



One Step at a Time: Hoof Trimming and Leg Stress

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Have you ever walked in shoes that you've had forever that are just a little worn to one side of the heel or the other? Did you notice that after awhile your knees would start to hurt, or maybe your ankles? Now think about wearing those shoes 24 hours a day, every day, for an entire month without ever taking them off. Imagine how miserable you'd feel.

Now, apply that to the horse whose owner says he can go a few more weeks before he needs a trim or even worse, to a horse whose owner thinks the animal can go all winter without any hoof care. Now, take a step back and imagine wearing those ill-fitting shoes for the entire winter. You should cringe at the thought.

The reality is that horses' feet are often neglected, especially during the winter months. Shoes are usually pulled, farrier visits become less frequent, and the horses are left to suffer.

As a rule of thumb, we know that our horses should be trimmed (and shod if necessary) at least every six to eight weeks. But where did those numbers come from? Sure, after eight weeks, hooves will start to appear long, they might crack or chip and look unsightly, or on a horse with poor conformation, the feet might show uneven wear. All of these observations might seem benign on the surface, but they're important, according to Meike van Heel, MSc, BSc, PhD, a researcher at Utrecht University's Equine Performance Laboratory in the Netherlands. Van Heel recently studied how a hoof changes between trims, and she found that neglecting your horse's feet could be setting him up for serious injury.

Van Heel says most early retirements in equestrian sports are the result of lameness problems caused by overloading injuries. Such injuries occur when the amount of force placed on a soft tissue structure (such as the tendon) exceeds its loading capacity. Severe overloading can cause an immediate effect resulting in acute damage. However, most overloading is chronic and repetitive, and it results in the injury of lesion-prone tissues of the limb, primarily tendons, ligaments, and articular cartilage.

In a series of recent studies, van Heel and a group of Utrecht researchers closely observed and measured the changes that occurred in horses' hooves during an eight-week shoeing interval. With the help of radiographs, motion sensors, video recordings, and pressure plate systems designed by van Heel, researchers were able to observe two major changes in the hooves that occurred during those eight weeks: The breakover point (the phase of stride between the time the horse's heel lifts off the ground and the time the toe is lifted) moved back toward the heel, and the hoof angle (the angle of the front of the hoof wall with the ground, as viewed from the side) significantly decreased, both of which, van Heel says, can place added stress to lesion-prone tissues in the leg.

Breaking Point

Van Heel says horses don't change their gaits excessively to compensate for the change in hoof angle, so it's hard to see a change in gait by simply watching a horse move. To study this change, she had to rely on slow-motion video and motion sensors that recorded data.

"It is also known that horses can compensate for changes in hoof conformation by changing their kinematics, i.e., limb placement or (breakover) timing, as they do after shoeing," she says. "Horses are very capable of maintaining their own way of movement; you don't see changes in limb timing such as stance time and breakover duration, nor do you see changes in limb placement.

"The compensation is seen not in timing or placement variables, but in the limb angulation of the fetlock joint (as the horse moves)," she continues. "After the eight-week interval, we see less fetlock extension. Less extension can result in a smaller shift of the (hoof's) CoP (center of pressure) as seen at midstance. In the hind feet, you see changes in hoof-unrollment (breakover) pattern, and we expect and have some indications of that also in limb placement of the hind limb as the horse compensates, but we were not able to show this in the studies. We were also able to see compensation at joint level."

Stephen O'Grady, DVM, MRCVS, of Northern Virginia Equine, says that during breakover, the toe acts as a pivot point (fulcrum) around which the heel rotates.

Breakover can be significantly delayed, O'Grady says, when the horse has a long toe and low hoof angle. The toe acts as a long lever arm, requiring more time and effort to rotate the heel around the toe. Imagine a cross-trainer athletic shoe (with a rolled toe) versus a clown shoe. The cross-trainer's shorter length and its breakover design allow for easier locomotion.

Shortening the lever arm, he explains, helps facilitate breakover: "Facilitating breakover may involve trimming to decrease toe length and/or applying a rolled-toe, rockered toe, or square-toed shoe."

Long Toe

In one of the Utrecht studies, van Heel measured the angles of the hoof and the column of bone above it using radiographs and the hoof's CoP, which is obtained with a system of pressure plates she designed. Researchers were mainly interested in the relationship between the proximal interphalangeal joint (pastern joint) and the distal interphalangeal joint (DIPJ, or coffin joint). Measurements were taken two days after the initial trimming and shoeing and were repeated at the end of the eight-week interval, and the data were compared.

Results showed the dorsal wall increased in length and the hoof angle decreases significantly during a shoeing interval of eight weeks. Horses must compensate for this change in hoof angle by rocking the hoof-pastern axis backward, thereby increasing the extension in the coffin joint. This places strain on lesion-prone tissues such as the deep digital flexor tendon (DDFT) and increases the risk of injury.

"Growth of the hoof between two shoeing sessions leads to a change in hoof conformation," van Heel says. "In a shod horse, this change in conformation cannot be compensated for by changing the bearing of the surface (how the hoof wall is shaped), as the shape and the size of the shoe changes very little, provided there is no excessive wear.

"The hoof-pastern axis breaks backwards in the DIPJ, resulting in an increased DIPJ loading of on average 17%," she continues.

If you're having a hard time visualizing what this feels like, do this: stand on the edge of a step with your heels hanging off. Now, slowly lower your heels. As you do so, notice the strain you feel on the back of your leg. If you had time enough to stand there for several hours, your legs would feel exhausted and sore because of the added stress placed on your muscles and tendons. Again, this is an extreme example of what happens, but it simulates the added energy and

stresses that are placed on the structures of the leg.

Horses are a little different, in that there's no sudden change in hoof angle during the growth period. Over time, the horse compensates for the decreasing angle by subconsciously rocking back on its heel to maintain comfort.

Van Heel says, "The substantial effect of the change in hoof angle during the shoeing interval on the joint angle of the DIPJ emphasizes the need for a relatively short shoeing interval and for an individually determined interval for each horse."

Also, she adds, as with breakover, the front feet are more affected by the change in angle than the hind feet. Van Heel speculates this is due to greater loading on the front feet than the hind. This is evidenced by her observation that, "Loading-related disorders, such as navicular disease, are much more common in the front feet than in the hind feet."

Van Heel stresses the importance of identifying an appropriate trimming interval for your horse to reduce the stresses not only caused by the change in angle from hoof growth, but also to limit the abrupt change that will occur after trimming the hoof. "The most difficult time for horses to compensate might be the abrupt changes that occur after eight weeks, when the horse is fitted with new shoes and the hoof conformation changes suddenly," she says.

Trim for Success

O'Grady says, "There may be no other routine procedure performed on a horse that has more influence on soundness than hoof preparation and shoeing." While methods might vary, the basic objectives of maintaining an angle that supports the hoof-pastern axis and facilitating breakover remain steadfast.

For years, O'Grady told horse owners that hoof angles should range from 48 to 55 degrees in front and 52 to 60 degrees behind. However, he's since changed his view. He says the correct angle is when the hoof-pastern axis is in alignment.

"A normal hoof-pastern axis is one in which a line drawn along the front of the hoof wall is parallel to the pastern," he says. "In this situation, each of the bones of the digit--P1, P2, and P3 (the proximal, middle, and distal phalanges, respectively)--is in normal alignment.

"In addition to trimming the hoof to normalize the hoof-pastern axis, it is important that the weight-bearing surface of the wall extend as far back as possible," O'Grady explains. "Ideally, an imaginary line dropped down from the center of the cannon bone should land right where the heel ends, not well behind the heels as is often the case. If the heel cannot be trimmed to provide optimal support at the back of the foot, the branches of the shoe can be extended to compensate and optimize the bearing surface area."

Van Heel says farriers and veterinarians need to change their philosophy concerning trimming/shoeing intervals.

"Instead of using a shoeing interval based on tradition, we should use an interval based on the individual horse--on his conformation and hoof growth," she says.

In these studies, "We saw horses adapt, to a certain extent, to a shoeing interval, but if the horse is re-shod after that interval, the horse has to make a relatively large adaptation and might therefore be predisposed to injuries," she says.

"So it is not a good idea to shoe a horse one or two days before a competition," she stresses.

Originally, the main reason to attach shoes was to protect the feet against excessive wear, but shoes can now be used as instruments to influence performance or therapeutic aids to treat lameness. In an age where the human market is filled with specific shoes for every sport or orthopedic purpose, most horses still perform on shoes that are essentially the same as those invented more than 2,000 years ago. (It is thought that horse shoes were invented around 500 B.C.)

To optimize shoes and shoeing techniques for today's sport horses, it is essential to know in detail the effects of normal trimming and shoeing.

Van Heel says farriers need to observe the horse's ability to adapt to a shoeing interval. The amount of time between trimming or shoeing should be "tuned to individual horses, where you take the hoof growth and the conformation of your horse (into consideration) when determining the optimal shoeing interval," she says.

Take-Home Message

"Shoeing horses has been performed throughout the ages, but farriery remains a profession based largely on traditional empirical craftsmanship, rather than on scientific evidence," van Heel says. That needs to change.

How long should you go between farrier visits? She says that depends on your horse, and how often and for what purpose he's used. Putting off your farrier visits can create serious underlying problems to structures within your horse's limbs far beyond what the eye can see. Work with your veterinarian and farrier to calculate an appropriate shoeing interval to suit your horse's individual needs.

Van Heel says, "A short, tailor-made shoeing interval, and a well-balanced hoof and shoe, are very important in the prevention of overload injuries in our sport horses."

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



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