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How to Shoe for Founder

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Dealing with a Seriously Dropped Dole, damaged Hoof Wall and Pedal Bone

This article is meant as a 'how to' article and follow-up to my previous article entitled 'Tracking a founder case over five years'.

I started working on Refreshing Pause – a.k.a. RP – in February 2002. This mare was a landmark horse for me since she helped me find ways to assist other horses with similar problems. RP was not my first foundered horse but to this day this mare is still the worse founder case I have encountered in terms of capsular damage. Her hooves literally crumbled apart as I started to work on her. After I removed the first shoe and pad, her pedal bone started to sag further down. Her entire pedal bone was on the verge of going through the sole right on the spot. Working on such damaged capsules was a big challenge, especially for the first few shoeings. I had to work around her damaged hooves and try to build walls and support her sole without adding pressure. I also tried to keep as much of the existing wall as possible – this is something I generally do with any founder case with damaged capsules, as long there are no signs of white line disease.

In general, my central goal is to ensure that the horse bears quite a bit of weight at the caudal (rear) part of the foot. Often in a case of founder the hoof wall at the toe is compromised, thus making the front portion of the hoof ill suited for load bearing. If possible, I like to trim the heels down to the 'healthy frog', and in so doing, move the point of support at the heels back as far as possible.

Along with bearing weight in the caudal portion of the hoof, I want to make sure that the angle of the pedal bone (relative to ground) is reasonable. In many founder cases, the bone 'rotates' somewhat and this can lead to an inordinate amount of weight bearing at the toe end of the pedal bone. If at

all possible, I will try to reduce the heel height in this situation to bring the palmar angle back into, or close to, reasonable bounds. In many cases, reducing heel height should be accomplished over the course of several trimming cycles, so a great change is not attempted at any one shoeing. In many cases, I know I will be working over several shoeings to keep the heel height down, and the angle of the pedal bone to a reasonable value.

I would like to stress the importance of leaving plenty of sole while working on these founder cases. In foundered horses, I rarely touch the sole except when it is ready to exfoliate naturally. If I do any work at the sole I tend to gently rasp the retained sole to avoid high points and blend it into the hoof. I will however open up the frog sulcus and lower the heels but I am very conservative (as I say 'Zen') with the sole. It is important to remember that the dermis and the epidermis of severely foundered hooves never recover to their original form and function [1]. Such hooves are more fragile, so try to work with them, not against them.

In the case of a 'dropped sole' as I had with RP, giving support so the horse can stand and move comfortably, is a fine art. My goal is to load at the caudal portion of the foot, and to give some 'soft support' to the sole, but not allow a great deal of loading on the sole. For RP, I did this as follows:

1) Trim the foot as best I could, given what horn is available. The goals are to move the heel support points back, and get the pedal bone into a reasonable angle. In the case of RP, there was not a lot of rotation, so this was not a big issue. The big issue was how to place the shoe and packing correctly. I could not trim anything the first time I worked on her. I had to rebuild walls and work around the damaged tissues.

2) To ensure good loading at the caudal portion of the hoof, I packed the commissures of the frog with an enhanced, FDA approved, two part silicone. I also put a triangle of two parts packing onto the caudal portion of the composite shoe. (see figure 4). When the shoe is later glued on, this material will directly contact the frog and the packing placed in the caudal portion of the hoof. I also make sure that the packing at the hoof is flat and flush and does not protrude out of the capsule. I also make sure that packing onto the shoe is totally flat. I do not believe in overloading any particular portion of the hoof.

3) I place a piece of foam on the shoe near the front, underlying the region where the tip of the pedal bone would be supported. This foam material is selected to be fairly soft but to maintain its shape without degrading over a shoeing interval. This foam serves as a guide when applying the shoe: the shoe is placed so this foam just contacts the sole underlying the tip of the pedal bone. Various thickness of foam is available as needed. In very rare occasions, I use foam over the entire sole and frog area.

4) The shoe is glued on to the foot. The glue is placed around the outer periphery of the shoe, so that it will be attaching to the base of the hoof wall, and also perhaps about ½" of the sole coming inwards from the wall. I use a fast setting methacrylate glue, this type of glue retains flexibility and does not become too hard on the sole. Note that it is important that the glue application is restricted to the outermost portion of the sole only. The shoe is gently pushed onto the hoof until the caudal part of the foot (pre-filled with packing) comes into contact with the packing triangle on the shoe. This will help create a small gap between the shoe and the sole. In RP's case, I glued a piece of memory foam at the sole portion of the shoe. My goal was to support and stabilize the coffin bone. In essence, I was trying to create a **prosthetic sole** that was soft enough to avoid adding pressure but sill supportive enough to the coffin bone. The foam is in general a bit thicker than the packing so I did press a little bit into till I felt the pre-filled caudal part of the shoe touching the frog. The glue is allowed to set up with this arrangement.

5) The result is that the weight is borne mostly in the caudal region of the hoof. If some weight is borne at the tip of the pedal bone, it will compress into the foam partway and the foam is soft enough that a large force is not generated. With the combination of the built in softer portion of the shoe, the use of packing material, the use of foam, and the use of glue, it is possible to achieve almost any pattern of load bearing and 'soft support' required by the animal. The skill of the farrier is the only limitation – and it can take some practice to get this right. I believe in sharing the load between the walls, the frog, and the bars. The use of packing in the commissures let me have a part of the load on the bars, which I think is a good thing [2]. I want to shoe for the whole hoof, and not just for one part of it.

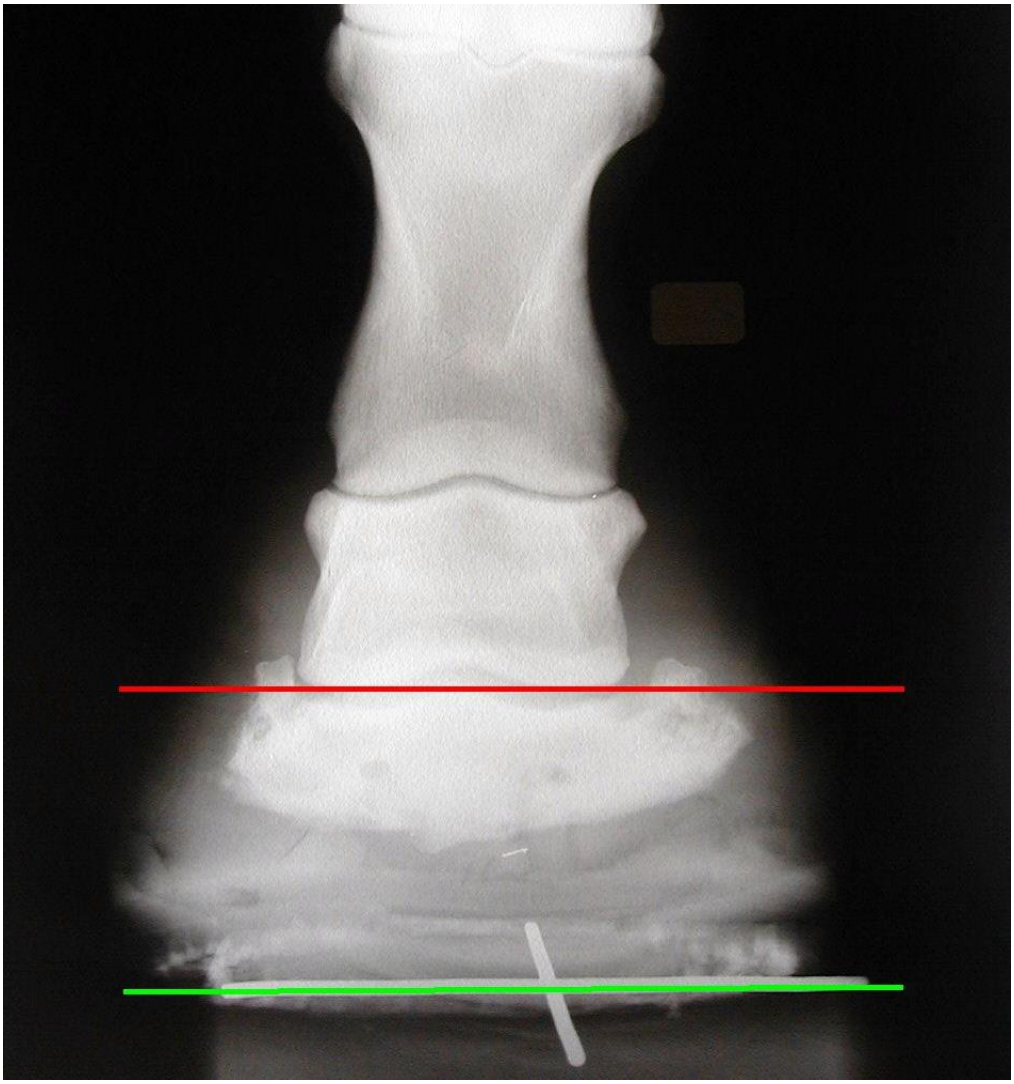

Figure 1: In the case of RP, glue had to be used to rebuild wall, due to the extreme 'dropped sole' situation. With the help of a radiograph, we can assess the medial-lateral balance that has been achieved: the axis of the coffin-joint (the red line) should be approximately parallel to the ground (the green line). The pedal bone is badly de-mineralized after years of living with founder (see figure 2). Radiograph from 2002

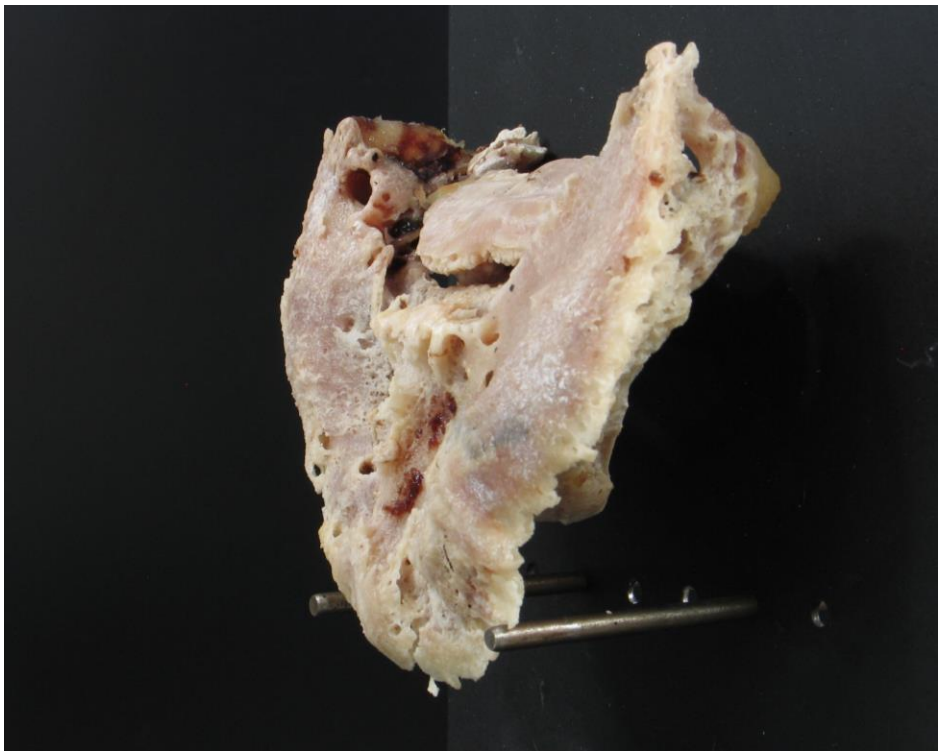

Figure 2: The badly de-mineralized pedal bone from RP. Despite this much damage, she was made comfortable for years, and was active for most of the five years that I owned her. Dissection from October 2006.

In the case of RP, in the early stages the glue was being used to actually rebuild some of the hoof wall. With the aid of radiographs, one can key off of the coffin-joint axis to estimate how this should be done to get the medial-lateral balance done properly. The case of RP shows that keying off the underside of the pedal bone for this assessment is difficult, as the bone is badly remodeled. Hence, I like to use the approximate axis of the coffin-joint (see figure 1) to assess if the medial-lateral balance is good. I try to use the glue so that this axis is approximately parallel to ground. We estimate the axis of the coffin-joint by keying off of the most distal part of the epicondyles of P2. With the composite shoe, if the 'after' radiograph shows that the medial-lateral balance is not quite right, the shoe can actually be rasped down a bit to correct for this.

In extreme cases (e.g. figure 3) a portion of the dropped sole may be the lowest point of the whole capsule, and will be the first point to touch a pad or packing. By allowing the foam to touch this lowest point first and letting the glue average itself around it, I have generally managed to get

my medial/lateral balance under check. I want to draw attention to the fact that soles of poor quality are the mirror image of the pedal bone. It is very apparent when you compare the radiograph and picture in figure 1 and 2. As tissues heal you will not noticed the dropped sole but unfortunately the damage to the pedal bone is irreversible.

Figure 3: Glue used to create some wall, due to dropped sole situation. The 'after' figure on the right corresponds to the radiograph of figure 1. The radiograph and picture were taken in May of 2002

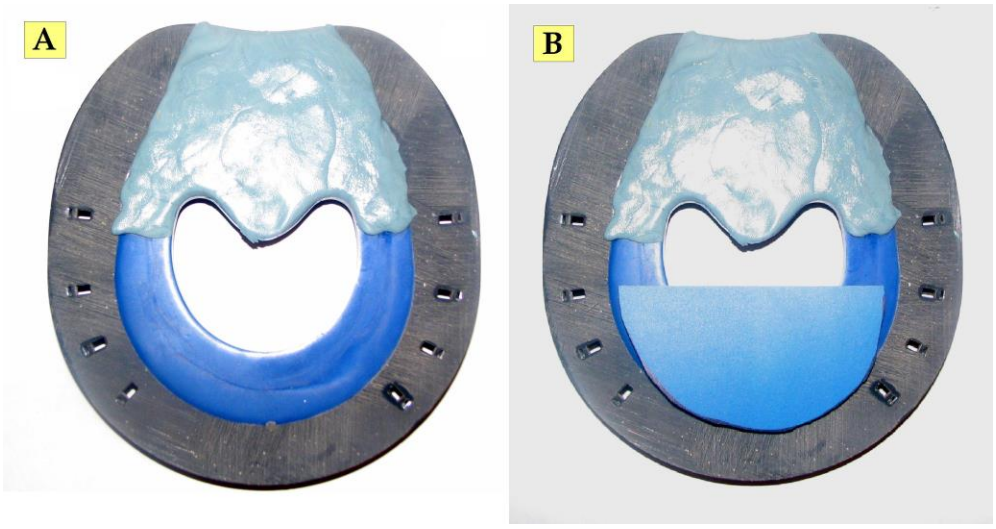

Figure 4: In figure A we have added some extra packing over the caudal portion of the Eponashoe which will ensure that the frog and bars are loaded when the shoe is placed on the foot. In figure B we add some relatively soft foam that will be set up against the dropped sole near the front of the foot, and will ensure that no extreme force is placed on the sole there. The gray portion of the shoe is where the glue is placed.

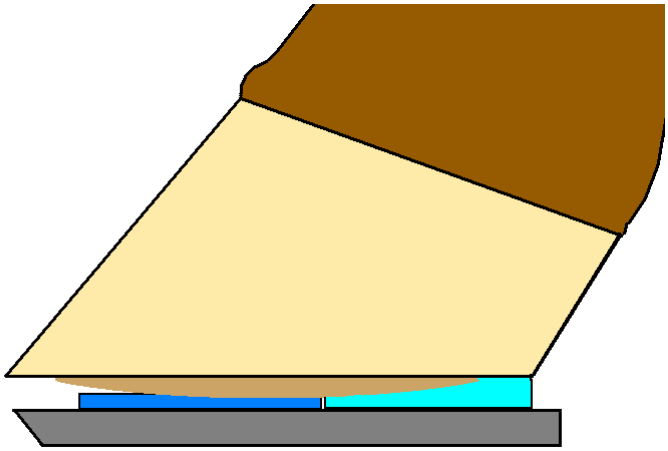

Figure 5: The dark blue material is soft foam, and the cyan-colored material is the two-part packing. The packing is used in the caudal part of the foot and can bear significant weight. The soft foam prevents too much pressure on the dropped sole, and yet gives some support.

Figure 6: This combination photograph and radiograph shows the positioning of the bones within the hoof capsule. The shoe can be further beveled as desired. Photo from July 2006.

Finally, I create a bevel at the toe of the shoe by rasping the shoe as desired. In badly remodeled bones I tend to create a very sharp pitch to the bevel in other cases I may not go this far.

My goal is to shoe the entire hoof and allow it to function dynamically. This means allowing the entire hoof capsule to regenerate as efficiently as possible. The keratinized hoof capsule is the last layer of the epidermis. The capsule is made of dead cells that were once live cells. These initial live cells are produced in the lowest layer of the epidermis – the stratum basale. The live cells are called skin stem cells and do not proliferate and differentiate (that is, specialize into keratinocytes) at a constant rate but rather are generated as needed. There is a very complex system of molecular signals that regulate stem cell production whether for repair or to respond to rough usage [3]. It is interesting to note that it is crucial for these cells to have the sufficient stimulation to help in the repair process. Allowing the hoof capsule to flex would seem important for its regeneration.

There are widely varying opinions about the nature of the hoof flexing, from those who don't believe it flexes at all, to those who think the hoof can flex just fine in a metal shoe. It's true that, with nails kept forward, the rear walls of the hoof can slide in and out slightly on top of a metal shoe, but this is the only sense in which a hoof can flex in a metal shoe. An unshod hoof can flex in various ways, for example one heel could be deflected upwards (when stepping on a rock, for example) while the other heel is down lower. The whole capsule can flex in various ways, and when we put a flexible shoe on, it does not impede this natural flexing. The glue, if used, must also be flexible so the whole combination can flex. Unless there is a good reason to attempt to restrict the natural flexing of the hoof, we should not do so. I have seen hooves restore very quickly and I attribute this to the proper support of the sole, bars, and frog, and to the ability of the shoeing system to flex. I have been using this system on horses for the past eight years.

References:

[1] Chris Pollitt, « Equine Laminitis »

[2] Bowker RM, Van Wulfen KK, Springer SE, Linder KE. "Functional anatomy of the cartilage of the distal phalanx and digital cushion in the equine foot and a hemodynamic flow hypothesis of energy dissipation." Am J Vet Res. 1998 Aug;59(8):961-8.

[3] Alberts et al, "Molecular Biology of The Cell", Fourth Edition, Garland Science, New York, N.Y., 2002.