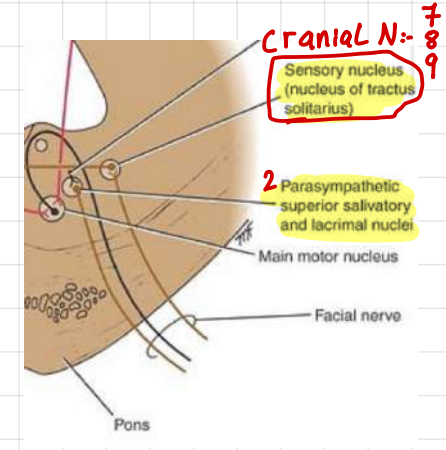
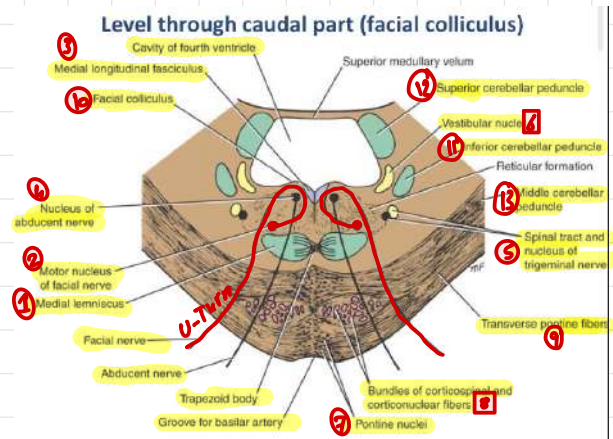


# ★ Topic 9:- pons & midbrain

## ① Level through caudal part (facial colliculus) (inferior)

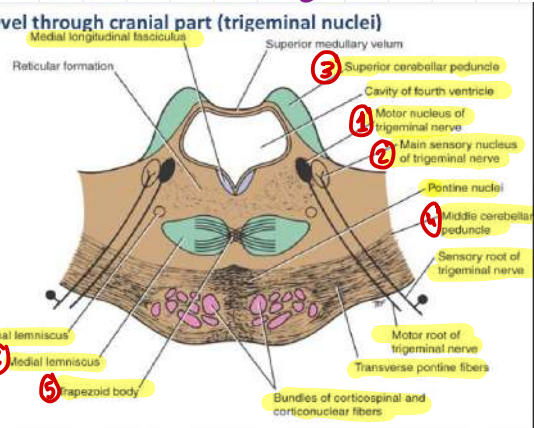
- 1 Medial Lemniscus:- most anterior part of Tegmentum
- 2 Facial nucleus → motor:- posterior of Lateral medial Lemniscus.  
 ↳ preganglionic parasympathetic nuclei :- posterolateral to motor nucleus
- 3 Medial longitudinal fasciculus (MLF):- Beneath the floor of 4th ventricle on midline.
- 4 Abducent nucleus:- Beneath the floor of the upper part of of the 4th. (motor)
- 5 Spinal nucleus of trigeminal & tract :- anteromedial aspect of Inferior cerebellar peduncle.
- 6 Medial vestibular nucleus:- Lateral to abducent.
- 7 Pontine nuclei:- small masses of nerves in Basilar part, Termination of Corticopontine  
 ↳ Transverse fibers → intersect the corticospinal & corticonuclear (##) tracts, Breaking them into small bundles (∴) → MCP → cerebellum (connection of cerebellum with cortex).
- 8 Facial colliculus:- Made By the U-Turn of facial nerve Below the 4th ventricle.
- 9 Cerebellar peduncles:- ICP, MCP, SCP.

hypothalamus  
 ↳ Salivatory  
 ↳ Lacrimal  
 ↳ sensory N of Trigeminal (Reflex)



## ② Level through cranial part (trigeminal nuclei) (mid pontine area, superior to 4).

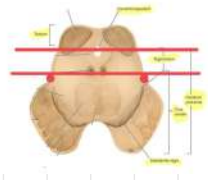
- 1 Motor nucleus of trigeminal :- in Rt. Beneath the lateral part of 4th, Medial to sensory N
  - 2 Main sensory nucleus of Trigeminal :- lateral to motor N. (principle sensory Nucleus).
  - 3 cerebellar peduncles:- SCP (posterolateral to motor N), MCP
  - 4 Trapezoid body
  - 5 Lemniscus → Medial 6  
 ↳ Lateral  
 ↳ Spinal 7 → lateral to medial
- no spinal nucleus of Trigeminal in this section.



- **Trigeminal Lemniscus:-** fibers of 2nd order neuron.
  - ↳ origin :- nucleus of Trigeminal (main sensory & spinal).
  - ↳ Termination:- VPM:- small nucleus, general sensory of head & neck & taste.

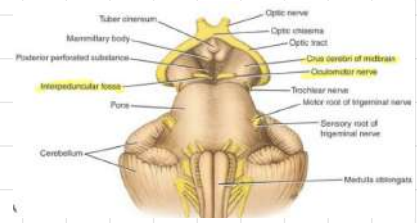
## • MidBrain

- ↳ Location:- Between the diencephalon/pons.
- ↳ cavity:- cerebral aqueduct.
- ↳ parts
  - ↳ Tectum (post)
  - ↳ cerebral peduncle:- By substantia nigra → Tegmentum posteriorly. (pyramidal tracts).
- ↳ Superior cerebellar peduncle:- midbrain + cerebellum. ↳ crus cerebri anteriorly.
- ↳ Two pigmented nuclei
  - ↳ Substantia nigra:- melanin, part of Basal ganglia.
  - ↳ Red nucleus:- Deep to Substantia nigra, Largest nucleus of Rt.



## Anterior view of midbrain

- interpeduncular fossa: - Between 2 crus cerebri
- crus cerebri
- oculomotor (3rd): - emerges from medial side of crus cerebri in the interpeduncular in the interpeduncular fossa.



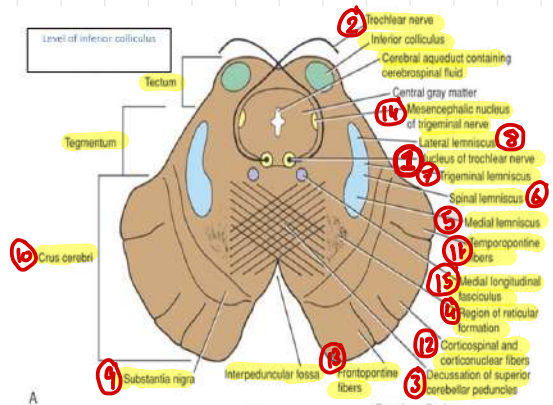
## posterior view of midbrain

- Corpora quadrigemina: - The Largest nuclei
  - Superior colliculi + Lateral geniculate body by superior brachium: - visual reflexes.
  - Inferior colliculi + medial geniculate body by Inferior brachium: - auditory reflexes.
- Trochlear nerve (4th): - emerges below inferior colliculus, innervate superior oblique muscle.
- oculomotor nerve (3rd): - emerges at the Lvl of superior colliculus.



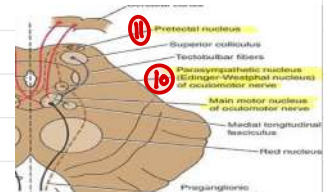
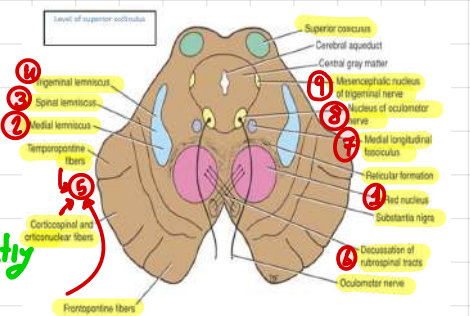
## ① Level of inferior colliculus

- Trochlear nucleus: - close to midline, posterior to MLF.
- Trochlear nerve: - Decussate in the superior medullary velum
- Decussation of scp: - central part of tegmentum, anterior to cerebral aqueduct. (Dentatorubrothalamic & interpositorubrothalamic)
- RF: - Lateral to the decussation.
- Lemnisci: - <sup>5</sup>Medial → <sup>6</sup>spinal → <sup>7</sup>Trigeminal → <sup>8</sup>Lateral: - posterior to Substantia nigra.
- Substantia nigra
- Crus cerebri: - <sup>5</sup>Lateral 1/5: - Temporopontine fibers.
  - <sup>10</sup>middle 3/5: - Corticospinal & corticonuclear fibers.
  - <sup>13</sup>medial 1/5: - Frontopontine fibers.
- mesencephalic nucleus of Trigeminal = Lateral to cerebral aqueduct.
- MLF (medial Longitudinal Fasciculus).

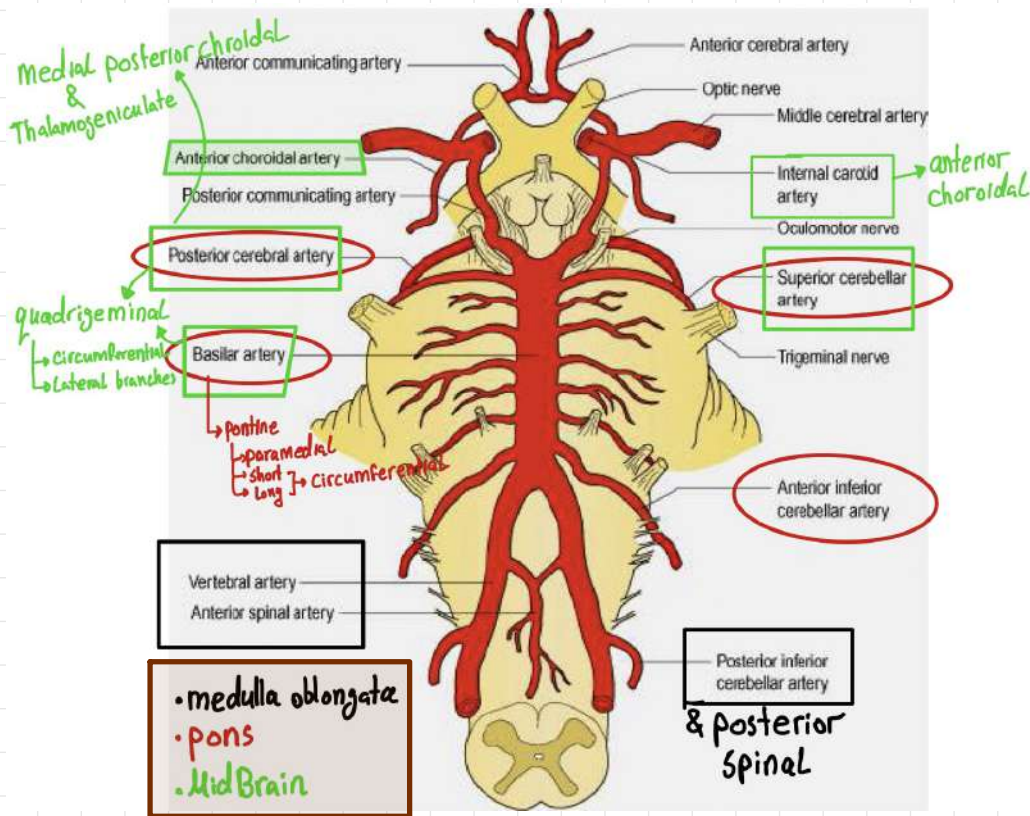


## ② Level of superior colliculus

- Red nucleus
- Lemniscus: - <sup>2</sup>Medial → <sup>3</sup>spinal → <sup>4</sup>Trigeminal (no Lateral → inferior colliculus).
- crus cerebri: - same as ①
- Decussation of Rubrospinal tract
- MLF
- Nucleus of oculomotor nerve: - posterior to MLF.
- Mesencephalic nucleus of Trigeminal.
- Edinger-westphal nucleus (3rd parasympathetic): - innervate the intrinsic muscles of the eye: - constricting the pupil & accomodating the eye.
- pretectal nucleus: - Lateral part of superior colliculus, light Reflexes.



# \* Topic 10 (Recorded Lecture 11) :- Blood supply & Lesions.



• **Hallmark of Brain stem vascular Lesions:-**  
**ipsilateral cranial nerve sign + Contralateral Long tract sign.**

## • Medulla oblongata

### 1 Medial medullary syndrome (Dejerine).

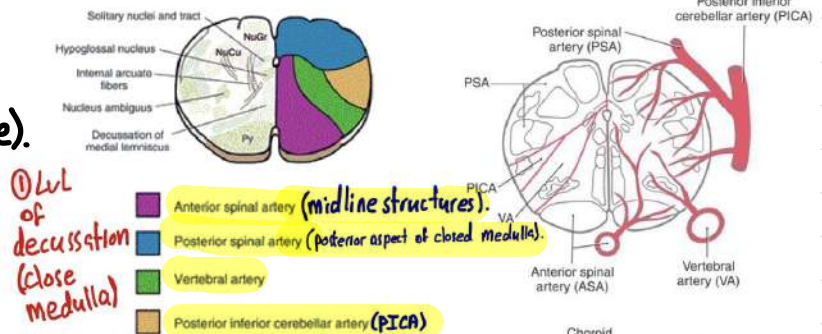
↳ Section:- Lvl of olive (open medulla).

↳ Symptoms:-

- 1) contralateral hemiparesis/paralysis (pyramidal or corticospinal).
- 2) contralateral loss of proprioception & vibratory sense (medial lemniscus).
- 3) Deviation of the tongue ipsilaterally when it is protruded (hypoglossal).

① Lvl of decussation (close medulla)

② Lvl of olive (open medulla)



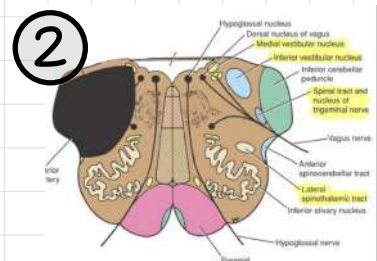
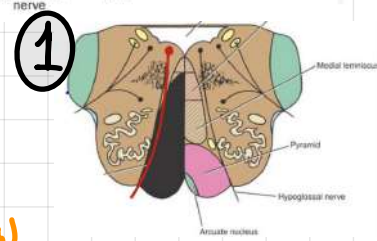
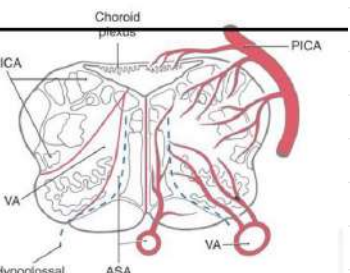
### 2 Lateral medullary syndrome (Wallenberg, PICA).

↳ Section:- Lvl of olive (open medulla).

↳ Symptoms:-

- 1) contralateral loss of pain & temp to body (anterolateral system).
- 2) ipsilateral loss of pain & temp to face (spinal trigeminal).
- 3) vertigo & nystagmus (medial & inferior vestibular nuclei & MLF).
- 4) ipsilateral loss of taste of the tongue (solitary nucleus & tract (7th, 8th, 9th)).
- 5) hoarseness & dysphagia (nucleus ambiguus & root of 9 & 10th (Recurrent laryngeal)).
- 6) ipsilateral Horner syndrome (hypothalamospinal fibers)

↳ Loss of sympathetic stimulation (ptosis, miosis, Anhidrosis).



### 3 Vascular Lesion of posterior spinal Artery.

↳ Section:- closed medulla.

↳ Symptoms:-

- 1) ipsilateral loss of proprioception & vibration (posterior column system)
- 2) ipsilateral loss of pain & temp to face (spinal trigeminal).

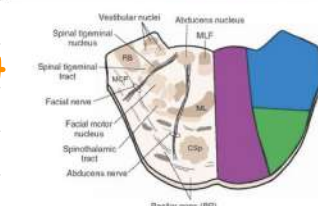
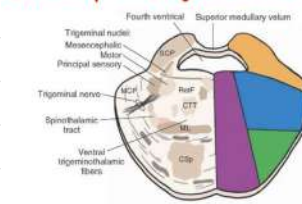
# pons

## 1 Foville syndrome (paramedial Branches)

↳ section:- **caudal part (facial colliculus).**  
 ↳ symptoms

- 1) ipsilateral abducens nerve paralysis.  
 (Lateral rectus → eyeball lateral movement → internal strabismus).
- 2) contralateral hemiparesis (corticospinal)
- 3) contralateral sensory loss (variable)  
 (medial Lemiscus).

### cranial part (trigeminal nuclei)



caudal part (facial colliculus)

- Basilar Branches
    - ↳ paramedial.
    - ↳ short circumferential.
    - ↳ long circumferential.
  - Paramedian branches of basilar artery
  - Long circumferential branches of basilar artery and branches of anterior inferior cerebellar artery (AICA)
  - Long circumferential branches of basilar artery
  - Long circumferential branches of basilar artery and branches of superior cerebellar artery (SCA)
- ↳ only on cranial part.

## 2 Millard-Gubler syndrome :- if the damaged area shifted laterally (facial nerve)

↳ symptoms

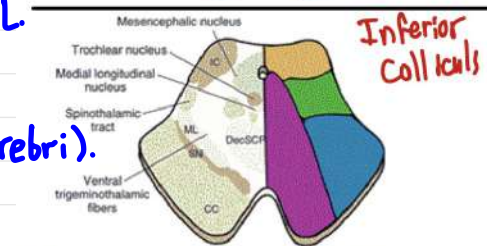
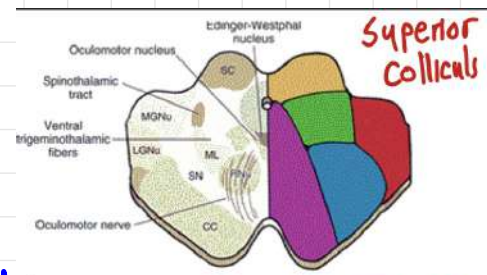
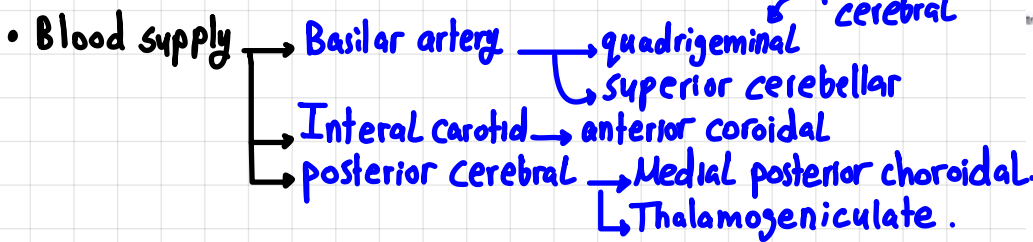
- 1) Same as Foville syndrome
- 2) + ipsilateral paralysis of the facial muscles.

## 3 Syndrome of the midpontine base (paramedial & short circumferential).

↳ section:- **cranial part (trigeminal nuclei).**  
 ↳ symptoms

- 1) contralateral hemiparesis (corticospinal).
- 2) ipsilateral loss of pain & temp
- 3) paralysis of the masticatory muscles } → Trigeminal roots (sensory & motor).
- 4) Ataxia (corticopontocerebellar pathway in MCP).

# Mid Brain



- Anteromedial (paramedian) branches of basilar bifurcation and posterior cerebellar artery (paramedian branches)
- Anterolateral (short circumferential) branches of the quadrigeminal and medial posterior choroidal arteries
- Lateral branches of quadrigeminal (level of inferior colliculus) and posterior medial choroidal arteries (level of superior colliculus)
- Quadrigeminal and superior cerebellar arteries (level of inferior colliculus), quadrigeminal and posterior medial choroidal arteries (level of superior colliculus)
- Thalamogeniculate artery posterior cerebral artery

## 1 Weber syndrome:- medial portion (oculomotor & crus cerebri).

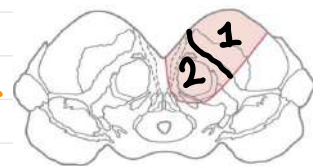
↳ symptoms

- 1) ipsilateral paralysis of extraocular muscle (except lateral rectus (abducent) & superior oblique (trochlear)) (oculomotor).
- 2) contralateral paralysis of the extremities (corticospinal tract in the crus cerebri).
- 3) ipsilateral dilation of pupil (parasympathetic nuclei of oculomotor).
- 4) contralateral weakness of lower face & deviation of the tongue when it is protruded (corticocaudal fibers in crus cerebri (not cranial nerve)).

## 2 Claude syndrome:- central Area (oculomotor & Red nucleus).

↳ symptoms

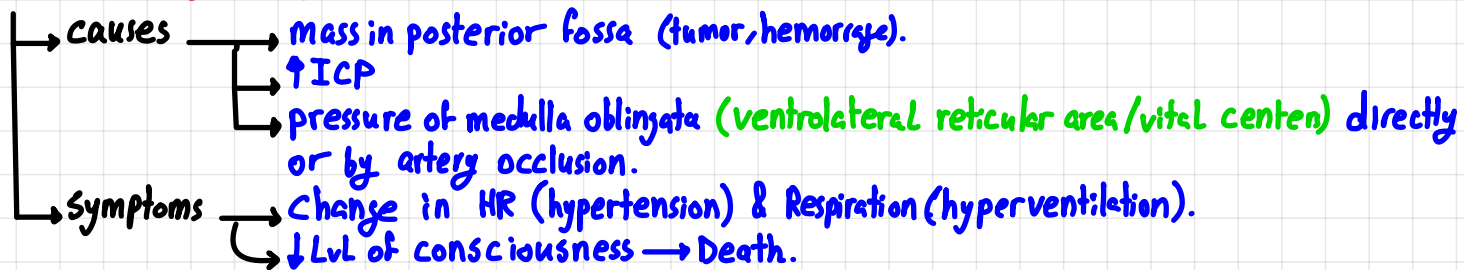
- 1) ipsilateral paralysis of eye movement → down & lateral (oculomotor).
- 2) ipsilateral dilation of pupil (parasympathetic nuclei of oculomotor).
- 3) contralateral ataxia, tremor, incoordination (Red nucleus).



## 3 Benedikt syndrome:- 1 + 2

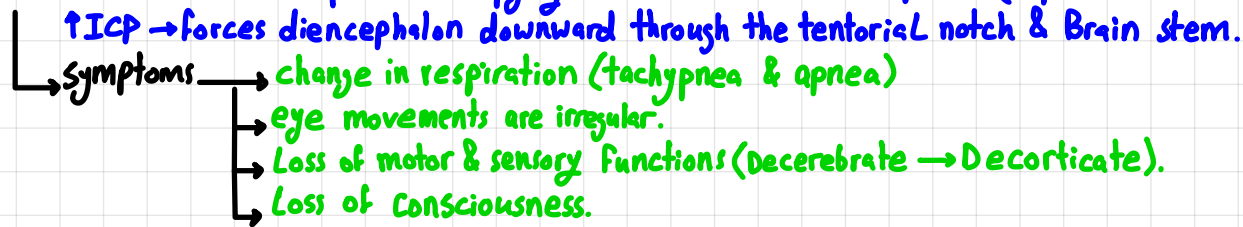
# • Herniation

## 1 Tonsillar herniation



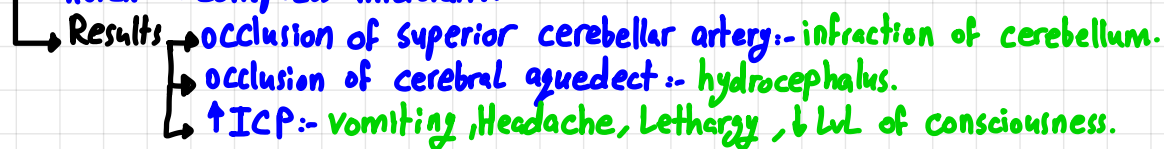
- **Arnold-chiari phenomenon**:- congenital tonsillar herniation, May be asymptomatic, surgical Tx & good prognosis.

## 2 central herniation:- space occupying lesion in the hemisphere (supratentorial → infratentorial)

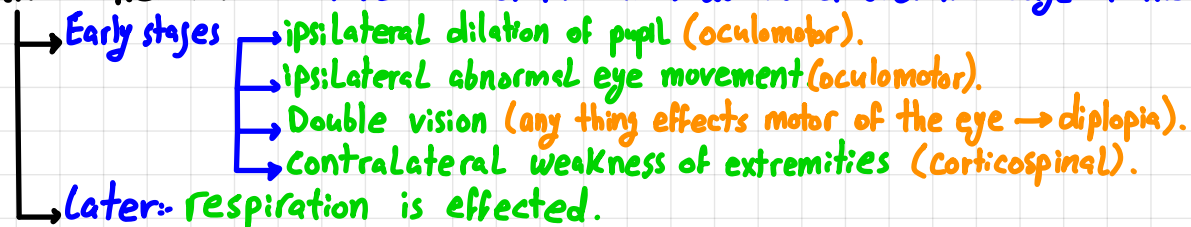


- **Falx cerebri**:- crescent. Anterior:- crista galli, posterior:- tentorium cerebelli.
- **Tentorium cerebelli**:- Horizontal. Anteriolateral:- superior petrous, posterior:- occipital lobe  
                                  Anteromedial:- free, tentorial notch.

## 3 upward cerebellar herniation:- mass in posterior fossa → cerebellum upward through the tentorial notch → compress midbrain.

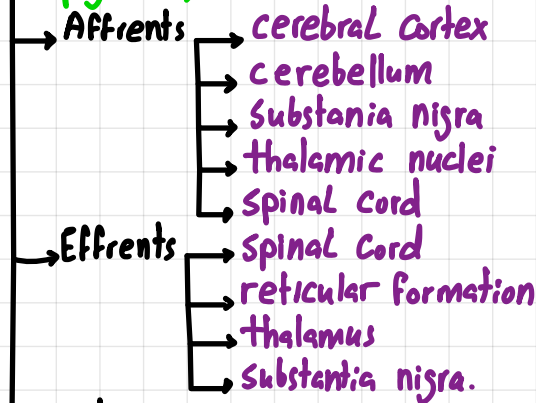


## 4 Uncal herniation:- movement of the uncus downward over the edge of the tentorium cerebelli.



# ★ Recorded Lecture 9 (17:17) :- RN, SN, cranial nerves (3, 4, 5, 6).

- **Red nucleus**:- rounded mass of gray matter in superior colliculus Lvl, situated between superior aqueduct (posteriorly) & substantia nigra (Anteriorly), Reddish blue (vascularized & iron containing pigment)



Action:- involving in motor coordination.

- **Substantia nigra (SN)**:- Large motor nucleus in midbrain, ↑ Lvl of melanin.

- Action:- reward, Addiction, movement, muscle tone.
- Connection with:- BG, Cortex.
- **Parkinson's disease**:- death of neurons in the SN.

mnemonic

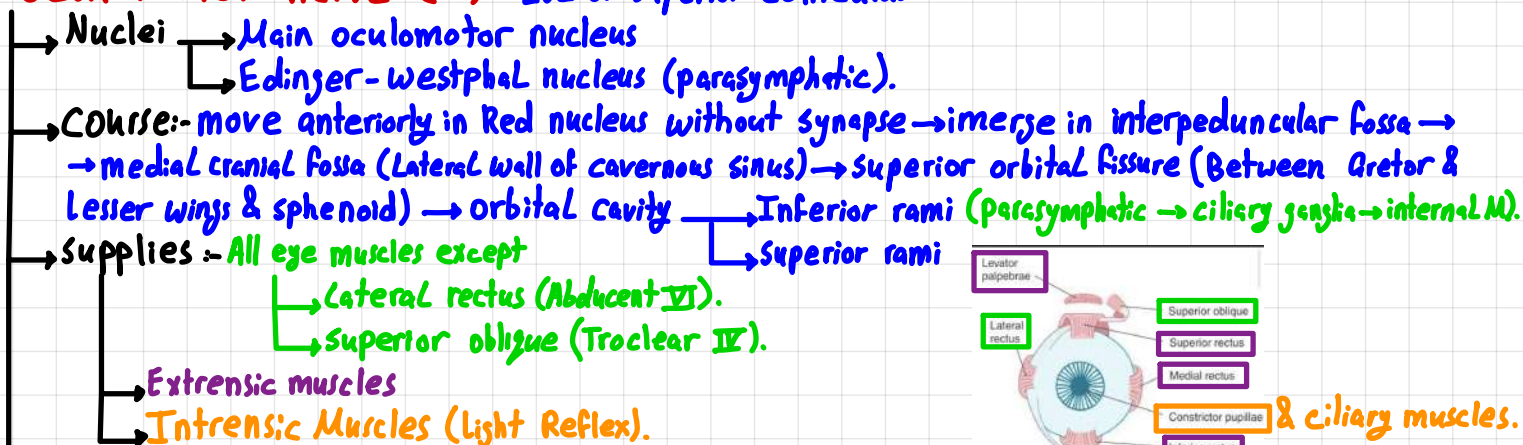
oh oh oh to touch and feel very good velvet as Heaven

I) olfactory (nose → smell)  
 II) optic (eye → visual acuity).  
 III) oculomotor (eyebrow → eye movement).  
 IV) Trochlear (eye → eye movement (downward/medially)).  
 V) Trigeminal (face → facial sensation, chewing). 3 branches (MoM Help me).  
 VI) Abducent (eye → lateral eye movement).  
 VII) Facial (face → facial muscle movement & eyelid closing).  
 VIII) Auditory (ear → hearing & Balance).  
 IX) Glossopharyngeal (tongue → taste for 1/3 posterior)  
 X) Vagus (tongue → palate muscle & swallowing).  
 XI) Accessory (shoulder → shoulder shrug).  
 XII) Hypoglossal (tongue → tongue movements).

- ophthalmic
- maxillary
- mandibular

All of cranial nerves get Affrent fibers from Both cortex hemispheres except (7 & 12).

- **Oculomotor nerve (III)**:- Lvl of superior colliculus



**Action** → **Extrensic M.**:- Lifting the upper eyelid, turning the eye up/down/medially.  
 → **Intrensic M.**:- constricting the pupil & accommodating the eye.

**Injury** → **Complete Lesion**:- all eye muscle Are paralyzed (except Lateral rectus & superior oblique).  
 ↳ **Symptoms** → External strabismus (medial rectus paralyzed → Later rectus overactive).  
 → Diplopia  
 → ptosis:- dropping of the upper eyelid (Levator palpebrae).  
 → The pupil is widely dilated & nonreactive to Light (constrictor pupillae).  
 → paralyzed Accommodation of the eye.  
 → **incomplete lesion** → External ophthalmoplegia :- paralysis of the extraocular muscles.  
 ↳ Internal ophthalmoplegia :- ↓autonomic innervation.  
 • diabetic neuropathy:- only effect the extraocular M → paralyzed.



• **Troclear nerve (IV)**:- Lvl of inferior colliculus

**Course**:- pass posteriorly around central gray matter (cerebral aqueduct & mesencephalic N)  
 → decussates in superior aspect → turn around crus cerebri → Lateral wall of cavernous sinus →  
 → superior orbital fissure → orbital cavity  
**Supplies**:- superior oblique muscle.  
**Action**:- turn the eye down & laterally.  
**injury symptoms** → Diplopia  
 → Difficulty in turning the eye downward & laterally (it turn up/medially).  
 → Difficulty in descending stairs.  
 → compensatory adjustment:- Head tilt to the opposite side of the paralysed eye.



• **Abducent nerve (VI)**:- Cudal part (facial Colliculus, Beneath the floor of 4th, close to midline).

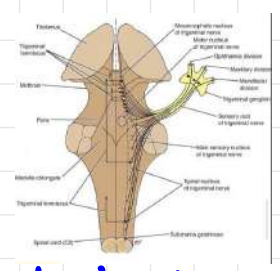
**Course**:- passes anteriorly → pontomedullary Junction → cavernous sinus (interior & lateral to internal carotid Artery) → superior orbital fissure → orbital cavity.  
**supplies**:- Lateral rectus.  
**Action**:- turning the eye laterally.  
**injury symptoms** → Diplopia  
 → Difficulty to turn the eye laterally (it turns medially).  
 → internal strabismus (medial rectus overaction).



• **Trigeminal nerve (V)**:- mixed

**Nuclei** → 3 sensory → **Main sensory** (Mid pontine area) (similar to PCML)  
 → **Spinal** (Substantia gelatinosa C2 → along medulla) (similar to ALS)  
 → **Mesencephalic** (above main sensory N) → Reflex proprioception of the periodontal Ljament. → muscles of mastication in the Jaw.  
 → **Ascending Branch**:- main sensory nucleus.  
 → **desending Branch**:- spinal nucleus.  
 → **Division** → **ophthalmic**:- inferior part of spinal nucleus.  
 → **maxillary**:- middle part of spinal nucleus. (SN)  
 → **mandibular**:- superior part of spinal nucleus.  
 → **Motor** (posterior part of the pons).  
 ↳ **Recives** → Same as spinal system.  
 → Corticonuclear fibers, RN, RF (Reticular formation), Tectum.  
 ↳ **supplies** → Muscles of mastication.  
 → Tensor tympani.  
 → Tensor veli palatini.  
 → Mylohooid.  
 → Anterior belly of the diagastric muscle.

★ **Mandibular** ★



Course:- Anterior Aspect of pons (mid pontine) → upper surface of petrous apex → Trigeminal ganglion in Meckel cave (pouch in dura mater) → division.

① **Ophthalmic** (inferior part of SN → Superior orbital fissure → cavernous sinus → Areas ↓).

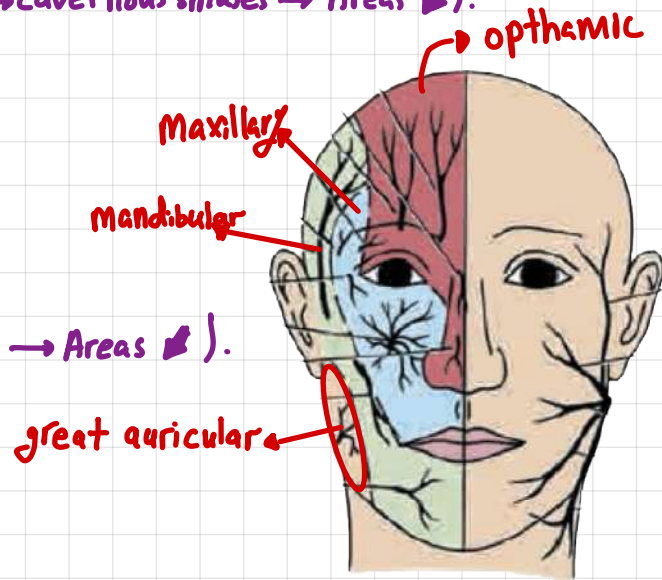
- ↳ supplies
- skin of forehead
  - part of scalp.
  - cornea.
  - eyelid.
  - nasal mucosa.
  - paranasal sinuses

② **Maxillary** (middle part of SN → Foramen rotundum → cavernous sinuses → Areas ↓).

- ↳ supplies
- upper Lip
  - skin of maxilla
  - maxillary teeth & sinuses
  - nasal mucosa
  - palate
  - lower eyelid.

③ **Mandibular** (Lower part of SN → Foramen ovale → Areas ↓).

- ↳ supplies
- All motor ↑
  - Lower Lip
  - skin of mandible & chin.
  - mandibular teeth.
  - lining of oral cavity
  - anterior 2/3 of the tongue.
  - TMJ (Temporomandibular Joint).



لا اقعدن على الطريق واشتكي . .





# ★ Recorded Lecture 10 :- cranial nerves (7,9,10,11,12) & RF.

• **facial nerve (VII)** :- Motor + sensory + parasympatic, cranial part.

Nuclei

Main motor (deep in RF in the lower part of pons)

- course :- posterior around the motor nucleus of VII & U-turn forming facial colliculus → anteriorly to pontomedullary Junction.
- upper part :- Receives from Both hemispheres.
- lower part :- Contralateral hemisphere only.



parasympathetic N (posterolateral to main motor N)

- other names :- superior salivatory lacrimatory or superior salivatory.
- Superior salivatory N :- receives from hypothalamus → sublingual & submandibular glands.
- Lacrimal N :- from hypothalamus (emotional) & sensory N of V (Reflex: foreign body → irritation)

Sensory N (upper part of tractus Solitarius N, floor of 4th ventricle) :- Anterior 2/3 of tongue by chorda tympani.

- Course :- cell bodies in geniculate ganglion (in middle ear cavity) → 1st order Neuron → upper part of tractus solitarius → 2nd order → pontomedullary Junction → VPM → primary gustatory area (43) (parietal lobe).

Course :- Anterior pontomedullary Junction → internal acoustic meatus → facial canal → inner ear → medial wall of tympanic cavity (geniculate ganglion → posterior wall of tympanic cavity → Stylohyoid foramen (+ cranial nerve VIII))

Branches :- in the middle ear.

- 1) Greater petrosal nerve** (parasympathetic N → greater petrosal foramen → middle cranial fossa → foramen lacerum (+ deep petrosal) → ptygoid canal → synapse with pterygopalatine ganglion → Maxillary nerve → Zygomatic nerve → Lacrimal nerve → Lacrimal gland.
  - Deep petrosal nerve :- sympathetic from T1 → synapse in superior cervical ganglia.

- 2) Chorda tympani Nerve** (infratemporal fossa → petrotympanic fossa (Glaserian fissure) → + Lingual nerve → Submandibular ganglia
  - Sublingual gland
  - Submandibular gland.
  - Taste Anterior 2/3 of tongue.

injury

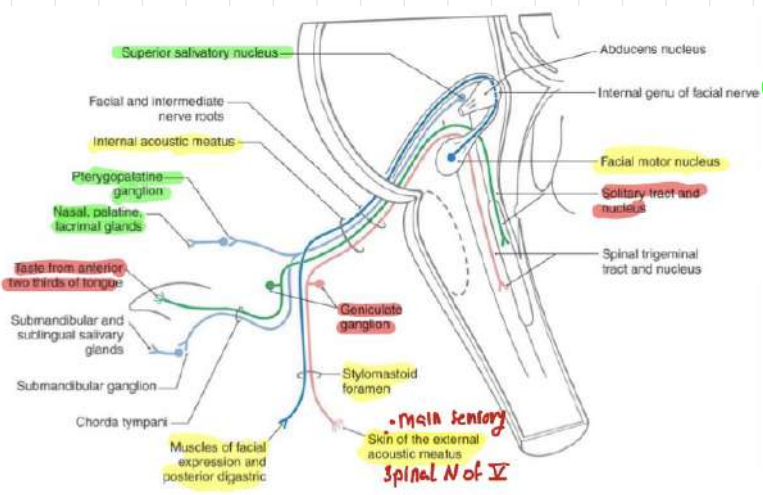
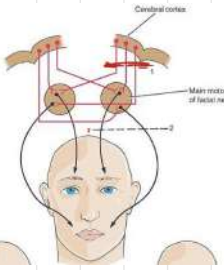
Depends on Location

- Pons (+ Abducent).
- internal acoustic meatus (+ vestibulocochlear).
- Loss of taste over Anterior 2/3 (chorda tympani).

Upper motor neuron :- ipsilateral paralysis of the face.

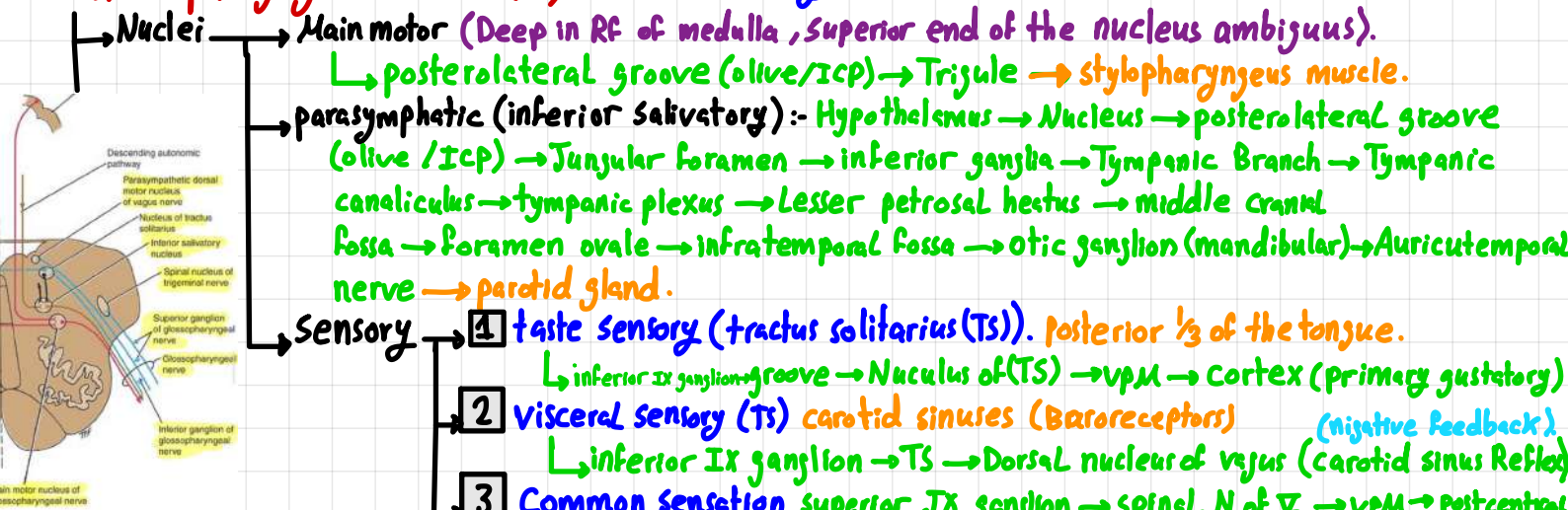
Lower motor neuron :- Contralateral paralysis of the lower face (the upper face will get innervated by the opposite hemisphere).

Bell's palsy :- unilateral, lower motor neuron type, cause is unknown (cold, DM, AIDS)

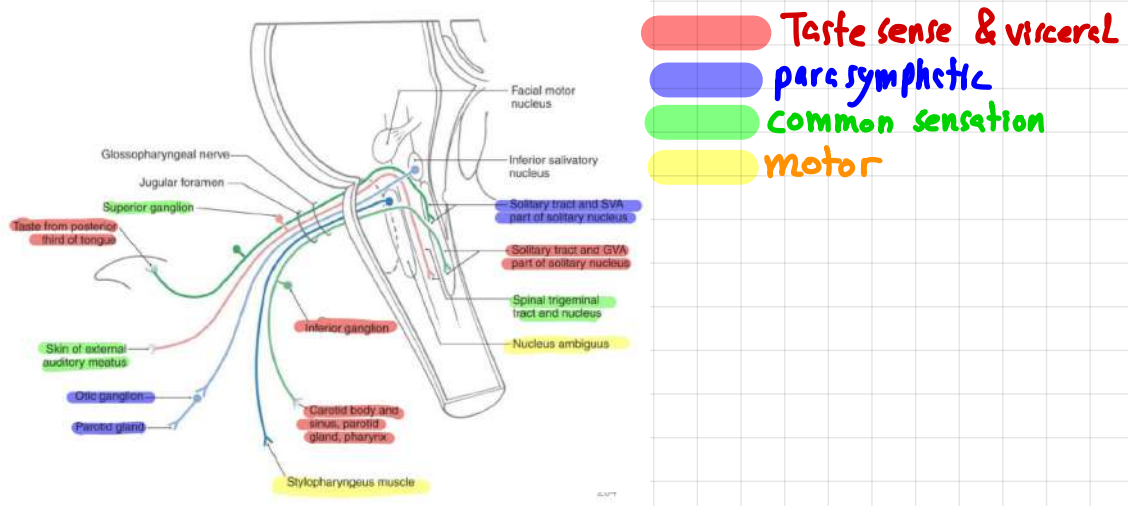


- motor.
- parasympathetic.
- sensory

**Glossopharyngeal nerve (IX) :- inferior olivary LVL.**



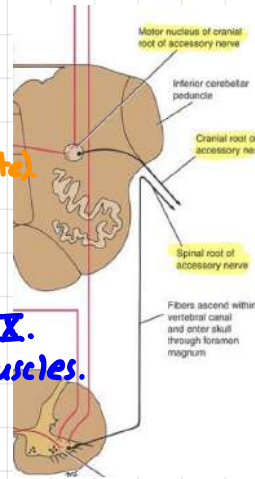
- Nuclei**
    - Main motor** (Deep in RF of medulla, superior end of the nucleus ambiguus).
      - ↳ posterolateral groove (olive/ICP) → Trigule → stylopharyngeus muscle.
    - parasympathetic (inferior salivatory) :- Hypothalamus → Nucleus → posterolateral groove (olive/ICP) → Jugular foramen → inferior ganglia → Tympanic Branch → Tympanic canaliculus → tympanic plexus → Lesser petrosal hestus → middle cranial fossa → Foramen ovale → infratemporal fossa → otic ganglion (mandibular) → Auriculotemporal nerve → parotid gland.**
    - Sensory**
      - 1 taste sensory (tractus solitarius (TS)). posterior 1/3 of the tongue.**
        - ↳ inferior IX ganglion → groove → Nuculus of (TS) → VPM → cortex (primary gustatory)
      - 2 visceral sensory (TS) carotid sinuses (Baroreceptors) (negative feedback).**
        - ↳ inferior IX ganglion → TS → Dorsal nucleus of vagus (carotid sinus Reflex)
      - 3 Common Sensation superior IX ganglion → spinal N of V → VPM → postcentral gyrus.**
        - ↳ Sensation from
          - Middle ear.
          - Auditory tube.
          - pharynx except nasopharynx (maxillary).
          - posterior 1/3 of tongue.
- 2 ganglion**
  - ↳ Superior ganglion of IX :- Common sensation.
  - ↳ inferior ganglion of IX :- taste & visceral.
- Course :- Anteriolateral upper medulla → groove (olive/ICP) → Jugular foramen → posterior border of stylopharyngeus muscle → Between superior & middle constrictors → sensory Areas.**
- Lesions**
  - ↳ Loss of pharyngeal Reflex (gag Reflex)
  - ↳ Loss of carotid sinus reflex
  - ↳ Loss of taste in posterior 1/3 of the tongue (vallate papillae).



**Vagus nerve (X) :- LVL of olivary.**

- Nuclei**
  - Main motor** (Deep in RF of medulla, Lower part of nucleus ambiguus), constrictor M of pharynx & Internal M of Larynx.
  - parasympathetic/Dorsal nucleus of vagus** (floor of 4th ventricle), Recives afferents from Hypothalamus & glossopharyngeal nerve (carotid sinus reflex).
    - Effrents to :- Bronchi, Heart, esophagus, stomach, intestine (→ distal 1/3 of transverse colon).
  - Sensory** (Lower part of nucleus TS).
    - ↳ Taste :- epiglottis → inferior ganglion of vagus → TS → VPM → postcentral gyrus.
    - ↳ Common sensation :- superior ganglion of vagus → spinal Nucleus of V (trigeminal).
      - ↳ from
        - outer ear.
        - mucosa of the Larynx.
        - Dura of posterior cranial fossa.

- Course: Groove (olive/ICP) → Jugular foramen → descends ventrically in the neck within carotid.
- Lesion
  - Uvula deviates to the healthy side
  - Hoarseness of the voice
  - Dysphagia & nasal regurgitation (muscles of pharynx).
  - Arrhythmia & irregularity in GIT (parasympathetic).



## • Accessory nerve (XI)

- Cranial Root (nucleus ambiguus), → anterior surface → olive/ICP → +vsjus (soft palate).
- Spinal Root (upper 5 cervical) :- Sternocleidomastoid & Trapezius.
- Course :- upper 5 cervical → Between anterior & posterior nerve roots of spinal nerve → foramen magnum (+cranial) → Jugular foramen → Cranial → X. Spinal → Muscles.

## • Hypoglossal nuclei (XII) (floor of 4th ventricle)

- Course: anterior surface of medulla → Between pyramid & olive → hypoglossal canal → Between internal carotid Artery & Jugular vein → Muscles of the tongue (except palatoglossus).
- genioglossus: receives from opposite cerebral hemisphere (as lower face).
- injury
  - Lower motor neuron → Tongue deviation toward the paralyzed side (no protrusion in the non healthy side).  
→ ipsilateral muscle atrophy.
  - Upper motor neuron → on protrusion tongue will deviate to the opposite side of Lesion (Protrusion by genioglossus).



## • Reticular formation: - continuous network of nerve cells & fibers extends from the spinal cord → Thalamus.

- parts
  - Median column: intermediate-size neurons.
  - Medial column: Large neurons.
  - Lateral column: Small neurons.
- General function
  - control of skeletal muscle (Reticulospinal tracts).
  - control of somatic & visceral sensations.
  - control of the autonomic nervous system (vital centers).
  - The reticular activating system (RAS).

