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NOTE

Surgery

Bilateral rostral mandibulectomy for treatment of necrotic mandibular open fractures in two Japanese Black cattle

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ABSTRACT. Two-month-old (Case 1) and one-year-old (Case 2) Japanese Black cattle presented with bilateral rostral mandibular open fractures. At presentation, the proximal edges of each fracture were discolored and had a severe stench, indicating necrosis caused by infection. In both cases, a bilateral rostral mandibulectomy over the symphysis was performed. Although the tongues of both animals prolapsed post-surgery, they had no significant problems with eating or drinking. Case 1 showed excellent growth during fattening, and Case 2 successfully became pregnant and gave birth. Rostral mandibulectomy can be an effective surgical option for the treatment of cattle with difficulty in internal or external fixation due to unfavorable necrotic cranial mandibular open fractures.

KEY WORDS: bilateral rostral mandibulectomy, Japanese Black cattle, necrotic mandibular open fracture

Mandibular fracture is frequently encountered in bovine veterinary practice, and the most common site of the fracture is in the rostral aspect of the bone [3]. Patients display an inability to feed and show excessive salivation. The diagnosis is relatively easy to make on the basis of clinical findings, and radiology can confirm the location and severity of the fracture [3].

Regardless of the animal species, the fundamental principles for the treatment of mandibular fractures would be to reduce anatomically the displacement of the fracture and obtain stabilization. Several surgical techniques for internal and external fixation have been proposed for bovine mandibular fractures, for example wiring, pinning, acrylic splinting, screwing, plating, and using a U-bar or Kirschner-Ehmer splint [1–6, 10, 11]. The availability of external coaptation for rostral fractures in calves has also been reported by Taguchi and Hyakutake [12]. Which option to use is determined based on the location and type of fracture and/or the surgeon's skills.

In calves, the rostral aspect of the mandible close to tooth root or including the symphysis is commonly fractured by trauma or obstetric manipulation [3]. Although a desirable treatment is considered one that preserves the teeth through internal fixations for stabilization, tooth extraction is often used because of the possible complication of abscess and/or for financial reasons [3]. In addition, rostral fractures involving the interdental space tend to have a serious deviation of the bone, resulting in an open fracture of the oral cavity that can often lead to complex bacterial infections [3].

Recently, the authors encountered bilateral rostral mandibular open fractures in two Japanese Black cattle. In both cases, the fracture edges had protruded into oral cavity and were suspected to have already been infected, and a desirable osseous fusion without complications was estimated to be difficult regardless of the surgical option to be performed. Taking a reference from surgical oncology [7], the authors performed a bilateral rostral mandibulectomy on the patients with necrotic open fractures.

This paper describes the clinical findings and surgical outcomes of two bovine cases that underwent bilateral rostral mandibulectomy.

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Case 1: A two-month-old, male, 92 kg, Japanese Black calf was presented to the Veterinary Teaching Hospital, University of Miyazaki for the surgical treatment of a bilateral open fracture of the rostral mandible. The owner of the calf informed that the fracture had possibly been caused by impact with an iron holder for a milk feeding bottle. The referred veterinarian attempted to restrict chewing and maintained the condition with the nasal feeding of milk. Sixteen days had passed from the accident to presentation at our hospital. At presentation, the calf's body temperature, pulse, and respiration were 39.6°C, 72/min, and 48/min, respectively, and the calf had severe salivation with an oral stench indicating bacterial infection. The calf reacted from mandible palpation, and the fractured edges were visible through the oral cavity. Furthermore, radiography revealed that the fracture location was extremely close to the dental roots of the incisors. On the basis of these findings, a desirable union of the fractured mandible seemed impossible and bilateral rostral mandibulectomy was selected for the calf. The calf was sedated with xylazine (0.2 mg/kg, Bayer, Osaka, Japan) via intravenous injection, followed by intubation, and anesthesia was maintained with isoflurane in oxygen. The calf was positioned in dorsal recumbency and further oral observation revealed that both of the edges of the fracture were discolored (black-brown color), suggesting that the edges had necrosed (Fig. 1). First, by manipulating the distal fractured part ventrally using towel forceps, the proximal normal mandibular bone was exposed by incision and the separation of the oral and gingival mucosa covering the bone. Prior to the incision, 5 m*l*, 2% lidocaine solution (AstraZeneca K.K., Osaka, Japan) was injected around the incised regions of the oral and gingival mucosa. Next, the bone with the necrotic edge was cut with a grossly clear margin using an electrical oscillating saw. Then, an *en bloc* resection of the incisors along with the distal fractured edge was performed. The lip and mandibular skin tissue were left for use in the later reconstructive surgery. The mandible was covered by the submucosal connective tissue of the lower lip and sutured along with the oral and gingival submucosal tissue with absorbable suture material (VICRYL 1, Ethicon Inc., Cincinnati, OH, USA). The excess lip with the soft tissue of the lower jaw was trimmed for the cheiloplasty, and the lip was sutured avoiding the midline in order to prevent the calf from damaging the surgical wound at feeding (Fig. 2). Oxytetracycline (10 mg/kg, Kyoritsu Seiyaku Co., Tokyo, Japan) and ampicillin (10 mg/kg, Nippon Zenyaku Kogyo Co., Ltd., Fukushima, Japan) and flunixin meglumine (2 mg/kg, Intervet K.K., Osaka, Japan) were administered for 10 days and seven days, respectively. For four days post-surgery, the calf received milk via nasal tube. At five days post-surgery, a small amount of grass and pellet feeding was initiated for the calf. At eight days post-surgery, purulent discharge was drained from the surgical wound, and the lesion received lavage, partial debridement, and a local injection of benzyl-penicillin procaine/dihydrostreptomycin sulfate solution (Meiji Seika Pharma, Co., Ltd., Osaka, Japan). No further problems were recorded, and the calf was discharged at 15 days post-surgery. Radiography suggested no significant findings in the osteotomized bones at 22 days post-surgery (Fig. 3a). At 118 days post-surgery, however, radiography revealed bilateral osseous proliferation from the resected edge forming a U-shape, much like mandibular regeneration (Fig. 3b). Involucrum formation was also observed (Fig. 3b), but there was no suppurative discharge. The calf had good growth during fattening with no significant problems for approximately 24 months except for tongue prolapse (Fig. 4).

Case 2: A one-year-old, female, 323 kg, Japanese Black cow had a rostral bilateral mandibular open fracture from impact with a fence on a farm. The patient was presented to our hospital eight days post-fracture for surgical management. The fracture was

Fig. 1. Gross appearance of the oral cavity just before surgery in Case 1. The fractured mandible is displaced and exposed to oral cavity, accompanied by the discolor.

Fig. 2. Gross appearance after surgery in Case 1. In order to prevent direct damage during feeding, surgical suture line was avoided midline of the lower lip.

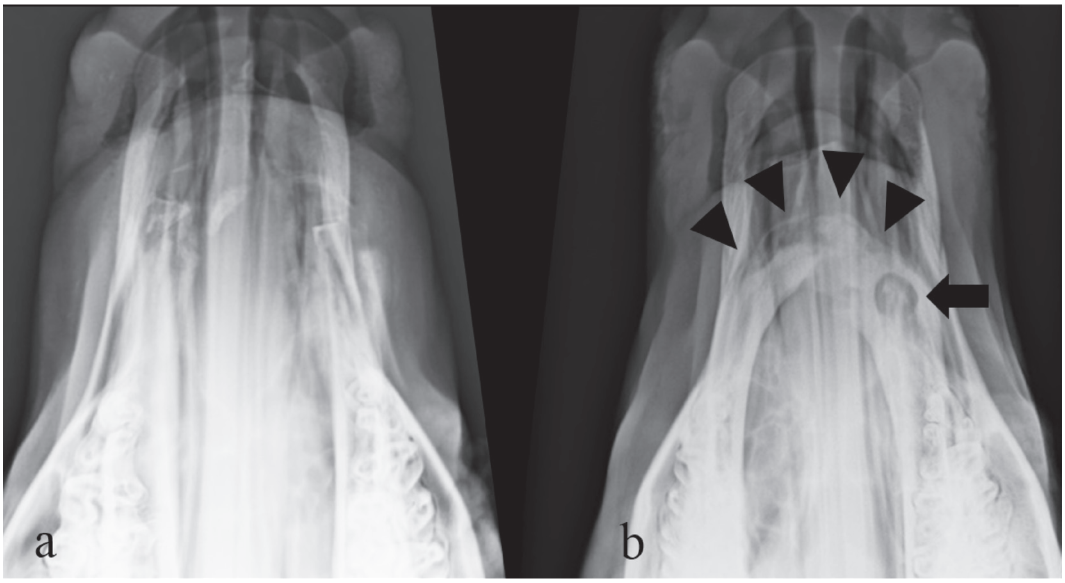

Fig. 3. Radiographs in Case 1, showing no significant changes in the mandible at 22 days post-surgery (a). At 118 days post-surgery, however, the mandible had osseous proliferation (arrowheads) from the resected edge forming U-shape, much like mandibular regeneration (b). Involucrum (arrow) was also detected in the mandible, but the discharge had not been observed during fattening.

Fig. 4. Gross appearance of Case 1 before the forwarding.

Fig. 5. Image for drinking of water in Case 2 at next day post-surgery.

similar to that of Case 1. Radiography confirmed the fracture site close to teeth roots. At presentation, the animal had a body temperature of 39.4°C,was alert, and displayed frustrated actions. The surgical procedure was almost consistent to that of Case 1. In brief, the animal received xylazine (0.2 mg/kg) sedation and general anesthesia with isoflurane in oxygen. The proximal aspect of the fracture was resected at the normal margin of the mandible, and the jaw was managed by reconstructive surgery as in Case 1. At first, the surgeon tried the mandibular resection with a wire saw for the osteotomy, but the bone was too rigid to cut and an electrical oscillating saw needed to be used. Oxytetracycline (10 mg/kg) and flunixin meglumine (2 mg/kg) were administered, and feeding was restricted until the next day in this case. After confirmation of the ability to drink water (Fig. 5), the animal was discharged two days post-surgery. Thereafter, the animal received antibiotics for 7 days and had no troubles concerning eating or drinking on the farm, and there was also no problem with the surgical wound healing. The animal came into heat two months post-surgery and successfully became pregnant through artificial insemination. The cattle delivered a calf 310 days post-surgery. At 318 days post-operation, radiography confirmed osteogenesis much like mandibular regeneration, the same as in Case 1 (Fig. 6).

Bilateral rostral mandibulectomy is commonly performed in dogs with benign and malignant oral tumors, such as acanthomatous ameloblastoma and squamous cell carcinoma [7]. In farm animals, however, the surgery has only been reported in a horse and cow with rostral ameloblastic tumors [9, 13]. In the former case, a 21-year-old mare received surgery for a rostral tumor and remained in good condition for 18 months without tumor recurrence and no complications [9]. In the latter case, a one-year-old heifer

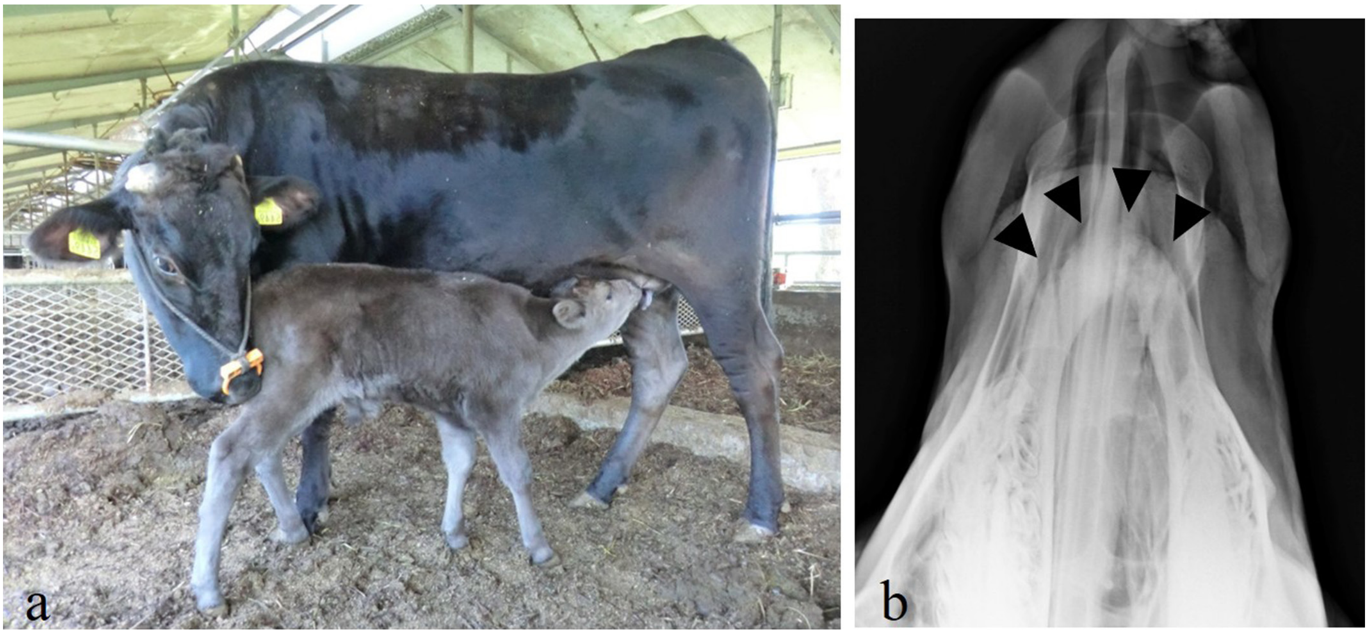

Fig. 6. Case 2 with a calf at 318 days post-surgery (a). Radiography demonstrated that the mandible had osteogenesis (arrowheads) as in Case 1 (b).

received a rostral mandibulectomy for ameloblastic fibro-odontoma, and the animal had an acceptable cosmetic appearance without a regrowth of the tumor for one year [13].

This report has described bilateral rostral mandibulectomy in two Japanese Black cattle with necrotic mandibular open fracture. Prior to the surgery, the main complication we expected was the inability to eat post-surgery. As for the results, however, the animals had no problems with prehension, eating, or drinking. The second complication that was considered was the instability of the mandible after osteotomy. While this complication can be avoided by preserving the symphysis in unilateral rostral mandibulectomy [14], our cases required mandibulectomy over the symphysis at the level of the inter-dental space. In addition, malocclusion or mandibular instability due to mandibulectomy may also have the potential to lead to temporomandibular joint disease in dogs [7].

Our two patients did not develop the complications. Case 1 had favorable growth, and Case 2 became pregnant post-surgery. The reason might be due to differences in dental articulation and mastication between carnivores and herbivores. In addition, in our two cases reported here, osseous proliferation from each hemi-mandible showed fusion and regeneration of the mandible. This unique phenomenon was also described in a horse by Mendez-Angulo *et al*. [9]. Despite uncertainty regarding the mechanism and morphogenesis, chronic and intermittent movement of the lingual site and mastication may have promoted the regeneration of the mandible. The reconstructed bridge may have also contributed to the long-term stability of the lower jaw in our patients. To our knowledge, this is the first description of such cases in the bovine literature.

In dogs and cats that have undergone mandibulectomy, complications including poor cosmetic appearance, incisional swelling, ranula-like lesions, wound dehiscence, excessive drooling, and miscellaneous other symptoms (hemorrhage, infection, and pain) have been reported [7]. Dogs that have undergone mandibulectomy usually present with good to excellent cosmetic appearance [7]. In a bovine case of mandibulectomy, the patient did not show tongue protrusion because an oblique osteotomy was performed at the level of the palatine fissure [13]. In an equine case, extensive rostral mandibulectomy up to caudal edge of the symphysis produced an acceptable cosmetic outcome [9]. In our cattle, tongue prolapse was a result of extensive surgery, but the condition did not influence their normal growth, fattening (Case 1), or breeding (Case 2). Wound dehiscence following mandibulectomy has been reported to be involved with most sites of the rostral end of the osteomized mandible and at the commissure of the lips in dogs [7]. Likewise, Case 1 in this report also showed partial dehiscence caused by infection and discharge. Furthermore, sequestrum was observed in radiographs at 118 days post-operation. In this case, it is still uncertain whether the mandibular condition was related to an incomplete debridement of the bone and damaged soft tissue or post-operative infection. Excessive drooling was also observed in our patients after the surgeries, but the salivation naturally improved subsequently in both cases.

In this report, the authors performed rostral mandibulectomy in two cases of cattle with bilateral necrotic open fracture, with a reference from surgical oncology: the affected bones and damaged soft tissue around the fracture were simply debrided, followed by cheiloplasty on the mandible. These procedures required no special instruments, such as orthopedic machines, for internal and external fixation techniques. In Case 2, the authors attempted osteotomy with a wire saw, but the bone was too hard to resect. In newborn and juvenile calves, a wire saw can be used for the osteotomy because their bones may be soft enough.

In addition, during surgery, general anesthesia in our cases was maintained with isoflurane. In a field setting, this type of anesthesia would usually be uncommon and infeasible. If mandibulectomy is to be performed under field conditions, continuous and deep sedation combined with regional nerve block would be required, taking a reference from procedures used in small animal practice [8, 11].

Our cases showed excellent post-surgery outcomes. In conclusion, bilateral rostral mandibulectomy at the level of the interdental space beyond the symphysis can be a reasonable surgical option for necrotic mandibular open fractures in cattle.

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