Use of magnetic resonance imaging to identify suspensory desmitis and adhesions between exostoses of the second metacarpal bone and the suspensory ligament in four horses

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A 10-year-old Arabian gelding (horse 1) that was used on 3-day eventing was admitted to the Washington State University Veterinary Teaching Hospital for evaluation of a left forelimb lameness of 6 months' duration. The referring veterinarian had localized the cause of the lameness to the metacarpus by means of perineural anesthesia of the medial and lateral palmar and palmar metacarpal nerves, and a diagnosis of desmitis of the interosseous ligament and exostosis of the left second metacarpal bone had been made. The exostosis had been treated with local injection of corticosteroids.

At examination, the horse had a grade 2 of 5 left forelimb lameness when trotted over a smooth, hard surface. There was a firm enlargement involving the middle third of the left second metacarpal bone. Digital palpation of this area elicited signs of pain. No other abnormalities were identified during palpation of the left forelimb, and perineural anesthesia was not repeated. Radiography of the left metacarpus revealed a 0.5 × 1.0-cm focal osseous reaction involving the middle third of the left second metacarpal bone. The osseous reaction appeared smooth and well defined. There was irregularity along the palmar margin of the reaction, suggestive of recent inflammation.

The horse was anesthetized and positioned in right lateral recumbency, and magnetic resonance (MR) imaging of both metacarpals was performed. Images were obtained with a 1.0-T MR imaging system. All images were obtained with a quadrature circular coil. A transverse dual echo (proton density and T2-weighted [T2-WT]) imaging sequence was performed (repetition time [TR], 2,000 milliseconds; echo time [TE], 17.9 and 100 milliseconds, respectively; 15.0-cm field of view [FOV]; 512 × 512 acquisition matrix) with 5.0-mm slices and 0.5-mm interslice gaps. Sagittal dual echo images were obtained (TR, 3,300 milliseconds; TE, 17.9 and 100 milliseconds, respectively; 24-cm FOV; 512 × 512 acquisition matrix) with 3.0-mm slices and 0.3-mm interslice gaps. Short tau inversion recovery (STIR) transverse images were obtained (TR, 1,725 milliseconds; TE, 35 milliseconds; 17.9-cm FOV; 256 × 256 acquisition matrix) with 5.0-mm slices and 0.5-mm interslice gaps. Sagittal STIR images were obtained (TR, 1,500 milliseconds; TE, 35 milliseconds; 25.9-cm FOV; 256 × 256 acquisition matrix) with 3.0-mm slices and 0.3-mm interslice gaps. Images were reviewed by a board-certified radiologist and a board-certified surgeon with experience in interpretation of MR images. Images of the affected limb were compared with those of the contralateral limb to determine abnormalities in size, shape, and fluid content.

Magnetic resonance imaging of the metacarpus revealed enlargement of the medial portion of the left suspensory ligament adjacent to the area of bone reaction involving the second metacarpal bone (Fig 1). In transverse MR images from unaffected horses, there was a small space between the suspensory ligament and the metacarpal bones that could clearly be seen as high signal intensity (white) because of the fluid content of the loose connective tissue in this area. This space was believed to allow the ligament to move freely past the metacarpal bones as the metacarpophalangeal joint was flexed and extended. In images from horse 1, however, this space between the suspensory ligament and reactive bone involving the second metacarpal bone was not seen. The space was filled with low signal intensity (black) on MR images, which was considered suggestive of a fibrous adhesion, although it could also have represented air or dense cortical bone. Transverse and sagittal STIR and T2-WT images revealed abnormal fluid in the medial portion of the suspensory ligament. Abnormal fluid and enlargement of the medial portion of the suspensory ligament extended 3 cm distal to the area of bone reaction and were considered to be indicative of suspensory desmitis.

The reactive bone and distal two-thirds of the second metacarpal bone were resected. Adhesions identified between the axial surface of the reactive bone and the suspensory ligament were sharply transected. The periosteum was removed with the amputated distal portion of the second metacarpal bone. Proliferative bone from the exostosis extended axially on the palmar cortex of the third metacarpal bone further than expected.

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from radiographic images; the exostosis was similar in size to that seen on MR images. This proliferative bone was removed with a chisel and bone curette.

After surgery, a 6-month rest and rehabilitation program was instituted to treat the suspensory desmitis. The program consisted of stall rest for 60 days. Hand walking was initiated 2 weeks after surgery, following suture removal, to minimize the likelihood that adhesions would reform. After 60 days, the horse began light jogging in hand for gradually increasing time each day and was allowed turnout in a small paddock (30 X 30 feet). The horse was not allowed to return to training or have free turnout in a pasture until 6 months after surgery. More than 2 years after surgery, the owner reported that the horse had returned to its previous level of athletic performance and had remained sound following amputation of the second metacarpal bone and transection of adhesions.

A 6-year-old Arabian gelding (horse 2) used for English pleasure riding was admitted to the Washington State University Veterinary Teaching Hospital for evaluation of a right forelimb lameness of 3 months’ duration. At examination, the horse had a grade 2 of 5 right forelimb lameness when trotted over a smooth, hard surface. Examination revealed a firm enlargement at the junction of the proximal third and distal two-thirds of the right second metacarpal bone. Digital palpation along the axial aspect of the enlargement elicited signs of pain. No other abnormalities were noticed during palpation of the limb. Diagnostic nerve blocks of the distal portion of the limb did not alter the lameness. The lameness was improved by perineural anesthesia of the medial and lateral palmar and palmar metacarpal nerves proximal to the enlargement. Radiography of the right metacarpus revealed a 0.5 X 1.0-cm area of smooth, well-margined bone proliferation involving the second metacarpal bone (Fig 2).

Magnetic resonance imaging of both metacarpi was performed as described for horse 1. On STIR and T2-WT images, abnormal fluid accumulation within the suspensory ligament adjacent to the exostosis on the right second metacarpal bone and extending 2 cm distally could be seen (Fig 3). The suspensory ligament was also enlarged from the region of the exostosis distally. There was tissue of low signal intensity occupying the space between the suspensory ligament and second metacarpal bone on all imaging sequences.

The exostosis and distal two-thirds of the second metacarpal bone were resected. Adhesions between the suspensory ligament and the exostosis were identified.
and transected at surgery. The owner reported that the horse continued to be sound 2 years after surgery and was competing at the same level of performance as before the injury.

A 7-year-old Arabian mare (horse 3) used for English pleasure riding was admitted to the Washington State University Veterinary Teaching Hospital for evaluation of a chronic, intermittent left forelimb lameness. The referring veterinarian had localized the cause of the lameness to the area of an exostosis on the second metacarpal bone by means of local infiltration of anesthetic solution. An ultrasonographic evaluation performed by the referring veterinarian demonstrated mild disruption of the fibers of the suspensory ligament adjacent to the exostosis.

At initial examination at the teaching hospital, the horse had a grade 1 of 5 left forelimb lameness when trotted over a smooth, hard surface. Signs of pain were evident during palpation of the suspensory ligament on the axial surface of the left second metacarpal bone, adjacent to the exostosis. No other abnormalities were identified, and additional diagnostic anesthesia was not performed. Radiography of the left metacarpus revealed a 1 × 1-cm area of bone reaction involving the surface of the second metacarpal bone.

Magnetic resonance imaging of both metacarpi was performed as described for horse 1. On MR images, enlargement of the body of the left suspensory ligament and a focal area of abnormal fluid within the ligament adjacent to the bone reaction and extending 3 cm distally was seen (Fig 4). An area of low signal intensity was seen in the area between the body of the left suspensory ligament and the bone reaction on the second metacarpal bone.

At surgery, an adhesion between the suspensory ligament and the exostosis on the second metacarpal bone was identified and transected. The exostosis and distal portion of the second metacarpal bone were then removed.

Seven months after surgery, the horse was reevaluated at the veterinary teaching hospital because of a grade 1 of 5 lameness of the contralateral forelimb. Diagnostic anesthesia was used to localize the cause of the right forelimb lameness to the area of the metacarpophalangeal joint. Radiography of the right metacarpophalangeal joint revealed osteophyte formation on the dorsoproximal aspect of the first phalanx. Magnetic resonance imaging of both forelimbs was performed to evaluate the right metacarpophalangeal joint and assess healing of the left suspensory ligament. Images of the left metacarpus revealed that the suspensory ligament remained slightly enlarged and that there was focal (1- to 2-mm) bone reaction at the site of amputation of the second metacarpal bone. There were no signs of abnormal fluid or inflammation in the area.

The cause of the right forelimb lameness was identified as osteoarthrosis of the metacarpophalangeal joint. The horse was treated systemically with anti-inflammatory medications. Eighteen months later, the owner reported that the horse remained in athletic performance at its previous level and was sound.

A 10-year-old Trakehner mare (horse 4) that was used for eventing was admitted to the Washington State University Veterinary Teaching Hospital for evaluation of right forelimb lameness of 6 months’ duration. The referring veterinarian had previously localized the lameness to an area of exostosis on the right second metacarpal bone by means of sequential perineural anesthesia distal and proximal to the exostosis. The horse had been stall rested for several weeks prior to examination at the veterinary teaching hospital.

At examination, the horse had a grade 1 of 5 right forelimb lameness when trotted over a smooth, hard surface. Firm flexion of the distal joints of the right forelimb increased the severity of the lameness. There was a palpable enlargement on the right second metacarpal bone at the junction of the proximal third and distal two-thirds of the bone. On palpation, the enlargement did not appear to extend toward the suspensory ligament. Digital palpation of the area resulted in...
signs of pain. Perineural anesthesia was not repeated. Radiography of the right metacarpus revealed a 1.0 X 0.5-cm exostosis of the second metacarpal bone.

On MR images of the right metacarpus, an area of low signal intensity was seen filling the space between the suspensory ligament and the bone reaction on the right second metacarpal bone. There was abnormal high signal intensity consistent with fluid in the medial aspect of the suspensory ligament adjacent to the exostosis and extending 2 cm distally (Fig 5). The medial branch of the suspensory ligament was also enlarged on all imaging sequences, compared with the contralateral limb.

At surgery, an adhesion between the suspensory ligament and the bone reaction on the second metacarpal bone was identified and transected. The exostosis and distal portion of the splint bone were then removed. This horse was convalescing at the time of final follow-up.

Exostoses involving the second and fourth metacarpal and metatarsal (splint) bones are common in horses. In 1 study, for instance, exostoses were identified in 192 of 200 metacarpi that were evaluated and many metacarpi had 2 or more areas of exostosis formation. Exostosis of the splint bones may develop secondary to direct trauma, when for instance interference with the contralateral limb results in a subperiosteal hematoma that undergoes maturation and mineralization. More commonly, exostoses develop secondary to desmitis of the interosseous ligament, which connects the splint bones to the third metacarpal bone. Interosseous ligament desmitis appears to occur as the result of differential loading of the splint bones at their articulations with the distal row of carpal and tarsal bones, resulting in abnormal strain on the ligament fibers at their attachments to the splint bones.

Most horses with exostosis of the splint bones have mild to moderate lameness that quickly subsides with rest. However, in some horses, the lameness persists or recurs with exercise. Desmitis of the suspensory ligament has been implicated as a possible cause of chronic or recurring lameness in these horses, especially in horses with large exostoses that impinge on the suspensory ligament. And suspensory desmitis has been documented ultrasonographically in some horses. Nevertheless, there are some horses with chronic or recurrent lameness localized to the area of a splint bone exostosis in which suspensory ligament abnormalities cannot be seen ultrasonographically.

Adhesions between the suspensory ligament and the splint bone have been identified at surgery. However, nonsurgical identification of such adhesions is difficult. Ultrasonography has been used extensively for evalu-
tion of the flexor tendons in horses, however, ultrasoundography of the suspensory ligament in the area of an exostosis can be inconclusive because of difficulties in maintaining good surface contact and acoustic shadowing caused by mineralization and refraction artifacts caused by the margins of the second metacarpal bone, the flexor tendons, and vascular structures. This makes it difficult to determine with ultrasonography whether an exostosis is adhered to the suspensory ligament, and our previous experience with ultrasonography to identify adhesions has been inconclusive. None of the horses described in the present report were examined with ultrasound.

Magnetic resonance imaging of musculoskeletal problems involving the distal portions of the limbs in horses has been described recently. Proton density sequences provide excellent anatomic detail, but have less tissue contrast than do other imaging sequences, whereas T2-WT images are useful for identifying fluid and pathologic changes and have prominent tissue contrast. Finally, STIR images are especially sensitive for identifying fluid and pathologic change within soft tissue and bone, but provide less anatomic detail than the other 2 imaging sequences. Magnetic resonance imaging has been reported to be useful in identifying adhesions and desmitis in people and was useful in documenting suspensory desmitis and an adhesion between an exostosis of the second metacarpal bone and the suspensory ligament in the 4 horses described in the present report. Further, our findings suggest that adhesions may develop between exostoses and the suspensory ligament in horses with chronic suspensory desmitis.

Splint bone exostoses in the 4 horses described in the present report were considered to be small on the basis of results of palpation and radiography. Large exostoses have been incriminated as a cause of persistent lameness in some horses in which the exostosis causes mechanical irritation of the suspensory ligament. Radiography is often performed to determine whether the exostosis is impinging on the suspensory ligament; however, this is difficult to determine because it is not possible to clearly identify the suspensory ligament in all cases. In addition, the presence or size of splint bone exostoses does not correlate with the severity of lameness. Horses may have mild to moderate lameness associated with acute exostosis formation; however, the lameness quickly subsides in most horses. Many horses are not lame following the acute phase of the condition, and lameness may not be detectable at any stage in some horses. The relatively small size of the exostoses in the horses described in the present report clearly demonstrates that such lesions do not have to be large to cause suspensory desmitis and affect performance. Thus, suspensory desmitis should be considered in the differential diagnosis when examining horses with chronic lameness and splint bone exostoses, regardless of the size of those exostoses.

Suspensory desmitis can be suspected on the basis of results of clinical examination and response to diagnostic local anesthetic blocks. In the horses described in the present report, firm digital palpation in the area of the splint bone exostosis resulted in signs of pain, especially along the axial border of the splint bone.

Injection of local anesthetic solution around the splint bone exostosis or perineural anesthesia of the medial and lateral palmar and palmar metacarpal nerves eliminated the lameness in all 4 horses. However, similar responses can be expected in horses with lameness of other causes, such as injury to the suspensory ligament at or near its attachment to the third metacarpal bone and desmitis of the accessory ligament of the deep digital flexor muscle, and MR imaging was invaluable in determining the cause of the lameness in these horses. On MR images, adhesions and suspensory desmitis associated with exostosis of the second metacarpal bone were clearly seen.

We believe that suspensory desmitis in the horses described in the present report was a result of adhesion of the suspensory ligament to the exostosis of the second metacarpal bone. This abnormal point of attachment presumably resulted in abnormal tensile strain within the suspensory ligament, causing tearing of the ligament fibers and subsequent inflammation. Suspensory desmitis was clearly demonstrated on MR images from these horses, with accumulation of fluid in the suspensory ligament evident on STIR and T2-WT images. The suspensory ligament abnormalities were always located on the same side as the adhesions that were seen. The area of fluid within the suspensory ligament extended distally from the adhesion, as would be expected since the suspensory ligament is loaded from distal to proximal.

Prior to examination of these horses at the veterinary teaching hospital, rest alone had not been successful in returning any of them to soundness. Although more cases must be evaluated, it appears that surgical removal of the splint bone exostosis may be necessary to resolve the suspensory desmitis. Surgical removal of the exostosis and a rest and rehabilitation program were successful in returning all 4 horses to their intended use. Why some horses with splint bone exostoses develop adhesions is not clear, but these adhesions seemed to be related to medial proliferation of the exostosis and inflammation in the bone, creating a situation for adhesions to form.

To our knowledge, nonsurgical diagnosis of suspensory ligament adhesion to exostoses involving the splint bones has not been reported previously. Suspensory desmitis secondary to exostosis of the second metacarpal bone should be considered as a possible cause of chronic or recurring lameness in horses. Surgical removal of the exostosis and distal portion of the second metacarpal bone and rehabilitation of the suspensory desmitis appear to be necessary to allow these horses to return to performance.

References

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Philips Medical Systems, Best, The Netherlands.