Effect of dental floating on the rostrocaudal mobility of the mandible of horses

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The goals of dental floating are to maintain the symmetry and balance of the dental arcades and allow a free elliptical chewing motion. However, analysis of videotapes of the equine mastication cycle reveals a small rostrocaudal component of the otherwise elliptical chewing cycle. This rostrocaudal mobility of the mandible also occurs as horses raise and lower their heads. Dental floating in horses is often undertaken to relieve discomfort associated with soft tissue injuries caused by dental lesions, improve digestion and feed efficiency by improving mastication, and prevent discomfort associated with the presence of a bit in the mouth. The benefits of dental floating on feed digestibility in horses have been critically evaluated, but to the authors’ knowledge, there are no published data regarding evaluation of the effect of dental floating on the mastication cycle or on the extent of oral discomfort associated with bit placement in performance horses.

The purpose of the study reported here was to investigate the effect of dental floating on the position of the mandible relative to the maxilla during extension and flexion of the head of horses, which is a measure of rostrocaudal mobility (RCM) of the mandible.

Materials and Methods

All procedures involving the use of animals received approval from the University Committee on Animal Care and Supply at the University of Saskatchewan and were conducted in accordance with the guidelines established by the Canadian Council on Animal Care.

Fifty-nine crossbred and purebred horses that were managed as a single group and housed in the same barn were included in this study. Mean ± SD age of these horses was 8.84 ± 4.1 years (range, 3 to 18 years). None of the horses had previously received any dental care. Clydesdales and Percherons were classified as heavy horses, heavy- with light-breed crosses were classified as intermediate horses, and light-breed crosses, American Paints, Appaloosas, and registered Quarter Horses were considered light horses. Each horse was formally randomized into a treatment or control group; the investigators were unaware of the group assignments.

Each horse was sedated with IV administration of either 200 mg of xylazine or 10 mg of detomidine, each combined with 25 mg of acepromazine and 5 mg of butorphanol. By use of a steel ruler that was graduated in 0.5-mm increments, the distance between the rostral aspect of the interproximal space of the central upper incisors (Triadan system 1/201) and the rostral aspect of the interproximal space of the central lower incisors (Triadan 3/401) was measured while the head was held with the mandible oriented parallel to the ground. With the horse’s neck fully flexed, the distance between the rostral aspects of the upper and lower incisor teeth was measured again; the difference between these 2 measurements was calculated and recorded as difference-1. After obtaining these measurements, a full-mouth speculum...
was placed, and the oral cavity was lavaged with water. The head was suspended in a dental halter; with light from a head-mounted lamp, a visual and manual examination of the oral cavity was performed. The number of specific dental lesions was recorded. Dental lesions of interest included sharp buccal and lingual edges, corresponding stepped and cupped-out teeth (teeth that extend beyond the occlusal surface of the juxtaposed teeth [stepped] while the opposing tooth does not reach or is lower than the occlusal surfaces due to excessive wear [cupped out]), hooks and ramps, excess transverse ridges (excessive ridges of enamel extending the bucco-lingual direction across the occlusal surface of the tooth), missing fractured teeth, wave mouth (a condition in which the upper and lower incisors occlude normally but the length of the molars vary, creating a bite that resembles a wave), and the presence of diastemata (abnormal gaps between cheek teeth).

After completion of the oral examination, the group assignment of each horse was revealed to the investigators. Horses in the control group were allowed to recover from sedation without further manipulation. Horses in the treatment group had dental lesions removed or corrected by means of a motorized dental float. Floating included removal of sharp lateral and lingual edges, hooks, and ramps; correction of wave-mouth; and flattening of stepped teeth and excess transverse ridges. After dental floating, the distance between the rostral aspects of the upper and lower incisor teeth was remeasured in each horse in the treatment group with the mandible parallel to the ground and with the neck flexed. The difference between these 2 measurements was calculated and recorded as difference-2. In the control horses, this value was determined under sedation 14 days later. For each horse, difference-1 was subtracted from difference-2 and the value recorded as the gain in RCM. All measurements and dental corrections were performed by 1 investigator (JLC).

Statistical analyses were performed with computer software. Variables such as age (years), breed, dental lesions, values of difference-1 and -2, and gain were examined for equality of variance. Linear regression analysis was used to determine whether age was a useful predictor of dental lesions. A 1-way ANOVA with a Tukey honest significant difference analysis was used to investigate the effect of breed on difference-1 and difference-2, as well as the effect of group (control or treatment) on breed. Stepwise logistic regression was used to examine whether difference-1 or difference-2 would predict the presence of any particular lesion. A t test was used to compare age and gain between the treatment and control groups; 95% confidence intervals were calculated. Values of \( P < 0.05 \) were considered significant.

Results

Mean \( \pm \) SD age of the 59 horses included in the study reported here was 8.84 \( \pm \) 4.1 years (range, 3 to 18 years). Twenty-six horses were randomized into the control group, and 33 were randomized into the treatment group. There was no significant \( (P = 0.98) \) difference in breed between horses in the control and treatment groups. Despite formal randomization, there was a significant difference in mean age between horses in the treatment \( (10.14 \pm 4.22 \text{ years}) \) and control groups \( (7.14 \pm 3.31 \text{ years}; 95\% \text{ confidence interval, } 7.3 \text{ to } 9.41; P = 0.008) \). Prior to dental floating, there was no significant \( (P = 0.32) \) difference between the treatment and control groups with regard to difference-1 (mean \( \pm \) SD difference-1, 2.10 \( \pm \) 1.6 and 2.6 \( \pm \) 2.0 mm, respectively). However, prior to treatment, breed affected difference-1 \( (P = 0.003) \). Further analysis with the Tukey pairwise comparison procedure revealed that mean \( \pm \) SD RCM of the mandible in heavy horses \( (3.88 \pm 2.31 \text{ mm}) \) was significantly greater than that of intermediate and light horses \( (2.43 \pm 2.1 \text{ and } 1.94 \pm 1.48 \text{ mm}, \text{ respectively}) \). Age and dental lesions were not significantly \( (P = 0.37 \text{ and } 0.25) \) associated with difference-1.

Mean values of difference-2 were significantly greater in treated horses \( (5.89 \pm 2.77 \text{ mm}) \) than that observed in control horses \( (2.12 \pm 1.64 \text{ mm}; 95\% \text{ confidence interval, } 4.96 \text{ to } 2.58; P < 0.001) \). Between floated and control horses, gain was found to be significantly \( (2.26 \pm 0.3; 95\% \text{ confidence interval, } 1.68 \text{ to } 2.84; P < 0.001) \) different. After dental floating, breed had a significant \( (P = 0.006) \) effect on difference-2. Further analysis with the Tukey pairwise comparison procedure revealed that mean \( \pm \) SD RCM of the mandible in heavy horses \( (8.64 \pm 3.12 \text{ mm}) \) was significantly greater than that of intermediate and light horses \( (5.3 \pm 1.87 \text{ and } 5.0 \pm 2.20 \text{ mm}, \text{ respectively}) \).

In the number of dental lesions was not significantly \( (P = 0.14) \) associated with gain. Difference-1 could not be used to predict the presence of specific dental lesions (eg, hooks or ramps).

Discussion

The evolution of the teeth and gastrointestinal system of horses is thought to be a consequence of global climatic change that caused alterations to habitat and available food sources. As the ancestors of horses modified their mode of foraging from browsing to grazing, several adaptations are thought to have occurred. Horses developed hypsodont teeth from brachyodont teeth, and the premolars acquired the characteristics of molars (molarization); they also developed large, powerful mandibular muscles to facilitate prolonged and forceful chewing. Another adaptation to grazing was the development of lateral shearing of prehended feed with a slight but important rostrocaudal movement of the mandible relative to the maxilla to promote the grinding of food. As horses evolved and increased in height, the ability to rostrally displace the mandible may have been important in ensuring maximal incisor apposition during prehension of grasses with the head lowered.

At present, relative incisor movement (ie, RCM of the mandible) is described in terms of fractions of teeth, which may be more useful than actual measurement in field situations. However, the technique described in this report is likely to be more accurate, as the shape and width of the incisor arcades are highly variable and change with age.

Our data indicated that prior to floating, light and intermediate horses had mean RCM of the mandible of 2.43 and 1.94 mm, respectively, whereas mean RCM of the mandible in heavy horses was 3.88 mm. Removal or correction of dental lesions increased the movement of the mandible relative to the maxilla during extension and flexion of the head by a mean distance of 3 mm in 31 of 33 horses. Further, failure to increase the RCM of the mandible was an indication that not all dental lesions had been corrected (data not shown). The degree of mandibular RCM could not be used to...
predict either the number of dental lesions or the presence of a specific type of dental lesion. However, a retrospective power calculation revealed that 76 horses/lesion group (ie, a total of 380 horses) would be necessary to make such a statement with 95% certainty. Despite this, dental floating resulted in significant gain; therefore, the use of mandibular RCM may be of practical benefit to veterinary practitioners asked to provide equine dental care.

The authors believe that the artificial RCM of the mandible induced by the investigators in the study reported here reflects natural mobility during the mastication cycle. After dental floating, mean ± SD RCM of the mandible was 5.89 ± 2.77 mm, which is consistent with a recent 3-D kinematic study of the temporomanibular joint of horses.6 The light-breath horses used in the latter study had routine dental care performed by an experienced veterinary dentist prior to inclusion. The observation that most horses have a maxillary incisor overbite (wherein the lower jaw is shorter than the upper jaw) is also consistent with the results of our study obtained with the head positioned so that the mandible is parallel to the ground (a common position of the horse’s head during dental examination of the incisors).3 The importance of changes in RCM of the mandible is unknown and remains to be elucidated. Many practitioners and laypeople believe that certain performance horses benefit from maximal mandibular excursion during the execution of certain movements. In the dressage arena, complete poll flexion and vertical head carriage is a necessary component of many tests. To achieve this, a horse must be able to rostrally displace the mandible.13,14 The effect of limited rostrocaudal mobility on dressage performance has not been critically evaluated.

Interestingly, our data indicated that the age of horses was not significantly linked to the number of dental lesions; this finding is contradictory to the commonly held belief that older horses have significantly greater dental disorders.1,10 The effect of breed (categorized by body weight) on RCM of the mandible was an unexpected and, to our knowledge, previously unreported finding. If RCM of the mandible affects feed digestibility or fecal particle size, it might confer an evolutionary advantage to the larger horses and explain why RCM of the mandible increases as weight increases. Alternatively, RCM of the mandible may be simply an anatomical measurement of the limit of temporomanibular joint motion. The correlation of temporomanibular joint movement with weight has not been examined in horses.

The finding that RCM of the mandible does not provide an indicator of the presence of dental lesions was surprising. It may be that the height of the dental abnormalities above the level of the occlusal surface of the dental arcade, and not simply the presence or absence of pathologic lesions, is the limiting factor in RCM of the mandible. An alternate hypothesis may be that although the investigators noted commonly described lesions, smaller, less apparent (but potentially more important) lesions were not recorded but nevertheless removed during the course of thorough dental floating. In our opinion, small micro-transverse ridges or steps were unapparent yet potentially important.

It has been suggested that complete reduction of the transverse ridges allows too much RCM of the mandible to occur as the horse masticates and that the increased movement may lead to diastemata formation between the second and third premolars.15 However, there is no scientific support for this statement, and no reference range values for RCM of the mandible are provided. Furthermore, it is difficult to appreciate how this could occur because during the rostral slide of the mandible (when the incisors are together), the molars are not in contact.10,13 The results of the study reported here suggest that RCM of the mandible, which is believed to be an important component of the mastication cycle and of importance to certain performance horses, can be increased by dental floating in most instances.

References


Dormosedan, 10 mg/mL, Pfizer Animal Health, Kirkland, QC, Canada.

Acepro-25, 25 mg/mL, MTC Pharmaceuticals, Cambridge, ON, Canada.

Torbugesic, 10 mg/mL, Ayerst (Fort Dodge), Montreal, QC, Canada.

PowerFloat, D&B Equine Enterprises Inc, Calgary, AB, Canada.


