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The Treatment of Gunshot Wound with Maxillofacial Fracture in a Dog

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Abstract : A one-year-old, intact male, 24 kg, mixed breed dog was referred to the Animal Medical Center, Iksan, Chonbuk, Korea for treatment of a gunshot wound to the head. Physical examinations revealed bilateral nasal bleeding and open-mouth breathing. Radiographic examination showed fracture of the right maxilla bone and multiple fractures of the nasal bone. A 1 cm × 1 cm × 1.8 cm region of mineral opacity material was observed in the right-cranial ventral-nasal cavity and a 6 mm × 6 mm × 9 mm region of mineral opacity material was present in the left-cranial dorsal-nasal cavity. The surgical procedure involved removal of bone fragments and the lodged bullet as well as the installation of three intraosseous wires. At two weeks after surgery, the patient exhibited no complications and had a good prognosis.

Key words **:** gunshot, maxillofacial, wire fixation, dog.

Introduction

Gunshot wounds associated with maxillofacial fractures are uncommon. In one study, which included a total of 121 cases, 14.3% of the cases involved trauma to the head and neck (13). Treatment for maxillofacial fracture includes conservative management, surgical fixation, and/or maxillectomy (4,16). Surgical fixation techniques include installing intraosseous wire, as well as external skeletal fixation and plate fixation. The intraosseous wiring technique has no stability in rotation or resistance to bending forces; however, it is less expensive than other fixation materials and can be easily installed between bone fragments (7). External skeletal fixation can be used in comminuted fractures, or with large gaps and severe soft tissue damage, as well as for temporary fixation (2). Plate fixation technique can provide three-dimensional buttress support; however, the associated screws may not achieve adequate purchase in thin bone, and there may be difficulty in matching the plate to bone contours (18). In the present case, we used the intraosseous wire fixation technique, and, in this report, we describe the management of a gunshot injury in the maxillofacial region of a dog.

Case

A one-year-old, intact male, 24 kg, mixed breed dog was referred to the Animal Medical Center, Iksan, Chonbuk, Korea for treatment of a gunshot wound to the head. The patient had been injured when a hunter killed a wild boar while the dog was trapped under the boar. On physical examination, the patient showed bilateral nasal bleeding and open-mouth breathing (Fig 1). Lung and heart auscultation were normal, and there was no other injury. Antimicrobial susceptibility testing was performed in the bleeding injury area, and no abnormalities were detected in blood test results. Radiographic examination revealed fracture of the right maxilla and multiple fractures of the nasal bone. A 1 cm × 1 cm × 1.8 cm area of mineral opacity material was observed in the right-cranial ventral-nasal cavity, and a 6 mm × 6 mm × 9 mm area of mineral opacity material was present in the left-cranial dorsal-nasal cavity (Fig 2). Based on the radiographic examination results, we inferred that the bullet penetrated the nasal cavity from the right side and passed to the left. Closed oral examination revealed multiple hard palatal defects as

Fig 1. The patient's initial facial features following the gunshot injury. Nasal bleeding and open-mouth breathing were observed. There were bilateral skin injuries inferred to be the result of bullet penetration.

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Fig 2. Pre-operative radiographic images reveal right maxilla bone fracture and multiple fractures of the nasal bone. A 1 cm × 1 cm × 1.8 cm area of mineral opacity material was present in the right-cranial ventral-nasal cavity, and a 6 mm × 6 mm × 9 mm area of mineral opacity material was observed in the left-cranial dorsal-nasal cavity.

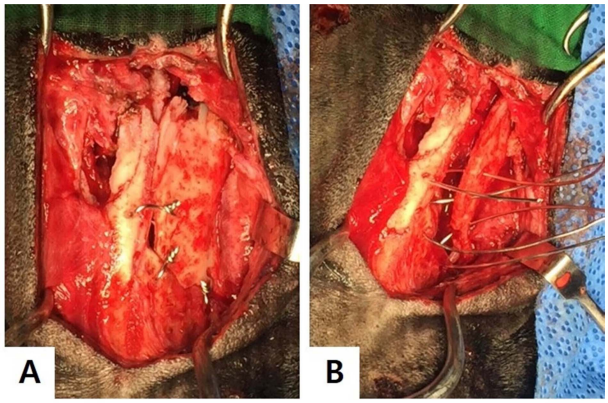

Fig 3. Intra-operative surgical images. During surgery, multiple small bone fragments and two bullet fragments were removed. Subsequently, three flexible intraosseous wires, visible in both images, were applied between the nasal and maxillary bones. Skin closure was performed by using the general closure method.

well as communication between the oral and nasal cavities.

For surgery, propofol (Provive 1%, Myungmoon Pharm Co Ltd, Hwaseong, Republic of Korea) 6 mg/kg was used as the anesthetic induction agent and sevoflurane (Sevofran, Hana Pharm, Hwaseong, Republic of Korea) was used as the anesthetic maintenance agent. Cefazolin (Cefazolin, Chong Kun Dang, Seoul, Republic of Korea) 22 mg/kg intravenous (IV) and tramadol (Maritrol, JE IL PHARM, Daegu, Republic of Korea) 3 mg/kg IV were used as premedications.

The patient was prepared and placed in sternal recumbency. A dorsal median incision from 2 cm caudal to muzzle to 2 cm cranial to orbit was made, and multiple small bone fragments and two bullet fragments were removed. Subsequently, three flexible intraosseous wires were installed between the nasal and maxillary bones (Fig 3). Skin closure was performed by applying the general closure method. Hard palatal defects were closed with 2-0 polydioxanone (PDS plus, Johnson & Johnson Medical Korea, Seoul, Republic of Korea); in addition, pharyngostomy was performed.

Postoperative medications were cefazolin (Cefazolin, Chong Kun Dang, Seoul, Republic of Korea) 22 mg/kg twice a day (bid) IV, tramadol (Maritrol, JE IL PHARM, Daegu, Republic of Korea) 3 mg/kg bid IV, carprofen (Rimadyl, Zoetis, Seoul, Republic of Korea) 2.2 mg/kg bid PO, and ranitidine (Ranitac, Hana Pharm, Hwaseong, Republic of Korea) 1 mg/kg bid IV for 3 days. After obtaining the results of the susceptibility test, Cefazolin (Cefazolin, Chong Kun Dang, Seoul, Republic of Korea) was changed to Enrofloxacin (Baytril, Bayer, Seoul, Republic of Korea) 10 mg/kg once a day (sid) SC.

One week after surgery, the pharyngostomy tube was removed. Two weeks after surgery, the patient visited the hospital for re-examination. Physical examination showed that the soft tissue swelling had decreased, and there were no signs of bleeding or infection. On radiographic examination, the three intraosseous wires were maintained in the same positions as those after surgery. Laboratory examination results were normal.

Discussion

The prevalence of gunshot wounds varies according to geographic location and each country's firearm possession laws (12). In Korea, hunters are required obtain a firearm license permit and a hunting license. Compared to other countries, the prevalence of gunshot wounds is uncommon in Korea. In addition, according to one retrospective study, gunshot wounds to the head occurred in only 14.3% of such wounds (13). That study classified wound locations as head and neck (without central nervous system involvement), central nervous system, dorsal thoracic and lumbar areas (without spinal cord involvement), forelimbs, hindlimbs and pelvis, penetrating or perforating the thoracic cavity, penetrating or perforating the abdominal cavity with internal organ injury, and penetrating the abdomen without apparent visceral injury. Another study reported that gunshot head wounds occurred in 11% of gunshot wounds (5). To our knowledge, four previous cases of gunshot wounds to dogs have been reported in Korea, but the present case is the first reported case of a gunshot wound to the maxillofacial region of a dog in Korea.

Maxillofacial fractures can be reduced with conservative treatment, such as through interosseous wire fixation or mini-plate fixation (1,5,6). Conservative management is usually recommended for soft tissue injuries without fractures or with minimal deviation of bone fragments and is preferred when there is difficulty in obtaining adequate stabilization of the multiple, thin bone fragments (5,8). Intraosseous wiring fixation is a suitable choice for comminuted longitudinal fractures and multiple transverse fractures, however, it only provides two-dimensional stability (8). A long-term follow-up clinical study showed that rigid plate fixation can provide a better prognosis than intraosseous wiring fixation (14). Mini-plate fixation generates a more rigid fixation than intraosseous wiring fixation, but the fixation screws may not achieve adequate purchase in thin bone, and there may be difficulty in matching the plate to the contours of the bone fragments (8,18). In the present case, there was incisive bone sublux-

ation, comminuted fractures in the nasal bone, and longitudinal fracture in the maxillary bone. The multiple fragments of the comminuted nasal bone fractures were removed because the bone had been crushed by the bullet. The nasal bone defect did not undergo treatment further than the removal of the broken pieces. The longitudinal maxillary bone fracture could have been reduced through intraosseous wire fixation or mini-plate fixation. In this case, mini-plate fixation could not be applied due to the nature of the nasal bone defect. Thus, we used intraosseous wiring fixation with three wires to achieve longitudinal maxillary fracture. There are many regimens for treating maxillary fractures, and regimen selection depends on fracture type and location, patient characteristics, and surgeon's experience and preference. As a result, the selected surgical method will differ case by case.

In general, a gunshot wound could result in contamination, nerve injury, malocclusion, and/or lead poisoning (11,15). In such wounds, palatal defect communication between the oral and nasal cavities is an important cause of inflammation, as well, the bullet can cause contamination (15,17). Palatal defects can be reduced by a simple suture or by a flap technique if there is tension at the suture line (10). In the present case, the palatal defects were sutured without tension at the suture line after reconstructing the maxillary bone and nasal bone fractures; thus, the flap technique was not required. The patient underwent pharyngostomy to prevent contamination when the patient takes in food through the mouth and to avoid affecting the reconstructed but unstable fracture region. Peripheral nerve injuries, particularly trigeminal and facial nerve, are common in gunshot wounds, however, it is difficult to undertake an accurate neurologic examination during the initial examination (11). Considering the injured region, trigeminal and facial nerve injury would be expected in this patient. When re-examined 2 weeks after surgery, the dog's right buccal region pain response was decreased; moreover, malocclusion was detected upon physical examination, but it was not an apparent problem to the patient. A retained bullet can result in lead poisoning, fistula formation, and recurrent infection (3,9). To prevent such complications, as much as possible of a bullet should be removed from a gunshot wound. In this patient, two large bullet fragments in the nasal cavity were removed. As well, as much as possible of the tiny bullet fragments were removed; however, tiny fragments that could not be distinguished with the unaided eye during surgery remained in the right-cranial upper-buccal region after surgery. Based on results of physical and laboratory examinations at 2 weeks after surgery, there were no signs of lead poisoning or other problems.

Conclusion

This case report describes an uncommon gunshot wound in a dog and the successful surgical reconstruction of the wound by using intraosseous wiring fixation. To the authors' knowledge, this is the first case report, in Korea, describing reconstruction of a gunshot wound in the maxillofacial region of a dog.

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