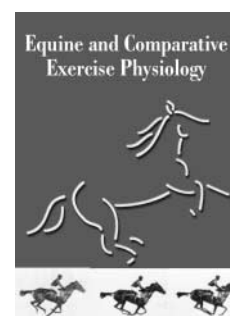


Effects of different bits and bridles on frequency of induced swallowing in cantering horses

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Abstract

It has been suggested that the presence of a bit reflexly increases salivation but, at the same time, interferes with the horse's ability to swallow. The objective of this study was to compare swallowing frequency in 12 horses exercising at canter while wearing a head collar, a bitless bridle, a jointed snaffle bit and a Myler correctional-ported barrel bit. Laryngeal movements were recorded videoendoscopically as the horses cantered (8 m s^{-1}) on a high speed treadmill, with the use of side reins to flex the poll. Swallowing was stimulated artificially by infusion of sterile water at a constant rate of 5 ml min^{-1} through a cannula in the endoscope's biopsy port. The results showed large differences in swallowing frequency between horses. Swallowing frequency was lower for the Myler snaffle than for the other conditions ($P < 0.05$). It is concluded that the presence of a bit does not preclude swallowing during exercise at canter with the poll in a flexed position, but certain types of bits may be associated with a reduction in swallowing frequency.

Keywords: exercise physiology; equestrian short; snaffle bit; saddlery

Introduction

Bits have been used for many centuries to control the horse's speed and direction of movement¹ by exerting pressure on structures within the oral cavity and at various sites on the head. The horse's response to, and acceptance of, the bit are important in some equestrian sports. In dressage, for example, one of the objectives is the acceptance of the bridle². Horses should chew gently, introducing air bubbles into the saliva, which makes it foamy. The presence of foamy saliva on the lips is regarded favourably by dressage trainers as a sign that the horse is accepting the bit in a relaxed manner, accompanied by salivation and chewing. However, excessive saliva at the mouth could also be caused by a combination of excessive saliva production induced by the bit and inhibition of swallowing by a combination of head position and bit effects.

It has been proposed that the presence of a bit in the oral cavity triggers the parasympathetic nervous system to increase salivary output³. Increased salivation is likely to increase swallowing, and during swallowing breathing is interrupted, making excessive swallowing during

exercise undesirable⁴. Furthermore, it has been suggested that a snaffle bit restrains the movement of the tongue⁵, making it difficult for the horse to swallow. Reduced or ineffective swallowing could result in aspiration of saliva into the trachea during exercise. Accordingly, modern bit makers [1] have sought to design bits that allow greater freedom of the tongue⁶. Others have proposed the use of bitless bridles that neither trigger salivation nor impede swallowing³.

If the presence of a bit in the oral cavity induces excessive salivation, it might be expected that horses would feel a need to swallow more frequently when wearing a bit, but frequency of swallowing under different biting conditions has not been investigated. Endoscopic visualization of deglutition has been described in humans⁷ and in horses⁸, and the presence of an endoscope does not appear to hinder swallowing. Infusion of water through the endoscope induces

¹ This is really not a contradiction; if the bit induces salivation and decreases swallowing, one would expect more saliva at the horse's mouth, especially if a flexed head position further decreases swallowing. Is this possibly the mechanism involved in the saliva seen at the mouth of collected dressage horses?

the horse to swallow more frequently and has been used to study arytenoid function in horses⁹. The objective of this study was to compare frequencies of artificially induced swallowing in horses exercising under different biting conditions.

Materials and methods

The study was approved by the university's animal ethics committee. The subjects were 12 sound horses (five Arabians, three Standardbreds, one Thoroughbred, two Warmbloods, one Quarter Horse) that were habituated to treadmill exercise, and were fit enough to perform the study protocol easily without becoming fatigued. Horses were ridden or lunged in each piece of equipment prior to data collection. The upper airway of all horses was normal as determined by endoscopic examination at rest and during exercise.

The four pieces of equipment studied were head collar, loose-ring jointed snaffle bit, Myler correctional-ported barrel bit (Toklat Originals, Inc., Lake Oswego, OR) and bitless bridle (The Bitless Bridle, Inc., York, PA). The head collar was fitted so that the noseband was just below the facial crest, and the side reins were attached to the rings on the left and right sides. When a bit was used, the width of the mouthpiece was 0.5 cm greater than the intra-oral distance between the left and right commissures of the lips, the cheekpieces were adjusted so that there were two small wrinkles at the corners of the lips and a flash noseband was adjusted to fit snugly, but not tightly enough, to indent the skin. The bits had a lateral ring for attachment of the reins, cheekpieces of the bridle and the mouthpiece. The cannons extended from the rings toward the central part of the bit and could articulate directly with each other as in the jointed snaffle, or could be separated by a port—as in the Myler bit used in this study. The jointed snaffle was a loose-ring, hollow mouth bit (Fig. 1). The central joint allowed rotation of the left and right cannons in a transverse plane. In addition, the rings rotated relative to the cannons in the transverse and sagittal planes. The cheek-pieces and side reins were attached to the rings of the bit. The Myler correctional-ported barrel bit had a joint within its central barrel (Fig. 1), which allowed the cannons and rings of the bit to rotate in a sagittal plane, and joints at each side of the port rotated in a transverse plane. The rings rotated relative to the cannons in a trans-



Fig. 1 Jointed snaffle bit (left) and Myler correctional-ported barrel bit (right).

verse plane only. The cheek pieces and side reins were free to move around the rings of the Myler bit. The bitless bridle was adjusted according to the manufacturer's instructions. The side reins were attached to rings on the end of the straps, which were connected to the poll piece on the opposite side via a strap running beneath the mandible and across the cheek.

Horses were also equipped with a lungeing surcingle to which the side reins were attached at mid-thoracic level. The side reins were used to maintain flexion at the atlanto-occipital joint. When attaching the side reins, the objective was to tighten the reins until the dorsum of the horse's face was vertical (Fig. 2).

The experimental protocol involved warming up the horses at trot (2 min at 4.5 m s^{-1}) and canter (1 min at 8 m s^{-1}) without attaching the side reins. The treadmill was then stopped. An endoscope (GIF-130, Olympus, Lake Success, NY) was passed through the right nostril and advanced until the tip of the scope was at the level of the openings of the auditive tubes, where it was secured in place using Penrose tubing tied to the noseband. A cannula was passed through the biopsy port of the endoscope and positioned so that the catheter tip was flush with the tip of the endoscope. The catheter was attached to a constant-rate infusion pump (Model 1901, Harvard Apparatus, Dover, MA) and a 20 ml syringe that was filled with distilled water.

The treadmill was restarted and belt speed was increased until the horse was trotting. The side reins were attached to rings on each side of the bit, bridle or head collar and shortened to flex the atlanto-occipital joint. Treadmill speed was then increased to 8 m s^{-1} , which was a comfortable cantering speed for all horses. The horses cantered at constant speed for at least 20 s to allow time for the stride to settle into a rhythm before the infusion of sterile water was begun at a constant rate of 5 ml min^{-1} . The video recorder (CV-100, Olympus) was started synchronously with the infuser and continued to run for 2 min. The infuser and VCR were then turned off and the treadmill speed was gradually reduced. As soon as the treadmill stopped, the side reins were removed and the endoscope was withdrawn. Horses were led off the treadmill, washed off and walked to the stall to rest for 30 min, after which the procedure was repeated using a different bit/bridle.

Horses performed two trials per day on two successive days. The order in which the different bits and bridles were applied was randomized in the following manner. The bit/bridle conditions were numbered: 1, head collar; 2, jointed snaffle; 3, Myler bit; 4, bitless bridle. Horses performed the trials in the manner of a Pearson's square, starting at sequential numbers but progressing through the conditions in the same order.

The videotapes were analysed to count the number of swallows per minute when water was being infused. Differences between the four conditions



Fig. 2 Horse cantering on treadmill wearing Myler correctional-ported barrel bit. Penrose tubing anchoring the endoscope is seen running from the left side of the noseband to the right nostril, and side reins attached to the bit flex the atlanto-occipital joint. Video monitor and VCR can be seen in the background.

were sought using non-parametric Friedman's two-way ANOVA performed in SPSS 11.5 (SPSS, Chicago, IL) using a significance level of $P < 0.05$.

Results

All horses performed the treadmill exercise test easily, and no pathological conditions of the pharyngeal or laryngeal structures were identified. Horse 11 became agitated during placement of the endoscope for the trial with the Myler bit and did not perform this trial. Swallowing frequency was estimated as an average of this horse's swallowing frequencies for three other trials.

Swallowing frequency varied widely between horses (Table 1). For example, Horse 3 swallowed 72 times over the four conditions with a range of 12–22

swallows for the different biting conditions, whereas Horse 10 swallowed only 14 times over the four conditions with a range of 3–4 swallows for the different biting conditions. The effect of the order in which the bits were tested was not significant ($P = 0.467$), with the mean ranks being similar between the first and fourth testing sessions at 2.58, 2.54, 2.83 and 2.01, respectively.

Friedman's two-way ANOVA indicated that the mean rank for the Myler snaffle (1.58) was significantly lower ($P = 0.026$) than that of the head collar (2.67), jointed snaffle (2.71) or bitless bridle (3.04).

Discussion

Biting has been proposed to increase salivation³, but saliva production during exercise has not been

Table 1 Swallowing frequencies (swallows min^{-1}) for 12 horses under four biting conditions

Horse	Head collar	Snaffle bit	Myler bit	Bitless bridle	Total
1	27	13	10	5	55
2	3	5	1	9	18
3	22	19	12	19	72
4	4	5	2	7	18
5	3	8	4	6	21
6	8	6	4	12	30
7	4	1	5	5	15
8	8	8	4	10	30
9	4	5	4	6	19
10	4	4	3	3	14
11	7	3	6	7	23
12	5	7	3	3	18
Total	99	84	58	92	333

measured. The fact that swallowing frequency did not increase when horses wore a bit argues against an increase in salivation. Horses competing in many equestrian sports are trained to perform with the poll strongly flexed; greater flexion (smaller angle between mandible and underside of the neck) may make it more difficult to swallow because compression of the pharynx and larynx hinders movement of the structures involved in swallowing. The reduced swallowing frequency with the Myler bit may have been due to physical interaction between the bit and the oral structures, leading to restriction of jaw or tongue motion, stimulation of sensory receptors that inhibited swallowing or reduction in salivation.

Fluid may leave the nasopharynx via the oesophagus by swallowing, via the nostrils by entrainment into the expiratory airflow or via the trachea during inhalation. Since the horses cantered at the same speed and with the same head position for all conditions, it seems unlikely that differences in swallowing frequency were associated with variations in the amount of infused water lost via the trachea or the nose. Since mean swallowing rate did not differ between head collar and bitless bridle, differences between bits are more likely due to physical interactions between bit and mouth rather than to other equipment effects such as noseband pressure or head position. Extrapolation of these findings to field conditions must be done with caution. Without infusion of water into the nasopharynx, swallowing rates may be unaffected by biting.

Infusion of distilled water was used to ensure stimulation of the swallowing reflex under all conditions. The rate of infusion was established in a pilot study as sufficient to induce swallowing but not great enough to cause distress. A study of swallowing induced by injection of water boluses⁸ indicated that the epiglottis moved caudally, a small amount of air was swallowed and the arytenoid cartilages moved ventrally and appeared to close. The epiglottis returned to its normal position after each swallow. In the study reported here, swallowing was easily recognized on the videotapes by the soft palate rising above the epiglottis to obscure the view of the *aditus laryngis*.

Bits have been implicated in a variety of respiratory problems³. During this study, no evidence of pathologic upper airway obstruction was seen. Similarly, no differences in respiratory parameters were measured when horses with intermittent dorsal displacement of the soft palate (DDSP) wore a tongue-tie or no tongue-tie^{10,11}. Another study failed to find increased negative inspiratory pressures prior to palate displacement¹². These results, as well as the lack of DDSP in our study, do not support the suggestion that bits cause an increase in negative inspiratory pressures that, in turn, can lead to DDSP³. Since swallowing

temporarily restricts a horse's ability to breathe, frequent swallowing may not be desirable during athletic events⁴. However, none of the horses in this study appeared to experience exercise intolerance secondary to a decrease in respiratory function because of swallowing. On the contrary, depression of the tongue, which may naturally occur with some bits, may stabilize the pharynx, allowing for better respiratory function¹¹.

Conclusions

Induced swallowing frequency during exercise at the canter varies between individual horses. The presence of a bit does not prevent swallowing when horses canter with the poll flexed, although the type of bit may affect swallowing frequency.

Acknowledgements

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