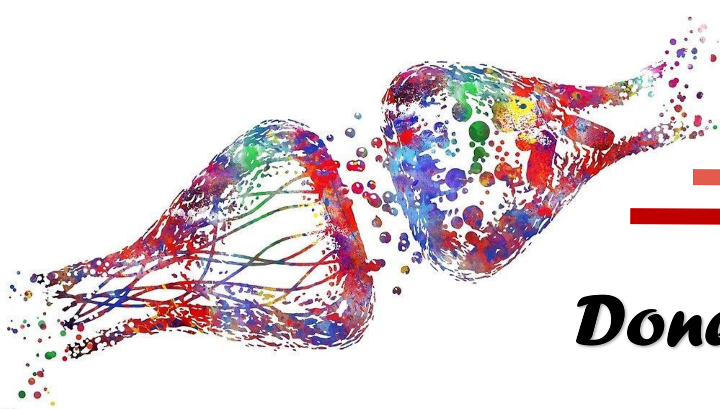
Neuro Anatomy

Dr.Mohammad Al-Salem Parrt Summary



Done by : Amal Saeed Odeh

Organization of nervous system

CNS

BRAIN

SPINAL CORD

PNS

31 SPINAL NERVE

12 CRANIAL NERVE

Somatic

Sensory

Muscles

Joints

Skin

Special sensations except taste

Motor

Voulantary (skeletal muscles)

Autonomic

Sensory

Receptors in visceral organs

Motor

Involuntary (smooth and cardiac muscles) and glands

Sensory

Motor

Meninges

Dura mater	Outermost layer; continuous with epineurium of the spinal nerves	Dense irregular connective tissue	from the level of the foramen magnum to S2 , Closed caudal end is anchored to the coccyx by the filum terminale externum
Arachnoid mater	Adheres to the inner surface of the dura mater	Thin web arrangement of delicate collagen and some elastic fibers.	-----------------
Pia mater	Bound tightly to surface OF SPINAL CORD	Thin transparent connective tissue layer that adheres to the surface of the spinal cord and brain	Forms the filum terminale , anchors spinal cord to coccyx Forms the denticulate ligaments that attach the spinal cord to the arachnoid mater and inner surface of the dura mater

Spaces

Epidural	space between the dura mater and the wall of the vertebral canal	Fat-fill	Anesthetics injected here
Subdural space	Between dura and arachnoid	serous fluid	-----------------
Subarachnoid	between pia and arachnoid	Filled with CSF	Lumbar puncture at supracristal line at level of L3-L4

Receptors

Mechanoreceptors

Meissner's corpuscle
Respond to touch, pressure and low frequency vibration (low frequency)

rapidly adapting

Merkel's disc (Tactile Disc)
Discriminative touch

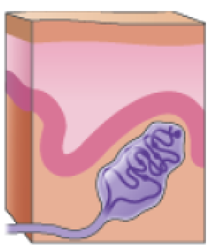
Slowly adapting

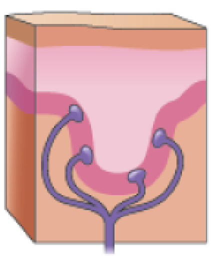
End organ of Ruffini
sensitive to skin stretch

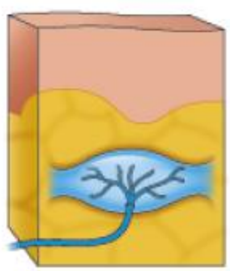
Slowly adapting

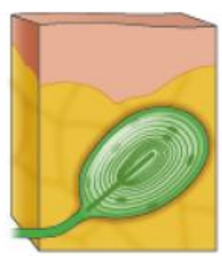
Pacinian corpuscles
Vibrations (high frequency)

rapidly adapting


Meissner's corpuscle (touch)


Merkel's discs (touch)


Ruffini's ending (stretch)


Pacinian corpuscle (vibration)

Thermoreceptors
Free nerve endings

Detect change in temperature

TRP channels

Nociceptors
Free nerve endings

Detect damage (pain receptors)

Multimodal

Ascending sensory tracts

Medial lemniscal pathway

Discriminative Touch Sensation , Conscious proprioception (Conscious muscle joint sense)

Receptor: Most types of receptors (like spindles and GTO) except free nerve endings

1st order Neuron: cell bodies lie in the Dorsal Root Ganglion ipsilaterally till they reach the lower part of medulla oblongata

2nd Neuron:lower part of medulla oblongata (decussation)

3rd Neuron: Thalamus (VPL) to area 312

Lateral spinothalamic tract

Modality: transmits pain and temperature.

Receptors: Free nerve endings (the opposite of the posterior column)

1st Neuron: The cell bodies lie in the Dorsal root ganglia doesn't go to the posterior white column, it synapses with the 2nd neurons' cell bodies directly in the dorsal horn in substantia gelatinosa then cross obliquely to the opposite side passing through the anterior gray and white commissures

3rd neuron pathway: Thalamus to either area 312 (3b) , The Reticular formation (slow pain) , Cingulate gyrus (emotional aspect of pain) , Insular gyrus (autonomic response)

Anterior spinothalamic tract

Modality: crude touch and pressure

Receptors: free nerve endings

1 st Neuron: Dorsal root ganglia

2 nd Neuron: the posterior horn of gray column specifically in nucleus proprius which represents laminae 3 and 4 of the gray matter , cross obliquely to the opposite side in the anterior gray and white commissures, ascending in the contralateral white column as the Anterior spinothalamic tract.

3 rd Neuron: Thalamus (VPL) Internal Capsule , Corona Radiata. Termination: Primary Somesthetic Area (SI)

Spinotectal tract

This is a sensory tract that relays information from the spinal cord (spino) to the tectum (tectal) , for spinovisual reflexes

the 1st order neurons start at the organs involved in the collection of information for the spinovisual reflexes, the cell bodies for them is, again, in the dorsal root ganglia. The 2nd order neurons synapses with the 1st order neurons early in the spinal cord, and then the axons of the 2nd order neurons cross the midline and ascend contra-laterally in the anterolateral white column of the spinal cord, lying close to the lateral spinothalamic tract. This tract terminates in the superior colliculus

Posterior spinocerebellar tract

Modality: muscle and joint sensation (unconscious proprioception)

Receptors: same as dorsal column system (Most receptors except free nerve endings)

1 st order neuron axons terminate at the base of post gray column (nucleus dorsalis or Clarks nucleus in lamina 7) • the axons of 2 nd order neurons enter posterolateral part of the lateral white matter column on the same side. • ascend ipsilaterally as the posterior spinocerebellar tract to medulla oblongata. • Terminates in cerebellar cortex (through inferior cerebellar peduncle)

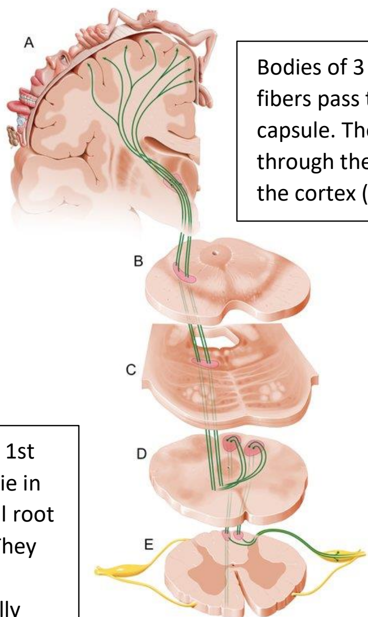
Anterior spinocerebellar tract

Modality: muscle and joint sensation (unconscious proprioception)

1 st order neuron axons terminate at the base of post gray column (nucleus dorsalis)

• Two pathways for the axons: 1- the majority of axons of 2nd order neurons cross to opposite side and ascend as anterior spinocerebellar tract in the contralateral white column. 2- the minority of axons ascend as anterior spinocerebellar tract in the lateral white column of the same side. • Ascend as anterior spinocerebellar tract to medulla oblongata and pons. • Terminates in cerebellar cortex, (through superior cerebellar peduncle). the fibers that crossed over in spinal cord cross back within cerebellum

Medial lemniscal pathway

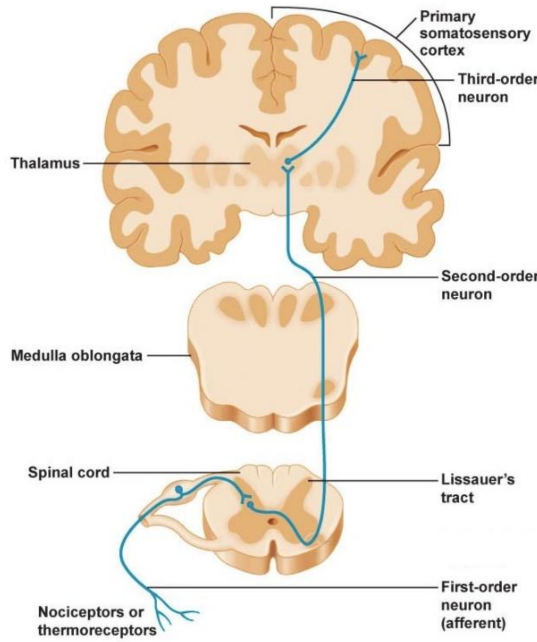


Bodies of 3 the thalamus. The fibers pass through the internal capsule. Then they radiate through the space until they reach the cortex (postcentral gyrus).

2^{nd} neurons' bodies lie in the nucleus cuneatus and nucleus gracilis. Their fibers (internal arcuate fibers) form the medial lemniscus and ascend contralaterally towards the thalamus.

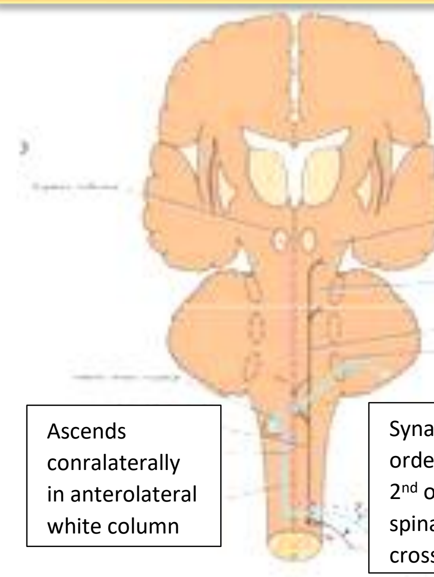
Bodies of 1st neurons lie in the dorsal root ganglia. They ascend ipsilaterally

Lateral & Anterior spinothalamic tract



The main difference is that the lateral have 1^{st} neuron synapse with the second neuron in substantia gelatinosa , while for the anterior will be in nucleus proprius

Spinotectal tract



Terminate in superior colliculus

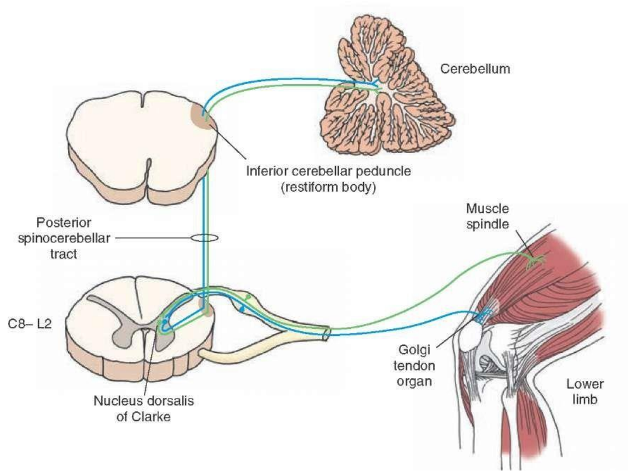
Ascends conralaterally in anterolateral white column

Synapsing of 1^{st} order neuron with 2^{nd} order neuron in spinal cord then cross the midline

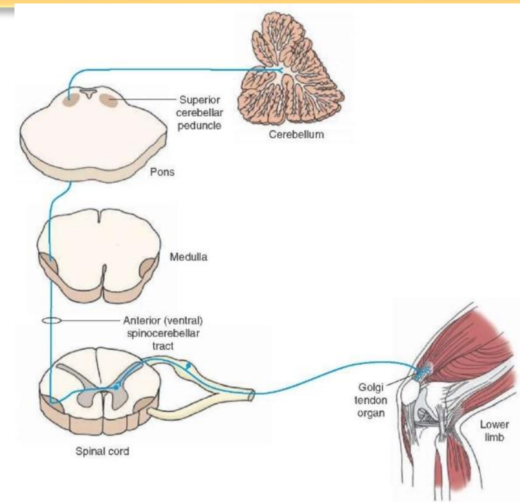
Posterior spinocerebellar tract

Ascends lateral white matter column on the same side

1 st order neuron axons terminate at the base of post gray column (nucleus dorsalis or Clarks nucleus in lamina 7)



Anterior spinocerebellar tract



Majority ascend as anterior spinocerebellar tract in the contralateral white column then they cross again at level of cerebullum , minority , s ascend as anterior spinocerebellar tract in the lateral white column of the same side

Pain

Types according to origin

Cutaneous pain: originates from the skin and is felt on it

Deep somatic pain: originates in a relatively large area representing the affected muscles, bones, joints & ligaments, dull diffuse

Intermittent claudication: a muscle pain which occurs during exercise classically in the calf muscles due to peripheral artery disease

Visceral pain: the origin for this type of pain is the internal organs, it's poorly localized & transmitted via C fibers (slow pain)

Occur due to : Distention , Ischemia , Spasm , Chemical damage

Referred pain

Referred pain is when the pain you feel in one part of your body is actually caused by pain or injury in another part of your body

convergence theory: Referred pain is presumed to occur because the information from multiple nociceptor afferents converges into individual spinothalamic tract neurons.

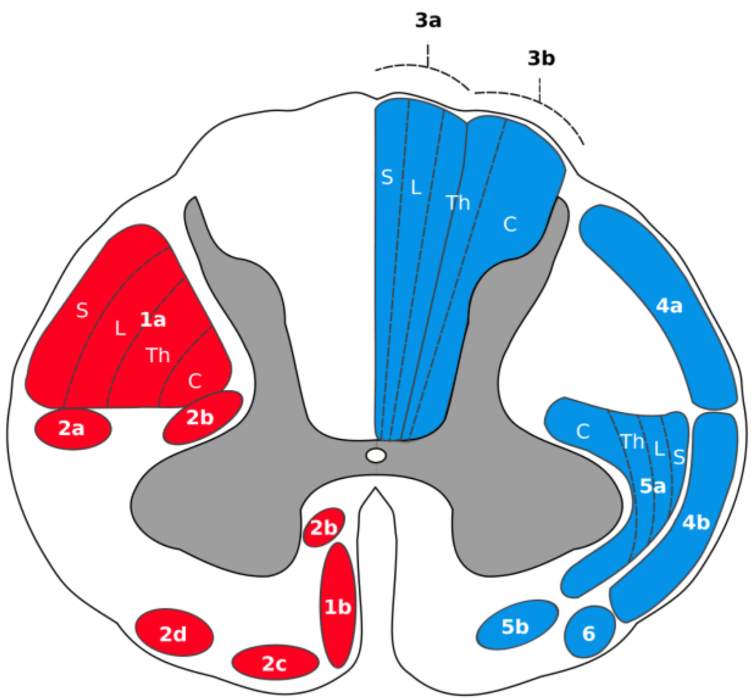
Control of pain

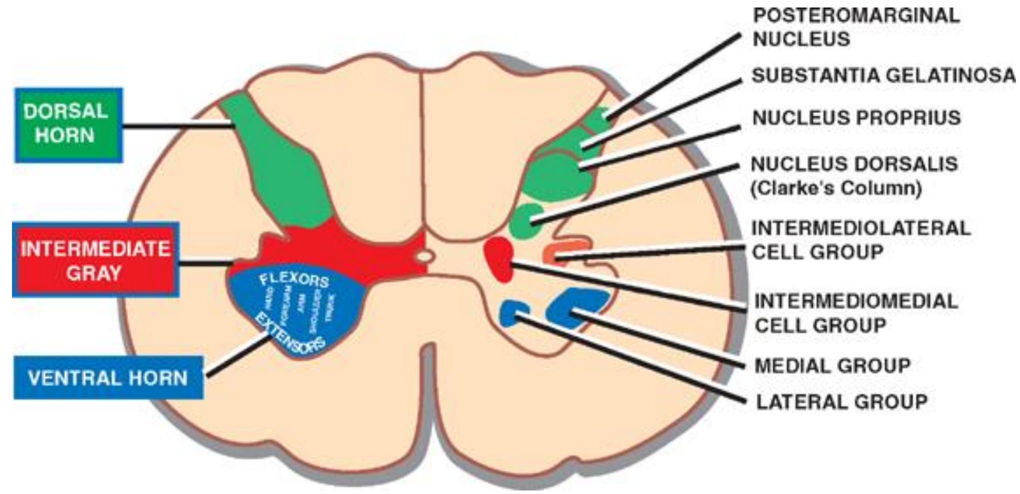
Gating theory: (inhibition of the pain by another mechanical stimulus). At the site where the pain fiber enters the central nervous system, inhibition could occur by means of connector neurons excited by large, myelinated afferent fibers carrying information of nonpainful touch and pressure.

Descending control (VIP):

• Spinoreticular fibers (coming from spinothalamic fiber (pain fiber)) stimulates periaqueductal gray in mid brain (PAG) • Excitatory neurons of PAG projects to Nucleus raphe magnus (NRM) • (NRM) neurons produces serotonin which activates inhibitory neurons that secretes enkephalins and the endorphins (morphine like actions) in substantia gelatinosa. This leads to termination of pain.

Note: Locus coeruleus (in Pons) is thought to directly inhibit substantia gelatinosa neurons





Motor and decending (efferent) pathways (left, red)

1. Pyramidal Tracts
1a. Lateral corticospinal tract
1b. Anterior corticospinal tract

2. Extrapyramidal Tracts
2a. Rubrospinal tract
2b. Reticulospinal tract
2c. Vestibulospinal tract
2d. Olivospinal tract

Somatotopy Abbreviations:
S: Sacral, **L: Lumbar**
Th: Thoracic, **C: Cervical**

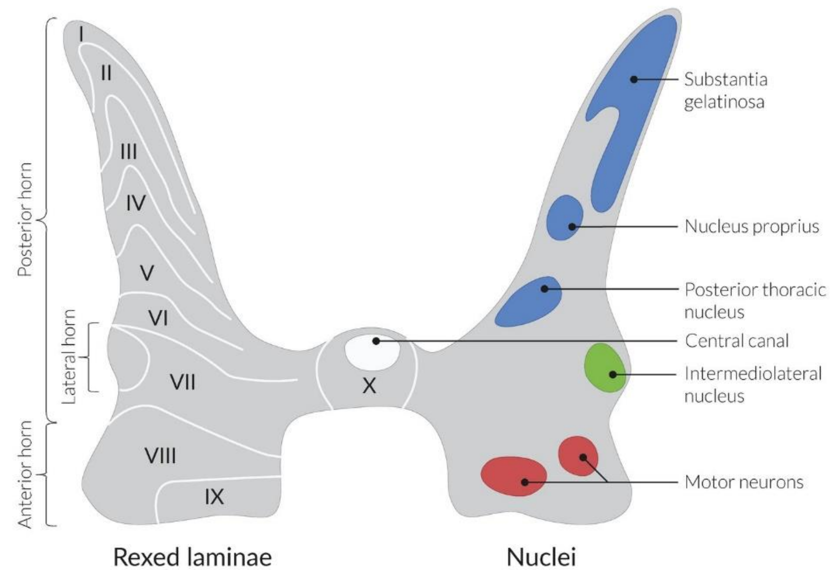
Sensory and ascending (afferent) pathways (right, blue)

3. Dorsal Column Medial Lemniscus System
3a. Gracile fasciculus
3b. Cuneate fasciculus

4. Spinocerebellar Tracts
4a. Posterior spinocerebellar tract
4b. Anterior spinocerebellar tract

5. Anterolateral System
5a. Lateral spinothalamic tract
5b. Anterior spinothalamic tract

6. Spino-olivary fibers



Descending motor tracts

Pyramidal tract

Both anterior and lateral corticospinal tracts start from the precentral gyrus of cerebral cortex, mainly area 4

To the brainstem (specifically; midbrain). Fibers will pass through middle 3/5th of the crus cerebr

In pones the fibers well scatter between the pontine nuclei in the anterior (basilar) part

medulla oblongata, and fibers will recollect again and form the anterior aspect of the medulla which is the pyramid

In the lower part of the medulla, fibers will split up: A. Majority of the fibers (85% approximately) will cross-over to the opposite side (primary motor decussation). These fibers are called lateral corticospinal tract. B. The rest (15%) descend ipsilaterally and are called anterior corticospinal tract

level of the spinal cord: A. The lateral corticospinal tracts descend in the lateral funiculus of the spinal cord to the lateral part of the anterior horn and then supply the lateral muscles. B. The anterior corticospinal tracts cross-over at the level of the spinal cord and go to the medial part of the anterior horn to supply the axial muscles

Corticonuclear Tract (Corticobulbar) , Fibers descend from the cortex (lower ¼) to a nucleus (motor nucleus)

The Midbrain: Oculomotor (3 rd cranial) & trochlear (4 th cranial).

- The Pons: trigeminal (5 th cranial).
- Ponto-medullary junction (between the pons and medulla): abducent (6 th cranial) & facial (7 th cranial).
- The Medulla: 9-12th cranial nerves

However, the corticonuclear tract input is neither ipsilateral nor contralateral, it's BILATERAL , But we have 2 exceptions to the bilateral corticonuclear input:Part of facial nerve (7 th cranial) which supplies the LOWER facial muscles. Part of the hypoglossal nerve (12th cranial) which supplies the genioglossus muscle. These exceptions are contralateral not bilateral (same as the spinal

Extra Pyramidal tract

Rubrospinal

refers to the red nucleus located in the midbrain at the level of superior colliculus

Red nucleus receives input from cerebral cortex and the cerebellum

Very early crossing (at the level of the nucleus

Its function is to facilitate the activity of flexors (excitatory) and inhibit the activity of extensors (inhibitory)

Reticulospinal

Pontine reticulospinal tract , to the anterior white column , The fibers stay uncrossed , This tract is tonically active, activate the axial and proximal limb extensors

Medullary reticulospinal tract , In the lateral white column , Some fibers cross and some do not cross, NOT tonically active , Inhibit the axial and proximal limb extensors

Vestibulospinal

From pons and medulla beneath the floor of 4th ventricle

receive afferent (sensory) fibers from: ➢ The inner ear, from the vestibule So, it's responsible for the sense of balance.

Input from deep cerebellar nucleus (Fastigial nuclei)

This tract descends uncrossed through the anterior white column

This tract descends uncrossed through the anterior white column

Tectospinal

From Tectum is the posterior aspect of the midbrain

It descends in the anterior white column close to anterior median fissure

Its function: The reflex movement of the head & neck in response to visual stimulus. (visuospinal reflex)

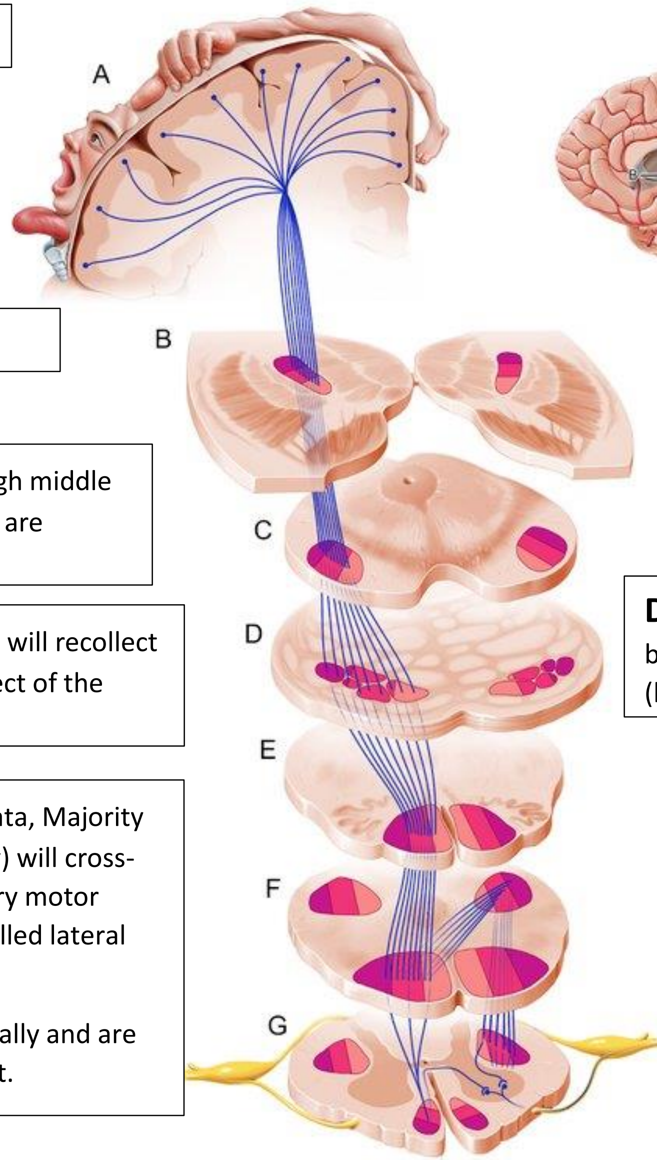
the majority of fibers of this tract terminate in the anterior gray column of upper cervical segments of spinal cord

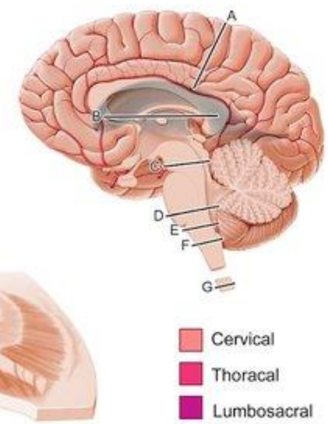
Corticospinal tracts

A : cortex , frontal lobe

B : internal capsule

C: midbrain , Fibers will pass through middle 3/5th (1/5th medial & 1/5th lateral are preserved) of the crus cerebr





D: pones , where the fibers well scatter between the pontine nuclei in the anterior (basilar) part

E: medulla oblongata, and fibers will recollect again and form the anterior aspect of the medulla which is the pyramid.

F: lower part of medulla oblongata, Majority of the fibers (85% approximately) will cross-over to the opposite side (primary motor decussation). These fibers are called lateral corticospinal tract.

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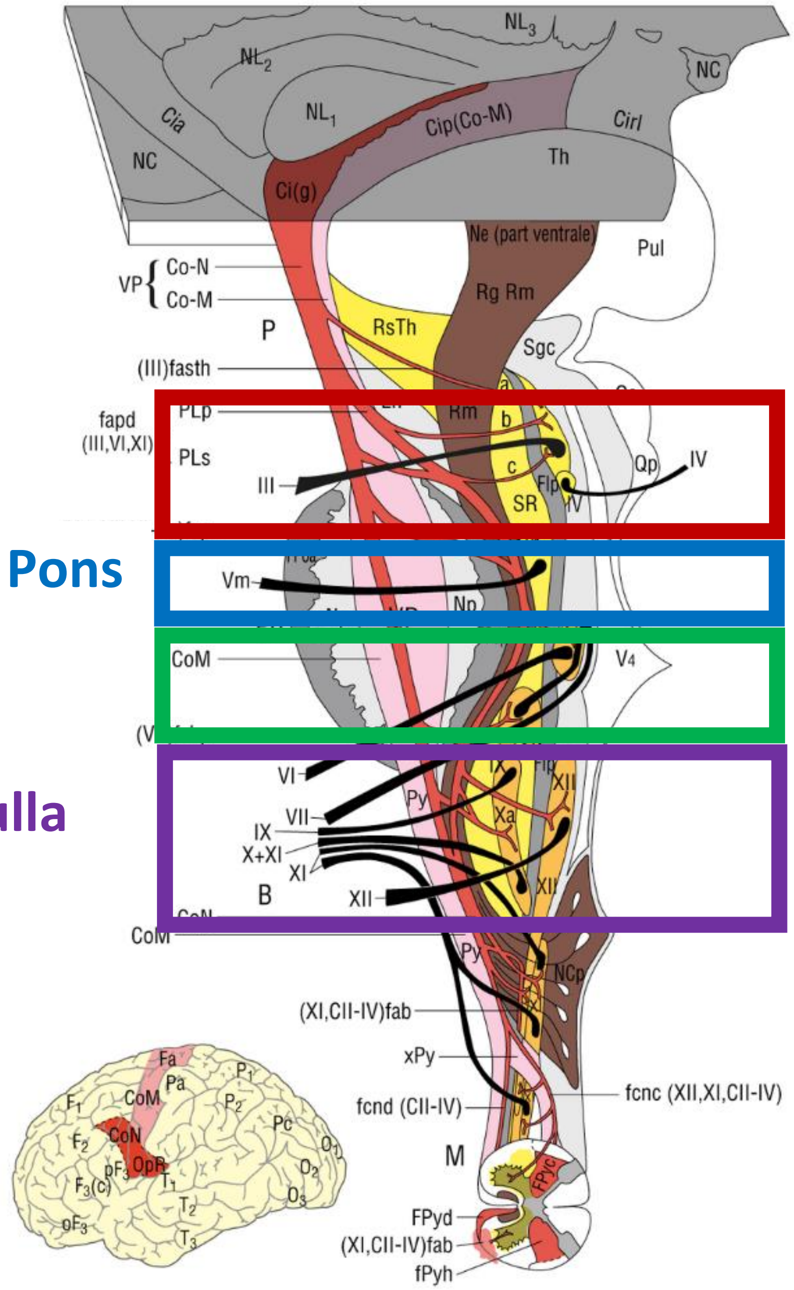
G: at the level of the spinal cord: A. The lateral corticospinal tracts descend in the lateral funiculus of the spinal cord to the lateral part of the anterior horn and then supply the lateral muscles.

The anterior corticospinal tracts cross-over at the level of the spinal cord and go to the medial part of the anterior horn to supply the axial muscles

Corticonuclear tracts



Midbrain

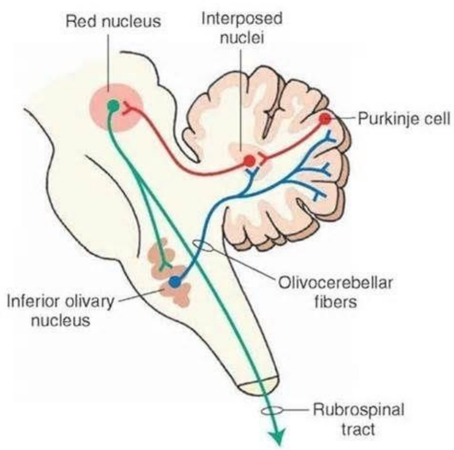
Pons

Ponto-medullary junction

Medulla

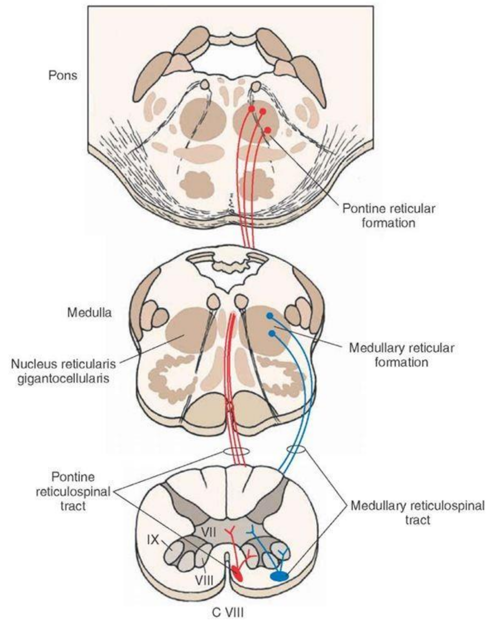
Extrapyramidal tracts

Rubrospinal tract



Anterior white column

Reticulospinal tract



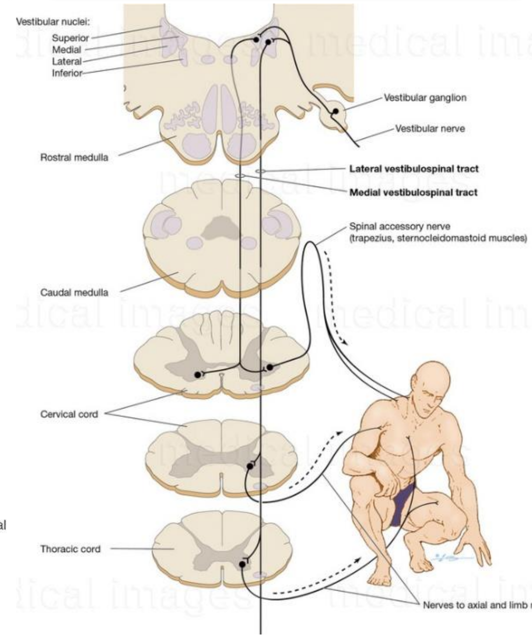
Pons

Anterior white column

Medullary

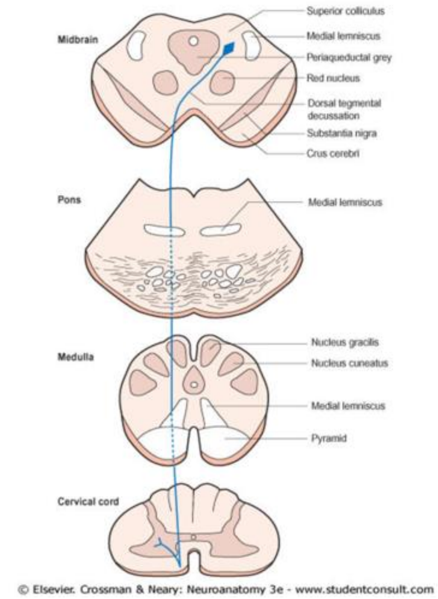
Lateral white column

Vestibulospinal tract



Anterior white column

Tectospinal tract



Anterior white column , next to median fissure

Lamina of motor tracts

Lamina 8

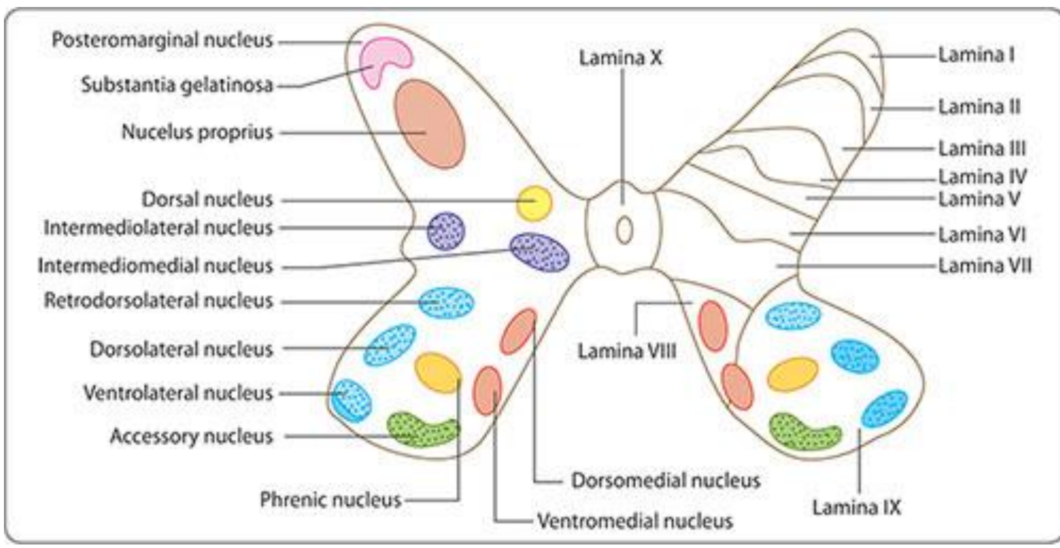
motor interneurons, Commissural nucleus

Lamina 9

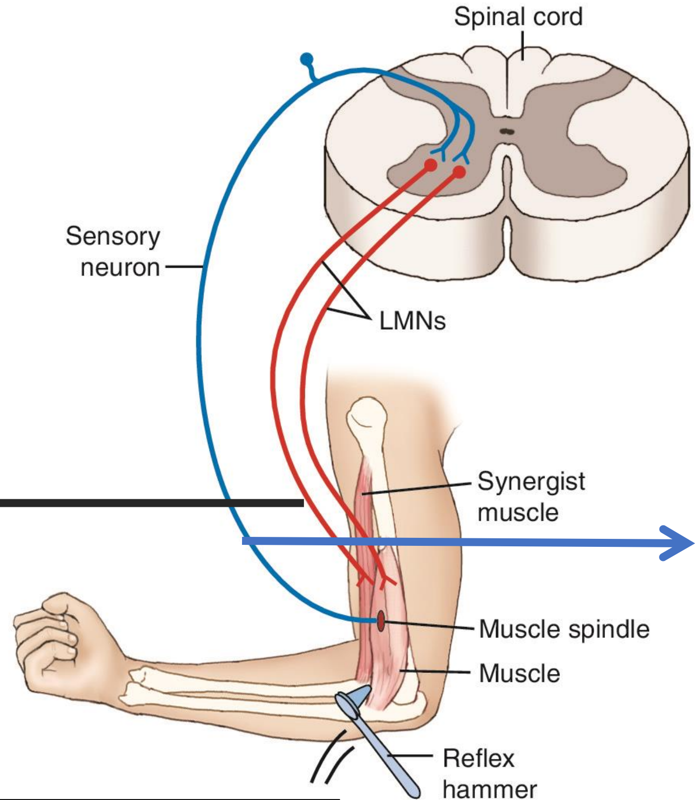
- **Ventromedia**: : all segments (extensors of vertebral column)
- **Dorsomedial**: T1-L2 (intercostals and abdominal muscles)
- **Ventrolatera**: C5-C8 (arm), L2-S2 (thigh)
- **Dorsolateral**: C5-C8 (Forearm), L3-S3 (Leg)
- **Reterodorsolate**: (In the enlargements) C8-T1 (Hand), S1-S2 (foot) → these are responsible for skilled movement
- **Central**: Phrenic nerve (C3-C5) → activates lower motor neuron that supplies the diaphragm

Lamina 10

Surrounds the central canal – the grey commissure. Its function is still not clear and controversia



Skeletal muscle innervation



Activation of **alpha motor neurons**:

Directly: from supraspinal centers, through the descending motor pathways (UMN).

Indirectly: through activated muscle spindles

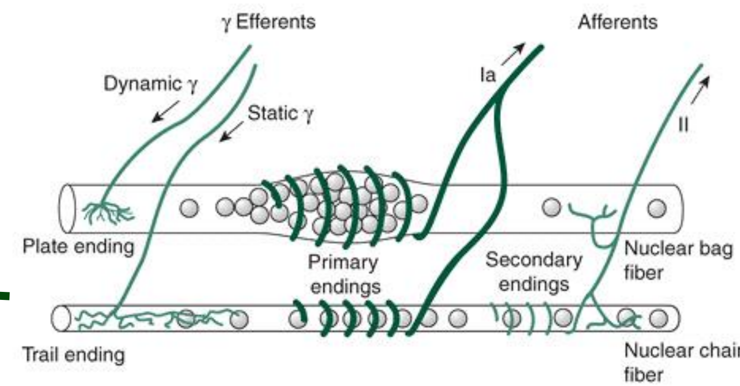
Stretch: Muscle spindle is sensitive to stretch which means that when the length of the muscle increases it gets activated then it will synapse directly with the lower motor neuron that goes to the same muscle then the muscle will contract and that to preserve muscle tone

Nuclear bag: the nuclei converge in the center like a bag, supplied by dynamic gamma fibers

Nuclear chain: the nuclei converge in the center like a chain, supplied by static gamma fibers

Primary afferent fibers: take sensation from both nuclear bag and chain , They have large diameter and high velocity (rapidly adapting) and is responsible for dynamic stretch reflex which happens in jerks

Secondary afferent fibers: take sensation from nuclear chain only , They have smaller diameter and lower velocity (slowly adapting) and is responsible for static stretch reflex which is important in muscle tone.



Motor lesions

	Upper motor neuron lesion	Lower motor neuron lesion
Bulk of muscles	**No wasting**	**Wasting of the affected muscles (atrophy)**
Tone of muscles	**Tone increases (Hypertonia) ,** result of an increase in gamma motor neurons activity	**Tone decreases (Hypotonia) ,** because you cut all innervation to the muscle
Power of muscles	**Paralysis affects movements of group of muscles Spastic/ clasp knife ,** muscle becomes hypertonic and has exaggerated reflexes	**Individual muscles is paralyzed Flaccid (flaccid paralysis) ‚due to hypotonia and hyporeflexia ,** because you cut all innervation to the muscle and muscles are relaxed
Reflexes	**Exaggerated (Hyperreflexia) ,** because usually, the effect of the cortex in general on the reflexes is inhibitory , result of an increase in gamma motor neurons activity	**diminished or absent (Hyporeflexia)**because you cut all innervation to the muscle
Fasciculation , alternating contracting and relaxation in the same muscle as the twitching of the eyelid	**Absent**	**Present**
Babinski sign , When a doctor stimulates the sole of the foot (specifically the lateral aspect) with a blunt object, the normal response is flexion of the toes But in cases of UMN lesions what occurs is the opposite	**Present**	**Absent**
Clasp-knife reaction , where the patient would have a flexed muscle and when the doctor tries to extend the arm of the patient initially there will be resistance but if he persists and applies enough force there will be “sudden release” and the arm will extend	**Present ,** Initial resistance: Exaggerated stretch reflex and Sudden release: Caused by activation of Golgi tendon reflex also called anti-stretch reflex, which resists excessive contraction in the muscle	**Absent**
Clonus , In testing for clonus the doctor would attempt to dorsiflex the foot and would face resistance (remember what we said above) and when he applies enough force clonus happens which is rhythmic contractions and relaxation of muscles when they are subjected to sudden sustained stretch caused by exaggerated reflexes	**Present**	**Absent**

Clinical applications

Decerebrate	Decorticate	lamination of the ascending tracts	Destruction of the LSTT	Destruction of the posterior column	Syringomyelia	Brown-Séquard Syndrome
if the lesion was lower than the level of red nuclus it's decerebrate in decerebrate, there is also complete rigidity and both the lower limbs and the upper limbs are extended Decerebrate posture (lesion below the red nucleus) the rubrospinal tract is part of the lateral motor system and is responsible for the flexion of muscles in upper limbs so if it is lost, there will be an extension of the upper and lower limbs decerebrate is worse because the lesion is closer to the vital	the lesion is higher than the red nucleus In decorticate there is rigidity in the entire body and the lower limbs are extended while upper limbs are flexed and rigid Decorticate posture (lesion above red nucleus so you affected\removed the cortex, from the name), remember what we said above about the pontine reticulospinal tract and that it is tonically active and removing the cortex causes more activation so its effect is more prominent and it causes activation of extensors in the leg and flexors in the arm (antigravity muscles)	Any external pressure exerted on the spinal cord in the region of the spinothalamic tracts will first experience a loss of pain and temperature sensations in the sacral dermatome of the body Intramedullary tumor: affect the cervical fibers (Medial) Extramedullary tumor would affect lower limb fibers (lateral) Sacral sparing: Occur at intramedullary tumor	Loss of pain and temperature sensation on the contralateral side (due to decussation which happens at the level of the spinal cord) below the level of the lesion	Loss of muscle-joint sense, position sense, vibration sense, and tactile discrimination ipsilaterally (because the decussation happens above at the level of the medulla oblongata, so the damage happened before the crossing over) below the level of the lesion	Cavitation of the central canal in the spinal cord (increase in size of the canal) could be due to any reason this will cause bilateral loss of pain and thermal sensations In some cases this cavitation extends to the anterior horns, causing muscle weakness and even paralysis sometimes, if the syrinx (cavity) extends to one anterior horn, this will cause an ipsilateral weakness if both anterior horns are involved, the weakness will be bilateral	Functional hemisection of the spinal cord (damage that involved half the spinal cord), this will cause damage to the corticospinal tract, ALS, posterior columns Contralateral loss of nociceptive and thermal sensations over the body below the level of the lesion. Ipsilateral loss of discriminative tactile, vibratory, and position sense over the body below the level of the lesion. Ipsilateral paralysis or weakness (hemiparesis, hemiplegia)

Arterial blood supply of spinal cord

Segmental arteries

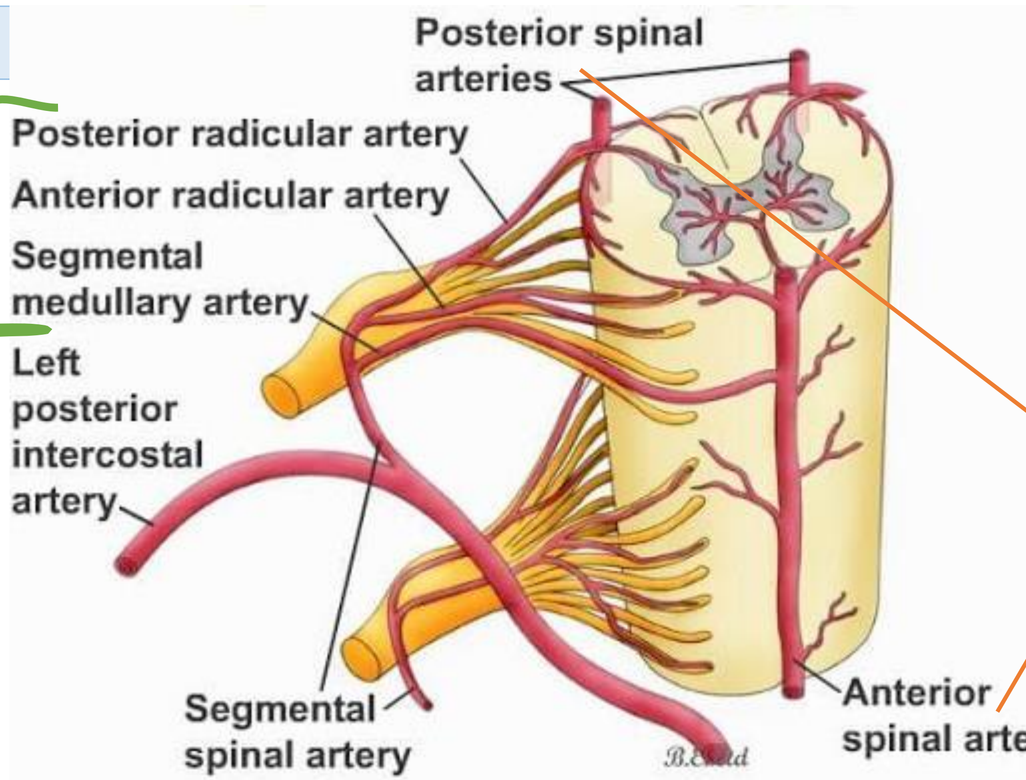
centers (CVS & RS)
so prognosis is worse

enter intervertebral foramen, arise from: - Vertebral arteries and deep cervical arteries (in the neck)

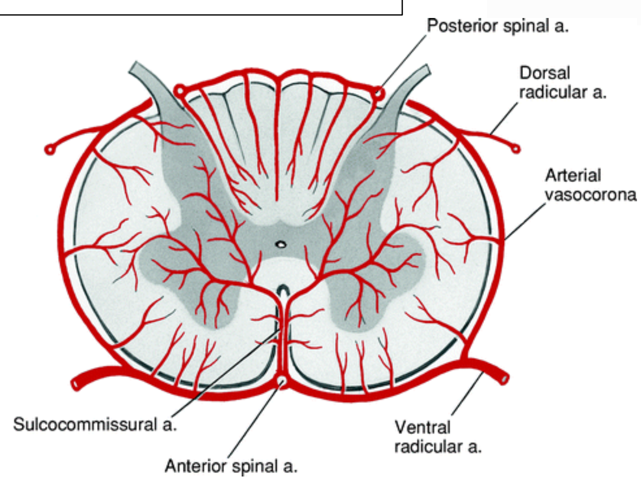
- Posterior intercostal arteries (in the thorax).

- lumbar arteries (in the abdomen)

Posterior radicular artery (runs with posterior "dorsal" root to reach spinal cord). Anterior radicular artery (runs with anterior "ventral" root to reach spinal cord). Segmental medullary artery (anastomose with anterior spinal artery



Longitudinal arteries



Posterior spinal arteries and arterial vasocorona: the posterior columns and peripheral parts of the lateral and anterior funiculi

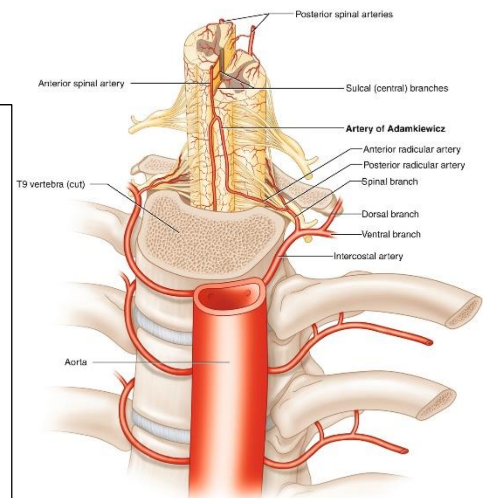
Anterior spinal artery: Most of the gray matter and the adjacent parts of the white matter

H

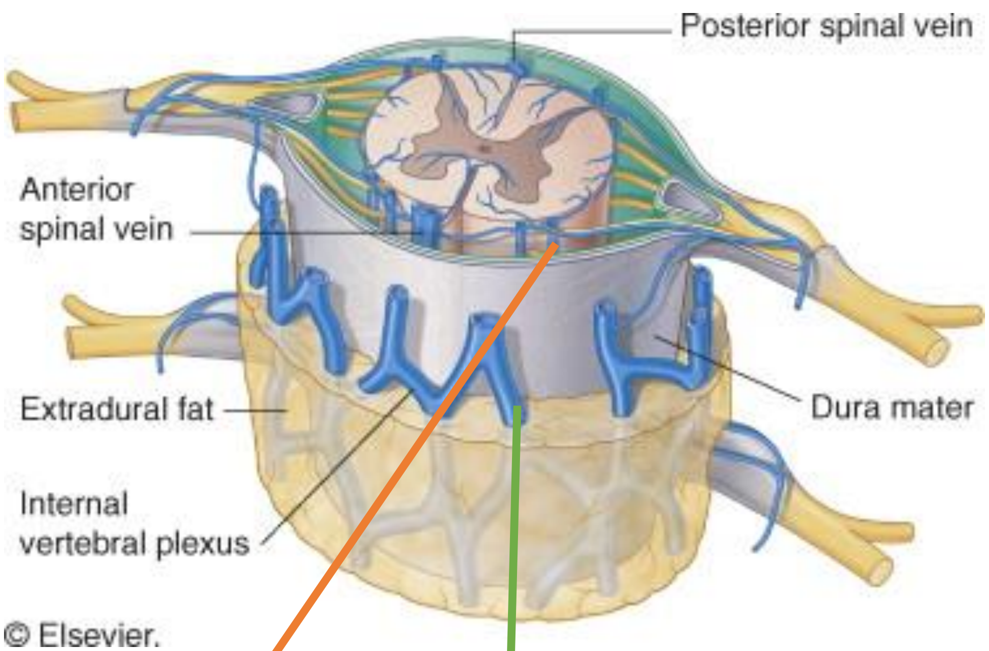
usually on the left side, from the left posterior intercostal artery at the level of the 9th to 12th intercostal artery, which braches from the aorta and supplies the lower two third of the spinal cord

This will reinforce the arterial supply to the lower portion of the spinal cord (far from circle of Willis)

- Anastomose with anterior spinal artery



Venous drainage of spinal cord



Two pairs of pairs on each side

Those veins will drain into an extensive internal vertebral plexus in the extradural (epidural) space of the vertebral canal, then drains into segmentally arranged vessels that connect with major systemic veins like azygos system in the thorax or intracranial veins.

Central cord syndrome

occlusion in **the blood supply of the anterior spinal artery**, which often occur in the case of neck hyperextension.

This results in bilateral weakness in extremities, more in upper than lower extremities

Also, its characterized by bilateral pain and thermal sensation loss, bladder dysfunction

Why Bilateral weakness? Because remember that we have one anterior spinal artery that supply both right and left side.

Why upper extremities are affected more than lower? Because the origin of the anterior spinal artery is from the vertebral artery, so its blood supply is coming from above so its affected more, furthermore the lower extremities receive blood supply from other sources (like Artery of Adamkiewicz)

Compromise **of blood flow in the posterior spinal artery** results in: Ipsilateral reduction or loss of discriminative, positional, and vibratory tactile sensations at and below the segmental level of the injury

Lateral leminiscus cant be seen at this level , its route is toward inferior colliculus

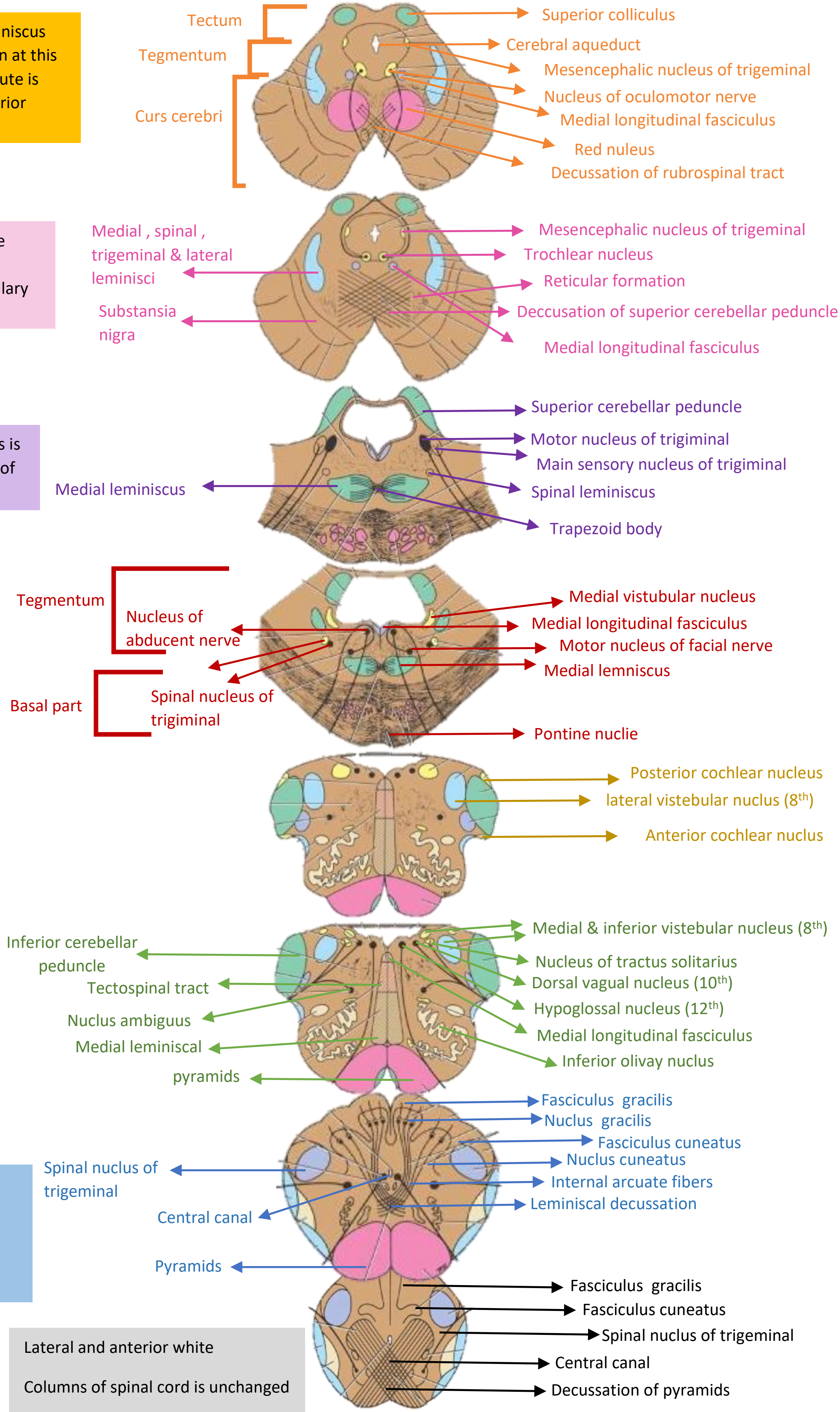
Trochlear nerve decussate in superior medullary velum

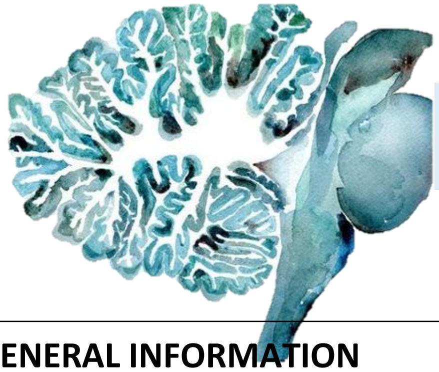
Lateral leminiscus is lateral extremity of medial one

spinal lemniscus lateral to the decussation of the lemnisci , The spinocerebellar vestibulospinal, and the rubrospinal tracts (anterolateral)

Lateral and anterior white

Columns of spinal cord is unchanged





Brain Stem

GENERAL INFORMATION

The brainstem also has vital centers in reticular formation in the core.

Pons is a bridge connect the cerebrum and cerebellum (it is not a bridge a between medulla oblongata and midbrain).

MEDULLA OBLONGATA

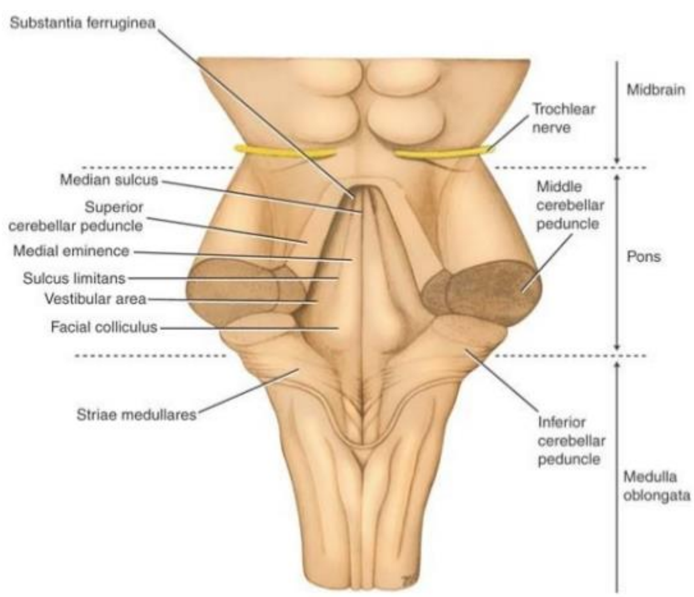
The medulla oblongata is divided into 2 halves: Lower half is called closed medulla because it has a small cavity called central canal (the same as the central canal of the spinal cord) and upper half is called opened medulla because it has a large cavity called 4th ventricle

PONS

In the 4 th ventricle floor (rhomboid fossa), the midline is made by a sulcus known as the median sulcus. Lateral to the midline, another sulcus can be seen, which is called the sulcus limitans. Between the median sulcus and the sulcus limitans is the median eminence, which forms the facial colliculus inferiorly.

• Vestibular area (lateral to sulcus limitans and superior to the facial colliculus) is related to underlying structure which is vestibular nuclei.

• Facial colliculus (inferior end of medial eminence) is related to facial nerves (not nuclei)



MIDBRAIN

It lies between the diencephalon and the pons. There are 2 peduncles called cerebral peduncles (NOT cerebellar). Between the two cerebral peduncles there is the interpeduncular fossa

The cavity of the midbrain is known as the cerebral aqueduct , Posterior to the cerebral aqueduct is the tectum. The tectum consists of 4 colliculi, 2 superior colliculi and 2 inferior colliculi (seen at posterior view)

Anterior to the cerebral aqueduct is collectively known as the cerebral peduncle, The cerebral peduncle is divided by the substantia nigra to crus cerebri (anterior) and tegmentum (between cerebral aqueduct and substantia nigra)

Superior brachium (connects the superior colliculus with the lateral geniculate body. (connecting the visual with visual) , Inferior brachium connects the inferior colliculus with the medial geniculate body.

Substania Nigra

Posterior to the crus cerebri is the susbtantia nigra, which separates it from the tegmentum. It is darkly stained due to the presence of dopaminergic neurons & the high levels of melanin. Anatomically, it is part of the midbrain. However, it is part of the basal nuclei functionally

The function of the substantia nigra is to initiate the movement (muscle tone). Degeneration of the substantia nigra will cause difficulty in initiating movements and is known as Parkinson's disease. Symptoms of Parkinson's disease include tremor and bradykinesia (difficulty in initiating movement) or even akinesia (inability to initiate movement)

Red Nuleus

It is the biggest nucleus in the reticular formation and round mass of gray matter.

The red nucleus named so because of its high vascularity and iron containing pigment)

When you focus on the GOOD

Then the GOOD become BETTER

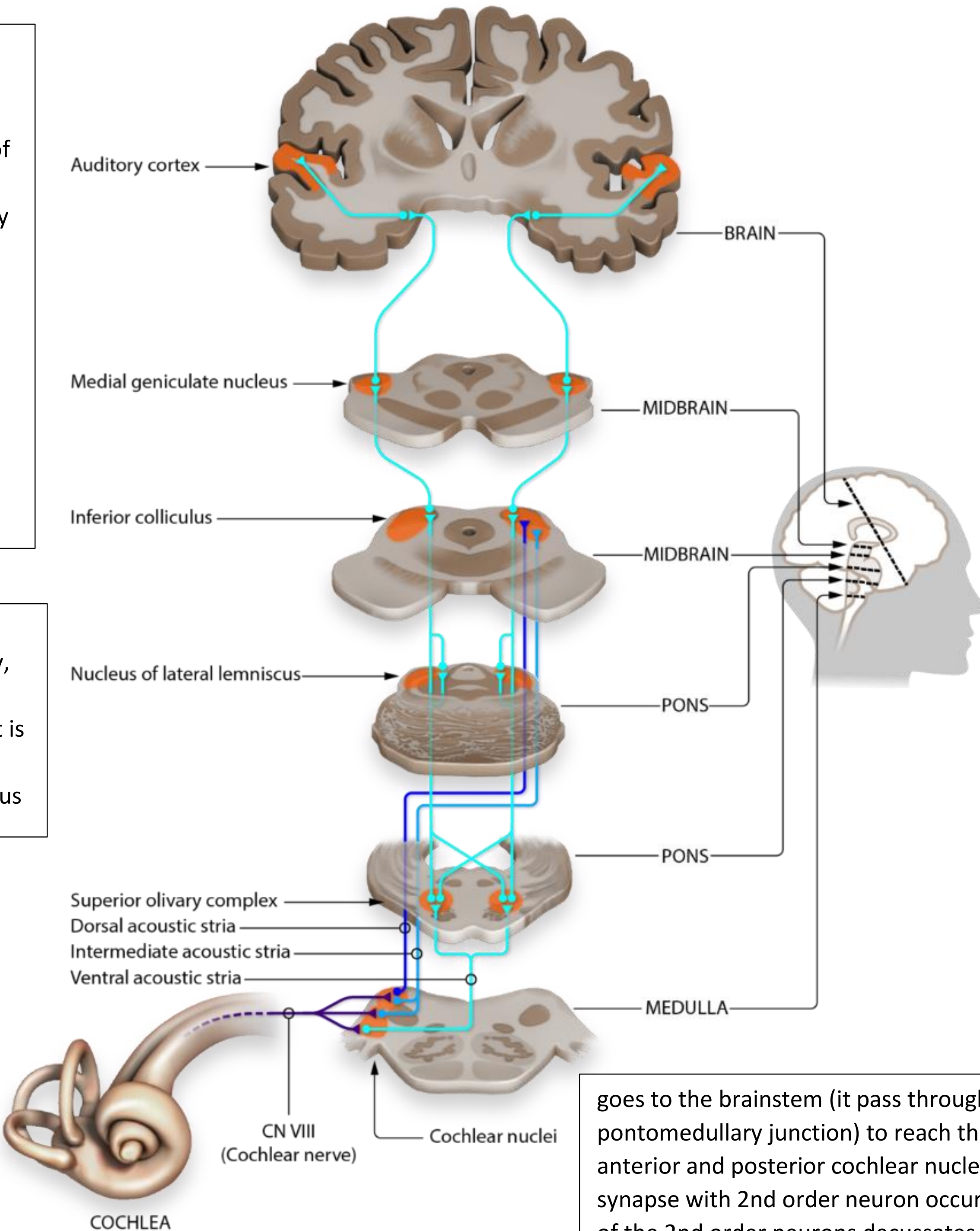
And you will see it developed to

THE BEST

Acoustic Pathway

These fibers will reach the inferior colliculus (In posterior aspect of midbrain/part of tectum), then they will go to the medial geniculate body within the thalamus, and finally they will project to the auditory part of cortex (temporal lobe)

From the trapezoid body, these fibers ascend in what is known as the lateral lemniscus



The acoustic pathway starts from the cochlea in inner ear, from which the cochlear nerve (part of vestibulocochlear nerve) which has its cell body in the spiral ganglion of cochlea

goes to the brainstem (it pass through pontomedullary junction) to reach the anterior and posterior cochlear nucle Where synapse with 2nd order neuron occurs , Most of the 2nd order neurons decussates at the midline (contralateral) (some stay ipsilateral) These fibers that cross the midline are known as the trapezoid body

Cranial Nerves

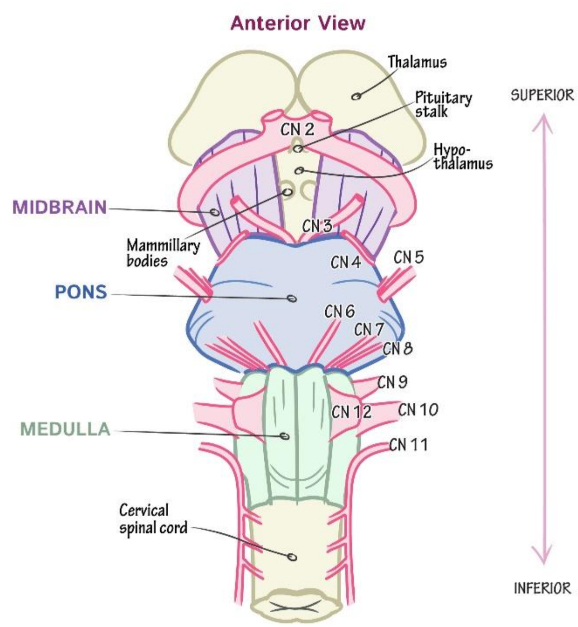
Origins of Cranial nerves (except CN1 & CN2):

The midbrain gives rise to CN3 & CN4

The mid-pontine area of the pons gives rise to CN5

The pontomedullary junction of the pons gives rise to CN6, CN7, CN8

The medulla oblongata gives rise to CN9, CN10, CN11, CN12



The trochlear nerve (CN4) is the only nerve that arises from the posterior aspect of the brainstem (midbrain)

The hypoglossal nerve is the only nerve that arises from the groove found between the olive and the pyramid (anterolateral groove). Whereas the glossopharyngeal (CN9), Vagus (CN10), and Accessory (CN11) all arise from the groove between the inferior cerebellar peduncle and the olive (posterolateral groove)

Never let your

Fear

decide your

Fate

Cranial Nerves

Nerve	Course	Function	Nuclei
Oculomotor nerve (CN3)	The motor and parasympathetic fibers from the two nuclei will pass through red nucleus without synapse. From the red nucleus, they then pass via the substantia nigra exiting through the interpeduncular fossa. Then they enter the middle cranial fossa in the lateral wall of the cavernous sinus.The nerve leaves the cranial cavity and enters the orbital cavity via the superior orbital fissure between the greater and lesser wing of sphenoid. Once there, it divides into two branches: superior and inferior rami, which supply most of the extraocular muscles ,the parasympathetic fibers(preganglionic) pass through inferior ramus and synapse in the ciliary ganglion. They will come out as postganglionic fibers through short ciliary nerve which eventually will innervate the intrinsic muscles of the eye	The oculomotor nerve supplies extrinsic muscles such as the levator palpebrae superioris, superior rectus, medial rectus, inferior rectus, and inferior oblique (all eyeball muscles except the lateral rectus and superior oblique). It also supplies intrinsic muscles such as the constrictor pupillae of the iris and ciliary muscles The action of the muscles supplied by the oculomotor nerve is lifting the upper eyelid, turning the eye upward, downward, and medially, constricting the pupil, and accommodating the eye	at level of superior colliculus of midbrain main motor nucleus , posteriolateral to it accessory parasympathetic nucleus of oculomotor nerve (the Edinger-Westphal nucleus) bilaterally fibers receiving
Trochlear Nerve (CN4)	Nerve Course: Fibers go posteriorly around the cerebral aqueduct and mesencephalic nucleus and then they emerge from the posterior aspect of the midbrain. The fibers then turn around crus cerebri and move along the lateral wall of the cavernous sinus (along with the oculomotor nerve) entering the orbit of the eye via the superior orbital fissure to innervate the superior oblique muscle	The superior oblique muscle : depression of the eyeball and lateral rotation of eyeball.	It has one nucleus (motor nucleus), it receives inputs from both cortex: Bilateral. - Location of the nucleus: it is found anterior to the cerebral aqueduct, at the level of the inferior colliculi in the midbrain
Abducent nerve (CN6)	The abducent nerve leaves the brainstem anteriorly at the pontomedullary junction medial to the facial nerve. It then enters the cavernous sinus below and lateral to the internal carotid artery. From there it enters the orbit through the superior orbital fissure and innervates the lateral rectus muscle of the eye	lateral rectus muscle of the eye that turns the eye laterally	- Has one motor nucleus found underneath the floor of fourth ventricle, at the level of the facial colliculus (caudal part) of the pons. It receives inputs from both cortex (bilateral).

Trigeminal Nerve (CN5)	The trigeminal nerve originates from three sensory nuclei and one motor at the level of the pons anteriorly. The sensory nuclei merge to form a sensory root. The motor nucleus continuesto form a motorroot(motor runsinferior tosensory). In the middle cranial fossa they expand into the trigeminal ganglion. Trigeminal ganglion is located lateral to the cavernous sinus, in the upper surface of the apex of the petrous bone in a depression called Meckel's cave (which is a pouch in the dura mater) The divisions of this nerve will go out through: – Ophthalmic: through superior orbital fissure. – Maxillary: through foramen rotundumto pterygopalatine fossa. – Mandibular: through foramen ovale to infratemporal fossa.	Receives sensations from all the face except the angle of the mandible which is supplied by great auricular nerve,+ receives sensations from the oral cavity, nasal cavity, paranasal sinuses Forthe mandibular division ONLY. It supplies: 1- Muscles of mastication (masseter, temporalis, medial pterygoid, and lateral pterygoid) 2- Tensor tympani 3- Tensor veli palatini 4- Mylohyoid 5- Anterior belly of thedigastric muscle.	Motor nucleus: Posterior part of the pons (Medial) at level of trigeminal nuclei of pons Main sensory nucleus: Posterior part of the pons (lateral) at level of trigeminal nuclei of pons , Discriminative and light touch of the face as well as conscious proprioception. (similar to PCML) Spinal nucleus: ends at midpontine area m Inferiorly start from C2 segment , Crude touch, pain, and temperature (similar to ALS) Mesencephalic nucleus: - Lateral part of the gray matter around the cerebral aqueduct. - Inferiorly main sensory nucleus Reflex proprioception of the periodontal ligament and of the muscles of mastication in the jaw.
Facial nerve (CN7)	The nerve emerges from the pontomedullary junction (remember sensory fibers go towards the brain while motor away from the brain), then enters the internal acoustic meatus in the petrous part of temporal bone and passes through the facial canal first behind the medial wall of the cavity of the middle ear (tympanic cavity) where it curves and forms the geniculate ganglion (knee), then it continues in the posterior wall of the tympanic cavity to finally emerge from the stylomastoid foramen. It gives two branches in the tympanic cavity: 1. Chorda tympani: It leaves the middle ear through the petrotympanic fissure and enters the infratemporal fossa, then attaches to the lingual nerve, it carries two types of fibers, preganglionic parasympathetic from the salivatory lacrimatory nucleus (submandibular ganglia), and taste fibers from the anterior two thirds of the tongue. 2. Greater petrosal: Emerges from the geniculate ganglion, then passes through the middle ear to enter the middle cranial fossa through the greater	Main motor nucleus is found in the deep reticular formation of the lower part of the pons (level of facial colliculus) The upper part of the face receives upper motor neurons from both hemispheres. The lower part only receives upper motor neurons from the contralateral hemisphere Sensory nucleus: • Taste of the anterior two thirds of the tongue: The cell bodies of the first order neurons are in the geniculate ganglia (from chorda tympani), and they synapse with the second order neurons in the nucleus of tractus solitarius, from there it ascends to the VPM nucleus of the thalamus then radiates to the primary gustatory cortex (area 43) in the parietal lobe. • General sensation from the skin of the external acoustic meatus is carried with the facial nerve (geniculate ganglion) into the spinal trigeminal nucleus	

	petrosal foramen, afterwards it passes over foramen lacerum and joins the deep petrosal nerve (sympathetic fibers from the superior cervical ganglia) to form the nerve to pterygoid canal, which passes through the pterygoid canal to reach the pterygopalatine fossa	
Glossopharyngeal nerve (CN9)	1. The glossopharyngeal nerve emerges from the groove between the olive and the inferior cerebellar peduncle. 2. Descends from jugular foramen to leave the skull and there it forms two ganglia (superior and inferior) 3. At the level of the inferior ganglia, it gives a branch called tympanic branch (preganglionic parasympathetic fibers) 4. It enters through the tympanic canaliculus to reach the tympanic cavity where it joins the tympanic plexus near the tympanic membrane (that's a lot of tympanic I know 5. It leaves the tympanic cavity as the lesser petrosal nerve through the lesser petrosal hiatus to reach the middle cranial fossa. 6. From the middle cranial fossa, it descends through foramen ovale to the infratemporal fossa and synapses in the otic ganglia which is suspended by the mandibular nerve, and through the auriculotemporal it reaches the parotid gland	Motor nucleus, deep in the reticular formation of the medulla, arises from the superior end of nucleus ambiguus, and only supplies the stylopharyngeus muscle. 2. Parasympathetic nucleus (inferior salivatory nucleus), posterior to nucleus ambiguus, receives from the hypothalamus (all autonomic from the hypothalamus) and passes to the otic ganglia (supplies the parotid gland). 3. Sensory nucleus (general, taste, and visceral sensation): • Taste from posterior third of the tongue: cell bodies of the first order neurons are in the inferior ganglia (special and visceral sensory), then it synapses with the second order neurons in nucleus tractus solitarius, and from there it ascends to synapse in the VPM of the thalamus to reach primary gustatory cortex. • Visceral sensation comes from the carotid sinus (baroreceptor). The glossopharyngeal passes between the internal and external carotid in the neck, and there it carries the visceral sensation from the carotid sinus. Cell bodies of the first order neurons are in the inferior ganglia, then they synapse in the nucleus tractus solitarius which is connected to the dorsal nucleus of the vagus nerve (parasympathetic of the vagus) which induces the carotid sinus reflex that reduces the blood pressure. • General sensation from the skin of auditory meatus, middle ear, auditory tube, pharynx except the nasopharynx (maxillary), and posterior 1/3 of the tongue (common sensation), the cell bodies are in the superior ganglion, and then it goes to the spinal nucleus of trigeminal (it carries general sensation from many cranial nerves but primarily from the trigeminal).
Vagus nerve (CN10)	Course not required; just remember that it can reach the abdomen	1. Motor nucleus (lower part of nucleus ambiguous). Supplies the constrictor muscles of the pharynx and the muscles of the larynx. 2. Dorsal nucleus of Vagus (parasympathetic), anterior to the floor of the lower part of the fourth ventricle, it receives afferents from the hypothalamus and glossopharyngeal nerve (carotid sinus reflex). Efferent to involuntary muscles of the bronchi, heart, esophagus, stomach, small intestines, and large intestines as far as the distal one-third of the transverse colon. 3. Sensory nucleus:

		• Taste from the epiglottis: carried to the lower part of nucleus tractus solitarius, cell bodies of the first order neurons in the inferior ganglia (don’t confuse it with the inferior ganglion of the glossopharyngeal, both have superior and inferior ganglia). • General sensation: cell bodies of the first order neurons in the superior ganglia, then to the spinal nucleus of trigeminal. carries sensation from the outer ear, mucosa of the larynx, and the dura of posterior cranial fossa	
Accessory nerve (CN11)	The spinal root ascends to the cranial cavity though foramen magnum to join the cranial root, they then move together (fibers of the two roots don’t mix) and leave through the jugular foramen. They separate once more and the cranial root joins the vagus nerve and courses along with it, while the spinal descends by itself and supplies the trapezius and sternocleidomastoid. *The soft palate is thought to be supplied by the cranial root		Motor and has two roots: cranial and spinal. 1. Cranial root from nucleus ambiguous. 2. Spinal root originates from the spinal cord (lamina IX from the upper 5 cervical segments)
Hypoglossal nerve (CN12)	Emerges between the olive and the pyramid (the other medullary cranial nerves emerge between the inferior cerebellar peduncle and the olive). • Leaves the skull through the hypoglossal canal. • Courses between the internal carotid artery and the internal jugular vein to eventually reach the tongue, during its course it attaches to the C1 spinal nerve but doesn’t mix with it.	Supplies all the muscles of the tongue except palatoglossus (from the vagus).	Has one motor nucleus, Beneath the floor of the lower part of the fourth ventricle (at level of olive in medulla oblongata) Cells responsible for supplying the genioglossus muscle receive from the opposite cerebral hemisphere (not bilateral)

Cranial Nerves Injuries

Nerve	Lesions
Oculomotor nerve (CN3)	**Complete lesion** of oculomotor nerve: Complete cut of the oculomotor nerve. All of the muscles are paralyzed except lateral rectus and superior oblique. , Symptoms: External strabismus , Diplopia , Ptosis, Mydriasis , Paralyzed accommodation **Incomplete lesions**: 1) Internal ophthalmoplegia: Loss of the autonomic innervation of the sphincter pupillae and ciliary muscle. Symptoms: the pupil will be widely dilated and nonreactive to light , 2) Incomplete lesions: ϖ Internal ophthalmoplegia: Loss of the autonomic innervation of the sphincter pupillae and ciliary muscle. Symptoms : the pupil will be widely dilated and nonreactive to light only
Trochlear Nerve (CN4)	symptoms: 1- Diplopia 2- Difficulty in turning the eye downward and laterally. So, at rest the patient eye will go upward & medially. 3- Difficulty in descending stairs
Abducent nerve (CN6)	symptoms: 1- Diplopia. 2- Internal strabismus
Facial nerve (CN7)	Location of the lesion 1. In the pons: Abducens and facial not working. 2. Internal acoustic meatus: Vestibulocochlear and facial 3. Chorda tympani: Loss of taste over the anterior two thirds of the tongue Order of the neuron affected: 1. Lower motor neuron lesion -> ipsilateral half paralysis 2. Upper motor neuron lesion -> contralateral lower part paralysis Bell's palsy: Usually unilateral, lower motor neuron paralysis, the cause is still not known.
Glossopharyngeal nerve (CN9)	Loss of the gag reflex (normally induces vomiting) Loss of the carotid sinus reflex Loss of taste from the posterior third of the tongue
Vagus nerve (CN10)	Uvula deviates to the healthy side. , Hoarseness of voice (paralysis in the muscles of the larynx) , Dysphagia and nasal regurgitation (paralysis in the muscles of the pharynx) , Arrhythmia in heart and irregularity in GI tract because (parasympathetic dysfunction)
Hypoglossal nerve (CN12)	Lower motor neuron lesion: Tongue deviates toward the paralyzed side during protrusion with muscle atrophy (ipsilateral) Upper motor neuron lesion: On protrusion, tongue will deviate to the side opposite the lesion (genioglossus paralysis) with no atrophy.

Blood supply of the brain stem

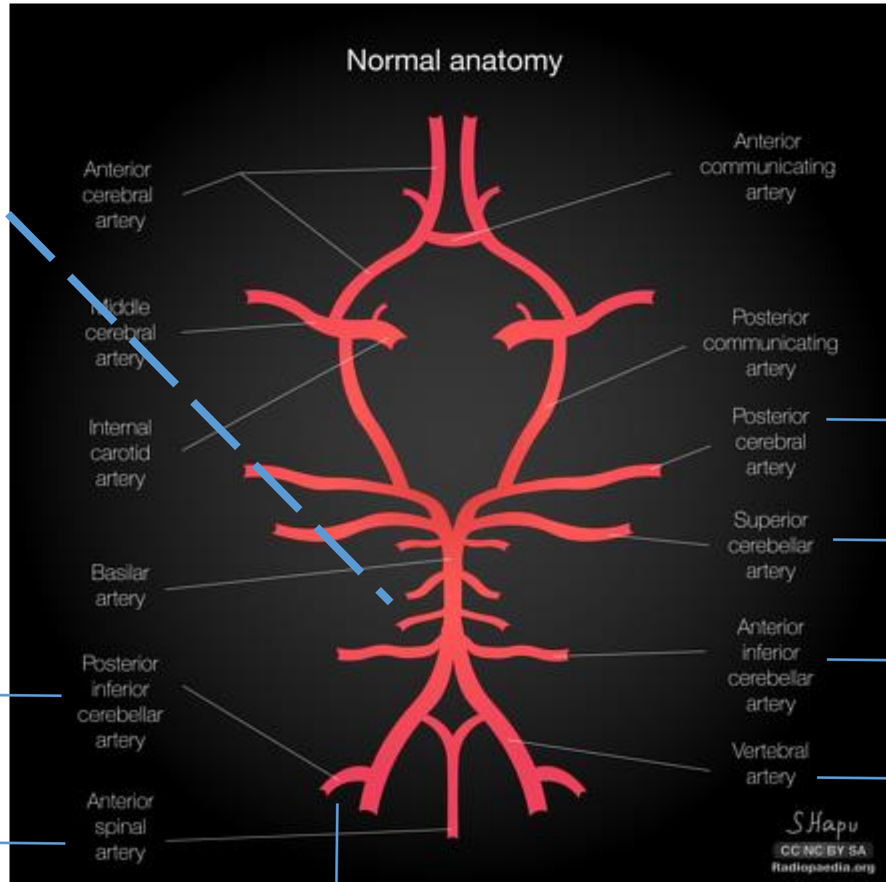
Pontine arteries

Paramedian : give structures close to midline in pons , The parts closer to the midline of midbrain

, Circumferential : give structures lateral & posterior in pons , Anterolateral parts of midbrain are supplied by circumferential branch of the quadrigeminal and posterior choroidal arteries

medial posterior choroidal arteries will give posteriolateral parts of midbrain

posterior part of midbrain from quadrigeminal



Posterior cerebral artery: Thalamogeniculate , the most lateral part of upper levels of midbrain

Superior cerebellar artery: Supply superior surface of cerebellum & pons , posterior parts of midbrain

Anterior inferior cerebellar artery: Supply Inferior surface of cerebellum , also contribute to lateral part of pons

Vertebral artery: Supply anterior lateral parts of medulla

Posterior inferior cerebellar artery: Supply posterior lateral parts of medulla

Anterior spinal artery: Supply anterior medial parts of medulla

Posterior spinal artery

Supply posterior parts of closed medulla

Blood supply of the brain stem

Subclavian

↓

Vertebral

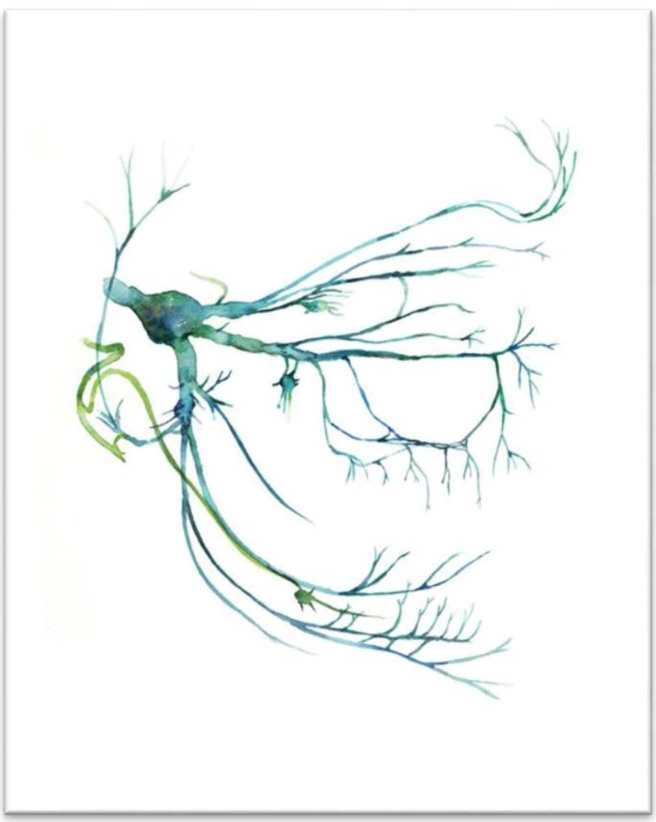
- ← Anterior spinal artery
- → Posterior inferior cerebellar artery → Posterior spinal artery

Two vertebral through foramen magnum unit to form

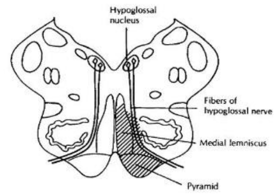
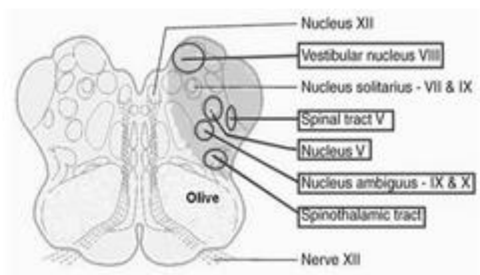
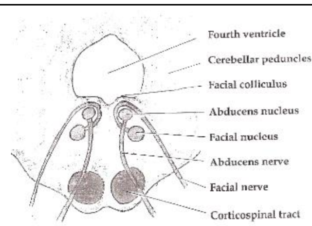
↓

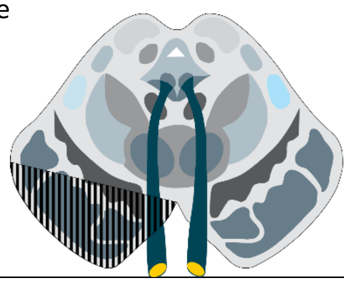
Basilar

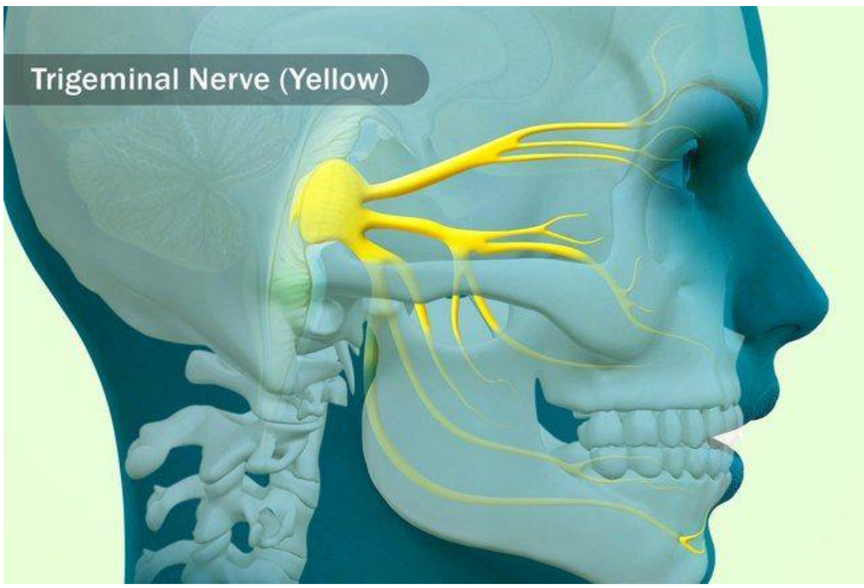
- Anterior inferior cerebellar artery
- Pontine arteries
- Superior cerebellar artery
- Posterior cerebral artery



Can you complete it with your imagination ?

Medulla		
Medial medullary syndrome (Dejerine syndrome)	It is caused by a lesion in anterior spinal artery which supplies the area close to the midline 	• Contralateral hemiparesis (pyramids (corticospinal tracts)) \ no decussation • Contralateral loss of proprioception, fine touch and vibratory sense due to damage to the medial lemniscus \ decussation • Deviation of the tongue to the ipsilateral (hypoglossal root or nucleus injury)
Lateral medullary syndrome (Wallenberg syndrome)	It is caused by a lesion in PICA which supplies the area close to lateral areas 	- contralateral loss of pain and temperature sensation from the body (anterolateral system) \ decussation - ipsilateral loss of pain and temperature sensation from the face (involvement of spinal trigeminal tract and nucleus) - Nystagmus is irregular movements of the eyeballs (the vestibular nucleus) - loss of taste from the ipsilateral half of the tongue (solitary tract and nucleus) - hoarseness and dysphagia (nucleus ambiguus or roots of cranial nerves IX and X) - Ipsilateral Horner syndrome (hypothalamospinal fibers)
Vascular lesions of the posterior spinal artery		- ipsilateral loss of proprioception and vibratory sense (related to PCML system) - ipsilateral loss of pain and temperature sensation from the face (lateral to the nucleus cuneatus is the trigeminal nucleus and is affected)
Pons		
Foville syndrome	Due to occlusion of the paramedial branches 	• ipsilateral abducens nerve paralysis (the abducent nucleus) • contralateral hemiparesis (corticospinal fibers) \ no decussation • variable contralateral sensory loss reflecting various degrees of damage to the medial lemniscus
Millard-Gubler syndrome	If the area of damage is shifted somewhat laterally to include the root of the facial nerve along with corticospinal fibers	the patient has a contralateral hemiparesis and an ipsilateral paralysis of the facial muscles
Syndrome of the midpontine base	Due to occlusion of the paramedial branches and short circumferential branches	• Corticospinal fibers causing contralateral hemiparesis • Sensory and motor trigeminal roots (trigeminal nuclei) • Fibers of the middle cerebellar peduncle (ataxia)

Midbrain		
Weber syndrome	Due to occlusion of vessels serving the medial portions of the midbrain involving the oculomotor nerve and the crus cerebri 	• Ipsilateral paralysis of all extraocular muscles except the lateral rectus (supplied by the abducent) and superior oblique (by the trochlear) • Paralysis of the contralateral extremities (Corticospinal fibers) \ no decussation • Ipsilateral dilatation of pupil • Contralateral weakness of the facial muscles of the lower half of the face • Contralateral deviation of the tongue when it is protruded
Claude syndrome	Due to occlusion of vessels serving the central area of the midbrain which includes the oculomotor nerve and the red nucleus	• ipsilateral paralysis of most eye movements • Ipsilateral dilatation of pupil • contralateral ataxia, tremor, and incoordination



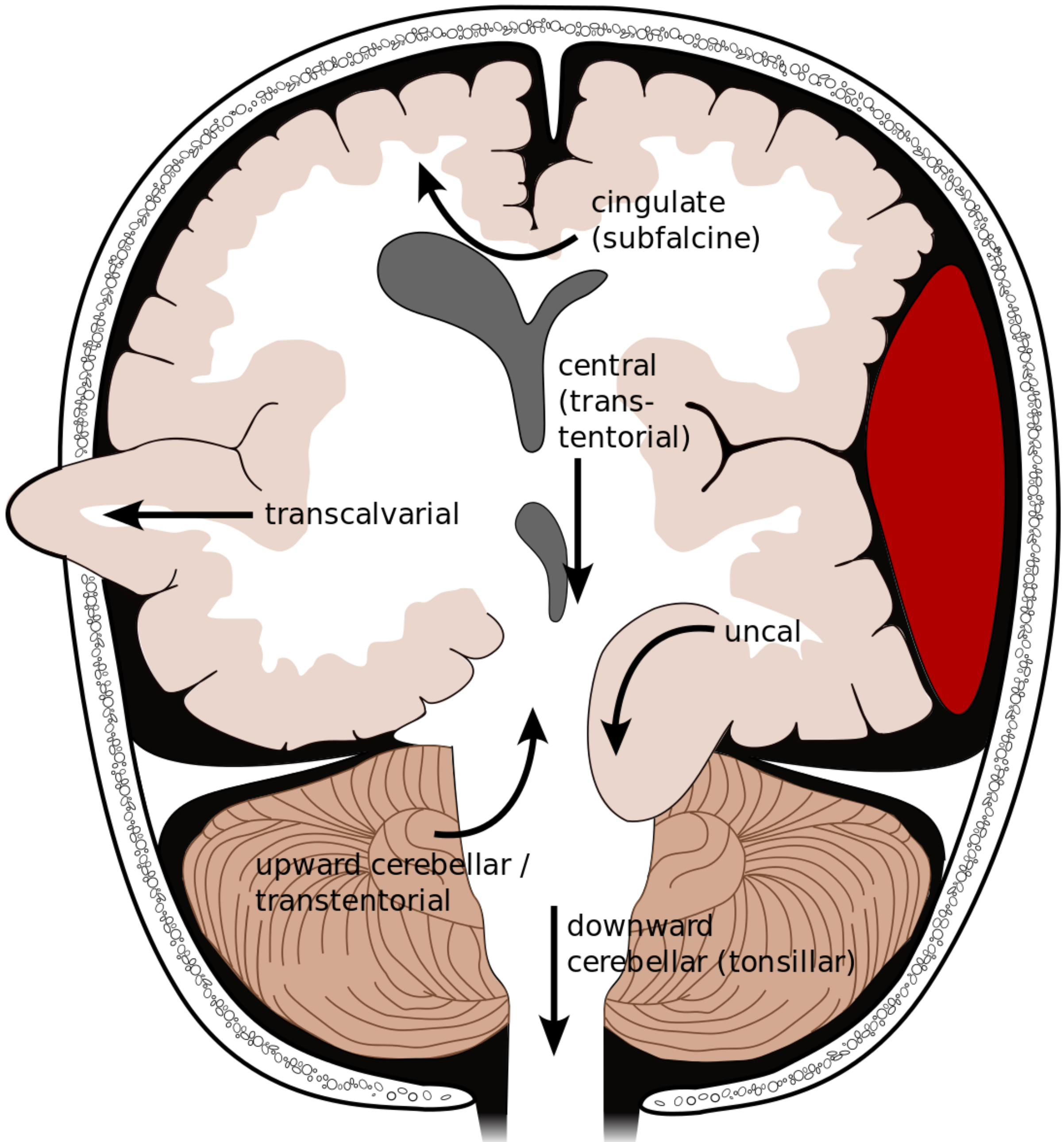
Yes the picture above have teeth missed !

No one but just dental studemt can't see trigeminal nerve without the teeth

Herniation

Type	Definition	Causes	Symptoms
TONSILLAR HERNIATION	There is a part of the cerebellum called tonsils, when it is pushed out of its normal location the condition is called tonsillar herniation (the direction of herniation which is downward towards the foramen magnum), this will cause pressure on the medulla oblongata in that area	any mass in the posterior cranial fossa (tumor, hemorrhage) increase in intracranial pressure	sudden change in heart rate and respiration hypertension hyperventilation rapidly decreasing levels of consciousness If sever, death
Arnold-Chiari Phenomenon	Congenital anomaly in which there is a herniation of the tonsils of the cerebellum and the medulla oblongata through the foramen magnum into the vertebral cana		It is less severe, and some people may be asymptomatic but as people get older symptoms might start appearing
Central herniation	space occupying lesion in the hemisphere (supratentorial compartment, above the tentorium cerebri)	elevates intracranial pressure and forces the diencephalon downward through the tentorial notch and into the brainstem affecting the midbrain mainly	change in respiration, eye movements are irregular. As the damage progresses downward into the brainstem, there is significant change in respiration (Tachypnea and apnea) profound loss of motor and sensory functions. probable loss of consciousness Decorticate posture may occur
Upward Cerebellar Herniation	A mass in the posterior cranial fossa may force portions of the cerebellum upward through the tentorial notch (upward cerebellar herniation) and compress the midbrain rather than causing tonsillar herniation.	The result may be occlusion of branches of the superior cerebellar artery with resultant infarction of cerebellar structures or obstruction of the cerebral aqueduct and hydrocephalus.	accumulation of fluids will lead to an increase in intracranial pressure causing vomiting, headache, lethargy, decreased levels of consciousness
Uncal Herniation	Movement of the uncus (anteromedial part of the temporal lobe) downward over the edge of the tentorium cerebelli, causing pressure on the midbrain	Early signs : dilated pupil ipsilateral to the herniation (involvement of oculomotor) abnormal eye movements ipsilateral to the herniation (oculomotor nerve) double vision ipsilateral to the herniation (loss of synchrony of movement of the eyes). Weakness of the extremities (corticospinal fiber involvement) opposite to the dilated pupil Later: respiration is affected	

Herniation types & directions



You can't go back and change the beginning , but you can start where you are and change the ending

Cerebellum

Functional zones of cerebellum	
Vermis	influences the movements of the long axis of the body (neck, shoulders, thorax, abdomen and hips)
Intermediate zone	control muscles of the distal parts of the limbs (hand and feet)
Lateral zone	concerned with planning of sequential movements of the entire body , such as speech

Structure of cortex of cerebellum (outer layer)	
molecular layer (outer)	stellate cell -basket cell -consisting of axons of granule cells (parallel fibers) and dendrites of Purkinje cells
Purkinje cell layer (intermediate)	large neuronal cell bodies (Purkinje cells) Flask shaped cells
granular layer (inner)	-small neurons called granular cells - Golgi cells: (Inhibitory)

Fibers from and to cerebellum

Input

Climbing fibers: terminal fibers of the olivocerebellar tracts , excitatory to purkinje cells , a single purkinje neuron makes synaptic contact with only one climbing fiber and one climbing fiber makes contact with one to ten purkinje

Mossy fibers: terminal fibers of all other cerebellar afferent tracts (anterior & posterior spinocerebullar tracts) , excitatory to purkinje cells , a single mossy fiber may stimulate thousands of

Output

Purkinje Cells - the only output neuron from the cortex utilizes GABA to inhibit neurons in deep cerebellar nuclei

Granule Cells- intrinsic cells of cerebellar cortex; use glutamate as an excitatory transmitter; excites Purkinje cells via axonal branches called “parallel fibers”

Basket Cells and stellate cells- inhibitory interneuron; utilizes GABA to inhibit Purkinie cells

Functional anatomy

Type	Parts of cerebellum	More info.	Fun.	Pathways
Spinocerebellum	comprises the vermis + intermediate hemisphere of the cerebellar cortex, as well as the fastigial and interposed nuclei.	- projects through fastigial and interposed nuclei. -has a somatotropic organization. -it receives major inputs from the spinocerebellar tracts. -Its output projects to rubrospinal, vestibulospinal, and reticulospinal tracts -It is involved in the integration of sensory input with motor commands to produce adaptive motor coordination	controls posture and movement of trunk and limbs	First one : the vermis will send efferents through fastigial n. TO Inferior cerebellar peduncles TO EITHER Medial descending pathways (vestibulospinal tract ,reticulospinal tract) OR VL (Medial (anterior) Corticospinal tract) Second one : The intermediate hemisphere will send efferents through interposed n. TO Superior cerebellar peduncle TO EITHER Red nucleus (Globose-emboliform-rubral pathway (Rubrospinal tract) OR VL (Lateral corticospinal tract)
Cerebrocerebellum	Located in the lateral hemisphere , projects to the dentate nucleus		participates in the planning of movement ,It is involved in the planning and timing of movements	Afferent input : from entire contralateral cerebral cortex TO pontine nuclei. TO Middle cerebellar peduncle TO Contralateral cerebellar cortex Efferent pathway : Dentate n. TO superior cerebellar peduncles Decussation of SCP TO VL TO corticospinal tract
Vestibulocerebellum	located in flocculonodular lobe	projects to vestibular nuclei. it is involved in vestibular reflexes (such as the vestibuloocular reflex) and in postural maintenance	functions in maintaining balance and controlling head and eye movements	Afferent input: vestibular nerve and vestibular nuclei. Efferent path vestibular nuclei TO EITHER VS tract OR Med longitud Fasciculus (eyes, head)

Stop trying to calm the storm

Calm yourself

The storm will pass

Keep Calm

Summary

Cerebellar afferent fibers

From cerebral cortex

1.Corticopontocerebellar pathway

2. Cerebro-olivocerebellar pathway

3.Cerebroreticulocerebellar pathway

From spinal cord

1. Anterior spinocerebellar tract

2. Posterior spinocerebellar tract

3. Cuneocerebellar tract

From vestibular nerve

Other afferents

1. Red nucleus

2. Tectum

Cerebellar efferent fibers

Dentothalamic pathway

- Globose-emboliform-rubral pathway
- Fastigial vestibular pathway
- Fastigial reticular pathway

Penducles

inferior cerebellar peduncle	afferent fibers from the medulla	efferents to the vestibular nuclei
middle cerebellar peduncle	afferents from the pontine nuclei	-------------
superior cerebellar peduncle	afferents from the spinocerebellar tract	efferent fibers from the cerebellar nuclei

Signs and symptoms of cerebellar disease

Nystagmus: rhythmic oscillations of the eyes.

Ataxia (inaccuracy and disturbances of voluntary movement)

Hypotonia: decrease in muscle tone: (Loss of the deep cerebellar nuclei, particularly of the interposed nuclei)

Tremors: involuntary oscillations of limbs (“intention tremor”), results from cerebellar overshooting and failure of the cerebellar system to “damp” the motor movements

Postural changes and alteration of gait to compensate for loss of muscle tone

Dysmetria (past pointing)

Failure of Progression : Dysdiadochokinesia (difficulty performing rapid alternating movements) due to failure to predict where the different parts of the body will be at a given time during rapid motor movements.

Dysarthria: Disorders of speech

ANS

Sympathetic nervous system

"fight or flight"

Major regulator of the smooth muscle of the cardiovascular system, it has a wider distribution as blood vessels are located everywhere in the body.

thoracolumbar system: all its neurons are in lateral horn of gray matter from T1-L2

sweat, hair stands on end , blood pressure rises (vasoconstriction , Also causes: dry mouth, pupils to dilate, increased heart & respiratory rates to increase O2 to skeletal muscles, heart and brain

acetylcholine in preganglionic , Norepinephrine is for postganglionic

Pathways

Synapse in a paravertebral ganglion ,that have white ramus communicans AND gray ramus communicans

SUPPLY Then out through the spinal nerve toward the skin (mainly targets like the arrector pili muscles and blood vessels and glands)

Synapse in a collateral ganglion (Prevertebral) , Bypasses paravertebral ganglion to continue to project away from the spinal cord in a separate nerve (splanchnic nerves)

influence the deeper visceral organs (heart, kidneys, and digestive

parasympathetic nervous

"rest & digest"

Major regulator of the smooth muscle of the digestive and respiratory systems , Only innervate internal organs

Craniosacral , Cranial nerves III,VII, IX and X , In lateral horn of gray matter from S2-S4

Pupils constrict , Stimulates digestive glands , Increases motility of smooth muscle of digestive tract , Decreases heart rate , Causes bronchial constriction

acetylcholine in preganglionic , Norepinephrine is for postganglionic

Pathways

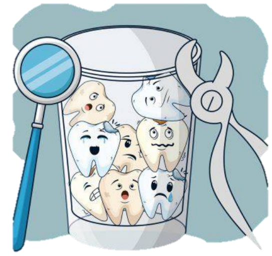
The myleinated efferent fibers of the craniosacral outflow are preganglionic and synapse in peropheral ganglia located close To the viscera they innervate

leave the sacral nerves and form the pelvic splanchnic nerves

Splanchnic nerves			
Greater splanchnic	5th-9th thoracic ganglia	Pierces the crus of the diaphragm	Synapse in the ganglia of the celiac plexus, the renal plexus, and the suprarenal medulla
Lesser splanchnic	10th -11th thoracic ganglia	Pierces the diaphragm	Synapses in lower part of the celiac plexus
The lowest splanchnic	12th thoracic ganglion	Pierces the diaphragm	Synapses in the ganglia of the renal plexus

Anatomy ?

Natural teeth ☹



Clinical !!!

EXTRACTION

Surgery ......

ORTHO

All this noise just to be a

?

Work until you no longer have to introduce yourself