The first reference to navicular disease appeared in the Grand Marechal, Expert et Francais published in Toulouse in 1701, by an unknown author who described the condition as an erosion of the cartilage of the navicular bone (Fleming 1869, cited by Hickman, Equine Vet J, 1989). Since then, navicular disease has become recognized as one of the most common causes of lameness in the horse. Signs of the disorder are characterized by gait changes related to pain emanating from the heel portion of the foot. Horses of various breeds and uses may be affected, and many become so lame that they are no longer useful.

Anatomy (Function)
The navicular bone is one of three sesamoid bones in the lower limb of horses. A sesamoid bone is one that is located inside or in close association with a tendon. The function of a sesamoid bone is to increase the mechanical effect of the tendon. In this case, the navicular bone increases the mechanical effect of the deep digital flexor tendon in the support and movement of the horse’s lower limb and foot. The navicular bone is canoe-shaped and its long axis is oriented horizontally (Figure 1). It lies behind the junction of the short pastern and coffin bones, and forms the back portion of the horse’s coffin joint (Figure 2).
Navicular Diseases

The navicular bone is supported by three ligaments (Figure 3). From above, the navicular bone is stabilized by paired collateral sesamoidean ligaments which arise from the end of the long pastern bone and attach to the top border and extremities of the navicular bone. Below, the navicular bone is stabilized by the distal sesamoidean impar ligament. This ligament attaches the bottom border of the navicular bone to the back of the coffin bone.

Biomechanical Considerations

During all functions (rest and exercise) at least three forces act on the navicular bone: 1) compression forces from the deep digital flexor tendon, 2) compression forces from the short pastern bone, and 3) tension forces from the navicular ligaments. The size and effect of these forces are related to the horse’s weight, conformation, and use. Factors such as excessive body weight, small foot relative to body size, upright conformation, hoof imbalances, and work on hard ground all increase the forces acting on the navicular bone.

Lower limb conformation probably affects these forces more than any other factor. In horses with broken-back hoof-pastern conformation (Figure 4), all three forces acting on the navicular bone are increased. With this sloped toe/upright pastern conformation: 1) the resting tension on the deep digital flexor tendon is increased resulting in greater compressive forces on the navicular bone by the tendon; 2) the resting tension forces on the navicular ligaments are increased causing greater stress/strain on the ligaments; and 3) the pastern angle is elevated resulting in increased compressive forces on the navicular bone from the short pastern bone.

Pathogenesis (How navicular disease happens)

In its most common form, navicular disease is a chronic progressive condition that affects the navicular bone, navicular bursa, and deep digital flexor tendon. Although many aspects of navicular disease remain unclear, abundant information indicates that it is a degenerative disorder similar to arthritis. It is important to note that, almost without exception, the pathologic changes associated with navicular disease are restricted to the flexor surface (back surface) of the bone. The coffin joint surface (front surface) of the navicular bone is rarely affected.

The navicular bursa is similar to a joint except that the apposing surfaces are composed of fibrocartilage and tendon rather than joint cartilage (Figure 2). Overt, microscopic, and chemical studies of the lining of the navicular bursa, the flexor surface fibrocartilage, and the deep digital flexor tendon from horses with navicular disease have demonstrated pathologic changes similar to those reported in arthritic joints of animals and humans (Figure 5A and B). Bone thickening and fibrosis of the marrow spaces beneath the flexor surface of the navicular bone of horses with navicular disease are very similar to the changes seen in arthritic joints. Increased pressure within the navicular bone (increased intraosseous pressure) related to impaired blood flow has also been identified in horses with navicular disease. This is a common finding in people with arthritis and is believed to be the cause of the dull aching pain that often accompanies arthritis.

Given the similarities between navicular disease and arthritis, the cause of navicular disease is most likely mechanical in nature. With this in mind, navicular disease may develop in one of two situations: 1) the horse’s lower limb conformation is normal, but abnormal loads are applied to the navicular region, which cause the tissues to fail; or 2) the applied loads are physiologically reasonable, but the horse’s conformation is less than ideal, resulting in abnormal loading of the navicular region; again causing the tissue to fail. In both situations, there is an imbalance between the load applied and the capacity of the navicular tissues to withstand that load. Thus, if the tissue damage is excessive or repetitive, navicular disease will result.

Abnormal loads on the navicular structures could be caused by a single traumatic event (“a bad step”), overuse (i.e. work at a rate that does not allow adequate tissue repair or remodeling), excessive body weight, work on hard ground, and even erratic use (the horse is a “weekend warrior,” meaning acute bouts of overload are placed on tissues that are not adapted to that level of use). The erratic-use scenario helps explain why horses with histories of relatively

Figure 5: Pictures of a normal (A) and abnormal (B) navicular flexor surface (navicular bone, apposing surface of deep digital flexor tendon, and navicular bursa).

Figure 6: Hoof-testers applied in this area of the foot usually elicit pain in a horse with navicular disease.
light work may develop navicular disease. Examples of less than desirable conformation include upright pasterns, broken-back hoof-pastern axes, and under-run heels.

The pain experienced by horses with navicular disease may originate from inflammation of the navicular bursa, inflammation of the deep digital flexor tendon, inflammation of the navicular ligaments, and increased navicular bone intraosseous pressure. It is likely that different horses have different degrees of pain originating from each source.

**Signalment (Which types of horses are affected) and Clinical Signs**

Navicular disease affects horses of various breeds and uses. In North America, Quarter Horses and Thoroughbreds have a higher reported incidence than other breeds. Males, in particular geldings, appear to be at greater risk than females. Affected horses are typically 4 to 15 years of age. A heredity predisposition that may be related to conformation has been suggested. The disease almost exclusively occurs in the forelimbs but has been reported in the hindlimbs.

Horses with navicular disease usually have a history of an insidious onset of lameness. Early in the course of the disease, a change in the horse’s performance or attitude may be the only problem noted. Loss of the suppleness is a common complaint. Later, lameness usually becomes obvious and is characterized by a short, choppy gait. Affected horses are usually lame in both forelimbs, although the lameness may be predominant in one limb. Work on hard ground or in tight circles usually exacerbates the lameness. In advanced cases, horses may point the affected limb or limbs at rest, and one or both feet may become smaller (contracted) and more upright.

**Diagnosis**

Various techniques are used to help diagnose navicular disease. Affected horses usually resent hoof tester pressure over the middle third of the frog (Figure 6). Diagnostic nerve blocks are important in confirming the navicular region as the source of lameness. Affected horses usually demonstrate marked improvement in gait after a local anesthetic is placed over the palmar digital nerves (Figure 7). This temporarily deadens sensation to the heel portion of the foot. However, it is important to recognize that palmar digital nerve blocks are not specific for navicular disease as pain from other structures within the foot will also be blocked. The results of a successful block should always be interpreted in light of historical, clinical, and imaging information.

Radiographic (X-ray) evaluation of the navicular bone is commonly performed to help diagnose this disorder. When evaluating the navicular bone it is important that multiple radiographic views be obtained and that each of the images are of high quality. Radiographic findings that are considered indicative of navicular disease include specific changes in the shape and structure of the navicular bone (Figure 8). It is important to realize however, that the absence of navicular bone radiographic changes does not rule out a diagnosis of navicular disease (pain). This is because: 1) radiographic changes may not be present in the early stages of the disease; and 2) radiographs do not provide good evaluation of the changes occurring in local soft tissues (i.e., cartilage, tendons, and ligaments).

For cases in which radiographic changes are not clearly evident (equiva-
J.R., a 20 year old Arabian gelding, presented to EFS for routine oral examination and dental floating. Initial examination revealed that there was an enlarged space (2-3mm) between his lower left and right first incisors which is a major dental abnormality. J.R. also resented manipulation of this area. J.R. was then sedated to facilitate a more thorough oral examination. Once sedated, his incisors were carefully inspected. This examination revealed that the space between these lower two front teeth was packed with foul smelling feed material, and his lower right first incisor was loose when touched.

Some chewing efficiency exercises were performed to better assess how well J.R. was able to move his jaw when placed in a normal chewing motion. First the mandible was pushed to the left and the right to determine if any obstructions in the mouth, such as overgrown teeth or sharp enamel points, were causing his range of motion to be limited. His head was then lifted up and down to assess his ability to move his jaw forwards and backwards. J.R.’s mandibular mobility was found to be limited in both of these tests, indicating that he had at least one tooth on each side if his mouth that was altering normal chewing motion. These obstructions would need to be removed for J.R. to have normal jaw motion while chewing. J.R.’s mouth was rinsed out with a dilute Nolvasan solution to remove most of the grain and grass that remained in his mouth from his last meal. An oral speculum was placed to allow J.R.’s mouth to be opened enough to facilitate a thorough examination of his premolars and molars – these are the cheek teeth critical to the process of chewing. Both visual and tactile examinations were performed which revealed sharp enamel points that were actually cutting into his cheeks, likely causing considerable discomfort when eating. These sharp enamel points, in addition to causing discomfort, were also likely the reason for J.R.’s limited range-of-motion tests. Equine Field Service veterinarians used a combination of power and hand floating techniques to reduce the sharp enamel points. The aim of this treatment was to provide J.R. with the most efficient and pain free motion of his jaw while chewing his feed. Once the dental motion to be limited. His head was then lifted up and down to assess his ability to move his jaw forwards and backwards. J.R.’s mandibular mobility was found to be limited in both of these tests, indicating that he had at least one tooth on each side if his mouth that was altering normal chewing motion. These obstructions would need to be removed for J.R. to have normal jaw motion while chewing. J.R.’s mouth was rinsed out with a dilute Nolvasan solution to remove most of the grain and grass that remained in his mouth from his last meal. An oral speculum was placed to allow J.R.’s mouth to be opened enough to facilitate a thorough examination of his premolars and molars – these are the cheek teeth critical to the process of chewing. Both visual and tactile examinations were performed which revealed sharp enamel points that were actually cutting into his cheeks, likely causing considerable discomfort when eating. These sharp enamel points, in addition to causing discomfort, were also likely the reason for J.R.’s limited range-of-motion tests. Equine Field Service veterinarians used a combination of power and hand floating techniques to reduce the sharp enamel points. The aim of this treatment was to provide J.R. with the most efficient and pain free motion of his jaw while chewing his feed. Once the dental floating.

Before any manipulations were conducted to remove the diseased tooth and its fractured root, a few simple nerve blocks were performed to make the procedure as pain free as possible. Local anesthetic was also injected into the gingiva around the loose incisor. Taking great care and exercising patience, the gums and gingival tissues were elevated off of the tooth and its root until the tooth itself was very loose and could be easily extracted. The area of the bone that had held the root was gently scraped to remove the root fragment and any diseased bone. Another radiograph was taken to confirm that the procedure had removed all tooth fragments and any abnormal bone (Figure 11). The rest of his incisors were then filed to even his smile. J.R. was given intravenous Banamine for ongoing pain relief. The now-empty tooth socket was rinsed daily with dilute Betadine solution to keep the surface clean while the tissues healed. J.R. has done well since his incisor extraction, and receives yearly oral examinations and dental floating.

Horses have teeth that continue to erupt throughout most of their lives. The upper teeth do not line up perfectly with the lower teeth, which leaves about half of the

Continued next page
grinding surface of the teeth overhanging. As horses chew, they slowly file down the areas of their teeth that actually touch, but the overhanging areas continue to get longer and sharper. This process is what necessitates routine dental care in horses to keep sharp enamel points to a minimum and to make sure that some teeth do not become overgrown. Since J.R. is now missing a mandibular tooth, the opposing maxillary tooth is erupting without an opposing tooth to keep it filed down (Figure 12). This means that J.R.’s incisors need to receive yearly veterinary care to keep them even.

Some horses develop enamel points, hooks, ramps, waves, etc. faster than others because of the way their mouth is shaped, but all horses require routine dental care. Some might need to have their teeth floated to adjust abnormalities once a year; others may require it only every few years. As horses are designed to spend most of their day chewing, it is very important that their teeth and mouth are operating correctly. If your horse shows any signs of oral discomfort, such as turning their head when they chew, dropping feed, choking frequently, bit aversion, or foul odor/discharge coming from the nostril or mouth, then there may be a serious oral problem that should be evaluated by your veterinarian.

Announcements

We are happy to introduce the newest additions to our Equine Field Service group, Dr. Annie Martin and Dr. Laura Hoholik. Annie and Laura are interns taking the place of Dr. Jenn Larson and Dr. Scott Wilson who recently finished their residency programs at the VMRCVM. Jenn is now working in a mixed animal practice, Ridge Runner Veterinary Services, in Winterport, Maine and Scott is working at an equine practice, Old Waterloo Equine Clinic, in Marshall, Virginia. We are sad to see them go, but are excited about their new positions in private practice.

Dr. Annie Martin is a graduate of the University of Florida’s College of Veterinary Medicine. She is a member of the American Association of Equine Practitioners and her areas of interest include internal medicine, ophthalmology, and reproduction. She enjoys riding for pleasure and show and is currently preparing her Quarter Horse, Ace, for the western pleasure show ring.

Dr. Laura Hoholik is a graduate of Michigan State University College of Veterinary Medicine. She is a member of the American Association of Equine Practitioners and the American Veterinary Medical Association. Laura’s professional interests include lameness, dentistry, and field surgery. In her free time, she enjoys running, horseback riding, and spending time with her Australian Shepherd, Becker.