Distal Limb Lameness in the Sport Horse: A Clinical Approach to Diagnosis

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Diagnosis of lameness caused by lesions of the distal limb requires a thorough clinical examination, including careful palpation, manipulative tests, hoof tester evaluation, examination of the horse in hand and under saddle, and regional anesthesia. Specific causative lesions may require technical imaging modalities to fully evaluate. Author's address: Fairfield Equine Associates, PC, 32 Barnabas Road, Newtown, CT 06470; e-mail: rmitch2074@aol.com.

1. Introduction

Today's high-level sport horse represents a significant investment of time and money. High-level show jumpers, dressage horses, and Western performance horses often take several years to train to their upper levels, and injuries or illness can substantially affect the time to produce a winning horse. Owners and trainers are concerned that these horses receive the best possible care without excess expenses and down time. The veterinary care of such horses should take a more aggressive approach to lameness diagnostics of the horse in training, not simply one of attending to lameness after the horse is no longer able to train. Recognition of potentially serious distal limb lameness early on may prevent significant loss of training and competition time as well as extending the horse's career.

2. Anatomy and Risk Factors

For the purposes of this discussion, the author will address the anatomical region from the fetlock distally. The bony structures involve the three metacarpals, (MC2, MC3, MC4 or medial splint bone, cannon bone, and lateral splint bone, respectively), the proximal medial and lateral sesamoids, the proximal phalanx (P1, long pastern bone), the middle phalanx (P2, short pastern bone), the distal phalanx (P3, coffin bone), and the distal sesamoid (navicular bone). Each of the articulations is supported by collateral ligamentous structures and fibrous joint capsules. The distal sesamoidean ligaments (as the extension of the suspensory apparatus) and the flexor tendons attach along the palmar aspect of the pastern and foot and provide support. The dorsal digital extensor attaches along the dorsal aspect, ultimately inserting on the extensor process of the distal phalanx.

The distal limb plays a significant role in adaptation to footing and shock absorption during locomotion. The corium parietis, composed of the epidermal and dermal lamellae, function as a ligament suspending P3 within the hoof wall. There is considerable movement of P3 within the hoof wall on landing and propulsion because of this function. The digital cushion also functions in shock absorption.[1–3] Foot balance, both medial/lateral and dorsal/palmar, can have a profound effect on the excursion of joints and the stress on soft tissues of the distal limb.[1,4] Footing surfaces that are very

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hard, excessively soft, or unstable can result in aberrant motion and stress that may result in injury. The demands of high-level sports result in more concussion as well as greater extension and flexion than casual exercise. Fatigue may not be as significant a factor in injuries of the sport horse compared with racing horses, but chronic repetitive trauma is thought to be a factor. The types of injuries seen in the sport horse, racing horse, or pleasure horse may vary considerably as to intensity and potential chronicity.[5,6]

3. History and Clinical Signs

Distal limb lameness may present in a peracute fashion with extreme discomfort such with a P3 fracture or foot abscess, but more often, signs may be more subtle with the horse having a subtle lameness that changes somewhat with work. "Gee doc, he feels tight in his shoulders," is a frequent comment for more insidious forms of early front distal limb lameness. Distal hind limb issues may mimic more commonly thought-of conditions such as distal tarsitis or proximal suspensory desmopathy in that the horse is "weak" behind and may "warm out" of the lameness. Some heat or swelling may be perceived in the distal limb, but often this is not the case. The current competitive environment in North America often allows for nonsteroidal anti-inflammatory drug (NSAID) use in competing horses; horses with mild distal limb pain are able to compete comfortably. However, when Monday morning rolls around and the effects of the NSAIDS are gone, the horse is suddenly more uncomfortable than before the event. This presents a good opportunity to investigate the case.

Horses may present with a unilateral lameness of varying degrees (0–5/5) or appear bilaterally lame, especially if circled or ridden, which will be discussed later. Some lameness may be very subtle and will require special efforts to make it more apparent for an objective diagnosis. Many horses vary in their degree of lameness, improving profoundly with a few days of rest. Such mild lameness issues may be best re-examined after a day or two of exercise.

4. Physical Examination

This author is of the opinion that it is essential to have periodic veterinary inspections of the training sport horse to catch subtle lameness and performance problems before they become serious clinical issues. Although many trainers and owners are very adept at catching subtle soundness and health related issues, many things may be overlooked by the individual who sees the horse every day. Periodic veterinary inspection should include a general health check and a thorough lameness evaluation. The frequency of these exams will be somewhat dependent on the age and activity of the horse, but two to four times yearly should be a minimum. Horses with successfully managed orthopedic disease may need to be checked more often.

A typical lameness examination should first involve a thorough visual exam of the horse, taking notice of body symmetry and muscle structure. Observing the horse in its stall may give the examiner some clues regarding the horse's level of comfort. Watching the horse step out of its stall may give big clues about chronic lameness issues. After the visual inspection, a palpation examination should be performed. The author uses a modification of an "acupuncture" examination that allows for complete palpation of the horse while eliciting responses from potentially painful areas. Careful inspection of the feet for balance and symmetry should be performed. Flexion manipulations can then be performed in a "passive" sense (not asking the horse to walk or jog away) while noting any resistance or painful responses. It may be appropriate to use hoof testers at this point before starting any exercise. Next, the horse can be moved in hand at a walk and trot, taking note of any obvious lameness or unusual foot flight or limb motion. This is best performed on hard footing if available. It is useful to see the horse walk in circles as well as on a straight line. Likewise, jogging the horse in circles as well as in a straight line may provide much more insight related to the horse's level of comfort. If the horse is too fractious to lunge in circles, jogging in hand on circles may provide an acceptable alternative. The author frequently gives a small dose of sedative (detomidine hydrochloride, 1.5 mg total dose)[a] to evaluate lameness if the horse is not well-behaved. Watching the horse move in straight lines and circles on both hard and soft footing can be immensely valuable in detecting lameness.

The next step is to perform flexion tests of all limbs with the horse then walking or trotting away. These may give clues to soreness that is not otherwise evident. It may be worth pursuing some positive flexion responses or readily apparent lameness at this point while simply recording some others for future reference. Keep in mind that a positive distal limb flexion may indicate a problem in any number of places, from the distal interphalangeal joint (DIPJ) to even a suspensory ligament issue. It is a tool for regionalization and augmentation for observation purposes.

"Wedge" tests are sometimes useful to aid in localization of the source of lameness. A reverse wedge that stretches the deep digital flexor tendon (DDFT) may increase a lameness related to that structure; a wedge placed laterally under the foot may stretch the medial collateral ligament of the DIPJ and increase lameness if that structure is injured. The latter effect is because of compression on the same side as the wedge and rotation of the DIPJ on the contralateral side that stretches the collateral ligament on that side.[1]

Care should be taken to not overexert the very lame horse (>3/5) until a good sense of the nature of

the problem is recognized. A detailed record of observations should be maintained for each examination. After flexion tests, it is advisable to observe the horse work on a lunge line and under saddle. Some horses are difficult to lunge and may pose a hazard for injury to horse and handler. These horses should be lightly sedated or simply watched under tack. Many lameness conditions are not otherwise apparent until a rider is aboard and/or the horse is asked to do more work.

The riding examination may give the veterinarian a great deal of information not otherwise apparent during the in-hand exam. Rider weight may change the balance of the horse in such a way as to augment lameness. Weight on the back may be the source of discomfort and may be demonstrated by a change in the shape of the back, height of head carriage, shortening of stride, or disobedience. The horse should be asked to perform the various gaits while under saddle and carefully observed for changes in the level of lameness with each gait, transitions from one gait to another, and at directional changes. Distal limb lamenesses of the lower limb are often exacerbated by circling, especially on hard footing.[5] Directional changes may enhance this effect and most significantly at the initiation of the change in direction.

It is very important to consider more than just the "limbs" when searching for the answer to lameness and performance problems. Axial skeletal issues may arise that can produce serious limitation in function and may cause diminished function that mimics distal limb lameness. Sacroiliac strain and lower lumbar pain are frequently encountered in jumping and dressage horses. Back pain may sometimes manifest as lameness in a hind limb. Neck pain related to muscle or ligament strain may make the horse unwilling to work in a specifically desired manner. Osteoarthritis of the cervical synovial facets may produce front limb lameness and should be taken into account during the physical examination.

At this stage of the examination, the examiner should have a good sense of the severity of any lameness and may proceed with further diagnostics such as nerve blocks. It should be noted that if the degree of lameness suggests that further damage may be incurred by exercise or exercise with regions desensitized, the author will go straight to radiography or ultrasound in select cases.[6] Diagnostic nerve blocks are the author's next diagnostic procedure of choice after the physical examination as long as they are deemed safe, relative to the severity of the lameness. Severely lame horses may be at risk because of limb instability and could suffer more damage if blocked and exercised in some fashion. Many lameness conditions look alike and flex alike; however, they are not of the same origin. If the lameness is of sufficient grade to produce a clear contrast and has not been reduced by exercise, for example, warming up, the examiner would be wise to pursue the lameness with diagnostic nerve blocks. Once localized, further physical examination, radiographs, and diagnostic ultrasound may further elucidate the nature of the problem. In some cases, physical examination and diagnostic imaging may be sufficient to clearly define the diagnosis, and, in such cases, nerve blocks may not be required, allowing the veterinarian to proceed with appropriate therapy.[7] More complicated cases may require more advance imaging techniques such as nuclear scintigraphy, magnetic resonance imaging (MRI), or computed tomography (CT).

5. Diagnostic Anesthesia

Distal limb regional anesthetic techniques are straightforward to perform and applicable for use, except for the most fractious of horses. Mild sedation of the more difficult horse may aide the process and still permits a working examination, as previously mentioned. The distal digital nerve block (posterior digital block) should be the initial block performed just proximal to the level of the collateral cartilage.[8] The use of a smaller amount of anesthetic agent (mepivicaine 2%)[b] such as 1.5 to 2 mL over each nerve, in the author's experience, will provide a reliable anesthetic effect at 5 to 8 minutes, with less likelihood of affecting more proximal structures through proximal diffusion. Checking the foot with hoof testers before and after the block will provide information about its efficacy. One may wish to block only one nerve at a time if hoof testers indicate significant asymmetrical pain; however, failure of this block does not eliminate the possibility of an asymmetrical cause, in this author's experience. The sole region, podotrochlear apparatus, and DIPJ may be anesthetized with this block most commonly. Occasionally some improvement of proximal interphalangeal joint (PIPJ)-related lameness may be produced by this block, probably because of the close proximity of the large palmar pouch of that joint.

Lack of response to the distal digital nerve block does not rule out the foot as a source of lameness because the distal limb may be incompletely blocked. In the author's experience, common conditions such as a severe hoof abscess sometimes require more proximal anesthesia. There are multiple options for anesthetic techniques at this point. One may elect to simply move more proximally to the proximal digital nerve block or basi-sesamoid block just distal to the fetlock joint. This block may effectively anesthetize the more dorsal structures of the digit that are sometimes missed with the distal digital nerve block; however, more proximal regions such as the fetlock joint and associated anatomy may be anesthetized.[9] Intra-articular anesthesia of the DIPJ with 5 mL of anesthetic agent may render the horse sound when the distal digital block did not have this effect. This is certainly more confining to the foot but not specific to the DIPJ because the distal aspect of the deep digital

flexor, navicular impar ligament, and navicular bone may be anesthetized as well. It has been reported that horses demonstrating MRI evidence of DDFT lesions do not reliably improve with palmar digital anesthesia, but 68% are improved with anesthesia of the distal interphalangeal joint.[10]

It has been proposed that lameness related to the distal DDFT may be diagnosed with an intrathecal block of the distal digital tendon sheath (3–5 mL), and certainly this may be true, but it must be kept in mind that this anesthetic technique can affect other structures on the palmar pastern such as the straight distal sesamoidean ligament and middle scutum.[11]

Anesthesia of the navicular bursa may be performed accurately with the use of radiographic or ultrasound guidance in a compliant patient. Three milliliters of anesthetic agent is sufficient to establish a block. The author prefers to perform this block with the limb held up by an assistant using a previously described navicular position technique[12] and confirmed by radiographic imaging. The author believes that this block is certainly specific to the foot and is a good indicator of problems in the podotrochlear apparatus.

The PIPJ may be selectively anesthetized also with either dorsal or palmar approaches, the latter being the author's preference. The large palmar pouch of the PIPJ reliably yields synovial fluid, and 5 mL of anesthetic will effectively block the joint in 5 to 8 minutes, in the author's opinion. The approach is oblique and appears to avoid the DDFT and digital sheath.

Ring blocks of the proximal pastern are probably the most inaccurate, and, in the author's experience, are subject to the most "drift" proximally and are rarely used by this author for diagnostics.

Proximal to the fetlock, the low volar or low four-point block is useful to regionalize the fetlock joint as the source of the lameness; however, this block may begin to drift proximally in as little as 10 minutes, in the author's experience. The author believes that intra-articular fetlock anesthesia, with the use of 5 mL of solution, is effective in assessing pain from the synovium and fibrous capsule and, in some cases, the immediate subchondral bone. Deeper subchondral lesions may not respond to this block.

6. Differential Diagnosis

Having established that the site of the lameness is the distal limb, the next step is to consider the differential diagnosis for the various issues in this region and the imaging techniques that can further establish a diagnosis. The most important imaging technique is simply thorough observation. Removal of the shoe certainly is the first of these techniques and may reveal a great deal. Foot symmetry, obvious deformity, and readily apparent pathology may establish a diagnosis without technical imaging. It is probably not indicated to immediately move to radiographic imaging of an acute abscess or heel bruise, but, if these prove refractory to treatment, that may not be the case. A profoundly effusive fetlock that is palpably uncomfortable and painful to flexion should probably be imaged with radiography and ultrasound regardless of other steps taken.

Careful assessment of flexion responses, nerve block results, and more thorough physical examination may reveal information concerning conditions of the hoof capsule and sole, along with some issues more proximally in the digit, but it is most likely that some form of technical imaging will need to be used to identify the origin of the lameness. The more common issues to consider are below:

- Solar bruising, abscesses, keratoma
- Sheared heel syndrome
- P3 trauma/inflammation or rotation (positive, negative, and possible laminar tearing)
- Desmopathy of the DIPJ collateral ligaments
- Synovitis of the DIPJ
- Navicular bone/bursal inflammation/navicular impar desmopathy
- DDFT tenosynovitis and tendinopathy (including dorsal fibrillation, core lesions, and enthesiopathy in the more distal aspect)
- Collateral sesamoidean and chondrocoronal desmopathy
- Desmopathy of the distal digital annular ligament
- Inflammation of the pastern joint (PIPJ) and associated collateral and palmar ligaments
- Trauma to the middle scutum
- Desmopathy of the various distal sesamoidean ligaments
- Fetlock synovitis and osteoarthritis
- Proximal sesamoiditis and suspensory branch insertional enthesiopathies
- Subchondral bone trauma/inflammation at any of the articulations
- Distal metacarpal fractures

Some of these conditions may be a straightforward visual/physical diagnosis, but many—such as osteoarthritis, soft tissue injury, and subchondral bone inflammation—will require some degree of technical imaging (such as MRI) to elucidate. Most often the above-mentioned conditions occur in various combinations related to function, foot balance, and sport discipline.

7. Imaging

Radiography remains the gold standard for imaging of the equine distal limb. Fractures, osteoarthritis, enthesiopathies, P3 rotation and malposition, advanced subchondral bone changes, and dystrophic mineralization are frequently detected in this manner. Many soft-tissue abnormalities may escape detection with radiography, but some subtle signs of

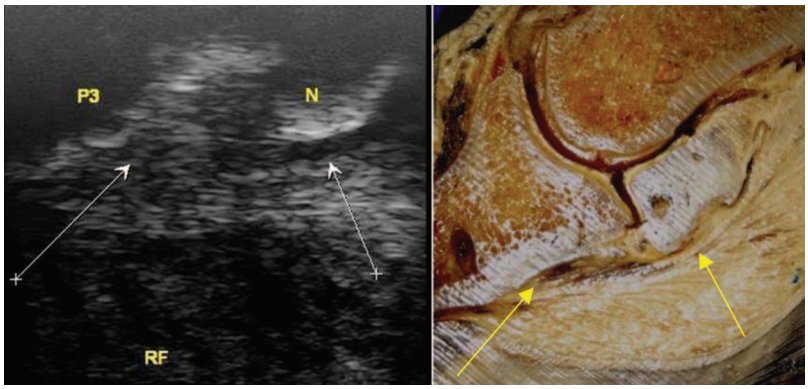

Fig. 1. Sonographic transcunean view and comparative anatomy of the DDFT coursing over the navicular flexor surface (right arrows in each image) and the insertion on P3 (left arrows in each).

problems may be evident because modern digital radiograph has improved overall image quality.

Ultrasound can be the next step in evaluating problems of the distal limb. Good knowledge of the anatomy is required to properly evaluate the structures, but most of the tendinous and ligamentous structures may be readily imaged. Collateral ligament desmopathies and flexor tendon injuries are easily evaluated with a 7.5–12-MHz linear transducer. The palmar fetlock and pastern, dorsal fetlocks and pastern, and dorsal coronet may be examined. The palmar aspect of the foot, with some trimming and soaking preparation of the frog, may be examined by means of a transcunean approach to visualize the distal DDFT, the navicular bone, and the insertion of the DDFT on P3 (Fig. 1).[13] The proximal aspect of the navicular bone, the bursa, and collateral sesamoidean ligaments may be visualized with an 8–10-MHz, microconvex probe placed between the bulbs of the heel. It should be mentioned that the distal insertion of the DIPJ collateral ligaments are beyond the view of the ultrasound probe because the hoof wall blocks the view.

Nuclear scintigraphy is very useful in further regionalizing the source of the lameness. It can be very helpful in determining what other diagnostics or imaging modalities might be best used. Areas of increased radioisotope uptake (IRU) are characteristic to some structures in working horses and knowledge of this is required,[14] but this imaging modality can be extremely helpful in evaluating the significance of the findings of other modalities such as radiography and ultrasound. A suspicious-looking navicular bone on radiography that demonstrates dramatic IRU on scintigraphy is thought to have more clinical significance in arriving at a diagnosis of navicular bone inflammation (Fig. 2).

In recent years, MRI has become more available to many equine practitioners for lameness evaluation. Although high-field magnets may produce a more detailed image, they currently require general anesthesia for imaging. The standing units are low-field magnets, and image resolution is not as high, but they are nonetheless capable of providing diagnostic images. A specific region should be identified before the MRI because the ability to image

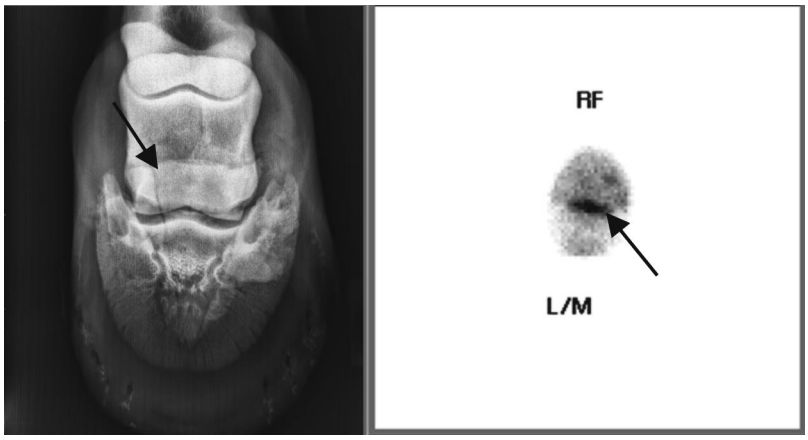

Fig. 2. Radiograph of navicular bone and corresponding solar view scintigraphy (right image) with IRU (arrows indicate the navicular bone in each image).

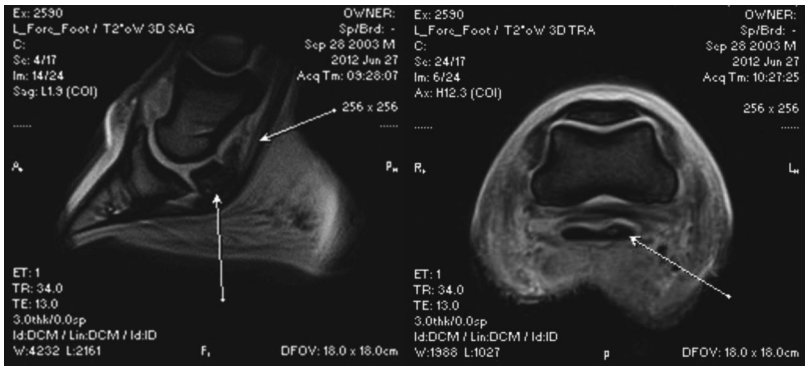

Fig. 3. Magnetic resonance image on left demonstrates mixed hyperintense and hypointense signals (lower arrow) associated with bone edema and sclerosis in the T2*oW series; upper arrow on left image demonstrates a core lesion in the DDFT; single arrow on the right MRI demonstrates a core lesion in the DDFT corresponding to that seen in the left image.

multiple regions is limited. MRI provides increased detail of the anatomy and pathology of the foot over other modalities currently used clinically.[15] Soft tissue issues not otherwise apparent may be readily visible with MRI. Changes in specific sequence signals related to processes such as bone inflammation are often evident with MRI before any appreciable radiographic changes are evident. The advantage in this is that detection of bone trauma and inflammation at an earlier stage may allow for more specific treatment modalities and exercise management (Fig. 3).[16] The use of computed tomography (CT), and especially contrast CT, has a similar application as does MRI in that it may demonstrate soft-tissue injuries as well a bone abnormalities.

The previously discussed imaging modalities are those most often used by this author. Choosing appropriately from this combination of modalities should give the practitioner specific information that increases the significance of physical exam findings and local anesthetic blocks, leading to a reasonable diagnosis.

8. Conclusions

Today's sport horse represents a significant economic and emotional investment for the horse owner. Precise and accurate diagnosis that is done in an efficient and thorough fashion is essential and will be appreciated by the client. The modern private practitioner has many basic skills that should be included in the basic work-up of a lameness case before embarking on advanced-level imaging. Advanced imaging modalities can ultimately lead to a very accurate and time-efficient diagnosis.

References and Footnotes

1. Denoix JM. Course notes: module 1, series 2. In: *The Foot and Pastern.* Middleburg, Virginia: The International Society of Locomotor Pathology; 2008.
2. Denoix JM, Houliez D. Déformations du pied à l'appui. In: *Proceedings.* Congrès de Podologie Vétérinaires-Maréchaux-Ferrants. Cluses, France. 1997:54–61.
3. *Nomina Anatomica Veterinaria.* 5th edition. International Committee on Veterinary Gross Anatomical Nomenclature, Integumentum Commune, Knoxville, TN; 2012:156–158.
4. Lawson SEM, Chateau H, Pourcelot P, et al. Effect of toe and heel elevation on calculated tendon strains in the horse and the influence of the proximal interphalangeal joint. *J Anat* 2007;210:583–591.
5. Ross M. Lameness in horses: Basic facts before starting. In: Ross M, Dyson SJ, editors. *Diagnosis and Management of Lameness in the Horse*. Philadelphia: Saunders; 2003:3–8.
6. Boswell RP, Mitchell RD, Dyson SJ. Lameness in the Show Hunter and Show Jumper. In: Ross M, Dyson SJ. *Diagnosis and Management of Lameness in the Horse.* Philadelphia: Saunders; 2003:951–975.
7. Dyson SJ. The swollen limb. In: Ross M, Dyson SJ, editors. *Diagnosis and Management of Lameness in the Horse.* Philadelphia: Saunders; 2003:150–151.
8. Schumacher J, Taylor DR, Schramme MC, et al. Localization of pain in the equine foot emphasizing the physical examination and analgesic techniques, in *Proceedings.* Am Assoc Equine Pract 2012;58:138–156.
9. Daniel AJ, Judy CE, Saveraid T. Magnetic resonance imaging of the metacarpo(tarso)phalangeal region in clinically lame horses responding to diagnostic analgesia of the palmar nerves at the base of the sesamoid bones: five cases. *Equine Vet Educ* 2013;25:220–228.
10. Dyson S, Murray R, Schramme M, et al. Lameness in 46 horses associated with deep digital flexor tendinitis in the digit: diagnosis confirmed with magnetic resonance imaging. *Equine Vet J* 2003;35:681–690.
11. Schramme MC. Deep digital flexor tendonopathy. *Equine Vet Educ* 2011:12:403–415.
12. Schramme MC. An in vitro study to compare 5 different techniques for injection of the navicular bursa in the horse. *Equine Vet J* 2000;32:263–267.
13. Jacquet S, Denoix JM. Ultrasonographic examination of the distal podotrochlear apparatus of the horse: a transcuneal approach. *Equine Vet Educ* 2012;24:90–96.
14. Dyson SJ, Martinelli MJ. Image description and interpretation in musculoskeletal scintigraphy. In: Dyson SJ, Pilsworth RC, Twardock AR, et al, editors. *Equine Scintigraphy.* Suffolk, United Kingdom: Newmarket; 2003:89–91.
15. Greet T. Foreword. In: Murray RC, editor. *Equine MRI.* West Sussex, United Kingdom: Wiley-Blackwell; 2011:xi–xii.
16. Mitchell RD, Edwards RB, Makreel LD, et al. Standing MRI lesions identified in jumping and dressage horses with lameness isolated to the foot, in *Proceedings.* Am Assoc Equine Pract 2006;52:422–426.

[a]Dormosedan, Pfizer Animal Health, Exton, PA 19341.
[b]Carbocaine-V, Pharmacia and Upjohn Company, Division of Pfizer Inc, New York, NY 10017.