Response to Hock Flexion Test in Sound Horses as Measured by a Wireless, Inertial Sensor-Based Motion Analysis System

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Introduction

The University of Missouri has developed a wireless, inertial sensor-based motion analysis system for the objective quantification of lameness in horses. They are hoping to commercialize the product in 2008. This system has been tested in forelimb and hindlimb lameness in horses, and has been found to be precise when a horse is trotting up and down in a straight line during a normal lameness test. However, in hindlimb lameness it is common for veterinarians to perform a hock flexion test. This test consists of holding the horse's hock flexed for 30-60 second before trotting off in a straight line. The purpose of this experiment is to establish how the hock flexion test affects normal horses as measured by the wireless motion analysis system. The results of this experiment may affect the utility of the wireless motion analysis system by establishing a baseline for results expected after the hock flexion test. It is generally thought that lameness is amplified (or even temporarily caused) in the hind leg after hock flexion in horses with hock-centered lameness, but that horses without hock lameness are unaffected by the hock flexion test. However, this has not been objectively tested. We hypothesized that the wireless, inertial sensor-based motion analysis system will detect significant asymmetry in the first three to four strides after the hock flexion test, even in sound horses.

Preliminary Results

Figure 3: Mean of the Maximum Differences of Pelvic Position

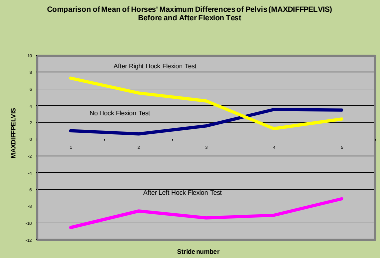
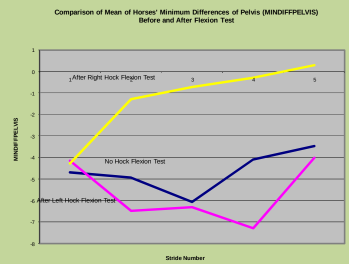


Figure 4: Mean of the Minimum Differences of Pelvic Position



Discussion

Preliminary results indicate that, even in horses without hock-centered lameness, the first few strides after the hock flexion test may be affected such that hind limb lameness may be incorrectly assumed. The difference in maximum height of the pelvis after pushoff (MAXDIFFPELVIS) was more affected than the difference in minimum height of the pelvis during the first part of stance (MINDIFFPELVIS). A left-sided hock flexion test caused a more negative MAXDIFFPELVIS for at least 5 strides (the maximum number of strides analyzed) after the hock flexion test, falsely indicating a left-sided, hock-centered lameness. A right-sided hock flexion test caused a more positive MAXDIFFPELVIS for the first 3 strides after the hock flexion test, falsely indicating a right-sided, hock-centered lameness. Results using MINDIFFPELVIS as the measure of lameness were less consistent and more difficult to interpret. There was no difference in MINDIFFPELVIS with or without hock flexion of either side for the first stride after hock flexion test. There was also no significant difference in MINDIFFPELVIS before or after left hock flexion test. However, after right hock flexion MINDIFFPELVIS was more positive than before flexion for every stride after the first up until the last stride collected, falsely indicating a right-sided, hock-centered lameness. Results of this study support the contention that the first few strides after hock flexion test should be discarded from evaluation.

Materials and Methods

Figure 1: Student performing a right-sided hock flexion test

This experiment used 10 horses from the University of Missouri's teaching herd. These horses were brought into the University of Missouri's equine veterinary teaching clinic, and underwent a veterinary evaluation. We then used the wireless motion analysis system to evaluate lameness and measure the response before and after performing the hock flexion test on a hind limb. This system consists of three sensors, as seen in Figure 2. The first is an accelerometer placed on the poll to measure vertical head acceleration, the second is a gyroscope placed on the cranial side of the right pastern to measure angular velocity and to be used as a stride position marker, and the third is an accelerometer placed between the tubera sacrale to measure vertical pelvic acceleration. We used this system to measure the maximum and minimum differences of the pelvic height as the horse trotted in a straight line. A sound horse should ideally have a difference of zero, with the maximum and minimum heights of the pelvis during the stance phases of the right and left hind limb strides being equal. We calculated these differences for each stride for five strides, and also calculated the mean of the differences. Because we evaluated each horse before and after both a right and a left hock flexion test, each horse serves as its own control.

Figure 2: Wish with wireless sensors

A: Sensor placed on poll to measure vertical head acceleration
B: Sensor placed on cranial side of pastern used as stride marker
C: Sensor placed between the tubera sacrale measuring vertical pelvic acceleration

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