A DISCUSSION OF WEAK, UNDER-RUN HEELS AND A STUDY OF THREE SHOEING METHODS

By Stewart Armstrong A.W.C.F

ACKNOWLEDGEMENTS

I acknowledge with many thanks the following for their guidance and support;

Sandy Beveridge F.W.C.F

Simon Curtis F.W.C.F Hon Assoc R.C.V.S.

Jim Ferrie F.W.C.F

Martin Deacon F.W.C.F

Ross Syme M.R.C.V.S.

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INTRODUCTION

This thesis will attempt to demonstrate the advantages and disadvantages of types of remedial shoes and shoeing methods for low weak heels which are widely acknowledged to be a large factor in the most common dorso-palmar imbalance; broken back hoof pastern axis (B.B.H.P.A.).

A study of five horses was carried out. The horses all suffered from weak, under-run heels and hypertrophied frogs. Each horse was shod three times, at regular intervals with broadweb shoes, eggbar shoes then finally heartbar shoes.

The three methods trialled are recently well recognised in redistributing the forces of bodyweight away from the heels.

Broadweb

> *"Extra length and width of shoe will result in a more caudal hoof placement at rest which in turn results in less pressure on the heels."*
>
> (Ross and Dyson 2002)

Eggbar shoe

> *"The eggbar shoe is especially beneficial for horses whose heels have collapsed forward."* (Stashak 2002)

Heartbar shoes

"The heartbar is the shoe of choice in the horse with collapsed heels and bars. Its effect is to remove some of the force being applied to the back third of the foot." (Deacon and Williams 1999)

Although they offer an instant correction to B.B.H.P.A., elevated shoes or wedges were not included in the study for the reasons described on pages 14-16.

COLLAPSED HEELS: A DESCRIPTION

Collapsed heels are in most cases related to a B.B.H.P.A. The hoof pastern axis (H.P.A.) is an imaginary straight line which bisects from the centre of the fetlock through the middle of all three phalanges and is parallel with the dorsal wall of the horse's foot (Fig 1). It should be noted that in this ideal conformation the horn tubules at the toe are parallel to those at the heels. According to Hickman and Humphrey (1988), these should both match the angle of the H.P.A. which is approximately 50 degrees from the horizontal.

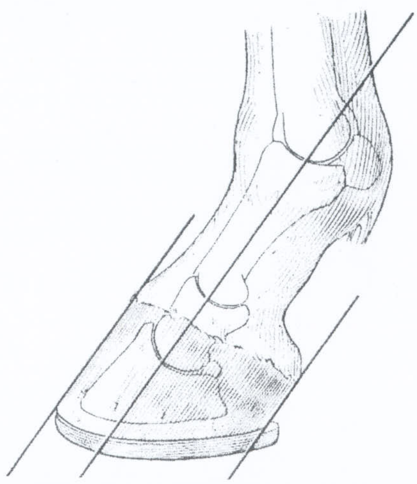

Fig 1

According to Colles (2000), if a plumb line is dropped where the H.P.A. line bisects the coronet, as shown in Fig 2, it will pass through the centre of the distal interphalangeal articulation and the point where it touches the ground will represent the centre of weight bearing on the ground surface (Fig 2).

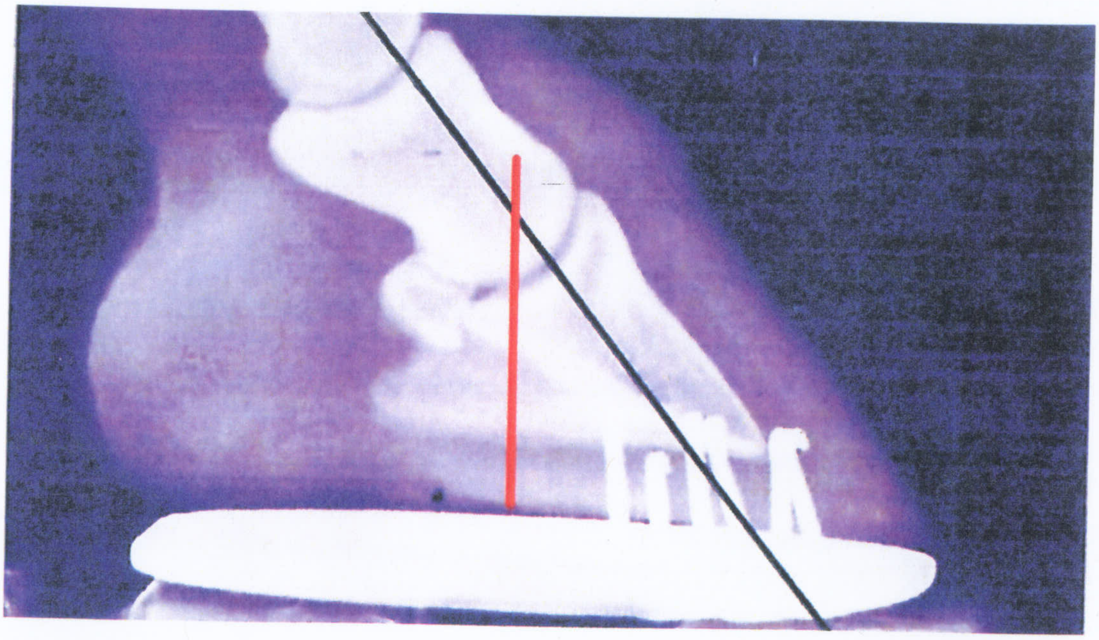

Fig 2

It follows, therefore, that if the H.P.A. is broken backwards the centre of weight bearing is transferred backwards on the foot upsetting the natural distribution of weight and concussion by overloading the palmar half of the foot.

In this scenario the overloaded horn tubules will buckle and yield forward at a much lower angle than the pastern axis. This is known as under-run or collapsed heels. If allowed to progress the angle of the heels will become more acute and in some cases almost parallel to the ground. The angle at the toe will be lower (Fig 3).

Fig 3

CAUSES OF B.B.H.P.A.

1. Excessively long shoeing intervals.

Abrasion from the shoe in the heel region caused by the foot's natural expansion means that from the onset of the shoeing cycle the weight centre is being moved in a heel biased direction. According to Clayton (1998), the hoof angle can change up to 4 degrees in 8 weeks however, if the shoeing cycle is correct, i.e. every 4-6 weeks, the effects of this are negligible. If left longer the weight centre is moved backwards into the palmar third of the foot resulting in overloading in this area.

2. Insufficient support from shoes.

> "*Using too small a shoe causes the palmar ground surface to move dorsally, imposing greater stresses on the heels which are then prone to collapse.*" (Moyer 1975)

If a shoe which is too short in length or too narrow a section is applied, the foot will very quickly grow over it and the heels of the shoe will drive upwards into the seat of corn. The horse, at this point, is walking on the wall at the heel and the shoe at the toe thus breaking the axis backwards.

3. Poor conformation.

"A horse with excessively long sloping pasterns will always be predisposed to collapsed heels due to the excessive pressure this places on them." (O'Grady 2002)

As a general rule thoroughbred horses have longer, more sloping pasterns and it is here that a greater percentage of collapsed heels are found.

4. Poor foot trimming.

"Insufficient removal of hoof wall at the toe or dorsal wall flare will create B.B.H.P.A." (Stashak 2002)

If the farrier fails to pay attention to H.P.A. trimming guidelines, B.B.H.P.A. is often the result.

RESULTING PROBLEMS FROM THIS CONDITION

Lamenesses originating from the palmar half of the limb are very often connected to stress, strain or compression, which can result in lesions of one or more of the following structures:

1. Navicular bone
2. Navicular bursae
3. Deep digital flexor tendon/ inferior check ligament
4. Navicular ligaments (collateral sesamoidean ligaments, distal impar ligament).
5. Distal phalanx (degeneration of the distal border of the wings).

"Decreasing the hoof angle increases the tension on the deep digital flexor tendon and the navicular ligaments, making the horse more susceptible to developing navicular syndrome and flexor tendon strain. Horses trimmed with a broken back H.P.A. and observed for approximately 1 year developed signs of navicular syndrome." (Stashak 2002)

All the previously mentioned structures are pressurised by the natural anticoncussion mechanism of the foot. Under loading they are trapped and compressed between descending body weight via the bone column and ground pressure via the frog, digital cushion, hoof wall and sole. The rotation of the distal interphalangeal articulation backwards during weight bearing also increases this compression. The deep digital flexor tendon further adds to the compression on this area through its use of the distal sesamoid as a pulley during motion.

Fig 2 demonstrates that a perpendicular line dropped from the point where the H.P.A. bisects the coronet band shows the centre of weight bearing. This is an ideal conformation and will result in an even and correct distribution of weight. Fig 4 shows that when the H.P.A. (black line) is broken back by the long toe and under-run heels the centre of weight bearing (red line) is moved palmarly and there will no longer be an even weight distribution. The majority of the bodyweight is being supported by the palmar half of the foot overloading the five structures mentioned on the previous page.

Fig 4

According to Ferrie and Clements (2002), B.B.H.P.A. will also result on extra stress on the suspensory apparatus with the most common injury being desmitis of the superficial flexor tendon due to its fetlock supporting role and small cross sectional area. The deep digital flexor tendon, inferior check ligament and suspensory ligament are also commonly affected.

Recent literature states that blood supply to this area is also restricted by the excessive loading.

> *"In the case of B.B.H.P.A. the internal structures of the heel are compressed to such an extent that the blood supply to the area especially the navicular bone is severely compromised."*
>
> (Price and Fisher 1996)

> *"In horses with long toes and under-run heels the vasculature around the cartilages of the foot are less well developed than in a better conformed foot."* (Rijkenhuizen and Nemeth 1989)

> *"In the case of B.B.H.P.A. so much of the horse's weight is concentrated towards the back of the foot the effect is to interfere with the blood supply to that area."* (Deacon and Williams 1999)

The typical bruising found in the region of the seat of corn when B.B.H.P.A. occurs suggests that light internal haemorrhaging involving the solar corium is present.

FOOT CHANGES IN RESPONSE TO B.B.H.P.A

When dealing with any conformation problems in the lower limb it should be remembered that due to its flexible properties, the hoof capsule will distort and flex in accordance to the pressures placed upon it.

"The hoof capsule will distort due to uneven loading for several reasons;

1. It is continually growing and can therefore be influenced by pressure away from its correct alignment.

2. It is not firmly fixed to the skeleton,

3. The hoof may wear unevenly.

4. Horn is compressible" (Curtis 2002)

As described earlier in the case of B.B.H.P.A., the majority of the forces involved have been transferred to the palmar half of the foot which distorts in the following ways;

The hoof wall and corresponding sensitive laminae at the heels, normally parallel to the angle of the pastern in an ideal conformation, will compress and bend forward bringing the bulbs of the heels closer to the ground (Fig 6). In severe cases the tubules may be almost horizontal with the bulbs of the heels coming into contact with the ground.

Fig 6

This in turn dictates that the frog corium receives more stimulation from ground pressure than is normal and responds by becoming very large and bulbous (Fig 7) to the point where weight bearing without a shoe can be uncomfortable, if not impossible, for some horses. The frog cannot be returned to its normal dimensions by trimming alone. In my experience, cases in which the frog does not become large and bulbous are often when the horse is in little work, permanently on a bedded environment, with little or no stimulation from movement, or when poor management has caused a degeneration of the tissue (thrush).

Fig 7

The large bulbous frog is trapped between ground resistance and descending bodyweight. The foot appears to respond to this scenario by becoming over expanded at its widest part. In my opinion this is due to the increased pressure being loaded onto the digital cushion which expands outwards and alters the shape of the coronet band and foot in this area. Flattened soles seem to allow the lower border of the foot to spread excessively weakening the foot and developing separation of the white line in the quarters (Fig 8).

Fig 8 (note cavities and weakening of wall in quarters)

On the dorsal aspect of the foot the wall takes on a much longer appearance and may lose its straight line from coronet band to ground surface with a change in angle half way to two thirds down (Fig 9) due to either flexion from the increased leverage or insufficient dressing resulting in a toe flare.

Fig 9

Details of the authors method of toe flare dressing will be covered in a later section. On the solar aspect the white line may become distended. This can develop into secondary problems such as white line disease or infection. According to O'Grady (2002), haemorrhage of the white line (Fig 10) is caused by laminal tearing which results from the long toe setting up an excessive mechanical lever arm.

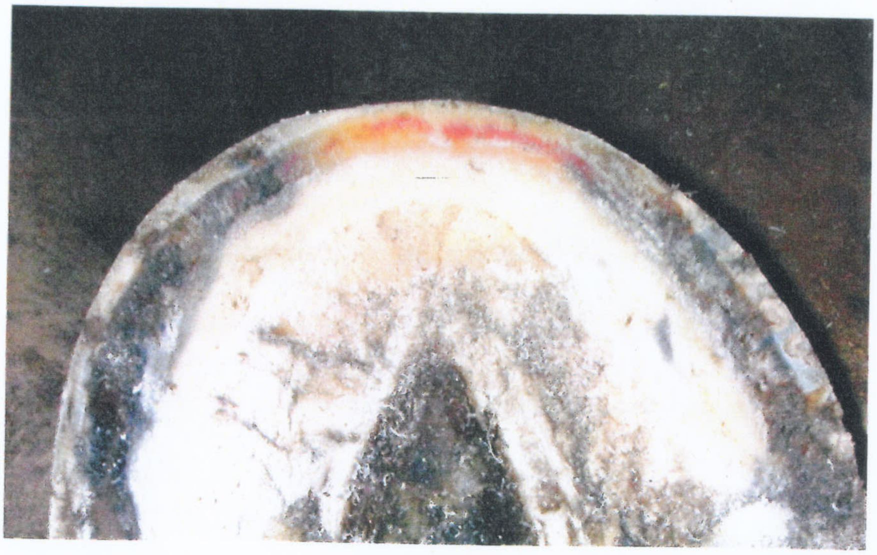

Fig 10

ELEVATED HEEL SHOES AND PLASTIC WEDGES

Although elevated heel shoes and plastic wedges have a high success rate in the case of certain cases, e.g., injuries to the deep digital flexor tendon and sub carpal check ligament or navicular problems on upright feet, both of these types of treatment were dismissed at an early stage due to earlier experience proving them unhelpful in the treatment of low weak heels.

The uneducated could easily be forgiven for thinking that the heels are low so the easy answer is to elevate them using one of the above methods, unfortunately this simplistic approach has major disadvantages.

> *"Changing the elevation of heels by any means other than trimming should be seen as a last resort and certainly not a long term answer. Heels raised with elevated heel shoes or plastic shoes have a tendency to collapse and crush further" (Curtis 2002).*

Whilst elevating heels will result in an instant improvement to B.B.H.P.A., when the shoes or wedges are removed the heel angle is no better than it was before being shod in this fashion. Even when shod with excessive length of shoes the bulbs of the heels remain unsupported (Fig 11) and can easily descend crushing the heels.

Fig 11

"The process of raising heels increases the pressure on the coronet band at the heels and decreases the rate of heel growth."
(Ross and Dyson 2002)

"The application of wedges drops the fetlock so that the descent to the ground is greater creating overextension of the joint and increased pressure on the heels." (Price and Fisher 1996)

The horse shown in (Fig 12) had long term navicular problems and had been shod with wedges for 21 months under veterinary direction. As the picture shows the heels were very under-run and had shown no signs of improvement throughout this period.

Fig 12

Material choice is also a problem when elevating horses heels. An elevated heel horseshoe which has been made from steel will always be much heavier in the palmar half hence encouraging the horse to land with an excessively heel first action. This problem can be eradicated with the use of aluminium, however this restricts the work rate of the horse due to aluminium's poor wear resistant qualities.

A plastic wedge fitted with a steel shoe addresses both these issues but the plastic seems to wear the heels excessively during the foots natural expansion. The wedge covers part of the frog resulting in poor hygiene of this area.

HEEL STUDY SAMPLE

A random group of horses was selected from a livery yard. The horses all suffered from B.B.H.P.A., low under-run heels and hypertrophied frogs. They suffered no other major limb imbalances or non related foot problems. All the horses were shod only by the author and largely followed the same work routine which was carried out on a sand surface or grass. Owners were asked to keep roadwork to a minimum, no more than three miles a week, in order to avoid excessive concussion. The horses were all shod at five week intervals with three consecutive shoeings of each shoe trialled. These were broad web shoes, egg bars and heartbars. Visual improvements in heel growth or strength were noted at every shoeing (see appendix 2). Photographs were taken at the end of each shoes trial period (see appendix 1).

Sample	Type	Use	Age	Height
Horse A	Thoroughbred	Eventer	6 years	16.1hh
Horse B	Thoroughbred X Irish Draught	Eventer	8 years	16.2hh
Horse C	Irish Sports Horse	Showjumper	13 years	15.3hh
Horse D	Connemara X thoroughbred	General purpose	10 years	15hh
Horse E	Thoroughbred	General purpose	12years	16hh

METHODS: TRIMMING THE FOOT WITH WEAK AND UNDER-RUN HEELS

The following guidelines were applied to all the horses in the study;

Sole dressing

It was found that none of the horses required any more than removal of flaky material which was usually minimal. This finding supports a statement made by Deacon and Williams (1999), that in these types of feet lack of appropriate nutrients being brought to the sole by blood supply results in deterioration in sole structure and the loss of the soles exfoliating appearance. The seat of corn was always relieved although not as much as to cause thinning of the horny covering. The bars were only removed if they were loose or harbouring debris.

Frog dressing

Any loose pieces of frog were removed and in the case of hypertrophy trimming reduced their size as much as possible without compromising the protection of the frog corium.

Hoof wall flare dressing

Only enough dorsal flare was removed to align the wall with its proximal third.

> *"Dressing the dorsal wall back to align with the proximal third has long been an accepted rule of foot balance."*
>
> *(Curtis 2002)*

Hoof wall dressing (toe)

In all cases the outer wall was dressed down in a manner which would allow hot fitting of the selected shoe type i.e. not too short.

Hoof wall dressing (heels)

The layman's approach to this would perhaps be to remove little or no material from this area thinking that it would worsen the problem. This however is not the case. If we liken the horn tubules to garden canes we see that the longer they are the easier they are to bend. This, therefore, suggests that we must dress the heels down as close to good straight horn tubules as is possible (Fig 13).

Fig 13

METHODS: SHOEING LOW WEAK HEELS

Placement of shoes in relation to the dorsal wall

None of the toes of the shoes were rolled in the traditional style (Fig 14) as this can cause a reduction in traction during breakover.

Fig 14

Many texts advocate fitting toes of shoes back under the dorsal wall to assist breakover but only a few provide any definitive rules on the placement of these in relation to a fixed point on the horse's foot.

The junction between the sole and white line (shown by the arrows in Fig 15) provides an ideal reference point for this purpose as its position never alters unlike the white line and hoof wall which can both be distended in a dorsal direction dependant on the forces placed upon them. This is due to the white lines flexibility, a factor which is very apparent in B.B.H.P.A. As the H.P.A. becomes more broken back the leverage force on the toe region will be increased.

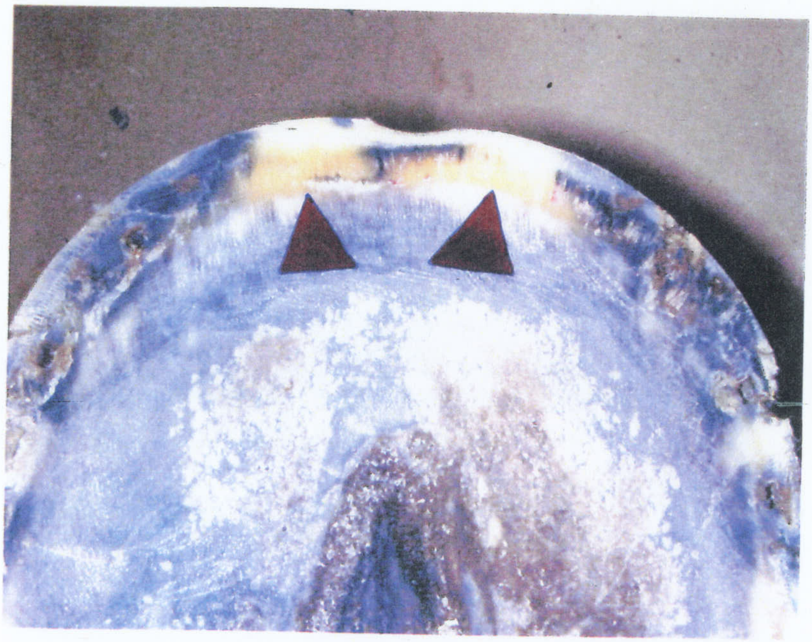

Fig 15

In all cases where clips were not required the shoes were fitted with the centre of the section of the shoe in alignment with the solar border union. I felt this was the maximum amount the shoe could be fitted under the toe whilst still retaining protection to the distended white line.

If toe clips were not required and a fully fullered shoe was used the breakover was further enhanced by closing the webs of the shoe together (Fig 16). This reduced breakover leverage whilst still retaining a good perimeter fit and protection of the white line. The application of toe or quarter clips depended on the individual horse's movement and foot placement.

Fig 16

Radiographs

Although not as essential as their use in laminitis, radiographs of the affected limbs are preferred as they provide a true idea of the hoof pastern axis and the pedal bones solar border in relation to ground surface. This should be around 3 degrees from the horizontal (Fig 17) but can be flat or rotated backwards in the worst cases (Fig 18). Note the dorsal wall indicator in both radiographs indicating the dorsal wall in Fig 18 has been overdressed.

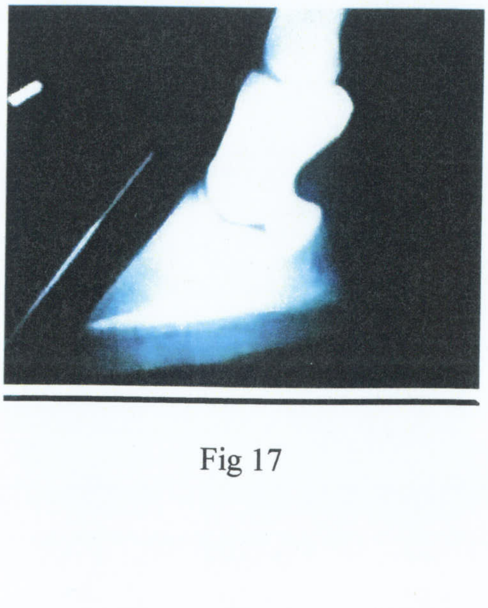

Fig 17

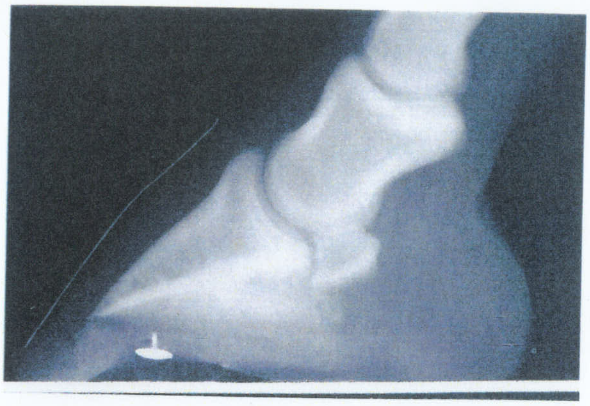

Fig 18

These cases have the confusing title of 'backwards rotation of the distal phalanx' or 'reverse rotation'. It should be remembered that unlike rotation in laminitis no laminal contact has been lost and it is simply the low heels coupled with descending bodyweight that have altered the position of the bone in relation to ground surface.

Due to cost limitations, the use of radiographs was limited in this study. The horses that were radiographed were all presented showing signs of navicular disease or palmar foot pain.

Broad web shoes

Working on the theory that an extension will always shift bodyweight away from it, the first and simplest method of shoeing trialled was to utilise a broad webbed (25mmX10mm) shoe with the heels fitted in line with the widest part of the horses frog or in some cases beyond depending on the severity of the condition (Fig 19a+b).

Fig 19a

Fig 19b

Egg bar shoes

Eggbars have many uses i.e. sheared heels, medial/lateral imbalances and providing support for horses with long sloping pasterns. It is traditionally accepted as a shoe to aid low weak heels under the mechanical theory that the extra palmar length would move the centre of weight bearing forward by making the horse stand with his feet in a slightly more palmar position than normal. All the egg bars used were made from 25mmX8mm flat and were three quarter fullered.

The egg bars were fitted in the same way with the centre of the horse's heel aligned with the centre of the section. This was necessary in order to provide cover and support for the seat of corn and start of the bars (Fig 20).

Fig 20

However, fitting in this manner necessitated a bar fit which encroached on the back of the frog (Fig 21a+b) with the palmar quarter of the frog being brought into contact with the shoe under weight bearing.

Fig 21a

Fig 21b

Some pressure relief could be achieved by seating out the bar in the area marked with red dots (Fig 22).

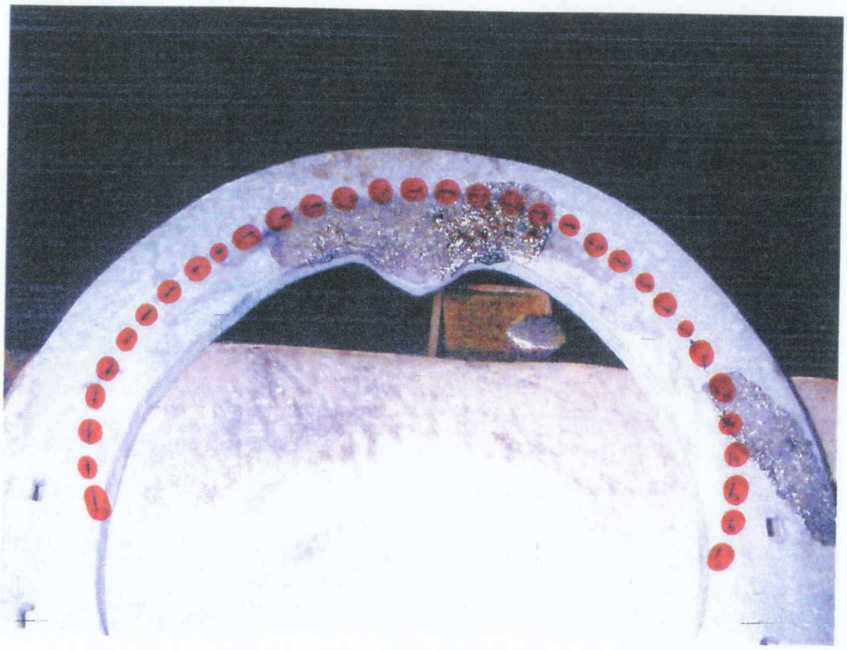

Fig 22

Reshaping the shoe into a more egg like shape to miss the palmar quarter of the frog resulted in poor support for the inner aspect of the heels (Fig 23) and a large amount of shoe protruding behind the bulbs of the heels.

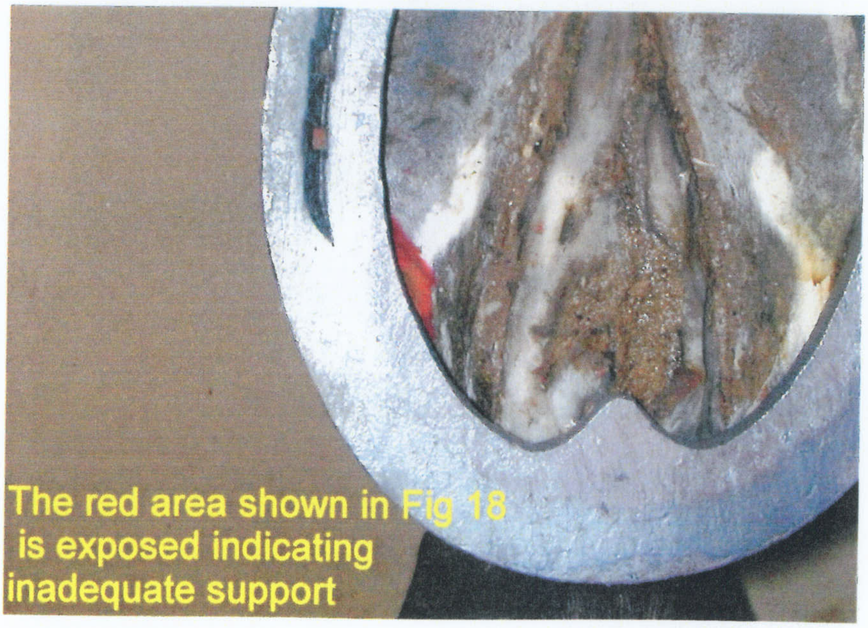

Fig 23

Heart bar shoes

A heartbar was selected with the following criteria;

1. A good perimeter fit was required.
2. The bulbs of the heels were offered adequate support e.g., the same as the eggbar.
3. The frog plate extended to approximately 10mm behind the point of the trimmed frog.

All sharp edges were removed by seating out (shown by the red dotted line in Fig 24). This was to remove pressure points concentrated on one area of the frog. In some cases the frog was able to be dressed down enough to enable contact to be made between the heels and the shoes.

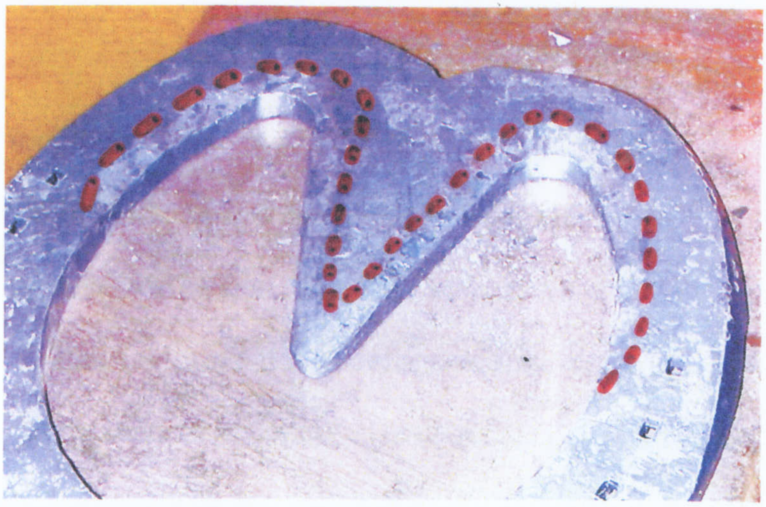

Fig 24

There was, however, cases in which the shoe did not make contact with the heels from the widest part of the foot back (Fig 25) and all the weight would have been borne by the frog. This was due to one of two factors;

1. Not enough depth of heel was present, due to the heels being too badly compressed and under-run, or trimming down of bent horn tubules.

2. Vascular supply prevented trimming the frog to a level which would have allowed the heels of the shoe to make contact with the foot.

Fig 25

In these cases application of the heart bars would have caused excessive discomfort. This was avoided by filling the space between the shoe and foot with Equithane Equi-pak. This was selected due to its flexible properties and fast set time. Initial attempts using Adhere hoof filler proved unsuccessful due to its rigidity being incompatible with the foots natural movement (expansion and return) in this area. Within days the Adhere had cracked and fallen out whereas the Equi-pak remained intact throughout the shoeing period.

Fig 26

The shoeing process began with the fitting up of a heartbar leaving a gap of around 8 - 10 mm between the heel and the shoe (Fig 26).

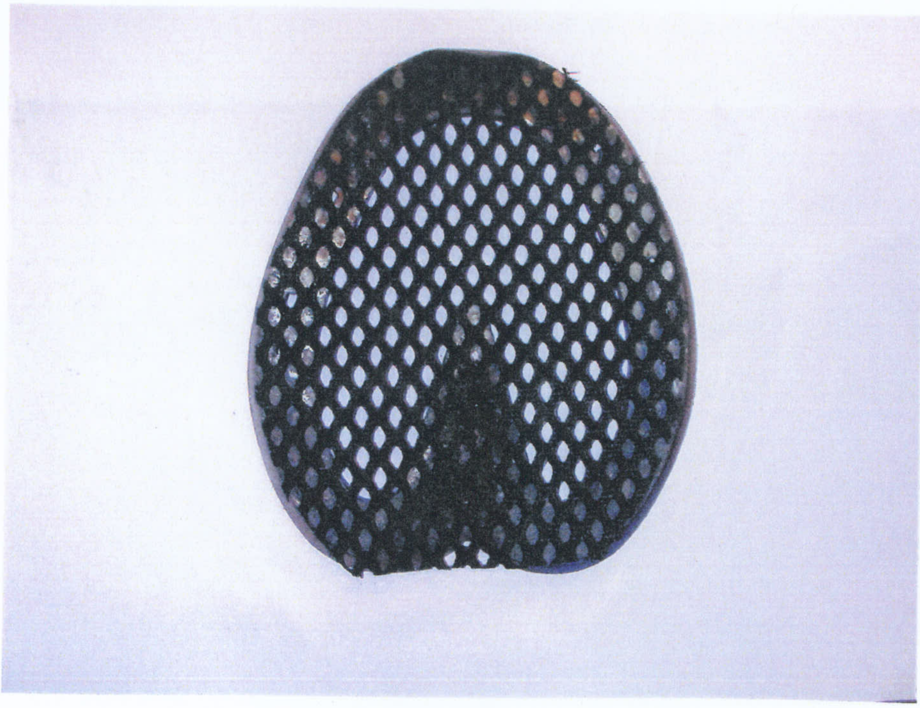

Fig 27

A piece of hoof mesh was cut to size and placed on the shoe (Fig 27).

Fig 28

The shoes were then fixed in position with two toe nails but not drawn up (Fig 28).

The outer edge of the foot and shoe was enclosed in duck tape (Fig 29a+b).

Fig 29a

Fig 29b

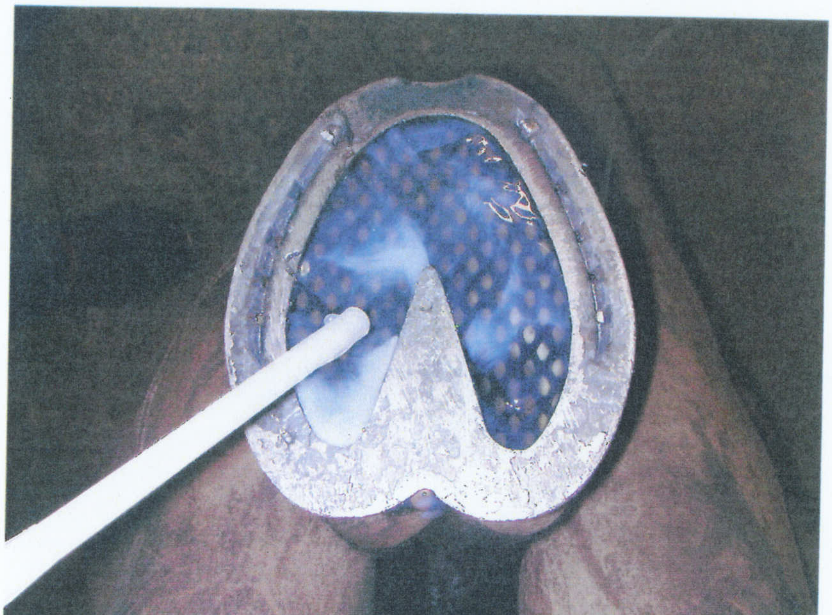

Fig 30

At this point the sole pack was applied to the solar surface of the foot (Fig 30). Curing time averaged 6-7 mins till weight bearing could be allowed so the process was quickened by the use of a hot air gun resulting in a curing time of 2-3 mins.

Fig 31

When cured the duck tape was removed and the nails could be drawn up and clinched (Fig 31).

RESULTS

Results have been tabulated on a scale of 1-5. 1 representing no improvement in heel angle or strength through to 5 being significant visual improvement.

Method trialled	Horse A	Horse B	Horse C	Horse D	Horse E
1st broadweb	1	1	1	1	1
2nd broadweb	1	1	1	1	1
3rd broadweb	1	1	1	1	1
1st eggbar	1	1	1	1	2
2nd eggbar	1	1	2	1	1
3rd eggbar	1	1	2	1	1
1st heartbar	3	4	4	4	4
2nd heartbar	4	4	4	5	4
3rd heartbar	4	4	4	5	4

DISCUSSION

Broadweb shoes

None of the horses studied responded well to the broadweb shoes and whilst it is fair to say the condition did not worsen in any case there were no visible improvements in heel height or horn tubule angle. Heel bruising was helped to the point of eradication by this method of shoeing suggesting that whilst it does offer some support it is not enough to counterbalance the effects of the horse's bodyweight on the low weak heeled foot.

Hypertrophy of the frog neither improved nor worsened whilst these shoes were trialled this method of shoeing was straight forward and easy to apply with few of the horses losing a shoe throughout the trial. It was also financially friendly to the owners.

Eggbar shoes

Treatment with the eggbar shoes also proved fairly unsuccessful. As with the broadweb shoes the condition did not seem to worsen but there were only very slight visual improvements in heel growth or horn tubule angle in two of the horses.

The use of the egg bar did, however, have some problematic side effects;

1. All of the horses suffered various degrees of crushing of the palmar quarter of the frog (Fig 32) which gave the frog area dorsal to this the appearance that it was descending through the middle of the shoe. A more realistic answer is simply that ground resistance to descending bodyweight is compressing the back quarter of the frog upwards whilst the unloaded frog remains able to grow unimpeded (Fig 33).

Fig 32

(Note the excessive crushing of the back third of the frog)

Fig 33

(Note that the frog has been allowed to grow to the same level as the shoe where ground resistance has halted its advance)

2. 60% of the horses were reported to have less grip than usual whilst working on grass. Riders reported no difference on tarmac or artificial surfaces. This problem could have been eradicated by the use of a concave section but it was felt this would have provided inaccurate results due to the lesser degree of support offered. One owner insisted on the fitting of screw in studholes to which she applied half inch studs when the environment required them. These did not seem to help nor hinder the egg bars role in the study although grip was dramatically improved as would be expected.

3. The shoes were difficult and costly to manage for the owner with 80% of the horses losing one shoe or more throughout the study. These, however, were all lost at an uncontrolled gait during turnout, a situation I would not recommend for a horse fitted with these shoes. Owners often struggle with the financial commitment and paying for the cost of lost shoes can discourage them greatly from continuing the treatment to the end of its cycle.

Heartbar shoes

The third and final shoe trialled was the steel heart bar shoe. This shoe whilst commonly known as a 'shoe for laminitis' is very useful in a variety of ways. The previous two shoes trialled demonstrated that the greatest enemy to alleviating this problem is trying to repair something which is always under considerable load (compression between the horses descending bodyweight and ground resistance). Suspension from the ceiling for a few shoeing cycles would no doubt result in the growth of strong upright horn tubules at the heels!

Obviously this is not an option and the best alternative is to remove as much pressure from the heels as possible and transfer it to another part of the horse's foot. In this instance the weight is transferred from the heels onto the frog and hoof wall at the dorsal half of the horse's foot, hence the reason for trying to retain strength to the dorsal wall by not overrasping. The frog is not strictly designed for load bearing but will sustain a proportion of body weight for a limited period of time.

After one shoeing the visual improvements were, on the whole, fairly dramatic. The frog had retracted slightly and heel growth was often sufficient enough to enable the heart bars to be reset without the use of the sole pack. In some cases a very slight gap was present which disappeared under weight bearing. As a general rule this was the threshold for the use of the sole pack i.e. if the gap disappeared under weight bearing it was not required because no discomfort was present.

By the third shoeing all the horses had stronger, shorter and more upright heels (horn tubules). Hypertrophy of the frog was reduced and a general improvement in hoof wall quality was noted due to the reduced stresses being placed on it. Although the frogs were regularly treated with hoof disinfectant, by the third shoeing they had become compressed and slightly necrotic on the frog plate surface with a tendency to harbour small foreign objects. The horn also felt very thin on this surface. Return to a normal shoe resulted in the frog returning back to a healthy state.

The heart bars were also more suitable to the horses work and environment with no reports of slipping, probably due to the shape of the frogplate emulating the natural shape of the frog. Only 20%, or one horse, of the horses lost a shoe, most likely due to the heart bar following the natural contours of the bulbs of the heels.

Excessive toe rasping is in no way beneficial. It may provide an aesthetically pleasing return to the correct hoof wall angle for the first few weeks of a shoeing cycle but it is in fact weakening an already compromised structure. On returning to the horse a dip one third of the way up the wall will be found where it has flexed under breakover leverage (Fig 34). In some cases this can cause lameness and confusion over the original diagnosis. This is especially true in thoroughbreds which can have particularly sensitive feet. It cannot be stressed enough that it is in the heel area in which the true problem lies.

Fig 34

CONCLUSION

The fact that all the sample horses responded so well to the heartbar shoes validates that in order to improve heel angle and strength with any great success we must partially unload the heels.

Neither the broadweb shoes nor the eggbars provided sufficient weight transfer away from the heels to achieve this. The heart bar shoes however showed consistently good results in an acceptable time scale. Using them on a long term basis would necessitate intermediate shoeings with open heeled shoes to allow the frogs a chance to recover from the consistent load bearing before returning to the use of the heartbars if they were required.

Whilst the visual changes to the horse's feet were easily recognised, the author acknowledges this study's shortcomings. In order to provide a scientific absolute, this trial would have to be repeated using a much larger sample. The photographs would have to be taken from a consistent distance and angle from the foot. A measuring scale would also have to be present in each photograph in order to record exact data.

APPENDIX 1 CASE HISTORIES

HORSE A

Fig 35

This horse was presented with very low weak heels and a history of interference injuries probably due to the changed flight arc normally associated with B.B.H.P.A. (Fig 35). Note the poor dorsal wall dressing.

Fig 36

Neither three shoeings with the broad web or egg bar shoes improved heel angle or strength (Fig 36).

Fig 37

Three shoeings with the heartbar shoes resulted in a dramatic improvement in heel strength and angle (Fig 37) although it should be noted that the heel angle is still not correct and further work would need to be carried out to attain this. (Note the angle of the coronet band in relation to the ground in all three photos.)

HORSE D

Fig 38

Although not as poor as the previous case, this horse presented with excessively long sloping heels (Fig 38).

Fig 39

After shoeing with the broadweb and eggbar shoes no significant improvement could be seen (Fig 39).

Fig 40

Three shoeings with heartbar shoes showed a large improvement with the heel angle almost matching that at the toe (Fig 40).

APPENDIX 2

Shoeing record 1

HORSE	OBS AFTER 1 SHOEING WITH BROADWEB	OBS AFTER 2 SHOEINGS WITH BROADWEB	OBS AFTER 3 SHOEINGS WITH BROADWEB
DARCY A Very poor heels also has interference problems. Heavy bruising in seat of corn.	No improvement in heels. Bruising still present in seat of corn. 4/1/04	No improvement in heel angle or strength. Bruising in seat of corn almost erradicated 9/2/04	Heel angle and strength no better than 4/1/04. Heel bruising gone. 14/3/04
HAILLY B Fairly poor heels good growth but heels run under with growth on Bruising present at seat of corn	No improvement in heel angle or strength Bruising erradicated. 12/1/04	No improvement. Lost shoe on 14/1/04. No damage to foot. 18/2/04	Heels show little to no improvement since 12/1/04 22/3/04
DARKO C Poor heels, large frog, over expanded at quarters	No improvement in heels. 6/1/04	No improvement in heels. Lost shoe on 14/1/04 (hunting) Very lame without shoe due to frog pressure 15/2/04	No change in heels since start of study. 19/3/04
STAR D Hind feet worse than front. Poor heels with very large frogs	No improvement in heels. Changed quarter clips to toe clips due to spread shoes 28/12/03	Heels unchanged. Changed back to quarter clips as horse forging badly 6/2/04	No improvement in heels since start of study 11/3/04
FINN E Poor heels, fairly large frog	No improvement 5/1/04	No change in heel strength or angle. 12/2/04	Heels no worse or better than start of study 16/3/04

Shoeing record 2

HORSE	OBS AFTER 1 SHOEING WITH EGGBARS	OBS AFTER 2 SHOEINGS WITH EGGBARS	OBS AFTER 3 SHOEINGS WITH EGGBARS
DARCY	No improvement or decline in heels. Back 1/3 of frog crushed by shoe. Lost shoe on 16/4/04 22/4/04	No improvement in heels. Back 1/3 of frog crushed. Lost shoe on 12/5/04. Asked owner to limit turnout. 28/5/04	Heels have not improved since start of study. 25/6/04
HAILLY	No improvement or decline in heels. Lost shoe on 15/4/04 30/4/04	No improvement in heels. Owner complain of slipping on grass 5/6/04	No improvement or decline in heels since start of study. Horse still slipping. 10/7/04
DARKO	No major improvement to heels. Crushing to back 1/3 of frog present. 26/4/04	Heels very slightly stronger but no change to angle. Back 1/3 of frog very compressed. 1/6/04	Heels very slightly stronger with more defined seat of corn but angle still as poor as at the start of study. 9/7/04
STAR	No improvement or decline in heels. Back 1/3 of frog badly crushed. Lost shoe on 1/4/04 15/4/04	No improvement in heels. Back 1/3 of frog badly crushed. Lost shoe on 17/4/04 28/5/04	Heels the same as at the start of the study. Back 1/3 of the frog badly crushed. 1/7/04
FINN	Possible very slight improvement in heels strength but not angle. Horse slipping badly. 24/4/04	No improvement in heels. Lost shoe on 14/3/04. Shoes fitted with studs due to constant slipping on grass. 30/5/04	No major improvement to heel strength or angle. Lost shoe on 11/5/04. 3/7/04

Shoeing record 3

HORSE	OBS AFTER 1 SHOEING WITH HEARTBARS	OBS AFTER 2 SHOEINGS WITH HEARTBARS	OBS AFTER 3 SHOEINGS WITH HEARTBARS
DARCY	Much improved heel growth. Tubules still bent forward. Reset shoes with hoof pack required 1/8/04	Tubules still bent slightly forward. Frog much retracted Reset shoes no heelpack required 10/9/04	Frog reduced to a normal size. Heels much better but still sloping slightly compared to angle at toe. 15/10/04
HAILLY	Heels much improved. Reset shoes without hoofpack. 14/8/04	Heels at same level as 14/8/04. Frog becoming thin. Horse lost shoe on 22/8/04 12/9/04	Heels much improved compared to period on egg bars. Could do with giving frog a break. Returning to normal shoes 18/10/04
DARKO	Heel angle much improved. Reset shoes with hoof pack 7/8/04.	Heel angle and strength improved. Hoof pack not required. 12/9/04	Heel angle and strength v. good. Frog retracted to extent horse can weightbear without shoe 19/10/04.
STAR	Horse reported slightly short for day after shoeing. Sound next day. Heel angle and strength improved Reset with hoofpack 2/8/04.	Heel angle and strength much better. No need for hoof pack. 10/9/04.	Heel angle and strength excellent. Horse had best response out of all the cases. Heel angle now much the same as toe. 18/10/04
FINN	Good improvement in heel strength and angle. Reset shoes no hoofpack. 24/9/04	Good improvement. No need for hoof pack. Frog becoming crushed. 19/9/04	Heel angle and strength much improved Frogs getting weak. Could do with a rest for a few shoeings. 23/10/04

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