Scientific Report

Use of locking plate in combination with dynamic compression plate for repair of tibial fracture in a young horse

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Summary

Grade 1 open spiral fracture of left tibia in a 1.5 year-old horse was treated using a combination of 4.5 mm locking compression plate (LCP) and a dynamic compression plate applied in a neutralization manner. The open wound was managed postoperatively by regular dressing and lavage. Radiograph at 24 days post-treatment revealed callus formation and at two months complete bridging callus was observed. At the end of six months complete healing of the fracture with functional recovery of the limb was observed.

Key words: Fracture, Horse, Locking plate, Tibia

Introduction

Successful management of tibial fractures in an adult horse by open reduction and internal fixation has been documented (Bramlage and Hanes, 1982). Successful management of tibial fracture in a horse with external coaptation and sling has also been reported (Springstead, 1969) but has been associated with complications of pressure sores, edema of ventral abdominal wall and heel contracture. Thus, open reduction and internal fixation has been advocated to manage tibial fractures in horses. The present report describes the use of open reduction and internal fixation using a combination of locking plate and a dynamic compression plate.

Case history

A one and a half year-old mare was referred to the referral veterinary clinic with non-weight bearing lameness of left hind limb. The injury was of unknown origin and the limb had been immobilized with two bamboo splints by the owner. The mare had been walked to the clinic. No prior treatment except application of bamboo splints had been given by the owner.

The mare weighed around 250 kg and was in good body condition. The general condition and demeanor were mildly impaired. There was no weight bearing on the left hindlimb. The mare was sedated with intramuscular injection of xylazine (Xylaxin; 20 mg/ml; Hyderabad, India). Removal of splints revealed a puncture wound on the medial tibial region with moderate external bleeding. Mediolateral (Fig. 1) radiographic view showed a complete spiral mid-diaphyseal left tibial fracture with well defined fracture edges. The distal fragment was longer than the proximal fragment. There was marked medial dislocation of the proximal tibial fragment with several pinpoint mineral opacities in the fracture gap and soft tissue swelling.

The horse was sedated with xylazine hydrochloride (1.0 mg/kg b.wt) administered intravenously (i.v.). General anaesthesia was induced with ketamine hydrochloride (2.2 mg/kg b.wt) i.v. and maintained by thiopental sodium administered till effect. The mare was placed in the right lateral recumbency. The circumference of the left hindlimb was clipped, and prepared aseptically from the distal end of the femur to the proximal end of the metatarsus. The incision was given directly over the muscle belly of cranial tibial muscle, from the lateral patellar ligament to the level of the hock. The skin was reflected medially until the tibia was reached. The periosteum was incised and a sub-periosteal dissection plane was established to elevate and retract the cranial tibial muscle and periosteum caudolaterally. The fracture was reduced and a hemicerclage wire was placed to achieve temporary alignment.

A 4.5 mm, 12 hole broad dynamic compression plate (Nebula Surgicals, Rajkot, India) was contoured to the craniolateral surface of the tibia followed by application of 4.5 mm, 14 hole narrow locking compression plate (LCP) (Nebula Surgicals) on the craniomedial surface after limb rotation. Self tapping 4.5 mm cortical screws and 4.9 mm locking screws were used in lateral and

medial plate, respectively. The lateral plate had 5 screws in the proximal fragment and 6 in the distal fragment. The medial plate accommodated 7 screws in both proximal and distal fragments. The tibial muscle was repositioned and subcutaneous fascia was apposed with absorbable sutures. Skin was closed with No. 2 silk in vertical mattress suture pattern. No external coaptation was used. Beginning from proximal to distal, the screw in the seventh hole of the lateral plate could not be tightened properly and a few millimeters of length remained protruding outside the plate hole. This did not create any problem with the fixation.

Fig. 1: A complete spiral mid-diaphyseal left tibial fracture

Results

The mare recovered smoothly and was able to rise without assistance and was bearing weight on the left hindlimb soon after recovery. Treatment with ceftriaxone (Intacef; 20 mg/kg, Intas, Ahmedabad, India) and meloxicam (Melonex; 2.2 mg/kg, Intas) was continued for 5 days. Stall rest for a period of 8 weeks was advised. After 5 days of operation, dehiscence of the proximal skin sutures was observed with mild seropurulent discharge from the wound. The sutures were removed and open wound management was initiated. Soft tissue swelling was resolved by 2 weeks after surgery and the remaining sutures were removed. Radiograph taken at 24 days after surgery showed fair axial alignment of the tibia (Fig. 2) and correct positioning of all the implants. Extensive periosteal new bone formation was observed proximal to the plate on the mediolateral view of radiograph. Another radiographic evaluation at 60 days showed complete radiographic healing with disappearance of the fracture line and exuberant callous formation (Fig. 3). Weight bearing was complete on the

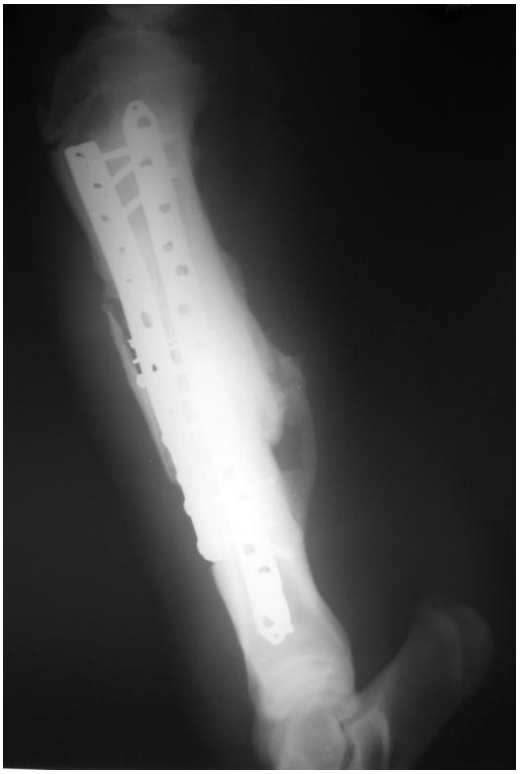

Fig. 2: Day 24 postoperative radiograph with callus formation

Fig. 3: Day 60 postoperative radiograph with radiographic union

Fig. 4: Photograph showing complete weight bearing on the affected limb

affected limb at 6 month clinical evaluation (Fig. 4). The animal was being used for pull cart and carriage and returned to work after another week of rest. The plates were left in place as no abnormality in limb carriage was observed.

Discussion

Successful outcome was achieved with a dynamic compression plate and LCP in a one and half year-old mare with a grade 1 complete mid-diaphyseal spiral open tibial fracture (Piermattei *et al*., 2006). Factors that led to a favourable outcome with minimal complications in our patient were the calm temperament and young age. It is well known that fracture osteosynthesis in young and light weight equines has a much better prognosis than heavier equine patients (Frankeny *et al*., 1998; Bramlage and Fackelmann, 2000; Radcliffe *et al*., 2001; Byron *et al*., 2002). For this reason surgical treatment of long bone fracture is rarely attempted in heavier and adult equines, and they are often subjected to euthanasia (Hance *et al*., 1992). Also, the single incision for cranial approach to the tibia which leads to minimal soft tissue damage may also have contributed to a good surgical outcome in the present case.

In the current case, the fracture had a large spiral component caused by torsional force due to which the fracture was easier to stabilize than a comminuted fracture, which typically occurs in adult horses. Young and growing animals also have a higher rate of bone repair and form a stronger callus than older patients (Mehta, 2010).

Equine tibia is subjected to large torsional and axial compression forces during weight bearing, thus a second plate is necessary to neutralize these forces and maintain the fixation for proper fracture healing. The locking plate screws lock to the plate, forming a fixed-angle construct. Fixed angle screws effectively convert the shear forces, experienced at the implant with the application of load, into compressive forces at the screw-bone interface (Egol *et al*., 2004). This force conversion is beneficial in fracture fixation because cortical bone is stronger against compressive forces than shear forces (Hendrickson, 2006). Compared with other methods, this construct (double plating) provides greater strength and stiffness (Radcliffe *et al*., 2001). The early weight bearing shown by the animal on the second postoperative day might have helped in preventing laminitis and contralateral limb plastic deformation in the present case. Complete fracture union was noticed 4 months postoperatively. Because axial alignment was only fair in the present case, it might have contributed toward the micromotion at the fracture site and resultant exuberant bridging callus.

The most common complication in internal fixation of long bone fractures is incisional infection or drainage, leading to premature loosening and failure of implants (Ethell *et al*., 2000). In the present case, the incisional infection and wound on the medial side were treated effectively by regular flushing of normal saline mixed with povidone iodine. Antibiotic-impregnated plaster of Paris or polymethylmethacrylate beads have been advocated for the management of infected fractures as they can maintain an effective antibiotic concentration at the surgical site for many weeks (Ethell *et al*., 2000). Early weight bearing by the mare in this case prevented the complications associated with prolonged treatment using external coaptation and immobilization.

In conclusion, younger equines may have a better chance of fracture repair if meticulous technique and proper implants are applied. The present report illustrates that currently available human bone plates can be used in the management of tibial fractures in younger equines with favourable results.

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