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Dental Emergencies: Management Strategies That Improve Outcomes

June 2017
Volume 19, Number 6

Abstract

Acute dental emergencies are a common chief complaint presenting to emergency departments, and they are increasing substantially in frequency. The diagnosis and management of dental emergencies is a core competency of the emergency clinician, and proper therapeutic strategies can significantly improve cosmetic and functional outcomes for patients. This issue provides a systematic review of the literature on common acute traumatic and atraumatic dental emergencies with a focus on the historical and physical examination findings that must be understood to identify life-threatening infections, relieve pain, salvage natural teeth, and communicate with specialists in the further management of patients after emergency treatment.

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CME Objectives

Upon completion of this article, you should be able to:

1. Describe basic dental anatomy and dental terminology.
2. Perform an appropriate dental history and physical examination.
3. Choose and perform appropriate orofacial nerve blocks for treating common dental emergencies.
4. Manage common acute dental emergencies.

Prior to beginning this activity, see "Physician CME Information" on the back page.

This issue is eligible for 4 Trauma CME credits

Case Presentations

Your first patient of the shift is a 20-year-old man who was involved in an altercation. On physical examination, you note that he is missing 2 teeth and has chipped another. EMS found 1 of the teeth on the scene and has stored it in milk. You wonder, "Was milk the best storage medium? Do I need to worry about the missing tooth or other injuries? How do I replant a tooth? Does the chipped tooth need any specific intervention?"

As you ponder these questions, your next patient arrives. She is an 18-year-old woman complaining of severe, dull pain 3 days after wisdom-tooth removal. Upon inspection, the socket that previously held her right mandibular third molar is devoid of any blood clot. You recognize this as "dry socket," or alveolar osteitis, but think, "What can I even do about this?"

Later that day, you see yet another patient with a dental complaint: a 60-year-old homeless man with fever, malaise, and severe gingival pain and bleeding. On examination, he has a temperature of 38.1°C and has submandibular lymphadenopathy as well as gingiva that are friable, with exudates and blunted papillae. You are dumbfounded at what this represents and how to treat it, and ask yourself, "Why didn't I read that dental emergencies article that arrived in the mail...?"

Introduction

Dental complaints present frequently to the emergency department (ED), yet studies show that emergency clinicians have a low level of comfort in managing them.[1,2] The number of dental visits to EDs nearly doubled from 2000 to 2010 and continues to rise. In 2012, there were 2.18 million ED visits for dental complaints,[3] underscoring the importance of expertise with the diagnosis and management of these conditions. Often, complications from dental procedures will first present to the ED and must be initially managed by an emergency clinician. Dental problems can range from benign and bothersome, such as localized tooth pain, fracture, or avulsion, to oropharyngeal cancer, deep-tissue infection, or facial trauma with emergent potentially life-threatening sepsis or airway compromise. Early recognition and treatment can decrease mortality, morbidity, and poor cosmetic outcome. This issue of *Emergency Medicine Practice* reviews important issues involving teeth, gingiva, periodontium, and mandible, and more serious infections that extend into the deep spaces of the neck.

Critical Appraisal of the Literature

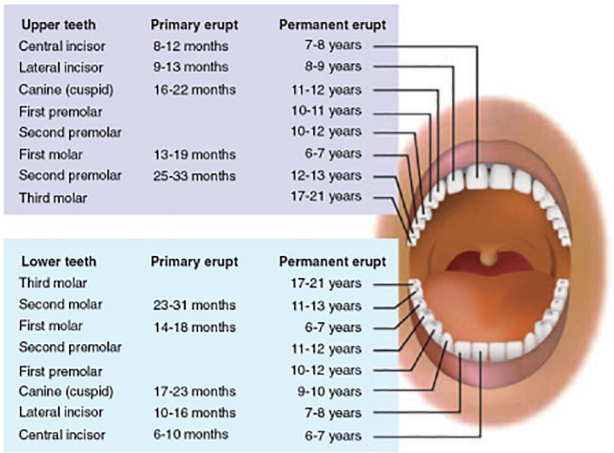
PubMed was searched for articles published in English in the last 5 years; references from these articles were then used to identify additional articles and guidelines. The search identified 171 articles related to *tooth avulsion*; 469 articles related to *tooth fracture*; 36 articles related to *alveolar osteitis*; 54 articles related to *pericoronitis*; and 26 articles related to *necrotizing periodontitis/periodontal infections*. Recommendations from the International Association for Dental Traumatology and the Cochrane Database of Systematic Reviews were also reviewed.

Data on tooth avulsion are generally strong, with studies assessing storage media and periodontal cell viability as well as some in vivo data. There is a lack of high-quality data to assess deciduous tooth replantation; for example, a systematic review that suggested a high negative consequence rate reviewed only 41 teeth in the study.[4] Management of dental fractures is guided mostly by expert opinion, and ED-based randomized trials do not exist; emerging data in case reports of using tissue adhesive glue have been described, but no high-quality studies exist. Splinting of luxated teeth has good data to support use, but data are scarce regarding types of splints and fixation periods.[5] Data on treatment of alveolar osteitis are poor, with a recent Cochrane review citing insufficient evidence to recommend any specific treatment for established alveolar osteitis. Studies on mandibular dislocation are not randomized compared to standard reduction techniques.

Anatomy

Humans have 20 deciduous (primary) teeth that are replaced by 32 permanent (secondary) teeth. **(See Figure 1.)** The first tooth to appear is typically one of

Figure 1. Age of Tooth Eruption for Deciduous (Primary) and Permanent (Secondary) Teeth



Note that the primary dentition does not include premolars or the third molars ("wisdom teeth").

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DOI: http://dx.doi.org/10.1016/j.otc.2013.06.009

the mandibular (lower) central incisors, which start erupting at approximately 6 months of age; by the third year of life, usually all of the primary dentition is present. Starting at age 5 or 6, the permanent teeth begin to replace the primary teeth.

The permanent teeth are numbered 1 through 32 starting from the top right, moving to the top left, then dropping down to the bottom left, then to the bottom right. The primary teeth can be named with a similar method using letters, but it is usually much easier to simply name the tooth involved because not all of the teeth may have erupted, making counting more difficult. From medial to lateral, the names of the permanent teeth in each quadrant are: central incisor, lateral incisor, canine, 2 premolars (not present in primary teeth), and 3 molars (including the "wisdom tooth"). **(See Figure 2.)**

The crown of the tooth has 3 layers, from outside to inside: enamel, dentin, and pulp. The root of the tooth (the part below the gingiva) has cementum instead of enamel, which allows it to attach to the alveolar bone with the help of the periodontal ligament. These structures together (cementum, periodontal ligament, and alveolar bone) are termed the *attachment apparatus,* and when combined with the gingiva, make up the periodontium. **(See Figure 3.)** These will be important when discussing tooth avulsions, as viability of the periodontal ligament is of utmost importance for successful replantation.

Periodontal disease can be mild (eg, gingivitis) or can be associated with significant morbidity (eg, acute necrotizing ulcerative gingivitis). Understanding the structures involved aids in correct classification of the condition.

In addition, there is terminology that should be understood when discussing the location of fractures or other pathology. An affected tooth can be described by number or by name. The upper teeth can be referred to as *maxillary* teeth and the lower teeth can be referred to as *mandibular* teeth. The part of the tooth facing the outside (toward the face) is termed *facial*, but may also be referred to as *labial* (for the incisors or canines, facing the lip) or *buccal* (for the premolars and molars, facing the buccal mucosa). The oral surface faces the inside of the oral cavity and may be referred to as *palatal* for upper teeth (toward the hard palate) and *lingual* (toward the tongue) for the lower teeth. The *mesial* surface is toward the midline, whereas the *distal* surface is toward the mandibular ramus. The *interproximal* surface is between teeth (ie, where floss goes) and the *occlusal* surface is the biting surface where the teeth occlude with closure of the jaw. Lastly, the *apical* direction is toward the root of the tooth, whereas the *coronal* direction is toward the crown.

Figure 2. Classification of Teeth

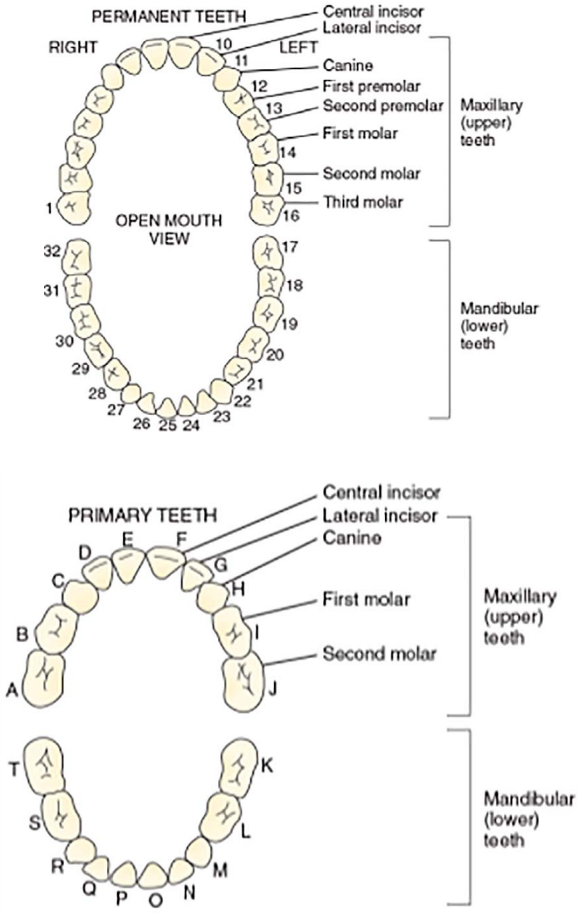

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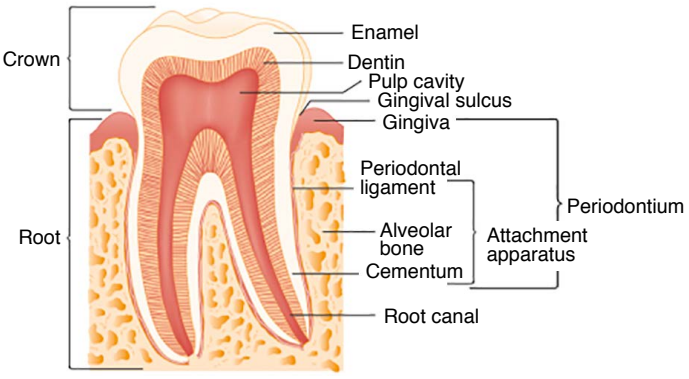
Figure 3. Periodontium



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Etiology and Pathophysiology

Dental emergencies are classified as either traumatic or atraumatic.

Dentoalveolar Trauma

When a patient sustains dental trauma, any of the following can occur: concussion, subluxation, luxation, avulsion, or fracture. A *concussion* is defined as dental pain to percussion, but there is no mobility of the tooth. With higher-energy injuries or with pre-existing periodontal disease, a tooth can become *subluxed*, where the tooth is mobile but is still in correct anatomic position. Luxation occurs when the tooth is both mobile and no longer in correct anatomic position.

Luxation of teeth can be in any direction. *Extrusive* luxation **(Figure 4A)** refers to a tooth that is moved partially out of the socket. *Intrusive* luxation **(Figure 4B)** refers to a tooth that is forced inward into the socket. *Lateral* luxation **(Figure 4C)** describes a tooth displaced in a direction other than inward (as in the case of intrusive luxation) or outward (as in the case of extrusive luxation). *Avulsion* is essentially complete extrusive luxation, where the tooth is fully removed from the socket.

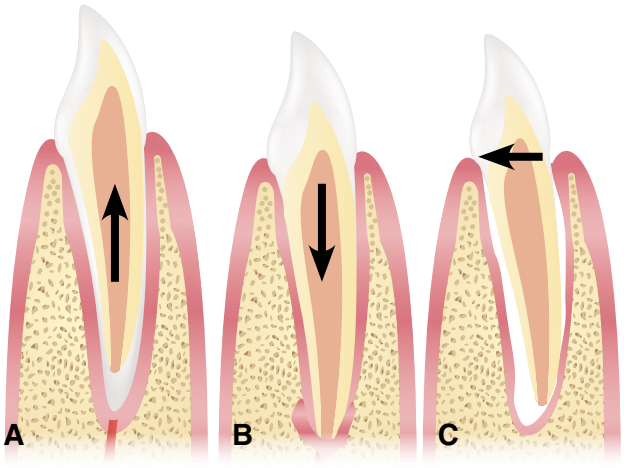
When an entire segment of teeth is displaced with respect to its neighbors, an underlying alveolar ridge fracture should be suspected. **(See Figure 5.)**

The last major group of injuries that can happen to teeth following dentoalveolar trauma is a dental fracture. These are classified by the depth of the injury. Ellis I fracture involves only the enamel; Ellis II fracture involves the enamel and dentin; Ellis III fracture involves the pulp. **(See Figure 6.)** Although some may be familiar with the Ellis classification, to reduce ambiguity, it is usually best to simply describe to the consultant the depth of the fracture.

With mandibular trauma or with forced opening (which may occur with dental procedures, yawning, etc), a temporomandibular joint dislocation can occur if the condyle translates too far anteriorly and becomes locked. Reduction techniques are described on page 16.

With clinical findings of movement in a large section of facial bones, the presence of facial asymmetry, malocclusion, trismus, or dislocation should prompt a high level of suspicion for concurrent maxillary or mandibular fractures. Grossly displaced fractures in either area could result in airway compromise. For more information on the diagnosis and treatment of

Figure 4. Luxation of Teeth

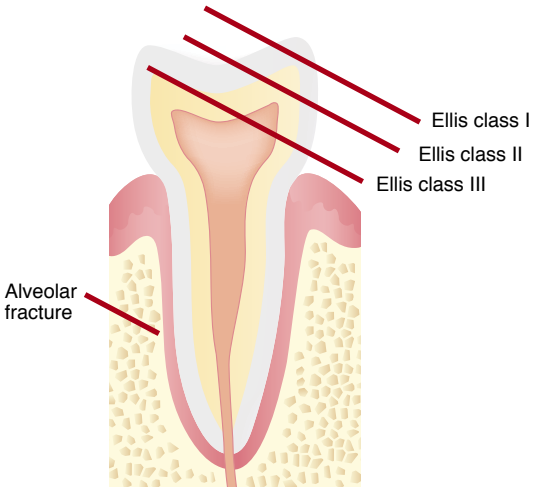


View A, extrusive luxation. View B, intrusive luxation. View C, lateral luxation.

Figure 5. Alveolar Ridge Fracture

Displaced upper (maxillary) central incisors.
Pediatric Emergency Medicine. Ran D. Goldman, Steven G. Rothrock. Pages 154-163. Copyright 2008, with permission from Elsevier.

Figure 6. Dental Fracture Classification



Ellis I fractures involve the enamel only, Ellis II fractures additionally involve the dentin, and Ellis III fractures additionally involve the pulp. An alveolar ridge fracture is a fracture of the surrounding alveolar bone that supports the tooth.

maxillofacial injuries, see the March 2017 issue of *Emergency Medicine Practice*, "Maxillofacial Trauma: Managing Potentially Dangerous And Disfiguring Complex Injuries" at www.ebmedicine.net/MaxFacial.

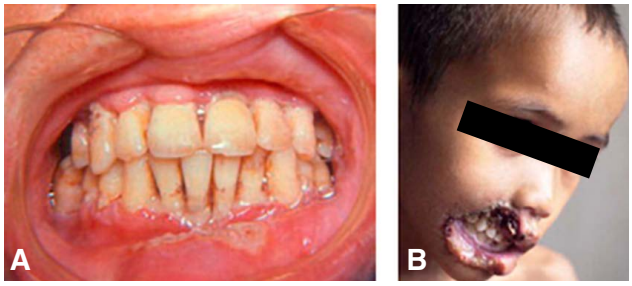
Atraumatic Dental Emergencies

The most common diagnosis for dental pain is pulpitis due to caries, where bacterial activity has demineralized the enamel to the point where dentin is exposed. The microtubular structure of dentin can then easily transmit infection to the pulp, leading to pulpitis. Pulpitis can be reversible or irreversible; in the former, hyperemia and inflammation of the pulp leads to temperature sensitivity and pain with pressure; in the latter, pain occurs without any stimulus, due to necrosis of the pulp.

The gingiva and periodontium are also common sites for pathology. The periodontium protects the roots of the teeth by acting as a barrier, and the associated attachment apparatus holds the teeth in place. Periodontitis is inflammation of all of these structures (gingiva and attachment apparatus), which can lead to loosening or loss of teeth over time; gingivitis is inflammation of just the gingiva. With immunocompromised individuals or with more aggressive organisms, bacteria can invade the periodontium itself and cause necrotizing disease. When affecting the gingiva, it is termed *acute necrotizing ulcerative gingivitis* or "trench mouth" **(Figure 7A)** and is usually polymicrobial in nature (including *Fusobacterium* and spirochetes).[6] When spreading to the adjacent oral mucosa, it is termed *necrotizing stomatitis* and, in the most severe form, it can spread to the entire oral cavity and is termed *noma* (also known as cancrum oris or fusospirochetal gangrene, **Figure 7B**), which is often fatal.

As the teeth erupt through the gingiva, a condition called *pericoronitis* can develop. **(See Figure 8.)** If a flap of gingiva (operculum) is present, food and bacteria can accumulate between the erupting tooth and operculum, leading to infection and pain. The

Figure 7. Necrotizing Stomatitis



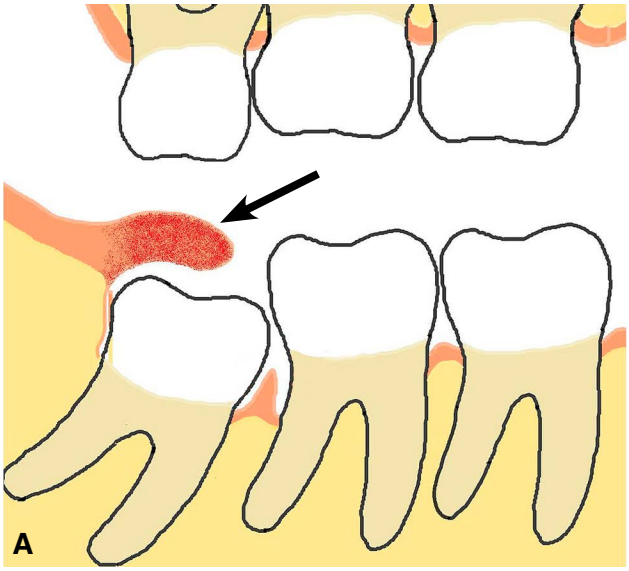
View A shows classic blunted "punched out" interdental papillae with necrotic tissue. Note that the surrounding oral mucosa (rather than just the gingiva) is involved, and is therefore stomatitis.

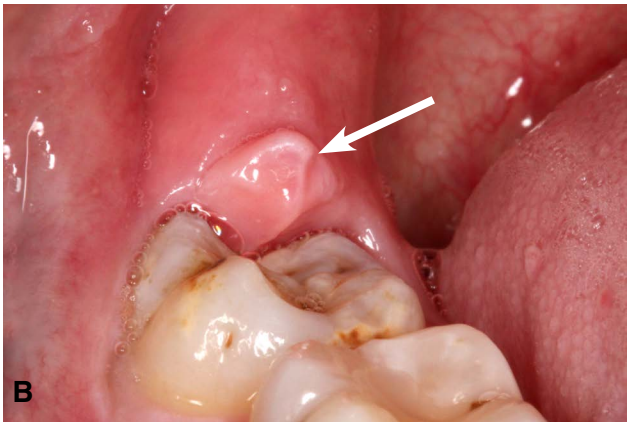
View B shows noma (cancrum oris, fusospirochetal gangrene), the most severe necrotizing periodontal disease.

View A source: *Oral and Maxillofacial Surgery Clinics of North America*. Volume 20, Issue 4. Julie Ann Smith. HIV and AIDS in the adolescent and adult: an update for the oral and maxillofacial surgeon. Pages 535-565. Copyright 2008, with permission from Elsevier. DOI: http://doi.org/10.1016/j.coms.2008.06.004

View B source: Republished with permission of *American Journal of Tropical Medicine and Hygiene*, from Noma in Laos: stigma of severe poverty in rural Asia. M. Leila Srour, Bryan Watt, Bounthom Phengdy, et al. Volume 78, Issue 4. 2008; permission conveyed through Copyright Clearance Center, Inc.

Figure 8. Operculum and Pericoronitis





As a tooth erupts, a gingival flap (operculum) can trap bacteria, leading to inflammation and infection. View A is an illustration of an operculum; View B is a photograph of a patient with pericoronitis due to a malerupting third mandibular molar.

View A source: Available at: https://commons.wikimedia.org/wiki/File:Lower_mandibular_third_molar_impaction_pericoronitis_diagram.jpg Reprinted under Creative Commons CC0 1.0 Universal Public Domain Dedication.

View B source: Available at: https://commons.wikimedia.org/wiki/File:48_clinical_pericornitis.jpg Reprinted under Creative Commons Attribution-Share Alike 3.0 Unported license. Author: Coronation Dental Specialty Group.

third molar (wisdom tooth) is the most common tooth eruption that leads to pericoronitis. Pericoronitis is a painful condition that has been rated as significantly affecting the quality of life of those who have it.[7]

The most common procedure-related complaint is alveolar osteitis, or dry socket. **(See Figure 9.)** When a tooth is extracted, a clot forms in the open fossa that previously housed the tooth. This clot protects the surrounding alveolar bone, but if it is dislodged, the lack of a protective clot will lead to significant pain due to inflammation of the exposed structure. Alveolar osteitis usually occurs 3 to 4 days after an extraction due to softening of the clot that occurs during this time period.

Pain can also occur after procedures such as root canals. This may be due to residual gas bubbles sealed into the cavity, or the pain may be neuropathic in origin. One study surveyed patients who had undergone a root canal, and 7% of respondents had persistent pain after the procedure. It was retrospectively thought that many of these individuals had neuropathic pain to begin with, and the problem did not lie with the tooth itself.[8]

Odontogenic Abscesses and Deep Neck Infections

Infectious dental emergencies include the more benign periapical abscesses to the emergently life-threatening Ludwig angina. In children, deep neck infections are most commonly sequelae of oropharyngeal infections, but dental infections are the most common precipitating factor in adults. In children, acute tonsillitis can lead to infections of either the peritonsillar space (leading to a peritonsillar abscess), or retropharyngeal lymphadenopathy can lead to lymphadenitis and retropharyngeal abscess. By approximately age 4, retropharyngeal nodes atrophy, so retropharyngeal abscess is rare in those over 4 years of age unless they have sustained an injury to the posterior oropharynx (eg, bone stuck in the throat, recent intubation, recent endoscopy, etc).[9]

In adults, irreversible pulpitis can lead to formation of a periapical abscess that, when confined to the alveolar bone, is localized and can be treated with incision and drainage by an emergency clinician. However, in a patient in an immunocompromised state or with aggressive organisms, the infection can spread into one of many secondary spaces in the neck.

For mandibular odontogenic infections, the important spaces are the submental, sublingual, and submandibular spaces. The submental space is a relatively narrow midline space that causes a focal midline swelling when edematous. **(See Figure 10.)** The sublingual space is under the tongue, as the name implies, but it shares a posterior border with the submandibular space, making communication of infection between these 2 spaces common. The submandibular space has the medial border at the anterior belly of the digastrics and causes lateral swelling under the mandible. **(See Figure 11, page 7.)** Ludwig angina occurs when all 3 spaces are infected.

Figure 9. Alveolar Osteitis ("Dry Socket")

Note there is no visualized clot within the fossa where a molar extraction had recently occurred.

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Figure 10. Submental Space Infection

By virtue of the digastric muscles that form the lateral borders, the swelling is focal and midline.

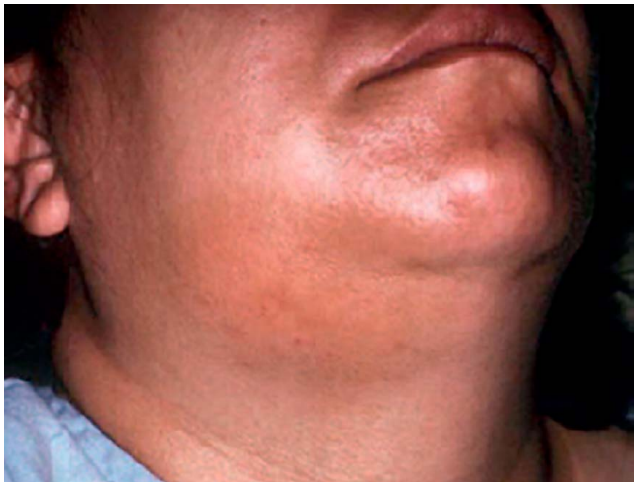
Reprinted from *Current Therapy in Oral and Maxillofacial Surgery*. Thomas R. Flynn. Principles and Surgical Management of Head and Neck Infections. Pages 1080-1091. Copyright 2012, with permission from Elsevier.

For maxillary odontogenic infections, the main spaces involved are the canine space and buccal space. With a canine space infection, swelling will occur just lateral to the nare, flattening the nasolabial fold. It can be complicated by cavernous sinus thrombosis. A buccal space infection will present with ovoid swelling between the buccinator muscle and the superficial fascia and skin.

Although children may not have specific risk factors for developing deep neck infections, adults often do. Based on a retrospective outcomes study, patients with diabetes are more likely to have abscess formation in the presence of an odontogenic infection (89.3% of diabetic patients vs 71.3% of nondiabetic patients, $P = .014$) and to have a longer hospital stay (19.7 days vs 10.2 days, $P < .0001$), with increased complication and intubation rates compared to nondiabetic patients.[10]

Patients with HIV infection have a higher risk, which may still hold true even if they are on highly active antiretroviral therapy (HAART). The largest HIV and deep neck infection study is a retrospective study analyzing deep neck infection rates in HIV-positive patients in the study (n = 9888) compared to matched controls, which found a relative risk of 2.05 for deep neck infection ($P < .0001$), even though all HIV-positive patients had free access to HAART. The study was limited by its retrospective nature and uncertainty about whether the patients were actually compliant with HAART.[11] There are no data to suggest the exact CD4 count at which this increased risk starts. Although further studies are needed, any patient with any degree of immunocompromise appears to have a significantly higher risk for deep neck infection and deep neck infection-related complications.

Figure 11. Submandibular Space Infection



Reprinted from *Emergency Medicine Clinics of North America.* Volume 18, Issue 3. The swollen face: severe ontogenic infections. Thomas R. Flynn. Pages 481-519. Copyright 2000, with permission from Elsevier.

Another serious complication of oropharyngeal infections is septic thrombophlebitis of the internal jugular vein, also called Lemierre syndrome. Most commonly, this syndrome is attributable to *Fusobacterium necrophorum*. The vast majority of cases arise from pharyngitis or tonsillitis, but approximately 4% of reported cases are of odontogenic origin.[12] Septic emboli can then travel from the internal jugular vein, resulting in embolic complications. In a retrospective review of 114 patients, the most scommon precipitant was a tonsillar, pharyngeal, or respiratory tract infection, and the most common complications were septic strokes (30%), septic arthritis or osteomyelitis (22%), or septic pulmonary emboli (22%).[13]

Differential Diagnosis

Not all dental pain is odontogenic, so a broad differential diagnosis that includes odontogenic and nonodontogenic causes should be considered. **(See Table 1.)** For instance, trigeminal neuralgia can present with dental pain, as can temporal arteritis with jaw claudication. Atypical odontalgia is thought to be a centralized trigeminal neuropathy, but this is a diagnosis of

Table 1. Differential Diagnosis of Orofacial Pain

Odontogenic Causes
- Dental caries
- Reversible pulpitis
- Irreversible pulpitis
- Periapical abscess
- Tooth eruption
- Pericoronitis
- Alveolar osteitis
- Bruxism
- Deep neck infection

Other Infectious Causes
- Oral candidiasis
- Herpes simplex virus
- Varicella zoster
- Herpangina
- Hand, foot, and mouth disease
- Sexually transmitted infections
- Parotitis (eg, mumps)

Oncologic Causes
- Squamous cell carcinoma
- Kaposi sarcoma
- Lymphoma
- Leukemia
- Graft-versus-host disease
- Melanoma

Periodontal Causes
- Gingivitis
- Periodontal disease
- Acute necrotizing periodontal disease

Traumatic Causes
- Dental fractures
- Concussion
- Subluxation
- Luxation (intrusive, extrusive, lateral)
- Avulsion
- Facial fractures
- Alveolar ridge fractures
- Soft-tissue injuries

Miscellaneous Causes
- Angina pectoris
- Cranial neuralgias (eg, trigeminal neuralgia)
- Stomatitis
- Mucositis
- Erythema migrans
- Pyogenic granuloma
- Atypical odontalgia
- Ulcerative diseases (eg, Crohn disease, Behçet syndrome, lichen planus, etc)
- Temporal arteritis

Adapted from: Kip Benko. Acute dental emergencies in emergency medicine. *Emergency Medicine Practice.* Volume 5, Issue 5. 2003. Pages 1-24.

exclusion and generally not one that should be made in the ED.[14] Many viral infections (eg, herpes simplex virus, varicella zoster, coxsackievirus, mumps) can cause orofacial pain and can be elucidated by a history and careful physical examination. Pain can also be referred from the sinuses (eg, sinusitis presenting as dental pain) or temporomandibular joint disorder masquerading as dental pain.

Postprocedural pain can be due to hemorrhage, alveolar osteitis, or trapped/retained air bubbles in the case of a root canal.

Traumatic injuries are usually more straightforward, with a narrower differential diagnosis, but a meticulous physical examination is required to differentiate subtle differences that impact management (eg, accounting for each tooth, inspecting teeth for presence of fractures, mobility, soft-tissue injury, or surrounding alveolar ridge injury, and facial bone stability).

Prehospital Care

Prehospital care should focus on airway protection, if indicated, and accounting for and preserving teeth that may have been avulsed. Orofacial injuries can also cause significant hemorrhage, and direct pressure is generally the preferred modality of control. For patients, an upright position is better if cervical spine immobilization is not required, as it aids in handling secretions. Suction, if available, should be set up if there are any concerns about secretions.

Avulsed permanent teeth can be replanted at the scene if the patient is not at risk for aspiration (eg, intoxication, cervical spine immobilization, etc) and no other significant maxillofacial trauma exists. In all cases, the teeth should be handled only by the crown and not the root, as the periodontal ligament cells on the root are easily injured and handling may damage those cells and compromise viability of replantation. The tooth can be rinsed gently with saline prior to replantation if debris needs to be cleared.

Storage Media

Permanent teeth that are not candidates for immediate replantation should be placed in Hanks' balanced salt solution (HBSS, commercially available as Save-A-Tooth™ or EMT Toothsaver™) or in milk.[15] **(See Table 2.)** A 2013 literature review found that milk performed significantly better than saliva[16] and, due to aspiration risks, storage under the patient's tongue or in the cheek should be generally avoided unless no alternatives exist and the patient is a low aspiration risk. HBSS loses effectiveness with duration of storage, according to in vitro testing.[17] If HBSS is expired, it should not be used unless no other alternatives are available. If oral rehydration solution is available, the osmolality and electrolyte composition is also favorable for periodontal ligament viability. In vitro studies that compared HBSS and oral rehydration solution found that there was no significant difference between them, and therefore both can be recommended for use.[18]

General public knowledge of management of avulsed teeth tends to be minimal,[19] with a survey showing that only 3% of university students knew how to correctly store avulsed teeth and that parents had similarly low knowledge.[20] The majority of firefighters and paramedics do not receive any dental trauma instruction, so adding this to their training curricula could improve replantation outcomes.[21]

Emergency Department Evaluation

The initial evaluation of a patient with a dental complaint is focused on physical appearance, vital signs, airway stability, and comprehensive history of medical comorbidities and recent symptoms. Knowing whether the onset of symptoms was traumatic or atraumatic may help to guide management.

History

Key clinical questions for patients with dental trauma include:

1. **When did the incident occur?** If replantation of an avulsed permanent tooth is considered, this question, along with the storage medium used, will determine the likelihood of success.
2. **Were any teeth found at the scene?** All teeth must be accounted for. If teeth are unaccounted for, each of these possibilities must be considered: (1) the tooth was aspirated, (2) the tooth was swallowed, (3) the tooth or fragments of the tooth are embedded in a laceration, or (4) a significant intrusive luxation is mimicking a tooth avulsion.
3. **If teeth were found at the scene, how were they stored?** The storage medium used and the time of storage will affect the likelihood of successful replantation.

Table 2. Length of Periodontal Ligament Cell Viability, Based On Storage Medium

Storage Medium	Length of Periodontal Ligament Viability
Dry (no storage medium)	< 60 minutes
Milk	3 to 8 hours
Hanks' balanced salt solution	12 to 24 hours
Oral rehydration solution	12 to 24 hours

Adapted from *Rosen's Emergency Medicine: Concepts and Clinical Practice*, 9th edition, Ron M. Walls, Robert S. Hockberger, Marianne Gausche-Hill, et al. Oral Medicine. Copyright 2017, with permission from Elsevier.

4. **Is the patient experiencing malocclusion (the feeling that their teeth do not line up correctly), or trismus (difficulty opening the mouth)?** Both of these should raise suspicion of a dental, mandibular, or maxillary injury.
5. **If an avulsion occurred and the tooth was recovered, is the tooth a primary or secondary tooth?** Primary teeth should not be replanted, as doing so may interfere with the appropriate eruption of the following permanent tooth. This is consistent with the International Association of Dental Traumatology guidelines,[22] but a systematic review found a lack of high-quality evidence for this recommendation given small studies (41 total replanted primary teeth, of which a total of 10 caused problems with the permanent successor).[4]
6. **Is there a history of bleeding disorders, or is the patient on any anticoagulant agent?** If oral hemorrhage is uncontrolled, reversal of bleeding disorders or anticoagulants should be considered.
7. **When was the patient's most recent vaccination against tetanus?** All significant orofacial traumatic injuries should have assessment for tetanus vaccination status and should be updated accordingly.

In the case of atraumatic dental complaints, other dental-specific information should be elucidated in addition to a standard history:

1. **Has there been any recent dental work or procedures?** Knowing about recent extractions may make a diagnosis of alveolar osteitis more likely.
2. **Does the patient have a history of poor dentition?**
3. **Is the patient diabetic or immunocompromised?** Diabetes, HIV, chronic steroid use, chemotherapy, etc, can all be risk factors for deep neck infections.
4. **What medications does the patient take?** Some medications can cause drug-induced gingival overgrowth. Anticonvulsants such as phenytoin, immunosuppressants such as cyclosporine, and, more uncommonly, some calcium-channel blockers such as nifedipine or diltiazem can cause gingival overgrowth.
5. **Are there complaints of shortness of breath, difficulty opening the mouth, changes in the voice, or difficulty swallowing?** Any of these symptoms should raise suspicion for a deep neck infection.

Physical Examination

If no contraindications exist, the physical examination of a patient presenting with a dental complaint should be performed in a dental chair or in an ear, nose, and throat chair, with the patient sitting upright. The initial visual inspection occurs when you first enter the room: is the patient handling secretions, is the patient phonating normally, and is there obvious swelling or asymmetry of the face or neck? The presence of any gross physical abnormality in the absence of trauma should place a deep neck infection high on the differential diagnosis.

The teeth should be inspected for the presence of fractures, caries, or gross malalignment, as in luxation or alveolar ridge injuries. Percussion with a tongue blade can be performed, as exquisite tenderness to percussion would suggest an underlying periapical abscess. Palpate the teeth for mobility that would be present with subluxation. Evaluate the teeth for any fractures; if any are present, inspect them to discern whether there is an injury to only the enamel or if the injury progresses to the dentin (a yellow-brown color with temperature sensitivity), or pulp (with a pinkish hue, and possibly visible blood).

The gingiva should be inspected for erythema, edema, and hypertrophy and evaluated for signs of necrotizing disease. The triad of findings for necrotizing periodontal disease are: (1) papillary necrosis (with ulcerated interdental papillae), (2) gingival bleeding, and (3) pain or tenderness. The oral mucosa should be inspected for lacerations, ulcerations, bleeding, or other evidence of injury. The external facial structures and neck should be inspected for erythema or swelling and palpated for induration or fluctuance.

The patient should be evaluated for regional lymphadenopathy that may be associated with an oropharyngeal infection, and the accessible neck spaces should be evaluated for evidence of infection. Of note, although data are limited, the physical examination in assessment of deep neck infections is often unreliable. One study prospectively enrolled 35 patients with a suspected deep neck infection and had a senior-level or attending-level surgeon evaluate the patient and clinically ascertain whether a space was healthy, cellulitic, or had an abscess associated with it. This study found that the accuracy of a clinical examination in correctly identifying a drainable collection was 63%, suggesting that liberal use of imaging in this population may be warranted.[23]

The jaw should be assessed for range of motion, as deep neck infections or mandibular fractures may cause trismus; a jaw that is open and unable to close should raise suspicion for a dislocation. If a mandibular fracture is suspected, the tongue-blade test can be considered. The tongue-blade test assesses the ability to crack a tongue blade bilaterally when it is twisted between the closed molars. In a recent prospective trial, the sensitivity was 95%, the negative likelihood ratio was 0.07, and the negative predictive value was 92%, suggesting that a negative tongue-blade test (meaning that the patient is able to break a tongue depressor bilaterally) is potentially a useful screening tool.[24]

Pediatric Patients

Pediatric patients may be difficult to examine due to anxiety, and they may require anxiolysis before appropriate assessment can occur. One study compared patients aged 3 to 8 years and found that 0.75 mg/kg of midazolam by mouth was more effective than a dose of 0.5 mg/kg, but the study was small and thus underpowered to evaluate for rarer adverse outcomes.[25] Therefore, it is reasonable to start with 0.5 mg/kg midazolam by mouth (maximum 10 mg) and, if the patient requires more anxiolysis and has no signs of adverse events, half the initial dose can be given again. Intranasal midazolam at a dose of 0.3 mg/kg is rated as highly effective for pediatric dental patients and can be considered for the patient that refuses to take oral medications.[26] However, concentrated midazolam typically comes in the 5 mg/1 mL concentration and the maximum amount of liquid per nare is usually recommended as 1 mL, so only a total of 10 mg can be administered in this fashion. This limits the usefulness of intranasal midazolam in patients who weigh more than approximately 35 kg.

Diagnostic Studies

Imaging Studies

Acute imaging is rarely indicated for localized periodontal disease. In addition, the emergent treatment of most isolated minor dentoalveolar trauma (eg, isolated dental fractures) is not changed by information obtained by imaging if the presence of and extent of injury can be ascertained clinically. However, if a tooth is unaccounted for, it is helpful to exclude aspiration or swallowing by obtaining a chest x-ray. If concern exists that a tooth could be intrusively luxated or embedded in a soft-tissue injury, radiographs may be helpful to detect these conditions.

Mandibular or alveolar ridge fractures can be diagnosed by panoramic x-ray views, but they are more frequently diagnosed via computed tomography (CT) of the maxillofacial bones. A series of mandibular radiographs can also be obtained, which includes 2 lateral oblique views, a reverse Towne view, and an anterior-posterior view, but these are inferior to a panoramic x-ray. A 1986 study found that 92% of fractures were diagnosed on panoramic radiographs, whereas only 66% were detected in the mandibular series.[27] When compared to panoramic x-ray, helical CT was not significantly different in detection of fractures, but it did have decreased interpretation error and increased interphysician agreement, suggesting that helical CT should be the standard imaging modality, if available.[28]

Liberal use of contrast-enhanced CT should be considered in patients suspected of having deep neck infections because, although evidence is limited, the extent of infection and the presence of a drainable fluid collection do not appear to be reliable based on physical examination alone.

Laboratory Studies

Laboratory studies are generally not helpful and do not routinely change management, except that an international normalized ratio (INR) should be obtained in patients taking warfarin with uncontrolled oral hemorrhage if reversal is planned. Standard coagulation studies (prothrombin time/partial thromboplastin time [PTT]/INR) are not usually helpful in evaluation of patients on the non–vitamin K antagonist oral anticoagulants.[29] The activated PTT (aPTT) can give an estimate of the anticoagulation status of patients taking direct thrombin inhibitors such as dabigatran (Pradaxa®), but more linear tests such as the ecarin clotting time or diluted thrombin time test, if available, are recommended over aPTT. When indicated, idarucizumab (Praxbind®) can reverse dabigatran.[30]

Treatment

Analgesia

Pain control for most acute minor atraumatic emergencies (such as irreversible pulpitis) is best achieved with nonsteroidal anti-inflammatory drugs (NSAIDs) given at scheduled times rather than as needed. Opioids are rarely indicated, as multiple studies have shown that NSAIDs are superior to opioids for dental pain.[31,32] NSAIDs are also superior to acetaminophen for pain associated with oral surgery.[33]

Orofacial nerve blocks can be considered for treatment of any orofacial complaint if the pain is localized to a single nerve distribution. The most commonly performed orofacial nerve blocks are the supraperiosteal nerve block, inferior alveolar nerve block, mental nerve block, and infraorbital nerve block. While it is acceptable to inject local anesthesia superficially beneath the soft tissue covering an infected area to enable incision and drainage or culture, block injections made through an area of infection and into the adjacent, uninfected, deep facial spaces may propagate the bacterial spread. This seeding may result in ocular infection, retropharyngeal abscess, Ludwig angina, or systemic sepsis.

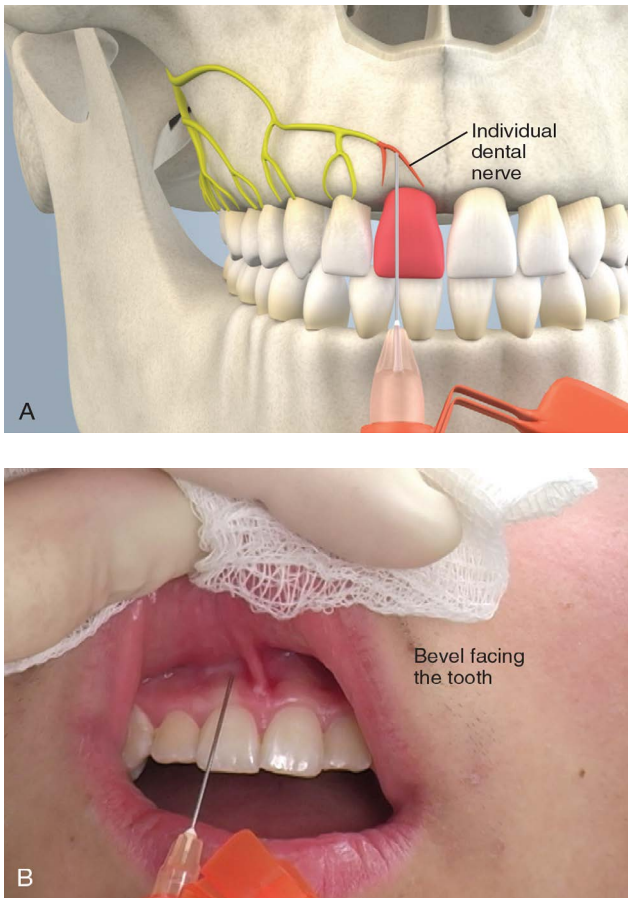
All orofacial regional nerve blocks should follow the same general principles. The anatomy should be understood and confirmed prior to performing the procedure. The mucous membranes are then dried and a local anesthetic is applied to the area. Next, the needle is inserted, and once intra-arterial position is excluded by aspiration, a small amount of local anesthetic (usually 2 mL of lidocaine 1% or 2% or bupivacaine 0.5%) is injected. Massaging the injected area can assist in permeation of the local anesthetic through tissue planes and is usually helpful.

The topical anesthetic can be delivered via benzocaine spray, or lidocaine gel can be applied with a piece of gauze. Nebulized lidocaine may be useful, depending on patient preference/compliance and the location of the injection site. An intraoral approach is generally preferred to an extraoral approach. With the mental nerve block, a prospective crossover trial found the intraoral approach to be less painful and more successful than the extraoral approach.[34] In a small crossover trial of the infraorbital nerve block, volunteers subjectively preferred the intraoral approach, but the pain score differences did not reach statistical significance.[35]

Supraperiosteal Nerve Block

A supraperiosteal nerve block **(Figure 12)** provides excellent analgesia to a single tooth and is more effective in the maxillary teeth rather than the mandibular teeth, owing to the thicker mandibular bone preventing permeation of anesthetic to the supraperiosteal nerve. After following the general instructions mentioned, aim the bevel toward the tooth, pierce the mucobuccal fold with the needle, and deposit 1 to 2 mL of local anesthetic in this area.

Figure 12. Supraperiosteal Nerve Block



View A: Anesthesia of a single maxillary tooth.
View B: Location of needle insertion on a patient.
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Inferior Alveolar Nerve Block

An inferior alveolar nerve block **(Figure 13, page 12.)** provides anesthesia to the entire ipsilateral mandible as well as anesthesia of the ipsilateral lower lip and chin area. The mental nerve is also blocked, since it is a continuation of the inferior alveolar nerve after it has left the mental foramen. This block can provide excellent analgesia in the case of multiple traumatized or infected mandibular teeth, a mandibular fracture, or alveolar ridge fracture. To perform the inferior alveolar nerve block, place the thumb of the opposite hand that will be injecting as far back along the intraoral mandible as possible, where it will seat in the coronoid notch. **(See Figure 13A.)** The syringe and needle will approach from the contralateral side, such that the barrel of the syringe is between the first and second premolars opposite to the side of the injection. **(See Figure 13B.)** Insert the needle 1 cm above the occlusal surface of the molars, contact bone, withdraw slightly, and aspirate; if no blood returns, inject the local anesthetic.

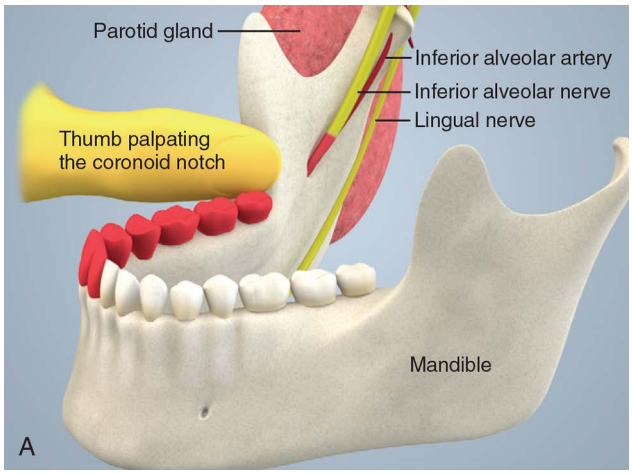
Mental Nerve Block

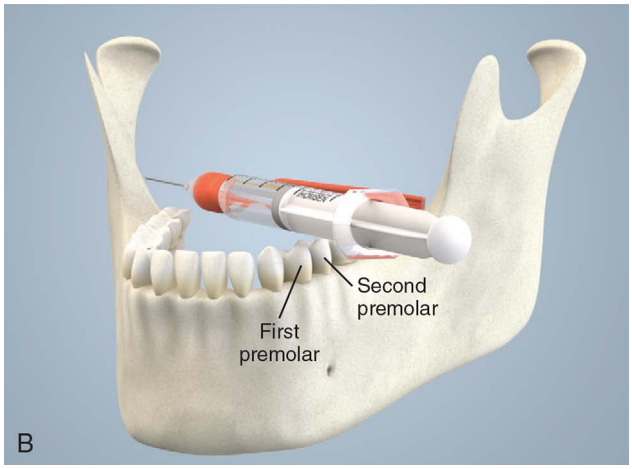
A mental nerve block is an outstanding block for ipsilateral lower-lip or chin lacerations because approximation of the vermilion border is critical to favorable cosmetic outcomes. With local infiltration of a lip laceration, the tissue has limited ability to accommodate sufficient anesthetic and landmarks often get distorted. To perform the mental nerve block, first identify the mental foramen via extraoral palpation (it is usually located just medial to the pupil of the eye when the patient has a forward gaze). Approach the mental foramen intraorally at a 45° angle and infiltrate adjacent to (not directly in) the foramen. **(See Figure 14, page 12.)**

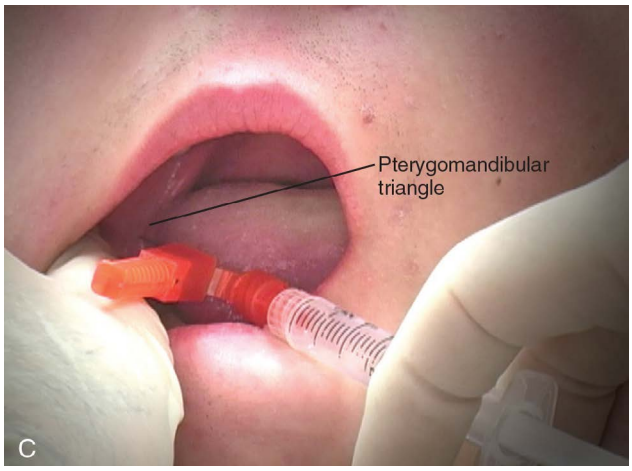
Infraorbital Nerve Block

An infraorbital nerve block is the preferred anesthetic modality for upper-lip lacerations because it provides ipsilateral midface and upper-lip anesthesia similar to the mental nerve block for lower-lip lacerations. Typically, the infraorbital foramen is in line with the pupil when the patient has a forward gaze, and although the foramen may not be palpable, it is present immediately under the easily palpated infraorbital ridge. The needle is inserted parallel to and at the level of the second maxillary premolar and advanced approximately 2.5 cm; injection is adjacent to the foramen. **(See Figure 15, page 13.)**

Figure 13. Inferior Alveolar Nerve Block







View A: Location of inferior alveolar nerve.
View B: Appropriate placement of needle on a figure.
View C: Location of needle insertion on a patient.
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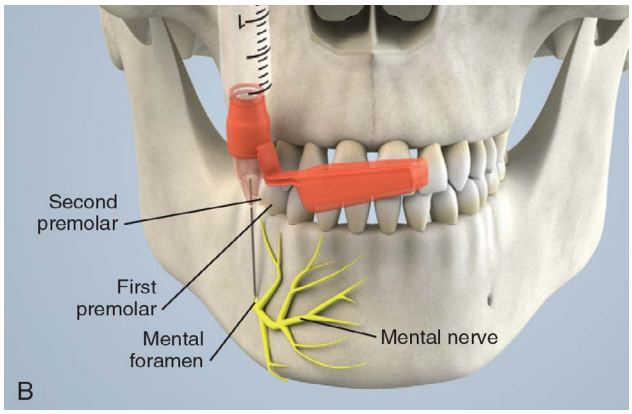
Figure 14. Mental Nerve Block



View A: The region of anesthesia provided.
View B: Diagram of the location of the mental foramen relative to the oral cavity.
View C: A patient receiving an intraoral mental nerve block.
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Antibiotic Treatment

Based on a 2016 Cochrane review, there is no evidence that antibiotics are beneficial in the treatment of pulpitis, though additional research is needed.[36] Patients with simple gingivitis do not benefit from systemic antibiotics, but do benefit from better routine oral hygiene. Nonetheless, necrotizing periodontal disease should be treated with oral antibiotics and chlorhexidine rinses and, if patients are treated as outpatients, they should be given prompt referral to a dentist for debridement of necrotic tissue as necessary. Recommended antibiotic regimens are outlined in **Table 3**.

Pericoronitis should be treated with chlorhexidine rinses; however, a randomized trial showed that green tea was just as effective.[37] Attempt at debridement of the operculum or debris in the emergency setting is usually not indicated, and definitive treatment consists of referral for surgical excision of the operculum and/or removal of the offending tooth. Severe pericoronitis can be treated with oral antibiotics.

An uncomplicated periapical abscess without systemic symptoms in an immunocompetent host does not require routine antibiotics after successful drainage, but based on a 2014 Cochrane review, there is no high-quality evidence to guide practice.[38] For patients with systemic symptoms or in an immunocompromised state, antibiotics are generally indicated; the duration of treatment is unclear. One study showed a brief (3-day) course of antibiotics was as effective as a course of longer duration (eg, 5 or 7 days) for a localized dentoalveolar abscess that was successfully drained.[39] However, the patient should be referred to a dentist for definitive treatment of the abscess etiology within 1 to 3 days.

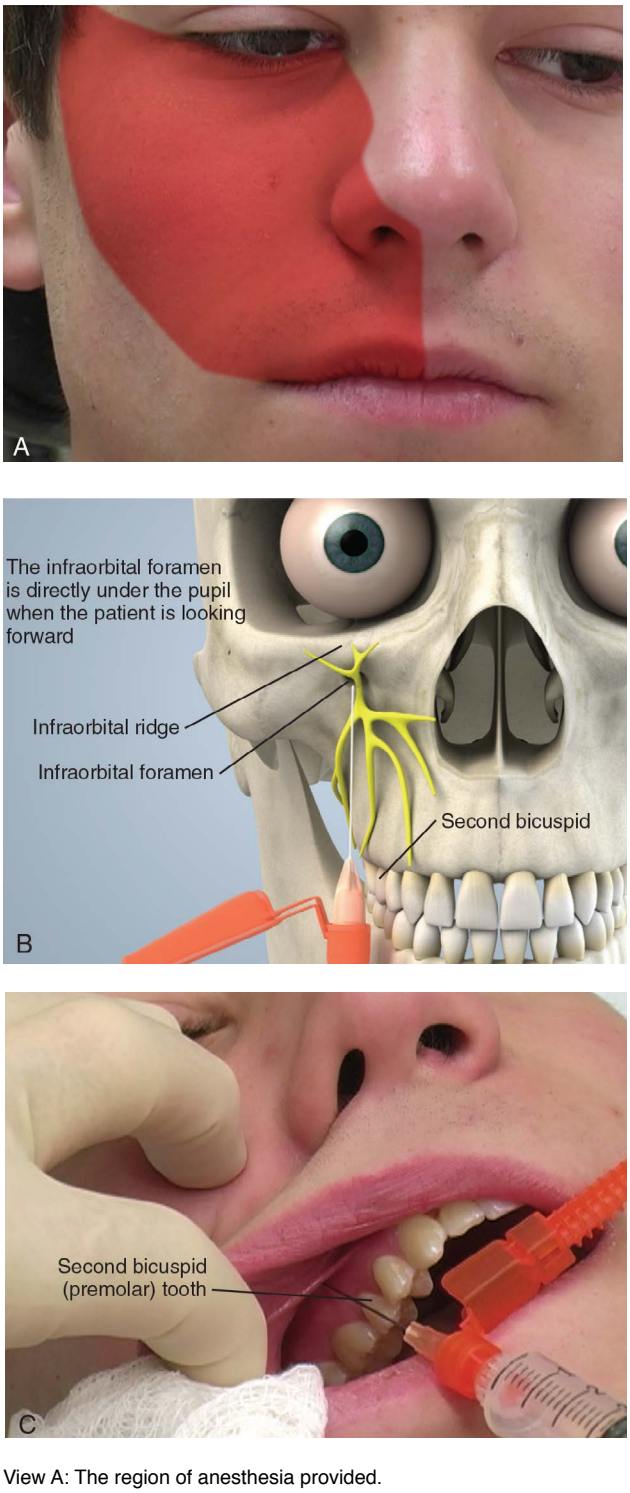
Table 3. Recommended Antimicrobials for Severe Periodontal Disease, Severe Pericoronitis, and Simple Odontogenic Infections

Antimicrobial	Dose	Duration	Comment
Penicillin VK	500 mg PO qid	10 days	None
Amoxicillin/ clavulanate	500 mg/125 mg PO q8h **or** 875/125 mg PO bid	10 days	None
Clindamycin	300 mg PO qid	10 days	If allergic to penicillin
Nystatin	100,000 units/mL 5 mL swish/spit, qid	10 days	If immunocompromised or suspected *Candida* infection

Abbreviations: bid, 2 times per day; PO, by mouth; q8h, every 8 hours; qid, 4 times per day.

Adapted from *Rosen's Emergency Medicine: Concepts and Clinical Practice,* 9th edition, Ron M. Walls, Robert S. Hockberger, Marianne Gausche-Hill, et al. Oral Medicine. Copyright 2017, with permission from Elsevier.

Figure 15. Infraorbital Nerve Block



View A: The region of anesthesia provided.

View B: A diagram of the location of the infraorbital foramen relative to the oral cavity.

View C: A patient receiving an intraoral infraorbital nerve block.

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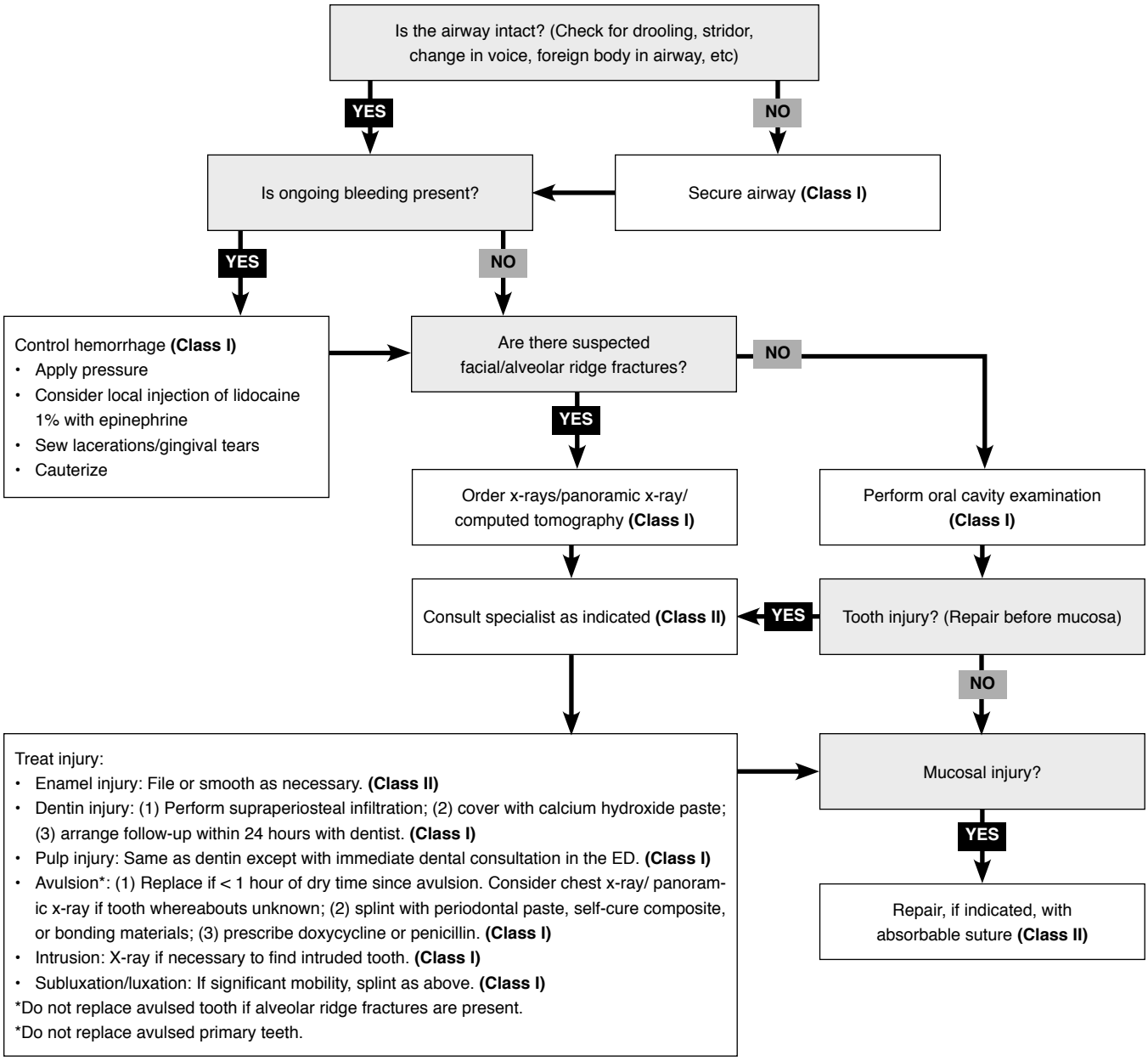
Clinical Pathway for Approach to the Patient With Dental Trauma



Class Of Evidence Definitions

Each action in the clinical pathways section of *Emergency Medicine Practice* receives a score based on the following definitions.

Class I
- Always acceptable, safe
- Definitely useful
- Proven in both efficacy and effectiveness

Level of Evidence:
- One or more large prospective studies are present (with rare exceptions)
- High-quality meta-analyses
- Study results consistently positive and compelling

Class II
- Safe, acceptable
- Probably useful

Level of Evidence:
- Generally higher levels of evidence
- Nonrandomized or retrospective studies: historic, cohort, or case control studies
- Less robust randomized controlled trials
- Results consistently positive

Class III
- May be acceptable
- Possibly useful
- Considered optional or alternative treatments

Level of Evidence:
- Generally lower or intermediate levels of evidence
- Case series, animal studies, consensus panels
- Occasionally positive results

Indeterminate
- Continuing area of research
- No recommendations until further research

Level of Evidence:
- Evidence not available
- Higher studies in progress
- Results inconsistent, contradictory
- Results not compelling

This clinical pathway is intended to supplement, rather than substitute for, professional judgment and may be changed depending upon a patient's individual needs. Failure to comply with this pathway does not represent a breach of the standard of care.

Facial cellulitis of dental origin is often polymicrobial, with a 2011 study showing an average of at least 2 organisms being cultured; more than half of the time, anaerobes were present.[40] Therefore, broader coverage should be obtainesd for significant facial cellulitis thought to be from an odontogenic origin.

Deep neck infections require broad-spectrum antibiotics. In the immunocompetent patient, ampicillin with sulbactam (Unasyn® in the United States) 3 g intravenously (IV) every 6 hours with vancomycin 20 mg/kg IV (up to institutional maximum) is reasonable; monotherapy with clindamycin can be undertaken in penicillin- or vancomycin-allergic patients. Broadening coverage in the immunocompromised patient to meropenem 1 g every 8 hours (or 500 mg every 6 hours, per institutional protocol) plus vancomycin is reasonable to ensure *Pseudomonas* species and extended-spectrum beta lactamase-producing bacteria are covered.

Patients who have replanted teeth should also receive antibiotics; this is discussed in the following section.

Concussion, Subluxation, and Luxation Injuries

The most important emergency aspect of intrusive luxation is recognition and referral, and not mistaking intrusive luxation for avulsion (if the intrusive luxation is severe, it may appear as though no tooth is in that socket). The ultimate management of intrusive luxation is controversial, with a retrospective study showing no difference between orthodontic extrusion and surgical repositioning; in any case, no ED-based intervention is warranted.[41]

If grossly mobile, subluxed teeth can be considered for splinting, but usually a soft diet, chlorhexidine rinses, and dentist referral are all that is indicated. Permanent teeth that have a luxation injury should be gently placed into anatomic position and then a dental splint (such as Coe-Pak™) should be applied if any mobility is present. Further treatment is identical to that of subluxed teeth. Dental splinting is accomplished by mixing a resin and a catalyst paste and applying to completely dry teeth; a nasal cannula with oxygen can be utilized as an air source, and gauze rolls can be placed in the mucobuccal fold to absorb saliva. Although the teeth must be dry, the clinician's gloved hands should be wet or lubricated to allow for easier handling. Apply the splinting to the facial side of the teeth, spanning approximately 1 to 2 teeth in either direction to the affected tooth, avoiding the occlusal (biting) surface, to allow for mastication.

Tooth Avulsion

The International Association of Dental Traumatology has published a series of guidelines on the management of traumatic dental injuries, including avulsion.[42] If the tooth is a permanent tooth and thought to be viable based on the time of the injury and storage medium, replantation should be considered.[43] To replant a tooth, handle by the crown, rinse any debris with sterile saline without traumatizing the periodontal ligament cells of the root, irrigate the socket if any clot or debris exists, and place the tooth in anatomic position.

Prior to replantation, analgesia can be achieved using a supraperiosteal nerve block (for maxillary teeth) or an inferior alveolar nerve block (for mandibular teeth). The teeth should be splinted using dental splinting material. A single case study reported using tissue adhesive glue and a pliable nasal metal bridge from a respirator mask to successfully stabilize a replanted tooth,[44] but further studies are needed to assess whether this method of splinting is viable.

After replantation, all patients should receive antibiotics; doxycycline 100 mg by mouth twice daily for 1 week is first-line treatment,[42] but in children at risk for tooth discoloration or those with tetracycline allergies, penicillin VK at a dose of 50 mg/kg/day divided 4 times per day (maximum 500 mg 4 times/day) should be prescribed instead. Chlorhexidine rinses and gentle brushing after meals (soft diet only) are encouraged until dental follow-up is obtained.

Although some sources recommend presoaking avulsed teeth in an antibiotic solution (such as doxycycline) based on canine in vitro data,[45] in vivo human studies failed to replicate this benefit, and this will delay time to replantation. Difficulty obtaining an appropriate antibiotic solution is likely to occur, so this should not be undertaken routinely.[46] The International Association of Dental Traumatology guidelines note doxycycline soaking as a consideration.

Dental Fractures

The International Association of Dental Traumatology also has recommendations for management of dental fractures.[22] The treatment and urgency of referral depend on the depth of the fracture, which is ascertained clinically. **(See Figure 6, page 4.)**

Fractures Involving the Enamel Only (Ellis I)

Fractures that involve only the enamel and no deeper structures (eg, dentin or pulp) are cosmetic injuries. Sharp edges can be gently filed down with an emery board for comfort. Nonurgent dental referral can be undertaken for re-evaluation and cosmetic reconstruction of the missing enamel.

Fractures Involving the Enamel and Dentin (Ellis II)

Fractures that go as deep as the dentin will be apparent due to the yellow hue of the exposed dentin and increased tooth sensitivity. Cover the exposed dentin with a calcium hydroxide paste (eg, Dycal®, Preline®, UltraCal®, et al) as a temporary cover to prevent spread of bacteria to the pulp. To accom-

plish this, anesthetize the tooth and then dry the tooth in the same fashion as described for dental splinting. Mix equal parts of catalyst and base on a mixing surface and place a small amount of paste over the exposed surface. One case report noted that use of tissue adhesive glue instead of calcium hydroxide paste for fracture coverage was successful, but more data are needed before this can be recommended as a viable substitute to traditional therapy.[47] Refer the patient to a dentist within 24 hours for further treatment.

Fractures Involving the Enamel, Dentin, and Pulp (Ellis III)

ED consultation with a dentist should be obtained if pulp exposure is identified, usually signified by either a pinkish hue or bleeding from the affected tooth. If available, it is reasonable to treat these fractures the same as fractures involving the enamel and dentin, but certain dental follow-up as soon as possible should be established. Attempt at ED pulpotomy is not indicated, as this can induce infection and emergency clinicians are, in general, not trained in this procedure.

Alveolar Ridge Fractures

Alveolar ridge fractures require rigid splinting of the affected segment. Ideally, this consultation would occur in the ED, as larger or more severe alveolar ridge fractures have the potential for displacement of the segment and subsequent aspiration risk. If the fracture is small, not grossly mobile, and the patient is reliable, an urgent follow-up with a specialist within 24 hours is reasonable.

Alveolar Osteitis

Patients with alveolar osteitis should have their treatment aimed primarily at pain control with NSAIDs with or without adjunctive opioid analgesics. A nerve block can be considered, and gentle irrigation of the socket with sterile saline can be performed, but the socket should not be curetted and any residual clot should not be removed. Alveolar osteitis is a localized osteomyelitis of the alveolar bone, and exposing more bone will serve to worsen the condition. If available, a commercially available "dry socket paste" can be applied, or packing gauze with eugenol can be applied. However, based on a Cochrane review, there is insufficient evidence to determine the effects of any intervention to treat alveolar osteitis.[48] A randomized trial showed that chlorhexidine gel after extraction may reduce the incidence of development of alveolar osteitis,[49] but there are no data to recommend this treatment once a patient has already developed the condition. Prompt follow-up with the provider who performed the initial extraction should occur.

Mandibular Dislocation

Mandibular dislocation is often difficult to reduce owing to masseteric spasm; procedural sedation is often necessary to relax the patient sufficiently to allow for successful reduction. Imaging is not routinely indicated for atraumatic dislocations, but should be obtained for traumatic injuries. If an intraoral approach is attempted, protection of the provider's thumbs is of utmost importance. Once the mandible is reduced, the patient often immediately fully closes the jaw, which can injure the provider, if unprotected. To avoid injury, wrap the thumbs in gauze, with or without addition of a taped piece of tongue depressor on either side. In the traditional intraoral approach, the emergency clinician faces the patient and places protected thumbs on the inferior molars and applies downward and backward pressure. **(See Figure 16.)** For a video demonstration of a mandibular dislocation reduction, scan the QR code or go to: https://www.youtube.com/watch?v=ECt863r7H-s If this fails and the patient has a bilateral mandibular dislocation, each side can be reduced individually. The "unified hands" technique was described in a case report and allows for more force to be applied to each side of the mandible.[50] **(See Figure 17.)**

In 2014, a new technique was described for a hands-free approach to mandibular reduction that did not require procedural sedation.[51] Termed the

Figure 16. Traditional Method of Reducing a Mandibular Dislocation

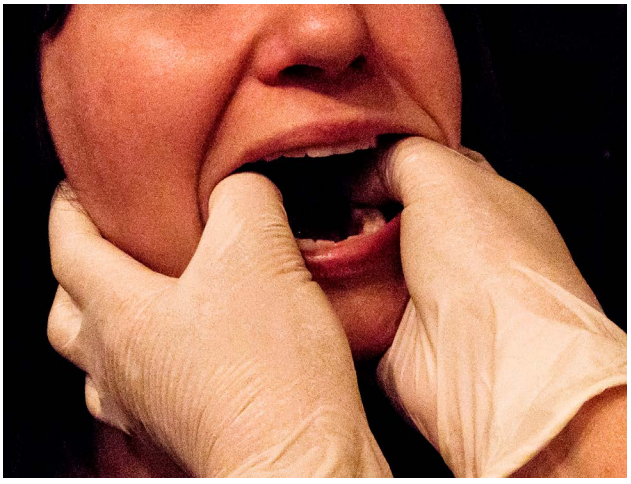


Image courtesy of Jerome Eno.

To view a video of a mandibular reduction, scan the QR code with a smartphone or tablet, or go to: https://www.youtube.com/watch?v=ECt863r7H-s

"syringe technique," a 5- or 10-mL syringe is placed between the posterior molars and the patient is instructed to attempt to bite down and roll the syringe back and forth. The syringe acts as a rolling fulcrum to attempt to slide the mandible posteriorly. Of 31 patients enrolled, 30 were successfully reduced using this method.

Controversies and Cutting Edge

There are few studies on ED-specific management of acute dental injuries. In isolated case reports, tissue adhesive glue (with metal from an oxygen mask) has been used and found to be acceptable for splinting and for sealing dental fractures, but there is not yet enough evidence to support it for routine use. Commercially available kits for treatment of dental emergencies have been constructed and are sold for use, such as The Dental Box, Dr. Stahl's Emergency Dental Kit, and others. A premade kit can be purchased, or items can be purchased separately. If purchased separately, they should include the items listed in **Table 4**.

A recent systematic review and meta-analysis found that implant-supported single crowns (where a titanium root is inserted into the jaw and an artificial tooth is attached) have longer survival than replanted teeth.[52] However, in the ED, there are no prediction rules regarding which patients will do better with each intervention, so those teeth that the emergency clinician feels are candidates for replantation should be replanted, and a dentist can subsequently manage the patient.

Figure 17. "Unified Hands" Technique

"Unified hands" technique to increase force for reduction of one side of a mandibular dislocation.

Reprinted from *Journal of Emergency Medicine.* Volume 38, Issue 3. David Cheng. Unified hands technique for mandibular dislocation. Pages 366-367. Copyright 2010, with permission from Elsevier. DOI: http://doi.org/10.1016/j.jemermed.2008.12.022

Disposition

In general, admission should be considered for dentoalveolar trauma if the patient has debilitating multisystem trauma that necessitates admission, difficulty handling secretions, too much trismus to be able to eat, or has uncontrolled pain. Patients with simple dentoalveolar trauma can be discharged with appropriate follow-up. Patients with signs of systemic illness or those who are immunocompromised presenting with more severe odontogenic infections, necrotizing periodontal disease, deep neck infection, facial cellulitis, or threatened airway compromise should be admitted for IV antibiotics and more extensive evaluation of their underlying disease. If there is any concern for impending airway compromise due to a deep neck infection such as Ludwig angina, consultation with a specialist with expertise in fiberoptic intubation and surgical airway management should be obtained, and admission to an intensive care unit is indicated.

Time- and Cost-Effective Strategies

- Regional anesthesia is easy to learn and effective for orofacial pathology.
- Use contrast-enhanced CT imaging liberally for deep neck infections, as physical examination alone may underestimate severity of infection.
- Assess the readiness of your ED to care for dental emergencies. Consider purchasing supplies (gauze, calcium hydroxide paste, dry socket paste or eugenol, periodontal splinting paste, HBSS or milk) or purchase a premade kit (The Dental Box, Dr. Stahl's Emergency Dental Kit).

Table 4. Dental Equipment Needed in the Emergency Department

- Packing gauze
- Dental roll gauze
- Calcium hydroxide paste, glass isonomer cement, or zinc oxide cement
- Dry socket paste or eugenol
- Topical anesthetic gel (20% benzocaine or 5% lidocaine)
- Topical bacterial intraoral solution (Ora-5®)
- Periodontal paste (Coe-Pak®) or self-cure composite
- Bupivacaine with epinephrine 0.5%, 1:200,000 cartridge
- EMT Toothsaver Preservation System or milk
- Zinc oxide/eugenol temporary cement (Temrex®)
- Ringed injection syringe
- Stainless steel spatula and mixing pads
- Oral surgery tray with arch bars and ligature wires
- Tongue blades and cotton-tipped applicators
- Disposable electrocautery (optional)

Adapted from: Kip Benko. Acute dental emergencies in emergency medicine. *Emergency Medicine Practice.* Volume 5, Issue 5. 2003. Pages 1-24.

Risk Management Pitfalls for Dental Emergencies in the Emergency Department

1. **"The patient had an open femur fracture; I didn't think to check his mouth for injuries."**
   All traumatic injury patients should be evaluated in a systematic manner, including for dental injuries. Unrecognized dental injuries or unrecognized aspiration of teeth can lead to unnecessary morbidity.

2. **"They didn't find the tooth at the scene, but I assumed it was just left on the pavement somewhere."**
   All teeth must be accounted for. If all teeth are not accounted for, consider intrusive luxation mimicking avulsion, aspiration of teeth, swallowing of teeth, or the possibility that a tooth is embedded in a laceration.

3. **"The patient required a lot of work, so I just left the tooth on the table."**
   More than 60 minutes of extraoral dry time makes replantation almost always unsuccessful. If not immediately replanted, teeth should be stored in an appropriate storage medium.

4. **"The patient's tooth was fractured, but he said he could follow up with his dentist in a few days, so I let him go."**
   Failure to appropriately manage dental fractures that involve the dentin or pulp with calcium hydroxide coverage and failure to obtain consultation or prompt follow-up can lead to unnecessary morbidity.

5. **"I put that patient's tooth back in, splinted it, and he came back 2 days later after it came out while eating a steak!"**
   All patients who have subluxation, luxation, or avulsion injuries should be advised to maintain a soft diet and be prescribed chlorhexidine rinses. For avulsion injuries, prescribe antibiotics, such as doxycycline.

6. **"That patient's neck was pretty full, but I never would have guessed there was a big abscess there."**
   The clinical examination has relatively limited sensitivity for detection of deep neck infections or to fully describe their extent based on physical examination findings alone. Liberal usage of contrast-enhanced CT scan should be considered for any patient suspected of having a deep neck infection.

7. **"The patient desaturated after I had to give him 6 doses of morphine for his mandibular fractures; there was nothing I could do to get him comfortable!"**
   Regional anesthesia is very effective for dentoalveolar trauma. Always consider whether an orofacial nerve block is indicated when managing these patients.

8. **"The patient had diabetes and HIV, but it seemed to just be an infected tooth. I didn't think she would come back needing surgery."**
   Have a high index of suspicion for patients in an immunocompromised state, as the incidence and the severity of deep neck infections is much higher in these populations.

9. **"The patient had 3 mobile teeth, but I didn't know how to splint them, so I let her go."**
   Become comfortable and familiar with usage of calcium hydroxide paste for fractures and with periodontal splinting material for luxation and avulsion injuries, as they can improve outcomes in patients with traumatized teeth.

10. **"I told him to follow up with a dentist. I assumed he understood to see the dentist the next day."**
    It is important to provide appropriate and feasible dental follow-up for many of these patients with acute dental emergencies, as many of the ED treatments are only temporizing.

Summary

Dental visits to the ED are increasing in frequency and have a broad spectrum of diagnoses ranging from painful but harmless to emergently life-threatening. In addition, many systemic illnesses have dental, facial, or pharyngeal manifestations. Prehospital care is critical to viability of avulsed teeth and, if teeth are accounted for at the scene and properly stored, replantation can improve cosmetic and functional outcome. Any tooth that is not accounted for on visual inspection should be considered to be aspirated, swallowed, or intrusively luxated until proven otherwise by imaging, if necessary. Luxated or avulsed teeth that are repositioned and replantated should be splinted and the patient referred to a dentist for prompt follow-up. Deep neck infections may be more extensive than appreciated on a clinical examination; in this population, use imaging liberally. To ensure your ED is equipped to treat a wide range of dental emergencies, regularly survey equipment and supplies.

Case Conclusions

For the 20-year-old man with avulsion of the right maxillary central and lateral incisors, you were able to replant the central incisor that was stored properly in milk, but you were concerned about the lateral incisor that was not accounted for on scene. A chest x-ray demonstrated that it was in his stomach. You splinted the replanted central incisor and gave the patient a prescription for doxycycline 100 mg by mouth twice a day for 1 week, a soft diet, and chlorhexidine rinses, and advised him to see his dentist the next day. The chipped tooth involved only the enamel, so you filed it down for comfort.

You gave the 18-year-old woman with alveolar osteitis an inferior alveolar nerve block with bupivacaine 0.5% to treat her severe pain, packed the socket with eugenol-soaked gauze, and discharged her on NSAIDs, with follow-up the next day with her surgeon.

For your third patient, the 60-year-old homeless man with fever and gingival pain, you found on examination that he had necrotizing ulcerative gingivostomatitis. He had a leukocytosis and bandemia, and you placed him in the observation unit with IV ampicillin/sulbactam 3 g IV every 6 hours. His HIV test was negative. You discharged him the next day on amoxicillin/clavulanate 875 mg/125 mg by mouth twice a day for 10 days, oral chlorhexidine washes, strict dental hygiene, and follow-up with a dentist for continued debridement.

Key Points

- Primary teeth should not be replanted.
- All teeth must be accounted for at the scene; if they are not, consider the possibility of intrusive luxation, aspiration, swallowing, or embedding of a tooth or fragments in a laceration.
- Avulsed teeth that are candidates for replantation should be stored in an appropriate storage medium (eg, Hanks' balanced salt solution or milk) and handled by the crown only.
- Any fractured tooth with exposed dentin should be covered with calcium hydroxide and followed up within 24 hours; those with exposed pulp should have consultation in the ED.
- Immunocompromised patients such as those with diabetes or HIV have a greatly increased risk of deep neck infections and related complications.
- Physical examination may not fully appreciate the extent of a deep neck infection; consider liberal contrast-enhanced CT imaging if a serious deep neck infection is suspected.
- Familiarity with orofacial nerve blocks, calcium hydroxide usage, and periodontal splinting materials will make management of most dental emergencies much easier.
- Ensure that your ED is appropriately stocked with dental supplies; if not, make your own kit or use a commercially available one.

References

Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study is included in bold type following the reference, where available. In addition, the most informative references cited in this paper, as determined by the authors, are noted by an asterisk (*) next to the number of the reference.

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CME Questions

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1. Regarding adult dentition, which of the following is correct?
   a. There are 4 incisors, 4 canines, 12 premolars, and 12 molars.
   b. There are 6 incisors, 4 canines, 10 premolars, and 12 molars.
   c. There are 8 incisors, 4 canines, 8 premolars, and 12 molars.

2. In cases of dental trauma, prehospital care providers should do all of the following EXCEPT:
   a. Have the patient sit upright (unless cervical spine immobilization is indicated)
   b. Store avulsed teeth under the patient's tongue
   c. Have suction available
   d. Use direct pressure to control oral hemorrhage

3. In the field, if a tooth has been avulsed and no commercially available storage solution is available, which of the following is the best storage medium?
   a. Saliva
   b. Water
   c. Milk
   d. Wrapping in a tissue

4. Avulsed primary teeth:
   a. Should be replanted only if it can be done within 30 minutes
   b. Should be replanted only if the child is younger than 6 years
   c. Should be replanted only if the root has been preserved adequately
   d. Should not be replanted

5. **The inability to crack a tongue blade bilaterally when it is twisted between the molars suggests:**
   a. A mandibular fracture
   b. A deep space infection
   c. Gingivitis
   d. Temporomandibular joint disorder

6. **A single maxillary tooth can be best anesthetized with which of the following nerve blocks?**
   a. Inferior alveolar nerve block
   b. Mental nerve block
   c. Infraorbital nerve block
   d. Supraperiosteal nerve block

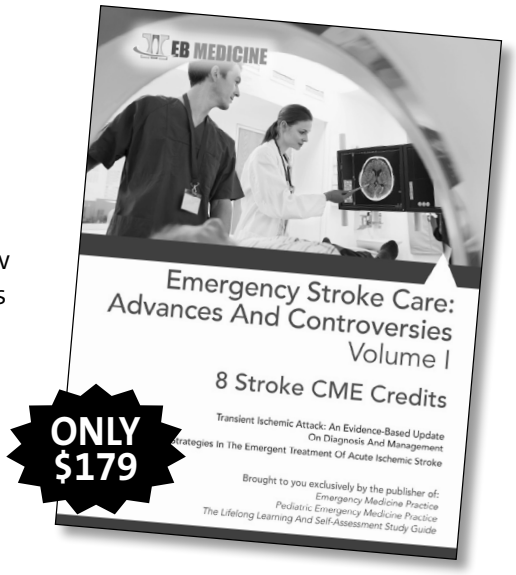
7. **Multiple mandibular teeth can be best anesthetized with which of the following nerve blocks?**
   a. Inferior alveolar nerve block
   b. Mental nerve block
   c. Infraorbital nerve block
   d. Supraperiosteal nerve block

8. **A patient presents with mild pericoronitis. Which of the following is indicated?**
   a. Sharp debridement of the operculum
   b. Broad-spectrum antibiotics
   c. Chlorhexidine or green tea mouth rinses
   d. Emergent oral and maxillofacial surgeon consultation

9. **Once a patient has a luxated tooth placed in anatomic position, what is the next step?**
   a. Splinting the tooth in place using Coe-Pak® or similar
   b. Splinting the tooth in place using calcium hydroxide paste
   c. Broad-spectrum antibiotics
   d. Covering the entire tooth with calcium hydroxide paste

10. **Regarding avulsed teeth, which of the following is TRUE?**
    a. Primary teeth should be replanted if the avulsion was recent.
    b. Antibiotics should be prescribed after replantation.
    c. The root should be rinsed and wiped down prior to replantation.
    d. Calcium hydroxide paste should be used to keep the tooth in place.

Leverage The Latest Advances In Stroke Care!



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