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AUTHORS

Stacey L. Poznanski, DO, Assistant Professor, Department of Emergency Medicine, Wright State University, Boonshoft School of Medicine, Dayton, OH.

Prabu Selvam, MD, MHS, Resident, U.S. Air Force/Wright State University, Integrated Emergency Medicine Residency Program, Dayton, OH.

Arya Namboodiri, DDS, General Dentist, Dayton, OH.

PEER REVIEWER

Michael A. Turturro, MD, Associate Professor of Emergency Medicine, University of Pittsburgh School of Medicine, PA.

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Dental Emergencies in the ED

There are more than 2 million dental-related visits to the emergency department (ED) every year.¹ Non-traumatic dental conditions alone lead to an estimated 4000 visits per day to EDs in the United States.^{2,3} Unfortunately, many emergency physicians are ill prepared and lack the necessary confidence to take on some dental complaints. In a survey of 103 ED physicians, nearly 90% were comfortable with suturing facial lacerations, but only 36% were confident managing dental avulsion injuries.⁴ Emergency physicians in a major metropolitan area of the United States were surveyed regarding their knowledge of dental emergency management, and the study revealed that less than 56% of providers had adequate training to manage dental fractures. An even smaller percentage of providers were comfortable managing these injuries in children.⁵

This knowledge gap is compounded by the rising number of patients seeking dental care in the ED. Dental visits to the ED increased by 59% between 2001 and 2008.³ The reasons for this change in dental health visits are multi-factorial; however, the steadily decreasing Medicaid coverage of adult dental care across the nation and decreased prevalence of employer-based dental insurance are likely major contributors.¹ This problem disproportionately affects adults in the 18-44 age group, as well as minorities and the uninsured.³

This article provides a concise summary of dental and oral emergencies presenting to the ED, key findings to help differentiate the diagnosis, and management pearls and pitfalls for the practicing emergency physician. The topics are organized into general considerations, followed by traumatic, non-traumatic, and peri-operative presentations, as well as a reference section on dental anesthesia.

General Considerations and Examining the Oral Cavity

As with any good physical exam, it is important to be systematic. Begin by examining the general appearance of the face, looking for lesions, swelling, and asymmetry. Palpate externally for lymphadenopathy and areas of tenderness. Next, perform the intra-oral exam in the following order using gloved hands and two tongue blades to move and manipulate tissue: lips, buccal mucosa, vestibule, the posterior pharynx, the tongue (don't forget to look under it!), and, lastly, the gingiva and teeth. Take note of the position of the uvula and any swelling. If the patient can localize a painful area, tap lightly on the nearby teeth with a hemostat tip or with the tongue blade to identify any individual teeth that are tender.⁶

A pitfall in the oral cavity exam is inadequate lighting. One trick of the trade is to use a fiberoptically-lit plastic speculum (normally used for pelvic exams) as a lighted tongue depressor — simply remove the top piece of the speculum. A curved laryngoscope blade works as well. These tools can be especially helpful

EXECUTIVE SUMMARY

- NSAIDs have been shown to be very effective analgesics for dental pain. While narcotics are often used, consider a dental injection with bupivacaine with epinephrine. This injection can last more than 7 hours.
- Ludwig's angina is a deep space infection of the submandibular space, which can lead to airway compromise. Admit these patients to an ICU or equivalent unit to observe their airway.
- The tooth layer involved (enamel, dentin, or pulp) factors significantly into the differential diagnosis and management of tooth fractures and non-traumatic tooth pain.
- Primary tooth injuries generally do not require treatment. Do not replace an avulsed primary tooth. Primary teeth are generally white and smooth.

when performing procedures, and can even be held by a cooperative patient to free up the physician's hands.⁷

Traumatic Presentations

Tongue and Lip Lacerations. Oral lacerations are a common presentation, especially in populations at high risk of falls, such as children and the elderly. Lip lacerations alone comprise a large number of these injuries. In one study of children presenting to the ED with oral injuries, 79.5% were lip lacerations.⁸ Tongue lacerations can also occur from falls, or may be associated with other pathologies, such as seizures. One pearl for management of oral lacerations is to irrigate the wound by having the patient run water over or inside his or her mouth with the mouth held open, allowing the irrigation to drain out. Consider anesthetizing the affected area before irrigation to improve patient comfort. A topical chlorhexidine rinse can also be considered before closure.

Tongue lacerations can be difficult to repair because of the challenging anatomy and mobility of this structure. Due to the favorable vascular supply, minor tongue lacerations will often heal well without repair. Indications for repair include a gaping wound, persistent bleeding, a full-thickness laceration, a hanging flap, a U-shaped laceration, or a wound greater than 1 cm in length.^{9,10} Anesthesia can be provided by several mechanisms: 4% topical lidocaine held on with gauze for 5 minutes, local 1% lidocaine injection, lingual nerve block (see section on dental anesthesia in this issue), or procedural sedation when indicated. Definitive repair requires special attention to approximating the deep muscular layers of the tongue using suture. Approximate wound edges by holding the free edges with pieces of

Table 1. Essential Dental Vocabulary Explained

Maxillary	Refers to the upper row of teeth
Mandibular	Refers to the lower row of teeth
Gingiva	Gums
Buccal	Involving the inside surface of the cheek. Ex: "Buccal mucosa"
Vestibule	Area between cheek and gums
Lingual	Toward the tongue. Ex: "Lingual gingiva, of mandibular teeth"
Palatal	Toward the hard palate. Ex: "Palatal gingiva, of maxillary teeth"
Distal	Away from the midline or away from the gap between central incisors. Ex: "The canine is distal to the central incisor"
Mesial	Toward the midline or toward the gap between central incisors. Ex: "The canine is mesial to the molars"
Occlusal surface	Biting surface of teeth (called "incisal surface" for anterior teeth)
Apex of tooth	The point immediately above the tooth's root (maxillary) or immediately below the tooth's root (mandibular).
Caries	Erosion of the tooth surface caused by bacteria (also known as a "cavity")

gauze, or by temporarily inserting suture into each free edge to ease manipulation. Use absorbable suture such as Vicryl, and either bury the knots or tie multiple knots to ensure they do not unravel, considering the tongue's mobility. Sutures should be deep and involve the muscular layers of the tongue. The superficial mucosal layers of the tongue will heal readily with minimal approximation, and are far less critical when compared to approximation of the muscular layers.¹⁰

A novel approach to relatively superficial tongue lacerations is to dry tissue edges with gauze and approximate them using a tissue glue such as 2-octyl cyanoacrylate, commonly known as Dermabond. Drying the tissues first allows for rapid drying of the adhesive, which minimizes swallowing. This has been shown to be effective in a case

study; however, this approach may require reapplication during a follow-up visit, and the adhesive may dissolve prematurely if hot liquids are consumed.⁹ This approach has not been validated in comparison testing, and the mainstay for tongue lacerations warranting repair is still to use absorbable suture.

Lip lacerations can be anesthetized with local infiltration or nerve blocks. Several factors should prompt consideration of a plastic surgery or oral surgery consult. These are: injury greater than 12 hours ago (although a relatively clean laceration can be safely closed up to 24 hours after injury); a through-and-through vertical lip laceration that is likely to disrupt the underlying musculature; or asymmetry with smiling that confirms compromise of the orbicularis oris muscle.¹¹ If there is vermilion border involvement, approximate this

Figure 1. Periodontal Dressing



margin first during closure. If there is significant swelling, apply ice to reduce distortion of the lesion for better approximation and an optimal aesthetic outcome. Use absorbable sutures on oral mucosal surfaces, and 5-0 or 6-0 non-absorbable suture on any lip surface or external facial surfaces for maximal aesthetic outcome. In some cases, absorbable sutures can be considered for small external facial lacerations. Generally, all facial lacerations should have suture removal after five days.¹¹

Concussed, Subluxated, Luxated, and Avulsed Teeth. (See Figure 1.)

Traumatic dental injury is most commonly seen in children and teenagers. Nearly 25% of all children will experience dental trauma during childhood, and in this age group, injuries are, by nature, much more likely to have life-long cosmetic and functional consequences.¹² Central and lateral incisors are most likely to be injured as a result of trauma, and maxillary teeth are more at risk than mandibular teeth.¹³

When considering tooth injury, it is important to differentiate between primary and permanent teeth, as the management is significantly different. Primary teeth are completely replaced by permanent teeth between 6 and 14 years of age. Whereas primary teeth are white and smooth, permanent teeth are more cream colored, larger, and jagged-edged. In general, primary teeth require little or no intervention, as viability of the tooth is not a concern. Primary teeth, when avulsed, should not be replaced because of the risk of

Table 2. Tooth Injury Summary

Injury Type	Clinical Features	Management
Concussion	After trauma, tooth still in place	Dental follow-up
Subluxation	Any movement of the tooth (loose tooth) or blood present at the gumline, but tooth remains in the correct position	Splint tooth using a commercially available periodontal dressing (i.e., Coe-Pak; see Figure 1 and see text for details of use).
Luxation	If there is any movement of the tooth and it sits in an irregular position	Use local anesthesia at the site as needed. Gently move to natural position. If intrusion injury, leave tooth in place. If tooth is extruded, push tooth in so it is in line with surrounding teeth. Splint tooth using a commercially available periodontal dressing (i.e., Coe-Pak; see Figure 1 and text for details of use). All patients with intrusion injury should receive a course of penicillin VK or clindamycin (see Table 3).
Avulsion	Tooth has separated from its socket (alveolus)	Store avulsed tooth in milk at room temperature until ready to reposition. 1) Use local anesthesia at the site as needed for patient comfort. 2) Saline irrigate the socket with a syringe to remove debris and coagulated blood. 3) Saline irrigate the tooth. Never wipe the root side of the tooth. Consider a 5 min. saline soak to loosen any stuck-on debris if needed. 4) Push the tooth into the alveolus with firm pressure until it is level with the adjacent teeth. 5) Splint tooth using a commercially available periodontal dressing (i.e., Coe-Pak; see Figure 1 and text for details of use). All patients should receive a course of penicillin VK or clindamycin (see Table 3). Update tetanus vaccination, if indicated, when the tooth has come into contact with soil.

disrupting the normal development of underlying permanent teeth.^{6,14}

A concussion injury is when a tooth is tender to percussion following trauma, but is firmly in place. No intervention is required in the ED other than dental referral.¹⁴ A subluxated tooth is loose but in its original position, whereas a luxated tooth is displaced from its original position. (See Table 2.) The primary difference in management is that luxated teeth are repositioned before splinting. The exception to this rule is an intrusion injury, which is a type of luxation in which a tooth is pushed further into its alveolus. Intrusion injuries are prone to infection and subsequent root disruption, underlying alveolar bone

injury, and in the case of primary teeth, damage to the underlying permanent tooth.¹⁵ Do not manipulate intrusion injuries in the ED, as therapy involves antibiotics alone, with penicillin VK or clindamycin (see Table 3).¹⁶ In contrast, extrusion injuries, in which the displaced tooth sits partially pulled away from its alveolus, should be pushed back in line vertically with surrounding teeth.¹⁴ Recommend a soft diet until prompt dental follow-up.

Avulsion is when a tooth is completely separated from its alveolus (also known as the socket), and appropriate management is key to ensuring viability of the patient's native tooth structure. An avulsed tooth is most readily stored

Table 3. Antimicrobials Guide^{31,33,56-58}

Indication	Agent	Dosing
General Odontogenic Use	Penicillin VK	> 12 yo: 500 mg 4 times daily for 7 days ≤ 12 yo: 10 mg/kg/dose (max 500 mg/dose) 4 times daily for 7 days
	Clindamycin (PCN allergic)	>12 yo: 150 mg 4 times daily for 7 days ≤ 12 yo: 5 mg/kg/dose (max 150 mg/dose) 4 times daily for 7 days
ANUG	Metronidazole	>12 yo: 500 mg 3 times daily for 7 days ≤ 12 yo: 10 mg/kg/dose (max 500 mg/dose) 3 times daily for 7 days
Deep Space Infections	Ampicillin-Sulbactam	See reference IV dosing
	Clindamycin (PCN allergic)	
Primary Herpes Gingivo-Stomatitis	Acyclovir	Children and Adults: Acyclovir 15 mg/kg/dose (max 200 mg/dose) 5 times daily for 7 days
Antibiotic Prophylaxis Single Dose (AHA Guidelines)	Amoxicillin	> 12 years old: 2 g ≤ 12 years old: 50 mg/kg
	Clindamycin (PCN allergic)	> 12 years old: 600 mg ≤ 12 years old: 20 mg/kg

or transported using milk; however, a specialized product called Hank's Balanced Salt Solution (HBSS) is also available. Recent studies show that milk is nearly as effective as specialized solutions, and storage at room temperature is adequate.¹⁷ In the event that saline or milk is unavailable, and the patient is conscious, store the tooth in the patient's mouth at the vestibule between the gingiva and buccal mucosa.¹⁶

Once a tooth is avulsed, it is no longer alive; however, the bone structure of the tooth can remain functional for years if the root fuses with the underlying alveolar bone — similar to a far more expensive and invasive prosthetic dental implant. For this process to occur, the tooth must be repositioned before the periodontal ligament (a highly specialized connective tissue layer that anchors teeth to alveolar bone) becomes necrotic.¹⁶ If an avulsed tooth is replanted before the patient arrives, splint the tooth in place. With tooth avulsion, there is a decrease in the rate of successful implantation when there is a delay in repositioning. Successfully reposition an avulsed tooth in its alveolus by following these five steps: 1) If possible, use the appropriate

local anesthesia so that the alveolus is not tender; 2) saline rinse the alveolus (socket) to remove any loose debris; 3) saline irrigate the tooth, taking care not to directly wipe the root surface since these structures must remain intact for the tooth to successfully re-implant (consider a 5 minute saline soak if debris appears to be stuck on); 4) push the tooth into the alveolus with firm pressure until it is level with the adjacent teeth; and 5) splint the tooth in place.¹⁸ Prescribe the patient a one-week course of penicillin VK or clindamycin (see Table 3), and update the tetanus vaccination if the patient is due when a tooth has come into contact with soil.¹⁸ Soaking the avulsed tooth in an antibiotic solution before repositioning has been recommended by some sources, but a clear benefit is not proven.¹⁹

Splinting of a tooth can be accomplished in various ways depending on the supplies available. A unique solution described in the literature is to use the metal nasal bridge from a facemask, cut it to size, and splint the affected tooth to an adjacent healthy tooth using 2-octyl cyanoacrylate (Dermabond) as the adhesive.²⁰ Many commercially available periodontal dressings are

available, which typically involve mixing a base with a catalyst to create a mixture that semi-hardens. Periodontal dressings have a consistency similar to hardened chewing gum or putty. A commonly used brand of periodontal dressing is Coe-Pak, but other types can be used. To use, cover the gum line on both the buccal and lingual surfaces of the affected tooth and wrap the material around an adjacent healthy tooth on either side, without covering the occlusal surface. (See Figure 1.) Dry dental surfaces and moist applicators will ease manipulation of the paste and prevent unwanted adherence. Once the splint has been applied, use rolled gauze as a bite block to keep the patient's mouth open for 15 minutes and allow proper drying. Prescribe a soft diet until prompt dental follow-up.¹⁶

Tooth Fractures

Tooth fractures are divided into three categories based on the depth of injury and the tooth layer involved. Fractures involving enamel (the white, hard outer layer) do not require emergent intervention. (See Table 4.) Fractures involving dentin can be identified by the softer, yellowish middle layer present on exam, and are typically accompanied by increased tooth sensitivity. Fractures involving the pulp are typically evidenced by the presence of blood. Fractures involving the dentin or pulp require a protectant sealant to prevent immediate pulp necrosis and to reduce pain. To apply calcium hydroxide or zinc oxide-eugenol temporary cement, wipe the affected tooth with saline-soaked gauze, dry the tooth, then fill the lesion with cement, taking care to maintain the contour of the tooth. Place a gauze roll bite block and allow the sealant to dry completely for 15 minutes.¹⁶ Alternatively, cover the tooth with 2-octyl cyanoacrylate and then wrap it in foil to coat the sensitive tooth structures.¹⁶

Enamel fractures need only dental follow-up within several days. Dentin fractures, when sealed with protective covering in the ED, should be followed-up within three days (although less than 24-hour follow-up is ideal). Fractures involving the pulp should be evaluated by a dentist on the same day (within 3

Table 4. Tooth Fracture Summary

Fracture Depth	Clinical Features	Management
Enamel	Superficial fracture of white, hard outer layer	<ul style="list-style-type: none"> • Dental follow-up, no urgent intervention • File down any sharp fragments and ensure no lodged or aspirated tooth fragments
Dentin	Yellow middle layer exposed	<ul style="list-style-type: none"> • File down any sharp fragments and ensure no lodged or aspirated tooth fragments • Wipe down the tooth with saline-soaked gauze, then wipe with dry gauze. THEN use calcium hydroxide or zinc oxide-eugenol temporary cement to fill the gap while maintaining the surface contour of the tooth. Alternatively, a more temporary solution is to apply 2-octyl cyanoacrylate (Dermabond) to injured tooth and then cover the tooth with foil. • Place a gauze roll bite block and let the sealant dry and set for 15 minutes. • Antibiotic course: Penicillin VK or clindamycin (see Table 3) • Ideally, dentin fractures should be followed-up by a dental professional within 24 hours. Same day follow-up is ideal for fractures involving the pulp.
Pulp	Presence of bloody discharge from fracture	<ul style="list-style-type: none"> • Dental follow-up, no urgent intervention • File down any sharp fragments and ensure no lodged or aspirated tooth fragments • Wipe down the tooth with saline-soaked gauze, then wipe with dry gauze. THEN use calcium hydroxide or zinc oxide-eugenol temporary cement to fill the gap while maintaining the surface contour of the tooth. Alternatively, a more temporary solution is to apply 2-octyl cyanoacrylate (Dermabond) to injured tooth and then cover the tooth with foil. • Place a gauze roll bite block and let the sealant dry and set for 15 minutes. • Antibiotic course: Penicillin VK or clindamycin (see Table 3) • Ideally, dentin fractures should be followed-up by a dental professional within 24 hours. Same day follow-up is ideal for fractures involving the pulp.

hours if possible), because a permanent tooth may be salvaged by performing an expedited root canal procedure. Primary teeth with fractures involving the pulp will typically be extracted.¹⁴

Large tooth fragments that detach in the context of a fracture can sometimes be re-attached, and should be stored in a milk bath until a dentist is seen.¹⁶ Try to account for all tooth fragments, as fragments may sometimes become lodged in the surrounding mucosa, or aspirated into the lungs. File down any sharp edges on a fractured tooth for patient safety.¹⁶

Non-Traumatic Presentations

Non-traumatic Tooth Pain. More than 41% of all dental visits to the ED are related to dental caries.³ When a patient presents with localized tooth pain, there are three major possibilities to consider: caries, pulpitis, and periapical abscess. A familiarity with tooth anatomy is necessary to understand these concepts. The enamel is the mineral-rich white and shiny part of the tooth; it protects the more sensitive deeper layers. Dentin is the next deeper layer, which is creamy and yellowish in

color, with microscopic microtubules that communicate with the underlying pulp chamber. The pulp chamber contains the neurovascular bundle of the tooth, and is the center of the tooth's sensitivity and viability. The roots are downward projections of the tooth structure, which extend from the bottom of the tooth into the alveolar bone. The neurovascular supply travels through the roots to connect the pulp chamber inside the tooth with larger underlying blood vessels and nerves outside the tooth.⁶

Caries can be thought of as inflammation that develops on the outside of a tooth and progresses inward as a result of plaque on the enamel of a tooth that harbors bacteria, classically *Streptococcus mutans*. Caries on the enamel surface of the tooth will typically appear opaque-gray and sometimes brownish.¹⁶

Extension of caries to the dentin causes sensitivity when certain substances touch the tooth — commonly hot, cold, or sweet substances — since the dentin layer communicates directly to the pulp chamber. Involvement of the dentin that causes episodic sensitivity at the level of the pulp chamber without direct involvement of the nerves or

blood vessels is called reversible pulpitis. Reversible pulpitis can be cured with a restoration (filling) that involves removal of the damaged dentin and enamel, and replacement with a substance that seals off access to the pulp chamber.^{6,16}

From the dentin layer, caries can extend deeper and eventually involve the pulp chamber directly, causing worsening pain that may either linger longer when it is triggered or may occur spontaneously without a specific trigger — this is called irreversible pulpitis. Irreversible pulpitis is inflammatory and gaseous distention within the pulp chamber's closed space. A characteristic finding is intractable pain that can often wake the patient from sleep.⁶ When pulp infection begins to extend into the periapical space, tenderness to percussion of the tooth may be present.²²

Periapical abscesses form when infections, initially contained within a tooth, extend out toward the underlying alveolar bone. With infection extending into the periapical space, the tooth is often tender to percussion. In this setting, assume a periapical abscess is present until proven otherwise. These abscesses are often hidden, but can penetrate the bone, and in some cases involve the surrounding gingiva. When this occurs, a fluctuant, tender lesion may be appreciated on exam, on either the buccal or lingual/palatal sides of the affected tooth.⁶ Periapical abscesses have the potential to progress and involve deeper tissues, potentially causing complications such as osteomyelitis and Ludwig's angina.^{6,23}

Treat reversible pulpitis with non-steroidal anti-inflammatory drugs (NSAIDs) as needed and dental follow-up. It does not warrant antibiotics. Pain control and avoidance of environmental triggers until dental follow-up are the mainstays of treatment.⁶ Coating deep caries with temporary cement can potentially improve comfort by creating a barrier from environmental triggers (use calcium hydroxide or zinc oxide-eugenol temporary cement, as described in the Tooth Fractures section). A Cochrane Review in 2013 showed no reduction in tooth pain as a result of treatment with penicillin, and suggested that evidence for the use of antibiotics

Table 5. Non-traumatic Tooth Pain Summary

Cause of Tooth Pain	Signs/Symptoms	Management
Reversible Pulpitis	<ul style="list-style-type: none"> • Caused by dental caries • Transient periods of pain and sensitivity in response to various triggers • No tenderness to percussion 	<ul style="list-style-type: none"> • NSAIDs
Irreversible Pulpitis	<ul style="list-style-type: none"> • Caused by dental caries • Sustained, severe periods of pain and sensitivity in response to various triggers, or occurring spontaneously without triggers • May have tenderness to percussion 	<ul style="list-style-type: none"> • NSAIDs • Optional narcotics for breakthrough pain • Penicillin VK or clindamycin (<i>see Table 3</i>) • Optional long-acting local anesthesia with bupivacaine • For readily identified deep caries, consider coating with calcium hydroxide or zinc oxide-eugenol temporary cement for improved comfort
Periapical Abscess	<ul style="list-style-type: none"> • From progression of dental infection • Sustained severe pain • Tenderness to percussion of tooth because underlying tissues are involved • A resulting adjacent gingival abscess may be present 	<ul style="list-style-type: none"> • NSAIDs • Optional narcotics for breakthrough pain • Penicillin VK or clindamycin (<i>see Table 3</i>) • Optional long-acting local anesthesia with bupivacaine • If gingival abscess present, this should be drained with local anesthesia and scalpel stab incision; discharge with chlorhexidine oral rinse.

in tooth pain remains inconclusive.²⁴ Generally, the dental literature does not support antibiotics for tooth pain unless there is confirmed periapical abscess formation. However, dentists can provide operative management and definitive diagnoses that are unavailable to emergency physicians. In the ED, treat all patients with intractable tooth pain or severe tooth pain exacerbated by percussion with a course of penicillin VK or clindamycin.^{22,23} (*See Table 3.*)

Although narcotics may be needed in some circumstances, evidence suggests that NSAIDs often have longer duration of dental pain relief when compared to narcotics, and that NSAIDs appear to be particularly more effective for dental pain than for pain in other parts of the body.⁶ In cases of intractable pain, a local anesthetic injection can provide both immediate and sustained relief (*see Table 11*).¹⁶

Anesthetize periapical abscesses with a fluctuant gingival lesion with the

appropriate dental block (*see dental anesthesia section*) and drain after incision with a scalpel. Irrigate the abscess cavity with saline and leave open to drain. Provide a prescription for chlorhexidine mouthwash, in addition to a course of antibiotics, pain medication, and prompt dental follow-up.²³

Pericoronitis. Pericoronitis is gingival inflammation and infection most often seen in the soft tissue overlying a partially erupted third molar (wisdom tooth) on the mandible. Clinically, the soft tissue overlying the eruption site will appear inflamed and occasionally purulent. A hallmark is exquisite pain, which may lead the patient to present to the ED.²⁵ This phenomenon can also occur at the soft tissue overlying the eruption site of other teeth, especially other molars in children.²⁶ The cause is likely microscopic impaction of debris and bacteria into this tissue, harboring primarily anaerobic bacteria.²² Pain can be severe, especially with chewing

and opening of the jaw.²⁵ In children, this can interfere significantly with oral intake.²⁶

In rare cases, an abscess may form in this region. Treatment is similar to a peri-apical abscess. In rare situations (1.6 per 100,000), pericoronitis infections can spread to deeper tissues, causing trismus and invasion of deep neck spaces, such as the parapharyngeal space.²⁵ Treat uncomplicated pericoronitis with penicillin VK or clindamycin.²⁶ (*See Table 3.*) Consider a local dental infiltration with an anesthetic such as bupivacaine in cases of severe pain.

Ulcerating Oral Lesions

Aphthous Ulcers. Aphthous ulcers, or “canker sores” as they are commonly known, are painful oral lesions that are caused by an immune-mediated inflammatory response. The trigger may be a traumatic tear in the oral mucosa, generalized immune system dysfunction, or an allergic irritation of the mucosa. In many cases, a trigger is not identified. Aphthous ulcers only occur on non-keratinized mucosa (which excludes the gingiva and hard palate) and typically begin as red, inflamed, circular lesions that develop a central yellowish eschar.²⁶

There are three different types of aphthous ulcers: major, minor, and herpetiform. The minor type consists of an ulcer of 2-3 mm in diameter, while the herpetiform type consists of small ulcers that occur in crops, with up to 100 small ulcers at a time. Both the minor and herpetiform types typically last for about 10 days when untreated.²⁶ The herpetiform type has no association with herpes simplex virus (HSV) infection. It is crucial to differentiate this from herpes gingivostomatitis, which causes more diffuse involvement of the oral mucosa and is accompanied by constitutional symptoms, such as malaise and fever. Aphthous ulcers of the major type are generally greater than 5 mm in diameter, invade deeper into the mucosa, are more painful, and require up to six weeks to completely heal.²⁶

Major-type aphthous ulcers require the same symptomatic treatment; however, in addition, treat with a steroidal mouth rinse, such as 0.01% betamethasone syrup or dexamethasone elixir. Steroidal rinses have been

Table 6. Ulcerating Oral Lesion Summary

Diagnosis	Clinical Findings	Acute Management
Aphthous ulcers	See aphthous ulcer table	
Acute necrotizing ulcerative gingivitis	Young adult with history of malnutrition, immune suppression, or severe stress Punched-out interdental papillae (key finding) Fever, foul breath, lymphadenopathy, loose teeth, and metallic taste	Loose cotton-swab debridement of gingival pseudomembranes Metronidazole 500 mg three times daily for 7 days Chlorhexidine 0.12% mouthwash for use twice daily Consider normal saline fluid bolus acutely Prompt dental follow-up for scaling and root planing as definitive care
Primary herpes gingivostomatitis	Generally preceded by fever and malaise Most often seen in children < 6 years old Crops of painful ulcers that occur anywhere inside or immediately outside of the mouth	Children and adults: Acyclovir 15 mg/kg (max 200 mg), five times daily for seven days Have a low threshold for narcotic pain medication, to facilitate oral intake

Table 7. Aphthous Ulcer Summary

Type	Clinical Findings	Acute Management
Minor	Ulcer 2-3 mm diameter Generally heal in 10 days	Pain control Treat like major type if severe
Herpetiform	Numerous small ulcers in crops Generally heal in 10 days Differentiate from herpes gingivostomatitis because aphthous ulcers do not involve the gums, skin outside the mouth, or constitutional symptoms such as fever	Pain control Treat like major type if severe
Major	Deeper, larger ulcer, often > 5 mm in diameter Can require 6 weeks to heal	Pain control Dexamethasone elixir 0.5 mg/5 mL; swish and spit 5 mL every 12 hours until symptoms improve For recurrent severe ulcers, Amelanox 5% paste can be used. Must be initiated early to be effective. Apply enough to cover ulcer, after drying surface, 3 times daily until symptoms improve.

shown to reduce the healing time of these ulcers.²⁶ Consider steroidal mouth rinses for minor and herpetiform lesions that cause significant discomfort. For

patients who develop recurrent aphthous ulcers, a topical immune modulator called amlexanox (Aphthasol) can be prescribed to reduce the duration of

subsequent ulcers. Amlexanox is most effective when applied to a developing aphthous ulcer in its early stages, at initial development of erythema and tenderness.⁶

Acute Necrotizing Ulcerative Gingivitis (ANUG). ANUG (also known in common vernacular as “trench mouth”) is a significantly painful polymicrobial infection with pathophysiology that is poorly understood, but is likely to involve some level of disruption in normal immune system function.²⁶ Prevalence in North America is estimated at 0.6%, with higher prevalence in whites, a mean age of 23 years, and equal sex distribution.^{26,28} ANUG is associated with immune-compromised states such as HIV and malnutrition; however, it is also associated with intense emotional stress and lack of sleep. As a disease, it became well-known for its prevalence among soldiers in World War I.

The clinical characteristics of ANUG are pain, ulcerated (or “punched-out”) interdental papillae, and gingival bleeding. Interdental papillae are the extensions of gingiva between teeth, and involvement of these structures is key to differentiating ANUG from herpes gingivostomatitis, which can present similarly. Lymphadenopathy, foul breath, fever, tooth mobility, and generalized malaise are also commonly seen.²⁶ Patients may also complain of a metallic taste in their mouth.²⁹

There are severe complications that can occur as a result of ANUG, but these complications are rarely seen in developed nations. ANUG can progress to a disease process called noma, which is progressive gangrene of surrounding tissues with potential spread to the bone structure of the maxilla and mandible. Noma primarily affects children living in poverty, and can cause significant irreversible disfigurement, with a mortality rate of 70-90% when left untreated.³⁰

The mainstay of treatment for ANUG is antibiotics, debridement, and improved nutrition and hydration. In the ED, provide loose debridement of gingival pseudomembranes using a cotton swab (if pseudomembranes are present), a course of metronidazole (*see Table 3*), chlorhexidine 0.12% mouthwash

Table 8. Deep Tissue Oral Infections

Deep Space infection	Key Clinical Findings	ED Management
Ludwig's angina	<ul style="list-style-type: none"> • Tender, edematous floor of mouth • Possible tongue protrusion • Fever • Potential for spread to skull base and mediastinum 	<ul style="list-style-type: none"> • Aggressive airway management as needed • CT with IV contrast as needed • ICU admission • IV ampicillin-sulbactam (consider clindamycin if PCN allergic) • ENT consult
Parapharyngeal abscess	<ul style="list-style-type: none"> • Medial displacement of lateral pharyngeal wall • Odynophagia • Fever • Lateral neck swelling • Potential for spread to skull base and mediastinum 	<ul style="list-style-type: none"> • Aggressive airway management as needed • CT with IV contrast • IV ampicillin-sulbactam (consider clindamycin if PCN allergic, and vancomycin if poor initial response and MRSA suspected) • ENT consult for possible operative drainage if abscess confirmed

for use twice daily, a strategy for pain control and improved nutrition and hydration, and referral to a dentist for prompt scaling and root planing under dental anesthesia.²⁶ Consider an IV fluid bolus with these patients. NSAIDs are the mainstay for treatment of pain in ANUG, with discretionary use of supplemental pain medication.

Primary Herpes Gingivostomatitis. There are more than 20,000 visits annually to U.S. EDs related to primary herpes gingivostomatitis.³¹ It is almost always caused by HSV-1, in contrast to HSV-2, which is implicated in genital herpes and is associated with sexual contact. Nearly 90% of Americans have antibodies to HSV-1, but only 1% of individuals experience symptoms that are attributed to HSV-1 infection.³¹ Most individuals are exposed to HSV-1 as children, but usually the primary infection is subclinical.³²

Acute gingivostomatitis associated with primary HSV-1 infection can be debilitating. The highest incidence is seen in children younger than the age of 6 years. The course of illness consists of fever, malaise, headache, and lymphadenopathy, which progresses to the development of painful oral lesions.³¹ These lesions begin as grayish crops of vesicles on an erythematous shiny base, which then become ulcerations with a red ring circumscribing the borders of each ulcer. These lesions can appear anywhere on

the oral mucosa, including buccal, labial, gingival, and lingual surfaces. Untreated, the gingivostomatitis will resolve spontaneously without scarring in 7-10 days, but the pain and discomfort can severely limit any oral intake, especially in young children.³²

Antiviral treatment has been shown to reduce the duration of illness, reduce the duration of feeding intolerance, and reduce the duration of infectivity. In addition to providing symptomatic relief with oral pain medication, treat with oral acyclovir suspension at 15 mg/kg (max 200 mg) five times daily for seven days. Alternatively, valacyclovir can be used in older children and adults, with the benefit of only two daily doses for the same duration. Despite antiviral treatment, primary herpes gingivostomatitis is highly contagious (with potential for auto-innoculation and ocular infection as well). Discharge patients with instructions for rigorous hygiene and avoidance of intimate contact while symptomatic.^{31,33}

Deep Tissue Infections

Ludwig's Angina. Ludwig's angina refers to extensive cellulitis that can occur in the area between the mucosa of the floor of the mouth and the fascia that attaches at the level of the hyoid bone. The floor of the mouth and tongue may be indurated and tender. In some instances, the tongue may be

pushed upward and can compromise the airway.³⁴ Fever is a common finding, and patients may present with sepsis. There is often an associated precipitating dental infection with deep extension beyond the periapical space.^{35,36} (See Table 8.)

The sub-mental, sub-lingual, and sub-mandibular spaces are most often implicated in Ludwig's angina, as these three spaces communicate with one another. In rare instances, infection can spread along facial planes to the skull base, and from the sub-mandibular space to the mediastinum. Trismus is an indicator that the muscles of mastication, and, thus, the sub-mandibular space, are involved. Trismus in adults can be diagnosed with inability to open the mouth and separate the central incisors 35 mm (or roughly two finger-widths) apart. Mandibular teeth have a much higher rate of progression to Ludwig's angina than do maxillary teeth due to their location.³⁶

Admit all patients with Ludwig's angina. Consider ear, nose, and throat (ENT) consultation and intensive care unit (ICU) admission for close monitoring of airway patency — although need for surgical intervention is rare. Intravenous (IV) clindamycin is commonly used, or ampicillin-sulbactam.³⁷

Parapharyngeal Abscess. The parapharyngeal space is a potential space at the sides of the pharynx, lateral to the pharyngeal constrictor muscles. This space can become involved in extension of dental infection, peritonsillar abscesses, or retropharyngeal abscesses.³⁹ Although peritonsillar abscesses are the most common nidus of infection in children, dental infections are responsible for the majority of parapharyngeal abscesses in adults. The average age of adults who develop a parapharyngeal abscess is approximately 34 years old.⁴⁰

Important clinical factors to suggest parapharyngeal abscess are fever, odynophagia, lateral neck mass, trismus, and medial displacement of the lateral pharyngeal wall.⁴⁰ Computed tomography (CT) with IV contrast is needed in all cases to identify the presence of abscess and depth of extension.³⁹ The parapharyngeal space is in close proximity to the carotid sheath, and communicates with other deep neck spaces such as the retropharyngeal space.⁴⁰ Mediastinitis,

Table 9. Algorithm for Addressing Dental Bleeding in the ED^{16,26,41-45}

Attempt each successive step if the previous step fails:

- 1) Have the patient bite down on a rolled piece of gauze at the bleeding site for 30 minutes.
- 2) Pack a piece of Avitene collagen microfiber, HemeCon (chotisan gauze), Gelfoam, or Surgicel into the bleeding site, place gauze over it, and ask the patient to bite down hard, for 30 minutes at a time.
- 3) Repeat the step above using the same material, now soaked in thrombin (up to 10 mL of 1000 IU/mL) or tranexamic acid (TXA) (up to 25 mg/kg of 100 mg/mL solution).
- 4) If bleeding is refractory, inject lidocaine with epinephrine near the site of hemorrhage to provide vasoconstriction and anesthesia, allowing the patient to bite down hard without discomfort.
- 5) If a post-operative wound is present, pack the wound with one of the above-mentioned pro-coagulant materials and suture closed with nylon or prolene suture in a figure of eight fashion. Ensure that this procedure is done under sufficient dental anesthesia.

Tips:

- Minimize interruptions during 30 minute cycles of pressure application.
- Coagulation studies are NOT indicated unless there is pertinent history to suggest a coagulopathy, or if the patient is on anti-coagulant medication.

Table 10. Antibiotic Prophylaxis Summary^{46,47}

Endocarditis Prevention: The AHA recommends antibiotic prophylaxis for procedures that involve significant manipulation of the oral mucosa AND one of the following characteristics:

- Prosthetic material in the heart
- Previous endocarditis
- Unrepaired congenital heart defects or residual defects post-repair
- History of heart transplant

ADA and AAOS Recommendation for Patients with a Prosthetic Joint: No routine antibiotic prophylaxis indicated.

internal jugular vein thrombosis, and airway compromise are rare complications of untreated parapharyngeal space infections. (See Table 8.) Treatment involves close attention to airway patency, early antibiotics (see Table 3), and ENT consultation for possible surgical drainage.³⁹

Peri-Operative Presentations

Post-Operative Bleeding. Post-operative bleeding, most commonly following dental extractions, can be a daunting problem in the ED. Intervention can be time-consuming, and access to the site of hemorrhage is inherently limited in the oral cavity — further obscured by the hemorrhage

itself.^{41,42} Post-operative bleeding can occur as late as six days after the initial procedure.⁴² The growing population of individuals who are anti-coagulated further complicates this problem. Serious complications, such as thromboembolism, have been documented in patients with anticoagulants temporarily held for dental procedures, and for this reason many patients remain anti-coagulated. Local measures are generally effective in controlling post-operative dental bleeding, even in anticoagulated patients.⁴³

Always assess the patient's overall volume status and attend to signs of shock with fluid resuscitation or blood products as appropriate. As soon as the patient arrives, place gauze at the bleeding site and have the patient apply

constant pressure, ideally by biting down, for a minimum of 20 minutes, as other materials are gathered. Consider a local anesthetic injection to facilitate application of pressure if the post-operative site is painful.⁴⁴ (See Table 9.)

Hemostasis can be achieved by using one of multiple materials that are now widely available. Gelfoam is a porous gelatin sponge derived from pork-based gelatin. It can absorb 40 times its weight in blood and facilitates hemostasis by providing a mechanical scaffolding to which a clot can adhere.^{45,26} Surgicel is derived from cellulose and, in addition to mechanically triggering clot formation, its low pH also promotes hemostasis by denaturing proteins in the blood and causing local vasoconstriction.¹⁶ Tranexamic acid (TXA) promotes hemostasis by preventing fibrinolysis, specifically by blocking the conversion of plasminogen to plasmin. In the oral surgery community, TXA is most often used as a post-operative mouth rinse, or systemically with proven reduction in bleeding complications when used for prophylaxis. However, TXA can also be used acutely as a topical agent in the ED. Aminocaproic acid is also an anti-fibrinolytic similar to TXA that may be available, but it is less potent in comparison to TXA.¹⁶

Antibiotic Prophylaxis. American Heart Association (AHA) guidelines, as recently as April 2015, recommend antibiotic prophylaxis for patients at high risk for infective endocarditis 30-60 minutes before a dental procedure that involves manipulation of the gingiva or oral mucosa. Only patients considered high risk for endocarditis based on AHA criteria should receive antibiotics: oral amoxicillin (2 g for adults or 50 mg/kg for children) or clindamycin in penicillin-allergic patients (600 mg for adults or 20 mg/kg for children).⁴⁶ (See Table 10.)

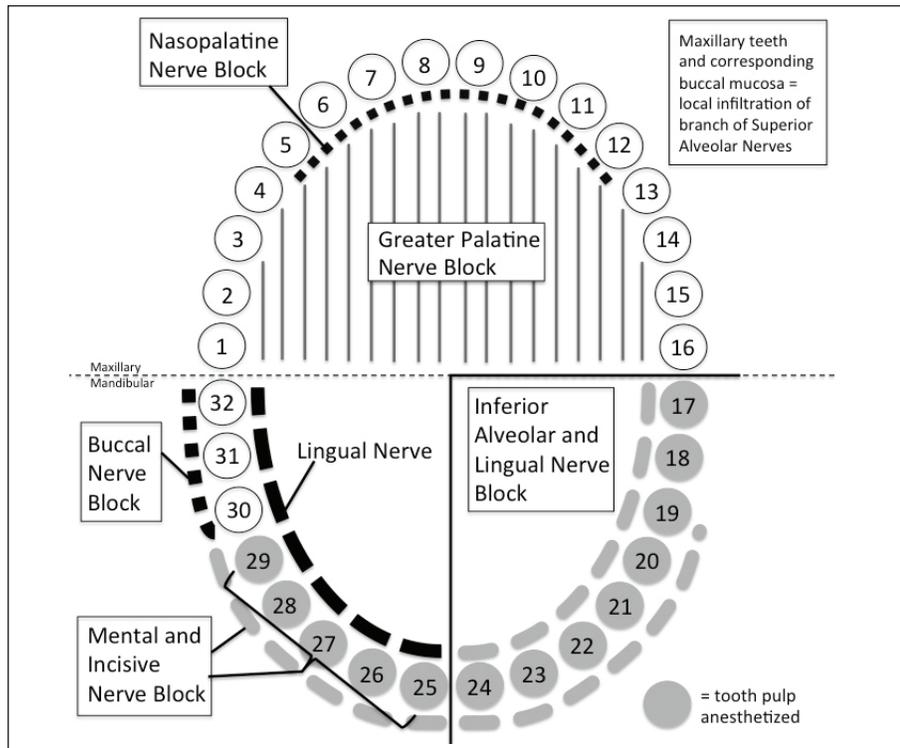
A 2015 American Dental Association (ADA) clinical practice guideline, based upon extensive literature review and consensus between the ADA and the American Academy of Orthopaedic Surgeons (AAOS), recommends avoiding routine use of prophylactic antibiotics for dental procedures in patients with prosthetic joint implants.⁴⁷

Dry Socket (Alveolar Osteitis). Dry

Table 11. Dental Anesthetic Options

Lidocaine 2% with epi 2-5 minute onset 3 hours duration	Max dose 7 mg/kg (0.35 mL/kg)
	Decrease dose to 80% of usual dose in children < 8 years old, and use 50% of usual dose if liver or kidney disease. Do not use if second or third degree heart block without pacemaker.
Mepivacaine 3% without epi 2-5 minute onset 3 hours duration	Max dose 6.6 mg/kg (0.22 mL/kg)
	Not to be used in pregnant women. Ideal for potentially epinephrine-sensitive patients. Higher pH so more effective in acidic infected tissue.
Bupivacaine 0.25% with epi 5-10 minute onset 7 hours duration	Max adult dose 90 mg (36 mL)
	Not FDA approved for children younger than 12 years old. Use with caution in elderly and frail. Caution in concurrent use with beta-blockers or digoxin.

Figure 2. Nerve Territory Diagram



socket usually occurs approximately two days following a dental extraction.²⁶ The primary symptoms are severe pain and halitosis.⁴⁸ When the blood clot lining the socket (alveolus) becomes displaced, local osteomyelitis can occur. On exam, exposed bone may be present, but the diagnosis of dry socket should be made based upon a history of pain that decreased over the initial two days after tooth extraction and then suddenly

worsened. Less than 5% of dental extractions result in dry socket, but close to 25% of impacted (unerupted) third molar (wisdom) tooth extractions lead to this phenomenon. Smoking, estrogen use, and poor periodontal health are risk factors.²⁶

The pathophysiology is not completely understood; however, premature breakdown of fibrin cross-links by plasmin likely plays a central role. There is

also evidence that bacterial infiltration can lead to premature fibrinolysis.⁴⁹ A retained root or other fragment remaining in the socket post-extraction can also play a role in the development of dry socket.²⁶

In the ED, irrigate the socket with saline or 0.12% chlorhexidine digluconate solution.^{26,49} Prescribe 0.12% chlorhexidine solution for home use, and instruct the patient to irrigate the socket using a syringe and spit out regularly until symptoms improve.⁴⁹ The socket can be loosely packed with eugenol-soaked half-inch ribbon gauze, a proprietary dressing such as Alvogyl, or with an anesthetic gel.⁵⁰ Some evidence suggests that packing of the socket in fact may delay healing and cause local inflammation; thus, its use is left to the discretion of the provider.⁴⁹ If the patient is immunocompromised, consider a course of penicillin VK or clindamycin.^{26,49} (See Table 3.)

Alveolar osteitis is largely a self-limited phenomenon, and management for most patients is focused on symptom control until healing occurs spontaneously.²² In some cases in which pain is prolonged and refractory to NSAIDs and irrigation with chlorhexidine, the patient will need dental evaluation, including X-rays, to identify any retained root or tooth fragments that may delay healing.⁴⁹

Dental Anesthesia in the ED

Local anesthesia still remains the most effective and efficient method of controlling intraoperative and postoperative pain in dentistry.⁵¹ With regard to pain control in the ED, the best approach is to understand the potential etiologies of a patient's dental pain and administer local dental anesthesia.

In general, dental anesthesia is most effective when it includes epinephrine. The vasoconstriction increases the duration of action and also lowers systemic toxicity by decreasing absorption at a local level.⁵² There are three major options to consider when it comes to choice of dental anesthetic for use in the ED.⁵³ (See Table 11.)

All providers who use dental anesthesia should be aware of potential

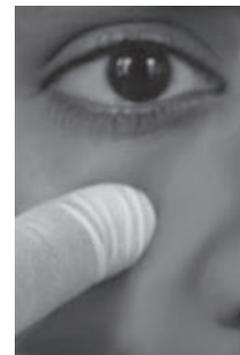
Table 12. Anesthesia Technique Guide⁵¹⁻⁵⁴

Location and Nerve Involved

Anesthesia of the upper lip and lateral nasal region on the ipsilateral side
Infraorbital Nerve

Technique Description

Externally, palpate along the infraorbital rim in the mid-pupillary line, and a notch can be felt. The infraorbital foramen is just 0.5 cm inferior to this notch, where a depression can be felt. Keep your non-dominant index finger at the depression as a point to aim toward. Use a 27-gauge needle at the location of the mucobuccal fold in a plane parallel to the root of the first premolar to deposit approximately 1 mL of anesthetic solution at this foramen, after advancing approximately 15 mm.



Location and Nerve Involved

Anesthesia of any maxillary teeth or the corresponding buccal gingiva
Anterior, Middle, and Posterior- Superior Alveolar Nerves

Technique Description

Local infiltration. Aim for the apex of the tooth, at the height of the buccal fold, and slowly deposit 1.5 mL of solution at the periosteum after advancing approximately 15 mm. Note: Superior to the maxillary molar area, there is a bony structure called the maxillary tuberosity, at the height of the vestibule — the infiltration for the tooth directly below it (usually 1st molar) should go both anterior and posterior to this structure, as infiltration right on this bony prominence will not be effective.



Location and Nerve Involved

Anesthesia of the anterior palatal gingiva from 1st premolar to central incisors (a midline block that achieves bilateral anesthesia)
Nasopalatine Nerve

Technique Description

Nerve block. Identify the incisive papilla, which is a little tuft of tissue in the midline just posterior to the maxillary central incisors. Approach from the side at a slight angle and inject slightly lateral to the papilla. The nasopalatine foramen is deep to the papilla. Insert the needle approximately 5 mm. Bone contact is typically felt. Deposit 0.5 mL of anesthetic solution.



Location and Nerve Involved

Anesthesia of the hard palate (roof of mouth) as well as palatal gingiva of molars; effect is ipsilateral
Greater Palatine Nerve

Technique Description

Nerve block. On the side of interest, the greater palatine foramen will be 1 cm just medial and posterior to the palatal gingival border of the 2nd molar. The site is on the hard palate, approximately 5 mm anterior to the transition from hard to soft. Optimal needle depth is 5-7 mm. Deliver approximately 0.7 mL of solution while advancing the needle until bone is contacted. Angle of needle insertion should be close to 90 degrees to the molars, directed laterally.

(continued)



complications, such as post-anesthesia pain caused by an injection that is too forceful or multiple injections at the same site.⁵² Hematomas can form after needle trauma to a blood vessel; however, do not confuse this with transient edema that occurs with infiltration of anesthetic. For hematoma formation, have the patient apply ice on the first day after the injury, and heat

on subsequent days until the lesion resolves.⁵¹ In rare instances, the needle can break during the injection. Avoid bending needles, and use 32 mm long, 27-gauge needles for inferior alveolar nerve blocks to avoid burying the needle all the way to the hub.⁵¹

The keys to successful dental anesthesia are distinct knowledge of the anatomic landmarks and the ability to keep

the patient calm and distracted during the procedure. Use topical benzocaine, if available, by placing a coated cotton swab at the injection site. Effective drying of the mucosa before application of topical anesthetic is an important step.⁵² A trick commonly used by dentists is to grasp the buccal mucosa and provide gentle vibration adjacent to the site of injection during infiltration of

Table 12. Anesthesia Technique Guide⁵¹⁻⁵⁴ (continued)

Location and Nerve Involved

Anesthesia of all the mandibular teeth on the ipsilateral side, buccal soft tissues anterior to the mental foramen, anterior 2/3 of the tongue, and lingual soft tissues

Inferior Alveolar Nerve and Lingual Nerve

Technique Description

Though this nerve block has been proven safe in most anticoagulated patients, it should not be attempted in the emergency department on patients who are under therapeutic anticoagulation.



Place the barrel of the needle in a plane bisecting the location of the premolars on the opposite side. Just posterior and medial to the last molar, a vertical skin fold called pterygomandibular raphe is present (posterior dashed line in photo). Palpate a bony ridge marking the location of the coronoid notch lateral to the last molar (lateral dashed line). Place the tip of the needle at a point between these structures and approximately 1 cm above the occlusal plane. Insert a 25- or 27-gauge needle slowly to a depth of 20-25 mm, until bone is contacted. Once negative aspiration is achieved, deposit 1.5-2.0 mL of solution. If bone is contacted too early in the injection process, exit and re-position the entry point.

Location and Nerve Involved

Anesthesia of the buccal gingiva of mandibular molars; effect is ipsilateral
Buccal Nerve

Technique Description

Align the needle parallel to the occlusal plane of the molars, aim slightly distal and buccal to the 2nd molar. Insert needle < 5 mm and contact bone before injecting 0.5 mL of anesthetic solution.



Location and Nerve Involved

Anesthesia of the ipsilateral lower lip and buccal gingiva from central incisor, distally to the premolars (Mental nerve)

Also anesthesia of the pulp of ipsilateral premolars and incisors (Incisive nerve)
Mental Nerve and Incisive Nerve

Technique Description

Aim toward the mandible, in between the first and second premolars at the vestibule. You may palpate the mental foramen inferior to the insertion point, which will feel like a circular depression. Using a 27-gauge needle, advance approximately 5-7 mm and deposit 0.5-1 mL of solution after negative aspirate is achieved. Gently massage over the foramen (externally or internally). Both mental and incisive nerves are blocked by depositing anesthetic in close proximity of the mental foramen. For supplemental anesthesia of the pulp of mandibular incisors, anesthetic can be deposited at the apex of the tooth of interest, identical to the technique used for superior alveolar nerve blocks of maxillary teeth.



the anesthetic. Care should be taken to deposit the anesthetic slowly.⁵⁴ These techniques, when used in combination, are likely to make a potentially anxiety-provoking experience less painful and more manageable for the patient.

Local anesthesia can be executed in several ways, but the two methods relevant to use in the ED are infiltration (deposition near the site of interest) and nerve block (targeting a specific nerve that innervates a broader area).⁵⁴ As a general rule, achieve maxillary anesthesia with infiltrations (with the exception of the infraorbital block), and mandibular anesthesia via nerve blocks

(of the inferior alveolar, lingual, buccal, and mental nerves). (See Figure 2.)

Dental Anesthesia Key Points:

- ALWAYS aspirate before injecting to ensure you are not in a blood vessel;
- Dry the area to be anesthetized and use topical anesthetic first, if available;
- Especially for palatal anesthesia, which can be painful, apply firm pressure with a cotton-tip swab immediately proximal to the injection site while you are injecting, to reduce pain perception.

Maxillary Anesthesia. A nerve block of the infraorbital branch of the maxillary nerve is useful when

anesthesia of the upper lip is required. Procedures involving the teeth of the maxilla necessitate infiltration of a segment of the maxillary branch of the trigeminal nerve. These segments are the posterior superior alveolar nerve, the middle superior alveolar nerve, and the anterior superior alveolar nerve. Anesthesia of the buccal gingiva and the teeth themselves is accomplished by infiltrating the corresponding superior alveolar branch just superior to the tooth/region of interest. If palatal anesthesia is required, infiltrate the greater palatine nerve (for premolar and molar teeth) or the nasopalatine nerve of

the nasopalatine foramen (for incisor teeth). Remember that patients will feel palatal injection to be more painful than simple infiltrations, as the tissue is very thick.^{52,54} See the Anesthesia Technique Guide for more details.

Mandibular Anesthesia. Blocking the inferior alveolar nerve (IAN) and its branches is essential for anesthesia of the lower teeth and gingiva.⁵⁴ The IAN branches off from the mandibular branch of the trigeminal nerve (V3). Before it passes into the mandible, it gives off a branch to innervate the lingual gingiva and tongue (the lingual nerve). Close to where the IAN comes off of V3, the long buccal nerve also comes off of V3, supplying the buccal gingiva of the mandibular molars. The inferior alveolar nerve further divides into the mental nerve, which innervates the anterior buccal gingiva and lower lip, and a branch called the incisive nerve, innervating the lower incisor teeth.⁵² A true block of the inferior alveolar nerve will anesthetize all teeth on the ipsilateral side, but local infiltration to supportive structures may be necessary for profound anesthesia.⁵⁴ (See Table 12 and Figure 2 for more details.)

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2. A patient presents 2 hours after tripping and falling on a concrete surface and has a lower lip laceration that is deep and oriented diagonally on the anterior lip. When the patient is asked to smile, the lower lip moves in an asymmetric fashion. How should this be managed?
 - A. Use skin adhesive to approximate the edges.
 - B. Use dissolving sutures deep and a second layer of sutures to close the surface.
 - C. Consult plastic surgery.
 - D. Use a single layer of sutures to close the skin surface.
 3. A 5-year-old is struck in the face by a softball and arrives to the ED within 1 hour, holding in his hand a central incisor that has fallen out. The tooth appears bright white, with smooth edges, suggesting it is a primary tooth. What is the best approach?
 - A. Rinse the tooth and socket with saline and re-insert the tooth immediately.
 - B. Re-insert the tooth after soaking in a 30 minute milk bath.
 - C. Re-insert the tooth after soaking in sodium hypochlorite and doxycycline solutions.
 - D. No specific intervention is necessary.
 4. A 17-year-old boy presents after a dirt bike accident with a mandibular incisor tooth that is now loose, and depressed into the gingiva. The tooth is in its original location, but the incisal (biting) surface of the tooth is lower than the surrounding teeth, suggesting an "intrusion" injury. How is this managed?
 - A. Grip the tooth with gauze and pull it out until it is level with surrounding teeth.
 - B. Grip the tooth with gauze and extract it completely.
 - C. Tell the patient to see his dentist in 1-2 weeks for cosmetic repair.
 - D. Splint the tooth if possible and initiate antibiotic course.
 5. A 23-year-old college student presents with a cracked canine tooth after trying to open a beer

CME Questions

1. A patient presents with transient tooth pain and sensitivity that only occurs when drinking a hot or cold substance. On exam, the tooth appears intact, there is no tenderness to percussion of the affected tooth, and there is no change in the surrounding gingiva. How should the patient be managed?
 - A. incision and drainage of surrounding gingiva
 - B. NSAIDs
 - C. penicillin or clindamycin course
 - D. dental anesthesia injection

- bottle with her teeth. A portion of the tooth is missing, and a small amount of blood is seen at the open, inner surface of the tooth. What is the depth of this fracture, and when should dental follow-up occur?
- enamel; follow-up within 72 hours
 - pulp; follow-up within 3 hours
 - dentin; follow-up within 3 hours
 - pulp; follow-up within 72 hours
- A 3-year-old girl presents with small ulcerating lesions covering her maxillary and mandibular gingiva, with a few lesions present on the lips. She has had decreased oral intake for the past 3 days, and currently has minimal urine output. How should this child be managed?
 - oral acyclovir and consider narcotic pain management
 - NSAIDs
 - dexamethasone elixir swish and spit regimen
 - narcotic pain management
 - A 23-year-old HIV-positive immigrant from Eastern Europe presents with generalized malaise, and complains of a strange taste in his mouth. On exam, he has a white, membranous material covering the gingival borders of his teeth, and the extensions of gingiva between his teeth appear eroded and inflamed. What is the most appropriate antibiotic choice for this patient?
 - penicillin
 - clindamycin
 - metronidazole
 - ciprofloxacin
 - What is the best choice for local anesthetic injection when the goal is long-term relief of dental pain?
 - lidocaine 1% with epinephrine
 - lidocaine 2% with epinephrine
 - mepivacaine 3%
 - bupivacaine 0.25% with epinephrine
 - According to American Heart Association guidelines, which of the following patients requires antibiotic endocarditis prophylaxis before drainage of a periapical abscess?
 - a patient with a mechanical mitral valve
 - a patient with a history of coronary artery bypass graft (CABG) surgery
 - a patient with a history of severe coronary artery disease and multiple stents placed in the past
 - patient with congenital heart defect repaired as a child with no residual abnormalities

- A 65-year-old man with a history of significant tooth decay presents with fever and complains of difficulty opening his mouth. On exam, his tongue is protruding and induration is present at the floor of his mouth. His airway is patent. What is the most appropriate disposition for this patient?
 - discharge with oral course of clindamycin
 - admit to general medical floor

- observe in ED until swelling resolves
- admit to ICU for close airway monitoring

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- apply state-of-the-art diagnostic and therapeutic techniques to patients with the particular medical problems discussed in the publication;
- discuss the differential diagnosis of the particular medical problems discussed in the publication;
- explain both the likely and rare complications that may be associated with the particular medical problems discussed in the publication.

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EMERGENCY MEDICINE REPORTS

Dental Emergencies in the ED

Essential Dental Vocabulary Explained

Maxillary	Refers to the upper row of teeth
Mandibular	Refers to the lower row of teeth
Gingiva	Gums
Buccal	Involving the inside surface of the cheek. Ex: "Buccal mucosa"
Vestibule	Area between cheek and gums
Lingual	Toward the tongue. Ex: "Lingual gingiva, of mandibular teeth"
Palatal	Toward the hard palate. Ex: "Palatal gingiva, of maxillary teeth"
Distal	Away from the midline or away from the gap between central incisors. Ex: "The canine is distal to the central incisor"
Mesial	Toward the midline or toward the gap between central incisors. Ex: "The canine is mesial to the molars"
Occlusal surface	Biting surface of teeth (called "incisal surface" for anterior teeth)
Apex of tooth	The point immediately above the tooth's root (maxillary) or immediately below the tooth's root (mandibular).
Caries	Erosion of the tooth surface caused by bacteria (also known as a "cavity")

Periodontal Dressing



Tooth Injury Summary

Injury Type	Clinical Features	Management
Concussion	After trauma, tooth still in place	Dental follow-up
Subluxation	Any movement of the tooth (loose tooth) or blood present at the gumline, but tooth remains in the correct position	Splint tooth using a commercially available periodontal dressing (i.e., Coe-Pak; see Figure 1 and see text for details of use).
Luxation	If there is any movement of the tooth and it sits in an irregular position	Use local anesthesia at the site as needed. Gently move to natural position. If intrusion injury, leave tooth in place. If tooth is extruded, push tooth in so it is in line with surrounding teeth. Splint tooth using a commercially available periodontal dressing (i.e., Coe-Pak; see Figure 1 and text for details of use). All patients with intrusion injury should receive a course of penicillin VK or clindamycin (see Table 3).
Avulsion	Tooth has separated from its socket (alveolus)	Store avulsed tooth in milk at room temperature until ready to reposition. 1) Use local anesthesia at the site as needed for patient comfort. 2) Saline irrigate the socket with a syringe to remove debris and coagulated blood. 3) Saline irrigate the tooth. Never wipe the root side of the tooth. Consider a 5 min. saline soak to loosen any stuck-on debris if needed. 4) Push the tooth into the alveolus with firm pressure until it is level with the adjacent teeth. 5) Splint tooth using a commercially available periodontal dressing (i.e., Coe-Pak; see Figure 1 and text for details of use). All patients should receive a course of penicillin VK or clindamycin (see Table 3). Update tetanus vaccination, if indicated, when the tooth has come into contact with soil.

Antimicrobials Guide

Indication	Agent	Dosing
General Odontogenic Use	Penicillin VK	> 12 yo: 500 mg 4 times daily for 7 days ≤ 12 yo: 10 mg/kg/dose (max 500 mg/dose) 4 times daily for 7 days
	Clindamycin (PCN allergic)	> 12 yo: 150 mg 4 times daily for 7 days ≤ 12 yo: 5 mg/kg/dose (max 150 mg/dose) 4 times daily for 7 days
ANUG	Metronidazole	> 12 yo: 500 mg 3 times daily for 7 days ≤ 12 yo: 10 mg/kg/dose (max 500 mg/dose) 3 times daily for 7 days
Deep Space Infections	Ampicillin-Sulbactam	See reference IV dosing
	Clindamycin (PCN allergic)	
Primary Herpes Gingivo-Stomatitis	Acyclovir	Children and Adults: Acyclovir 15 mg/kg/dose (max 200 mg/dose) 5 times daily for 7 days
Antibiotic Prophylaxis Single Dose (AHA Guidelines)	Amoxicillin	> 12 years old: 2 g ≤ 12 years old: 50 mg/kg
	Clindamycin (PCN allergic)	> 12 years old: 600 mg ≤ 12 years old: 20 mg/kg

Antibiotic Prophylaxis Summary

Endocarditis Prevention: The AHA recommends antibiotic prophylaxis for procedures that involve significant manipulation of the oral mucosa AND one of the following characteristics:

- Prosthetic material in the heart
- Previous endocarditis
- Unrepaired congenital heart defects or residual defects post-repair
- History of heart transplant

ADA and AAOS Recommendation for Patients with a Prosthetic Joint: No routine antibiotic prophylaxis indicated.

Tooth Fracture Summary

Fracture Depth	Clinical Features	Management
Enamel	Superficial fracture of white, hard outer layer	<ul style="list-style-type: none"> Dental follow-up, no urgent intervention File down any sharp fragments and ensure no lodged or aspirated tooth fragments
Dentin	Yellow middle layer exposed	<ul style="list-style-type: none"> File down any sharp fragments and ensure no lodged or aspirated tooth fragments
Pulp	Presence of bloody discharge from fracture	<ul style="list-style-type: none"> Wipe down the tooth with saline-soaked gauze, then wipe with dry gauze. THEN use calcium hydroxide or zinc oxide-eugenol temporary cement to fill the gap while maintaining the surface contour of the tooth. Alternatively, a more temporary solution is to apply 2-octyl cyanoacrylate (Dermabond) to injured tooth and then cover the tooth with foil. Place a gauze roll bite block and let the sealant dry and set for 15 minutes. Antibiotic course: Penicillin VK or clindamycin (see Table 3) Ideally, dentin fractures should be followed-up by a dental professional within 24 hours. Same day follow-up is ideal for fractures involving the pulp.

Non-traumatic Tooth Pain Summary

Cause of Tooth Pain	Signs/Symptoms	Management
Reversible Pulpitis	<ul style="list-style-type: none"> Caused by dental caries Transient periods of pain and sensitivity in response to various triggers No tenderness to percussion 	<ul style="list-style-type: none"> NSAIDs
Irreversible Pulpitis	<ul style="list-style-type: none"> Caused by dental caries Sustained, severe periods of pain and sensitivity in response to various triggers, or occurring spontaneously without triggers May have tenderness to percussion 	<ul style="list-style-type: none"> NSAIDs Optional narcotics for breakthrough pain Penicillin VK or clindamycin (see Table 3) Optional long-acting local anesthesia with bupivacaine For readily identified deep caries, consider coating with calcium hydroxide or zinc oxide-eugenol temporary cement for improved comfort
Periapical Abscess	<ul style="list-style-type: none"> From progression of dental infection Sustained severe pain Tenderness to percussion of tooth because underlying tissues are involved A resulting adjacent gingival abscess may be present 	<ul style="list-style-type: none"> NSAIDs Optional narcotics for breakthrough pain Penicillin VK or clindamycin (see Table 3) Optional long-acting local anesthesia with bupivacaine If gingival abscess present, this should be drained with local anesthesia and scalpel stab incision; discharge with chlorhexidine oral rinse.

Ulcerating Oral Lesion Summary

Diagnosis	Clinical Findings	Acute Management
Aphthous ulcers	See aphthous ulcer table	
Acute necrotizing ulcerative gingivitis	Young adult with history of malnutrition, immune suppression, or severe stress Punched-out interdental papillae (key finding) Fever, foul breath, lymphadenopathy, loose teeth, and metallic taste	Loose cotton-swab debridement of gingival pseudomembranes Metronidazole 500 mg three times daily for 7 days Chlorhexidine 0.12% mouthwash for use twice daily Consider normal saline fluid bolus acutely Prompt dental follow-up for scaling and root planing as definitive care
Primary herpes gingivostomatitis	Generally preceded by fever and malaise Most often seen in children < 6 years old Crops of painful ulcers that occur anywhere inside or immediately outside of the mouth	Children and adults: Acyclovir 15 mg/kg (max 200 mg), five times daily for seven days Have a low threshold for narcotic pain medication, to facilitate oral intake

Aphthous Ulcer Summary

Type	Clinical Findings	Acute Management
Minor	Ulcer 2-3 mm diameter Generally heal in 10 days	Pain control Treat like major type if severe
Herpetiform	Numerous small ulcers in crops Generally heal in 10 days Differentiate from herpes gingivostomatitis because aphthous ulcers do not involve the gums, skin outside the mouth, or constitutional symptoms such as fever	Pain control Treat like major type if severe
Major	Deeper, larger ulcer, often > 5 mm in diameter Can require 6 weeks to heal	Pain control Dexamethasone elixir 0.5 mg/5 mL; swish and spit 5 mL every 12 hours until symptoms improve For recurrent severe ulcers, Amelanox 5% paste can be used. Must be initiated early to be effective. Apply enough to cover ulcer, after drying surface, 3 times daily until symptoms improve.

Supplement to *Emergency Medicine Reports*, October 4, 2015: "Dental Emergencies in the ED." Authors: Stacey L. Poznanski, DO, Assistant Professor, Department of Emergency Medicine, Wright State University, Boonshoft School of Medicine, Dayton, OH; Prabu Selvam, MD, MHS, Resident, U.S. Air Force/Wright State University, Integrated Emergency Medicine Residency Program, Dayton, OH; and Arya Nambodiri, DDS, General Dentist, Dayton, OH.

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