Effect of dental floating on weight gain, body condition score, feed digestibility, and fecal particle size in pregnant mares

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Objective—To investigate the effect of routine dental floating on weight gain, body condition score, feed digestibility, and fecal particle size in pregnant mares fed various diets.

Design—Randomized controlled clinical trial.

Animals—56 pregnant mares.

Procedure—Mares were randomly allocated to 1 of 4 feed groups (n = 14 mares/group). All horses were sedated and an oral examination was performed, after which dental floating was performed on 7 horses in each group. Body weight was measured, and a body condition score was assigned before and at various times for 24 weeks after dental floating. Feed digestibility and fecal particle size were analyzed 7 and 19 weeks after dental floating.

Results—Weight gain, change in body condition score, feed digestibility, and fecal particle size were not significantly different between horses that underwent dental floating and untreated control horses. In contrast, weight gain was significantly associated with feed group. In the control horses, neither the number of dental lesions nor the presence of any particular type of lesion at the time of the initial oral examination was significantly associated with subsequent feed digestibility.

Conclusions and Clinical Relevance—Results suggest that dental floating does not result in significant short-term changes in body weight, body condition score, feed digestibility, or fecal particle size in healthy pregnant mares. Further studies are necessary to determine the clinical utility of regular dental floating in apparently healthy horses. (*J Am Vet Med Assoc* 2004;225:1889–1893)

Dental floating (ie, rasping or filing of the teeth to remove irregularities) is the most common dental procedure performed in horses,[1] as it is suggested by some authors[2-4] that dental irregularities may be involved in the development of weight loss, ptyalism, and colic, along with other medical abnormalities, and that the prevalence of dental disease is higher in older horses. The high prevalence of dental abnormalities in horses has been attributed to domestication,[5] and there is some evidence to suggest that certain dental conditions, such as sharp molar points, are uncommon in equine fossil skulls and feral horses.[6,7]

The pregnant mare urine industry in western Canada involves approximately 70,000 horses. Mares used in the industry range widely in age and breed, but a large number are between 3 and 10 years old. During these years, horses shed 8 cheek teeth during eruption of the permanent dentition, a process that can lead to oral ulceration, fibrosis, pain, and quidding.[8] In a survey of necropsy specimens, these oral lesions were the ones most frequently identified in horses < 10 years old, whereas abnormalities of wear including waves, shear, and steps were found in horses between 8 and 30 years old.[8]

Discussions with ranchers suggest that routine dental prophylaxis programs are uncommon in the pregnant mare urine industry, although it is commonly believed that dental floating leads to improved feed digestibility, better feed conversion, lower feed costs, prolonged productivity, and improved welfare of the horses.[9] The purpose of the study reported here was to determine whether dental floating had any effects on weight gain, body condition score, feed digestibility, and fecal particle size in pregnant mares being fed various diets.

Materials and Methods

Fifty-six mares between 3 and 18 years old and approximately 4 months pregnant were used in the study. Mares consisted of a mixture of light, intermediate, and heavy horses. They were housed in a single barn and identified by stall number, physical description, and name. None of the mares had previously undergone dental floating. All procedures were approved by the University of Saskatchewan's Assurance of Animal Care and Use Committee.

During the week prior to the study, all mares were fed a diet consisting of hay and a pelleted vitamin-mineral mixture.[a] Baseline body weight was obtained with a large animal scale,[b] and a body condition score was assigned by a single investigator (NFC) using a standard scoring scheme.[10]

Mares were then randomly allocated to 4 feeding groups (14 mares/group) with each group consisting of light, intermediate, and heavy horses. Mares in each group were assigned to be fed a hay and oats (2.27 kg/d [5 lb/d]), hay and soy pellet (1.59 kg/d [3.5 lb/d]), hay and canola meal pellet (1.59 kg/d), or all hay diet. Hay consisted of mature timothy grass with a crude protein content of 5%. Supplemental feed was given as needed to ensure a consistent 7.5% crude protein intake across feed groups. Mares fed the all hay diet were also fed the pelleted vitamin-mineral mixture.

On day 1 of the study, horses were sedated with a mixture of xylazine, acepromazine, and butorphanol. A full-mouth speculum was inserted, and the oral cavity was

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lavaged. The horse's head was then suspended in a dental halter, and a complete examination of the oral cavity was performed. Lighting was provided with a head-mounted lamp. Teeth were identified with a modified Triadan numbering system,[11] and the number of dental lesions was determined. Dental lesions included hooks, ramps, excessively tall transverse ridges, stepped teeth (ie, teeth taller than other teeth in the same arcade), cupped teeth (ie, teeth lower than the occlusal surface), diastemata, missing or fractured teeth, wave mouth, sharp lateral edges, and soft tissue ulceration. A single point was assigned for each of these abnormalities, and the oral pathology score was the sum of all abnormalities found. All oral examinations were performed by a single investigator (JLC) who was blinded to treatment and feed group assignments of the horses.

After the initial oral examination was completed, 7 horses in each feed group were randomly assigned to undergo dental floating, with the remaining 7 in each group left as untreated control horses. Dental floating was performed by a single investigator (JLC) with a motorized dental instrument.[c] Dental floating included removal of sharp edges; restoration of rostrocaudal movement of the mandible, which included removal of rostral hooks and caudal ramps; flattening of stepped teeth; and correction of wave mouth. The incisors were realigned if necessary. In no instance was complete smoothing of the occlusal surfaces of the cheek teeth performed.[12]

Body weight was measured, and body condition scores were assigned on days 7, 17, and 29 and every 4 weeks thereafter to week 24. Voluntary hay intake was measured throughout the study. The number and weight of hay bales offered to the horses and the amount of feed remaining were measured for each feed group to determine weekly feed intake.

Feed digestibility was determined during weeks 7 and 19. For this, voluntary hay intake was determined daily for 5 days by summing the weight of 4 preweighed hay meals and subtracting the weight of any uneaten hay. The weight of any grain or pellets that were fed was also recorded. Hay was offered in a sufficient amount to ensure that 5% to 10% remained uneaten after each 24-hour period. Uneaten hay was collected and weighed before any grain or pellets were offered to the horses the next morning. During these weeks, feces were collected from 10 horses (5 that had undergone dental floating and 5 control horses) in each feed group daily for 5 consecutive days. Total fecal wet weight was recorded, and a sample of each mare's daily output was placed in an aluminum tray, weighed, and dried for 96 hours in a forced-air oven. Mean moisture content of the feces was then calculated.

Horses were provided water 5 times a day for 4 to 5 minutes each time; each horse was provided an individual watering bowl with an attached flow meter. Urine was collected and volume determined. Water balance was determined during weeks 7 and 19 by measuring daily water intake (water consumed plus water content of the feed) and daily water output (fecal moisture content plus urine output). Values were corrected for horse weight to allow for comparisons across breed.

A 50-g composite aliquot of dried feces was used for fecal particle size analysis. Each sample was spun for 60 seconds at 830 Hz in an agitator containing six 25-g rubber balls to break up clumped dry feces. Mean fecal particle size was measured with a sieve shaker[d] in 2 stages in accordance with American Society of Agricultural Engineers standards.[13] United States standard sieve sizes 3, 4, 5, 6, 8, 14, and 20 (diagonal pore sizes of 6.7, 4.75, 4.00, 3.36, 2.36, 1.41, and 0.85 mm, respectively) were used initially. This combination sieve stack was shaken for 6 minutes. For the second stage, sieves sizes 20, 30, 45, 100, 200, and 270 (diagonal pore sizes of 0.85, 0.589, 0.355, 0.15, 0.075, and 0.053 mm, respectively) were used. This combination sieve stack was shaken for 12 minutes. Between each sample, sieves were cleaned with a 5-inch coarse-hair paintbrush and reweighed to ensure that all of the previous sample had been removed. Fecal particle size analyses were performed by a single investigator (JLC) blinded to feed group and dental treatment group.

Dried feed and fecal samples were analyzed for nutrient content including dry matter, crude protein, acid detergent fiber, neutral detergent fiber, sodium, potassium, chloride, calcium, magnesium, and phosphorus contents.

Quidding was determined by examination of the stalls 30 minutes after feeding once weekly for 5 weeks. A horse was considered to have quidded if masticated feed or grain kernels were found on the floor.

Statistical methods—Descriptive statistics were used to examine normality of distribution and equality of variance of the data. The effect of dental floating on total weight gain, feed digestibility, and fecal particle size was examined with Student 2-sample *t* tests. The effect of feed group on total weight gain was determined by use of a 1-way ANOVA followed by the Tukey honest significant difference test. The effect of dental floating on body condition score and the effect of number of dental lesions on fecal particle size were examined by use of a Kruskal-Wallis 1-way ANOVA. A repeated-measures ANOVA was used to determine the effect of feed group on weight gain over time. The effects of dental floating and number of dental lesions on prevalence of quidding were examined by means of χ^2 analyses. All analyses were performed with standard software.[e] Values of $P < 0.05$ were considered significant; data are given as mean ± SD.

Results

Mean ± SD initial body weight of horses that underwent dental floating (606 ± 105 kg [1,335 ± 231 lb]) was not significantly ($P = 0.95$) different from mean initial body weight of control horses (607 ± 100 kg [1,339 ± 220 lb]). Similarly, mean number of dental lesions for horses that underwent dental floating (4.4 ± 2.1) was not significantly ($P = 0.46$) different from mean number of dental lesions for control horses (4.8 ± 1.3), and mean initial body condition score for horses that underwent dental floating (6.1 ± 0.8) was not significantly ($P = 0.26$) different from mean initial body condition score for control horses (6.3 ± 0.8). However, horses that underwent dental floating were significantly ($P = 0.001$) older than control horses (9.7 ± 3.9 years vs 6.6 ± 3.1 years).

The most common dental lesion was sharp lateral edges, which were present in 44 (81.5%) horses. Detection of sharp lateral edges was significantly ($P = 0.007$) associated with detection of soft tissue ulcers, which were identified in 33 (61%) horses. Thirty-one (61%) horses had rostral hooks on the second premolars, and in 23 of these (75%) horses, these rostral hooks were present bilaterally. A ramp was seen on the caudal surface of the mandibular third molar in 19 (35%) horses, of which 11 (57%) had bilateral ramps. There was no significant association between detection of hooks and detection of ramps. Thirty-nine (69.6%) horses had stepped teeth (ie, teeth that were taller than other teeth in the same arcade); all stepped teeth involved the mandibular arcades. Fourteen (25%)

horses had cupped teeth (ie, teeth that were lower than the occlusal surface of adjacent teeth). Cupped teeth always involved the maxillary arcades, and 12 (86%) of the cupped teeth involved the maxillary fourth premolar (tooth 1/208) or the maxillary first molar (tooth 1/209). There was no significant association between detection of stepped teeth and detection of cupped teeth. Thirteen (24%) horses had excessively tall transverse ridges of enamel running in a lateromedial direction across a tooth.

Age of the horse was not significantly associated with total number of dental lesions ($P = 0.33$) or with the presence of sharp lateral edges, soft tissue ulcers, stepped teeth, cupped teeth, or excessively tall transverse ridges. However, horses with hooks were significantly ($P < 0.001$) younger than horses without hooks (6 ± 3.1 years vs 9.5 ± 3.6 years). In contrast, horses with ramps were significantly ($P = 0.03$) older than horses without ramps (10 ± 3.8 years vs 7.5 ± 3.6 years).

For horses that underwent dental floating, mean number of dental lesions after floating (0.7 ± 0.9) was significantly ($P < 0.001$) lower than mean number prior to floating (4.1 ± 2.13). Lesions that remained after floating consisted of cupped teeth and soft tissue ulcers.

Mean ± SD total weight gain during the 24 weeks of the study for the 28 horses that underwent dental floating (80.8 ± 23.4 kg [177.8 ± 51.5 lb]) was not significantly ($P = 0.78$) different from mean weight gain for the 28 control horses (82.6 ± 25.9 kg [181.8 ± 57.0 lb]; **Figure 1**). However, feed group was significantly ($P = 0.002$) associated with total weight gain **(Figure 2)**. Mean total weight gain for horses fed the all hay diet (65.8 ± 20.7 kg [144.8 ± 45.5 lb]) was significantly less than mean total weight gain for horses fed hay and oats (82.2 ± 23.9 kg [180.8 ± 52.6 lb]), hay and soy pellets (90.8 ± 15.4 kg [199.8 ± 33.9 lb]), and hay and canola meal pellets (97.2 ± 19.1 kg [213.8 ± 42.0 lb]). There was no interaction between dental floating and feed group on weight gain.

Mean increase in body condition score for horses that underwent dental floating (1.3 ± 0.8) was not significantly ($P = 0.6$) different from mean increase for control horses (1.4 ± 0.5), and digestibility values were not significantly different between groups (horses that underwent dental floating vs control horses) for any of the nutrients examined **(Table 1)**.

Mean water intake during weeks 7 and 19 for horses that underwent dental floating (21.4 ± 2.45 mL/kg/d) was significantly ($P = 0.05$) higher than mean water intake for control horses (19.4 ± 3.54 mL/kg/d). Similarly, mean water balance (ie, water intake through water consumption and water content of the feed minus water output in feces and urine) during the same time period for horses that underwent dental floating (4.9 ± 1.03 mL/kg/d) was significantly ($P = 0.001$) higher than mean water balance for control horses (3.7 ± 1.17 mL/kg/d).

Mean particle size of a composite week 7 and week 19 fecal sample for horses that underwent dental floating (372 ± 17 µm) was not significantly ($P = 0.33$) different from mean fecal particle size for control horses (379 ± 24 µm). However, fecal particle size was significantly ($P < 0.001$) associated with feed group. Mean fecal particle sizes for horses fed hay and oats (398 ± 19 µm) and for horses fed the all hay diet (387 ± 13 µm) were significantly larger than mean values for horses fed hay and soy pellets (360 ± 21 µm) and for horses fed hay and canola meal pellets (365 ± 16 µm).

In control horses, the number of dental lesions at the time of initial examination was not significantly ($P = 0.051$) associated with digestibility of any of the nutrients examined or with fecal particle size. In addi-

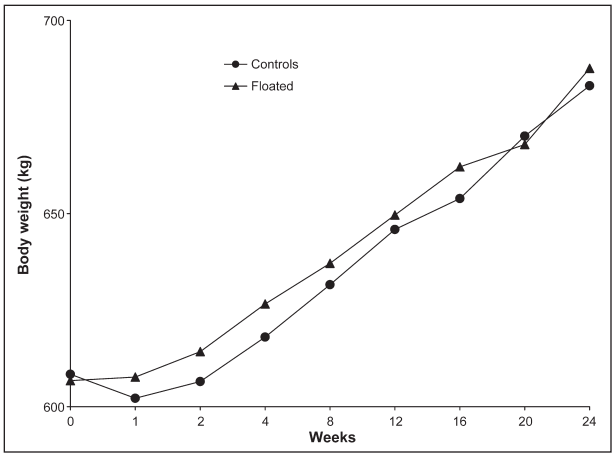

Figure 1—Mean body weight in healthy pregnant mares (n = 28/group) that did (floated) or did not (controls) undergo dental floating.

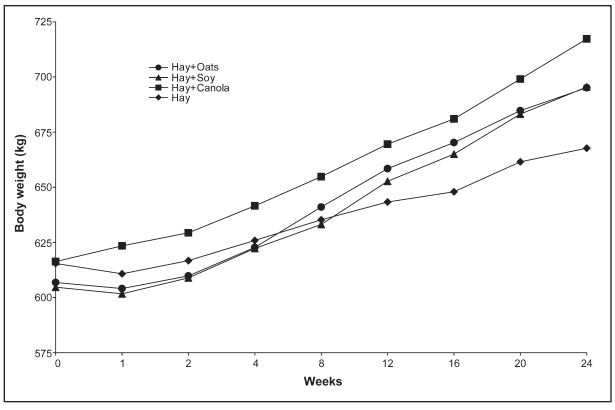

Figure 2—Mean body weight in healthy pregnant mares (n = 14/group) fed various diets.

Table 1—Mean digestibility of various nutrients in healthy pregnant mares (n = 28/group) that did or did not undergo dental floating.

Nutrient	Treated horses	Control horses	*P* value
Dry matter	46.7 ± 2.9	46.9 ± 2.3	0.82
Acid detergent fiber	27.9 ± 4.6	27.1 ± 4.2	0.56
Neutral detergent fiber	27.2 ± 5.3	27.9 ± 6.1	0.67
Crude protein	52.8 ± 4.2	51.9 ± 2.4	0.43
Sodium	27.3 ± 21.6	20.5 ± 24.5	0.36
Potassium	69.1 ± 8.4	68.1 ± 9.1	0.73
Calcium	71.8 ± 5.8	69.8 ± 7.5	0.34
Magnesium	26.6 ± 7.1	25.1 ± 10.2	0.59
Phosphorus	12.2 ± 5.5	10.8 ± 7.9	0.52
Chloride	68.6 ± 10.2	68.4 ± 7.3	0.94

Data are given as mean ± SD (after controlling for feed group). Digestibility was measured 7 and 19 weeks after routine dental floating in treated horses.

tion, no single lesion or any combination of lesions (present vs absent) was significantly associated with digestibility values. The number of dental lesions was not significantly associated with subsequent weight gain ($P = 0.641$) or body condition score ($P = 0.599$).

Prevalence of quidding during the 5-week observation period was not significantly ($P = 0.32$) different between horses that underwent dental floating and control horses. In addition, in control horses, the number of dental lesions at the time of initial examination was not significantly ($P = 0.66$) associated with prevalence of quidding.

Discussion

Results of the present study indicate that although diet has a significant impact on weight gain in pregnant mares, dental floating does not. These findings suggest that weight gains observed in horses following routine dental floating are likely related to other management factors, particularly improvements in the diet. The significant effect of feed group on weight gain could not be explained by differences in digestibility, and it is more likely that this effect was associated with differences in energy density of the diets. Dental floating did not significantly affect feed digestibility in the present study, which supports results of a previous study.[14]

Two previous studies[14,15] examined the effect of dental correction in horses. In one,[14] the authors tested whether routine dental correction (ie, removal only of sharp hooks and points from molars and premolars) would improve digestion of a hay-grain ration. Eight horses were used in the study (4 horses that underwent dental correction and 4 control horses), and 5-day digestion trials were performed before and 2 and 4 weeks after dental correction. No significant differences in feed digestion were observed between groups. In contrast, authors of the other study[15] concluded that dental floating increased the digestibility of crude fiber and the percentage of smaller fiber particles. However, only 4 horses were included in the study and historical, rather than concurrent, controls were used.

In the present study, total number of dental lesions was not significantly associated with age or with the prevalence of quidding. These findings are contrary to published opinions that dental lesions are more common in older horses[4,8,16] and suggest that horses can compensate for a variety of dental abnormalities.

The finding in the present study that dental floating was not associated with weight gain was unexpected, in that other authors have suggested that horses with dental abnormalities are unable to efficiently grind their feed and thus present the feed to the rest of the digestive tract in an unsuitable form, resulting in weight loss and possible colic.[3] Additionally, dental floating did not have a significant effect on feed digestibility or mean fecal particle size in the present study.

Mean fecal particle size for all horses in the present study was 395 µm, whereas previous studies[17,18] have reported that mean particle size for equine feces ranges from 1,630 to 7,079 µm. This difference may be explained, in part, by variations in technique. Measurements in the present study were performed on dried feces, whereas wet feces were used in the study reporting the largest fecal particle size.[17] In addition, agitation with rubber balls in the present study may have artificially reduced the overall mean particle size. However, because significant differences were found between feed groups, we do not believe our method of fecal processing can account for the lack of an effect of dental floating on fecal particle size.

The present study was designed to examine the effect of routine dental floating in healthy mares. Therefore, our results may only be applicable for horses in good body condition for which dental floating is a routine management practice. The study determined weight gain and the change in body condition score following floating but did not address the potential effect of routine dental floating on long-term dental health, determine whether treating severe dental lesions would have any effects, or evaluate the potential benefits of examination of the teeth as part of a routine health examination. The effects of dental floating on water intake and balance were unexpected and cannot be easily explained, given that floating did not affect any other variable examined in this study.

Horses in this study were considered representative of horses normally subjected to this procedure. In addition to this, they had been born and raised on the study farm where meticulous records were kept. For this reason, we can be confident that these horses had not previously undergone dental floating. Nevertheless, there were no significant differences between horses that underwent dental floating and control horses in regard to weight gain, change in body condition score, feed digestibility, or fecal particle size. Neither the number of dental lesions nor the presence of any particular type of lesion was significantly associated with subsequent weight gain, body condition score, feed digestibility, fecal particle size, or the prevalence of quidding in control horses.

[a]Consultant Formula Premix, Feed-Rite, Winnipeg, MB.
[b]Toledo scale, Mettler-Toledo Inc, Columbus, Ohio.
[c]PowerFloat, D&B Equine Enterprises Inc, Calgary, AB.
[d]Ro-Tap sieve shaker, WS Tyler, Mentor, Ohio.
[e]Statistix 7, Analytical Software Inc, Tallahassee, Fla.

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