Sinking Coffin Bones (Part 1 of 2)

Horseback Magazine 8-10-2013 Pete Ramey

When looking at a lateral radiograph of a horse's foot, if the exact location of the top of the hoof wall (hairline) has been marked with a radiopaque paste or object, there is a measurable distance between the "elevation" of the top of the hoof capsule and the top of the coffin bone. Veterinarians and farriers typically refer to this measurement as the CE (coronet-to-*extensor process* distance).

The markers (taped-on wires) were placed contouring the hoof wall and stopping precisely at the base of the hairs at the coronet. In figure A, the CE is more than one inch, with most of the short pastern bone (P2) buried within the hoof capsule. In figure B, the same hoof six-months-later, the CE is almost within a normal range (post-treatment). In both photos, the sole thickness is roughly the same, yet the overall wall length in figure A is dramatically longer than in the healthier situation of figure B. Photo reprinted from the book Care and Rehabilitation of the Equine Foot , P. Ramey.

Cross-section of a stillborn foal's foot. The CE is near zero—the hairline is almost level with the top of the coffin bone. Photo reprinted from the book Care and Rehabilitation of the Equine Foot, P. Ramey.

In newborn horses, and in the healthiest examples of adult horses, the CE measurement will be near zero. In other words, the top of the coffin bone will be level with (or within 1/2-inch of) the top of the hoof capsule (hairline). This "high" (actually normal) bone position allows the overall hoof length to be very short and compact (usually around 3-3 ½-inches long at the toe), while still having room for a thick, strong, robust sole beneath the bone and sensitive tissues.

Over time, many domestic horses literally sink through their hoof capsule. The CE measurement can grow to an inch or more in horses that are not extremely lame (though they will not be "right," either). When the CE measurement becomes abnormally high (more than 1/2-inch), this means—among other things—that if the horse is to have an adequately-thick sole, he must also have a longer-than-normal overall hoof wall length. This, of course, leads to all sorts of locomotive and performance problems, whether the farrier chooses to, a) thin the soles to achieve *normal* wall lengths, or b) leave adequate sole thickness at the expense of leaving the extra wall length along with it. Which is correct? Neither. The right choice is to maintain the CE of your horse between zero and 1/2-inch. Then you can have a thick sole **and** a short, compact hoof capsule.

In figure D (left), the toes (and heels) would be considered too long by any hoof professional, yet the soles are paper-thin. If this hoof was to be cut shorter—thus thinning the sole more—it would be severely damaging for the horse. By, instead, focusing on reversing the coffin bone sinking, the same foot (shown in figure E, right) now has a thick sole **and** a normal heel and toe length (four months duration between photos). Photo reprinted from the book Care and Rehabilitation of the Equine Foot, P. Ramey.

Understanding the Problem

To understand how to reverse or prevent the sinking, you must first understand how and why it occurs. The coffin bone is shaped like a miniature hoof, creating the foundation for the front-half of the horse's foot. The bone is surrounded by a 1/8-to-1/4-inch "sock" of blood vessels, nerves, and connective

tissue. The hoof wall, around the perimeter, and the sole underneath forms a tough outer shell—like a boot—about 1/2-inch-thick. In a natural and healthy situation, the hoof wall and the sole share the load of the horse's weight. In this situation, the laminae—the bonds between the hoof wall and the coffin bone—have little or no shear stress forces applied to them. However, if the hoof wall is allowed to overgrow well-past the sole, or if a shoe is lifting the sole off the ground, the forces change dramatically—the horse's entire weight is literally hanging from the laminae. These forces set up two possible scenarios:

1) If the diet is correctly balanced and the horse is generally healthy, so that no additional stressors are placed on the integrity of the laminae, the additional vertical forces applied to the laminae may allow the horse to slowly sink through the hoof capsule over time. This can occur without a lot of pain, and can be fairly easy to reverse.
2) If the horse's health is compromised, or if an improper diet is weakening the laminae, the horse may suddenly *fall through the hoof capsule*, essentially until the sole reaches the ground. This may destroy connective tissue and blood supply to a point that the foot could never be fully healed.

In either case, I feel that the sinking was caused by the unloading of the horse's sole to begin with—by placing the laminae in the solitary support role, without the aid of the rest of the foot (sole, bars, frogs). This brings us to the concept of the *sole penetration*. In the most extreme laminitis cases, the coffin bone supposedly pierces through the sole of the horse. Since the sole is *skin* that literally grows from the bottom of the coffin bone, I do not understand why people believe that this "piercing" can occur—the sole is *attached to* the bone, and moves around with it wherever it goes. If the bone sinks, so must the sole. So instead, I consider the CE as one issue, and the sole *thickness* as a completely separate-but-important issue. In cases that people believe the bone penetrated the sole; I would, instead, be asking why the sole is *missing*. Did the corium abscess and allow the sole to fall off? Did someone cut it off? Did it wear away? Has it failed to grow? This may seem like a simple semantics game, but if we ask the right questions, we are more likely to find the right answers.

Luckily, most cases of coffin bone sinking aren't quite so dramatic. Instead, all you will notice over time is that the toes (and/or heels) seem to be getting longer, or the soles seem to be getting thinner, or both. The horse is not quite as sound as he used to be—or is not an *easy-mover* anymore. If radiographs verify that the CE is ½- to ¾-inch or more, your horse will benefit from a conscious effort to reverse the situation. To do this, we basically set up the *opposite of* the forces that caused the situation to begin with. We try to reduce the load on the walls, while increasing the load on the rest of the foot. This means frequent trimming of the walls, conservation of the sole and frog tissue, and using hoof boots with padded insoles to compensate for the reduced support that would normally be provided by longer hoof walls.

Since the laminae are weakened by sugar overload and/or mineral imbalances, we also carefully balance the diet. This gives the best chance of success by helping the wall connection *be the best it can be*.

How to Reverse Coffin Bone Sinking (part 2 of 2)

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Last month, I covered some of the warning signs and problems associated with coffin bone sinking (often called *distal descent* or *sinker*). This month, I will go deeper into the work involved in reversing the problem. **This is serious business, and needs to be done by an experienced trimmer or farrier, and under the supervision and care of your veterinarian.** But here are the basics:

Trimming the Hoof to Reverse Sinking

As detailed last month, your farrier (or you) may realize your horse has a coffin bone position that is too deep in the hoof capsule because the heels and/or toes are longer-than-normal, in spite the fact that the sole is NOT excessively thick—these feet cannot simply be shortened to an optimal length without excessively thinning the sole. Your veterinarian may also diagnose this condition by using a lateral radiograph to compare the "height of" the top of the coffin bone to the "height of" the top of the hoof capsule (coronet-to-extensor process or *CE measurement,* see Figure 1).

At first glance, this hoof may appear healthy—no rotation or flaring, and an adequately thick sole. But a timely visit from the veterinarian revealed a good reason for low performance and general unsoundness. The CE measurement is 2 centimeters (about 7/8th inch)—a quite severe case. This problem is often overlooked until it is too late. Photo reprinted from the book Care and Rehabilitation of the Equine Foot.

Either way, steps should be taken to reverse the condition. A combination of hoof trimming, specific protective devices, and strategic terrain selection can be used to set up forces where the sole, frog and bars are bearing more of the weight—the hoof walls are then bearing less of the weight. Generally speaking, preserve sole material, avoiding even "routine" clean-up of exfoliating material. Leave the

hoof walls 1/8th-inch longer than the sole, but bevel them sharply—usually at about a 60 degree angle—as shown in figure1. On yielding terrain (or on a foam insole in a hoof boot) this sets up the opposite of the forces that probably got the hoof in this condition to begin with, namely *peripheral loading* (allowing the hoof walls to bear all of the horse's weight for an extended time). Repeat trims often enough to keep the hoof walls out of a primary weight-bearing situation so that they can settle into a more natural position (relative to the coffin bone) over time.

This is a typical trim I use to reverse (and prevent) coffin bone sinking. All or most of the frog and sole are preserved, while the hoof wall is sharply beveled. Generally it is important (for soundness) to leave 1/8th inch of wall height extending past the sole. On yielding terrain, this allows the sole to bear some of the horse's weight, thus allowing the hoof walls to settle into a more natural position over time. Photo reprinted from the book Care and Rehabilitation of the Equine Foot.

But extra caution must be taken! The soles are certainly designed to bear weight, but not ALL of the weight—in a healthy situation, the hoof walls are supposed to be sharing this load. Also, the sole's corium is designed for pressure and release, not constant pressure. Any pressure applied to the sole must release completely when the hoof is in flight! So during this time of rehabilitation, be sure to provide extra protection for the horse's sole while avoiding any type of hoof protection that is rigidly attached to the hoof wall. Also avoid any protective device that applies constant pressure to the sole, **and/or** lifts the sole out of a weight-bearing role. If the sole is well-callused and at least ½-inch thick, the horse can usually be safely turned out barefoot on yielding terrain and these criteria will be met. However, if the sole is thin, if the terrain is hard or rocky, or if the horse is tender-footed, you need to provide hoof boots with ½-inch-thick foam rubber insoles during turnout. If booting for turnout, clean the hooves and boots daily, allowing the hooves a chance to dry out for a few hours while the horse is barefoot and confined to soft footing. This may seem like a lot of trouble, but worth it, since we are talking about a very serious condition previously thought to be impossible to reverse.

Riding can almost always be continued during this process—use quality riding boots, and discontinue riding if the horse shows any lameness or hesitation. If the horse is comfortable, and the hooves are trimmed properly and well-protected, the extra exercise tends to speed healing.

Laminitis

Sinking coffin bones are often, but not always, a direct result of past or present laminitis. If the horse's diet has contributed to the problem, you cannot expect an improvement without also improving the diet. Discuss your horse's individual diet and body condition with your vet. Sugar reduction and general nutritional balancing is often necessary in these cases, and medication may be indicated as well. This was the case with the horse pictured in Figures 3 and 4: dramatic changes to the diet (sugar reduction and mineral balancing) and PPID medication were prescribed.

Insert Figures 3&4 (7ramey3 and 7ramey4) side-by-side, sharing one caption: In Figure 3, aside from some hoof capsule rotation, this horse had quite severe coffin bone sinking. The heels and toes were too long and could not be significantly shortened because of a paper-thin sole. Using the methods described here, 5 months later, Figure 4 shows the same foot with a thick sole and a much-shorter hoof capsule—the CE measurement has become normal—the sinking reversed. Photos reprinted from the book Care and Rehabilitation of the Equine Foot.

Insert Figure 5 (7ramey5) Caption: Venogram showing normal blood circulation through the horse's foot. When the coffin bone sinks too deep into the hoof capsule, this blood flow—particularly the supply to the laminae—is reduced. This could theoretically make a horse more vulnerable to laminitis and can lead to permanent tissue death. Photo reprinted from the book Care and Rehabilitation of the Equine Foot.

How Consistent Are the Results?

There seems to be a "point of no return" or at least "much greater difficulty" when the CE measurements are at or beyond ¾-inch. For many years I had noticed this, and assumed that it was because more ripping and tearing had been done to the coronary papillae when the CE surpassed ¾-inch (instead of simply bending and distorting). This is not to say that larger CEs cannot be reversed, but that it is less likely, and will be a harder, longer road—for one thing, abscessing is very common in these cases, and that alone can make a horse want to give up.

When Debra Taylor DVM, DACVIM (Auburn School of Veterinary Medicine) and I first started working together we compared notes on this type of case. Using venograms (see Figure 5), she had been noting a dramatic decrease in circulation into the hoof capsule in cases that had more than ¾-inch CE, and normal circulation in most horses with CEs less than ¾-inch. The two stories fit together well—what I had seen in the field made sense.

Another factor that seems to affect reversal results is the speed that the sinking occurred. The long, slow, gradual sinkers seem easier to fix than the sudden and severe founder cases. This, again, is probably due to bending and stretching of connective tissue vs. ripping it apart. As you might guess, the latter type also causes significantly more pain, which can affect the outcome as well.

As with most problems, an ounce of prevention is worth a pound of cure. This why older farrier texts say to pull shoes during the off-season to "drive up the quick." They were reversing a season's-worth of sinking without even fully realizing it. This is why I personally prefer hoof boots instead of perimeter-fit shoes—I like to load the whole foot to prevent this problem. This is also why pour-in pads (and other sole-support methods) are getting more popular among top farriers in most disciplines. Even the dirt packed in a shoe or bare foot can help support the horse's weight and give the laminae a rest. And hopefully, of course, just being aware of the problem will help—so that you can *see it coming* and take preventative steps before it is too late.