

SKULL

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I. CALVARIUM - skull cap.

A. Bones - Calvarium consists single Frontal, Sphenoid and Occipital bones and paired Parietal and Temporal bones (lobes of Cerebral Cortex are named for bones of skull).

B. Sutures - named fibrous joints that connect bones of calvarium:

1. **Coronal suture** - between Frontal and Parietal bones
2. **Sagittal suture** - between Parietal bones
3. **Lambdoidal suture** - between Parietal and Occipital bones

C. Landmarks:

1. **Bregma** - midpoint of Coronal Suture
2. **Lambda** - midpoint of Lambdoidal suture
3. **Pterion** - area of junction of Sphenoid, Temporal, Parietal and Frontal bones (**Note: Skull fractures in region of Pterion are clinical important, ex. Epidural Hematoma**)

D. Fontanelles - in infants, bones are further apart and joined by fontanelles; fontanelles permit cranial compression at birth, later cranial growth:

1. **Anterior Fontanelle** - at Bregma
2. **Posterior Fontanelle**- at Lambda
3. **Lateral Fontanelle**- at Pterion

Clinical: **Anterior Fontanelle** can be used to **access Superior Sagittal venous sinus in neonates**.

Forensic note: Sutures progressively fuse with age; extent of fusion can be used to estimate age of skull.

E. Internal structure of calvarium

1. Calvarium consists of **hard inner and outer tables** of cortical bone surrounding layer of **spongy bone (Diploe = double)**.

2. **Diploic veins** - course within diploe, connect both to cranial cavity and surface of skull via **Emissary veins (can transmit infection through emissary veins, see below)**.

F. Blood supply to calvarium - outer surface receives branches from arteries to scalp (see below); inner surface receives branches from Meningeal arteries (coursing immediately below bone).

II. **SCALP** - layers of skin and connective tissue overlying calvarium.

A. Layers - superficial to deep

1. **Skin** - with associated hair follicles, sweat glands and sebaceous glands.
2. **Connective tissue layer** - dense fibrous connective tissue surrounding arteries and nerves.
3. **Epicranial Aponeurosis** - thin tendinous sheet, tightly attached to skin and connective tissue above; moveable anteriorly and posteriorly; laterally attached to temporal fascia; attached to Frontalis and Occipitalis muscles.
4. **Loose Areolar tissue** - loosely connects epicranial aponeurosis to periosteum of skull; crossed by emissary veins (see below).
5. **Pericranium** - periosteum (connective tissue layer) of outer side of calvarium.

Clinical note: Infections can readily spread through loose areolar layer deep to epicranial aponeurosis.

Primitive note: When tribesmen scalp someone, they merely cut along the periphery of the scalp. It is then readily **removed between the layers of the epicranial aponeurosis and the loose areolar tissue**. Civilized people (including medical students) do not keep scalps as souvenirs.

B. Innervation

1. branches of Trigeminal nerve innervate anterior and lateral scalp: 1) Supratrochlear and 2) Supraorbital nerves (anterior scalp), 3) Zygomaticotemporal and 4) Auriculotemporal nerves (lateral scalp).
2. Cervical spinal nerves innervate lateral and posterior scalp: 1) Lesser Occipital nerves (from ventral ramus of C2) and 2) Greater Occipital nerves (from dorsal ramus of C2).

C. Arterial Supply - very rich

1. branches of Ophthalmic artery (from Internal Carotid Artery): Supratrochlear and Supraorbital arteries (anterior scalp)

2. branches of External Carotid artery - 1) Superficial Temporal artery (to lateral scalp); 2) Posterior Auricular artery (scalp above and posterior to external ear); 3) Occipital artery (posterior scalp).

Clinical note: There are extensive anastomoses between arteries to scalp; scalp wounds can bleed profusely from both sides of cut.

D. Venous drainage - by veins with same names as arteries; **also drain via emissary veins (passing into diploe) into interior of skull.**

Clinical note: Infections can spread from scalp to brain via Emissary veins.

III. **CRANIAL NERVES** - brain is bilaterally symmetrical; cortex is connected to spinal cord by brainstem; outflow/inflow of brain is via cranial nerves; cranial nerves are numbered using Roman numerals:

I. Olfactory - sense of smell

II. Optic - vision

III. Oculomotor - eye muscles

IV. Trochlear - eye muscles

V. Trigeminal - sensory to skin; motor to muscles of mastication (chewing), etc.

VI. Abducens - eye muscles

VII. Facial - motor to muscles of facial expression, etc.; taste to ant. tongue

VIII. Vestibulo-Cochlear - hearing and balance (vestibular apparatus)

IX. Glossopharyngeal - sensory to pharynx

X. Vagus - sensory and motor to larynx (voice box), etc.

XI. Accessory - motor to Trapezius and Sternocleidomastoid

XII. Hypoglossal - motor to muscles of tongue (no sensory)

IV. LANDMARKS AND BONES OF SKULL

A. Views of skull

1. Front of skull

a. Frontal bone – forms forehead, upper margin and roof of orbit

b. Orbit - bones covered in orbit lecture.

c. Zygomatic bones - form cheeks.

d. Maxilla - has sockets for upper teeth (alveolar processes); infraorbital foramen (below orbit).

- e. Nasal apertures (Choanae) - covered superiorly by nasal bones.
- f. Mandible - separate bone; alveolar processes for lower teeth; mental foramen (below second pre-molar tooth).

2. Lateral view

- a. Zygomatic arch - consists of zygomatic bones and zygomatic processes of maxillary and temporal bones.
- b. Temporomandibular joint - joint between head of mandible (upper end of ramus) and temporal bone.
- c. Temporal bone - has parts: 1) mastoid process (inferiorly), 2) squamous (flat) part laterally; 3) tympanic part forms anterior side of external auditory meatus (opening of ear); 4) petrous part is inside skull.
- d. Parietal, Temporal, Frontal and Sphenoid bones form lateral side of cranial cavity.

3. Posterior view of skull

- a. Occipital bone - has Superior and Inferior Nuchal lines; External Occipital protuberance (inion) is raised bump in middle of Superior Nuchal line.

4. Base of skull

- a. Temporal bone - has Styloid process for muscle attachment.
- b. Occipital bone - has Foramen Magnum for spinal cord and vertebral arteries; occipital condyles articulate with vertebra C1 (Atlas).
- c. Palatine bones and palatine process of maxillary bones form hard palate.

B. Individual bones of skull

- 1. Sphenoid bone - "core" of skull - forms part of orbit, lateral side of skull, base of skull, parts of all three cranial fossae.
 - a. Medial and Lateral Pterygoid plates - processes for muscle attachments.
 - b. Spine of Sphenoid - on inferior side of sphenoid for ligament attachment.
 - c. Lesser wing of Sphenoid - in interior of skull, above Superior Orbital fissure.
 - d. Greater wing of sphenoid - extends below Superior Orbital fissure, extends out laterally.
 - e. Sella Turcica (Turkish saddle) - depression above body of sphenoid (central part) between Anterior and Posterior Clinoid processes; pituitary gland is located in

Sella Turcica.

f. Clivus - central part of sphenoid that extends down to Posterior Cranial Fossa.

Clinical Note: **Parts of Sphenoid bone are important landmarks in Neurology.**

V. **CRANIAL CAVITY** - divided into depressions or fossae that are functionally related to parts of brain and facial skeleton.

A. Anterior cranial fossa - related to roof of nasal cavity (also forms roof of orbit).

1. contains Olfactory bulbs and Frontal lobes of cortex.
2. Foramina - in cribriform plate of ethmoid bone conduct branches (fila olfactoria) of olfactory nerve (CNI).

B. Middle cranial fossa - related to orbit, nasal cavity and face.

1. contains - Pituitary gland, Temporal lobes of cortex and cranial nerves from rostral brainstem.
2. Foramina - for nerves to orbit (Optic nerve and nerves to eye muscles), nasal cavity and face (CNII-CNVI).

C. Posterior cranial fossa - related to face oral cavity, neck.

1. contains - lower brainstem and cerebellum; Petrous part of Temporal bone contains cochlea (hearing) and semicircular canals (gravity).
2. Foramina - for nerves to face, oral cavity (also taste), muscles of tongue and neck (CNVII-CN XII); Foramen Magnum transmits Spinal Cord and Vertebral arteries.

CHECKLIST OF FEATURES AND BONES OF SKULL TO IDENTIFY

Coronal suture - between Frontal and Parietal bones

Sagittal suture - between Parietal bones

Lambdoidal suture - between Parietal and Occipital bones

Bregma - midpoint of Coronal Suture

Lambda - midpoint of Lambdoidal suture

Pterion - junction of Sphenoid, Temporal, Parietal and Frontal bones (fracture - **Epidural Hematoma**)

Anterior Fontanelle - located at Bregma

Posterior Fontanelle - located at Lambda

Lateral Fontanelle - located at Pterion

Diploe - spongy bone in calvarium between hard inner and outer tables

Zygomatic arch - zygomatic bones and zygomatic processes of maxillary and temporal bones

Temporomandibular joint - joint between head of mandible and mandibular fossa of temporal bone

Mastoid process - inferior part of temporal bone posterior to external auditory meatus

Squamous part of Temporal bone - lateral part, contributes to calvarium

Tympanic part of Temporal bone - anterior to external auditory meatus

Petrous part of Temporal bone - hard bone, inside cranial cavity (contains cochlea, semicircular canals)

Superior and Inferior nuchal lines - raised ridges on posterior surface of Occipital bone

External Occipital protuberance - raised midline bump in Superior Nuchal line

Bony palate - palatine bones, palatine process of maxillary bones

Medial Pterygoid plates - inferior projection of Sphenoid bone for muscle attachment (has hamulus (hook) for Tensor Palati muscle)

Lateral Pterygoid plates - inferior projection of Sphenoid bone for muscle attachment (Pterygoid muscles)

Spine of Sphenoid - inferior projection for ligament attachment

Lesser wing of Sphenoid - smaller part of Sphenoid Superior to Superior orbital fissure

Greater wing of Sphenoid - larger part of Sphenoid, extends laterally

Sella Turcica - depression above body of sphenoid (contains pituitary gland)

Anterior and Posterior Clinoid processes - anterior and posterior projections around sella turcica

Clivus - central part of sphenoid extending into Posterior Cranial Fossa