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Arthroscopic guided repair of a slab fracture of the fourth carpal bone in an 8-month-old thoroughbred horse

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An 8-month-old thoroughbred colt presented with sudden onset right forelimb lameness. A radiographic series of the right carpus was performed, and it revealed a slab fracture of the fourth carpal bone and fracture of the proximal part of the third metacarpal bone. Arthroscopically guided repair of the slab fracture of the fourth carpal bone with a 3.5 mm cortex screw and lag screw fixation of the fracture of the proximal part of the third metacarpal bone were performed. The horse started to race at 32 months old and started in 65 races over three years without any trouble associated with the right carpus.

Key words: *arthroscopic surgery, foal, horse, internal fixation*

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Horses with slab fractures of the carpal bone should be surgically treated as soon as is practical after injury [3]. Slab fractures of carpal bones most commonly involve the third carpal bone [7, 13]. Slab fractures of the fourth carpal bone are uncommon in horses [7, 8]. Frontal slab fractures of the intermediate and fourth carpal bones have been described and treated by arthrotomy, but the results were unsatisfactory [1]. In a standardbred foal, a sagittal slab fracture of the fourth carpal bone was repaired using two 3.5 mm fully-threaded cortical screws by arthrotomy [5]. The fourth carpal bone was compressed to the third carpal bone by two screws with a lag technique [5]. Follow-up information was obtained for the horse until 8 months after surgery, and the result was not clear, meaning the horse could not be used as intended [5]. Since articular surfaces can be accurately and safely reconstructed, this should be the primary treatment goal [8]. Arthroscopically guided repair is required to restore joint congruity in the case of a slab fracture of the third carpal bone [4]. Recent articles indicate that 42% [4] and 63.1% [2] of horses treated for third carpal bone slab fractures by arthroscopically guided repair raced at least once postoperatively. Fractures of the proximal metacarpus in racehorses are usually incomplete longitudinal fractures [9]. These fractures commonly occur in the palmar cortex [9]. Dorsomedial articular fractures of the proximal aspect of the third metacarpal bone occur as short longitudinal fractures in standardbred horses [11]. Articular fractures of the dorsoproximolateral aspect of the third metatarsal bone have been reported in standardbred racehorses [12]. There has been no report describing internal fixation of a fourth carpal bone slab fracture by arthroscopic surgery and internal fixation of an articular fracture of the dorsoproximolateral aspect of the metacarpal bone. This report describes the use of a 3.5 mm cortex screw for arthroscopic guided repair of a fourth carpal bone slab fracture and the repair of an articular fracture of the dorsoproximolateral aspect of the third carpal bone in an 8-month-old thoroughbred colt.

An 8-month-old, 256 kg, thoroughbred colt showed right forelimb lameness. The foal could not be bear weight on the right forelimb. The soft tissue over the entire carpus region was swollen. No wounds were apparent at the site.

Upon admission to our hospital a day later, the colt could not bear weight on its right forelimb (AAEP Grade 4/5 [15]). Flexion of the carpus was resented, and the right carpus was swollen. A radiographic series of the right carpus was performed. The dorsomedial-palmarolateral oblique view demonstrated the presence of a slab fracture of the fourth carpal bone and the proximal part of the third metacarpal bone (Fig. 1).

The colt was administered dihydrostreptomycin sulfate (12.5 mg/kg, IM) and benzylpenicillin procaine (10,000

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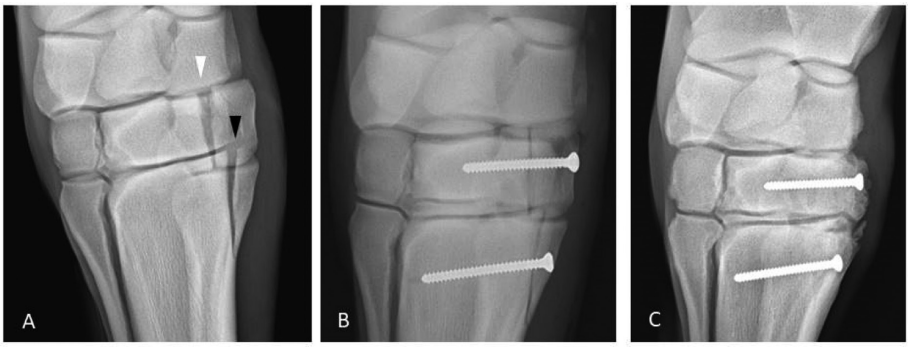

Fig. 1. Radiographic images of the fractures. (A) Preoperative radiographic image of the fractures of the fourth carpal bone (white arrowhead) and proximal metacarpal bone (black arrowhead). (B) Intraoperative radiographic image. (C) Radiographic image at 5 months after surgery.

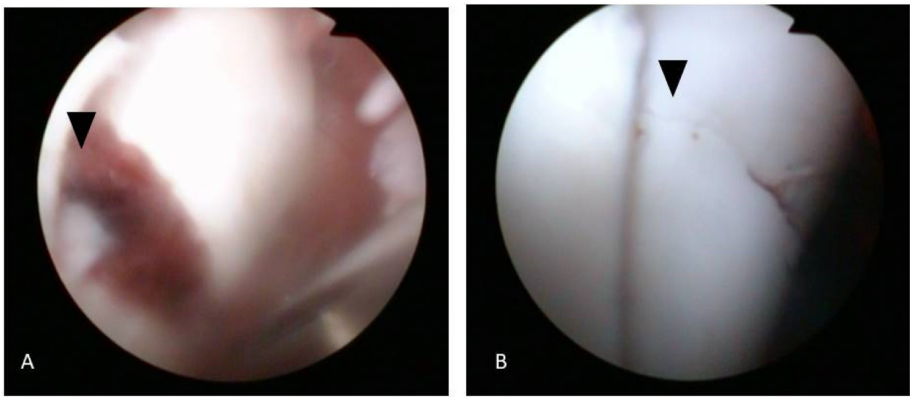

Fig. 2. Intraoperative arthroscopic images. (A) Before compression. The black arrowhead indicates the fracture line of the fourth carpal bone. (B) After internal fixation. The black arrowhead indicates the fracture line of the fourth carpal bone.

IU/kg, IM) and then sedated with medetomidine (6 μg/kg, IV) and butorphanol (0.01 mg/kg, IV), and anesthesia was induced with ketamine (2.2 mg/kg, IV) and GGE (500 mg/head, IV). A squeeze gate was used. The foal was then placed in dorsal recumbency, and the right limb was extended. The right carpus and metacarpus region were clipped and aseptically prepared. Arthroscopic examination of the middle carpal joint was performed. The middle carpal joint was evaluated using the dorsomedial arthroscopic portal. Slab fracture of the fourth carpal bone (Fig. 2) and chip fractures of the third carpal bone and intermediate carpal bone were revealed. Lag screw fixation of the slab fracture of the fourth carpal bone was performed according to the technique for lag screw fixation of frontal slab fractures of the third carpal bone [10]. First, the chip fragments of the third carpal bone and intermediate carpal bone were removed. Next, the carpal was flexed to approximately 50 degrees—smaller than the standard angle (70 degrees) for arthroscopic surgery of the middle carpal joint—to achieve a good arthroscopic view for finding the fracture line of the fourth carpal bone. A short incision was made midway between the spiral needle and the needle in the carpometacarpal joint using a No. 11 blade. A glide hole was drilled in the fragment to the fracture plain using a 3.5 mm drill. A 2.5 mm drill guide sleeve was inserted into the glide hole, and the fracture was manipulated under arthroscopic guidance. A thread hole was then drilled into the body of the fourth carpal bone. A countersink was used to create an appropriately sized bed for the 3.5 mm cortex screw head. A 32 mm × 3.5 mm cortex screw was inserted as a lag screw. Compression of the fracture plane of the fourth carpal bone was revealed under arthroscopic view (Fig. 2). The displaced dorsal plane of the proximal part of the third metacarpal bone fracture was treated with a 3.5 mm cortex screw placed in lag fashion. Skin portals were closed in a routine manner using 2-0 Poliglecaprone 25, and a padded dressing was applied. Head and tail ropes were used to assist recovery from anesthesia.

After recovery from anesthesia, the colt was treated with

procaine penicillin (10,000 IU/kg, IM, once daily) for 8 days. It was confined to a box stall for the first 2 months post-surgery and then allowed limited exercise in a small paddock. The colt could bear weight on the forelimb on the day after surgery and was sound at a walk on postoperative day 7. Three months after surgery, it was sound at a trot. Serial radiographs taken over the ensuing five months showed progressive fracture healing with no signs of osteomyelitis (Fig. 1).

The colt was sound during free exercise in a large pasture area at 8 months after surgery. This horse started a race at 32 months old. It started in 65 races and won 5 races over three years. The horse experienced no right forelimb lameness during its three-year racing career.

This is the first case report of a horse starting races after arthroscopic repair of a slab fracture of the fourth carpal bone with a lag screw.

Slab fracture of the fourth carpal bone is unusual in horses, but a small case series [1] and a case report [5] have been reported. These fractures may be the result of either direct trauma or abnormal concentrations of force in the carpus [1, 5]. In the present case report, the colt was found to have acute onset lameness while in a pasture area. The colt was suspected to have sustained an abnormal concentration of force in the right carpus while in the pasture area.

Screw fixation by arthrotomy has been reported for slab fractures of the fourth carpal bone [1, 5]. Auer *et al*. reported that none of the 5 horses in their case report that underwent screw fixation by arthrotomy for slab fractures of the fourth carpal bone or the fourth and the intermediate carpal bone were able to begin or return to work successfully [1]. A case of sagittal slab fracture of the fourth carpal bone was treated by internal fixation via arthrotomy to compress the fourth carpal bone to the third carpal bone by the lag technique [5]. At eight months post-surgery, the horse was receiving preliminary training, was showing no signs of residual lameness, and appeared to have a full range of motion in the affected carpus. No follow-up information after 8 months post-surgery was included in the article [5]. In the present case, the colt could bear weight on the limb on the day after surgery, was sound at a walk on postoperative day 7, and started a race at 32 months old. This case report supports the view that articular surfaces can be accurately and safely reconstructed by an arthroscopic guided internal fixation technique.

Richardson reported a technique for arthroscopic repair of third carpal bone slab fractures in horses [10]. This technique has been described in some textbooks and used in recent clinical case series [2, 7, 8], because it has become the standard for the repair of or the standard technique for the repair of third carpal bone slab fractures. Slab fractures of the radial carpal bone can be treated conveniently with lag screw fixation using an arthroscopic technique [8]. The present case suggests that the technique of Auer *et al.* [1] for arthroscopic guided internal fixation of slab fractures of the third carpal bone could be applied to repairing slab fractures of the fourth carpal bone. In previous reports, 68.3% (28/41) [14] and 67.8% (21/31) [6] of Thoroughbred horses with internal fixation of the third carpal bone raced after surgery. Recently, two articles reported the racing performance of horses with placement of a lag screw by arthroscopic surgery [2, 4]. They indicated that 43–63.1% of the horses that underwent arthroscopically guided repair raced at least once postoperatively [2, 4]. There is limited information about racing performance after internal fixation of other carpal bone slab fractures. Slab fracture of the fourth carpal bone is uncommon, and there are no articles describing arthroscopic surgery for a slab fracture of the fourth carpal bone and the subsequent racing performance after surgery. In the present case report, the horse underwent internal fixation of the slab fracture of the fourth carpal bone and started in races 65 times without any trouble associated with the middle carpal joint of the right carpus.

At the start of the surgery, the fracture line of the fourth carpal bone was difficult to recognize by arthroscopy because it was more caudal than the fracture line of the standard slab fracture of the third carpal bone. The arthroscopic view of the fracture line was improved by adjusting the angle of carpal flexion to approximately 50 degrees, which is smaller than the standard angle (70 degrees) used in arthroscopic surgery of the middle carpal joint.

Articular fracture of the dorsoproximolateral aspect of the third metacarpal bone has not been reported. Ross and Martin reported dorsomedial articular fractures of the proximal aspect of the third metacarpal bone in standardbred racehorses [11]. Only one of their seven cases was treated with internal fixation [11]. The fractures of all their cases were nondisplaced, articular, oblique fractures extending distad toward the dorsomedial cortex. Because they were nondisplaced fractures, the horses were recommended to be treated by conservative management [11]. In another report, two standardbred racehorses with displaced articular fractures of the dorsoproximolateral aspect of the third metatarsal bone were treated with 3.5 mm cortex screws [12]. One case was able to return to training 1 year after surgery, but the horse was ultimately retired because of continued lameness. The other was able to start in a race 7 months after surgery [12]. The present case was a good candidate for internal fixation treatment because the fragment was displaced.

A limitation of this case report is that racing performance after arthroscopic guided internal fixation of the slab fracture of the fourth carpal bone and articular fracture of the dorsoproximolateral aspect of the third carpal bone was only

considered in one case. Further case studies are needed.

This case report describes arthroscopic guided internal fixation of a slab fracture of the fourth carpal bone and internal fixation of an articular fracture of the dorsoproximolateral aspect of the third carpal bone. The procedure for arthroscopic guided internal fixation of a slab fracture could be applied to a slab fracture of the fourth carpal bone. The authors recommend this technique for slab fractures of the fourth carpal bone based on its ability to reconstruct articular surfaces accurately and safely.

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