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Treatment of a distal radius and ulna fracture in a young llama with a combination of external and internal fixation

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Abstract: The case consisted of a 1-month-old female llama with a left distal diaphyseal forearm fracture caused by trauma. Clinical and radiographic examination confirmed the presence of a distal fracture of the left radius and ulna. Treatment was carried out by combining internal and external fixation techniques. Successful fracture healing was achieved without any complications using this method of treatment, which has not been reported before.

Key words: Radius-ulna fracture, internal-external fixation, llama

1. Introduction

The llama (*Lama glama*) belongs to the family of South American Camelids. It is generally bred for its high commercial value. However, many llamas are considered pets by the public and excellent large animals by veterinarians because of their calm temperament, rapid bone healing, and ease with which they tolerate external fixators compared to other ruminants (1–5).

Fractures are the most common orthopedic conditions seen in llamas and are most often located in the metacarpus and metatarsus; however, fractures of the humerus, radius, and ulna may be also encountered. Fractures are usually traumatic in origin, and most of the time the real reason is unknown (6,7). For fracture repair, methods used for other small ruminants are generally implemented. These methods include external fixation, internal fixation, limb amputation, and prosthetic procedures. The method to be used is determined according to the location of the fracture, the presence of soft tissue or neurovascular damage, whether the fracture is open or closed, and the experience of the surgeon (5,7). Previous studies (2,3) have demonstrated that with the use of internal fixation techniques in long bone fracture repair in llamas the healing time is shortened and the return to normal activity is faster. In the same way, postoperative complications have been reported to be minimized with these techniques (2,5). Fixation methods of choice for fracture repair may include external fixations because of the preservation of periosteal vascularization, less implanted foreign material, shorter anesthesia time, and ease of implant removal following healing (7,8).

In llamas, complications related to fracture healing may include chronic lameness, osteomyelitis, nonunion, and implant failure (6–8). In the case of a complication such as neurovascular tissue damage, which is difficult to repair, limb amputation may be performed, as the llama can easily stand on 3 legs. Prosthetics may also be tried or euthanasia may be suggested (6).

Johnson et al. (2) reported that fractures of the long bones in llamas are not common, are usually located in the proximal part of the limb, and are mostly observed in llamas aged less than 1 year.

The aim of the present study was to describe and evaluate a distal radius and ulna fracture and its surgical treatment in a llama, carried out for the first time in Turkey.

2. Case history

A 1-month-old female llama was brought to the Surgery Department Clinic, Veterinary Faculty, İstanbul University, as it was unable to use its left foreleg.

The case history revealed that the patient was being reared at a private farm, together with horses, and that it had been kicked by a horse. Clinical examination revealed a nonweight-bearing lameness in the left forelimb. Upon palpation, instability, crepitation, swelling, and pain in the distal forearm were noted. Radiographic examination of the forearm in the anteroposterior (AP) and mediolateral (ML) projections revealed the presence of a distal

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transverse fracture of the diaphysis of the radius and ulna (Figure 1).

The owner gave his consent for the surgical repair of the fracture. The fracture site was protected using a bandage until the day of surgery, for 3 days. The llama was given no food for 2 h and no water for 1 h prior to anesthetic induction.

Taking into consideration that the patient was very young, anesthesia induction was carried out using isoflurane at a concentration of 4%, administered via a face mask. Following the loss of palpebral reflex and jaw muscle tone, the mask was removed. The patient was placed in a sternal position. The mouth was opened with the aid of bandages placed through the upper and lower jaws. A laryngoscope was used to visualize the epiglottis and arytenoids. Lidocaine was sprayed onto the area in order to prevent possible laryngeal spasm, after which a no. 7 endotracheal tube was placed in the trachea. General anesthesia was maintained with 1.5% isoflurane vaporized in 100% oxygen in a semiclosed circle system. Throughout anesthesia, neither respiratory arrest nor any other anesthesia complication was encountered.

For surgery, the patient was placed in lateral recumbency with the fractured leg uppermost. The skin was prepared for aseptic surgery. A 20-cm incision was made in the dorsal aspect of the distal radius and carpus. The skin and subcutaneous connective tissue was incised and the fracture site was reached following the retraction of the tendons of the radial carpal extensor and common digital extensor muscles. Blood clots and soft tissue debris were removed from the fracture site.

Two 2.5 mm in diameter Steinmann pins were placed into the distal fragment of the radius in a retrograde fashion. Following repositioning of the fracture, the pins were advanced into the proximal fragment in a normograde approach. In order to ensure the rigidity of the fracture, 2 further 2 mm in diameter Steinmann pins were placed inside the distal and proximal fragments and supported with a biplanar external fixator using a cast (X-lite) (Figures 2A and 2B). Immediately after fixation of the fracture, passive movements were applied to the elbow joint and carpal joint. No restriction of movement was seen in either joint.

The subcutaneous fascia was closed in a simple continuous pattern, using a 2-0 polyglactin-910 (Vicryl, Ethicon, UK) suture. The skin was closed using simple interrupted sutures and a stapler. Radiographs (AP and ML) of the area were taken immediately after the surgery. The surgical site was then protected with a dressing.

Perioperative antimicrobial treatment included cefazolin sodium [Sefazol®, Mustafa Nevzat İlaç San. A.Ş., İstanbul, Turkey, 25 mg/kg, intravenously (IV)]. Postoperative antibiotic treatment included cefazolin sodium [25 mg/kg, intramuscularly (IM), every 8 h]. The drugs were administered for 7 days after surgery. Nonsteroidal antiinflammatory drugs (flunixin meglumine, Finadyn®, Intervet, İstanbul, Turkey, 1 mg/kg IV, every 12 h) were administered for 5 days after surgery.

3. Results and discussion

Following surgery, the patient was returned to its owner, who was advised to restrict the patient's movements for approximately 1 week.

The owner was asked to return the patient 10 days later for suture removal. Primary wound healing was observed in the incision line and the skin sutures were removed. On clinical examination, a very slight lameness was observed during walking.

Approximately 1 month after surgery, the lameness had completely disappeared and the patient's gait was normal. Radiographs (AP and ML positions) were taken to assess the fracture healing. The secondary callus in the fracture

Figure 1. Preoperative AP radiographic view of distal diaphyseal antebrachium fracture in a 1-month-old female llama.

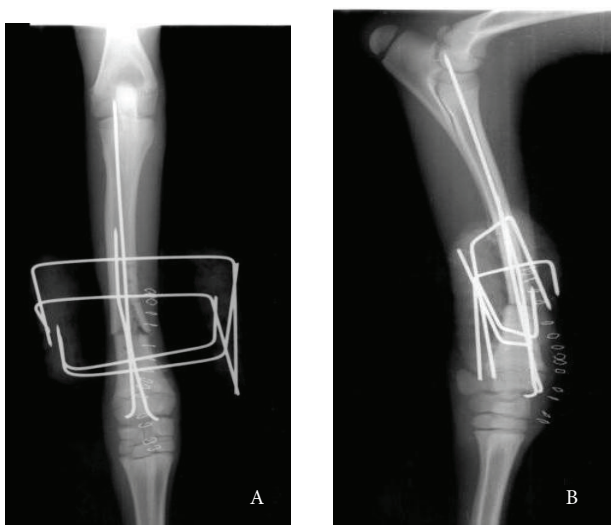

Figure 2. Immediate postsurgical AP (A) and ML (B) radiographic views.

site was determined to be sufficient to grip the fracture ends (Figures 3A and 3B).

Clinical examination at 45 days after surgery revealed that the llama could walk and trot uneventfully. On radiographic examination, the secondary callus was seen to have significantly regressed and the fracture gap had disappeared (Figures 4A and 4B). The external fixation pins were then removed. No complications in relation to the external fixation pins (such as pin base infection or bending or breaking of the pins) were observed. There were no findings to suggest pin threat or the restriction of joint movements.

On clinical examination carried out 90 days after surgery, the llama walked and trotted without any problem. Radiographic examination revealed that the secondary callus had significantly resolved and remodeling had begun. The growth plates were not affected. There were no findings to suggest either pin threat or the restriction of joint movements (Figures 5A and 5B).

On clinical examination carried out 120 days after surgery, no problems were observed in the patient's movements. However, considering a possible future threat to the medial humeral condyle, it was decided to remove the pin directed towards the humerus. The patient was given xylazine HCl sedation (Rompun, Bayer, Turkey, 0.5 mg/kg, IM) and the pin removal was achieved by retraction (Figures 6A and 6B).

The most frequent orthopedic disorders occurring in llamas are fractures, which mostly occur in the metacarpus and metatarsus, whereas long bone fractures are less frequent. Fractures usually occur in young llamas, aged less than 1 year. The origin of most fractures is trauma,

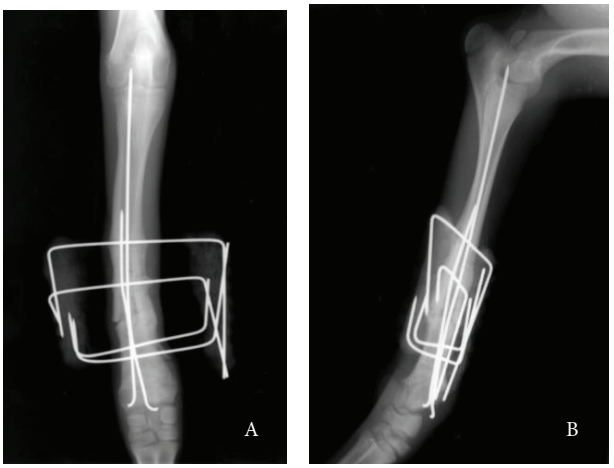

Figure 3. Postoperative day 30, AP (A) and ML (B) radiographic views.

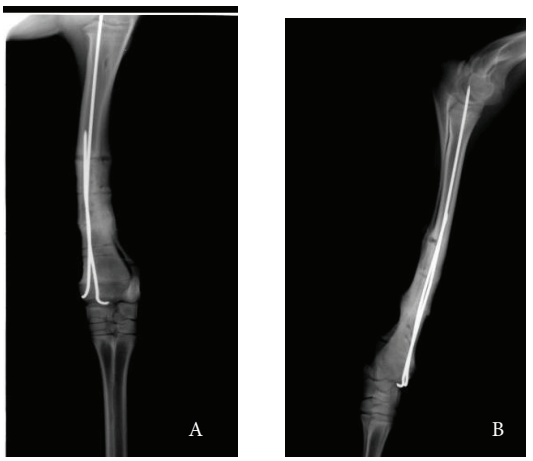

Figure 4. Postoperative day 45, AP (A) and ML (B) radiographic views.

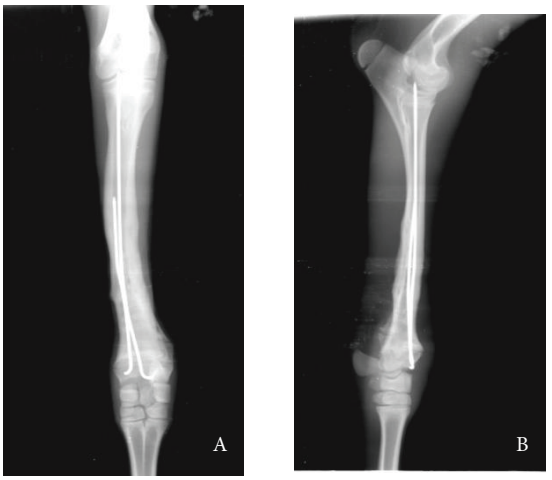

Figure 5. Postoperative day 90, AP (A) and ML (B) radiographic views.

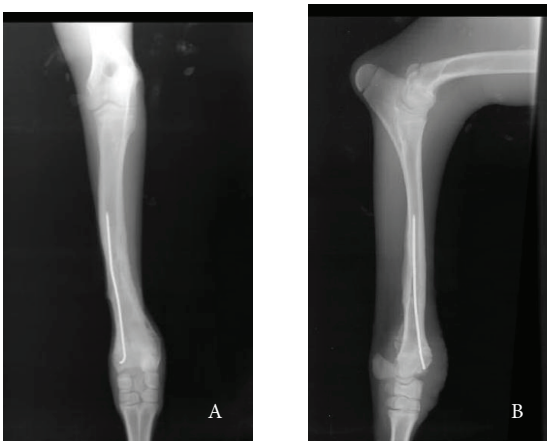

Figure 6. Postoperative day 120, AP (A) and ML (B) radiographic views.

with the real reason usually unknown (2,6,7). The case in the present study involved a 1-month-old female llama. The diaphyseal fracture in the left distal radius and ulna was determined to be attributed to a traumatic incident.

For the treatment of fractures seen in llamas, it has been reported that internal and external fixation techniques used in other small ruminants may be applied (7). In this study, due to the very young age of the patient, and in order to minimize the effects on the growth plates, fracture fragments were aligned using intramedullary pins. In order to achieve sufficient stability following the internal fixation alone, it is necessary for the limb to be supported with a splint and bandage. However, the splint and bandage applied during the healing period will cause muscle atrophy and delay full limb function. In the animal of the present study, a combination of internal and external fixation was carried out to repair a distal diaphyseal forearm fracture. Total fixation was achieved with this combination. There was no problem in relation to fracture stability. It was concluded that the method of combining internal and external fixation techniques, used in fractures of small animals, could also be reliably applied to ruminants such as llamas.

In previous studies (6–8), it has been reported that complications in healing, such as osteomyelitis, nonunion, or implant failure related to fracture repair in llamas, may be seen. Semevolos et al. (1) found that in the postoperative period following internal or external fixation procedures in llamas or alpacas, complications can be observed at a rate of 87%, and that these can result in chronic lameness. However, Johnson et al. (2) have reported that with the use of internal fixation techniques in long bone fractures in llamas, the recovery time decreases and postoperative complications are minimized. In this study, none of the fracture complications reported in the literature (1,6–8) were encountered during any period of the fracture repair and the fracture healed without problem. Our findings are in agreement with those reported by Johnson et al. (2).

On clinical examination performed 120 days after surgery, no problem was observed regarding the patient's gait. However, considering a possible future threat to the medial humeral condyle, the pin directed towards this area was removed by retraction.

In the present study, a distal diaphyseal forearm fracture in a llama was repaired successfully using a combination of internal and external fixation. This type of fixation in llamas was reported for the first time in Turkey.

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