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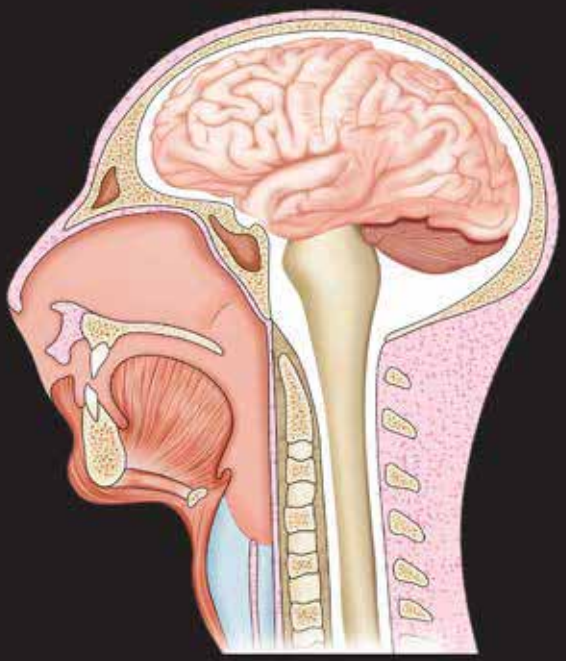
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Textbook of ANATOMY

As per the Competency Based Medical Education Curriculum (NMC)



Volume Three

Head & Neck
Neuroanatomy

SEVENTH EDITION

Revised and Edited by

V Subhadra Devi

Highlights

- Thoroughly revised & updated
- Richly illustrated & easily reproducible figures
- Dissection steps and surface anatomy included
- Case scenarios added
- New flowcharts and tables included
- MCQs added
- Interactive Online Student Resource

Revised Reprint

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Contents

Section 1 Head and Neck

1. Introduction to the Head and Neck 3
2. Bones and Joints of Head and Neck 14
3. Scalp, Face and Lacrimal Apparatus 63
4. Parotid Region 88
5. Temporal Region, Infratemporal Region and Temporomandibular Joint 98
6. Submandibular Region 119
7. Oral Cavity—Teeth, Tongue, Tonsil and Palate 129
8. Cranial Cavity and Vertebral Canal Including Meninges 158
9. Fascia, Muscles and Triangles of the Neck 176
10. Nasal Cavity, Paranasal Sinuses and Viscera of Neck 210
11. Orbit and Eye 249
12. Ear and the Organs of Hearing and Balance 273
13. Endocrine Glands of the Head and Neck, Carotid Sinus and Carotid Body 298
14. Blood Vessels of Head and Neck 313
15. Nerves of the Head and Neck 364
16. Multiple Choice Questions: Head and Neck 429

Section 2 Neuroanatomy

17. Introduction to Central Nervous System 437
18. Spinal Cord—Gross Anatomy and Internal Structure 451
19. Gross Anatomy of the Brainstem 463
20. Tracts of the Spinal Cord and Brainstem 480
21. Cranial Nerves—Nuclei and Functional Aspects 498
22. Cerebellum—Gross Anatomy and Internal Structure 511
23. Cerebrum, Thalamus and Hypothalamus—Gross Anatomy and Internal Structure 524
24. Ventricles of the Brain 557
25. Special Senses and their Pathways 567
26. Blood Supply of the Central Nervous System 577
27. Multiple Choice Questions: Neuroanatomy 592

Index *597*

Temporal Region, Infratemporal Region and Temporomandibular Joint

CHAPTER 5

Learning Objectives

- Temporal region—boundaries and contents
- Infratemporal fossa—boundaries, communications, contents
- Muscles of mastication—origin, insertion, nerve supply, action
- Maxillary artery—origin, course, branches
- Mandibular nerve—branches
- Pterygopalatine fossa—boundaries, contents
- Temporomandibular joint—type, bones articulating, ligaments, movements and muscles producing

TEMPORAL REGION

The temporal region is that region of the head, which overlies the ***temporal fossa*** presents on the lateral aspect of the skull, above and in front of the auricle.

Boundaries:

- ***Above*** by the superior temporal line
- ***Below*** by the zygomatic arch
- ***Anteriorly*** by the frontal and zygomatic bones
- ***Posteriorly*** by the superior temporal line
- The ***floor*** of the temporal region is formed by the ***temporal fossa*** which in turn is formed by parts of frontal bone, parietal bone, squamous part of temporal bone, and greater wing of sphenoid bone.
- The ***anterior wall*** of fossa is made up mainly by the temporal surface of the zygomatic bone with contributions from the greater wing of the sphenoid and from the frontal bone.
- The ***anteroinferior boundary*** of the temporal fossa is the infratemporal crest. The temporal fossa communicates with the infratemporal fossa beneath the zygomatic arch.
- The ***roof*** of the temporal region is formed by the temporal fascia.

Contents: The temporal region contains:

- Auriculotemporal nerve
- Superficial temporal vessels
- Temporal branch of facial nerve
- Posterior auricular branch of the facial nerve
- Zygomaticofacial branch of the maxillary nerve
- Parts of epicranial aponeurosis, subcutaneous muscles of the auricle and orbicularis oculi
- Temporal fascia
- Temporalis muscle—the ***temporalis muscle*** is the main content of the temporal fossa and is situated deep to the temporal fascia. It is one of the muscles of mastication and is responsible for chewing movements. ***Refer Table 5.1 for description of the muscle.***
- Deep temporal vessels and nerves—deep to the temporalis muscle, the deep temporal nerves and vessels are present. The anterior, middle, and posterior ***deep temporal arteries*** are branches of the maxillary artery; they run between the temporalis and the underlying pericranium, usually grooving the latter. They anastomose with branches of the superficial temporal arteries and supply the fasciae and muscles of the region. The ***deep temporal nerves*** (anterior and posterior) arise from the anterior division of the mandibular nerve,

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Table 5.1: Muscles of mastication.

Muscle	*Origin*	*Insertion*	*Action*	*Nerve supply*
Temporalis (Figs. 5.7A and B)	Fan-shaped muscle Floor of temporal fossa on the lateral side of skull up to the inferior temporal line, temporal fascia	Fibers converge below to form the tendon Tendon passes deep to zygomatic arch and is inserted to the coronoid process of mandible and the anterior border of the ramus of the mandible	• Elevates mandible and closes the mouth • Posterior fibers—retracts the mandible • Both side muscles—assists in side to side grinding movements	Deep temporal branches of anterior division of mandibular nerve
Masseter (Fig. 5.8)	• Quadrilateral in shape • Superficial fibers from anterior two-thirds of lower border of zygomatic arch • Deep fibers from deep surface and posterior one-third of lower border of the arch	On the lateral surface of the ramus and the angle of mandible	• Elevates mandible and closes the mouth • Protraction of jaw	Branch from anterior division of mandibular nerve
Lateral pterygoid (Figs. 5.9 to 5.11)	***Upper head:*** Infratemporal surface and infratemporal crest of greater wing of sphenoid bone ***Lower head:*** Lateral surface of the lateral pterygoid plate	Both heads run backward and laterally and converge to form a tendon for insertion into the • Fovea on the anterior surface of the neck of mandible • Intra-articular disc and capsule of temporomandibular joint	1. Depresses the mandible and opens the mouth 2. Combined action of lateral and medial pterygoids protraction of the mandible 3. With the medial pterygoid of same side and alternating action with muscles of the opposite side, causes side to side movements of jaw	Branch from the anterior division of mandibular nerve
Medial pterygoid (Figs. 5.9 to 5.11)	***Deep head*** from medial surface of lateral pterygoid plate ***Superficial head*** from pyramidal process of palatine bone and maxillary tuberosity	The fibers of both heads run downwards, backwards and laterally for insertion into the medial surface of angle of mandible and adjoining part of the ramus	• Elevates the mandible and closes the mouth • Protraction of the mandible • With the lateral pterygoid and the muscles of the opposite side causes side to side movements of jaw	Branch from the trunk of the mandibular nerve

enter the deep surface of the temporalis, and supply the muscle.

TEMPORAL FASCIA

This is a thick, strong fibrous membrane covering the temporal region, and the temporalis muscle.

Attachments: The fascia is attached (Fig. 5.1)

- ***Superiorly*** to the temporal lines, especially to the superior temporal line and blends with the periosteum.
- ***Inferiorly,*** it splits into two layers; these layers attach to the medial and lateral surfaces of the zygomatic arch. The gap between the two layers contains some amount of fat, the zygomaticotemporal branch of the maxillary nerve and the zygomatico-orbital branch of the superficial temporal artery.
- The ***deep surface*** of temporal fascia gives attachment to the temporalis muscle, which is also covered by the fascia.
- The ***superficial surface*** of the fascia is overlapped by the epicranial aponeurosis, the subcutaneous muscles of

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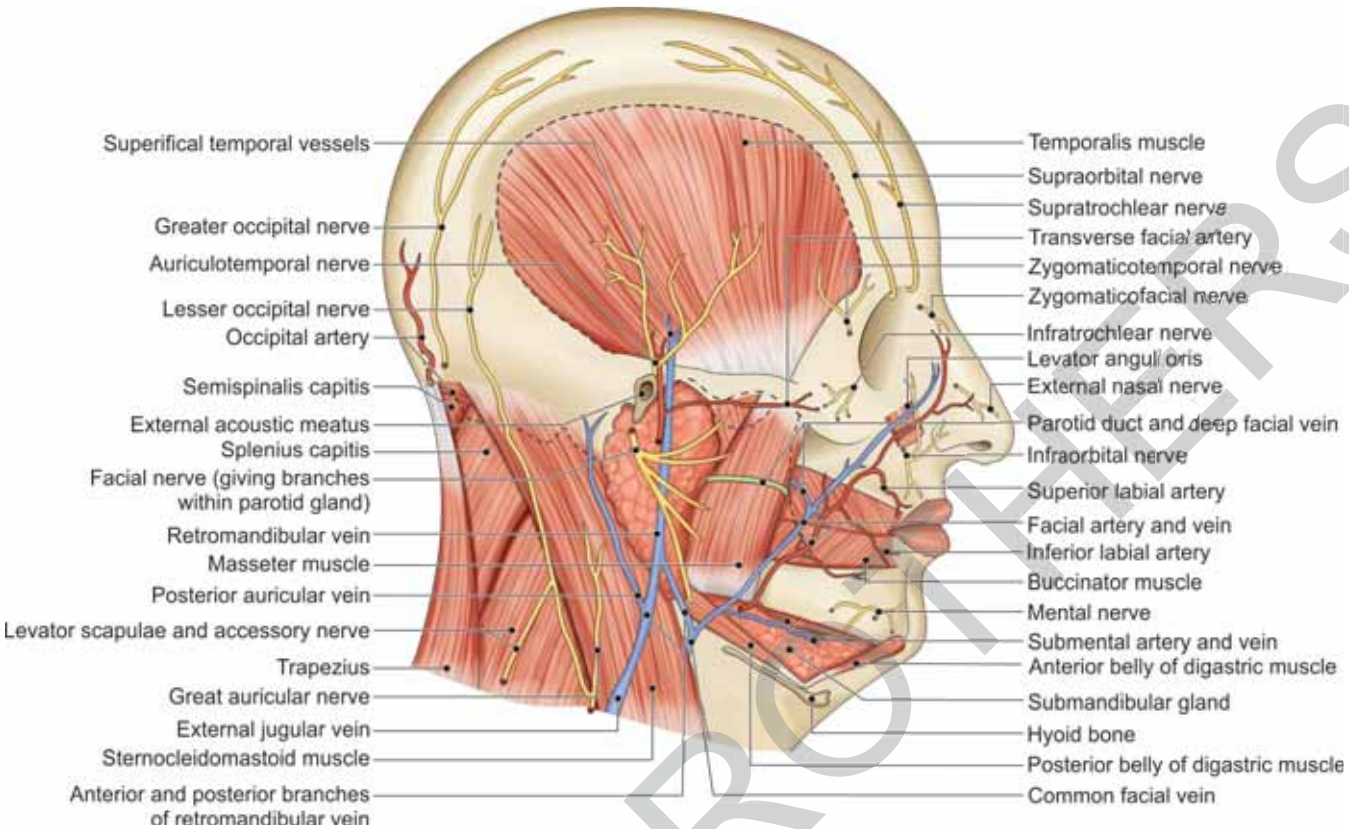


Fig. 5.1: Deep dissection of the face and parotid region. The superficial part of the parotid gland has been removed. A superficial view of the submandibular region is also seen. Temporalis and masseter muscles can be viewed.

DISSECTION

- In the superficial fascia of the temporal region the superficial temporal artery and auriculotemporal nerve can be identified (Figs. 5.1 and 5.2).
- Clean and define the masseter muscle. Detach it from its origin and reflect it downward (Fig. 5.2).
- See the masseteric nerve and vessels entering the deep surface of the muscle. Remove the zygomatic arch using a saw (Figs. 5.2 and 5.3).
- Using a bone forceps and chisel, remove the coronoid process of the mandible along with the insertion of the temporalis (Fig. 5.4).
- Turn the temporalis upward. See and study the deep temporal nerve and vessels (Fig. 5.4).
- After studying all the structures of the region, enter into the infratemporal region by removing a portion of the ramus of mandible.
- Once in the infratemporal fossa, identify and clean the mandibular nerve and its branches. Define the pterygoid muscles. Identify and clean the maxillary artery and its branches. Trace the pterygoid plexus of veins (Fig. 5.4).
- Identify the branches of the mandibular nerve. Trace the lingual nerve. Identify the chorda tympani that joins the lingual nerve. Trace the nervus spinosus. After defining the pterygoid muscles, cut across them to expose the deeper structures. Trace and define the third part of maxillary artery and its branches.

the auricle, which arise from it, namely the ***auricularis superior***, the ***auricularis posterior*** and the ***auricularis anterior,*** and part of the orbicularis oculi muscle.

Superficial Temporal Vessels

Superficial temporal artery is the terminal branch of external carotid artery. It is accompanied by superficial temporal vein. The artery divides into branches and through them supplied the temporal region and scalp. Its branches are shown in Figure 5.5.

- Frontal branch
- Parietal branch
- Anterior auricular branch
- Middle temporal artery
- Zygomaticotemporal branch
- Transverse facial artery.

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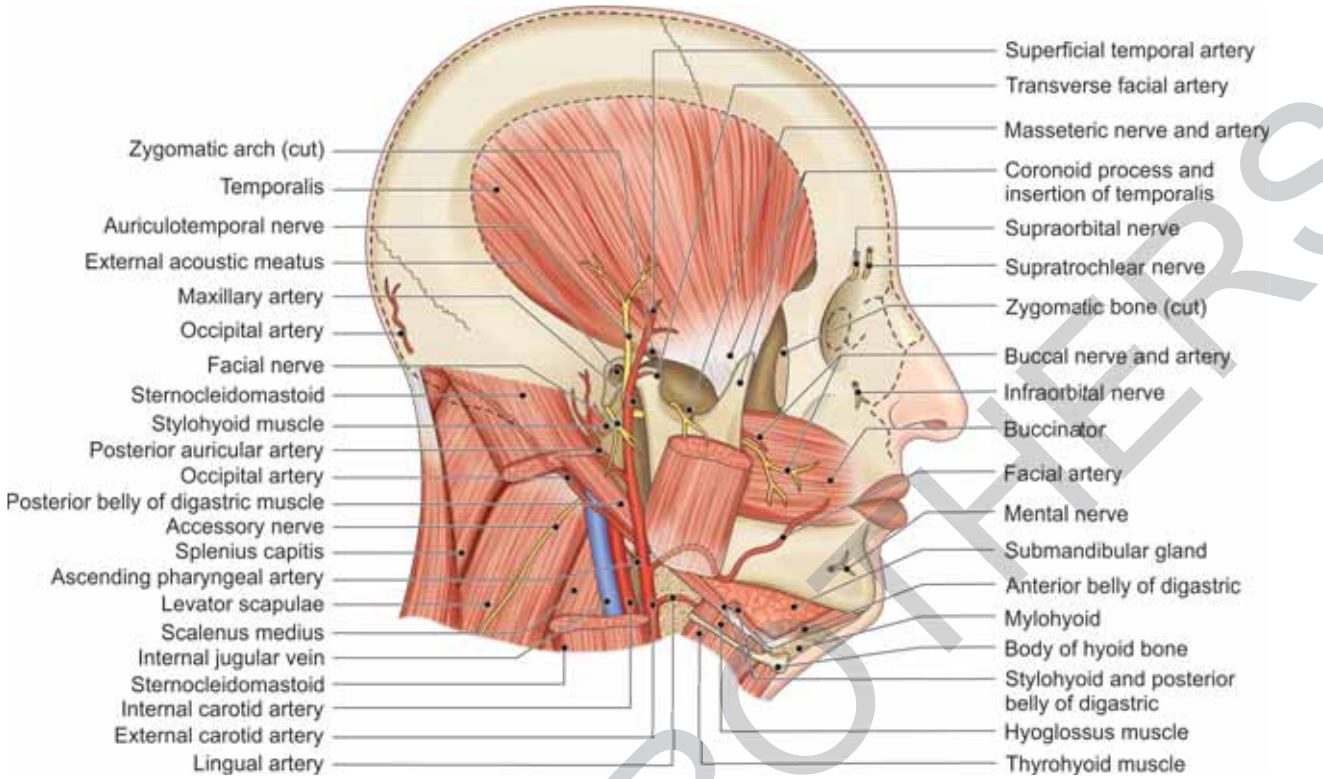


Fig. 5.2: Dissection of side of the head at a deeper plane than Figure 5.1. The parotid gland, the zygomatic arch, a segment of the sternocleidomastoid, and a segment of the masseter have been removed. The entire temporalis muscle is now seen.

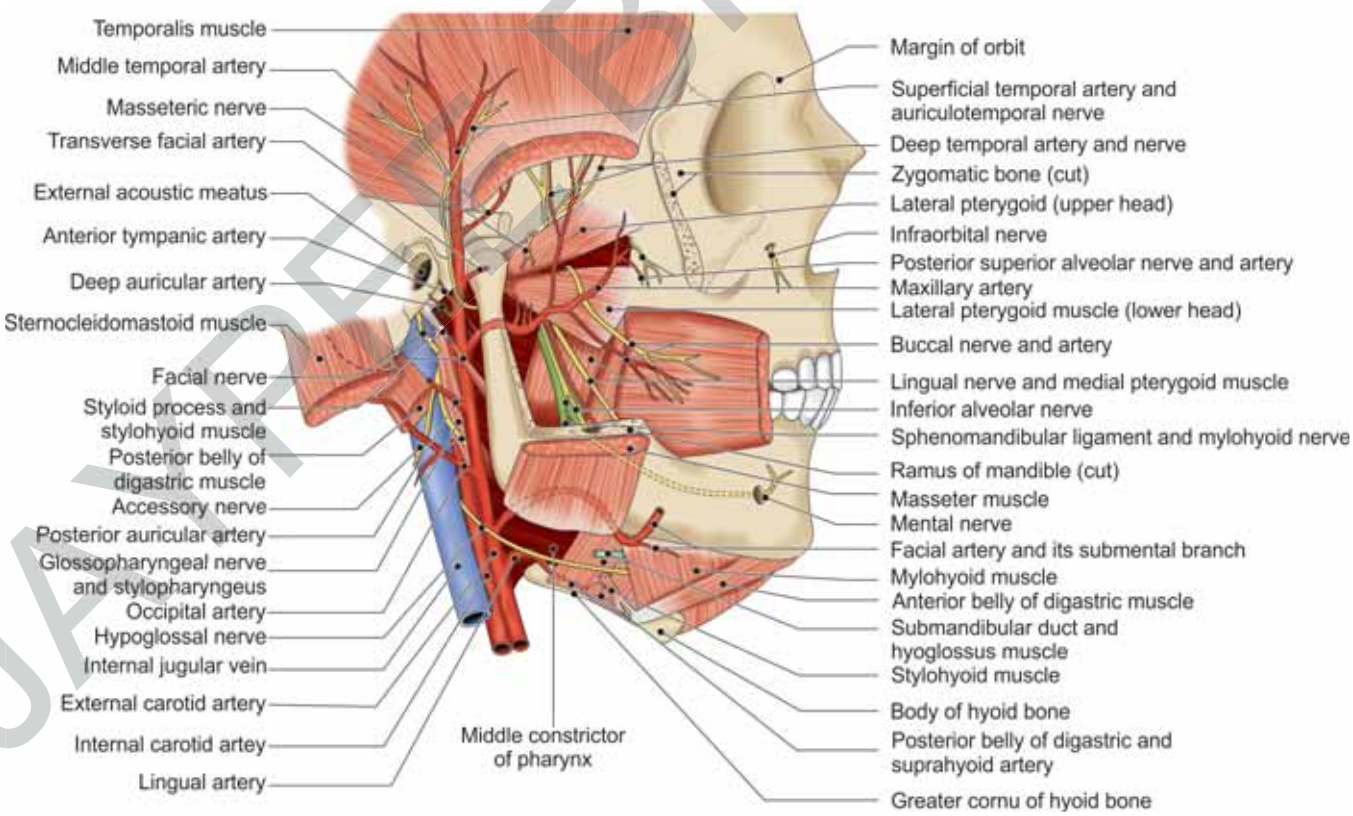


Fig. 5.3: Dissection of the side of the head at a deeper plane than Figure 5.2. The infratemporal, temporal, and submandibular regions are seen. Removal of the sternocleidomastoid brings the internal and external carotid arteries, and the internal jugular vein into view. Note the various branches of the external carotid artery.

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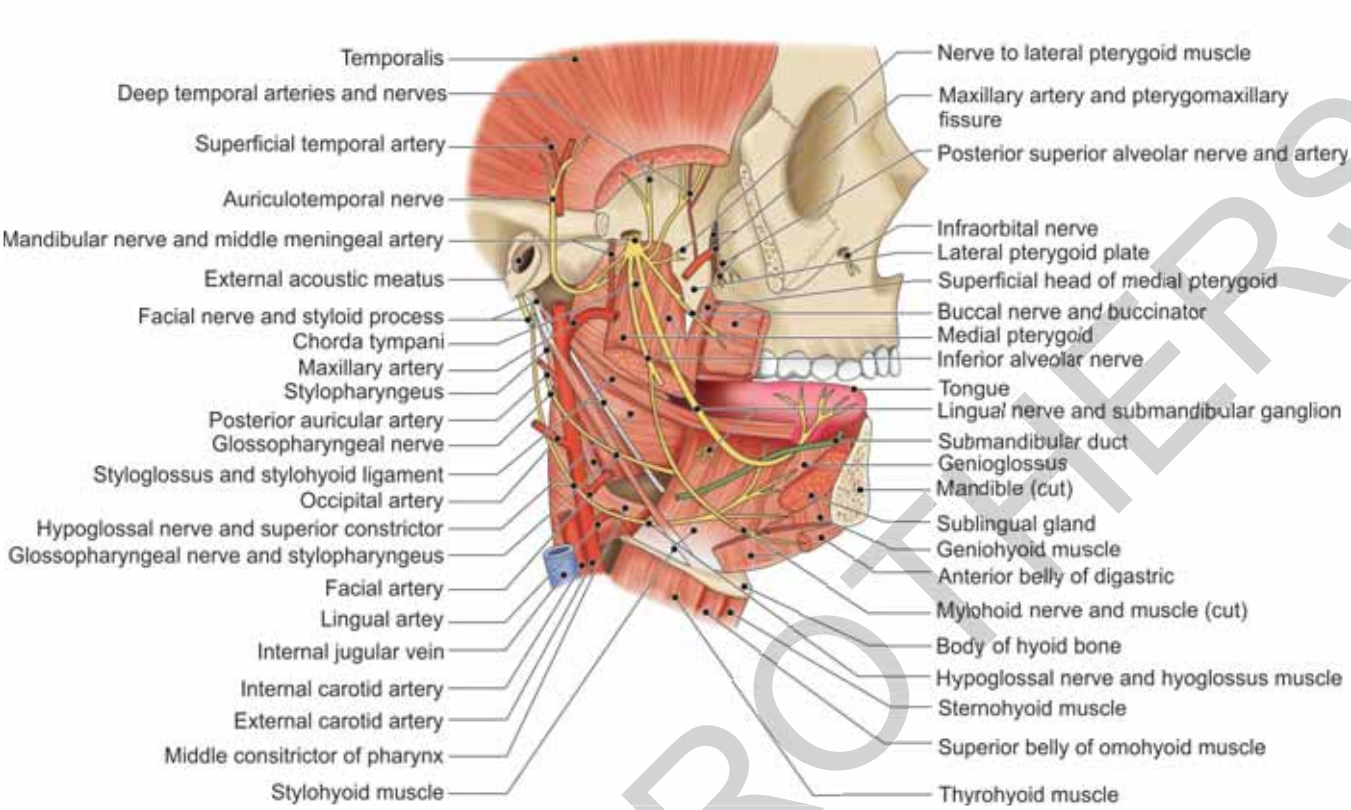


Fig. 5.4: Dissection of the side of the head at a deeper plane than Figure 5.3. Deep structures in the temporal, infratemporal, and submandibular regions are exposed. Note the mandibular nerve and its branches, the structures lying superficial to the hyoglossus muscle, the superior and middle constrictors of the pharynx, and the structures related to them.

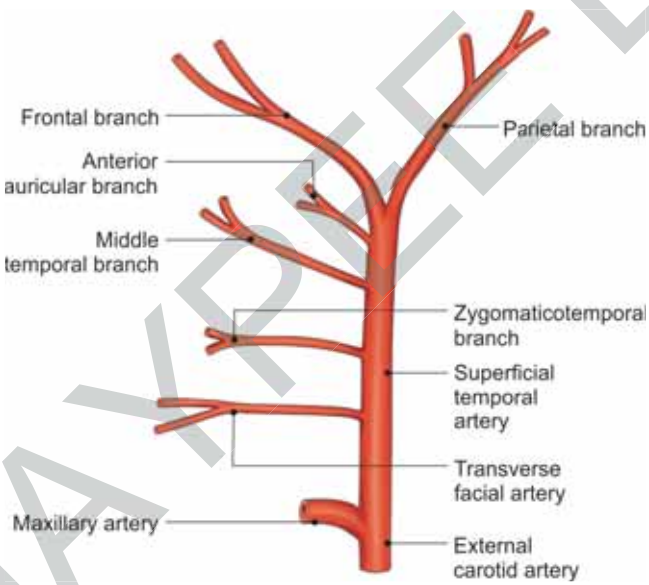


Fig. 5.5: Branches of superficial temporal artery.

The superficial temporal vein enters the parotid gland and forms the retromandibular vein after joining with the maxillary vein.

INFRATEMPORAL FOSSA

- The infratemporal region is an irregular space lying below the lateral part of the base of the skull and deep to the ramus of mandible. It is below the middle cranial fossa and is between the pharynx and ramus of mandible. Due to its deep location, it is often called the infratemporal fossa.
- Its boundaries, communications and contents are shown in Table 5.2 and Figures 5.3, 5.4, and 5.6.

Description of contents

Muscles: The pterygoids are two of the four muscles of mastication. The tendon of the temporalis muscle descends through the gap between the zygomatic arch and the lateral aspect of the skull. It, therefore, passes from the temporal fossa to the infratemporal fossa.

MUSCLES OF MASTICATION

The muscles of mastication are four in number and are very intimately connected with the movements of the temporomandibular joint. These are:

1. Temporalis

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Table 5.2: Infratemporal fossa—boundaries, communication, and contents.

Boundaries	*Communications*	*Contents*
Roof: Formed mainly by the infratemporal surface of greater wing of the sphenoid bone, with a small contribution from the squamous temporal bone.	***In front:*** With the orbit through the inferior orbital fissure.	***Muscles:*** • Lateral pterygoid • Medial pterygoid • Lower part of temporalis
Medially: Lateral pterygoid plate of the sphenoid bone.	***Medially:*** With the pterygopalatine fossa through the pterygomaxillary fissure.	***Vessels:*** • Maxillary artery and its branches • Pterygoid venous plexus
Laterally: Ramus of the mandible and its coronoid process.	***Above and laterally:*** With the temporal fossa through the gap between the zygomatic arch and the rest of the skull.	***Nerves:*** • Mandibular nerve and its branches • Chorda tympani nerve • Otic ganglion
Anteriorly: Posterior surface of the maxilla.	***Above and medially:*** With the middle cranial fossa through the foramen ovale and foramen spinosum.	***Joint:*** Temporomandibular joint
Posteriorly: Styloid process of temporal bone and carotid sheath.		
Inferiorly: The region is open and has no floor; it is continuous with the tissue spaces along the pharynx and esophagus.		

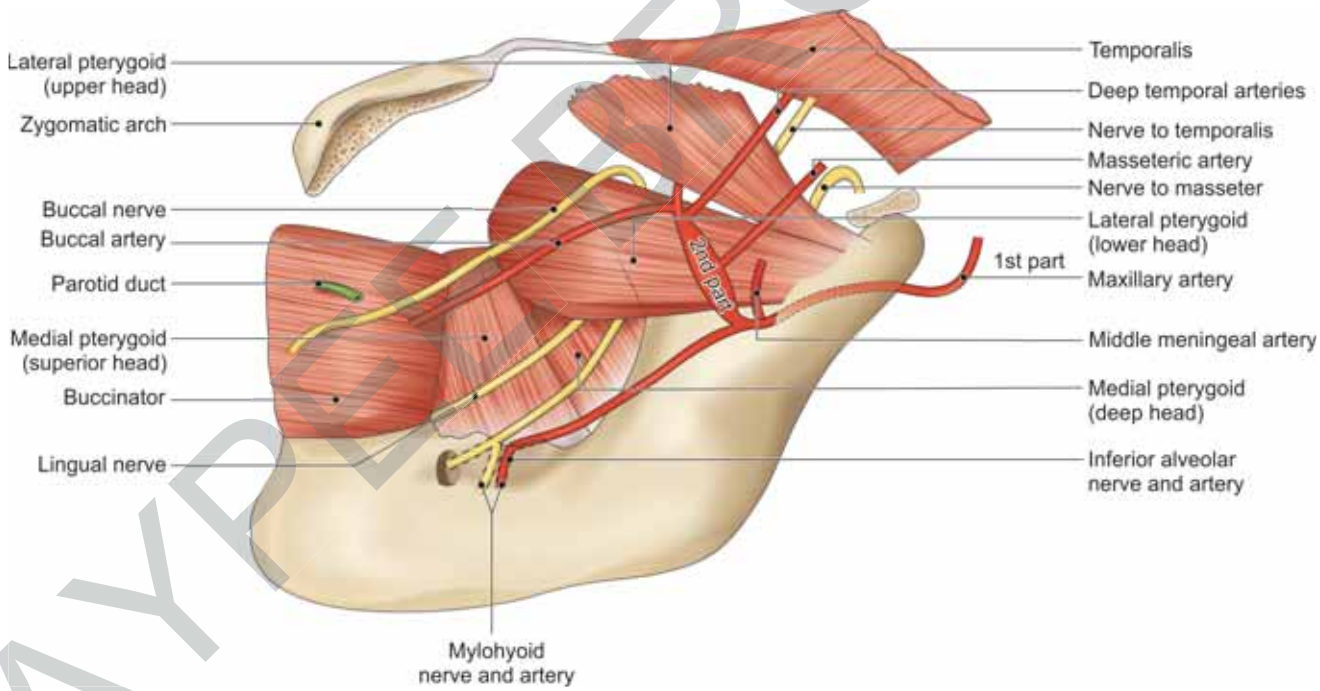
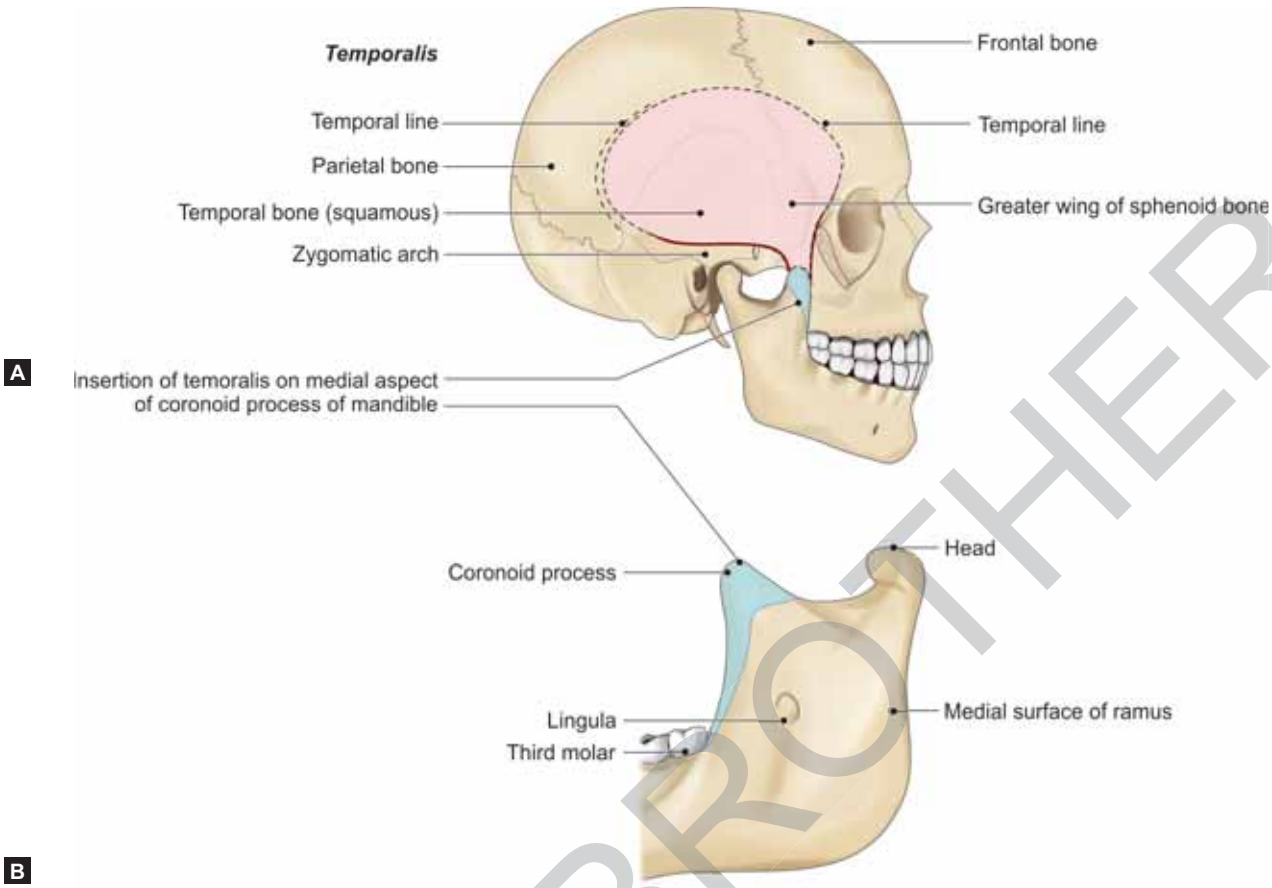


Fig. 5.6: Infratemporal fossa—contents.

2. Masseter
3. Lateral pterygoid
4. Medial pterygoid

The muscles are described in Table 5.1, Figs. 5.1 to 5.4 and Figs. 5.6 to 5.11. The relations of pterygoid muscles are described in Table 5.3 and Figure 5.12.

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Figs. 5.7A and B: (A) Lateral view of the skull showing the origin of the temporalis muscle from the temporal fossa. Note the bones involved; (B) Ramus of mandible seen from the medial side to show the insertion of the temporalis.

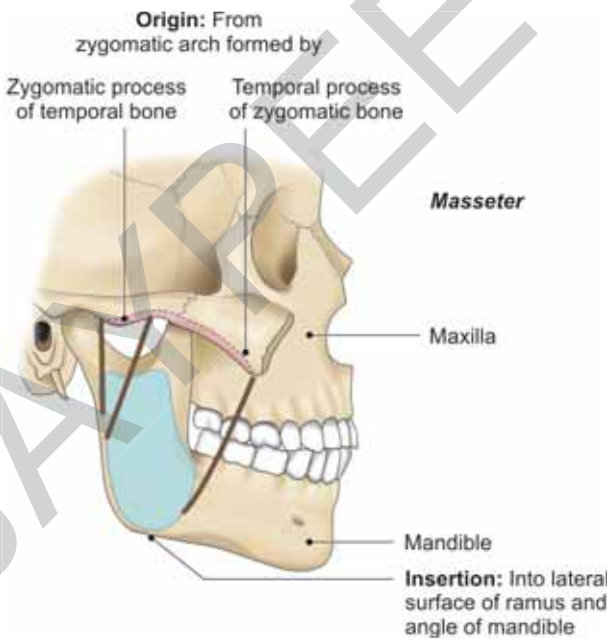


Fig. 5.8: Attachments of the masseter muscle.

Accessory Muscles of Mastication

A. ***Suprahyoid***
   1. Digastric
   2. Geniohyoid
   3. Mylohyoid
   4. Stylohyoid.

B ***Infrahyoid***
   1. Sternohyoid
   2. Sternothyroid
   3. Omohyoid
   4. Thyrohyoid.

Special Features of Muscles of Mastication

- All the four muscles are inserted into the ramus of mandible.
- All develop from mesoderm of first pharyngeal arch and are supplied by the nerve of the arch the mandibular nerve.
- They all act on the temporomandibular joint.

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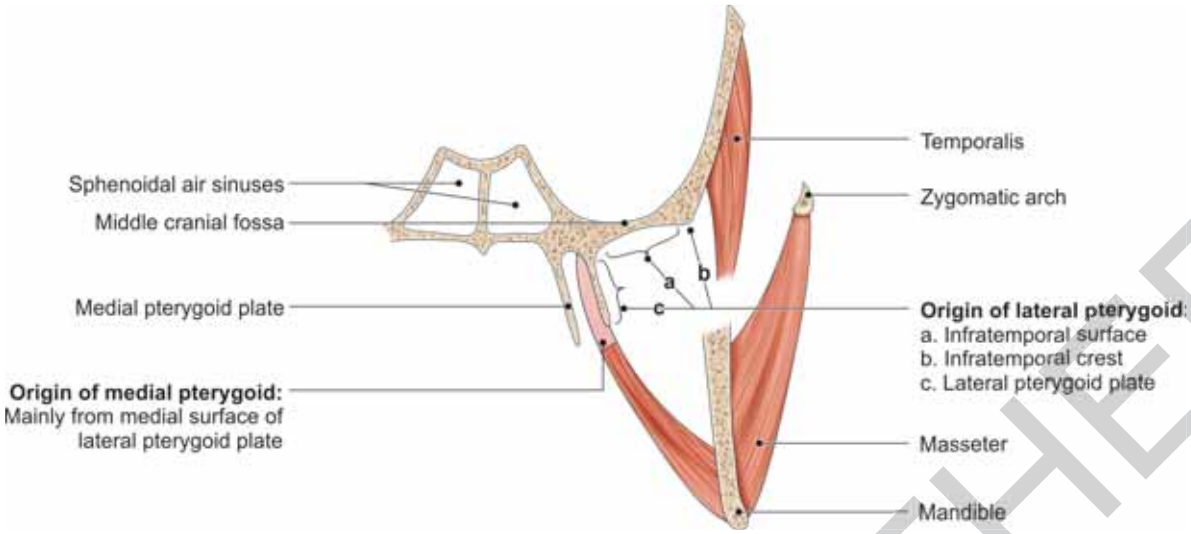


Fig. 5.9: Schematic coronal section across the base of the skull, in the region of the infratemporal fossa, to show the area of origin of the lateral pterygoid muscle. The medial pterygoid, the masseter, and part of the temporalis are also shown.

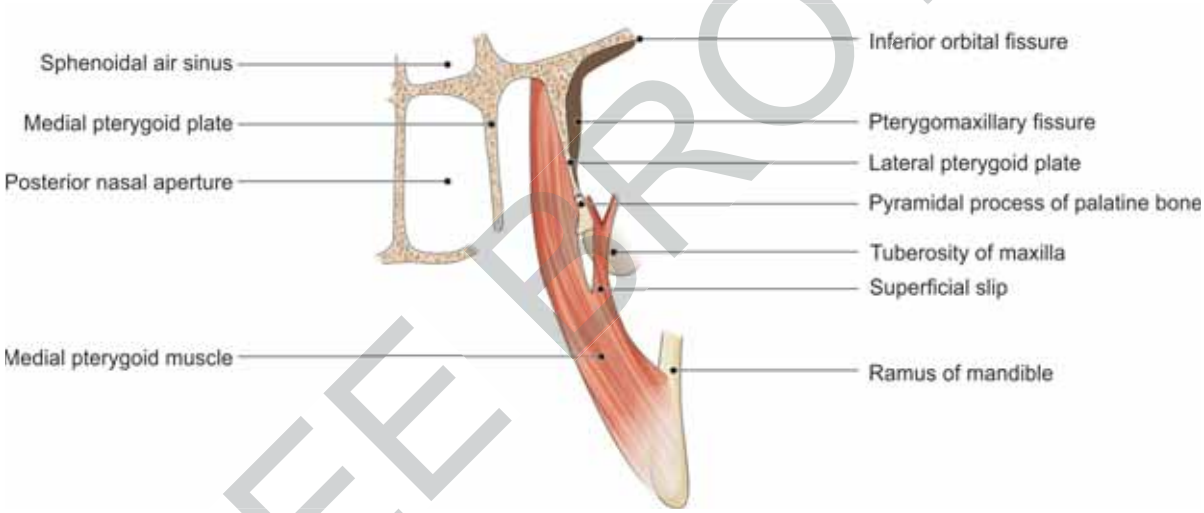


Fig. 5.10: Scheme to show the arrangement of the medial pterygoid muscle.

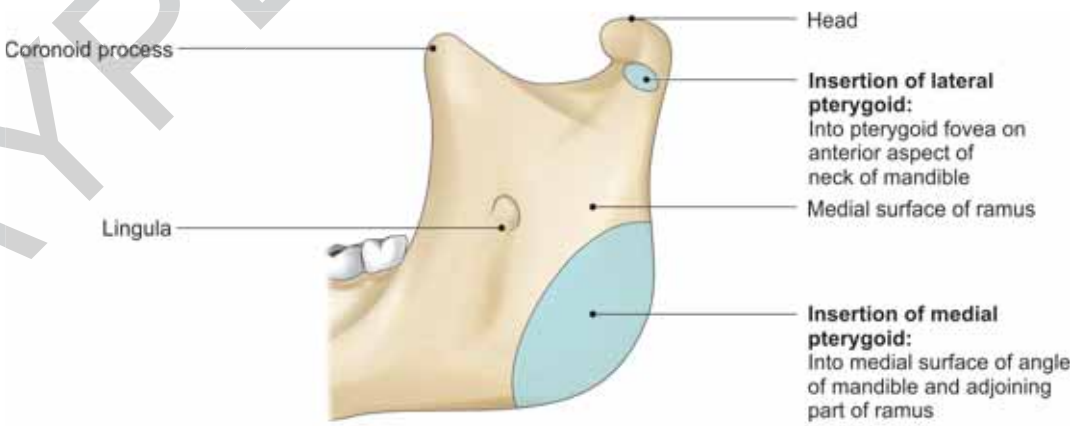


Fig. 5.11: Medial aspect of the ramus of the mandible showing areas for insertion of the lateral and medial pterygoid muscles.

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Table 5.3: Relations of pterygoid muscles.

Lateral pterygoid	*Medial pterygoid*
Superficial: (from outside inward) 1. Masseter 2. Ramus of mandible 3. Tendon of temporalis 4. Maxillary artery	***Lateral surface:*** It is separated from the ramus of mandible by the following structures: 1. Lateral pterygoid muscle 2. Sphenomandibular ligament 3. Maxillary artery 4. Inferior alveolar nerve and vessels 5. Lingual nerve 6. A part of parotid gland
Deep: 1. Mandibular nerve and its branches 2. Chorda tympani nerve 3. Middle meningeal artery 4. Sphenomandibular ligament 5. Deep head of medial pterygoid	***Medial surface:*** 1. Tensor veli palatini muscle 2. Superior constrictor muscle of pharynx. Separated from above two muscles by: 1. Styloglossus muscle 2. Stylopharyngeus muscle
Upper border: The following nerves emerge: 1. Deep temporal nerve 2. Masseteric nerve	
Lower border: 1. Lingual nerve 2. Inferior alveolar nerve 3. Sphenomandibular ligament 4. Middle meningeal artery	
Structures passing between the heads: 1. Maxillary artery (junction of second and third parts) 2. Buccal branch of mandibular nerve	

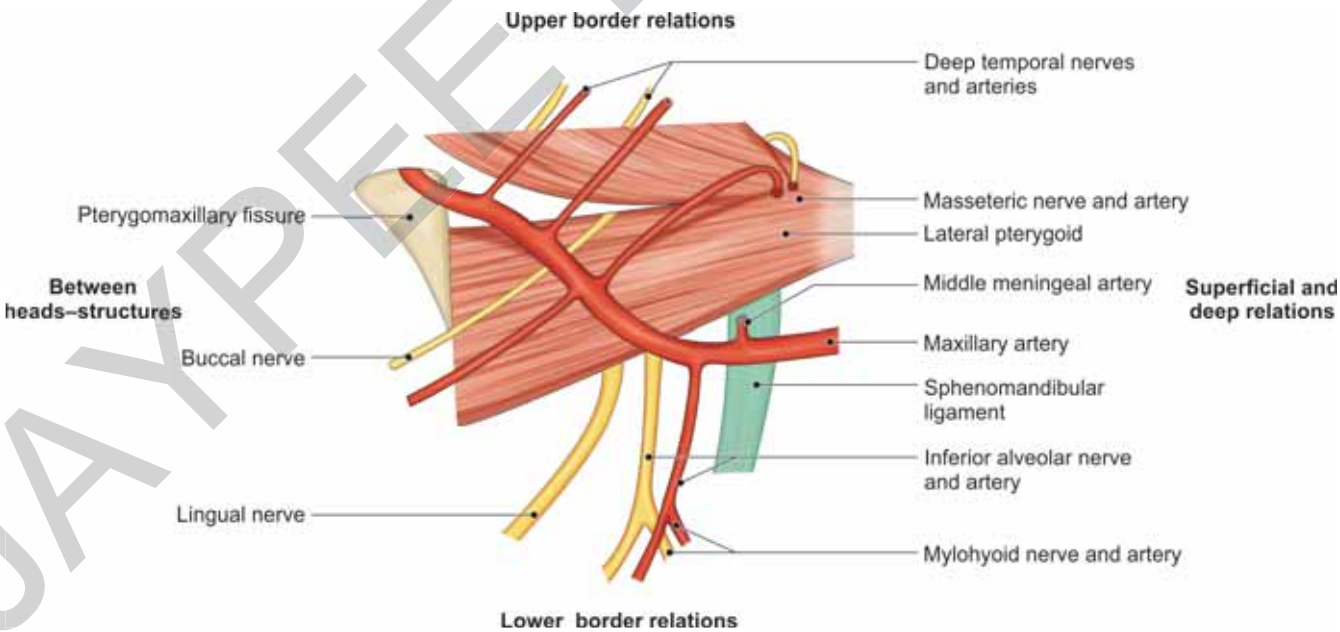


Fig. 5.12: Relations of lateral pterygoid muscle.

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Additional Notes on Muscles of Mastication

Temporalis

- The temporalis muscle is a fan-shaped muscle.
- The anterior most fibers are almost vertical; the posterior most are more or less horizontal; the intervening fibers are oblique.
- The muscle closes the mouth by elevating the mandible.
- Contraction of the anterior fibers provides an upward pull and that of the posterior fibers provides a backward pull. Both pulls are required for the complete closure of mouth and also for approximation of teeth.
- Contraction of both temporalis muscles causes side-to-side grinding movements.
- Isolated contraction of the posterior fibers helps a protracted mandible come back to normal position.

Masseter

- The muscle of mastication lies on the lateral aspect of the ramus of mandible.
- It can easily be palpated in a living individual and is made prominent by clenching the teeth.
- The muscle itself has three layers—the superficial, the middle and the deep layers. All the three layers merge anteriorly.
- The anterior part of the muscle overlaps the posterior part of buccinators muscle.
- The masseter itself is overlapped (from superficial to deep) by skin and superficial muscles of the face, anterior part of the parotid gland, parotid duct, branches of the facial nerve and transverse facial vessels.
- Deep to the masseter are the ramus of the mandible, lower part of temporalis and the posterior part of buccinator.

Pterygoid Muscles

- The medial and lateral pterygoids of both sides acting together protract the mandible.
- The medial and lateral pterygoids of one side, acting together, pull the mandibular condyle of the side forwards and medially.
- As a result, the chin moves forwards and to the opposite side. The movement is facilitated by sight rotation of the head of mandible of the opposite side.
- Alternate action of the muscles of both the sides results in side-to-side chewing movements.
- The two pterygoid muscles have opposite actions as far as opening and closing of the mouth is concerned.
- The lateral pterygoid helps in opening the mouth by pulling the head of the mandible forwards along with the intra-articular disc.
- The medial pterygoid elevates the mandible and thus helps in closure of the mouth.

Clinical Application

MUSCLES OF MASTICATION

- Tonic spasm of both masseters is the characteristic symptom of tetanus and it causes locked jaw.
- Paralysis of temporalis muscle produces hollow in the temple area.
- Paralysis of masseter causes flattening of the angle of the jaw. Clenching of the teeth becomes impossible.
- Paralysis of lateral pterygoid causes deviation of jaw to the paralyzed side on opening the mouth because of the action of normal muscle.
- Lateral pterygoid is the only muscle of mastication that opens the mouth by depressing the mandible.
- Myofascial disorders of muscles of mastication can cause TM joint pain.

MAXILLARY ARTERY

Origin: The ***maxillary artery*** (also called the internal maxillary artery) is the larger terminal branch of the external carotid artery and arises behind the neck of the mandible within the parotid gland.

Course: The course of the artery is divided into three parts by the lower head of lateral pterygoid muscle.

For detailed course and distribution of maxillary refer to Chapter 14 on blood vessels of head and neck.

Branches: Refer to Table 5.4 and Figure 5.13.

Table 5.4: Branches of maxillary artery.

First part	*Second part*	*Third part*
Deep auricular	Deep temporal	Posterior superior alveolar
Anterior tympanic	Pterygoid branches	Infraorbital
Middle meningeal • *Extracranial* ➢ Frontal branch ➢ Parietal branch • *Intracranial* ➢ Ganglionic ➢ Petrosal ➢ Superior tympanic ➢ Temporal branches	Masseteric artery	Greater palatine
Accessory meningeal	Buccal artery	Pharyngeal
Inferior alveolar	Artery of pterygoid canal	
	Sphenopalatine	

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Clinical Application

TEMPOROMANDIBULAR JOINT

- ***Blow on chin when the mouth is closed:*** The occlusal position (when the mouth is closed) is the stable position of the joint. The head of the mandible lies within the articular fossa in both the occlusal position and mouth in slightly open position. Hence, a blow on the chin, when the mouth is closed or slightly open causes fracture of the mandible rather than dislocation. Backward dislocation toward the external acoustic meatus is also prevented by the strong lateral temporomandibular ligaments.
- ***Blow on chin with mouth open:*** When the mouth is opened wide, the head of the mandible moves forwards and comes to lie just below the articular tubercle. In this position, the temporomandibular joint is highly unstable. A blow on the chin, or even sudden opening of the mouth as in yawning, which involves sudden contraction of the lateral pterygoid muscle will cause the head of the mandible to slip forwards to the front of the articular tubercle. With the joint dislocated, the mouth cannot be closed. This is called ***lockjaw***. To reduce the dislocation, the surgeon inserts both his thumbs into the mouth and exerts downward pressure over the lower molar teeth. Simultaneously, the mandible is pressed backwards.
- ***Derangement of TM Joint:*** The term derangement of the temporomandibular joint is applied to a condition in which part of the articular disc gets detached from the joint capsule which happens after injury. In this condition, the movements of the jaw become painful, and clicking sounds may be produced while opening and closing the mouth.
- ***Referred pain:*** Because the TM joint, external auditory meatus and teeth of lower jaw are supplied by the same mandibular nerve pain of anyone of these will be referred to the other.

Clinical Importance

KNOWLEDGE OF MUSCLES OF MASTICATION AND TEMPOROMANDIBULAR JOINT

Case scenario 5.1

A 27-year-old man came to the hospital with an open mouth and complained that he could not close his mouth. Something appeared to block his closing the mouth. On examination, he said that the condition occurred after yawning.

Questions:

- What condition is he probably suffering from?
- Why is he not able to close his mouth?
- In what way is yawning and this condition related?

Explanation:

- The man is probably suffering from dislocation of temporomandibular joint.
- He is not able to close his mouth because the head of mandible would have slipped forwards to the area in front of the articular tubercle. Closure of the mouth is then not possible.
- In yawning, the lateral pterygoid muscle is suddenly and powerfully contracted. This contraction makes the joint unstable and causes the head of mandible to slip forward.

Case scenario 5.2

A 34-year-old woman presented with fever, sore throat, and restriction in opening her mouth. There was no swelling. On close examination, she revealed that she had pain in the submandibular area.

Questions:

- What condition do you think is the woman suffering from?
- Why is not there any visible swelling?
- Why is there a restriction in opening the mouth?

Explanation:

- The woman is likely to be suffering from submasseteric space infection.
- This space is present between masseter and the ramus of mandible. Accumulation of pus in this space will not cause any visible swelling because of its internal rotation.
- Muscle spasm produced by accumulation of pus in the space causes pain and restriction in the opening of the mouth.

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Review or Practice Questions

Write essays on:

- Discuss the infratemporal fossa in detail.
- Write in detail on the temporomandibular joint and its movements.

Write short notes on:

- Temporal fascia.
- Temporalis muscle.
- Middle meningeal artery.
- Pterygoid plexus of veins.
- Write notes on maxillary artery.

Write briefly on:

- Masseter.
- Lateral pterygoid.
- Sphenomandibular ligament.
- Movements of temporomandibular joint.

TAKE HOME MESSAGE

INFRATEMPORAL REGION

- It is an irregular space lying below the lateral part of the base of the skull and deep to the ramus of mandible.
- It communicates with the orbit, pterygopalatine fossa, temporal fossa, and middle cranial fossa.

PTERYGOPALATINE FOSSA

- It is a pyramidal depression below and behind the apex of orbit, deep from the infratemporal fossa toward the nasal cavity, and deep within face.
- By seven foramina or canals, it communicates with the cranial cavity, orbital, oral and nasal cavities, and infratemporal fossa.
- The important contents are the pterygopalatine ganglion, maxillary nerve and 3rd part of maxillary artery.

TEMPOROMANDIBULAR JOINT

- It is an articulation between one facial bone (mandible) and one cranial bone (temporal bone).
- It consists of two bones, a disc that divides the joint into two spaces, a joint capsule, four ligaments, four main muscles and it performs five motions.
- The four ligaments are the articular disc, temporomandibular, sphenomandibular, and stylomandibular ligaments.
- Four main muscles that produce the movements of the joint are the masseter, temporalis, medial, and lateral pterygoids. These are called muscles of mastication.
- The muscles that assist the joint are the four suprahyoids (mylohyoid, geniohyoid, stylohyoid, and digastric) and four infrahyoids (sternohyoid, sternothyroid, thyrohyoid, and omohyoid).
- The five movements of the joint are the protraction, retraction, elevation, depression, and side-to-side chewing movements.

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Inderbir Singh's Textbook of ANATOMY

Salient Features

- Simple language and presentation of material in the form of points for ease of understanding, remembering and reproduction by the students
- Simplified presentation in the form of flowcharts, tables and several images for better perception, comprehension and presentation in the examination
- Simplification and organization of content under several subheadings to motivate the students to read the subject in a sequence
- Organization of book into various chapters with each chapter presenting all the relevant components that has to be followed for continuity at one place like all arteries of that part in one chapter
- Clinical importance of each structure was presented in boxes for greater emphasis on clinical application of anatomical knowledge
- Dissection of the region wherever required is explained in brief in a separate box
- Osteology of individual bones in limbs and thorax are presented in a novel way with description of general features in text form and the muscular attachments in table format for easy reference
- Take home message for each chapter to recap the highlights of that chapter was done
- Greater emphasis on clinical application of anatomical knowledge by providing case scenarios with explanation
- Mnemonics given in respective chapters are close to the students, for easy to remembering and recall
- To motivate the students in this direction almost all chapters are provided with real-time case scenarios and explanations to introduce the anatomical basis for the clinical practice.

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