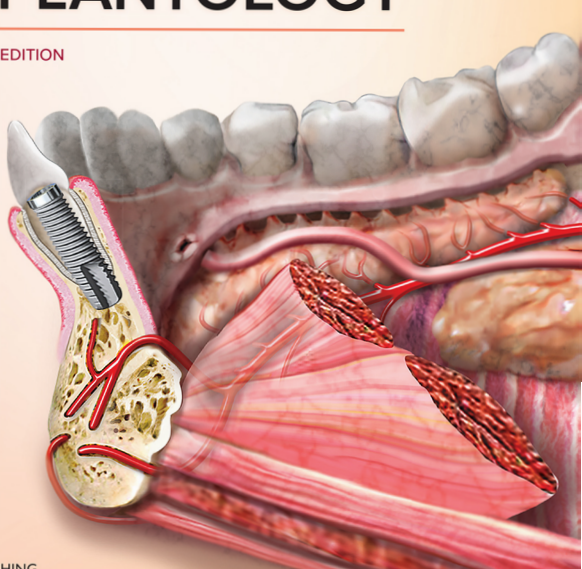
Louie Al-Faraje, DDS

CLINICAL ANATOMY FOR ORAL IMPLANTOLOGY

SECOND EDITION



QUINTESSENCE PUBLISHING

Clinical Anatomy for Oral Implantology, *Second Edition*

CLINICAL ANATOMY FOR ORAL IMPLANTOLOGY

SECOND EDITION

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TO THE ANONYMOUS DONORS

We are respectful of and deeply indebted to the six anonymous individuals whose cadaver sections are shown in this book. They have made a donation to science that will enrich the fundamental knowledge base of human anatomy and will benefit today's students and clinicians of oral implantology. Future generations can then build on this foundational knowledge.

I have done all in my power to preserve, protect, and maintain the dignity of these individuals. We did not know them in life but studied them in death; whoever they were, we honor their remains and dignify their gift.

To these six, our deepest thanks.

CONTENTS

DEDICATION

This book is dedicated to Ala-al-din abu Al-Hassan Ali ibn Abi-Hazm al-Qarshi al-Dimashqi, known as Ibn al-Nafis.

Ibn al-Nafis was an Arab physician who is mostly famous for being the first to describe the pulmonary circulation of the blood. He was born in 1213 in Damascus. He attended the Medical College Hospital (Bimaristan Al-Noori) in Damascus. Apart from medicine, Ibn al-Nafis learned jurisprudence, literature, and theology. He became an expert on the Shafi'i school of jurisprudence and an expert physician.

In 1236, Al-Nafis moved to Egypt. He worked at the Al-Nassri Hospital and subsequently at the Al-Mansouri Hospital as a chief physician. When he died in 1288, he donated his house, library, and clinic to the Mansuriya Hospital.

Discovery of pulmonary circulation

The theory that was accepted prior to Al-Nafis was that of Galen from the 2nd century. Galen had theorized that the blood reaching the right side of the heart went through invisible pores in the cardiac septum, to the left side of the heart, where it mixed with air to create spirit and was then distributed to the body. According to Galen, the venous system was quite separate from the arterial system, except when they came in contact through the unseen pores.

Based on his anatomical knowledge, Al-Nafis stated that:

> The blood from the right chamber of the heart must arrive at the left chamber but there is no direct pathway between them. The thick septum of the heart is not perforated and does not have visible pores as some people thought or invisible pores as Galen thought. The blood from the right chamber must flow through the vena arteriosa [pulmonary artery] to the lungs, spread through its substances, be mingled there with air, pass through the arteria venosa [pulmonary vein] to reach the left chamber of the heart and there form the vital spirit.

Elsewhere in his book, he said that:

> The heart has only two ventricles … and between these two there is absolutely no opening. Also dissection gives this lie to what they said, as the septum between these two cavities is much thicker than elsewhere. The benefit of this blood [that is in the right cavity] is to go up to the lungs, mix with what is in the lungs of air, then pass through the arteria venosa to the left cavity of the two cavities of the heart and of that mixture is created the animal spirit.

In describing the anatomy of the lungs, Al-Nafis stated:

> The lungs are composed of parts, one of which is the bronchi; the second, the branches of the arteria venosa; and the third, the branches of the vena arteriosa, all of them connected by loose porous flesh.

He then added that:

> The need of the lungs for the vena arteriosa is to transport to it the blood that has been thinned and warmed in the heart, so that what seeps through the pores of the branches of this vessel into the alveoli of the lungs may mix with what there is of air therein and combine with it, the resultant composite becoming fit to be spirit, when this mixing takes place in the left cavity of the heart. The mixture is carried to the left cavity by the arteria venosa.

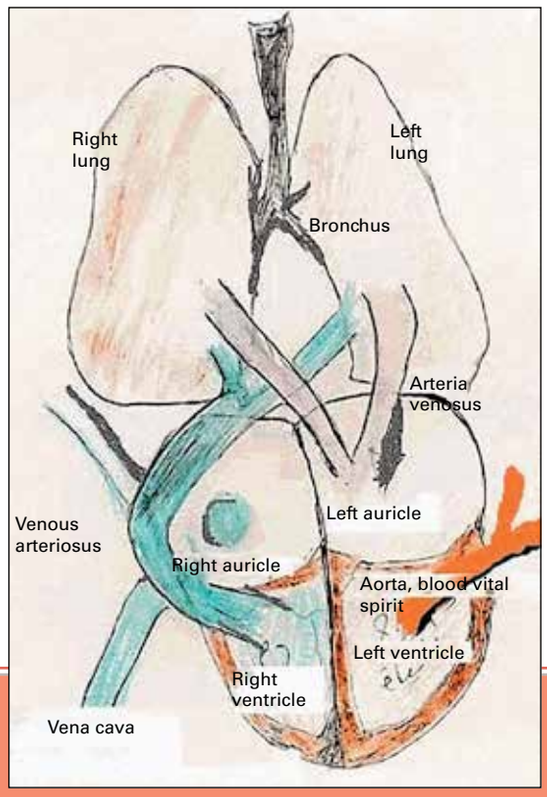
Al-Nafis also postulated that nutrients for the heart are extracted from the coronary arteries:

> Again, his [Avicenna's] statement that the blood that is in the right side is to nourish the heart is not true at all, for the nourishment to the heart is from the blood that goes through the vessels that permeate the body of the heart.

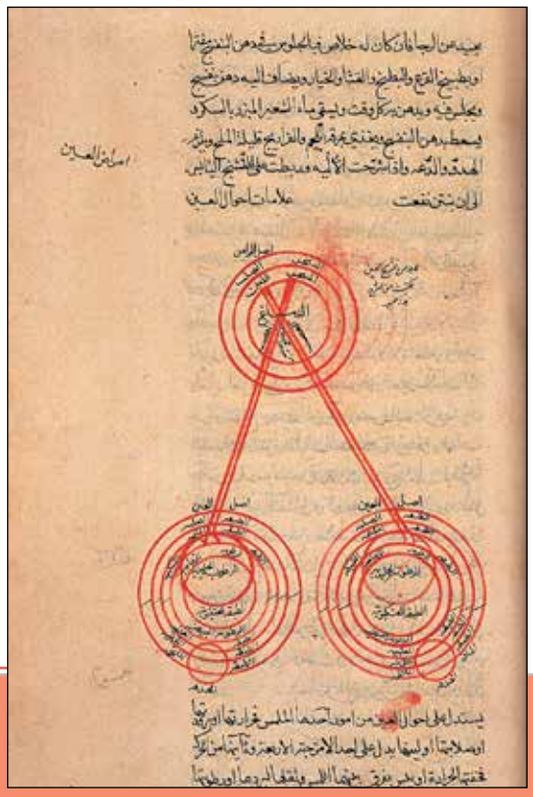
Writings

The most voluminous of his books is *Al-Shamil fi al-Tibb*, which was planned to be an encyclopedia comprising 300 volumes but was never completed because of his death. The manuscript is available in Damascus.

His book on ophthalmology is largely an original contribution. His most famous book is *The Summary of Law (Mujaz al-Qanun)*. Another famous book embodying his original contribution was on the effects of diet on health, entitled *Kitab al-Mukhtar fi al-Aghdhiya*.



The pulmonary circulation of the blood according to Ibn al-Nafis.



A page from the book on ophthalmology by Ibn al-Nafis.

PREFACE

Anatomical knowledge has always been the foundation of sound clinical medicine. It is vital not only for the safe and successful execution of surgical procedures, but also as the basis for accurate diagnosis and treatment planning. Although human anatomy itself is not a particularly dynamic field, there have been significant advancements in surgical techniques and imaging in the past several years, which is what prompted an updated edition of this atlas.

Over the past year, I have spent over 300 hours applying my clinical and teaching experience to this project, ensuring that this new edition has the utmost relevance to the clinical reality of oral implantology today. The result of this effort is an entirely new chapter on the zygomatic bone as well as extensive improvement to existing chapters, amounting to an increase of 50 pages and nearly 150 images and illustrations.

The new chapter detailing the anatomy of the zygomatic bone (chapter 4) is especially relevant because of the recent popularity of zygomatic implants. Clinical evidence has shown significant advantages for placing implants in the zygomatic region, particularly as a way to avoid bone grafting in patients with severe maxillary bone loss, leading to the development of new techniques and indications for this approach. This new chapter provides implant dentists with clinical cases, CT and CBCT scans, and detailed illustrations that will allow them to safely and predictably offer zygomatic implant treatment to their patients. Other major changes in this new edition have been made to the chapters on the anterior and posterior mandible (chapters 6 and 7) as well as the chapter on anatomy for surgical emergencies (chapter 9).

As in the previous edition, the aim of this book has been to present an adequate amount of anatomical material in a readable and interesting form. Every effort has been made to sequence the information in a logical manner.

The illustrations in this book are the result of very hard work and cooperation between the illustrator and myself. Nonetheless, certain anatomical landmarks are hard to illustrate in a diagrammatic format, and this leads to confusion when students and professionals are confronted with an actual specimen in the dissecting room or in the operatory. Therefore, photographs of clinical cases and dissected structures of the maxilla, the mandible, and the nasal cavity that are provided in this book show structures as they actually exist in the dissected or live body, and I am hoping that this will bridge the gap that exists occasionally between books and the "real thing."

In addition, this book provides a good number of CT and CBCT images of those anatomical landmarks that usually do not appear in 2D imaging (ie, panoramic, intraoral, and cephalometric radiographs). I encourage the use of CBCT imaging for every dental implant surgery. The CT scan technology allows us to visualize patient anatomy and pathology like never before. With these images, we can measure the exact distance available for implant placement under or above certain anatomical landmarks, determine the exact bone density, measure precisely the width of the available alveolar ridge, and select the most suitable locations for the planned implants. This leads to improved treatment planning as well as reduced morbidity and liability.

It is my hope that these illustrations, CT images, photographs, and text will simplify the learning and execution of implant-related surgical procedures in a region of the body that presents special topographic and anatomical difficulties.

Acknowledgments

To God, the creator of the perfect human body, who has made all my projects possible through his guidance and gracious love.

To my parents Omar Al-Faraje and Nadia Al-Rifai, whose guidance and nurturing instilled in me the quest for perfection.

To my wife Rana and my children, Nadia, Omar, and Tim. Their smiles and inspiration provide me the fortitude and drive in my life. I am very blessed.

To my brother Tarek and my sisters Elma and Razan. You are my friends in the journey of life.

To my dedicated teammates at the California Implant Institute and Novadontics. You have been showing dedication to your jobs on a daily basis for years by devoting more personal time to your work, volunteering for special assignments, and agreeing to be on call 24/7 for after-hours customer inquiries. Very few companies were built by a single person who had no help. It takes a team of devoted workers to make a company a success. Thank you.

My special thanks go to Dr Christopher Church for his contribution to the nasal and sinus anatomy sections of the book. It is a privilege to have a friend like him.

My deepest thanks to Bill Hartman and Marieke Zaffron from Quintessence Publishing for the opportunity to educate my colleagues on the special anatomical considerations for surgical oral implantology. I am very fortunate to have such highly skilled and professional editors.

To my patients, without them I would not have been able to compile the clinical photographs I have. They make my profession so enjoyable and rewarding.

To all of my students at the California Implant Institute. It is always a pleasure and an honor to share with you my knowledge and expertise in implant dentistry. For the last 18 years, my greatest professional joy has been interacting with my students and colleagues at the California Implant Institute.

I am also particularly grateful to the illustrators who worked on this book. Many hours were spent and countless emails sent back and forth to produce these specific illustrations.

1

ARTERIES, VEINS, AND INNERVATION OF THE MAXILLA AND THE MANDIBLE

This chapter describes the following anatomical landmarks and their relevance to implant-related oral surgical procedures: the external carotid artery, the maxillary artery, the pterygopalatine fossa, the veins of the head, and the trigeminal nerve.

External Carotid Artery

The arteries that supply blood to the face, the maxilla, and the mandible arise largely from the external carotid artery. However, branches of the ophthalmic artery (a branch of the internal carotid artery) supply the forehead, scalp, upper eyelid, and nose. The external and internal carotid arteries (Figs 1-1 and 1-2) branch off the common carotid artery at the level of the superior border of the thyroid cartilage. The external carotid artery has eight branches:

- Three anterior branches: the superior thyroid artery, the lingual artery, and the facial artery
- Two terminal branches: the maxillary artery and the superficial temporal artery
- Two posterior branches: the occipital auricular artery and the posterior auricular artery
- One medial branch: the ascending pharyngeal artery

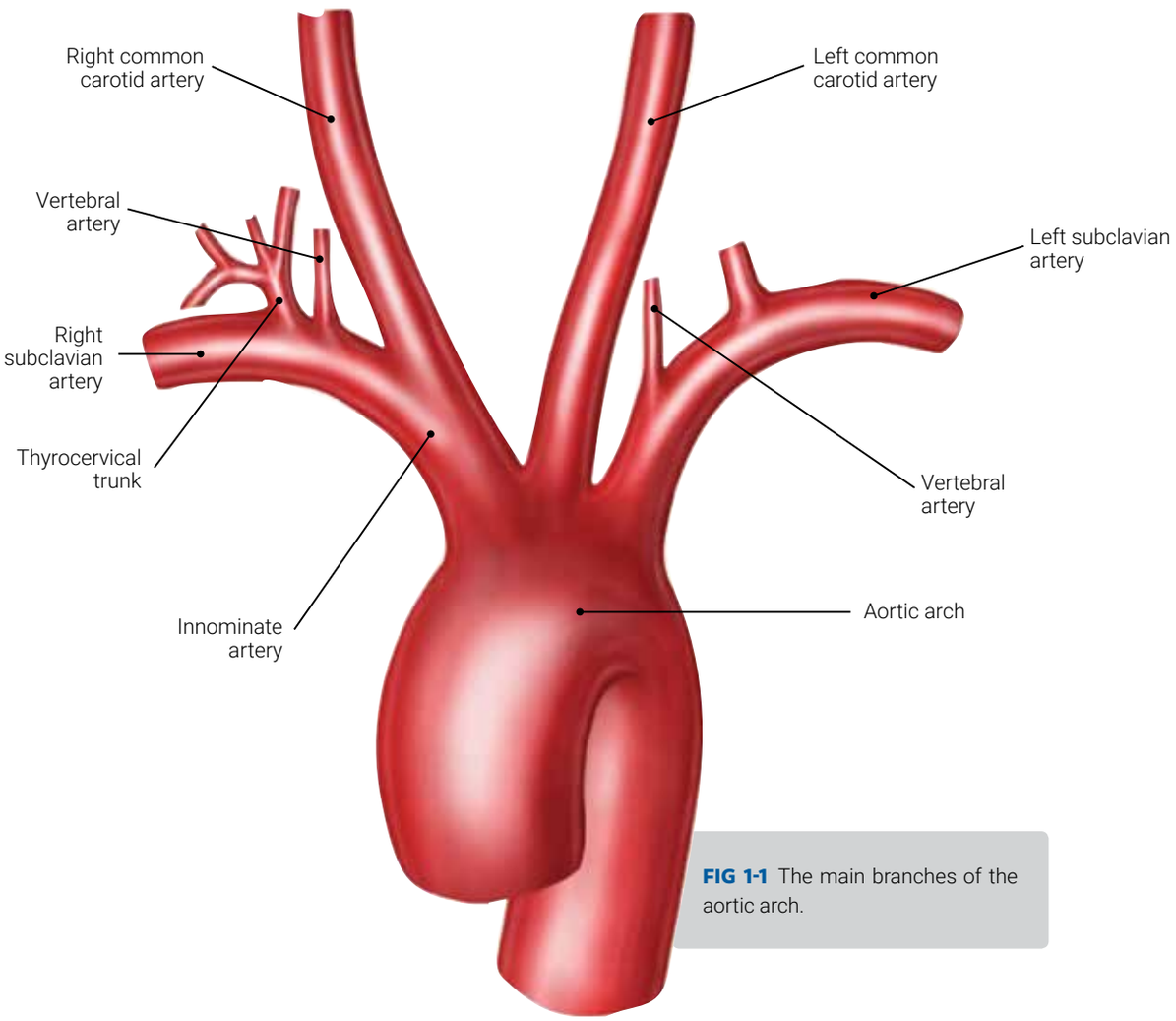


FIG 1-1 The main branches of the aortic arch.

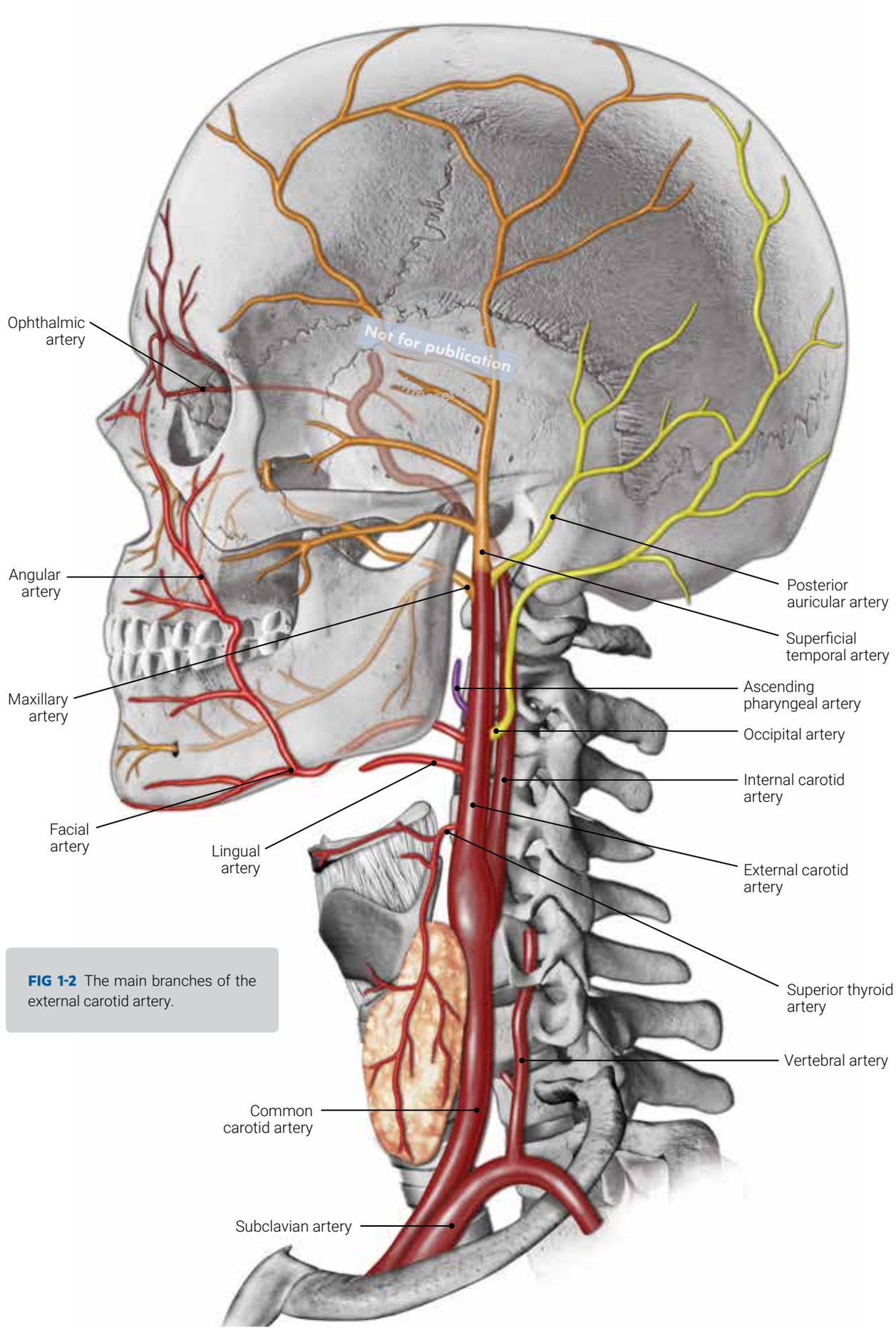


FIG 1-2 The main branches of the external carotid artery.

Maxillary Artery

The maxillary artery (Fig 1-3) arises in the parotid gland as a terminal branch of the external carotid artery. The branches of the maxillary artery can be divided into three parts:

- *Part I* or the *mandibular part* (located within the substance of the parotid gland and anterior to the external acoustic meatus): In this part, the maxillary artery gives branches to the ear, the dura, the temporomandibular joint, the mandibular teeth, and the mylohyoid muscle.
- *Part II* or the *pterygoid part* (located in the infratemporal fossa): The branches here are mainly to the muscles of mastication, the buccal mucosa and skin, and the buccinator muscles through the buccal artery.
- *Part III* or the *pterygopalatine part* (the branches in the pterygopalatine fossa after entry through the pterygomaxillary fissure): The branches here are mainly to the hard and soft palate through the branches of the descending palatine artery, to the maxillary molars and premolars through the posterior superior alveolar artery, to the upper pharynx and tympanic cavity through the artery of the pterygoid canal, to the nasopharynx and sphenoidal sinus through the pharyngeal artery, and to the maxillary anterior teeth through the infraorbital artery.

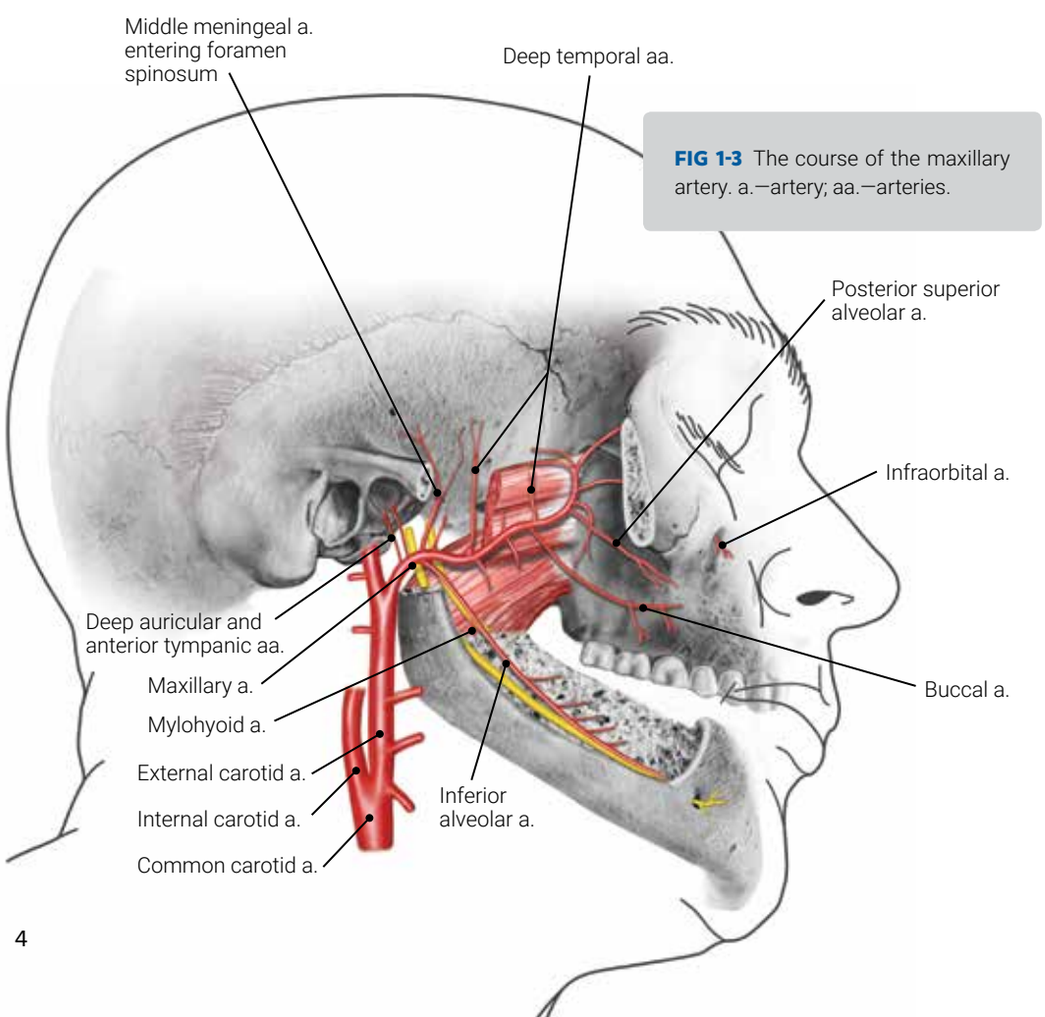


FIG 1-3 The course of the maxillary artery. a.—artery; aa.—arteries.

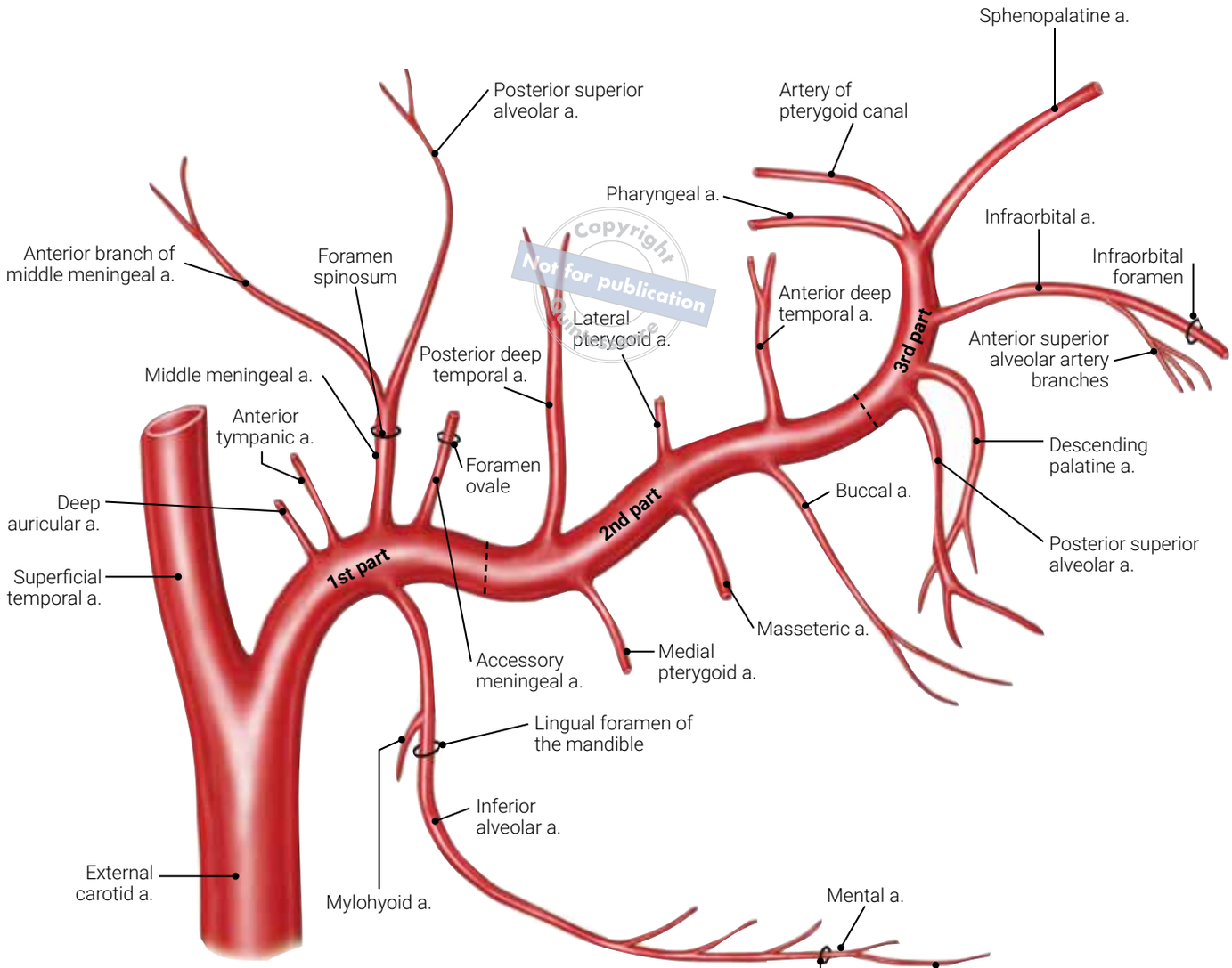


FIG 1-4 The distribution of all three parts of the maxillary artery. a.—artery.

The maxillary artery terminates as the sphenopalatine artery on the nasal septum after splitting into nasal branches. Figure 1-4 demonstrates in detail the branches of all three parts of the maxillary artery.

Pterygopalatine Fossa

The *pterygopalatine fossa*, also called the *sphenopalatine fossa*, is a narrow, pyramid-shaped fossa on the lateral aspect of the skull. The fossa is a crossroads between the orbit, nasal cavity, oral cavity, nasopharynx, and middle cranial fossa (Figs 1-5 to 1-7). The pterygopalatine ganglion and the terminal branches of the maxillary artery are situated in its superior part. The pterygopalatine fossa along with the infratemporal and pterygoid fossae are referred to as the *retromaxillary space*.

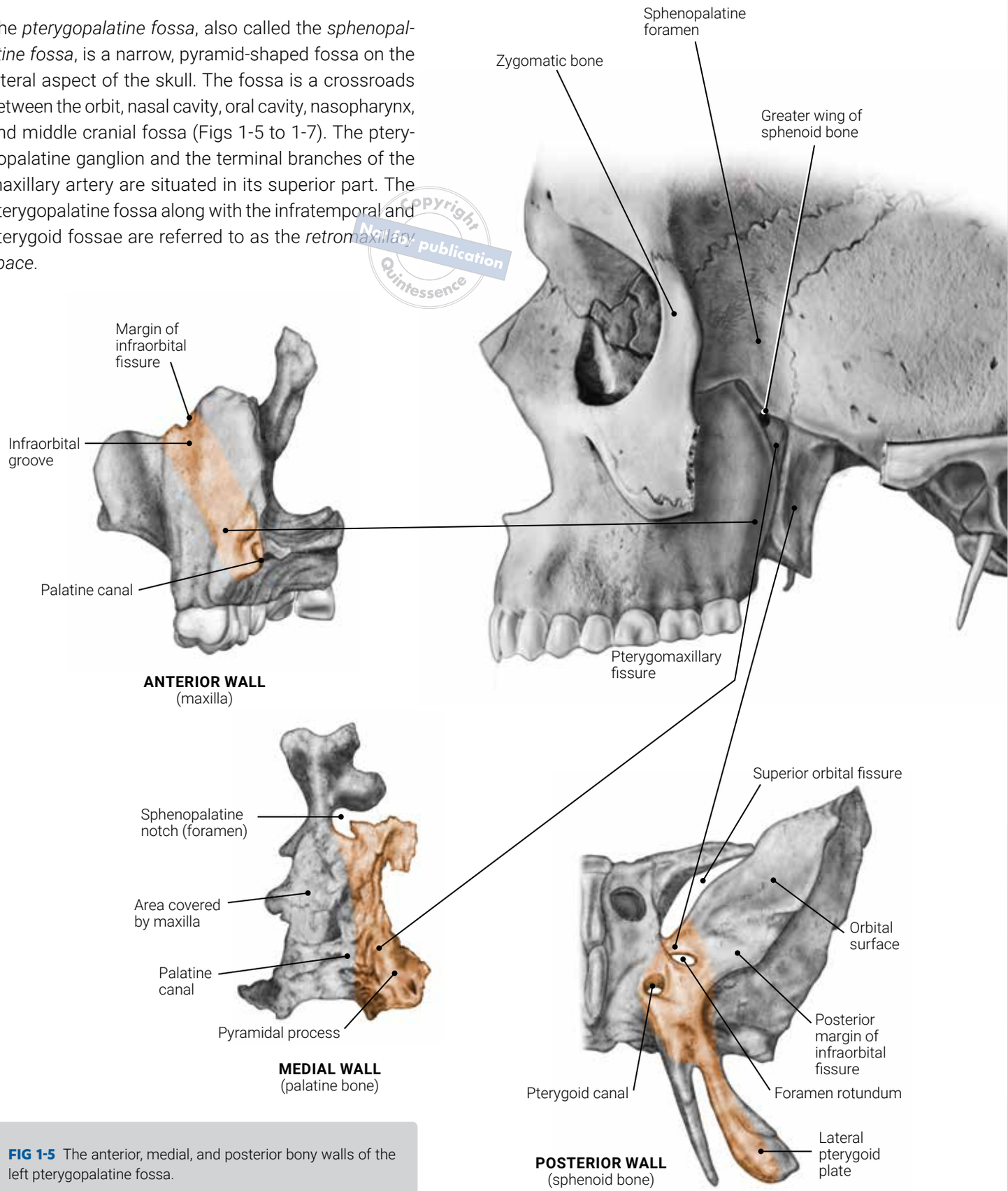


FIG 1-5 The anterior, medial, and posterior bony walls of the left pterygopalatine fossa.

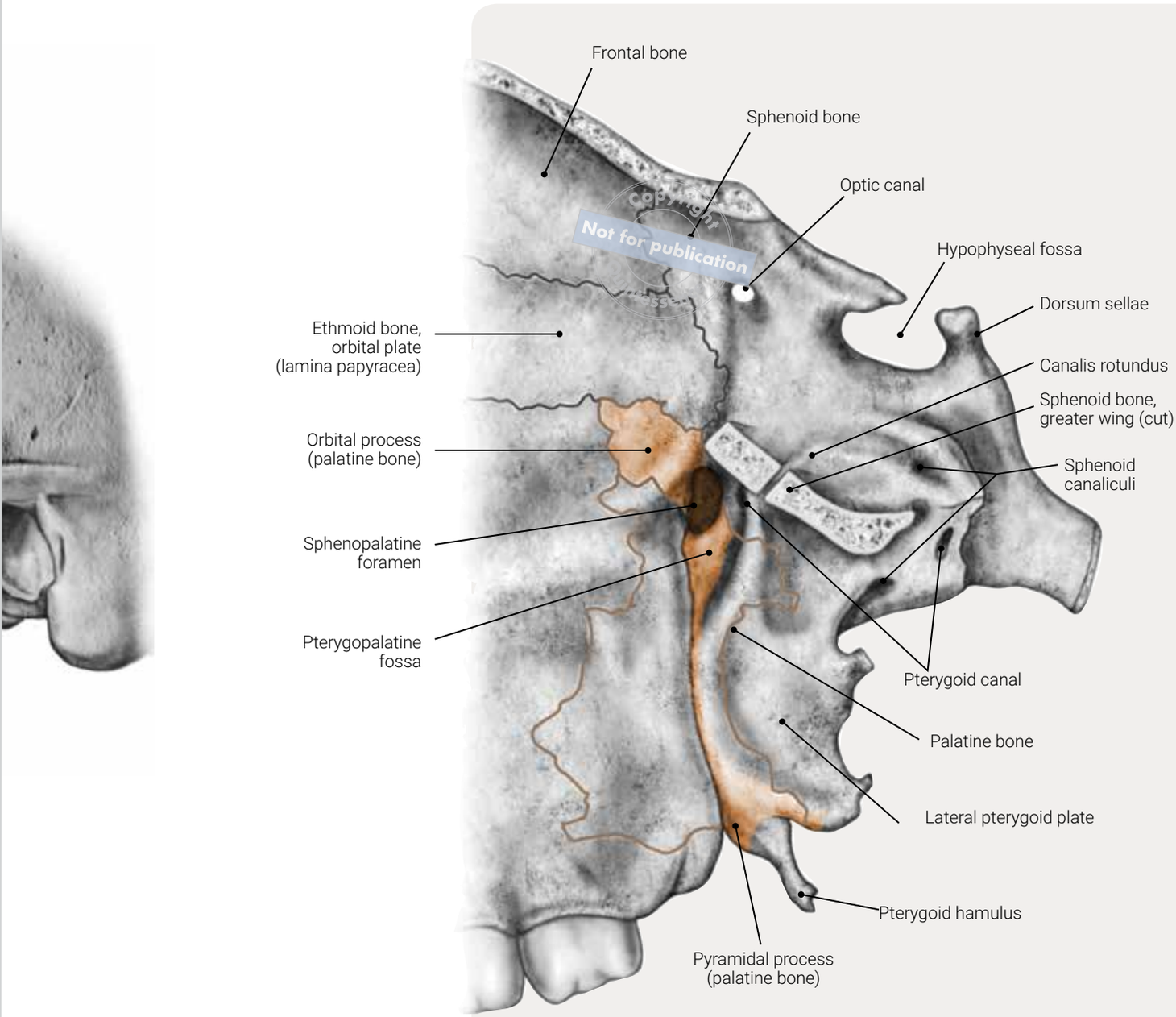


FIG 1-6 The pterygopalatine fossa after removal of the zygomatic bone, greater ala of the sphenoid bone, zygomatic arch, and temporal squama.

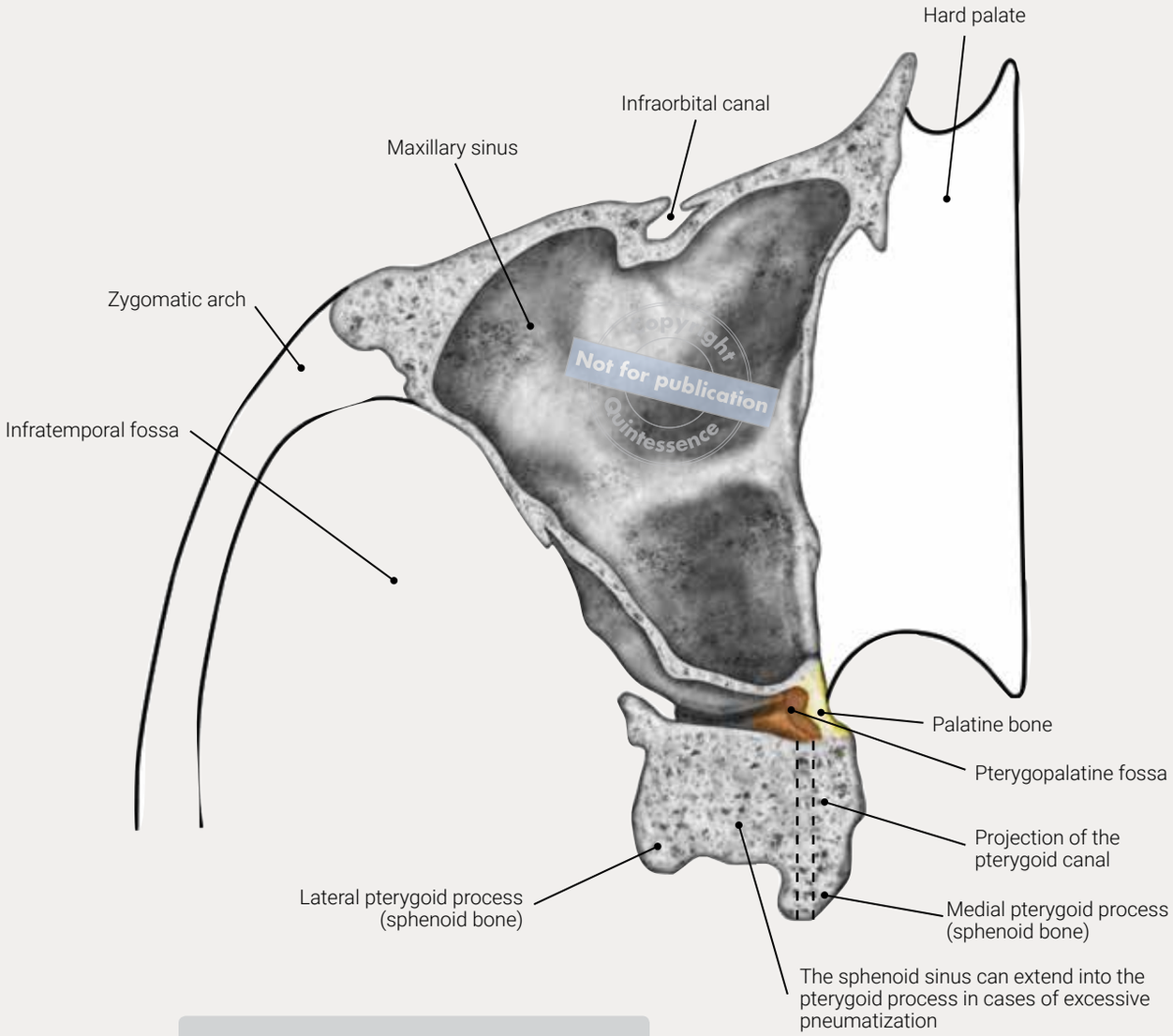


FIG 1-7 Horizontal section of the pterygopalatine fossa at the level of the infraorbital foramen.

Boundaries and communications of the pterygopalatine fossa[1–3]

The *anterior boundary* comprises the superomedial part of the infratemporal surface of the maxilla. The *posterior boundary* comprises the root of the pterygoid process of the sphenoid bone. Through this posterior wall, the fossa communicates with the middle cranial fossa via the foramen rotundum and the pterygoid canal (also called the *vidian canal*). The foramen rotundum lies lateral and superior to the pterygoid canal at the base of the pterygoid process. The vidian canal is located medial and superior to the pterygopalatine ganglion, and thus its nerve lies medial to the major vessels of the pterygopalatine fossa, which allows the surgeon to avoid excessive bleeding during vidian neurectomy (Fig 1-8).

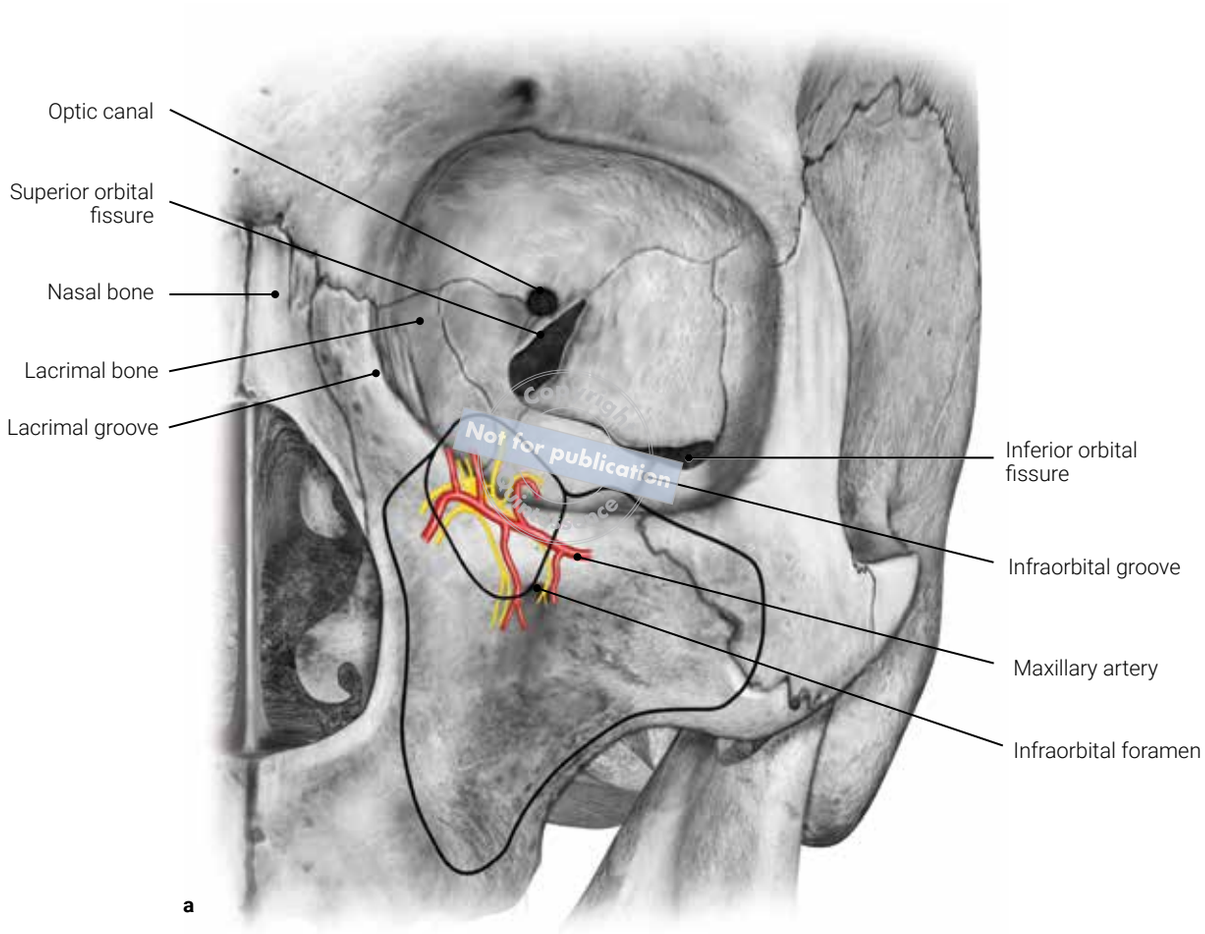


FIG 1-8 *(a and b)* The branching pattern of the maxillary artery in its relationship to the pterygopalatine ganglion in the pterygopalatine fossa. Some variation in the branching pattern does exist.

Also, at the posterior wall and in an inferoposterior direction, the fossa communicates with the nasopharynx through the palatovaginal (pharyngeal) canal. The palatovaginal canal is located between the vaginal process of the vomer bone and the sphenoid process of the palatine bone, and it passes into the floor of the sphenoid sinus between the pterygoid canal and the vomerine crest of the sphenoid. The opening to the palatovaginal (pharyngeal) canal in the nasal cavity is located near the lateral margin of the ala of the vomer, at the roots of the pterygoid process.

The *medial boundary* comprises part of the perpendicular plate of the palatine bone and its orbital sphenoidal processes. The pterygopalatine fossa communicates with the nasal cavity at this wall through the sphenopalatine foramen. The sphenopalatine foramen is bounded in front, below, and behind by the palatine bone (and the sphenopalatine incisure) and above by the body of sphenoid bone. Laterally, the pterygopalatine fossa communicates with the infratemporal fossa through the pterygomaxillary fissure.

The *superior border* of the pterygopalatine fossa comprises a small part of the orbital plate of the palatine bone and part of the maxillary surface of the greater wing of the sphenoid bone and junction with the inferior orbital fissure.

The *inferior border* of the pterygopalatine fossa is formed by the pyramidal process of the palatine bone; the pterygopalatine (greater palatine) canal is located at this inferior border. The *pterygopalatine canal* is a continuation of the pterygopalatine fossa and is formed when the maxillary surface of the perpendicular plate of the palatine bone articulates with the maxilla. It leads to the greater and lesser palatine foramina in the roof of the oral cavity. Table 1-1 provides a detailed description of the contents of the pterygopalatine fossa.

Surgical importance of the anatomy of the pterygopalatine fossa

The anatomy of the pterygopalatine fossa is especially important for the following surgeries:

- Vidian neurectomy (the surgical sectioning of the pterygoid nerve for the treatment of vasomotor rhinitis, Sluder's neuralgia of the pterygopalatine ganglion, crocodile tears syndrome, allergic rhinitis [hay fever], and nasal polyposis)
- Transmaxillary ligature of the maxillary artery (in cases of severe nasal bleeding that cannot be controlled by anterior and/or posterior tamponades)
- Craniofacial surgery
- Surgery of the base of the skull or nasopharynx
- Lateral approaches to the orbit
- Traumatology

Vasomotor rhinitis is a condition that results from a relative imbalance of parasympathetic to sympathetic stimulation of the blood vessels and glands of the nasal mucosa. It is characterized by symptoms of clear rhinorrhea and nasal congestion.

Sluder's neuralgia of the pterygopalatine ganglion is a rare disorder characterized by unilateral, severe, burning, boring, or nagging headache, starting around the eye and the bridge of the nose and radiating to the maxilla and maxillary teeth, zygoma, mastoidal area and occiput, or even as far down as the shoulder and arm.

Crocodile tears syndrome (gustatory lacrimation; tearing on eating) is a rare complication of a facial nerve lesion proximal to the geniculate ganglion, whereby regenerating preganglionic salivary fibers intended for the chorda tympani nerve are misdirected to the sphenopalatine ganglion, which project to the lacrimal gland.

TABLE 1-1
Contents of the pterygopalatine fossa

Opening	Communication	Location	Transmitted structures
Foramen rotundum	Middle cranial fossa	Posterior wall	• CN V2
Pterygoid canal	Middle cranial fossa	Posterior wall	• Nerve of the pterygoid canal (vidian nerve) (formed from the greater petrosal and deep petrosal nerves) • Artery of pterygoid canal • Veins of pterygoid canal
Palatovaginal (pharyngeal) canal	Nasopharynx	Posterior wall	• Pharyngeal branches of the pterygopalatine ganglion of CN V2 (the ganglion is located in the pterygopalatine fossa) • Pharyngeal artery (maxillary artery) • Pharyngeal vein
Sphenopalatine foramen	Nasal cavity	Medial wall	• Nasopalatine nerve and posterior superior nasal nerve (both are pterygopalatine ganglionic branches of CN V2) • Sphenopalatine artery (maxillary artery) • Sphenopalatine vein
Pterygomaxillary suture	Infratemporal fossa	Lateral wall	• Posterior superior alveolar nerve • Pterygoid part of the maxillary artery (after branching off into the posterior superior alveolar artery, its only branch outside the fossa) • Posterior superior alveolar vein
Inferior orbital fissure	Orbit	Superior wall	• Infraorbital and zygomatic nerves (CN V2) • Infraorbital artery (maxillary artery) • Infraorbital vein
Pterygopalatine (greater palatine) canal	Oral cavity	Inferior wall	• Descending palatine nerve (CN V2) (splits into the greater and lesser palatine within the canal) • Descending palatine artery (maxillary artery) (splits into the greater and lesser palatine within the canal) • Descending palatine vein

Yellow bullet—nerve; red bullet—artery; blue bullet—vein.

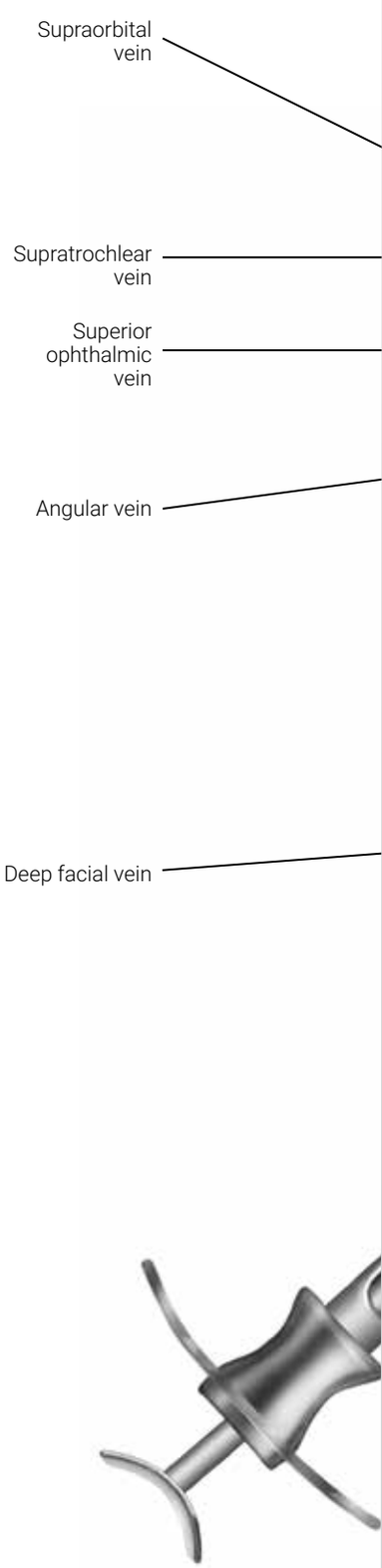
Veins of the Head

The principal veins of the head and neck are the internal jugular vein, the external jugular vein, and the anterior jugular vein. The *internal jugular vein* collects blood from the interior of the skull, the anterior and lateral face, and the oral cavity and the neck via the sigmoid sinus, the inferior petrosal sinuses, and the facial, lingual, superior, and middle thyroid and retromandibular (anterior division) veins. The *external jugular vein* collects blood from the lateral skull and the occiput via the posterior auricular and the retromandibular (posterior division) veins. The *anterior jugular vein* collects blood from the anterior neck region.

Pterygoid venous plexus

The *pterygoid venous plexus* is situated on the medial side of the mandibular ramus within the pterygoid muscles. It is linked to the facial vein via the deep facial vein, to the retromandibular vein via the maxillary vein, and to the cavernous sinus via the sphenoidal emissary vein. The pterygoid plexus drains into the jugular veins.

This plexus is of a special importance to dentists because if the needle is overinserted during posterosuperior alveolar block, it may penetrate the pterygoid plexus of the vein and the maxillary artery in the infratemporal fossa (Fig 1-9), thus causing hematoma. This results in extraoral swelling a few minutes after the injection. The hematoma will cause tissue tenderness and discoloration, which will last until the blood is broken down by the body, and possible spread of infection to the cavernous venous sinus if the needle is contaminated. A hematoma can also result during other blocks, such as infraorbital and inferior alveolar blocks. To avoid injection into blood vessels, aspiration should always be attempted for all injections.



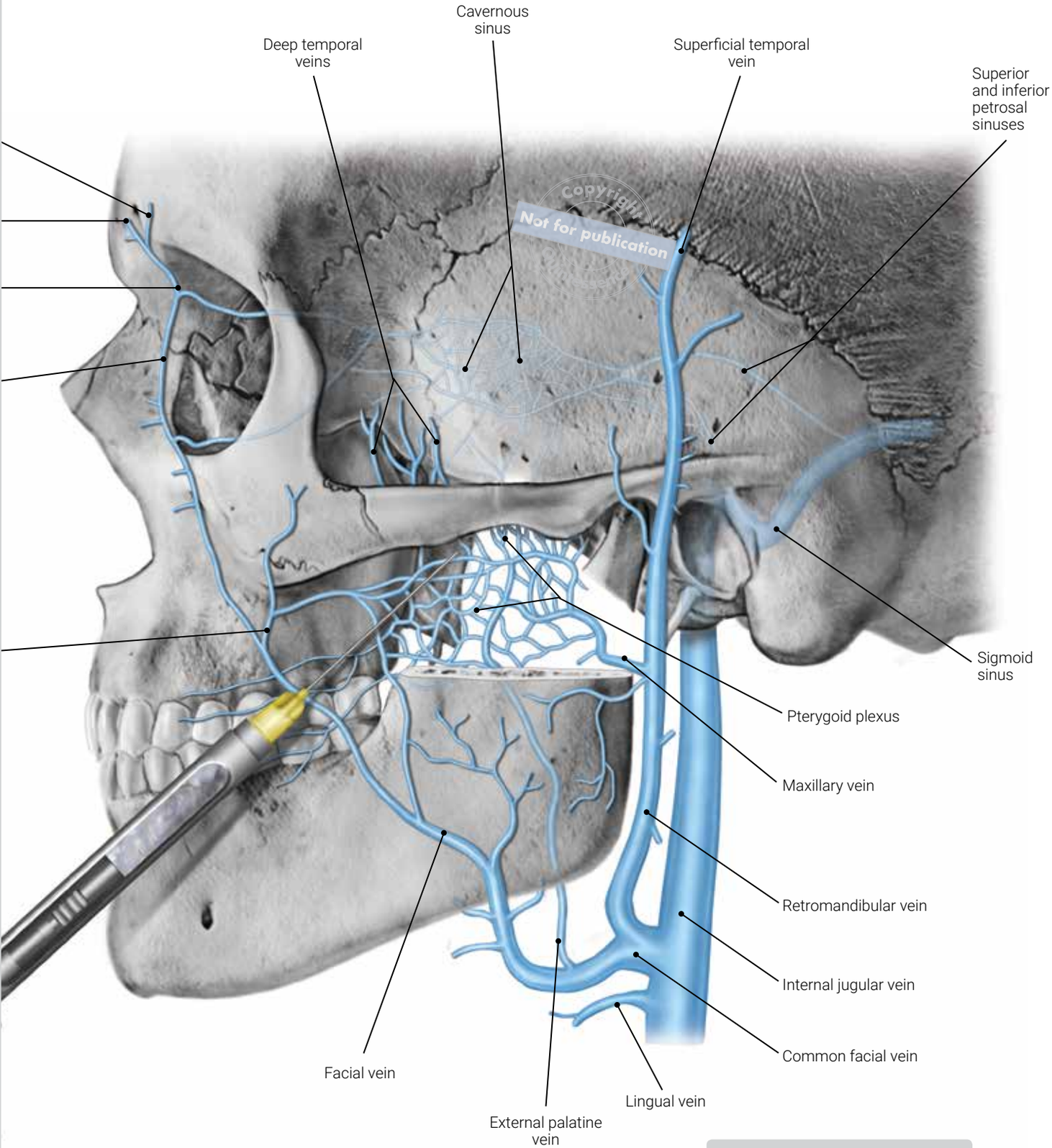


FIG 1-9 Pterygoid venous plexus.

Trigeminal Nerve

The 12 cranial nerves control motor and sensory functions of the head and neck. Figure 1-10 and Table 1-2 summarize the skull base foramina from which these nerves exit the skull and their functions.

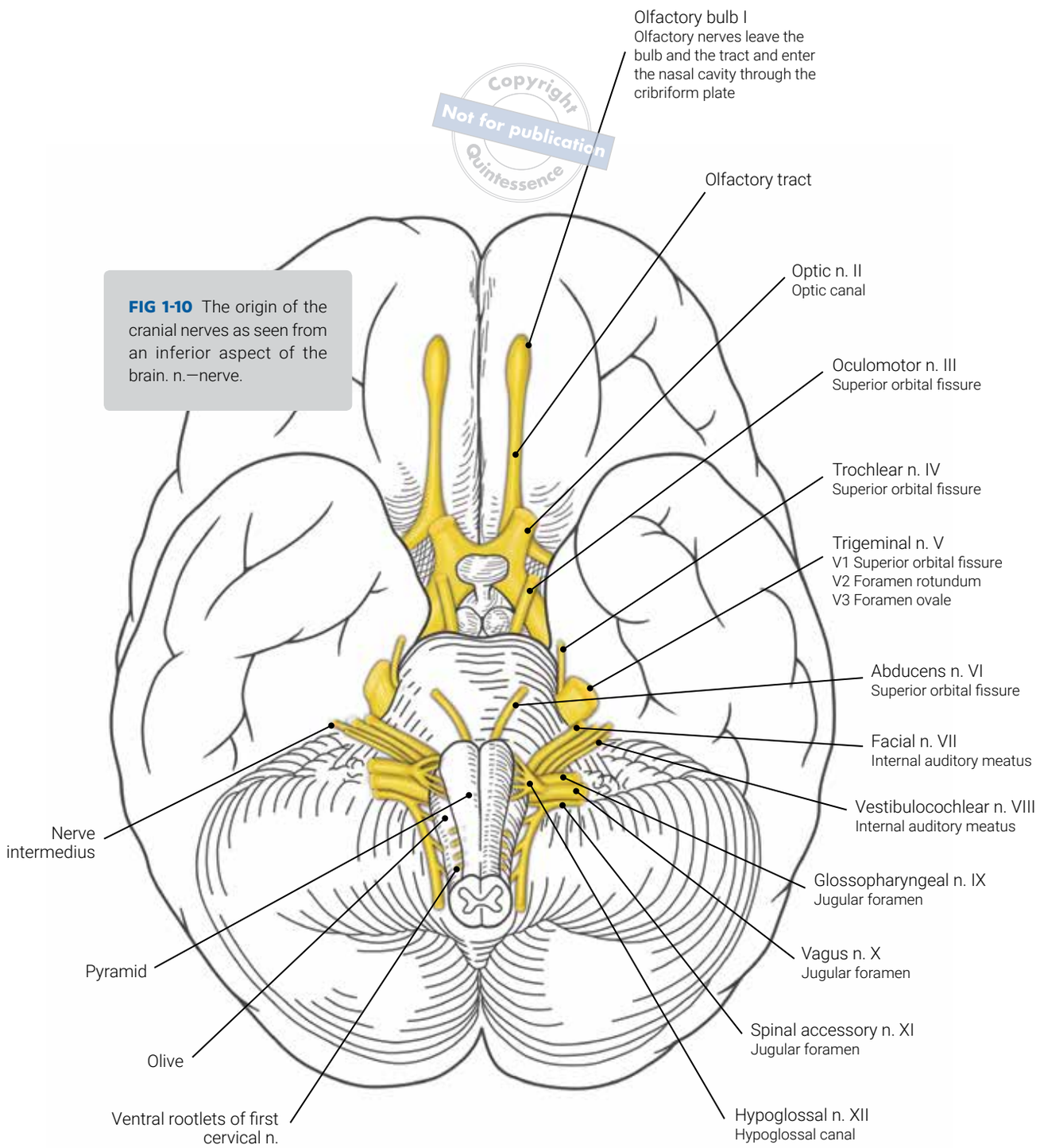


FIG 1-10 The origin of the cranial nerves as seen from an inferior aspect of the brain. n.—nerve.

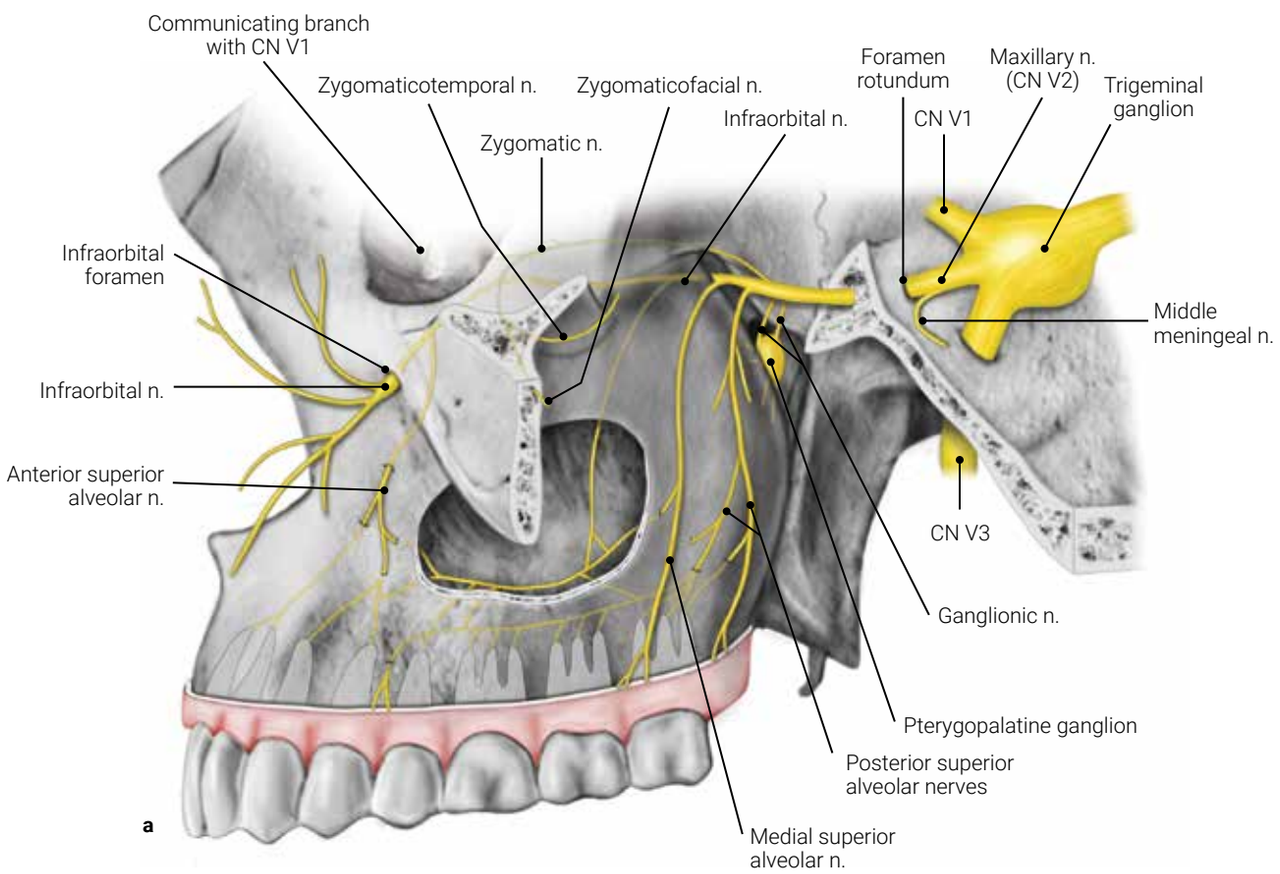
TABLE 1-2
Exit foramina and functions of the cranial nerves

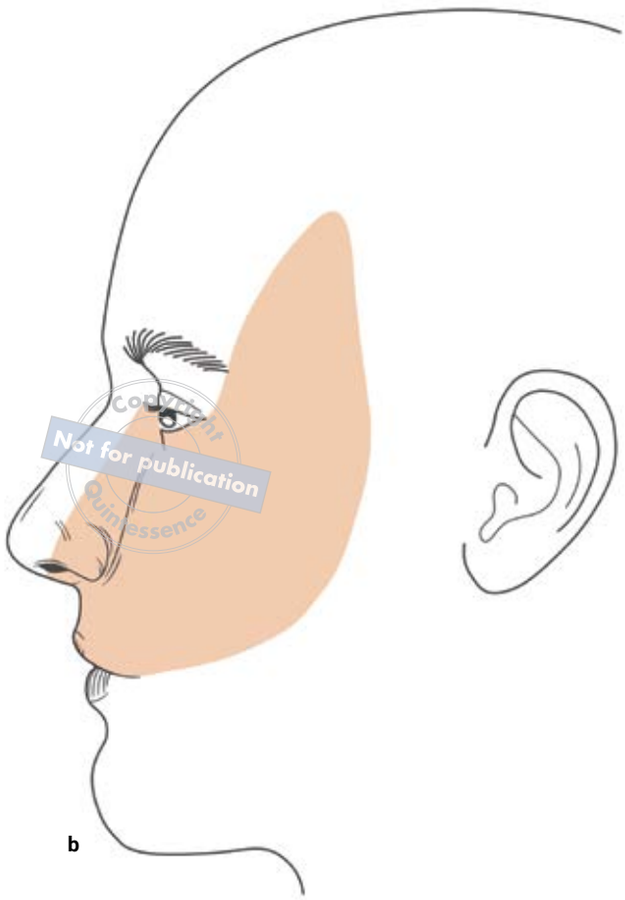
Nerve	Name	Skull base foramina	Functions
I	Olfactory	Cribriform plate	Sensory for smell
II	Optic	Optic canal	Sensory for vision
III	Oculomotor	Superior orbital fissure	Motor for six eye muscles
IV	Trachlear	Superior orbital fissure	Motor for one eye muscle
V1	Trigeminal/ ophthalmic division	Superior orbital fissure	Sensory for lacrimal gland, nearby air sinuses, scalp, forehead, upper eyelid, and nose
V2	Trigeminal/ maxillary division	Foramen rotundum	Sensory for parts of the nasal and oral cavities and the skin of the cheek and upper lip
V3	Trigeminal/ mandibular division	Foramen ovale	Sensory for the skin over the mandible, lower lip, temporal region, and much of the oral cavity Motor for muscles of mastication as well as the anterior belly of the digastric muscle, mylohyoid muscle, tensor tympani, and tensor veli palatine muscles
VI	Abducens	Superior orbital fissure	Motor for one eye muscle
VII	Facial	Internal auditory meatus	Motor for muscles of facial expression, stapidius, and posterior belly of the digastric muscle; also motor for the lacrimal glands, oral and nasal mucosa, and submandibular and sublingual glands Sensory for the external auditory meatus; lateral pinna; mastoid; mucosa of the pharynx, nose, and palate; as well as sensory for taste for the anterior two-thirds of the tongue via the chorda tympani
VIII	Vestibulocochlear	Internal auditory meatus	Sensory for balance and hearing
IX	Glossopharyngeal	Jugular foramen	Motor for the stylopharyngeus muscle and parotid gland Sensory for the posterior external ear, tragus, posterior third of the tongue, soft palate, nasopharynx, tympanic membrane, Eustachian tube, and mastoid region and sensory for taste for the posterior third of the tongue
X	Vagus	Jugular foramen	Motor for the pharyngeal and laryngeal muscles, including the palatoglossus muscle; also motor to the smooth muscles and glands of the pharynx, larynx, heart, esophagus, and stomach Sensory for the ear, external auditory meatus, external surface of the tympanic membrane, dura of posterior cranial fossa, larynx, lungs, heart, esophagus, and stomach
XI	Spinal accessory	Jugular foramen	Motor for the sternocleidomastoid and trapezius muscles
XII	Hypoglossal	Hypoglossal canal	Motor for all intrinsic tongue muscles and all extrinsic tongue muscles except the palatoglossus muscle (innervated by CN X)

Maxillary nerve (CN V2)

The maxillary nerve (Fig 1-11a) is the second branch of the fifth cranial nerve (trigeminal nerve). Its function is the transmission of sensory fibers from the maxillary teeth, the nasal cavity, the sinuses, and the skin between the palpebral fissure and the mouth (Figs 1-11b and 1-11c). In the cranium, the maxillary nerve branches off into the middle meningeal nerve, then passes through the foramen rotundum into the pterygopalatine fossa, where it divides into the zygomatic nerve, the ganglionic branches (pterygopalatine branches), and the infraorbital nerve.

- The zygomatic nerve passes through the inferior orbital fissure and gives branches of sensory fibers to the lacrimal nerve, then divides into the zygomaticotemporal branch (temple) and the zygomaticofacial branch (for the skin over the zygomatic arch).
- The ganglionic branches are nasal branches (sphenopalatine branches) that pass through the sphenopalatine foramen into the nasal cavity, the palatine nerves (greater and lesser) for the soft and hard palates, and the pharyngeal nerve, which provides sensory supply to the upper pharynx.
- The infraorbital nerve enters the orbit through the inferior orbital fissure (after branching off into the posterior superior alveolar nerves to the molars and the medial superior alveolar nerves); it traverses the infraorbital groove and canal in the floor of the orbit, where it branches off into the anterior superior alveolar nerve, and appears on the face at the infraorbital foramen. Here it is referred to as the infraorbital nerve, a terminal branch. At its termination, the nerve lies beneath the quadratus labii superioris and divides into several branches that innervate the side of the nose, the lower eyelid (inferior palpebral nerve), and the upper lip (the superior labial nerve), joining with filaments of the facial nerve.





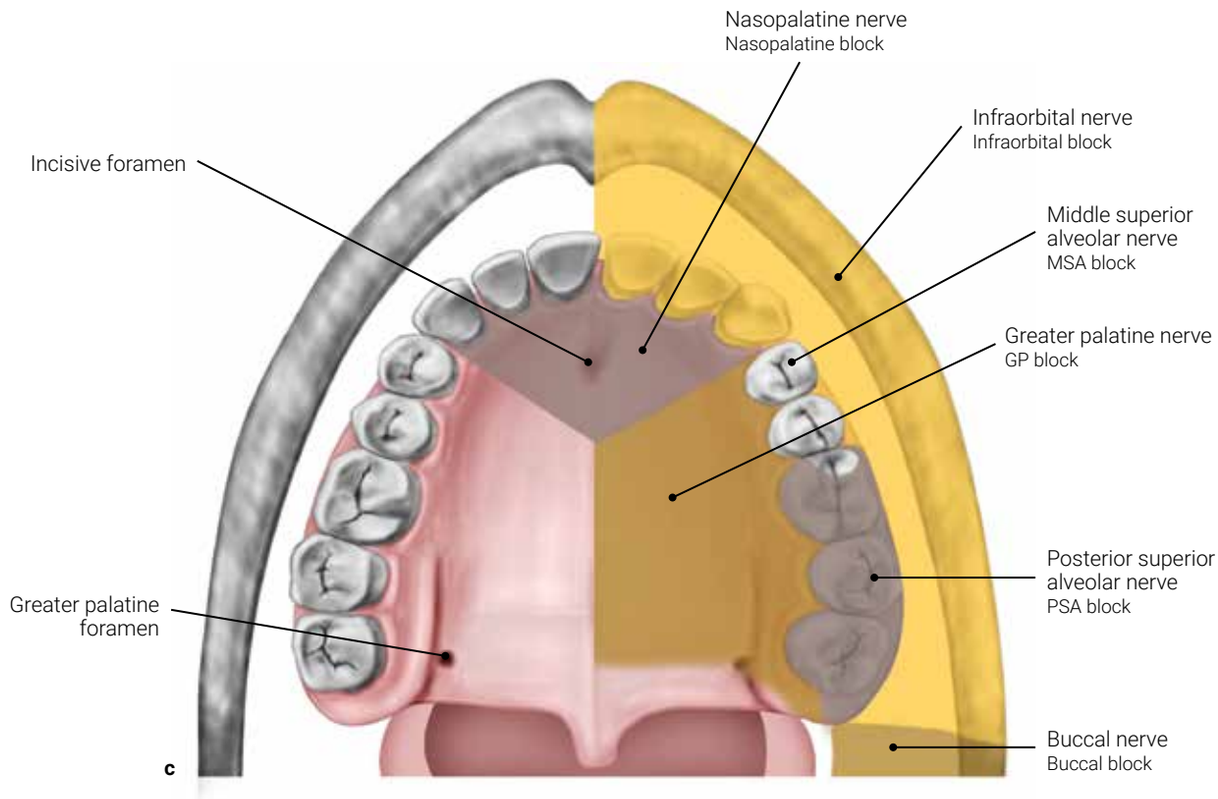
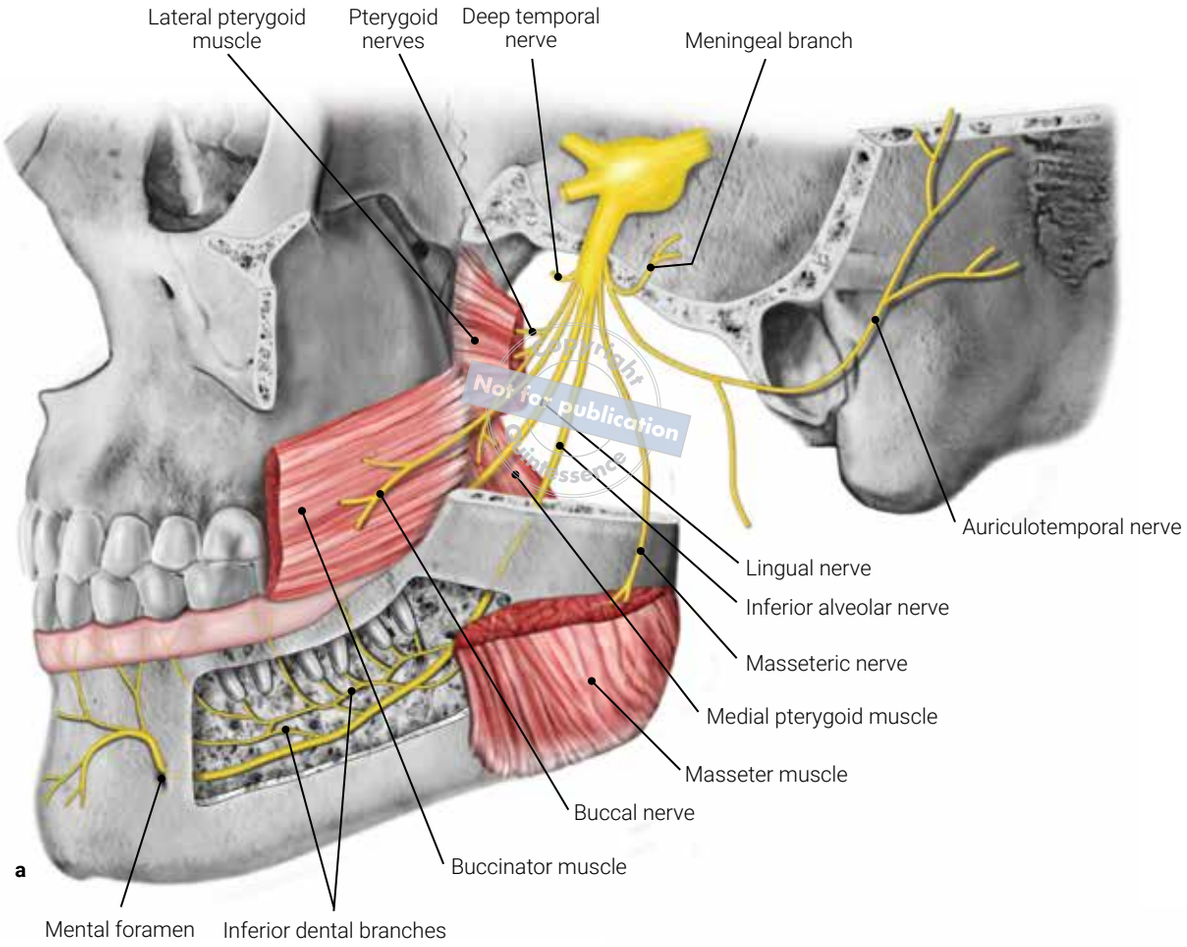


FIG 1-11 *(a)* The maxillary nerve. n.—nerve; CN V1—ophthalmic nerve; CN V3—mandibular nerve. *(b)* Region of skin supplied by the maxillary nerve. *(c)* Innervation of the maxilla along the recommended anesthesia technique per area.

Mandibular nerve (CN V3)

The mandibular nerve (Fig 1-12a) is the third branch of the trigeminal nerve, arising from the trigeminal ganglion. Unlike the other two branches (the maxillary and the ophthalmic nerves, both entirely sensory), the mandibular nerve has both sensory and motor divisions. After passing through the foramen ovale and branching off into a meningeal branch in the infratemporal fossa, the nerve divides into the sensory branches—the auriculotemporal, lingual, inferior alveolar, and buccal nerves to the skin over the mandible, lower lip, temporal region, and much of the oral cavity (Fig 1-12b)—and the motor branches that innervate the muscles of mastication (masseteric, deep temporal, and pterygoid nerves).

The inferior alveolar nerve carries motor fibers for the mylohyoid muscle and the anterior belly of the digastric muscle and sensory fibers that enter the canal through the mandibular foramen; it gives branches to the mandibular teeth and exits through the mental foramen under the *mental nerve* (see chapter 7). Damaging the inferior alveolar nerve will alter the sensation to areas supplied by it and by the mental nerve. Branches of the trigeminal nerve are also frequently used to distribute fibers derived from other cranial nerves.



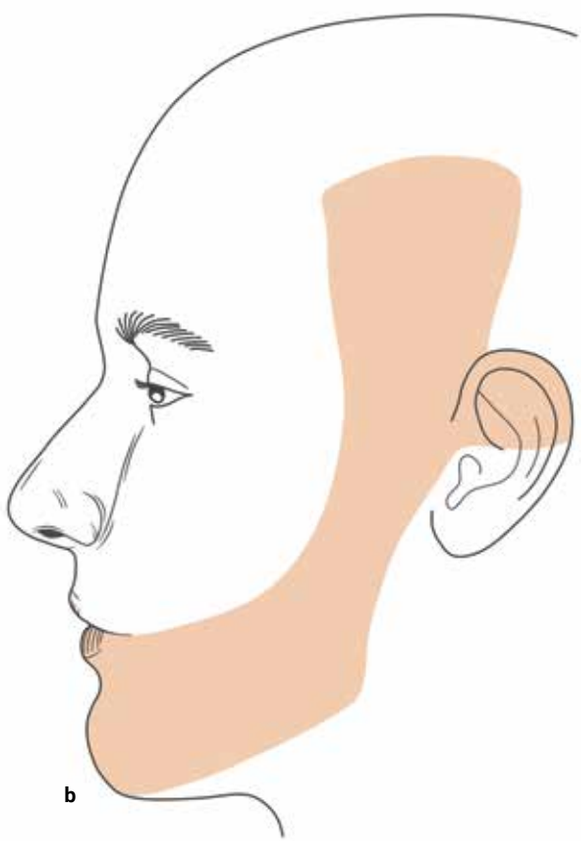


FIG 1-12 *(a)* The mandibular nerve. *(b)* Region of skin supplied by the mandibular nerve.

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