

External fixation to correct tarsal-metatarsal fracture in rock pigeon (*Columba livia*)

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ABSTRACT

Orthopedic conditions, such as bone fractures, are very common in avian medicine. External fixators have been considered the gold standard for birds, since they allow early movement of the limbs and minimal invasive surgery. Fractures in several bones have been successfully treated in pigeons. However, to the best of our knowledge, this case represents the first report of successful surgical repair of tarsal-metatarsal fracture in rock pigeon. External fixator was made with four 24G catheters, being inserted manually proximal and distal to the fracture and connected with polymerizable acrylic. Radiographic consolidation of fracture was observed 60 days post-surgery and anti-inflammatory and antibiotic protocols were successful on avoiding pain and infection during surgery and bone healing.

Key words: rock pigeon; avian orthopedics; external fixator; tarsal-metatarsal fracture; polymerizable acrylic.

RESUMO

Fixação externa para correção de fratura tarsal-metatarsal em pombo-comum (*Columba livia*)

Afeções ortopédicas são muito comuns na medicina aviária, tais como fraturas ósseas. Os fixadores externos estão sendo considerados o “gold standard” para aves, uma vez que permitem retorno rápido ao movimento dos membros através de cirurgia minimamente invasiva. Fraturas em vários ossos haviam sido tratadas com sucesso em pombos. No entanto, este caso representa o primeiro relato de tratamento cirúrgico bem sucedido em fratura tarsal-metatarsal desta espécie. Um fixador externo foi confeccionado com quatro cateteres 24G, sendo inseridos manualmente proximal e distalmente à fratura, e conectados com acrílico polimerizável. A consolidação radiográfica da fratura foi observada aos 60 dias de pós-operatório, e os protocolos de anti-inflamatórios e antibióticos foram efetivos em evitar dor e infecção durante a cirurgia e a cicatrização óssea.

Palavras-chave: pombo doméstico; ortopedia aviária; fixador externo; fratura tarsal-metatarsal; acrílico polimerizável.

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INTRODUCTION

In recent years, clinical care to wild species has increased due to an interest in wildlife preservation and in the use of these as companion animals, among them the birds (Bolson *et al.*, 2008).

Several methods have been used for treatment of fractures in birds. However, due to variations in size, weight, and conformation of different species, as well as the peculiar bone anatomy, the high incidence of complicated fractures and differences in functional requirements between species and individuals, it is not possible yet to establish an ideal method of osteosynthesis for long bones in these animals (Alievi *et al.*, 2002). In this work, we aimed to describe type II external skeletal fixator for the reduction of diaphyseal fractures in tarsus of domestic pigeons, being evaluated by clinical and radiographic examinations.

MATERIAL AND METHODS

A rock pigeon (*Columba livia*) was assisted in the veterinary hospital Tigre D'Água (Vila Matilde, São Paulo, Brazil), suffering from functional disability in right pelvic limb. On physical examination, burn and fracture in the tarsal-metatarsal region (Figure 1A) were observed. The animal was medicated with 3 mg/kg of anti-inflammatory ketoprofen 10% (Ketojet® 50 ml/100 mg, Agener União, São Paulo, SP, Brasil) and 5 mg/kg of antibiotic enrofloxacin 2.5% (MSD Saúde Animal, São Paulo, SP, Brasil), both intramuscularly. Bandage and splint were made with tape, over a gauze with saline solution to prevent bone dehydration until the moment of surgery (Figure 1B).

For surgical procedure, the animal was taken to the surgical center of the hospital after 2 h of fasting. Pre-anesthetic medication was made with 4 mg/kg morphine (Dimorf®, Cristalia, Porto Alegre, RS, Brasil) and 15 mg/kg ketamine (Agener União, São Paulo, SP, Brasil), both intramuscularly (Figure 2A). General anesthesia was induced by isoflurane in mask (Hoechst, Suzano, SP, Brasil) (Figure 2B) and subsequently maintained by isoflurane in orotracheal tube (Figure 2C). Blood pressure was monitored using Doppler placed in the carotid artery region (Figure 2D). Feathers of tibiotarsal and tarsal-metatarsal regions were removed by traction and surgical field was subjected to antiseptics with chlorhexidine gluconate 4% (Vico Farma, Santa Maria, RS, Brasil). As a prophylactic measure, 5 mg/kg of enrofloxacin 2.5% (MSD Saúde Animal, São Paulo, SP, Brasil) were administered intramuscularly 30 min before the procedure.

With animal in dorsal recumbency, skin incision was made with scalpel in cranio-medial portion of the right tarsal-metatarsal, allowing bone exposure and osteosynthesis with implantation of type II external fixator. This fixator was composed of four 24G catheters (Nipro Medical Ltda, Sorocaba, SP, Brasil), two proximal and two distal to the osteotomy, in parallel (Figure 3A). Pins were inserted through medial surface of the bone using manual circular movements, piercing the skin, muscle, and bone. The ends were angled at 90° to promote their approach and then pins were connected externally by two bars of polymerizable acrylic (Jet Acrílico, Artigos Odontológicos Clássicos, São Paulo, SP, Brasil), one in lateral and another in medial face of tarsal-metatarsal region of right hind limb (Figure 3B). After placement of lateral bar, and previous to the placement of medial bar, synthesis of subcutaneous

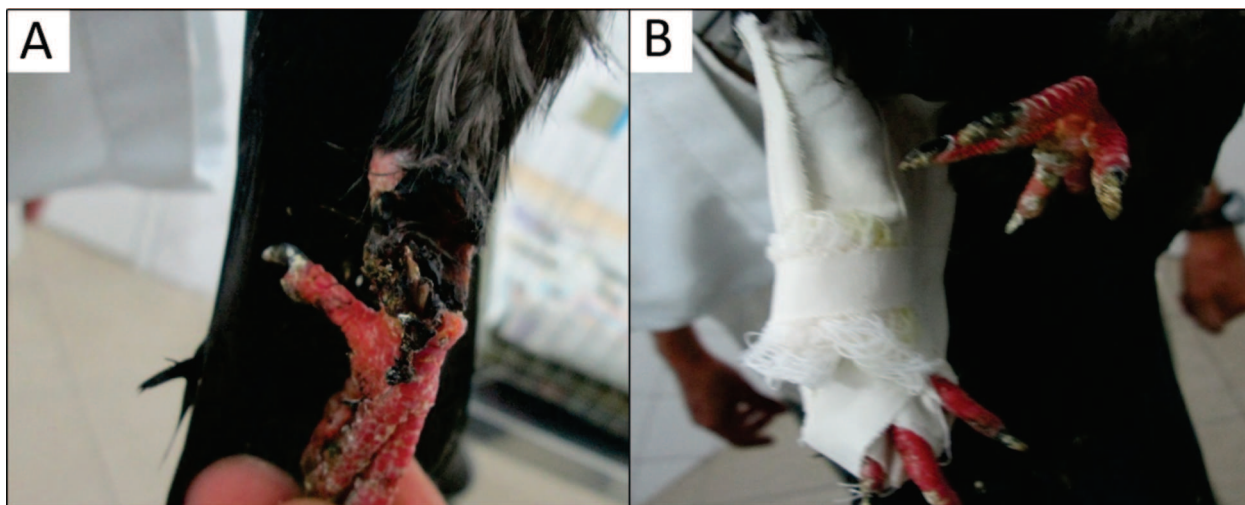


Figure 1: Orthopedic examination and limb immobilization.

A: Burn and fracture in tarsal-metatarsal region of right hind limb in rock pigeon (*Columba livia*).

B: Splint with tape and gauze soaked in saline solution in fracture region.

tissue and skin was made with mononylon 3-0 (Nylon Bioline, Goiania, GO, Brasil) in simple interrupted sutures.

After surgery, anti-inflammatory therapy was performed intramuscularly for three days, using ketoprofen in doses calculated by interspecific allometric extrapolation. Sterile gauzes soaked in saline solution were placed on the surgical site, replaced every other day until seventh postoperative day, when skin sutures were removed, and then every four days until bone healing.

After a period of 60 days, bone healing was confirmed by radiography (Figure 3C) and bird was anesthetized by combination of 3 mg/kg xylazine (Copazine®, Mallinckrodt Veterinária Ltda, Cotia, SP) and 60 mg/kg ketamine (Francotar®, Virbac, São Paulo, SP, Brasil) intramuscularly and the external fixator was removed with orthopedic pliers (Figure 3D).

RESULTS AND DISCUSSION

To the best of our knowledge, this case represents the first report of successful surgical repair of tibiotarsal fracture in a rock pigeon. The option for using external fixation was adequate, ensuring reduced surgical time, besides being an implant of low total weight - approximately 7% of the weight of the animal, an advantage also reported by other authors (Bush, 1983; Guzman *et al.*, 2007; Ferraz *et al.*, 2008).

Some studies have recommended placing pins with a divergent angle to maintain mechanical adhesion in the bone (Egger, 1991). An angle of 30-40° between pins placed in each base of fragment has been suggested as the best way to join the bone. In this case, pins are placed perpendicularly across the bone, considering the pins



Figure 2: Anesthesia and anesthetic monitoring during osteosynthesis procedure in rock pigeon (*Columba livia*).

- A: Intramuscular pre-anesthetic medication.
- B: Induction of anesthesia by isoflurane in mask.
- C: Maintenance of anesthesia and airways by orotracheal intubation.
- D: Pressure monitoring by Doppler placed in carotid artery.

as individual units, without considering the stiffness of external skeletal fixation, which has also been successfully reported in literature (Dernell *et al.*, 1993; Degernes *et al.*, 1998; Dalmolin *et al.*, 2007; Pérez *et al.*, 2008).

Research conducted previously with pigeons has presented a minimum adaptation period of 15 days for adjustment of diet, environment, and handling (Alievi *et al.*, 2001; Gaiga & Schossler, 2002; Leotte *et al.*, 2004; Dalmolin *et al.*, 2007). In this case, however, this time is doubled as observed before. Surgical approach is dorsal, between deltoid and propatagial muscles, being minimally invasive and providing necessary exposure of surgical site (Leotte *et al.*, 2004; Bolson *et al.*, 2008). Ventral access is avoided in order to preserve radial nerve (Gaiga & Schossler, 2002). Knowledge of musculoskeletal anatomy

of birds is essential for the success of osteosynthesis (Hatt, 2009).

There are reports of the use of drill (Alievi *et al.*, 2008), oscillating saw (Wander *et al.*, 2000), osteotome (Putney *et al.*, 1983), and digital pressure in bird osteosynthesis (Williams *et al.*, 1987; Alievi *et al.*, 2002). In 27.77% of animals, oblique fractures occurred in osteotomy due to very thin cortex in this species (West *et al.*, 1996). In this report, manual movements were used and problems related to lack of dense bone in metaphysis and presence of thin bone trabeculae along the length of bone, such as migration of the pin and rotational instability of fracture, were avoided due to the presence of perpendicular pins, which prevented the occurrence of such setbacks, as indicated by other authors (Kingsley, 1983; Dalmolin *et al.*, 2007; Rahal *et al.*, 2008).

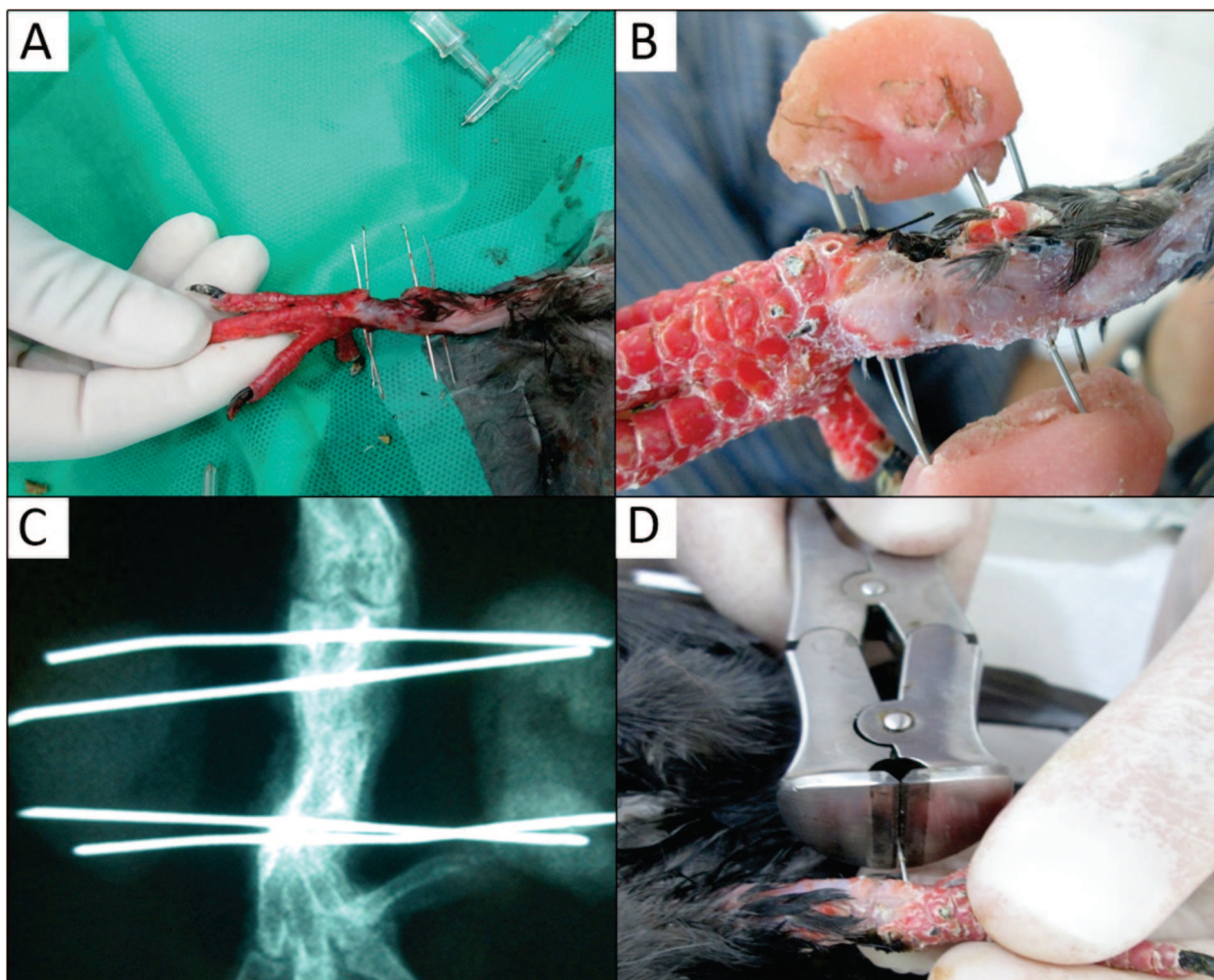


Figure 3: Osteosynthesis of tarsal-metatarsal fracture of the right hind limb in rock pigeon (*Columba livia*) with external fixation and post-surgical management.

A: External fixator using four 24G catheters.

B: Connection of pins with polymerizable acrylic.

C: Radiographic image of bone healing.

D: Removal of pins with orthopedic pliers.

Anesthetic protocol was satisfactory, as reported for birds (Coles, 2007; Sá *et al.*, 2012). However, some authors have stated that the used association may predispose to hypoxemia, hypercapnia, cardiovascular depression, and prolonged recovery in birds (Pascoe, 1985; Ludders *et al.*, 1989; Ludders & Matthews; 1996). Isoflurane has been reported to promote more stable anesthesia than halothane, being the anesthetic of choice in avian medicine, as well as in a broad range of species (Dohoo, 1990; Olkowski & Classen, 1998; Rocha *et al.*, 2009).

At 15 days post-surgery, radiographic examination showed no presence of callus or disappearance of fracture. During this period, animal had use of limb, which meets citations that radiographic consolidation happens later than clinical use of the limb (Williams *et al.*, 1987; Wissman, 1999; Alievi *et al.*, 2001). This supports findings that external fixators allow adequate movement of joints proximal and distal to the fracture, avoiding complications of non-use of the limb during bone healing (Pead & Cardmichael, 1989; Dalmolin *et al.*, 2007).

The antibiotic used (enrofloxacin) and the dose calculated by allometric extrapolation were efficient, avoiding postoperative infections, as observed by other authors (Leotte *et al.*, 2004; Alievi *et al.*, 2001; Gaiga & Schossler, 2002; Dalmolin *et al.*, 2007; Rocha *et al.*, 2009). Some other studies have reported positive use of ampicillin (Alievi *et al.*, 2008). Dose of ketoprofen and interval of application was satisfactory; despite the difficulty in evaluation of pain, the animal did not present any signs described in literature (Heard, 1997; Williams *et al.*, 1987). Other studies have suggested the use of flunixin meglumine with no complications as anorexia, vomiting, or diarrhea (Jenkins, 1992; Rocha *et al.*, 2009).

CONCLUSIONS

This case reports the first successful surgical treatment of tarsal-metatarsal fracture in rock pigeon, establishing an effective methodology for this condition using external fixator adapted for this species. Thus, we contribute to avian orthopedics, providing an effective technique for surgical correction of tarsal-metatarsal fractures.

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