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Fragmentation of the dorsal distal aspect of the talus on weanling survey and pre-sale radiographs of juvenile Thoroughbreds: prevalence and 2- and 3-year-olds racing performance

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Background Fragmentation of the dorsal aspect of the distal talus (FDDT), at the dorsolateral articular margin of the proximal intertarsal joint (PITJ) on pre-sale radiographs of yearling Thoroughbreds has not been previously described and data to support decisions made by veterinarians to predict future racing potential of horses with these lesions are lacking.

Methods In this retrospective case–control study we aimed to determine the prevalence of FDDT in juvenile Thoroughbreds and to report their race records. From a database of survey and repository radiographic examinations of 5709 horses, 36 with FDDT were identified.

Results The prevalence of FDDT was 0.63% (36/5709; 95%CI 0.44, 0.87), compared with 5.01% (286/5709; 95%CI 4.46–5.61) for osteochondrosis of the distal intermediate ridge of the tibia in the same population. In most cases, a single oval-shaped fragment 1–12 mm in diameter was present. When comparing cases with matched controls, there were no significant differences in mean sale price, whether horses started in a trial or race and mean number of starts, wins, places and prize money when 2- and 3-years old.

Conclusion FDDT did not appear to affect racing performance, although a larger-scale study is warranted to confirm this finding.

Keywords bone fragments; juvenile osteochondral conditions; repository radiographs; survey radiographs; tarsus; talus; Thoroughbred yearlings

Abbreviations AUD, Australian dollars; CI, confidence interval; D10–20°LPMO, dorso10–20° lateral–plantaromedial oblique; D55–65°MPLO, dorso55–65°medial–plantarolateral oblique; DIRT, distal intermediate ridge of the tibia; FDDT, fragmentation of the dorsal aspect of the distal talus; LM, lateromedial; LTR, lateral trochlear ridge of the talus; MTR, medial trochlear ridge of the talus; OCD, osteochondrosis; OR, odds ratio; PITJ, proximal intertarsal joint.

Radiographic examination is routinely performed before Thoroughbred yearlings are presented for public auction. With expert interpretation, these examinations can highlight abnormalities that may affect sale, soundness and performance.[1,2] A repository system for sales in Australia and New Zealand requires a standard set of radiographic views of all four feet and fetlocks, the stifles, carpi and tarsi within 42 days before sale. In addition, survey radiographs of weanlings and early yearlings may be obtained by vendors during July through September preceding the major yearling sales that are held from January the following year. This is conducted to identify horses that may need surgical intervention or management changes before sale. Radiographic changes are often detected and may represent normal variations in the appearance or development of bones or result from congenital, acquired or developmental abnormalities.[3] Studies have assessed the prevalence of some of these findings in juvenile Thoroughbreds[3–11] and their association with race performance[5,10,12–14] although evaluation of uncommon lesions has been limited by the low power of some studies.[1,15]

Osteochondrosis (OCD) is the most common lesion identified in the tarsus on yearling sale radiographs, most frequently affecting the distal intermediate ridge of the tibia (DIRT) and less commonly the lateral trochlear ridge of the talus (LTR), medial malleolus of the tibia and the medial trochlear ridge of the talus (MTR).[3,4,6,7,9,10] A limited number of studies have investigated the clinical significance of radiographically visible fragments arising from the talus at locations other than these OCD predilection sites.[16,17] Two of the authors (ARA and SRH) recognised fragmentation of the dorsal aspect of the distal talus (FDDT), distal to the lateral trochlear ridge at the dorsolateral articular margin of the proximal intertarsal joint (PITJ) in juvenile horses, a lesion not previously described. The aims of this study were (1) to determine the prevalence of FDDT and to compare the prevalence with that of OCD lesions of the DIRT within a cohort of yearling Thoroughbreds, (2) to describe the radiographic appearance of lesions and whether they improve or resolve between survey and repository examinations and (3) to investigate the effect of these lesions on performance. We hypothesised that FDDT would be uncommon in juvenile Thoroughbreds and would not affect future racing ability. We also hypothesised that surgical removal of these lesions is unnecessary for racing success.

Materials and methods

Case selection

A database search was performed of the radiographic reports for juvenile Thoroughbreds undergoing pre-sale radiographic examinations by Scone Equine Hospital between 1 August 2010 and 1 April 2016. All radiographic reports were prepared or reviewed by a specialist equine surgeon (SRH or ARA). The search terms used to identify cases were ‘hock’, ‘talus’, ‘fragment’, ‘fracture’ and ‘chip’. The digital radiographs of both hocks for each case were then reviewed by a final-year veterinary student (SD) and an additional specialist equine surgeon (CMS), using DICOM files and the digital imaging software OsiriX (v.8.0. OsiriX Imaging Software, Geneva, Switzerland). Cases were included if FDDT was present and the positioning and quality of radiographs of both tarsi were of a diagnostic standard. Cases were excluded if the fragment was identified outside the anatomical area of interest, which was the dorsolateral aspect of the talus distal to the lateral trochlea ridge. Cases of OCD of the DIRT were identified using a database search using the terms ‘hock’, ‘tarsus’, ‘OCD’, ‘osteochondrosis’ and ‘DIRT’, but a detailed review of these radiographs was not performed. Cases of OCD of the DIRT on yearling repository examination included those with an OCD lesion at this site as well as those in which previous surgery to treat a lesion at this site was indicated in the radiology report.

Radiographic examination

In general, two radiographic examinations were performed: when horses were weanlings (survey radiographs) and as yearlings prior to sale (repository radiographs). Additionally, horses entered in weanling sales had repository radiographs obtained as weanlings before sale. Three standard views of each tarsus (dorso10–20° lateral–plantaromedial oblique (D10–20°LPMO), lateromedial (LM) and dorso55–65°medial–plantarolateral oblique (D55-65°MPLO)) obtained using computed radiography were reviewed.

For each tarsal radiographic series the date, sale, dam and sire, date of birth, sex, presence and location (left/right tarsus or bilateral, proximity of FDDT to the PITJ) and other radiographic changes were recorded. Fragment size (maximum length × maximum width) was measured with electronic calipers using OsiriX and the maximum dimension recorded as < 3 mm, 3–6 mm, or > 6 mm.

Prevalence

The prevalence of each lesion type (FDDT or OCD of the DIRT) was determined by dividing the number of horses with that lesion by the total number of horses that had survey and/or repository examinations performed during the same period.

Racing performance

Yearlings with FDDT (cases) were one-to-one matched with a control. Controls were maternal siblings that were radiographed pre-sale during the study period. If more than one control was identified for a case, then the sibling closest in age was used. Cases and controls were further matched by sex if possible. Race performance for each case–control pair was compared for their 2-year-old (from 1 October in the year they turned 2 to the following 31 July) and 3-year-old (1 August to following 31 July) racing seasons. If no maternal control match was found, because of either a lack of a sibling from the case dam or if the sibling(s) had clinically significant radiographic findings, cases were age- and sex-matched to randomly selected non-siblings from the Scone Equine Hospital's database.

The sale price was obtained from an online auction database (https://www.salesresults.bloodstock.com.au). Race performance information was obtained from the official repository of Australian racing results (http://www.racingaustralia.horse). For each animal the number of barrier trials, number of race starts, number of times placed, number of wins, total prize money (AUD) and yearling sale price (AUD) were recorded.

Statistical analysis

Data distribution of continuous variables was assessed for normality by examining histograms. All continuous variables were non-normally distributed and log-transformed for analysis. Mean and standard deviation (SD) of the raw values are presented. Univariable conditional logistic regression was used to assess differences between cases and their matched controls. Odds ratios (OR) with 95% confidence intervals (CI) are presented. Statistical significance was set at P d 0.05. Statistical analyses were conducted using Stata/SE, version 14.2 (StataCorp, College Station, Texas, USA).

Results

FDDT was identified in 43 tarsi of 36 horses (Figure 1): affecting the left tarsus only (17 horses), right tarsus only (12 horses) or both tarsi (7 horses). Of the 36 horses, there were 20 colts and 16 fillies: 2 were born in 2009, 7 in 2010, 4 in 2011, 8 in 2012, 11 in 2013 and 4 in 2014. For these 36 horses, 63 sets of radiographic views (3 projections) of both tarsi were assessed and FDDT was evident in one or both tarsi on 54 of the examinations (Figure 1). The remaining 9 examinations (all survey radiographs) did not reveal FDDT, yet FDDT was later diagnosed on repository examination. A total of 8471 radiographic examinations of 5709 horses were performed during the study period. Therefore, the prevalence of FDDT was 0.63% (36/5709; 95% CI 0.44, 0.87). In comparison, the prevalence of OCD lesions of the DIRT within the same population and period was 5.01% (95%CI 4.46–5.61).

In all cases FDDT was evident on the D55-65°MPLO view (Figure 2) and in two cases the fragment could also be identified on the LM view. No cases required exclusion because of inadequate radiographic positioning or quality.

The mean age when initial survey radiographs were taken was 10.75 months (SD 1.35, range 8.0–12.25 months) and for repository radiographs was 16.6 months (SD 1.90, range 13.5–20.0 months). Of the 36 horses diagnosed with FDDT, 23 had undergone survey radiographic examination as weanlings (Figure 1). Of these, 15 horses had FDDT evident at that examination. An additional 4 horses had either osteolysis (both tarsi of 2 horses) or modelling (both tarsi of 2 horses) of the dorsal aspect of the distal talus, distal to the lateral trochlear ridge at the site where fragmentation was to later occur. The remaining 4 horses had no bone abnormalities at this site on weanling survey examinations. Of the 23 horses with survey radiographs, 22 had repository radiographs performed a mean 5.9 months (SD 1.59, range 3.5–8.0 months) later. In these cases, there was minimal if any change in fragment size on subsequent examinations; however, in one tarsus the fragment appeared larger (5 × 7 mm on survey examination, 10 × 7 mm on repository examination), in one tarsus in which the fragment had initially appeared non-displaced the lesion was no longer evident and in one tarsus the fragment appeared attached to the talus.

Fragments were generally oval-shaped with rounded margins (Figure 2a, c) and occurred at the dorsolateral articular margin of the PITJ. The mean fragment size was 4.2 × 3.5 mm (SD 2.8 × 2.3, range 1 × 1–12 × 9 mm). A single fragment was evident in 40 tarsi, with the greatest measured fragment dimension < 3 mm in 12 tarsi, 3–6 mm in 15 tarsi and > 6 mm in 14 tarsi, with the smallest being 1 × 1 mm and the largest 12 × 9 mm. The remaining two affected tarsi appeared to have several fragments at the site of interest, accurate measurement was difficult, yet each was estimated as < 6 mm in diameter (Figure 2b). In 17 horses there was a radiolucent defect or modelling of the talus immediately adjacent to the fragment, consistent with a site of fragment origin (Figure 2a–e).

Concurrent lesions in the affected tarsus included osteophyte formation within the tarsometatarsal joint (3 tarsi) (Figure 2d) or distal intertarsal joint (2 tarsi), modelling of the dorsolateral aspect of the 3rd tarsal bone (2 tarsi) and incomplete slab fracture of the 3rd tarsal bone (3 tarsi) (Figure 2a). Wedged conformation of the 3rd or central tarsal bone was also present in five tarsi with these concurrent lesions. Two affected tarsi had minor modelling and one had a small OCD lesion of the distal aspect of the LTR of the talus. Lesions of the contralateral tarsus included OCD of the DIRT (3 tarsi) and osteoarthritis of the distal intertarsal joint with narrowing of the joint space and subchondral bone lysis (1 tarsus).

The mean sales price was not different for controls compared with FDDT horses (Table 1). For two case horses and three control horses, yearling sales price was 'reserve not attained'. For two controls no sales price was available (one horse was withdrawn). These horses were excluded from the statistical analysis of yearling sales price.

As 2-year-olds, 20 of the 36 horses with FDDT (56%) were unraced, although 6 had started in at least one barrier trial. As 3-year-olds, 8 horses with FDDT remained unraced (22%). In comparison, 18 of the 36 (50%) control horses were unraced as 2-year-olds, although 5 had started in a barrier trial (a practice race of at least 600 m in distance using starting gates) and 7 remained unraced (19%) as 3-year-olds. There was no difference between controls and cases when comparing whether horses had started in a barrier trial or race and mean values for starts, wins, places and prize money (Table 1).

Discussion

As hypothesised, FDDT was uncommon in the population of juvenile Thoroughbred horses studied and we did not identify an effect on subsequent racing performance. We report a prevalence of 0.63% of FDDT and 5.01% of OCD of the DIRT in juvenile Thoroughbred horses subjected to pre-sale survey or repository radiographic examination. The prevalence of FDDT is similar to that of OCD of the LTR and/or MTR of the talus, and of OCD of the medial malleolus of the tibia in previous studies.[4,6,7–11,13] The prevalence of OCD of the DIRT in the current study (5.01%) was 7.95-fold greater than that of FDDT lesions and was similar to that previously reported in Australian yearlings[7,9,11] and in yearling populations in the USA,[4,13] France,[14] South Africa,[8] New Zealand[6] and Japan.[10] However, the true prevalence is likely to be underestimated in studies in which surgical removal of lesions before repository examination is not reported.

Fragments were typically oval-shaped, single, mostly unilateral and appeared at least partially intra-articular. They ranged in size from 1 to 12 mm in diameter and usually appeared similar in size on subsequent radiographic examination, although in several cases lesions appeared attached to the adjacent talus. In most cases, FDDT was present on weanling radiographs and in several additional cases, although a definite fragment was not evident on initial examination, there was lysis or modelling of the talus at the site of interest and fragmentation was later diagnosed on repository radiographs.

Although the cause of FDDT is unknown, these fragments may be considered another juvenile osteochondral condition, a term suggested by Denoix et al. to describe a variety of OCD conditions and lesions presumed to be of developmental or traumatic origin to which genetics, nutrition, exercise regimen and breed disposition may contribute.[18] In our opinion the most likely cause of FDDT is increased cyclic loading on the dorsolateral tarsus during pasture turnout, with increased body mass or malalignment being additional potential contributing factors. Subchondral bone modelling in T3 and Tc evident by around 2 years of age and incomplete slab fracture of T3 in juvenile horses in the same population as the current study (Steel et al. unpubl. data) also affect the dorsolateral aspect of the tarsus. Although it is possible that small fragments may result from bone or cartilage debris from the tarsocrural joint OCD lesions that has settled in this location and subsequently ossified and modelled, this is an unlikely cause in many cases as the site of origin of the fragment from the distal lateral aspect of the talus is usually evident. Further investigation, including histopathology and longitudinal radiographic study, of juvenile horses was beyond the scope of the current study, but is needed to determine the likely aetiopathogenesis of FDDT.

The most useful radiographic view for observing FDDT was the D55–65°MPLO view and fragments were only occasionally evident on the LM view. One of the authors (SRH) has also recognised that views taken from a more dorsal position (D45°MPLO) are useful in identifying these lesions. A limitation of the current study is that only the standard survey and repository radiographic views were available and therefore small fragments, particularly if minimally displaced, may have been under-diagnosed. Ultrasound may be useful to locate fragments and determine whether they are intraor extra-articular.[17,19] Computed tomography[17] and magnetic resonance imaging may help determine the precise location of tarsal fragments, but would be difficult to justify in the absence of clinical signs.

Radiographic abnormalities are frequently seen in the tarsus of juvenile Thoroughbreds,[3,4,6,7,10,11,14] yet few have been associated with reduced future racing performance. OCD affecting any part of the distal tibia and fragments of the distal trochlea ridge diagnosed on repository radiographs have not been associated with a significant reduction in future racing performance,[12] although yearlings with severe lesions may have been excluded from pre-sale examination. Osteophytes and enthesiophytes of the distal intertarsal joint may be associated with reduced future racing performance within a population,[12] yet not necessarily preclude an affected individual from racing successfully.[2] Wedge-shaped conformation of the 3rd tarsal bone and tarsal bone slab fracture are conditions that have not been studied in sufficiently large numbers to assess their effect on subsequent performance. In the current study, various concurrent lesions did not occur in enough cases to determine their effect on prognosis. Although mean prize money as a 2-year-old and a 3-year-old was lower for cases than for controls in the current study, the difference was not significant. Similarly, we were unable to identify any significant differences between cases and controls when comparing the likelihood of starting in a trial or race, the number of starts, wins and places. Therefore, it appears that FDDT does not affect subsequent 2- and 3-year-old racing performance, yet evaluation of a larger case–control study is needed to make a firm conclusion, particularly in respect to determining whether larger lesions or certain concurrent lesions may affect the outcome of individual horses.

In the current study, all horses were allowed unrestricted paddock turnout after diagnosis. Horses with FDDT were as likely as control horses to race and were comparable in parameters of racing success even though surgical removal of fragments was not performed. Surgical removal of FDDT lesions was not attempted because it was anticipated that fragments were unlikely to affect future performance and as earlier efforts by one of the authors (ARA) to remove these fragments in several horses had been difficult because they were only partially intra-articular. Similarly, fragments associated with the distal aspect of the MTR are considered an incidental finding for which surgical removal is not required.[20] In comparison, for OCD lesions within the tarsocrural joint, arthroscopic debridement is often performed to reduce the likelihood of osteoarthritis.[21]

Horses identified with FDDT were not reported lame at the time of radiographic examination and joint effusion or swelling at the site was not evident (observations of ARA). However, it is not usual for weanlings and yearlings to undergo thorough examination for lameness when presented for radiographs and we cannot completely rule out the possibility that lesions can cause clinical signs in some cases. Furthermore, follow-up clinical examination information was not available and would be difficult or inappropriate to obtain for sales yearlings because of the change of ownership and client confidentiality. We cannot be completely certain whether horses with FDDT may suffer any related subsequent lameness or other clinical signs.

Conclusions

Fragments located distal to the LTR of the talus at the dorsolateral articular margin of the PITJ in juvenile Thoroughbreds are uncommon and best visualised on D55–65°MPLO views of the tarsus. These fragments do not appear to affect the racing potential of horses, although a larger study of sufficient power is needed before making a firm conclusion.

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Conflicts of interest and sources of funding

None of the authors has any financial or personal relationships that could inappropriately influence or bias the content of the paper.

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Figure 1. Flowchart of radiographic examinations of 36 horses with fragmentation of the dorsal aspect of the distal talus (FDDT), distal to the lateral trochlear ridge at the dorsolateral articular margin of the proximal intertarsal joint.

Figure 2. Radiographic views (dorso55–65°medial–plantarolateral oblique) of the tarsus of horses with fragmentation of the dorsal aspect of the distal talus (FDDT) cropped to show the distal tarsus. (a) Small (3-mm diameter) oval-shaped fragment (arrow) within a lytic defect in the talus and concurrent healing incomplete slab fracture of the 3rd tarsal bone (arrow head) at survey examination of an 11½-month-old filly. (b) Multiple small fragments adjacent to the talus at the articular margin of the PITJ on repository examination in a 19-month-old filly. (c) An intermediate sized (7 × 8 mm) fragment at the articular margin of the PITJ and irregular lysis of the adjacent talus of an 18½-month-old colt. (d) A less well-defined, larger fragment at the distal articular margin of the talus and modelling of the adjacent proximal articular margin of the central tarsal bone on survey examination of a 10-month-old colt. An osteophyte of the proximal 3rd metatarsus is also evident. (e) A non-displaced fragment on repository examination of a 16-month-old filly. PIPJ, proximal interphalangeal joint.

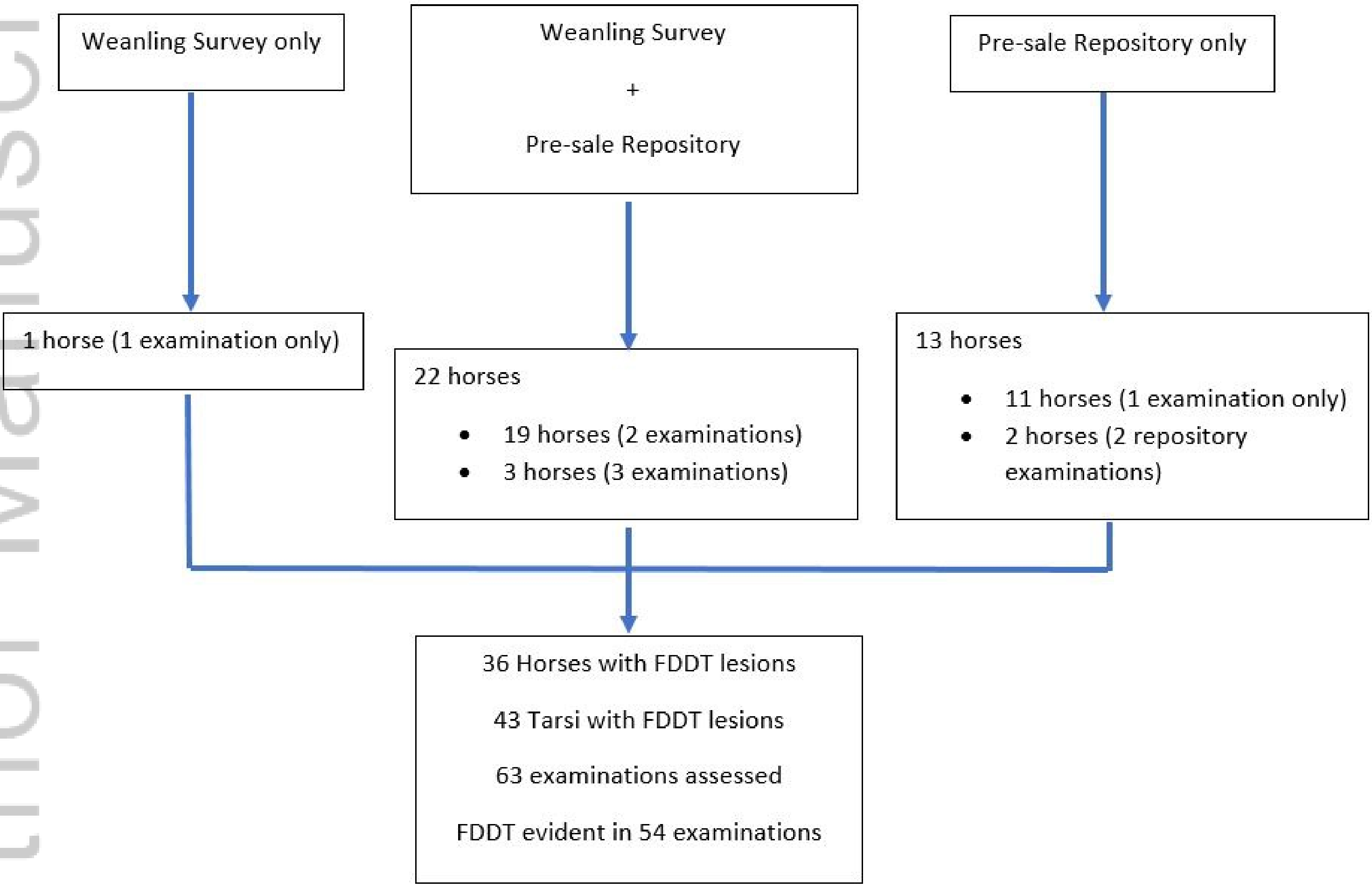
Table 1. Racing performance of 36 horses with fragmentation of the dorsal aspect of the distal talus (FDDT), distal to the lateral trochlear ridge at the dorsolateral articular margin of the proximal intertarsal joint (PITJ) and matched controls

	Cases (n = 36)		Controls (n = 36)		OR	P value
	n	mean ± SD	n	mean ± SD	(95% CI)	
Sex						
Female	16	-	17	-	1.00	
Male	20	-	19	-	1.13 (0.43, 2.92)	0.808
Sales price (AUD)	34	134, 103 (111, 504)	31	137, 516 (140, 979)	1.02 (0.61, 1.72)	0.941
2-year old season						
Raced or unraced						
Unraced	20	-	18	-	1.00	
Raced	16	-	18	-	0.82 (0.34, 1.97)	0.655
Barrier trials	36	1.19 (1.45)	36	1.25 (1.48)	0.97 (0.69, 1.37)	0.862
Race starts[a]	36	1.28 (2.06)	36	1.39 (1.78)	0.97 (0.77, 1.22)	0.816
Wins[a]	36	0.08 (0.28)	36	0.31 (0.75)	0.20 (0.02, 1.66)	0.135
Places[a]	36	0.39 (1.10)	36	0.25 (0.60)	1.18 (0.70, 2.01)	0.538
Prize money (AUD)[b]	36	4,520 (12,308)	36	11,327 (28,799)	0.85 (0.56, 1.29)	0.439
3-year old season						
Raced or unraced						
Unraced	8	-	7	-	1.00	
Raced	28	-	29	-	0.83 (0.25, 2.73)	0.763
Barrier trials	36	1.42 (1.50)	36	1.61 (1.71)	0.92 (0.67, 1.25)	0.583
Race starts[a]	36	4.42 (3.71)	36	4.61 (3.42)	0.99 (0.88, 1.11)	0.833
Wins[a]	36	0.61 (0.93)	36	0.75 (0.97)	0.70 (0.33, 1.49)	0.359
Places[a]	36	0.89 (1.26)	36	0.89 (0.92)	1.00 (0.66, 1.53)	1.000
Prize money (AUD) [b]	36	22, 043 (33, 236)	36	38, 329 (76, 785)	0.73 (0.41, 1.29)	0.280

[a]Summary statistics for horses that started in a race. [b]Logistic regression was performed using log-transformed variables and a dummy indicator variable for unraced horses (where prize money was zero).

Supporting information

Additional supporting information may be found in the online version of this article at the publisher's website: ?????



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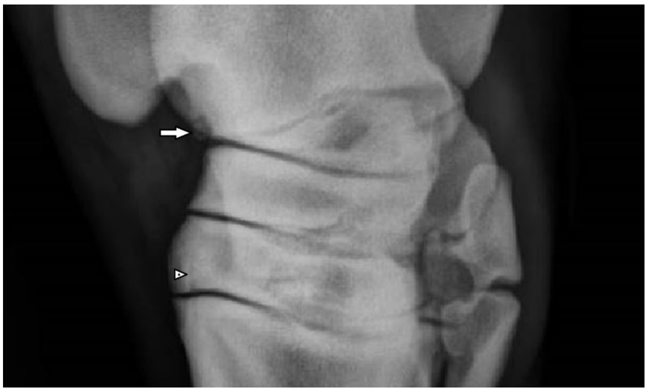

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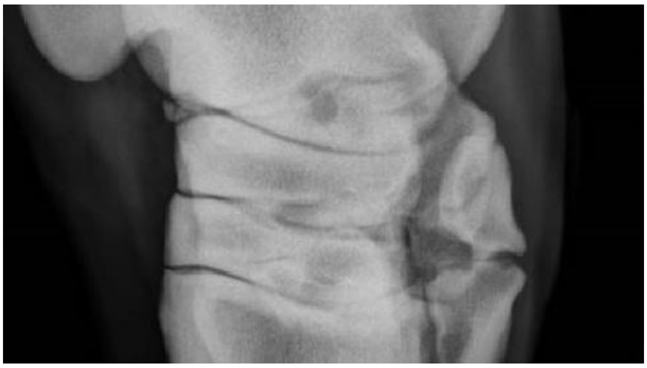

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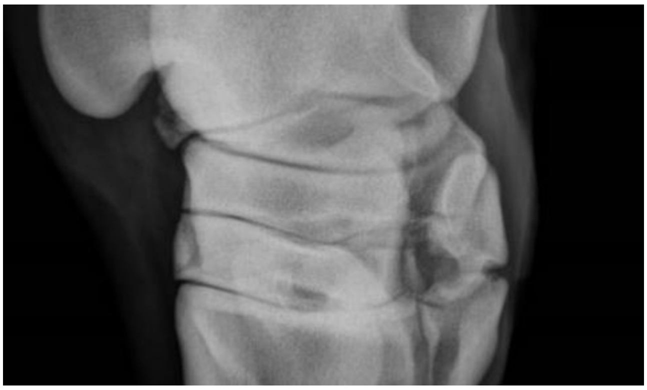

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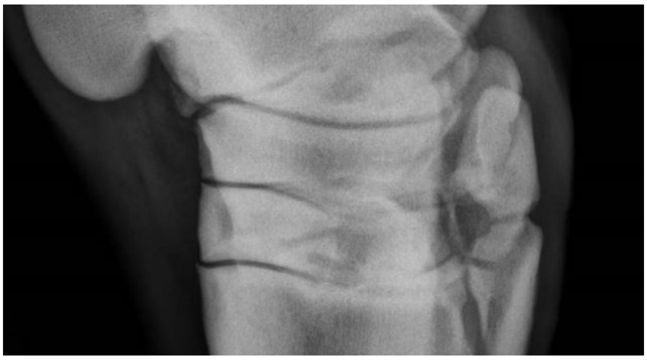

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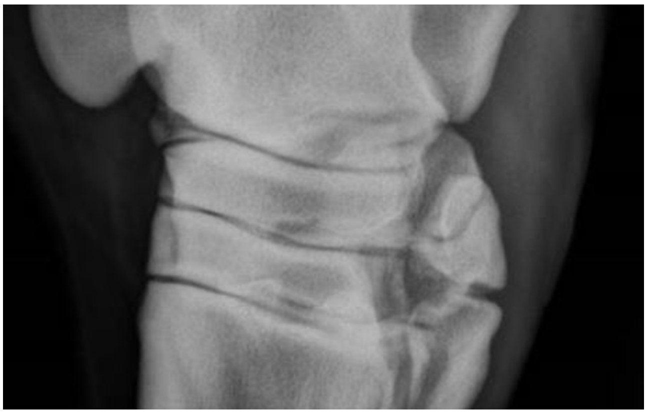

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