Healthy Hooves, Inside and Out

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Do your horse's hooves have these healthy characteristics?

Much has been written about the equine foot, yet many of us know little about how it's really supposed to look and work. Sound horses don't all have the same size or shape feet (just like humans), and that fact often makes it more difficult to understand the healthy foot's form and function.

This means we can't use a one-size-fits-all approach to say what makes a healthy foot. We have to learn about how the horse's foot is built and how it works, and we must understand how individual variation changes the equation. With that understanding, we can look at our horses' feet and identify characteristics that are healthy, and those that hint at problems in the making.

Outside of the Healthy Foot

The healthy hoof wall is a semi-rigid, keratinized (nonsensitive) structure that protects underlying structures and supports weight along with the sole and frog. It has a hard, dense, naturally polished surface with distinct tubules that run straight (not flared) from the coronary band (at the hairline) to the ground. The wall should be intact, not cracked or chipped, and it should have a dense, tight tubular pattern. The toe is the thickest part of the wall and should be at least three-eighths of an inch thick in most mature breeds. It thins at the widest point of the foot and thickens again as it reaches the turning point at the heel.

THE MYTH OF MATCHING FEET

Most horses do not have perfectly matching feet. Why? Often, the shapes of the coffin bones inside them are very different. When the bone angles vary by up to 15°, is it any wonder that the hooves are shaped differently?

Matching hoof angles when bone angles are significantly different has an inherent risk of causing unwarranted lameness because the forces within the foot are drastically altered.

If you try to make feet like these match externally, you might create a lameness problem. It's a mistake to think that forcing one to match the other or making both conform to a vague standard will make them healthier. A horse's feet can be perfectly healthy and functional at very high levels of competition without matching each other or some "perfect" standard. They just have to be in equilibrium with their internal structures to stay "happy."

--Ric Redden, DVM, with Christy West

Healthy adult hooves normally are wider at the ground than at the coronary band, but foals have feet that are narrower at the ground.

Growth rings, where they haven't been rasped off, provide valuable information on the health of the foot. They should be evenly spaced around the foot, indicating that toe and heel growth are equal (each ring shows about 30 days' growth). A narrow pattern in one area indicates slower growth due to reduced circulation; this could be from overloading as a result of poor conformation and/or balance, injury, or disease. (Note that slightly narrower growth rings on the medial or inner side of the foot are common due to asymmetrical loading from the horse's limbs being placed at the body's corners; this is not normally a cause for concern.)

Hoof angles are a function of conformation of external as well as internal structures, age, breed, load, growth rate, and environmental conditions. We'll get to the internal structures in a bit.

The heels form an angle significantly lower than the toe angle on all horses. This doesn't mean all horses have underrun heels; wide variations in healthy heel and toe angles exist between the various breeds. Heels are low and underrun when they progressively collapse, pushing the ground surface of the foot farther and farther out in front of the heels.

There is no global perfect hoof angle; watch your horse's feet to tell you what works. If you have improving wall thickness, increasing sole depth, and stronger heels with your trimming/shoeing program, then you're on the right track.

The heel bulbs might be symmetric, or one might be pushed up higher than the other, and it's almost always the medial (inner) side (that's higher). It's not necessarily unhealthy until the heel tubules start to collapse, show signs of excessive loading, and diminish growth This sets the stage for bruising and quarter cracks (pathology in the foot). Pushed-up heels are associated with conformational flaws and, therefore, are often very difficult to manage.

Now let's pick up the horse's foot to look at its ground surface. At the heel bulbs, the wall folds inward, forming the bars. This is a very wide, strong area of the capsule in the healthy foot. The bars on healthy, bare feet often appear much stronger and more durable than those in the healthy, shod foot. When small, hairlike projections appear under the shoe in this area, they are the first indicators that the heel is becoming weak. They are the heel tubules that are literally fraying and separating from each other as the wall breaks down.

Unfortunately, hard-working equine athletes often beat their heels into oblivion, jeopardizing their soundness, their careers, and even their lives. More research is needed on how to strengthen weak feet, but I feel that heel degeneration starts with inadequate sole depth and compromised circulation.

The sole protects the sensitive structures inside the foot and houses many blood vessels, thus playing a vital role in the overall health of the foot. The conformation of the sole varies greatly among healthy feet, from being very concave (deep), to shallow with a small natural cup or none at all.

In the bare foot, the outer sole is calloused, tough, and dense. The shod foot's sole will look quite different; the sole will have a softer, flaky zone of exfoliated sole that might fall out easily. Its function as a protective shell has been altered by protective shoes, pads, etc.

Farriers are often expected to cup out soles when trimming, but removing the sole callus removes protection of internal structures, including solar blood vessels. When the sole is too thin, these blood vessels recede and, thus, the sole doesn't get the nutrients it needs to recover; growth slows to a crawl. Problems aren't just external; internal bruising, a compressed digital cushion and circulation, lameness, and poor wall growth can result as well in these "flat tire" feet.

Between the sole and wall is the white line, which is actually yellowish-brown and lies just inside the inner white portion of the wall. When small, dark fissures appear in this area, there is cause for concern. These cracks allow dirt and bacteria to access the sensitive areas of the hoof, resulting in abscesses (termed "gravel"). Less-than-adequate hoof mass contributes to this problem.

Last but not least, there's the wedge-shaped frog. It lies in the back of the foot and is slightly more flexible than the wall and sole, and its shape and depth vary greatly in healthy feet. In wet conditions, the frog will be rubbery; in dry conditions, it is very hard and calloused. The healthy frog generally does not need to be trimmed; frogs will periodically shed in some horses. In dry weather irregular tags of loose frog help retain a little moisture so I leave them alone, but in wet conditions I trim these out and any other irregular part of the frog that might be trapping mud, moisture, and bacteria.

Inside the Healthy Foot

A horse's hooves reflect the shape and health of the structures inside them and can significantly influence that health in turn. We won't detail all the foot's anatomy here, but we will discuss parameters you'll see on a soft-tissue radiograph and what they tell you about the health of that foot (keep in mind that all of these parameters vary with age, breed, and foot size). These parameters can change long before any changes are visible externally, so it can pay great dividends to monitor them, especially with severe problems like laminitis.

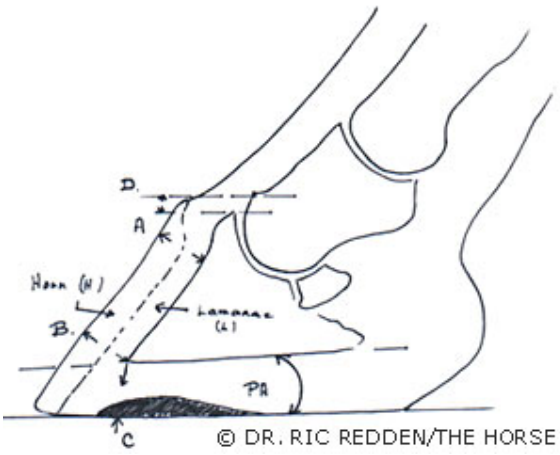
Horn-laminar (HL) zone is expressed as two numbers denoting the distance between the coffin bone (third phalanx or P3) and the outer hoof wall just under the extensor process and at the bone's tip. This zone consists of horn

SOFT TISSUE PARAMETERS OF THE HOOF

(wall) and laminae divided approximately 50/50 with most breeds. Typical light-boned breeds (except Standardbreds) will have a healthy HL zone of 15/15 mm (upper measurement/lower measurement), while heavier, older horses such as stallions and broodmares often have HL zones of 20/20 mm.

Significance The HL zone tells you a lot about the health of the laminae, particularly with sequential radiographs over time. If the lower measurement is smaller in an adult horse, the toe has been backed up (by rasping the toe from the front of the hoof wall to shorten it). If the lower one is larger, the horse might have laminitis or white line disease, or he might have a club foot with a thickened H (horn) side of the HL zone due to the heel being repeatedly taken down to try to make the club disappear. An experienced clinician can tell the difference. Lastly, a sudden, uniform increase in both numbers compared to a previous X ray means the laminae are swelling; this indicates early, acute laminitis.

Palmar angle (PA) measures the angle the wings of the coffin bone make with the ground. When the wings are parallel to the ground, this is a zero-degree PA. When the wings are higher than the apex, it's a positive PA; a negative PA means they are lower. The PA can vary greatly between horses and even among the feet of the same horse.



Measure:
• Horn-laminar (HL) zone (from outer hoof wall to coffin bone) at A and B
• Sole depth (SD) at C (add cup of sole; 12 mm sole + 3 mm cup = 15 mm SD)
• Palmar angle (PA, angle the wings of the coffin bone make with ground)
• Coronary band-extensor process (CE) at D

Significance Most breeds are healthiest with a slightly positive PA; a zero or negative PA indicates some degree of heel crushing with subsequent pain, and most will have a broken-back hoof-pastern axis. This combination, coupled with a thin sole, can cause soundness concerns.

Sole depth (SD) is the distance between the tip of P3 and the ground (or shoe in a shod horse). Sole cup is also considered (i.e., 15 mm SD with 3 mm cup = 12 mm of actual sole; see diagram on page 80).

Significance The healthy shod foot requires at least 15 mm of sole to protect the vascular supply. Bare feet require slightly less, as the vascular supply is normally compressed tighter against the bone.

Digital breakover (DB) is the horizontal distance between the tip of P3 and the breakover point--the forwardmost point of ground contact on a hard surface.

Significance When toe length increases, so does DB; this conformation applies increased leverage on various internal structures at breakover. Shortening DB can be accomplished with a variety of shoes. Their efficiency is related to where breakover is located. Backing the toe up fails to significantly reduce digital breakover, and it most often only weakens the hoof capsule. Take into consideration SD, PA, and degree of damage when applying breakover-enhancing shoes.

Coronary band-extensor process distance (CE) is the vertical distance from the top of the hoof wall to the top of the extensor process of P3, and this describes the depth that P3 sits within the hoof capsule. This measurement has often been called the founder distance, but this is a misnomer *unless* it is a higher number compared to an earlier CE measurement in a horse that has acute laminitis.

Significance The initial CE measurement is primarily a baseline because there is such a wide variation in healthy CEs (zero to 17 mm). The true significance is if it increases in laminitic cases; this indicates the bony column is unstable within the hoof and sinking.

Bone angle (BA) is the angle the bottom of P3 makes with its face at the toe.

Significance Most light-breed horses will have a bone angle around 50-51°, but variations of up to 15° can occur

between feet on the same horse. Matching feet with such different bones can cause unwarranted problems (see "The Myth of Matching Feet" on page 82).

Pulling it All Together

Become a student of your horse's feet, evaluating them regularly and systematically. From that you'll gain insight into what they look like in good times and bad, and learn what practices keep them in the "good" range.

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Readers are cautioned to seek the advice of a qualified veterinarian before proceeding with any diagnosis, treatment, or therapy.