Developing Treatment Strategies for Palmar Foot Pain

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Thorough examination of the horse affected with palmar foot lameness syndrome is important not only to determine that the horse has the syndrome but also to try to determine which type of disease process is at work. Treatment then should be based on the type of injury.

The treatments of navicular syndrome vary widely, which probably reflects the treatment of multiple causes. By determining the most likely cause of the syndrome, the most specific problem can be treated. The treatment of caudal hoof lameness is as controversial as any aspect of this syndrome. However, it has been shown that correct shoeing should be basis of all treatment. Any medicinal or surgical therapy should be as an adjunct to shoeing.

The most successful approach to shoeing is that based on individual case needs rather than a standard formula. The following principles should be followed: (1) Correct any pre-existing problems of the hoof, such as underrun heels, contracted heels, sheared heels, mismatched hoof angles, broken hoof/pastern axis. (2) Use all weight bearing structures of the foot. (3) Allow for hoof expansion. (4) Decrease the work of moving the foot. Shoeing is most effective when corrections are made within the first 10 months of lameness, up to 96% success. This is in contrast to when shoeing changes are not made until after 1 year of lameness, where only 56% of the cases have been successfully treated.

These principles can be accomplished using many different methods and techniques. Shoeing is of utmost importance in dealing with hoof pain causing the signs associated with navicular syndrome or remodeling of the bone (osseous form). It is necessary to insure proper hoof balance and support in order to eliminate the pain and stop or decrease the stresses that are causing the problem.

Six hoof balance abnormalities have been described: broken hoof axis, underrun heels, contracted heels, shear heels, mismatched hoof angles, and small feet. Some authors have attempted to define these hoof abnormalities objectively. A broken hoof axis exists when the slopes of the pastern and hoof are not the same. This condition is further defined as broken-back, when the hoof angle is lower than the pastern angle, and as broken-forward when the hoof angle is steeper than the pastern angle. Underrun heels have been defined as angle of the heels of 5^{o}

less than the toe angle. A contracted heel was defined as frog width less than 67% of the frog length. Sheared heels were defined as a disparity between the medial and lateral heel lengths of 0.5cm or more. Small feet (small feet to body size) were defined as a weight to hoof area ratio of greater than 78 pounds per square inch.

Numerous factors contribute to the balance of an equine hoof. Toe length is important because it determines the length of the lever arm over which the limb rotates and the timing of hoof lift. Hence, a long toe, that would delay breakover, could be expected to increase the pressure of the deep flexor tendon over the navicular bone, increase the tension on the proximal suspensory ligament of the navicular bone, and increase the dorsal rim pressure on the joints of the leg. The optimal toe length has not been determined. Toe length to a certain extent will be dictated by the horse's use as well as the horse's height and weight. Guidelines have been described that relate toe length to body weight. A graph of hoof measurements will document disparities in hoof wall length between feet. Lengthening one hoof over its opposite has been suggested as a treatment for limb length disparity in the horse. However, this condition has not been scientifically documented in the horse. It has been the author's experience that apparent limb length disparities are more commonly due to mild flexural deformities (contracted tendon) rather than actual differences in limb length and that this condition is most commonly manifested as mismatched hoof angles. One study indicated that 28% of normal performance horses might be affected in this manner. This can most easily be documented utilizing the lateral radiographs.

The hoof angle should be the same as the hoof axis. Utilizing the lateral radiographic projection, the ideal hoof angulation to properly align the second and third phalanges can be measured accurately (Figure 22). The appropriate correction can be determined by measuring the degree of malalignment (flexion or extension) present in the coffin joint and raising or lowering the hoof angle that amount. For instance, if the lateral radiographic projection showed 4^o flexion of the coffin joint, then the hoof angle should be lowered 4^o. In most cases, the aligned hoof axis is $52^o \pm 2^o$ for the front feet and $55^o \pm 2^o$ for the back feet. Intentional lowering of the hoof angle has been used to increase stride length in racehorses but studies have shown that this is not true; therefore, there is no reason not to shoe for a correct hoof axis and a broken hoof axis can predispose to lameness problems and it has been associated with a greater risk of breakdown in racehorses.

In addition to hoof axis deviations, the lateral radiographic projection can be used to document problems of heel support, i.e. underrun heels. In horses with hoof angles between 50 and 55 degrees, the hoof length graph also documents underrun heels if toe length to heel length ratio is less than 3:1. Either drawing a bisecting line through the metacarpus to the ground, or measuring the appropriate position on the radiograph can determine the proper position of the heels. Where these lines contact the ground is the point where the heels should be. From a practical point, the heel-ground contact should be even with the base of the frog. Underrun heels are the most commonly encountered hoof abnormality. In one study of foot related lameness it was found in 77% of the horses and in another study of normal performance horses this condition was found in 52% of the horses. The necessity of correcting underrun heels has been well documented. If left uncorrected underrun can cause alterations in hoof wall growth that can be very difficult to correct and it can predispose to lameness problems that range from bruised heels to navicular syndrome.

One of the most difficult parameters to assess is the hoof's ability to expand. Applied clinical studies have shown that the frog length to width ratio is useful for this purpose; when the frog's width is at least two-thirds its length, the hoof has normal expansive abilities. When the frog is narrow, hoof expansion is reduced. Whether this is a function of frog pressure is not known, although both reduced and excessive frog pressure have been shown to cause hoof contracture. Identification of a narrow frog should alert the clinician that steps need to be taken to promote hoof expansion. These may vary from simply ensuring proper heel support to encouraging hoof expansion through the use of slipper heels.

Medial/lateral imbalance or shear heels have been shown to cause, or predispose to, a number of hoof related lameness. Medial/lateral balance can be assessed by both the hoof measurements and the radiographic examination. The graph of hoof wall measurements will clearly show if one side of the hoof is longer than the other. The obvious correction is to make the walls equal, although it is not always that simple. The dorso-palmar radiograph will also clearly demonstrate any imbalance. Since this projection will also show the effect the imbalance has on the coffin joint, this radiograph can be used to emphasize the need for correction. The magnification in most radiographs makes even subtle disparities more obvious. It is accepted that conformation can alter this balance. The radiograph will help determine if the imbalance is hoof

related or conformational. Hoof related imbalances will show medial/lateral hoof length disparities, and the first and second phalanges can be bisected equally. If the medial/lateral disparity is conformationally related the first and second phalanges will appear oblique on the DP radiograph.

The final assessment of balance is the weight of the horse in proportion to its feet. Small feet have been a commonly described problem, particularly in Quarter Horses, that predispose the horse to lameness. One study identified small feet as an indicator of poor prognosis in the treatment of navicular syndrome. Most descriptions of what actually constitutes a small foot are quite subjective. However, studies have been performed utilizing simplistic formulas to make this assessment objective. These studies measured the circumference of the hoof immediately below the coronary band. This was done to get a rough idea of the hoof cross sectional area. This was then compared to the horse's weight and statistical analysis was performed. A ratio of seventy-eight pounds per square inch was determined to be the maximum weight to hoof area ratio for a normal performance horse. The steps to determine this number have been simplified to the following formula:

$12.56 \text{ X } wt(lbs)/C^2(in^2)$.

Once identified, a high weight to hoof area ratio can be used to show a client that their horse should lose weight. In addition, it can be used to show the necessity of fitting a shoe as fully as practical in order to produce the largest surface area as possible for that particular horse's hoof.

The author believes there is a hierarchy of hoof problems, in other words when dealing with these problems which is the most important. The most important problems relate to heel support and this means not simply adding shoe but improving the ability of the quarters and heels of the hoof capsule to bear weight. The next most important issue to deal with is that of medial to lateral balance. Improving the ability of the hoof to expand follows this. This is followed by body size to foot size mismatches. The least important of the hoof problems appears to be hoof pastern axis. Oddly enough this is the one most commonly and easily treated.

These hoof balance issues have importance relative to prognosis. Caudal hoof lameness treated with shoeing alone within the first 10 months of lameness has been 97% successful in managing the lameness. However, horses that have been lame for one year or more shoeing is

only 54% successful. The presence of underrun, contracted and sheared heels in the feet makes it four times less likely to be successful. Finally, horses with a hoof area to weight ratio of 83 lbs/in^2 or more, none were successfully treated with shoeing.

Even though shoeing is the key to therapy, each of these cases usually require additional therapy. The selection of therapy should be based on clinical and imaging findings. Coffin joint pain is inferred in horses that respond to coffin joint anesthesia. Coffin joint pain may be suspected if the distal limb flexion is very positive and other manipulative tests are either mild positive or negative. It is my opinion; these cases should be treated for inflammation of that joint. This may include systemic non-steroidal anti-inflammatory therapy but intra-articular therapy or specific joint therapy should be considered. The use of hyaluronic acid and corticosteroids as anti-inflammatories within the joint is well documented. I prefer to use a combination of high molecular weight hyaluronic acid (10-20mg) and triamcinolone (8mg) injected intra-articularly followed by a second shot of hyaluronic acid in 2 weeks. In addition, the use of intra-articular or intramuscular polysulfated glycosaminoglycans has been useful in the control of joint disease. Most frequently I use PSGAGs if I suspect cartilage damage (500mg IM, every 4 days for 4 weeks). Whenever encountering coffin joint pain, if the horse responds to medial/lateral wall wedge tests I suspect distal interphalangeal collateral desmitis. I will exam the collaterals sonographically to determine if desmitis is present. If desmitis is present the joint is treated differently. Collateral desmitis must be treated with rest to allow time for the ligaments to heal. The average time for healing is 4 to 5 months. The author has found shockwave therapy to reduce the healing time by half. PRP and stem cell therapy have also been used to reduce healing time. Occasionally horses affected with coffin joint synovitis also have a chronic broken forward hoof axis. Many of these cases appear to be mild flexural deformities. Because of the malarticulation of the short pastern and coffin bones, the joint remains inflamed despite therapy. In these cases, inferior check desmotomy to allow correction of the broken forward axis has been very useful in treatment of these types of cases.

In cases where the frog wedge test is the most positive manipulative test, I suspect pain in the navicular bursa area. This lameness should be eliminated by navicular bursa analgesia. The author treats these cases by intrabursal corticosteroid. Cartilage damage on the flexor surface, can most easily be assessed by contrast navicular bursagraphy. Cartilage damage is treated is

treated by polysulfated glycosaminoglycans. Tears in the bursa need to be treated with rest; however, persistent pain in this region has been a problem.

Treatment of vascular forms of the disease will need to be treated with vasoactive drugs. Four drugs have been used for this purpose. Warfarin is used to improve the circulation to the podotrochlea by increasing the one-stage prothrombin time by 20% up to 50% if improvement not seen within 8 weeks.[6-9] The drug is administered orally at a dose of 0.2mg/kg daily (total daily dose 6-85mg daily to the 500kg horse). Vitamin K_1 must be available at all times because of the possibility of fatal hemorrhage caused by warfarin. This is also why this drug has fallen out of favor. Isoxsuprine HCl is the most common drug used to increase the circulation to the podotrochlea. Although there is some controversy as to the effectiveness of oral administration.[22] It is dosed at 0.6-1.2mg/kg b.i.d. until sound, then decreased to s.i.d. for 2 weeks then further decreased to every other day. My approach to using this drug has been to dose at 1.2 mg/kg b.i.d. for 2 weeks, followed by 1.2 mg/kg s.i.d.for 1 week, and then 0.6 mg/kg s.i.d. for 1 week. The drug is discontinued after the fourth week and the effect reassessed. If the horse becomes lame after discontinuance the drug is restarted at 1.2 mg/kg s.i.d. then reduced weekly to the minimum effective dose.Other drugs have been studied. Metrenperone is a serotonin antagonist and thereby increases circulation. It has been used at a dose of 0.1mg/kg b.i.d. However, the drug has not been shown to be as efficacious as isoxsuprine. A new drug that is showing promise is pentoxifylline which increases RBC deformability and decreases blood viscosity thus aiding circulation.[21]The drug is dosed at 4.5-7mg/kg t.i.d. Clinical trials in Canada have shown much promise. However, the research failed to determine which patient profile is best suited to this treatment. Some surgeries have been suggested to be useful in the treatment of vascular forms of the disease. Palmar digital neurectomy causes vasodilation and the effect lasts as long as the neurectomy. Fasciotomy of the palmar digital nerve has also been suggested but the effect does not last and may cause more damage to the nerve.

In cases where desmitis of the navicular suspensory ligament or impar ligament is suspected there are basic 2 treatment alternatives. Treatment is designed to reduce strain on the ligament. This can be achieved by either raising the heels of the horse's foot or by cutting the collateral sesamiodean ligaments (CSL). Collateral sesamoidean desmotomy is a surgery that has become popular in Europe and has been effective on selected cases of navicular syndrome.

The surgical approach is made just proximal to the collateral cartilages, just cranial to the digital vein. A 2cm incision is made, the vein is retracted in a palmar direction, and the CSL can be located as it courses proximally and dorsally over the short pastern bone. A hemostat is used to dissect around the ligament and then transection is performed. Closure is standard. The horses are allowed to rest for 2 weeks for skin incision healing, and then they are returned to work.

Similarly, when the deep flexor tendon is involved, raising the heels of the hoof will decrease strain on the tendon. But in addition, desmotomy of the inferior check ligament has also recently been shown to be effective in treatment of these cases. But if tendonitis is diagnosed the tendon needs to be rested. With the new regenerative medicine, tendons certainly can be aided in their healing by PRP or stem cell injections. Shockwave therapy has also been used in these cases.

In long standing cases of navicular pain, excessive remodeling of the navicular bone is a problem. In these cases **Tildren®** has been used effectively to treat the disease. Dosage is either 0.1mg/kg administered slowly intravenously daily for 10 consecutive days or 1mg/kg administered slowly intravenously once. There are reports of veterinarians using the 0.1mg/kg dose as a regional perfusion, there is no scientific evidence that this is an effective administration of the drug.

When all other treatments have failed or have not had the desired affect, palmar digital neurectomy remains a viable treatment alternative. Numerous techniques are available but all follow some basic rules. First, the neurectomy will not improve the lameness any more than a palmar digital nerve block. Therefore, it is highly recommended that the nerves be anesthetized with the owner/rider present so that they can decide whether the horse has sufficiently improved. Second, neuromas are a common problem but can be avoided by atraumatic surgical technique. Atraumatic surgery can really only be learned by practice. Neuroma formation can be decreased by allowing the surgical wounds to heal as well as possible before returning to work. This usually requires 4 to 6 weeks rest after the surgery. Third, the horse will lose skin sensation in the back half of its foot but probably loses all or most of its sole sensation. However, the horse will always know where the foot is. The foot then should be protected some how, usually by a pad.

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Therapeutic Flow Chart

APPROPRIATE SHOEING IS THE BASIS

ANALGESIA as PART of the MANAGEMENT

(ANTI-INFLAMMATORIES/CHEMICAL NEURECTOMY)