

Neurobiology of my Subdural Hematoma

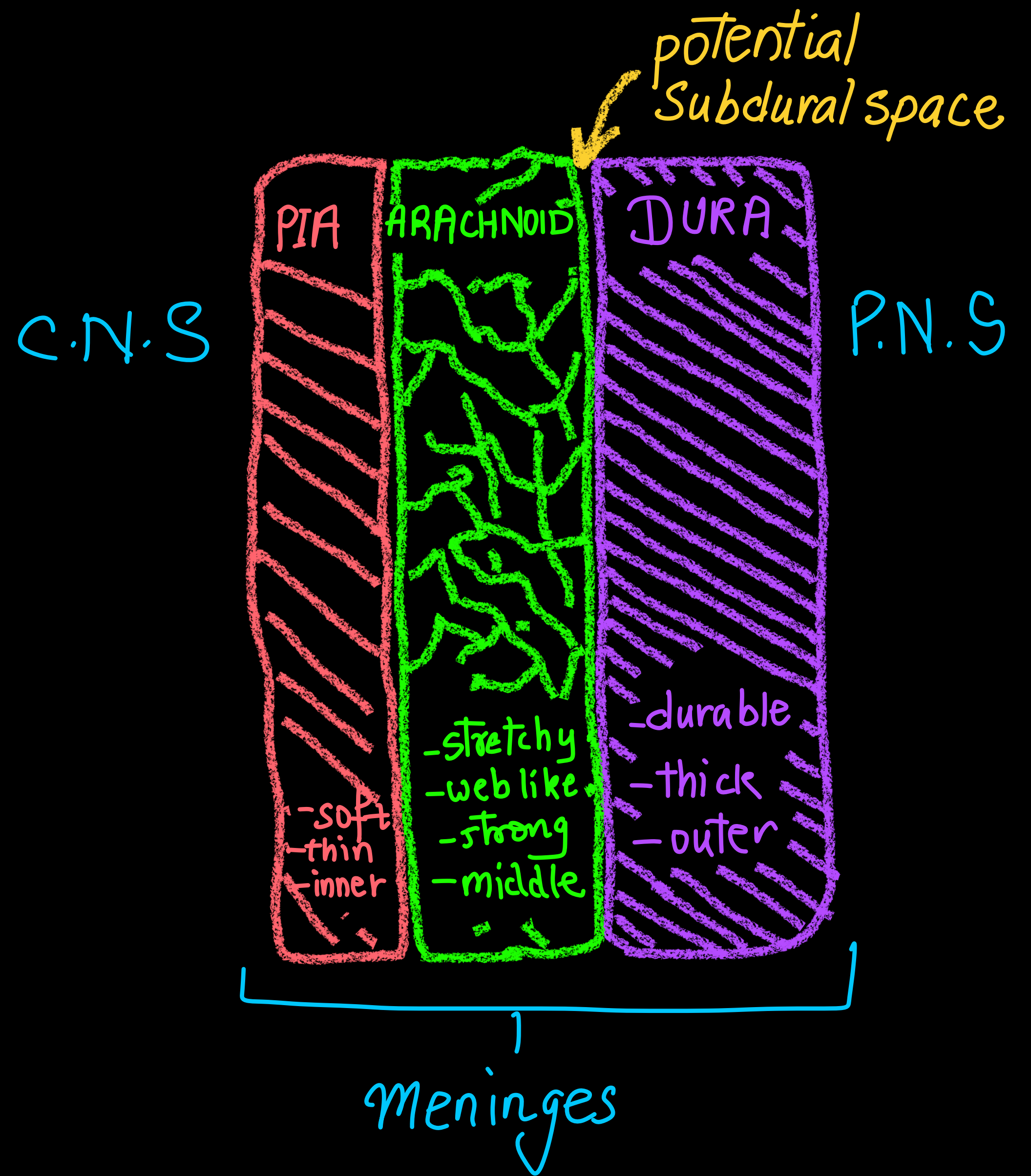
Hi! Welcome

- I am a curious Computer Engineer.
- Suffered Acute Subdural Hematoma due to an accident
- Its pain sowed a seed of curiosity for course
- And now analysing injury in this assignment

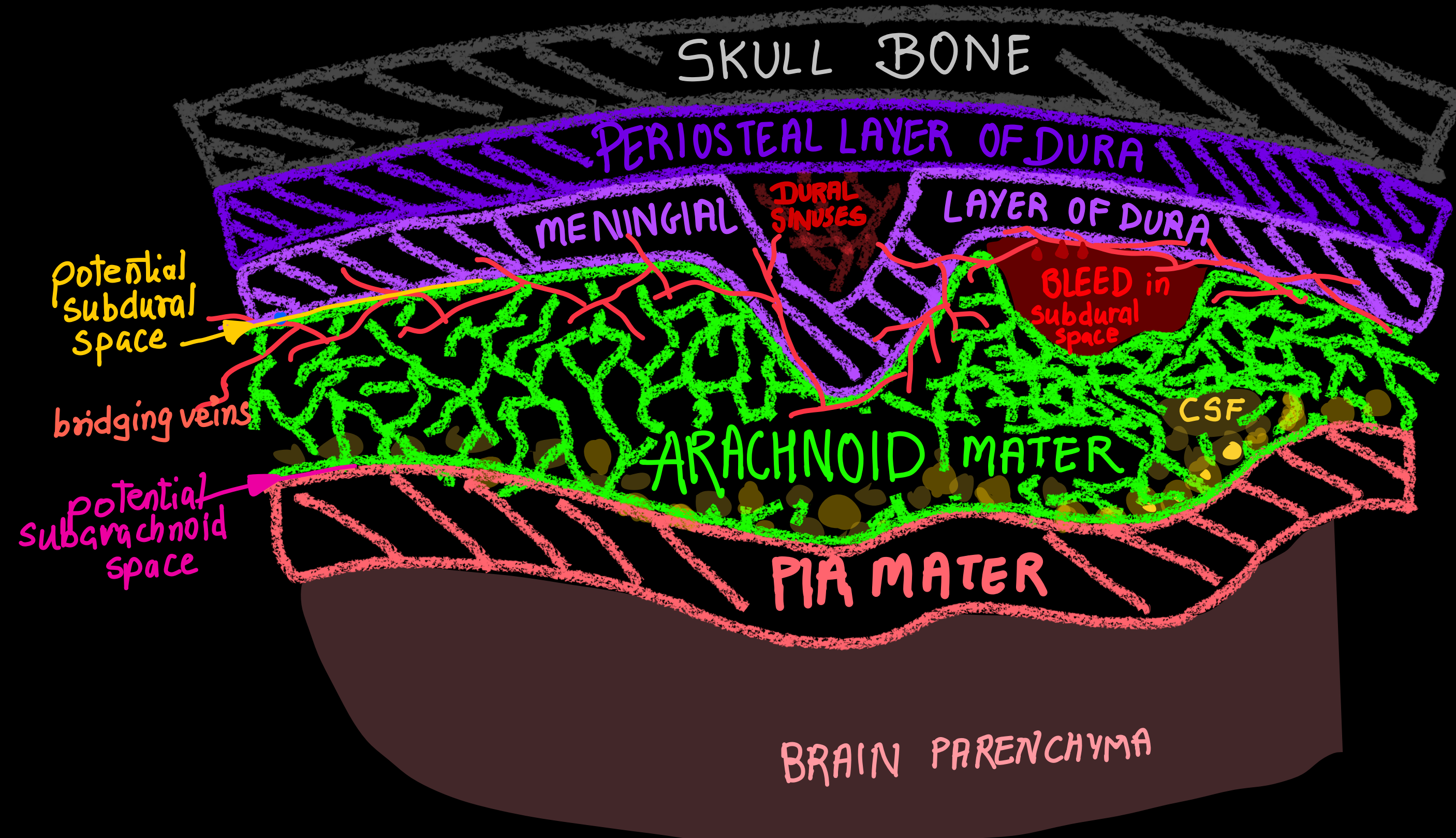
Let's analyse injury from higher levels to lower levels of abstraction:

Subdural space

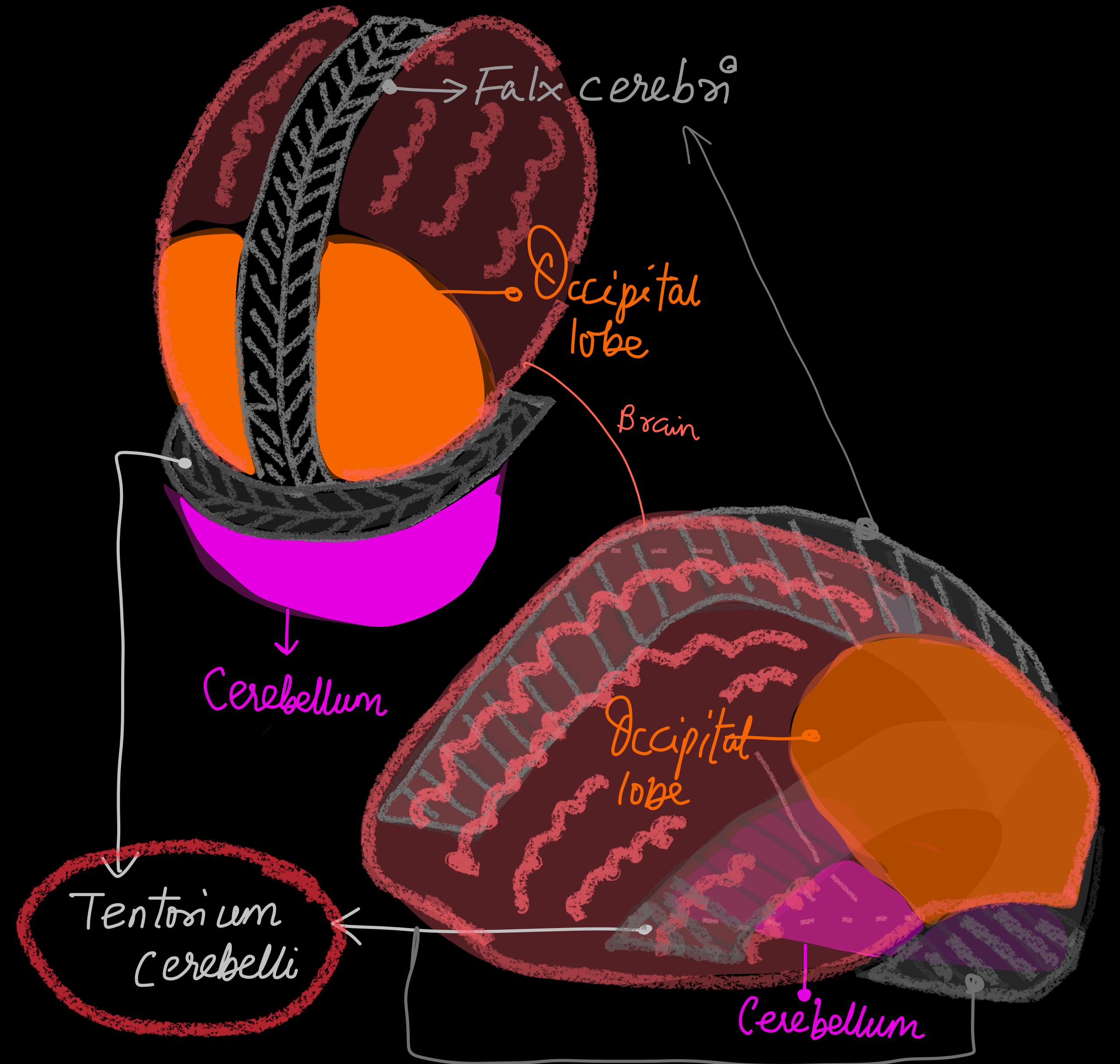
- My injury concerns Meninges that line the skull to enclose the brain.
- The 3 layers of Meninges are, Pia mater, Arachnoid mater, and Dura mater
- Between Arachnoid and Dura layers, there's a potential space called **Subdural space**.
- When due to an accident/age, blood clotting happens in this space, it's called **SUBDURAL HEMATOMA**.



- Blood clot swells, increasing pressure on the brain, disrupting normal functions
- **Bridging veins** crossing these layers contribute more blood into it, as they burst due to rapid acceleration or deceleration movements (motor accident)
- The lower meningeal layer of dura invaginates to form **folds of dura**



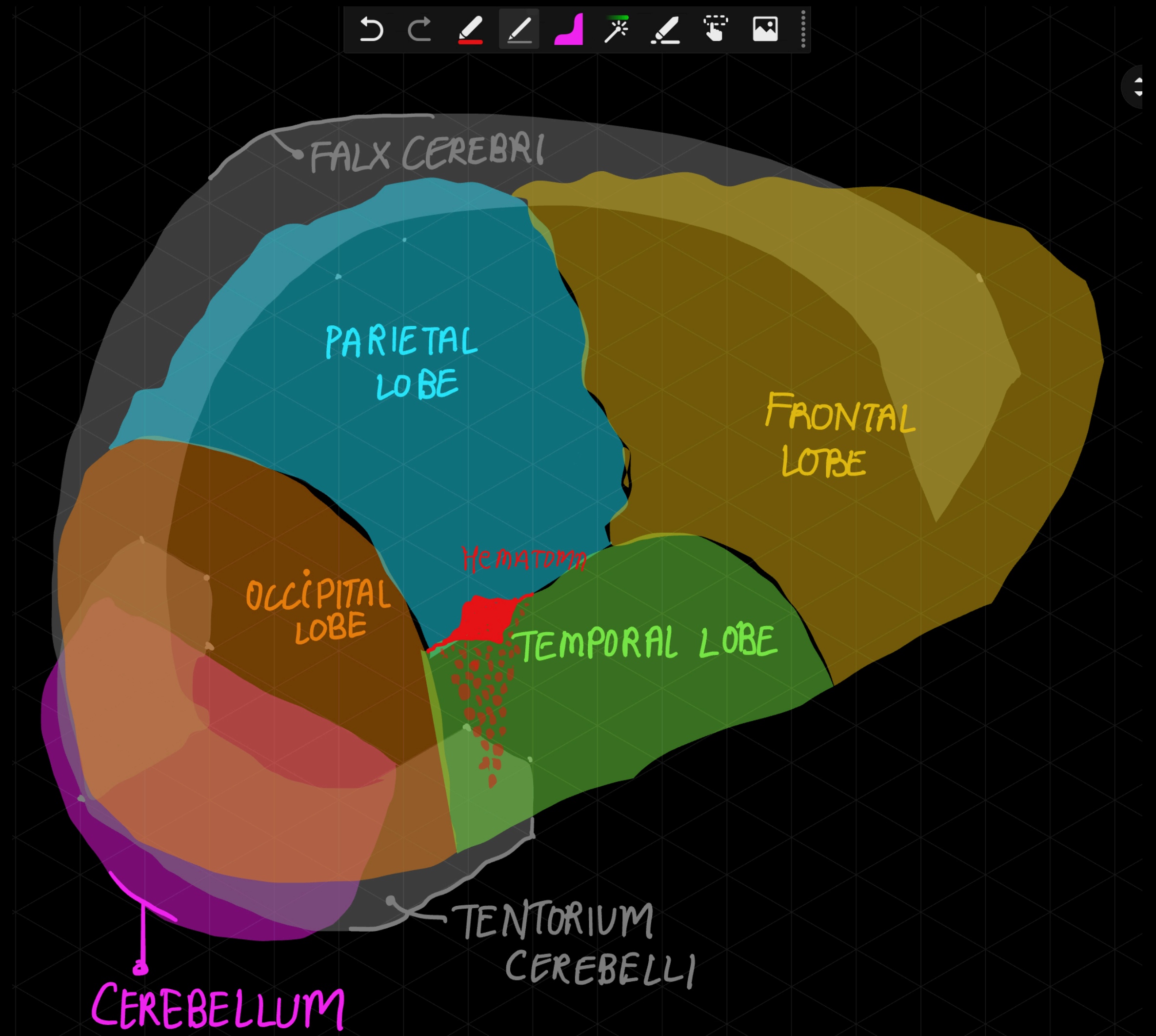
- The folds of Dura compartmentalise the cranial cavity, preventing brain from displacement
- These folds are Falx cerebri, **Tentorium cerebelli**, Falx cerebelli and Diaphragma sellae
- The tentorium cerebelli is a U-shaped tent like, horizontally slant fold of dura separating the cerebellum and occipital lobes.
- In my injury blood spread into the Tentorium cerebelli as well, which we will later connect to symptoms



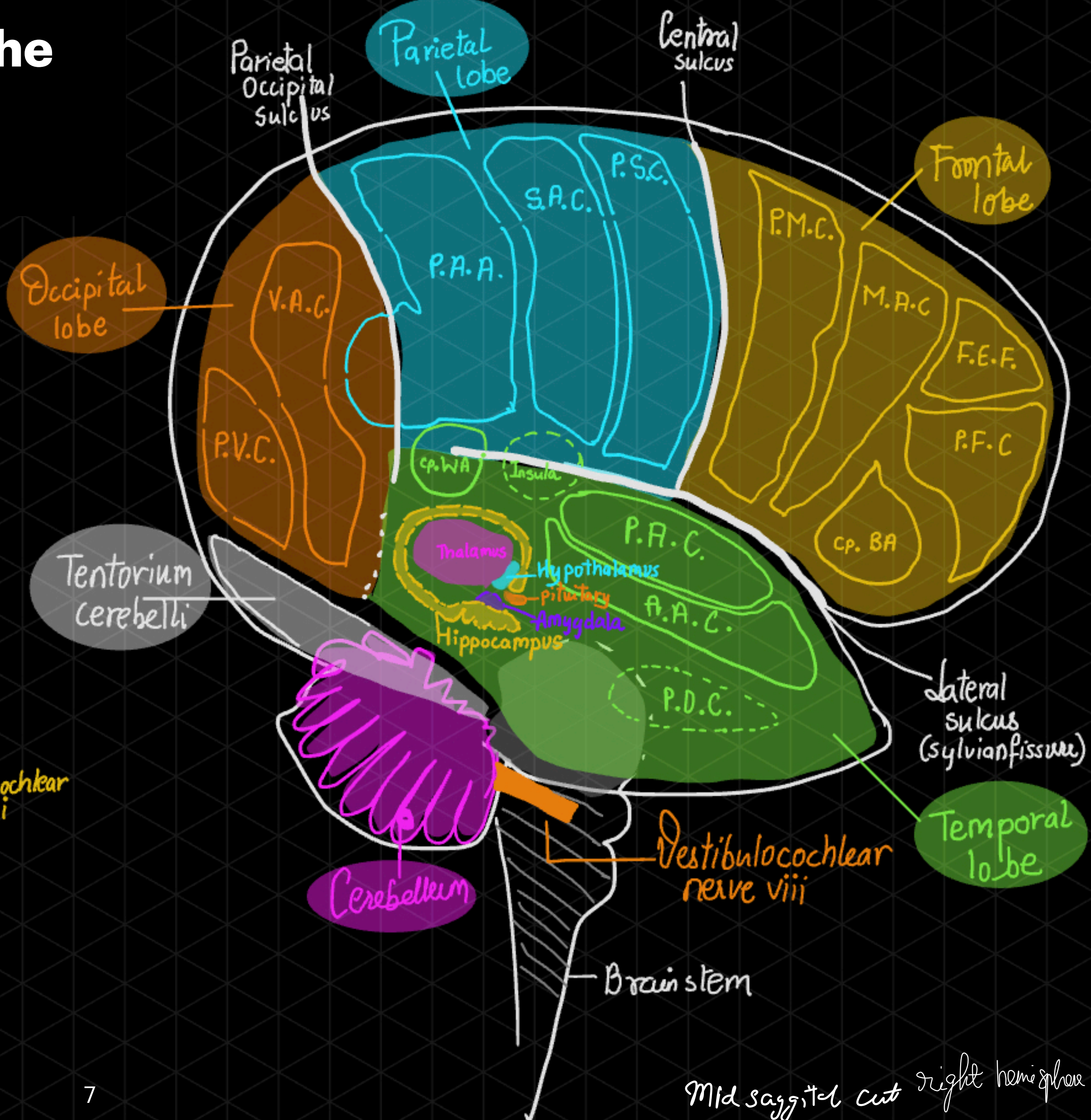
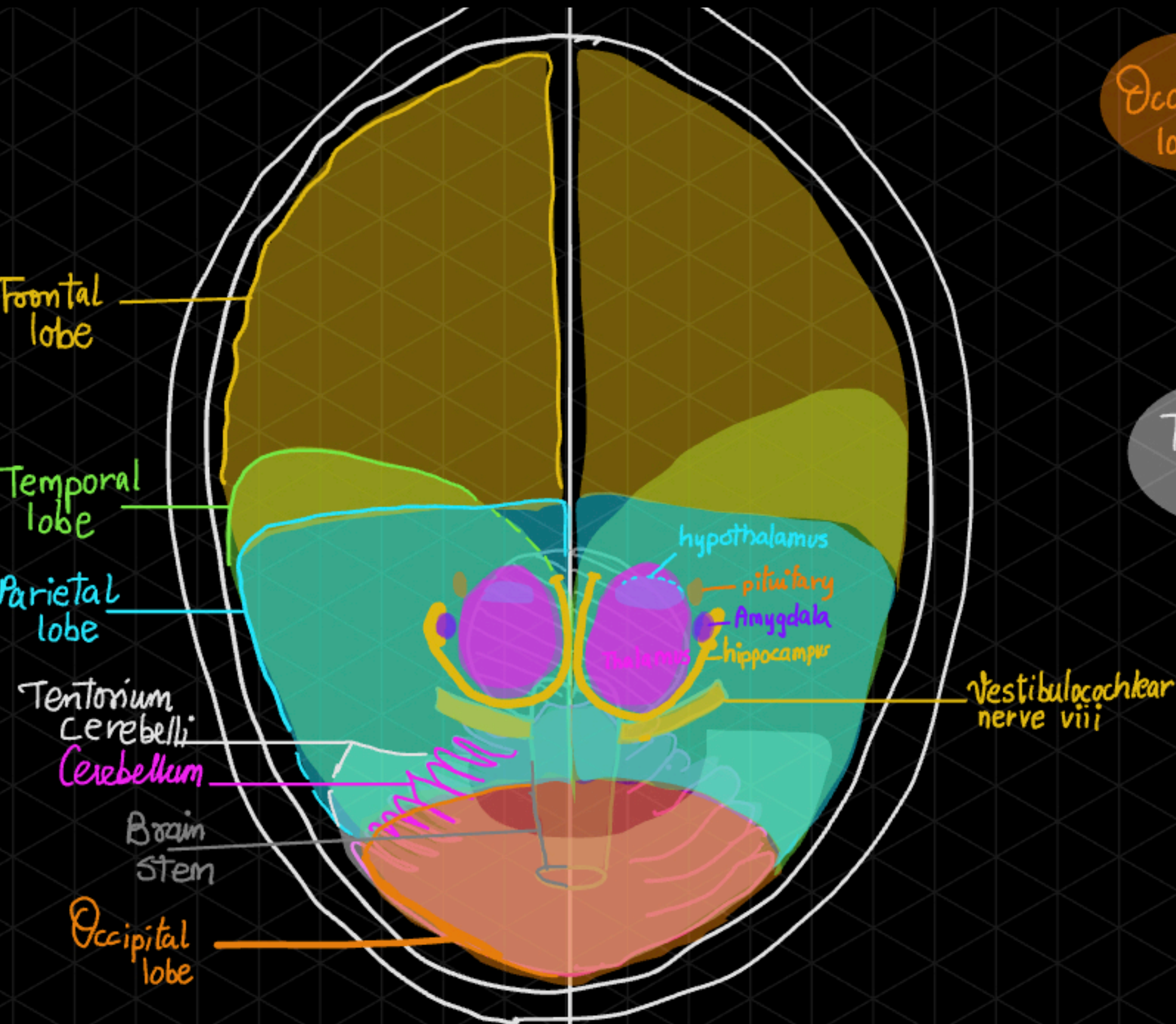
Acuteness of injury

Depending on onset of symptoms Hematomas are classified as being :

- Acute: symptoms show within minutes to 2-3 days.
- Sub-acute: symptoms appear days or weeks after head injury
- Chronic: symptoms may not appear for weeks or months.



You can zoom, take an overview of the brain before we dive into areas pertaining injury.



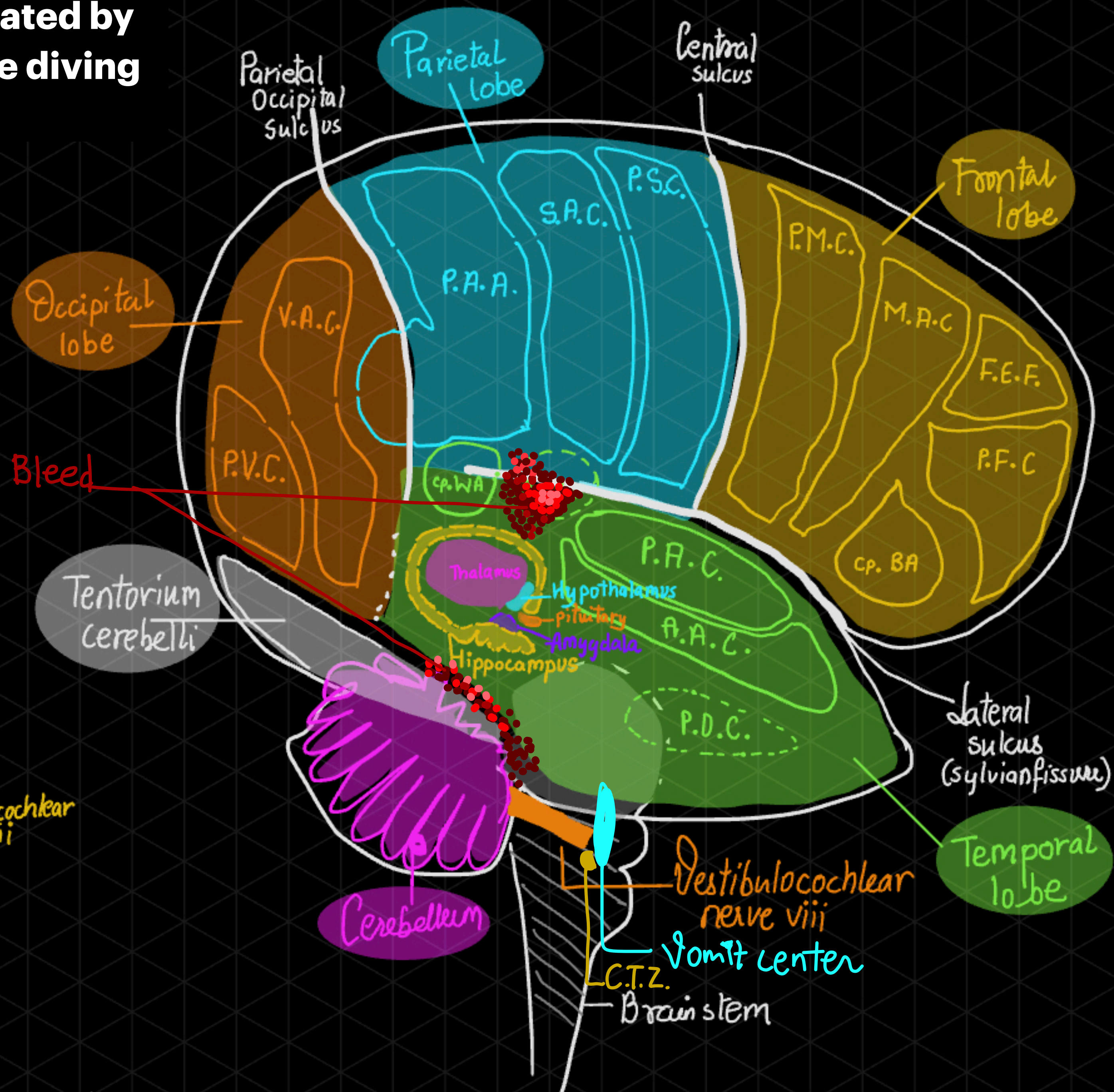
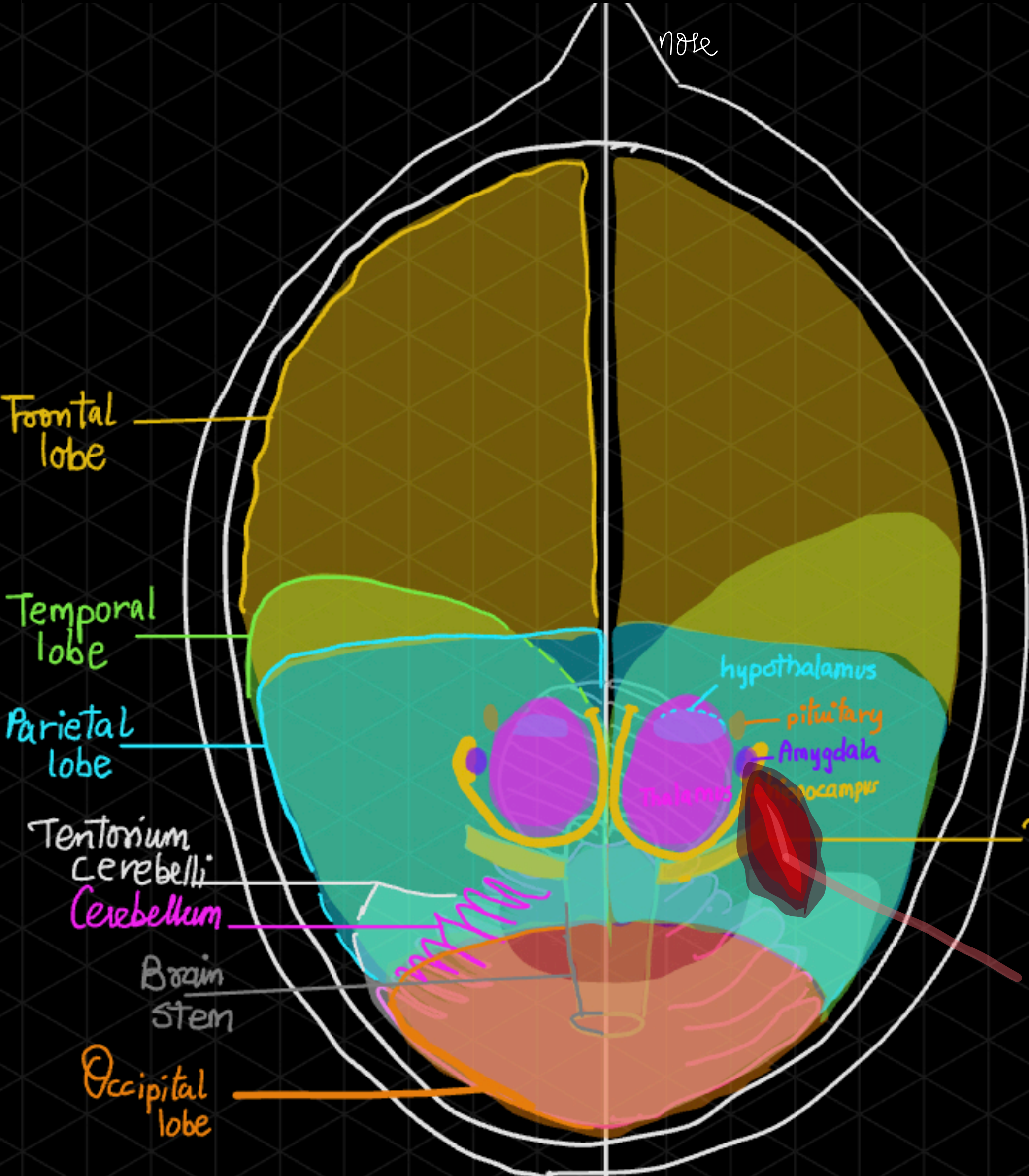
Horizontal cut

Mid sagittal cut right hemisphere

**Now let's learn injury area and try
to visualise :**

**Acute Subdural Hematoma
(in right parietal-temporal
convexities and tentorium
cerebelli)**

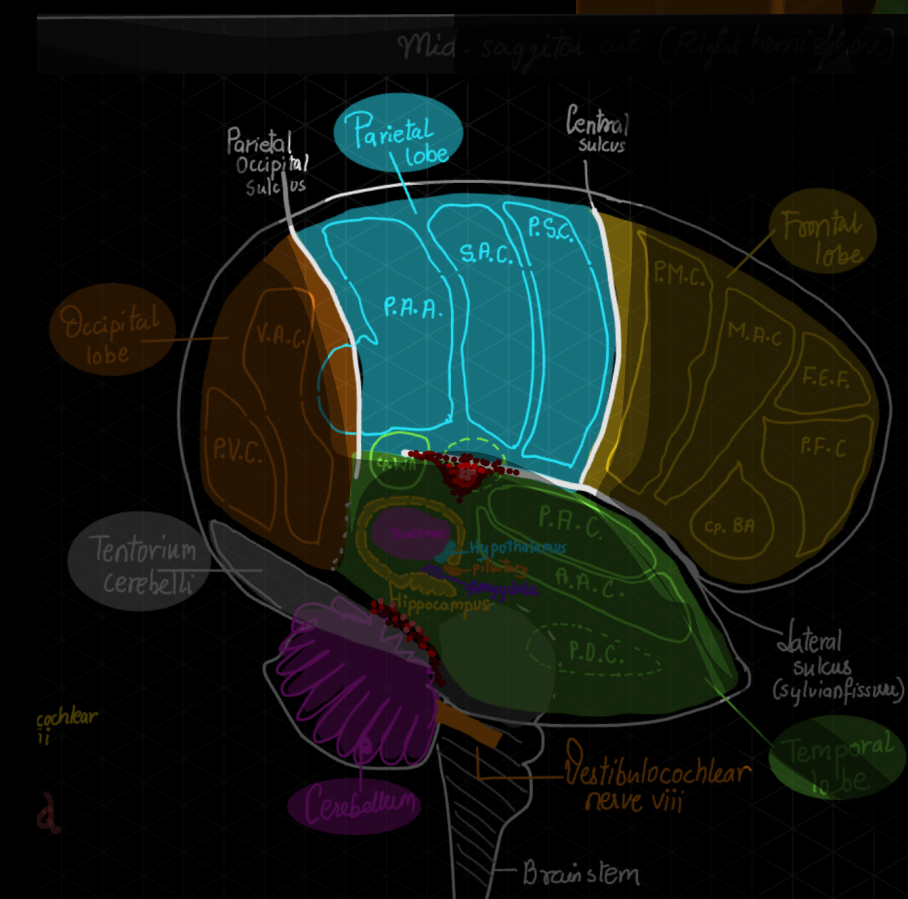
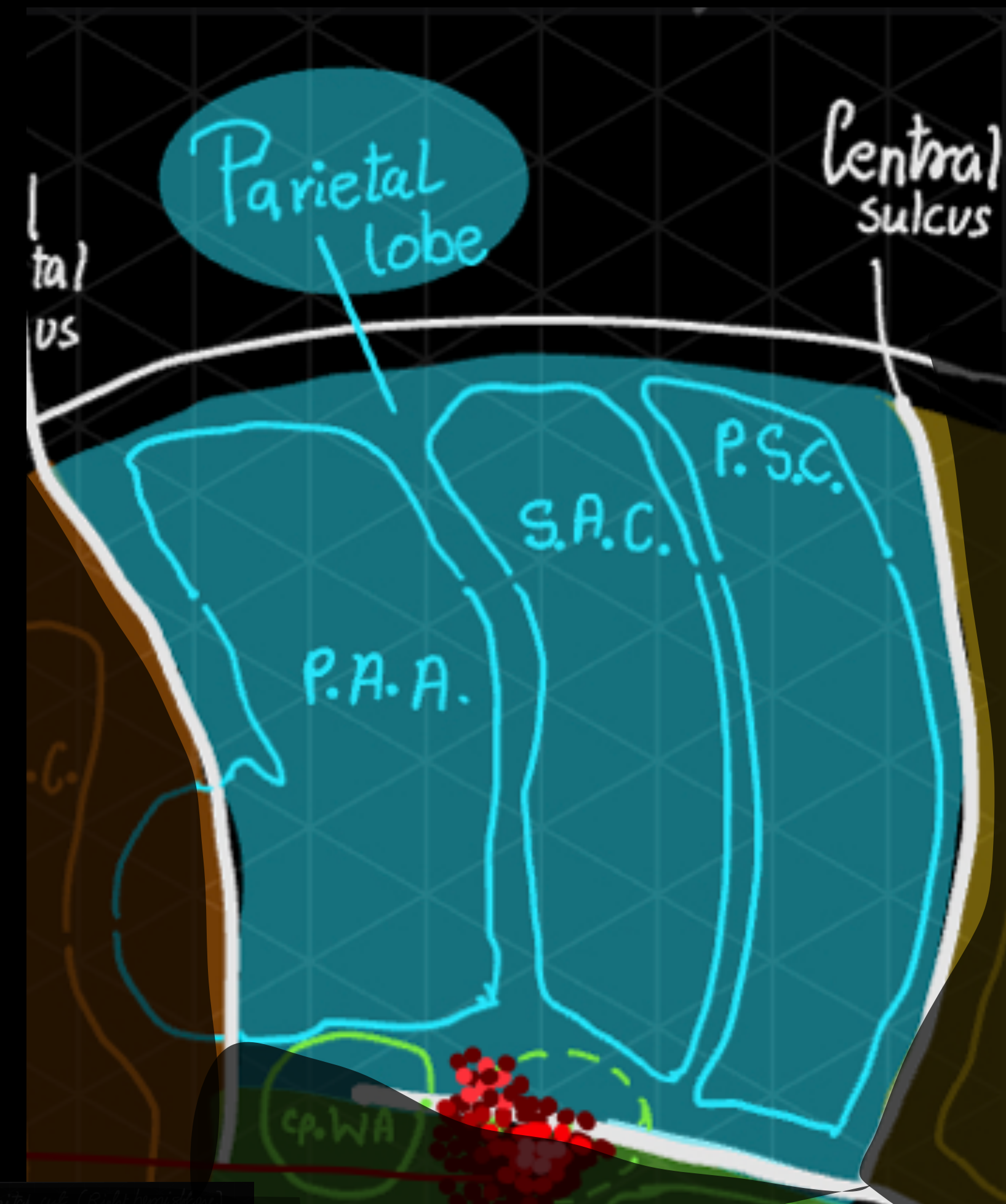
Observe probable area of bleed in red, approximated by me from my case file, observed symptoms, before diving into affected parts



Functions of affected lobes

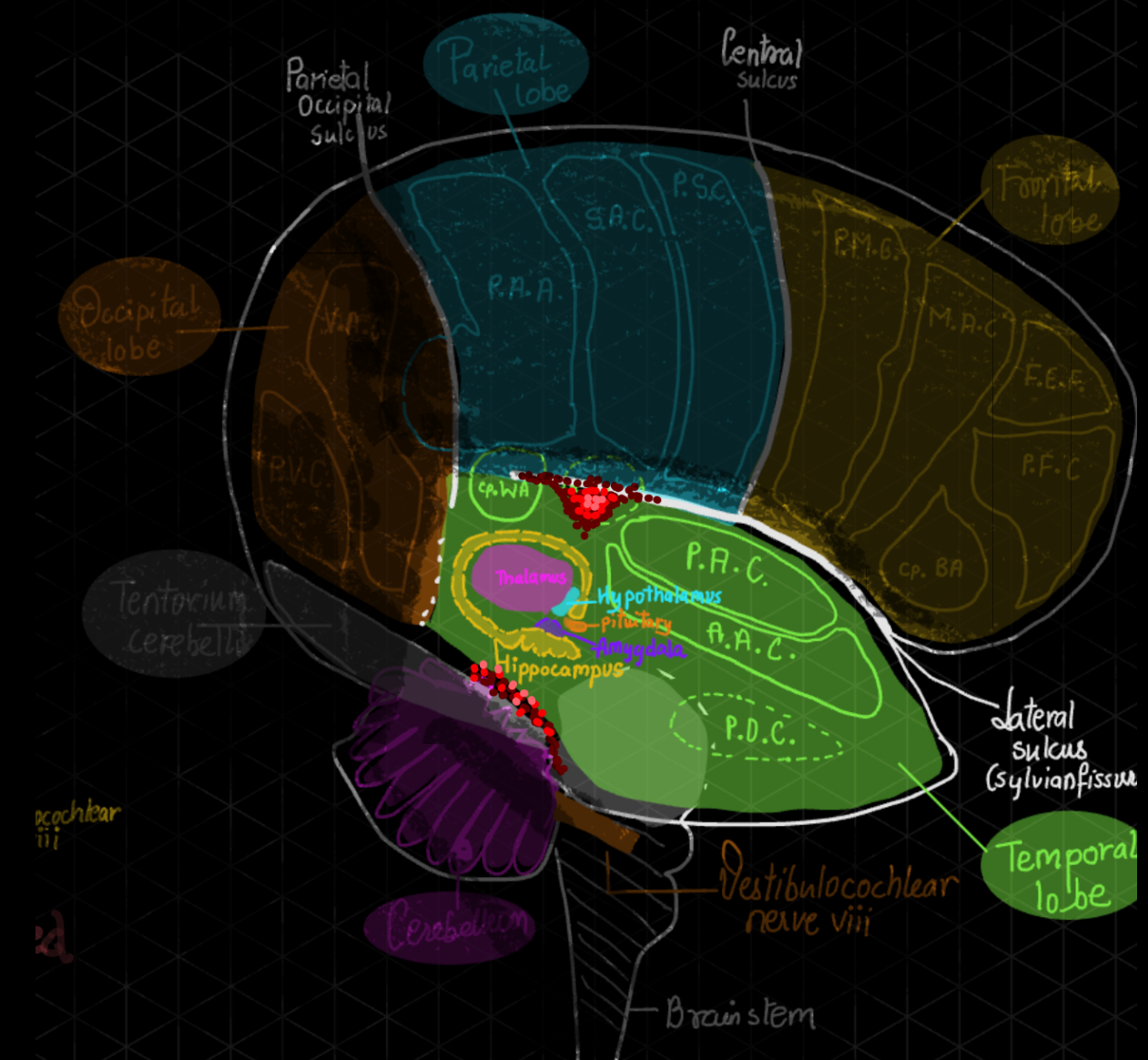
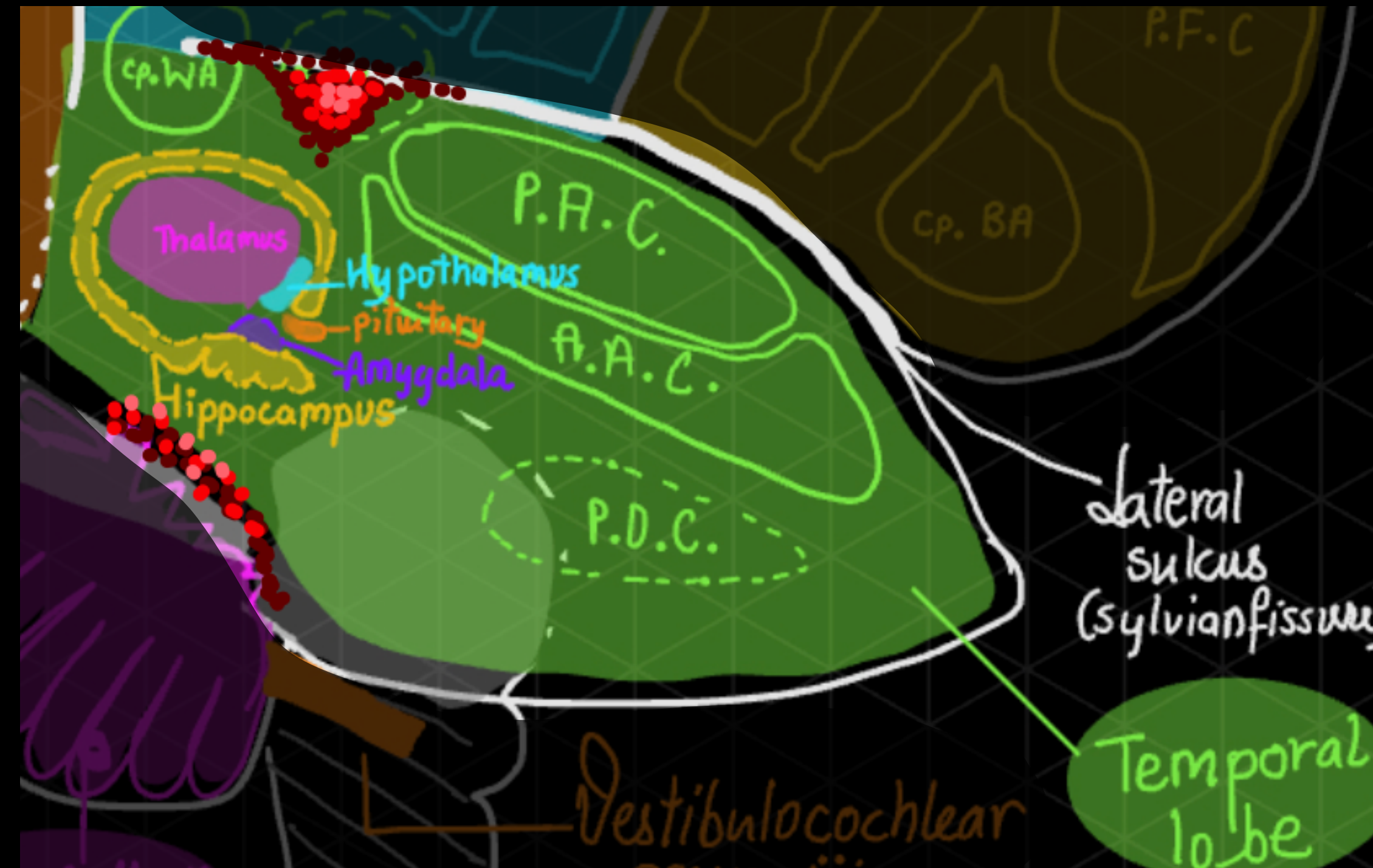
Parietal lobe contains:

- **Primary Somatosensory Cortex (P.S.C.):** Which receives sensory inputs for bringing into awareness sensations like fine touch, proprioception, vibration, pressure
- **Somatosensory Association Cortex (S.A.C.):** analyses, recognises, categorises sensations received by P.S.C.
- **Posterior Association Area (P.A.A.):** forms associations between multimodal sensations like vision, audition, sensations coming from the primary visual, auditory and sensory cortices, for spatial coordination
- Damage to parietal lobe can cause hemi-spatial neglect of body or space, problems in proprioception, hand-eye coordination, keeping balance, numbness to sensory inputs (touch, taste)
- In my case, keeping balance, walking straight and taste was affected.



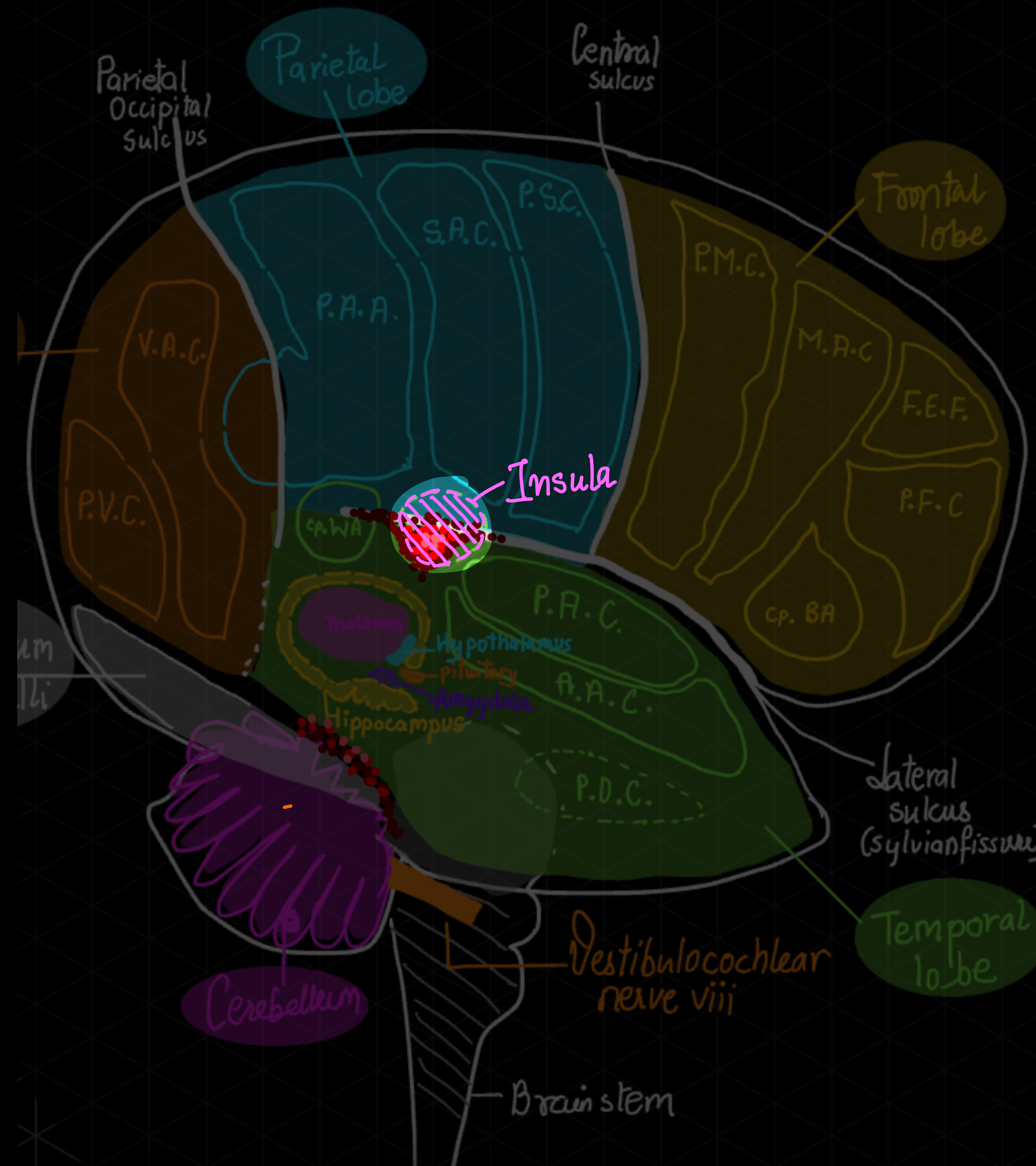
Temporal Lobe contains:

- **Primary Auditory Cortex (P.A.C.):** receives sensations for awareness of sound, pitch, location, frequency
- **Auditory Association Cortex (A.A.C.):** analyses and recognises the sound received by P.A.C.
- Wernicke area's right hemisphere counterpart (**cp W.A.:**) responsible for comprehension of prosody
- **Primary Olfactory Cortex (P.O.C):** awareness and association of smell
- Damage to temporal lobe can cause problems with comprehension of prosody, impaired memory functions (amnesia), disturbance to what we see and hear etc.
- In my case contusion was focal to temporal lobe, but affected its deeper structures



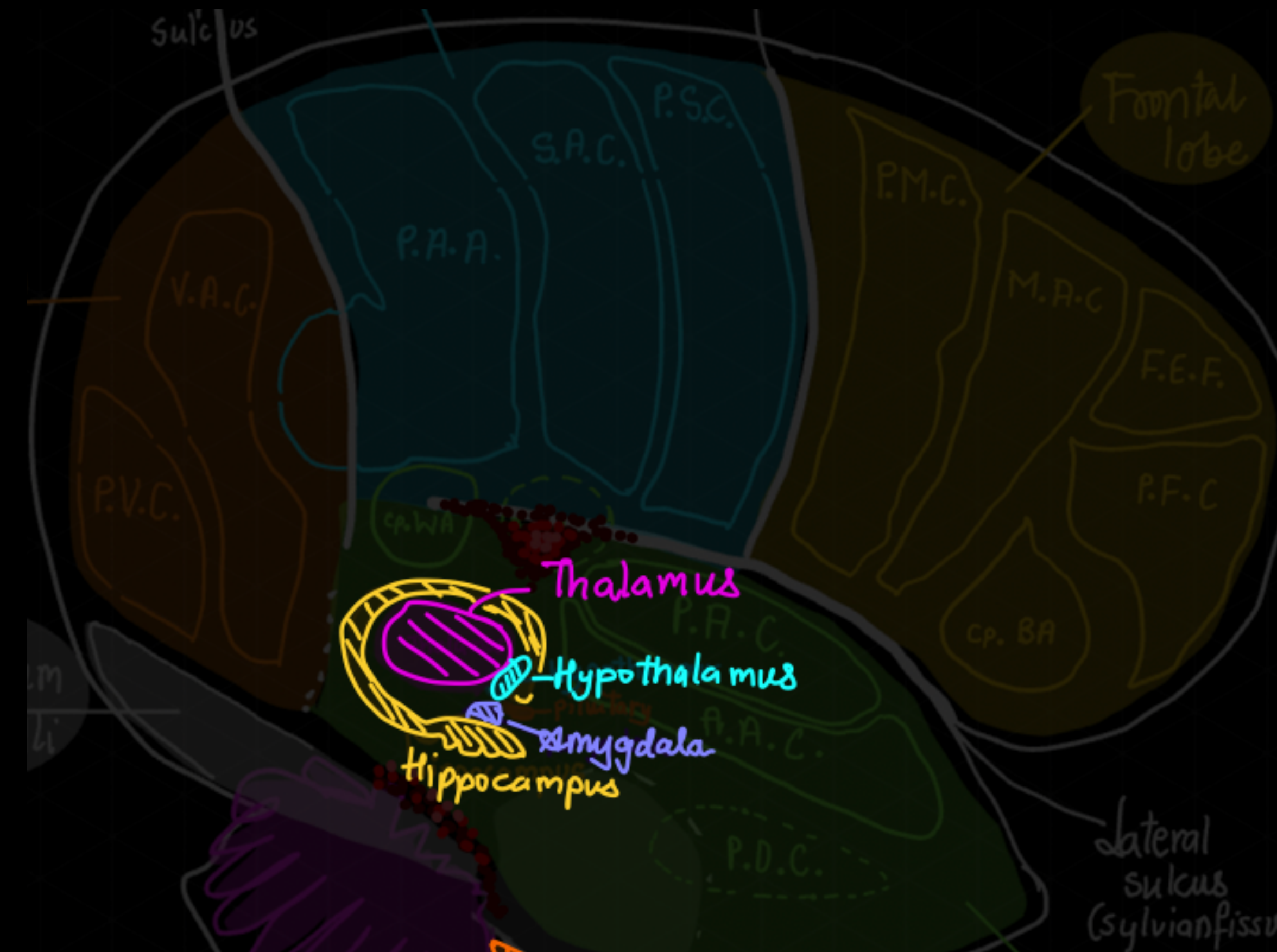
Insula

- Deep in temporal lobe
- It's responsible for receiving, recognising, associating taste, visceral sensations (GI tract etc, make associations regarding vestibular sensations, movements
- It also has a role in many homeostatic functions, and in regulation of immune system
- In my case as insula pressure affected with dizziness, nausea/vomiting, difficulty in balance



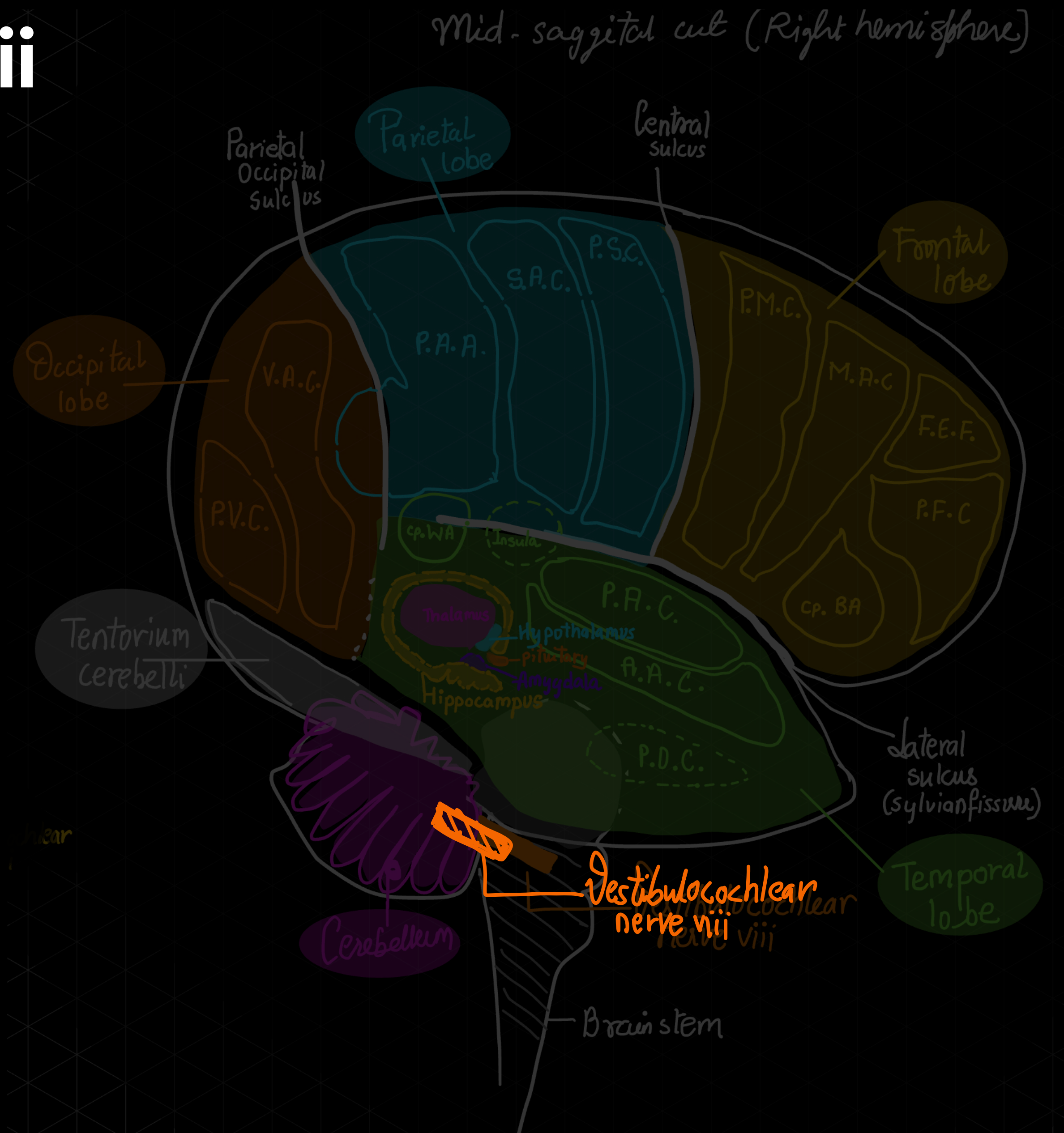
Limbic system deep in temporal lobe

- THALAMUS : is like a junction where sensory information gets interpreted and filtered before send to higher lobes.
- HYPOTHALAMUS:- controls hormonal systems so damage can cause problems in hormonal balance
- HIPPOCAMPUS: has major role in memory and learning damage affects those functions
- AMYGDALA: Defines, regulates and associates our experiences(in memory) with emotions. Damage Can cause problems with linking emotions to memory or processing memories, can lead to abnormal emotional reactions and decision making, personality changes, (right amygdala) heavy increase in fear and sadness, can even affect retention of episodic memory as strength of episodic memory depends on strength of our emotions while experiencing
- In my case mild retrograde amnesia, personality change, dizziness, sleep problems, irritability to stimulus, hormonal imbalance was caused by pressure on these structures.



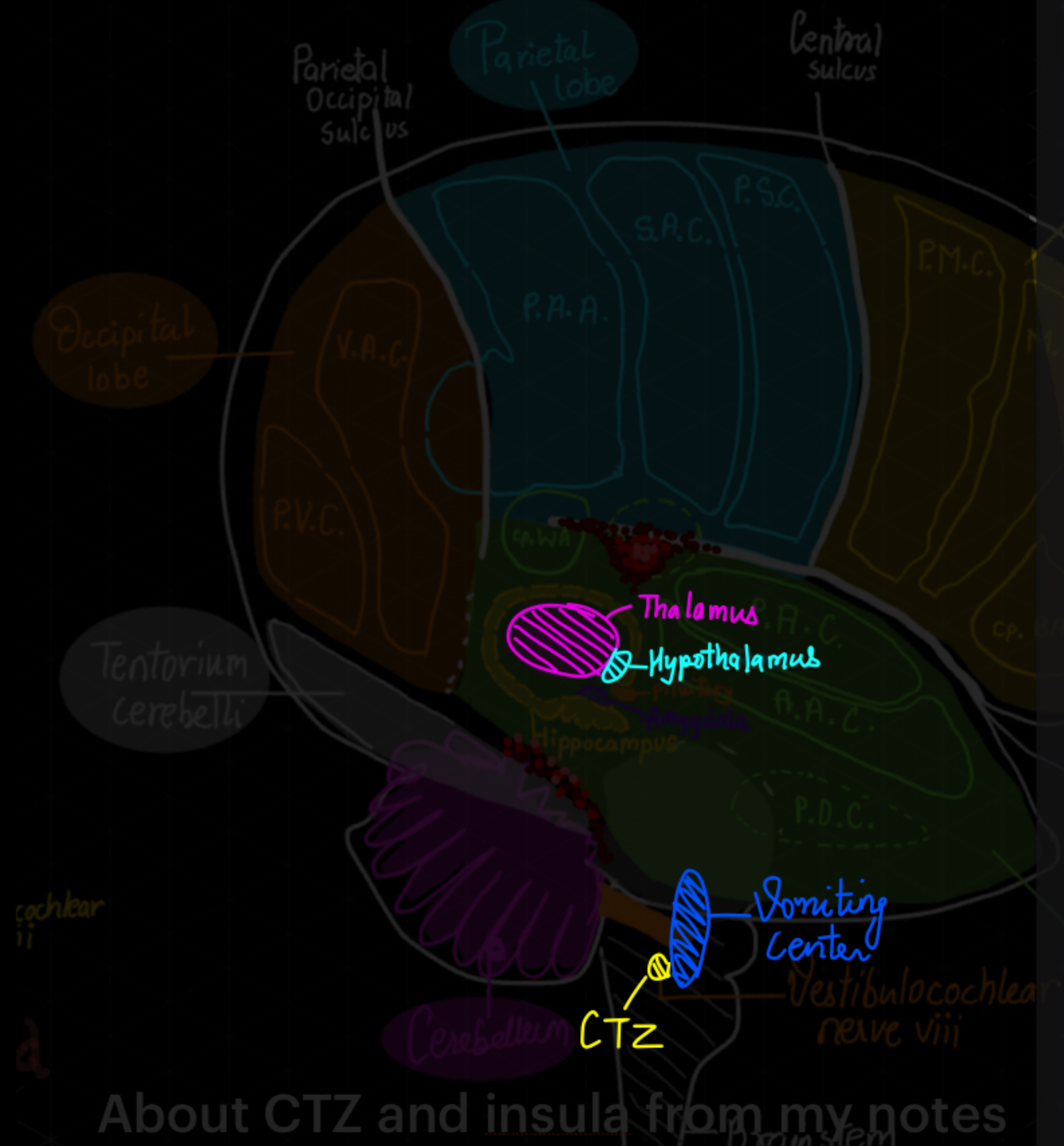
Vestibulocochlear nerve viii

- There are 12 cranial nerves that send communication between brain and various body parts
- The vestibulocochlear nerve viii carries information about position, movements, space.
- It splits into two, vestibular nerve is to maintain body balance, eye movements while cochlear nerve is for hearing
- In my case it affected functions of balance, nystagmus etc.



Vomiting Center and CTZ

- The Vomiting centre initiates vomiting response, based on inputs from Chemoreceptor Trigger Zone (CTZ) in the medulla.
- The CTZ response get heightened or inhibited based on the traumatic brain injury
- The vomiting center receives input from GI tract and vestibular systems besides CTZ to decide its response.
- Affect on any one of the following can trigger vomiting response




About CTZ and insula from my notes

MY SYMPTOMS/AFFECTED FUNCTIONS:

- Loss of consciousness for 2 hrs
- No memory of moments leading to accident
- Unbearable constantly exacerbating headache
- Constant Sleepiness with trouble falling asleep, irregular sleep
- Dizziness
- Loss of balance
- Difficulty in walking
- Nausea and vomiting
- Loss of appetite, sense of taste
- Personality change, fitfully angry, depressed, fearful, no filter in responses, few instances of seeing ghost like figures
- Extremely irritated by light, loud sounds, electronic screens
- Horizontal Nystagmus (rapid eye movements, due to vestibular system issue, but for me did not affect vision)
- Hormonal imbalances like period delayed by months, dermal problems, acne etc.

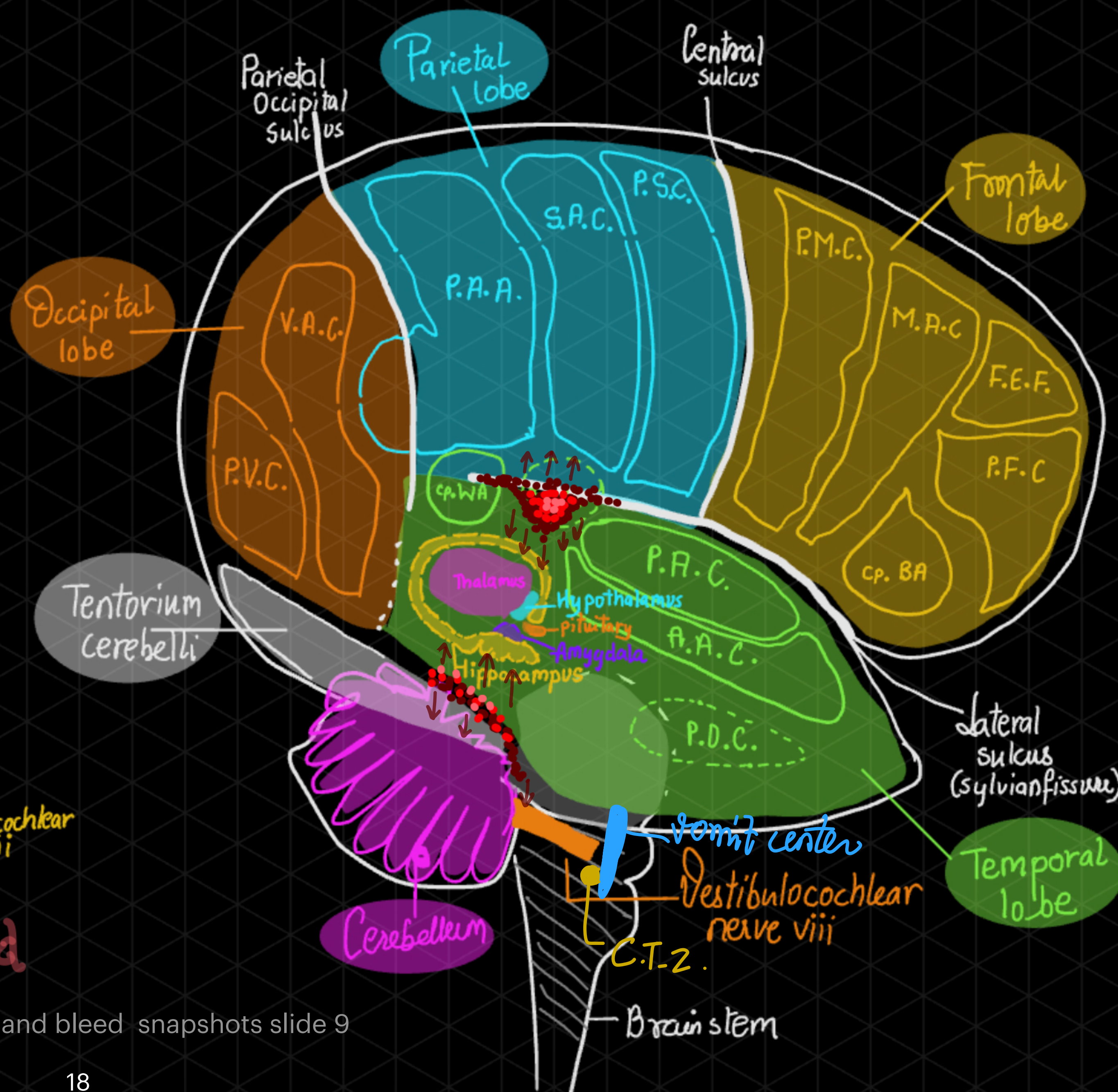
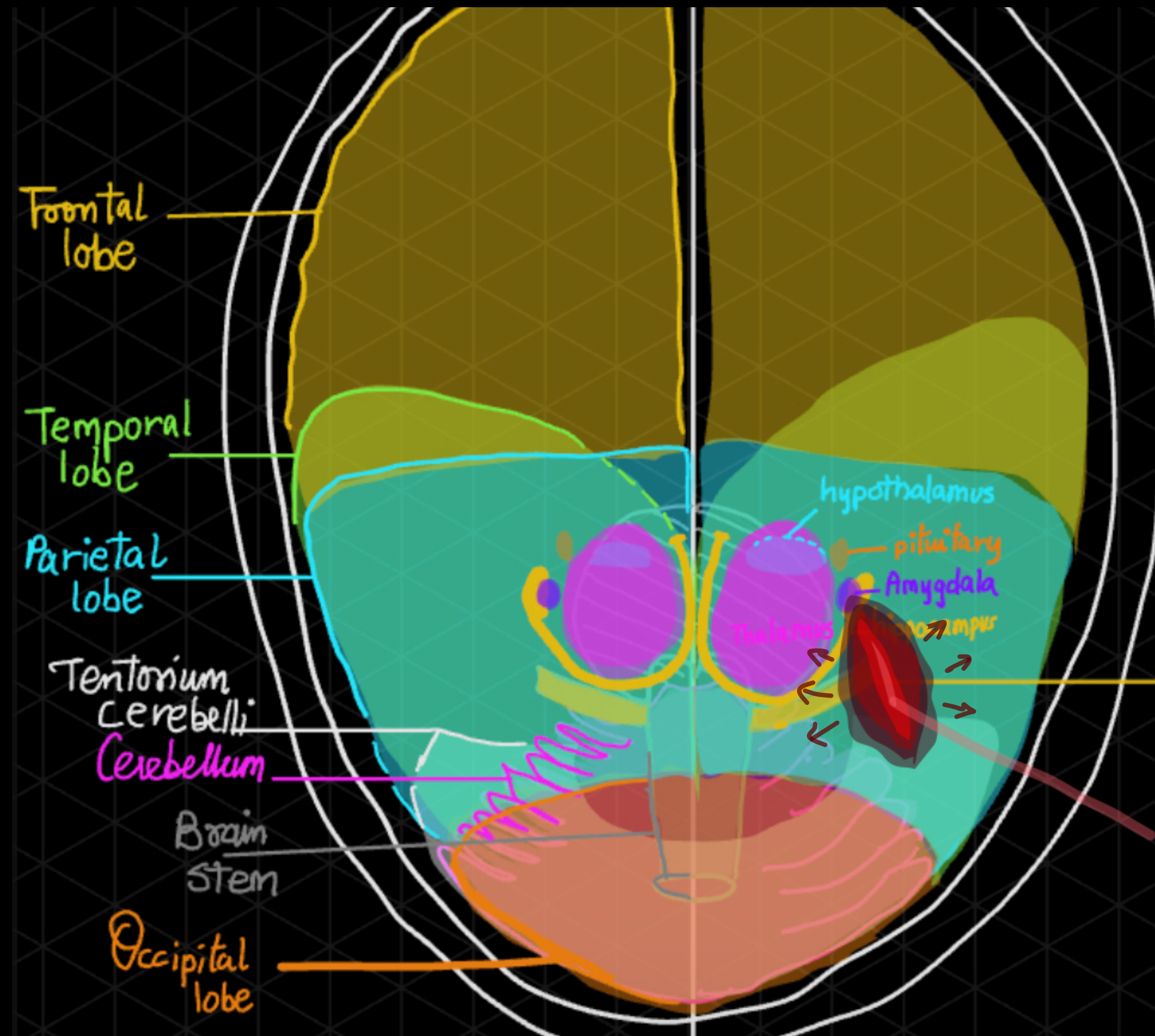
Created own table for My Case

 Parts probably responsible for functions	Parietal lobe			Temporal lobe							Vomit centre	Vestibulo cochlear nerve VIII	Cerebellum & Tentorium Cerebelli	
	P.S.C.	S.A.C.	P.A.A.	P.A.C.	A.A.C.	P.D.C.	Insula	Thalamus	Hypo thalamus	hippo campus	amygdala	CTZ	CN 8	
Symptoms, affected functions														
① Loss of consciousness (< 3hrs)	Sudden acceleration/deceleration cause disruption in neural connections/activity. ∴ Fainting is shock response by Autonomic Nervous System switching from sympathetic tone to parasympathetic for controlling blood loss injury.													
② Retrograde Amnesia (few moments upto accident)											✓		✓	✓
③ Unbearable headache constant	blood clotting in subdural space puts pressure on brain, bruises on area of injury hurt till healed & clot dissolve													
④ Dizziness			✓				✓	✓					✓	→ due to tentorium held TC
⑤ Problems with sleep, yet always sleepy							✓	✓	✓					
⑥ Nausea and Vomiting							✓					✓	→ TC	
⑦ loss of appetite, taste			✓						✓					
⑧ Personality change (interviewed Mom, what she noticed) ↳ threatening to kill ↳ crazy angry bouts ↳ heavily depressed thoughts ↳ lack of filter in responses ↳ loss of self confidence, hopelessness											✓			
⑨ Difficulty in walking, loss of balance		✓	✓				✓						✓	→ TC
⑩ Sudden irritability to light, sound stimulus				✓				light sensitive	✓				✓	→ TC light, sound sensitive
⑪ Nystagmus													✓	→ TC
⑫ Hormonal imbalances ↳ Sudden onset of acne ↳ late period after months ↳ depressed thoughts ↳ no libido etc.									✓					→ affects pituitary glands & hormones

Take a deep breath!

You now know more than I or my parents did when I was injured. Can probably help someone with Hematoma understand the source of their pain and probably educate people around them.

Mid-sagittal cut (Right hemisphere)

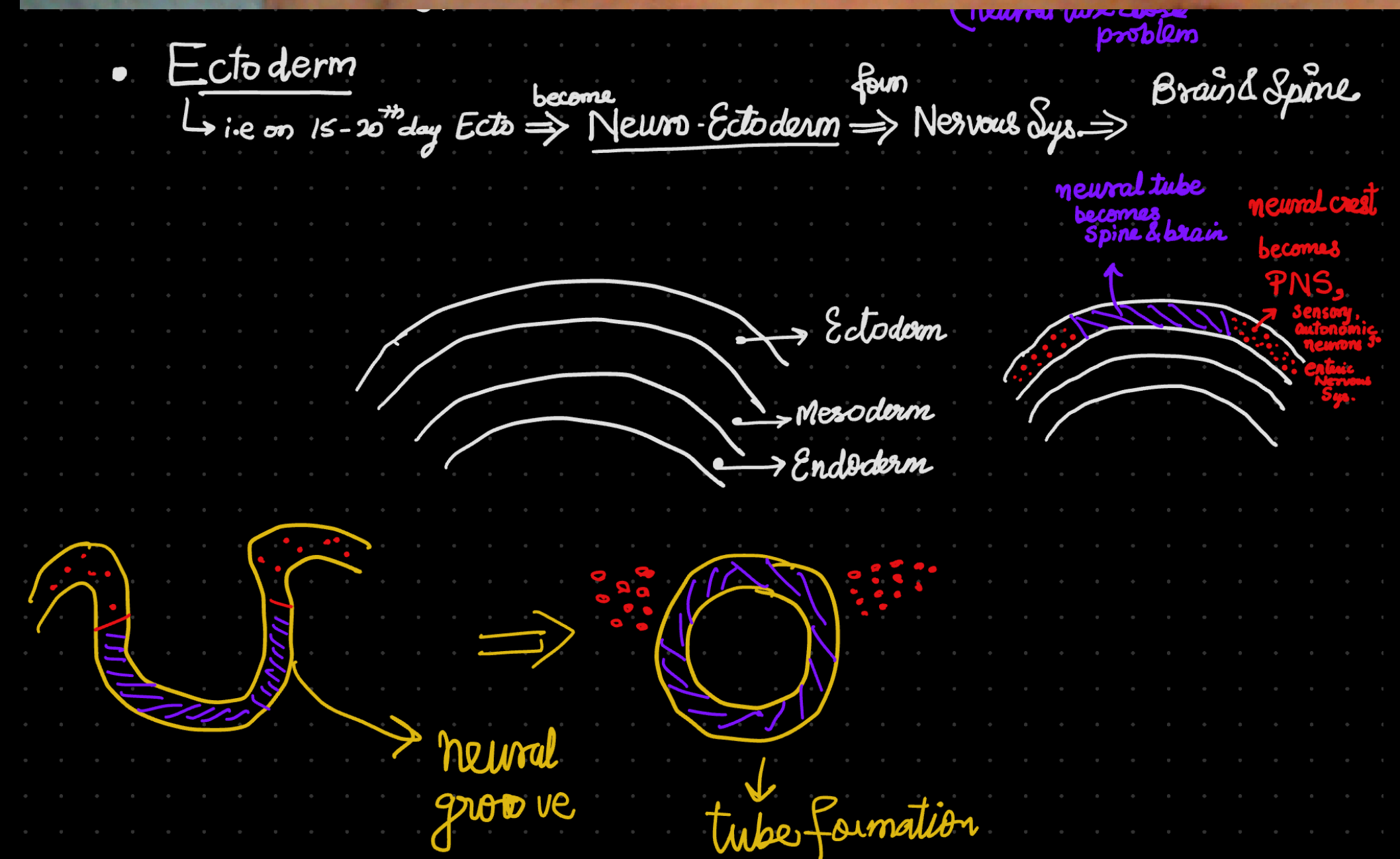
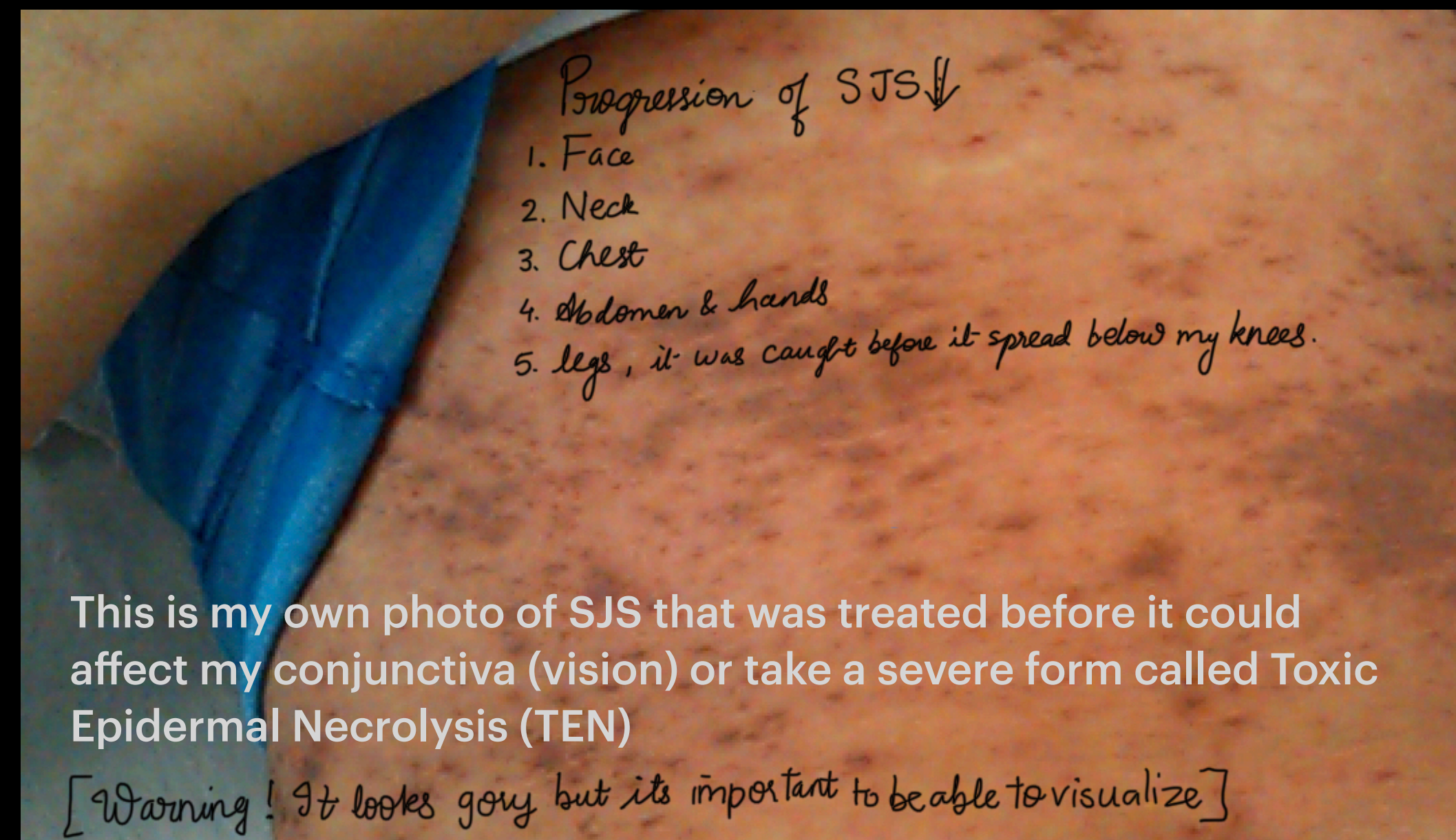


Lobes and bleed snapshots slide 9

**How this course
increased my empathy
and sensitivity**

Stevens Johnson Syndrome (SJS)

- I developed head injury medication (AEDs-phenytoin, valproate) induced autoimmune reaction Stevens Johnson Syndrome (SJS).
- In SJS first a few chicken pox like spots appeared on my face, then chest and soon turned to purple rashes, burn like blisters, acne all over body. Itching and ulcers all over lips, tongue, genitalia. Skin began very painfully peeling,
- But after this course I am fascinated by early neural development lectures, because SJS causes ulcers in the same epithelial tissues that form from ECTODERM layer from which brain and spine come as well. Seeing trauma in a new light.



Cousin with seizures and autoimmune disease

- My cousin had seizures ever since we were kids, I was scared of him until my own brain injury.
- Due to this course I am starting to interview him, talking about our injuries, diving into his case, affected areas, functions.
- His seizure medication still continues but I am trying to figure if his autoimmune disease Lupus is drug induced and if there's a real connection between coincidental timings of our autoimmune responses and our injury areas, like Insula etc. that play part in regulating immune system.

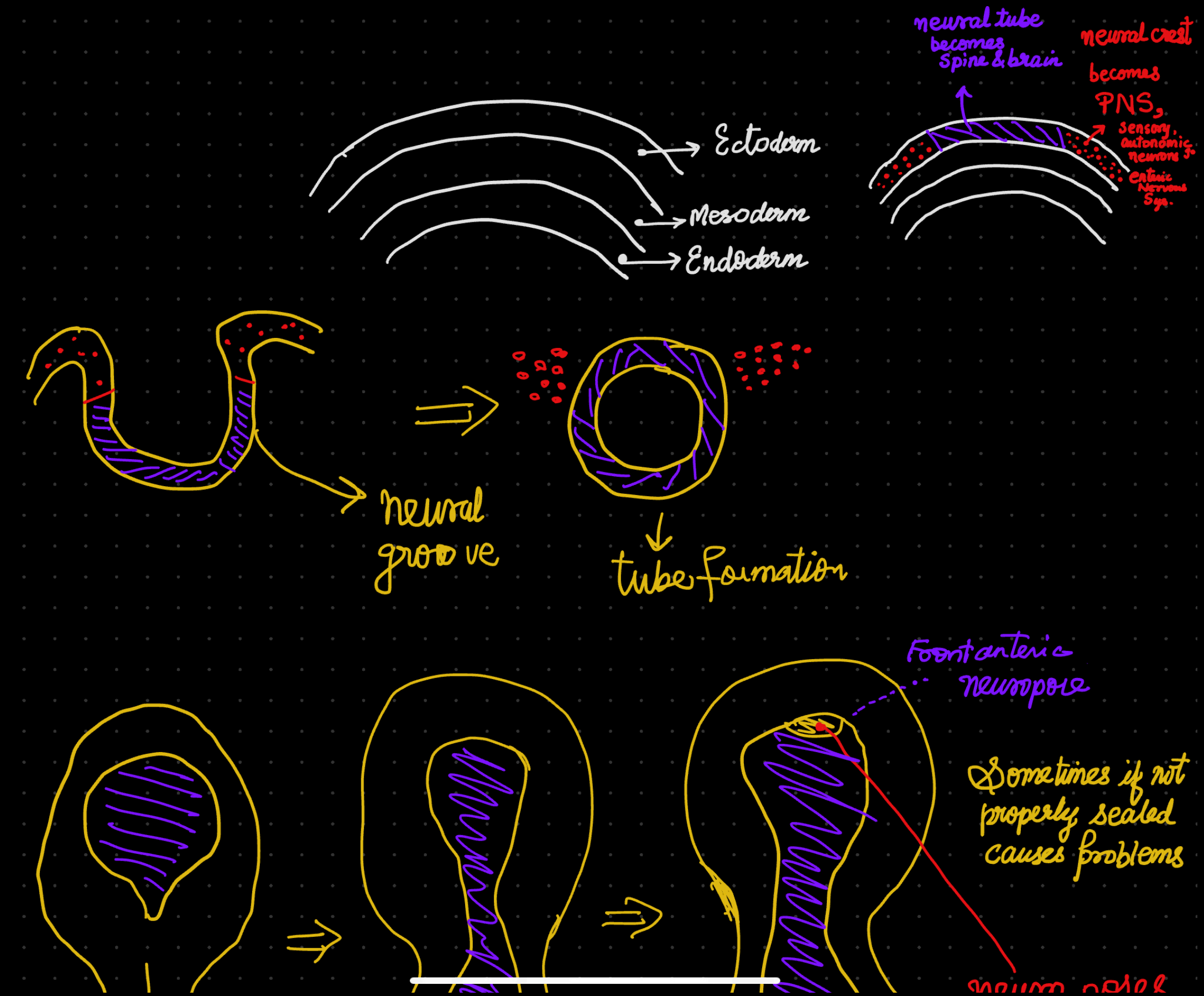
Early brain Development

↳ Birth of Nervous System on 15th-20th day of gestation.
 ↳ Embryo - 3 layers

- Ectoderm ⇒ outer ⇒ Nervous Sys. & Skin
- Mesoderm
- Endoderm

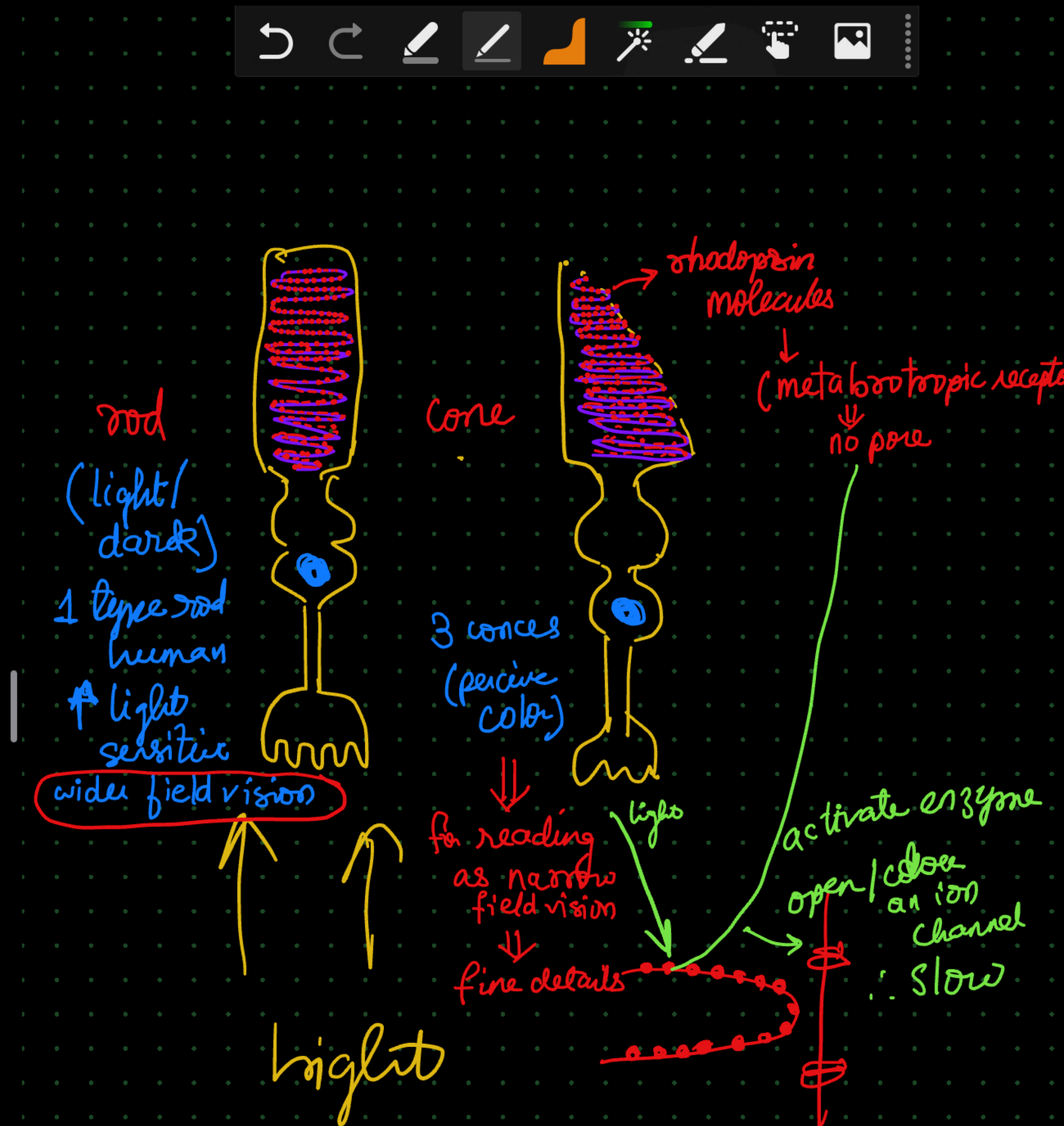
• since common origin some disorders involve both
 (Cranioachisis's neural tube close problem)

• Ectoderm
 ↳ i.e on 15-20th day Ecto ⇒ become Neuro-Ectoderm ⇒ form Nervous Sys. ⇒ Brain & Spine



Uncle with colourblindness

- As a kid, I had an uncle who often asked me, “Why does your mom wear such bright clothes but dresses you up in such dull, ashy clothes, what colour is it sweetie?”
- It felt confusing as a kid, because I always wore pink dresses. It felt as if he was making fun of me and my affinity for pink.
- But after Prof. Mason’s lecture on perception, though my uncle is dead, I finally understand why he refused to drive in cities (where we have traffic signals), why he asked me if my pink dress is ashy
- Adults of family knew about his colour perception (protanopia: red cones absent) but couldn’t explain it to me back then. Now I was able to explain it with my diagrams to my aunt, mom about rods, cones, colour perception, how it must’ve been in his world.



References

- All diagrams (slide 1-24), photos (slide 20), most phrasing are from my notes, made during this course, referencing my case files and memories of Neurologist appointments
- Diagrams slides no. 7-18, are snapshots of diagram on slide 9, from my notes on case file. Diagram on slide 4,5,6 are representations of my own imagination
- I have tried not to “quote” anyone or directly reference anything while making this assignment, relying on memory, not most accurate .
- But for reconfirmation of areas within diagram (slide 9) of my injury I did refer to a lecture by Prof. Zach Murphy at <https://www.ninjanerd.org/lecture/cerebral-cortex-anatomy-function-overview>, reference is given here once for all its snapshots, basic function descriptions.
- Diagrams (slide 3,20,21,22) were made during/after the Course lectures, over weeks 1-10 taught by Prof. Peggy Mason, so there is resemblance with her course diagrams.

Vote of thanks!

- **THANK YOU !!** For taking time to see my presentation, leaving a review.
- Thankful to life, for having recovered without suffering the worst cases possible towards healing, after a emotionally tumultuous phase but finally towards Neuroscience, being better to myself and others.
- Thankful to this Neurobiology course made with love by Prof.Mason, her team, Coursera.

THE END