CASE REPORT
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REPAIR OF OPEN FRACTURE OF METACARPAL BY FREE-FORM EXTERNAL SKELETAL FIXATION TECHNIQUE USING EPOXY PUTTY CASTED POLYETHYLENE TUBE CONNECTING BARS IN A CALF

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ABSTRACT

A two month old cross-bred Jersey calf weighing 78 kilograms was presented at the District Veterinary Centre, Kannur with the history of non weight bearing lameness on the right forelimb. On clinical examination, the proximal end of fractured right metacarpal was found protruding through the skin on the medial side above the fetlock joint. Radiographic examination confirmed an open long oblique fracture of distal diaphysis of right metacarpal. Bilateral-multiplanar free-form external skeletal fixation technique using polyethylene tube casted with epoxy putty was performed under brachial plexus nerve block and general anaesthesia. Postoperative antibiotics, analgesics and regular dressing were advised. The wound healed completely by two weeks. Animal started bearing weight during 2nd postoperative week and normal weight bearing was observed by the 4th postoperative week. Radiographic union was observed by the 6th postoperative week and the fixator was removed. Mild exuberant granulation was observed on the wound which resolved by the subsequent week following topical application of copper sulphate-potassium permanganate-glycerine paste in the ratio 1:1:5 and the animal had an uneventful recovery.

Keywords: Epoxy putty, Trans-fixation pins, External skeletal fixation

INTRODUCTION

External skeletal fixation (ESF) has been widely used for the management of compound fractures as it is less invasive, easy to apply and required minimum instrumentation (Anderson and Jean, 1996). However, in small ruminants, the ESF of compound fractures poses challenges attributed to the extensive postoperative care, the stability and the expensiveness of the external fixator frame used (Aithal *et al*., 2007). The ESF is generally performed unilaterally or bilaterally in uni-, bi- or

multi- planar configurations and the complexity of the fixation frame determines the strength of the fixator (Anderson and Jean, 1996). The free-form ESF engages alternative materials as external fixation frame for connecting the trans-cortical pins of desired diameter placed at the desired locations (Martinez *et al*., 1997). However, light weight materials such as aluminum are fragile whereas acrylics are expensive for application in small ruminants (Chourasia *et al*., 2019). Although the use of an epoxy resin compound (M-seal) as external fixator frame could overcome these drawbacks, its use as a sole external fixator might lead to increased weight of the frame, instability of the fixator at pin-side bar interface or spontaneous breakage of the epoxy putty during an insult (Kumar *et al.*, 2012; Aithal *et al*., 2019). The present case report documents the repair of open fracture of metacarpal in a calf by bilateral-multiplanar free-form ESF using epoxy putty casted polyethylene tube as external frame.

CASE HISTORY AND CLINICAL OBSERVATION

A two month old cross-bred Jersey calf weighing 78 kilograms was presented at the District Veterinary Centre, Kannur with the history of non weight bearing lameness on the right forelimb after falling from a height. On clinical examination, the right forelimb was found hanging below the knee joint. The fractured proximal end of right metacarpal was found protruding through the skin on the medial side above the fetlock joint (Fig. 1A). Radiographic examination (Antero-Posterior view) confirmed an open long oblique fracture of distal diaphysis of right metacarpal. Surgical repair of the compound fracture by free-form ESF technique using polyethylene tube impregnated with epoxy putty was resorted to under brachial plexus nerve block and general anaesthesia.

TREATMENT AND DISCUSSION

The surgical site was clipped, shaved and scrubbed with 1% chlorhexidine solution and aseptically prepared with povidone iodine (5%) solution. Preoperatively, the calf was administered with ceftriaxone sodium (Intacef pet, Intas Pharmaceuticals Ltd., Ahmedabad, India) at the rate of 10 mg/kg body weight; butorphanol (Butrum-1, Aristo Pharmaceuticals Pvt. Ltd., Raisen, India) at the rate of 0.05 mg/kg body weight; meloxicam (Melonex, Intas Pharmaceuticals Ltd., Ahmedabad, India) at the rate of 0.5 mg/kg body weight. Sedation was achieved by xylazine hydrochloride (Xylaxin, Indian Immunologicals Limited, Telangana, India) at the rate of 0.05 mg/kg, administered intramuscularly. In order to block the brachial plexus, a 22-gauge 7.5-cm spinal needle was inserted through a small stab puncture at a point medial to

scapula-humeral joint. The needle was advanced towards the costo-chondral junction of the first rib medial to the scapula and 7 mL of 2% lignocaine hydrochloride (Xylocaine two per cent, Astra Zeneca Pharma India Ltd., Dundigal, India) was injected by fanning the needle dorsally and ventrally. General anaesthesia was induced with ketamine hydrochloride (Aneket, Neon Laboratories Limited, Mumbai, India) at the rate of 3 mg/kg body weight intramuscularly followed by diazepam (Calmpose, Ranbaxy Laboratories Limited, Baddi, India) at the rate of 0.2 mg/kg body weight intravenously. Anaesthesia was maintained with a mixture of ketamine hydrochloride and diazepam (1:1 v/v) along with intravenous infusion of normal saline perioperatively.

The animal was positioned in the right lateral recumbency and the surgical site was draped. The proximal and distal fracture fragments were initially reduced and aligned by applying traction and counter-traction manually using a cotton rope tied around the hoof and was held throughout the surgery. The trans-fixation pins of 2.5 mm diameter were drilled through both the cortices of proximal and distal fragments at the predetermined points using a low speed, high torque orthopedic drilling machine. In order to achieve a bilateral multi-planar configuration, five trans-fixation pins were passed on the proximal fragments and four pins in the distal fragments, perpendicular to the long axis of bone crossing at an angle of 50° to 70°. Once the trans-fixation pins were passed, a corrugated polythene tube of 2 mm diameter was inserted on to the pins interconnecting them on each side. The pins were then bent at a distance of 2 cm from the skin surface using pin benders towards the direction of fracture site. The bent pins on each side were secured to connecting bars using orthopedic wires and adhesive tapes in such a way that the scaffold of pins rested within the longitudinally sectioned corrugated tube. The frame was completed by connecting the proximal and distal pins respectively on each side using an additional proximal and distal connecting bar. The corrugated tube with the scaffold of pins was manually filled with the uniform dough produced by kneading the base of the epoxy resin compound (M-seal) and hardener (Fig. 1B). The epoxy-pin construct was then allowed to harden. The surgical site was then thoroughly lavaged with 0.9% normal saline solution. The skin wound was closed in simple interrupted suture pattern using 2-0 monofilament polyamide (Dynalon, Dynamic Techno Medicals Pvt. Ltd., Aluva, India). Postoperatively, antibiotics (ceftriaxone sodium) were continued for five more days and analgesics (meloxicam) for three more days. Antiseptic dressing of

the wound and the skin-pin interface was done regularly using povidone iodine (5%) solution. Animal started bearing weight during the 2nd postoperative week (Fig. 1C) and radiographic evaluation (Antero-Posterior view) during the 2nd immediate postoperative week showed proper alignment of fracture fragments (Fig. 1D). The wound healed completely by two weeks and the skin sutures were removed on the 16th postoperative day (Fig. 1E). Normal weight bearing was observed by the 4th postoperative week. Radiographic union by periosteal callus formation was observed by the 6th postoperative week (Fig. 1F) and the fixator was removed. Mild exuberant granulation was observed on the wound during the 7th postoperative week which resolved by the subsequent week following topical application of copper sulphate-potassium permanganate-glycerine paste in the ratio 1:1:5 and the animal had an uneventful recovery.

The bilateral-multiplanar free-form ESF using epoxy putty as external frame

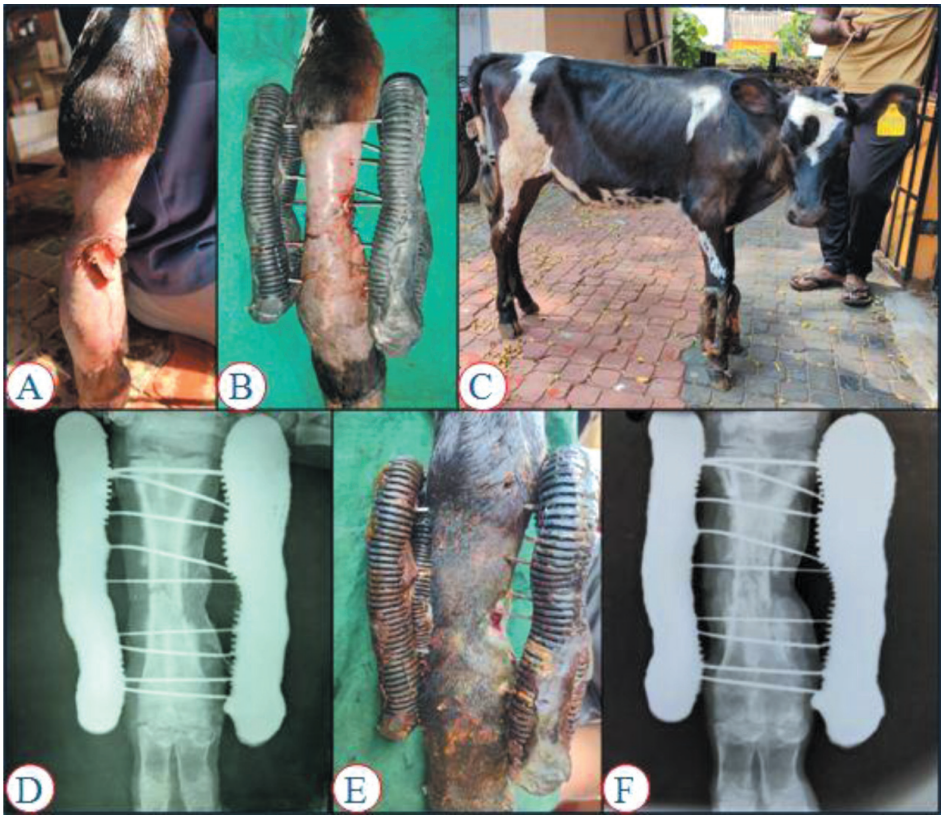

Fig. 1: **A**. The fractured proximal end of right metacarpal protruding through skin
B. The bone-epoxy-pin construct after application
C. Animal bearing weight on the 2nd postoperative week
D. Properly aligned fracture fragments during the 2nd postoperative week
E. The completely healed skin wound during the 16th postoperative day
F. Periosteal callus formation during the 6th postoperative week.

was found effective in the management of compound metatarsal fracture in the present case as observed by Aithal *et al*. (2019) and Rawat *et al.* (2020). The weight of the calf was 78 kg and free-free form ESF using epoxy putty has been successfully used in calves weighing up to 100 kg (Aithal *et al*., 2019; Rawat *et al.*, 2020). The use of corrugated tube as the external frame reduced the amount of epoxy putty required for the construction of the frame and thereby the weight of the construct. The construct was well tolerated by the animal during rest and progression. The size of the transcortical pins used was 2.5 mm and the pins of similar dimensions were suggested by Aithal *et al*. (2019) for calves weighing between 60 to 80 kg. As with any type of ESF, early limb usage was observed in the present case also and radiographic union was observed by the 6th postoperative week. Similar findings were reported by Kumar *et al.* (2012), Aithal *et al*. (2019) and Rawat *et al.* (2020). Unlike the conventional ESF wherein the fracture heals by endosteal callus formation (Anderson and Jean, 1996), the fracture in the present case healed by periosteal callus formation as observed by Aithal *et al*. (2019) and Rawat *et al.* (2020). The fracture complications reported with ESF were associated with pin tract discharge, osteolysis, osteomyelitis and loosening of construct (Harari, 1992) and such complications were not observed in the present case. However, mild exuberant granulation formation was observed around the wound following implant removal. Topical application of copper sulphate-potassium permanganate-glycerine paste in the ratio 1:1:5 was effective in resolving the exuberant granulation as reported by Shivaraju *et al*. (2021) and the animal had an uneventful recovery.

SUMMARY

The repair of open fracture of metacarpal in a two month old cross-bred Jersey calf by bilateral-multiplanar free-form ESF using polyethylene tube impregnated with epoxy putty as external frame and its outcome was discussed.

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