

CASE REPORT



Surgical management of severe facial trauma after dog bite: A case report

Bernhard Prem^a, David Tianxiang Liu^a, Bernhard Parschalk^a, Boban M. Erovic^b and Christian A. Mueller^a

^aDepartment of Otorhinolaryngology, Head and Neck Surgery, Medical University of Vienna, Vienna, Austria; ^bInstitute of Head and Neck Diseases, Evangelical Hospital Vienna, Vienna, Austria

ABSTRACT

Dog-bite injuries are regularly treated in emergency departments. Every bite wound is unique, and thus requires a customized treatment plan. Here, we report the case of a 27-year-old woman who was transferred to the main hospital of Vienna due to a facial dog-bite injury. Primary closure of the wound was possible. The patient received amoxicillin–clavulanate as anti-microbial therapy, and was vaccinated against tetanus, polio, pertussis and diphtheria due to her unknown immunization status. At 183 days after the attack, the aesthetic outcome and nasal ventilation were satisfactory. Based on the reconstructive ladder for wound closure, more severe injuries may require skin or composite grafts, distant or local flaps and microsurgical procedures. Anti-infective therapy against tetanus, rabies and other bacteria also represents a central pillar of dog-bite injury treatment. This case report adds to the knowledge about dog-bite injuries and the required individual multidisciplinary treatment approach.

ARTICLE HISTORY

Received 17 October 2019
Revised 10 December 2019
Accepted 16 December 2019

KEYWORDS

Dog bite; facial reconstruction; nose; surgery; primary closure

Introduction

In the USA, animal bites account for approximately 1% of all injury-related visits to emergency departments. Of these cases, about 85–90% are caused by dogs [1] and, in general, the victims are more commonly children than adults [2,3]. The uniqueness of every single dog bite presents challenges for clinical treatment and the development of guidelines. Dog-bite injuries range from small superficial abrasions or crush wounds to major tissue loss including bone damage [4]. Individual treatment is guided by the degree of each trauma [5,6]. In particular, bites affecting the human face present a great challenge for surgeons. Treatment options range from primary and delayed primary closure (PC) to secondary intention, including surgical approaches, such as local flaps, and skin or composite grafts [5]. In addition to surgical procedures, another important aspect of dog-bite treatment is anti-infective therapy against rabies, tetanus and other bacteria [2]. Antimicrobial therapy is always indicated, whereas treatment against tetanus depends on the patient's immunization status and therapy against rabies is determined by the immunization status and health of the attacking dog. Here, we report the case of a 27-year-old patient who

suffered a subtotal amputation of her nose after a facial dog bite.

Case report

A 27-year-old woman was transferred to the main hospital of Vienna due to a facial dog bite (Figure 1). While playing with a friend's dog, the animal bit her face, including her nose and parts of her left cheek and upper lip. On site, the patient received initial wound management and intravenous analgesia with 75 mg diclofenac, 15 mg piritramide and 3 mg granisetron (to avoid nausea due to piritramide). She was then transported by helicopter, in a clinically and cardiorespiratory stable condition, to the trauma center of the main hospital of Vienna. At the hospital, the patient was intubated and ventilated by our colleagues from the department of anesthesiology.

The bite wound extended from the upper lip, *via* the left paranasal cheek region underneath the nasal root, to the right lateral nose region. This soft tissue could be flipped to the right side of her face, revealing the nasal cavity (Figure 2). A computer-assisted tomography (CAT) scan of the head and face showed multisegmental fractures of the nasal bone and nasal

CONTACT Christian A. Mueller ✉ christian.a.mueller@meduniwien.ac.at Department of Otorhinolaryngology, Head and Neck Surgery, Medical University of Vienna, Währinger Gürtel 18–20, 1090 Vienna, Austria

© 2020 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

septum. Swelling, bleeding and soft tissue damage were observed in this area. The CAT scan did not reveal any other fractures or intracranial bleeding.

The patient was immediately started on antibiotic therapy with amoxicillin–clavulanate (2000/200 mg) twice daily, and received vaccination against tetanus, diphtheria, polio and pertussis due to her unknown immunization status. No further steps were taken regarding rabies vaccination since the dog had received all necessary vaccinations and was stated to be healthy.

Surgery was performed by the senior author and started within 4.5 h after the attack. The first step was adequate cleansing and rinsing of the wound using povidone-iodine solution for 15–20 min, followed by marginal necrosectomy and debridement. Nasal airway reconstruction began with fixation of the nasal septum. Next, the mucosa of the nasal cavity was attached to the nasal vestibule to reconstruct the passage between the nostrils and the nasal cavity. Absorbable sutures (Vicryl® 5-0) were used to perform multilayer closure of the wounded oral vestibule in the area of the upper lip, resulting in the implementation of a proper vermilion border. Finally, the wound was closed from the left cheek, underneath the nasal root to the right lateral side of the nose, using multiple layers with as little tension as possible (Figure 3). At the end of the surgery, a nasogastric tube was inserted to avoid oral nutrition and bacitracin zinc/neomycin ointment was applied on the wound. Following surgical treatment, the patient was transferred to the intensive care unit for one night.

On the next day (day 2), the woman was transferred to the ward of the otorhinolaryngology department. During her stay, she received antimicrobial therapy, with intravenous amoxicillin–clavulanate (2000/200 mg) twice daily for 10 days. On day 6, the nasogastric tube was removed and a soft food diet was started. On days 9 and 10, we partially removed the sutures from her face. On day 12, the woman was able to leave the hospital in a good general health condition. Local therapy was continued with dexpanthenol–chlorhexidine cream three times daily to take care of the wound (Figure 4).

Her first check-up after discharge was on day 20. The wound looked fine, except for a small granuloma on the right lateral area of the nose due to a subcutaneous suture. Crusts inside the nasal cavity were removed, and the woman stated that she had proper nasal ventilation. From day 26 on, the patient started scar treatment, using once daily application of prescribed Contractubex gel® and Kelosoft

Table 1. Peak nasal inspiratory flow (PNIF) on day 183 after injury.

	PNIF (L/min)
Both nostrils	126.7
Right nostril	53.3
Left nostril	108.3

scar-ointment®. On day 76, the patient visited our department for another check-up. The granuloma was smaller and the patient reported a good general health condition and proper nasal ventilation.

We invited the woman for another check-up on day 183 (Figure 5). The granuloma was no longer visible and the scars appeared inconspicuous, thus, causing no cosmetic issues for the patient. During all her check-ups, we tested the function of the facial nerve, showing no impairment at any time. Furthermore, the patient reported a normal health condition and proper nasal ventilation. To quantify her statement, we tested her peak nasal inspiratory flow for both nostrils together, and for each nostril separately (Table 1) [7]. Those results showed reduced PNIF of the right in comparison to the left nostril. Nasal examination demonstrated minor constriction of the right vestibule, without bothering the patient.

Discussion

Emergency departments have to treat many different injuries every day, commonly including dog-bite injuries [1]. Dog-bite injuries to the human face are each unique and require individualized treatment [6]. The methods of dog-bite treatment must be selected based on the degree and circumstances – for example, the type of injury, contamination of the wound and health status of the dog [5]. With every surgical approach, the aim is a good functional and aesthetic outcome.

The reconstructive ladder indicates the best means of treatment for each individual case [8]. PC of the wound should always be considered first. Previous reports describe PC leading to good outcomes in treating similar injuries [9,10]. Time is an important aspect, with guidelines and evidence indicating that surgery should be performed within 6–8 h after the bite [5,11]. Although prolonging this time limit is widely accepted and commonly leads to satisfactory results [4], a delayed surgical approach reportedly leads to more frequent structural and functional deformities [12], highlighting the individuality and unique treatment of each case. Fortunately, the surgery in this case was performed within 4.5 h after the attack. Regarding infection risk, studies show no

significant difference between infection rates after PC or secondary intention [1]. The robust blood supply to the face enables PC without an increased infection rate [9,13]. The wound should be thoroughly cleansed and rinsed with povidone-iodine solution to lower the risk of infection [2,5].

Importantly, PC is not always possible, for example, due to the degree of defect or other life-threatening injuries that must be treated first. In such cases, delayed PC may be indicated [5]. Antibiotic therapy and intense wound management are required until surgery can be performed. In rare cases of highly contaminated wounds, doctors should consider healing by secondary intention, which also necessitates antimicrobial therapy and aggressive wound care [5]. The obvious disadvantage of secondary intention is the potentially unsatisfactory aesthetic outcome [13,14].

Some dog bites may result in complete avulsion of parts of the nose or even the whole nose. In cases of small and superficial defects, skin grafts may be the ideal treatment. The possibility to perform skin grafting is defined by the limited applicability in the area of the nose tip or wings, and the requirement of an intact cartilaginous framework underneath [5]. If the cartilaginous framework and other aesthetic subunits are destroyed beyond salvage, local flaps are indicated [14]. In particular, the forehead flap technique is commonly used due to the similar color and texture of the skin [5]. Even though at least one revision surgery is required, patients treated with forehead flaps are typically satisfied with their outcome [5,14,15]. If closure of the damaged area is not possible due to the size of the injury, there is the option of performing several free tissue transfers [5].

Another reconstructive option is the replantation of a completely bitten-off nose. While early attempts to replant totally amputated noses were unsuccessful [16], successful replantation has now been reported in several cases [17,18]. This technique requires that there be salvageable tissue after the bite, and the possibility of microanastomosis [14,18]. For example, vein grafts from a superficial temporal vein may be used [17]. The implementation of microsurgical procedures has resulted in more successful replantation [18].

During the acute phase after a dog bite, another crucial aspect of treatment is anti-infective management with regards to rabies, tetanus and other bacteria [1,2,10]. Wound infections primarily exhibit a polymicrobial origin, with smear tests typically showing a mixture of aerobic and anaerobic bacteria from

the dog's oropharynx and the skin of the attacked human [2]. The most clinically important pathogens include *Pasteurella* spp., *Capnocytophaga canimorsus*, streptococci, staphylococci, *Neisseria* and anaerobic bacteria, such as *Fusobacterium* [1]. *Pasteurella* spp., particularly *Pasteurella canis*, is found in 50% of infections due to dog bites, and *C. canimorsus* can be isolated from up to 56% of all infections [2]. Authors recommend starting empiric antimicrobial therapy, even before receiving microbiological culture results, since dog bites are considered primarily infected [1,2]. Various published recommendations are largely similar, suggesting administration of amoxicillin-clavulanate for 7–10 days [1,2,19]. Therapeutic alternatives include doxycycline or clindamycin plus ciprofloxacin, for example, in cases of penicillin allergy [1]. After receiving the results of the microbiological culture, therapy should be adapted as needed.

Possible tetanus infection is another important aspect to consider after animal bites. Tetanus management depends on the immunization status of the attacked person (see Table 2) [1,2,20]. If the patient has been vaccinated according to the recommended schedule at least three times, with the most recent booster administered within the last 5 years, no further steps regarding immunization are required. If the most recent vaccination was over five years ago, a booster is given. In cases where the immunization status is unclear or where the last booster was administered over 20 years ago, both active and passive immunization are recommended [1,2,19,20].

With regards to rabies, the individual attacking dog must be considered (see Table 3). If the dog is and remains healthy for an observational period of 10 days after the attack, no intervention is necessary. However, if the animal shows signs of rabies or rabies is

Table 2. Tetanus immunization according to patient history.

History of received tetanus immunization	Tetanus immune globulin	Tetanus vaccine
Uncertain or less than 3 times	Yes	Yes
At least 3 times	No, unless >20 years since last dose	No, if the last vaccination was implemented within the last 5 years

Adapted from Ellis and Ellis [1].

Table 3. Rabies management in cases of dog bite.

Healthy dog and available to observe for 10 days	Signs or detected rabies	Unknown dog
Immunization only in the case of signs or detected rabies	Active and passive immunization	Consult public health officials

Adapted from Bula-Rudas and Olcott [2].



Figure 1. A 27-year-old woman after a facial dog-bite. The wound extended from the upper lip, via the left cheek underneath the nasal root, to the right lateral nose region.

detected, prompt active immunization should be administered following the guidelines [1,2,19,20]. For example, the ESSEN scheme calls for vaccination as soon as possible (defined as day 0), followed by immunizations on days 3, 7, 14 and 28. Vaccination is more urgent in cases where the bite is close to the brain. The application of human rabies immune globulin (passive immunization), intradermally in the area of the wound as well as intramuscularly, depends on the patient's immunization status before the bite [20].

In our presently reported case, direct closure of the subtotally amputated nose was possible. To avoid post-operative nasal obstruction, we aimed to reconstruct the nasal airway without applying tension. At half a year after the attack, we and the patient deemed the aesthetic outcome to be satisfactory. Furthermore, the woman reported proper nasal ventilation. Regarding anti-infective therapy against bacteria, our patient received intravenous amoxicillin-clavulanate twice daily for 10 days, with no need to adapt this therapy. Due to the patient's unknown vaccination status, we implemented active immunization against tetanus, diphtheria, polio and pertussis. Due to the decreasing attendance to vaccinations and the



Figure 2. The subtotal amputated soft tissue could be flipped to the right side of the patient's face, revealing the nasal cavity, without any instruments.



Figure 3. Photograph from the end of surgery, after all wounds were sutured.



Figure 4. Photograph from the check-up on day 11, after all sutures were removed.

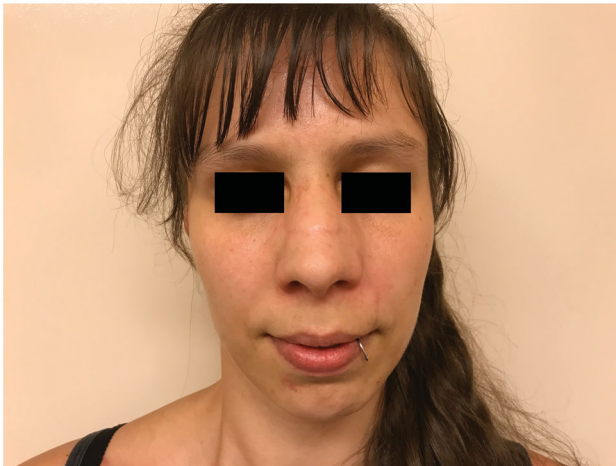


Figure 5. Photograph from the follow-up on day 183, showing a satisfying aesthetic outcome for the patient.

problems that arise when only tetanus is boosted, it should be considered that emergency departments administer tetravalent vaccines (diphtheria, tetanus, polio and pertussis). Since the dog in this case had received all recommended vaccinations against rabies and showed no signs of the disease, there was no reason to vaccinate the patient against rabies.

Conclusion

Each dog-bite injury is unique, and thus demands individualized therapy. In the presently reported case, PC of the wound was feasible. However, other cases may require skin or composite grafts, local or distant flaps, and microsurgical reconstructions. In contrast, anti-infective therapy is always provided based on concrete guidelines. The present case report adds to the knowledge about dog-bite injuries and the required individualized multidisciplinary treatment approach.

Acknowledgements

We would like to thank the patient, who gave her consent for us to publish this case, including the pictures of her.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

- [1] Ellis R, Ellis C. Dog and cat bites. *Am Fam Physician*. 2014;90(4):239–243.
- [2] Bula-Rudas FJ, Olcott JL. Human and animal bites. *Pediatr Rev*. 2018;39(10):490–500.
- [3] Cohen-Manheim I, Siman-Tov M, Radomislensky I, et al. Epidemiology of hospitalizations due to dog bite injuries in Israel, 2009–2016. *Injury*. 2018; 49(12):2167–2173.
- [4] Rothe K, Tsokos M, Handrick W. Animal and human bite wounds. *Dtsch Arztebl Int*. 2015; 112(25):433–442.
- [5] Ramachandra T, Ries WR. Management of nasal and perinasal soft tissue injuries. *Facial Plast Surg*. 2015;31(03):194–200.
- [6] Cerne JW, Rock AN, Smith SW, et al. A novel approach for treating nasal dog bite injury. *Ear Nose Throat J*. 2019;98(2):76–77.
- [7] Ottaviano G, Scadding GK, Coles S, et al. Peak nasal inspiratory flow; normal range in adult population. *Rhinology*. 2006;44(1):32–35.
- [8] Janis JE, Kwon RK, Attinger CE. The new reconstructive ladder: modifications to the traditional model. *Plast Reconstr Surg*. 2011;127(Suppl 1): 205S–212S.
- [9] Javaid M, Feldberg L, Gipson M. Primary repair of dog bites to the face: 40 cases. *J R Soc Med*. 1998; 91(8):414–416.
- [10] Piccart F, Dormaar JT, Coropciuc R, et al. Dog bite injuries in the head and neck region: a 20-year review. *Cranial Maxillofac Trauma Reconstr*. 2019; 12(3):199–204.
- [11] Hochberg J, Ardenghy M, Toledo S, et al. Soft tissue injuries to face and neck: early assessment and repair. *World J Surg*. 2001;25(8):1023–1027.

- [12] Vasconez HC, Buseman JL, Cunningham LL. Management of facial soft tissue injuries in children. *J Craniofac Surg.* 2011;22(4):1320–1326.
- [13] Shipkov H, Traikova N, Stefanova P, et al. The forehead flap for immediate reconstruction of the nose after bite injuries: indications, advantages, and disadvantages. *Ann Plast Surg.* 2014;73(3):358.
- [14] Huang AH, Wong MS. Acute nasal reconstruction with forehead flap after dog bite. *Ann Plast Surg.* 2013;70(4):401–405.
- [15] Cantarella G, Mazzola RF, Pagani D. The fate of an amputated nose after replantation. *Am J Otolaryngol.* 2005;26(5):344–347.
- [16] Grabb WC, Dixgmax RO. The fate of amputated tissues of the head and neck following replacement. *Plast Reconstr Surg.* 1972;49(1):28–32.
- [17] Akyurek M, Perry D. Microsurgical replantation of completely avulsed nasal segment. *J Craniofac Surg.* 2019;30(1):208–210.
- [18] Marsden NJ, Kyle A, Jessop ZM, et al. Long-term outcomes of microsurgical nasal replantation: review of the literature and illustrated 10-year follow-up of a pediatric case with full sensory recovery. *Front Surg.* 2015;2:6.
- [19] Lange B, Wessel LM. Wunden und Wundbehandlung [S1-Guideline]. 006-129. 2014. German.
- [20] Bundesministerium für Arbeit S, Gesundheit und Konsumentenschutz, Sektion VIII. Impfplan Österreich 2019. In: Bundesministerium für Arbeit S, Gesundheit und Konsumentenschutz, editor. Vienna: Bundesministerium für Arbeit, Soziales, Gesundheit und Konsumentenschutz; 2019. German.