CASE REPORT

Locking plate femur fracture repair in a juvenile Western chimpanzee (Pan troglodytes verus) in Sierra Leone

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Abstract

This case reports the successful management of a traumatic diaphyseal femoral fracture in an infant Western chimpanzee (Pan troglodytes verus) from a rescue centre in Sierra Leone using a 2.4-mm intramedullary pin and two 2.7-mm String of Pearls™ locking plates. Locking plate use has not been previously described in chimpanzees.

KEYWORDS

bone, orthopaedic, primate, surgery

1 | CASE REPORT

A 2.5-year-old, 3.5 Kg, female Western chimpanzee (Pan troglodytes verus) housed with her mother in a group of 15 chimpanzees in a rescue facility in Sierra Leone had an acute-onset non-weight bearing lameness of the left leg. Although she continued eating normally, no clinical response was noted after 4 days of oral 0.1 mg/kg meloxicam (15 mg/mL Equicam, ScanVet) once daily. Radiographs revealed a closed mid-shaft transverse slightly oblique diaphyseal fracture of the left femur (Figure 1).

She was kept in a small indoor enclosure with her mother until surgery, performed 1 week later. Ethics approval was given by both Tacaguma Chimpanzee Sanctuary trustees, and the ethics board of Wildlife Surgery International. Anaesthesia was induced with intramuscular hand injection of 3 mg/kg tiletamine and zolazepam (100 mg/mL Zoletil 100, Virbac) after oral premedication with 0.1 mg/kg medetomidine (10 mg/mL Medetomidine, Kyron) mixed in honey, followed by and maintained with isoflurane in oxygen with intermittent positive pressure ventilation through a 4.5-mm endotracheal tube. The following were administered at the start of surgery: 0.1 mg/kg meloxicam (5 mg/mL Loxicom, Norbrook), 20 mg/kg amoxicillin clavulanate (175 mg/mL Noroclav, Norbrook), 10 mg/kg enrofloxacin (Baytril 10%, Bayer) and 2 mg/kg ranitidine (50 mg/2 mL Zantac, GlaxoSmithKline), all by subcutaneous injection. An intravenous infusion of 2 µg/kg/h of fentanyl (Fentanest 0.05 mg/mL, Kern Pharma) was administered throughout surgery, with 10 mls/kg/h sterile physiological saline.

A cranio-lateral skin incision was made over the quadriceps muscle and the fracture site approached by blunt dissection. Following retrograde placement of a 2.4-mm intramedullary pin, a 10-hole 2.7-mm String of Pearls™ (SOP™, Orthomed), with 4 self-tapping screws in the proximal fragment and 3 screws in the distal fragment, was applied laterally to the mid-femur bridging the fracture site. A 6-hole 2.7-mm SOP™ locking plate was applied on the cranio-lateral aspect of the femur, staggered to the first plate, with 2 screws proximally, and 2 screws distally. The muscle, fascia and sub-cutis were sutured in separate layers with simple continuous 2-0 USP poliglecaprone (Monocryl, Ethicon). The skin was closed with 4-0 USP poliglecaprone (Monocryl, Ethicon) in a continuous intradermal pattern.

Post-operatively, 10 mg/kg oral enrofloxacin (Piroflox, Pisa) and 0.1 mg/kg oral meloxicam once daily for 7 days were administered. The chimpanzee refused attempts to administer potentiated amoxicillin or oral paracetamol post-operatively. Within 36 hours, the pain score had improved when compared to pre-operative scoring, using the human paediatric pain profile. The profile is a behaviour-rating...
scale designed to assess pain in children with severe neurological impairment. The chimpanzee was kept on its own for the week of medication in an enclosure measuring 1.5 × 2 metres and 1.5 metres high, before being returned to its mother for a further week, both being in an inside house, separated from their group but with visual access to the group. Both were then returned to the group and allowed normal access to the large natural outside enclosure and trees. Anaesthesia and radiographs were repeated 16 weeks post-operatively and revealed remodelling and complete healing of the fracture. (Figure 2).

Habitat loss and fragmentation are the main threats to wild chimpanzees, but poaching, and bushmeat hunting also pose a significant threat. The International Union for the Conservation of Nature (IUCN) lists the Western chimpanzee subspecies as critically endangered. The remaining wild population in Sierra Leone is estimated to be only 5500 individuals. Forest habitat protection is the main requirement for great ape conservation, but successful treatment, rehabilitation and release of individuals can potentially help repopulate suitable areas where apes have been eradicated.

Despite extensive previous use in biomedical and surgical research, there are few peer-reviewed reports of naturally occurring fractures or their surgical repair in chimpanzees or other great apes. A series of 8 femoral and 5 humeral successfully managed fractures in Bornean orangutans (Pongo pygmaeus pygmaeus) have been described. In contrast, while there are reports of chimpanzee orthopaedic surgery in the media, the majority have not subsequently been published, and the long-term outcomes are unknown.

Eighty-three per cent of naturally occurring long-bone fractures of wild shot chimpanzees in museum collections were of their arms. Chimpanzees had a higher proportion of upper limb fractures to lower limb fractures than gibbons, gorillas or humans. The ulna was the most frequently fractured bone, believed to be due to raising an arm to block a blow from another chimpanzee. In captive chimpanzees, long-bone fractures appear uncommon, with only a single report in an infant male in 1362 spontaneous pathologies reported over 35 years in 245 chimpanzees kept at the Texas Biomedical Research Institute. There is a single report of a traumatic vertebral fracture in a seizuresing captive chimpanzee. While low bone mineral density, consistent with osteoporosis in humans, was found in an elderly wild female chimpanzee’s skeleton from Tanzania, she did not suffer any fractures.

A systematic review of published wildlife surgery found low reported complication rates, while in contrast actual surgical

![FIGURE 1](image1) Radiograph obtained in a juvenile Westerns chimpanzee (Pan troglodytes verus) showing a left femoral diaphyseal transverse fracture with normal bone density

![FIGURE 2](image2) Radiograph obtained 16 wk post-surgery showing remodelling and complete healing of the left femoral diaphyseal transverse fracture with two 2.7-mm SOP™ locking plates and a 2.4-mm intramedullary pin
complication rates in zoos were found to be notably higher, signifying under-reporting of adverse outcomes.15 This was particularly striking for primate surgery where a reported complication rate of only 1.86% over 377 operations was found, while retrospective examination of 445 zoo primate surgery records revealed an actual complication rate of 34.78%.15

Locking plates are the equivalent of using external fixation internally.16 The growth plates are unaffected, which is advantageous in young animals.17 Locking plates do not compress the periostea and vascular tissue beneath the plate compared to normal bone plates. Weight bearing can commence rapidly after surgery, and immobilisation is not needed. Their use has been associated with less pain and lower infection rates than other techniques by some authors.18,19

While there are no previous reports of locking plate use in any great ape fracture repairs, based on its use in human paediatrics, domestic animals and a small number of wildlife species,20,21 this technique potentially holds advantages over alternatives for use in wild animals such as chimpanzees.

Chimpanzees are a large, arboreal and social species that may fight aggressively, using rocks or sticks as weapons. Individuals need to be returned to their social group as rapidly as possible after surgery, to limit social disruption which can result in fighting. Fracture repairs may be subjected to greater forces post-operatively than would be expected in humans or domestic animals that can be rested after surgery. Locking plates usually do not need removal after fracture healing, again advantageous for their use in wild animals. Techniques employed should encourage rapid robust secondary bone healing, rather than aiming for primary bone healing. Locking plate fixation of the femur has been advocated in children with neurological defects, due to their increased risk of non-union or re-fracture.18 It is also reported that locking plates function better in paediatric patients at risk of non-union with other techniques such as intramedullary nailing.22

SOP™ plates hold potential advantages over other locking plate systems when applied to wildlife patients, using regular bone screws, and can be highly contoured.23,24 These allow greater application of a smaller stock of orthopaedic implants in different species, bones and fracture types, eliminating the need for expensive and extensive equipment.

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