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Use of diagnostic reports to estimate prevalence and distribution of skeletal lesions in young Thoroughbreds

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ABSTRACT

Diagnostic reports written to assist stud managers in the sale of young Thoroughbreds have not previously been used as a data source for the study of skeletal lesions. However, analyses of these reports may provide efficient and cost-effective insights into the prevalence and distribution of skeletal lesions within a population. Diagnostic reports written by veterinarians were acquired from Thoroughbred stud managers in Australia and New Zealand. The reports were based on approximately 1300 sets of weanling and yearling radiographs taken between 2002 and 2007. The prevalence and anatomical distribution of skeletal lesions in weanlings (299 horses) and yearlings (1004 horses) were determined from these reports. Overall, 69.9% of weanlings and 64.5% of yearlings were reported as having one or more skeletal lesions. Diagnostic reports in weanlings were a strong indication of what was likely to be seen in subsequent yearling reports. These diagnostic reports are typically used by stud managers in the sales process and the potential drawback is that some categories of skeletal lesions may be under-reported. However, there was substantial agreement between the prevalence and distribution of several skeletal lesions reported in this study and those previously reported from direct evaluation of radiographs for Australian and New Zealand Thoroughbred yearlings. Strong agreement was found for osteophytes, enthesiophytes and other modelling in the hocks, and for lesions in the hind fetlocks and stifles. This indicates that written diagnostic reports are a useful and a reliable source of data for the study of some skeletal lesions in young Thoroughbred horses.

Introduction

In almost every Thoroughbred racing country in the world, public auctions are the primary avenue for the trade of young Thoroughbred horses. Median sale prices at auctions can be higher than $100,000 (AUD) per horse, and in Australia and New Zealand these auctions have seen the most sought-after yearlings achieve prices in excess of $2 million (AUD/NZD) (Inglis Bloodstock, 2014a). With so much money at stake, it should come as no surprise that buyers generally undertake due diligence on any prospective purchase. As such, it is common practice within the industry for stud managers to arrange for a set of radiographs to be taken of weanlings and yearlings bound for auctions. Veterinary surgeons then examine these radiographs and provide the stud manager with written reports describing any visible skeletal defects. These reports allow managers to not only better judge the financial value of a horse they are selling, but also better understand any concerns that may be voiced by a potential buyer.

Previous studies examining the prevalence and distribution of skeletal lesions in Thoroughbred yearlings have been based on direct evaluations of sale radiographs by experienced veterinarians, as opposed to using data from the reports written by veterinarians for stud managers (Kane et al., 2003; Spike-Pierce and Bramlage, 2003; Cohen et al., 2006; Oliver et al., 2008; Jackson et al., 2009; Preston et al., 2010; Furniss et al., 2011). The aim of the present study was to estimate the prevalence and distribution of skeletal lesions revealed in Thoroughbred weanling and yearling radiographs using the written diagnostic reports provided to stud managers. In addition, we compare these results with past studies to identify any systemic differences between the alternative data sources and examine the persistence of skeletal lesions as weanlings mature into yearlings.

Materials and methods

Study population

The study population consisted of both intact male and female horses that were radiographed between 2002 and 2007 as part of the normal operating procedure at the stud in which they were raised. Seventeen commercial Thoroughbred horse

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studs located in Australia and New Zealand agreed to participate in the study, resulting in a sample containing 299 weanling and 1004 yearling Thoroughbred horses. The average ages of the weanling and yearling research cohorts were 10.3 ± 1.9 and 15.5 ± 1.7 months (mean ± standard deviation), respectively. Horses from New Zealand accounted for 22% ($n = 67$) of the weanlings and 54% ($n = 538$) of the yearlings.

Diagnostic report data

Each stud provided written diagnostic reports summarising findings from sets of weanling and/or yearling radiographs. Reports for weanlings were based on radiographs submitted with each horse when it was presented for sale as a weanling, or on weanling "survey" radiographs that were taken to identify horses requiring corrective surgery prior to sale. Reports for yearlings were based on the radiographs submitted with the horse when it was presented for sale at a yearling auction. When more than one set of yearling pre-sale radiographs were available for a horse, only diagnostic report data based on the latest set of radiographs were used. Each report was authored by one of 16 experienced (at least 5 years of equine practice and at least 5 years of experience interpreting weanling and yearling radiographs, over 100 reports/year) equine veterinarians, based on a set of radiographs taken by the veterinarian's own practice. All sets of radiographs were commissioned and paid for by the participating studs.

The radiographic projections on which each written report was based were a standard set, suitable for submission to yearling sale X-ray repositories in Australia or New Zealand (Inglis Bloodstock, 2014b). This standard set contains a minimum of 34 projections, and is intended to allow veterinarians to detect the majority of skeletal lesions in the limb joints (Jackson et al., 2009). Table 1 describes the joints and anatomical sites within each joint used to categorise the location of a lesion.

Findings from each written diagnostic report were entered into a MySQL database (MySQL Community Edition (GPL) 5.0.77). When the presence of a lesion was indicated in a report, both the site of the lesion (lesion site; Table 1) and the phenotype of the lesion (lesion type; Table 2) were recorded. With respect to any combination of lesion type and lesion site, the binary status of each horse (0 = unaffected, 1 = affected) was also determined. Some horses had more than one affected site. Many reports did not consistently state lesion size or depth, resulting in the exclusion of lesion size and depth from all analyses. The absence of consistent data regarding lesion size or depth also precluded the use of ordinal or other scales that could indicate lesion severity.

Weanling vs yearling radiographs

In some instances ($n = 84$), written reports describing findings in a single horse as both a weanling and a yearling were available. These reports were used to determine if there were changes in diagnosis as the horses matured from weanlings to yearlings. Measures of association and tests of independence for weanling versus yearling were carried out on paired count data for particular lesion types occurring at particular anatomical sites. Using the statistical package R (version 2.9.1), Gwet's AC_1 statistic was chosen to quantify association as it provides a chance-corrected estimate, can be used on categorical data, and has less bias than kappa or pi statistics when the prevalence of a trait is particularly high or low (Gwet, 2008; R Core Development Team, 2014). It is a measure from 0 to 1, with 1 indicating perfect association. Fisher's exact test for count data was used to test for independence between weanling and yearling diagnoses. These statistics were estimated for 22 traits where more than 10 of the 84 horses were affected as weanlings, and more than 10 of the 84 were affected as yearlings.

Table 1
Lesion sites within each region used to categorise lesion location.

Joint	Common name	Lesion site
Carpal	Front knee	Any location
Metacarpophalangeal	Fore fetlock	Sagittal ridge of the third metacarpal bone
		Proximal palmar/plantar first phalanx
		Proximal dorsal first phalanx
		Any other location
Metatarsophalangeal	Hind fetlock	Sagittal ridge of the third metatarsal bone
		Proximal palmar/plantar first phalanx
		Proximal dorsal first phalanx
		Any other location
Tarsocrural	Hock	Lateral trochlear ridge of the talus
		Medial trochlear ridge of the talus
		Distal intermediate ridge of the tibia
		Medial malleolus of the tibia
		Any other location
Femorotibial and femoropatellar	Stifle	Lateral trochlear ridge of the distal femur
		Medial trochlear ridge of the distal femur
		Medial femoral condyle
		Any other location

Table 2
Lesion types.

Lesion type	Description
Osteochondritis dissecans	Displaced or non-displaced radiodense fragments overlying irregular radiolucency at the bone margin
Marginal bone lysis	Irregular radiolucency at the bone margin, occurring most frequently on a bony ridge that is part of an articulating joint surface
Bone chip(s) or fragment(s)	Small displaced or non-displaced radiodense fragments indicating calcified tissue that has separated from the bone
Subchondral cystic lesion	Radiolucency contained beneath the bone surface, often approximately spherical in shape, sometime with a visible cloaca joining the lucency to the joint surface
Marginal bone lysis	Radiolucency showing smooth flattening of a bony ridge that is part of an articulating joint surface
Osteophytes or enthesiophytes	Bony growths that occur due to joint inflammation or subchondral bone damage. Osteophytes can occur on any bone surface while enthesiophytes occur at sites of insertion of soft tissue structures including muscles and ligaments
Bone modelling	The formation of new bone tissue other than osteophytes or enthesiophytes, generally reported as occurring on an articular surface, indicated radiographically as surface irregularity, localised radiodensity or tide marks
Bone collapse or wedging	Specific to the tarsocrural joint, the collapse or partial collapse of the third and/or central tarsal bones

Results

Table 3 summarises the number of affected weanlings for each lesion type at each site (with left and right limbs pooled). Table 4 provides similar information for yearlings. Prevalence and distribution of skeletal lesions were very similar between the weanling and yearling populations. Overall, 69.9% of weanlings and 64.5% of yearlings were reported as having one or more skeletal lesions (Tables 3 and 4).

There were moderate to very strong associations ($AC_1 = 0.644$ to 0.967) between a horse's status as a weanling and a yearling for all skeletal lesions. No horses developed new lesions as yearlings when they were found to be unaffected as weanlings, and some lesions present in weanlings had healed by the time the horse was radiographed as a yearling. It is important to note that weanlings did not undergo any surgery prior to being radiographed as yearlings. Weanling surveys were to identify horses requiring treatment, which could be put in lighter condition to facilitate a lesion resolving without additional treatment (injections for cysts or for example surgical debridement of a lesion) as thought appropriate by the stud manager, owners or veterinarians. In the metacarpophalangeal and metatarsophalangeal joints of yearlings and weanlings OCD (osteochondritis dissecans) at the SRMC3 (sagittal ridge of the third metacarpal bone) diminished from 8% in weanlings to 6% in yearlings (Table 5). Additionally, FLAT (flattened ridge) of the SRMC3 showed a decrease from 6% in weanlings to 2.6% in yearlings. This association between weanling and yearling results is supported by Fisher's exact test for all diagnoses where a horse's status as a weanling and a yearling were shown not to be independent of each other (all $P < 10^{-6}$). It is important to note that this relatively strong association between weanling and yearling results is not inconsistent with some traits showing a slight decrease from weanlings to yearlings. For the majority of traits, the incidence is the same in both groups, and where they do differ, the difference is small and in the same direction.