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Interlocking nail for tibiotarsal fracture repair in a black swan (*Cygnus atratus*) - a case report

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ABSTRACT

The efficacy of interlocking nail repair of a tibiotarsal fracture in a black swan (*Cygnus atratus*) is described. A one year old, 3.70 kg black swan presented with a closed, spiral, midshaft, AO 42-A1, Winquist-Hansen type-0, left tibiotarsal fracture. The fracture was reduced and fixed with a 3.5-mm diameter, 113 mm long four-hole interlocking nail. The animal was weightbearing three days postoperatively on the bandaged limb. The fracture was assessed as clinically stable 14 days postoperatively. Twenty weeks postoperatively the function of the limb was assessed as normal. There seem to be only a few published cases of the presented method. Providing early return of limb function, the interlocking nail was a good method for tibiotarsal fracture repair in this black swan.

Key words: interlocking nail, tibiotarsus, black swan

Introduction

Tibiotarsal fractures are perhaps the most common fractures seen in birds (McCLUGGAGE, 1997). Most fractures of the tibiotarsus are best treated with internal stabilization, especially in larger birds (BENNETT, 1997). By providing both rotational and compression stability, interlocking nail (IN) is an effective fixation method for diaphyseal fracture repair (PIERMATTEI and FLO, 1997). These features have been heretofore available only by bone plate fixation. Improvements to the IN system, based on experience, have led to increases in its efficacy (HOLLAMBY et al., 2004). Concerning the avian bone structure, the IN method and the nail design provide advantageous features for avian fracture repair

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(LANGLEY-HOBBS and FRIEND, 2002). There are only two published cases, to the authors' knowledge, both with successful outcomes. In one case the fracture was of the femur in a turkey (LANGLEY-HOBBS and FRIEND, 2002) and in the other the tibiotarsus in a bald eagle (HOLLAMBY et al., 2004). Here is our contribution to the topic.

Materials and methods

A black swan (*Cygnus atratus*), one year old, 3.7 kg, was found in its dwellings in the zoo with the left tibiotarsus „hanging by the skin". The injury was believed to have been inflicted by another animal the day before. Physical and radiographic examination revealed a closed, spiral, midshaft, AO 42-A1, Winquist-Hansen type-0, left tibiotarsal fracture (Fig. 1).

The limb was immobilized with a modified Robert-Jones bandage and antimicrobial therapy was initiated with enrofloxacin (Vetoflok 5%, Veterina d.d., Kalinovica, Croatia) 20 mg/kg i.m. Three days later the animal underwent open reduction and fixation with a 3.5 mm four-hole interlocking nail (IN; Königsee Implantate GmbH, Allendorf, Germany) under sevoflourane-maintained general anaesthesia. The animal was premedicated with ketamine (Narketan 10, Vétoquinol SA, Lure Cedex, France) 20 mg/kg i.m. and midazolam (Dormicum, F.Hoffmann-La Roche Ltd, Basel, Switzerland) 0,5 mg/kg i.m. The anaesthesia was induced with propofol (Propofol 1% Fresenius, Fresenius Kabi Austria GmbH, Graz, Austria) 2 mg/kg i.v. (basilic vein). The patient was intubated with a 3.5 mm endotracheal cuffless tube and the anaesthesia was maintained with 2-2.5% sevoflourane (Sevorane, Abbott Laboratories Limited, Queenborough, U.K.) in 2 L/min oxygen. Additional analgesia was provided by Ketofen (Ketofen 10%, Merial, Lyon, France) 2 mg/kg i.m. as a single postoperative dose.

The surgical site was plucked of feathers and aseptically prepared. Open reduction was performed using a minimal medial approach to the fracture site. Normograde placement of the 3.5 mm diameter, 113 mm long, four-hole titanium interlocking nail (Königsee Implantate GmbH, Allendorf, Germany) into the tibiotarsus was accomplished with the stifle flexed. The robust design of the nail-jig interface prevented the optimal intramedullary positioning of the nail. The jig had to be left out. Fluoroscopy-assisted aiming was used to guide the three 14 mm 2.0 cortical screws through the nail. The top proximal screw had to be longer than the screws available at the time in the OR and had to be replaced by a 2.0 mm stainless steel Kirschner wire (Fig. 2). The fascia, subcutis and skin were all sutured using Maxon 3-0 in the simple continuous fashion and the limb was bandaged. Immediate postoperative control radiographs were taken. Antimicrobial therapy was continued for seven days postoperatively. No nutritional supplements were administered at any time.

Fig. 1. Preoperative sagittal view of the fractured left tibiotarsus.

Fig. 2. Immediate postoperative control radiograph

Fig. 3. Control radiograph 14 days after surgery. The top proximal K-wire is missing.

Fig. 4. Control radiograph 20 weeks after surgery. Proximal screw is slightly bent. Complete union.

The patient was weightbearing and walking slowly on both legs three days postoperatively. Slight abduction of the operated limb was noticed. The bandage was discontinued twelve days postoperatvely, thus facilitating the adduction of the affected limb. Fourteen days after the surgery, control radiographs revealed callus formation (Fig. 3). The proximal Kirschner wire was no longer there. The pin must have penetrated the overlaying skin and/or was removed by the animal. However, the fracture was clinically assessed as stable. In these conditions the loss of the pin was not considered critical, as we previously discussed the removal of the steel pin after the completion of the healing process to avoid possible metal-on-metal associated problems. By the eighteenth day after the surgery the limb function was assessed as normal, with the patient exercising even running. Throughout the whole five-week recovery period there were no recorded feeding abnormalities. The fracture was assessed as clinically stable 14 days postoperatively. By day twenty-six the recovery was clinically assessed as satisfactory with excellent return of function, and control radiographs showed bridging callus formation. The patient remained in the Zoo.

Twenty weeks postoperatively the function of the limb was assessed as normal. The swan was walking and swimming without any functional deficit. The radiographs showed complete healing of the bone with thinner remodelling callus (Fig. 4). The proximal screw was slightly bent, but still sufficiently strong to allow for complete union.

Discussion

The IN method of fixation may be biomechanically advantageous for tibiotarsal fractures in birds compared to IM pins, bone plates, or ESFs. Interlocking transcortical screws allow interlocking nails to provide axial and rotational stability, as well as bending stability (WHEELER et al., 2004a). The IN provides stability at the fracture site in terms of rotation and compression, avoiding the joint penetration hazard at the same time. Being less invasive than the bone plate, the light titanium IN pin causes less demineralization of the bone, and compared to ESF, it is practical for the patient and usually does not require subsequent implant removal. The reported incidence of IN related osteomyelitis is lower than with other internal stabilization methods (KALTENECKER et al., 1990; MOSES et al., 2002).

The exit and loss of the proximal steel pin might be the result of the same forces that reportedly lead to screw breakage (HOLLAMBY et al., 2004; LANGLEY-HOBBS and FRIEND, 2002; ROUSH, 1999). No revision was necessary in this case. Nevertheless, a screw or a bolt might be a better solution, since they both have threads that engage the bone cortex, thus preventing their migration, and bolts have a solid shaft providing better contact with the nail (WHEELER et al., 2004b). However, clinical evidence that bolts improve stability compared with screws has not been reported (LANSDOWNE et al., 2007).

Although multiple screws add more rotational stability, a single screw at each side of the fracture may still be sufficient in small animals (DUELAND et al., 1996; DURALL et al., 1994). Bending of the proximal screws has been reported, but it does not seem to have any significant effect on the healing of the fracture (HOLLAMBY et al., 2004; LANGLEY-HOBBS and FRIEND, 2002). In our case, the proximal screw (2.0) was slightly bent by the 20th week, being the only transcortical support in the proximal fragment after the loss of the Kirschner wire 14 days postoperatively.

The intraoperative complication due to the oversized IN application apparatus for the patient prolonged the duration of both anaesthesia and surgery, but that did not seem to have any significant negative effect on the overall outcome. That experience should influence preoperative planning, leading to the avoidance of such intraoperative anaesthetic and technical failure risks. The use of smaller application apparatus may be advocated, subject to availability.

The IN pin is a good method for tibiotarsal fracture repair in birds, providing early return of limb function. There seem to be only a few recorded cases of the presented method. The familiarity with the species-specific anatomy and bone structure, the presence of wildlife experienced team members and the level of technical support available all led to a good clinical outcome, but certainly are no guarantee, leaving a wild avian fracture repair a challenging task.

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SAŽETAK

Crni labud u dobi od godinu dana, tjelesne mase 3,70 kg, doveden je sa zatvorenim, spiralnim lomom dijafize lijevoga tibiotarzusa, AO 42-A1, Winquist-Hansen tip-0. Lom je reponiran i fiksiran ukotvljenim čavlom promjera 3,5 mm, duljine 113 mm, sa četiri vijka. Tri dana nakon operacije, životinja se oslanjala na operiranu nogu koja je bila zaštićena povojem. Četrnaest dana nakon operacije, lom smo procijenili kliničkistabilnim. Dvadeset tjedana nakon operacije, funkcija ekstremiteta bila je normalna. Dosad su objavljena tek dva opisa predstavljene metode. Omogućavajući brz povratak funkcije, ukotvljeni čavao valjana je metoda operacijskoga liječenja loma tibiotarzusa u ptica.

Ključne riječi: ukotvljeni čavao, tibiotarzus, crni labud