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Anatomy

Third molar surgical complications can be minimized or eliminated with proper case selection, surgical protocol, and a thorough knowledge of oral anatomy. Removal of third molars, including impactions, can become routine. A brief review of oral anatomy related to third molars is the first step in your journey to become proficient in the safe removal of impacted third molars. The structures relevant in the safe removal of third molars are the following:

1) Nerves
2) Blood vessels
3) Buccal fat pad
4) Submandibular fossa
5) Maxillary sinus
6) Infratemporal fossa

Nerves

In classical anatomy there are 12 paired cranial nerves (I–XII) providing sensory and motor innervation to the head and neck (see Figure 1.1).

The trigeminal nerve (V), the fifth cranial nerve, is responsible for sensations of the face and motor functions of the muscles of mastication. This cranial nerve derives its name from the fact that each trigeminal nerve (one on each side of the pons) has three major branches: the ophthalmic nerve (V_1), the maxillary nerve (V_2), and the mandibular nerve (V_3) (see Figure 1.2). The ophthalmic and maxillary nerves are purely sensory, while the mandibular nerve has sensory and motor functions (see Figure 1.3).

The mandibular nerve (V_3) is the largest of the three branches or divisions of the trigeminal nerve, the fifth (V) cranial nerve. It is made up of a large sensory root and a small motor root. The mandibular nerve exits the cranium through the foramen ovale and divides into an anterior and posterior trunk in the infratemporal fossa. The mandibular nerve divides further into nine main branches, five sensory and four motor (see Figure 1.4).

The five sensory branches of the mandibular nerve control sensation to teeth, tongue, mucosa, skin, and dura.

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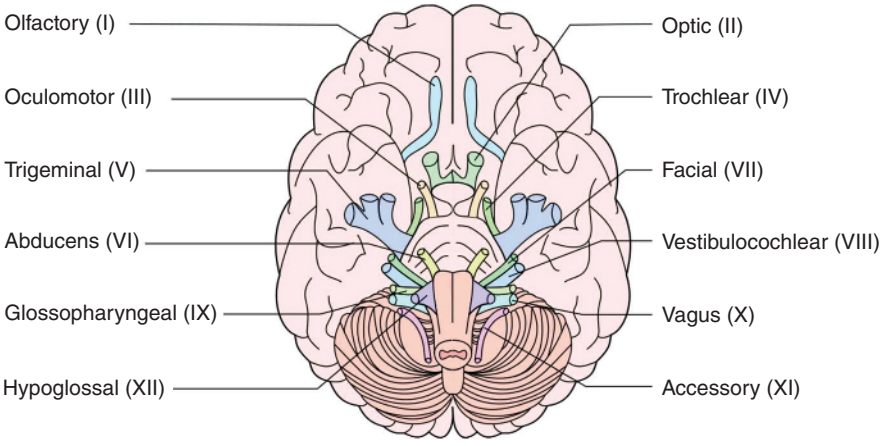

Figure 1.1 The 12 cranial nerves emerge from the ventral side of the brain. *Source:* Courtesy of Michael Brooks.

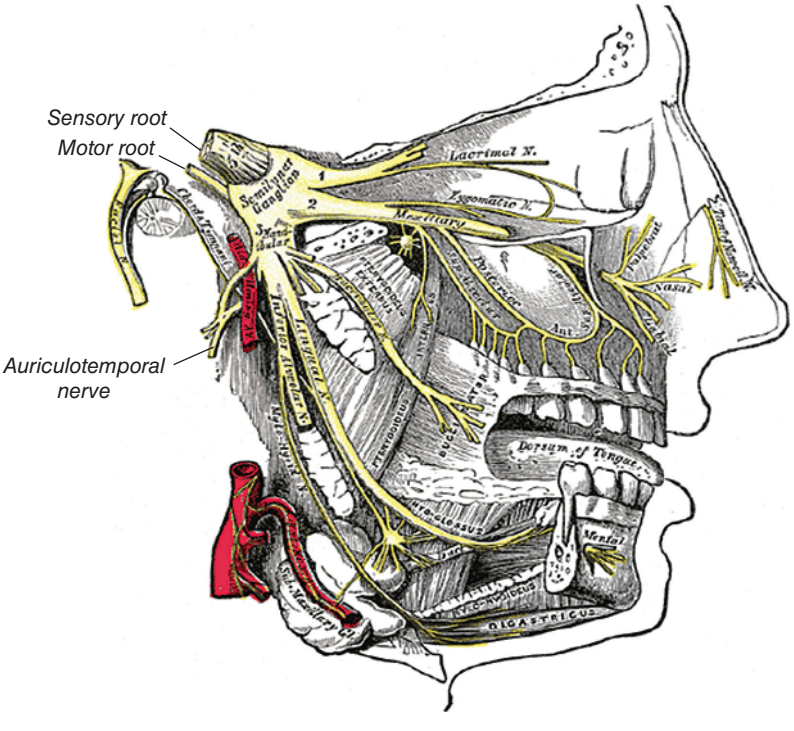

Figure 1.2 The 5th cranial nerve and three branches of the trigeminal nerve: (1) the ophthalmic nerve, (2) the maxillary nerve, and (3) the mandibular nerve. (By Henry Vandyke Carter, via Wikimedia Common.)

1) Inferior alveolar—exits the mental foramen as the mental nerve and continues as the incisive nerve
   - The nerve to the mylohyoid is a motor and sensory branch of the inferior alveolar nerve.
   - Mean inferior alveolar nerve diameter is 4.7 mm.[1]
2) Lingual—lies under the lateral pterygoid muscle, medial to and in front of the inferior alveolar nerve
   - Carries the chorda tympani nerve, affecting taste and salivary flow.
   - May be round, oval, or flat and varies in size from 1.53 mm to 4.5 mm.[2]
   - Average diameter of the main trunk of the lingual nerve is 3.5 mm.[3]
3) Auriculotemporal—innervation to the skin on the side of the head
4) Buccal or long buccal—innervation to the cheek and second and third molar mucosa
5) Meningeal—innervation to dura mater.

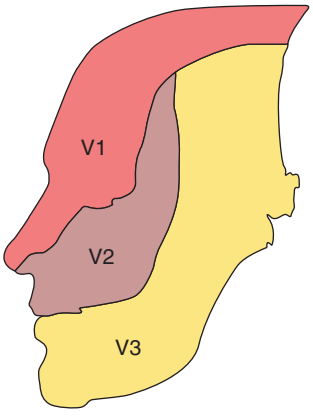

Figure 1.3 Sensory innervation of the three branches of the trigeminal nerve. *Source:* Madhero88, https://commons.wikimedia.org/wiki/File:Trig_innervation.svg. CC BY 3.0.

The four motor branches of the mandibular nerve control the movement of eight muscles, including the four muscles of mastication: masseter, temporal, medial pterygoid, and lateral pterygoid. The other four muscles are the tensor veli palatini, tensor tympani, mylohyoid, and anterior belly of the digastric. Nerves to the tensor veli tympani and tensor veli palatini are branches of the medial pterygoid nerve. Nerves to the mylohyoid (motor and sensory) muscle and anterior belly of the digastric (motor only) muscle are branches of the inferior alveolar nerve. The nerve to the anterior belly of the digastric muscle is a motor branch of the inferior alveolar nerve.

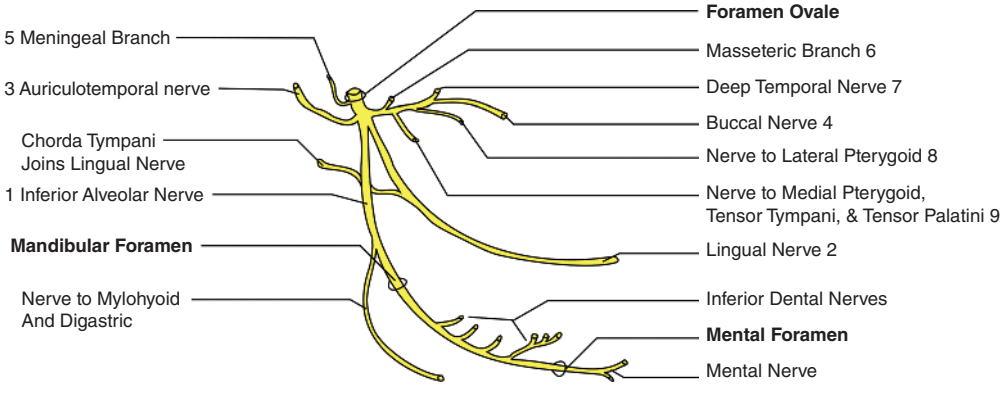

Figure 1.4 Mandibular nerve branches from the main trunk; anterior and posterior divisions. *Source:* Courtesy of Michael Brooks.

Nerve Complications Following the Removal of Impacted Third Molars

Injury to the inferior alveolar, lingual, mylohyoid, and buccal nerves may cause altered or complete loss of sensation of the lower third of the face on the affected side.

The majority of serious nerve complications result from inferior alveolar or lingual nerve injuries. Most surgical injuries to the inferior alveolar nerve and lingual nerve cause temporary sensory change, but in some cases they can be permanent. Injury to these nerves can cause anesthesia (loss of sensation), paresthesia (abnormal sensation), hypoesthesia (reduced sensation), or dysesthesia (unpleasant abnormal sensation). Injury to the lingual nerve and associated chorda tympani nerve can also cause loss of taste of the anterior two-thirds of the tongue.

Damage to the mylohyoid nerve has been reported to be as high as 1.5% following lower third molar removal, but this is probably due to the use of lingual retraction.[4] Most third molars can be removed by utilizing a purely buccal technique. Utilizing this technique, it is not necessary to encroach on the lingual tissues or to remove distal or lingual bone.[5]

A search of the literature found no specific reports of long buccal nerve involvement (AAOMS white paper, March 2007), although one article did note long buccal involvement when the anatomical position was aberrant. In this case, the long buccal nerve was coming off the inferior alveolar nerve once it was already in the canal and coming out through a separate foramen on the buccal side of the mandible.[6] Long buccal nerve branches are probably frequently cut during the incision process, but the effects are generally not noted.[7]

Blood Vessels

Life-threatening hemorrhage resulting from the surgical removal of third molars is rare. However, copious bleeding from soft tissue is relatively common. One source of bleeding during the surgical removal of third molars is the inferior alveolar artery or vein. These central vessels can be cut during sectioning of third molars, leading to profuse bleeding. The path of vessels leading to the inferior alveolar neurovascular bundle begins with the common carotid arteries and the heart.

The common carotid arteries originate close to the heart and divide to form the internal and external carotid arteries. The left and right external carotid arteries provide oxygenated blood to the areas of the head and neck outside the cranium. These arteries divide within the parotid gland into the superficial temporal artery and the maxillary artery. The maxillary artery has three portions: maxillary, pterygoid, and pterygomaxillary (see Figures 1.5a and 1.5b).

The first portion of the maxillary artery divides into five branches. The inferior alveolar artery is one of the five branches of the first part of the maxillary artery. The inferior alveolar artery joins the inferior alveolar nerve and vein to form the inferior alveolar neurovascular bundle within the mandible. Three studies confirm that the inferior alveolar vein lies superior to the nerve and that there are often multiple veins. The artery appears to be solitary and lies on the lingual side of the nerve, slightly above the horizontal position.[8]

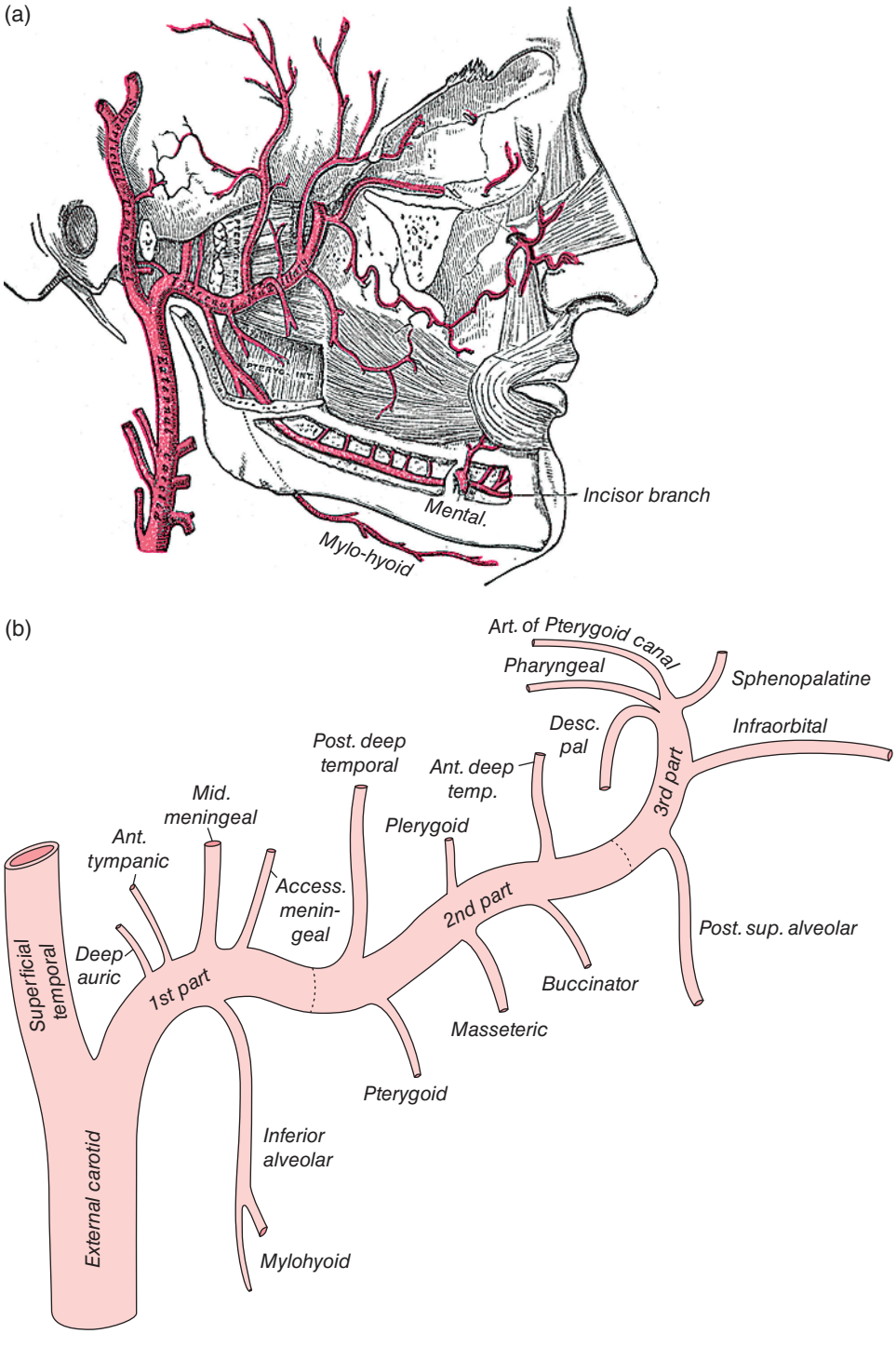

Figure 1.5 (a) The maxillary artery. (by Henry Gray, 1918, via Wikimedia Commons.) (b) Branches of the maxillary artery depicting maxillary, pterygoid, and pterygomaxillary portions. (By Henry Vandyke Carter, via Wikimedia Commons.)

Bleeding during and after third molar impaction surgery is expected. Local factors resulting from soft-tissue and vessel injury represent the most common cause of postoperative bleeding.[9] Systemic causes of bleeding are not common, and routine preoperative blood testing of patients, without a relevant medical history, is not recommended.[10]

Hemorrhage from mandibular molars is more common than bleeding from maxillary molars (80% and 20%, respectively), because the floor of the mouth is highly vascular.[11] The distal lingual aspect of mandibular third molars is especially vascular and an accessory artery in this area can be cut leading to profuse bleeding.[12,13] The most immediate danger for a healthy patient with severe postextraction hemorrhage is airway compromise.[14]

Most bleeding following third molar impaction surgery can be controlled with pressure. Methods for hemostasis will be discussed further in Chapter 3.

Buccal Fat Pad

The buccal fat pad is a structure that may be encountered when removing impacted third molars. It is most often seen when flap incisions are made too far distal to maxillary second molars. It is a deep fat pad located on either side of the face and is surrounded by the following structures (see Figure 1.6):

- Anterior—angle of the mouth
- Posterior—masseter muscle
- Medial—buccinator muscle
- Lateral—platysma muscle, subcutaneous tissue, and skin

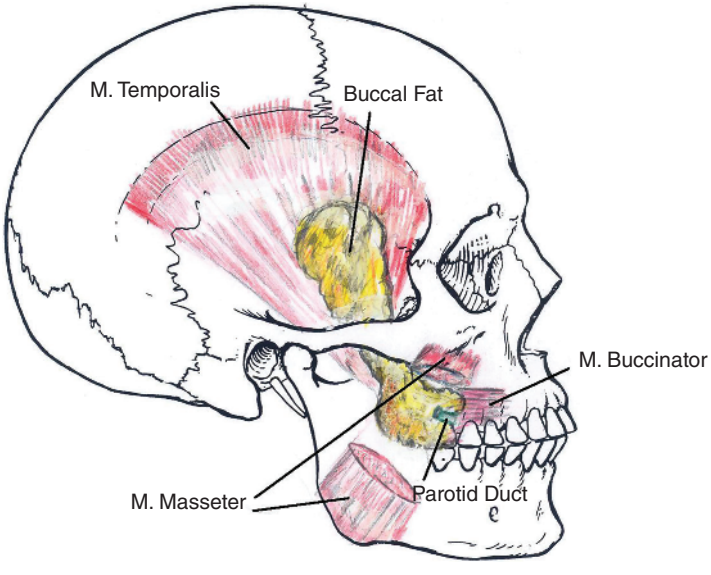

Figure 1.6 Buccal fat pad. *Source:* Otto Placik, https://clinanat.com/mtd/833-buccal-fat-pad-of-bichat. CC BY-SA 3.0.

- Superior—zygomaticus muscles
- Inferior—depressor anguli oris muscle and the attachment of the deep fascia to the mandible

Zhang, Yan, Wi, Wang, and Liu reviewed the anatomical structures of the buccal fat pad in 11 head specimens (i.e., 22 sides of the face). They found the following:

> The enveloping, fixed tissues and the source of the nutritional vessels to the buccal fat pad and its relationship with surrounding structures were observed in detail. Dissections showed that the buccal fat pad can be divided into three lobes—anterior, intermediate, and posterior, according to the structure of the lobar envelopes, the formation of the ligaments, and the source of the nutritional vessels. Buccal, pterygoid, pterygopalatine, and temporal extensions are derived from the posterior lobe. The buccal fat pad is fixed by six ligaments to the maxilla, posterior zygoma, and inner and outer rim of the infraorbital fissure, temporalis tendon, or buccinator membrane. Several nutritional vessels exist in each lobe and in the subcapsular vascular plexus. The buccal fat pads function to fill the deep tissue spaces, to act as gliding pads when masticatory and mimetic muscles contract, and to cushion important structures from the extrusion of muscle contraction or outer force impulsion. The volume of the buccal fat pad may change throughout a person's life.[15]

Submandibular Fossa

The submandibular fossa is a bilateral space located medial to the body of the mandible and below the mylohyoid line (see Figure 1.7). It contains the submandibular salivary gland, which produces 65% to 70% of our saliva.

Third molar roots are often located in close proximity to the submandibular space (see Figure 1.8). The lingual cortex in this area may be thin or missing entirely. Therefore, excessive or misplaced force can dislodge root fragments or even an entire tooth into the adjacent submandibular space.[16]

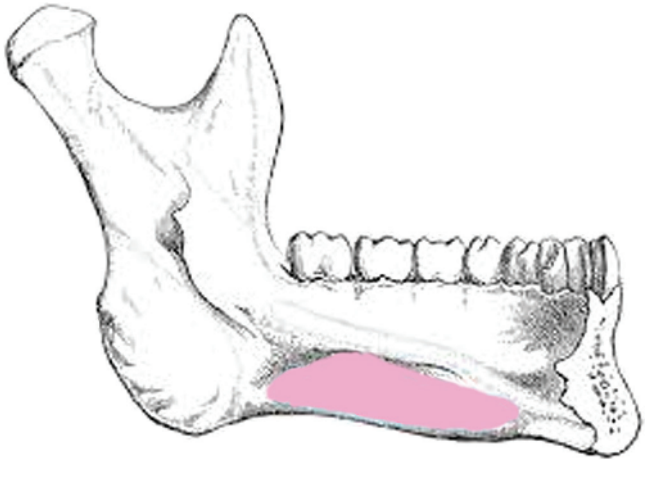

Figure 1.7 Submandibular fossa. *Source:* Adapted from Henry Vandyke Carter, via Wikimedia Commons.

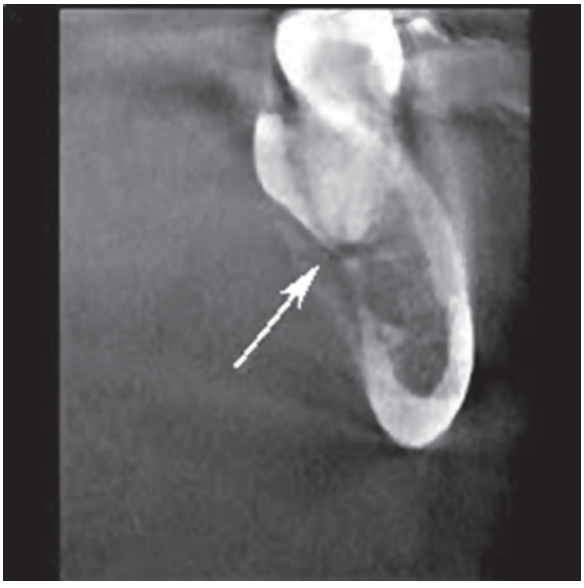

Figure 1.8 Third molar roots near submandibular fossa. *Source:* Reproduced by permission of Dr. Jason J. Hales, DDS.

Patients presenting with partially impacted third molars can develop pericoronitis. This localized infection can spread to the submandibular, sublingual, and submental spaces. Bilateral infection of these spaces is known as Ludwigs Angina.[17] Prior to the advent of antibiotics, this infection was often fatal due to concomitant swelling and compromised airway.

Maxillary Sinus

The maxillary sinus is a bilateral empty space located within the maxilla, above the maxillary posterior teeth. It is pyramidal in shape and consists of an apex, base, and four walls (see Figure 1.9 and Box 1.1).

The size and shape of the maxillary sinus vary widely among individuals and within the same individual. The average volume of a sinus is about 15 ml (range between 4.5 and 35.2 ml).[18]

Maxillary third molar teeth and roots are often in close proximity to the maxillary sinus. The distance between the root apices of the maxillary posterior teeth and the sinus is sometimes less than 1 mm.[19] Complications related to the removal of maxillary third molars include sinus openings, displacement of roots or teeth into the sinus, and postoperative sinus infections.

Infratemporal Fossa

The infratemporal fossa is an irregularly shaped space located inferior to the zygomatic arch and posterior to the maxilla. Six structures form its boundaries (see Figure 1.10 and Box 1.2).

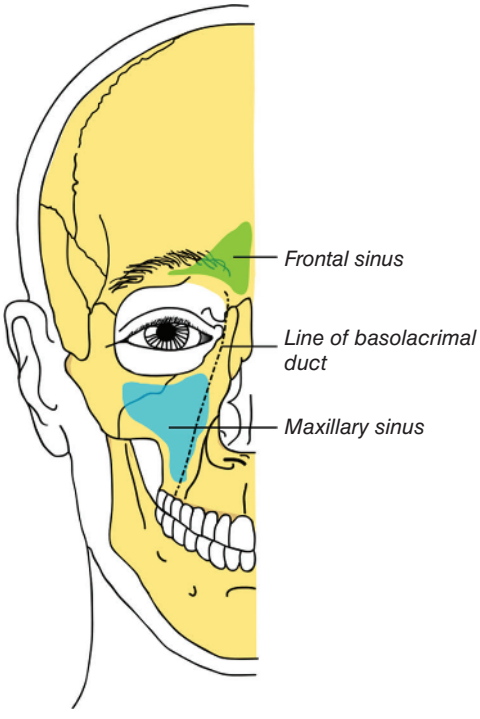

Figure 1.9 Maxillary sinus coronal view. (By Henry Vandyke Carter, via Wikimedia Commons)

Box 1.1 Boundaries of the maxillary sinus.

Apex – pointing towards the zygomatic process
Anterior wall – facial surface of the maxilla
Posterior wall – infratemporal surface of the maxilla
Superior – floor of the orbit
Inferior – alveolar process of the maxilla
Base – cartilagenous lateral wall of the nasal cavity

Although rare, there are documented cases of maxillary third molars displaced into the infratemporal fossa. This complication is most likely to occur during the early removal of deeply impacted third molars positioned near the palate.

Unlike the maxillary sinus, the infratemporal fossa is not an empty space. It contains many vital structures, including nerves, arteries, and veins. A third molar displaced into the infratemporal fossa is considered a major complication. Dentists removing impacted maxillary third molars should understand the anatomy of the infratemporal fossa.

This chapter is not intended to be a comprehensive review of oral anatomy but instead a review of structures relevant to third molars. This knowledge is essential to avoid surgical complications. Although no surgical procedure is without risk, most impacted third molars can be removed safely and predictably.

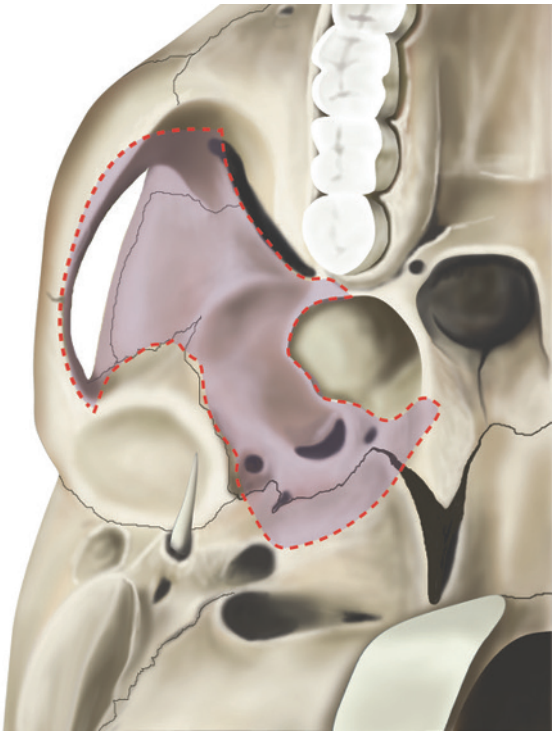

Figure 1.10 Boundaries of the infratemporal fossa. *Source:* Reproduced by permission of Joanna Culley BA(hons) IMI, MMAA, RMIP.

Box 1.2 Boundaries of the infratemporal fossa. *Source:* Reproduced by permission of Joanna Culley.

Anterior: posterior maxilla
Posterior: tympanic plate and temporal bone
Medial: lateral pterygoid plate
Lateral: ramus of the mandible
Superior: greater wing of the sphenoid bone
Inferior: medial pterygoid muscle

An important key to avoid complications is deciding when to refer to an oral surgeon. This will be different for each dentist depending on experience and training. When to refer may be the most important factor to consider prior to treating your patients. Case selection, including surgical risk and difficulty, is discussed in the next chapter.

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