The Professional Animal Scientist 34:488–493
https://doi.org/10.15232/pas.2017-01717

Effects of squared-toe or perimeter-fit horseshoes on quality of movement and gait kinematics of the western pleasure horse

Laura White,*[1] Paeden Underwood,* Libby Hirtz,† Douglas Hogue,* and Kelly Walter†
*Animal and Range Sciences, New Mexico State University, PO Box 30003, Las Cruces 88003; and †Agriculture Science, Truman State University, 100 East Normal Ave., Kirksville, MO 63501

ABSTRACT

Our objective was to evaluate gait quality and kinematics of the western pleasure horse shod with a squared-toe aluminum shoe (ST) in comparison with a perimeter-fit aluminum shoe (PF) on the thoracic digit. Nine Quarter horses were used in a repeated-measures study and randomly selected to be shod with either a ST or PF shoe for 6 wk and then reshod with the opposing treatment. Horses were videoed being ridden at the walk, jog, and lope 2 wk after each shoeing cycle. Evaluations of forelimb gait kinematics (stride length, metacarpophalangeal extension, humeroradial and carpal range of motion) were performed by EquineTec gait software analysis (Equine Tec Inc., Monroe, GA), and evaluation of quality of movement was conducted by 10 equine judging professionals. Quality of movement scores were not different ($P > 0.45$) for the walk, jog, or lope. Kinematic advantages of the PF treatment were revealed, including increased humeroradial extension ($P < 0.05$), increased ($P < 0.02$) carpal flexion at most gaits, increased ($P < 0.01$) carpal extension at most gaits, increased ($P < 0.05$) metacarpophalangeal extension at the jog and lope, and longer ($P = 0.02$) stride length at the lope. Results indicate that kinematic evaluation by video analysis software reveals advantages in stride length and thoracic limb extension of western pleasure horses when shod with the PF shoe. However, pragmatic evaluation by professional judges reveals no advantages to either treatment; therefore, the industry has the option to use a PF horseshoe and achieve the same quality of movement as the ST, while potentially amplifying the longevity of the western pleasure horse.

Key words: gait kinematics, horseshoe, quality of movement

INTRODUCTION

Traditionally, horseshoes are used to protect, to increase traction, or for correction of horse hooves (Butler, 1993). Horse sport disciplines are increasingly diverse and competitive, fostering a desire for enhanced performance, resulting in diverse horseshoe types available without scientific knowledge of how they affect gait characteristics or longevity and soundness (Willemen et al., 1994; Huguet and Duberstein, 2012). Alteration of horseshoes to enhance performance may ultimately challenge the integrity of the horse hoof as an unrealized consequence of the modified shoe (Balch et al., 1996; Singleton et al., 2003; Johnston and Back, 2006; Murphy, 2009; Rumpler et al., 2010; Huguet and Duberstein, 2012).

For the western pleasure show horse, quality of movement is paramount and maximal extension of the humeroradial, carpal, and metacarpophalangeal joints is highly desired. Horse farriers will often manipulate the hoof of the western pleasure horse by squaring the toe and moving the horseshoe caudally on the hoof capsule, which is thought to shorten breakover and decrease the carpal angle (Willemen et al., 1996). Previous research found no difference in breakover time between a squared-toe shoe and a perimeter-fit shoe, but they did not evaluate gait quality (Willemen et al., 1996; Eliashar et al., 2002). The squared-toe shoe may be detrimental to the horse because of reduced ground surface area on the hoof capsule, concentrating energy upon impact and increasing dorsiflexion of the metacarpophalangeal joint and ventriflexion of the distal interphalangeal joint causing increased total joint rotation and work load (Moyer and Anderson, 1975; Johnston and Back, 2006). Increased load on the thoracic limb may impose strain on the leg and increase risk of lameness (Moyer and Anderson, 1975). A perimeter-fit, round-toe shoe increases the ground surface area, allowing absorption and dissipation of energy throughout the entire digit and hoof capsule, and decreases loading pressure at the toe (Oosterlinck et al., 2011). Therefore, our objective was to quantify gait quality and characteristics of the western pleasure horse shod with a squared-toe aluminum shoe (**ST**) in comparison with a perimeter-fit aluminum shoe (**PF**) on the thoracic digit.

MATERIALS AND METHODS

Experimental Design

All testing and procedures were approved by the New Mexico State University Institutional Animal Care and

The authors declare no conflict of interest.

[1] Corresponding author: lmwhite@nmsu.edu

Use Committee. Nine clinically sound Quarter horses (5 geldings, 4 mares; 8.8 ± 2 yr; 505.9 ± 34.8 kg) were used in a repeated-measures study and randomly selected to be shod with either a ST (Natural Balance Shoe, Anaheim, CA; 159.9 ± 9.3 g) or PF (Mustad, Forest Lake, MN; 165.4 ± 16.9 g) aluminum horseshoe for 6 wk and then reshod with the opposing treatment. Both shoes possessed a rolled toe, which has been shown to smooth breakover (van Heel et al., 2006). All horses were being used as show horses before, during, and following the study and had previously been maintained with traditional steel horseshoes or were barefoot. Treatments were applied by a certified journeyman farrier throughout the study, except in the case of one horse, where that horse's regular farrier applied both treatments. Five horses were housed in stalls and 4 horses were maintained in turn-out pastures during the entirety of the trial. Although horses were maintained differently, individual horses experienced the same management, nutrition, and exercise schedule during both periods of the trial. All horses beginning the study had at least 6 wk of hoof growth since their last shoeing and trimming and were evaluated by a veterinarian familiar with lameness in horses before and during the study. On d 1 of the experiment, horses were trimmed and then randomly selected to be fitted with a ST or PF shoe. On d 43, horses were trimmed and shod with the opposing treatment. Horses were videoed for quality of movement and gait kinematic analysis on d 15 and 57, allowing horses 2 wk to properly acclimate to the type of shoe applied. Horses were allowed a 2-wk period to acclimate to their new shoe type before being videoed to ensure that any movement changes because of the previous shoe type were no longer seen and also to limit growth of the foot so movement was not affected by hoof growth. The study was completed on d 85, and all horses returned to their regular shoeing schedule (Figure 1).

Video Recording Procedure and Data Collection

Researchers shaved a small area at the olecranon, carpus, and metacarpophalangeal joint and made a mark on the toe of the hoof with permanent paint. Shaved areas were fitted with reflective paint during video of both treatments to aid in kinematic measurements and to ensure measurements occurred at the same place for both treatments so they could be compared appropriately as suggested by previous researchers (Khumsap et al., 2004; Huguet and Duberstein, 2012). Horses were ridden by the same rider, in the same western tack, and in the same location for both shoeing treatments, except in the case of one horse, where a rider injury precluded them from finishing the study and an alternate rider familiar with the horse was used. Horses were warmed up at the walk, jog, extended jog, and lope for 20 min before being videoed. The video camera was set up 1.2 m off the ground, perpendicular to the line of travel 6 m away from the middle of the recording path similar to previous research (Huguet and Duberstein, 2012).

Horses were videoed being ridden both directions at the walk, jog, extended jog, and lope for 3 repetitions over 50 m. The entire 50 m of both directions was used as the recording frame for quality of movement evaluation. The middle 14.63 m of the recording frame of both directions was used for kinematic analysis, which resulted in 4 to 6 strides depending on the gait. The 3 strides most perpendicular to the camera were evaluated, and the 3 measurements were averaged to produce the most precise kinematic measurement for the left and right directions. Only the strides most perpendicular to the camera were evaluated so camera angle did not affect measurements.

Data Analysis

All horses were coded so the researcher was blind to the shoe type during quality of movement and kinematic analysis. Forelimb gait kinematic analyses were performed by EquineTec gait software (Equine Tec Inc., Monroe, GA), internally validated and used by previous researcher (Huguet and Duberstein, 2012; Duberstein et al., 2013). One researcher, trained with the EquineTec software, was used to conduct all kinematic evaluations. Using tools in

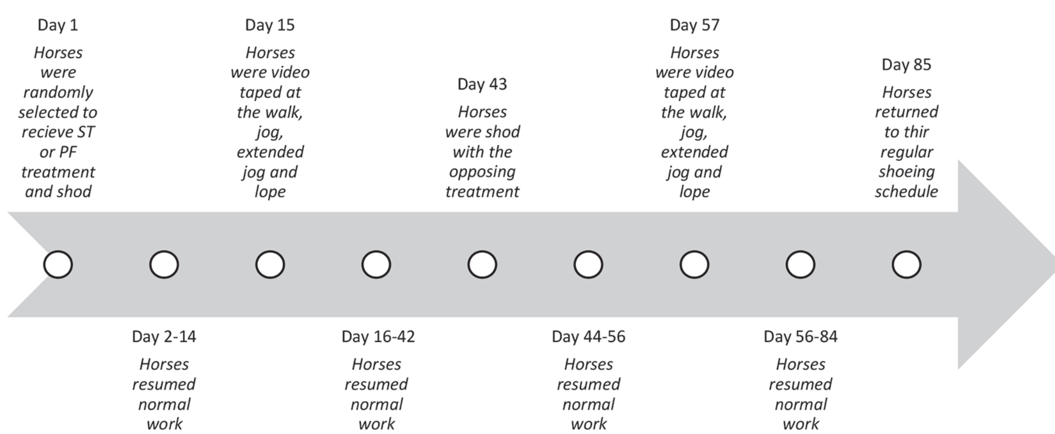

Figure 1. Timeline of treatments and data collection for western pleasure horses undergoing squared-toe (ST) or perimeter-fit (PF) horseshoe treatments.