CNS Module

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Pons

Brain Stem

- **By the end of this session, you should be able to :**

1. *Connection, External, and internal features of the Pons.*

2. *Motor and sensory pathway.*

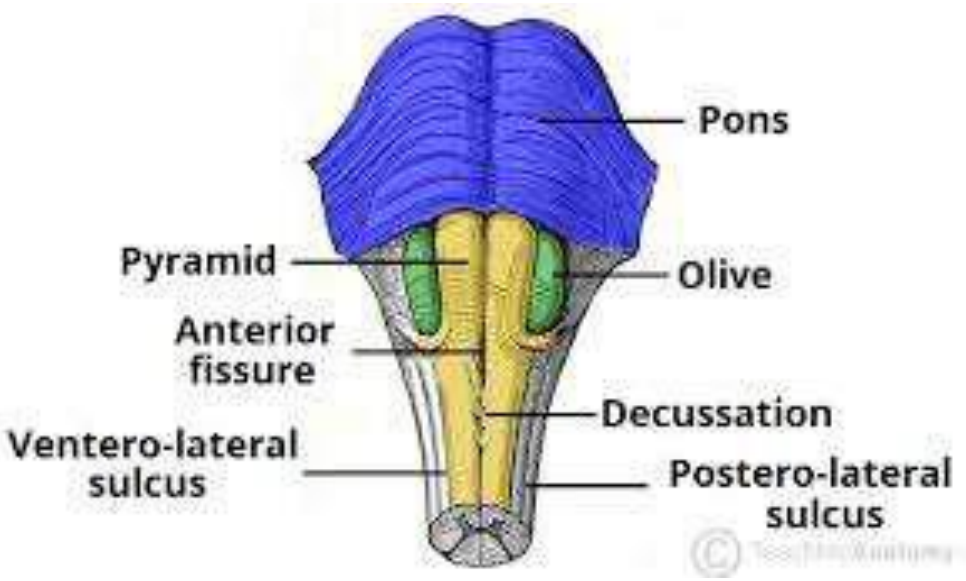
The Pons

The word "***pons***" means ***bridge***, connecting the right and left cerebellar hemispheres by a middle cerebellar peduncle (MCP) on each side.

It lies between the medulla oblongata and the midbrain just anterior to the cerebellum

The Pons

- ***Extent:*** it extends between the medulla oblongata from below, to the midbrain above and lies in front of the cerebellum.



External Features of the Pons

The anterior surface of the pons presents the following features:

1. ***The basilar groove:*** for basilar artery.
2. ***The transverse pontine fibers:*** to form middle cerebellar peduncle.
3. ***The middle cerebellar peduncle.***

External Features of the Pons

4. ***The trigeminal nerve*** from the middle of ventrolateral, aspect of pons, as 2 roots: a small medial motor root and a large lateral sensory root..

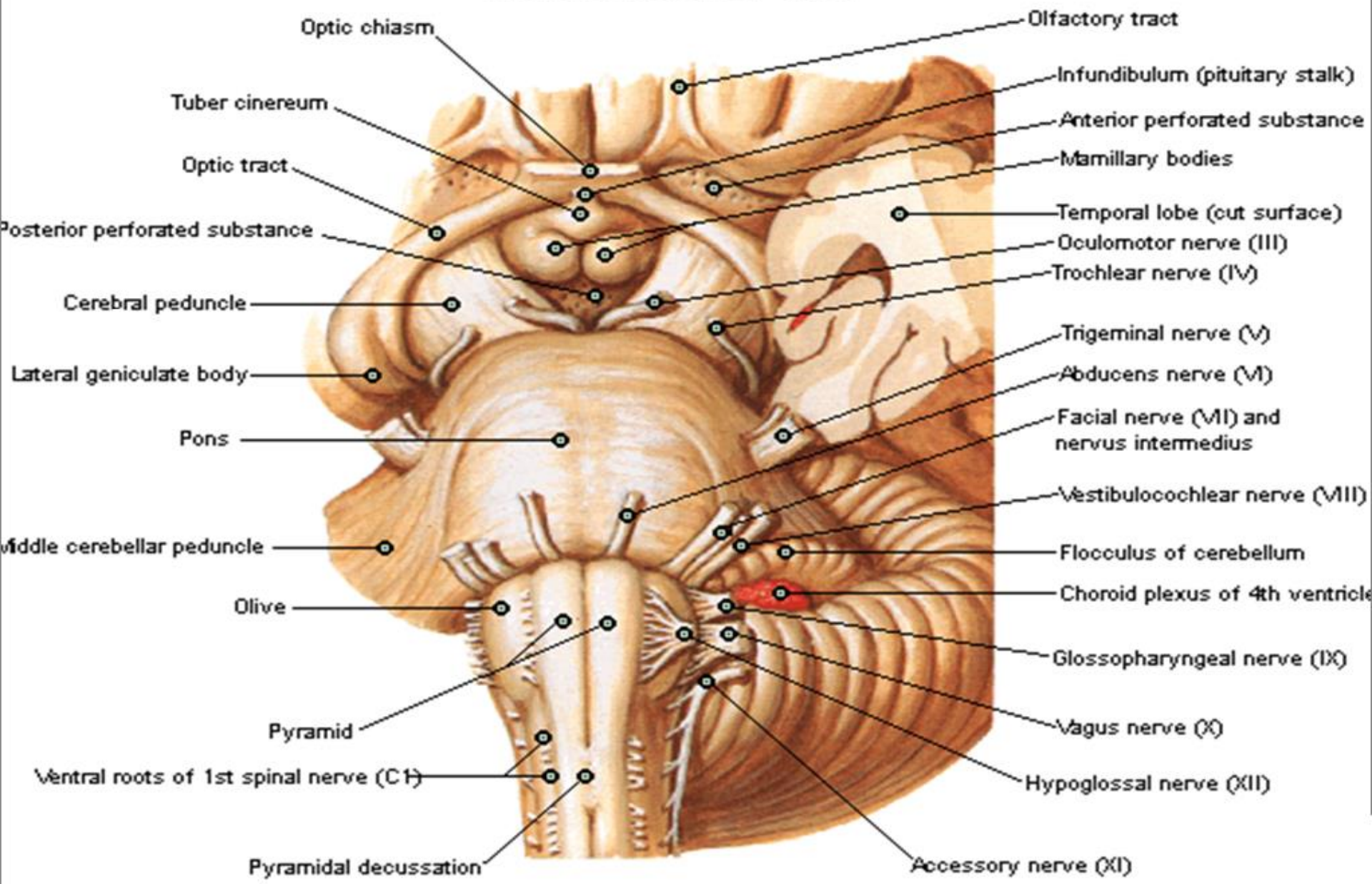
5. ***The abducent nerve*** from sulcus between pons and pyramid.

6. ***The facial nerve at cerebello-pontine angle*** (bet. medulla & pons) by 2 roots (motor: large & med. + sensory: nervus intermedius: small & lat.).

7. ***The vestibule-cochlear nerve*** at cerebello-pontine angle, lateral to VII, by 2 roots (vestibular medially & cochlear laterally.

Brainstem

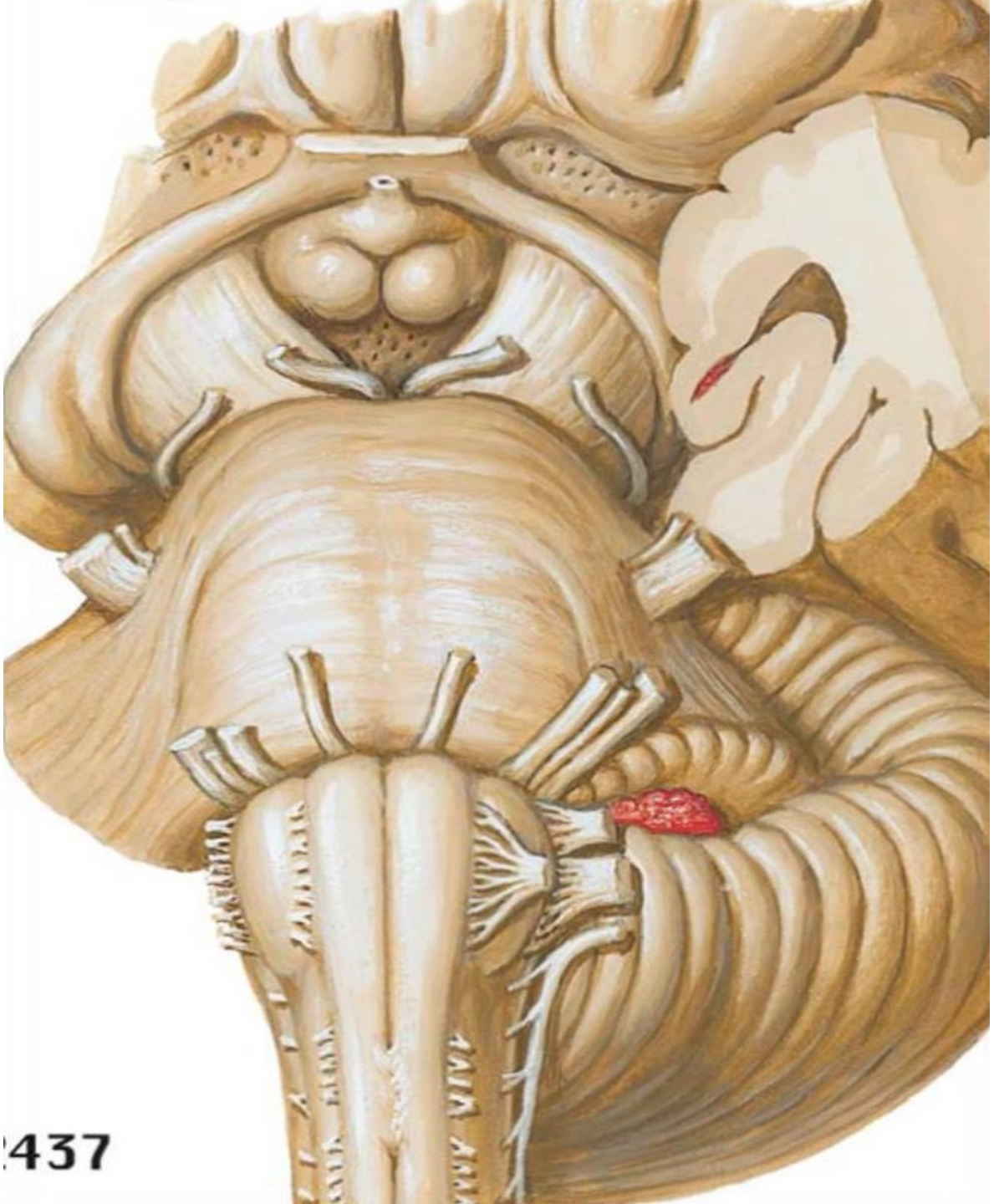
Anterioinferior View



Cerebellopontine Angle

The ***cerebellopontine angle*** is a structure at the margin of the cerebellum and pons containing arachnoid tissue, cranial nerves, and associate vessels. Contents:

1. Facial nerve (CN VII)
2. Vestibulocochlear nerve (CN VIII)
3. Flocculus of the cerebellum
4. Lateral recess of the 4th ventricle



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External Features of the Pons

- ***The posterior surface of the pons presents the following features:***

1. The ***median longitudinal sulcus***: the middle line.

2. Lateral to the median sulcus lies the ***medial eminence*** which is ***formed*** by the ***abducent nucleus*** and ***bounded*** laterally ***by*** the ***sulcus limitans*** . Lateral tu it, the ***vestibular area***

External Features of the Pons

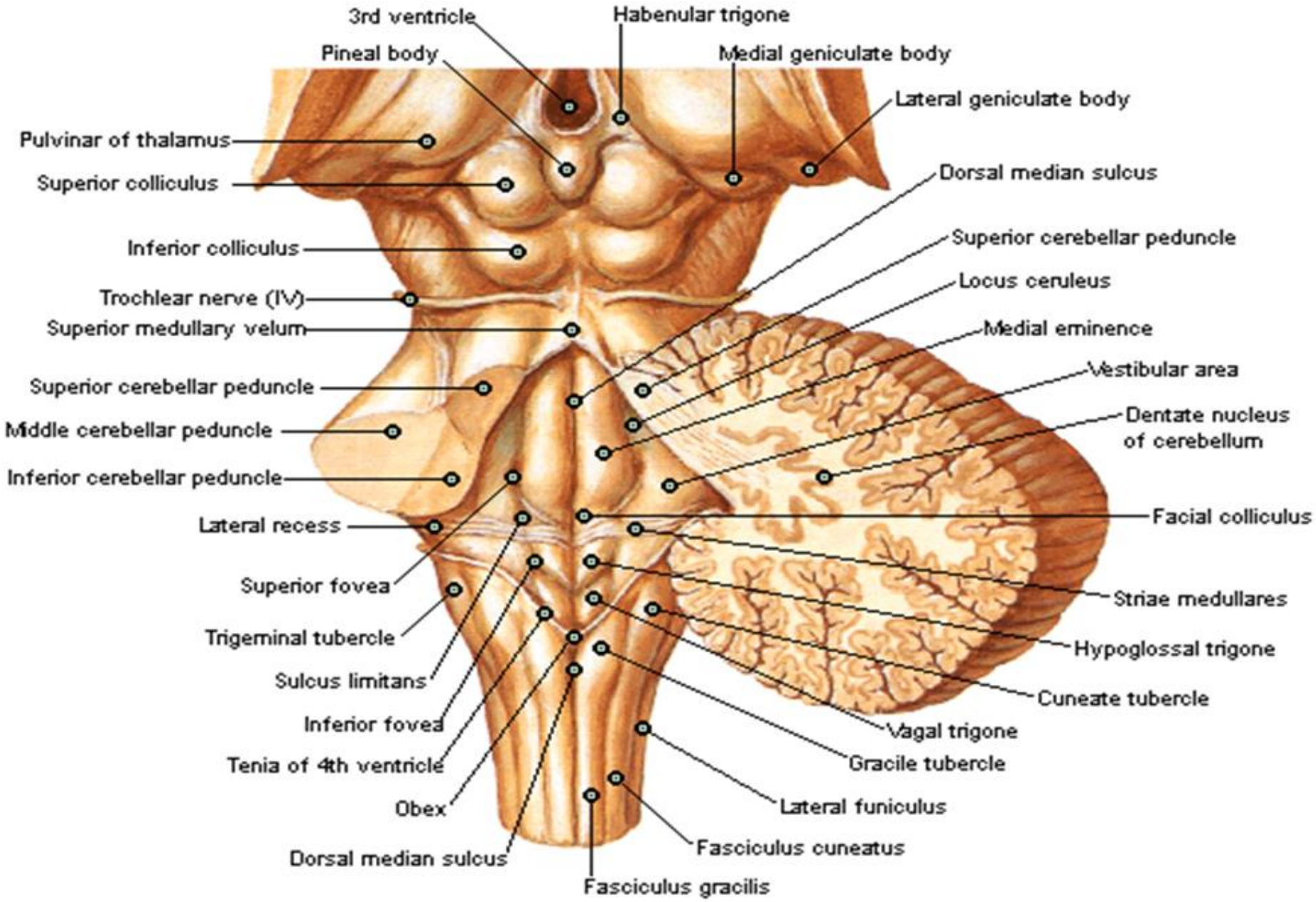
3. ***The facial colliculus:*** it produced by the ***facial nucleus***.

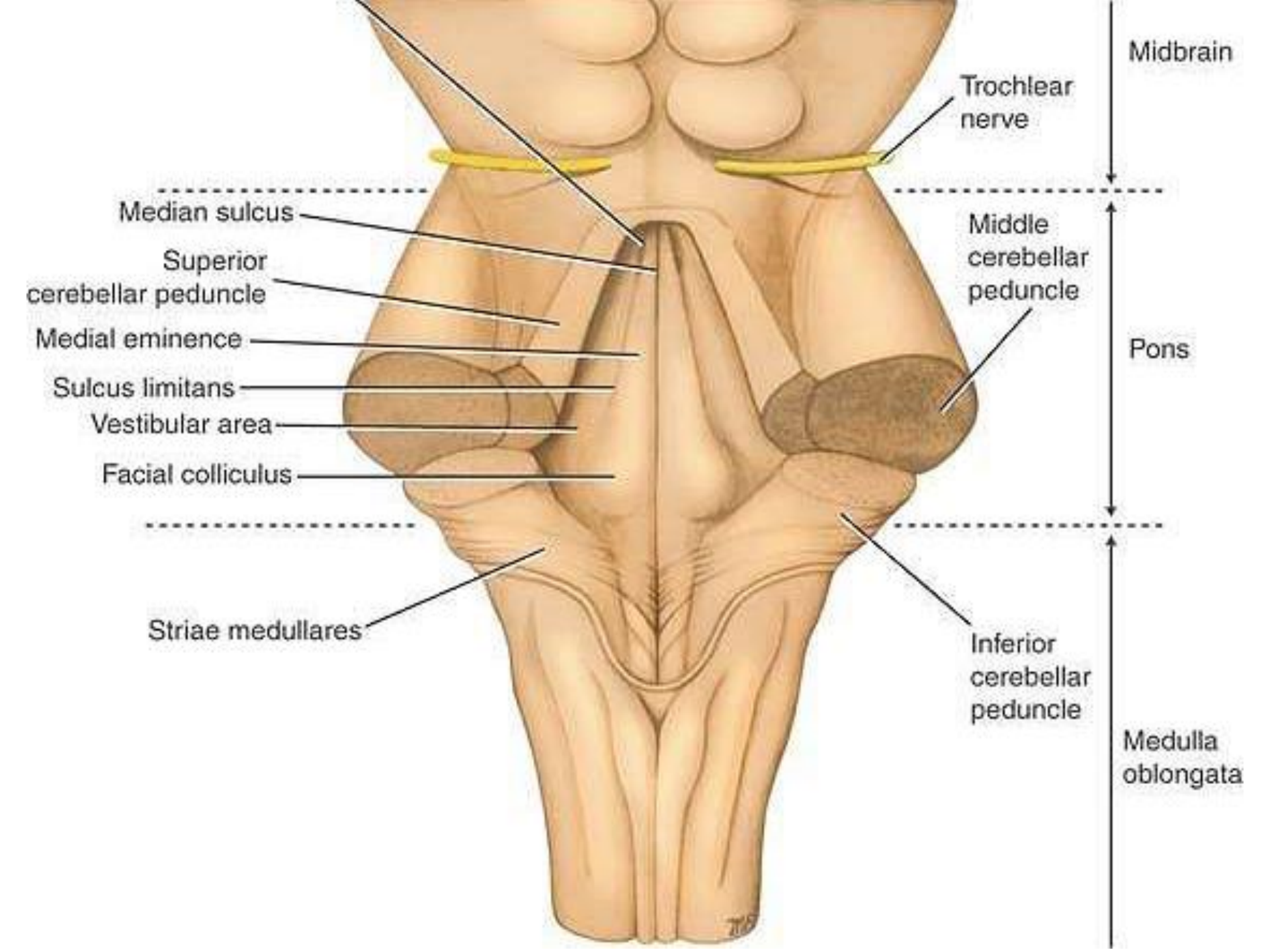
4. ***The medullary stria:*** transverse nerve fibers which ***separate*** the posterior surface of ***pons from*** that of ***medulla*** oblongata.

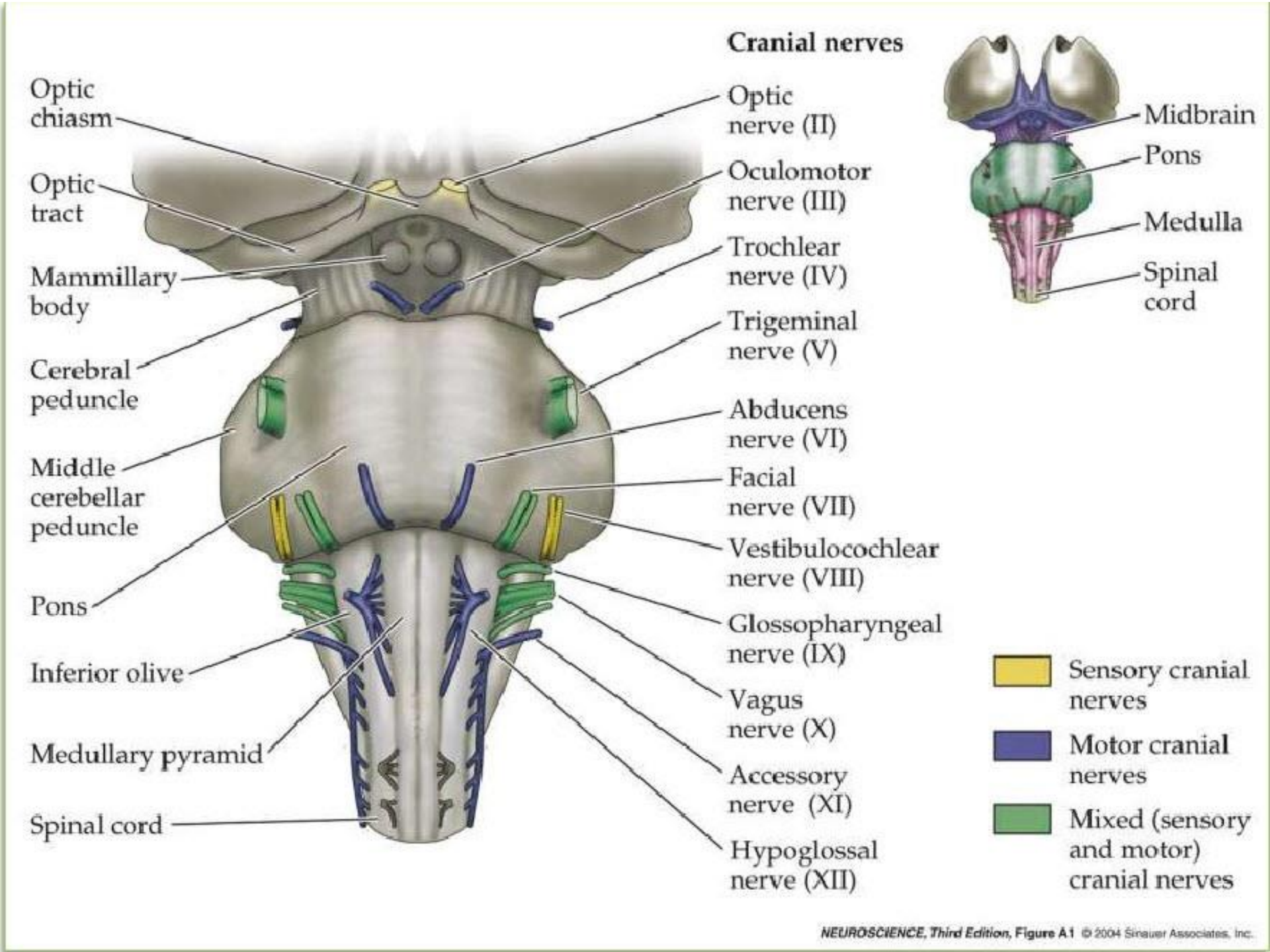
5. ***Superior fovea.***

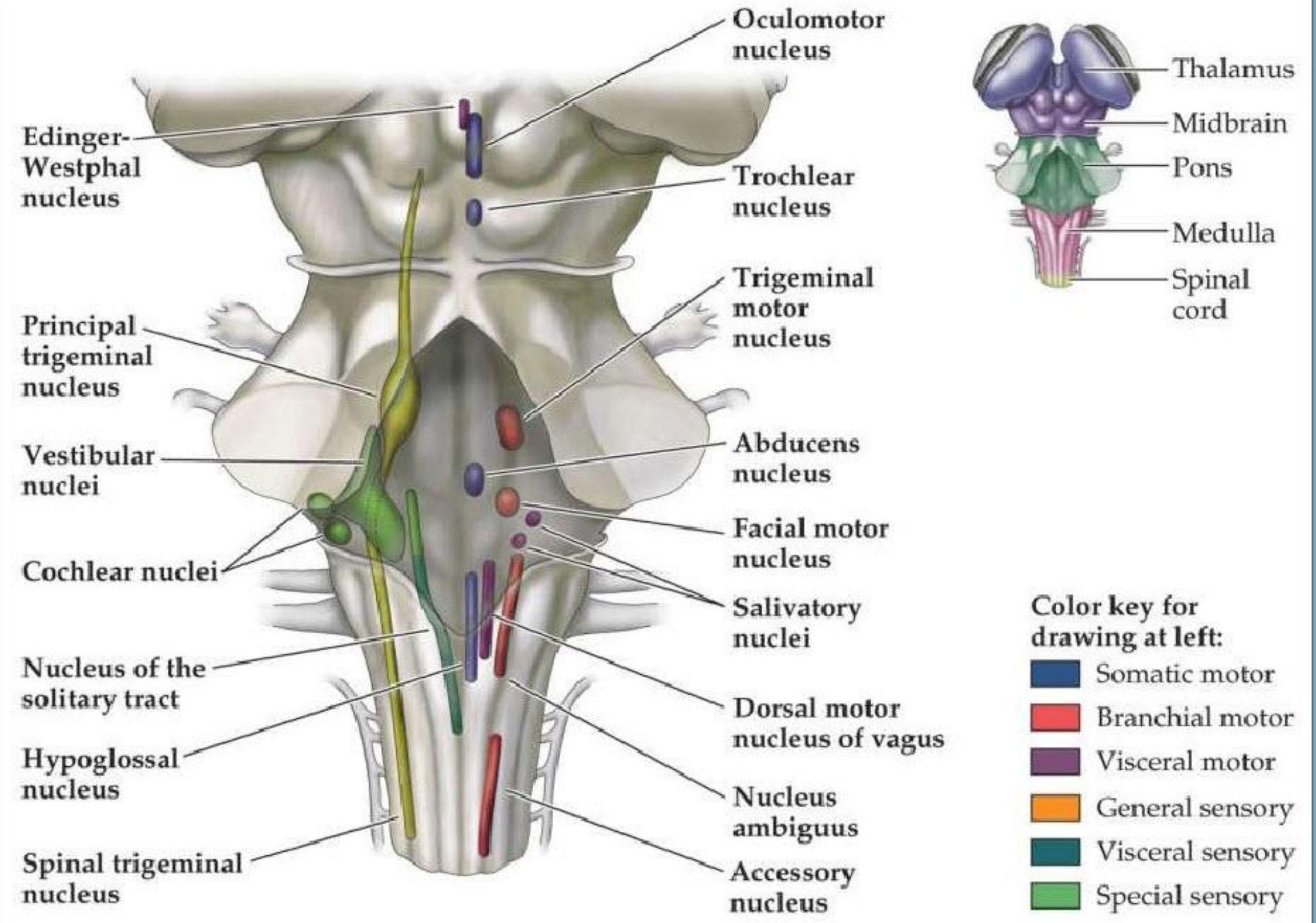
Fourth Ventricle and Cerebellum

Posterior View




Midbrain
Trochlear nerve
Median sulcus
Superior cerebellar peduncle
Medial eminence
Sulcus limitans
Vestibular area
Facial colliculus
Middle cerebellar peduncle
Pons
Striae medullares
Inferior cerebellar peduncle
Medulla oblongata



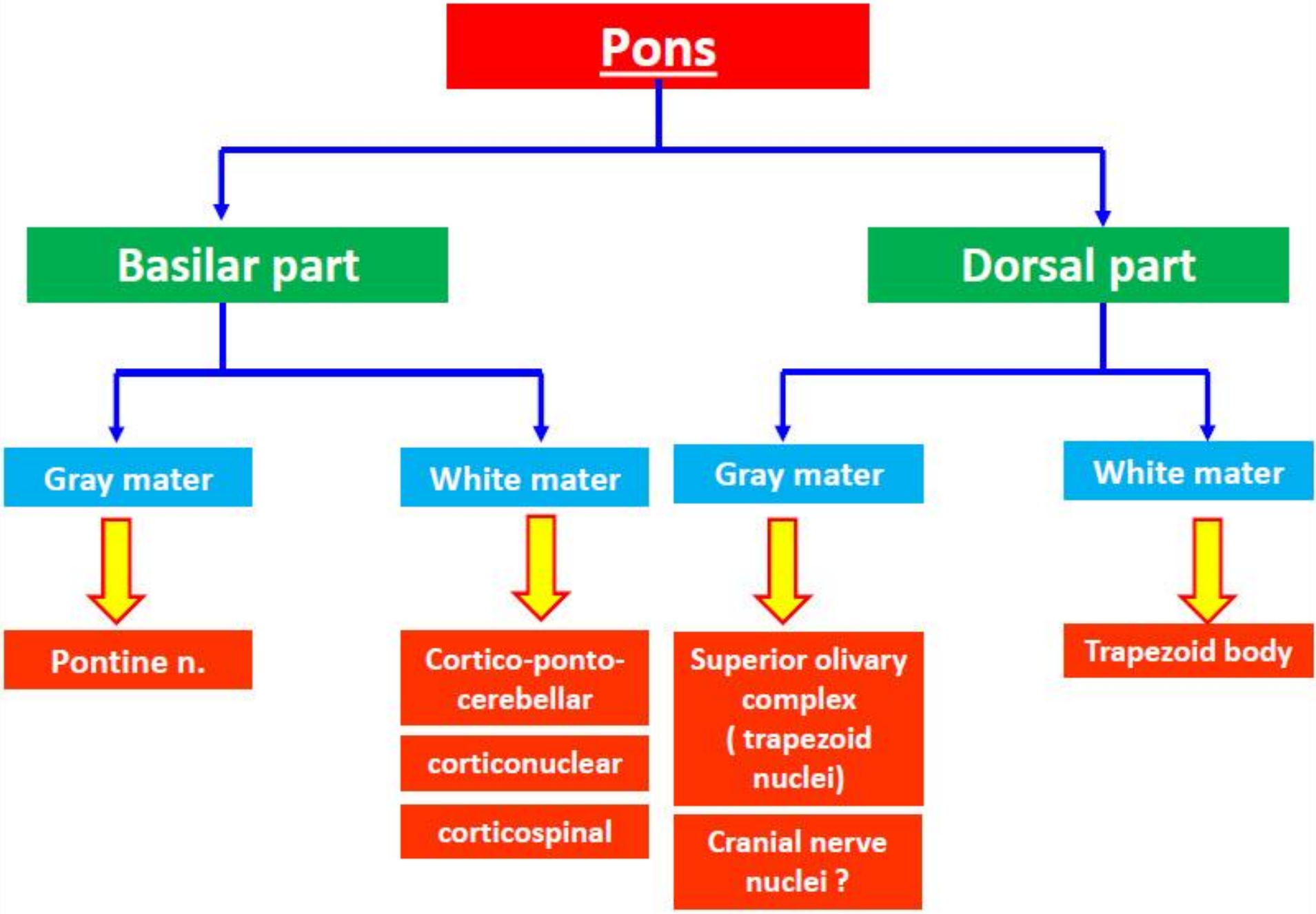


Internal Structures

The pons is divided into anterior part the **basilar part (basis pontis) and** posterior part the **tegmentum, separated by transversely running** fibers of **trapezoid body.**

Levels of sections in pons are:

1. **Transverse section through the caudal part**
2. **Transverse section through the rostral part**


Pons
Basilar part
Dorsal part
Gray mater
White mater
Gray mater
White mater
Pontine n.
Cortico-ponto-cerebellar
corticonuclear
corticospinal
Superior olivary complex (trapezoid nuclei)
Cranial nerve nuclei ?
Trapezoid body

Internal Structures of the Pons

1. ***Pontine nuclei:*** they form part of the cortico-ponto-cerebellar pathway

2. ***Transverse fibers:*** pontocerebellar fibers.

3. ***Longitudinal fibers:*** which include pyramidal and cortico-pontine fibers.

Caudal Pons - Tegmental Part

Trapezoid body and trapezoid nuclei

1. Lie in the lower part of the pons & represent part of the acoustic pathway

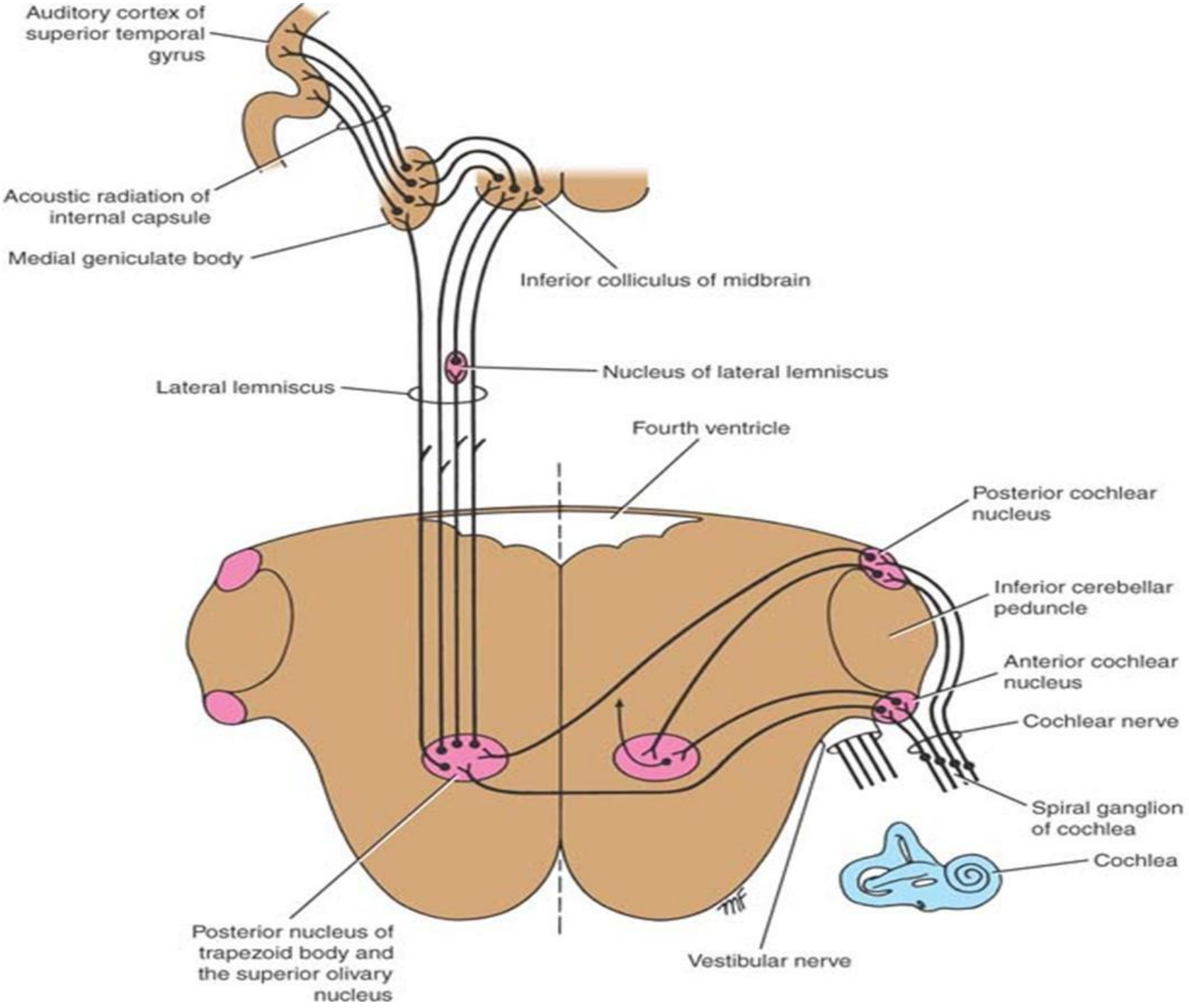
2. Consist of transverse fibers coming from the cochlear nuclei bilaterally (especially from the opposite side)

Caudal Pons - Tegmental Part

Trapezoid body and trapezoid nuclei

3. These fibers end in grey matter nuclei called nuclei of trapezoid body (superior olivary complex)

4. From these nuclei fibers ascend as the ***lateral lemniscus*** to higher centers

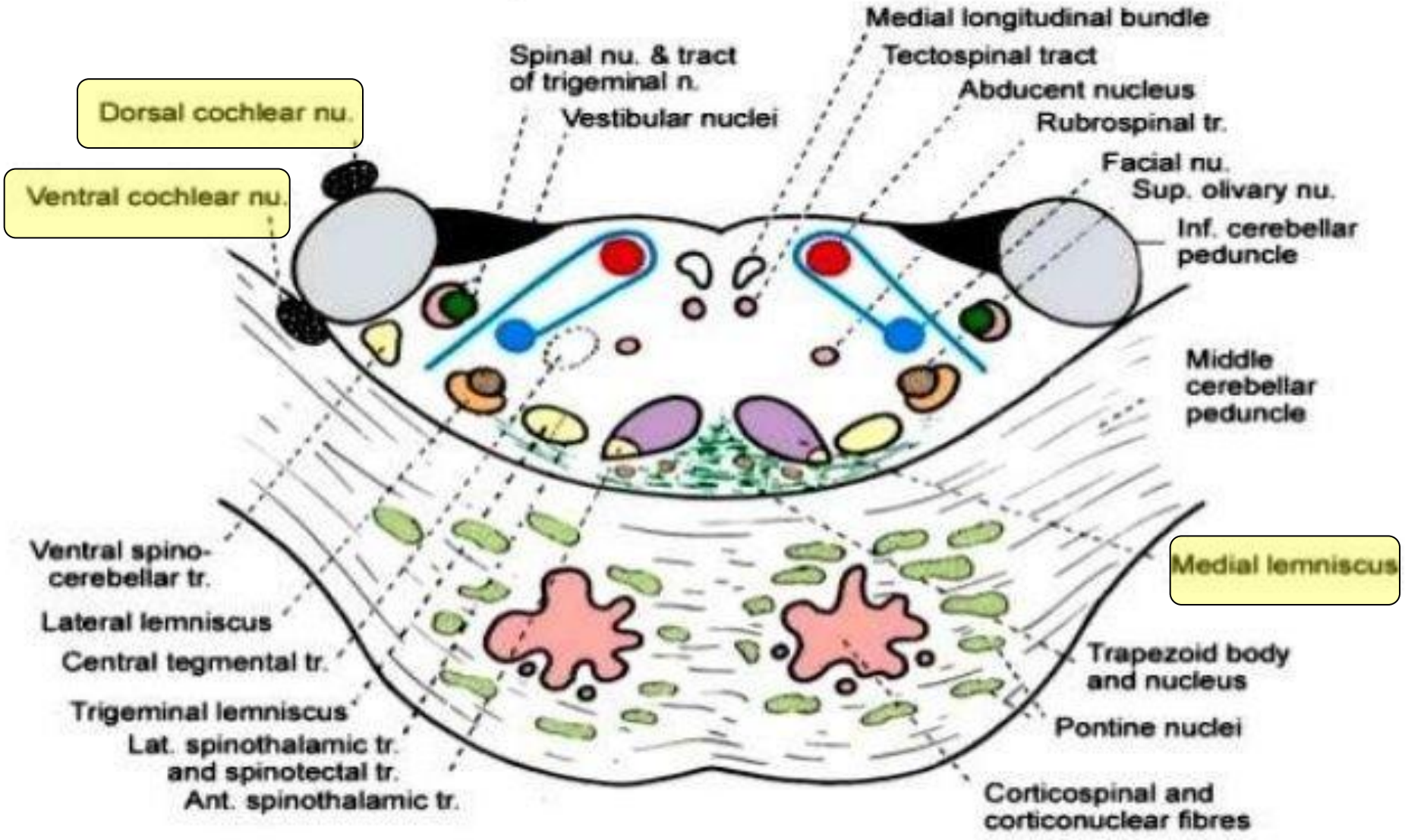

Auditory cortex of superior temporal gyrus
Acoustic radiation of internal capsule
Medial geniculate body
Inferior colliculus of midbrain
Nucleus of lateral lemniscus
Lateral lemniscus
Fourth ventricle
Posterior cochlear nucleus
Inferior cerebellar peduncle
Anterior cochlear nucleus
Cochlear nerve
Spiral ganglion of cochlea
Cochlea
Posterior nucleus of trapezoid body and the superior olivary nucleus
Vestibular nerve

Caudal Pons - Tegmental Part

The ascending fibers of the ***medial lemniscus*****, become separated from the** pyramid and displaced dorsally.

Spinal lemniscus: the ascending fibers carrying pain, temperature and crude touch from the opposite side of the body below the head

Transverse section through the lower part of Pons



Caudal Pons - Tegmental Part

1. ***Spinal nucleus of the trigeminal*** (sensory)

2. ***Nucleus of Abducens*** nerve (motor): lateral rectus muscle

3. ***Facial motor nucleus*** (motor): muscles of facial expression (The facial colliculus is formed by the abducent nucleus and the internal genu of the facial nerve).

Caudal Pons - Tegmental Part

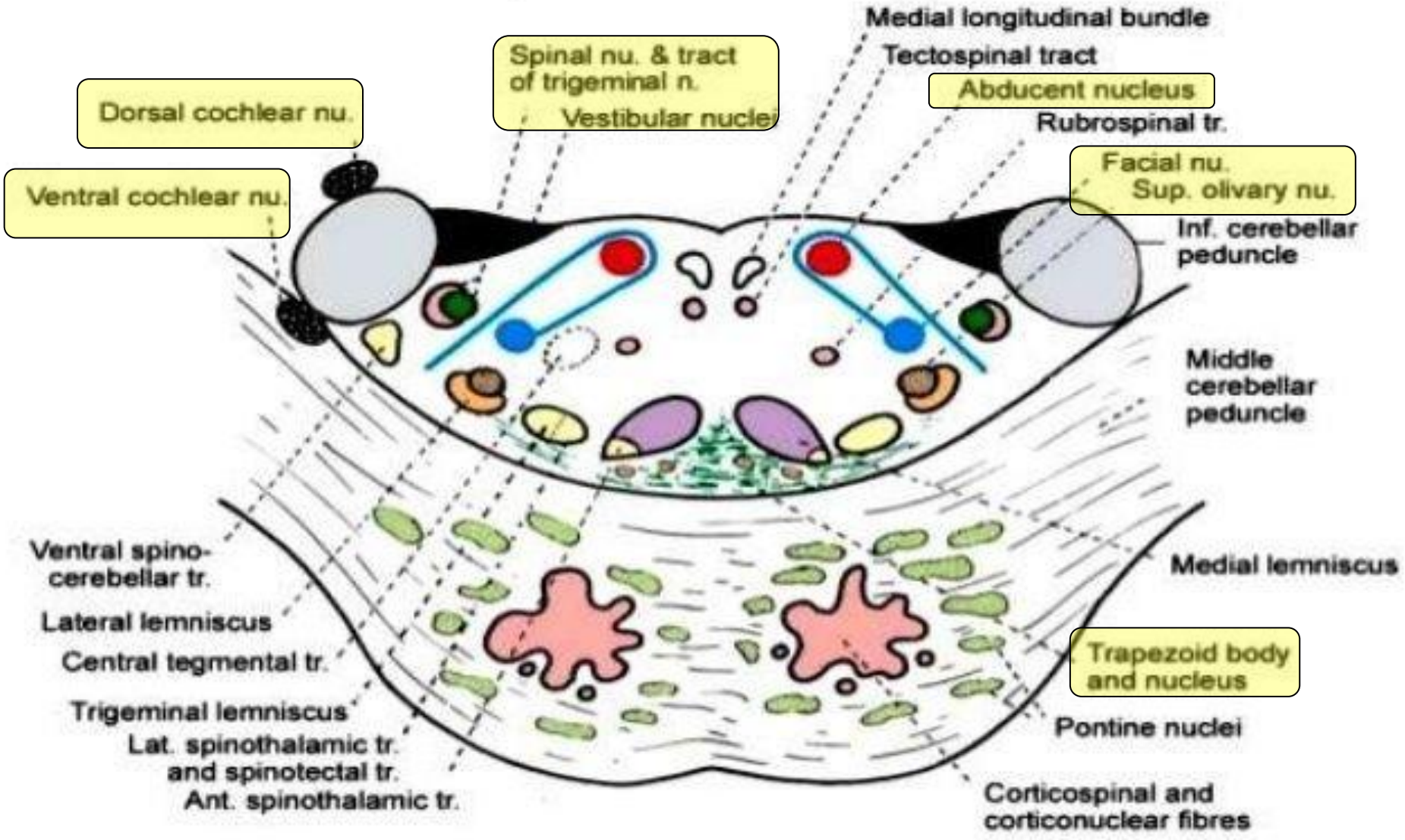
4. ***Superior salivary nucleus***: parasympathetic function via facial nerve.

5. ***Inferior salivary nucleus***: parasympathetic function via glossopharyngeal nerve

6. ***Nuclei of the vestibulocochlear*** nerve.

1. Vestibular nuclei (sensory)
2. Cochlear nuclei (sensory)

Transverse section through the lower part of Pons



Caudal Pons - Basilar Part

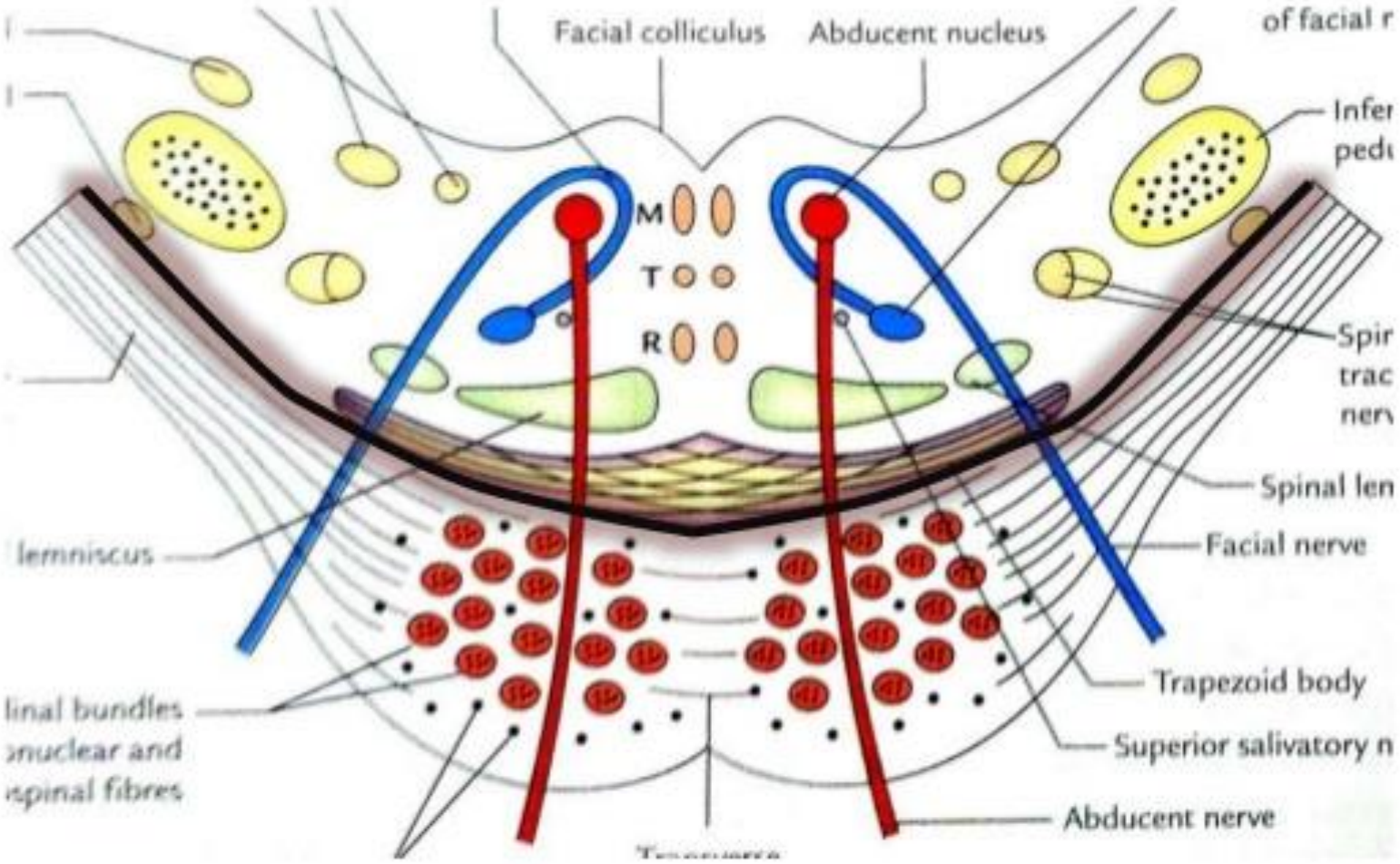
It is marked by the presence of:

Cortico-pontine fibers

1. Numerous transversely oriented ***pontocerebellar fibers*** **that originate** from scattered cell groups, the **pontine nuclei, and that pass to the contralateral side of the cerebellum through the *massive middle cerebellar*** peduncle (MCP).

2. Bundles of **corticospinal and corticonuclear fibers (***to form pyramidal fibers***).**

Internal = Basilar & Tegmental Part

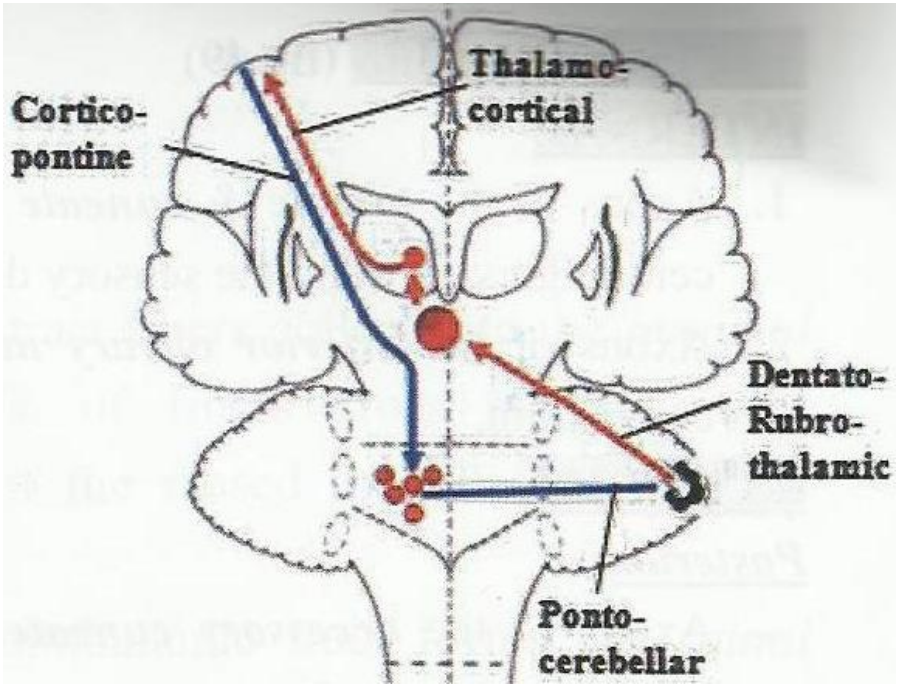


The basilar (Ventral) part - Uniform structure throughout-
Tegmentum (dorsal) part - Differs in upper & lower part of - pons.

Cortico-Ponto-Cerebellar Pathway

The neocerebellum **[responsible for coordination of voluntary movements]** is connected to the contralateral cerebral cortex by a feedback circuit formed of:

1. **Cortico-pontine fibers**
2. **Ponto-cerebellar fibers**
3. **Dentato-thalamic fibers**
4. **Thalamo-cortical fibers**



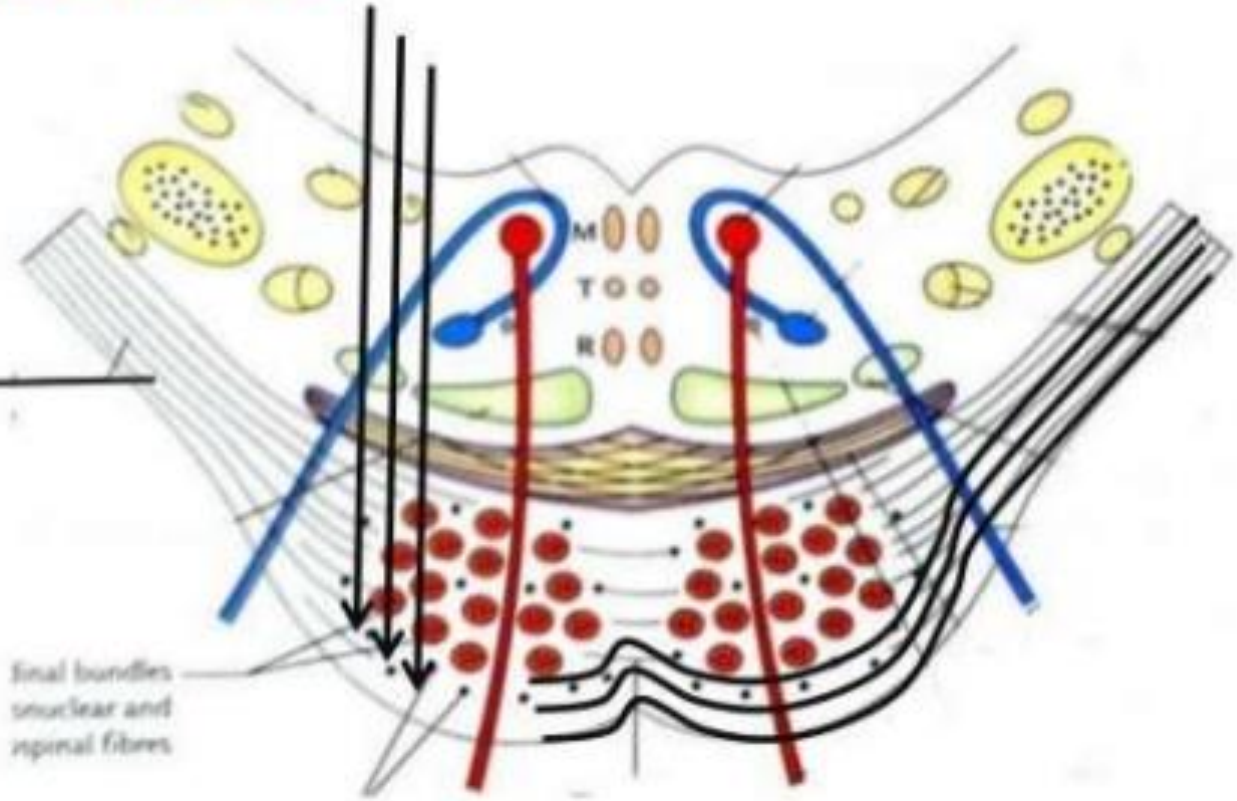
Basilar Part

White mater

- Cerebral cortex ⟶ internal capsule ⟶ crus cerebri ⟶ dividing to 3 parts !!
  1. ***Cortico-ponto-cerebellar fibers*** synapse with pontine nuclei then go to the cerebellum through middle cerebellar peduncle
  2. ***Corticonuclear fibers*** to motor nuclei of cranial nerve
  3. ***Corticospinal fibers*** to form the pyramids

- Middle cerebellar peduncle contains cortico-ponto-cerebellar fibers of the opposite side only.

Ventral (Basilar) Part Pons



GREY MATTER

Pontine nuclei:

Afferents - Corticopontine fibres of the same side.

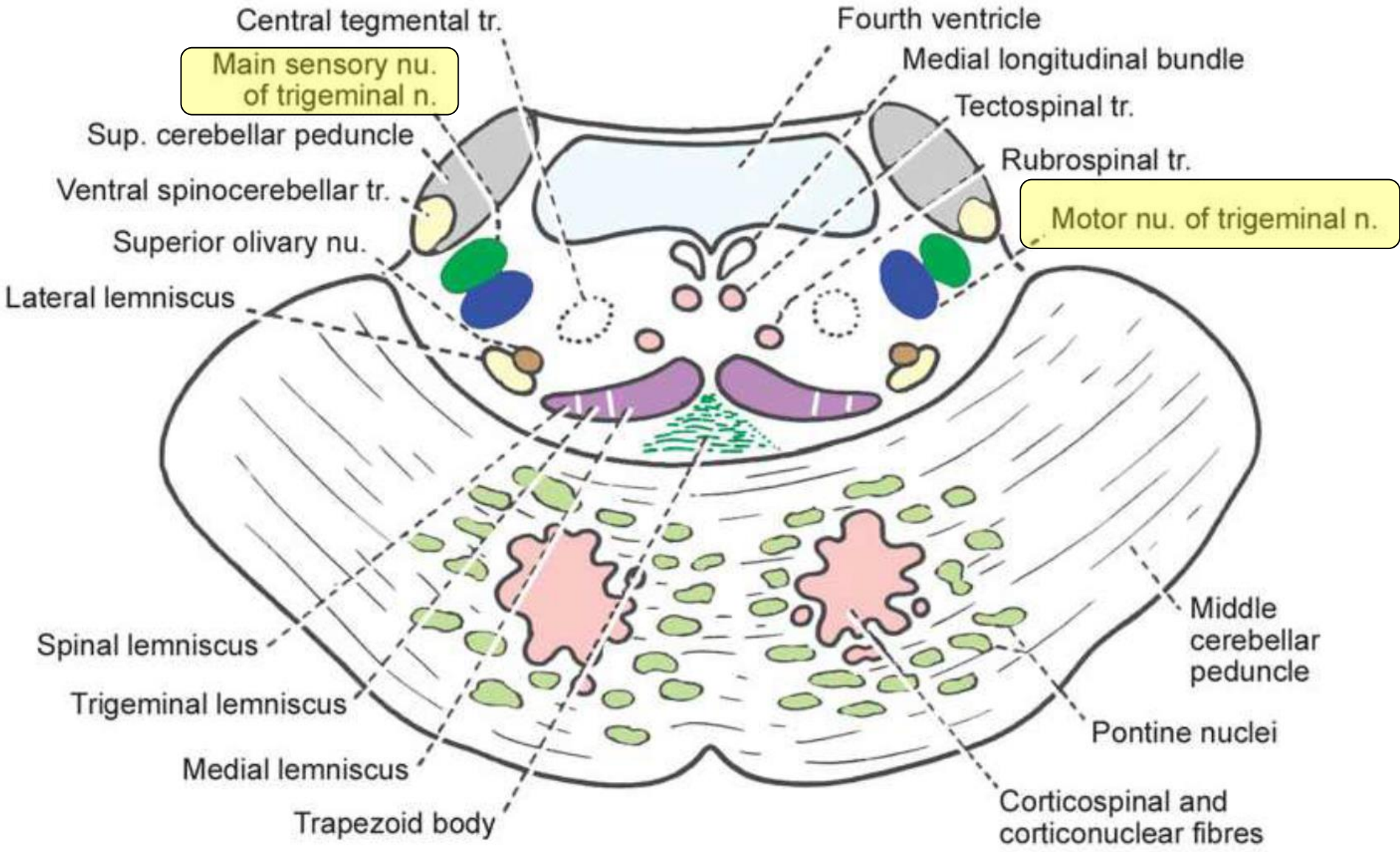
Efferents - Pontocerebellar fibres that cross the midline & pass through the middle cerebellar peduncle to enter the cerebellum. (Cortico-ponto-cerebellar pathway)

Cranial/Rostral Pons - Nuclei

The ***internal structure*** of the rostral part is ***similar to*** that of the ***caudal part*** with ***addition*** of some ***nuclei*** and ***tracts.***

Motor nucleus of the trigeminal nerve: Lies in the lateral part of the floor of the 4th ventricle.

Main sensory (Spinal) nucleus of the trigeminal nerve: Reaches its maximum extent in the pons and it lies lateral to the motor nucleus.

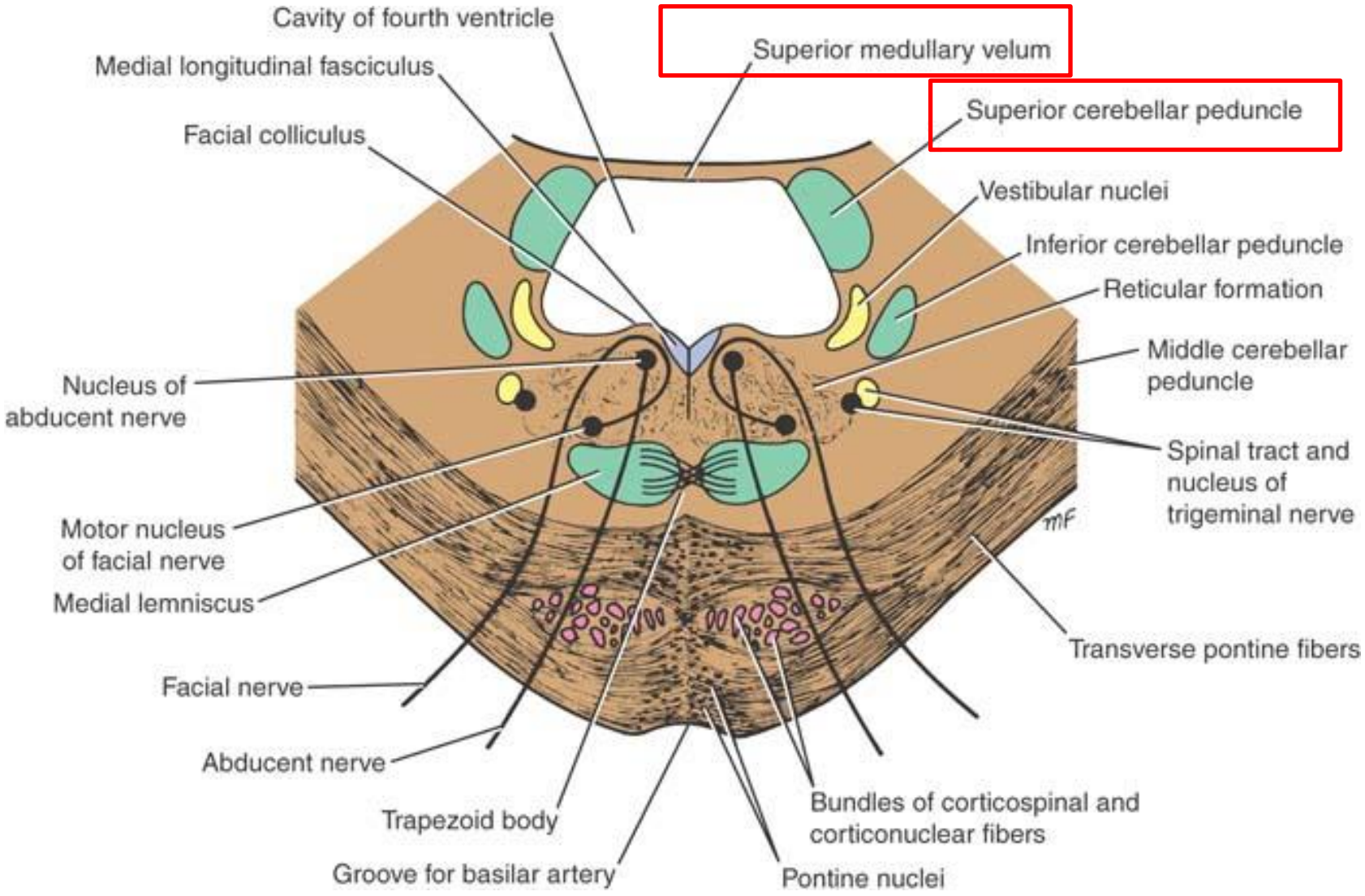

Central tegmental tr.
Main sensory nu. of trigeminal n.
Sup. cerebellar peduncle
Ventral spinocerebellar tr.
Superior olivary nu.
Lateral lemniscus
Fourth ventricle
Medial longitudinal bundle
Tectospinal tr.
Rubrospinal tr.
Motor nu. of trigeminal n.
Spinal lemniscus
Trigeminal lemniscus
Medial lemniscus
Trapezoid body
Middle cerebellar peduncle
Pontine nuclei
Corticospinal and corticonuclear fibres

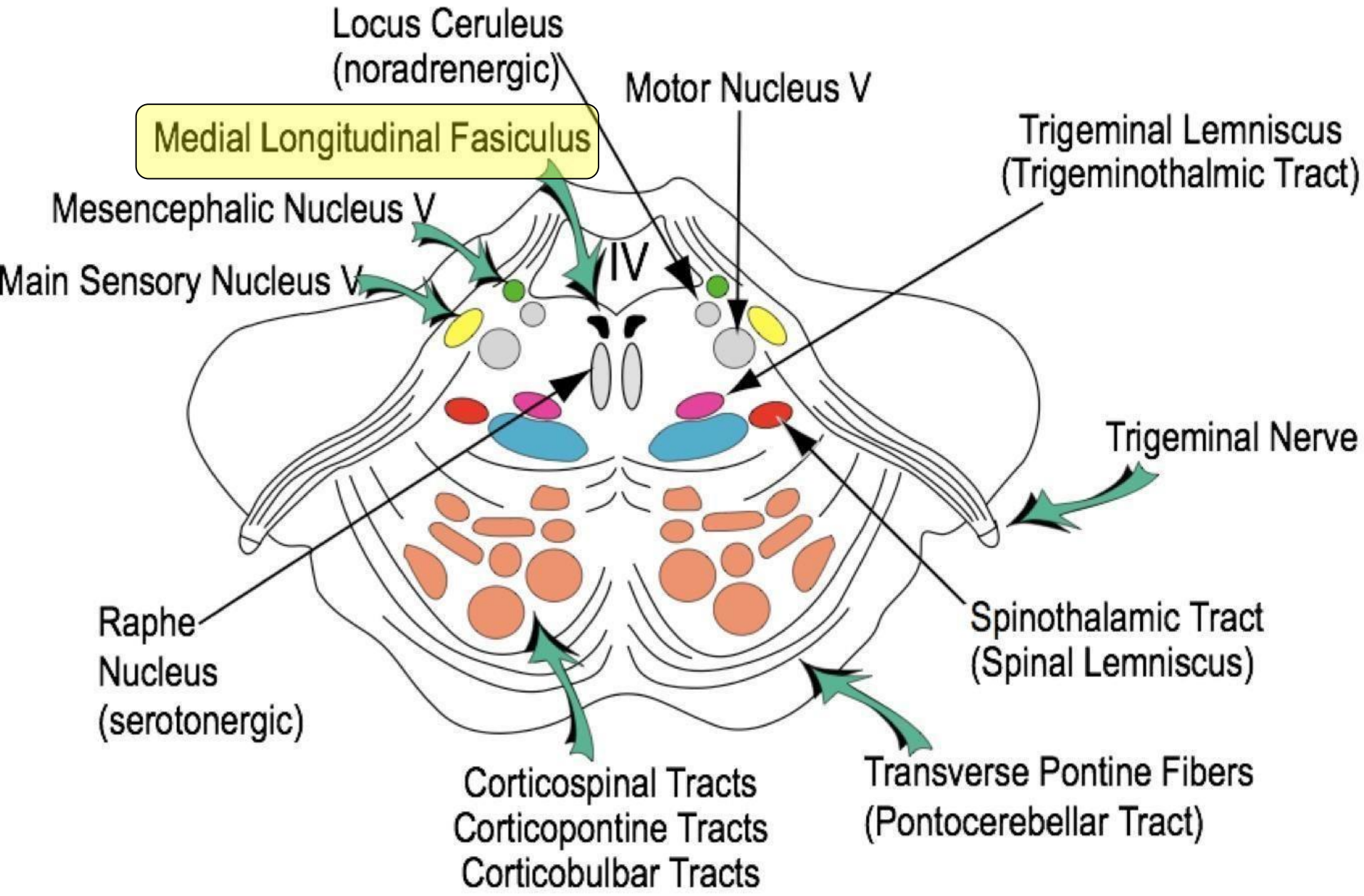
Cranial/Rostral Pons - Tracts

Superior cerebellar peduncles form the lateral boundary of the 4th ventricle.

Superior Medullary Velum: Passes between the two peduncles and forms the roof of the 4th ventricle.

Medial longitudinal fasciculus: Lie close to the midline beneath the floor of the 4th ventricle.


Cavity of fourth ventricle
Medial longitudinal fasciculus
Facial colliculus
Superior medullary velum
Superior cerebellar peduncle
Vestibular nuclei
Inferior cerebellar peduncle
Reticular formation
Middle cerebellar peduncle
Nucleus of abducent nerve
Spinal tract and nucleus of trigeminal nerve
Motor nucleus of facial nerve
Medial lemniscus
Transverse pontine fibers
Facial nerve
Abducent nerve
Trapezoid body
Bundles of corticospinal and corticonuclear fibers
Groove for basilar artery
Pontine nuclei


Locus Ceruleus
(noradrenergic)
Motor Nucleus V
Medial Longitudinal Fasiculus
Trigeminal Lemniscus
(Trigeminothalmic Tract)
Mesencephalic Nucleus V
Main Sensory Nucleus V
IV
Trigeminal Nerve
Raphe
Nucleus
(serotonergic)
Spinothalamic Tract
(Spinal Lemniscus)
Corticospinal Tracts
Corticopontine Tracts
Corticobulbar Tracts
Transverse Pontine Fibers
(Pontocerebellar Tract)

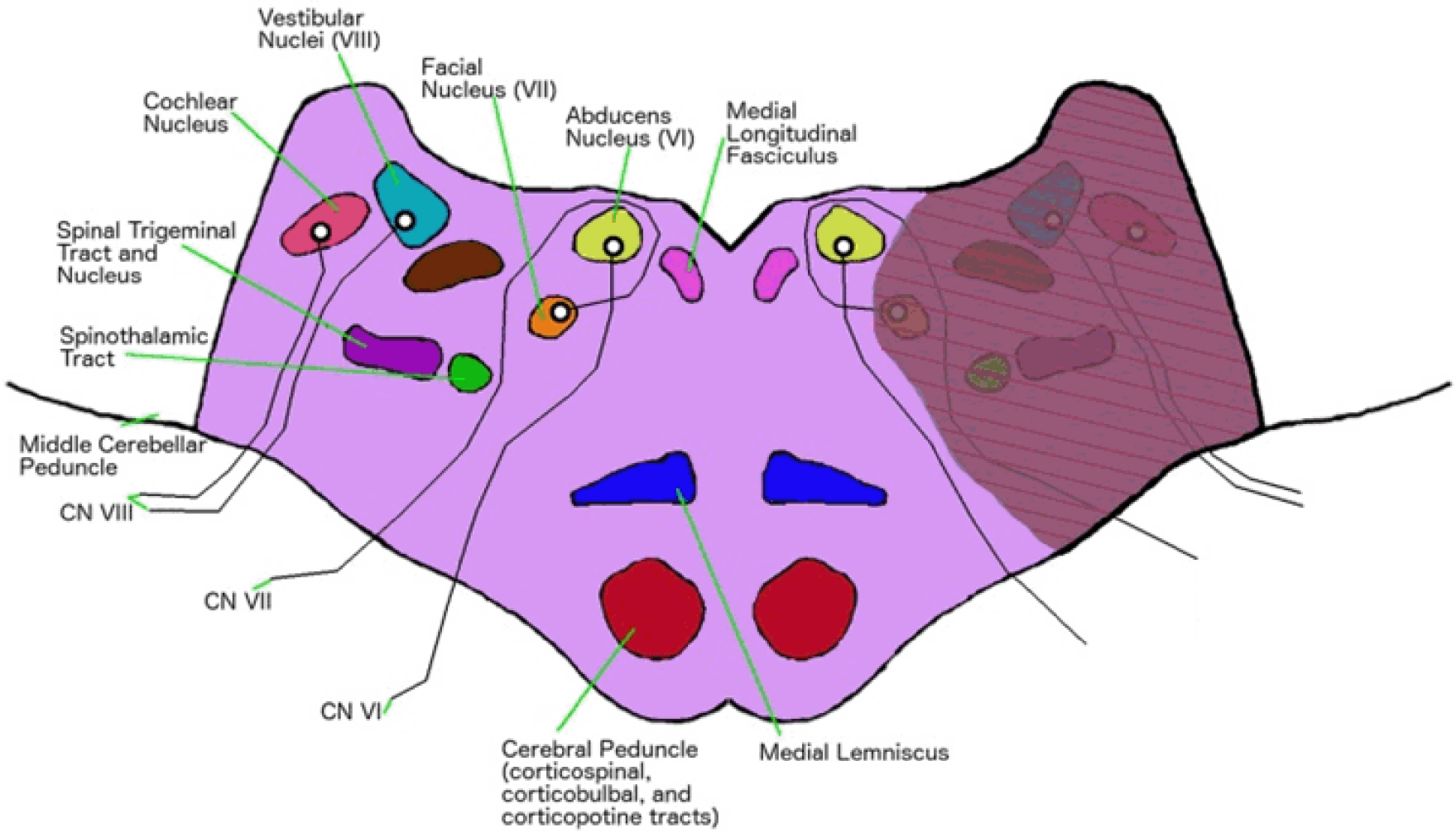
Blood Supply of the Pons

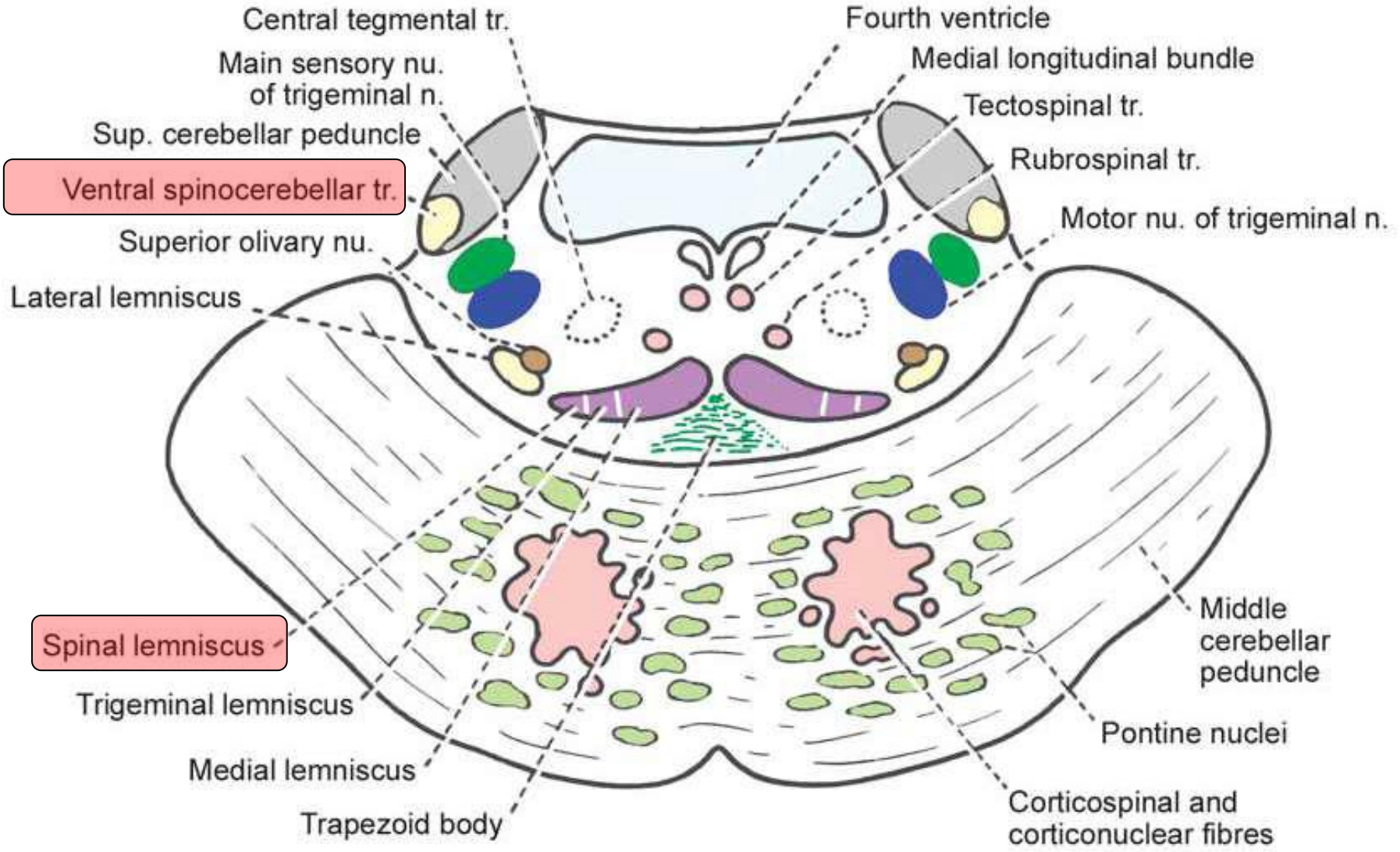
The pons is supplied by:

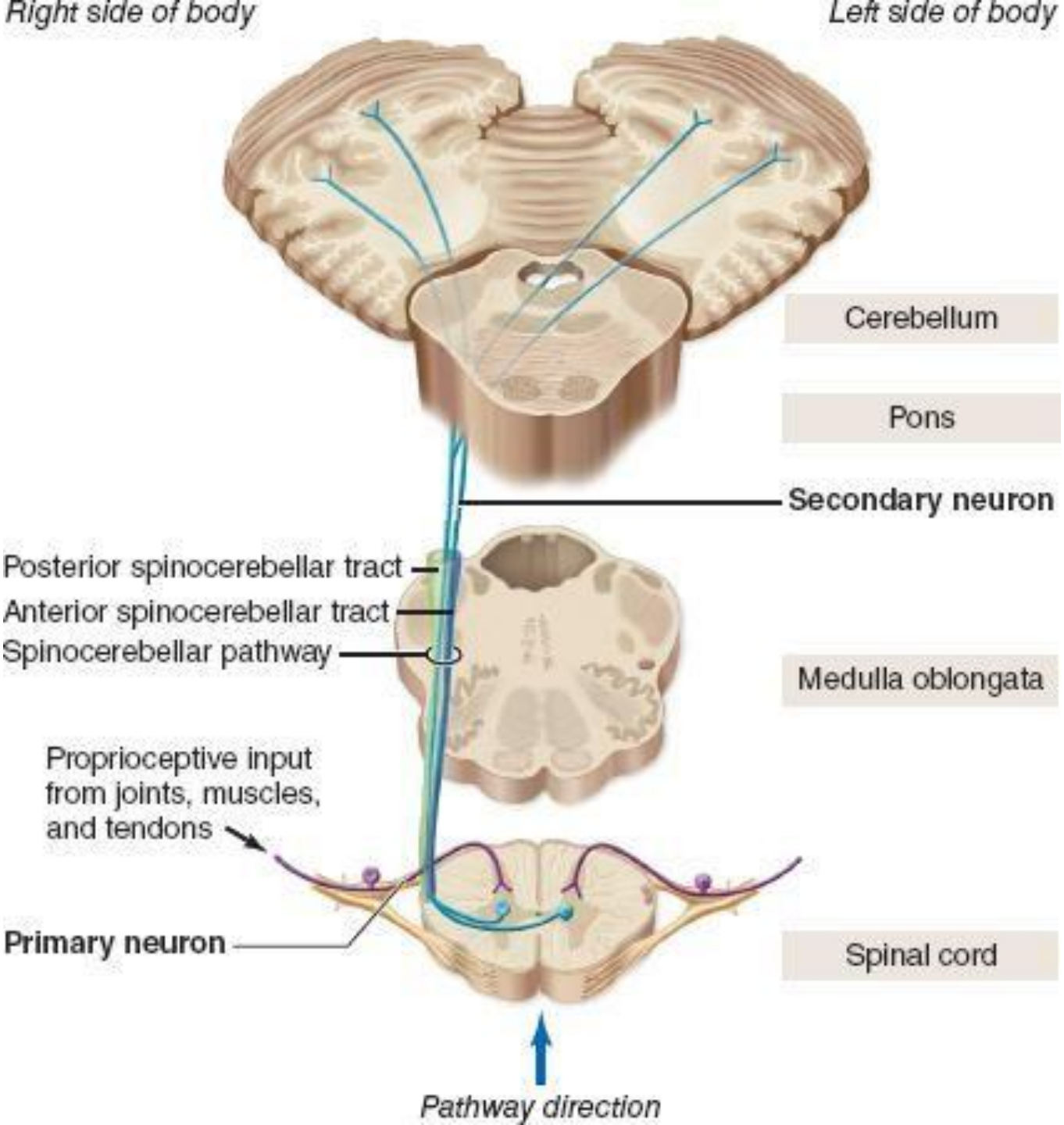
1. The anterior inferior cerebellar arteries.
2. The superior cerebellar arteries.
3. The basilar artery (gives pontine arteries).

Lateral Pontine Syndrome

- ***Loss of pain and temperature*** of the ***contralateral*** arm and leg (***spinothalamic*** tract)
- ***Ataxia*** of the ***ipsilateral*** arm and leg (***spinocerebellar*** tract)
- ***Horner's syndrome*** of the ***ipsilateral*** eye (***sympathetic pathway***) through reticulospinal tract


Vestibular Nuclei (VIII)
Facial Nucleus (VII)
Cochlear Nucleus
Abducens Nucleus (VI)
Medial Longitudinal Fasciculus
Spinal Trigeminal Tract and Nucleus
Spinothalamic Tract
Middle Cerebellar Peduncle
CN VIII
CN VII
CN VI
Cerebral Peduncle (corticospinal, corticobulbal, and corticopotine tracts)
Medial Lemniscus

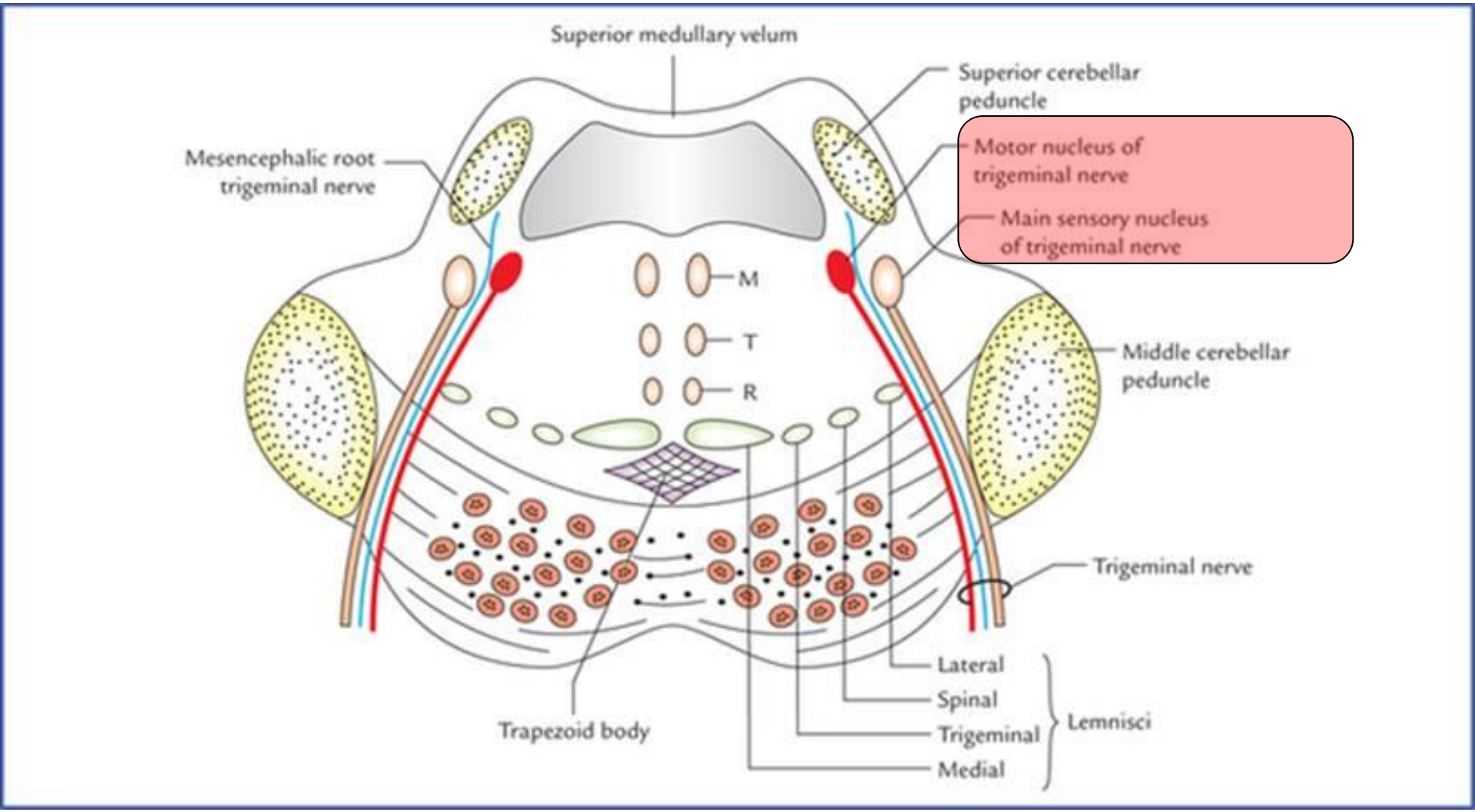

Central tegmental tr.
Main sensory nu. of trigeminal n.
Sup. cerebellar peduncle
Ventral spinocerebellar tr.
Superior olivary nu.
Lateral lemniscus
Fourth ventricle
Medial longitudinal bundle
Tectospinal tr.
Rubrospinal tr.
Motor nu. of trigeminal n.
Spinal lemniscus
Trigeminal lemniscus
Medial lemniscus
Trapezoid body
Middle cerebellar peduncle
Pontine nuclei
Corticospinal and corticonuclear fibres

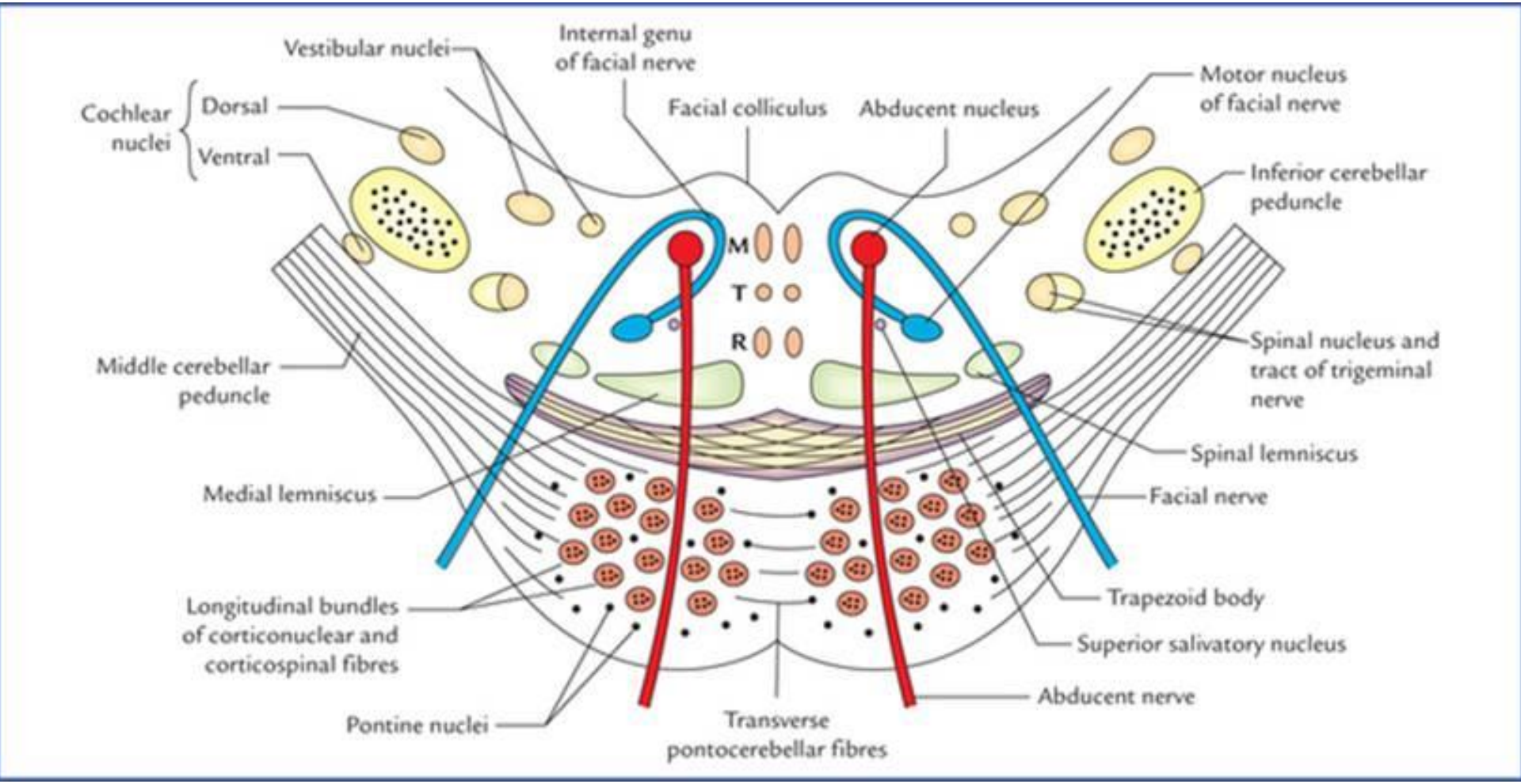

Right side of body
Left side of body
Cerebellum
Pons
Secondary neuron
Posterior spinocerebellar tract
Anterior spinocerebellar tract
Spinocerebellar pathway
Medulla oblongata
Proprioceptive input from joints, muscles, and tendons
Primary neuron
Spinal cord
Pathway direction

Lateral Pontine Syndrome

- ***Ipsilateral LMN facial*** paralysis (damage to ***fascial*** motor ***nucleus***)

- ***Ipsilateral*** loss of ***facial sensation*** and ***mastication muscles*** (***Trigeminal nerve nuclei damage***)

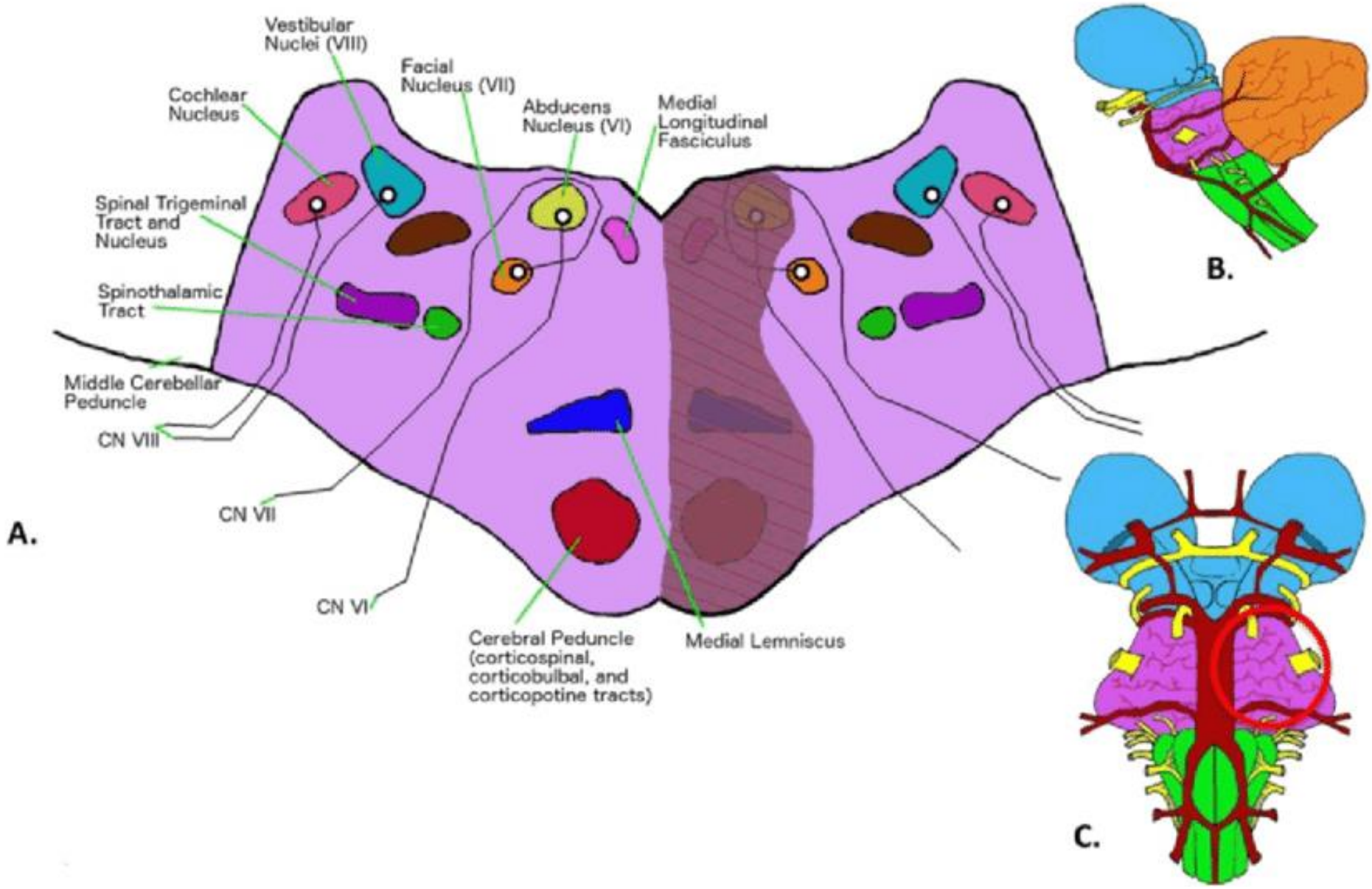

Superior medullary velum
Superior cerebellar peduncle
Mesencephalic root trigeminal nerve
Motor nucleus of trigeminal nerve
Main sensory nucleus of trigeminal nerve
M
T
R
Middle cerebellar peduncle
Trigeminal nerve
Lateral
Spinal
Trigeminal
Medial
Lemnisci
Trapezoid body


Vestibular nuclei
Internal genu of facial nerve
Cochlear nuclei
Dorsal
Ventral
Facial colliculus
Abducent nucleus
Motor nucleus of facial nerve
Inferior cerebellar peduncle
M
T
R
Middle cerebellar peduncle
Spinal nucleus and tract of trigeminal nerve
Spinal lemniscus
Medial lemniscus
Facial nerve
Trapezoid body
Longitudinal bundles of corticonuclear and corticospinal fibres
Superior salivatory nucleus
Abducent nerve
Pontine nuclei
Transverse pontocerebellar fibres

Medial Pontine Syndrome

- ***Millard Gubler Syndrome:*** It is the clinical condition which results due to occlusion of paramedian pontine branches of ***basilar artery*** feeding lower and ventral part of pons.

- It involves basilar part of pons through which ***traverses corticospinal tract*** and emerge fibers of ***6th*** cranial nerve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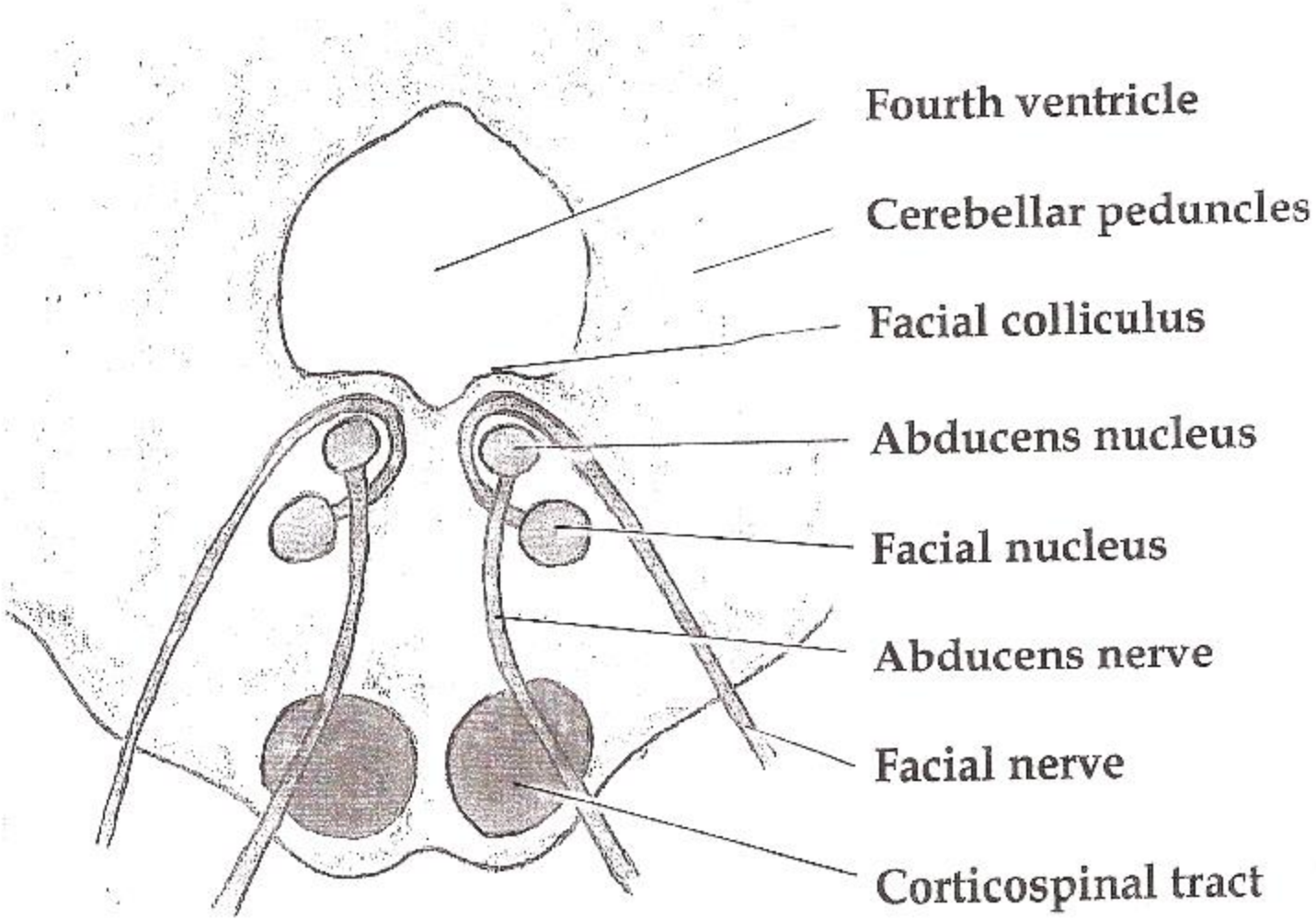
Facial Nucleus (VII)
Cochlear Nucleus
Abducens Nucleus (VI)
Medial Longitudinal Fasciculus
Spinal Trigeminal Tract and Nucleus
Spinothalamic Tract
Middle Cerebellar Peduncle
CN VIII
CN VII
CN VI
Cerebral Peduncle (corticospinal, corticobulbal, and corticopotine tracts)
Medial Lemniscus
A.
B.
C.

Medial Pontine Syndrome

- ***Clinical manifestations:***

1. **Contralateral spastic hemiparesis (above decussation)**

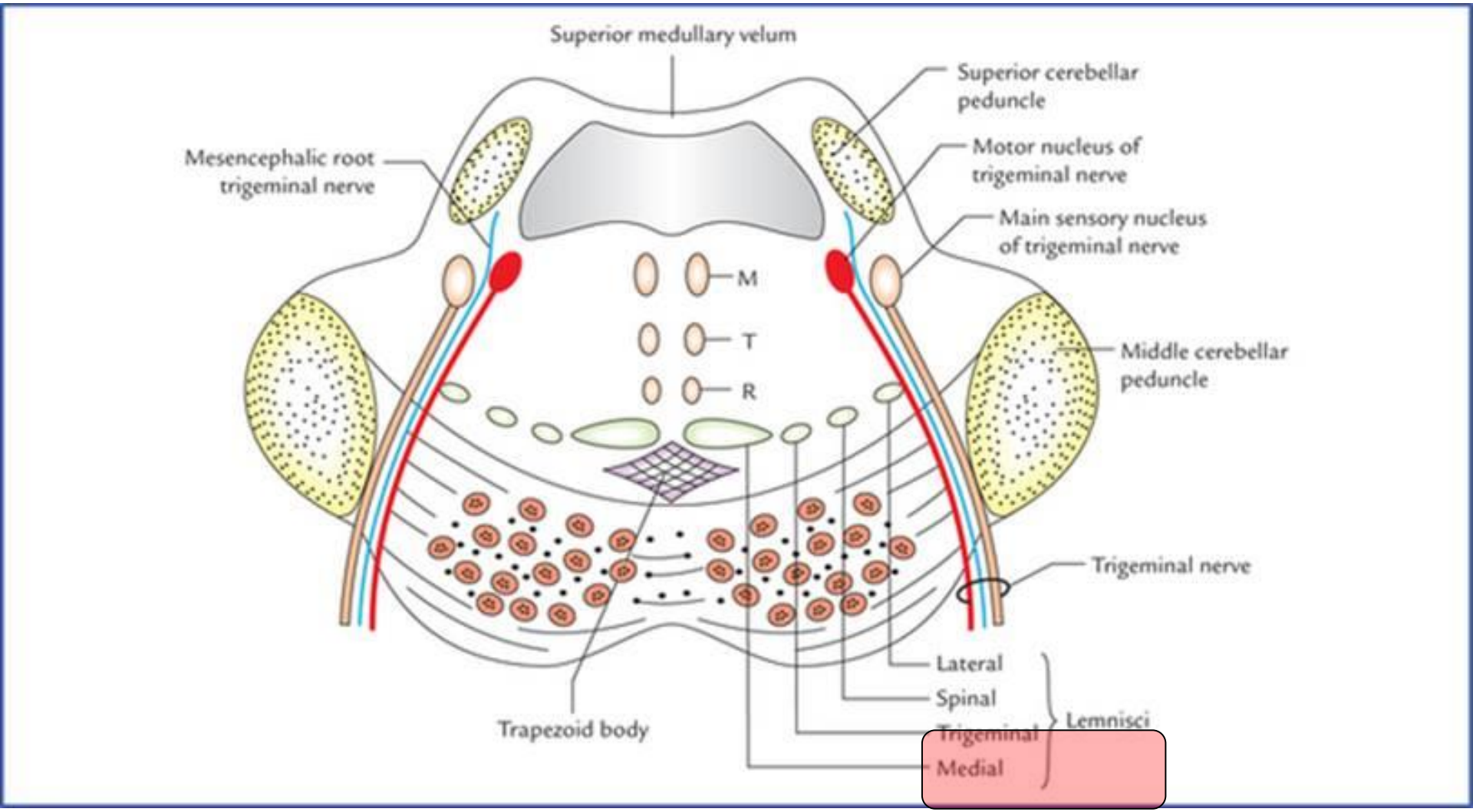
2. **Ipsilateral medial** (***squint***) due to unopposed action of medial rectus as a result of ***paralysis of lateral rectus*** supplied by ***abducent nerve***. The affected eye looks down and towards the nose).


Fourth ventricle
Cerebellar peduncles
Facial colliculus
Abducens nucleus
Facial nucleus
Abducens nerve
Facial nerve
Corticospinal tract

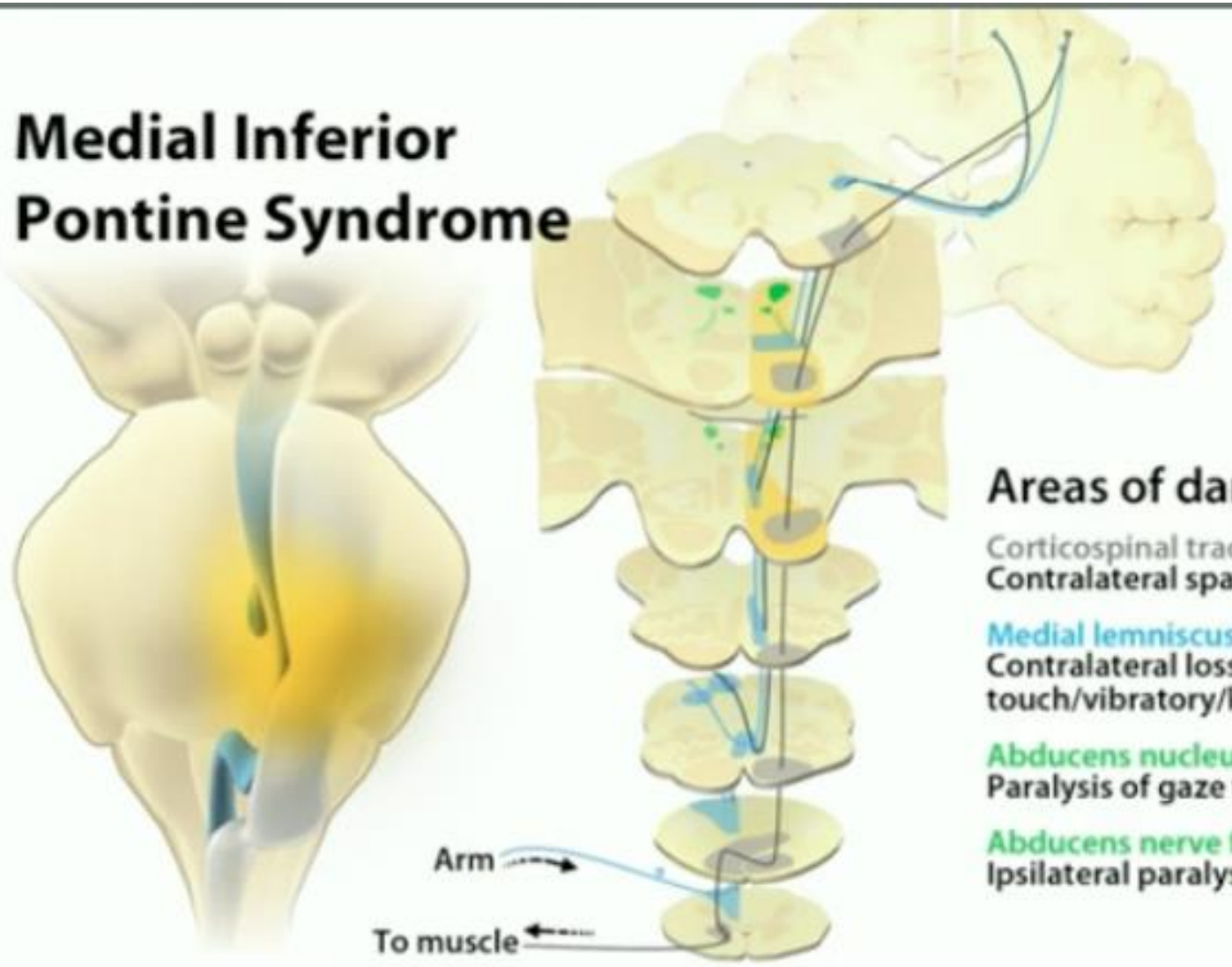
Medial Pontine Syndrome

3. ***Abducent nerve lesion localizes the lesion to inferior pons.***

4. ***Medial lemniscus: Contralateral*** (***Post. Column***) pathway loss (tactile, vibration, and stereognosis)


Superior medullary velum
Superior cerebellar peduncle
Mesencephalic root trigeminal nerve
Motor nucleus of trigeminal nerve
Main sensory nucleus of trigeminal nerve
M
T
R
Middle cerebellar peduncle
Trigeminal nerve
Lateral
Spinal
Trigeminal
Medial
Lemnisci
Trapezoid body

Medial Inferior Pontine Syndrome



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Infarct

Areas of damage:

Corticospinal tract:
Contralateral spastic hemiparesis

Medial lemniscus:
Contralateral loss of light touch/vibratory/kinesthetic sensation

Abducens nucleus/PPRF:
Paralysis of gaze to side of lesion

Abducens nerve fibers:
Ipsilateral paralysis of lateral rectus muscle

Pontine Hemorrhage

- It is extensive and bilateral in nature so that clinical condition will cause bilateral type of all manifestations as stated above.

- In addition, it will present the following two specific manifestations.

1. ***'Pinpoint' pupil:*** Due to involvement of ocular sympathetic fibers.

2. ***Hyperpyrexia:*** It is because of severe lesions in pons which disconnect the body from heat regulating center in hypothalamus.

- For further inquiries ***PLZ*** feel free to contact at any time through email

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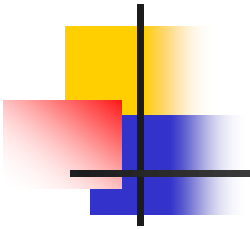
gamal.abdelhady@yu.edu.jo



Thank You