Flexural limb deformities in a cohort of Thoroughbred foals on commercial stud farms

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Introduction

The production focus of the New Zealand Thoroughbred breeding industry is the generation of successful racehorses which are marketed for sale as a yearling (Fennessy 2010). The return on investment is largely influenced by the ability to sell to international buyers and this, is in turn, influenced by the auction sales through which the yearling is marketed (Waldron et al. 2011). Selection into the different sales categories is dependent on the pedigree and physical appearance (mature height and correctness of conformation). The focus by purchasers on conformation, and limb conformation in particular, may be due to musculoskeletal injury accounting approximately one third of lost training days and the industry perception of an association between certain conformations and a predilection to injury (Perkins et al. 2005).

Thus, there is considerable focus by breeders on optimising the growth rate of the foal and the presentation of a foal with correct conformation. Poor or incorrect conformation can be attributed to acquired or congenital deformities. Acquired deformities are often associated with an acute event or in some cases associated with rapid growth rates, and because of this, can be mitigated by changes in management practice. The causes of congenital deformities are poorly understood, and as such not easily prevented.

The management of congenital limb deformities requires rapid decision making by the breeder within the first week(s) post-partum due to the rapid growth of the Thoroughbred foal (Morel et al. 2007) and the relatively small developmental window in which the foal is responsive to conservative or aggressive treatment of the limb deformity. It is, therefore, important to obtain data on the risk factors for limb deformities, the range of severity of limb deformities present and the responsiveness of the limb deformities to the common treatments routinely used in the commercial Thoroughbred industry.

Materials and methods

Data were collected from a convenience sample of five commercial Thoroughbred stud farms (farms A-E); one in the South Auckland and four in the Waikato region. Farm staff were asked to score all foals at birth and to provide additional scoring where possible during/after treatment, at two weeks and six weeks of age.

Each farm was visited twice before the official start of breeding season (1 August) initially to discuss the study protocol and obligations, and then a second visit for training on limb-evaluation protocols and data recording and management. All farms utilised the same on-farm recording systems (*pro-forma* data-recording sheets and standard operating procedures) for recording limb deformity data. Data were collected from foals at birth (usually within 0-24 hours postpartum), 2 weeks, and at 6 weeks of age, to reflect key developmental timeframes and ease of assessment within standard stud farm-management protocols.

Scoring systems:

The *pro-forma* grading sheets permitted identification of the site (leg and joint affected) of the flexural deformity(s) and respective score for the contracture or laxity observed. Contracture deformities were graded using a three-point scale describing the magnitude of contracture (from normal to entire sole of hoof off the ground). Laxity was described using a four-point scale quantifying the magnitude of the laxity (normal to hoof completely off the ground and the foal standing on the caudal aspect of the metacarpophalangeal (fetlock) joint). A three-point scale was used to quantify the effect of the deformity(s) on the foals ability to stand and locomotor capability. These grading systems were adapted from previous descriptions (Adams & Lescun 2011; Lescun & Adams 2011) and the master scoring sheet contained both a written description and visual images (diagrams and pictures) to provide clear delineation among scores.

Data management and statistical analysis

Study personnel visited each farm fortnightly to assist with data collection. Completed data sheets were entered into a customised Microsoft access database. Data were exported to Microsoft excel or Stata v12 (StataCorp LP, Texas, USA) to screen for errors using simple descriptive statistics and exploratory plots. After screening data were tested for normality using the Shapiro-Wilks test. Parametric data are presented as means ± standard error, non-parametric data were tested using Kruskal Wallis or Wilcoxon rank sum test and presented as median and InterQuartile Range (IQR). All analysis were performed using Stata v12 (StataCorp LP, Texas, USA).

Results

Across the five farms, data were recorded for a selected population of 203 foals within the first 48 hours after birth. Of these foals, 135 (67%) were observed to have one or more flexural deformities present (multiple legs or sites). Foals presented with laxity (87/135, 58%) more often than with a contracture (57/135, 38%), nine foals presented with multiple deformities (contracture and a laxity). Six foals (4%) were recorded as being "back at the knee".

Laxity was most often identified in the hind limbs (69/135) and most of those affected were affected bilaterally (58/69). Fewer affected foals were recorded as having laxity in the forelimbs (40/135) with most bilaterally affected (33/40). Approximately 22% (22/109) foals had laxity recorded in both the fore- and hindlimbs.

Contracture was severe enough to alter the hoof ground contact in 28 foals. There was equal distribution of fore- or hindlimb or for bilateral or single limbs affected. The metacarpophalangeal joint was more commonly affected by contracture than the carpus (Table 1).

Table 1 The number of cases of contracture in the carpal and fetlock regions scored 2 or 3 (out of a 3 point scale) observed in foals between birth and 2 days of age. The number of foals affected bilaterally is shown in brackets.

	Affected Limb				
Location	LF	RF	LH	RH	Total
Carpus	13 (13)	13			26
Fetlock	4 (3)	3	17 (7)	16	40

The majority of the flexural limb deformities (FLD) recorded were moderate for both laxity and contracture. The median score for legs with laxity was mild (2 IQR 2-2). The median score for contracture affecting hoof ground contact was moderate (2 IQR 2-3) and at the joint (carpus or matacarpophalangeal) the median score was moderate 2 (IQR 2-2).

Within the dataset, more male foals were recorded as having a FLD (73/92, 79%) than filly foals (61/100, 56%). The gestation length for all the foals was 347 ± 9 days. There was no significant difference in the median time to expel placenta for mares with foals with limb deformities (30 minutes; IQR 20-59) and those with foals with no limb deformities (35 minutes; IQR 25-60) (P=0.28). Foals scored clean at birth took a median time of 35 minutes (IQR 27-50) to stand following birth similar to that of foals with a flexural limb deformity (40 minutes; IQR 30-50; P=0.65). There was no significant difference in the time to suckle between foals with limb deformity and those without (P=0.379).

There was a within season bias in the frequency of foal data recording by farm staff. More foals were recorded by farm staff early in the foaling season than were subsequently scored later in the season during the busy months of October and November. There was no effect of birth month on the percentage of foals scored with a FLD. Most of the foals (151/203, 74%) were from mares aged <12 years old when served in the 2012/2013 season. There was a significant association of mare age and a higher percentage of foals scored with a FLD; 62% (93/151) of mares aged <12 had foals with FLD vs. 79% (41/52) of mares ≥12 years of age (P=0.024).

Mare and foal treatment and movement decisions were made by the foaling and stud managers on 3/5 (60%) farms, one farm relied mainly on veterinary opinion and on one farm the decision maker was dependant on the severity of the deformity. On all farms all foals were routinely kept in small individual paddocks (0.128 ha) 3/5 (60%) or loose boxes 2/5 (40%) for the first two days post-partum. Foals with any limb deformity were kept in loose boxes until improvement was shown on 3/5 (60%) farms. The remaining farms (2/5) altered the confinement strategy based on the type and severity of the limb deformity; foals with contracture remained in small paddocks where possible (only foals knuckled over or unable to stand were in loose boxes), while those with laxity were routinely boxed. When at pasture, mares and foals were kept in mobs of six to 10 mares in 1 – 2 ha paddocks.

A subset of foals with any FLD score (n=69) had follow-up data recorded. The majority of foals at follow-up had an improvement in score (64/69, 93%). The majority of foals previously identified with laxity were subsequently graded as clean at revisit (90/97 legs). A similar trend was observed with the contracture scores, with the majority of hoof ground contacts subsequently recorded as normal (16/17 foals). At the joint 45/51 were subsequently recorded as being normal.

Discussion

Prospective data collection on commercial equine (farming) operations provides the opportunity to collect "real world" data at the industry coal face but also faces the challenges of commercial constraints on time and the impact this has on time available for data collection and the possible bias this may create. The influence of time constraints on data collection were observed in the bias of the foals enrolled in the study, with the number of foal being evaluated and recorded decreasing as the breeding season progressed. It would also appear that miscommunication between researchers and farm staff led to some pre-selection of foals with FLD and this over-representation precluded the estimation of the prevalence of FLD in this population. However, this does not negate the ability of this data to provide descriptive epidemiological data on FLD observed on commercial Thoroughbred-breeding operations in New Zealand, the management of these foals and any subsequent changes in FLD score.

The gender effect identified in the current study has limited biological plausibility and is likely to reflect some of the effects of the selection bias. The current economic pressures in the New Zealand Thoroughbred-breeding industry means colt foals are worth considerably more than

filly foals of similar pedigree. This greater economic worth of colt foals translates to some differences in subsequent management practices, and it may be the greater scrutiny of the conformation of colt foals and subsequently more conservative management of them that led to more colt foals being identified as having mild or moderate FLD and being included in our data set.

The commercial pressures within the New Zealand Thoroughbred breeding industry constrain the age profile of the national broodmare herd, the majority of mares reaching the end of their commercial productive career around 12 years old (Rogers et al. 2014; Rogers et al. 2009). This age distribution was also observed with the farms in this study. Within the literature there is a suggestion that older mares tend to have more foals with extensor and flexor limb deformities (Platt 1979). It is possible that mare age may be associated with a higher percentage of foals with FLD. However, selection bias may again add to this over representation in the >12 year old mare category in our data. If a farm retains a mare over the age of 12 years she would be a proven "commercial" broodmare and, hence, her foals will be of greater value and similar to the colt foal effect are likely to be subject to greater scrutiny and conservative management.

The management of the foals during the first days and weeks post-partum was similar to previous reports of commercial foal management in New Zealand (Rogers et al. 2007). Confinement of the mares and foals in the first few days post-partum is common practice to provide the opportunity to intensively observe the early neonate and provide the chance for the foal to strengthen before management in larger paddocks. Access to free exercise is important for the stimulation of the neonates musculoskeletal system so that it is prepared for a career as an equine athlete (Rogers et al. 2012). When the foal presents with a FLD, restriction of exercise is often the initial conservative treatment applied and was successful with the predominately moderate FLD identified in this study.

Within the study there were few foals documented with severe FLD and the majority of the FLD documented were mild or moderate. This distribution of scores reflects some of the debate as to what is the "normal" range of neonatal conformation within the first few days post-partum. The lack of association of gestation length with FLD indicates that there may be a range of flexural presentations that are normal for Thoroughbred foals and that many of the mild and moderate scores allocated may actually just be within this range. Allocation of scores at the lower end of the scale, even with clear semi-objective parameters, is often difficult and suffers from lower inter-observer agreement than the more obvious FLD at the higher end of the scale. The large cluster of horses in the mild and moderate category may be a reflection of this lower precision at the lower end of the scale (i.e. false positives) and a conservative management approach taken by farm staff with animals of high commercial value.

Conclusion

Despite possible pre-selection of foals by farm staff, the majority of FLD evaluated were mild or moderate and resolved with conservative treatment (confinement). The number of mild cases and the rapid resolution indicates that many FLD at the lower end of the severity scale may represent the normal variation in flexural presentations in the neonatal foal.

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