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Case Report

Standing repair of a proximal, incomplete, articular fracture of the third metatarsal bone

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Summary

A 5-year-old National Hunt Thoroughbred mare presented with sudden onset left hindlimb lameness after race training on the gallops. Clinical examination revealed a marked painful reaction over the proximal metatarsal region but no other obvious abnormalities were detected. Survey radiographs at the yard did not reveal any abnormalities. Nuclear scintigraphic examination 3 days after injury revealed focal marked increased radiopharmaceutical uptake in the proximal metatarsal region. Subsequent radiography revealed an incomplete, articular fracture of the proximal left third metatarsal bone. Repair of the fracture using 3 × 4.5 mm cortical screws placed in lag fashion was performed under standing sedation following perineural analgesia. Follow-up radiographs demonstrated progressive healing of the fracture. The mare returned to race training 8 months after the fracture was repaired and raced successfully 12 months post injury.

Introduction

Third metacarpal and metatarsal bone distal condylar fractures are the most common long bone fracture affecting Thoroughbred (TB) racehorses in training (Ferraro 1990; Ross 2003). The clinical presentation is typically predictable with acute onset lameness with swelling around the fetlock region.

Metatarsal and metacarpal fractures are common pathologies in racehorses due to the high-speed and repetitive loading of the limbs; the lateral condyle of the left third metacarpal bone being more commonly affected (Jacklin and Wright 2012; Ramzan *et al.* 2015). Metacarpal fractures are more common than metatarsal fractures in Thoroughbreds but the ratio is nearly equal in Standardbred horses (Rick *et al.* 1983; Zekas *et al.* 1999).

Different surgical treatments for the common orientations of metatarsal fractures have been described, including; screw fixation (either standing or under general anaesthesia), application of a buttress plate (or plates), dynamic compression plates and locking compression plates under general anaesthesia, for medial condylar fractures that spiral proximally (Russell and Maclean 2006; Bischofberger *et al.* 2009; Smith *et al.* 2009; Jalim *et al.* 2010; Payne and Compston 2012; Goodrich *et al.* 2014; O'Brien and Hunt 2014). In recent years, standing fracture repair has become a useful technique for reducing cost and risk associated with general anaesthesia. Incomplete fractures are often good candidates for standing repair as they are non or minimally displaced so require little surgical manipulation to achieve accurate reduction (Payne and Compston 2012).

This case report describes an unusual fracture configuration in the proximal aspect of the third metatarsal bone. The fracture originated at the tarsometatarsal joint and coursed distally in a dorsomedial to plantarolateral plane to the level of the mid-metatarsus. This fracture configuration has been previously reported and repaired with lag screws in the metacarpal region but not the metatarsal region (Ross and Martin 1992). The fracture was repaired under standing sedation following nerve blocks using three 4.5-mm cortical screws placed in lag fashion (Russell and Maclean 2006; Smith *et al.* 2009). Previous publications have reported standing fracture repair for lateral and medial condylar fractures, but to the authors' knowledge this is the first case report describing this fracture configuration and its repair in a standing horse.

Case history

A 5-year-old National Hunt TB mare presented with an acute onset left hindlimb lameness (grade 4/5) (Ross 2003) after fast exercise on the gallops. Initial examination revealed that the mare was reluctant to bear weight fully on the limb and a painful reaction was elicited by palpation of the proximal metatarsal region. Survey radiographic examination of the limb, including the proximal third metatarsus, using a wireless digital radiography (DR) system[1] (Cuattro Slate 3) at the yard did not did not reveal any obvious fracture and nuclear scintigraphy was recommended. In the interim and based upon the clinical findings the mare was cross tied in the stable and treated with i.v. phenylbutazone (Equipalazone®[2] 2.2 mg/kg bwt) and maintained on oral phenylbutazone (2.2 mg/kg bwt). No bandage was applied to the limb. The mare underwent nuclear scintigraphy, at the earliest opportunity, 3 days after initial onset of lameness.

Scintigraphy and radiography

Three days post injury the mare was injected intravenously with 6.5 MBq technetium-^{99}methyldiphosphonate (^{99m}Tc-MDP) and 2 hours later images of both hindlimbs and the pelvis were acquired using a gamma camera and a dedicated computer system (MiE medical)[3] This revealed a focal, marked increase of radiopharmaceutical uptake at the level of the proximal left third metatarsal region (**Figs 1** and **2**).

Following a mandatory period of radioactive isolation, radiographs of the proximal third metatarsal region were

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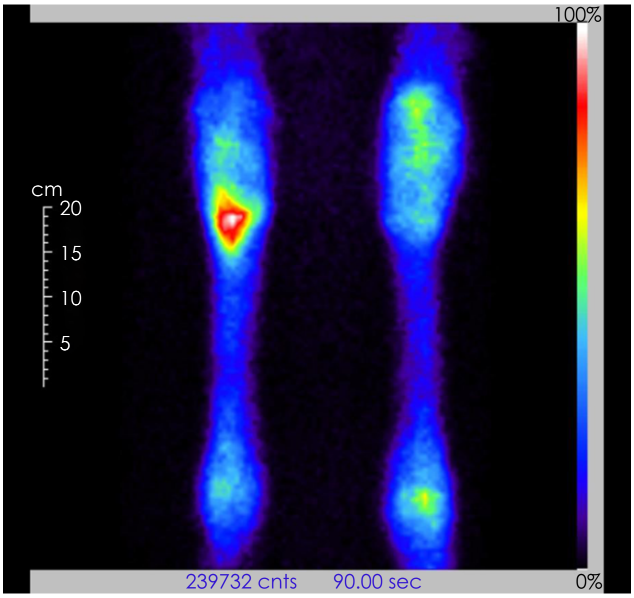

***Fig 1:** Plantaro-dorsal scintigraphy image showing marked increase of radiopharmaceutical uptake at the level of the proximal left third metatarsal bone.*

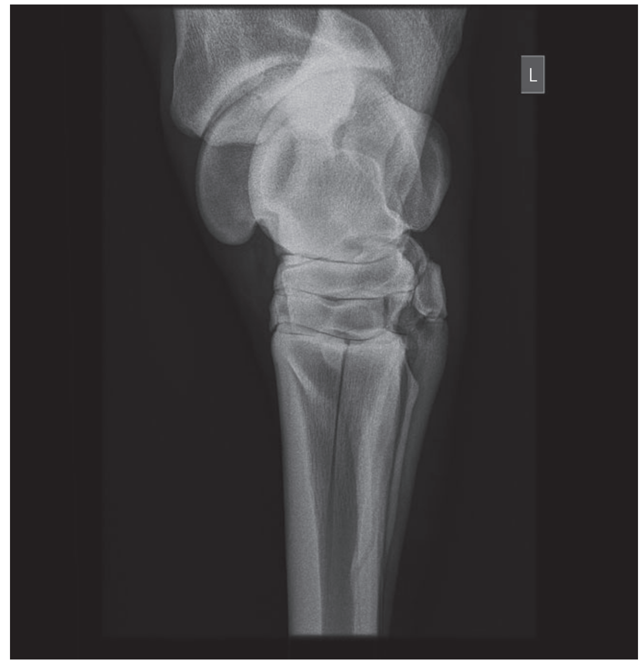

***Fig 3:** 45° dorsomedial plantolateral radiographic projection showing proximal left MtIII fracture.*

obtained using a Siemens Gigantos 1012MP x-ray unit[4] with a 24 × 30 cm CRMD4.0 General cassette and CR25.0 processor,[5] including lateromedial, dorsolateral–plantarmedial oblique 45°, dorsomedial–plantarlateral oblique 45° and dorso plantar projections (Butler *et al.* 2016). This revealed an incomplete, articular, minimally displaced, proximal metatarsal fracture extending approximately 3 cm distally in a dorsomedial to plantarolateral plane (**Figs 3** and **4**). No radiographic or scintigraphic evidence of spiralling of the fracture was evident but it was presumed to have a significant risk of propagation. At this time (5 days post injury), the mare was still not fully weightbearing on the limb. Following discussion with the trainer the decision was made to stabilise the fracture using cortical bone screws with the mare standing and sedated (**Figs 5** and **6**).

Surgical procedure

The mare was sedated using a combination of i.v. detomidine hydrochloride (Medesedan®[6]) (0.02 mg/kg bwt) and morphine sulphate (Butador®[6]) (0.1 mg/kg bwt i.v.) followed by a continuous i.v. infusion with detomidine hydrochloride (to effect) through an i.v. catheter. Ceftiofur hydrochloride (Excenel®[7] 2 mg/kg bwt i.v.) and phenylbutazone (Equipalazone®[2] 2.2 mg/kg bwt i.v.) were administrated 30 min before surgery.

Left perineural tibial/peroneal nerve block plus additional ring block at the level of the proximal metatarsal bone were performed using a combination of mepivacaine hydrochloride (Intra-epicaine®[2], 30 mL) and lidocaine and

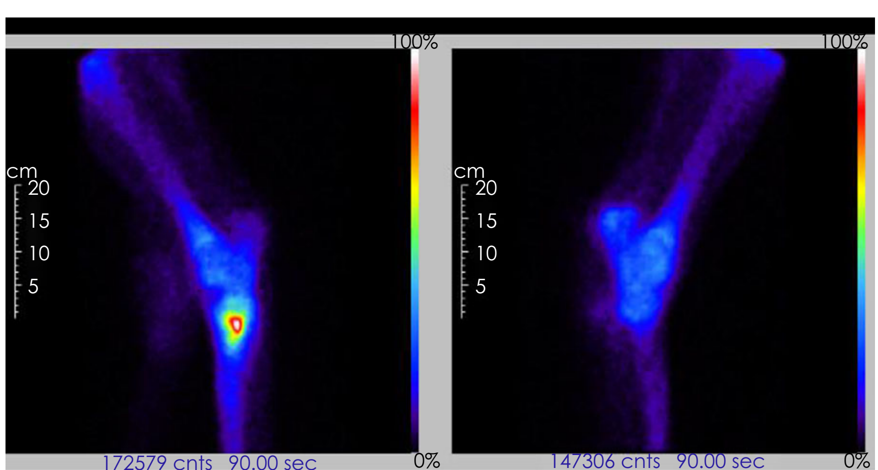

***Fig 2:** Lateromedial scintigraphy image showing marked increase of radiopharmaceutical uptake at the level of the proximal left third metatarsal bone.*

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***Fig 4:** 35° dorsomedial plantarolateral radiographic projection showing proximal left MtIII fracture.*

***Fig 6:** Dorsomedial plantarolateral radiographic projection showing MtIII fracture repair with three 4.5 mm cortical bone screws.*

***Fig 5:** Dorsomedial plantarolateral radiographic projection showing drilling of distal hole.*

adrenaline (Lignol®,[8] 40 mL). The contralateral limb was bandaged with sterile Vetrap™, sterile drapes were not used due to the temperament of the mare. Aseptic preparation of the left hindlimb was carried out using povidone/iodine scrub (Vetasept®[9]) after clipping and sterile bandaging of the distal and proximal limb was performed with sterile Vetrap™.

Skin staples were placed on the proximal cannon under radiographic guidance. Three 1.5-cm stab incisions were created, the first most proximal was just distal to the tarso–metatarsal joint. Three 4.5-mm cortical bone screws were placed in lag fashion across the fracture line using a Cordell drill (DeWalt®[10]). The Cordell drill had been sterilised using an ethylene oxide autoclave (Anprolene®[11] sterilisation system). Screws were placed approximately 2 cm apart proximally to distally from dorsolateral to plantar medial to cross the fracture line at 90 degrees. The proximal screw was 44 mm long, middle 42 mm and distal 40 mm. Saline was used throughout the procedure for lavage and irrigation during drilling of the fracture. The screws were placed in amikacin sulphate (Amikin®[12]) prior to insertion. After all screws were placed the screws were tightened from proximal to distal while the horse was not fully weightbearing. Final radiographs confirmed reduction of the fracture gap. Routine closure of the stab incisions was carried out with simple interrupted 3.5 metric polyglactin 910 sutures in the skin (Vicryl®[13] 3,5 Metric). A modified Robert Jones bandage was applied from foot to proximal tibia plateau. The mare was fully weightbearing after surgery and remained comfortable on the limb once the perineural blocks had worn off. The horse was discharged from the hospital 24 h after surgical repair with instructions to continue with box rest and a course of Ceftiofur hydrochloride (Excenel®[7] 2 mg/kg bwt i.v.) and oral phenylbutazone (Equipalazone®[2] 2.2 mg/kg bwt) for 5 days.

Results

The mare was strictly box rested for 8 weeks after discharge from the hospital. She remained comfortable and fully weightbearing on the limb during that time. The modified Robert Jones bandage was changed after 4 days and replaced for a 2-layer bandage which was changed every 4–6 days. Following this, the mare was maintained in a stable bandage.

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The owners were advised that there was a continued risk of catastrophic failure during the initial healing process if the fracture propagated distally after the surgery. The mare was immediately comfortable following stabilisation of the fracture and quiet box rest was required to allow healing without further injury.

Radiographic examination 4 weeks after surgery revealed moderate widening of the fracture line as expected for this stage (Panjabi *et al.* 1985). Distal propagation of the fracture was still considered a possibility so despite the mare being fully weightbearing, the mare was maintained on box rest for a further 4 weeks. Repeat radiographic examination at 8 and 12 weeks post surgery revealed reduction of the fracture gap, with the screws remaining in position with mild remodelling at the level of the screw heads. Clinical examination at 12 weeks revealed mild bony exostosis at the level of screws but no pain on palpation or flexion of the limb. The mare was sound at walk. Based on these findings a controlled walking exercise programme was instigated for 4 weeks. Further radiographic examination at 16 weeks after surgery revealed reduction of the fracture line, mild periosteal reaction was observed around the proximal screw head and slight bending of the proximal screw.

At this point, the mare was turned out in a small paddock for 6 weeks prior to free field turn out. The mare returned to training 8 months after original injury without signs of lameness and won a hurdle race 12 months after the original injury.

Discussion

This case report describes both an unusual fracture of the third metatarsal bone and the successful standing repair using cortical bone screws placed in lag fashion. The fracture was incomplete and minimally displaced making it a good candidate for standing fracture repair, which avoided the risk of propagation during induction or recovery from general anaesthesia.

Proximal articular fractures of the MtIII are unusual in racehorses but are reported and normally occur on the dorsomedial aspect of the bone (Lloyd *et al.* 1988; Pleasant *et al.* 1992; Ross and Martin 1992). These fractures are commonly incomplete, longitudinal fractures caused by repetitive cyclic loading of the bone (Morgan and Dyson 2012) and normally propagate distally from the tarsometarsal joint into the third metatarsal bone and toward the dorsomedial cortex. Some incomplete fractures can be difficult to diagnose as there can be very little swelling and they do not always improve after intra-articular analgesia of the tarsometatarsal joint. Firm pressure around the proximal cannon can elicit pain in some cases, as was observed in this case. Precise radiographic orientation is required to visualise these fractures radiographically, which may explain why this was not observed on the initial screening radiographs taken at the yard and/or that the fracture had propagated by the time of the second radiographic study 5 days post injury. Nuclear scintigraphy can be very useful in ascertaining the location of a fracture prior to more targeted radiography and has the advantage of helping to rule out other bony pathology in the hindlimb, which can be difficult to otherwise image successfully. MRI, computer tomography or ultrasound may also have been useful to identify a linear discontinuity in the proximal plantar cortex of MtIII (Gaschen and Burba 2012).

Conservative management of incomplete fractures of the proximal third metatarsal bone has been reported to be successful (Pilsworth 1992). In this case the perceived risk of propagation and the level of lameness exhibited by the mare several days after initial injury were major factors in the decision to recommend standing surgical repair. Surgical repair of McIII/MtIII fractures involving the diaphysis (particularly those that appear to spiral) can include the use of locking plates placed dorsally and dorsomedially at 90 degrees to each other (Ahern *et al.* 2010; Goodrich *et al.* 2014), with minimally invasive approaches described (James and Richardson 2006). However, major complications of repairing fractures in this way include infection, implant failure (Ahern *et al.* 2010) and the requirement for plate removal after the fracture has healed. Use of a minimally invasive lag screw technique reduced the risks of these complications.

The decision to cross tie the mare and not apply any bandage was made in the initial period due to the lack of accurate injury localisation and may have contributed to the apparent progression of the fracture from the initial screening radiographs. The application of a Robert Jones dressing that ends near the fracture site provides only limited support and increases the leverage arm, potentially resulting in more tissue damage (Ladefoged *et al.* 2017). On this basis, the limb was left unbandaged until the fracture was localised. With fractures of MtIII a cast or splint should be applied from the hoof to the stifle joint (or in some cases only to the top of the calcaneus). The limb was bandaged after surgery to help reduce the post-operative swelling and to protect the surgical site from further trauma even though full support of the fracture was not achieved. Many veterinary surgeons find bandaging of the mid hindlimb of questionable benefit, due to the intolerance from many horses; in this case the mare tolerated the post-operative bandage well, so it was retained.

The decision to use i.v. dose of ceftiofur hydrochloride was based on the mare's resentment of i.m. injections, the lack of availability of i.v. penicillin in our clinic at that time and the concerns of using procaine penicillin in a horse with a fractured limb due to the possible reactions (Olsen *et al.* 2007). While ceftiofur hydrochloride is not licenced for i.v. use in horses and has been linked to increased risk of diarrhoea by some, because of its benefits by this route, it was considered an appropriate choice in this case.

Conclusion

This case report describes a novel surgical technique for an unusual third metatarsal fracture. The procedure was well tolerated by the horse and placement of the screws from the dorsolateral aspect of the limb was carried out safely and with relative ease. The authors recommend this technique for this fracture configuration based on the associated costs and balance of the risks involved.

Authors' declaration of interests

No conflicts of interest have been declared.

Ethical animal research

Not applicable.

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Authorship

All authors helped with this case report and with the preparation of the manuscript.

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[7]Zoetis UK Limited, UK.
[8]Norbrook, Newry, Northern Ireland, UK.
[9]Animalcare Ltd, York, North Yorkshire, UK.
[10]DeWalt®, Screwfix, Penicuik, Midlothian, UK.
[11]H.W. Andersen Products Ltd., Clacton-On-Sea, Essex, UK.
[12]Bristol-Myers Squibb, Uxbridge, Middlesex, UK.
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