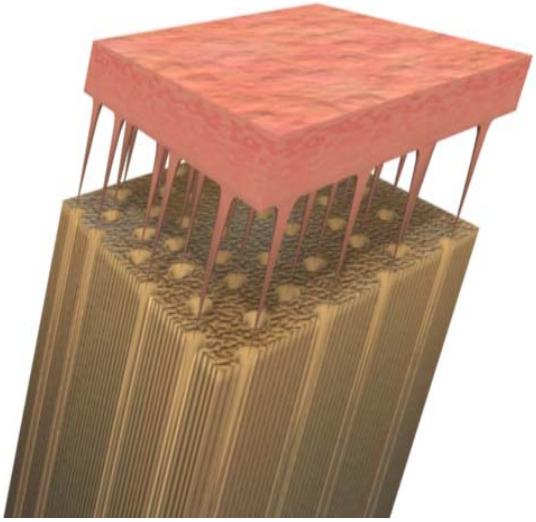
The Hoof as a Smart Structure

The function of the hoof is to carry and move the body, anytime and regardless of temperature, terrain and age of the horse.
The hoof has two ways of dealing with various changes.
One way is to simply tolerate them. The hoof is a structure that is constructed to take a lot of mechanical abuse and allow the animal to travel on footings that are quite unpredictable. The hoof has a high tolerance for variability in the forces and shocks it has to withstand.
The second way the hoof deals with changes is to respond to them over time, the most obvious being the response in growth rate and shape.

Hoof material is tough; it has to be, given the energy of repeated impacts it has to absorb. The individual horn tubules act as shock absorbers and so does the soft connective horn between the horn tubules. The hoof capsule expands when becoming weight bearing. This deformation, better described as “flexion” is great enough to be visible, but happens too quickly to be easily seen.



Hoof Deformation / Flexion

The hoof is a very vascular structure; however, it is the structure the farthest removed from the heart. In order for the blood to be pumped back to the rump of the horse, the horse is equipped with pulsating veins, which pump the blood up the leg.

Upon weight bearing the frontal wall of the hoof sinks minimally towards the middle of the hoof (see picture); the lateral walls move slightly down and out. When there is no pressure on the hoof, there is no pressure on the lateral walls either.

During weight bearing the solar vault is flattened; the frog gets closer to the ground; and the bulbs of the hoof are lowered. When weight is removed, all structures "spring" back into their orig-

inal position.

The hoof capsule of a living horse moves at its widest point about 2mm (hard hoofed horses) to 3 mm (softer hoofed horses). When the horse moves very fast, the spreading of the hoof capsule becomes more pronounced.

The weight of the body pushing down on the coffin bone causes the bone to pull down on the hoof wall at the toe via the laminar junction. Under this force the wall is dragged down and backward. The sole also moves down, mainly being pulled flatter by the expanding walls. The expansion of the walls from the zero point at the toe is most visible in the heel area.

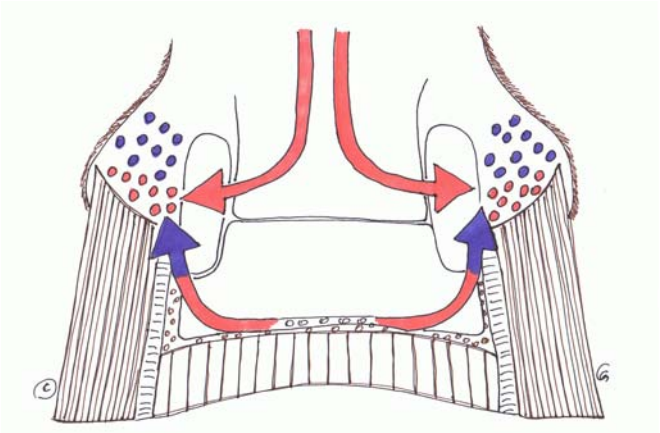
When the foot is lifted for the next step and the hoof capsule decreases in size, the blood in the corium is squeezed out. It passes into the venous system inside and above the coronary corium, which is in its relaxed state when the hoof is non- weight bearing.
In the non-weight bearing phase, blood can reach the arterial arch inside the coffin bone but can go no further. Because the hoof capsule is narrow, the corium is pressed against the wall. Only when the hoof becomes weight bearing again can the blood fill the lamellae corium.

Proving Hoof Deformation

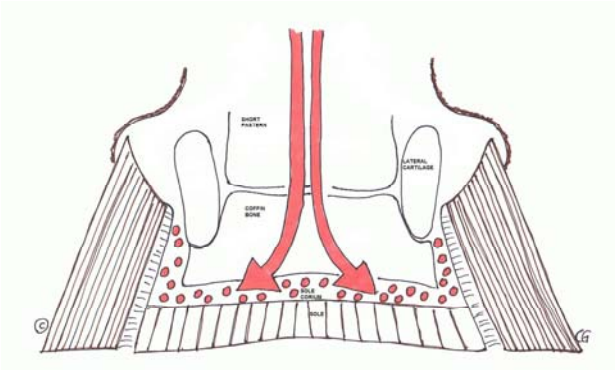
In 1980 Prof. Preuschoff (University of Bochum, Germany) proved with a paint and glaze test that the entire hoof wall moves upon weight bearing. The movement begins on either side of the coronet at the center of the toe.

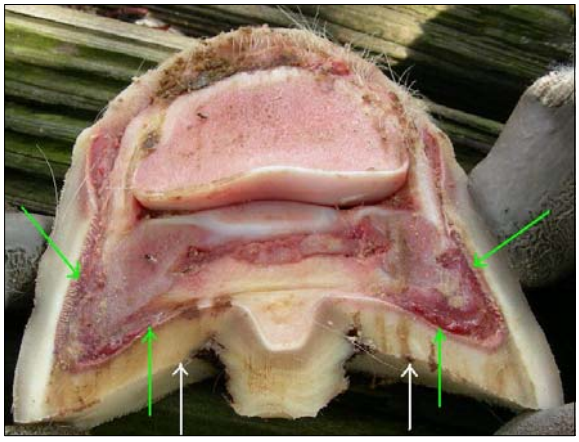
Here we see the hoof in the non-weight bearing situation. The space between

the coffin bone and the hoof capsule is narrow, the corium is expressed.

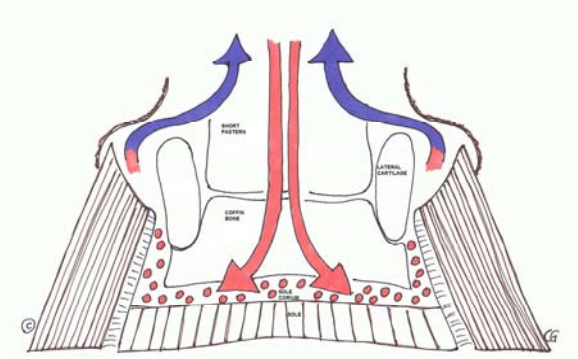


Here is the hoof in the weight bearing phase. The coffin bone sinks down in the hoof capsule. The increased diameter of the hoof capsule upon weight bearing allows for more space around the coffin bone (green arrows). The laminar corium fills with blood. The sole draws flatter (white arrows), making room for the descending coffin bone and also filling the solar corium with blood (lower green arrows).





With the next step, the top of the hoof capsule pushes against the venous plexus while expanding, expressing the venous plexus and initializing the blood return via the pulsating veins.



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HoofCareUnLtd. and The Glass Horse-The Equine Distal Limb