SPINAL CORD

T/S OF SPINAL CORD SHOWING ASCENDING AND DESCENDING TRACTS (SE)

CROSS SECTION OF SPINAL CORD TO SHOW ASCENDING AND DESCENDING TRACTS (SE)

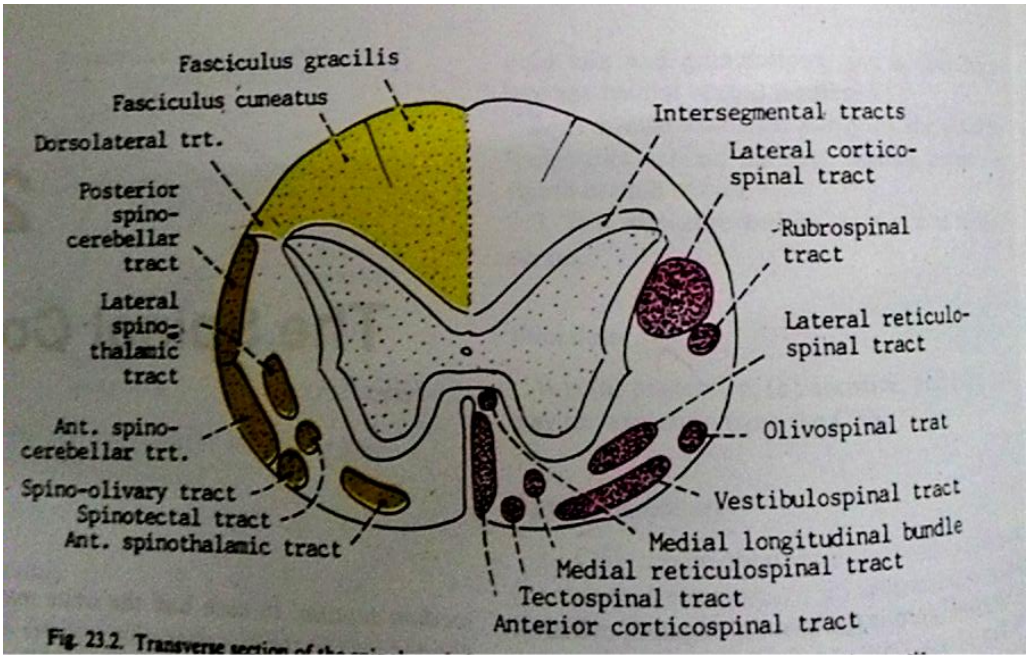


Fig. 23.2. Transverse section of the

The tracts seen in a transverse section of the spinal cord are

Ascending tracts:-carry impulses from periphery to the brain

a) Lateral spinothalamic tract – carries the sensations of pain and temperature
b) Anterior spinothalamic tract – carries the fibres for crude touch and pressure
c) Fasciculus gracilis (tract of Goll)- carry sensations of conscious proprioception , two point tactile discrimination and vibration from sacral , lumbar,and lower thoracic segments.
d) Fasciculus cuneatus (tract of Burdach) - carry sensations of conscious proprioception , two point tactile discrimination and vibration from upper thoracic and cervical segments.
e) Posterior(dorsal) spino cerebellar tract – carry unconscious proprioceptive sensations through inferior cerebellar peduncles.
f) Anterior (ventral) spino cerebellar tract – carry unconscious proprioceptive sensations through superior cerebellar peduncles.
g) Spino olivary tract – responsible for visual and proprioceptive reflexes.
h) Spino tectal tract – responsible for visual and proprioceptive reflexes.

Descending tracts:- carry impulses from the brain to spinal cord. They control the voluntary movements of skeletal muscles through anterior horn cells

Pyramidal tracts

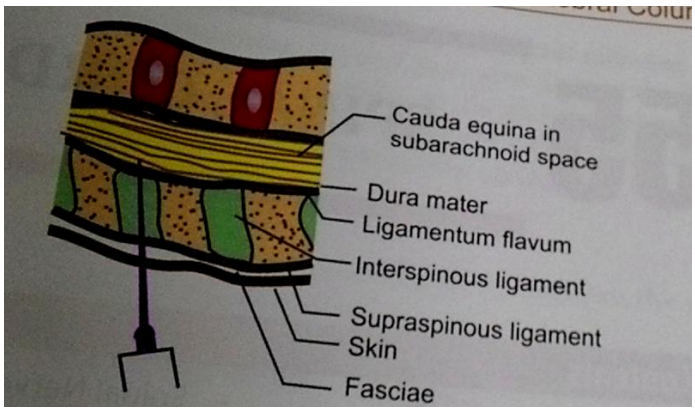
a) Lateral corticospinal tract (crossed pyramidal tract) – control conscious skilled movements
b) Anterior corticospinal tract (uncrossed pyramidal tract) – control conscious skilled movements

Extrapyramidal tracts

c) Rubrospinal tract- controls unconscious coordination of movements(muscle tone)
d) Medial reticulospinal tract- inhibitory influence on motor neurons
e) Lateral reticulospinal tract- facilitatory influence on motor neurons
f) Tectospinal tract- controls the movements of head , neck and arms in response to visual stimuli
g) Vestbulospinal tract- controls unconscious maintainence of posture and balance

LUMBAR PUNCTURE(SE)

It is done to withdraw cerebrospinal fluid for various diagnostic and therapeutic purposes. The interspinous space between L3 and L4 is preferred because in this region the subarachnoid space is moreroomy and contains only filum terminale and roots of lumbar, sacral and coccygeal nerves forming the cauda equina.



During this procedure the spine must be fully flexed so that the inter spinous spaces are opened up to the maximum extent.

The needle inserted at this point passes through

Skin,
Fasciae,
Supraspinous Ligament,
Interspinous Ligament,
Ligamentum Flavum,
Dura Mater And
Arachnoid Mater Before Reaching Subarachnoid Space.

BLOOD SUPPLY OF SPINAL CORD (SE)

The Spinal Cord receives its blood supply from two major sources;

Branches of the **vertebral arteries**, the major source of blood supply, via the anterior spinal and posterior spinal arteries.

Multiple radicular arteries, from **segmental arteries**

Anterior Spinal Artery,

Formed from a Y- shaped union of a branch from each vertebral artery.

It Runs down the ventral median fissure of the spinal cord.

Distribution:

Supplies the ventral 2/3 of the spinal cord

Posterior Spinal Arteries ,

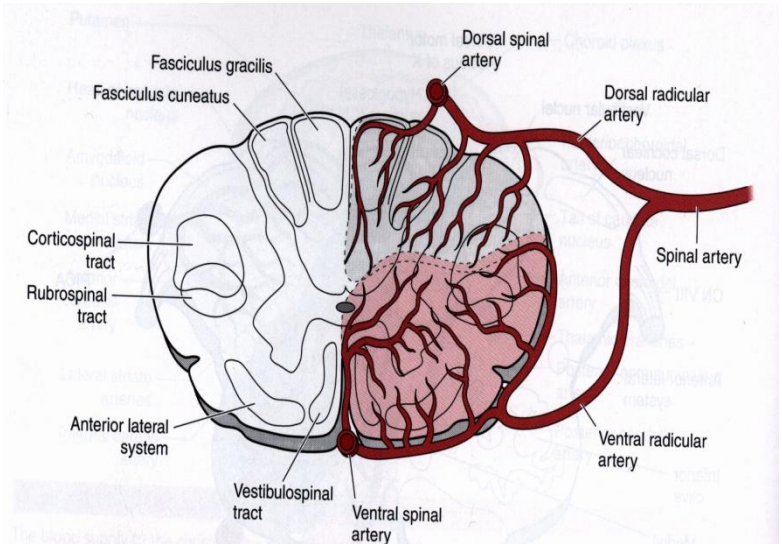
Originate from each vertebral artery or Posterior Inferior Cerebellar artery on each side of the Medulla.

Descends along the dorso lateral sulcus.

Distribution:

Supplies the dorsal 1/3 of the spinal cord.

These arteries are reinforced by segmental arteries which are spinal branches of deep cervical, ascending cervical, posterior intercostals, lumbar and lateral sacral arteries. The segmental arteries divide into anterior and posterior radicular arteries and supply the spinal cord.



SENSATION CARRIED BY POSTERIOR COLUMN (SA)

The posterior white column is occupied by two tracts-

Fasciculus gracilis occupies medial part of posterior column

Fasciculus cuneatus occupies lateral part of posterior column

The sensations like deep touch, pressure, tactile localisation, tactile discrimination, stereognosis, sense of vibration are carried by them.

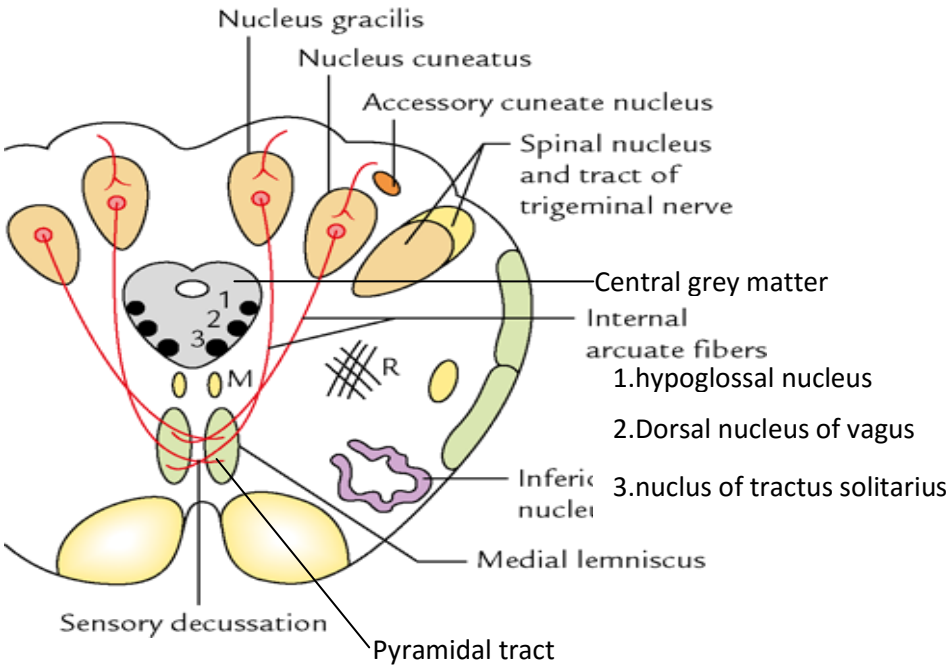
The fibres are composed of the first order neuron fibres from dorsal root ganglia.

The fibres synapse with the neurons in nucleus gracilis and nucleus cuneatus

.MEDULLA OBLONGATA

DRAW A DIAGRAM OF TRANSVERSE SECTION OF MEDULLA OBLONGATA AT SENSORY DECUSSATION AND LABEL THE PARTS (LE)

Section at the level of sensory decussation contains grey matter and white matter. At this level the sensory fibres from the nucleus gracilis and cuneatus decussate in front of the central grey matter and form the medial leminscus.



Grey matter shows the following features.

The nucleus gracilis and the nucleus cuneatus

are seperated from the central grey matter.

The fibres of fasciculus gracilis and cuneatus synapse in nucleus gracilis and nucleus cuneatus respectively.

It represents posterior grey column at this level.

Their axon forms internal arcuate fibres.

Accessory cuneate nucleus.

It lies dorsolateral to the cuneate nucleus.

It relays unconscioius proprioceptive fibres from the upper limbs.

The nucleus of the spinal tract of the trigeminal nerve

occupy a dorsolateral position.

Lower part of inferior olivery nucleus

It is a convoluted lamina of grey matter with a hilum directed medially.The efferent fibres of the nucleus come out from its hilum and form olivocerebellar tract &crosses the midline to enter the inferior cerebellar peduncle of the opposite side.

Central grey matter contains the following nuclei.

Hypoglossal nucleus.

It forms an elongated nucleus about 2cm long.

its upper end occupies the hypoglossal triangle of the floor of the fourth ventricle.

It is situated close to the midline & belongs to the somatic efferent column.
It supplies all muscles of the tongue except palatoglossus

Dorsal nucleus of the vagus.

It lies dorso lateral to the hypoglossal nucleus and reprsents general visceral efferent column.
The cranial end of the dorsal nucleus occupies the vagal triangle of the floor of fourth triangle.
It provides origin to the preganglionic parasympathetic fibres of the heart and to the respiratory and alimentary systems.

Nucleus of tractus solitarius .

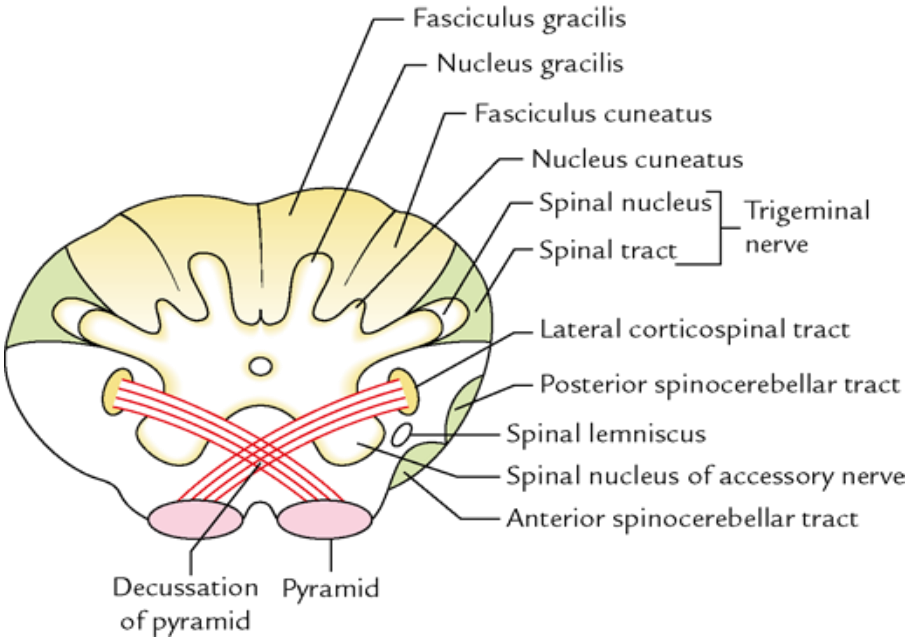
It is an elongated nucleus situated in dorsolateral to the dorsal nucleus of vagus.
It receives taste fibres from the facial ,glossopharyngeal and vagus nerve.

White matter shows the following features..

Internal arcuate fibres .

These are axons of second order neurons present in nucleus gracilis and cuneatus .
cross to the opposite side to form medial leminiscus that occupies a paramedian position.
The fibres of medial leminiscus extend through the brain stem and terminate in the ventral postero lateral nucleus(VPL) of the thalamus.
The central canal is pushed dorsally and opens on the dorsal surface of medulla forming the fourth ventricle.
The pyramidal tracts present anteriorly.
Medial longitudinal bundle lies posterioir to medial leminscus.
The spinocerebellar and lateral spinothalamic tracts lie in the anterolateral area.

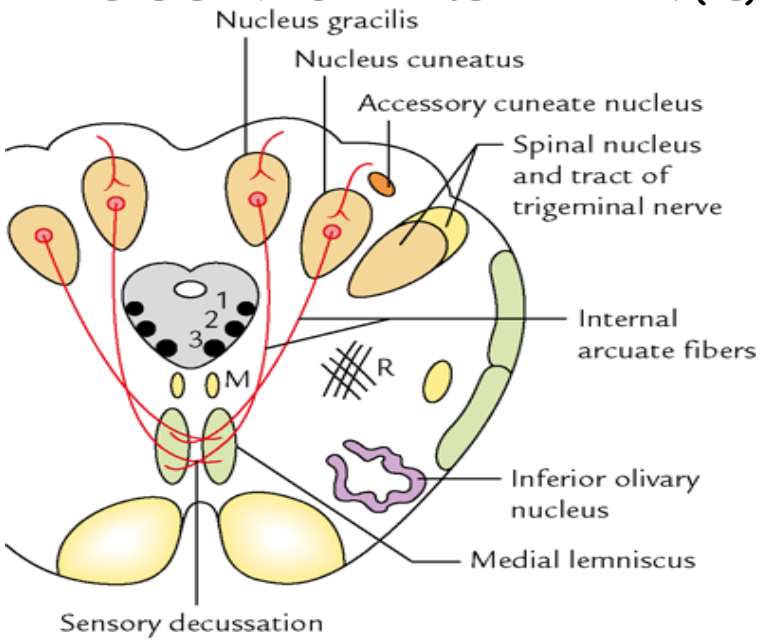
PYRAMIDAL DECUSSATION OF MEDULLA OBLONGATA (SE)
DRAW AND LABEL THE T/S OF MEDULLA OBLONGATA AT THE PYRAMIDAL DECUSSATION (SE)



The corticospinal fibres are grouped on each side of the anterior median fissure in the anterior region of the medulla and form pyramid.
The pyramidal fibres for the lower limb are on lateral side & fibres for the trunk and upper limbs are on the medial side.

About 75% of these fibres cross to the opposite side deep to the anterior median fissure,pass dorsolaterally and desend in the lateral funiculus of the spinal cord as lateral corticospinal tract.
The remaining fibres (uncrossed) form anterior corticospinal tract and descend in the anterior funiculus of the spinal cord.
This crossing of pyramidal fibres in the medulla forms the motor decussation and takes place ventral to the central canal,which is pushed dorsally.
The continuity between the anterior grey column and central grey matter is broken.
The detached anterior grey matter forms the supraspinal nucleus of the first cervical nerve.

SECTION OF MEDULLA AT THE LEVEL OF SENSORY DECUSSATION. (SE)



Grey matter

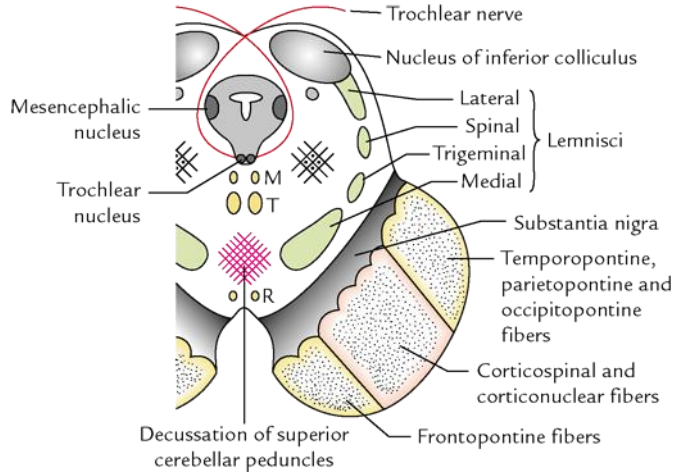
1. The nucleus gracilis and the nucleus cuneatus are much larger & are separate from the central grey matter.The fasiculus gracilis and fasiculus cuneatus end inthese nuclei.
2. Accessory cuneate nucleus situated lateral to cuneate nucleus. It relays unconscious proprioceptive fibres from the upper limbs.
3. The nucleus of the spinal tract of the trigeminal nerve is also separate from the central grey matter.
4. Lower part of inferior olivery nucleus is seen.
5. Central grey matter contains the following nucleus.
   (a)Hypoglossal nucleus
   (b)Dorsal nucleus of the vagus.
   (c)Nucleus of tractus solitaries

White matter.

1. Internal arcuate fibres arises from the nucleus gracilis and nucleus cuneatus .
2. The pyramidal tracts present anteriorly.
3. Medial longitudinal bundle lies posterioir to medial leminscus.
4. The spinocerebellar and lateral spinothalamic tracts lie in the anterolateral area.

MIDBRAIN

DRAW AND LABEL SECTION OF MIDBRAIN AT LEVEL OF INFERIOR COLLICULUS (LE)



MIDBRAIN (SE)

External features:

Midbrain is the upper part of brainstem connecting the cerebrum above and pons and cerebellum below. It is connected to the cerebellum through the superior cerebellar peduncle. Ventral nsurface presents two crura cerebri and dorsal surface four rounded elevations, two superior colliculi and two inferior colliculi. Crura cerebri diverges as it ascends to cerebrum and forms postero-lateral boundary of interpeduncular fossa.

Internal features:

Cerebral aqueduct of Sylvius communicates the third ventricle with the fourth ventricle and divides midbrain into two parts, ventral cerebral peduncles and dorsal part tectum.

Cerebral peduncle is further divided into 3 parts-

crus cerebri, substantia nigra, tegmentum.

The fibers passing through crus cerebri are

frontopontine fibers in the medial part,

corticospinal fibers in the middle and

temperopontine, parietopontine, occipitopontine in the lateral part.

Substantia nigra is pigmented area of nerve cells between crus cerebri and tegmentum.

Features in tegmentum are different at superior and inferior collicular level.

Inferior collicular level:

Trochlear Nerve Nuclei,

Mesencephalic Nuclei,

Decussation Of Superior Cerebellar Peduncles,

Rubrospinal Tract,

Tectospinal Tract,

Medial Longitudinal Fasciculus,

Ascending Tracts Like Medial Lemniscus,
Trigeminal Lemniscus,
Spinal Lemniscus,
Lateral Lemniscus.

Superior collicular level:

Occulomotor Nuclear Complex,
Mesencephalic Nuclei,
Ventral And Dorsal Tegmental Decussation,
Red Nucleus,
Ascending Tracts Like Medial Lemniscus,
Trigeminal Lemniscus, Spinal Lemniscus.

SUPERIOR COLLICULI (SE)

Paired superior colliculi are situated in the rostral tectum and connected to lateral geniculate body through superior brachium concerned with vision.

Afferents:

It receives fibers from retina, cerebral cortex, inferior colliculus and spinal cord.

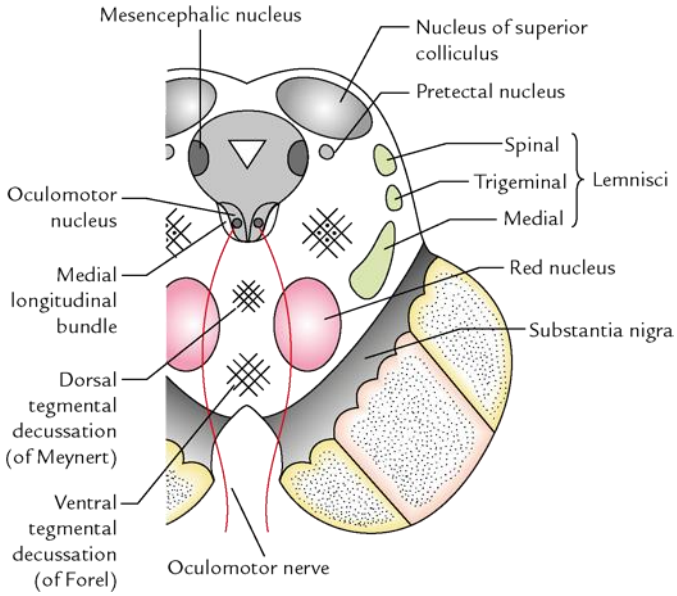
Efferents:

The fibers from the superior colliculi are projected to spinal cord, occulomotor, trochlear and abducent nuclei bilaterally, pontine nuclei, lateral geniculate body.

Functions:

It Acts As Reflex And Integrating Centers Of Visual System,
Concerned With Accommodation For Near Objects,
Scanning Movements In Visual Field,
Protective Closure Eye Lids,
Turning Head And Eyes Towards The Source Of Cutaneous And Auditory Stimulus.

LABELED DIAGRAM SHOWING TRANSVERSE SECTION OF MIDBRAIN AT LEVEL OF SUPERIOR COLLICULI. ADD NOTE ON CONNECTIONS OF RED NUCLEUS (SE)



Red nucleus – location and connections

Red nucleus is ovoid nuclear mass situated in tegmentum of midbrain dorsal to medial part of substantia nigra.

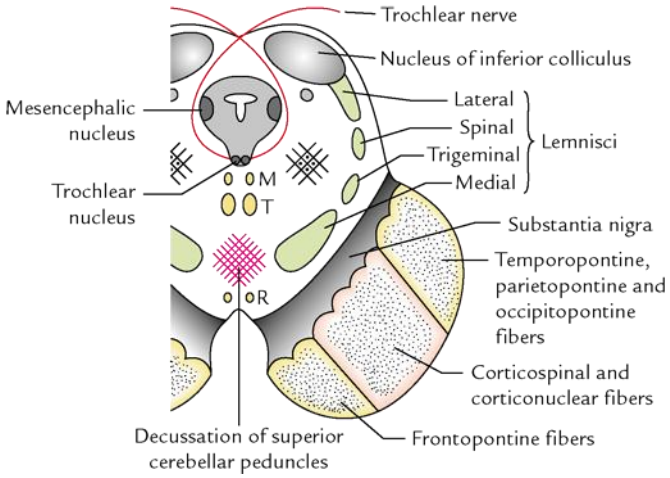
Afferents: cerebello-rubral fibers from globose, emboliform and dentate nuclei, cortico-rubral fibers from motor area, pallid-rubral fibers from globus pallidus of corpus striatum, tecto-rubral fibers from superior colliculus

Efferents: rubro-spinal, rubro-bulbar, rubro-reticular, rubro-olivary, rubro-thalamic fibers.

CRUS CEREBRI (SA)

Crus cerebri is the ventral part of cerebral peduncle of midbrain. The fibers passing through crus cerebri are from the motor cortexfrontopontine fibers in the medial part, corticospinal fibers in the middle and temperopontine, parietopontine, occipitopontine in the lateral part.

DRAW TRANSVERSE SECTION OF MIDBRAIN AT INFERIOR COLLICULUS (SA)



PONS

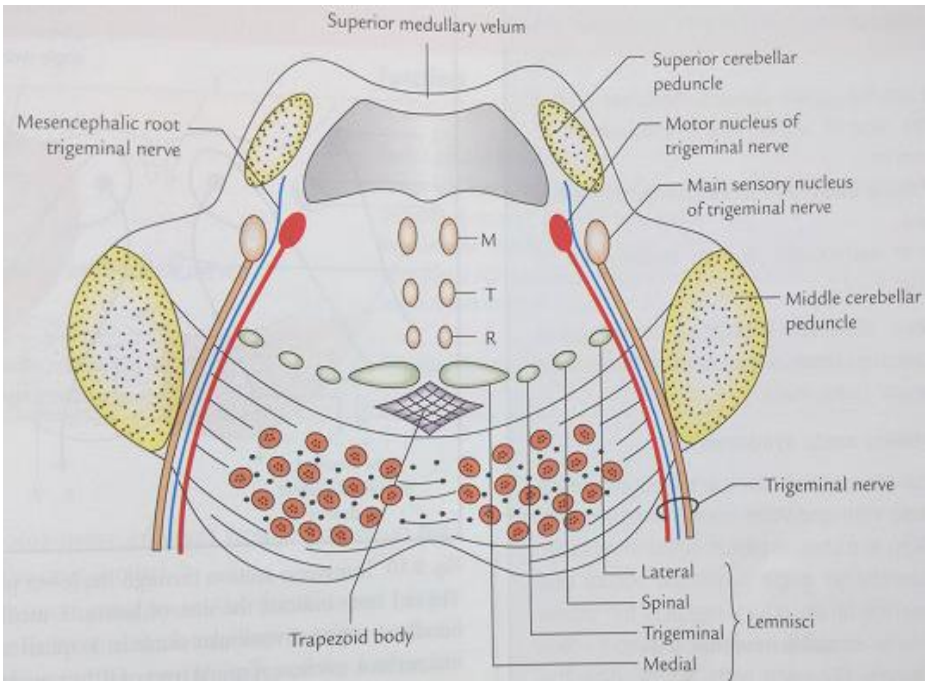
SECTION OF PONS AT MID LEVEL (SE)

Pons is the middle part of brainstem which is continuous above with midbrain, below with medulla

Cross section of pons shows 2 distinct regions. both contain grey and white matter

Large ventral part – Basilar part - upward continuation of pyramids of medulla

Small dorsal part – Tegmental part – upward continuation of medulla excluding pyramids



BASILAR PART :

GREY MATTER:

Pontine nuclei:

-Small masses of grey matter scattered among longitudinal & transverse fibres

-form an important part of **cortico ponto cerebellar pathway**

WHITE MATTER: Most of the fibres arises from cerebral cortex, but terminates at various levels.

-**Corticopontine fibres**

-**Corticonuclear fibres**

-**Corticospinal fibres**

-**Pontocerebellar fibres** arise from pontine nuclei, cross midline reach opposite half of cerebellum through middle cerebellar peduncle

TEGMENTAL PART :

Shows small cavity of 4th ventricle bounded on either side by superior cerebellar peduncle & roofed by superior medullary velum.

GREY MATTER:

-Motor nucleus of Trigeminal nerve :

- **Principal sensory nucleus of Trigeminal nerve**

WHITE MATTER :

From medial to lateral the following ascending tracts are arranged in ventral part of tegmentum

Medial lemniscus :

- medial lemniscus (which is formed by decussation of internal arcuate fibres) rotates in such a way fibres from nucleus gracilis are lateral & fibres from nucleus cuneatus are medial

Trigeminal lemniscus :

-carry fibres from contralateral spinal nucleus & principal sensory nucleus of trigeminal nerve

Spinal lemniscus :

-rostral continuation of lateral spinothalamic tract

Lateral lemniscus :

-fibres from dorsal cochlear nuclei cross midline, ascend as contralateral lateral lemniscus

In paramedian position, tegmentum contains pair of Medial longitudinal fasciculus, Tectospinal tracts, Rubrospinal tracts(dorsal to ventral).

Medial longitudinal fasciculus :

-co-ordinates movement of eyes, head & neck in response to stimulation of vestibulocochlear nerve

Tectospinal tracts :

- responsible for spinovisual reflex

Rubrospinal tracts :

-facilitates activity of flexor muscles & inhibits activity of extensor muscles

PONTINE NUCLEI – LOCATION, CONNECTIONS (SE)

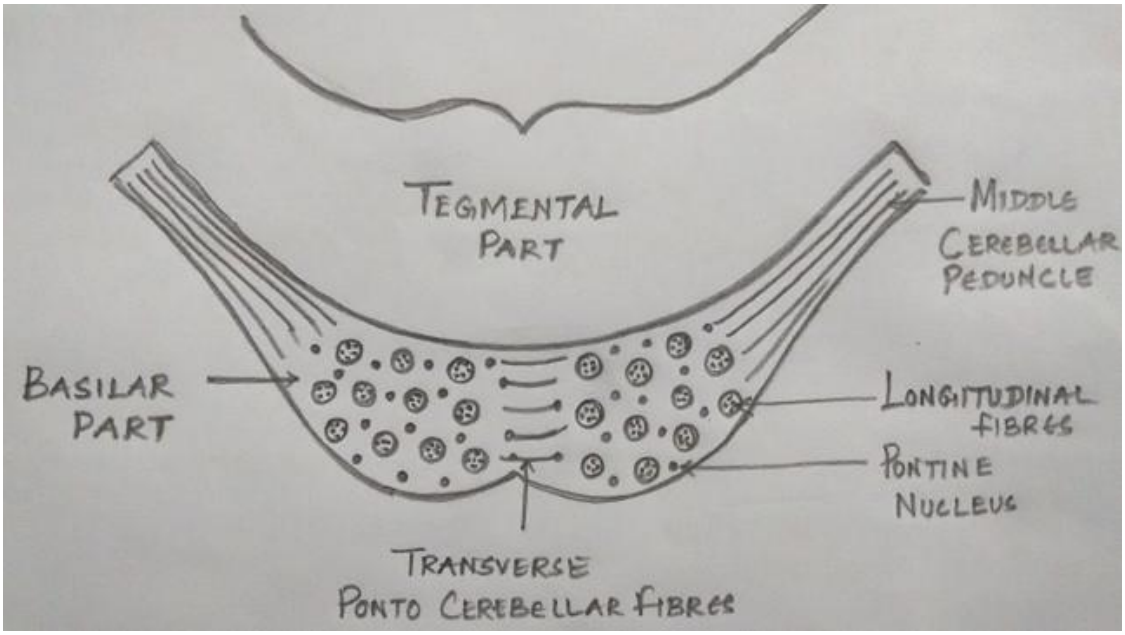
-Pontine nuclei are small masses of grey matter

Location :

-located in ventral basilar part of the entire length ofpons .

-is scattered between longitudinal & transverse fibres

-some of these nuclei get displaced during development & form arcuate nucleus and pontobulbar body



Connections :

Cortico ponto cerebellar pathway

Cerebral cortex

↓ **Corticopontine fibres**

Pontine nuclei

↓

Efferent fibres arise from pontine nuclei

↓ **Pontocerebellar fibres**

most of the fibres cross midline

↓

pass through contralateral middle cerebellar peduncle

↓

contralateral cerebellar hemisphere

Other connections

Pontine nuclei also receives fibres from superior colliculus, lateral geniculate body, cerebellum,

hypothalamus, reticular formation

CEREBELLUM

ARCHICEREBELLUM (SA)

Archicerebellum is called so because it is the oldest part of cerebellum to evolve.

It is also known as **Vestibular cerebellum**

It is the **first to appear in evolution** in aquatic vertebrates

Parts of Archicerebellum :

- Flocculonodular lobe and
- lingula

Connections:

Receives input from vestibular nerve and the medial and lateral vestibular nuclei.

Function: Vestibular in function

Concerned with maintenance of balance, tone and posture of trunk muscles.

ENUMERATE THE NUCLEI OF CEREBELLUM (SA)

There are 4 intracerebellar nuclei on either side of midline.

From lateral to medial :

Dentate nucleus –

It appears like a crumpled bag. Largest in primates. Receives input from neocerebellum.

Emboliform nucleus-

Receives input from paleocerebellum.

Globose nucleus-

Receives input from paleocerebellum.

Fastigial nucleus-

Receives input from Archicerebellum

NAME THE TRACTS IN THE INFERIOR CEREBELLAR PEDUNCLE (SA)

Inferior cerebellar peduncle:

Connects cerebellum and medulla oblongata

Fibers Passing through it:

Afferent fibers:

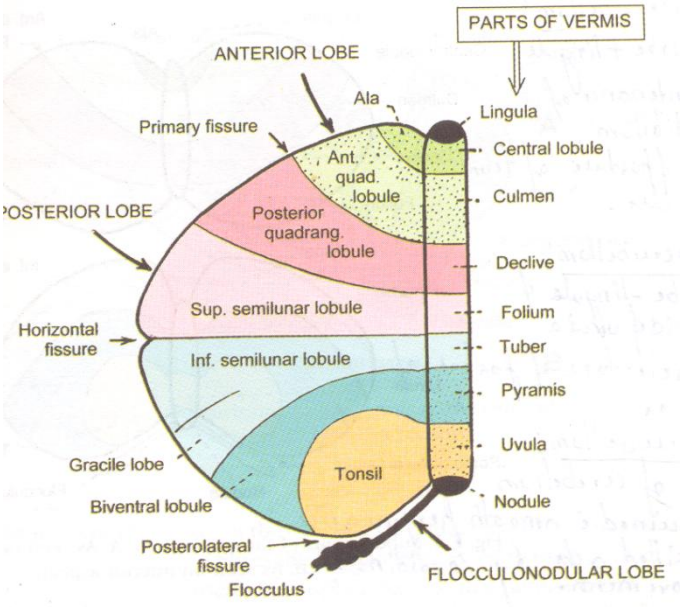
- Posterior spinocerebellar fibers
- Olivocerebellar fibers
- Parolivocerebellar fibers
- Cuneocerebellar fibers
- Anterior external arcuate fibers
- Vestibulocerebellar fibers
- Reticulocerebellar fibers

Efferent Fibers:

- Cerebello-vestibular fibers
- Cerebello-reticular fibers
- Cerebello-olivary fibers

CEREBELLUM- PARTS OF VERMIS AND ITS FUNCTIONS (SE)

Median worm like part of cerebellum is called vermis



Parts of Vermis:

Lingula

Central lobule

Culmen

Declive

Folium

Tuber

Pyramid

Uvula

Nodule

Function:

Cortex of the median vermis gets projected into Nucleus Fastigii.

It is concerned with the movements of the trunk and extensor muscle tone through the vestibulospinal tracts and reticulospinal tracts

DENTATE NUCLEUS – SITUATION, SHAPE, CONNECTIONS AND FUNCTIONS (SE)

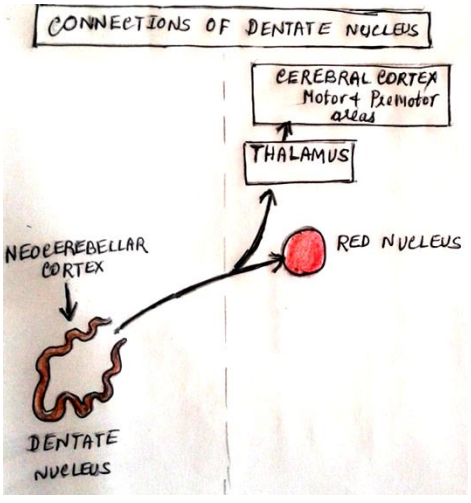
Dentate nucleus –

Most prominent nucleus of intracerebellar nuclei and largest in primates.

Situation:

It is situated within the white matter of cerebellum.

It is the most lateral nucleus among the cerebellar nuclei.



Shape:

It resembles a **crumpled bag**

Connections:

Afferent:

It receives input from neocerebellum .

Efferents:

Dentatorubral and Dentatothalamic fibres .

Functions:

The dentate nucleus is **responsible for the planning, initiation and control of voluntary movements**. The dorsal region of the dentate contains output channels involved in motor function,

Ventral region contains output channels involved in cognition and visuospatial function.

The dentate nucleus sends commands and information to the motor and premotor areas in the forebrain.

CEREBELLAR PEDUNCLES (SE)

3 pairs of peduncles connect cerebellum with the brainstem.

Superior cerebellar peduncle

Middle cerebellar peduncle

Inferior cerebellar peduncle

Superior Cerebellar Peduncle:

Connects Cerebellum and midbrain

Afferent Fibres:

Anterior spinocerebellar tract

Trigeminocerebellar fibers

Tectocerebellar fibers

Hypothalamocerebellar fibers

Ceruleocerebellar fibers

Efferent Fibers:

Cerebellorubral fibers

Dentatorubral and dentatothalamic fibers

Cerebello-olivary fibers

Cerebello-reticular fibers

Middle Cerebellar Peduncle:

Connects Pons and cerebellum

Afferent Fibers:

Pontocerebellar fibers - form the bulk of this peduncle

Reticulo-cerebellar fibers

Seratogenic fibers

Efferent Fibers: NO efferent are carried by middle cerebellar peduncle.

Inferior cerebellar peduncle:

Connects cerebellum and medulla oblongata

Afferent fibers:

Posterior spinocerebellar fibers

Olivocerebellar fibers

Parolivocerebellar fibers

Cuneocerebellar fibers

Anterior external arcuate fibers

Vestibulocerebellar fibers

Reticulocerebellar fibers

Efferent Fibers:

Cerebellovestibular fibers

Cerebello-reticular fibers

Cerebello-olivary fibers

INFERIOR CEREBELLAR PEDUNCLE – PARTS, CONNECTIONS AND FIBERS PASSING THROUGH. (SE)

Inferior cerebellar peduncle:

It is made up of **Restiform body** and **Juxtarestiform Body**

Connection: It connects cerebellum with medulla oblongata and spinal cord.

Fibers passing through:

Afferent fibers:

- Posterior spinocerebellar fibers
- Olivocerebellar fibers
- Parolivocerebellar fibers
- Cuneocerebellar fibers
- Anterior external arcuate fibers
- Vestibulocerebellar fibers
- Reticulocerebellar fibers

Efferent Fibers:

- Cerebellovestibular fibers
- Cerebello-reticular fibers
- Cerebello-olivary fibers

FUNCTIONS AND APPLIED ANATOMY OF CEREBELLUM (SE)

Cerebellum controls the **same side of the body**

Functions Of cerebellum:

Maintenance of Posture and equilibrium.

Maintenance of muscle tone.

Coordination of voluntary motor activity (precise and smooth).

Applied Anatomy of cerebellum:

All the signs of cerebellar dysfunction affect the motor system.

Presenting features of cerebellar dysfunction are:

Trunkal ataxia

Nystagmus

Hypotonia of muscles

Pendular knee jerk

Asynergia:

Dysmetria

Intention tremor

Dysdiadochokinesia

Dysarthria/ Scanning speech

Rebound phenomenon