A lag-screw technique for bridging of the medial aspect of the distal tibial physis in horses

Stefan Witte, DVM; Paul E. Thorpe, DVM; Robert J. Hunt, DVM, MS, DACVS; Micheal A. Spirito, DVM; Dwayne H. Rodgerson, DVM, MS, DACVS

Although often overlooked, angular deformities of the tarsus are common in foals.[1,2] Treatment depends to some extent on whether the deformity is congenital (ie, a result of incomplete ossification of the tarsal bones[3]) or acquired (ie, a result of unfavorable limb conformation, nutritional imbalances, or trauma[1,4]) but generally is directed at enhancing or retarding growth at the adjacent physis.[1,5] Traditionally, hemicircumferential periosteal transection and elevation has been used to enhance growth of the physis in foals with angular limb deformities.[6] However, this procedure has not proven to be as effective for tarsal valgus deformities as it is for carpal valgus deformities.[1] In addition, it generally is not effective in foals that are > 2 to 4 months old, in which methods to retard the growth of a portion of the physis are advocated.[1]

Transphyseal briding with staples or wire placed in a figure-eight fashion around 2 screws has been used to retard the growth of the physis in foals.[7-9] In our experience, however, either of these methods may leave postoperative blemishes when used to treat tarsal valgus deformities. In addition, the dissection of the subcutaneous tissue required to place a transphyseal wire increases the risk of seroma formation and subsequent infection.

We believe, therefore, that a technique for transphyseal bridging that requires only a single stab incision and minimal dissection of subcutaneous tissues would be beneficial. In this report, we describe a lag-screw technique for transphyseal bridging of the medial aspect of the distal tibial physis in foals with tarsal valgus deformities and results of the technique in 11 foals (6 with bilateral tarsal valgus deformities and 5 with unilateral tarsal valgus deformities).

Surgical Technique

Horses were considered to be candidates for surgery if they had clinical evidence of a tarsal valgus deformity of > 7° that had not corrected spontaneously before 6 months of age. Preoperative radiographs were not used to determine severity of the deformity.

Prior to surgery, treatment with procaine penicillin (22,000 U/kg [10,000 U/lb], IM, q 6 h) and gentamicin (6.6 mg/kg [3 mg/lb], IV, q 24 h) was begun. Horses were sedated with xylazine hydrochloride (1.1 mg/kg [0.5 mg/lb], IV), and anesthesia was induced with ketamine hydrochloride (2.2 mg/kg [1 mg/lb], IV) and maintained with isoflurane.

From Hagyard-Davidson-McGee Associates PLLC, 4250 Iron Works Pike, Lexington, KY 40511-8412. Dr. Witte's present address is the Department of Large Animal Medicine, College of Veterinary Medicine, University of Georgia, Athens, GA 30602-7385.
Address correspondence to Dr. Witte.

Horses were positioned in lateral or dorsal recumbency on the basis of the attending surgeon's preference and whether the procedure was scheduled to be performed unilaterally or bilaterally. Hair was clipped from the medial aspect of the affected tarsus and distal portion of the tibia, and the area was aseptically prepared. A proximally directed stab incision was made through the skin to the underlying bone over the most distal aspect of the medial malleolus. A 20-gauge needle was placed in the incision to guide screw placement (**Figure 1**). Under radiographic control, a 4.5-mm drill bit, inserted through a drill guide, was used to create a glide hole parallel to the medial cortex of the distal portion of the tibia; the glide hole penetrated to the level of the physis (**Figure 2**). A 3.2-mm drill sleeve was then inserted in the glide hole, and a 3.2-mm drill bit was used to create a thread hole at least 50 mm in length. A 4.5 X 50-mm self-tapping screw was then inserted to bridge the physis (**Figure 3**). The skin incision was closed routinely with a single, simple interrupted suture of 2-0 poliglecaprone 25. The incision was covered with gauze sponges, and the tarsus was wrapped with an elastic bandage.

Figure 1—Dorsoplantar radiographic view of the tarsus in a horse. A needle has been inserted to illustrate the plane for correct placement of a lag screw to retard growth of the medial aspect of the distal tibial physis.

Figure 2—Dorsoplantar radiographic view of the tarsus in a horse, illustrating the second step in placement of a lag screw to retard growth of the medial aspect of the distal tibial physis. A 4.5-mm drill bit, inserted through a drill guide, has been used to create a glide hole parallel to the medial cortex of the tibia.

Figure 3—Dorsoplantar radiographic view of the tarsus in a horse, illustrating placement of a lag screw to retard growth of the medial aspect of the distal tibial physis.

Horses were treated with procaine penicillin (22,000 U/kg, IM, q 12 h) and gentamicin (6.6 mg/kg, IV, q 24 h) for 3 days after surgery. They were then treated with a trimethoprim-sulphonamide antimicrobial (30 mg/kg [13.6 mg/lb], PO, q 12 h) for an additional 5 days. The tarsus was bandaged for 21 to 28 days after surgery. Horses were kept in a large stall for the first 2 weeks after surgery and were then turned out into a small paddock. Horses were reevaluated every 3 to 4 weeks until screws were removed. Screws were removed when the tarsal valgus deformity was clinically assessed to have improved by at least 80%.

For screw removal, horses were anesthetized and positioned in dorsal or lateral recumbency. The site was clipped and aseptically prepared. The screw head was located by inserting a 20-gauge needle at the location of the previous skin incision, and a 5-mm incision was made through the skin and subcutaneous tissue to allow screw removal. No sutures were placed to appose the incision. Horses were confined to a stall for the first 14 days after screw removal and were then turned out into a small paddock.

Results

The lag-screw technique for transphyseal bridging of the medial aspect of the distal tibial physis was performed in 11 foals (7 males and 4 females) with bilateral (6 foals) or unilateral (5 foals) tarsal valgus deformities admitted to the Hagyard-Davidson-McGee Equine Hospital between 2002 and 2004. Ten of the horses were Thoroughbreds; the remaining horse was an American Quarter Horse. All horses had a history of being carried to term, and none were reported to be immature or dysmature.

In 3 of the horses, hemicircumferential periosteal transection and elevation had been performed but had not resolved the angular limb deformity. Horses were 39, 58, and 76 days old at the time hemicircumferential periosteal transection and elevation was performed.

In 10 of the 11 horses, radiographs of the affected tarsi were obtained at the time of surgery. None of these horses had any radiographic abnormalities of the tarsal joint.

Two horses had an angular limb deformity involving a joint other than the tarsal joint in addition to the tarsal valgus deformity. One of these horses underwent hemicircumferential periosteal transection and elevation because of a varus deformity of the left metacarpophalangeal joint; this procedure was carried out at the same time a lag screw was inserted for treatment of a tarsal valgus deformity. The other underwent hemicircumferential periosteal transection and elevation because of carpal valgus deviation at 35 days of age. In addition to these horses, 1 horse required surgery for treatment of an osteochondral dissecans lesion of the left metacarpophalangeal joint; this surgery was performed at the same time that the lag screw was removed.

Mean and median ages of foals at the time of lag-screw implantation were 220 and 213 days, respectively (range, 116 to 364 days). Implants remained in place a mean of 62 days (median, 63 days; range, 39 to 89 days). The tarsal valgus deformity resolved in all 11 horses.

No complications were identified during screw placement. Postoperative examination of the horses did not reveal any signs of lameness at a walk. Incisional complications such as discharge, excessive swelling, or dehiscence were not encountered. At the time of screw removal, the cosmetic appearance at the surgical site was judged to be excellent in all horses. No incisional complications were noted following removal of the screws. Long-term cosmetic appearance of the surgical sites was considered excellent.

Discussion

Results for horses in the present report suggest that the lag-screw technique is a viable method of retarding the growth of the medial aspect of the distal tibial physis in foals with tarsal valgus deformities. Clinically, the deformity was corrected in all 11 horses, and importantly, none of the horses developed cosmetic blemishes in association with the technique.

In the horses described in the present report, the diagnosis of tarsal valgus deformity was made on the basis of clinical assessments, both static (standing) and dynamic (at a walk), with surgery considered to be necessary in horses with a tarsal valgus deformity greater than approximately 7°. In these horses, the assessment of tarsal valgus deformity was made through comparison with the contralateral limb and with the limbs of other foals. Geometric measurements on radiographic views of the limb have also been used to identify angular limb deformities but have limited practicality, and visual examination remains most important.[1,5]

Preoperative radiography may be useful in differentiating congenital from acquired deformities in foals with angular limb deformities and was performed on 10 of the 11 foals in the present report. None of these foals had radiographic evidence of tarsal bone collapse; therefore, whether the lag-screw technique would be useful in foals with tarsal valgus deformities associated with collapse of the tarsal bones remains to be determined. All foals in this report responded to transphyseal bridging of the medial aspect of the distal tibial physis.

Hemicircumferential periosteal transection and elevation does not appear to be as effective for treatment of tarsal valgus deformities as for treatment of carpal valgus deformities.[1] Periosteal transection and elevation was attempted in 3 horses in the present report and did not result in correction of the deformity. However, this may have been associated with the age at which this procedure was performed (39, 58, and 76 days old), as it has been recommended that hemicircumferential periosteal transection and elevation be performed before 60 days of age in foals with tarsal valgus deformities.[1]

Retarding the growth of a portion of the physis appears to be the most promising method for correction of tarsal valgus deformities in foals.[1] The fastest growth period for the distal tibial physis seems to be from birth to approximately 6 months of age. Thus, the optimal time for retarding the growth of the distal tibial physis has been reported to be prior to 4 months of age.[10,11] Radiographically, however, the physis does not fuse until 17 to 24 months of age.[10] In the horses described in the present report, mean age at the time of lag-screw implantation was 220 days (median, 213 days), and 1 horse was 364 days old at the time of surgery. In all horses, the lag-screw technique was associated with resolution of the tarsal valgus deformity.

Mean time that implants were in place in horses described in the present report was 62 days (median, 63 days). In our opinion, the rate of change in the angle of deviation during the time that implants were in place did not differ from that expected with conventional implants. The time required for correction of an angular limb deformity seems to be more related to the degree of deviation than to the age of the horse. Although a limited number of horses were included in the present report, there did not appear to be any relation between age at the time of screw placement and time required for satisfactory correction of the deformity.

In our experience, implantation of transphyseal staples or screws and wires to retard growth of the distal tibial physis is associated with postoperative blemishes. In contrast, the technique described in the present report was associated with an excellent cosmetic result. The lag-screw technique relies on a single stab incision, as opposed to the 2 necessary for placement of conventional transphyseal implants, and does not require dissection of the subcutaneous tissue, as is necessary when placing a figure-eight wire.

There may be some concern associated with the formation of a permanent transphyseal bridge as a result of the lag-screw technique. None of the horses described in the present report had any evidence of overcorrection following screw removal, and all horses were at least 9 months old at the time of final follow-up examination. Thus, all horses had bypassed the period of fastest physeal growth (approx 6 months of age). Although the physis had not fused radiographically and growth was still occurring, it would appear that there is minimal risk of overcorrection with this technique.

A further potential complication of the lag-screw technique, although not encountered in these horses, is screw breakage during implant removal. Bone growth during the time the screw is in place leads to increased tension on the screw and may also result in bending of the screw, making it more prone to breakage. Use of self-tapping screws would be expected to reduce surgery time, and such screws provided sufficient tension across the physis for adequate correction in horses in the present report. Use of other types of screws (eg, cancellous screws) may complicate both screw implantation (eg, by requiring tapping of the screw hole) and removal (ie, the larger thread diameter may make it more difficult to remove the screw). Two of the authors (PET and RJH) have used a similar lag-screw technique for correction of carpal valgus deformities in horses.

EQUINE

References

1. Dutton DM, Watkins JP, Honnas CM, et al. Treatment response and athletic outcome of foals with tarsal valgus deformities: 39 cases (1988–1997). *J Am Vet Med Assoc* 1999;215:1481–1484.
2. Leitch M. Musculoskeletal disorders in neonatal foals. *Vet Clin North Am Equine Pract* 1985;1:189–207.
3. Dutton DM, Watkins JP, Walker MA, et al. Incomplete ossification of the tarsal bones in foals: 22 cases (1988–1996). *J Am Vet Med Assoc* 1998;213:1590–1594.
4. Caron JP. Angular limb deformities in foals. *Equine Vet J* 1988;20:225–228.
5. Bramlage LR. The science and art of angular limb deformity correction. *Equine Vet J* 1999;31:182–183.
6. Auer JA, Martens RJ. Periosteal transection and periosteal stripping for correction of angular limb deformities in foals. *Am J Vet Res* 1982;43:1530–1534.
7. Heinze CD. Epiphyseal stapling, in *Proceedings*. 9th Annu Meet Am Assoc Equine Pract 1964;203–216.
8. Fackelman GE, Frolich D. The current status of ASIF techniques in large animals, in *Proceedings*. 18th Annu Meet Am Assoc Equine Pract 1973;325–342.
9. Fretz PB, Turner AS, Pharr J. Retrospective comparison of two surgical techniques for correction of angular deformities in foals. *J Am Vet Med Assoc* 1978;172:281–286.
10. Fretz PB. Angular limb deformities in foals. *Vet Clin North Am Large Anim Pract* 1980;2:125–150.
11. Auer JA. Angular limb deformities. In: *Equine medicine and surgery*. 4th ed. Goleta, Calif: American Veterinary Publications Inc, 1991;1478–1479.