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Case Report

Distal third metacarpal bone palmar cortical stress fractures in four Thoroughbred racehorses

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Introduction

Stress fractures of the third metacarpal bone (McIII) are a common cause of lameness in Thoroughbred racehorses. The most commonly described location is the mid-dorsolateral cortex (Copelan 1979; Richardson 1984, 1999; Stashak 1987; Stover *et al.* 1988; Cervantes *et al.* 1992; Pilsworth and Shepherd 1997; Stover 1998; Sullins 1998), but they also occur distally and proximally in the dorsal cortex (Richardson 1984, 1999; Stashak 1987; Stover *et al.* 1988; Cervantes *et al.* 1992). On the palmar aspect of McIII, stress fractures have been identified in the proximal cortex (Pleasant *et al.* 1992; Lloyd *et al.* 1988) and the distal condyle (Kawcak *et al.* 1995).

Identification of stress fractures may require multiple views and sequential radiographs or nuclear scintigraphy to demonstrate the lesion. For this reason, knowledge of predilection sites and the optimal means of fracture identification are clinically valuable. **In this report, the authors describe the clinical characteristics and outcome of horses having metacarpal stress fractures in a previously unreported location.**

Clinical details

Cases

Four Thoroughbred racehorses were diagnosed with distal McIII palmar cortical stress fractures at the Randwick Equine Centre 1997–1999. Clinical data on each horse was obtained from the medical records. All cases underwent lameness examination and the grade of lameness was recorded (Kester 1991). Subsequently, radiographic and bone phase scintigraphic evaluations were performed. All horses underwent repeat lameness and radiographic examination 3 or 4 months after diagnosis. Outcome was determined from direct trainer interview and analysis of race records. The horses were at varying stages of training and none had a history of a recent traumatic incident.

Horse 1

History

A 4-year-old gelding was presented for investigation of an acute onset, right forelimb lameness of *grade 4/5*. The gelding was undergoing a rehabilitation programme after sustaining a right forelimb superficial digital flexor tendon injury 5 months previously, and commenced trotting under saddle 3 weeks prior to the onset of lameness.

Examination

Clinical examination revealed marked distension of the right forelimb fetlock joint and a positive fetlock flexion test in this limb. Palpation of the palmarolateral aspect of the distal metaphyseal region of the right McIII revealed a small firm swelling and elicited a pain response. Arthrocentesis of the right fore fetlock joint revealed uniformly serosanguinous fluid, consistent with recent intra-articular haemorrhage (nucleated cell count 0.2 $x10^9$/l, packed cell volume 0.16 l/l and protein concentration 21.0 g/l). Radiographic projections of the right fore fetlock joint and distal third metacarpal region included dorsal 45° proximal- palmarodistal oblique (D45Pr-PaDiO), dorsal 45° medial-palmarolateral oblique (D45M-PaLO), dorsal 45° lateral-palmaromedial oblique (D45M-PaLO) and flexed lateromedial (L-M) views as the 4 standard views. In addition, a 125° dorsopalmar metacarpal skyline projection was obtained to assess the distal condyle region (Hornoff and O'Brien 1980). Radiographic abnormalities were limited to mild supracondylar lysis of the palmar cortex of McIII.

Subsequently, bone phase nuclear scintigraphic examination of the forelimbs was performed. Scintigraphic images were obtained 3 h after an i.v. injection of 7 GBq technetium 99m combined with dihydrophosphate (TechneScan HDP)[1] using a gamma camera (400AC-)[2] and an

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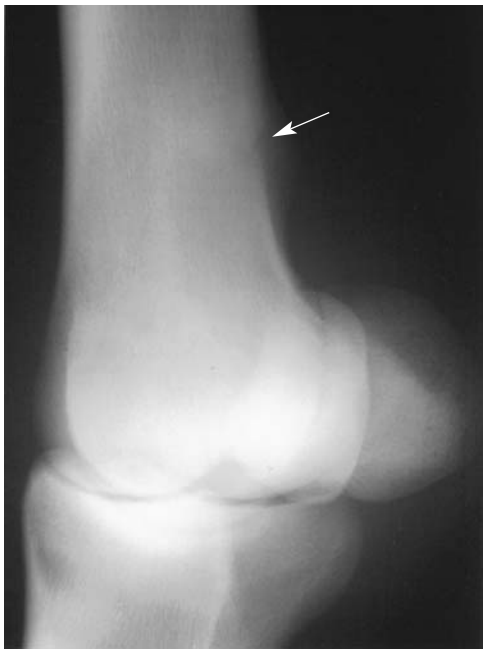

Fig 1: Dorso60°lateral to palmaromedial oblique radiographic view of the right fore fetlock of* Horse 1*, 3 weeks after initial presentation, displaying the typical appearance of a distal palmar third metacarpal bone cortical stress fracture (arrow). *There is also presence of callus formation around the fracture site.*

integrated nuclear imaging system (Starcam H3300C and H2507AG Video Formatter)[2]. Lateral and dorsal scintigraphic views revealed a focal area of intense radiopharmaceutical uptake in the distal palmarolateral metaphyseal region of the right McIII. There was a corresponding, although less intense, distribution of radiopharmaceutical in the contralateral forelimb. Repeat radiographs, 3 weeks after presentation, demonstrated an intracortical fracture coursing at an angle of approximately 30° to the periosteal surface in a proximopalmar to dorsodistal direction in the palmarolateral metaphyseal cortex of McIII. The fracture was located at a point equidistant from the distal aspect of the fourth metacarpal bone and the apex of the proximal sesamoid bones in the standing limb. The fracture line was best demonstrated radiographically with a dorsal 60° lateral-palmaromedial oblique view (D60L-PaMO) (**Fig 1**), and could also be appreciated on the lateromedial view. A moderate sized smooth periosteal callus was seen associated with the fracture site. No radiographic abnormalities were evident at this site in the contralateral limb.

Management and follow-up

From the time of presentation the affected limb was maintained in a lower limb support bandage, and exercise restricted to box rest for 6 weeks with limited hand-walking commencing after 4 weeks rest. The gelding was then allowed 4 weeks in a small yard followed by a further 4 weeks of pasture turnout. Follow-up radiographs at 12 weeks showed fracture healing and a small smooth periosteal callus present at the previous fracture site. Repeat examination revealed no lameness at a trot in a straight line. Joint distension and pain on palpation of the fracture site had resolved; however, a fetlock flexion test was still positive.

The gelding returned to race training 90 days after diagnosis. It was sound in training for 3 months, but then developed bilateral superficial digital flexor tendonitis which resulted in its retirement.

Horse 2

History

A 2-year-old filly developed acute onset lameness after 9 weeks of race training.

Examination

The filly was *grade 4/5* lame in the left forelimb with marked fetlock joint distension and a positive fetlock flexion test. There was a firm swelling with surrounding oedema of the medial aspect of the distal palmar region of the left McIII. A pain response was elicited on palpation of this swelling. Four standard radiographic projections of the left fore fetlock joint and distal third metacarpal region were performed as for *Horse 1*. Additionally multiple oblique views, medial and lateral 15°, 30°, 60° and 75° oblique views from dorsal were obtained. These radiographs revealed periosteal new bone formation on the palmar medial cortex of the distal metaphyseal region of the left McIII, although no fracture was evident. Bone phase nuclear scintigraphic examination was performed as detailed for *Horse 1*. A focal area of intense radiopharmaceutical uptake was observed in the distal palmaromedial metaphyseal region of the left McIII (**Fig 2**). A tentative diagnosis of a stress fracture of the distal palmar McIII was made.

Management and follow-up

The filly was maintained in a lower limb support bandage and box rested. Repeat radiographs, 3 weeks after presentation, demonstrated an intracortical fracture in the palmaromedial metaphyseal cortex of McIII. The site and fracture configuration were similar to those observed in *Horse 1*, except that the palmaromedial rather than palmarolateral cortex was affected. The fracture line was best demonstrated with a dorsal 60° medial-palmarolateral oblique view, but it could also be visualised on the dorsal 45° medial-palmarolateral oblique and the lateromedial views. An extensive irregular periosteal callus was present at the fracture site. The radiographic findings prompted continued box rest and application of a modified Robert-Jones bandage for a further 3 weeks.

After 6 weeks of stall confinement and limited hand-walking, access to a small yard was allowed for 4 weeks, followed by pasture turnout until repeat examination at 12 weeks. Follow-up examination at 12 weeks revealed no lameness at the trot. The joint distension and pain on palpation of the fracture site had resolved, although a

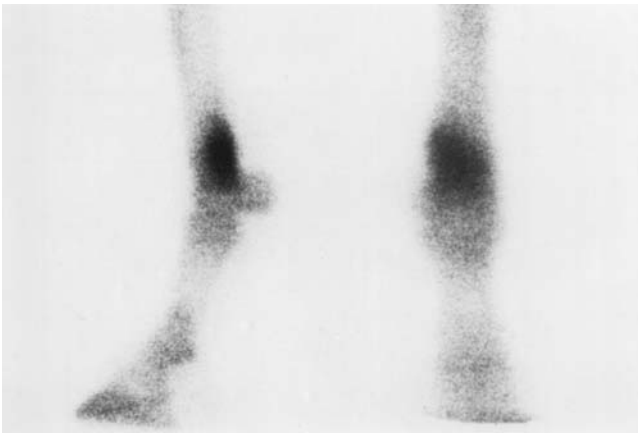

Fig 2: Dorsal and lateral scintigraphic images of the left distal limb of* Horse 2*, showing the intense focal area of increased radiopharmaceutical uptake in distal medial palmar third metacarpal bone.

positive fetlock flexion test persisted. Follow-up radiographs showed fracture healing and a diminished smooth callus present at the fracture site.

The filly commenced training at 12 weeks postinjury. Follow-up scintigraphy at 18 weeks revealed no increased radiopharmaceutical uptake at the previous fracture site. After 19 weeks of training, the filly was retired after developing tendonitis of the left fore superficial digital flexor tendon.

Horse 3

History

A 3-year-old gelding was presented with a history of acute onset left forelimb lameness while cantering, 5 days after its last race.

Examination

The gelding was *grade 3/5* lame in the left forelimb and exhibited a positive fetlock flexion test. Palpation of the palmaromedial aspect of the distal metaphyseal region of the left McIII elicited a mild pain response over a small firm swelling in this area. A low palmar and palmar metacarpal nerve block at a level just above the proximal sesamoid bones, and intra-articular anaesthesia of both middle and antebrachiocarpal joints failed to improve the lameness. However, a high palmar and palmar metacarpal nerve block (performed at a level just above the midmetacarpus) improved the lameness by 2 grades.

A bone phase nuclear scintigraphic examination revealed focal intense radiopharmaceutical uptake in the distal palmaromedial metaphyseal region of the left McIII. The distal caudal metaphyseal region of the left humerus also exhibited a focal area of intense radiopharmaceutical uptake. Both areas of bone activity were consistent with stress fractures. The results of diagnostic anaesthesia suggested that the majority of the lameness was due to the metacarpal stress fracture and the remainder due to the humeral stress fracture.

Four standard radiographic views and a dorsal 60° medial-palmaro-lateral oblique view of the left fore fetlock and distal McIII region were performed. An intracortical fracture was identified with a site and configuration similar to that observed in *Horse 2*. The fracture line could be visualised only on the dorsal 60° medial-palmarolateral oblique view and there was a moderate sized smooth callus. A mediolateral radiographic projection of the distal humerus did not show any evidence of a stress fracture.

Management and follow-up

Management included box rest for 6 weeks with limited hand-walking commencing after 4 weeks. The gelding then received 4 weeks in a small yard followed by a further 4 weeks of pasture turnout. Repeat lameness examination at 12 weeks revealed no lameness in a straight line at the trot. The pain on palpation of the fracture site had resolved; however, a fetlock flexion test was still positive at this time. Follow-up radiographs showed a smooth callus but no evidence of a fracture line at the previous fracture site.

At this stage, the gelding was judged as suitable to return to training. However, at the owner's and trainer's discretion, the gelding did not resume training until 20 weeks following fracture. After 4 weeks training the gelding was reassessed and found no longer to have a positive fetlock flexion test. The gelding remained sound during training and returned to racing 34 weeks after fracture. At the time of writing it has competed in 5 races, with one win, and has not had any recurrence of lameness.

Horse 4

History

A 4-year-old mare presented for lameness evaluation 5 days after a race.

Examination

On clinical examination, the mare was *grade 2/5* lame in the left forelimb. Diagnostic anaesthesia of the left middle carpal joint resolved the left fore lameness and revealed a *grade 2/5* right forelimb lameness. A right middle carpal joint block improved the right fore lameness to a *grade 1/5* lameness. Further diagnostic nerve blocks were not performed due to limitations in interpreting a response with the mild lameness. The mare had a marked response to a fetlock flexion test in the right forelimb. Palpation of the palmaromedial aspect of the distal metaphyseal region of the right McIII bone revealed a small firm swelling and elicited a pain response.

Radiographs performed of both carpi and proximal McIIIs revealed a cresent-shaped area of lysis at the proximal medial palmar region of the left McIII. Radiographs of the distal right McIII and fetlock revealed a moderate sized callus and a cortical fracture of similar location and configuration to *Horses 2* and *3*. The fracture was best appreciated on the dorsal 60° medial-

Fig 3: Dorso60°medial to palmarolateral oblique radiographic view of the left fore fetlock of* Horse 3*, 12 weeks after initial presentation. Demonstrating a healed fracture.

palmarolateral oblique radiographic projection. However, it could also be delineated on the dorsal 45° medial-palmarolateral oblique and flexed lateromedial views. The left fetlock was radiographed, but no abnormalities were identified.

A bone phase nuclear scintigraphic examination revealed an area of intense radiopharmaceutical uptake in the distal palmaromedial metaphyseal region of the right McIII. The contralateral limb had a similar but less intense distribution of radiopharmaceutical uptake. There was an area of moderate radiopharmaceutical uptake in the proximal palmar left McIII.

Management and follow-up

The filly was confined to a large stall without a support wrap for approximately 6 weeks, with limited hand-walking commencing after 4 weeks rest. It was then given access to a small yard for 4 weeks followed by 4 weeks of pasture turnout. The filly was re-examined at 12 weeks after diagnosis and was not lame in a straight line at the trot. The pain on palpation of the fracture site had resolved, but a fetlock flexion test was still positive. Follow-up radiographs showed a greatly reduced smooth callus and fracture healing.

The filly resumed training 15 weeks after injury, and returned to racing 37 weeks after injury delayed by an episode of pedal osteitis. At the time of writing, it had completed 5 races, including 2 wins, without recurrence of lameness.

Discussion

The distal palmar McIII cortex has not previously been identified as a site of stress fractures in Thoroughbred racehorses. Incomplete and complete transverse fractures of the distal diaphyseal and metaphyseal region of McIII have been briefly described (Butler *et al.* 1993; Fulton and McKellar 1996). One clinical report describes incomplete transverse fractures located in the distal diaphyseal and metaphyseal regions of the third metacarpus that appear more extensive than those in this series (Fulton and McKellar 1996).

The horses in this series were of varying age and stages of training. There was no limb predilection, despite all horses training in a clockwise direction. In contrast, the majority of McIII stress fractures occur in the mid-dorsal cortex of the left forelimb in 3-year-old Thoroughbred racehorses exercising anticlockwise in the second year of race training (Copelan 1979; Richardson 1984, 1999; Stashak 1987; Stover *et al.* 1988; Cervantes *et al.* 1992; Stover 1998; Sullins 1998). One of the horses in this series showed radiographic evidence of McIII palmar supracondylar lysis (Hayes 1980; Pool 1996), which may have predisposed to fracture at this site. This finding was absent in the other horses.

The horses in this study presented with varying degrees of lameness; however, a positive fetlock flexion test and pain on palpation of the fracture site was a consistent finding in all horses. The lameness in *Horses 1* and *2* was localised to the fracture site using clinical signs only, whereas regional diagnostic anaesthesia was utilised in *Horses 3* and *4*. In *Horse 3*, the results of the diagnostic anaesthesia localised the majority of the lameness to the distal McIII region. This was the site of the palmar cortical third metacarpal stress fracture, rather than the humeral stress fracture. *Horse 4* also required sequential diagnostic anesthesia, presenting with a left forelimb lameness; a middle carpal joint block resulted in the horse switching lameness to the contralateral limb. The site of lameness in the left forelimb was diagnosed as a stress reaction/stress fracture of proximal palmar McIII, based on clinical, radiographic and scintigraphic findings. The lameness in the right forelimb was localised partially to the middle carpal joint. The remainder of the *grade 1/5* lameness was attributed to the distal McIII palmar cortical stress fracture, based on the marked response to fetlock flexion and a pain response on palpation of the fracture site.

Since lameness examinations were not performed prior to fracture identification, persistent positive fetlock flexion tests in 3 of these horses after the fracture healing could not be attributable definitively to the fracture. This finding may be due to either pre-existing or a resultant fetlock arthrosis due to the fracture. Alternatively, the positive fetlock flexion test may have been due to pain associated with the apices of the sesamoid bones impinging on the fracture callus at full flexion. As pain on palpation of the fracture site was well correlated with the presence of these fractures, careful palpation of the distal palmar cortex of the McIII bone is considered a valuable part of lameness examinations in Thoroughbred racehorses. The marked synovial distension in *Horses 1* and *2*, with haemorrhage in *Horse 1*, indicates that distal third metacarpal palmar cortical stress fractures may have an articular involvement. Articular involvement may result from proximity of the joint capsule attachment to the fracture site and extension of the fracture across the palmar cortex to involve

the joint in the region of the palmar pouch (Firth 1996). This may also explain the positive response to flexion tests.

Fractures in all horses were located in the distal diaphyseal and metaphyseal region of the McIII bone, 3 occurring in the medial and one in the lateral palmar cortex. They all shared a similar configuration, with the fracture coursing in a proximopalmar to dorsodistal direction at an angle of approximately 30° to the periosteal surface. This differs from dorsal cortical stress fractures, which are typically orientated from dorsodistal to proximopalmar (Richardson 1984; Sullins 1998). All fractures occurred at a similar level in the distal McIII palmar metaphyseal cortex, approximately midway between the apex of the proximal sesamoid bones and the distal aspect of the second or fourth metacarpal bones. Three of the 4 horses had callus formation at the fracture site on presentation, indicating the presence of a subclinical incomplete fracture or stress reaction some time prior to presentation. While the fracture line could be seen on the appropriate dorsal 45° oblique or lateromedial view in *Horses 1, 2* and *4*, a dorsal 60° oblique view best demonstrated the fracture in all cases. This was due to the fractures occurring in the palmar aspect of the medial or lateral cortex and the oval cross-section of the bone at this level. Therefore, we recommend this radiographic projection if a fracture is suspected in this area.

As with other sites of stress fracture, nuclear scintigraphy is a valuable diagnostic aid when radiographs are inconclusive. All cases displayed a focal marked increased uptake of radiopharmaceutical at the fracture site. Two cases displayed mild radiopharmaceutical uptake at the same site in the contralateral limb without any radiographic changes, providing further evidence that this region of McIII is subject to cyclic fatigue and resultant remodelling. Conservative treatment consisting of box rest and controlled exercise for 6 weeks was successful in all horses. *Horses 1* and *2*, presenting with marked *grade 4/5* lameness, had lower limb support bandages applied to the distal limb. *Horse 2* developed a large callus with transverse propagation of the fracture line. This finding may indicate potential instability associated with this fracture configuration. Propagation and complete fracture of an incomplete transverse distal diaphyseal third metacarpal fracture has been reported previously (Fulton and McKellar 1996). Conservative therapy resulted in fracture healing with a small smooth callus 3–4 months after initial examination in all horses (**Fig 3**). The results from this small series suggest that conservative treatment is not associated with delayed healing or recurrence, as may occur with dorsal cortical McIII fractures. Evaluation of a larger series of horses would allow more definitive assessment of the predictability of healing, athletic outcome and recurrence rate with this type of fracture.

The clinical and radiographic characteristics of the fractures observed in these horses suggests the distal third metacarpal palmar cortex as a further site of stress fractures in Thoroughbred racehorses. Clinical awareness of this area as a potential site of stress fracture may assist clinicians in diagnosing these fractures. In this small case series, conservative management of the horses resulted in fracture healing with a favourable prognosis for return to function with this injury.

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Manufacturers' addresses

[1]Mallinckrodt Medical Inc, St Louis, Missouri, USA.
[2]General Electric, Horsolm, Denmark.

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