

State University of Medicine and Pharmacy “Nicolae Testemitanu“
Republic of Moldova

Functional anatomy of the skull

HUMAN ANATOMY DEPARTMENT

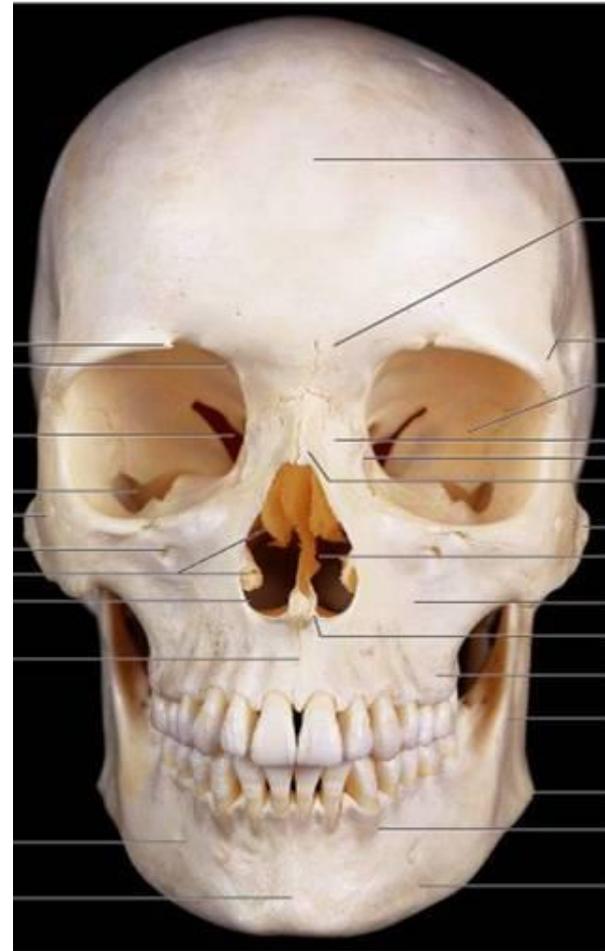
Dr. Babuci Angela

Plan of the lecture

- **General data about the skull.**
- **Morphological peculiarities of the bones of the skull.**
- **Ontogenesis of the skull.**
- **Variants and developmental abnormalities of the skull.**
- **Age specific features of the skull.**
- **Examination of the skull on alive person.**

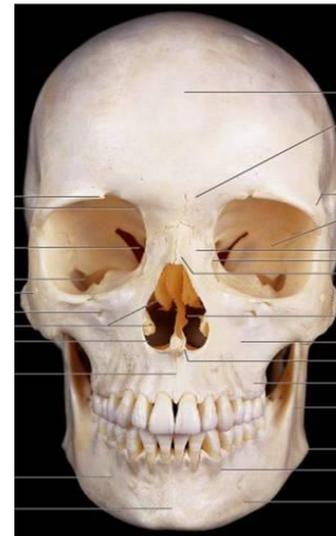
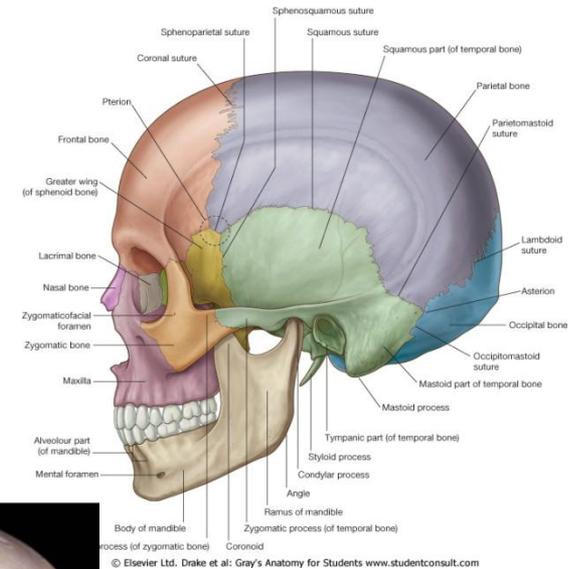
General data

- The cranium is the skeleton of the head.
- The skull is the receptacle for the most highly developed part of the nervous system, the brain and also for the sensory organs connected with it.
- The initial parts of the digestive and respiratory systems are located in this part of the skeleton.



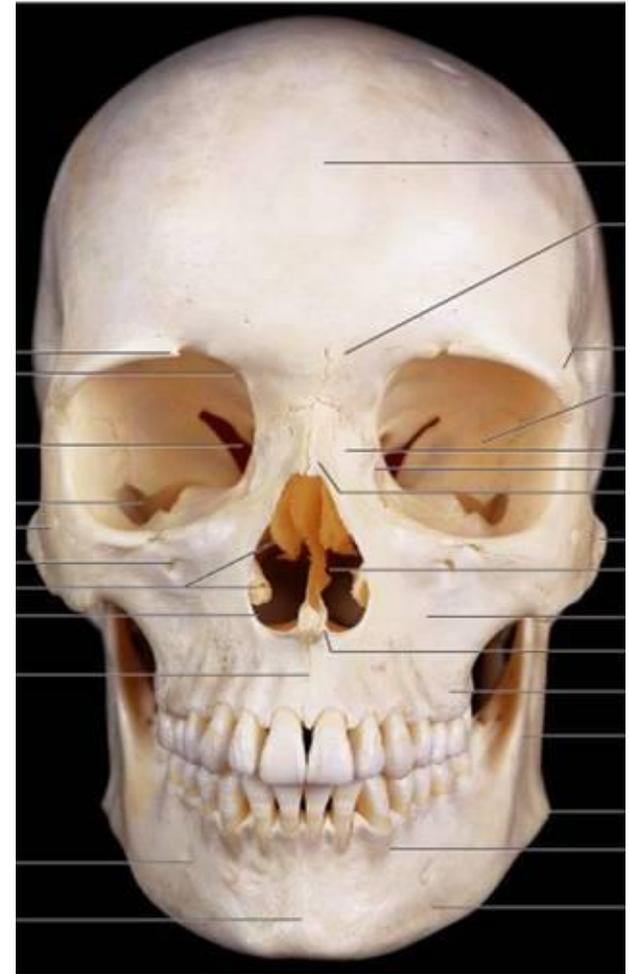
The skull

- The *skull* consists of two sets of bones:
 - a) The cranial bones that form the ***neurocranium***, which lodges the brain.
 - b) The facial bones, which form the ***viscerocranium***.
The bones of the visceral skull form:
 - the *orbits*,
 - the *oral cavity*.
 - the *nasal cavity*.

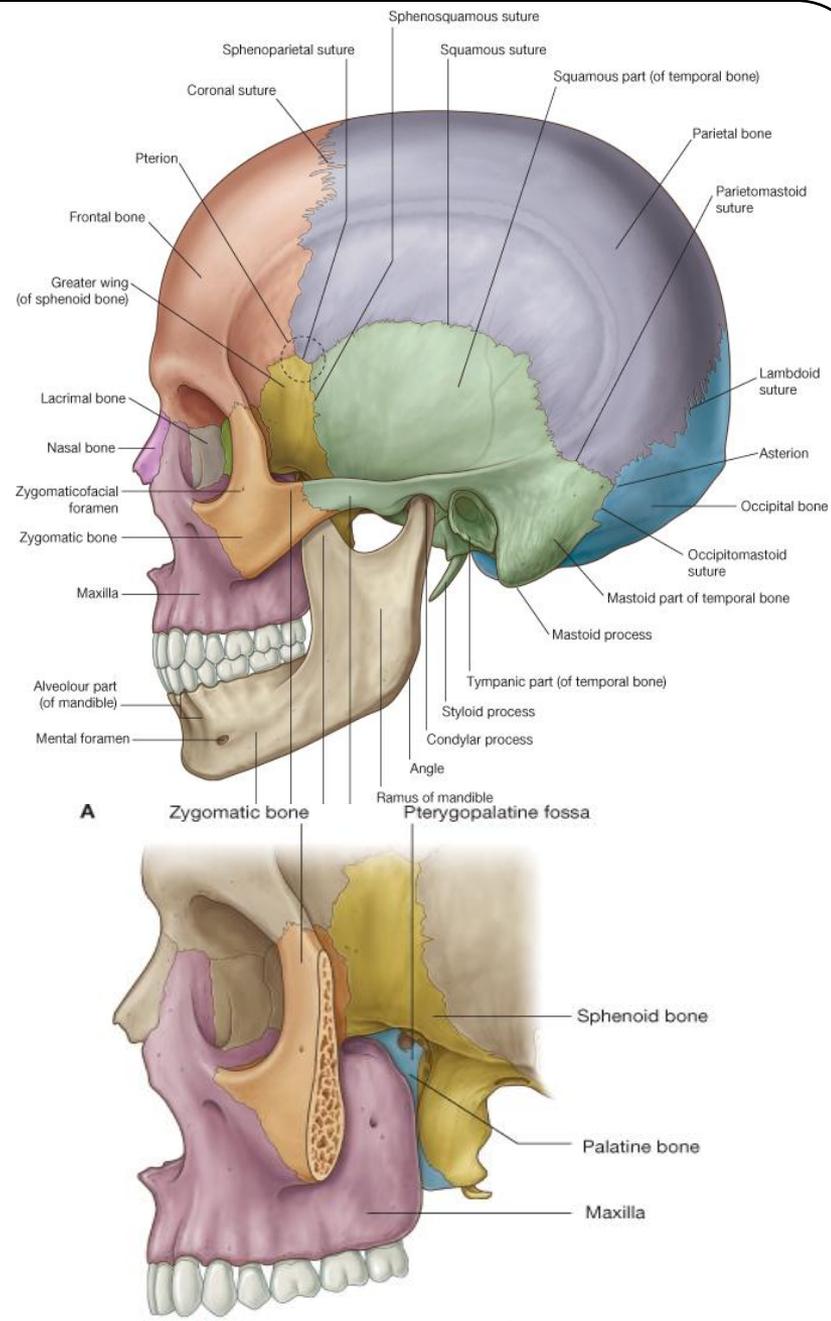


The terms used for examination of the skull

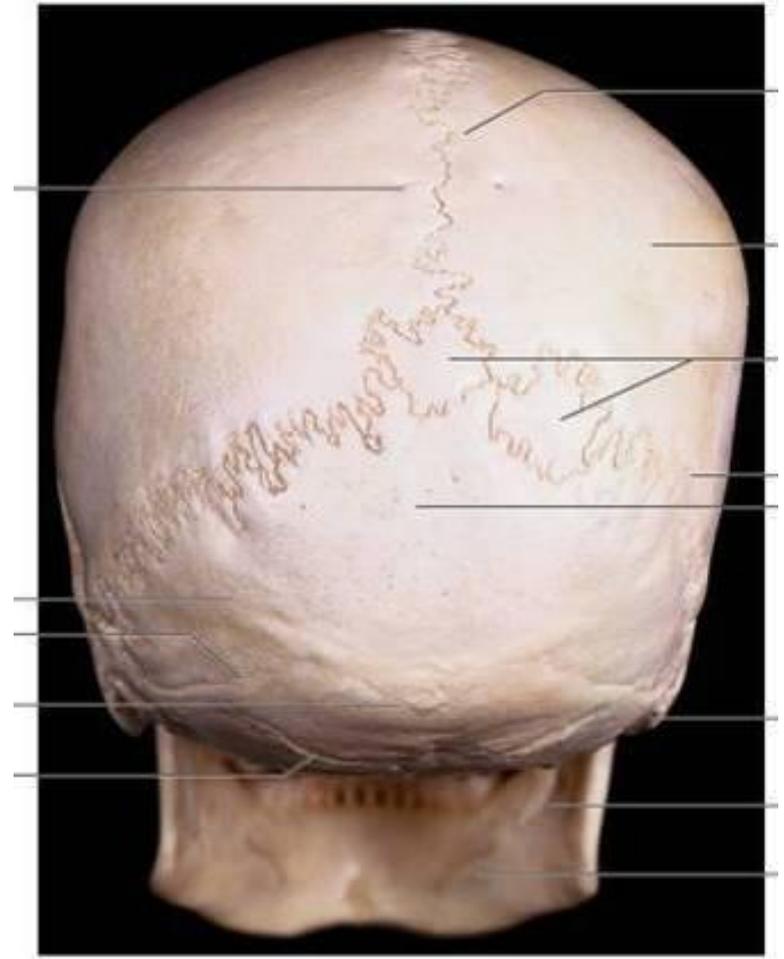
- **The frontal norm** (*norma frontalis*).
- The shape of the skull is oval, but the upper part is wider than the lower one.
- In frontal norm the bones of the visceral cranium can be divided into three floors:
 - a) The superior floor of the visceral cranium corresponds to the forehead.
 - b) The middle floor includes the orbits and the nasal cavity.
 - c) The inferior floor corresponds to the oral cavity.



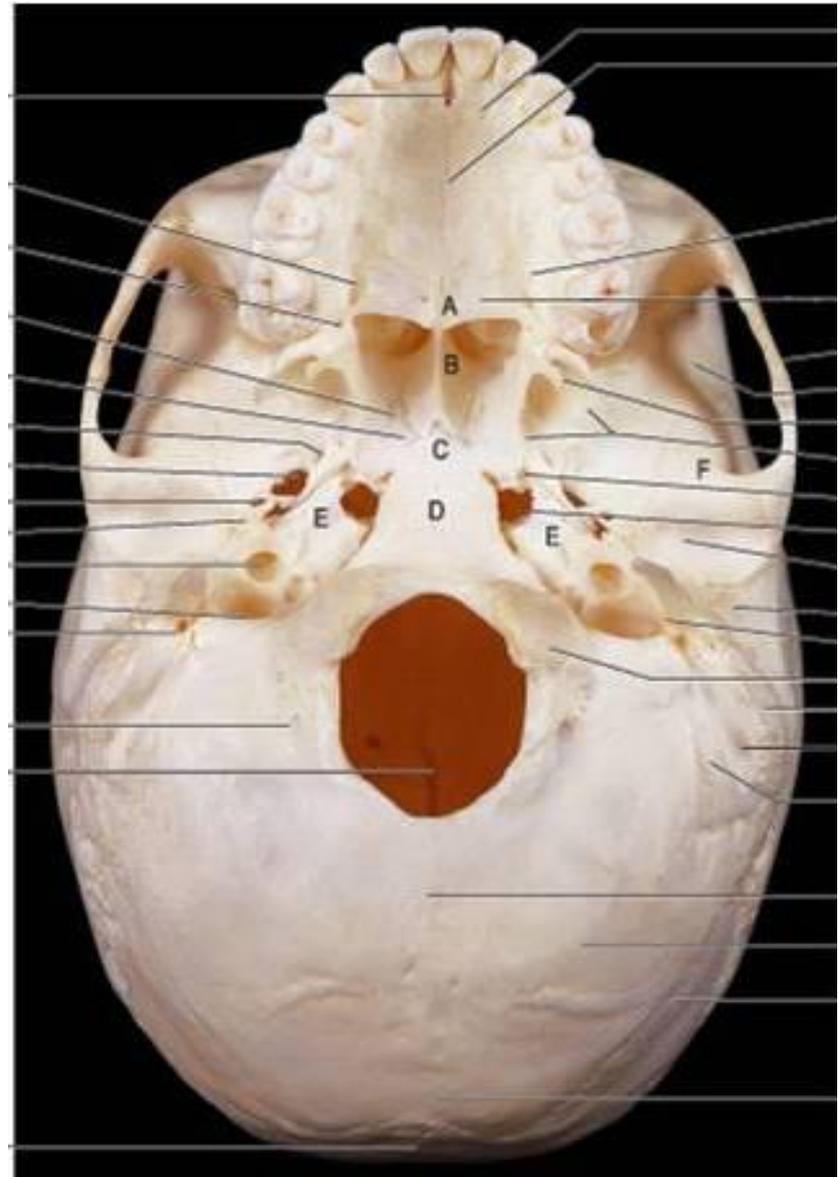
- **The lateral norm** (*norma lateralis*). The skull is seen from the lateral side.
- *Norma lateralis* exposes to our sight the **temporal**, **infratemporal** and **pterygopalatine fossae**.



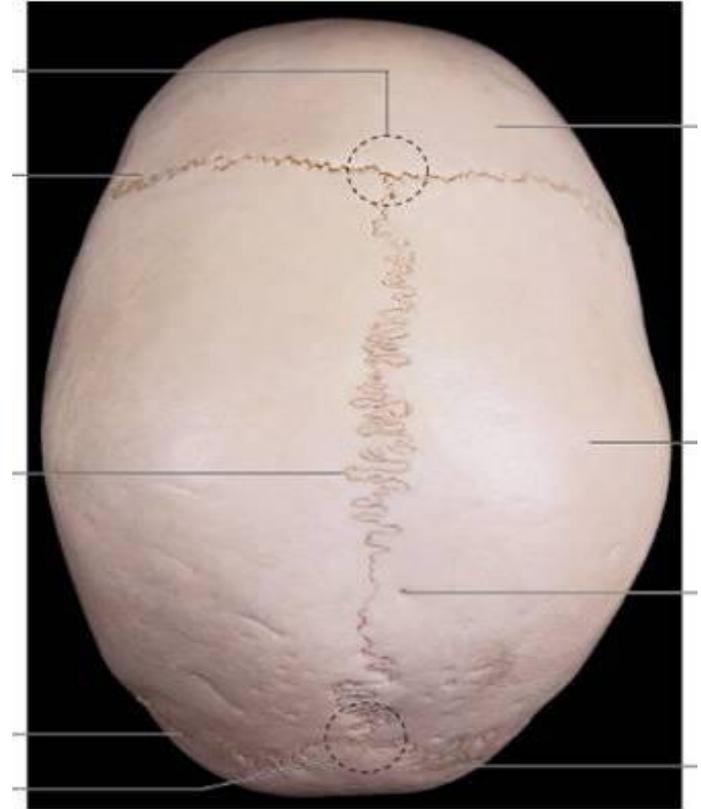
- **The occipital norm** (*norma occipitalis*).
- The posterior surface of the skull can be examined by this norm.



- **The basal norm** (*norma basalis*), corresponds to the external base of the skull.



- **The vertical norm**
(*norma verticalis*).
- The skull is seen from the upper part, and it has an oval shape, but there are some racial and individual peculiarities.



Shapes of the skull

On examining the skull in *norma verticalis* the following shapes of the skull can be distinguished:

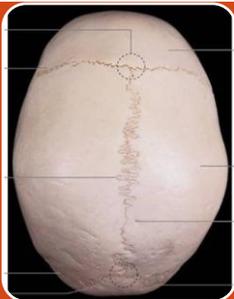
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Dolichocephalic skull – the skull has an oval shape.



Brachycephalic skull – the skull has a spheroid shape.

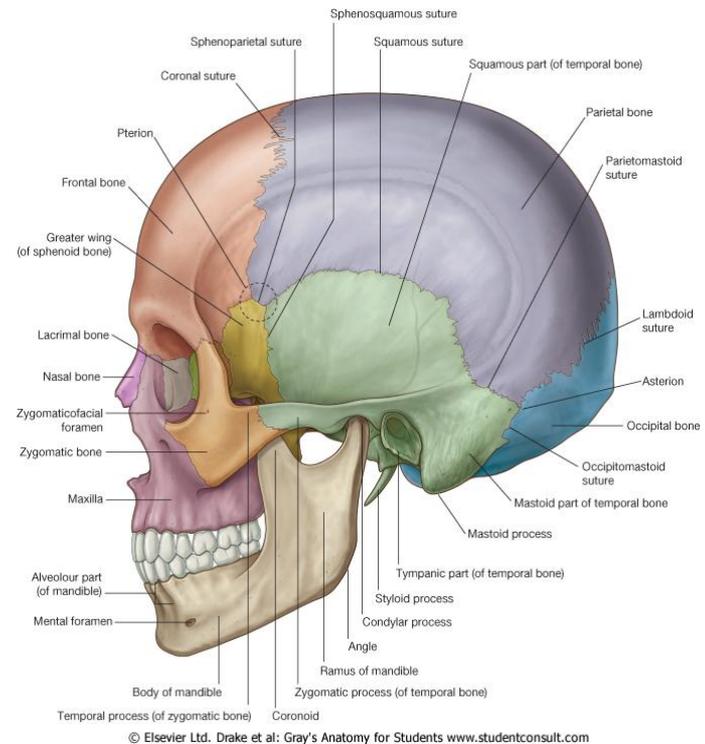


Mesocephalic skull – an intermediate shape between the two previous ones.

Shapes of the skull

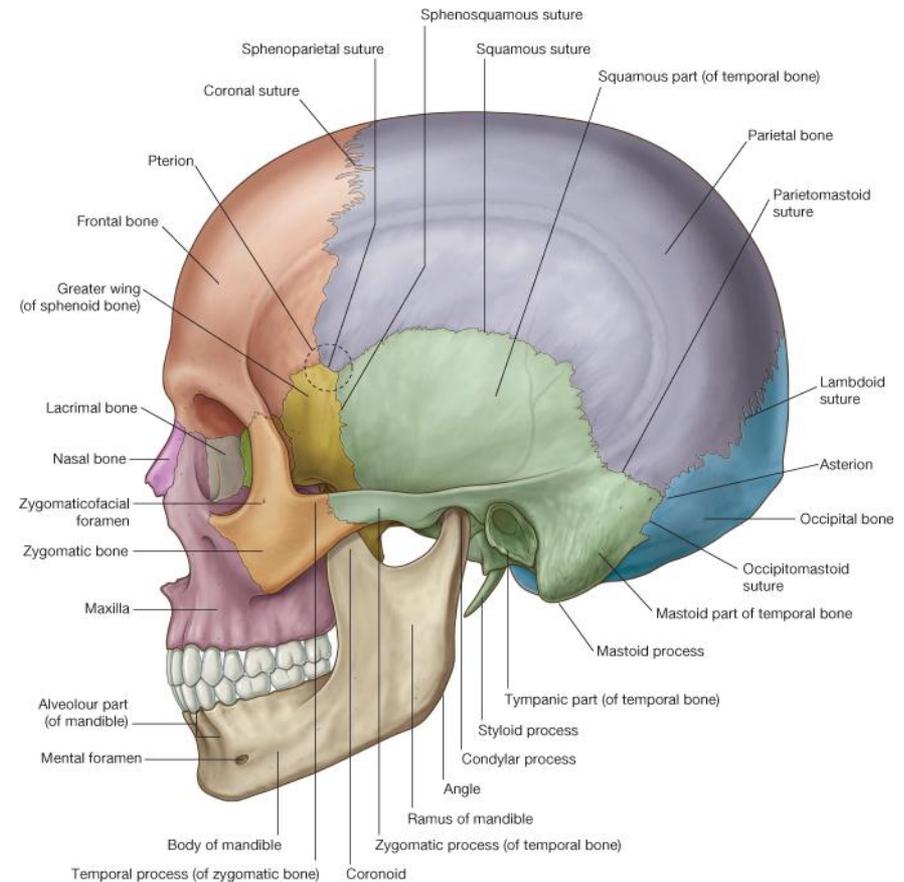
The shape of the skull is oval and its volume is from 1400cm^3 to 1600cm^3 .

- **Microcephalic cranium**, when the brain is smaller than usually, its capacity is lower than 1300cm^3 .
- **Mesocephalic cranium**, when the brain capacity is from 1300 cm^3 to 1450cm^3 .
- **Megacephalic cranium**, when the brain capacity is more than 1450cm^3 .



Topographical areas of the skull

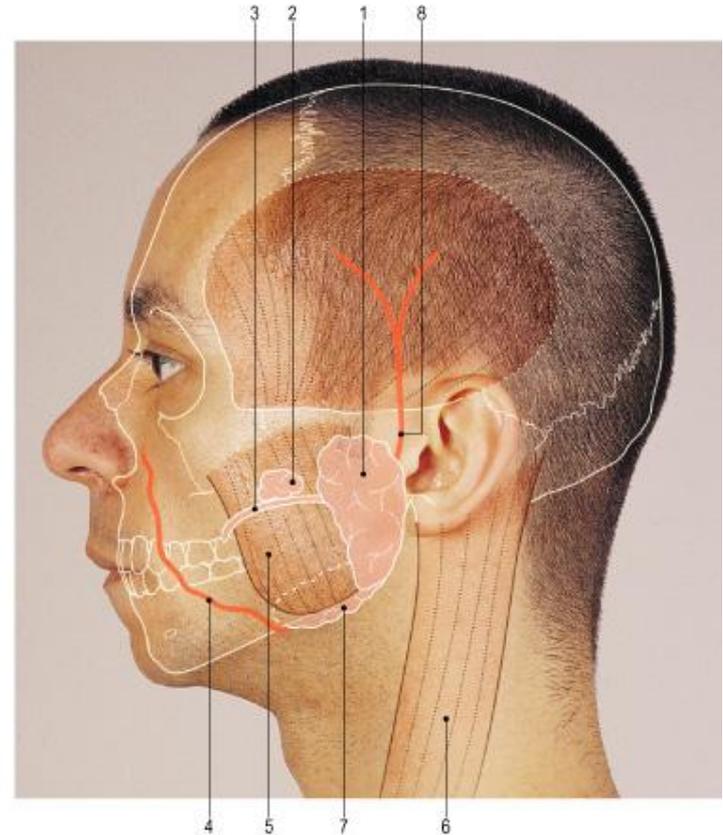
- **Frontal area**
- **Parietal area**
- **Occipital area**
- **Temporal area**
- **Infratemporal area**



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Areas of the visceral cranium

- *Regio orbitalis*, orbital area,
- *Regio infraorbitalis*, infraorbital area,
- *Regio nasalis*, nasal area,
- *Regio oralis*, (corresponds to the the lips area),
- *Regio mentalis*, mental area,
- *Regio zygomatica*, zygomatic area,
- *Regio buccalis*, (corresponds to the cheeks),
- *Regio parotideomasseterica*, parotideomasseteric area.



1. Parotid gland. 2. Accessory part of parotid gland. 3. Parotid duct. 4. Facial artery.
5. Masseter. 6. Sternocleidomastoid. 7. Submandibular gland. 8. Superficial temporal artery.

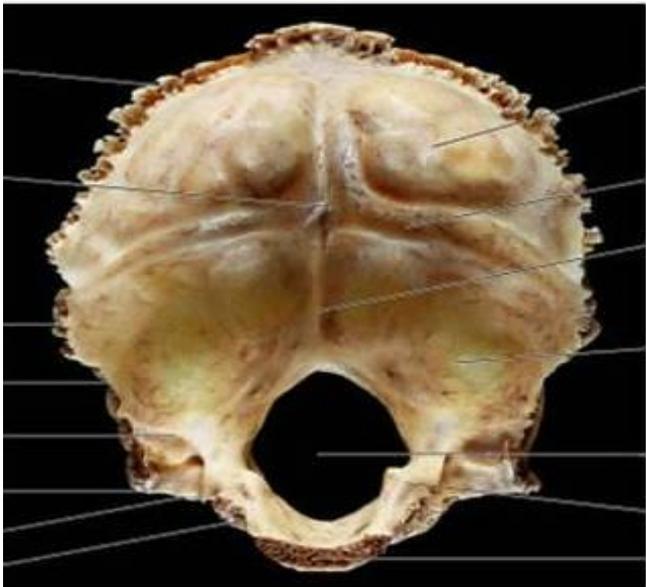
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Structural peculiarities of the bones of the skull

- The bones of the skull perform predominantly a protective function.
- The bones of the vault of the skull differ in structure from the other bones.
- They consist of spongy substance which is referred to as *diploe*.
- The spongy substance is placed between two plates of compact bone tissue
 - a) the outer (*lamina externa*),
 - b) the inner (*lamina interna*).

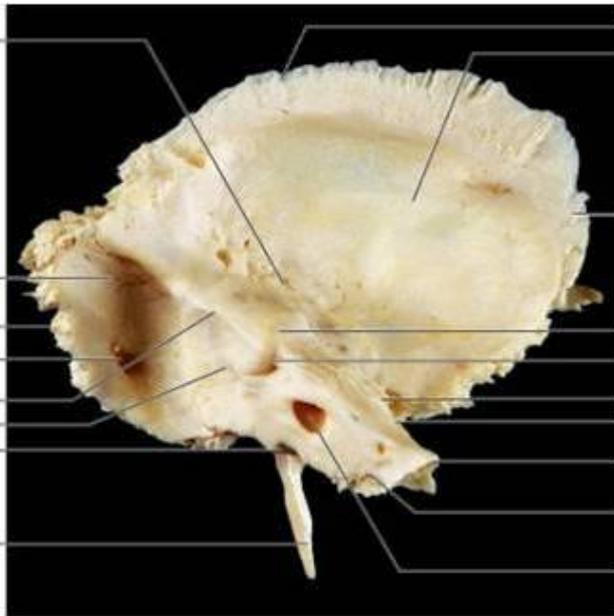


1. Coronal suture.
2. Groove for superior sagittal sinus.
3. Sagittal suture.
4. Parietal foramen.
5. Lambdoid suture.
6. Frontal crest.
7. Frontal bone.
8. Groove for middle meningeal vessels.
9. Parietal bone.
10. Occipital bone.



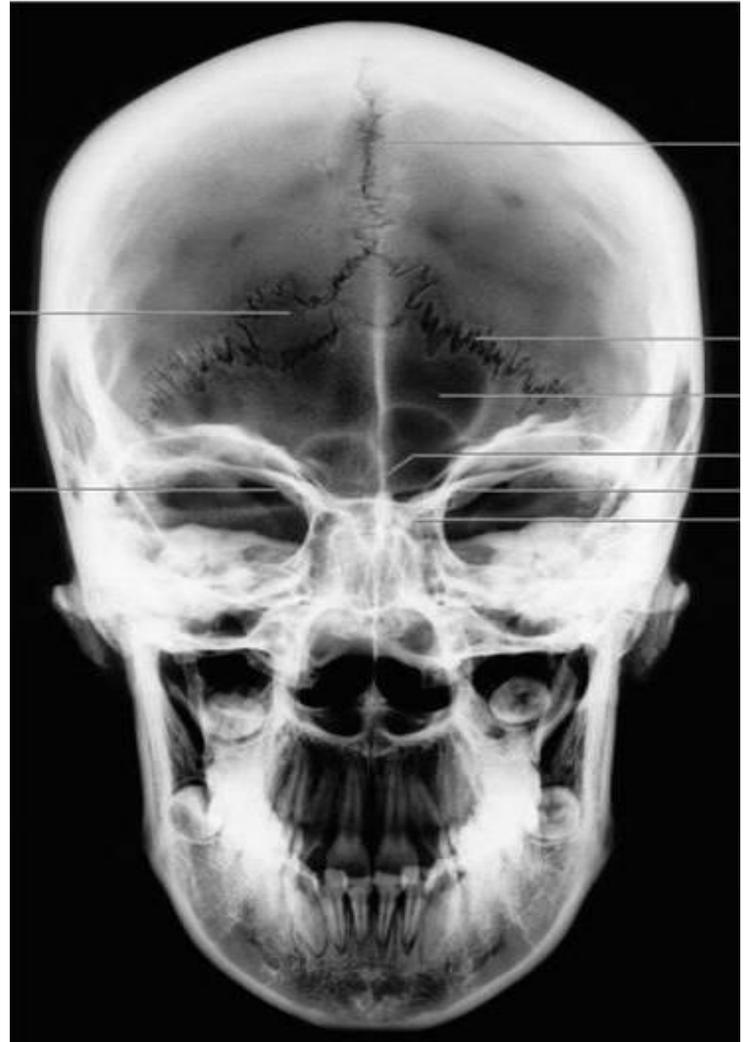
Structural peculiarities of the bones of the vault of the skull

- *Lamina interna* is also called vitreous (*lamina vitrea*), because it fractures more easily than the outer table in injury to the skull.
- Only the temporal squama has no diploe, among the membrane bones of the vault of the skull.

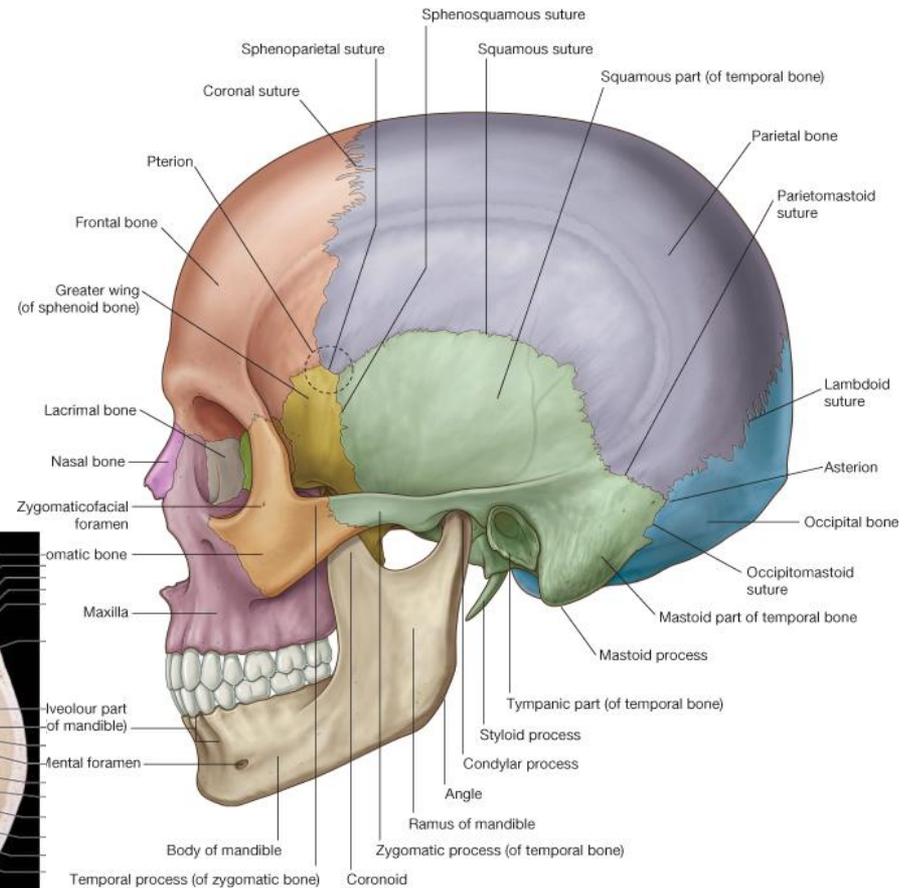
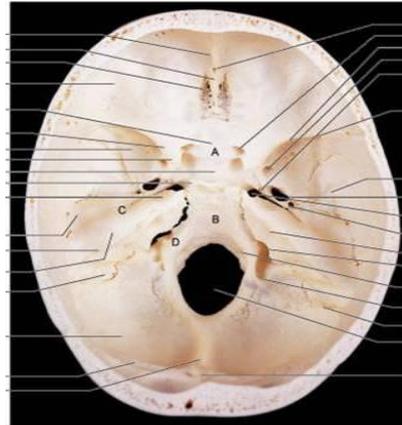


Some bones of the skull are called pneumatic bones, because they have inside air cavities, named sinuses.

- **Frontal bone**
- **Sphenoid bone**
- **Ethmoid bone**
- **Maxilla**
- **Mastoid process of the temporal bone**



- The upper part of the skull is named the vault, or *calvaria* and the lower part forms the *base* of the skull.



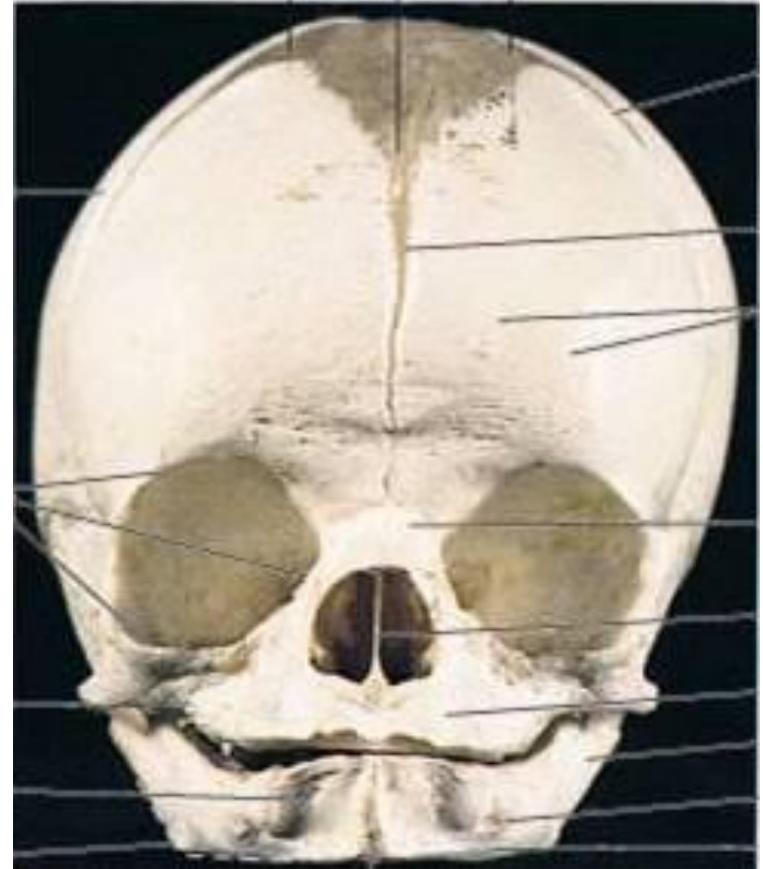
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Evolution of the skull

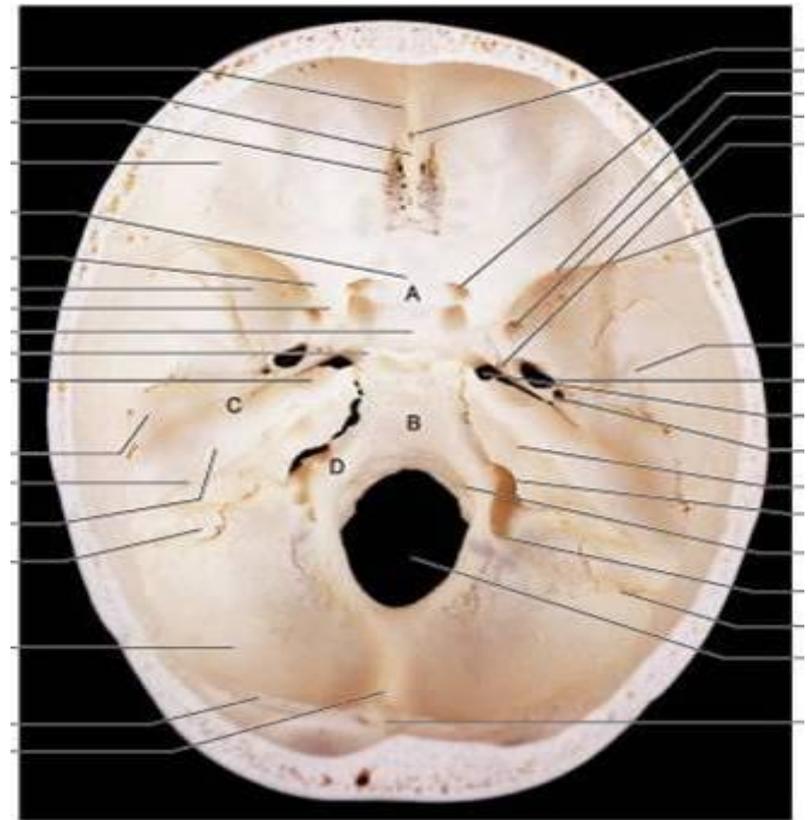
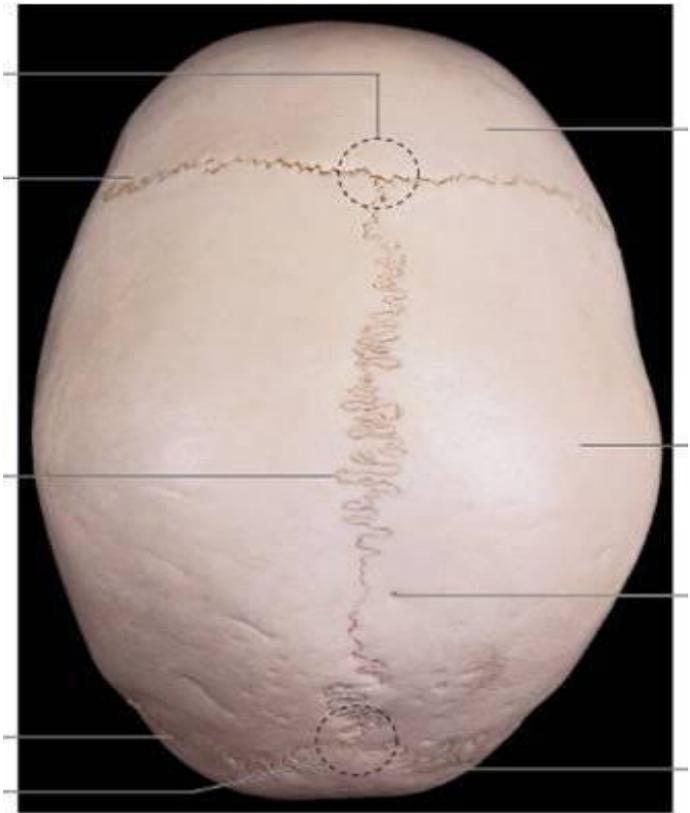
- Replacement of the membranous and cartilaginous skull by a bony skull.
- Fusion of the bones of the cerebral cranium, reduction of their number with simultaneous complexity of their structure and development as mixed bones.
- Conversion of the visceral arch cartilages to bones of the visceral skull.
- Union of the cerebral skull with the visceral (facial) skull.
- Progressive development of the cerebral cranium and its predominance over the visceral skull.

Development of the skull

- The **membranous neurocranium**, or *desmocranium* develops from *mesenchyme*, that derives from *mesoderm*.
- The **cartilaginous neurocranium** (*chondrocranium*) is formed by separate cartilages, which further by encondral ossification will form the bones of the base of the skull.



The bones of the **vault of the skull** develop in connective-tissue, and therefore are referred to membrane (**desmal**), or **primary** bones. The bones of the **base of the skull** develop in cartilage and they are referred to **secondary** bones.



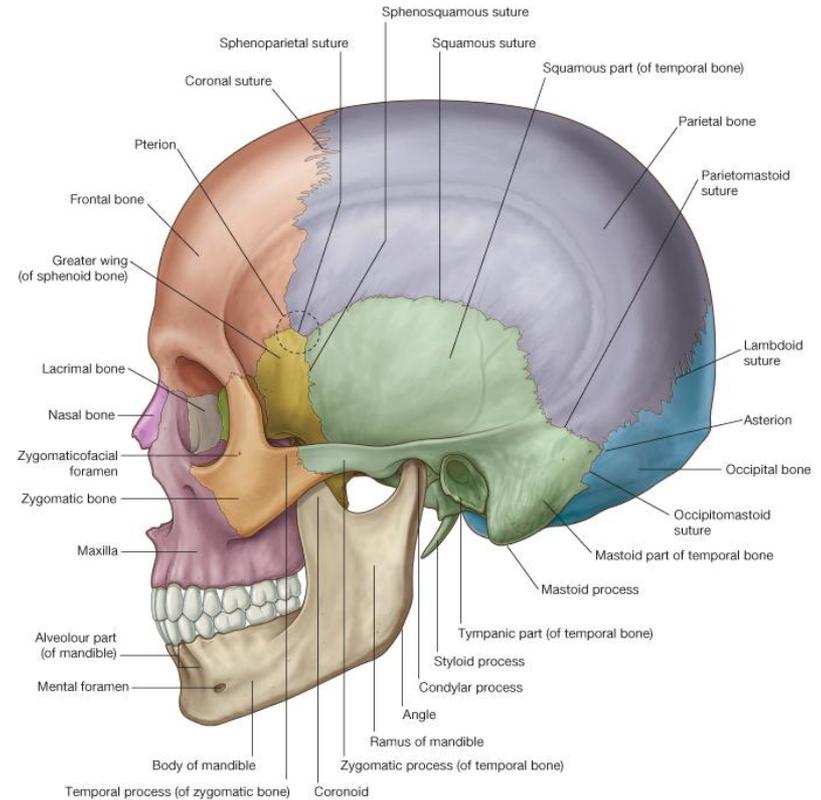
Development of the skull

In man, according to their development, the bones of the skull are divided into three groups:

- A. Bones that develop from the *cerebral capsule*.
- B. Bones that develop from the *nasal capsule*.
- C. Bones that develop from the *visceral arches*.

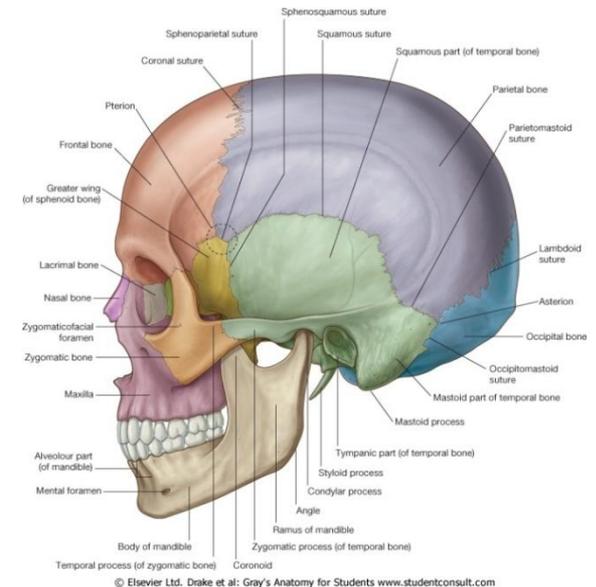
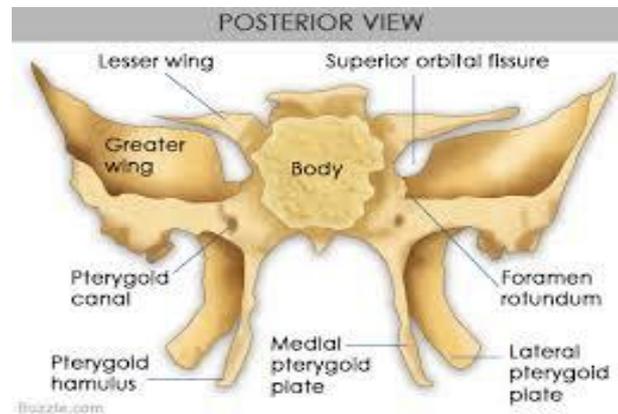
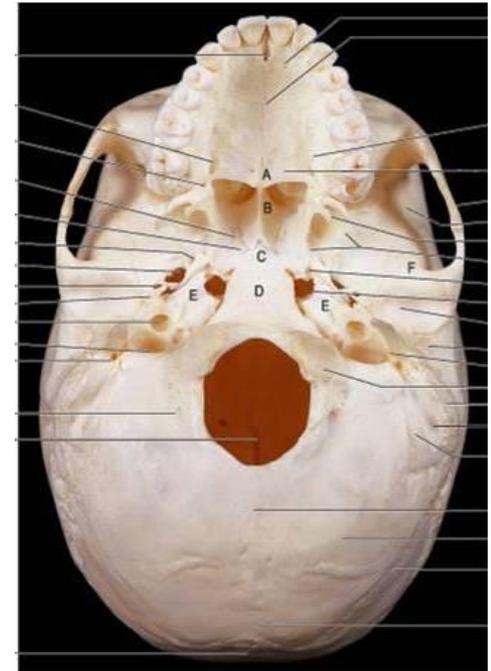
A. Bones that develop from the cerebral capsule

- The **primary bones** are the bones of the vault of the skull:
 - a) **parietal** bone
 - b) **frontal** bone
 - c) **occipital squama**
 - d) **temporal squama** and **tympanic part** of the temporal bone.
- The named above bones are also called *membranous*, or *desmal* bones.



B. The secondary bones that develop from the cerebral capsule are:

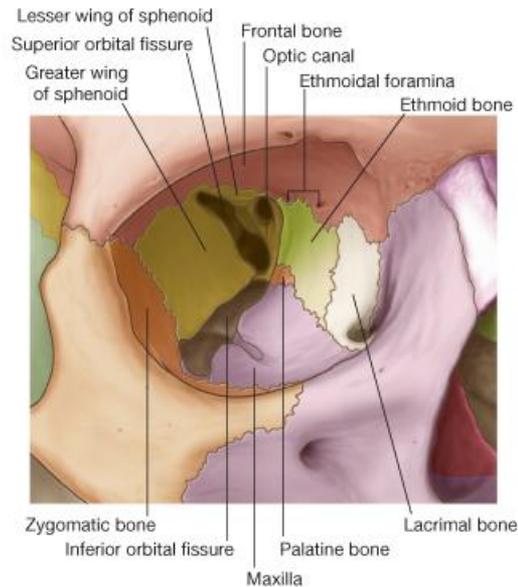
- a) bones of the **base** of the skull;
- b) the **sphenoid** bone excepting the **medial plate** of the pterygoid process;
- c) the **condylar parts** of the occipital bone;
- d) the **mastoid process** of the temporal bone.



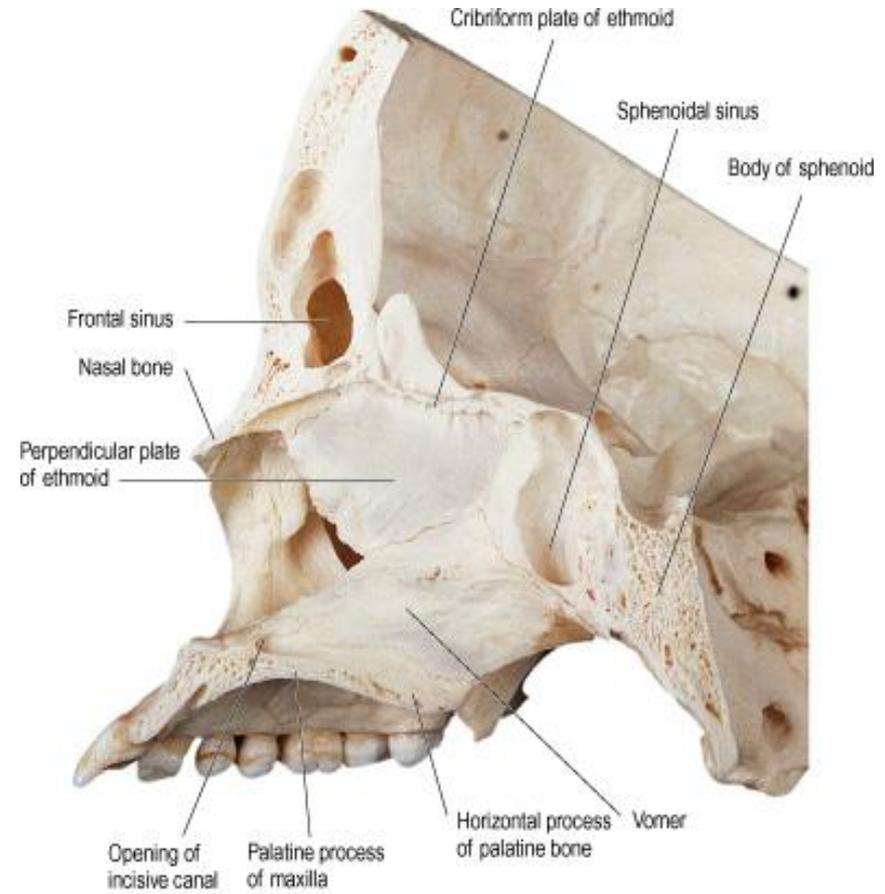
B) Bones that develop from the nasal capsule

Primary bones are:

- a) the lacrimal bone
- b) the nasal bone
- c) the vomer



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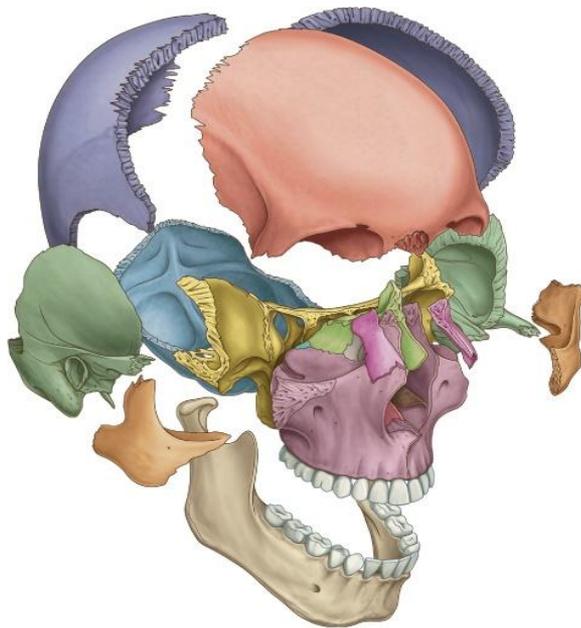
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B) Bones that develop from the nasal capsule

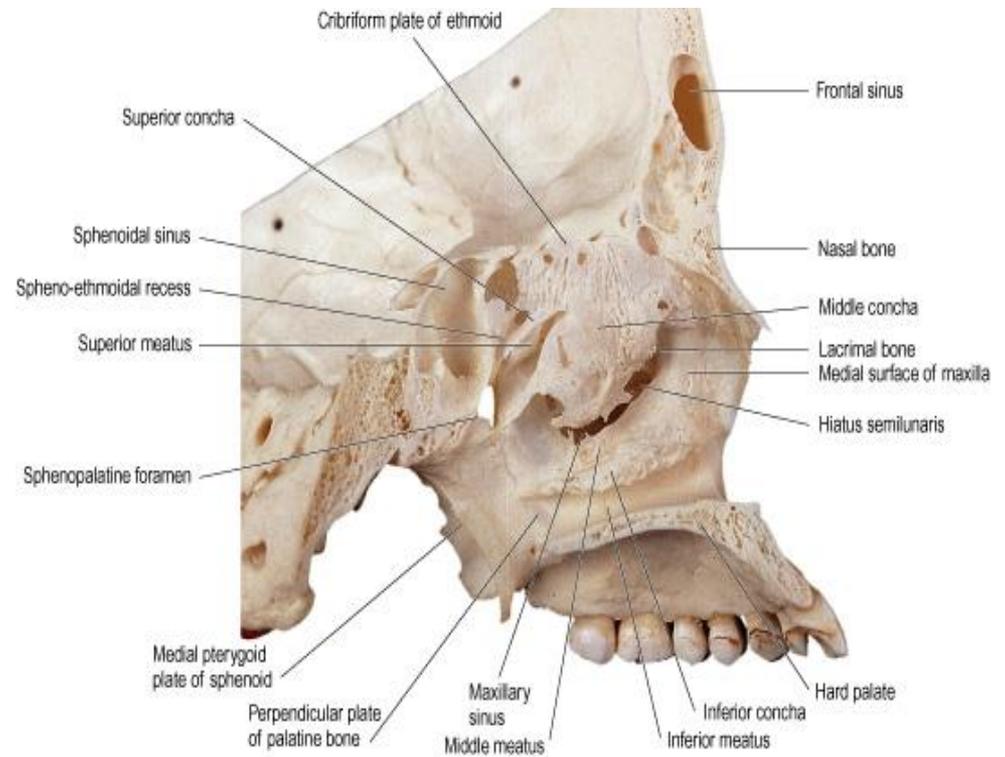
The **secondary bones** are:

- a) the **ethmoid bone**
- b) the **inferior nasal concha**

A

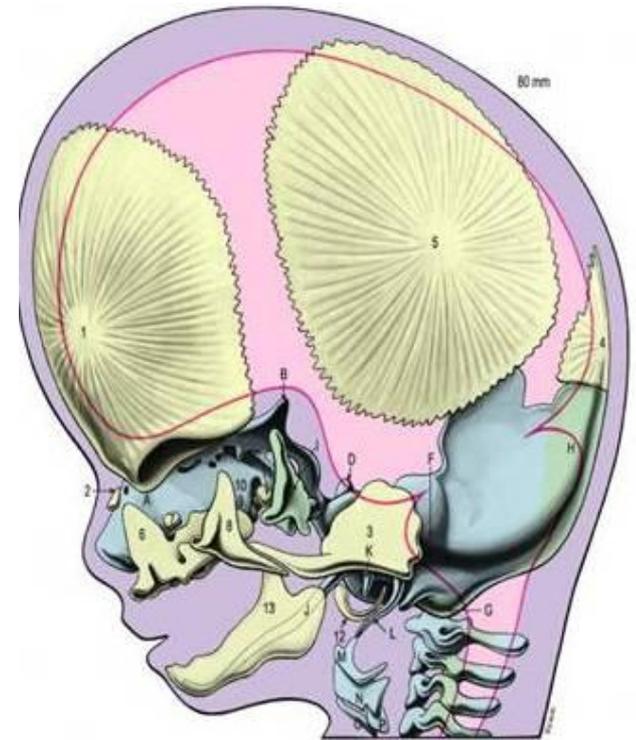


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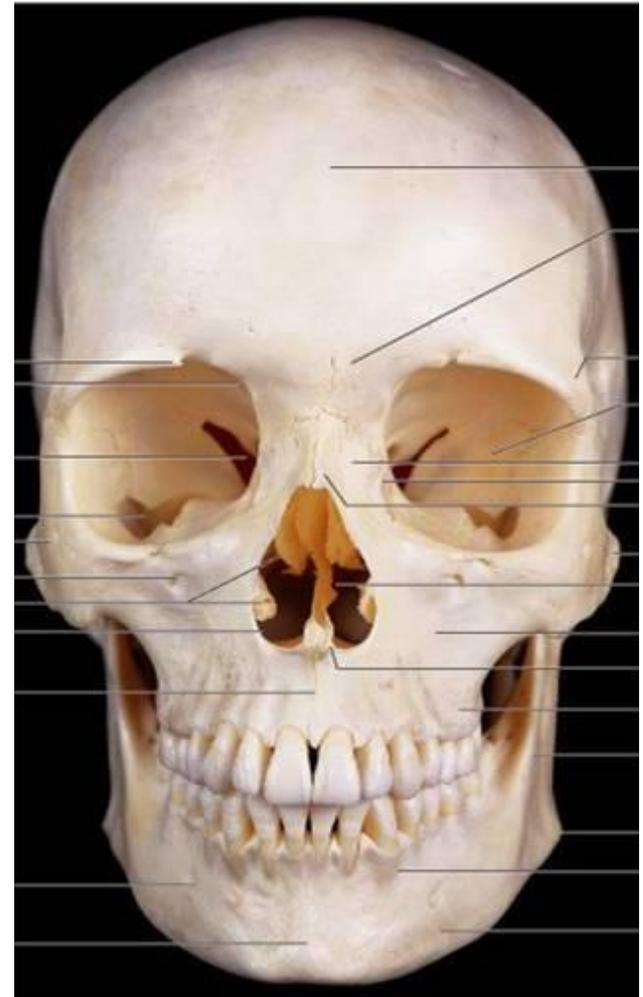
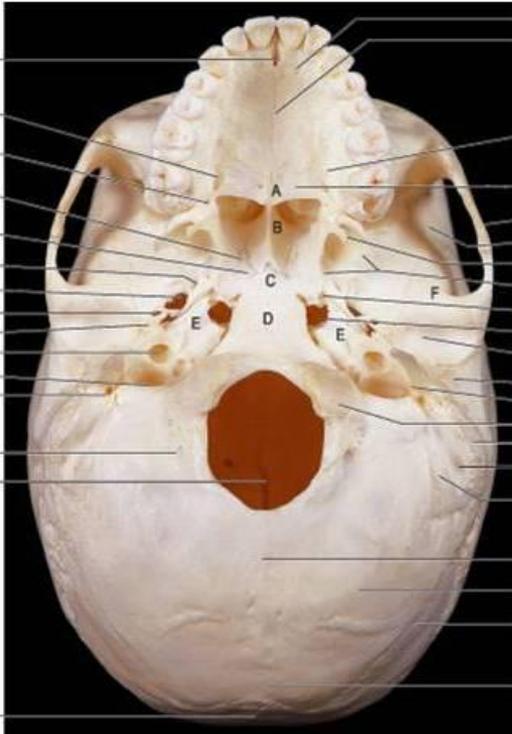
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- The **visceral cranium** – develops from the **first** and **second** visceral arches.
- The **first visceral arch**, or *mandibular arch* is made up of two parts:
 - a) The upper part is called *palatoquadratic cartilage*.
 - b) The lower part is called *Meckel's cartilage*.
- The **second visceral arch**, or the *hyoid arch* is also divided into two parts:
 - a) The upper part called – *hyo-mandibular cartilage*;
 - b) The lower one is called – *hyoid cartilage*.
- **The third visceral arch**
 The remaining visceral arches beginning with the third are called *branchial arches*, thus the third visceral arch is called the first branchial, the fourth visceral is the second branchial ,and so on until the fifth one.



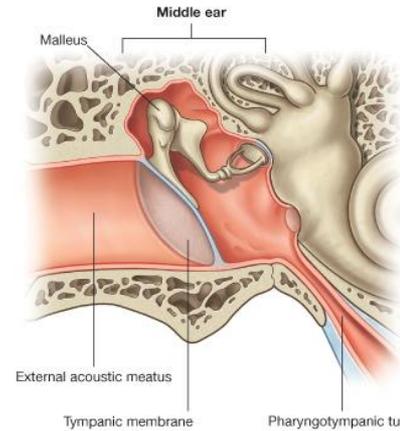
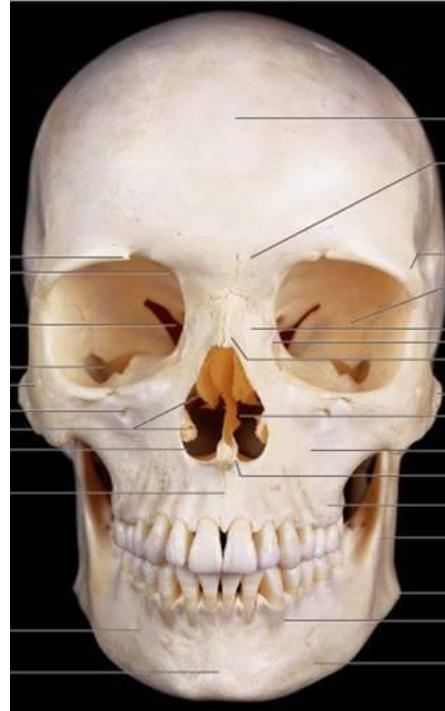
The bones that develop from the visceral arches

- Immobile bones:
 - a) the upper jaw
 - b) the palatine bone

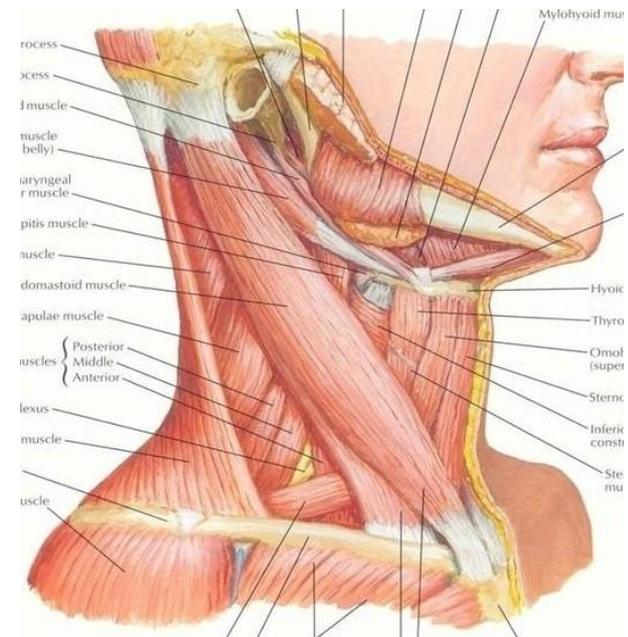


The bones which develop from the visceral arches

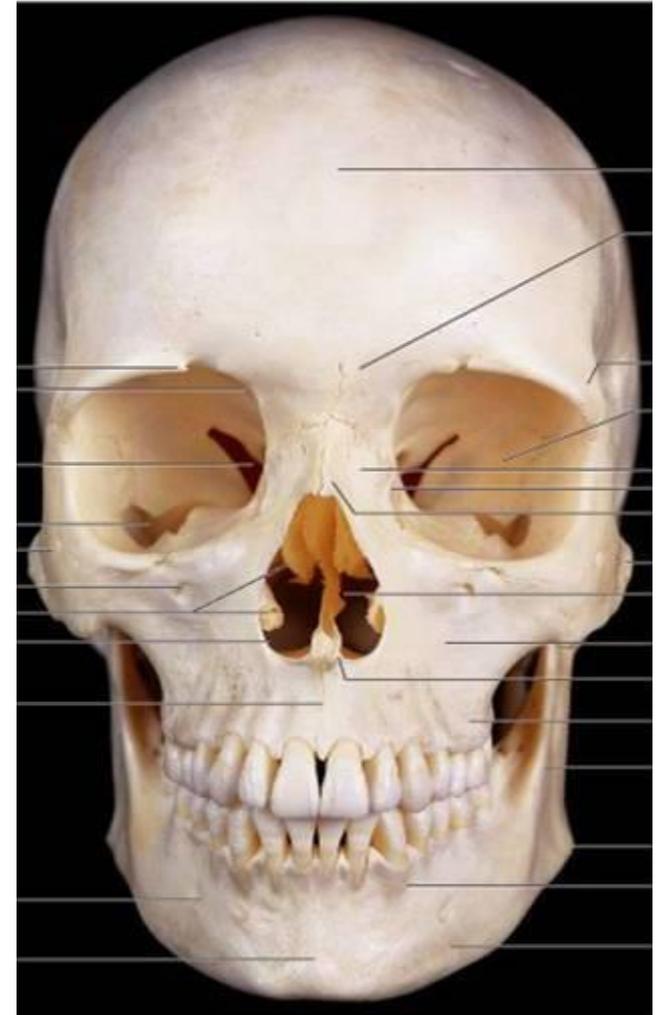
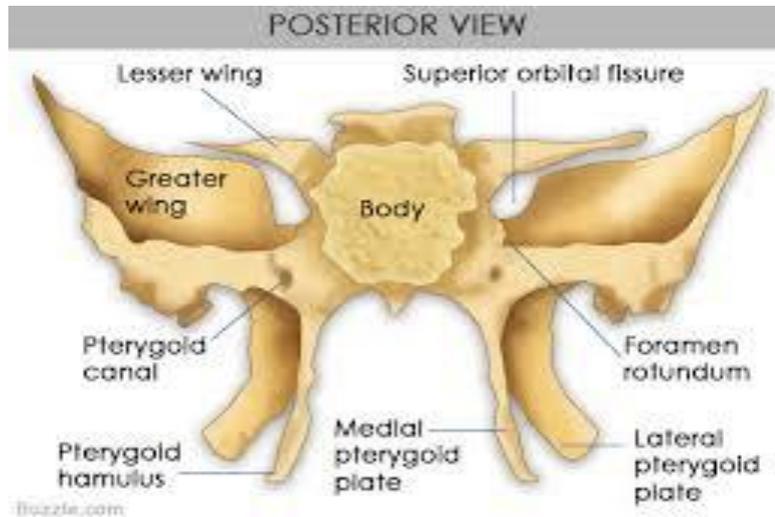
- Mobile bones:
 - a) the lower jaw
 - b) the hyoid bone
 - c) the auditory ossicles



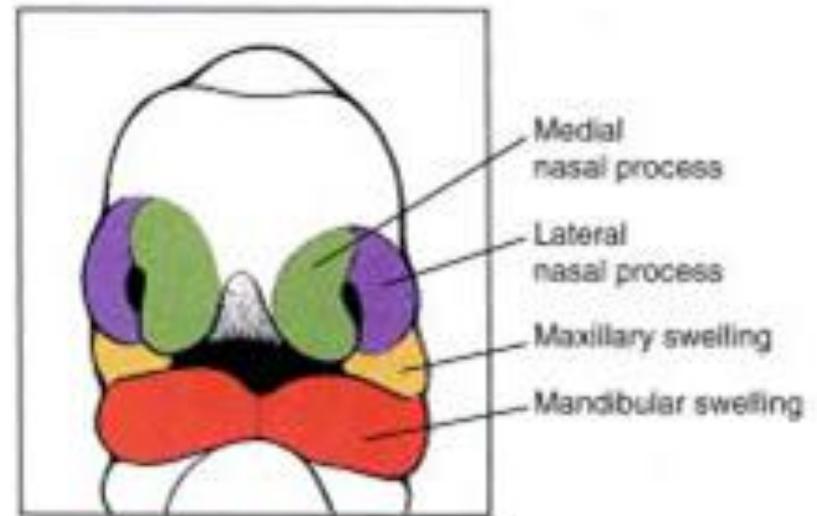
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- From the maxillary process develop:
 - a) **maxilla**
 - b) **zygomatic** bone
 - c) **palatine** bone
 - d) **medial plate** of the pterygoid process of the **sphenoid** bone

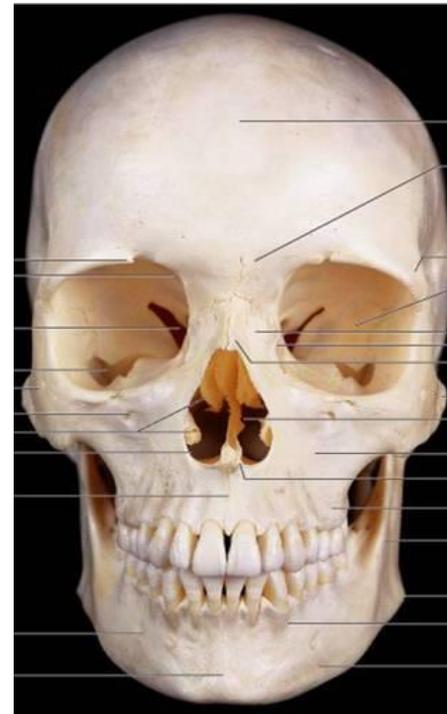
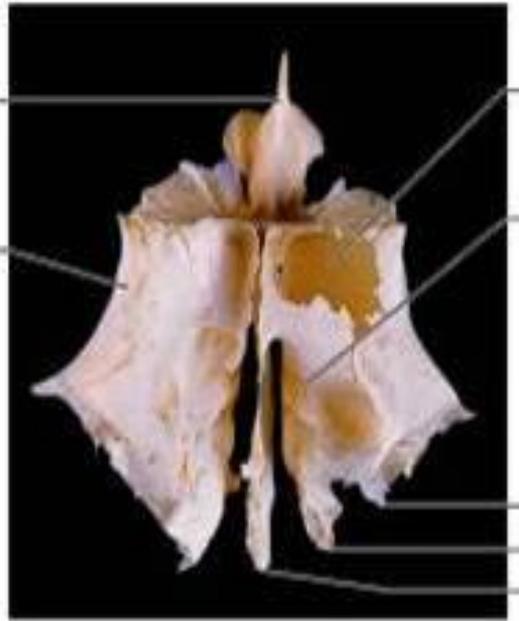


- The *frontal process* during its development (at 6th week) is divided into five parts:
- unpaired – frontal process
- paired – two medial nasal processes and two lateral nasal processes

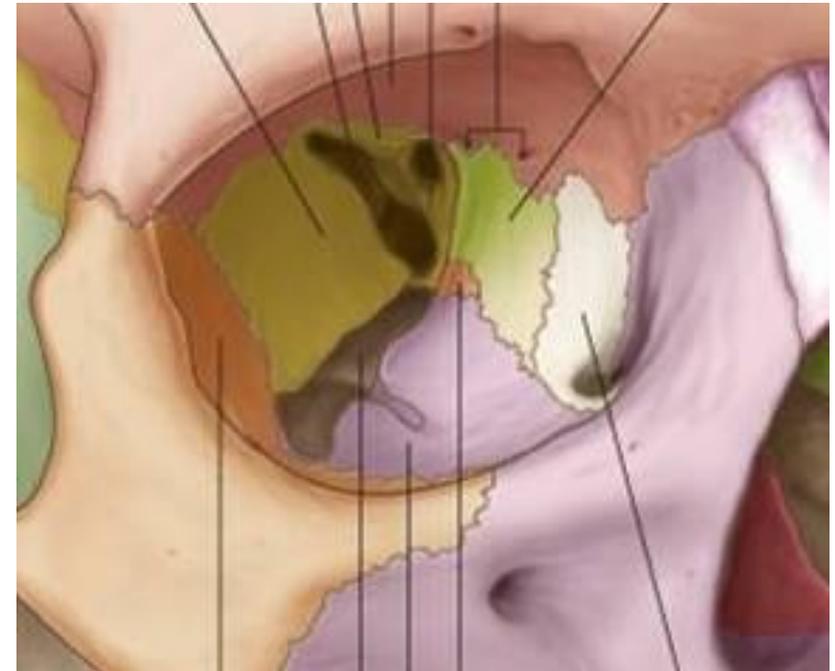
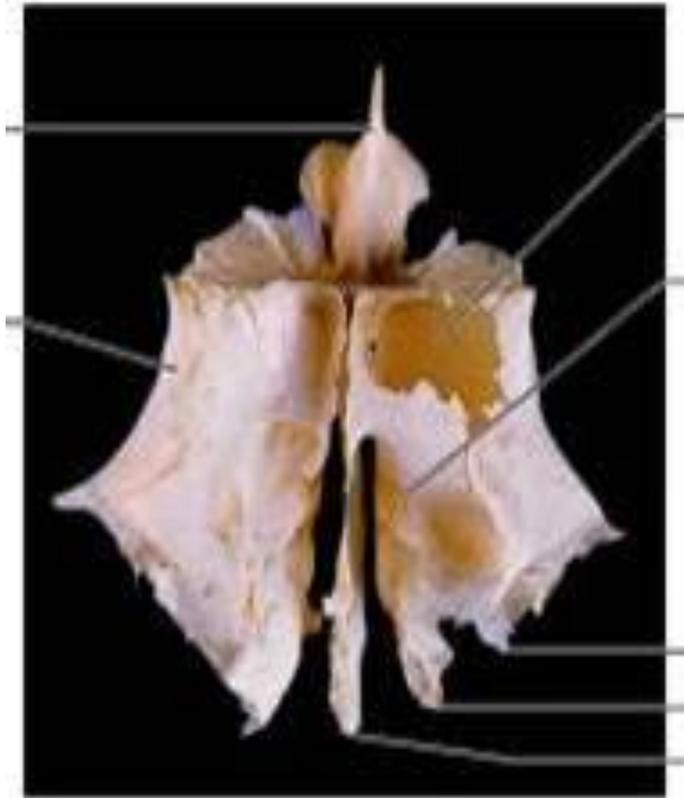


- From the medial nasal process develop:

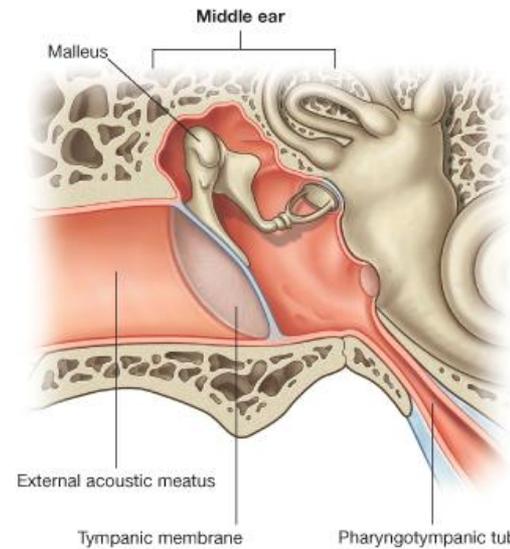
- a) the vomer
- b) the perpendicular plate of the ethmoid bone.



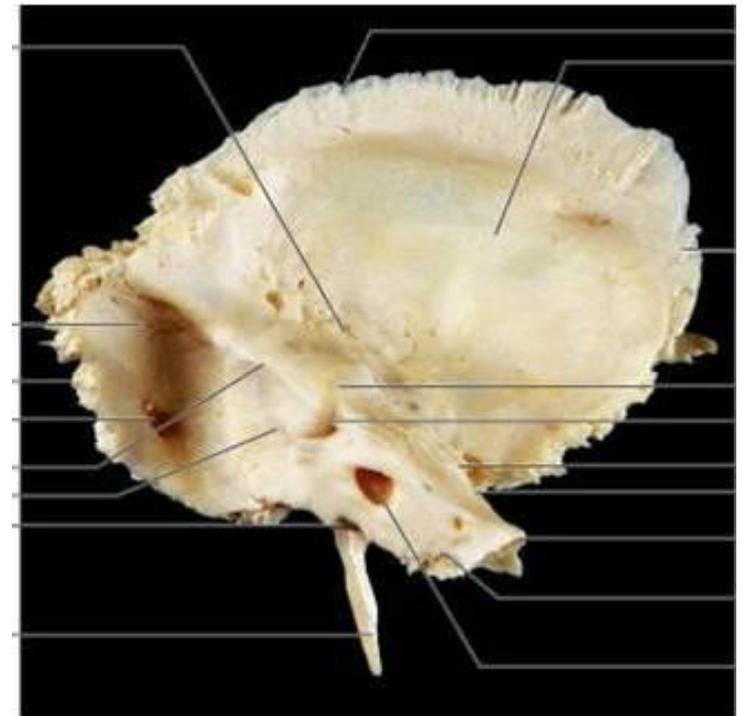
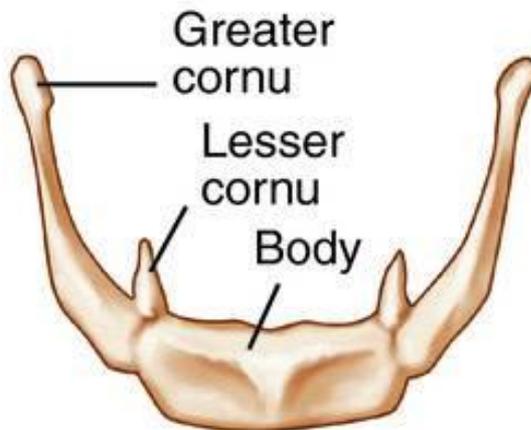
- **From the lateral nasal process develop - the ethmoidal labyrinths, the nasal bones and the lacrimal bones.**



- From the first visceral arch develop - the hammer and anvil (the ossicles of the middle ear).
- From the second visceral arch develop - the stirrup, the styloid process of the temporal bone, and the lesser horns of the hyoid bone.

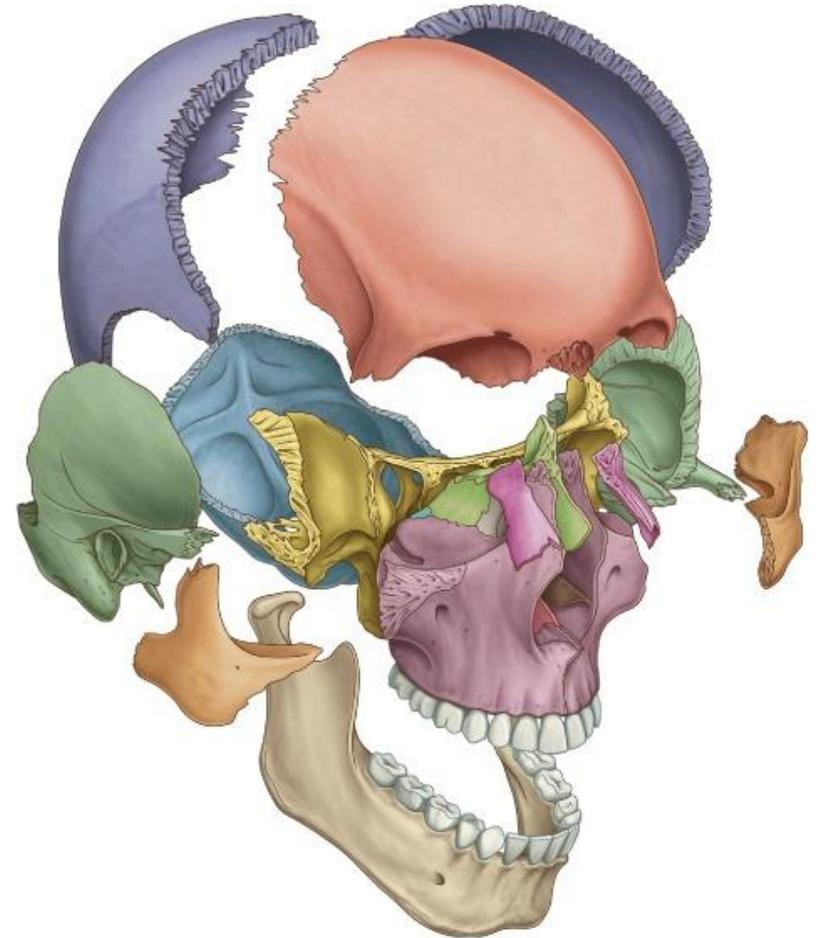


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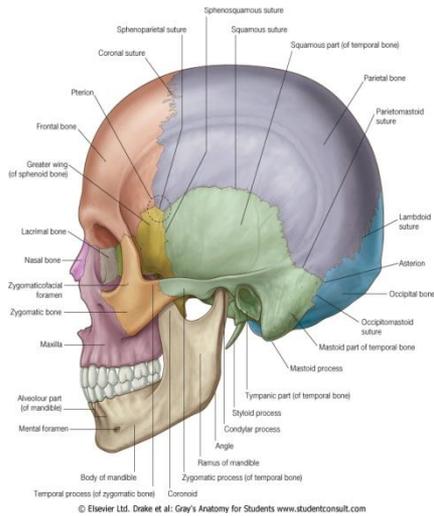
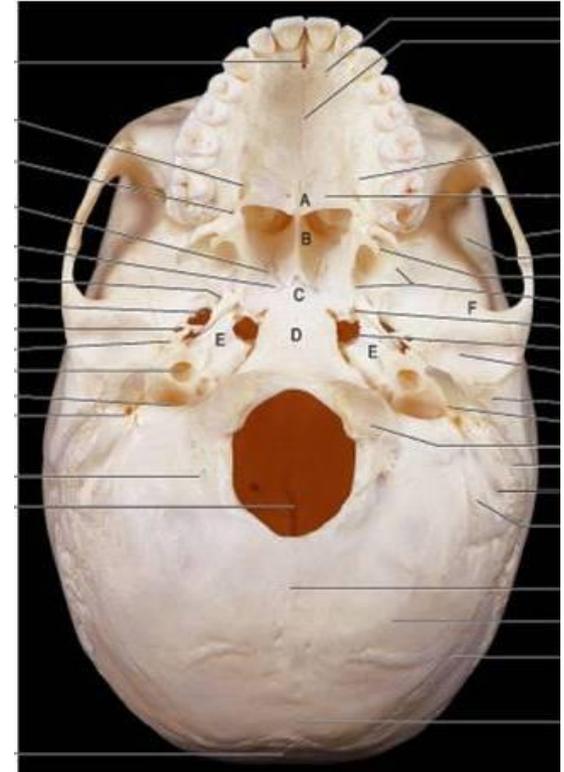
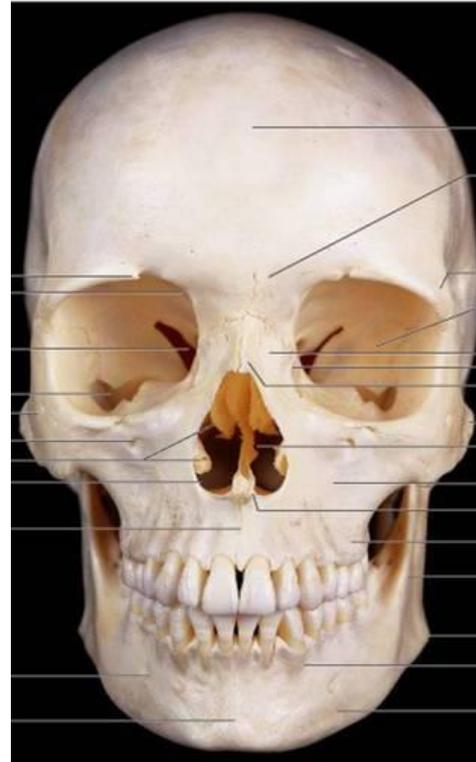
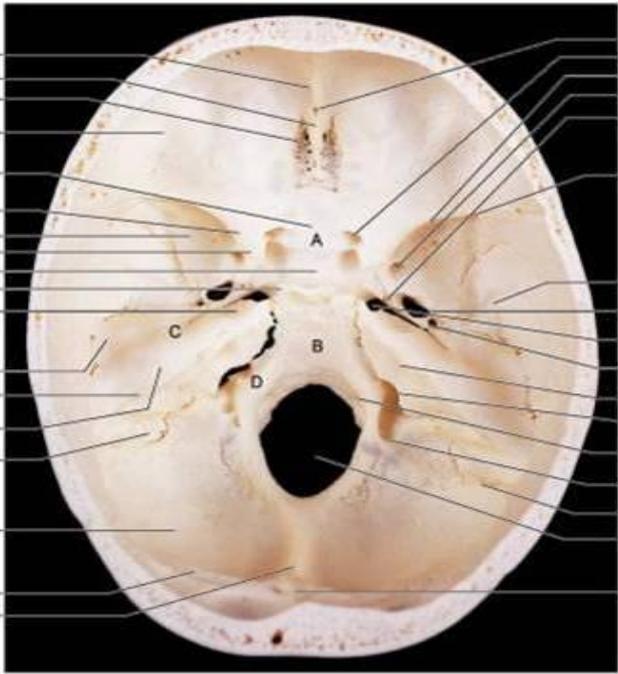
- From the mandibular process develops - the **mandible** (through periosteal ossification).

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Skull as a whole



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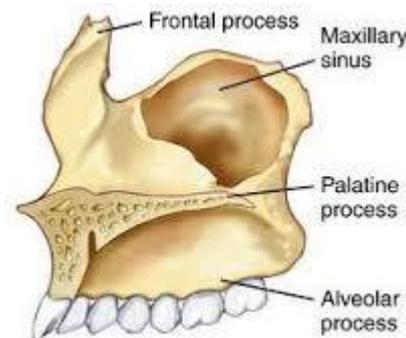
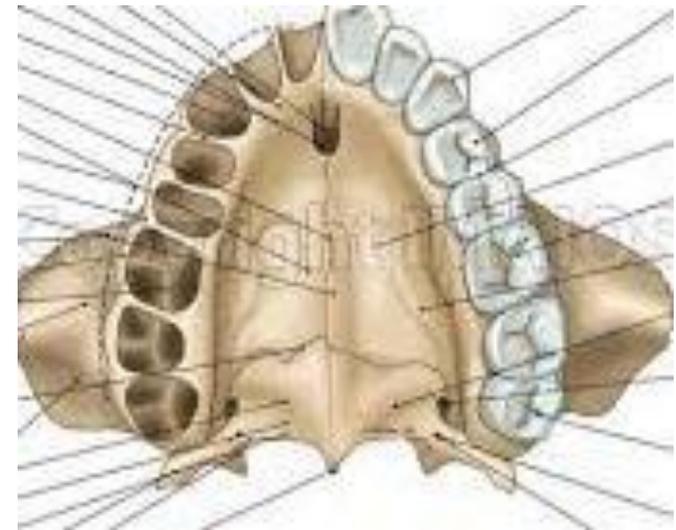
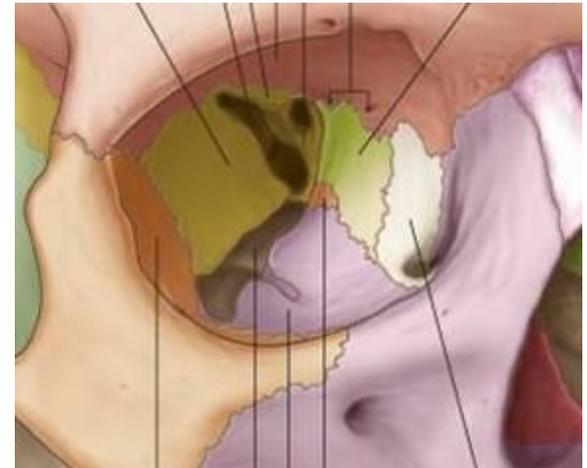
Variants of the bones of the viscerocranium

- **The lacrimal bone**

The shape and dimensions of this bone are not constant, and in case of its absence it is substituted by the excessive growth of the frontal process of the maxilla or by the orbital plate of the ethmoid bone.

- **The maxilla**

The dental sockets may frequently vary in number and shape. Sometimes can be present impair incisive bone which is characteristic for mammals. The incisive canal and the maxillary sinus may vary in shape and size.





A



B



A



B



C



D



C



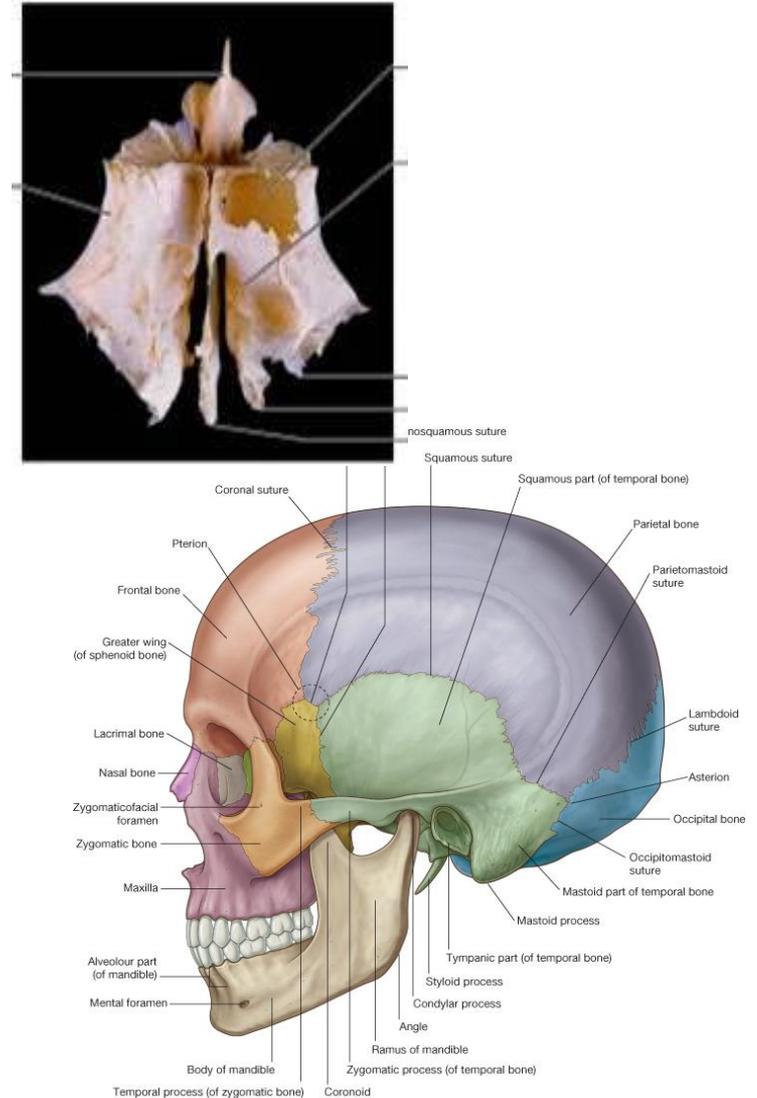
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FIGURE 1- Different extents of isolated cleft palate: A) uvula, B) soft palate, C) incomplete hard palate and D) complete hard palate

The most redoubtable developmental abnormality of the maxilla is the **cleft palate** (*palatum fissum*).

Abnormalities of the bones of the skull

- The **ethmoidal cells** can be various in shape and size.
- Often can be present the **supreme nasal concha**.
- When the ossification nuclei do not fuse the **parietal bone** consists of two parts, one superior and another inferior.

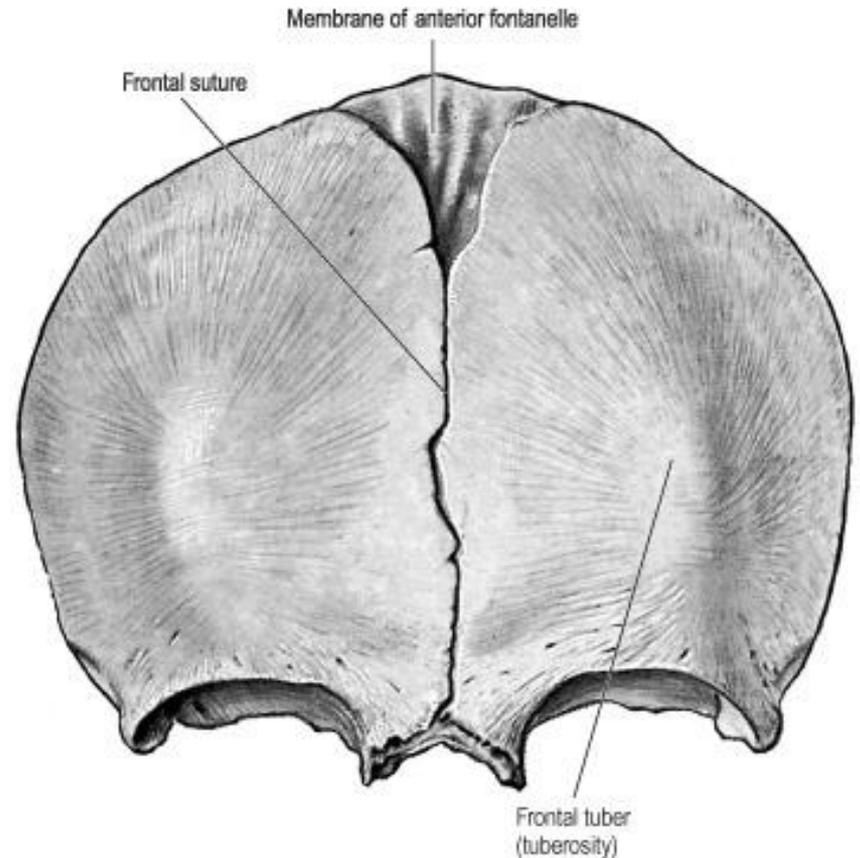


Developmental variants and abnormalities of the bones of skull

- **The frontal bone**

In approximately 10% of cases the frontal bone consists of two parts between which persists the frontal suture (metopic suture).

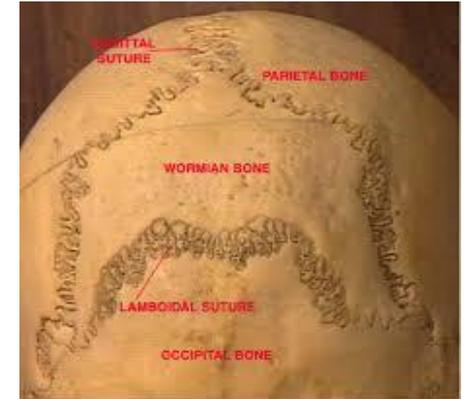
- The size of the frontal sinuses varies and in rare cases it can be absent.



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Abnormalities of the occipital bone

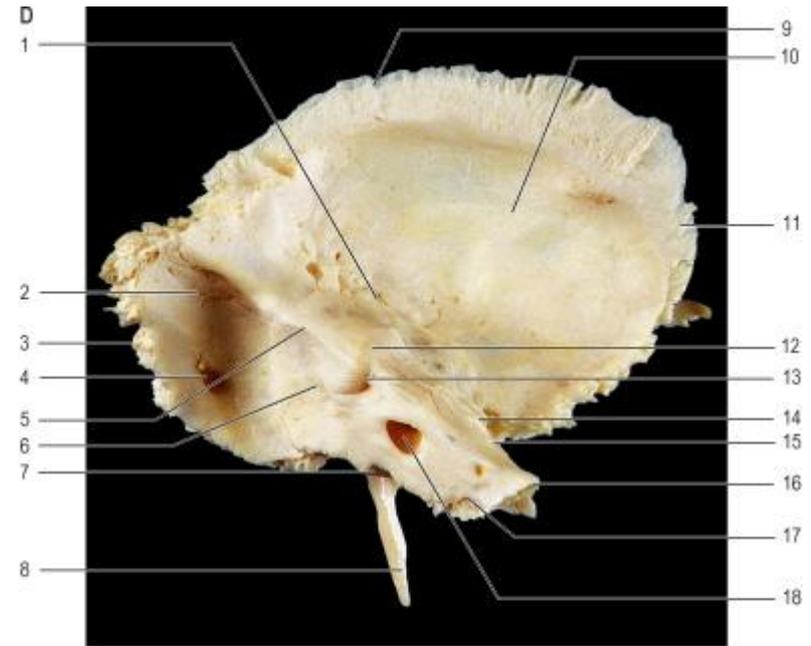
- The superior part of the occipital squama can be totally or partially separated from the rest of the bone by a transverse fissure.
- As a consequence develops an additional bone named intraparietal bone (*os intraparietale*).
- Around the occipital bone sometimes can appear accessory bones of the cranium (**ossa suturalia, wormian bones**).
- In rare cases the external occipital protuberance can reach very big dimensions.
- There can be present the third occipital condyle, which is situated on the anterior border of the greater occipital orifice. In case it is present, then it articulates with the anterior arch of the first cervical vertebra forming an additional joint.



Abnormalities of the temporal bone

- *The temporal bone*

- a) The jugular notch of the temporal bone can be separated by a long intrajugular process into two parts and if the same process does exist at the jugular notch of the occipital bone than the jugular orifice is double.
- b) The styloid process can be absent or vice-versa in case of ossification of the stylohyoid ligament, it would be very long.

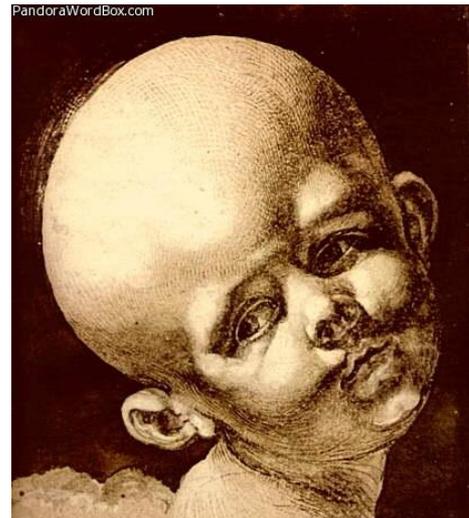
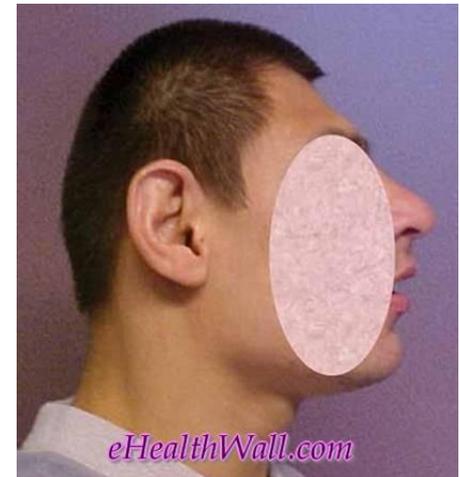
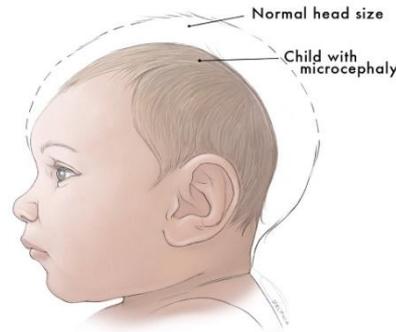


1. Petrosquamous fissures.
2. Groove for sigmoid sinus.
3. Occipital margin.
4. Mastoid foramen.
5. Petrous ridge with groove for superior petrosal sinus.
6. Opening of aqueduct of vestibule.
7. Opening of cochlear canaliculus.
8. Styloid process.
9. Parietal margin.
10. Groove for middle meningeal vessels on squamous part.
11. Sphenoidal margin.
12. Arcuate eminence.
13. Subarcuate fossa.
14. Semi-canal for pharyngotympanic tube.
15. Trigeminal impression.
16. Apex of petrous part with opening of carotid canal.
17. Groove for inferior petrosal sinus.
18. Internal acoustic meatus.

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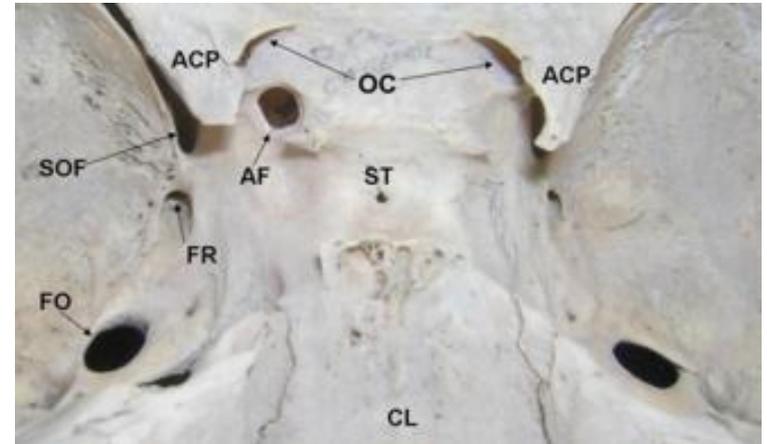
Abnormalities of the skull

- **Microcephalia** – the skull does not grow because the brain stops its development.
- **Macrocephalia** – great disproportional dimensions of the skull.
- **Hidrocephalia** – voluminous skull (when there is a lot of cerebrospinal fluid inside the cerebral ventricles).



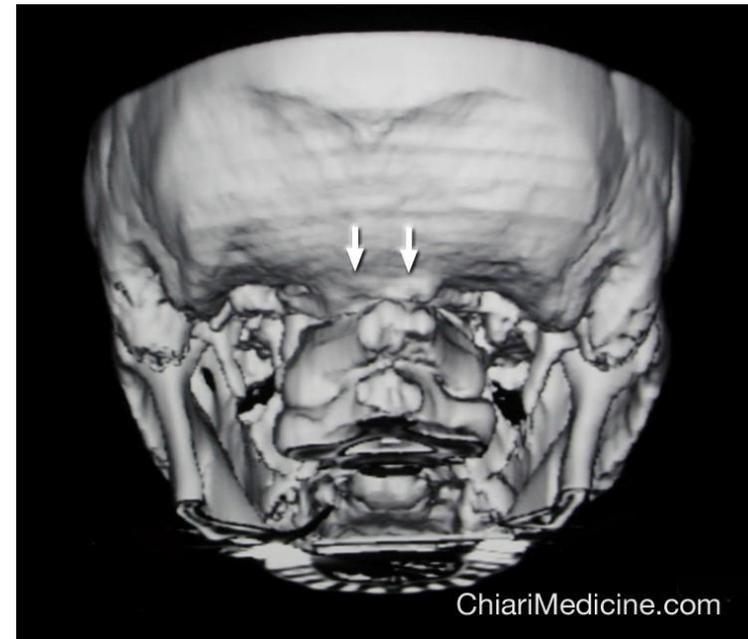
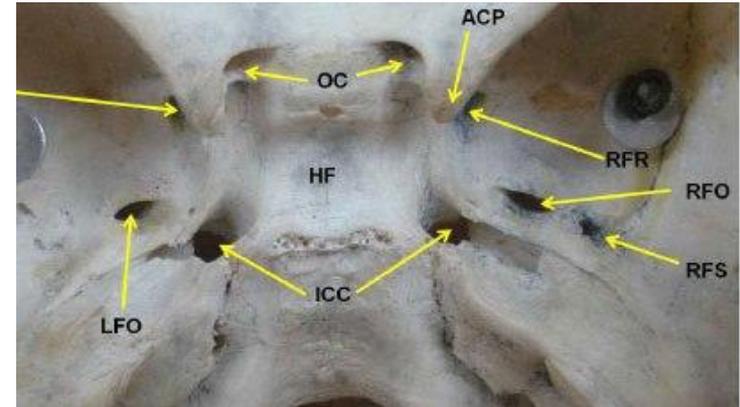
Abnormalities of the skull

- Persistence of the **craniopharyngeal canal** in the Turkish saddle (it contains remnants of the pharyngeal recess).
- **Clinoideocarotid foramen** (when the anterior clinoid process is connected with the body of the sphenoid bone).



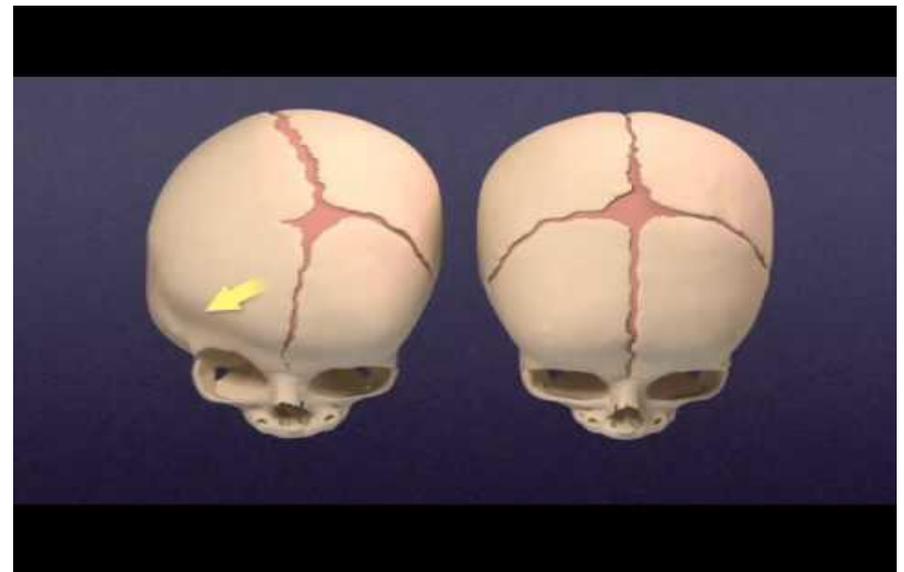
Abnormalities of the skull

- Common *spinosum* and *ovale* orifices.
- Assimilation of the atlas by the occipital bone (occipitalization).
- Presence of the *paramastoid process* (when there is additional process in close relationship with the mastoid one).



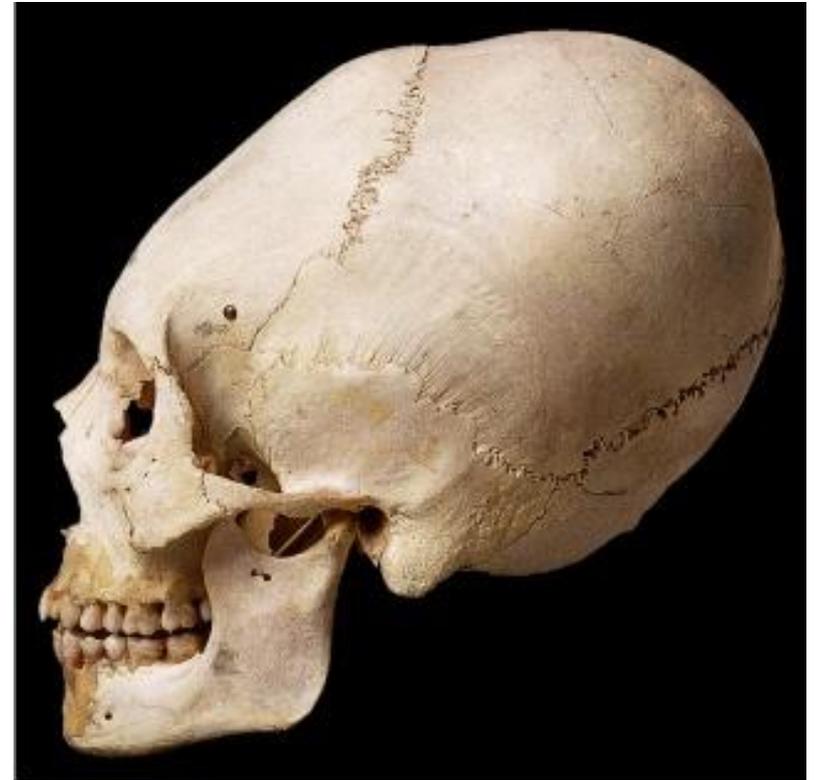
Abnormalities of the skull

- **Cranioschisis** – congenital failure of the skull to close. Usually it is accompanied by deficient development of the brain (the sagittal suture does not close).
- **Plagiocephalia** – premature closure of the sutures and fontanelles only from one side.



Abnormalities of the skull

- **Scaphocephalia** – earlier ossification of the sagittal suture, being a condition of appearance of a long and narrow skull.
- **Acrocephalia** – premature closure of the coronary suture.

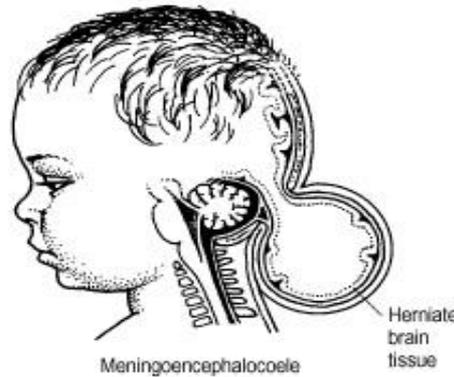


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Abnormalities of the skull



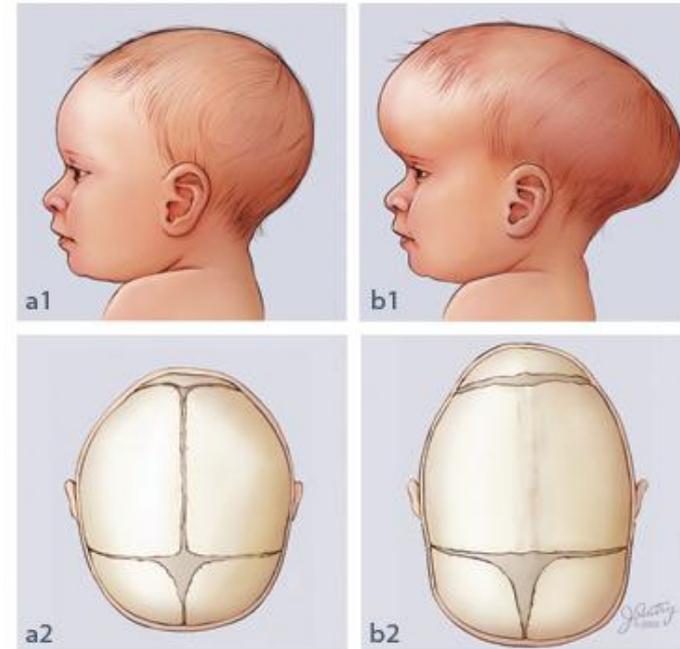
Anencephaly



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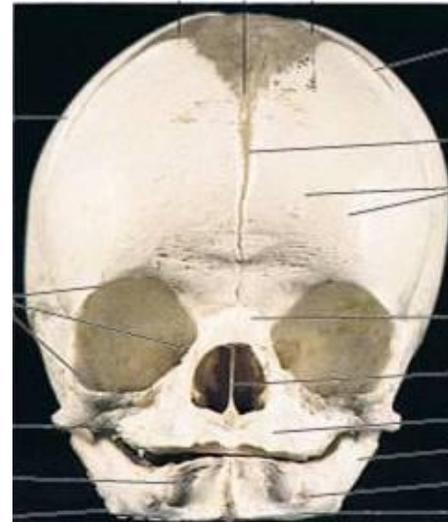
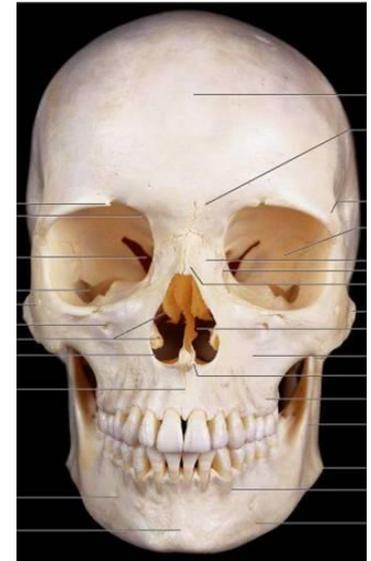


- **Anencephalia** – this term isn't correct, because the absence of the cerebral extremity of the trunk, does not permit the development of the embryo at all.
- **Meningoencephalocele** – a protrusion of the meninges and brain through a congenital defect in the cranium. Also called *encephalomeningocele*.
- **Craniosostenosis** – premature ossification of the fontanelles and of the sutures.



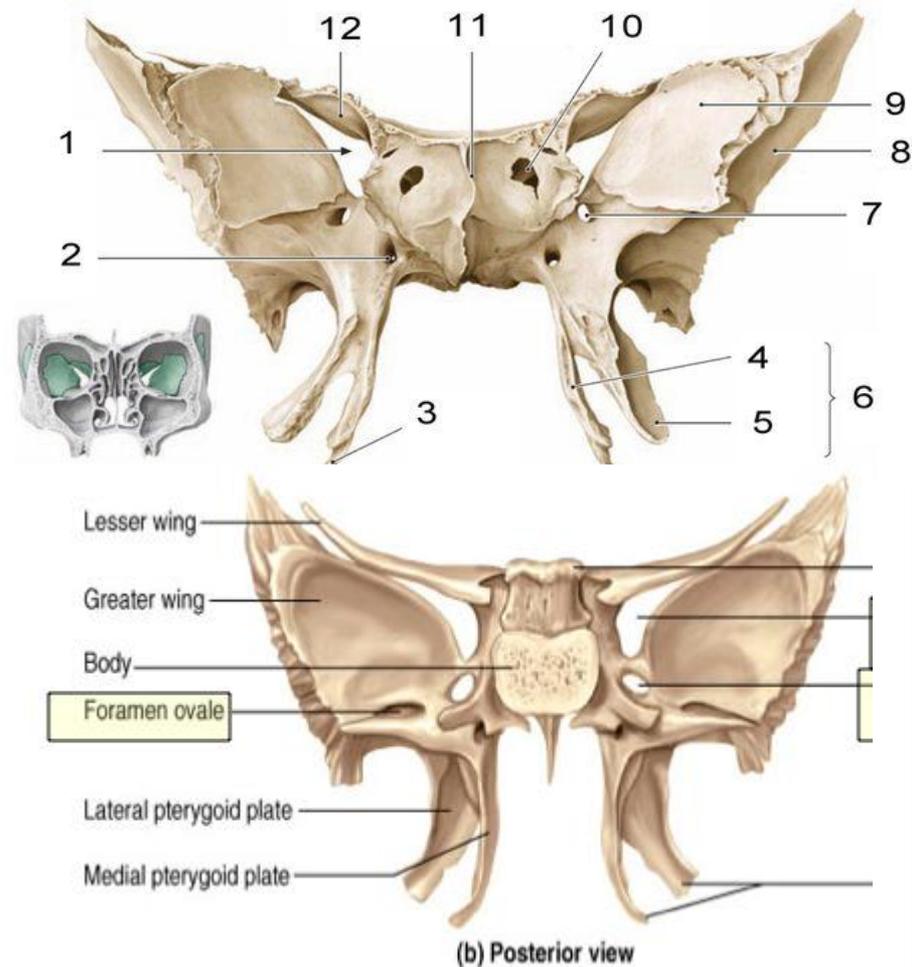
Nuclei of Ossification

- *The frontal bone* starts its development during the 9th week of the intrauterine development on the basis of connective tissue by endesmal osteogenesis.
- Two nuclei of ossification appear in this bone at the level of the two frontal tubers.
- In new-born this bone consists of two symmetrical parts which are united by means of a metopic suture.



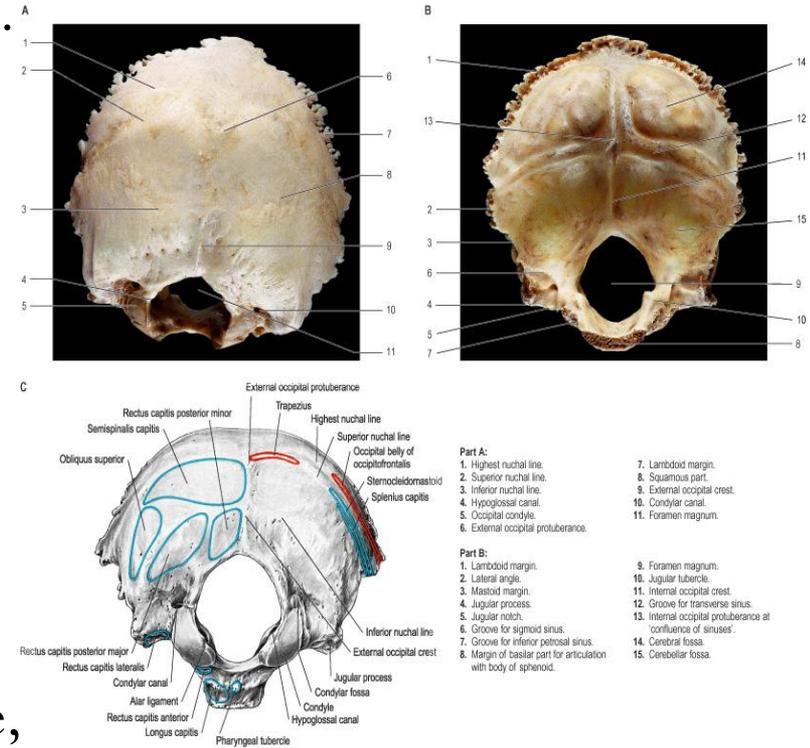
Nuclei of Ossification

- Nuclei of ossification in the *sphenoid bone* appear within the 9th week of the intrauterine life.
- Five pairs of nuclei of ossification are distinguished in this bone.
- The largest part of this bone develops on the basis of cartilage, but the lateral portion of the greater wings and the medial plate of the pterygoid process (excepting *hamulus pterygoideus*) are membranous in their origin.



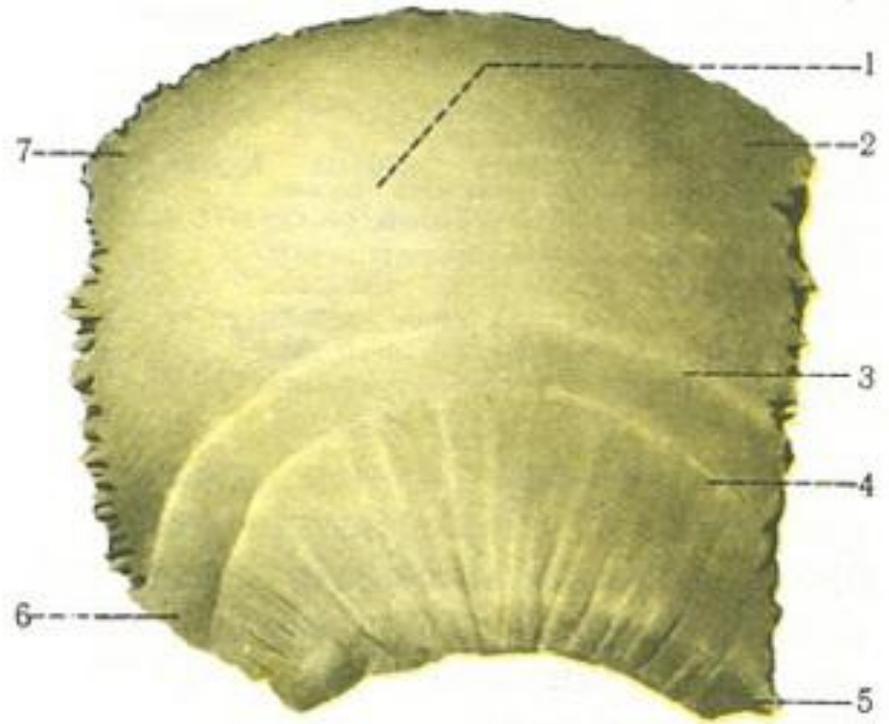
Nuclei of Ossification in Occipital bone

- It is a secondary bone by its development.
- Four ossification nuclei appear in this bone in each of its parts.
- The upper part of the occipital squama is membranous in its origin and here two nuclei are formed.
- The ossification nuclei begin to form in the 8th and 10th weeks of intrauterine life, but all parts of the occipital bone fuse to form a single bone at 3-5 years of age.



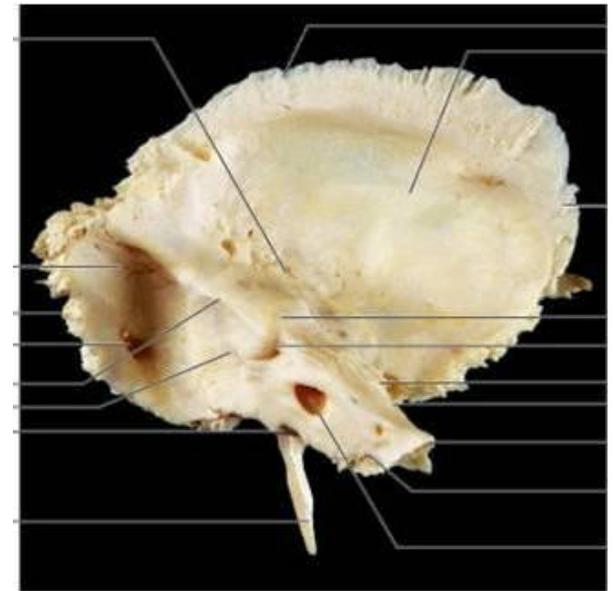
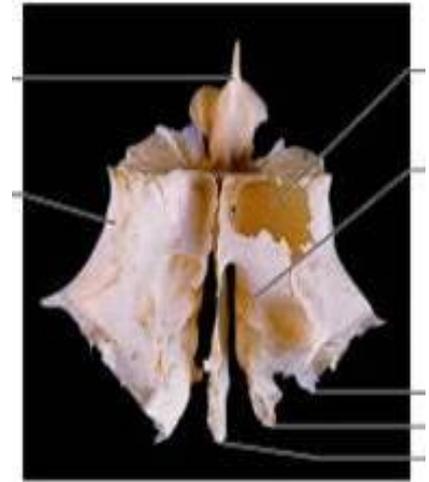
Nuclei of Ossification

- *The parietal bone* develops on the basis of connective tissue and a single nucleus of ossification appears during the 8th week of intrauterine life in parietal tuber.



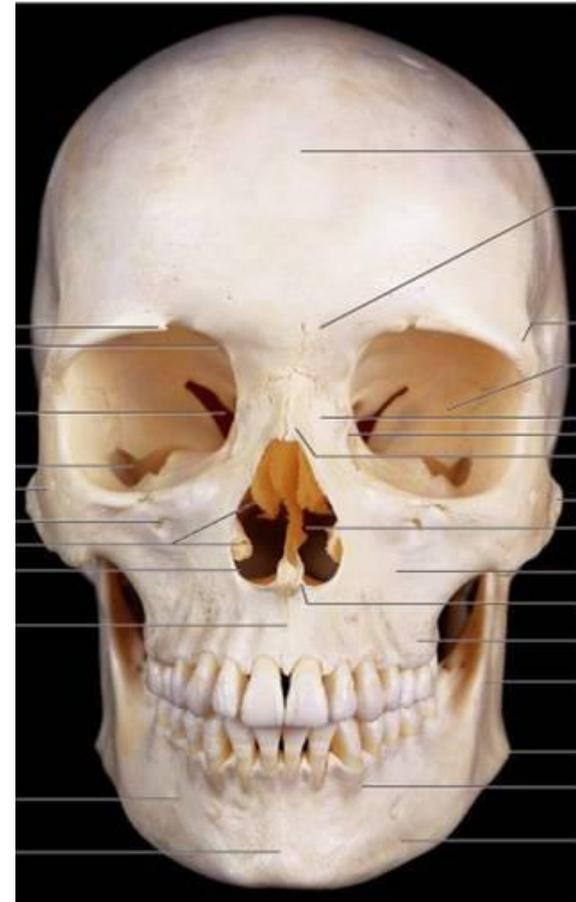
Nuclei of Ossification

- *The ethmoid bone* has three nuclei of ossification: one median and two lateral.
- *The temporal bone*
 - a) The nuclei of ossification in the temporal bone appear in the auditory capsule cartilage during the 5th-6th weeks of intrauterine development.
 - b) The **temporal squama** (9th week) and the **tympanic part** (10th week) – develop on the basis of connective tissue.
 - c) The **styliod process** develops from the cartilage of the second visceral arch, and it has two nuclei of ossification (one before birth and another at 2 years of age).
 - d) Fusion of the parts of the temporal bone, start after birth and continue until 13 years of age.
 - e) The styliod process unites with temporal bone within the 2nd year and lasted until 12 years of age.



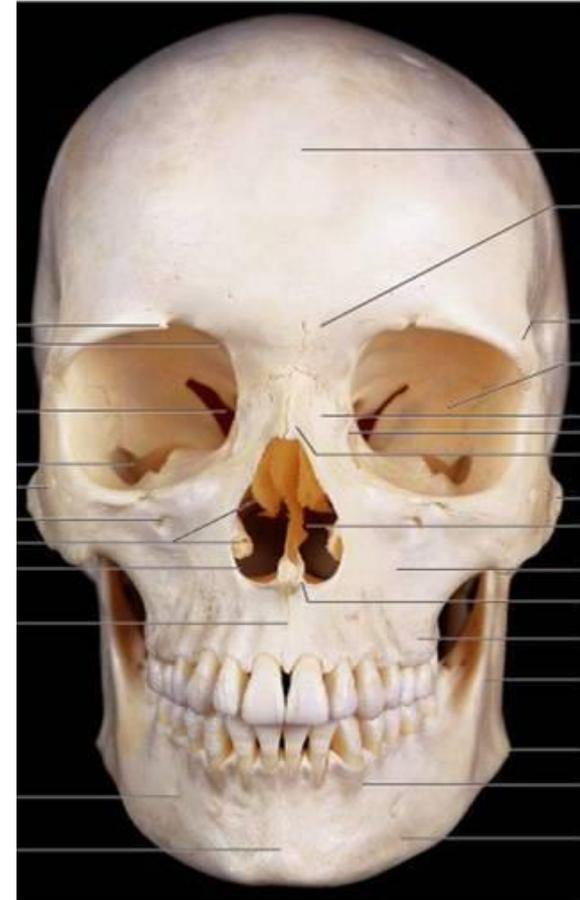
Nuclei of Ossification

- ***The maxilla***
At the end of the second month of the intrauterine life few nuclei of ossification appear in the connective tissue of the maxilla.
- ***The small bones of the visceral cranium*** such as: palatine, nasal, lacrimal, zygomatic bones and the vomer develop from 1, 2, or even 3 nuclei of ossification (at the end of the 2nd and beginning of the 3rd month of the intrauterine life).
- The inferior nasal concha, as it was mentioned above, develop as well as the ethmoid bone from the nasal capsule cartilage.



Nuclei of Ossification

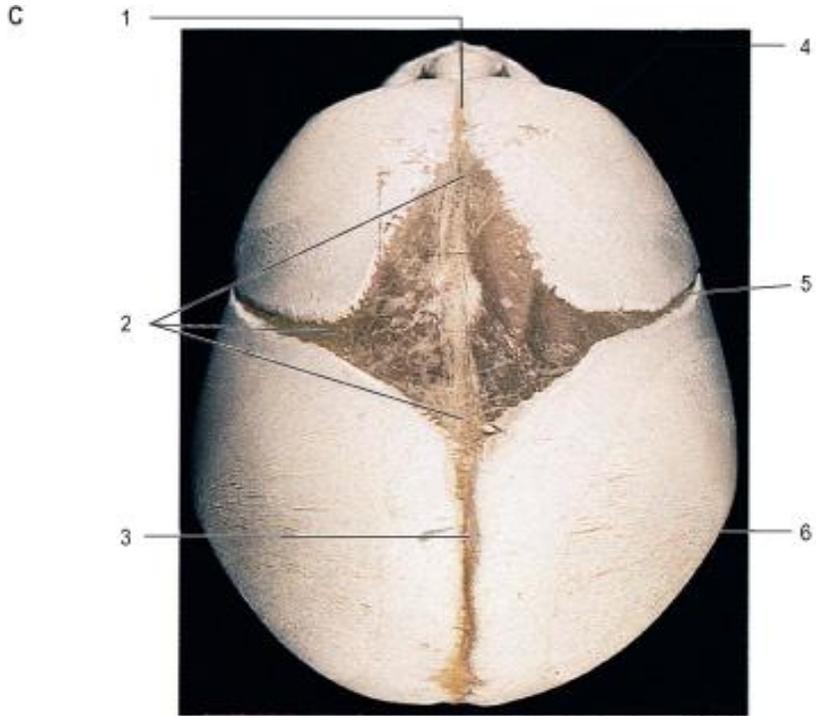
- ***The lower jaw*** (mandible) develops from connective tissue of the Meckel's cartilage. In **both halves** of the mandible appear by one nucleus in the **2nd month** of the intrauterine development. Fusion of both parts of the mandible occurs at 1-2 years of age.
- ***The hyoid bone***
Nuclei of ossification appear in its **greater horns**, at about **8th month** of the intrauterine development, in its **lesser horns** during the **1st and 2nd year** of age. Fusion of its parts occurs at 25-30 years of age.



Age specific features of the skull

Median fontanelles of the skull

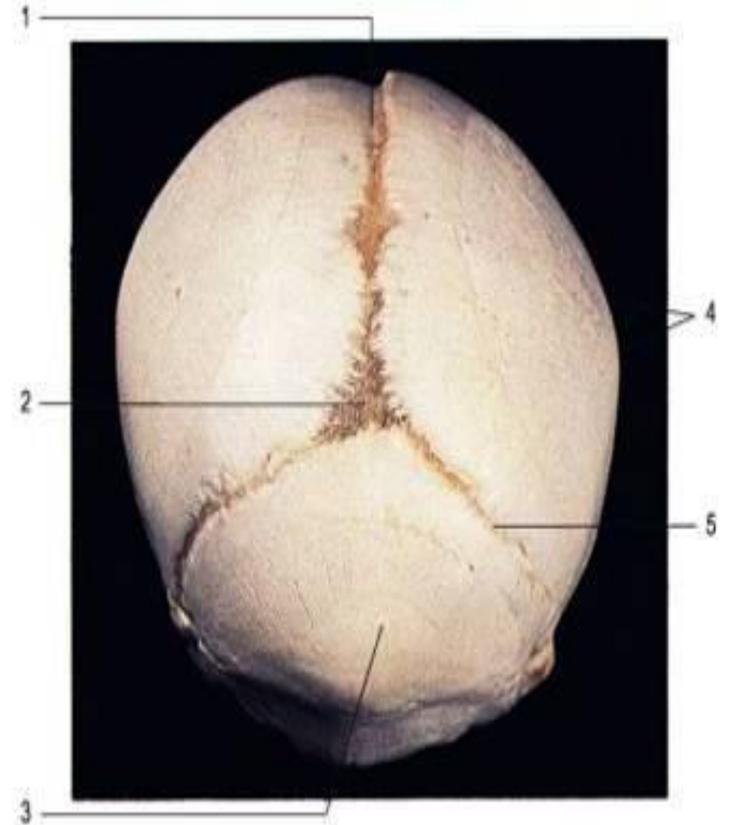
- Anterior fontanelle



- 1. Frontal (metopic) suture.
- 2. Anterior fontanelle.
- 3. Sagittal suture.
- 4. Frontal bone and tuber.
- 5. Coronal suture.
- 6. Parietal bone and tuber.

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- Posterior fontanelle

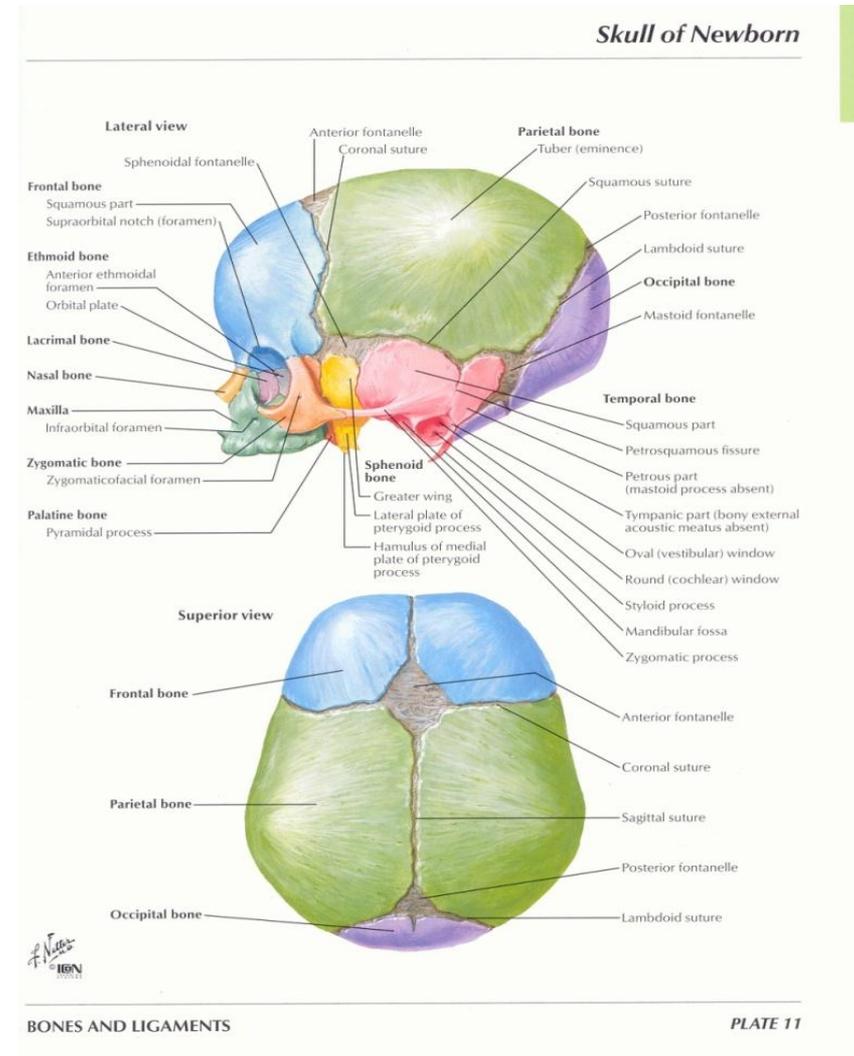


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Lateral fontanelles

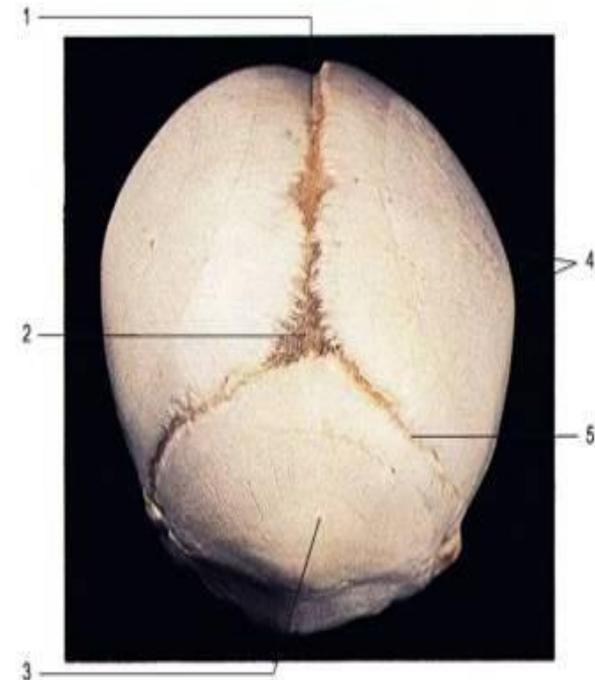
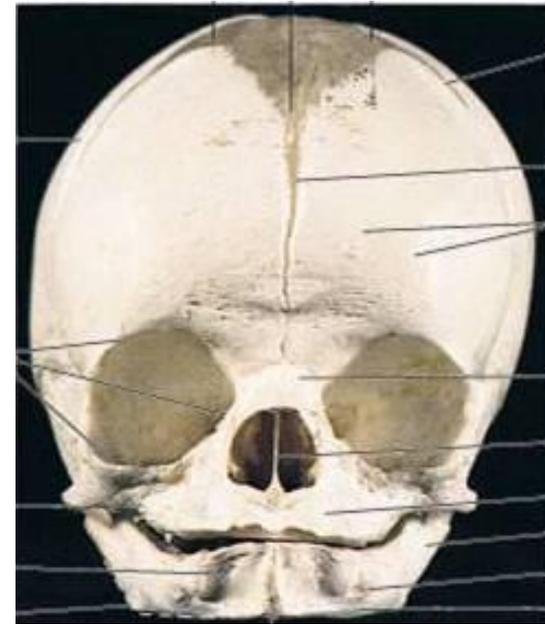
- Sphenoidal fontanelle
- Mastoid fontanelle

Persistence of fontanelles after **1,5 – 2 years** is a signal of some deviations in the development of the child (which usually has a rachitic nature).



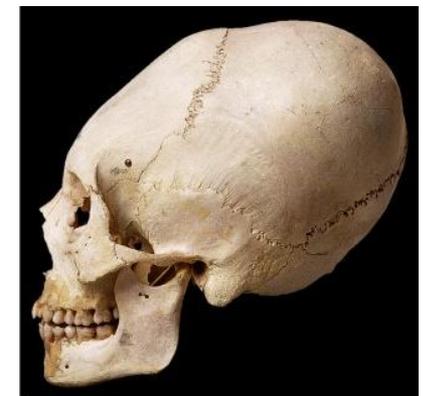
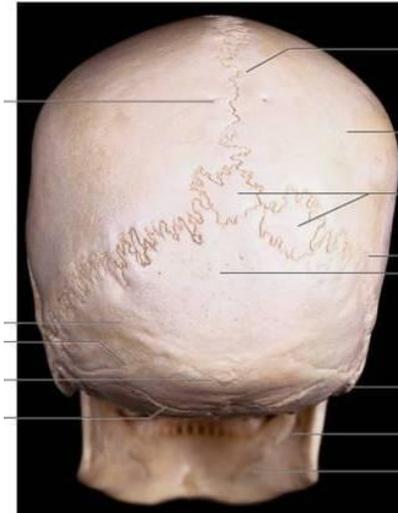
In some pathological conditions can be present additional fontanelles:

- The naso-frontal fontanelle.
- The medio –frontal fontanelle is situated in the middle part of the frontal bone, when the metopic suture is very large.
- The sagittal fontanelle is situated along the sagittal suture.
- The cerebellar fontanelle is placed into the occipital squama on the posterior border of the foramen magnum.



The functional role of sutures

- The sutures connect the bones of the skull and due to their elasticity, they assure the tridimensional growth of the skull.
- After 25 years the sutures start their ossification and may transform to synostoses.
- When the closure of sutures is disturbed by some factors there can appear abnormalities of the cranio-facial skeleton.
- Between the sutures of the bones of the neurocranium can appear sutural, or wormian bones.



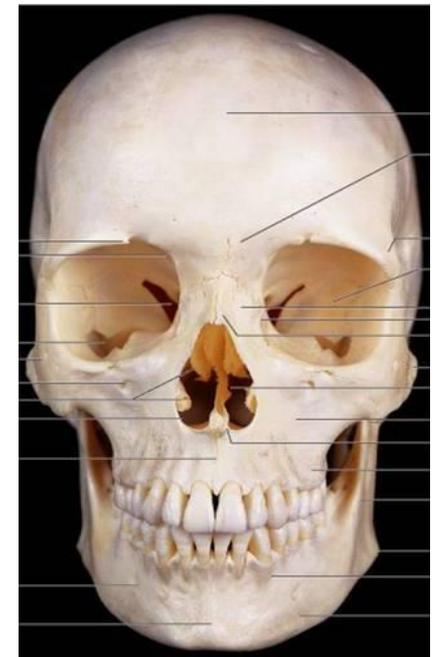
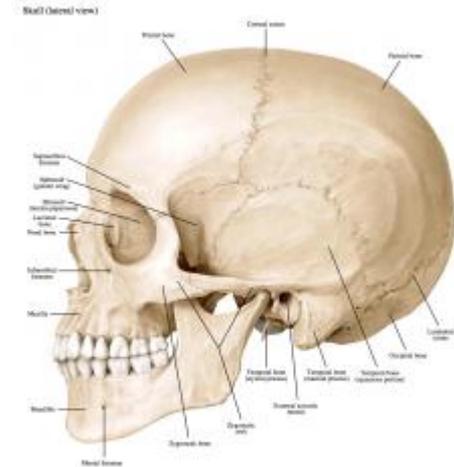
Examination of the Skull on Alive Person

- On the temporal bone:
 - a) the temporal squama,
 - b) the mastoid process,
 - c) the spina suprameatum (it is used as a reference point in trepanation of the mastoid antrum),
 - d) the initial portion of the external auditory meatus (the other part of the external auditory meatus can be examined by otoscopy).



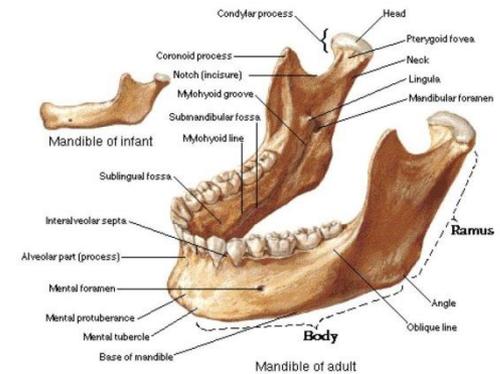
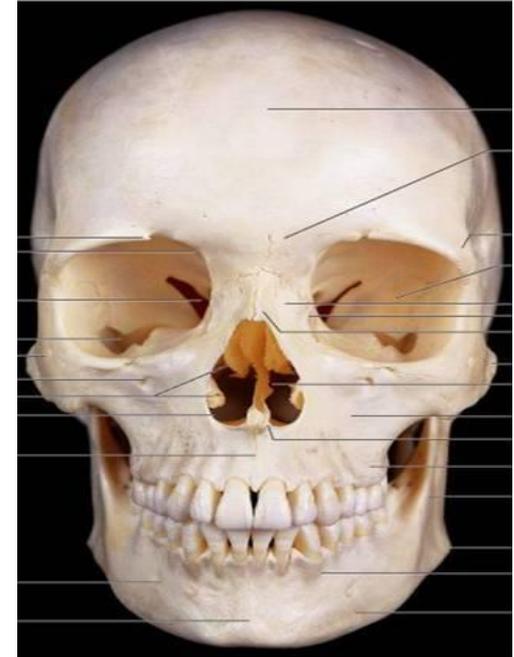
Examination of the Skull on Alive Person

- At the level of the viscerocranium by inspection and palpation:
 - a) the nasal bones,
 - b) zygomatic bones,
 - c) the zygomatic arch,
 - d) the margins of the piriform aperture,
 - e) the anterior nasal spine,
 - f) the mental protuberance,
 - g) the inferior margin of the mandible, the posterior margin of the mandibular branch,
 - h) the head of the mandible,
 - i) the mandibular angle,
 - j) the inferior margin of the body of the mandible.



Examination of the Skull on Alive Person

- The mandibular head can be palpated by a finger, which is introduced into the external acoustic meatus.
- Through the vestibulum of the mouth and the oral cavity proper can be palpated:
 - a) the alveolar arches and *juga alveolaria*,
 - b) the hard palate,
 - c) the inferior margin of the mandible,
 - d) the canine fossa.
- In stomatological (dental) practice the infraorbital and mental orifices are used for the trigeminal anesthesia.

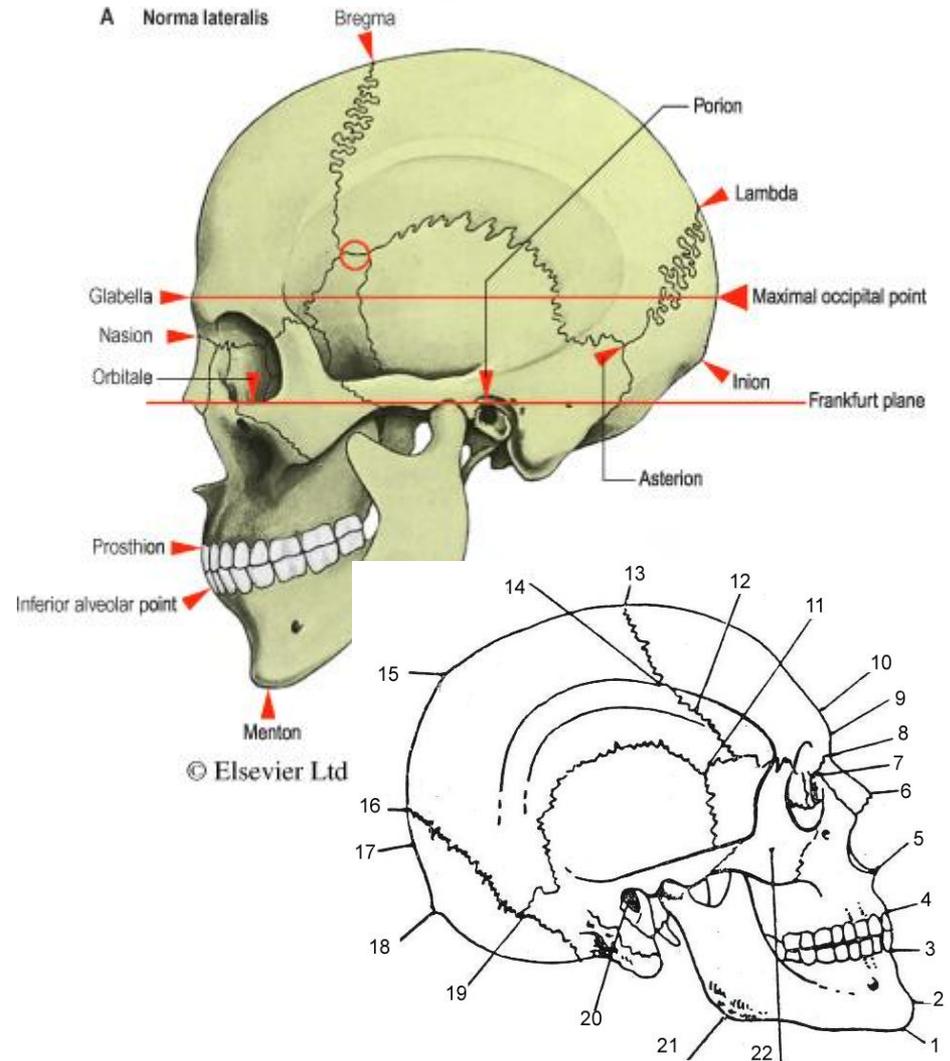


Examination of the Skull on Alive Person

- An efficient method of examination of the skull shape, of its dimensions and modifications of its configuration in anthropology and medicine is the **craniometry**, or establishment of the dimensions and diameters of the skull.
- For this aim are used reference points, named craniometrical points.
- **Craniometrical points** are divided into:
 - a) median** (impair) craniometrical points,
 - b) lateral** (pair) craniometrical points.

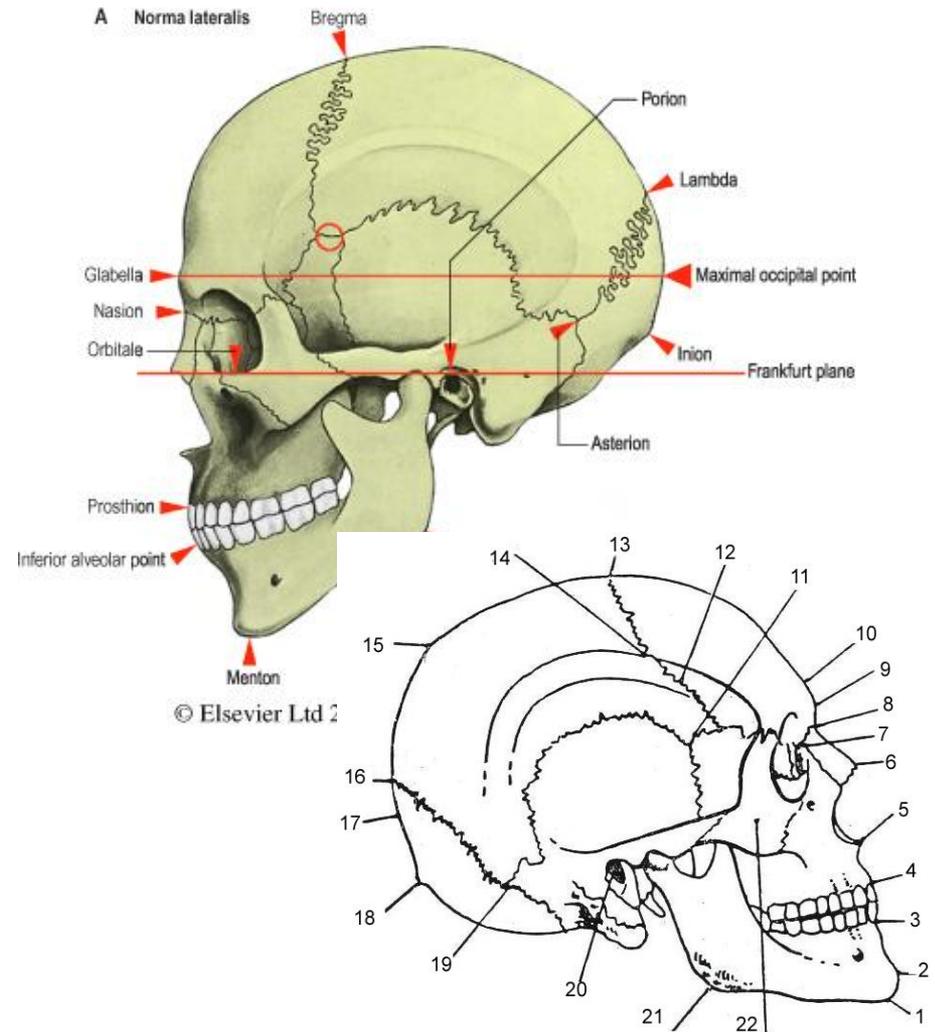
Median craniometrical points

- **Gnathion** – the lowest point of the chin.
- The **menton** (symphysian) point – the most prominent point of the mental eminence.
- The **inferior incisive point** (infradental) – on the alveolar arch, between the median incisors.
- The **superior incisive point** (prosthion) – on the alveolar process of the maxilla between medial incisors.
- **Nasospinal** point (spinal) – on the anterior nasal spine.
- **Rhinion** – the inferior point of the suture between the both nasal bones.
- **Nasion** – the point of intersection of the fronto-nasal suture with the median line.



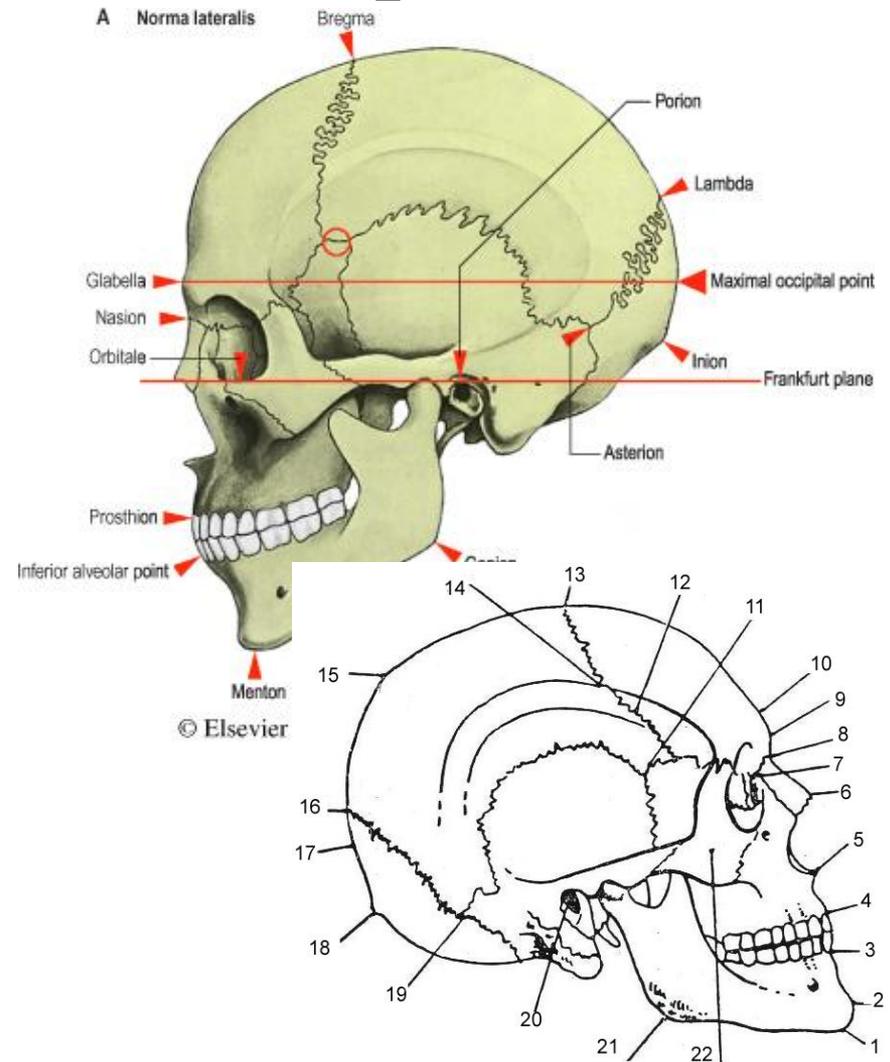
Median craniometrical points

- **Glabella** – corresponds to the median area, which is situated between the superciliary arches.
- **Ofrion** – the point of intersection of the frontal minimal diameter with the median line; (the frontal minimal diameter is the list distance between the both temporal crests of the frontal bone).
- **Bregma** – the point of intersection of the coronary suture with the sagittal one, and it corresponds to the vertex of the vault (the highest point of the skull).



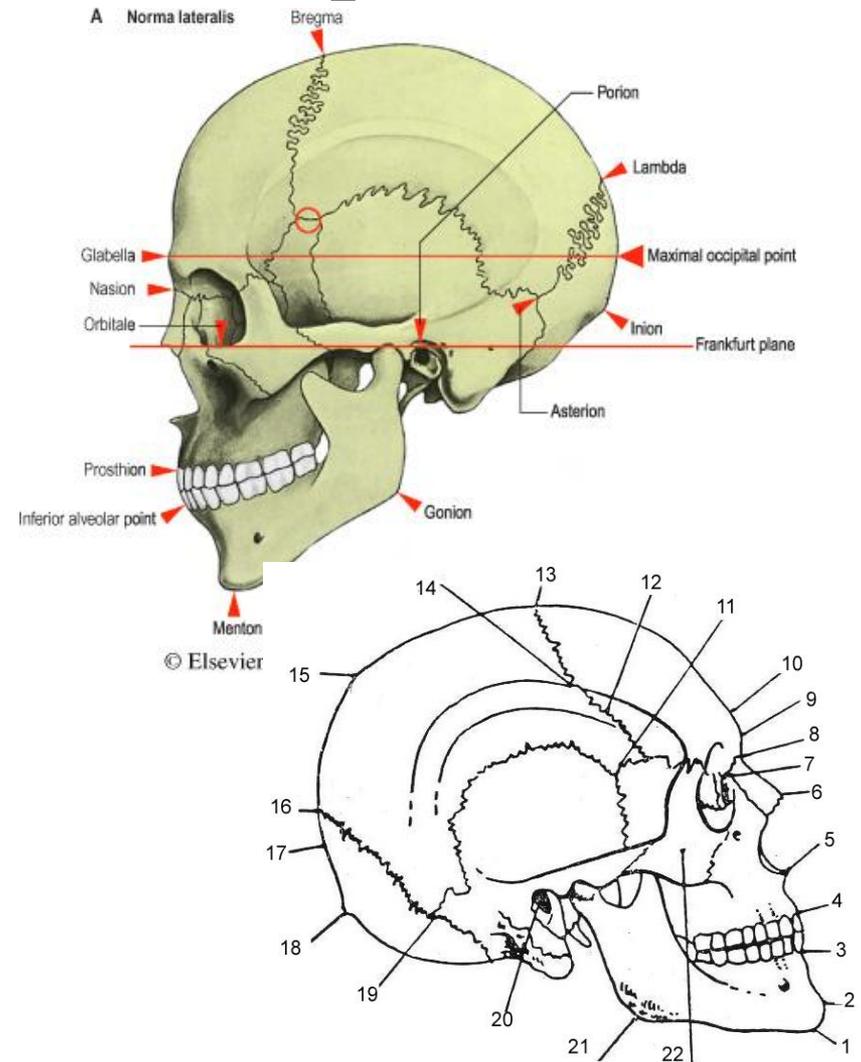
Median craniometrical points

- **Obelion** – is the point in which the sagittal suture is intersected by the line that connects to each other both parietal orifices.
- **Lambda** – the point which connects the sagittal suture with the lambdoid one.
- **Opisthocranium** – the most posterior point of the sagittal plane of the skull.
- **Innion** – the point which corresponds to the external occipital protuberance.
- **Basion** – the median point of the anterior border of the foramen magnum.
- **Opisthion** – the median point of the posterior border of the foramen magnum.



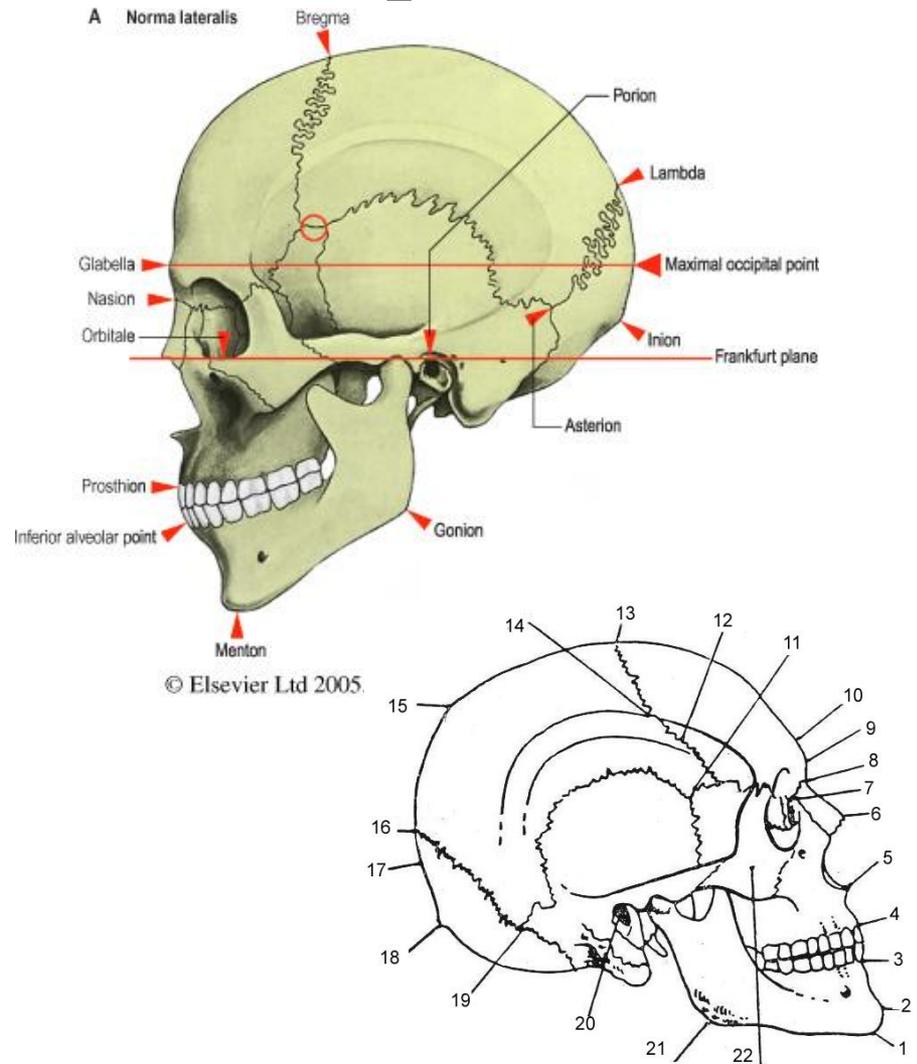
Lateral craniometrical points

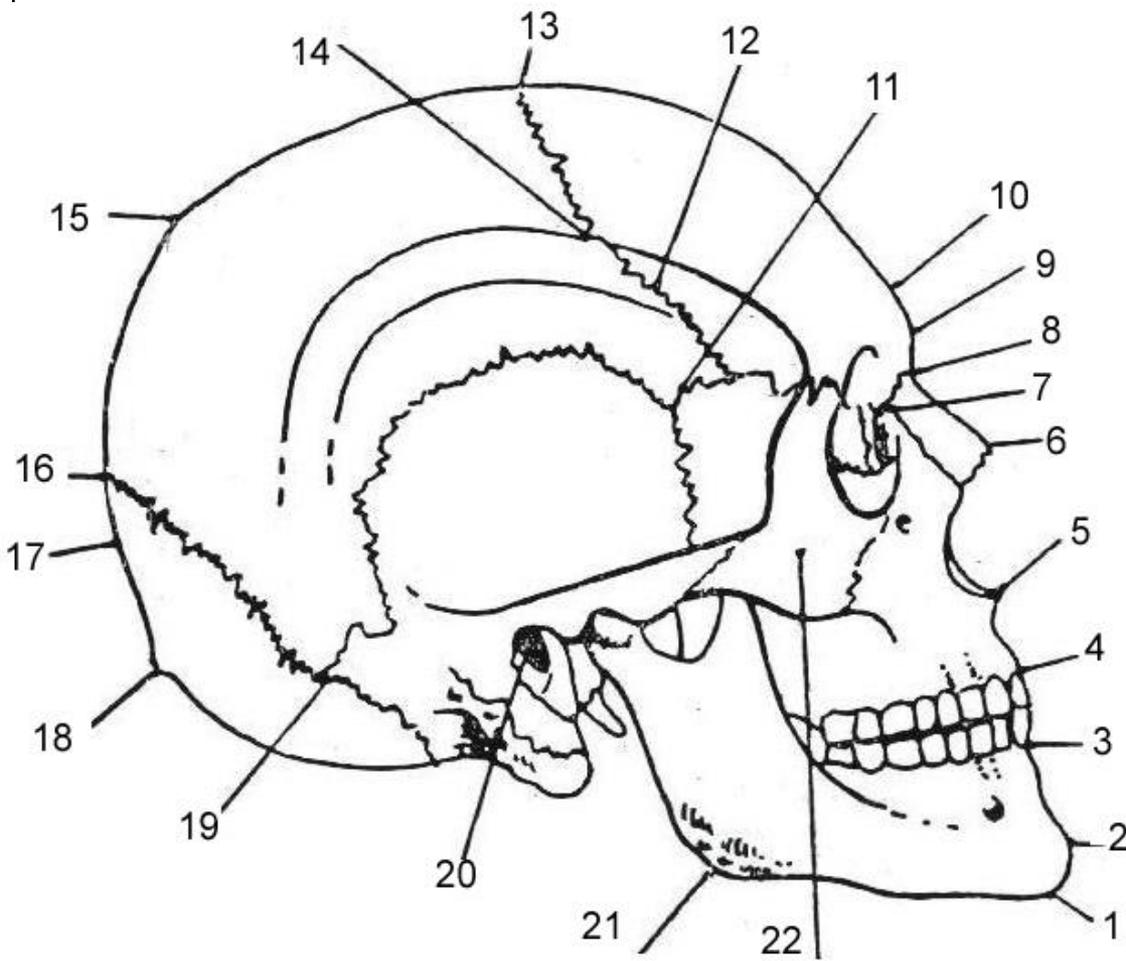
- The **maxillofrontal point** – is situated at the level of the suture between the frontal process of the maxilla and the frontal bone.
- **Dacrion** – is the point where the lacrimofacial and lacrimofrontal sutures meet each other.
- The **malar point** – is the most prominent point of the zygomatic bone.
- **Pterion** – is the point where the squama of the temporal bone, the parietal bone and the greater wing of the sphenoid bone and the frontal bone meet each other.



Lateral craniometrical points

- **Coronary point** – is the most lateral point of the coronary suture.
- **Stefanion** – is the point where the coronary suture meets the superior temporal line.
- **Gonion** – corresponds to the angle of the mandible.
- The **auricular point** – is situated on the middle of the external auditory meatus.
- **Eurion** – is the highest point of the parietal eminence.
- **Asterion** – is the point where the temporal bone, the parietal one and the occipital bone meet each other.

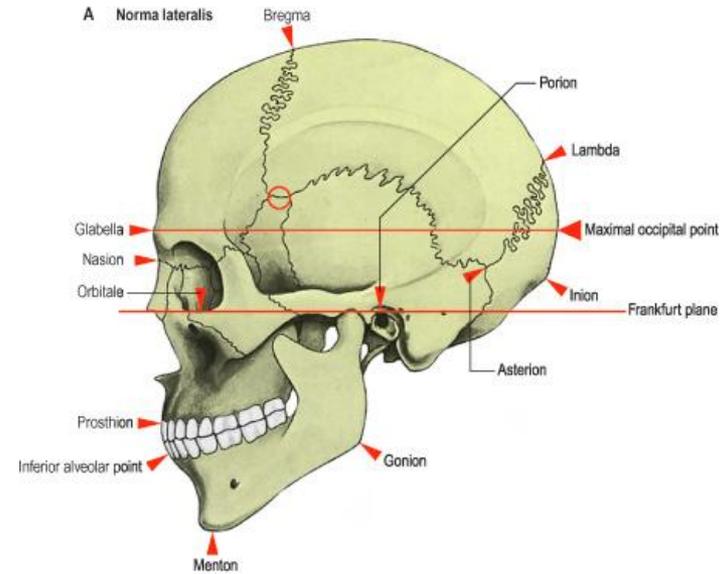




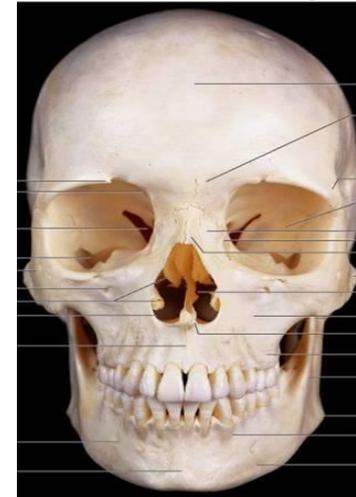
- 1 – *gnathion*;
- 2 – *spina mentalis*;
- 3 – *punctum incisivum inferius*;
- 4 – *punctum incisivum superius*;
- 5 – *punctum nasospinale*;
- 6 – *rhinion*;
- 7 – *dakrion*;
- 8 – *nasion*;
- 9 – *glabella*;
- 10 – *ophrion*;
- 11 – *pterion*;
- 12 – *sutura coronalis*;
- 13 – *bregma*;
- 14 – *stephanion*;
- 15 – *obelion*;
- 16 – *lambda*;
- 17 – *opistocranium*;
- 18 – *inion*;
- 19 – *asterion*;
- 20 – *punctum auriculare*;
- 21 – *gonion*;
- 22 – *punctum ossis zygomatici*.

Diameters of the skull

- The transversal diameter – is the distance in centimeters between the most far-off points of the both parietal bones (or between the two auricles).
- The anteroposterior diameter – is the distance in centimeters between the glabella and the opisthocranium.
- The auricular height – is the distance in centimeters between the vertex and the superior margin of the external auditory meatus on the vertical line that intersects perpendicularly the Frankfurt's horizontal line.
- Frankfurt's horizontal line is the line which passes through the most inferior point of the infraorbital margin and through the superior margin of the external auditory meatus.



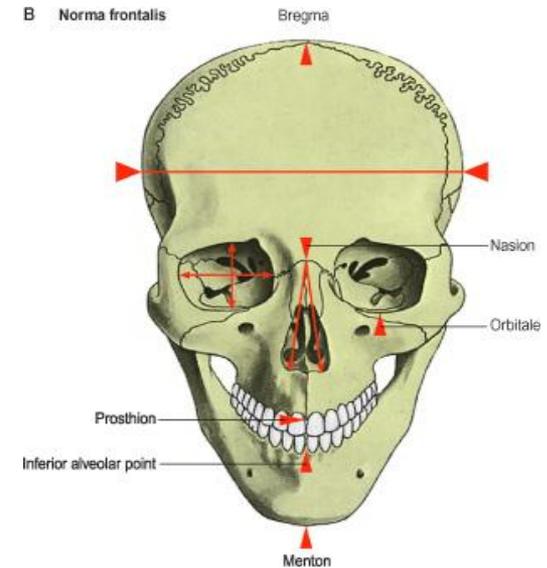
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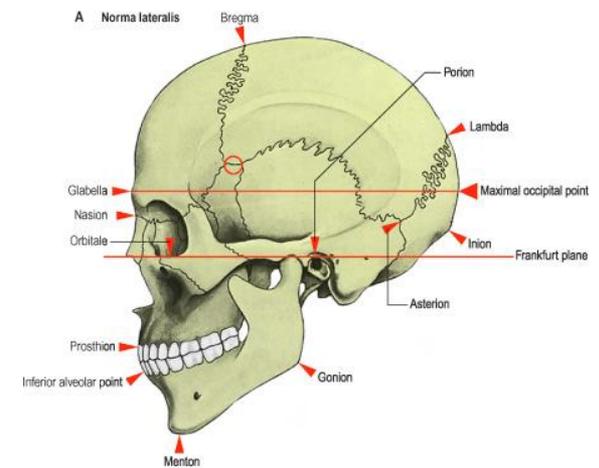
Indexes of the skull

The longitudinal cephalic index can be determined as follows:

- The *transversal diameter* (in cm) x 100 reported to the *anteroposterior diameter* (in cm).
 - a) If the obtained value is 75 or less it is characteristic for the **dolichocephalic skull** or long skull.
 - b) When the value is from 76 to 79 the skull is considered to be **mesocephalic skull**.
 - c) The value of 80 and more is characteristic for the **brachycephalic skull** or short skull.



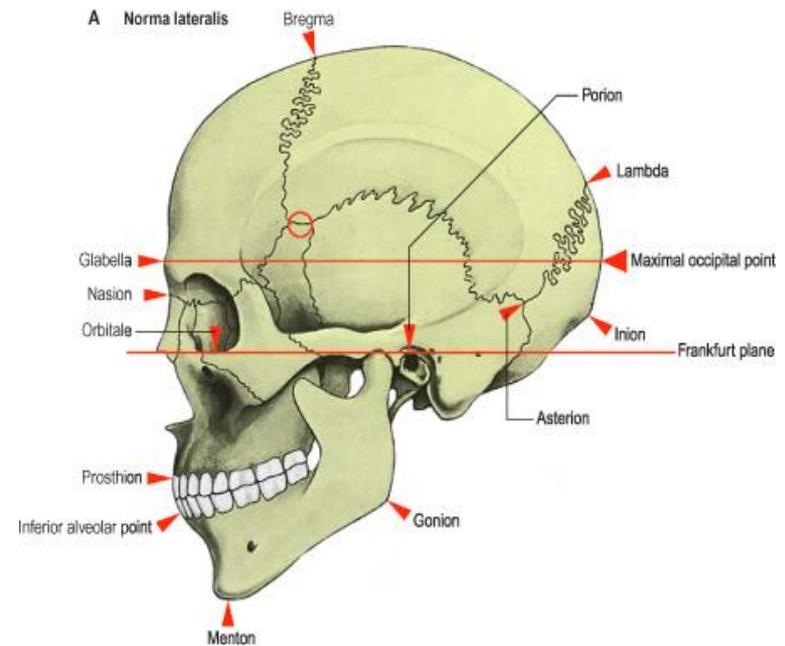
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The vertical cranial index can be determined by the following account

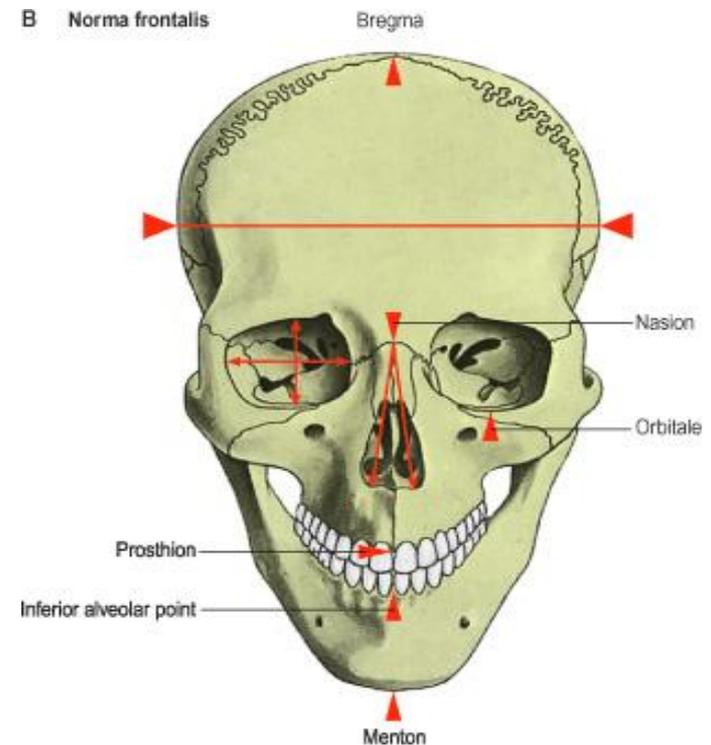
- The auricular height of the head (in cm) x 100 reported to the anteroposterior diameter (in cm).
- If the obtained value is 75 and more it denotes a **hypsicephalic skull**.
- When the value is from 70 to 75 the skull is of a middle height, or **orthocephalic skull**.
- If the value is lower than 70 it characterizes the plate skull, or **platicephalic skull**.



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The facial index

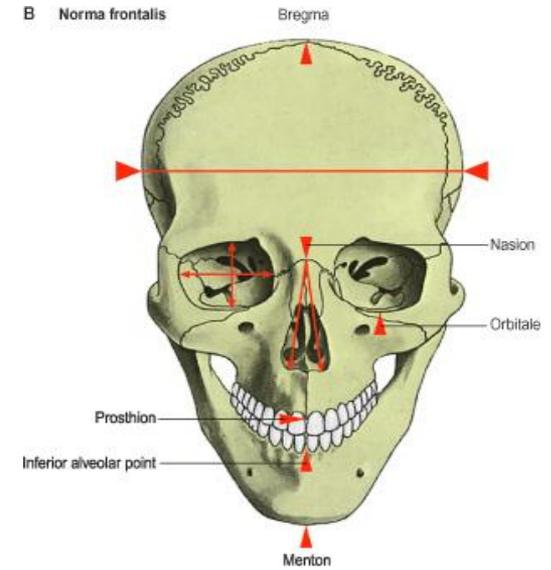
- Ofrioalveolar line (in cm) x 100 reported to the bizygomatic diameter, (the ofrioalveolar line is the distance between the ofrion and mental points).
- The *facial index* has a value from *62 to 74*. An index with a value more than this indicates an elongated face, and an index with a value less than this indicates a wide face.
- Position of the facial cranium reported to the cerebral one may be characterized by *facial angle*. The facial angle represents the profile line (traced between the nasion and prostion) and the horizontal line (traced through the inferior point of the profile line) measured in degrees.



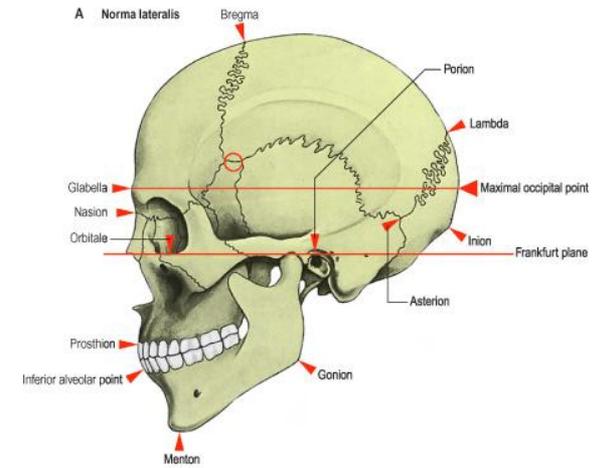
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- The facial angle lesser than 80° characterizes prognatias or prognatismus.
- A right facial angle is registered in ortognatismus.
- The most common values for the *facial angle* are values from 80° to 90° , and are characteristic for mesognatismus or nasognatismus.

- *Two forms of prognatismus can be distinguished:*
 1. Total prognatismus, when there is a protrusion both of the maxilla and of the mandible.
 2. Inferior prognatismus, when only the mandible protrudes anteriorly.

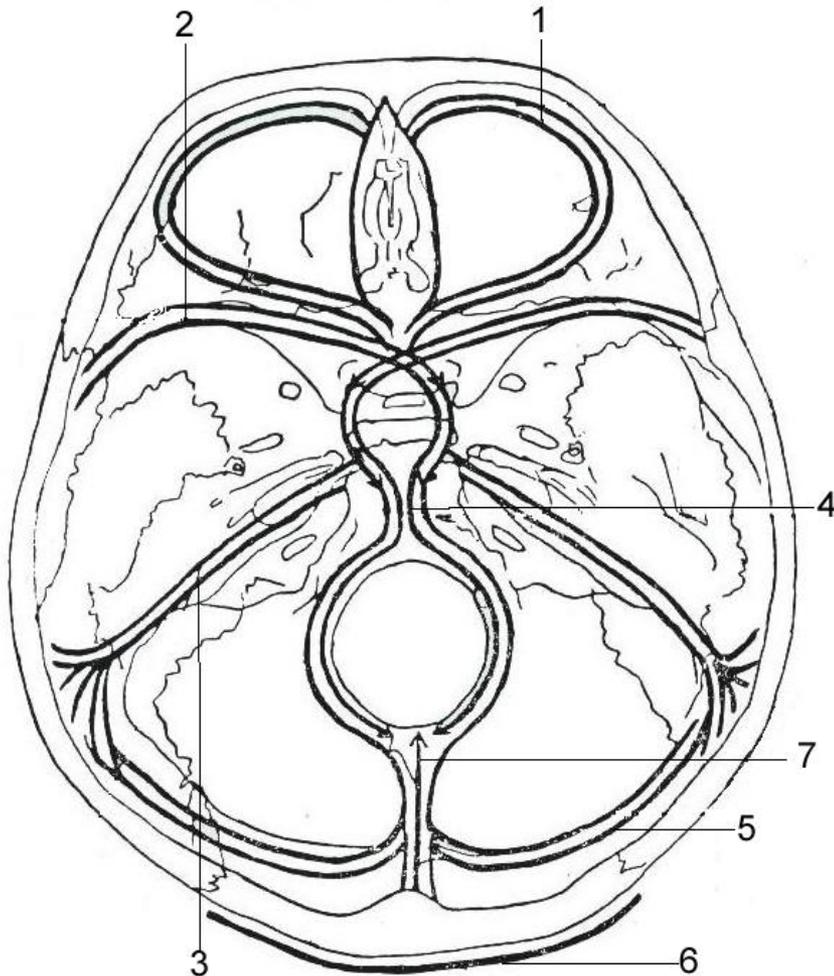


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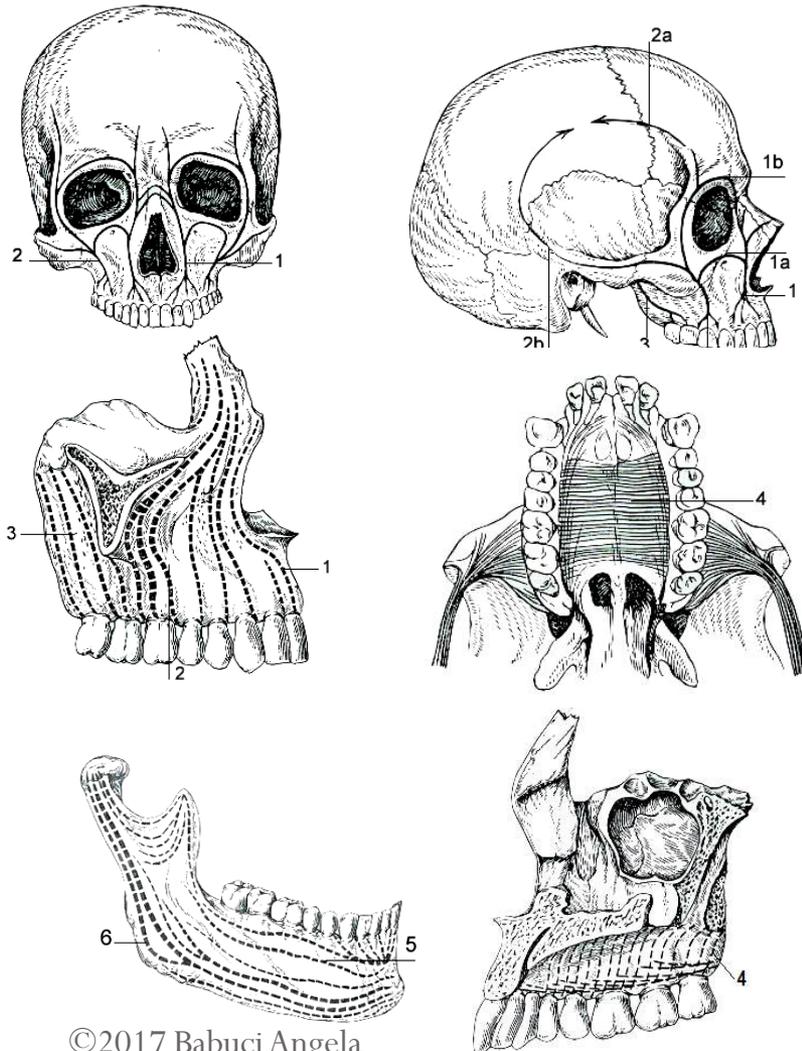
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Structures of resistance of the base of the skull



1. *Arcus orbitalis (arcus transversus I) (frontalis) [linea sustentaculi (resistentiae frontalis)];*
2. *Jugum sphenoidale et alae minores ossis sphenoidalis (arcus transversus II, orbitosphenoidalis or columna anterior);*
3. *Margo inferior partium petrosarum temporalium (arcus transversus III, petromastoideus) posterior;*
4. *Basis ossea mediosagittalis;*
5. *Sinus transversus (arcus transversus IV);*
6. *Linea resistentiae occipitalis;*
7. *Linea cristae occipitalis.*

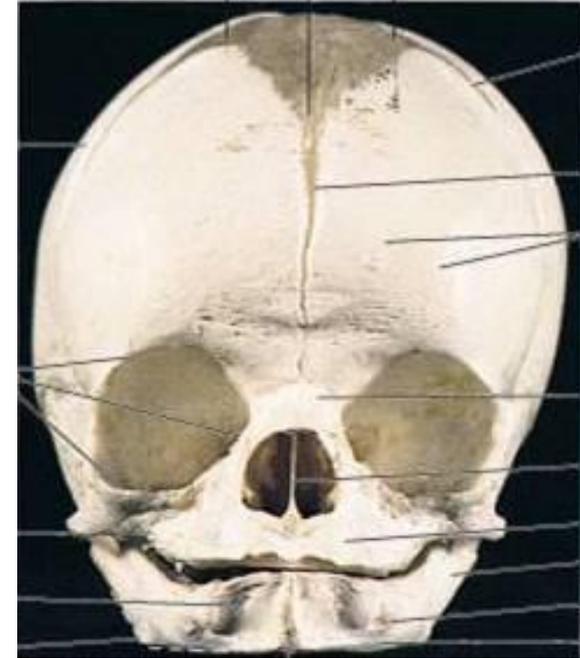
Resistance pillars of the visceral cranium



- *Sustentaculum (columna, linea sustentaculi) anterius (caninum or nasofrontale);*
- *1a. linea infraorbitalis;*
- *1b. linea supraorbitalis;*
- *Sustentaculum medium (zygomaticum or alveolo-zygomaticum);*
- *2a. linea anterior;*
- *2b. linea posterior;*
- *Sustentaculum posterius (pterygopalatinum or pterygoideum);*
- *Linea resistentiae palati (palati ossei);*
- *Linea trajecta alveolaris;*
- *Linea trajecta ascendens.*

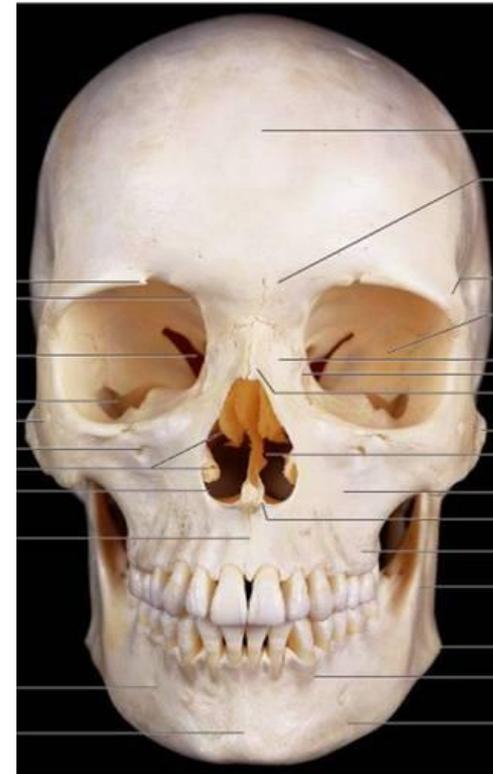
Age peculiarities of the skull

- In new-born the crests, muscular tuberosities, and lines are not pronounced because the muscles do not function yet and are therefore weakly developed.
- Weakness of the muscles of mastication due to the absence of the masticating function causes weak development of the jaws: the alveolar processes are hardly formed and the mandible consists of two non-united halves.
- As a result the visceral cranium is less prominent in relation to the cerebral skull and is only 1:8 the size of the cerebral, whereas in adult their ratio is 1:4.



Age specific features of the skull

- The skeleton of the skull in its development depends on the development of the brain, sense organs, oral and nasal cavities.
- The neurocranium lodges the brain and the viscerocranium with the participation of some bones of the neurocranium forms cavities for the sense organs.



Specific feature of the skull	Male	Female
	It is heavy and rough	It is lighter and smoother
	It is larger	It is smaller (by about 10%)
	Forehead is usually sloping	Forehead is more vertical
	Superciliary arches are more prominent	Superciliary arches are less prominent
	Sinuses are larger	Sinuses are smaller
	Mandible is large and robust	Mandible is lighter and smaller
	Teeth are large	Teeth are smaller

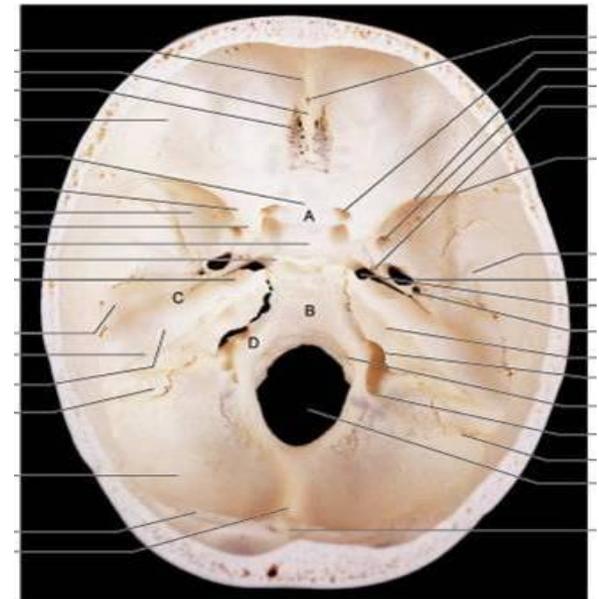
Periods of the Growth of the Skull

- The *first period* (the first 7 years) is characterized by **intensive growth**, mainly of the posterior part of the skull.
- The *second period* (from the age of 7 to the beginning of puberty), and this is the period of **relative rest**.
- The *third period*, from the beginning of puberty (13-16 years of age) to the end of skeletal growth (20-23 years of age), is again one of **intensive growth**, and during this period grows mainly the anterior part of the skull.



The age changes that take place later in the human skull are characterized by the following peculiarities:

- **I. Fusion of the separate parts of bones forming a single bone:**
 - a) Both halves of the mandible fuse at 1-2 years of age.
 - b) Fusion of both halves of the frontal bone at the site of the frontal suture occurs from 2 years until 7 years of age.
 - c) Fusion of all parts of the occipital bone between ages 3 and 5.
 - d) Synostosis between the body of the occipital bone and the sphenoid bone to form a single *os basilare* at the level of sphenoccipital synchondrosis occurs between the ages of 18-20, and with the development of this synostosis growth of the base of the skull in length ceases.



- **II. Closure of the fontanelles and formation of sutures with typical serrated contours at 2-3 years of age.**

- **III. Appearance and future development of pneumatization.**
 - a) The air sinuses are still not developed in the skull of a new born.
 - b) The maxillary sinus begins to develop in the 5th -6th month of the intrauterine life and it is demonstrated on radiograph of the skull at birth as an elongated clear space the size of a pea. It reaches full development in the period of replacement of deciduous teeth by the permanent teeth and is distinguished by great variability.

