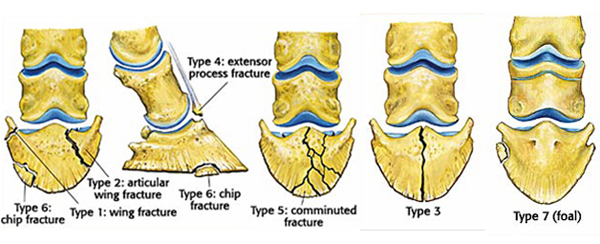
Diagnosis and Management of Fractures of the Coffin Bone and Navicular Bone

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**Take Home Message:**Coffin bone and navicular bone fractures are painful conditions of the hoof. They can only be differentiated by radiography. The radiographic configuration has prognostic implications.

**Coffin bone fractures:**   Distal phalangeal fractures can be classified into one of seven types.2,6,7 *Type I* is a non articular fracture of the palmar process (wing) of the distal phalanx. *Type II* fractures are articular wing fractures. *Type III fracture*s are sagittal and divides the bone nearly into equal halves. *Type IV* fractures comprise all extensor process fractures. Finally, *type V* fractures are all other fractures not defined in I-IV, except marginal (peripheral distal phalanx) fractures which are considered type VI fractures and small non-articular palmar process fractures in foals.

The etiology of these fractures are primarily traumatic.2,6 Improper shoeing, hard surfaces, stone bruises, infectious conditions and nutritional deficiencies are all considered to be contributing factors.

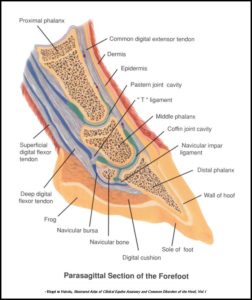
The diagnosis is based on several clinical signs, such as the sudden onset of modereate to severe (grade 3 -5 of 5) lameness.2 The lameness is usually accompanied by an increased digital pulse. Extensor process fractures are often accompanied by swelling over the coronary band. Hoof tester examination usually reveals marked pain over the entire hoof but especially over the fracture. Hoof percussion reveals sensitivity around the entire hoof but especially over the fracture. These two techniques usually can aid the practitioner to center the x-ray beam on the fracture.

Radiographs are necessary to confirm the diagnosis.6 Usually at least 4-5 views (LM, DP, D60PrPDi, PPrPDi minimally) should be made in order to examine the entire bone from several angles. Multiple oblique views may be necessary in order to center the beam on the fracture and see the fracture.  The fracture may not be visible for 5-7 days. In early cases, you must have the x-ray beam centered on the fracture in order to see it.

Treatment of types I, II, III, and V can be treated by therapeutic shoeing.2,6 A full bar shoe with quarter clips, full rim shoe, or glu-strider shoes will immobilize the hoof capsule and effectively turn the capsule into a cast. Types II, III, and IV are amenable to lag screw fixation. Lag screw placement may be difficult because the fracture line can not be seen during surgery. Therefore radiographic or fluoroscopic guidance during surgery is essential for a successful outcome. The bone in the palmar processes of third phalanx is more porous and does not hold screws well. Type IV fractures are best treated by surgical intervention. Small fragments are easily removed via arthroscopy. Larger fragments should be stabilized by lag screw fixation or can be removed completely via an arthrotomy. Neurectomy of the palmar digital nerve may be necessary due to chronic low grade pain. This surgery is usually only effective for palmar process fractures but can reduce pain in all the fractures. It should not be performed if a palmar digital nerve block does not substantially improve the lameness.

The prognosis for fracture types I and II is fair to good.2,6 For types III and IV the prognosis is guarded to fair due to the possibility of distal interphalangeal arthritis. The prognosis for type V fractures depends on the circumstances of the fracture that is whether  it is traumatic or pathological. Type VI fractures have an excellent prognosis.

**Navicular bone fractures:**    Navicular bone fractures can be classified into one of four types.5 These are simple sagittal fractures, comminuted fractures, avulsion fracture of the navicular collateral sesamoidean ligament, and avulsion fractures of the impar ligament. The etiology is always traumatic but can be predisposed by either infection or chronic demineralization from navicular disease. In order to diagnosis this condition one first needs to be sure they are dealing with a fracture. The navicular bone may have more than one center of ossification, resulting in either a bipartite or tripartite bone. True fractures have pain referable to the navicular bone. They are usually acute and exhibit a grade III-V of V lameness. Generally speaking, the horse is unwilling to place the heels of the affected foot on the ground. Marked pain over the navicular area is noted with hoof testers. Distal limb flexion markedly exacerbates the lameness.

Navicular bone fractures may be treated conservatively or by surgery.3,5 Surgery is expensive and difficult. Therefore, most veterinarians use a conservative management approach.3 Conservative therapy usually entails variable periods of rest with corrective trimming and shoeing to immobilize the hoof. Palmar digital neurectomy is an option after the fracture heals to increase the horse’s soundness. However, the results of this type of therapy have been poor.The poor results are thought to be due in part to adhesion formation between the navicular bone and the deep flexor tendon. Utilizing a variation on a technique originally described in a Norwegian veterinary journal1 the has have treated navicular fractures with shoeing only and the horses have each become serviceably sound for riding and some of these horses have returned to competition.5

Following the diagnosis of a navicular bone fracture, the affected  hoof should be trimmed to its normal hoof pastern axis.1,5 The hoof is then shod so as to elevate the heels 12o. Using four, 3o wedge pads and a flat shoe is the easiest method to achieve this but the patten shoe can be used as well. The objective is to prevent the navicular bone from having weight bearing contact with the second phalanx and to decrease the strain on the deep flexor tendon. Proper elevation of the hoof can be confirmed through the use of a lateral radiograph.

The horse should be stall rested for the first 60 days, then short periods of handwalking (15 minutes daily) may begin.5 The shoe is reset every 4 weeks. At each reset the hoof is trimmed and the horse is reshod but with 3o less elevation. The simplest method is to remove one pad per month. At the end of 4 months when the horse is shod normally, an assessment of the degree of soundness is made.        Podotrochlear bursography or MRI can be utilized at the end of the 4 month period to assess the degree of adhesion formation.

To date, the author has mulitple cases that have been treated utilizing this method.  Four have been reported.5  Three horses had simple sagittal fractures of the navicular bone involving the forelimb and one had a comminuted fracture of a rearlimb navicular bone. Upon initial presentation these horses were grade IV-V/V lame. Typically, when radiographed the fracture was well demarcated with defined, sharp margins. The fracture line became less defined within 30 days. This was presumably due to bone resorption. Recalcification around the fracture in each of these cases occurred but complete radiographic healing of the fracture did not occur in any case. However, the horse’s lameness resolved after the 4 month treatment period. Two horses returned to competition, one as a gaited horse and the other is a multi-purpose Arabian show horse. The other 2 horses are ridable and are not lame.

We compared the results of a bursogram on one horse treated in the conventional method and one horse treated with the described method of shoeing to assess any differences in adhesion formation between the navicular bone and the deep flexor tendon. Podotroclear bursography of the horse treated conventionally indicated an adhesion (15mm thickness) that covered one-third of the flexor cortex. The lameness had improved with conventional therapy but the horse was only useful after a palmar digital neurectomy. However, that horse did return to a high level of competition after the neurectomy.  Bursography was performed on the most recent case treated with the heel elevation technique. After the 4 months of treatment, there was only a small adhesion present, less than 2mm in thickness. No lameness was present at that time and distal limb flexion did not exacerbate a lameness.

The main benefit of this therapy appears to be reduced adhesion formation between the navicular bone and deep flexor tendon.  Initially, after application of the shoe the horses are less lame. This is probably a two fold effect. Firstly, by raising the hoof angle 12o  the navicular bone assumes a position palmar to the weight bearing surface of the second phalanx. In addition, the deep digital flexor and the navicular collateral sesamoidean ligament are relieved of tension so there is less pressure and possibly less contact between the navicular bone and tendon.4  Generally, as healing of the fracture occurs adhesions form between the tendon and bone.3  As the angle is then lowered, it is possible that the adhesions are allowed to stretch or breakdown, so that when the normal angle is restored the adhesions are minimal. The bursography has indicated that this is may be true but more cases will have to be followed in this fashion to prove this hypothesis.

This technique is an effective method to treat navicular fractures without surgery. It is the author’s opinion that use of this technique, one can offer a better prognosis for navicular bone fractures than with  conventional shoeing methods3,5. Lag screw fixation may still be the best means of repair3 but there is inherent difficulty of the surgery and the special instrumentation and radiographic (fluoroscopic) guidance required for placement of the screw.3 The heel elevation technique offers the most viable means to treat the majority of these cases and can be employed by the practitioner in the field.

Palmar digital neurectomy is a very viable alternative once the bone has had time to heal. The prognosis for traumatic fracture has a guarded prognosis due to likelihood of arthritis. Pathologic fractures due to infection have a grave prognosis.

**Conclusion:** Fractures of the distal phalanx and navicular bone cause moderate to severe lameness. The fractures need to be identified by radiography and can be classified by their configuration. The configuration has therapeutic and prognostic implications. Shoeing is an important aspect of therapy.

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