

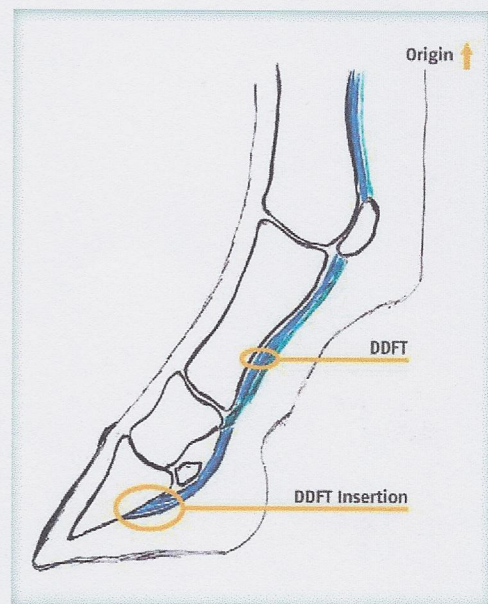
## Principles for Evaluating Hoof Health

by Mark and Karen Plumlee, Mission Farrier School PHOTOS COURTESY OF MARK PLUMLEE

### Understanding Foot Falls

**T**his 5-part series, Principles for Evaluating Hoof Health, will give you the basics for evaluating your horse's hoof health by addressing five topics: Understanding Foot Falls, Identifying Distortion, Understanding the Sole Plane, What is Breakover, and Load Sharing.

What do we mean by "foot falls" and why do we evaluate them? When farriers are called in to evaluate a horse, or for even basic trimming or shoeing, the first thing we do is watch the horse move; and we do this every time. As a grazing and flight animal, horses are all about movement. So before we make decisions for trimming or shoeing it is imperative that the hoof care professional watch how the horse moves, specifically how the foot meets the ground. Is the foot reaching out and landing heel first, flat, or toe first? This simple observation will tell you a lot about your horse's level of comfort.



In my years of specializing in lameness rehabilitation, scores of horses have shown us that a heel-first landing is how a sound horse's foot meets the ground. To understand this, you'll need to understand a bit about lower limb anatomy. The Deep Digital Flexor Tendon (DDFT) originates in the flexor muscle of the

radius (forearm) and runs down the back of the limb making its attachment to the bottom of the coffin bone within the hoof.

Discomfort in the lower limb creates tension in the DDFT and associated muscle. This tension pulls on the bottom of the coffin bone and affects how the foot meets the ground showing us a flat or toe-first landing, as opposed to a relaxed DDFT resulting in the full extension of the limb and a heel-first landing. Tension on the DDFT is simply the horse's way of taking care of himself; much like your stride would shorten up if you took your shoes off and walked across a gravel drive.

The coffin bone sits within the front half of the hoof capsule. The back half is soft tissue—tendons, ligaments, cartilage, an extensive venous network, nerves, sensitive frog and the digital cushion. In a healthy foot, when the foot meets the ground via a heel-first landing, the load is introduced **up** through the frog and digital cushion, which supports the entire bone column and, more specifically, lifts and supports the coffin joint (including the navicular bone) **up and forward** in the hoof capsule.

This subtle movement is important and

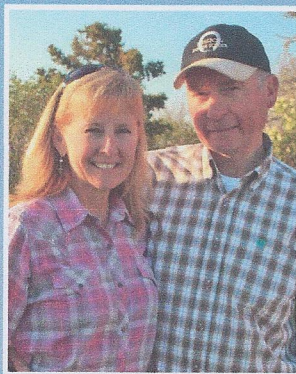
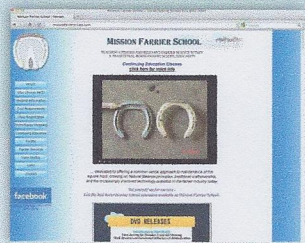


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offers a broad benefit to the soft tissue and support structures though out the hoof. Of particular importance is the unloading of the impar ligament of the navicular bone, as well as reducing tension on the DDFT. As this unloading occurs, a vacuum effect is created by the expansion of the collateral cartilages that moves blood in a manner called hemo-hydraulics.

This unloading effect and the movement of blood is how the foot was designed to dissipate concussion.

If a foot lands flat or, even worse, toe-first the internal anatomy of the foot is compressed in a reverse manner by the descending force of the weight placed upon the bone column, which can lead to destructive lameness pathology such as chronic bruising, joint ailments, ligament damage, tendon strain, compromised blood flow, mechanical laminitis and the dreaded navicular disease. It's my opinion that navicular disease starts here, in the unrecognized lack of a heel-first landing where

## A heel-first landing is essential for prolonged healthy foot function.

by the loading forces load **down** through the impar ligament of the navicular bone.

To best evaluate foot falls, have a helper walk your horse on firm, level ground on a loose lead. Position yourself out in front and a bit to the side and watch

as the horse comes toward you at a free walk. Start by picking out just one front foot and watch as that foot

meets the ground. You should see a slight flip in the toe as the heel and frog engage the ground first, just as our feet engage the ground when we walk. Normal healthy foot function is for all four feet to have a slight heel-first landing.

In summary, a heel-first landing is essential for prolonged healthy foot function. The lack of it is a clear sign of a compromised limb, which will result in unsoundness at some point. A healthy, functional back of the foot dictates the overall health of the foot. Regular observation of foot falls will give you the early warning signs of a potential debilitating lameness.

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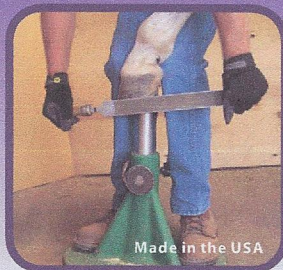
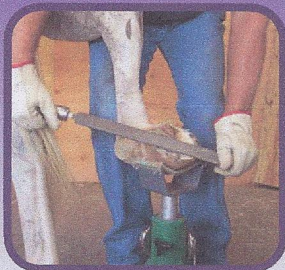


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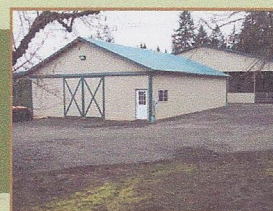
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## Principles for Evaluating Hoof Health

by Mark and Karen Plumlee, Mission Farrier School PHOTOS COURTESY OF MARK PLUMLEE

### Part 2: Identifying Distortion

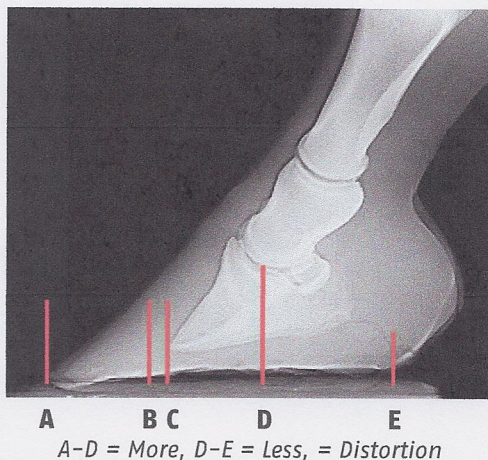
Using the principles in this 5-part series will give you the basics for evaluating your horse's hoof health. They include *Understanding Foot Falls*, *Identifying Distortion*, *Understanding the Sole Plane*, *What is Breakover?*, and *Load Sharing*. In August we talked about foot falls and the importance of a heel first landing. This month we'll discuss how to identify distortion—what does it mean to your horse, and distortion from what?

Distortion is defined as any excess growth of the hoof wall that creates more mass (leverage) ahead of the center of the foot and less mass behind center. Distortion occurs when the length of the hoof wall extends beyond what is considered normal positioning around the coffin bone in a healthy foot.

Excess distortion is a result of three factors: 1) All feet distort simply because they grow; 2) Environmental influence that exacerbates the forward migration of the hoof capsule, i.e., a wet or soft environment; 3) A lack of understanding of the foot as it was designed to function, i.e., continually shoeing a distorted toe and saving heel.

Leverage on the front of the foot is simply due to the fact that the hoof wall grows in length. As the horn grows, the result is not only vertical but also a horizontal extension of the toe, which creates a leverage force that works against the equilibrium of the coffin joint, creating strain on the tendons and ligaments around the joint (Think, working in ski boots or snow shoes). In sound feet, and on feet that are maintained in a healthy natural environment, we find more weight bearing mass behind center and less mass ahead of center to breakover. As we compare

this picture of sound horses vs. horses that are struggling with lameness issues, we continually find that these balance ratios are reversed (more in front and less behind).



Most prominent researchers of equine hoof disorders readily agree that excess leverage on the front of the foot will lead to predictable lamenesses. Not might or maybe, but *will*. It's just a matter of time. We have lost sight of what normal really is. Conventional farrier science has focused on shortening the front of the foot through the sole and saving heel in an effort to achieve hoof/pastern alignment. And while alignment of the bone column through the pastern and coffin joint is desirable, sculpting the sole and hoof wall to achieve this angle has proven detrimental to the overall health of the limb. Now that we understand the importance of proper equilibrium around the coffin joint, we need to adjust our picture of what we think of as normal. We must focus instead on the balance parameters around the coffin bone within the foot, specifically referencing *center*.

How do we find center? Here is an easy way for you to evaluate your own horse for

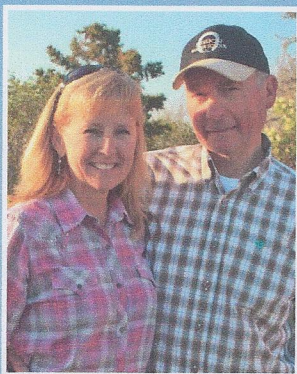
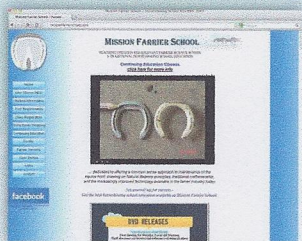


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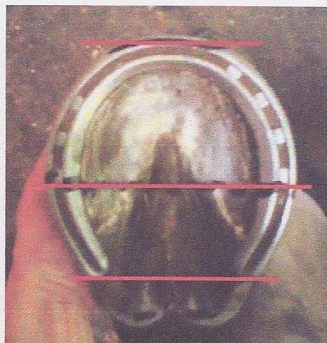
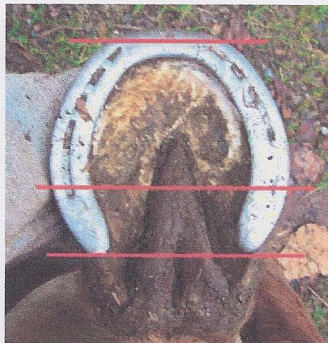
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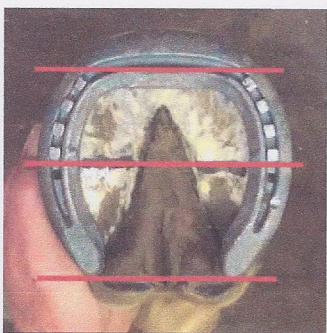
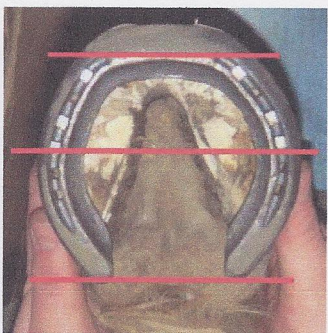
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distortion: Looking at the solar surface, or bottom of the foot, we find the widest part of the foot. This will coincide with the center of articulation of the coffin joint and will be roughly 1 inch back from the frog apex (average size foot) and also where the bars blend in towards the frog and collateral sulci. This is where we draw our first line.



**Undesirable.** Too much distortion at the front of the foot, and saving heel has allowed the heels to run forward and taken the frog out of the picture. From center to posterior support (as dictated by the heels of the shoe) is "less" and from center to breakover (as dictated by the slight rolled toe of the shoe) is "more."



**Desirable.** The back of the foot is "more" (from center to posterior support), and from center to breakover (as dictated by the rolled toe and higher inner rim) is "less."

Once we have identified center it's important to understand that the most posterior weight bearing anatomy on the bottom of the foot should be, and needs to be, the frog buttress (this is where the heels of the shoe should be placed). Without engagement of the frog buttress, proper support of the internal structures of the foot cannot be accomplished. In a shod horse the heel of the shoe defines posterior support. In a barefoot horse it's the frog buttress. Draw your second line where the heels of the shoe ends or across the frog buttress. Your third line will go at the leading edge of the toe, or wherever the toe is allowed to roll forward, or "break over." Breakover is defined as the pivot point for forward movement and is variable, depending upon shoe style or trimming techniques (more on that later).

Ideally, we'd like to see more weight bearing mass from center to the back of the foot and less weight bearing mass from center to breakover. Skilled farriers can modify all types of shoes to

offer improved equilibrium and attain better anterior/posterior balance; however, there are many shoes on the market which are designed to regulate distortion by reducing the leverage on the front of the foot. In fact, every major manufacturer now produces a shoe designed to improve the equilibrium around the joint through a built-in breakover advantage. You can't just lop off the toe. It's important to understand appropriate hoof preparation. *Understanding the Sole Plane* will be discussed in October and, specifically, how to deal with distortion in the November issue in *What is Breakover?*

Proper trimming and shoeing preserves the integrity of the sole, while addressing leverage by reducing the distortion on the front of the foot.

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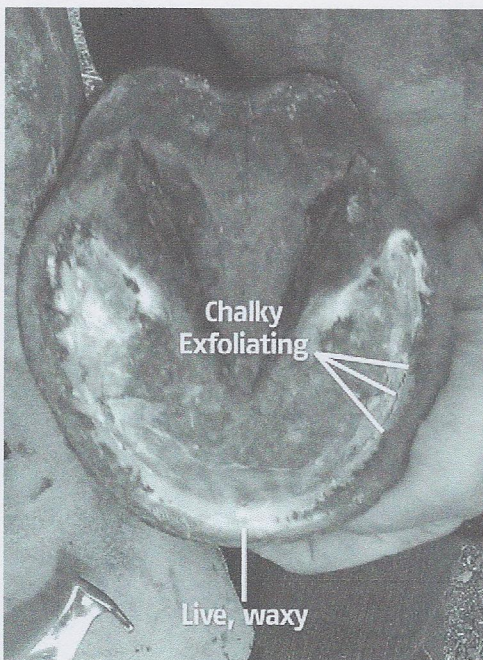
## Principles for Evaluating Hoof Health

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### Part 3: Understanding the Sole Plane

Using the principles in this 5-part series will give you the basics for evaluating your horse's hoof health. They include *Understanding Foot Falls, Identifying Distortion, Understanding the Sole Plane, What is Break-over?*, and *Load Sharing*. This month we cover the "sole plane" and the importance of properly balancing the foot.

The sole plane is the angle at which the sole sits within the hoof capsule. Hooves have an **exfoliating** sole plane and a **live** sole plane. The exfoliating sole plane is that chalky, flaky material that moves easily under the farrier's knife. The live sole plane is the waxy, shiny sole, absent the chalk.



The sole plane is a reliable representation of the coffin bone plane. We use the sole plane as a reference to achieve medial/lateral balance. It mirrors the angle at which the coffin bone sits within the hoof capsule.

Identifying the live sole plane also keeps us "safe" and shows us where we can safely take

our nipper cut without invading the sole. We remove the chalky exfoliating layer and we stop at the live waxy layer. We do not invade this layer with our knife.

Respecting the live sole plane is a better tool than using "thumb pressure." Most of us were taught to carve out the sole until the sole "gave" to thumb pressure. When we could get the sole to move under pressure from our thumbs, that's where we took our nipper cut. Not such a good deal for the horse. If I can make that sole flex to my thumb pressure, what is the coffin bone doing inside as our 1000 lb. horse trots down the trail? We don't want soles to "flex." For that matter, we don't want feet to flex. The equine hoof is designed to be harder than the environment in which he lives and works. A flexible hoof is a hoof that is already in trouble, and unfortunately due to environment, we see a lot of that in Western Washington and other irrigated environments. There is an entire movement out there that talks about the hoof "flexing" as if that's a good thing. Flexible feet are not good. Blood is not "pumped" by flexing. But this is a subject that is best left for another article.

The foot reaches out to meet the ground in a manner that best suits that horse's conformation of the limb, be that a good straight-legged horse, or one with angular limb deformities, pigeon-toed or toed out. Most of us were taught to site down the back of the limb, looking for the hoof wall to be perpendicular to the long axis of the limb. This just doesn't work on most horses. To do this would assume that there are no joints in the lower limb, or that all horses are conformationally perfect. A better way is to trust our sole plane, trimming to the plane of the coffin bone. This will assure proper loading up through the coffin joint and will assure medial/lateral balance without over trimming the sole and making the horse sore. I've heard it said that "a horse doesn't really get into his

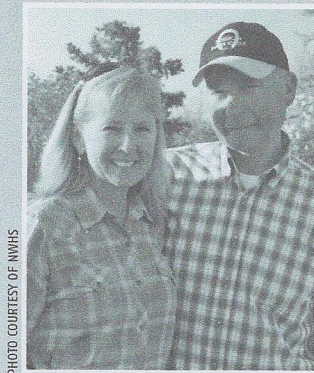
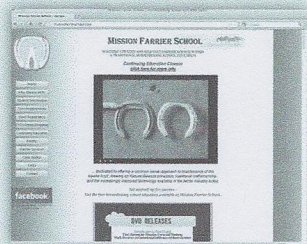


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shoeing until 3 weeks after being shod," as if owners should expect their horses to be sore after shoeing. Our opinion? If it takes 3 days or three weeks for a horse to recover from shoeing (or trimming), then we've done something TO the horse, not something FOR the horse.

If you try to trim the hoof wall at a right angle to the long axis of the limb, with no regard for conformation, this eventually creates a shift of the hoof capsule at the coronary band. The long term results of this approach to medial/lateral balance includes: sheared heels, quarter cracks, compromised vasculature and blood flow through the coronary band, reduction of sole density under the coffin bone, stress around the soft tissue of the coffin and pastern joints and unequal load on those joints which leads to deterioration of the articular cartilage. Although this is a traditional and commonly taught method to balancing a foot, and might be adequate on horses with perfect conformation and genetically good quality feet, most domesticated horses have some compromising issues. These issues are exacerbated by over-trimming the foot to achieve this medial/lateral balance. Excessive thinning of the sole under the farrier's knife leads to chronic inflammation and a demineralization of the coffin bone.

In conclusion, trust the sole plane. That IS the reference to the coffin bone plane, no guessing. It will keep you from over trimming a foot, and since it mirrors the coffin bone plane, it's more reliable than sighting down the back of the limb and you will be medially/laterally balanced to the skeletal structure within the hoof capsule. NWHS

**If you missed the first two installments of this valuable series, *Understanding Footfalls* and *Identifying Distortion*, you can catch up on the information by visiting back issues online at [www.nwhorsesource.com](http://www.nwhorsesource.com).**

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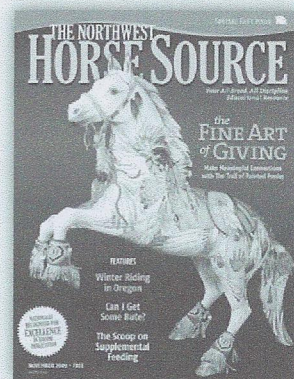
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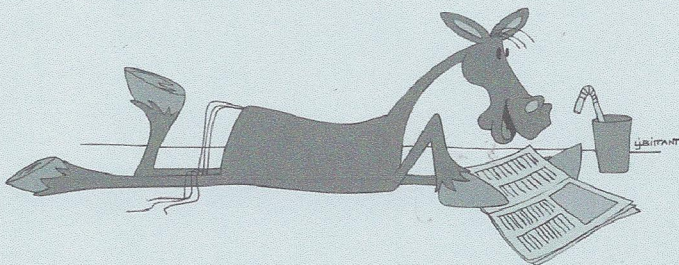
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## Principles for Evaluating Hoof Health

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### Part 4: What is Breakover?

Using the principles in this 5-part series will give you the basics for evaluating your horse's hoof health. It includes: Understanding Foot Falls, Identifying Distortion, Understanding the Sole Plane, What is Breakover?, and Load Sharing.

#### Breakover – Maintaining Equilibrium of the Distal Limb

“Breakover” is defined as “the pivot point for forward movement.” It is that point at which the foot rolls forward as it begins to leave the ground. To further understand this think about ski boots vs. athletic shoes. Ski boots breakover out beyond the end of our toe, athletic shoes breakover under the ball of our foot. So how does this relate to horses? As previously discussed, all feet are subject to distortion simply because they grow. As the horn grows in length, the result is not only vertical but also a horizontal extension of the toe, which initiates a leverage force that works against the equilibrium of the coffin joint, creating strain on tendons and ligaments around the joint.

Breakover, as it relates to soundness, is the act of balancing the foot with the focus of maintaining the equilibrium of the distal limb in and around the coffin joint. Many top-line issues are initiated by an inappropriate extended breakover and the leverage force it places on the front of the foot. To maintain proper balance through the top line, this equilibrium must be met.

Studies of feral horses have consistently shown that breakover occurs approximately 1” ahead of the frog apex (on a size 0-1 foot). The breakover point is determined by a strong sole callus and a rolled dorsal wall trimmed by the environment through constant movement over abrasive terrain from the first day of birth. And while it's true that we don't all

ride feral horses, all equine feet are designed to function the same. In order to achieve optimum equilibrium around the coffin joint in our domesticated horses, we can affect breakover through an appropriate trim or shoe designed to “ease” breakover.

In a barefoot trimming application, when there is sufficient sole density, the farrier can rasp in a low roll from that point forward, unloading the wall at the toe. If there is not sufficient sole density or where a shoe is needed to meet a performance or soundness expectation, there are several shoes designed for this purpose. Every major manufacturer now produces a shoe designed to improve the equilibrium around the joint through a built-in breakover advantage.

Below are just a few examples of both front and hind pattern shoes, starting with shoes with no breakover advantage to shoes with significant breakover advantage. We should point out that a skilled farrier can modify all types of shoes to provide some easing of breakover, depending on a specific horse's needs. Not all equine feet are created equal, and while “appropriate” breakover should be addressed in all horses, it is possible to get breakover too far back. A farrier trained in hoof mapping techniques can identify where breakover belongs.

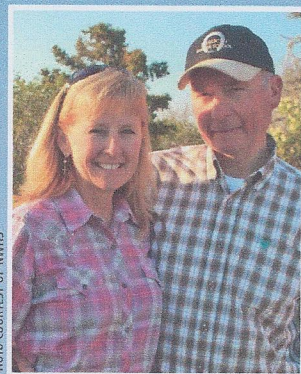
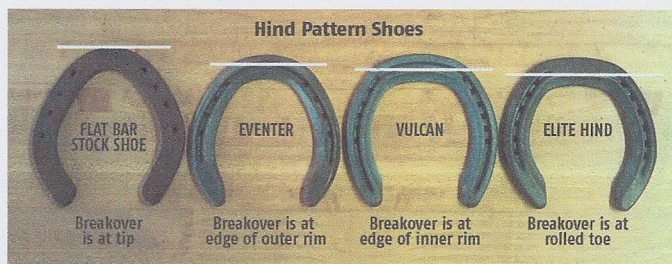
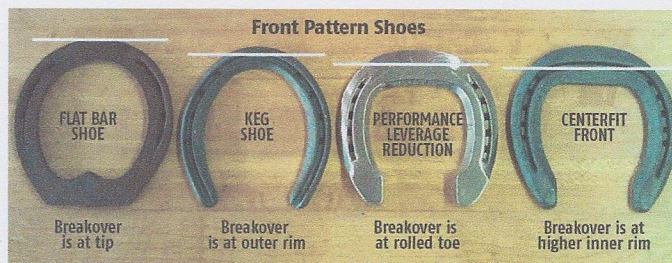


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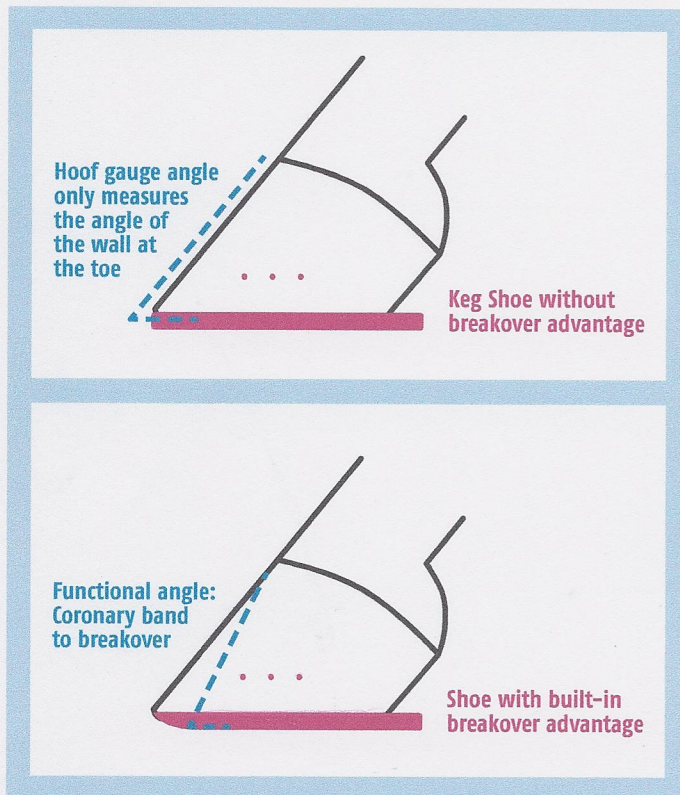
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Extended breakover—breakover that is set too far forward—creates a subluxation of the coffin joint, putting excessive strain or tension on the deep digital flexor tendon, as well as the ligaments of the navicular bone. (See Part 2 in the series: *Identifying Distortion*). Most soft tissue injuries of the lower limb can be associated with extended breakover, which delays the limbs ability to lift off the ground. This in turn affects the entire equine body, from the shoulders to the hips, through the hock and stifle and especially the top-line.

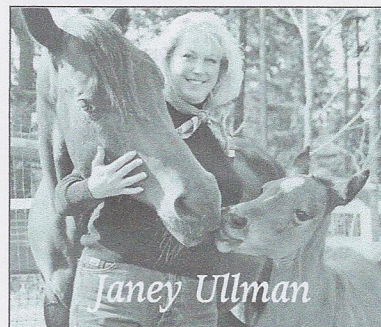
**Side Note:** Hoof gauges have been used to measure angles in an attempt to create “pairs of feet.” However, even though they are considered traditional tools of the trade, they fall way short as a means of balancing feet. It is my opinion that this tool, more than any other, inhibits the farrier’s ability to get equilibrium correct around the coffin joint. Of more importance is the proper placement



of breakover and “functional angle,” which is defined as the angle from the coronary band to breakover. We don’t yet have a tool to measure functional angle. We just know that this angle is steeper than the hoof gauge angle, which only measures the angle of the wall at the toe. By focusing on functional angle, we can reduce excess leverage on the front of the foot without over trimming the sole.

The August issue discussed the importance of watching foot falls and identifying a healthy heel first landing. September’s online issue talked about how to identify distortion. October’s article focused on the importance of not over-trimming the live sole. This month’s article on breakover hopefully has shown you that you can move breakover back underneath the toe which most importantly **reduces distortion** without over-trimming the sole, while still creating a steeper functional angle. NWHS

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## Principles for Evaluating Hoof Health

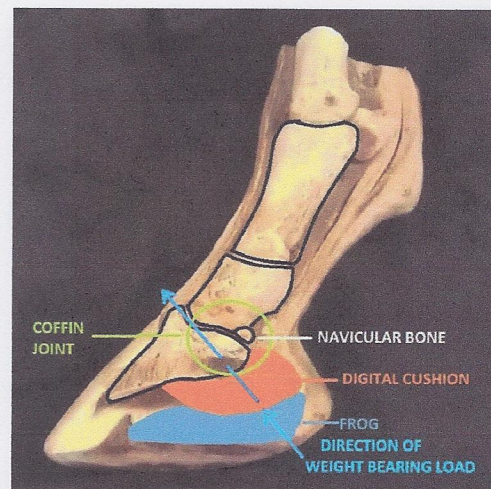
by Mark and Karen Plumlee, Mission Farrier School PHOTOS COURTESY OF MARK PLUMLEE

### Part 5: Ensuring Optimum Load Sharing

Using the principles in this 5-part series will give you the basics for evaluating your horse's hoof health. It includes: *Understanding Foot Falls, Identifying Distortion, Understanding the Sole Plane, What is Breakover?, and Load Sharing.*

The definition of "load sharing" is that which distributes the weight of the horse across a broad surface at the back of the foot, including the frog, bars, heels, sole, and wall. The wall was never meant to be the primary weight bearing structure of the hoof, but rather to work together to share the load.

The back half of the foot is designed to collect material (ideally good dirt) into the commissures around the frog and bars. This collection of good dirt works much like nature's pad material and offers a broad load distribution across the soft tissue in the back of the foot, which is vital in supporting the internal structures.



Remember that the coffin bone is located primarily in the front half of the hoof capsule, and while most people think of the weight of the horse as being supported by the coffin bone and hoof wall, it's actually the soft tissue in the back of the foot. In a healthy foot the frog, digital cushion, co-lateral cartilages, and venous network work together to support the bone column.

Load sharing is the last of our 5 guidelines and takes us back to principle #1: foot falls and the importance of a heel first landing. As the horse's weight becomes fully borne on the limb, the load is transferred from the frog up through the digital cushion through the palmar region of the coffin joint. The result is a subtle lifting of the coffin joint up and forward in the hoof capsule. This lifting minimizes the force on the laminae of the hoof wall, unloading the sole and the ligaments of the navicular bone, allowing for the expansion of the co-lateral cartilages as they move outward at the top. This action creates a vacuum effect that pulls blood from the toe to the heel region where it returns via a venous network back up the limb. This movement of blood is how the hoof was designed to dissipate concussion.

All of this anatomy working together is vital to healthy foot function. When load sharing is

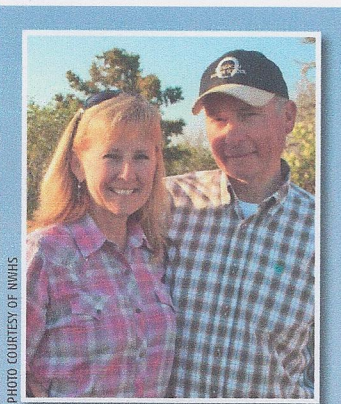
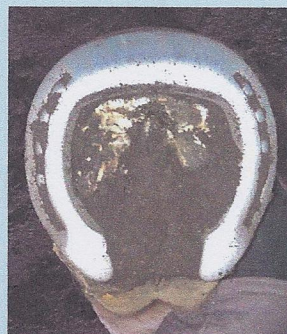
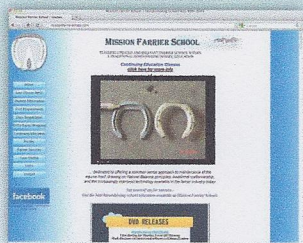


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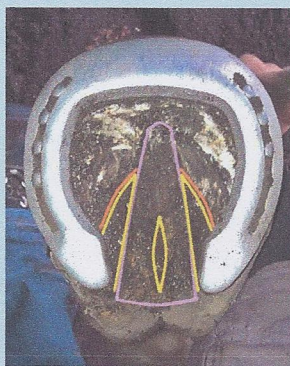
Mark Plumlee is a Certified Journeyman Farrier through the American Farriers Association, a Registered Journeyman Farrier through the Guild of Professional Farriers, and a Certified Barefoot Trimmer, Certified Farrier and Certified Lameness Specialist through the Equine Lameness Prevention Organization. These diverse certifications speak to Mark's commitment to the horse.

Mark has published 6 educational DVDs, and has been a pioneer in the advancement of farrier education for over 20 years. Mark, with his wife Karen, own and operate Mission Farrier School in Snohomish, Washington where they have graduated over 400 students from across the United States and 10 foreign countries.

For more information visit [www.MissionFarrierSchool.com](http://www.MissionFarrierSchool.com) and "like" them on Facebook.



Shoe with dirt



Shoe with no dirt



Heel-first footfall

not introduced through the back of the foot, the coffin joint subluxates, forcing the navicular bone to carry the load. Inappropriate loading of the navicular bone compromises blood flow, which leads to navicular disease.

So, in the interest of promoting load sharing, should I clean my horse's feet? Absolutely. Horse's feet should be cleaned and evaluated regularly to minimize bacterial infections and to remove undesirable compactions such as gravel, rocks, foreign objects or manure. And while the back of the foot is designed to hold a compaction of good material, you do not want this compaction to harden against the front of the foot where it could bruise the coffin bone.

So consider your terrain. If you are going on a trail ride up a rocky logging road, you will want to investigate your horse's feet before you go, but leave the good dirt in to act as nature's pad, ensuring load sharing across the back of the foot. If you are going to compete in arena footing, remove any compactions so that the foot can effectively and appropriately interact with the arena footing.

In conclusion, horse owners, hoof care providers and veterinarians can all benefit from these 5 general guidelines concerning hoof health. But it's important that all 5 things work together to ensure soundness, or improve soundness in compromised horses. We can't just make an adjustment in breakover without appropriate hoof preparation. And the hoof care provider cannot just simply trim to the sole plane then apply a perimeter fit shoe. The foot is an integral unit with all parts working appropriately together to achieve proper function and long term health.

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