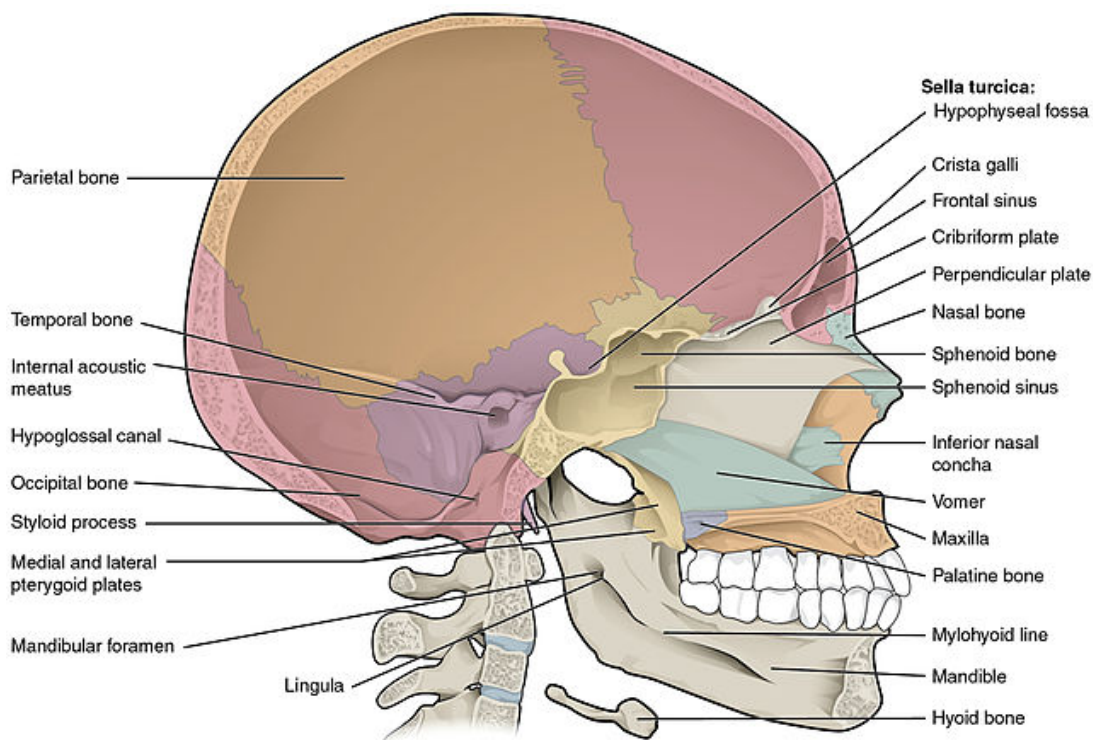


## The Bony Skull – Structure, Functions and Diseases

[See online here](#)

**The 22 bones (Latin: Os, Greek: Ost-, Oste- or Osteo-) of the skull are lamina and pneumatized bones, which have a cortical outside and inside and in between a cancellous bone with red bone marrow for blood formation, like any other bone. They give us protection, stability, and shape. The structure and characteristics of the skull have an especially great relevance for medical students. Even the skull growth and specific diseases are often tested.**



### Development and Growth of the Skull

The following facts are fundamental to understand the development of the skull:

- The cranial bones develop partly from the **head mesenchyme** and partly from the **occipital somites**
- The cranial bones arise from a **blastomeric mesenchymal tendency**, partly on the cartilaginous basis (**chondral ossification**), on the basis of connective tissue (**intramembranous ossification**) as well partially mixed, that is, on cartilaginous and membranous basis

The development of the cranium is closely related to the system of the brain and meninges. As the enclosure of the brain conditioning, a **mesenchyme compression**,

**meninx primitive** is apparent in the head region in the fifth and sixth week, which is divided into an inner (**endo meninx**) and outer (**ecto meninx**) layer. The endo meninx then differentiates itself into pia **mater encephali** and **arachnoid** and the **ecto meninx** into the **dura mater encephali**. Predominantly **enchondral** ossifies the skull base whereas the skullcap, the **membrane**.

The **neurocranium** and **viscerocranium** can be distinguished at the skull. The **neurocranium** is the braincase, which comprises of the brain and consists of the cranial base and the cranial vault. In the **neurocranium** region, the **ethmoid bone** forms the cartilaginous base, the **parietal bone** and **frontal bone** on the connective tissue base, plus the **occipital bone**, the **temporal bone** and the **sphenoid bone** on the mixed base (**chondral and membrane**).

Apart from serving as a part of the face, the **viscerocranium** serves as the bone base as well as for the entrances to the digestive and respiratory tract. In the **viscerocranium** region, the **hyoid bone**, **inferior nasal concha**, and the **Malleus** are formed among others on the cartilaginous base. The **maxilla**, **nasal bone**, **lacrimal bone**, **zygomatic bone**, etc. are formed on the base of connective tissue.

As already mentioned, the bones of the cranial vault are formed purely membranous. A fixed boundary does not exist between the skullcap and cranial base. Nevertheless, one counts the **frontal bone**, the **occipital bone** and both the **parietal bones** among the skullcap, which are involved in the formation of the skull.

When two adjacent bones abut against each other, the connective tissue forms sutural bones which are called sutures. The most significant sutures are:

- **Sagittal suture**
- **Coronal suture**
- **Lambdoid suture**

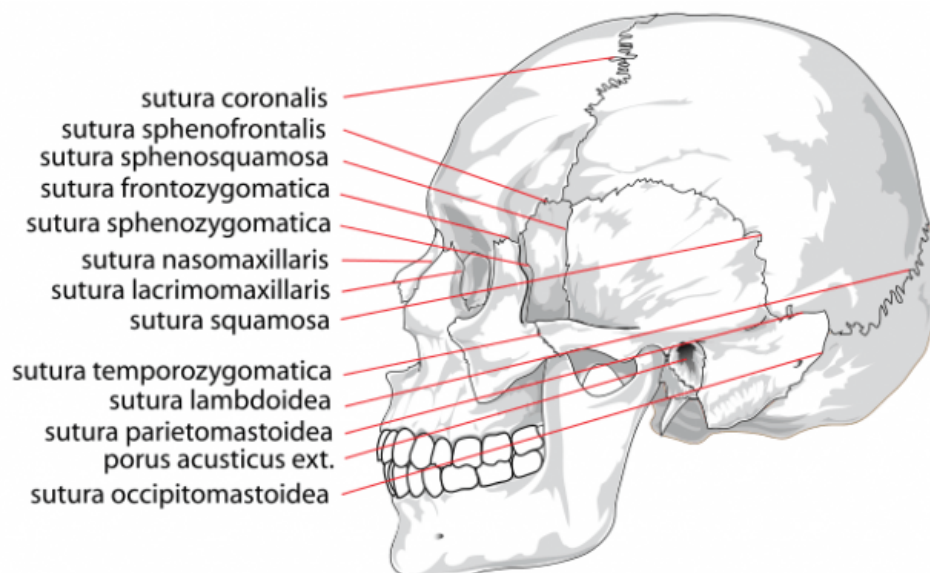
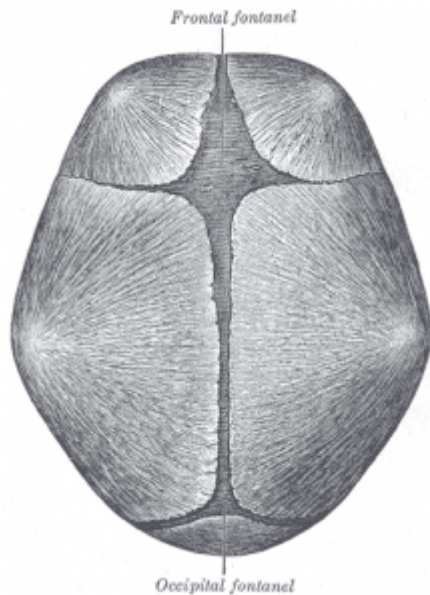


Image: "Human skull side suturas" by LadyofHats. License: [Public domain](#)

At places where several bones coincide, there are major gaps covered by connective tissue membranes. These are called **fontanelles (fonticuli cranii)**. In case of a toddler, they remain open for some time before they join. There are 4 large fontanel:

- **Anterior fontanelle:** It is located between both the **frontal bones** and both the **parietal bones**, closes with the age of 2 and is referred to as a large square fontanel.
- **Posterior fontanelle:** The small triangular fontanel is located between the parietal bone and the occipital bone and closes with the 3rd month of life.
- **Sphenoid fontanelle:** It is located between the frontal bone, parietal bone, temporal bone and sphenoid bone and closes soon after birth.
- **Mastoid fontanelle:** The fontanelle lies between parietal, occipital, and temporal bone and also closes soon after birth.



The skull bones can merge into sutures and fontanelle at birth, in order to adapt to the size of the birth canal. In addition, the fontanelles are a basic requirement for it that the child's skull can keep up with the rapid growth of the brain after the birth step.

The **synostosis** of the sutural bones (**sutures**) occurs only in adulthood.

## The Neurocranium Bones

The skull bones, also called the **cranial bones** form the cranial cavity, which encloses and protects the brain. Among these 8 bones, one counts:

- **Frontal bone**
- Two **parietal bones**
- Two **temporal bones**
- **Occipital bone**
- **Sphenoid bone**
- **Ethmoid bone**

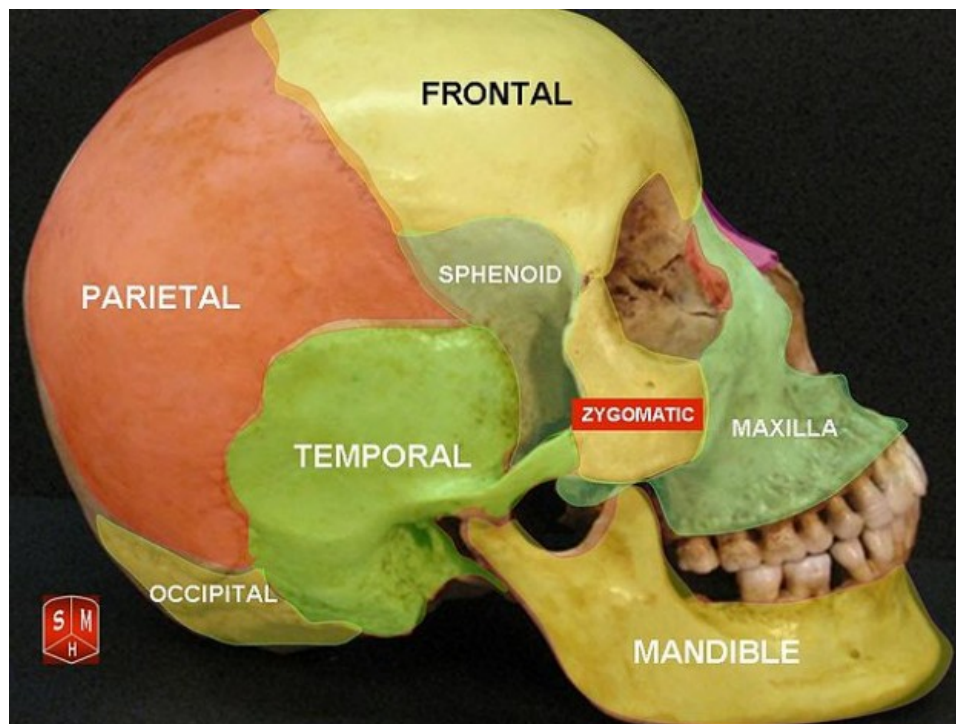


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## Frontal bone

The frontal bone forms the forehead, the **orbital roof** and most of the anterior cranial base. The two frontal bones are joined together shortly after birth and the cranial suture (**metopic suture**) disappears between the sixth and eighth year.

The forehead is formed on the front surface of the skull by the squama frontalis, a scale-like bone plate. From the **coronal suture**, it bends down from the cranial vault and makes a sudden bend in the vertical. The **frontal bone** thickens above the **orbits to the Margo supraorbitalis**, which includes a small opening, the supraorbital foramen medially from its center. The **supraorbital nerve** runs there along.

## Parietal bones

A large part of the skull sides, as well as the cranial vault, form the two parietal bones.

The special feature of parietal bones is located on the inner surfaces, which carries many protrusions and notches for the blood vessels of the **dura mater**, the superficial meninges of the dense connective tissue.

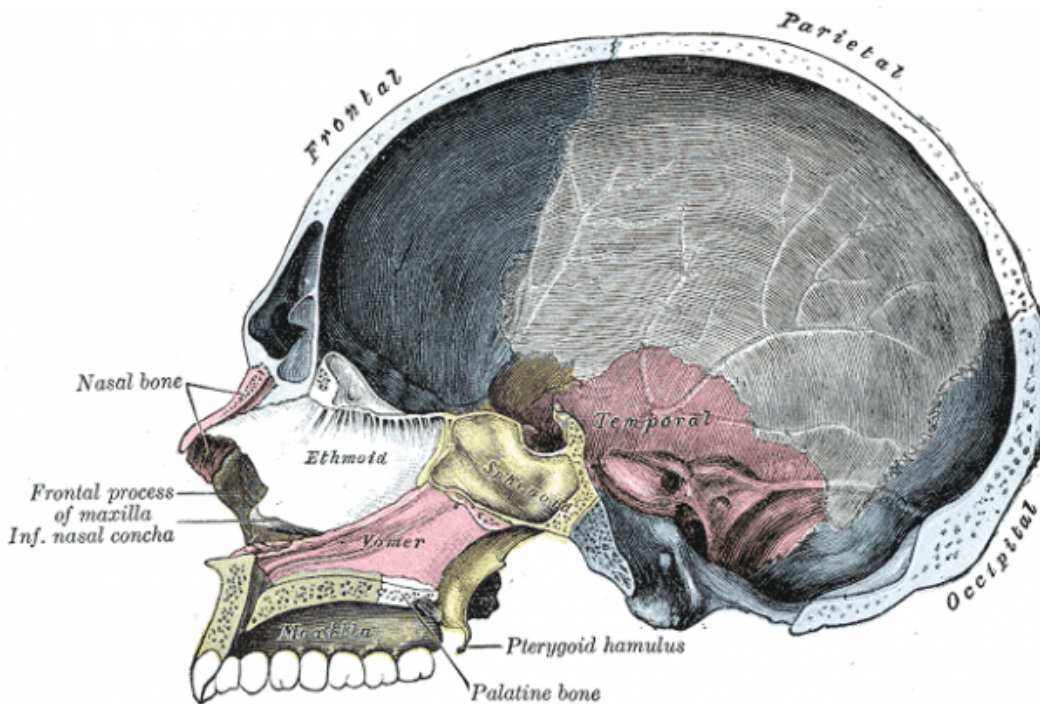
## Temporal bones

The paired temporal bones form the lower sides of the skull as well as a portion of the skull base, which lies between the **occipital, sphenoid** and **parietal bone**. A thin flat portion (squama) of the **temporal bone** forms the front and upper part of the temple. The **zygomatic process** protrudes **anteriorly** at the lower portion, where it forms a joint with the **processus temporalis** of the zygomatic bone.

A special portion of the **temporal bone** is the **mastoid part**, which is located **posterior** and **inferior** to the external auditory canal. It contains some cavities filled with air and lined with mucous membrane and is separated from the brain by extremely thin bone

walls. In case of an inflammation, the infection can spread directly to the brain.

The **processus mastoideus (mastoid process)** is located behind the external auditory canal, which is the place of leverage for some neck muscles.



## Occipital bone

The occipital bone forms the main part of the skull base and the back of the skull.

The **foramen magnum**, which is also referred to as a large opening, is located in the lower part of the bone. The extended spinal cord connects to the spinal cord in the height of this foramen. Furthermore, the **vertebral artery**, as well as the spinal artery, passes through the large opening.

The small palpable elevation on the back of the head, above the neck, is called the external protuberance. From there, two curved projections extend **laterally**, which serve as a leverage for different muscles.

## Sphenoid bone

The shape of the sphenoid bone resembles that of a bat with outstretched wings. It is located in the center of the skull base and is called the collarbone since it is connected to other cranial bones and holds them together. It lies **posteriorly** and slightly **superiorly** of the nasal cavity and forms a part of the base, the side walls and the rear wall of the orbit.

The **sella turcica** (sella = saddle, turcica = Turkish: Turkish saddle) rises up as a bony saddle-shaped structure on the superior surface of the sphenoid body. The **hypophysis** (pituitary gland) is located in the front part of the sella turcica, which fulfills a significant hormonal function.

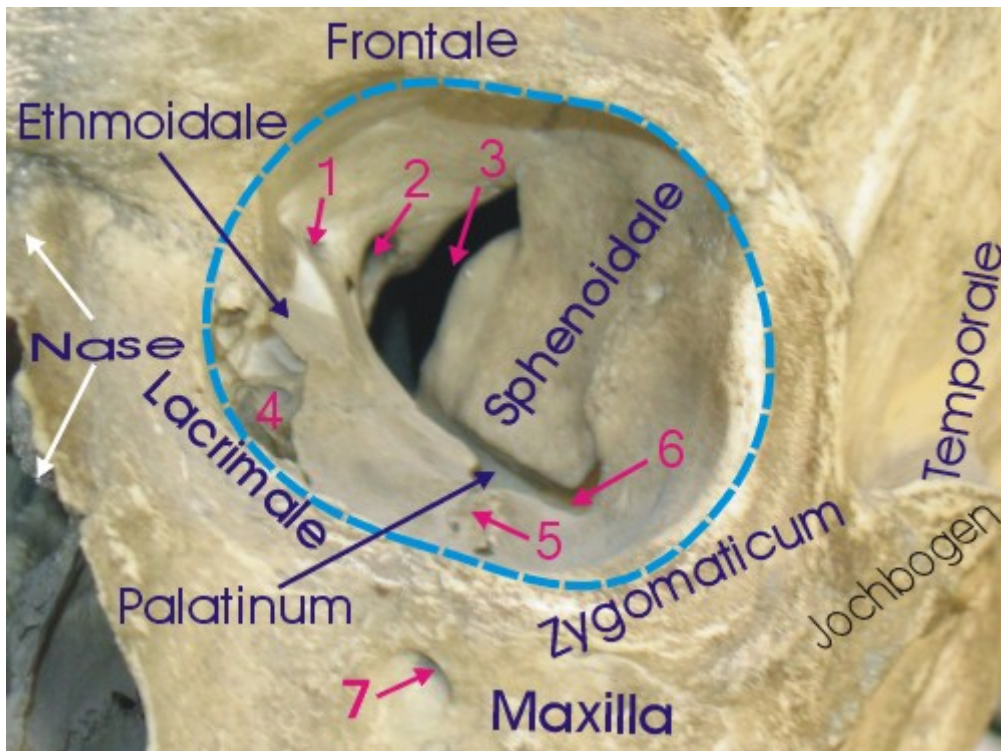


Image: "Left human orbit. 1 Foramen ethmoidale, 2 Canalis opticus, 3 Fissura orbitalis superior, 4 Fossa saci lacrimalis, 5 Sulcus infraorbitalis, 6 Fissura orbitalis inferior, 7 Foramen infraorbitale, Nase: nasal bone" by Uwe Gille. License: [CC BY-SA 3.0](https://creativecommons.org/licenses/by-sa/3.0/)

## Ethmoid bone

The ethmoid bone is located in the midline in the front part of the skull base **medially** to the **orbit** in front of the sphenoid and behind the nasal bone and is characterized by a sponge-like structure.

The following parts form the **ethmoid bone**:

- A part of the front base of the cranial fossa
- The medial wall of the **orbit**
- The upper part of the **nasal septum**
- A large part of the side walls of the nasal cavity

The **ethmoid bone** is a supporting structure of the nasal cavity and supports it from the top.

A special component of the ethmoid is the **nasal concha**. The nasal turbinates increase the surface area of the nasal mucosa and increase the effectiveness of the sense of smell, by heating, filtering and moistening the inhaled air, before it flows into the lungs.

## The Facial Skull Bones

During the first two years of life, the face shape changes dramatically, the bones of the skull and face expand, the first teeth are formed and break through and the sinuses gain in size.

The growth ends around the age of sixteen.

One assigns the following 14 bones to the facial skeleton:

- Two **nasal bones**
- Two **maxillae** (maxillary bones)
- Two **ossa zygomatic** (jugal bones)
- **Mandible** (lower jaw bone)
- Two **ossa lacrimalia** (lacrimal bones)
- Two **ossa palatina** (palatine bones)
- Two **inferior nasal concha** (inferior turbinate)
- **Vomer** (Vomer bone)

## Nasal bones

The nasal bone is referred to as the roof of the nasal cavity which connects to the **frontal process of the maxilla** and **nasal pars** of the **frontal bone**.

The rest of the nasal supporting tissue consists of cartilage.

## Maxillae (Maxillary bones)

The paired maxillary bones connect to the maxilla, which articulates with every other facial skull bone, except with the **mandible** (lower jaw bone). They form the part of the **orbital floor**, assist in the side walls as well as the floor of the nasal cavity and form the major part of the hard palate. Each maxilla includes a maxillary sinus, which empties into the nasal cavity.

An opening in the **maxilla** is located below the **orbit** which is called the **infraorbital foramen**. It is crucial for the **infra-orbital nerve**, blood vessels, and a branch of the ramus maxillaris of the **trigeminal nerve**.

At the time of birth, the coalescence and fusion of the upper jaw bone are completed. If the fusion does not take place, it thus results in a so-called cleft palate or cleft lip. In case of a cleft lip, there is a gap in the upper lip, which can lead to speech and swallowing difficulties, as well as middle ear inflammations.

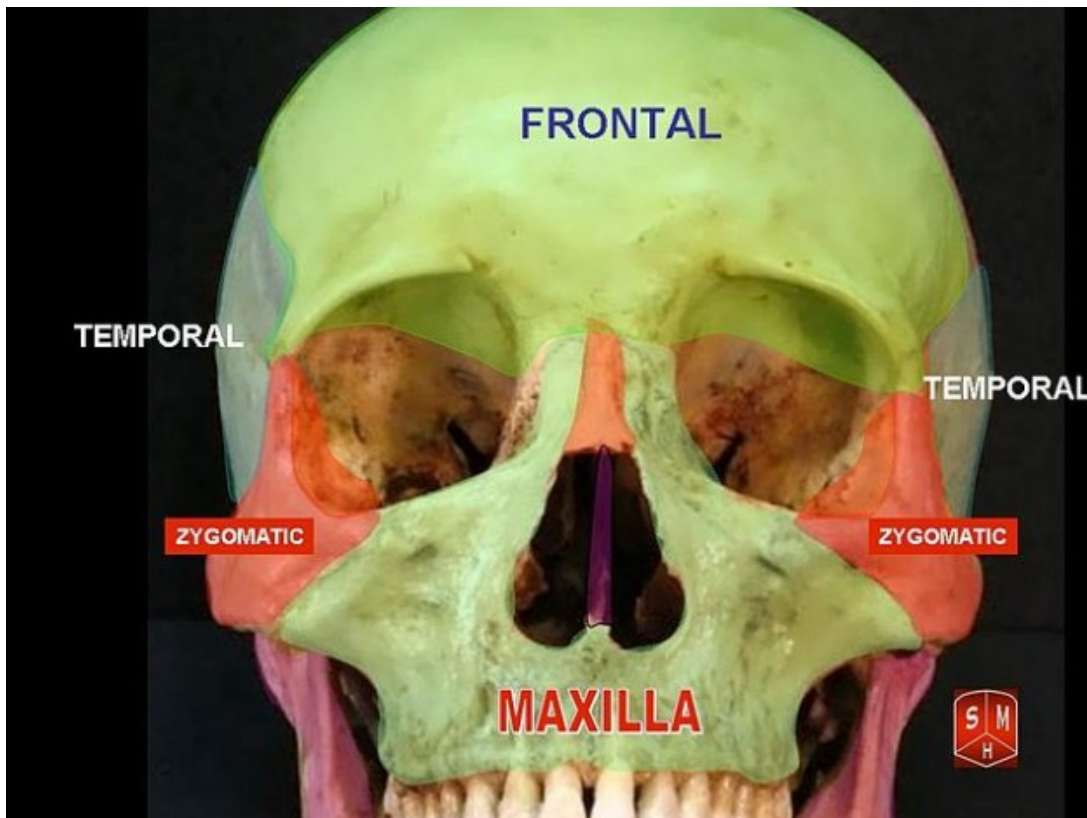


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## Ossa zygomatic (Jugal bones)

The two jugal bones are also called cheekbones, form the cheek contours and a part of the side walls as well as on the floor of the orbit. They are connected with the **frontal bone**, the **maxilla**, the **sphenoid bone** and the **temporal bone**.

The jugal arch (**zygomatic arch**) is formed by the **processus temporalis** of the zygomatic bone, which articulates with the **zygomatic process** of the **temporal bone**.

## Mandible (Lower jaw bone)

The lower jaw bone is the largest and most powerful facial bone. Apart from the auditory ossicles, the **mandible** is the only bone that can be moved.

The **mandible** consists of a **mandibular body** (lower jaw body) as well as two ascending structures that are defined as the **mandibular rami** (rami = branches). Each **ramus** has a **condylar process** at its rear end, which is connected to the **mandibular fossa** and **articular tubercle** of the **temporal bone**. This branch is called **temporomandibular joint (TMJ)**.

The **mental foramen** (mentum = chin) lies approximately below the second **premolar**, where the **mental nerve** runs along. Anesthetics are often injected in the nerve in case of painful dental procedures.

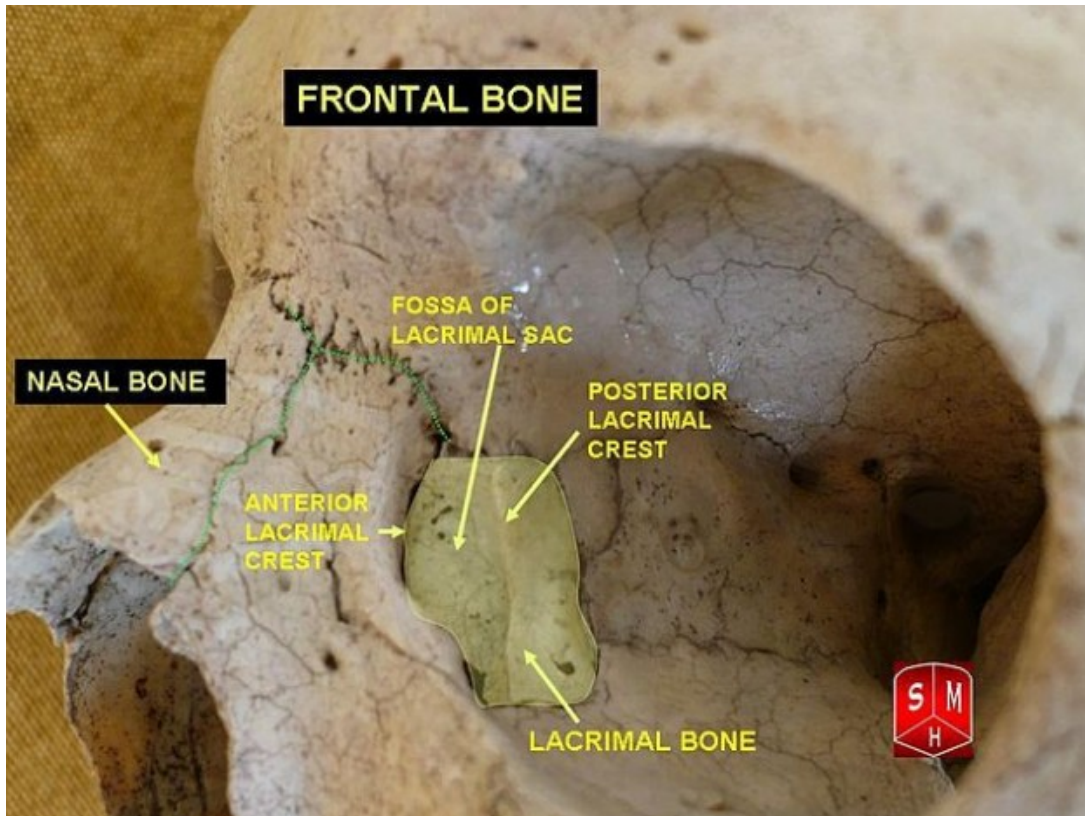
## Ossa lacrimalia (Lacrimal bones)

The paired lacrimal bones are similar to a fingernail in size and shape, are very thin bones and hence also the smallest bones of the facial skeleton. They lie beside the nasal



bones and form part of the medial **orbital wall**.

Each lacrimal bone contains a lacrimal pit (**fossa for lacrimal sac**), a vertical pit which is formed together with the **maxilla**. The lacrimal sac is located in the pit, in which the tear fluid is collected and discharged into the nasal cavity.



[Image](#): "Lacrimal and nasal bones" by Anatomist90. License: [CC BY-SA 3.0](#)

## Palatine bone (Palatines)

The two **palatine bones** form the rear part of the hard palate, a part of the floor and the side walls of the nasal cavity as well as a small part of the **orbital floor**. They are characterized by their L-shape.

The rear part of the hard palate is formed from the horizontal plate of the palatine bones.

## Inferior nasal concha (Inferior turbinate)



Image: "Conchae nasales" by Welleschik. License: [CC BY-SA 3.0](https://creativecommons.org/licenses/by-sa/3.0/)

The two inferior turbinates are located below the **middle nasal concha** of the ethmoid bone, which is their own bones and does not belong to the ethmoid bone. They constitute a part of the inferior side wall of the nasal cavity and protrude into the nasal cavity. Judging by their shape, they look like parchment roll-like bony prominences.

As already mentioned, all three **nasal conchae (superior, medial, inferior)** support the whirling and filtering of the inhaled air before it reaches the lungs. In the picture on the right side, the **inferior nasal concha** is at number 3.

## Vomer (Vomer bone)

The vomer bone is an approximately triangular bone at the base of the nasal cavity, which forms the lower portion of the **nasal septum**.

It connects to the ethmoid bone along the center line over the **perpendicular lamina** above and below with both the maxillary bones as well as the palatine bones.

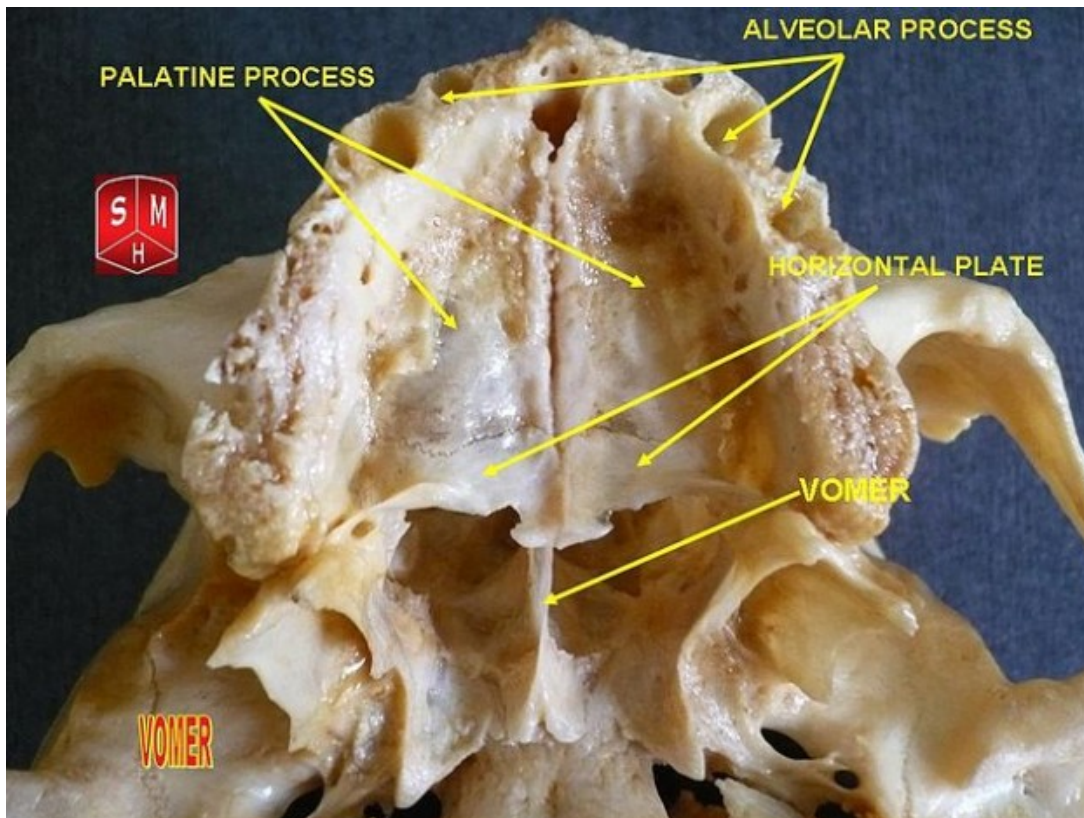


Image: "Vomer" by Anatomist90. License: [CC BY-SA 3.0](https://creativecommons.org/licenses/by-sa/3.0/)

## Hyoid bone characteristic (Tongue bone)

The hyoid bone is a special feature of the torso skeleton and is located in the front of the neck region between the **mandible** and the **larynx**. It articulates with no other bone and is fixed on the **styloid process** of the **temporal bone** via ligaments and muscles.

The hyoid bone supports the tongue and is used as an entrance for some tongue, neck, and laryngeal muscles. The **hyoid bone** does not belong to the 22 cranial bones and facial bones.

## Functions of the Skull

In addition to its function of protecting the organs, the skull stabilizes the position of the brain, blood vessels, lymph vessels and nerves through the build-up of its inner surfaces at the **meninges**.

Large areas for muscle attachments are provided on the outer surface of the skull, which is responsible for head movements and allow facial expressions, such as the frown.

The basis for the face forms the facial bones, which provide the entrances for the digestive system and the respiratory system. Along with the bones of the skull, they create protection and support for the various sensory organs:

- Eyes (sense of sight)
- Mouth (sense of taste)
- Nose (sense of smell)
- Ears (hearing sense, sense of balance)

# Diseases of the Skull

Bones and joints do hard work and can be damaged because of lack of exercise, poor nutrition but also by accidents and tumors.

A known injury of the cranial bone is the proverbial “blue eye”.

A sharp bone edge is located directly on the **orbit**. If there is a blow to the edge, this can lead to fractures or bleed injuries of the overlying skin. An accumulation of tissue fluid as well as blood in the surrounding connective tissue is caused by a contusion of the skin against that edge. A swelling with the corresponding coloring is the result.

Further diseases are:

- **Temporomandibular joint syndrome (TMJ Syndrome)**
- **Septal deviation**
- Palate and cleft lip
- Trauma
- **Paget’s disease**
- Bone tumors
- Fractures (Mandible fracture, basal skull fracture)

## Popular Exam Questions about Bony Skull

**1. Which fontanelle is located between both the frontal bones and both the parietal bones and closes with the age of 2?**

- A. Superior fontanelle
- B. Anterior fontanelle
- C. Posterior fontanelle
- D. Sphenoid fontanelle
- E. Mastoid fontanelle

**2. Which cranial bones does one assign to the skull roof, which is involved in the formation of the skull cap?**

- A. Ethmoid bone, occipital bone, and the two parietal bones
- B. Ethmoid bone, occipital bone, and the two temporal bones
- C. Sphenoid bone, occipital bone, and the two parietal bones
- D. Frontal bone, occipital bone, and the two temporal bones
- E. Frontal bone, occipital bone and the two parietal bones

**3. If the coalescence and fusion of the bone do not take place at the time of birth, so there is a so-called cleft palate or cleft lip. Which facial bones are being talked about?**

- A. Ossa lacrimalia (Lacrimal bones)
- B. Mandible (Lower jaw bone)
- C. Maxillae (Upper jaw bones)
- D. Ossa palatina (Palatine bones)
- E. Ossa zygomatic (Jugal bones)

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**Correct answers:** 1B, 2E, 3C

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Notes