FORM FOLLOWS FUNCTION

CHARACTERISTICS OF THE NATURAL HOOF

Ann Corso, CP

Dear Reader,

It is my sincerest hope that this article will help horse owners appreciate the amazing design of the equine hoof. I invite you to read the article and to share it with others.

Sincerely,

Ann Corso

F O R M F O L L O W S F U N C T I O N

Characteristics Of The Natural Hoof

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A C K N O W L E D G E M E N T S

Thank you to Jaime Jackson for patiently describing the Wild Horse Model to a hoof care neophyte; to Dr. Bruce Nock who encouraged me to write this article, it has turned out to be the tremendous learning experience that he said it would; and to my husband, Ken, who has supported me in my hoof care journey and who provided critical feedback on earlier versions of this manuscript.

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INTRODUCTION

"Form follows function" is a phrase I first became acquainted with years ago as I answered phones and filed papers at the University of Kansas School of Architecture. I wasn't a designer myself, just a student in a part-time job, but I found this adage profound. Poor design, by definition, does not serve its intended function – or at least doesn't serve it very well.

Years later, I embraced "Form follows function" as a guidepost in my work as a Natural Hoof Care professional. In the midst of a storm of misunderstandings, misinformation, and controversy in the field of hoof care, this adage keeps me focused. Through it all, I've held onto one thing I know is certain: to function optimally, a hoof must have optimal form. The question is, "What is the hoof form that best supports optimal function?"

DOMESTICATED HORSES DON'T PROVIDE A GOOD ANSWER

The domesticated horses in our barns and paddocks do not provide a convincing answer to this question. A multitude of trimming and shoeing methods, on top of unnatural living conditions, does little to help horses attain optimal or even healthy hoof form. Trying to derive the optimal hoof form from such hooves is like trying to decipher the form of a tree from a wood sculpture.

This becomes self evident to students in the hoof trimming program of the *Association for the Advancement of Natural Horse Care Practices* (AANHCP). Before

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learning to trim live horses, the students practice using cadaver hooves. Each session I ask them to consider what they would regard as an optimal shape based on the 200+ cadaver hooves before them. The vacant expressions topped off by wrinkled brows is a testament to the hopelessness of the task.

LOOKING FOR THE OPTIMAL, NATURAL FORM

So, where can we turn for the answer? Fortunately, we have the landmark work of hoof care pioneer Jaime Jackson. In 1982, this veteran farrier traveled to the Great Basin lands of the American West to study the free-roaming herds of mustangs. Jackson chose to work in this locale because the semi-arid environment of the Great Basin, like the steppes of Eurasia, is the native environment for horses. It is here that the interaction between the horse and this environment shapes the hoof to its optimal form, one that properly aligns internal and external structures and promotes optimal growth and repair. During the next four years, Jackson spent part of his time at the Bureau of Land Management holding facility in Litchfield, California where he took meticulous measurements of the hooves of horses that had been in captivity only a few days. The rest of the time he spent in the field observing the behavior, movement, and social interactions of free-roaming feral horses.

Jackson's years of experience as a farrier didn't prepare him for what he found in wild horse country. In the dry, rugged terrain, with sparse vegetation and limited water,

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the horses had stronger, healthier hooves than the horses he saw in captivity. He was accustom to seeing hooves shaped by different trimming and shoeing methods and unnatural living conditions. The form of the hooves of the free-roaming horses challenged everything he thought he knew about hooves. He was astounded. In fact, the hoof form he found was so radically different from the hooves of domesticated horses that his initial reports were dismissed as a hoax by both farriers and veterinarians. But in the 25 years since Jackson roamed wild horse country, others have confirmed his findings. Jackson's work, however, still stands as the best and most thorough information we have about the optimal form of the hoof. I had the opportunity to see these feet for myself in February 2008 during the *AANHCP Symposium for the Humane and Natural Care of the Horse*. During that symposium the Bureau of Land Management gave us the unique opportunity to visit the Palomino holding facility and to observe the hooves up close. I was able to see the optimal, natural hoof form, and confirm Jaime Jackson's descriptions for myself.

CHARACTERISTICS OF THE OPTIMAL, NATURAL FORM

Jackson found a striking consistency in size, shape, texture, and strength among the hooves observed. Most immediately apparent was size. The entire hoof is more compact than what Jackson usually saw in domesticated horses. The most common toe lengths ranged between 3 and 3 ½ inches long, but some hooves were as short as 2 ½ inches

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(Figure 1). This smaller compact size increases strength and durability and supports bio-mechanically efficient movement. Less material means less weight for the horse to carry during daily travels of 20+ miles.

Figure 1. The short compact hoof of the wild horse supports efficient movement with minimal weight. This minimizes fatigue for horses that routinely travel 20+ miles each day over varied terrain.

In contrast, the hooves of domesticated horses often exceed the 3 ¾ inch maximum length that Jackson observed. Then, a shoe adds even more length and weight to what is already an overgrown hoof, by natural, optimal standards. If you've ever looked at a hoof from the side you know that hooves don't grow straight down, they grow down and forward. So, as a hoof grows longer the landing surface extends further forward in front of the leg (Figure 2). This shift in the landing surface misaligns internal and external structures placing stress on bones and joints. The horse is no longer able to move in a bio-mechanically efficient way, sort of like walking in clown shoes.

Figure 2. In contrast the compact hooves of wild horses, thoses of domesticated horses are often long, placing the landing surface too far forward. This deviation from optimal form, contributes to fatigue, interference, and stumbling.

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In addition to being shorter than the typical hooves of domesticated horses, the hoof wall of free roaming horses is flat; the angle of growth from the coronary band is retained all the way to the ground (Figure 3). This is not always true for domesticated horses. Instead of a smooth, flat plane projecting from the coronary band to the ground, there is often an outward curve somewhere along the way. The curve is an abnormality called a divergent toe angle (Figure 4). It results from unnatural hoof and horse care

Figure 3. The hoof wall of free-roaming horses is flat; the angle of growth from the coronary band is retained all the way to the ground.

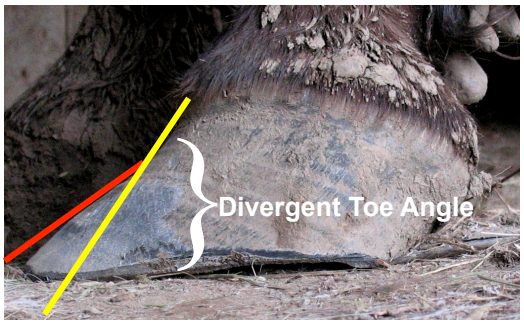

Figure 4. In contrast to the flat smooth wall seen in the hooves of the free-roaming horses observed by Jackson, domesticated horses are often subjected to unnatural hoof and horse care practices that stress the relationship between internal and external structures. This can result in the divergent toe angles like the one seen in the hoof of this domesticated horse.

practices that compromises the relationship between internal and external structures. Like excess length, a divergent toe angle puts the toe too far forward contributing to fatigue, interference, and stumbling.

The compact shape also allows efficient movement, free from interference. It's not uncommon to see the back feet of domesticated horses interfere with the movement of the front feet, which is known as forging. This is an example of form not suiting function. The timing gets all messed up because the toes are so long the horse doesn't

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get the front feet out of the way fast enough to avoid being hit by the back feet. Then the horse injures the soft tissues of the heel bulbs or the skin of the pastern, or he stumbles. The bio-mechanically inefficient movement also contributes to fatigue, which increases the chances of stumbling. Stumbling can be a dangerous problem that disappears when the hooves are shortened to the more natural, optimal lengths and form that Jackson observed. This requires accurate measurements and trimming that not only safely shortens the hoof but also promotes the retention of the angle of growth that emerges from the coronary band. Encouraging the hoof towards optimal size and form improves function, in this case efficient movement.

Jackson also found the strength and quality of the hoof walls he sampled to be superior to most domesticated horses (Figure 5). The hoof walls of the feral horses are thick and hard in contrast to the thin, weak and "shelly" hoof walls of many domesticated horses. This poor hoof quality can be attributed to the horse's inability to cope with the unnatural stressors it endures in captivity. Stressors include confinement in small spaces like stalls or small paddocks, isolation from other horses, or work

Figure 5. Mustang hoof – note the smooth surface of the wall. This is not to say that the free-roaming horses do not experience stress. The stress response is designed for the types of natural stresses encountered in the wild, which are usually short in duration. These include flight from predators or fighting an opponent. The physiological changes that occur during the stress (fight or flight) response enable the animal to respond.

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that is too difficult for the fitness level of the horse. All take a toll on the hoof. Sometimes this shows up as "stress rings:" the ripples, ridges, and grooves in the hooves. These are not common in the hooves of free-roaming animals (Figures 6 – 9).

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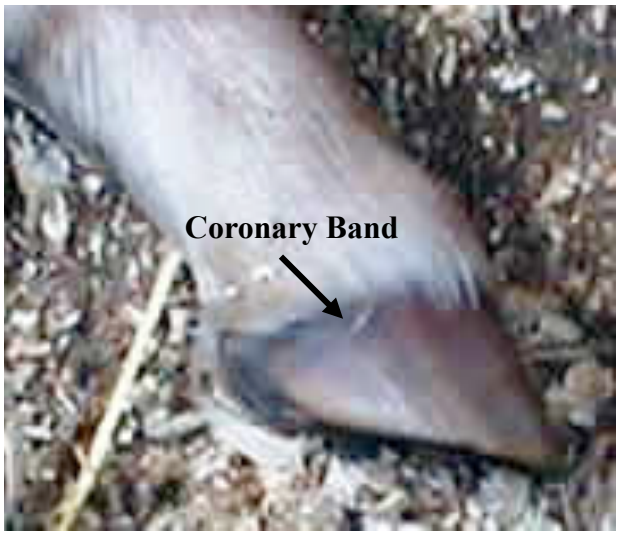


Figure 6. No stress rings are visible on the hoof of this 2-day old foal.

Figure 7. Stress rings form as new growth at the coronary band is interrupted during a stressful event. Hooves grow at approximately 1cm per month. Birth, a physiologically stressful event, left a visible ring on the hoof of this 4-month-old foal.

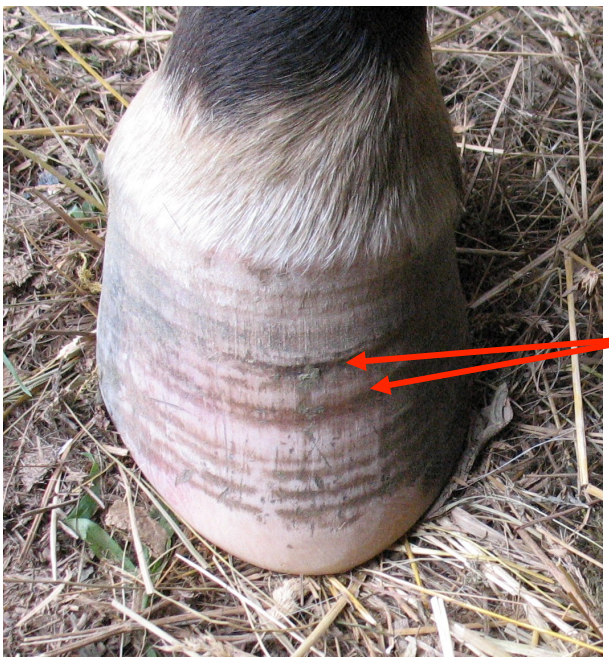
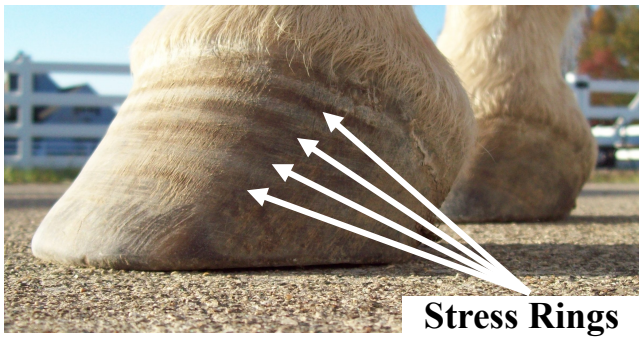


Figure 8. This 2-year-old stud-colt is kept separate from the herd of mares. Although he has turnout, unlike many stallions, the stress of isolation is apparent in the hooves.

The two most severe rings are evidence of the stress of extended travel from familiar surroundings to a training experience out of state. Although the owner traveled with the horse, and the training methods are gentle and tactful, the events were stressful none-the-less.

Figure 9. During past few months the peaceful life of this 20-year-old mare was interrupted when her pasture mate was taken off property to several multi-day events. Although the mare stayed home in her familiar surroundings and routines, the absence of her companion was clearly stressful for her.



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The hoof walls of free-roaming horses are also uniform in thickness all the way around (Figure 10). This even wear and growth is an indication of balanced movement that results in a state of equilibrium between growth and wear supported by proper alignment of internal structures. The irregularities in wall thickness, such as uneven wear and excess wall thickness, called flare, often seen in the hooves of domesticated horses is absent in the hooves of the free-roaming horses. These irregularities place uneven stress on the wall contributing to cracking (Figure 11). The authentic natural trim removes wall flare, returning the wall to a more uniform thickness and removing local stress points.

Figure 10. The mustang hoof wall is uniform in thickness.Uneven wear and flaring are absent.

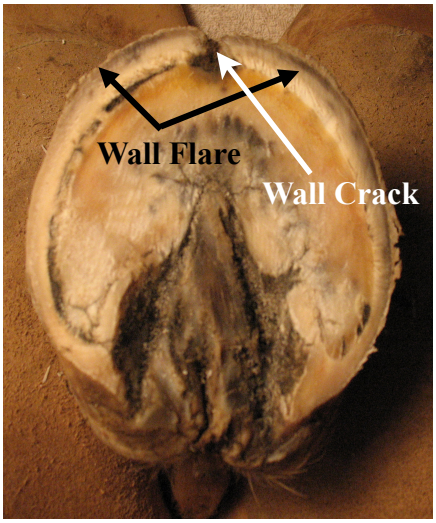

Figure 11. Unlike the uniform wall thickness found in the hooves of free-roaming horses, the wall thickness of domesticated horses often fluctuates. The thicker wall-flare places mechanical stresses on the crack at the toe

Another characteristic of the free-roaming mustang's hooves is the rounded outside edge. This edge is rounded off by wear into what Jackson called the "mustang roll" all the way around the bottom of the wall (Figure 12). This trait supports quick changes in direction with minimal stress to soft tissues. The hoof can smoothly break over in any direction without the interference

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of a sharp edge obstructing the movement. In addition, the outer most layer of the hoof wall is up away from the initial concussion as it strikes the ground. The outer wall is the most rigid layer; it's dryer and easier to crack. The more resilient inner wall, called the water line, is first to strike the ground. This layer is resilient enough to receive the shock of the hoof hitting the ground without cracking. The water line is nature's horseshoe, and it serves the function without adding excess length or nail holes. The mustang roll is an important characteristic of the hooves of the wild horses and of an authentic natural trim. At the same time, it does not define the natural trim which is based on the wild horse model. All of the common characteristics of the optimal form are included in an authentic natural trim.

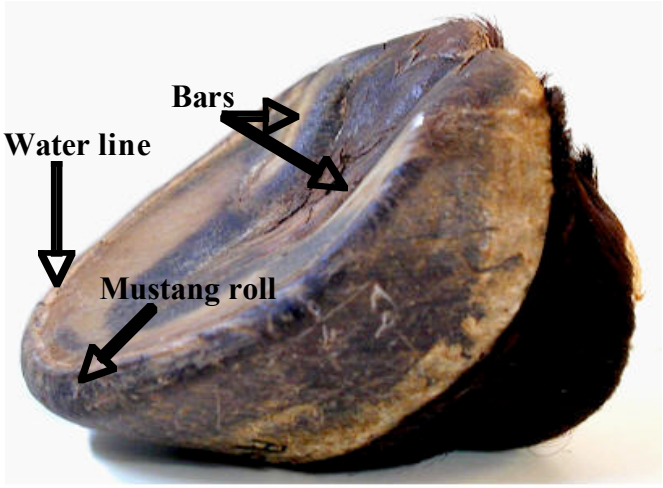

Figure 12. Notice that all of the structures of the bottom of the foot blend together into a domed shape.

Among the hooves that he studied, Jackson consistently found that the sole, frog, and bars of the wild horses merge together into a dome-shape that arches upward from the water line, the inner-most layer of the hoof wall (Figure 12). As any engineer will tell you, an arch, or dome, is able to span space while supporting a heavy vertical load (Figure 13). Because the bottom of the hoof spans space, internal structures are

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Underwater tunnel at Sea World

Bridges over the Cuyahoga River

Figure 13. The arch spans space while supporting a vertical load. The strength of this shape is demonstrated in these two structures.

protected from the initial impact with the ground. This property protects against the kind of bruising seen in the flat soles of many domesticated horses. Lighter than a solid shape, this semi-hollow form also minimizes fatigue during miles of daily travel. It may even improve reaction time and speed vital to survival in the wild.

The broad and healthy frogs of the feral hooves are also a sharp contrast to the atrophied frogs of domesticated horses, often found pinched between contracted heels of shod hooves. The domed shape and healthy frog protect the pliable digital cushion inside (Figure 14). Contracted heels distort the arch of the hoof, damage the frog, and impair the function of the digital cushion (Figure 15). Since these structures along with the fetlock joint and other soft tissues

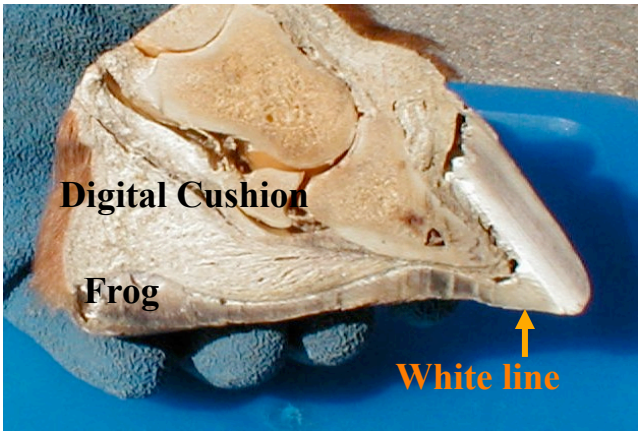

Figure 14. In the hooves of the free-roaming horses the healthy frog forms a protective cover for the shock-absorbing digital cushion inside the hoof. The white line (really more yellowish in color) tightly connects sole and hoof wall.

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receive the weight of the horse as it loads onto the leg, it's no surprise that many lameness complaints among domesticated horses are isolated to pain in the back portion of the hoof where unhealthy frog and contracted heels hamper shock absorption. An authentic natural trim encourages wide heels and a healthy frog which support optimal function of the internal structures (Figure 16).

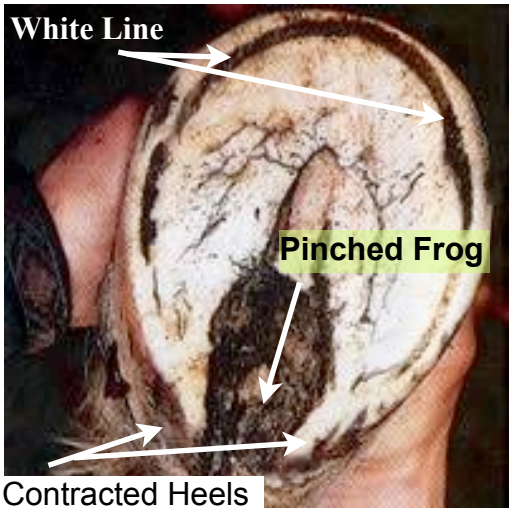

Figure 15. Unhealthy frog pinched between contracted heels, and unhealthy connection between sole and wall (white line) are all too common in the hooves of domesticated horses. These deviations from the natural form do not optimally support the function of the internal structures like the connective lamina and the shock-absorbing digital cushion.

The hoof wall and the sole are tightly connected in the hooves of the free-roaming horses. This indicates strong, healthy connective tissues, called the lamina, between the wall and coffin bone inside the hoof. This tight connection may help support the domed shape by supporting the tension of the wall around the sole. In addition, this healthy sole-to-wall connection, called the white line, prevents debris from working its way up into the sensitive lamina inside, reducing the risk of abscesses. In contrast

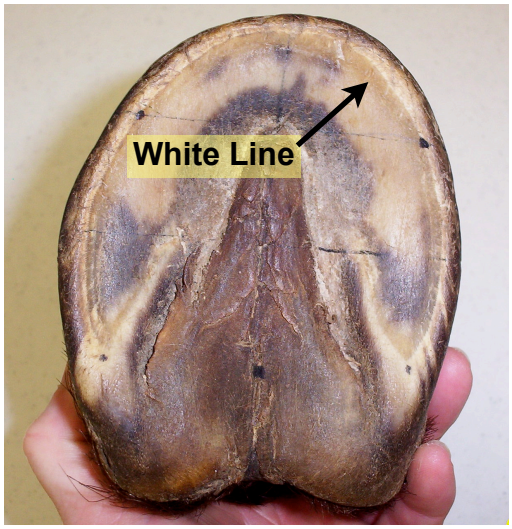

Figure 16. Wide heels, broad and healthy frog, and the tight connection between the sole and the wall (white line, which is actually a yellowish color) support optimal function in the hooves of free-roaming horses.

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to the free-roaming horses, domesticated horses frequently experience a poor connection between the hoof wall and sole as seen in white line disease. This condition heals with an authentic natural trim, and appropriate changes in environment and life way that support optimal growth and repair (Figure 17).

Front Hoof

Back Hoof

Front Hoof

Figure 17. Hooves receiving natural hoof care.

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WHAT DOES THIS MEAN TO THE HORSE OWNER?

Now that you have read this article, if you are anything like me, you're not likely to look at hooves in the same way ever again. You'll look for the natural form and wonder what's causing any deviations from it: What caused that stress ring? Why does the hoof wall curve half way down? And why are the heels so close together? What about the frog; why is it so puny? You might also have questions for your hoof care professional that would never have occurred to you before, specific questions about hoof form and health. Is the connection between the sole and the hoof wall, the white line, healthy and tight? How come his feet are so flat? And so on. You're forever changed—and that's good news for your horse. You see, all around the world, horses are already benefiting from a successful transition to authentic natural hoof and horse care that support optimal hoof form and health.

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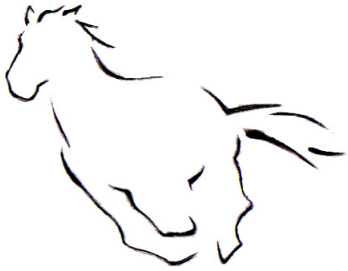

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