

How to Take, Read, and Interpret Radiographs for the Treatment of the Laminitic Horse with Heart Bar Shoes

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Introduction

Laminitis is a complex disease with significant animal, human, and economic impacts. The cases are often frustrating and clinically challenging to manage. The most significant consequence of laminitis is that it remains a potentially crippling performance laminitis, life threatening disease.

It is wise to treat the laminitic and foundered horse with the principles, techniques, and tools that will provide the highest chance of success. There are several different modalities and methods for the mechanical treatment of laminitic and foundered horses. As with any method of treatment, a complete understanding of the application of the treatment increases the chances of success. Some practitioner's discount a method of treatment due to a lack of understanding of the treatment modality and due to incorrect application of such treatments.

One such treatment for laminitic horses' is the use of heart bar shoes. The heart bar shoe must be constructed, fit, and applied with accuracy in order to achieve the greatest chance of success.

Materials and Methods

Shoeing laminitic horses with heart bar shoes should never be done without radiographs. In order to correctly construct and fit heart bar shoes, good quality radiographs will need to be taken so the heart bar shoe will be able to be applied with accuracy and increase the chances of success.

A few simple preliminaries will make the difference between a radiograph that is useful for the mechanical treatment of laminitis and one that is not.

Two wooden blocks are needed about 2 ½” to 3 ½” high and wide enough for the horse to stand on. Latero-medial views of the distal phalanx normally require the foot to be raised of sufficient thickness to bring the solar surface of the foot level with the center of the radiograph beam. This allows the bottom of the cassette to be placed lower than the solar surface of the foot so that it is included on the film. Preparation of the horse is essential to good radiographs. Quiet horses will reduce movement. The horse’s foot should be cleaned out and the frog and sole should have any defoliation removed. A clean foot will eliminate confusing artifacts.

The frog does not show up well on latero-medial radiographs. In order to show the frog in relation to the distal phalanx, a tack is used to highlight the apex of the frog. The tack is merely a reference point to determine proper placement of the toe and frog plate of the heart bar shoe. The tack is pushed into the apex of the frog. The exact placement is not as important as long as its position on the frog is marked in some way. A heavy felt tip pen is ideal for marking the frog and sole (figure 1).



Figure 1

Due to the design of both CR and DR units, radiograph images are subject to a magnification mechanism of minor or larger magnitude. This means that all objects measured in a radiograph image will always appear larger on the image than in reality (Sectra, 2009).

The magnification factor depends on both the distance between the focal point of the radiograph tube and the image plate as well as the distance between the imaged object and the image plate. If the imaged object is moved toward the focal point of the radiograph tube the magnification factor is increased and if the imaged object is moved toward the image plate the magnification factor is reduced. Since all radiograph units are different, they will all create different magnification factors on radiograph images. A larger distance between the focal point of the radiograph tube and the image plate reduces the effect of such movements (Sectra, 2009).

When acquiring a conventional radiograph image on which measurements of any type should be made, a calibration marker should always be present in the image (Sectra, 2009).

To correct for magnification, a marker is used on the front of the hoof wall. A straight stiff wire of known length (about 30 to 50 mm) is used to highlight the front and top of the hoof wall. A piece of copper or steel wire works best. Do not use flexible or braided wire as this makes radiographic interpretation more difficult. The length of the wire must be known so the effects of radiographic magnification can be adjusted. The wire is taped to the hoof wall so the top of the wire is located where the wall changes from hard to soft (Sectra, 2009; Eustace, 1996; Buff, 1990)(figure 2).



Figure 2

The horse should stand with one foot on each block with the cannon bone vertical (figure 3). This is the ideal situation, however many of us deal with horses that can't even stand. In a well positioned radiograph, the radiograph beam is perpendicular to the cassette to avoid image distortion. The radiograph beam should be parallel to the top of the block and perpendicular to the axis of the limb so that precise latero-medial radiographs are produced. The importance of a true latero-medial radiograph cannot be overemphasized for proper interpretation.

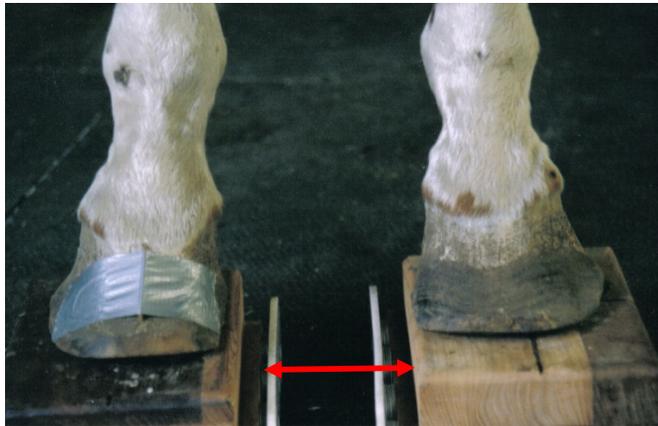


Figure 3

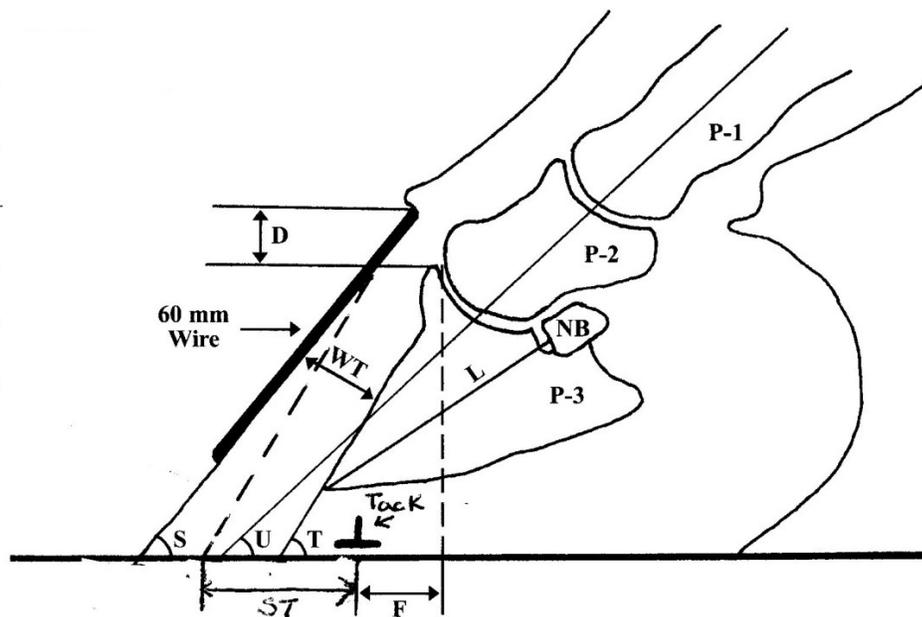


Figure 4

The following data is to be collected from the radiographs in order to be able to correctly construct and apply a heart bar shoe (Buff, 1990)(figure 4):

Actual Wire Length (figure 4) - The actual wire length is the actual length of the dorsal wall wire marker used.

Radiographic Wire Length (figure 5) - This is the measured length of the dorsal wall wire marker from the radiograph.

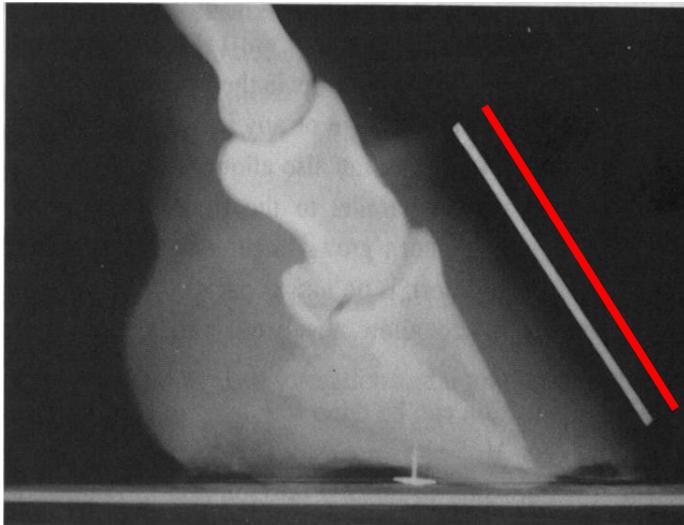


Figure 5

With the known actual wire length and the measured length of the wire from the radiograph, the effects or radiographic magnification can be adjusted.

Magnification Correction - In order to get actual working measurements, calculations need to be made. The magnification formula is actual wire length divided by radiographic wire length. For example, if an 50 mm wire is used and the wire measures 55 mm on the radiograph, then the magnification correction is 0.9 ($50 \div 55$). For any measurement taken from the radiograph, it will need to be multiplied by the magnification correction in order to obtain the actual measurement. For example, if you take a measurement of 45 mm on the radiograph, then you need to multiply that number by the magnification correction, to get the actual length. In this example, $45 \text{ mm} \times 0.9 = 40.5 \text{ mm}$.

Wall Thickness (figure 4 and figure 6) - This is the distance from the wire marker on the dorsal hoof wall to the dorsal cortex of the distal phalanx. This is to be measured half way up dorsally from the tip of the distal phalanx to the base of the extensor process, and at a right angle to the dorsal cortex of the distal phalanx. Normal wall thickness, uncorrected for magnification, has been shown to be 13-15 mm for miniatures, 15-17 mm for horses, and 17-19 mm for drafts

(Cripps and Eustace, 1999; Buff, 1990, 2005). Wall thickness will be use to determine the Shoe Toe placement of the toe of the heart bar shoe.

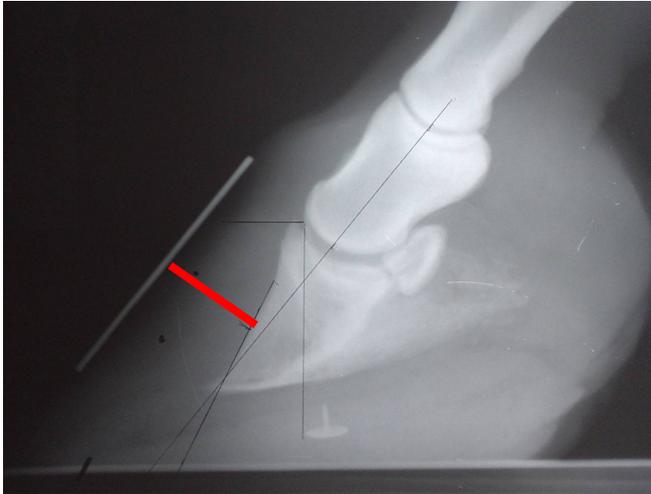


Figure 6

Palmar Cortex of the Distal Phalanx Length (figure 4 and figure 7) - This is the length of the palmar cortex of the distal phalanx from the tip of the distal phalanx to the articulation of the distal phalanx and the navicular bone. It has been shown that the wall thickness in the normal horse is approximately 25% of this measurement when corrected for magnification (Pollitt, 2001). For example, if you take a measurement of 65 mm on the radiograph, then you need to multiply that number by 25% (0.25) to get wall thickness. In this example, $65 \text{ mm} \times 0.25 = 16.25 \text{ mm}$. Remember, normal hoof wall thickness for horses is between 15 mm and 17 mm, uncorrected for magnification. In this case, the horse has a normal hoof wall thickness of 16.25. This measurement will later be used to establish the correct placement of the toe of the heart bar shoe.



Figure 7

Shoe Toe Placement Calculation (figure 4 and figure 8) - This is the distance between the tack (which is merely a reference point to determine the proper placement off the toe of the shoe), and a line drawn parallel to the dorsal aspect of the distal phalanx, at the normal hoof wall thickness that was calculated from the Palmar cortex of the distal phalanx length. In this case, 16.25 mm. The spot that this line intersects the bottom of the hoof is the spot that the toe of the heart bar shoe will be placed at. This is the easiest and most accurate method to determine the toe placement of the heart bar shoe. After taking this measurement, correct for magnification and transfer this measurement to the foot (figure 10). After the shoe is applied, the distorted hoof will then be removed, exposing the dead laminar wedge.

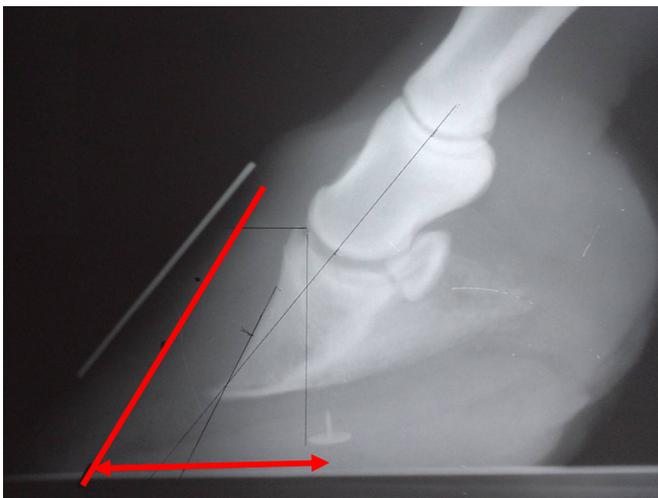


Figure 8

Frog Plate Placement Calculation (figure 4 and figure 9) - This is the distance between the tack (which is merely a reference point to determine the proper placement of the frog plate), and a line drawn perpendicular to the ground, immediately behind the extensor process and bisecting the coffin joint space. This is the easiest and most accurate way to calculate this measurement. This is the reason why correct radiographs need to be taken and utilized for the shoeing treatment of any laminitic horse that heart bar shoes will be applied to. After taking this measurement, correct for magnification and transfer this measurement to the foot (figure 10).

A second method for determining frog plate placement is to measure the length of the solar margin of the distal phalanx and then measure back 37% from the tip of the distal phalanx (Chapman and Platt, 1984; Chapman, 1998; Butler and Platt, 2001). This method doesn't work well when the distal phalanx is degenerating.

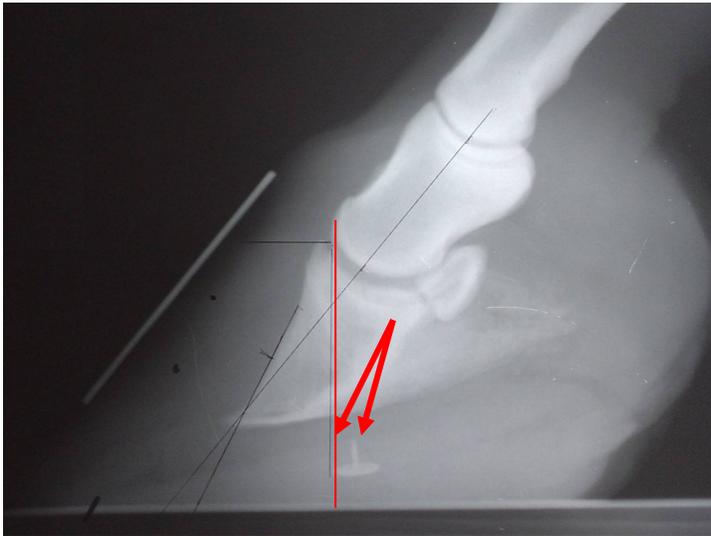


Figure 9



Figure 10

There are many ways to make a heart bar shoe. The most accurate, efficient, and cost effective method is best used. For this reason, a standard rim horseshoe with a forged frog plate made out of round stock, welded into the shoe, is advisable to use (figure 11). A rim shoe makes it easier to pull the nails at time of reset. Purchased heart bar shoes are adequate but usually increase the amount and difficulty of work due to having to re-alter the shoe to fit the foundered foot.

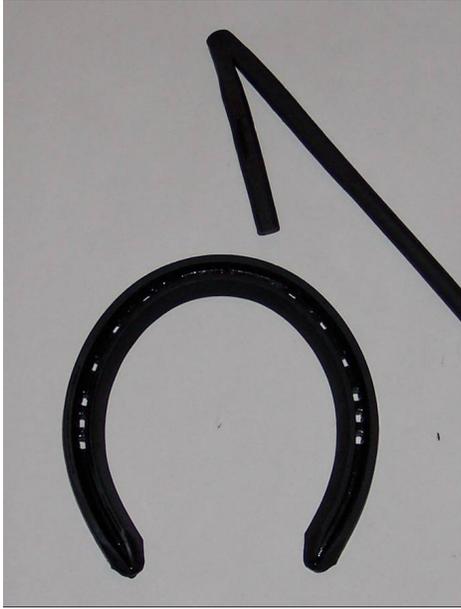


Figure 11

The rim shoe that best fits the hoof should be used. The shoe should be fit so that the toe of the shoe ends at the Shoe Toe Calculation marker line drawn on the foot. The frog plate is then forged out of 3/8" round stock and fitted into the shoe so it ends at the Frog Plate Calculation marker line (figure 12).



Figure 12

The frog plate is then welded into the heels of the rim shoe at the same plane as the frog (figure 13). The frog must be visible on all sides and in front of the frog plate to prevent any constriction of the paracuneal artery. A guideline is to ensure at least 1/8" of visible frog around the frog plate.



Figure 13

The goal of heart bar shoeing is to counteract the downward movement of the distal phalanx. The heart bar stabilizing effect is via controlled pressure on the frog. Therefore, the frog plate of the heart bar shoe should apply enough pressure on the frog. The pressure placed against the frog by the heart bar shoe is determined by feel. The shoe should be squeezed down against the frog by the thumbs. The force required to resist the frog and rest the shoe on the wall is about right for most horses. Usually this distance is about 12/8" (Buff, 1999).

If not enough pressure against the frog is obtained, apply a layer of adhesive such as Superfast™. After the adhesive has dried, rasp it down to the desired thickness (figure 14 and figure 15).



Figure 14



Figure 15

Tack on the shoe with two nails and allow the horse to bear weight, watching for signs of discomfort (figure 16). Resting the opposite foot or a big sigh of relief as the horse loads the shod foot are good signs. However, starting to load the foot then backing off and resting it, as well as developing tension, are bad signs (Butler, 200, 2004; Butler and Platt, 2001; Buff, 2005). Proceed nailing making sure that the nails are located behind the point of the frog plate in order to avoid further damage to the laminae (figure 17), (Butler, 2001; Buff, 1990, 2005).



Figure 16



Figure 17

The distorted hoof should be rasped down to the same shape as the toe of the shoe, exposing the laminar wedge (figure 18).



Figure 18

Conclusion

A properly fitted heart bar shoe transfers part of the weight bearing capacity of the foot to the frog, thus allowing other parts of the foot to be rehabilitated. Heart bar shoes should be reset at intervals not to exceed four weeks. In the early stages of treatment, the heels will outgrow the toe and it will be essential to trim and reset the heart bar shoe for correct placement. The heart bar shoes should be applied until the feet have stabilized, from new hoof wall, and the horse is comfortable while walking. As the horse progressively becomes better, apply less and less frog pressure until no frog pressure has been applied for a period of one or two shoeings.

The use of correctly placed heart bar shoes was introduced at the 1983 American Farriers Association Convention and the 1984 American Association of Equine Practitioner's Convention (Chapman and Platt, 1983, 1984). As stated then as now, The heart bar shoe must be constructed, fit and applied with accuracy in order to be effective. There is still widespread errors in the fitting and application of heart bar shoes.

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