Reversing Distal Descent of P3

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In the healthiest of equine feet, the hoof walls should be firmly attached to the coffin bones and the coronet should lie at the same level or even slightly below the coffin bone (P3). This allows proper uninhibited motion of the coffin joint. It also ensures the horse can have a naturally short hoof capsule, while at the same time have thick callused sole to protect the inner structures. All too often, in our domestic horses, we see the coffin bones; literally the whole horse descending through the hoof capsule over time. Previously, farriers have been left with a very hard choice with no correct answer. Do you thin the sole to provide the safe and proper bio-mechanics of a short toe, or leave the foot long, favoring the soundness and protection provided by adequate sole thickness. Neither bodes well for the horse. Combine that with the resulting restriction of the coffin joint and you end up with a bio-mechanical nightmare. Fortunately, we are learning to truly reverse the situation.

How does this happen to begin with? Most professionals consider it to be an immediate and irreversible result of chronic laminitis. The laminae loose all integrity and P3 drops to the ground through the hoof capsule (the classic sinker). While this does occasionally happen, it is more commonly a very slow process over the course of several years. It is truly an epidemic in sport horses; particularly among jumpers.

Fig. 1) 20 year old, domestic cadaver with healthy hoof wall/P3 relationship. (sound at death; died in accident) It has adequate sole thickness and a very short hoof capsule. This healthy combination is possible, because of the proper relationship between P3 and the coronet.

Fig. 2) Feral cadaver with healthy hoof wall/P3 relationship. The lateral cartilages, the laminae and coronary papillae have been left intact in the photo. Again, we see a very short hoof capsule (3 1/2 inch toe in a #2 sized foot), coupled with tremendous sole thickness made possible because of the correct bone/wall relationship.

Fig. 3) Cadaver with severe distal displacement. In this particular cadaver the top of the coronet is actually level with the center of the second phalanx. With this pathological bone position (I should say hoof capsule position, as the bones are exactly where they should be. It is the entire hoof capsule that is truly displaced.), it is impossible for the horse to enjoy a naturally short hoof and a thick sole at the same time.

Important note added in '08: Notice how steep the coronary groove/proximal end of the hoof wall are. Also notice that the inner proximal corner of the hoof wall is in the exact perfect position it should be at the base of the extensor process. In digital lateral radiographs we can clearly see this shape of the proximal end of the hoof wall and its position on P3. Typically a case like this is quick and easy to reverse. The proximal end of the hoof wall simply relaxes to a lower angle; the laminae do not actually have to move. However, if you see the inner corner of the proximal end of the hoof wall (at the lamellar/coronary junction) is displaced from the base of the extensor process, the case will tend to be far more difficult to rehabilitate/reverse. Do-able, but never 'smooth'.

Dr. Bowker and his team of researchers at MSU have confirmed what many insightful farriers suspected all along. The horse was never intended to hang from the laminae. The hoof walls, soles, bars and frogs are supposed to work in unison to support the horse. Trimming and shoeing practices that force the hoof walls to bear all of the force of impact create more constant stress than the laminae were ever intended to withstand. Add to this the constant stress of landing from jumps, or toe first landings throughout life caused by weak, underdeveloped frogs and digital cushions: The result is a gradual downward movement of P3 (relative to the coronet) over time. This is remarkably common, but seldom recognized until the horse finally becomes lame.

That's why so many horse's hooves seem to get longer as they age. Our predecessors knew this at some level. It's hard to find an old shoeing text that doesn't recommend barefoot periods in the "off-season" to "drive up the quick". What they were actually doing was driving up P3, relative to the coronet. As we have shifted away from this old standard and back to back shoeing has become increasingly common, it has gotten very difficult to find mature horses that do not have much of the pastern buried within the hoof capsule.

Once you learn to look for it, you will spot it to varying degrees everywhere. The most accurate way, of course, is by taking lateral radiographs with markers that stop at the hairline. In a lateral radiograph, the hairline should be level with or even distal to the top of P3 (extensor process). You can, however, learn to readily spot distal descent of P3 in the field with the trained eye.

The collateral grooves along the frog, are very consistent in their distance to the sole's corium (unless subsolar abscessing is present). This makes them an extremely reliable landmark for determining sole thickness (or the distance P3 is off the ground). If you visualize the natural vault of the sole's corium and you understand that the bottom of the collateral groove is consistently about a 1/2 inch away from the corium, you can get a clear estimate of how deep the sole is covering the rest of its corium.

Basically, you look for the height the collateral groove is being lifted off the ground (or the plane of the shoe) by the outer band of sole adjacent to the white line. In a horse with a 1/16th inch thick sole, the collateral groove at the apex of the frog will be lifted off the ground very little or none at all. When the same horse builds adequate (1/2 to 3/4 inch) sole thickness under P3, the collateral grooves will be lifted 1/2 inch to 3/4 inch off the ground by the outer band of sole. They will be the bottom of the "bowl" of natural solar concavity.

Fig 4a represents a hoof capsule with the collateral grooves lifted too high off the ground by excess sole and wall. The hoof should probably be trimmed to the dashed line to shorten the hoof capsule and allow proper function and callusing of the sole and frog.

Fig. 4) Partially dissected feral cadaver with sole and frog corium, P3 and lateral cartilages left intact.

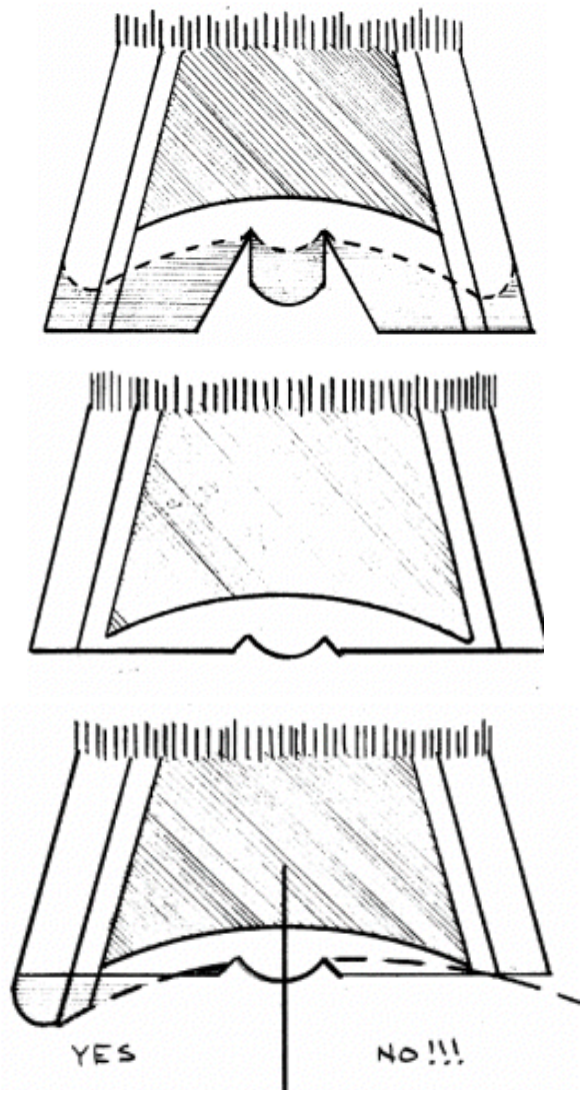

Fig.4a *Fig. 4b* *Fig. 4c*

Fig. 4b demonstrates the valuable information we can get in the field from a shallow collateral groove. If you have done hoof dissections and understand the relatively consistent shape of the inner structures, and the consistent distance from the collateral grooves to the inner structures, you can very accurately estimate the amount of sole under P3 and the lateral cartilages. When faced with this "flat foot" many professionals still try to cut the foot shorter from the bottom (right side of Fig. 4c). This undermining of P3 leaves the entire horse free to migrate downward through the hoof capsule.

The left side of Fig. 4c represents the true need in this situation. We need to build a natural sole depth to achieve solar concavity and a healthy foot. Contrary to the way the sketch must be drawn, this generally does not cause the hoof capsule to become longer. Instead, the building of the callus drives P3 upward, relative to the coronet; often shortening the overall length of the hoof capsule as the relationship between the coronet and P3 becomes more correct.

So in the field, if you see a "long" hoof capsule with shallow collateral grooves at the apex of the frog, you can almost count on distal descent of P3, and should get radiographs and take corrective measures immediately.

You can also use these landmarks to ensure your trimming isn't the cause of sensitivity and descent of P3. The farriers rasp should not get closer than 5/8 inch from the bottom of the collateral grooves for any reason. Doing so overexposes P3 and the sole's sensitive corium and should be considered surgery, in my humble opinion. [Please read the article, Understanding the Soles at www.hoofrehab.com for further clarification of using the collateral grooves to read sole depth.]

The hoof in Fig. 5 is a classic example. This was the condition of the front left hoof the first time I saw it; after four years of lameness through numerous shoeing protocols. The collateral groove at the apex of the frog is only 1/8th inch deep. This should immediately tell you that you will not be able to shorten this long toe from the bottom. In order to build adequate sole depth under P3, thus lifting the collateral grooves off the ground, almost a half inch of sole needs to be built up! In fact you can clearly see the imprint of P3 on the sole. I traced its "footprint" with my hoof pick so it shows up white in the photo. It also should be clear that the walls are no longer attached to P3 either, and lamellar wedge (keratin proliferation by the laminae; between the dermal and epidermal laminae) has filled in the void between P3 and the wall. (Many professionals think this area in front of P3's callus ridge is sole, when in fact it is intertubular hoof horn grown from the dermal laminae. The sole only grows from the bottom of P3.)
The bone position is so low, cutting this long hoof to a "natural length" would actually cause you to rasp away part of P3!

Fig. 5) Fr. Left before setup trim and Fig. 6) same foot eight months later; before six week maintenance trim. P3 has moved upward, relative to the coronet; shortening the hoof capsule while thickening the sole. She had been happily giving lessons for a living for six months.

Fig. 6 shows the same hoof eight months later, before her six-week maintenance trim. Note that the hoof has now reached a more natural length, but the collateral groove at the apex of the frog is now recessed within a 5/8 inch deep bowl of solar concavity. This healthier toe length that would have quicked the horse eight months ago exists with much more armor underneath, at the same time. P3 has moved upward (relative to the coronet) significantly. At no time was the sole of this horse cut. This concavity was built, by adding adequate sole thickness under P3.

The radiographs give the same information. Fig. 7 and 9 were taken a year before I first saw the horse and the photo above was taken. It appears the sole was a bit thicker, rotation less and distal descent less severe at that time, than what I had to start with a year later. So how do you fix such a situation? The horse has to be barefoot for a while. The horse got this way by having its walls overloaded; without the assisting support through the sole. To reverse it; simply do the opposite. The

first priority is to build adequate sole depth and heavy callus under P3. Pressure and release stimulates growth, so the fastest way to do this is to maximize movement while the hooves are bare or on foam boot insoles.

Fig. 7) [Top photo; Fr. Right Before] and Fig. 8) [Bottom photo; Fr. Right (same foot) 3 years later]

At the same time, the walls should be rolled or beveled out of a "lifting role" and P3 should be loaded through the sole so the coronet can migrate toward a more natural position relative to P3. One might think that if we add a half inch of sole to a hoof this long, the hoof capsule will end up even longer. The opposite is true. With the walls rolled and the sole unmolested and callusing, the hoof capsule actually becomes much shorter as the coronet moves down to its normal position relative to P3 and the lateral cartilages.

I need to stress to use foam padded hoof boots if there is any discomfort or if the terrain is rocky. Running around in rocks on a thinned sole is dangerous. You need to build a thick callused sole before you do that. Pressure to an unnaturally thinned sole can cause bruising and can even restrict blood supply to the sole by restricting flow through and from the circumflex artery that follows the perimeter of the distal border of P3. This can "starve" the sole and reduce the sole's ability to thicken and callus. Keep the horse on yielding terrain at first, and/or use the foam insoles in boots to avoid this pitfall.

I usually use dense foam rubber insoles (1/2 inch thick). Many combinations will work, but over the counter, I've had the best results with Easyboot Epic Boots, and their Comfort Pads available as accessories. (Read the article, "Boots and Pads" at www.hoofrehab.com for more specific information.) In this particular case, however, the horse became comfortable immediately when the pressure was relieved from the disconnected walls and lamellar wedge; there were no rocks in the environment, so the horse was worked and turned out bare. Let the horse be the judge and use the pads and boots for any situation that causes discomfort or possible bruising.

The Quarter Horse hoof in Fig. 11 shows the basic trim we use to help move P3's higher in the hoof capsule. It is also the very fastest way to grow out white line separation or hoof capsule rotation I've ever seen, so it makes a great tool for any farrier's bag of tricks. It's tempting, I know, to want to cut that sole down below the wall at the toe; making it "passive". You have to realize it still won't be passive in varied terrain, but the sensitive structures will just be closer to the outdoors. Let the callus build (unless the collateral groove depth exceeds 3/4 inch). This horse only has 1/4 inch of collateral groove depth. We still need to build more sole under P3 to drive P3 upward as the coronet relaxes into a healthy position. In the real world, the walls aren't quite as passive as it may appear. As the hooves sink into terrain and of course after breakover as the horse is pushing off its toes, the walls are definitely still doing a share of the work. The force is directed inward a bit, so stress on the laminae is minimal. In fact, I estimate that in yielding terrain or rocky terrain, there is more of a "squeezing together" force on the laminae than vertical sheer force. This becomes even more important if the diet is weakening the laminae.

Don't bring the large bevel onto the heel buttress. In fact I usually only bevel from the widest part of the foot forward. The heel buttress must be left strong and intact in every circumstance. Like the sole, allow frog to build into dense callus. Routine frog thinning can cause sensitivity and a toe first landing. It is very important that you achieve heel first impact with these horses (at any gait faster than the walk; a flat impact is okay at the walk). Toe first impact will continue to drive P3 lower into the hoof capsule no matter how you trim or shoe.

Fig. 11) Trimming to move P3 upward in the hoof capsule and grow out white line separation or capsule rotation. Repeat at 4 week intervals, never allowing the walls to lift the sole out of a support role.

Once an adequately thick layer of callused sole covers P3, the resulting shape of the sole mirrors the inner structures and the collateral grooves will be lifted 5/8 to 3/4 inch off the ground, even with a very short overall hoof capsule length. The result is incredible traction, performance and hoof function.

Why is it difficult or impossible to lift P3 higher in the hoof capsule with fixed shoeing methods? There are two important reasons. First, according to Bowker's research the sole "hates" constant pressure, but "loves" and grows the best with continued pressure and release. Second and most important, the hoof wall grows much faster than the sole or frog. If you attach perfect P3 support to the hoof walls today, by tomorrow your support has crept away a tiny bit. Four weeks later, the support may have moved distally 1/4 inch or more and in an already compromised situation P3 is free to migrate right on down with the "fixed support" and the growing walls. Am I suggesting that farriers start carrying around a stock of hoof boots and rubber insoles? If they work with foundered horses or work to keep sport horses at optimum performance; yes. They can reap tremendous results during the "off season".

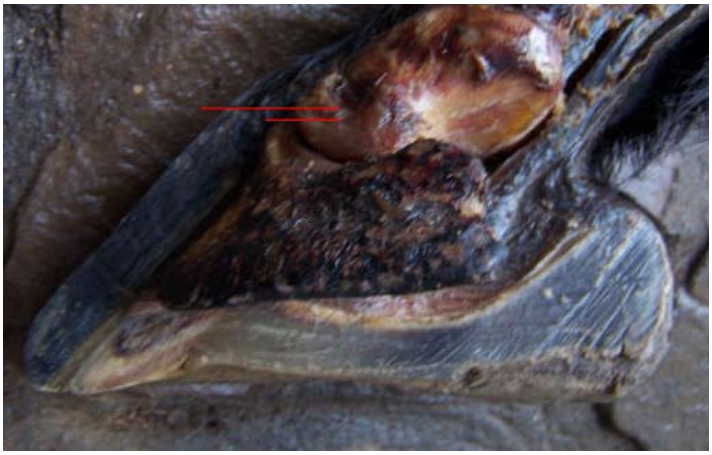

Fig. 12) Teenage Feral cadaver. This adult horse kept the P3/wall relationship of a newborn foal throughout life; without man's "help". Let's make sure we provide hoof care that is better than none at all.

Fig. 12 shows the front foot of a teenage feral cadaver that died on the range in a cattle grate. This healthy vertical relationship between P3 and the hoof walls exists in our foals, and should remain there throughout life. If you monitor and maintain this relationship in the horses in your care you will help ensure healthy hoof function and joint mobility. It will also allow them to enjoy thick callused soles and naturally short breakover; all in the same foot. The reversal of distal descent is a slow process. The most important thing to understand is it is much easier to prevent. Keep foals trimmed; never allowing the walls to lift the sole out of an assisting support role. Avoid carbohydrate overload and mineral imbalance, which can constantly weaken the laminae. Give shod horses a barefoot period in the off-season while continuing a strict, routine trim schedule. A little prevention can add years to the horse's life.

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