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Incidence and management of facial animal bites in pediatric population: A 5-year review

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ABSTRACT

Introduction: Animal bite injuries in children, particularly those to the head region, are a significant concern in pediatric emergency departments. Facial bites can vary from minor lacerations to life-threatening injuries, often resulting in long-term physical and psychological effects.

Aim: The study aims to assess the characteristics of facial bites in the pediatric population, available management strategies, and the physical and psychological impact on bite victims.

Material and methods: The study is a retrospective analysis of 25 cases of facial bite injuries treated from January 1, 2019, to March 31, 2024, at the Regional Specialized Children's Hospital in Olsztyn, Poland. Statistical analyses were performed using GraphPad Prism, Statistica and MedCalc.

Results and discussion: The cohort included 9 females and 16 males, with an age range from 3 months to 12 years. Significant differences between gender and age at the time of injury were noted ($P = 0.043$). Of the 25 patients, 64% of incidents occurred at home, with dogs responsible for 96% of the injuries. Most injuries were superficial; however, severe injuries included large defects of soft tissues, fractures, eye globe trauma or brain edema were noted. Comprehensive treatment is based on debridement, prompt surgical intervention and infection prophylaxis. Nearly all patients (96%) received antibiotic prophylaxis, while 76% received rabies vaccination.

Conclusions: Animal bites to the face require multidisciplinary care due to potential for severe physical and psychological impacts. This study underscores the potential psychological impact of such trauma and need for preventive education to reduce the incidence of animal bites in children.

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1. INTRODUCTION

Animal bites are a common problem presented in emergency departments (ED). In the United States, they account for approximetely 4.7 million ED visits annully, representing around 1% of all such visits.[1,2] Among them, facial bite injuries deserve special attention. The face is reported to be the most common localization of bite trauma in pediatric population.[3–6] Facial bites account for only 10% of all bites, but more than 70% of these occur in children under 10 years of age.[7–9] Older children and adults are more vulnerable to bite injuries to the upper and lower extremities, which account for at least 75% of all bites.[7] In this group, the most common bite site is the hand, particularly the right hand, which is considered to be the dominant extremity.[7,9–11] The most common aggressors are dogs, followed by cats and humans.[8,9,12] Bites from other animals account for less than 1%.[8] Dogs account for 70%–90% of all animal bites, with an incidence of 103-118 cases per 100,000 population.[1,9] This high incidence is likely related to their status as the most common domestic animals worldwide. The largest dog population was recorded in the United States. In the European Union, the largest domestic dog populations are in Germany (10.7 million), the UK (8.5 million), and Poland (7.85 million). In 2020, in Poland, almost half of the population (42%) owned at least one dog. This is the second-highest percentage of households with dogs in the EU, with Romania having the highest.[13] Approximately, 2% of dog bites victims require hospitalization.[9] The severity of injuries varies widely, ranging from superficial scratches and lacerations to life-threatening traumas.[4] The most frequent complication is infection, caused by microorganisms from the animal's saliva or from the skin of the bitten child.[9,14] These infections are polymicrobial, with both Gram-positive and Gram-negative species. A significant risk factor for infection is a wound length of more than 3 cm.[10] Wound contamination can result in a local infection, for example an abscess, cellulitis, or tenosynovitis, but may also spread as a systemic infection, including sepsis.[1,4,14] Animal bites carry a risk of rabies and tetanus infections. More severe consequences, including neurovascular injuries, fractures, globe rupture, and even death, have been reported.[2,15,16] Particularly brutal attacks lead to functional disorders, leave disfigurement and have a significant psychological impact on the child.[17,18] The management of these injuries requires multidisciplinary cooperation among specialists.

2. AIM

The article will discuss the incidence of facial bites, the nature and common presentation of the injury, available management, the physical and psychological impact on bite victims, and potential complications. To enhance understanding the problem of facial bite injuries in children, we retrospectively analyzed medical records over the past 5 years in our department of pediatric surgery.

3. MATERIAL AND METHODS

This retrospective review includes cases of patients spanning from January 1, 2019 to March 31, 2024 treated at Regional Specialized Children's Hospital in Olsztyn, Poland. The target population of the study included children 18 years of age or younger who were hospitalized due to facial bite trauma. To ensure the reliability of the inclusion criteria, the International Classification of Disease (ICD-10), was used. Patients were filtered using the codes S00.0–S09.9, for head injuries, yielding 3109 cases. We excluded all children with the ICD codes for superficial injury of scalp (S00.0), which reduced the cohort to 461 cases. Medical records of selected patients were analyzed to identify those with animal-bite injuries to the face. A total of 25 cases were included in the study. For all included patients, information about the gender, the location of the incident, the animal species, and the age at time of the injury, were collected. Information about symptoms, injuries other than facial bite wounds, diagnostics procedures and treatment were also recorded.

Quantitative data analyses were performed using GraphPad Prism (Version 8 for Windows, GraphPad Software, La Jolla, California, USA San Diego, CA, USA). Data are presented as means ± standard error of measurement (SEM). The normality and lognormality test (Shapiro–Wilk test) was performed before the statistical analysis. In cases where the data did not follow a normal distribution, the Mann–Whitney U test was used. In the case of normal distribution, the Student's t-test was performed. $P \leq 0.05$ value was considered as statistical significance. Moreover, all datasets were tested for presence of outliers by using the Grubbs' test ($\alpha = 0.05$). Categorical variable (gender) was analyzed using the chi-square (χ^2) and Fisher's exact tests. Effect sizes were reported as odds ratios (OR) with 95% confidence intervals (CIs). The calibration of the prediction model was performed. The categorical data was performed using Statistica v. 13 (StatSoft Inc., Tulsa, OK, USA) and MedCalc Software Ltd. Two-way chi-squared test. https://www.medcalc.org/calc/chisquared-2way.php Version 23.0.6; accessed October 24, 2024, Odds ratio calculator. https://www.medcalc.org/calc/odds_ratio.php (Version 23.0.6; accessed October 23, 2024).

4. RESULTS

Baseline data for the entire cohort are presented in Table 1. The cohort consisted of 25 patients, a total of 9 females and 16 males. The mean age of females age was 5.55 years and mean age of males was 3.48 years (range from 3 months to 12 years). There was a statistically significant correlation between gender and age at the time of injury ($P = 0.043$). Bites were caused by a dog in 24 cases and in 1 case by a rooster. The most common location of the incident was a house (64%), followed by the street (20%), a yard (8%) and in two cases the place was unknown (Table 1).

Injury characteristics are shown in Table 2. Isolated head

Table 1. Base data.

Variables	Women, *n*(%)	Men, *n*(%)	Woman vs Man χ^2 (*P*)
Gender	9	16	–
Mean Age	5.55	3.48	(0.0430)
Species			
Dog	9	15	–
Rooster	0	1	–
Place of the incident			
Unknown	1(11.11)	1(6.25)	0.1775(0.6735)
House	5(55.56)	11(68.75)	0.4178(0.5180)
Street	3(33.33)	2(12.5)	1.5000(0.2207)
Yard	0(0)	2(12.5)	1.1739(0.2786)

Table 2. Injury characteristics.

Injury	Total, *n*(%)	OR	95% CI	*P* value	Women, *n*(%)	Men, *n*(%)	Woman vs Man χ^2 (*P*)
Isolated head injury	19(76)	0.8822	0.3427–2.2711	0.7950	6(66.67)	13(81.25)	0.6447(0.422)
Multisite/multiorgan	6(24)	1.1489	0.4462–2.9584	0.7736	3(30.00)	3(13.33)	0.6447(0.422)
Injuries to the braincase (wounds, hematomas)	2(4)	0.3488	0.0076–0.4217	0.1585	1(11.11)	0(0.00)	1.7778(0.1824)
Ruptured globe	1(4)	–	–	–	0(0.00)	1(6.25)	–
Eyelids trauma	3(32)	–	–	–	2(22.22)	1(6.25)	–
Auricle trauma	3(32)	–	–	–	1(11.11)	2(12.5)	–
Contusion of the facial skeleton	1(4)	0.0565	0.0807–1.5079	0.0051	0(0.00)	1(6.25)	0.5625(0.4533)
Multiple skull fractures	1(4)	0.2611	0.0347–1.9662	0.1924	0(0.00)	1(6.25)	0.5625(0.4533)
Sinus fracture	1(4)	–	–	–	0(0.00)	1(6.25)	–
Orbital fracture	1(4)	–	–	–	0(0.00)	1(6.25)	–
Mandibular fracture	1(4)	1.0938	0.1392–8.5968	0.9321	0(0.00)	1(6.25)	0.5625(0.4533)
Broken tooth	1(4)	0.8667	0.1116–6.7330	0.8912	0(0.00)	1(6.25)	0.5625(0.4533)
Posttraumatic brain edema	2(8)	0.9662	0.2189–4.2641	0.9638	1(11.11)	0(0.00)	1.7778(0.1824)
Pericerebral hematoma	1(4)	0.2038	0.0271–1.5304	0.122	0(0.00)	1(6.25)	0.5625(0.4533)
Open head injury	1(4)	1.1694	0.1482–9.2274	0.8819	0(0.00)	1(6.25)	0.5625(0.4533)

Table 3. Clinical manifestation of animal bite to the face.

Clinical manifestation/symptom	Total, *n*(%)	OR	95%CI	*P*	Women, *n*(%)	Men, *n*(%)	Woman vs man χ^2 (*P*)
Loss of consciousness	1(4)	0.1516	0.0202–1.1353	0.0663	1(11.11)	0(0)	1.7778(0.1824)
Somnolence	2(8)	0.5556	0.1277–2.4184	0.4336	2(22.22)	0(0)	3.7101(0.0541)
Headaches	3(12)	0.1454	0.0429–0.4929	0.002	2(22.22)	1(6.25)	1.3359(0.2478)
Vomiting	1(4)	0.1205	0.0161–0.9013	0.0393	1(11.11)	0(0)	1.7778(0.1824)
Nose bleed	1(4)	0. 0.362	0.0478–2.7403	0.3252	0(0)	1(6.25)	0.5625(0.4533)
Symptoms of focal CNS damage	0(0)	–	–	–	0(0)	0(0)	–
Permanent neurological deficit	0(0)	–	–	–	0(0)	0(0)	–
Death	0(0)	–	–	–	0(0)	0(0)	–

injury were observed in 19 patients (76%). Most of the incidents resulted in puncture or superficial lacerations to the facial skin. Two patients had injuries to the braincase (wounds and hematomas). One patient had a broken tooth, another suffered ruptured globe with scleral laceration, while 3 patients experienced eyelids trauma and another three had auricle trauma. Multiple skull fractures occurred in only 1 case involving fractures of the orbit, sinus and mandible. Fractures of the mandible were specifically correlated with bite injuries, with an OR of 1.0938 (95% CI: 0.1392–8.5968);

Table 4. Radiological examinations.

Radiological examinations	Total, *n*(%)	Women, *n*(%)	Men, *n*(%)
CT	3(12)	2(22.22)	1(6.25)
MRI	0(0)	0(0)	0(0)
X-ray	0(0)	0(0)	0(0)
Pantomogram	0(0)	0(0)	0(0)
USG	1(4)	0(0)	1(6.25)

however, this correlation was not statistically significant (P = 0.9321). Another interesting finding was posttraumatic brain edema, present in 2 cases and a pericerebral hematoma found in 1 case. Posttraumatic brain edema was considered not statistically significant (P = 0.9638), with an OR below 1 (OR = 0.9662; 95%CI: 0.2189–4.2641). However, we want to highlight the potential risk of this outcome. Multisite injuries were observed in 6 patients (24%). These injuries were specifically correlated with bite injuries, with an OR of 1.1489 (95%CI: 0.4462–2.9584). A statistically significant correlation was not achieved (P = 0.7736). A few patients developed symptoms like loss of consciousness, somnolence, headache, vomiting and nose bleeding (Table 3). The OR for headaches was 0.1454 (95%CI: 0.0429–0.4929), and for vomiting, it was 0.1205 (95%CI: 0.0161–0.9013). These outcomes were negatively correlated with bite injuries and were considered statistically significant, with P values of 0.002 for headaches and 0.0393 for vomiting. Radiological examinations are presented in Table 4. A computer tomography (CT) scan was obtained in 2 cases, additionally the transfontanellar ultrasound was performed in 1 of these patients. Both of these patients had posttraumatic brain edema.

All patients received multidisciplinary medical care, including a total of 27 consultations across various specialties (Table 5). The most frequent was consultation with an infectious disease specialist, followed by ophthalmology, otolaryngology, and maxillofacial surgery consultations. The treatment administrated after bite injuries is summarized in Table 6. All patients received pain relief treatment. Paracetamol was the most commonly used painkiller, other

Table 5. Medical consultations after bite injury.

Consultations	Total, *n*(%)	Women, *n*(%)	Men, *n*(%)
Otolaryngological consultation	2(8)	1(11.11)	1(6.25)
Ophthalmological consultation	5(20)	3(33.3)	2(12.5)
Neurological consultation	0(0)	0(0)	0(0)
Neurosurgical consultation	0(0)	0(0)	0(0)
Maxillofacial surgeon consultation	1(4)	0(0)	1(6.25)
Consultation with the infectious disease specialist	19(76)	6(66.67)	13(81.25)
Psychological consultation	0(0)	0(0)	0(0)
Psychiatric consultation	0(0)	0(0)	0(0)
Orthopedic consultation	0(0)	0(0)	0(0)
Rehabilitation consultation	0(0)	0(0)	0(0)

medications included non-steroidal anti-inflammatory drugs (NSAIDs), metamizole and opioids. Rabies vaccination was administrated according to vaccination protocol in 19 patients. A total of 24 patients received antibiotic prophylaxis (Table 7). Only a small number of patients needed a hemostatic agents or anti-edema treatment. Pressure-controlled ventilation was necessary in 1 case. Three patients were treated with wound cleansing and dressing under local anesthesia only. Surgical treatment under general anesthesia was required in 22 cases; in 1 of these, both general and local anesthesia were administered. There was a statistically significant correlation between the method of anesthesia used during wound dressing and the patient's gender (P = 0.0044). Surgical treatment (Table 8) of most patient's wounds, consisted of direct closure using simple suturing. In 3 cases, eyelid reconstruction was required. Furthermore, in 1 of these cases, intubation of lacrimal canaliculus was performed. Reconstructive surgery was necessary in 3 patients with auricular trauma, and osteosynthesis was performed in 1 case involving a mandibular fracture. Six patients underwent laser treatment for postoperative scars. For this purpose, two types of lasers were used: a carbon dioxide (CO_2) laser and a pulsed dye laser (PDL).

Table 6. Treatment for bite injuries

Treatment	Total, *n*(%)	Women, *n*(%)	Men, *n*(%)	Woman vs Man, χ^2(P)
Fluid therapy	14(53.85)	3(33.33)	11(68.75)	2.8149(0.0934)
Paracetamol	24(92.31)	8(88.89)	16(100)	1.78(0.1824)
NSAID	2(8)	0(0)	2(12.5)	1.1739(0.2786)
Metamizole	1(4)	0(0)	1(6.25)	0.5625(0.4533)
Opioid	2(8)	0(0)	2(12.5)	1.1739(0.2786)
Antibiotic therapy	24(96)	9(100)	15(93.75)	1.7778(0.1824)
Rabies vaccination	19(76)	6(66.67)	13(81.25)	0.6447(0.4220)
GKS	2(8)	0(0)	2(12.5)	1.1739(0.2786)
Mannitol	1(4)	0(0)	1(6.25)	0.5625(0.4533)
Hemostatic drug	2(8)	0(0)	2(12.5)	1.1739(0.2786)
Controlled breathing	1(4)	0(0)	1(6.25)	0.5625(0.4533)
Surgical treatment under local anesthesia	4(16)	4(44.44)	0(0)	8.1270(0.0044)
Surgical treatment under general anesthesia	23(92)	7(77.78)	16(100)	0.5625(0.4533)

Table 7. Antibiotic treatment.

Variables	n(%)
Antibiotic prophylaxis	
Yes	24(96)
No	1(4)
Type of antibiotics	
Cefuroxime	11(44)
Metronidazole	9(36)
Amoxicillin with clavulanic acid	9(36)
Clindamycin	2(8)
Ceftriaxone	1(4)
Cefazolin	1(4)
Meropenem	1(4)
No data	3(12)

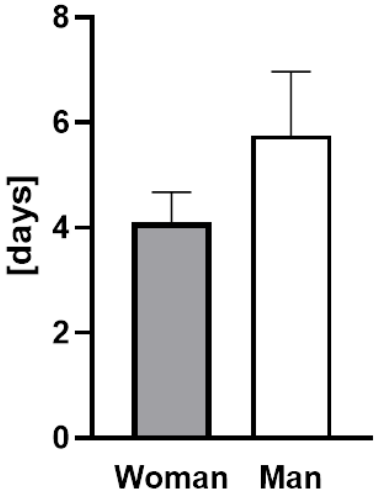

Figure 1. Distribution of length of hospitalization.

A notable aspect of this study is that length of hospitalization was longer in the male group compared to the female group (Figure 1). Male patients spent an average of 5.75 days in the hospital whereas female patients stayed for an average of 4.11 days (range 2–23 days).

5. DISCUSSION

Children are the most common victims of animal bites.[3,14,19] Our study demonstrated the vast majority of these incidents are caused by dogs, which is confirmed by other studies.[3,4,20] The literature establishes that the majority of children are bitten at home by familiar aggressors.[3,4,14,17,19,21] Animal bites were more prevalent in boys. Although our study did not find a significant correlation between genders, but the difference in male-to-female ratio is highlighted in other reviews.[4,20–22] In our study, most of the patients were school-aged children. In agreement with literature the highest rate of serious injury is in children under 5 years of age.[4,5,18] The reasoning behind this is that children tend to have less experience in interacting with animals. Children are more prone to provoke the animal and are unable to recognize the dangerous animal behavior.[6,16,18,20] According to the literature, another risk factor for injury from animal bites and post-bite complications may be behavioral disorders such as attention deficit hyper activity disorder (ADHD) or autism spectrum disorder (ASD).[15] ADHD and related conduct or disruptive disorders, particularly in males, are associated with a 21% increased risk of emergency department admission due to all bite injuries.[23] Meanwhile, children with ASD are more vulnerable to bite injuries to the head.[24] These children may have difficulty interpreting animal warning signals and may respond unusually to sensory stimuli, increasing the likelihood of defensive or aggressive reactions from animals. The child's face is the most common target of the attacking animal. This is likely caused by short statures of younger children and larger head size with respect to their bodies, making the face more accessible to animals.[3,4,6,18]

Table 8. Surgical treatment.

Variables	*n*(%)
Suturing the wound	22(88)
Eyelid reconstruction	3(12)
Intubation of lacrimal canaliculus	1(4)
Sclera suturing	1(4)
Auricle reconstruction	3(12)
Osteosynthesis of the mandible	1(4)
Laser therapy	6(24)
No data	3(12)

In our study, injury following by animals bites ranged from scratches and superficial lacerations to large defects of soft tissues and bone fractures. Although fatal cases are reported in the literature, they remain extremely rare.[18] Dog bites typically cause soft-tissue damage to the face.[4] The soft-tissue injuries can be categorized into three main types: lacerations (cuts), punctures (deep, narrow wounds), and avulsions (where tissue is torn away).[4,20] Lacerations and puncture wounds are the most common.[20] Concomitant fracture due to animal bites are rare. In our study, the risk of facial bone injury was low, with an odds ratio of 0.0565 (95%CI: 0.0807–1.5079), and it was statistically significant (P = 0.0051). Our findings are in line with the literature, which reports a 1% to 3% incidence of such injuries.[16,25] When a skull fracture or craniocerebral injury is suspected, radiological examinations, especially CT scan, should be performed.[20] In our study, we performed 2 CT scans which showed cerebral edemas and, additionally, in 1 patient a skull fracture and a pericerebral hematoma. Although tranfontanellar ultrasound was performed in 1 patient, it is no longer considered the diagnostic standard due to its limitations in evaluating the structures of the posterior cranial fossa.[26]

Essential steps in the management are surgical treatment with adequate debridement of the wound, primary closure if possible, antibiotic and rabies prophylaxis.[4,16,18] It is crucial

to minimize infection risk and prevent complications such as increased scarring and cosmetic impairment.[20] Following the literature, the choice of anesthesia method depended on the type of wound, localization, and the child's age.[22] In our study, all debridement under local anesthesia were performed in the female group. The reason behind that observation might be milder injuries and older age in the female group.

Severe injuries, such as avulsion wounds with tissue loss, skull fractures, or trauma to functionally sensitive areas, require multidisciplinary care. For these cases, reconstructive procedures – commonly involving local or advancement flaps, full-thickness skin grafts, eyelid reconstructions, and auricular reconstructions – are often necessary. Coordination among specialists, including maxillofacial surgeons, plastic surgeons, ophthalmologists, otolaryngologists, and neurosurgeons, is essential to ensure optimal management.[14]

To prevent infections, which are a common complication of bite wounds, proper antibiotic therapy was administered. In our review 96% of the patients received antibiotics prophylaxis. The most common choice was cefuroxime, followed by amoxicillin with clavulanic acid. In 1 case, modification of antibiotic therapy was needed; in this case, four types of antibiotics were administered. According to the literature, amoxicillin with clavulanic acid is the antibiotic of choice, due to its broad-spectrum activity against both gram-positive and gram-negative organisms involved in bite wounds.[3,20] As alternatives to amoxicillin with clavulanic acid, mainly cefuroxime and clindamycin were administered.[3] Antibiotics prophylaxis is not necessary for injuries such as scratch or excoriations.[4] Some authors recommend antibiotic prophylaxis (amoxicillin with clavulanic acid) when there is deep injury involving muscle,[3] while other suggest early prescribing of prophylactic antibiotics in all cases of bite injuries.[18,21,27]

In each case included in the study, the tetanus and rabies immunization status and the risk of infection were ascertained. The risk of rabies infection following exposure to a rabid animal is approximately 15%; however, a bite injury of the head carries the greatest risk of transmission.[16] Tetanus and rabies prophylaxis must be evaluated in animal bites according to established recommendations and protocols. In Poland the prevention of tetanus and rabies infection is supervised by government institutions. The tetanus vaccine is mandatory and is administered during childhood in accordance with the vaccination program, which is updated annually by the General Sanitary Inspectorate. The General Veterinary Inspectorate obliges dog owners to vaccinate their pets against rabies annually after they turn 3 months old. Post-exposure prophylaxis requires cooperation with an infectious disease expert for the management of these injuries. Vaccination and immune globulin should be administered when it is necessary.[1,9]

The most common complication following surgery is hypertrophic scarring, which may result in both aesthetic and functional impairment.[16] This potentially affects patient's social adaptation and contributes to a negative attitude towards physical appearance.[17,18] Laser therapy after primary surgical treatment is a method to improve skin elasticity and the aesthetic effect after surgical management. However, initiation of laser therapy is optional and based on shared decision-making between the medical team, patient, and guardians.

It is well established that animal bites to the face can result in physical but also psychological consequence. Psychological impact of such trauma ranges from fear of dogs to post-traumatic stress disorder.[14,17,20,22,28] Due to the long-term mental health problems, victims of dog bites should be provided with prompt intervention such as psychological and psychiatric care. In addition, preventive strategies – such as educational programs targeting both children and parents – are essential.[5,19] This preventative approach, along with the provision of psychological support following severe injuries, is essential for mitigating the long-term social and emotional impacts of facial bite injuries in pediatric patients.

Our study did not find a significant correlation between the length of hospitalizations in male and female group. The longer hospital stay among men is a result of a single case involving a 3-month-old patient with multi-organ injuries, who spent 23 days in various departments. The fact that boys under 5 years old are at risk of more severe injuries is similar to the results of previous studies.[4,21]

6. CONCLUSIONS

(1) This study highlights the significant risks associated with facial bite injuries in children, emphasizing the need for prompt, multidisciplinary treatment due to the potential for both severe physical and psychological consequences.
(2) Animal bites to the face, primarily caused by familiar dogs, frequently occur in household settings and are more common in younger children.
(3) Despite a broad range of injury severity – from superficial wounds to complex fractures and cranial trauma – nearly all cases required antibiotics prophylaxis, surgical intervention, and rabies prophylaxis.
(4) The study underscores the importance of early intervention to prevent infections, manage wounds, and minimize long-term complications.

Conflict of interest

The authors declare no conflict of interest.

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