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Case Report

Arthroscopic debridement of a palmar third metacarpal condyle subchondral bone injury in a Standardbred

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Introduction

Exercise-induced overload or stress arthrosis occurs in racehorses subsequent to repetitive cyclic loading, which induces subchondral bone sclerosis, lucency and fragmentation (Pool and Meagher 1990). One of the more common sites of overload arthrosis in equine athletes is the palmar third metacarpus and plantar third metatarsus (Norrdin *et al.* 1998). Clinical fetlock subchondral bone injury has been described in the third metacarpus/metatarsus of both Thoroughbred racehorses (O'Brien *et al.* 1981; Riggs *et al.* 1999) and Standardbred racehorses (Nilsson and Olsson 1973; Ross 1998). Treatment usually includes athletic rest, nonsteroidal anti-inflammatory drugs, and intra-articular injections (Richardson 2003; Ross 2003). The athletic prognosis for racehorses with stress related third metacarpal/metatarsal subchondral bone injury is currently poor to fair (O'Brien *et al.* 1981; Richardson 2003; Ross 2003), with many cases exhibiting progressive osteoarthritis and subsequent retirement from racing. Surgical treatment for this disease involving arthroscopic debridement has only been briefly mentioned in the literature, with disappointing results (Ross 2003; Nixon 2005).

This report describes the surgical treatment of a Standardbred racehorse with palmar third metacarpal subchondral bone injury and presents follow-up performance data.

Case details

History, clinical findings and diagnosis

A 3-year-old castrated male Standardbred pacer weighing 512 kg was admitted to the Veterinary Teaching Hospital of the University of Illinois with several weeks history of progressive left forelimb lameness during training. Physical examination revealed the horse to be bright, alert, and responsive with a normal rectal temperature (38.0°C), normal heart rate (28 beats/min) and mild tachypnoea (36 breaths/min). Mild effusion was noted in the left and right metatarsophalangeal joints and moderate effusion was noted in the left metacarpophalangeal joint. Lameness evaluation revealed a left forelimb lameness of grade 3/5 (AAEP scale) (Stashak 2002). Sequential flexion of the left forelimb digit, carpus, elbow and shoulder did not exacerbate the lameness.

Nuclear scintigraphy of both forelimbs was performed on the day of admission. A 14 gauge catheter[1] was placed in the right jugular vein and 159 mCi (0.31 mCi/kg) of ^{99m}technetium-methylene diphosphonate was administered i.v. Images were acquired with a gamma camera[2]. Pool phase images were acquired as follows: lateral views of the left fore foot (3 and 7 min post injection), lateral views of the right fore foot (5 and 9 min post injection), a palmar view of the left fore foot (12 min post injection), and a palmar view of the right fore foot (15 min post injection). Delayed-phase images were acquired approximately 2 h post injection. These consisted of lateral views of the left and right forelimbs from the carpi distally, dorsal views of the carpi, and palmar views of the left and right fore feet.

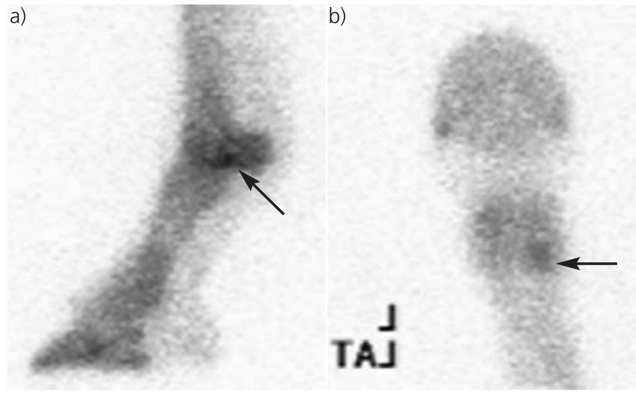

Fig 1: Lateral (a) and palmar (b) delayed phase scintigraphy images obtained of the distal left forelimb on the day of admission. Note the increased radionucleotide uptake corresponding to the medial palmar aspect of the distal third metacarpus.

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Nuclear scintigraphy revealed mild radiopharmaceutical uptake in the medial palmar aspect of the left metacarpophalangeal joint on the pool phase images and moderate uptake in the same area on the delayed phase images (**Fig 1**). There was also mild radiopharmaceutical uptake in the area of the left third carpal bone on the delayed phase images.

Computed radiography images of the left carpus, right carpus, left metacarpophalangeal joint, and left forefoot were obtained on Day 2 of hospitalisation[3]. Radiographs of the right and left carpi revealed mild sclerosis of the radial facet of the third carpal bone. Dosopalmar, lateromedial, flexed lateromedial, 30° down-angled dorsolateral 45° palmaromedial, and 30° down-angled dorsomedial 45° palmarolateral projections of the left metacarpophalangeal joint revealed an 8 mm diameter radiolucent area in the palmar aspect of the medial condyle of the third metacarpal bone with a faint sclerotic margin (**Fig 2**). There was mild osteophytosis along the dorsolateral joint margin, at the proximal articular aspect of the proximal sesamoid bones, and at the distal articular aspect of the proximal sesamoid bones. The lucency corresponded to the area of moderate radionucleotide uptake on the nuclear scintigram.

Serum biochemistry and complete blood count were performed on Day 5 of hospitalisation. Results were unremarkable other than hypophosphataemia (32 mg/l; normal 40–70 mg/l), elevated aspartate aminotransferase (321 u/l; normal 160–300 u/l), and elevated gamma-glutamyl transferase (23 u/l; normal 4–20 u/l).

Surgical treatment

The horse was prepared for diagnostic arthroscopic exploration and debridement of the radiolucent area on Day 6 of hospitalisation. Feed was withheld 12 h prior to surgery. Perioperative medication consisted of tetanus toxoid (1 ml i.m. once), potassium penicillin (22,000 u/kg bwt i.v. q. 6 h), gentamicin (6.6 mg/kg bwt i.v. q. 24 h) and phenylbutazone (4.4 mg/kg bwt i.v. once).

The horse was premedicated with xylazine and anaesthesia induced with tiletamine-zolazepam, ketamine and detomidine 7 min later. An endotracheal tube was inserted and the horse placed in left lateral recumbency on the surgery table. Anaesthesia was maintained with halothane in oxygen through a semiclosed circle system.

The left metacarpophalangeal area was clipped, prepared for aseptic surgery, and draped routinely. A 20 gauge needle was placed in the dorsomedial metacarpophalangeal joint pouch and the joint was distended with sterile saline. An 8 mm skin incision was made in the proximal palmar joint pouch with a No. 15 blade. The joint capsule was penetrated with a No. 11 blade and the arthroscopic sheath with conical obturator was inserted into the palmar joint pouch. The obturator was replaced with a 4 mm diameter 30° lens angle

a)

b)

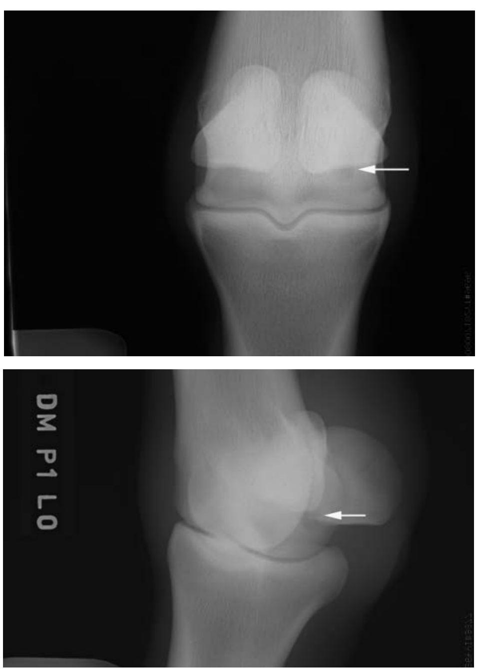

***Fig 2:** Dorsopalmar (a) and dorsomedial to palmarolateral oblique (b) radiographic images of the left metacarpophalangeal joint obtained after nuclear scintigraphy. Note the radiolucency in the palmar medial third metacarpal condyle.*

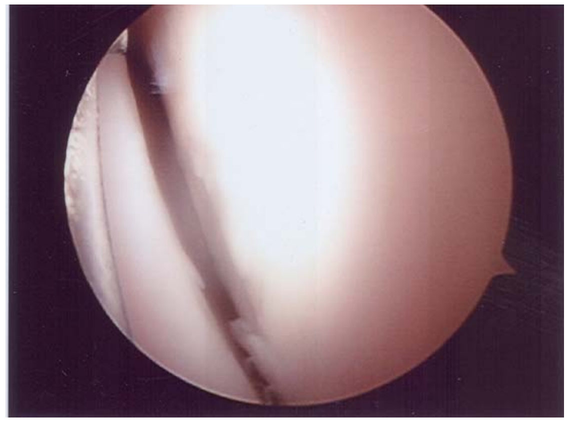

***Fig 3:** Arthroscopic view of the palmar medial third metacarpal condyle lesion showing irregular malacic cartilage overlying the subchondral bone defect. The first phalanx is oriented in the lower left hand corner and the third metacarpus is to the right.*

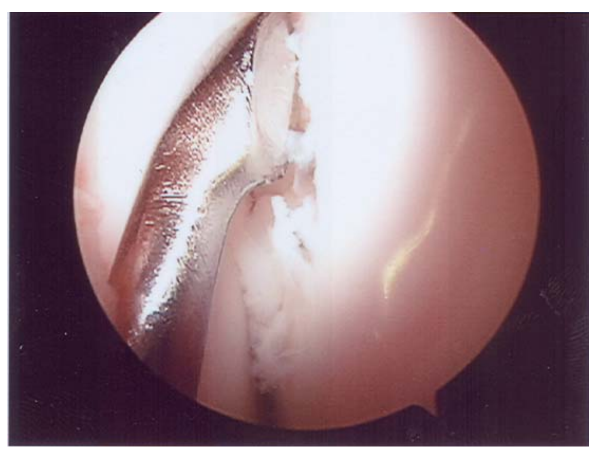

***Fig 4:** Arthroscopic view of the palmar medial third metacarpal condyle lesion showing curettage of the cartilage and subchondral bone defect.*

rigid arthroscope[4]. Exploration of the joint revealed evidence of mild articular cartilage damage with faint score lines. Visualisation of the area of stress-related bone injury proved difficult. A small cartilage defect overlying the area could be seen intermittently; however, visualisation was not sufficient to allow debridement. The 30° arthroscope was replaced with a 70° lens angle arthroscope[4], which resulted in improved visualisation of the defect (**Fig 3**). A 20 gauge needle was used to locate an appropriate instrument portal through the distal portion of the medial collateral sesamoidean ligament. A 6 mm portal was created and a blunt arthroscopic probe was introduced. Cartilage overlying the defect was malacic and the underlying subchondral bone was soft. The diseased cartilage and bone were debrided with straight and angled closed spoon curettes and small angled Ferris-Smith rongeurs (**Fig 4**). Debridement was continued until a firm, bleeding bone bed was reached. Intraoperative radiographs demonstrated mild enlargement of the radiolucency after debridement. The joint was copiously lavaged, the skin incisions closed with No. 2-0 polydioxanone[5] in an interrupted cruciate pattern and a sterile half-limb compression bandage placed. The horse was moved to a padded recovery stall and recovered without incident.

Post operatively potassium penicillin and gentamicin were continued for 24 h. Phenylbutazone was administered (2.2 mg/kg bwt *per os* q. 12 h) for 5 days. The horse exhibited mild signs of colic the evening after surgery which resolved overnight after temporary feed withdrawal. The bandage was changed the day after surgery revealing minimal swelling at the surgery site and no increase in joint effusion. The horse was discharged from the hospital with instructions to restrict exercise to stall rest for 4 weeks, followed by hand walking exercise for 4 weeks, followed by small paddock turnout for 4 weeks.

Outcome

The horse returned for a recheck examination 8 weeks after surgery. On lameness evaluation the horse exhibited a baseline lameness of 1/5 in the left forelimb, and digit flexion increased the lameness to 2/5. Radiographs of the left metacarpophalangeal joint revealed that the radiolucent area was still present but the margins were less distinct and the defect showed increased mineral density. The horse was discharged with instructions to begin paddock turnout for 2 months followed by a gradual return to training.

Prior to admission the horse had raced 17 times at a distance of 1 mile. Mean finish time was 1:57.6 (median 1:56.3; range 1:52.4–2:10.2). There were 7 first-place finishes, 0 second-place finishes and 3 third-place finishes.

Time to return to racing after surgery was 265 days. Follow-up race data were available for the entire year following the year of surgery, which included 16 races. Mean post operative finish time for this period was 1:53.0 (median 1:52.0; range 1:50.1–1:57.4). Post operative race times were significantly faster than preoperative race times (Mann-Whitney Rank Sum Test, $P = 0.002$)[6]. There were 6 first-place finishes, 3 second-place finishes and 2 third-place finishes.

Discussion

Radiolucent areas of the distal metacarpophalangeal and metatarsophalangeal joints in horses have been attributed to subchondral cystic lesions (SCL) and overload-induced arthrosis (Nixon 1990; Norrdin *et al.* 1998). Subchondral cystic lesions of the metacarpal and metatarsal bones have been reported to represent 6% of all SCL (von Rechenberg *et al.* 1998). These lesions are typically attributed to a defect in epiphyseal endochondral ossification during development, and are therefore usually seen in younger horses. However, older horses may present with clinically significant lameness referable to SCL, suggesting that onset of clinical disease is a multifactorial process (Hogan *et al.* 1997). Horses with SCL of the distal third metacarpal bone usually present with moderate lameness, the lesions usually occur on the medial condyle, and they are typically positioned at or slightly dorsal to the transverse ridge of the condyle. This location lends itself well to debridement via a dorsal arthroscopic or arthrotomy approach, and the athletic prognosis for horses treated in this manner is favourable (Hogan *et al.* 1997).

Overload-induced arthrosis occurs on the palmar/plantar aspect of the metacarpophalangeal/metatarsophalangeal condyles as sequelae to compression and shear forces from sesamoid bone impact during high-speed exercise (Norrdin *et al.* 1998). These lesions have been found more commonly in the metacarpus than the metatarsus with an equal distribution between medial and lateral condyles (Pool and Meagher 1990; Pool 1996). Subchondral bone injury has been described in the third metacarpus of Thoroughbred racehorses (O'Brien *et al.* 1981; Norrdin *et al.* 1998; Riggs *et al.* 1999), and in the third metacarpus and third metatarsus of Standardbred racehorses (Nilsson and Olsson 1973). A clinical retrospective review of Standardbred racehorses undergoing metatarsophalangeal scintigraphic examination has correlated the scintigraphic findings with clinical and radiographic parameters (Ross 1998). Of the 114 Standardbred racehorses in that study, 67 had increased radionucleotide uptake of the plantarolateral third metatarsus, and 12 horses had radiographically detectable plantar sclerosis and/or radiolucency.

It is likely that the palmar radiolucency and sclerosis seen in the present case reflects overload-induced arthrosis. Appearance of lameness after more than one season of successful training and racing with a lack of earlier clinical signs suggests the accumulation of stress-induced bone remodelling. The nuclear scintigraphic and radiographic changes are consistent with this scenario. Unlike SCL, the athletic prognosis for racehorses with stress related metacarpal/metatarsal subchondral bone injury is poor to fair (O'Brien *et al.* 1981; Richardson 2003; Ross 2003). Treatment most commonly involves athletic rest, shoeing changes, phenylbutazone, aspirin, isoxsuprine and intra-articular injections with polysulphated glycosaminoglycans, hyaluronan and corticosteroids (Richardson 2003; Ross 2003). Medical therapy can result in racing soundness; however, osteoarthritis is expected to progress, leading to a drop in racing class or cessation of racing activity (O'Brien *et al.* 1981; Ross 2003).

Scintigraphy is the most sensitive diagnostic modality for the diagnosis of palmar/plantar subchondral bone damage (Ross 1998; Richardson 2003). Scintigraphic changes may be apparent well before radiographic detection of the lesion is possible. If palmar/plantar subchondral bone damage is suspected, radiographic examination should include dorsoplantar, lateromedial, flexed lateromedial and 30° down-angled dorsolateral 45° palmar/plantaromedial projections (Ross 1998). A flexed dorsopalmar projection may also improve visualisation of palmar/plantar third metacarpal and metatarsal lesions (Pilsworth *et al.* 1988). Response to local analgesia is inconsistent (Richardson 2003; Ross 2003). The subchondral lucency in the present case was detectable on all radiographic views due to the relatively large size of the lesion. Diagnostic analgesia was not performed in this case due to the strong correlation between scintigraphic and radiographic findings, and the inconsistent analgesic response with this type of lesion. However, intra-articular diagnostic analgesia may be useful in some cases.

Arthroscopic access to palmar third metacarpal and plantar third metatarsal subchondral bone lesions is difficult due to the fact that most of these lesions occur close to the transverse ridge and the joint must be maintained in partial flexion during the procedure, thereby obscuring the site. A palmar/plantar arthroscopic approach to these lesions has been briefly mentioned in the literature; however, details are scant (Ross 2003; Nixon 2005). One horse that underwent arthroscopic debridement of a platarolateral metacarpal lesion went on to race but dropped substantially in class and was subsequently retired (Ross 2003).

While arthroscopic debridement in this case was difficult, visualisation of the lesion was aided by use of the 70° lens angle arthroscope. Initial use of the 30° lens angle arthroscope is still recommended in all cases for diagnostic arthroscopic joint exploration. Additionally, distal placement of the instrument portal allowed improved instrument access to the lesion compared with a more proximal portal location. Instrument portal placement through the distal collateral sesamoidean ligament did not result in any negative sequelae in the present case. Access to the lesion was aided by the relatively palmar and medial location of the lesion in the present case, and arthroscopic access may be hindered in other cases by lesions located more dorsal and axial. This horse has returned to a successful racing career post operatively with significantly improved race times. The positive outcome may be attributed to the lack of advanced generalised cartilage damage and osteoarthritis. A poorer prognosis is expected in racehorses with severe degenerative joint disease.

In summary, Standardbred racehorses with palmar third metacarpal overload arthrosis may benefit in select cases from arthroscopic debridement through a palmar approach. Debridement may be aided by a relatively palmar and abaxial lesion location and the use of a 70° lens angle arthroscope. While more cases will be needed to define case selection criteria and prognostic variables, it is reasonable to attribute the best prognosis to horses with early rather than advanced osteoarthritis.

Acknowledgements

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Manufacturers' addresses

[1]Abbott Animal Health, Abbott Park, Illinois, USA.
[2]Technicare Inc., Solon, Ohio, USA.
[3]Kodak, Rochester, New York, USA.
[4]Conmed Linvatec Arthroscopy, Largo, Florida, USA.
[5]Ethicon, Somerville, New Jersey, USA.
[6]Sigma Stat, Systat Software, Richmond, California, USA.

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