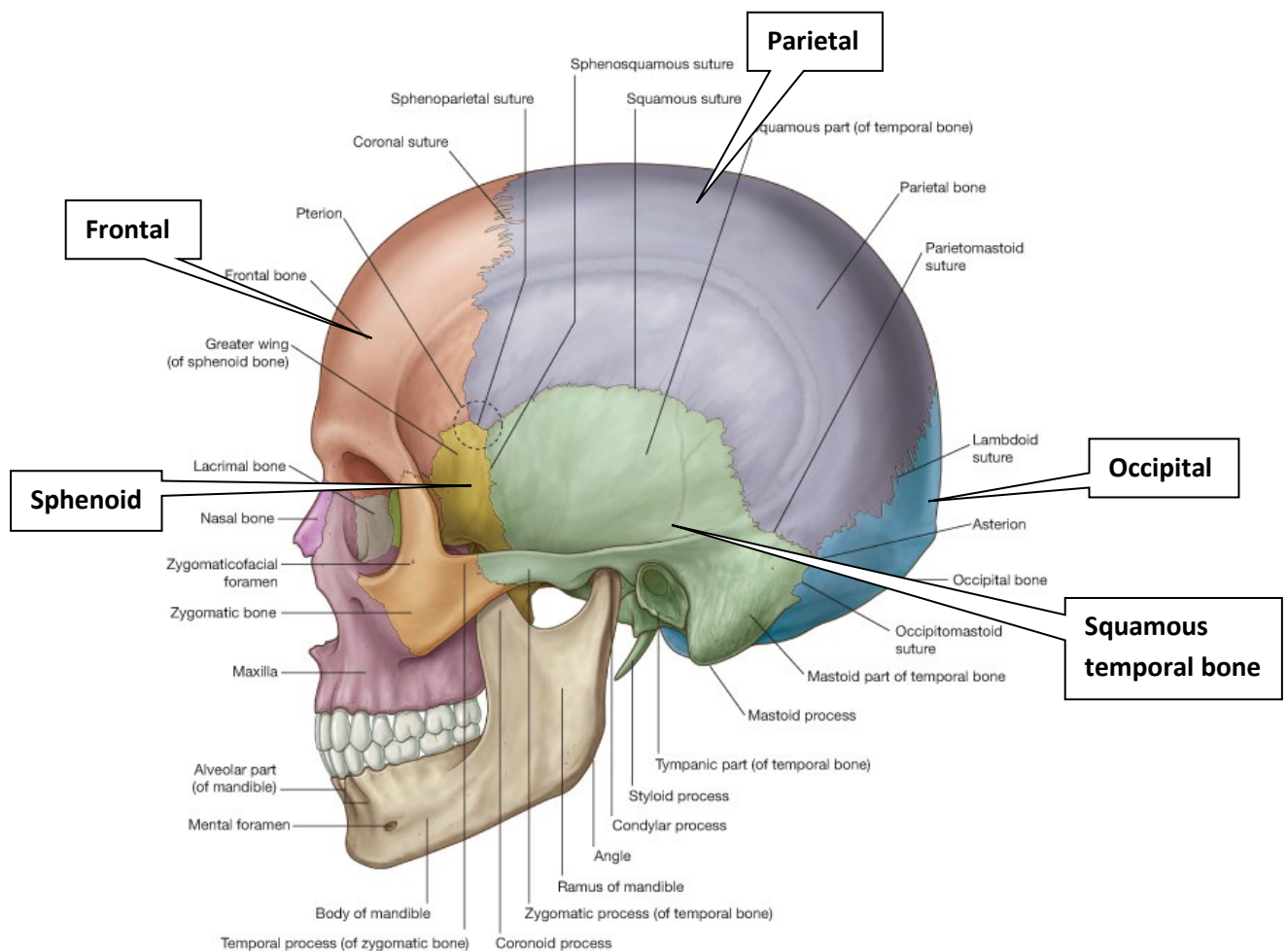


SKULL VAULT, CRANIAL CAVITY & MENINGES

- Cranial cavity contains:
 - Brain
 - Meninges
 - BVs and nerves that pass to and from the brain
- Surrounded by:
 - Vault bones at sides and above
 - Cranial base below

THE VAULT BONES:

- The skull vault is composed of several bones:
 - Frontal
 - Parietal
 - Occipital
 - Squamous temporal
 - Sphenoid
- Squamous temporal = flattened part of temporal bone

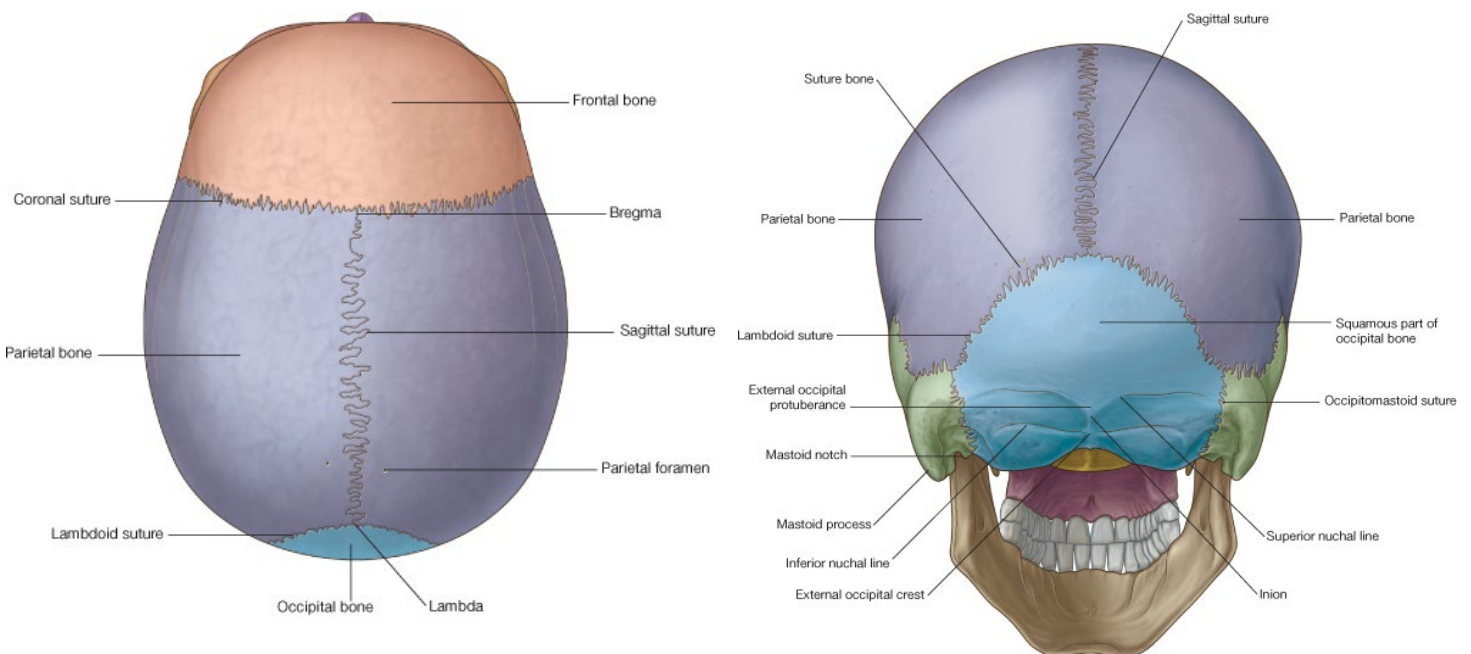


- **Sutures** - interlocking fibrous joints which join the bones of the vault together
- **Coronal suture** runs in the coronal plane:
 - Links the frontal and 2 parietals
- **Sagittal suture** runs in the sagittal plane:
 - Between the 2 parietal bones
- **Metopic suture**: at birth there is an additional suture in the midline, separating the frontal bone into 2.
 - Usually fuses by 2nd year of life.

- **Bregma**: point where the sagittal and coronal sutures meet in an adult
- At birth the bones at the bregma are not fused – leaves a gap which is covered over with fibrous tissue, which fuses with the underlying dura.
- This gap is the **anterior frontanelle**
- Anterior frontanelle is easily palpated in neonates
- It closes in the 2nd year of life.

- **Lambdoid suture**
 - Runs inferiolaterally on each side towards the mastoid process
 - Looks like λ
 - (Note only one lambdoid suture, *not* 2 separate ones on each side)

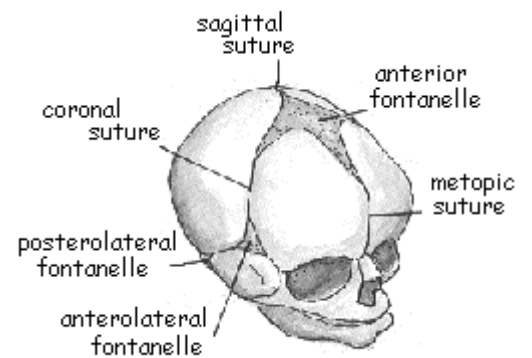
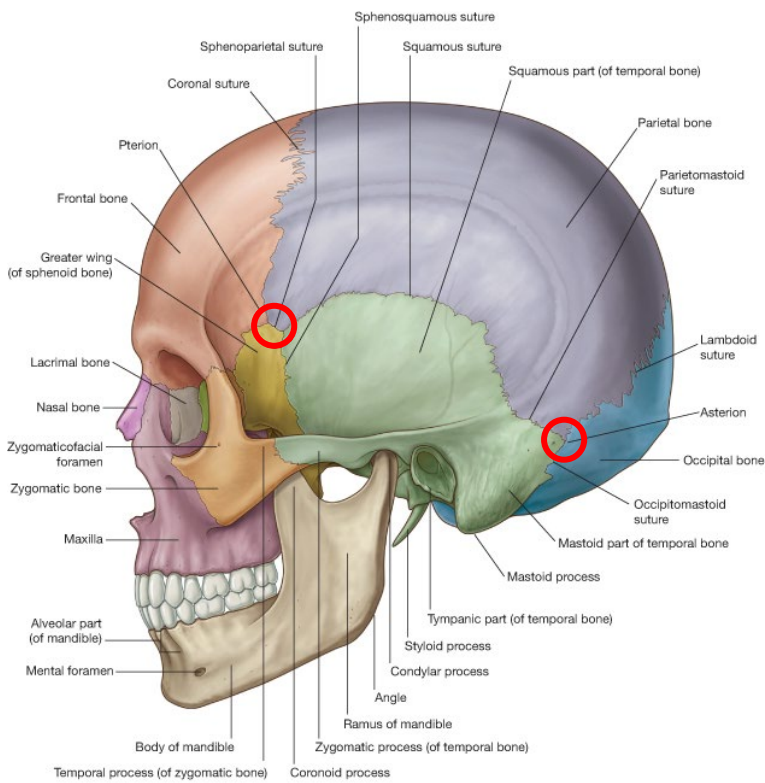
- **Lambda**: point at which the occipital bone meets the parietal bones in the midline



- **Asterion** – point at which temporal, occipital and parietal bones meet
- **Pterion** - point at which frontal, parietal, temporal and sphenoid bones meet.

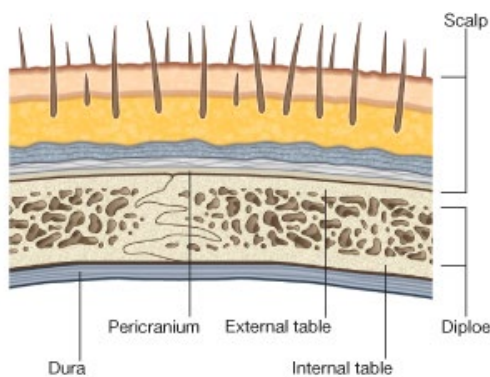
Neonates:

- Bregma – anterior frontanelle
 - Lambda – posterior frontanelle
 - Asterion – posterolateral frontanelle
 - Pterion – anteriolateral frontanelle
- The bones surrounding these frontanelles coalesce and fuse in the first few months of life.



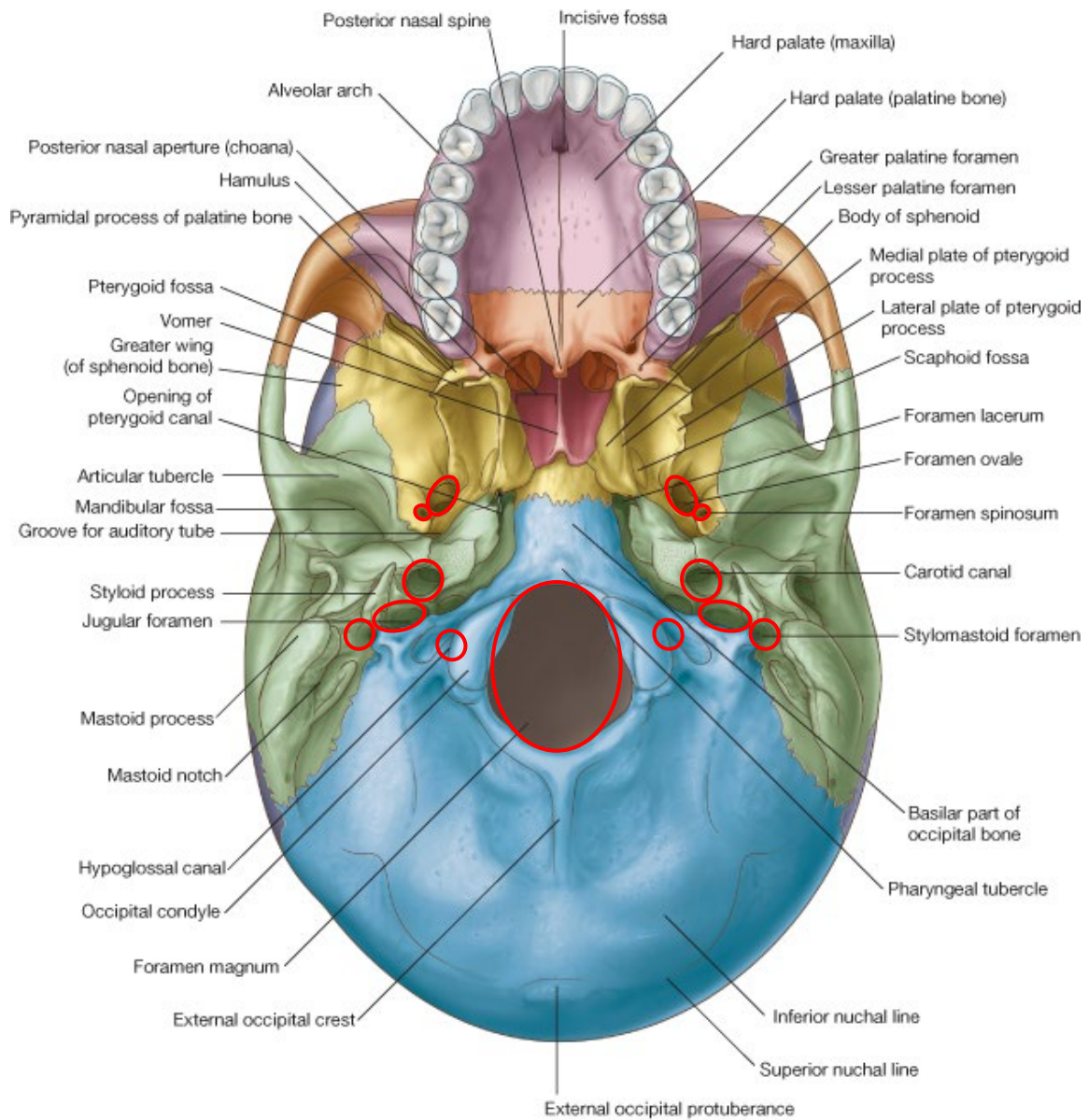
Structure of the adult vault bones:

- Each bone is constructed like a sandwich
 - Outer: table of compact bone
 - Middle: diploe of spongy / trabecular bone
 - Inner: table of compact bone
- Within the **diploe** there is active erythropoiesis throughout life
- Δ in some anaemias, the diploe increases in thickness.



CRANIAL BASE:

- Lies beneath the brain



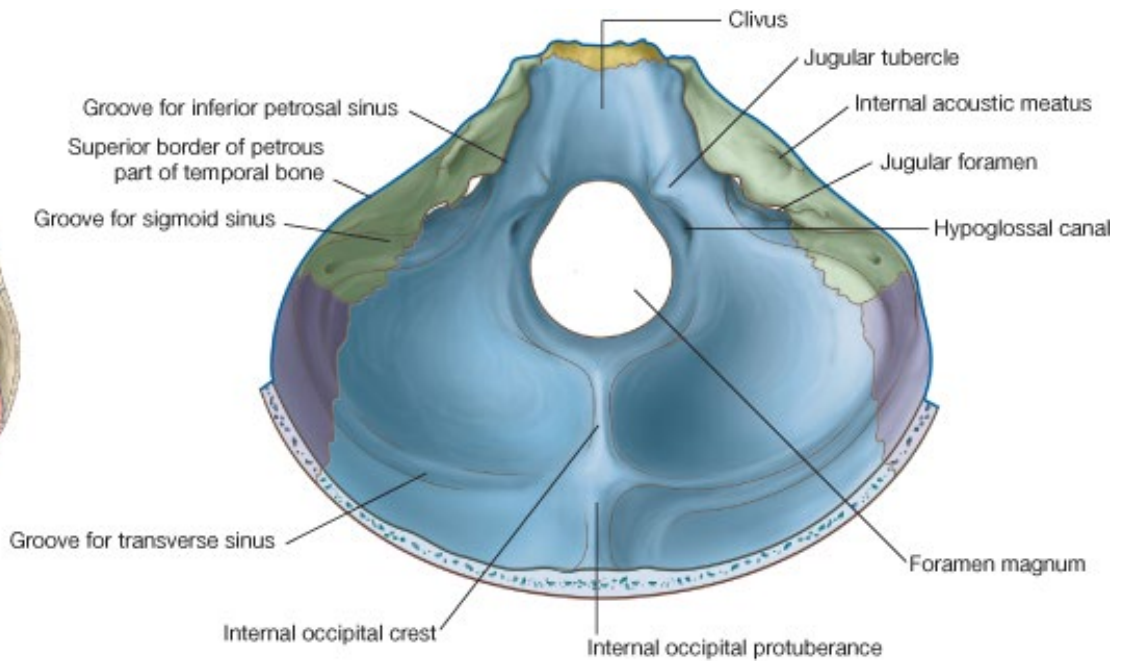
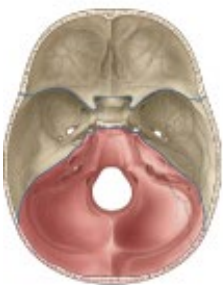
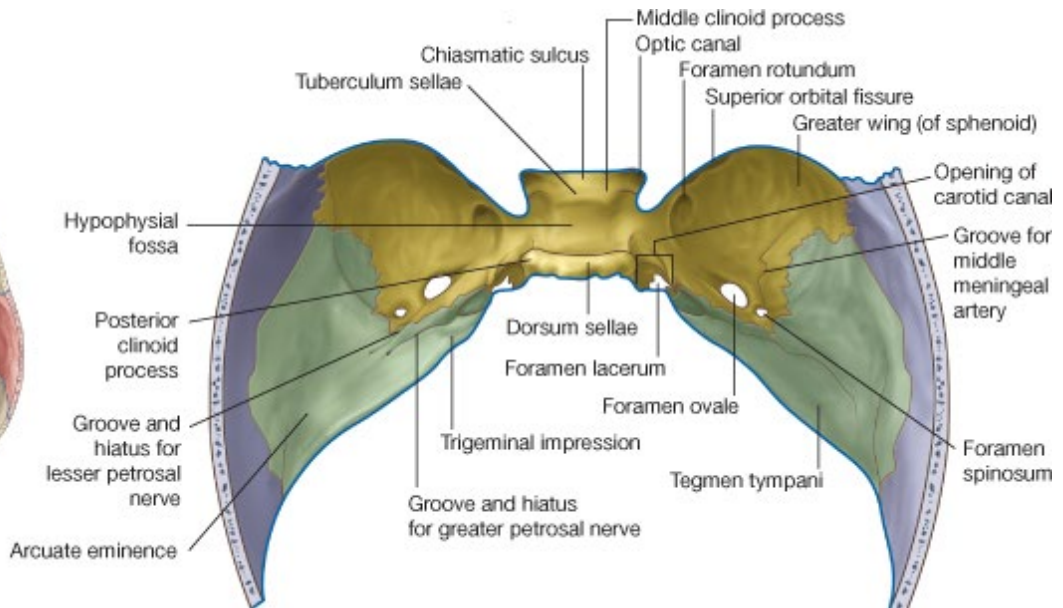
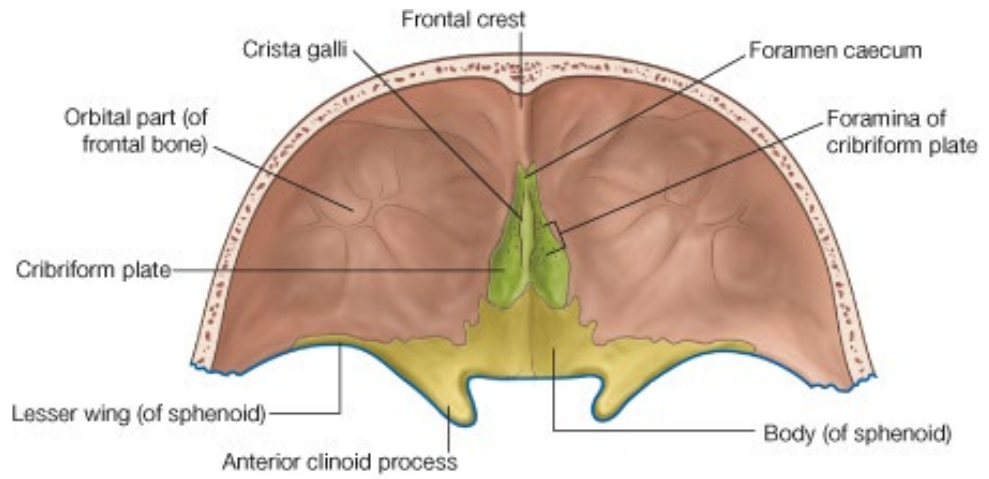
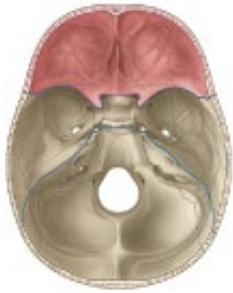
- Frontal lobe has **orbital processes** which run a short way beneath the frontal lobes of the brain (forming roof of orbital cavity).
- **Sphenoid bone** is wedged across the cranial base between the frontal bone & the 2 temporal bones.
- Sphenoid Δ support:
 - Part of frontal lobe
 - Part of temporal lobe
 - Pituitary gland in the midline
- **Petrous temporal bones** are processes of the **temporal bone**
- Run across the temporal base
- Support temporal lobes of the brain

- **Occipital bone** has a large **foramen magnum** – through which the spinal cord is continuous with the medulla.
- In front of the foramen magnum the **basioccipital** runs forwards to join with sphenoid bone.
- Behind the foramen magnum, the occipital bone is cup-shaped – supports the cerebellum

- Δ the bones which make up the cranial base are:
 - Frontal
 - Temporal
 - Sphenoid
 - Occipital
- Support the brain from beneath
- Only bones which don't contribute to the cranial base are the parietal bones.
- **Parietal does not contribute to cranial base**

INTRACRANIAL REGION

- The floor of the cranial cavity can be divided into 3 fossae:
 - Anterior cranial fossa
 - Middle cranial fossa
 - Posterior cranial fossa
- The anterior fossa is at a slightly higher level than the middle fossa
- The middle fossa is at a slightly higher level than the posterior fossa



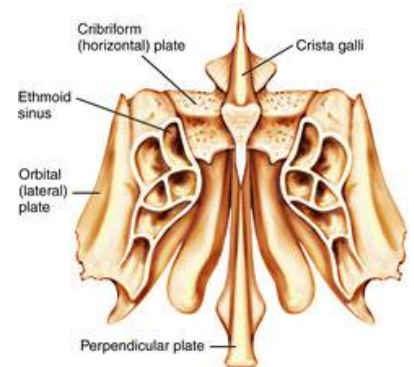
ANTERIOR CRANIAL FOSSA

Orbital processes of frontal lobe

- Formed from 2 flattened orbital processes of the frontal lobe, one on each side
- These form the roof over each orbit

Ethmoid bone

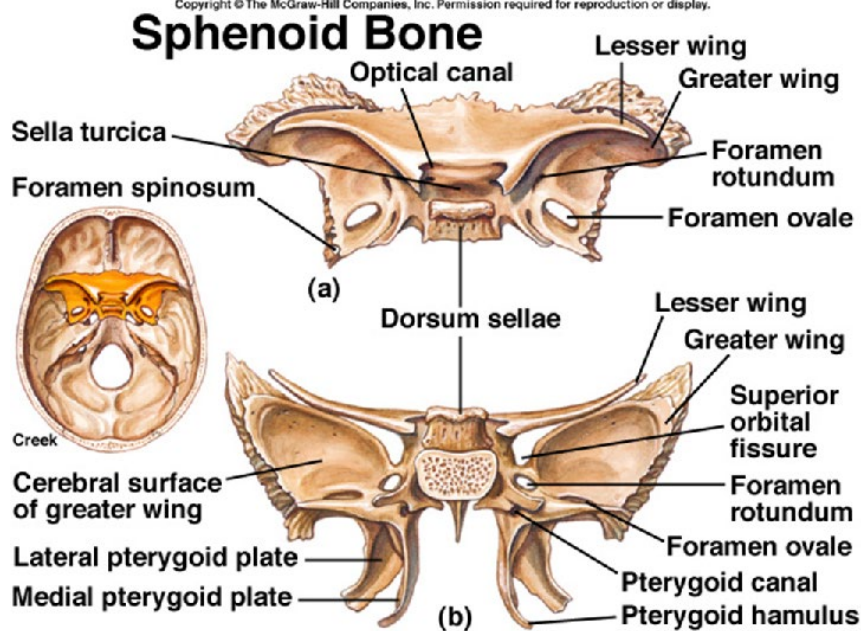
- Between the 2 orbital cavities is the **ethmoid bone**
- Delicate bone
- Upper surface of ethmoid can only be seen intracranially
- Intracranial surface of ethmoid bone is perforated with tiny holes for branches of cranial nerve I – **olfactory nerve** – to run from the top of the nose.
- Δ known as the **cribriform plate** of the ethmoid bone
- In midline of the anterior cranial crest, the ethmoid bone is raised as a crest – **crista galli**
- Sides of the ethmoid bone are below the level of the anterior cranial fossa
- Here the ethmoid bone makes up the:
 - Later walls of the nasal cavity
 - Medial wall of the orbital cavities
- Ethmoid bone has a midline septum – **perpendicular plate**
- Perpendicular plate lies high in the nasal cavity, in the plane of the crista galli
- Continuous with the midline cartilage of the nose lower down.
- Ethmoid bone is very fragile & Δ very easily fractured
- Damage →
 - Loss of CSF
 - Bleeding into orbit (subconjunctival haemorrhage)
 - Bleeding nose (epistaxis)



Sphenoid bone:

- Sits behind the orbital processes of frontal bone and the ethmoid bone.
- Sphenoid bone forms part of both the anterior and medial cranial fossae.
- Composed of:
 - Central **body**
 - **Wings** which arise from the body and pass laterally
- Anteriorly, it is shaped like a butterfly.

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Superior orbital fissure:

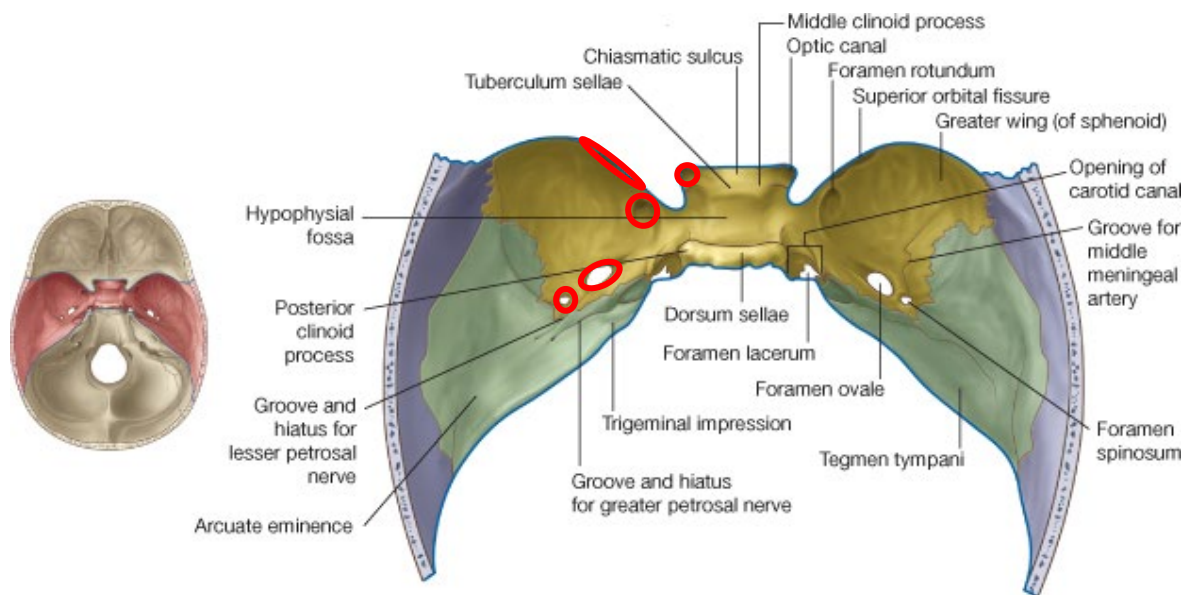
- Foramen in the skull lying **between the lesser and greater wings of the sphenoid**
 - Upper margin: lesser wing of sphenoid
 - Lesser wing arises from upper part of sphenoid body
 - Forms posterior margin of the anterior cranial fossa
 - Lower margin: greater wing of sphenoid
 - Spreads laterally to form the floor and side walls of the middle cranial fossa.
 - It is the flattened outer portion of the greater wing which contributes to the pterion.

MIDDLE CRANIAL FOSSA

Sphenoid bone:

- Mainly formed from **body** and **greater wing** of sphenoid bone
- **Pituitary fossa / sella turcica** (hypophysial fossa) is a depression in the midline which houses the pituitary gland.
- Pituitary fossa has at its corners:
 - 2 x **anterior clinoid processes**
 - 2 x **posterior clinoid processes**
- In the roots of the anterior clinoid processes on each side, in front of the pituitary fossa, there are 2 important passages through the lesser wing of the sphenoid bone into the orbital cavities.
- These are the **optic foramina**
- Transmits the **optic nerve** to the eye.
- Lateral to the optic foramina is the **superior orbital fissure**
- Superior orbital fissure leads into orbital cavity

- Just beneath the superior orbital fissure, close to the body of the sphenoid, is another circular foramen: **foramen rotundum**
- Foramen rotundum leads to the pterygopalatine fossa & conducts cranial nerves which are sensory to dermatomes of the mid-face.
- 2 more foramen on the floor of the middle cranial fossa
- Both pass through greater wing of the sphenoid to reach the region below the cranial base.
 - **Foramen ovale** (conducts Viii)
 - **Foramen spinosum**
 - Lateral to foramen ovale in the spine of the greater wing of sphenoid.



- Branches of the **trigeminal nerve (cranial nerve V)** are transmitted through:
 - Superior orbital fissure (Vi)
 - Foramen rotundum (Vii)
 - Foramen ovale (Viii)
- The trigeminal nerve is a massive sensory nerve (V3 also motor to muscles of mastication)
- It has a ganglion analogous to the dorsal root ganglion in the sensory spinal cord.
- Trigeminal nerve then splits into 3 sensory nerves.
- The foramen spinosum transmits the **middle meningeal artery**
- Middle meningeal artery creates a deep groove in the bone along its course over floor of the middle cranial fossa, and inner aspect of side wall of cranial vault.
- Important nutrient artery to the bones of the cranial vault.

Temporal bones:

- The rest of the middle cranial fossa is made by the 2 temporal bones
- **Petrous part:** middle part of each temporal bone is thick and hard and projects like a pyramid across middle cranial fossa
- **Squamous part:** other part is thin and flat and forms the side walls of the fossa and cranial vault

- Petrous part has a superior margin forming a thick boney ridge which runs obliquely forwards across the cranial cavity towards the sphenoid bone.
- Top edge of the petrous bone is the **petrous ridge** - forming the boundary between the middle and posterior cranial fossa.
- The **petrous temporal bone** contains the organs of hearing and balance.

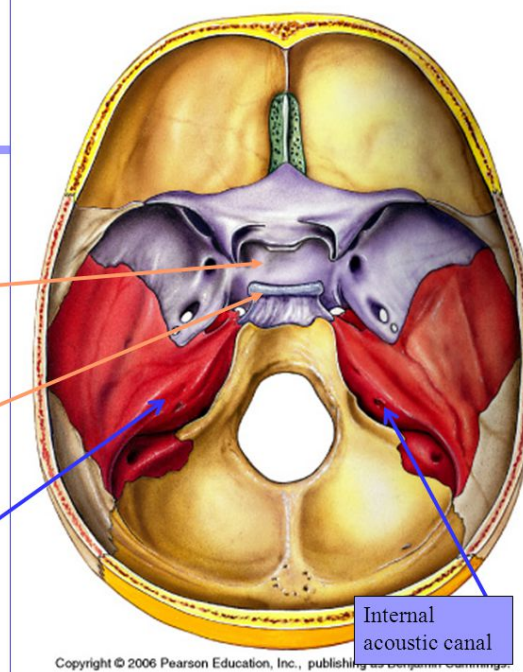
POSTERIOR CRANIAL FOSSA

Sphenoid Bone

Hypophyseal Fossa

Dorsum Sella

Petrous ridge



Petrous temporal bone:

- Formed anteriorly by the vertically orientated **petrous temporal bone**
- **Internal acoustic meatus** is a prominent foramen in the petrous temporal
- The internal acoustic meatus transmits:
 - Nerve to muscles of the face (facial nerve VII)
 - Nerves of organs of hearing and balance (vestibulocochlear nerve VIII)

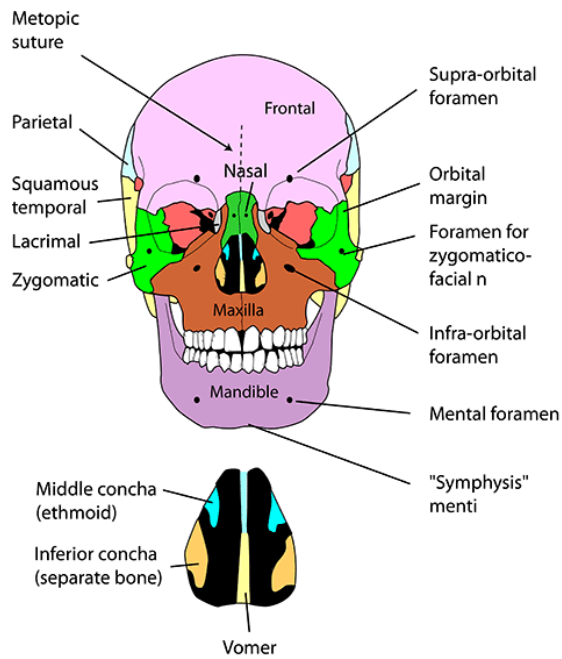
Occipital bone:

- Occipital bone forms the posterior aspect of the posterior cranial fossa
- **Jugular foramen** lies between the petrous temporal bone and the occipital
- Technically it is a space between the 2 bones
- Transmits:
 - **3 cranial nerves** (glossopharyngeal IX, vagus X, accessory XI)
 - **Internal jugular vein** (blood from brain → neck & thorax)
- **Foramen magnum** dominates posterior cranial fossa
- Spinal cord and medulla are continuous through the foramen magnum
- The **hypoglossal canals** sit on either side of the foramen magnum, and emerge above the occipital condyle on the underneath of the cranial base.

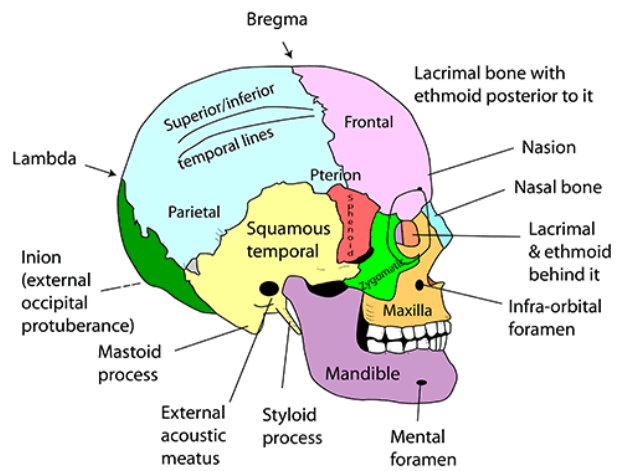
- The hypoglossal canals transmit the **hypoglossal nerve** (cranial nerve XII) out of the posterior cranial fossa.

Skull vault summary:

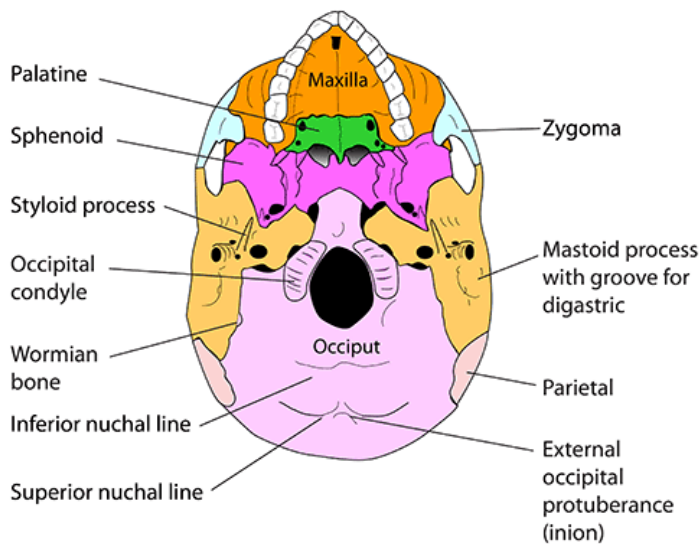
ANTERIOR VIEW OF SKULL TO SHOW BONES & OTHER FEATURES



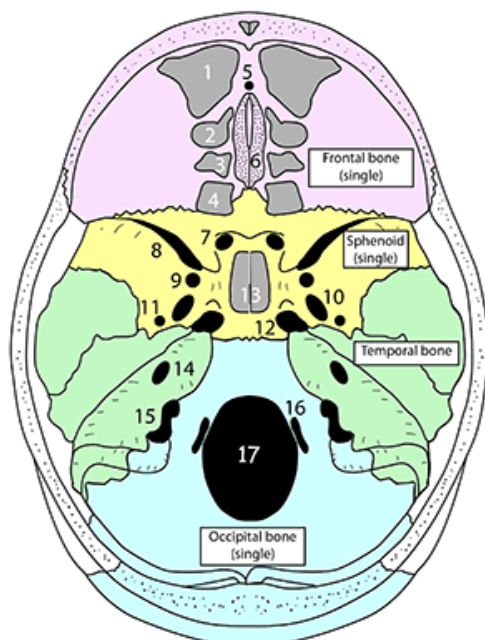
LATERAL VIEW OF SKULL TO SHOW BONES & OTHER FEATURES



POSTERIOR/INFERIOR VIEW OF SKULL TO SHOW BONES & OTHER FEATURES



INTERNAL VIEW OF BASE OF SKULL TO SHOW SINUSES AND FORAMINA



FORAMINA AND AIR SINUSES

- | | |
|-----------------------------------|--|
| 1 Frontal air sinuses | 10 Foramen ovale |
| 2 Anterior ethmoidal air sinuses | 11 Foramen spinosum |
| 3 Middle ethmoidal air sinuses | 12 Foramen lacerum |
| 4 Posterior ethmoidal air sinuses | 13 Sphenoid air sinuses |
| 5 Foramen caecum (single midline) | 14 Internal acoustic (auditory) meatus |
| 6 Cribriform plate of ethmoid | 15 Jugular foramen |
| 7 Optic canal | 16 Hypoglossal canal |
| 8 Superior orbital fissure | 17 Foramen magnum (single midline) |
| 9 Foramen rotundum | |

Frontal	County Cricket	Caecum (foramen) Cribriform plate	Emissary vein (nose to superior sag sinus) Olfactory nerve
Sphenoid	Oh So Radiaent, Oh So Lovely	Optic canal Superior orbital fissure Rotundum (foramen) Ovale (foramen) Spinosum (foramen) Lacerum (foramen)	Optic nerve + ophthalmic artery III (S+I), IV, Vi (NC + F + L), VI Vii (maxillary trigeminal) Viii + accessory meningeal artery (MALE) Middle meningeal artery + vein Nerve + artery pterygoid canal
Temporal- occipital	I'm Jack Hello!	Internal acoustic meatus Jugular (foramen) Hypoglossal canal	CN VII + VIII (facial + vestibulocochlear) CN IX, X, XI + jugular vein + inf petrosal sinus CN XII (hypoglossal)

Superior orbital fissure:

III

superior division of the oculomotor nerve

inferior division of the oculomotor nerve

IV: trochlear nerve

Vi

lacrimal nerve

frontal nerve

nasociliary nerve

VI: abducens nerve (CN VI)

Foramen oval: MALE

M: mandibular branch of trigeminal (Viii)

A: accessory meningeal artery

L: lesser petrosal nerve (parasymp from CNIX)

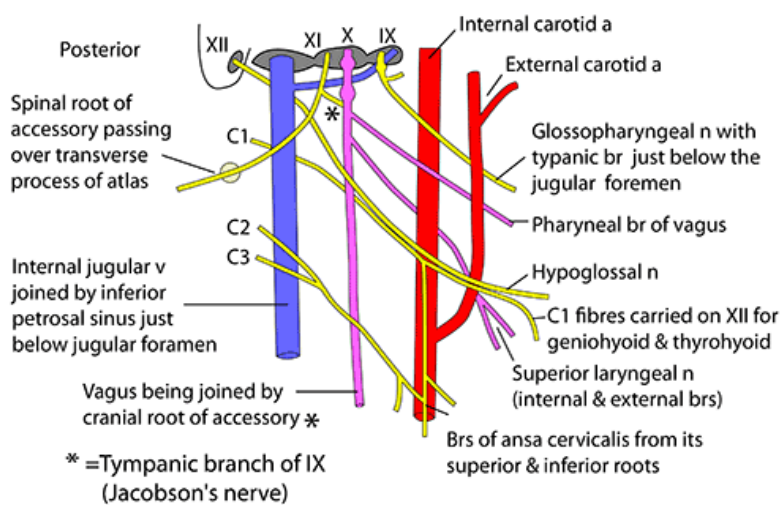
E: emissary vein

Foramen lacerum → pterygoid canal

Nerve of pterygoid canal:

- Greater petrosal nerve (parasymp from facial nerve CN VII)
- Deep petrosal nerve (symp from carotid plexus)

EXPLODED VIEW OF RIGHT JUGULAR FORAMEN



Note:

1. Hypoglossal nerve passes lateral to internal & external carotid arteries
2. Superior laryngeal nerve passes medial to both arteries
3. Glossopharyngeal & pharyngeal branch of vagus pass between them

- The vagus lies most medial in the foramen
- Glossopharyngeal nerve & inferior petrosal sinus exit from the anterior compartment of the foramen
- Vagus & accessory nerves exit from the middle compartment
- The sigmoid sinus exits from the posterior compartment, is soon joined by the inferior petrosal sinus to become the internal jugular vein

RADIOGRAPHY OF THE VAULT BONES

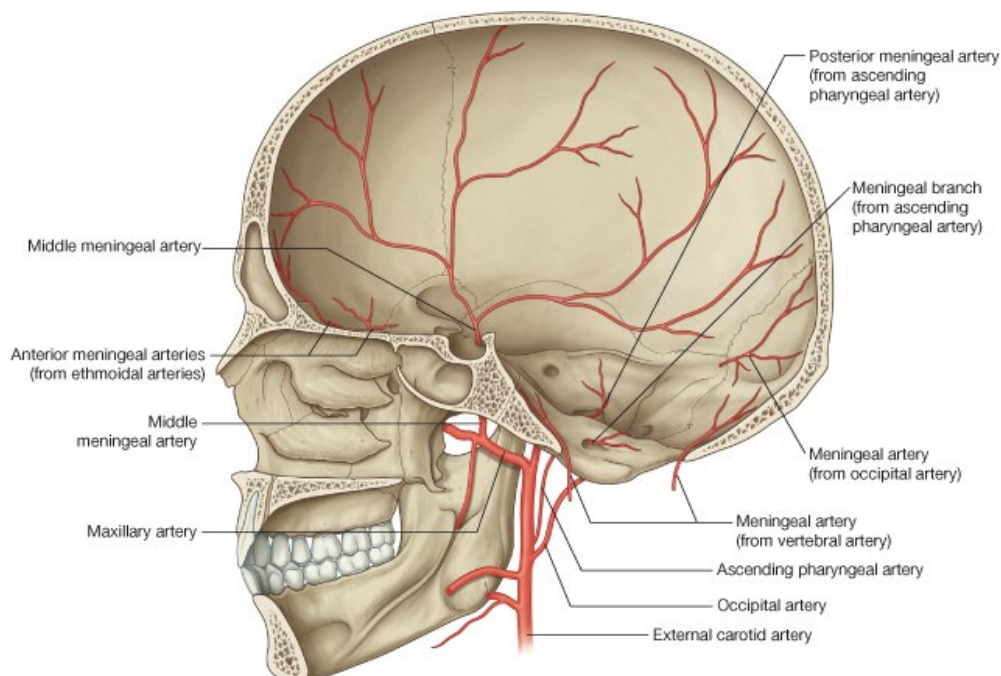
▪ **Sinuses** – radiolucent air cavities present in the bones of:

- Frontal

- Sphenoid
 - Ethmoid
 - Maxilla
- There are blood vessels within the diploe – **diploic veins** – which look like spiders in the parietal region: **parietal spiders**
 - **Middle meningeal artery** makes deep grooves on the inside of the cranial vault bones
 - Must distinguish BVs in a radiograph from fractures.
 - **Fractures** of the skull are common in many head injuries
 - Involve either the base or the vault of the skull
 - Fractures of the petrous temporal bone can easily injure the organs of balance and hearing.

THE MENINGES AND THE CRANIAL VENOUS SINUSES

- 3 layers of meninges:
 - Pia mater
 - Arachnoid mater
 - Dura mater
- The meninges surrounding the brain and the spinal cord are continuous through the foramen magnum
- I.e. cranial pia is continuous with the spinal pia etc.
- **Dura** is a tough collagenous membrane
- Cranial dura, unlike the spinal dura, is fused with the periosteum of the internal surface of the vault wherever it is in direct contact with it.
- This fusion of dura with periosteum takes place over wide areas within the skull
- Removal of the skull cap → the periosteum strips off from the bone and remains fused to the outer surface of the dura.
- **Middle meningeal artery** ascends into the skull through the foramen spinosum
- It supplies some blood to the dura
- Acts mainly as a nutrient artery to the bones of skull
- Its course is extradural (outside the dura), where its branches pierce the periosteum to supply the bone.



- Fusion of the dura and periosteum of the skull is incomplete:
- A. In places the dura delves inwards towards the interior of the cranial cavity to form **fibrous septa** between regions of the brain.
- B. In other places long gaps remain between the dura and periosteum – **venous sinuses** containing venous blood.

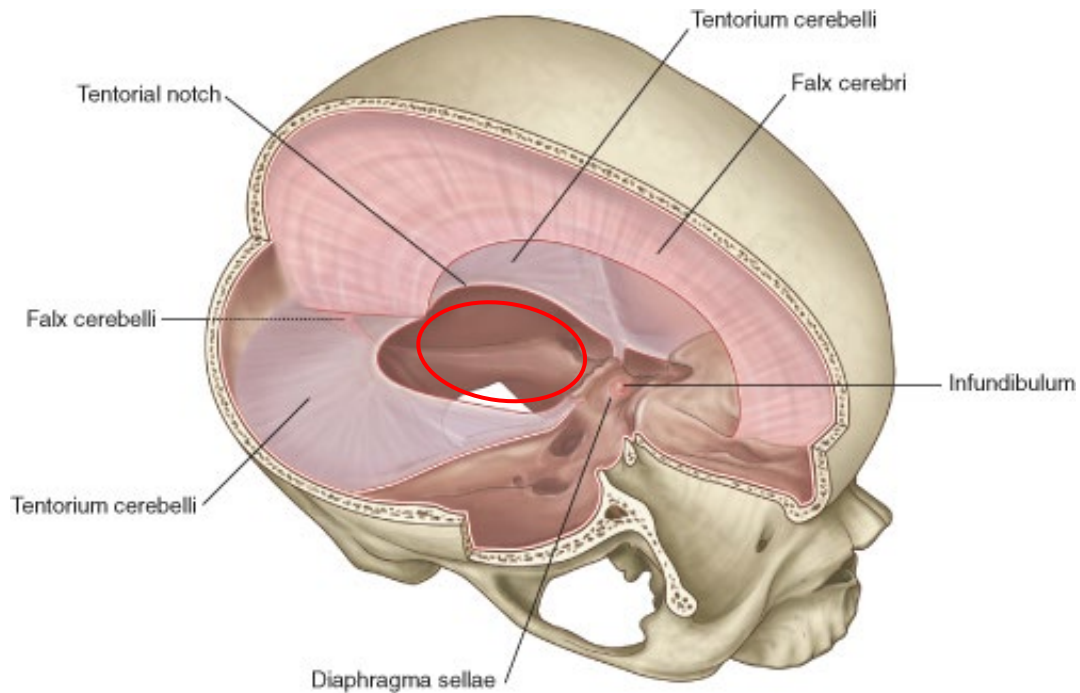
A. SEPTA FORMED BY DURA:

- **Falx cerebri** – vertical sickle-shaped reflection of the dura between the 2 cerebral hemispheres
 - Attached anteriorly to crista galli (crest of ethmoid bone)
 - Posteriorly it spreads out to become the tentorium cerebelli

- **Tentorium cerebelli**
 - Supports the cerebral hemispheres above
 - Forms roof over posterior cranial fossa below
 - It deflects the weight of the cerebral hemispheres out towards the parietal bones (forming the walls of the cranial cavity)
 - Outer margin:
 - Runs forward around rim of posterior cranial fossa
 - Anteriorly*
 - I. Onto the crests of the petrous temporal bones → **petroclinoid ligament**
 - II. Anterior clinoid processes
 - Inner margin: crescentic in shape and free.

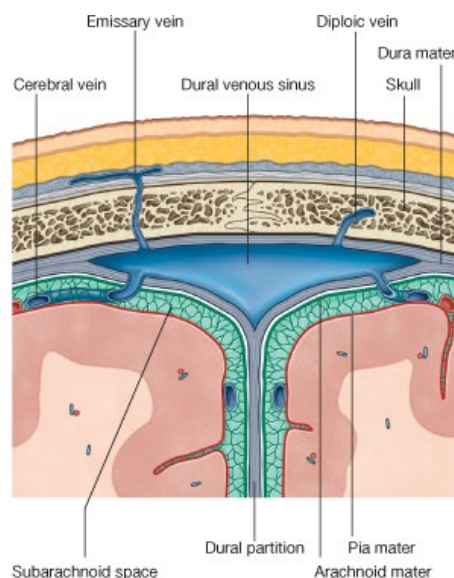
- Petroclinoid ligament joins the apex of the petrous temporal bone to the posterior clinoid process.

- Space between the free margin of the tentorium and the body of the sphenoid.
- It is through this space that the **brainstem** passes
- Brainstem links cerebral hemispheres above with the midbrain and pons below.



B. CRANIAL VENOUS SINUSES

- Drain blood from the meninges, brain & skull
- The sinuses drain into a number of different veins:
 - Mainly into the **internal jugular vein** – sigmoid sinus leaving the skull through **jugular foramen**
 - Some of the small venous sinuses are continuous through the foramen magnum with the **vertebral venous plexus** around the spinal cord.
 - Some venous sinuses link with extracranial veins via **emissary veins**
 - Emissary veins pass all the way through the skull in **emissary foramina** in the vault bones
- In contrast to emissary foramina, **diploic foramina** transmit diploic veins from the diploe to either the inside or outside of the vault - *Δ don't* pass all the way through the skull like the emissary foramina.



- **Superior sagittal sinus**
 - Found in the upper border of the falx cerebri
 - Increases in size towards the posterior end
 - Posteriorly, where the falx joins the tentorium, the superior sagittal sinus turns to the right to become the right transverse sinus.

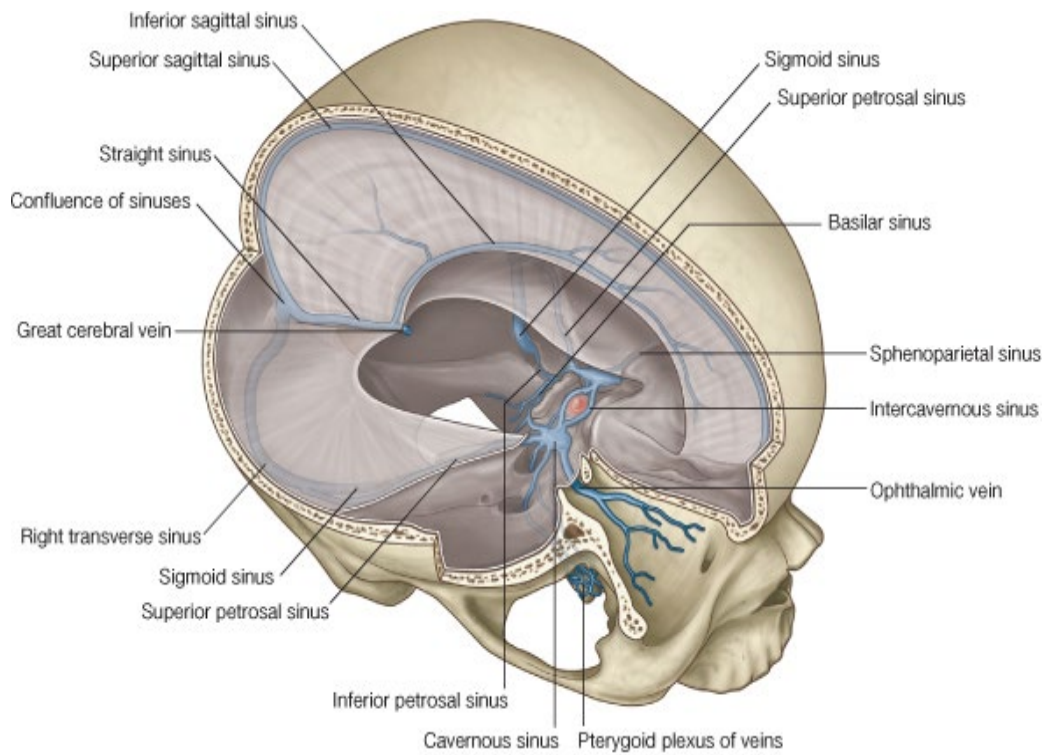
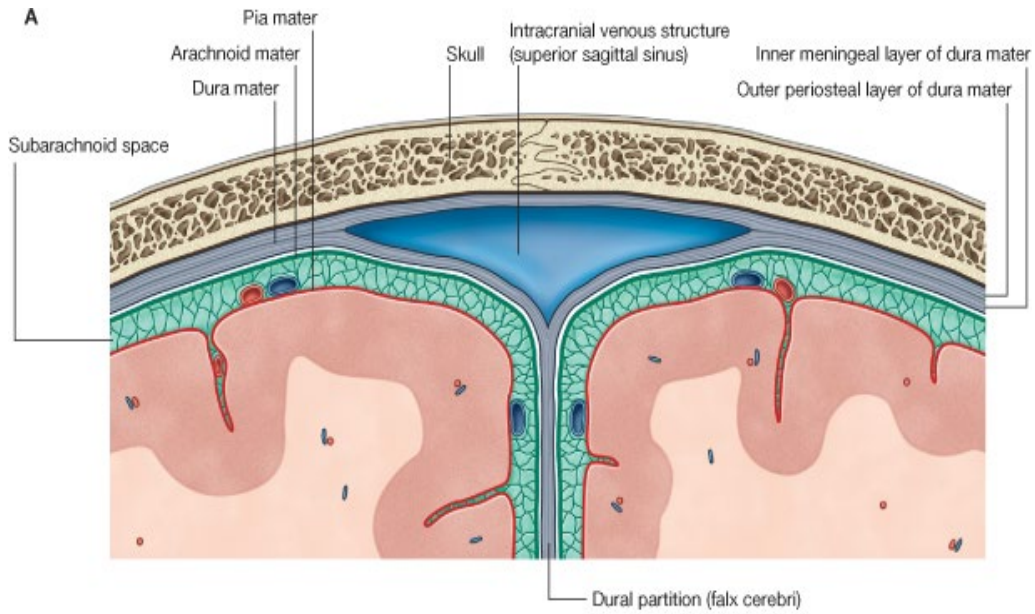
- **Transverse sinuses**
 - Travels around the sides of the cranial cavity in attached margin of the tentorium
 - Then follows an S-shaped (sigmoid) course to the jugular foramen – **sigmoid sinus**
 - On passing through the jugular foramen the sigmoid sinus becomes the internal jugular vein.

- The **confluence of sinuses** lies between the transverse sinuses and sagittal sinuses at the back in the midline.

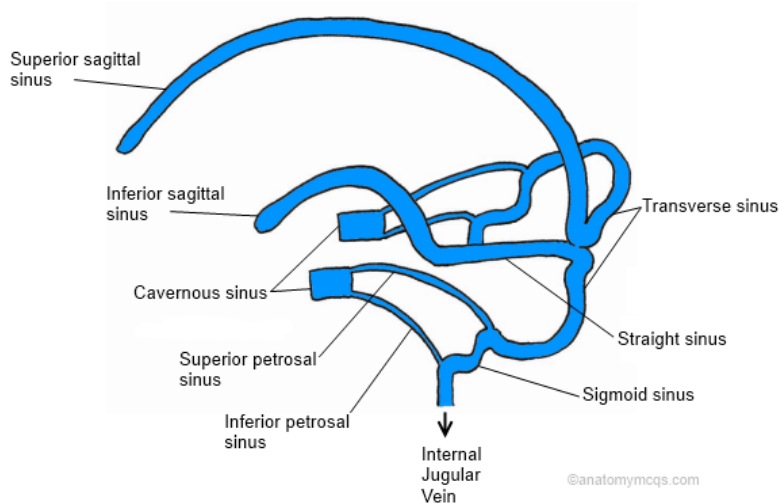
- ***There are 2 more venous sinuses which are formed entirely between dural folds (rather than between dura and periosteum):***

- **Inferior sagittal sinus**
 - Found in lower free edge of falx
 - Joins the **great cerebral vein** from the brain to form the **straight sinus**

- **Straight sinus** continues posteriorly to the attached margin of the tentorium, to form the **left transverse sinus** (or occasionally right).



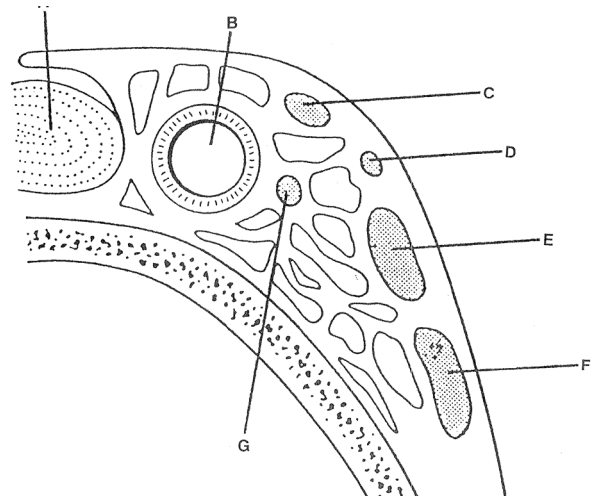
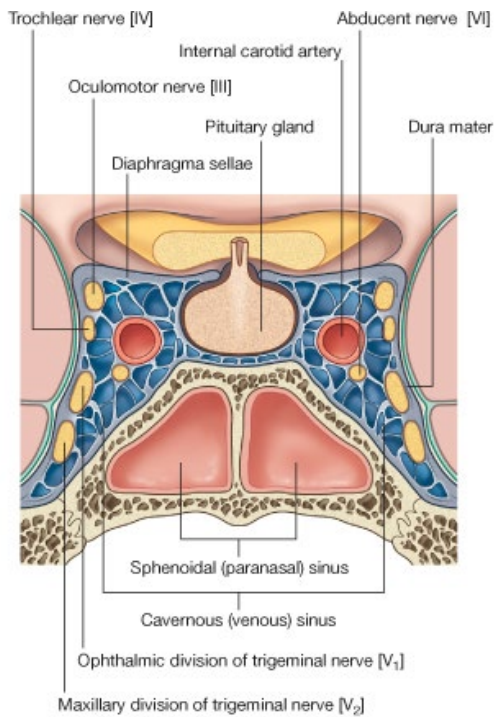
VENOUS SINUSES



➤ Cavernous sinus

- Found either side of the body of the sphenoid bone.
- Very important clinically
- Cavernous sinuses are large and contain meshwork of fine fibrous tissue - Δ spongy consistency.
- Several important cranial nerves travel in dura of lateral wall of cavernous sinus → orbital cavity & maxilla:
 - **Oculomotor (III)**
 - **Trochlear (IV)**
 - **2 divisions of trigeminal (V):**
 - Vi: ophthalmic division
 - Vii: maxillary division
- **Abducens nerve VI** travels **free** through the substance of the cavernous sinuses (the other nerves in the sinus are not in direct contact with the venous blood).
- It enters the cavernous sinus from posterior cranial fossa, passing underneath the petroclinoid ligament (which links apex of the petrous temporal bone to the posterior clinoid process)
- Travels close the **internal carotid artery** within the cavernous sinus (the artery then passes out of sinus to supply blood to brain)
- Travels into the orbit to supply lateral rectus muscle
- Each cavernous sinus receives venous blood from:
 - Veins of the orbit
Δ infections of face / orbital cavity can track backward → cavernous sinus
 - Veins below the skull base (pterygoid plexus)
Δ infections from upper jaw can track into cavernous sinuses.
- Such infections can → thrombosis within the sinuses – v. dangerous.

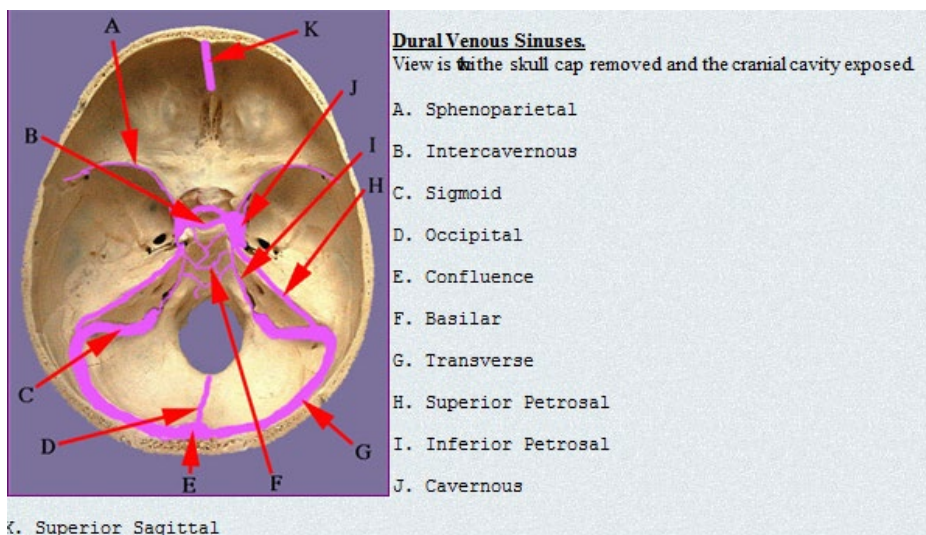
- Cavernous sinuses communicate with one another across the midline.



The cavernous venous sinus in coronal section. The sinus contains fibrous trabeculae. The abducent and internal carotid artery run through its substance. The oculomotor, trochlear, ophthalmic (VI) and maxillary (VII) nerves run in its lateral wall.

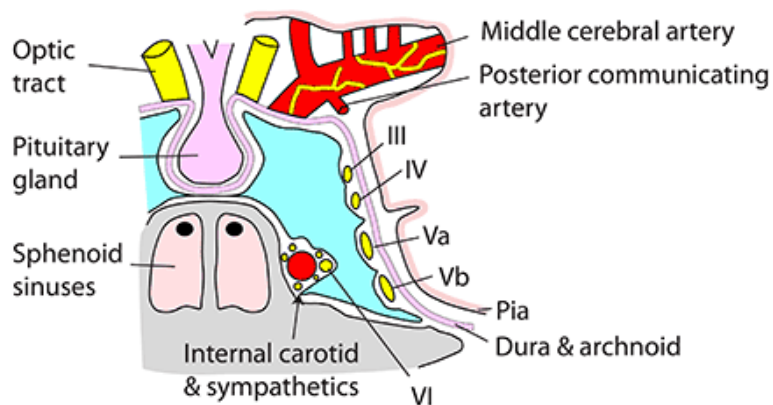
- | | |
|---------------------------|-------------------------|
| A Pituitary gland | E Ophthalmic nerve (VI) |
| B Internal carotid artery | F Maxillary nerve (VII) |
| C Oculomotor nerve (III) | G Abducens (VI) |
| D Trochlear nerve (IV) | |

- Blood is drained from the cavernous sinus through venous channels along upper and lower borders of petrous temporal bones.
- These are the **petoral sinuses**:
 - Superior petrosal sinus:
 - Runs along crest of the petrous temporal bone
 - Joins the transverse sinus posteriorly
 - Inferior petrosal sinus:
 - Runs along lower posterior edge of petrosal bone
 - It first drains blood from the inner ear via **labyrinthine vein**
 - Then runs to jugular foramen, to join the **sigmoid sinus** and form the **internal jugular vein**.



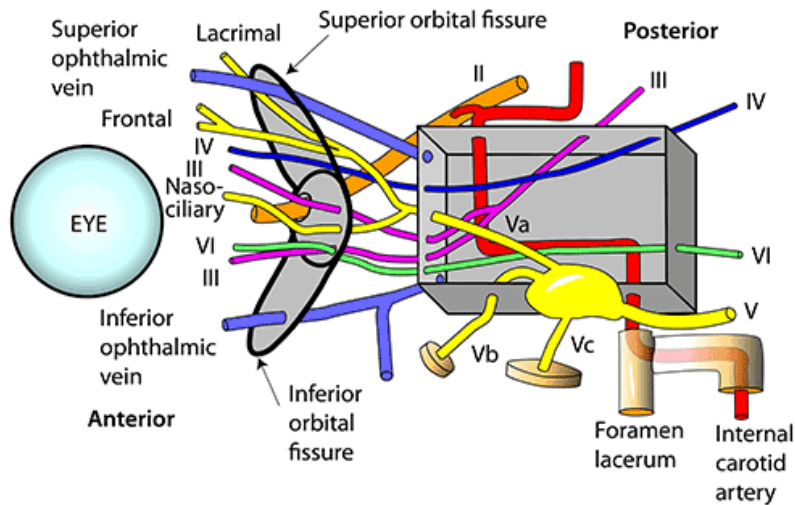
CAVERNOUS SINUS
CORONAL (TRANSVERSE) VIEW
RIGHT SIDE LOOKING ANTERIORLY

- Each lies alongside the body of the sphenoid in the middle cranial fossa between periosteal (endosteal) and meningeal (fibrous) layers of dura
- **Roof:** Anterior & posterior clinoid processes with uncus of temporal lobe & internal carotid artery on it, III & IV into it
- **Lateral wall:** Dura, temporal lobe, III, IV, Va, Vb in the wall
- **Floor:** Greater wing of sphenoid
- **Medial wall:** Dura over sphenoid, sella turcica, pituitary, sphenoid sinus
- **Posterior wall:** (narrow), dura of posterior fossa, superior and inferior petrosal sinuses, peduncle of brain
- **Anterior wall:** (narrow), medial end of superior orbital fissure, ophthalmic veins, orbit
- **Contains:** Internal carotid artery, VI & blood
- **Draining into it:** Superior/inferior ophthalmic veins, intercavernous sinuses, sphenoparietal sinuses, superficial middle cerebral vein
- **Draining out of it:** Superior/inferior petrosal sinuses, emissary veins to pterygoid plexus



CAVERNOUS SINUS

Diagrammatic view of left side - lateral view



THE ARACHNOID & PIA MATER

- The **subdural space** is only a potential space between the dura and arachnoid mater – in reality they are held closely together.
- Many of the veins from the brain drain into the superior sagittal sinus Δ they must cross the subdural space.
- If these veins rupture \rightarrow subdural haematoma
- In contrast, rupture of the middle meningeal artery (which lies in the extradural space) will lead to an extradural haematoma

Arachnoid:

- Very thin membrane
- Outermost part of arachnoid is several layers of flattened cells linked by **tight junctions** to form continuous sheet.
- Acts as a barrier to the free passage of ions and molecules into and out of the subarachnoid space.
- The subarachnoid space is extensive and continuous with that of the spinal cord.
- The **subarachnoid space contains CSF**

Pia:

- Delicate membrane
- Intimately covers the brain and spinal cord.
- Dips into fissures on brain surface
- Blood vessels supplying the brain lie on the surface of the pia – anastomosing freely
- They pierce the pia to access the brain.

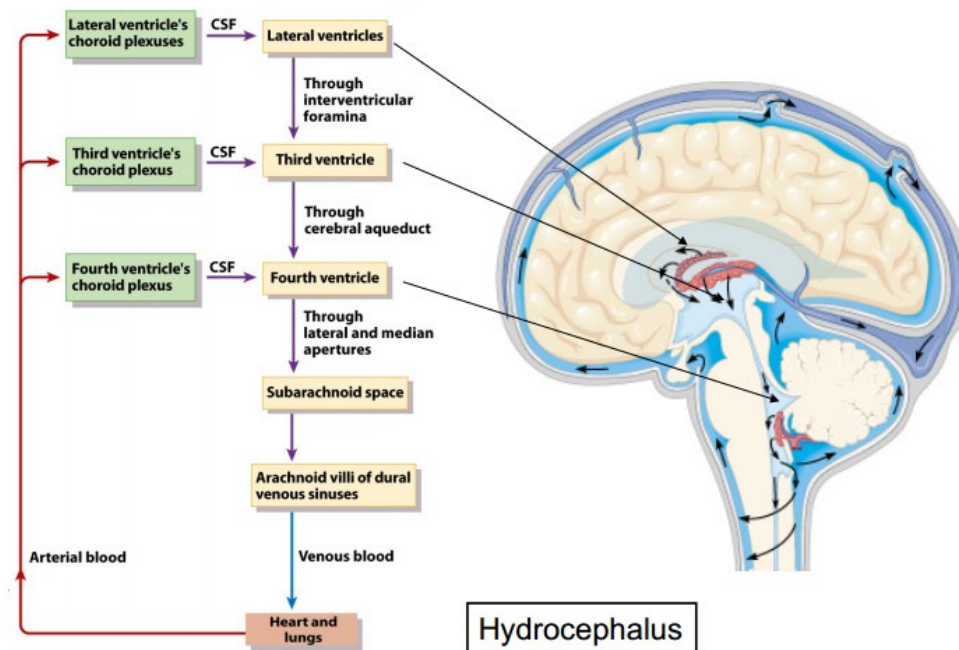
CEREBROSPINAL FLUID (CSF)

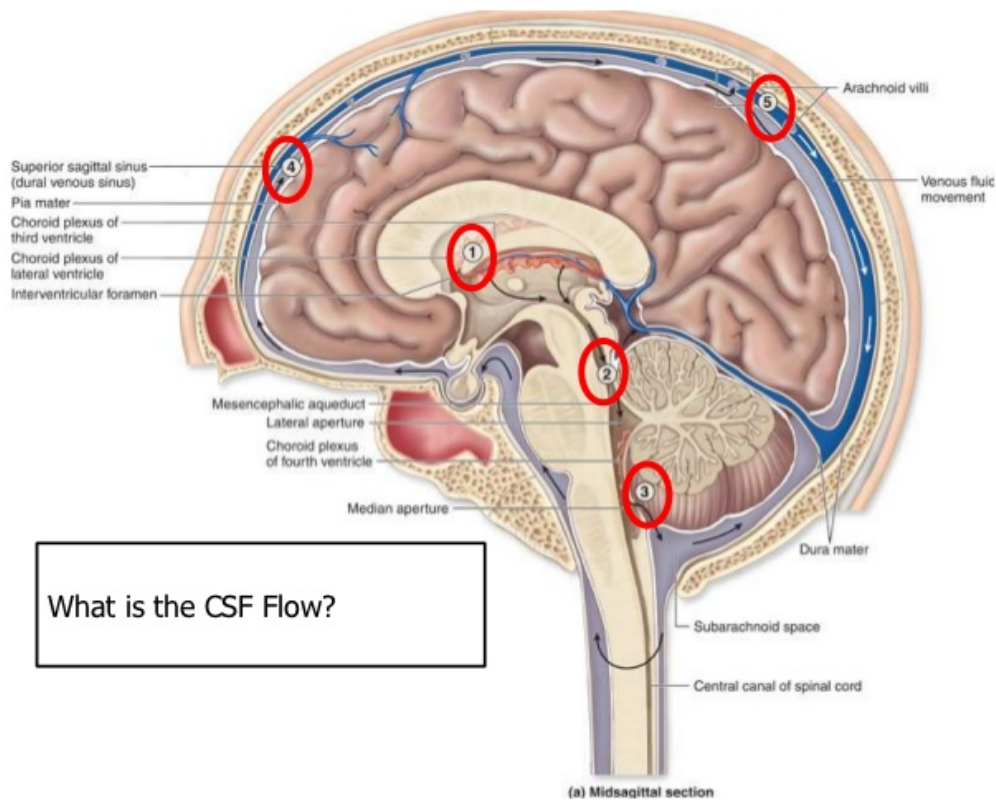
- Protective & regulatory
- Surrounds and protects brain and spinal cord from injury
- Regulates intracranial pressure (which changes with changes in cerebral blood flow)

Production of CSF

- CSF is formed in vascular plexuses (cavities) of the brain.
- The walls of these plexuses are often composed of only thin layer of epithelium
- Here a vascular network of the pia invaginates the cavity as a series of tufts projecting into the cavity.
- These tufts form the **choroid plexus**.
- CSF is formed as fluid leaks from the choroid plexus into the cavity.
- The CSF formed then escapes from the brain through small holes in the back of the brain stem in the roof of the 4th ventricle
- → **subarachnoid space**.
- Circulates around brain and spinal cord in subarachnoid
- There are enlargements of the subarachnoid at some points, leading to pools of CSF – **subarachnoid cisterns**:
 - Around base of brain
 - Lumbar cistern (used for lumbar puncture).

Pathway of CSF flow

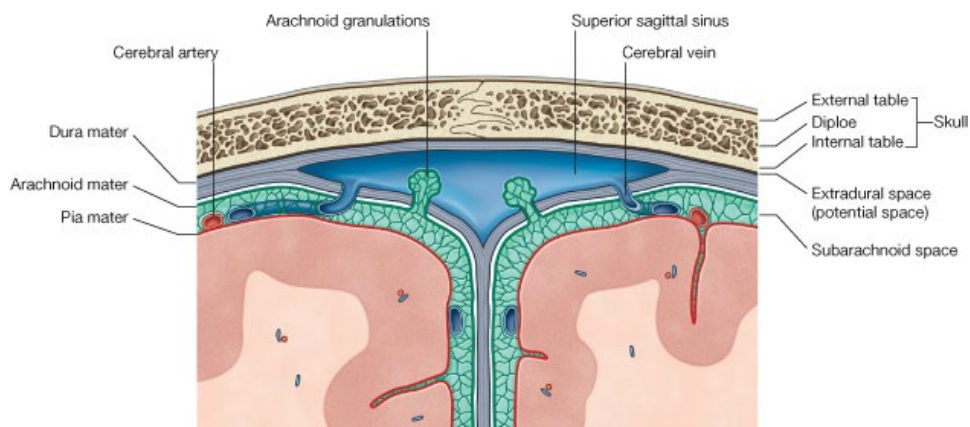




What is the CSF Flow?

Reabsorption of CSF

- Takes place through **arachnoid villi**
 - Minute protrusions of the arachnoid through small openings in the dura which forms the superior sagittal sinus.
 - **I.e. bulging of the subarachnoid space into the dural venous sinuses**
 - Each villus contains a tiny tubule, which opens at the end of the villus into the sinus
 - When CSF pressure > venous sinus pressure:
 - Villus fills with CSF which then flows into the venous sinus.
 - When venous sinus pressure > CSF pressure:
 - Villi & their tubules collapse Δ no reabsorption of CSF into venous blood
 - The collections of arachnoid villi become larger with age – can be seen with naked eye in the superior sagittal sinus.
 - Collections of villi are called **arachnoid granulations**



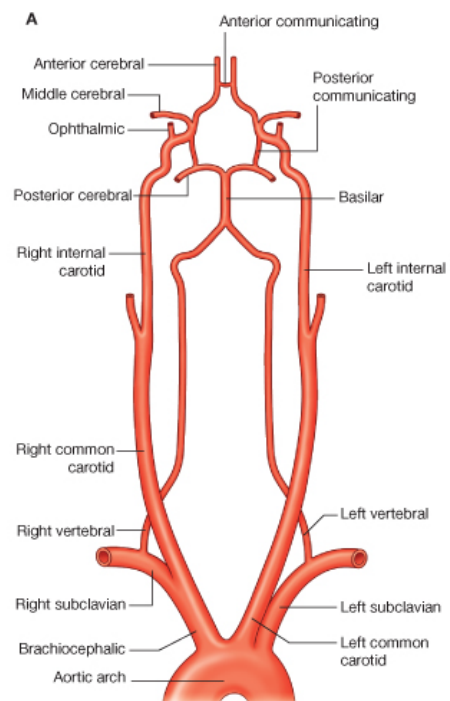
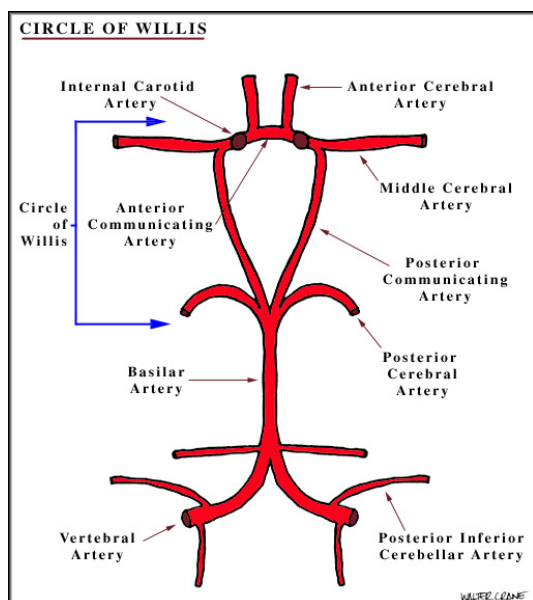
- If during injury to the anterior cranial fossa the brain coverings in the region of the cribriform plate are torn → CSF may leak into nasal cavity; **rhinorrhoea**
- Fracture of the petrous temporal bone → CSF may leak into ear; **otorrhoea**
- Δ must ask a patient who has had a head injury if they have noticed blood-stained fluid coming from nose or ear.

BLOOD SUPPLY TO THE BRAIN:

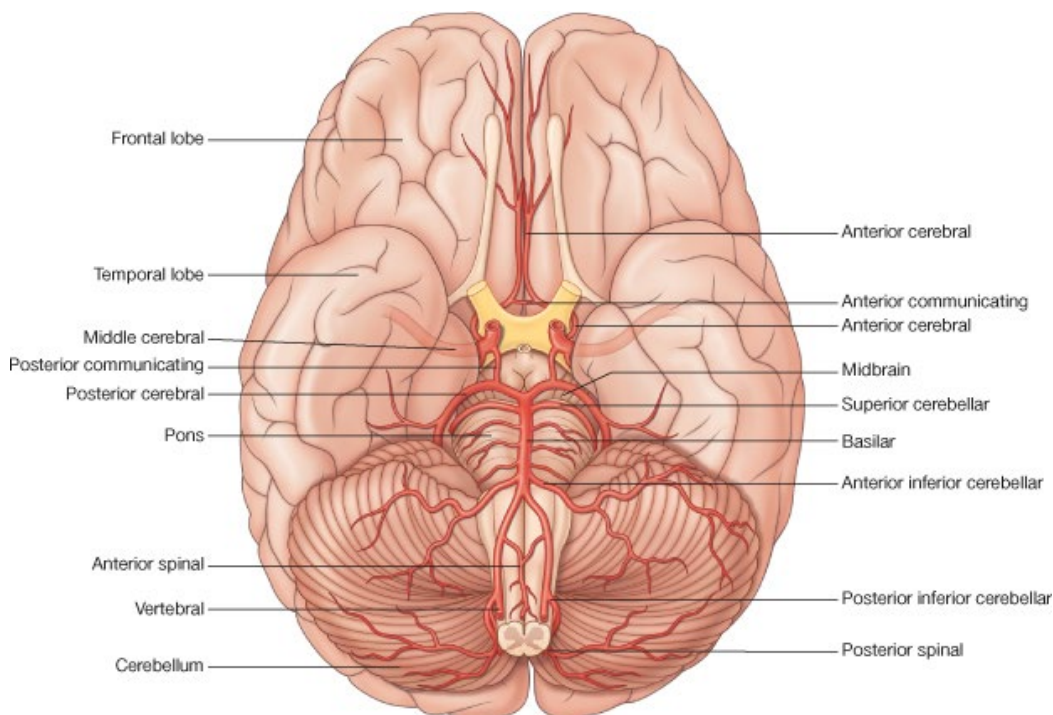
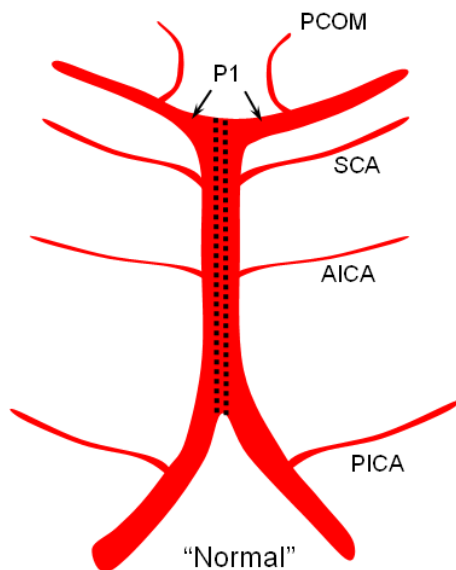
- Blood supply to the brain comes from:
 - **Vertebral arteries**
 - **Internal carotid arteries**

Vertebral arteries

- Branch of the subclavian artery in the neck
- Enters the **foramen transversarium** on each side at the **level of C6**
- Ascends through the foramen transversarium of cervical vertebrae
- Comes to lie on side of lateral mass of atlas
- Passes over posterior arch of the atlas → **foramen magnum**
- Pierces the dura mater at the foramen magnum → enters cranial cavity
- Runs along lateral aspect of medulla
- Fuses with the vertebral artery of the other side, to form the **basilar artery** in front of the pons.
- The vertebral artery gives off the:
 - **Anterior spinal arteries**
 - **Posterior spinal arteries**
- These arteries are extremely important to supply of spinal cord.
- **Basilar artery** supplies:
 - Cerebellum
 - Pons
 - Labyrinth of the ear
- Basilar artery splits into **2 x posterior cerebral arteries** which communicate with the **middle cerebral arteries** via the **circle of Willis**



- At the circle of Willis there is communication between all the arteries that supply the cerebrum
- This is important for:
 - Equalisation of pressure
 - Allowing collateral blood supply if there is occlusion of one BV
- **Posterior cerebral arteries** supply much of the:
 - Occipital lobes
 - Temporal lobes

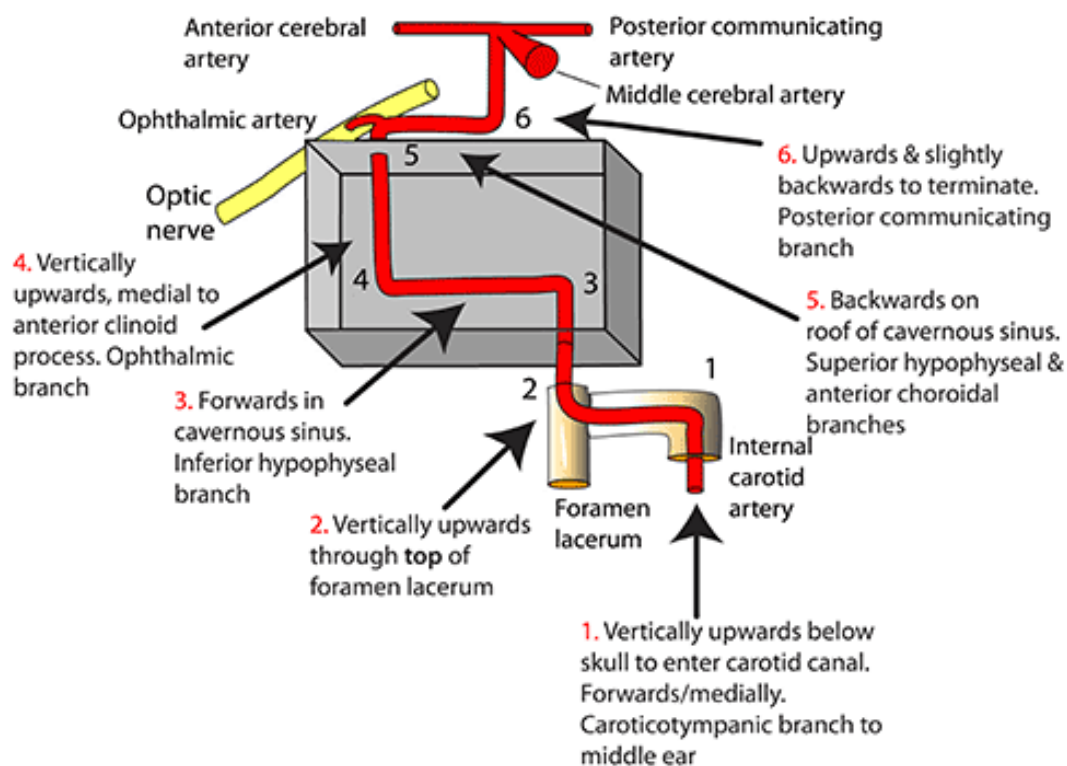


Internal carotid arteries:

- Arise from bifurcation of the common carotids in the neck
- Internal carotid doesn't give any branches in neck

1. Enters the carotid canal of petrous temporal bone
2. Turns a right angle to travel through the petrous bone to its apex
3. Runs out of the bony canal across top of **foramen lacerum**
 - Foramen lacerum is a gap between temporal and sphenoid, which in life is filled with cartilage.
4. Turns another right angle at level of foramen lacerum to enter the cavernous sinus.
5. Travels forwards within the cavernous sinus
6. Another right angle turn brings the internal carotid through roof of cavernous sinus – where it gives off the **ophthalmic artery**.
7. Lies just medial to anterior clinoid process
8. Turns backwards and then upwards at the level of **optic chiasma**
9. Divides into:
 - a. **Anterior cerebral artery**
 - b. **Middle cerebral artery**

DIAGRAMMATIC REPRESENTATION OF THE 6 RIGHT ANGLE BENDS OF THE INTERNAL CAROTID ARTERY



Anterior cerebral artery:

- Winds around genu of corpus callosum
- Supplies medial and superolateral aspects of cerebral hemispheres

Middle cerebral artery:

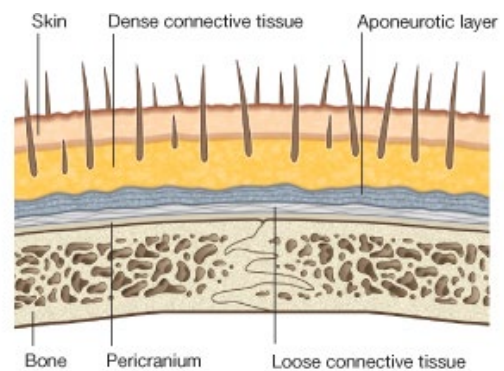
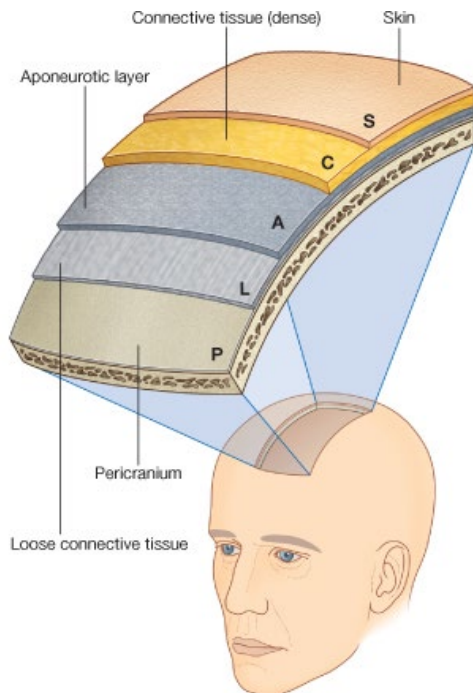
- Enters lateral cerebral sulcus
- Supplies delicate branches to internal capsule
- Continues on to supply lateral aspects of cerebral cortex

Ophthalmic artery:

- Emerges from internal carotid just after it emerges through the roof of the cavernous sinus.
- Enters the orbit through the optic foramen below and lateral to the optic nerve.
- Supplies:
 - Contents of orbit
 - Skin of forehead & eyebrow
- Gives of a branch called **central artery of the retina** – the only artery to the retina
 - Runs with the optic nerve to reach the retina.

APPLIED ANATOMY

- Layers of the SCALP:
 - **S: skin**
 - **C: dense connective tissue**
 - **A: epicranial aponeurosis**
 - **L: loose connective tissue**
 - **P: periosteum**



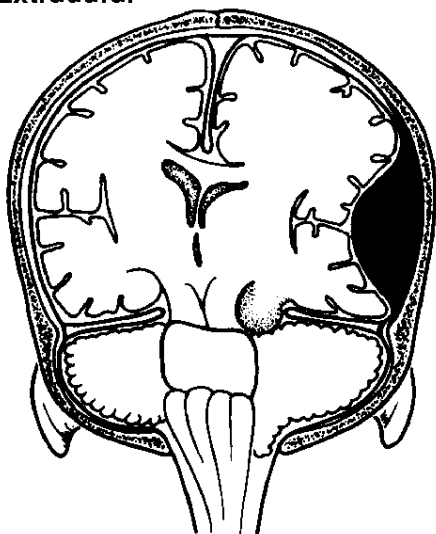
- **Epicranial aponeurosis:**
 - Tough
 - Attached at back, sides & front to the muscles that move the scalp.
- If a laceration does not damage aponeurosis, the wound will not pull apart.
- If the aponeurosis *is* damaged, the muscles to which it is attached will pull in opposite directions → a gaping wound, requiring deep sutures.
- **Loose connective tissue** layer below the aponeurosis allows free movement of the scalp.
- Blood and infection can easily track through the loose CT layer

- This is dangerous, as the emissary vessels can then conduct the infection into the intracranial region / cranial venous sinuses.
- **Dense connective tissue** layer usually forms a good barrier against infections & lacerations
- Nerves and BVs run upwards through the dense CT to reach the scalp.

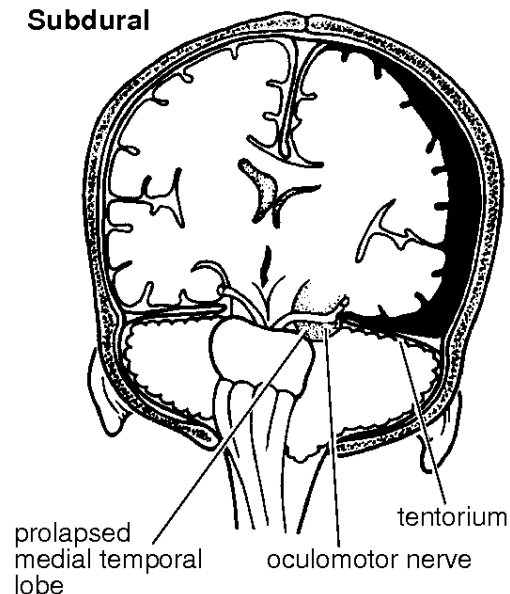
Intracranial bleeding:

- Often occurs as a result of head trauma
- **Extradural haemorrhage:**
 - Damage to meningeal arteries & diploic veins within the vault bones
 - Prolonged extradural bleeding can compress the brain
 - Drowsiness
 - Loss of consciousness
 - Extreme compression → forces medial part of temporal lobe over free edge of the tentorium cerebelli on the same side as the lesion.
 - → stretches / traps the oculomotor nerve (III)
 - → loss of parasymp. to sphincter pupillae
 - → pupillary dilation that will not respond to light.
- **Subdural haemorrhage:**
 - Bleeding between the dura and the arachnoid
 - Due to trauma which shakes the brain sufficiently to tear cerebral veins passing from brain → cranial venous sinuses.
 - May be:
 - Acute & sudden
 - Slow & chronic
 - Chronic bleed may spread & then localise, forming a subdural haematoma / clot
 - The haematoma may slowly draw in water & expand: Δ symptoms may not until weeks after initial injury.

Extradural



Subdural

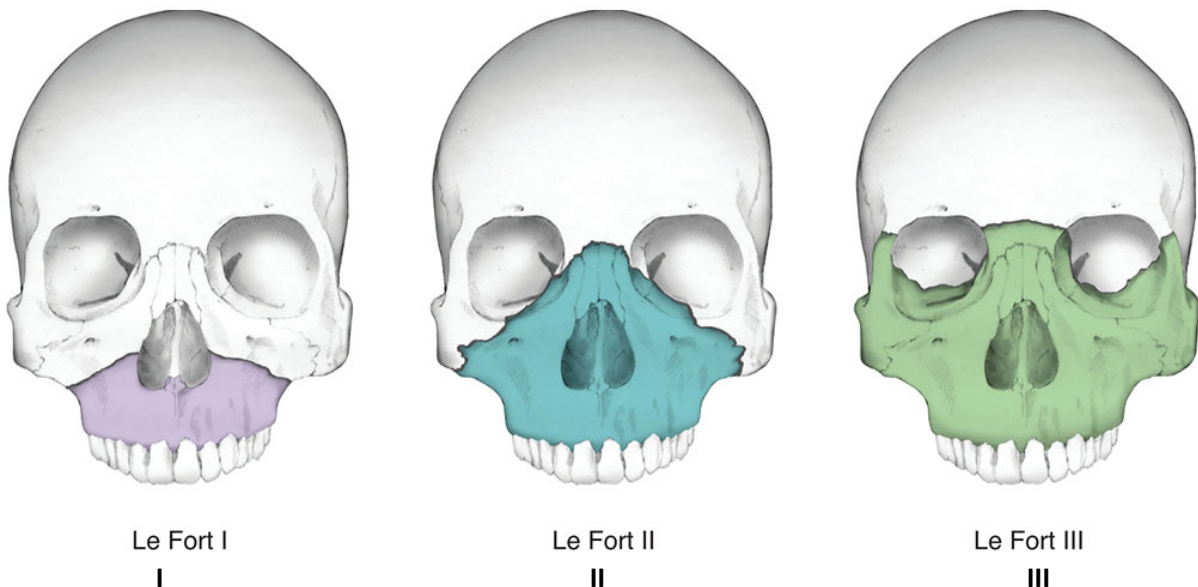


- **Subarachnoid haemorrhage:**
 - Sudden
 - Can be mistaken by patient for a blow to the head

- V. painful – causes immediate meningeal irritation
- Commonly the result of rupture of a berry aneurism
 - Thin walled outpouches of the large arteries that supply the brain
 - Prone to rupture under continued arterial pressure
 - This one cause of a **'stroke'**
- Intracranial bleeds are more common in older people, especially those with hypertension.
- Middle cerebral artery is a classic site of stroke
 - Bleeding from delicate branches of this artery in the internal capsule → paralysis of motor fibres running from motor cortex
 - → hemiplegia & loss of speech.

FRACTURES OF THE SKULL

- Usually occurs in one of 3 positions, outlined by 'Le Forts' classification:



- Le Fort I: across mandible
- Le Fort II: through zygomatic
- Le Fort III: beneath sphenoid

SOME KEY POINTS ABOUT THE SKULL:

- Internal carotid artery supplies blood to the brain
 - It does not branch in the neck – instead travels directly to brain
- Internal jugular vein takes blood away from brain
 - Receives many tributaries
- Cranial nerve number depends on its position of origin in the brain
- Cranial nerves can be:
 - Entirely motor
 - Entirely sensory
 - Mixed
 - Special sensory

- Skull = mandible + cranium
- 'Vault' is also known as 'neurocranium'
- There are several air sinuses in the skull:
 - A large one in frontal bone
 - Lined with respiratory epithelium
- **Diploic veins** do not run all the way through the vault
- **Emissary veins** do run all the way through the vault
- **Middle meningeal artery:**
 - Branch of the **external carotid artery (maxillary artery)**
 - Extradural
 - Nutrient artery to diploic bone
 - Makes clear grooves on bones of vault
- The **olfactory nerves** (I) have bulbs – they sit either side of the cribiform plate of the ethmoid bone.
- The 2 **optic nerves** cross and decussate at the **optic chiasma** above the pituitary gland and pituitary fossa.
- Originally a growth plate exists between the sphenoid and occipital bones