles of corticospinal & corticonuclear fibres
 3. The ascending fibres of the medial lemniscus
 4. Spinal tract & nucleus of Trigeminal
 5. Deep origin of cranial nerve nuclei:
 - **Abducent nucleus**
 - Facial motor nucleus
- **Midbrain:** Inferior Colliculus Level
 - large nucleus of gray matter that lies beneath a corresponding surface elevation
 - It is part of the auditory pathway & its efferent fibers pass to the thalamus
 - **It receives fibers from the lateral lemniscus**

Structures: 1. Trochlear nucleus 2. Decussation of the superior cerebellar peduncles

3. Substantia nigra: Its degeneration is associated with **Parkinson's disease**
- **Midbrain:** crus cerebri
 - It is a massive mass ventral to the substantia nigra
 - **It consists entirely of descending cortical efferent fibers (Frontopontine, Corticospinal & corticobulbar and Temporopontine Fibres) to the motor cranial nerve nuclei & to anterior horn cells**
 - Involved in the coordination of movement
 - Present in both levels of colliculi

L7: Cranial Nerves 5&6(V & VII)



L8: Cranial Nerves 9&10(IX & X)

Nerve	Glossopharyngeal (9th)	Vagus (10th)
Type	Sensory (mainly)	Mixed
Exits from	Ventral medulla (b/w olive and inferior cerebellar peduncle)	Ventral medulla (b/w olive and inferior cerebellar peduncle)
Leaves cranial cavity via	Jugular foramen	Jugular foramen
Nuclei	<ol style="list-style-type: none"> Nucleus ambiguus (motor) Inferior salivatory nucleus (Parasympthetic) Nucleus of solitary tract(sensory) 	<ol style="list-style-type: none"> Nucleus ambiguus Dorsal nucleus of vagus Spinal tract & nucleus of trigeminal Nucleus of solitary tract
Branches	<ol style="list-style-type: none"> Tympanic (secretomotor to parotid gland) Nerve to stylopharyngeus muscle Pharyngeal Tonsillar Lingual(general and sensory to posterior 1/3 of the tongue) Sensory (from carotid sinus and body) 	<ol style="list-style-type: none"> Meningeal Auricular nerve Pharyngeal To carotid body Superior laryngeal (internal and external laryngeal) Recurrent laryngeal
Nerve lesion manifestation	<ol style="list-style-type: none"> Difficulty swallowing Impairment of taste and sensation of posterior 1/3 of the tongue, palate and pharynx. Absent gag reflex Dysfunction of parotid gland 	<ol style="list-style-type: none"> Palatal, pharyngeal, and laryngeal paralysis. Abnormalities of: <ul style="list-style-type: none"> esophageal motility gastric acid secretion gall bladder emptying heart rate Other autonomic dysfunction Hoarseness of voice (Dysphonia)
Cause of nerve lesion	<ol style="list-style-type: none"> Lateral medullary syndrome Tumors compressing the cranial nerves in their exit 	

Pharyngeal muscles are supplied by **Nucleus ambiguus**

L9: Cranial nerves 11(XI) & 12(XII)

- CN11 (Accessory nerve) is **Motor** | CN12 (Hypoglossal nerve) is **Motor**
- Accessory nerve has two parts (roots):
 - **Cranial part:** carries fibres that originate in the **caudal part of nucleus ambiguus (remember it gives 9th, 10th & now 11th)**
 - **Spinal part:** arises from motor neurons in **ventral horn of the spinal gray matter** at levels **C1-C5 (spinal nucleus "supplying the sternocleidomastoid muscle")**
- **Injury of Accessory nerve (Spinal Root):**
Manifestations: **(Which indicates injury to the spinal part of accessory nerve)**
 - It produces atrophy and weakness of trapezius.
 - Unilateral paralysis of trapezius is evident by (1) inability to elevate & (2) retract the shoulder, (3) difficulty in elevating the arm & (4) Winging of scapula.
 - **Dropping of the shoulder is an obvious sign of injury of nerve**
 - The lesion also causes difficulty in swallowing and speech & Inability to turn head
- **Injury of Hypoglossal nerve:**
Manifestations:
 - UMN:** spastic paralysis
 - LMN:** flaccid paralysis

L11: Cranial nerve 8(VIII)

- CN8 (vestibulocochlear nerve) is **Sensory**, components:
 - Vestibular part:** conveys impulses associated with body posture, balance and coordination of head & eye movements
 - Cochlear part:** conveys impulses associated with hearing
- Vestibular & cochlear parts attach to the ventral surface of brain stem through the **pontomedullary sulcus** at the junction of the medulla & pons (**cerebellopontine angle**) run laterally in **posterior cranial fossa** and enter (meet & emerge) through **internal acoustic meatus** along with facial nerve
- Vestibular Cortex/Area (location): located in the **lower part of postcentral gyrus**
- **Representation of cochlea is bilateral at all levels above cochlear nuclei.**
- **Vestibular nuclei** belong to **special somatic afferent** column in brain stem.
- Cochlear (Auditory) nuclei belong to **special somatic afferent** column in brain stem.

L10: Anatomy of the Ear

● External Ear:

- Receives the insertion of extrinsic muscles (which are supplied by the **facial nerve**).
- Sensation is carried by:
 - **Great auricular** (from cervical plexus)
 - **Auriculotemporal** (from mandibular)

● Middle Ear (Tympanic Cavity):

- Communicates **anteriorly** with the **Nasopharynx** through the **Auditory Tube**.
- The Floor is formed by a thin plate of bone, which separates the **middle ear** from the **bulb of the internal jugular vein**.
- The anterior wall is formed below by a thin plate of bone that separates **tympanic cavity** from the **internal carotid artery**.
- In the medial wall there is oval window (Fenestra Vestibuli), which is **closed by the base of the stapes**, and there is round window (Fenestra Cochleae), which is **closed by the secondary tympanic membrane**.

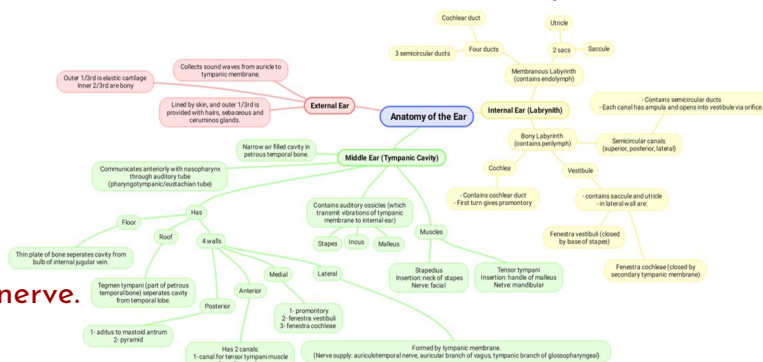
● Nerve supply of ear drum:

Outer surface:

- 1- **Auriculotemporal nerve.**
- 2- **Auricular branch of vagus nerve.**

- Inner surface:

Tympanic branch of glossopharyngeal nerve.

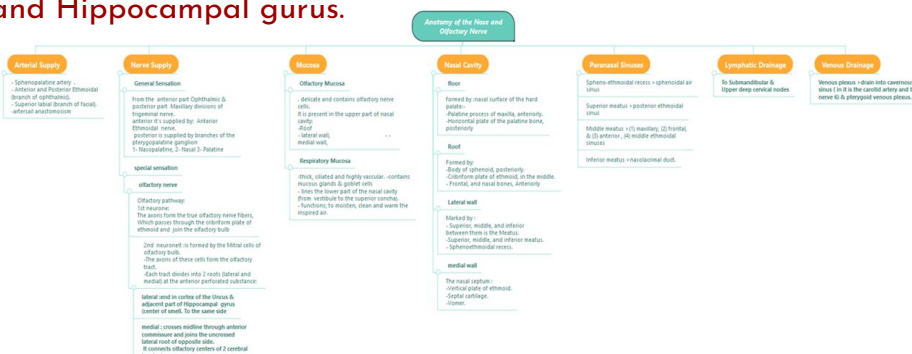


L12: Anatomy of the Nose

- **Nasal cavity Floor** is Formed by Nasal (upper) surface of the hard (bony) palate.
 - Palatine process of maxilla (anteriorly)
 - **Horizontal plate of the palatine bone (posteriorly)**
- **Olfactory mucosa** is present in the upper part of nasal cavity:
 - Roof
 - On the lateral wall, it lines the upper surface of the superior concha and the sphenoidal recess
 - On the medial wall, it lines the superior part of the nasal septum.
- The vestibule is lined by **skin**.
- First order neuron is the **olfactory receptor**.
- Second order neuron is **mitral cell of olfactory bulb**.
- The center of smell is **uncus and Hippocampal gurus**.

Meatus	Receives the opening of
Sphenoidal recess	receives the opening of sphenoidal air sinus
Superior meatus	receives the opening of posterior ethmoidal sinus .
Middle meatus	receives the openings of: (1) maxillary , (2) frontal , & (3) anterior , (4) middle ethmoidal sinuses . contains bullae ethmoidalis* , hiatus semilunaris** , Infundibulum***
Inferior meatus	receives the opening of nasolacrimal duct .

*Receives opening of (4) *** Receives opening of (2) and (3) **Receives opening of (1)



L13: Cranial nerves 2,3,4 & 6(II, III, IV & VI)

- CN2 (Optic nerve) is **Sensory** | CN3 (Oculomotor nerve) is **Motor**
CN4 (Trochlear nerve) is **Motor** | CN6 (Abducens nerve) is **Motor**
- Optic nerve:
 - **Photoreceptors:** Rods & Cones of the retina
 - **Three neurons pathway:**
 - 1st order neurons:** Bipolar cells of retina
 - 2nd order neurons:** Ganglion cells of retina
 - 3rd order neurons:** Neurons in the lateral geniculate body
- **VISUAL Defects**
 1. Disease of the **eyeball** (cataract, intraocular hemorrhage, retinal detachment, glaucoma & methyl alcohol poisoning) & disease of the **optic nerve** (multiple sclerosis, optic nerve tumors) lead to : **loss of vision** in the affected eye (**monocular blindness**).
 2. Compression of the optic chiasm by an adjacent pituitary tumor leads to: **bitemporal hemianopia**.
 3. Vascular and neoplastic lesions of the **optic tract, optic radiation or occipital cortex** produce: **contralateral homonymous hemianopia**.
- **Oculomotor nerve emerges on the anterior surface of the midbrain in the interpeduncular fossa medial to crus cerebri.**
- **Abducens nerve passes through the floor of cavernous sinus.**
- Abducens nerve functions:
 - 1- Rotates the eyeball laterally (abduction)
 - 2- supplying lateral rectus muscle**
- ***REMEMBER! (Lesions)**
Oculomotor nerve = lateral squint | Abducens nerve = medial squint
- **To move the eye (just up) which muscle will work? Inferior oblique & Superior rectus**
- **To move the eye (just down) which muscle will work? Superior oblique & Inferior rectus**
- **What are the three sensory & motor going through superior orbital fissure?**
Sensory: ophthalmic, nasociliary & maxillary
Motor: 3rd , 4th & 6th cranial nerves
- **What are the 4 parasympathetic ganglion of head & neck?**
 - 1- Otic (for glossopharyngeal nerve)**
 - 2- Submandibular (for chorda tympani)**
 - 3- Pterygopalatine (for greater petrosal nerve)**
 - 4- Ciliary (in the orbit)**

GOOD LUCK

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وَمَا تَوْفِيقِي إِلَّا بِاللَّهِ