Evaluating any changes in a horse's gait after trimming and shoeing can improve care

Solid Footing

RESEARCHERS LOOK AT **FARRIER WORK** RELATIVE TO **PERFORMANCE, WELFARE**

By **AMANDA DUCKWORTH**

A BETTER UNDERSTANDING of the mechanics of hooves, and especially hooves in motion, can improve the performance and welfare of racehorses.

Researchers delving into how farrier work and hoof movements correlate have examined the way horses are trimmed and shod. They have found that these techniques can be crucial for racing success and equine welfare.

Dr. Stephen O'Grady examined the basics in "Guidelines for Trimming the Equine Foot: A Review," which was written for the American Association of Equine Practitioners (AAEP).

"The importance of understanding the practice and art of farriery is obvious in equine veterinary medicine," O'Grady said. "The equine foot is unique because it is a biological entity that follows the laws of physics. A working knowledge of the biomechanics of the foot as we perceive (it) is essential for the clinician, either veterinarian or farrier, to implement appropriate farriery.

"Often, trimming and shoeing methods are based on theoretical assumptions and aesthetic decisions derived from empiric experience rather than consistent repeatable guidelines or landmarks that can be applied to the foot on an individual basis."

Researchers tackled the cause and effect of basic farrier work in "The Immediate Effect of Routine Hoof Trimming and Shoeing on Horses' Gait" published in the July 2021 edition of the *Journal of Equine Veterinary Science*.

Researchers found that evaluating changes in horses' gait after routine trimming and shoeing is needed to improve routine foot care. For the study, 15 horses took part in routine hoof trimming and horseshoe application. Researchers took dorsal and lateral photographs of the right and left front feet and inertial gait analysis at the trot. The photos and analysis were completed before and after trimming and shoeing. Using a calibrated system, researchers then compared gait and hoof measurements before and after farrier work.

"Hoof measurement changes in relation to gait changes before and after farrier intervention were analyzed for significant associations," explained researchers. "Mean medial to lateral coronary band length, lateral and medial coronary band height, dorsal hoof wall length, heel length, heel overhang length, palmar coronary band height, and hoof angle in each foot were significantly different pre- and post-farrier intervention. There was no statistical difference in the total head and pelvis movement before and after farrier intervention."

In short, for sound horses on a regular farrier cycle, which is typically every four to six weeks, trimming and shoeing should not significantly change their gaits. However, it is important that the farrier work is tailored to the horse's particular hoof needs.

"Change in hoof conformation due to routine hoof trimming and shoeing does not change the gait in non-lame

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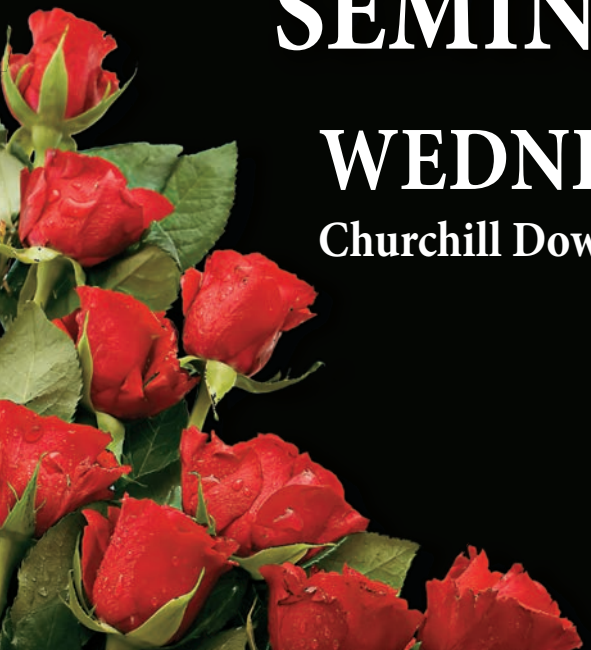

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horses; however, some hoof characteristics' measurements are correlated with immediate change in stride parameters," concluded researchers. "Use of hoof measurements may assist farriers and veterinarians in applying routine hoof care. Further studies could help determine what hoof conformation changes may be helpful to treat lame horses."

One of the critical moments in a horse's stride cycle is hoof breakover, which occurs when a horse's hoof pushes off the ground surface and rotates through an angle of approximately 90 degrees before it is lifted off. How farrier work can impact this part of the stride is examined in the study "Influence of trimming, hoof angle, and shoeing on breakover duration in sound horses examined with hoof-mounted inertial sensors," published by the *Veterinary Record* in August 2021.

> **"THE IMPORTANCE OF UNDERSTANDING THE PRACTICE AND ART OF FARRIERY IS OBVIOUS IN EQUINE VETERINARY MEDICINE."**
>
> —DR. STEPHEN O'GRADY IN A PAPER FOR THE AAEP

"In equine orthopaedics, one of the most debated, controversial, and scientifically studied motion events is breakover," researchers said. "This term describes the terminal part of the stance phase: the time period from heel-off to last hoof-ground contact (toe-off). In the second part of the stance phase, strain on the deep digital flexor tendon (DDFT) increases, causing passive flexion of the interphalangeal joints. This leads to full contact of the palmar surface of the navicular bone and the DDFT, resulting in high compressive and tensile forces on the navicular bone during early breakover.

"The peak forces exerted by the DDFT on the navicular bone occur at 86% of the way through the stance phase defining the beginning of breakover. During late breakover, as force

When it comes to farrier work, one size does not fit all; it should be tailored to horses' particular needs

is transferred to the ground to promote limb propulsion, a strong load acts at the dorsal hoof wall and the dorsal suspension of the distal phalanx. Therefore, in the context of everyday shoeing and orthopaedic treatment, several methods have been established to ease breakover by trimming and shoeing."

Because breakover is such an important moment in a horse's gait, researchers investigated the effect of trimming, heel elevation, and different types of shoeing on breakover duration with a novel, hoof-mounted inertial measurement unit sensor system. For the study, researchers used 10 riding school horses kept in the same stable and given the same feed, management, and use schedule.

The study horses were trimmed and shod by two experienced, certified farriers. They were examined barefoot before and after trimming, and fitted with an inertial measurement unit sensor at the dorsal hoof wall. Then applications of five-degree heel wedges, plain steel shoes, rolled-toe shoes, and palmarly-placed quarter-clip shoes were tested.

Measurements were performed at the walk and at the trot on a concrete walkway. Each horse took 40-50 steps for each measurement. Examinations were repeated with each of the different shoeing options. If a horse became upset while moving, data collection was stopped and only restarted once the horse had settled.

"Trimming had no significant influence on (breakover duration)," researchers concluded. "Heel elevation caused a significant decrease of (breakover duration) in walk and trot. Shoeing with a plain steel shoe resulted in a significant increase in breakover duration in walk. This could be rescinded by creating a rolled toe or placing the shoe palmarly. Obtained results emphasize the use of heel wedges or rolled-toe and palmarly-placed shoes to ease breakover in the context of therapeutic shoeing.

"The current study showed that the use of hoof-mounted IMU sensors to evaluate (breakover duration) dependence on trimming and shoe modification is a practical approach. Due to a very high measuring frequency and good resolution, the technical innovation of IMU sensors enables observation of small effects on specific motion events, such as the (breakover duration)."

Understanding more about hoof breakover has practical applications in Thoroughbreds as well. For the safety of both the horse and its jockey, the importance of healthy hooves is at a premium when racing. When it comes to racehorses in particular, researching what happens during breakover at

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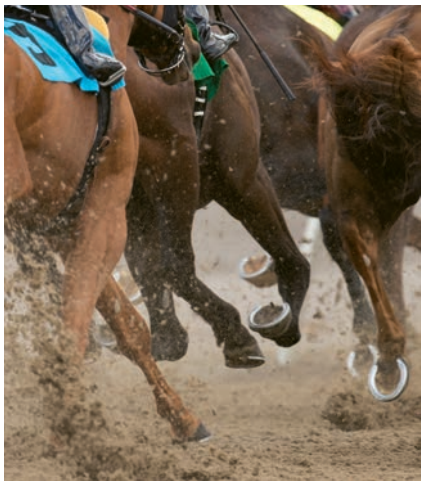
full speeds is important.

Researchers explored this in "Influence of Speed, Ground Surface and Shoeing Condition on Hoof Breakover Duration in Galloping Thoroughbred Racehorses," which was published by *Animals (Basel)* in September 2021.

"Understanding the effect of horseshoe-surface combinations on hoof kinematics at gallop is relevant for optimizing performance and minimizing injury in racehorse-jockey dyads," explained researchers. "Although gait is expected to impose a fundamental constraint on the rate of breakover, through its influence on speed, farriery manipulations of the hoof and environmental surface conditions are also relevant considerations."

Researchers used slow-motion video to measure breakover duration in 13 retired Thoroughbreds for the study. The horses were galloped on both turf and artificial tracks. Four different shoeing conditions were compared—aluminum, barefoot, GluShu, and steel—and hooves from different limbs were assessed separately.



MICHAEL BURNS

An understanding of the best horseshoes for various surfaces can optimize performance and minimize injury

"In galloping horses, breakover is thought to take place in the time period approximately 85% to 100% through stance," said researchers. "Increased breakover durations have been linked to increased hoof toe lengths as a longer toe is associated with a longer moment arm at the distal interphalangeal joint. Horses with low heels and long toes often lack phalangeal alignment, and it is plausible that these horses might benefit from trimming to shorten the toe or using shoes with the toe section positioned more caudally.

"Placing the toe region of a horseshoe more caudally causes the moment arm of the ground reaction force on the distal interphalangeal joint to reduce, and should therefore accelerate breakover. However, the peak moment and force on the navicular bone may not be greatly influenced because breakover starts earlier and at a high ground reaction force."

The horses used for the study were in regular work, including gallop training, as they were used for jockey education at the British Racing School. They were between 6 and 20 years of age, and their heights ranged from 15.3 to 16.3 hands. All were deemed sound by the jockeys, farriers, and veterinarian involved with the study.

Four jockeys also participated in the study, and the horse-jockey pairings were fixed. Each horse was ridden by two jockeys, leading to 14 possible total pairings, as the shoe-surface

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conditions were varied. The hoof-ground interactions were filmed at 1,000 frames per second using high-speed video cameras, and 384 filmed breakover events were quantified using Tracker software.

"Increasing speed was correlated with decreasing breakover duration, and this trend was more enhanced in the hindlimbs than in the forelimbs at high gallop speeds," researchers concluded. "Breakover duration was faster on the artificial surface compared to the turf surface for all limbs, under the ground conditions studied. The first limb to contact the ground surface after the suspension phase (the 'non-leading' hindlimb), was additionally influenced by shoeing condition and an interaction that occurred between shoeing condition and speed.

"Determining parameters that alter breakover duration will be important for lowering the risk of musculo-skeletal injuries, optimizing gait quality, and improving performance in galloping racehorses during both training and racing."

"INCREASED BREAKOVER DURATIONS HAVE BEEN LINKED TO INCREASED HOOF TOE LENGTHS ..."

—RESEARCHERS IN A SEPTEMBER 2021 STUDY PUBLISHED BY *ANIMALS (BASEL)*

When dealing with soundness in horses, one of the biggest threats to equine welfare is laminitis. Better understanding of breakover patterns might help with treatment. This was examined in the study "Effect of heel elevation on breakover phase in horses with laminitis" published in October 2020 by *BMC Veterinary Research*.

"In a laminitic horse, the maximal loading of the toe region occurs during the breakover phase," explained researchers. "To date, no kinetic data demonstrates the effect of supportive orthopedic therapy in horses with laminitis on breakover phase. Thus, the purpose of this study was to examine the effect of heel elevation on the breakover phase."

Eight horses who had been diagnosed with acute laminitis and treated medically, as well as with the application of a hoof cast with a heel wedge, were used for the study.

"Immediately following cessation of clinical signs of acute laminitis, two measurements using the Hoof System were taken: the first with (hoof cast heel wedge) and the second immediately following removal of the (hoof cast heel wedge), i.e. in barefoot condition," explained researchers. "The hoof print was divided into three regions: toe, middle hoof, and heel. Kinetic parameters included vertical force, stance duration, contact area for all hoof regions during stance phase, duration of breakover, vertical force in the toe region at onset of breakover, and location of center of force."

Researchers found that the vertical force and contact area were 63% and

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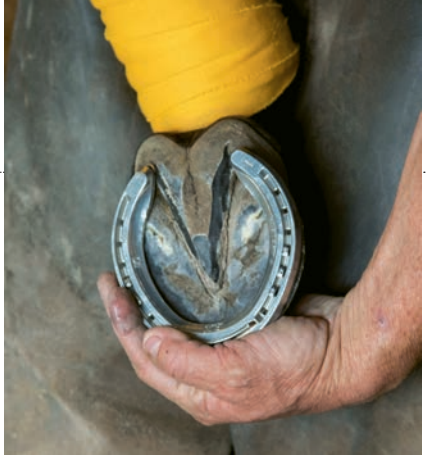
61% higher, respectively, in the heel region. They decreased 43% and 28%, respectively, after the removal of the hoof cast heel wedge. They also found that the breakover phase in horses with a hoof cast heel wedge was significantly shorter than barefoot. Additionally, the vertical force at onset of breakover for the toe region in horses with a hoof cast heel wedge was significantly lower, and the center of the force was located at the heel region in all horses with the hoof cast heel wedge, and at the middle the hoof region in the barefoot horses.

"Heel elevation in horses with laminitis as examined on a concrete surface significantly shortens breakover phase and decreases the vertical force in the toe region during breakover," researchers said. "(A hoof cast heel wedge) provides adequate support to the palmar hoof structures by increasing the contact area in the heel region and incorporating the palmar part of frog and sole into weight bearing, thus decreasing the stress on the lamellae. Hoof cast with heel elevation could be a beneficial orthopedic supportive therapy for horses suffering from acute laminitis."

Understanding the mechanics of how hooves work and how they are impacted by routine farrier care and shoeing options can improve the well-being of horses, both on the track and after suffering from a major setback such as laminitis. And, working with veterinarians and farriers to maximize the welfare of the horse can help Thoroughbreds achieve success on the track. BH



ALEXANDER BARKOFF PHOTOS

A racing plate is secured to a horse's hoof; Farrier Blake Labruzzo, who has about 100-120 sets of shoes in his truck at any one time, reaches for the proper shoe during a job

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