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CLINICAL TECHNIQUES

Long Toes in the Hind Feet and Pain in the Gluteal Region: An Observational Study of 77 Horses

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ABSTRACT

This study deals with the relationship between long toes in the hind feet and pain in the gluteal region in horses, and the remedial value of trimming/shoeing that moves the breakover point back at the toe. Seventy seven client-owned horses were studied, 67 shod riding horses retrospectively and 10 barefoot broodmares prospectively. The 10 mares were evaluated twice, and 24 of the 67 riding horses were re-evaluated at the next shoeing, for a total of 111 observations. Each horse underwent gluteal palpation and lateral radiographs of both hind feet. Toe length was quantified as breakover distance (BD), the horizontal distance between the tip of the third phalanx and the dorsalmost point at which the wall/shoe was in contact with the ground. The BD was then shortened with trimming +/− shoeing to a length of ≤15mm (shod horses) or ≤20 mm (barefoot horses). The 24 riding horses were re-evaluated 4-6 weeks later and the 10 broodmares 1 week after trimming.

The results showed that of the 67 riding horses, 75% were positive for gluteal pain at initial evaluation. The mean BD for the positive and negative horses was 24.2 ± 1.3 mm and 18.8 ± 2.0 mm, respectively ($p = 0.04$). At the next shoeing, the mean BD was 10.9 ± 2.3 mm and gluteal pain was improved in all 24 horses; 20 horses (83%) were negative and 4 horses (17%) were now only mildly positive. The 10 broodmares were all positive for gluteal pain initially. The mean BD before and after trimming was 23.7 ± 1.2 mm and 10.9 ± 1.1 mm, respectively. One week later, gluteal pain was improved in all 10 mares; 8 mares (80%) were negative, and the other 2 mares (20%) were only mildly positive.

The conclusion is that excessive toe length in the hind feet may be accompanied by pain in the gluteal region and, in our experience, may be associated with gait or performance problems. Shortening the toe can alleviate this pain within days or weeks. Aiming for a BD of between 0 and 20 mm probably is appropriate for the average-size horse.

Keywords: Horse; Foot; Hoof; Toe; Gluteal; Pain

INTRODUCTION

This article addresses an observation we have made that horses with long toes in the hind feet often show a pain response on palpation of the gluteal region. The riders or trainers of these horses often report performance problems that are related to bad behavior, resistance to the rider, lack of impulsion, or a stiff or irregular gait. Typically, the horse's gait and performance are improved with the trimming and shoeing strategy discussed in this article, which includes moving the breakover point back at the toe. However, what we had not yet ascertained was whether the gluteal pain also abated with this approach of hoof care, and thus was related to toe length in the hind feet.

In addition to long toes, the hind feet in these horses typically have low heels and lack adequate mass in the frog and digital cushion, in some cases having crushed, underslung, or collapsed heels. On lateral radiographs of these feet, the solar or plantar angle of the third phalanx (P3) in relation to the ground usually is zero or even negative (ie, the wings of P3 are level with or lower than the tip).

The hindlimb stance in these horses is one in which the load-bearing surface of the hoof appears to be too far forward in relation to the coronary band and to the fetlock and cannon (Fig. 1). These horses tend to "stand under themselves" with their hind feet, meaning that at rest the foot is placed further forward than normal in relation to the vertical axis of the limb and the main mass of the hindquarter, giving the horse a "sickle-hocked" appearance (Fig. 2). This stance may provide a clue to the reason why many of these horses show a pain response on palpation of the gluteal region and why many are performing below the expectations of their owner and/or trainer.

Myers used a railway metaphor to describe the complex biomechanics of the human musculoskeletal system and show how anatomical connections act as functional continuities.[1] Adapting that approach to the equine body, one

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Figure 1. Left: The load-bearing surface of the foot (between the two green lines) appears to be too far forward in relation to the coronary band and to the fetlock and cannon. Also, note that this horse is "standing under himself" with the right hind. Right: Close-up of the left hind foot, showing an underslung heel.

Figure 2. Horses with long toes and low heels in the hind feet often stand under themselves with their hind feet, making the horse appear sickle-hocked.

can track "lines of pull" through the various connective tissues and muscles all the way from the hind P3 up into the pelvic region and forward into the trunk (Fig. 3). According to this approach, a problem in any one of the functionally related structures between digit and head can affect that entire myofascial line, its counteracting line(s), and therefore posture and movement. One would also expect a pain response on palpation of areas under excessive tension or contracture.[1] With this concept in mind, it becomes easier to understand how the long toe, low heel, forward stance described previously and shown in Figure 2 could cause excessive tension and palpable pain in the gluteal region.

The aim of our study was simply to document this relationship between long toes and gluteal pain in a group of client-owned horses, and to show the remedial value of shortening the toe. Because "long toe" is a subjective visual assessment, we used an objective measurement (breakover distance or BD) taken from a lateral radiograph of each hind foot to document toe length in each horse. Our hypotheses were as follows: (1) BD in the hind feet is greater in horses with palpable gluteal pain than in those without gluteal pain, and (2) trimming and shoeing (or trimming alone in barefoot horses) to shorten the BD alleviates the pain in horses with gluteal pain.

MATERIALS AND METHODS

Subjects and Study Design

In the course of this observational study, we evaluated a total of 77 client-owned horses that were presented to our Equine Podiatry and Rehabilitation Service or examined on the farm by a member of our team, between April 2006 and December 2007. To be included in the study, the horse had to have a minimum of one set of lateral radiographs of the hind feet and recorded results of gluteal palpation performed on the same day. All horses, except 10, were studied retrospectively. The remaining 10 comprised a group of broodmares that were studied prospectively. For

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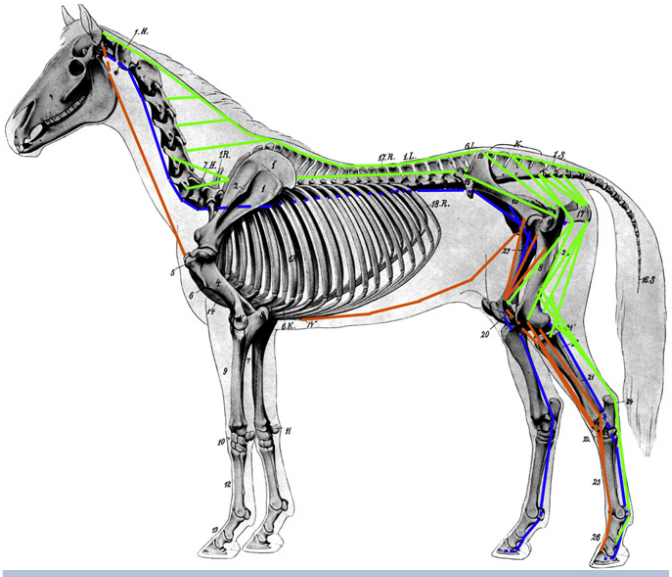

Figure 3. A simplified schematic of the most relevant functional myofascial lines in the equine hindlimb and their extensions through the trunk. Adapted from Myers,[1] Getty,[2] and Ashdown and Done.[3]

Figure 4. In the barefoot mares in study 2, the toe was trimmed to shorten the breakover distance (BD) to <20 mm. The black line drawn on this sole indicates where this toe is to be trimmed to achieve the desired BD, using the tip of the frog (red thumbtack) as a landmark (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article).

simplicity, we present the two groups here as two separate studies.

Study 1. Study group 1 consisted of 67 horses. Most were medium or lower level adult performance horses. Various breeds and disciplines were represented, consistent with the general population of riding horses in this area. The horses ranged in age from 4 to 24 years. Many were presented because of a gait or performance issue, but some were presented simply for routine evaluation and shoeing. The objective with this group was to compare the mean BD (defined below) between horses with and without gluteal pain.

The trimming and shoeing approach was fundamentally the same for all of the horses in this study group. The feet were trimmed to move the load-bearing surface further back under the coronary band (ideally, to the widest part of the frog at the heels). The shoe was then selected and positioned such that the breakover point at the toe was located no more than 15 mm forward of the tip of P3, using the apex of the frog as an external landmark. In horses with very low heels, the farrier applied a 3° heel wedge for a minimum of one shoeing cycle. However, heel wedges were not a primary component of this trimming and shoeing strategy and were used in less than half of the horses in this study group.

Within this group, 24 horses with gluteal pain on initial presentation were reevaluated 4 to 6 weeks later at their next scheduled shoeing visit. (Our Podiatry Service is primarily a referral centre, so less than half of the horses in this study group were presented again or available for follow-up.) The same procedures performed at the first visit (gluteal palpation, lateral radiographs of the hind feet, and measurement of BD) were repeated in these 24 horses at their second visit. The objective with this subset of horses was to see whether shortening the BD alleviated the gluteal pain in the course of a shoeing interval.

Study 2. Study group 2 consisted of 10 nonpregnant broodmares, selected because they had gluteal pain on initial evaluation. The group included six Thoroughbreds and four Warmbloods, all aged between 9 and 11 years. All 10 mares were living on the same breeding farm; all were kept barefoot and otherwise managed in the same way with respect to diet, housing, turnout, and footing.

On the first visit, lateral radiographs were taken of the hind feet. The BD was measured as described later in the text and then the toe was trimmed to create a BD of <20 mm. Specifically, the farrier used hoof nippers to remove the horn at the toe that laid dorsal to a straight line drawn on the sole at the desired BD as shown in Figure 4. No other trimming or dressing of the hoof was performed at that time.

The hind feet were radiographed once again immediately after trimming to ensure that the desired BD had been achieved, and the mares were reexamined for gluteal pain 1 week later. The objective with this group was to determine whether just shortening the BD (ie, making no other

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Figure 5. Palpating the gluteal area from the opposite side of the horse.

Figure 6. The equipment and setup used for taking lateral radiographs of the hind feet.

changes to the foot) alleviates gluteal pain, and if so, whether in days rather than weeks.

Gluteal Palpation

All of the horses in both study groups were evaluated for gluteal pain by the principal author (R.A.M.), with a manual palpation technique developed and used by him in clinical practice for the past 30 years. Although the technique is inherently subjective, some measure of consistency and repeatability is acquired through years of practice. Therefore, we endeavored to reduce variability by ensuring that the horses were all examined by the same experienced individual. Also, palpation was performed before the hind feet were radiographed. Thus, although the examiner could plainly see the horse's hind feet and stance, he was unaware of the BD at the time of palpation.

With this technique, the examiner stands on one side of the horse's hindquarter and, reaching over the croup, applies pressure with the fingertips along the lateral margins of the *tuber sacrale* of the ilium and the dorsal spinous processes of the sacrum, from there extending laterally to include the bellies of the gluteal muscles and the sacrotuberous origins of the hamstring muscles (Fig. 5). The examiner then moves around to the other side of the horse and repeats the procedure. Thus, both sides of the rump are palpated and the examiner avoids getting kicked.

Abnormal reactivity, which we interpreted as discomfort or pain, was recorded when the horse showed an evasive response to even light pressure or an exaggerated response to any amount of pressure that horses normally tolerate. Exaggerated responses included buckling of the hindlimbs, pinning the ears back, and threatening to kick or actually kicking the examiner. For the purpose of this study, we recorded each horse's reactivity as negative (normal response), positive (pain response), or mildly positive (mild pain response).

Figure 7. The BD is the horizontal distance between the two vertical lines drawn on the lateral radiograph below: at the tip of P3 and at the dorsal-most extent of ground contact of the shoe and/or wall.

Breakover Distance

Lateral radiographs were taken of both hind feet in all study horses, using the equipment and setup shown in Figure 6. The BD was determined by drawing a vertical line at the dorsal-distal margin (tip or apex) of P3, another at the dorsal-most point at which the shoe (shod horse) or hoof wall (barefoot horse) contacted the wooden positioning block, and measuring the horizontal distance between these two lines (Fig. 7).

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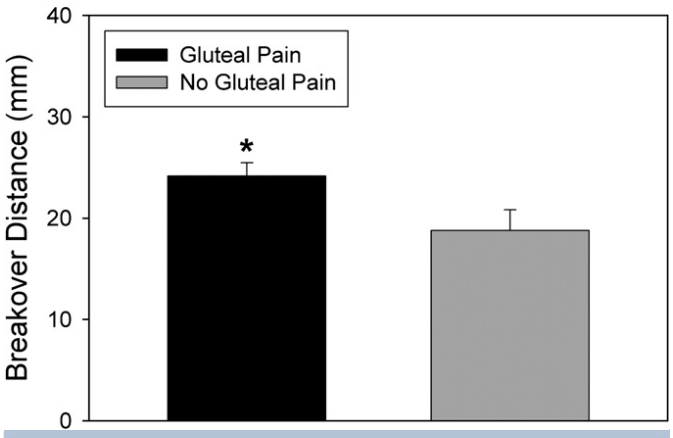

Figure 8. Results for the 67 horses in study 1. Of the 50 horses with gluteal pain, the mean BD was 24.2 ± 1.3 mm. The mean BD in the 17 horses without gluteal pain was 18.8 ± 2.0 mm (*$P = .04$).

Statistical Analysis

Descriptive statistics regarding BD were compiled for each study. In study 1, a *t*-test was used to compare the mean BD in horses that were positive on gluteal palpation and those that were negative. Values are reported as mean ± standard error of the mean.

RESULTS

Study 1

Of the 67 horses in this study group, 50 horses (75%) were positive on gluteal palpation and 17 horses (25%) were negative. The mean BD in the positive horses was 24.2 ± 1.3 mm (range, 5–43.5 mm; Fig. 8). The mean BD in the negative horses was 18.8 ± 2.0 mm (range, 5–33 mm). Although small, the difference in mean BD between positive and negative horses was statistically significant ($P = .04$).

The 24 horses with gluteal pain that were subsequently reevaluated had a mean BD of 25.6 ± 2.1 mm (range, 5–43.5 mm) at initial evaluation. At follow-up evaluation 4 to 6 weeks later, the mean BD was 10.9 ± 2.3 mm (range, −14.0 to 35.5 mm). At that time, all 24 horses (100%) showed improvement in gluteal pain; 20 horses (83%) were negative and four horses (17%) were now only mildly positive (each of those four horses with residual gluteal pain had no gluteal pain at the second shoeing).

Study 2

The 10 horses in this study group were all positive on gluteal palpation at initial evaluation. The mean BD before trimming was 23.7 ± 1.2 mm (range, 17.7–30.7 mm). The mean BD immediately after trimming was 10.9 ± 1.1 mm (range, 5.6–17.2 mm). On reevaluation 1 week later, all 10 horses (100%) showed improvement in gluteal pain; 8 of 10 horses (80%) were negative, and the other two horses (20%) were only mildly positive. None of the horses appeared lame at reevaluation, and no gait problems were reported by the farm manager.

Figure 9 is a graphic representation of the combined data from both study groups, including the repeat evaluations for the 24 horses in study 1 and all 10 horses in study 2 (ie, 111 observations in all).

DISCUSSION

The aims of our study were met because we showed a statistically significant relationship between long hind toes and gluteal pain and also the remedial value of shortening the BD. One could argue that a difference in mean BD of only 5 mm or so between the positive and negative horses in study 1 is too small to be clinically relevant. Furthermore, there was a good deal of overlap in individual BD between positive and negative horses. However, as Figure 9 graphically illustrates, there was a clear trend for BD to be longer in the horses with gluteal pain.

Clearly, some horses tolerate a long BD, at least with respect to the development of gluteal pain, or at least for a while. But that does not detract from the fact that shortening the BD alleviated the gluteal pain in all 34 horses that were available for reevaluation. Furthermore, the gluteal pain was improved or resolved within one shoeing cycle (study 1) or 1 week (study 2) of remedial trimming and/or shoeing. One might argue that the pain may have abated on its own, being transient or intermittent in nature. That is certainly a possibility, and one that was not accounted for in our study design. However, in our clinical experience the gluteal pain persists until the trimming and/or shoeing is corrected.

The next step is to investigate the functional significance of this association between BD and gluteal pain. Although not specifically addressed in this present study, several of the owners or trainers of the horses in study 1 reported that the horses were moving better or otherwise showed an improvement in performance coincident with the change in shoeing. These informal observations are consistent with the findings of McGinness, who studied the effects of a similar shoeing strategy in the hind feet (S. G. McGinness, BVSc, unpublished thesis, 2004). His approach involved moving the breakover point back at the toe and correcting the negative plantar angle with heel wedges. Measuring joint angles and stride length in the hindlimbs before and after shoeing, he found that shortening the toe and correcting the plantar angle significantly improved stride length. The horses were not lame and were in regular work at the time of his study, and still changing the shoeing in this way improved one function of the horse's gait (stride length), which in some equestrian

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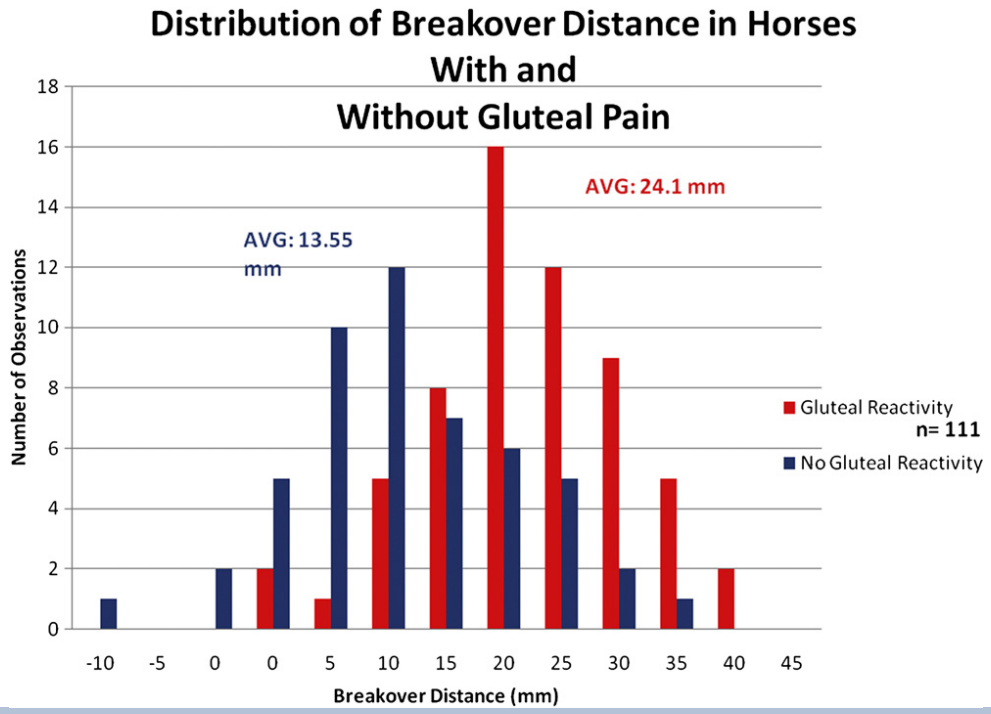

Figure 9. Graphic representation of all 111 observations in the study horses (including repeat palpations for 24 horses in study 1 and all 10 horses in study 2).

disciplines would translate into an improvement in movement and therefore performance.

With regard to the gluteal pain in the horses in our study, there are several possible reasons why a horse might be painful on palpation of the gluteal region. Most involve pathology of the muscles or skeletal structures of the sacroiliac region.[4-6] In this study, we propose another reason: excessive toe length in the hind feet. The biomechanics remain to be explored, but they could simply involve greater work for the hip extensors including the middle gluteal muscle, owing to the longer lever arm (ie, long toe). Although studies of the forefeet in sound horses showed no significant change in the duration of either stance or breakover with shoes designed to shorten or ease breakover,[7,8] hoof-unrollment, and therefore the work of breakover is eased by moving the breakover point back with the use of a rolled-toe shoe.[8]

What constitutes "excessive" toe length for a particular horse remains to be determined. However, on the basis of this single observational study, aiming for a BD of <20 mm seems to be appropriate for the average-sized horse. This target BD was effective in the horses in our study, and it may have some foundation in the anatomy of the hoof as well. As a priority of the locomotory system is to rotate P3 around the distal interphalangeal (DIP) joint, and the digit around the metacarpo- and/or tarsophalangeal joint, there would not seem to be any structural or functional advantage to the BD being any greater than the thickness of the dorsal hoof wall, which in the average-sized horse is in the range of 15 to 20 mm.[9]

Moleman et al showed that, over the course of an 8-week shoeing interval, the moment around the DIP joint increases.[10] Although toe length was not measured in that study, dorsal hoof angle was, and it decreased by at least 3.5° over the shoeing cycle, which is consistent with a progressive increase in toe length. One could reasonably conclude that shortening the BD would lessen the work of moving P3 around the DIP joint. Whether shortening the BD to zero or to negative figures has any extra advantage remains to be seen. We have inadvertently created a negative BD in a few horses, and noted that the horses did not seem very comfortable with it. From these observations and the present study, it would seem that the optimal BD for the average-sized horse is approximately between 0 and 20 mm.

In conclusion, the presence of long toes in the hind feet is often associated with pain on palpation of the gluteal region. Shortening the toe with trimming and shoeing, or trimming alone in the barefoot horse, alleviates the gluteal pain in a relatively short period (days or weeks). In cases when the toe length or gluteal pain was adversely affecting the horse's comfort or function, then one could also expect an improvement in the horse's gait and performance after remedial trimming and/or shoeing.

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