The Effect of Shoe Shape on the Biomechanics of Locomotion in Horses with Bone Spavin.

Newman S J

The Army School of Farriery, Defence Animal Centre, Melton Mowbray, Leicester, LE13 0GX.

The author wishes to thank the following for their help in producing this work;

Pardoe C H, McGuigan M P, Schramme M, Boswell J, Wilson A M.

Department of Veterinary Basic Sciences, Department of Farm Animal and Equine Medicine and Surgery, The Royal Veterinary College, Hawkshead Lane, North Mymms, Hatfield, Herts AL9 7TA, England.

This work formed part of a presentation given as a free communication at the BEVA Congress, Birmingham, 2000.

To my knowledge no other investigation has been carried out with regards to this study.

Stephen Newman

Abstract.

Pathological shoeing has long since been related to spavin in equine hind limbs, by either raising the heels, changing their gait or by supporting the lateral aspect of the hoof. These techniques are said to change the weight distribution under the hoof thereby altering all aspects of gait and foot placement, making the horse more comfortable. However, little is known about how horses change their weight distribution when suffering with bone spavin.

Five horses with clinical (lameness and intra-articular analgesia) and radiographic signs of bone spavin in the hind limb were shod in normal plain-stamped roadster shoes, trailers and lateral extensions shoes. Each horse was trotted for eight placements per hind foot over a force plate (9287BA, KISTLER) set in a rubber matting runway. Force plate data were low pass filtered at 50 Hz. Simultaneous kinematic data were recorded at 240Hz (PROFLEX, QUALISYS) for the determination of foot position relative to the forceplate. The position of the point of zero moment, the theoretical point on which all forces act, (PZM) relative to the foot stance was determined, interpolated and averaged.

Introduction.

According to recent archaeological research in the Ukraine, horses have been domesticated and ridden since about 4000BC. From this date, humans began to understand and exploit the locomotor process of the horse in order to optimize the use of this animal's power for hunting, transporting a rider or pulling a load. Aristotle (384-322BC) described the anatomy of the equine locomotor apparatus in detail. (Berry 1999) In more recent times we have analysed the equine locomotion using cameras and force plates (situated at ground level).

Bone *spavin* (from old French, *èspavin*) or tarsal osteoarthritis is a commonly diagnosed cause of chronic hindlimb lameness (Stashak, 1987). The pathological lesion is an osteoarthritic lesion of the small tarsal joints, which is most marked on the medio-dorsal aspect of the joints. A clinical diagnosis is usually confirmed by a return to soundness after injection of local anaesthetic into the distal intertarsal and or tarsometatarsal joint, along with radiographic changes, usually narrowing of the joint space or bone spurs (*fig 1)*. The hind limb hock joint or tarsal joints main function is kinematics (movement of the body) and has an immense amount of kinetic force (movement) applied to it during locomotion.

The tarsal joints can be found between the Tibia and 3rd Metatarsal bone (Cannon bone) in both hind limbs. The tarsal joints are made up of the following joints: Tibiotarsal joint, Tarsocrurual joint, Proximal intertarsal joint, Distal intertarsal joint, and the Tarsometatarsal joint. The following bones can be found between the joints: Tibial tarsal bone (talus), Calcaneus, Central tarsal bone, Third tarsal bone, Fourth tarsal bone, Second and Fourth metatarsal bones. This can be seen in *fig 2*

Other types of spavin that can be found and are not covered in this study are: Bog spavin which is considered a blemish and may develop due to injury and can be an indication of severe strain. Juvenile spavin which can be described as osteoarthritis in the tarsus of young (less then two years) and mature (young) Thoroughbred and Standardbreds. Blind spavin which may have no physical and radiographic signs. Jack spavin which is a large bony spavin. Blood spavin which is a harmless swelling of the subcutaneous saphenous vein and can be sometimes mistaken for bog spavin.

Many authors (Butler 1985) identify specific conformational abnormalities, which are suggested to predispose to the condition by concentrating limb loads on the medial aspect of the joint; for instance sickle hocks, cow hocks and narrow thin hocks (Stashak, 1987). There are also characteristic gait changes associated with the condition; these are commonly dragging and wearing of the dorsal toe, causing bloodstains in the white line at the toe (Butler, 1985). Limb adduction during the swing phase of foot flight and a lower arch due to reduced flexion of the tarsus is also common (Stashak, 1987).

The efficacy of rest as a treatment is controversial and treatment is usually based on continuation in moderation of work and corrective shoeing in the first instance, although approximately half of the affected horses do not respond and remain unserviceable (Stashak 1987). The corrective shoeing is based upon attempting to redistribute limb load onto the lateral side of the limb by the application of a lateral extension shoe and or rotating the foot inwards by the application of a shoe with a trailer *(fig3)*. These are usually placed on the lateral heel to give lateral support as well as to prevent certain types of interference, especially in standardbred racehorses.

Lateral trailers may also be used to alleviate some cases of torque and rotation of the foot or to prevent twisting of the hock which may predispose a horse to arthritis, (Martinelli *et al*, 1998). Whilst there is anecdotal evidence that such techniques improve the appearance of these horses i.e. they appear sounder, there is little biomechanical evidence that weight distribution is actually changed. Indeed it may be the gait changes are regarded as characteristic of the condition and are the results of the horse attempting to unload the medial side of the limb and reduce the pain. In this case while such treatments would improve the horses' appearance they would actually prevent it compensating for the pain and accelerate the progression of the condition.

It is possible using a force-plate and video motion analysis to determine the co-ordinates of the Point of Zero Moment (PZM), a theoretical point of balance where all weight is transferred from the limb to the ground. This has been shown to be displaced by relatively minor alterations in medial/lateral foot balance (Wilson *et al*, 1998) and the proposed rational for shoeing of horses with bone spavin on lateral extensions and lateral trailers would predict that the PZM would be displaced laterally compared to the state with a normal plain stamp roadster shoe. Additionally a lateral trailer would be expected to turn the toe inwards, which would be easily determined by simultaneous motion analysis. Previous studies have demonstrated no such affect in sound horses but such an investigation has not to my knowledge been undertaken to date in horses with clinically diagnosed bone spavin. Although it has been proven that horses with bone spavin transfer their weight to the caudo-lateral aspect of the limb during stance compared to sound horses without bone spavin (Boswell *et al, 2000)*

In this study we have set out to test the following hypotheses:

1. Application of a lateral extension shoe will move the PZM laterally relative to the foot in a horse with bone spavin.

2. Application of a lateral extension shoe will result in a more lateral foot placement relative to the midline of the horse.

3. Application of a shoe with a lateral trailer will result in the foot being turned inwards (pronated) during stance.

Materials and Methods.

Horses

Horses from the Household Cavalry Mounted Regiment were assessed by two experienced clinicians at walk and trot, in a straight line on a hard surface. Lameness scores were attributed on a sliding scale from 1 to 10, with 1/10 being just detectable as an asymmetry in weight bearing between both hind limbs and 10/10 being none weight-bearing lame. In each horse, flexion tests of each hind limb were performed by holding the hock and stifle in flexion for 60 seconds and then immediately assessing the horse at trot in a straight line. While walking and trotting all horses demonstrated a low foot flight with regular dragging of the toe, causing wearing of both shoe and hoof if not protected with a set toe shoe.

In horses demonstrating constant hindlimb lameness, 5ml mepivicaine solution (INTRA-EPICAINE: ARNOLDS) was injected into the tarsometatarsal joint of the lame limb. Intra-articular injection was conformed by mixing 2mls of sodium diatrizoate/meglumine diatrizoate (370 mg I / ml) (UROGRAFFIN: SCHERING-PLOUGH) with the local anaesthetic solution and taking a latero-medial radiograph of the tarsus immediately after injection. The horses were re-assessed for lameness at 15 and 30 minutes after injection.

In horses in which the lameness was significantly improved by intra-articular injection of local anaesthetic solution, four standard radiographic projections (dorso-planter, latero-medial, dorso-lateral / plantaro-medial obligue and plantaro-lateral /dorso-medial oblique) of each tarsus were taken.

Five horses were selected into the test group, as they fulfilled all of the following criteria:

1. They demonstrated constant hindlimb lameness at trot in a straight line, and on the lunge, on a hard surface.

2. Lameness was temporarily exacerbated after a proximal limb flexion test.

3. Lameness was improved following intra-articular injection of mepivicaine solution into the tarsometatarsal joint.

4. Radiographic signs of joint space narrowing, subchondral bone sclerosis, periarticular new bone formation and/or subchondral bone lysis were observed in either (or both) distal intertarsal and tarsometatarsal joints.

The five horses consisted of four Irish Draught X Thoroughbreds and one Arab X Thoroughbred, with a mean weight of 591kg (range 405kg – 700kg) and a mean age of 12.8 years (range: 8y – 16y).

Shoeing.

The horses were assessed for good dorsal-planter and medio-lateral hoof balance before each shoeing using both static and dynamic methods of assessment and the 'T Square' as a reference point. All shoes were hand forged plain-stamped flat roadster type shoes, trailers and lateral extensions made from mild steel, application using six standard shoeing nails. They where all assessed and shod by the same farrier (the author) to eliminate personal variations in technique.

The study was conducted over four weeks with all horses being shod with plain stamp roadster shoes on the first week, seven days before the data was collected. The shoes were then changed, with three horses being shod with lateral extensions and two with lateral trailers with data being collected one hour after shoeing and seven days after shoeing. This process was then repeated with three being shod on lateral trailers and two with lateral extensions. Finally all were shod with plain stamped roadster shoes as per the beginning of the study *(fig4)*.

All shoes were made roadster style and plain stamped, from a gauge **(normally ¾ or 1 inch)** to suit the individual build of horse. The lateral extensions *(Fig 5)* extended 16mm laterally from the ground surface of the hoof wall *(fig 6)*, and the lateral trailers *(fig 3)* extended 30mm caudally and laterally from the ground surface of the lateral heel. All front feet where shod with three quarter fullered handmade shoes to suit each horse *(fig7)*.

Assessment.

Hemispherical retro-reflective markers were attached to the lateral side of the left hind hoof and the medial side of the right hind hoof at the quarter and the heel using hot melt glue (BOSTIC, UK). Outlines of each hoof were traced and the position of the markers marked in order to determine their position in relation to the centre of the toe.

Horses were trotted in-hand, at a speed comfortable for each horse, along a 25mtr runway contained in a tunnel covered with lightproof material *(fig8)*. A forceplate (9287BA, KISTLER) which was set in concrete halfway along *(fig 9)*, was covered with a 900 x 600 x 10mm aluminium plate under the 6mm thick commercial conveyer belt matting runway bolted together (Wilson et al, 1998). The forceplate signal was amplified by integral eight channel charge amplifiers, filtered through a low pass filter (6db/octave from 50Hz) and logged via a 12 bit AD converter at 500 samples per second into a personal computer using software written in Lab View (NATIONAL INSTRUMENTS).

Simultaneous kinematic data were recorded at 240Hz with a 3D video motion analysis system (PROREFLEX, QUALISYS) in order to determine the position of the foot on the forceplate.

Eight foot placements were recorded for each hind limb.

Data Analysis

Forceplate model specific, systematic errors in the determination of the coordinates of the PZM relative to the plate were reduced using a previously published polynomial correction (Bobbert and Schamhardt, 1990). Standard formulae were used to calculate the PZM relative to the centre of the toe. Vertical ground reaction force (Fz) and medio-lateral and cranio-caudal PZM were interpolated to 100 points evenly spaced throughout stance to enable averaging of several foot strikes (McGuigan et al, 1999). Average plots of these variables were produced for each horse.

Statistical Analysis

Medio- lateral and cranio-caudal PZM for all horses shod in the three types of shoes were then compared. This can be seen in *Charts 1 and 2.*

Results

In the test, two horses demonstrated a 2/10 right hindlimb lameness, two horses demonstrated a 3/10 right hindlimb lameness and one horse demonstrated a 4/10 left hindlimb lameness at trot on a straight line.

LAMENESS SCORES		
Horse	Straight line	Post TMT analgesia
1	2/10 RH	1/10 RH
2	2/10 RH	Sound
3	3/10 RH	1/10 LH
4	3/10 RH	1/10 RH
5	4/10 LH	1/10 RH

Following intra-articular analgesia of the tarsometatarsal joint of the lame limb, one horse improved from 2/10 to 1/10 right hind, one horse appeared sound, one horse improved from 3/10 to 1/10 right hindlimb lame and two horses began to demonstrate 1/10 lameness on the contralateral limb.

Comparing the statistics in *chart 1*, the medial-lateral position of the PZM between the plainstamped flat roadster, lateral extensions and lateral trailer shoes (ax lines). The chart shows the lateral PZM landing at about –40, then moving medially to –5 for mid stance, then back laterally for toe off at about –25 to -30 of all the horses and shoes in the test.

The PZM *(chart 1)* also landed caudally about –60 then moved slightly forward into stance at –50 before toe off at about –10 to –15 between the plainstamped flat roadster, lateral extensions and lateral trailer shoes of all the horses and shoes in the test (ay lines).

Comparing the statistics in chart 2, the vertical ground reaction forces between the plainstamped flat roadster, lateral extensions and lateral trailer shoes (Fz lines). The chart shows a start just below 1, then moving up to 9 at mid stance, then back down to between 0 and 1 before toe off, of all the horses and shoes in the test.

The cranio-craudal ground reaction forces in chart 2, between the plainstamped flat roadster, lateral extensions and lateral trailer shoes (Fy lines). Shows a start just below 0, then moving up to -1 until mid stance where it is 0, then moving to +1 before going back down to 0 before toe off, of all the horses and shoes in the test.

The horses with spavin bore more weight in a more caudal position than normal horses ($P<0.01$) (Boswell 2000). Neither extensions or trailers caused any consistent displacement of the PZM. Two horses were less lame in extensions and one of these was also less lame in the trailer shoes. The remaining horses were unchanged.

Chart 3 is a comparison of the PZM between horses with spavin, and normal sound horses hind limbs (Boswell 2000). This clearly indicates that spavined horses prefer to load laterally, compared to normal sound horses. Although it is interesting to note that normal sound horses load laterally, indicating that lateral shoe wear is to be expected in the sound horse.

Discussion

Horses with bone spavin have long since been associated with the aggressive wearing of the lateral branch of the hind shoes or hoof. It is said that this wear is a direct result of the lateral branch contacting the ground first, (primary concussion) due to pain in the dorso-medial aspect of either (or both) of the intertarsal and tarsometatarsal joints. This could be why many of the coronary bands of the hinds appear to be 'shunted up', giving an impression of an uneven coronary band in relation to the ground surface. Also the lack of locomotion during walk and trot, with the characteristic stabbing of the hind toes into the ground during the swing phase, resulting in the excessive wearing of the toe.

The application of a lateral extension shoe did not move the PZM laterally relative to the foot in this study enough to make any significant different to the horse. Nor did the application of a lateral extension shoe, result in a more lateral foot placement relative to the midline of the horse. The application of a shoe with a lateral trailer resulted also with no significant evidence in the foot being turned inwards (pronated) during stance.

Conclusion

Horses with bone spavin will not move their PZM laterally with the application of either lateral extensions or lateral trailers compared to normal flat roadster shoes.

This study confirms that there is little, if any difference in the way horses move with the application of lateral extensions and lateral trailers in comparison with plain stamped flat shoes in horses with bone spavin. As with most equine treatment, each horse has to be treated as an individual, what works for one horse may not work for another.

This study indicates that shoeing with plain stamped shoes, may be all that is required by the professional farrier when treating spavin. Placing lateral extensions or trailers on the shoes may have limited or no effect. Further investigation would be required to fully understand how we should be shoeing horses with spavin, taking into account new techniques, and techniques passed down over hundreds of years from our predecessors.

Acknowledgments

We acknowledge the financial support of The Rest Home for Horses for this study.

References

Berry, E, (1999) Methods, applications and limitations of gait analysis in horses. *Equine Veterinary Journal 157,7-22.*

Bobbert, M.F. and Schamhardt, H.C. (1990). Accuracy of determining the point of force application with piezoelectric force plates. *J. Biomech. 23, 705-710.*

Boswell, J.C., McGuigan, M.P, Schramme, M.C., Newman, S.J., Wilson, A.M. (2000) Position or the point of zero moment in sound horses and horses with osteoarthritis of the distal tarsal joints.

Butler D, (1985) The Principles of Horseshoeing. *Doug Butler Publishers.*

Gough, M, Munroe, G, (1993) Decision making in the diagnosis and management of bone spavin in horses. *In practice, May.*

Martinelli, M.J., Ferrie, J.T., (1998) Farrier primer for the student and practising veterinarians. *Equine Vet E, No 4.*

Miyamoto, M (1998). Quantitive kinematic Analysis of the effect of lateral extension shoes on hind foot position during the stance and swing phases of the trot in sound horses with good conformation. *Final year elective project, equine clinical studies.*

McGuigan, M.P., Pardoe, C.H., Webster, C, Miyamoto, M, Wilson, A.M. (1999). Effect of lateral extensions on hind limb kinetics in normal horses. *Proc. International society of Biomechanics.*

Ross, W, Dyson, S. (2003) Diagnose and Management of Lameness in the Horse. *Saunders.*

Stashak, T.S., (1987). The tarsus. In: Adam's Lameness in Horses 4th Edition. *Lea and Febiger, Philadelphia.*

Stashak, T.S., (2002). Adam's Lameness in Horses 5th Edition. *Lippincott Williams and Wilkins..*

Wilson, A.M., Seelig, t., Shields, R.E.W., Silverman, B.W. (1998). The effect of foot imbalance on the point of force application in the horse. *Equine Vet J. 30.540-545.*

Chart 1

Medio-lateral position of the point of zero moment relative to the midline of the foot for all horses shod with plain stamped roadster shoes, trailers and lateral extensions. Data are normalised to percentage of stance and expressed as a percentage of maximum foot width. Negative numbers represent more lateral displacement. Dotted lines represent +- one sem, the normal plain stamped roadster shoes are in blue lateral trailers are in pink, and the lateral extension shoes are in green.

Cranio-caudal position of the point of zero moment relative to the middle of the toe for all horses shod with plainstamped roadster shoes and lateral extensions. Data are normalised to percentage of stance and expressed as a percentage of maximum foot length. Negative numbers represent more caudal displacement. Dotted lines represent +- one sem, the normal plainstamped shoes are in orange, lateral trailers are in blue, and the lateral extensions are in black.

Chart 2

Vertical ground reaction forces with plainstamped roadster shoes, lateral extensions and lateral trailers. Data are normalised to percentage of stance and body weight. Dotted lines represent +- one sem, the normal plainstamped shoes are in blue, lateral extensions in green and the lateral trailers are in orange.

Cranio-caudal ground reaction forces plainstamped roadster shoes, lateral extensions and lateral trailers, negative numbers represent more lateral displacement. Data are normalised to percentage of stance. Dotted lines represent +- one sem, the normal plainstamped shoes are in red, lateral extensions in black and the lateral trailers are in blue.

Chart 3

The position of the point of zero moment within the foot in relation to horses without spavin.

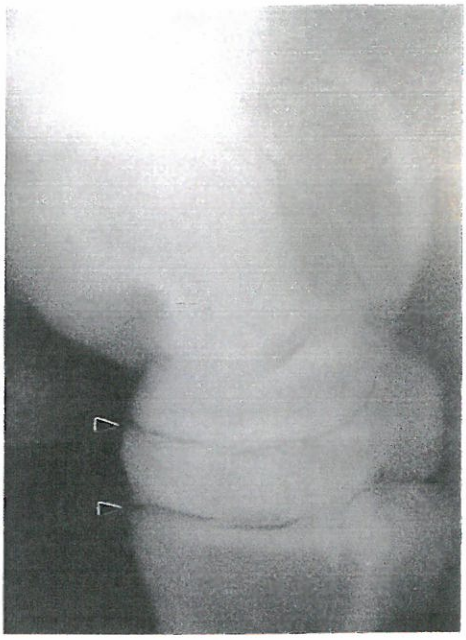


Fig 1 Radiograph of tarsal joins showing possible location of spavin in the Distal Intertarsal Joint and the Tarsometatarsal Joint.
Ross, w. Dyson, S. Diagnosis and Management of Lameness in the hose p442, (2003).

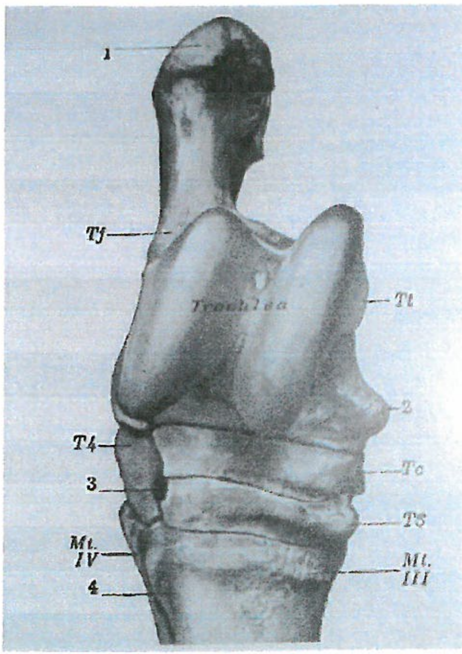


Fig 2 Tarsal joint (Adams Lameness in Horses p932, (2002) 5 edition)

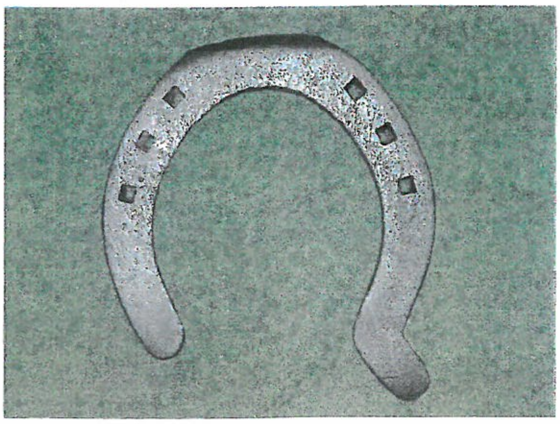


Fig 3. Plain stamp hind shoe with lateral trailer.

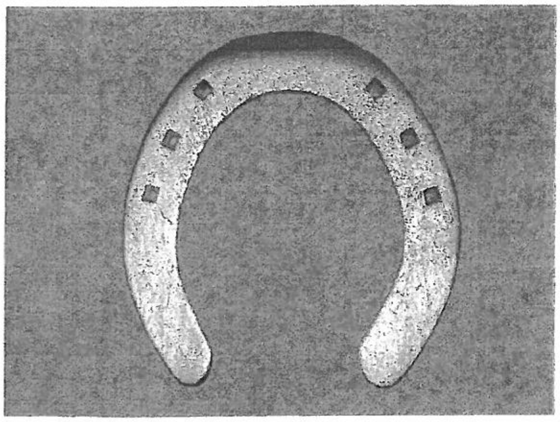


Fig 4. Plain stamped hind shoe

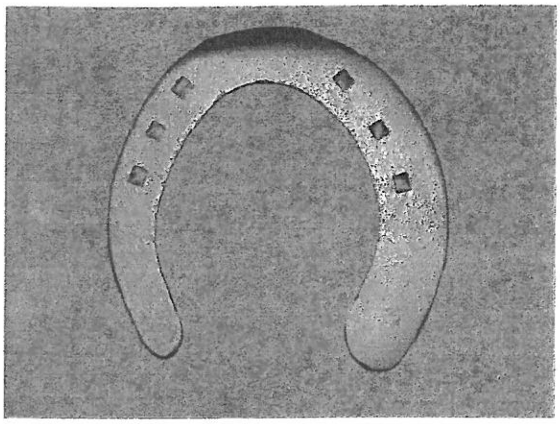


Fig 5. Plain stamped hind shoe with lateral extension. Ground surface.

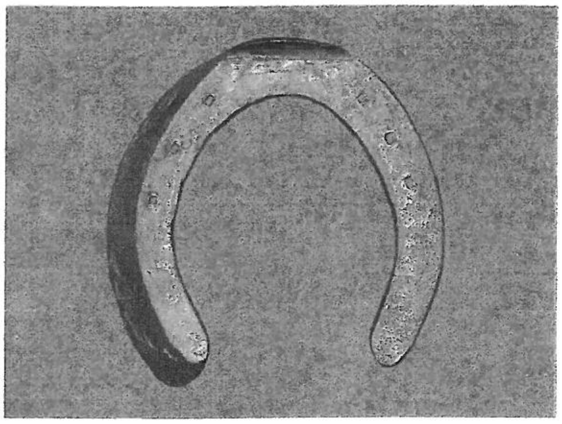


Fig 6. Plain stamped hind shoe with lateral extension. Bearing (foot) surface.

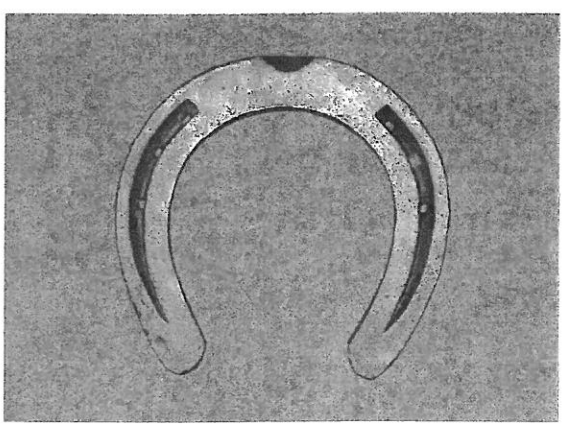


Fig 7. Three quarter fullered hand made front shoe.

Fig 8. Force plate runway in the tunnel

Fig 9. The force plate.

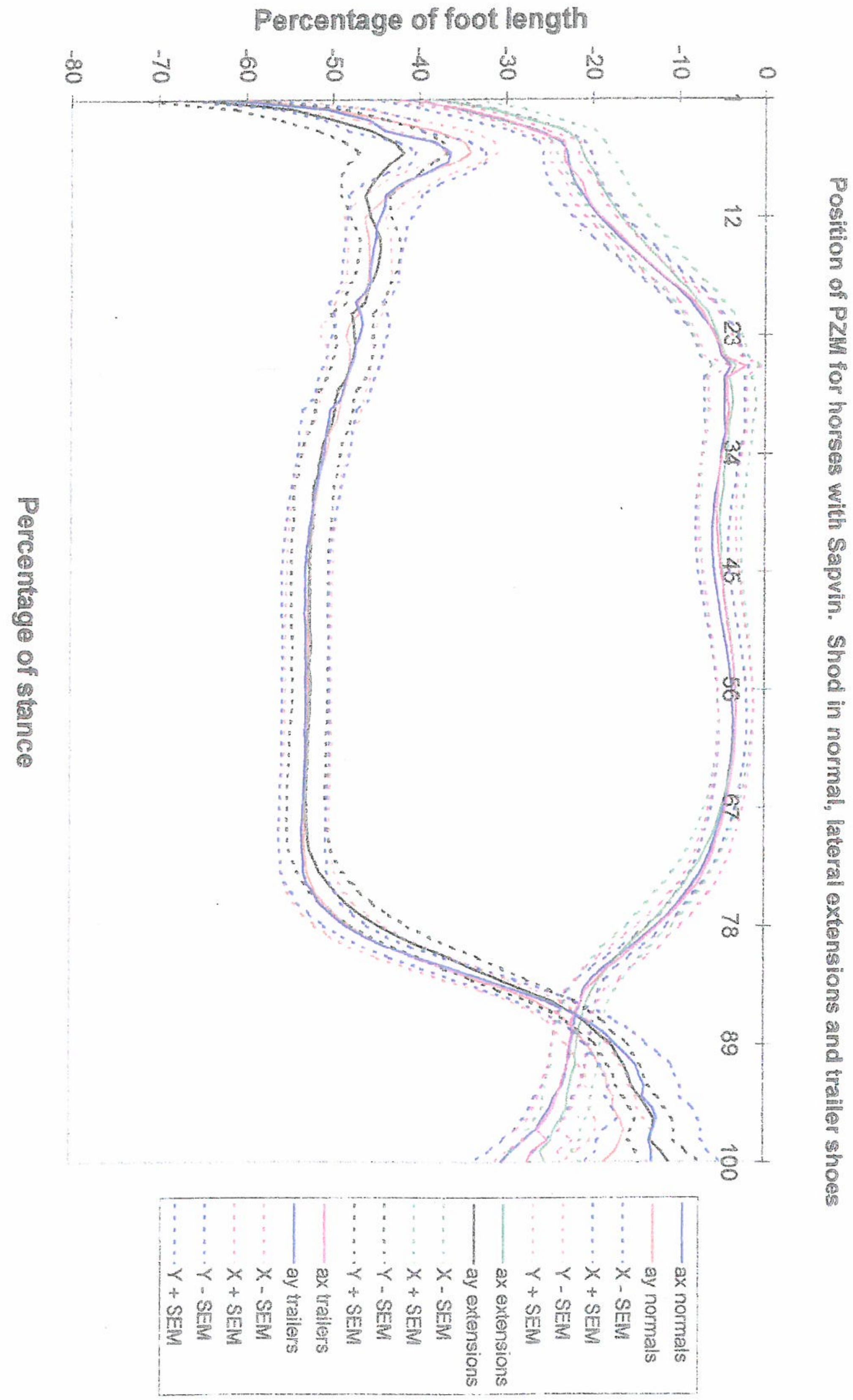


Chart1
Position of PZM for horses with Sapvin. Shod in normal, lateral extensions and trailer shoes
Percentage of foot length
0
-10
-20
-30
-40
-50
-60
-70
-80
1
12
23
34
45
56
67
78
89
100
Percentage of stance
ax normals
ay normals
X - SEM
X + SEM
Y - SEM
Y + SEM
ax extensions
ay extensions
X - SEM
X + SEM
Y - SEM
Y + SEM
ax trailers
ay trailers
X - SEM
X + SEM
Y - SEM
Y + SEM

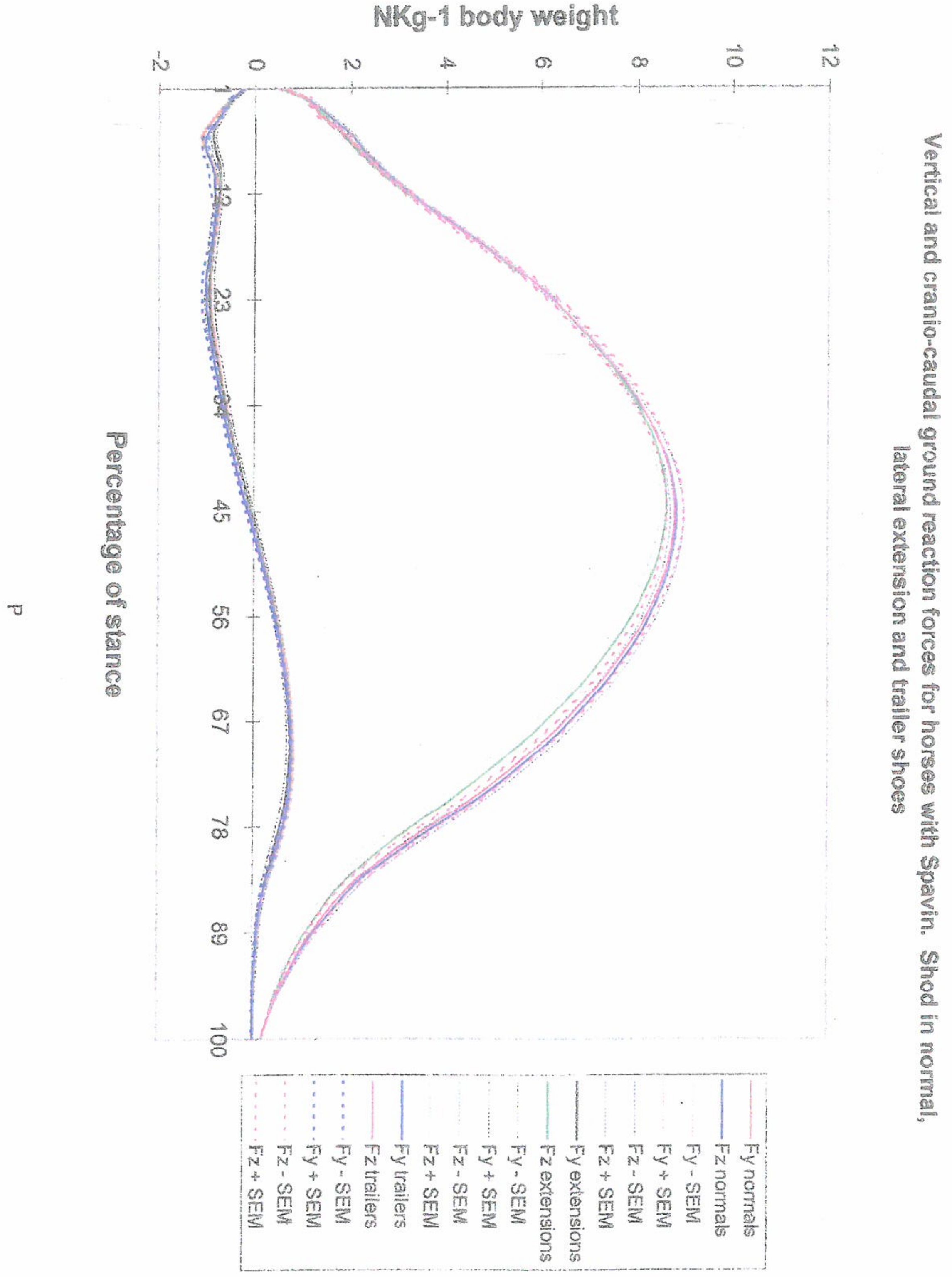
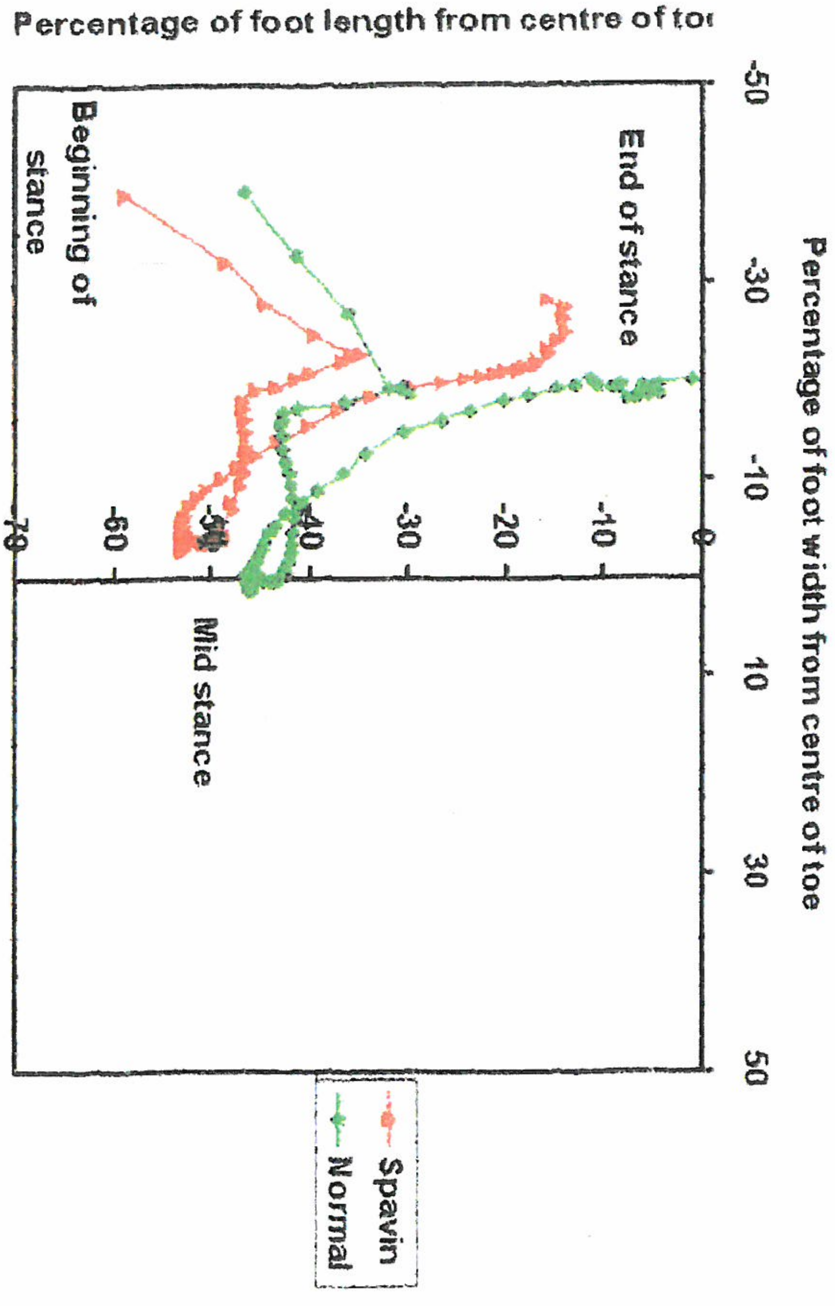


Chart2
Vertical and cranio-caudal ground reaction forces for horses with Spavin. Shod in normal, lateral extension and trailer shoes
NKg-1 body weight
-2
0
2
4
6
8
10
12
1
12
23
34
45
56
67
78
89
100
Percentage of stance
Fy normals
Fz normals
Fy - SEM
Fy + SEM
Fz - SEM
Fz + SEM
Fy extensions
Fz extensions
Fy - SEM
Fy + SEM
Fz - SEM
Fz + SEM
Fy trailers
Fz trailers
Fy - SEM
Fy + SEM
Fz - SEM
Fz + SEM
P

Chart 3

Position of PZM within the foot



Newman S., Rogers K.M., McGuigan M.P., Boswell J.C., Schramme M.C., Wilson A.M. (2000)
The effect of corrective shoeing on the position of the point of zero moment relative to the foot in horses suffering from osteoarthritis of the small tarsal joints. (Bone Spavin)
Proc. 39th Congress of British Equine Veterinary Assoc. Birmingham, UK. *Free communication.* Pg.198.

Introduction. Osteoarthritis of the small tarsal joints (bone spavin) is often treated by corrective farriery, which aims to support the lateral side of the foot. This study set out to test the hypothesis that these shoes change the weight distribution under the foot, making the horse more comfortable.

Methods. Five horses with clinical (lameness and intra-articular anaesthesia) and radiographic signs of bone spavin were shod in steel wide-web shoes, trailer shoes and lateral extension shoes. After one week in each shoe type, each horse was scored for lameness and trotted for 8 placements/ hindfoot over a forceplate (9287BA, Kistler) set in a rubber matting runway. Forceplate data were low pass filtered at 50 Hz. Simultaneous kinematic data were recorded at 240 Hz (ProReflex, Qualysis) for determination of foot position relative to the forceplate. The position of the point of zero moment relative to the foot during stance was determined.

Results. The horses with spavin bore more weight in a more caudal position than normal horses ($P<0.01$). Neither extensions or trailers caused any consistant displacement of the PZM. Two horses were less lame in extensions and one of these was also less lame in the trailer shoes. The remaining horses were unchanged.

Discussion. These results confirm that horses with spavin attempt to unload the dorsal aspect of the small tarsal joints by redistributing their weight. Corrective shoeing was of only limited benefit to the horses in this study.

We acknowledge the financial support for this work from the Home of Rest for Horses.

2000 BEVA CONGRESS, BIRMINGHAM

CLINICAL RESEARCH ABSTRACTS

Title: THE EFFECT OF CORRECTIVE SHOEING ON THE POSITION OF THE POINT OF ZERO MOMENT RELATIVE TO THE FOOT IN HORSES SUFFERING FROM OSTEOARTHRITIS OF THE SMALL TARSAL JOINTS (BONE SPAVIN).

Author(s): #Newman, S Rogers, KM McGuigan, MP *Boswell, JC *Schramme, MC Wilson, AM
Department of Veterinary Basic Sciences, *Department of Farm Animal and Equine Medicine and Surgery, The Royal Veterinary College #Household Cavalry Mounted Regiment.

Abstract:

Introduction: Osteoarthritis of the small tarsal joints (bone spavin) is often treated by corrective farriery, which aims to support the lateral side of the foot. This study set out to test the hypothesis that these shoes change the weight distribution under the foot making the horse more comfortable.
Methods: Five horses with clinical (lameness and intra-articular anaesthesia) and radiographic signs of bone spavin were shod in steel wide web shoes, trailer shoes and lateral extension shoes. After one week in each shoe type each horse was scored for lameness and trotted for eight placements per hindfoot over a forceplate (9287BA, Kistler) set in a rubber matting runway. Forceplate data were low pass filtered at 50Hz. Simultaneous kinematic data were recorded at 240Hz (ProReflex, Qualisys) for determination of foot position relative to the forceplate. The position of the point of zero moment relative to the foot during stance was determined.
Results: The horses with spavin bore weight in a more caudal position than normal horses ($p<0.01$). Neither extensions or trailers caused any consistent displacement of the PZM. Two horses were less lame in extensions and one of them was also less lame in the trailer shoes. The remaining horses were unchanged.
Discussion: These results confirm that horses with spavin attempt to unload the dorsal aspect of the small tarsal joints by redistributing their weight. Corrective shoeing was of only limited benefit to the horses in this study.
We acknowledge the financial support for this work from the Home of Rest for Horses.

PLEASE COMPLETE THE FOLLOWING:

PRESENTER: STEVE NEWMAN SIGNATURE: S. Newman
TITLE: ~~PROF/DR/MRS/MS~~/MR QUALIFICATIONS: AWCF
ADDRESS: C/O DR. A. WILSON, DEPARTMENT OF VETERINARY BASIC SCIENCES, THE ROYAL VETERINARY COLLEGE, HAWKSHEAD LANE, NORTH MYMMS, HATFIELD, HERTFORDSHIRE
COUNTRY: UNITED KINGDOM POST (ZIP) CODE: AL9 7TA
TELEPHONE: 01707 666259
FAX: 01707 666371 E-MAIL: awilson@rvc.ac.uk

Send two hard copies of the abstract plus disc by **1st March 2000** to:

J.G. Lane BVetMed DESTS FRCVS,
Department of Clinical Veterinary Science,
University of Bristol,
Langford House,
Langford,
Bristol BS40 5DU,
England.

To arrive by **1st March 2000**