In this talk Dr. Clayton will describe the latest research findings from the McPhail Equine Performance Center at Michigan State University, including studies describing the effects of physical therapy and rehabilitation in horses, the development of gaits and balance in foals, and measurements of saddle pressure and rein tension.

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Dr. Hilary Clayton is a veterinarian, researcher and trainer. Her research interests are in equine sport sciences, especially biomechanics and conditioning of sport horses, and the interaction between rider and horse. She has competed successfully in many equestrian sports and is currently competing at the Grand Prix level in dressage. She has earned USDF gold, silver and bronze medals riding a horse bred by Michigan State University.

Saddle Pressure Measurement

We use an electronic pressure mat with 256 small sensors embedded in it to measure pressure of the saddle on the horse's back. The mat is placed under the saddle to record the amount of pressure between the saddle and the horse's back. Pressure registered by the sensors is transmitted to a laptop computer using Bluetooth technology, so there are no wires connecting the horse to the computer. This allows the horse and rider to move freely around the arena while pressures are being measured.

A software program calculates the total force on the horse's back by adding the forces on all the individual sensors. This allows us to compare the pressure distribution between the left and right sides of the horse's back and monitor weight shifts between the front and back of the saddle.

The pressure pattern on the horse's back is displayed in color on the computer screen with black representing the lowest pressure and increasing through blue, cyan, green, yellow, red and pink, which represents the highest pressure. Since this article is published in black and white, the color bands appear as shades of gray, with darker gray areas representing higher pressure.

Information from the sensors can be displayed in three ways as shown in figure 2: the sensor plot (below left), the 2D contour plot (below center) and the 3D contour plot (below right). The sensor plot shows each individual sensor as a rectangle. The 2D contour plot blurs the edges between individual sensors to give a smooth pattern that looks like a contour map. In the 3D contour plot, areas of higher pressure are more elevated, which makes the gradations in pressure easier to appreciate in black and white pictures. Therefore, the pressure patterns in this article will be shown as 3D contour plots.

Three displays of saddle pressure information: left: individual sensor plot; center: 2D contour plot; right: 3D contour plot. The pommel is toward the top, the cantle toward the bottom, and the left side of the horse's back is on the left. The 3D contour plot has been rotated a little counter-clockwise to show the elevations that represent higher pressure.

Saddle Fit

Some problems of saddle fit are evident with the pressure mat as shown in the pictures below.

Pads are useful to even out the pressure in saddles that are basically the correct size and shape. Sheepskin has performed particularly well in our studies with the pressure mat.

Mounting Study

One of the essentials of riding is that we must mount our horse every time we go for a ride. Surprisingly, there has not been any research on the pressures exerted on the horse's back during mounting nor have there been any comparisons of how much force is associated with different mounting techniques. The purpose of this study was to compare the force and pressure pattern on the horse's back when a rider mounted from the ground versus mounting from a two-step mounting block, 34 cm high.

The subjects were 10 experienced riders ranging in weight from 53 to 76 kg. Each subject mounted from the left side; three times from the ground (using the method described in the Pony Club's Manual of Horsemanship) and three times from the raised mounting block in random order. The pressure mat showed the pressure pattern and displayed a graph showing the total force on the horse's back throughout the mounting effort.

During mounting, the pressure distribution was not symmetrical on the left and right sides of the horse's back. Pressure was highest on the right side of the withers, which stabilized the saddle as the rider weighted the left stirrup. The left side of the withers was unweighted but there was an area of high pressure on the horse's left shoulder. The horse had to brace himself to withstand this asymmetric loading pattern, and it is easy to speculate that this could be associated with uneven muscle development in the left and right shoulders, which is frequently identified by veterinarians and saddle fitters.

The force on the horse's back was highest when the rider's right leg was swinging up over the horse's haunches. The maximal force was significantly higher when mounting from the ground than from a mounting block.

These results confirm that the use of a mounting block reduces the force on the horse's back compared with mounting from the ground, which is particularly important because of the asymmetrical distribution of the pressure on the horse's back. If possible, I would recommend using a platform that is high enough for you to step onto the horse without using the stirrup or, as an alternative, to accept a leg up. If you have to mount using the stirrup, then use a mounting block and get into a habit of switching between the left and right sides, even though mounting on the right may feel awkward at first. We expend considerable effort trying to make our horses straight and symmetrical on the left and right sides. Mounting from the ground is counter-productive in our search for straightness.

We picked up some other interesting tidbits of information from this study. There were large differences between riders in how much force they placed on the horse's back when they landed in the saddle. A soft landing was associated with much lower forces, so it's worth the effort to sink gently into the saddle.

Mounting with the stirrup displaces the saddle to the left, resulting in higher pressures on the left side of the horse's back. Some riders had a habit of stepping strongly into the right stirrup to center the saddle, which was associated with high forces on the horse's back. This movement was partially, but not completely, effective in equalizing the pressure distribution between the left and right sides. This is another good reason for mounting without using the stirrup.

Bitting Studies

We have preformed a series of studies to investigate the position and action of different bits in the horse's mouth using a technique called fluoroscopy in which radiographs are recorded as videos. Eight horses were fitted with a bridle adjusted so the bit was high enough to just lift the corners of the mouth and a flash noseband was fitted just tightly enough to contact the face but not tight enough to indent the skin. Fluoroscopy was performed with six bits: loose ring, single jointed snaffle, boucher, KK Ultra, and three Myler bits. The bits are shown in the photo on next page.

Jointed Snaffle

The single jointed snaffle hung downwards on the tongue with the joint protruding toward the roof of the mouth where it can put pressure on the underlying bone of the hard palate. When tension was applied to the reins, the mouthpiece became more deeply embedded in the tongue, so it moved away from the palate.

KK Ultra

The KK Ultra is a double-jointed bit with a short rounded middle piece. Unlike a single jointed snaffle, it has a smooth surface facing toward the palate. Rein tension moved the entire mouthpiece of this bit away from the palate by compressing the tongue. The relatively large separation of the metal from the palate, combined with the smoothness of the surface of the central link, may explain why many horses perform well in this bit.

Boucher

The Boucher bit has an upper ring for attachment of the cheek pieces and a lower ring for attachment of the reins, which results in this bit having a more stable position in the horse's mouth when tension is applied to the reins. The joint is lies close to the palate and, since the mouthpiece has relatively little mobility, it is difficult for the horse to move the bit within his mouth. Consequently, this may be an uncomfortable bit for some horses.

Myler Bits

The two arms of a Myler bit meet within a central barrel that allows a swiveling motion but does not permit any nutcracker action. The Myler mouthpieces were positioned relatively high on the tongue and the barrel prevents any squeezing action on the tongue. The horse may be able to use his tongue to push against the mouthpiece, giving him a degree of control over the position of the bit and the areas affected by pressure.

Radiographic views of the horse’s head with the different bits in place.