ANATOMY OF THE SKULL

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Preface

Despite the many anatomical atlases and textbooks currently available, there appeared to be need for a book which combined the advantages of each of these forms of presentation. This book was conceived with the intention of filling that need. With a good combination of photographs of natural skulls, accompanying concise important text, this aims to provide dental and medical students with better understanding the anatomy of the skull particularly in the dissection laboratory.

The basis of this work is the natural human skulls; and each skull was specially prepared and photographed to display all the most important features.

The level of detail contained in this book is appropriate for current courses in topographical anatomy for medical and dental undergraduates. In addition, it will be of value to postgraduates and students entering those professions allied to medicine in which anatomy is part of the curriculum.

Preparation of this work has occupied the author for nearly more than one year. Our objective was to create a high quality and visually attractive pure Iraqi anatomical work and I hope that the time and effort spent in its preparation is reflected in the finished product.

I would like to record our thanks to the dean of college of dentistry and to the Mosul university for their invaluable support to complete this work.

Dr. Ayad AL-Saraj

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Chapter 1

SKULL

The human skull consists of 22 bones which are mostly connected together by ossified joints, so called sutures.

The skull is divided into :

1- The cranium or braincase (neurocranium,8 bones)

2- The facial skeleton (viscerocranium ,14 bones)

Its main function is the protection of the most important organ in the human body: the brain and some sense organs such as the eyeball.

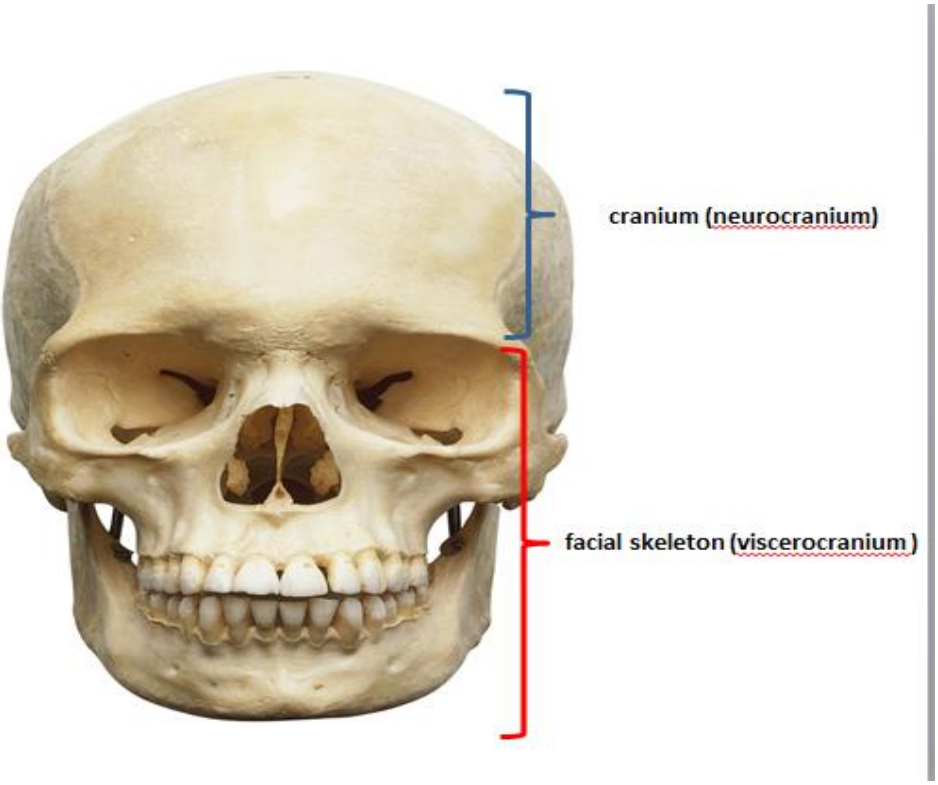

Fig. 1: Anterior view of the skull

Superior view of the skull

The superior aspect of the skull present somewhat egg- shaped outline with the small end anteriorly

Only 4 bones are seen form this view

Frontal bone anteriorly , the right and left parietal bones laterally and the occipital bone posteriorly.

1- The coronal suture separates the frontal bone anteriorly from the parietal bones posteriorly

2- The sagittal or interparietal sutures sparest the right and left parietal bones

3- The lambdoidal suture separates parietal and temporal bones from the occipital bones

4- Bregma is located between sagittal and coronal sutures

5- Lambda is located between lambidoidal and sagittal suture.

8- Parietal foramina are paired foramina on either side of the sagittal suture

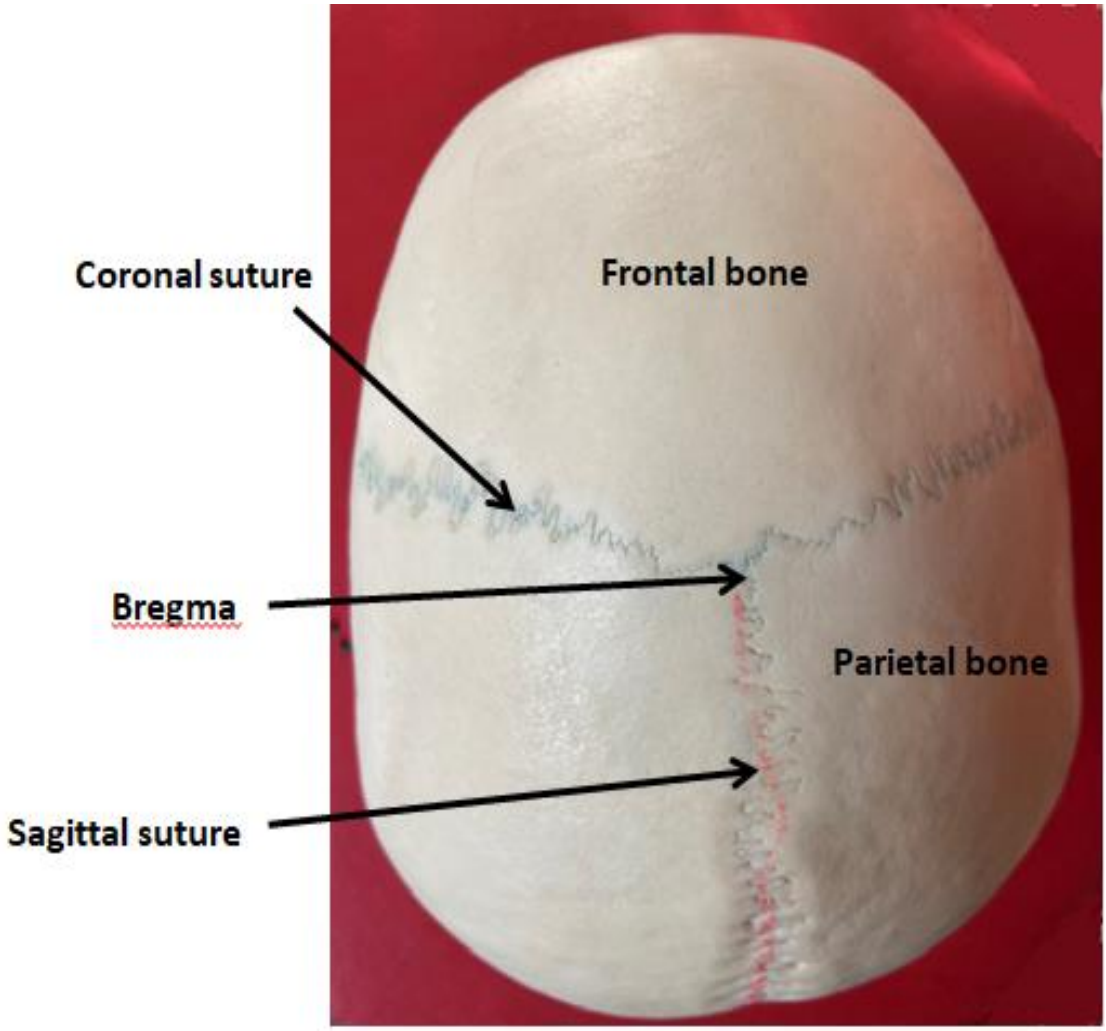

Fig. 2: Superior view of the skull

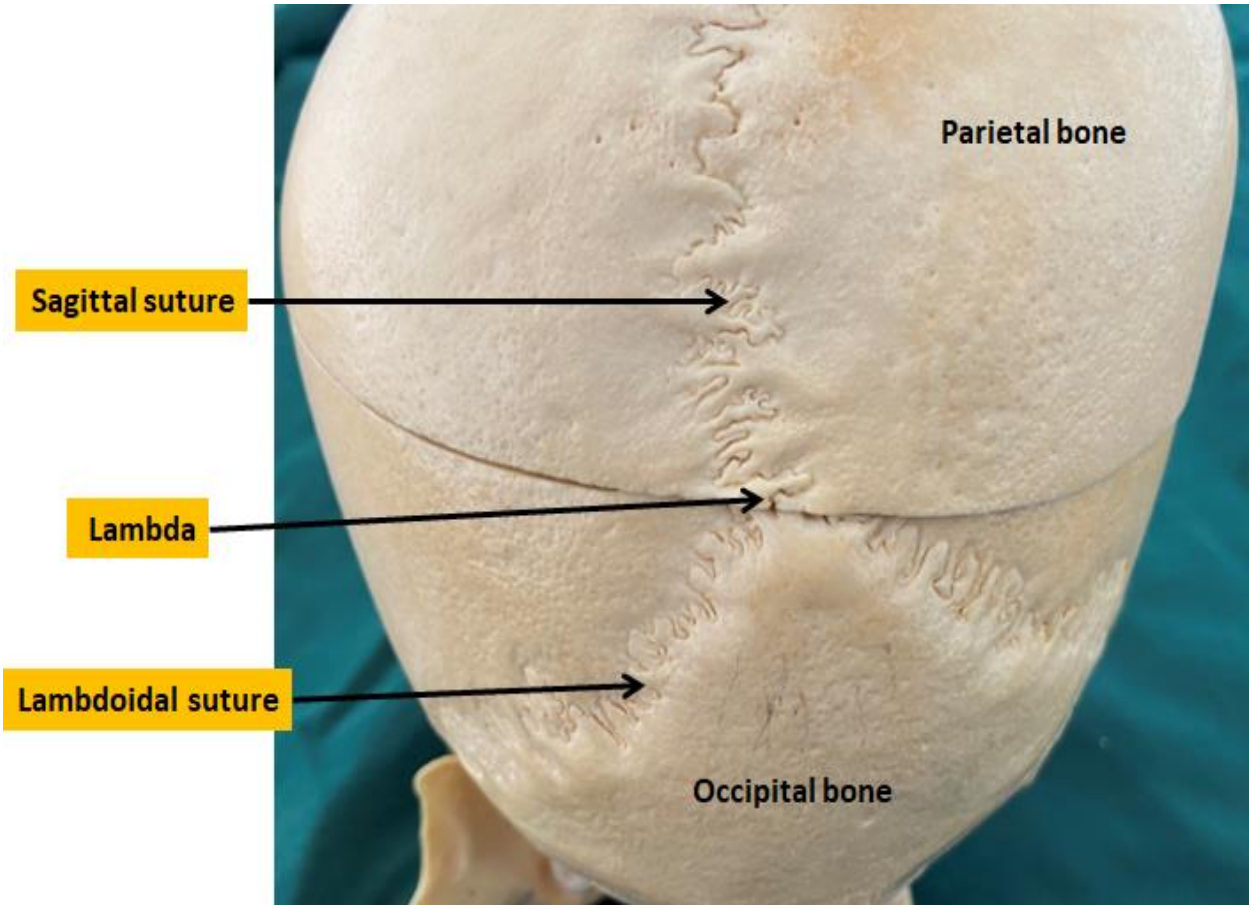

Fig. 3: Supero-posterior view of the skull

Posterior view of the skull

The most prominent feature of the posterior view is the rounded posterior pole of the skull called the occiput (occipital area)

The bones seen from this view are the paired parietal bones superiorly and laterally the occipital bone posteriorly and the paired temporal bones(mastoid portion) at the infero -lateral aspect.

1-External occipital protuberance(inion) located at the midline between lambda and foramen magnum

2- Superior nuchal line radiates laterally on either side of the external occipital protuberance and ending at the mastoid process

3-Inferior nuchal line it is parallel line below the superior nuchal line

4- Highest nuchal line it is less distinct just above the superior nuchal line.

5- The external occipital crest runs down in med-line from the external occipital protuberance to the foramen magnum.

6-The mastoid process of the temporal bone which provide insertion of sternoclidomastoid muscle.

7-The mastoid foramen is a variably-present foramen . Most commonly located near the posterior margin of the mastoid process.

It transmits the emissary veins

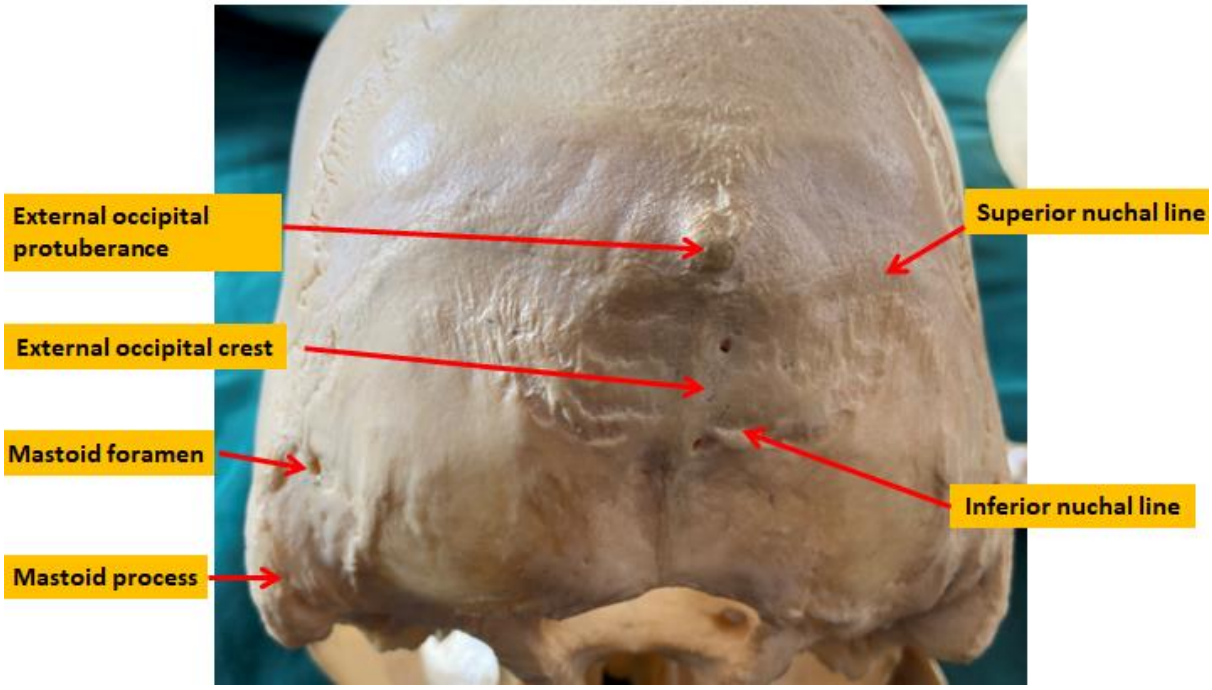

Fig. 4: Posterior view of the skull

Lateral view of the skull

The bones of the lateral aspect area

Frontal bone,

Parietal bones

Occipital bone

Temporal

Greater wings of sphenoid bone

Zygomatic

Maxilla

Nasal

Mandible.

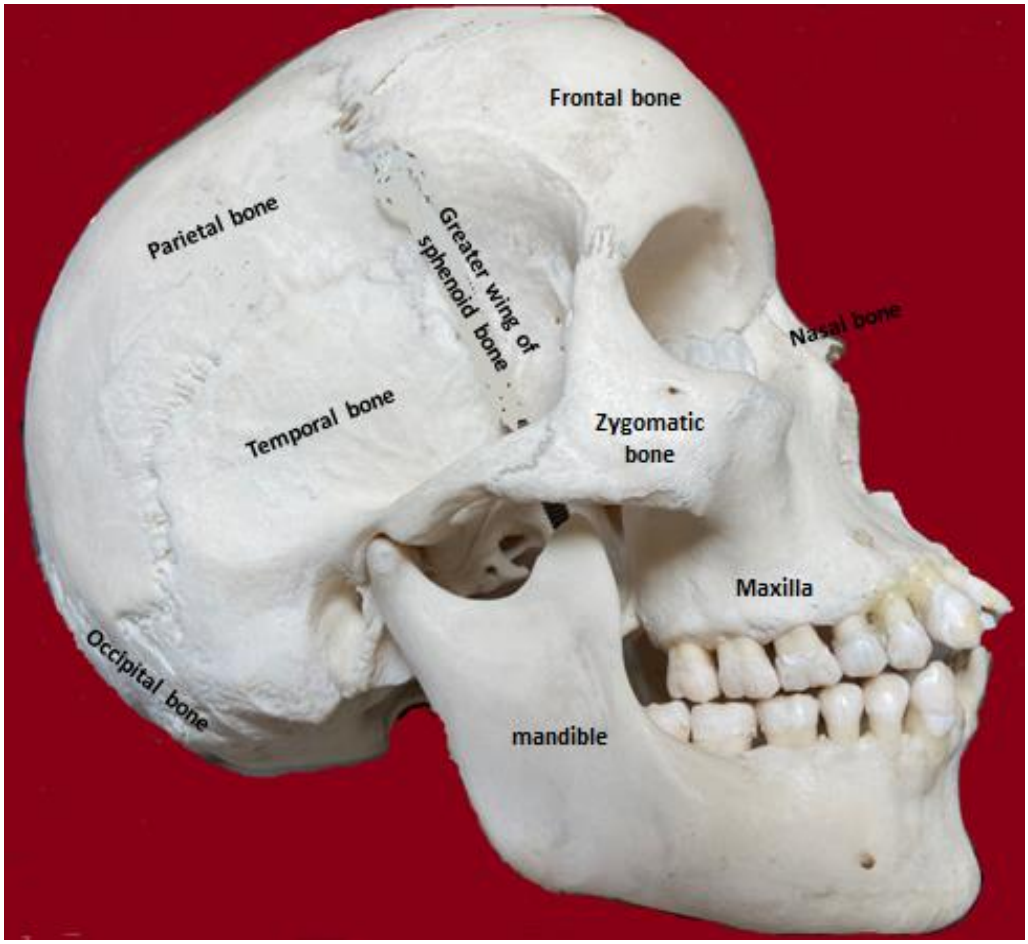

Fig. 5: lateral view of the skull

1-Temporal lines superior and inferior are two curved lines that arch from the zygomatic bone of frontal bone to the parietal bone.

They represent the superior limit of the temporal fossa.

2- ***Pterion*** it is a landmark at the junction of frontal, parietal, greater wing of sphenoid and temporal bone.

3- The temporal fossa is a slight depressed area on the temporal region (lateral surface of the skull).

The temporal bone, the sphenoid bone, the parietal bone and the frontal bone contribute to form its concave floor .

It is superior to the infratemporal fossa which lies beneath the zygomatic arch It contains and provides bony attachment for temporalis muscle

Borders of the temporal fossa :

Both superiorly and posteriorly the temporal fossa is bordered by the superior temporal line

The inferior border runs along the zygomatic arch .

The anterior border is marked by the frontal process of the zygoma and the zygomatic process of the frontal bone.

It filled by temporalis muscle.

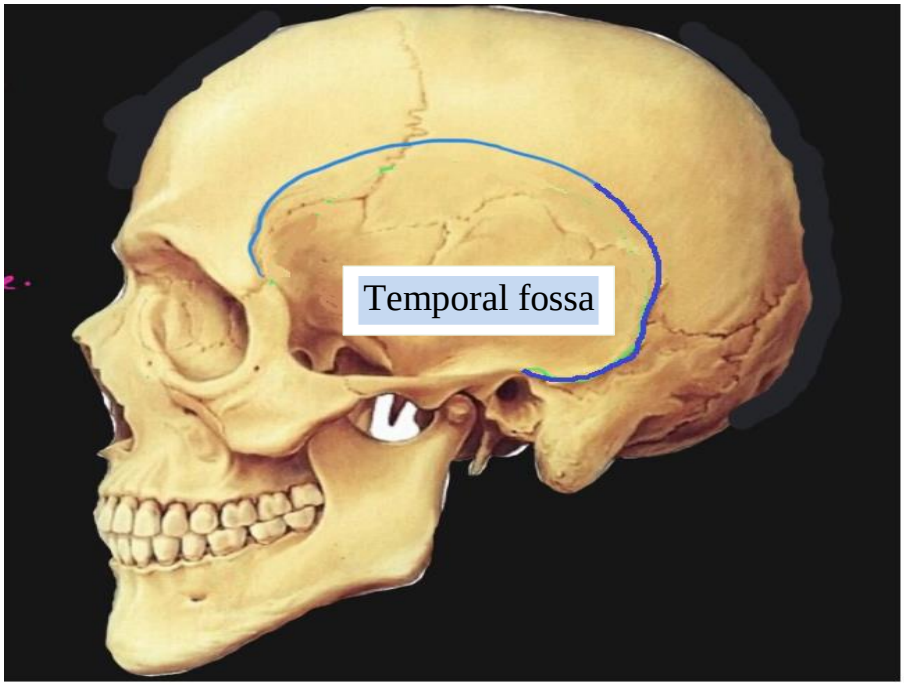

Fig. 6: Lateral view of the skull (temporal fossa)

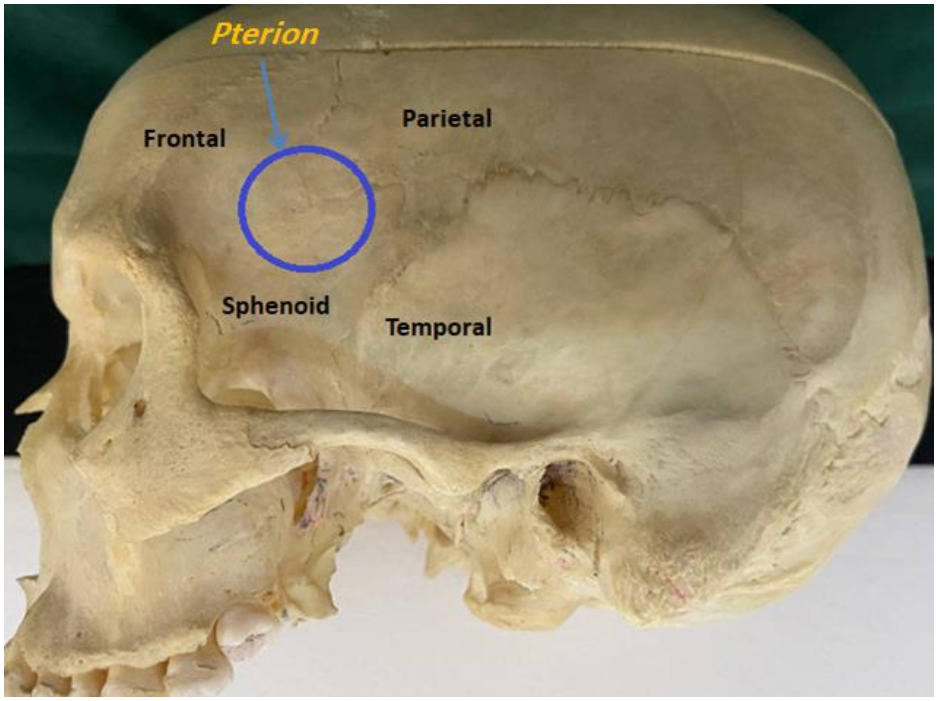

Fig. 7: Lateral view of the skull (pterion)

4- External auditory meatus of the temporal bone which forms the entrance to middle ear.

5- Mastoid process it is located posterior and inferior to the external auditory meatus.

6-Mandibular(glenoid) fossa is a depression anterior to the external auditory meatus, it articulate with the head (condyle) of mandible.

7- Articular tubercle or (eminence) is a small bone located anterior to the mandibular fossa

8- Zygomatic process of the temporal bone which forms the posterior root of zygomztic arch.

9- Body of mandible is the horizontal portion

10- Ramus of mandible is the vertical portion

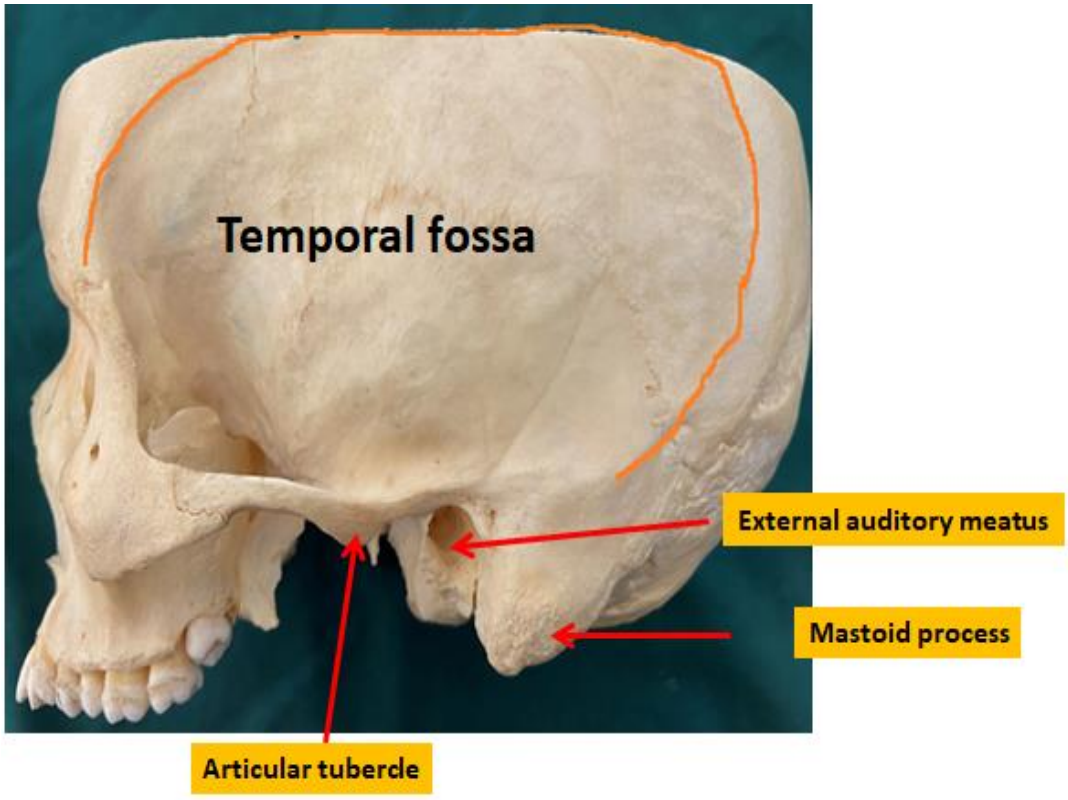

Fig. 8: Lateral view of the skull

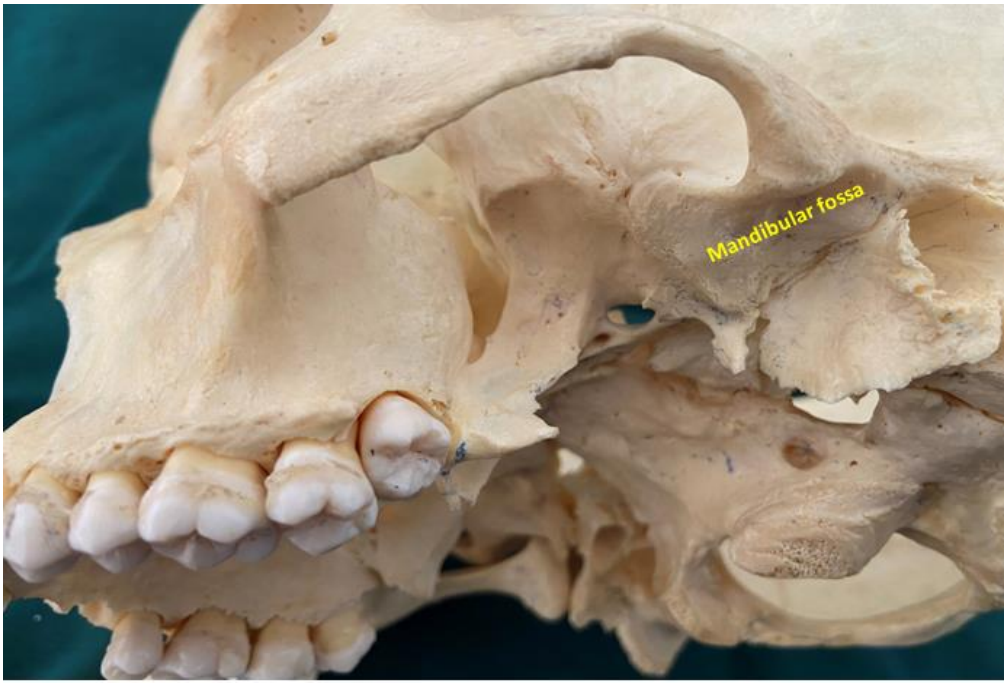

Fig. 9: Infero-lateral view of the skull

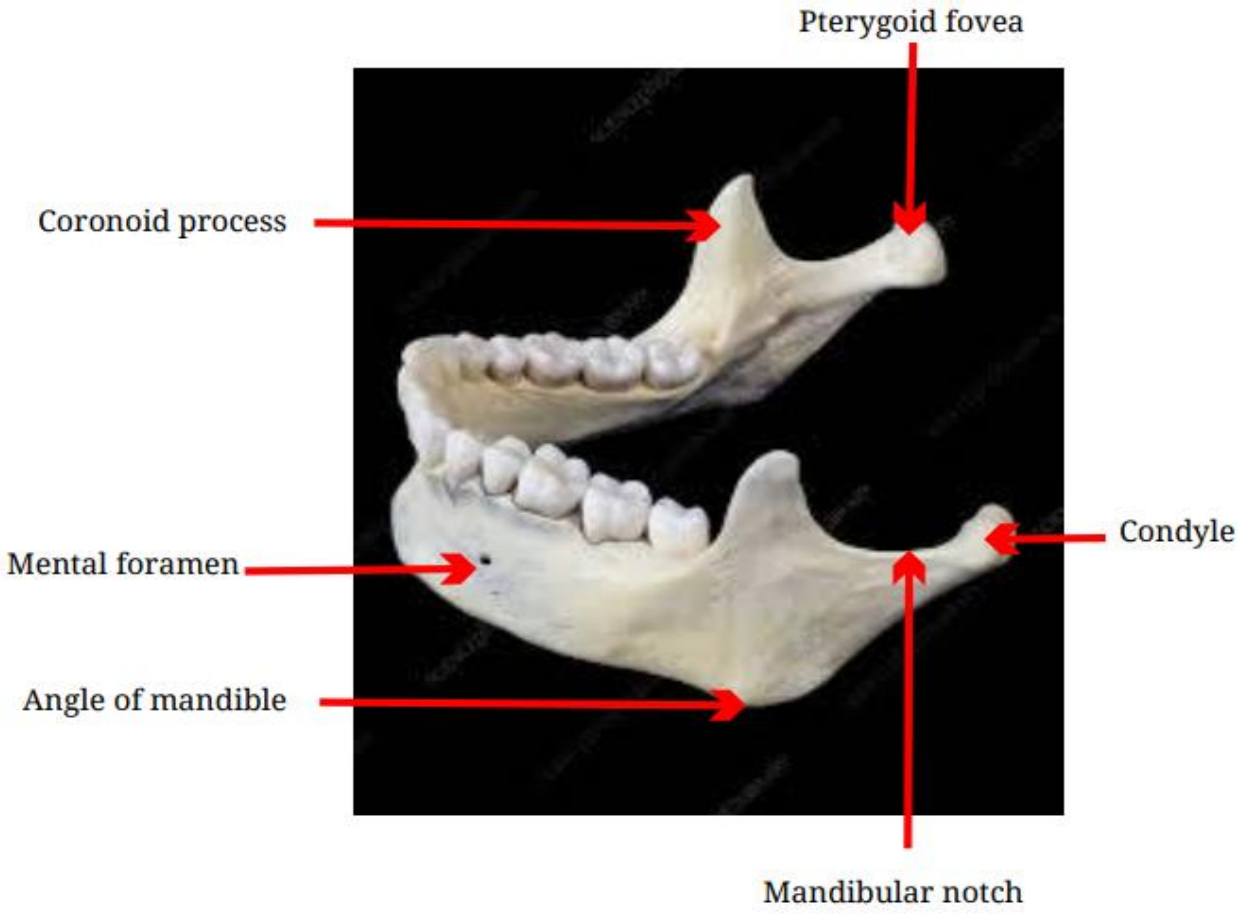

Fig. 10: The mandible

11- Neck of condyle

12- Coronoid process of the mandible ramus of

13- Mandibular notch it is the concavity between coronoid process and condyle.

14- External oblique line located on the lateral aspect of the body of the mandible.

15- The mental foramen is located at the midpoint of the inferior border and alveolar and between the 1st and 2nd premolars.

The open transmit the mental nerve and vessels.

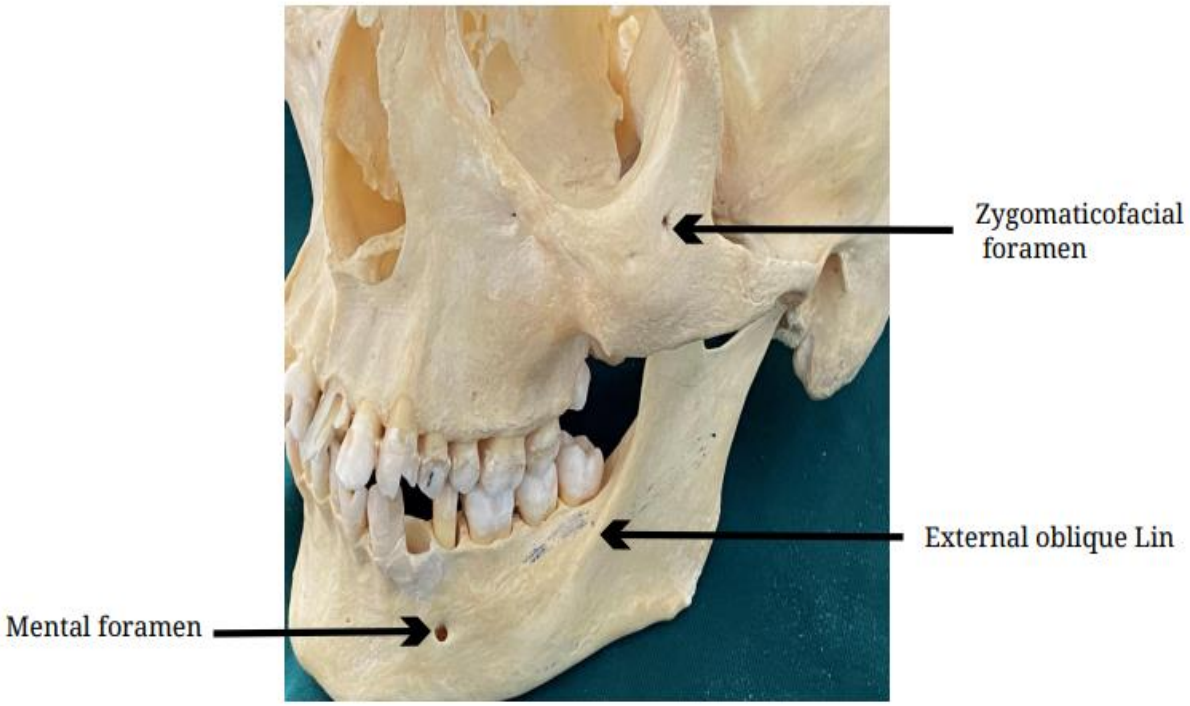

Fig. 11: Lateral view of the skull.

16- Infratemporal fossa:

It is irregular space located deep to the ramus of mandible

Boundaries:

Superiorly: the infratemporal crest (inferior region of the greater . wing of sphenoid bone)

Medially: lateral surface of the lateral pterygoid plate

Laterally: the medial surface of the ramus of mandible

Anteriorly: the posterior surface of the maxilla

Posteriorly: styloid process and the stylomandibular ligament

Inferiorly: Imaginary line extend from the maxillary alveolar process and directed posteriorly.

Main features :

1-Infraorbital fissure: It is located in the upper part of the infraorbital surface.

It is a horizontal cleft between the infratemporal fossa and the . floor of the orbit.

2- Pterygomaxillary (pterygoplatine) fissure:

It is a cleft located between the lateral pterygoid plate and the maxilla and leads from the infratemporal fossa to the pterygoplatine fossa.

3- The foramen ovale and foramen spinosum located at its roof and they communicate the fossa with the middle cranial fossa

4- Posterior superior alveolar foramina: group of foramens located on the posterior surface of maxilla.

5- maxillary tuberosity: a rounded elevation distal to the last maxillary molar tooth

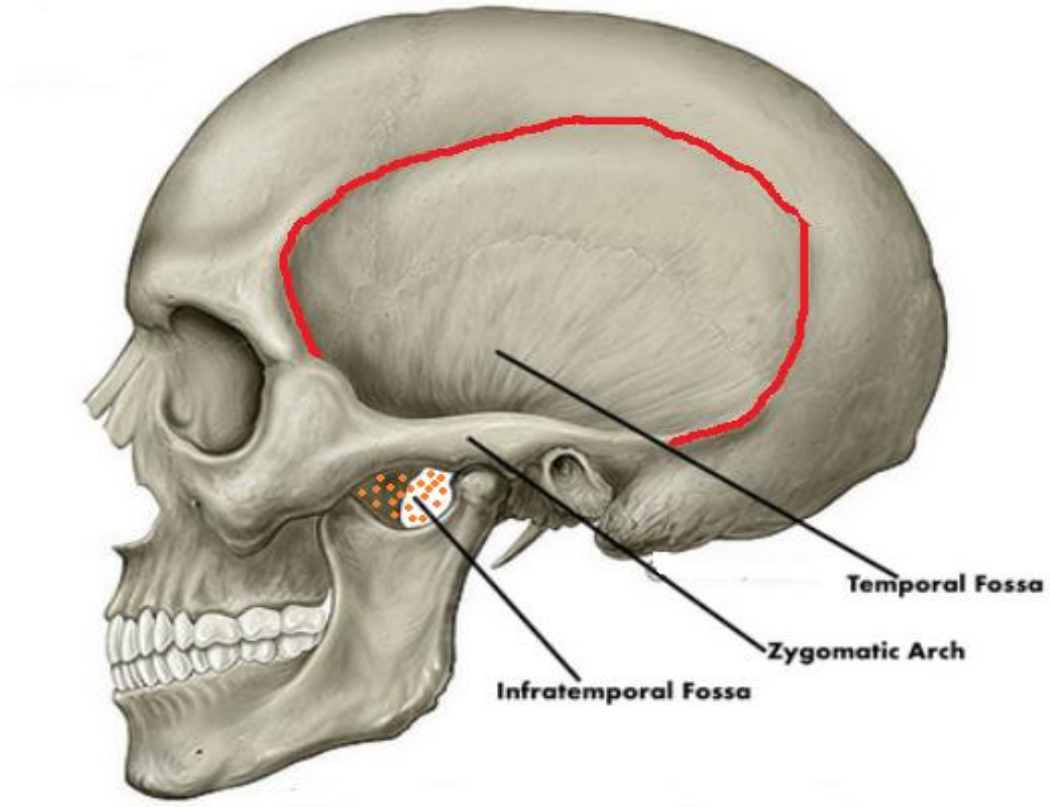

Fig. 12: lateral view of the skull

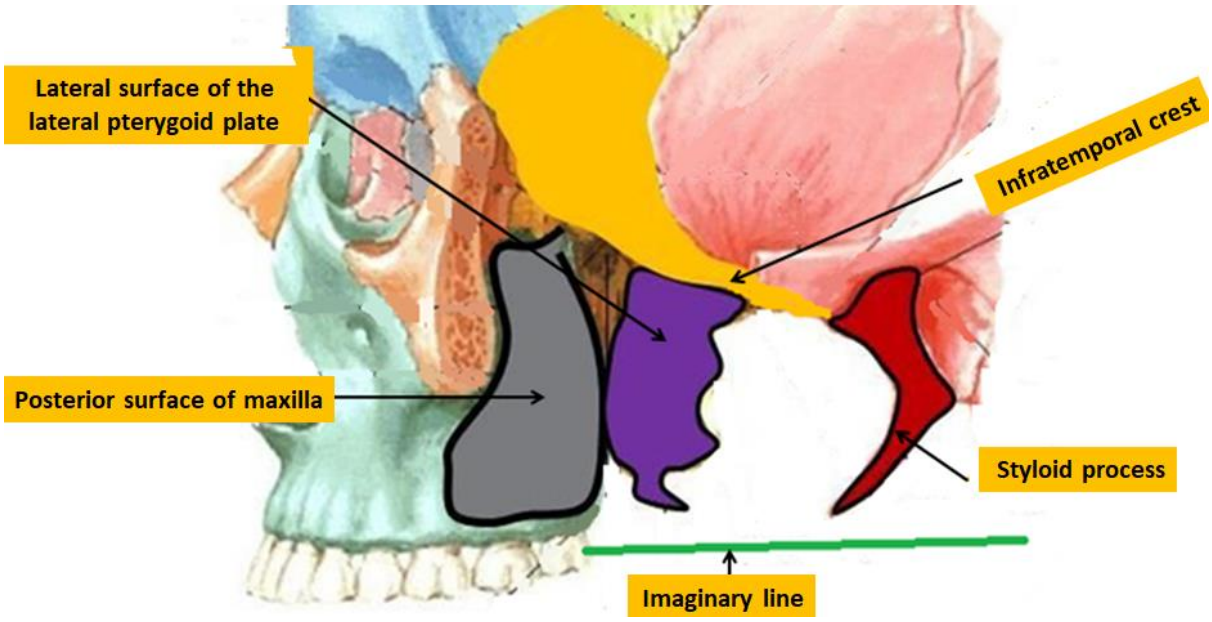

Fig: 13: Boundaries of the infratemporal fossa

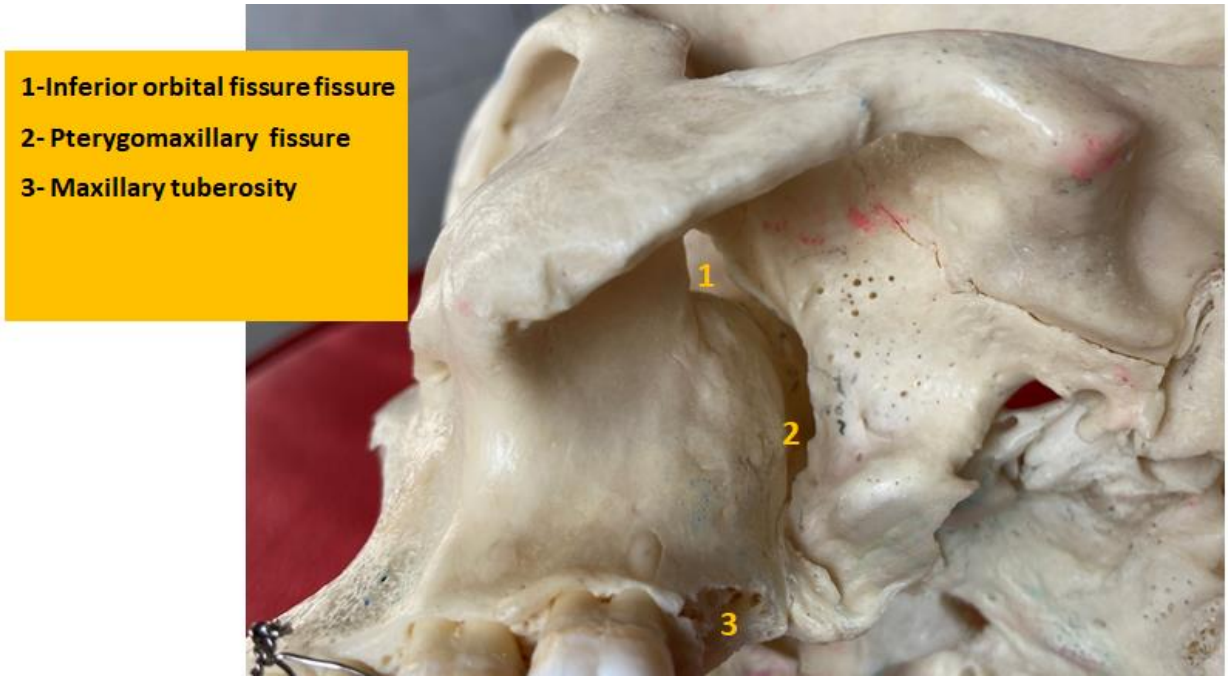

Fig. 14: Infratemporal fossa

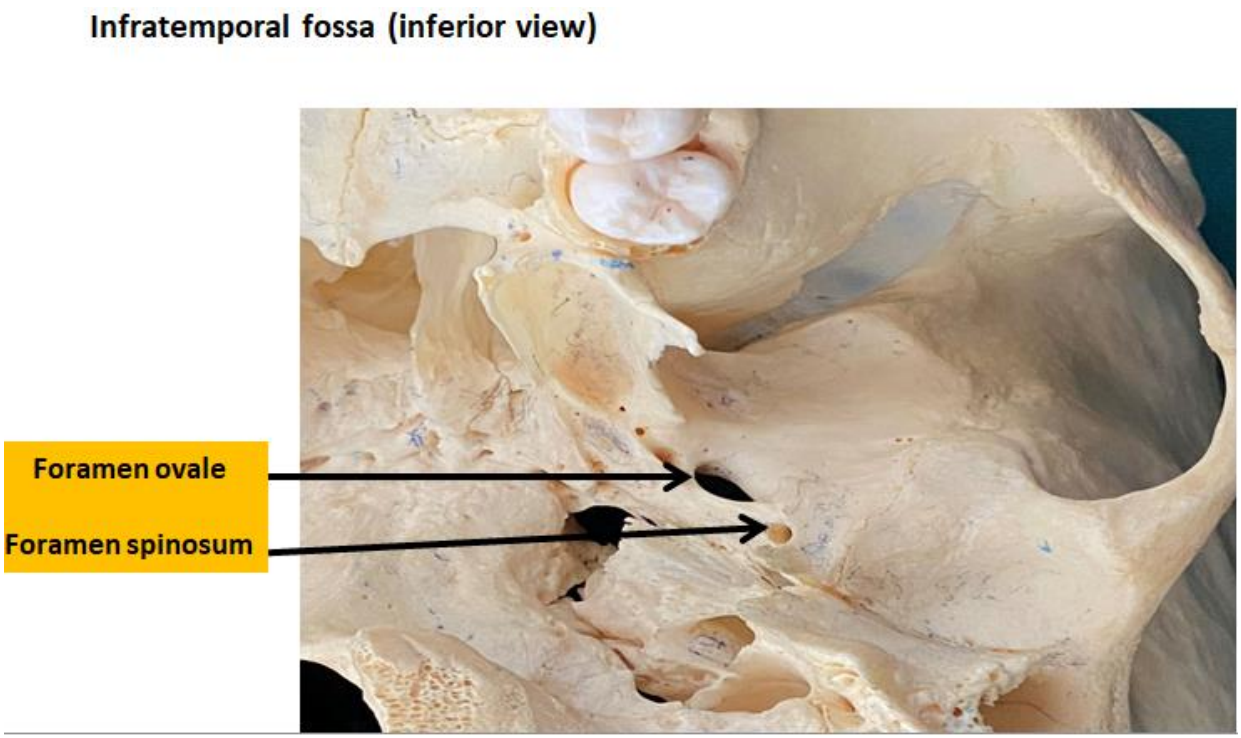

Fig. 15: Inferior view of the skull (roof of the infratemporal fossa)

Anterior view of the skull

The region of the forehead mainly by portion of frontal bone

1- Glabella is a midline elevation just above

the bridge of nose

2- The frontal eminences are genteelly rounded(corners of forehead)

3- Supercilliary arch

(brow ridge) lie on either side of glabella just above the superior margin of the orbit

In men is more prominent.

4- Supraorbital foramen or notch it located at the junction of the medial and middle thirds of the supraorbital regions.

5- Infraorbital foramen lies just below the orbit and lateral to nasal aperture. It transmit the infraorbital vessels and nerve

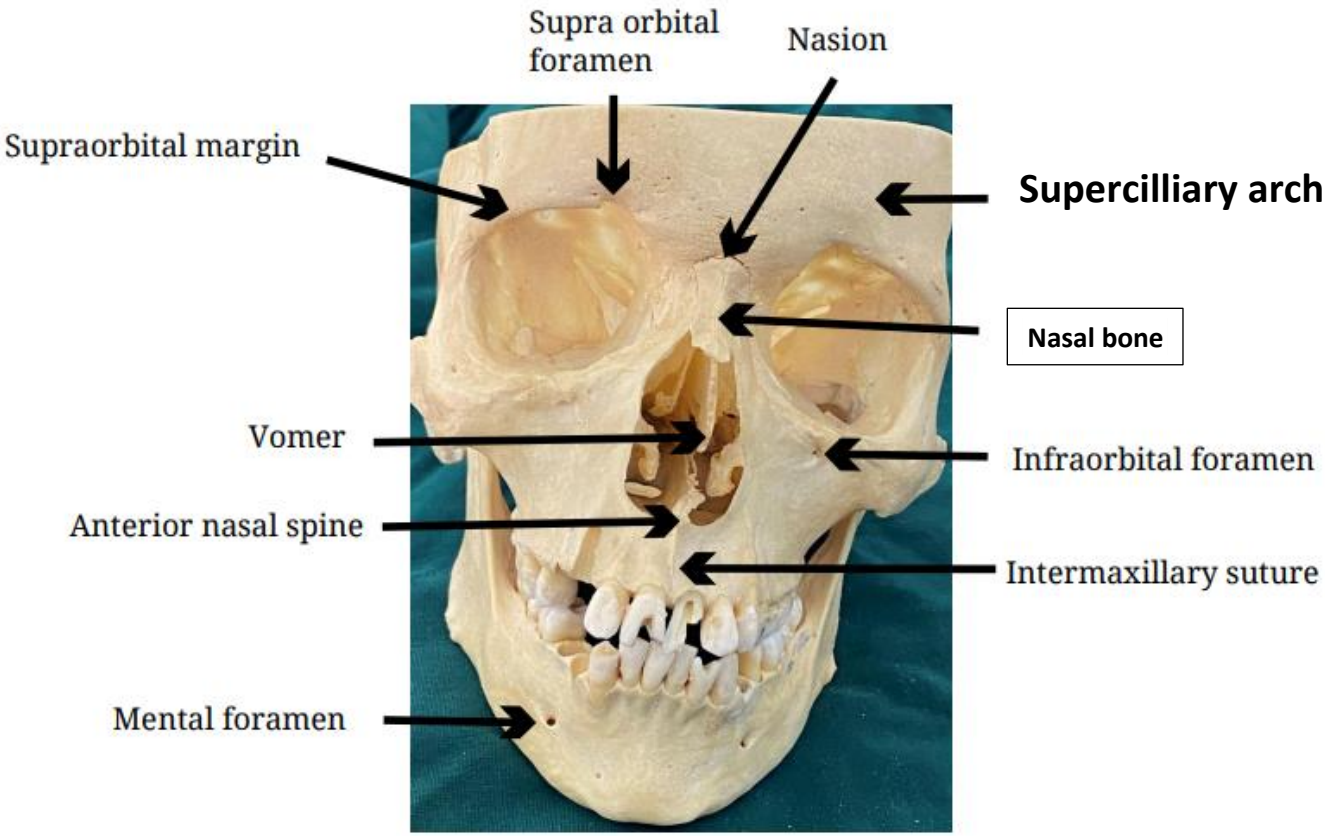

Fig. 16: Anterior view of the skull

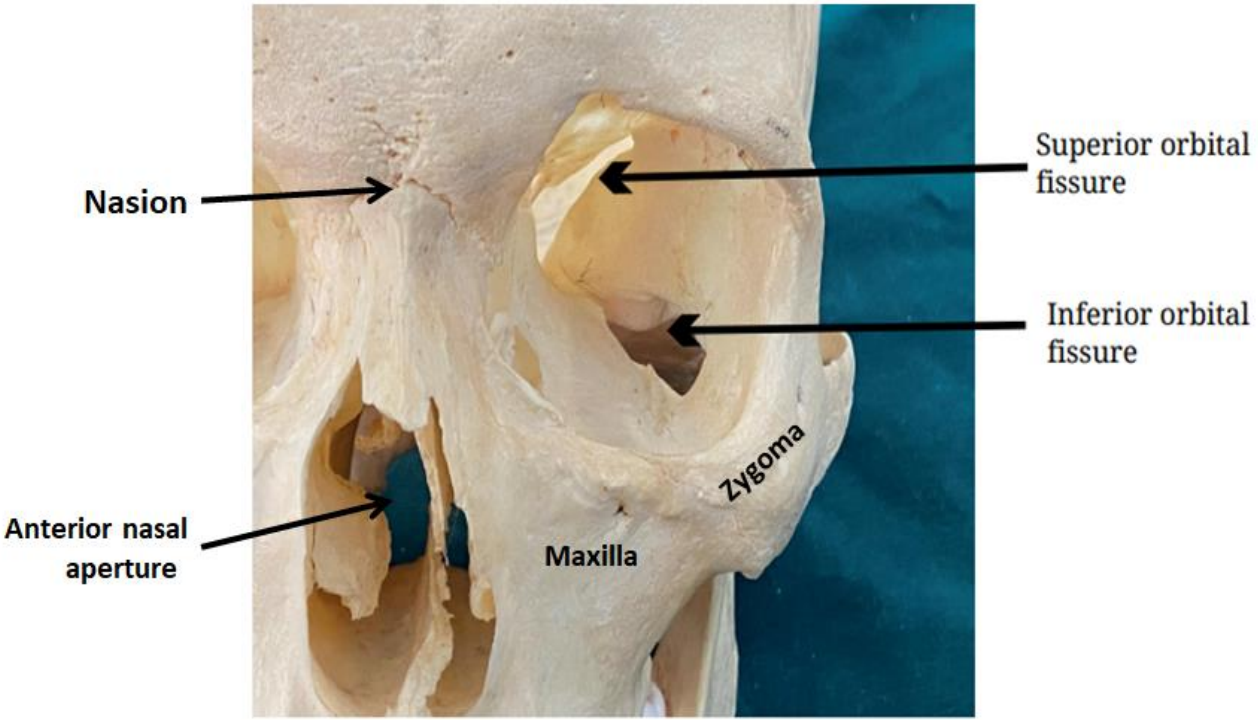

Fig. 17: Anterior view of the skull

6- Zygoma is the area of check bones which arranged inform of arch, three bones support the zygomatic arch, the maxilla ,the frontal bone and temporal bone .

The main bone of the arch is the zygomatic bone

7- Zygomaticofacial foramen located on the zygomatic bone and transmit zygomatic- facial vessels and nerve

8- Anterior nasal aperture is a midline pear –shaped opening.

9- Anterior nasal spine is a sharp midline projection extending anteriorly from the floor of nasal cavity.

10- Nasion is a landmark represent the articulation between the nasal bones and frontal bone-

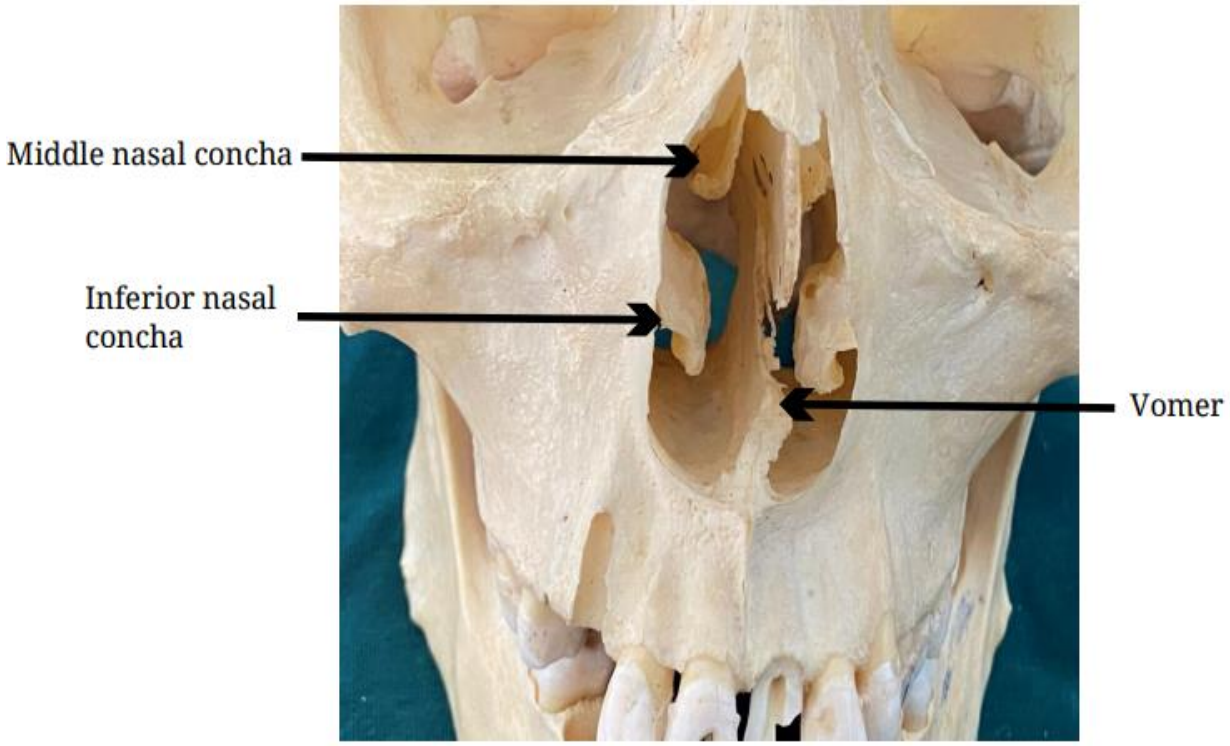

Fig. 18: Anterior view of the skull (nasal cavity)

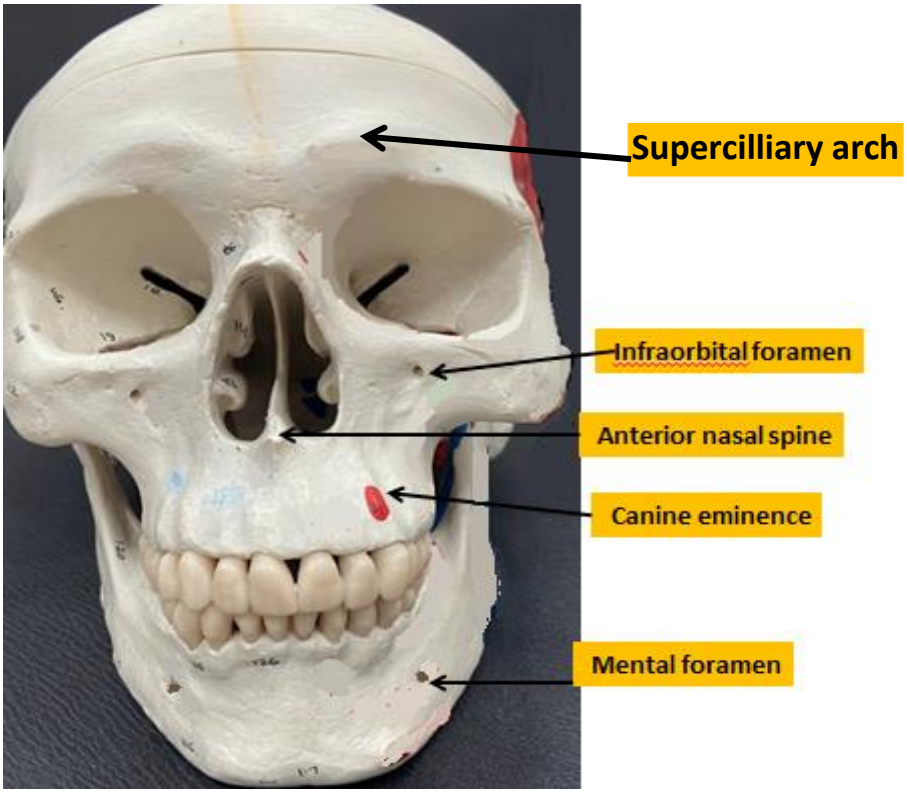

Fig. 19: Lateral view of the skull

The upper and lower jaws house the teeth

The upper jaw is fixed and consists of two bones

The lower jaw (mandible) is a movable jaw and formed by one bone

1- The teeth are the obvious features of the region there are 32 teeth in the complete adult dentition and 20 in child

2- The alveolar process of maxilla and mandible are the boney socket that support the teeth.

3- The canine eminence or ridge of maxilla is a prominent ridge of bone overlying the long and prominent maxillary canine teeth.

4- The incisive fossa of the maxilla is a depression overlying the incisor maxillary roots

5- The canine fossa of the maxilla is the depression overlying the premolar roots.

6- Mental protuberance of the mandible is the triangular elevation of bone that form the chin.

7- The incisive fossa of the mandible is the concavity just inferior to the mandibular incisors and above the mental protuberance.

8- Mental foramen of the mandible is an opening located at the level of 2nd mandibular premolar.

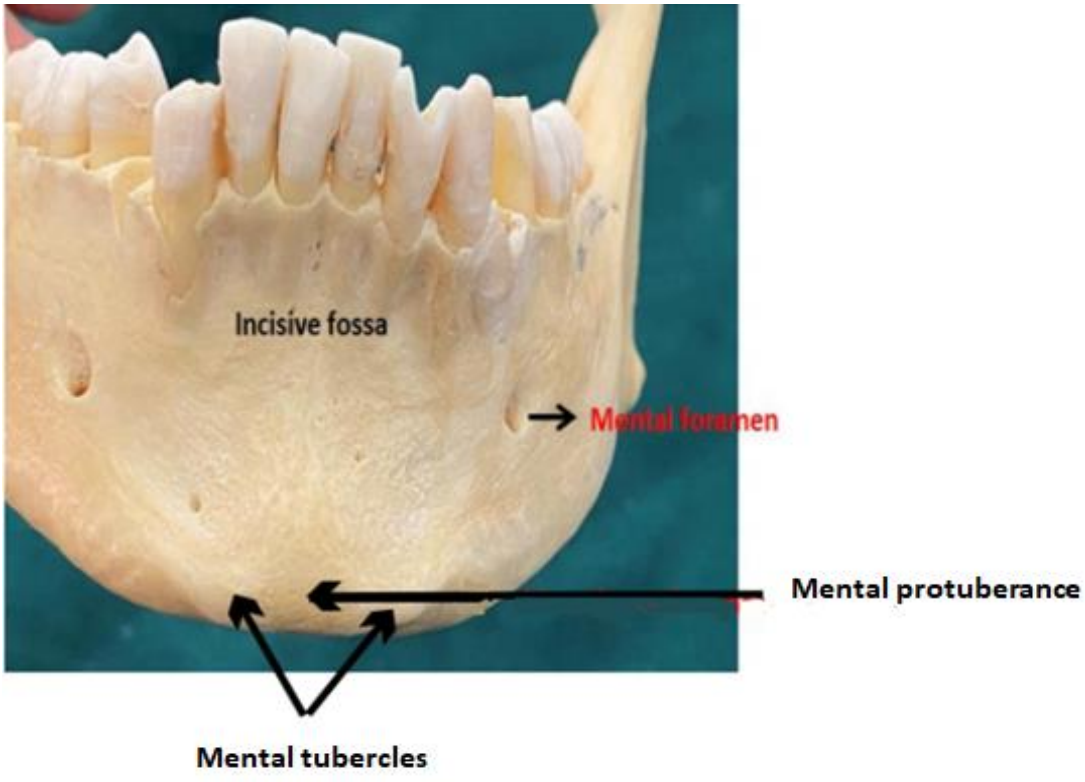

Fig. 21: Anterior view of the mandible.

Chapter 2

Features at the base of skull

The anterior region

1- Maxillary teeth and maxillary alveolar process which end posteriorly at the **maxillary tuberosity**.

2- hard palate: composed two bones:

A- palatine process of maxilla which form the anterior 2 thirds of palate.

B- **Horizontal plate of palatine bone** form the posterior third .

3- Posterior nasal spine: It is a mid-line posterior projection from the posterior border of the horizontal plate of palatine bone.

4- Incisive canal: is a midline opening on the palate posterior to the central incisors. It transmits the nasoplatine nerve and vessels.

5- Greater palatine foramen: Paired opening on the palate medial to the last maxillary molar. It transmits the greater palatine nerve and vessels.

6- Lesser palatine foramen: is a second paired opening posterior to the greater palatine foramen. Located medial to the maxillary tuberosity,

It transmits the lesser palatine nerve and vessels

7- Posterior nasal aperture (posterior choanae): It represent the posterior limits of nasal cavity.

The nasal septum (vomer +Vertical plate of ethmoid bone) divides the aperture in right and left chambers.

8- The maxillary tuberosity is the most (distal) aspect of the upper jaw (maxilla) . It is a rounded eminence and upper wisdom tooth lies just in front and within the maxillary tuberosity

9- At the either side of posterior nasal aperture there are a wing like processes called **pterygoid plates or lamina**(medial and lateral pterygoid plates.

10- The **medial pterygoid plate** is long and narrow and ends inferiorly as a small hook called **hamulus**.

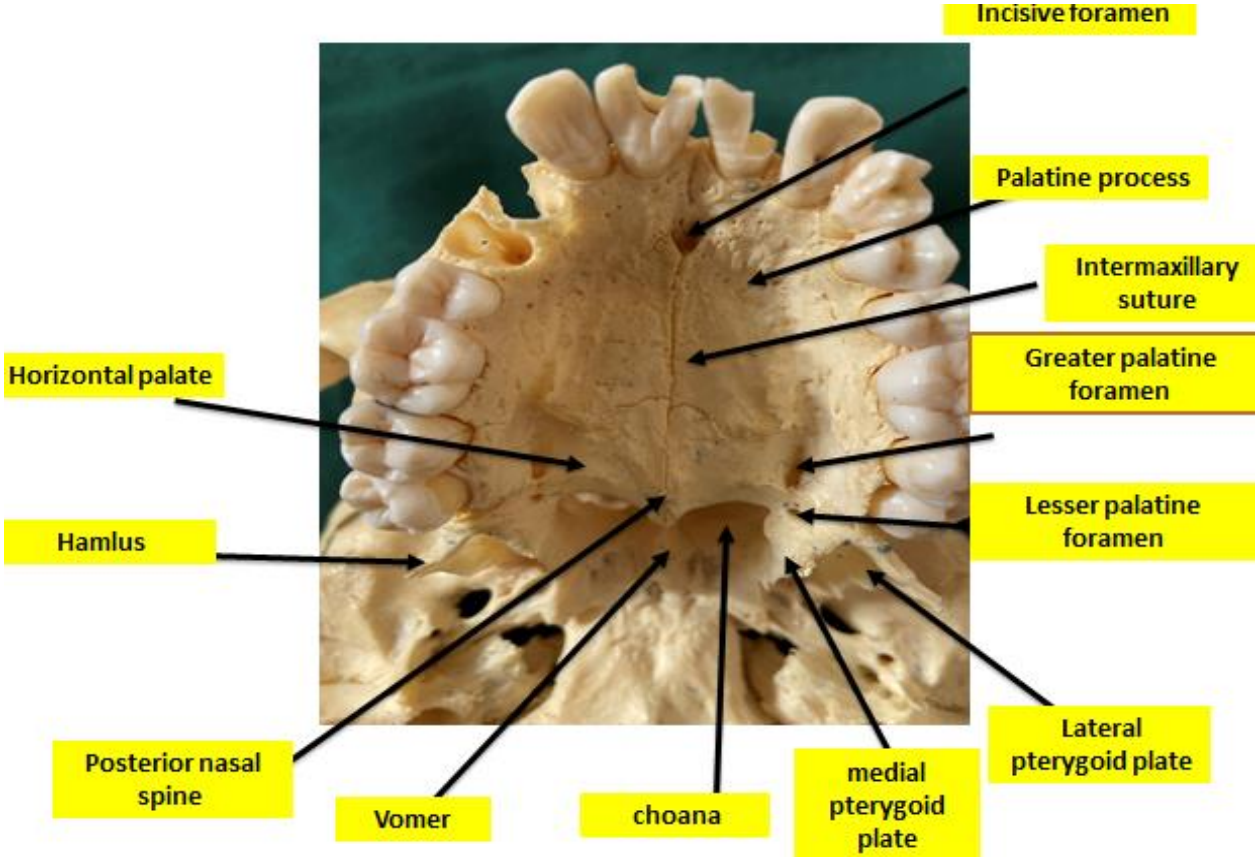

Fig. 22: Inferior surface of the skull(anterior region of the base)

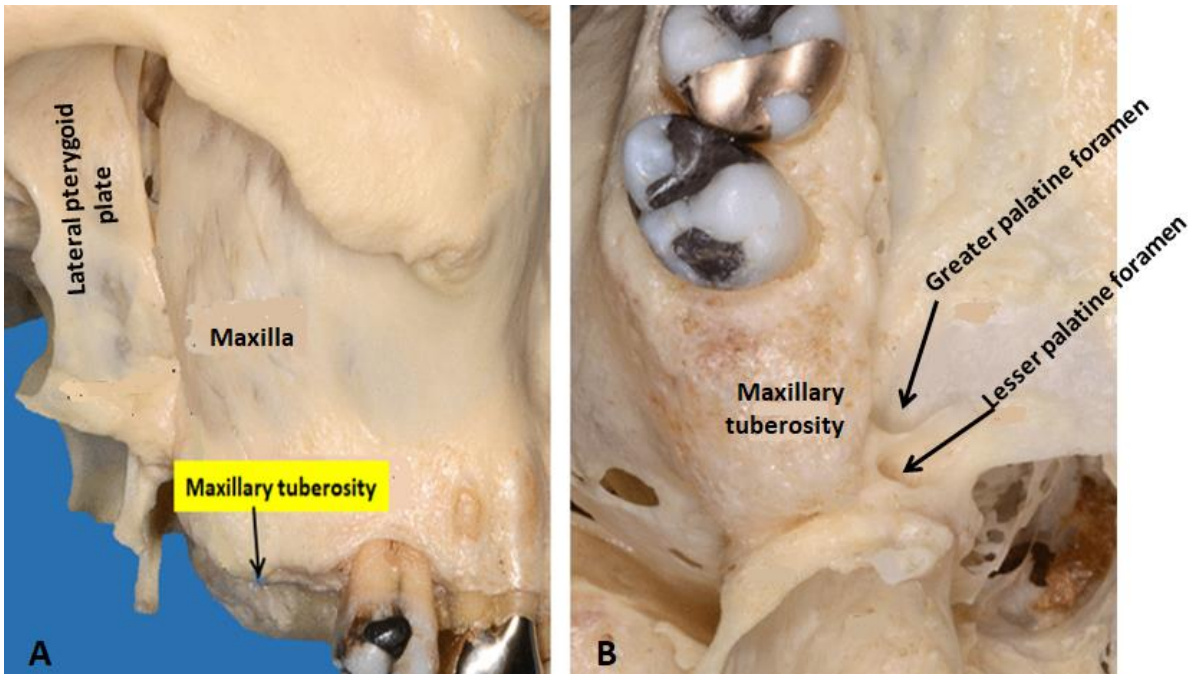

Fig. 23: Lateral view of skull(A), inferior view of the skull (B).

Intermediate region of the skull

1- Mandibular fossa : which accommodate the condyle of mandible.

2- External auditory meatus: located behind the mandibular fossa.

3- The tympanic part of temporal bone which forms the wall of the external auditory meatus.

4- **Seqamotympanic (petrotympanic) fissure** which separates the squamous part from tympanic part of temporal bone.

The part of fissure which extends to the mandibular fossa called petrotympanic fissure

5- Sphenoid spine : is a projection medial to mandibular fossa.

6- Foramen spinosum: is a small opening just anterior to the sphenoid spine.

7- Foramen Ovale: it lies anterior to the foramen spinosum (and at the base of lateral pterygoid plate) , through it pass the mandibular nerve and the middle meningeal artery.

8- Groove for the auditory tube (austacian canal) ,it located medial to the sphenoid spine and the cartilagenous part of the auditory tube lies within this groove.

9-Pharyngeal tubercle : is a small median elevation on the basal portion of the occipital bone.

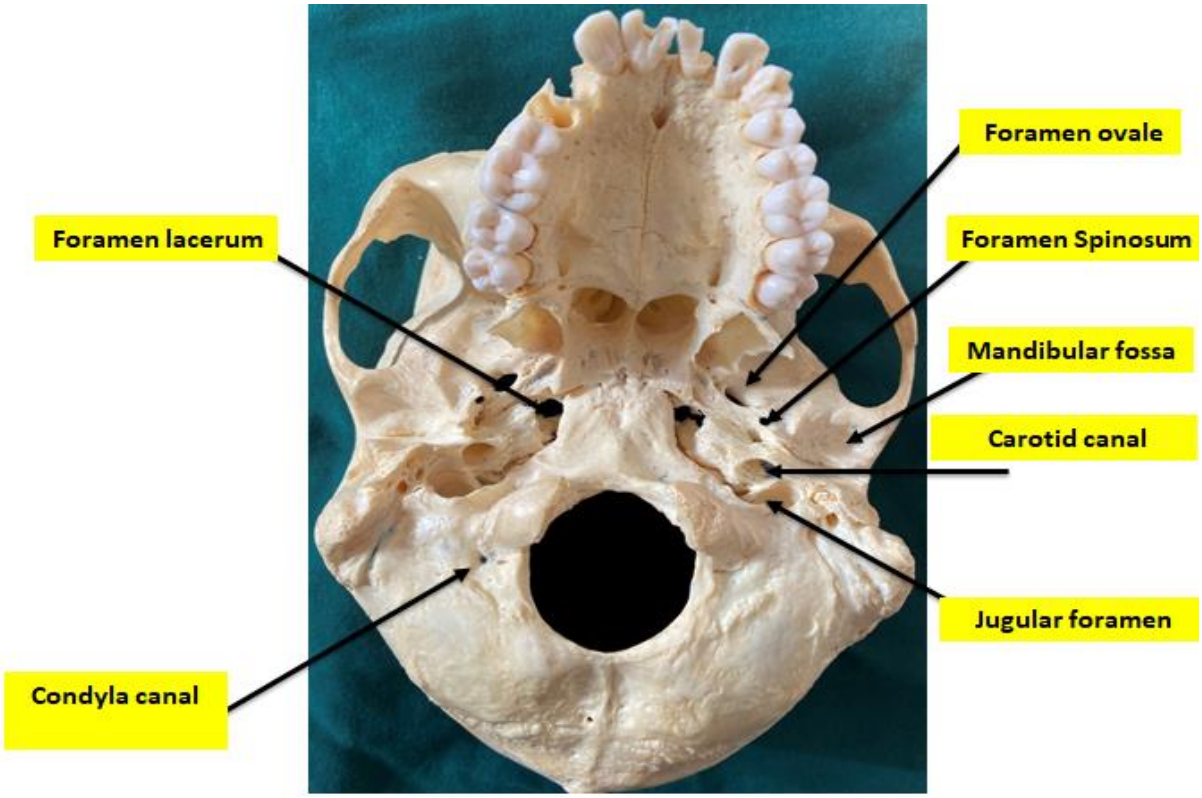

Fig. 24: Inferior view of the skull.

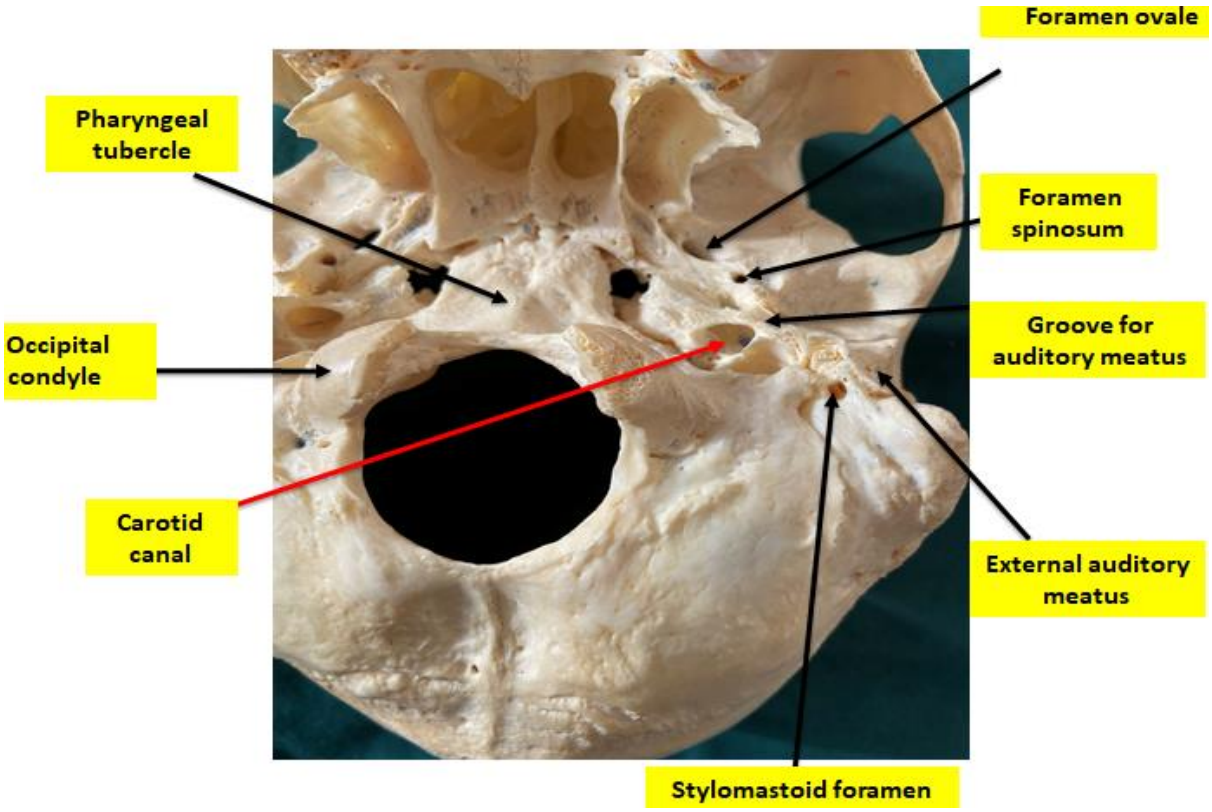

Fig. 25: Inferior surface of the skull.

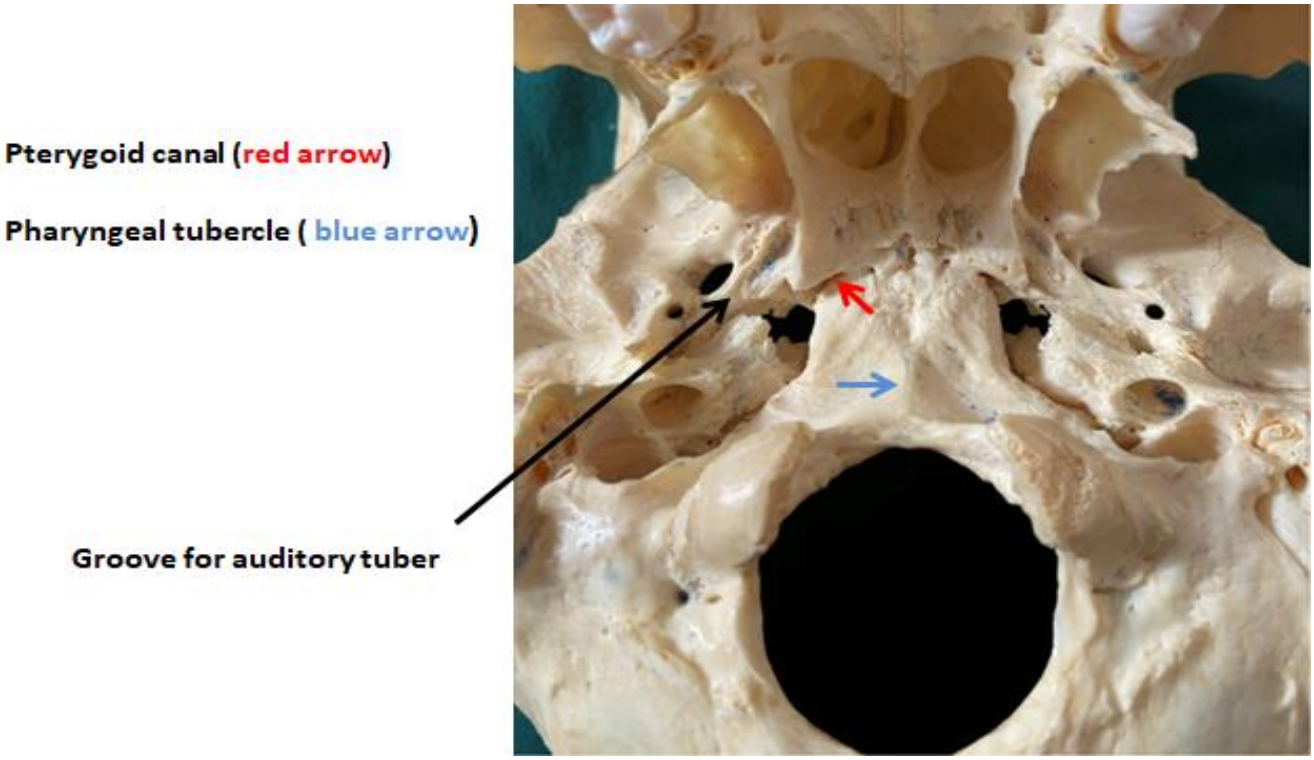

Fig. 26: Inferior surface of the skull.

10- Mastoid process: part of temporal bone for insertion of sternomastoid muscle.

11- Styloid process: is a long slender, needlelike process.

12- Stylomastoid foramen: lies between the mastoid and styloid processes. The facial nerve passes through it.

13- Jugular foramen: a large opening and through it passé the internal jugular vein, and cranial nerves IX,X and XI.

14- Carotid canal: it is located immediately anterior to jugular foramen. Passing through it the internal carotid artery.

15- Foramen lacerum: Is irregular area between the tip of petrous bone the greater wing of sphenoid and the side of the basilar portion of occipital bone.

This gap is filled normally by fibrocartilage and only seen in dry skull.

Anterior to it located the **pterygoid canal** which opened into the **pterygoplatine fossa**.

.

1-Foramen ovale
2- Foramen spinosum
3-mandibular fossa
4- Foramen lacerum
5-Carotid canal
6- jugular foramen
7- Stylomastoid foramen
8- Styloid process
9- Mastoid process
10-Extenal auditory meatus
11- Sulcus for auditory tube
12-petrotympanic fissure

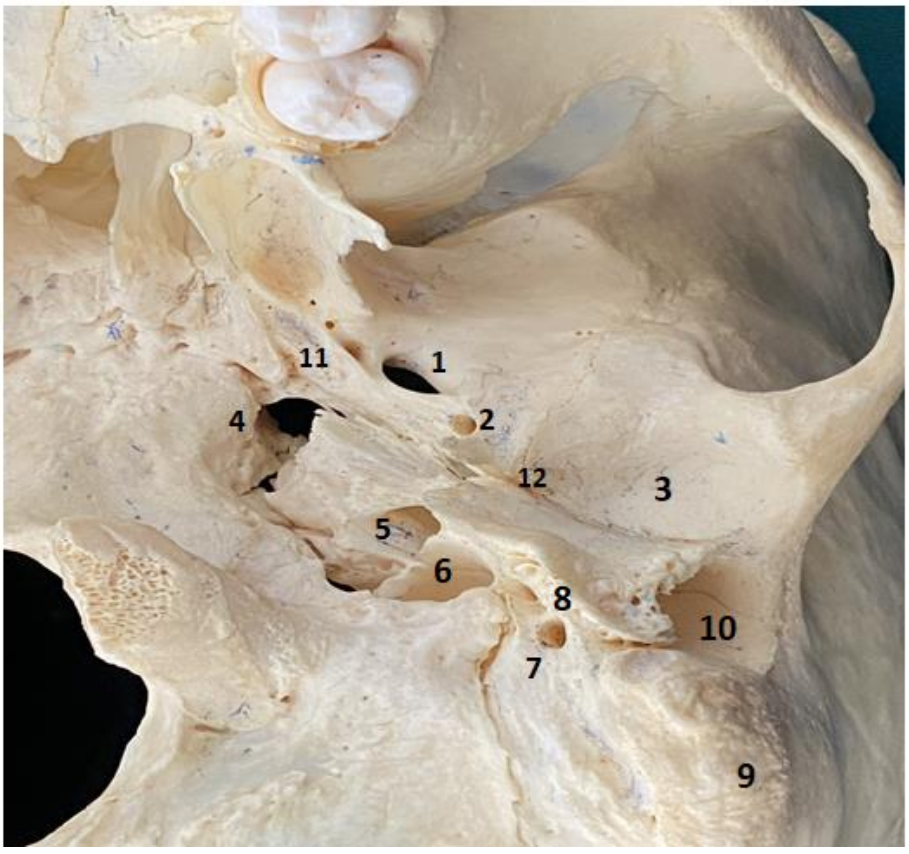

Fig. 27: Inferior surface of the skull(intermediate region of the base)

The posterior region of the skull

1- Foramen magnum: is a large egg-shaped opening that transmits the spinal cord.

2- Occipital condyles: are two bean-shaped articular processes on either side of foramen magnum. They articulate inferiorly with the atlas.

3- Anterior to each occipital condyle is the **hypoglossal canal** for the hypoglossal nerve.

4-Posterior to each occipital condyle is the **condylar canal** for emissary vein.

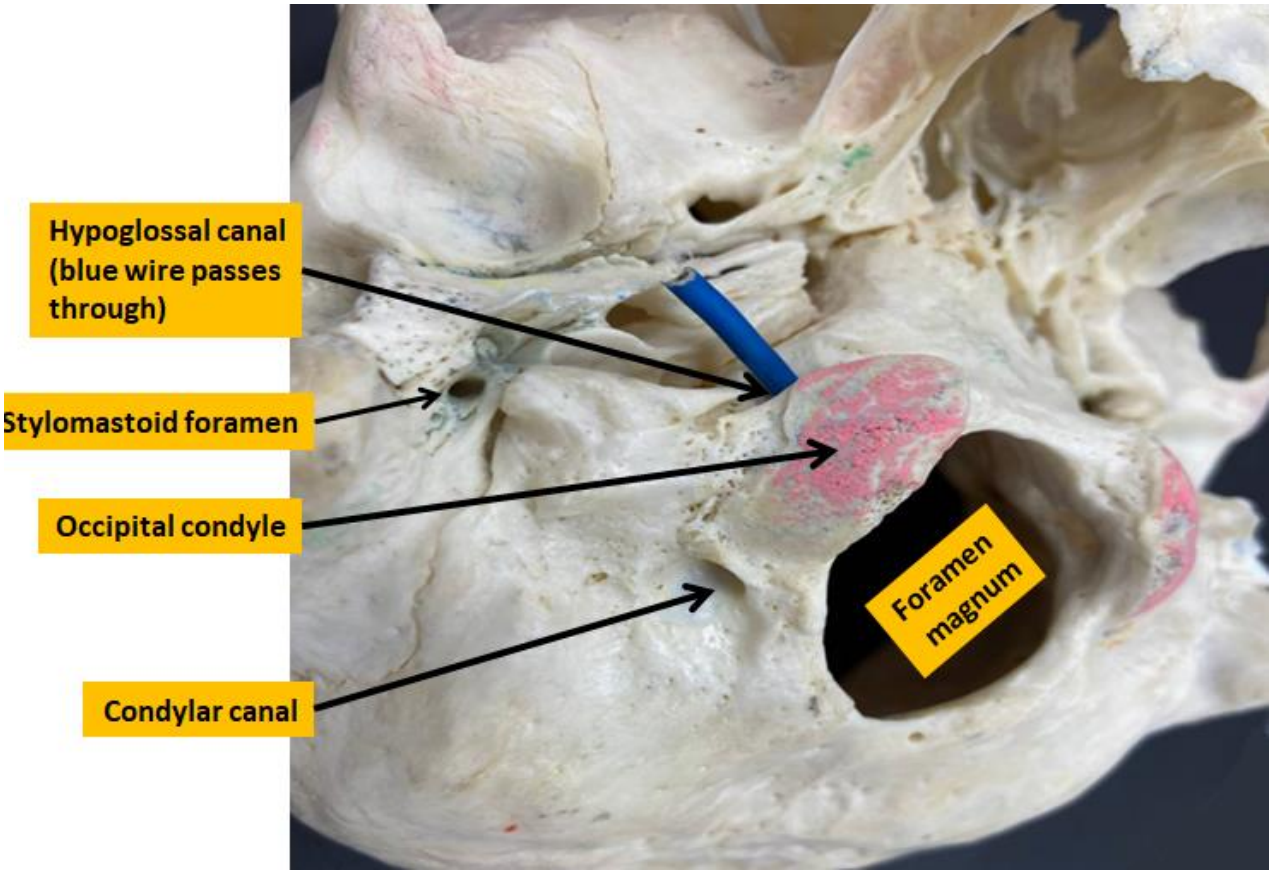

Fig. 28: Inferior view of the skull (posterior region of the base)

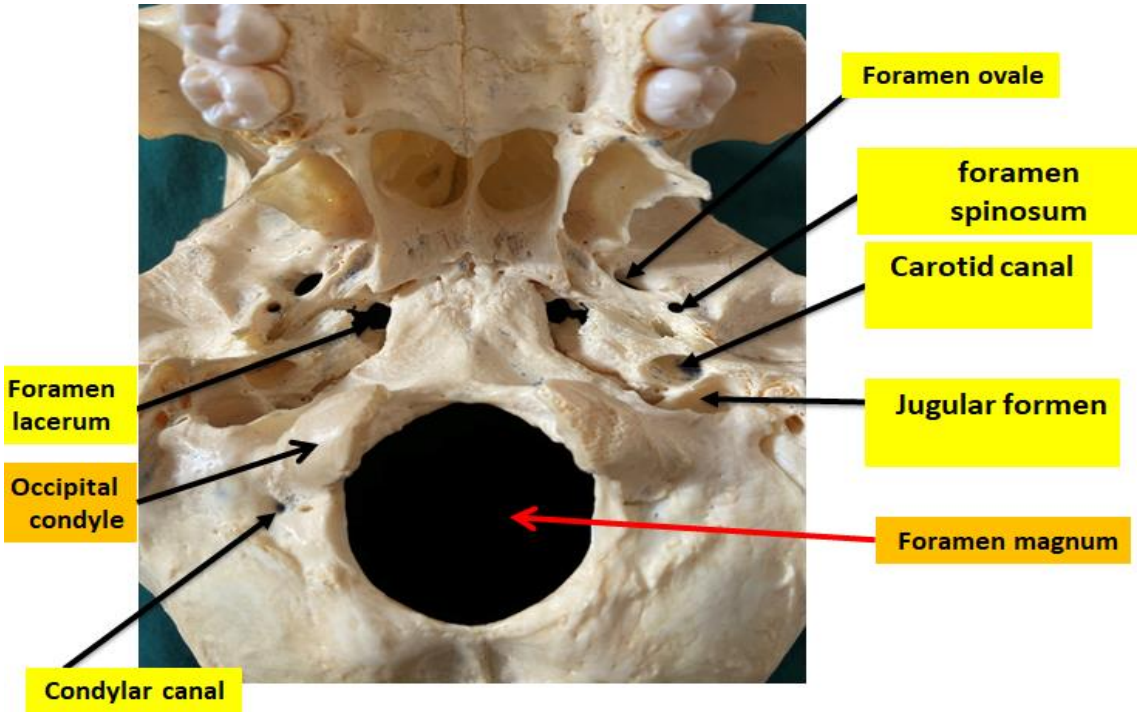

Fig. 29: Inferior view(base) of the skull.

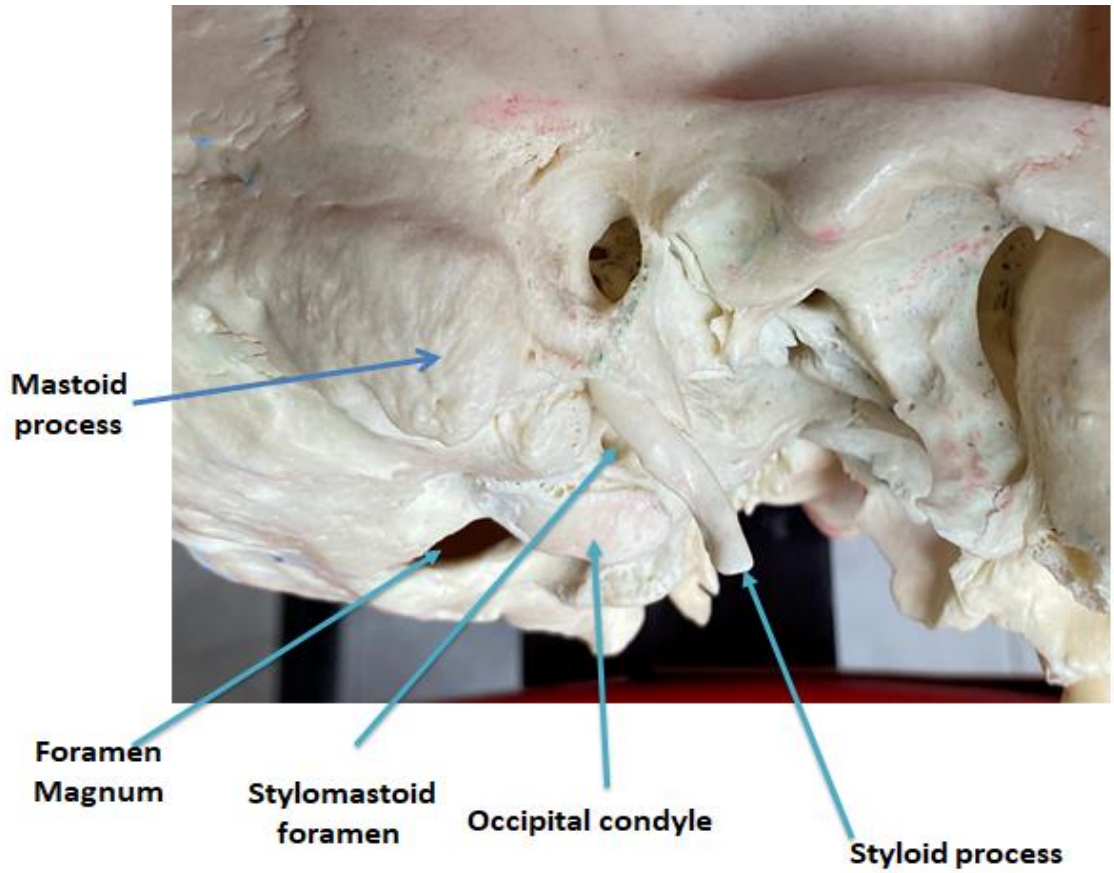

Fig. 30: Lateral view of the skull.

Chapter 3

The internal aspect of the skull (cranial cavity)

Vault of the Skull (skull-cap or calvaria):

The bones forming the calvaria are the frontal, occipital and parietal bones.

The internal surface of the vault shows the coronal, sagittal, and lambdoid sutures.

In the midline is a shallow sagittal groove that lodges the superior sagittal sinus.

On each side of the groove are several small pits, called granular pits, which lodge the lateral lacunae and arachnoid granulations.

Several narrow grooves are present for the anterior and posterior divisions of the middle meningeal vessels as they pass up the side of the skull to the vault.

The term **'diploe'** is used to describe the spongy or cancellous region of intervening bone between the hard outer layer and the inner hard layer of the e skull.

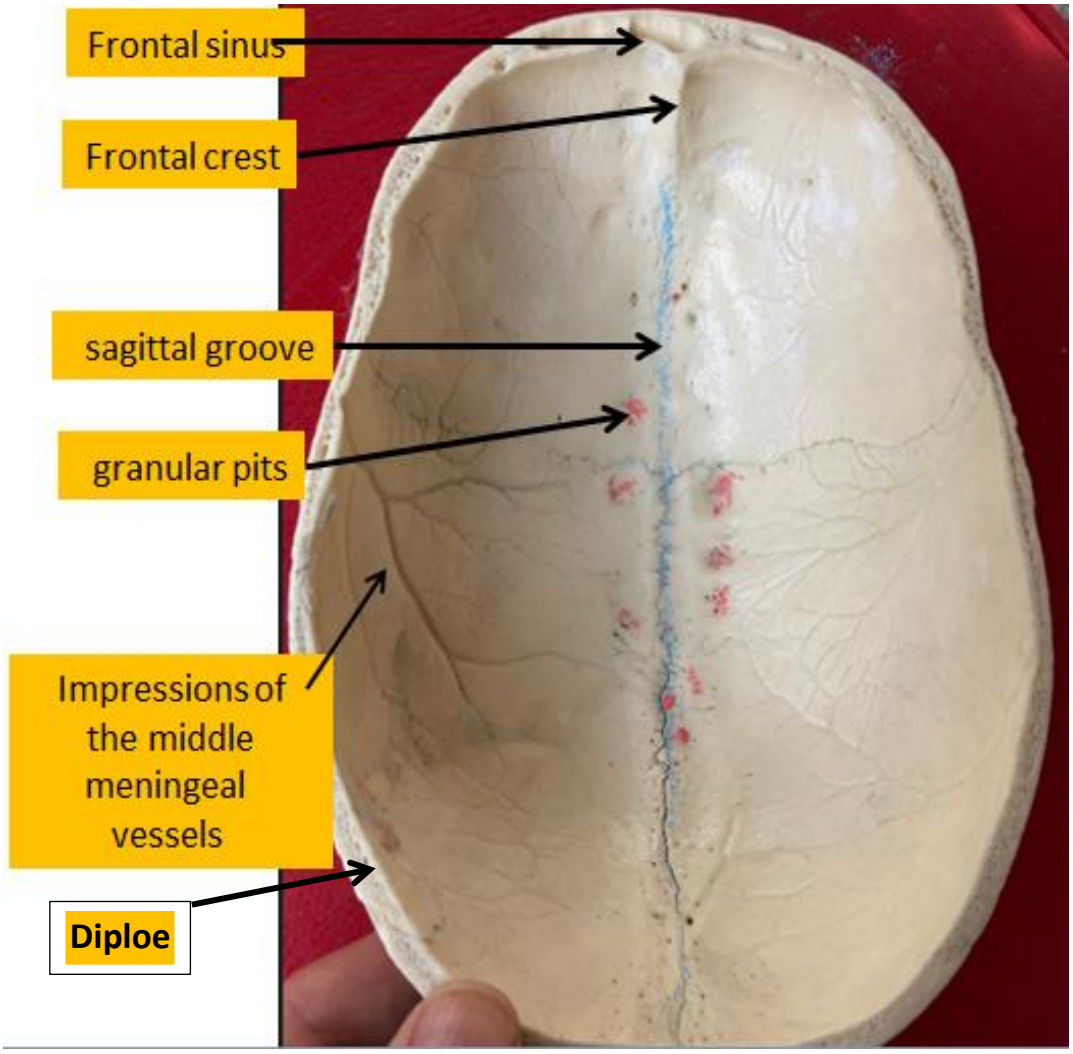

Fig. 31: Inner surface of calvaria.

Internal aspect of the base of the skull:

The internal aspects of skull divided into 3 fossae:

1- Anterior cranial fossa : which bounded anteriorly by frontal bone and posteriorly by the lesser wing of sphenoid bone.It contains the frontal lobes of the cerebrum.

2- middle cranial fossa: which bounded anteriorly by lesser wing of sphenoid bone and posteriorly by dorsum sellae and the two petrous portion of temporal bone. It contains the temporal lobes of the brain.

3- Posterior cranial fossa: it bounded anteriorly by dorsum sellae and the two petrous portion of temporal bone and posteriorly by the occipital bone. It contains the occipital lobe of cerebrum and the cerebellum

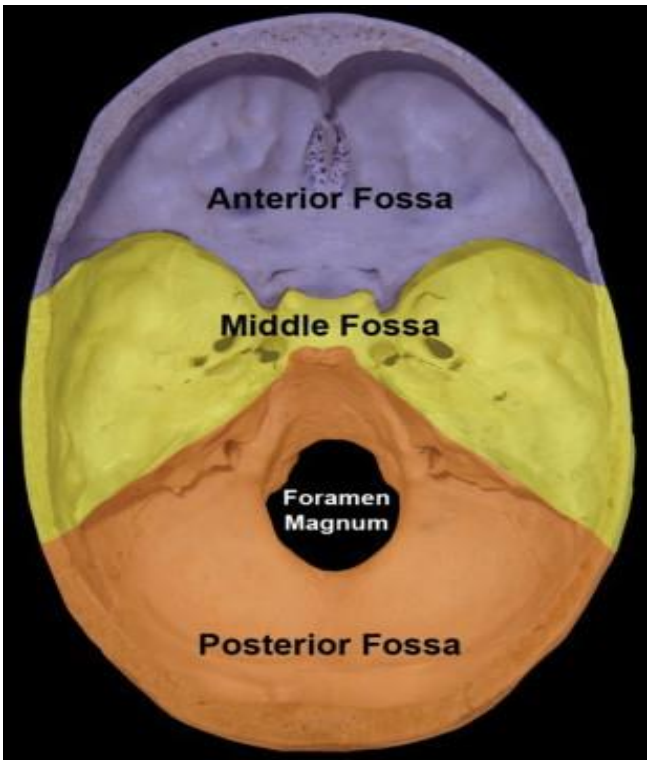

Fig.32 : Internal aspect of the skull.

Anterior cranial fossa of the skull

1- The frontal crest: is a midline bony extension of the frontal bone and serves as bony attachment for falx cerebri.

2- Crista galli (cocks comb): part of ethmoid bone which project upward in the midline and serves as bony attachment for falx cerebri.

3- cribriform plate of the ethmoid bone: are perforated area on either side of crista galli. The small perforations(foramens) communicate with the roof of nasal cavity to transmit the olfactory nerve.

4- Foramen cecum :is a blind ended opening between the crista galli and the frontal crest. Through it passes emissary vein.

5- Orbital plates of the frontal bone: are convex elevations to either side of cribriform plates. They form the roof of the bony orbit.

6- lesser wing of sphenoid bone

7- Anterior clinoid processes :which extend posteriorly from the lesser wing.

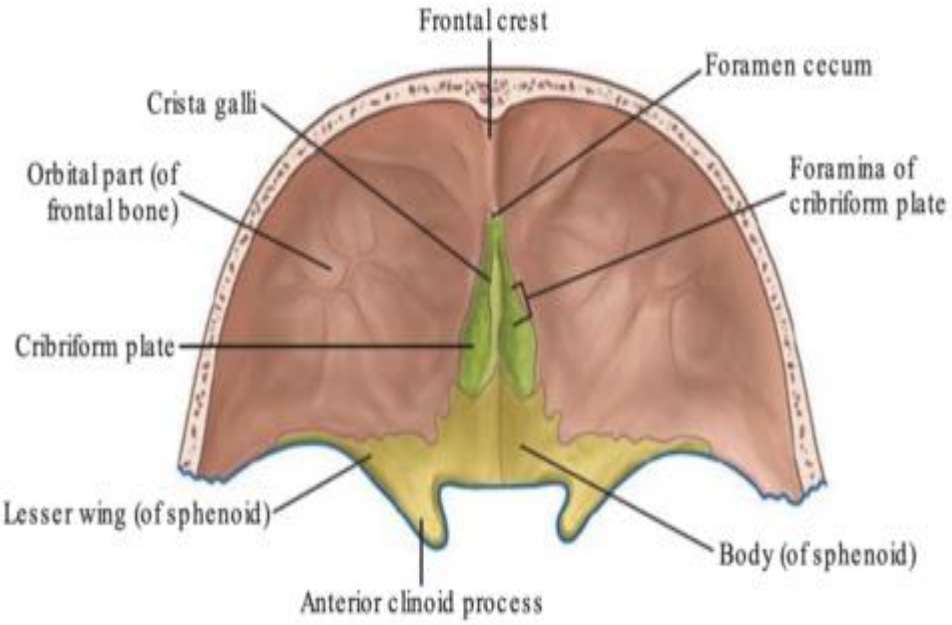

Fig. 33: Anterior cranial fossa

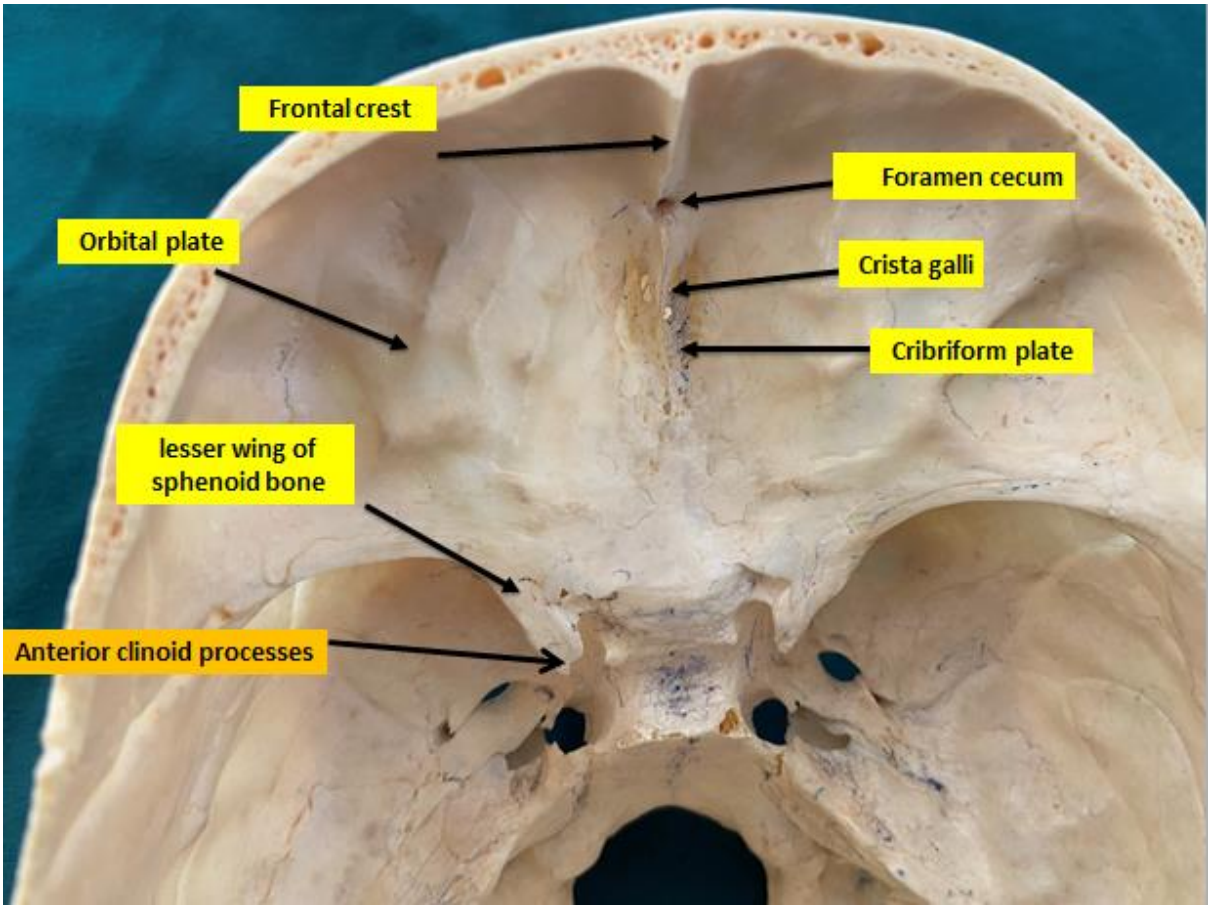

Fig. 34: Anterior cranial fossa.

Middle Cranial Fossa of the skull

It contains deep depression at either side of the body of sphenoid bone.

The bones of this fossa are: the body and greater wings of sphenoid bone, squamous part of temporal bone , the anterior surface of the petrous portion of temporal bone and part of parietal bones.

1- Chiasmatic groove: located central part anteriorly on the central part of the fossa and leads at either side to optic canal.

2- Optic canal: it passes laterally and forward to the orbit. It transmit the optic nerve and ophthalmic artery.

3- Sella turcica: On the superior surface of the sphenoid bone, behind the optic canal , a deep depression, the sella turcica, the deepest part of which lodges the hypophysis cerebri (pituitary gland) and is known as the hypophyseal fossa .

4- The anterior boundary of the sella turcica is completed by two small eminences, one on either side, called the **middle clinoid processes**, while the posterior boundary is formed by plate of bone, the dorsum sella, ending at its superior angles in two tubercles, the **posterior clinoid processes**, and give attachment to the tentorium cerebelli.

While the **anterior clinoid processes** are projected backward from the lesser wings

5- Carotid groove : located lateral to sella turcica and begins at foramen lacerum.

6- Superior orbital fissure : located on the anterior part of fossa between the lesser and greater wings and communicates with the orbit . Through it passes many structures to the orbital cavity.

7- Foramen rotundum: located behind the superior orbital fissure; it leads to pterygoplatine fossa and transmit the maxillary nerve.

8- Foramen ovale (oval foramen): large opening located behind and lateral to the foramen rotundum. It transmit the mandibular nerve

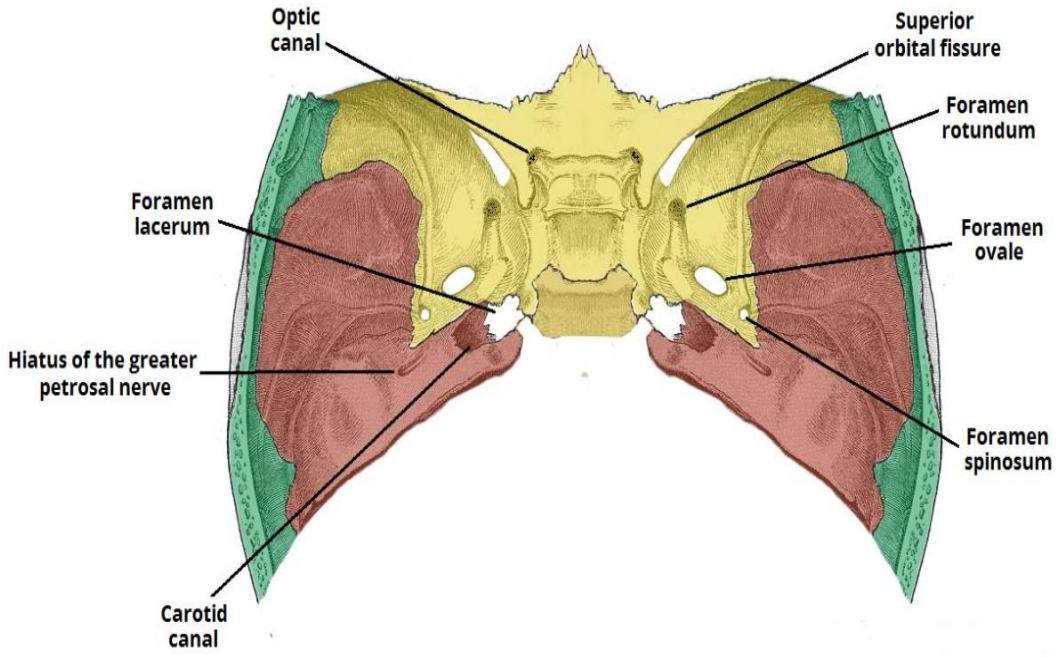

Fig. 35: Middle cranial fossa.

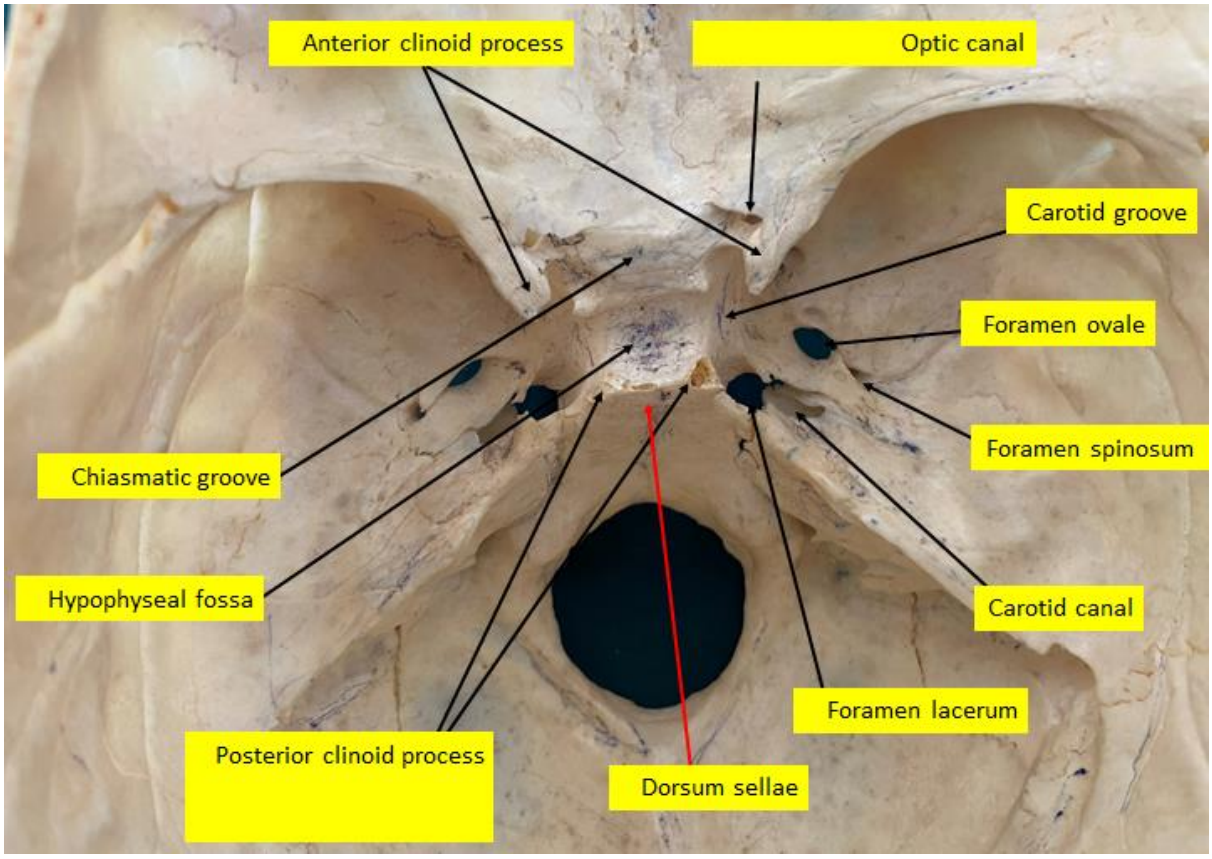

Fig. 36: Middle cranial fossa.

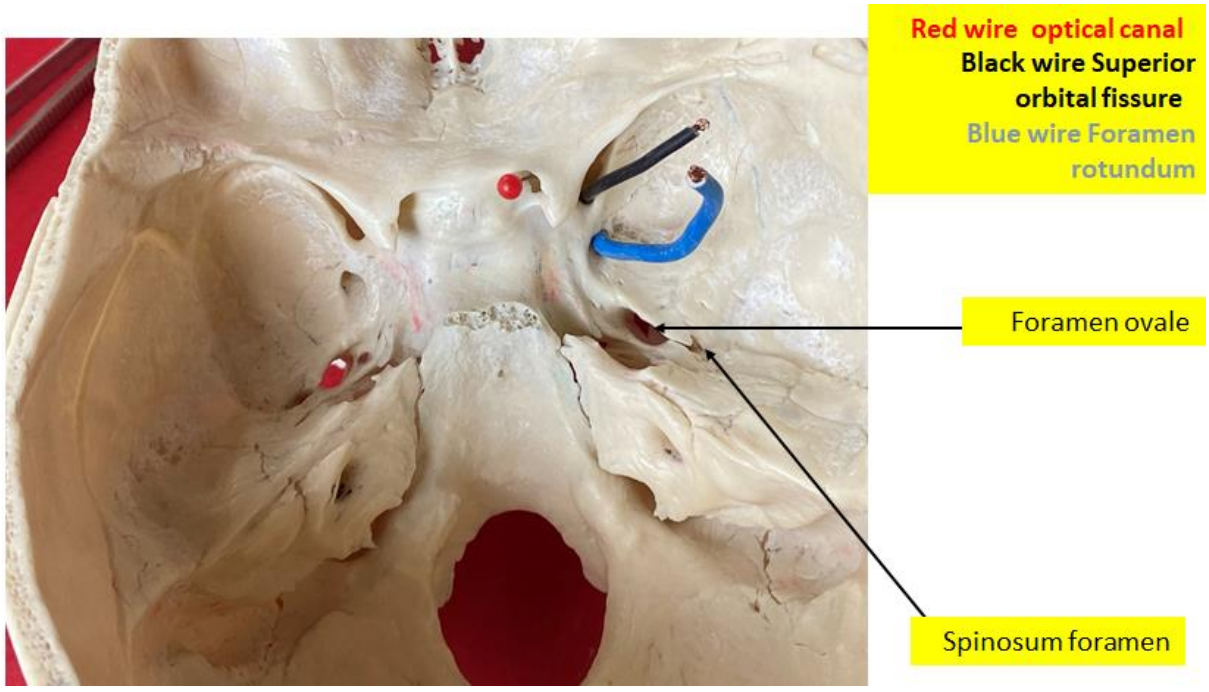

Fig. 37: Middle cranial fossa.

9- Foramen spinosum: small foramen located behind and lateral to the foramen ovale . It transmit the middle minengeal artery.

10- Foramen lacerum: located medial to the foramen ovale. It is closed in life by fibrocarilage .The internal carotid artery pass on it as it enters the carotid groove.

11- Depression for trigeminal ganglion: it is a shallow depression located on the anterior surface of the petrous bone near its apex and lodges the trigeminal ganglion.

11- Hiatus and groove for greater petrosal nerve: exits from the anterior surface of petrous bone and directed towed the foramen lacerum. It transmits the greater petrosal nerve.

12- Hiatus and groove for the lesser petrosal nerve: it located parallel and inferior to the hiatus for greater petrosal and directed towered the foramen ovale.

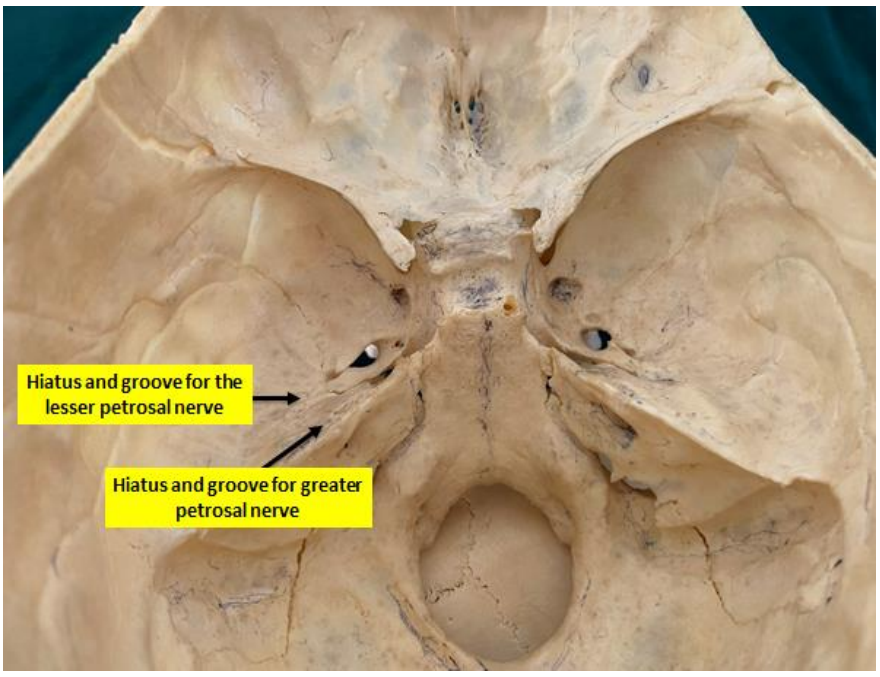

Fig. 38: Middle cranial fossa.

Posterior cranial fossa of the skull

It is large and deep fossa .It is formed by the dorsum sellae of sphenoid bone , occipital bone, and the petrous and mastoid portions of the temporal bone.

1- Foramen magnum: It is large oval opening located at the center of the fossa, through it passes the spinal cord.

2- hypoglossal canal: located on the lateral margin of the foramen magnum anterior to the occipital condyle. Through it passes the hypoglossal nerve.

3- Jugular foramen : is a large opening lateral to the foramen magnum, it transmit the internal jugular vein and XI,X and XI cranial nerves.

4- Internal auditory meatus: lies at the posterior surface of petrous bone and transmits the VII and VIII cranial nerves.

5- Internal occipital protuberance: is an internal projection at the posterior pole of the fossa.

6- Confluence of sinuses: is an area just below the Internal occipital protuberance and represent the junction of venous sinuses.

7- Transverse groove (sulcus): runs laterally from the confluence and curves anteriorly and medially as sigmoid groove.

8- Sigmoid groove(sulcus): is S-shaped groove and lodges the sigmoid sinus and it ends at jugular foramen.

9- Internal occipital crest: it passes downward from the confluence to the posterior border of the foramen magnum.

10- superior petrosal sulcus: it runs along the crest(upper part) of the petrous bone.it occupied the superior petrosal venous sinus.

11- Basilar portion of the occipital bone(clivus): it is located anterior to the foramen magnum .

12- Inferior petrosal sulcus: it is located at the side of the basilar portion of occipital bone(between it and petrous bone) and ends inferiorly at the jugular foramen. It occupies the inferior petrosal sinus

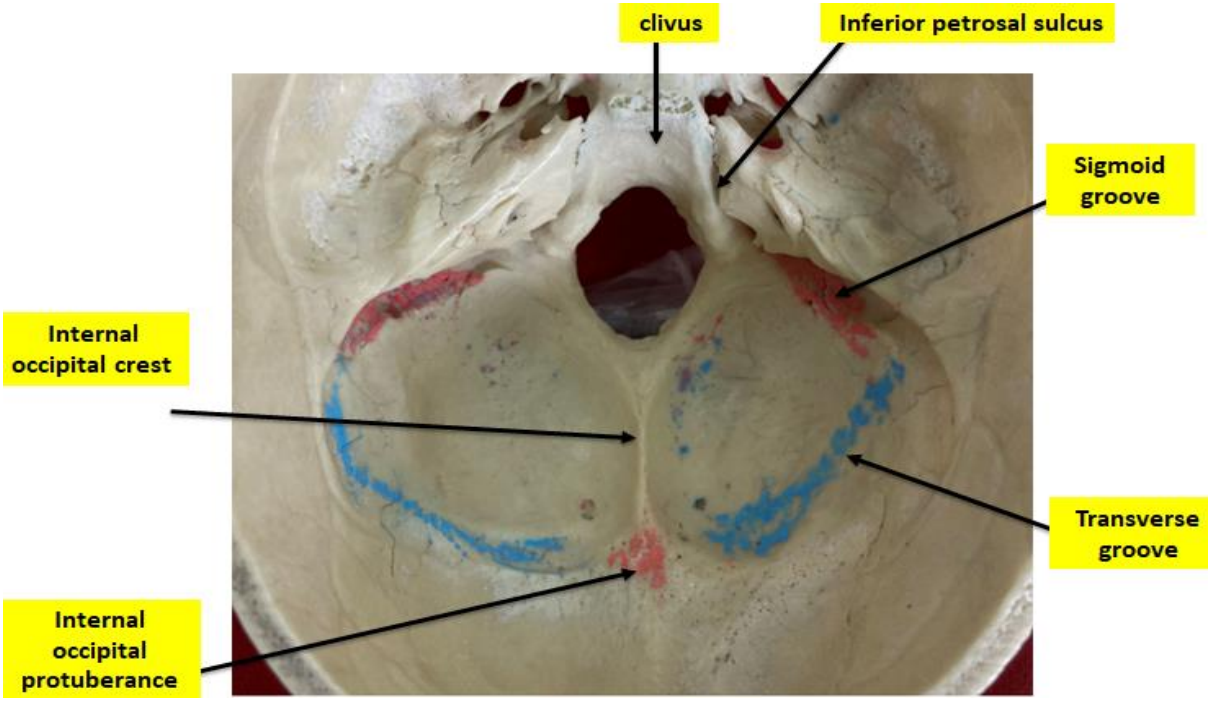

Fig. 39: Posterior cranial fossa.

Chapter 4

MANDIBLE

The mandible, is the largest and strongest bone of the face.

It forms the lower jaw and acts as a receptacle for the lower teeth.

It also articulates on either side with the temporal bone, forming the tempromandibular joint

The mandible consists of a horizontal **body** (anteriorly) and two vertical **rami** (posteriorly).

The body and the rami meet on each side at the **angle** of the mandible.

Body

The body of the mandible is like a horseshoe. It has two borders:

1- Alveolar border (superior) – contains 16 sockets to hold the lower teeth.

2- Base (inferior) – is thick, smooth and rounded

The **body** is formed by the fusion of the two halves during development and marked in the midline by the **mandibular symphysis**.

The symphysis encloses a triangular eminence – the(**mental protuberance**), which forms the shape of the chin

. There are two small bony projection lateral to the mental protuberance named the **mental tubercles.**

Above the mental tubercles on either side of the symphysis menti , there are two slight concavities the **incisive fossae.**

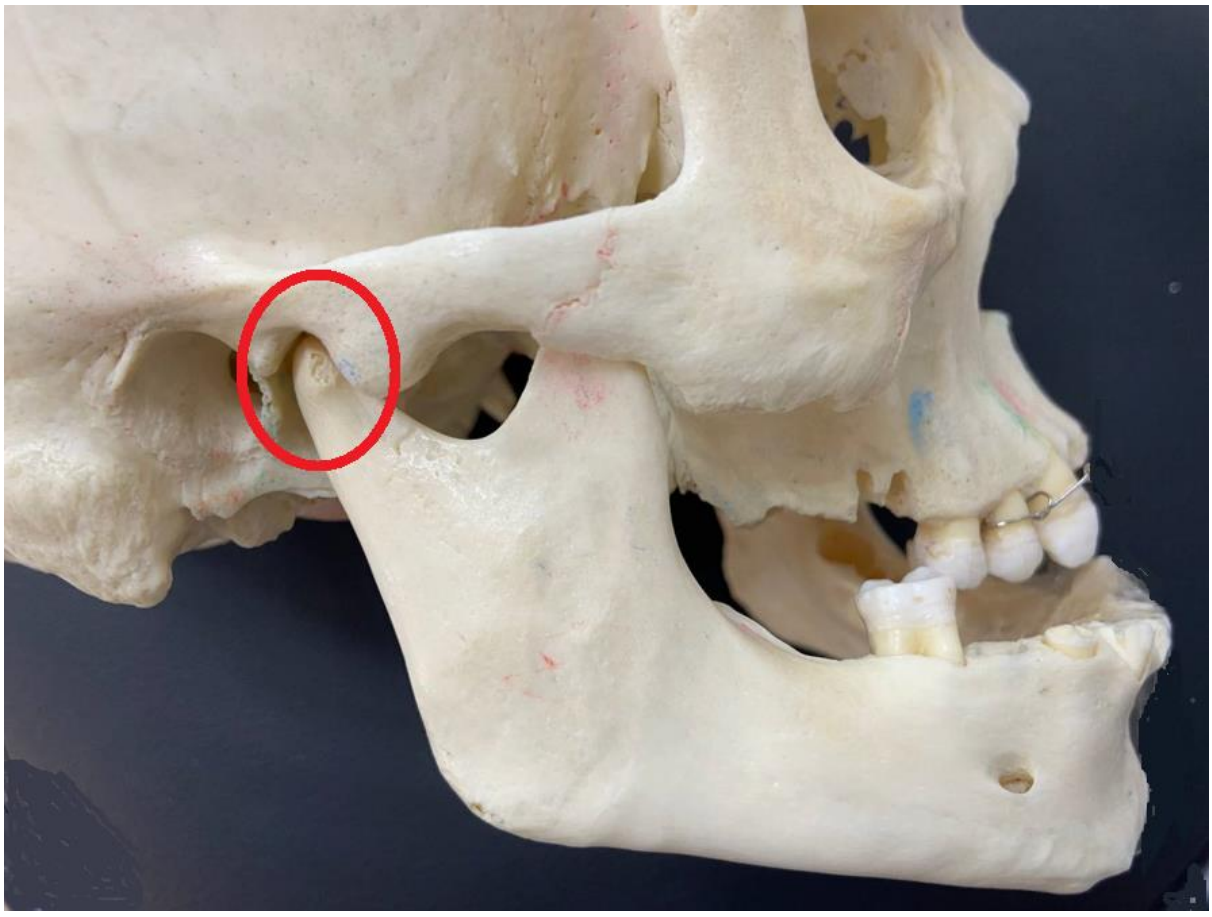

Fig. 40: Lateral view of the skull (tempromandibular joint).

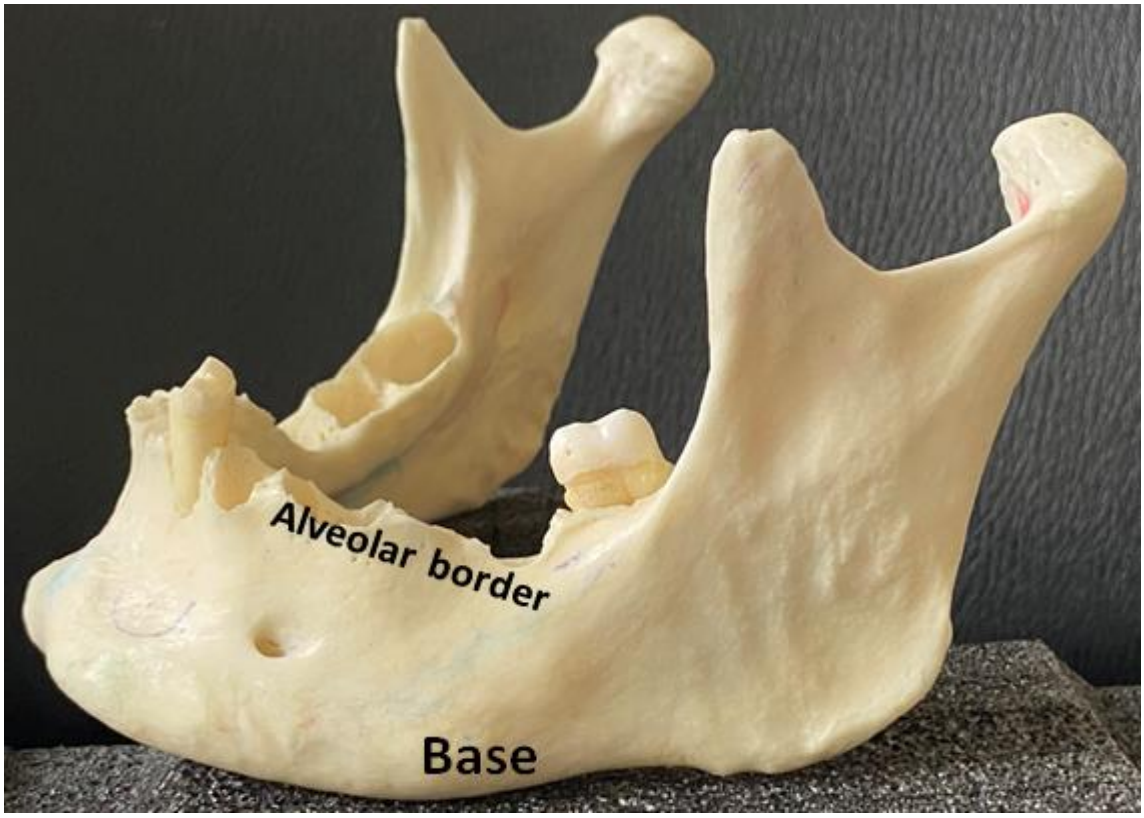

Fig. 41: Lateral view of the mandible.

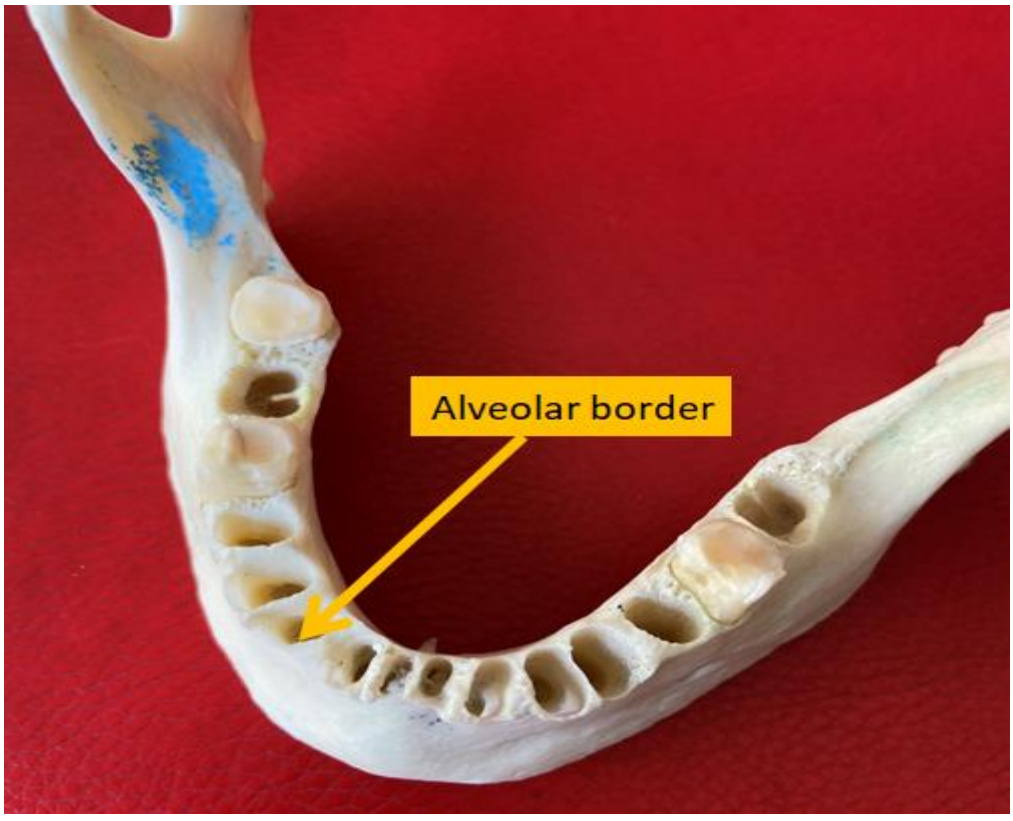

Fig. 42: Superior view of the mandible.

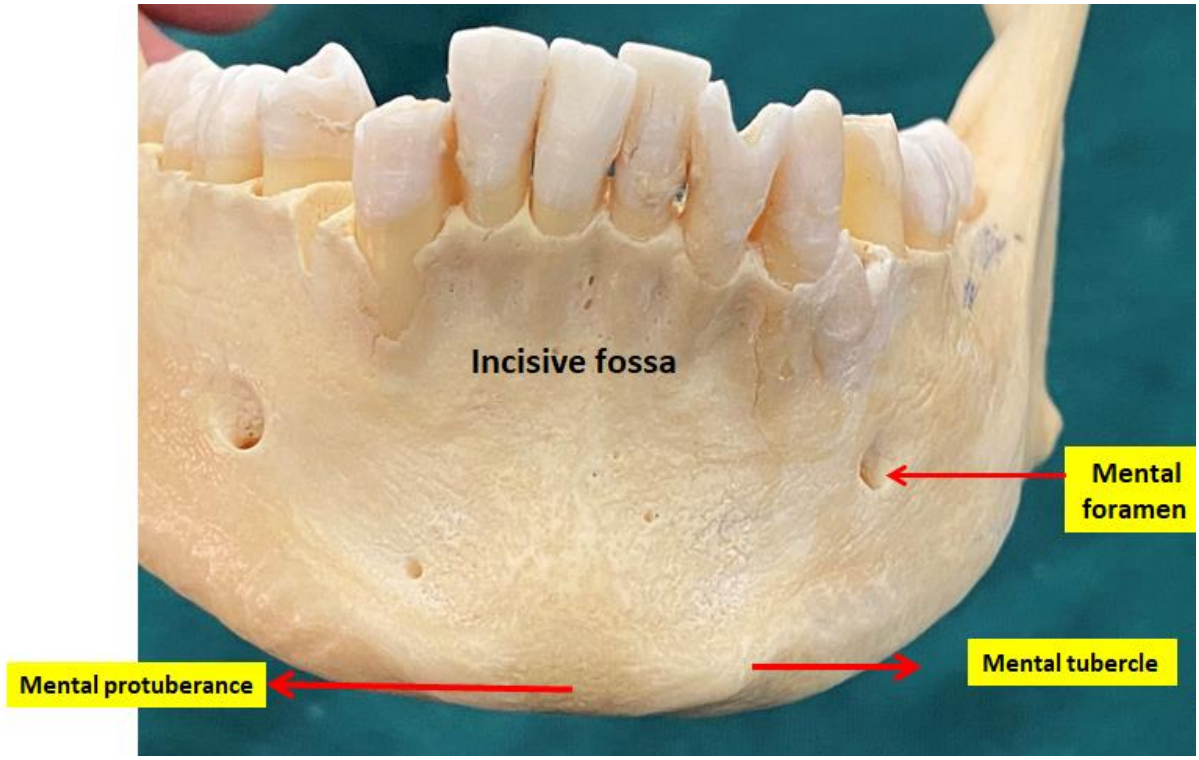

Fig. 43: Anterior view of the mandible.

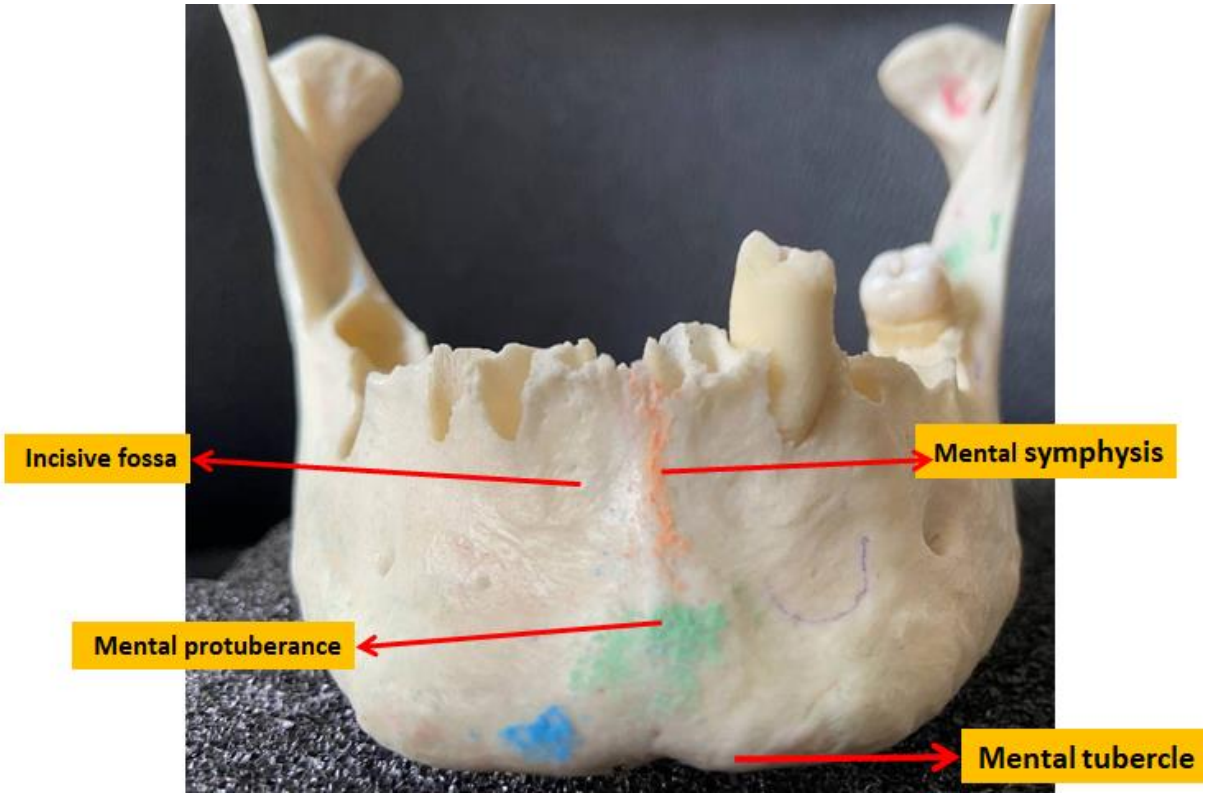

Fig. 44: Anterior view of the mandible.

On the lateral surface the **mental foramen** is located at the midpoint of the inferior border and alveolar and between the 1st and 2nd premolars.

It transmit the mental nerve and vessels.

The external oblique line is a ridge of bone extend from the mental tubercle to the anterior border of the ramus

Posterior to the body of the mandible is the ramus .

The region where the posterior border of the ramus meet the posterior end of the lower border of the base of the mandible is named the **angle of the mandible.**

The lateral surface of the ramus is rough due to the attachment of the ***masseter muscle***.

The upward extension of the ramus ends in the **coronoid and condylar processes**

The flattened triangular **coronoid process** serves as the insertion of the ***temporalis muscle***.

The insertion of this muscle is also occupied the anterior border of the ramus on its medial aspect

The condylar process is a roller-shaped process.

The condyle of the mandible articulates with the temporal bone (TMJ).

The region just below the condyle is named the **condylar neck,** on its medial surface the lateral pterygoid muscle inserts into a slight depression**(pterygoid fovea).**

The region between the coronoid and condylar processes is a harp concavity named the **mandibular notch.**

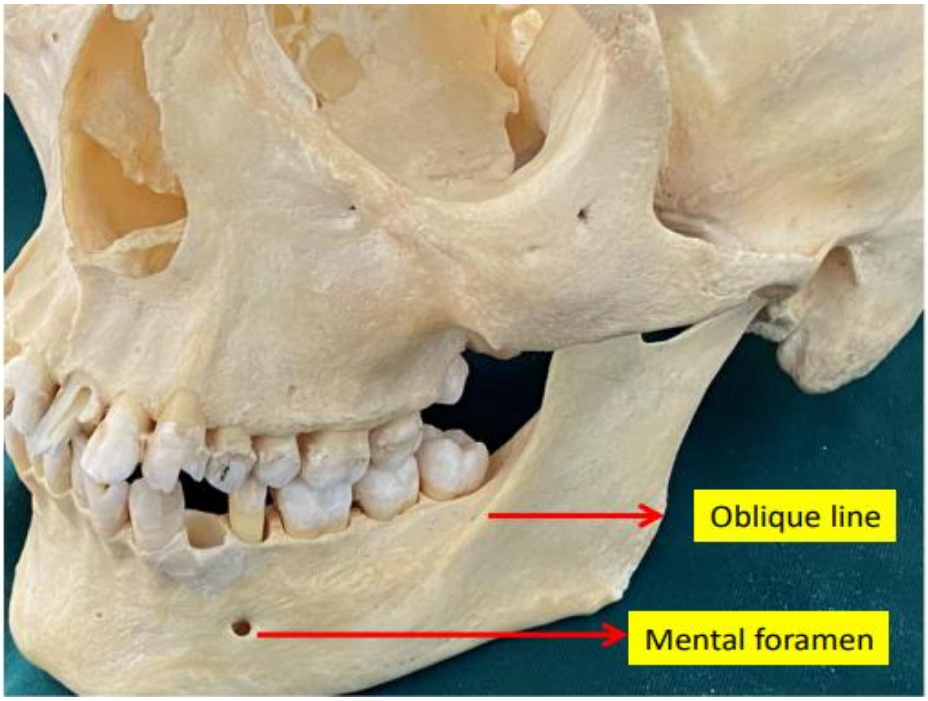

Fig. 45: Lateral view of the mandible.

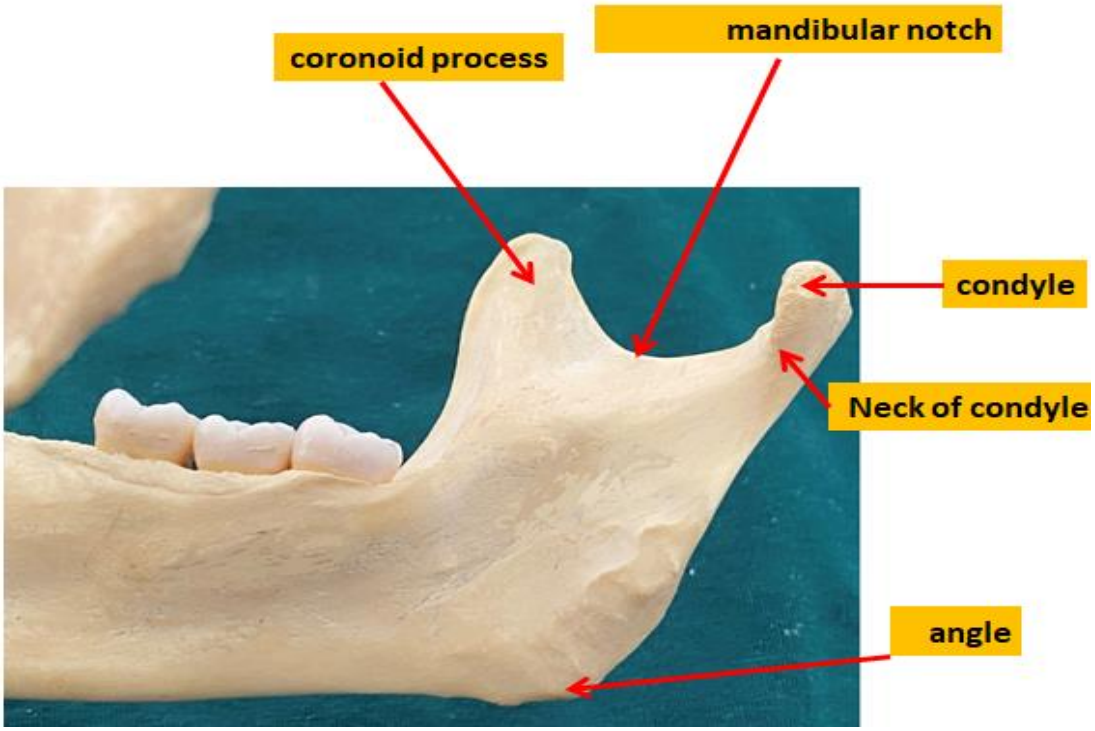

Fig. 46: lateral view of the mandible.

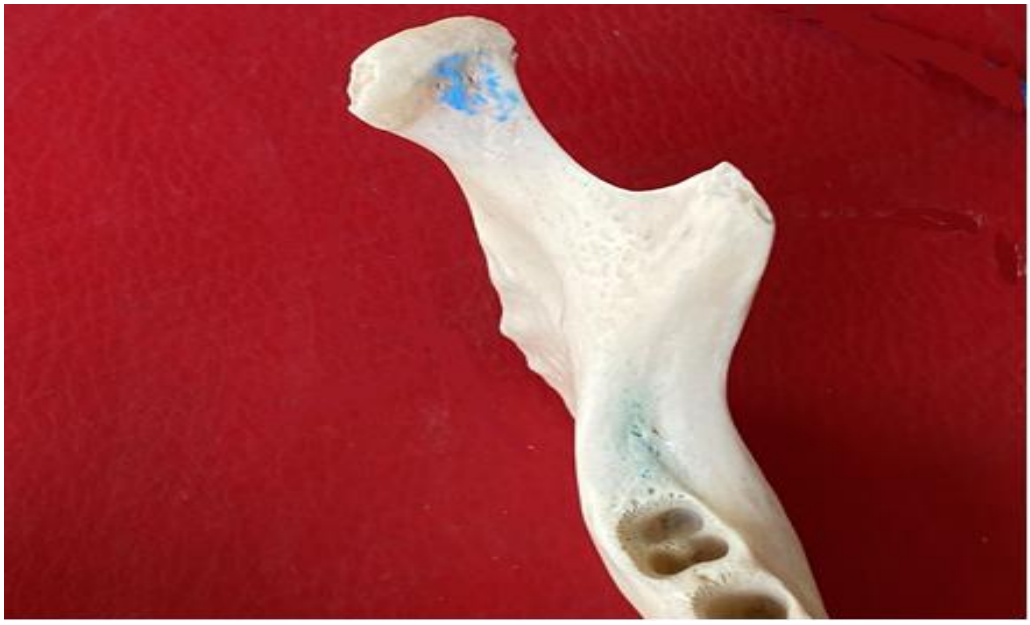

Fig. 47: Mandible (pterygoid fovea- blue color).

The internal surface of mandible

1-The internal surface in the midline of the body of the mandible bears 2 tubercles or (**mental spines**).

A-The two superior ones named the **superior genial tubercle** (superior mental spines)from which the genioglossus muscle originates.

B-While the two **inferior genial tubercle** (inferior mental spines)serve as the origin of the geniohyoid muscles.

2- Digastric fossae are found on the anterior, internal surface just above the inferior border.

They are small depressions on either side of the midline and reflect the origin of the ***anterior belly of digastric muscle.***

3-The medial aspect of the body of the mandible bears a boney ridge, the **mylohyoid line**, extending from the symphysis manti to the region of the third molar.It is the origin of mylohyoid M.

4-Superior to the mylohyoid line anteriorly is a shallow fossa (the **sublingual fossa**).

5-While the **submandibular fossa** projects posteriorly below this line.

Each fossa named as the major salivary gland occupied it

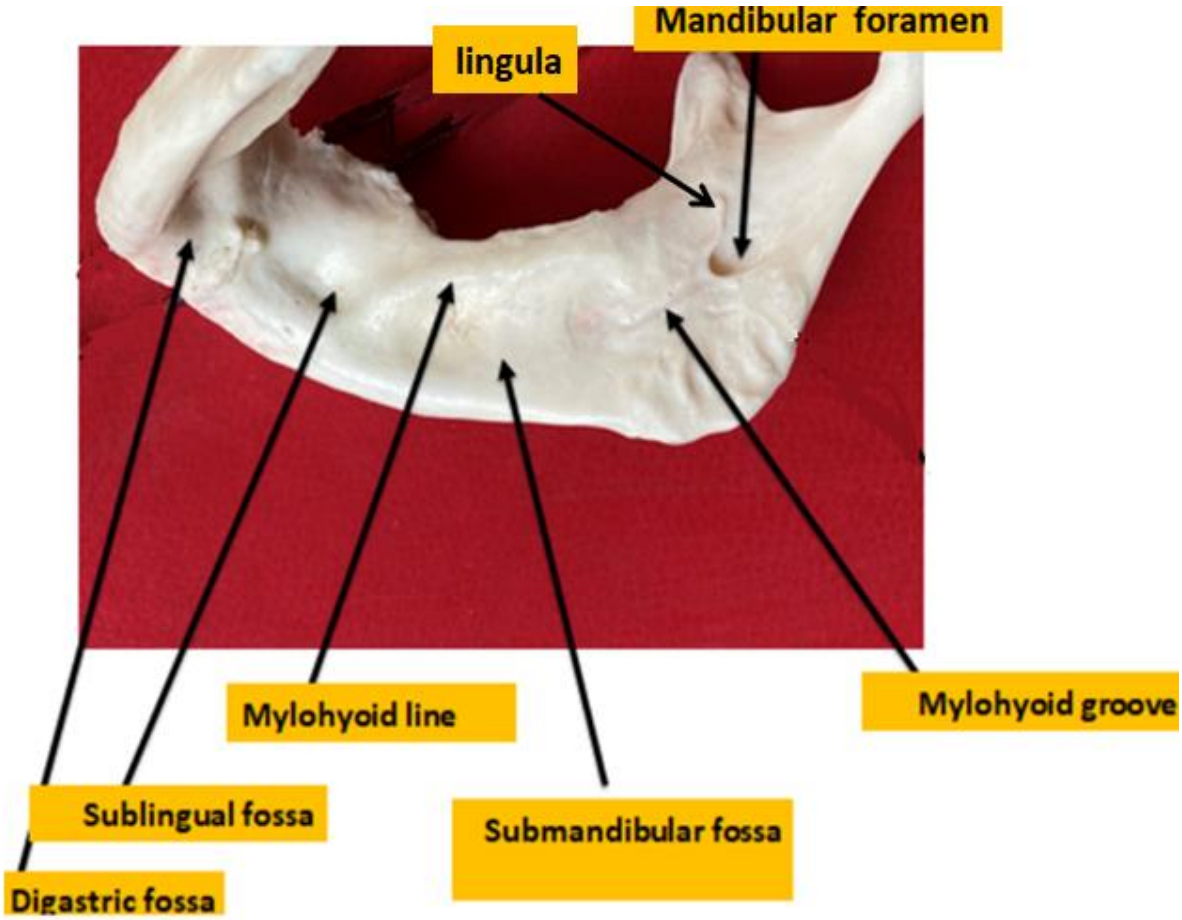

Fig. 48: Internal surface of the mandible.

6-Near the middle of the medial surface of the ramus is the **mandibular foramen** , which opens into the mandibular canal housing the inferior alveolar nerve and vessels.

7-The mandibular foramen is guarded anteriorly by a sharp boney projection called the **lingula** .

8-The lingula serve as the site for attachment of the ***spheno-mandibular ligament.***

9- Inferior to the lingula is the **mylohyoid groove (sulcus)** , extending from the mandibular foramen in an anteroinferior direction and marking the coarse of the ***mylohyoid nerve***.

The angle of the mandible and the region posterior to the mylohyoid groove presents a roughened appearance caused by the insertion of the ***medial pterygoid muscle***.

((There are terminology (not found in Nomina Anatomica)used by dentist which important in locating the site of injection for an anesthetic block of the inferior alveolar nerve)).

1- *Temporal crest* : it is a ridge of bone on the internal surface of ramus and extends to the last molar tooth.

2- *Coronoid notch* : it is a concavity between the coronoid process and the body.

3- *Retromolar fossa (triangle*): is a depression between the anterior border of the ramus and the temporal crest

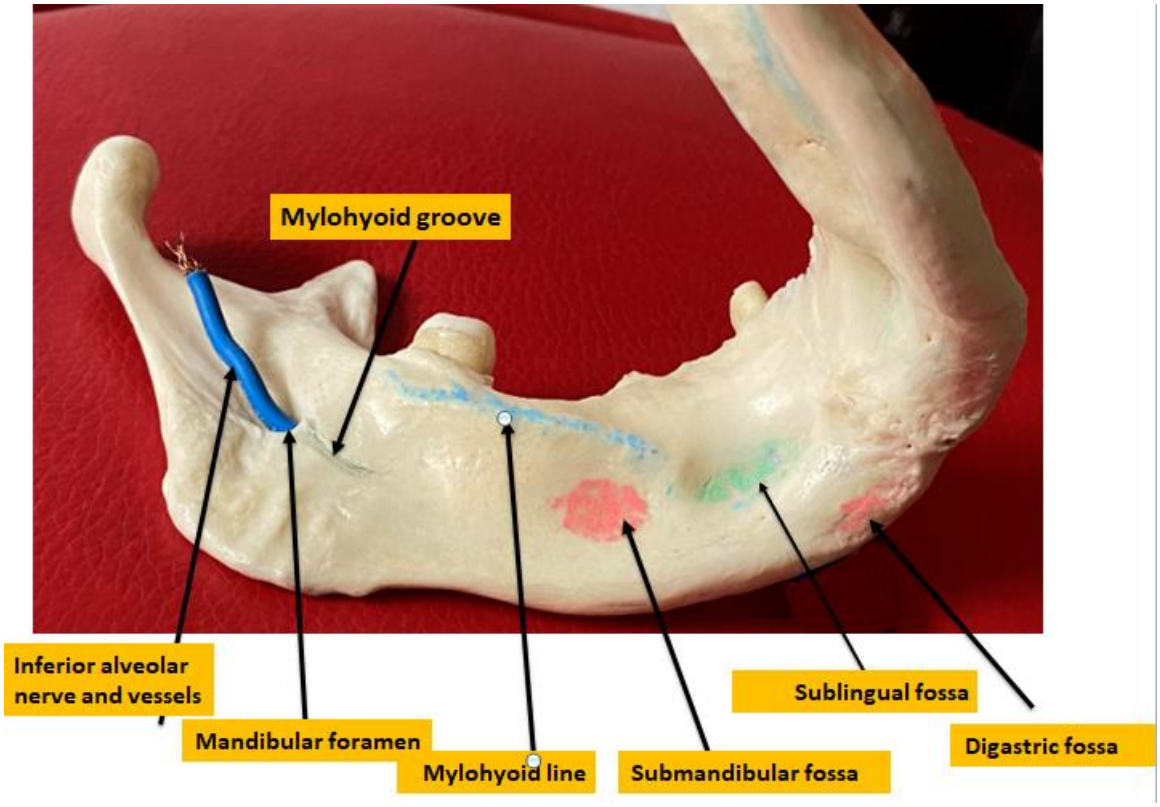

Fig. 49: Internal surface of the mandible.

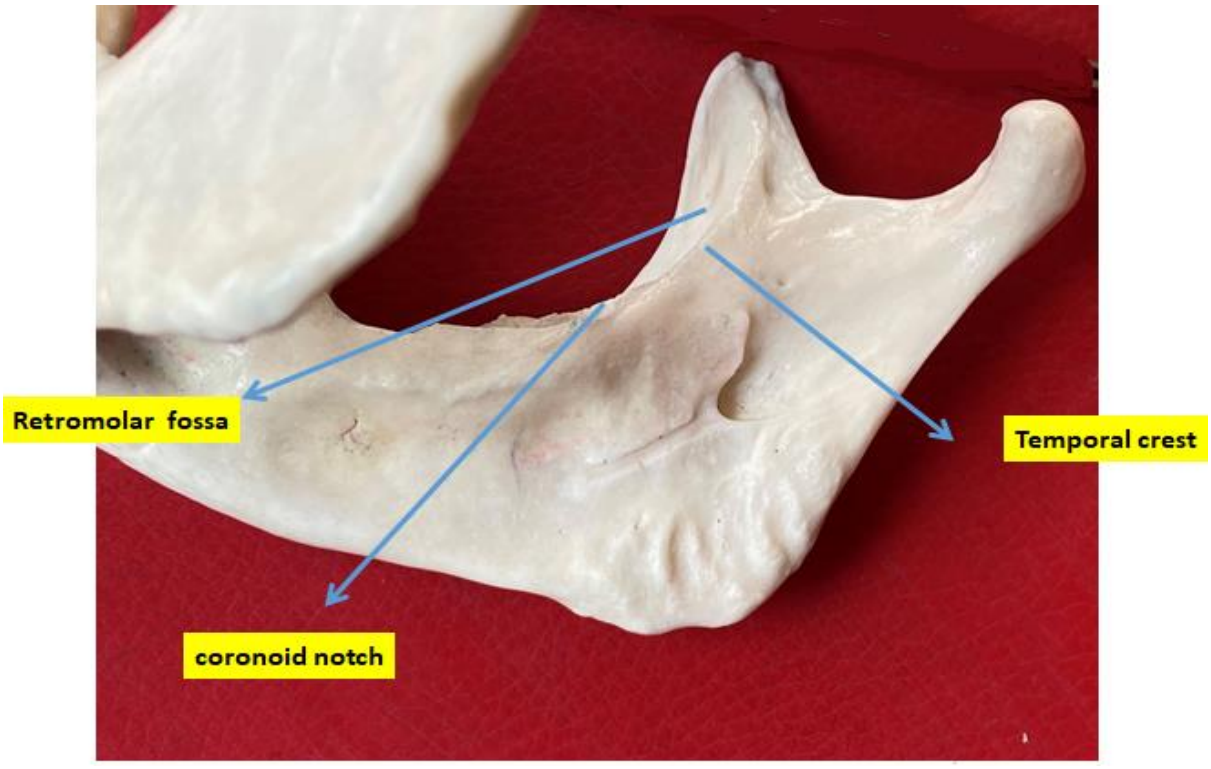

Fig. 50: Internal surface of the mandible.

Chapter 5

MAXILLA

The maxilla (or upper jaw bone) is a paired bone that has a body and four processes:

Frontal process

Zygomatic process

Palatine process

Alveolar process

The two maxillary bones (maxillae) are fused in the midline by the intermaxillary suture (median palatine suture) to form the upper jaw

The body of the maxilla is the largest and the central part of the bone and shaped like a pyramid and supporting the four processes of the maxilla.The body of the maxilla has four surfaces: anterior, orbital(superior), nasal(medial), and infratemporal (posterior)surfaces . It contains the maxillary sinuses .

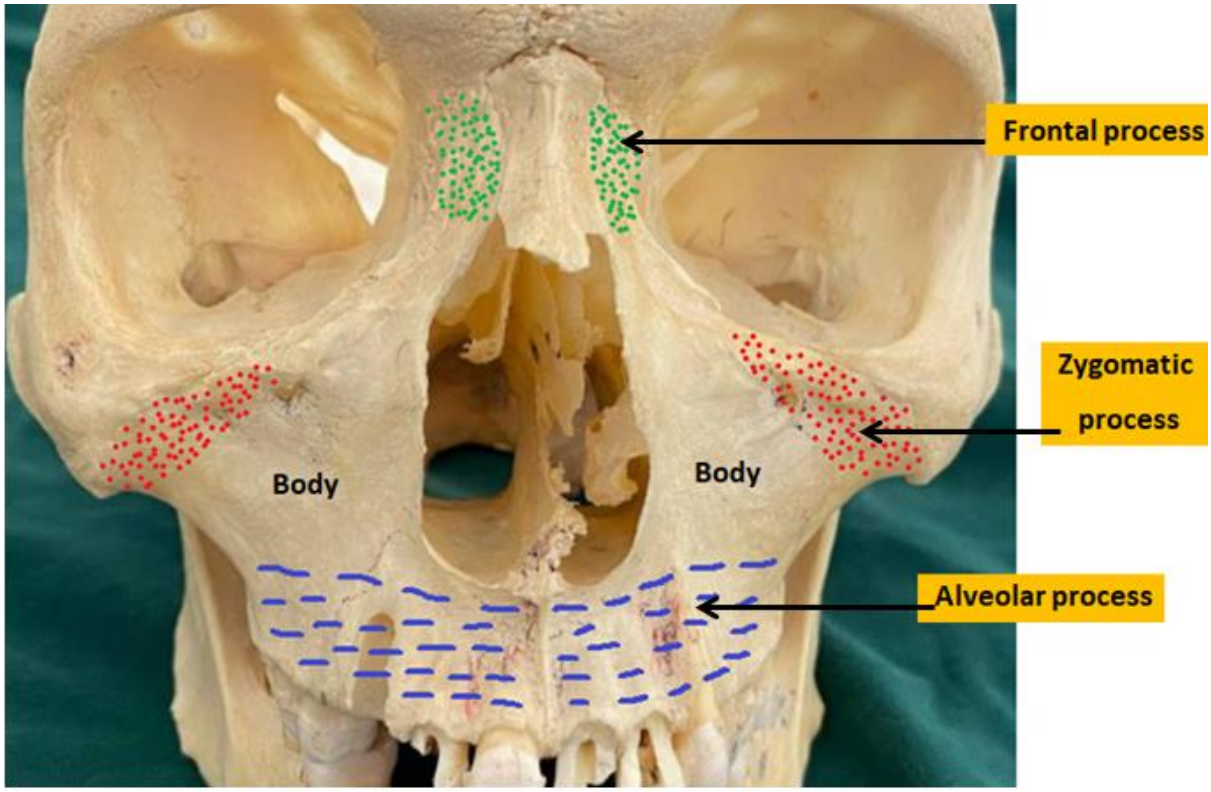

Fig. 51: Anterior view of the skull(processes of the maxilla).

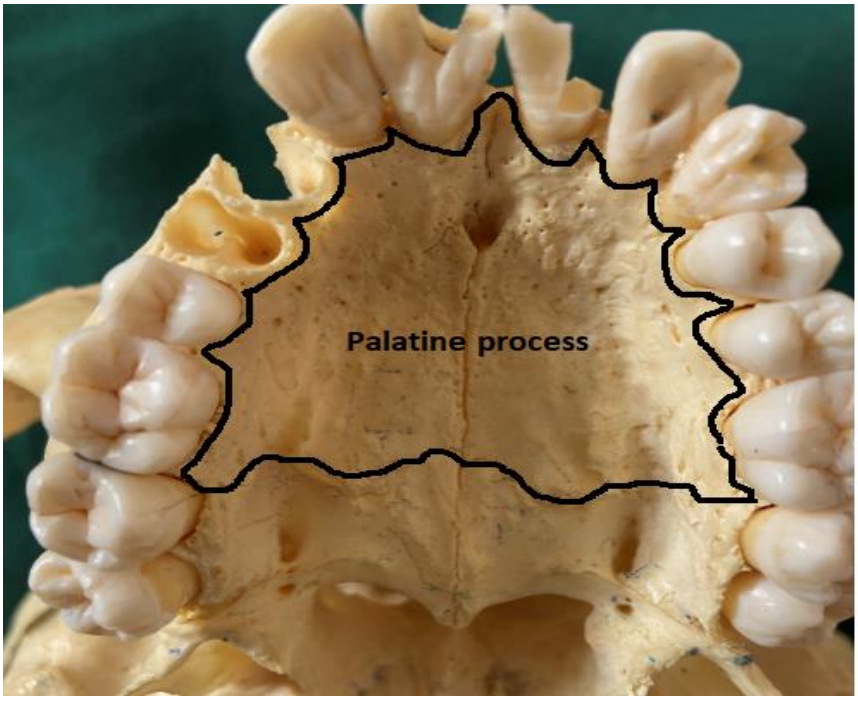

Fig. 52: Palatine process of the maxilla.

The frontal process

The frontal process of the maxilla is an extension of the maxilla projecting upward, for articulation with the frontal bone.

The frontal process of the maxilla features the lacrimal groove.

The lacrimal groove situated between the lacrimal bone and the frontal process of the maxilla .

The Zygomatic process

The zygomatic process of the maxilla is the lateral extension of the maxilla for articulation with the zygomatic bone

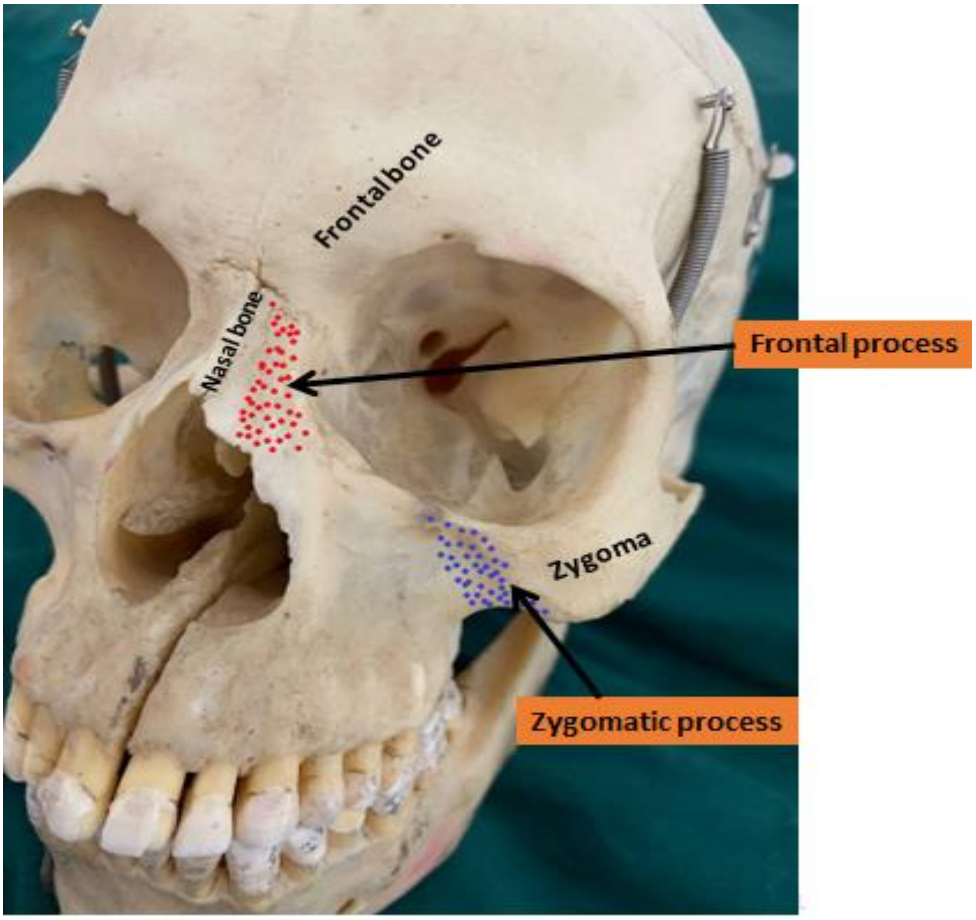

Fig. 53: anterior view of the skull(processes of the maxilla).

The palatine process

The palatine process is a horizontal extension on the medial side of the bone forming the roof of the mouth and the floor of the nasal cavity.

Together with the **palatine bone** it forms the ***hard palate***.

Anteriorly it features a small process, the anterior nasal spine. **The incisive foramen** can be found on the median line just posteriorly to the incisor teeth where the ***nasopalatine nerve*** and greater palatine vessels pass through.

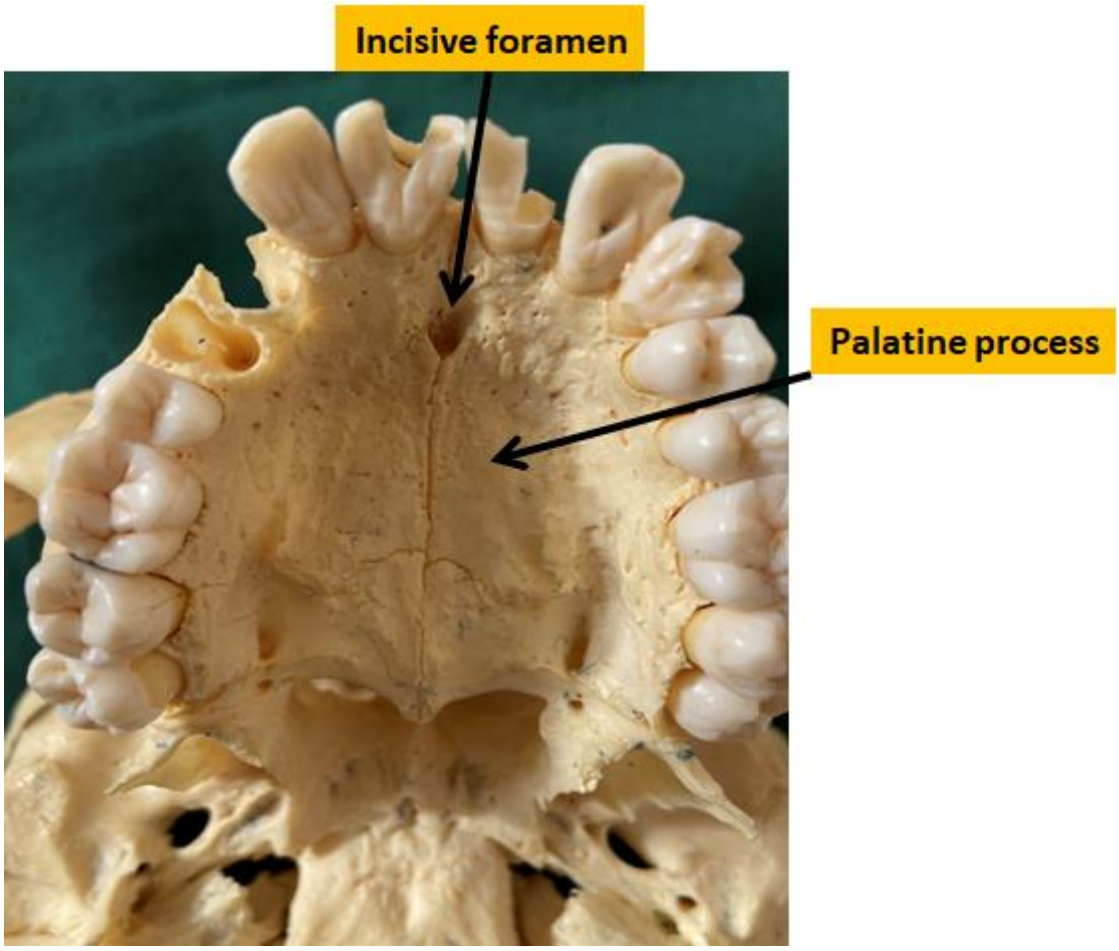

Fig. 54: palatine process of the maxilla.

The alveolar process

The alveolar process is an inferior extension of the maxilla .

It forms the maxillary dental arch containing eight cavities where the upper teeth are held.

The dental alveoli are sockets in the alveolar process where the roots of the teeth lie.

The interalveolar septa are bony ridges between adjacent dental alveoli .

The interradicular septa are bony ridges forming compartments in dental alveoli for the roots of the teeth .

The alveolar yokes (juga alveolaria) are eminences on the outer surface of the jaw produced by the projections of the dental alveoli

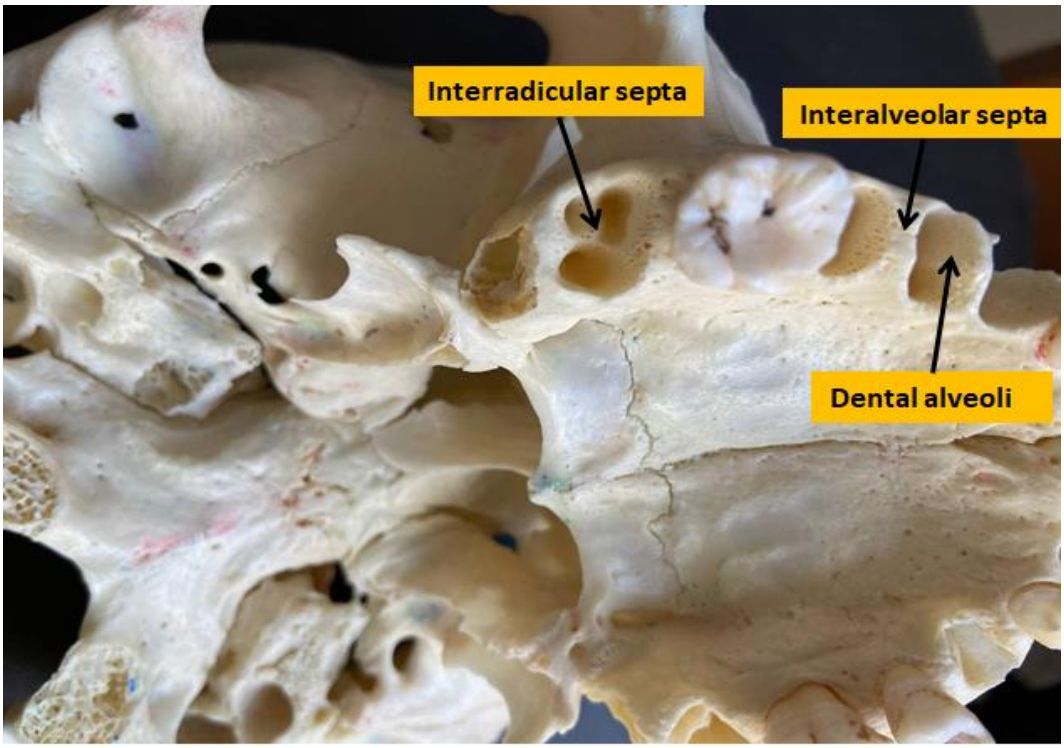

Fig. 55: Alveolar process of the maxilla.

Features of the maxilla:

Anterior surface

1- The infra-orbital margin is the lower margin of the orbit formed partly by the maxilla, and partly by the zygomatic bone

2- The infra-orbital foramen is an opening on the anterior surface of the body of the maxilla located below the infra-orbital margin. It is the outer opening of the infra-orbital canal serving as the passage for the infraorbital nerve, as well as for the infraorbital artery and vein.

3- Incisive fossa is a shallow depression overlying the roots of incisor teeth just below the nasal cavity.

4- Canine ridge it is elongated elevation overlying the large maxillary canine root

5- The canine fossa is a depressed area on the anterior surface of the body of the maxilla located below the infra-orbital foramen and overlying the maxillary premolar roots. The canine fossa is the origin site of the levator anguli oris muscle.

6- Nasal margin forms the lateral and inferior borders of anterior nasal aperture.

7- Anterior nasal spine it is a sharp midline anterior projection of the nasal border of maxilla.

8- The orbital surface of the body of the maxilla forms most of the floor of the orbit and features the infra-orbital groove leading into the infra-orbital canal.

The infra-orbital groove is situated on the orbital surface of the body of the maxilla (on the floor of the orbit) that continues as the **infraorbital canal,** thus serving as the passage for the infraorbital nerve and blood vessels.

The infra-orbital canal is a bony passage within the anterior wall of the maxilla starting from the infra-orbital groove and opening on the anterior surface of the body of the maxilla (with the **infra-orbital foramen**). The infra-orbital canal is the passage for the infraorbital nerve, as well as the infraorbital artery, and veins.

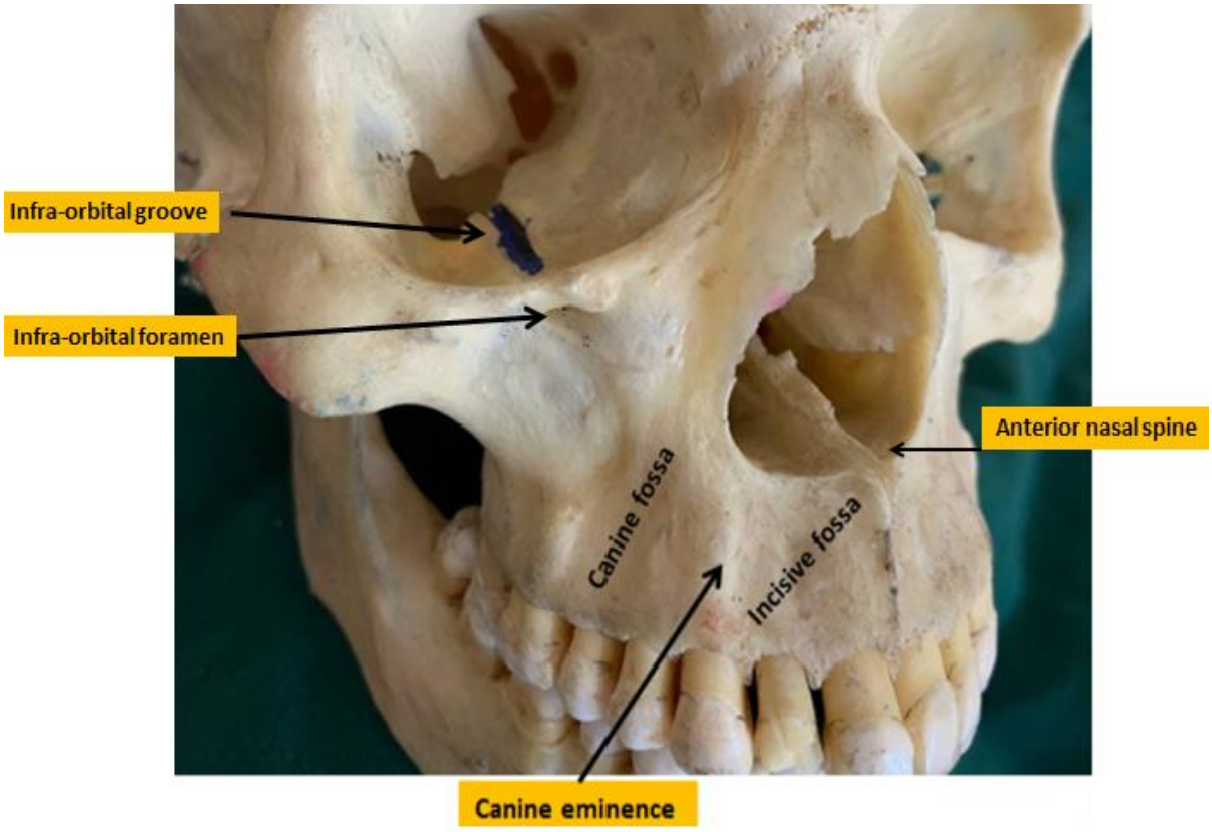

Fig. 56: Features of the anterior surface of the maxilla.

Posterior(infratemporal) surface

1- The maxillary tuberosity (or maxillary eminence) is a rounded eminence immediately posterior to the last maxillary molar,at the lower part of the infratemporal surface of the body of the maxilla. The maxillary tuberosity is the origin site for a few fibers of the medial pterygoid muscle .

2- Posterior superior alveolar foramina are several small openings on the infratemporal surface of the body of the maxilla leading into the alveolar canals for the passage of the posterior superior alveolar nerves and blood vessels to the upper teeth.

3- Inferior orbital fissure: it is located in the upper part of the infratemporal surface .

It is a cleft between maxilla and greater wing of sphenoid bone.

4- The pterygomaxillary fissure is vertical cleft, and descends at right angles of the inferior orbital fissure;

it is a triangular interval, formed by the divergence of the maxilla from the sphenoid bone.

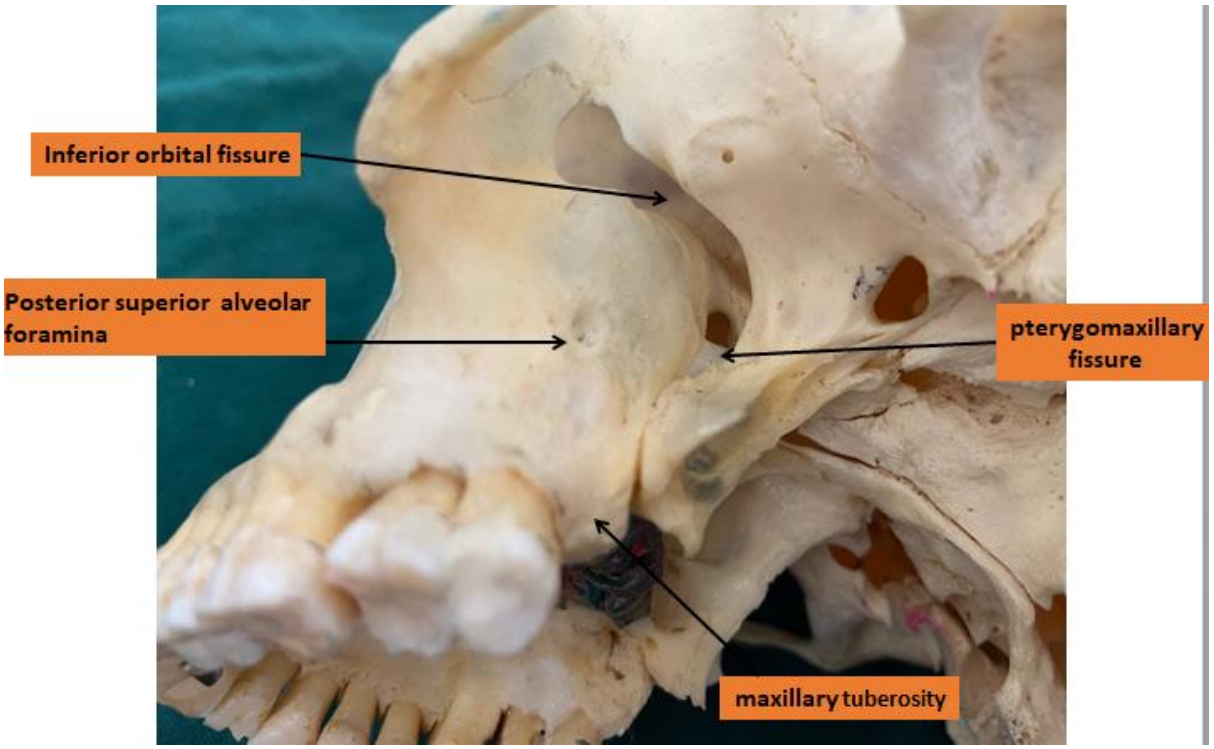

Fig. 57: Posterior surface of the maxilla.

Inferior(oral) surface:

When the two maxillae are articulated, a funnel-shaped opening, the **incisive foramen**, is seen in the middle line, immediately behind the incisor teeth.

In this opening the orifices of two lateral canals are visible; they are named the **incisive canals** ; through each of them passes the terminal branch of the descending palatine artery and the ***nasopalatine nerve***.

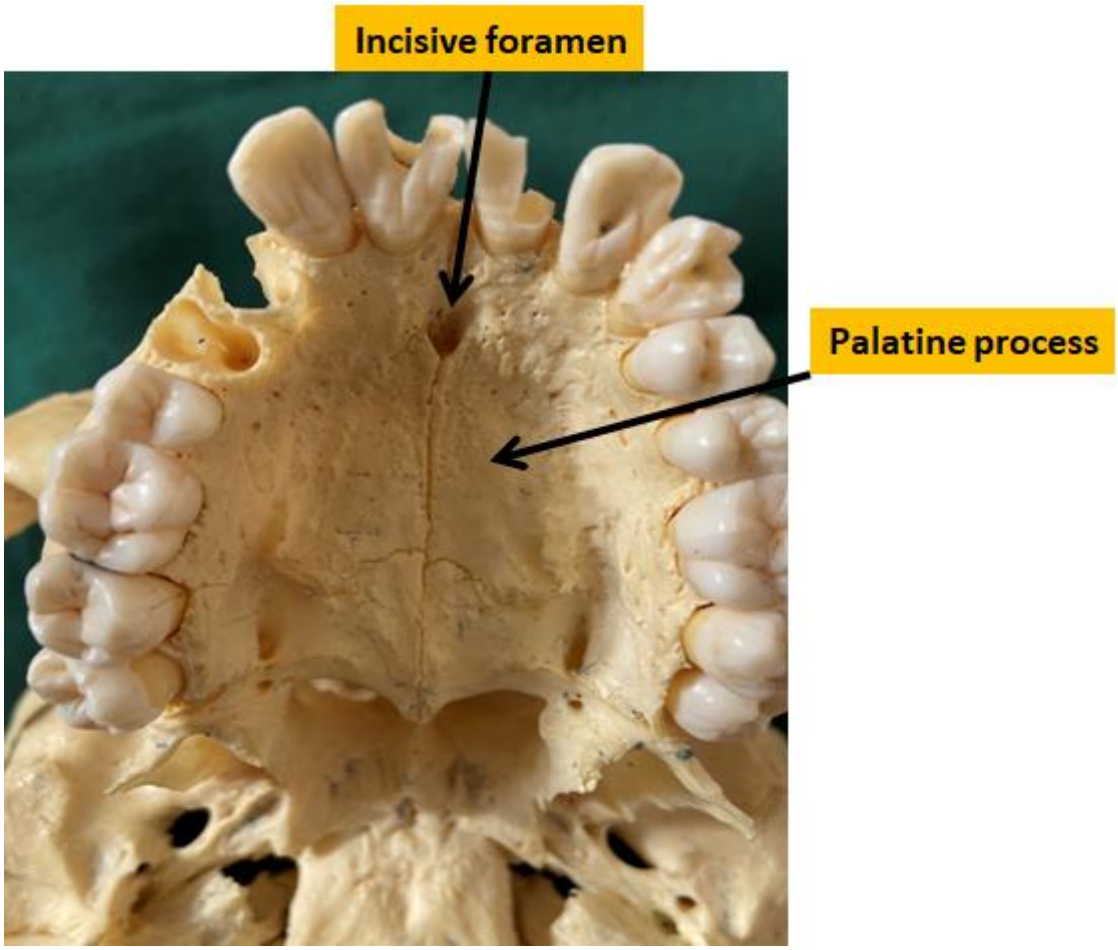

Fig. 58: Inferior (oral) surface of maxilla.

Medial (nasal) surface:

The nasal surface presents a large, irregular opening leading into the **maxillary sinus.**

The maxillary sinus is a paranasal sinus, an air-filled cavity located within the body of the maxilla.

The maxillary hiatus is an opening to the maxillary sinus located on the nasal surface of the maxilla.

On the nasal surface of the body of the maxilla, in front of the opening of the sinus is a deep groove, the lacrimal groove (or lacrimal sulcus), which is converted into the nasolacrimal canal,

Incisive canal passes downward from the midpoint of the nasal surface to the oral surface behind the central incisors

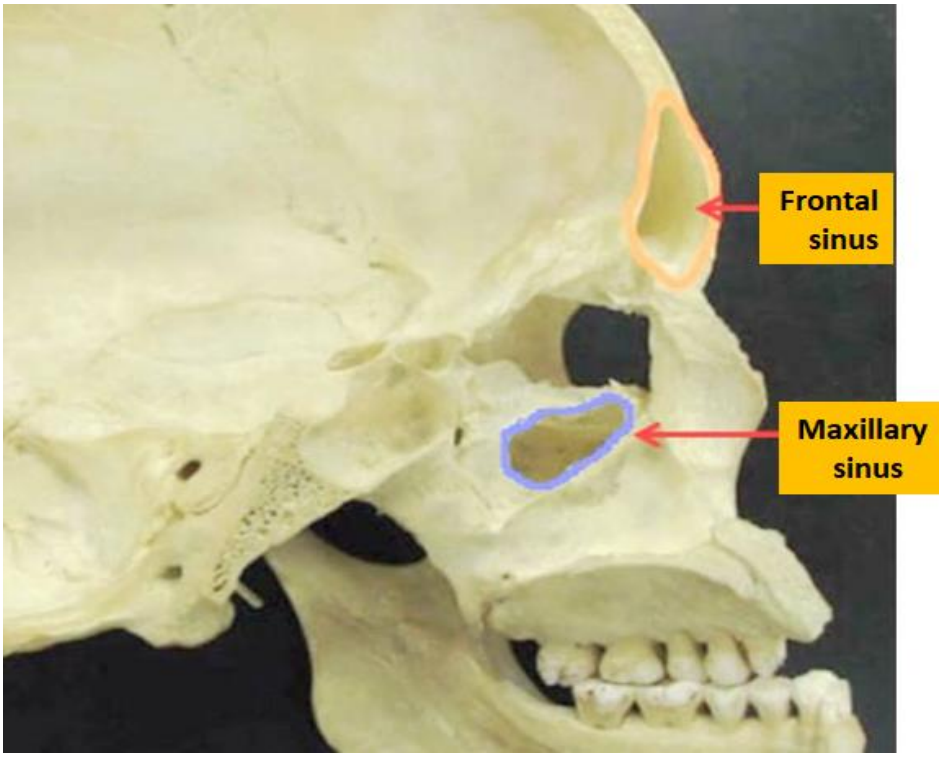

Fig.59: Medial (nasal surface)of maxilla.

Chapter 6

ZYGOMATIC BONE

The zygomatic bone (zygoma) is an irregularly shaped bone of the skull. It is often referred to as the cheekbone and forming the prominence of the cheek.

The zygomatic bone is nearly quadrangular in shape and it features three surfaces, five borders and three processes.

The zygomatic bone also contributes to the formation of the zygomatic arch, the walls of the temporal and infratemporal fossae and the floor and lateral wall of the bony orbit.

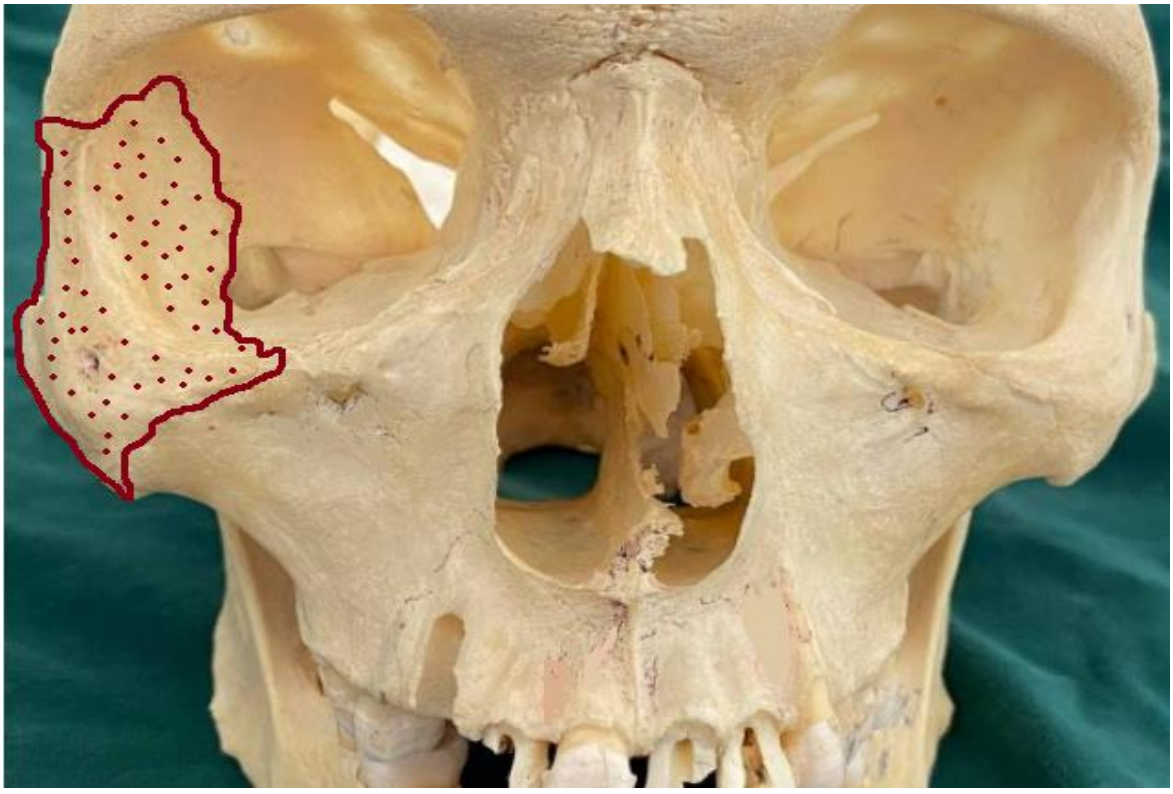

Fig. 60: Anterior view of the skull (zygomatic bone).

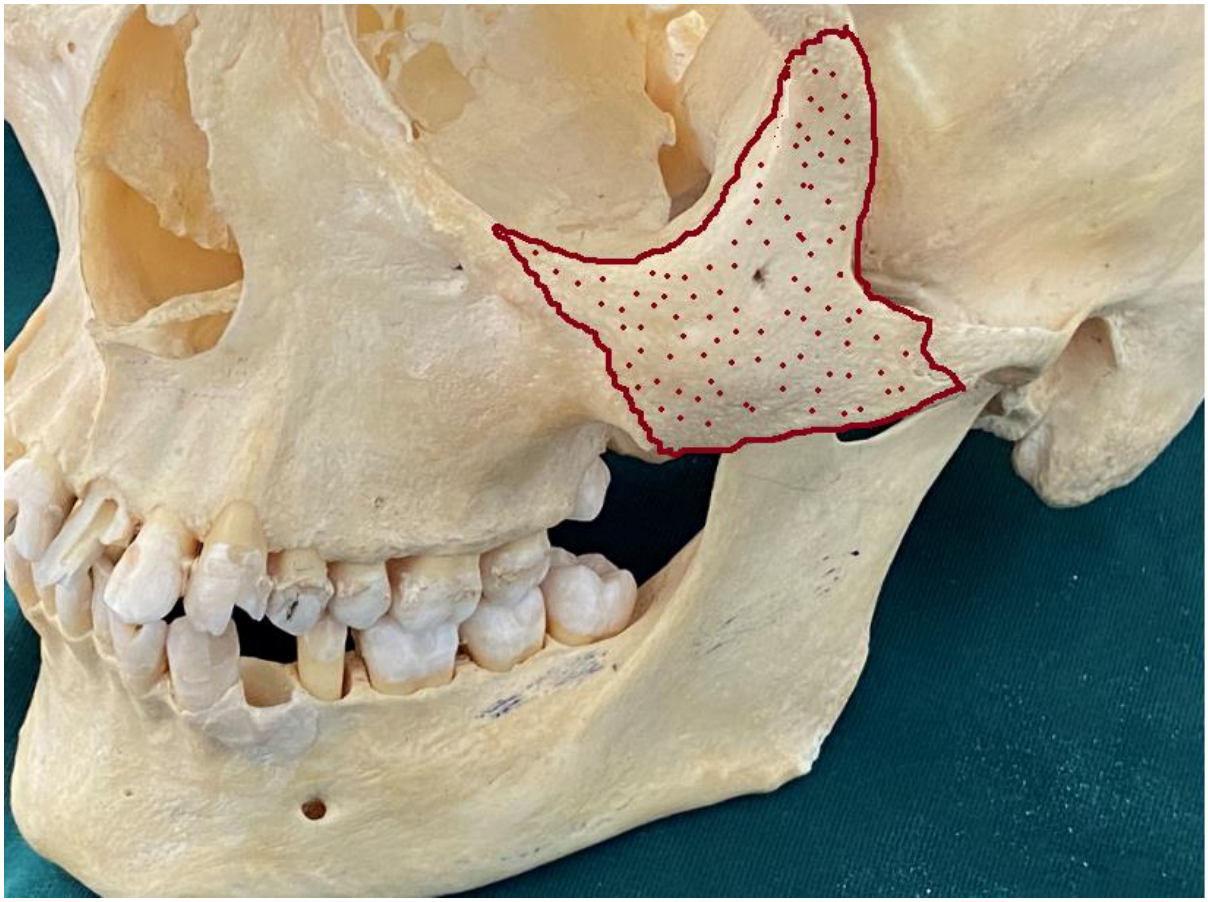

Fig. 61: Lateral view of the skull (zygomatic bone).

The zygomatic bone has three surfaces:

1- lateral(facial)

2- Posteromedial(temporal)

3- Orbital surfaces.

The lateral (facial) surface faces towards the outside.

It is smooth and convex, and it features a small opening called the zygomaticofacial foramen.

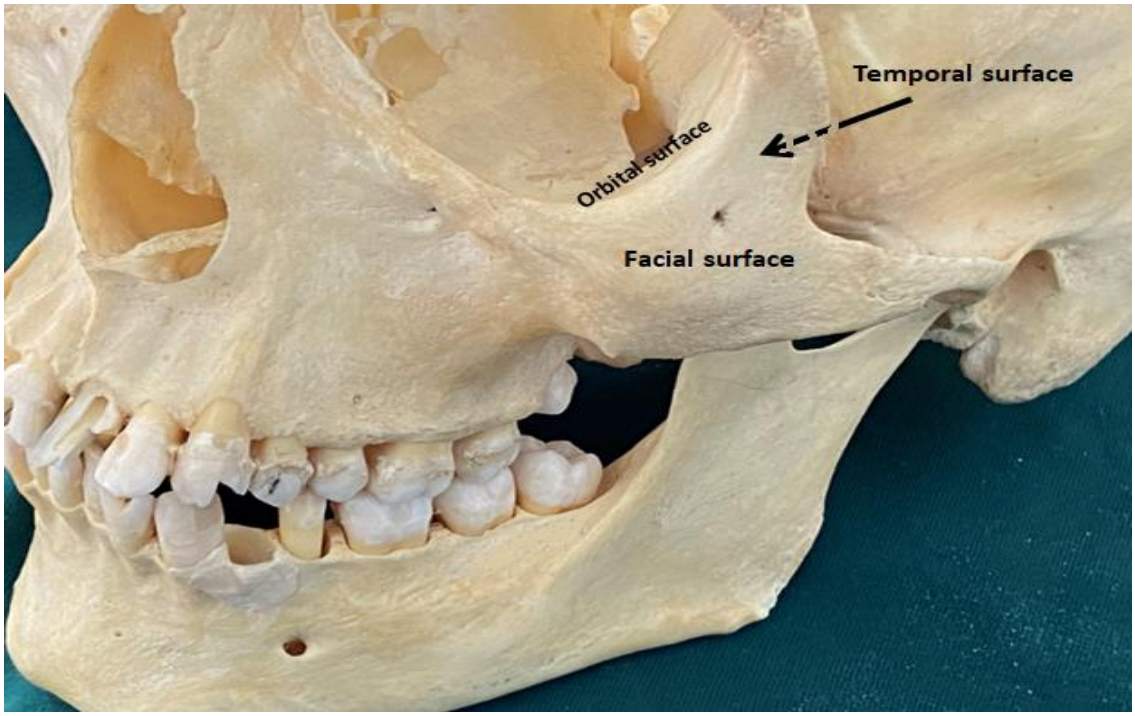

Fig. 62: Lateral view of the skull (surfaces of zygomatic bone).

The posteromedial (temporal) surface faces towards the temporal and infratemporal fossae.

The orbital surface is smooth and concave. It faces towards the orbit and forms part of its floor and the lateral wall.

Temporal process of zygomatic bone it articulates with the zygomatic process of temporal bone to form the zygomatic arch.

Frontal process of zygomatic bone •

. It articulates with the zygomatic process of frontal bone •

Maxillary process of zygomatic bone.

It extends anteriorly, and forms the inferior and lateral margin of the orbit .

The inferior margin of this process articulates with the maxilla.

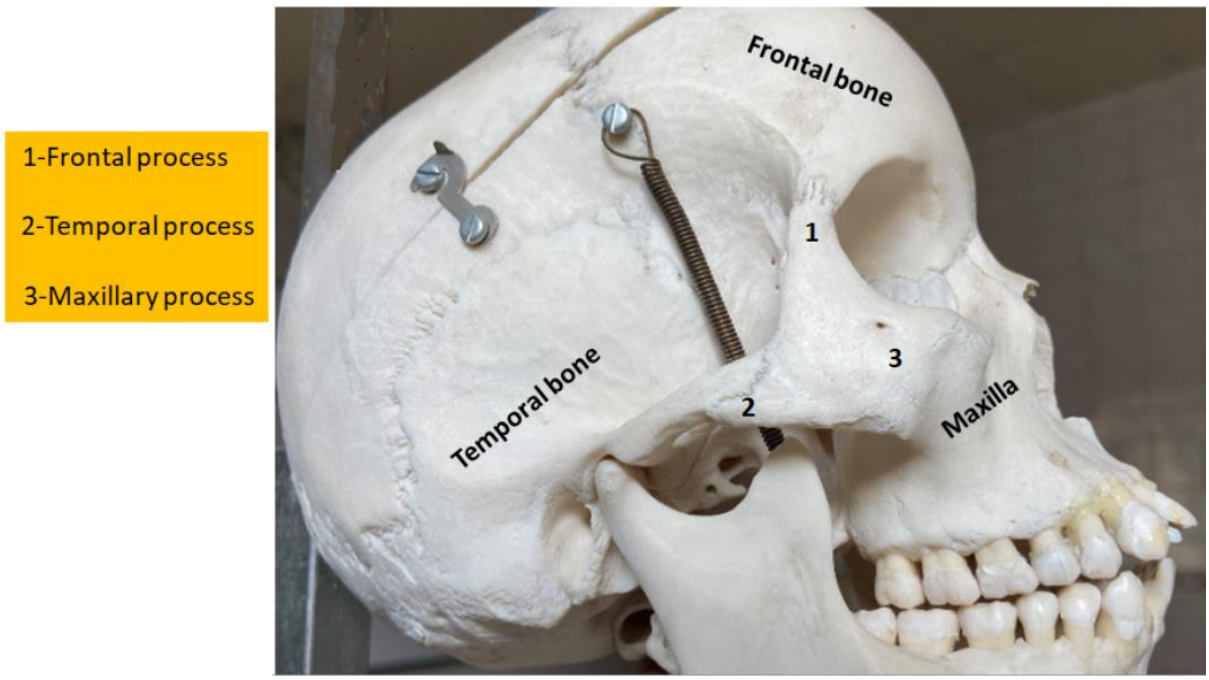

Fig. 63: Lateral view of the skull (processes of zygomatic bone).

Fig. 64: Lateral view of the skull (zygomatic arch).

Chapter 7

BONY ORBIT

The bony orbits (or eye sockets) are bilateral and symmetrical cavities in the head.

They enclose the eyeball and its associated structures.

The orbit look as a pyramidal structure, with the apex pointing posteriorly and the base situated anteriorly.

Orbital margin :

The superior half of the orbital margin(the supraorbital margin) and the inferior half (the infraorbital margin) formed by:

Frontal, maxillary, and zygomatic bones contribute to the orbital margin(orbital rim), which is generally strong so as to protect the orbital contents

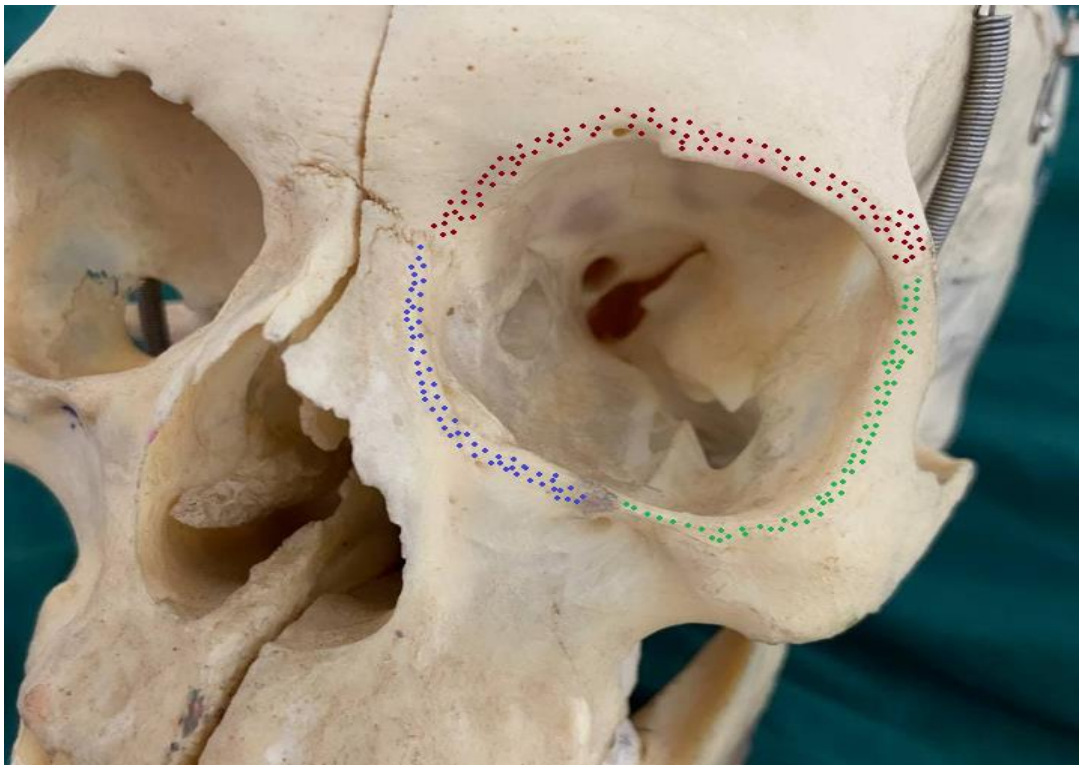

Fig. 65:Anterior view of the skull (orbital boundaries).

Orbital walls

Roof (superior):

Orbital part of the frontal bone.

Medial wall:

From anterior to posterior are :

1- Maxilla.
2- lacrimal bone.
3- Ethmoid bone.
4- Lesser wing of the sphenoid bone

Floor(inferior):

1- Maxilla
2- Zygomatic bone

Lateral wall:

1- Zygomatic bone

2- Greater wing of sphenoid bone.

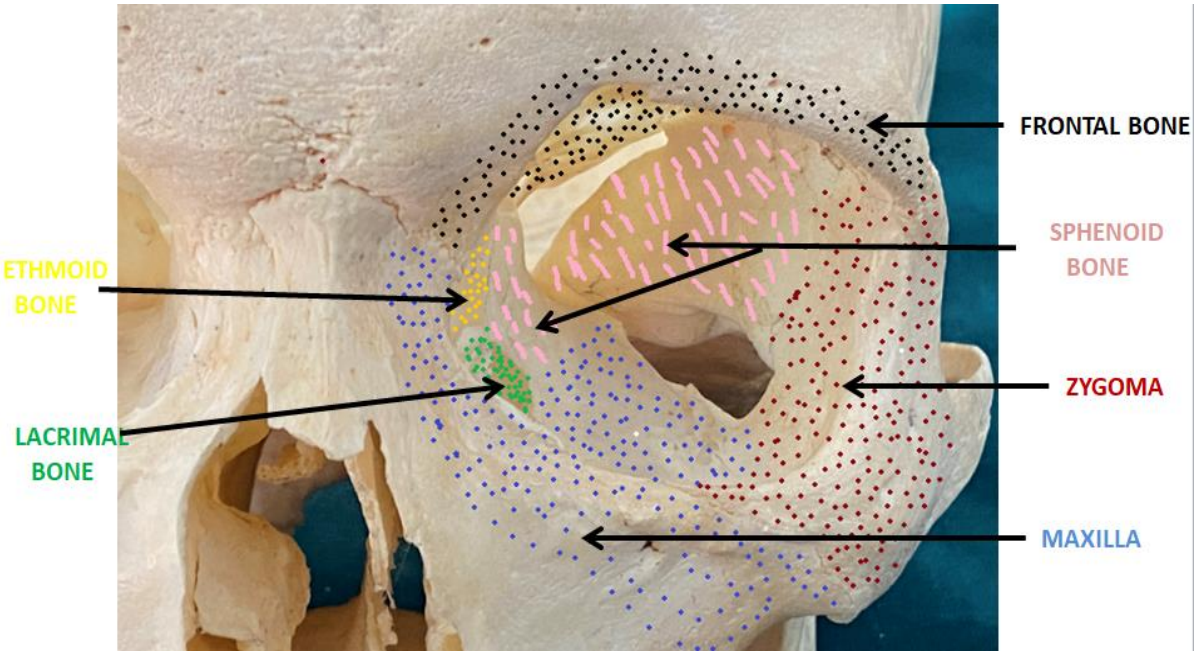

Fig. 66: Anterior view of the skull (orbital wall).

Openings of the orbital cavity:

1-supraorbital foramen .
2-Infraorbital groove, canal and foramen.
3-Superior orbital fissure.
4- Inferior orbital fissure.
5- Optic canal.
6-Anterior and posterior ethmoidal foramen .

Fig. 67: opening of the orbital cavity.

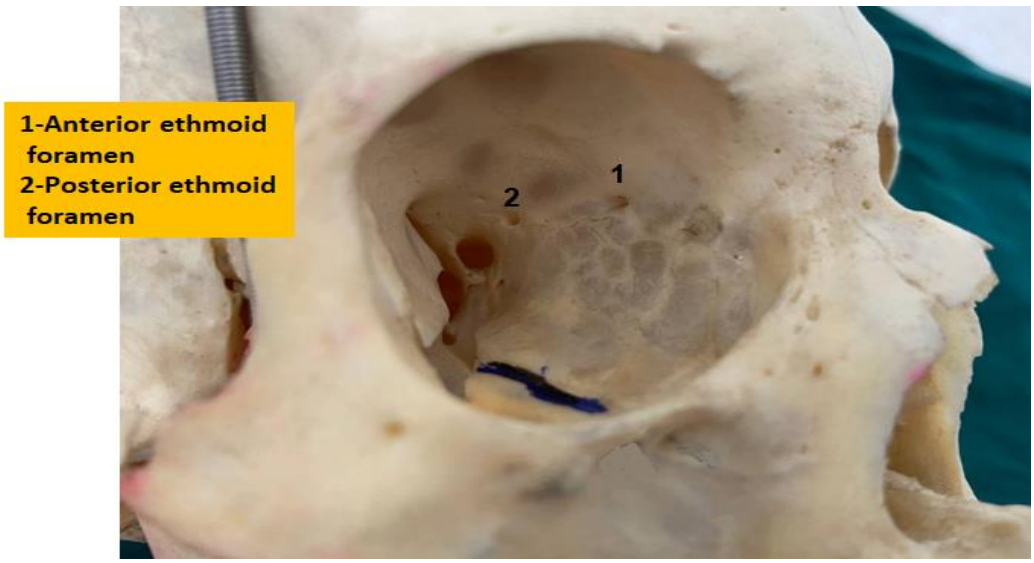

Fig. 68: opening of the orbital cavity.

Chapter 8

VERTEBRAE

The vertebrae protect and support the spinal cord.

They also bear the majority of the weight.

Vertebrae are the 33 individual bones that articulate with each other to form the spinal column.

The vertebrae are numbered and divided into regions: cervical(7), thoracic(12), lumbar(5), sacrum(5), and coccyx(4).

Each typical vertebra has the following features:

1- Body which is heavy and built for support.

2- Vertebral arch which located posterior to body and encircles and protects the spinal cord.

The arches of all articulating vertebrae forming the vertebral canal which houses the entire spinal cord.

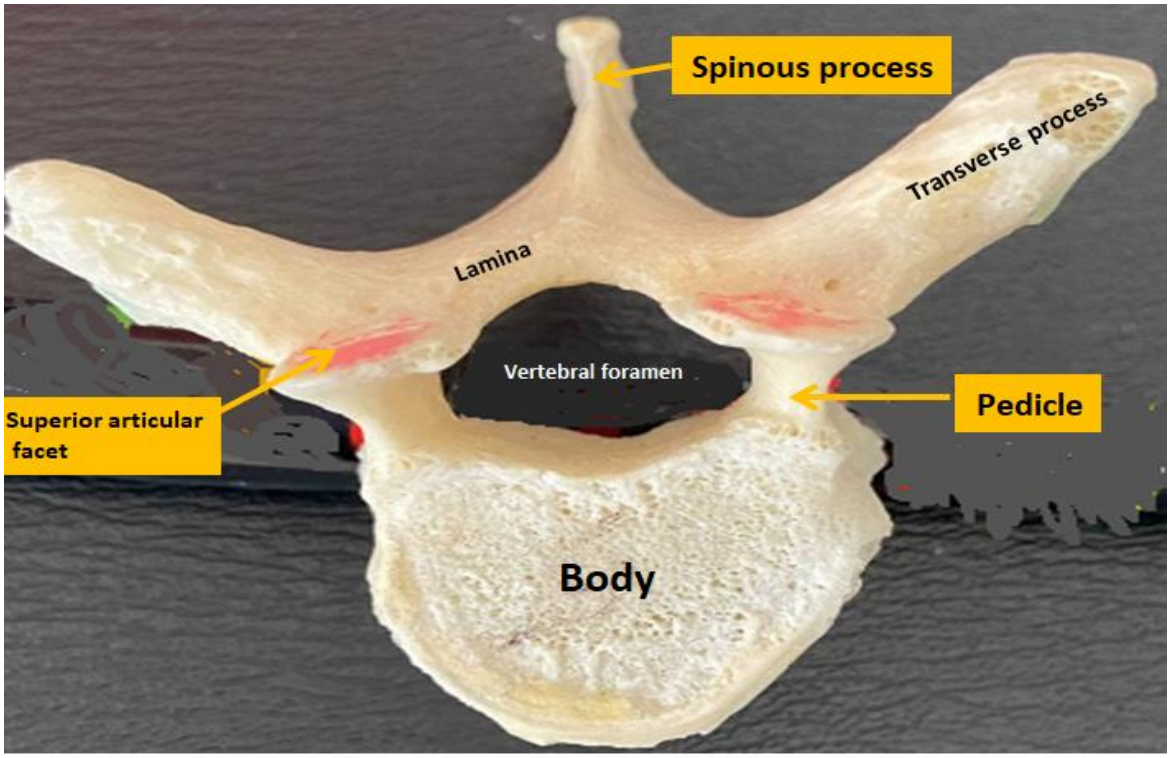

Fig. 69: Anterior view of the features of typical vertebra.

3- The arch formed by roots called **pedicales** which connect the arch to body, and also formed by two plates of bones called lamina which complete the arch posteriorly.

4- Superior and inferior articulating processes (facets) : they are cup-shaped which allow the vertebra to articulate with the above and below vertebra.

5-superior and inferior vertebral notches : these are grooves on the superior and inferior surfaces of the pedicales.

In articulating column these notches forming the intervertebral foramina, through which pass the spinal nerves

6- Spinous process is a single process extending postero-inferiorly from the posterior end of the arch.

7- Transvers processes : two processes arising laterally from the arch.

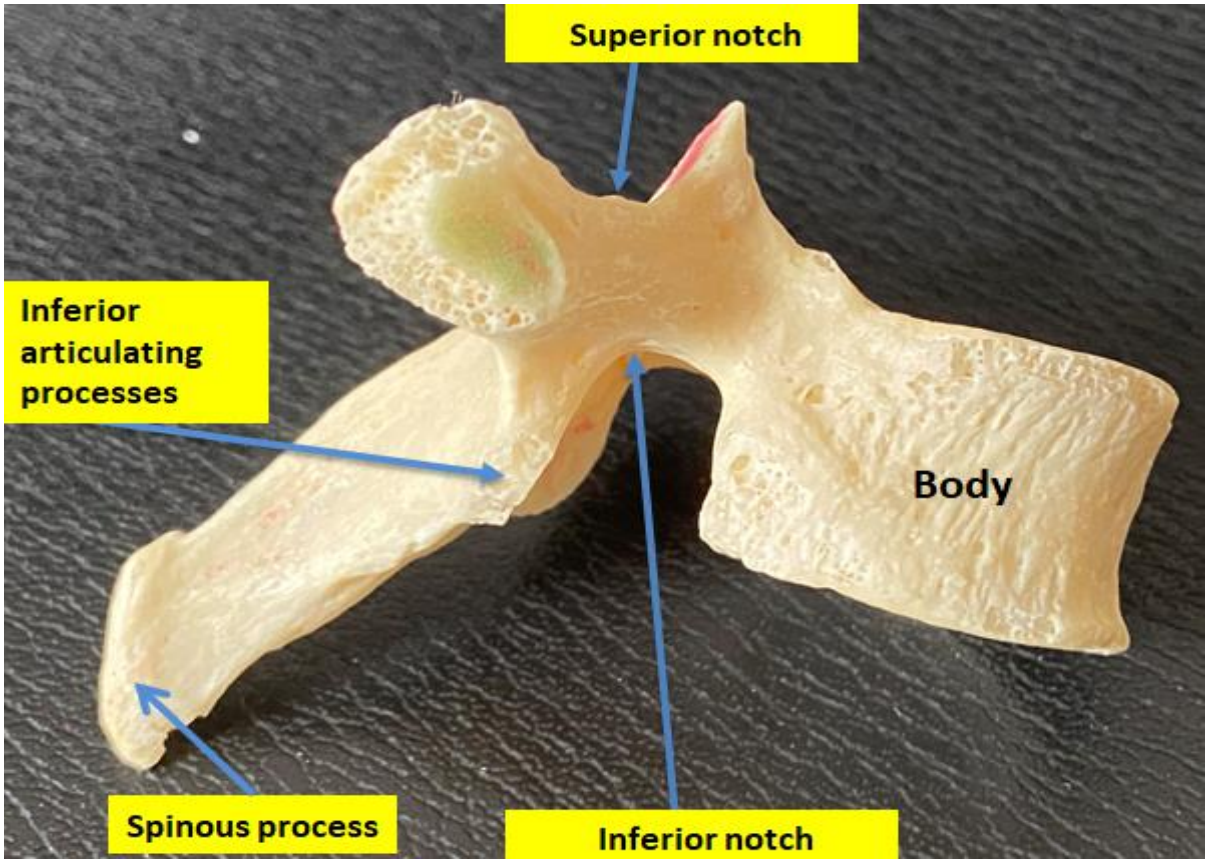

Fig. 70: Lateral view of the features of typical vertebra.

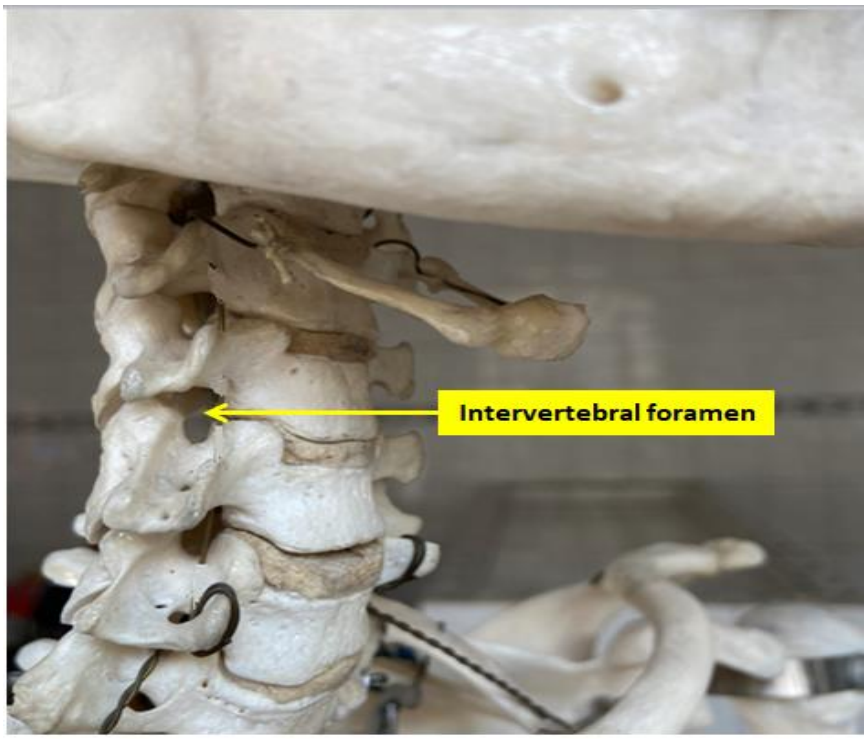

Fig. 71: articulation between vertebrae.

CERVICAL VERTEBRAE

In addition to the general features, the cervical vertebrae exhibit the:

1- Transverse foramen through the transvers processes to transmit the vertebral artery.

2- A bifid spinous process.

3- The transverse process ends laterally as anterior and **posterior tubercles.**

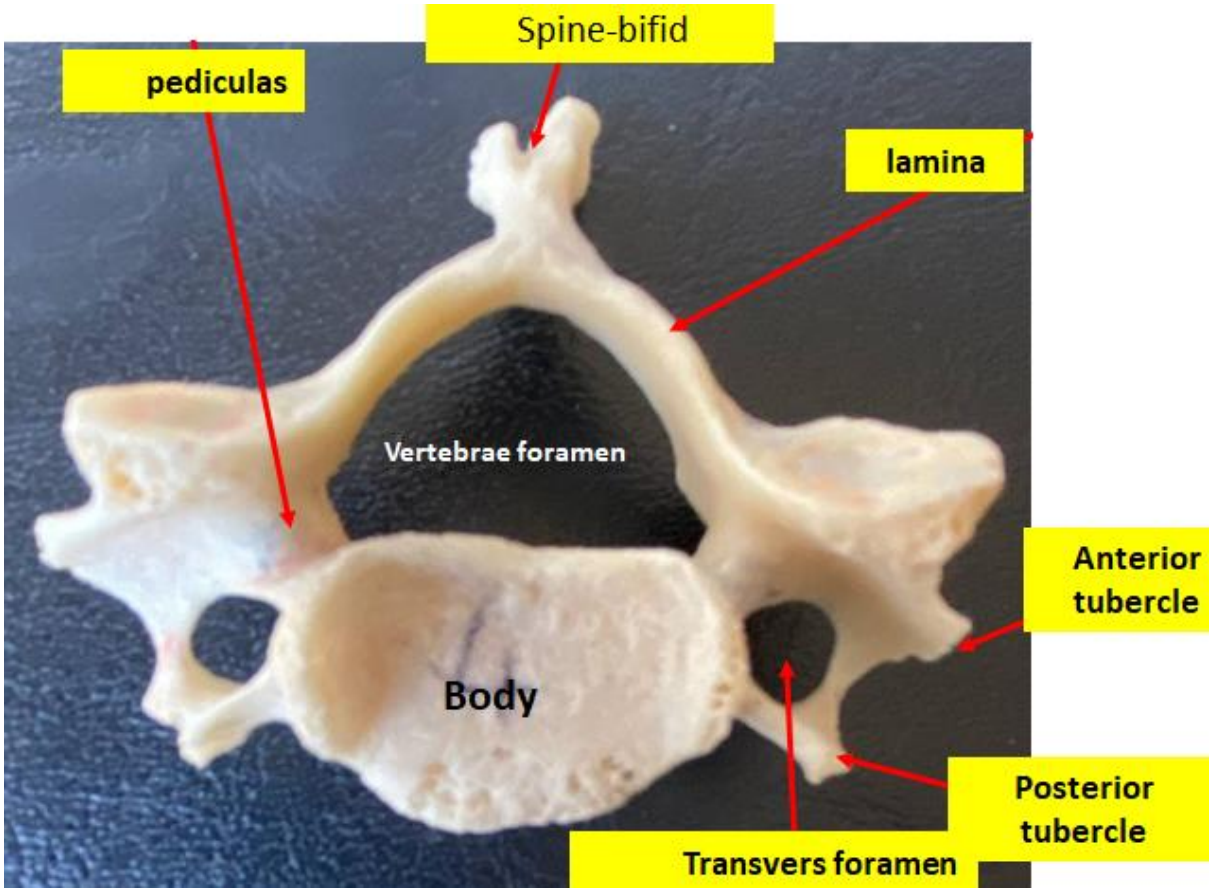

Fig. 72: Typical cervical vertebra.

ATLAS

The first cervical vertebra (C1) differs from the remaining vertebrae by the following:

1- The body is lost early in development and fused with the body of the axis below, leaving only anterior arch in its place.

2- It lacked the spinous process

3- The superior articulating processes(facets) are large bean – shaped to accommodate the occipital condyles.

4-There are two grooves for vertebral arteries just posterior to the superior articulating facets.

5-There is a facet on its posterior surface of the anterior arch for articulation with the dens of axis below.

6- There are two grooves for vertebral arteries just posterior to the superior articulating facets.

7-There is a facet on its posterior surface of the anterior arch for articulation with the dens of axis below.

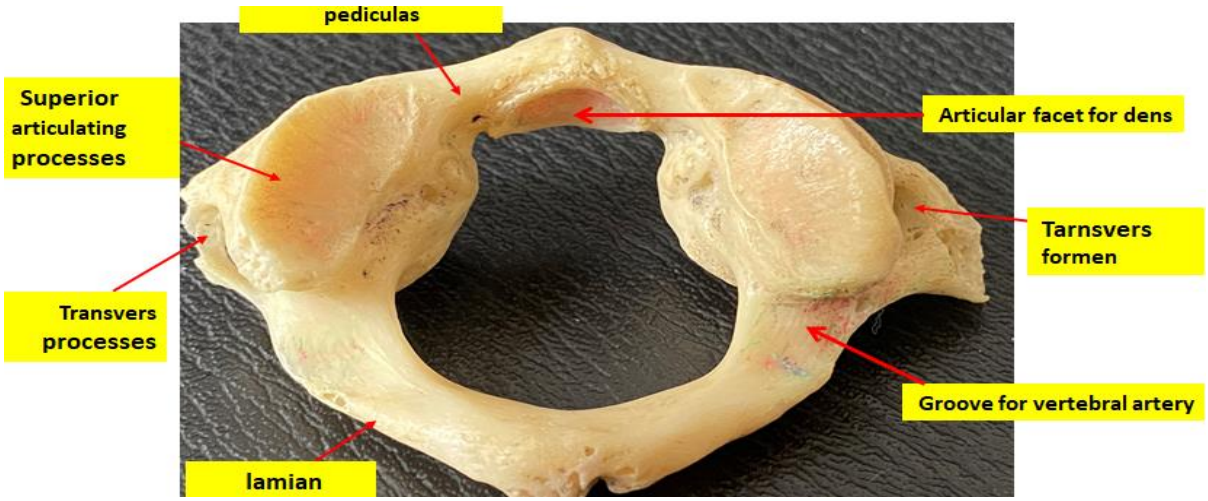

Fig. 73: Atlas (first cervical vertebra).

AXIS

The axis (C2) is characterized by the ***dens (or odontoid process)***, which projects upward from the body

The dens is articulates with the anterior arch of the atlas and is limited behind by the transverse ligament of the atlas.

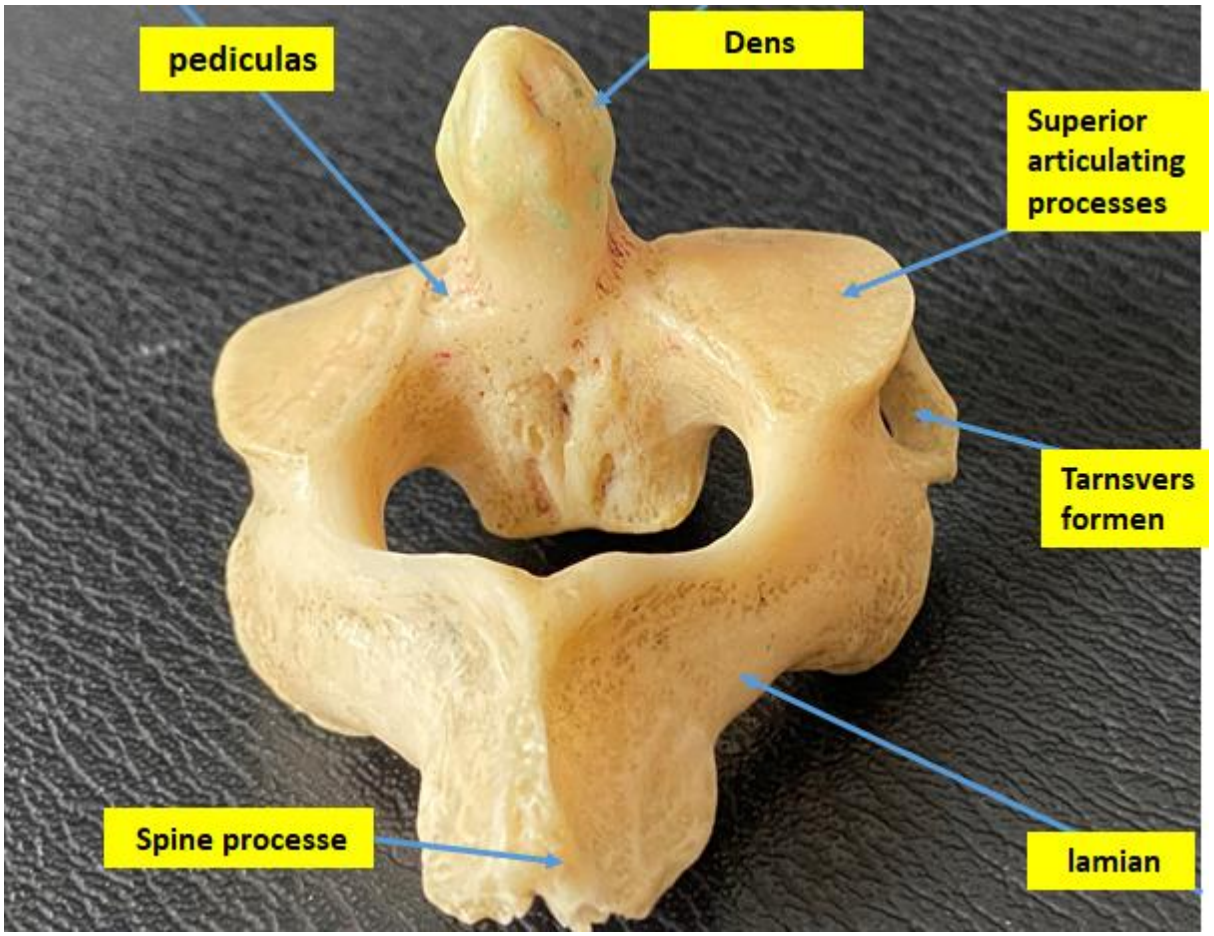

Fig. 74: Axis (second cervical vertebra).

Chapter 9

HYOID BONE

U-shaped bone situated at the root of the tongue in the front of the neck and between the lower jaw and the largest cartilage of the larynx. The primary function of the hyoid bone is to serve as an attachment structure for the tongue and for muscles in the floor of the oral cavity. It has no articulation with other bones. The hyoid consists of a body, a pair of larger horns, called the greater cornua, and a pair of smaller horns, called the lesser cornua. The bone is more or less in the shape of a U, with the body forming the central part, or base, of the letter.

Fig. 75: Parts of the hyoid bone.

Fig. 76: location of the hyoid bone.

Summary of foramina in skull

Foramen	Contain
Anterior ethmoidal	Anterior ethmoidal nerve and vessels
Carotid canal	Internal carotid artery and associated sympathetic plexus
Cecum	Emissary veins
Condyloid	Emissary veins
Greater palatine	Greater palatine vessels and nerve
Hiatus of the facial canal	Greater petrosal nerve
Hypoglossal canal	Cranial nerve XII
Incisive	Nasopalatine nerves and descending sphenopalatine artery
Inferior orbital fissure	Maxillary division ofc ranial nerve V, zygomatic nerve, infraorbital vessels , ophthalmic vein
Infraorbital	Infraorbital vessels and nerve

Internal auditory meatus	**Cranial nerves VII and VIII , nervus intermedius and internal auditory vessels**
Jugular	**Cranial nerves IX, X, and XI; internal jugular vein**
Lacerum	**Covered by cartilaginous plate, which is pierced by meningeal arteries and emissary veins**
Lesser palatine	**Lesser palatine vessels and nerve**
Magnum	**Brainstem/spinal cord** **Vertebral arteries** **Spinal portion of the accessory nerve ((CNXI** **Anterior and posterior spinal arteries** **Dural veins**
Mandibular	**Inferior alveolar vessels and nerve**
Mastoid	**Emissary veins**
Mental	**Mental nerve and vessels**
Nasolacrimal canal	**Nasolacrimal duct**
Olfactory	**Olfactory nerve**
Optic	**Optic nerve CNII** **Ophthalmic artery**

Ovale	**Mandibular division of the trigeminal nerve (CNV3)** **Accessory meningeal artery** **lesser petrosal nerve(occasionally)**
Parietal	**Emissary vein to superior sagittal sinus**
Pharyngeal canal	**Pharyngeal nerve**
Posterior ethmoidal	**Posterior ethmoidal nerve and vessels**
Posterosuperior alveolar	**Posterosuperior alveolar nerve and vessels**
Pterygoid canal (vidian canal)	**Nerve and vessels of the pterygoid canal (vidian nerve and vessel)**
Rotundum	**Maxillary division of the trigeminal nerve CNV2**
Sphenopalatine	**Sphenopalatine vessels and nasopalatine nerve**

Spinosum	**Middle meningeal vessels**
Stylomastoid	**Facial nerve (VII) , stylomastoid artery**
Superior orbital fissure	**Cranial nerves III, IV, VI ;ophthalmic division of V ; superior ophthalmic vein**
Supraorbital	**Supraorbital nerve and vessels**
Zygomaticofacial	**Zygomaticofacial nerve and vessels**
Zygomaticotemporal	**Zygomaticotemporal nerve and vessels**

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