

INTERNATIONAL SURGICAL
ANATOMY TEACHING
SERIES



ISATS HANDOUT 2023/24

Neuroanatomy: Brain

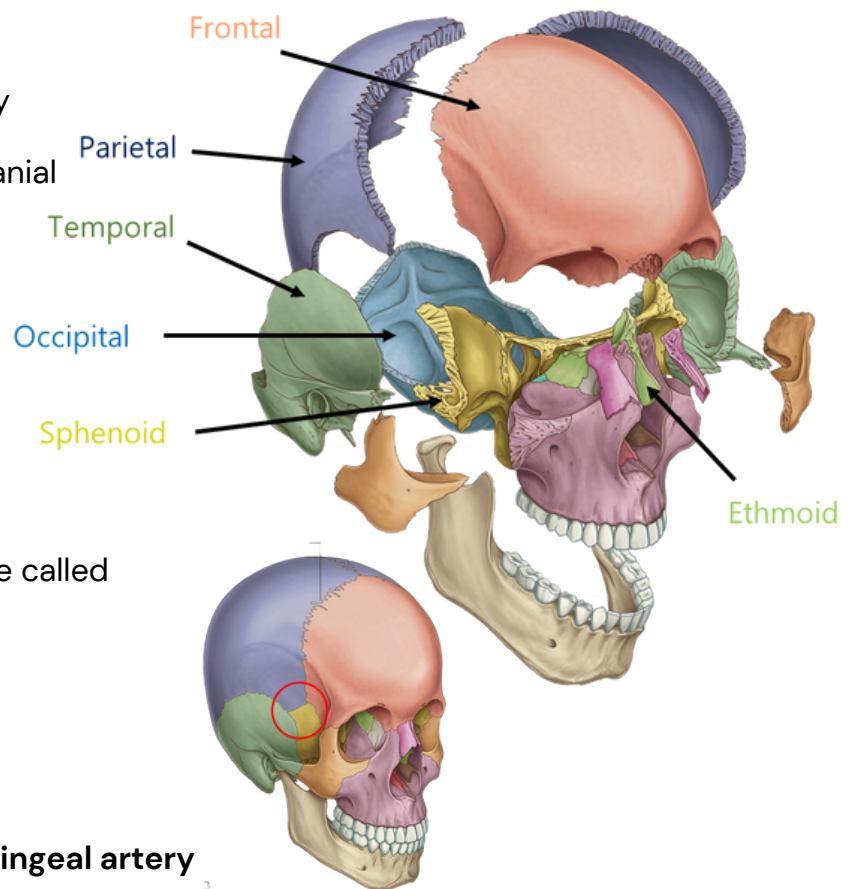
BRAIN ANATOMY

Objectives: Appreciate the fundamental anatomy of the brain and its surroundings, including the skull, cranial base and meninges. Detail the vascular supply to the brain and the ultrastructure of the ventricles. Apply anatomical knowledge to the setting of common neurosurgical procedures.

Bony Anatomy

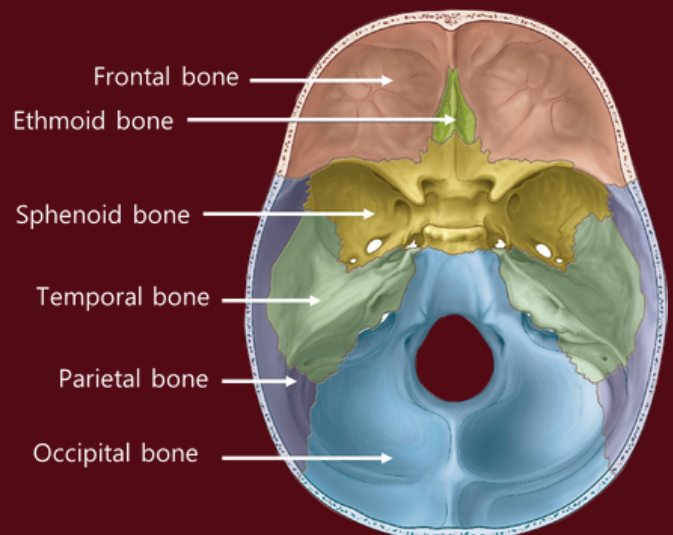
Bones of the Skull

- The skull is a highly complex bony structure
 - **Neurocranium** (calvaria & cranial base)
 - Viscerocranium
- The Neurocranium is made up of:
 - Frontal
 - Parietal
 - Temporal
 - Occipital
 - Sphenoid
 - Ethmoid
- The joints between each bone are called **sutures**
 - Sagittal suture
 - Coronal suture
 - Lambdoid suture
- Pterion
 - Weakest point of the skull
 - Close relation to **middle meningeal artery**



Cranial Base

- The cranial base is relevant in neurosurgery, ENT, plastics and maxillofacial surgery
- Can be split into 3 fossae
 - **Anterior cranial fossa**
 - Houses frontal lobes
 - Cribriform plate for olfactory nerve (CNI)
 - **Middle cranial fossa**
 - Houses temporal lobes & pituitary
 - Foramina for cranial nerves
 - CNII-VI
 - **Posterior cranial fossa**
 - Houses cerebellum, pons & medulla
 - Foramina for cranial nerves
 - CNVII-XII



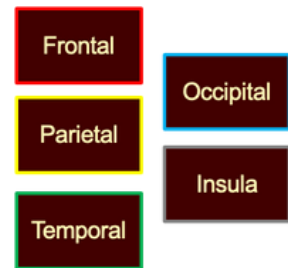
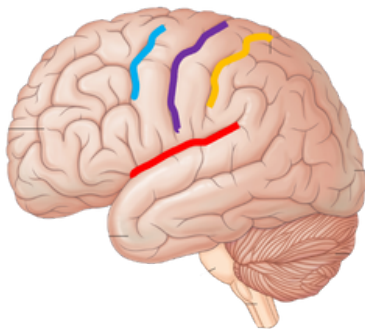
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Topography of the Hemispheres

Lateral View

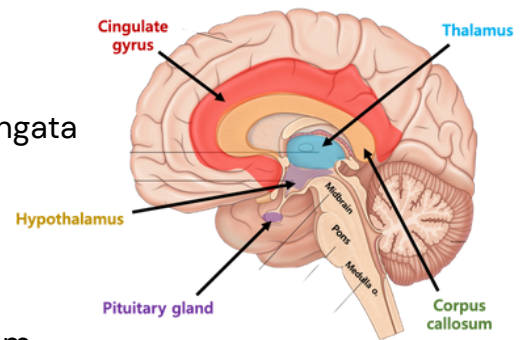
- Gyrus = bump
- Sulcus = groove
- 5 lobes in each cerebral hemisphere



Sylvian Fissure (lateral sulcus)	Separates temporal from frontal & parietal lobes
Central Sulcus	Separates frontal & parietal lobes
Pre-central Sulcus	Primary motor cortex
Post-central Sulcus	Primary somatosensory cortex

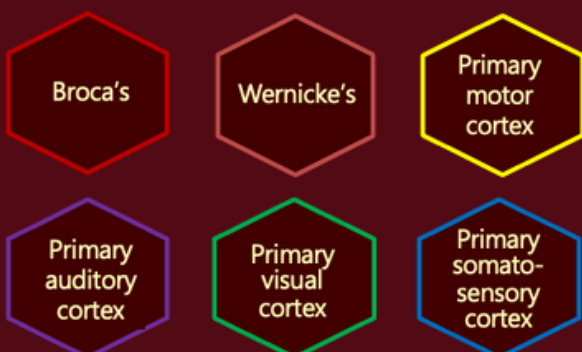
Medial View

- Brainstem
 - Midbrain
 - Pons
 - Medulla oblongata
- Corpus callosum
- Cingulate gyrus
- Thalamus
- Hypothalamus
- Pituitary gland
- Ventricular system

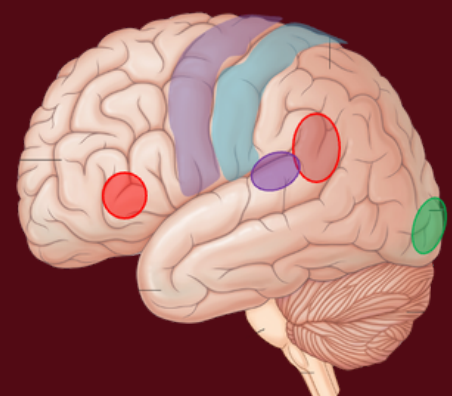


Eloquent Topography

- Eloquent areas = localised hubs of specialised functional neurones
- The highest cognitive function requires the whole cortex and white matter to function and integrate



Area	Function
Broca's area	Motor component of speech
Wernicke's area	Sensory component of speech



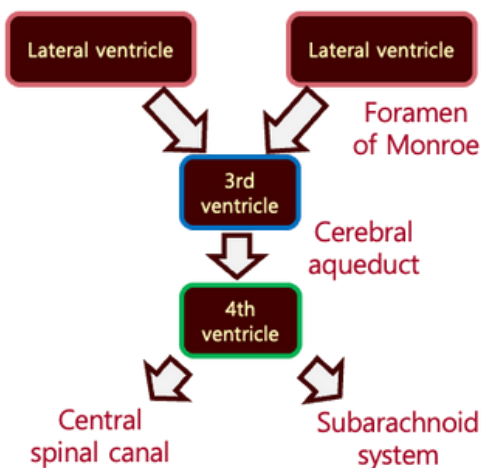
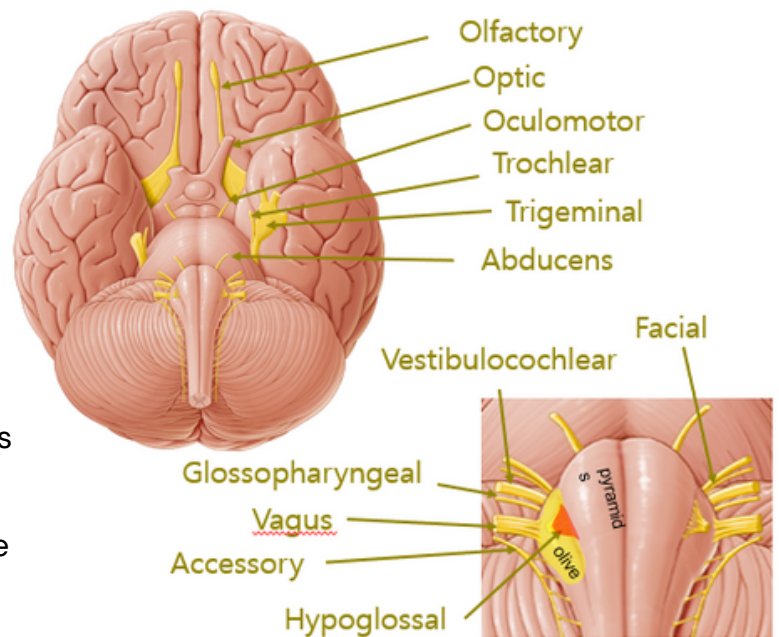
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Cranial nerves

Tips to remember:

- The first 2 cranial nerves emerge directly from the **cerebral hemispheres**
- Remaining **10** from the **brainstem**
- **CNIII** – oculomotor is sensitive to herniation
- **CNIV** – trochlear exits at posterior brainstem
- **CNVIII** – vestibulocochlear is 2 nerves
- **CNXI** – accessory has spinal routes
- **CNXII** – hypoglossal is the only one between medullary pyramids and the olives



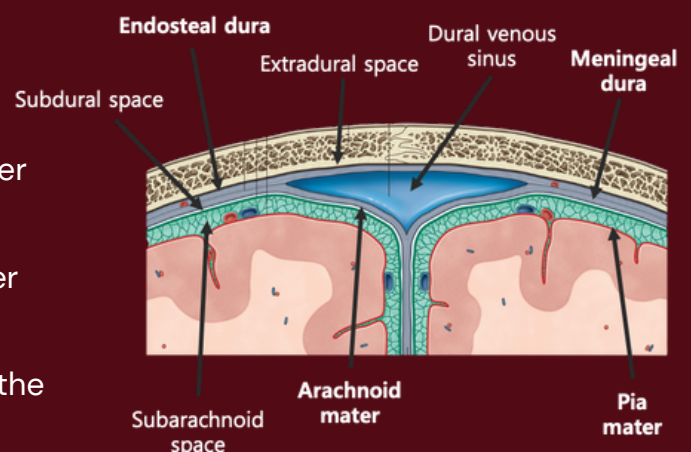
Ventricles

- **Function:** storage & production (choroid plexus) of CSF, protection and buoyance of the brain
- Hold **25ml** of the 150ml of CSF
- Foramen of Munro = **interventricular** foramen
- 3rd to 4th via: **Cerebral aqueduct**
- Foramen of Magendie = **median** aperture
- Foramen of Luschka = **lateral** apertures
- The ventricles drain CSF into the **subarachnoid cisterns**

Meninges

Layers

- **Dura mater** – thick fibrous, split into endosteal layer and meningeal layer
 - Subdural space – potential
- **Arachnoid mater** – thinner and looser, bridges over sulci
 - Subarachnoid space – actual
- **Pia mater** – microscopic layer, adheres closely to the brain



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Arterial Supply to the Brain Circle of Willis

- The **Circle of Willis** is an in-built mechanism to allow for **collateral** supply to the brain
 - If there is restricted blood flow in one area, total ischaemia can be avoided
 - Terminal branches do not have this luxury
- The supply can be divided into **anterior** and **posterior** circulation
 - Each route has distinct **signs** and **symptoms** when obstructed

Vertebral artery branches (posterior circulation)

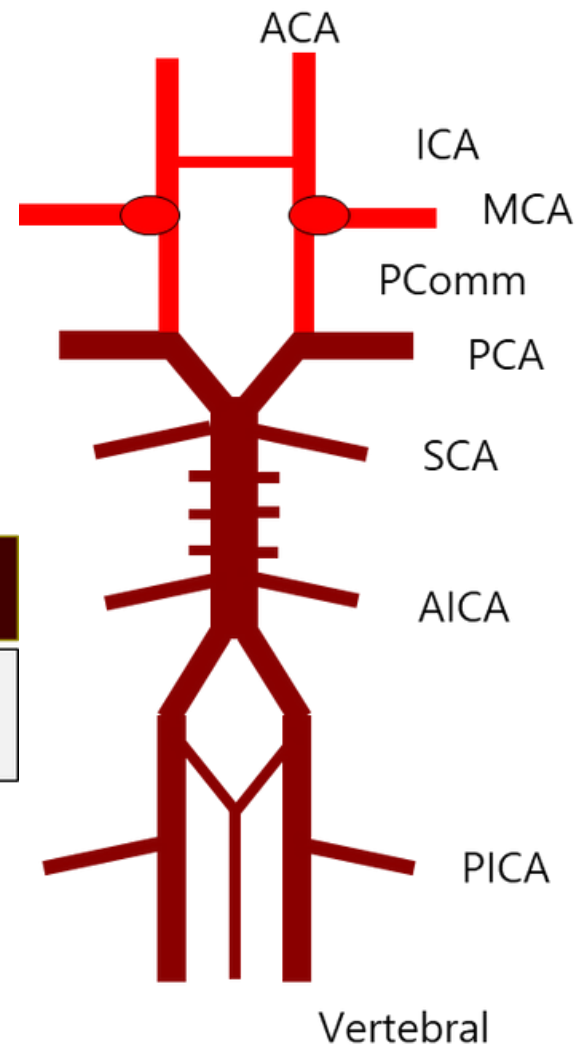
- Posterior inferior cerebellar artery (PICA)
- Anterior spinal artery
- Join to form: Basilar artery

ICA branches (anterior circulation)

- Anterior cerebral artery (ACA)
- Middle cerebral artery (MCA)
- **Posterior communicating artery (P.comm)**

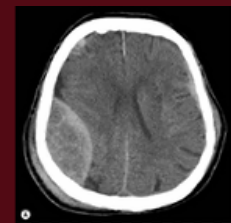
Basilar artery branches

- Anterior inferior cerebellar artery (AICA)
- Pontine branches
- Superior cerebellar artery (SCA)
- Posterior cerebral artery (PCA)

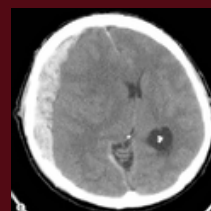


Brain bleeds

- **Extradural haematoma**
 - Most commonly pterional fractures
 - Do not cross sutures – endosteal dura fixed
 - Biconvex/lentiform appearance
- **Subdural haematoma**
 - Bridging veins
 - Shear force between dura mater and arachnoid
 - Cross suture lines – crescent sign
- **Subarachnoid haemorrhage**
 - Cerebral arteries burst (commonly aneurysm)
 - Blood fills the subarachnoid space
 - Cisterns can be seen filling with blood on CT



Extradural haematoma



Subdural haematoma



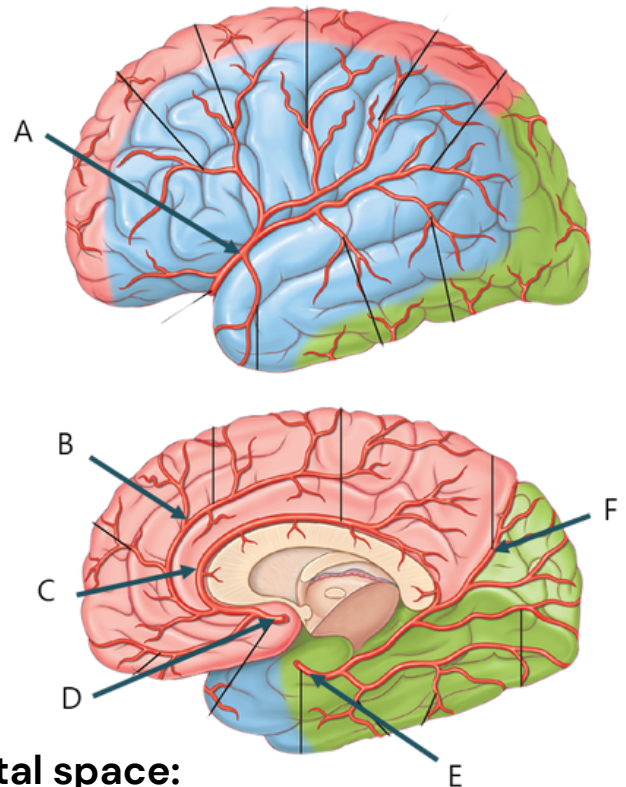
Subarachnoid haematoma

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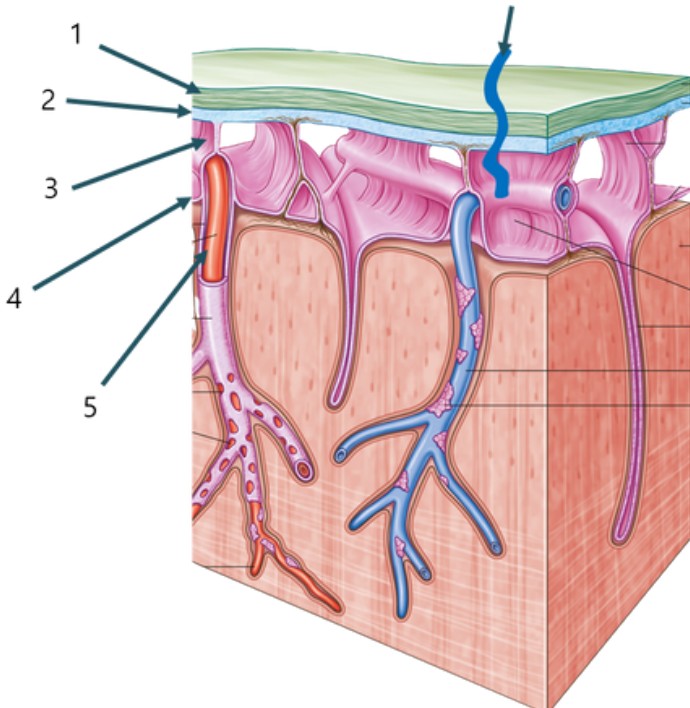
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1) Label the structures present within the hilum of the right lung:

- A)
- B)
- C)
- D)
- E)
- F)



2) Label the layers within the intercostal space:



- 1)
- 2)
- 3)
- 4)
- 5)
- 6)

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MCQ 1:

Which of the following regarding a subdural haemorrhage is true?

- A. Found in-between the endosteal and meningeal layers of dura
- B. Due to spontaneous rupture of a cerebral aneurysm
- C. Unable to cross the lines of the skull suture
- D. Due to a venous bleed
- E. Causes a thunder-clap headache

MCQ 2:

Which structure passes through the foramen rotundum?

- A. Optic nerve (CNII)
- B. Abducens nerve (CNVI)
- C. Maxillary nerve (CNVb)
- D. Middle meningeal artery
- E. Mandibular nerve (CNVc)

MCQ 3:

The primary auditory cortex within the temporal lobe receives its main blood supply from which of the following arteries?

- A. Anterior cerebral artery
- B. Posterior cerebral artery
- C. Middle cerebral artery
- D. Pontine branches
- E. Internal carotid artery

MCQ 4:

The central sulcus delineates which lobes of the brain?

- A. Frontal and temporal
- B. Parietal and occipital
- C. Temporal and occipital
- D. Frontal and insula
- E. Frontal and parietal

MCQ 5:

Which structure drains cerebrospinal fluid from the lateral ventricles to the third ventricle?

- A. Cerebral aqueduct
- B. Foramen of Monroe
- C. Foramen ovale
- D. Foramen lacerum
- E. Foramen of Luschka

MCQ 6:

Which cranial nerve emerges posterior to the brainstem?

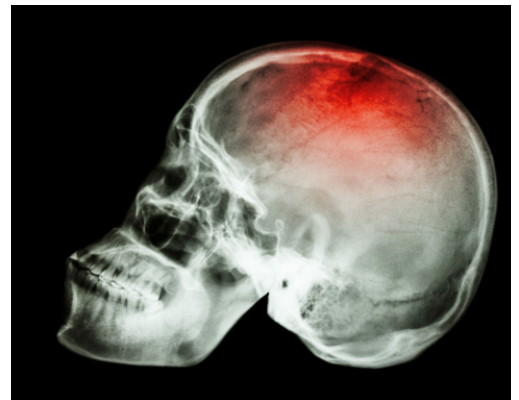
- A. Trochlear nerve (CNIV)
- B. Oculomotor nerve (CNIII)
- C. Facial nerve (CNVII)
- D. Glossopharyngeal nerve (CNIX)
- E. Vestibulocochlear nerve (CNVIII)

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OSCE Station – Case Based Discussion

A 26 year old hockey player is accidentally struck in the side of their head during a game causing them to lose consciousness. They rapidly recover showing some signs of concussion but are not taken to hospital. 5 hours later, they are found unconscious at home. They cannot be woken and are breathing in an irregular pattern. By the time they arrive at the hospital, the junior doctor on call notices an unusual orientation of their right eye. Radiology report suggests this is an extradural haematoma.



Q1. What imaging study is vital for this patient for diagnosis? Describe the image you would see?

Q2. Explain the anatomy of this pathology with specific reference to the meningeal layers

Q3. Give one simple manoeuvre you could do to help this patient and give one surgical option

Q4. Why was this patient initially fine but then progress to unconsciousness?

Q5. Briefly explain the orientation of their right eye

Q6. Aside from routine observations, what other continuous monitoring does this patient need and how will this be done?

Answers
 MCQs: 1) D, 2) C, 3) C, 4) E, 5) B, 6) A
 OSCes: 1) CT head. Bi-convex / lentiform opacity representing an extradural haematoma. 2) Fracture likely occurred at the pterion damaging the anterior branch of the middle meningeal artery (branch of maxillary artery). This artery when damaged will bleed between the endosteal dura and the bone opening the extradural space (usually a potential space). 3) Sit the patient up above 30 degrees. Decompressive craniectomy. 4) Extradural haematomas often have a latent phase up to a few hours. Mass effect grows and causes raised intracranial pressure (ICP) and eventually herniation of the brain. 5) Down and out eye orientation due to oculomotor nerve palsy – unopposed action of lateral rectus & superior oblique. 6) ICP monitoring. Can be placed as an extra-ventricular drain (into the ventricles) or a subarachnoid bolt (into subarachnoid space)