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Clinical Report

Use of Tie-in Fixation and Modified Poliglecaprone-25 Suture Cerclages in a Complex Femoral Diaphysis Fracture in a Black-Eared Opossum (*Didelphis aurita*): Case Report

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ABSTRACT

A juvenile opossum was found after an episode of trauma caused by a vehicular collision. In the emergency care, vital parameters and changes related to the trauma were measured, and it was not possible to verify any changes, other than a crepitation in the left femur. Radiographic examinations revealed a complex fracture in the femur, requiring surgical intervention. The animal was submitted to an anesthetic procedure using dexmedetomidine, ketamine, and isoflurane. Femur osteosynthesis was performed using the external fixation technique in tie-in configuration, associated with absorbable poliglecaprone 25 sutures modified cerclage. The post-surgical analgesia was performed with dipyrone, tramadol chloride, and meloxicam. After 40 days of care, including removal of fixation, healing, and rehabilitation, the animal was reintroduced to its natural habitat.

Introduction

The impact of the human occupation in Brazilian fauna is increasingly evident, both in terms of the expansion of roads and highways, in which deaths of animals in danger of extinction are reported daily.[1,2] In urbanized areas, especially in Sao Paulo state, where the greatest impact it is against synanthropic animals, those that use the by-products of human habitation to survive, whether native species such as opossums (*Didelphis sp.*), black-headed vultures (*Coragyps atratus*), capybaras (*Hydrochaerus hydrochoeris*), or exotic species such as domestic pigeons (*Columba livia*) and sparrows (*Passer domesticus*). As an approach to these traumatized animals, the protocol commonly used in other areas of veterinary medicine is recommended: checking the airways, breathing, circulation, approaches to neurological deficits, analgesia, examination of possible injuries, complementary tests, and energy supply. In the case of opossums, the main causes related to trauma involve fractures, pulmonary contusions and organic ruptures,

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often requiring surgical interventions.[3]

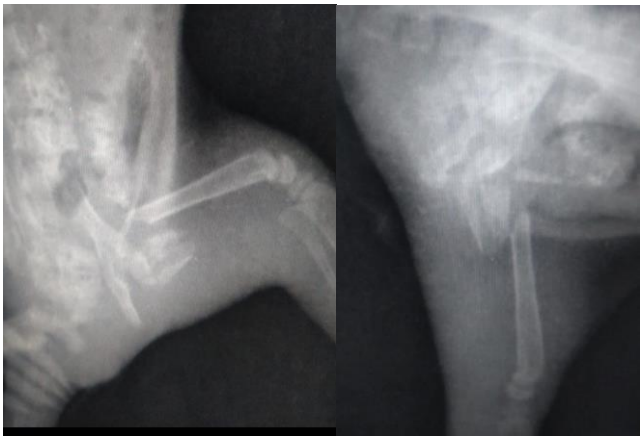
Case Description

A young female black-eared opossum (*Didelphis aurita*) weighing 135 grams was admitted at a private veterinary hospital in the city of Guarujá, São Paulo state, Brazil due to the main complaint of trauma by vehicular impact. The animal was promptly taken to the emergency room for a clinical examination, where it did not show signs of shock, hemorrhage or changes in vital parameters.

On physical examination, it was noticed a bone crackling in the left femur, leading to the suspicion of a fracture in the proximal region. The analgesia protocol was performed with sodium dipyrone (D-500, 500 mg/mL, Zoetis, Campinas, Brazil) at a dose of 30 mg/kg, tramadol hydrochloride at a dose of 3 mg/kg and meloxicam (Flamavet 0,2%, Agener-União, Embu-Guaçu, Brazil) at a dose of 0.2 mg/kg, all administered subcutaneously. Soon after, the animal was taken to the radiology sector, where radiographs of the left femur were taken in left mediolateral and craniocaudal projections, confirming the diagnosis of a complex diaphyseal fracture in the lesser trochanter region with approximately 4 fragments (Figures 1 and 2).

Treatment and Outcome

Due to the characteristic of the fracture, the osteosynthesis surgical procedure was chosen, to be performed the following day of the trauma. As preanesthetic protocol, dexmedetomidine hydrochloride (Dexdomitor, 05 mg/mL, Zoetis, Campinas, Brazil) at a dose of 0.15 mg/kg in association with ketamine hydrochloride (Ketamina 10%, Agener-União, Embu-Guaçu, Brazil) at a dose of 10 mg/kg, both intramuscularly in the limb contralateral to the fracture. After administration of the medication pre-anesthetic, the animal was kept in a transport box in a dark and calm environment for better drug effectiveness. During the effects of sedation, a venous access was placed in the ventral caudal vein for possible complications, using a 26 G catheter. The opossum remained in pre-oxygenation for approximately 3 minutes, after being induced into the anesthetic plane with inhaled isoflurane (Isoforine, Cristalia, Itapira, Brazil) through a mask and intubation with a 2 mm diameter endotracheal tube. The patient was monitored using a multiparametric monitor, carefully analyzing heart rate, electrocardiographic tracing, peripheral oxygen saturation, pulse plethysmography, noninvasive blood pressure and esophageal temperature (Figure 3). Lumbosacral epidural regional anesthesia was performed for better analgesia, for the technique a 13 mm x 4.5 mm needle was used, since Tuohy needles, which are blunt and indicated for the procedure, would not be adequate due to its diameter, with the administration of lidocaine hydrochloride (Lidovet, 20 mg/mL, Bravet, Rio de Janeiro, Brazil) at a dose of 5 mg/kg, promoting good relaxation of the hind limbs, tail and pseudocloaca (Figure 4).



Figures 1 and 2. Radiographic projections of the opossum's femur.

Figures 3 and 4. Anesthesia monitoring (Right). Epidural anesthesia (Left).

For surgery, the animal was placed in the right lateral decubitus position, enabling the disinfection of the surgical site and placement of the surgical field. To access the fracture focus, an incision was made parallel to the femur in the skin and musculature, exposing the four bone fragments, the first one proximal, still articulated to the acetabulum comprising the femoral head, femoral neck, greater trochanter, the second and the third comprised the diaphysis that was vertically bipartite, and the fourth fragment comprised the most

distal portion of the diaphysis and the epiphysis of the femur (Figure 5), classified according to AO/OTA

Fracture and Dislocation Compendium Classification, as a classic 32C1 fracture [4]. For bone stabilization, an intramedullary 1 mm Steinmann pin was passed from the trochanteric fossa towards the femoral diaphysis. To stabilize the diaphysis fragments, approximately five cerclages were made with 3-0 poliglecaprone 25 monofilament absorbable suture (Monocryl, Atramat, Ciudad de Mexico) (Figure 6), since the planning for the animal would be a possible reintroduction, making it impossible to use permanent implants. Muscle, subcutaneous tissue and skin were sutured right after. A 1 mm self-drilling Schanz pin was also placed externally in the distal region, together with the intramedullary pin and stabilization, to form a tie-in external fixation, preventing rotation and compression of the fragments. For the support rod of the external fixator, a fragment of the 14G catheter needle was used to connect the clamps, with the 1.5 mm clamp system, providing an efficient and light support, adequate for the animal's weight (Figures 7, 8, 9, and 10). An immediate post-surgical radiography was performed to evaluate the intramedullary fixation (Figure 11).

The animal did not show anesthetic instability during the procedure and had a quick return from the anesthetic plan after the completion of the surgery. As immediate postoperative therapy, tramadol hydrochloride, meloxicam and sodium dipyrone were used in the same doses described above, in addition to the use of penicillin as a prophylactic antibiotic in a single subcutaneous dose. As post-operative care, a reduced enclosure with environmental enrichment was established to simulate the arboreal behavior of the species. An Elizabethan collar made of plastic was used to avoid direct contact of the face to the surgical wound, which was cleaned twice daily, and the animal's behavior was observed, avoiding possible mutilations.

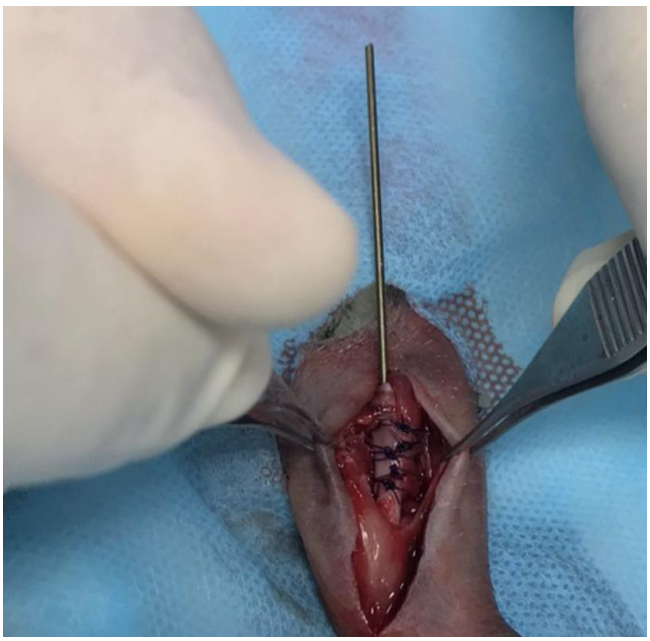
After the surgery the opossum was already maintained with minimal human contact and a specific diet to avoid any human-animal bond. Eight days after the procedure, the animal was healthy and was already supporting the affected limb (Figure 12). A radiographic study of the fracture was performed within 20 days of the procedure confirming that the femur had consolidated correctly with no gap or compression, which can be explained by the fact that the individual was a young opossum. The procedure for removing the tie-in fixation was performed with chemical inhalation containment using isoflurane in an anesthetic mask. Analgesia was provided by the use of dipyrone, at the dose described previously.

After the removal process, the animal was sent to a fauna rehabilitation center, where it was subjected to rigorous rehabilitation processes, which involved climbing, foraging and adaptation training with new foods commonly found in its natural habitat, in a fragment of Atlantic Forest. The opossum was reintroduced 40 days after its initial rescue (Figure 13), demonstrating that the surgical procedure and post-operative care had been successfully completed.

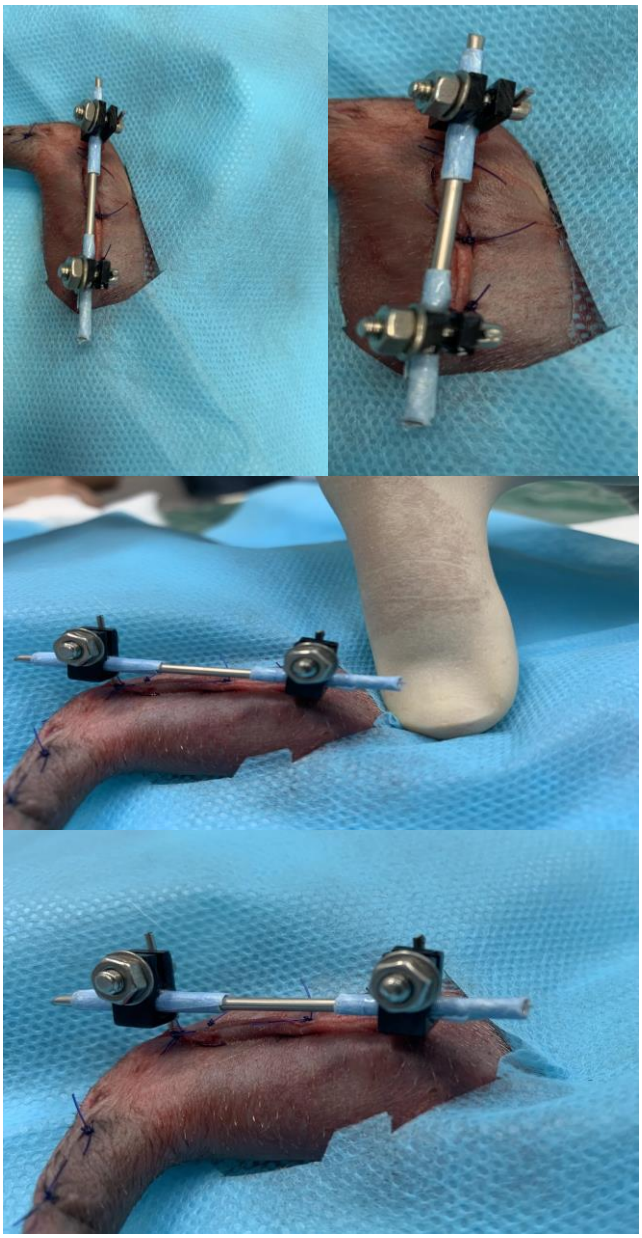
Clinical Relevance

Mead *et al*. (2009) evaluated bone lesions in adult individuals of *Didelphis virginiana* who died from roadkill, an animal of the same genus and habits similar to the black ear opossum, in which femoral lesions were

Figure 5. Fracture exposure.



Figures 6. The intramedullary pin insertion with the absorbable cerclages.



Figures 7, 8, 9, and 10. The fixation system in the immediate post-surgical.

present in only one individual and were old lesions, with bone callus fracture and bone remodeling [5] . In dogs and cats, femur fractures in the mid diaphysis, usually present simpler solutions, using techniques that provide great stability such as plates associated with screws, intramedullary pins associated with cerclages and even interlocking nail systems, when complex, combined techniques are usually used.[6,7]

For the fixation of fractures of the proximal diaphysis of the femur of quadruped mammals, several techniques can be used, mostly associated, such as plate-screw systems, external fixations, locking nail systems, associated with cerclages, made of stainless steel or alternative material. External fixations are

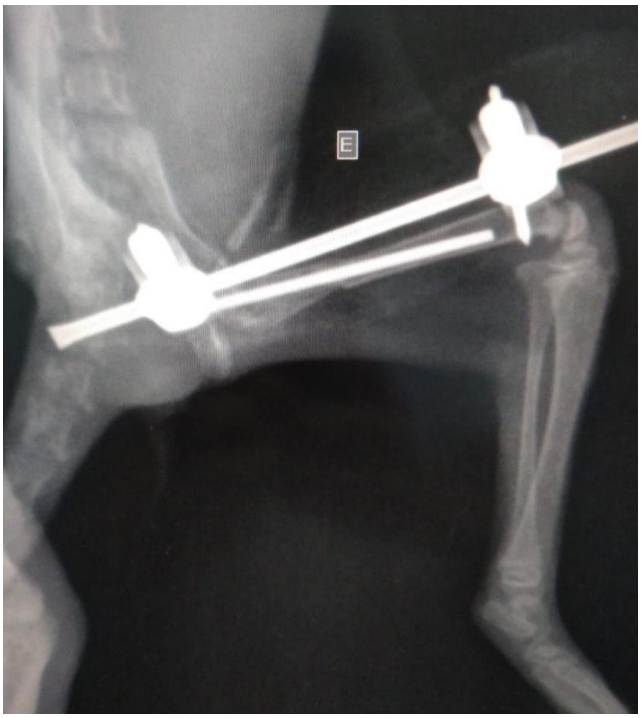


Figure 11. Post-surgical radiographic examination.

Figure 12. The opossum 8 days after the procedure.

Figure 13. The opossum reintroduction.

extremely effective in many cases, whether they are linear or circular.[8] The tie-in configuration is the union

of an intramedullary pin with an external fixation, in this case using a uniplanar one, where the pin, after being introduced in a normograde way, had its proximal fragment twisted, when twisted, was connected to the clamp system with an external bar and a second pin. Tie-in fixations promote good stability, avoid compression of fracture fragments, and are recommended in cases where total removal of implants is mandatory, in addition to presenting itself as a low-cost system, commonly used in several species.[9,10] Due to the characteristic of the lateral fragments of the fracture, it was decided to associate a suture cerclage to the tie-in configuration, with preference of an absorbable material because the animal would be reintroduced to its natural habitat.

Several researches have been developed in the field of veterinary orthopedics for alternatives to metallic cerclages, such as da Silva *et al*. (2018), who described the use of adjustable nylon ties for simple femoral shaft fractures in dogs and cats.[11] Oronan *et al*. (2020) research, however, compared by several parameters such as fracture gap, angulation, bone callus formation and histology, the use of polydioxanone (PDS) sutures for stabilization of oblique fractures of the femoral diaphysis, compared to steel cerclage wires.[12] The use of PDS sutures was effective, but caused a later clinical improvement compared to traditional cerclages, but in cases where non-absorbable materials cannot be applied, it would be a good alternative. In the case of the opossum, the use of poliglecaprone 25 was used because it is an absorbable suture, with a characteristic similar to the PDS, with lower tensile strength, but with shorter body absorption time and possibility of tissue reaction,[13] which would be ideal in the case of an animal that would later be reintroduced into nature.

This case was effective in showing that orthopedic surgeries in wild animals are often difficult due to the various nuances involved, such as the lack of bibliographic references and research in the area, although the procedures can be decisive in a possible reintroduction of individuals and should be notified and carefully analyzed. In the case of *Didelphidae* family, specific researches such as the biomechanics of orthopedic conditions and fracture management are necessary for a better understanding of the management of fractures in these species.

Conflict of Interest

The authors declare no conflicts of interest related to this report.

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