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Primary Repair of a Complex Panfacial Fracture by Dog Bite

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Summary: Facial fractures due to dog attacks have an unknown incidence rate. To date, only 41 cases of canine bite trauma in a pediatric patient, associated with facial fracture, have been reported in the literature. As major species of involving dogs are the American pitbull terrier and rottweiler. Due to the intense kinematics of this trauma, the treatment becomes complex. Thus, attention to the primary repair of such complex lesions ensures satisfactory results, which is the focus of this discussion. The purpose of this review was to analyze how different ways to approach this type of trauma in children for clarification or correct management. In addition, we address the treatment plan of a complex case of panfacial fracture by a canine bite in a 4-year-old patient. According to a review addressed, the main involved are orbit, nasal, and zygomatic. Antibiotic therapy is indicated for infected bite wounds and wounded considerations at risk of infection, with high complexity and when involving important structures such as bones, vessels, and joints. The state of tetanus immunization and the risk of rabies infection should be routinely addressed in the management of the bite wound. *(Plast Reconstr Surg Glob Open 2018;6:e1719; doi: 10.1097/GOX.0000000000001719; Published online 12 April 2018.)*

Animal bite traumas have increased in prevalence and represent 1% of emergency trauma cases in the United States, largely because the number of domestic animals has increased.[1] Canine bites are often presented at emergency centers and represent a major public health concern worldwide.[2] This type of trauma causes complex facial injuries. Functional and cosmetic impairment together with potential polymicrobial infections are challenging for maxillofacial surgeons.[3] The majority of animal bites come from dogs; 80–90% of animal bites reported in the literature of United States are dog bites.[4,5] Almost 900,000 dog bites are treated in the United States each year.[6] Most patients are children;

57% of dog bite victims are less than 10 years old.[7] According to Foster and Hudson,[8] the American Pit Bull Terrier is responsible for the majority (45%) of attacks with the highest morbidity. Canine bites involve intense kinematics and are associated with soft-tissue damage, including mutilation, severe lesions, and neuro-sensory impairments. However, they are rarely associated with facial bone fractures.[6] According to Tu et al.,[6] only 5% of canine bites in the head and neck region are accompanied by facial bone fractures. The objective of this work was to review facial bone fractures in pediatric canine bite patients and to investigate the initial treatment for this type of trauma. In addition, we present a case report of a pediatric canine bite patient with extensive lacerations on the face and multiple bone fractures in the middle and lower face.

CASE REPORT

A 4-year-old patient, bitten by an American Pit Bull Terrier, had multiple blunt wounds on the face and scalp. Initial treatment was performed at the emergency in Hospital de Pronto Socorro by the buccomaxillofacial surgery and traumatology team and plastic surgery team (Fig. 1). CT scans revealed multiple bilateral fractures in the middle third of the face, including the nasal bones, zygomatic bone, and medial cantonal portion of the orbital bone. In addition, a comminuted mandible fracture was detected in the symphysis and angle regions (Fig. 2). Dental alveolar fractures involving the dental germs were observed in

Fig. 1. Extensive lacerations on the face caused by the bite of the canine.

Fig. 2. Comminuted middle face fractures and comminuted jaw fractures.

Fig. 3. Comminuted mandibular fragments with dental germ and lower deciduous molar.

the molar region of the mandible (Fig. 3). According to the classification of Lackmann et al.,[7], this case was classified as a stage IV B trauma. This means that deep lesions were present that affected the muscle and caused extensive skin defects, involving the bone.

The patient was treated with mandibulomaxillary fixation (MMF) by 3 weeks. Sutures were performed in lacerations.

Currently, after the 18-month follow-up, patients with normal mouth opening, with no deviations from opening and closing (Fig. 4).

Aesthetically, the results are considered satisfactory, by the magnitude of the trauma in question.

DISCUSSION

Large dog attacks cause major trauma because canine bites have intense kinematics that apply considerable force (50–100 kg/cm^2).[9,10] Children are the main victims of this type of trauma, and most patients are less than 5 years old.[3,4,11]

Facial fractures are not frequently associated with canine bites.[12,13] In a retrospective study conducted between 2003 and 2011, only 17 canine bite patients out of 1,201 (1.4%) were children with facial fractures.[14] A review of the literature published between 1972 and 2002 found only 16 cases of maxillofacial fractures in children.[6] The current incidence of facial fractures related to canine bites is not known. However, we have counted a total of 41 cases to date.

In our review, we observed that facial fractures occurred more frequently in the zygomatic, nasal, and orbital bones. Orbital fractures were the most prevalent, representing 21% of all reported cases. These fractures were isolated or associated with other concomitant fractures. Pediatric bone has a high osteogenic potential and high regenerative capacity; therefore, fracture healing is optimal. This is an advantage in young dog bite patients and allows a more positive outcome following this type of trauma.[15]

Fig. 4. Patient with normal opening of the mouth, without deviations. Satisfactory aesthetic results with 18 months of follow-up.

Most reviews have suggested that large dogs, such as American Pit Bull Terriers, Rottweilers, and German Shepherds are the main species involved in this type of trauma.[16–18] Wolff[19] and Morgan et al.[20] claimed that American Pit Bull Terriers and German Shepherds are responsible for the majority of fatal attacks. In a retrospective study of 20 maxillofacial canine bite cases, 45% of attacks were made by Pit Bull Terriers. This may be explained by the increasing use of this breed as guard dogs for their aggressiveness and physical imposition.[8] These data are in agreement with our findings that most facial fractures were caused by American Pit Bull Terrier attacks.

ANTIBIOTIC SELECTION

The bacteriology of animal bite wounds varies. Most infections associated with canine bites are polybacterial, with a mixture of anaerobic and aerobic organisms. *Pasteurella* is the most common genus, and the species *Pasteurella canis* is present in 50% of canine bites.[3,21] According to Talan et al.[21] and Goldstein et al.[22], the most commonly found anaerobes are *Fusobacterium nucleatum, Bacteroides tectum, Prevotella heparinolytica,* and *Porphyromonas.* These species play an important role in canine bite infections. Canine oral microorganisms are mainly Gram positive, and antibiotics of choice are directed against *Staphylococcus, Pasteurella,* and *Streptococcus.*[23] However, other Gram-negative microorganisms are also present, including *Pseudomonas multocida.*[24,25] No antibiotic can eliminate all potential contaminating microorganisms, and it is often necessary to use different antibiotics to successfully combat infection. However, penicillins have been suggested as the first choice of antibiotics. Erythromycin, tetracycline, or cephalosporin have been recommended as alternatives to penicillin in cases of allergy.[26] Only 3 case reports analyzed in our review reported no antibiotic use during treatment; antibiotics were used in 92% of cases. Amoxicillin and clavulanic acid were the most commonly used antibiotics, followed by IV generation cephalosporins and ampicillin with sulbactam.

The combination of amoxicillin with clavulanic acid is considered the gold standard treatment for canine bites because it acts against most anaerobic and aerobic microorganisms present in infected wounds.[3,23,27,28] Antibiotics should be administered for 10–14 days in cases of extensive wounds with bone involvement.[3,29]

We reported only 2 cases or 4% of infected wounds in canine bite patients. This was in agreement with the findings of Zook et al.[30], who reported an infection rate of 1.6%. Similarly, Javaid et al.[31] and Graham et al.[32] found infection rates of around 2.5%. According to Callaham,[26] antibiotic therapy does not improve the infection rate of simple lacerating wounds. These findings indicate that antibiotic therapies are limited to deep puncture wounds and complex wounds involving important structures such as bones, vessels, and joints. In addition, antibiotics should be considered in patients with impaired immune status, diabetes, > 50 years of age, prosthetic heart valves, and joint prostheses.[3,26]

TETANUS AND RABIES PROPHYLAXIS

Rabies is a serious public health problem with high annual mortality rates.[8] According to the World Organization for Animal Health, 60,000 deaths occur from rabies each year, and 95% of these are related to canine bite.[33] Rabies is caused by the rhabdoviridae virus and is transmitted through the saliva of infected dogs.[34] Postexposure rabies prophylaxis should be considered in all cases of unprovoked bite, or when the offending animal or immunization status is unknown.[23] If possible, the animal should be kept in isolation and quarantine for a period of 14 days to evaluate possible behavioral changes suggestive of rabies. Any behavioral changes should be treated immediately.[3]

When the offending dog is not known, caution should be exercised. The trauma history needs to be assessed together with the local epidemiology of rabies to determine whether treatment for rabies is needed.[20] In our review, no signs of rabies were reported, and no drug prophylaxis was administered. Rabies prophylaxis therapy with the human rabies immunoglobulin follows the recommendations of the Advisory Committee on Immunization Practices. These guidelines indicated 4 doses of the human diploid cell vaccine administered intramuscularly 0, 3, 7, and 14 days after infection.[3,4,35]

It is important to check the tetanus immunization status of each administered patient. A tetanus vaccination should be administered if the patient has not been vaccinated in the last 5 years, if there are less than 3 immunizations, or if immunization information is lacking.[7,28,32,36]

PRIMARY TREATMENT

In case of canine bite trauma and craniomaxillofacial trauma, maintaining life must take priority according to Advanced Trauma Life Support guidelines.[3,23,37] Important information such as the circumstances of the attack, systemic conditions of the patient, possible allergies, and vaccination status should guide decisions. Because the kinematics of this type of trauma are intense, it is important to analyze all major structures for involvement, particularly in the case of deep perforating wounds. Detailed imaging using CT scans is important for planning the optimal treatment.[6,14]

The pediatric facial skeletal structure absorbs more energy during the impact because there is a higher proportion of spongy bone and more cartilaginous growth sutures. Thus, significant force must be applied to the facial bones to cause fracture.[38] The pattern of facial fractures in pediatric patients is different from adults because the structural support of the face is different. A child's face is not fully supported because dentition is mixed, some teeth are not erupted, paranasal sinuses are lower, and there is a higher proportion of spongy bone.[39]

Trauma in the orbital region requires ophthalmologic evaluation.[40] Possible alterations such as enophthalmos, loss of functional support of the orbital walls, restriction of orbital contents that cause diplopia, and entrapment of extraocular muscles are all indications for surgical treatment.[38] In the present case, surgical treatment was performed in 2 stages because the facial fractures and soft-tissue injuries were multiple and complex. Postoperative ocular sequelae were not diagnosed. An esthetic defect was detected in the orbital region. An extensive comminuted fracture and loss of substance were detected in the right mandibular body and branch, involving the deciduous lower molar tooth. A closed reduction and maxillo-mandibular block were performed using steel wire.

Small, scattered bone fragments should be removed during debridement because they are potential sources of infection. Careful inspection of the oral cavity is important when evaluating this type of trauma, since deciduous dentition and fragments of teeth can become avulsed and aspirated, leading to potential airway obstruction.[37] The choice of open or closed treatment in the pediatric patient remains controversial due to potential changes in the growth of the developing facial skeleton.[41,42] The management of mandibular fractures in pediatric patients is challenging because fractures behave differently than in adult patients. The developing mandible and mixed dentition limit fixation methods because of potential damage to permanent dentition.[39] The main objective of mandibular fracture correction is to restore occlusion and limit any potential impact on normal growth.[37] When the anatomical position of the fractured stump is obtained in the mandible region, the fracture can be correctly aligned and closed treatment is possible.[43] This is useful for treating comminuted fractures, because the open reduction procedure may reduce blood supply to the bone fragments, resulting in kidnappings, infections, and loss of substance. This can be difficult to consolidate without sequelae.[43–45] Kazanjian[46] reported that the most important requirement for bone union in comminuted fractures is correct stabilization of the fragments. According to Ellis et al.[43], open reduction and stable internal fixation was associated with fewer complications and higher treatment effectiveness. However, not all comminuted fractures can be treated with this method. Alternatives such as closed reduction with maxillo-mandibular locking or external fixation may be necessary.

Treating and reducing comminuted fractures is complex and requires the use of long 2.7 mm reconstruction plates to fix the fractured region.[43] Fitting these plates requires surgical skill and time, and the outcome is not always perfect. In pediatric patients, it is important to consider the effect of plaque and screw systems on maxillofacial growth. When removing titanium devices after the fracture consolidation period, the patient's age, plate location, and plate size should be considered.[42,47] Resorbable polylactic and polyglycolic acid plates and screws have been used to prevent growth restriction and avoid the need for a second surgical intervention to remove the device.[41] Another advantage of this approach is that tip of the screw is blunt and avoids possible damage to patient dentition because it only penetrates the external cortex.[48] However, absorbable materials are not as versatile as titanium systems, which have greater resistance and are easier to handle, increasing the efficiency of fixation.[37]

The time between the trauma and the beginning of the treatment needs to be evaluated when managing soft-tissue injuries in the head and neck region to avoid delays and optimize results. Earlier treatments of this type of injury achieved better wound closure without significantly increasing the wound infection rate.[3] The primary repair of uninfected wounds should be indicated within the first 24 hours of trauma for the best esthetic and functional results.[7,26,31,49,50]

Wound closure should follow plastic surgery and delicate, tension-free synthetic materials should be used.[50] In large injuries, deep sutures should be minimized and drains should be used to eliminate dead spaces, because this minimizes the possibility of infection. Stitches should be removed early, after around 5 postoperative days in these situations.[3,7] The main objective of treating this type of insult is to prevent infections and promote tissue repair to avoid esthetic deformities. To this end, high-pressure irrigation with a saline solution should be performed during debridement of the devitalized tissues to reduce bacterial load and to remove unwanted particles and fragments from the region.[20,23,26] Large-volume syringes such as 60 ml syringes equipped with 18×1 1/2" gage needles are recommended to irrigate the lesion and reduce contamination.[23,51]

Lacerated surfaces should be closed first according to the correct anatomical positioning of the lesion edges. In cases where there is substantial tissue loss, such as in skin avulsions and amputations of important structures, reconstruction should be performed using local patches, mucosal advances, divided skin grafts, or total thickness grafts.[31] According to Palmer and Rees,[52] the greatest reconstructive difficulties are in the central target area, including

the lips, nose, and cheeks. In these regions, the contours of the vermilion of the lip, the filter and commissure of the lips, the margins of the nose, and nasal columella are complex to reconstruct. If initial care is delayed beyond the first 24 hours, then the wound should be kept open for 5 days before the definitive treatment, with daily irrigation. The wound should be covered with moist gauze to drain secretions and prevent edema until the wound can be closed.[3,20,26]

CONCLUSIONS

The treatment for patients who are victims of trauma caused by bites of dogs deserves special attention, given the difficulty in handling the injuries and care that the case demands.

In addition to the treatment of face fractures, aesthetic involvement is very important, and the relationship with important structures should be considered.

Cases should be individualized, and restorative treatment should be planned for the best possible outcome.

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