Barefoot Endurance Riding

The Feral Foot as a model for High Performance Barefoot trimming on the domestic horse

In 2003 my endurance horse Jasper (Magica's Minstrel - a full Arab) finished his first full barefoot competition year by coming 5th in the Red Dragon 2 day 160km/100 miles Endurance competition in the Welsh hills. He did 10 rides in a range of footing conditions and was never lamed out, even when other riders complained of hard ground. Tiffany, our ageing TB, completed 3 days at the Lindum Festival of Endurance in Lincolnshire and two TREC competitions. This year Jasper has completed rides of varying distances: 40 km, 65 km, 85 km, 124 km (in one day), and 160 km (over two days), again without a hint of lameness. In his final ride of this year, the Red Dragon, he was shod for the competition, for 5 days only, as the persistent wet weather through the season worked against us doing the final ride barefoot. We were eliminated at the final vet gate with a metabolic problem related to a lack of calcium.

Over the four years our horses have been barefoot I have put a great deal of research and thought into how to optimise the foot for this hard competition work. I would like to share my thoughts and experiences on the subject with others in the endurance world who may find it useful.

One of Jasper's hind feet after completing a 160km/100 mile ride over two days in 2003

A typical feral horse foot

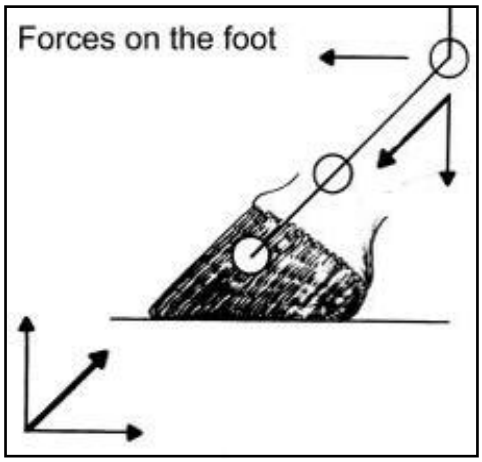
As the genetic make-up of the horse is virtually identical across breeds and continents then, if we can understand how the horse evolved this amazing foot we can hope to perform the best possible trim.

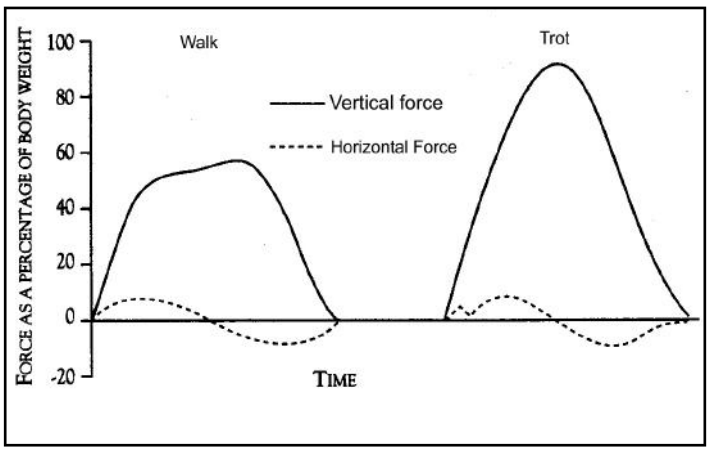
The foot is primarily a deliverer and acceptor of force. Every force has an equal and opposite force so the foot experiences the force of the equine body in movement and the reaction force of the ground pushing against the foot. The body acts through the bones towards the ground and ground towards the bones through the hoof capsule, this generates a shear force (a scissor action) in the hoof capsule between the coffin bone and the outer wall. When the horse stands or moves that shear force is always there to a lesser (standing) or greater (jumping) extent.

The structures of the hoof have evolved to handle and minimise this shear force. Nature has done this by creating a massive surface area not only in the lamella but also in the coffin bone (find a coffin bone x-ray picture and note the 'airy' structure). This structure not only 'glues' the capsule and bone together with bio-adhesive (boiled hooves make great glue) but it grows to replace wear and responds to increases in stress by toughening the structure (like our skin responds to hard work and

bone strengthens with stress). If this glue starts to yield under the shear forces, then the foot is heading for trouble, slowly or quickly.

In the force graph below notice the vertical and horizontal forces and, interestingly, the complete lack of a heel strike force. This indicates that the landing of the foot from heel to flat foot is not controlled, being simply a rotation of the foot on the coffin joint. This lack of active control being the case the





The forces on the foot are both vertical and horizontal. With a barefoot horse it is the horizontal force that wears the foot (like a moving rasp) and the vertical force determines how much of the solar surface is removed in each stride (like the degree of pressure of the rasp).

horizontal force tips the toe into the ground with each step. To compensate for this the hoof has evolved to respond to the increased toe force by growing more densely at the toe, so making it harder wearing than the rest of the hoof wall.

There are two primary movement forces which bear upon the horse’s hoof. One from the mass of the horse's body as it moves; it has a low frequency charateristic (walk, trot, canter) and has the full force of the horses movement. The other is high frequency with small movement and generated when the hoof hits the ground.

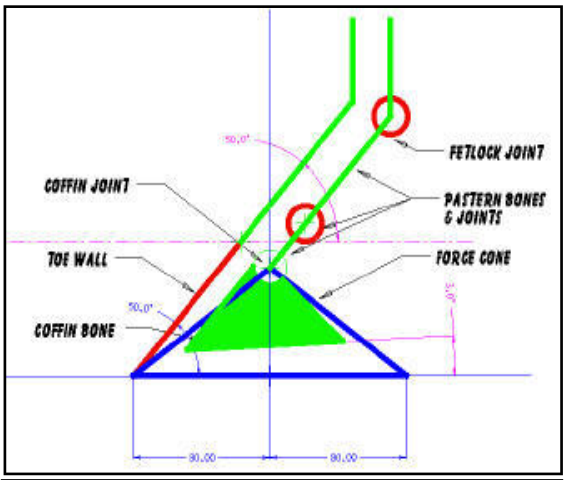
The low frequency is handled by the suspensory system in the lower leg, and much like a car suspension it has a spring (suspensory ligament) and a damper (comprising: digital cushion, frog, lateral cartilages, blood vessels, blood). This lot works quite well on its own with the leg chopped of just above the knee or hock, even minus the blood. Some fancy control is added by the muscles of the tendons, a bit like a computer controlled suspension system in some cars, which softens or hardens depending on the forces experienced at any instant.

The high frequencies are, I think, handled in the foot. These jarring frequencies vary with the ground surface; for a human example, try slapping your desk with the palm and fingers of the flat hand. This is very different from slapping your seat cushion. One hurts and the other doesn't. This jarring is absorbed in the materials of the hoof at the structural level.

What has been noticed with barefoot domestic horses is that the hoof wall thickness increases towards that of the feral horse. Jasper’s dorsal wall from coffin bone to horn surface is about 20mm thick and half the wall thickness is taken up by the non-pigmented wall (sometimes called the water line). This structure is less regular and contains more water than the outer wall. It is ideally suited to absorbing the jarring ground effects and converting them into heat, via microscopic structural distortion, the heat being carried away by the blood via the large surface area of the lamellar corium. The feral hoof’s rounded edge, the “mustang roll”, puts the waterline in contact with the ground to absorb this jarring shear. The feral hoof therefore does not contact the ground with the outer hoof wall. Trimming a mustang roll on a domestic horse produces the same effect. Also a good sole is very much like the 'water line' in structure and will have a similar ability to damp out shock when the foot hits the ground. Being modified skin it responds to the work it gets. Put shoes or boots on and

it will lose toughness. Put the sole in touch with the ground and it toughens up.

There is much argument about the validity of using the feral horse model for the domestic horse. There is however one thing which is indisputable 'the feral horse keeps a balanced foot'. If it didn't, it would wear the hoof unevenly, be much more prone to injury and lameness, and be dead meat before its time. Let's consider how this balanced foot can be maintained in the domestic horse away from the environment in which the equine foot has evolved.



Schematic diagram of a balanced foot with the hoof pastern axis (HPA) aligned. The angles are not absolute values and will vary from horse to horse but the HPA should always be aligned.

Given that there is consistency of material on the solar surface of the foot, then to maintain even wear there should be no more pressure on the rear of the foot than there is on the front of the foot. The forces from the horse's movement all end up in the coffin bone joint when the foot contacts the ground. The forces must move through the foot as if the coffin bone joint was the peak of a cone and the ground contact surface of the foot the base of the cone (admittedly a simplification but useful conceptually).

Under these circumstances all of the base of the cone will be under equal pressure against the ground. The force distribution cone does not exactly follow the lines of the coffin bone as all the tissues in the foot are involved in the transmission of the force.

Les & Jasper on an endurance ride

However the conceptual ‘cone base’ has a missing triangular slice for the frog and associated low frequency shock absorption equipment. As the ‘cone base’ is incomplete the forces at the coffin joint cannot be evenly distributed so more pressure (pressure = force divided by surface area) will be felt by the heels either side of the gap. If this modified ‘cone base’ were now scraped across a wearing surface it would wear most at the corners of the gap, the heels. The bars evolved to replace this missing area of hard foot. By making contact with the ground they provide extra support and help to keep an even wear pattern on the hoof from front to back, allowing the self trimming feral horse to maintain a balanced foot.

The horse left to its own devices in the environment it evolved into keeps a balanced, short stubby hoof. We humans have taken the horse out of its adapted habitat, which is harsh underfoot and dry, and placed it in nice soft wet pastures. The habitat in which our domestic horse’s hoof evolved is gone! The forces stay the same, the genetics stay the same but the grinding ground has gone. The hoof is at a loss as it grows to match a wearing surface that it may never meet, a surface that wore the hoof to keep it balanced, so the horse lived to breed.

To balance Jasper’s feet I have used the feral horse data on hoof angles and hoof lengths. This shows a front (dorsal) wall angle for the fore feet of 54°± 4° and the hinds at 60°± 4° depending on the individual horse. For Jasper the optimised front foot angle appears to about 53° and 59° for the hinds. At these angles the HPA looks correct for both front and hinds and has been confirmed with x-rays. Feral hoof dorsal wall lengths have a mean of 3¼”±**3/8**”. Jasper performs best barefoot with a hoof length between 3¼” and 3**½**”. As he nears 3” I need to consider shoeing for the longer rides

as was the case for part of the Scottish Championships and the whole of Red Dragon as the very wet weather this year worked against being barefoot in these long rides. Working within these guide lines has produced a tight white-line all round the hoof with no flare being generated between trims. The frequently maintained 'mustang roll' eliminates any serious chipping even when crossing the roughest of ground.

For our own little herd of domestic horses we have decided to take the responsibility to trim the hooves so they are balanced to produce even loading on the ground whether barefoot, booted or shod. For the barefoot horse, once even loading is achieved and it is ridden on rough ground often enough in dry conditions the hoof will stay balanced. If such a situation is not available, or if the horse is shod or booted, there will be a constant need to re-balance the foot, as it continues to grow in its genetically programmed pattern. Committing to this task has the benefit of seeing and feeling a happier, freer moving friend with fewer hoof, foot and leg troubles.

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Jasper's FR recently trimmed in March this year, 2005, prior to applying the 'mustang roll'. Points to note:

- *heels bulbs wide apart*
- *deep clefts between bars and frog*
- *well formed heels in-line with widest part of frog*
- *tight white-line; thick horn about 50/50 pigmented/non pigmented*
- *once 'mustang rolled'; frog, bars, non pigmented horn, white-line and 'moon sickle' sole are in ground contact*
- *dorsal wall angle 54^{o}*
- *dorsal wall length 3 1/8"*