

★ Topic 5: Motor tract (corticospinal).

• motor tracts

→ Pyramidal tracts

→ Anterior & Lateral corticospinal

→ Function:- Conscious control of skeletal muscles.

→ Area:- 4, primary motor cortex (paralysis).

→ extrapyramidal tracts

→ Tracts

→ Vestibulospinal:- from vestibular nuclei in Brain stem

→ Reticulospinal:- from Reticular formation

→ Rubrospinal:- from Red nucleus.

→ Tectospinal:- from Tectum

• Under the influence of the cerebral cortex (cortico-)

→ Function:- Subconscious regulation of balance, muscle tone, eye, limbs & position.

→ Area:- 6, secondary motor area (x motor proprioception).

↳ premotor area:- uses external cues (vision, hearing).

↳ supplementary motor area:- uses internal cues (memory).

• Area 3, 1, 2 sends some tracts too.

• Rexed Laminae

→ Lamina 8 → motor interneurons
→ Commissural nucleus.

→ Lamina 9:- ventral (Anterior) horn, LMN.

↳ ventromedial:- extensors of vertebral.

↳ dorsomedial:- Intercostal & abdominal.

↳ ventrolateral:- arm & thigh

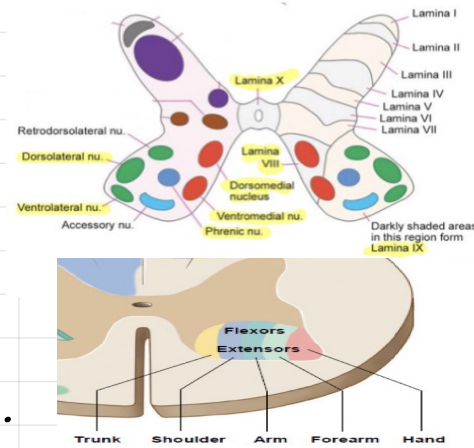
↳ dorsolateral:- Forearm & Leg

↳ Reterodorsolateral:- Hand & foot

↳ central:- phrenic nerve

medially.

laterally.



• Motor neurons of anterior horn

Pyramidal tracts

→ medial group:- Medial (axial) Muscles
→ lateral group:- Lateral (distal) Muscles

1 Lateral corticospinal tract (LCST)

→ upper motor neuron origin:- Area 4, precentral gyrus

→ Midbrain:- middle 3/5 of basis pedunculi:- anterior to substantia nigra (cerebral crus).

→ pons:- pontine nucleus (Basilar/Anterior part):- Scattered fibers.

→ medulla oblongata:- pyramids (Anterior aspect):- 85% decussation

→ spinal cord:- descends in lateral funiculus as LCST

→ Termination → Anterior gray horn

→ Function:- fine skilled movements

→ α & γ nuclei (Gamma)

→ 55% Cervical (upper limb):- more skilled movement

→ 20% thoracic

→ 25% Lumber & Sacral (lower limb)

→ Interneurons Lamina

IV, V, VI, VII, VIII

→ Exception:- 3% From 8th Layer of area 4 synapse directly to lower motor neuron (accurate movements)

2 Anterior corticospinal tract (ACST).

→ fibers that don't decussate in the pyramid on the medulla & descends ipsilateral.

→ 99% decussate in the anterior white commissure → synapse with interneurons.

→ function:- medial (proximal) muscles (postural & Balance):- medial motor system.

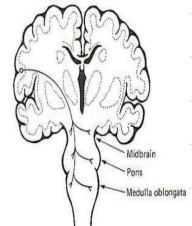
* Topic 6: extrapyramidal tracts & clinical (UMN/LMN)

3 Corticospinal Tract

- Origin: - precentral gyrus (lower quarter).
- Termination: - motor nuclei of cranial nerves
- Bilateral, Except
 - 7th: - lower facial Muscles.
 - 12th: - genioglossus Muscles.

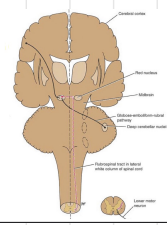
- midbrain: - II, IV
- pon: - V, VI, VII
- medulla: - IX, X, XI, XII

ply - site of Anterior horn.



The subconscious motor tracts (extrapyramidal)

- Function
 - Axial muscles, balance, posture.
 - coarse movements of proximal limbs.
 - Head, neck & eye movement



1 Rubrospinal tract

- Red nucleus: - in midbrain at the lvl of superior colliculus.
 - Receives afferent fibers from
 - Cortex
 - Cerebellum (Globose-emboliform-rubral pathwy).
- Crossed: - at the lvl of nucleus (contralateral)
- Lateral white column.
- Function: - ↑ flexors, ↓ extensors

28 Reticulospinal tract: - pontine & medullary, afferent from

- Cortex
- hypothalamus (from lateral reticulospinal)

2 pontine reticulospinal tract.

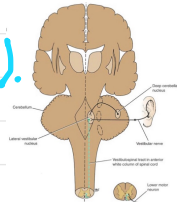
- pons → uncrossed → spinal cord (Anterior white column) (ipsilateral)
- characteristics: - tonically active, normally under inhibition from cortex
- function: - active axial & proximal limb extensors (Gravity).

3 medullary reticulospinal tract (opposite to pontine reticulospinal)

- medulla → crossed & uncrossed → spinal cord (Lateral white column).
- characteristics: - not tonically active, normally under stimulation.
- function: - inhibits the axial & proximal limb extensors.

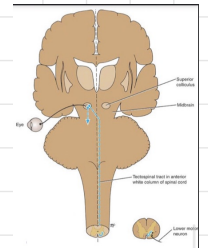
4 Vestibulospinal Tract

- Vestibular nuclei: - in pons & medulla (floor of 4th ventricle)
 - Receives afferent fibers from
 - inner ear (vestibular N).
 - Cerebellum (fastigial Nucleus).
- uncrossed
- Anterior white column.
- Function: - ↑ extensors, ↓ flexors, association with balance (antigravity)



5 Tectospinal tract

- origin: - Nerve cells in superior colliculus of the tectum
- Crossed
- anterior white column close to anterior median fissure.
- Termination: - Anterior gray horn of upper cervical segments.
- Function: - Reflex movement of head & neck in response to visual stimuli



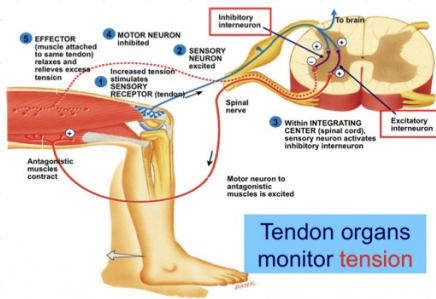
- motor pathways:
 - Medial motor system
 - Anterior corticospinal tract.
 - Extrapyramidal in general.
 - Lateral motor system
 - Lateral corticospinal tract.
 - Rubrospinal tract
 - medullary reticulospinal tract

| Features | Upper motor neuron lesions(UMN) | Lower motor neuron lesion(LMN) |
|----------------------|--|---|
| | UMN starts from motor cortex to the cranial nerve nuclei in brain and anterior horn cells in spinal cord | LMN is the motor pathway from anterior horn cell(or Cranial nerve nucleus)via peripheral nerve to the motor end plate |
| Bulk of muscles | No wasting | Wasting of the affected muscles (atrophy) |
| Tone of muscles | Tone increases (Hypertonia) | Tone decreases (Hypotonia) |
| Power of muscles | Paralysis affects movements of group of muscles Spastic/ clasp knife | Individual muscles is paralyzed Flaccid (flaccid paralysis) |
| Reflexes | Exaggerated. (Hyperreflexia) | diminished or absent. (Hyporeflexia) |
| Fasciculation | Absent | Present |
| Babinski sign | Present | Absent |
| clasp-knife reaction | Present | Absent |
| Clonus | Present | Absent |

- **Clasp Knife reaction** :- overactivity of pontine excitatory system (spasticity)
 - ↳ initial resistance :- Exaggerated stretch reflex
 - ↳ sudden release :- ↑Tension → Golgi tendon organs activation → relaxation.

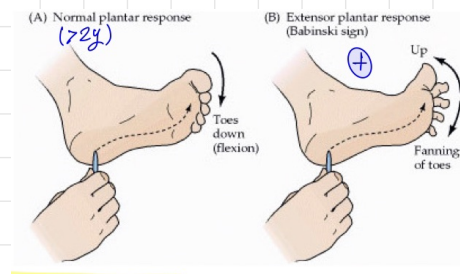


• Tendon Reflex



• polysynaptic
• reciprocal innervation

• Babinski sign



• withdrawl Reflex
• pyramidal tract responsibility.

- **Rigidity**
 - ↳ Decerebrate :- Below Red nucleus, more dangerous (near vital centers) extension of upper & lower limbs.
 - ↳ Decorticate :- Above Red nucleus, Lower limb extension, upper limb flexion (Rubrospinal tract activity)

- **clonus** :- Rhythmic contractions & relaxation of muscles when they are subjected to sudden sustained stretch.

• Clinical significance of lamination of ascending tracts

- ↳ Intramedullary tumor - affect the cervical fibers (medial) (upper limb)
 - ↳ Sacral sparing (not effected).
- ↳ Extramedullary tumor :- affect the lower limb fibers (Lateral)

• Destruction of Lateral spinothalamic tract

- ↳ Loss of pain & thermal sensation on the contralateral side, Below the LVL of Lesion.

• Destruction of Fasciculus gracilis & cuneatus (posterior-white column-medial Lemniscal).

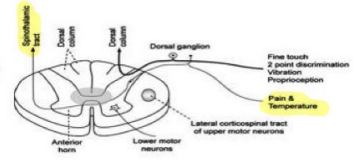
- ↳ Loss of joint sense, position, vibration & tactile discrimination on the same side (ipsilateral) Below the LVL of the Lesion

- Extremely rare to have Localized Lesion as to affect one sensory tract only.

*Topic 7:- Syringomyelia, BSS, Blood supply, part of Brain stem.

• **Syringomyelia** :- Cavitation of the central region (central canal) of the spinal cord

- ↳ **causes** :- Bilateral Loss of pain & Temp. (spinothalamic)
- ↳ **Fibers affected** :- Spinothalamic (fibers that cross in the anterior white commissure).
- ↳ **Example** :- C4-C5 → Sensory Loss from shoulders to nipple level
 - extend to anterior horn: **one** → ipsilateral, **two** → bilateral
 - ↳ Bilateral sensory loss (spinothalamic)
 - ↳ Weakness of corresponding extremity (Anterior horn).



• **Brown-Séquard syndrome** :- Hemisection (Lateral corticospinal, ALS, posterior columns (PWCMLT))

- ↳ **causes**
 - 1) Contralateral loss of thermal sensation below the lesion (spinothalamic/ALS).
 - 2) ipsilateral loss of discriminative tactile, vibration, position sense (PWCMLT).
 - 3) ipsilateral paralysis of extremities (leg or leg & arm) (Lateral corticospinal).

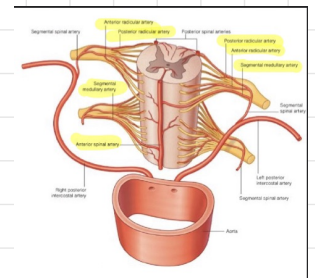
• Blood supply

• **Brain** :- By internal carotid (carotid canal) & vertebral (foramen magnum) in subarachnoid → circle of willis

• Spinal cord

- 1) **Longitudinal Arteries (By vertebral A)**
 - ↳ 1 anterior spinal A :- anterior median fissure
 - ↳ Supplies most of the gray matter & anterior white matter
 - ↳ 2 posterior spinal A :- (PICA) posterolateral sulcus.
 - (+ Vasocorona) ↳ supplies posterior columns & peripheral of lateral & anterior funiculi.

- 2) **Segmental spinal arteries**
 - ↳ Arise from **vertebral A.**
 - ↳ Deep cervical A in the neck
 - ↳ posterior intercostal A in the thorax.
 - ↳ Lumbar A in the abdomen.
 - ↳ **Branches**
 - ↳ Anterior reticular A.
 - ↳ posterior reticular A.
 - ↳ Segmental medullary A. → Terminal branch :- arterial vasocorona.

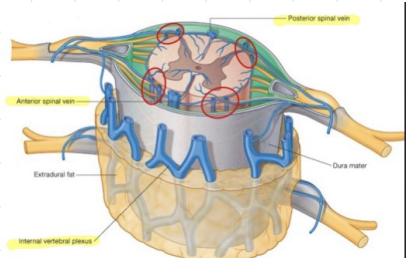


• **Artery of Adamkiewicz** :- Left, lower portion of spinal cord, 9th-12th posterior intercostal Arteries → Anastomose with anterior spinal Artery.
↳ Supply lower 2/3 of the spinal cord.

• Venous drainage

Two pairs of veins in each side
 Anterior spinal vein (Anterior fissure)
 posterior spinal vein (posterior sulcus) } internal vertebral plexus (extradural/epidural)

- ↳ Azygos system (thorax)
- ↳ internal vertebral system
- ↳ intracranial veins.



Central Cord syndrom

- Results from:- hyperextension of the neck.
- Artery occluded:- anterior spinal artery
- Signs
 - Bilateral weakness of the extremities (more in upper limb) (Anterior horn)
 - Pain & thermal sensation loss (Lateral spinothalamic)
 - Bladder dysfunction. (Lateral horn)

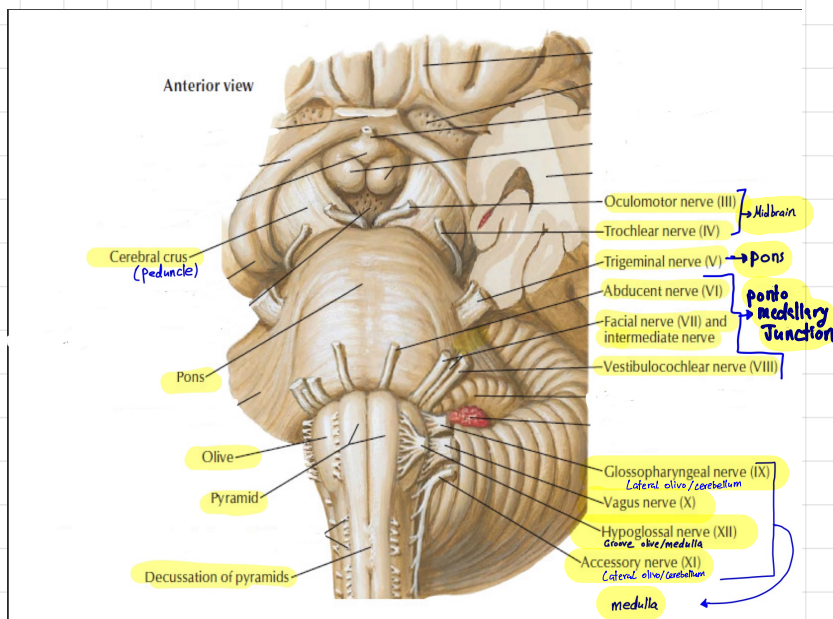
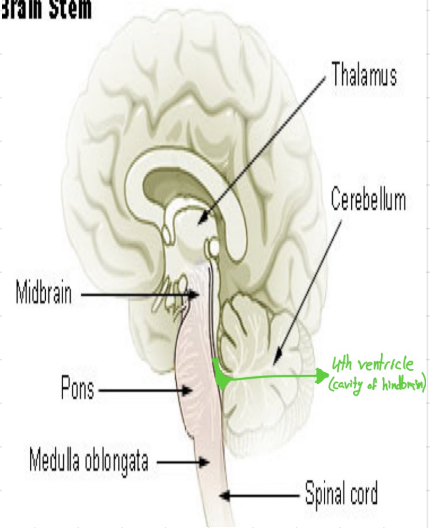
Posterior spinal Artery (PWCMLT).

- Ipsilateral ↓ or Loss of discriminative, positional & vibratory tactile sensation.

Brain stem:- stalk like in shape, connect spinal cord & forebrain

- parts
 - medulla oblongata
 - pons
 - midbrain
- Consists of
 - sensory/motor/parasympathetic nuclei (no sympathetic).
 - vital centers.
 - Ascending & descending tracts.

Brain Stem



Internal structure of medulla

- LVL of decussation of pyramids (motor/cbse medulla)
- LVL of decussation of Lemnisci (sensory/cbse medulla).
- LVL of olive (open medulla).
- LVL Just inferior to the pons.

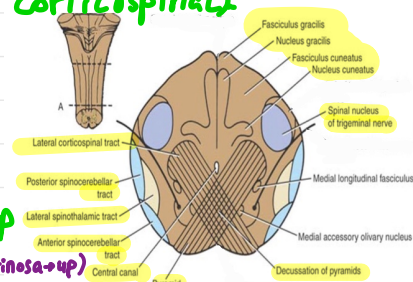
most inferior



Most superior

1 Level of decussation of pyramids

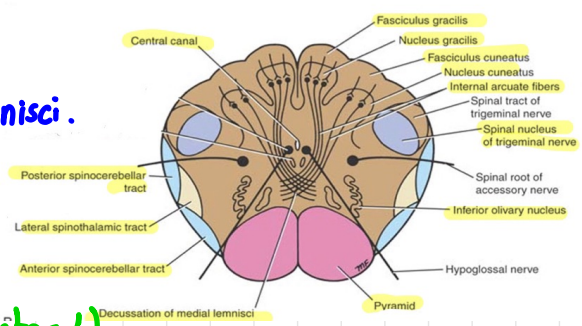
- Decussation of pyramids (Anterior to central canal, Lateral corticospinal)
- posterior column system
 - Fasciculus gracilis } Horn (gray)
 - Fasciculus cuneatus } (gray)
 - Nucleus gracilis } Column (white)
 - Nucleus cuneatus } (white)
- spinal nucleus of Trigeminal:- sensory nuclei for pain & Temp & crude touch for Head & neck area. (Longitudinal, substantia gelatinosa-up)
 - Vagus, facial, glossopharyngeal nerve Rely some sensations in this nucleus.
- The anteriolateral system (Anterior & lateral white column) is unchanged.
- central canal.



★ Topic 8:- medulla sections , Introduction to pons.

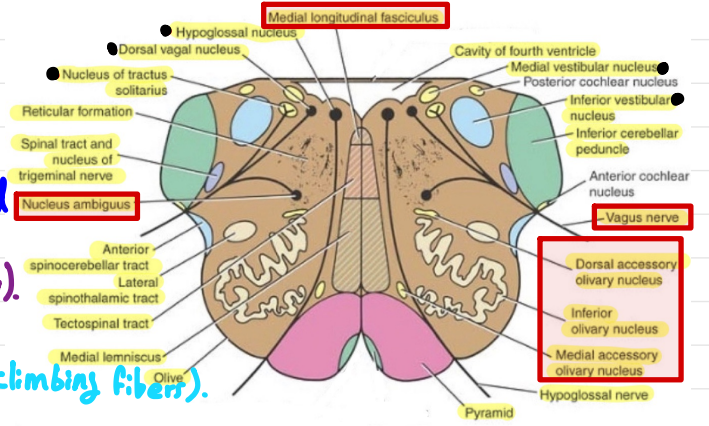
2 Level of decussation of Lemnisci (closed medulla)

- Sensory decussation (Anterior to central canal)
- nucleus gracilis & cuneatus → internal arcuate → Lemnisci.
- Decussation in posterior to pyramids
- spinal nuclei & tract of the trigeminal nerve (Lateral to internal arcuate fibers).
- Spinal Lemniscus:- Lateral to decussation.
- spinocerebellar, vestibulospinal & rubrospinal (anterolateral).
- central canal
- pyramid:- most anterior part



3 Level of olives (open medulla):- inferior (floor) of 4th ventricle

- pyramids
- Inferior cerebellar peduncle:- posterolateral corner.
- Medial / anterior medial Lemniscus → Tectospinal → medial longitudinal fasciculus.
- Reticular formation (Nucleus ambiguus).
- spinal nucleus of Trigeminal N & Trunk:- anteriomedial to ICP.
- Nuclei of
 - 9 :- Glossopharyngeal
 - 10 :- Vagus
 - 11 :- Accessory
 - 12 :- Hypoglossal



- Inferior olivary nucleus (olivary complex)
 - Crumpled bag with its mouth directed medially (Grey matter).
 - Responsible of:- the elevation olive (Grossly).
 - Communication with
 - spinal cord.
 - Cerebellum. (climbing fibers).
 - Cortex.
 - Function:- Voluntary muscle movement.

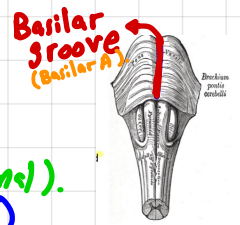
- Nucleus ambiguus:- Large motor neuron.
 - Location:- Deep in Reticular formation, elongated nucleus in medulla oblongata.
 - Emerging fibers from 9 & 10 & 12
 - Function:- supply striated muscles of the larynx, pharynx, soft palate.
- Medial Longitudinal fasciculus:- small tract of nerve fibers.
 - Location:- each side, posterior to med. Lemniscus & Tectospinal, Anterior to 12th nucleus
 - Vestibular nuclei + cochlear nuclei + 3rd (oculomotor) & 4th (Trochlear) & 5th (Abducens) + cervical segments (move of head & neck).
- central gray matter:- Beneath the floor of 4th ventricle
 - Hypoglossal nucleus:- 12th, motor.
 - Dorsal nucleus of vagus:- 10th, presynaptic parasympathetic.
 - Solitary nucleus (of tractus solitarius):- sensory (taste & visceral).
 - medial & inferior vestibular nuclei
- Vagus nerve connections
 - Dorsal vagal nucleus.
 - Solitary nucleus
 - Nucleus ambiguus

4] Level Just Inferior to the pons:- No major changes.

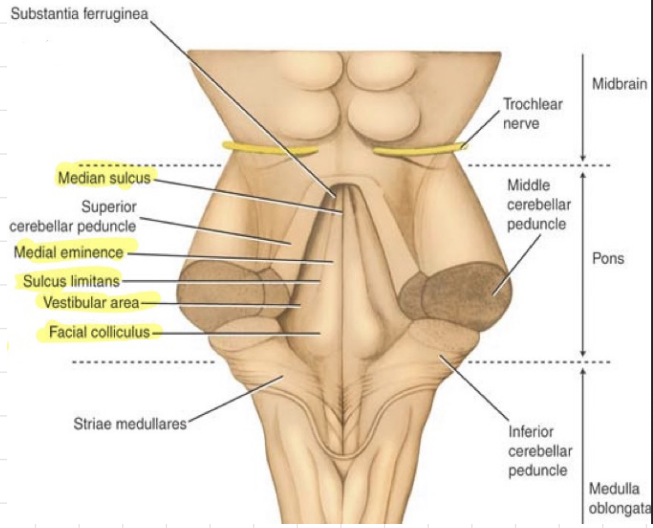
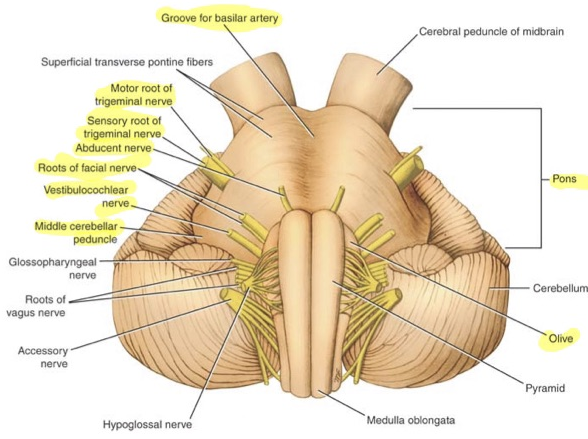
- ↳ Lateral vestibular nucleus:- replaced by inferior vestibular nucleus.
- ↳ cochlear nuclei:- anterior & posterior surface of ICP. (8th = vestibulocochlear (1/2)).

pons

- ↳ Location:- anterior to cerebellum
- ↳ shape:- 1 inch long, Anterior surface is convex
- ↳ Nuclei
 - ↳ ponto-medullary Junction:- VI, VII, VIII.
 - ↳ Anterolateral surface:- V (motor & sensory Trigeminal).
- ↳ Middle cerebellar peduncle:- Transverse fibers (pons + cerebellum)
- ↳ posterior view:- upper half of floor of 4th ventricle (Rhomboid fossa).
 - ↳ median sulcus
 - ↳ median eminence:- Between median sulcus & sulcus limitans
 - ↳ sulcus limitans
 - ↳ Facial colliculus:- Inferior end of median eminence.
 - ↳ Area vestibuli:- Lateral to sulcus limitans.

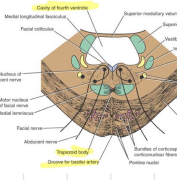


Pons – anterior view



Internal structures of the pons

- ↳ Divided Transversely by Trapezoid body into
 - ↳ Anterior Basal part.
 - ↳ posterior Tegmentum.
- ↳ Levels
 - ↳ caudal part (facial colliculus)
 - ↳ cranial part (Trigeminal nuclei).



- The trapezoid body :- part of acoustic pathway, made up of fibers derived from cochlear nuclei.
- Lateral Lemniscus :- tract of axons in brain stem → contralateral inferior colliculus.

cochlear nuclei → Trapezoid body → Lateral Lemniscus → inferior colliculus → medial geniculate body (Thalamus) → Auditory cortex (superior Temporal gyrus).

