THE INCIDENCE OF DEVELOPMENTAL ORTHOPEDIC DISEASE (DOD) ON A KENTUCKY THOROUGHBRED FARM

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Summary

The incidence of developmental orthopedic disease on a commercial Thoroughbred farm was studied over a four year period. A total of 271 foals were monitored. DOD was diagnosed in 10% of the foals. Fetlock OCDs tended to occur before 180 days of age while hock, shoulder and stifle OCDs occurred around 300-350 days of age. Foals that developed hock and stifle OCDs as yearlings tended to be large foals at birth that grew rapidly from 3 to 8 months. These foals were heavier than the average population as weanlings. Foals that developed fetlock OCDs before 6 months of age were born early in the year (January, February or March). The results of this study suggest that growth rate and management may affect the incidence of certain types of DOD.

Introduction

Developmental orthopedic disease (DOD) is a term used to describe a group of diseases that affect the skeleton of growing horses. These include physitis, osteochondrosis, osteochondritis dissecans (OCD), wobbler syndrome and acquired flexural deformities. Although not a new problem, DOD captured the attention of horse breeders in 1985 when a survey conducted by Ohio State University suggested that many of the orthopedic problems in young horses were the result of nutrient deficiencies or imbalances (Knight, *et al*., 1985). Major changes were made in the way most horse feeds were formulated, with much higher levels of trace mineral fortification added to the diets of pregnant mares and young growing horses. There seemed to be a reduction in certain types of DOD with these dietary changes, but the problem did not go completely away. Why has trace mineral supplementation not proven to be the panacea that breeders had once hoped it would be? What other factors play a role in DOD? This paper will summarize the incidence of DOD on a large Thoroughbred farm over a four year period, evaluating various factors which may play a role in the DOD syndrome.

Materials and methods

Over a four year period (1991-1994), the incidence of developmental orthopedic disease was monitored on a single large commercial Thoroughbred farm in Kentucky. During this period, the farm produced a total of 271 foals. Foals were weighed on a portable electronic scale monthly. For the purpose of this study, developmental orthopedic disease was defined as osteochondrotic lesions occurring in either the fetlock, hock, shoulder or stifle. Lesions were initially diagnosed radiographically after a foal displayed either lameness or joint effusion. Often this diagnosis was confirmed by arthroscopy. Other manifestations of DOD such as physitis, acquired contracted flexor tendons and angular limb deformities were not included in this study since they were more difficult to quantify. No foals were diagnosed as wobblers during this four year period.

This farm used a single grain mix for brood mares, weanlings and yearlings. This grain mix consisted of oats, molasses and a protein/vitamin/mineral supplement pellet. The grain mix contained 15.5% protein, 1.0% Ca, 0.81% P, 144 ppm Zn, 59 ppm Cu and 0.5 ppm Se. Brood mares were fed 3-5 kg of the grain mix during pregnancy and 4-6 kg during lactation. Foals were first offered grain starting at 90 to 120 days of age. From 90 days until weaning (at 5 months), the foals received grain at a level of intake equal to 0.5 kg per month of age. At weaning, the foal's grain intake was increased to 3 kg/day. Grain intake for the weanlings and yearlings was then adjusted based on growth rate and body weight, but averaged between 3 and 5 kg/day until the yearlings were sold or sent away for training. In certain instances, a weanling's or yearling's grain intake might fall below 3 kg/day. When this happened, the protein/vitamin/mineral pellet was supplemented at a level equal to 0.33 kg of pellet for each 1 kg of grain intake below 3 kgs.

Mares with foals born before April 15 were kept in box stalls from 15:00 in the afternoon until 8:00 the following morning. During the day, the mares and foals were housed in small grass paddocks (1-2 hectares). After April 15, mares with foals older than 4 weeks stayed out during the night in large grass paddocks (25-50 hectares) and were kept in box stalls between 8:00 and 15:00. The mares were fed their grain in two meals while in their box stalls. The paddocks housing the mares and foals were well drained and level, but the ground could become quite hard during dry weather or when frozen.

During the winter months, the mares and foals received a grass/legume hay free choice both outside and while in their stalls. During the spring, summer and fall months, the majority of the horses' forage intake came from pasture. Table 1 contains the average composition of the supplement pellet, grain, hay and pasture from this farm.

Table 1. NUTRIENT COMPOSITION OF GRAIN, HAY AND PASTURE.

Nutrient	*Supplement*[1] *pellet*	*Grain*[1] *mix*	*Mixed*[1] *hay*	*Fall*[2] *pasture*	*Spring*[2] *pasture*
Crude protein (%)	25.00	15.50	12.10	16.00	16.50
DE (MJ/kg)	11.68	11.95	8.27	9.20	10.11
Calcium (%)	2.57	1.00	0.82	0.55	0.48
Phosphorus (%)	1.73	0.81	0.20	0.30	0.43
Zinc (ppm)	360.00	144.00	24.00	35.00	28.00
Copper (ppm)	143.00	59.00	9.00	12.00	15.00
Manganese (ppm)	228.00	105.00	75.00	70.00	75.00

[1]as fed basis
[2]100% DM basis

Results

Tables 2 and 3 summarize the frequency of DOD as a function of sex, month and year of birth, age and lesion location. 30% of the foals in this study were born in January or February and 30% were born in March. 23% of the foals were born in April and 17% of the foals were born in May or June. DOD was divided into four categories based on the location of the lesion and the age at diagnosis. Lesions in the fetlock were divided into early lesions (102 ± 48 days) and late lesions (379 ± 140 days), while lesions of the stifle and shoulder were grouped together. Hock lesions were grouped separately.

Table 2. FREQUENCY OF DOD (NUMBER AND PERCENTAGE OF TOTAL FOALS BORN EACH MONTH)

Birth Month	*Total foals*	*Total No. DOD*	*% DOD*	*Early fetlock (total)*	*Early fetlock (%)*	*Late fetlock (total)*	*Late fetlock (%)*	*Stifle & shoulder (total)*	*Stifle & shoulder (%)*	*Hock (total)*	*Hock (%)*
Jan-Feb	81	9	11.0 %	3	3.7 %	1	1.2 %	1	1.2 %	4	4.9 %
March	81	11	11.1 %	3	3.7 %	2	2.5 %	4	4.9 %	2	2.5 %
April	62	2	3.2 %	0	0 %	0	0 %	0	0%	2	3.2 %
May-June	47	5	10.3 %	0	0 %	0	0 %	1	2.1 %	4	8.5 %
TOTAL	271	27	10.0 %	6	2.2 %	3	1.1 %	6	2.2 %	12	4.4 %
Colts	136	13	48.1 %	1	16.6 %	2	66.6 %	4	66.6 %	6	50 %
Fillies	135	14	51.9 %	5	83.3 %	1	33.3 %	2	33.3 %	6	50 %

A total of 10% of the foals in this study suffered one of these types of lesions. The incidence of total lesions was evenly distributed between January-February, March and May-June foals. April foals had a lower incidence of total lesions (3.2%) ($p<0.05$)

and all of these lesions were confined to the hock. Fetlock lesions only occurred in January-February and March foals. Early fetlock lesions occurred in more than one joint 83.3% of the time. Stifle, shoulder and hock lesions tended to occur most often in a single joint.

Table 3. AGE OF DIAGNOSIS, NUMBER OF JOINTS AFFECTED, AND DISTRIBUTION BY YEAR

	Early fetlock	*Late fetlock*	*Stifle and shoulder*	*Hock*
Age of diagnosis days (mean ± SD)	102 ± 48	379 ± 140	335 ± 102	304 ± 100
Single joint (%)	16.7 %	66.6 %	83.3 %	75 %
Both joints (%)	83.3 %	33.3 %	16.7 %	25 %
1991 (number)	1	0	0	1
1992 (number)	1	1	3	5
1993 (number)	1	2	1	4
1994 (number)	3	0	2	2

The body weights of the affected foals are graphed relative to the Kentucky average in figure 1. Foals with early fetlock lesions tended to be of average size and their growth rates were similar to the average of a large population of Thoroughbred foals raised in Kentucky (Pagan, *et al*., 1996). Foals that were diagnosed with fetlock lesions at a later age tended to be of normal size during the first 120 days, but grew heavier than the Kentucky average after weaning. Those foals that developed hock OCDs averaged 5 kg heavier than the Kentucky average at 25 days of age. By 240 days, these foals were 14 kg heavier than the population average. Foals that developed stifle or shoulder lesions averaged 5.5 kg heavier than the Kentucky average at 25 days of age and 17 kg heavier at 120 days of age. By 300 days of age, these foals were 12 kg heavier than the Kentucky average.

Discussion

The nutrition program on this farm was carefully monitored and both pregnant mares and growing foals received adequate quantities of both macro and micro minerals throughout the year (Table 1). In spite of this, this farm still experienced a 10% incidence of DOD. Therefore, other factors besides mineral intake must have played a role in the development of skeletal lesions in these foals.

Dr. Roy Pool, a pathologist from the University of California at Davis veterinary school, has recently addressed the question of what is the primary cause of skeletal lesions in growing horses (Pool, 1995; 1993). His conclusions may explain why dietary changes have not totally eliminated DOD from horses.

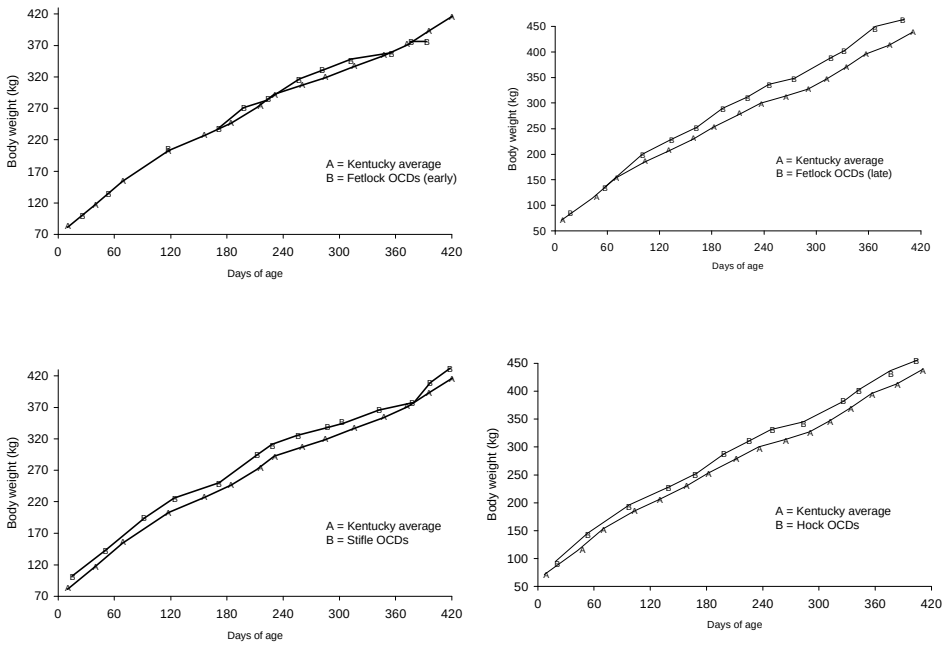

Figure 1. Body weights of DOD foals compared to Kentucky average

Dr. Pool maintains that early explanations of DOD in horses were based on studies in other animals such as swine and poultry. In these animals, osteochondrosis is a systemic disease affecting joints scattered throughout the body. It is largely genetic and can be enhanced or suppressed through nutritional manipulation. These are not the "typical" types of lesions seen in horses. In horses, lesions usually occur in specific joints such as the stifle, shoulder, hock and fetlock. Usually, only one or two joints are affected and if two are affected, they normally occur bilaterally in the same joint. For instance, one stifle may have a large lesion causing lameness while another smaller, asymptomatic lesion may be found in the other stifle. This was the pattern of lesions seen in the foals on this farm.

Dr. Pool maintains that these types of lesions are most likely the result of excessive biomechanical forces exerted on otherwise normal cartilage. These forces disrupt the blood supply to the cartilage and prevent its conversion to bone. There are several possible reasons why normal cartilage could not withstand these forces:

1) Specific joints have "windows of vulnerability" when they are particularly susceptible to damage. At this point in development, perhaps there is not adequate underlying bone to support the weight and force exerted on the joint. For example, stifles and hocks seem to be most vulnerable at 6 to 8 months of age. At this point, excessive force may damage the underlying bone and vascular

supply to the cartilage. The cartilage does not ossify and a lesion forms. The clinical expression of the lesion may not occur until later when the lesion becomes severe enough to cause lameness or swelling.

The average ages of diagnosis of hock and stifle lesions in this study were 304 days and 335 days, respectively. These foals grew faster and were heavier than the Kentucky average. Perhaps this extra weight caused excessive forces on otherwise normal cartilage leading to the development of a lesion. Kentucky foals born early in the year enter this 6 to 8 month age period at a time when pasture quantity and quality increase during the months of September and October. Increased intake of high quality pasture may have contributed to the rapid growth rates seen in these large foals.

2) Foals with genetic potential for rapid skeletal and muscle development may simply develop more muscle mass than the rapidly growing bone can support. Again, the foals that developed hock and stifle lesions may have fit this category.

3) Foals that don't have the genetic potential for rapid growth become fat because of excessive energy intake and overload the joint. This was probably not the case in the present study, since each foal's body condition was regularly evaluated and individuals that were deemed too fat had their grain intake restricted.

4) A conformation defect creates an uneven distribution of force upon the joint surface. No records were kept of conformation defects, so this factor cannot be adequately addressed in the present study.

5) Foals that have been confined due to illness do not develop enough subchondral bone to support their weight. When they are finally returned to the herd, the bone is too weak to support a normal amount of exercise and the joint cartilage collapses.

6) Rapid changes in management that greatly alter the foal's exercise patterns may overload the joint. For instance, foals born early in the year are kept inside for up to 16 hours per day. When the weather improves in April, they are turned out all night with their dams. Often, mares run their foals for long periods in the paddock and the foal becomes fatigued. At this point, joints may be more vulnerable to injury. This may have been a factor in the foals which developed early fetlock lesions. All of the foals that developed early fetlock lesions were born in January, February and March. These foals were all housed indoors at night until mid April. Perhaps these foals did not develop adequate subchondral bone to withstand the forces placed on it once they were allowed greater amounts of exercise as the weather improved.

Osteochondrosis involving the cervical vertebra often affects multiple sites randomly and may be considered an "atypical" type according to Dr. Pool. This type of lesion

is often responsible for "wobbles" in foals and it may result from a mineral deficiency or imbalance. None of the horses in the present study were diagnosed with this type of OCD lesion, suggesting that macro and micro mineral intake were adequate.

Conclusions

The etiology of developmental orthopedic disease is almost certainly multifactorial. A primary focus of much of the research concerning DOD has been on mineral intake and balance. While minerals are certainly important for skeletal development, mineral deficiencies or imbalances are not the only cause of DOD. In the present study where mineral intake was carefully monitored, 10% of the foals still developed DOD.

A major factor to consider in the etiology of DOD is whether the lesion develops because of a failure in proper cartilage formation and maturation or whether the lesion develops in normal cartilage. The types of lesions seen in the present study may have been the result of excessive biomechanical forces exerted on otherwise normal cartilage. Early fetlock OCDs may have resulted from inadequate subchondral bone formation due to restricted activity in foals born early in the year and housed indoors at night. Hock and stifle lesions may have occurred in heavy foals that grew rapidly after weaning.

The present study raises several intriguing questions about which factors are involved in the development of orthopedic disease under commercial management conditions. Controlled research is necessary to determine if management of growth rate and exercise can reduce the incidence of developmental orthopedic disease in horses.

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