

THE HUMAN SKULL

By
Dr. Tuan Duc Pham

The specific aims of the lecture

1. Name all bones of the skull
2. Name major parts of complex bones
3. Review of the formation of bones of the skull
4. Identify the bones of major cavities of the skull
5. Locate openings and channels for nerves, arteries and veins
6. Examine common views of the skull

The skull is the skeleton of the head. The skull consists of twenty two flat and irregular bones which are bonded at their edges to form eight cavities and the face. The largest cavity is the **cranium** which contains the brain and cranial nerves, the two **nasal cavities** which serve both the respiratory system and the olfactory system, the two **orbital cavities** which contain the eyes, the **auditory cavities** which contain receptors for hearing and equilibrium and the **oral cavity** which serves both the digestive system and gustatory system. The bones of the skull also form the **skeleton of the face**.

1. The name of the bones of the skull

Although the skull consists of twenty two bones, there are only fourteen specific names because eight bones have identical twins.

The names of the twins are the right and left **parietal, temporal, nasal, inferior nasal conchal, lacrimal, zygomatic, maxillary** and **palatine** bones. These bones are symmetrically located in the parasagittal planes of the skull.

The names of the six single bones are the **frontal, ethmoid, sphenoid, occipital, vomer** and **mandibular** bones. The center of these bones is located in the sagittal plane of the skull.

2. The major parts of complex, irregular bones of the skull.

The bones of the skull vary significantly in size, shape and strength. In general, the large cavity is made of large bones and the small cavity consists of small bones. Many bones are complex and consist of several parts. Each part may form the wall of two or more cavities. The major parts of a bone are good markings for important portion of the brain, cranial nerves, arteries and veins. The list below includes several complex bones and their major parts.

The **frontal bone** forms the anterior part of the cranium and the roof of the orbits. It consists of a large **squamous** part and a small **orbital** part.

The **squamous** part has three surfaces. The external surface is marked by the **frontal eminences, superciliary arches, supraorbital margin, supraorbital notch/foramina**. The temporal surface is marked by the **temporal lines** and **temporal fossa**. The cerebral surface is marked by the **frontal crest** for the falx

The anterior surface is marked by the **grooves** of the greater and lesser petrosal nerves, and by the **arcuate eminence** of the anterior semicircular canal.

The posterior surface is marked by the **internal acoustic meatus** of the facial nerve, vestibulocochlear nerve and auditory artery.

The inferior surface is marked by the **jugular fossa** of the jugular bulb, the **carotid foramen** of the internal carotid artery, the **stylomastoid foramen** for the facial nerve.

The superior margin is marked by the **superior petrosal groove** of the superior petrosal sinus and provides attachment for the tentorium cerebelli.

The inferior margin is marked by the **inferior petrosal groove** of the inferior petrosal sinus.

The mastoid portion has 2 surfaces. The external surface is marked by the **groove** of the posterior auricular artery and by the **fossa** of the posterior digastric muscle.

The internal surface is marked by the **groove** of the sigmoid venous/dural sinus.

The tympanic part is a plate of thin bone which forms most of the wall of the **external acoustic meatus** and the **middle ear**.

The styloid part provides attachment for several muscles and ligaments.

The **occipital bone** is located behind the parietal and temporal bones. It has four parts: squamous, right lateral, left lateral and basilar.

The squamous part is marked, on its external surface, by the **external occipital protuberance**, the horizontal **supreme, superior, inferior nuchal lines** and the vertical **external occipital crest**. The internal surface of the squamous part is marked by the **internal occipital protuberance**, vertical **internal occipital crests**, horizontal **occipital crest**, and **occipital grooves**. The **vertical crests** provide attachments for **falx cerebri** and **falx cerebelli**. The vertical and horizontal **grooves** belong to the superior sagittal sinus and transverse sinuses, respectively. The lateral parts are marked by the **occipital condyles** for atlanto-occipital joints, the **condylar canals** for emissary vein, the **jugular notch** for jugular foramen and the **hypoglossal canal** for hypoglossal nerve.

The external surface of the basilar part is marked by the **pharyngeal tubercle**.

The **foramen magnum** is surrounded by all four parts of the occipital bone.

The **zygomatic bone** is located between the maxilla, frontal and sphenoid bones. It has a body with three surfaces and several processes.

The lateral surface forms the prominence of **the cheek** and is marked by the **zygomaticofacial foramen** for the zygomaticofacial nerve.

The orbital surface forms the inferolateral **wall and margin of the orbit**.

The temporal surface forms a small part of the **temporal fossa**.

The frontal process articulates with the frontal bone at the frontozygomatic suture.

The temporal process sutures with the zygomatic process of the temporal bone to form the **zygomatic arch** or **zygoma**.

The **maxillary bone** is located under the frontal bone and anterior to the zygomatic and ethmoid bones. It has a body, four surfaces and four processes.

The body is pyramidal and contains the largest **paranasal sinus**

The anterior border begins at the coronoid process and continues down toward the oblique line of the body.

3. The formation of bones of the skull

During fetal development, the developing brain is surrounded by the mesenchymal membrane. In the second month, some part of the membrane is replaced by cartilage. The cartilage is, in turn, replaced by bone. The type of bone that forms in the cartilage is called endochondral bone. In other part of the mesenchymal membrane, bone develops directly in the membrane. This type of bone is called membranous bones. Many bones of the skull consist of both the endochondral and membranous types.

At birth, the base of the cranium is occupied mostly by endochondral bones and elsewhere by membranous bones; however, the mesenchymal membrane still exists at the **anterior fontanelle**, **posterior fontanelle**, **sphenoidal fontanelle** and **mastoid fontanelle**. These membranous areas allow the cranium to enlarge continuously in response to the increase in size of the growing brain.

The posterior fontanelle, mastoid fontanelle, sphenoid fontanelle and anterior fontanelle are completely ossified at 2 months, 3 months, 1 year and 2 years, respectively.

In the adult, the **frontal**, **parietal**, **vomer**, **nasal**, **lacrimal**, **zygomatic**, **maxillary**, **palatine** are the membranous bones, the **ethmoid** and **inferior nasal conchal** are endochondral bones and the **sphenoid**, **temporal**, **occipital** and **mandibular** bones consist of both the membranous and endochondral types.

The mature bones of the skull are mold into cavities which accommodate the brain, the nose, the eyes, the ears and the mouth. These bones are immovable except the mandible. The bond of fibrocartilage between immovable bones are **sutures**. The sutures are named after the adjacent bones. Thus, the **frontonasal suture** is located between the frontal and nasal bones. However, there are several exceptions. The **coronal suture**, **sagittal suture**, **lamdoid suture** are located between the frontal and parietal bones, between the two parietal bones and between the parietal and occipital bone, respectively.

The mandible is movable at **synovial joints** formed by the heads of the mandible and the temporal bones.

The articulated skull formed eight cavities: the cranium of the brain, the nasal cavities of the nose, the orbital cavities of the eyes, the auditory cavities of the ears and the oral cavity of the mouth.

4. The bones of major cavities of the skull

Each cavity of the skull is formed by its own bones and other common bones that are shared by other cavities.

The bones that form the cranium:

Proper bones: the **parietal** and **occipital**

- Foramen ovale** for mandibular division of trigeminal nerve
Foramen spinosum for middle meningeal artery, meningeal branch of mandibular n.
Jugular foramen for glossopharyngeal, vagal and spinal accessory nerves, inferior petrosal sinus and internal jugular vein.
Stylomastoid foramen for facial nerve
Hypoglossal foramen for hypoglossal nerve
Foramen magnum for spinal cord, spinal accessory nerve, sympathetic nerve, vertebral arteries and spinal arteries

6. Common views of the skull in Netter's Atlas

1. **Superior View**: plate 7
Bones: frontal, parietal, occipital
Sutures: coronal, sagittal, lambdoid
Foramen: parietal foramen for emissary vein

2. **Lateral view**: plate 4
Cranial bones: frontal, ethmoid, sphenoid, temporal, occipital, parietal (festop)
Lines: superior and inferior temporal lines, pterion
Fossae: temporal fossa and infratemporal fossa, mandibular fossa

Facial bones: nasal, maxillary, lacrimal, zygomatic, mandibular
Apertures: orbital, nasal, oral
Foramina: supraorbital foramen on frontal bone, infraorbital, posterior superior alveolar foramina on maxillae, mental foramen on mandible, zygomaticofacial foramen on zygomatic,

3. **Midsagittal View**: plate 7
Cranial bones: frontal, ethmoid, sphenoid, temporal, occipital, parietal (festop)
Landmarks: crista galli, clinoid processes, superior petrous border/margin
Crest: frontal, parietal, occipital
Fossae: anterior cranial, middle cranial, posterior cranial and hypophyseal
Foramina: cribriform, jugular, foramen magnum
Meatus: internal acoustic
Grooves: meningeal, petrosal, transverse, sigmoid

Facial bones: nasal, maxilla, lacrimal, inferior nasal concha, vomer, palatine
Canals: incisive for nasopalatine nerve, sphenopalatine for sphenopalatine nerve

4. **Anterior View**: plate 2
Cranial bones: frontal, ethmoid, sphenoid, temporal, parietal
Facial bones: nasal, maxillary, lacrimal, zygomatic, mandibular
Foramina: supraorbital, infraorbital, mental, zygomaticofacial
Canal: optic canal at apex of orbit
Fissures: superior orbital fissures, inferior orbital fissure in orbit
Meatus: middle meatus, inferior meatus in nasal cavity

Landmarks: dorsum sellae and base of sphenoid bone, superior margin and posterior surface of petromastoid part of temporal bone, vertical and transverse crests, grooves on squamous, lateral and basal parts of occipital bone.

Canals: hypoglossal canal for hypoglossal nerve

Foramina: jugular foramina, foramen magnum, foramen lacerum

Meatus: internal acoustic meatus