Use of Magnetic Resonance Imaging to Diagnose Injuries in the Proximal Metacarpus and Metatarsus in Horses

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The exact cause of lameness in the proximal metacarpal and metatarsal region in horses can be difficult to determine when traditional diagnostics do not yield a diagnosis. High field-strength magnetic resonance imaging (MRI) provides clear evaluation of the proximal metacarpus/metatarsus in horses with performance-limiting injuries. The ability to accurately diagnose the source of lameness is important in selecting treatment that will maximize the horse’s chances to return to performance. Authors’ addresses: Department of Large Animal Clinical Sciences, College of Veterinary Medicine, University of Florida, Gainesville, FL 32610 (Brokken); Department of Veterinary Clinical Sciences, Washington State University, Pullman, WA 99164 (Schneider, Sampson, Tucker, Gavin); and California Advanced Imaging at Atherton, 3301 El Camino Real, Suite 100, Atherton, CA 94027 (Ho); e-mail: brokkenm@vetmed.ufl.edu (Brokken). © 2007 AAEP.

1. Introduction
Injuries associated with the proximal metacarpal and metatarsal regions are a common cause of lameness in all types of performance horses. Numerous pathologic processes have been described,1–5 and the majority of horses need diagnostic local analgesia to determine whether or not this region is the source of lameness. Radiography and nuclear scintigraphy are helpful in detecting osseous changes, and ultrasound has been beneficial in detecting abnormalities within tendons and ligaments. However, detection of abnormalities, specifically desmitis of the inferior check ligament (ICL) and proximal suspensory ligament (PSL), has not been possible in some horses.6 The use of magnetic resonance (MR) to diagnose injuries that cannot be determined from other imaging modalities has been documented.7–9 MR provides clear visualization of bone and soft tissues in the proximal metacarpal/metatarsal region. The purpose of this study was to describe the MR imaging findings in a group of horses with lameness localized to the proximal metacarpus/metatarsus.

2. Materials and Methods
Medical records of all horses with lameness localized to the proximal metacarpus/metatarsus that were evaluated with MR at Washington State University between April 2000 and December 2005 were reviewed. Signalment, history, clinical signs, response to local analgesia, and treatment were obtained from the medical records. MR images
were evaluated for every horse. Radiographs, ultrasound, and nuclear scintigraphy were also evaluated if available. The technique for local analgesia consisted of local infiltration around the proximal insertion of the suspensory ligament. Horses were examined for lameness at 30 min after the block. If partial improvement was noted at that time, the horses were examined again at 45–60 min. Horses were blocked distally to the proximal metacarpus/metatarsus and evaluated for change in lameness prior to injection of local anesthetic around the proximal suspensory ligament.

All horses were anesthetized, and either the forelimbs or hindlimbs were placed into a 1.0-Tesla magnet. Images were acquired in transverse, sagittal, and dorsal planes using proton density (PD), T2-weighted, and short $T_1$-inversion recovery (STIR) sequences. In 36 horses, both limbs were imaged for comparison with the opposite limb. In nine horses, MR imaging of other anatomic areas limited anesthetic time available for the proximal metacarpus/metatarsus and only the affected leg was imaged.

3. Results

Subjects
Forty-five horses were included in this study. There were 20 Warmbloods, 12 Thoroughbreds, 8 Quarter Horses, 3 Arabians, 1 Paint Horse, and 1 New Forest pony. The horses ranged in age from 3 to 17 yr (median age = 9 yr) and were used for a variety of performance events: showjumping (20 horses), dressage (8 horses), Western pleasure (7 horses), hunter (5 horses), reining (2 horses), 3-day eventing (1 horse), trail riding (1 horse), and racing (1 horse). There were 29 geldings, 14 mares, and 2 stallions.

Lameness Evaluation and Response to Diagnostic Analgesia
The horses in this study were all examined because of lameness. Twenty-two horses had lameness for $<4$ mo, 22 had lameness for $>4$ mo, and 1 had lameness for an undetermined amount of time. Twenty-nine horses had forelimb lameness (18 right, 10 left, and 1 bilateral). Sixteen horses had hindlimb lameness (eight right, seven left, and one bilateral). At examination, 31 horses had a grade 3 of 5 lameness and when trotted over a smooth, hard surface. Nine horses had a grade 2 of 5. One horse had a lameness grade 4 of 5. Four horses did not exhibit a consistent lameness at the time of examination, but during previous lameness evaluations by the referring veterinarian, improvement in lameness was observed after injection of local anesthetic into the proximal metacarpal/metatarsal regions. The lameness in 43 horses in this study was improved by infiltration of local anesthetic around the ICL and the area of the attachment of the PSL to the third metacarpus or metatarsus. The two horses that were not blocked had swelling and sensitivity in the region of the proximal metacarpus. Improvement in lameness was estimated at 60–90% after injection of local anesthetic in 36 horses. In seven horses, the lameness was completely eliminated by this diagnostic block. All horses were blocked with a low four-point diagnostic nerve block before the injection of local anesthetic in the proximal metacarpal or metatarsal region. Horses were examined for lameness at 30 min after the block. If partial improvement was noted at that time, the horses were examined again at 45–60 min.

Radiographic, Ultrasound, and Scintigraphic Findings
Radiographs (dorsopalmar/plantar, lateromedial) of the proximal metacarpus/metatarsus were performed on 22 horses. The only abnormalities were splint exostoses in five horses. Eight horses had ultrasound examinations performed at Washington State University. Three of those horses had abnormalities. One horse had mineralization of the deep digital flexor tendon (DDFT) that made evaluation of the ICL and PSL difficult. Another horse was diagnosed with ICL desmitis with ultrasound, but MR examination revealed an abnormal PSL and a normal ICL. The third horse had evidence of PSL desmitis on ultrasound, and the MR examination was performed to determine if there were adhesions of the PSL to a splint exostoses. Nuclear scintigraphy was performed on three horses with mild radiopharmaceutical uptake around the distal hock joints in two of the horses.

MR Observations
Twenty-three horses were diagnosed with PSL desmitis (13 hindlimbs and 10 forelimbs). The transverse PD images were most useful in detecting enlargement and abnormal high signal within the PSL and low signal at the PSL attachment to the third metacarpus/metatarsus. The transverse STIR images were beneficial in detecting high signal within the third metacarpal/metatarsal bone at the attachment of the PSL. Ten horses with forelimb lameness had MR abnormalities in the PSL. Three of those horses also had high signal on STIR (Fig. 1) and low signal on PD sequences (Fig. 2) at the PSL attachment to the proximal third metacarpal bone. Three other horses had low signal in the third metacarpus at the proximal attachment of the suspensory ligament without high signal on STIR sequences. All ten horses had enlargement of the PSL, and all but one horse had increased signal within the PSL (Fig. 3). All lesions were within the proximal 4 cm of the suspensory ligament. Thirteen horses had desmitis of the hindlimb PSL on MR examination. Five of these horses had low signal of the proximal third metatarsal bone at the PSL attachment. Only one of these horses had high signal in the same area on STIR sequences. Eleven horses had enlargement and increased signal intensity within the PSL (Fig. 4). The other two horses had enlargement of the PSL without an increase in signal.
Sixteen horses were diagnosed with ICL desmitis. The transverse PD sequences were most useful in detecting injury to the ICL. All horses with desmitis had regions of high signal and enlargement within the ICL (Fig. 5). Twelve horses had lesions which occurred or began 1–4 cm distal to the carpo-metacarpal joint (CMCJ). The other four horses had lesions 5–10 cm distal to the CMCJ. One horse had desmitis of both the ICL and PSL on the same limb and one horse had desmitis of the left front ICL and the right front PSL. One horse had a bone contusion/injury of the proximal third metacarpal bone. There was high signal on STIR and low signal on PD sequences in the proximal third metacarpal bone. One horse had effusion of the distal tarsal sheath with no other MR abnormalities. A different horse had a DDFT injury in the proximal metatarsal area, and another horse had no abnormalities noted on the MR examination of the proximal metatarsus.
Treatment

Treatment of all horses was determined by the severity and duration of the injury. Twenty horses with PSL desmitis were treated with a 6-mo rest and rehabilitation program (11 hindlimbs and 9 forelimbs), which consisted of 30 days of stall rest with hand walking followed by small paddock turnout. The amount of exercise was gradually increased over the next few months, but the horses were not turned out or returned to regular training until 6 mo after the start of the program. Five horses had periligamentous injections with a combination of isoflupredone acetate, betamethasone sodium phosphate and acetate, and polysulfated glycosaminoglycans before entering rehabilitation programs. Three horses were treated surgically and placed in rest and rehabilitation programs. One of these horses had ligament-splitting surgery performed on the PSL, and the two other horses had fasciotomy and neurectomy as described by Bathe. Both of the PSL, and the two other horses had fasciotomy and neurectomy as described by Bathe.12

The one horse with PSL injury on one leg and ICL desmitis that had ICL desmotomy were able to return to their intended use. Three of the horses were continued in performance after injection. The horse with no abnormalities on the MR examination was placed in a 6-mo rest and rehabilitation program.

Follow-up

Follow-up with owners or trainers was available for 43 of 45 horses in this study. At the time of follow-up, all horses were at least 1 yr from the time of diagnosis (range = 1–6 yr; mean = 1.3 yr). Eight of ten horses (80%) with forelimb PSL desmitis returned to their intended use. Nine of thirteen horses (69%) with hindlimb PSL desmitis were able to return to their intended use. Ten of sixteen horses (63%) with ICL desmitis were able to return to their intended use. Five of eight horses (63%) that had ICL desmotomy were able to return to their intended use.

The four horses that did not have abnormalities in the PSL or ICL were injected in the proximal metacarpal/metatarsal region with the combination of medications used for PSL and ICL injuries. Three of the horses were continued in performance after injection. The horse with no abnormalities on the MR examination was placed in a 6-mo rest and rehabilitation program.

Four horses that did not have abnormalities in the PSL or ICL were injected in the proximal metacarpal/metatarsal region with the combination of medications used for PSL and ICL injuries. b,c,d

Three of the horses were continued in performance after injection. The horse with no abnormalities on the MR examination was placed in a 6-mo rest and rehabilitation program.

Fig. 5. Left-front and right-front transverse proton density images of a horse with enlargement and increased signal intensity in the ICL of the right proximal metacarpus (arrow).
cause an accurate diagnosis allows appropriate treatment recommendations for these horses.

Injury to the ICL or PSL was characterized by an increase in size or high signal within the ligaments on MR images. Normal ligaments are seen as lower signal on all MR sequences; an increase in signal intensity occurs in areas of ligamentous damage. The MR sequence and section that was most helpful in detecting subtle changes in signal and size within the ICL and PSL was the transverse PD sequence. The images from this sequence are best for evaluating anatomic structure and detail. Careful and systematic examination of both limbs is necessary to detect differences on MR images, especially when evaluating the PSL. The normal PSL has variations in signal caused by the muscle fibers within the ligament. Without comparison between limbs, subtle changes in size and signal within the PSL can be very difficult to detect.

MR images allow detection of abnormalities in bone. Bone reaction or sclerosis was observed at the proximal attachment of the suspensory ligament to the third metacarpus/metatarsus. The sclerosis most likely results from the bone’s response to tearing of the suspensory fiber insertions (Sharpey’s fibers) from the third metacarpal/metatarsal bone. Sclerosis (low signal) may be a sign of chronic injury; all but 1 of the horses with sclerosis had been lame for >2 mo. Sclerosis could also occur because of remodeling of the bone secondary to increased loading of the palmar/plantar cortex, but this is unlikely in a lame horse. On STIR sequences, acute bone injuries were observed as abnormally high signal caused by fluid accumulation from hemorrhage, inflammation, or edema within the bone. Four of five horses with fluid within the proximal metacarpus/metatarsus had lameness <2 mo in duration. Bone injuries in this location have been previously recognized with nuclear scintigraphy and correlated with MR images.

MR images proved to be more sensitive than ultrasound for finding abnormalities in 8 of the horses in this study. In these cases, ultrasound was unremarkable or was misinterpreted as a PSL injury when the problem was in the horse’s ICL. In addition, most of the horses in the study had ultrasound examinations performed by the referring veterinarian, who did not diagnose the injury before referral. Ultrasonographic examination of the PSL is technically challenging, especially in the hindlimbs. Large vessels plantarolateral to the suspensory ligament may result in broad linear anechoic artifacts within the suspensory ligament. The overlying digital flexor tendons create edge enhancement artifacts that result in anechoic defects in the PSL. Both of these can make detection of abnormalities in fiber pattern difficult. MR allowed evaluation of the PSL in all horses in this study.

Ultrasound evaluation of the ICL has some limitations. The proximal insertion of the ligament on the palmar third carpal bone is difficult to image, because the contour of the accessory carpal bone inhibits 90° contact of the transducer with the ICL. MR images, especially the transverse PD sequences, allowed detection of abnormalities in the ICL. Abnormalities in 76% of the horses in this study were observed in the proximal 1–4 cm of the ligament, an area that is difficult to evaluate with ultrasound.

In this study, the most common finding in horses with proximal metacarpal lameness was ICL desmitis (59%). There is a wide range of success reported in the literature on the return to performance after conservative management. Van den Belt et al. reported a success rate of only 18%, whereas Dyson reported complete functional recovery to be at 76%. McDiarmid stated that the long-term prognosis for ICL desmitis is guarded, and 43% of horses returned to their previous level of performance. In this study, 63% of horses returned to their intended use. Five of eight horses (63%) with ICL desmotomy returned to their intended use. The success of ICL desmotomy in these horses further supports the importance of making an accurate diagnosis, because horses with ICL desmitis have a surgical option that is not appropriate for horses with PSL desmitis.

Eighty percent of horses with forelimb PSL desmitis and 69% of horses with hindlimb PSL desmitis were able to return to their intended use. The forelimb percentage is consistent with previous reports in the literature. Estimates of horses that return to performance without residual lameness from hindlimb PSL desmitis range from 14–58%. More cases with follow-up are needed to establish a prognosis for this injury. Accurate diagnosis with MR imaging will help in determining a prognosis for athletic horses in the future.

There are several local anesthetic techniques used to desensitize the proximal metacarpus/metatarsus. The local anesthetic technique used on the horses in this study allowed localization of the lameness to the proximal metacarpal and metatarsal regions. In our experience, allowing adequate time for the anesthetic to diffuse throughout the proximal metacarpus/metatarsus region helps confirm this location as the source of lameness. The majority of the horses in this study did not block soundly. This is consistent with previous reports of proximal metatarsal diagnostic analgesia. In the same report, Dyson states that improvements after fibular and tibial nerve blocks usually took longer (>45 min) to develop. As described in other articles,21,22 the risk of desensitizing the carpometacarpal and middle carpal joints is present and should be considered when evaluating horses with lameness in this region.

In conclusion, lameness localized to the proximal metacarpal and metatarsal region has been a diagnostic challenge. The purpose of this study was to report on the use of MR to diagnose proximal metacarpal and metatarsal lameness in horses where the cause of lameness was not clear with other imaging modalities. High field-strength MRI should be con-
sidered in performance horses with lameness localized in the proximal metacarpal and metatarsal areas.

References and Footnotes


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