The Natural Angle

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Can Farriery Resolve the Negative Palmar Angle?

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Introduction

The equine hoof can be divided into dorsal and palmar/plantar sections. The deformable soft tissue structures located within the palmar/ plantar section of the hoof capsule are the frog, frog corium, digital cushion, ungual cartilages and the deep digital flexor tendon. The function of these structures is to absorb concussion, dissipate the energy of impact and decrease the vibrations associated with the foot landing on the ground. These soft tissue structures can accept or share some weight-bearing function but unfortunately, they are often subject to compromise when excessive load is placed on this section of the foot over time. This deterioration in the palmar foot structures is not readily apparent when the horse is barefoot (unless previously shod), so there must be a correlation to the application of shoes. However, there appear to be multiple factors that may contribute to this demise, such as:

- Foot conformation
- Inappropriate trimming practices
- Inappropriate size and placement of shoes
- Obesity
- Excessive exercise
- Type of surface or footing
- Any combination of the above

Damage to the integrity of the soft tissue structures and a loss of structural mass result in varying degrees of a negative palmar/plantar angle. The negative palmar angle (NPA) or more correctly, ***'the angle of the solar border of the distal phalanx'***, has become a diagnosis, a disease, and a focus for a myriad of veterinary / farriery treatments. Simply stated, the negative palmar angle results from a loss of the soft tissue structures (especially the digital cushion) in the palmar section of the foot. The loss of mass allows the distal phalanx to descend distally in the palmar section of the hoof capsule. The result is a change in the position of the distal interphalangeal (DIP) joint which places the joint in dorsiflexion and leads to a distortion of the hoof conformation.

The NPA will have negative consequences on continued soundness.

The change in position of the bone creates a broken back hoof-pastern axis (HPA), changes the position of the (DIP) joint which changes the distribution of weight bearing on the solar surface of the foot and increases the tension in the deep digital flexor tendon (DDFT) **(Figure 1)**. The decreased mass of the soft tissue structures in the palmar foot hinders the foot from dissipating the energy of impact and providing adequate shock absorption. The DDFT forms a sling under the navicular bone that descends into the soft tissue

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Figure 1. Radiograph shows the loss of soft tissue structures allowing the distal phalanx to descend. Blue is the broken back hoof-pastern axis and red circle is the DIP joint placed in dorsiflexion. Note the rounded appearance of the heel bulb that occurs with the loss of mass in the palmar foot. Radiograph is taken of the foot on the right.

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structures in the palmar foot as the joint moves in a distopalmar direction when the heel strikes the ground, thus forming one of the initial shock absorbing mechanisms of the foot. This primary shock absorbing mechanism is lost when a significant decrease in soft tissue mass occurs **(Figure 2)**. All these changes can have harmful effects on the equine foot and soundness because the functionality of the palmar foot is lost.

The biomechanical aspects and the correlation to lameness related to the effect of the negative angle of the distal phalanx on the podotrochlear apparatus (navicular area) is significant. Eliashar (Eliashar et al EVJ 2004) showed that a 1° decrease in palmar angle of the distal phalanx results in a 4% increase in peak force on the navicular bone. This places excessive load on the navicular bone, the navicular bursa, and the distal extent of the DDFT **(Figure 3)**. The horse will now spend a substantial amount of time with the DIP joint in dorsiflexion which is not only an abnormal position of the joint but also changes the pattern of weight bearing on the solar surface of the foot.

Improving hoof conformation to address the negative palmar angle of the distal phalanx presents clinicians with a farriery challenge. Often improvement cannot be achieved and therefore, the focus is to maintain the compromised structures. One of the traditional farriery methods used to improve the digital alignment and reposition the DIP joint is to provide heel elevation. However, this practice can be detrimental if the soft tissue structures in the palmar foot are markedly compromised or lack the appropriate mass. When heel elevation is added, it temporarily improves the appearance of the hoof capsule and the HPA, but the pressure placed on the soft tissue structures over time will damage them further.

Figure 2. Note the wide expanse of the DDFT under the navicular bone. Red arrow shows the direction of descent of the DIP joint in a distopalmar direction upon impact.

The limiting factor, when attempting to improve the structures in the palmar foot, is the inability to grow hoof wall in the heel area necessary to improve the hoof capsule. The primary soft tissue structure involved in the compromised palmar foot is the digital cushion. Genetics are incriminated for the decreased size of the digital cushion as many animals are born (TBs for example) with inadequate tissue mass in the palmar foot while other factors, in the author's opinion, are lack of foot development as a juvenile, shoes applied too early, training regimens, overuse, surfaces and inappropriate farriery practices. Considering the type of cells that comprise the digital cushion (collagenous/elastic fibers, adipose tissue, and small bundles of fibrocartilage), there is little evidence to suggest that it can be restored or increase in mass.

When the mass of the digital cushion is decreased, more weight is placed on the frog which causes it to enlarge and often protrude or prolapse below the solar surface of the foot. It is the author's opinion, based on many years of farriery, that hoof wall growth requires a structural framework

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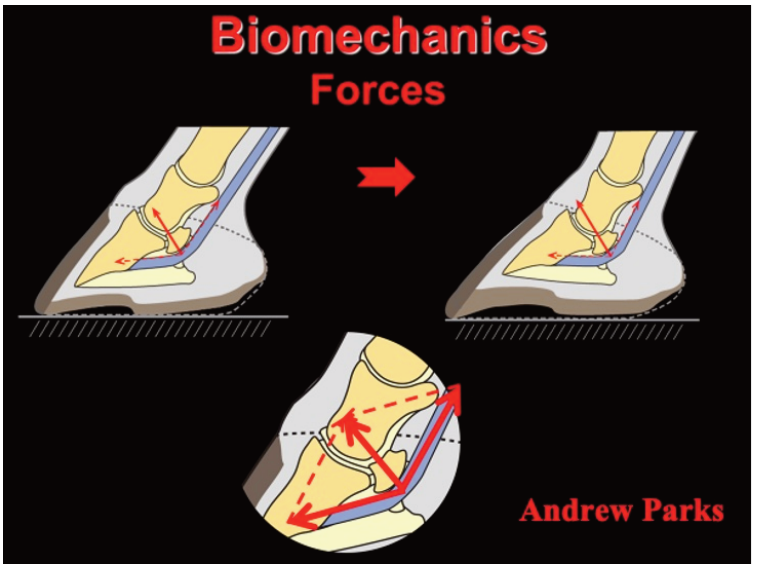

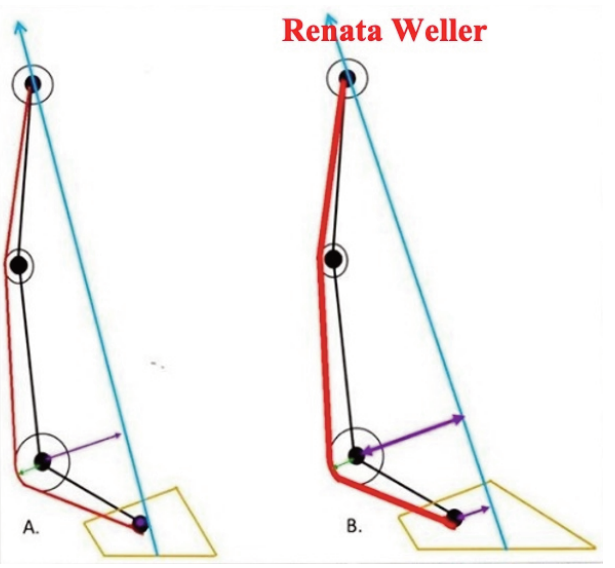

Figure 3. The biomechanical forces increase on the navicular bone and bursa with the descent of the distal phalanx and the DIP joint placed in dorsiflexion. The NPA is often combined with a long toe hoof conformation and together, they affect not only the DIP joint but also the joints proximal to the foot.

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Figure 4. Red circle is the compromised soft tissue structures in the palmar foot with the frog prolapsing between the shoe. Frog is now located below the level of the hoof wall. Anatomy of the soft tissue structures of the palmar foot showing the predominance of the digital cushion. Loss of digital cushion mass eliminates the structural framework necessary to grow hoof wall in the palmar foot.

between the heels of the hoof capsule to produce horn. Loss of that framework occurs when the mass of the soft tissue structures in the palmar foot is markedly decreased **(Figure 4)**.

Farriery

Various farriery options are used to address this problem: heart bar shoes, roller motion shoes, frog support pads, heel plate shoes, stabilizer (spider) plates, etc.…all with varying degrees of success and usually related to the amount of compromise in the soft tissue structures. There is a direct relationship between the osseous structures in the dorsal section of the foot and the soft tissue structures in the palmar/plantar foot. For a healthy foot, the importance of this relationship cannot be over emphasized in maintaining structural integrity and proper intracapsular location of anatomic components **(Figure 5).** The NPA conformation creates a puzzle for the farrier but by using the pieces representing the anatomy, biomechanics and basic farriery principles, an overall picture of the problematic hoof capsule can be generated, and a farriery plan formulated. Appropriate farriery for this condition requires careful evaluation of the foot conformation, assessing the amount of damage to the structures of the palmar foot, the landing pattern of the horse, the weight of the horse, the surface on which the horse works and the proper farriery necessary to address the amount of compromise. Farriery must be based on principles such as the appropriate trim, protection of the compromised structures, redistribution of forces and placement of all palmar foot structures in a 'load sharing' position. The trim is always the initial step, especially to improve hoof conformation/distortions. The type, size and placement of the shoe are intended to protect the trim, increase surface area, and add the necessary biomechanics.

Finally, there are many farrier products and synthetic materials available; that, when combined with the appropriate trim and shoe, can add resiliency to improve the function of the palmar foot. There is no single answer, method or 'one size fits all' that can be used for consistent success when addressing the NPA.

Conclusion

The NPA poses a constant dilemma to both the veterinary and farriery professions with regards to a healthy foot and continuing soundness. The position of and the forces on the distal interphalangeal joint resulting from the NPA can be a source of pain and one of the most common joints treated in veterinary medicine. However, any medication used to treat this joint will only have transient benefits unless the conformation of the palmar foot is addressed and improved. Another example that a good veterinarian farrier relationship compliments both professions and ultimately benefits the horse.

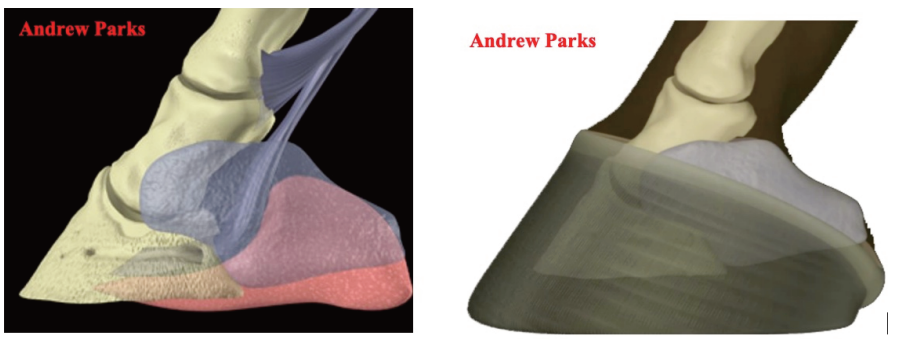


Figure 5. Osseous structures in the dorsal section and soft tissue structures in the palmar/plantar section of the foot. All structures housed within the hoof capsule.

Dr. Steve O'Grady operates Virginia Therapeutic Farriery which is a referral practice devoted to therapeutic farriery located in Keswick, Virginia. Website: https://www.equipodiatry.com
Disclaimer: Dr. O'Grady has no financial interest in Farrier Product Distribution (FPD) but routinely uses and recommends their products in his veterinary practice.

TOOL TIPS

Rubber Belt Cleaning Stick Installation

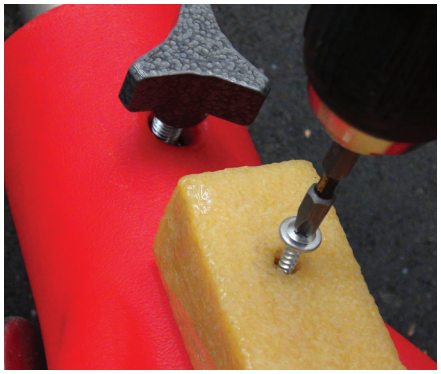
HANDY ADD-ON FOR YOUR HOOFJACK

The FootPro Rubber Belt Cleaning Stick attached to a Hoofjack is a great way to manage dirt build-up on your hoof buffer sleeves. Keeping them clean improves performance and the life of the sleeve. ■

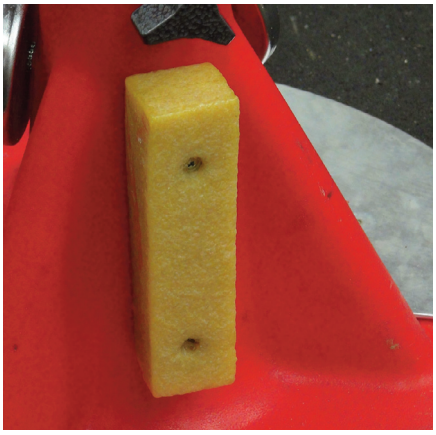
1. WHAT YOU NEED:

- **TWO SCREWS LIKE THOSE SHOWN (AVAILABLE AT MOST HARDWARE STORES)**
- **5/16" OR 3/8" DRILL BIT**
- **FOOTPRO RUBBER BELT CLEANING STICK**
- **BATTERY-OPERATED SCREW DRIVER (NOT SHOWN) AND MATCHING BIT**
- **SELF-PIERCING SCREWS (1.5" LONG WILL EASILY PENETRATE THE HOOFJACK MATERIAL)**

2. THE FOOTPRO RUBBER CLEANING STICKS DO NOT COME PRE-DRILLED. DRILL APPROXIMATELY HALF WAY INTO THE STICK WITH A 5/16" OR 3/8" BIT.

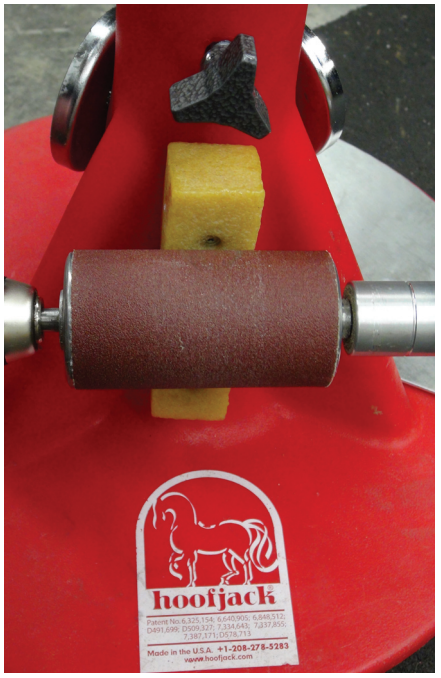


3. LAY THE HOOFJACK ON ITS SIDE, BRACE IT AND APPLY THE SELF-PIERCING SCREWS IN YOUR HOLES. MAKE SURE YOU TIGHTEN UNTIL THE HEAD IS SUNKEN INTO THE STICK ABOUT 3/4", NOT JUST FLUSH WITH THE OUTSIDE.



4. TWO SCREWS SHOULD BE ADEQUATE. MOUNTING BELOW THE TENSION KNOB IS THE BEST LOCATION.

5. STICK APPLIED AND READY TO GO.



6. WHEN YOUR BUFFER SLEEVE GETS DIRT BUILDUP, SIMPLY RUN THE TOOL AND APPLY SLIGHT PRESSURE ON THE STICK. IT WILL CLEAN UP VERY QUICKLY.

NEW PRODUCT SPOTLIGHT

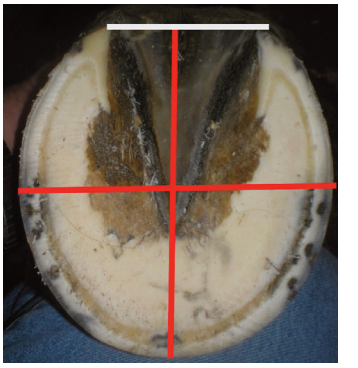
3D HOOF PADS

Recently, Derek Poupard CJF, DipWCF introduced a new, very simplistic, easy-to-apply pad that readily addresses many of the farriery principles discussed in our lead article. These pads can be used with any type of shoe that is open at the heels. The pad is injection molded using a rubber elastomer material. The material makes it thin and light weight yet firm and resilient. The dorsal part of the pad is in the form of a rim and at the middle of the foot it forms a wide expanse including a frog plate that covers the palmar/plantar section of the foot. There are holes placed in the pad corresponding to the frog and frog sulci, so when dental impression is added, it forms even uniform pressure under the soft tissue structures of the foot. Finally, there is an arm that connects the dorsal and palmar section of the pad for stability. When applied properly, the pad has all the properties to make the palmar/plantar section of the foot 'load sharing'. It is always helpful to note that all aspects of applying farriery begin with the appropriate trim.

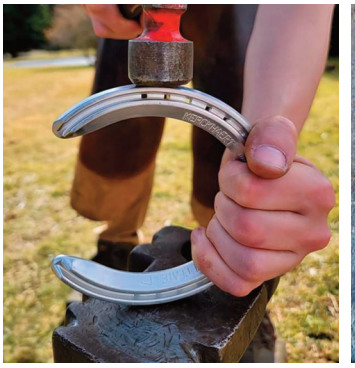
STEP-BY-STEP APPLICATION GUIDE

3D HOOF CARE
DEREK POUPARD

STEP 1.
Foot trimmed to approximate proportions and heels trimmed to the base of the frog or to the same horizontal plane as the frog.

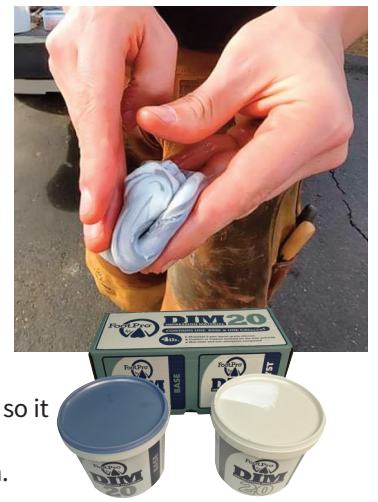


STEP 2.
Once the shoe is fit to the foot, the pad can be adjusted to fit the shoe. The frog plate is adjusted to fit the space between the heels of the shoe to form a mirror image of the frog.



STEP 3.
Nail or rivet the pad to the shoe. There is guideline in the pad to cut a notch for a toe clip. When using side clips, tap the shoe with the clip side down to mark the pad and then cut a notch. Using nippers and a rasp, a pad cutter, or a belt sander to trim the pad around the perimeter of shoe.

STEP 4.
Using equal amounts of FootPro DIM (Impression Material), mix until a uniform color is achieved. The amount of impression material needed will depend on pad size, frog sulci depth and surface area of frog to be covered. DIM will start curing immediately, so it must be applied quickly before becoming too firm.



STEP 5.
Place the FootPro DIM between the heels of the hoof capsule and push down into frog sulci as shown here.

STEP 6.
Position the shoe and pad on the foot, press pad into the proper position and secure with two nails. With the DIM still soft, place the foot on the ground and lift the opposite limb, spreading the impression material evenly under the pad. This process will press excess material out through the holes in the pad and ensure a smooth, uniform distribution.

STEP 7.
Remove excess DIM with a finger or cloth while still soft. It is difficult to remove once it cures. Apply the remainder of the nails and clench in a routine manner.

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Find These Quality Products at Montana Farrier Supply

New! Kerckhaert SX-8 Bold

Bolder, wider toe and slightly narrower branches than the regular SX-8 provides additional wear, support and modification options. 5-nail pattern with set back toe nail. Front unclipped only. Punched for 5 City, 5 Slim and 5 Combo Slim nails. Made in Holland.

Liberty 4 Combo Slim

This nail is a great option for 5/16" shoes in smaller sizes (000, 00, 0) where the hoof doesn't need the length of the 5 Combo Slim or a 5 City but requires a head to fit the same crease. The head is only slightly smaller than the 5 Combo Slim and the nail length of 48.5 mm is between a 5 Race and 5 City. This nail also works well with Kerckhaert Triumph and Century Aluminum. Available in Steel and Cu Shield.

Kerckhaert Steel Comfort Sport

The Steel Comfort Sport replaces the previous Kerckhaert Steel Comfort shoe. The new design has clips between the 2nd and 3rd nail holes. It has slightly wider heels for extra support and is marked to drill for traction devices in the heel area. Punched for Liberty Combo Slim or Hybrid Nails.

Bellota Prime Level

The Bellota Prime Level complements the Top Level rasp, providing the same wider, thinner model and aggressive rasp side with a chip breaker file side. Same weight as regular rasp models.

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