



Bite Trauma

by Julie Aberger

EMT Objectives

After reading this article, the EMT will be able to:

- explain how human bites cause infection;
- list motivations for human biting;
- describe “fight bites” and how they occur;
- list dog breeds most likely to cause significant physical trauma to humans;
- describe why victims of dog bites are at a minor risk of rabies;
- identify bite injuries & their treatment;
- understand the emotional toll of treating severely injured dog bite victims.

Teeth: Hard, tough, bonelike structures made of enamel, the hardest material in our bodies, essential to mastication, or chewing. We need our teeth to break down the food we eat which is the first step in digestion.

But teeth may also be used aggressively, as weapons. Under attack, humans – like other mammals – may use their teeth to protect themselves by biting. When mortally threatened, it’s deeply instinctive to revert to “jaws and claws.”

Every year in this country, almost 1% of emergency department (ED) visits are due to mammalian bites, both human and animal. The medical costs are astronomical – over hundred million dollars. Bites may cause pain, emotional suffering, infection, disability, disfigurement, and sometimes death.

In this article, we will first explore human and, then dog bites, and discuss how EMTs assess and treat these injuries. We will examine the major risks of bites, how they affect the victim’s body and what medical emergencies EMTs can expect to encounter on these calls.

JAWS: Teeth As WMD

Humans have 32 permanent teeth, notwithstanding the wisdom teeth that sometimes do not develop. As we know, teeth come in different shapes and sizes; all have specific functions. Incisors are chisel-shaped and built to cut. Conical eyeteeth tear or pierce and are aptly named canines. Bicuspids and molars have broad crowns and are best suited to crush and grind.

Teeth are embedded in the jaw that contains the masseter muscle, the strongest muscle in your body. (See Figure 1.) The masseter runs from the sides and base of the skull, (the temporal bone) to the lower jaw, (the mandible). It lifts the lower jaw to

close the mouth. What distinguishes the masseter is its mechanical advantage of being broadly attached to a short-armed lever. *The Guinness Book of Records* has listed the world record for the strongest bite: In 1986 a man in Florida produced a bite-strength of 975 lbs. for two seconds. That’s more than six times the normal biting strength of a human!

Human bites can cause severe tissue damage. Teeth can rip off an ear, or amputate a nose, damage

The masseter muscle is the strongest muscle in the body.

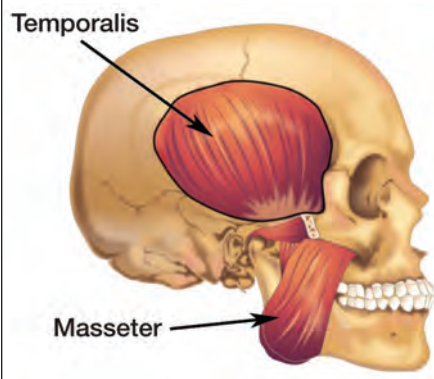
nerves or even fracture the facial bones. Bleeding may be copious, requiring pressure dressings or tourniquets.

Bites may become seriously infected caused by rapid growth of bacteria in broken skin. Infectious disease may be transmitted. Motor function may be lost. Disfigured faces may require lengthy healing and expensive specialized plastic surgery. And human-bite victims often suffer severe emotional trauma from the wanton and malicious act of being bitten.

Who Gets Bitten, Where and Why?

Human bites are not uncommon. However, many are unreported and treated at home. The peak incidence occurs in persons aged 10-34 years. Sixty percent occur in an upper

Figure 1: Masseter and temporalis muscles



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extremity while 15% occur in the head and neck region, most commonly the ears, nose or lips. The remainder occurs on the breasts, genitals, thighs and other areas. Closed fist bites, or “fight bites” accounted for 8%. The remaining number is “occlusion bites,” i.e., when the bite is forceful enough to breach the skin.

Why do people bite?

- Aggression fueled by anger often results in human bites: Young kids bite each other as they roughhouse; partners or spouses may physically fight, baring their teeth and biting out of malice and hatred.

After a night of drinking and arguing, a sleeping man was awakened when his 31-year old “angry” girlfriend bit his penis, intending to “bite it off.” The man’s organ was avulsed and required stitches at the hospital.

- Sadistic/masochistic sex can also lead to biting of the nipples, ears, lips tongue and genitals. Many of these types of bites go unreported unless they are severe or become infected.

- Developmentally disabled persons may revert to biting as signs of frustration and anger. During a “rage attack,” persons with Tourette’s syndrome have been known to bite their caregivers.

- Bites can be self-inflicted due to disorders or disease. Lesch-Nyhan syndrome, an uncommon genetic disease that causes cognitive and behavioral disturbances, causes children between ages two and three to “self-mutilate” or bite themselves,



Photo 2: A man’s sutured ear after being bitten off in a bar fight.



Photo 1: Perhaps the most famous human bite in history: Mike Tyson bites Evander Holyfield’s ear during their 1997 heavyweight title bout.

their fingers, hands, lips and cheeks.

- People experiencing seizures often bite their tongues that can result in copious bleeding and airway problems.

- Young children – two and three year olds – bite each other for many reasons. And sometimes for no reason at all. My four-year old daughter was once kissing her infant brother’s face when her kiss turned into a bite that left rings of teeth marks on either side of his tiny nose. I later asked her why she bit her brother and she answered innocently, “because he tasted good.”

Children are developing emotionally and do not have the tools to say what they need. If threatened, they often bite. Child abuse bites, when an adult bites a child out of anger or frustration, however, is a criminal offense and must be reported to the ED or police.

Critical Bite Locations

The three sites on the human body where complications from bites commonly arise are: the fist, the fingers and the head.

- “Fight bites” or bites that inadvertently occur during a fistfight, are especially dangerous. These are the most serious human bite wounds and require the most aggressive treatment.

One man, fueled by alcohol, takes a swing at another, and his closed fist hits the teeth of the victim, tearing open a small area of thin skin on the closed fist. The simple injury appears innocuous. The fighter has another drink, wipes off the blood on his

hand and forgets all about it. The next day, however, the laceration is red and hot, then soon after the whole hand begins to swell and becomes painful.

What happened? When the aggressor’s fist impacted the victim’s teeth, bacteria on the teeth were inoculated directly into the skin and extended tendons of the fist.

The tendons in the hands extend from muscles in the forearms that allow fingers to move. Directly under that surface, tendons attach muscle to bone. They are enclosed in sheaths that contain a minute amount of synovial fluid that prevents friction when the tendon moves against the bone. When the aggressor makes a fist, his

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tendons are extended within the sheath. When the fist is subsequently relaxed, tendons retract in the sheaths carrying the bacteria into the enclosed tendon sheath.

Underlying damage in a fight bite can cause tissue death, (necrosis) but also torn tendons and/or damage and/or infection to the spaces between the joints. Infections that begin less than 24 hours after the injury are usually produced by a mixture of organisms and can rapidly cause whole areas of tissue to necrose. If untended, these injuries can result in cellulitis, osteomyelitis, septic arthritis and permanent hand disability. Specialized surgery is most often needed to clean and debride the dead tissue and repair tendon or joint damage.

- “Chomping injuries” are considered medically significant. The skin on the fingers is thin and easily broken and the sheathed tendons are superficial to the skin and may easily be lacerated. (See Photo 3, next page.) When the bite occurs, bacteria are inoculated into the tendon. Within

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the tendon sheath, the bacteria causes infection, just like fight bites.

● **Head:** Biting here commonly occurs among young males who are fighting and intoxicated. A victim with occlusive bites to the head or neck should be taken to the ED as intravenous antibiotics are required within 48 hours. The wound may not be immediately sutured as closing the wound can trap bacteria that will fester and exacerbate infection.

Suturing or closing a bite wound is controversial: In general, hand wounds, puncture wounds, infected wounds, or wounds more than 12 hours old are not sutured. These wounds are allowed to heal without sutures. Head and neck wounds, however, are closed if they are less than 12 hours old and not infected.

Bite marks on a child's skin or scalp should raise your index of suspicion for abuse.

*Bite marks on a child's skin or scalp should raise your index of suspicion for abuse. These kids need to be seen immediately by a physician in the ED. The teeth marks are carefully assessed for size and spacing to make certain it wasn't another child (or dog) who caused them. Obviously, adult teeth are larger, and therefore, leave a bigger imprint. In that case, the ED staff may photograph the injury next to a ruler as evidence of the extent of abuse and alert special services.

Complications of Human Bites

Hemorrhage is rare in human bites, but infection caused by the contaminated saliva of the biter, is rife. This occurs when the bite is occlusive. The victim's skin also contains bacteria that can be inoculated into her own skin that has been torn. Oral flora is a hotbed of bacteria, including *Staphylococcus*, *Streptococcus*, and *Corynebacterium*, among many others. A variety of staph is found in 30% of infected

Photo 3: A crush-and-tear type injury resulting from a dog bite.



human bite wounds and is associated with some of the most severe infections. Abscesses grow from *E. corrodens*, a slow-growing pathogen also found in 30% of human bite wounds. And that's the tip of the iceberg!

Skin that has been bitten by a human, a dog (or cat), may result in *cellulitis*, a bacteria infection of the dermis and subcutaneous tissue. The skin becomes red and warm; it swells and becomes painful. Any skin wound or ulcer that exhibits these signs may be developing cellulitis.

Organisms in saliva can also cause more serious systemic diseases such as hepatitis. In patients with Hep B and C, the antigen is detectable in their saliva.

Bites caused by children rarely become infected because they are usually shallow. However, adult bites must always be assessed and treated because infection is common, especially in closed-fist injuries. Between 15-30% of bites caused by adults become infected, with a higher rate for closed-fist injuries.

One final consideration: rabies. The only well-documented cases of rabies caused by human-to-human transmission occurred among eight recipients of transplanted corneas, and among three recipients of solid organs.

Dog Bites

No one will ever understand the sheer horror of being attacked by someone's pet unless you have been a victim yourself, or, as in my case, being the daughter of one who was savagely attacked and killed a few years ago.

How serious are dog bites? Ask anyone who has been bitten or who is a parent or caregiver of a child who has been mauled and bitten. The experience may be devastating physically and emotionally. And dogs can kill, and do.

A dog has 42 permanent teeth, ten more than humans. In their wild state dogs were carnivores and needed those teeth to capture and kill other animals for food. (Now domesticated dogs have become omnivores eating dog food loaded with non-meat products.) The types of their teeth correspond with humans: incisors, canines, premolars and molars. The canines are also called "fangs," pointed conical eyeteeth that pierce and rip.

The strength of a dog's bite varies from breed to breed, animal to animal, and even incident to incident. The dogs with the greatest measurable jaw strength are Rottweilers, pit bulls, German shepherds, mastiffs and Dobermans, the dogs often bred for guarding, fighting and killing. Their bite strengths range from 250-500 pounds of pressure. (You and I have about 120 pounds of bite pressure.)

How pervasive are dog bite-related fatalities? Last year in the U.S., there were 42 deaths. Twenty were children under 13-years old; 22 were adults, 20-years and older. Of the adults, 16 were ages 50 and older. Already this year, nine people have been killed by "family dogs," including an 18-month old boy playing on the porch under the care of his grandfather and an 87-year old man who was taking down his Christmas tree when the pit-bull viciously attacked and bit him multiple times. Both victims were DOA at the hospital.

Who is responsible? In New Jersey (NJ Statutes, Section 4:19-16) the dog owner is legally liable for all of the damages inflicted upon a dog bite victim, even if the dog had never previously exhibited the tendency to bite humans.

The types of dog primarily responsible for these deaths are pit bulls and Rottweilers which have been bred, trained or reinforced by owners to

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fight. These breeds are also the darlings of gangs and drug dealers. (See Figure 2, below.) These dogs make surprise attacks on humans, bite, hold and shake the victim ruthlessly. "It wouldn't let go," is the remark most often heard after such an attack.

Bleeding & Infection

"Man's best friend" can maim and kill, their teeth cut, scratch, puncture, lacerate, rip, crush, avulse, and amputate. Dog bite-related deaths usually result from exsanguination caused by multiple severe bites. But infections can be just as deadly or disabling.

When a dog sinks its teeth into human skin, saliva is inoculated directly into the body as well as any microorganism on the skin of the victim, or in the environment. That fluid consists of more than 100 multiple pathogens such as *Staphylococcus* and *Streptococcus* species, *Escherichia coli*, and *Pasteurella multocida*, all major players in the infection game. Eighty-five percent of bites harbor potential pathogens and the average wound contains five types of bacteria.

Pastuerella and *bartonella* in dog (and cat) saliva are bacteria that can cause skin and lymph node infection in humans. *E. coli* and *salmonella* live in the intestines of pets and can give us severe intestinal disease. Parasites, such as *Giardia* are in canine feces and can be transmitted to humans who may not wash their hands after cleaning up after their animals.

Zoonosis is a disease common to animals and humans and is more common and serious in third world countries and tropical climates. Still, pet owners should be aware of the potential risk of the zoonoses that dog (or cat) bites can carry.

Zoonosis is a disease common to animals and humans; one of the most serious of zoonotic viral diseases is rabies.

One of the most serious of zoonotic viral diseases is rabies. However, the Centers for Disease Control reports "Over the last 100 years, rabies in the United States has changed dramatically. More than 90% of all animal cases reported annually to CDC now occur in wildlife; before 1960 the majority were in domestic animals. The principal rabies hosts today are wild carnivores and bats." Only one or two deaths are now reported per year in the U.S. They state: "Modern day prophylaxis has proven nearly 100% successful."

The rabies virus is transmitted by the infected animal's saliva through a bite that has penetrated the victim's skin. It is deadly. The virus has a long incubation period, on average about two months between the exposure and the appearance of symptoms. Therefore, the vaccine is effective even though it is given *after* exposure to the virus.

If you have been exposed to rabies through a wild animal bite or the bite of an animal with symptoms of rabies (such as bizarre or unusual behavior), you are given the vaccine. In the past, the rabies vaccine required 23 to 30 shots in the stomach that were very painful. The "new" rabies vaccine requires far fewer shots in the arm and is much less painful.

EMS Assessment & Treatment of Bite Victims

Scene Safety: The animal that bit the victim may still be at the scene and loose. Always be certain that the animal has been secured away from the victim and YOU. Do not step out of your ambulance until that has been ascertained.

BSI: Be prepared for the worst. If there is hemorrhaging, put it all on: gloves, goggles, masks, and gowns. Saliva also poses a risk to responders.

ALS? If there are life threatening injuries, e.g., hemorrhaging, or the patient is unresponsive or disoriented, you'll want the medics.

Consider C-Spine: If there is extensive head, neck and back trauma, you may want to board and collar. Any pediatric patient who has been extensively bitten around the head or neck and then dragged, shaken or thrown by an animal, needs spinal immobilization.

Primary Assessment: Treat hemorrhage first. Use direct pressure with your gloved hand or sterile dressing. If an extremity hemorrhage persists after multiple layered pressure dressings, use a tourniquet. Cover all bite wounds with sterile dressings after noting location, size and approximate depth.

As one EMT treats the bite wounds, another should be immediately *assessing level of responsiveness*. Then: *Does the patient have an airway?* If not, open, clear, maintain. Use a head-tilt, chin-lift or if trauma is present, a jaw thrust. Clear the airway of blood, debris, teeth, etc. with suction. Finally maintain the airway with an oral airway, or if the patient has a gag reflex, a nasal. *Then assess for breathing:* You need an approximation of the rate and depth. That does not

Figure 2 - Injuries/deaths caused by dog attacks from 1982 through 2014, by breed

Breed	Bodily Harm	Child Victims	Adult Victims	Deaths	Maimings	% of total dog population
Pit bull	3397	1355	1312	295	2110	6.69%
Rottweiler	535	297	141	85	296	2.76%
Husky	83	51	8	26	27	1.04%
Wolf hybrid	85	70	5	19	49	
Bullmastiff: Presa canario	111	46	41	18	63	.02%
German shepherd	113	65	41	15	73	3.72%
Pit bull-mix	206	78	54	12	115	
Akita	70	44	22	8	52	.07%
Chow	61	37	18	8	40	.01%
Doberman	23	12	9	8	12	1.70%
Unidentified	81	16	29	8	32	
Boxer	64	19	23	7	31	1.25%
German shepherd-mix	45	28	14	7	30	

Source: DogsBite.org

mean an actual count, but a visual estimate: Is the patient breathing too fast? Too slow? Too shallow? Too deep? If the breathing is inadequate – if the chest is not rising and falling with enough, or too much, depth or speed – then ventilate! Remember the normal breathing rate of a child is faster than an adult. And an infant is even faster! (A=12-20 BPM, C=15-30 BPM, I=25-50 BPM) If the patient has a normal rate, but is bleeding, you should still give 100% oxygen with a nonbreather at 15 lpm.

Does the patient have a pulse? Assess for radials first, and if none is present, carotids. No carotid? Start CPR. Also note the patient's skin color, temperature and condition.

Do a rapid body scan looking for other potential life threats, such as other major bleeds. **Then determine priority.**

If there is hemorrhage, responsiveness, airway, breathing or other circulation issues, the patient is a high priority patient and you should transport as safely, but quickly as possible.

In the hospital the emergency department physician assesses the patient for airway-breathing-circulation

Bite lacerations are often not sutured immediately as closing them keeps bacteria localized, causing infection.

tion and manages any immediate life threats. Lacerated arteries that are still bleeding are sutured. If there is no neurovascular injury, the ED physician irrigates the wound with high-pressure normal saline and closes it, if indicated. If needed, the patient is given a tetanus shot, and the first of the rabies shot series. She may also be prescribed antibiotics that are necessary if she is diabetic or immunocompromised. As stated before, bite lacerations are often not sutured immediately as closing them often keeps bacteria localized, causing infection.

Rabies: A Deadly Disease Fueled By Misinformation

Did you know that on September 28th every year we celebrate "World Rabies Day?" This is an appropriate occasion for squads to educate their communities about this deadly disease and how to take the steps necessary to keep themselves, their families and their pets free from rabies. There is a tremendous amount of false, outdated information in our communities that needs revising.

The CDC has developed resources that can help you get out the word. Visit this link to download materials for healthcare professionals. (<http://www.cdc.gov/worldrabiesday/>) The CDC even has a webpage (<http://www.cdc.gov/rabiesandkids/>) for children. The site answers questions such as: What is rabies? How do you know an animal has rabies? Warning signs, etc. It's a great educational tool for squads to distribute during a town fair or at schools.

EMS Report to the ED Doc

You must report:

- History of the incident and the animal involved, describing its behavior and whether it has been inoculated for rabies. Do not bring any dead animal to the ED; animal control is responsible for its disposition and disposal. (Exception: spiders, if dead.)

- Vital signs, including a respiratory rate!

- The patient's estimated blood loss. Was the scene drenched with blood or was the victim in a pool of blood? If the crew has applied a tourniquet, the physician asks what time the device was placed and why it was needed.

- Your physical exam should include an assessment of the bites, their location and size and approximate depth. If an extremity is involved and the patient is *not* critical, you should also report the neuromuscular status of distal pulses, movement and sensation of the injured arm or leg. Can the patient flex and extend the affected extremity?

After all life threats are assessed and managed, the physician examines the wounds to determine the need for specialized care, such as an orthopedic surgeon for tendon and nerve damage. He is called immediately and, if he finds neuromuscular injury, determines the need to do surgery.

Postscript

One last word:

When dispatched for "dog bite victim" you must be prepared for an emotionally-charged scene. Nine times out of ten the call is for a victim with minor bites to the arms or legs. No problem. But that tenth call may yield a victim with shocking number of bites all over his body, particularly his face and neck. And if the victim is a child, you must overcome additional shock to act. You must dispatch medics, remain calm, assess and manage the ABCs, and get on the road quickly and safely.

The victim of a dog bite(s) is often distraught, angry and frightened. If a child is involved, you may have more than one patient. You may have to call for back-up (EMS, police) to have enough crew to care for the parent or caregiver who may even hamper your care.

I have a friend, an experienced EMT, who suffered severe post traumatic stress disorder after treating a three-year old with multiple dog bites to her face. The call took an emotional toll: The EMT is no longer answering 911 calls with her squad.

After these traumatic, sometimes terrifying calls, you may need to ask for help. Take care of yourself – talk with colleagues, have adequate time off duty with family and friends, and use any available mental health services.

Thankfully, calls like these do not occur everyday. But when they do, recognize and respect your emotional limitations.

Julie Aberger is an EMT instructor and an active member of the Pennington First Aid Squad. Julie is also the editor emerita of The Gold Cross.

References available upon request.

