Case Report

Standing surgical treatment of spiral longitudinal metacarpal and metatarsal condylar fractures in 4 horses

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Introduction

Condylar fractures are common injuries in Thoroughbred racehorses (Bassage and Richardson 1998) as a result of the stress accumulation in this area during high-speed exercise (Riggs and Boyde 1999; Riggs *et al.* 1999). The forelimb is affected more frequently than the hindlimb, and the lateral condyle more frequently than the medial (Martin 2000).

Condylar fractures have been classified into 4 main groups (Rick *et al.* 1983); incomplete and complete nondisplaced fractures, complete displaced and spiral longitudinal fractures (also referred to as diaphyseal fractures). Spiral longitudinal fractures are long, incomplete and progress into the diaphysis, often in a spiralling configuration (**Fig 1**). The medial condyle is involved more commonly than the lateral condyle (Barr *et al.* 1989; Ellis 1994).

General anaesthesia and surgical repair with AO/ASIF cortical screws placed in lag fashion is the treatment of choice for complete displaced and spiral longitudinal fractures (Richardson 1998, 1999). A special recovery system is recommended in the spiral longitudinal fracture in order to avoid a catastrophic fracture during recovery from general anaesthesia (Bassage and Richardson 1998; Richardson 1999).

The purpose of this report is to evaluate an alternative surgical technique, performed on a standing, heavily sedated horse, thereby circumventing the post anaesthetic recovery period.

Case details

Four horses were referred for surgical repair of spiral longitudinal condylar fractures (1999–2003).

A standard radiographic examination consisting of 4 projections - dorso-palmar/plantar, dorsolateral-palmaro/plantaro-medial oblique, lateral-medial and dorsomedial-palmaro/plantaro-lateral oblique of the metacarpo/metatarso-phalangeal joint was made. When a spiral longitudinal condylar fracture was diagnosed, the same projections were taken of the full length of the metacarpus/metatarsus. Also when indicated special projections, such as 125° dorso-palmar/plantar (skyline), were taken (*Case 4*).

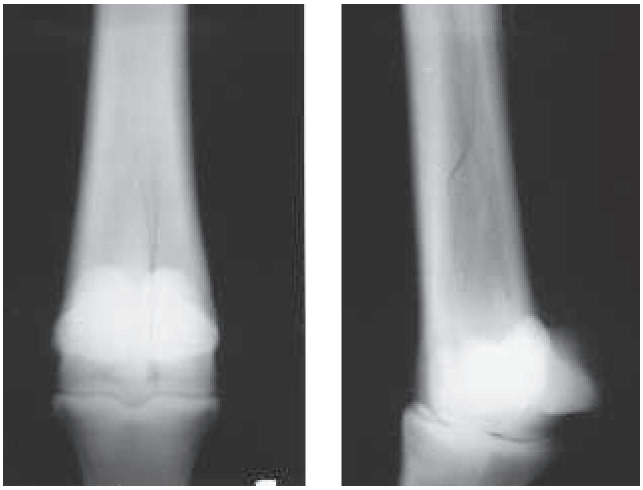

***Fig 1: Preoperative dorso-palmar/plantar (DP) and dorsomedial-palmaro/plantaro-lateral (DMPLO) radiographs of* Case 2.**

Case 1

A 6-year-old Thoroughbred gelding in training was referred to the hospital 5 days post injury. The horse had a nonweightbearing lameness affecting the left forelimb. The metacarpo-phalangeal joint and distal aspect of the third metacarpal bone (MCIII) were swollen and painful to palpate.

A radiolucent defect (2 mm wide) commencing at the sub-chondral bone plate, 20 mm from the lateral aspect of the distal third metacarpal bone (MCIII) was noted. The radiolucent defect extended proximally from the subchondral bone plate as 2 separate radiolucent lines. One radiolucent line extended in a proximo-lateral direction for approximately 75 mm and did not appear to exit the lateral cortex. The other radiolucent line extended in a proximo-medial direction for approximately 120 mm and did not appear to exit the medial cortex. These radiographic findings indicated the presence of

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a lateral condylar spiral longitudinal fracture of the third metacarpal bone.

Case 2

A 5-year-old Thoroughbred gelding in training was referred to the hospital one day post injury. The horse had a nonweightbearing lameness affecting the right forelimb. The metacarpo-phalangeal joint and distal aspect of the MCIII was swollen and sore on palpation.

A radiographic examination was performed. A radiolucent defect (3 mm wide) commencing at the subchondral bone plate, 25 mm from the medial aspect of the distal MCIII was noted. The radiolucent defect extended proximally from the subchondral bone plate as 2 separate radiolucent lines. One radiolucent line extended approximately 85 mm in a medio-proximally direction and did not appear to exit the medial cortex. The other radiolucent line extended approximately 100 mm in a proximo-lateral direction and did not appear to exit the lateral cortex. On the dorsomedial-palmarolateral oblique projection, 2 radiolucent lines could be identified in the mid diaphysis of MCIII. One radiolucent line was extending in a dorso-medial direction and the other in a palmaro-lateral direction. Both lines appeared to cross each other in a spiralling configuration. These findings were consistent with a spiral longitudinal medial condylar fracture of the MCIII (**Fig 1**).

Case 3

A 6-year-old Thoroughbred gelding in training was presented one day post injury. The horse had a nonweightbearing lameness affecting the right forelimb.

A radiographic examination was performed. A 3 mm wide radiolucent line was noted in the subchondral bone plate, 25 mm from the medial aspect of distal MCIII. The radiolucent line extended 35 mm proximally and then divided into 2 separate radiolucent lines. One radiolucent line extended 75 mm in a proximo-medial direction and was not seen to exit the medial cortex. The other radiolucent line extended approximately 100 mm in a proximo-lateral direction and was not seen to exit the lateral cortex. On the dorsomedial-palmarolateral oblique projection both radiolucent lines could be seen to cross each other in a spiralling fashion from the distal aspect of the diaphysis to the proximal metaphysis of the MCIII. These findings were consistent with a spiral longitudinal medial condylar fracture of the MCIII (**Fig 2**).

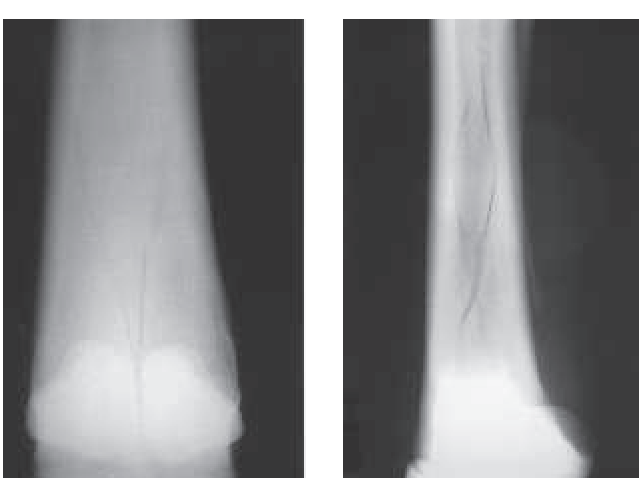

***Fig 2: Preoperative DP and DMPLO radiographs of* Case 3.**

Case 4

A 5-year-old Thoroughbred gelding in training was referred to the hospital 10 days post injury. The horse was Grade 4/5 lame on his right hindlimb and presented with a cast on his leg.

A radiographic examination was performed. A 2 mm wide radiolucent line was noted in the subchondral bone plate, 25 mm from the medial aspect of the distal third metatarsal bone (MTIII). The radiolucent line extended proximally 10 mm and then divided into 2 radiolucent lines. One radiolucent line extended in a proximo-medial direction for approximately 90 mm and was not seen to exit the medial cortex. The other extended in a proximo-lateral direction for approximately 90 mm and was not seen to exit the lateral cortex. These finding were consistent with a spiral longitudinal medial condylar fracture of the MTIII.

Treatment

The fracture treatment of all 4 cases was performed in an anaesthetic induction room, which has a padded floor (13 cm foam with a rubber seal).

Each horse was brought into the padded room and then sedated heavily using a combination of 10 mg detomidine hydrochloride and 10 mg butorphanol tartrate. Anaesthesia of the distal limb was achieved by local infiltration of the lateral and medial palmar/plantar metacarpal/metatarsal and palmar/plantar nerves at the level of the proximal third metacarpal/metatarsal metaphysis (high 4 point block) using mepivacaine hydrochloride. A ring block in the region of the proximal third metacarpus/metatarsus was also used. During the surgical procedure, 3 of the 4 horses were administered boluses of 100 mg of xylazine hydrochloride and *Case 4* was given 3 mg detomidine hydrochloride as necessary in order to maintain a level of deep sedation.

Once the nerve block was completed, the leg was prepared by clipping the hair and the skin sterilised with chlorhexidine gluconate and surgical spirit. The limb was then draped with sterile adhesive drapes.

Two 18 gauge needles were placed on the dorsal aspect of the distal metacarpus/metatarsus approximately 10 mm apart, perpendicular to the long axis of the bone. A radiograph was then taken and the needles used as surgical landmarks. A stab incision was made over the lateral/medial epicondyle of the distal metatarsus/metacarpus. A 4.5 mm drill bit was used to make the glide hole in the near cortex and a radiograph taken to confirm that the glide hole had passed the fracture line. A 3.2 mm hole was then drilled in the far cortex. The depth of the drill hole was measured using the AO/ASIF depth gauge.

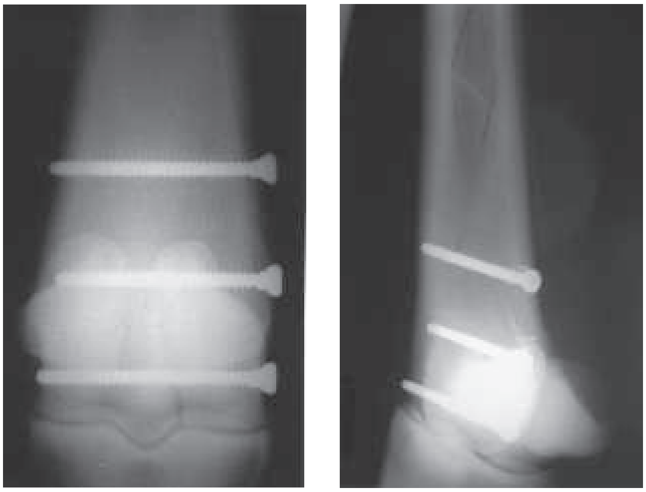

Fig 3: Post operative DP and DMPLO radiographs of* Case 3*.

The drill hole was tapped with a 4.5 mm cortical AO/ASIF screw tap and a 4.5 mm cortical screw inserted. Countersinking was not performed for the cortical screws placed through the collateral ligament of the fetlock joint, but was performed for the cortical screws placed proximal to the epicondyle of the distal metatarsus/metacarpus. Profuse bleeding from the bone was apparent in all 4 cases when the bone was drilled and the counter sinking performed. Each cortical screw was placed in the same manner. The final tightening of each cortical screw was performed with the limb held up off the ground by an assistant. This technique ensured that each cortical screw achieved maximum compression across the fracture line.

The 4.5 mm glide hole was drilled through the lateral cortex to repair the lateral condylar metacarpal fracture and through the medial cortex to repair the medial condylar metacarpal fractures. The work position in the medial approach was quite difficult but was performed to minimise the risk of technical error (such as overdrilling) when drilling the glide hole. However, in the medial condylar fracture affecting the right hindlimb (*Case 4*), the screws were inserted through the lateral cortex .

Once the screws were in place, the stab incisions were closed using skin staples (Reflex TL)[1]. A sterile nonadherent dressing was placed over the wounds and a heavy compression bandage was placed on the leg. When the horse had recovered from the sedation, he was walked back to his stable. The horse was allowed free movement inside the stable.

Two medial condylar fractures and the lateral condylar fracture were repaired with 2 cortical screws; 1 medial condylar fracture (*Case 3*) was repaired with 3 cortical screws. Satisfactory fracture fragment reduction and fixation was confirmed by radiographs in all cases (**Fig 3**).

Post operative period

All 4 horses were markedly lame (*Grade 4–5* out of *5*) post operatively. Two horses showed some improvement in the degree of lameness after surgery (*Cases 3* and *4*); however 2 horses were anorexic for the first 24 h post operatively and had to be kept on a maintenance i.v. infusion of fluids for the first 24 h.

All 4 horses were medicated with 3 mg/kg bwt of marbofloxacin i.v. q. 24 h and 2 mg/kg bwt phenylbutazone *per os* b.i.d. for 7 days. *Case 1* was medicated with 0.06 mg/kg bwt butorphanol tartrate i.v. as an analgesic in the first 24 h of post operative period.

Four days post operatively, all 4 horses had a significant improvement in the grade of lameness seen at the walk. Bandages were changed every 48 h and at each bandage change clean and dry surgical sites were noted. All 4 horses were discharged from the hospital one week post surgery when they were seen to be comfortable and minimally lame at the walk (1 out of 5 lameness). A standard radiographic examination was performed on each horse predischarge. The degree of fracture reduction was deemed satisfactory in each case. The cortical screw implants appeared stable in all 4 cases.

Results

Bandages, which were changed every 2–3 days, were maintained for one month. After 4 months box rest, the horses were hand walked for a further month before being turned out into small paddock. Radiography was performed on all the horses by the referring veterinarian before they were turned out into a paddock. The horses commenced pre-race training on average 7 months post surgery.

All 4 horses returned to race training following fracture repair and currently all of them have raced (**Table 1**). All horses raced at least twice and *Case 2* was placed and then retired from racing. *Case 3* suffered an incomplete nondisplaced sagittal fracture of P1 on the same leg that had the condylar fracture repair (right fore), 12 months after surgery. He was box rested for 6 months and the fracture healed completely. Since that he raced 3 times and he won twice. *Case 4* won a

TABLE 1: Details and results of cases

Case	Limb	Fracture type	Time between injury and surgery	No. of cortical screws used	Results of radiographs post operatively	Athletic outcome post operatively
1	LF	LCF	6 days	2 screws	Satisfactory reduction	Raced twice
2	RF	MCF	1 day	2 screws	Excellent reduction	Raced 3 times. Retired.
3	RF	MCF	1 day	3 screws	Excellent reduction	Raced. Sagittal fracture P1 in RF. Rested and raced again
4	RH	MCF	10 days	2 screws	Excellent reduction	Raced

LCF: lateral condylar fracture, MCF: medial condylar fracture, P1: first phalanx.

point-to-point race first time out. *Case 1* has been destroyed because of lack of ability.

Discussion

The most common types of condylar fractures are incomplete nondisplaced, complete nondisplaced or minimally displaced lateral condylar fractures (Zekas *et al.* 1999). These fractures are usually repaired under general anaesthesia with 2 or more AO/ASIF cortical screws placed through stab incisions in the skin. The horse is then recovered with a heavy compression bandage. In these cases, the risk of a catastrophic fracture during the recovery period is small because the placement of cortical screws stabilises the fractured portion of the bone. Medial condylar fractures are less common. Undisplaced medial condylar fractures may be successfully treated either by conservative management or internal fixation and have a good prognosis for the return to athletic activity (Richardson 1984). The advantages of internal fixation over conservative treatment have been reported previously (Richardson 1984). Cortical screws inserted in a lag fashion increase the horses´ comfort, improve compression at the articular surface, decrease the potential risk of degenerative joint disease and avoid propagation and extension of the fracture. The disadvantages of surgery for nondisplaced fracture are the anaesthetic and recovery risk, cost of the procedure, risk of implant failure and infection or pain associated with the implant in the long term.

A thorough preoperative radiographic assessment is essential to determine the extent of the fracture and any other adjacent bony lesions that could affect the horse's long-term prognosis. Radiographs (at least the 4 standard projections) of the full length of the metacarpus/metatarsus are necessary to identify spiralling propagation of the fracture. None of the cases reported here had complicating secondary fractures such as apical sesamoid fractures, axial sesamoid fractures or comminution at the palmar/plantar aspect of the distal metacarpus/metatarsus. Projections such as 125° dorso-palmar/plantar (skyline) and flexed dorso-palmar/plantar are very useful to identify comminution at the palmar/plantar aspect of distal metacarpus/metatarsus (Kawcak *et al.* 1995).

Medial or lateral spiral longitudinal condylar fractures with some degree of abaxial displacement at the articular surface have a poor prognosis when managed conservatively (Richardson 1984). These fractures may propagate rapidly to a comminuted fracture of the metacarpal/metatarsal diaphysis at any time. There are several possible ways to repair this type of fracture. Under general anaesthesia, cortical screws can be inserted in lag fashion, perpendicular to the fracture line. A dynamic compression plate can be placed on the lateral cortex of the metacarpus/metatarsus with the cortical screws placed in lag fashion. Two dynamic compression plates may be utilised when the fracture has a Y shaped configuration. The main risk of repairing this kind of fracture under general anaesthesia is the risk of complete catastrophic fracture of the metacarpal/metatarsal diaphysis (considered to be greater with metatarsal fractures) during the recovery period. Richardson (1984) reported that there is a 50% incidence of a catastrophic fracture when the horse had an unassisted recovery independent of the method used to protect the leg. Special recovery systems have been reported - full limb casts and a raft recovery in a swimming pool - in order to reduce the risk of a catastrophic fracture occurring (Richardson 1984, 1999). A standing technique was selected in the cases reported here to avoid the complications associated with recovery from general anaesthesia. There are disadvantages to standing surgery, such as movement of the horse, maintenance of a sterile surgical field and poor visibility of anatomic structures because of inadequate tissue retraction and difficulty controlling haemorrhage (Richardson 1998). The work position is uncomfortable and the risk for the operating personal is greater on a standing surgery than with general anaesthesia. However, these disadvantages are outweighed by the benefits of avoiding recovery from anaesthesia in these patients.

The fractures in these 4 cases were incomplete and slightly displaced abaxially at the articular surface. The fracture could then be reduced easily without any manipulation of the fragment when the cortical screws were tightened. Cortical screw placement was achieved with radiographic guidance. As the third metacarpus/metatarsus is perpendicular to the ground, instrument orientation is made parallel to the ground. These factors resulted in a good anatomical reduction at the articular surfaces and allow for surgery without general anaesthesia. The fractures were repaired in the 4 horses in an induction box where the floor is padded. It is hypothesised that the vibrations created during the drilling phase of the repair are absorbed by the padded floor, thus reducing the likelihood of the horse moving during the surgical procedure. Unsuccessful attempts to place a cortical screw with the horse standing on an unpadded surface using a combination of heavy sedation and nerve blocks have been reported to the authors (J. Watkins, personal communication 2002). Medial condylar fracture repair by placing cortical screws through the medial cortex is a very uncomfortable technique for the operator. Alternatively, cortical screws can be inserted through lateral cortex for medial condylar fracture repair as the bone density in the distal aspect of the metacarpus has excellent cortical screw holding properties (Richardson 1984, 1999). The objective of inserting cortical screws was to get optimal reduction and fixation of the intra-articular aspect of the fracture. A maximum of 3 cortical screws were considered necessary in the cases presented.

Deep sedation and local anaesthesia produced sufficient analgesia to perform the procedure. Each horse progressed from being nonweightbearing to fully weightbearing on the affected leg after the nerve block was performed. It is the authors´ opinion that the horse should not be allowed to move once the local anaesthesia has taken effect as further displacement of the fracture could happen on the unprotected affected limb. In 1 medial condylar fracture (*Case 3*), a 3 mm displacement at the articular surface on the nonweightbearing limb increased to 5 mm displacement following local anaesthesia of the limb and the resultant increased weightbearing (**Fig 4**). This finding indicated that when all the

***Fig 4: Increased displacement at the joint surface following limb anaesthesia in preparation for surgery* Case 3.**

cortical screws were in place, the final tightening of the cortical screws should be made on the nonweightbearing limb. This was simply achieved by lifting the affected limb off the ground. A bone reduction forceps placed on the leg after sedation and local anaesthesia could help to avoid this further displacement when the horse assumes a full weightbearing position or when the bone is drilled.

The prognosis for a return to racing following surgical repair of condylar fractures is 70–80% (Richardson 1999). The most important limiting factor is the degree of displacement at the joint surface after reduction and fixation of the fracture. Any articular joint surface incongruency is going to predispose the patient to the development of degenerative joint disease. In the case of spiral longitudinal condylar fractures, a significant limiting factor is the very real possibility of a spontaneous catastrophic fracture occurring at the perioperative period. Therefore, it is our opinion that standing surgical lag screw compression of longitudinal medial and lateral condylar fractures is a viable technique, which eliminates the risk associated with general anaesthesia and recovery of these patients, especially in spiral longitudinal metatarsal fractures. However, further cases are required in order to evaluate if the technique really prevents the risk of catastrophic fracture happening on recovery, therefore we do not suggest that this technique is the treatment of choice but it is an option to be considered.

Manufacturer's address

[1]Reflex TL Imagyn Surgical, Richland, Michigan, USA.

References

Barr, A.R.S., Sridhar, B. and Denny, H.R. (1989) Long incomplete longitudinal fractures of the third metacarpal and metatarsal bone in horses. *Vet. Rec.* **124**, 580-582.

Bassage, L.H. and Richarson, D.W. (1998) Longitudinal fractures of the condyles of the third metacarpal and metatarsal bones in racehorses: 224 cases (1986-1995). *J. Am. vet. med. Ass.* **212**, 1757-1763.

Ellis, D.R. (1994) Some observations on condylar fractures of the third metacarpus and third metatarsus in young thoroughbred. *Equine vet. J.* **26**, 178-183.

Kawcak, C.E., Bramlage, L.R. and Embertson, R.M. (1995) Diagnosis and management of incomplete fracture of the distal palmar aspect of the third metacarpal bone in five horses. *J. Am. vet. med. Ass.* **206**, 335-337.

Martin, G.S. (2000) Factors associated with racing performance of thoroughbreds undergoing lag screw repair of condylar fractures of the third metacarpal or metatarsal bone. *J. Am. vet. med. Ass.* **217**, 1870-1877.

Richardson, D.W. (1984) Medial condylar fractures of the third metatarsal bone in horses. *J. Am. vet. med. Ass.* **185**, 761-765.

Richardson, D.W. (1998) Standing orthopaedic procedure. In: *Current Technique in Equine Surgery and Lameness,* Eds: N.A. White and J.N. Moore, W.B. Saunders, Philadelphia. pp 476-480.

Richardson, D.W. (1999) The metacarpal and metatarsal bones. In: *Equine Surgery*, 2nd edn., Eds: J.A. Auer and J.A. Stick, W.B. Saunders, Philadelphia. pp 810-821.

Rick, M.C., O'Brian, T.R., Pool, R.R. and Meagher, D. (1983) Condylar fracture of the third metacarpal bone and third metatarsal bone in 75 horses: Radiographic features, treatments, and outcome. *J. Am. vet. med. Ass.* **183**, 3, 287-295.

Riggs, C.M. and Boyde, A. (1999) Effect of exercise on bone density in distal regions of the equine third metacarpal bone in 2-year-old Thoroughbreds. *Equine vet. J., Suppl.* **30**, 555-560.

Riggs, C.M., Whitehouse, G.H. and Boyde, A. (1999) Pathology of the distal condyles of the third metacarpal and third metatarsal bones of the horse. *Equine vet. J.* **31**, 140-148.

Zekas, L.J., Bramlage, L.R., Embertson, R.M. and Hance, S.R. (1999) Characterisation of type and location of fracture of the third metacarpal/metatarsal condyles in 135 horses in central Kentucky (1986-1994). *Equine vet. J.* **31**, 304-308.