BRAIN STEM II

BY

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Functional classification of cranial nerve fibers & nuclei

Motor (Efferent)			Sensory (Afferent)			
Somatic	Visceral		Visceral		Somatic	
General	Special	General	General	Special	General	Special
GSE	SVE	GVE	GVA	SVA	GSA	SSA
Motor to skeletal muscles derived form somites (ms of orbit & tongue	Motor to Skeletal muscles derived from branchial arches	Motor to smooth muscles & exocrine glands (parasympathetic)	sensation from viscera (mechanicl, pain, temperature& proprioception	taste sensation & olfaction	somatic sensation as touch, pain & temperature& proprioception	vision, hearing & equilibrium

❖ Motor(efferent):

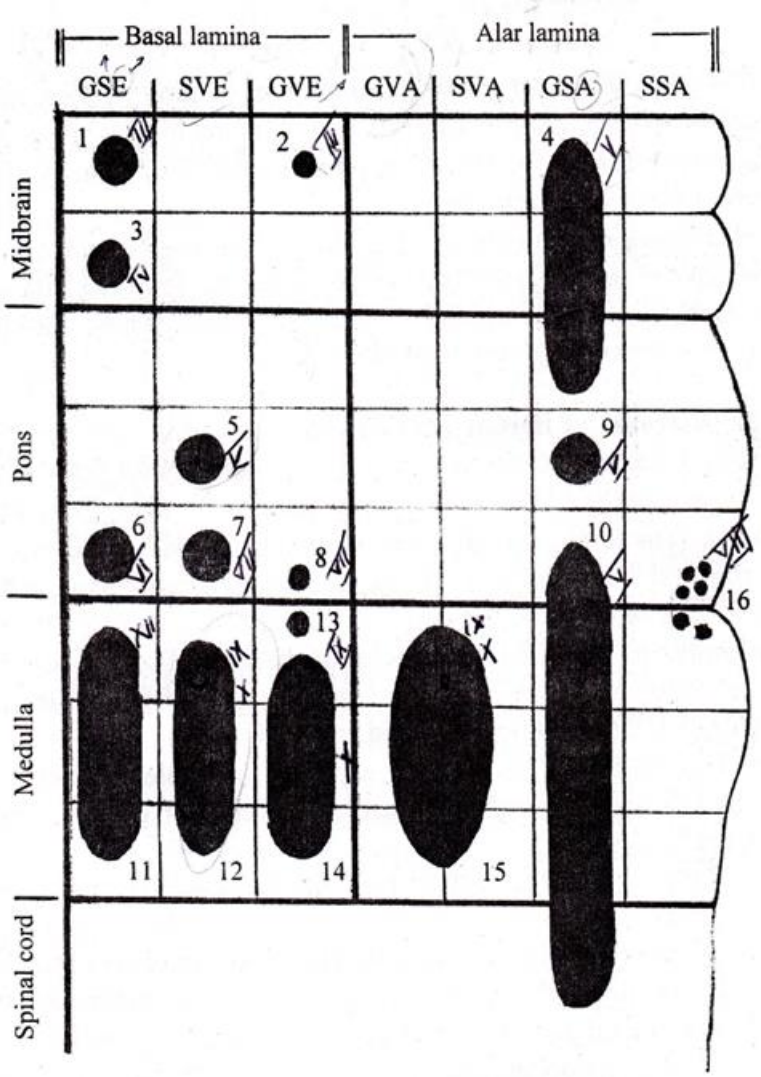
1. **GSE: Motor to skeletal muscles derived form somites (ms of orbit& tongue)**
2. **SVE: Motor to Skeletal muscles derived from branchial arches**
3. **GVE: Motor to smooth muscles & exocrine glands(parasympathetic)**

❖ Sensory(afferent):

1. **GVA: sensation from viscera (mechanicl, pain& proprioception)**
2. **SVA: taste sensation & olfaction**
3. **GSA: somatic sensation as touch, pain & temperature& proprioception**
4. **SSA: vision, hearing & equilibrium**

Brain stem nuclei

1 . Oculomotor nucleus.
2 . Edinger-Westphal nucleus.
3 . Trochlear nuclus.
4 . Mesencephalic nucleus.
5 . Motor nucleus of trigeminal.
6 . Abducent nucleus.
7 . Facial nucleus.
8 . Superior salivary nucleus.
9 . Main sensory nucleus of trigeminal.
10. Spinal nucleus of trigeminal.
11. Hypoglossal nucleus.
12. Nucleus ambiguus.
13. Inferior salivary nucleus.
14. Dorsal nucleus of vagus.
15. Solitary nucleus.
16. Vestibular and cochlear nuclei.



General Somatic Efferent (GSE) column

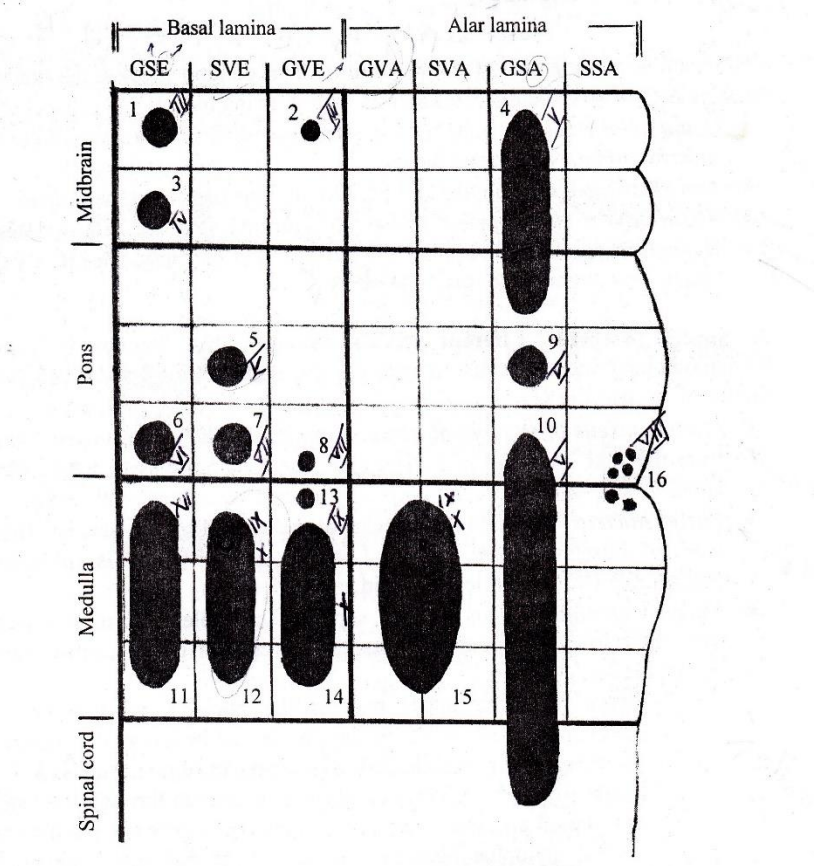
- **This column supplies the skeletal muscles derived from somites. It includes the following nuclei:**

1. Oculomotor nucleus: Supplies the extrinsic muscles of the eyeball except superior oblique and lateral rectus.

2. Trochlear nucleus: Supplies the superior oblique muscle of the eyeball.

3. Abducent nucleus: Supplies the lateral rectus muscle of the eyeball.

4. Hypoglossal nucleus: Supplies all intrinsic and extrinsic muscles of the tongue except palatoglossus.

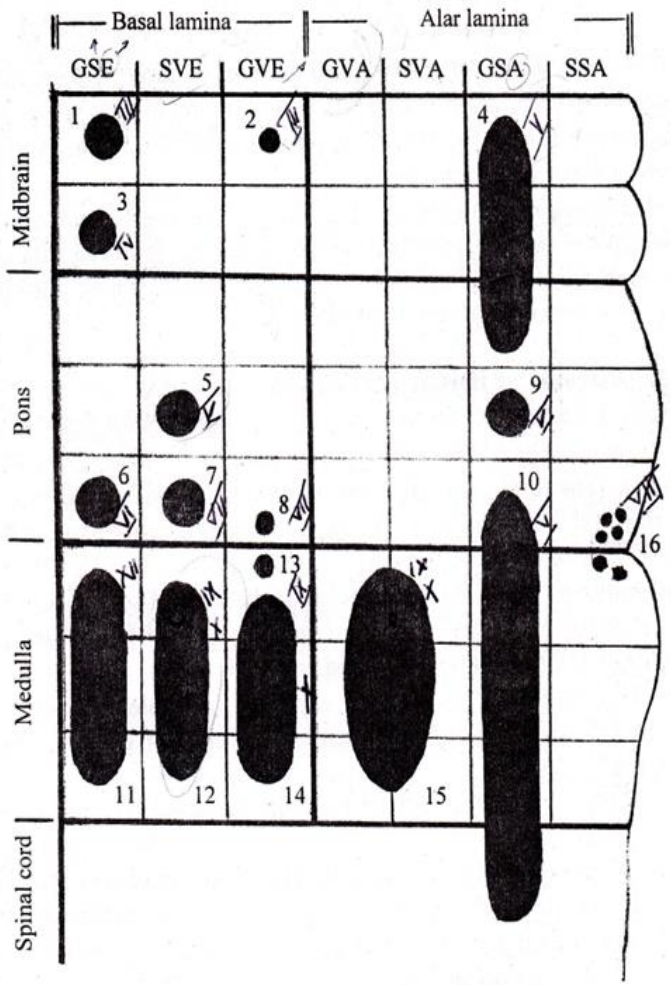


Special Visceral Efferent (SVE) column

- **This column is called branchiomotor column because it supplies the skeletal muscles derived from branchial or pharyngeal arches. This column includes the following nuclei:**

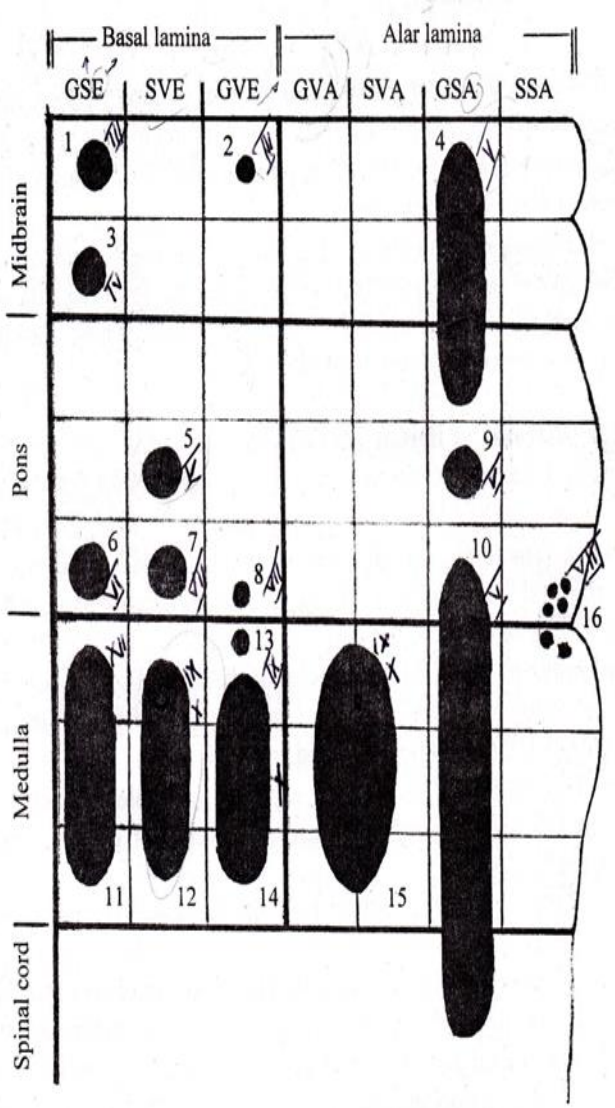
1. Motor nucleus of trigeminal nerve: **Supplies the skeletal muscles derived from the first branchial arch. These are the four muscles of mastication, anterior belly of digastric, mylohyoid, tensor palati and tensor tympani.**

2. Facial nucleus: Supplies the muscles of the second branchial arch. These are the muscles of the face and auricle, occipitofrontalis, platysma, posterior belly of digastric, stylohyoid and stapedius.



3. Nucleus ambiguus: This nucleus supplies the skeletal muscles derived from the third, fourth and sixth branchial arches. It gives fibers to three cranial nerves:

- Fibers from the upper part of the nucleus run through the glossopharyngeal nerve to supply the stylopharyngeus
- Fibers from the greater part of the nucleus run through the vagus and cranial accessory nerves to supply the muscles of the pharynx (except stylopharyngeus), muscles of the palate (except tensor palati) and intrinsic muscles of the larynx.

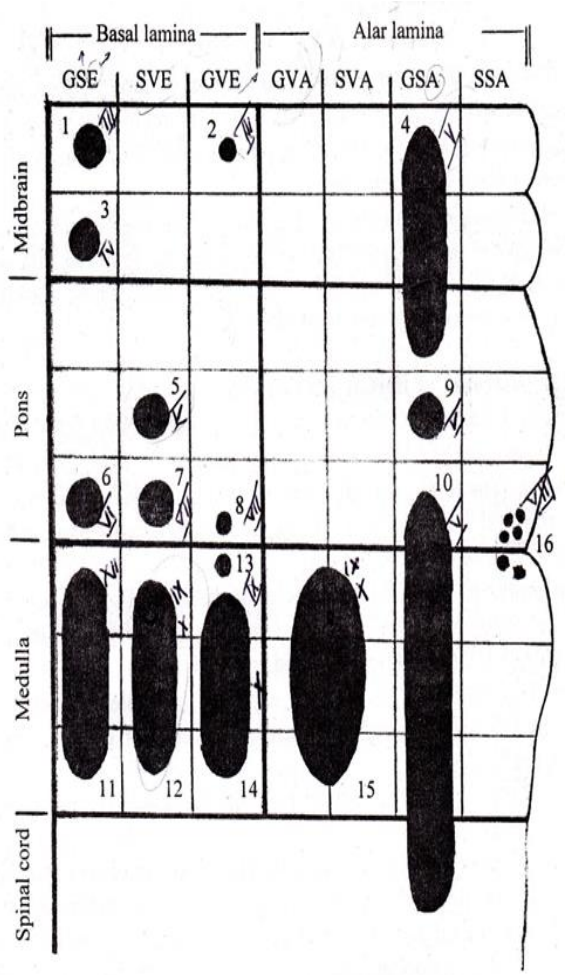


General Visceral Efferent (GVE) column

- **This column supplies the smooth muscles and exocrine glands. It is called parasympathetic column as it forms the cranial outflow of the parasympathetic nervous system. Its nuclei give preganglionic parasympathetic fibers to the glands and smooth muscles of the viscera. This column includes the following nuclei:**

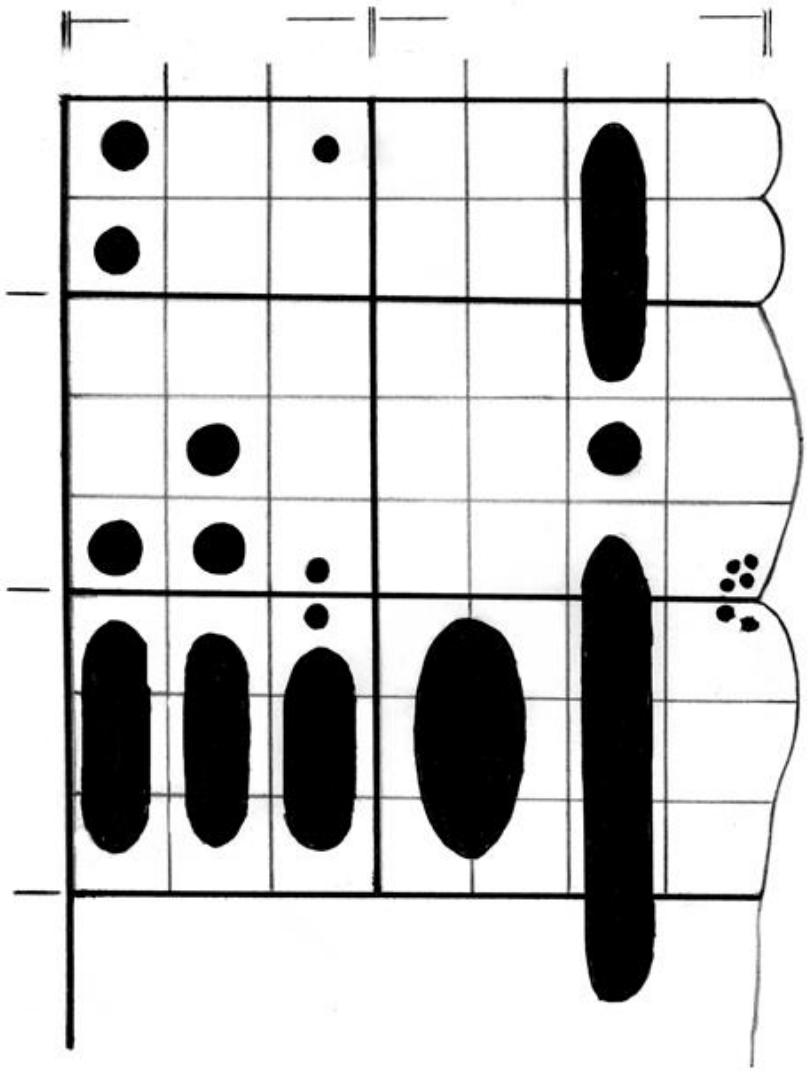
1. Edinger-Westphal nucleus: It is the parasympathetic part of the oculomotor nerve. This nucleus gives preganglionic motor fibers to the constrictor of the pupil and ciliary muscle.

2. Superior salivary nucleus: It gives preganglionic secretomotor fibers to the lacrimal, nasal, palatine, buccal, submandibular and sublingual glands. These fibers are carried by the facial nerve



3. Inferior salivary nucleus: It gives preganglionic secretomotor fibers to the parotid gland, which are carried by the glossopharyngeal nerve.

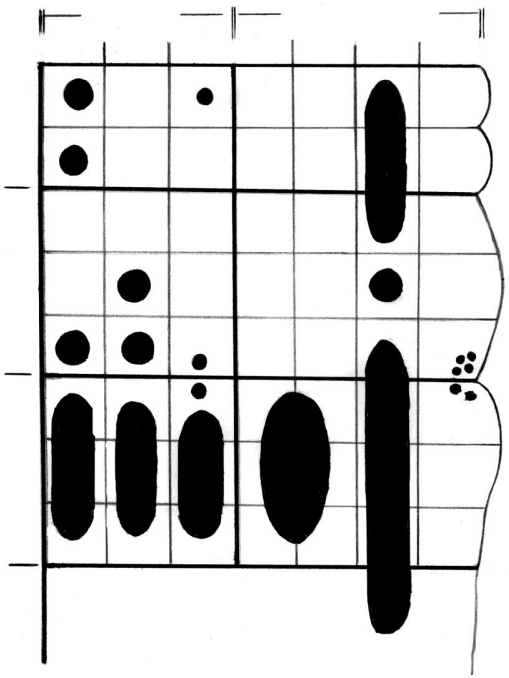
4. Dorsal nucleus of vagus: It gives preganglionic parasympathetic motor fibers to the bronchial tree, abdominal viscera, and gastrointestinal tract till the junction of the right two thirds and left third of the transverse colon. It also gives preganglionic parasympathetic inhibitory fibers to the heart.



General Visceral Afferent (GVA) column

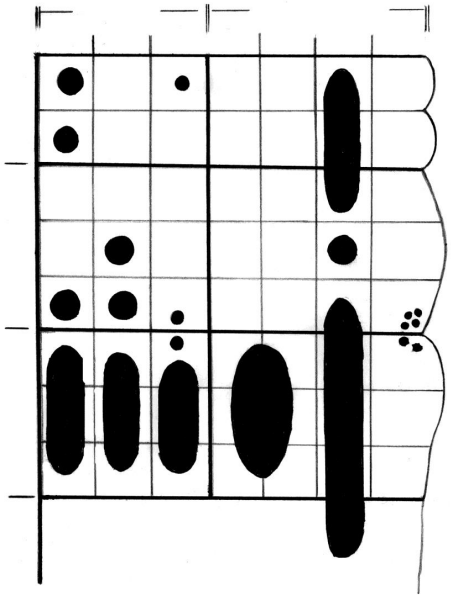
- **This column receives sensation from the viscera.**

- **This column is represented by the solitary nucleus (=nucleus of the tractus solitarius).**
- **The upper part of this nucleus receives general sensory fibers running in the glossopharyngeal nerve**
- **The lower and greater part of the nucleus receives general visceral sensory fibers running in the vagus nerve; these fibers carry general sensation from the respiratory tract, abdominal viscera and gastrointestinal tract till the junction of the right two-thirds and left third of the transverse colon.**



Special Visceral Afferent (SVA) column

- **This column receives taste sensation from the tongue and epiglottis. It is also represented by the solitary nucleus. This nucleus receives taste fibers running through three nerves:**



- **Taste fibers from the anterior two-thirds of the tongue which are carried through the chorda tympani branch of facial nerve.**
- **Taste fibers from the posterior third of the tongue which are carried through the lingual branches of glossopharyngeal nerve.**
- **Taste fibers from the most posterior part of the tongue and epiglottis as well as vallecula which are carried through the internal laryngeal branch of vagus nerve**

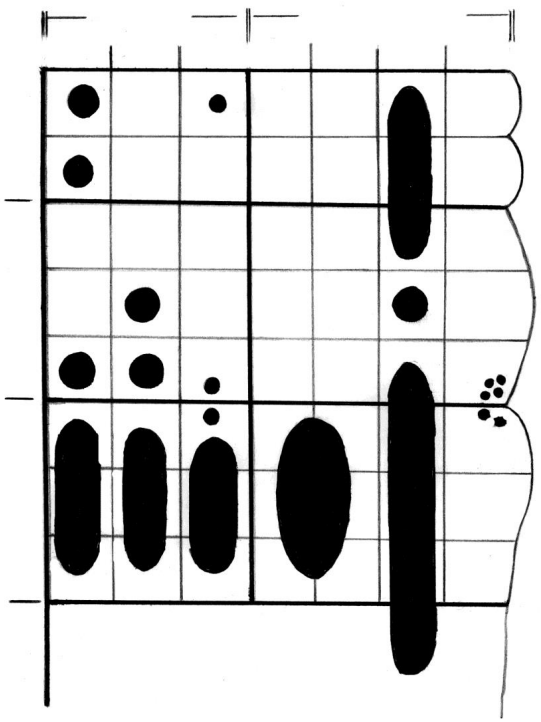
General Somatic Afferent (GSA) column

- **This column receives general somatic sensations from the head and face.** It includes the three sensory trigeminal nuclei:

1. Mesencephalic nucleus: This nucleus is responsible for carrying proprioceptive sensation from the head.

2. Main sensory nucleus: This nucleus is responsible for receiving touch sensation from the head.

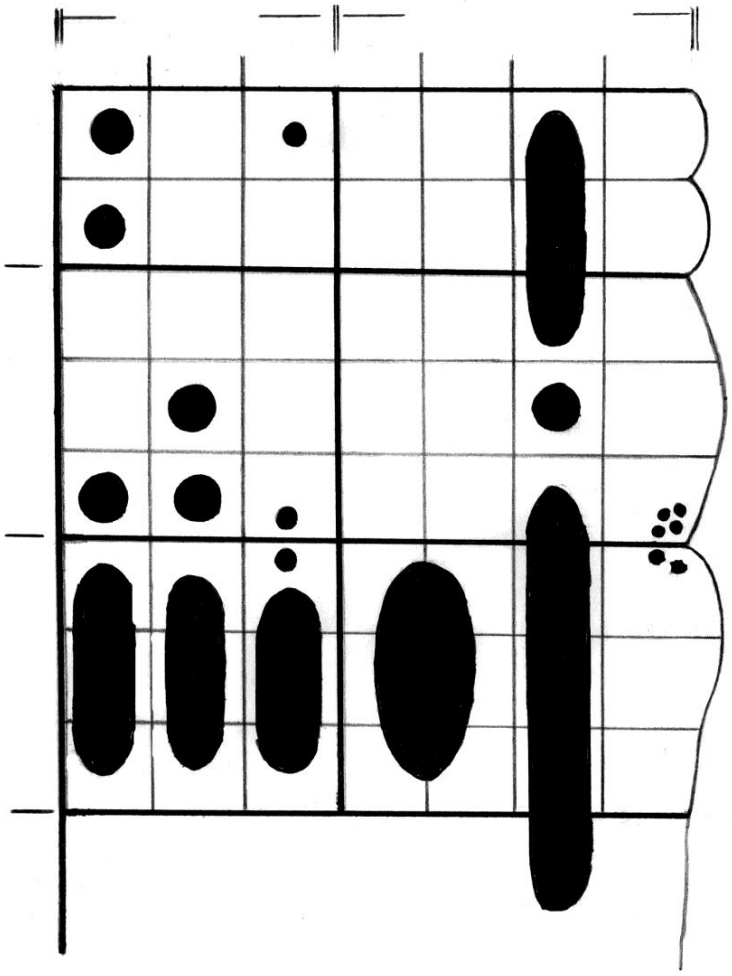
3. Spinal nucleus of trigeminal: This nucleus receives pain and temperature sensation from the head



Special Somatic Afferent (SSA) column

- **This column receives special types of sensation from the head. This column include two groups of nuclei:**

1. ***Vestibular nuclei:*** **Which receives vestibular impulses (responsible for equilibrium)**
2. ***2. Cochlear nuclei:*** **Which receive auditory impulses from the cochlea.**



Functional components of cranial nerves

1 . Olfactory nerve (SVA):

It arises from the bipolar neurons located in the nasal mucosa, the olfactory epithelium.

II. Optic nerve (SSA):

It consists of axons of neurons located in the ganglion cell layer of the retina.

III. Oculomotor nerve:

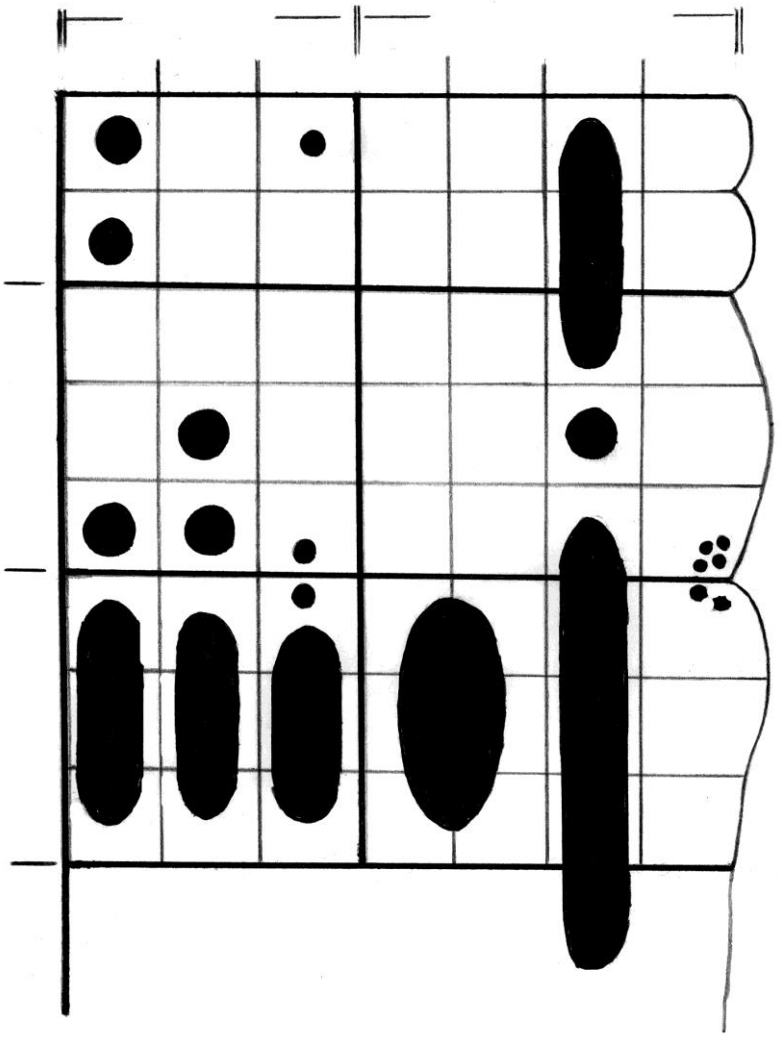
1. Oculomotor nucleus (GSE).
2. Edinger-Westphal nucleus (GVE).

IV. Trochlear nerve:

1. Trochlear nucleus (GSE).

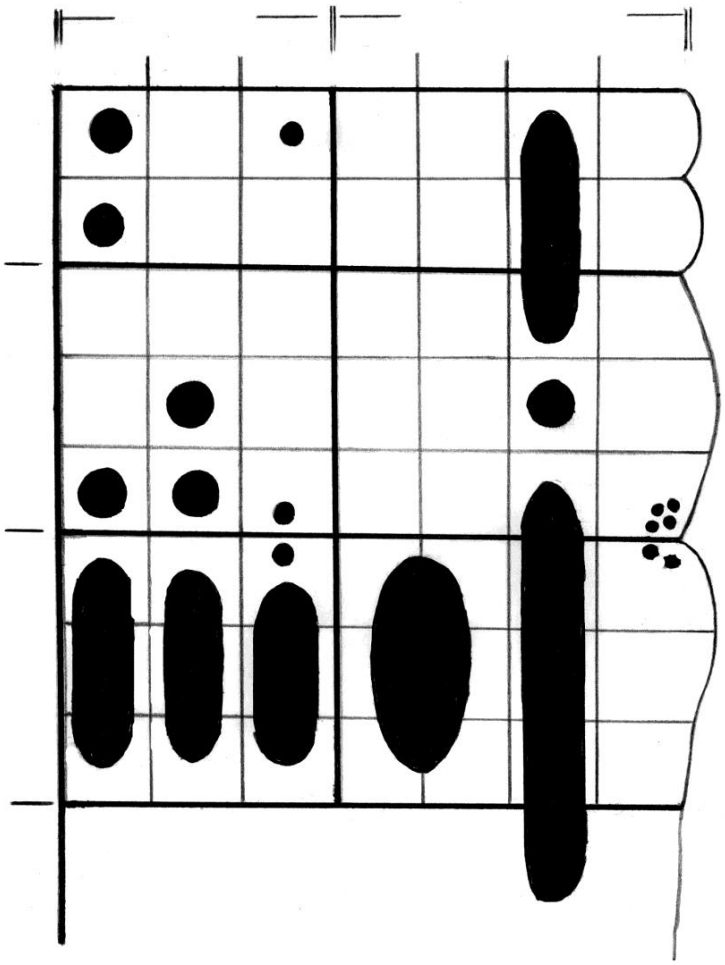
VI. Abducent nerve:

1. Abducent nucleus (GSE).



V. Trigeminal nerve:

1. Motor nucleus of trigeminal (SVE).
2. Main sensory nucleus of trigeminal (GSA; touch).
3. Mesencephalic nucleus (GSA; proprioceptive).
4. Spinal nucleus of trigeminal (GSA; pain & temp.).



VII . Facial nerve:

1. Facial nucleus (SVE).
2. Superior salivary nucleus (GVE).
3. Solitary nucleus (SVA).

VIII. Vestibulocochlear nerve (SSA):

It consists of two functional divisions: the vestibular nerve and the cochlear nerve.

IX. Glossopharyngeal nerve:

1. Nucleus ambiguus (SVE).
2. Inferior salivary nucleus (GVE).
3. Solitary nucleus (GVA & SVA).
4. Spinal nucleus of trigeminal (GSA).

X. Vagus nerve:

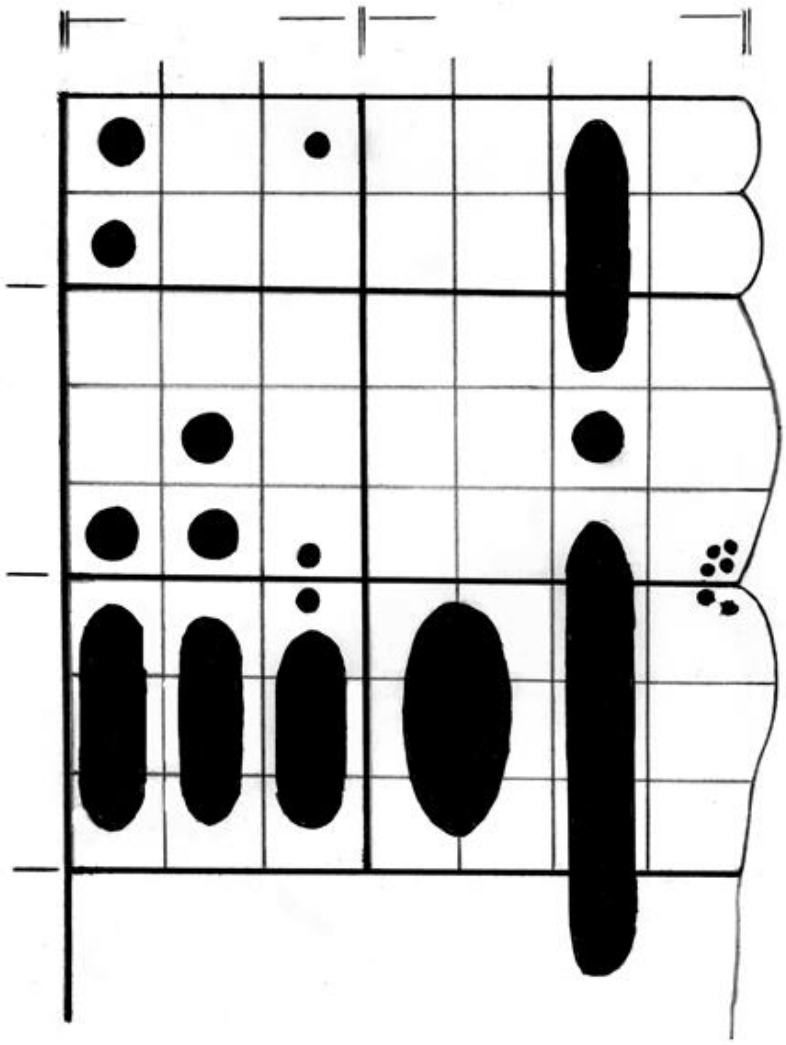
1. Nucleus ambiguus (SVE).
2. Dorsal nucleus of vagus (GVE).
3. Solitary nucleus (GVA & SVA).
4. Spinal nucleus of trigeminal (GSA).

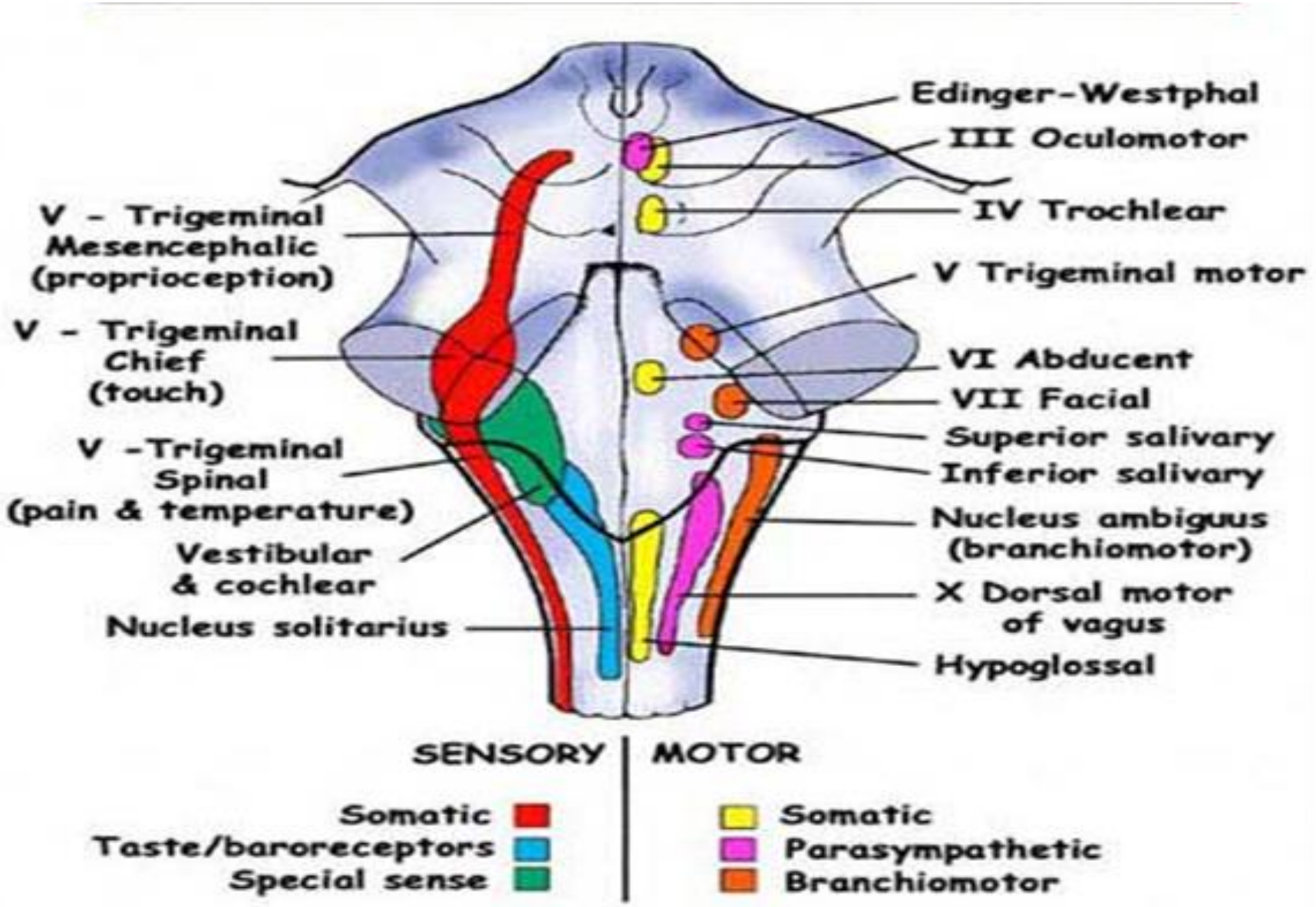
XI. Accessory nerve:

1. Cranial part: From nucleus ambiguus (SVE).
2. Spinal part: From anterior horn cells of the upper 5 or 6 cervical spinal segments.

XII. Hypoglossal nerve:

1. Hypoglossal nucleus (GSE).




Edinger-Westphal
III Oculomotor
IV Trochlear
V Trigeminal motor
VI Abducent
VII Facial
Superior salivary
Inferior salivary
Nucleus ambiguus (branchiomotor)
X Dorsal motor of vagus
Hypoglossal
V - Trigeminal Mesencephalic (proprioception)
V - Trigeminal Chief (touch)
V -Trigeminal Spinal (pain & temperature)
Vestibular & cochlear
Nucleus solitarius
SENSORY
MOTOR
Somatic
Taste/baroreceptors
Special sense
Somatic
Parasympathetic
Branchiomotor

Internal structure of the medulla

- The medulla presents the following features:

Nuclei present in the medulla

A. Cranial nerve nuclei:

1. Hypoglossal nucleus.
2. Nucleus ambiguus.
3. Dorsal nucleus of vagus.
4. Solitary nucleus.
5. Inferior salivary nucleus.
6. Spinal nucleus of trigeminal.
7. Inferior & medial vestibular nuclei.

B. Others:

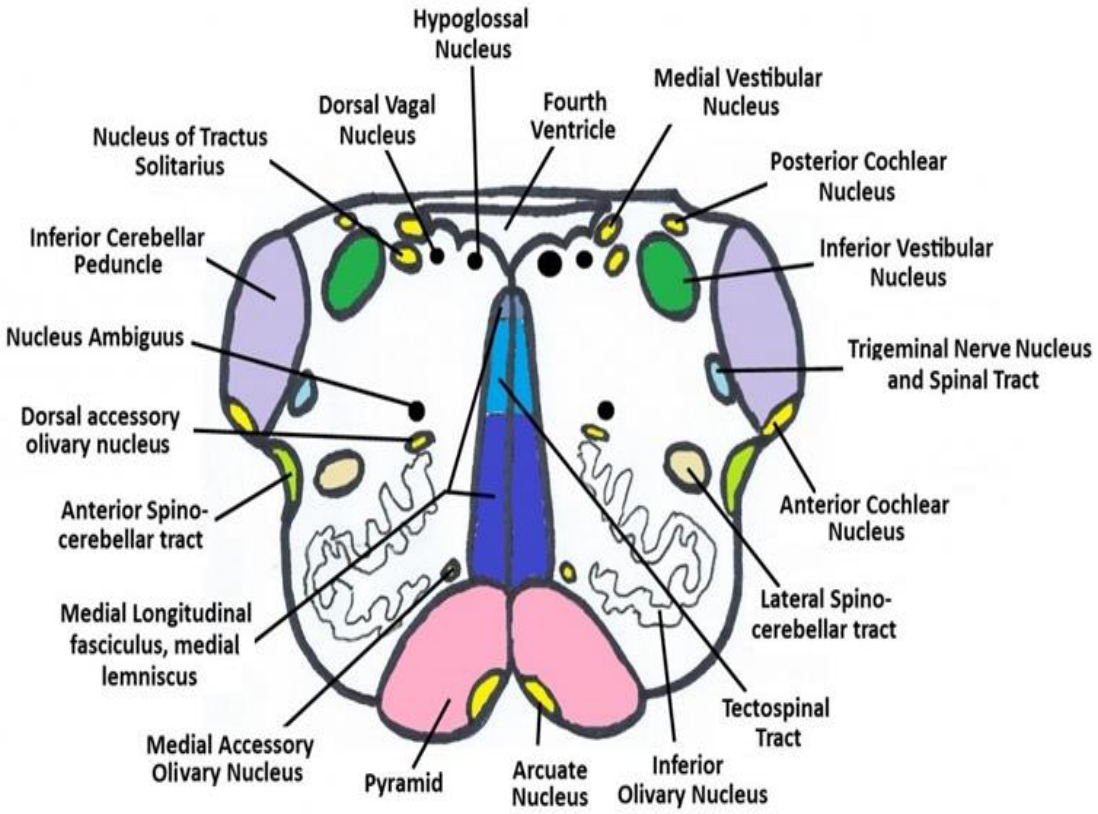
1. Inferior olivary nucleus.
2. Gracile & cuneate nuclei.
3. Accessory cuneate nucleus.
4. Arcuate nuclei.

Infeior olivary complex:

The most characteristic nuclear structure in the medulla is the inferior olivary complex. consists of 3 parts:

1) The inferior olivary nucleus appearing as folded bag with the opening or hilus directed medially,
2) A medial accessory olivary nucleus, and
3) A dorsal accessory olivary nucleus.

The most important efferent fibres arising from ION are the olivo-cerebellar fibers.

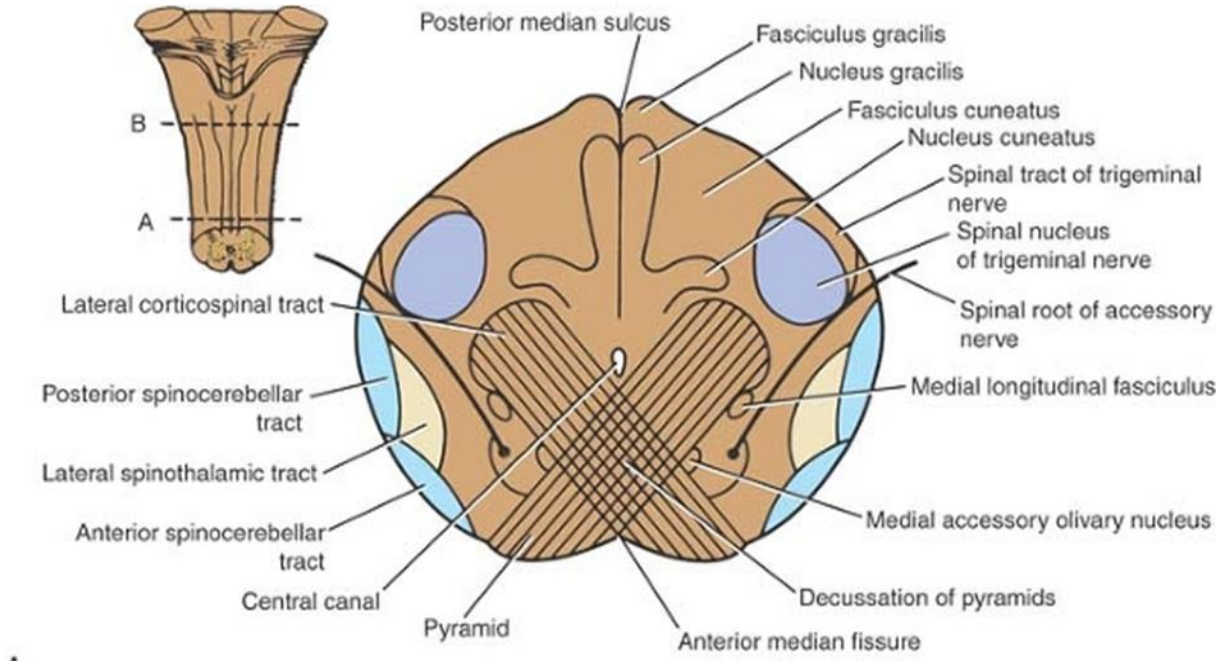


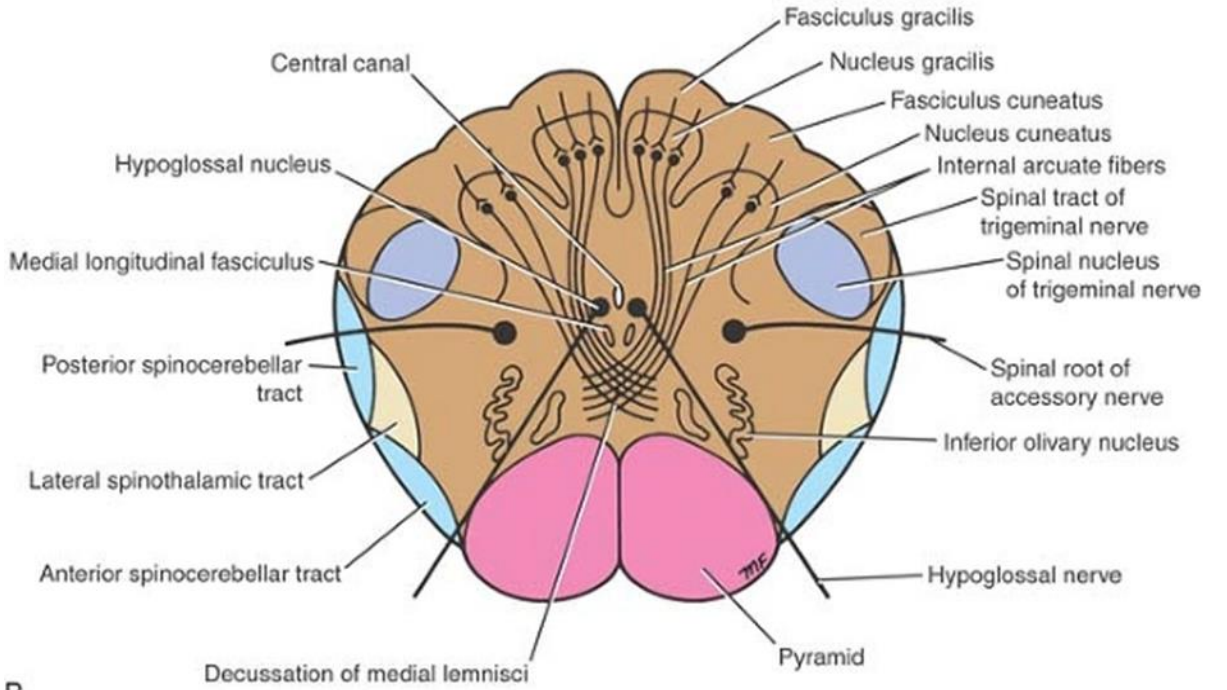
2. Gracile and cuneate nuclei:

They receive the fibers of the gracile and cuneate tracts, and give rise to the internal arcuate fibers which cross the midline forming the sensory decussation; then ascend upwards as medial lemniscus.

3. Accessory cuneate nucleus:

It is a small nucleus situated just lateral to the cuneate nucleus.





Internal structure of the pons

- **The pons is formed of 2 main parts:**

A. Ventral part called basilar part or basis pontis: **The contents of this part appears to be constant in the 3 levels.**

B. Dorsal part called tegmentum: **Which is continuous with the tegmentum of the midbrain. Its contents vary in the 3 levels of the pons.**

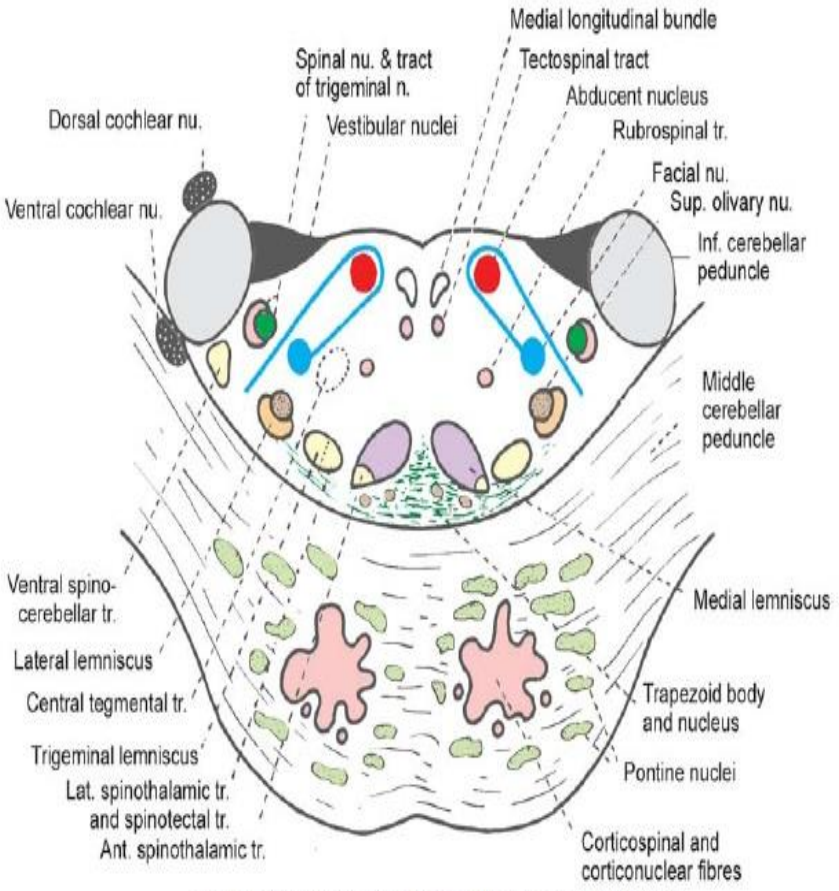


Fig. 11.5. Transverse section through the lower part of the pons.

A. Basilar Part (basis pontis):

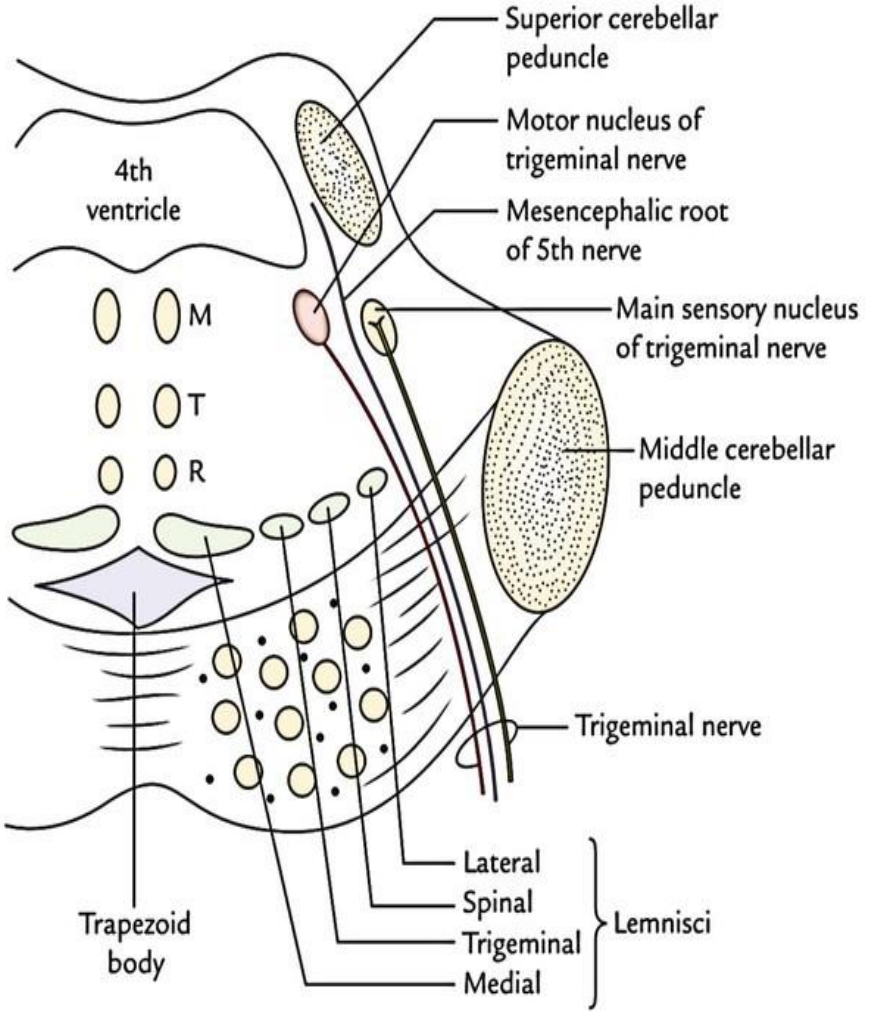
It is the larger ventral part of the pons; the contents of which are:

1. Bundles of the pyramidal tract.

2. Corticopontine fibers: **These fibers descend from the different lobes of the cerebrum. They include frontopontine, parietopontine, occipitopontine and tempropontine fibers.**

3. Nuclei pontis: **These are groups of small neurons receive the terminations of the corticopontine fibers on the same side. Axons of the cells of the nuclei pontis cross to the opposite side**

4. Transverse pontine fibers: **These are the axons of the nuclei pontis. They cross to the opposite side and form the bulk of the middle cerebellar peduncle**



B. Tegmentum:

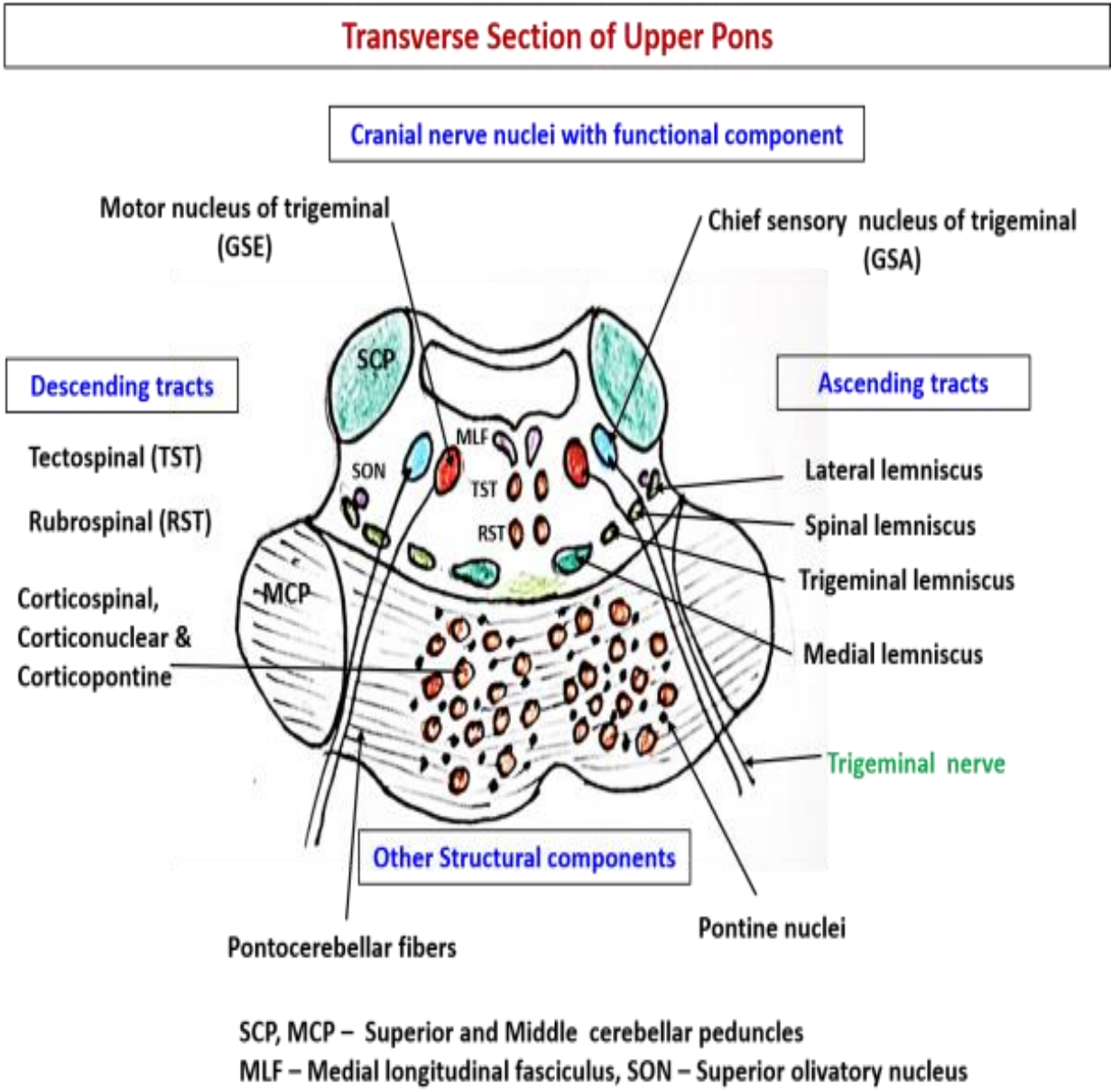
This is the smaller dorsal part of the pons. Its contents vary in the 3 levels of the pons. It contains the following structures:

I. *Tracts*

II. *Cranial nerve nuclei:* These include:

1. Trigeminal nuclei.
2. Abducent nucleus.
3. Facial nucleus.
4. Superior salivary nucleus.
5. Vestibular nuclei.
6. Cochlear nuclei.

III. *Lemnisci:* These are trigeminal, spinal, medial and lateral lemnisci (will be given later).



Internal structure of the midbrain

A. Ventral part:

1. Crus Cerebri:

Notice the fibers passing through in transverse section.

2. Substantia nigra:

. It is an extrapyramidal center.

3. Tegmentum:

It contains a mixture of grey matter nuclei and white matter tracts scattered in the reticular formation. Therefore, its contents are:

a. Cranial nerve nuclei:

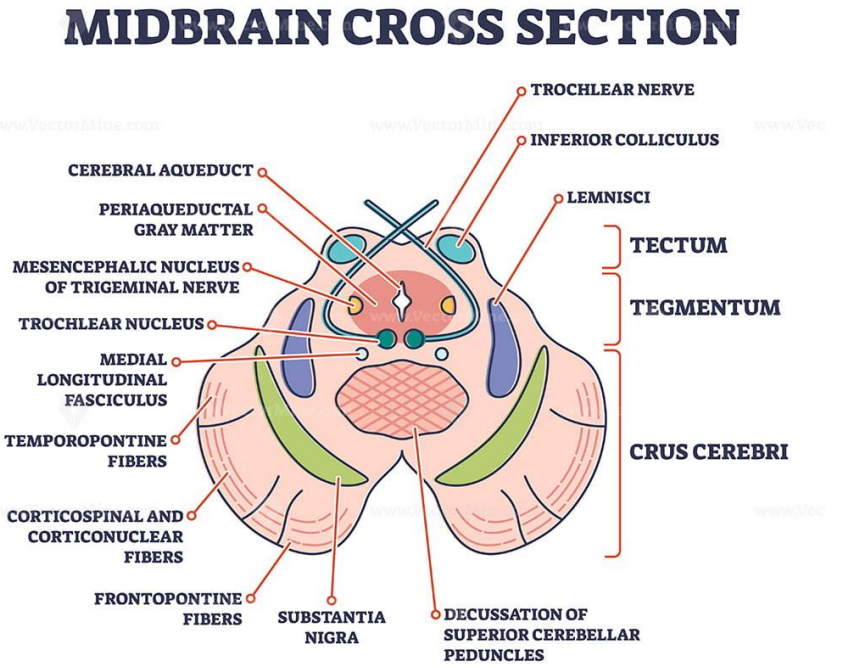
- Oculomotor and Edinger-Westphal nuclei
- Trochlear nucleus.
- Mesencephalic nucleus.

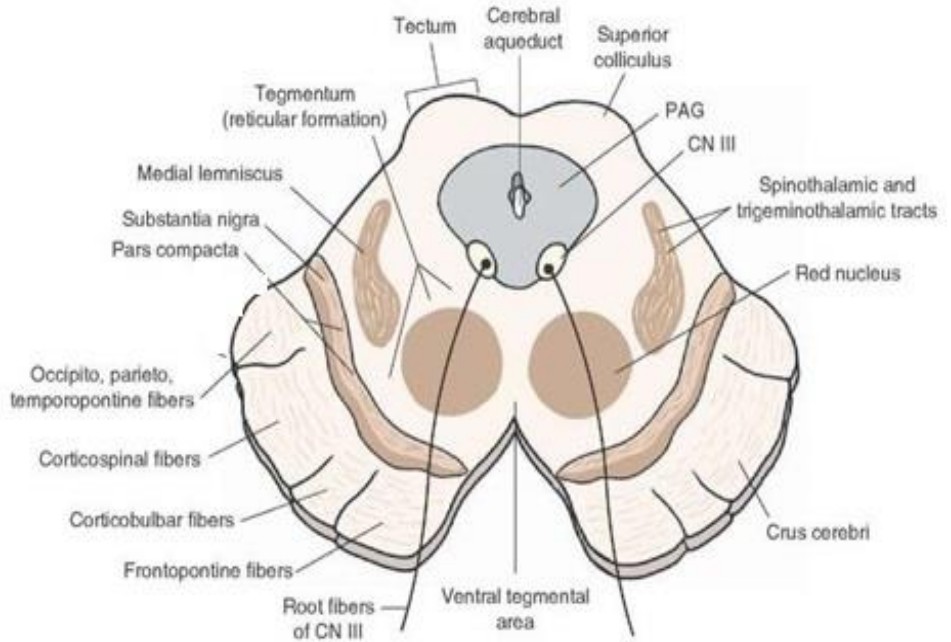
b. Red nucleus.

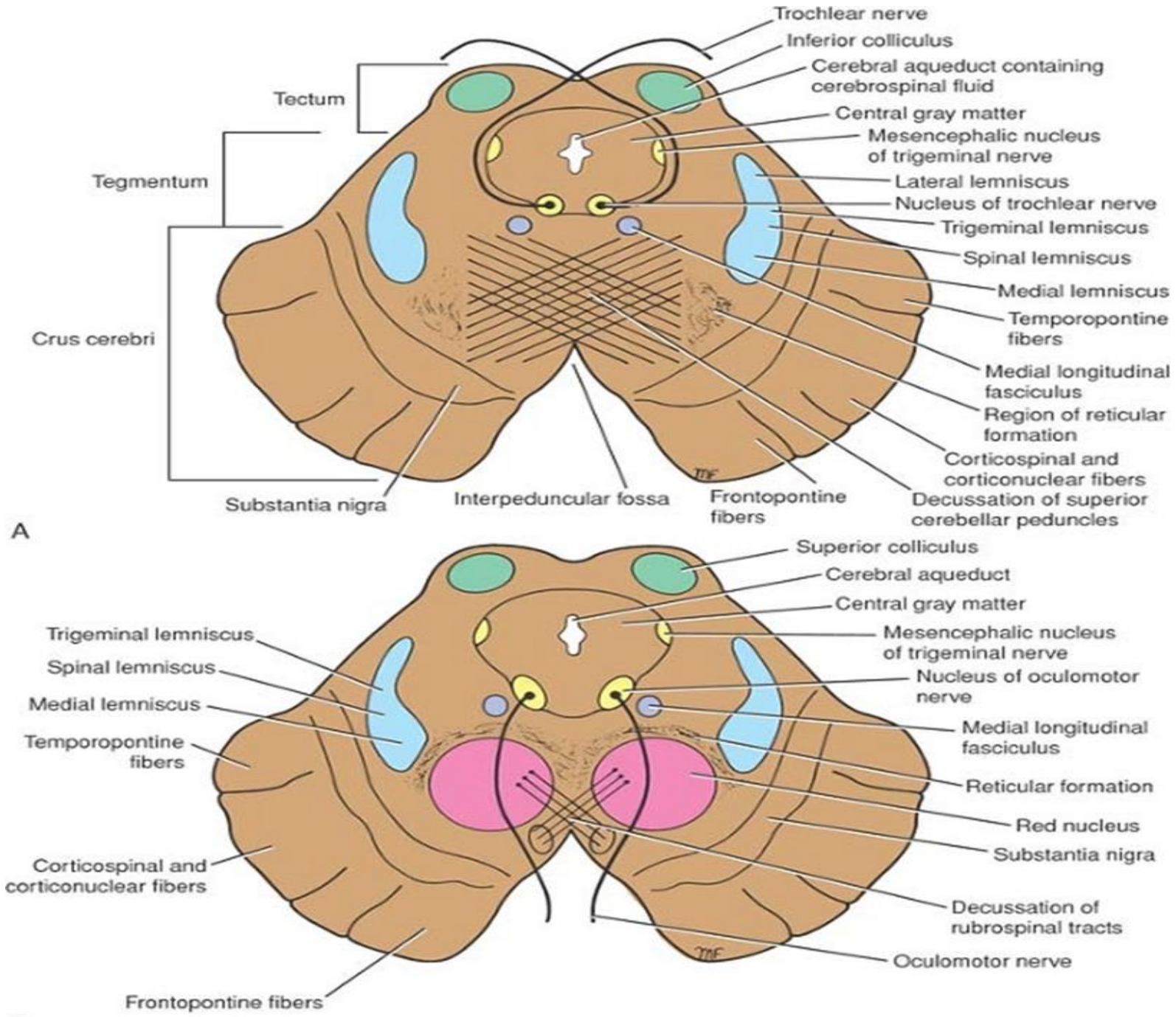
c. Decussations:

- Decussation of superior cerebellar peduncles (at the lower level).
- Dorsal tegmental decussation (at the upper level).
- Ventral tegmental decussation (at the upper level).

d. Tracts & bundles.



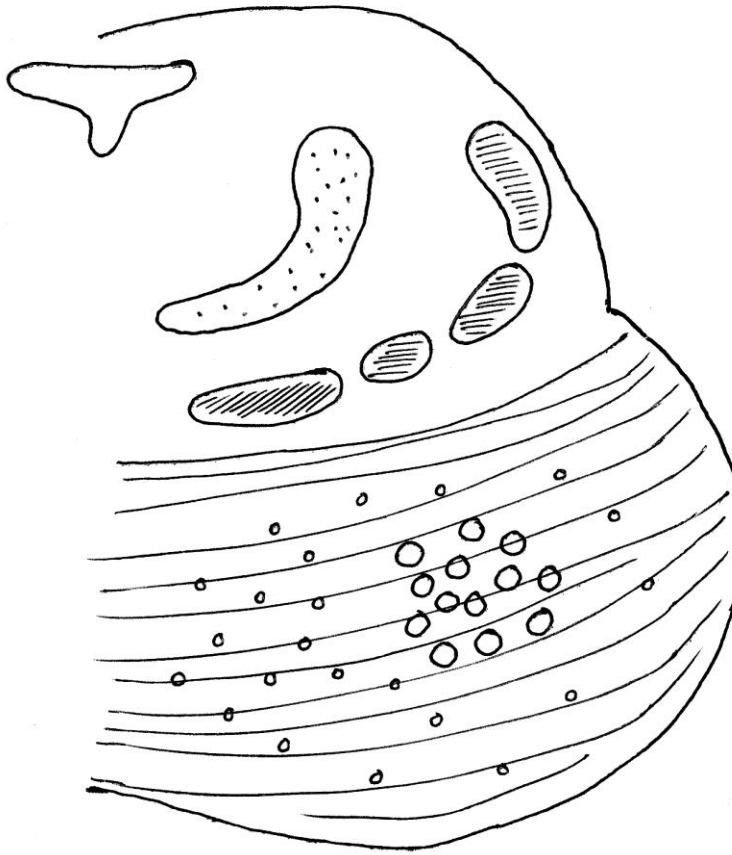



Trochlear nerve
Inferior colliculus
Cerebral aqueduct containing cerebrospinal fluid
Tectum
Central gray matter
Mesencephalic nucleus of trigeminal nerve
Tegmentum
Lateral lemniscus
Nucleus of trochlear nerve
Trigeminal lemniscus
Spinal lemniscus
Medial lemniscus
Temporopontine fibers
Crus cerebri
Medial longitudinal fasciculus
Region of reticular formation
Corticospinal and corticonuclear fibers
Decussation of superior cerebellar peduncles
Substantia nigra
Interpeduncular fossa
Frontopontine fibers
A
Superior colliculus
Cerebral aqueduct
Central gray matter
Trigeminal lemniscus
Mesencephalic nucleus of trigeminal nerve
Spinal lemniscus
Nucleus of oculomotor nerve
Medial lemniscus
Temporopontine fibers
Medial longitudinal fasciculus
Reticular formation
Red nucleus
Corticospinal and corticonuclear fibers
Substantia nigra
Decussation of rubrospinal tracts
Oculomotor nerve
Frontopontine fibers
B

Lemnisci

- The lemnisci are formed of ascending sensory fibers as they pass through the brainstem. There are 4 lemnisci. They are arranged from medial to lateral as follows:

- **Medial lemniscus:** These are the axons of the gracile and cuneate tracts as well as the ventral spinothalamic tract.
- **Trigeminal lemniscus:** These are the axons of the spinal nucleus and the main sensory nucleus of the trigeminal.
- **Spinal lemniscus:** These are the axons of the lateral spinothalamic tract.
- **Lateral lemniscus:** These are the axons of the trapezoid and superior olivary nuclei.



Decussations

- **Motor decussation: Decussation of the corticospinal fibers at the lower level of the medulla.**
- **Sensory Decussation: Decussation of the axons of the gracile and the cuneate nuclei which form the internal arcuate fibers. They decussate at the middle level of the medulla.**
- **Decussation of the superior cerebellar peduncle: Lies at the lower level of the midbrain. These are the axons of the dentate nucleus crossing to the opposite side to reach the red nucleus and the thalamus.**
- **Ventral tegmental decussation: Lies at the upper level of the midbrain. It is formed by the decussating rubrospinal and rubroreticular tracts.**
- **Dorsal tegmental decussation: Lies at the upper level of the midbrain. It is formed by the decussating tectospinal and tectobulbar tracts.**

THANK YOU

BEST WISHES