A NOTE ON THE HEAD BOB IN THE GALLOPING HORSE AT LIBERTY AND THE HARMFUL EFFECT OF THE BIT ON THE HEAD BOB[1]

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The natural swing of the head and neck pendulum in a galloping horse is known as the head bob. The degree of head bob, as with all other characteristics, will vary from horse to horse. But, in general, it seems reasonable to assume that the more the better, as this is a mechanism that enables a galloping horse to conserve energy spent on locomotion and respiration.

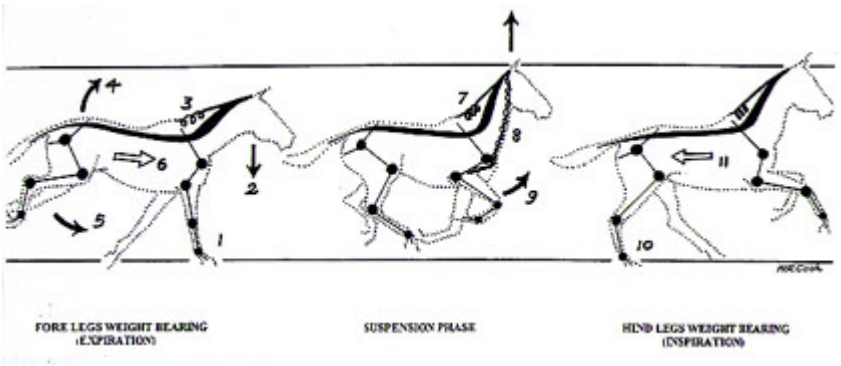

Figure 1: Showing how, in a horse that is galloping at liberty, the head bob constitutes an energy-saving mechanism. One complete stride at the gallop is here represented by examples from its three major components; fore leg weight bearing, suspension phase, and hind leg weight bearing. The first and last phases have been chosen as representing those moments when the head bob is at its lowest and highest, respectively. As a horse at the gallop breathes in time with its legs and takes one breath for every stride, the phases of the gallop synchronize with the phases of respiration. See the text for an explanation of the numbered items.

The cascade of events can be described in eleven stages.

1. The forelegs become weight bearing and a momentary decelaration occurs
2. The force of gravity results in a downward movement of the head and neck
3. This stretches the strong elastic rope (the *ligamentum nuchae*) that runs from the back of the skull to the withers and forms the top line of the neck.
4. The downward swing of the head/neck pendulum has a cantilever effect on the rest of the spine which, unlike the neck, is rather rigid. The result is that the tail end of the spine is raised.
5. Elevation of the hips tends to swing the hind legs forward. This helps to overcome the inertia that follows the backward movement of the hind legs from the previous phase of the stride, thus saving on the expenditure of muscle energy needed for drawing them forward in the next stage of the stride.
6. The initial deceleration, combined with elevation of the hips, results in the liver and abdominal contents being thrust against the diaphragm. This diminishes the volume of the thorax and assists expiration.

7. During the suspension phase of the stride, when all four feet are off the ground, the elastic recoil of the ligamentum nuchae, now serves to help restore the head to its previous position.
8. Elevation of the head results in a tug on strong and non-elastic fibrous tissue that envelop two powerful muscles originating on the back of the skull and the first few vertebrae of the neck These muscles run the entire length of the neck and insert on the shoulder blade and humerus.
9. This tug helps to draw the forelegs forward and overcome the inertia that follows their previous backward movement
10. When the hind legs become weight bearing and the forelegs are drawn forward, there is a tendency for this combined action to elevate the spine at the level of the withers.
11. The liver and abdominal contents now fall back towards the tail end of the horse. As the liver is firmly bound to the diaphragm, this has the effect of flattening the diaphragm and enlarging the thorax, so assisting inspiration.

Unfortunately, the natural head bob of the horse at liberty is often interfered with under conditions of domestication. The presence of a rider sitting on the horse's thorax needs to be considered and also the effect of a tight girth around the thorax and a bit in the horse's mouth.

The rider and the girth:

The rider's weight, falling in the saddle during the foreleg phase of the stride, can be expected to promote expiration. In general, as long as the weight is not excessive, this in itself may not be harmful to respiration, though it does of course increase the load on the forelegs and must be a factor in the occurrence of breakdowns.

During the hind-leg phase of the stride, the rider's weight must be regarded as a handicap to both inspiration and to locomotion. The horse's thorax is being elevated and, consequently, the rider tends to be thrown upwards. At the canter, this effect is particularly noticeable to rider and observer, as daylight appears between the rider's seat and the saddle unless the rider makes a special effort to sit down. At the gallop, whether or not the jockey or exercise rider is standing in the stirrups, the weight of the rider must be a factor in reducing the degree to which the front end of the horse is elevated by the thrust of the hind legs. The horse now has to raise its own body weight and that of the rider, so it is unlikely that the natural energy-saving mechanism at this stage will operate efficiently. The front end of the horse will not rise to the point it would otherwise have reached and this will have a limiting effect on the stride.

Another result is that the horse has to spend more energy on breathing, as inspiration is handicapped. Even if this extra energy is available (unlikely in the Thoroughbred racehorse) each intake of air will require more effort because the thorax has now been made less easily expandable (less compliant) by reason of a tight girth. To get the same amount of oxygen the horse must now generate a greater suction pressure on inspiration. Any such exaggeration of normal inspiratory negative pressures would increase the likelihood of asphyxia-induced pulmonary hemorrhage ('bleeding'). Finally, any interference with inspiration has a handicapping effect on locomotion, as it interferes with the stride.

The bit

Any horse that leans on the bit, gets its tongue over the bit, or the bit between its teeth, has a neck that is locked up and rigid. This, together with the traction on the reins and bit pressure deliberately brought about by the jockey during attempts at rating the horse, is bound to reduce the natural swing of the head and neck pendulum and so interfere with respiration and locomotion. The combined effect of a bit, a tongue-tie and a rigid neck is a shorter and less fluid

stride. A reduction in stride length equates to a reduction in speed, because a horse cannot compensate by increasing stride rate.

A bit is also a potent source of poll flexion which, in turn, obstructs the airway. In addition, a bit further obstructs the airway by stimulating tongue retraction, elevation and displacement of the soft palate. Finally, a bit stimulates digestive system responses such as salivation and chewing reflexes which are physiologically opposed to deep breathing at exercise. These sources of upper airway obstruction are superimposed on the obstruction to inspiration caused by the weight of a rider.

Some horses, like Secretariat, a horse that declined to be rated and seemed able to ignore the bit, retain a marked head bob. Some jockeys, like Shoemaker, have the ability to ride with a loose rein, and this also would produce least interference with the head bob.

Preservation of the head bob under conditions of domestication

The answers to this question are more or less self apparent.

- The rider should be as light as possible
- Use the new Bitless Bridle to avoid locking up the neck, interfering with stride, and obstructing the upper airway by poll flexion and digestive system reflexes
- Avoid an overtight girth. From a purely engineering point of view, the attempt to keep a weighted saddle in position with one (or even two) "U' shaped strap(s) does not make good mechanical sense. Even with extreme tension on the strap it cannot be regarded as a secure and reliable fastening. Use of a breast plate is recommended. This is essentially a neck strap attached ventrally to the girth and with a couple of rings dorsally, which lie either side of the withers about six inches below the pommel of the saddle. A couple of short straps run from the rings to the 'D' rings on the front of the saddle. A breast plate will not interfere with the windpipe and will stabilize the saddle, preventing it from rotating or slipping back, without having to rely exclusively on an overtight girth for this purpose.
- A properly fitted saddle will be less likely to slip than one that does not conform to the shape of the horse's back. Neither a tight girth nor a breast plate should be used to compensate for a badly fitting saddle.
- As a degree of inspiratory obstruction is unavoidable in any ridden horse, particular care should be taken to avoid breeding or buying horses with either defects of conformation (e.g., tracheal deformities) or diseases (e.g., recurrent laryngeal neuropathy) that further add to this problem.

1 Unpublished material