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The Anatomy of the Maxilla and the Mandible

Related Structures and Inserted Muscles

Dmitri Lev and Zvi Artzi

The success of oral rehabilitation and related surgical interventional procedures in oral implantology depends upon in-depth knowledge and understanding of the head and neck anatomy. Anatomical structures in the head and neck region are numerous and densely packed in a relatively small volume. These organs are designed to serve various systems, such as masticatory, olfactory, lacrimal, visual, and others. Overlapping of these systems, however, makes it almost impossible to draw clear demarcation lines between them.

This chapter will focus mainly on the oral anatomy, and additionally consider the structures which are topographically and functionally part of the oral apparatus.

Bones

The mandible, maxilla, and palatine bones form the boundaries of the oral cavity. Because the number of teeth changes during an individual's lifetime, the mandible and maxilla, more than the other bones of the viscerocranium, are permanently and extensively developed and modified during childhood and adolescence, only to undergo significant degeneration with aging.

Maxilla

Each maxilla is composed of two bones, the maxilla proper and the premaxilla, which fuse during the last trimester of fetal development (Figure 1.1). The incisive suture connecting the maxilla proper and premaxilla is located on the inferior surface of the hard palate, and it becomes obliterated in varying degrees during midlife. Two maxillae form the entire upper jaw and most of the middle face. Maxillary occupation of the central part of the facial skeleton involves the oral, nasal, and orbital cavities, and their articulation with the ethmoid, frontal, lacrimal, nasal, inferior nasal concha, vomer, palatine, and opposite maxilla bones. Its hollowed pyramidal-shaped body includes four processes (see Table 1.1) which radiate from the maxilla in directions corresponding to the buttress lines of the viscerocranium.

The long **frontal process** ascends between the lacrimal and nasal bones to articulate with the frontal bone via the frontomaxillary suture. The short **zygomatic process** protrudes laterally and connects with the maxillary process of the zygomatic bone via the zygomaticomaxillary suture. The ridge on the inferior aspect of the zygomatic process separates the anterior and posterior concavities: the former continues up to the anterolateral surface of the maxillary body, while the latter terminates opposite the infratemporal fossa. The **alveolar process** (Figure 1.1) descends from the anterolateral and posterior maxilla body surface. It supports the teeth and gradually becomes wider in a posterior direction. The alveolar process is composed of one external and one internal cortical plate, and a considerable amount of trabecular bone tissue is sandwiched between them. Posteriorly, the cortical plates are united. The inferior edge of the alveolar process is deeply grooved, and the cortical plates are interconnected by perpendicular interalveolar septa, which divide the groove into eight alveolar sockets in the adult maxilla. In the posterior/distal three sockets, the inter-radical septa separate between the individual roots in multirooted teeth. The inter-radical septum of the first premolar socket is parallel to the alveolar/cortical plates. The configuration and size of the roots determine the alveolar socket morphology. Tooth extraction causes gradual resorption of the alveolus. The **palatine process** originates from the border between the anterior two-thirds of the maxilla and its alveolar process. It projects medially to meet its fellow palatine process at the intermaxillary suture. The posterior edge of the palatine process connects with the horizontal process of the palatine bone at the transverse palatine suture. The horizontal plate of the palatine process forms a right angle with the posterior aspect of the

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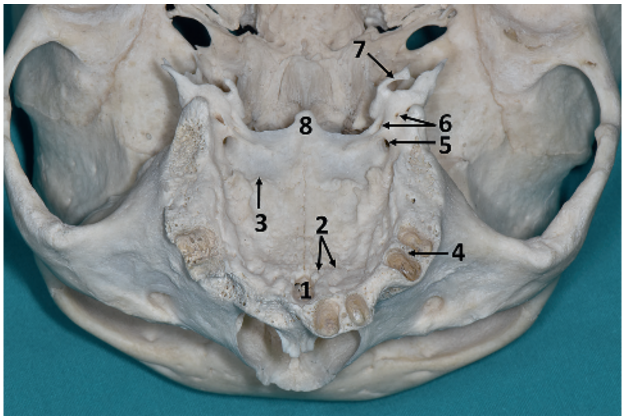

Figure 1.1 Hard palate (inferior view). 1 – Incisive foramen, 2 – incisive suture, 3 – transverse palatine suture, 4 – interalveolar septum, 5 – greater palatine foramen, 6 – lesser palatine foramina, 7 – hamulus pterygoidei, 8 – posterior nasal spine.

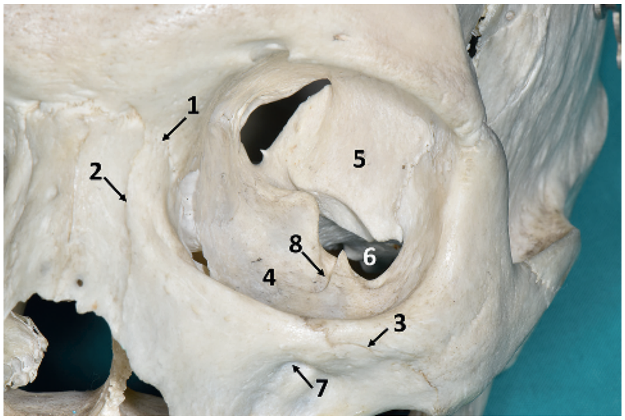

Figure 1.2 Orbit (anterior view). 1 – Frontomaxillary suture, 2 – nasomaxillary suture, 3 – zygomaticomaxillary suture, 4 – superior surface of the maxillary body, 5 – greater wing of the sphenoid bone, 6 – infraorbital fissure, 7 – infraorbital foramen, 8 – infraorbital groove.

Table 1.1

Process	Direction	Articulation
Frontal	Superior	Frontal, nasal, lacrimal bones
Zygomatic	Lateral	Zygomatic bone
Palatine	Medial/ horizontal	Palatine, contralateral maxilla, and vomer bones
Alveolar	Inferior	Upper teeth

alveolar process. The angle is poorly defined anteriorly, and the oral surface of the palatine process slopes down at this point. The concave, rough undersurface of the palatine process provides firm attachment of the masticatory mucosa. The superior nasal surface is also concave but smooth, and the mucosa is loosely attached to it. Two palatine processes have an elevation along the intermaxillary suture, which forms the nasal crest for attachment of the vomer bone. The prominent anterior part of the nasal crest (the "incisor spine") is the site of attachment of the cartilaginous nasal septum. The nasopalatine canal traverses the palate just posteriorly to the incisor spine.

The **nasopalatine canal** is usually described as a Y-shaped channel starting from two Stenson's foramina on the nasal surface of both palatine processes and ending inferiorly as a single opening on the oral roof on the bottom of the incisive fossa, just posterior to the central incisors. However dominant, this arrangement is present in only fewer than 50% of the population. The nasopalatine canal may contain from one to four channels between the superior and inferior openings (Song et al. 2009). Within the nasopalatine canal, the nasopalatine nerve communicates with the greater palatine nerve, and the greater (descending) palatine artery anastomoses with the posterior septal branch of the sphenopalatine artery.

The hollowed **maxillary body** has a pyramidal shape. The *pyramid apex* protrudes laterally and continues to the base of the zygomatic process. The *base (medial surface)* of the maxillary body contributes to the lateral wall of the nasal cavity. The posterosuperior portion of the medial surface of the disarticulated maxilla has a large opening (the maxillary hiatus), which connects the maxillary sinus with the nasal cavity. The greater palatine groove descends toward the posterior edge of the palatine process along the posterior edge of the medial maxillary wall. Another greater palatine groove is present on the perpendicular lamina of the adjacent palatine bone. When these two bones articulate with each other, their grooves form a canal for the greater palatine vessels and nerve. The lacrimal groove is located anteriorly to the maxillary hiatus. When the lacrimal bone and inferior nasal concha articulate with the maxilla, the groove is converted to a canal which contains a nasolacrimal duct. From the lacrimal groove, the conchal crest descends obliquely in an anteroinferior direction to eventually articulate with the inferior nasal concha.

The *superior side* of the maxillary pyramid faces the orbit and forms a considerable part of the orbital floor (Figure 1.2). Three bones articulate with the medial border of the orbital surface of the maxilla. They are (in an anteroposterior direction) the lacrimal and ethmoid bones and the orbital process of the palatine bone. The inferior orbital fissure separates the posterior border of the superior wall from the greater wing of the sphenoid bone. The infraorbital groove, which contains the infraorbital neurovascular bundle, begins from the midpoint of the posterior border.

In their anatomical study, Nguyen et al. (2016) demonstrated that the groove was present only in 10% of cadavers, and that it was roofed by osseous tissue in the remaining skulls. When the groove approaches the round and thick anterior border of the maxillary orbital surface, it curves in an inferomedial direction, about 20 degrees in the sagittal plane and about 30 degrees in the horizontal plane (Aggarwal et al. 2015), extending towards the infraorbital foramen on the anterior surface of the maxilla.

The anterolateral or malar surface is separated from the posterolateral surface by a curved ridge that descends from the zygomatic process toward the first molar tooth. The medial edge of the malar surface forms the lateral and inferior borders of the piriform aperture. A number of fossae and elevations are present on the anterolateral surface. They are produced by the roots of the teeth. The infraorbital foramen is located in the upper, deepest part of the canine fossa about 6 mm inferior to the infraorbital margin (Aggarwal et al. 2015).

The canine fossa is the depression situated just laterally to the canine eminence which is formed by the socket of the canine tooth. The canine eminence separates the canine fossa laterally and incisive fossa medially to it (Figure 1.3).

Several mimic muscles, including the depressor septi, nasalis, and levator anguli oris, that are associated with movements of the lips and external nose originate from the anterior maxillary surface.

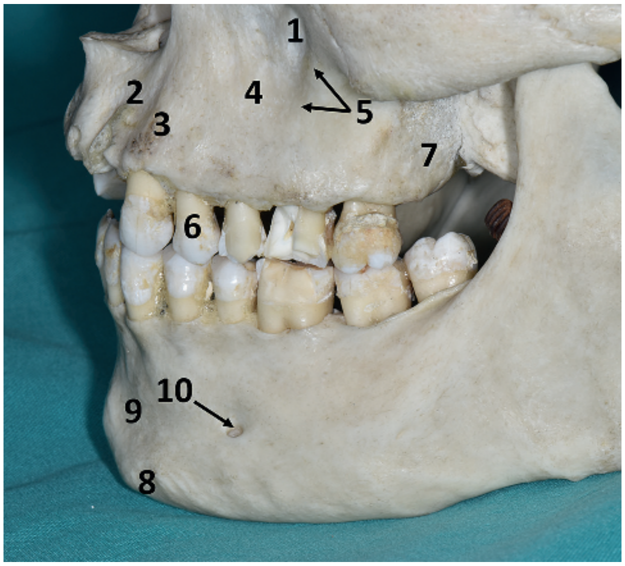

Figure 1.3 Maxilla and mandible (lateral view). 1 – Infraorbital foramen, 2 – incisor fossa, 3 – canine eminence, 4 – canine fossa, 5 – ridge between the anterolateral and posterolateral maxillary surface, 6 – 1st upper molar tooth, 7 – tuber of maxilla, 8 – mental tubercle, 9 – mental fossa, 10 – mental foramen.

The convex *posterolateral or infratemporal surface* of the maxillary body (Figure 1.4) forms an anterior wall of the infratemporal fossa. The posteroinferior part of the maxillary body, the maxillary tuberosity, articulates with the pyramidal process of the palatine bone and occasionally with the lower part of the lateral pterygoid plate of the sphenoid bone. The maxillary tuberosity is associated with the upper molar teeth and can be fractured during a molar tooth extraction.

Maxillary Sinus

The maxillary sinus was described, although not discovered, by Nathaniel Highmore in 1651 and named after him ("antrum of Highmore"). It is the largest paranasal sinus, with an average volume of 15 ml. Its inner surface is lined by the Schneiderian membrane, a 1-mm-thick layer of pseudostratified ciliated columnar epithelium attached to the periosteum and continuing to the epithelium of the nasal cavity. The maxillary sinus cavity resembles a four-sided pyramid, the base and the apex of which coincide with those of the pyramid of the maxillary body. The size and morphology of the sinus are also dependent upon the size of the adjacent cavities or fossae. The extent of pneumatization varies from person to person. For instance, the apical part of the sinus pyramid can invade the zygomatic

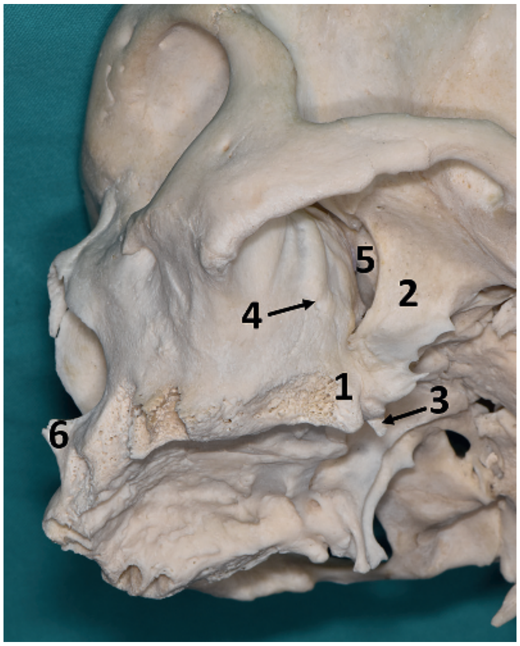

Figure 1.4 Posterolateral aspect of the maxilla. 1 – Maxillary tuberosity, 2 – lateral pterygoid plate, 3 – pyramidal process of the palatine bone, 4 – entrance into the posterior superior alveolar canal, 5 – pterygopalatine fossa, 6 – anterior nasal spine.

process of the maxilla or even the zygomatic bone. Asymmetry in size and shape is also common, and a larger size is usually associated with thinner walls. The walls of the maxillary sinus separate it from the adjacent spaces in the skull. The hollowed medial wall is located between the sinus and the nasal cavity, the roof is inferior to the orbit, the alveoli of the alveolar process are inferior to the floor of the sinus, and the infratemporal and canine fossae are defined by the posterior and anterior walls, respectively.

The most prominent feature of the *medial wall* is the antrum of Highmore through which the maxillary sinus communicates with the bony nasal cavity. The passage between those two cavities is considerably narrowed when the uncinate process of the ethmoid bone, inferior nasal concha, and perpendicular plate of palatine bone articulate with the maxilla. Inferiorly, the maxillary antrum is defined by the upper premolar and molar teeth. The *roof* of the maxillary sinus is defined by to the orbital floor. The variations in thickness of the sinus roof are related to the risk of the spread of odontogenic infection to the orbit (Mills and Kartush 1985). The infraorbital neurovascular bundle passing in the infraorbital canal is embedded into the roof of the maxillary sinus and, in some cases, protrudes into the maxillary cavity (Lantos et al. 2016). The *sinus floor* is lower than the hard palate and much lower than the maxillary antrum. The reason for this anatomical position, which is inadequate for mucous drainage, is that the sinus of the fetus starts to develop very superiorly, just below the orbital floor, and maintains its drainage point at the same level during growth in an inferior direction. One of the clinically important anatomical variations is the presence of the septae, which usually arise from the sinus floor and divide the sinus into compartments. The prevalence of the septae presence ranges from 13–35.3% (Maestre-Ferrin et al. 2010).

The anterior superior alveolar canal and its neurovascular bundle pass through the *anterior wall* of the maxillary sinus. The *posterior wall* is associated with transmission of the posterior superior alveolar nerve and vessels, also through the alveolar canal (Figure 1.4).

Palatine Bone

The palatine bone is sandwiched between the maxilla anteriorly and the pterygoid process of the sphenoid bone posteriorly. It consists of the horizontal and perpendicular plates. Together with its contralateral fellow, the former comprises the posterior 1/4 of the bony palate, and, together with the medial plate of the pterygoid process of the sphenoid bone, the latter contributes to the posterior part of the lateral nasal wall. Both plates have two surfaces and four borders.

The medial or nasal surface of *the perpendicular plate of the palatine bone* is smooth and contains a numbers of concavities and ridges, which include (from superior to inferior directions): the groove of the superior nasal meatus, ethmoid crest, depression of the middle nasal meatus, conchal crest, and depression of the inferior nasal meatus. Ethmoid and conchal crests serve for attachment of the middle and inferior nasal conchae, respectively. The lateral or maxillary surface is in contact with the posterior aspect of the maxillary body. The greater palatine groove descends to the lateral surface from the sphenopalatine notch toward the junction of the perpendicular and horizontal plates. Together with the greater palatine groove of the maxilla, it forms the greater palatine canal.

The superior border contains the orbital and sphenoid processes, which are separated by the sphenopalatine notch. When the body of the sphenoid bone articulates with this area, the notch is converted into the sphenopalatine foramen through which the pterygopalatine fossa communicates directly with the posterosuperior aspect of the nasal cavity. From the anterior border, on the level of the conchal crest, the maxillary process points anteriorly and considerably lessens the hiatus between the maxillary sinus and the nasal cavity. The posterior border extends between the sphenoid and pyramidal processes and articulates with the medial pterygoid plate via the serrated suture. The inferior border corresponds to the lateral border of the horizontal plate.

The superior surface of the *horizontal plate of the palatine bone* is smooth and concave, while the inferior surface is rough and slightly concave. The anterior and medial borders of the horizontal plate articulate with the palatine process of the maxilla and the contralateral palatine bone, respectively (Figure 1.1). The medial border has two elevations, the crest and the spine. They form the posterior part of the nasal crest and the posterior nasal spine, while two palatine bones articulate with each other by the interpalatine suture. Musculus uvulae fibers originate from the posterior nasal spine at the angle between the medial and posterior margins of the horizontal plate. The thin, concave posterior margin is the site of attachment to the palatine aponeurosis. The pyramidal process is at an angle between the posterior and lateral horizontal plate border, protruding in a posterolateral direction. Its posterior surface slopes down and has two furrows for articulation with the lateral and medial plates of the pterygoid process. In combination, the pyramidal process, tuber of maxilla, and inferior portion of the pterygoid process of the sphenoid bone form a complex which is important for implant placement in the posterior aspect of the maxilla (Lee et al. 2001).

The lateral border of the horizontal plate is notched by the descending pterygopalatine groove at the base of the pyramidal process. When the maxilla is attached to the lateral aspect of the palatine bone, this notch becomes the greater palatine foramen which is seen on the inferior surface of the hard palate (Figure 1.1). In the vast majority of cases, the greater palatine foramen is located opposite or distally to the 3rd molar tooth (Chrcanovic and Custodio 2010, Dave et al. 2013). The lesser palatine foramina are present on the inferior surface of the pyramidal process and vary in number from 1 to 4 (Saralaya and Nayak 2007).

Mandible

The mandible develops from two halves which fuse at the midline during the first year of life. The adult mandible is a single, irregular bone composed of a horizontally oriented body which supports the teeth and two vertical rami that articulate with the temporal bones and serves for attachment of the masticatory muscles. The vertex of the angle between the lower border of the body and the posterior border of the ramus (the gonion) varies between 110 to 140 degrees.

The complete fusion of the mandibular halves forms the midline ridge descending from the lower margin of the alveolar process on the *external (labial) surface* of the adult mandible. The inferior end of the mental ridge points towards the apex of the mental protuberance or mental trigon. The base of the mental protuberance is found at the lower margin of the mandible. The inferior ends of the lateral extremities of the protuberance (the mental tubercles) are usually slightly elevated. A median depression, the mental fossa, lies inferiorly to the incisors and superolaterally to the mental protuberance. The complex of the protuberance, mental tubercles, and mental fossa is unique to the human chin. It is thought to be a result of the postnatal bone resorption in the upper part of the mandibular body and/or bone deposition at its lower margin (Schwartz and Tattersall 2000).

The mental foramen (Figure 1.3) is the opening of the mandibular canal and it is situated on the mandibular buccal surface halfway between the lower borders of the alveolar part and mandibular body. The position of the mental foramen in the anteroposterior direction varies considerably among sexes and races, with the highest prevalence on the level of the 2nd premolar for the Mongoloid and African populations, and on the level between the 1st and 2nd premolar for Caucasians. The mental foramen has sharp anteroinferior and round posterosuperior margins for accommodation of the mental nerve which emerges from the foramen at a sharp angle to the mandibular surface.

The oblique line descends on the lateral surface of the mandibular body from the anterior margin of the mandibular ramus and gradually becomes less prominent, almost disappearing when it approaches the mental tubercle. The buccinator and depressor anguli oris muscles originate from the posterior and anterior parts, respectively, of that oblique line.

The round and thick inferior border of the mandible has a sinusoid shape, and it is concave posteriorly and convex anteriorly. The digastric fossa for attachment of the digastric muscle anterior belly is located on its anterior end, below the mental tubercle.

The alveolar part of the mandible contains 16 sockets for tooth accommodation. Anteriorly, the curvature of the alveolar part matches that of the mandibular body, while the molar sockets are in a more medial plane than the mandibular body at this level. Similar to the maxillary alveolar process, the alveolar process of the mandible is composed of two outer laminae of the cortical bone and the inner region of the trabecular bone. The cortical bone of the alveolar process is thicker in the mandible than in the maxilla, with the maximal thickness located in the premolar and molar regions.

The *inner surface of the chin area* distributes one to four mental spines for the attachment of two pairs of muscles, the genioglossi superiorly and the geniohyoid inferiorly. The variations in the number of mental spines is a result of their fusion in vertical or horizontal planes or both. The lingual foramen is found just superior to the mental spine. It enters the bony canal and transports a branch of the lingual and/or submental arteries. The mylohyoid line starts from the inferior aspect of the mental spine, where it is barely visible, and run obliquely toward the 3rd molar where it becomes much more prominent. Apexes of the 2nd and 3rd molar teeth are located below the mylohyoid line, while the apexes of the incisors and the premolar and 1st molar teeth are above it. The mylohyoid muscle, which forms the mouth floor, originates from the mylohyoid line. Thus, the surface above the mylohyoid muscle attachment is part of the oral cavity, and it is covered with mucosa. The submandibular fossa is below the posterior portion of the mylohyoid line, and the sublingual fossa is above its anterior portion. The former contains the superficial part of the submandibular salivary gland, and the latter contains the sublingual salivary gland.

Vertically elongated, the *quadrilateral mandibular ramus* articulates with the temporal bone and serves as the site of attachment of the masticatory muscles. Both the lateral and medial surfaces of the inferior aspect of the ramus have ridges for insertion of the masseter and medial pterygoid muscles, respectively. The ridges on the lateral surface are more or less parallel to each other. They extend anterosuperiorly, sometimes to the level of one-half of the ramus, and their direction coincides with that of the masseter fibers. The medial surface ridges are less organized and restricted to the area of the gonion.

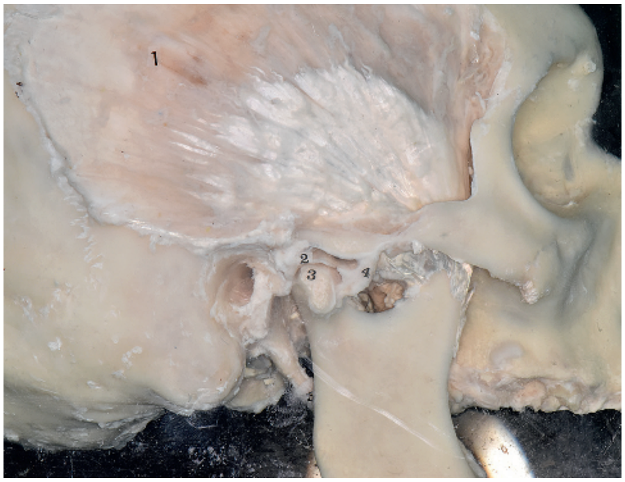

Figure 1.5 Temporomandibular joint (sagittal section, lateral view). 1 – Temporalis muscle, 2 – articular disk, 3 – mandibular condyle, 4 – fibrous capsule.

Two processes protrude from the superior aspect of the ramus, the anterior coronoid and the posterior condylar (Figure 1.5). The superior border of the ramus between them (the "mandibular notch") is deeply concave. The condylar process is composed of the head (condyle) and neck, and the size and shape of the mandibular condyle vary considerably. A superior view reveals an oval shape, while its side-to-side dimension is double that in the anteroposterior direction. The convex articular surface is in contact with the articular disk of the temporomandibular joint. The neck of the condylar process is flattened in an anteroposterior direction. The pterygoid fovea is found on the neck anterior surface, medially to the border of the mandibular notch where it approaches the lateral aspect of the condyle. More than 90% of the lateral pterygoid muscle fibers are inserted into the pterygoid fovea (Bittar et al. 1994). The coronoid process is flat and triangular in shape. Its tip is higher than the condylar process. The concave posterior edge of the coronoid process is an anterior continuation of the mandibular notch, and the convex anterior edge continues to the sharp anterior border of the ramus. However, both the temporalis and masseter muscles insert into the lateral surface of the coronoid process, which is smooth compared with its rough medial surface into which most of the temporalis muscle fibers are inserted. Here, the vertical temporal crest extends from the apex of the coronoid process to the level of the 3rd molar tooth, turning anteriorly and approaching its distal surface. The retromolar trigon is the wider horizontal part of the temporal crest immediately posterior to the last molar. The retromolar trigon is included in the larger, triangular area, the retromolar fossa, which is bounded by the temporal crest laterally, by the anterior border of the ramus medially and by the 3rd molar tooth at the base. One of the important variations of the retromolar fossa is the presence of the retromolar foramen, which found in 8–16% of people in various human populations (e.g., Ossenberg 1987). It is situated 10.5 mm posterior to the 3rd molar (Gamieldien and Van Schoor 2016). The foramen leads into the retromolar canal and transmits a neurovascular bundle that supplies the area of the 2nd and 3rd molar teeth.

The lingula is located close to the center of the medial surface of the ramus, and the sphenomandibular ligament is attached to its irregular sharp spine. It is in close proximity to the upper end of the mylohyoid line and the mandibular foramen. The mandibular foramen is the entrance for the inferior alveolar nerve and vessels into the mandibular canal, and it is inferior to the occlusal plane or at its level in most cases (Nicholson 1985).

The mandibular canal follows the direction of the mandibular ramus and body and ultimately approaches the region of the incisors. It communicates with the apexes of the lower tooth alveoli via small bony canals. On the level of the premolar teeth, the mental canal branches out from the mandibular canal, traversing in a postero-superior direction and opening into the mental foramen. The "incisor" part of the mandibular canal lies anterior to the mental canal. Several types of bifid mandibular canals that must be taken in account in dental surgery have been described in the literature (e.g., Kang et al. 2014).

Two fossae are associated with the maxilla and mandible, the infratemporal and the pterygopalatine. The *infratemporal fossa* is formed when the mandible articulates with the temporal bone. It can be easily identified between the mandibular ramus laterally and the lateral plate of the pterygoid process medially. This fossa is limited anteriorly by the posterior surface of the maxillary body which separates it from the maxillary sinus (Figure 1.4). The upper border of the fossa is on the level of the zygomatic arch. Medially to the zygomatic arch, there is free passage from the infratemporal fossa superiorly to the temporal fossa, which is found on the lateral aspect of the cranium. The inferior aspect of the greater wing of the sphenoid bone forms part of the roof of the fossa where the oval foramen and foramen spinosum are located. The infratemporal fossa communicates with the middle cranial fossa through these foramina. The infratemporal fossa is patent in both the posterior and inferior directions. The pterygomaxillary fissure leading into the pterygopalatine fossa is located between the medial and anterior walls of the fossa.

The pterygopalatine fossa is a well-delineated space resembling an inverted pyramid. It is located between the root of the pterygoid process of the sphenoid bone posteriorly and the posterior surface of the maxilla anteriorly

(Figure 1.4). The posterior wall of the pterygopalatine fossa is perforated by the pterygoid canal and the foramen rotundum, connecting it with the middle cranial fossa. The distal part of the greater palatine canal is in relation to the inferior aspect of the pterygopalatine fossa. Both the infratemporal and the pterygopalatine fossa communicate anteriorly with the orbit via the inferior orbital fissure.

Muscles

The muscles that are anatomically and functionally part of the oral cavity belong to several groups comprised of the suprahyoid, mimic, masticatory, extrinsic, and intrinsic muscles of the tongue and the palatal muscles.

Suprahyoid Muscles

The origin of the *stylohyoid muscle* is on the posterior and lateral surfaces of the base of the styloid process. It inserts into the junction of the body and greater horn of the hyoid bone. The stylohyoid muscle descends obliquely, anteriorly to the digastric muscle posterior belly, and is pierced by an intermediate tendon of the digastric muscle at the insertion point. The stylohyoid muscle is positioned medially to the parotid and submandibular glands and laterally to the hypoglossal nerve and hyoglossus muscle. The *digastric muscle* is composed of anterior and posterior bellies. The posterior belly originates from the mastoid notch of the temporal bone, and the anterior belly originates from the digastric fossa of the inferior border of the mandible. A tendinous loop extends from the deep cervical fascia and connects the curved intermediate tendon of the digastric muscle to the junction of the greater horn and the body of the hyoid bone. The posterior belly of the digastric muscle is covered by the inferior portion of the parotid gland near the mandibular angle. The posterior aspect of the intermediate tendon is crossed medially by the hypoglossal nerve. The anterior belly is defined by the floor of the mouth and found superficially to the mylohyoid muscle (Figure 1.6).

The *mylohyoid muscle* originates on the inner mandibular surface and extends from the symphysis to the 3rd molar tooth. It inserts into the anterior surface of the hyoid bone and the median raphe, extending from the symphysis menti to the anterior aspect of the hyoid bone. It is the principal muscle of the floor of the mouth floor, separating the oral cavity from the neck area. The posterior, free border of the mylohyoid muscle is in contact with the submandibular gland, whose superficial part is below the mylohyoid muscle and deep part above it. The deep surface of the mylohyoid muscle is influenced by the extrinsic muscles of the tongue, the styloglossus and the hyoglossus.

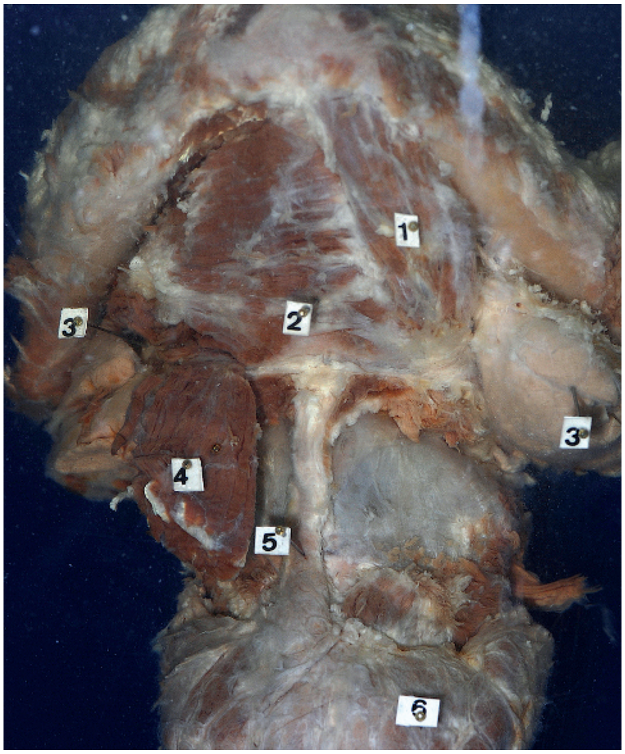

Figure 1.6 Mouth floor (anteroinferior view). 1 – Anterior belly of the left digastric muscle, 2 – mylohyoid muscle, 3 – submandibular gland, 4 – anterior belly of the right digastric muscle (reflected), 5 – pyramidal lobe of the thyroid gland, 6 – left lobe of the thyroid gland.

The mylohyoid muscle separates the sublingual and submandibular spaces which communicate with each other posteriorly to the free border of the muscle. The floor of the mouth is reinforced by the anterior belly of the digastric muscle inferiorly and the geniohyoid muscle superiorly.

The *geniohyoid muscle* originates in the inferior mental spine of the mental tubercle and inserts into the anterior aspect of the hyoid bone body. The anterior belly of the digastric and mylohyoid muscles are innervated by the trigeminal nerve (the nerve of the first branchial arch), while the posterior belly of the digastric and stylohyoid muscles is innervated by the facial nerve (the nerve of the second branchial arch). The geniohyoid muscle derives from the somites, and it receives motor fibers from the C1 spinal cord segment via the hypoglossal nerve.

The suprahyoid muscles can be divided into posterior and anterior groups in accordance with their relation to the hyoid bone. The anterior group includes the geniohyoid, mylohyoid, and anterior belly of the digastric muscles. The posterior group is composed of the posterior belly of the digastric and stylohyoid muscles. The anterior group of suprahyoid muscles is attached to the mandible superiorly and to the hyoid bone inferiorly, and has a dual action: it elevates the hyoid bone when the mandible is fixed by contraction of the masticatory muscles, and it depresses the mandible when the hyoid bone is stabilized by contraction of the infrahyoid group of muscles. Contraction of the anterior group of muscles causes protrusion of the hyoid bone, while contraction of the posterior group retracts it. The suprahyoid muscles in combination elevate the hyoid bone.

Mimic Muscles

The common characteristics of this group of muscles is that they are all embedded into the hypodermis or, in anatomical terms, into the superficial fascia. The superficial musculoaponeurotic system is a complex of the fascia and mimic muscles. The origin of mimics is usually bone or dermis, and their insertion is mostly into the skin, but also into the fascia, cartilaginous structures, and the modiolus (a fibromuscular mass situated immediately laterally to the mouth commissure). Muscles which are inserted into the modiolus decussate and blend with each other. This arrangement very effectively controls the position of the angle of the mouth. Despite the term "mimic" or muscles of facial expression, their primary function is to regulate the size of the primary openings of the face, i.e., the orbits, nostrils, and mouth. Contraction of the mimic muscles is under the control of the facial nerve. The origin and insertion of the mimic muscles, which are functionally and anatomically part of the oral cavity, are summarized in Table 1.2.

Muscles of Mastication

The four muscles of mastication are designed to move the mandible during mastication and speech, and they include the temporalis, masseter, and medial and lateral pterygoid.

The origin of the *temporalis muscle* (Figure 1.5) is the temporalis fossa and the deep temporal fascia. It inserts into the coronoid process, and continues along the anterior surface of the mandibular ramus down to the alveolar process. At their origin, the temporalis muscle fibers gradually change their direction from vertical-anterior to horizontal-posterior. All the fibers converge towards the zygomatic arch, where they partly blend with it and with the masseter muscle. They are then replaced by a thick tendon. The anterior tendinous fibers which insert into the anterior border of the mandibular ramus and temporal crest bypass the retromolar fossa.

The *masseter muscle* is composed of both superficial and deep parts. The origins of the superficial part are the zygomatic process of the maxilla, the maxillary process of the zygomatic bone, the inferior border of the body of the zygomatic bone, and the inferior border of the anterior two thirds of the zygomatic arch. The origin of the deep part is the medial aspect of the zygomatic arch, with the exception of the area posterior to the articular eminence of the zygomatic process of the temporal bone. The masseter muscle inserts into the external surface of the mandibular angle, but it can extend to the entire mandibular ramus lateral surface. There is a space between the superficial and deep portions at their origin which is filled with loose connective tissue. The fibers of the deep part descend vertically, and their attachment area occupies mostly the superior half of the ramus. The fibers of the superficial part run in a posteroinferior direction and blend with the deep portion of the muscle.

The origins of the *medial pterygoid muscle* (Figure 1.7) are the medial surface of the lateral pterygoid plate, the inferolateral surface of the pyramidal process of the

Table 1.2

Muscle	Origin	Insertion
Levator labii superioris	Body of the maxilla, parallel to the inferior orbital rim	Lateral aspect of the upper lip
Levator anguli oris	Canine fossa of the maxilla	Modiolus
Zygomaticus major	Zygomaticotemporal suture	Modiolus
Risorius	Zygomatic arch, parotideomasseteric fascia	Modiolus
Depressor anguli oris	Anterior part of the oblique line of the mandible	Modiolus
Depressor labii inferioris	Oblique line of the mandible, above the depressor anguli oris origin	Skin of the lower lip
Mentalis	Incisive fossa of the mandible	Skin of the chin
Platysma	Fascia of the pectoralis major and deltoid muscles	Lower border of the mandible, modiolus
Buccinator	Base of the mandibular and maxillary alveolar processes at the level of the molar teeth, pterygomandibular raphe	Modiolus
Orbicularis oris	Modiolus	Skin of the lips

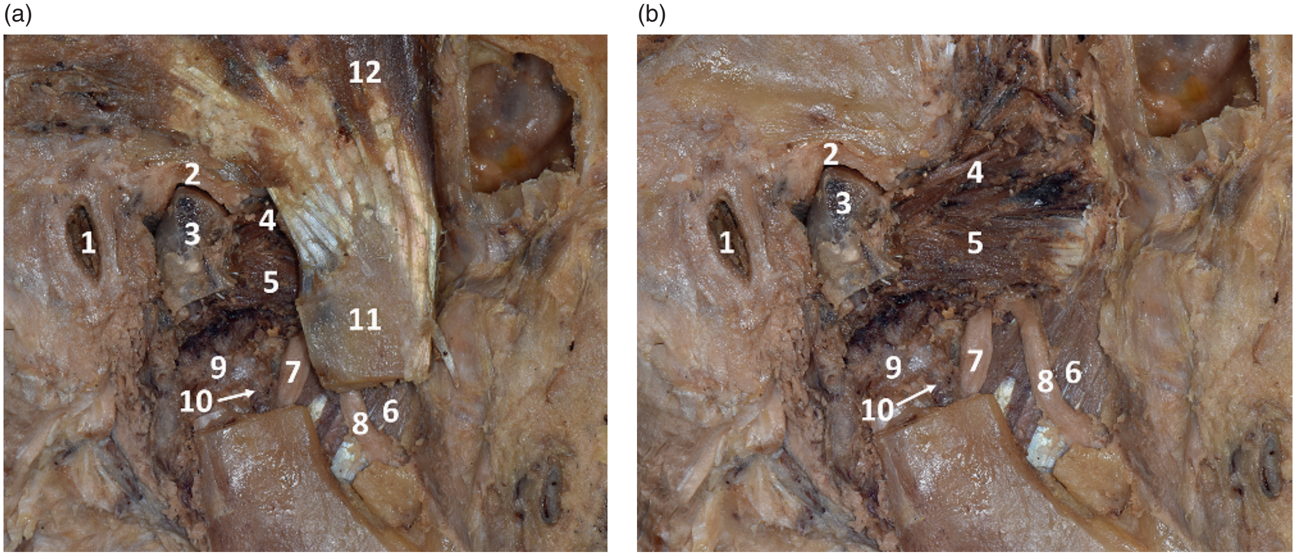

Figure 1.7 Temporomandibular joint (sagittal section, lateral view) and associated structures. The segment of the mandibular ramus is removed to expose the contents of the infratemporal fossa (a,b); the coronoid process and the temporalis muscle are reflected superiorly (b). 1 – External acoustic meatus, 2 – articular disk, 3 -mandibular condyle, 4 – superior head of the lateral pterygoid muscle, 5 – inferior head of the lateral pterygoid muscle, 6 – medial pterygoid muscle, 7 – inferior alveolar nerve, 8 – lingual nerve, 9 – maxillary artery, 10 – inferior alveolar artery, 11 – coronoid process, 12 – temporalis muscle.

palatine bone, and the maxillary tuberosity. It inserts into the medial surface of the mandibular angle. It is a thick, rectangular-shaped muscle whose fibers descend in a posterolateral direction. The space between the muscle and the medial surface of the mandibular ramus contains a number of extremely important structures: the sphenomandibular ligament, maxillary artery, lingual nerve, inferior alveolar nerve and vessels, lateral pterygoid muscle, and a deep extension of the parotid gland.

The *lateral pterygoid muscle* (Figure 1.7) is composed of superior and inferior heads. The origin of the superior head is the infratemporal crest and the inferior surface of the greater wing of the sphenoid bone. The origin of the inferior head is the lateral surface of the lateral pterygoid plate. It inserts into the anterior aspect of the fibrous capsule of the temporomandibular articulation, the pterygoid fovea of the mandibular condyle. The superior head curves posteriorly, inferiorly, and laterally towards the mandibular neck where it fuses with the inferior head fibers. The attachment of the lateral pterygoid muscle to the disk-capsule complex of the temporomandibular joint varies. However, the most common site of the superior head insertion is the fibrous capsule and articular disk, with the superior head fibers having been reported as being exclusively attached to the condyle in approximately one third of the cases (Naidoo 1996). The tendon of the temporalis muscle pass laterally to the lateral pterygoid muscle, sphenomandibular ligament, mandibular nerve, and the upper portion of the medial pterygoid muscle which are located medially to it (Figure 1.7a).

The temporalis, masseter, and medial pterygoid muscles are powerful elevators of the mandible, and the lateral pterygoid is the main protrusion muscle. The posterior fibers of the temporalis and the deep portion of the masseter muscle act as retractors. Lateral deviation of the mandible can be performed by contraction of the contralateral lateral pterygoid muscle alone. However, the contralateral medial pterygoid muscle and the ipsilateral temporalis and masseter muscles are also physiologically active in the lateral movement of the mandible. All the muscles of mastication are derivatives of the 1st branchial arc, and they all are innervated by the mandibular division of the trigeminal nerve.

Extrinsic and Intrinsic Muscles of the Tongue

The extrinsic muscle of the tongue are named according to the structures from which they originate. The s*styloglossus muscle* originates mainly from the styloid process, while some fibers can originate from the stylomandibular ligament and/or the angle of the mandible. Fibers of the styloglossus muscle run in an anteroinferior direction and reach the inferior aspect of the tongue where they blend with the posterior fibers of the hyoglossus muscle and continue anteriorly to the tip of the tongue. The *hyoglossus muscle* originates from the greater horn and the

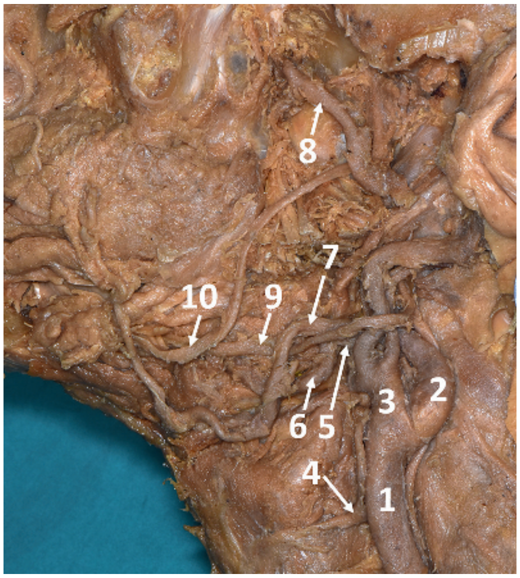

Figure 1.8 Blood supply of the oral apparatus. 1 – Common carotid artery, 2 – internal carotid artery, 3 – external carotid artery, 4 – superior thyroid artery, 5 – linguofacial trunk, 6 – lingual artery, 7 – facial artery, 8 – maxillary artery (cut), 9 – hypoglossal nerve, 10 – lingual nerve.

adjoining part of the body of the hyoid bone. Thin fibers of this delicate muscle rise almost vertically and insert into the lateral aspect of the tongue. The styloglossus and hyoglossus muscles are retractors and depressors of the tongue, respectively. The fan-like fibers of two *genioglossi muscles* begin from the superior mental spines and spread from tip of the tongue to its root as well as to the body of the hyoid bone. The genioglossus muscle protrudes the tongue and depresses its central part. The intrinsic muscles are entirely incorporated into the tongue, and act together with the extrinsic muscles to alter its shape. All the muscles of the tongue are innervated by the hypoglossal nerve (Figure 1.8).

Muscles of the Palate

This group of muscles is composed of:

1) the tensor and levator veli palatini muscles, which are situated above the palate
2) the palatoglossal and palatopharyngeus muscles, which extend from the palate downwards
3) the musculus uvulae, which is embedded in the soft palate.

The origin of the *levator veli palatini* is the cartilaginous part of the eustachian tube and the inferior surface of the petrous portion of the temporal bone. It extends obliquely in the antero-inferomedial direction and inserts into the soft palate aponeurosis.

The *tensor veli palatini* originates from the scaphoid fossa, the spine of the sphenoid bone, and the cartilaginous part of the eustachian tube. It inserts into the posterior aspect of the horizontal plate of the palatine bone and into the palatine aponeurosis. The tensor veli palatini descends laterally to the levator veli palatini muscle. The muscular fibers are replaced by the tendon, which hooks around the hamulus pterygoidei prior to being inserted into the palatine aponeurosis.

The origin of the *palatoglossus muscle* is the palatine aponeurosis. It inserts into the lateral aspect of the tongue, anteriorly to the palatine tonsil. When covered by mucosa, it forms the palatoglossal arch.

The *palatopharyngeus muscle* originates on the posterior border of the horizontal plate of the palatine bone, which is the upper surface of the palatine aponeurosis on both sides of the palatoglossal muscle. It inserts into the posterolateral pharyngeal wall at the posterior aspect of the thyroid cartilage. This descending muscle forms the palatopharyngeal arch, after which its muscle fibers blend with the fibers of the stylopharyngeus muscle forming the longitudinal muscular layer of the pharynx.

The origin of the *musculus uvulae* is the posterior nasal spine of the palatine bone and palatine aponeurosis. It inserts under the uvular mucosa. The palatal muscle acts in concert with it in order to isolate a bolus when it is in the oropharynx.

The levator and tensor veli palatini muscles elevate and tightly stretch the soft palate, respectively, and, together with the musculus uvulae, prevent the entrance of the bolus into the nasopharynx. This action is assisted by contraction of the palatopharyngeus muscles, which elevate and adduct the palatopharyngeal folds. Simultaneously, the palatoglossal muscles approach each other and elevate the tongue, thus closing the oropharyngeal isthmus.

The tensor veli palatini muscle is supplied by the mandibular nerve, and the other palatal muscles are innervated by the cranial accessory nerve fibers via the nerves of pharyngeal plexus, the vagus and the glossopharyngeal.

Nerves

Most of the structures of the middle and lower face are innervated by branches of the trigeminal and facial cranial nerves. Only a small area of the angle of the mandible is innervated by the spinal nerves C2–3. Innervation of the tongue is provided by the facial, trigeminal, glossopharyngeal, and hypoglossal cranial nerves. The fibers of the facial and hypoglossal cranial nerves are involved in the secretomotor innervation of the salivary glands. The branches of the nerves which are closely related to the maxilla and mandible will be discussed in the present chapter.

Trigeminal Nerve

The trigeminal nerve divides into the ophthalmic, maxillary, and mandibular nerves in the cranial cavity. The latter two supply the area related to the masticatory apparatus. The *maxillary nerve* is a pure sensory nerve. It originates from the Gasserian ganglion, between the ophthalmic and mandibular nerves. The meningeal branch starts from the cranial portion of the maxillary nerve before it passes through the foramen rotundum to the pterygopalatine fossa. In this fossa, the parasympathetic pterygopalatine ganglion is connected by the sphenopalatine nerve, or sensory root, to the inferior aspect of the maxillary nerve. The maxillary nerve sensory fibers continue uninterruptedly through the pterygopalatine ganglion and enter the nerves which are referred to as the pterygopalatine ganglion branches, namely, orbital, nasal, palatine, and pharyngeal. These branches convey both the sensory fibers of the trigeminal nerve and the taste fibers from the soft palate and postganglionic parasympathetic fibers innervating the mucosa. Both the taste and parasympathetic fibers belong to the facial nerve.

The *orbital branches* of the pterygopalatine ganglion supply the internal surface of the orbit, as well as the intraorbital structures and mucosa of both the sphenoidal and ethmoid sinuses. The longest and largest of the *nasal branches,* the *nasopalatine nerve,* enters the nasal cavity through the sphenopalatine foramen, descends obliquely under the mucosa of the ipsilateral surface of the nasal septum where it gives off a few branches, and reaches the nasopalatine or incisive canal of the maxilla. In the upper part of the canal, the left and right nasopalatine nerves pass either separately through the anterior and posterior foramen, respectively, or together through the common foramen. In the incisive canal, the nasopalatine nerve communicates with its contralateral fellow and with the terminal part of the greater palatine nerve. Two nasopalatine nerves innervate the palatal tissue of six upper anterior teeth, namely, four incisors and two canine teeth.

The *palatine nerve* branches into the *greater and lesser palatine nerves*. The greater palatine nerve descends through the palatine canal, traverses the greater palatine foramen, and branches into the hard palate in a plane between the bony tissue and mucosa. The communication of the greater palatine and nasopalatine nerve has been described earlier. The lesser palatine nerve occupies the palatine canal and emerges from the lesser palatine foramen. It provides full scale sensation including taste, as well as the parasympathetic fibers for the soft palate and for the palatine tonsil (with the exception of the taste fibers).

The *pharyngeal nerve* leaves the pterygopalatine fossa via the palatovaginal canal and supplies the mucosa of the posterior aspect of the nasopharynx.

In addition to the sphenopalatine branch, the short pterygopalatine segment of the maxillary nerve sends the zygomatic and posterior superior alveolar branches. The zygomatic nerve splits into the zygomaticotemporal and zygomaticofacial branches which supply the skin of the temporal area and the cheek prominence, respectively.

The posterior superior alveolar nerve arises from 1 or 2 trunks of the pterygopalatine portion of the maxillary nerve. These trunks branch out and enter into a number of irregularly scattered foramina found on the infratemporal surface of the maxillary body. The branches which provide a sensory supply for the maxillary sinus are located between the mucosa and the bony tissue. Other branches descending into the posterior alveolar canals form the posterior part of the alveolar plexus and innervate the upper molar teeth.

After giving off branches in the pterygopalatine fossa, the maxillary nerve passes through the infraorbital fissure into the orbit. It is lodged in the infraorbital groove and canal, after which it becomes the infraorbital nerve. The branches given off by the infraorbital nerve are the middle and anterior superior alveolar nerves, which descend into the bony canals of the lateral and anterior maxillary walls, respectively. The middle superior alveolar nerve supplies the premolar teeth and partially supplies the middle part of the alveolar plexus. In its absence, the posterior superior alveolar nerve takes over its function. The anterior superior alveolar nerve originates from the infraorbital nerve in the posterior part of the infraorbital canal, enters its own canal, and descends towards the incisors and canine teeth. It forms the anterior part of the alveolar plexus, which supplies these teeth, and split as nasal branches to the mucosa of the anterior aspect of the lateral wall and floor of the nasal cavity. The terminal portion of the infraorbital nerve exits the infraorbital foramen on the anterior surface of the maxilla and divides into terminal branches named after the areas they supply, namely, inferior palpebral, external and internal nasal, and superior labial.

Mandibular Nerve

This is a mixed sensory and motor nerve. Its sensory fibers innervate the lower teeth and gums, as well as the mucosa of the anterior two-thirds of the tongue and floor of the mouth. Externally, it innervates the skin over the temporal area, anterior wall of the external acoustic meatus, tragus of the auricle, and lower jaw. The motor component of the mandibular nerve innervates the masticatory, tensor veli palatini, and tensor tympani muscles. *The sensory and motor roots* pass separately in the posterior and middle cranial fossa and join each other only at the oval foramen, which transports the mandibular nerve into the infratemporal fossa. The mandibular nerve branches located in the infratemporal fossa are intimately related to the fossa

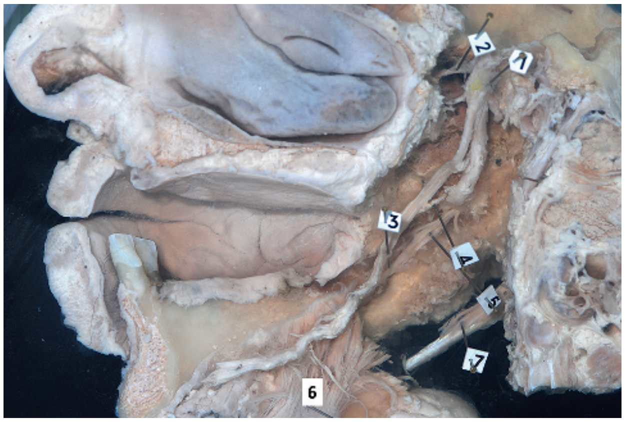

Figure 1.9 Mandibular nerve branches. 1 – Mandibular nerve, 2 – anterior division, 3 – lingual nerve, 4 – chorda tympani, 5 – inferior alveolar nerve, 6 mylohyoid muscle, 7 – digastric muscle (posterior belly).

contents comprised of the muscles of mastication, pterygoid venous plexus, maxillary artery branches, etc. The first branches given off by the nerve beneath the skull are the sensory meningeal branch and the nerve to the medial pterygoid muscle. The latter also supplies the tensor veli palatini and the tensor tympani muscles. The mandibular nerve then divides into smaller anterior and larger posterior trunks (Figure 1.9), both of which are mixed nerves.

The *anterior trunk* gives off only one sensory branch, the *buccal nerve*. It is closely related to the lateral pterygoid muscle, passing between its two heads to reach the anterior border of the masseter and join the buccal branch of the facial nerve. The buccal nerve fibers innervate the skin and mucosa related to the buccinator muscles and the gingivae on the buccal surface of the first two molars. Other motor branches of the anterior trunk, namely, the masseteric, deep temporal and lateral pterygoid nerves, supply the corresponding muscles.

The *masseteric nerve* passes above the lateral pterygoid muscle and mandibular notch and enters the medial surface of the masseter muscle. *The deep temporal nerves* (usually two and sometimes three in number) are also found superiorly to the lateral pterygoid muscle, between it and the skull base. The anterior and posterior deep temporal nerves may communicate with the buccal and masseteric nerves, respectively. The *lateral pterygoid nerve* arises either directly from the anterior trunk or from the buccal nerve. It approaches the medial surface of the lateral pterygoid muscle. The *posterior trunk* is a direct continuation of the mandibular nerve. It gives rise to the auriculotemporal nerve, after which it splits into the lingual and inferior alveolar nerves. All of them are sensory nerves, and only the latter conveys the motor fibers for the mylohyoid and anterior belly of the digastric muscles.

The *auriculotemporal nerve* usually arises from two roots encircling the middle meningeal artery, however, the number of roots can vary from one to five (Komarnitki et al. 2015). The roots of the auriculotemporal nerve are located near the lateral pterygoid muscle and sometimes run through its fibers. After surrounding the middle meningeal artery, the roots of the auriculotemporal nerve form a single trunk, which crosses the mandibular condyle and turns superficially behind it. Here, the nerve enters the parotid gland and divides into the branches that innervate the temporal region, part of the auricle and external acoustic meatus, auriculotemporal joint, and skin of the posterior cheek. The auriculotemporal nerve receives the postganglionic parasympathetic fibers from the otic ganglion of the glossopharyngeal nerve. It also communicates with the upper terminal branches of the facial nerve, thus conveying stimuli from the mimic muscle proprioceptors.

The *lingual nerve* (Figures 1.7–1.9) starts approximately 1 cm below the skull base. At the beginning, it is located anteromedially to the inferior alveolar nerve, after which it descends between the lateral and medial pterygoid muscles. The chorda tympani, which is a branch of the facial nerve, crosses the inferior alveolar nerve medially to it and joins the posterior aspect of the lingual nerve at the lower border of the lateral pterygoid muscle. The chorda tympani carries the taste fibers for the anterior two-thirds of the tongue and for the parasympathetic preganglionic fibers that innervate the submandibular ganglion. Distally to the junction of the chorda tympani, the lingual nerve descends towards the superior end of the mylohyoid line where it is sandwiched between the medial pterygoid muscle and mandibular ramus. At this point, the nerve acquires a more horizontal position and runs anteriorly in the space between the mylohyoid and hyoglossus muscles. When the lingual nerve approaches the superior aspect of the deep portion of the submandibular gland, it sends off communicating branches to the submandibular ganglion. The postganglionic parasympathetic fibers of this ganglion innervate both the submandibular and sublingual glands. The terminal portion of the lingual nerve crosses the submandibular duct (of Wharton) and branches out laterally to the genioglossus muscle.

The *inferior alveolar nerve* (Figure 1.7, 1.9) is the largest branch of the mandibular nerve. It lies on the lateral surface of the medial pterygoid muscle, between it and the lateral pterygoid muscle. It then turns under the lateral pterygoid muscle toward the inner surface of the mandibular ramus, passes very close to the medial aspect of the temporomandibular joint capsule and articular disk, and finally squeezes through the interval between the ramus and the sphenomandibular ligament. It now enters the mandibular canal where it is accompanied by the inferior alveolar vessels which are found just posteriorly to it. The mylohyoid nerve arises from the inferior alveolar nerve at the entrance into the canal. This branch contains the motor fibers that innervate the mylohyoid and anterior belly of the digastric muscle and a few sensory fibers that are delivered to the skin over the mental protuberance. The mylohyoid nerve proceeds anteriorly along the mylohyoid line. It approaches the inferolateral surface of the mylohyoid muscle where it divides into muscular and sensory branches.

The inferior alveolar nerve follows the mandibular canal and, from the depth of the mandible, it sends off three sensory branches: the dental branches, the mental nerve, and the incisive branch. The dental branches are inserted one to each other, and form the inferior dental plexus, which supplies the premolar and molar teeth. The mental nerve is a single nerve in more than 90% of the population. It appears from the mental foramen and divides into between two and four branches. Each of these branches divides further into variable numbers of secondary branches (Loyal 2013) that supply the skin of the chin and the mucosa of the lower lip.

Blood Vessels

Arteries

The vast majority of the arteries of the oral cavity are branches that originate from the external carotid system, namely, the superior thyroid, lingual, facial, posterior auricular, occipital, ascending pharyngeal, maxillary, and superficial temporal arteries. The lingual, facial, and maxillary arteries are directly related to the blood supply of the oral cavity (Figure 1.8).

The *lingual artery* originates in the carotid triangle, either directly from the external carotid or, in almost 20% of the population, from the common linguofacial trunk (Figure 1.8). It rarely forms a common thyrolingual trunk together with the superior thyroid artery. The proximal part of the lingual artery forms an ascending loop, which is crossed laterally by the hypoglossal nerve. The artery then proceeds anteriorly and runs along the medial surface of the mylohyoid muscle, between it and the genioglossus muscle. The terminal part of the lingual artery (the deep lingual artery) runs along the ventral surface of the tongue towards its tip where it is covered solely by the oral mucosa. The suprahyoid branch arises from the proximal part of the lingual artery. It supplies the suprahyoid muscles at their attachment to the hyoid bone. The sublingual artery branches out from the lingual artery at the anterior margin of the hyoglossus muscle. This branch is located on the medial surface of the sublingual gland, and it supplies that gland as well as the mucosa of the oral floor.

When the lingual artery crosses the hyoglossus muscle, it sends from one to three dorsal lingual arteries to supply the posterior aspect of the tongue and the adjacent part of the oropharynx. The sublingual and submental arteries anastomose with each other in reciprocal relationships.

The origin of the *facial artery* is hidden from the lateral view by the posterior belly of digastric muscle. This artery passes just medially to the angle of the mandible and then cut through the submandibular gland. The facial artery enters the submandibular triangle, passes under the inferior border of the mandibular body at the anterior aspect of the masseter attachment, and turns in an anterosuperior direction towards the nasolabial groove. Here, the facial artery has a very characteristic tortuous course until it reaches the lateral border of the nose. The distal part of the facial artery that approaches the medial angle of the eye is labeled the “angular” artery. The facial artery gives off two main branches in the neck. One is the ascending palatine artery, which anastomoses with the descending or greater palatine artery from the maxillary artery system, and the other is the submental artery, which anastomoses with the sublingual artery.

The external carotid artery divides into its terminal branches, the maxillary and superficial temporal arteries, within the parotid gland. Embryologically, the maxillary artery is a continuation of the external carotid artery. The course of the maxillary artery can be generally described as anterior, superior, and medial. The most proximal portion of the maxillary artery is found between the sphenomandibular ligament and the mandibular neck. The relation of the maxillary artery to other structures in the infratemporal fossa varies. It can be found either laterally or medially to the lateral pterygoid muscle. It crosses the inferior alveolar nerve either medially (most of the time) or laterally to it, and the same holds true for the lingual nerve. Finally, the maxillary artery passes between the two heads of the lateral pterygoid muscle and enters the pterygopalatine fossa via the pterygomaxillary fissure. Among the numerous branches of the maxillary artery, those which are directly related to the oral cavity are the inferior alveolar, buccal, posterior superior alveolar, infraorbital, and greater (descending) palatine arteries. They follow the course of the branches of the trigeminal nerve of the same names.

The sphenopalatine artery is the direct continuation of the maxillary artery when it passes through the sphenopalatine foramen. It appears in the nasal cavity on the level of the superior nasal meatus and gives off the lateral branches to the posterior aspect of the nasal conchae. The lateral arteries also contribute to the blood supply of the maxillary, frontal, ethmoid, and sphenoidal sinuses. The posterior septal branch of the sphenopalatine artery runs diagonally from the posterosuperior to anteroinferior corner of the nasal septum, and enters the incisive canal where it anastomoses with the terminal branch of the greater palatine artery.

Veins

The veins of the upper and lower jaws essentially follow the course of the corresponding arteries and nerves, forming neurovascular bundles.

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