In-Vitro Cyclic Fatigue Properties of Parallel Screw and Dorsal Plate Arthrodesis of the Proximal Interphalangeal Joint

J. P. Watkins, DVM, MS, DACVS; T. G. Eastman, DVM, MPVM; J. L. Easter, DVM, DACVS

Dorsal plate (DP) arthrodesis of the pastern joint provides significantly better fatigue properties than the parallel screw (PS) method. These findings further substantiate the clinical utility of the DP arthrodesis technique. Authors’ addresses: Department of Large Animal Medicine and Surgery, College of Veterinary Medicine, Texas A&M University, College Station, TX 77843-4475 (Watkins and Eastman); 5100 Cnty Rd 703, Alverado, TX 76009 (Easter). © 2000 AAEP.

Introduction
Persistent lameness resulting from high ringbone seldom resolves without arthrodesis of the pastern joint. Three parallel transarticular screws with 30 to 60 d of postoperative cast support is the arthrodesis technique currently advocated. Reported success varies in the forelimb from 46 to 67% and in the hind limb from 83 to 86%. Previous work in our laboratory demonstrated significantly more stability at the dorsal aspect of the arthrodesis with the DP technique.1

The purpose of this study was to compare the fatigue tolerance of the DP and PS methods of arthrodesis. Increased fatigue tolerance would allow a reduction in the duration of postoperative cast support, decrease the duration of hospitalization, and potentially allow an earlier return to function.

Material and Methods
Forelimbs were harvested from 6 adult horses euthanized for reasons other than lameness. One forelimb of each pair underwent pastern arthrodesis using the currently accepted parallel screw (PS) technique with three 5.5 mm cortical bone screws positioned in lag fashion. The contralateral limb underwent arthrodesis utilizing a dorsally applied plate.

Dorsal Plate (DP) Arthrodesis
A 3-hole narrow DCP was contoured and affixed to the proximal aspect of the middle phalanx with a 5.5 mm cortical screw placed through the distal plate hole. Two 5.5 mm cortical bone screws were positioned abaxial to the bone plate in transarticular lag fashion. The plate was affixed to the proximal phalanx with a 5.5 mm screw in the middle hole of the plate positioned to provide dynamic compression. A 4.5 mm cortical bone screw placed through the proximal plate hole engaged only the dorsal cortex of the proximal phalanx.

Biomechanical Testing
Prior to testing, the metacarpophalangeal joint was stabilized at an angle of 145° using a three-sixteenth inch cable as a figure eight tension band across the palmar aspect of the joint, and the fetlock was wrapped with fiberglass cast material. The entire metacarpus and fetlock were then incorporated into the testing pedestal. Constructs were loaded in axial compression to 2300 pounds at 1 cycle per second until failure. Posttesting radiographs documented mode of failure.

Data Reduction
Number of cycles to failure were compared using the Wilcoxon signed-rank test. Significance was established at \( p \leq 0.05 \).

Results
Failure occurred through the screw holes in the proximal phalanx in all PS constructs (\( \bar{x} < 1200 \) cycles; range 181 to 3800). In the DP constructs, 5 specimens failed by separation of the hoof capsule from the distal phalanx and in 1 specimen the plate failed (\( \bar{x} > 4000 \) cycles; range 1824 to 7123). The difference was significant (\( p \leq 0.05 \)).

Discussion
Previous in vitro studies have shown the DP technique provides increased stability across the dorsal...
aspect of the proximal interphalangeal joint when tested in single cycle to failure. Increased stability (i.e., decreased interfragmentary motion) is noted clinically by improved patient comfort and decreased proliferation of new bone at the dorsal aspect of the arthrodesis. Although improved patient comfort allows for the early removal of postoperative cast support, it was important to determine if the DP construct was more resistant to fatigue failure, because with early removal of the cast, the DP construct would be subjected to an increased number of cycles prior to bony healing at the arthrodesis site.

At our clinic, we routinely remove cast support from DP arthrodesis patients 2 weeks postoperatively and discharge the patient from the hospital shortly thereafter. Compared to our previous experience with the PS method, results for athletic performance post arthrodesis are as good or better. Furthermore, morbidity associated with prolonged postoperative cast support has virtually been eliminated and the duration of hospitalization has been substantially reduced. The only potential drawback to the DP technique is a slight increase in the risk of implant-associated complications.

The authors wish to thank the American Association of Equine Practitioners for funding this project.

Reference