The Effect of Radiographic Changes in Thoroughbred Yearlings on Future Racing Performance

Albert J. Kane, DVM, MPVM, PhD; C. Wayne McIlwraith, BVSc, PhD; Richard D. Park, DVM, PhD; Norman W. Rantanen, DVM, MS; James P. Morehead, DVM; Larry R. Bramlage, DVM, MS

Palmar supracondylar lysis of the third metacarpus, enthesophytes on the proximal sesamoid bones, proximal dorsal P1 fragments in the hind fetlocks, and dorsal medial intercarpal joint disease in Thoroughbred yearlings are associated with decreased likelihood of starting at least one race during the 2- or 3-year-old years. Authors' addresses: Equine Orthopaedic Research Laboratory, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, CO 80523 (Kane, McIlwraith, Park); P.O. Box 1351, Fallbrook, CA 92028-1351 (Rantanen); Equine Medical Associates, P.O. Box 13116, Lexington, KY 40583 (Morehead); Rood and Riddle Equine Hospital, P.O. Box 12070, Lexington, KY 40511 (Bramlage). © 2000 AAEP.

1. Introduction

Radiographic changes found at the time of Thoroughbred yearling sales have a substantial impact on the sale process but can be difficult to interpret. Consignors want to sell their yearlings at a fair market price, and buyers want to identify yearlings with orthopedic problems that are likely to influence future racing performance so new purchases have every chance of reaching their full potential. The sale veterinarian is often asked to identify radiographic changes that could be a future problem without unjustifiably declaring a horse unsuitable for purchase.

There are several reports describing the influence of radiographic changes on future racing performance in Standardbreds. However, comparable information is limited in Thoroughbreds. Spike et al. reported significantly fewer starts and lower total earnings for horses with more than two abnormally shaped linear defects in a proximal sesamoid bone. Most of the interpretation of yearling sale films is still based on the clinical experience of the practitioner with horses that have shown clinical signs or required surgery when in race training.

The objectives of this historical cohort study were to identify radiographic changes in the fetlocks, proximal sesamoid bones, carpi, stifles, tarsi, or forefeet of Thoroughbred sale yearlings that are associated with future racing performance; the occurrence of orthopedic problems; and the need for surgery. This abstract is focused on identifying the radiographic changes in Thoroughbred yearlings that are
associated with the likelihood of starting at least one race during the 2- or 3-year-old years.

2. Materials and Methods

Radiographs from 1162 pre- and post-sale purchase examinations conducted at the 1993–1996 Keeneland and Fasig-Tipton yearling sales were obtained from a private practice (Morehead) serving buyers and consignors at these sales. Joint examinations included fore fetlocks (DP, flexed LM, DLPMO, and DMPLO views), hind fetlocks (DP, LM, DLPMO, and DMPLO views), carpi (LM, DLPMO, and DMPLO views), tarsi (DP, DLPMO, and DMPLO views), stifles (LM view), and forefeet (DP and LM views). Joint series with missing or non-diagnostic films for any view of a left and right pair were not included in the analysis.

All of the films were evaluated independently by two authors (Kane and Rantanen) in a blinded manner and radiographic changes present were categorized by location and the type of lesion (e.g., flattening, lucency, fragment, etc.). Discrepancies between these two interpretations were resolved using a third assessment (Park) and the consensus opinion to decide the final categorization of changes. Yearlings were then classified as having a radiographic change if changes were present in either the left or right limb. If both limbs were affected, the higher (more severe) category was used to classify the yearling. For variables related to vascular channels in the proximal sesamoid bones, the sesamoid with the highest total number of vascular channels (the “worst” sesamoid) was used to classify the yearling. Fore fetlocks and proximal sesamoid bones were analyzed separately from hind fetlocks and sesamoid bones.

Racing performance data for the 2- and 3-year-old years was obtained from the Jockey Club Information Systems for each horse included in the study. Horses without an official race record were assigned a value of zero starts. The number of race starts during the 2- and 3-year-old years combined was categorized as YES, the horse started at least one race or NO, the horse did not start a race during its 2- or 3-year-old years. Sale price was obtained from the Keeneland and Fasig-Tipton sale companies. For yearlings that did not meet their reserve price, the amount of the final bid was used. Yearlings withdrawn from the sale prior to bidding were assigned a sale price of zero dollars.

Contingency tables were used to crosstabulate horses by radiographic variables and whether the horse started a race during the 2- or 3-year-old years. Values reported here are the percent of horses that started at least one race and the number of horses that started (starters) divided by the total number of horses with the same radiographic classification. Separate logistic regression models for each variable were used to obtain likelihood ratio chi-square p-values adjusted for sale price to test for an association between the presence or grade of a radiographic change and starting a race while simultaneously controlling for the potential confounding effect of sale price.

3. Results

The 1162 yearlings included in the study represent 7% of all yearlings sold at the same sales during this time. Six hundred seventy-three (58%) were colts and 489 (42%) were fillies. Most (1074, 92%) of the yearlings were actually sold with only 80 (7%) not reaching their reserve price and eight (1%) being withdrawn prior to entering the sale ring. The typical price of yearlings included in the study (median $40,000; mean $70,474 ± 2584 SEM) was higher than that for all other yearlings sold at the same sales but not included in the study (median $20,000; mean $45,596 ± 676).

There were 1127 fore fetlock, 1102 hind fetlock, 1130 carpal, 1101 tarsal, 660 stifle, and 300 foot series that were complete and included in the analyses. Overall, approximately 82% of horses without radiographic changes started at least one race during their 2- or 3-year-old years. (This number provides a convenient reference for comparison with most of the percentages of starters among those yearlings with radiographic changes.) The prevalence of radiographic changes in the fetlocks, proximal sesamoid bones, carpi, stifles, and tarsi for both limbs of horses included in this study is detailed in a companion abstract by the same authors.

A. Fore Fetlocks and Proximal Sesamoid Bones

Among radiographic changes observed in the fore fetlock joints, only moderate or extreme palmar supracondylar lysis of the distal palmar third metacarpus had a significant (p = 0.02) effect on the likelihood of starting a race. While 878/1073 (82%) yearlings with no supracondylar lysis and 26/30 (87%) yearlings with slight supracondylar lysis started only 14/24 (58%) with moderate or severe lesions started a race. Fourteen of 18 (78%) yearlings with proximal dorsal P1 fragments started, and all of the five yearlings with proximal palmar P1 fragments started. More than half of the yearlings with subchondral cysts (5/8, 62%) in the distal third metacarpus or proximal first phalanx started, however with these few cases this was not significantly (p = 0.13) different from the 913/1119 (82%) that started without cysts in this location. Size of the cysts did not appear to affect the likelihood of starting as three of the five cysts in starters were greater than 5 mm in diameter. Radiographic changes of the distal dorsal third metacarpus (includes proximal third of the dorsal sagittal ridge) did not have a significant effect on starting (p = 0.28). Compared to the percent (606/749, 81%), of yearlings with no changes at this location that started, 290/347 (84%), yearlings with a “normal” semicircular notch at the most proximal aspect of the dorsal sagittal ridge started, 15/22 (68%) of those with a lucency (Type I lesion) started, and 7/9 (78%) of those with a defect...
and a fragment or loose body (Type II or III lesion)\(^9\) started. Changes recorded on the distal two-thirds of the dorsal sagittal ridge or metacarpal condyles or on the distal palmar sagittal ridge or condyles had little effect on the likelihood of starting a race.

Enthesophytes at the attachments of the suspensory or distal sesamoidian ligaments to the proximal sesamoid bones had a significant (\(p = 0.04\)) effect on the likelihood of starting a race. Only 8/14 (57%) yearlings with enthesophytes on the proximal sesamoid bones started compared with 910/1113 (82%) that started without this change. One of two yearlings (50%) with an apical fracture of a proximal sesamoid bone started while 2/3 (67%) with abaxial fractures and 5/6 (83%) with basal fractures started, however these percentages were not significantly (\(p > 0.4\)) different from the percentage of starters among those without sesamoid fractures. There was no significant difference (\(p > 0.4\)) in the percentage of yearlings that started with elongated or abnormally shaped proximal sesamoid bones or circular lucencies in the proximal sesamoids compared with yearlings without these changes. Most yearlings in this study had two or three vascular channels (range 0–9) in the “worst” proximal sesamoid bone. No significant (\(p > 0.40\)) association was detected between the number of regular (\(\leq 2\) mm and parallel sides) or irregular (\(> 2\) mm or nonparallel sides) vascular channels or the total number of vascular channels and the likelihood of starting a race.

B. Hind Fetlocks and Proximal Sesamoid Bones

Only 25/36 (69%) yearlings with proximal dorsal P1 fragments in a hind fetlock started at least one race compared with 874/1066 (82%) that started without these fragments (\(p = 0.08\)). Proximal plantar P1 fragments did not appear to have a significant association with starting (\(p = 0.37\)), with 18/20 (90%) yearlings with non-articular fragments and 34/45 (76%) yearlings with articular fragments starting. Only two horses had subchondral cysts in the distal third metatarsus or proximal first phalanx, both started. Similar to the forelimbs, changes of the distal dorsal third metatarsus (includes proximal third of the dorsal sagittal ridge) did not have a significant (\(p = 0.24\)) association with starting. Compared to the 619/768 (81%) yearlings with no changes at this location that started, 254/300 (85%) of the yearlings with a “normal” semicircular notch at the most proximal aspect of the dorsal sagittal ridge started, 15/18 (83%) of those with a lucency (Type I lesion) started, and only 11/16 (69%) of those with a defect and a fragment or loose body (Type II or III lesion) started. Both of the horses with a flattened distal sagittal ridge of the third metatarsus and 13/18 (72%) horses with lucency at this location started. Changes found on the distal plantar aspect of the third metatarsus were not associated with starting. Unlike the forelimbs, supracondylar lysis of the plantar distal metatarsus was not observed on the hind limbs.

Similar to the results from the fore proximal sesamoids, a smaller percentage (9/14, 64%) of yearlings with enthesophytes on the hind sesamoid bones started compared with yearlings without this change (890/1088, 82%), however this difference was not significant (\(p = 0.13\)). Yearlings with elongated or abnormally shaped hind proximal sesamoid bones as well as those with osteophytes or circular lucencies in these bones were just as likely (\(p > 0.47\)) to start as those without these changes. Fracture of the hind proximal sesamoid bones did not appear to affect the likelihood of starting. Twenty-two of twenty-six (85%) with apical fractures started and 3/4 (75%) of those with basal fractures started. Abaxial and comminuted fractures were found in two horses (1 each), and both started. The number of regular and irregular vascular channels as well as the total number of vascular channels in the “worst” hind proximal sesamoid bone were not significantly (\(p > 0.50\)) associated with starting. In fact, 87/102 (85%) yearlings with more than four irregular vascular channels in the “worst” sesamoid started.

C. Carpi

Yearlings with dorsal medial intercarpal joint changes were less likely to start (19/30, 63% started, \(p = 0.02\)) compared with those without these changes. A smaller percentage (13/19, 68%) of yearlings with osteophytosis in the carpal joints started compared with the percentage of starters for yearlings without this change (909/1111, 82%), however this effect was not significant (\(p = 0.17\)). The percentage (183/227, 81%) of yearlings starting with circular lucencies in the palmar ulnar carpal bone was nearly identical to that for horses without these lucencies (739/903, 82%, \(p = 0.68\)). Seven of nine (78%) of the horses with carpal fragments started, this is similar to the percent (915/1121, 82%) of starters among those without fragments. Two horses with subchondral cysts \(\geq 9\) mm in diameter in a carpal bone started, and one horse with a 4 mm cyst did not start. Accessory carpal bone fractures were detected in four horses, all of which started at least one race.

D. Tarsi

Yearlings with osteophyte or enthesophyte formation at the distal intertarsal or tarsometatarsal joint margins were significantly (\(p = 0.03\)) less likely to start a race (147/193, 76%) compared with those without this lesion (753/908, 83%). Similarly, 61/80 (76%) yearlings with subchondral lucency in these joints started compared with 839/1021 (82%) that started without this change. The effect of subchondral lucency, however, was not significant (\(p = 0.19\)). Only 9/13 (69%) yearlings with wedging of the distal tarsal bones started compared with 891/1088 (82%) that started without this lesion (\(p = 0.25\)). Most of the tarsal wedging or collapse that was seen in these sale yearlings was slight. There were no significant (\(p > 0.26\)) differences in the...
percentage of starters for yearlings with changes of the medial malleolus, intermediate ridge of the distal tibia, or lateral or medial trochlear ridges of the talus.

E. Stifles

All four yearlings with flattening of the lateral trochlear ridge of the distal femur started. However, only 24/34 (71%) with lucency, subchondral defects and/or fragments on this location started compared to 330/387 (85%) that started without any changes in this location (p = 0.10). Two horses with lucency, subchondral defects, and/or fragments on the medial trochlear ridge started. One of two horses with lucency of the patella and one horse with fragmentation of the distal patella started. Subchondral cysts on the medial femoral condyle or proximal tibia were not found among the 178 yearlings where these locations could be visualized clearly on the LM view.

F. Forefeet

There was no significant (p = 0.41) association detected between radiographic changes in the feet and the likelihood of starting a race.

4. Discussion

This study identified several radiographic changes in the joints of Thoroughbred yearlings that are associated with the probability of starting at least one race during the 2- or 3-year-old years. It should not be surprising that supracondylar lysis of the distal palmar third metacarpus was associated with decreased probability of starting a race. This lesion is recognized as a sign of chronic inflammation of the fetlock joint, and has been associated with decreased likelihood of returning to function among a group of older horses examined at a veterinary referral center. Enthesophytes are also recognized as an early manifestation of osteoarthritis. This is consistent with the results reported here, that yearlings with this lesion are less likely to start a race during their 2- or 3-year-old years. It is surprising that the number of vascular channels (regular, irregular, or both combined) was not associated with failure to start. A lower average number of starts has been reported for yearlings with more than two abnormal linear defects in a proximal sesamoid bone. There were however only 10 yearlings (2%) in that study that had more than two abnormally shaped linear defects compared with 366/1127 (32%) yearlings in this study. This indicates a substantial difference between the studies in how these criteria were applied. Many of the vascular channels classified as irregular in this study were 2 mm wide with parallel sides for most of their length, but widened into a "V" shape 3–4 mm from the abaxial border.

A large effect on the probability of starting a race was seen with dorsal medial intercarpal joint disease (only 63% started with this lesion). These changes were characterized by a rounded appearance to the radial carpal bone and/or a thickened dorsal cortex, proliferative change, enthesophyte or fragment involving the radial carpal or third carpal bones. All of these changes are characteristic of early osteoarthritis, so it should not be surprising that they affect the probability of starting a race. It is somewhat alarming that a radiographic change as common as osteophytosis/enthesopathy of the distal intertarsal and tarsometatarsal joint margins (affected 193/1101 [18%] yearlings overall) was significantly associated with failure to start. The magnitude of the difference in the percent of starters between those with lesions (76%) and without lesions (83%) however was small.

A significant effect on the ability to start a race was not detected for many radiographic changes that one might expect to influence the future potential of a yearling (e.g., fore fetlock fragments and cysts, sesamoid fractures, OCD lesions of the tarsi or stifles). The reader should recognize, however, that many of these lesions are rare and affected only a few horses in the study. As a result the ability to detect a significant effect if one truly exists (power of the study) is likely to be low for many of these comparisons.

Results of this study should be used in parallel with a clinical impression based on one’s personal experience to best evaluate yearling films. As future studies confirm or refute areas of concern brought to light with this study, a greater foundation of hard evidence on which to base purchase decisions will be built. Further analysis of these and additional data on the development of orthopedic problems and the need for surgery is planned, and a clearer picture of lesions that should be considered significant in the Thoroughbred yearling will develop.

The Yearling Radiograph Study was supported by the AAEP with funds provided by the Keeneland Association, the Fasig-Tipton Sales Company, the Ocala Breeders Sales Company, the AAEP Foundation, Barretts Equine Limited, Blood Horse Publications, and the Jockey Club. The authors thank Fred Arnold, Gary Lavin, Jim Becht, Noah Cohen, the AAEP Research Committee, Gary Carpenter, Clay Murray, Mark Adkinson, Bruce Irwin, Donald Butte, Mike King, Jim zumBrunnen, and the staff of Equine Medical Associates for guidance and technical support.

References and Footnotes

3. Grondahl AM, Gaustad G, Engelstad A. Progression and association with lameness and racing performance of radio-


aJockey Club Information Systems, 821 Corporate Drive, Lexington, KY 40503-2794.
bKeeneland Association, Inc., P.O. Box 1690, 4201 Versailles Road, Lexington, KY 40588-1690.
cFasig-Tipton Company, Inc., 2400 Newtown Pike, Lexington, KY 40583.