Treatment response and athletic outcome of foals with tarsal valgus deformities: 39 cases (1988–1997)

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Objective—To evaluate the response to various treatments and long-term outcome of foals with tarsal valgus deformities.

Design—Retrospective study.

Animals—39 foals with tarsal valgus deformities.

Procedure—Data collected from medical records, included signalment, history, reason for admission, and clinical findings. Radiographic views of the tarsus were evaluated for incomplete ossification of tarsal bones and were classified as normal in appearance, type-I incomplete ossification, or type-II incomplete ossification. Treatment and athletic outcome were documented for each foal.

Results—Radiographic assessment revealed that 22 of 39 foals (56%) had concomitant tarsal valgus deformities and incomplete ossification of the tarsal bones. Eight of 19 foals with tarsal valgus deformities that were treated with periosteal stripping responded favorably. Foals ≤ 60 days old were significantly more likely to respond to periosteal stripping than older foals. Five of 8 foals with tarsal valgus deformities that were treated with growth plate retardation responded favorably. Eleven of 21 foals with long-term follow-up performed as intended. Compared with foals with type-II incomplete ossification, foals with tarsal bones that had a normal radiographic appearance or type-I incomplete ossification were significantly more likely to perform as intended.

Conclusions and Clinical Relevance—Foals with tarsal valgus deformities should have lateromedial radiographic views of the tarsus obtained to assess the tarsal bones for incomplete ossification, which will affect athletic outcome. Because foals with type-II incomplete ossification of the tarsal bones respond poorly to periosteal stripping alone, treatment by growth-plate retardation is recommended. (*J Am Vet Med Assoc* 1999;215:1481–1484)

Angular limb deformities are axial deviations of a limb in the frontal plane. Valgus refers to a lateral deviation of the limb distal to the origin of the deformity.[1] The joint adjacent to the origin of the deformity is used to describe the anatomic location.[1] There are several causes of angular limb deformities, and they can be grouped into 2 main categories, perinatal and developmental.[2] Perinatal factors include incomplete ossification of the bones and laxity of periarticular support structures.[1,2] Developmental factors include nutritional influences, trauma, excessive exercise, and asynchronous growth rates.[1,2]

Several studies have evaluated the response of foals with angular limb deformities to various treatments.[3-6] These studies have focused on the response of carpal and fetlock deformities to hemicircumferential periosteal transection and stripping (periosteal stripping)[3,4,6] or to growth-plate retardation.[5] To our knowledge, reports detailing the response of tarsal valgus deformities to these treatments have not been published.

The purposes of the study reported here were to retrospectively evaluate the treatment response of foals with tarsal valgus deformities, to assess athletic outcome in these foals, and to identify factors that affect prognosis in foals with tarsal valgus deformities. We hypothesized, on the basis of clinical impression, that foals with tarsal valgus deformities do not respond to treatment as favorably as foals with carpal valgus deformities and have a worse prognosis for future performance.

Criteria for Selection of Cases

We evaluated medical records of all foals with tarsal valgus deformities that were admitted to the Texas A&M University Veterinary Medical Center between January 1988 and June 1997. To be included in the study, tarsal valgus must have been diagnosed and determined to be clinically important by the attending clinician.

Procedures

Data obtained from the medical records included signalment, history, owner's initial reason for admitting the foal, and clinical findings. The history was specifically evaluated to determine whether foals were born prematurely or were twins. Foals were considered premature if gestational length was < 320 days.[7] Physical examination findings were documented, and other concurrent angular limb deformities were recorded. The degree of tarsal valgus deformity was obtained from the medical records and was determined on the basis of assessment by the attending clinician, rather than by radiographic evaluation, because of the inability to consistently and accurately measure degree of tarsal valgus deformity from tarsal radiographs. Degree of tarsal valgus deformities were divided into 3 groups, slight (< 5°), moderate (6 to 10°), and severe (> 10°).

Tarsal radiographs were used to assess the degree of tarsal bone ossification. Tarsal bone ossification was classified as ossification that was normal in appearance, type-I incomplete ossification, or type-II incom-

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plete ossification.[8] Type-I lesions had incomplete ossification only with mild collapse (< 30% collapse) of the dorsal aspect of the central or third tarsal bone.[8] The height of the dorsal aspect of the central or third tarsal bone at the point of collapse was compared with the height of the plantar aspect of the affected tarsal bone.[8] Type-II lesions had a more severe form of incomplete ossification, in which there was greater collapse (> 30% collapse) that led to collapse with dorsal protrusion of the affected bone or fragmentation.[8]

Treatment and response to treatment was evaluated for each foal. Treatments consisted of conservative (stall confinement, splints, corrective shoes), periosteal stripping, or growth plate retardation techniques. Growth-plate retardation techniques consisted of screws and wires or screws and plates to bridge the medial aspect of the distal tibial physis. When growth plate retardation was performed, it was routine to also perform periosteal stripping concurrently.

Athletic outcome in regards to owner expectations was also documented for each foal. Follow-up information was obtained by clinical reevaluation or telephone interview with the owners. Owners that could not be contacted by phone were mailed a questionnaire. Data collected included whether angular limb deformities were corrected, evidence of hind limb lameness, and ability to perform athletically as intended by the owner.

Statistical Analyses

Results were evaluated by a 2-tailed Fisher exact test. Categoric data were evaluated on the basis of association of age, degree of tarsal valgus deformity, degree of tarsal ossification (ie, normal appearance, type I, or type II), and treatment (ie, periosteal stripping alone or growth-plate retardation) with correction of tarsal valgus deformity (ie, corrected or not corrected). In foals with concomitant tarsal and carpal valgus deformities, correction of tarsal valgus deformity versus carpal valgus deformity was also evaluated. Degree of tarsal ossification (ie, normal appearance, type I, or type II) with athletic outcome was evaluated. For all analyses, a value of $P \leq 0.05$ was considered significant.

Results

Thirty-nine foals with tarsal valgus deformities were admitted to the hospital during the 9-year study period and met the selection criteria. Distribution of tarsal valgus deformity among breeds was 17 Quarter Horses, 10 Thoroughbreds, 5 miniature horses, 2 mixed breeds, 1 Arabian, 1 Paint, 1 Hanovarian, 1 Trakehner, and 1 mule. Twenty-five were males, and 14 were females; there was a male-to-female ratio of 1.8:1. Age at initial evaluation ranged from 1 day to 16 months, with a median age of 45 days.

Twenty-eight of the 39 foals were admitted because of an angular limb deformities. Six of the 28 were admitted for evaluation because of carpal valgus deformities; the owners were unaware of concurrent tarsal valgus deformities. Eleven of the 28 were admitted for evaluation of the tarsus only. The remaining 11 were admitted for evaluation of the carpus and tarsus. Eleven of the 39 foals were admitted for reasons other than an angular limb deformity.

Ten foals were premature with gestational lengths of < 320 days, and 2 were twins. Ten foals were known to be full term with gestational lengths of > 330 days; physical findings did not suggest prematurity at birth. Gestational length was unknown in the remaining 17 foals.

Degree of tarsal valgus deformity was recorded in the medical records of 23 foals and was made on the basis of clinical impression. Nine foals were considered to have slight tarsal valgus deformity, 11 foals had moderate tarsal valgus deformity, and 3 foals were classified as having severe valgus deformity. Degree of tarsal valgus deformity was not recorded in the medical records of 16 foals. Effect of severity of tarsal valgus deformity on correction was evaluated. Complete follow-up was available for 20 foals. Angular limb deformities were corrected in 5 of 7 foals with slight tarsal valgus deformities, 6 of 10 foals with moderate tarsal valgus deformities, and 1 of 3 foals with severe tarsal valgus deformities. A significant association was not found between the degree of tarsal valgus deformity and whether the angular limb deformity was corrected.

Radiographic assessment revealed 22 of the 39 foals had incomplete ossification of the tarsal bones. Seventeen were classified as having type-II incomplete ossification of the tarsal bones (> 30% collapse with dorsal protrusion or fragmentation).[8] Five were classified as having type-I incomplete ossification (< 30% collapse).[8] Tarsal ossification was normal in appearance in 14 foals, and 3 foals did not have tarsi evaluated radiographically.

Long-term follow-up information on response to treatment was available for 31 of 39 foals. Two foals were euthanatized during initial hospitalization, and 6 foals were lost to long-term follow-up. Therefore, response to treatment was assessed on the basis of the 31 horses with follow-up information.

Nineteen of the 31 foals were treated by periosteal stripping of the lateral aspect of the distal tibial metaphysis. Tarsal valgus deformities were corrected in 8 of these foals, and 11 had minimal to no response. Only 2 of 10 foals with type-II incomplete ossification responded favorably to periosteal stripping alone, compared with a favorable response in 2 of 5 foals with tarsal bones that appeared normal, 2 of 2 foals with type-I incomplete ossification, and 2 of 2 foals that did not have tarsal radiography. In response to periosteal stripping, foals with type-I incomplete ossification appeared more likely, although not significantly, to have the condition corrected than foals with type-II incomplete ossification ($P = 0.091$; $P > 0.05$ may reflect small sample size).

Median age of foals that had angular limb deformities corrected with periosteal stripping was 60 days, compared with 90 days for foals that failed to respond to treatment. There was a significant association between age at treatment and favorable response to periosteal stripping. Foals 60 days old were significantly more likely to have tarsal valgus deformities corrected with periosteal stripping, compared with foals > 60 days old ($P = 0.003$).

Eight foals were treated with growth-plate retardation techniques. Four had undergone previous periosteal stripping alone and were unresponsive; they were reevaluated, and a second surgery was performed for growth-plate retardation. Tarsal valgus deformities were corrected by growth-plate retardation in 5 of 8 foals. Two of 4 foals with tarsal bones that were normal in appearance, 1 of 1 with type-I incomplete ossification, and 2 of 3 with type-II incomplete ossification responded favorably to growth-plate retardation. Three did not respond to growth-plate retardation. Significant associations were not found between the degree of tarsal bone ossification or age and whether the angular limb deformity was corrected following treatment with growth-plate retardation.

Tarsal valgus deformities were corrected in 3 of 6 foals by confinement only in a stall or small paddock. Tarsal valgus deformities had been identified as slight in these 3 foals, which ranged in age from 1 day to 2 months. One foal had ossification of the tarsi that appeared normal, 1 did not have tarsal radiography, and the other had a diagnosis of type-II incomplete ossification at 1 day of age.

Tarsal valgus deformity was corrected in one 12-day-old foal by the use of splints. One foal was treated with corrective shoes that had medial extensions. This foal was treated at 3 days of age, and ultimately, the tarsal valgus deformity was corrected.

Twenty-two of 39 foals with tarsal valgus deformities were observed to have concomitant carpal valgus deformities; however, follow-up information was only available for 17 of these foals. Of the 17 foals, carpal valgus deformities were corrected in 13 by periosteal stripping of the lateral aspect of the distal radial metaphysis, in 2 by growth-plate retardation, and in 1 by use of a tube cast. One of the 17 foals did not receive treatment for the carpal valgus deformity, but the deformity was corrected over time. In 17 foals with concurrent carpal and tarsal valgus deformities, carpal valgus deformities were corrected significantly more often than tarsal valgus deformities (ie, 17 foals vs 10 foals, respectively; $P = 0.007$). Similarly, in 12 foals with concurrent carpal and tarsal valgus deformities treated by periosteal stripping alone, carpal valgus deformities were corrected significantly more often than tarsal valgus deformities (ie, 12 foals vs 6 foals, respectively; $P = 0.014$).

Information on athletic outcome in regards to horses performing at the owners' expectations was available for 21 of the 31 foals with follow-up. Of the 10 foals without information for athletic outcome, 3 were euthanatized. Two were euthanatized because of a poor prognosis for performance resulting from lameness; this was attributed to incomplete ossification of the tarsal bones at 4 and 8 months after periosteal stripping was performed. One 2-year-old horse fractured its tibia (1.5 years after evaluation). Seven horses are going to be 2 years old and are not in performance training.

Ten of the 21 foals did not meet the expectations of their intended use and are currently being used for other purposes. Six of these 10 foals did not respond to treatment and continued to have tarsal valgus deformities. Two foals did respond to periosteal stripping but remained lame. Nine of the 10 foals were treated with periosteal stripping, and 3 were also treated with growth-plate retardation. Eight of the 10 foals were classified as having type-II incomplete ossification.

Eleven out of the 21 foals met the expectation of their intended use. Ten foals had tarsi with normal angles after treatment. One horse still had a slight tarsal valgus deformity. Five foals had tarsal bone formation that appeared normal, 2 had type-I incomplete ossification, 2 had type-II incomplete ossification, and 2 did not have tarsal radiography. Compared with foals with type-II incomplete ossification of the tarsal bones, foals with tarsal bones that had a normal appearance or type-I incomplete ossification were significantly more likely to perform as intended ($P = 0.023$).

Discussion

When compared with the entire hospital population during the same period, Thoroughbreds and miniature horses were overrepresented, and Quarter Horses were underrepresented. More males were admitted for tarsal valgus deformities than females (1.8:1). A similar male-to-female ratio (1.9:1) for angular limb deformities of the carpus has been reported.[4]

Degree of tarsal valgus deformity is difficult to assess radiographically, because the tibia is not in the same frontal plane as the tarsus and metatarsus.[9] Clinical assessment is the best method for evaluating hind limb conformation. Foals with tarsal valgus deformities appear cow-hocked. It has been our observation that owners readily identify angular limb deformities of the carpus as an important problem but often fail to recognize concurrent tarsal deformities. In one study,[4] the carpus was the most common site of deformity in foals (85%), followed by the metatarsophalangeal region (12.5%). However, the tarsocrural region was identified as abnormal in only 2.4% of foals with angular limb deformities.[4]

In our study, 22 of 39 foals (56%) admitted for tarsal valgus deformities also had evidence of incomplete ossification of the tarsal bones. In another study,[8] 73% of foals with incomplete ossification of the tarsal bones had tarsal valgus deformities. Taken together, these findings emphasize the importance of evaluating foals radiographically for incomplete ossification of the tarsal bones.

In our study, only 2 of 10 foals with type-II incomplete ossification responded favorably to periosteal stripping alone, compared with 2 of 2 foals with type-I incomplete ossification. Our findings differ from those of a study on carpal valgus deformities,[10] in which success of periosteal stripping was not influenced by location of the pivot point or abnormalities of the carpal bones.

In another study,[5] success of growth-plate retardation of the distal radial physis decreased as the pivot point moved distally, and morphologic changes were found in the carpal bones. The pivot point refers to the point of intersection of a line drawn parallel and through the center of the proximally located long bone and a line drawn through the distally located long bone; it is considered the origin of the angular limb

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deformities. In our study, tarsal valgus deformities were corrected in 5 of 8 foals by growth-plate retardation. A significant association was not found between the abnormalities of the tarsal bones and ability to correct angular limb deformities with growth-plate retardation.

In our study, tarsal valgus deformities were corrected in 8 of 19 foals initially treated with periosteal stripping of the lateral aspect of the distal tibial metaphysis. It was observed that the median age of foals that responded favorably to this treatment was less than that for foals that did not respond (ie, 60 days vs 90 days). It is reported that successful treatment of carpal valgus deformity by periosteal stripping is > 80%.[4,6]

Furthermore, 12 foals in our study had concurrent carpal and tarsal valgus deformities that were treated by periosteal stripping alone. In these foals, carpal valgus deformities were corrected significantly more often than tarsal valgus deformities (ie, 12 foals vs 6 foals, respectively). Factors that could contribute to this discrepancy in treatment response between angular limb deformities may include age at the time of treatment, anatomic position of the tibia in relation to the tarsus and metatarsus in which the tibia is not in the same frontal plane, and the possibility of not transecting an existing fibrous fibular remnant. Miniature horses can have a complete fibula, which should be transected when performing periosteal stripping. However, none of the miniature horses in our study were treated with periosteal stripping alone, and there was no radiographic evidence of a complete fibula in the other breeds in which periosteal stripping was performed.

Eight foals were treated by growth-plate retardation techniques. Screws and wires or screws and plates were used to bridge the medial aspect of the distal tibial physis. Deformities were corrected in 5 of 8 of these foals. Our results indicate that the most promising modality to ensure correction of tarsal valgus deformities is growth-plate retardation, especially in foals with type-II incomplete ossification. Compared with the carpus, overall prognosis for tarsal valgus deformities treated with growth-plate retardation is decreased. In one study,[5] carpal valgus deformities were corrected in 80% of foals by transphyseal bridging; these foals went on to a form of athletic use.

It has been proposed that the fastest growth period of the distal tibial physis is from birth to 6 months of age; however the distal tibial physis is not radiographically fused until 17 to 24 months of age.[11] The recommended period for growth plate retardation or periosteal stripping of the distal portion of the tibia is before 4 months of age.[9,11] In our study, foals ≤ 60 days old were significantly more likely to have tarsal valgus deformities corrected with periosteal stripping, compared with foals > 60 days old. A similar significant association was not found between correction with growth-plate retardation and age. Thus, our recommendation would be to perform periosteal stripping for tarsal valgus deformities before foals are 60 days old.

If foals are seen at an early age (birth to 1 month old), then more conservative treatments such as splints and corrective shoes with medial extensions can be instituted. In our study, tarsal valgus deformities were corrected in 1 foal by treatment with splints and in another foal by treatment with corrective shoes.

In our study, 11 of 21 foals with long-term follow-up at performance age met the expectation of their intended use. Compared with foals with type-II incomplete ossification of the tarsal bones, foals with tarsal bones that had a normal appearance or type-I incomplete ossification were significantly more likely to perform as intended. On the basis of the results of other studies, it appears that the long-term outcome for foals with tarsal valgus deformities is less favorable than for foals with carpal deformities; 60% of foals with carpal deformities that were corrected with periosteal stripping met their intended use,[4] and 80% of foals with carpal deformities corrected with transphyseal bridging went on to a form of athletic use.[5]

Results of our study support our hypothesis that foals with tarsal valgus deformities should be given a guarded prognosis for future athletic potential when compared with foals with carpal valgus deformities. Foals with tarsal valgus deformities should have lateromedial radiographic views of the tarsi taken to assess the tarsal bones for signs of incomplete ossification, which will ultimately affect the outcome for future performance. Periosteal stripping is not as effective for tarsal valgus deformities as it is for carpal valgus deformities. Foals with type-II incomplete ossification respond poorly to periosteal stripping alone; thus, growth-plate retardation is recommended in these foals. Neglecting the tarsal valgus deformities could ultimately limit future athletic performance.

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