This chapter will train you to evaluate and treat oral and dental conditions that occur in the wilderness, according to the following criteria:

- To understand basic tooth anatomy
- To be able to describe etiologies and treatment of painful pulpitis.
- To be able to recognize and treat failed dental restorations.
- To be able to describe and treat various types of oral infections.
- To be able to describe and treat a fractured tooth
- To be able to describe and treat an avulsed tooth.
Case 1

A 38 year-old male is attempting to summit Mount McKinley when he injures a tooth while biting down on a piece of hard candy. He complains of sensitivity to cold and liquids and pain when he bites on the involved tooth, which is his upper left canine. On examination, you note a missing filling and part of the tooth lost on the buccal side. There is no bleeding.

1. What is the most likely complication, other than pain, that this climber will have if the tooth is not repaired?
2. What is the best way to repair the tooth?
3. Does this situation require antibiotics?

Case 2

A 56 year-old woman is backpacking the Appalachian Trail when she develops a constant ache in her lower left first molar, with sensitivity to cold and pressure. She denies trauma to the tooth. On examination, the tooth has an intact large filling, with pain on percussion. There is no evidence of tooth fracture or gum swelling.

1. What is the most likely etiology for her symptoms?
2. What is the best way to manage this situation, other than pain management?
3. Does this situation require antibiotics? If you were going to use an antibiotic, which one would you select?

Case 3

A 16 year-old climber is struck in the face by a falling rock, which knocks out his right front permanent upper incisor. Fortunately, the rock knocked the tooth back into his mouth, so the victim possesses the avulsed tooth.

1. What is the first step in the management of this tooth avulsion?
2. Is this a tooth that should be replanted?
3. How would you clean this tooth if it fell into the dirt?
4. What is the best way to transport this tooth if you do not replant it?
5. Would your management be different if this was a primary tooth in a 4 year-old male?
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Basic Dental Anatomy

- There are three primary regions of the tooth: enamel, dentin, and pulp.
- The supporting tissue consists of the gingiva (gum), periodontal ligaments (PDL), and bone.

Enamel
- Enamel is the outer layer of the tooth and constitutes the crown (part of the tooth one sees when looking in the mouth).
- It is the hardest substance in the human body and devoid of nerve endings.

Dentin
- The dentin, while still a fairly hard substance, is made up of tiny fluid-filled tubules. The dentin provides nutrients to maintain tooth viability and the ability for a tooth to handle stress loads.
- If the stress load is too great or a tooth becomes brittle because it has lost vitality, it can break or crack.
- If dentin is exposed, a person can experience pain when an applied stimulus makes the fluid in the dentinal tubules move and thus elicit a response from the nerve.

Pulp
- The inner layer of the tooth is the pulp chamber, which consists of the neurovascular bundle, often referred to as the "pulp."
- When this area is affected, a person can experience pain.
- If a tooth is fractured down to the pulp, one may notice bleeding from the tooth.

Clinical Presentation & Management

Pulpitis
- Inflammation of pulp tissue (neurovascular bundle) is the primary cause of most toothaches.
- Pain can range from mild to debilitating and can be steady or intermittent.
- The etiology of inflammation can arise from:
  - Bacterial invasion (consequences of the tooth decay ("cavity") process)
  - Local irritation (e.g., a restoration being placed in close proximity to the pulp chamber)
  - Physical trauma, first causing inflammation of the pulp, and then reducing or eliminating blood supply to the tooth, which causes necrosis of pulp tissue.
- Pulpitis in early stages can be reversed. Early on, the tooth will be sensitive to a stimulus such as heat or cold, or sweet or sugary food placed on the tooth. Once the noxious stimulus is removed, the tooth returns to its normal status. With irreversible pulpitis, the tooth will frequently remain achy or painful after the stimulus has been removed.
- Pulpitis can be classified into mild, moderate, and severe. The amount of treatment needed varies with severity of toothache. Mild pulpitis is often reversible and can be treated simply by avoiding any stimulus. Severe pulpitis requires removal of pulp tissue or extraction of the tooth. This is usually not feasible in the backcountry and therefore warrants evacuation. Until that time, the patient must be managed to reduce pain and to prevent the situation from worsening.
- Signs and symptoms
  - Tooth sensitivity or pain to stimulus (cold, hot, sweets)
  - Transient sensitivity to debilitating pain
  - In early stages, it may be difficult to identify the offending tooth
  - Radiating pain may make it seem as if other teeth are involved
  - Pain intensity may increase when the victim lies down
  - Rarely, sensitive to percussion or biting pressure
  - Look for tooth decay or a void (hole) in the tooth
- Treatment
  - Remove any irritant or debris
  - Temporarily fill any defect in the tooth
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- Avoid stimulus that makes the tooth respond with pain
- Pain management using NSAIDs for mild to moderate/severe pain and opiate analgesics for more severe pain.
- If the pain is severe, a local anesthetic can be used
- Antibiotics at the first sign of swelling or abscess

Complications
- If necrotic pulp tissue escapes into surrounding tissue outside of the tooth, the infection can begin to develop into an abscess. Abscesses in the backcountry need to be monitored very closely because of delay to treatment and the possibility of their spreading into deeper and more serious anatomical areas.
- Note: The percussion test is tapping on the tooth with a hard object such as the handle of a spoon. Responses that elicit pain indicate inflamed tissue surrounding the tooth.

**Failed Dental Restorations**

There are several reasons why a restoration (filling or crown) may fail. With the restoration gone, the tooth may be sensitive or food may get packed between the teeth and irritate and inflame the gingiva (gums). Temporary filling materials can be used to make repairs until a dentist can be found and a more permanent restoration created.

**Lost filling**

Signs and symptoms of a lost filling:
- Tooth sensitivity to stimulus (cold, hot, sweets). The tooth is usually fine without any stimulus present.
- Missing filling
- Sore tongue from rough or sharp tooth edge
- Food impaction between teeth, making tooth and gums sore

Treatment
- Remove any debris in or around the tooth
- Temporarily fill any defect
- Temporary filling material
  - There are several commercially available temporary filling materials
  - *Cavit* comes pre-mixed and will harden once placed in the mouth. *Cavit* can be thinned, if necessary, by mixing it with petrolatum jelly (Vaseline).
  - *IRM* comes in a powder/liquid form that requires mixing. The advantage of IRM is that it can be mixed to any consistency.
- Smooth rough or sharp edges

Complications
- Left untreated, bacterial invasion can begin the decay process that eventually leads to irreversible pulpitis and the need for endodontic therapy (root canal).

**Lost Crown or Bridge**

Symptoms of a lost crown or bridge
- Tooth sensitivity to stimulus (cold, hot, sweets)
- Food impaction around tooth

Treatment
- Clean out old cement from inside of crown
- Remove any debris around the tooth
- Check to make sure that the crown still fits
- Place a thin film of soft temporarily filling material in the crown and place the crown back on the tooth. Have the patient bite down to squeeze out excess cement.
- Note: You may need to thin the temporary filling material if it is too thick.
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- Have patient bite down to ensure that the replaced crown doesn’t interfere with his or her bite
- Remove excess filling material
- Check the bite again

Complications
- Left untreated, bacterial invasion can begin the decay process that eventually leads to irreversible pulpitis.
- If decay is present under the crown, it may have gone unnoticed. If it is severe enough, the tooth may break off at the gum line and there won’t be enough retention to cement the crown back into place. In this case, one could place a small amount of temporary filling material over the remaining part of the tooth to make it smooth, so that the tooth is less sensitive and the tongue won’t become irritated.

**Oral Infections**

Mouth infections can be viral, fungal or bacterial. The first two are less frequent and generally not a major health threat in the backcountry. Bacterial infection can become a serious problem if not treated, in part because they have the potential to spread.

**Viral**
- While there are several viruses that have oral manifestations, herpes virus is the one most commonly encountered in the backcountry. Herpes simplex virus generally presents with small vesicles in localized clusters, which may coalesce to form a large lesion. When the vesicles rupture, they leave a shallow, ragged, and extremely painful ulcer covered by a gray membrane and surrounded by an erythematous halo. Herpes labialis manifests as blistering followed by a brown crust on the lips. One may reduce the incidence of recurrent herpes labialis (cold sores or fever blister) by using sun block.

**Symptoms**
- Prodromal paresthesia or “tingle”
- Lymphadenopathy
- Sore throat
- Low grade fever

**Treatment**
- Analgesics
- Acyclovir or valacyclovir
- Soothing mouth rinses, such as warm saline solution
- Diminish the incidence by using sunscreen

**Fungal**
- Fungal infections are most commonly found in individuals who are immunocompromised, debilitated, or taking antibiotics.
- The fungal infection most likely to be encountered is candidiasis, otherwise known as “thrush.”

**Symptoms**
- White patches on the mucosa that can be rubbed off, leaving a raw, red surface

**Treatment:**
- Nystatin or clotrimazole (Myclex Troche)

**Bacterial**
- A bacterial infection in the maxillofacial region can become a serious health threat. In the backcountry, such an infection should be treated aggressively. Oral infection generally spreads slowly, but rapid spread to deep fascial spaces may occur.
- Regional lymphadenopathy is common. Osteomyelitis is uncommon even though bone is often involved
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- Where definitive treatment is delayed, antibiotics should be started
- If the swelling is soft and fluctuant, drainage will relieve pressure and prevent further spread

**Odontogenic Abscesses**
- Odontogenic infections can be caused by dental caries (cavity), deep restorations that approximate the pulp chamber, pulpitis, and periodontitis (gum disease).
- An abscess from a tooth will follow the path of least resistance. Generally, it will stay localized and drain into the oral cavity. However, in some cases it may spread along fascial planes and into deep tissue spaces.
- All abscesses should be monitored and treated. Any increased swelling or spread of infection is reason to evacuate the patient to obtain proper treatment.

**Acute Apical Abscess**
- The swelling in this abscess is confined to the apex area of the tooth. Swelling is more common on the facial aspect of the jaw and the buccal vestibule adjacent to the offending tooth.

**Signs & Symptoms**
- Pain
- Swelling (localized)
- Tooth sensitive to percussion
- The affected tooth may be unresponsive to thermal changes because of pulpal necrosis
- The patient may have a prior history of a toothache

**Treatment**
- Pain management
- Antibiotics
- Drainage
  - Drainage is accomplished by extraction, incision, or endodontic therapy (root canal)
  - Extraction or endodontic therapy are generally impractical in the backcountry setting
  - Incision and drainage become the treatment of choice in an emergency situation

**Pericoronitis**
- This infection is found in the tissue around a partially erupted tooth. The most common site is the mandibular third molars ("wisdom teeth"). This infection seldom produces purulent drainage.

**Signs & Symptoms**
- Trismus (difficulty opening the mouth)
- Symptoms mimicking pharyngitis or tonsillitis
- Common in college age patients because this is the age range during which wisdom teeth erupt

**Treatment**
- Warm saline rinses (¼ tsp salt in 8 oz water) every two hours
- Irrigate the area around the tooth and under the tissue flap
- Antibiotics
- Pain management

**Periodontal Abscess**
- Proliferation of bacteria between the tooth and gingiva (gums)

**Signs & Symptoms**
- Swelling is near the gingiva where it meets the tooth, rather than in the vestibule
- The tooth is sensitive to percussion
- The affected tooth responds to thermal changes

**Treatment**
No incision is necessary. Drain through the gingival sulcus (between the tooth and gums) with a blunt instrument. Follow up with warm to hot saline rinses.

**Fascial Space Abscesses**
- While most dental abscesses localize around a tooth, there is potential for the infection to spread into areas of the head and neck in such a manner that they may become life threatening. Due to proximity of the central nervous system and airway to the oropharynx, timely efforts are required to treat this situation. In the backcountry, immediate evacuation is indicated.

**Sign & Symptoms**
- Severe swelling
- Pain
- Trismus (difficulty opening mouth)
- Elevated temperature
- Rapid and weak pulse
- Difficulty swallowing
- Difficulty or shallow breathing

**Treatment**
- Antibiotics
- Airway management
- Pain management
- Immediate evacuation

**Antibiotic Use**
- Odontogenic infections are typically polymicrobial. Anaerobes are prevalent, so penicillin has historically been the first choice for these infections. However, increasing rates of resistance have led to recommendations to use clindamycin.
- Indications for antibiotic use for oral infections:
  - Antibiotics are warranted in local infections for patients who are immunocompromised, or if the infection has inadequate drainage, or if delay to definitive care is anticipated.
  - A patient who shows signs of disseminated infection, such as lymphadenopathy, fascial space involvement, or systemic symptoms, should be treated with antibiotics.
  - Compound maxillofacial fractures involving tooth-supporting bone warrant treatment with antibiotics.

**Dental Trauma**
- Injuries to the tooth and supporting tissues are more likely to occur during high adventure activity mishaps, such as mountain biking, skiing, climbing, or rafting.
- Trauma can be isolated to only the tooth, but more likely involves soft tissue and supporting tissue as well. Soft tissue consists of the lips, tongue, and cheeks, while supporting tissue is made up of bone, ligaments, and gingiva (gums).

**History & Exam**
- Proper evaluation and history are helpful in a trauma situation. In addition to examination of the dental arches and surrounding tissue, the victim should be asked about loss of consciousness, nausea, vomiting, and dizziness, to identify any possible head injury.
- Clean the region well to unmask injuries hidden by blood or debris. Evaluate lacerations for any foreign material, including parts or pieces of broken teeth.
- Examine teeth for fractures and pulp exposures.
- Evaluate the mandible and facial bones for any fractures.
Injuries to the Tooth
- Tooth injuries consist of fractured or chipped teeth. A fracture can vary from just losing a corner of a tooth to an entire tooth breaking off at the gum line.

Uncomplicated Crown Fracture
Signs & Symptoms
- Visible chip on tooth
- No visible pulp tissue or bleeding
- Sensitive to stimulus (hot, cold, sweets)

Treatment
- Pain management
- Smooth sharp edges by placing temporary filling (IRM, Cavit, soft wax, or tape) over the tooth
- Avoid any stimulus that may aggravate the tooth

Uncomplicated Crown-Root Fracture
- This fracture usually occurs with pre-molar and molar teeth, when part of the cusp has broken away but remains in the mouth because it is still attached to gingiva.

Signs & Symptoms
- Loose piece of tooth
- Pain or irritation on biting

Treatment
- Remove loose fragment
- Cover the tooth with a temporary filling
- Pain management
- Avoid any stimulus that may aggravate the tooth

Complicated Crown Fracture
Signs & Symptoms
- Fracture involving exposure of pulp
- Sensitive to air, cold and other stimuli because of exposed nerve

Treatment
- Stop bleeding by biting on gauze
- Because the nerve has been exposed, the tooth is very sensitive, so the sooner the victim is taken to a dentist, the better
- Cover the tooth with a temporary filling
- Pain management

Complicated Crown-Root Fracture
Signs & Symptoms
- Fracture that exposes pulp
- Sensitive to air, cold, etc.
- Loose fragment of tooth attached to gingiva

Treatment
- Remove or stabilize fragment
- Proceed as for a complicated crown fracture

Root Fracture
- This injury may be difficult to differentiate from an extruded tooth (next section) without a radiograph. However, treatment in the field is the same.
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Signs & Symptoms
- Slight to severe mobility
- Generally anterior teeth

Treatment
- Reposition the tooth and splint
- Pain management

**Injuries to Periodontal Tissues**

- Trauma to the oral cavity may not fracture a tooth. However, damage may occur in the supporting structures around the tooth, in which case the tooth will be displaced from its normal position. The following are possible scenarios that can affect teeth and supporting tissues.

**Concussion and Subluxation**
- The tooth is properly positioned but tender to touch and percussion with possible increased bleeding from gums.
- Treatment consists of a soft diet, rest and NSAIDs for pain management if necessary. If the patient keeps biting on the tooth, thus causing pain, have them hold something between their teeth to prevent biting.

**Intrusive Luxation**
- The tooth has been pushed into the socket. There is no mobility.
- Field treatment is palliative because the tooth is out of occlusion.
- Endodontic and orthodontic treatment should be initiated within two weeks of the incident.

**Extrusion Luxation**
- The tooth is extruded partially from its socket and extremely mobile.
- Use gentle steady pressure to reposition the tooth, allowing time to displace any blood that has collected in the socket area. After reduction, the tooth should be nonrigidly splinted.

**Lateral Luxation**
- The tooth is displaced laterally because of bone fracture and can get locked into a new position. If this happens, the tooth will not be mobile.
- Reduce the tooth using the two finger technique: one finger over the apex pushing toward the crown while the other finger places a small amount of pressure outwards to help position the tooth back into its socket. The tooth may snap back into position and be quite stable.
- Splint if mobility is present after reduction.

**Exarticulation (Avulsion)**
- Quick action is needed to increase survival of the tooth. The longer the tooth is out of the mouth, the less the chance for survival of the tooth.
- Prognosis also depends on the health of the periodontal ligament (PDL) cells, some of which are on the root of the tooth (others are in the socket).
- Do not scrub, curette, disinfect, or let the root surface dry out; rinse the tooth with saline to remove debris before replanting it back in the socket. When removing clotted blood from the socket, use gentle irrigation and suction; avoid scraping the socket walls. Replace the tooth gently with steady pressure to displace any accumulated blood.
- If contaminated, rinse the tooth before replanting.
- If immediate replantation is not possible, place tooth in the best transportation medium available.
- Transport media (in order of effectiveness)
  - Save-A-Tooth (Hank's balanced salt solution, which is a physiologically pH balanced saline)
  - Milk
  - Saliva
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- Saline and water do not work well as transport solutions because they can damage the PDL cells. They should only be used to clean the tooth for immediate replantation and not for transportation.

**Management of the root surface**
- Keep the tooth moist at all times.
- Do not handle the root surface (hold by the crown).
- Do not scrape or brush the root surface.
- If the root appears clean, replant the tooth.
- If the root surface is contaminated, rinse with HBSS or saline (use water if saline is not available).
- Persistent debris can be removed with tweezers and then rinsed.

**Management of the socket**
- Gently aspirate without entering the socket. If a clot is present, use light irrigation to remove it.
- Do not curette the socket.
- Do not make a surgical flap unless bony fragments prevent replantation.
- If the alveolar bone is collapsed and prevents replantation, carefully insert a blunt instrument into the socket to reposition the bone to its original position.
- After replantation, manually compress facial and lingual bony plates (only if spread apart).
- Splint or stabilize the tooth

**Splinting**
- Once a tooth has been repositioned back into the socket it will need to be splinted so that the ligaments can reattach. There are two types of splinting: rigid and non-rigid.
- Rigid splinting is best for the bony segment fractures or jaw bone fractures.
- Non-rigid is the splinting of choice for tooth stabilization. In a backcountry environment, it may be necessary to improvise with material on hand. Fishing line or even floss could be bonded to splint teeth. Sutures can also be used to support the tooth by running the suture through the gingiva on the facial aspect of the tooth and then through to the lingual gingival, making a sling that will stabilize the tooth.

**Injuries to Primary Teeth**
- Primary teeth, baby teeth, and deciduous teeth are all different terms for the same thing.
- When dealing with first aid for primary teeth, the general rule is to remove the tooth if it is in the way.
- If a young child has sustained an injury that results in a tooth becoming dislodged or loose, the best treatment is simply to remove it.
- It is not necessary to replant avulsed primary teeth. If the displaced primary tooth does not interfere with occlusion, no treatment other than palliative is needed.