

SOME RADIOLOGICAL MEASUREMENTS FROM THE FRONT FEET OF SOUND DAREH-SHORI HORSES WITH RELEVANCE TO LAMINITIS AND FOUNDER

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ABSTRACT

Laminitis is a severe inflammation of the sensitive laminae of the foot. The sensitive laminae exist to support the pedal bone inside the hoof. This study was conducted to estimate radiological factors refers to anterior motor limb. According to this purpose ten apparently healthy Dareh-shori horses were selected from kazerun and suburban. After cleaning and washing the horses hooves, metal marker placement, the hooves were marked by the contrast, then hand-made block placed under the following limb, lateral view radiograph were made to get the following measurements and values: Founder Distance = 5.6 ± 1.1 mm; Hoof wall thickness in three regions (STTP = 16.9 ± 1.2 mm, STTM = 17.1 ± 1.1 mm, STTD = 16.7 ± 1.1 mm); PCL = 59.9 ± 5.8 mm; STTP/PCL% = 28.4 ± 3.1 mm; STTM/PCL% = 28.7 ± 3.7 mm; STTD/PCL% = 28.1 ± 4.2 mm. Values for angles: Hoof axis = 48.5 ± 4.1 ; P3 axis = 47.1 ± 4.5 ; H angle = 1.1 ± 3.6 ; P2 axis = 45.4 ± 3.7 ; R angle = 1.7 ± 5.4 . Measurements of this study may differ with those reported from other breeds, so it can be used in the future as reference values for diagnosis of laminitis and founder in front feet of Dareh-shori horses.

KEY WORDS: Radiological Measurements, Front feet, Dareh-shori horses, Laminitis

INTRODUCTION

Dareh-Shori is one of the Iranian nomadic tribes that located in south of iran. Dareh-Shori horse originating from this tribe and used as a riding horse. Many authors have described the normal radiographic anatomy of the front feet of normal horses (Butler et al., 1993; Quick and Rendano, 1977; Rendano and Grant, 1978; Shively, 1977). Laminitis is one of the most common causes of lameness in horses (Eustace and Cripps, 1999; Stashak, 2002). Laminae are the structures which attach the pedal bone to the inside of the hoof wall, if these laminae become inflamed or damaged they can cause severe pain and distress. When laminitis occurs, some of the laminae die off, which results in an unstable foot. The pedal bone may then rotate within the foot, or in more severe cases the pedal bone may sink within the foot (Stashak, 2002). Laminitis can occur in all shapes and sizes of horses and ponies, although it is more commonly seen in small, overweight native ponies (Rendano and Grant, 1978). Most frequently, laminitis will occur in both front feet which is logical given that horses bear approximately 60% of their weight on their front limbs (Baxter, 1995; Hood et al., 2002). However, it can occur in just one foot, as well as in all four feet or just both hinds.

Lateromedial radiographs should be taken at the first sign of acute laminitis to develop a baseline for continuous radiographic comparison. Early radiographic signs in laminitis include mild bony reaction along the dorsal aspect of the distal phalanx in addition to widening the distance between the distal phalanx and the dorsal hoof wall (Stashak, 2002). This distance should be less than 18 mm in normal horses or less than 30% of the palmer length of the distal phalanx measured from the tip of the bone to its articulation with the navicular bone (Linford et al., 1993). Palmar or plantar rotation of the distal phalanx away from the dorsal hoof wall confirms the diagnosis of laminitis (Cripps and Eustace, 1993; Redden, 2003; Stick et al., 1982). This study measured the distances and angles in order to establish a database of normal values in Dareh-shori horses to compare with the results of other reports.

MATERIALS AND METHODS

Measurements were taken from 10 Dareh-shori horses (7 stallions, 3 mares) ranging in age from 3-17 years and with a height (measured at the highest point of the withers) between 153-159 cm were included in this study. All of the horses had no previous history of lameness and they were all clinically sound and the feet showed no abnormality or distortion. The sole and wall were cleaned using a hoof pick and wire brush. The horn on the dorsal part of the hoof just below the coronary band was lightly rasped to remove rough perioplic horn. The proximo-dorsal hoof wall was palpated just below the coronary band and the point at which the wall horn began to yield to moderate digital pressure was marked with an indelible pen. A straight stiff wire marker, of known length (20mm), was taped to the dorsal hoof wall with the proximal end at the indelible pen line. The horses' feet were radiographed standing on a flat wooden block 70 mm thick incorporating a metal ground line. Both front feet were radiographed with the limb in vertical position. Radiographs were made using a portable X- ray unit with 5MAS, 80 kVP exposure factors.

RADIOGRAPHIC MEASUREMENTS

Radiographs were fixed onto a horizontal viewing box and lines were drawn with a fine tipped pen. Following measurements were made from each latero-medial radiograph (Figure1).

1. Angle S: the angle between the dorsal hoof wall and the ground.
2. Angle T: the angle between the dorsal cortex of the distal phalanx and the ground.
3. Angle U: the angle between a line connecting the centers of curvature of the proximal and distal interphalangeal joints and the ground.
4. Angle H: Angle T minus Angle S.
5. Angle R: Angle T minus Angle U.

6. The vertical distance, between the top of the dorsal wall wire marker and the proximal limit of the extensor process of the distal phalanx (D-founder), after correcting for magnification according to the M.C.F formula.
7. The thickness of hoof wall and under beneath soft tissues in place: proximal (STTP), Middle (STTM), Distal (STTD) and length of palmarcortical of p3 (PCL) after correction for magnification according to the M.C.F formula.
8. The thicknesses of hoof wall in the percent of length of palmarcortical of third phalanx.

M.C.F= Actual length of marker / radiographic length of marker so the true distance = length measured radiographically x M.C.F

RESULTS AND DISCUSSION

Tables 1 and 2 summarise the results of Measurements such as distances and angles in lateromedial radiographs from the front feet of all horses that describe the position of P3 in relation to the hoof capsule. No significant differences was found between left and right feet obtained in this study. In Table 3 the results of our study compared with that of Cripps et al. (1999).

Many published studies have been done on measurement of coffin bone in front feet, (Baxter 1994; Cripps and Eustace, 1993; Eustace and Cripps, 1999; Cripps and Eustace, 1999; Kummer et al., 2006; Linford et al., 1993). While few studies have been done on hind feet (Cripps and Eustace, 1999). Cripps et al measured the angles in front feet of mix breeds. These authors found that the mean angle S and T in the front feet of 22 thoroughbred horses were 48.6 and 47.6 degrees respectively. When the H angle was -1 degree. The measurement of these parameters in our study is in close agreement with that of Cripps et al (Cripps and Eustace, 1999). They reported that Angle U was 43.8 degree, While R angle was 3.8 degree (Cripps and Eustace, 1999). The finding of our study was different with cripps. In our study the amount of angle U and R are 45.4 and 1.7 digrees. Differences between the two studies may be related to breed or type of horses. Differences in measurement techniques may also have contributed (Cripps and Eustace, 1999; Kummer et al, 2004). The measurement values of wall thickness in this study and that of reported by Cripps et al are different (Cripps and Eustace, 1999). According to Cripps et al in 1999, the mean wall thickness measurements from front feet of normal Thoroughbred horses was 16.3 mm (Cripps and Eustace, 1999). In our study the mean wall thickness is 17.1 mm (STTM). Wall thickness in the normal horse is less than 30% (25-30) of PCL (Linford et al., 1993). In this study our results are 28.4 ± 3.1 , 28.7 ± 3.7 and 28.1 ± 4.2 in three regions (Proximal, Middle and Distal). Table 3 shows a morphometric comparison between the results of this study and that of Cripps and Eustace (1999). Founder distance is a parameter first described in 1999 by Cripps and Eustace. Our measurements according to Cripps and Eustace method were based on a marker with the most proximal end at the point below the coronary band, where the wall horn began to yield to moderate digital pressure (Cripps and Eustace, 1999). In another study the marker was positioned with the proximal end at

the hairline (Kummer et al., 2006). The different position of the marker explains the differences of measurements. Cripps et al reported that FD values in front feet of 22 thoroughbred horses was about 5.2 ± 1.97 mm (Cripps and Eustace, 1999). In our study founder distance is about 5.6 ± 1.1 mm. The differences between left and right feet were not statistically significant ($P > 0.05$). Generally, differences in FD (apart from the effect of marker placement) may be due to variations in limb loading, or as a consequence of laminitis. However, the degree of natural variation indicates that this parameter is only of limited usefulness in the early stages of laminitis (Cripps and Eustace, 1999; Linford et al., 1993).

REFERENCES

- Baxter G.M. (1994).** Acute laminitis. *Vet Clin North Am Equine Pract*, 3,627-642.
- Butler J.A., Colles C.M., Dyson S.J., Kold S.E. and Poulos W. (1993).** Foot, Pastern and Fetlock. In: *Clinical Radiology of the Horse*. Blackwell Scientific Publications, Oxford, 26-27.
- Cripps P.J. and Eustace R.A. (1999).** Radiological measurements from the feet of normal horses, with relevance to Laminitis. *J Equine Vet*, 31.5, 427-433.
- Eustace R.A. and Cripps P.J. 1999.** Factors involved in the prognosis of laminitis in the UK. *J Equine Vet*, 31. 5, 433-443.
- Hood D.M., Taylor D. and Wagner I.P. (2001).** Effects of ground surface deformability, trimming, and shoeing on quasistatic hoof loading patterns in horses. *Am Journ Vet Res*, 62, 895-900.
- Kummer, M, Gayer H., Imboden I., Auer J. and Lischer C. (2006).** The effect of hoof trimming on radiographic measurement on the front feed of normal warmblood horses. *J Vet*, 172, 58-66.
- Kummer M., Lischer C., Vargas J. and Hugelshofer J. (2004).** Evaluation of a standardised radiographic technique of the equine hoof. *Schweizer Archiv fÅ¼r Tierheilkunde*, 11, 507-514.
- Linford, R.L, O'Brien T.R. and Trout D.R. (1993).** Qualitative and morphometric radiographic findings in the distal phalanx and digital soft tissue of sound thoroughbred racehorse. *J Am vet Res*, 54, 38-51.
- Quick, C.B. and Rendano V.T. (1977).** Equine radiology; the pastern and foot. *Modern Veterinary Practice*, 58, 1022-1027.
- Redden R. (2003).** Hoof capsule distortion: understanding the mechanisms as a basis for rational management. *The veterinary clinics of North America Equine Practice*, 19, 443-462.
- Rendano V.T. and Grant B. (1978).** The equine third phalanx; its radiographic appearance. *J Am Vet Rad Soc*, 19, 125-135.
- Shively M.J. (1977).** Normal radiographic anatomy of the equine digit. *Southwest Veterinarian*, 30, 193-199.
- Stashak T.S. (2002).** Laminitis. In: Stashak TD, eds. *Adam's lameness in horses*. 5th Ed. Baltimore, Williams and Wilkins, 645-664.
- Stick J.A., Jann H.W., Scott E.A., et al. (1982).** Pedal bone rotation as a prognostic sign in laminitis of horses. *Am Vet Med Ass*, 180 (3), 251-253.

Table 1. Statistical description of radiographic measurements of distances from the front feet of 10 normal Dareh-shori horses

Parameter	Mean	SD	Min	Max
STTP(mm)	16.9	1.2	13.3	19.2
STTM(mm)	17.1	1.1	14.1	19.2
STTD(mm)	16.7	1.1	14.1	19.2
PCL(mm)	59.9	5.8	50	70
STTP/PCL×100	28.4	3.1	24	36.2
STTM/PCL×100	28.7	3.7	23.7	38.4
STTD/PCL×100	28.1	4.2	20.1	36.8
FD(mm)	5.6	1.1	0.9	7.7

Table 2. Statistical description of radiographic measurements of Angles from the front feet of 10 normal Dareh-shori horses

Parameter	Mean	SD	Min	Max
Angle S	48.5	4.1	36	55
Angle T	47.1	4.5	34	53
Angle U	45.4	3.71	36	58
Angle H(T-S)	-1.1	3.6	-8	6
Angle R(T-U)	1.7	5.4	-11	13

Table 3. Morphometric comparison between Cripps and Eustace and this study

parameter	Cripps and Eustace 1999	This study
Angle S	48.6±3.51	48.5±4.1
Angle T	47.6±2.09	47.1±4.5
Angle U	43.8±5.86	45.4±3.71
Angle H	-1±2.72	-1.1±3.6
Angle R	3.8±6.46	1.7±5.4
Wall Thickness (mm)	16.3±1.75	17.1±1.1
FD(mm)	5.2±1.97	5.6±1.1

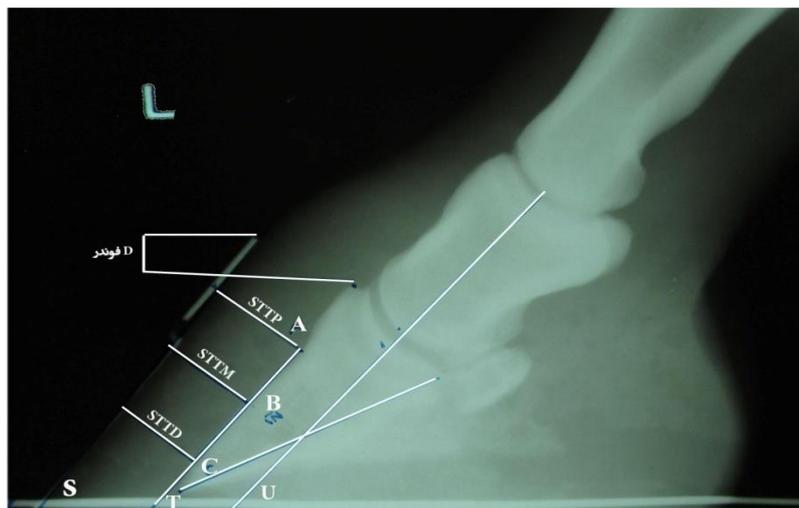


Figure 1. Lateromedial radiograph from the front feet of a normal horse that indicating the measured parameters (Angles and Distances)

Parameters: STTP = Total soft tissue thickness dorsal to the proximal aspect of the distal phalanx
 STTM =Total soft tissue thickness dorsal to the middle aspect of the distal phalanx
 STTD =Total soft tissue thickness dorsal to the distal aspect of the distal phalanx
 FD = Founder Distance
 S = Hoof Angle,T = P3 Angle,U = P2 Angle