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Relationships between Hoof, Leg, and Whole-Horse Conformation.

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In a broad sense, most readers would probably agree that there is a relationship between hoof conformation and the conformation of the entire horse. But how does one assess the consequences of poor hoof conformation on the entire horse?

This is the million dollar question that may be hard to ever fully answer! To understand the exact ramifications of hoof conformation as it relates to the horse, we need more information on equine locomotion, biomaterials mechanics and equine neurology. When compared to human biomechanical research, equine research is in its infancy. Generally speaking, the study of biomechanics is a relatively new field compared to that of the well-established fields of biology and physiology. There is still much to gain by future explorations of equine biomechanics.

Due to the complexity of the subject matter, I will broadly discuss hoof conformation as it relates to the stance of the horse. Also I will try to address the difference between external hoof conformation and the shape of internal structures. For instance, a hoof may appear externally to be 'normal' but may have internal deformities. What effect do these internal deformities have on the horse? It is important to point out that any quantitative definition of "normalcy" ought to refer to an *acceptable range* rather than an exact number.



Figure 1: The radiograph shows a hoof that has a good stance. The arch (red curve) supports the larger part of the pedal bone. The vertical green line intersecting the pedal bone is placed approximately where the apex of the frog would be. As one can see a large portion of the hoof lays behind this line. The two solar pictures of the hoof show two different hooves with reasonably good conformation. Note that a larger portion of the hoof is behind the red line in the two solar views.

My ballpark definition of a 'normal' hoof is the following: the hoof ought to stand under the bony column and have heels that provide adequate support to the bulbs (figure 1.) A higher percentage of the hoof should be behind the apex of the frog, than in front of it. It makes a lot of sense to have a larger load percentage present in this area rather than at the toe. The caudal area of the hoof (approximately, the region that lies behind the middle part of the frog toward the bulbs) can be regarded as functioning as a pad. Shifting the load to the toe area has serious consequences to the health of the pedal bone. Internally, the arches should have a good definition. The sole should be at least half an inch in thickness or more. The sole plays an important part in supporting the entire limb. It also acts as a shock absorber and also provides a form of insulation against the cold and heat. If possible, the hoof should not present internal pathologies, i.e. articular ringbone, nor external

abnormalities, i.e. permanent scars on the hoof capsule. Ideally, the hoof should be able to function as intended. This means that the sole, walls and frog should share the load and be able to flex according to their normal mechanical properties.



Figure 2: This image shows models of the bones that were reconstructed from a radiograph of the same horse, so that we can visualize the approximate positioning of the bones within the lower limb. This horse has a poor stance: the hoof is not beneath the bony column of the leg – it is “out in front”.

Now let us examine what could happen when a hoof deviates from ‘the norm’. Figure 2 shows a horse with very poor stance conformation, the hoof is too far ahead of the bony column (cannon bone) and the bone alignment is not ideal. This poor lower limb stance also may affect the conformation of the entire horse. It is very likely that as the bone alignment within the hoof changes, it will also have an effect on the entire frame of the horse (figure 3).

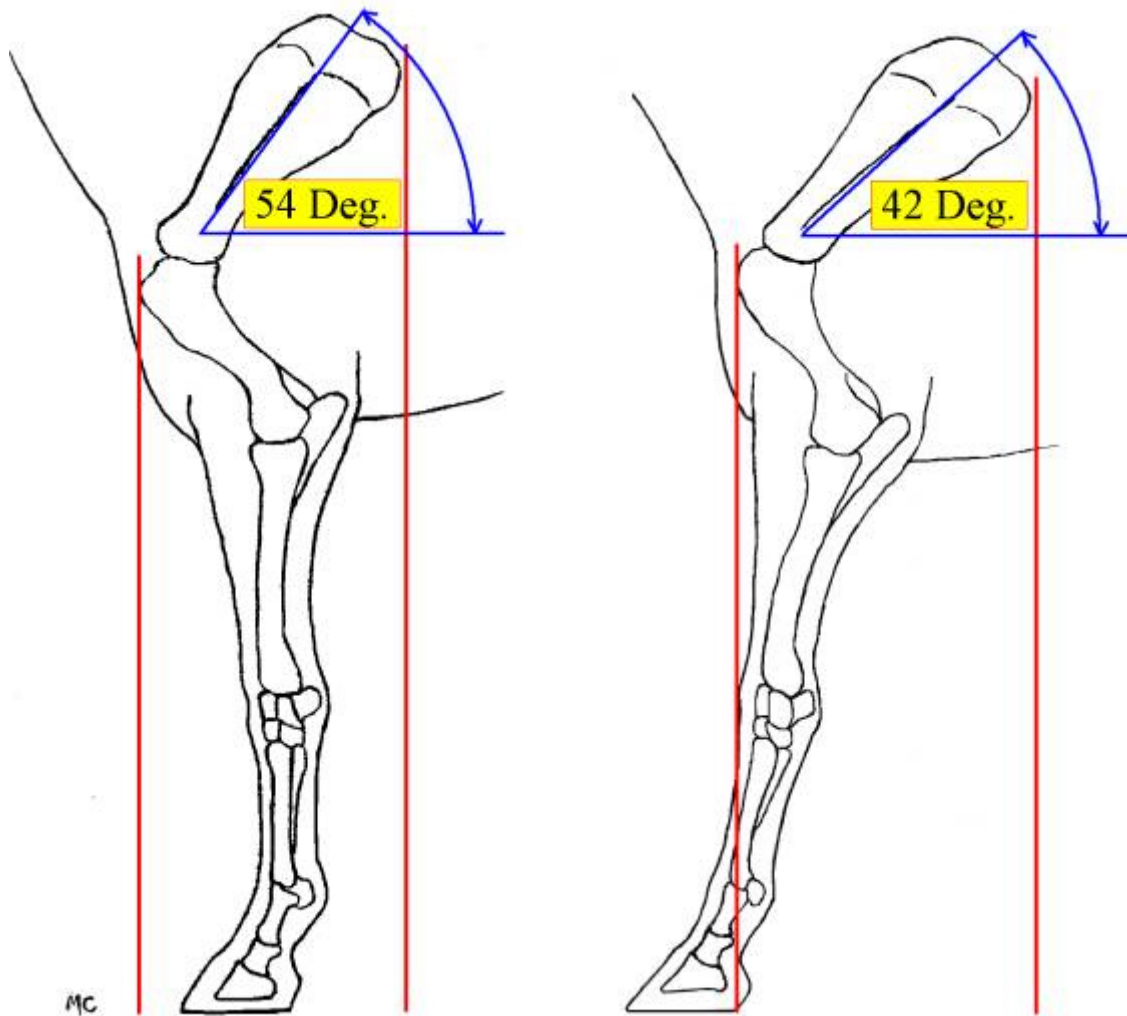


Figure 3: The horse on the left is standing ‘under itself’ and would be considered normal. The horse on the right is standing ‘in front of itself’ and is indicative of a problem.

As a rule of thumb, poor stance and hoof deformities seem to go hand in hand (figure 4.) I believe that some deformities can be reversed if caught on time and proper care is applied.

Figure 4 shows a ‘before/after’ sequence of the same horse whose stance was improved through trimming and shoeing techniques.

Support points at the heels were ‘moved back’ over time and the width of the heels also increased. At the same time, the horse’s stance became more ‘upright’ and stood under itself better.

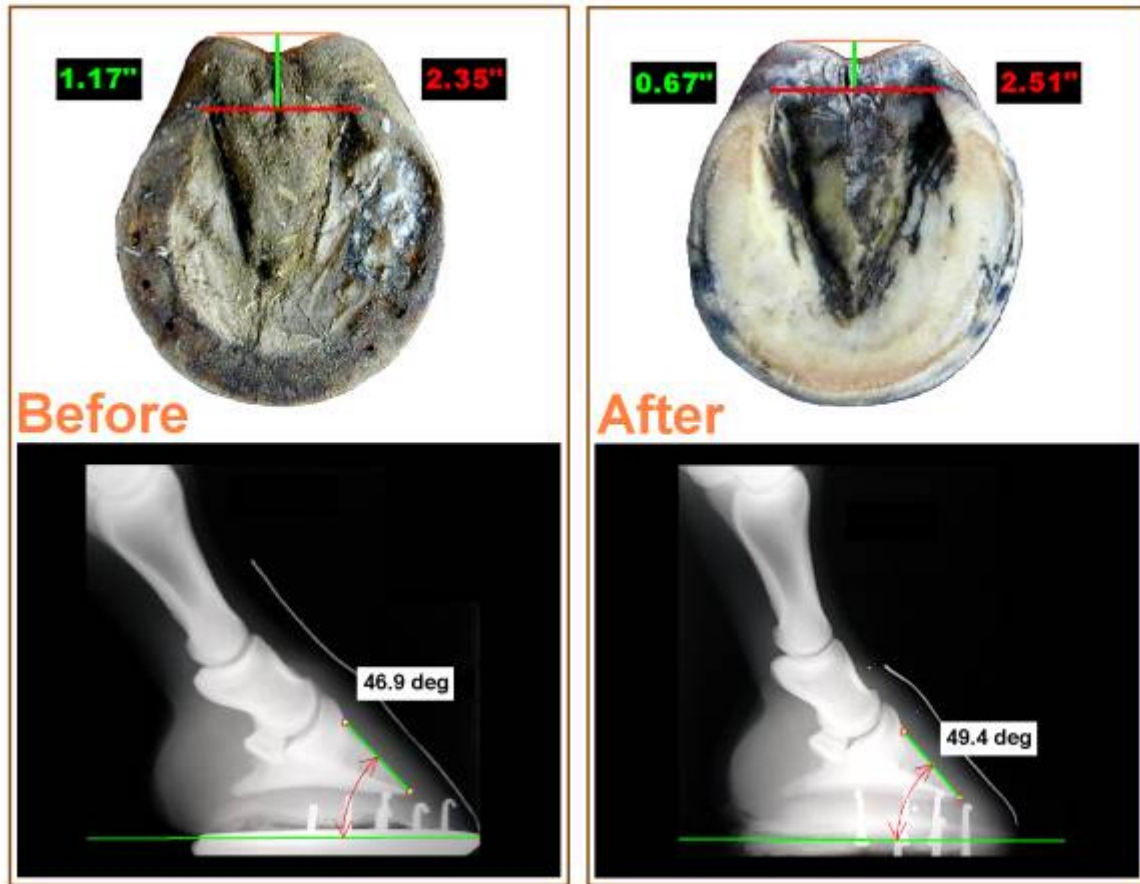


Figure 4. Heel support points “moved back” while stance improved to be more “upright”.

The changes in stance and hoof conformation shown in figure 4 raise a question about the meaning of ‘true’ conformation of a horse. I feel that before assessing a particular horse conformation, care should be taken in addressing the health of the hoof externally and the bone alignment internally in order to tell what we are really dealing with. I try to improve first the state of the hoof before worrying too much about what is above it (the leg, the shoulder, etc).

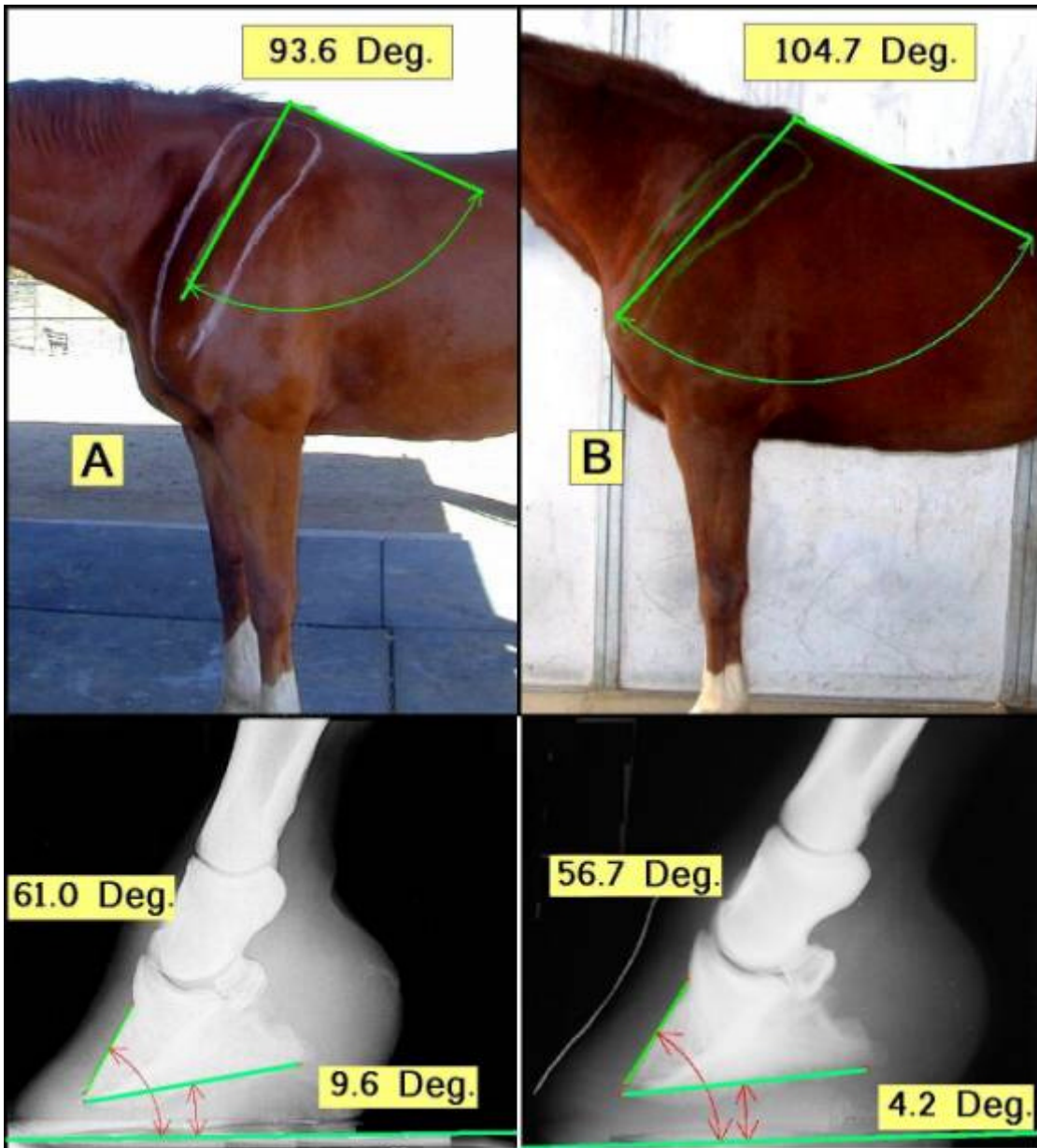


Figure 5. These shoulder pictures are not taken under exactly the same conditions – horses cooperate only so far! One can notice the difference in shoulder angles. Even accounting for some photographic error, a change is apparent, and the relationship of that change to angulation of the pedal bone is shown here.

Deformities are more insidious to recognize to the naked eye when a horse stands under the bony column and the external hoof conformation looks acceptable.

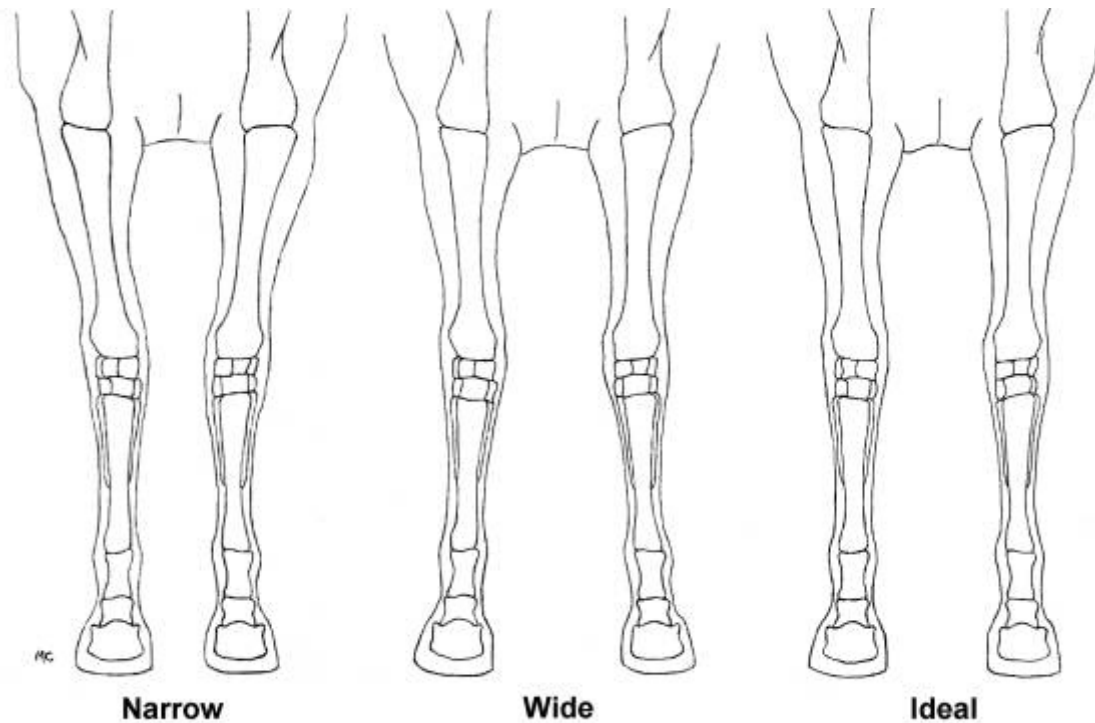


Figure 6. Various stance possibilities viewed from the front.

Figure 5 shows how the shoulder angles have modified as the internal bone alignments (seen in the radiographs) changed. The difference in coffin bone angles (from 9.6 degrees to 4.2 degrees) has affected the shoulder angles. It is easier to track changes in bone alignments through radiographs than subtle soft tissue shifts within the hoof itself. The cause of these shifts can be traced to poor bone alignment but also to changes in the structure of the hoof capsule. The hoof capsule is the keratinous part of the hoof. This capsule is highly deformable depending on trimming and shoeing methods, weather conditions, etc. (see “Hoof Adaptability” in Trail Blazer Magazine, 2005 issue #8.) Changes in the capsule may cause the following soft tissues to shift and/or compress: the collateral cartilages, the digital cushion, coronary cushion, sensitive laminae, sole dermis, nerves, veins and arteries. There will be a trickle effect to the entire limb as soft tissues shift and compress within the hoof capsule. The tissues most affected in the limb are: muscles, tendons, ligaments, cartilages, and nerves. Although bones are not considered soft tissues, they can structurally change due to stress caused by improper loading and change in bone alignments (see fig. 7 and fig. 8)



Figure 7: These images show the changes in legs and knee conformation over three years. The pictures were taken in August 2000, in November 2001 and in September 2003. Again, there is some photographic error, but one can notice the splint reducing over 3 years. This horse is a riding horse.

Amazingly, the horse in figure 7A never showed signs of lameness. I would consider such a horse mechanically lame although there were no blatant signs of lameness or diagnosable pathologies. This horse's lack of performance ability was attributed to its poor limb conformation. One may ask again what is the true conformation of a horse. Is it man made or is it real? Probably, it is a little of both. The horse in figure 7 is naturally offset at the knees but poor trimming and shoeing will inevitably make a slight limb deviation worse. In my experience it always takes longer for a horse to return to its 'normal' conformation than the reverse. The hooves and limbs in figure 8 recovered very quickly, but it then took a longer period of time for the entire horse to regain its old form.



Figure 8: Conformation improves with proper trimming. “Before” is in April, “After” is in August of the same year.

I cannot stress enough the importance of taking preventative radiographs and keeping track of hoof conformation. Pre-pathological lameness problems are often difficult to pin down for everyone. Having photos and/or radiographs from an earlier time can be extremely useful. Without them, you may have a difficult time convincing others that changes have occurred in your horse's hooves and movement. Unfortunately, it often takes a real lameness issue, such as a bowed tendon or an active splint to recognize that there may be a problem with the trimming and shoeing.

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