HOW GIRTHS

HAVE BEEN SCIENTIFICALLY PROVEN TO HAVE AN IMPACT ON PERFORMANCE

Groundbreaking research has revealed the effect girths can have on the locomotion of the galloping racehorse.

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Generally, whenever the subject of tack and equipment is discussed, the saddle is always the first, and possibly even the only, consideration. Recent scientific studies have revealed interesting findings relating to girth design and its association with gallop kinematics (movement). These findings could bring significant benefits for trainers—in terms of performance and equine health.

It seems the girth has the potential to be more influential and important than ever been imagined. Indeed, the girth's impact on equine locomotion has been reported to be so great that authors of a study suggest the girth and its fit should be considered by a veterinarian when evaluating a horse for poor performance.

Thanks to advances in technology, we have enhanced our understanding of the physiological and biomechanical demands placed on the horse. This evidence-based knowledge is leading to progress in the development of race and exercise tack, allowing trainers to optimise benefits brought about by the design and fit of saddles and girths—benefits which have been quantified using scientifically robust principles and state-of-the-art measuring systems.

Pressure matters

The association between saddle pressures and back discomfort is a topical area within the equine literature. Studies have reported that a mean saddle pressure of more than 13kPa, or peak pressure of more than 35kPa, has the potential to cause ischemia—compression leading to soft tissue and follicle damage. This can result in the appearance of white hairs, muscle atrophy and skin ulcerations, with the potential to induce discomfort.

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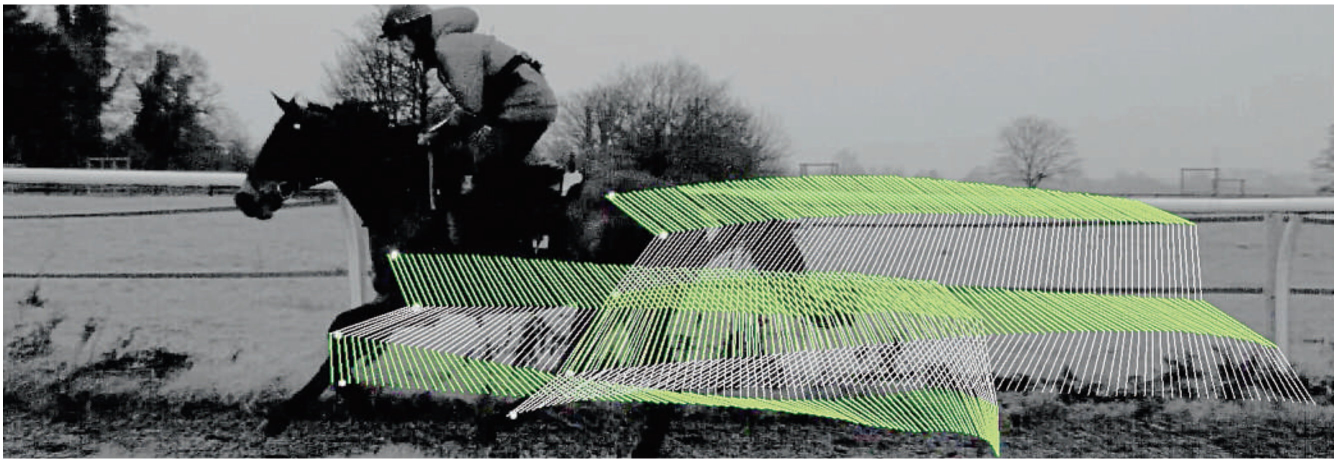


It has always been assumed that girth pressures are at their highest on the midline of the horse's trunk, at the horse's sternum (breastbone) where the girth passes over the bone. In a study investigating girth design on sport horse performance, researchers identified repeatable high pressures beneath the girth, but these pressures were actually located behind the elbow, not on the sternum. This also seems logical, given it is the location where girth galls and girth pain may appear.

Adapting technology previously used in saddle-based research, using a pressure mat with 256 individual pressure sensor cells, researchers were able to quantify the precise levels and exact location of actual pressures beneath the girth. For the first time, they were able to demonstrate how the pressure distribution changes during locomotion and show that the pressure peaks are directly associated with the timings of the gait.

Limb kinematics were quantified using a two-dimensional motion capture system. The combination of pressure mapping and gait analysis demonstrated that a girth designed to alleviate pressure, particularly in the region behind the elbow, resulted in an improvement in equine locomotion and the horse's movement symmetry.

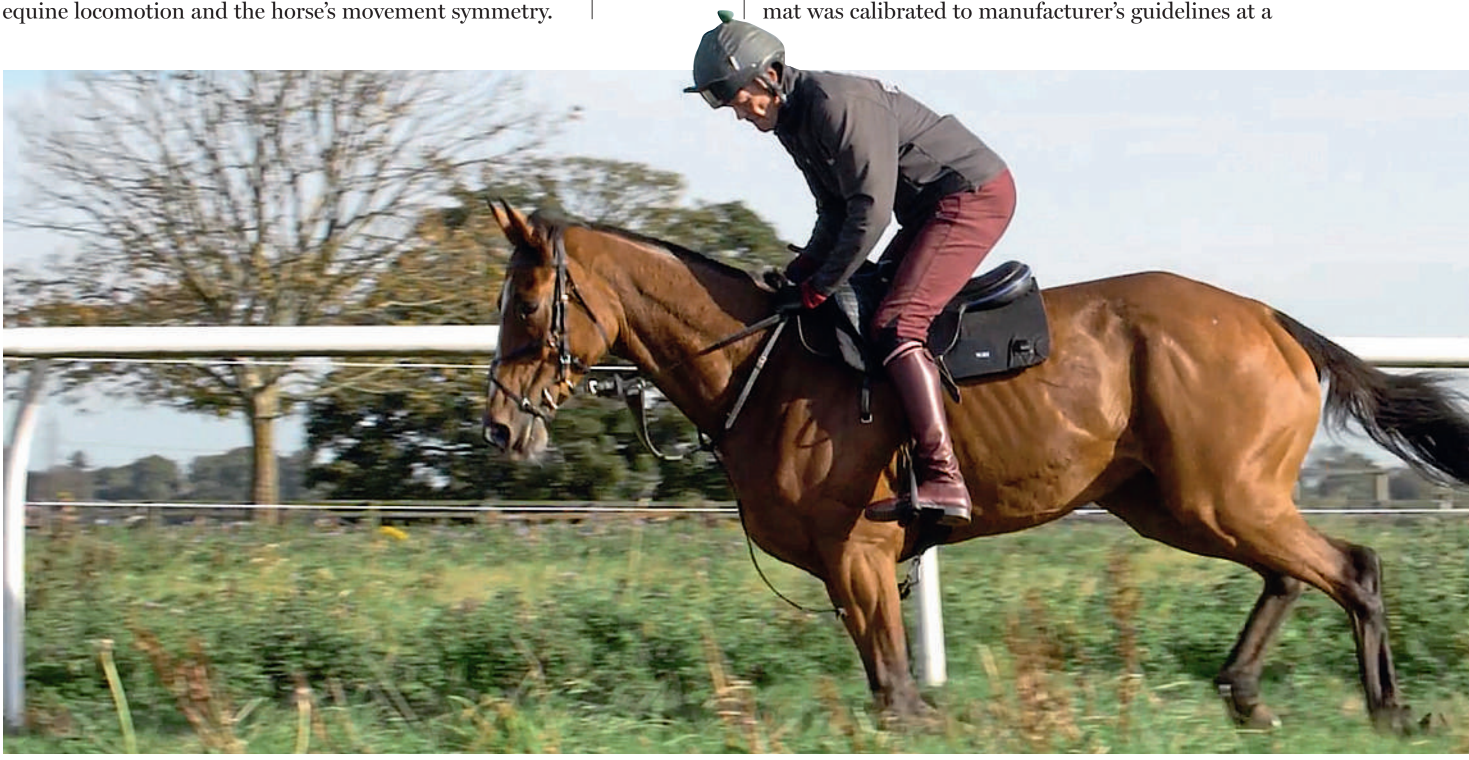
ABOVE: Two-dimensional motion capture is used to quantify improvements in gait.

Speed increases pressure

The groundbreaking findings from the sport horse study sparked further investigation into racing thoroughbreds. It is accepted that high speeds are associated with higher pressures under the saddle and, applying the same principles to a girth, it was speculated that girth pressures may increase with an increase of speed.

In a recent experiment, researchers quantified girth pressures in a group of racehorses that were galloping on a treadmill at a standardised speed wearing commonly-used exercise girths. All girths were of the same length and tension. Just as in the sport horse study, increased girth pressures were identified behind the elbow in the galloping thoroughbred, with pressure peaks occurring when the forelimb opposite to the leading leg was in stance (see photo).

Although the location of pressure was consistent between sport horses and racehorses, the magnitude of the pressures recorded under commonly used race girths was dramatically higher—and far higher than had been reported in any previous saddle study. The girth pressure mat was calibrated to manufacturer's guidelines at a



RIGHT: The area of peak pressure (shown in red) caused by a straight girth is avoided by the cutaway shape of the modified girth.

maximum of 106kPa, but in the racehorse study pressure values for a galloping horse wearing a regular girth peaked out above the highest calibration point. It was not possible to estimate the exact magnitude of girth pressure, but it is worth noting that 106kPa is already three times the peak pressure reported to cause capillary damage and discomfort beneath a saddle.

In the second part of the experiment, the same horses were galloped over-ground in order to quantify gallop kinematics and determine if there was any change when girth pressures were reduced. Data demonstrated that a modified girth, designed to avoid areas of peak pressures, significantly improved the horse's locomotion at gallop with increased hock flexion, hindlimb protraction and knee flexion.

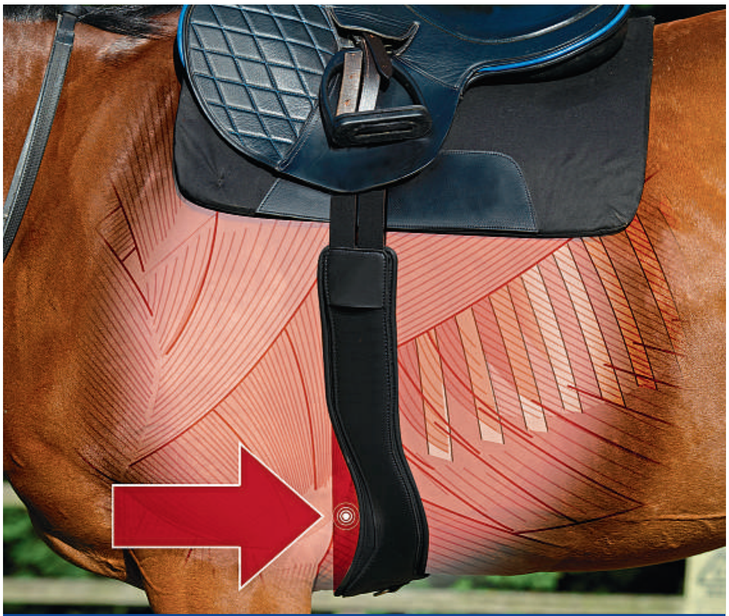
Space to breathe

Girth pressures are also thought to have an influence on the horse's capacity to breathe efficiently. One study demonstrated a relationship between increased girth tension and a reduced run-to-fatigue time on a treadmill, indicating that girths can affect the breathing apparatus of the galloping horse.

The more recent girth pressure study also identified a relationship between peak pressures in a normal girth and breathing. This study didn't quantify respiration rate, but visual observation of the pressure mat data indicated a peak pressure on inhalation. When the horse was wearing the modified girth, the pressure spikes (speculated to be related to the intake of breath) were no longer evident.

It has been reported that the equine rib cage has a limited range of expansion directly where the girth sits.

BELOW: The moment in the stride when peak pressure is seen—the point where the musculature is trapped between the front of girth and back of leg.



THE SHAPE OF THINGS TO COME

The research performed on the treadmill demonstrated that a straight girth created areas of high pressures in excess of 106 kPa behind the elbow, on muscles that are vital for locomotion and respiration (see Essential anatomy).

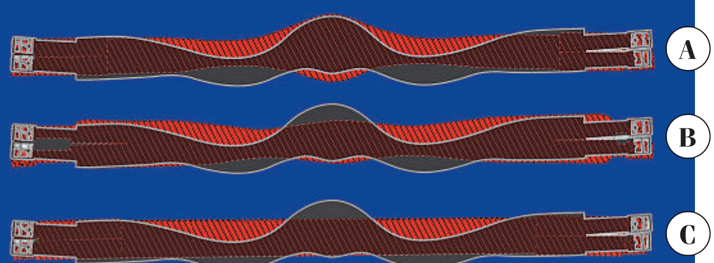
These high pressures may lead to discomfort and could subsequently compromise performance. It is likely that horses will still perform, but in doing so, they will develop a locomotor compensatory strategy to alleviate discomfort caused by the girth.

Consider this: A horse galloping seven furlongs twice a day will make approximately 363 repeated gallop strides. In a girth that creates high pressures, this will result in 363 peak pressure spikes behind the elbow.

A compensating strategy caused by girth pressure will undoubtedly have a negative effect on gallop performance and efficiency, and ultimately health. Compensation strategies may manifest themselves with horses altering their gallop lead, demonstrating excessive lateral bending away from the leading leg, or stiffening of the thoracolumbar spine. In addition, there may be clinical signs of skin ulcers and bruising, along with muscle pain in and around the girth region.

The development of compensatory locomotor strategies will lead to asymmetric force production. We know these asymmetries have an effect on the horse at walk, trot and canter; and it is likely that these will be amplified when galloping.

Researchers compared a modified girth, designed to avoid areas of peak pressure behind the elbows, to the most commonly-used designs. Pressures were significantly reduced in the modified girth, which incorporates a medical-grade, close-cell layer which is proven to reduce force. A publication is currently under review which demonstrates that this pressure reduction is associated with improved gallop efficiency and performance.



The new modified design in comparison to A: anatomic girth, B: shaped girth, C: straight girth.

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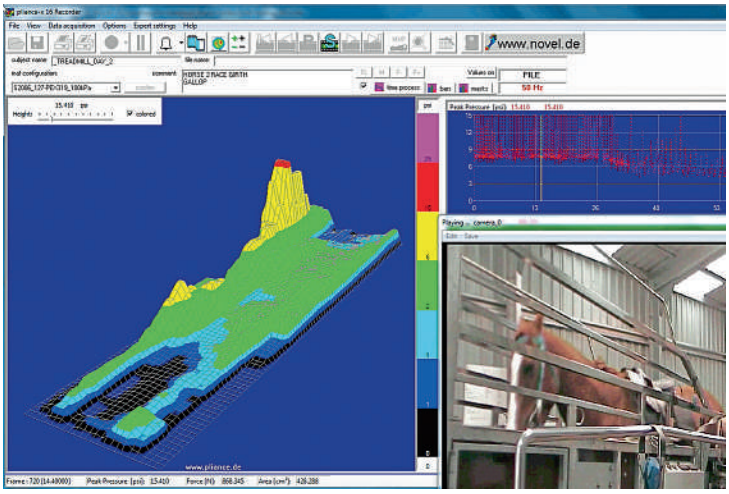
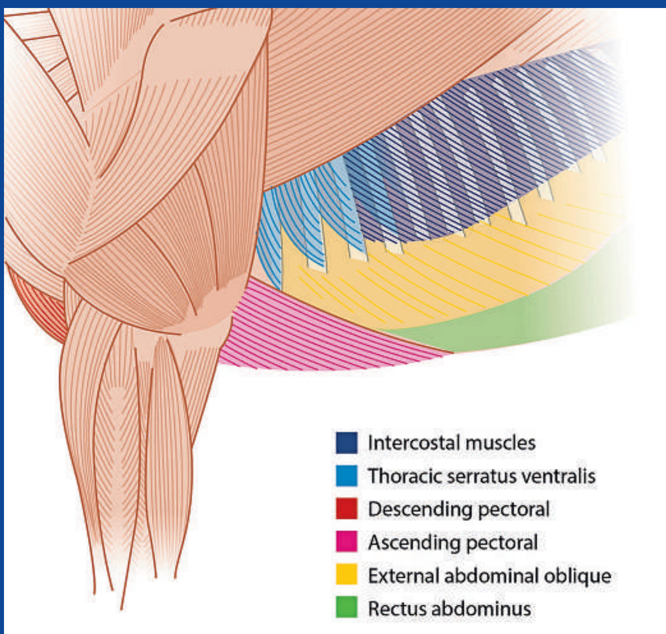


ABOVE: Pressure under a straight girth on a horse galloping on a treadmill was higher than the pressure mat could record.



ESSENTIAL ANATOMY

From an anatomical viewpoint, girth design and fit are important in order not to hinder equine locomotion. A girth lies over the junction of various muscles that are involved in posture and forelimb locomotion (see diagram). Muscles require room to contract efficiently, and if they are restricted by girth pressures, contraction may be compromised, which will limit locomotion.

Pectorals and thoracic serratus ventralis
The thoracic serratus ventralis is part of the thoracic sling mechanism. Together with the pectorals, it is important in support and elevation of the ribcage.

Rectus abdominis and external abdominal oblique muscles
Also situated in the girth region, these muscles are responsible for raising the trunk and inducing flexion of the thorax, lumbar and sacral sections of the spine. Increased flexion of these regions facilitates hindlimb protraction. Therefore, discomfort caused by girth pressures are likely to affect the extension of the hindlimb.

Intercostal muscles
These small muscles between the ribs are used in respiration. The external intercostals are responsible for inhalation.

The shape and fit of the modified girth design reduces pressure from the intercostal muscles and therefore does not hinder the rib cage's naturally occurring expansion.

The girth pressure studies in sport horses and racehorses suggest that muscle function could be highly significant in relation to the time it takes a galloping horse to fatigue.

Muscles need to contract in order to work effectively. If pressure from the girth negatively affects muscle activity, this could result in restricted function and limit the limb's full range of motion. Subsequently, the muscles may have to work harder and, if they are required to work harder, may fatigue faster.

When scientific evidence shows that commonly used girths are compromising muscle function and restricting breathing during galloping, the advantage of the modified design becomes obvious.

Not so fantastic elastic

One anecdotal belief is that girths modified with elastic inserts offer some form of pressure relief, allowing the horse's rib cage to expand, therefore enhancing instead of hindering breathing mechanics. However, in the sports horse research, adding an elastic component to the end of the girth did not result in increased locomotion or any alteration in pressure distribution beneath the girth. In contrast, the addition of the elastic decreased the stability of the saddle. Furthermore, new elastic girths can provide up to six inches of stretch and, as a result, are easy to over-tighten. With daily use, the elastic component of the girth weakens over time, losing its elastic properties and stretching. From a safety viewpoint, where elastic girths are being used in race training, routine checks of the stitching and elastic strength are crucial.

Anticipated pain and ulcers

In practice, without the use of sophisticated measuring systems and in the absence of skin ulcers, girth pressures will largely go undetected. However, behaviour when being tacked up, particularly when the girth is being done up, can be indicative of girth-related pain and discomfort.

Similar to humans anticipating pain, horses increase cortisol and gastric acid production, leading to gastric irritation. For horses that already have clinical signs of ulcers, this, combined with excessively high girth pressures in excess of 106kPa behind the elbow at gallop, is likely to lead to increased discomfort. As a result, health and performance are likely to be compromised.

The use of a pressure-relieving girth may be an effective tool when used as part of a multidisciplinary approach in supporting horses undergoing treatment and management of ulcers. If pressure-related discomfort is eliminated, it seems likely that the anticipation of, and response to, pain will be reduced over time. T

Further reading
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