ON THE BRIDLE

SCIENTIFIC RESEARCH UNCOVERS THE PERFORMANCE ADVANTAGES OF REDUCING BRIDLE PRESSURE

Dr. Russell Mackechnie-Guire Steven Cargill

Using a modified bridle design has a significant impact on whole horse locomotion–front and hindlimb–not just the head.

Recent scientific advances have seen an increase in performance-based research, particularly in the sport horse world where a podium finish can depend on the smallest of margins. The findings from the sport horse research can be translated to the racing thoroughbred where the shortest distance can put you first past the post. All items of training tack and equipment have found themselves under scientific scrutiny, with some unexpected results which could have significant effects on racehorse performance.

Perhaps one of the most surprising discoveries was the effect that bridle fit and design has on the locomotor apparatus of the horse (biomechanics). The bridle is a neglected item of tack which has, until now, received little scientific attention.

Ahead of the game

As well as improving locomotion these findings could have a significant benefit when it comes to resolving common issues affecting race performance, such as oral lesions in the commissures (corners) of the lips, tongue lolling and hanging, as well as steering or control issues.

Research indicates that these behaviours are likely to occur as a result of the horse seeking relief from bridle pressure and instability. Tongue ties or Australian nosebands are two examples of gadgets traditionally used to remedy these issues, but they have their own welfare and pressure-inducing concerns. A more effective solution would be to remove the primary cause of discomfort which leads to the negative or undesirable behaviour by using a modified pressure-relieving bridle design.

Pressure head

Research using a calibrated pressure sensor mat, which was positioned beneath all parts of the bridle, revealed interesting findings and disproved some long-held assumptions.

It had long been thought that horses experience bridle pressure directly on their poll. In contrast, the research team found no significant areas of pressure over the poll. Instead, areas of high peak pressure were located at the base of the ears in the region where the browband attaches to the headpiece. Anatomically this corresponds to the temporomandibular joint (TMJ). The TMJ is an essential part of the physiological apparatus, associated with the swallow reflex and the hyoid apparatus (see anatomy panel). The location of pressure (base of the ear and TMJ) was consistent in all commonly-used headpieces and occurred at the same moment in the stride, regardless of the make or design.

The research team also used gait analysis where markers are placed on the horse's anatomical locations (joints), allowing locomotion to be measured. This enabled them to quantify how front and hindlimb kinematics altered, revealing an increased range of limb motion when the peak pressures in the anatomical zones were removed.

Noseband knowledge

Published research has shown that nosebands, as well as the headpiece, can be associated with extremely high pressure and distribution, and therefore also have significant effects on equine locomotion. From the research it was found that maximum noseband pressure was located on either side of the nasal bone, causing compression of the soft tissues in this area. Similar to the headpiece, the timing and location of the noseband pressures were consistent in every stride cycle.

During locomotion, noseband pressures differed relative to the horse's head position. When the head was positioned more horizontally (for example when galloping) the frequently-chosen cavesson exerted significantly higher pressures on the lower edge of the noseband, which was associated with a reduced range of motion. Previous studies from this group have shown that reducing high pressures beneath a girth and saddle is associated with improved locomotion. The same relationship is seen with the bridle; areas of high pressures beneath the headpiece and noseband have a significant effect on equine locomotion and cause the horse to develop a compensatory locomotor strategy.

Fig 1: A sensor mat was used under many different bridles and nosebands to measure and record pressure on the horse's head in motion.

A specially designed Mexican grackle, which sits higher on the side of the horse's head above the main artery and vein running under the facial crest, was found to exert the least pressure and, consequently, was associated with an improved locomotion and increased joint range of motion.

It might be easy to assume that removing the noseband removes the problem, but this has been shown to be counterproductive. noseband provides stability to the bridle and improves the interface between bridle and head. It has been shown that horses perform better when the bridle (and all equipment) is stable. Horses require stability in order to effectively transfer propulsive forces from the hindlimbs to propel their mass forward. If the horse is unstable, it will seek a stabilising strategy, which consequently will induce asymmetry and a loss in performance. The use of a noseband to improve bridle stability could therefore improve the locomotor apparatus, give the jockey a more refined contact and help influence gallop efficiency more effectively.

A bit of stability

As well as stabilising the bridle, bit stability is likely to be improved in a bridle with a noseband. Researchers speculate there is a link between bit stability, bridle pressure and the horse hanging. If a horse is holding its head to one side to alleviate bridle discomfort, an unstable bit is able to be pulled through the mouth, increasing loss of control and oral discomfort.

A jockey who finds himself dealing with a hanging issue could inadvertently also be compromising hindlimb power. A study, which is under review, has found that in sport horses, increased rein tension when turning affects the inside hindlimb protraction (how far the hindlimb can come forward under the horse). In a racing context, if the horse is hanging to the right and its trunk is going to the right, the jockey has to counteract this with the left rein. The research suggests this will have a negative effect on the left hindlimb. So, if we can eradicate hanging by means of a pressure-reducing bridle design, we could reduce the negative effect and improve performance.

> "ORAL LESIONS CAN OCCUR IN A HORSE WEARING A BIT WHEN IT OPENS AND CLOSES ITS JAW, TRAPPING THE SKIN BETWEEN THE UPPER AND LOWER TEETH."

Oral lesions

If the bit pulls through the mouth, as well as control being compromised, the chance of oral lesions and blood at the commissures (corners) of the lips is increased.

A recent research study across a variety of equestrian disciplines has shown that lesions and sores in the mouth are 2.6 times more likely in horses ridden with no noseband compared to those with a loosely-adjusted noseband. Furthermore, 48% of racehorses were shown to have oral lesions—the highest percentage across any of the disciplines in the study. Interestingly, they are also the group where bridles without nosebands are most commonly used.

Oral lesions can occur in a horse wearing a bit when it opens and closes its jaw, trapping the skin between the upper and lower teeth. The function of a correctly fitted noseband is not to apply pressure when the jaw is closed; pressure is only applied when the jaw is opened. Therefore, the use of a correctly fitted noseband could contribute to a reduction in oral lesions.

There is no evidence to suggest that a well-fitting noseband restricts airway function or respiration, in fact with the jaw closed and the lips therefore sealed, nasal respiration is shown to be optimised and the horse's breathing improves.

TONGUE IN CHEEK

In ground-breaking research, Professor Hilary Clayton used X-ray fluoroscopic videos (moving X-rays) to examine what happens inside the mouth when using various bits, and captured footage of cases where the horse got its tongue over the bit. In these cases, when contact is taken on the reins, the tongue balloons backwards in an attempt to protect the sensitive areas from discomfort. To do this, the horse has to open the jaw itself, which can result in oral lesions and discomfort. Also, when the tongue is retracted like this, the airway can become obstructed by the soft palate which limits oxygenation and reduces athletic performance.

Studies have identified a correlation between lateral tongue displacement (lolling) and compromised power in the opposite hindlimb—for example when the tongue was lolling to the left, this led to reduced power in the right hind. Lateral tongue displacement of any type should always be investigated. Of course, there are multiple factors to consider including bridle pressures, bit size or bit design. Dental health is another important factor that requires regular attention and should never be neglected.

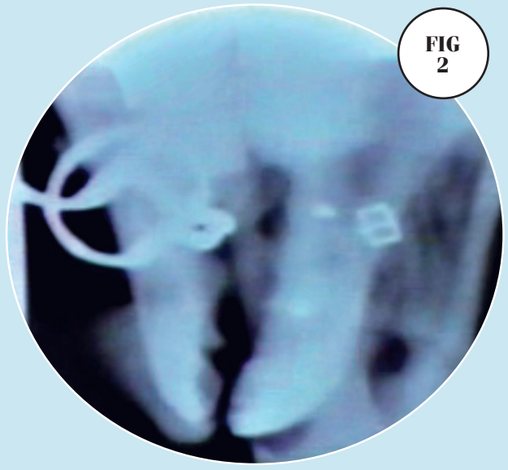
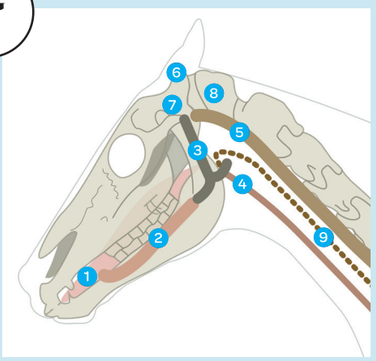


Fig 2: Fluoroscopic video (moving X-ray) images were used to record what happens in the mouth when a horse gets its tongue over the bit.



1. Tongue
2. Muscles linking the hyoid apparatus to the tongue and the jaw
3. Bones of hyoid apparatus
4. Sternohyoideus + omohyoideus muscles
5. Brachiocephalicus muscle - used to flex the neck and protract (bring forward) the forelimb
6. Poll
7. TMJ
8. Wing of Atlas
9. Position of windpipe

ASPECTS OF ANATOMY

To understand why a bridle is so influential, we have to look at where it sits in relation to the anatomy of the horse's head. As the head and neck are important for balance in the horse, increasing freedom to allow different muscle patterns in training could improve balance and therefore the ability to alter gait. If the bridle design changes the pressure and force distribution on the head, then the change in peak pressure may allow the muscles in that area to work more effectively, as they are not having to work against the pressure that was previously placed on them.

The TMJ (7) is the joint of the upper and lower jaw bones, and it is connected to the hyoid bone by small muscles. It is also an important location for the cranial nerves that control proprioception and balance.

The intermittent high pressures located under the attachments of the browband to the headpiece involve the muscles of the hyoid apparatus (3), the associated movement of the tongue, and the swallowing mechanism actively creating pressures against the bridle each time the horse swallows.

The location of maximum pressure under the headpiece (5) lies over an area of muscle involved in flexing the neck and bringing the forelimb forward. It is therefore understandable that relief of pressure at this location could de-restrict movement.

Fig 4: Important locomotor muscles are all linked to the mouth and tongue via the hyoid.

CHAIN REACTION

Three significant muscles from the hyoid link directly to the horse's chest, shoulders, and poll. Then, each one continues its influence on the horse's movement and balance by means of 'chains' of muscle and fascial attachments which extend to the abdominals, neck, back, pelvis, and hindquarters.

Sternohyoideus chain (pink)

The sternohyoid muscle connects the mouth and tongue (via the hyoid) to the sternum (breastbone). From this point, the chain continues through the pectorals, and along the abdominal muscles on the underside of the horse, extending into the pelvis.

Omohyoideus chain (orange)

The omohyoid muscle connects the hyoid to the shoulder blade. From here the connecting muscles and fascia continue along the sides of the horse and all the way down the hindlimbs.

Occiptohyoideus chain (blue)

The occiptohyoid muscle connects the hyoid to the poll. The nuchal ligament continues the connection from the poll down the neck, through the back muscles and hindquarters.

These direct and indirect connections from the mouth to the locomotor muscles of the body indicate that compromising the hyoid (by either direct pressure or restriction of the tongue or mouth), will impact the horse's movement and gait.

Further reading
- R Murray, *Journal of Equine Veterinary Science* 2015; 35: 947-955
- H Clayton, *Equine Vet Sci* 1985; 5:68-77
- WR Cook, *Equine Vet Journal* 2009; 41:827-30
- R Murray, *Vet Journal* 2013; Oct: 92-97
- *European Trainer Magazine* Jan-March 2020
- M Uldahl & H Clayton, *Equine Vet Journal* 2019; 154-162

High peak pressures were recorded in 7 key zones around the horse's head:

1. At the back edge of the headpiece against the wing of the atlas
2. At the front edge of the headpiece on the ear bulbs
3. Across the crown of the head
4. Under the browband above the TMJ
5. Under the noseband on either side of the nasal bone
6. Under the back of the noseband on the jaw bones
7. Under the facial crest on top of the vein and artery

Peak pressures were consistently recorded at the same locations in all commonly-used bridle and headpiece designs.

New bridle design significantly reduces pressure around the horse's head:

1. Anatomically contoured to prevent interference with the wing of the atlas
2. Lined with pressure relieving cushioning at the back of the ear
3. Headpiece has a wider centre section to increase stability
4. Cushion pads on both sides lift the browband clear of the sensitive TMJ area
5. Large pressure relieving pad to hold the cross straps clear of the sides of the nasal bone
6. Wide pressure relieving jowl pad to protect the jaw bones
7. High ring sets the noseband above the artery and vein, allowing the noseband to articulate with the movement of the horse's head

Using a bridle designed to avoid locations of maximum pressure led to lower peak pressure under the noseband and headpiece compared with the horse's usual bridle. T