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Girth pressure measurements reveal high peak pressures that can be avoided using an alternative girth design that also results in increased limb protraction and flexion in the swing phase

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ABSTRACT

Girths are frequently blamed for veterinary and performance problems, but research into girth/horse interaction is sparse. The study objectives were (1) to determine location of peak pressure under a range of girths, and (2) to compare horse gait between the horse's standard girth and a girth designed to avoid detected peak pressure locations. In the first part of the study, and following validation procedures, a calibrated pressure mat placed under the girth of 10 horses was used to determine the location of peak pressures. A girth was designed to avoid peak pressure locations (Girth F). In the second part, 20 elite horses/riders with no lameness or performance problem were ridden in Girth F and their standard girth (Girth S) in a double blind crossover design. Pressure mat data were acquired from under the girths. High speed video was captured and forelimb and hindlimb protraction, maximal carpal and tarsal flexion during flight were determined in trot. In standard girths, peak pressures were located over the musculature behind the elbow.

Pressure mat results revealed that the maximum forces with Girth S were 22% (left) and 14% (right) greater than Girth F, and peak pressures were 76% (left) and 98% (right) greater ($P < 0.01$ for all). On gait evaluation, Girth F was associated with 6–11% greater forelimb protraction, 10–20% greater hindlimb protraction, 4% greater carpal flexion, and 3% greater tarsal flexion than Girth S ($P < 0.01$ for all). Peak pressures were located where horses tend to develop pressure sores. Girth F reduced peak pressures under the girth, and improved limb protraction and carpal/ tarsal flexion, which may reflect improved posture and comfort.

Introduction

Girths are frequently blamed for veterinary and performance problems, but research into girth/horse interaction is sparse. It has long been accepted that girth galls (or sores) may occur when a dirty or poorly fitting girth is used or overused, and the location that is accepted as a high risk area is the skin of the axilla, caudal to the olecranon (Smythe, 1959; Rose, 1982; Fraser, 1992; Lloyd et al., 2003; Pusey et al., 2010). Muscles that lie under the girth are involved in locomotion and maintenance of posture, so excessive pressure or restriction of these muscle groups could potentially have a negative effect on movement patterns (Pilliner et al., 2002; Wyche, 2003; Wright, 2010). However, there has been no previous reported investigation into the pattern of pressure distribution under girths and whether this could be alleviated to reduce the potential for development of injury or to improve performance.

The objectives of this study were (1) to determine the sites of maximum pressure under different girths in horses in trot using a pressure mat; (2) to design a girth that avoids sites of maximal pressure during movement, and (3) to compare the maximum pressure and gait characteristics of horses wearing the designed girth with those in the same horses wearing their usual girths. It was hypothesised (1) that there are repeatable locations of maximum pressure under different girth designs; (2) that use of a girth designed to avoid locations of maximum pressure does reduce maximum pressure compared to the horse's usual girth, and (3) that use of the designed girth leads to greater stride length, carpal and tarsal flexion in trot compared to the horse's usual girth.

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Materials and methods

Experiment 1: Assessment of pressure distribution under frequently used girths

Ten elite competition horses (3 jumpers, 3 eventers, 4 dressage), of height (1.62–1.70 m [16–16.3 hands]) were used to evaluate pressure distribution under 15 girths: nine were standard girths (length 127–137.2 cm [50–54 inches]) and six were dressage girths (61–76.2 cm [24–30 inches]). All girths were normally used by these horses for training and competition.

A small format pressure mat (432 mm long and 108 mm wide, 32 sensors long and 8 sensors wide) (Sensor Elastisens ES-256, Novel) was positioned centrally underneath the girth, with the end of the sensors located 4 cm above the olecranon process (±2 cm) (Fig. 1). The girth was fastened until just touching the skin, the mat was zeroed then the girth was tightened symmetrically to the tension that the rider normally used, ensuring that the mat remained central. Prior to testing, repeatability of positioning and data collection was confirmed. A camera (Samsung Digital Cam VP-D371W) capturing at 50 frames/s was synchronized with the mat and the programme. The mean peak pressures for each rein were plotted against point in the stride.

Horses were warmed up in their usual routine. Readings were obtained from three straight line passes on each rein in rising trot between markers placed 10 m apart. Pressure mat data were captured using blue tooth technology and simultaneous video footage was recorded.

The magnitude of peak pressure at each sensor was recorded, and the locations of highest peak pressures during trotting were identified. The timing of peak pressures on each limb was compared with the simultaneous video data to identify the point in the stride at which the peak pressures occurred.

Experiment 2: Effect of girth type on pressure distribution and gait parameters

Based on the results of Part 1, a girth was designed to avoid the locations of peak pressure (Girth F). The locations of the peak pressures for all Girth S designs were plotted on a grid and a common high pressure zone towards the cranial aspect of the girth was identified. A girth was then designed to avoid the high pressure zone. The cranial border and underside of the girth was lined with high performance pressure absorbing material to improve the interface with the horse (Girth F). Pressure patterns under the girth and horse gait were compared between Girth F, and the horse's usual standard girth (Girth S).

Fig. 1. The pressure mat positioned under a horse's girth during the study.

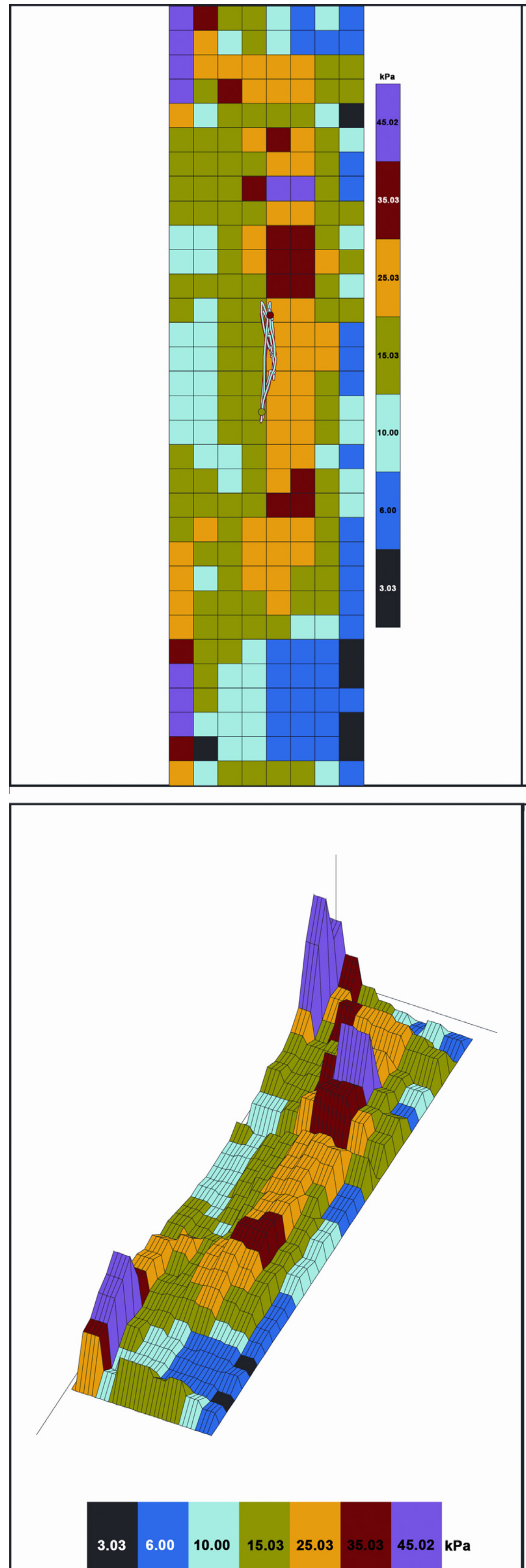

Fig. 2. Pressure distribution detected by the pressure mat located under the usual girth (Girth S) of a horse in trot illustrating the consistent pattern of peak pressure locations under the cranial edge of the girth. These areas of high peak pressure correspond to a location on the horse immediately caudal to the olecranon process of the ulna. The scale at the bottom of the picture shows the scale for peak pressure measurements at each location. Cranial is to the left of the picture.