1 Surface Anatomy

Surface Anatomy

The Skull

The skull can be divided into two portions: neural and facial. The neural skull is made up of 6 bones: frontal, parietal, temporal, occipital, sphenoid and ethmoid. The facial skull comprises 8 different bones. In this chapter, they will be briefly described. Synthetic descriptions of sutures between them and of the skull base foramina will follow.

I. Skull Bones

- **frontal bone**

The frontal bone resembles a cockleshell, and consists of two portions: a vertical portion, the squama, corresponding to the forehead region; and an orbital or horizontal portion, which extends to form the roofs of the orbital and nasal cavities.

- **parietal bone**

The parietal bones form the sides and roof of the cranium. Each bone is irregularly quadrilateral in form.

- **temporal bone**

The temporal bones are situated at the base of the skull. Each consists of five parts: squama, petrous, mastoid, and tympanic parts, and styloid process.

- **occipital bone**

The occipital bone is trapezoid-shaped and situated at the back and lower part of the cranium. It contains a large oval aperture, the foramen magnum, through which the cranial cavity communicates with the vertebral canal. The curved, expanded plate behind the foramen magnum is termed the squama, while the thick part in front of the foramen is called the basilar part.

- **sphenoid bone**

The sphenoid bone is a bone situated at the base of the skull in front of the temporal and basilar parts of the occipital bone. It resembles a bat with open wings. It is divided into a median portion or body, two greater and two lesser wings extending outwards from the sides of the body, and two pterygoid processes which project from it downwards.

- **ethmoid bone**

The ethmoid bone is located at the roof of the nose and separates the nasal cavity from the brain. It is lightweight due to a spongy construction. The ethmoid bone consists of four parts:

- the horizontal "cribriform" plate (lamina cribrosa), part of the cranial base
- the vertical "perpendicular" plate (lamina perpendicularis), which is part of the nasal septum
- the two lateral masses (labyrinths)

- **mandible**

The mandible forms the lower jaw (inferior maxillary bone). It is the largest bone of the face. The mandible consists of a curved, horizontal portion, the body, and two perpendicular portions, the rami, connected with the ends of the body at almost right angles.

- **maxilla**

The maxillae join together to form the whole of the upper jaw. They hold the upper teeth, and are connected to the zygomatic bones on the left and right. They assist in forming the roof of the mouth, the floor and lateral wall of the nose, and the floor of the orbit. They contribute to the formation of two fossae, the infratemporal and pterygopalatine, and two fissures, the inferior orbital and pterygomaxillary. Each bone consists of a body and four processes - zygomatic, frontal, alveolar, and palatine.

- **palatine bone**

The palatine bone is situated at the back part of the nasal cavity between the maxilla and the pterygoid process of the sphenoid bone. It contributes to the walls of three cavities: the floor and lateral wall of the nasal cavity, the roof of the mouth, and the floor of the orbit; it contributes to the formation of the pterygopalatine and pterygoid fossae, and the inferior orbital fissure. The palatine bone consists of a horizontal and a vertical part.

- **zygomatic bone**

The zygomatic bone (zygoma; malar bone) is a paired bone articulated with the maxilla, the temporal bone, and the sphenoid bone. It presents a malar and a temporal surface; four processes, the frontosphenoidal, orbital, maxillary, and temporal; and four borders.

- **nasal bone**

The nasal bones are two small oblong bones, varying in size and form; they are placed side by side at the middle and upper part of the face, and join to form the nose.

- **lacrimal bone**

The smallest and most fragile bone of the face, the lacrimal bone is situated at the front part of the medial wall of the orbit.

- **vomer bone**

The vomer bone is located in the midsagittal line, forms the hind and lower part of the nasal septum, and touches the sphenoid, the ethmoid, the left and right palatine bones, and the left and right maxillary bones.

- **inferior nasal concha**

The inferior nasal concha is a lamina of spongy bone (concha nasalis inferior; inferior turbinated bone) that extends horizontally along the lateral wall of the nasal cavity.

II. Sutures

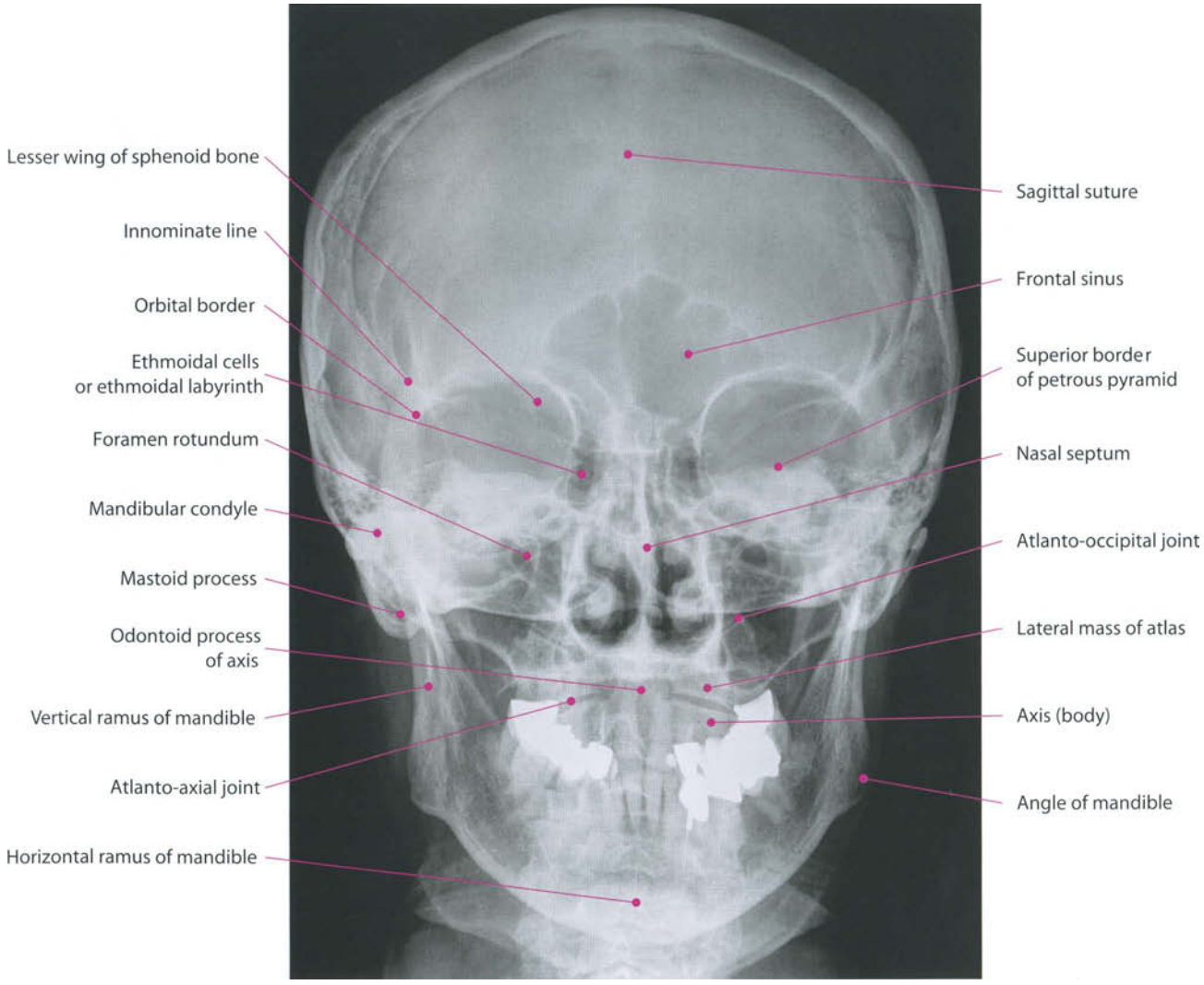
- Sagittal - along the midline, between parietal bones
- Coronal - between the frontal and parietal bones
- Lambdoid - between the parietal and occipital bones
- Squamosal - between the parietal and temporal bones
- Metopic - between the two frontal bones, prior to the fusion of the two into a single bone

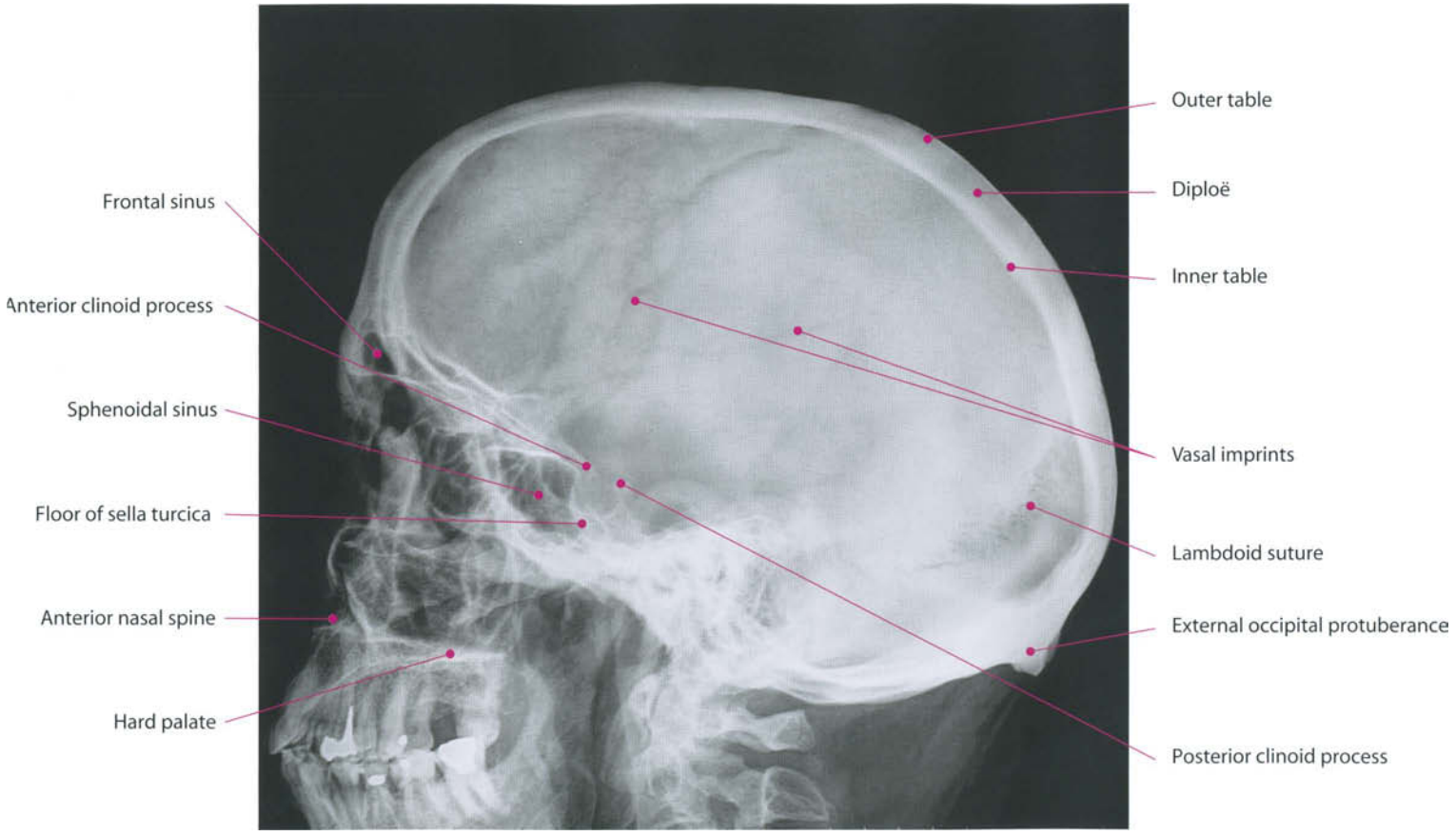
III. Skull Base Foramina

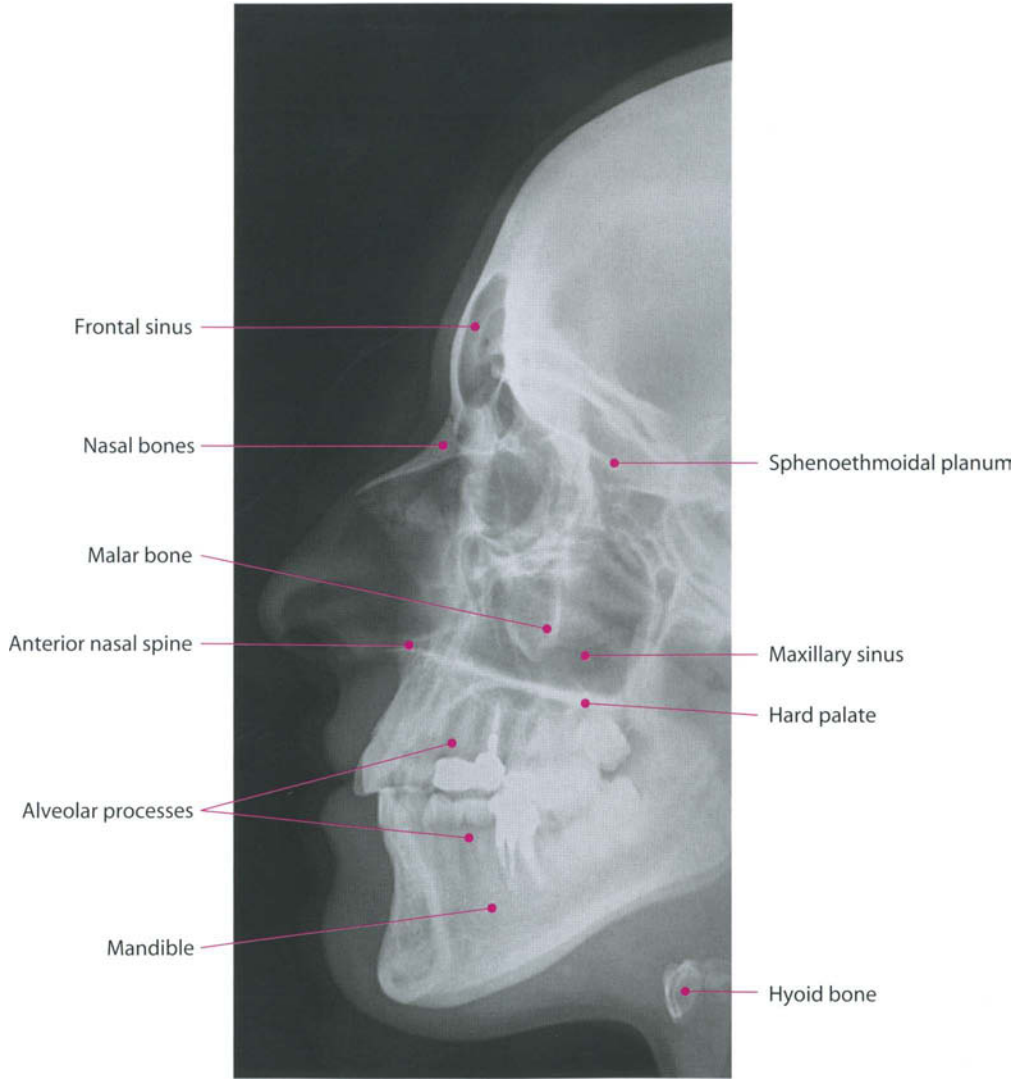
The skull base is crossed by several foramina. The following is a list of them and their contents:

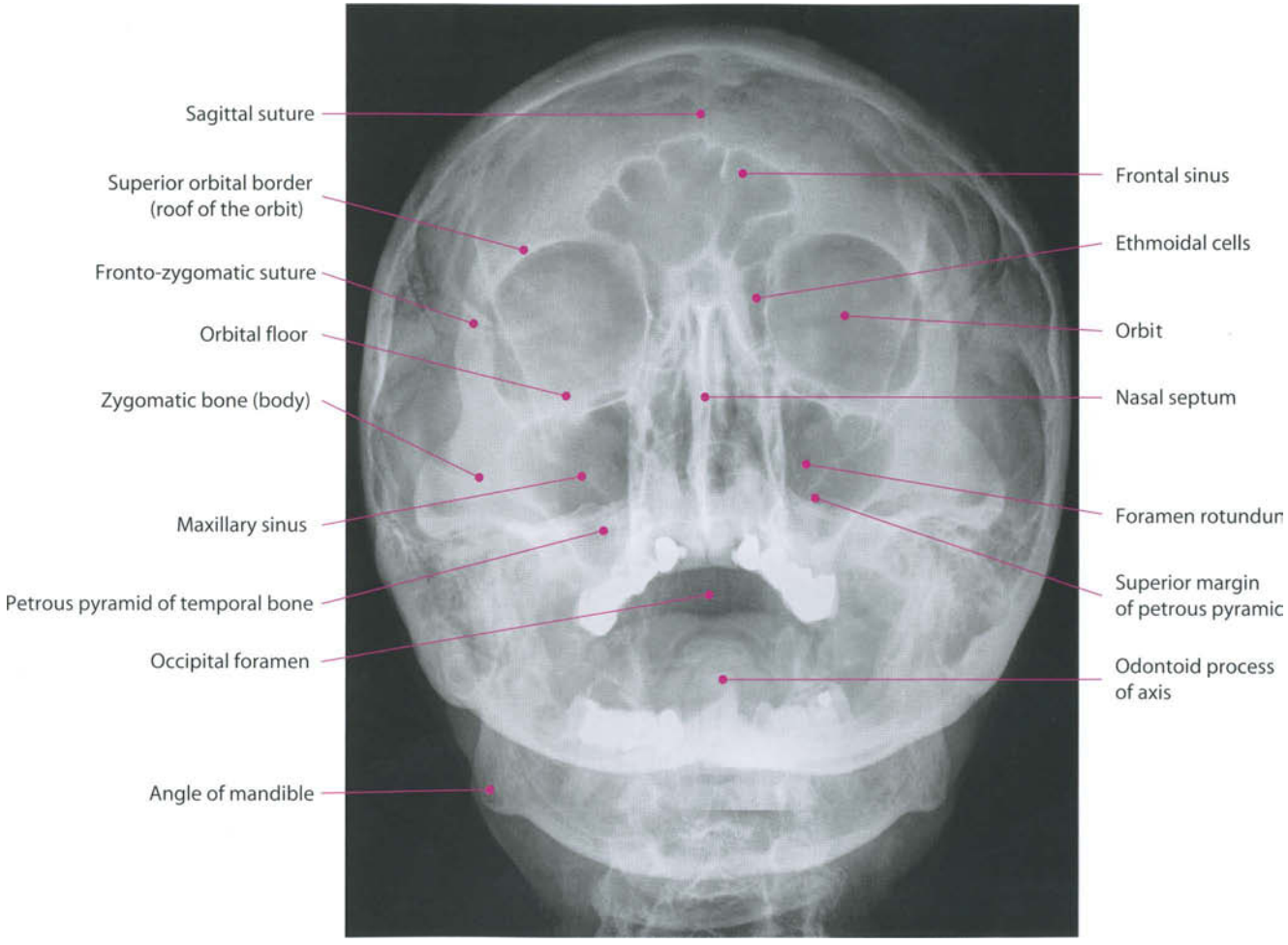
- foramen caecum: emissary vein to superior sagittal sinus
- foramina of cribriform plate: olfactory nerve bundles
- posterior ethmoidal foramen: posterior ethmoidal artery, vein and nerve
- optic canal: optic nerve [II], ophthalmic artery
- superior orbital fissure:
  oculomotor nerve [III]
  trochlear nerve [IV]
  lacrimal, frontal and nasociliary branches of ophthalmic nerve [V1]

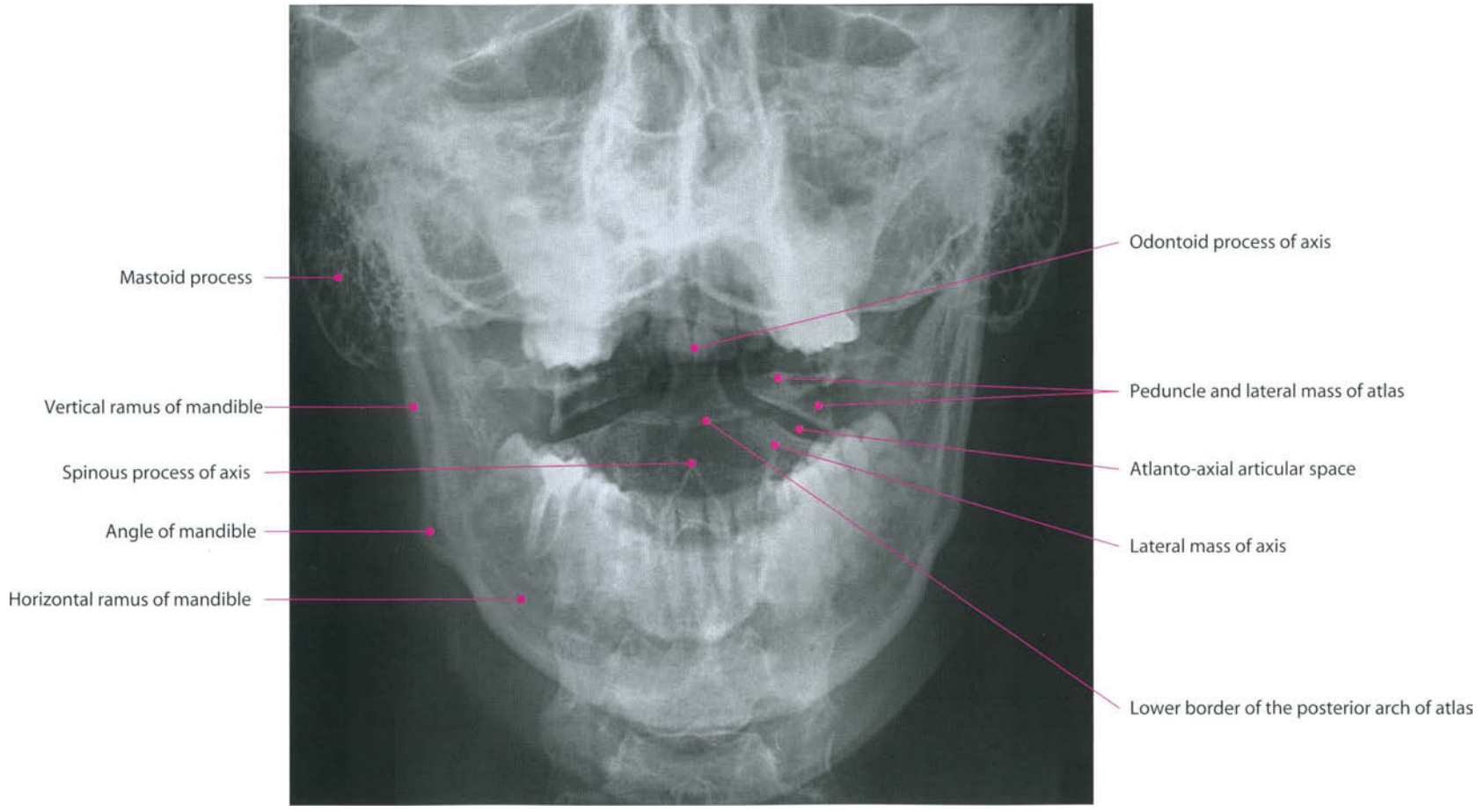
abducens nerve [VI]
superior ophthalmic vein
- foramen rotundum: maxillary nerve [V2]
- foramen ovale:
  mandibular nerve [V3]
  accessory meningeal artery
  lesser petrosal nerve (occasionally)
- foramen spinosum:
  middle meningeal artery and vein
  meningeal branch of mandibular nerve
- foramen lacerum:
  internal carotid artery
  internal carotid nerve plexus
- canal of lesser petrosal nerve
- canal of greater petrosal nerve
- internal acoustic canal:
  facial nerve [VII]
  vestibulocochlear nerve [VIII]
  labyrinthine artery
- jugular foramen:
  inferior petrosal sinus
  glossopharyngeal nerve [IX]
  vagus nerve [X]
  accessory nerve [XI]
  sigmoid sinus
  posterior meningeal artery
  internal jugular vein
- hypoglossal canal: hypoglossal nerve [XII]
- foramen magnum:
  medulla oblongata
  vertebral arteries
  meningeal branches of vertebral arteries
  spinal roots of accessory nerves.

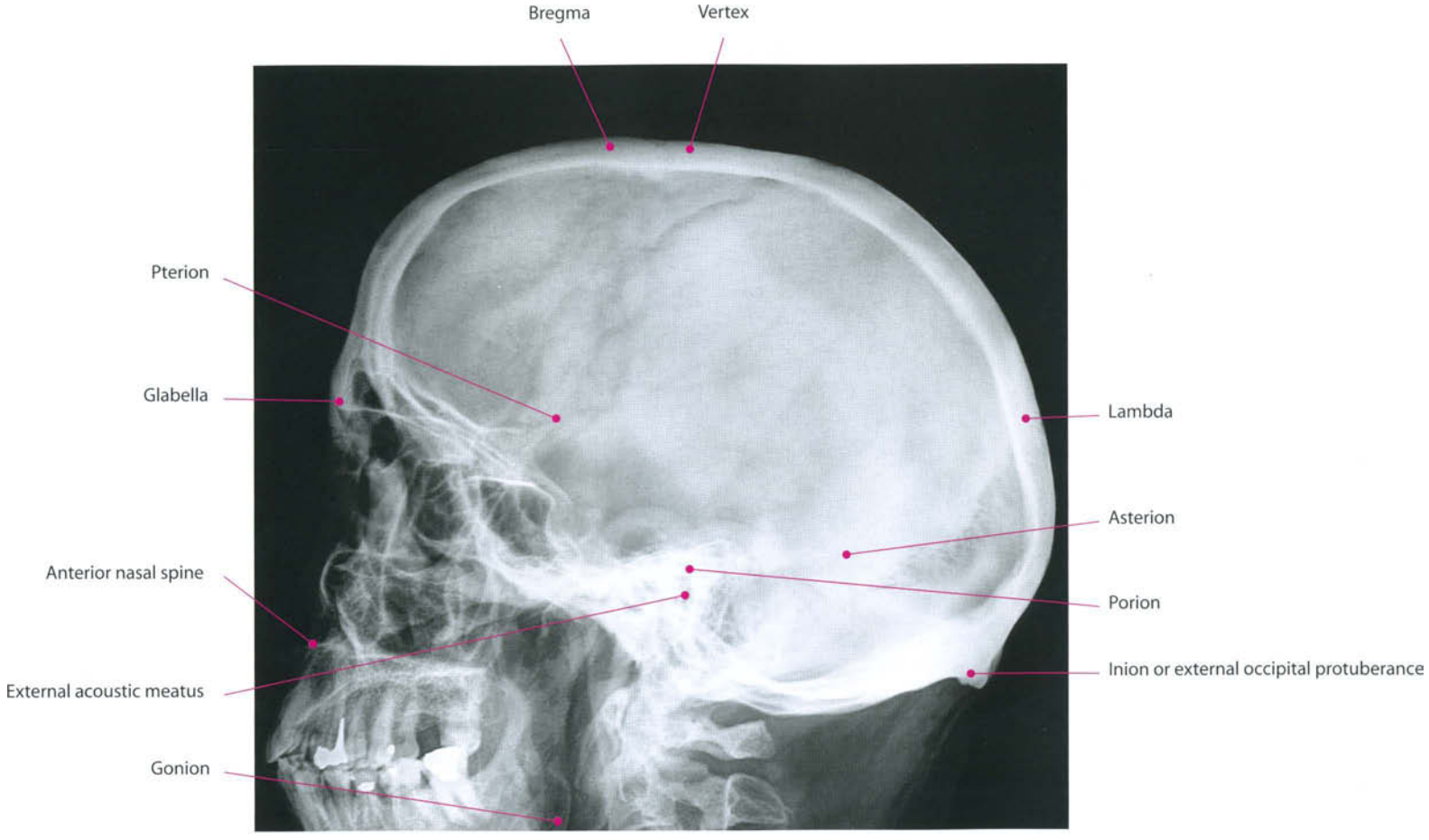


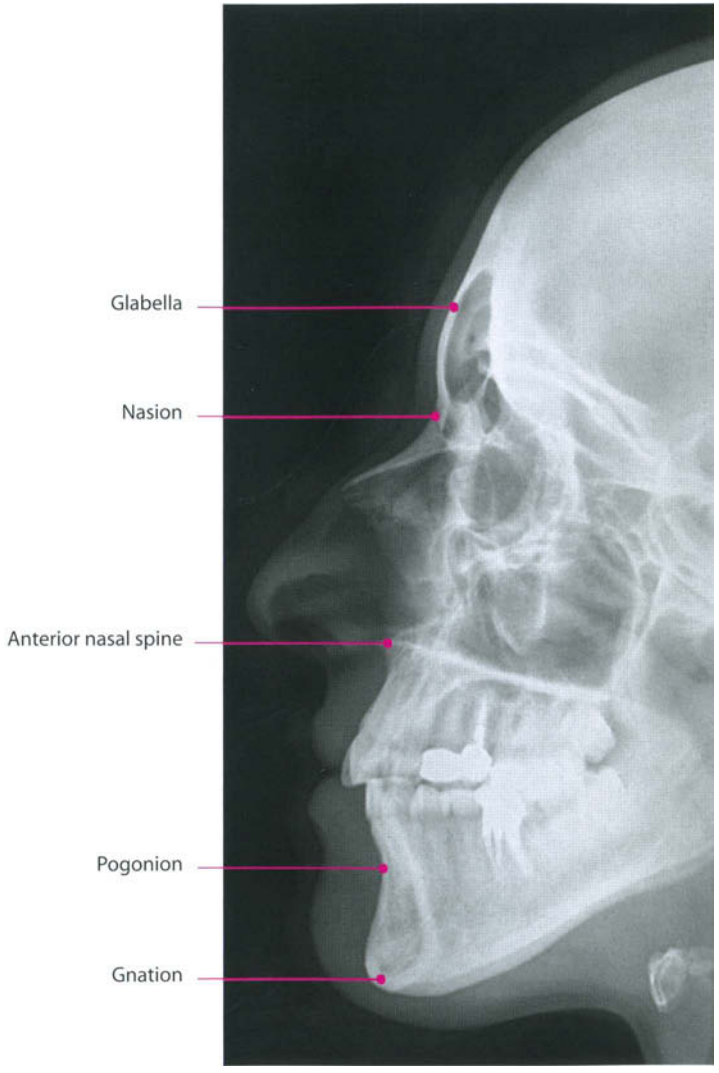

Outer table
Diploë
Inner table
Frontal sinus
Anterior clinoid process
Sphenoidal sinus
Floor of sella turcica
Anterior nasal spine
Hard palate
Vasal imprints
Lambdoid suture
External occipital protuberance
Posterior clinoid process

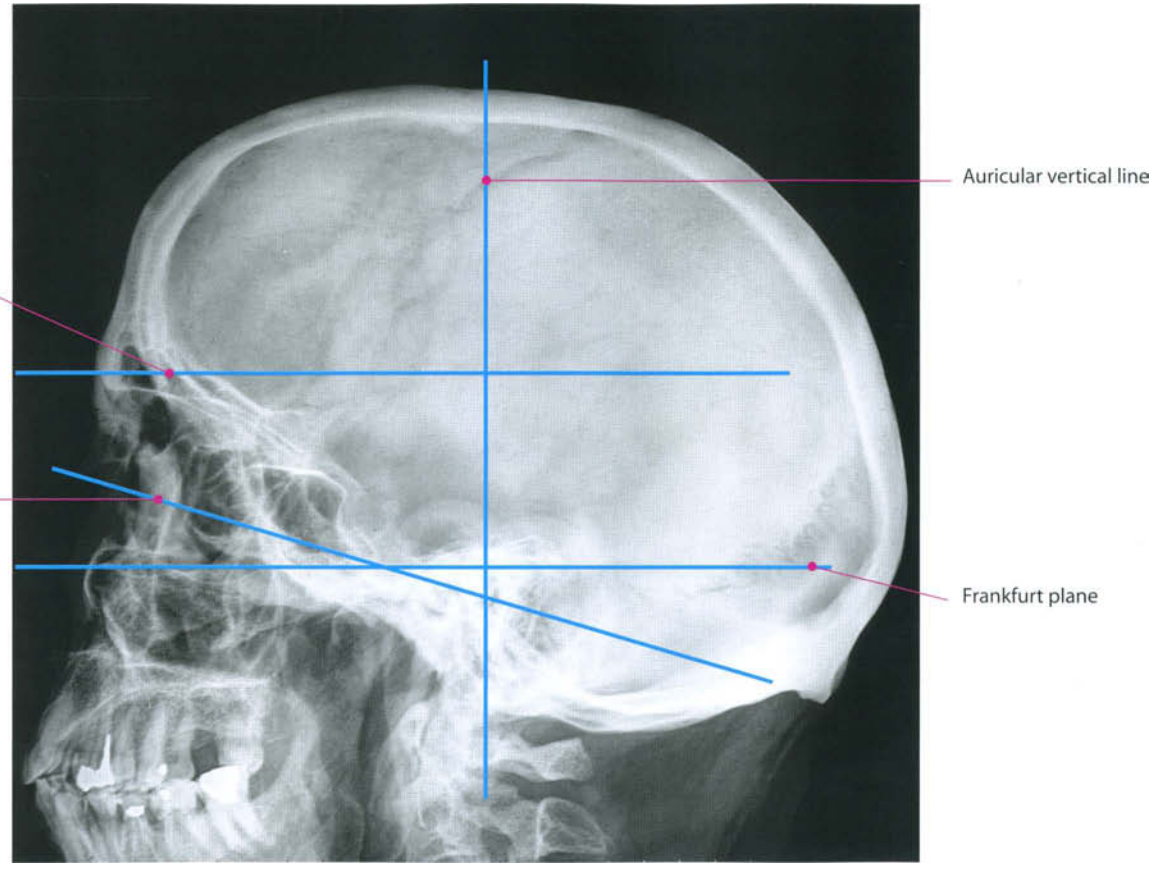

Frontal sinus
Nasal bones
Malar bone
Anterior nasal spine
Alveolar processes
Mandible
Sphenoethmoidal planum
Maxillary sinus
Hard palate
Hyoid bone

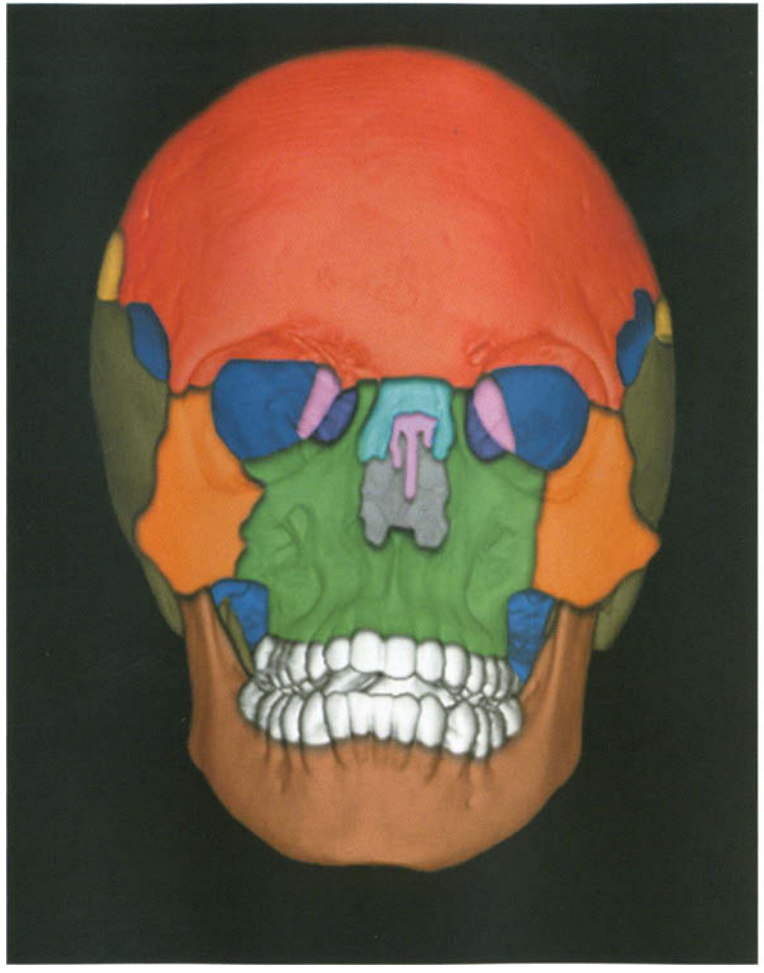

Sagittal suture
Superior orbital border (roof of the orbit)
Fronto-zygomatic suture
Orbital floor
Zygomatic bone (body)
Maxillary sinus
Petrous pyramid of temporal bone
Occipital foramen
Angle of mandible
Frontal sinus
Ethmoidal cells
Orbit
Nasal septum
Foramen rotundun
Superior margin of petrous pyramic
Odontoid process of axis


Mastoid process
Vertical ramus of mandible
Spinous process of axis
Angle of mandible
Horizontal ramus of mandible
Odontoid process of axis
Peduncle and lateral mass of atlas
Atlanto-axial articular space
Lateral mass of axis
Lower border of the posterior arch of atlas


Bregma
Vertex
Pterion
Glabella
Lambda
Asterion
Anterior nasal spine
Porion
External acoustic meatus
Inion or external occipital protuberance
Gonion

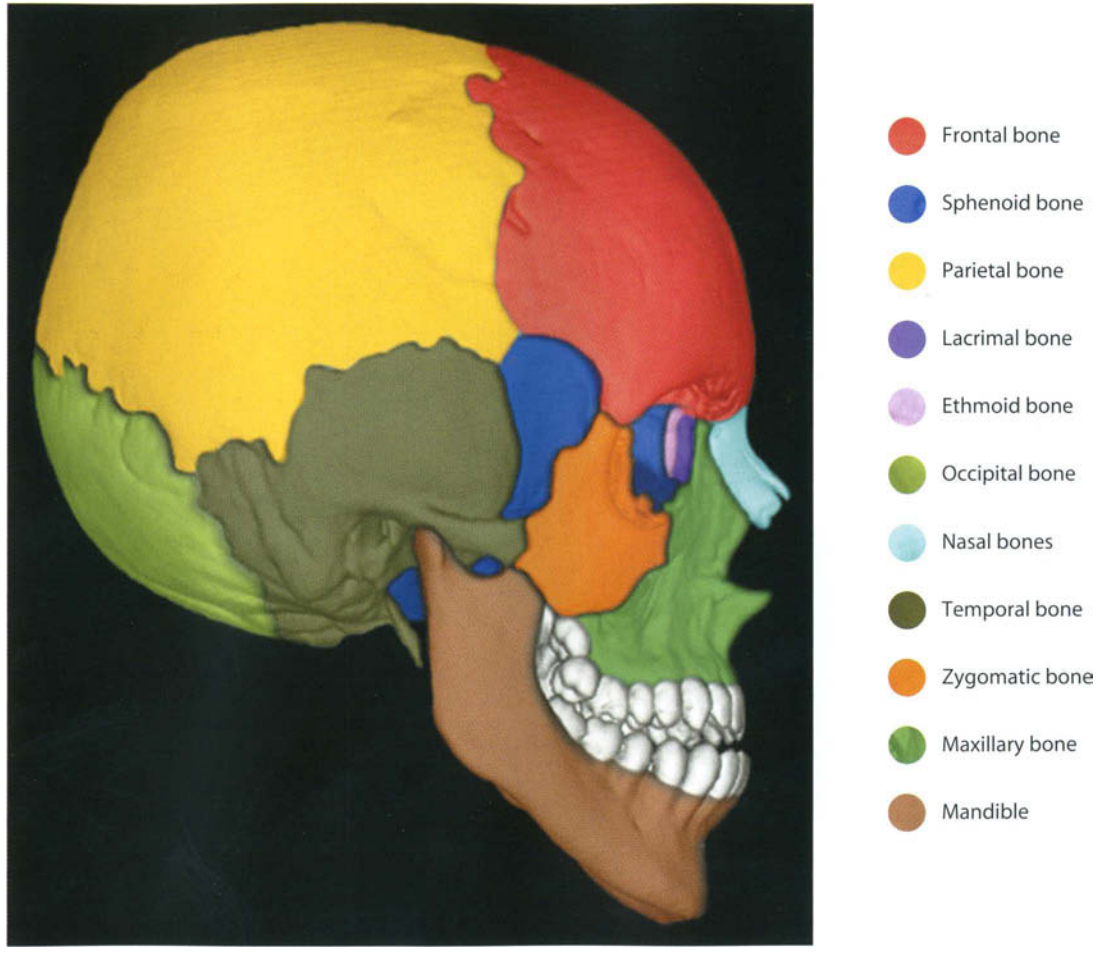

Glabella
Nasion
Anterior nasal spine
Pogonion
Gnation

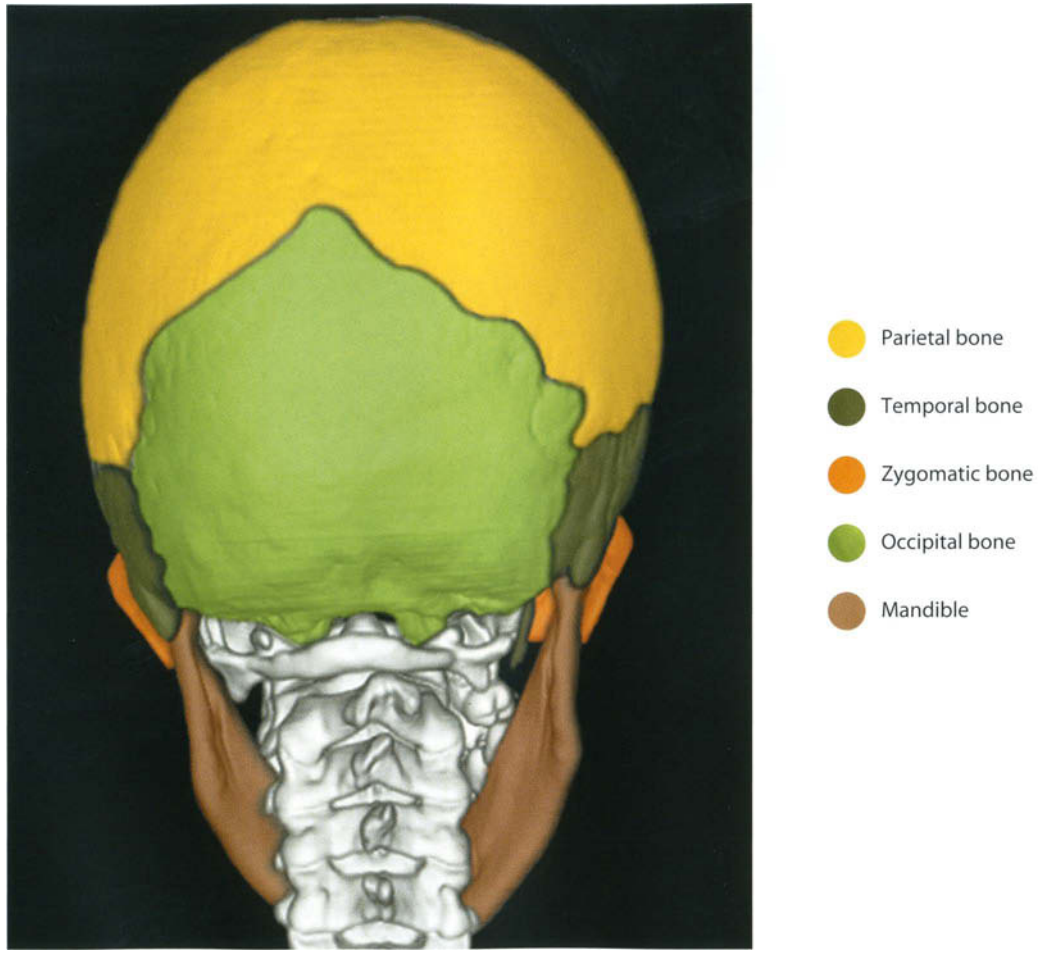

Auricular vertical line
Superior horizontal line
Orbitomeatal line
Frankfurt plane

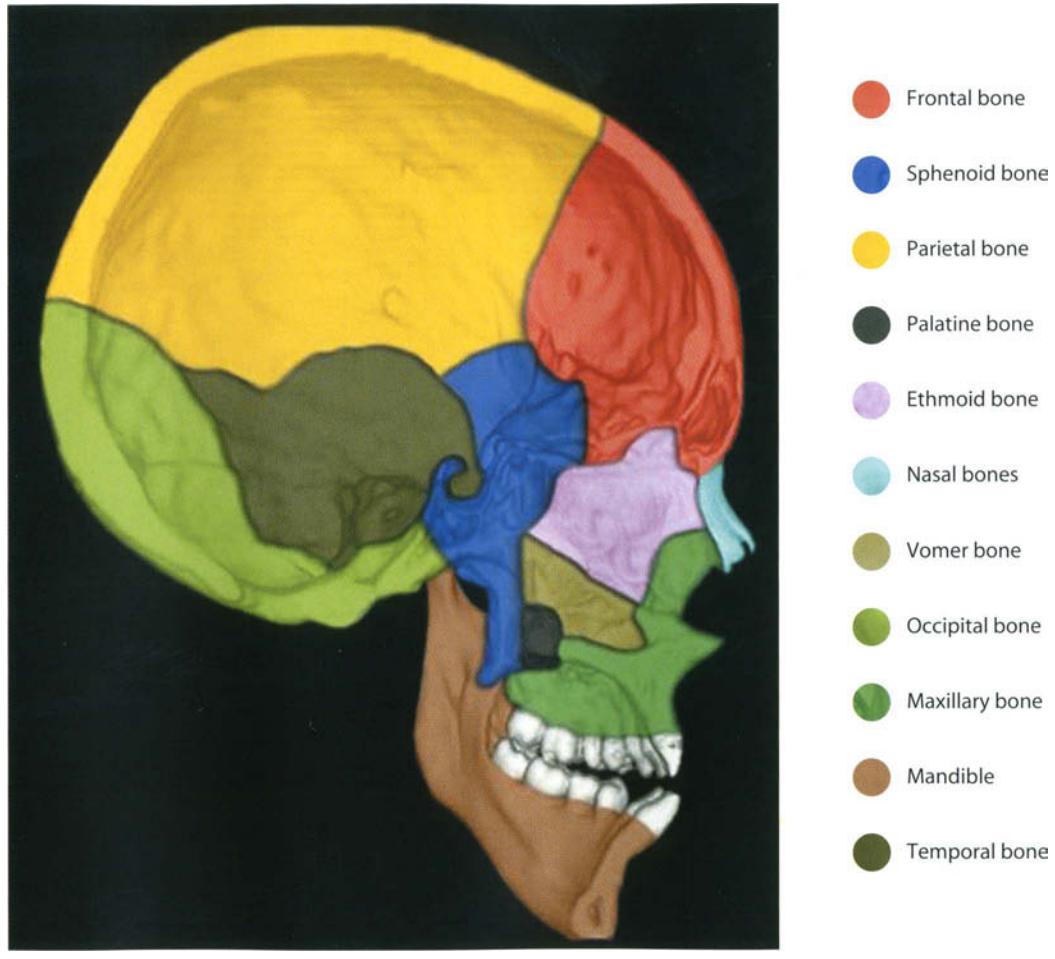


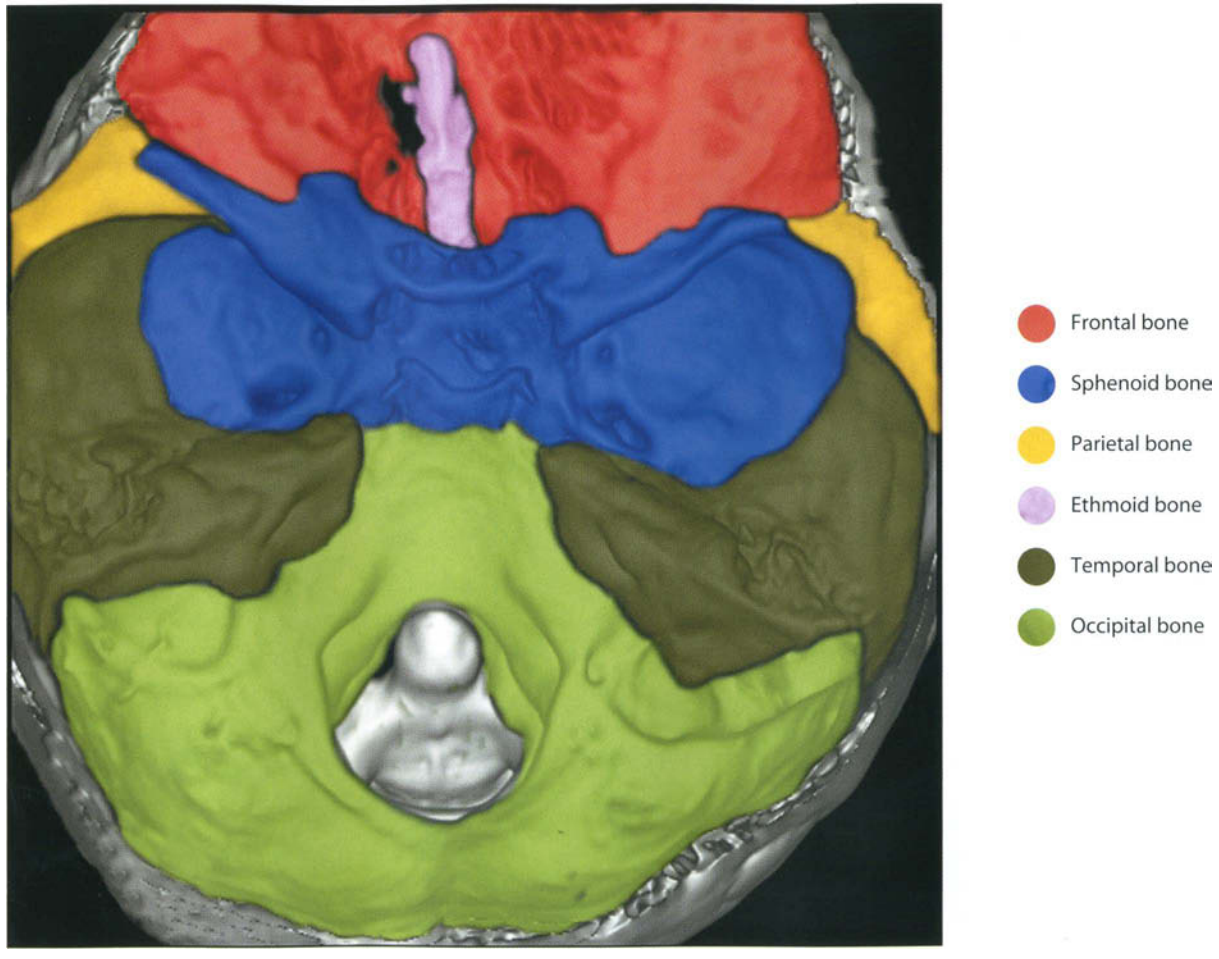
- Frontal bone
- Sphenoid bone
- Parietal bone
- Lacrimal bone
- Ethmoid bone
- Nasal bones
- Temporal bone
- Zygomatic bone
- Maxillary bone
- Mandible

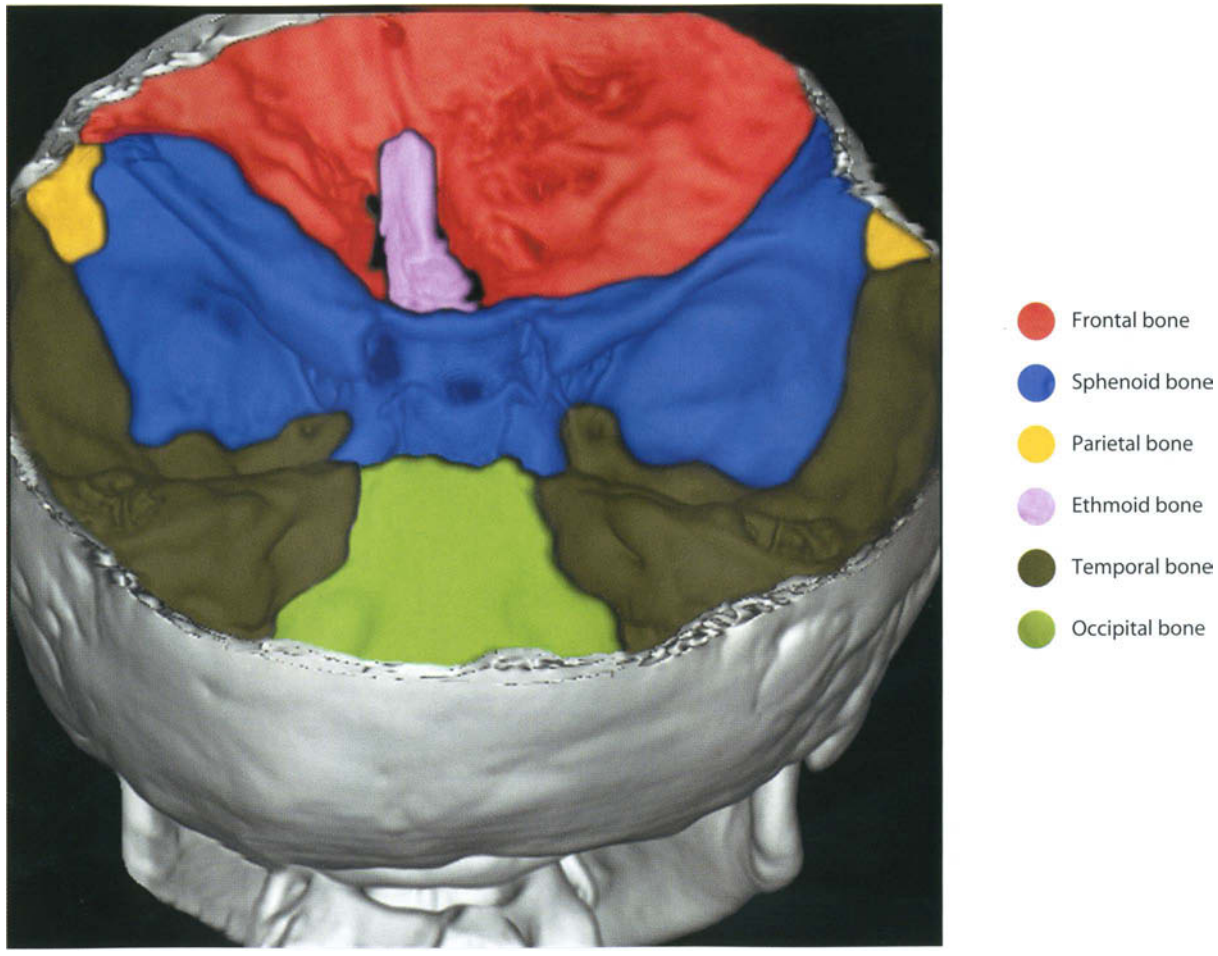

Orbital process of the palatine bone
Frontal bone
Sphenoid bone
Parietal bone
Lacrimal bone
Ethmoid bone
Nasal bones
Temporal bone
Zygomatic bone
Maxillary bone
Mandible

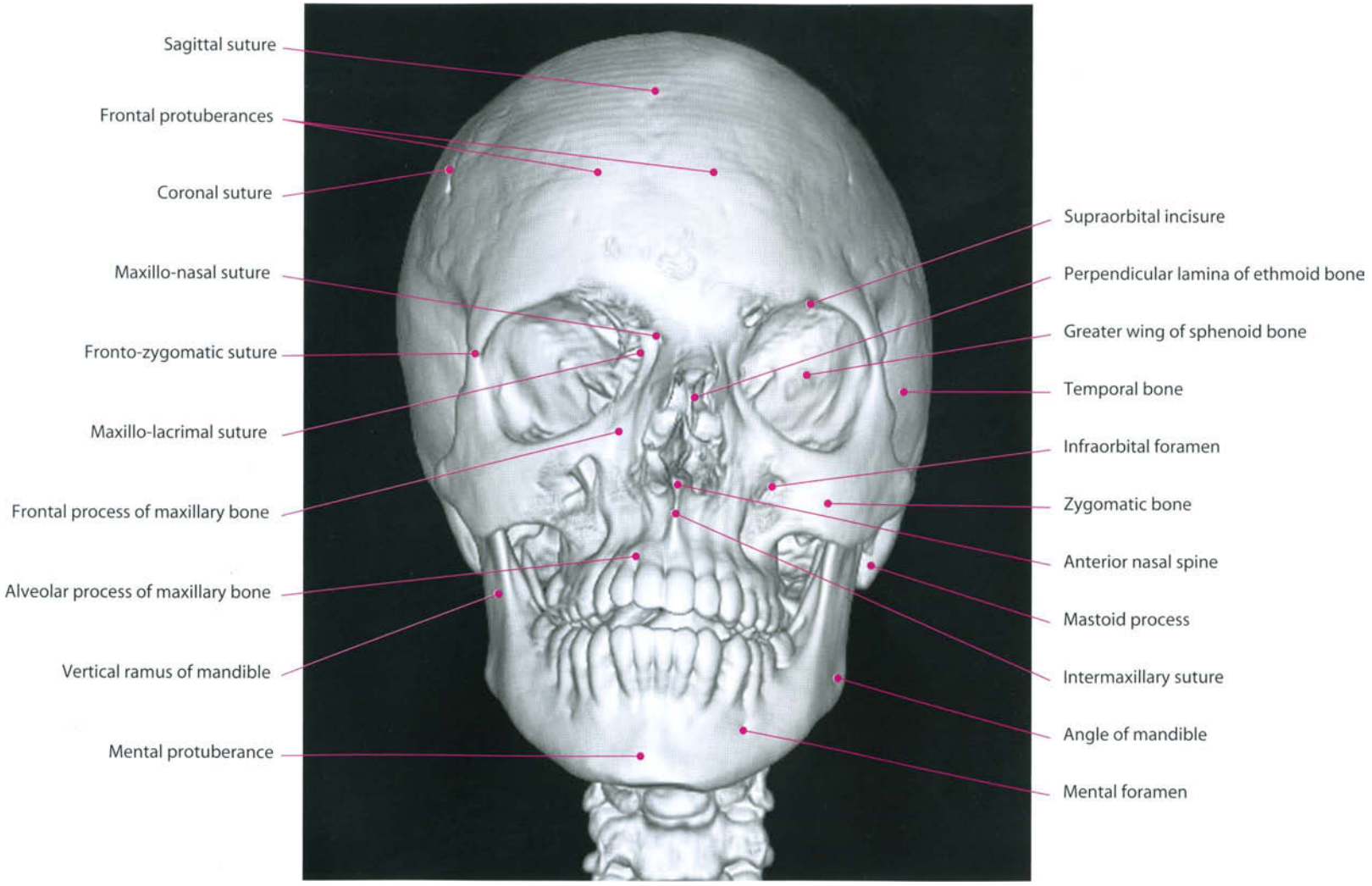

Frontal bone
Sphenoid bone
Parietal bone
Lacrimal bone
Ethmoid bone
Occipital bone
Nasal bones
Temporal bone
Zygomatic bone
Maxillary bone
Mandible

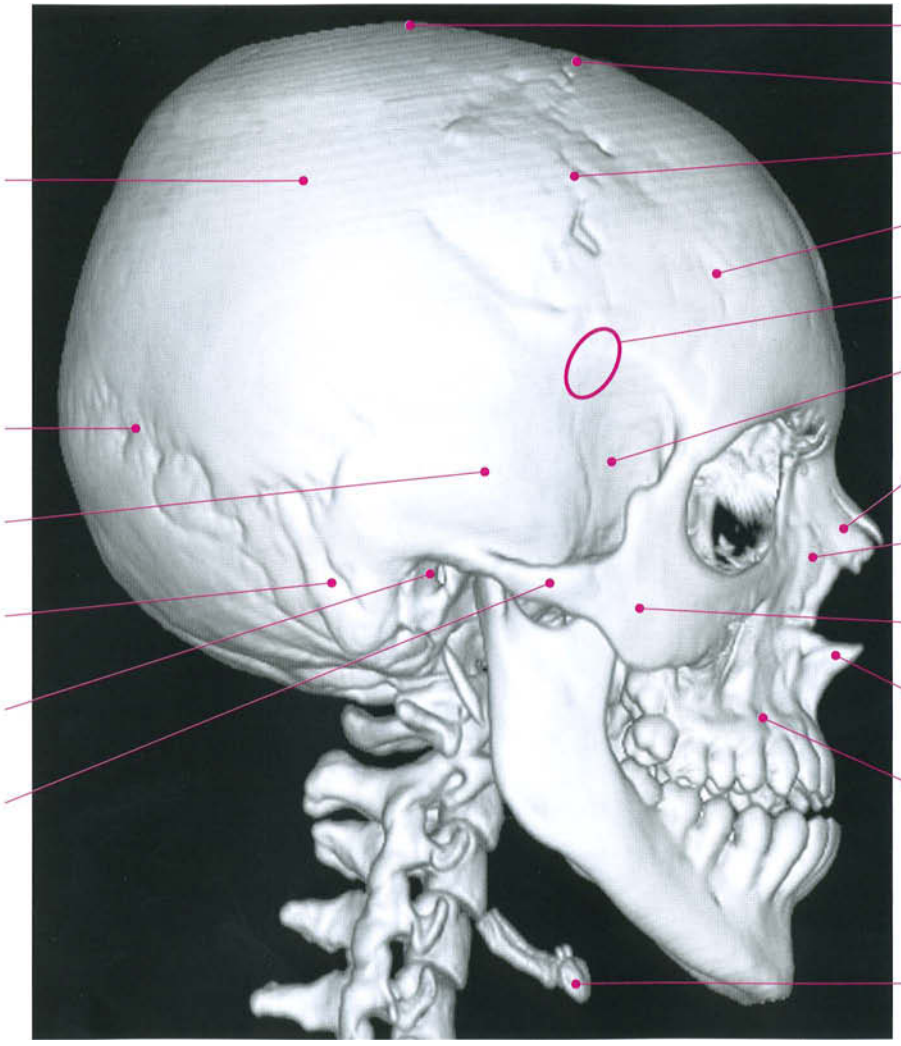

Parietal bone
Temporal bone
Zygomatic bone
Occipital bone
Mandible

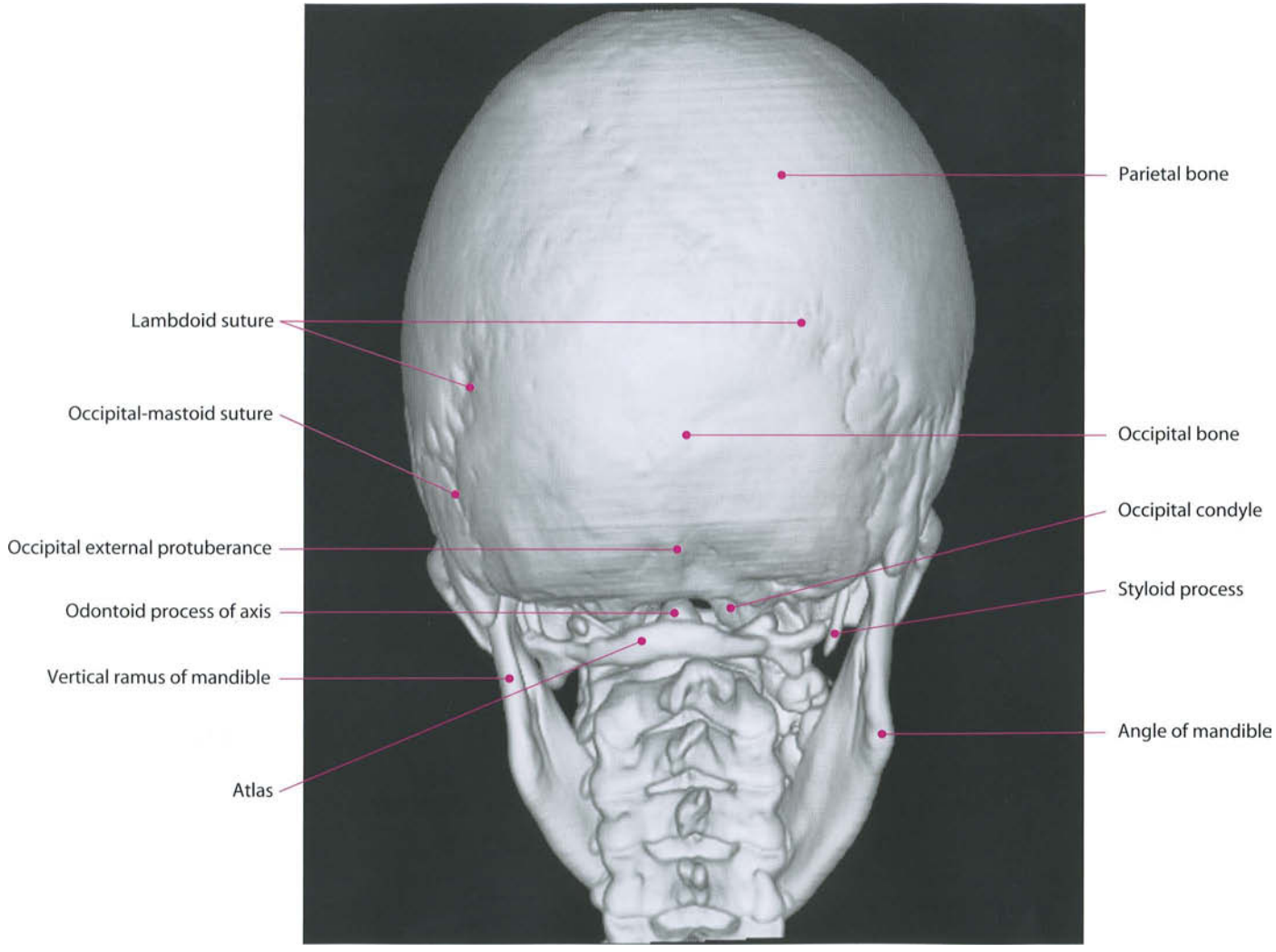

Frontal bone
Sphenoid bone
Parietal bone
Palatine bone
Ethmoid bone
Nasal bones
Vomer bone
Occipital bone
Maxillary bone
Mandible
Temporal bone

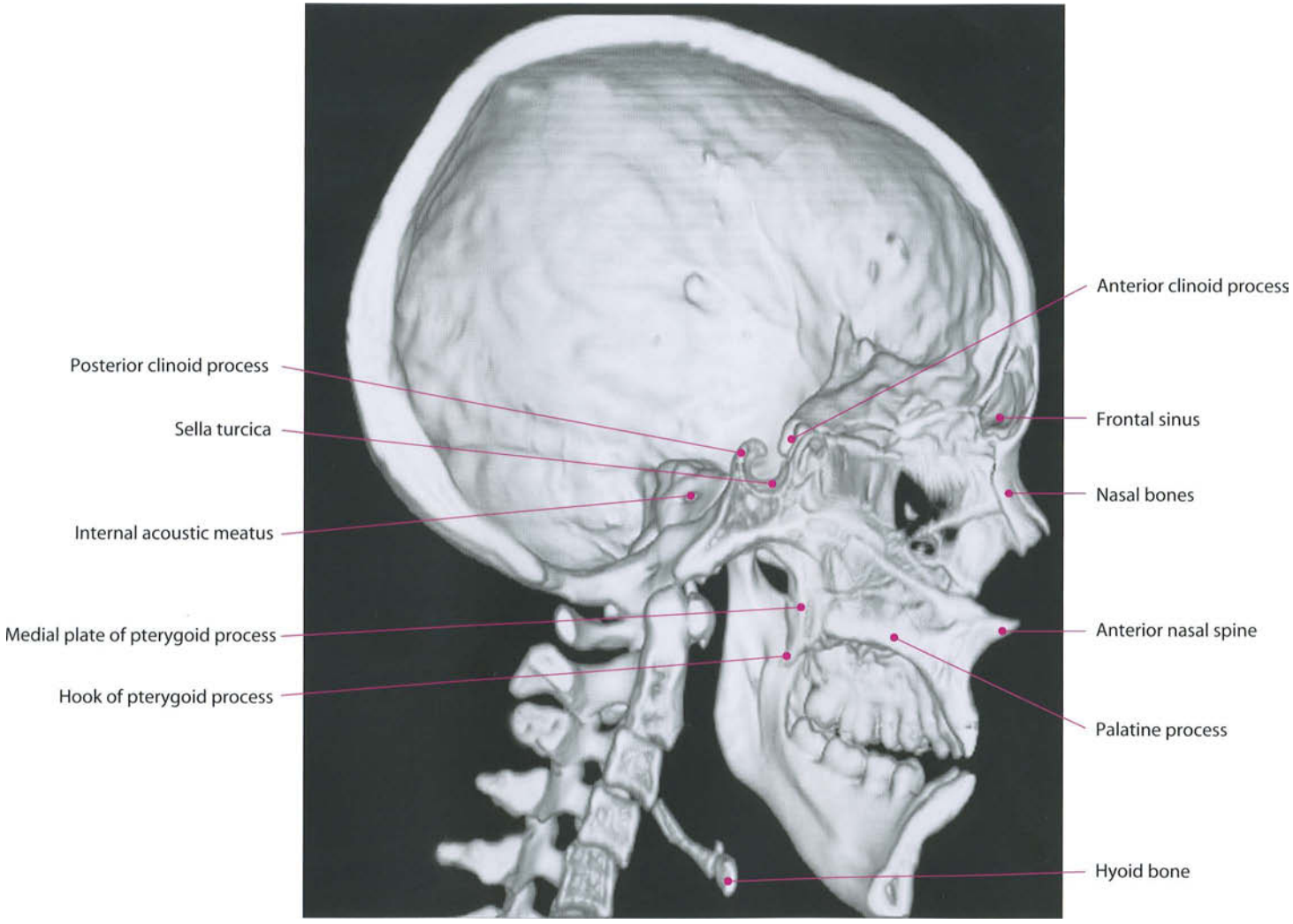

Frontal bone
Sphenoid bone
Parietal bone
Ethmoid bone
Temporal bone
Occipital bone

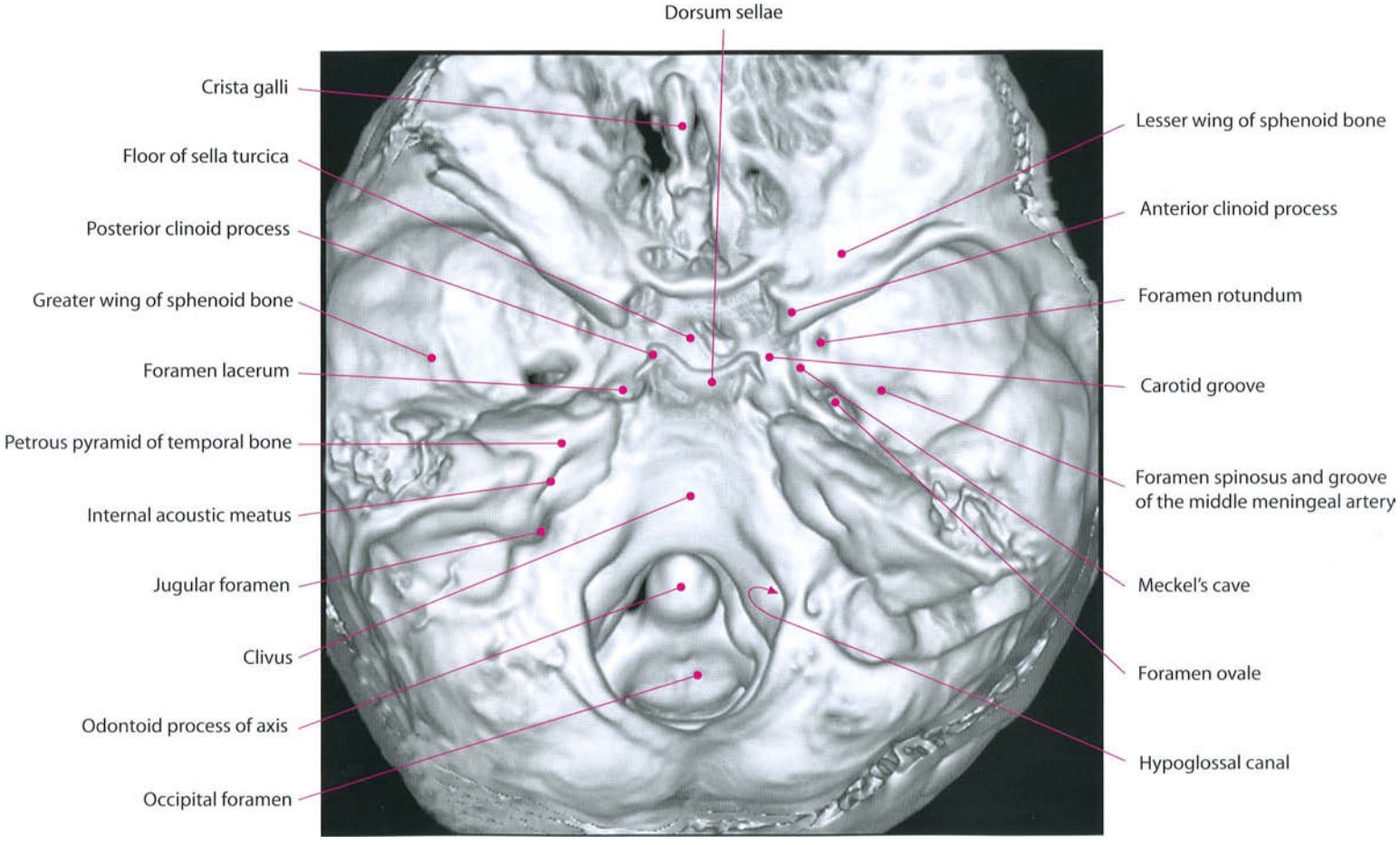

Frontal bone
Sphenoid bone
Parietal bone
Ethmoid bone
Temporal bone
Occipital bone

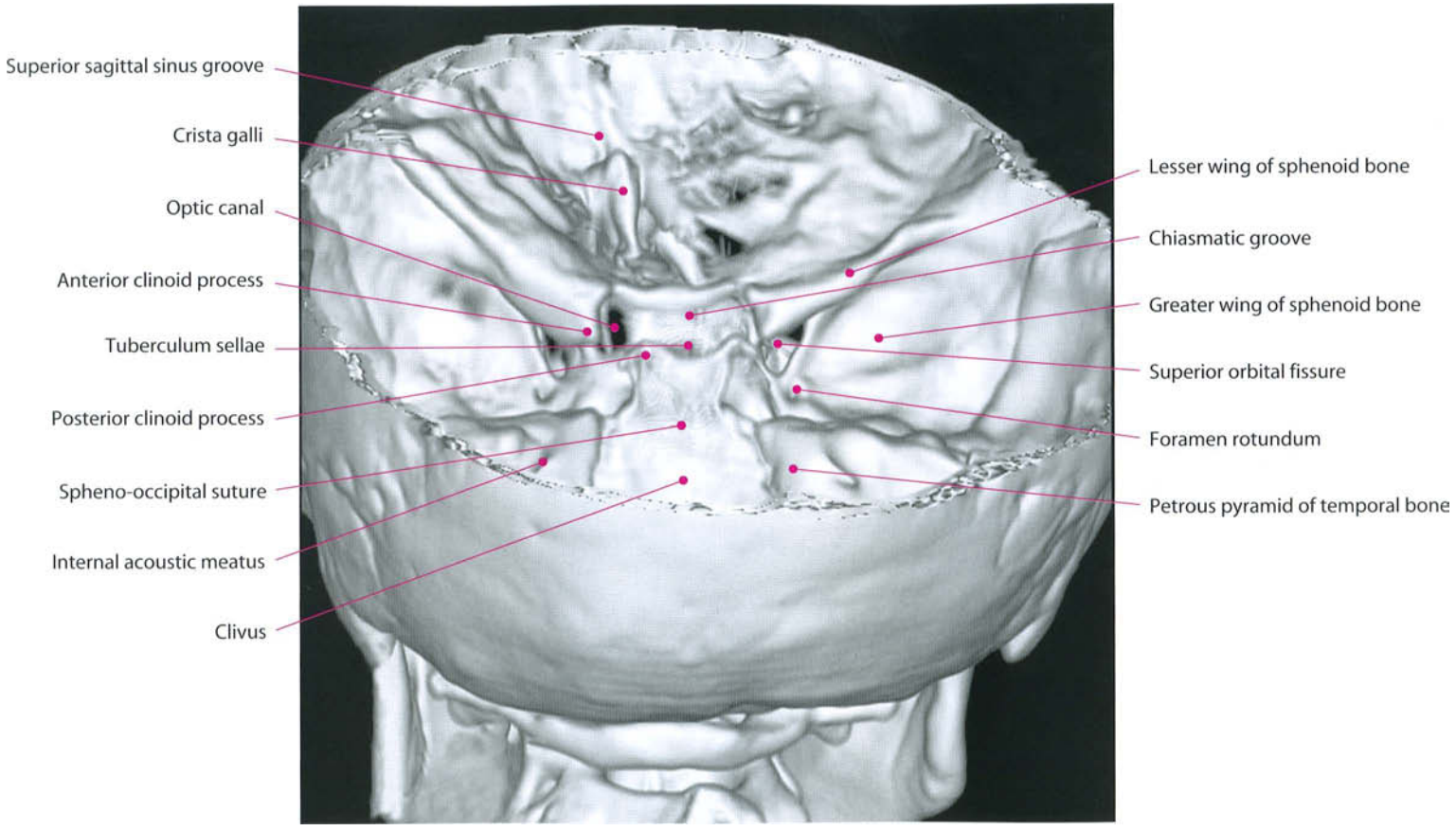

Sagittal suture
Frontal protuberances
Coronal suture
Maxillo-nasal suture
Fronto-zygomatic suture
Maxillo-lacrimal suture
Frontal process of maxillary bone
Alveolar process of maxillary bone
Vertical ramus of mandible
Mental protuberance
Supraorbital incisure
Perpendicular lamina of ethmoid bone
Greater wing of sphenoid bone
Temporal bone
Infraorbital foramen
Zygomatic bone
Anterior nasal spine
Mastoid process
Intermaxillary suture
Angle of mandible
Mental foramen


Vertex
Bregma
Coronal suture
Frontal bone
Pterion
External side of the greater wing of sphenoid bone
Nasal bone
Frontal process of maxillary bone
Zygomatic bone
Anterior nasal spine
Alveolar process
Hyoid bone
Parietal bone
Lambdoid suture
Temporal squama
Mastoid process
External acoustic meatus
Zygomatic process of temporal bone


Parietal bone
Lambdoid suture
Occipital-mastoid suture
Occipital bone
Occipital condyle
Occipital external protuberance
Styloid process
Odontoid process of axis
Vertical ramus of mandible
Angle of mandible
Atlas


Posterior clinoid process
Sella turcica
Internal acoustic meatus
Medial plate of pterygoid process
Hook of pterygoid process
Anterior clinoid process
Frontal sinus
Nasal bones
Anterior nasal spine
Palatine process
Hyoid bone


Dorsum sellae
Crista galli
Floor of sella turcica
Posterior clinoid process
Greater wing of sphenoid bone
Foramen lacerum
Petrous pyramid of temporal bone
Internal acoustic meatus
Jugular foramen
Clivus
Odontoid process of axis
Occipital foramen
Lesser wing of sphenoid bone
Anterior clinoid process
Foramen rotundum
Carotid groove
Foramen spinosus and groove of the middle meningeal artery
Meckel's cave
Foramen ovale
Hypoglossal canal


Superior sagittal sinus groove
Crista galli
Optic canal
Anterior clinoid process
Tuberculum sellae
Posterior clinoid process
Spheno-occipital suture
Internal acoustic meatus
Clivus
Lesser wing of sphenoid bone
Chiasmatic groove
Greater wing of sphenoid bone
Superior orbital fissure
Foramen rotundum
Petrous pyramid of temporal bone

The Brain

The brain or encephalon is the cranial part of the neuraxis, distinguished from the spinal cord (medulla spinalis).

The average weight of the brain is about 1380 g in the adult male and about 1250 g in the adult female. The brain increases rapidly during the first four years of life and reaches its maximum weight by about the twentieth year. As age advances, the brain decreases slowly in weight.

It is composed of a rostral portion, the forebrain (prosencephalon), and the truncus cerebri (brainstem). The prosencephalon is formed by two hemispheres (telencephalon) and an impair and median structure. The latter has an anterior part named telencephalon impair, and a posterior part consisting of the diencephalon.

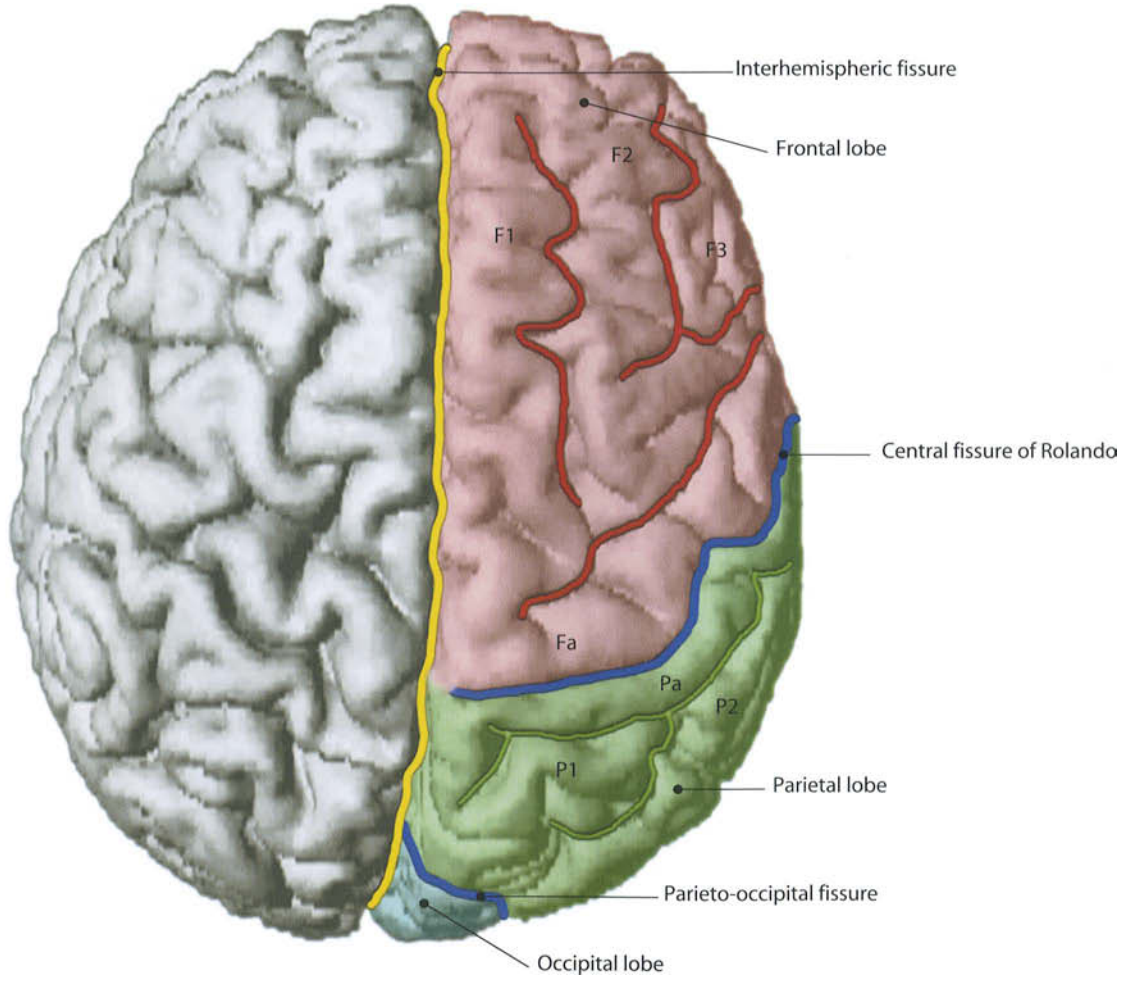
The brainstem is formed by the mesencephalon (midbrain) and the rhombencephalon. The latter is divided into metencephalon (pons and cerebellum) and myelencephalon (medulla oblongata).

The surface of the cerebral hemisphere is characterized by the presence of furrows of two different types: fissures, more prominent and relatively constant in their relationships, and sulci, less deep and more subject to individual variations.

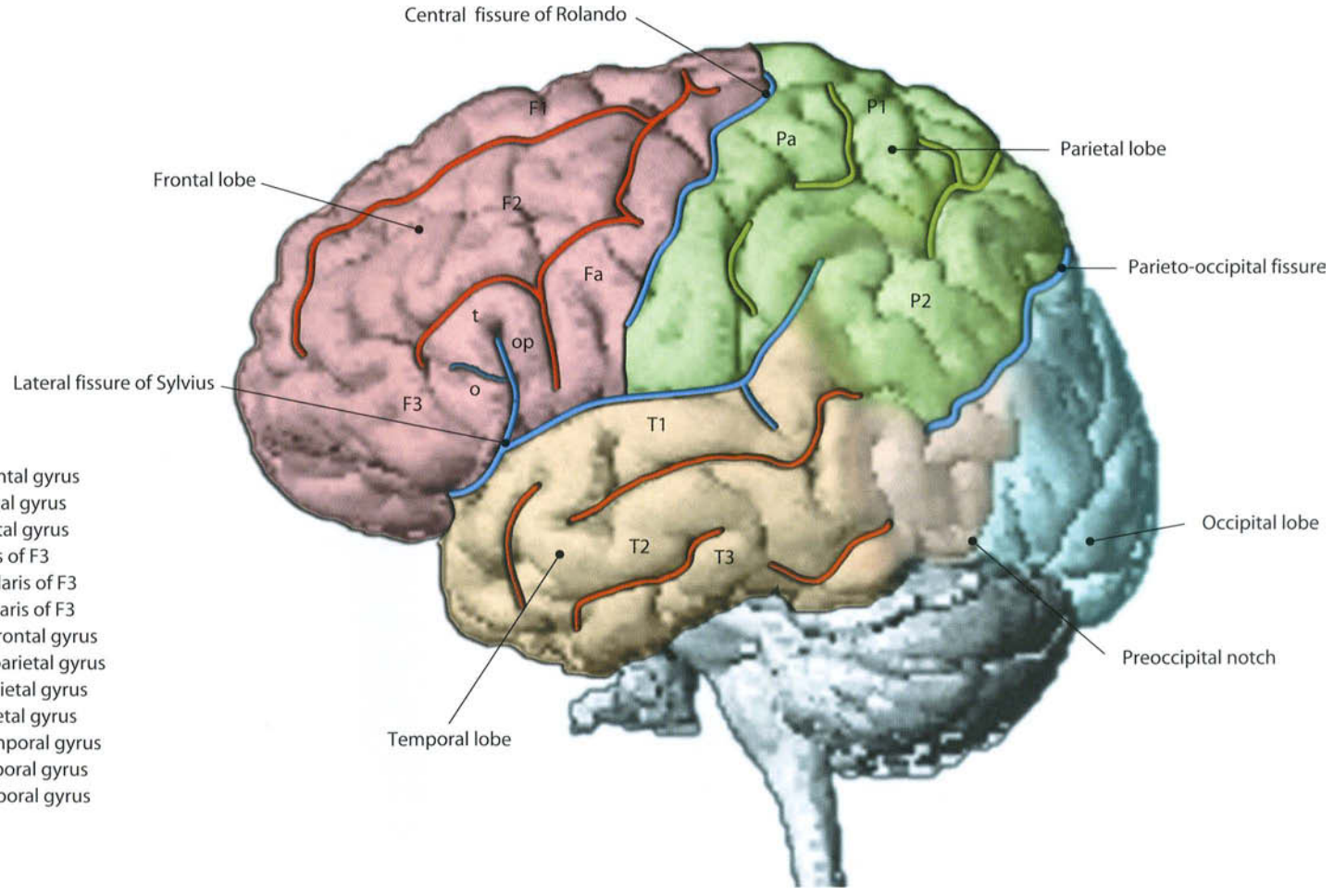
The interhemispheric fissure separates the two hemispheres and hosts the great cerebral falx, a thick meningeal membrane. The sylvian or lateral fissure, quite deep, divides the frontal and parietal lobes from the temporal one. The rolandic or central fissure separates the frontal and parietal lobes. On the medial surface the parieto-occipital fissure divides the precuneus (parietal) from the cuneus (occipital). It extends on the outer aspect of the hemisphere. The border between occipital and temporal lobes on the lateral surface of the brain is less sharp and the division is somewhat arbitrary, passing through the parieto-occipital fissure and the preoccipital notch, in the inferior aspect of the temporal lobe. The preoccipital notch is difficult to identify and it is conventionally located 4 cm frontal to the occipital pole.

The insula is hidden inside the sylvian fissure. In order to see it, the frontal and temporal opercula must be opened.

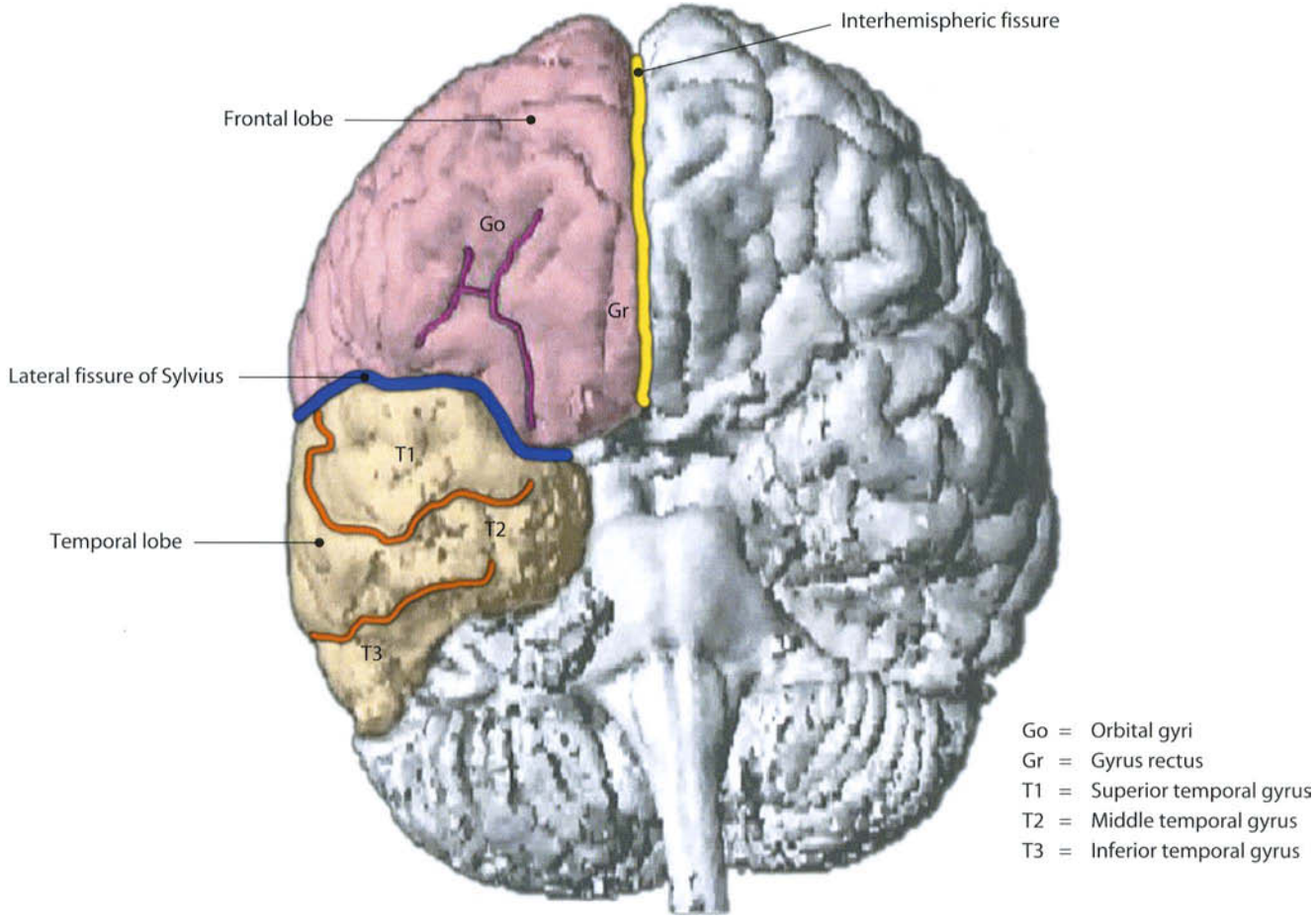
The most relevant feature in the medial aspect of the brain hemisphere is the corpus callosum (see also p. 275). This is the most important interhemispheric commissure, made of 5 parts: the most anterior and inferior one is the rostrum, immediately dorsal to the anterior commissure (connects portions of middle and inferior temporal gyri): above the rostrum, the genu continues posteriorly with the body of the corpus callosum, which ends in correspondence with the frontal lobe, followed by a notch, the isthmus, and finally the splenium. The corpus callosum is cranially covered by the cingulate gyrus, separated from it by the callosal sulcus. Immediately below its posterior aspect, the fornix is found. This peculiar structure is an interhemispheric commissure (hypothalamic commissure) comprising two columns that originate from the mammillary bodies. They extend forwards and upwards, toward the center of the corpus callosum, where the columns travel together to form the body of the fornix, while maintaining their fibers separate. Afterwards, they become separate by the commissure of the fornix, and continue backward and then down and forward, towards the anterior commissure and hippocampus, ending in the region of the uncus. The parieto-occipital fissure separates the precuneus and cuneus. The medial aspect of the temporal lobe offers the clear distinction of the uncus of the hippocampus, followed posteriorly by the parahippocampal and the fusiform gyri.



F1 = Superior frontal gyrus
F2 = Middle frontal gyrus
F3 = Inferior frontal gyrus
Fa = Ascending frontal gyrus
Pa = Ascending parietal gyrus
P1 = Superior parietal gyrus
P2 = Inferior parietal gyrus



F1 = Superior frontal gyrus
F2 = Middle frontal gyrus
F3 = Inferior frontal gyrus
o = Pars orbitalis of F3
t = Pars triangularis of F3
op = Pars opercularis of F3
Fa = Ascending frontal gyrus
Pa = Ascending parietal gyrus
P1 = Superior parietal gyrus
P2 = Inferior parietal gyrus
T1 = Superior temporal gyrus
T2 = Middle temporal gyrus
T3 = Inferior temporal gyrus


Interhemispheric fissure
Frontal lobe
Go
Gr
Lateral fissure of Sylvius
T1
T2
Temporal lobe
T3
Go = Orbital gyri
Gr = Gyrus rectus
T1 = Superior temporal gyrus
T2 = Middle temporal gyrus
T3 = Inferior temporal gyrus