

# Treatment of Facial Dog Bite Injuries in the Emergency Department Compared to the Operating Room

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DOI: 10.1177/2473974X19858328

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## Abstract

**Objective.** To assess factors associated with repair of facial dog bites in the emergency department (ED) versus the operating room (OR) and to compare rates of surgical site infection and reoperation for each venue.

**Study Design.** Case series with chart review.

**Setting.** Single institution.

**Subjects and Methods.** All patients younger than 18 years of age who underwent surgical repair by a consulting surgical service within 24 hours of presentation for facial dog bites between 2010 and 2013 were included. Demographics, site of injury, associated evidence of complex injury, surgical site infections within 30 days, and reoperation within 2 years were compared between patients undergoing surgical repair in the ED versus the OR.

**Results.** One hundred sixty-five patients were evaluated; 75 patients underwent repair in the ED, and 90 patients were treated in the OR. Patients treated in the ED underwent surgery more promptly than patients treated in the OR (median time from arrival to procedure start 3.3 vs 6.8 hours,  $P < .001$ ). Patients treated in the OR were more likely to have longer lacerations (3.0 cm vs 7.8 cm,  $P < .001$ ), lacerations of the eyelid (17% vs 42%,  $P = .001$ ), involvement of multiple regions of the face (11% vs 22%,  $P = .039$ ), and multiple indicators of severe injury (3% vs 12%,  $P = .024$ ). There were no differences in surgical site infections (1% vs 1%,  $P = .721$ ) or reoperation rates (5% vs 13%,  $P = .071$ ).

**Conclusions.** Surgical management of pediatric facial dog bites may be successfully performed in both the ED and OR settings. Severity of the injury should dictate the choice for management.

## Keywords

pediatric otolaryngology, facial dog bite, trauma, emergency department

Received February 7, 2019; accepted May 30, 2019.

Facial dog bite injuries continue to be a significant public health concern with the potential to create significant long-term morbidity, disfigurement, and even death. An estimated 4.5 million Americans are bitten by dogs annually, and half of these cases involve pediatric patients.<sup>1,2</sup> Twenty percent of dog bites result in injuries that require some form of medical attention, surgical repair, or both, and children between 5 and 9 years of age appear to suffer this type of trauma most frequently.<sup>1</sup> In addition, most dog bites that involve the head and neck region are in children, and it has been reported that these injuries may account for up to 4% of emergency department (ED) visits and 40% of all pediatric trauma cases.<sup>3,4</sup> There is a broad range in severity of these injuries from minor abrasions to more complex injuries with tissue loss and facial bone

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fractures; unfortunately, all are counted as a single bite, which makes studying dog bites challenging. Other injuries unique to the head and neck (and potentially independent of soft-tissue damage) that are known to change the complexity of repair include damage to the facial nerve, salivary duct, lacrimal duct, and extraocular muscles.<sup>5</sup>

Despite an increase in public awareness about dog bites, there was an 86% increase in hospitalizations from 1993 to 2008 and an 82% increase in fatal injuries from the 1980s to 2012.<sup>6</sup> Children are disproportionately affected by bites to the head and neck,<sup>3</sup> and this may be partially explained by physical characteristics including shorter stature (which places the child on the same level as the dog), larger head circumference, and underdeveloped motor skills used to evade injury.<sup>7,8</sup> Other factors that may account for an increased rate of injury in children may relate to an inability to recognize a distressed animal and the child's being overly comfortable with a familiar dog.

Repair of facial injuries may be performed in the ED or the operating room (OR). Regardless of repair venue, prompt surgical repair of facial dog bite lacerations in children results in improved cosmesis with no increased risk of wound infection as compared with delayed repair.<sup>5,9</sup> While existing studies identify some characteristics of patients who have received surgical repair in the OR instead of the ED, outcomes based on repair venue (ED versus OR) for pediatric head and neck bite injuries have not been evaluated.<sup>3,7,10</sup> Therefore, the objective of this study was to assess further the factors associated with venue selection and to compare the rates of surgical site infection and reoperation following repair of facial dog bite injuries in the ED versus the OR.

## Methods

The institutional review board at Nationwide Children's Hospital (Columbus, Ohio) approved this study. Following approval, a case series was conducted at Nationwide Children's Hospital. Inclusion criteria were the following: patients less than 18 years of age who underwent surgical repair of a dog bite injury to the head and neck and presented within 24 hours of injury from January 2010 to December 2013. Patients were excluded if injury occurred more than 24 hours prior to presentation. Patients were identified using CPT codes, and a consecutive sample was obtained. The decision for repair in the ED or was made by the consulting service covering for facial trauma and reconstruction. Depending on the specific injury, repairs were performed by the following services: otolaryngology, plastic surgery, oromaxillofacial surgery, or ophthalmology. Demographics, site of injury, and evidence of the complexity of injury were compared. The primary outcome measures were surgical site infection within 30 days and reoperation within 2 years.

Chi-square and Fisher exact tests were used to compare categorical variables, and Wilcoxon rank-sum tests were used to compare continuous variables between the 2 groups. Demographic data were reviewed. All analyses were

**Table 1.** Patient Characteristics.

|                              | ED<br>(n = 75) | OR<br>(n = 90) | P Value |
|------------------------------|----------------|----------------|---------|
| Age <sup>a</sup>             | 4.4 (2.3-7.1)  | 4.5 (2.7-7.5)  | .475    |
| Noncaucasian <sup>b</sup>    | 10 (14)        | 10 (12)        | .439    |
| Female <sup>b</sup>          | 35 (47)        | 40 (44)        | .449    |
| Medical history <sup>b</sup> |                |                |         |
| ADHD                         | 5 (7)          | 3 (3)          | .265    |
| Asthma                       | 2 (3)          | 2 (2)          | .627    |
| Tympanostomy tube placement  | 2 (3)          | 4 (4)          | .425    |
| Tonsillectomy                | 2 (3)          | 4 (4)          | .425    |

Abbreviations: ADHD, attention-deficit hyperactivity disorder; ED, emergency department; OR, operating room.

<sup>a</sup>Value reported as median (interquartile range).

<sup>b</sup>Value reported as count (percentage).

performed using SAS 9.3 (Carey, North Carolina), and  $P < .05$  was considered statistically significant.

## Results

One hundred sixty-five patients were treated for facial dog bite injuries from January 2010 to December 2013 by the consulting facial trauma service; 75 patients underwent repair in the ED, and 90 patients were treated in the OR. Patient age ranged from 3 months to 15 years. The median age of patients undergoing repair in the ED was 4.4 years, and the median age of patients undergoing repair in the OR was 4.5 years. There were no identifiable differences in gender, race, ethnicity, or prior medical conditions between the 2 groups (**Table 1**). Patients treated in the ED underwent surgery more promptly than patients treated in the OR (median time from arrival to incision 3.3 vs 6.8 hours,  $P < .001$ ). Patients treated in the OR were more likely to have longer lacerations (mean 3.0 cm vs 7.8 cm,  $P < .001$ ), lacerations of the eyelid (17% vs 42%,  $P = .001$ ), involvement of multiple regions of the face (11% vs 22%,  $P = .039$ ), and multiple indicators of severe injury (3% vs 12%,  $P = .024$ ). There were no differences in surgical site infections (1% vs 1%,  $P = .721$ ) or reoperation rates (5% vs 13%,  $P = .071$ ).

## Discussion

Based on our outcome analysis, surgical management of these facial dog bite injuries may be performed in the ED or OR. The most significant independent indicator of severity to decide the need for OR repair was injury to the orbital structures, specifically the eyelid (13 patients ED, 38 patients OR) and canalicular injury (4 patients ED, 20 patients OR). In addition, involvement of multiple facial subsites or the presence of 2 or more indicators of severity increased the likelihood of OR repair (**Table 2**). Although there may have been a preponderance of more severe injuries taken for repair in the OR, the overall surgical site

**Table 2.** Preoperative Characteristics.

|   | ED (n = 75) | OR (n = 90) | P Value |
|---|-------------|-------------|---------|
| Presented 6:00 PM to 6:00 AM <sup>a</sup> | 43 (57)     | 50 (56)     | .819    |
| Length, cm <sup>b</sup>                   | 3 (2-5)     | 6 (4-10)    | <.001   |
| Regions involved <sup>a</sup>             |             |             |         |
| Mouth                                     | 28 (37)     | 28 (31)     | .250    |
| Ear                                       | 17 (23)     | 11 (12)     | .058    |
| Nose                                      | 14 (19)     | 22 (24)     | .240    |
| Eyelid                                    | 13 (17)     | 38 (42)     | .001    |
| ≥2 regions                                | 8 (11)      | 20 (22)     | .039    |
| Indicators of severity <sup>a</sup>       |             |             |         |
| Oral commissure involvement               | 2 (3)       | 4 (4)       | .690    |
| Canalicular laceration                    | 4 (5)       | 20 (22)     | .002    |
| Nerve injury                              | 0 (0)       | 3 (3)       | .111    |
| Parotid duct involvement                  | 0 (0)       | 1 (1)       | 1.000   |
| Cartilage exposure                        | 12 (16)     | 14 (16)     | .938    |
| Tissue avulsion                           | 12 (16)     | 14 (16)     | .938    |
| Associated facial fracture                | 1 (1)       | 5 (6)       | .222    |
| ≥2 indicators of severity                 | 2 (3)       | 11 (12)     | .024    |

Abbreviations: ED, emergency department; OR, operating room.

<sup>a</sup>Value reported as count (percentage).

<sup>b</sup>Value reported as median (interquartile range).

**Table 3.** Outcomes.

|  | ED (n = 75) | OR (n = 90) | P Value |
|--|-------------|-------------|---------|
| Hours from injury to surgery <sup>a</sup>  | 6 (4-8)     | 8 (6-11)    | <.001   |
| Hours from arrival to surgery <sup>a</sup> | 3 (2-4)     | 5 (3-8)     | <.001   |
| Length of stay (hours) <sup>a</sup>        | 5 (4-7)     | 19 (13-24)  | <.001   |
| SSI within 30 days <sup>b</sup>            | 1 (1)       | 1 (1)       | .721    |
| Reoperation within 2 years <sup>b</sup>    | 4 (5)       | 12 (13)     | .071    |

Abbreviations: ED: emergency department; OR, operating room; SSI, surgical site infection.

<sup>a</sup>Value reported as median (interquartile range).

<sup>b</sup>Value reported as count (percentage).

infection rates were low and not significantly different between venues (1 patient ED, 1 patient OR). Time to repair and length of stay, however, was significantly longer in patients undergoing repair in the OR (**Table 3**). The number of patients who needed reoperation within 2 years of repair was higher in the OR cohort; however, these patients were found to have more severe injuries, and the reoperation rate was not found to be statistically significant. These results suggest that patients undergoing repair for dog bite injuries to the face gain no added benefit of decreased surgical site infection rates if repaired in the OR, but instead it must be noted there was an increase in the time to repair as well as the overall length of hospitalization.

While there are distinct advantages to repairing injuries in the OR, these data support repair with local anesthetic or conscientious sedation whenever possible. Over the past several years, concern has been raised regarding the neurotoxicity associated with general anesthesia and sedative

drugs in infants and toddlers.<sup>11</sup> Results from both animal models and retrospective human studies have demonstrated a potential negative impact of general anesthesia on neurodevelopment.<sup>12</sup> Patients younger than 4 years may be at particular risk as peak synaptogenesis is thought to occur from the third trimester through 3 to 4 years.<sup>13</sup> McCann et al<sup>14</sup> recently showed that less than 1 hour of anesthesia in early infancy did not alter neurodevelopmental outcomes at age 5 years compared with awake regional anesthesia.<sup>14</sup> The overall paucity of research about the impact of the number of exposures and types of anesthetics used makes it difficult to issue specific recommendations on the subject of neurotoxicity associated with anesthesia at this time. As a pediatric consulting service for facial trauma and reconstruction, we evaluate and treat patients with a wide range of injuries, some of which are complex and require treatment by multiple surgical services. Although these do not represent elective surgeries, we recommend treatment in the ED when

feasible and the use of a multidisciplinary approach for more severe injuries such that the need for multiple anesthetics is minimized.

The pediatric population is particularly at risk for both short- and long-term morbidity from dog bite injuries, and the need for rapid institution of medical treatment and surgical repair in this patient population has been established. Wu and colleagues<sup>15</sup> published a review of 87 pediatric patients who suffered facial dog bites and their subsequent management. Fifty-one percent underwent early irrigations, debridement, and repairs in the OR. They concluded that all patients should receive antibiotic prophylaxis. They also concluded that younger patients (mean age 5.7 versus 8.0 years, respectively;  $P < .01$ ) and those with more severe/complex injuries to the soft tissues were more likely to undergo wound exploration and repair in the OR.<sup>15</sup> Debridement and repair of injuries with the aid of general anesthesia, as reported by Lackmann and colleagues,<sup>16</sup> provided a controlled environment in which good-to-excellent results were noted postoperatively as well as during the follow-up of up to 5 years.

Hersant and colleagues<sup>17</sup> reported a retrospective study of 77 cases in which treatment was performed by maxillofacial surgery and plastic surgery colleagues at their institution. They reported an average healing time of almost 11 months, and a third of their patient cohort required multiple surgical interventions. A third of these patients also suffered psychological sequelae from their injuries and from subsequent medical/surgical management. Multidisciplinary approaches to repair these potentially complex injuries involving the head, neck, face, orbits, or other areas can provide an optimal functional and cosmetic repair and may diminish significant long-term physical and psychological sequelae.<sup>17,18</sup> Gurunluoglu et al<sup>10</sup> published a review of 75 patients, including both pediatric and adult bite victims who were treated at a single level 1 trauma center. In their cohort, the mean duration from presentation to repair was 13.7 hours, and most wounds were repaired in the OR. In conjunction with the other studies mentioned, they concluded that a multidisciplinary approach with availability of a plastic and reconstructive surgery service provided for an optimal treatment and was associated with decreased postoperative wound infection rates as well as higher scores on Likert patient satisfaction scales after their repairs within their cohort.<sup>10</sup>

Not only do dog bites pose a serious health risk but their economic burden cannot be ignored. Since 2006, there has been nearly a 24% increase in the number of homeowner insurance liability claims made to dog bite victims.<sup>19</sup> In 2016 alone, dog bites and dog-related injuries accounted for more than one-third of all homeowner insurance liability claims, totaling more than \$600 million.<sup>20</sup> Bini et al<sup>21</sup> reported dog bites as the second most costly public health problem in the United States. In an era of significant health care expenditure and subsequent cost containment, the choice of venue is not equivocal in terms of cost. Hoff et al<sup>22</sup> reported the median cost of dog bite injury repair in

the ED to be \$300 and the median cost of hospitalization from a dog bite injury to be \$4700 between 1998 and 2002. With 1 of every 6 dog bite injuries requiring medical care and 1 of 14 requiring emergency care,<sup>20</sup> it is important to determine which patients can be treated at the bedside and which patients require repair in the OR.

There are currently no standard guidelines to determine which patients benefit from repair of dog bite injuries in the OR versus the ED. Although Lackmann et al. set the groundwork for staging and classification of dog bite injuries in the pediatric population, its utility in surgical decision making and venue selection is lacking in the literature.<sup>15,16</sup> A future area of study could include creating a severity index that incorporates venue in the decision analysis. A few limitations of this study should be acknowledged. The reported results were obtained from a single institution. An increased sample size from multiple institutions would increase the strength of the results and improve their generalizability. In addition, if a patient received a revision surgery elsewhere, it is possible that this may not have been recorded in the patient's follow-up data. The purpose of this study was to explore factors associated with the choice of repair venue and to compare the rates of surgical site infection and need for reoperation.

## Conclusions

Surgical management of pediatric facial dog bites may be successfully performed in both the ED and OR settings. Severity of injury and individual patient needs should guide management when selecting venue.

## Author Contributions

**Garth F. Essig Jr**, design and analysis, drafting and revising, final approval, accountability for the work; **Cameron C. Sheehan**, design and analysis, drafting and revising, final approval, accountability for the work; **Weston L. Niermeyer**, analysis of data, drafting, critical revisions, final approval, accountability for the work; **Joseph J. Lopez**, analysis of data, drafting, final approval, accountability for the work; **Charles A. Elmaraghy**, design, revising critically, final approval, accountability for the work.

## Disclosures

**Competing interests:** None.

**Sponsorships:** None.

**Funding source:** Intramural: Center for Surgical Outcomes Research and the Department of Pediatric Otolaryngology at Nationwide Children's Hospital.

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