An Investigation into the effects on heel morphology following the insertion of 3° proprietary plastic heel wedge pads.

Sarah Mary Brown AWCF.

Thesis submitted in consideration for the Fellowship of The Worshipful Company of Farriers.

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Declaration by author

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text.

Signed..

Sarah M. Brown A.W.C.F.

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Finally a special note of appreciation goes to my parents Katherine and Hugh Brown for their dedicated parenting and constant support.

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Sarah Mary Brown A.W.C.F.

Manor Cottage Farm, Trenholme-Bar, Northallerton, North Yorkshire. DL6 3JZ.
Telephone: 07765601996 email: farrieress@msn.com

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Summary

Introduction: There is considerable anecdotal evidence amongst hoof care professionals to suggest that the use of plastic heel wedges may contribute to degradation of horn quality and loss of mass in the heel region.

Aims: This investigation aims to investigate the effects on heel morphology following the insertion of 3° proprietary plastic heel wedged pads in a group of riding school horses trimmed and shod to the national standards of competence for farriery (Lantra 2010).

Materials and methods: This study was a pilot random double cross over trial to investigate the effects on heel conformation following the insertion of 3° proprietary plastic heel wedged pads. Six riding school horses of similar size weight and conformation were selected with each horse acting as its own control. All horses were shod over 9 shoeing cycles at intervals of 35 days with machine made fullered concave shoes to the national standards of competence for leisure horse fit (Lantra 2010).

Results: Results from the current study found no evidence, in the study sample (n=6), to support the commonly held belief that plastic heel wedges increase heel deformation and collapse. Results suggest there were no significant differences between treatments ($p>0.05$) and that those results were not influenced by either the shoeing period or the alternating of treatment methods ($p>0.05$).

Conclusion: Results show that in some cases the inclusion of a proprietary 3° plastic heel wedge may not influence heel migration when shod to the national standard on a regular 35 day cycle. Further research is warranted.

Introduction

It has become common practice in prescriptive and therapeutic farriery practice to manipulate foot conformation by the insertion of proprietary plastic heel wedges. The insertion of a proprietary plastic heel wedge is widely prescribed in the treatment of poor hoof conformations, such as low heels, long toes syndrome, navicular syndrome, collateral ligament damage, or small lesions to the deep digital flexor tendon (DDFT)(Ross and Dyson 2002). It is commonly believed that heel elevation of this type offers a mechanical advantage, reducing tension on the DDFT, Eliashar 2004, found 4° reduction in tension in the DDFT for every 1° of heel elevation. Furthermore heel elevation has been shown to assist breakover and reducing pressure on the distal interphalangeal joint (DIP), in addition to distal sessamoid and associated structures (Viitanen et al 2003). However, there is considerable anecdotal evidence amongst hoof care professionals to suggest that the use plastic heel wedges may contribute to degradation of horn quality and loss of mass in the heel region (Williams and Deacon 1999; Curtis 2002).

Science has investigated the biomechanical consequences of heel elevation on tendon strain and joint pressure (Viitanen et al 2003; Eliashar 2004), however to this researcher's knowledge there is no peer reviewed data available on the affects of heel elevation on horn quality and heel growth.

This investigation aimed to conduct a pilot study, with a double cross over design, into the effects on heel morphology following the insertion of 3° proprietary plastic heel wedged pads.

Literature review

To validate and substantiate the substance of this study various different resource areas were explored to gain knowledge of similar studies and also to support the chosen methods of the study. Various farriery text books were used and the internet was used extensively for searching various scientific papers via Google Scholar and Wiley Inter Science search engines.

Static hoof balance

United Kingdom farriery training is regulated by animal welfare legislation. The Farriers registration Council (FRC) produces detailed guidelines for the standards of trimming and shoeing of equines in the UK. These guidelines outline foot balance and shoe fitting criteria for different styles of work and type of horse within critically acceptable tolerances of craftsmanship. These guidelines are based on a syllabus laid down by the Worshipful Company of Farriers (WCF) which has been mostly derived from the empirical knowledge from a range of authors dating since 1890.

Conventional farriery teaching, reiterated in numerous current texts (Williams & Deacon 1999, Curtis 2002, 2006, & Stashak 2002), is based on the importance of achieving correct hoof pastern axis (HPA) and assumes that the maintenance of normal HPA can be achieved by aligning the dorsal hoof wall angle (DHWA) with the angle of the central axis of the phalanges. In practice HPA is generally easily manipulated by excess trimming of the dorsal hoof wall in the toe region and reduced trimming of the heels.

In the resting horse, relationships between limb conformation and static foot balance are examined by viewing the foot from the lateral, dorsal and solar aspects. From the lateral aspect, the foot pastern axis should be straight and in the forelimb is about 50-52 degrees to the ground with the hoof wall angle at the toe and heel presenting parallel (Stashak 2004). Ideally the vertical height of the heel is said to be one third that of the toe (Stashak 2002) and a vertical line from the centre of rotation of the distal interphalangeal joint is said to bisect the ground surface of the foot. In addition, a vertical line that bisects the third metacarpal should intersect with the ground at the most palmar aspect of the weight bearing surface. This relationship defines static dorsopalmar balance and conformation (Parks 2003).

Assessment of foot balance abnormalities

Numerous authors (O'Grady and Poupard 2003, Parks 2003) have described the assessment of hoof balance abnormalities based on the descriptions of Turner (1998; 1992). Turner utilised a measurement system, commonly referred to in farriery terms as "coronary band mapping", to record seven hoof measures including medial and lateral heel, wall, dorsomedial and dorsolateral toe lengths, and sagittal toe lengths to define a series of significant hoof balance abnormalities. These included broken hoof axis, underrun heels, contracted heels; shear heels, mismatched hoof angles.

Turner acknowledged a number of factors can influence hoof balance, not least of which is conformation. However he placed particular emphasis on DHWL and DHWA, which he believed determined the length of the lever arm over which the limb rotates and the timing of hoof lift. He rationalised that a long toe that would delay breakover, which 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 pressure on the joints of the lower limb. Turner's model of poor foot balance remains a primary basis for prescriptive corrective farriery intervention and manipulation of the hoof by elevating the heels.

Hoof shape and pathology

There is a considerable weight of evidence within the literature supporting the contention that poor foot conformation predisposes to foot pain, lameness or lower limb pathology. Both Kane et al (1998) and Balch et al (2001) have reported correlations between toe length and angle and the incidence of catastrophic injury in thoroughbred race horses. Kane et al (1998), compared dorsopalmar hoof measures of a control group with those of groups of horses reporting catastrophic musculoskeletal injuries. Their results suggested that there were only modest differences in DHWA between the control group and the study group reporting catastrophic injury. Of particular significance was the difference between DHWA and heel angle. From these results the authors extrapolated odds ratios and concluded that a 3° increase in DHWA would reduce the risk of catastrophic injury by 25%. However the DHWA and heel angles reported by Kane et al (1998) fall well within the conflicting range of normal DHWA cited by others (O'Grady et al 2003; Stashak 2002 and Butler 2005).

Dynamic foot balance

In farrier terms a horse is said to be in dynamic balance when the foot lands level with both heels simultaneously (O'Grady 2009). The distal limb is functionally a set of levers and pulleys which respond to force down the limb and an equal and opposite force from the ground on the limb, the ground reaction force (GRF) (Parks 2003). GRF is applied to the DIP joint through the hoof (figure 1). Because these 2 vertically opposed forces are not aligned, they create a turning force (moment) that would rotate the phalanges, and the metacarpophalangeal joint would descend towards the ground. This moment is opposed by tensile force from the digital flexor muscles and associated check ligaments at the insertion / attachment of the tendons and suspensory ligament (Rooney 2007).

During the impact and loading part of the stance phase several events within the foot occur. The DIP and PIP joints flex slightly and the distal phalanx is said to rotate within the foot so that the palmar processes move towards the ground. Elevating the heels is said to increase fetlock hyperextension and pressure on the heels (Figure 2) leading to their collapse (Ross and Dyson 2002 and Parks 2012). During the breakover phase the digital flexor muscles releases stored energy in the tendon and inferior check ligament, flex the fetlock, and extend the DIP and PIP joints (Parks 2012). The hoof acts as an extension of P3, the leverage about the DIP joint may change when the heels are elevated.

Science has investigated biomechanical variations of force, pressure and strain by manipulating hoof conformation (Willeman et al 1999; Viitanen et al 2003). Willeman et al (1999) demonstrated that changes in the heel / toe height ratio by elevating the heels changed the angle of inclination of the DDFT reducing compressive force to the distal sesamoid. However, the decrease in force applied by the DDFT resulted in an increased load on the SDFT and SL. Viitanen et al (2003) investigated the effects in DIP joint pressure using a 5° plastic wedge which was inserted under the hoof to simulate variations in dorsopalmar foot balance. The results demonstrated increased pressure within the area of the DIP joint closest to the intervention.

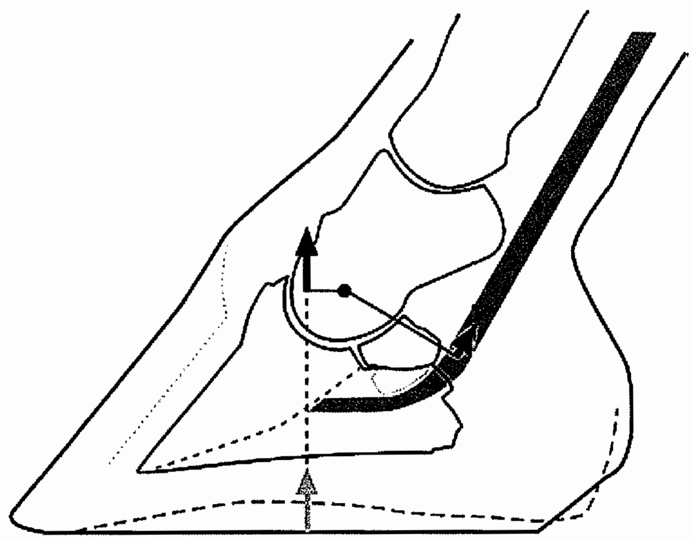

Figure1. At rest, the ground reaction force (grey arrow) is dorsal to the centre of rotation of the distal interphalangeal joint. As such, it creates an extensor moment that is opposed by an equal and opposite moment, the flexor moment, generated by the force in the deep digital flexor tendon so that the foot is stationary. *After Parks 2012*

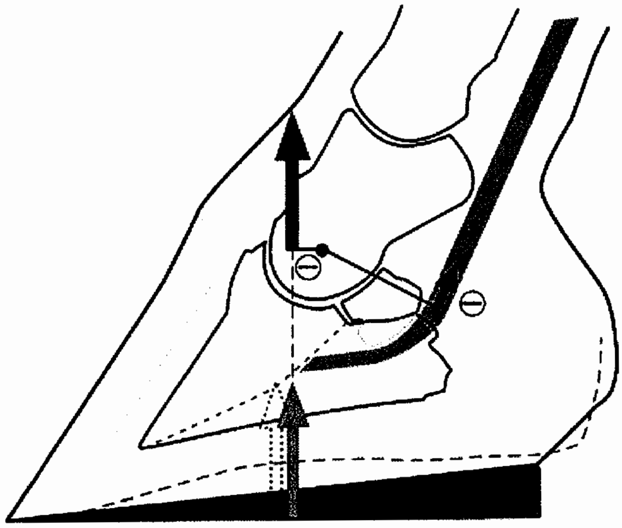

Figure 2 elevating the heels causes the simultaneous decrease in tension in the deep digital flexor tendon and movement of the centre of pressure in a palmar direction toward the centre of rotation of the distal interphalangeal joint. The decrease in tension in the deep digital flexor tendon and the flexion of the distal interphalangeal joint cause the force on the navicular bone to be reduced. However moving the centre of pressure in a palmar direction increases the load on the heels and increases intra-articular pressure. Additionally, flexion of the joint changes the distribution of pressure within the distal interphalangeal joint. Any of these effects of heel elevation are potentially harmful. *After Parks 2012*

Aim

This investigation aims to investigate the effects on heel morphology following the insertion of 3° proprietary plastic heel wedged pads in a group of riding school horses of similar size weight and conformation trimmed and shod to the national standards of competence for farriery (Lantra 2010).

Hypothesis

There is no difference in heel growth and orientation between feet shod to the national standard of competence for farriery (Lantra 2010) and those shod with the insertion of a proprietary 3° plastic wedge than those shod in flat.

Materials and Methods

This study was a pilot random double cross over trial to investigate the effects on heel conformation following the insertion of 3° proprietary plastic heel wedged pads. Six riding school horses of similar size, weight and conformation were selected with each horse acting as its own control. All horses were shod over 9 shoeing cycles at intervals of 35 days with machine made fullered concave shoes to the national standards of competence for leisure horse fit (Lantra 2010). Three (3) horses were randomly selected, by blind draw, and 3° firm plastic proprietary heel wedge were inserted in between the bearing surface of the shoe and hoof. Treatments were alternated between horses at 105, 210 days. Lateral, medial and dorsal heel migration measures were initially recorded post trim, as described below, and subsequently pre-trim at the each shoeing from day 35.

Horse Selection and Assessment

10 general purpose riding horses were selected from a local riding school. The horses were selected according to work type, height and weight. Height range was between 14hh and 15hh, weight between 427kg and 607kg. Horses were measured on a flat hard surface to point of wither with a measurement stick. The weight of the horse was assessed with a weight measurement tape.

All horses were dynamically assessed at the walk and trot over the same hard surface for soundness using American Association of Equine Practitioners (AAEP) lameness grading system. Horses that graded above 1 on the AAEP scale were excluded. Those horses not excluded on the basis of lameness were assessed from a dorsal and lateral aspect for conformation using a standardised scoring system, (Mawdsley et al 1996). Horses with conformation scores outside the range of 3-5 in any single criteria were excluded. Six horses met the criteria for the study; the descriptive details are displayed in table 1 below.

Name	Sex	Age	Height	Weight Kg.
Poppy	Mare	13	15hh	607
Drummer	Gelding	18	14.hh	474
Sasha	Mare	18	14hh	427
Ben	Gelding	20	14hh	482
Alice	Mare	15	15hh	584
Zeus	Gelding	16	14hh	461

Table 1. The descriptive details of horses included in the sample.

Trimming and Shoeing Protocol

To ensure reliability all horses were trimmed and shod by the author. The trimming protocol was based on Farriery National Occupational Standards (Lantra 2010). Briefly, the collateral margins of the frog were trimmed along its length to form an angle approximately 55°-60° to the bars. The ground bearing surface of the frog was then trimmed with the caudal aspect of the bearing border of the frog becoming level with the horizontal plane of the wall and sole. After this, the bars and excess wall were trimmed at the bearing border to produce a horizontal plane and the heels reduced in height to extend the bearing border to either the widest or highest aspect of the frog. Following rasping the hoof flat, any flaring of the dorsal hoof wall was reduced from quarter to quarter, leading to a consistent hoof wall bearing border. All horses were shod with a machine made steel fullered concave shoe (Figure 3), J and A Ferrie Farrier Supplies[1] with symmetrical branches fitted in a leisure style to each horse according to Lantra (Lantra, 2010). Initially three (3) horses were randomly selected, by blind draw, and 3° firm plastic heel wedge, Stromsholm[2] were inserted in between the bearing surface of the shoe and hoof (Figure 4). The initial shoeing style for each horse was alternated after the completion of three full 35 day shoeing cycles (105 days). At the end of

[1] J and A Ferrie Farrier Supplies; The Smithy, High Street, Newmilns, Ayrshire. KA16 9AE
[2] Stromsholm Limited, Wood Court, Chesney Wold, Bleak Hall, Milton Keynes MK6 1NE

the second treatment period of 3 x 35 day shoeing cycles, day 210, the horses were returned to their original format of shoeing in order to test the reliability and repeatability of the results.

Data Collection

Initially three identifiable marks were drilled both medially and laterally, using a motorised burr Dremel®[3]. The first marker was placed 10mm palmar-dorsal of the heel buttress origin and 10mm distal to the distal coronary margin . A second mark was drilled parallel to the first mark and 10mm proximal of the bearing border these two marks were used to calculate proximodistal heel migration. This was calculated by subtracting the pre-trim measurements from markers 1 and 2 from each other.

A third mark was drilled 10mm from palmar-dorsal from the heel buttress proximal of the bearing border to measure dorsal heel migration between data collection times. (Figure 5). For validity and reliability all marks were measured using a digital measurement vernier calliper; RS Components Ltd;[4] pre trim every 35 days by both the researcher and a third year apprentice trained in the technique. All data was recorded to Microsoft Excel®[5] for subsequent analysis.

All drilled holes were filled with Imprint™ thermo-plastic granules, Poynton Limited[6] immediately post shoeing and re-drilled as previously described.

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[3] Dremel UK. PO Box 98, Broadwater Park, North Orbital Road, Denham, Uxbridge, Middlesex, UB9 5HJ
[4] RS Components Ltd. Birchington Road, Corby, Northants, NN17 9RS, UK
[5] Microsoft Excel: Microsoft UK PLC; Microsoft Campus, Reading Thames Valley Park Reading RG6 1WG
[6] Poynton Ltd, Town Forge, High Street, Malmesbury, Wiltshire. SN16 9AT. UK

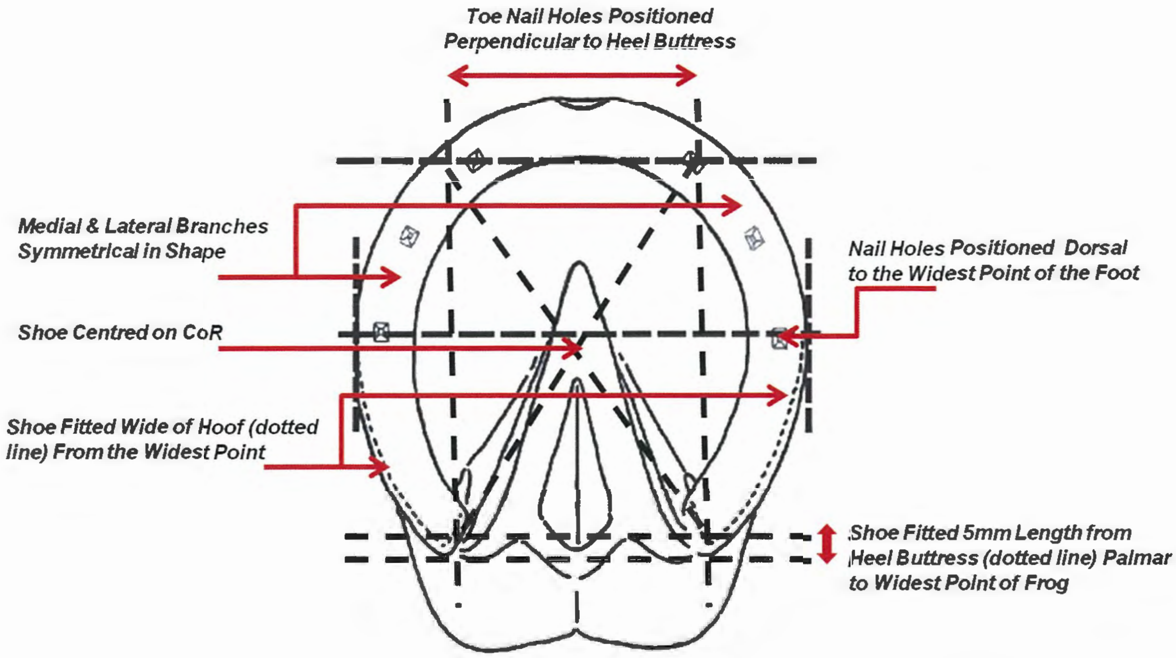

Figure 3. A schematic illustration of the standardised shoeing protocol used throughout the study. The illustration highlights the nail hole position and the fitting with width and length of the shoe in the palmar half of the foot. This fitting style is said to minimise the effects of any restrictions in normal physiological function of the foot caused by the attachment of a steel horseshoe (Butler 2005).

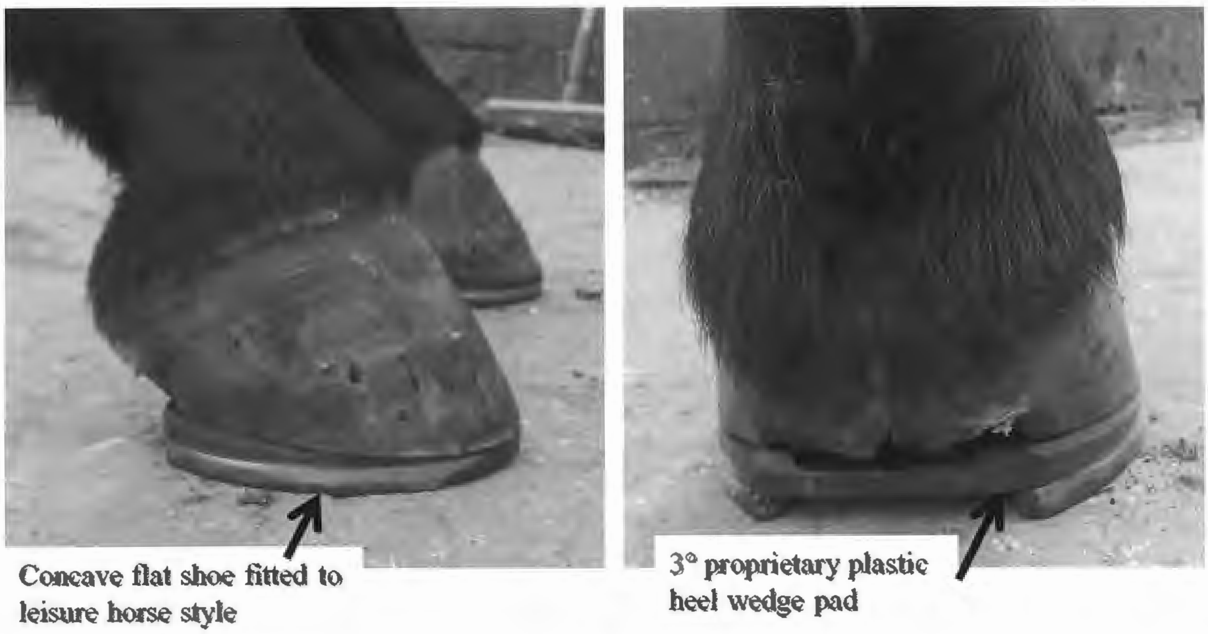

Figure 4. Concave shoe fitting style and placement of the proprietary 3° plastic heel wedge utilised within the study.

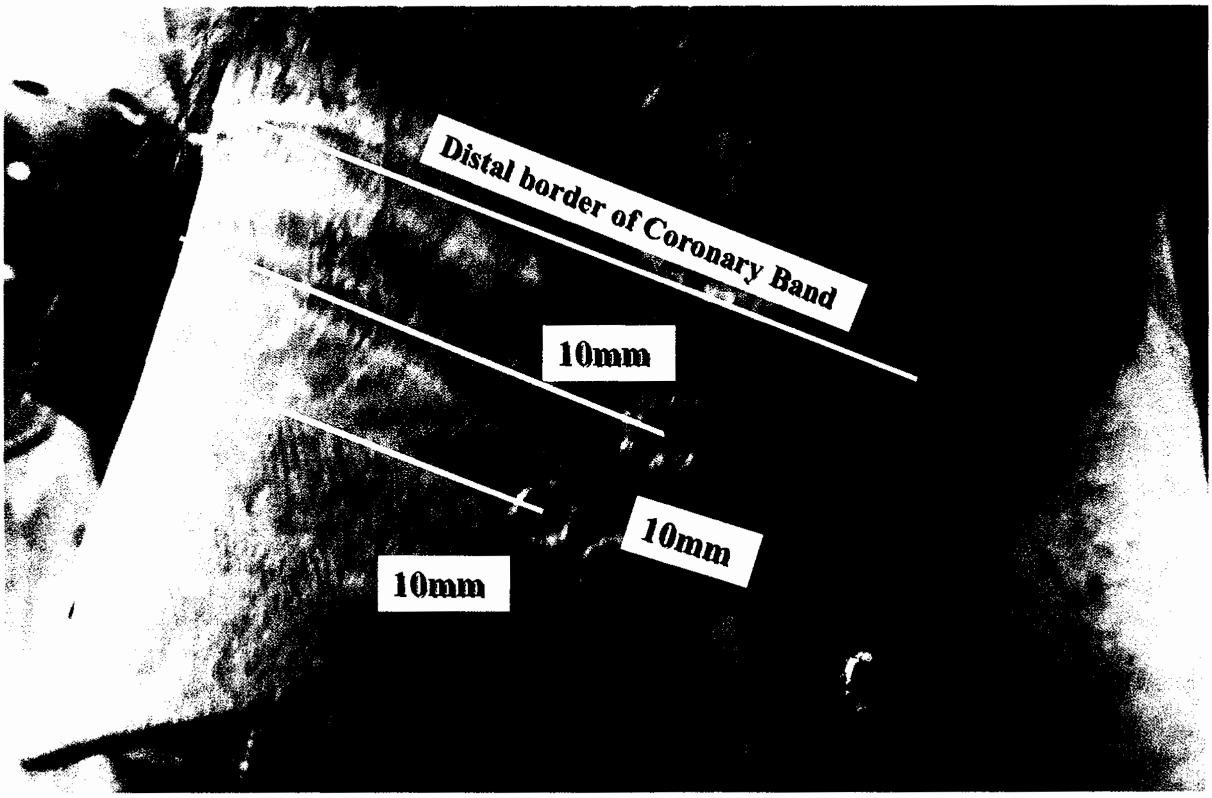

Figure 5 The placement of measurement marks used to calculate distal and dorsal heel migration. Marks were repeated subsequently at each data collection point post-shoeing.

Statistical Analysis

Unless otherwise stated, data is presented as mean ± sd. Data was tested for normality using Anderson-Darling. Significant differences were determined by Students t-test and one-way analysis of variance (ANOVA) with Tukey *post hoc* corrections. A P value of <0.05 was considered statistically significant. Analyses were performed using Microsoft Excel® data analysis software with statistiXL®[7].

[7] StatistiXL. P.O. Box 3302, Broadway – Ned lands. Western Australia, 6009

Results

It was hypothesised that there would be no difference in heel growth and orientation between feet shod to the national standard of competence for farriery (Lantra 2010) and those shod with the insertion of a proprietary 3° plastic wedge pads inserted between the bearing border of both shoe and hoof. This hypothesis was tested, using the methodology previously described, in a pilot study incorporating a blind double cross over trial of six riding school horses of similar size weight and conformation (Table 1). The descriptive statistics and results for the overall trial period are displayed in table 2 below.

Day 310	**Flat ± Se**	**Wedge ± Se**	**Difference ± Se**	**Significance P value**
Mean Lateral Proximodistal Migration	**12.60 ±0.56**	**12.98 ± 0.67**	**0.39 ± 0.87**	0.66
Mean medial Proximodistal Migration	**12.17 ± 0.57**	**13.04 ±0.67**	**0.87 ± 0.88**	0.33
Mean Dorsal Migration	**2.20 ± 0.23**	**2.13 ± 0.34**	**0.07 ± 0.41**	0.86

Table 2. Descriptive statistics and results between treatments. Data is quoted as mean heel migration (mm) ± standard error (SE) per 35 day shoeing cycle. *Significance is calculated at* $p<0.005$.

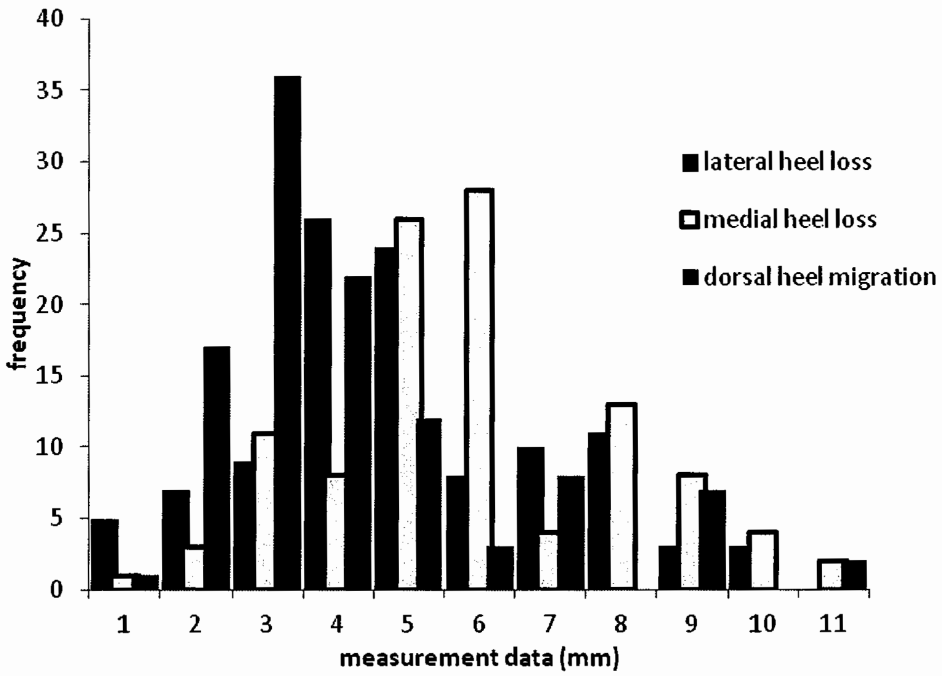

Figure 6. A frequency histogram showing normality of distribution for all heel migration measures over the duration of the trial period. Dorsal heel migration is skewed left, this is treated as normal as there is no palmar heel migration during the shoeing cycle. Data are shown in mm.

Data for net for proximodistal and palmar-dorsal heel migration was collected by subtracting post - shoeing measures from the pre-trim measures at the data collection opportunity at each medial and lateral markers previously described (figure 5). Figure 6 illustrates the normality of distribution of the data for each pre trim measures. Table 3 highlights the details of the mean ± se pre-trim differences in heel measures over three 35 day shoeing cycles prior to alternating treatment type. There were no significant differences in all pre-trim heel measures with or without the addition of 3° heel wedges p>0.05.

	Data Collection Period (days)	Data Collection Period	Mean Diff.	SE	Significance P value
Mean Lateral Proximodistal Heel Migration	0 - 105	105 - 210	-1.89	0.75	0.18
		210n - 315	-0.68	0.76	0.80
	105 - 210	210n - 315	1.21	0.76	0.50
Mean Medial Proximodistal Heel Migration	0 - 105	105 - 210	-2.45	0.75	0.06
		210n - 315	-1.49	0.76	0.35
	105 - 210	210n - 315	0.96	0.75	0.64
Mean Dorsal Heel Migration	0 - 105	105 - 210	1.08	0.34	0.07
		210n - 315	1.34	0.34	**0.02**
	105 - 210	210n - 315	0.26	0.34	0.85

Table 3 Shows the results between differences in heel migration measures over three 35 day shoeing cycles prior to alternating treatment type. Data are displayed as mean difference (mm) in heel migration at the end of each overall 105 day treatment period ± se *Significance is calculated at p<0.005 and is adjusted using Tukeys post-hoc analysis.*

Variable	Data Source	DF	F	Significance P value
Mean Lateral Proximodistal Heel Migration	**Treatment Period**	2	1.597	0.21
	Treatment Type	1	0.164	0.69
	Period * Type	2	0.345	0.71
Mean Medial Proximodistal Heel Migration	**Treatment Period**	2	2.684	0.07
	Treatment Type	1	0.938	0.33
	Period * Type	2	0.911	0.41
Mean Dorsal Heel Migration	**Treatment Period**	2	4.299	**0.02**
	Treatment Type	1	0.032	0.86
	Period * Type	2	1.764	0.18

Table 4. The results between heel migration measure, treatment periods and treatment type. *Significance is calculated at $p<0.005$ and is adjusted using Tukeys post-hoc analysis.*

Shoeing styles were alternated at the end of the third and sixth 35 day shoeing cycle (105 and 210 days). Horses with 3° plastic heel wedges inserted between the foot bearing surface of the shoe and bearing border of the wall were shod with a flat concave riding horse style and vice versa. With the exception of palmar-dorsal heel migration between day 35 and day 315 ($p = 0.02$) the results indicate there were no significant differences in mean pre-trim heel measures between alternative treatments, $p>0.05$, prior to alternating shoeing styles (Table 3).

The results displayed in Table 4 indicate there were no significant differences between treatment type, $p>0.05$. Results further indicate that there were no interactions between 105 day treatment periods and treatment type for any of the heel migration measurements, $p>0.05$. These results suggest that the application of plastic heel wedges has no additional adverse affect on heel conformation and that the types of changes often witnessed following their application may be influenced by factors not accounted for within this research. However post hoc analysis shows variations in results between individual horses (Figure 7 & 8).

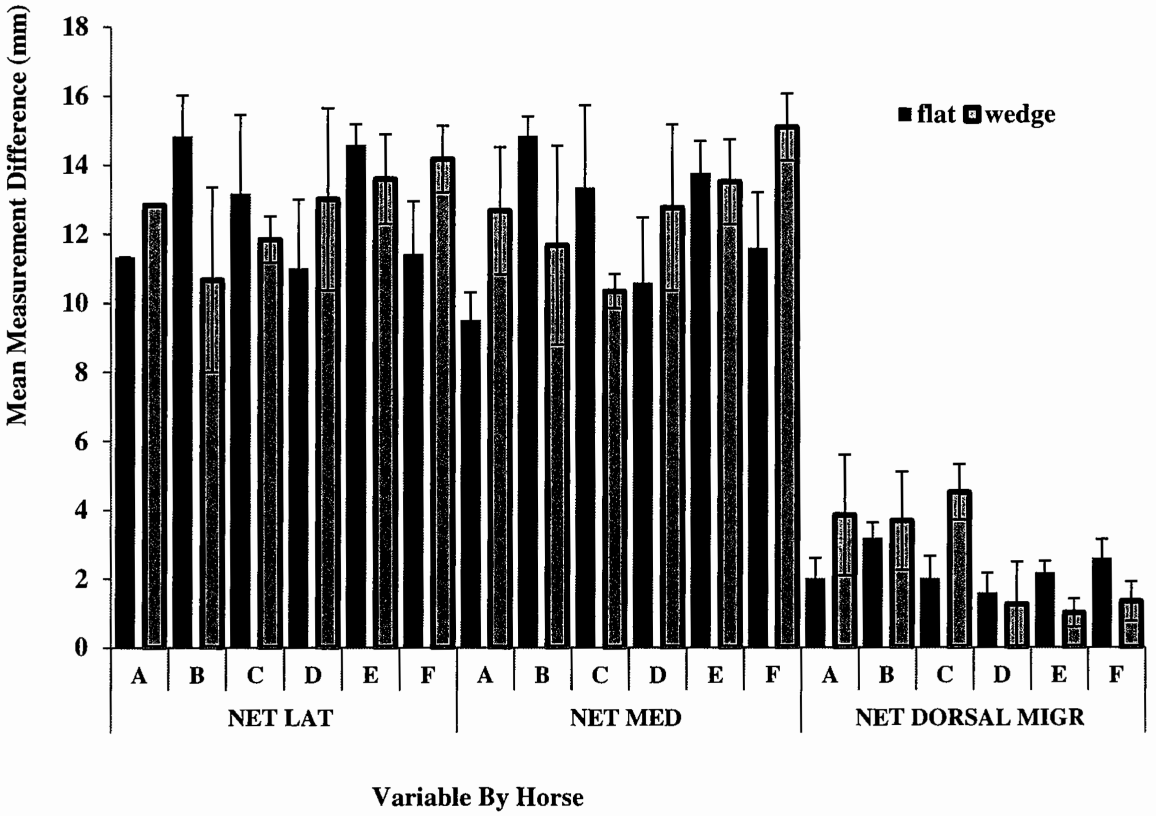

Figure 7. The mean pre-trim lateral, medial proximodistal and dorsal heel migration measures between shoeing methods for individual horses. Data is quoted as mean per treatment in millimetres (mm). Error bars denote standard error.

Variable	Data Source	DF	F	Significance P value
Mean Lateral Proximodistal Heel Migration	**Horse**	5	1.305	0.27
	Type	1	0.418	0.52
	Horse*TYPE	5	3.351	**0.01**
Mean Medial Proximodistal Heel Migration	**Horse**	5	1.450	0.21
	Type	1	1.702	0.20
	Horse*TYPE	5	2.223	**0.05**
Mean Dorsal Heel Migration	**Horse**	5	1.490	0.20
	Type	1	0.484	0.49
	Horse*TYPE	5	1.411	0.23

Table 5. The results of multi factorial ANOVA between heel measurement variables and treatment type and individual horses shows interactions between horse and treatment type for both lateral and medial heel migration. There were no interactions for dorsal heel migration. *Significance is calculated at p<0.005 and is adjusted using Tukeys post-hoc analysis.*

Horse	Variable	Mean Diff.	SE Diff.	Significance P
A	Lateral Heel	-1.5	2.92	0.62
	Medial Heel	-3.17	2.94	0.33
	Dorsal Migration	-1.83	1.49	0.27
B	Lateral Heel	4.17	2.38	0.13
	Medial Heel	3.17	2.44	0.25
	Dorsal Migration	-0.50	1.04	0.64
C	Lateral Heel	1.33	3.30	0.70
	Medial Heel	3.01	3.06	0.35
	Dorsal Migration	-3.00	1.40	0.06
D	Lateral Heel	-2.00	1.42	0.18
	Medial Heel	-2.17	1.55	0.17
	Dorsal Migration	0.33	0.53	0.54
E	Lateral Heel	1.00	1.81	0.59
	Medial Heel	0.25	1.87	0.89
	Dorsal Migration	1.17	0.80	0.16
F	Lateral Heel	-2.75	2.01	0.19
	Medial Heel	-3.50	1.85	0.08
	Dorsal Migration	1.25	0.84	0.15

Table 6. The differences between treatment types for each individual horse. Data is shown as mean difference (mm) between and wedged shoeing styles. *Significance is calculated at p<0.005.*

There were significant differences between the study horses in pre-trim proximodistal heel measures $p<0.05$. These results support those highlighted in Table 4 and strongly suggest that there is significant influence on changes in heel conformation from factors outside the scope of this investigation. These results are supported by results displayed in Table 5. This pilot study was conducted as a double cross over trial with each individual being its own control. The results displayed in table 5 highlight the differences in heel migration measures between treatment types for each horse within the sample. These results highlight a broad range of variation in heel migration measures for each horse. However there were no significant differences in heel measure between the treatments in any of the individual horses in the sample $p>0.05$.

Summary of Results

1. There were no significant differences in all pre-trim heel migration measures with or without the addition of 3° heel wedges over the duration of the study.
2. There was no significant difference in mean pre-trim heel migration measures between the data collection periods.
3. There were no interactions between the periods between alternating of treatment and treatment type for any of the mean heel migration measures.
4. There were significant differences in pre-trim proximodistal heel measures between the individual horses within the study $p<0.05$.
5. There were no significant differences in pre trim heel migration measures by treatment recorded in any of the individual horses in study samples $p>0.05$.

This investigation found no evidence to support the hypothesis that the insertion of proprietary plastic heel wedges reduces heel height over and above that experienced when a flat steel concave shoe is fitted to the UK national standards of competence riding / leisure horse style. However broad range of heel migration experienced within our sample suggests we neither accept nor reject the null hypothesis.

Discussion

It was hypothesised there would be no difference in heel growth and orientation between feet trimmed and shod to the national standard of competence for farriery (Lantra 2010) and those shod with the insertion of a proprietary 3° plastic wedge pads inserted between the bearing border of both shoe and hoof. This hypothesis was tested in a pilot study incorporating a blind double cross over trial of six riding school horses of similar size weight and conformation.

Current theories

Wilson et al (1988) demonstrated that the application of a standard steel shoe to a balanced foot has a minimal effect on the location of the point of force (PoF) during stance. However it is generally accepted that increasing heel height induces flexion of the DIP and proximal interphalangeal (PIP) joints and extension of the MCP joint. Furthermore most authors agree that heel wedges reduce strain in the DDFT and subsequently the force and stress exerted on the navicular bone (Wilson *et al* 1988; Chateau et al 2006), it is important to emphasize that heel wedges do not appear to unload the heels. Results can be conflicting; mainly due to the different experimental protocols, furthermore, studies that relate to changes to the treatment of clinical conditions, such as collapsed heels, are still lacking and consequently the clinical relevance of any such change is unknown (Williams & Deacon 1999; Curtis 2002).

Main findings

This investigation found no evidence in the study sample(n=6) to support the hypothesis that the insertion of proprietary plastic heel wedges influences net heel migration over and above that experienced when a flat steel concave shoe is fitted to the riding / leisure horse style.

Study design

The study utilised a double cross over design with each horse as its own control. This type of study is an acceptable methodology in clinical studies where large sample sizes are difficult to find. The design allows direct comparison of the effects different treatments against the originally applied shoeing protocol.

Data collected for the current study focused on heel migration calculated by the difference in position of discreet markers pre-shoeing at 35 day intervals to reflect heel compression and wear of horn in the heel region. The results indicate that additional morphological measures such as DHWA, heel angle (HA), heel width and the distance between the palmar extremity of the heel bulb and the heel buttress, may have produced a more complete data set from which to compare overall morphological changes to the hoof, specific to the heel region. Results indicate that hoof morphology may have been influenced by factors not included in the scope of the current study, such as, hoof digit conformation. A more detailed analysis of digit conformation may have influenced the final analysis of the results and allowed for direct comparison of treatment type to individual conformation. This may have proved to be of greater clinical significance. Further research is clearly required to measure the effects throughout different conformation types. Long toe/low heel, collapsed heel conformations would be of particular interest. Any proposed further studies should include additional morphometric measurements for a more detailed analysis.

Importance/relevance of main findings

Results from the current study found no evidence to support the commonly held belief that plastic heel wedges increase heel deformation and collapse. Results suggest there were no significant differences between treatments ($p>0.05$) and that those results were not influenced by either the shoeing period or the alternating of treatment methods ($p>0.05$). However, results indicate a strong trend of differences in dorsal heel migration in individual horses (table 6) over the initial alteration in shoeing method (day 105 – day 210) $p<0.05$.

The results from the current study contradict the weight of anecdotal evidence in support of the null hypothesis however they do support the contention that individual conformation, and thus changes in magnitude and duration of torque forces, may be a significant factor in heel morphology (Eliashar 2012).

Conclusion and clinical relevance

In conclusion, while most authors agree that heel wedges reduce strain in the DDFT and subsequently the force and stress exerted on the navicular bone, it is important to emphasize that both the application of heel wedges and shoeing with length of delay unloading of the heels. Hence, it is likely that their use in horses with collapsed heels and poor lower limb conformation has to be time limited or the condition may worsen. Results show that in some cases the inclusion of a proprietary 3° plastic heel wedge may not influence heel migration when shod to good standards on a regular 35 day cycle Clearly further research is warranted.

Manufactures Addresses

1. J and A Ferrie Farrier Supplies; The Smithy, High Street, Newmilns, Ayrshire. KA16 9AE
2. Stromsholm Limited, Wood Court, Chesney Wold, Bleak Hall, Milton Keynes MK6 1NE
3. Dremel UK. PO Box 98, Broadwater Park, North Orbital Road, Denham, Uxbridge, Middlesex, UB9 5HJ
4. RS Components Ltd. Birchington Road, Corby, Northants, NN17 9RS, UK
5. Microsoft Excel: Microsoft UK PLC; Microsoft Campus, Reading Thames Valley Park Reading RG6 1WG
6. Poynton Ltd, Town Forge, High Street, Malmesbury, Wiltshire. SN16 9AT. UK
7. StatistiXL. P.O. Box 3302, Broadway – Ned lands. Western Australia, 6009

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Annex A

Robinsons Equiteach
Tunstall Lane
Stokesly
Cleveland
North Yorkshire

To Whom It May Concern:

This is to confirm that I have been advised, and consented to, the nature of the research to be carried out on my horse's feet by Sarah-Mary Brown AWCF.

I understand that should I so wish I can withdraw all of my animals from this trial at any time without notice.

I have been advised that all descriptive data relating to myself or any of my animals included in this trial will be deleted on its successful completion.

Yours Sincerly