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Application of Plate and Circumferential Wiring with Resin to Bilateral Mandibular Fractures in a Calf: Case Report

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Abstract : A 2-month-old, 50 kg male Korean native calf was referred with bilateral mandibular fractures. The bilateral mandible was hanging loose, with inability to use the jaw, indicated by excessive salivation. Radiography revealed a long oblique fracture in the right mandible, and a short oblique fracture in the left mandible. Computerized Tomography, a different form of radiography, revealed the fracture in the left mandible to be a comminuted fracture. In order to stabilize the bilateral mandible fractures, a combination of bone plate and wiring was applied; in addition, resin was applied to enhance stabilization of the mandible. Six weeks after surgery, the calf was able to masticate and ruminate well. In this case, application of the plate and wiring with resin to bilateral mandibular fractures presented a successful functional recovery. Accordingly, the combination of bone plate and wiring with resin can be an effective technique for treating mandibular fractures.

Key words **:** calf, mandibular fracture, plate, wire, resin.

Introduction

Bovine mandibular fractures are uncommon and even less commonly treated (4). Many factors can cause mandibular fractures in cattle. In calves, the most common is traumatic injury. Blunt trauma is commonly caused by the mother. Other factors include dystocia during manual extraction of the calf, or other kinds of severe trauma such as slipping or falling on a hard surface (10).

The dental formulae of calves are 0/0/3 in the maxilla and 3/1/3 in the mandible. Some authors refer to the canine tooth as a fourth or corner incisor. The wide gap that separates the incisors from the premolars is called the diastema (11). The most common fracture sites of the mandible are the interdental space (diastema), the molar region, and the symphysis (3,10).

If the fracture is minimally displaced, so that it does not impede the animal's ability to masticate, swallow, or breathe, it can be treated conservatively (13). However, some authors insist that conservative management of mandibular fractures in cattle has a poor prognosis, because the animals are unable to chew and therefore lose weight rapidly (10). Some calves fracture the rostral aspect of both mandibles in the interdental space, resulting in significant displacement that requires treatment. The goal of surgical treatment of mandibular fractures is to achieve temporary stabilization of the main fragments in order to allow pain-free mastication and rumination, until callus formation is sufficient to stabilize the fracture (14).

Understanding the biomechanics of the mandible is critical to fracture repair, as it dictates optimal implant placement. Bending forces are the primary forces acting on the mandible. A continuum of tensile-to-compressive stresses exists from one side of the bone to the other during bending stress. Tensile stresses exist at the oral, or alveolar surface, while compressive stresses exist at the aboral, or ventral margin of the mandible (6). When eating or ruminating, calves apply disruptive forces against the fracture, and the tension side is on the oral surface of the mandible. Implants should thus be placed on the tension side (13).

In equines, mandibular fractures can be treated by intraoral or extraoral fixation techniques. Intraoral fixations include cerclage wires, Steinmann pins, screws, the U-bar, dental acrylic, or plates. Combined modalities are commonly used in equines (2,5,12). In calves, mandibular fractures are treated less commonly. However, the present case was treated using a combination of bone plate and wiring with resin. In this report, we explain the application of this combination technique to bilateral mandibular fractures, which resulted in the animal's successful recovery.

Case Report

A 2-month-old, 50 kg male Korean native calf was referred with bilateral mandibular fractures. It was assumed that the animals had been kicked by its mother while suckling, and it was believed that the fracture occurred at dawn or late the night before. The bilateral mandibles were hanging loose with inability to use the jaw, indicated by excessive salivation.

On physical examination vital signs were normal, but the mandible was bilaterally fractured in the diastema region. Edema was presented in the sublingual region (Fig 1). The incisors and canine teeth presented restricted mobility. Clinical pathology testing did not produce specific values. For

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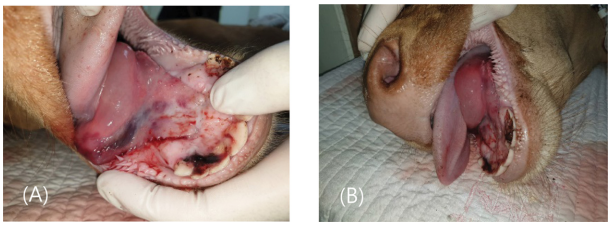

Fig 1. Lower jaw and sublingual region. (A) The mandible was fractured bilaterally in diastema region. (B) Edema was presented in sublingual region.

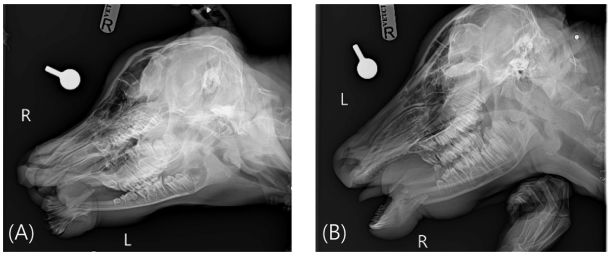

Fig 2. Preoperative radiographs. In oblique view, (A) Left mandible was short oblique fracture and caudal, ventral, lateral displacement of fragment. (B) Right mandible was long oblique fracture and caudal, ventral, medial displacement of fragment.

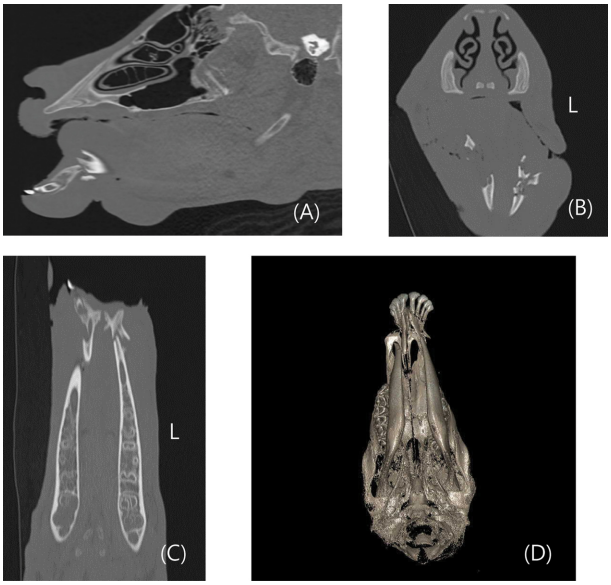

Fig 3. CT images and 3D reconstruction image. (A) is sagittal plane image. (B) is transverse plane image. (C) is dorsal plane image. (D) is 3D reconstruction image.

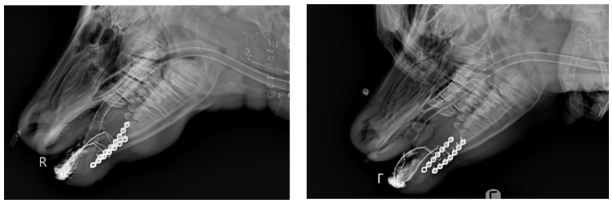

Fig 5. Immediate post-operative radiography. In oblique view, mandible was stabilized by implants and was corrected to its position.

radiographic examination, Xylazine (Rompun; Bayer, 0.1 mg/kg) and Ketamine (Ketamine; Yuhan, 4 mg/kg) were administered via intramuscular injection. Radiography revealed a long oblique fracture in the right mandible, with caudal, ventral, and medial displacement of fragments. The left mandible presented a short oblique fracture, with caudal, ventral, and lateral displacement of fragments (Fig 2). A CT scan revealed a comminuted fracture in the left mandible, while for the right mandible the results were from the same as those for radiography. TM joints and teeth were normal (Fig 3).

For surgery, propofol (Provive; Myungmoon, 6 mg/kg) was used as the anesthetic induction agent, while sevoflurane was used for the anesthetic maintenance agent. Cefazolin (CEFOZOL; Korus, 25 mg/kg) and tramadol (Toranzin; Samsung Pharm., 3 mg/kg) were used for premedication.

The calf's lower jaw was clipped and placed in ventrodorsal recumbency, and an incision was performed from the canine teeth to first premolar teeth. The right mandible long oblique fracture was reduced and fixated by a 2.7 locking plate (BS Corem; Jeonbuk, Korea) on the ventral margin of the mandible (Fig 4(A)). Circumferential wiring was then applied to the right mandible using a 21G needle and 23G cerclage wires, while a wire knot was placed in front of the incisors (Fig 4(B)). For the left mandible, the main fragments of the comminuted fracture were reduced by fixation of a 2.7 locking plate to the ventral margin of the mandible. Circumferential wiring was then applied to the left mandible in the same way as for the right mandible. The incision site was sutured using the conventional technique.

The calf's position was then changed to dorsoventral recumbency. The sublingual edema was incised, drained, and sutured. Etching and bonding was applied to the incisors and canine teeth to prepare for the application of resin. Resin was then applied to all of the incisors and canine teeth to reduce mobility, improving stabilization of the mandible (Fig 4(C)).

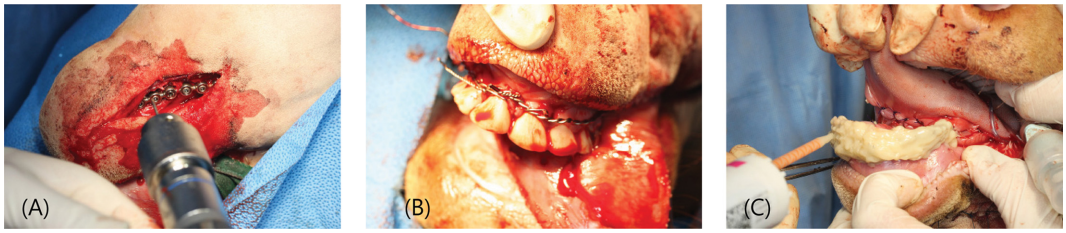

Fig 4. Intraoperative surgical Images. (A) Right mandible long oblique fracture was reduced and fixated by 2.7 locking plate on ventral margin of mandible. (B) Circumferential wiring used 21G needle and 23G cerclage wires. And wire knot was placed in front of incision teeth. (C) All incision teeth & canine teeth were applied resin to reduce mobility and the resin improved the stabilization of the mandible.

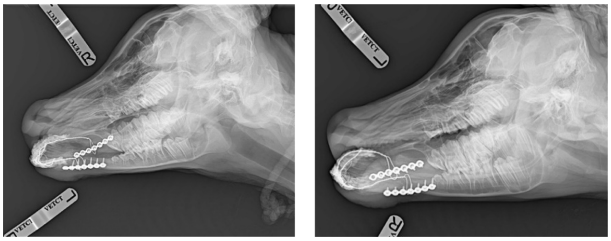

Fig 6. Radiographs 2 weeks after surgery. In oblique view, Implants were maintained in the same positions as those after surgery.

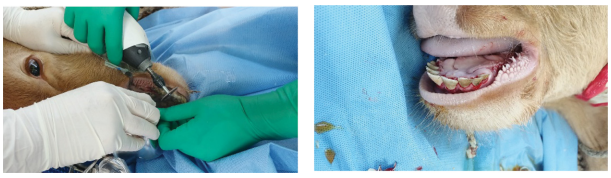

Fig 7. Implants removal 6 weeks after surgery. The calf could masticate and ruminate well, so the wire and resin were removed.

Post-operative radiography was performed immediately (Fig 5). The post-operative medications were penicillin and streptomycin (PPS; Daesung, 0.06 ml/kg) at two-day intervals via intramuscular injection. The incision site was disinfected using Povidone-iodine 0.5%, and Povidone-iodine ointment was applied twice daily.

Two weeks after surgery, the suture was removed and radiographs taken. Radiography revealed that the implants had maintained the same positions as after surgery (Fig 6). By six weeks after surgery, the calf was able to masticate and ruminate well, so the wire and resin were removed (Fig 7).

Discussion

Appendicular fractures (i.e. to bones of the front or hind limbs) are common in calves, but fractures involving the axial skeleton (skull, spine, pelvis) are less common, and less commonly treated. The most common bones involved in fractures in calves are the metacarpus and the metatarsus, followed by the tibia, the radius and ulna, the humerus, and the femur. Although fractures of the axial skeleton and phalanges are rare, the most common axial skeleton fractures are to the sacrum, followed by the pelvis, and the mandible (4). According to a paper published in 2019, of 278 fractures in bovines, the number of fractures involving long bones was 251, while only 15 in cattle were mandibular fractures. Among these 15 mandibular fractures, 6 cases involved bilateral mandibular fractures, which accounted for only 2% of the total number of fractures (15). Since in the present case the calf mandible was fractured bilaterally, it was therefore highly uncommon.

The surgical techniques used for bovine mandibular fractures in the diastema region include circumdental wiring, cross pinning, tension band wiring, external skeletal fixator, and bone plate (13). In this case, a combination of bone plate and wiring was used, while resin was also applied to enhance stabilization of the mandible.

The bone plates used for fixation were 2.7 locking reconstruction plates. The wire used for the circumferential and tension band wiring was 23G stainless steel orthopedic cerclage wire. The etchant material was of the semi-gel type and contained 37% phosphoric acid. The bonding agent used was a fifth-generation single component bonding agent, of the "one-bottle systems" type that combines the primer and adhesive into one solution. These bonding systems create a mechanical interlocking bond with etched dentin and show high bond-strength values both on etched enamel and dentin (7). The resin used was bis-acryl composite resin, a temporary crown and bridge material automix system. This dental acrylic technique serves as a buttress to enhance stability. The acrylic composite resin used in this case does not produce an exothermic reaction during the hardening process, so is not harmful to the gingival tissues (5,8).

In this case, the mandible fractures were bilateral, with a comminuted fracture in the left mandible. The use of a plate was chosen in order to reduce and stabilize the mandible fracture, and an attempt was made to apply two plates to the ventral margin and the alveolar margin (9). The ventral margin plate was successfully applied, but the alveolar margin plate could not be applied. When drilling the alveolar margin, the bone was too fragile, so application of the plate was unsuccessful (5). Circumferential wiring, tension band wiring, and resin were chosen in order to reduce bending forces and the mobility of the incisor tooth and canine teeth. These were used to support stabilization of the mandible. This combination of plate, wiring and resin, enabled the mandible fractures to be stabilized successfully, leading to a successful prognosis.

In a previous study, among 17 cases of bovine mandibular fractures, seven cases required euthanization or slaughter, while five cases received conservative therapies. Surgical treatment of fractures was attempted in only five cases. Of these, four cases involved neonates and one involved an animal one month after birth. Among the cases that received surgical treatment by internal fixation, all four neonates died due to conditions related to septicemia, while only the one month after birth case survived (1). According to this study, the age at which mandibular fractures are sustained may be related with the prognosis. Since the calf in the case presented was two months old when it sustained its injuries, this may have been a factor in its positive prognosis.

Conclusion

This case report has described bilateral mandibular fracture repair in a calf. Bilateral mandibular fractures in calves are uncommon, and even less commonly treated. Surgical treatment of mandible fractures in a calf using a combination of plates and wiring with resin suggests that it offers an effective treatment option.

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