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Fractures of the equine distal phalanx may be a form of stress-related bone injury much like other stress fractures in the racehorse. Early scintigraphic examination of racehorses with palmar foot pain may identify stress-related bone injury before fracture and allow corrective shoeing to be instituted. These fractures most commonly occur in the lateral aspect of the left forelimb and the medial aspect in the right forelimb. Despite the fact that this injury can lead to osteoarthritis of the distal interphalangeal joint, there is a favorable prognosis for return to racing. Authors’ address: Department of Clinical Studies, University of Pennsylvania, New Bolton Center, 382 West Street Road, Kennett Square, PA 19348. © 2002 AAEP.

1. Introduction
Fractures of the distal phalanx (P-III) have previously been classified by fracture configuration into six categories, non-articular fracture of the palmar/plantar process (type I), articular wing fracture extending from the solar margin to the distal interphalangeal (DIP) joint (type II), articular, mid-sagittal fracture (type III), extensor process fracture (type IV), comminuted fracture (type V), and solar margin fracture (type VI).1–3 In racehorses, P-III fractures occurred most commonly in the medial aspect of the right forelimb and the lateral aspect of the left forelimb, and most commonly, were nonarticular or articular wing fractures.1,3–4 One of us observed that abnormal scintigraphic findings of P-III in racehorses had a characteristic distribution more commonly seen in the left forelimb lateral and right forelimb medial aspects of the bone.5 Because increased radiopharmaceutical uptake (IRU) had a similar distribution as fractures, it was proposed that P-III fractures were likely the result of stress-related bone injury (SRBI) and not single event injuries.5 Scintigraphic evaluation is useful for early diagnosis of P-III when radiographic evidence is not yet present.5,6 Long-term follow-up in racehorses, using objective criteria and quality and extent of healing, have not been reported. The purpose of this study was to reaffirm distribution of P-III fractures, to examine the possibility that P-III fractures are a form of SRBI, to obtain objective long-term follow-up information about race performance, to describe scintigraphic abnormalities, and to obtain information about quality of fracture healing.

2. Materials and Methods
Case records, radiographs, and scintigraphic images of horses admitted to the George D. Widener Hospital for Large Animals with P-III fractures from January 1, 1990 to December 31, 2001 were examined. The study group was limited to racehorses with non-articular wing, articular wing, mid-sagittal, and solar margin fractures. Information obtained from medical records included signalment, limb affected, fracture type and location, diagnostic analgesia if
performed, cause of fracture, treatment, treatment outcome (including convalescence and follow-up radiographic examination), and scintigraphic and radiographic findings. Radiographs (or xeroradiographs) of the affected limb included dorsoproximal-palmarodistal oblique, dorsopalmar/plantar, lateromedial, horizontal oblique, dorsolateral palmaromedial, and dorsomedial palmarolateral oblique (DLPMO, DMPLO, horizontal obliques) in some horses and D45°-L65°Pr-Pa(Pl)DiO, D45°-M65°Pr-Pa(Pl)DiO (wing) in all horses. Delayed phase scintigraphic images were available for review in 15 horses, including standing dorsal and solar images. Bone scintigraphy was performed by administering 99mTe-HDP (15 MBq/kg, IV), and delayed (bone phase) images were obtained using a rectangular large field of view (LFOV) gamma camera with a low-energy, high-resolution parallel hole collimator mounted on a custom-made central column overhead gantry. Images were stored and analyzed using a dedicated nuclear medicine computer. A small field of view (SFOV) camera, permanently mounted in the floor was used for solar views. In some horses, lateral and dorsal pool phase images were obtained.

Follow-up information was obtained through case record examination, radiographic evaluation, and obtained race records. From race records, number of starts before and after injury, mean earnings per start for five starts before and after injury, and time to first start were recorded.

3. Results

During the study period, 127 horses were admitted with P-III fractures, including 72 racehorses, 47 adult non-racehorse sport horses, and 8 horses <1 yr of age. The study group included 72 racehorses of which 46 were Standardbred racehorses (STBs) and 26 were Thoroughbred racehorses (TBs). Forty-four (96%) of 46 STBs had wing fractures, and the most common distribution was right front medial (15 horses) and left front lateral (12 horses). The remaining fracture distribution was left front medial (5), right hind medial (3), left hind medial (5), right front lateral (3), and left hind lateral (1). There was one sagittal fracture and one solar margin fracture in addition to the 44 wing fractures. Of the STBs with wing fractures, 8 were non-articular and 33 were articular. In one horse, initial radiographs were negative but intense increased radioisotope uptake was seen. This horse subsequently developed articular wing fracture (left front lateral). In two horses, routine radiographic views were negative, but increased radioisotope uptake prompted the acquisition of horizontal oblique radiographic views, on which incomplete fracture could be seen.

Twenty-seven of 28 TBs had wing fractures (total of 28 fractures): 7 were right front medial and 6 were left front lateral. Medial and lateral wing fractures in the same foot occurred in one TB on two different occasions. The remaining wing fracture distribution included left front medial (5), right hind medial (5), and left hind medial (5); 7 of 27 were right front lateral, 0 of 27 were right hind lateral, and 2 of 27 were left hind lateral wing fractures. Nine of the 27 were non-articular, and 18 of 27 wing fractures had an articular component. Additionally, there was one sagittal fracture.

Increased radioisotope uptake was seen in all horses that underwent scintigraphic examination. Abnormal uptake was most prominent in lateral views when fractures were lateral, but dorsal, plantar, or solar views were necessary for diagnosis in horses with medial fractures. In two horses (one STB and one TB), scintigraphic examination was positive but initial radiographic examination was negative; both horses subsequently developed articular wing fracture.

Management included rest and corrective shoeing in 52 (72%) horses. Corrective shoeing included bar shoes with clips, bar shoes alone, or glue-on shoes with hospital plates; however, specific information regarding shoeing was unavailable. In addition to corrective shoeing, some horses were also treated with nonsteroidal anti-inflammatory drugs such as phenylbutazone and/or flunixin meglumine (1.3%), isoexpressurine (4.2%), and intra-articular medication including steroids and hyaluronan (4.2%). Furthermore, it was recommended that horses be confined to a box stall for 8–12 wk and then obtain follow-up radiographs at 4–6 wk. If fracture healing was evident on radiographs, the horse could then be walked in hand or under saddle for an additional 4 wk, followed by 4 wk of light exercise (5–10 min jogging per day on soft ground). If lameness developed during convalescence, then extended periods of stall confinement up to several months were recommended. Palmar/plantar digital neurectomy was performed in 13 (18%) horses, which led to complete resolution of lameness. Lag screw fixation was performed in one horse. Treatment was unknown in six horses. Follow-up radiographs were available in 33 horses, and evidence of osteoarthritis in the DIP joint was seen in 11 horses. Osteoarthritis was defined by radiographic abnormalities including proliferative changes on distal P-II or proximal aspect of P-III. All horses with osteoarthritis (or joint incongruity) had articular wing fracture. Follow-up radiographs were obtained at 1–18 mo after initial fracture (mean, 6.8 mo). Of those horses in which radiographs were taken ≥4 months, 55% healed.

Race records were available for 58 horses. Of those available, information was recorded for 29 STBs and 19 TBs. For STBs, mean race starts before the injury was 33 (range, 0–101) and after injury was 63 (range, 0–161). In TBs, mean race starts was 8.7 (range, 0–30) before fracture and was 23.8 (range, 0–102) after fracture. In STBs, mean earning/start decreased from $2672 to $1151 and in TBs the mean earning/start decreased from $4864 to...
Time to first start after injury was substantially longer for STBs at 290 days (range, 11–870 days) compared with 151 days (range, 18–490 days) for TBs.

4. Discussion
Distal phalanx fractures in the forelimb may be a form of SRBI in the racehorse, based on the preclinical evidence of increased radioisotope uptake in two horses before fracture. The fractures involving the palmar/plantar process were best identified on standard down-angled oblique radiographic views (wing) but in two horses could only be seen on horizontal obliques. Therefore, if a P-III fracture is suspected, we suggest horizontal oblique radiographic views be taken. Delayed scintigraphic views lead to a diagnosis of P-III fracture in all horses that underwent scintigraphic examination. Our study reaffirmed that wing fractures most commonly involved the left front lateral and right front medial aspect of P-III, but in a previous study, 89.5% involved these locations, whereas in our study fractures were more widely distributed.1 In our study, 11 horses had hind limb P-III fracture, and in these horses, the etiology may be a single event injury such as wall kicking and not necessarily SRBI as we propose is most common in the forelimb.

Seventy-three percent of wing fractures in this report were articular, and although radiographic follow-up was only available for only 50% of horses, all of them had evidence of osteoarthritis. Neither presence of osteoarthritis nor a step in the articular surface precludes future racing. Osteoarthritis was a common radiographic finding that may have limited but did not preclude racing and should not be over-interpreted. Fracture healing seemed to be delayed in this bone compared with fractures in other bones; however, it did not seem to affect racing. Although there was an overall decrease in earnings/start after injury, this is similar to many other retrospective studies in which there is a decrease in race performance, a phenomenon that is associated with an aging population.7 Whereas earnings/start decreased, horses were productive earners. A natural decline in athletic ability may occur in horses regarded as normal. Rest and corrective shoeing seem to be effective, but neurectomy was a useful adjunctive treatment. Convalescence should be expected within 6–7 mo.

References