A New Angle on Hoof Wall Growth

Throughout my career as a farrier I was often asked the question, what should I do to get better hoof wall growth? I soon began to ask myself the question, how did the hoof wall grow to the ground and still remain firmly attached, suspending the coffin bone within? Traditionally it is accepted that the continuous production of horn tubules at the coronary band is responsible for downward movement of the hoof wall. This theory seemed too over simplify things and became. unacceptable as time went on and my research continued.

The hoof wall itself is very complex and made up of distinct and definable structures.

Within my practice the move to barefoot allowed for observations that were far less obvious with the application of the horseshoe. One such observation was the increased production of inner wall, or more accurately the interstratum medium. The following lines appear in "Veterinary Notes for Horse Owners." "Some horn appears to be secreted by the sensitive laminae. Repair processes after surgical operations involving the hoof prove that this occurs." (Hayes MH, 1877) These historical notes and other written observations would indicate that not all wall growth occurs at the coronary band.

My theories developed over time and are outlined here.

The innermost wall possesses high moisture content and is made up primarily of intertubular horn. This intertubular horn is avascular (having no blood vessels) and originates at the secondary dermal laminae. This avascular layer, termed the epidermal layer depends on the capillaries (tiny blood vessels that join veins and arteries) of the adjacent dermal laminar corium (covering the pedal bone) for the nutrients needed to produce the cells that make up this intertubular horn. Intertubular horn is best described as a pliable plastic or clay-like substance that bonds to and binds the tubules of the inner hoof wall together.

I hypothesize that the intertubular horn acts as a vehicle for the downward movement of the outer hoof wall, thus providing a stable and very strong attachment of the wall to pedal bone through the laminae attachment.

The outer wall originates at the coronary band with the tubules running from the coronary band to the ground, with the cells of its binding intertubular horn originating at the valleys of the papillae of the coronary band. The intertubular horn produced acts much like super glue. The outer wall has a much higher tubule to intertubular horn ratio, than that of the inner wall. The tubules of the outer wall are packed tightly together.

The outer wall has a lower moisture content than the inner wall, and when fully keratinized, forms a very hard protective barrier that prevents the loss of moisture of the inner wall. This is accomplished by limiting the inward or outward passage of water-soluble substances.

The outermost wall and inner wall appear to be laminated to one another by a strong keratin bond. As a result, the movement of the inner wall both outward and downward allows for the carrying of the outer hoof wall to the ground.

It is commonly held that it takes approximately twelve months for the hoof wall to grow from hairline to ground. This may be true of the outer wall, but my field studies are providing evidence to the contrary. Growth of the inner wall aids in accelerating the downward growth rate of the outer wall when the stimulus (shock and pressure) is correct. The growth of the inner wall is apparently in volume of intertubular horn at a right angle to the wall tubules. (La Pierre, Natural Horse, 2002)

By exploring fluid dynamics, we may come to a better understanding of how the hoof wall moves to the ground and allows for a solid attachment to the coffin bone within. In fluid dynamics, it is understood that fluid flowing over a given surface is in fact stationary at the surface it is flowing over, and the velocity of that fluid increases with its depth. This principle when applied to the intertubular horn, which can be defined as a fluid very high in viscosity (a fluid nonetheless), would answer many of the questions that have arisen in my studies of the barefoot horse.

I hypothesize that as the inner wall increases in thickness (depth), the velocity of the downward movement of the outer wall will increase, the intertubular horn of the inner wall being the vehicle for the outer wall. At some point, the downward velocity of the two achieves equilibrium, at the same time, there is little to no movement of the innermost surface of the hoof wall. This principle applied would account for the stability of P3 (coffin bone) within the hoof capsule.
(La Pierre, Natural Horse, 2002).

It is important that the function of each wall (inner and outer) be understood. The inner wall (interstratum medium) with a higher percentage of tough intertubular horn in ratio to the number of tubules, is far better suited to the dissipation of the forces created by impact than that of the harder outer wall. The inner wall being more pliable has a higher mechanical strength and is far more resistant to fracture than the outer wall. The inner wall acts as a buffer between the laminar corium and the hard outer wall. It also allows for the dissipation of these energies preventing trauma, which could result in the rupturing of capillaries or inflammation of the laminae. The outer wall being harder and more flint-like is far better suited for protection against abrasion, and acts as a barrier protecting the inner wall from the harsh environment. A substance called periople, a varnish type covering, provides protection for new outer wall growth. Periople is produce at the perioplar papillae of the perioplar corium.

It is interesting to note that in the hoof lacking inner wall (intertubular horn), there seems to be a higher incidence of blood serum (bruising) being seen in the white line at ground level, far more than in that of the hoof with sufficient inner wall (intertubular horn). Evidence thus points to the function of the inner wall being one of shock absorption, with the energies being dissipated at a right angle to the outer wall, preventing capillary rupture. The inner wall allows for necessary distortion without the loss of structural stability.

I have observed growth or stress rings in the hoof gradually disappear when the outer wall is relieved at ground level. This would indicate that the outer wall is meant to

protect and not to support. The inner wall is meant to support and to dissipate shock, acting as a carrier for the outer wall. By loading the outer wall, as has always been done in shoeing, the hoof's ability to dissipate shock through the inner wall is hindered. The energies are transmitted proximally up the outer hoof wall increasing the growth rate of the outer wall (shock and pressure being the stimulus for growth). Stress or growth rings appear when the growth rate of the outer wall exceeds that of the vehicle that is meant to carry it to the ground, the inner wall. When the energies are dissipated correctly through the inner wall and the other protective systems of the foot, less shock reaches the coronary band and the growth of the inner and outer walls are kept in equilibrium. Growth rings can be viewed as an indication that there has been a loss of equilibrium of function.

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