

OSTEOLOGY OF THE HEAD

DR. MUSTAPHA O. A. DEPT. OF VET. ANATOMY, COLVET, UNAAB.

The skull is the collection of flat bones which forms the skeleton of the face and protects the brain. It also supports organs of mastication and keeps open the passage to the stomach, larynx, pharynx and lungs. It also houses the organs of sight and hearing. Hence, the skull is not a solid mass of bones.

OSTEOLOGY OF THE SKULL

The skull is made up of two parts namely: the cranium and the face. The cranium consists of bones which surrounds the brain and its membrane (meninges). The face makes up the rest of the skull. In both cases there are single bones as well as paired bones. The terms caudal and rostral are used in describing the skull. The caudal parts are the parts near the cranium while the rostral indicates parts/structures near the face.

BONES OF THE CRANIUM

They include:

- Occipital bone
- Ethmoid bone
- Sphenoid bone and
- The interparietal bone

All these four bones are single, other bones of the cranium include

- Parietal bone
- Temporal bone and
- Frontal bone

All these three bones are paired

BONES OF THE FACE

- Vomer bone and
- Mandible

These two bones are single.

Other bones are paired and they include

- The Incisive bone
- Maxilla bone
- Palatine bone
- Lacrimal bone

- Malar (Zygomatic) bone
- Nasal bone
- Turbinates
- Pterygoid bone

DESCRIPTION OF BONES OF THE CRANIUM

OCCIPITAL BONE

It is a single bone of the cranium and it lies at the most caudal aspect of the cranium and forms the caudal wall of the skull and brain cavity (cranium) as well as part of the ventral wall. The occipital bone is made up of three parts: **the lateral, basilar and squamous part**. It is perforated by a large foramen called *foramen magnum*. This foramen is formed by both the lateral and basilar part of the occipital bone.

The lateral part of the occipital bone bears two **occipital condyles** (bounded by the foramen magnum laterally) which articulate with the atlas bone. Along the lateral part is a long stout process called **paracondylar (paramastoid/jugular) process**. It is a strong plate of bone projecting rostrally and caudally. Between the root of this process and the condyle is a smooth depression, the condyloid fossa; in this is the hypoglossal foramen which transmits the hypoglossal nerve.

The basilar part of the occipital bone constitutes a strong bar of bone which extends rostrally from the caudal border of foramen magnum. Internally, the bone supports the medulla oblongata. On the ventral surface of the basilar part of the occipital bone are two small bony structures called the **basilar tubercles** which facilitate the attachment of the straight muscle of the head. On the corresponding dorsal surface of basilar tubercles is a slight transverse elevation called the sphenoid-occipital crest.

The **squamous part of the occipital bone** lies dorsal to the foramen magnum and does not contribute to the formation of the foramen magnum. It is relatively flat and the dorsal aspect is extended to a ridge referred to as the nuchal crest. This is the highest part of the skull in the life animal. Ventral to this crest is a central eminence called the external occipital protuberance on which the funicular part of the ligamentum nuchae is attached. The nuchal crest runs rostrally and ventrally to form a thinner crest of bone called the parietal crest which also provides attachment for the muscle of the head.

Relations

It is related rostrally to the interparietal bone, rostrolaterally related to the parietal bone, ventrolaterally to the temporal bone and ventrally to the sphenoid bone.

INTERPARIETAL BONE

This is a very small of the cranium located on the dorsal aspect of the cranium. It is wedged between the two parietal bones rostrally and occipital bone caudally. It is usually paired in the young animal but most times fused in the adult.

The internal surface of the interparietal bone bears an important three sided projection called internal occipital protuberance which projects into the cranium. This projection gives attachment to the membranes (meninges) which covers the cerebellum. The projection is found between the space of cerebral hemisphere and cerebellum.

PARIETAL BONE

It is found at the dorsal aspect of the cranium and rostral to the occipital bone and it articulates with the interparietal bone. Each parietal bone has the appearance of a curved plate of bone which forms the bulk of the two parts of the roof of the cranium. The two parietal bones are joined medially by a parietal suture which forms a crest in the older. This crest is referred to as the parietal crest and it is absent in the young.

The dorsal aspect of each parietal bone enters into a fossa called temporal fossa. The fossa lodges the temporalis muscle. It is well developed in the carnivores than in the herbivores.

Relations

Caudally it is related to the occipital bone, ventrally to the temporal bone, rostrally to the frontal bone.

FRONTAL BONE

It is a flat, large paired, smooth and subcutaneous bone. It is placed on the upper aspect of the skull and it forms the limit between the cranium and the face. In the bovine, it is a large bone where it occupies a good portion of the face and the entire cranium while the parietal bone is displaced ventrally in the ox.

The frontal bone posses a **supra orbital process** that overlies the eye socket. The main part of this bone constitutes the fore head. The supraorbital process assists in the formation of the Zygomatic arch. The base of the process is perforated by the supra-orbital foramen. Underneath this foramen, there is a depression which lodges or accommodates the lacrimal gland.

The internal surface of the frontal bone helps in the formation of the cranium and nasal cavity. The bone possesses a **frontal sinus** - one of the very important paranasal sinuses of the skull. The internal part of the sinus articulates with the Ethmoid bone. In the bovine, this sinus is very extensive because it extends into the corneal process of the frontal bone. It helps to make the head lighter as it creates a space between the horns. The lower border of the frontal bone articulates in the sphenoid bone.

Relations

The frontal bone articulates with the parietal caudally, and with the squamous part of the temporal bone. Caudoventrally, it articulates with its fellow medially. It also articulates with the nasal bone rostrally and the ventrolaterally with the Lacrimal bone.

ETHMOID BONE

This bone can not be seen from the exterior or outside the skull. It lies right in front of the body of the sphenoid and between the orbital wings of the sphenoid bone. It forms the rostral border of the brain cavity and the caudal border of the nasal cavity. It forms the demarcation of the two very important cavities in the skull. The bone consists of two parts: ***cribriform plate and the lateral masses.***

The cribriform plate is a sieve-like plate of bone bearing a large number of perforations which allows the passage of nerve fibres into the brain (the olfactory nerve pierces through this structure). They also could prevent cerebrospinal meningitis. This plate has two concavities (ethmoidal fossa) which house the olfactory lobes of the brain.

The lateral masses, two in numbers are fragile in the horse but more durable in the ox and they lie on either side of the cribriform plates to which they are attached. They are conical in shape and they entirely fill up the caudal part of the nasal cavity. They consist of an extremely large numbers of paper-thin scrolls of bones to increase the surface area and also to ensure that air passes through a wider surface thus the incoming air is warmed up and dirt coming with it is removed. Ethmoid turbinates (Ethmoturbinates) are scrolls of the bones which are placed above the other.

Relations?

SPHENOID BONE

This bone lies at the base of the skull. The central part of the base of the skull is continuous with the basilar part of the occipital bone. It consists of a ***body and two pairs of wings.***

The body is situated medially and flattened dorsoventrally. It is wider rostrally than caudally. The ventral surface is convex in shape and the rostral end disappears underneath the vomer and Pterygoid bone. The body possesses internally a small depression which accommodates the pituitary gland called the sella turcica.

Rostrally to this depression is a foramen through which the optic nerve passes. This foramen is called optic foramen. The rostral part of the body of the foramen possesses a small sinus called sphenoid sinus is of little clinical importance. The body of the sphenoid articulates with the basilar part of the occipital bone at the basilar tubercle.

The wings of the sphenoid bone comprises of the orbital wing and the temporal wing.

The *orbital wing* curves from the body of the sphenoid to form part of the wall of the orbit. It articulates therefore with the frontal bone. The root of the orbital wing is pierced by a number of foramina. There are usual four of these

foramina and are referred to as the orbital groups of foramina. The first of these foramina and topmost is the ethmoidal foramen and below is the optic foramen, ventral to the latter is the foramen orbitale and under the latter (separated from it by only a thin plates of bone) is another foramen called foramen rotundum.

In the bovine, the thin plate of bone separating the orbital foramen from the rotundum is absent. The absence of this thin plate of bone gives rise to a single foramen called foramen orbito-rotundum.

The *temporal wing* of the sphenoid bone articulates with the temporal bone. It is somewhat quadrilateral in outline and possesses an important process rostrally called the Pterygoid process. The caudal border of the temporal wing of the sphenoid bone forms the rostral border of a large irregular foramen at the base of the skull. This foramen is called the foramen lacerum.

TEMPORAL BONE

This bone comprises mainly the *squamous and petrous temporal bone*.

The squamous temporal bone has a body and a main process. The body is convex and leads to the Zygomatic process. The body is smooth internally and forms part of the wall of the cranium. In the horse, both bones are never fused. They appear as two different bones while in the ox they are fused. The zygomatic process of the squamous temporal bone joins the supraorbital process of the frontal bone and the temporal process of the Malar bone to form the *Zygomatic arch*.

The ventral aspect of the surface of the Zygomatic process of squamous temporal bone is important because it possesses a depression containing an articular surface. This is where the condyle of the mandible articulates with the rest of the skull. This articular surface is called the glenoid fossa (glenoid cavity). It is the only true (diarthrodial) joint known as the temporomandibular articulation. Caudal to the glenoid fossa extending in the ventral direction is a process called post-glenoid process.

The squamous temporal bone terminates caudally in a notch which forms a sort of bay which lodges the bony auditory processes. The external surface is convex.

The petrous temporal bone, so-called because it is rock-like, is one of the strongest bone of the body. It houses the middle and inner ear, hence the strength of the bone. The petrous temporal bone lies between the occipital bone caudally, the parietal bone dorsally and the squamous part of the temporal bone rostrally.

The bone possesses a short tube of bones which projects laterally and is referred to as the external auditory process. In a life animal, it is covered by a tympanic membrane or ear drum. Immediately caudal to the petrous temporal bone is a projection referred to as the paramastoid process. Just rostral to the paramastoid process and forming the ventral part of the petrous temporal bone is another projection called the mastoid process.

Ventromedial to the petrous temporal bone is a large and irregular foramen (foramen lacerum). Projecting from the ventrolateral aspect of the petrous temporal bone is a bony process to which the hyoid apparatus is attached in life.

Foramen lacerum is a large irregular foramen on the ventromedial aspect of the petrous temporal bone. It lies at the base of the skull. It is irregular in outline bounded by the occipital bone, sphenoid and the temporal bone. It transmits:

- The internal carotid and the middle meningeal arteries
- The mandibular nerve, glossopharyngeal, vagus and accessory nerve
- The ventral cerebral vein

BONES OF THE FACE

PTERYGOID BONES

It is small, paired slightly twisted thin bone. It is paired one on either side of the guttural opening. It articulates with the sphenoid bone caudally, rostrally with the palatine bone and medially with the vomer bone. The most part of this bone is the free rostral end which turns ventrally to form a process called the hamulus pterygoideus. This process provides attachment for the tendon of the tensor palatine muscle.

Relations?

PALATINE BONES

This is a fairly large bone situated on either side of the caudal nares. It helps to form part of the medial wall of the nose and also part of the hard palate. The bone consists of two parts namely: the vertical and horizontal parts.

The vertical part is large and articulates with the maxilla bone. It also helps to form part of the orbit. The horizontal portion is also called the palatine portion of the palatine bone. The horizontal portion is flattened and forms part of the hard palate and it helps to form along with the maxilla bone the palatine canal which carries the palatine blood vessels. On the dorsal aspect of the horizontal part of the palatine bone is the nasal crest. This crest gives attachment to the Vomer bone.

LACRIMAL BONE

This bone lies on the rostral portion of the face. It is a small bone and has two important surfaces: *the orbital surface and the facial/frontal surface.*

The orbital surface is roughly triangular in shape and assist in the formation of the medial wall of the orbit. This surface contains the deep fossa in which lies the lacrimal sac or Lacrimal lake.

The frontal surface is smooth and flat. It articulates caudally with the frontal bones, rostrally with the nasal and maxilla bone and ventrally with the Malar or Zygomatic bone. Both edges of the two surfaces meet at the lacrimal tubercle.

Relations?

MALAR (ZYGOMATIC) BONE

It lies ventral to the lacrimal bone and bears a process called the zygomatic process of the zygomatic bone. The process passes caudally to join the supraorbital process of the frontal bone and the zygomatic process of the temporal bone to form the zygomatic arch.

It articulates rostrally and ventrally with the maxilla bone, dorsally with the lacrimal bone and caudally with frontal and temporal bone.

The malar bone has a very well developed crest on its lateral surface. This crest begins from the frontal process of the bone and moves rostrally to the end of the bone. This crest is called facial crest and gives attachment to the masseter muscle.

Relations?

MAXILLA BONE

It is the largest paired bone of the skull. It lies on the lateral aspect of the face and it carries the cheek (grinding) teeth. It articulates with nearly all the facial bones and also with the frontal bone of the cranium.

On the lateral surface of this bone a little way above the midline is a foramen which is called the *infraorbital foramen*. This is the external opening of the infraorbital canal which carries many blood vessels and nerves. Just a little caudal and ventral to this foramen the facial crest ends.

The maxilla bone forms a greater part of the nasal cavity medially. The ventral border of the bone is thick and is called the alveolar border. This border carries alveoli or socket for the lodgment of the cheek teeth. Between each socket or alveolus is a bony *interalveolar septum*. The rostral part of the alveolar border may contain a small socket which is the position of the wolf/needle tooth. It is not present in all horses. The caudal end of the maxilla bone forms a large knob called the maxillary tuberosity.

Immediately dorsal to this tuberosity is a depression which carries three foramina. These foramina are the maxillary, sphenopalatine and the caudal palatine foramen (from top to bottom). The maxillary foramen is the caudal entrance to the infraorbital canal while the sphenopalatine foramen opens into the nasal cavity. The caudal palatine foramen transmits the palatine artery.

The maxilla bone has a long and important process (**palatine process**) on the roof of the mouth. This process forms the larger part of the hard palate. The process possesses a large number of foramina. The dorsal surface of this process possesses a crest which is an extension of the nasal crest of the palatine bone on which the vomer attaches.

NASAL BONES

It forms the dorsal border of the nasal cavity. It is triangular in outline and the rostral end is free and pointed. The free pointed end is called the **nasal peak**. The bone articulates with the Lacrimal bone Caudoventrally, caudally with the frontal bone, ventrally with the maxilla and the incisive bone. Between the nasal and maxilla bone is a notch called the **nasomaxillary notch**.

Relations?

INCISIVE BONE

It is formerly referred to as the premaxilla. It forms the rostral part of the face and of the upper jaw and it carries the upper incisor teeth, hence its name. This bone presents two surfaces for description namely: **the labial and the palatine surface**.

The labial surface is covered by the upper lip while the palatine surface forms part of the hard palate. The bone possesses an alveolar border which carries the alveoli or sockets for the upper incisor teeth.

The palatine surface is concave and possesses a central foramen called the foramen incisivum. This foramen also appears on the labial surface.

The ventral wall of the nasal cavity is completed by the **nasal process** which extends to the body of the incisive bone.

The nasal process is involving in bridging over the void of the incisive bone.

Relations?

VOMER BONE

It is median in position and it forms part of the partition between the left and right halves of the nasal cavity. It forms the skeleton of the nasal cavity and extends as far as the incisive bone rostrally.

The dorsal border is thin whereas the ventral border is relatively thick and inserts on the nasal crest. The caudal aspect of the bone extends backward until it makes contact with the sphenoid bone and forms a division of the guttural opening.

MANDIBLE

It forms the lower jaw. It is the largest single bone of the skull. At about 3 months of age in the horse, the two halves are fused completely together thus forming a single bone unlike in the bovine where the two halves can be separated

at old age. The mandible carries the lower teeth and it is the only bone that truly articulates with the remainder of the head. The bone possesses for description ***the body and two rami***.

The body consists of two portions namely the ***incisive and molar part***. The latter (molar part) turns dorsally to become the ramus of the mandible. The incisive part possesses two surfaces: the labial surface and the lingual surface.

The labial surface is convex and is covered by the lower lip while the lingual surface is the surface upon which the tongue rests and is concave. The alveolar border of the incisive portion of the mandible carries the alveoli which houses the incisor teeth.

In the animals < 3months, two halves of the mandible joins at the mandibular symphysis which is medial in position. Between the two halves is the mandibular space. This space lodges the tongue and all the muscles which help in the attachment of the tongue as well as the hyoid apparatus.

Between the molar parts of the body of the mandible and the ramus of the mandible is a flattened and roughened area called the angle of the jaw/the angle of the mandible for muscular attachment. This expanded and roughened area of the mandible gives attachment for the masseter muscle laterally and to the pterygoid bone medially.

The angle of the mandible carries a ***mandibular foramen*** at the dorsal aspect of its medial surface. This foramen leads into the mandibular canal. The mandibular canal passes rostrally under the cheek teeth and emerges as the ***mental foramen*** on the lateral surface at about the junction between the incisive part and the molar part of the mandible.

From the mental foramen, a smaller ***alveolar canal*** emerges rostrally to supply blood to the incisor teeth. The alveolar border of the molar portion of the body of the mandible carries sockets for the lower cheek teeth. The ventral border of the molar part is relatively smooth and straight. Just before the molar part merges with the angle of the mandible is a smooth depression through which the facial vessels and the parotid ducts passes.

The posterior extremity of ***the ramus*** presents two important features:

- The rostral feature is the ***coronoid process*** which projects into the temporal fossa and serves for the attachment of the temporalis muscle whose action is to move the lower jaw in relation to the upper jaw. The coronoid process is separated from the caudally placed ***articular condyle (condylar process)*** by a notch called the mandibular notch. It is through this notch that the vessels supplying the masseter muscle passes. The coronoid process is much higher than the articular condyle. The articular condyle possesses two main features: the head and the neck.

NASAL CAVITY

The nasal cavity consists of the following structures and landmarks:

- **Nasal septum:** this structure separates the right and left nasal cavities and the skeletal frame is the vomer bone
- **Cribriform plate:** it completes the caudal wall of the nasal cavity.
- **Ethmoid turbinates:** about 10 – 30 of these structures depending on the species of the animal. They are small scroll-like structures which are tightly packed together and attached to the nasal septum to the lateral nasal wall and to the cribriform plate of the Ethmoid bone.
- **Dorsal turbinate bone:** a single bone and elongated large scroll of bones. It is situated on the dorsolateral aspect of the nasal wall.
- **Ventral turbinate bone:** similar to the dorsal turbinates but it is attached to the maxilla. It consists of a double scroll. In the horse, the ventral branch is lost or absent. In the dog, the double scroll is typical and in addition other smaller scrolls emerging from it are present.
- **Internal nares:** this is the opening between the nasal cavity and the pharynx
- **Bony floor:** formed by the maxilla and palatine bone
- **Nasal cartilages:** they extend over the face and form the movable part of the nose. In brachycephalic breed of dogs, the facial bones are greatly shortened so that the nasal cartilages form a relatively large portion of the nose.

Between the dorsal wall and the dorsal turbinate is a space called the dorsal meatus. Between the dorsal and ventral turbinate is another space called the middle meatus while between the ventral turbinate and the floor of the nasal cavity is the ventral meatus. The three meatus open into a common space called the common meatus - between the nasal septum and the turbinates.

PARANASAL SINUSES

They are invaginations / excavations into the inner surface of bones. These excavations are lined by relatively thick epithelium. This coupled with the narrow openings of these sinuses to the nasal cavity makes them prone to obstruction.

There are four major sinuses in the skull namely:

- Frontal sinus
- Maxilla sinus
- Palatine sinus

- Sphenoidal sinus

The last two are of little clinical significance.