Management of Human and Animal Bite Wound Infection: An Overview

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Animal and human bite wounds can lead to serious infections. The organisms recovered generally originate from the biter's oral cavity and the victim's skin flora. Anaerobes were isolated from more than two thirds of human and animal bite infections. *Streptococcus pyogenes* is often recovered in human bites, *Pasteurella multocida* in animal bites, *Eikenella corrodens* in animal and human, *Capnocytophaga* spp, *Neisseria weaveri*, *Weeksella zoohelcum*, *Neisseria canis*, *Staphylococcus intermedius*, nonoxidizer-1, and eugonic oxidizer-2 in dog, *Flavobacterium* group in pig, and *Actinobacillus* spp in horse and sheep bites. *Vibrio* spp, *Plesiomonas shigelloides*, *Aeromonas hydrophila*, and *Pseudomonas* spp can cause infections in bites associated with marine settings. In addition to local wound infection, complications include lymphangitis, local abscess, septic arthritis, tenosynovitis, and osteomyelitis. Uncommon complications include endocarditis, meningitis, brain abscess, and sepsis with disseminated intravascular coagulation especially in immunocompromised individuals. Wound management includes administering local care and using proper antimicrobial therapy when needed.

Introduction

Animal and human bites and other orally contaminated wounds are common, with more than 1 million animal bites occurring annually in the United States [1–3,4••] Bite wounds typically contain polymicrobial flora that generally reflect the aerobic and anaerobic microbiology of the oral flora of the biter, the skin of the victim, and the environment. Bite wounds include scratches, punctures, lacerations, and evulsions. Often these wounds can appear innocuous initially, but frequently lead to serious infection and complications [5]. This review presents the microbiology and management of animal and human bite infections.

Microbiology

The organisms that can be recovered from bite wounds generally originate from the oral cavity of the biting animal and from the victim's own skin flora. Most infections are polymicrobial and synergistic. In studies that used adequate methods to recover aerobic and anaerobic bacteria, anaerobes were isolated from more than two thirds of human and animal bite wound infections, especially those associated with abscess formation [6–9]. *Streptococcus pyogenes* is generally found in human bites, *Pasteurella multocida* in animal bites [10], *Eikenella corrodens* in both animal and human bites (mostly with the latter), *Capnocytophaga canimorsus* (formerly Centers for Disease Control and Prevention [CDC] group DF-2) [11], *Capnocytophaga cynodegmi*, *Neisseria weaveri* (formerly CDC group M-5) [10], *Weeksella zoohelcum* (formerly II-J) [11], *Neisseria canis* [12], *Staphylococcus intermedius* [13], nonoxidizer-1 [14], and eugonic oxidizer-2 [15] in dog bites, a *Flavobacterium* group IIb-like organism in an infected pig bite [16], and *Actinobacillus* spp in horse and sheep bites [17]. *Vibrio* spp, *Plesiomonas shigelloides*, *Aeromonas hydrophila*, and *Pseudomonas* spp have caused infections in bites occurring in marine settings [18].

Serious systemic infections can be transmitted through bites: tularemia from cats [19], herpes B virus from monkeys, rat-bite fever and sodoku from rats, hepatitis B virus from humans, leptospirosis from dogs and rodents, and rabies from dogs and other mammals.

Human bites

Staphylococcus aureus was the organism most frequently isolated in studies that did not use anaerobic methodology [20]. Penicillin-resistant gram-negative rods alone or in mixed culture were reported in 24% to 43% of bite wounds cultured [21].

Studies that used anaerobic methodologies reported the recovery of anaerobic bacteria in human bites in adults [21] and children [22]. Goldstein et al. [21] recovered anaerobic bacteria in more than half of human bite wounds and clenched-fist injuries. The predominant isolates were anaerobic gram-negative bacilli (including pigmented *Prevotella* and *Porphyromonas* spp, and *Bacteroides* spp), *Fusobacterium nucleatum*, and anaerobic gram-positive cocci. The predominant aerobes recovered

Table 1. Predominant aerobic facultative and anaerobic bacteria isolated from patients with animal bite and human bite wounds

Isolates	Animal bite	Human bite
Aerobic and facultative		
Streptococcus spp		
α-Hemolytic	+	+
Group A β-hemolytic	+	+
Non–group A β-hemolytic	+	+
γ-Hemolytic	+	+
Enterococcus spp	+	+
Staphylococcus aureus	+	+
Staphylococcus epidermidis	+	+
Neisseria spp	+	+
Corynebacterium spp	+	+
Pasteurella multocida	+	–
Eikenella corrodens	+	+
Acinetobacter spp	+	–
Weeksella zoohelcum	+	–
Haemophilus spp	+	+
Moraxella spp	+	–
Capnocytophaga spp	+	–
Anaerobic		
Peptostreptococcus spp	+	+
Veillonella spp	+	+
Bifidobacterium spp	–	+
Eubacterium spp	–	+
Fusobacterium spp	+	+
Bacteroides spp	+	+
Prevotella spp	+	+
Fusobacterium spp	+	+

were *S. aureus*, group A β-hemolytic streptococci, and *E. corrodens*.

Talan et al. [2] conducted a multicenter, prospective study of 50 patients with infected human bites. Fifty-six percent of injuries were clenched-fist injuries and 44% were occlusional bites. The median number of isolates per wound culture was four (three aerobes and one anaerobe); aerobes and anaerobes were isolated from 54% of wounds, aerobes alone were isolated from 44%, and anaerobes alone were isolated from 2%. Isolates included *Streptococcus anginosus* (52%), *S. aureus* (30%), *E. corrodens* (30%), *F. nucleatum* (32%), and *Prevotella melaninogenica* (22%). *Candida* spp were found in 8% of wounds. *Fusobacterium*, *Peptostreptococcus*, and *Candida* spp were isolated more frequently from occlusional bites than from clenched-fist injuries. Many strains of *Prevotella* and *S. aureus* were β-lactamase producers.

Brook [22] recovered anaerobes in 90% of 18 children with human bites (Table 1). A total of 97 isolates (range, 1 to 8 per specimen) were recovered (5.4 per specimen): 44 aerobes (2.4 per specimen) and 53 anaerobes (3.0 per specimen). β-Lactamase activity was noted in 13 isolates that were recovered from 11 patients. These included all 9 isolates of *S. aureus*, 2 of the 6 pigmented *Prevotella* and *Porphyromonas* spp, 1 of 3 *Prevotella oralis*, and the single isolate of *Bacteroides ovatus*. The results of these studies show that normal oral flora, rather than skin flora, is the source of most bacteria isolated from human bite wound cultures.

Animal bites

Almost any aerobic or anaerobic oral flora isolate is a potential pathogen, and therefore the bacteriology of bite wounds is variable and needs individual study [23,24].

Holst et al. [10] investigated the distribution of 159 *P. multocida* isolates from bite wounds. *P. multocida* accounted for 60% of the isolates and was recovered in all cases of bacteremia. *Pasteurella septica* accounted for 13% of isolates, was more commonly isolated from cat than from dog bites, and caused more central nervous system complications. *Pasteurella canis* (biotype 1) was recovered from 18% of wounds—all dog bites. Isolates less often recovered include *Pasteurella stomatis*, *Pasteurella dagmatis*, *Pasteurella gallinarum*, *Pasteurella haemolytica*, and *Pasteurella pneumotropica*, which have also been associated with endocarditis and bacteremia.

In addition to *Pasteurella* spp, anaerobic bacteria play a prominent role in bite wound infections [6–9,23]. They can be isolated from about three quarters of dog and cat bite wound infections, mostly from those where an abscess formed [6–9,23]. Anaerobic gram-negative bacilli are the predominant anaerobic isolates. The most frequently isolated strains include *Porphyromonas salivosa*, *Porphyromonas gingivalis*, and *Porphyromonas canoris*. Other isolates include *Porphyromonas cangingivalis*, *Porphyromonas cansulci*, *Porphyromonas circumdentaria*, *Porphyromonas levii*-like strains, and some unidentified species [9]. Saccharolytic *Bacteroides* and *Prevotella* spp are also often recovered from dog and cat bite wounds. These include *Bacteroides tectum*, *Prevotella heparinolytica*, *Prevotella zoogleoformans*, *Prevotella buccae*, and *Prevotella oris* [8].

Using aerobic and anaerobic cultural methods, Goldstein et al. [23] evaluated 27 dog bite wounds and isolated 109 organisms—87 aerobes and 22 anaerobes. All positive cultures yielded multiple organisms; most were potential pathogens. *P. multocida* was recovered from 7 of 27 wounds (30%), and the most common aerobes were the α-hemolytic streptococci and *S. aureus*. Anaerobes were present in 41% of wounds, especially gram-negative bacilli (pigmented *Prevotella* and *Porphyromonas* spp) and *Fusobacterium* spp. Similar data were found regarding other animal bites (cats, squirrels, other rodents, and rattlesnakes) [10].

Brook [22] evaluated 21 children who had animal bites—17 from dogs and 4 from cats. Aerobes only were isolated in 5 children (24%), anaerobic bacteria only in 2 (10%), and mixed aerobic and anaerobic isolates in 14 (66%). A total of 59 isolates (2.8 per specimen) were recovered: 37 aerobes (1.8 per specimen) and 22 anaerobes (1.0 per specimen).

Talan et al. [24] studied wounds of 50 patients with dog bites and 57 patients with cat bites. They recovered a median of five isolates per culture. Aerobes and anaerobes were found in 56% of the wounds, aerobes alone in 36%, and anaerobes alone in 1%. *Pasteurella* spp were the most common isolates from both dog and cat bites. Other aerobes included streptococci, staphylococci, *Moraxella* spp, and *Neisseria* spp. Anaerobes included *Fusobacterium* spp, *Bacteroides* spp, *Porphyromonas* spp, and *Prevotella* spp. Isolates not previously identified as human pathogens included *Reimerella anatipestifer* from two cat bites and *B. tectum*, *P. heparinolytica*, and several *Porphyromonas* spp from dog and cat bites. *Erysipelothrix rhusiopathiae* was isolated from two cat bites.

The microbiology of monkey and simian bite wounds is similar to human bites, in which aerobic and anaerobic pathogens are the infecting agents. These include *Streptococcus* spp, *Enterococcus* spp, and *Staphylococcus* spp, *E. corrodens*, *Neisseria* spp Enterobacteriaceae, and anaerobes such as gram-negative bacilli and *Fusobacterium* spp.

B virus (also known as *Herpes-virus simiae*; Cercopithecine herpes virus 1) is a potential pathogen with some monkey bites [25]. This infection can cause fatal encephalomyelitis. It is enzootic in monkeys of North Africa and Asia, and affects the macaque and rhesus monkeys.

The organisms recovered from horse bite wounds include *S. aureus*, *Streptococcus* spp, *Neisseria* spp, *Escherichia coli*, *Actinobacillus lignieresii*, *Pasteurella* spp, *Bacteroides ureolyticus*, *Bacteroides fragilis*, other anaerobic gram-negative bacilli, *Prevotella melaninogenica*, and *P. heparinolytica* [26,27]. *Actinobacillus* organisms are associated with sheep bites [26].

The organisms recovered from pig bite infections are *Staphylococcus* spp, *Streptococcus* spp (including *Streptococcus sanguis*, *Streptococcus suis*, and *Streptococcus milleri*), diphtheroids, *P. multocida*, other *Pasteurella* spp, *Haemophilus influenzae*, *Actinobacillus suis*, *Flavobacterium* IIb-like organisms, *B. fragilis*, and other anaerobic gram-negative bacilli [16,27–30].

Organisms from marine environments cause aquatic animal bite infections [31–37]. These infections often involve *Vibrio* and *Aeromonas* spp, which can also be recovered from the oral cavity of the shark [31–33]. *Vibrio carchariae* was recovered from a shark bite infection [32]. *Aeromonas hydrophila* was recovered from a cellulitis that occurred after a piranha bite [35] and alligator bites [36]. Isolates from catfish bites and injuries were *Vibrio* spp (as *Vibrio vulnificus*), *Vibrio damsela*, *Pseudomonas* spp, *Enterobacteriaceae*, *A. hydrophila*, and *Peptostreptococcus* spp [37].

Bird pecking and bites can induce serious infections. A brain abscess that was caused by *Streptococcus bovis*, *Clostridium tertium*, and *Aspergillus niger* developed in an infant after a rooster pecked his skull [38]. An owl attack resulted in superficial cellulitis caused by two non-*fragilis Bacteroides* spp [39], and a swan bite induced cellulitis from *Pseudomonas aeruginosa* [40].

Ferrets caused serious facial injuries in three infants, and *S. aureus* was isolated in one patient [41].

Diagnosis

The symptoms that emerge following a bite depend on the type of animal inflicting the insult. The immediate local or systemic symptoms can be severe following a bite from a venomous animal (eg, snake, lizard, spider). Human or dog bites generally do not cause immediate symptoms in addition to the laceration injury. However, because of the direct inoculation of oral and skin flora into the wound, an infection can develop rapidly, with signs and symptoms appearing in 24 to 72 hours. The signs of infection include redness, swelling, and clear or purulent discharge. The adjacent lymph nodes may be enlarged, and range of motion of an extremity can be reduced. Leukocytosis may occur, with 15,000 to 30,000 cells/mm³. The observation of an eschariform lesion in a sick-appearing individual may suggest the presence of *C. canimorsus* infection [42].

Human bites generally are more serious than animal bites. This is especially the case in a clenched-fist injury, when the skin over the knuckles is penetrated after striking the teeth of another person. The teeth can cause a deep laceration that implants oral and skin organisms into the joint capsules or dorsal tendons, thus causing septic arthritis or osteomyelitis. Radiographs of hands injured by teeth are recommended [43]. It is very important to determine the medical status of the source of the human bite (eg, infections with a hepatitis virus, HIV status, and other transmittable diseases).

About 2% to 5% of all typical dog bite wounds seen in emergency departments become infected [4••]. However, the rabies status of the dog should be ascertained in each instance. Wounds that completely penetrate the skin have an infection rate of 6% to 13%, depending on location. In comparison, the infection rate of clean lacerations repaired in the emergency department is about 5% [44].

Gram stain and culture for aerobic and anaerobic bacteria should be obtained from human and animal bite wounds. Using culture and microbiologic methods that are adequate for the recovery of anaerobic bacteria are essential. If wounds are contaminated by soil or vegetative debris, culture for mycobacteria and fungi should also be performed. Determination of the sedimentation rate or C-reactive protein can help in cases of osteomyelitis and septic arthritis to determine the duration of antimicrobial therapy.

Management

Management of wounds includes proper local care, and use of antimicrobial agent(s) when needed. The steps involved in evaluation and wound care for bites include recording the medical history (animal involved, provoked or unprovoked attack, current medications, splenectomy, mastectomy, allergies, chronic disease, and immunosuppression), examination of the wound and related structures (odor of exudates, depth, type, location, range of motion, joint involvement, edema or crush injury, nerve and tendon damage, presence of infection), obtaining wound cultures, irrigating the wound with saline, débridement, obtaining radiographs (when bone penetration is suspected), wound approximation, administering antimicrobials, tetanus and rabies immunization when indicated, herpes B virus evaluation (in monkey bites), and re-examination at 24 and 48 hours. The incident should be reported to the local health authorities when indicated.

Bites should be managed as any laceration: cleanse, explore, irrigate, débride, drain, and possibly suture. The wounds should be washed vigorously with soap or a quaternary ammonium compound and water. This is of primary importance in reducing the high inoculum of the oral flora of the biting human or animal. The physician should explore for tissue damage caused by crushing or tearing and should search for damaged tendons, blood vessels, joints, and bones. X-ray examination for fractures and foreign bodies should be done when feasible. The wound should be irrigated through a 19-gauge needle with 150 mL or more of sterile normal saline or lactated Ringer's solution. Devitalized tissues should be débrided. Drainage of the wound, when indicated, can be performed in customary fashion or by using gentle suction with a 19-gauge scalp vein tubing connected to a vacuum blood-collecting tube [45]. A controversy still exists regarding whether or not bite wounds that are clinically uninfected and are seen within 24 hours should be surgically closed [23,28]. Margins of puncture wounds should be excised and left open after irrigation. Margins of other wounds should be excised and primary closure carried out, with or without drainage [46••]. The utility of suturing fresh bite wounds less than 6 hours after the injury is undetermined, except for facial wounds. Delayed primary closure or edge approximation should be done in wounds associated with crush injury, preexisting edema, and injuries to the hands or feet.

In caring for a bite by a monkey that may be a B-virus carrier, the wound should be thoroughly scrubbed with soap or detergent and irrigated for at least 15 minutes, and viral cultures should be performed after cleansing [43]. Serum for B-virus–specific acute viral serology should be stored at -20°C, and compared with a second sample obtained 21 days later. Antiviral therapy with acyclovir, valacyclovir, or famciclovir should be given to those with moderate or high-risk wounds [25].

Bites of the hand are at the highest risk of deep damage and severe infection because sharp teeth may penetrate tendon sheaths or the midpalmar space. Human bites should be treated by widely opening the wound, débriding, and irrigating thoroughly; primary closure and tendon and nerve repair should be delayed [47]. Following débridement and irrigation, dog bites can be considered clean, and primary closure can be performed. Hospitalization may be necessary in severe cases, with immobilization by splinting or bulky dressings and elevation.

Facial bites, especially of children, require meticulous management. Nearly all victims do well with careful débridement, ample irrigation and cleansing, and loose closure by suture. Close follow-up for at least 5 days is required. Subsequent plastic reconstruction may be needed, and consultation with a plastic surgeon at the time of initial repair may be useful.

Early management of all human bites, especially those to the hand, must be thorough and vigorous. Clenched-fist injuries require more intensive care, preferably by a hand surgeon, to evaluate the seriousness of injury to the tendon, sheath, joint capsule, joint, and bone.

Rabies prevention should be given after dog bites that indicate such measures [48]. This includes hyperimmune serum and active immunization. A tetanus toxoid booster should be administered if the patient has been adequately immunized before and has received the most recent dose within the past 10 years. Tetanus immune globulin (human) is required if tetanus immunization has not taken place or is inadequate.

The infectious complications of dog bites make the concept of prophylactic antibiotics attractive. Using antibiotics may be helpful, particularly in high-risk wounds such as those of the hand. The choice of a particular antibiotic for prophylaxis and/or treatment must be based on bacteriology. Unfortunately, no single antibiotic can be expected to effectively treat infections caused by all the organisms that can be present in an infected bite.

The role of prophylactic antimicrobial therapy in bite wounds presenting early is uncertain [43,45]. However, because these wounds are usually contaminated with potential pathogens, preemptively treating all patients having deep bite wounds with antibiotics is advisable. These include puncture wounds, facial bites, and any wound over a tendon or bone.

Antimicrobial treatment should be administered for all bite wounds, with the exception of patients who present 72 hours or more after injury and have no clinical signs of infection. Antimicrobial therapy of bite wounds is not usually prophylactic, but rather a therapeutic intervention.

Because no single antimicrobial reliably eradicates all of the major pathogens responsible for bite wound infections, establishing a specific etiologic diagnosis by

Table 2. Antimicrobials effective in the empiric treatment of patients with animal bite and human bite wounds

	Animal bite	Human bite
Amoxicillin-clavulanate (PO)	+	+
Ampicillin-sulbactam (IV)	+	+
Cefoxitin (IV)	+	+
Moxifloxacin (PO, IV)	+	+
Gatifloxacin (PO, IV)	+	+
Doxycycline (PO, IV) .	+	+
IV—intravenously; PO—orally.		

obtaining cultures is helpful in guiding therapy (Table 2) [49]. Penicillin or ampicillin are the most active agents against *P. multocida* and the other oral flora. However, *S. aureus* and almost half of the anaerobic gram-negative bacilli recovered in human bite wounds are resistant to these drugs [50]. The isolation of β-lactamase–producing organisms from more than 40% of bite wounds excludes the use of penicillins for bite infections [11]. Although oxacillin is effective against *S. aureus*, it has poor activity against many bite isolates; 18% of *P. multocida*, 24% of *Bacteroides* spp, and more than 50% of other aerobic gram-negative strains were resistant to oxacillin [50]. Doxycycline is a good alternative but should not be used in children younger than 8 years of age. When *S. aureus* is suspected (based on the gram stain of aspirate, which is specific but not sensitive), penicillin (to cover strepto-cocci) and a penicillinase-resistant penicillin should be used. If methicillin-resistant *S. aureus* (MRSA) is recovered, vancomycin, linezolid, or other MRSA-effective antimicrobial should be administered. The combination of amoxicillin and clavulanic acid has been effective in the therapy of human bites and dog bites [49,51]. This combination has a wide spectrum of activity against most pathogens isolated from these wounds. First-generation cephalosporins are not as effective as the combination of amoxicillin and clavulanic acid because of the resistance of some anaerobic bacteria and *E. corrodens.* Clindamy-cin and the penicillinase-resistant penicillins should not be administered without penicillin because of their poorer activity against *P. multocida.* Erythromycin is generally ineffective against *P. multocida*, *Moraxella* spp, fusobac-teria, and peptostreptococci. Azithromycin is generally more active than clarithromycin against all *Pasteurella* spp. Azithromycin and clarithromycin are only modestly effective against *E. corrodens* and peptostreptococci. Cefoxitin or the combination of penicillin or a first-generation cephalosporin plus a β-lactamase–resistant penicillin or the combination of ticarcillin and clavulanic acid will provide adequate parenteral therapy for animal and human bites. The newer quinolones (gatifloxacin and moxifloxacin) are active against all major bite wound pathogens, including anaerobic bacteria [52]. However, these agents are not approved for use in children.

E. corrodens, a capnophilic Gram-negative rod that is part of the normal oral flora, can be recovered from 25% of human bite wounds [21]. *E. corrodens* is susceptible to penicillin, ampicillin, and the quinolones but resistant to oxacillin, methicillin, nafcillin, and clindamycin, and some strains are resistant to cephalosporins [49,50,52]. Therefore, any isolated *E. corrodens* should undergo sus-ceptibility testing if cephalosporin therapy is considered.

When antibiotics are administered in this manner and are combined with good wound toilet, most bite wounds can be sutured with good results and an acceptable infec-tion rate. The duration and route of antibiotic therapy should be individualized based on the site involved, the culture results, and the response to treatment. A 7- to 14-day course is generally adequate for infections limited to soft tissue, and a minimum of 21 days of therapy is gen-erally required for infections involving joints or bones.

Complications

Complications are common in hand wounds, with 30% or more becoming infected [45]. The rate of complica-tions is high because of the presence of avascular tendon and sheath spaces and the propensity of the infection to spread. These infections may have disastrous consequences on function. In addition to local wound infection, other complications include lymphangitis, local abscess, septic arthritis, tenosynovitis, and osteomyelitis [22,43]. Rare complications include endocarditis, meningitis [53], brain abscess [54], and sepsis with disseminated intravascular coagulation [55], especially in immunocompromised indi-viduals. Especially prone to complications are individuals receiving systemic corticosteroids and patients with lupus erythematosus or acute leukemia.

Transmission of other infections

Cat scratches and cat bites, as well as flea bites, can trans-mit the cat scratch-disease agent *Bartonella* (formerly *Rochalimaea*) *henselae* [56].

Tetanus can result from animal and human bites [57]. The patient's tetanus immunization status must be deter-mined after bite wounds that penetrate the skin. Tetanus toxoid and/or tetanus immune globulin should be given when required or if doubt exists about the timing or pre-vious receipt of tetanus immunization [57].

Bites, abrasions, scratches, or exposure to animal saliva through mucous membranes or a break in the skin all can transmit rabies. The possibility of rabies exposure should always be considered after most animal bites, especially for unprovoked attacks or if the animal seems ill or was a stray. Postexposure prophylaxis can prevent unnecessary deaths and should be administered when indicated [58].

Human bites can transmit other infections. These include hepatitis viruses B (HBV) and C, primary syphi-lis, and herpes simplex virus [58]. Because the risk for transmitting HIV through saliva is very low, postexpo-sure prophylaxis is not recommended [59,60].

Patients negative for anti-hepatitis B surface antibodies who were bitten by an individual positive for hepatitis B surface antigen should receive both hepatitis B immune globulin and hepatitis B vaccine. Individuals working in institutions where the risk for human bites is high should receive the HBV vaccination at the start of employment.

Conclusions

Animal and human bite wounds can lead to serious infection and complications. The organisms that can be isolated from bite wounds generally represent the oral cavity of the biting animal and the victim's skin flora. When proper techniques are used, anaerobic bacteria can be isolated from more than two thirds of human and animal bite wound infections, especially those associated with abscess formation. Management of bite wound infections includes administering proper local therapy and using appropriate antimicrobial agents when needed.

Disclosure

No potential conflict of interest relevant to this article was reported.

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have been highlighted as:

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This review outlines the treatment of facial bites, which are especially prone to infectious complications, both local and systemic. Beyond the initial tissue damage, complications can create difficulties for restoring an esthetic appearance. Management should aim to neutralize the potential for infection and provide an infection-free environment for wound healing. Wound cleansing followed by primary closure is the treatment of choice, and use of prophylactic antibiotics may further decrease the infection risk.

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