Diagnosis of Palmar Foot Pain in Horses

Tracy A. Turner, DVM, MS, Dipl. ACVS
Anoka Equine Veterinary Services
Elk River, Minnesota

The palmar digital nerve block desensitizes the palmar one-third to one-half of the foot. Lamenesses in this region account for more than one-third of all chronic lamenesses in the horse. It must be understood that a palmar digital nerve block simply localizes the source of the pain the horse senses to the back of the foot. It is important to identify as specifically as one can the pathological and clinical findings. This in turn will help the clinician make their best assessment of the problem, and recommend the most specific treatment.

There are numerous causes of pain in the palmar aspect of the foot of the horse. These causes can be arbitrarily divided into conditions of the hoof wall and horn producing tissues, conditions of the third phalanx, and conditions of the podotrochlear region. Hoof problems would include hoof wall defects, such as cracks or clefts that involve the sensitive tissue; any laminar tearing, separation or inflammation; contusions of the hoof causing bruising or corn formation; abscess formation; and pododermatitis (thrush or canker). Third phalanx lamenesses blocked out by a palmar digital anesthesia would include wing fractures, marginal fractures, solar fractures, or deep digital flexor insertional tenopathy. Conditions of the podotrochlear region have been reported to include distal interphalangeal synovitis, deep digital flexor tendinitis, desmitis of the impar (distal navicular ligament) or collateral sesamoidean ligaments, navicular osteitis or osteopathy, and vascular disease. The common denominator of all these conditions is that they are characterized by pain that can be localized to the caudal aspect of the hoof.

The first step in developing a logical approach to the treatment of palmar hoof pain is accurate assessment of the pain and careful evaluation of hoof structure that may predispose to or cause the pain. Four diagnostic tests should be performed: hoof tester examination, distal limb flexion, hoof extension wedge test, and palmar hoof wedge test. A positive response to any of these tests is important but a negative response is equivocal and does not rule out any problem. Hoof tester examination should begin with systematic evaluation of the sole and then to the distal sesamoid region which includes the collateral sulci to opposite hoof wall, central sulcus to toe, and across the heels. A positive response should be repeatable, and in the distal sesamoid region the pain response should be uniform over those areas and must be evaluated in relation to examination of the remaining foot. That is, a positive response in the heels and quarters of the sole would also be expected to cause a positive response across the distal sesamoid region in the same area of the foot. Percussion utilizing a small hammer can also provide important information regarding pain in the hoof wall or sole.

Distal limb flexion test may exacerbate lameness if any of the three distal joints of the leg are affected by synovitis or osteoarthritis. A positive response could also be expected by any condition that causes induration of the tissues of the foot. This has been shown to be positive in over 95% of horses with palmar foot pain.

The hoof extension test is performed by elevating the toe with a block, holding the opposite limb, and trotting the horse away after 60 seconds. The palmar hoof wedge test is performed by placing the block under the palmar two-thirds of the frog and forcing the horse to stand on that foot. The test can be further modified so that the wedge can be placed under either heel to determine if the pressure there causes exacerbation of the lameness.

Typically, all these before mentioned lamenesses will be improved by at least 90% after perineural anesthesia of the palmar digital nerves but it does not help differentiate these lamenesses. Anesthesia of the distal interphalangeal (DIP) joint or the podotrochlear bursa are additional procedures that provide information about palmar hoof pain. In a study reported by Dyson, in 95% of the horses examined using DIP and bursa anesthesia, significant new information about the pain the horse exhibited was realized. The pain relief by anesthesia of any of these three regions have been shown to overlap. The DIP joint and podotrochlear bursa do not communicate, and yet the results of injecting anesthetic into these synovial cavities is similar. Both cavities have in common the navicular bone, the impar ligament, and the collateral sesamoidean ligament (proximal suspensory ligament of the navicular bone). The neuroreceptors for the navicular bone are in those 2 ligaments and they can be anesthetized from either synovial cavity. Further, Bowker has showed that the palmar digital nerve is in very close proximity to the medial and lateral limits of the bursa and the nerve may be anesthetized at this level whenever the bursa is injected. Palmar foot pain can be divided into 5 groups, those horse with navicular region pain (desensitized by DIP analgesia and bursa analgesia, as well as palmar digital analgesia), those with distal interphalangeal pain (desensitized by DIP analgesia, as well as palmar digital analgesia but not bursa analgesia), those that are not desensitized by DIP analgesia but are desensitisized by bursa analgesia, as well as palmar digital analgesia, those that are improved by either DIP or bursa analgesia but are not sound but are sound after palmar digital analgesia, and those that are not desensitized by either DIP or bursal analgesia but are desensitized by palmar digital analgesia. It has also been noted recently that injection of the podotrochlear bursa can be very difficult and that it is quite easy to inject the DIP joint instead. We have found that not only is radiographic control necessary to successfully perform this block but that adding contrast media to the anesthetic to prove the limits of the block is also necessary.

This has lead to a new method of assessing navicular pathology, by evaluating the cartilage of the flexor surface of the navicular bone by contrast arthrography.Injection into the bursa was made from the palmar surface with the limb flexed at the carpus. Aseptic injection techniques were used to inject a 3ml mixture of 1:1 contrast material and local anesthetic. The landmarks for needle insertion were just proximal to the central sulcus of the frog with the needle directed in line with the apex of the frog and in a direction parallel to the ground surface of the hoof. An 20 gauge 3.5 inch needle was used. The needle was inserted until resistance was encountered, this was usually at 2/3 the length of the needle. If the needle was inserted further it usually indicated incorrect placement. A lateral radiograph of the hoof was taken to confirm the position of the needle prior to injection. Ideally the needle should be midway between the proximal and distal borders. Once needle position was confirmed the bursa was injected with the contrast mixture and a second lateral hoof radiograph was taken to confirm filling of the bursa. If the bursa has been injected, then a PP-PD oblique projection of the navicular bone was obtained.

A distinct line of contrast material juxtaposed to the deep digital flexor tendon was normally separated from the navicular cortical bone by a layer of radiolucent fibrocartilage. Five basic findings were noted on contrast navicular bursography: (1) normal flexor fibrocartilage, (2) thinning or erosions of the flexor fibrocartilage (confirmed by post mortem examination in 3 cases), (3) Complete focal loss of the dye column which was thought to be due to flexor tendon adhesions to the bone (confirmed by post mortem in 2 cases), (4) presence of flexor subchondral bone cystic defects which was noted as focal filling of the flexor cortical area with contrast, (5) fibrillation of the deep flexor tendon which was noted as filling defects along the bursal surface of the deep flexor tendon. Normal fibrocartilage was seen in 13% of the examinations. Thinning or erosions of the flexor fibrocartilage was seen in 69% of the bursograms. Adhesions (loss of the dye column) were noted in 8% of the cases. Filling defects of the navicular flexor surface was noted in only 2% of the horses. Fibrillation of the deep flexor tendon was recognized in 21% of the horses. When the cases were divided between horses with navicular pain and palmar foot pain according to the criteria described by Turner[4] more interesting comparisons could be made. Horses with normal flexor cartilage were more likely to have navicular pain (np) (8 of 97) rather than palmar foot pain (pfp) (5 of 97). This is in contrast to horses with cartilage thinning or erosions where horses with palmar foot pain were more likely to exhibit this change (38/ 97 for pfp versus 29/97 for np). Horses thought to have adhesions, all were in the navicular pain group while there was no difference in horses with flexor filling defects (1/97pfp and 1/97np). Horses showing tendon fibrillation were also more likely to show palmar foot pain (14/97) rather than navicular pain (6/97). Contrast navicular bursography indicated pathology in the flexor cortex region 60% more often than plain film radiography.

Navicular bursography was devised due to the necessity to confirm injection of local anesthetic into the bursa. The bursa is not only a small space but is also in close proximity to other synovial structures such as the distal interphalangeal joint or distal tendon sheath. Because of this the bursa can be difficult to inject. Use of this technique allows one to know bursa injection has occurred. The contrast study was begun once it was realized that one could identify the flexor fibrocartilage of the navicular bone. After, the changes that were noted were simply identified and recorded for every case.

Interestingly, normal flexor fibrocartilage was noted more frequently in horses thought to have navicular pain. This finding tends to refute the long believed premise that navicular disease begins as damage to the flexor fibrocartilage or at the very least suggests that there may be more than one pathogenesis of navicular pain. Following these cases with subsequent bursography would be a method to follow the pathogenesis of these cases. To date, we have not repeated the bursography on any case.

The most common change noted on the bursograms was that of flexor cartilage thinning. However, when horses lame due to navicular pain were compared to horses lame due to other pain in the palmar foot there was no statistical difference between the 2 groups although the change occurs more frequently in the pfp group. This may reflect that this change is a normal wearing process or it may be either a primary or secondary response. Rooney has shown that toe first landing can lead to this change. Toe first landing may be seen with any cause of palmar foot pain. It would follow then that the change in biomechanics from the toe first landing is causing this change rather than some other biomechanical reason. The results of this study would tend to support that reasoning since this change was more common in pfp cases. Further, this would underline the importance of pain management in these cases in order to get the horse to load the foot correctly.

Adhesion formation was only noted in horses with navicular pain; whereas, flexor filling defects occurred equally in navicular as well as other causes of palmar foot pain. This indicates that the adhesions are associated with navicular pain but that defects on the flexor surface may be developmental and have no effect on pain. Lesions of the flexor surface of the deep flexor tendon have been noted and some have suggested that this may be an early navicular pathology. However, in this study fraying of the tendon was seen more than two times more often in the palmar foot pain group. In most cases, tendon fraying was associated with flexor fibrocartilage thinning and erosions (12 of 20 cases). At this time no speculation can be made which came first.

Overall, navicular bursography is a simple technique that can be used to confirm injection into the navicular bursa and can also give valuable new information regarding pathology in the region of the navicular bone. Changes seen via contrast navicular bursography represent stages of pathologic damage and allows more timely therapeutic intervention and more accurate prognostication. The author=s approach to these types of cases is to develop a treatment strategy based on the individual case needs rather than a treatment formula. Bursography has improved the ability to identify pathology such as flexor cartilage erosions and to utilize therapy such as chondroprotective agents, identification of tendon injuries causes concern for tendinitis and strict rest to allow healing of the tendon can be instituted and the identification of adhesions has been a grave prognositic indicator for conservative management. This technique also provides a means to study the pathogenesis of navicular disease or navicular pathology because it provides important information about anatomical structures that have only been able to be evaluated at post mortem. By utilizing this technique we can further our understanding of navicular problems.

Recently it has become possible to examine the podotrochlear region sonographically. In order to examine the podotrochlea the superficial horn must be pared from the frog to expose soft, spongy frog tissue. Next, sonographic gel is liberally applied to the frog. The ultrasound transducer is then applied to the frog. Images of the podotrochlea are apparent from the center of the frog to the apex. A 7.5 MHZ probe provides the best image.

Generally, at the center third of the frog, the flexor surface of the navicular bone is readily noticeable as a hyper echoic line. The bursa is seen as a hypo echoic (fluid filled) region juxtaposed to the navicular bone. The deep flexor fibers can be seen curving around the bone. As the probe is moved toward the apex of the frog, the distal aspect of the navicular bone can be identified as can the intersection between the deep flexor tendon and the impar ligament. As the probe reaches the apex of the frog the deep flexor’s insertion on the third phalanx becomes apparent.

Ultrasound is an excellent means to visualize soft tissue structures. However, examination of the foot has been limited to the pastern because the hoof capsule served as a barrier to examination of the hoof. The proximal regions of the navicular bone could be examined if one had a special probe that would fit between the bulbs of the horse’s heels. However, this gave no information as to what may be occurring further distally. The frog however, because of its high water content can serve as the hoof’s “stand off”. By removing the hard, outer layers this exposes tissue that can transmit sound waves allowing the examiner to see this distal tissues.

Radiography of the navicular bone includes a minimum of 5 projections of each foot, the D65Pr-PaDiO, the D45Pr-PaDiO, the lateral to medial, the PaPr-PaDiO projection, and a horizontal DP projection. Projections are assessed for changes of the navicular bone including enlarged synovial fossa, enthesiopathy, cyst-like formations, or changes of the flexor cortical region. Radiographic examination is the imaging method most often used to assess osseous changes in the distal sesamoid bone and third phalanx. These changes with the exception of fractures are usually not pathognomonic but do provide insight into damage that has occurred to the foot. Fractures also may not be radiographically visible until 10 to 14 days after the injury occurred.

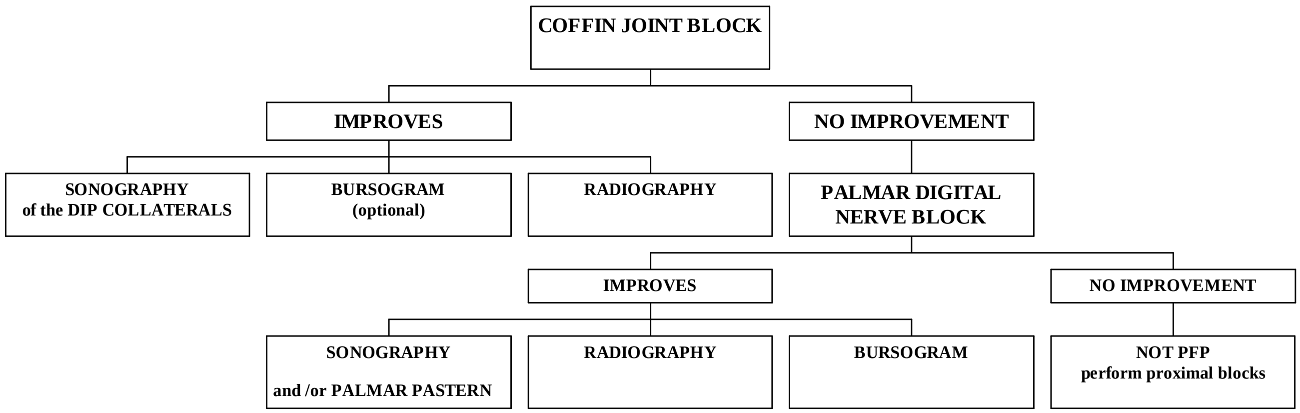
Scintigraphy is a technique that measures gamma ray emission from a radioactive nuclide injected into the animal. The technique provides information on relative vascularity and rate of tissue metabolism. This is particularly useful in studying bone pathology and can help differentiate sites of injury in the foot.

Thermography provides information regarding skin temperature. It has been shown to be useful in assessing the relative blood flow to a region. This information is of particular interest when pre- and post exercise temperatures are determined. Exercise will normally cause a 0.5^{o}C rise in skin temperature. Whenever, the skin temperature does not rise, poor blood flow should be considered a factor in the disease being assessed.

Through thorough examination of the horse affected by pain in the palmar region of the foot a more precise diagnosis can be made, whether the diagnosis reflects injury to the hoof capsule, third phalanx, or podotrochlear region. Treatment then should be based on the type of injury. There are differences in the clinical presentation of navicular region pain (NRP) and palmar heel pain (PHP). The University of Minnesota has had an ongoing prospective study of these findings. So far approximately 54% of the cases seen are effected by NRP and 46% by other sources of PHP. Clinical signs for these two groups have shown interesting differences. Distal limb flexion has been positive in 100% of the NRP and only 88% positive in horses in the PHP group. Hoof tester examination which is considered a cardinal sign of navicular problems was positive in only 54% of the horses with NRP as compared to 65% for those with PHP. The frog wedge was positive in 79% of the NRP as compared to 70% of the PHP horses; whereas, the toe wedge was positive 64% in NRP and only 43% in PHP. Circulatory testing indicated that only 26% of the NRP horses had poor circulation as a component to their disease, compared to 53% of the PHP horses having compromised circulation. Scintigraphy was positive in only 62% of the NRP cases indicating that pain can be present without scintigraphic changes. Also 20% of the PHP horses has a positive bone scan indicating that the navicular bone may be involved in a complex problem of heel pain.

Thorough examination of the horse affected with navicular syndrome is important not only to determine that the horse has the syndrome but also to try to determine which type of disease process is at work. Treatment then should be based on the type of injury.

LAMENESS



Flow chart for palmar foot pain diagnosis

REFERENCES:

1. Turner TA, Fessler JF: The anatomic, pathologic and radiographic aspects of navicular disease. Comp Cont Ed, 4(8): S350-S355, 1982.
2. Turner TA, Fessler JF, Lamp M, Pearce JA, Geddes LA: Thermographic evaluation of horses with podotrochlosis. Am J Vet Res 44(4):535-539, 1983.
3. Turner TA, Kneller SK, Badertscher RR, Stowater JL: Radiographic changes in the navicular bones of normal horses. Proceedings, 32nd Annual Meeting of Am Assoc of Equine Practnr, 32: 309-314, 1986
4. Turner TA: Predictive value of diagnostic tests for navicular pain. Proceedings 42nd Annual Meeting Am Assoc Eq Practnr, 42: 201-204, 1996.
5. Turner TA: Use of navicular bursography in 97 horses. Proceedings, 44th Annual Meeting Am Assoc Eq Practnr, 44: 227-229, 1998.
6. Sage AM, Turner TA: Ultrasonography of the soft tissues of the equine foot. Eq Vet Educ, 4: 278-283, 2002.