Balancing the Hoof to the Fifth Dimension

What's all the excitement about going barefoot these days? We're all hearing about it more and more. Why? Ask a simple question, you should get a simple answer only that is not likely to happen in today's complicated world. Yes, I know the barefoot craze has come and gone many times over the decades, but this time, something is different. Today, we are dealing with a Horse Owner that has evolved, and with this evolution, comes an increase in the desire to take direct responsibility for the care of their equine wards.

Don't get me wrong, I am not a barefoot fanatic. I will be the first to admit that shoeing is here to stay, in one form or another. There will always be a need for protection, traction and stabilization. The question that arises is this: Has our profession and science kept pace with these industry changes? Does our science provide a model that can effectively meet the demands of today's horse owner; those wishing to have their horses go shoeless? These were the questions that plagued me, following my development of the Suspension Theory of Hoof Dynamics[6.] I had and upon investigation realized that there were many shortcomings in the very foundation of the science we are asked to follow.

Frustration best described my mind set prior to developing the HPT Model. I think what we should be calling today's hoof care is "Imperfectly Natural Hoof Care." After all, none of us are perfect. Couple this with domestication and you can see way "Imperfectly" works. We as professionals are being asked to practice within the parameters of Natural Hoof Care and that is a mighty tall order, considering the environments we have created for the modern horse is defined as domestication.

Describing the HPT Model and the theories it is based on is far beyond the scope of this paper. What I hope to do with this paper is to offer new insight into Applied Equine Podiatry, insight that may have, in some way, a positive impact on your own practice. At the end of the day, whether you shoe or not, having the ability to discern the proper course of action for each individual foot and the horse it belongs to will determine your worth as a hoof care provider.

Balance is the one most talked about subject in the industry. It has been the subject of heated debate for centuries and in all likelihood will continue to be for decades to come. My work as a traditional blacksmith had caused me concern over how we were being taught to balance the equine foot. It was this re-examination of conventional theory that sent me down a different road. Thank you for letting me share my findings with you.

The Balance Dilemma

Balance, as defined by conventional farrier trade, is for the most part based on supposition; this is a statement that this paper should defend. How can we be expected to achieve consistent, repeatable results when we have not been provided with addiquate tools? Over the last decade, I have striven to develop the tools needed to answer the demands of today's horse and owner.

It was with the development of the HPT Model (High Performance Trim Model) that I found an easily definable plane of reference, a plane of reference that made possible consistent, repeatable and desirable results. But,

before I explain how I define balance, I believe it is important that we all have a clear understanding of how balance is most often viewed within the practice of farriery today. Let us make sure we are all on the same page, so to speak.

Retrospect studies indicate that traditional/conventional hoof balance has been primarily developed using *Statics Mechanics* as its foundation. Though in recent years, we have seen the science of Kinematics influencing the way today's farrier is asked to view the foot during the flight phase of the stride.[5] Today's farrier is being asked to establish dynamic balance in an effort to achieve high performance from the horse.[11] [12] Dynamic balance as it is used by today's farrier describes the placement of the foot at initial contact, and will be discussed in greater detail shortly.
Though the topic of this paper is dimensional balance, it is important that you understand that dimensional balance is used to create ***dynamic equilibrium of function***. Having ***dynamic equilibrium of function*** will allow for the correct execution of stride, and the maintenance of healthy structure.

STATIC BALANCE: A HISTORIC PERSPECTIVE

Static balance, or balance of the foot at rest, is detailed in numerous publications. I will be referencing text from *Ross M W, Dyson S J, Lameness in the Horse, New York, 2003,* as it is a recent publication, and does provide the latest information on how static balance is viewed by today's farrier and veterinarian. It is conceded that optimum function intuitively demands optimum conformation and balance. This is equally stated in the fundamental principle of Applied Equine Podiatry: **Structure + Function = Performance**

Over the centuries, practitioners have contrived beliefs and notions based on conformation and static balance, often influenced by breed and discipline coming to conclusions as to what does not work and what might cause problems. Many of these beliefs predate modern motion analysis, and as stated earlier in this paper, are based on statics mechanics. This view takes into consideration only conformation and static balance. I have read numerous articles that have tried to supplement traditional belief with data obtained through modern research; these studies often exposing contradictions in the application of traditional geometrical balance.

Static Balance and Conformation (Modern/Traditional)

Viewed from the lateral aspect, the foot-pastern axis should be straight. The dorsal hoof wall should be parallel to the dorsal surface of the pastern, and when viewed from the side, the wall at the angle of the heel should approximate that of the dorsal wall. The angle of the wall and that of the pastern to foot axis is said to be variable, often cited between 50º and 54º in the forelimb and approximately 3º steeper in the hindlimb[13]. There have been numerous theories that went so far as to suggest that the only correct angle for the dorsal hoof wall in the forelimb is 45º. It is my humble opinion that these theories are based on unsubstantiated evidence, and are supported only by supposition, not evidence based science.
It has been suggested that hoof length in the domestic horse is linked to the weight of the horse. In contrast, studies suggest that the length of toe of the feral horse is independent of its weight, with variability being determined by environment. It can be hypothesized that environment is likely to influence the shoeless domestic horse in the same fashion as the feral horse.
Modern texts suggest that the heel length in the domestic shod or unshod horse should be approximately 1/3 that of the toe[14] [15], but once again in the feral horse, this varies with terrain (environment).

An imaginary line that bisects the third metacarpal bone should intersect the most palmar aspect of the weight bearing surface of the heel (angle of the bar). It is this belief that has led many farriers to the supposition that one function of the horseshoe is support.

When viewed on a lateral radiograph, the dorsal hoof wall and the dorsal surface of the pedal bone should be parallel to one another. The angle made by the solar distal border of the pedal bone with that of the ground is said to range from 2º to 10º [6.16.17.18]. There are and have been theories hypothesising that the angle created by the distal border of P3 and the ground should be parallel on the dorsal to palmar plane. This belief has been promoted by those following the less than traditional wild horse model. Shortly, you will be exposed to my own findings in regards to this angle.

Viewed from the dorsopalmar radiographic view, a line bisecting the metacarpal region should bisect the phalanges and foot, so that the foot is approximately symmetrical on either side of the line.

The medial quarter is often steeper than the lateral, so that the medial is also shorter than the lateral wall. A line drawn between any two comparable points on the coronary band should be parallel to the ground surface of the foot. The centre of the distal interphalangeal joint should be centred over the ground surface of the foot. The interphalangeal joint spaces should be symmetrical.

Viewed from the ground surface, the width and length of the hoof capsule of the forefoot should be approximately equal. It is also suggested that it may be slightly wider than it is long. The hind foot is consistently slightly longer than it is wide. The point of breakover is best assessed from the ground surface and should be located at the center of the toe. The ideal location for breakover in the dorsopalmar axis is disputed. In traditionally trimmed and shod horses, breakover is positioned where the line of the dorsal hoof wall intersects the ground. With the hoof wall as a reference point, breakover should be located between the dorsal margin of the hoof and the white line. *Once more, I want it to be understood that this section is a review of traditional static balance, and not balance according to the HPT Model that will follow shortly.*

The relationship of the longitudinal axis of the frog to that of the pedal bone (P3) stays relatively constant compared to the rest of the ground surface structures. The medial and lateral aspects of the ground surface of the foot are symmetrical about the axis of the frog, although slight asymmetry with the lateral side being about 5% wider than the medial side being seen as beneficial. This asymmetry is exhibited in the coronary band, with the medial wall being steeper. The sole should be concave. The frog width should be at least 50% to 67% of the frog length, and the weight bearing surface of the heels should coincide with the widest part of the frog.

Dynamic Balance

Claims that today's practitioner is implementing the practice of dynamic balance based on modern findings may be a bit overstated. Contradictions exposed by these modern motion analysis studies may in fact be a point of confusion.

The concept of dynamic balance is not new. In the late nineteenth century, there was great interest shown in perfecting the stride of the trotting horse. This is substantiated by published works that showcase shoeing to prevent gait problems, such as speedycutting, knee hitting, cross firing, forging and overreaching. Static balance, though considered important, was often disregarded, or at the very least, placed second to that of dynamic balance. Though the term "dynamic balance" was not used, achieving the desired results would often result in what today is defined as dynamic balance.

The modern farrier sciences defines dynamic medial/lateral balance as being achieved when both heels strike the ground simultaneously, and the foot breaks over at the centre of the toe[11] [12]. Dynamic dorsal/palmar balance is achieved when either the heels land slightly before the toe, or the toe and heel land simultaneously. Evidence has been presented that would indicate that one heel commonly lands before the other[2]. Thus, I believe it would have been very difficult to use observation in attempts to achieve dynamic balance.

It is my belief that dynamic balance will be redefined to include achieving a state of dynamic equilibrium of function. As continued research reveals the workings of the equine foot, dynamic balance becomes viable and obtainable through the application of correct dimensional balance coupled with correct environmental stimulus.

The HPT Model (Dimensional balance)

For centuries, the farrier student has been taught how to achieve balance in the equine foot. Teaching the principles of balance varies greatly among teachers and schools, with this leading to an inherent problem; a multitude of difficult to define reference points being left to the interpretation of the student. Achieving balance cannot be compared to mechanics or mathematics. It is not simply completing the formula or outlined task, as there are few true absolutes on the equine foot. Achieving correct balance depends on one's ability to correctly reference a multitude of factors as outlined throughout this paper. Though each dimension listed by tradition has been defined as an absolute, most are a misrepresentation of true balance. Angle of hoof is one such dimension that has been badly misinterpreted. In an effort to justify that which has been interpreted as an absolute, various measuring devices have been developed. The farrier begins to rely on such devices and perceives the reading of the protractor, dividers, T- squares and rulers, as a means to achieve absolute balance. It is impossible to state an absolute such as hoof angle, and then expect anyone to use a device that uses undefined reference points to achieve the same. The protractor and dividers for instance, use reference points that are vague; therefore, any absolute perceived is based solely on the user's interpretation of those points. Example: dividers use the hair line, and protractors use dorsal wall and sole surface, all of which can be deviated to the point that the only absolute that can be stated is that neither can be measured accurately with these traditional tools. Further, traditionally we are taught to use external angles to guide us in achieving balance. We are all aware of the angles involving shoulder to pastern in relationship to the hoofs' dorsal wall, as outlined earlier. Are these absolute, considering conformational defects? What about dorsal wall angle to heel angle, and hairline to ground, and so on, and so on, and so on?

It is true that with years of practice and experimentation, the farrier can capably achieve relative balance. This is a statement often used in defence of the traditional farrier trade: "leave it to the experts; it takes a long time to learn what is needed to achieve proper hoof balance." There are some farriers out there that have the ability to interpret or read a hoof, and can consistently achieve static balance. Most of these farriers will often admit haven taken many years to get to the point where they can make this claim, and the percentage to those that cannot is overwhelming in my opinion.

Just as we have seen a misinterpretation of the many natural balance theories being practiced, how traditional balance is achieved has been misinterpreted to a far greater extent. By having so many variables being left to one's individual interpretation, it is little wonder there has been such difficulty in defining balance. Therefore, *the true definition of balance should be defined as dynamic equilibrium of function, resulting in the growth of proper structure, and a sound horse.*

The inherent problem is that the traditional farrier trade does not clearly define dimensional balance, and further do not scientifically support the importance of establishing the correct stimulus for proper structure and function. Yes, there are outlines on how to achieve balance; many are based on ones' ability to visualise what lies beneath (bone structure) and what is proper for balance. Dr Doug Butler, author of "The Principle of Horse Shoeing" and renowned educator, stated in the American Farriers Journal that most farriers have difficulty visualising the internal bone structures, and their relationship to the hoof capsule. I find this remark to be of paramount importance. If the method for establishing balance is based on one's ability to interpret so many variables, and the experts are finding it difficult, then my belief that there is an inherent problem has been confirmed. How then did I overcome these problems? First I took a long look at how I was taught to establish balance. There were three dimensions that were addressed, all of which have been outlined above. To make things a bit more clear, I will outline them again here.

First is **Medial/Lateral** balance: having equal **height** to both heels. Often the T-Square Method of balance is used. This method dictates that a line across each heel bisect a line that follows the vertical axis of the metacarpal bone. We as farriers are instructed to hang the leg of the horse and visualise this line, and trim the heels accordingly.

Second to be addressed is **Anterior/Posterior** balance: this balance is achieved when the dorsal wall angle matches that of the dorsal surface of the pastern, and that of the shoulder. Often, this is achieved by **lowering** or **raising** the heels.

A third dimension is **Yaw**. Yaw is described as **rotational balance,** and most often comes into play with the application of the horseshoe, the desire to have the centre of the shoe's toe line up with the centreline of the foot on its ground surface. Yaw is seldom considered when going shoeless, or in the application of the conventional trim.

It should be easier to understand why the guidelines for *traditional static balance* can be very difficult to apply consistently in the field, considering that each is in actuality defined incorrectly. Traditional definition dictates that conformation of the lower limb dictates distal/proximal balance (height) on the medial/lateral ground plane of the foot, and not medial/lateral balance itself. Whereas, conformation of the shoulder dictates distal/proximal (height) balance on the dorsal/palmar ground plane of the foot, and not Anterior/Posterior balance. Why this practice of balancing has occurred is likely to be due to the inability of the farrier to envision the internal structures of the foot; after all, we do not have x-ray vision. With the lack of understanding of the importance of the soft connective tissue of the foot and its internal arch, it is understandable why the blacksmith would subscribe to statics mechanics, and the balance dictated by the science of the time. As a Traditional Blacksmith, I can understand why the need for such simplicity became acceptable. Having defined angles, which can easily be achieved by removal of structure, is by virtue a definition of simplicity itself. Using the dorsal wall angle to achieve anterior/posterior balance has caused, in my opinion, an oversight in how most farriers address dorsal/palmar balance. Today's farrier does attempt to create dorsal/palmar balance, though all too often, only breakover is addressed. This oversight has led to a disregard for the placement of heel purchase which has proven to be of utmost importance.

Within the introduction of my book, "*The Chosen Road*," I have included an excerpt from "Artistic *Horseshoeing*" first published in 1887. The texts suggest that the idea of attaching an iron shoe may have first been suggested by examining some old foot that in the process of decay of the animal to which it belonged, had naturally, because of its hard substance, survived longer than the flesh or even bone. It is my opinion that this very simplistic view of the equine foot has permeated the farrier sciences to date.

This recent research paper highlights the need for a means to achieve dynamic balance:

Comparison of the trimming procedure of six different farriers by quantitative evaluation of hoof radiographs. Kummer M, Gygax D, Lischer C, Auer J.

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Abstract

Hoof preparation and shoe fit are integral to the long term soundness and athletic ability of horses. The farrier influences the balance of the hoof by both the trimming and the shoeing procedure. The goal of this study was to investigate and quantify the influence of the farrier on hoof parameters by trimming. Forty Warmblood horses ranging in age from 6-12 years and withers height 162-172cm were included. They were divided into six groups consisting of six or seven horses each, shod by one of six different farriers. The hoofs of the horses were radiographed twice using a standardized method before and after trimming. Measurements were taken from digitalized radiographs using a software program. Significant differences were identified between farriers for almost all parameters on the lateromedial radiographic views after two consecutive trimming procedures. Comparing the results of both trimming procedures, significant differences for several farriers were found in the lateromedial and dorsopalmar views. There were significant differences for most of the measured hoof parameters between the six farriers and between consecutive trimmings of the same farrier. The results underline the individual influence of the farrier on hoof shape and balance. (Vet J. 2009 Mar; 179(3):401-6. Epub 2008 Mar 7).

With my review of current accepted beliefs, it is obviously not a far stretch to come to the conclusion that traditional balance terminology is too simplistic and does not suffice. I took it upon myself to redefine the dimensional expressions I would use in the treatment of the equine foot. It was Einstein who defined four dimensions - height, length, width and time. As an example, I could meet you at the corner of 33rd (W) and 3rd (L) on the 34th floor (H) at three o'clock (T). Balance as outlined by Einstein is also insufficient, as it does not account for rotational balance. If in fact the building we had to enter had a revolving door, then we would have to add rotational balance to the example that I used to define Einstein's dimensions. The revolving door would have to be aligned with the opening in the building for us to enter (Y).

Within the practice of farriery, it has been conceded that the dimension of height on two planes would be sufficient, when coupled with rotational balance. Perhaps this is an observation that I alone hold, but I honestly believe that a more accurate means of achieving dimensional balance in the equine foot is needed. Applying literal definition to the labels used in the traditional practice of farriery enabled me to define a five dimensional model for the treatment of the equine foot. The model is based in part on the plane created by the distal most surface of the internal arch (internal foot) within the healthy hoof. Four of these dimensions were first outlined in my book, *the Chosen Road*, and a means to achieve a plane of reference for these dimensions is clearly detailed there.

The four dimensions are: (W) medial/lateral balance; (X) dorsal/palmar balance (Y) yaw or rotational balance and (Z) distal/proximal balance on both the medial/lateral and dorsal/palmar plane.

W	**Medial/Lateral** balance is achieved by having the hoof capsule centered left to right of the center line of the internal arch and coffin joint
X	**Dorsal/Palmar** balance is achieved by having proper heel and toe placement in relationship to the axis of the limb (coffin joint)
Y	Balanced **Yaw** or rotational balance is achieved when the hoof capsule is centered on the established center line of the internal arch and coffin joint
Z	**Distal/proximal** balance is achieved when the heel and toe planes are parallel to the established live sole plane, slightly distal to the live/viable sole.

It should become clear that if our goal is to have repeatable results in our attempt to achieve static balance, then a minimum of four dimensions are required.

The HPT Model (Dynamic Balance)

Dynamic balance in the HPT Model is far more than simply having the ground surface of the hoof capsule making parallel contact with the ground at the time of initial contact. Dynamic balance can only be achieved with the understanding that providing correct stimulus is the means by which we can achieve dynamic equilibrium of functions. Dynamic balance as it pertains to the HPT Model is dynamic equilibrium of functions. When dynamic equilibrium of functions is achieved, ground parallel contact does occur. Ground parallel contact coupled with the delivery of deliberate and correct stimulus results in the maintenance or return of vital structure and function. What correct stimulus is has been defined within the Suspension Theory of Hoof Dynamics[6].

Conclusion

While discussing my speaking at the International Hoof Care Summit with Frank Lessiter, I presented him with an analogy that I use in my teaching of Applied Equine Podiatry. It goes something like this: often the aircraft is used to define conventional balance. The aircraft is said to be in balance when it is parallel to the ground plane. The dimensions referred to are pitch, roll and yaw; they equate to anterior/posterior, medial/lateral and yaw. This is a good example of conventional balance, and the model we as farriers are ask to use. I though, have a problem with this example. The control of the plane is in the hands of the pilot, and if at any point in time, the ground is not visible, how does he maintain balance with the ground? A simple question and a simple answer: he uses instrumentation. The question now becomes: what if the instruments are not calibrated correctly? A simple answer: he prays he has a real strong sense of direction. My point is this, having the hoof capsule balanced to the ground plane does not necessarily mean that the instruments are calibrated correctly. It is the relationship of the epidermal layer (horn) to the dermal layer (corium) that will determine neurological function. If we can determine the plane of the dorsal/distal dermal layer (internal arch), we then can balance the hoof (epidermal) to that of the foot (dermal). We then can essentially calibrate the instrumentation that the horse (pilot) uses to maintain balance of stride and function.

It all starts with providing correct stimulus via a correctly balanced hoof capsule. My studies have revealed that creating balance of hoof capsule to that of the Internal Arch will aid in achieving dynamic equilibrium of functions[19]. Redefining the terminology used to define dimensional balance in the equine foot allows us to be more precise in our assessment of hoof capsule balance. With the return of correct functions comes the return of correct structure.

Simply stated: Structure + Function = Performance

"Performance is achieved when each structure is capable of sustaining Dynamic Equilibrium of function for the demands asked of it."

In defense of an industry that has served me well, I would like to state that I believe "Shoeing is not the necessary evil that it is proclaimed to be, it is the lack of knowledge that makes shoeing *necessary* that is the true evil." As I go about my daily routines as a professional hoof care provider, I find comfort in knowing that I never have to worry about becoming arrogant; god has made me a student of the greatest teacher of humility I could ever wish for, our true client, the horse. It never ceases to amaze me, when you think you have all the answers, the horse will present another question.

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