CHAPTER 60

Oral Medicine

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INTRODUCTION

Dental concerns are a common chief complaint in the emergency department (ED). The spectrum of oral disease ranges from bothersome to emergently life-threatening. This chapter covers disorders of the tooth, gingiva and periodontium, dental procedure-related issues, odontogenic and deep infections of the head and neck, traumatic dental emergencies, as well as temporomandibular joint disorder (TMD) and dislocation.

DISORDERS OF THE TOOTH

Principles

Anatomy

Humans have 20 deciduous (primary) teeth and 32 permanent (secondary) teeth, which are supported and maintained in the maxilla (upper teeth) and mandible (lower teeth) by the periodontium. The tooth that is normally visible in the mouth is considered the crown, whereas the tooth that is under the gingival line is the root (Fig. 60.1).

The crown of the tooth has three layers; from outside to inside they are the enamel, dentin, and pulp. The enamel is the only part of the tooth that is visible in the absence of pathology (eg, fractures, caries) and is a hard coating that protects the tooth. The next layer deep to the enamel is the dentin, which is an intermediate layer between the enamel and the pulp (for the crown) and between the cementum and the pulp (for the root). Yellow in appearance, dentin is comprised of porous microtubules, supports the enamel, and acts as a cushion during mastication. If dentin is exposed from caries or trauma, the patient will have tooth sensitivity and/or pain. The deepest layer is the pulp cavity, which houses its neurovascular supply.

The normal primary, or deciduous, dentition ("baby teeth") consists of 10 mandibular and 10 maxillary teeth (Fig. 60.2). The lower central incisor is the first tooth to erupt at approximately 6 months of age; all primary teeth should be present by 3 years of age. The permanent dentition begins to erupt at approximately 5 to 6 years of age with the appearance of the first molar.

The permanent dentition consists of 32 teeth; there are 8 teeth per quadrant (eg, right upper, right lower, left upper, left lower). From medial to lateral, the names of the teeth in each quadrant are: the central incisor, lateral incisor, canine, two premolars (also called *bicuspids*), and three molars (also called *tricuspids*). The third molars ("wisdom teeth") are the last to erupt, appearing at approximately 16 to 18 years of age. The permanent dentition are numbered from 1 to 32, starting with the upper right third molar (1) and moving to the upper left third molar (16), to the lower left third molar (17), and to the lower right third molar (32). The starting point for this numbering system can be recalled by the mnemonic "upright." It is often easier to name the tooth or teeth involved; for instance, if tooth 8 is injured, the clinician could describe the tooth as the "right maxillary central incisor" or the "right upper central incisor." If multiple teeth are involved, numbering is more concise.

Specific terminology is also used to describe the various surfaces in the mouth. The *facial* (also referred to as *labial* or *buccal*) surface faces outside the oral cavity; the *oral* (also referred to as *palatal* for upper teeth, or *lingual* for lower teeth) surface faces the tongue; the *mesial* surface is toward the midline; and the *distal* surface is toward the ramus of the mandible. The *interproximal* surface refers to the contacting area of adjacent teeth, and the *occlusal* surface refers to the biting area. Finally, *apical* is in the direction of the root, whereas *coronal* is toward the crown of the tooth.

Pathophysiology

Dental caries are caused by breakdown of the teeth secondary to bacterial activity. Bacteria generate acid as a byproduct from cellular metabolism of food left on the tooth surface, subsequently demineralizing the enamel. Once the enamel is breached, the microporous dentin is able to transmit saliva, byproducts of the bacteria, and the bacteria to the pulp. The pulp initially reacts with a hyperemic response, which continues to an inflammatory state termed *pulpitis*, which can be reversed. Untreated, pulpitis can further progress to total degeneration and necrosis *(irreversible pulpitis)*.

Cracked tooth syndrome (CTS) is a condition that generally affects adults 30 to 60 years old and is defined as "a fracture plane of unknown depth and direction passing through tooth structure that may progress to communicate with the pulp and/or periodontal ligament."[1] These fractures can occur due to either excessive forces on a normal tooth (eg, accidentally biting on a hard object, such as metal or bone), or normal forces on a weakened tooth (eg, a carious tooth or one that has undergone dental procedures previously). Because of the mechanism of injury, teeth subjected to larger forces (such as the mandibular molars) are most commonly affected. If misdiagnosed, the fracture may propagate into the pulp or periodontal ligament and compromise viability of the tooth.

Clinical Features

Dental caries is the most common cause of odontogenic pain. The patient may give a variable history of a sudden or gradual onset of a sharp to dull, throbbing pain. In most cases, the patient can

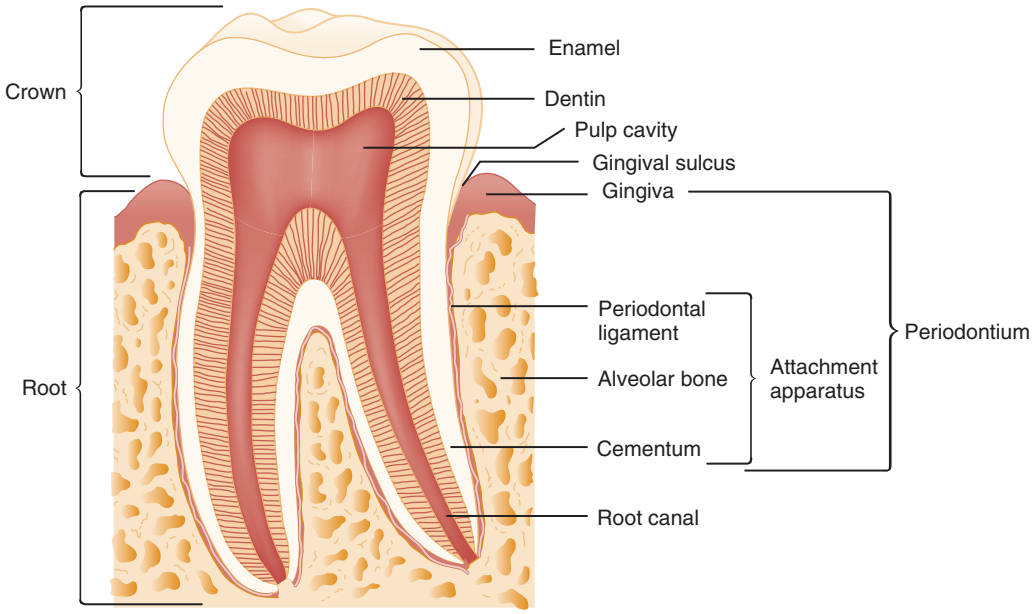


Fig. 60.1. The anatomy of the tooth and associated attachment apparatus.

indicate the specific tooth involved, but pain may be generalized. Early (reversible) pulpitis is sensitive to changes in temperature and pressure; irreversible pulpitis can have pain without any stimulus.

CTS patients may provide a history of preexisting dental procedures or disease, or they may have a history of occlusive trauma. Presenting symptoms are similar to those of dental caries.

Physical Examination

The physical examination described here is applicable to all sections of this chapter. Ideally the patient should be placed in a dental or ear, nose, and throat chair or on a bed at a 45-degree angle with adequate lighting. Pediatric patients often are examined while sitting in the parent's lap.

Pediatric patients may require anxiolysis or sedation to permit adequate oral assessment and treatment of a painful condition. Pediatric procedural sedation is described in Chapter 162.

A complete examination includes inspection of the oral cavity, gingiva, teeth, and surrounding structures (eg, throat, neck, sinuses) if indicated. Assess teeth for caries or cracks. Localization of the involved tooth may be accomplished by percussing the teeth or by having the patient bite on a tongue blade. Exquisite pain to percussion suggests an underlying periapical abscess (discussed in the section Odontogenic and Deep Neck Infections).

Examine the nares and sinuses for discharge and pain, respectively, to evaluate for sinusitis. Palpate the temporomandibular joint (TMJ) with opening and closing of the jaw to assess for "clicks" or "pops," which may indicate the etiology of pain as TMJ disorder. In older individuals, palpate the temporal artery for tenderness and prominence.

Differential Diagnoses

Most dental pain in the ED is odontogenic, the most common being pulpitis due to caries. Tooth pain is not always odontogenic, however. Unilateral upper tooth pain (usually the posterior teeth) can be related to maxillary sinus dysbarism or inflammation. Trigeminal neuralgia can present as tooth pain, but it is usually lancinating and may not be related to temperature changes or mastication (see Chapter 95). Atypical odontalgia is a centralized trigeminal neuropathy localized in a tooth or teeth. Frequently-misdiagnosed, patients will often undergo multiple dental procedures with worsening of their pain.[2] Atypical odontalgia causes persistent throbbing or burning pain that does not fulfill diagnostic criteria for another disorder and therefore is a diagnosis of exclusion.

Older patients with temporal (giant cell) arteritis may have pain with mastication because of jaw claudication.

Diagnostic Testing

No laboratory or radiographic testing is routinely indicated.

Management

Management of dental caries with pulpitis and CTS is aimed at treating the patient's pain and referring to a dentist for definitive care.

Severe pain can be treated with supraperiosteal infiltration of local anesthetic to provide temporary relief (Fig. 60.3). To perform this, dry the area with gauze, apply a topical anesthetic to the gingiva (eg, 20% benzocaine or 5% lidocaine) and allow it to sit for 5 minutes. Inject 1 to 2 mL of local anesthetic (eg, 2% lidocaine) through the mucobuccal fold of the affected tooth with the bevel facing the tooth. Alternatively, an inferior alveolar nerve block may be used when multiple lower teeth are affected on one side.

The patient can be discharged with ibuprofen 400 to 600 mg tablets every 4 to 6 hours. Nonsteroidal antiinflammatory drugs (NSAIDs) given at scheduled times (rather than as needed) are more effective than opioid analgesics for these conditions.[3] However, for severe odontalgia, a short course of opioid analgesics *in addition to* scheduled NSAID administration is reasonable. Opioid analgesics should not be prescribed for long-standing dental problems, such as well-established caries.

Disposition

The patient with odontalgia from dental caries or CTS should follow-up with a dentist within the week. Those with CTS should be instructed to avoid chewing on the affected side to avoid further trauma and fracture propagation.

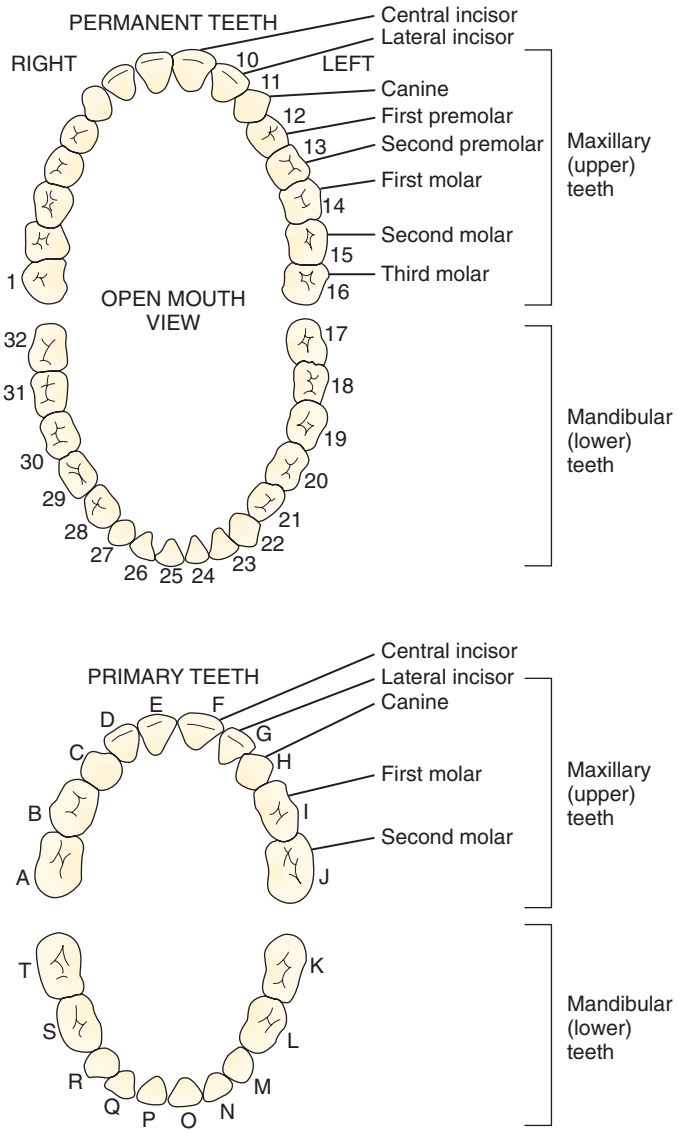


Fig. 60.2. Identification of teeth, adult and child. Conventional numbering starts with the upper right third molar 1 to the upper left third molar 16; lower left third molar 17 to the lower right third molar 32. For the primary dentition, A to J and K to T. (Modified from Roberts J: Roberts & Hedges' clinical procedures in emergency medicine, ed 6, Philadelphia, 2014, Elsevier, Fig. 64.2, p 1344.)

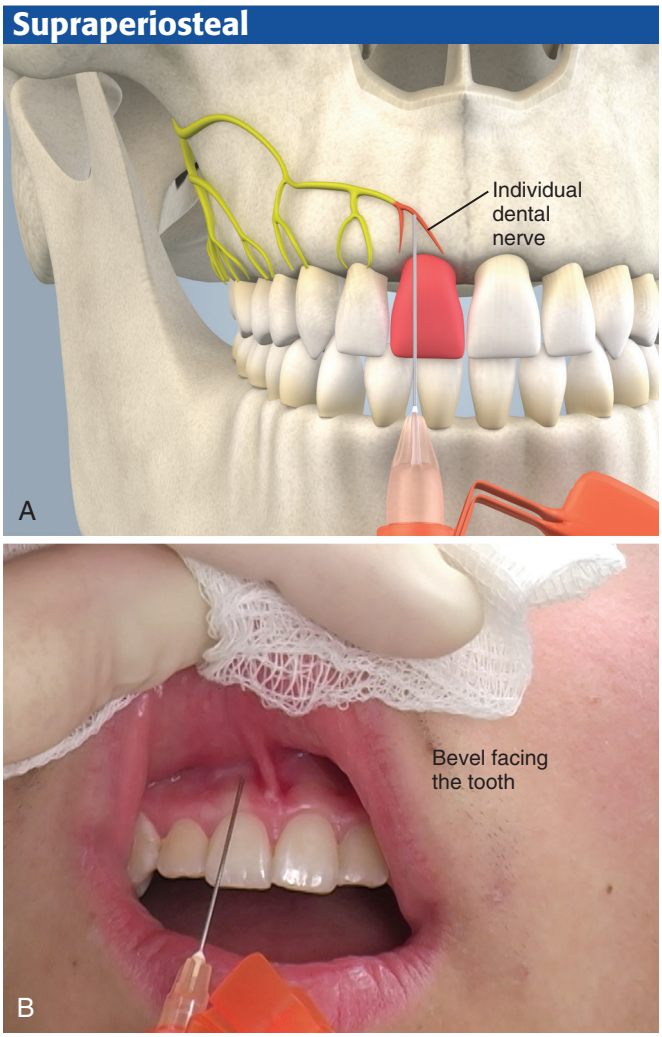


Fig. 60.3. **A** and **B,** Supraperiosteal nerve block for anesthesia of individual teeth. (From Roberts J: Roberts and Hedges' clinical procedures in emergency medicine, ed 6, Philadelphia, 2014, Elsevier, Fig. 30.5.)

DISORDERS OF THE GINGIVA AND PERIODONTIUM

Principles

Anatomy

The periodontium serves to hold the teeth in place, as well as protect the root from bacteria. Surrounding the root of the tooth instead of enamel is cementum, which helps fix the tooth to the alveolar bone by attaching to the periodontal ligaments. Collectively, the periodontal ligament, alveolar bone, and cementum comprise the attachment apparatus. The attachment apparatus plus the gingiva ("gums") is referred to as the *periodontium*. The gingiva consists of the mucosal tissue that overlies the mandible and maxilla inside the mouth and, in the normal state, acts as a barrier to infection and injury.

Pathophysiology

Gingivitis and Periodontitis. Periodontitis is inflammation of the supporting structures of the teeth (gingiva, alveolar bone, cementum, periodontal ligament). Degradation of the support structure leads to loss of alveolar bone and subsequent loosening or loss of teeth.

In necrotizing periodontal diseases, polymicrobial bacteria (with a predominance of *Fusobacterium* and spirochetes) invade the tissue and cause pain, bleeding, and destruction. These diseases include necrotizing gingivitis (acute necrotizing ulcerative gingivitis [ANUG], or "trench mouth") if only the gingiva are involved, necrotizing periodontitis if the attachment apparatus in addition to the gingiva is involved, and necrotizing stomatitis if the disease further extends into the surrounding oral mucosa (Fig. 60.4). Infection of the tonsils and pharynx is termed *Vincent's angina.* The most diffuse necrotizing disease is termed *noma* (cancrum oris, fusospirochetal gangrene) where the entire mouth is involved and is often fatal; this disease is most commonly encountered in young children in developing countries (Fig. 60.5).

Pericoronitis. The gingiva and surrounding tissue can also become inflamed due to a condition known as *pericoronitis.* As teeth start to erupt, debris and bacteria can accumulate between

Fig. 60.4. Necrotizing stomatitis. The gingiva has classic papilla necrosis but the oral mucosa is also involved, making this condition necrotizing stomatitis and not simply necrotizing gingivitis. (From Smith J: HIV and AIDS in the adolescent and adult: an updated for the oral and maxillofacial surgeon. Oral Maxillofac Surg Clin North Am 20(4):535–565, 2008, Fig. 8.)

Fig. 60.5. Noma (cancrum oris, fusospirochetal gangrene) is usually found in children in developing countries and can be disfiguring or even fatal. Noma represents the most severe end of the necrotizing periodontal disease spectrum. (From Farrar J, Hotez PJ, Junghanss T, et al, editors: Manson's tropical diseases, ed 23, London, 2014, Saunders/Elsevier, Fig. 29.1.)

the tooth and the surrounding soft tissue (this "gum flap" overlying the tooth is called the *operculum;* Fig. 60.6). The third molar ("wisdom tooth") is most commonly implicated, and symptoms typically occur in the second or third decade of life. This condition is more common with teeth that are malerupted or impacted. As the tissue becomes enlarged due to inflammation, the problem is worsened by trauma to the area during mastication.

Gingival Hyperplasia. Gingival hyperplasia can occur secondary to medications. The most commonly-associated drug classes are anticonvulsants, calcium channel blockers, and immunosuppressants (Table 60.1).

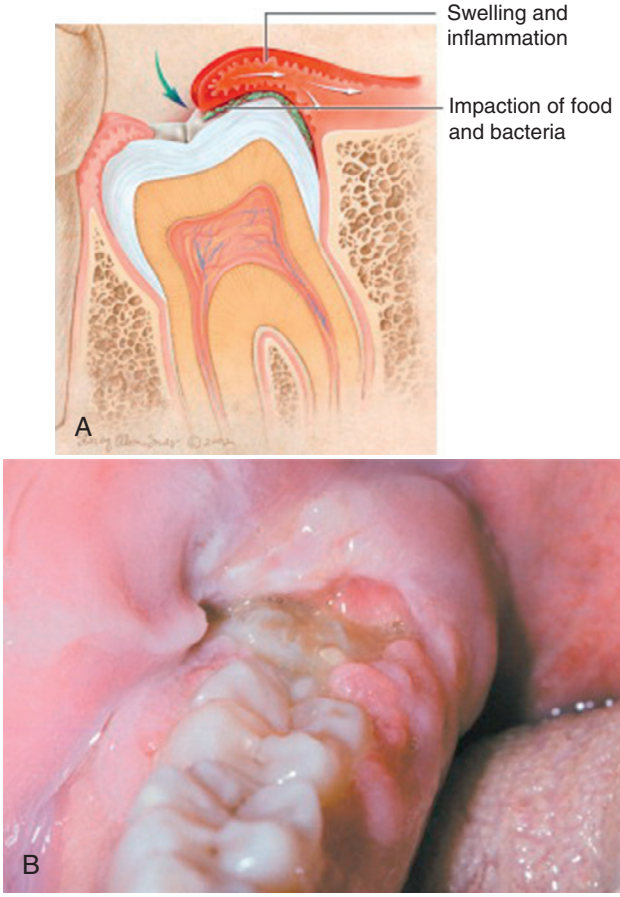


Fig. 60.6. Pericoronitis. **A,** Illustration of pericoronitis with swollen and inflamed operculum. **B,** Picture of pericoronitis of the third molar with erythema and inflammation of the surrounding tissue. (**A,** From Buttaravoli P, Leffler SM: Minor emergencies, ed 3, St Louis, 2012, Elsevier, Fig. 46.1; **B,** From Neville BW, Damm DD, Allen CM, et al: Oral and maxillofacial pathology, ed 4, St Louis, 2016, Elsevier.)

TABLE 60.1

Medication Classes and Their Risk of Drug-Induced Gingival Overgrowth

CATEGORY	PHARMACOLOGIC AGENT	PREVALENCE
Anticonvulsants	Phenytoin	50%
	Sodium valproate (valproic acid)	Rare
	Carbamazepine	None
Immunosuppressants	Cyclosporine	25% to 30% (adults) 70% (children)
Calcium channel blockers	Nifedipine	6% to 15%
	Felodipine	Rare
	Amlodipine	Rare
	Verapamil	<5%
	Diltiazem	5% to 20%

From Song HJ: Periodontal considerations for children. Dent Clin North Am 57(1):17–37, Table 1.

Clinical Features

Historical Features

The presentation of periodontitis is variable, depending on the severity of the disease. Simple gingivitis presents with complaints

of swollen gingiva that are tender, gingival bleeding after manipulation (eg, brushing teeth, flossing), and halitosis from bacterial overgrowth. Periodontitis involves the attachment apparatus as well; therefore, patients often will have the aforementioned symptoms but in addition may have gingival recession from loss of alveolar bone and concomitant teeth loosening. Individuals with more severe periodontitis may also report fevers and malaise. A medication history should be obtained to assess for drug-induced gingival overgrowth.

Physical Examination

The gingiva should be inspected for erythema, edema, and hyperplasia. Gingivitis is typically painless but will show inflammation, edema, and bleeding with probing. The interdental papillae should normally be pointed but, in necrotizing disease, the interdental papillae become blunted, "punched out," ulcerated, and covered with a whitish-yellow pseudomembrane of necrotic tissue and bacteria. The triad for necrotizing periodontal diseases includes papillary necrosis, gingival bleeding, and pain.[4] More severe infection (eg, necrotizing stomatitis) may also have associated submandibular lymphadenopathy.

Mobile teeth suggest alveolar bone loss, where the disease has progressed deeper than the gingiva. Partially-erupted teeth should be examined for evidence of pericoronitis. The overlying tissue (operculum) should be assessed for bleeding and inflammation.

Differential Diagnosis

Ulceration of the mucosa can be caused by necrotizing stomatitis but also by aphthous ulcers and other oral lesions. Aphthous ulcers are 2 to 3 mm in diameter and have a whitish center and are tender, but they usually do not become infected. The neighboring gingiva should not be affected and appear healthy. Recurrent aphthous lesions can occur with Behçet disease and human immunodeficiency virus (HIV). Treatment is symptomatic with hydrogen peroxide rinses and topical anesthetics. Another consideration is acute herpetic gingivostomatitis, which is the most common manifestation of primary herpes simplex virus infection in children. For patients with gingival hyperplasia, an infiltrative process (such as, leukemia) should be considered, especially if the patient is not on any medications associated with hyperplasia.

Diagnostic Testing

Necrotizing periodontal disease occurs most often in patients with diabetes, and those who are immunocompromised, such as patients with HIV or long-term immunosuppressive therapy. Blood glucose and HIV testing may be initiated in the ED or as part of follow-up.

Management

Gingivitis and Periodontitis

Gingivitis will respond to proper oral hygiene, and the patient should be instructed on twice daily flossing and brushing. Antibacterial mouth rinses should be prescribed if the gingivitis is severe: either chlorhexidine rinses (preferred agent, 0.12% to 0.2%) or 3% hydrogen peroxide (diluted 1:1 with warm water) should be performed twice daily. Necrotizing periodontal disease should be treated by a dentist, who will need to débride the necrotic tissue. Oral antimicrobials should be prescribed for patients with extensive disease or systemic effects; see Table 60.2 for suggestions.

All patients who smoke should be counseled on smoking cessation; this is the most common risk factor in HIV-negative patients. Analgesia with an NSAID or acetaminophen relieves pain and facilitates appropriate oral hygiene, because periodontal conditions are painful. Opioid analgesics rarely are needed. Topical analgesics (eg, viscous lidocaine) can also be effective, but should be applied only to small areas; patients must be cautioned about targeted use to avoid local anesthetic toxicity.

Pericoronitis

Patients with pericoronitis should receive rinses as described for periodontal disease; systemic antibiotics are not necessary unless the pericoronitis is severe. In such cases, antibiotics are as described for periodontal disease. Patients with pericoronitis should be referred to dentist or oral surgeon for local treatment of the operculum or, if impacted or malerupting, removal of the tooth.

Disposition

Patients with gingivitis are discharged with dental follow-up in 1 to 2 weeks. Those with necrotizing gingivitis or mild necrotizing stomatitis should see a dentist within 24 to 72 hours, because they require frequent débridement until the infection is controlled. Patients with severe necrotizing stomatitis or gingivitis should have emergency dental consultation (within 24 hours). Patients with significant systemic symptoms (especially fever), those who are immunocompromised with severe oral disease, and those who are unable to adequately hydrate because of mouth pain are admitted to hospital or placed in an observation unit for intravenous (IV) hydration, analgesia, and dental or oral medicine consultation.

TABLE 60.2

Recommended Antibiotics for Severe Periodontal Disease, Severe Pericoronitis, and Simple Odontogenic Infections

ANTIBIOTIC	DOSAGE	DURATION	NOTES
Penicillin V	500 mg by mouth qid	10 days	
Amoxicillin/clavulanate	500 mg/125 mg by mouth tid	10 days	
Metronidazole	500 mg by mouth bid	10 days	If allergic to penicillin
Clindamycin	300 mg by mouth qid	10 days	If allergic to penicillin
Nystatin	100,000 units/mL 5 mL swish/spit qid	10 days	If immunocompromised or suspect candidal infection

DISORDERS INVOLVING DENTAL PROCEDURES

Principles

Anatomy

The most common dental procedures include fillings, crowns, root canals, and extractions. Fillings cover caries and protect the underlying tooth from further decay and infection. Crowns (or "caps") cover the portion of the tooth exposed above the gingiva and require an intact root for attachment. Root canals involve opening the pulp chamber, removing pulp tissue and root, sterilizing the canal, and sealing it to prevent ingress of saliva and contamination. Extractions are performed for non-salvageable teeth and involve removal of the entire tooth. All of these procedures can have complications that may bring a patient to the ED.

Pathophysiology

Dislodgement of a filling or crown can expose the highly-innervated pulp and lead to significant odontalgia. Similarly, the pulp can be irritated during procedures that involve the pulp (eg, root canal) because of residual gas bubbles that are inadvertently sealed into the cavity. In addition, any swelling that may elevate the tooth even minimally post-procedurally will cause premature and painful contact during mastication.

After an extraction, the patient will have an adherent clot in the fossa where the root of the tooth previously was. If this clot becomes dislodged (typically 3 to 4 days post-extraction) a condition called *alveolar osteitis* ("dry socket") can occur (Fig. 60.7). The incidence of alveolar osteitis is 2% after routine extraction but as high as 20% to 30% after removal of impacted mandibular third molars. The pain is secondary to localized inflammation of the now-exposed surrounding alveolar bone.

Clinical Features

Historical Features

Patients usually can provide the history of their dental procedures; dislodgement of a filling or crown can happen at any time but is more common early or with trauma. Post-root canal pain due to retained gas bubbles typically occurs immediately after the initial nerve block wears off.

Fig. 60.7. Alveolar osteitis ("dry socket") with extraction site devoid of clot. (From Krakowiak PA: Alveolar osteitis and osteomyelitis of the jaws. Oral Maxillofac Surg Clin North Am 23[3]:401–413, 2011, Fig. 1.)

Alveolar osteitis characteristically presents 3 to 4 days after an extraction with severe dull, aching pain at the site of extraction, which is often associated with halitosis and a foul taste in the mouth. They may have an antecedent history of sucking through a straw or other activity that dislodged the clot.

Those with continued bleeding after an extraction should have their medical history and medications reviewed with specific attention to coagulopathies, such as hemophilia, as well as medications, such as anticoagulants, including anti-platelet agents.

Physical Examination

Patients with dislodged fillings or crowns will have exposed dentin or pulp over the affected teeth. Post-extraction pain secondary to inflammation or retained gas bubbles may have a normal examination. Those with alveolar osteitis will have a tooth socket that has at least partial loss of the blood clot with exposed bone.

Diagnostic Testing

An international normalized ratio (INR) is indicated for patients who are on warfarin and have post-extraction bleeding.

Management

For teeth with exposed pulp, calcium hydroxide cement (Dycal) application to cover the exposed surface may provide symptomatic relief. If the patient has a loose or displaced crown, the crown itself can be reimplanted if the tooth surface is clean; place the calcium hydroxide cement and ask the patient to bite down.

Analgesia with NSAIDs is generally sufficient. For those with severe pain and objective findings, a short course (2 to 3 days) of an opioid can be prescribed. Patients with retained gas bubbles after a root canal have intense pressure-like pain, often refractory to analgesics and even nerve blocks, and they should be referred to an endodontist, preferably the clinician who performed the initial procedure.[5]

Patients with alveolar osteitis should receive NSAID analgesia and have prompt (next working day) consultation by their treating oral surgeon. If follow-up will be delayed, nerve block followed by gentle irrigation of the socket with sterile saline can be performed. The socket should not be curetted and the clot should not be removed if residual clot exists, because this will expose more bone and lead to higher risk of continued pain and osteomyelitis. Medicated iodoform gauze with eugenol (an anesthetic) can be placed in the cavity and changed by the patient's surgeon within 24 to 48 hours with repeat irrigation. No other treatment for alveolar osteitis has enough evidence to recommend use.[6]

Extraction site bleeding should first be managed with direct pressure with the patient biting on dry gauze. If this fails, perform a supraperiosteal nerve block with lidocaine *with epinephrine*, because this will decrease blood supply as well as anesthetize the area so that more firm direct pressure can be applied. Repeat the direct pressure. If bleeding continues after a second trial of pressure, the socket should be packed with absorbable gelatin sponge (Gelfoam) with or without topical thrombin. The gingiva can also be loosely closed with a 3-0 absorbable suture in a figure-of-eight fashion. If there is significant ongoing hemorrhage that will not respond to local measures, reversal of anticoagulation may be undertaken in consultation with the patient's cardiologist (see Chapter 114).

Disposition

In the absence of infection and with control of bleeding, patients with dental procedure-related complications can be discharged

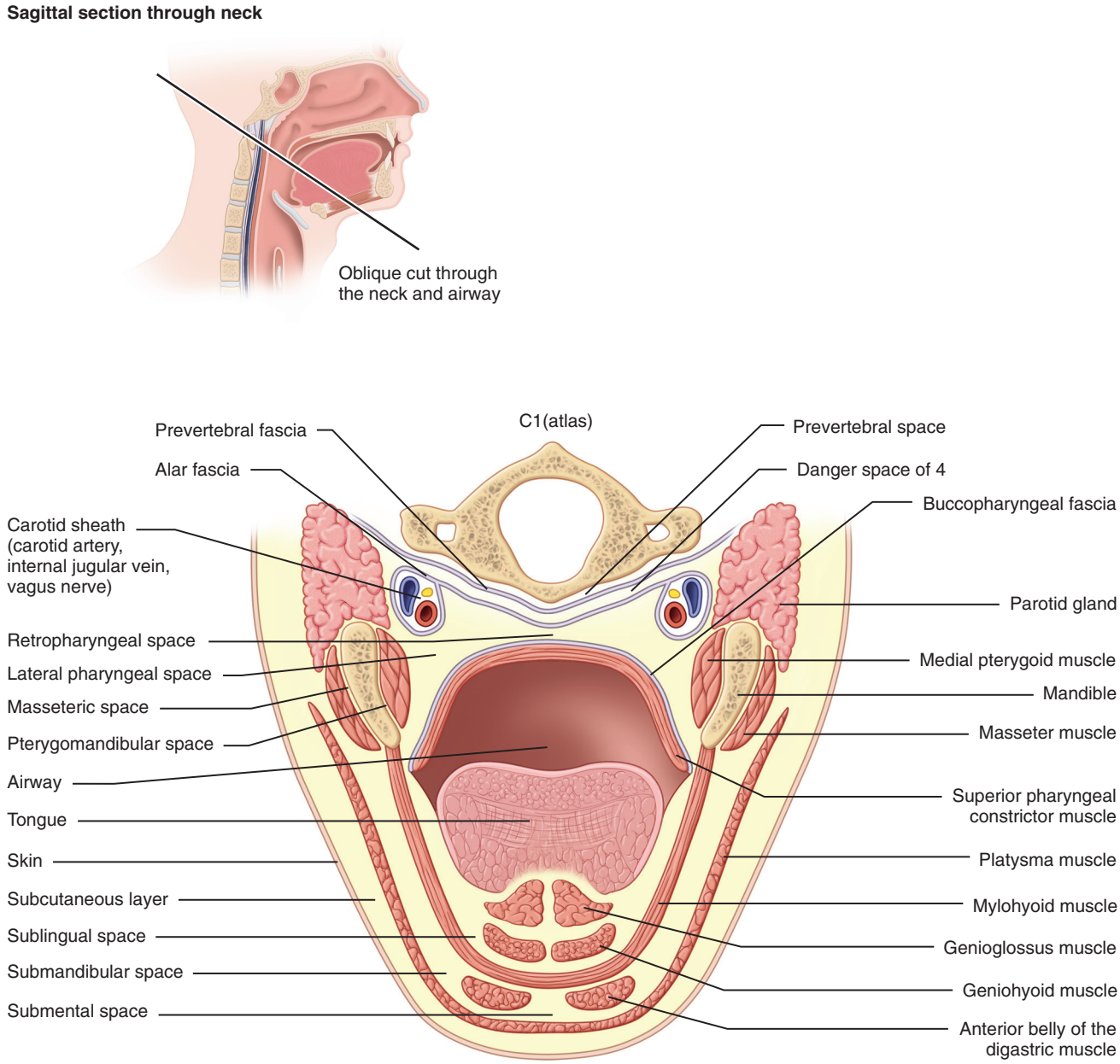


Fig. 60.8. Anatomy of maxillofacial space infections. (From Bagheri SC: Clinical review of oral and maxillofacial surgery, ed 2, St Louis, 2013, Elsevier/Mosby, Fig. 4.4.)

home with follow-up with the provider who performed the procedure.

ODONTOGENIC AND DEEP NECK INFECTIONS

Principles

Anatomy

The anatomy of the neck is complex and comprises multiple true and potential spaces. There are fascial planes that normally act to contain infection; with aggressive organisms, an immunocompromised state, or surgical breech of these planes, further extension can occur. For odontogenic infections, these spaces can be divided into those involved with maxillary infections and those involved with mandibular infections. More severe infections of the head and neck (such as, those involving these spaces) are called deep neck infections. An overview of the anatomy relevant to the discussion is presented in Fig. 60.8.

There are two primary spaces that can be involved with maxillary deep neck infections: the canine and buccal space. Infections of the root of the maxillary canine can lead to a *canine* space infection and often present with flattening of the ipsilateral nasolabial fold (Fig. 60.9). The major complication of this type of infection is cavernous sinus thrombosis. The *buccal* (buccinator) space can be involved with maxillary molars but also with mandibular molars (Fig. 60.10). Occasionally, the maxillary sinus itself can be involved.

The mandible has three associated primary spaces: submental, sublingual, and submandibular. The *submental* space is bound laterally by the digastric muscles and therefore causes a very discrete midline swelling when involved in a deep neck infection (Fig. 60.11); the mandibular incisors are the main culprits, because other teeth do not overly this space. The *sublingual* space is

between the floor of the mouth and the mylohyoid muscle, but it does not have a posterior border and therefore communicates with the submandibular space. Characteristically, infection of this space causes elevation of the tongue and firmness of the floor of the mouth (Fig. 60.12). Lastly, the *submandibular* space is usually involved as an extension of infection from a mandibular molar (Fig. 60.13). Although submandibular space infections have their medial border at the anterior belly of the digastric muscle, it can easily bypass this and enter the submental space and move to the contralateral submandibular space, as well as the sublingual space (because there is no posterior boundary); this leads to infection of all three spaces and causes *Ludwig angina.*

Fig. 60.9. Left canine space infection. (From Lypka M, Hammoudeh J: Dentoalveolar infections. Oral Maxillofac Surg Clin North Am 23[3]:415–424, 2011.)

These primary space infections can progress to secondary spaces and lead to more wide-spread infection into the neck and mediastinum. A discussion of these spaces (eg, retropharyngeal, parapharyngeal, prevertebral, and "danger" spaces) can be found in Chapter 65.

Pathophysiology

Oropharyngeal infections are the most common cause of deep neck infections in children (Fig. 60.14, Scenario 1 and 2). Acute tonsillitis can lead to peritonsillar abscesses and, if further invasion of the parapharyngeal space occurs, can spread into either the retropharyngeal (leading to a retropharyngeal abscess) or submandibular space (potentially leading to Ludwig angina). Children can have retropharyngeal lymphadenopathy with pharyngeal and/or sinus infections, which can lead to retropharyngeal cellulitis, lymphadenitis, or abscess. By age 4, there is spontaneous atrophy of these nodes; therefore, a retropharyngeal abscess in the absence of trauma (esophagogastroduodenoscopy [EGD], bone stuck in

Fig. 60.11. Submental space infection with characteristic discrete midline swelling. (From Flynn TR: Complex odontogenic infections. In Hupp JR, Ellis E, Tucker MR: Contemporary oral and maxillofacial surgery, ed 6, St Louis, 2014, Elsevier/Mosby, pp 319–338.)

Fig. 60.10. Left buccal space infection. **A,** Schematic. **B,** Photograph. (From Lypka M, Hammoudeh J: Dentoalveolar infections. Oral Maxillofac Surg Clin North Am 23[3]:415–424, 2011.)

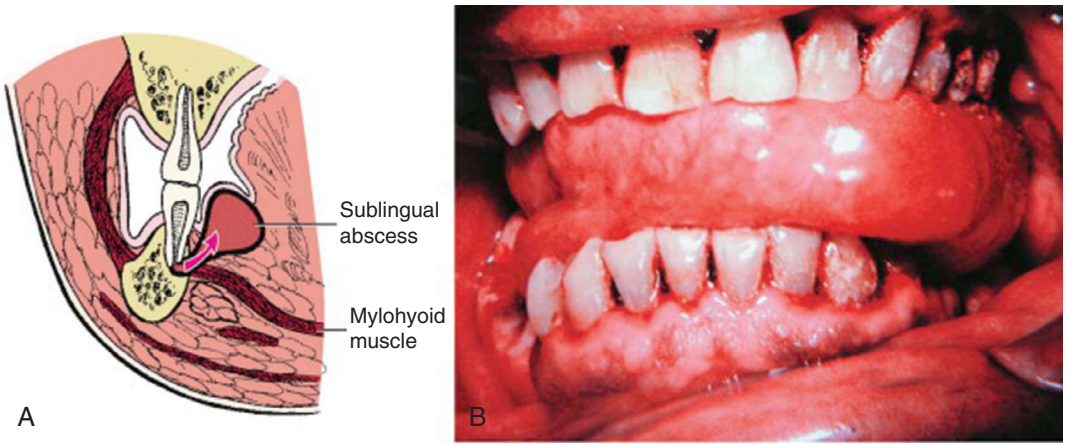


Fig. 60.12. **A,** The sublingual space lies between the oral mucosa and the mylohyoid muscle. The space is primarily involved by infection from mandibular premolars and first molar. **B,** Significant swelling causing elevation of the tongue. (From Flynn TR: Complex odontogenic infections. In Hupp JR, Ellis E, Tucker MR: Contemporary oral and maxillofacial surgery, ed 6, St Louis, 2014, Elsevier/Mosby, pp 319–338.)

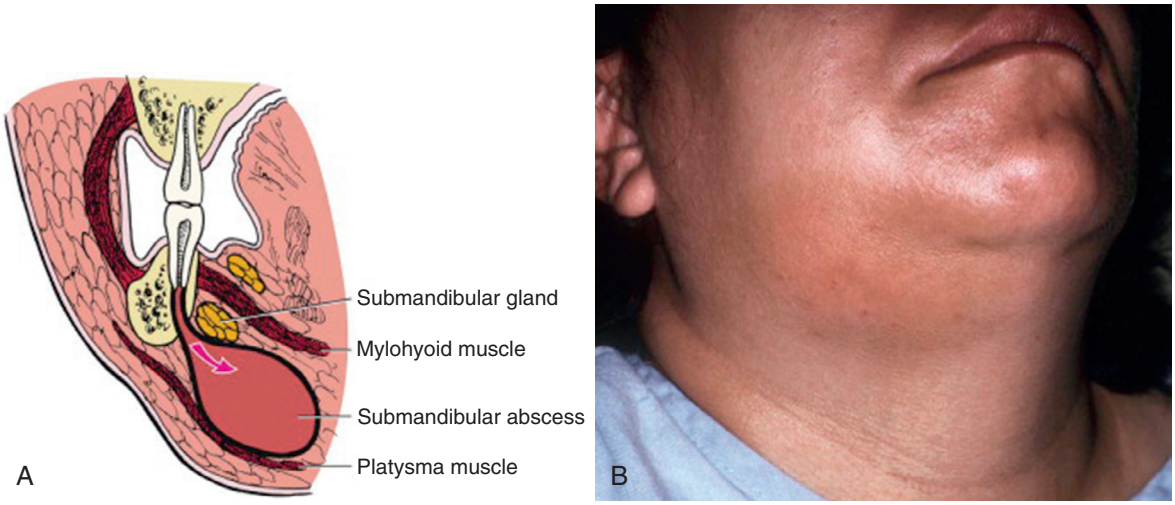


Fig. 60.13. **A,** Schematic of the submandibular space. **B,** Significant swelling that is bound medially by the digastric muscle. (From Flynn TR: Complex odontogenic infections. In Hupp JR, Ellis E, Tucker MR: Contemporary oral and maxillofacial surgery, ed 6, St Louis, 2014, Elsevier/Mosby, Figs. 17.15 and 17.16.)

throat, and so on) in older children or adults is rare.[7] Another complication of oropharyngeal infections is septic thrombophlebitis of the internal jugular vein, termed *Lemierre syndrome,* and is most frequently secondary to *Fusobacterium necrophorum.* Septic emboli dislodge from the internal jugular vein and lead to necrotic pleuropulmonary emboli, abscesses, and empyema. More distant embolic events can occur, leading to brain abscesses, meningitis, and septic joints.

Dental infections are the most common cause of deep neck infections in adults (see Fig. 60.14, Scenario 3). Pus can leak from the apex of an infected tooth root and form a periapical abscess, confined within the alveolar bone (Fig. 60.15). The abscess may break through the cortical plate of either the mandible or the maxilla and spread subperiosteally, extending into the previously-described spaces. When the submental, submandibular, and sublingual spaces are involved with cellulitis with or without abscess, Ludwig angina occurs. Ludwig angina is a bilateral, boardlike swelling involving the submandibular, submental, and sublingual spaces with elevation of the tongue (Fig. 60.16). The most serious immediate sequelae is airway obstruction. A characteristic brawny induration is present; there is no fluctuance for incision and drainage. Hemolytic Streptococcus is most commonly responsible for the infection, although a mixed staphylococcal-streptococcal flora is common, and both may lead to an overgrowth of anaerobic gas-producing organisms, including *Bacteroides fragilis.*

Facial cellulitis is typically polymicrobial with a predominance of anaerobes, which reflects typical oropharyngeal flora.[8] However, atypical organisms can also be present: Actinomyces can cause cervicofacial actinomycosis with draining sinus tracts, tuberculosis can cause cervical lymphadenopathy (scrofula) with secondary infection, and *Bartonella henselae* (the causative organism for cat scratch disease) can cause cervical lymphadenitis.

Clinical Features

Historical Features

Facial cellulitis and deep neck infections have many common historical features: in children, an antecedent sinus or pharyngeal infection is common; in adults, a history of poor dentition is common. Frequently-reported symptoms include pain at the affected site, fever, and malaise.

Recent dental work or trauma, recent upper airway manipulation or surgery, intravenous (IV) drug abuse, sinusitis, and

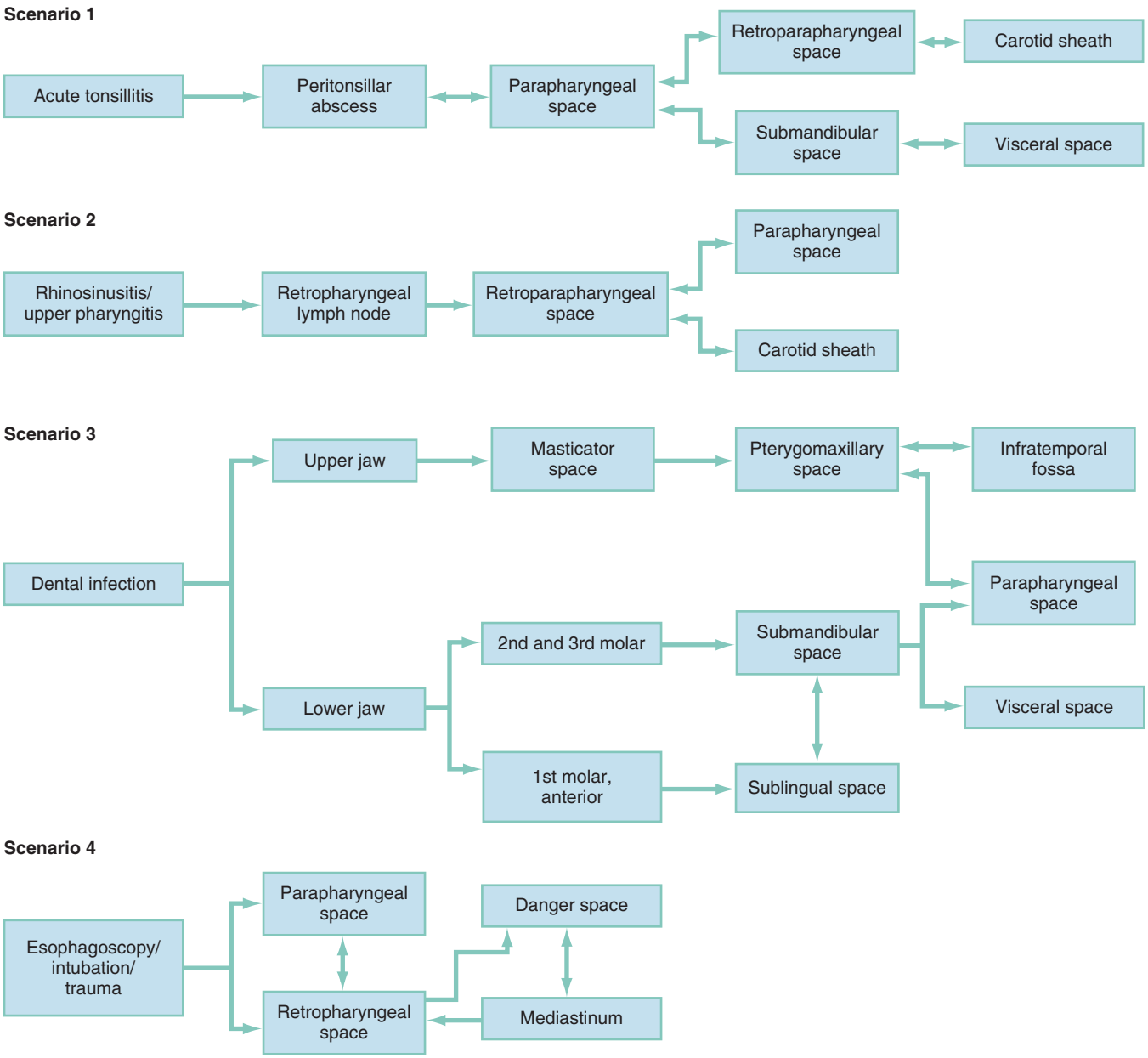


Fig. 60.14. Common routes of spread in deep neck infections. (Modified from Cummings CW, Flint PW, Harker LA: Cummings otolaryngology head & neck surgery, ed 4, St Louis, 2004, Elsevier/Mosby, Fig. 10.2.)

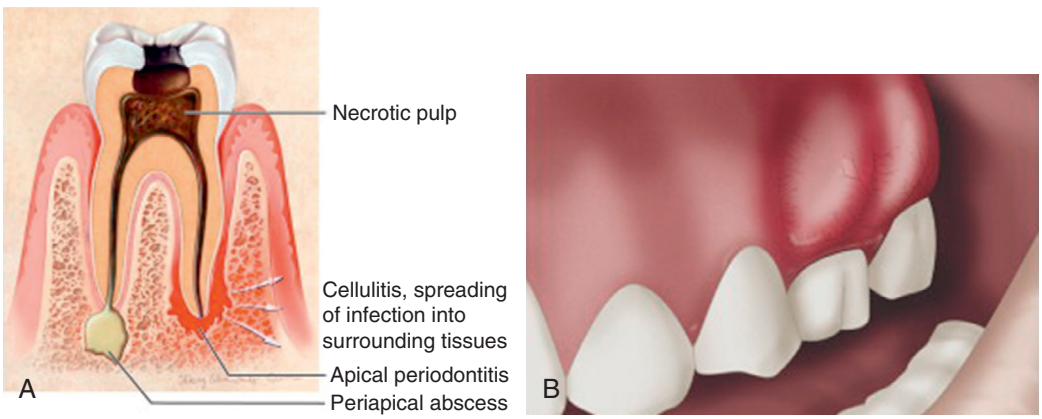


Fig. 60.15. **A,** Periapical abscess diagram. **B,** Physical examination findings of a periapical abscess. (From Buttaravoli P, Leffler SM: Minor emergencies, ed 3, St Louis, 2012, Elsevier, pp 178–180, Figs. 45.3 and 45.4.)

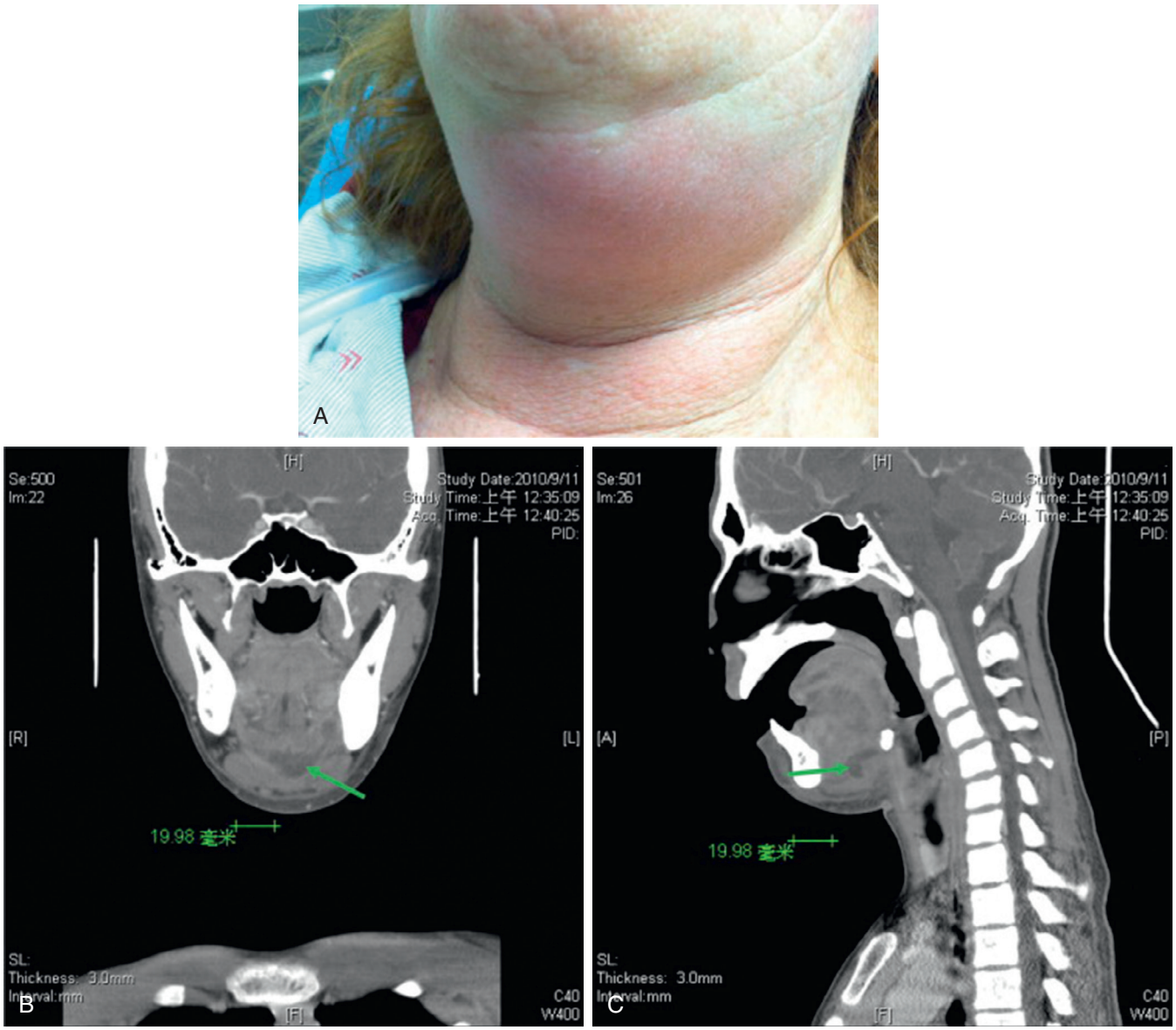


Fig. 60.16. Ludwig angina. **A,** Photograph. **B,** Coronal computed tomography (CT) scan. **C,** Sagittal CT scan. (**A,** From Hughes D, Holt S, Kman NE: Ludwig's angina triaged as an allergic reaction. J Emerg Med 45[5]:e175–176, 2013, Fig. 2. **B** and **C,** From Kao, et al: Ludwig's angina in children. J Acute Med 1[1]:23–26, 2011, Fig. 3 [coronal] and 4 [sagittal].)

otitis media are all risk factors for infection. Patients who are immunosuppressed from HIV/acquired immunodeficiency syndrome (AIDS), cirrhosis, diabetes, chemotherapy, and/or steroid use are all at higher risk and should raise suspicion.

Physical Examination

A complete head and neck examination is required, keeping in mind the aforementioned anatomy. Extraoral palpation can help assess whether there is deep space involvement; presence or absence of tenderness, warmth, fluctuance, and crepitus should be evaluated. The quality of dentition should be assessed and any concerning areas should be percussed for tenderness, which may indicate a periapical abscess. The floor of the mouth should be evaluated to see if the sublingual space is involved.

Irritation of the internal pterygoid or masseter muscles causes trismus, which is the inability to open the mouth because of involuntary muscle spasm. Trismus limits the ability to perform a complete oral examination; it will also make intubation difficult because it is not relieved with neuromuscular blockade. Difficulty swallowing or handling secretions suggests the possibility of retropharyngeal or parapharyngeal infection. Respiratory distress may be apparent, or the airway may occlude rapidly after a period of minimal signs of impending obstruction.

Diagnostic Testing

A complete blood count usually shows leukocytosis, but the absence of such does not rule out a deep neck infection or significant cellulitis. The imaging modality of choice is a computed tomography (CT) of the face (and, if clinically indicated, the neck as well) with IV contrast (if not contraindicated). The physical examination may be inaccurate in correctly determining the extent of an infection, and CT is required to delineate the infection and to ascertain its effects on adjacent structures (eg, the airway). Patients with HIV have an increased risk of deep neck infections, and HIV testing may be helpful for patients not known to have HIV and not recently tested.[9]

TABLE 60.3

Recommended Antibiotics for Deep Neck Infections

ANTIBIOTIC	DOSAGE	NOTES
Ampicillin/sulbactam **plus** vancomycin	3 g IV every 6 hours 20 mg/kg (2 g maximum)	
Clindamycin	600 mg IV every 8 hours	If allergic to penicillin
Meropenem **plus** vancomycin	1 g IV every 8 hours	If immunocompromised

IV, Intravenous.

Management

Well-appearing patients with simple odontogenic infections (localized infection, no recent antibiotics, and an immunocompetent patient) can be managed with antibiotics as shown in Table 60.2. Simple tooth abscess can be drained with local incision under local anesthesia if the clinician is skilled in the procedure. A 3-day course of antibiotics is as effective as a 5- or 7-day course of antibiotics after drainage of a localized dentoalveolar abscess if the patient has systemic symptoms. In the absence of systemic symptoms, routine antibiotics are unnecessary after successful drainage of a periapical abscess.[10]

Most abscesses are drained by dentists or oral surgeons and tooth extraction may be required. Oral or oral maxillofacial surgery consultation is advisable before drainage of suspected deeply-seated abscesses.

All serious deep neck infections should have broad-spectrum IV antibiotics administered. We recommend ampicillin-sulbactam with vancomycin or, if allergic to penicillin, clindamycin monotherapy in the immunocompetent host. See Table 60.3 for further details regarding antibiotic therapy in deep neck infection.

Ludwig angina management consists of antibiotics and airway management. Oral intubation may be difficult because of inability to displace the tongue with a laryngoscope. Intubation is not generally emergent and can be done in the operating room. Examination of the glottis and supraglottic airway by flexible endoscopy will ascertain the degree of airway compromise and, hence, the urgency of airway management. When emergent intubation is indicated, or a patient requires intubation before a prolonged transfer for care, we recommend use of a videolaryngoscope or flexible intubating endoscope (see Chapter 1). Consultation with an oral maxillofacial surgeon or otolaryngologist is indicated.

Disposition

Those with simple odontogenic infections can be discharged with close outpatient follow-up; more severe odontogenic infections, systemic toxicity, or immunocompromised patients should be admitted. Deep neck infections should be admitted. Those with concern for airway compromise (eg, Ludwig angina) or with extension into the neck or mediastinum should be admitted to the intensive care unit (ICU) after thorough evaluation of the airway by CT, flexible endoscopy, or both.

DENTOALVEOLAR TRAUMA

Principles

Anatomy

Dentoalveolar trauma is common complaint and can involve any tooth. The maxillary central incisors are commonly-involved because many children have an anterior overbite, predisposing these teeth to injury. When teeth are subject to trauma, they can become concussed (with pain to percussion), subluxed (whereby teeth become more mobile, but are in their normal anatomic position), luxed (moved from their anatomic position), avulsed (out of the socket), or fractured. Refer to the first section of this chapter to review the relevant dental anatomy.

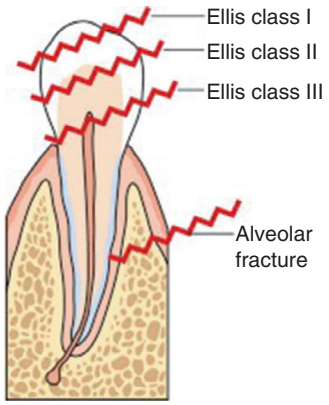


Fig. 60.17. Ellis fracture classification. *Ellis class I* fractures involve the enamel only; *Ellis class II* fractures involve the enamel and dentin; *Ellis class III* fractures involve the enamel, dentin, and pulp. (From Fowler GC: Management of dental injuries. Pfenninger JL, Fowler GC, editors: Pfenniger and Fowler's procedures for primary care, Philadelphia, 2011, Elsevier/Mosby, pp 511–515, Fig. 81.2.)

Pathophysiology

Dental Fractures. Forces that are applied to a tooth can lead to fractures. Fracture classification is important, because it guides management. When a fracture only involves the enamel, it is termed an *Ellis class I;* when a fracture involves the enamel and dentin, it is termed an *Ellis class II;* when a fracture involves the enamel, dentin, and pulp, it is termed an *Ellis class III* (Fig. 60.17). It is appropriate to name the fracture either anatomically (eg, a fracture of the right maxillary central incisor involving the enamel and dentin) or by Ellis classification (eg, an Ellis class II fracture of the right maxillary central incisor). Some practitioners are unfamiliar with the Ellis classification, but an anatomic description is always understood and is therefore probably preferred. The presence of dentin can be ascertained by seeing the yellow tint of the dentin through the fracture. Fractures involving the pulp have a pinkish tinge or have a small amount of visible blood.

Concussion, Subluxation, Luxation, and Avulsion. Concussion occurs when the periodontal ligament sustains a mild injury, causing tooth pain but no mobility. More severe injuries include subluxation or luxation. If a tooth is mobile but is in the correct anatomic position, it is subluxed and will heal as long as no further trauma occurs. Luxation is where the tooth itself is moved in any direction that is no longer anatomic, and it can be further divided into four types: (1) extrusive luxation is where the tooth is forced partially out of the socket in an axial direction, (2) intrusive luxation occurs when a tooth moves apically (and can be mistaken for an avulsion if completely intrusively luxated), (3) laterally luxed, where the tooth is displaced laterally with potential surrounding alveolar bone injury, and (4) avulsion where the tooth is completely out of the socket (Fig. 60.18). A long-term sequela of blunt trauma or reimplantation of teeth is resorption of the root.

Dental trauma can also involve the surrounding alveolar bone. The alveolar bone usually breaks in segments, leading to malocclusion, pain, and a segment of teeth that are misaligned with respect to their uninvolved neighbors (Fig. 60.19). These injuries usually present in conjunction with injury to the tooth itself.

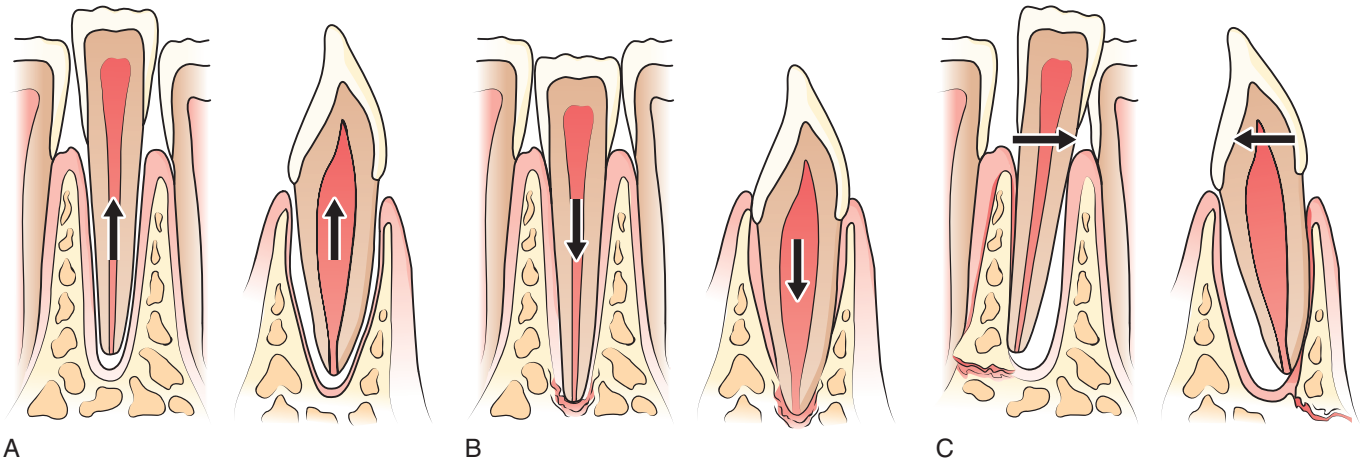


Fig. 60.18. Luxation of teeth. **A,** Extrusive luxation occurs when the tooth is forced partially out of the socket in an axial direction. **B,** Intrusive luxation of a tooth compresses the periodontal ligament and vascular supply of the pulp. It may even crush the apical bone. **C,** Lateral luxation occurs when the tooth is displaced in a lingual, mesial, distal, or facial direction. Fractures of the alveolar bone frequently accompany lateral luxation injuries. (From Roberts J: Roberts and Hedges' clinical procedures in emergency medicine, ed 6, Philadelphia, 2014, Elsevier, Fig. 64.9.)

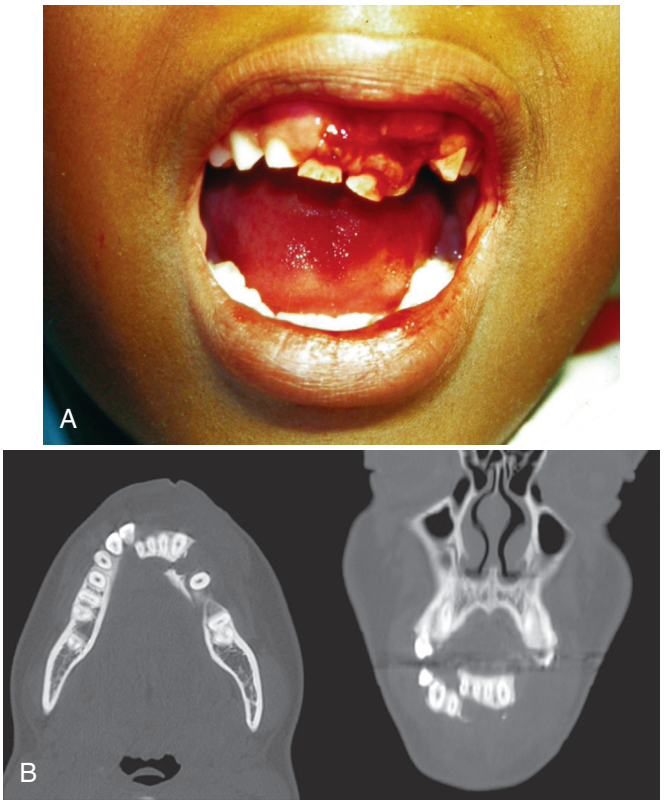


Fig. 60.19. A, Alveolar ridge fracture involving the maxillary incisors with a segment of teeth misaligned with respect to their neighboring teeth. **B,** Computed tomography (CT) demonstrating an alveolar ridge fracture in the axial and coronal planes, respectively. (From Roberts J: Roberts and Hedges' clinical procedures in emergency medicine, ed 6, Philadelphia, 2014, Elsevier, Figs. 64.14 and 64.15.)

Clinical Features

Historical Features

Patients invariably will have a history of dentoalveolar trauma. Replantation of a pediatric tooth depends on whether the tooth is primary or secondary. Fig. 60.20 can be used as a general guideline; primary dentition should never be reimplanted. Reimplanted primary teeth ankylose or fuse to the bone, potentially leading to interference with the eruption of the permanent tooth. Assessing the storage medium and timing of avulsion of a permanent tooth is important as it predicts success of reimplantation.

Physical Examination

Missing teeth should be accounted for. If a tooth appears to be missing, ask if there were teeth recovered at the scene. If no tooth is visualized, examine the socket to see if the tooth has been intrusively luxated. The surrounding soft tissue should be evaluated, because parts of teeth and even entire teeth can be embedded in a deep mucosal laceration. If no tooth is found, a chest x-ray should be obtained to exclude aspiration.

The teeth should be inspected to evaluate for fractures, tenderness, and mobility. The diagnosis of subluxation can be made by gently tapping a tooth with two tongue blades: any perceptible mobility is evidence of subluxation.

The oral mucosa and tongue should be evaluated for trauma. Small lacerations can usually be managed expectantly, but larger lacerations may require repair. Evaluate injuries for foreign bodies and to ensure injuries are not full-thickness.

Diagnostic Testing

Diagnosis of a tooth fracture or luxation is clinical, but CT of the face or an orthopantomogram (Panorex) x-ray can be ordered if CT is not available. Specialized views (eg, maxillary anterior, periapical views) are used by dental professionals but are not regularly available in the ED.

Management

Prior to any manipulation of teeth, appropriate analgesia should be administered. Nerve blocks such as supraperiosteal nerve blocks (for isolated teeth) or inferior alveolar nerve blocks (for multiple traumatized mandibular teeth) are highly effective and easy to perform.

The status of tetanus immunization should be checked, and the patient should be treated according to the standard for a non-tetanus-prone wound (10-year immunization update). All patients with dentoalveolar trauma (especially those who have splinting or

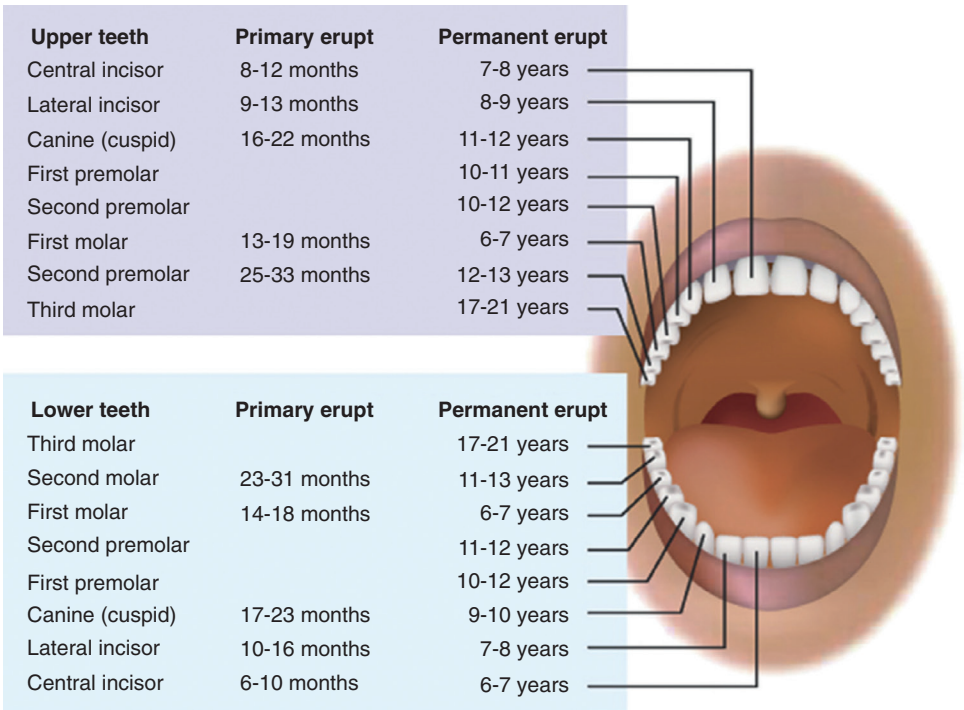


Fig. 60.20. Age of primary dentition and secondary (permanent) dentition of various teeth. (From Olynik CR, Gray A, Sinada GG: Dentoalveolar trauma. Otolaryngol Clin North Am 46[5]:807–823, 2013, Fig. 2.)

calcium hydroxide paste applied) should be placed on a liquid diet for several days and advanced to a soft diet for 1 week.

Dental Fractures

Fractures of teeth involving the enamel only (Ellis I) need no emergent treatment. If available, an emery board can be used to file down any sharp edges to prevent intraoral trauma. Deeper fractures involving the dentin only (Ellis II) or both dentin and pulp (Ellis III) need to be covered with a calcium hydroxide paste to protect the underlying structures from infection. ED pulpotomy to remove exposed pulp has been described, but it has a high complication rate and should not be attempted. The main difference in management between an Ellis II and III fracture is immediacy of follow-up: Ellis III needs immediate consultation, whereas Ellis II needs follow-up within 24 hours. We recommend follow within 24 hours for all dental fractures that do not receive dental consultation in the ED.

To cover the tooth, dry the affected tooth. Mix the catalyst and base of the calcium hydroxide product and directly apply to the exposed tooth surface (Fig. 60.21). To keep the tooth dry, gauze rolls in the mucobuccal fold and a nasal cannula with air or oxygen directed at the anesthetized tooth surface is often helpful.

Tooth Avulsion

Avulsed *permanent* teeth should be reimplanted at the earliest opportunity. Permanent teeth should be handled only by the crown to avoid injury to the periodontal ligament at the root. In the prehospital setting, the tooth can be reimplanted or stored in an appropriate medium. Ideally, the tooth should be stored in either a commercially-available solution, such as Hank's balanced salt solution (eg, Save-A-Tooth, EMT Toothsaver) or milk. Oral rehydration solution can also be used as a storage medium.[11] A 2013 literature review of all storage solutions found that milk performed better than even saliva; therefore, if a commercially-available storage solution is not available and immediate reimplantation is not undertaken, milk is the preferred storage medium.[12] See Table 60.4 for the approximate length of viability of a tooth based on the solution in which it is stored.

TABLE 60.4

Periodontal Ligament Cell Viability by Storage Medium

SOLUTION	LENGTH OF PRESERVATION OF PERIODONTAL LIGAMENT
None (dry)	Less than 60 minutes
Milk	3 to 8 hours
HBSS	12 to 24 hours
Oral rehydration solution	Similar to HBSS

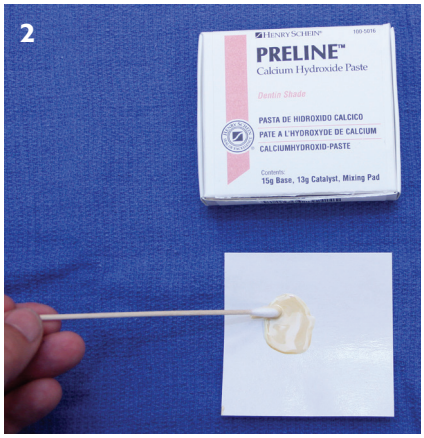
HBSS, Hank's balanced salt solution.

Some texts recommend soaking the tooth in a 5% doxycycline solution for 5 minutes prior to reimplantation based on experimental data with periodontal cells, but a 2015 study demonstrated no clinical benefit and obtaining the solution and completing the soaking simply delays reimplantation. Therefore, we do not recommend this practice.[13] The 2012 International Association of Dental Traumatology guidelines list doxycycline soaking as only a consideration.[14]

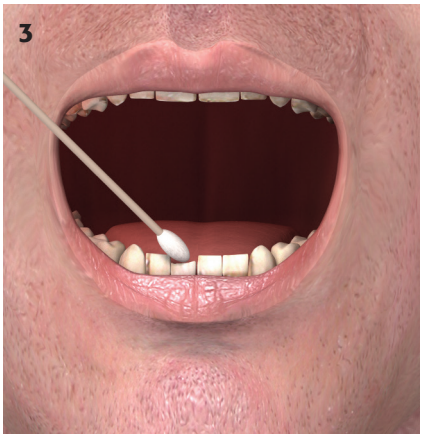
In the awake patient not at risk for aspiration, provide analgesia (eg, supraperiosteal nerve block), rinse the permanent tooth with saline, irrigate the socket to remove debris, and reimplant the tooth into the socket. Do not remove debris from the tooth that does not come off with saline, because manual removal can damage the periodontal ligament cells. After replantation, a dental consultant can provide immobilization for the reimplanted tooth. If dental consultation is not available, use periodontal dressing material (Coe-Pak) to splint the tooth to the adjacent normal

CALCIUM HYDROXIDE APPLICATION

Calcium hydroxide is used to treat dentin fractures and aids in prevention of infection and pain relief. It is supplied in separate tubes of catalyst and base.



Mix equal portions of catalyst and base on the mixing pad that is supplied with the product. A dental spatula is an ideal tool; however, a simple cotton applicator will suffice.



Dry the tooth surface prior to application by having the patient bite down on a gauze pad. Then place a small amount of the paste onto the exposed surface. It will dry within minutes.

Fig. 60.21. Calcium hydroxide application for the treatment of fractures involving the dentin (Ellis class II) and pulp (Ellis class III). (From Roberts J: Roberts and Hedges' clinical procedures in emergency medicine, ed 6, Philadelphia, 2014, Elsevier, Fig. 64.7.)

teeth to provide a 24 to 48 hour temporary splint. A resin and catalyst paste are mixed together in equal quantities to a firm consistency and molded over the anterior and posterior aspects of the involved tooth and two or three adjacent teeth on each side (Fig. 60.22). The gingiva and enamel must be completely dry; the provider's gloves should be wet or covered in lubricating jelly to allow for ease of handling of the paste. The positioning of the tooth does not need to be anatomically perfect, just approximate. Avoid getting the paste on the occlusal surface of the tooth. Advise the patient to have a soft diet (but avoid hot liquids that may soften the packing) and follow up with a dentist within 24 hours. Doxycycline 100 mg by mouth bid for 7 days should be prescribed in adults; in children younger than 12 years old (in whom doxycycline is contraindicated), penicillin 50 mg/kg/day divided qid (maximum 500 mg qid) for 7 days is an alternative. Patients should be further counseled on brushing gently with a soft toothbrush after each meal and utilizing chlorhexidine mouth rinses twice a day for 1 week.

Luxation and Alveolar Fractures

Teeth that are concussed or subluxed usually do not need specific treatment. Teeth that have undergone extrusive or lateral luxation should be gently placed into anatomic position and splinted in place. Intrusive luxation does not have any ED-specific interventions except referral to a specialist, because the tooth cannot be easily retrieved.

Alveolar fractures may be apparent clinically from exposed pieces of bone or diagnosed radiographically. In massive facial trauma, care should be taken to conserve as much of the alveolar bone as possible, unless there is a great danger of aspiration. Indiscriminate loss of alveolar bone results in tremendous cosmetic deformity that is difficult to restore with prosthetic devices or leaves no foundation for a dental implant, thus necessitating autologous bone grafting procedures. An alveolar fracture will eventually require 4 to 6 weeks of stabilization for adequate healing; if there is an associated subluxed or avulsed tooth, stabilization is maintained at the expense of possible ankylosis of the tooth.

Soft Tissue Injuries

Generally, lacerations to the buccal mucosa do not require repair if under 1 cm. A common rule is that if food can get stuck in the laceration, it should be considered for repair. Lacerations to the gingiva that expose the base of the teeth should be repaired; this is a complex repair, however, and consultation or referral is indicated if the clinician is not experienced with the procedure. Frenulum injuries generally are not repaired. However, frenulum injuries in neonates and infants should raise suspicion of child abuse (see Chapter 177).

Tongue lacerations usually heal well without intervention unless they are gaping, have a flap, involve the muscle, cause a bifid or grooved tongue, or if hemostasis cannot be achieved otherwise. After a lingual block or direct infiltration of anesthetic and irrigation, absorbable sutures such as 4-0 chromic, Vicryl, Dexon, or Vicryl Rapide can be used. Lacerations involving the muscular layer of the tongue should be closed with one set of deep sutures that involve both the muscle and mucosa; a two-layer repair is not necessary. Full-thickness tongue lacerations can be closed either in three layers (eg, mucosa inferiorly, muscle, mucosa superiorly) or one side of the mucosa can be repaired followed by a set of deep sutures that closes the muscular layer and opposing mucosa.

Disposition

Patients with dentoalveolar trauma usually do not need to be admitted, unless they have other concomitant trauma, uncontrolled pain, or have severe trismus preventing oral intake. All patients should have appropriate follow-up. Discharge with appropriate analgesia, antibiotics if indicated, and dental hygiene instructions.

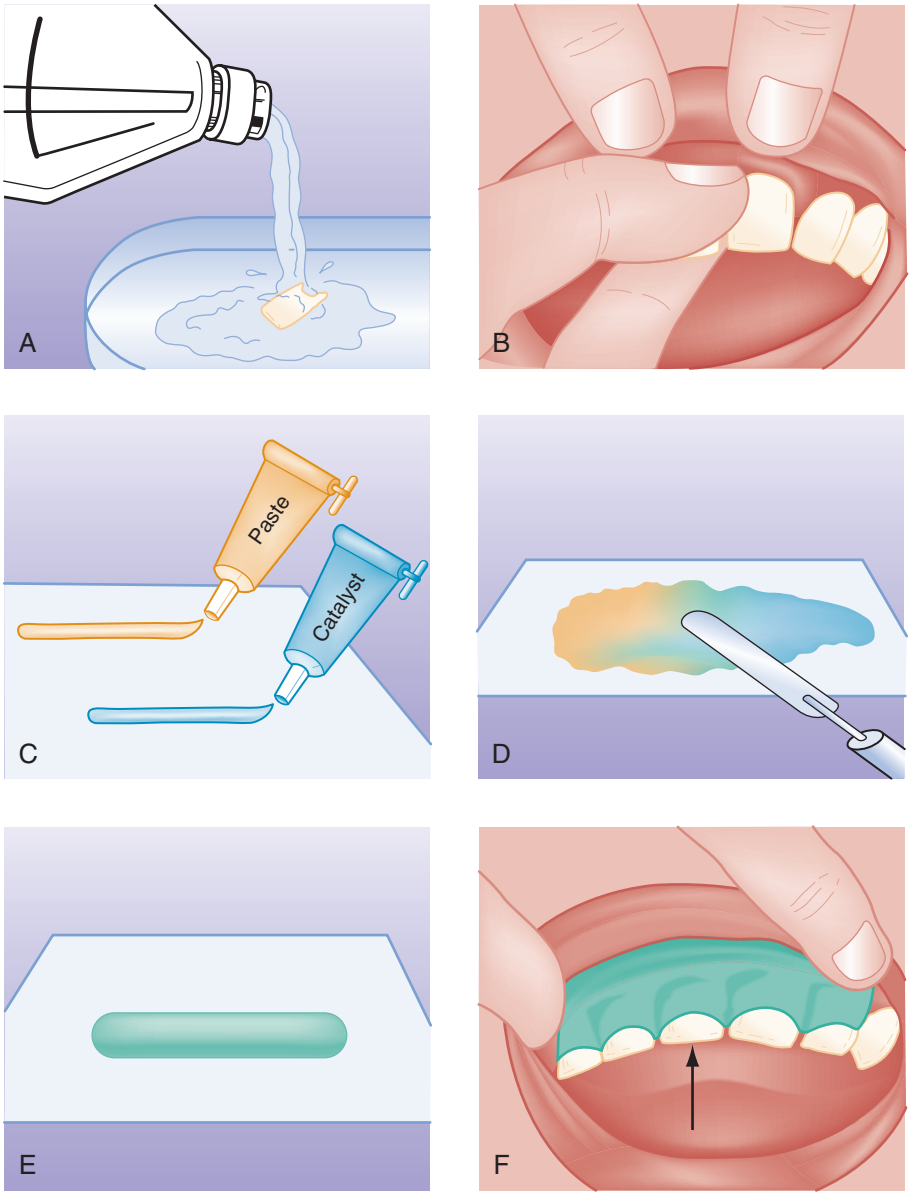


Fig. 60.22. Reimplantation and stabilization of an avulsed tooth. **A,** Tooth is rinsed. **B,** Tooth is placed back into socket. **C** and **D,** Periodontal pack is mixed. **E,** Splint material is ready for application. **F,** Packing is molded over reimplanted tooth and two adjacent teeth to either side.

TEMPOROMANDIBULAR JOINT DISORDER AND DISLOCATION

Principles

Anatomy

The TMJ is the articulation between the squamous portion of the temporal bone and the condyle of the mandible. It is comprised of two types of synovial joints: hinge and sliding. The hinge joint action dominates during normal mouth opening, but with wide opening, translational movement occurs and the articular disc and condyle complex slide inferiorly (Fig. 60.23). When the condyle moves anterior to the articular eminence, dislocation occurs.

Pathophysiology

Temporomandibular Joint Disorder. The cause of TMD is debated, but jaw clenching and grinding associated with stress is thought to contribute. Tooth malocclusion was previously thought to be a common etiology, but this is rare unless there is an inciting event (eg, if symptoms began after dental work with resultant malocclusion).

Temporomandibular Joint Dislocation. TMJ dislocation occurs when the condyle travels anteriorly along the eminence and becomes locked in the anterosuperior aspect of the eminence. The masseter, internal pterygoid, and temporalis go into spasm attempting to close the mandible; trismus results and the condyle cannot return to the temporal fossa. Mandibular dislocation is painful and frightening for the patient. Patients prone to mandibular dislocation include individuals with anatomic disharmonies between the fossa and articular eminence, weakness of the capsule and the temporomandibular ligaments, or torn ligaments. Dystonic reaction to drugs may result in mandibular dislocation. Patients who have had one episode of mandibular dislocation are predisposed to further dislocations. If a unilateral dislocation has occurred, the jaw deviates to the opposite side. More commonly, a symmetrical dislocation occurs.

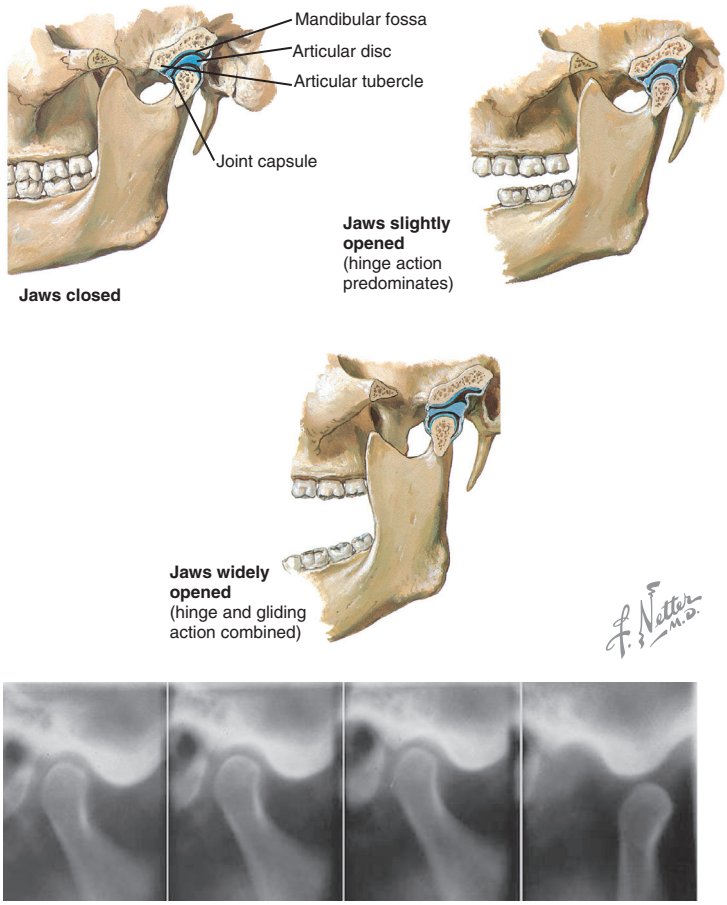


Fig. 60.23. The temporomandibular joint (TMJ). With slight opening, the joint's function as a hinge predominates. With greater jaw opening, there is translational movement. (From Norton NS: Temporomandibular joint. In: Netter's head and neck anatomy for dentistry, ed 2, Philadelphia, 2012, Elsevier/Saunders 2011.)

Clinical Features

Historical Features

Temporomandibular Joint Disorder. TMD is defined as "aching in the muscles of mastication, sometimes with occasional brief severe pain on chewing, often associated with restricted jaw movement and clicking or popping sounds." Therefore, history should focus on elucidating whether or not the patient has those features. Patients may complain of a headache, facial pain, or even an earache. Pain is often precipitated by use of the muscles of mastication (eg, chewing) or with increased ranging of the TMJ (eg, laughing, yawning).

Temporomandibular Joint Dislocation. The mandibular condyles may dislocate from trauma, but more often, dislocation follows extreme opening of the mandible, such as the case with yawning. Patients may have had prolonged jaw opening, such as in the case of dental procedures. They will complain of not being able to close the mouth. Recurrent dislocations are common, and patients may present knowing they have an anterior dislocation. Verbalization of their complaint is often difficult because their mouth is stuck open.

Physical Examination

Temporomandibular Joint Disorder. For TMDs, the main physical signs are related to three items: joint sounds, such as crepitus or a joint click upon range of motion; limitations of joint movements with pain during assisted maximum mouth opening; and muscle and joint pain and pain just anterior to the auricular canal. None of these findings alone has sufficient testing characteristics to rule TMD in or out, however.[15] The diagnostic criteria of TMJ is outside the scope of this text, because there are many subtypes; the criteria were most recently updated in 2014 and the included reference can be used.[16]

Temporomandibular Joint Dislocation. On examination, jaw dislocations are usually readily apparent. The jaw will not be able to be closed, and a depression can be felt and seen in the preauricular area; there may be the appearance of an underbite as the mandible is anteriorly displaced. Symmetry should be evaluated, because occasionally a jaw dislocation will be unilateral. If a traumatic mechanism is suspected, a secondary survey for trauma should be initiated.

Differential Diagnoses

The diagnosis of a TMJ dislocation is straightforward. However, TMD has many presenting complaints and therefore consideration for other etiologies is warranted. Pain can be secondary to pulpitis, an odontogenic infection, headache, otitis media (as ear pain is a presenting complaint of TMD), sinusitis, and trigeminal neuralgia.

Diagnostic Testing

Radiographs are not indicated for straight-forward nontraumatic dislocation, unless the diagnosis is not certain. In cases of traumatic dislocation, a panoramic view of the mandible (Panorex)

or CT scan of the facial bones should be considered to exclude the possibility of a fracture.

Management

Temporomandibular Joint Disorder

Patients with TMD often have symptoms that fluctuate over time, and therefore initial therapy should be conservative. NSAIDs, application of heat or cooling, and consideration of bite guards if the patient has bruxism are all reasonable first-line therapies. Heat therapy is typically 15 minutes at a time, four to six times daily. Refractory cases can also benefit from diazepam (2 to 5 mg by mouth tid or qid).[17] If the symptoms are more severe, referral to a specialist is warranted because a multidisciplinary approach is often necessary to manage symptoms; there are even studies investigating transcutaneous electrical nerve stimulation therapy, and refractory cases may benefit from surgical intervention.[18-19]

Temporomandibular Joint Dislocation

Reduction of a dislocated mandible is often difficult, because masseter muscle contraction must be overcome. To relax the masseter, procedural sedation and analgesia is almost invariably necessary. Either facing the patient or from behind, the emergency clinician grasps the mandible with both hands; the thumbs rest on the ridge of the mandible intraorally, posterior to the molars, and the fingers wrap around the outside of the jaw. It is best to have the patient sitting up, with a firm surface behind the head, so that posterior and inferior pressure can be exerted without accompanying movement of the patient's entire head. Some physicians prefer to place the thumbs on the occlusal surfaces of the teeth; in this case, the thumbs are wrapped with gauze and fortified with a piece of wooden tongue blade to protect them when reduction is accomplished, because the masseter muscles can contract with tremendous force.

Firm, progressive, downward pressure is applied on the mandible to free the condyles from the anterior aspect of the eminence; the mandible is guided caudally, then posteriorly and superiorly back into the temporal fossae (Fig. 60.24). If this maneuver is unsuccessful, both hands can be used on the affected side of the mandible.[20] The patient is advised to avoid extreme opening of the mandible, such as occurs during laughing and yawning, to begin a soft diet for 1 week, and to apply warm compresses in the TMJ area. NSAIDs and muscle relaxants may be helpful. Patients with chronic dislocation may be helped initially with the application of a Barton bandage (elastic fabricated bandage that wraps around the top of the head and mandible).

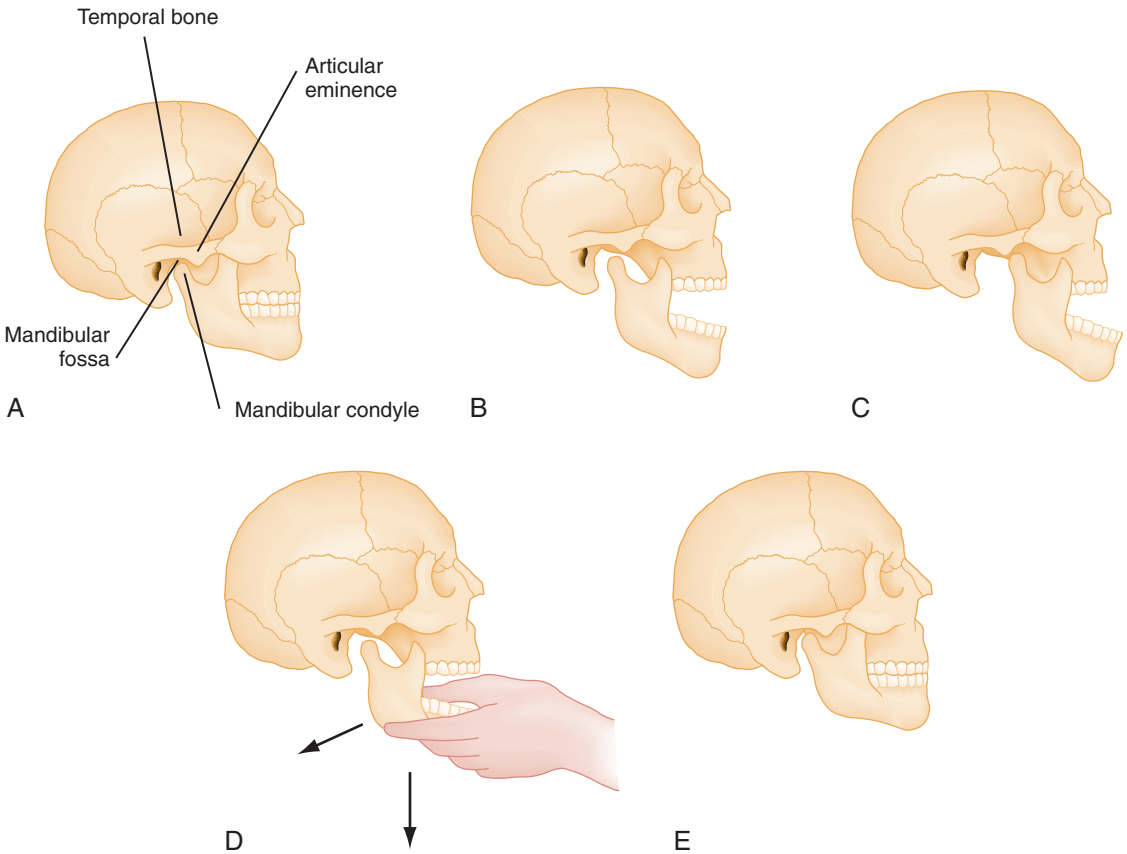


Fig. 60.24. Reduction of temporomandibular joint (TMJ) dislocation. The TMJ is illustrated in normal and dislocated positions. **A,** Closed position, with the mandibular condyle resting in the mandibular fossa behind the articular eminence. **B,** In maximally open position, the mandibular condyle is just under and slightly behind the articular eminence. **C,** In dislocated position, the mandibular condyle moves forward and upward slightly above the articular eminence; muscle spasm then occurs. **D,** For reduction of dislocation, the thumbs are placed intraorally and lateral to the lower molars, and pressure is applied to the lower molar ridge area near the jaw angle in a downward and backward direction. **E,** When the mandibular condyle has cleared the articular eminence, muscle contraction returns the jaw to a normal closed position. (Adapted from Rose LF, Hendler BH, Amsterdam JT: Temporomandibular disorders and odontic infections. Consultant 22:125, 1982.)

More recently (2014) a new technique was described for a hands-free approach for reduction of acute nontraumatic TMJ dislocation using a "syringe" technique.[21] With this technique, a 5- or 10-mL syringe is placed between the posterior upper and lower molars (or gums if edentulous) on the affected side. The patient then gently bites down and rolls the syringe back and forth; the syringe is a rolling fulcrum that helps the anteriorly-displaced condyle slip back into its normal position.

Disposition

Patients with TMD and with TMJ dislocation who have been relocated can be discharged home. Those with irreducible TMJ dislocation or those with TMJ dislocation in conjunction with a fracture should have specialty consultation and may require admission for surgical reduction and fixation.

KEY CONCEPTS

- Assessment of airway patency, either by CT or flexible endoscopy, is important during assessment of deep space infections of dental origin. Patients with significant airway compromise should be intubated.
- Tissue infections are treated for 10 days with simple penicillin or ampicillin/sulbactam. For penicillin-allergic patients, use metronidazole or clindamycin.
- Fractures of teeth are managed differently depending on which structures are involved—enamel, dentin, or pulp exposure.
- Avulsed *permanent* teeth are reimplanted as quickly as possible and are best preserved in Hank's solution; primary teeth should not be reimplanted.

The references for this chapter can be found online by accessing the accompanying Expert Consult website.

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CHAPTER 60: QUESTIONS & ANSWERS

60.1. A 27-year-old previously healthy man presents with dental pain and facial swelling. Physical examination is remarkable for trismus, poor dentition with diffuse periodontal disease, and inability to manage secretions. You determine endotracheal intubation is necessary. Which of the following statements regarding the patient's management is *true?*

A. An awake intubation technique is indicated.
B. Pre-induction methocarbamol will decrease the trismus.
C. Rapid sequence induction with rocuronium is indicated.
D. Succinylcholine will worsen the trismus.
E. Transtracheal retrograde wire intubation is indicated.

Answer: A. The trismus is "mechanical," or muscular. Neuromuscular blockade, regardless of the choice between depolarizing or non-depolarizing agents, is not likely to help. Awake intubation, using a videolaryngoscope or flexible endoscope is indicated. Transtracheal retrograde wire intubation is rarely, if ever, indicated in modern emergency practice. Traditional "muscle relaxants" are sedatives and have no direct muscle-relaxing properties.

60.2. A 21-year-old man presents with tooth pain. He underwent a left mandibular premolar extraction 3 days ago. Examination is remarkable for a painful but nonbleeding tooth socket. The face and mandible are not swollen. Which of the following statements regarding this patient's condition is *true?*

A. Analgesia is the main goal of emergency department (ED) therapy.
B. Antibiotics are indicated.
C. Dental consultation in the ED is indicated.
D. Opioids are the treatment of choice.
E. Provocation of socket bleeding is encouraged to form new clot.

Answer: A. A dry socket is an exquisitely painful post-extraction syndrome that typically occurs 3 or 4 days later. The pathophysiology is loss of the healing blood clot and localized bone infection. Treatment consists of pain control. Optionally, gentle irrigation, and packing with gauze soaked in eugenol can be performed. Opioids may be used, but this would be in addition to nonsteroidal antiinflammatory drugs (NSAIDs), which are excellent analgesics for dental pain and are preferred due to the inflammatory component.

60.3. A 2-year-old previously healthy toddler presents with an avulsed tooth after hitting his mouth on the ground after a trip and fall. Physical examination is remarkable for a non-toxic appearing child who is crying and has an open slightly oozing pocket at the maxillary central incisor. Which of the following statements regarding the patient's management is *true?*

A. Set-up for conscious sedation should be arranged, because the replacement of the avulsed tooth may be painful.
B. The mother should have the patient place the tooth in the patient's mouth.
C. The tooth should be placed in milk or Hank's balanced salt solution.
D. The tooth should be replaced in the socket as soon as possible.
E. The tooth should not be reimplanted.

Answer: E. Management of recovered avulsed teeth depends on the age of the patient and the length of time for which the tooth has been displaced. Avulsed primary teeth in a pediatric patient 6 months old to 6 years old are *not* replaced in the socket. Reimplanted primary teeth ankylose or fuse to the bone, so although the dentofacial complex grows downward and forward, the reimplantation site does not. There also may be interference with the eruption of the permanent tooth. Cosmetic deformity results in either case. Thus, this patient should be referred to a pedodontist for consideration of a space maintainer or cosmetic appliance.

60.4. A 25-year-old previously healthy woman presents with recurrent pain from her temporomandibular joint disorder (TMD). The pain is described as being dull, and it worsens during the course of the day. Physical examination is remarkable for a non-toxic appearing female with normal dentition without any deformities but mild tenderness to palpation over the temporomandibular

joint (TMJ) and some spasm noted over the masseter and internal pterygoid. Which of the following statements regarding the patient's management is *true?*

A. A computed tomography (CT) scan of the face would be helpful.
B. A Panorex should be obtained.
C. Patient should be prescribed narcotic agents.
D. Treatment consists of external application of heat for 15 minutes four to six times per day, soft diet, analgesics including nonsteroidal antiinflammatory drugs (NSAIDs), and a muscle relaxant, such as diazepam (2 to 10 mg up to four times per day).
E. Ultrasound of the joint should be obtained.

Answer: D. TMJ radiographs are not helpful. Treatment consists of the external application of heat for 15 minutes four to six times per day, soft diet, analgesics including NSAIDs, and a muscle relaxant, such as diazepam (2 to 10 mg up to four times per day). Patients should be referred to a dentist specializing in TMD, such as a periodontist or a periodontal prosthodontist.

60.5. A 32-year-old previously healthy man presents with a fractured maxillary lateral incisor after a mechanical trip and fall. Physical examination is remarkable for a portion of the tooth that has an ivory-yellow appearance. You determine that he has a fractured tooth. Which of the following statements regarding the patient's management is *true?*

A. A calcium hydroxide paste should be used to cover the exposed dentin.
B. A dressing can be placed for comfort.
C. An urgent pulpotomy is indicated.
D. If this were a pediatric patient or an adolescent, it would be considered less serious, because children have more dentin than adults.
E. The patient will likely need a subsequent root canal.

Answer: A. This patient has a fracture involving the dentin, which has an ivory-yellow appearance. The pulp continually lays down dentin throughout the life of the tooth. In a child, the pulp is relatively large in size, and there is less dentin; the inverse is true in the adult. Because dentin is a microtubular tissue capable of preventing bacteria to percolate into the pulp chamber, fractures involving dentin are more serious in children and adolescents. In younger patients, the management of dentin fractures involves the immediate placement of a dressing of calcium hydroxide paste over the exposed dentin. Early intervention may prevent contamination of the pulp and avoid the need for subsequent root canal. In an adult, who has a greater thickness of dentin compared with pulpal tissue, there is less need for urgent referral to a dentist. A dressing can be placed on the tooth for comfort. Referral should be made to a dentist for the next working day. Fractures involving pulp exposures are true dental emergencies.