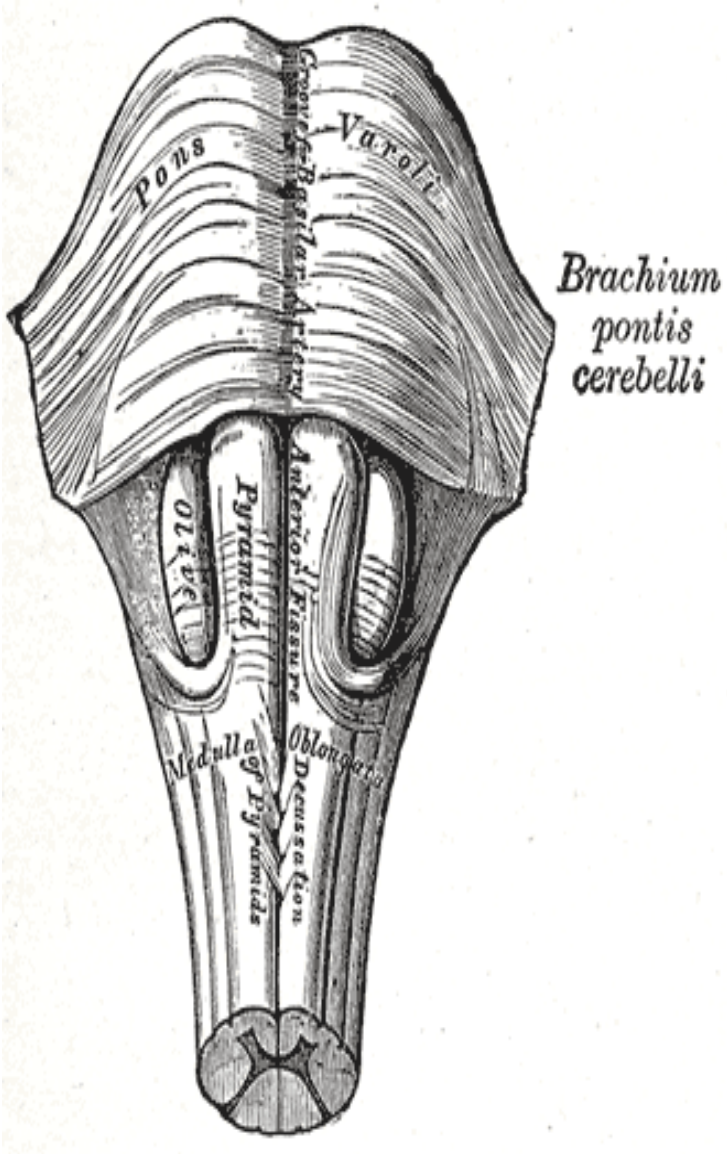
Pons

- Located anterior to cerebellum
- 1 inch long
- Anterior surface is convex &

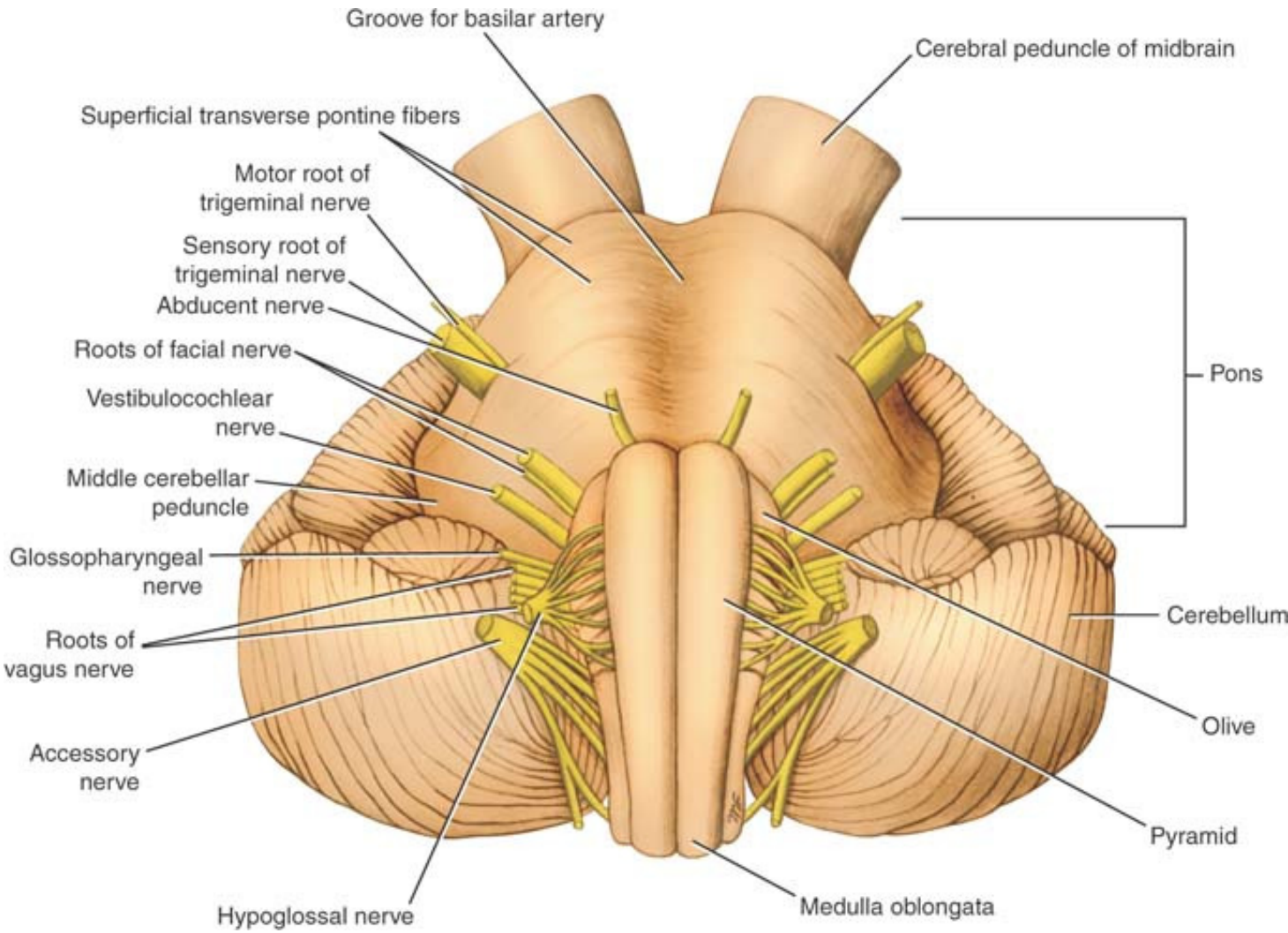
shows transverse fibers that converge on each side to form middle cerebellar peduncle

- Located between the midbrain and medulla oblongata
- Contains the nuclei of cranial nerves V, VI, VII and VIII



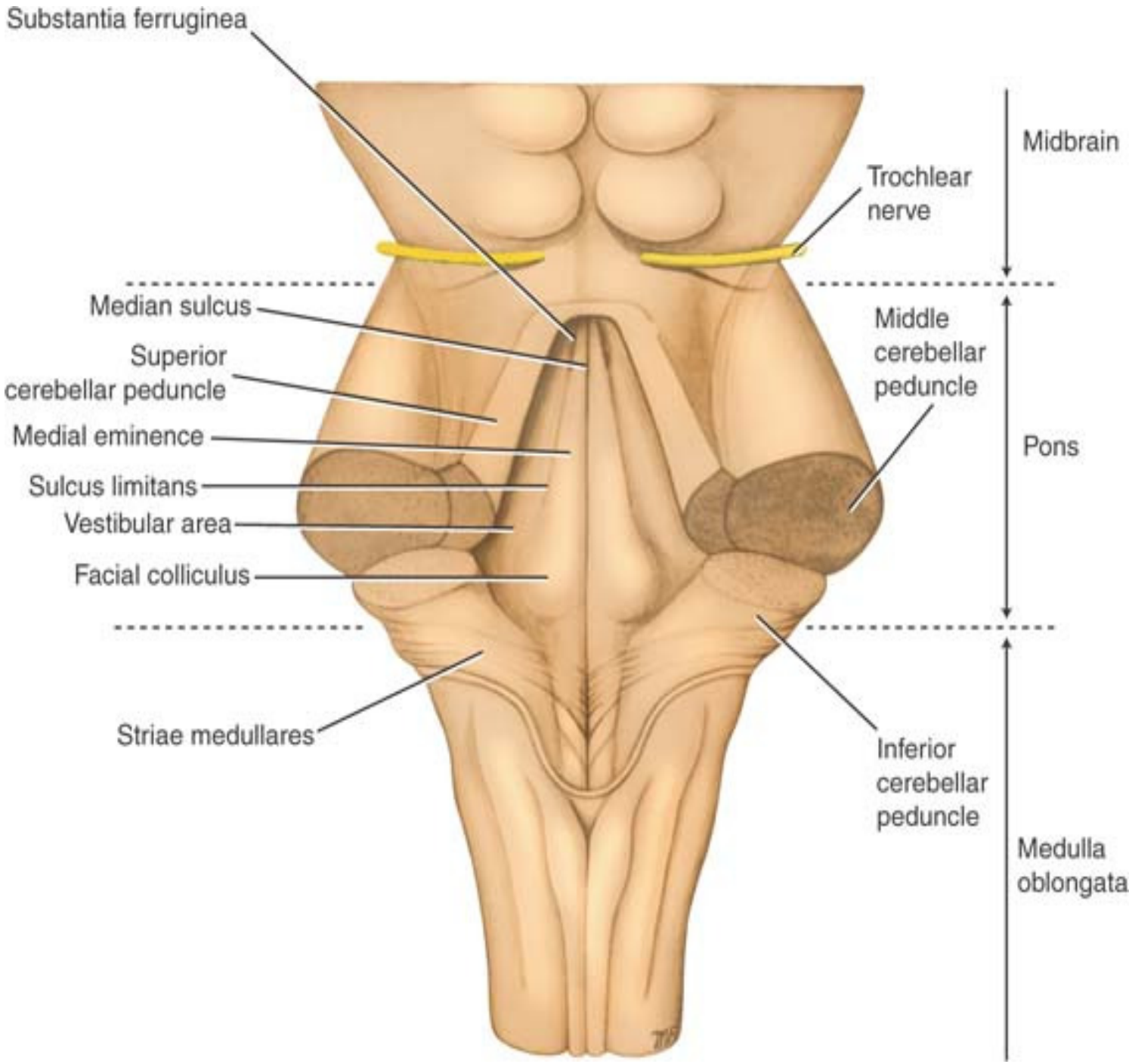
Gross appearance (anterior surface)

- Basilar groove (midline)..lodges basilar artery
- 5th nerve emerges from anterolateral surface (small motor (medial) and large sensory (lateral)
- 6th 7th & 8th emerges at pontomedullary junction M→L



Pons (posterior view)

- Its hidden by from view by cerebellum
- Forms the upper half of floor of 4th ventricle
- Triangular in shape
- Median sulcus
- Medial eminence
- Sulcus limitans
- Facial colliculus (inf end of medial eminence)
- Area vestibuli (Lateral to sulcus limitans)



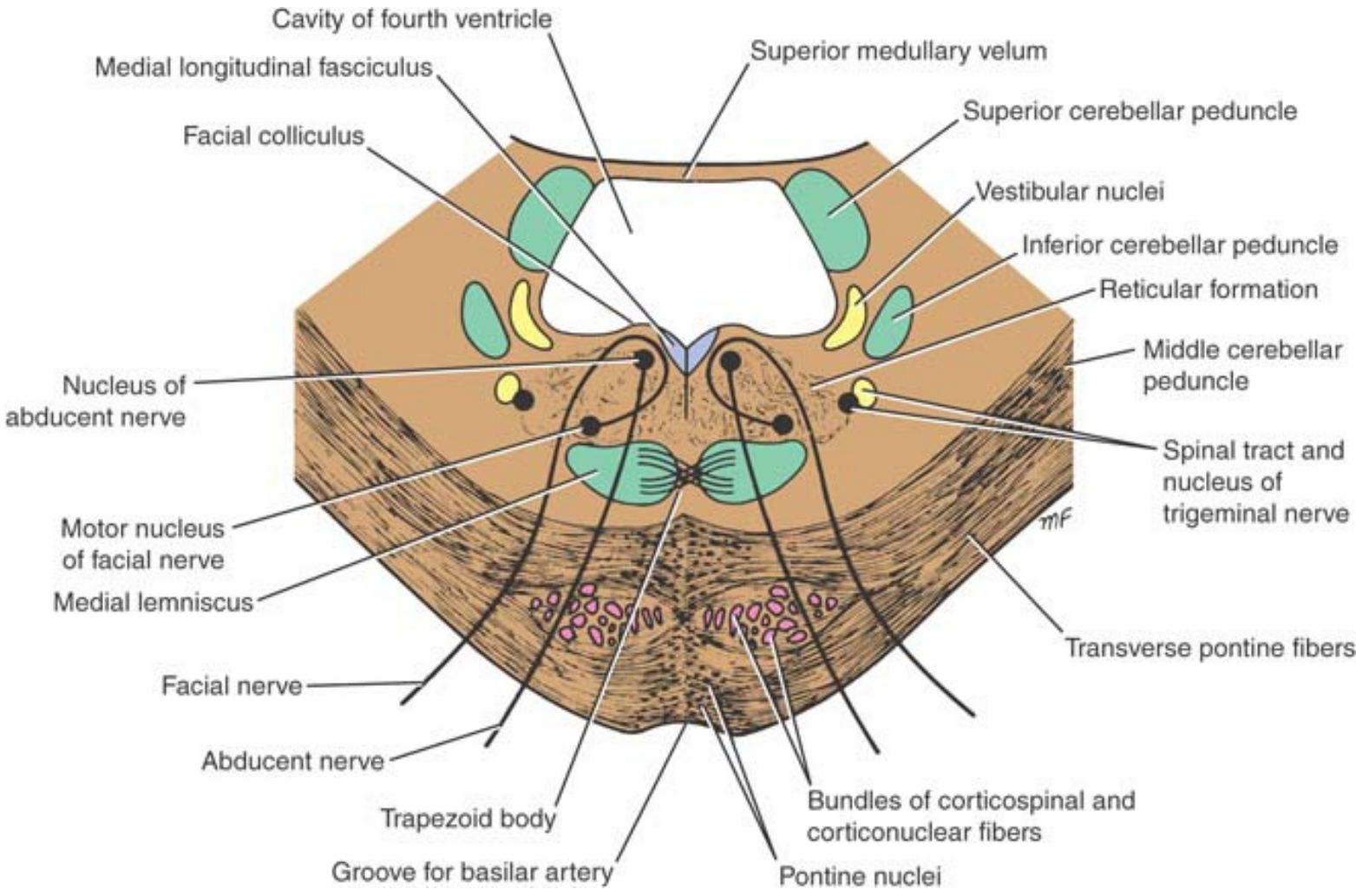
Internal structure of pons

- Its divided by transversely running fibers of trapezoid body into:

1. Tegmentum (post part)
2. Basal part (ant part)

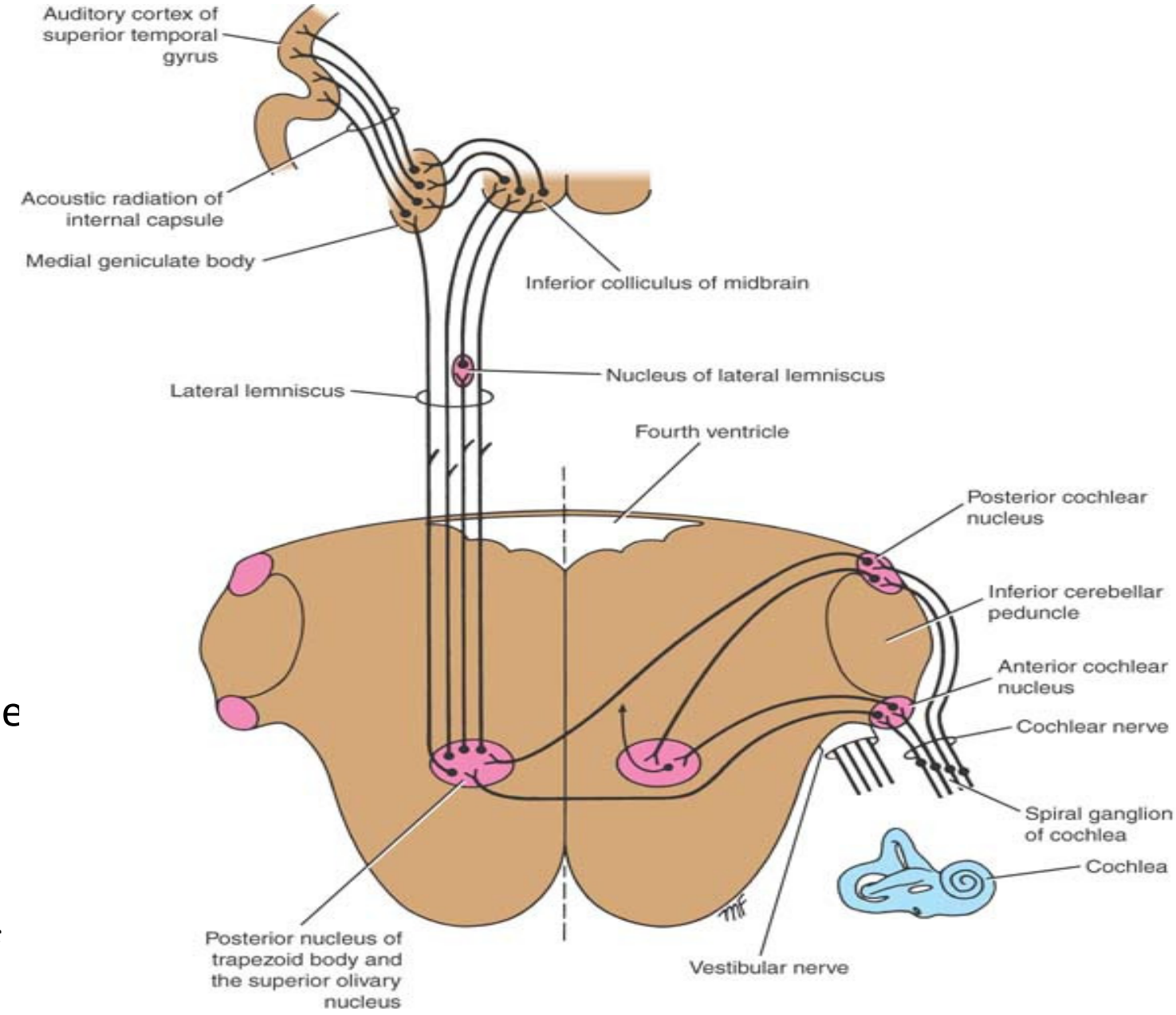
levels

- Level through caudal part (facial colliculus)
- Level through cranial part (trigeminal nuclei)



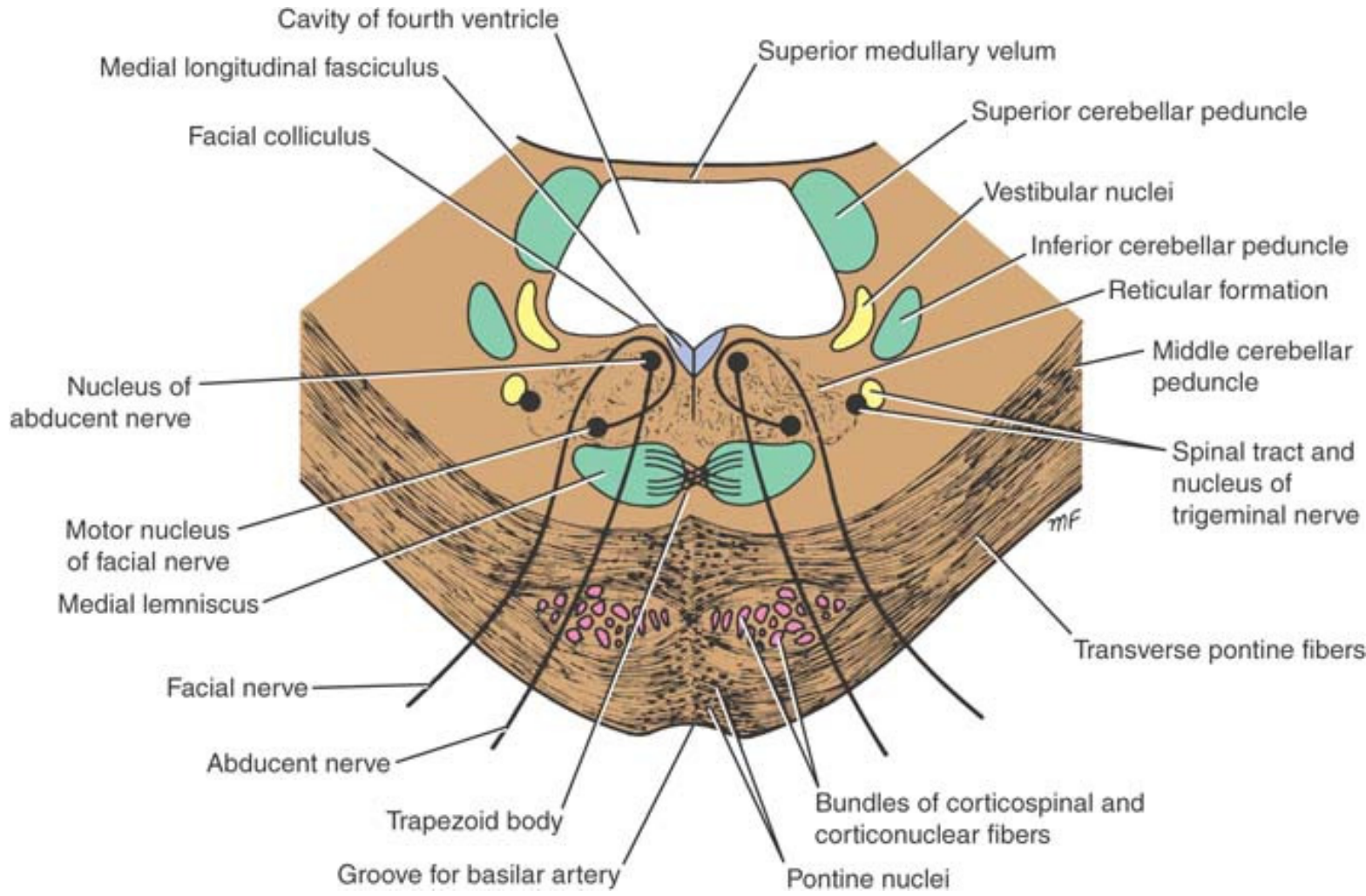
The trapezoid body

- is part of the acoustic pathway
- Made up of fibers derived from cochlear nuclei
- **lateral lemniscus**: tract of axons in the brainstem that carries information about sound from the cochlear nucleus to the contralateral inferior colliculus of the midbrain
- Cochlear nuclei---- trapezoid body---- lateral lemniscus----inf colliculus-----medial geniculate body----- auditory cortex



Level through caudal part (facial colliculus)

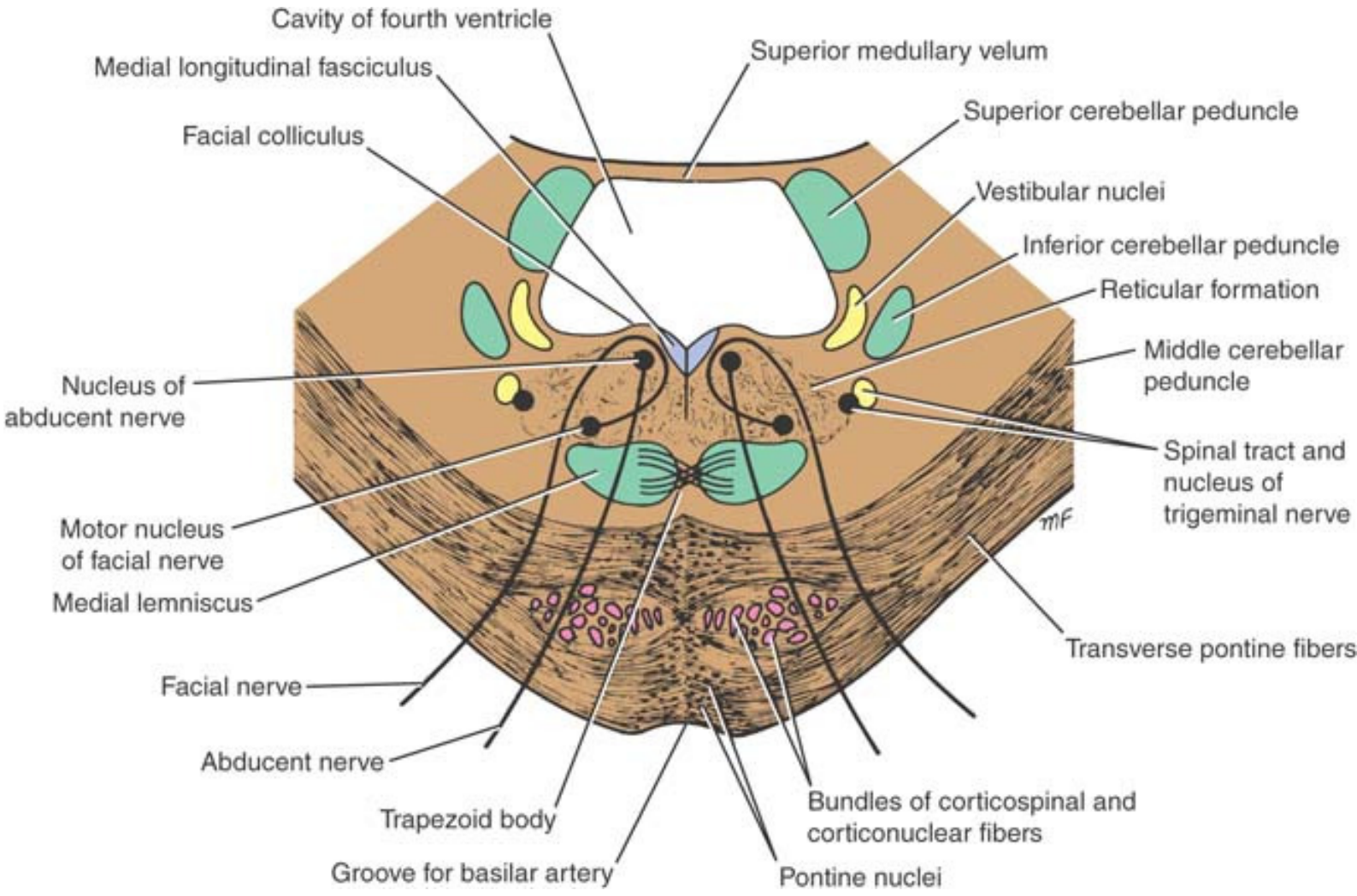
- **Medial lemniscus** most anterior part of the tegmentum, long axis running transversely
- **Facial nucleus** posterior to the lateral part of the medial lemniscus
- **MLF**: beneath the floor of the fourth ventricle on either side of the midline



- **Abducent nucleus:** beneath the floor of the upper part of the fourth
- **Spinal nucleus** of trigeminal and its tract: anteromedial aspect of ICP
- **Medial vestibular nucleus:** lateral to the abducent nucleus

Level through caudal part (facial colliculus)

- Basilar part of pons contain small masses of nerve cells called pontine nuclei
- Corticopontine fibers terminate in pontine nuclei
- Axons of these cells give origin to transverse fibers of the pons which cross the midline and intersect the corticospinal & corticonuclear tracts, breaking them into small bundles



- Transverse fibers enter MCP to cerebellum
- This connection is the main pathway linking cerebellum to cerebral cortex

Facial Nerve Nuclei

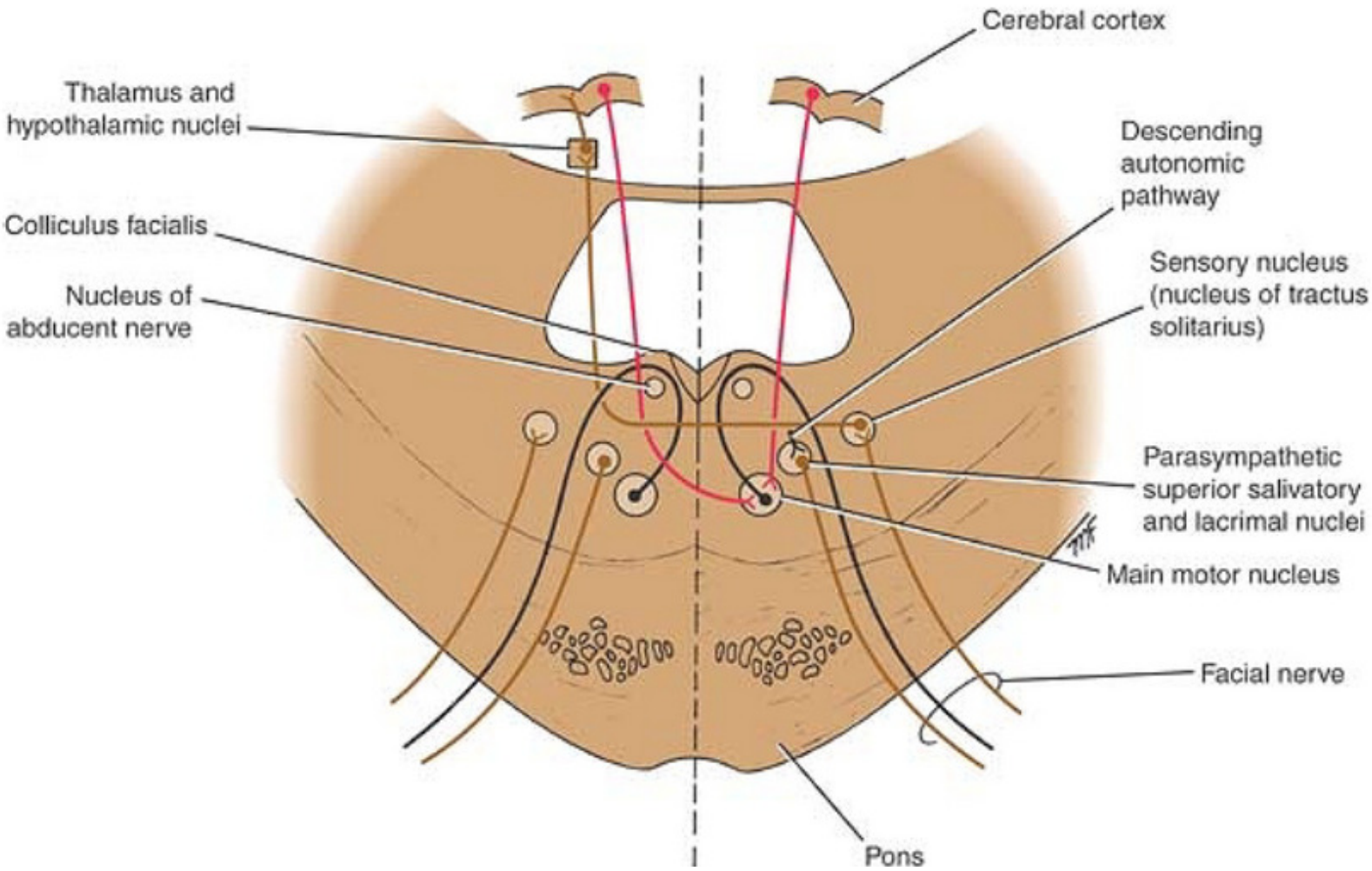
Parasympathetic Nuclei:

- **Location**: Posterolateral to the main motor nucleus

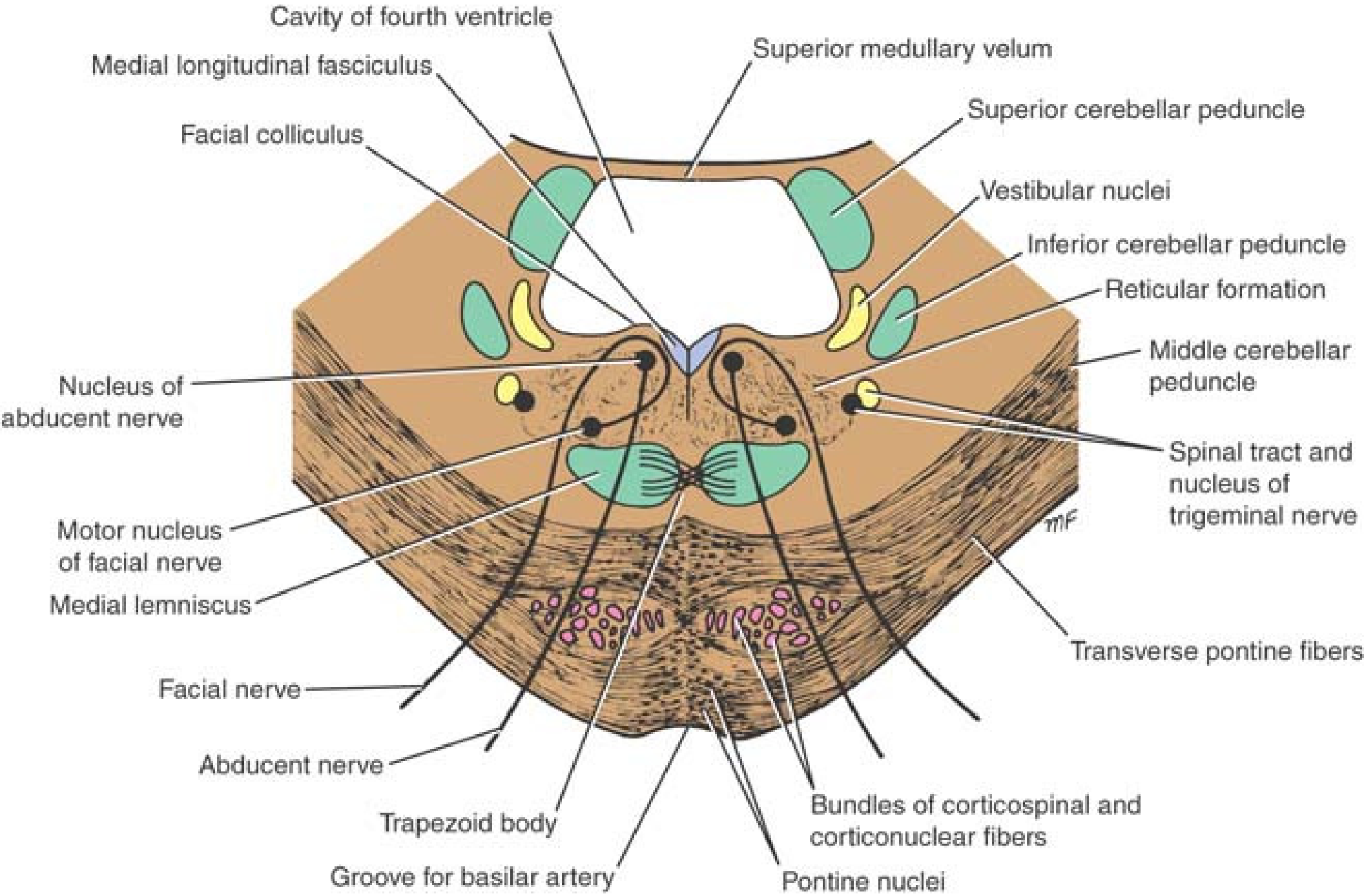
- superior salivatory: receives from the hypothalamus

- Lacrimal nucleus: receives from

  - hypothalamus (Emotional)
  - sensory nuclei of the trigeminal (reflex)

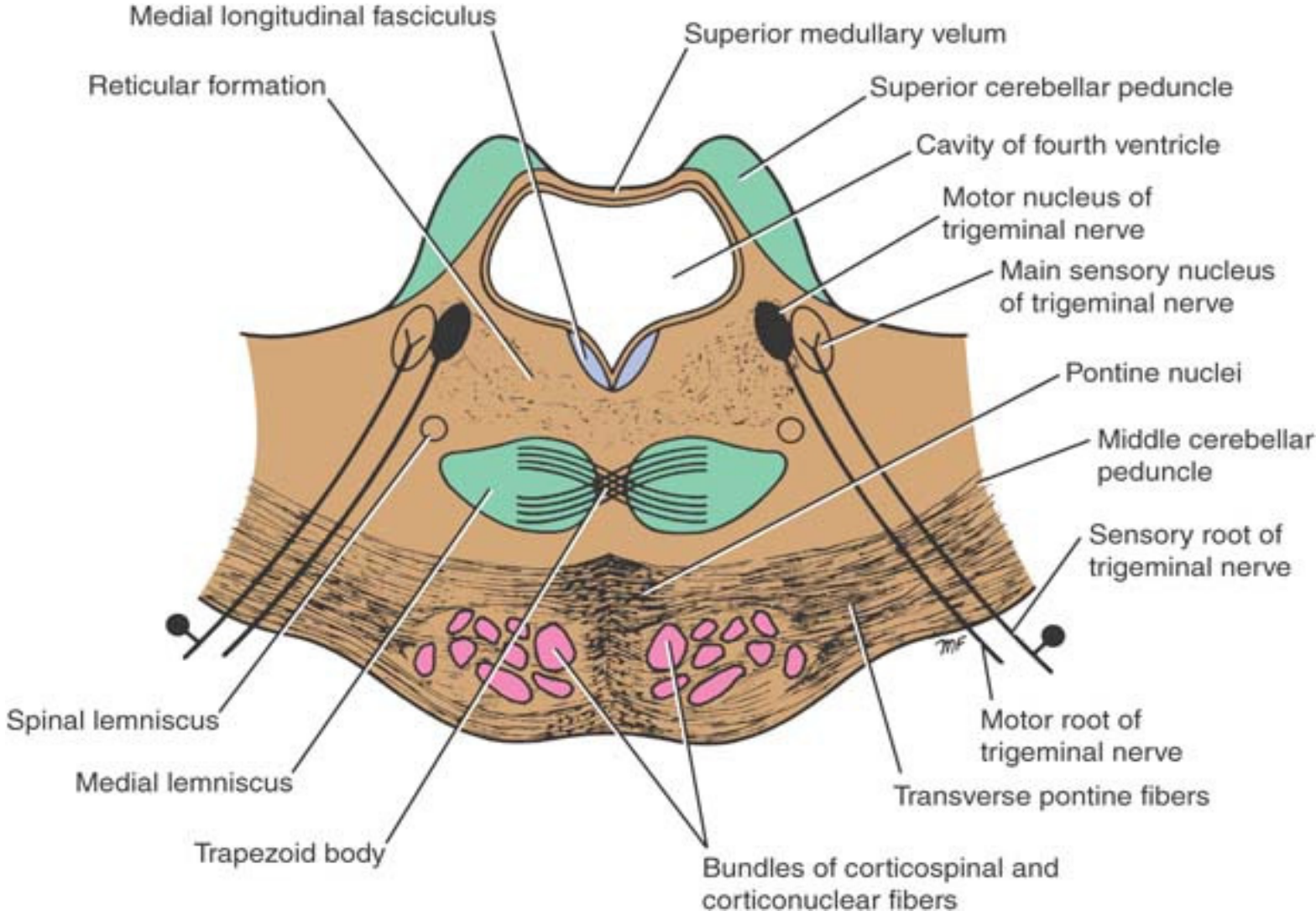


Level through caudal part (facial colliculus)

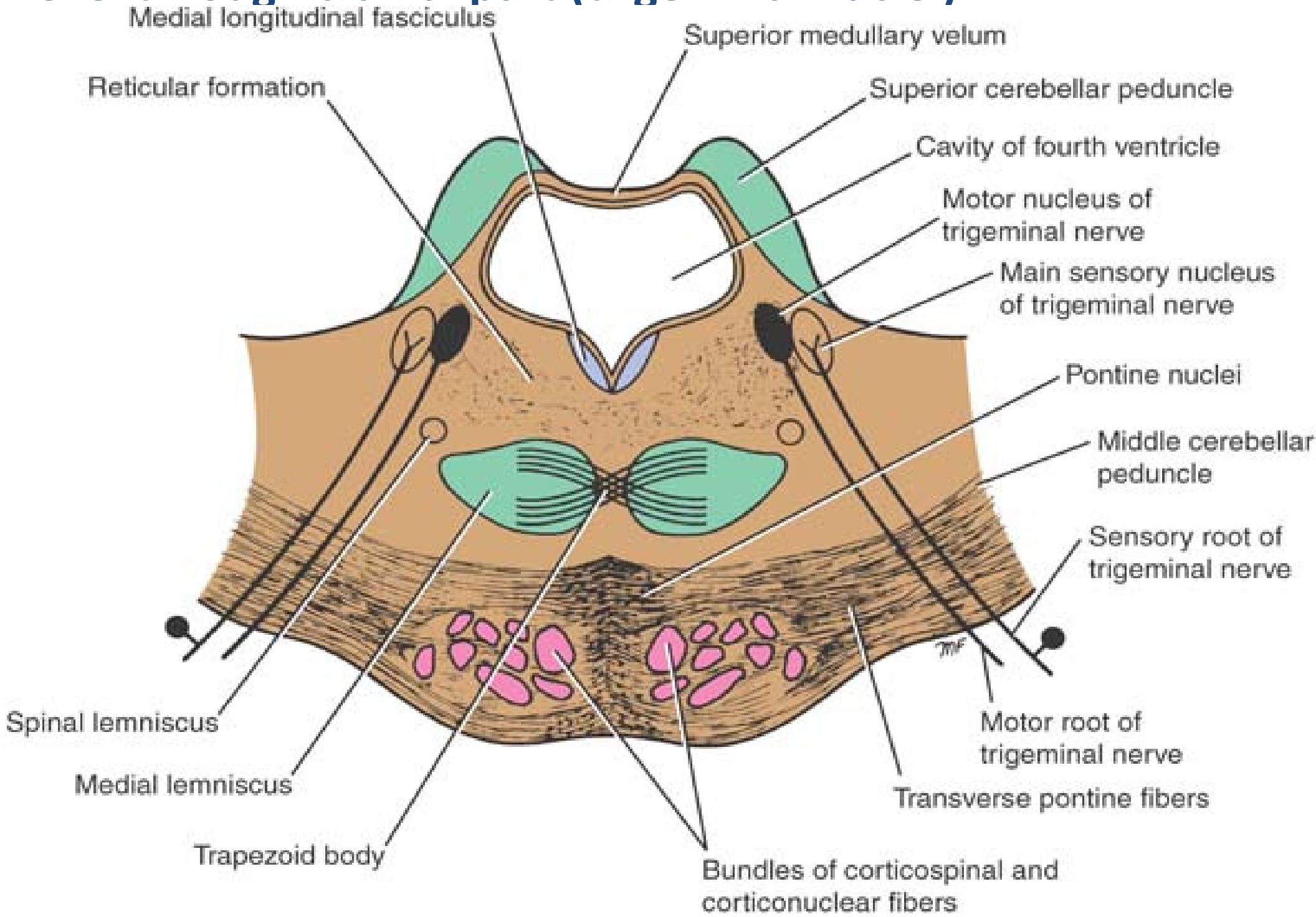


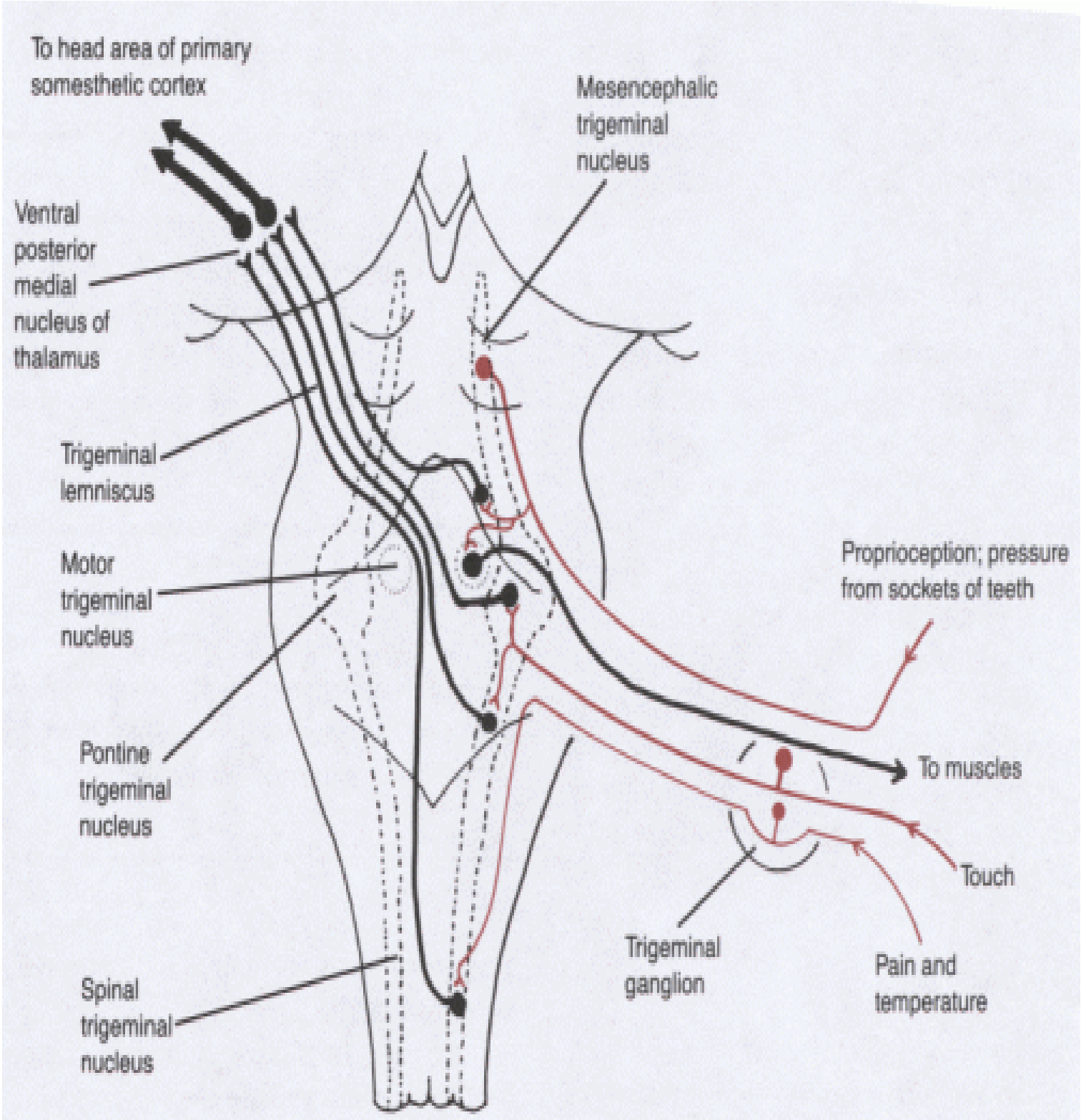
Level through cranial part (trigeminal nuclei)

- **Motor nucleus** of trigeminal n: beneath the lateral part of thefourth ventricle within the reticular formation
- **Main Sensory** nucleus of trigeminal n (*lateral*)
- **SCP:** posterolateral to the motor nucleus of V
- **Trapezoid body**
- **Medial leminiscus**
- **Lateral leminiscus, Spinal leminiscus**: lateral extremity of the medial lemniscus



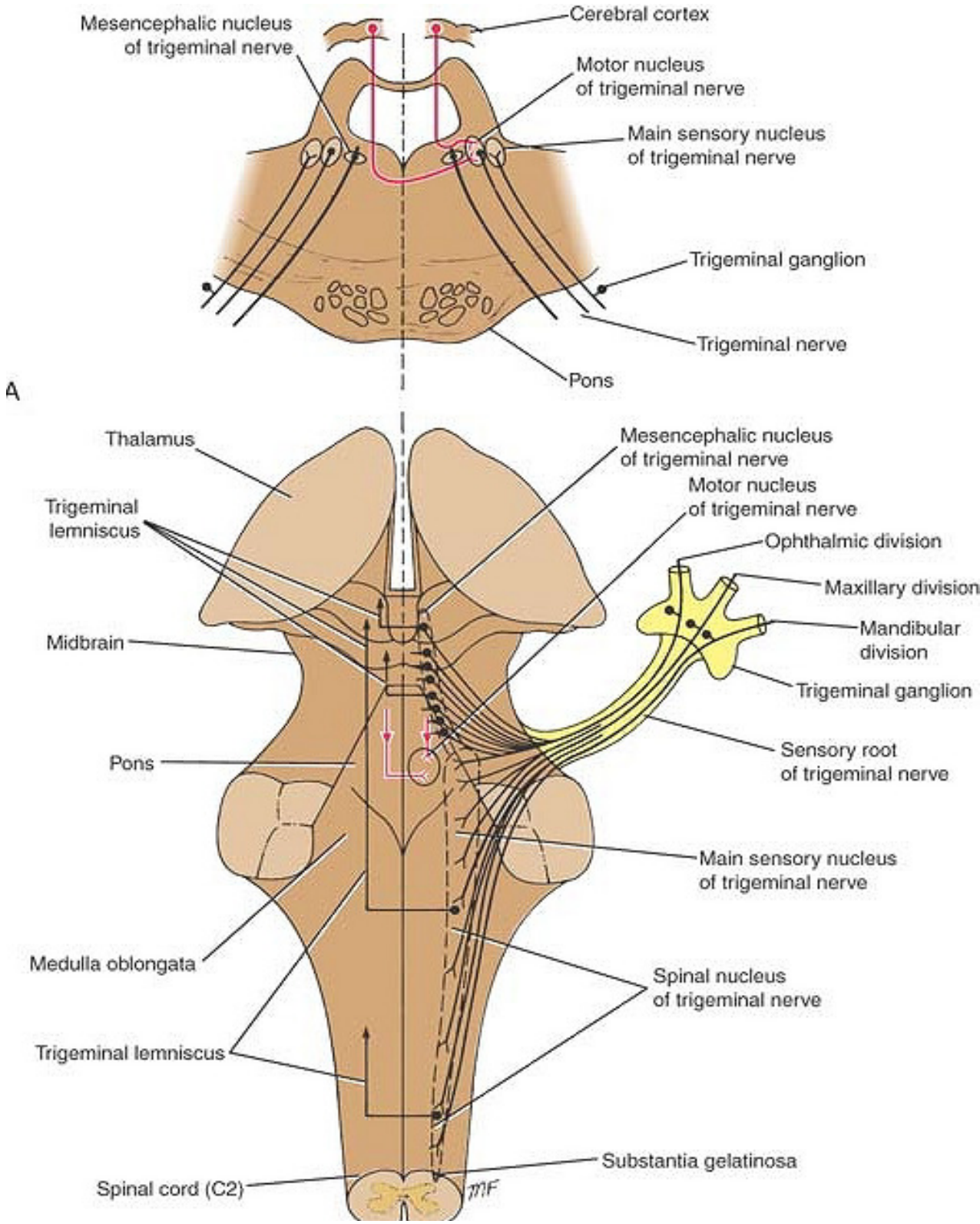
Level through cranial part (trigeminal nuclei)




To head area of primary somesthetic cortex
Mesencephalic trigeminal nucleus
Ventral posterior medial nucleus of thalamus
Trigeminal lemniscus
Motor trigeminal nucleus
Pontine trigeminal nucleus
Spinal trigeminal nucleus
Proprioception; pressure from sockets of teeth
To muscles
Touch
Trigeminal ganglion
Pain and temperature

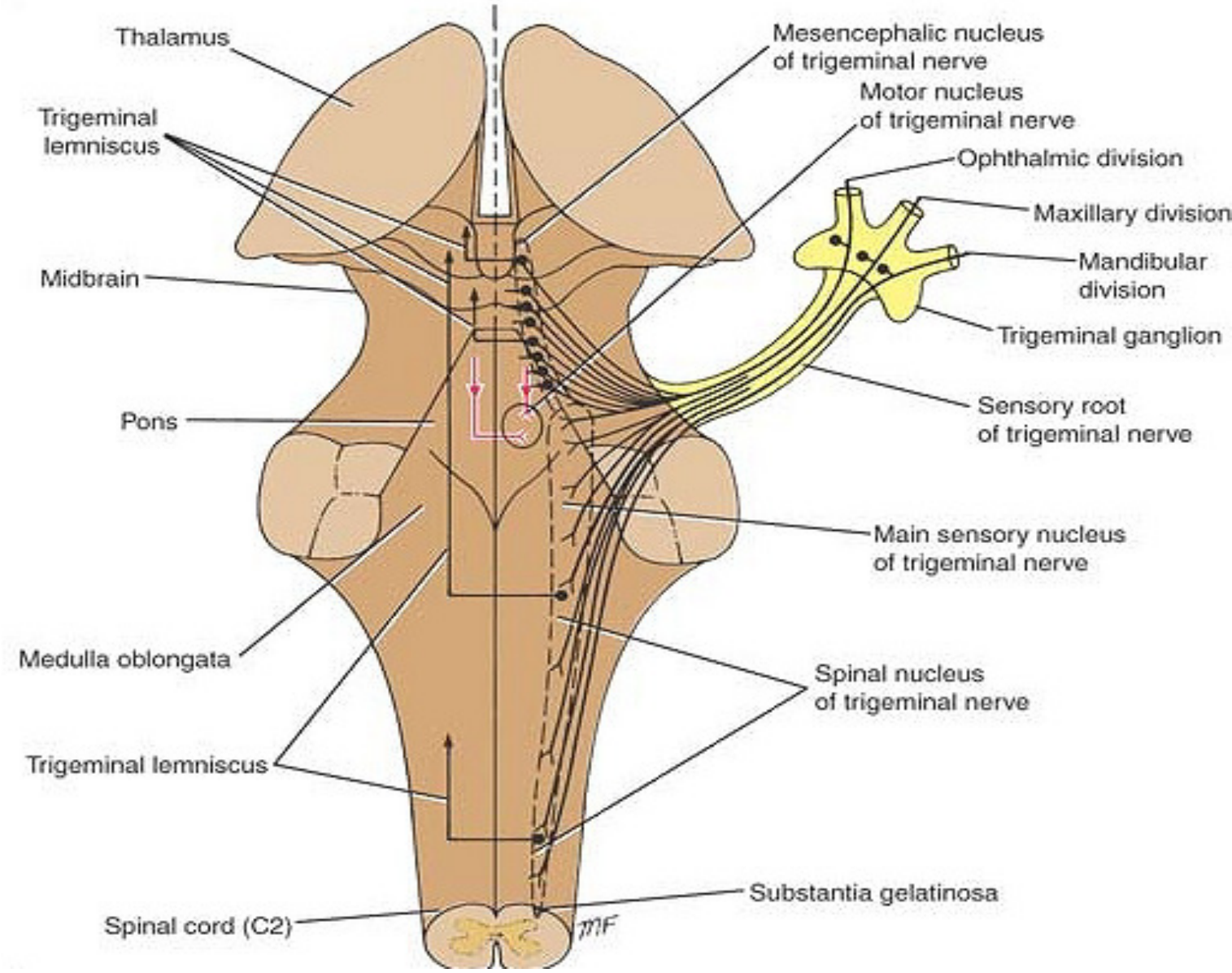
Trigeminal Nerve Nuclei

- **Main sensory nucleus**
  - Posterior part of the pons (lateral)
- **Motor nucleus**
  - Posterior part of the pons (Medial)
- **Spinal nucleus**
  - Superiorly: main sensory nucleus
  - Inferiorly: C2 segment
- **Mesencephalic nucleus**
  - Lateral part of the gray matter around the cerebral aqueduct
  - Inferiorly main sensory nucleus

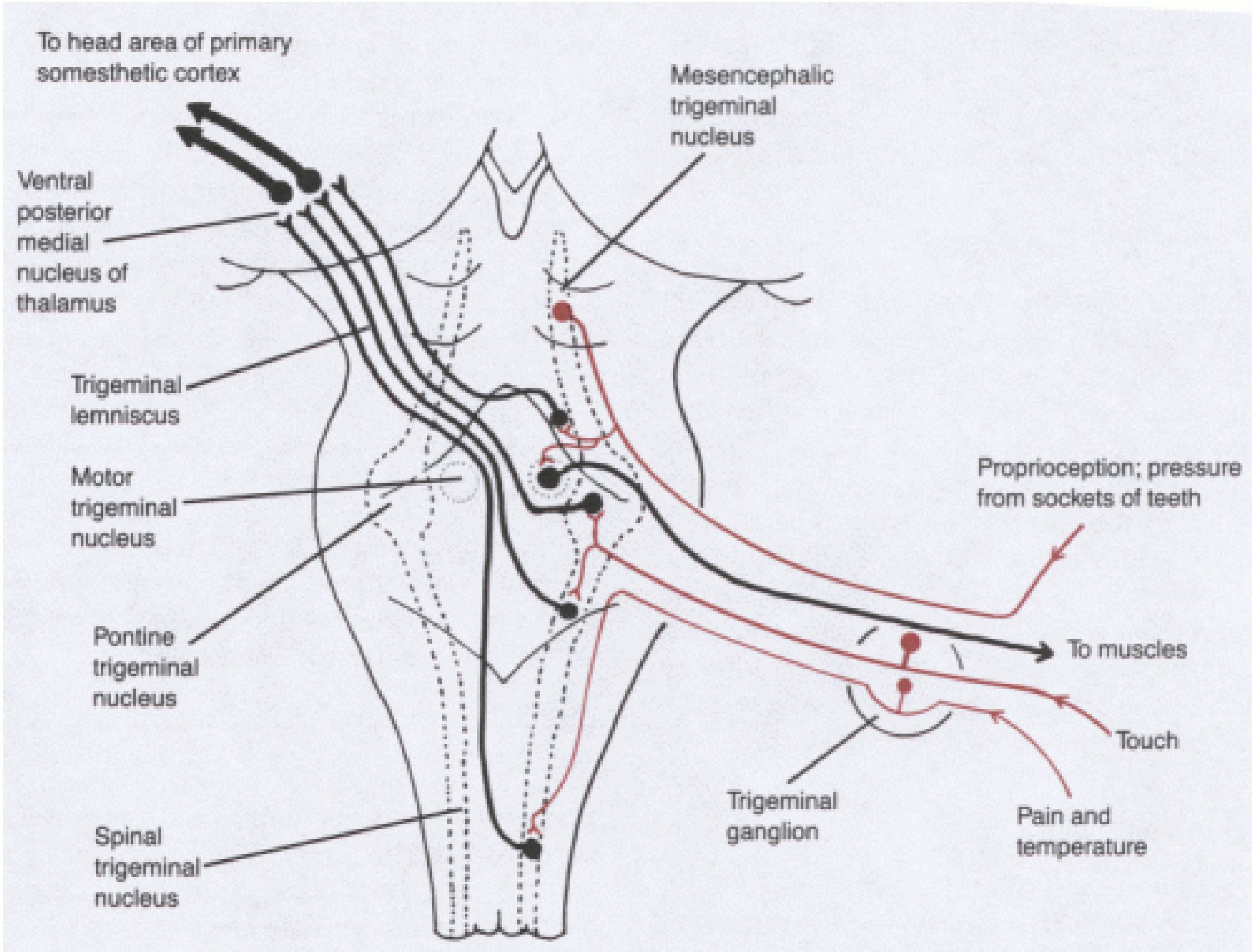


Sensory Components

- Trigeminal sensory ganglion: (Cell bodies)
- Ascending branches: main sensory nucleus
- Descending branches: spinal nucleus
- Division:
  - ophthalmic inferior part of SN
  - Maxillary: middle part of SN
  - Mandibular: superior part of SN

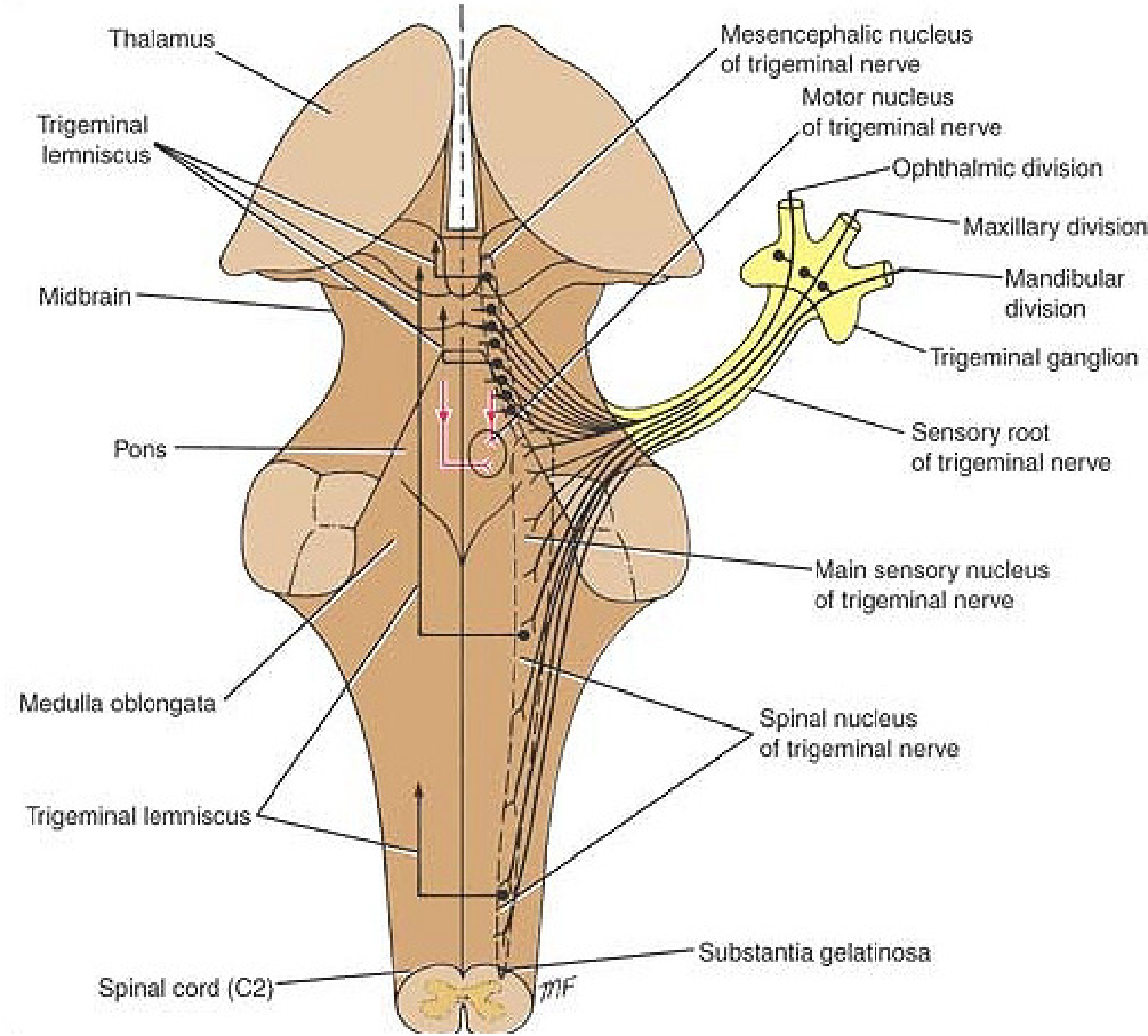


- Main sensory nucleus: discriminative and light touch of the face as well as conscious proprioception, (similar to PCML)
- Spinal nucleus: crude touch, pain, and temperature (similar to ALS)
- Mesencephalic nucleus: reflex proprioception of the periodontal ligament and of the muscles of mastication in the jaw


To head area of primary somesthetic cortex
Mesencephalic trigeminal nucleus
Ventral posterior medial nucleus of thalamus
Trigeminal lemniscus
Motor trigeminal nucleus
Pontine trigeminal nucleus
Spinal trigeminal nucleus
Proprioception; pressure from sockets of teeth
To muscles
Touch
Pain and temperature
Trigeminal ganglion

Motor Components

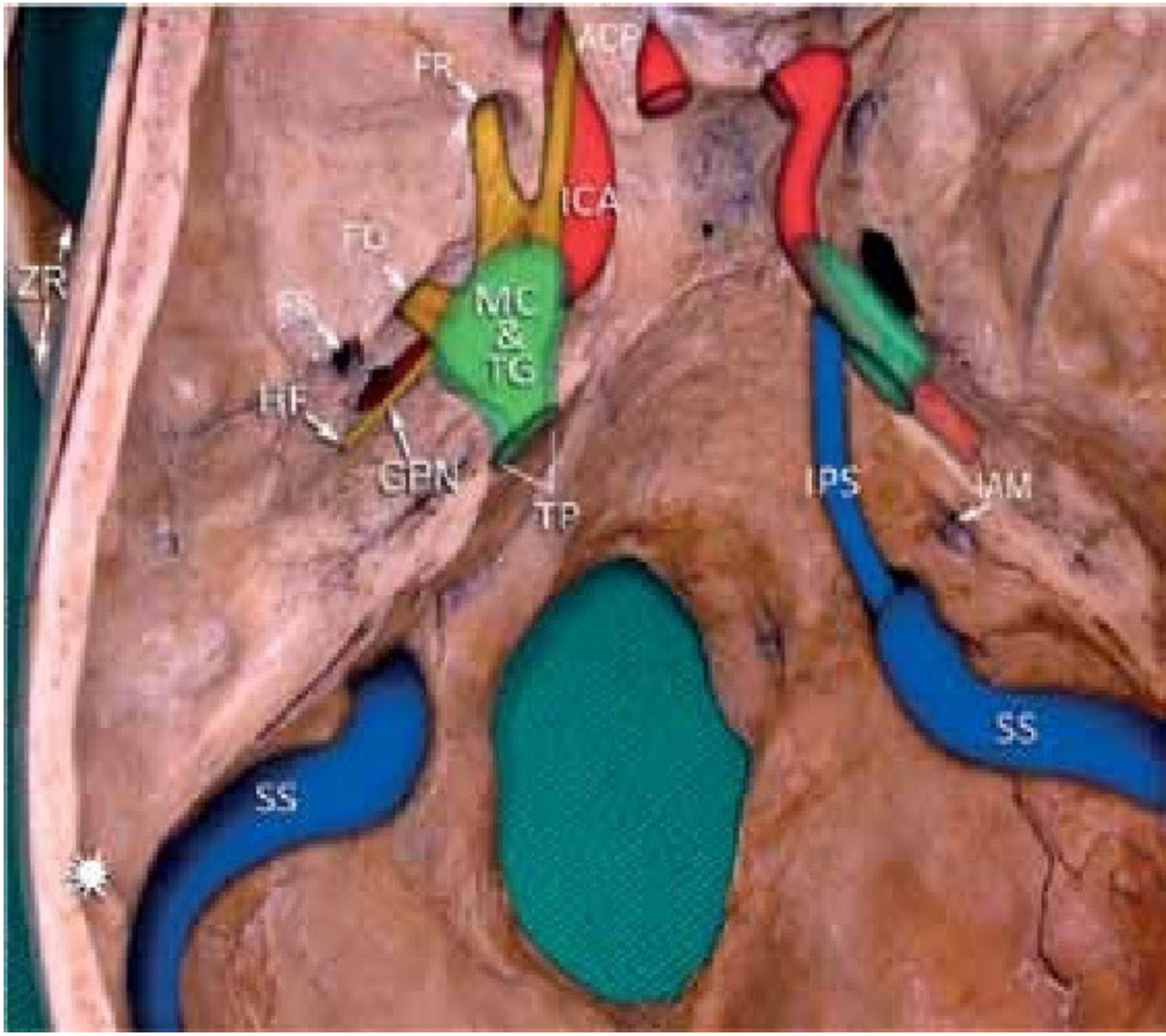
- Motor nucleus receives
  - Corticonuclear fibers
  - Red nucleus
  - Reticular formation
  - Tectum

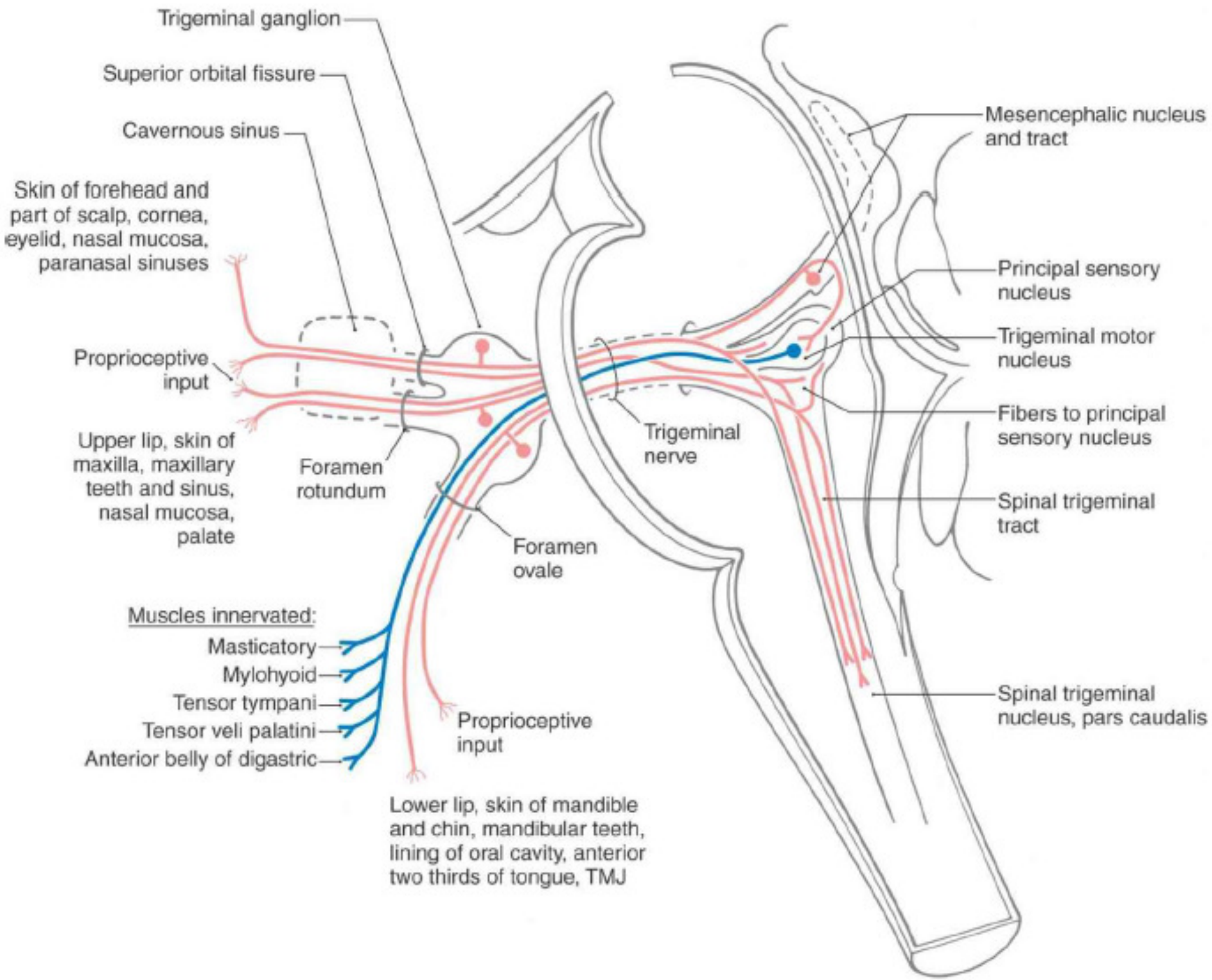


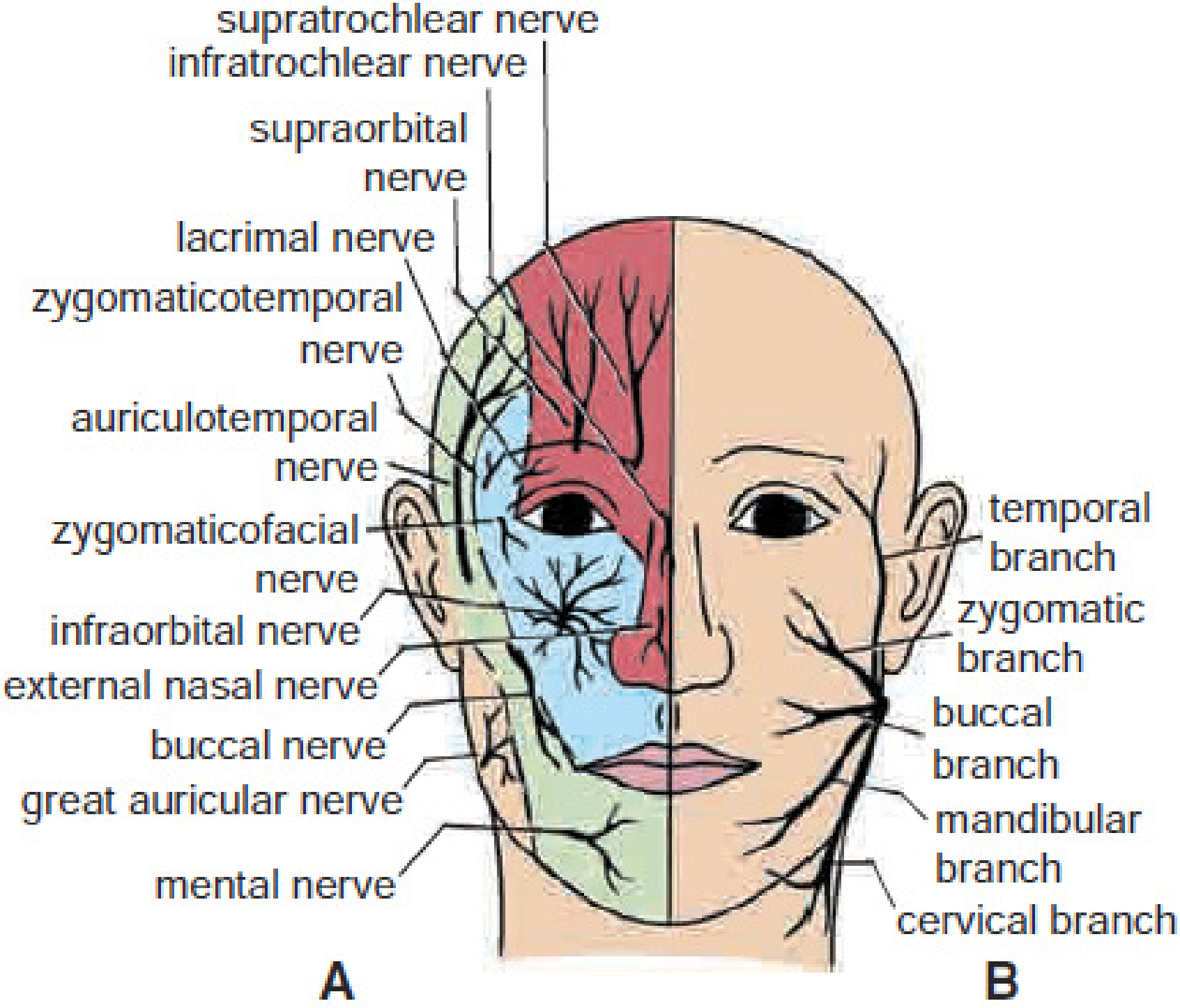
- Supplies
  - Muscles of mastication
  - Tensor tympani
    - Tensor veli palatini
    - Mylohyoid
    - Anterior belly of the digastric muscle

Course of V

- Anterior aspect of the pons
- Upper surface of the apex of the petrous bone
- Trigeminal ganglion: in **Meckel cave:** pouch of dura mater
- Divisions:
  - Ophthalmic: superior orbital fissure
  - Maxillary: foramen rotundum
  - Mandibular: foramen ovale

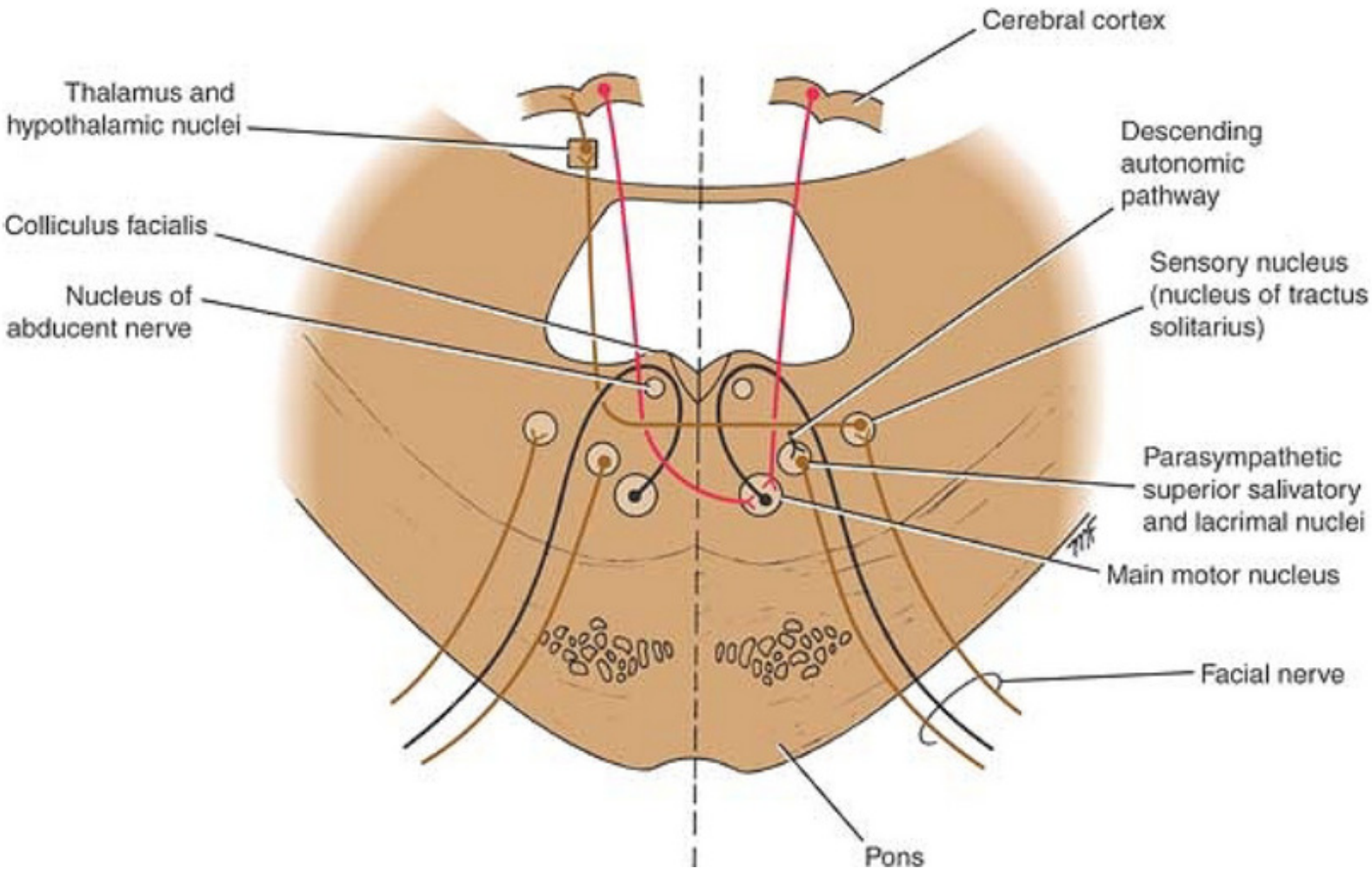



Trigeminal ganglion
Superior orbital fissure
Cavernous sinus
Skin of forehead and part of scalp, cornea, eyelid, nasal mucosa, paranasal sinuses
Proprioceptive input
Upper lip, skin of maxilla, maxillary teeth and sinus, nasal mucosa, palate
Foramen rotundum
Trigeminal nerve
Foramen ovale
Muscles innervated:
Masticatory
Mylohyoid
Tensor tympani
Tensor veli palatini
Anterior belly of digastric
Proprioceptive input
Lower lip, skin of mandible and chin, mandibular teeth, lining of oral cavity, anterior two thirds of tongue, TMJ
Mesencephalic nucleus and tract
Principal sensory nucleus
Trigeminal motor nucleus
Fibers to principal sensory nucleus
Spinal trigeminal tract
Spinal trigeminal nucleus, pars caudalis


supratrochlear nerve
infratrochlear nerve
supraorbital nerve
lacrimal nerve
zygomaticotemporal nerve
auriculotemporal nerve
zygomaticofacial nerve
infraorbital nerve
external nasal nerve
buccal nerve
great auricular nerve
mental nerve
temporal branch
zygomatic branch
buccal branch
mandibular branch
cervical branch
A
B

Facial Nerve Nuclei

- **Main Motor Nucleus**
- Deep in the reticular formation of the lower part of the pons
- The part of the nucleus that supplies
  - **Upper part** of the face receives corticonuclear fibers from **both** hemispheres.



- **lower part** of the face receives only corticonuclear fibers from the **opposite** cerebral hemisphere

Facial Nerve Nuclei

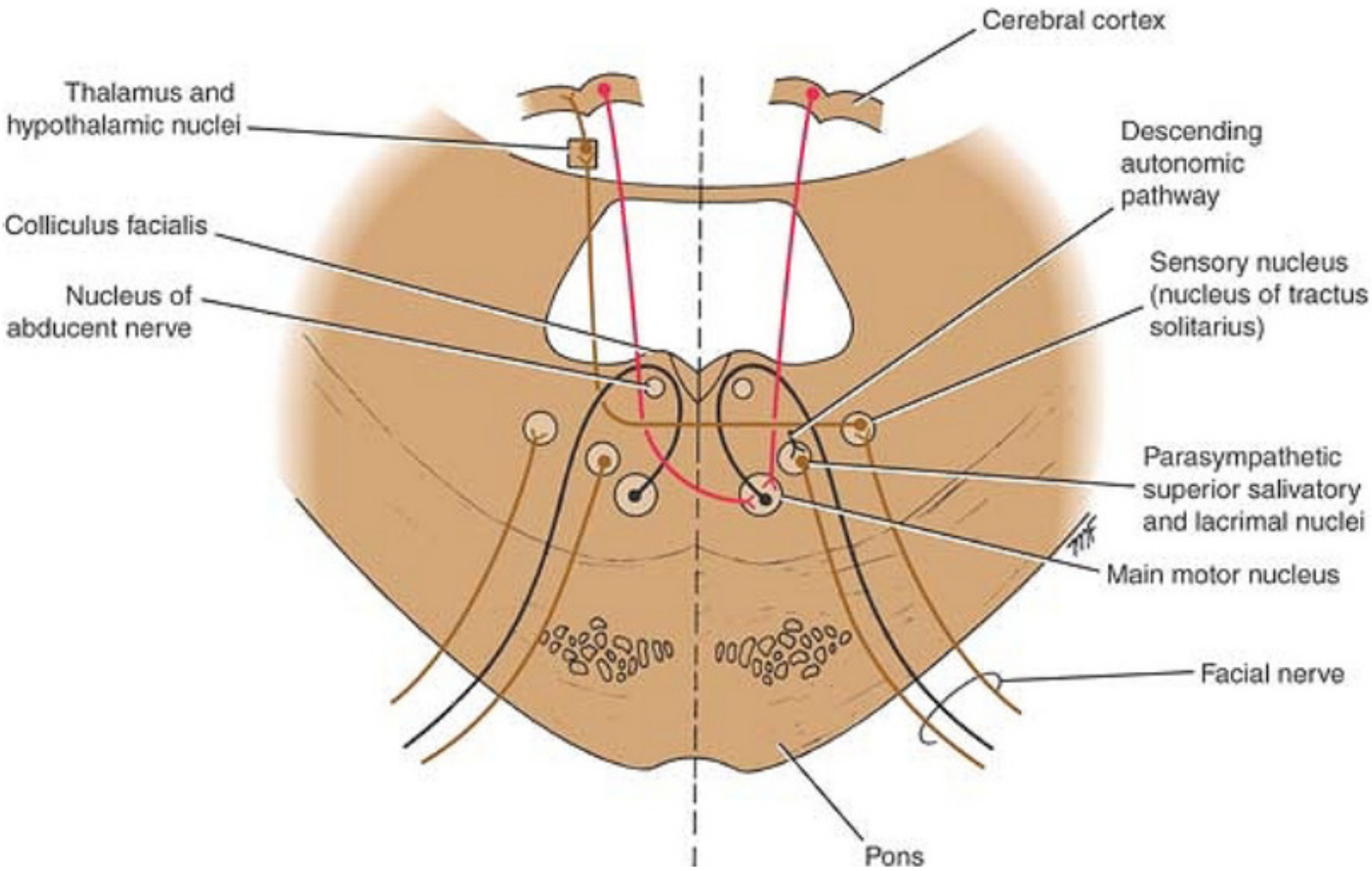
Parasympathetic Nuclei:

- **Location**: Posterolateral to the main motor nucleus

- superior salivatory: receives from the hypothalamus

- Lacrimal nucleus: receives from

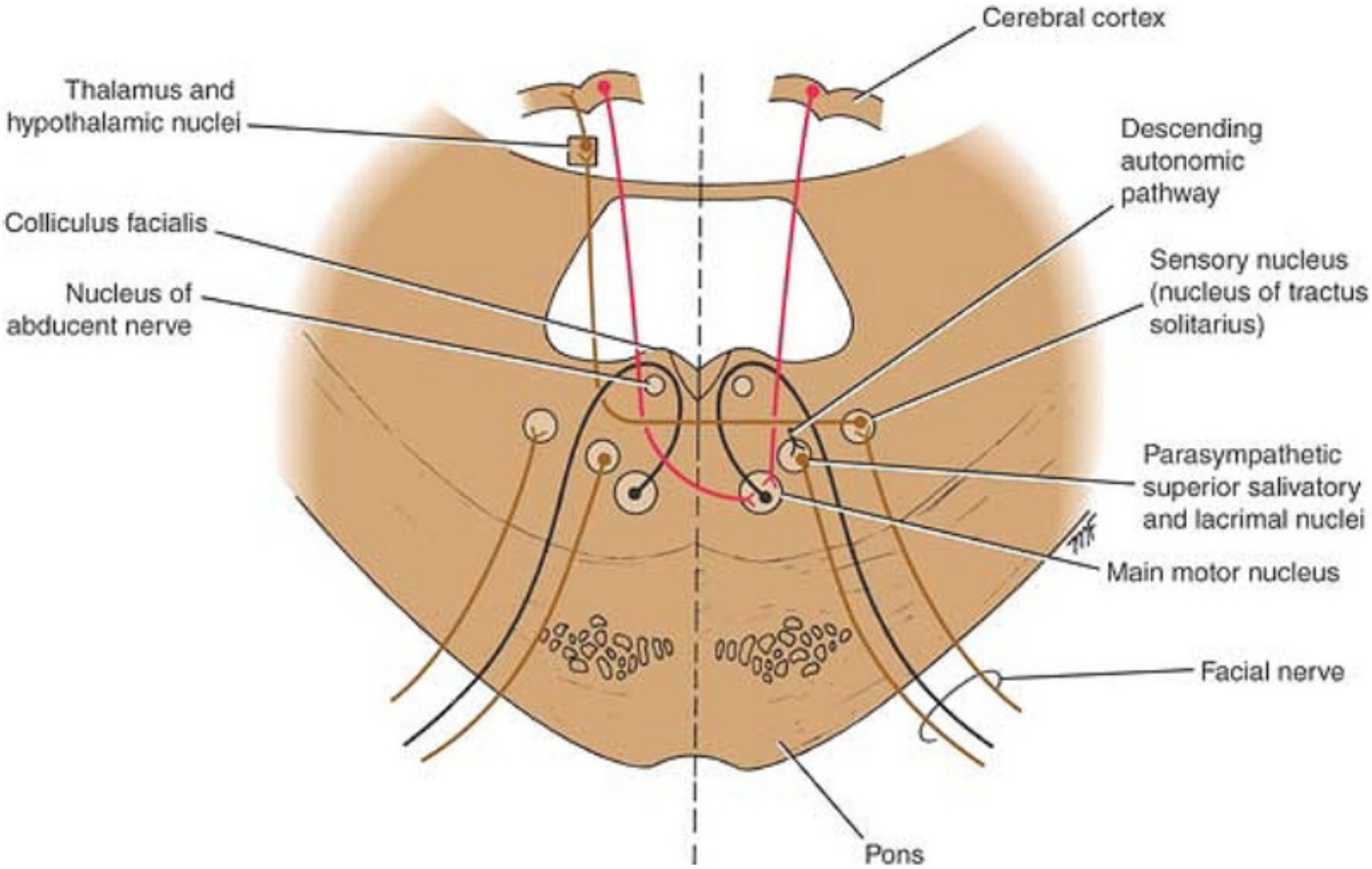
  - hypothalamus (Emotional)
  - sensory nuclei of the trigeminal (reflex)



Facial Nerve Nuclei

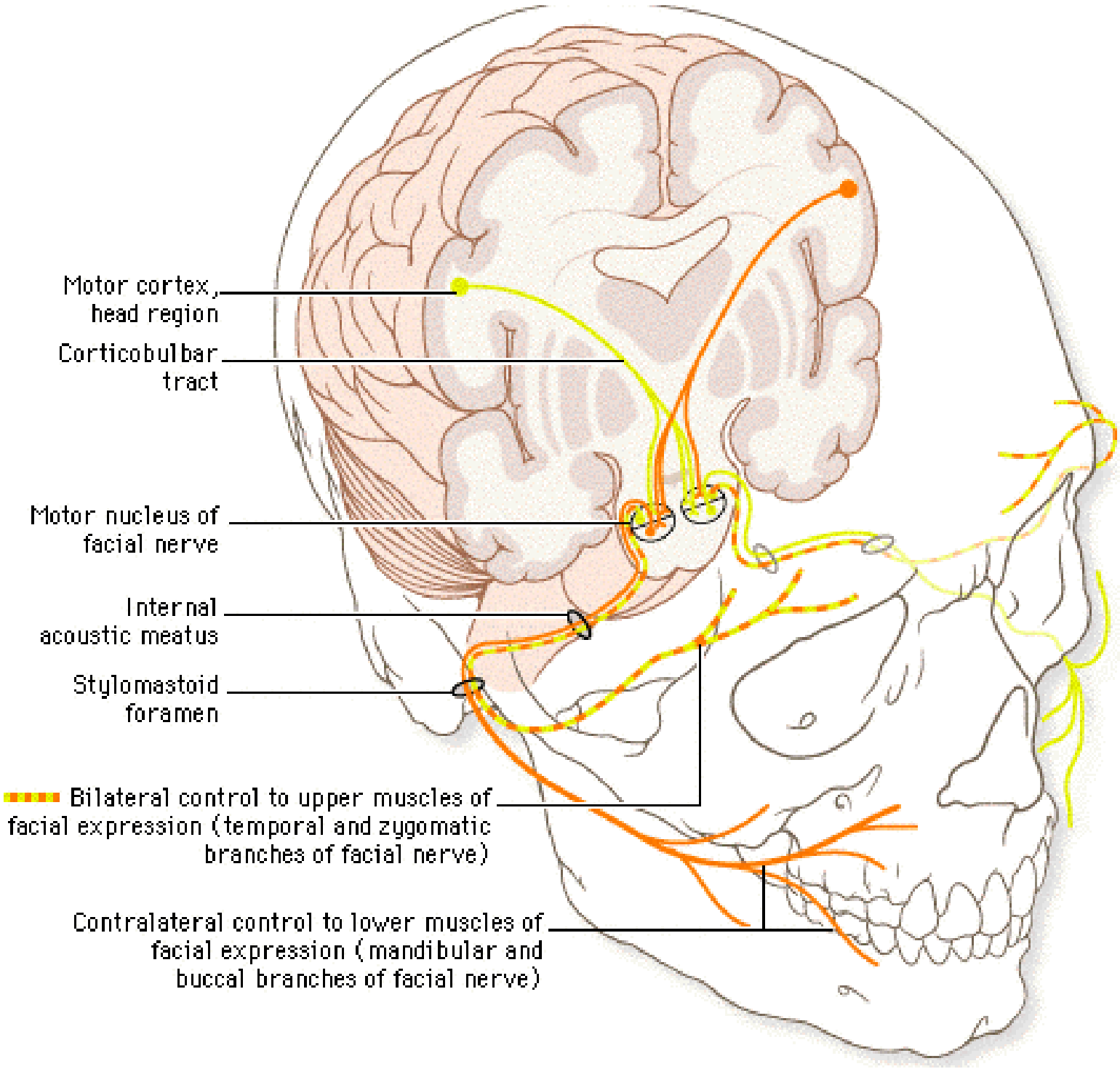
Sensory Nucleus: Taste

- **Location**: upper part of the nucleus of the tractus solitarius
- Sensations of taste
  - Cell bodies in geniculate ganglion
  - Sensory Nucleus
  - VPM
  - Primary gustatory cortex (area 43)



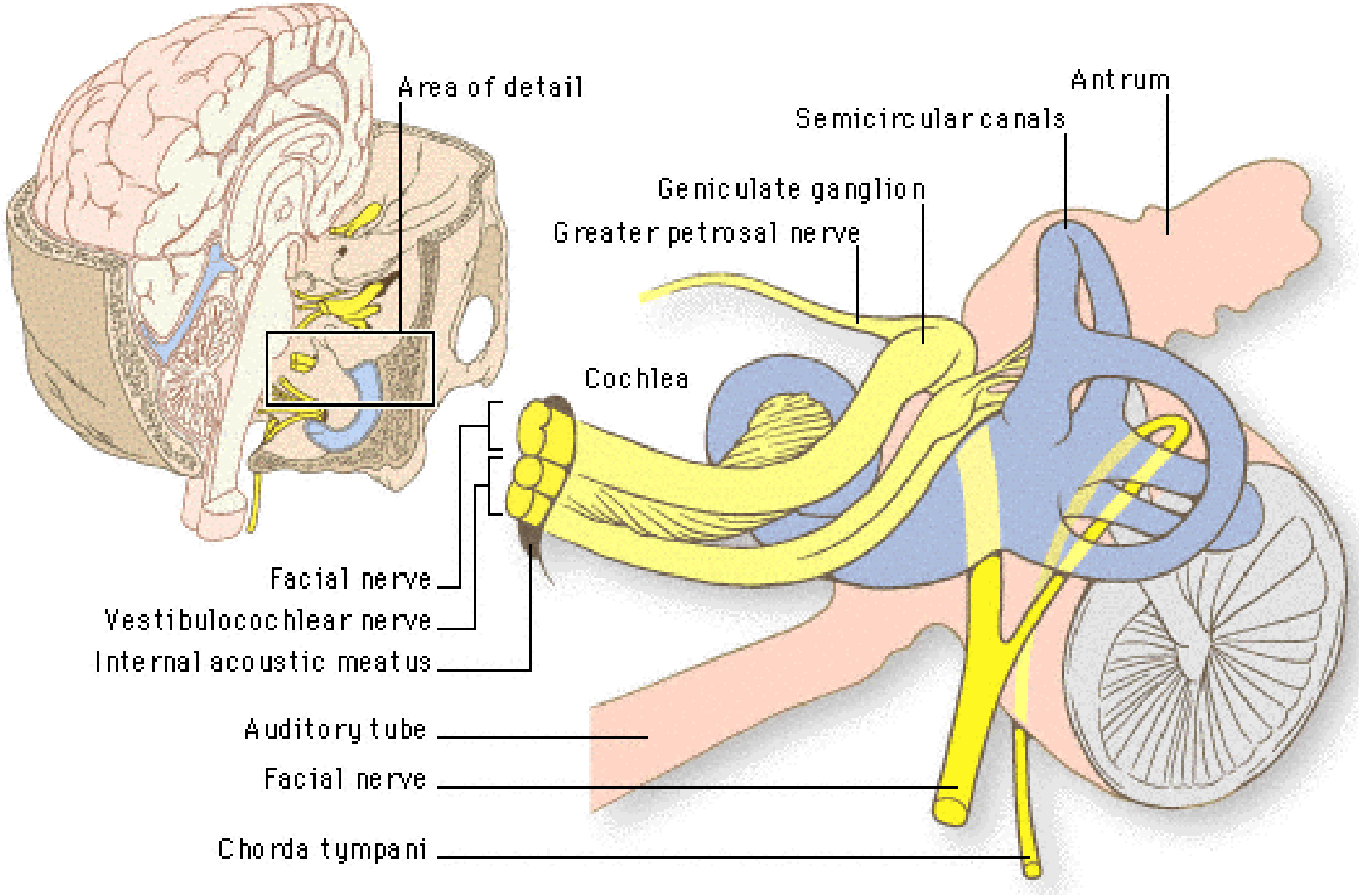
Course of VII

- Anterior surface between the pons and the medulla oblongata
- Internal acoustic meatus
- facial canal then laterally through the inner ear



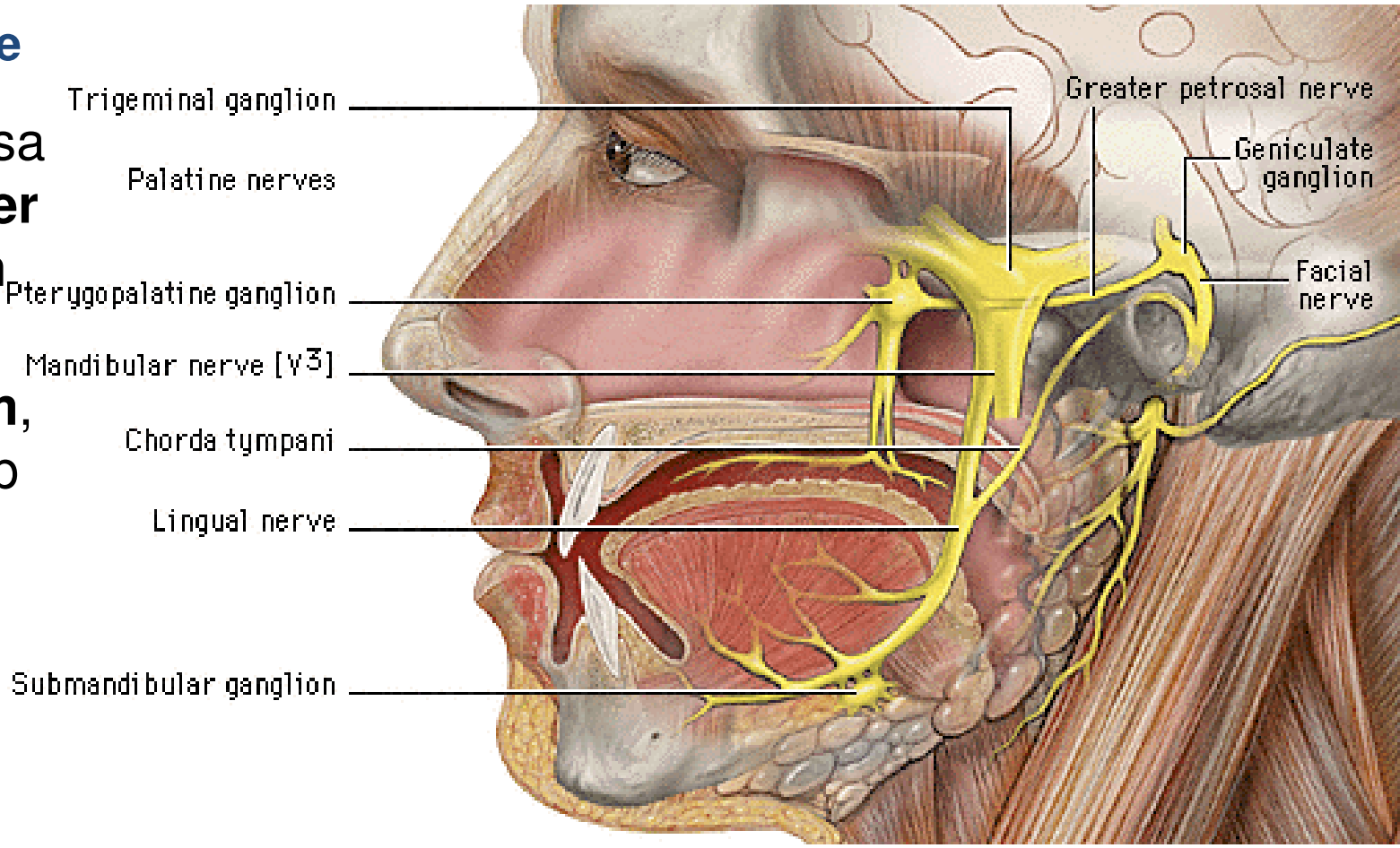
Course of VII

- Medial wall of the tympanic cavity **geniculate ganglion**
- Posterior wall of the tympanic cavity
- Emerges from the stylomastoid foramen.



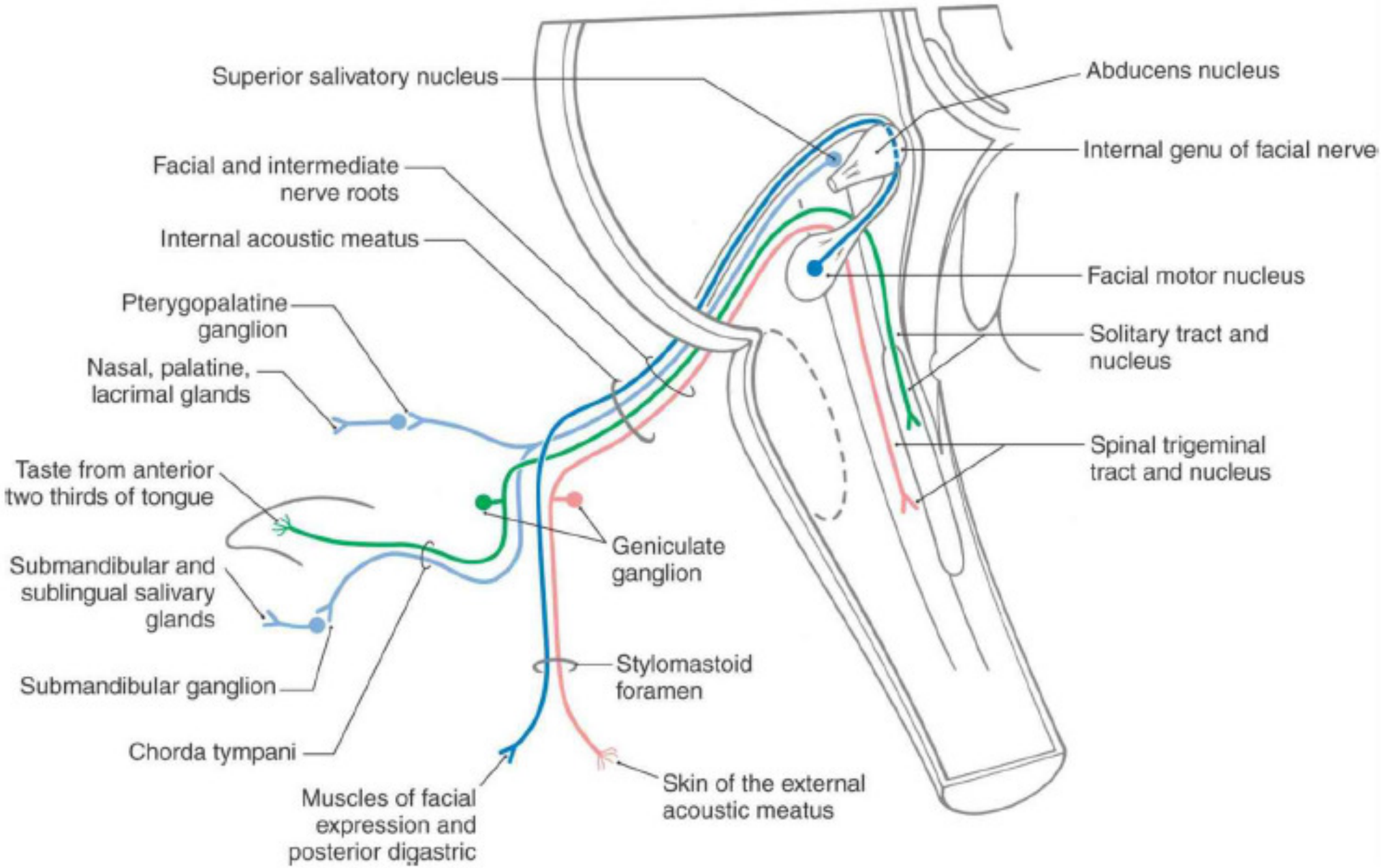
greater petrosal nerve

- Middle cranial fossa through the **greater petrosal foramen**
- Passes over **Foramen lacerum**, where it joins deep **petrosal nerve** to form the nerve to pterygoid canal
- Pterygoid canal
- Pterygopalatine gangilion
- Maxillary nerve



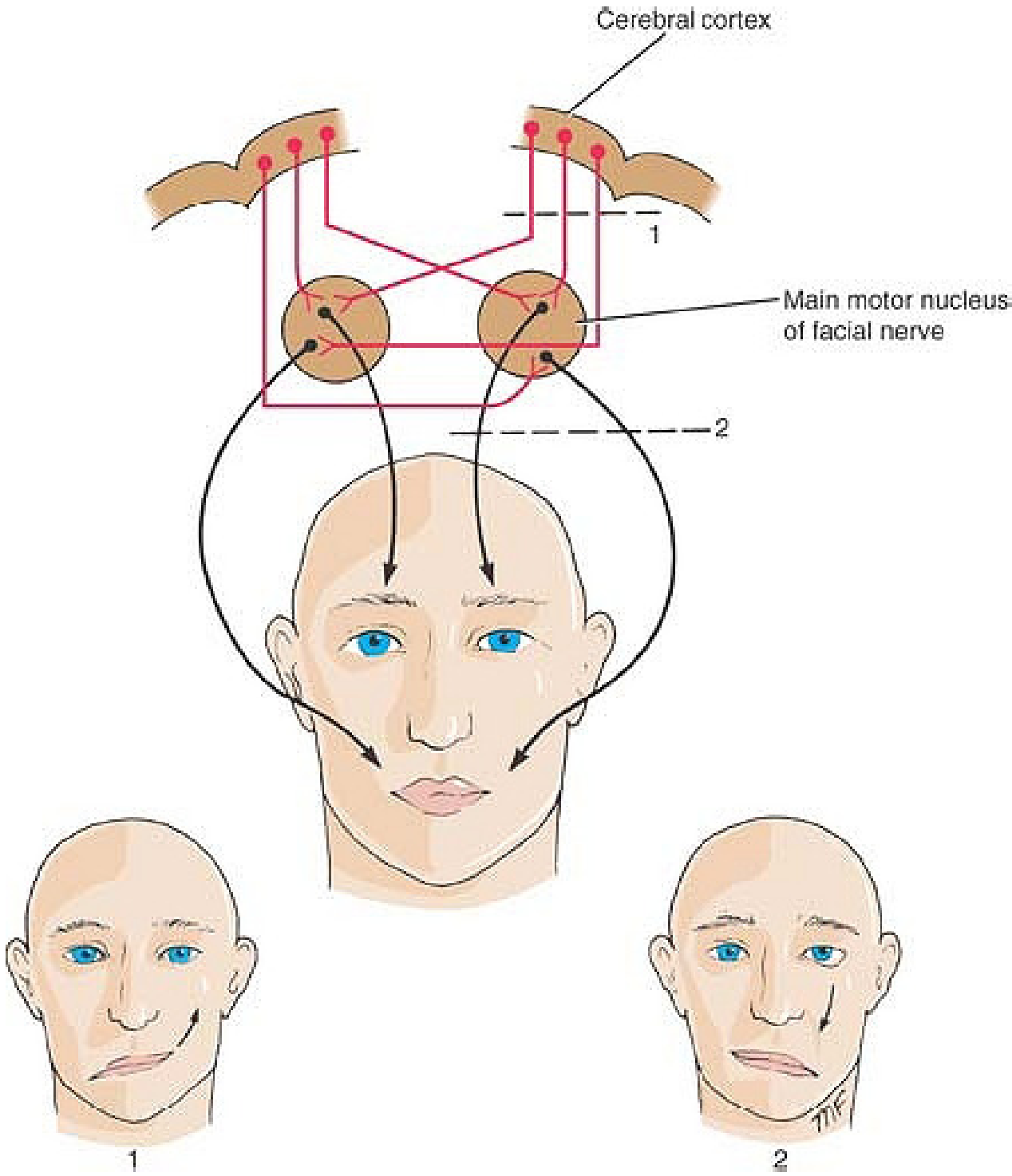
The chorda tympani nerve

- continues through the petrotympanic fissure after which it emerges from the skull into the infratemporal fossa. It soon combines with the larger lingual nerve (Taste Anterior 2/3 of tongue)


Superior salivatory nucleus
Abducens nucleus
Internal genu of facial nerve
Facial and intermediate nerve roots
Internal acoustic meatus
Facial motor nucleus
Pterygopalatine ganglion
Solitary tract and nucleus
Nasal, palatine, lacrimal glands
Spinal trigeminal tract and nucleus
Taste from anterior two thirds of tongue
Geniculate ganglion
Submandibular and sublingual salivary glands
Stylomastoid foramen
Submandibular ganglion
Chorda tympani
Skin of the external acoustic meatus
Muscles of facial expression and posterior digastric

Facial Nerve injury

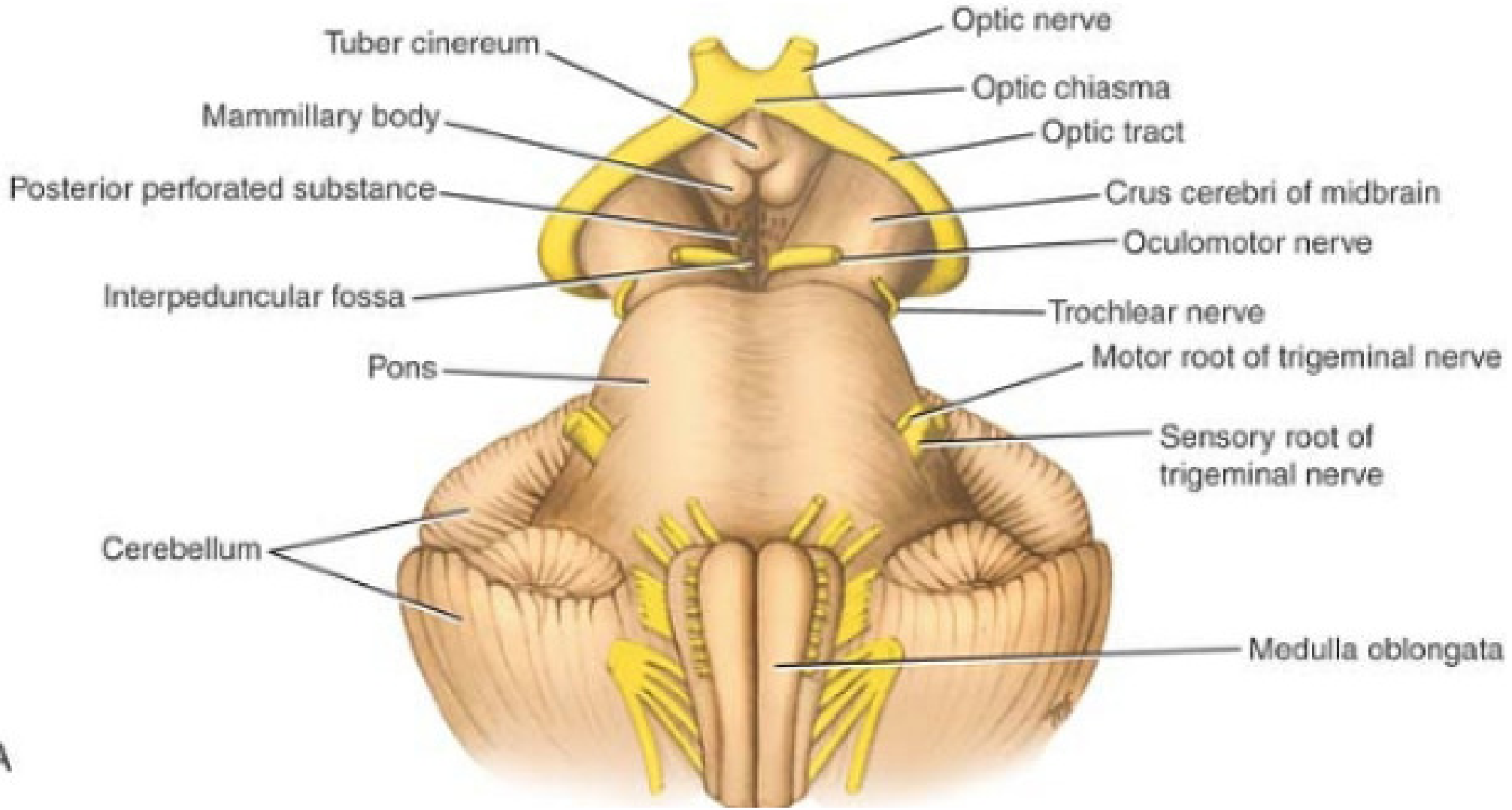
- Location of the lesion:
  - Abducent and the facial nerves are not functioning: lesion in the **pons:**
  - Vestibulocochlear and the facial nerves are not functioning: lesion in the **internal acoustic meatus**
  - Loss of taste over the anterior two-thirds: damaged to the **chorda tympani** branch
- Upper vs lower motor neuron injury



Bell's Palsy

- Usually unilateral
- Lower motor neuron type of facial paralysis.
- Cause is not known,
  - Exposure of the face to a cold draft?
  - Complication of diabetes?
  - Can occur as a result of tumors or AIDS?

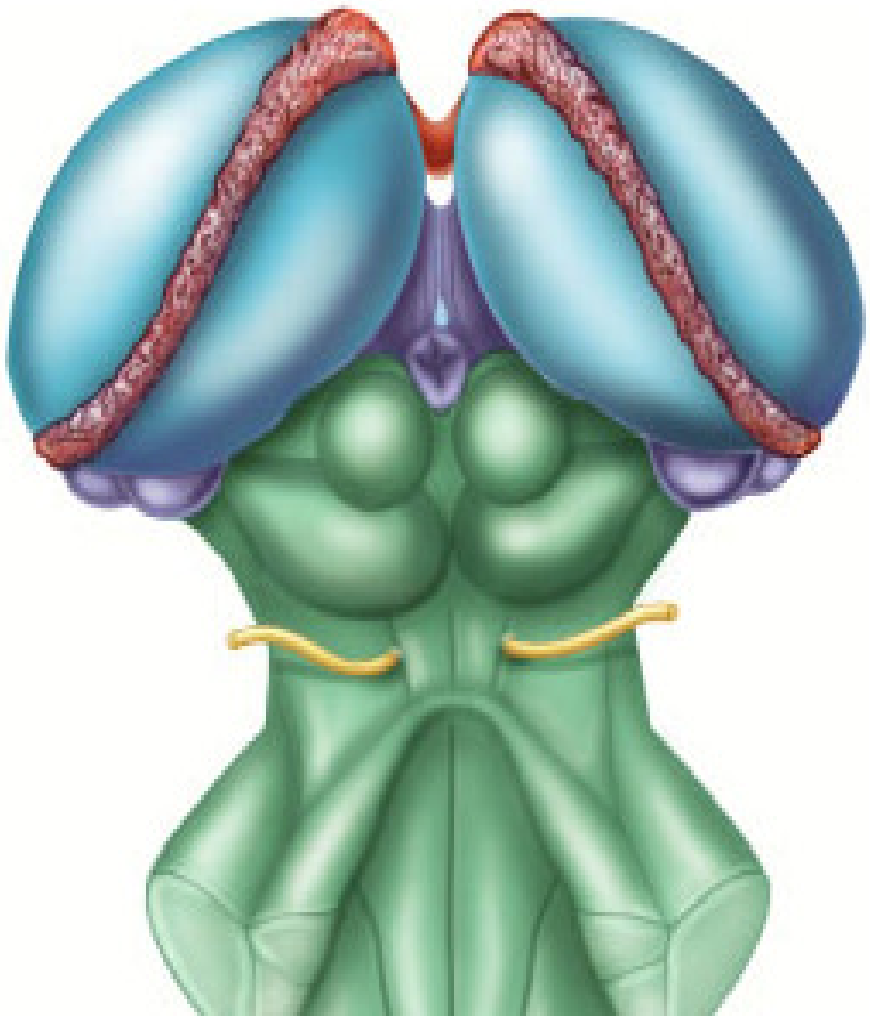
Midbrain ant. View



- Interpeduncular fossa
- Crus cerebri
- 3rd nerve emerges from medial side of crus cerebri in the interpeduncular fossa

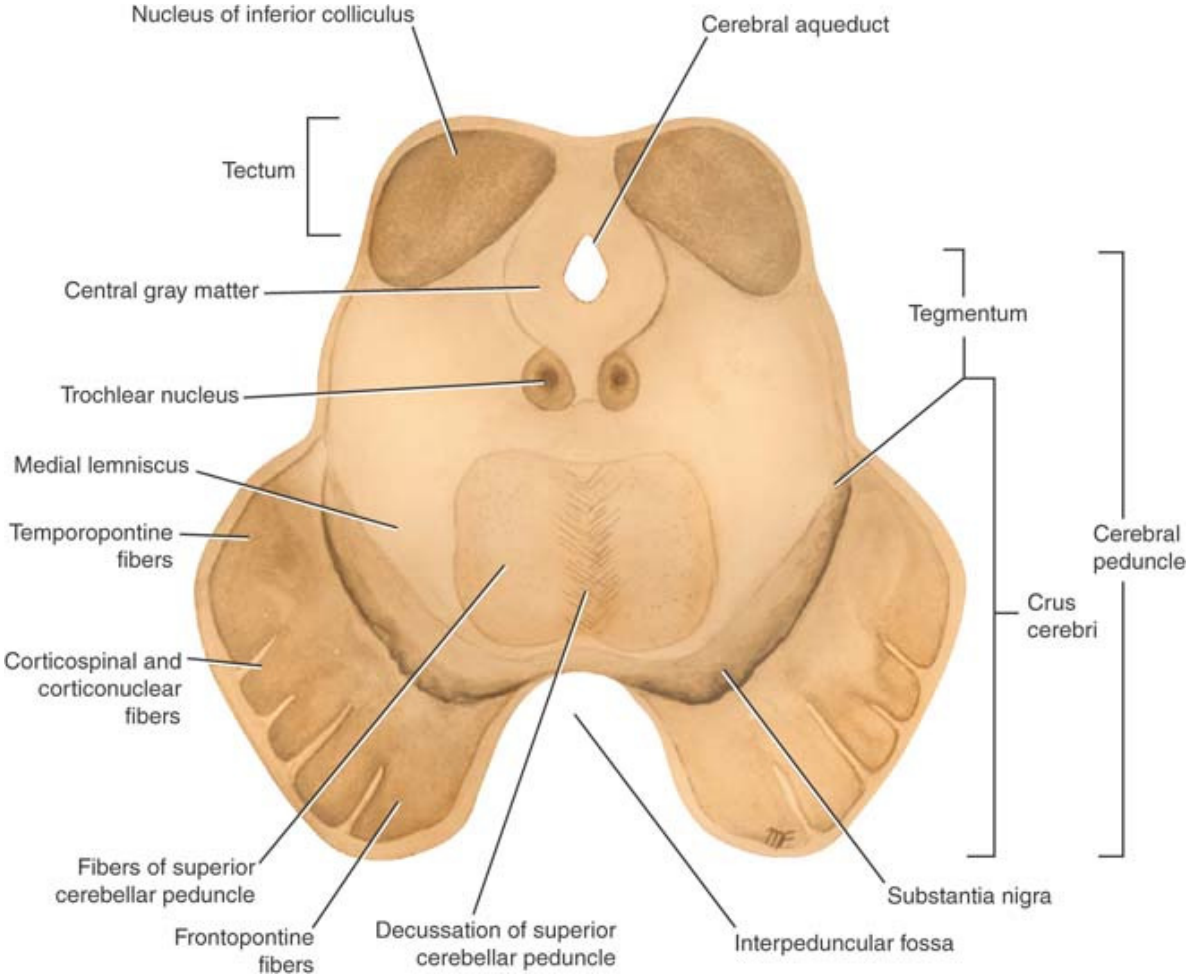
The Midbrain-posterior view

- Corpora quadrigemina – the largest nuclei
  - Divided into the superior and inferior colliculi
    - Superior colliculi – nuclei that act in visual reflexes
    - Inferior colliculi – nuclei that act in auditory reflexes
- Trochlear nerve emerges below the level of inf. Colliculus (from posterior surface)
- Occulomotor nerve emerges at the level of sup. colliculus
- Sup.brachium (to lateral geniculate body)
- Inf. Brachium (to medial geniculate body)
- 4th emerges



The Brain Stem – The Midbrain

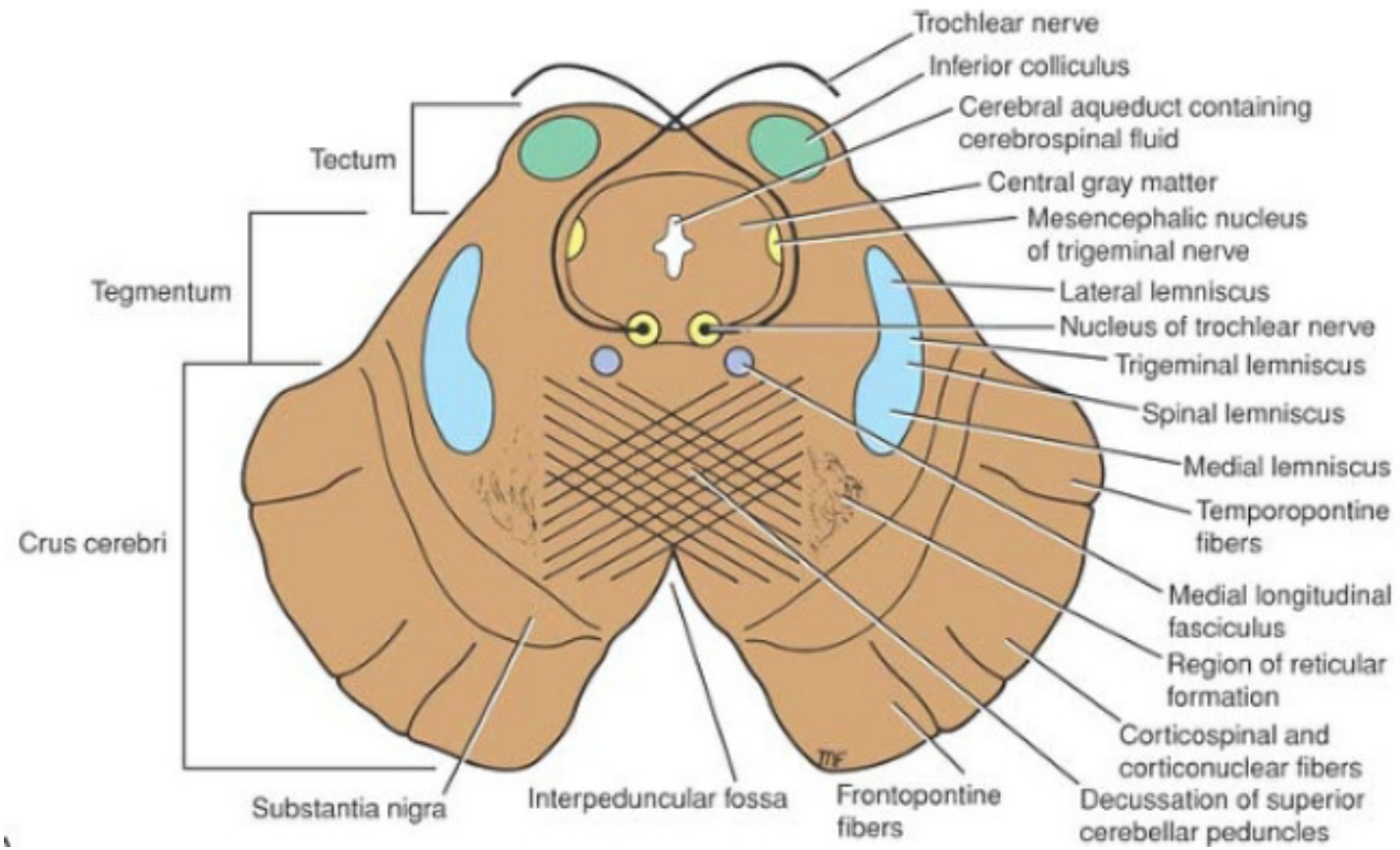
- Lies between the diencephalon and the pons
- Central cavity – the **cerebral aqueduct**
- Cerebral peduncles located on the ventral surface of the brain divided by the **substantia nigra** into**:**
- **Crus cerebri: Anterior**
- **Tegmentum: Posterior**
  - Contain pyramidal (corticospinal) tracts
- Superior cerebellar peduncles
  - Connect midbrain to the cerebellum



- Cerebral peduncle is divided into crus cerebri (ant) & tegmentum (post)
- Tectum is post to cerebral aqueduct

- Trochlear nucleus lies close to midline in the central gray matter (posterior to MLF)
- Trochlear nerves decussate in the superior medullary velum
- Decussation of sup. cerebellar peduncles (central part of the tegmentum anterior to the cerebral aqueduct)
- RF is lateral to decussation
- Medial, spinal ,trigeminal & lateral leminisci (Posterior to Substantia nigra)

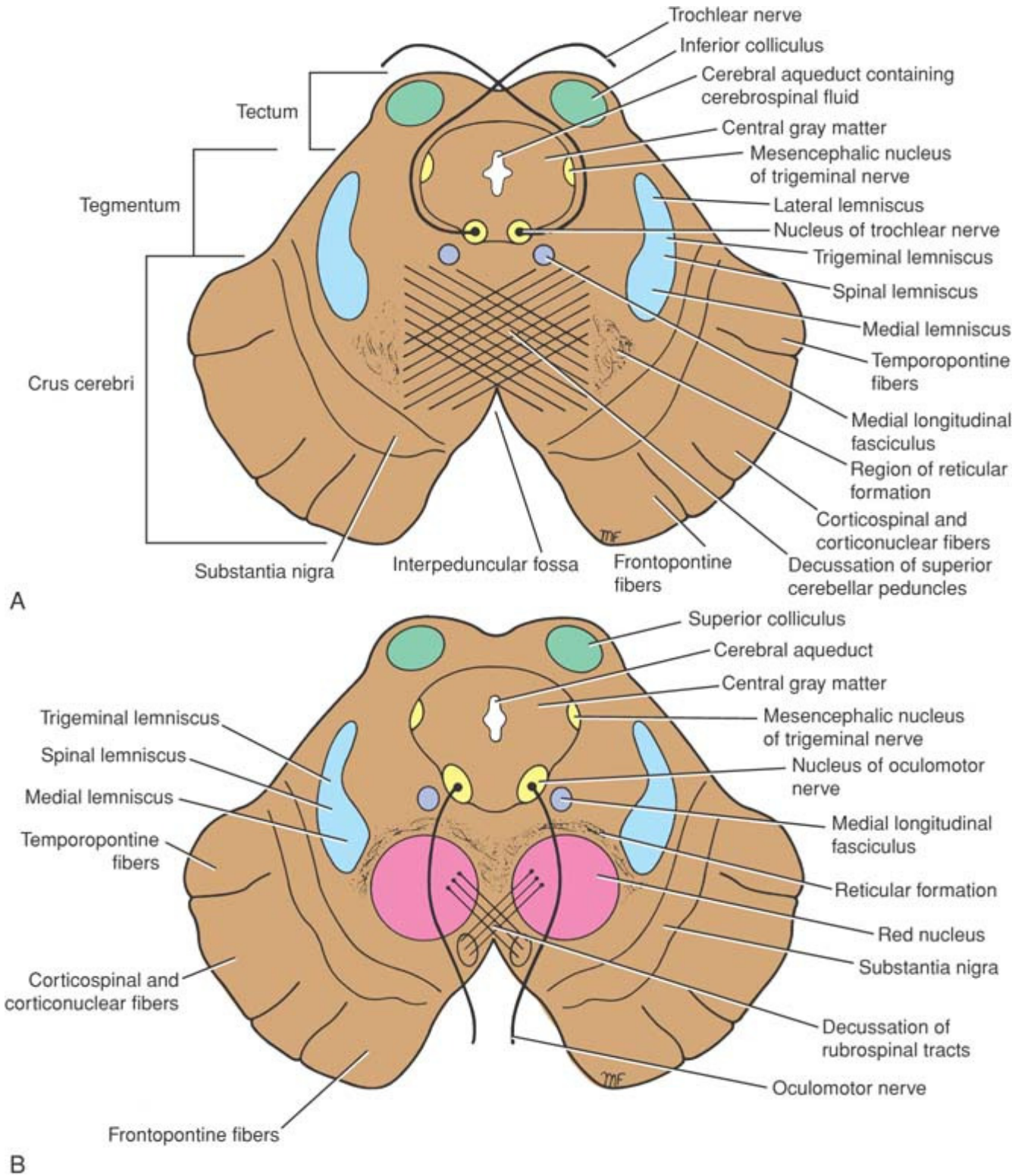
Level of inf. colliculus



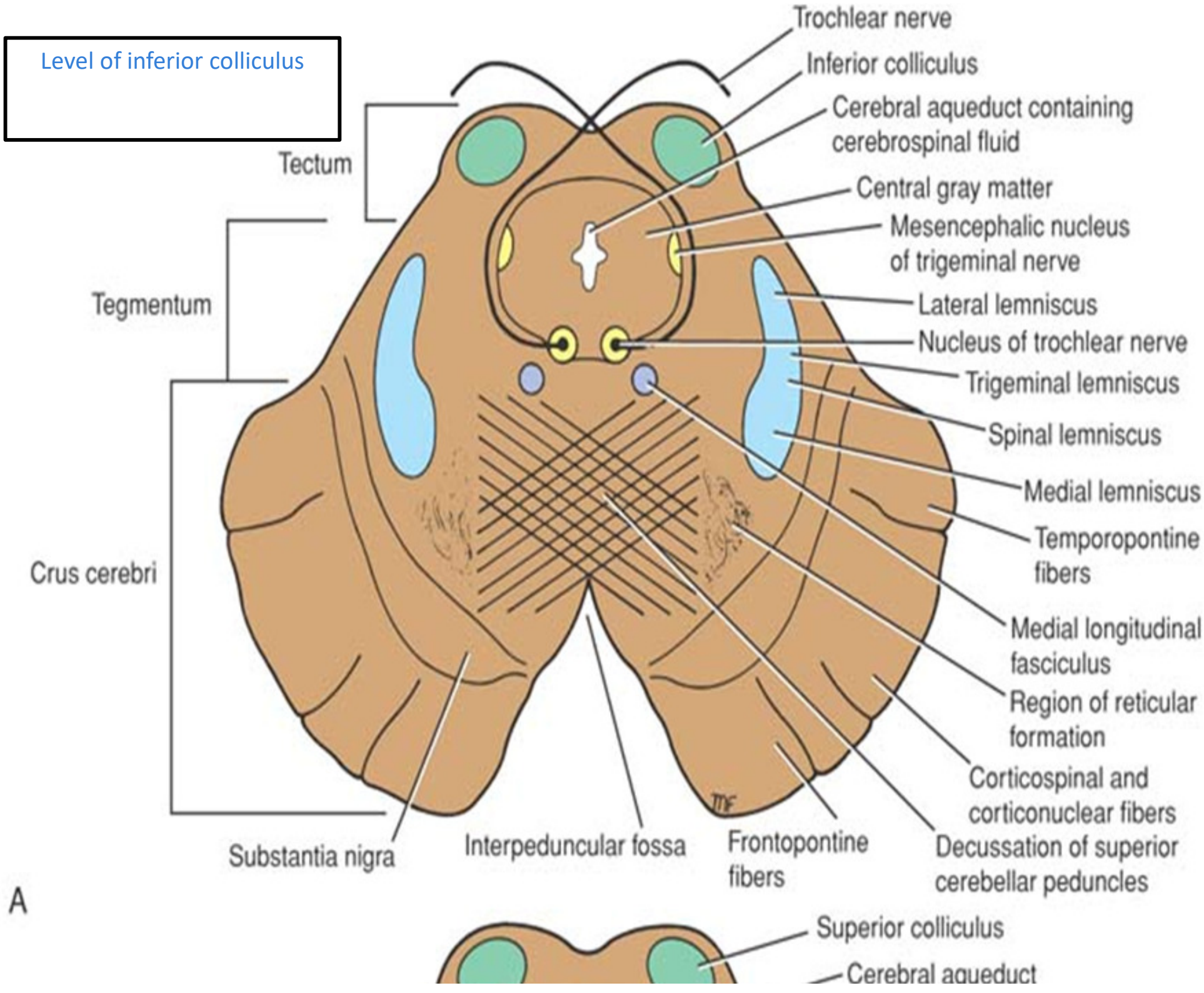
- Substantia nigra
- Crus cerebri
- Mesencephalic nucleus of trigeminal *(lateral to cerebral aqueduct)*
- MLF

Substantia nigra

- Large motor nucleus
- is a brain structure located in the midbrain
- plays an important role in reward, addiction, and movement.
- *Substantia nigra* is Latin for "black substance" due to high levels of melanin
- has connections with basal ganglia ,cerebral cortex
- Concerned with muscle tone
- Parkinson's disease is caused by the death of neurons in the substantia nigra

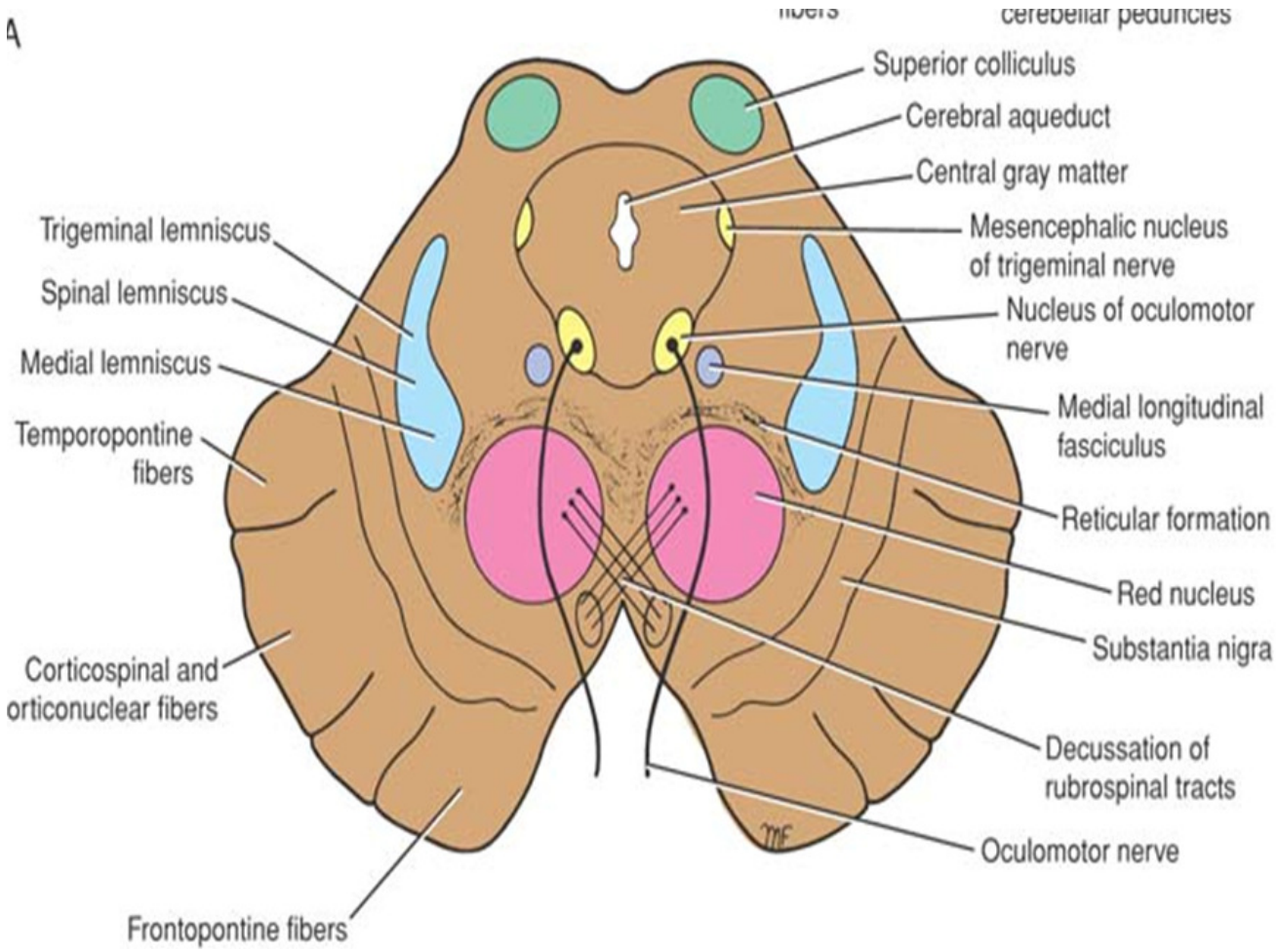


Level of inferior colliculus



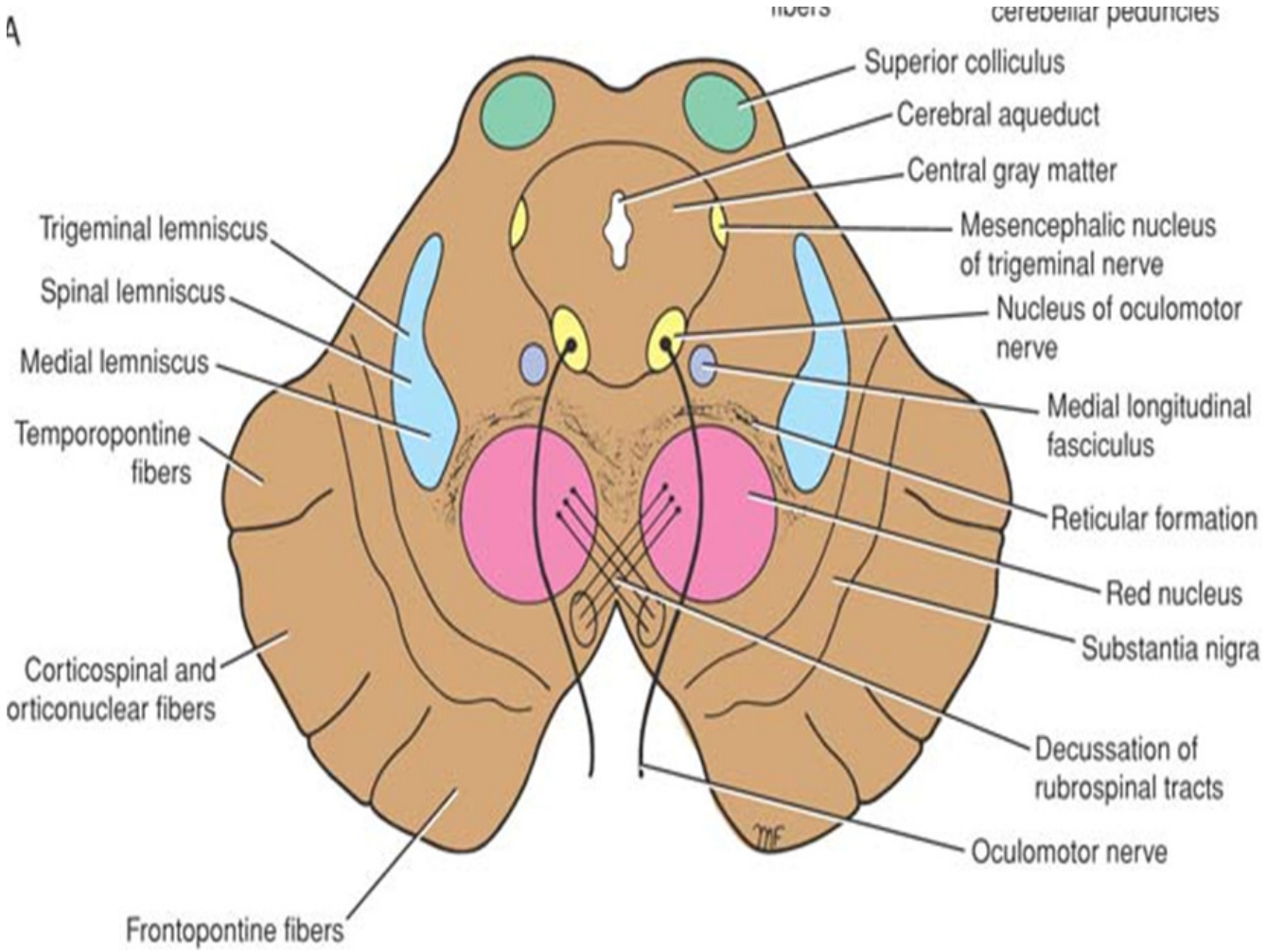
Level at superior colliculus

- Superior colliculus
- Occulomotor nucleus (posterior to MLF)
- Occulomotor n emerges through red nucleus
- Edinger-Westphal nucleus
- **pretectal nucleus:** close to the lateral part of the superior colliculus.
- MLF
- Medial , trigeminal, spinal leminiscus (**no** lateral leminiscus)
- Red nucleus
- Substantia nigra
- Crus cerebri
- RF

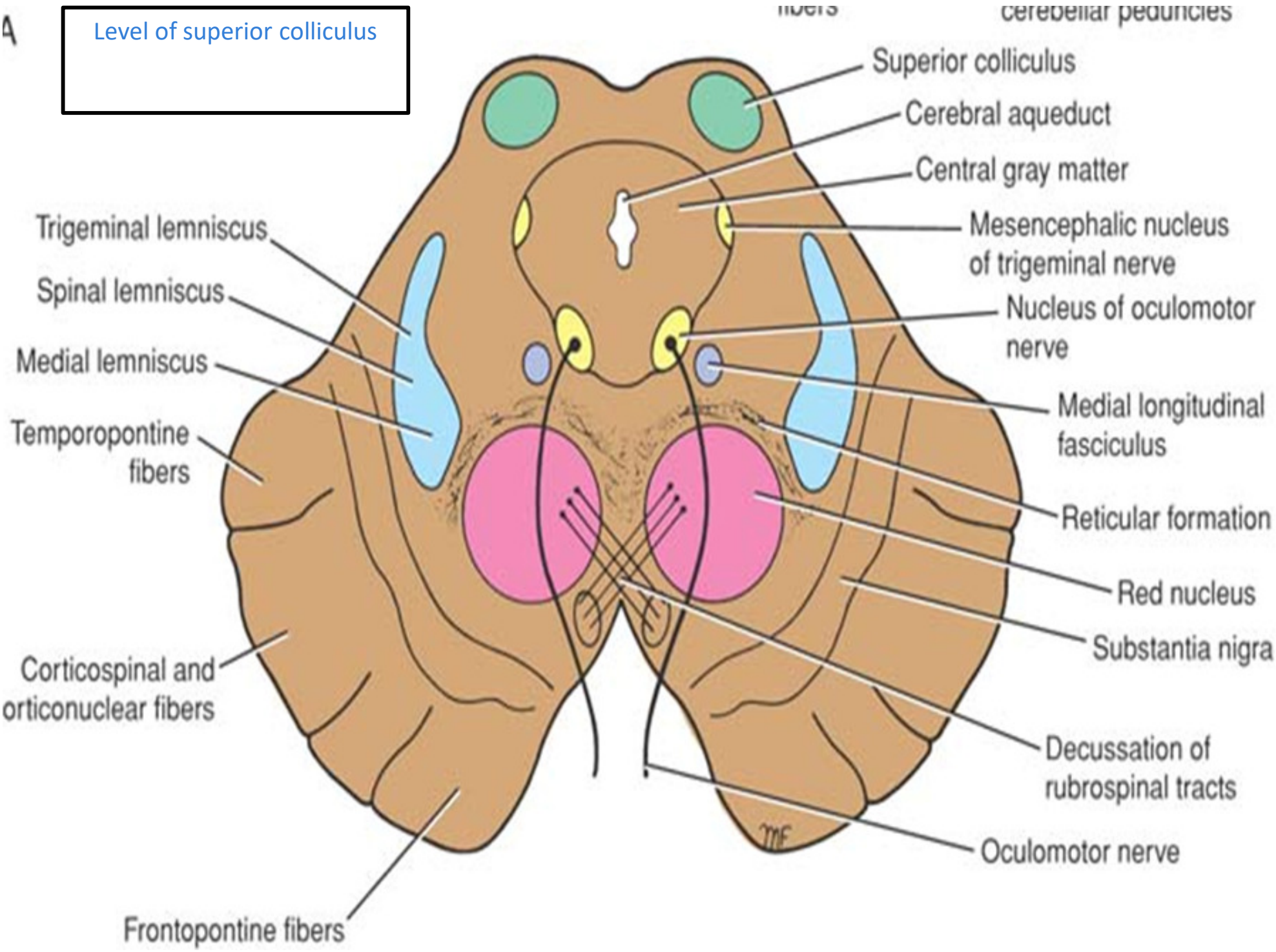


Red nucleus

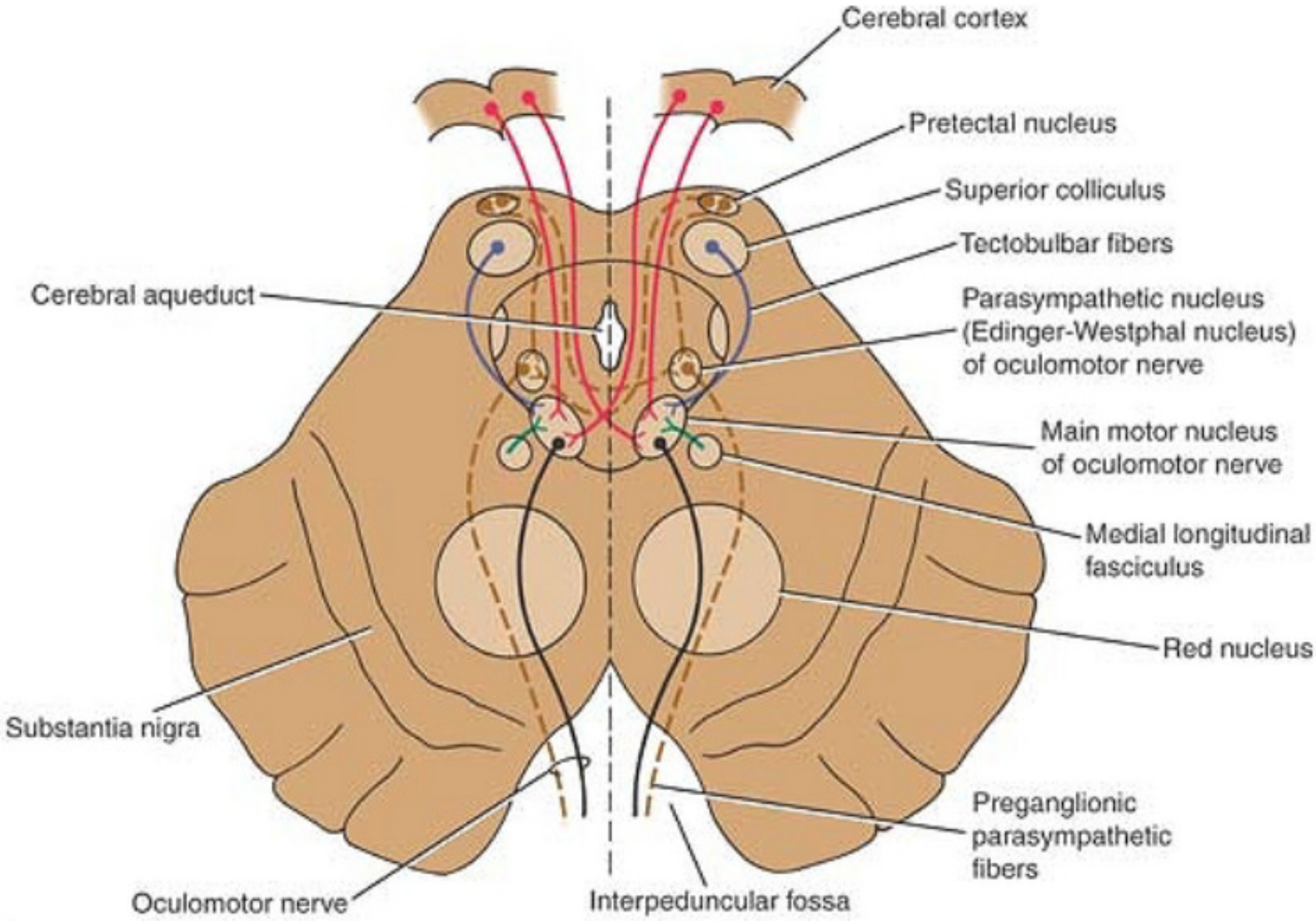
- Rounded mass of gray matter
- Situated bt cerebral aqueduct and substantia nigra
- Reddish blue(vascularity & iron containing pigment)
- Afferents from: cerebral cortex,cerebellum,substantia nigra, thalamic nuclei, spinal cord
- Efferent to: spinal cord, reticular formation. thalamus and substantia nigra
- involved in motor coordination.

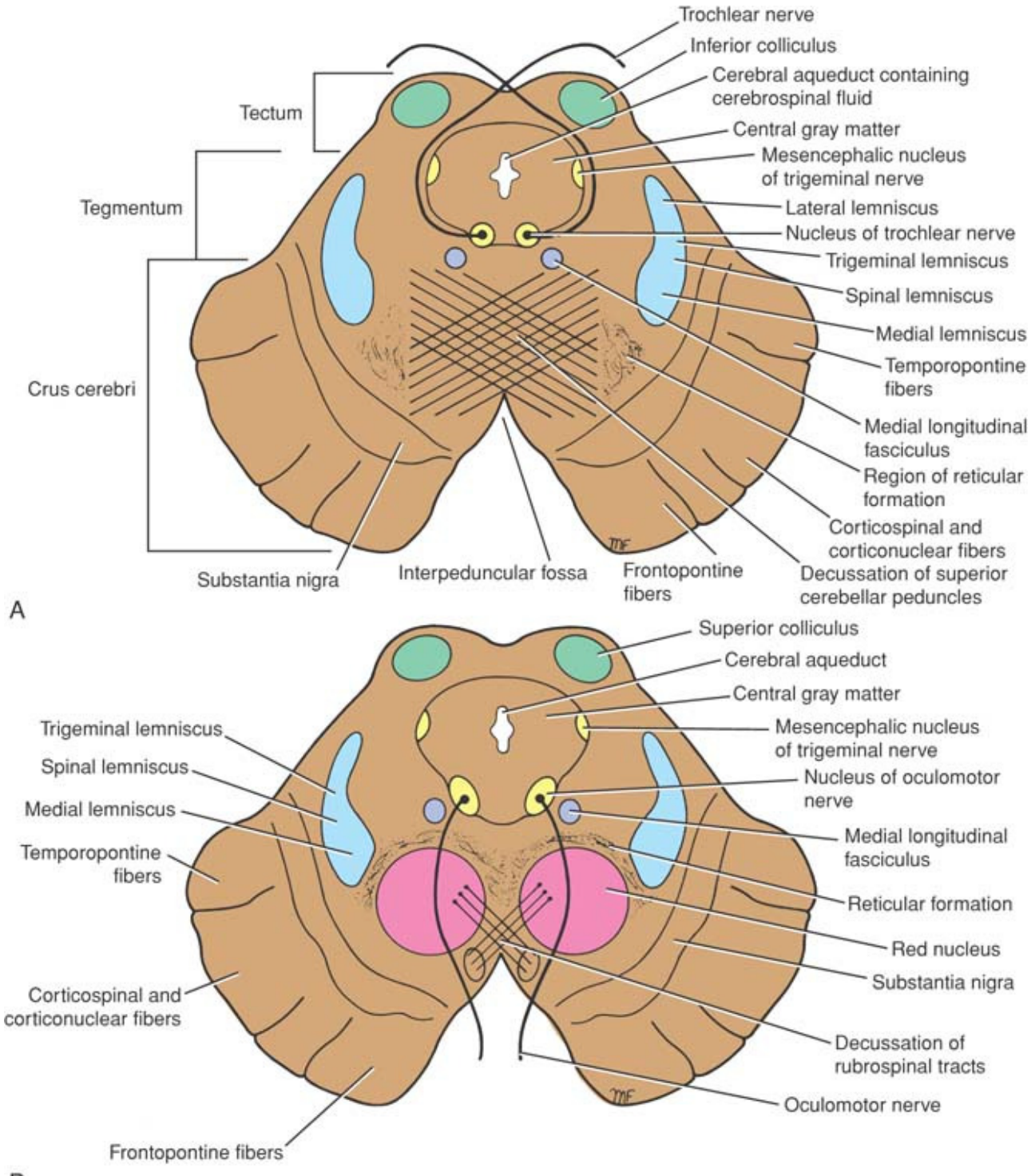


Level of superior colliculus



- Edinger-Westphal nucleus
- **pretectal nucleus:** close to the lateral part of the superior colliculus.

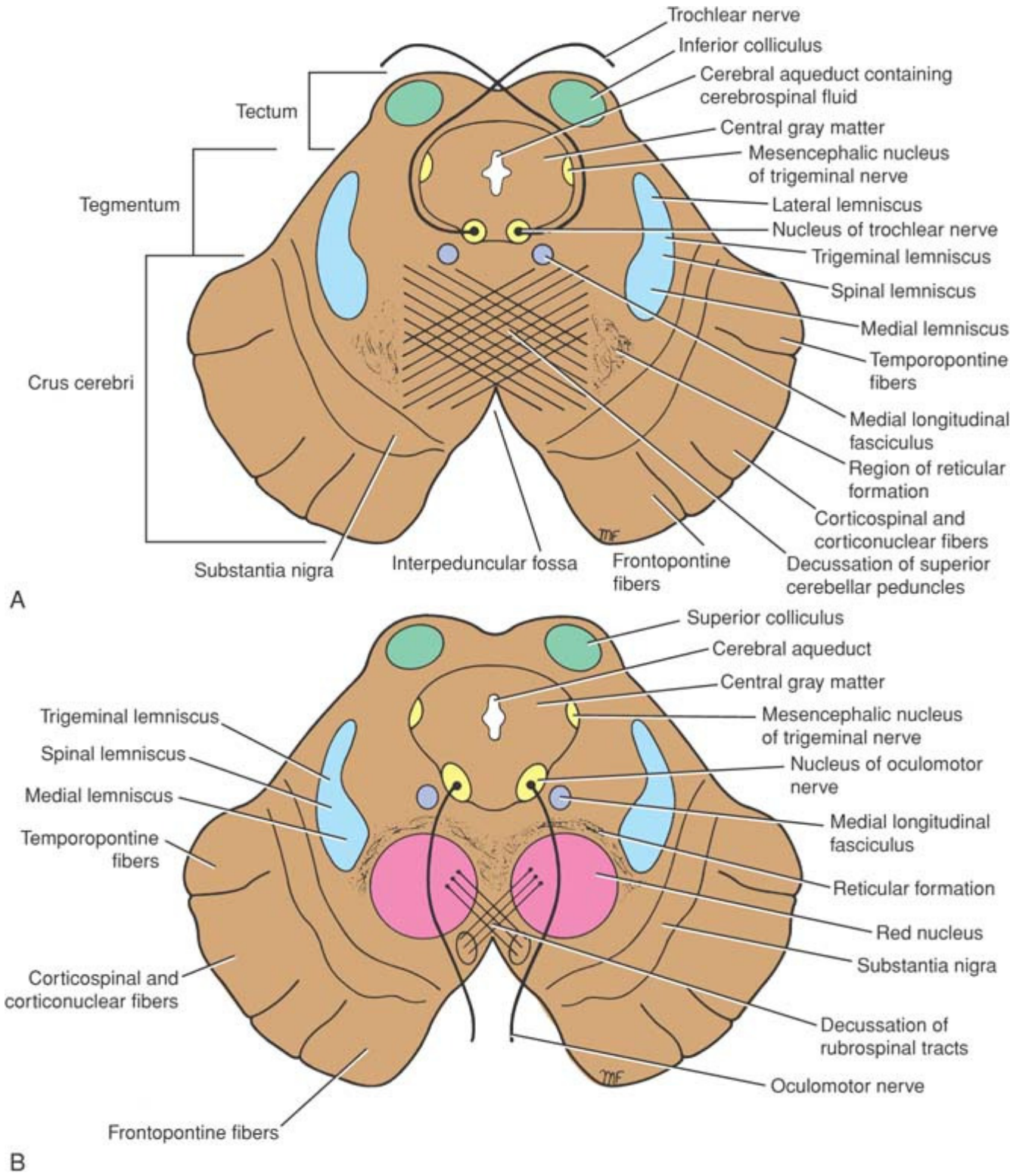



Trochlear nerve
Inferior colliculus
Cerebral aqueduct containing cerebrospinal fluid
Tectum
Central gray matter
Mesencephalic nucleus of trigeminal nerve
Tegmentum
Lateral lemniscus
Nucleus of trochlear nerve
Trigeminal lemniscus
Spinal lemniscus
Medial lemniscus
Temporopontine fibers
Crus cerebri
Medial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

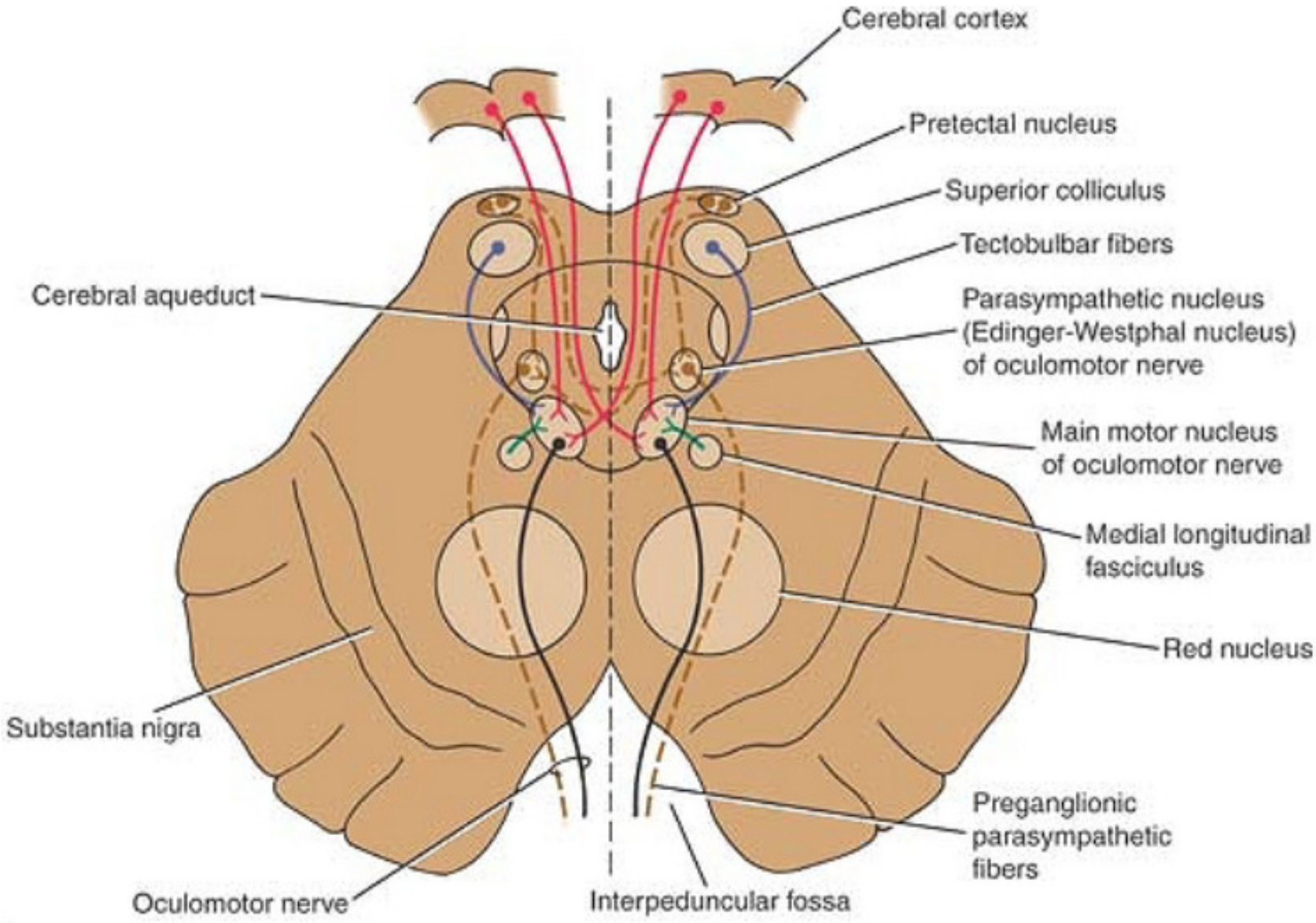
Crus cerebri

- Corticospinal & corticonuclear fibers (middle)
- Frontopontine fibers (medial)
- Temporopontine fibers (lateral)

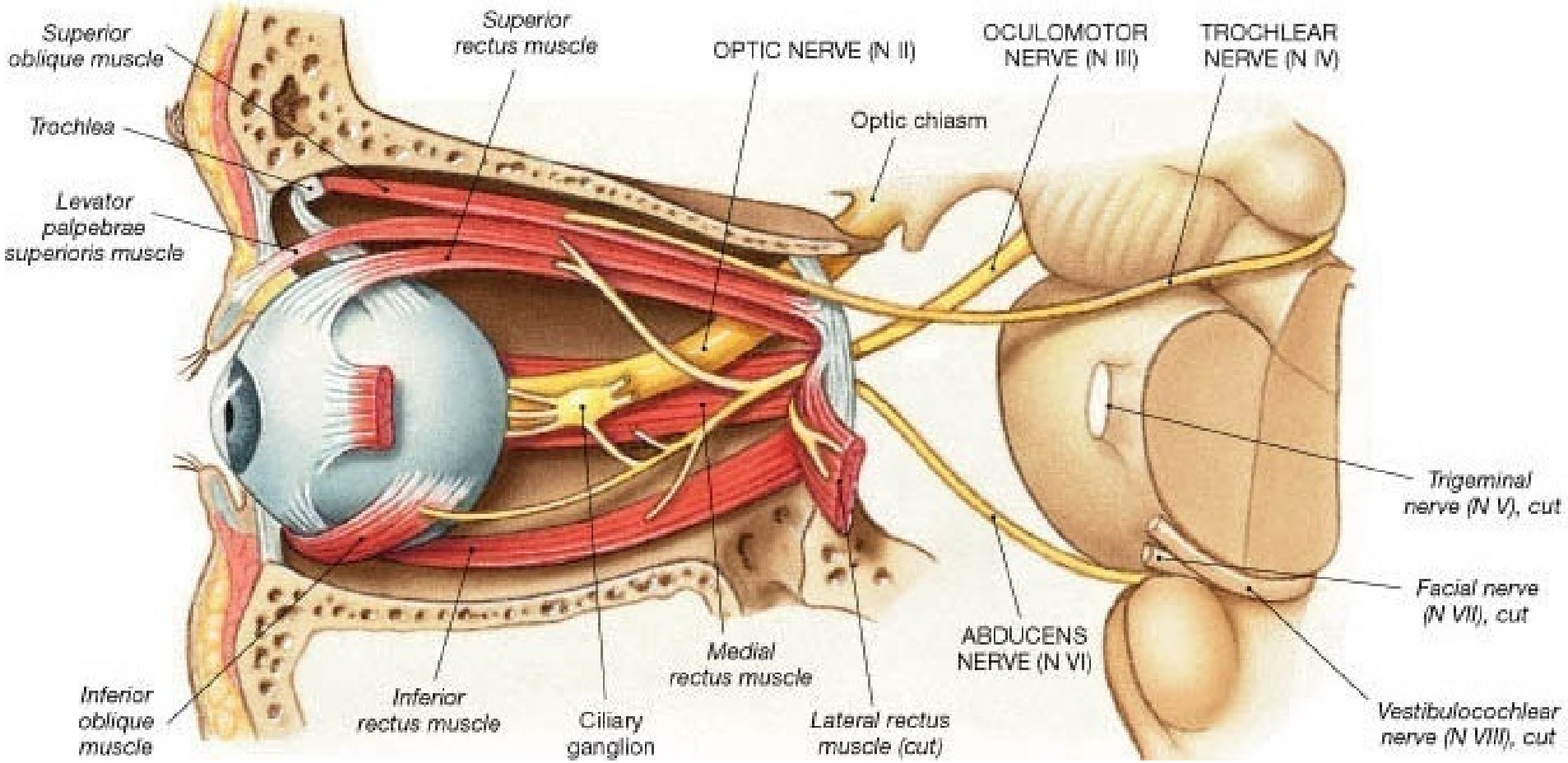
these descending tracts connect the cerebral cortex with spinal cord, cranial nerves nuclei, pons & cerebellum



Oculomotor Nerve (III)



- **Main oculomotor nucleus**
- **Accessory parasympathetic nucleus (Edinger-Westphal nucleus)**

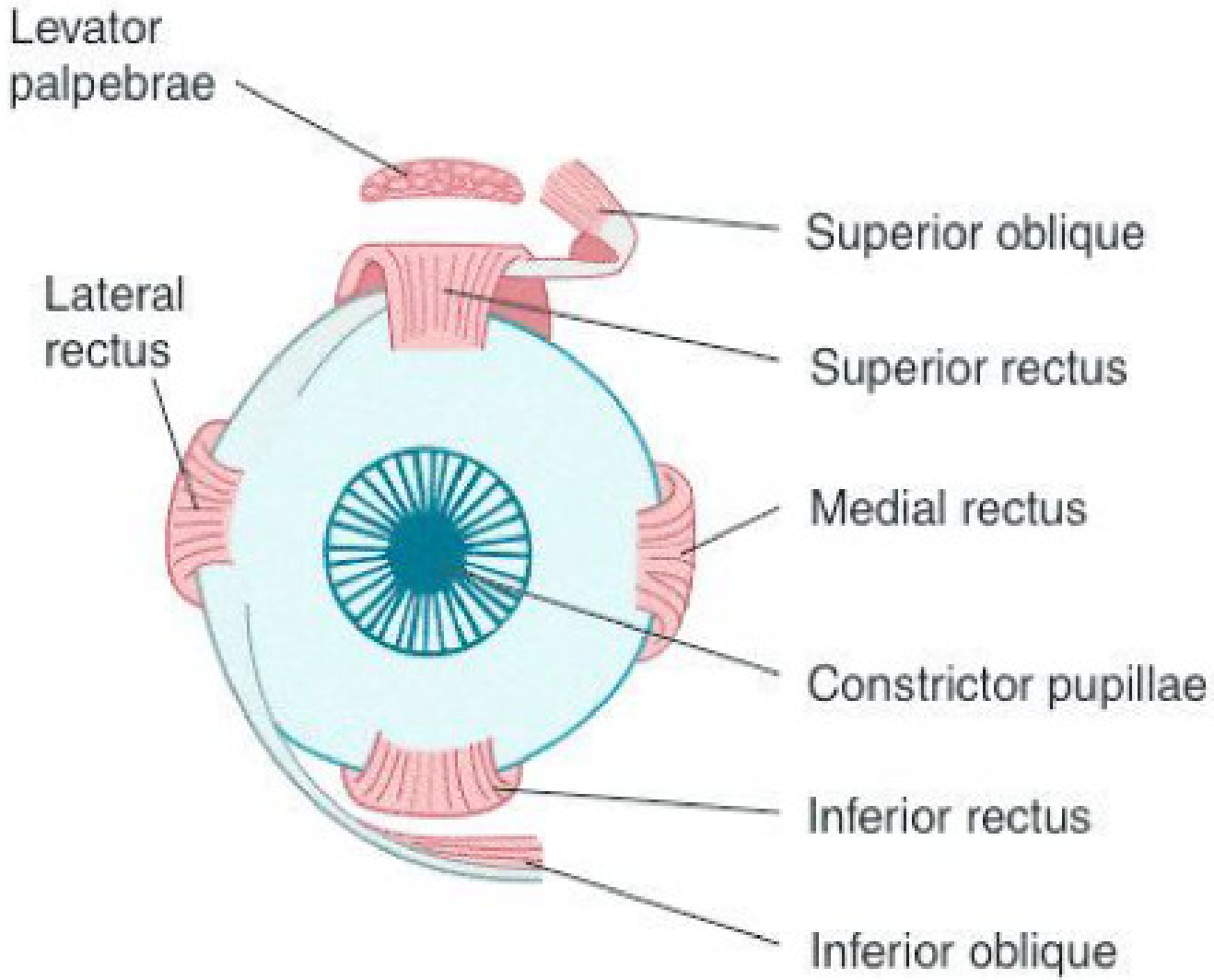


Course of occulomotor nerve

- Red nucleus
- Interpeduncular fossa
- Middle cranial fossa in the lateral wall of the cavernous sinus (Two rami)
- superior orbital fissure

Oculomotor Nerve (III)

- **Extrinsic muscles:**
  - The levator palpebrae superioris, superior rectus, medial rectus, inferior rectus, and inferior oblique
- **Intrinsic muscles:**
  - The constrictor pupillae of the iris and ciliary muscles



- **Action:**
  - Lifting the upper eyelid; turning the eye upward, downward, and medially; constricting the pupil; and accommodating the eye

Oculomotor Nerve injury

- **Complete lesion**
  - All of the muscles are paralyzed except lateral rectus and superior oblique
  - Symptoms:
    - External strabismus
    - Diplopia
    - Ptosis: drooping of the upper eyelid.
    - The pupil is widely dilated and nonreactive to light
    - Accommodation of the eye is paralyzed.
- **Incomplete lesions:**
  - **Internal ophthalmoplegia:** loss of the autonomic innervation of the sphincter pupillae and ciliary muscle
  - **External ophthalmoplegia.:** paralysis of the extraocular muscles

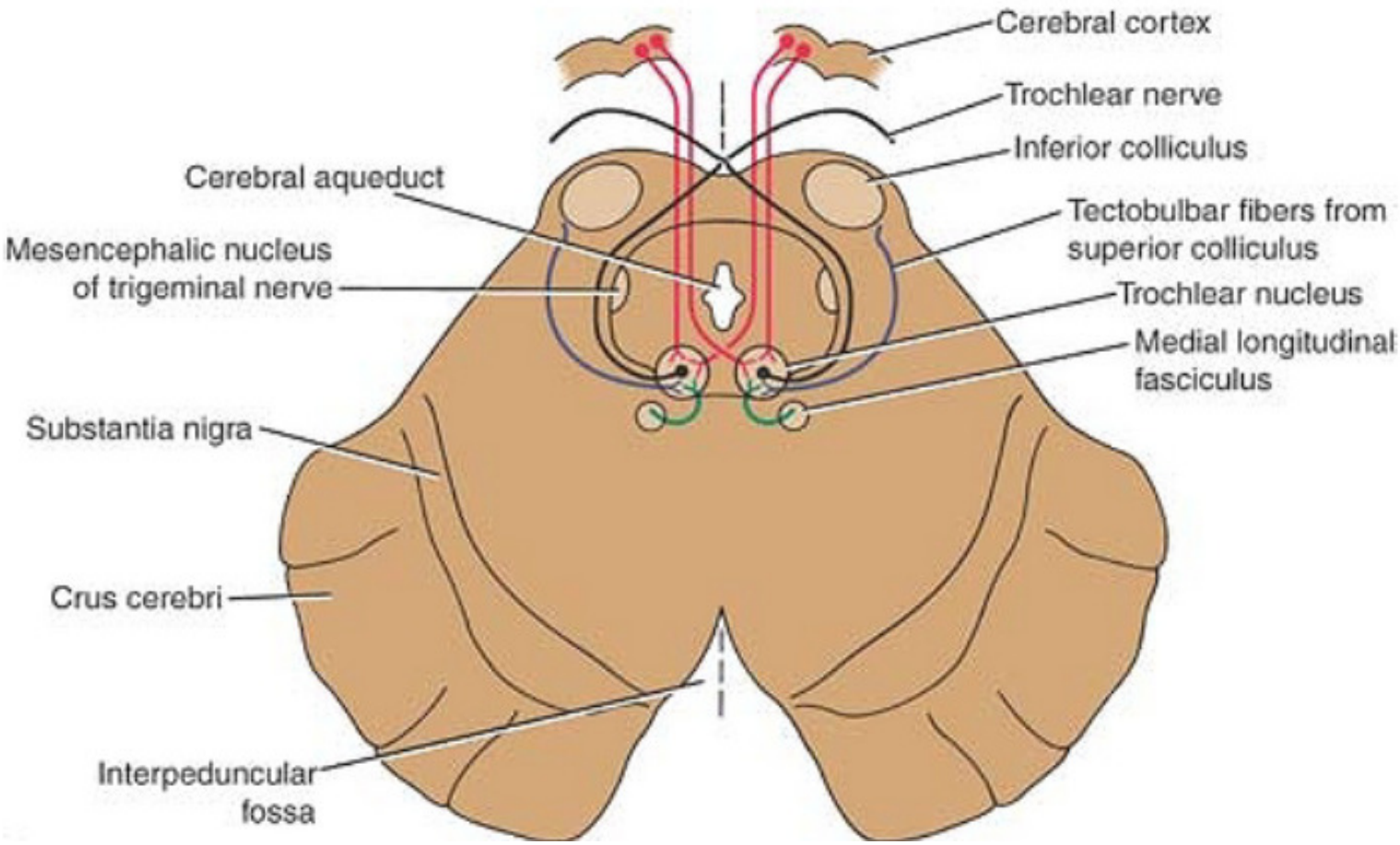
Double Vision

In cases of (diabetic neuropathy), the autonomic fibers are unaffected, whereas the nerves to the extraocular muscles are paralyzed.

Trochlear Nerve

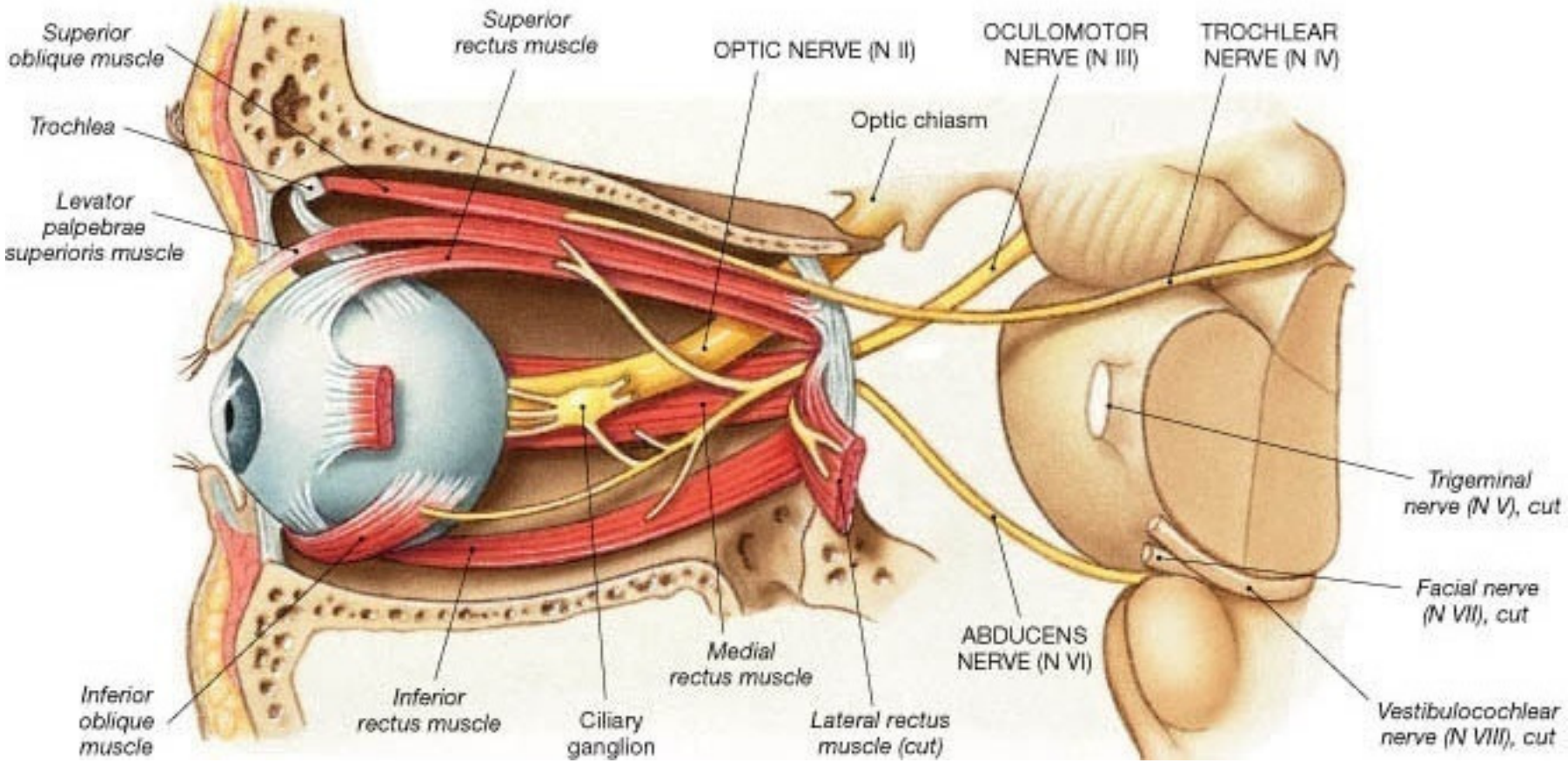
Nucleus

- **Location**

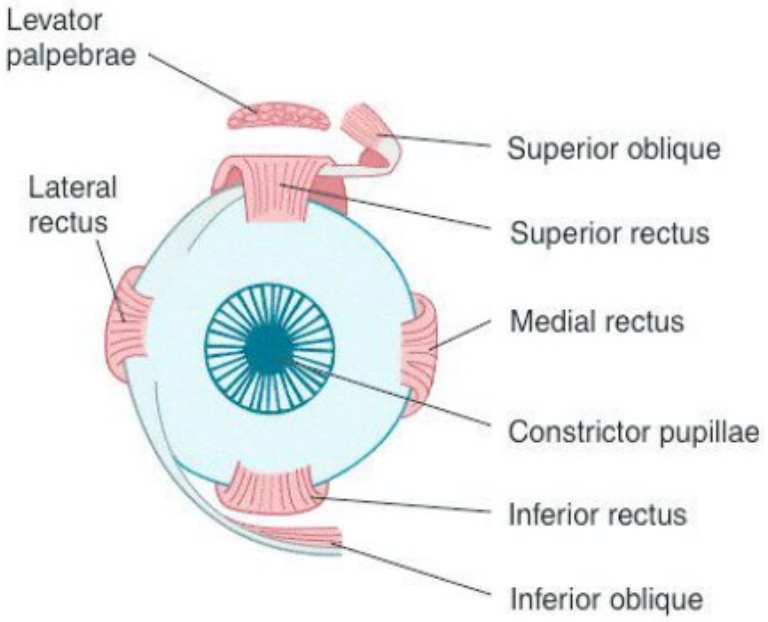


- Pass **posteriorly** around the central gray matter
- Immediately decussates

Trochlear Nerve



- **Supplies**: superior oblique muscle
- **Action:** turning the eye downward and laterally



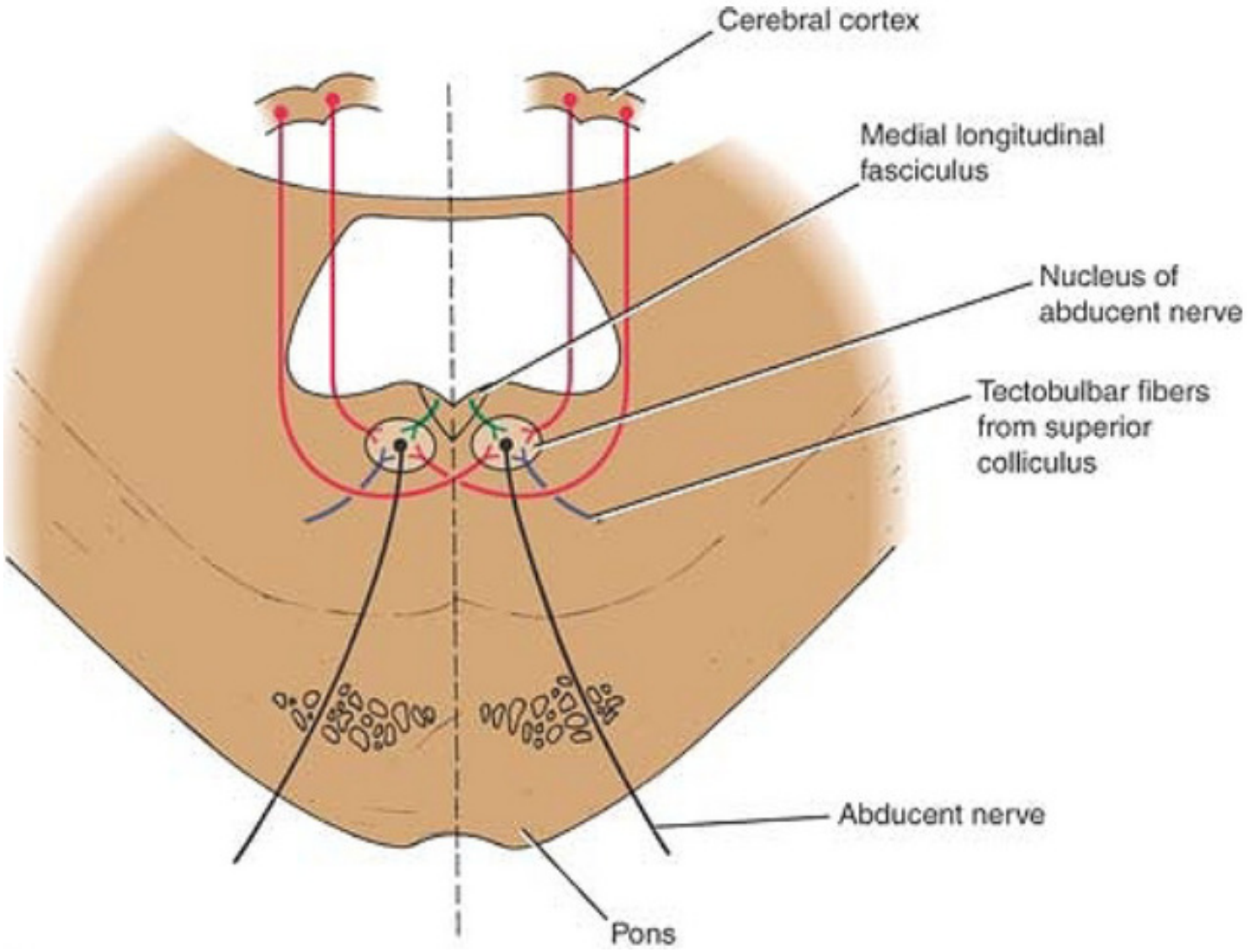
Trochlear Nerve injury

- Symptoms:
  - Diplopia
  - Difficulty in turning the eye downward and laterally.
  - Difficulty in descending stairs
  - Head tilt to the side opposite the paralsied eye (compensatory adjustment)

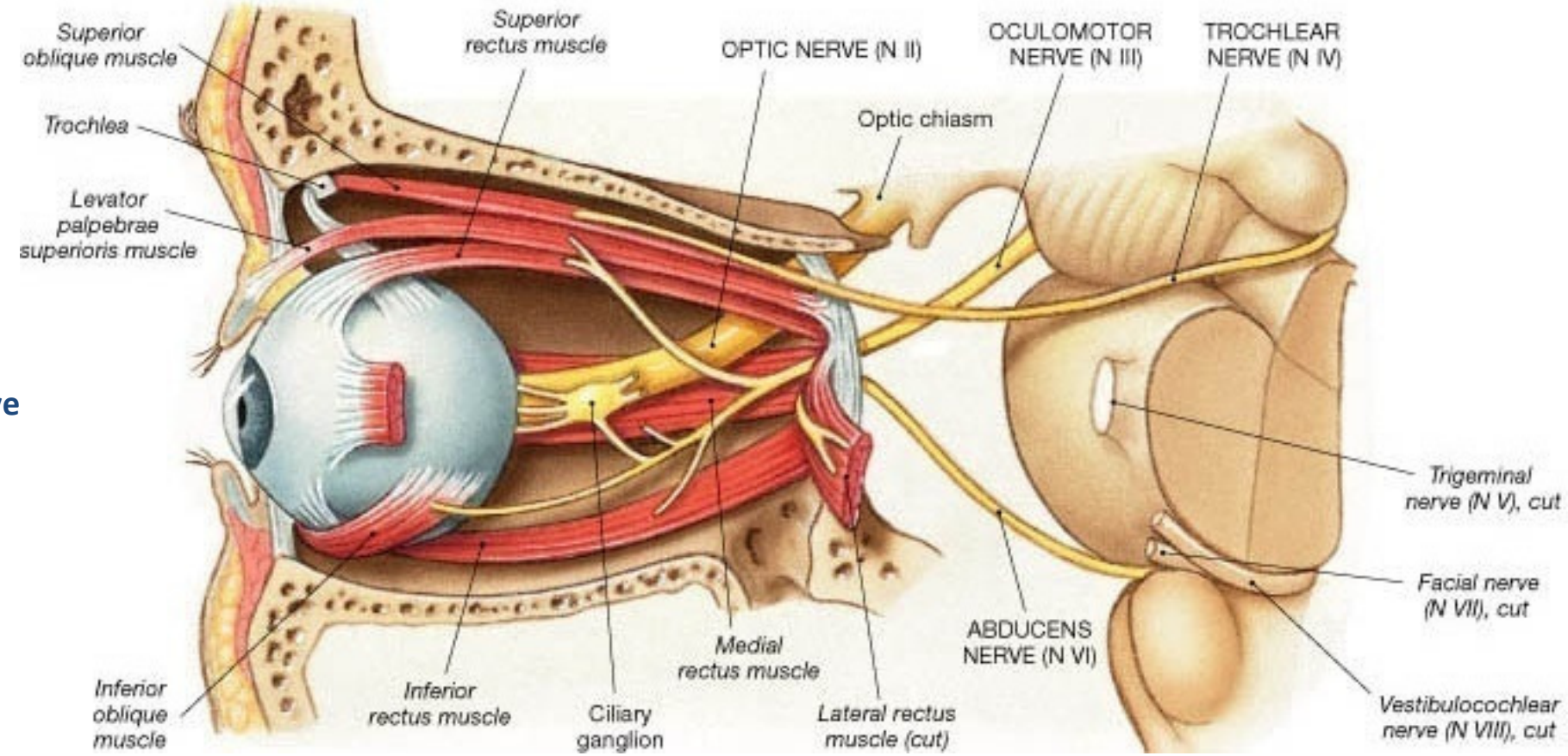
Abducent Nerve

Nucleus

- **Location:** beneath the floor of the upper part of the fourth ventricle, close to the midline



Course of Abducent nerve



- Passes anteriorly: groove between the lower border of the pons and the medulla oblongata
- Through the cavernous sinus, below and lateral to the internal carotid artery
- Superior orbital fissure
- Supplies the lateral rectus: turning the eye laterally

Abducent Nerve injury

- Symptoms:
  - Diplopia
  - Difficulty in turning the eye laterally.
  - **internal strabismus.** unopposed medial rectus pulls the eyeball medially