

--- Gross Anatomy of the nervous system, skull & Meninges ---

Lecture (11).

→ The bones of the skull may contribute in the skull base only like (Temporal, Ethmoid & sphenoid) bones or in both skull base & calvarium.
like [Frontal, parietal, occipital] bones.

* 8 cranial Bones.
 { 2 paired → parietal bone, Temporal u.
 { 4 single. → Frontal, Sphenoid, Ethmoid, occipital.

* Skull has { skull base.
 { calvarium (vault).

↓
Skull cap or vault

* First: Frontal bone:-

(Atlas, P.11).

- single bone.
- Has many different part:
 - squamous part.
 - Nasal part.
 - 2 orbital plates. (The frontal bone curved downward to make the upper margin of the orbits).
 - 2 zygomatic bone process.
- Medially, the frontal bone articulate with ~~frontal~~ the frontal process of the Maxilla & the nasal bone.
- laterally, the frontal bone articulate with zygomatic bone.

* About the orbital margin:-

- 1) Superiorly: Frontal bone.
- 2) laterally: Zygomatic bone.
- 3) Inferiorly: Maxilla.
- 4) Medially: process of the maxilla & Frontal bone.

- Frontal bone contains 2 Frontal air sinuses:
 → Just above the orbital margins.

→ Clinical points: 1 Sinusitis

2 Any trauma or fracture in the Frontal bone may lead to clava & Meninge injury & that leads to CSF leakage from frontal sinuses to the Nose and Meningitis may occurs.

→ Hint:

More thinner, so easily to be fractured.

- Fracture in ethmoid bone cause Rhinorrhea
- Fracture in temporal bone cause otorrhea. (CSF From ear)

cause (Salvatore) Meningitis.

Second: Parietal bone:

- paired.
- Two bones of the parietal connect.
 - with each other by sagittal suture
 - anteriorly with frontal bone by coronal suture (Rt, Lt).
 - posteriorly with occipital bone by lamboid suture (Rt, Lt)
 - Inferiorly with temporal by squamous suture.
 - Inferiorly with sphenoid bone

Hints: 1st: About sagittal suture:

* Be open in the Newborn to make delivery easy to happen. [Decrease the size of the baby head & that's allowed to be delivered from the canal].

* Also, It's closed between the age of [6 month - 2 years].

- To allow brain growing.
- In 2 years to child, The size of the brain is about 90% of the ~~total~~ adult brain size.
- Key, premature closure happened [abnormal] → that cause Craniosynostosis. & we have to make operation for suture opening.
- The head shape depends on any of the sutures will close.

3rd: Occipital bone:

- single bone.
- has a squamous part, Basilar part.
 - Occipital condyle: articulate with Atlas vertebra (C1) via Atlantoccipital Joint.
 - Foramen magnum: largest Foramen in the body.
 - exit from it → spinal cord, Vertebral a., Ant & post spinal a., XI nerve meninge → then enter the Jugular foramen.
 - Jugular foramen:
 - Exit from it → Internal Jugular v → The main venous return in the brain. so once obstruction or tumor occur in the vein → No venous return → brain swelling [life-threatening].
 - Hypoglossal canal:
 - IX, X, XI nerves.
 - exit from it → XII nerve.
 - locate above antero lateral boundary of the Foramen magnum.

4th: Temporal bone: - paired.

- consist of:
 - squamous part.
 - Zygomatic process. (articulate with zygomatic bone).
 - styloid process [attached with styloid muscle].
 - petromastoid [petrous part with Mastoid in its end, attach with stylo mastoid m].
- Tympanic → contribute to: ant., post & inf. wall of the external acoustic meatus.
 - Opening / Meatus.
 - External acoustic: auditory n.
 - Internal II. [VII, VIII, labyrinthine a].
 - Vestibular Schwannoma: Tumor arise from VIII n & we find widening & dilation in the internal acoustic meatus.
 - Carotid canal.
 - open into the side of the foramen lacerum above the closed inf. opening.
 - ICA → enter the foramen through CC.
 - Foramen lacerum: lie between the apex of the petrous part of the temporal bone & the sphenoid part.
 - Stylomastoid foramen (VII n)
 - Skull Fracture cause → otorrhea & Facial (VII n) palsy

5th: Sphenoid bone: - Single (Atlas Fig)

- Has a lesser and Greater wings where commonly Meningioma occurs. On any where ^{Medially to laterally} _{In the middle} (ant. clinoid) process.

- Contains:

- Sella turcica:
 - ↳ consist of pituitary G.
 - ↳ if there is a tumor in this gland or this area → Bitemporal hemianopia.
- Sphenoid sinuses: [air sinuses]
 - ↳ where Transnasal transsphenoidal pituitary adenoma ~~is~~ first resection.
- Optic canal:
 - ↳ Optic II n.
 - ↳ Medial to clinoid process.
- Superior orbital fissure:
 - ↳ between G & L. wings.
 - ↳ connects Middle Fossa & orbits
 - ↳ Transmit (III, IV, V-1, VI) n.
- Foramen Rotundum: (V-2)
- Foramen Ovale: (V-3).
- Foramen spinosum: (Middle meningeal a.).

Any injury or trauma to this artery will cause Epidural hematoma [life-threatening].

Cranial Fossae: -

The interior of the base of the skull is divided into 3 Cranial Fossae:

- Ant.
 - ↳ The ant. CF is separated from middle CF by: lesser wing of the sphenoid.
 - Middle.
 - ↳ The middle CF is separated from post. CF by: petrous part of the temporal bone.
 - Post.
- (Image in slide)

* Once skull base fracture occur, the symptoms depend on the site of this fracture along 3 CFs.

In Anterior CF:

- ↳ Rhinorrhea.
- ↳ Cranial n I injured.

In Middle CF:

- ↳ Facial palsy
- ↳ Deafness.

[Trauma is immediate & S.S.]
That's mean cut injury occurs to this nerve & its bad prog.

but, If patient is fine & Gradually the symptoms of facial palsy appeared, so it's usually ischemic & has a Good prog.

6th: Ethmoidal bone: Single. (Atlas Fig)

- Located in the midline of the ant. cranium base
- Separates the ant. cranial fossa & the nasal cavity
- Form the Medial orbital walls → Its wings form the Medial part of this wall but its Root is formed by Frontal bone.

- Contains:

- Cribriform plate.
 - ↳ exit from it CN.I (Olfactory n.)
 - ↳ Fracture lead to Rhinorrhea, Anosmia. [loss smelling]
- Crista Galli → attachment point of the Falx cerebri for fixation.

It's a dural fold for separating the cerebrum (hemisphere of the brain) into Rt & Lt.

- This bone is easily fractured.
- May congenital absent & congenital CSF leakage occurs.

Clinical Scenarios:

I] Craniosynostosis:

- : premature closure of one or more cranial sutures in newborns.
- Irregular head shape.
 - Sometimes $\uparrow$ ICP.
 - Surgical correction is indicated.

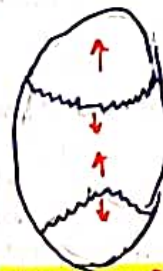
: when the suture fuses prematurely the frontal bone and forehead can't grow in response to the growth of the brain.

[The remaining open sutures must grow to make up for the lack of growth in the forehead, leading to a triangular head shape.]



Trigonocephaly

: early closure of fusion of the sagittal suture.



Scaphocephaly

[This suture runs front to back, down the middle of the top of the head. This fusion causes a long, narrow skull. The skull is long from front to back & narrow from ear to ear.]



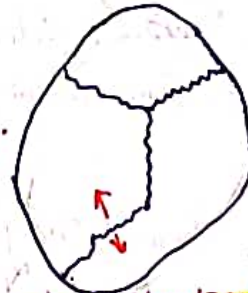
Normocephaly

: characterized by a shortened anteroposterior skull length & a widened biparietal diameter.

[Flattening of the back for too long].



Brachycephaly



post. plagiocephaly

: when a baby develops a flat spot on one side of the head or the whole back of the "



Ant. plagiocephaly



الراس عريضة وقصيرة الخلف

ال Subcutis في بيسر الكلا closure بسكو نمو الرأس
بيس متواز في الكلا وتكون عودي علما

[2] Skull Fracture: → closed by itself.

- The fracture itself is usually of little consequence. → called fissure fracture.
 - More important: brain injury & 2nd complication. [one or two months for closure].
- This fracture will consider serious once middle meningeal artery is injured - / may hematoma occurs.

* Classification:

- **Closed (simple) or opened (compound):**
 - ↳ without puncture or opened wound in the skin.
 - ↳ with puncture or opened wound in the high risk skin of infection.
- **Linear (Fissure) or depressed:**
 - ↳ breaks in the bone, but doesn't move the bone
 - ↳ broken bones displace inward.
- **Vault or base Fracture:**
 - ↳ More dangerous, may CSF leakage, Meningitis & cranial nerve injury occur.

[3] Pterion: The H-shaped formation of sutures on the side of the calvarium representing the Junction of 4 skull bones. [The Greater wing of the sphenoid bone, squamous portion of the temporal bone, Frontal bone] - and parietal bone.

* Skull Fracture in this point lead to injury to Ant. branch of middle meningeal artery leading to **epidural Hematoma**.

Sphenoidal craniotomy common site → to access to several intracranial pathology.

الطريقة التي يستخدمها الجراح للوصول إلى البنية الدماغية.

* Meninges:

- surround the brain & the spinal cord.
- **3 layers:** [From external to Internal].
 - ↳ **The dura:** tough, outer layer, lined the cranial cavity.
 - ↳ **The arachnoid:** a Delicate avascular, middle layer.
 - ↳ **The pia:** An inner layer firmly attached to the surface of the brain.
- The cranial dura consist of 2 layers → periosteal Meningeal.
- The spinal " " " 1 layer: only Meningeal.

There is 9 Sinuses here receive the vessels & do the CSF absorption [↓ Friction].

* About Cranial dura:

- The **periosteal layer** & the **meningeal layer** are closely united except along certain lines, where they separate to form **Venous sinuses**.

↳ **Endosteal layer:** Endosteum covering the inner surface of the skull bone.
↳ Doesn't continuous through the foramen magnum to become, but it's continuous to the **periosteum** on the outside of the skull bone.

→ The meningeal layer: [Dura mater proper].

• Dense strong membrane, is continuous through the foramen magnum with dura mater of the spinal cord.

→ Falk: lies in the midline between the 2 cerebral hemisphere.

→ Tentorium cerebelli: crescent shaped fold of dura mater that roofs over the post. cranial fossa.

* cover upper surface of the cerebellum.

* support the occipital bone lobes of the cerebral hemispheres.

* Blood supply of the cranial dures:-

→ Ant. cranial fossa: ant. meningeal a. ← ophthalmic a. ← ICA.

→ Middle " ": Middle " " ← Maxillary a. ← ECA.

→ post " ": post. " " ← Ascending pharyngeal ← ECA.

* Clinical Scenarios:-

→ Extradural (Epidural hematoma).

: (under bone, above dura)

→ Subdural hematoma. (between dura & arachnoid).

→ subarachnoid hemorrhage. [Traumatic or aneurysmal].

↓
contain major vessels.

→ CSF leak [post traumatic, spontaneous, iatrogenic].

→ Meningitis [infection of leptomeninges].

→ Meningioma:

[Extra-axial tumor, originates from arachnoid cap cells].

* In CT scan: * Extradural H. appear as Biconvex, lenticular shape.

* Subdural H. " " crescent shape

* Subarachnoid H. → Spontaneous

- Most common.

- Due to rupture aneurysm.

- Basal.

→ Traumatic.

- cortical.

* Brain:

• Telencephalon: cerebrum

• Diencephalon: Thalamus, Hypothalamus.

• Mesencephalon: Mid brain

• Metencephalon: pons & cerebellum

• Myelencephalon: Medulla oblongata

Slides 11-24

First: Telencephalon (cerebrum):-

- It's two hemispheres.

- In each hemisphere, there is 4 lobes:

→ Frontal lobe. (Motor)

→ Parietal (sensory).

→ Temporal

→ Occipital

→ occipital a.

8

14

Notes: * The surface layer of each hemisphere is called the cortex & is composed of a gray matter.

* The cerebral cortex is thrown into Folds or Gyri, separated by Fissures or Sulci.

* Several of the large sulci conveniently subdivide the surface of each hemisphere ^{into} lobes. (The lobes are named for the cranial bones that overlie them).

- Central sulcus: Separated the frontal lobe & parietal lobe.
- lateral sulcus: separate the parietal lobe & temporal lobe.
- parietooccipital s: " " parietal lobe & occipital lobe.

* The frontal lobe is situated in front of the central sulcus & above the lateral sulcus.

* The parietal lobe is situated behind the central sulcus & below above the lat. sulcus.

* The occipital lobe lies below the parietooccipital sulcus.

* The temporal lobe is situated below lateral sulcus.

→ Precentral Gyrus:

- lies immediately anterior to the central sulcus and is known as a Motor area.

- The large motor nerve cells in this area → control voluntary movements on the opposite side of the body.

→ Postcentral Gyrus:

- lies immediately post. to the central sulcus & is known as sensory area.

- The small nerve cells in this area → Receive & input sensation of pain, T, touch, pressure from the opposite side of the body.

→ superior temporal gyrus
see later

First: Frontal lobes

• The most important points here:

- Motor
- Behaviour
- Gaze
- Broca's area

* Clinical points: The injury or Defect in Frontal lobe lead to:

1 Behaviour change

2 contralateral weakness

3 Gaze paralysis to contralateral side.

→ area VIII [Frontal eye field].

→ control of Gaze [eye movement to the same direction in the same time i.e. someone look to other].

* RT area VIII: Move both eye to the left and vice versa.

* If there is a problem in the RT area VIII → eyes move to the RT only [looking to the lesion]

* If there a lesion or irritation in the Rt area VIII
 ↳ seizure will occur [The area not completely damage],
 So Fitting occurs [repeatedly the eye goes toward the partial damaged part].

But → what make this issue more difficult is:

Brain stem controls the Horizontal Gaze but not with contralateral movement.

So → If we have a lesion and don't know the ~~place~~ its location, and the eyes move to the Right,

Is it a lesion in the Rt area VIII or in the Lt brain stem ???

↳ Motor Broca's Dysphasia [in dominate side damage].

the patient understand what you say & can think healthy but can't describe the idea that he thinks is. [Expressive prob.]

↳ There is a sensory dysphasia Due to the damage in

Superior temporal Gyrus:

[Lies immediately below the lateral sulcus, and The middle of this Gyrus is concerned with the reception & interpretation of sound [Auditory area].

↳ patient with damaged sup. temporal G. has a receptive problem → He doesn't understand you but talk like a salad. (Gérard)

Dysphasia may a result from a problem is:

Motor [Broca's area] [Frontal L. damage] → expressive
Sensory [Wernicke's area] [Temporal L. damage] → Receptive.

Second: parietal lobe:

↳ contain the sensory cortex in the post central gyrus.

Third: Temporal lobe:

contain → sensory dysphasia (Wernicke's area).
 ↳ Auditory cortex.
 ↳ olfactory cortex.

↳ The Aphasia square. (Wernicke's)

Fourth: occipital lobe:

- Visual cortex → controlling contralateral visual field. [contralateral hemianopia].

** Calcarine sulcus: Anatomical landmark locate in the medial aspect from occipital pole & it separate the cuneus cortex & lingual cortex in occipital lobe.

→ About cuneus cortex:

- Is a smaller lobe in the occipital lobe of the brain.
 - locate posteriorly from parietooccipital sulcus.

→ locates in the upper quadrant.

Function:

control in contralateral lower quadrant.

Left (L) Right (R) Eye (E) Mouth (M) Nose (N) Ear (A)

↳ The cuneus receive input from the contralateral superior retina corresponding to the lower visual field.

→ About lingual cortex:

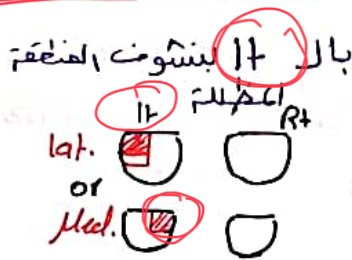
Function:

Function of the lingual area:

- control the contralateral upper quadrant.

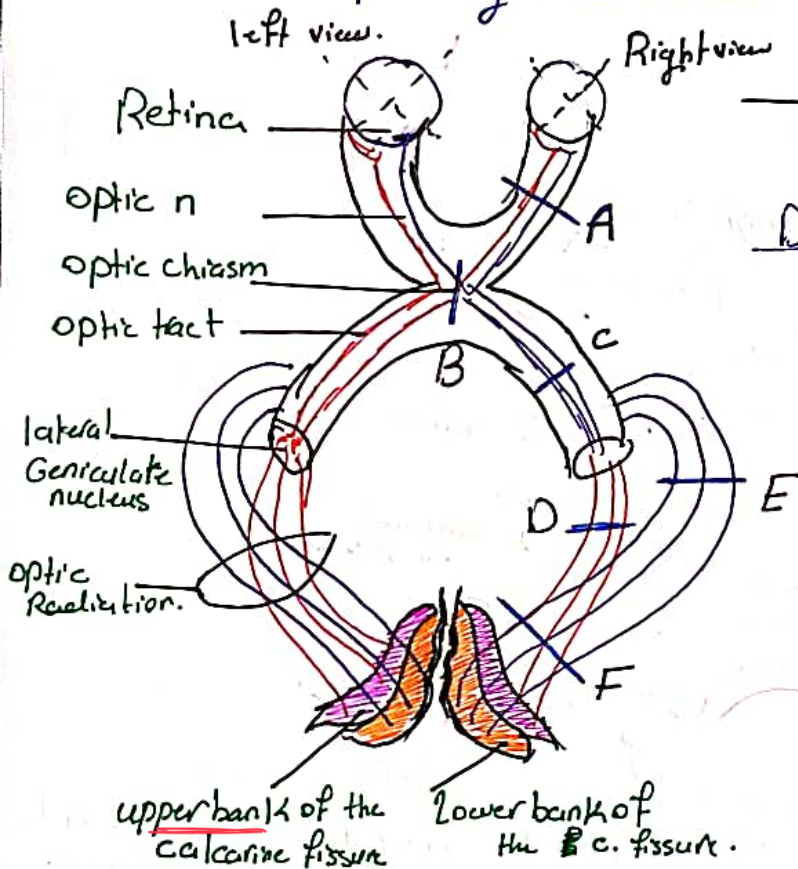
→ The lingual receives input from the contralateral inferior area of retina corresponding to the upper visual field.

*Example:



If there is a lesion in both crosses & lingual areas → loss of lat. vision leading to Bitemporal hemianopia.

Visual pathway field defect:-



→ If there is a defect in area:-

[1] A:

Defect in:-

- Rt Medial Fiber → loss of Rt lateral vision
- Rt Lateral Fiber → " " " Medial vision.
- (Rt optic nerve) [loss of vision in Rt eye].

[2] B: optic chiasm

Defect in 2 Medial fiber (Rt, Lt).
→ loss of 2 lateral vision (Rt, Lt).

[Bitemporal Hemianopia]

[3] C:

Defect in Rt optic tract

- Rt lateral optic.
- Lt Medial " "

→ [loss of Rt Medial vision
" " Lt lateral "]



[Contralateral homonymous Hemianopia]

بالصالح (2) بس
التي تغيرت، صارت لات (2)
من حال (3) الحمايا hemianopia
بعكس فقط ال (CR) .

[4] E: Defect of fibers that attach to lower bank of C.F.

→ loss of contralateral superior quadrates.v.

[Contralateral superior quadratopia]

[5] D: Defect of Fibers that attach to upper bank of C.F.

→ loss of Inferior quadrates.v.

[Contralateral inferior quadratopia]

[6] F: E+D [Contralateral homonymous]

Hemianopia + Macular sparing

- 2 sources → BS (B) لائقا
- Middle cerebral a.
- occipital a.

Brain Ganglia:-

- a group of subcortical nuclei, responsible primarily for motor control.

* Caudate nucleus, putamen & Globus pallidus in the cerebrum.

* Subthalamic nucleus in the diencephalon.

* Substantia nigra in the midbrain.

Contents of the white matter in different places.

Ventricular System:-

↳ consist of

- 2 lat. ventricles
- 3rd ventricle
- 4th "

- The 2 lateral v. communicate with 3rd v. through Interventricular Foramina.
- The 3rd v. communicates with 4th v. by Foramina of Monro.
- The 4th v. is continuous cerebral aqueduct with the narrow central canal of spinal cord & through the three foramina in its roof with subarachnoid space. [2 Luschka; 1 Magendie].

* Thalamus:-

- * paired gray matter structure located near the center of the brain.
- * It's above the midbrain → allowing for nerve fiber connections to the cerebral cortex in all directions. [Relay motor & sensory signals to the cerebral cortex].

* Hypothalamus:-

- * Small area located above the pituitary gland & below the thalamus & attached to the pituitary by a small stalk.

- * Functions:
1. Releasing & controlling Hs.
 2. controlling appetite.
 3. Managing sexual behaviour.
 4. Regulating body T.
 5. Fluid & Electrolyte balance [Thirst].

* Brain Stem

- ↳ connect brain to spinal cord.
- * Contain cranial nuclei III to XII.
 - I, II From cerebrum.
 - III, IV From midbrain.
 - V, VI From pons.
 - VII, VIII From medulla oblongata.
 - IX, X, XI, XII From spinal cord.
- * Function: Regulate respiration, CV function & consciousness.
- * parts: Midbrain (III + IV), Pons (V → VI), Medulla oblongata (VII → XII).

→ Brain stem:

* The cavity of the pons & MO is 4th vent.

* The cavity of the Midbrain is 3rd vent.

* The cavity of spinal cord is Central canal

* Cranial Nerves:

- 1 Olfactory n I
- 2 optic n II
- 3 oculomotor, III
- 4 Trochlear n IV
- 5 Trigeminal n V
- 6 Abducens n VI
- 7 Facial n VII
- 8 Vestibulocochlear n VIII
- 9 Glossopharyngeal IX
- 10 Vagus n X
- 11 Accessory n XI
- 12 Hypoglossal XII

1) Mid brain:

→ III & IV CN

→ within it, there is a 2 crus cerebri (R+L), pass through it a pyramidal tracts which make up of neurons that connect the cerebral hemispheres to the cerebellum.

→ The narrow cavity of the midbrain is cerebral aqueduct.

[connect the 3rd v. to 4th v.]

→ Tectum [Quadrigeminal plate]:

* part of the midbrain, post. to the cerebral aqueduct.

* Has four small surface swelling [2 sup. Colliculi, 2 inf. "]

→ colliculi are deeply placed between the cerebellum & the cerebral hemisphere.

Clinical Note:

when for example, It crus cerebri is damaged by trauma, Rt hemiplegia occurs to the muscles that's supplied by it.

2) Pons:

→ V, VI, VII, VIII CN.

→ The post. surface of the pons face the cerebellum & form the upper part of the floor of the 4th vent.

3) Medulla oblongata:

→ connect with spinal cord at the level of the Foramen magnum.

→ IX, X, XI, XII CN.

→ The post. surface of the medulla faces the cerebellum & forms the lower part of the floor of the 4th vent.

* Cerebellum:

* located in the post. fossa, infratentorial.

* consists of 2 Hemispheres connected by a median portion. [vermis]

* Function: Coordination of motor movement.

→ Hemisphere: responsible on the motor m. of the limbs.

→ Vermis: " " of the trunk.

* The Rt control the Rt side of the body & same for Lt.

→ For example when there is a tumor (Medulla blastoma) in the Rt hemisphere.

→ lead to Rt limb ataxia (No coordination).

→ vermis - contralateral control

→ Trunk ataxia.

* Spinal cord:

→ Begins below the Foramen magnum & ends opposite to L1-L2

* total of 31 pairs of spinal nerves attach to the spinal cord.

* Each spinal nerve originates with a paired series of post. & Ant. Rootlets, which attach to the posterolateral & anterolateral sulci of the spinal cord, respectively. & extend the whole length of the corresponding segment of the cord.

cervical	8
thoracic	12
lumbur	5
sacral	5
coccygeal	1

important → The spinal cord has cervical & lumbur enlargement and ends by Conus medullaris.

* Each paired bundle of post. & ant. rootlets joins together and forms a single post. & ant. root within vertebral canal.

* Each paired post & ant. root merges within intervertebral foramen & form an individual spinal nerve.

* Each post. root possesses a post. root ganglion which is located through the IUF & immediately divides into a smaller post. ramus & larger ant. ramus.
 ↳ inter vertebral foramen. ♥

* Functionally:

↳ The post. Rootlets & Root: carry sensory (afferent) impulses.

↳ The Ant. " " " " carry motor (efferent) impulses
 [From spinal cord → spinal n.]

** Clinical points:

The spinal n & the post. & Ant. rami are Mixed components [They convey both Sensory & Motor information to or from periphery].

Therefore

- ↳ Lesions of the ant. roots → affects only motor neurons.
located in spinal n.
- ↳ Lesions of the post. roots → affect only sensory neurons.
- ↳ Lesions of the ant./post. rami → affect both Motor and sensory fibers.

So, Lesions of the Roots & Rami → Result in a different combination of sensory & motor deficit.

↳ The Location of the Gray & white matter in the spinal cord is opposite to their location in the Brain.

Brain

In spinal cord

The gray matter (central)
 : is divided into 10 zones known as Rexed's laminae.

The white matter (peripheral).

↓
 The ant. column (Funiculus) contains → Motor axons.
 The post column contains → Sensory axons.

↓
 The ant. horn contains → Motor n.
 The post. horn " → Sensory n.

Continued...

→ Spinal ns exit above the corresponding vertebra in cervical spine, but below it in thoracic & lower spine.

This is because we have 7 cervical vertebrae but 8 cervical cord segments.

(T₁ منقطة)
ناتك T₁ n
T₁ vert.

→ In adults, The spinal cord is significantly shorter than the vertebral column. → Because of this disparity, the length of the spinal roots ↑ From above downward.

→ In the upper cervical Region, The spinal nerve roots are short & run almost horizontally to the IVF.

→ The roots of the lumbosacral & coccygeal ns form long, thick nerve roots obliquely & vertically.

→ The collective bundle of the nerve roots below the conus (at the level of L1) plus the filum terminale is cauda equina (horse tail).

* Important tracts:-

[1] Lateral corticospinal (pyramidal t.)
[between ^{cerebral} cortex & spinal cord]
• Motor Function.

[2] Anterolateral spinothalamic t.
[between the spinal cord & thalamus]
• Sensory Function.

→ For superficial sensation (pain & T.)

[3] Post. column medial lemniscal pathway.
→ For Deep sensation [conscious proprioception, vibration & Discriminative touch].

→ This tract if it's damaged cause complete loss of sensation (on the side toward lesion)
[contralateral sensation].

Clinical Importance:-

• The disk between L4 & L5 → Make L5 injury.

• If this disk extend to the other side of the same vertebra & cause a compression on the L5 (on other side) → cauda equina occurs. [pain with loss of control of urination, defecation.]

→ This tract is closed from foramen magnum. So if it's damaged cause Ipsilateral weakness.

تميز محمد الله

في خيرا

Dreams Alhaman