



Facial dog bites treated at the Massachusetts General Hospital over a 20-year period

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Objective. The aim of this study was to identify risk factors associated with facial dog bites and discuss prevention strategies.

Study Design. This is a retrospective analysis of facial dog bites treated at the Massachusetts General Hospital (MGH) from 1997 to 2018. Patients were identified through the Research Patient Data Registry. The predictor variables included demographic characteristics, circumstantial information regarding the injury, and dog characteristics. Other study variables were wound and treatment specifics and follow-up. Descriptive and bivariate statistics were computed.

Results. In total, 321 patients were identified (mean age 29.5 years; range 0.7–81 years). There were 141 males and 180 females. The majority of patients were adults (age > 18 years; $n = 223$ [69.5%]). Most dogs ($n = 281$ [87.5%]) were known ($P < .00001$), and provocation was recorded in 207 cases (64.5%; $P < .00001$). Bites were preceded by the following behaviors: playing with the dog, feeding the dog, and placing the face close to the dog. Pitbulls led in the number of bites ($n = 26$ [8.5%]). Location on the face was predominantly the middle or lower third ($n = 299$ [93.1%]).

Conclusions. The results of this study suggest that education of dog owners, parents, and children should focus on avoidance of known provoking behaviors. This may help decrease the incidence of these devastating injuries. (Oral Surg Oral Med Oral Pathol Oral Radiol 2020;130:136–143)

Dog bites are consistently among the top 15 causes of nonfatal injuries in the general population and among the top 10 among 5- to 9-year-olds.¹ This serious public health issue has yet to be adequately addressed in terms of policy and education among vulnerable populations. Dog bite laws vary by region but, generally, focus on liability of the incident with no requirements for dog training or owner education to prevent future occurrences.² Depending on the state, the dog involved in the incident may be declared “dangerous” or “vicious” at an administrative, civil, or criminal hearing. Owners of dogs so designated must follow specific guidelines, such as confinement, micro-chipping, tattooing, or muzzle requirements.³ In 2001, the American Veterinary Medical Association formed a task force on canine aggression and human–canine interactions to formulate a community approach. The task force recommended establishing an advisory council consisting of animal control officials, attorneys, dog breeders, and health care providers, as well as an educational system to represent a wide spectrum of community concerns, to conduct investigations and make recommendations.⁴ However, mandatory changes and educational efforts have been scarce. Dog ownership continues to increase in the United States. According

to the American Veterinary Medical Association, the number of pet dogs is now 76.8 million, up 10% from 2011.⁵ Dogs remain the most popular household pets, with 38.4% of households owning dogs in 2017, up from 36.5% in 2011.⁵

There has been a wide range in estimates of the number of dog bites requiring medical attention in the United States annually. This ranges from 800,000, based on a nationwide telephone survey,⁶ to 350,000, based on emergency room (ER) visits.⁷ These disparate numbers make it difficult to estimate the true annual incidence. However, the increasing trend can be analyzed by using the National Electronic Injury Surveillance System of the Centers for Disease Control and Prevention reporting the number of dog bite–related ER visits at the 100 hospitals selected as a probability sample of all U.S. hospitals each year. Averaging the number of attacks between 2004 and 2010, approximately 109 of 100,000 persons visited the ER for treatment of dog bites. This number has increased to approximately 112 of 100,000 when averaging the data for the period 2011–2017.⁷

To further highlight the burden of these injuries, the Insurance Information Institute reports a 93.4% increase in the estimated number and cost of dog bite claims nationwide between the years 2003 and

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Statement of Clinical Relevance

The results of this study suggest that educational initiatives focusing on the avoidance of provoking behaviors and targeting dog owners, parents, and children are crucial factors in preventing facial dog bites.

2017.⁸ The cost of these dog bite claims accounted for more than one-third of all homeowner's insurance liability claims in 2014, costing in excess of \$500 million.⁹ This only includes data from claims that were filed, suggesting that the actual cost may be far higher. Despite the prevalence of dog bite injuries and the obvious financial burden placed on both the victim and the health care system, there is no nationwide mandatory reporting or centralized database.^{10,11} For instance, the Massachusetts Dog Bite Reporting Law mandates health care providers who have treated a person for an animal bite injury to report the incident to a local animal officer within 24 hours,¹² whereas the California Code of Regulations requires the victim and the dog owner, but not the doctor, to report to the local health officer immediately.¹³

Most studies report that children are more likely to be bitten compared with adults, with some studies estimating that nearly 50% of children experience a dog bite injury.¹⁴⁻¹⁸ Dog bites in children are more likely to involve the head and neck region with the potential for long-term aesthetic, psychological, and functional consequences.^{19,20} The current literature shows that educational programs to behavioral training for both children and parents to prevent bites is effective in lowering the chances of injury.²¹ In designing educational programs, there is a need to fully understand all of the potential risk factors and provocations. Currently, we lack sufficient knowledge of the circumstances surrounding injuries. The most efficacious methods of promulgating educational information needs to be addressed as well.

The purpose of this study was to answer the following clinical question: In all patients presenting to a tertiary care hospital for treatment of a facial dog bite, are there identifiable risk factors associated with the injury? In particular, we aimed to focus on those provocations and behavioral issues that can be modified in an effort to decrease the incidence of this devastating injury. This will help focus our efforts on improving education and outreach programs and identifying vulnerable populations who would most benefit from them.

MATERIALS AND METHODS

Study design

This is a retrospective analysis of all facial dog bite injuries treated at the Massachusetts General Hospital (MGH) from May 1997 to August 2018. Institutional Review Board approval was obtained for this study (Protocol No. 2017 P002392), and the tenets of the Helsinki Declaration were followed.

Sample identification and selection

Patients were identified through the MGH Research Patient Data Registry by using relevant International

Classification of Diseases (ICD)-9/-10 codes for facial dog bites. Inclusion criteria, in addition to the diagnosis, were availability of records that included specific information about the circumstances surrounding the bite and descriptors of the type and location of the injury. Incomplete records resulted in exclusion. Patient consent was obtained for use of photographs.

Variables

Candidate risk factors for facial dog bite injuries were identified after review of the existing literature. Data intake included the following: demographic characteristics (patient age and gender); circumstantial information regarding the bite (provocation, history of aggression); dog characteristics (relationship to patient, breed, health history); wound and treatment specifics (location of bite, type of injury, involvement of other structures, vaccination history, antibiotics); and follow-up information (wound care, need for revision surgery). Dogs were classified as "known" if they belonged to family members, friends, or neighbors and as "unknown" if they did not have any previous interactions with the victims. Dog breed documentation relied on self-reporting by the patient or an accompanying family member or friend. Attacks were classified as "provoked" if the victim was playing with the dog, feeding the dog, or interacting in any way with the dog at the time of attack. Accidents, such as the dog bumping into the victim's face, were classified as "unprovoked" events. The location of the bite was classified as upper, middle, or lower third of the face. The upper-third is bound superiorly by the trichion and inferiorly by the glabella, the middle third inferiorly by the subnasal point, and the lower third inferiorly by the menton.

Data analyses

Patient medical record numbers were deidentified, recoded, and recorded in Microsoft Excel version 16.22 (Microsoft Corp., Redmond, WA). Data analyses were performed by using SPSS software version 25 (SPSS Inc., Chicago, IL). Descriptive statistics (mean, frequency, range, standard deviations) were calculated for applicable study variables. Bivariate analysis (*t* test) was used to measure the association between variables of interest. The χ^2 test was used for categorical variables. A *P* value less than .05 was considered statistically significant.

RESULTS

In total, 321 patients were identified (mean age 29.5 years; range 0.7–81 years). There were 141 males and 180 females (*P* = .90). Of the recorded victims, 223 (69.5%) were over older than 18 of age, and 98 (30.5%) were younger than 18 years of age. Of the

study patients, 129 patients (40.2%) were up to date on tetanus vaccination (Table I, A).

The vast majority of dogs (n = 281 [87.5%]) were known, and provocation was recorded in 207 cases (64.5%). With regard to the vaccination history of the dogs, 246 (76.6%) were up to date on their vaccinations; 8 (2.5%) were not up to date; 27 (8.4%) had an uncertain history of vaccination; and 40 (12.5%) had no known history of vaccination. The fate of the attacking dog had been documented in 47 cases: of these, 36 were placed in quarantine, 9 euthanized, and 2 given away. Only 5.6% of the animals had a history of aggressive behavior (see Table I, B).

The most common documented provoking behaviors in all age groups included playing with the dog (n = 70); face placed close to dog (n = 44); petting the dog (n = 25); startling the dog (n = 19); injurious behavior toward the dog (n = 16); food-related confrontation (n = 12); dog awakened from sleep (n = 9); tending to a dog in a kennel facility, hospital, or dog spa (n = 9); breaking up a fight between dogs (n = 4); and protection of territory (n = 3). These are summarized in Table II.

A total of 33 dog breeds were documented. Pitbulls (including mixed breeds) led in number of bites (n = 24 [7.5%]), followed by Labradors (including black and

Table II. Provocative behavior

	n*	%
Playing	70	33.8
Face close to the dog	44	21.3
Petting the dog	25	12.1
Startling the dog	19	9.2
Injurious (stepped, fell on, etc.)	16	7.7
Food-related incident	12	5.8
Awaking the sleeping dog	9	4.3
Working with animals	9	4.3
Territorialism (taking toy away etc.)	3	1.4

*All reported numbers are out of a total n = 207.

chocolate Labradors, as well as mixed breeds) (n = 18 [5.6%]), German Shepherds (including mixed breeds) (n = 13 [4%]) and other terrier breeds (including Welsh, Boston, and Jack Russell, as well as mixed breeds) (n = 13 [4%]) (Table III). Dog breed did not correlate with location of injury on the face (P = .999), need for revision surgery (P = .100), or provocation (P = .130). Of those provoked bites in which breed was recorded, the following were identified: Pitbull (7); German Shepherd (4); Husky (2); Boxer (2); Bulldog (2); Akita (1); Beagle (1); Dalmatian (1); Ridgeback (1); Rottweiler (1); Labrador (1); and unspecified mixed breed (1).

The location on the face was predominantly the middle or lower third (n = 299 [93.1%]) (Table IV). Among the 98 patients age 18 years or greater, 87 (88.8%) injuries were located on the middle or lower third. Among the 223 patients age 18 years or greater, 212 injuries (95.1%) were located on the middle or lower third (Figure 1). There was no association between age group of the patient and the location of the injury (P = .75) (Table V). The type of injury (often mixed) included 284 lacerations (88.5%), 72 punctures (22.4%), 48 avulsions (15%), and 20 (6.2%) involving contiguous structures, including the mental nerve, ear, gingiva, nasal cartilage, and the Stenson duct (see Table IV). Among all age groups, 28 patients (8.7%) required revision surgery, and 5 patients (1.6%) reported long-term psychological effects, including post-traumatic stress disorder and anxiety. Figure 2 demonstrates a lower third facial laceration in a child from a dog bite immediately post-op, intraoperative, and at one-week follow.

DISCUSSION

The purpose of this study was to identify the risk factors associated with patients presenting to a tertiary care hospital for treatment of facial dog bite injuries. The specific aim was to focus on provocation and modifiable patient behavior in an effort to improve education and outreach.

Table I. Descriptive summary of study sample

A – Patient Characteristics		
	n*	%
Gender		
Female	180	56.1
Male	141	43.9
Age (years)		
≤ 18	98	30.5
> 18	223	69.5
Vaccination history		
Up to date	129	40.2
Not up to date	10	3.1
Uncertain	18	5.6
Not reported	164	51.1
B – Dog Characteristics		
	n*	%
Provocation		
Yes	207	64.5
No	39	12.1
Not reported	75	23.4
Relationship		
Known	281	87.5
Unknown	33	10.3
Not reported	7	2.2
Vaccination history		
Up to date	246	76.6
Not up to date	8	2.5
Uncertain	27	8.4
Not reported	40	12.5

*All reported numbers are out of a total n = 321.

Table III. Top 5 dog breeds

	n	%
Pitbull + mix	24	7.5
Labrador (black, chocolate) + mix	18	5.6
German Shepherd + mix	13	4.0
Terrier (Welsh, Boston, Jack Russell) + mix	13	4.0
Boxer + mix	8	2.5

Most of offending dogs in our cohort were known (n = 281 [87.5%]) and were provoked (n = 207 [64.5%]). More attacks were provoked by patients younger than 18 years of age (68.4%). Common provocations in both dog populations included getting too close to the dog’s face, playing with the dog, petting the dog, waking the dog from sleep, and startling the dog. Pitbulls led as the offending breed in injuries caused to both children and adults. Injuries were found predominantly in the middle or lower third, accounting for 93.1% of all injury locations. These results identified provocation as a modifiable risk factor and highlight the preventable nature of certain facial dog bite injuries.

Children under age 18 years are the population most vulnerable to dog bite injuries, with a male predominance.^{15,22} Our study, however, found more injuries in patients older than 18 years of age and a female predominance in all age groups. The high density of tertiary care hospitals (both pediatric and nonpediatric) in

Table IV. Characteristics of injury

	n	%
Facial site of bite		
Lower third	86	26.8
Middle third	135	42.1
Middle, lower thirds	78	24.3
Upper third	3	0.9
Upper, lower thirds	2	0.6
Upper, middle thirds	10	3.1
Upper, middle, lower thirds	3	0.9
Not reported	4	1.2
Type of wound	n	%
Laceration	284	88.5
Puncture	72	22.4
Avulsion	48	15.0
Facial fracture	8	2.5
Involvement of other structures	20	6.2
Surgical treatment	n	%
Yes	207	64.5
No	98	30.5
Not reported	16	5.0
Longer-term effects	n	%
Psychological	5	1.6
Need for revision surgery	28	8.7

*Site of bite, surgical treatment, and long-term effect numbers are reported out of a total n = 321; type of wound was often mixed, resulting in a total greater than 321.

the area where our study was conducted may have influenced the number and demographic characteristics of patients reviewed.

The provocation factor has been addressed by other authors. Abraham et al. reviewed 100 facial dog bites and reported the following provocations: playing with or petting the dog (39%); food-related (14%); protective encounters involving territory or a family member (10%); and disturbing a sleeping dog (5%).²³ In a retrospective study, Schalamon et al. also noted that children interfered with the dog, such as bothering an eating dog or pulling its tail, in the majority of dog bites occurring in this population.²⁴ Milot et al. reported 5 common behaviors of children that incited biting behavior in the dog: (1) threatening the dog (suddenly putting the chest forward; raising the hand or projecting it toward the dog); (2) hitting the dog; (3) pulling on the dog’s tail or fur; (4) pulling the dog by its collar; and (5) patting the dog.²⁵ These behaviors can all be interpreted as aggressive or provocative from the dog’s perspective.

In the United States, rabies vaccination mandates are state dependent. According to the American Animal Hospital Association canine vaccination guidelines, some areas require yearly vaccinations, whereas other areas call for vaccinations every 3 years, depending on the product label of the rabies vaccine.²⁶ Generally, most states require that all dogs be vaccinated against rabies, and usually, the first shot is given at age 16 weeks.²⁷ Massachusetts specifically requires that every dog between ages 12 weeks and 6 months receive the rabies vaccination, with a booster vaccination given within 365 days after the initial vaccine.²⁸ The majority of our cohort (76.6%) met these regulations. Those that did not were mostly stray dogs or unknown to the victim.

Current prevention measures in cities across the United States utilize breed-specific legislation. This legislation stipulates the removal of predicted “dangerous breeds” from the population. In our study, the Pitbull breed was the most common offending breed identified, which is consistent with other studies that have recorded data on specific breeds.²⁰ This was also a common missing data point in our retrospective study. It should be noted that emerging data regarding the legislated removal of predicted “dangerous breeds” from the population are ineffective and costly.^{16,29,30} In 2008, The Netherlands repealed its 15-year ban on Pitbulls after a government-commissioned study concluded that it did nothing to reduce the incidence of dog bites.³¹ The study strongly suggested that the focus should be placed on better understanding of provocation and the circumstances surrounding dog bites and highlights the need for more effective educational efforts.³¹

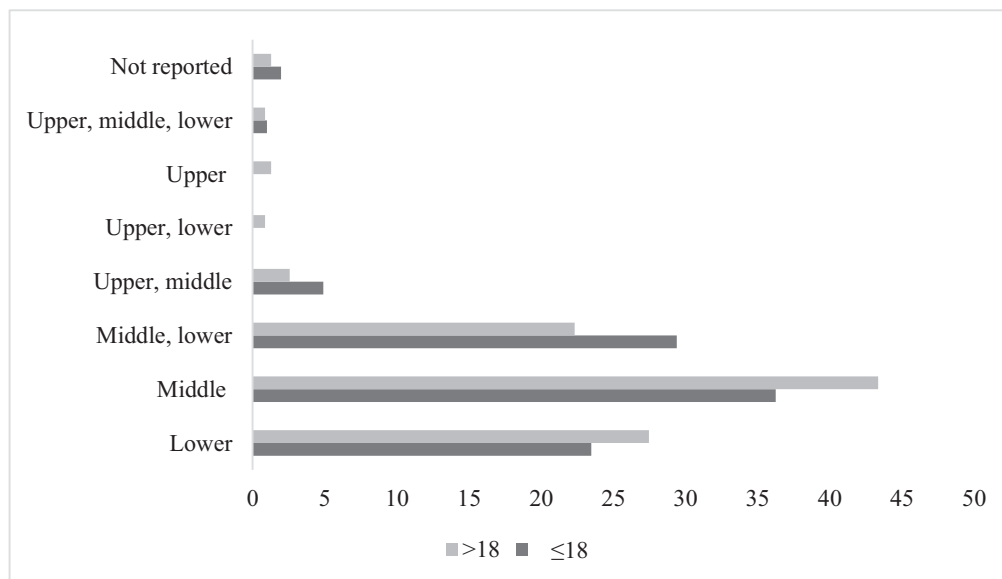


Fig. 1. Location of injury analysis based on age.

Both the location of the injury and the type of injury found in our cohort are consistent with those reported by other studies. Touré et al., Gurunluoglu et al., and Mannion et al. all reported that the majority of injuries involved the lower and middle thirds of the face.^{18,32,33} Lacerations were more common than puncture wounds and avulsive injuries in a systematic review by Jerrard.³⁴

Although not many studies have evaluated the long-term psychological effects of dog bite injuries, a French study found that 35.1% of patients (n = 77) had psychological problems afterward,³⁵ and a larger study conducted in China found that 1.1% experienced acute stress disorder 1 week after the attack and 0.53% experienced post-traumatic stress disorder 3 months after the attack (n = 358).³⁶ In our study, 1.6% reported long-term psychological effects, similar to those found in the Chinese study, although this information was seldom found in the medical records of our cohort.

Table V. Location of injury analysis based on age

Location on face	n* (age ≤ 18 years)	n* (age > 18 years)
Lower third	27	59
Middle third	33	102
Middle, lower thirds	27	51
Upper, middle thirds	2	8
Upper, lower thirds	2	0
Upper third	2	1
Upper, middle, lower thirds	2	1
Not reported	3	1

*All reported numbers are out of a total n = 321.

Many professional associations, including the American Academy of Pediatrics³⁷ and the American Veterinary Medical Association,³⁸ have accessible information online about the prevention of dog bites. The Centers for Disease Control and Prevention recommendations include always asking for permission to pet someone else’s dog, remaining motionless if approached by an unfamiliar dog, not disturbing a dog that is sleeping or eating, not petting a dog without allowing it to see and sniff you first, and not encouraging the dog to play aggressively.³⁹ The American Society for the Prevention of Cruelty to Animals also recommends avoiding contact with off-leash dogs, not petting dogs that are behind a fence or in a car, and avoiding eye contact with unsecured dogs.⁴⁰ However, because of the rising incidence of dog bites, it can be assumed that the resources mentioned above are being underutilized. A survey of 700 7- to 12-year-old children found that only 61% were able to recognize an aggressive dog.¹⁴ Direct educational intervention appears to be most effective. Duperrex et al. observed less “inappropriate behavior” or “provocation” from children and adolescents participating in a 30-minute educational intervention session.⁴¹ From a policy standpoint, Villalbi et al. demonstrated that government regulations, such as stricter licensing requirements and dog bite reporting, were associated with a 38% decrease in hospitalizations caused by dog bite injuries.⁴²

A successful educational effort for as little as 30 minutes among children and parents has been shown to dramatically reduce high-risk behavior toward dogs.^{43,44} Education could be provided to first-time dog owners in a consistent fashion similar to education



Fig. 2. Patient X. *Left:* Immediately preoperative. *Middle:* Intraoperative. *Right:* At 1-week follow-up.

given to first-time parents. When a new baby is seen by a pediatrician, parents are counselled about injury risks, such as medicine cabinets, sharp furniture, and electrical outlets, as well as car safety. Special education for gun safety has become routine. So, too, should be educational initiatives for parents bringing an infant into a home with a dog. Additionally, once a dog bite has occurred, the child and the parents should be taught bite-avoidance strategies that can be applied going forward. Dog behavior workshops can be conducted and staffed by volunteer humane organizations. School programs can be designed. Animal shelters and pet supply stores can provide orientation courses for first-time dog owners. Thus, there are many opportunities and venues for such programs to be implemented.

The strength of this review lies in the large number of patients evaluated and the specific focus on provoking behaviors that can be modified. The study identifies information that should be a mandatory part of the medical record, including the dog's breed, age, and history of aggressive behavior, as well as long-term psychological effects in the victim. We believe that including these factors in the medical record would help better understand and analyze the nature of dog bites in relation to the dog involved and the lasting effects a bite may have on the victim. Opportunities for educational initiatives have not been discussed in previous reviews of facial dog bites. Proposals for broad collaboration are also stressed in this study.

This retrospective review, however, has some limitations. Circumstances regarding the incidents were self-reported by the victims or their family members. Provoking behaviors can be difficult to categorize. Lack of documentation of the dog breed can impede drawing any association between a specific breed and the risk of bite injury. Review of cases in a single tertiary care site may have introduced bias in terms of patient demographic characteristics. The less-than-expected number of pediatric patients in this study has already been

discussed. Incomplete medical records resulted in missing data points, also mentioned earlier. These limitations emphasize the need for comprehensive and mandatory reporting of these injuries, and it is hoped that a national database can be developed to promote better understanding as well as more effective prevention initiatives.

CONCLUSIONS

This study highlights the role of provocation in dog bite injuries and suggests that vulnerable populations may benefit from efforts aimed at improved education, outreach programs, and policy changes. Future initiatives should focus on mandatory documentation and reporting to ensure collection of complete information. More effective methods of promulgating educational information is required. Partnering with veterinarians, pediatricians, rescue and adoption agencies, and pet supply companies will help achieve this goal.

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PRESENTATIONS

Data from this study were presented in oral abstract form at the American Dental Association (ADA) World Dental Federation (FDI) 2019 Conference in San Francisco, CA, USA.

REFERENCES

- Centers for Disease Control and Prevention. Leading causes of nonfatal injury; Web-based Injury Statistics Query and Reporting System (WISQARS). Available at: https://www.cdc.gov/injury/wisqars/pdf/leading_causes_of_nonfatal_injury_2017-508.pdf. Accessed August 9, 2019.
- Wisch RF. *Brief Summary of Dog Bite Laws*. East Lansing, MI: Michigan State University College of Law; 2004.
- Walden C. *State Dangerous Dog Laws*. East Lansing, MI: Michigan State University College of Law; 2015.
- American Veterinary Medical Association Task Force on Canine Aggression and Human-Canine Interactions. A community approach to dog bite prevention. *J Am Vet Med Assoc*. 2001;218:1732-1749.
- American Veterinary Medical Association. U.S. Pet ownership & demographics sourcebook. Available at: <https://www.avma.org/News/JAVMANews/Pages/190115a.aspx>. Accessed August 9, 2019.
- Sacks JJ, Kresnow M, Houston B. Dog bites: how big a problem? *Inj Prev*. 1996;2:52-54.
- Centers for Disease Control and Prevention. Overall dog bite nonfatal injuries and rates; Web-based Injury Statistics Query and Reporting System (WISQARS). Available at: <https://webappa.cdc.gov/cgi-bin/broker.exe>. Accessed August 9, 2019.
- Insurance Information Institute. Estimated number and cost of dog bite claims nationwide, 2003–2018. Available at: <https://www.iii.org/table-archive/20669>. Accessed August 9, 2019.
- Insurance Information Institute. Dog bites accounted for more than 1/3 of all homeowners' liability payouts last year as cost per claim soars. Available at: <https://www.iii.org/press-release/dog-bites-accounted-for-more-than-one-third-of-all-homeowners-liability-pay-outs-last-year-as-cost-per-claim-soars-051315>. Accessed August 9, 2019.
- Palmer J, Rees M. Dog bites of the face: a 15 year review. *Br J Plast Surg*. 1983;36:315-318.
- Calkins CM, Bensard DD, Partrick DA, Karrer FM. Life-threatening dog attacks: a devastating combination of penetrating and blunt injuries. *J Pediatr Surg*. 2001;36:1115-1117.
- Massachusetts General Laws. Chapter 112, Section 12 Z. Available at: <https://malegislature.gov/Laws/GeneralLaws/PartI/TitleXVI/Chapter112/Section12z>. Accessed August 9, 2019.
- California Code of Regulations. Title 17, §2606. Available at: [https://govt.westlaw.com/calregs/Document/ID6AF-CE80D60511DE88AEDDE29ED1DC0A?viewType=FullText&originationContext=documenttoc&transitionType=Category-PageItem&contextData=\(sc.Default\)](https://govt.westlaw.com/calregs/Document/ID6AF-CE80D60511DE88AEDDE29ED1DC0A?viewType=FullText&originationContext=documenttoc&transitionType=Category-PageItem&contextData=(sc.Default)). Accessed August 9, 2019.
- Pai D, Kamath A, Panduranga KP, et al. Survey of knowledge of school children towards the prevalence, severity, management of maxillofacial injuries, and rescue skills in the event of a dog bite. *J Indian Soc Pedod Prev Dent*. 2018;36:334.
- Fein J, Bogumil D, Upperman JS, Burke RV. Pediatric dog bites: a population-based profile. *Inj Prev*. 2019;25:290-294.
- Ramgopal S, Brungo LB, Bykowski MR, Pitetti RD, Hickey RW. Dog bites in a U.S. county: age, body part and breed in paediatric dog bites. *Acta Paediatr*. 2018;107:893-899.
- Lin W, Patil PM. Facial dog attack injuries. *Indian J Surg*. 2015;77:55-58.
- Touré G, Angoulangouli G, Méningaud J-P. Epidemiology and classification of dog bite injuries to the face: a prospective study of 108 patients. *J Plast Reconstr Aesthet Surg*. 2015;68:654-658.
- Boat BW, Dixon CA, Pearl E, Thieken L, Bucher SE. Pediatric dog bite victims: a need for a continuum of care. *Clin Pediatr (Phila)*. 2012;51:473-477.
- Essig GF, Sheehan C, Rikhi S, Elmaraghy CA, Christopher JJ. Dog bite injuries to the face: is there risk with breed ownership? A systematic review with meta-analysis. *Int J Pediatr Otorhinolaryngol*. 2019;117:182-188.
- Barnes JE, Boat BW, Putnam FW, Dates HF, Mahlman AR. Ownership of high-risk ("vicious") dogs as a marker for deviant behaviors: implications for risk assessment. *J Interpers Violence*. 2006;21:1616-1634.
- Bykowski MR, Shakir S, Naran S, et al. Pediatric dog bite prevention: are we barking up the wrong tree or just not barking loud enough? *Pediatr Emerg Care*. 2019;35:618-623.
- Abraham JT, Czerwinski M. Pediatric dog bite injuries in central Texas. *J Pediatr Surg*. 2019;54:1416-1420.
- Schalamon J. Analysis of dog bites in children who are younger than 17 years. *Pediatrics*. 2006;117:e374-e379.
- Milot JL, Filiatre JC, Gagnon AC, et al. Children and their pet dogs: how they communicate. *Behav Process*. 1988;17:1-15.
- American Animal Hospital Association. 2017AAHA Canine Vaccination Guidelines. Available at: <https://www.aaha.org/aaha-guidelines/vaccination-canine-configuration/frequently-asked-questions/what-are-the-recommendations-for-rabies-vaccinations/>. Accessed August 9, 2019.
- PetSmart. Puppy vaccinations: when to get them and why. Available at: <https://www.petsmart.com/learning-center/dog-care/puppy-vaccinations-when-to-get-them-and-why/A0067.html>. Accessed August 9, 2019.
- Massachusetts Animal Coalition. MDAR announces major changes to the Massachusetts Rabies Regulations. Available at: <https://massanimalcoalition.org/resources/massachusetts-rabies-regulations/>. Accessed August 9, 2019.
- Wolff KD. Management of animal bite injuries of the face: experience with 94 patients. *J Oral Maxillofac Surg*. 1998;56:838-843.
- Gilchrist J, Sacks JJ, White D, Kresnow M-J. Dog bites: still a problem? *Inj Prev*. 2008;14(5):296-301.
- Cornelissen JRM, Hopster H. Dog bites in The Netherlands: a study of victims, injuries, circumstances and aggressors to support evaluation of breed specific legislation. *Vet J*. 2009;186:292-298.
- Gurunluoglu R, Glasgow M, Arton J, Bronsert M. Retrospective analysis of facial dog bite injuries at a level I trauma center in the Denver metro area. *J Trauma Acute Care Surg*. 2014;76:1294-1300.
- Mannion CJ, Graham A, Shepherd K, Greenberg D. Dog bites and maxillofacial surgery: what can we do? *Br J Oral Maxillofac Surg*. 2015;53:522-525.
- Jerrard D. Bites (mammalian). *BMJ Clin Evid*. 2006;2006:0914.
- Hersant B, Cassier S, Constantinescu G, et al. Facial dog bite injuries in children: retrospective study of 77 cases. *Ann Chir Plast Esthet*. 2012;57:230-239.
- Ji L, Xiaowei Z, Chuanlin W, Wei L. Investigation of posttraumatic stress disorder in children after animal-induced injury in China. *Pediatrics*. 2010;126:e320-e324.
- American Academy of Pediatrics. Dog bites prevention tips from the American Academy of Pediatrics. Available at: <https://www.aap.org/en-us/about-the-aap/aap-press-room/news-features-and-safety-tips/Pages/Dog-Bite-Prevention-Tips-2017.aspx>. Accessed August 9, 2019.
- American Veterinary Medical Association. Dog bite prevention. Available at: <https://www.avma.org/public/Pages/Dog-Bite-Prevention.aspx>. Accessed August 9, 2019.
- Centers for Disease Control and Prevention. Preventing dog bites. Available at: <https://www.cdc.gov/features/dog-bite-prevention/index.html>. Accessed August 9, 2019.

40. American Society for the Prevention of Cruelty to Animals. Vaccinations for your pet. Available at: <https://www.aspcare.org/pet-care/general-pet-care/vaccinations-your-pet>. Accessed August 9, 2019.
41. Duperrex O, Blackhall K, Burri M, et al. Education of children and adolescents for the prevention of dog bite injuries. *Cochrane Database Syst Rev*. 2009;2:CD004726.
42. Villalbi JR, Cleries M, Bouis S, Peracho V, Duran J, Casas C. Decline in hospitalizations due to dog bite injuries in Catalonia, 1997–2008. An effect of government regulation. *Inj Prev*. 2010;16:408-410.
43. Chapman S. Preventing dog bites in children: randomized controlled trial of an educational intervention. *BMJ*. 2000;320:1512-1513.
44. Wilson F, Dwyer F, Bennett PC. Prevention of dog bites: evaluation of a brief educational intervention program for preschool children. *J Community Psychol*. 2003;31:75-86.

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