

Facial Fractures from Dog Bite Injuries

Alexander H. Tu, B.A., John A. Girotto, M.D., Navin Singh, M.D., Craig R. Dufresne, M.D., Bradley C. Robertson, M.D., D.D.S., Alan E. Seyfer, M.D., Paul N. Manson, M.D., and Nicholas Iliff, M.D.

Baltimore, Md., and Portland, Ore.

Dog bites are commonly associated with soft-tissue injury to the face but rarely result in facial fractures. This article reports six new cases of facial fractures associated with dog bites and reviews additional cases reported in the literature. The demographics of the patients attacked, the location of facial fractures, and the characteristics of associated soft-tissue injuries or complications developing from the dog bite are described. With six new cases and 10 from the literature, this article reviewed a total of 16 cases involving 27 facial fractures. Eighty-seven percent of the cases involved children less than 16 years of age. The periorbital or nasal bones were involved in 69 percent of the cases. Lacerations were the most frequently associated soft-tissue injury. Additional injuries included facial nerve damage, lacrimal duct damage requiring stenting and reconstruction, ptosis from levator transection, and blood loss requiring transfusion. Although facial fractures are not commonly considered to be associated with dog bite injuries, the index of suspicion for a fracture should be raised when the injury occurs in a child, particularly when injury occurs near the orbit, nose, and cheek. (*Plast. Reconstr. Surg.* 109: 1259, 2002.)

Dog bites are a significant health care problem: their sequelae range from minor to fatal injuries. Estimates suggest that over 2 million dog bites occur every year in the United States.¹ Children are the most common victims of dog bite injury,^{2,3} and most of the dogs responsible reside in the household of the victim.^{2,4} Among the more serious dog bite injuries are those that occur to the face. An estimated 44,000 facial injuries occur in children each year from dog bites in the United States.⁵ Dog bites to the face tend to be severe, potentially disfiguring, and costly to treat.^{5,6} One percent of facial dog bite injuries require hospitalization.⁷ The incidence of facial dog bites varies inversely with the age of the victim.^{8,9}

Although facial dog bites often result in var-

ious soft-tissue injuries, very few cases are associated with a facial fracture.^{7,10} Facial fractures are commonly not even suspected by the medical personnel initially caring for dog bite injuries. The overall incidence of facial fractures in dog bite injuries is unknown. In Brogan et al.'s² review of 40 cases of severe dog bite injury, one-quarter suffered fractures of the skull or facial bones. However, in the review by Palmer and Rees¹¹ of 109 cases and Karlson's⁵ review of 87 cases of facial dog bite injuries, no facial fractures occurred. Our own experience is that facial fractures from dog bites occur in less than 5 percent of cases. This article presents six cases of facial fractures caused by dog bite and reviews these cases with those that have been reported in the literature.

CASE REPORTS

Case 1: Nasal Fracture and Permanent Facial Nerve Injury

A 12-year-old boy presented with multiple facial lacerations including an extensive U-shaped laceration of the left cheek with damage to the zygomatic branches of the facial nerve. The boy also had a compound, comminuted nasal fracture from the dog bite. The lacerations and nasal fracture were repaired and reduced under a local anesthetic. The boy was admitted for observation, treated prophylactically for potential rabies, and placed on an intravenous cephalosporin for 3 days. On follow-up observation within weeks after the injury, he had weakness of the left facial nerve branches to the nose and upper lip. On examination 3 years after the attack, the boy continued to have weakness of the facial nerve branches to the nose and upper lip. Swelling and deformity were apparent in the left cheek. His left alar base, oral commissure, and left side of his cheek were slumped as compared with the right.

From the Division of Plastic, Reconstructive, and Maxillofacial Surgery, The Johns Hopkins University School of Medicine; Division of Plastic and Reconstructive Surgery, R Adams Cowley Shock Trauma Center; University of Maryland School of Medicine; and Division of Plastic and Reconstructive Surgery, Oregon Health Sciences University. Received for publication July 25, 2000; revised June 18, 2001.

Case 2: Fractures of the Maxilla and Zygomatic Arch

A 7-year-old girl presented with multiple bite injuries to her face and trunk. She had a fracture of the lateral wall of the maxillary sinus and a comminuted left zygomatic arch fracture (Fig. 1, above). The arch itself was depressed (Fig. 1, below). The girl underwent open reduction and internal fixation of these fractures through the traumatic injury site (Fig. 2). A LactoSorb (Walter Lorenz Surgical, Inc., Jacksonville, Fla.) absorbable plate and screw fixation system (3.0-mm and 4.0-mm screws) was used to secure the arch in proper alignment. She was hospitalized for 3 days and given an intravenous cephalosporin.

Case 3: Orbital Rim Fracture and Lacrimal System Laceration

A 4-year-old boy presented with a deep scalp laceration, a right facial laceration just below the eyebrow, a right lower lid laceration just lateral to the medial canthus, and a lower left cheek laceration along the mandible. The boy sustained a greenstick fracture of the left inferior orbital rim, which was not displaced and did not require reduction. In addition to his laceration repair, silicone tubing was placed to stent the lacrimal drainage system on the right. He was placed on an intravenous antibiotic for 2 days until discharge.

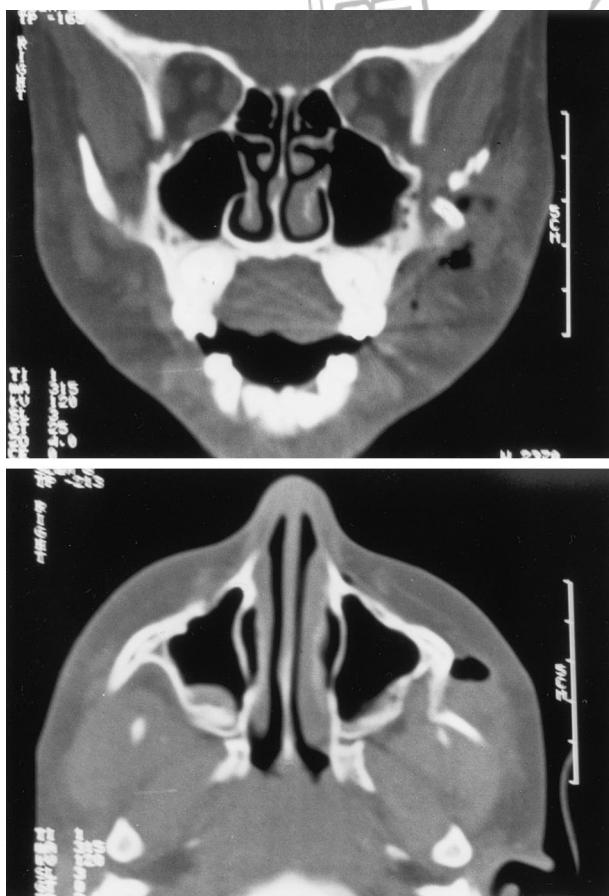


FIG. 1. (Above) Coronal computed tomographic scan showing left comminuted zygomatic arch fracture and lateral maxillary sinus fracture in a 7-year-old girl (case 2). (Below) Axial computed tomographic scan showing left depressed zygomatic arch fracture (case 2).



FIG. 2. Intraoperative view of soft-tissue injury exposing the zygomatic arch fracture (case 2).

Case 4: Fractures of the Orbit, Maxilla, and Zygoma with Laceration of the Lacrimal System

A 4-year-old girl presented with lacerations and tissue avulsion of the right side of her face with full-thickness injury to both the upper and lower eyelids. She sustained several fractures of the lateral orbital wall, the orbital floor, the zygoma, the maxilla, and the zygomatic arch (Fig. 3). The girl underwent open reduction and internal fixation with titanium plates (Fig. 4). She was hospitalized for 3 days and placed on an intravenous cephalosporin. In addition to her fracture repairs, a dacryocystorhinostomy was performed to reconstruct her lacrimal drainage system. The injury to the upper eyelid resulted in ptosis. This was repaired with a frontalis sling using autogenous fascia lata (Fig. 5).

Case 5: Fractured Zygomatic Arch

An 8-year-old boy presented with multiple lacerations on the left side of his face, lateral to the dorsum of the nose and the lateral canthus. Computed tomographic scan documented a fracture of the left zygomatic arch (Fig. 6). He was started on intravenous clindamycin. The boy went to the operating room for repair of his lacerations and reduction of the zygomatic arch fracture. He did not require hospitalization postoperatively and was discharged on Augmentin.

Case 6: Fractures of the Nasal Bone, Maxilla, Zygomatic Arch, and Orbital Floor

A 7-year-old girl presented with a full-thickness flap avulsion involving the nasal dorsum, left lateral nasal wall, left ala, left upper lip, and left periorbital skin. The bony and cartilaginous nasal vault was missing. Her left eye was displaced laterally without globe injury. The left zygoma was crushed deep into the left maxillary sinus. In addition, there were complex lacerations extending full-thickness through the

right cheek (Fig. 7). Irreparable facial nerve damage occurred on both sides of her face. In the operating room, the avulsed soft-tissue component (Fig. 8) was thinned for use as a free full-thickness graft after microscopic exploration did

not reveal any suitable replant vessels. The remnant of the left zygoma was retrieved from within the maxillary sinus, anatomically reduced, and stabilized (Fig. 9). The medial orbit, orbital floor, and lateral orbital wall were reconstructed with a titanium plate. The left medial canthus was repositioned anatomically with a transnasal wire technique. Over the ensuing days, the child had overall excellent take of the graft with the exception of the severely damaged components of the nose (Fig. 10). The parts that progressed to necrosis were debrided and a temporary skin graft was applied. The child was discharged home on hospital day 17 with the plan for secondary nasal reconstruction once the current tissues have fully recovered.

RESULTS

Sixteen cases of dog bite injury involving 27 facial fractures are summarized in Table I. Sixty-nine percent (11 of 16) of these cases involved fractures of the nasal or periorbital region. The orbital, nasal, and maxillary bones were the most frequent sites of fracture, constituting 78 percent (21 of 27) of the reported fractures. If a patient sustained more than one fracture type, each fracture type was counted. A naso-orbital fracture was counted as one nasal, one orbital.

One-third of the cases demonstrated additional problems (Table I). Two cases involving orbital injury required silicone stenting of the lacrimal system. One patient with fractures of the periorbital bones, the zygoma, and the maxilla required a dacryocystorhinostomy and ptosis repair. Two patients suffered permanent facial nerve damage. One patient needed re-



FIG. 3. (Above) Axial computed tomographic scan showing fractures of the lateral orbital wall in a 4-year-old girl (case 4). (Below) Coronal computed tomographic scan showing fractures of lateral orbital wall and the orbital floor (case 4).



FIG. 4. (Left) Intraoperative repair, (center) open reduction and internal fixation, and (right) primary closure of dog bite injury to the right side of the face (case 4).



FIG. 5. Postoperative result showing ptosis repair with a frontalis sling using autogenous fascia lata (case 4).

construction of the orbital floor. Two patients with multiple facial fractures required a blood transfusion.

DISCUSSION

The fractures reported from dog bite have occurred predominantly in the orbital, nasal,

and maxillary regions of the midfacial skeleton (Table I). These areas of facial fracture correspond with the most frequent sites of soft-tissue dog bite injury. The nose, lips, and cheeks have been designated the "central target area" and are the most common structures damaged in cases of facial dog bites.^{1,6,8,9,11}

The majority of cases of facial fracture were associated with some type of soft-tissue injury (Table I). Soft-tissue injuries resulting from dog bite have been classified into lacerations, punctures, and avulsions.^{1,5} Facial fractures may occur with each of the three soft-tissue injury types and occur most often with lacerations. Gonnering¹² generalized that orbital and periorbital dog bites tend to involve periorbital puncture wounds and lid lacerations. This reflects the cases reported here, as four orbital fractures were associated with lacerations. Given this correlation and the potential for damage to the globe, lacerations around the orbit should be explored carefully for the possibility of a fracture. Two puncture wounds in the malar/maxillary region resulted in fracture in this study. Fourie and Cartilidge⁷ have similarly suggested that puncture wounds in these areas be treated with a high index of suspicion for fracture.

The majority of dog bite injuries occur in children, and the most common area to be targeted by the dog in children is the

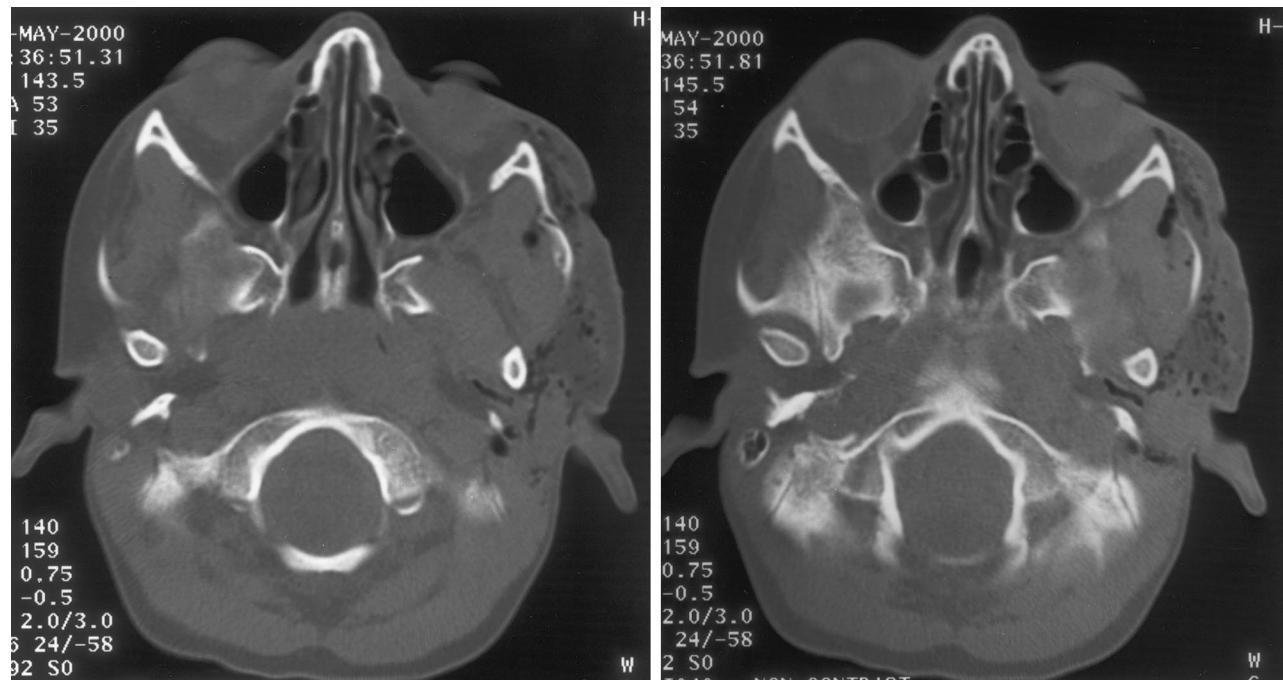


FIG. 6. Axial computed tomographic scan in an 8-year-old girl showing left zygomatic arch fracture (case 5).



FIG. 7. Intraoperative view showing full-thickness injury to the nasal dorsum, left lateral nasal wall, left ala, left upper lip, and left periorbital skin with complex lacerations involving the right cheek (case 6).



FIG. 10. After graft placement with some necrosis along the left nasal border (case 6).

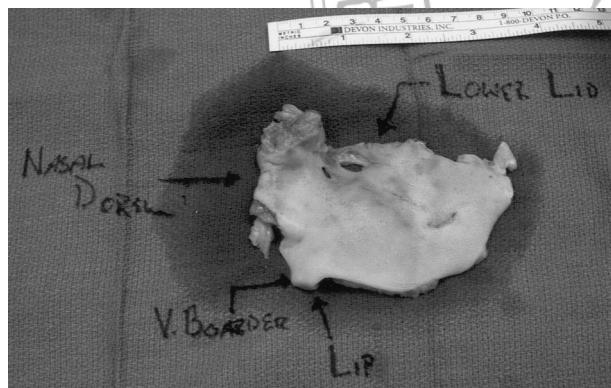


FIG. 8. Avulsed soft-tissue component to be used as a full-thickness graft (case 6).



FIG. 9. Intraoperative view of open reduction and internal fixation (case 6).

head.^{2,3,7-9} Young children are more likely than adults to be attacked in the head region for several reasons. The small stature of the child places his or her head in closer proximity to the dog. The undeveloped motor skills and the relatively large size of the head in comparison with the body in children provide little or no defense against attack. Children are also more willing to bring their faces within the area perceived as an intimate and threatening distance by dogs.² The demographics of those suffering a facial fracture were provided in all but one article (Schultz and McMaster⁶), and in all but one case, the victims were children. Overall, facial fractures are less common in childhood, in comparison with both other bones of the body and the incidence in adults.^{13,14}

Management of these injuries focuses on prevention of infection and repair of skeletal and soft-tissue deformities. The overall rate of infection after a dog bite is low, usually under 10 percent.¹ When infection does develop after dog bite injuries, *Pasteurella multocida* is the most commonly cultured organism, found in over 50 percent of the infections.^{15,16} *Staphylococcus*, 25 percent, and *Streptococcus*, 15 percent, are also commonly seen pathogens. If an infection develops in a wound within 24 hours after a dog bite injury, *Pasteurella multocida* is most likely responsible.¹⁶ Facial dog bites rarely become infected if treated with meticulous irri-

TABLE I
Summary of Six New Facial Fracture Cases and 10 Cases from the Literature

Authors	Patient Age (yr)	Soft-Tissue Injury	Fracture	Dog	Repair	Antibiotics	Complications
Tu et al.	12	Laceration	Compound, comminuted, nasal	Akita	Closed reduction	Cephalosporin IV 3 days	1. Facial nerve damage with weakness of left zygomatic muscle 2. Left alar base, left cheek slumped
Tu et al.	7	Avulsion	Left maxillary and left, comminuted, zygomatic arch	Mastiff	ORIF	Cephalosporin IV 3 days	1. None
Tu et al.	4	Laceration	Greenstick of left orbital rim	Rottweiler	None	Antibiotics IV 2 days	1. Silicone tubing right lacrimal drainage
Tu et al.	4	Laceration, avulsion	Orbital, maxillary, zygoma	Rottweiler	ORIF	Cephalosporin IV 3 days	1. Dacryocystorhinostomy
Tu et al.	8	Laceration	Left zygomatic arch	Rottweiler/Labrador	ORIF	2. Ptosis Clindamycin IV 1 day then Augmentin	1. None
Tu et al.	7	Laceration, avulsion	Left maxillary, comminuted, zygomatic arch, orbital floor, nasal	Pit Bull	ORIF	Cephalosporin IV 5 days	1. Titanium mesh reconstruction of orbital floor 2. Soft-tissue loss 3. Lacrimal duct damage 4. Blood transfusion
Schultz and McMaster ⁶		Puncture	Malar			Antibiotics given but not specified	
Rapuano and Stratigos ²¹	4	Laceration	Mandible		Closed reduction, elastic fixation	Lincomycin IV 1 day then orally 3 days	1. None
Wiseman et al. ²²	<16		Nasal				
Wiseman et al. ²²	<16		Zygoma				
Gonnering ¹²	2.5		Open, left naso-orbital		Open reduction	Cephalosporin IV perioperatively then orally 3 days	1. Silicone tubing nasolacrimal canal
Brogan et al. ²	<16		Naso-orbital				
Brogan et al. ²	<16		Orbital				
Brogan et al. ²	<16		Orbital				
Fourie and Cartilage ⁷	49	Laceration, Puncture	Orbital rim, maxilla	Cross-Rottweiler	ORIF	Penicillin IV and metronidazole for 1 day postoperatively then full course of oral antibiotics	1. None
Anderson et al. ¹⁰	1	Laceration	Right infraorbital, right nasoethmoidal, left malar	Rottweiler	ORIF	Antibiotics given but not specified	1. Blood transfusion

ORIF, open reduction, internal fixation; IV, intravenously.
Blank spaces occur when information was unattainable or not provided.

gation and judicial debridement. The use of pressure irrigation to reduce wound contamination and the rate of wound infection has been demonstrated.^{8,16-18} The cases reviewed here are unique in that they involved fractures and therefore potential osteomyelitis. Lack-

mann et al.⁹ have suggested that any dog bite injury with bone involvement should be treated with antibiotics empirically. Apart from two articles where antibiotic use was not specified, all reviewed cases cited antibiotic use. Among the new and reviewed cases, a cephalo-

sporin was used most often. No infectious complications occurred in any of the cases.

Although these fractures were caused by a dog bite, the actual technique of repair of the facial fractures did not differ from traditional methods of fracture repair. At our institutions, we address these injuries with rigid internal fixation, most commonly with titanium plates and screws. The stability afforded by rigid fixation has been shown to improve rates of bony union and decrease rates of infection.¹⁹⁻²²

Facial fractures resulting from dog bites are not common. However, facial fractures should be actively excluded in any young child with dog bite injuries to the head or midface. A computed tomographic scan is the diagnostic tool of choice in our institutions. The index of suspicion for a fracture should be raised especially when large breeds of dog that are capable of crush-type injuries are involved. Although identification of a fracture may imply that the dog attack was severe, if such patients are properly managed, repairs tend to be uncomplicated.

Paul N. Manson, M.D.

*Division of Plastic, Reconstructive, and Maxillofacial Surgery
The Johns Hopkins University School of Medicine
8152F McElderry
601 North Caroline Street
Baltimore, Md. 21287-0981
pmanson@jhmi.edu*

REFERENCES

1. Hallock, G. G. Dog bites of the face with tissue loss. *J. Craniomaxillofac. Trauma* 2: 49, 1996.
2. Brogan, T. V., Bratton, S. L., Dowd, M. D., and Hegenbarth, M. A. Severe dog bites in children. *Pediatrics* 96: 947, 1995.
3. Gershman, K. A., Sacks, J. J., and Wright, J. C. Which dogs bite? A case-control study of risk factors. *Pediatrics* 93: 913, 1994.
4. Wolff, K. D. Management of animal bite injuries of the face: Experience with 94 patients. *J. Oral Maxillofac. Surg.* 56: 838, 1998.
5. Karlson, T. A. The incidence of facial injuries from dog bites. *J.A.M.A.* 251: 3265, 1984.
6. Schultz, R. C., and McMaster, W. C. The treatment of dog bite injuries, especially those of the face. *Plast. Reconstr. Surg.* 49: 494, 1972.
7. Fourie, L., and Cartilage, D. Fracture of the maxilla following dog bite to the face. *Injury* 26: 61, 1995.
8. Morgan, J. P., III, Haug, R. H., and Murphy, M. T. Management of facial dog bite injuries. *J. Oral Maxillofac. Surg.* 53: 435, 1995.
9. Lackmann, G. M., Draf, W., Isselstein, G., and Tollner, U. Surgical treatment of facial dog bite injuries in children. *J. Craniomaxillofac. Surg.* 20: 81, 1992.
10. Anderson, P. J., Koppel, D. A., Moos, K. F., and MacKay, I. R. Personal communication.
11. Palmer, J., and Rees, M. Dog bites of the face: A 15-year review. *Br. J. Plast. Surg.* 36: 315, 1983.
12. Connering, R. S. Ocular adnexal injury and complications in orbital dog bites. *Ophthal. Plast. Reconstr. Surg.* 3: 231, 1987.
13. Anderson, P. J. Fractures of the facial skeleton in children. *Injury* 26: 47, 1995.
14. Posnick, J. C., Wells, M., and Pron, G. E. Pediatric facial fractures: Evolving patterns of treatment. *J. Oral Maxillofac. Surg.* 51: 836, 1993.
15. Mason, A. C., Zabel, D. D., and Manders, E. K. Occult craniocerebral injuries from dog bites in young children. *Ann. Plast. Surg.* 45: 531, 2000.
16. Kenevan, R. J., Rich, J. D., Gottlieb, V., and Muench, A. G. A dog bite injury with involvement of cranial content: Case report. *Mil. Med.* 150: 502, 1985.
17. Gross, A., Cutright, D. E., Bhaskar, S. N., et al. The effects of antibiotics and pulsating water jet lavage on contaminated wounds. *Oral Surg. Oral Med. Oral Pathol.* 31: 32, 1971.
18. Chisholm, C. D., Cordell, W. H., Rogers, K., et al. Comparison of a new pressurized saline canister versus syringe irrigation for laceration cleansing in the emergency department. *Ann. Emerg. Med.* 21: 1364, 1992.
19. Zachariades, N., Papademetriou, I., and Rallis, G. Complications associated with rigid internal fixation of facial bone fractures. *J. Oral Maxillofac. Surg.* 51: 275, 1993.
20. Cohen, M. (Ed.). *Mastery of Plastic and Reconstructive Surgery*. Boston: Little, Brown, 1994. P. 721.
21. Rapuano, R., and Stratigos, G. T. Mandibular fracture resulting from dog bite: Report of a case. *J. Oral Surg.* 34: 359, 1976.
22. Wiseman, N. E., Chochinov, H., and Fraser, V. Major dog attack injuries in children. *J. Pediatr. Surg.* 18: 533, 1983.