



BONES OF THE HEAD

OUTLINE

I. Cranium	II. Temporomandibular Joint (TMJ)
A. Parts	A. Articulations
B. Facial Aspect	B. Ligaments
C. Lateral Aspect	C. Movements of the Mandible
D. Craniometric Aspect	D. Muscles of Mastication
E. Occipital Aspect	
F. Superior Aspect	
G. External Surface of the Cranial Base	
H. Internal Surface of the Cranial Base	

LEGENDS

Must know	Lecturer	Book	Presentation	Old Trans
!				

LEARNING OBJECTIVES

At the end of the lecture, the student should be able to:

- ✓ Discuss the parts of the cranium and the bones that constitute each part.
- ✓ Enumerate the different parts and landmarks of the cranium in each of its aspects.
- ✓ Give the boundaries, contents and neurovasculature of the infratemporal fossa.
- ✓ Define temporomandibular joint.
- ✓ Give the movements of the temporomandibular joint.
- ✓ Discuss the muscles of mastication.

CRANIUM

- The cranium is the skeleton of the head.
- It is composed of 22 named bones.
- It is divided into two main parts: the neurocranium and the viscerocranium.
- **Anatomical Position:** The inferior margin of the orbit and the superior margin of the external acoustic opening of the external acoustic meatus of both sides lie in the same horizontal plane.
- Several bones of the cranium are pneumatized bones, meaning they contain air spaces to decrease their weight.
- Examples of pneumatized bones include the frontal, temporal, sphenoid, and ethmoid bones.

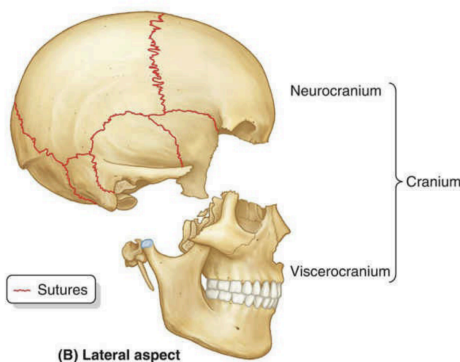


Figure 1. Cranium

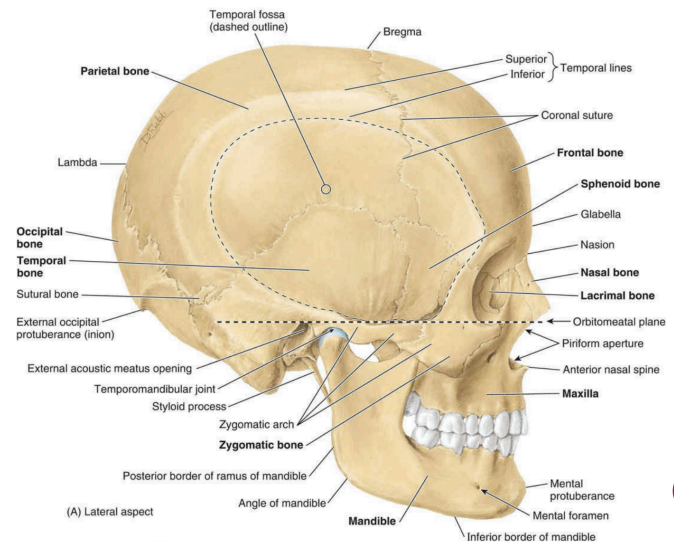


Figure 2. Detailed Parts of Cranium

A. PARTS

Neurocranium

- The neurocranium is the bony case of the brain and its membranous coverings, the cranial meninges.
- It contains the proximal parts of the cranial nerves and the vasculature of the brain.
- It is formed by a series of eight bones.
- The bones forming the neurocranium are curved, with convex external and concave internal surfaces.
- **Calvaria (Skullcap):** The dome-like roof formed by flat bones (frontal, parietal, and occipital).
 - Calvarial bones are formed by intramembranous ossification of head mesenchyme from the neural crest.
 - Calvarial bones are united by fibrous interlocking sutures.
- **Cranial Base (Basicranium):** The floor of the neurocranium, primarily composed of irregular bones with substantial flat portions (sphenoidal and temporal).
- The cranial base is formed by endochondral ossification of cartilage.
- **Ethmoid Bone:** An irregular bone that makes a relatively minor midline contribution to the neurocranium but is primarily part of the viscerocranium.

Viscerocranium

- The viscerocranium comprises the facial bones that mainly develop in the mesenchyme of the embryonic pharyngeal arches.
- It forms the anterior part of the cranium and consists of the bones surrounding the mouth, nose/nasal cavity, and most of the orbits.
- It consists of 15 irregular bones in total.
- **Singular Bones:** 3 bones centered on or lying in the midline (mandible, ethmoid, and vomer).
- **Bilateral Pairs:** 6 bones occurring in pairs (maxillae, inferior nasal conchae, zygomatic, palatine, nasal, and lacrimal bones).

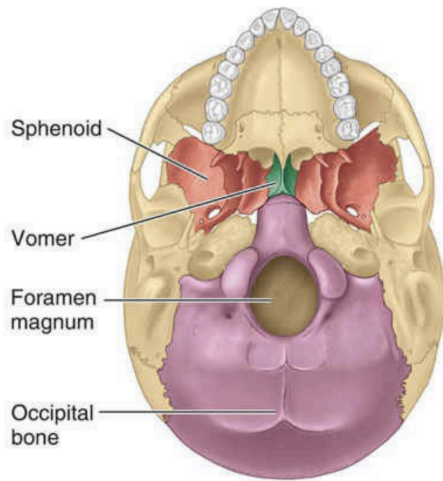


Figure 3. Inferior Aspect of Cranium

B. FACIAL ASPECT

Frontal Bone

- Forms the skeleton of the forehead.
- Articulates inferiorly with the nasal and zygomatic bones.
- **Metopic Suture:** A persistent frontal suture in some adults, seen in the middle glabella (the smooth, slightly depressed area between the superciliary arches).
- The frontal suture divides the frontal bones of the fetal cranium.
- **Supra-orbital Margin:** The angular boundary between the squamous and orbital parts of the frontal bone.
- The supra-orbital margin has a supra-orbital foramen (or notch) for the passage of the supra-orbital nerve and vessels.
- **Superciliary Arch:** Located superiorly, extending laterally on each side from the glabella.
- The prominence of the superciliary ridge, deep to the eyebrows, is generally greater in males.

Nasion

- The intersection of the frontal and nasal bones.
- In most people, it is related to a distinctly depressed area known as the bridge of the nose.
- It is one of many craniometric points used radiographically in medicine.
- It is used to make cranial measurements, compare and describe the topography of the cranium, and document abnormal variations.

Zygomatic Bones

- Form the prominences of the cheeks.
- Lie on the inferolateral sides of the orbits and rest on the maxillae.
- Articulate with the frontal, sphenoid, temporal bones, and the maxillae.
- The zygomaticofacial foramen pierces the lateral aspect of each zygomatic bone.

Piriform Aperture

- A pear-shaped anterior nasal opening in the cranium.
- Located inferior to the nasal bones.
- The bony nasal septum can be observed through this aperture, dividing the nasal cavity into right and left parts.
- Curved bony plates called nasal conchae are located on the lateral wall of each nasal cavity.

Maxillae

- Form the skeleton of the upper jaw, which is fixed to the cranial base.
- Contribute the greatest part of the upper facial skeleton.
- The two maxillae are united at the intermaxillary suture in the median plane.
- Surround most of the piriform aperture and form the infraorbital margins medially.
- Have a broad connection with the zygomatic bones laterally.
- House the teeth and provide the sockets and supporting bone for the maxillary teeth.
- Alveolar processes include the tooth sockets (alveoli).
- **Infra-orbital Foramen:** Located inferior to each orbit for the passage of the infra-orbital nerve and vessels.

Mandible

- Forms the skeleton of the lower jaw and is movable because it articulates with the cranial base at the temporomandibular joints.
- A U-shaped bone consisting of a horizontal part (the body) and a vertical part (the ramus).
- Contains an alveolar part that provides sockets and supports the mandibular teeth.
- **Mental Foramina:** Located inferior to the second premolar teeth for the mental nerves and vessels.
- **Mental Protuberance:** A triangular bony elevation forming the prominence of the chin.
- The mental protuberance is located inferior to the mandibular symphysis (the osseous union where the halves of the infantile mandible fuse).

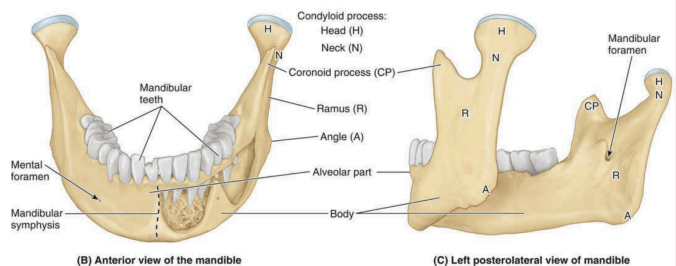


Figure 4. Anterior and Left Posterolateral View of Mandible

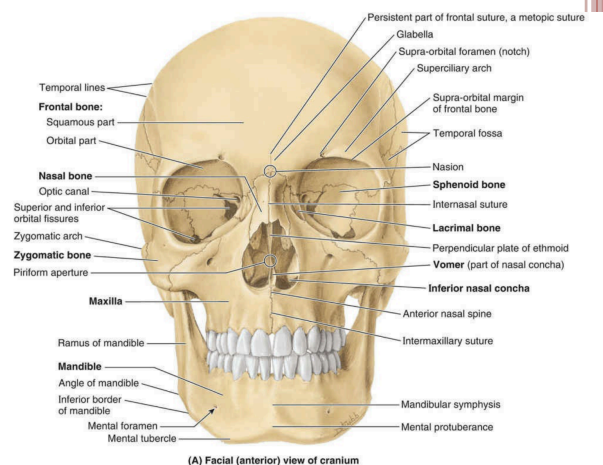


Figure 5. Facial or Anterior View of Cranium

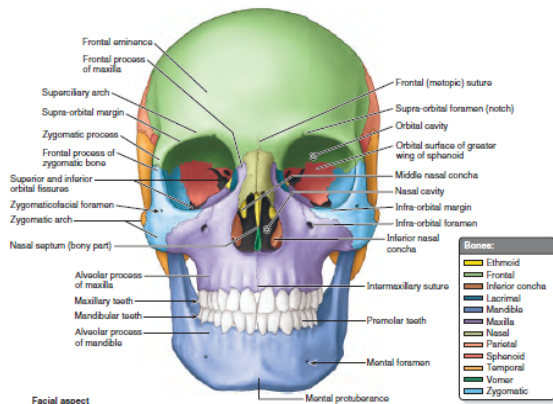


Figure 6. Facial Aspect Anatomy

C. LATERAL ASPECT

- It is formed by both **neurocranium** and **viscerocranium**
 - provide for muscle attachments
- Main features of the **neurocranial part**:
 - Temporal Fossa
 - External acoustic meatus opening
 - Mastoid process of the temporal bone
- Main Features of the **viscerocranial part**:
 - Infratemporal Fossa
 - Zygomatic Arch
 - Lateral Aspects of the maxilla and mandible
- Temporal Fossa** is bounded:
 - superiorly and posteriorly by the superior and inferior temporal lines
 - anteriorly by the frontal and zygomatic bones
 - inferiorly by the zygomatic arch
- Zygomatic Arch**
 - formed by the union of the temporal process of the zygomatic bone and zygomatic process of the temporal bone
- Temporal Fossa – Anterior part**
 - 3-4 cm superior to the midpoint of the zygomatic arch
 - clinically important area of bone junctions: **pteron**
 - Indicated by an H-shaped formation of sutures that unite the frontal, parietal, sphenoid (greater wing), and temporal bones
- External Acoustic Meatus Opening**
 - entrance to the external acoustic meatus (canal)
 - leads to the tympanic membrane (eardrum)
- Mastoid process** of the temporal bone
 - postero-inferior to the external acoustic meatus opening
- Styloid Process** of the temporal bone
 - Anteromedial to the mastoid process
 - a slender needle-like, pointed projection
- Infratemporal Fossa**
 - irregular space inferior and deep to the zygomatic arch and mandible and posterior to the maxilla

D. CRANIOMETRIC ASPECT

Landmark	Shape and Location
Pterion (G. wing)	Junction of the greater wing of sphenoid, squamous temporal, frontal, and parietal bones; overlies course of anterior division of middle meningeal artery
Lambda (G. the letter L)	Point on calvaria at junction of

	lambdoid and sagittal sutures
Bregma (G. Forepart of the head)	Point on calvaria at junction of coronal and sagittal sutures
Vertex (L. whirl, whorl)	Superior point of neurocranium, in middle with cranium oriented in anatomical (Orbitomeatal or Frankfort) plane
Asterion (G. asterios, starry)	Star shaped; located at junction of three sutures: parietomastoid, occipitomastoid, and lambdoid
Glabella (L. smooth, hairless)	Smooth prominence; most marked in males; on frontal bones superior to root of nose; most anterior projecting part of forehead
Inion (G. back of the head)	Most prominent point of external occipital protuberance
Nasion (L. nose)	Point on cranium where frontonasal and internasal sutures meet

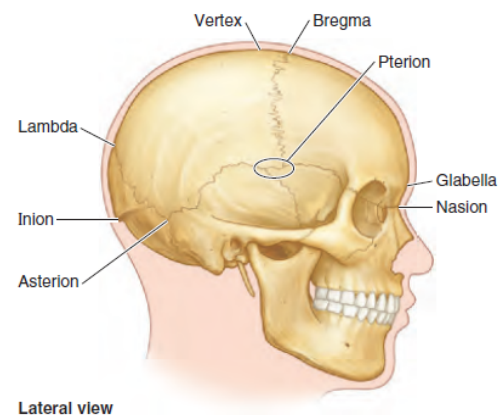


Figure 7. Craniometric Points

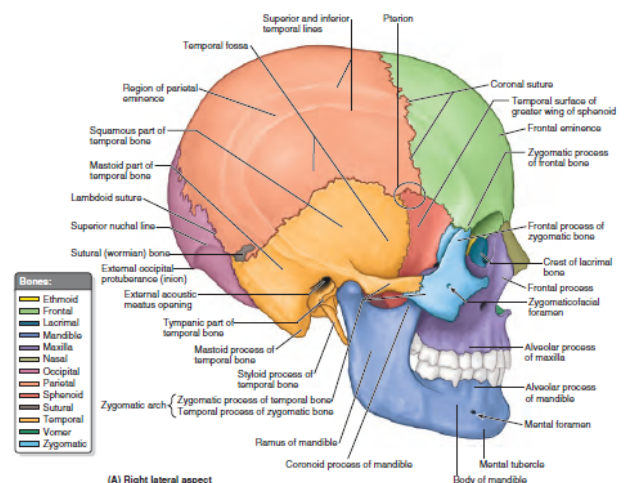


Figure 8. Lateral Aspect of Cranium

E. OCCIPITAL ASPECT

- **Composed of the following**
 - Occiput or back of the head
 - Convex posterior protuberance of squamous part of the occipital bone
 - Parts of the parietal bones
 - Mastoid parts of the temporal bones
- **External Occipital Protuberance**
 - Usually easily palpable in the median plane.
 - Inion: Craniometric point defined by the tip of the external protuberance.
- **External Occipital Crest**
 - Descends from the external protuberance toward the foramen magnum.
 - Large opening in the basal part of the occipital bone.
- **Superior Nuchal Line**
 - Marking the superior limit of the neck.
 - Extends laterally from each side of the external protuberance.
- **Inferior Nuchal Line**
 - Less distinct.
- **Lambda**
 - In the center of the occiput.
 - Indicates the junction of the sagittal and the lambdoid sutures
 - Can sometimes be felt as depression.
 - One or more **sutural bones** may be located at lambda or near the Mastoid process

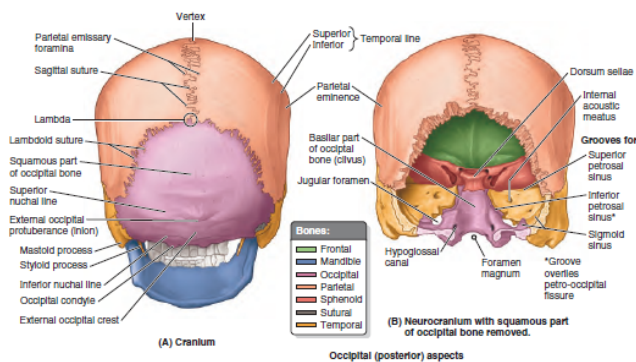


Figure 9. Occipital Aspect of Cranium

F. SUPERIOR ASPECT

- usually somewhat oval in form
- broadens posterolaterally at the **parietal eminences**
- In some people, **frontal eminences** are also visible, giving the calvaria a somewhat square appearance
- **Coronal suture** separates the frontal and parietal bones
- **Sagittal suture** separates the parietal bones
- **Lambdoid suture** separates the parietal and temporal bones from the occipital bone
- **Bregma** is the craniometric landmark formed by the intersection of the sagittal and coronal sutures
- **Vertex**, the most superior point of the calvaria, is near the midpoint of the sagittal suture
- **Parietal foramen**
 - small, inconstant aperture located posteriorly in the parietal bone near the sagittal suture
 - sometimes, paired parietal foramina are present
- **Emissary foramina**
 - Most irregular, highly variable foramina that occur in the neurocranium
 - transmit emissary veins connecting scalp veins to the venous sinuses of the dura mater

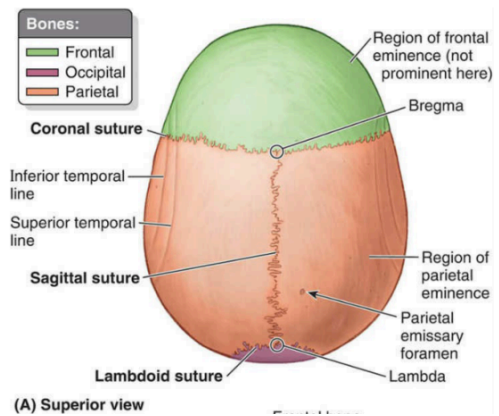
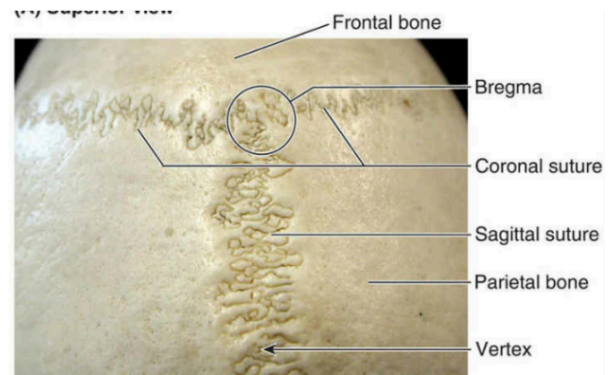
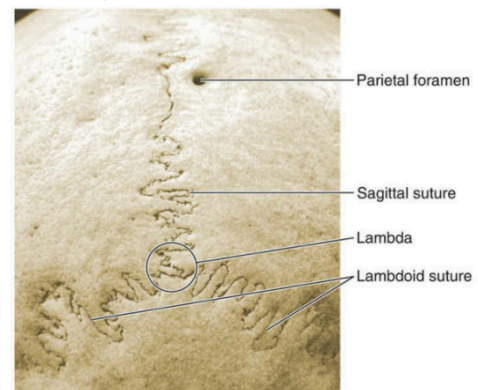


Figure 10. Superior View



(B) Superior (vertical) aspect

Figure 11. Superior (Vertical) View



(C) Posterosuperior view

Figure 12. Posterosuperior View

G. EXTERNAL SURFACE OF THE CRANIAL BASE

- Cranial base (basicranium) is the inferior portion of the neurocranium and viscerocranium minus the mandible
- Features the following:
 - alveolar arch of the maxillae
 - palatine processes of the maxillae
 - palatine, sphenoid, vomer, temporal, and occipital bones
- **Hard Palate**
 - formed by the palatal processes of the maxillae anteriorly and the horizontal plates of the palatine bones posteriorly
- **Posterior Nasal Spine**
 - free posterior border of the hard palate projects posteriorly in the median plane
- **Incisive Foramen**
 - Posterior to the central incisor teeth

- Depression in the midline of the bony palate into which the incisive canals open
- right and left nasopalatine nerves pass from the nose through a variable number of incisive canals and foramina
- Posterolateral: **greater and lesser palatine foramina**
- **Choanae** (posterior nasal apertures)
 - Large openings superior to the posterior edge of the palate
 - Separated from each other by the **vomer**
 - a flat unpaired bone of trapezoidal shape that forms a major part of the bony nasal septum
- **Sphenoid**
 - wedged between the frontal, temporal, and occipital bones
 - irregular unpaired bone that consists of a body and three pairs of processes: greater wings, lesser wings, and pterygoid processes
- **Greater and Lesser wings of the sphenoid**
 - spread laterally from the lateral aspects of the body of the sphenoid
- **Pterygoid Processes**
 - consisting of lateral and medial pterygoid plates
 - extend inferiorly on each side of the sphenoid from the junction of the body and greater wings
- **Groove for the Cartilaginous part of the Pharyngotympanic (auditory) tube**
 - lies medial to the spine of the sphenoid, inferior to the junction of the greater wing of the sphenoid and the petrous part of the temporal bone
- **Mandibular Fossae**
 - Depressions in the squamous part of the temporal bone
 - accommodate the mandibular condyles when the mouth is closed
- Occipital bone
 - articulates with the sphenoid anteriorly, forming the posterior part of the cranial base
- **Foramen Magnum**
 - Where the four parts of the occipital bone are arranged
 - major structures passing through this large foramen:
 - spinal cord; meninges; vertebral arteries; anterior and posterior spinal arteries; and spinal accessory nerve (CN XI)
- **Occipital condyles**
 - Located on the lateral parts of the occipital bone
 - where the cranium articulates with the vertebral column
- **Jugular Foramen**
 - large opening between the occipital bone and the petrous part of the temporal bone
 - where the internal jugular vein and several cranial nerves (CN IX–CN XI) emerge from the cranium
- **Carotid Canal**
 - Entrance for the Internal carotid artery
 - anterior to the jugular foramen
- **Mastoid processes**
 - provide for muscle attachments
- **Stylomastoid Foramen**
 - transmitting the facial nerve (CN VII) and stylomastoid artery
 - lies posterior to the base of the styloid process

H. INTERNAL SURFACE OF THE CRANIAL BASE

- three large depressions that lie at different levels:
 - Anterior cranial fossa
 - Middle cranial fossa
 - Posterior cranial fossa
- form the bowl-shaped floor of the cranial cavity,
- the space enclosed within the neurocranium occupied by the brain

ANTERIOR CRANIAL FOSSA

- Occupied by the inferior and anterior parts of the frontal lobes of the brain
- shallowest of the three cranial fossa
- formed by the frontal bone anteriorly, the ethmoid bone in the middle, and the body and lesser wings of the sphenoid posteriorly
- **Orbital parts of the frontal bone**
 - Greater part of the fossa
 - support the frontal lobes of the brain and form the roofs of the orbits
 - shows sinuous impressions (*brain markings*) of the orbital gyri (ridges) of the frontal lobes
- **Frontal crest**
 - a median bony extension of the frontal bone
 - At its base is the **foramen cecum**
 - passage to vessels during fetal development
- **Crista Galli**
 - thick, median ridge of bone posterior to the foramen cecum
- **Cribiform Plate of Ethmoid Bone**
 - transmit the olfactory nerves (CN I) from the olfactory areas of the nasal cavities to the olfactory bulbs of the brain, which lie on this plate

MIDDLE CRANIAL FOSSA

- butterfly-shaped
- has a central part composed of the sella turcica on the body of the sphenoid and large, depressed lateral parts on each side
- separated from anterior cranial fossa by the sharp sphenoidal crests laterally and the limbus of the sphenoid centrally
- lateral parts of the middle cranial fossa support the temporal lobes of the brain
 - boundary between the middle and the posterior cranial fossa
 - Lateral: superior border (crest) of the petrous part of the temporal bone
 - Medial: flat plate of bone, the dorsum sellae of the sphenoid
- **Sphenoidal crests**
 - formed mostly by the sharp posterior borders of the lesser wings of the sphenoid bones
 - End medially in two sharp bony projections, the anterior clinoid processes
- **Limbus of the Sphenoid**
 - forms the anterior boundary of the transversely oriented prechiasmatic sulcus extending between the right and the left optic canals
- **Sella turcica**
 - saddle-like bony formation on the upper surface of the body of the sphenoid
 - which is surrounded by the anterior and posterior clinoid processes
 - composed of three parts:
 - tuberculum sellae
 - hypophysial fossa
 - dorsum sellae
- **Tuberculum Sellae (horn of saddle)**
 - a variable slight to prominent median elevation forming the posterior boundary of the prechiasmatic sulcus and the anterior boundary of the hypophysial fossa

- **Hypophysial fossa (pituitary fossa)**
 - a median depression (seat of saddle) in the body of the sphenoid that accommodates the pituitary gland
- **Dorsum sellae (back of saddle)**
 - a square plate of bone projecting superiorly from the body of the sphenoid
 - forms the posterior boundary of the sella turcica, and its prominent superolateral angles make up the posterior clinoid processes
- On each side of the body of the sphenoid:
 - a crescent of four foramina perforates the roots of the cerebral surfaces of the greater wings of the sphenoids
 - structures transmitted by the foramina are the following:
 - Superior orbital fissure
 - Foramen rotundum
 - Foramen ovale
 - Foramen spinosum
- **Superior orbital fissure**
 - Located between the greater and the lesser wings, it opens anteriorly into the orbit
- **Foramen rotundum**
 - Located posterior to the medial end of the superior orbital fissure
 - runs a horizontal course to an opening on the anterior aspect of the root of the greater wing of the sphenoid into a bony formation between the sphenoid, the maxilla, and the palatine bones, the pterygopalatine fossa
- **Foramen ovale (oval foramen)**
 - A large foramen posterolateral to the foramen rotundum; it opens inferiorly into the infratemporal fossa
- **Foramen spinosum (spinous foramen)**
 - Located posterolateral to the foramen ovale
 - opens into the infratemporal fossa in relationship to the spine of the sphenoid
- **Foramen lacerum (lacerated or torn foramen)**
 - not part of the crescent of foramina
 - ragged foramen lies posterolateral to the hypophysial fossa and is an artifact of a dried cranium
 - Only some meningeal arterial branches and small veins are transmitted vertically
 - Internal carotid artery and its accompanying sympathetic and venous plexuses pass across the superior aspect of the cartilage
- **Groove for the Greater Petrosal nerve**
 - Extending posteriorly and laterally from the foramen lacerum
- **Groove for the Lesser Petrosal nerve**
 - a small groove on the anterior surface of the petrous part of the temporal bone.
- **POSTERIOR CRANIAL FOSSA**
 - largest and deepest of the three cranial fossa
 - lodges the cerebellum, pons, and medulla oblongata
 - formed mostly by the occipital bone, except
 - the dorsum sellae of the sphenoid marks its anterior boundary centrally
 - the petrous and mastoid parts of the temporal bones contribute its anterolateral walls
- **Clivus**
 - marked incline

- center of the anterior part of the fossa leading to the foramen magnum
 - **posterior cranial fossa** – divided by **internal occipital crest** - bilateral large concave impressions, the **cerebellar fossae**
- **Internal Occipital Protuberance**
 - Where the internal occipital crest ends
 - Formed in relationship to the confluence of the sinuses
 - a merging of dural venous sinuses
- **Jugular Foramen**
 - Located At the base of the petrous ridge of the temporal bone
 - transmits several cranial nerves (CN IX, X, XI)
- **Internal Acoustic Meatus**
 - Anterosuperior to the jugular foramen
 - Transmit CN VII, VIII and labyrinthine artery
- **Hypoglossal Canal**
 - superior to the anterolateral margin of the foramen magnum
 - Transmit CN XII

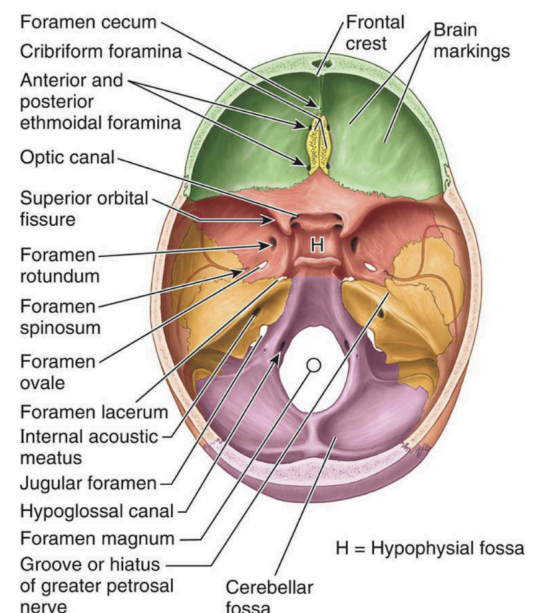
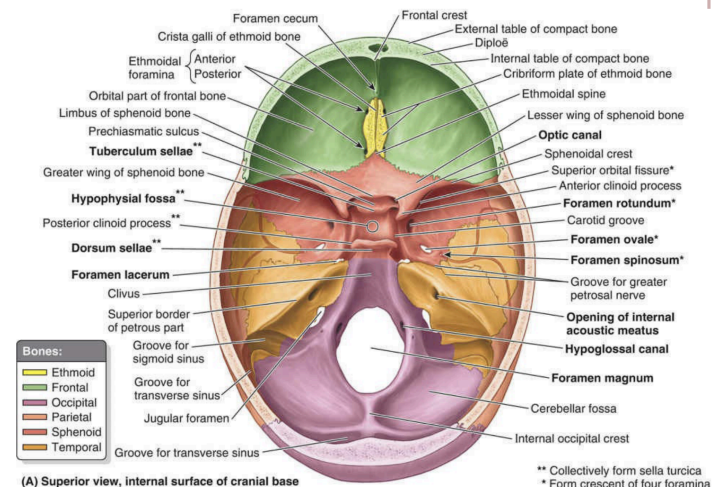


Figure 13. Internal surface of the cranial base.

INFRATEMPORAL FOSSA

- irregularly shaped space deep and inferior to the zygomatic arch, deep to the ramus of the mandible, and posterior to the maxilla
- communicates with the temporal fossa through the interval between the zygomatic arch and the cranial bones
- parotid and temporal regions and the infratemporal fossa collectively include the temporomandibular joint and the muscles of mastication that produce its movements

BOUNDARIES

- Laterally: the ramus of the mandible.
- Medially: the lateral pterygoid plate.
- Anteriorly: the posterior aspect of the maxilla.
- Posteriorly: the tympanic plate and the mastoid and styloid processes of the temporal bone.
- Superiorly: the inferior (infratemporal) surface of the greater wing of the sphenoid.
- Inferiorly: where the medial pterygoid muscle attaches to the mandible near its angle

CONTENTS

- inferior part of the temporalis muscle.
- lateral and medial pterygoid muscles.
- maxillary artery.
- pterygoid venous plexus.
- mandibular, inferior alveolar, lingual, buccal, and chorda tympani nerves.
- otic ganglion

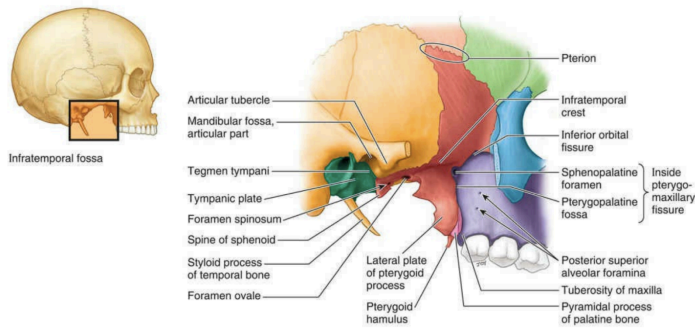


Figure 14. Infratemporal Fossa.

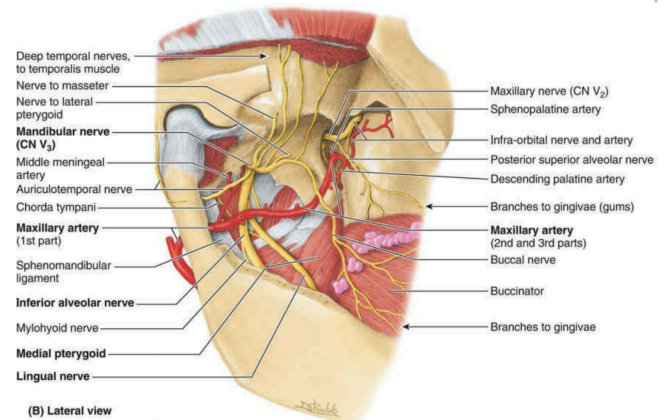
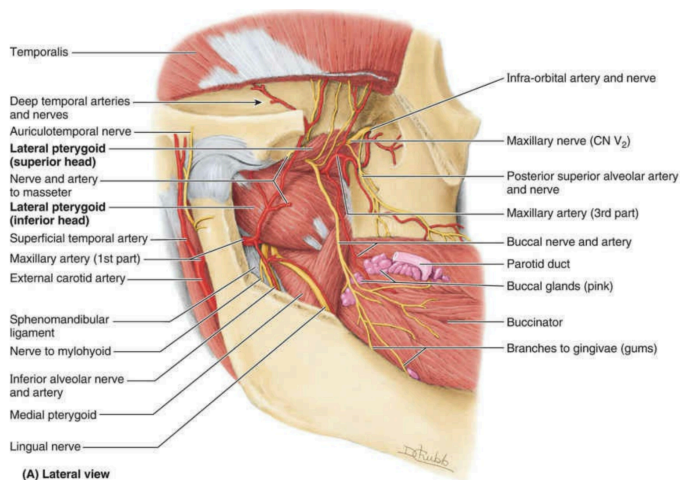


Figure 15. Infratemporal Fossa in Lateral View.

BLOOD SUPPLY

- Maxillary artery
 - larger branch of the external carotid artery
 - arises posterior to the neck of the mandible
 - divided into three parts based on its relation to the lateral pterygoid muscle:
 - Mandibular (1st part)
 - Pterygoid (2nd part)
 - Pterygoid-Palatine (3rd part)

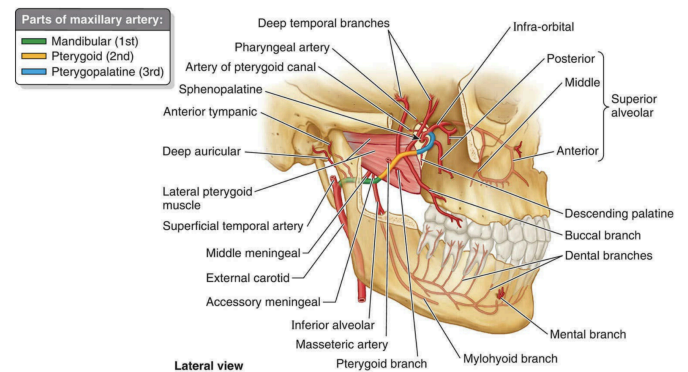


Figure 16. Infratemporal Fossa (Parts of the Maxillary Artery)

VENOUS DRAINAGE

- Pterygoid venous plexus
 - Located partly between the temporalis and pterygoid muscles
 - Venous equivalent of most of the maxillary artery
 - Anastomoses anteriorly with the facial vein via the deep facial vein and superiorly with the cavernous sinus via emissary veins
 - Difficult to appreciate in the cadaver

NERVE SUPPLY

- Mandibular Nerve
 - Arises from the trigeminal ganglion in the middle cranial fossa
 - Immediately receives the motor root of the trigeminal nerve and descends through the foramen ovale into the infratemporal fossa
 - Branches: Auriculotemporal, Inferior alveolar, Lingual, and Buccal nerves
 - Branches of CN V3 also supply the four muscles of mastication
 - Except buccinator, which is supplied by the facial nerve
- Auriculotemporal Nerve

- Encircles the middle meningeal artery
- Supplies sensory fibers to the auricle and temporal region
- Also sends articular (sensory) fibers to the TMJ
- Conveys postsynaptic parasympathetic secretomotor fibers from the otic ganglion to the parotid gland
- **Inferior Alveolar Nerve**
 - Enters the mandibular foramen and passes through the mandibular canal
 - forming the inferior dental plexus - ends branches to all mandibular teeth on its side
 - Mental nerve
 - passes through the mental foramen
 - supplies the skin and mucous membrane of the lower lip, the skin of the chin, and the vestibular gingiva of the mandibular incisor teeth
- **Lingual Nerve**
 - Lies anterior to the inferior alveolar nerve
 - Sensory to the anterior two thirds of the tongue, the floor of the mouth, and the lingual gingivae
 - Enters the mouth between the medial pterygoid muscle and the ramus of the mandible
 - Passes anteriorly under cover of the oral mucosa, medial and inferior to the 3rd molar tooth
 - Chorda tympani nerve - branch of CN VII (taste fibers from anterior two thirds of tongue)
 - joins the lingual nerve in the infratemporal fossa
 - also carries secretomotor fibers for the submandibular and sublingual salivary gland
- **Otic ganglion (parasympathetic)**
 - Located in the infratemporal fossa
 - inferior to the foramen ovale
 - medial to CN V3
 - posterior to the medial pterygoid muscle
 - **Presynaptic parasympathetic fibers**
 - derived mainly from the glossopharyngeal nerve synapse in the otic ganglion
 - **Postsynaptic parasympathetic fibers**
 - secretory to the parotid gland - pass from the otic ganglion to this gland through the auriculotemporal nerve

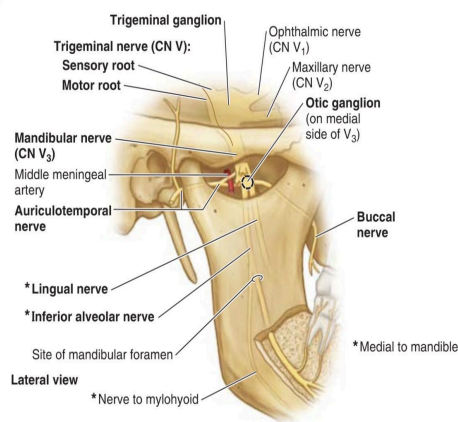


Figure 17. Nerves of Infratemporal Fossa.

TEMPOROMANDIBULAR JOINT (TMJ)

- It is a modified type of a hinge type of synovial joint, articulating between the condylar process of the mandible to the mandibular fossa of the temporal bone.

A. ARTICULATIONS

- Bony articular surfaces involved:
 - mandibular fossa and articular tubercle of the temporal bone superiorly
 - head of the mandible inferiorly

- Loose fibrous layer of the joint capsule attaches to the margins of the articular cartilage on:
 - temporal bone
 - around the neck of the mandible
- Two bony articular surfaces are completely separated by intervening fibrocartilage
 - superior and inferior articular cavities
 - lined by separate superior and inferior synovial membranes

B. LIGAMENTS

The mandible is connected to the cranium through the two (2) extrinsic ligaments and one (1) intrinsic lateral ligament.

- **Extrinsic Ligament**
 - **Stylomandibular Ligament**
 - thickening of the fibrous capsule of the parotid gland
 - runs from the styloid process to the angle of the mandible
 - does not contribute significantly to the strength of the joint
 - **Sphenomandibular ligament**
 - runs from the spine of the sphenoid to the lingula of the mandible
 - primary passive support of the mandible
 - serve as a "swinging hinge" for the mandible
 - serves as a fulcrum
 - check ligament for the movements of the mandible at the TMJ
- **Lateral Ligament**
 - Formed by the thickened part of the joint capsule
 - Strengthens the joint laterally
 - Acts to prevent posterior dislocation of the joint together with the postglenoid tubercle

Table X. Movements of Temporomandibular Joint	
Movements of Mandible	Muscle(s)
1. Elevation (close mouth)	Temporalis, masseter, and medial pterygoid
2. Depression (open mouth)	Lateral pterygoid, suprahyoid, and infrahyoid muscles
3. Protrusion (protrude chin)	Lateral pterygoid, masseter, and medial pterygoid
4. Retrusion (retrude chin)	Temporalis (posterior oblique and near horizontal fibers) and masseter
5. Lateral movements (grinding and chewing)	Temporalis of same side, pterygoids of opposite side, and masseter

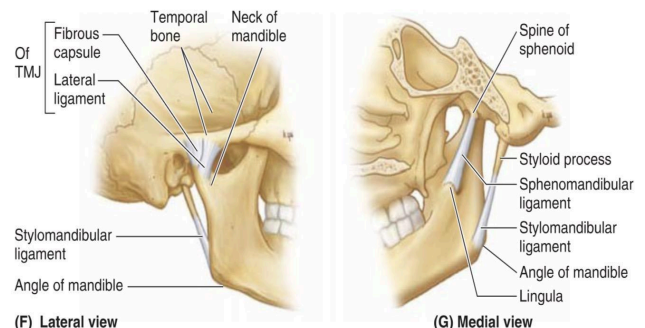


Figure 18. Temporomandibular Joint Extrinsic Ligaments

C. MOVEMENTS OF THE MANDIBLE

- Permits the following movements:
 - gliding (translation)
 - small degree of rotation (pivoting)
 - flexion (elevation)
 - extension (depression)
- Superior Cavity**
 - gliding movements of protrusion and retrusion (translation)
- Inferior Cavity**
 - hinge movements of depression and elevation and rotational or pivoting

D. MUSCLES OF MASTICATION

- Produce TMJ movements
- Develops from the mesoderm of the embryonic first pharyngeal arch
- All innervated by mandibular nerve (CN V3)
- It consists of/includes (4) muscles:
 - temporalis
 - masseter
 - medial pterygoid muscle
 - lateral pterygoid muscle

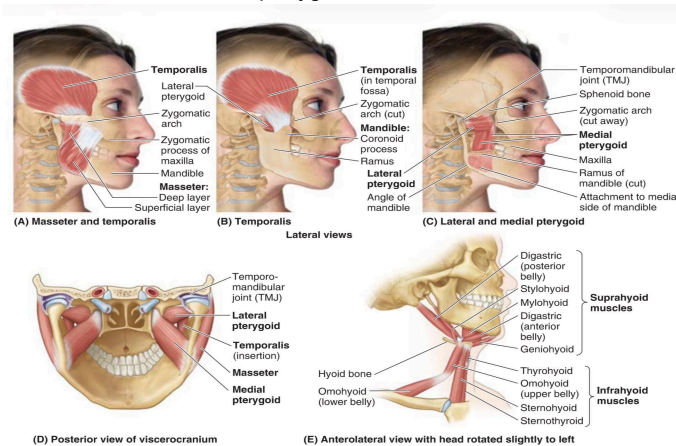


Figure 19. Muscles acting on mandible or Temporomandibular Joint

Muscle(s)	Proximal Attachment	Distal Attachment	Innervation	Action on Mandible
Muscles of mastication				
Temporalis	Triangular muscle with broad attachment to floor of temporal fossa and deep surface of temporal fascia	Narrow attachment to tip and medial surface of coronoid process and anterior border of ramus of mandible	Via deep temporal branches	Elevates mandible, closing jaws; posterior, more horizontal fibers are 1° retractors of mandible.
Masseter	Quadrilateral muscle attaching to inferior border and medial surface of maxillary process of zygomatic bone and the zygomatic arch	Angle and lateral surface of ramus of mandible	Via masseteric nerve	Elevates mandible, closing jaws; superficial fibers have limited contribution to protrusion of mandible.
Lateral pterygoid	Triangular two-headed muscle from (1) infratemporal surface and crest of greater wing of sphenoid and (2) lateral surface of lateral pterygoid plate	Superior head attaches primarily to joint capsule and articular disc of TMJ; inferior head attaches primarily to pterygoid fovea on anteromedial aspect of neck of condylar process of mandible.	Anterior trunk of mandibular nerve (CN V ₃) Via lateral pterygoid nerve	Acting bilaterally, protracts mandible and depresses chin; acting unilaterally, swings jaw toward contralateral side; alternate unilateral contraction produces larger lateral chewing movements.
Medial pterygoid	Quadrangular two-headed muscle from (1) medial surface of lateral pterygoid plate and pyramidal process of palatine bone and (2) tuberosity of maxilla	Medial surface of ramus of mandible, inferior to mandibular foramen; in essence, a "mirror image" of ipsilateral masseter, two muscles flanking ramus	Via medial pterygoid nerve	Acts synergistically with masseter to elevate mandible; contributes to protrusion; alternate unilateral activity produces smaller grinding movements.

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Appendix A: Foramina And Other Apertures Of Cranial Fossae And Contents

Foramina/Apertures	Contents
Anterior cranial fossa	
Foramen cecum	Nasal emissary vein (1% of population)
Cribriform foramina in cribriform plate	Axons of olfactory cells in olfactory epithelium that form olfactory nerves
Anterior and posterior ethmoidal foramina	Vessels and nerves with same names
Middle cranial fossa	
Optic canals	Optic nerves (CN II) and ophthalmic arteries
Superior orbital fissure	Ophthalmic veins; ophthalmic nerve (CN V ₁); CN III, IV, and VI; and sympathetic fibers
Foramen rotundum	Maxillary nerve (CN V ₂)
Foramen ovale	Mandibular nerve (CN V ₃) and accessory meningeal artery
Foramen spinosum	Middle meningeal artery and vein and meningeal branch of CN V ₃
Foramen lacerum*	Deep petrosal nerve and some meningeal arterial branches and small veins
Groove or hiatus of greater petrosal nerve	Greater petrosal nerve and petrosal branch of middle meningeal artery
Posterior cranial fossa	
Foramen magnum	Medulla and meninges, vertebral arteries, CN XI, dural veins, anterior and posterior spinal arteries
Jugular foramen	CN IX, X, and XI; superior bulb of internal jugular vein; inferior petrosal and sigmoid sinuses; and meningeal branches of ascending pharyngeal and occipital arteries
Hypoglossal canal	Hypoglossal nerve (CN XII)
Condylar canal	Emissary vein that passes from sigmoid sinus to vertebral veins in neck
Mastoid foramen	Mastoid emissary vein from sigmoid sinus and meningeal branch of occipital artery

Appendix B: Movements of muscles of mastication

Muscle(s)	Proximal Attachment	Distal Attachment	Innervation	Action on Mandible	
<u>Muscles of mastication:</u>					
Temporalis	Triangular muscle with broad attachment to floor of temporal fossa and deep surface of temporal fascia	Narrow attachment to tip and medial surface of coronoid process and anterior border of ramus of mandible	Anterior trunk of mandibular nerve (CN V ₃)	Via deep temporal branches	Elevates mandible, closing jaws; posterior, more horizontal fibers are 1° retractors of mandible
Masseter	Quadrilateral muscle attaching to inferior border and medial surface of maxillary process of zygomatic bone and the zygomatic arch	Angle and lateral surface of ramus of mandible		Via masseteric nerve	Elevates mandible, closing jaws; superficial fibers make limited contribution to protrusion of mandible
Lateral pterygoid	Triangular two-headed muscle from (1) infratemporal surface and crest of greater wing of sphenoid and (2) lateral surface of lateral pterygoid plate	Superior head attaches primarily to joint capsule and articular disc of TMJ; inferior head attaches primarily to pterygoid fovea on anteromedial aspect of neck of condyloid process of mandible		Via lateral pterygoid nerve	Acting bilaterally, protracts mandible and depresses chin; acting unilaterally, swings jaw toward contralateral side; alternate unilateral contraction produces larger lateral chewing movements
Medial pterygoid	Quadrilateral two-headed muscle from (1) medial surface of lateral pterygoid plate and pyramidal process of palatine bone and (2) tuberosity of maxilla	Medial surface of ramus of mandible, inferior to mandibular foramen; in essence, a "mirror image" of ipsilateral masseter, two muscles flanking ramus	Anterior trunk of mandibular nerve (CN V ₃)	Via medial pterygoid nerve	Acts synergistically with masseter to elevate mandible; contributes to protrusion; alternate unilateral activity produces smaller grinding movements

Appendix C: Movements of muscles of mastication

Part	Course	Branches	Distribution
First (mandibular)	Proximal (posterior) to lateral pterygoid muscle; runs horizontally, deep (medial) to neck of condylar process of mandible and lateral to stylomandibular ligament	Deep auricular artery	Supplies external acoustic meatus, external tympanic membrane, and temporomandibular joint
		Anterior tympanic artery	Supplies internal aspect of tympanic membrane
		Middle meningeal artery	Enters cranial cavity via foramen spinosum to supply periosteum, bone, red bone marrow, dura mater of lateral wall and calvaria of neurocranium, trigeminal ganglion, facial nerve and geniculate ganglion, tympanic cavity, and tensor tympani muscle
		Accessory meningeal artery	Enters cranial cavity via foramen ovale; its distribution is mainly extracranial to muscles of infratemporal fossa, sphenoid bone, mandibular nerve, and otic ganglion
		Inferior alveolar artery	Descends to enter mandibular canal of mandible via mandibular foramen; supplies mandible, mandibular teeth, chin, mylohyoid muscle
Second (pterygoid)	Adjacent (superficial or deep) to lateral pterygoid muscle; ascends obliquely anterosuperiorly, medial to temporalis muscle	Masseteric artery	Traverses mandibular notch, supplying temporomandibular joint and masseter muscle
		Deep temporal arteries	Anterior and posterior arteries ascend between temporalis muscle and bone of temporal fossa, supplying mainly muscle
		Pterygoid branches	Irregular in number and origin; supply pterygoid muscle
		Buccal artery	Runs antero-inferiorly with buccal nerve to supply buccal fat-pad, buccinator, and buccal oral mucosa
Third (pterygoid-palatine)	Distal (anteromedial) to lateral pterygoid muscle; passes between heads of lateral pterygoid and through pterygomaxillary fissure into pterygopalatine fossa	Posterior superior alveolar artery	Descends on maxilla's infratemporal surface with branches traversing alveolar canals to supply maxillary molar and premolar teeth, adjacent gingiva, and mucous membrane of maxillary sinus
		Infra-orbital artery	Traverses inferior orbital fissure, infra-orbital groove, canal, and foramen; supplies inferior oblique and rectus muscles, lacrimal sac, maxillary canines and incisors teeth, mucous membrane of maxillary sinus, and skin of infra-orbital region of face
		Artery of pterygoid canal	Passes posteriorly through pterygoid canal; supplies mucosa of upper pharynx, pharyngotympanic tube, and tympanic cavity
		Pharyngeal branch	Passes through palatovaginal canal to supply mucosa of nasal roof, nasopharynx, sphenoidal air sinus, and pharyngotympanic tube
		Descending palatine artery	Descends through palatine canal, dividing into greater and lesser palatine arteries to mucosa and glands of hard and soft palate
		Sphenopalatine artery	Terminal branch of maxillary artery, traverses sphenopalatine foramen to supply walls and septum of nasal cavity; frontal, ethmoidal, sphenoid, and maxillary sinuses; and anteriormost palate