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Cross sectional epidemiological study of the severity of buccal ulceration and sharp enamel points in ridden and unridden horses

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ABSTRACT

The process of domestication of the horse introduced changes limiting accessibility to graze land and roughage while increasing highly digestible carbohydrates content of meal-fedrations. We have tested whether the effect of a higher degree of human contact impacts horses' welfare by assessing the development of sharp enamel points (SEP) and buccal ulcerations (BU) in ridden and unridden horses. We were able to fit logistic regression models significantly differentiating the impact of these two conditions in both groups of horses ($p < 0.001$ for SEP and $p < 0.01$ for BU). The impact is higher in ridden horses for both conditions. These two conditions were found to correlate positively ($\rho = 0.63$, $p < 0.001$). We argued that human contact may impact on horses' welfare. Further studies may help to clarify this impact with more detail. Dentistry may be helpful to provide improved welfare conditions; however, without regular access to grazed land, the stabled horses' welfare may be at stake.

KEYWORDS

Buccal ulceration; equine dentistry; horse behavior; horse welfare; sharp enamel points

Introduction

The horse has an evolution of over55 million from the Hyracotherium or Eohippus (Dacre, 2006; Dixon, 2017). Horses' ancestors evolved in accordance with environmental changes (Dixon, 2017). One of the most distinguished evolutionary changes was seen within the teeth. The teeth evolved from the brachydont teeth of the aforementioned forest dwelling browsers to the hypsodont teeth required for grazing, in parallel with the transition from forest to grassland (Dixon, 2017; MacFadden, 1994).

Evidence of humans domesticating the horse can be found as early as3500 BC (Outram et al., 2009). Domestication of horses involved an increase in workload for the horse (ridden work, driven work, and haulage), accompanied by stabling and the introduction of a diet that decreased coarse roughage grazing and increased meal feeding of concentrate rations (Johnson & Porter, 2006). The concentrate rations richer in starch have lower percentages of fiber (especially long fiber) and are easily broken down mechanically in the mouth and, therefore, the mastication cycle is shortened (Scoggins, 2004). As a consequence, the buccal edges of the upper teeth and the lingual edges of the lower teeth tend to be poorly occluded, resulting in sharp enamel points (SEP) (Johnson & Porter, 2006). This change in feeds results also in a vertical motion of the mandible rather than the desired and more natural, horizontal motion (Meyer, Coenen, & Gurer, 1985).

The reduced horizontal mastication and decreased time spent masticating food results in inefficient attrition of the surface of the equine cheek teeth and therefore an increased formation of excessive transverse ridging and SEP (Dixon, 2002; Dixon & Dacre, 2005). The SEP cause

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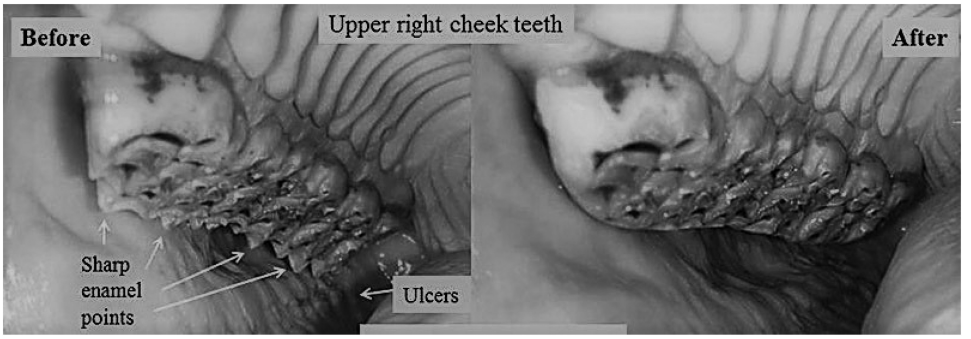


Figure 1. Equine check tooth before and after floating. Note the sharp enamel points on the left photo with associated buccal (cheek) ulceration. Sourced by Central Equine Vets, Edinburgh, UK.

buccal and lingual ulceration within the mouth, which impacts mastication performance (Tell, Egenvall, Lundstrom, & Wattle, 2008). Sharp enamel points are among the most common dental disorders seen in the domestic horse by equine dental practitioners (Chinkangsadarn, Wilson, Greer, Pollitt, & Bird, 2015; Maslauskas, Tulamo, McGowan, & Kucinskas, 2009) and also in the domestic donkey (Serag et al., 2020). The sharp enamel points can be managed by dental care through floating (Figure 1).

Tacking a horse to ride it is the common practice. The bit can cause pinching of the commissures of the lips, the bars of the mouth and the buccal mucosa when a contact is taken with the reins (Mata, Johnson, & Bishop, 2015; Tell et al., 2008). This in turn can lead to ulcerations and ridden and masticatory discomfort (Mellor, 2020; Scoggins, 2001). Horses ridden with a bit and bridle have a significantly higher prevalence of large and acute buccal ulcerations (Tell et al., 2008). Nosebands can also be associated with discomfort due to the increased pressure of the band of leather or nylon around the nose, which causes the mucosa of the lips and cheeks to be pressed against the prominent cinguli of the cheek teeth (Clayton, 1985; Uldahl, Bundgaard, Dahl, & Clayton, 2022; Uldahl & Clayton, 2018).

The aim of this study is to relate the development of SEP and BU with the use of the horse by humans to identify any potential risk factor impacting horses' welfare.

Methods

This study was carried out after data collection from cadavers at Potters Abattoir, Taunton, Somerset, United Kingdom. The observation in cadavers has the advantage over live animals of allowing a full detailed noninvasive inspection of the oral cavity. A total of 60 horses were selected by convenience sampling, of which 30 had never been ridden (unridden) and 30 had previously been ridden. Ridder/unridden information was collected at registration in the abattoir. No selection of gender, breed, age, or any other variable was considered. The horses used in the study were not euthanized for the purpose of this study, and therefore no ethical considerations were raised by the Ethics Committee of the Hartpury University.

Once euthanized, the horse's head was brought for examination of the buccal mucosa. The area of the BU was assessed according to the grading system developed by Allen (2004) and presented in Table 1. The height of the SEP was also assessed according to the grading system developed by Simhofer, Griss, and Zetner (2008) and presented in Table 2.

Generalized linear models from the binomial family were fitted to the data to model SEA and BU grades as dependent variables, function of the independent binary variable ridden/not ridden. Despite the score not being a continuous variable, they are derived from measurements, and therefore, they can be used as a continuous variable. The link function with the best adjustment (AIC – Akaike Information Criterion) was found to be the logit, and logistic regressions were therefore, implemented.

Table 1. Grading system for buccal ulceration. Adapted from Allen (2004).

Grade	BU area(cm^2)
1	0–4.5
2	5–9.5
3	10–14.5
4	15–19.5
5	>20

BU – buccal ulceration

Table 2. Grading system for sharp enamel points. Adapted from Simhofer et al. (2008).

Grade	SEA height (mm)
1	0
2	0–5
3	5–10
4	10–15
5	>15

SEA – sharp enamel points

Data were analyzed using the glm routine of the R-Cran software, version 4.0.4 × 64 bits. Predictor effect plots (Fox & Weisberg, 2018) were also produced using this software.

Results

For both the ridden and unridden groups, the most frequent grade of BU was 2 with 53% of the ridden horses and 60% of the unridden horses displaying this grade. Both ridden and unridden groups displayed grades 1 and 2 of BU, however only the ridden group displayed grade 3 (27%) and 4 (3%).

Both groups only displayed grades 2 and 3 of SEP, however the percentages differed greatly between groups. The ridden group displayed 43% of grade 2 and 40% of grade 3, while the unridden group displayed 76.753% grade 2 and only 17% grade 3. In addition, 10% of the ridden horses scored 4 and 3% of the unridden scored 1. The distribution of the scores for the different traumas and ridden factors are presented in Table 3.

Logistic regressions were successfully fitted to the data: likelihood ratio chi-square8.8257, 1 degree of freedom, $p < 0.01$, for BU; likelihood ratio chi-square10.914, 1 degree of freedom, $p < 0.001$, for SEP. The parameters of the two models are presented in Tables 4 and 5, with Wald 95% confidence intervals. Figures 2 and 3 illustrate the effect plots derived from the two models. As can be observed, higher grades of both BU and SEP predict ridden horses.

BU and SEP were also tested for correlation (Spearman's rho) and were found to correlate positively ($\rho = 0.63$; $p < 0.001$).

Table 3. Number of ridden and unridden horses observed for each of the conditions and scores.

		Scores				
		1	2	3	4	5
Ridden	BU	5	16	8	1	0
	SEP	0	13	12	3	0
Unridden	BU	12	18	0	0	0
	SEP	1	16	5	0	0

BU – Buccal ulcerations; SEP sharp enamel points

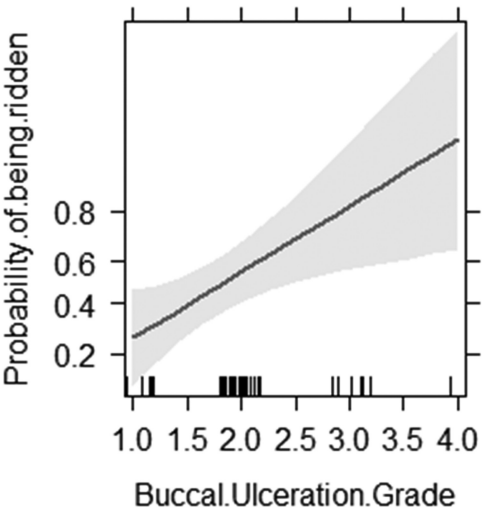
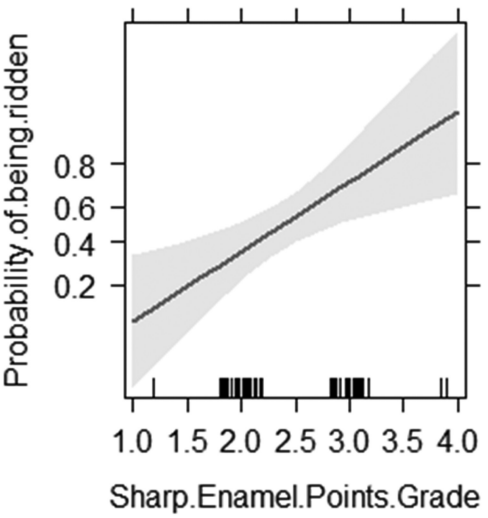


Figure 2. Predictor effect plot (Fox & Weisberg, 2018) with prediction of horses being ridden or not ridden as a function of buccal ulceration grade.



Q4 **Figure 3.** Predictor effect plot (Fox & Weisberg, 2018), with prediction of horses being ridden or not ridden as a function of sharp enamel points grade.

Discussion

While comparing the results obtained in this study with those from other similar studies, we can identify agreement with Allen (2004) and Tell et al. (2008) regarding BU. Allen (2004) found a higher prevalence of BU in horses ridden more frequently or to a higher standard. Tell et al. (2008) have also found a higher prevalence of severe and acute large oral ulcers in horses more recently ridden. The bit can cause pinching of the commissures of the lips, the bars of the mouth and the buccal mucosa when a contact is taken with the reins (Tell et al., 2008). This in turn can lead to ulcerations and ridden and masticatory discomfort (Scoggins, 2001).

Table 4. Parameters of the logistic regression fitted between the dichotomous variable ridden or not and the buccal ulceration grade.

Parameter	β	SE	95% Wald CI		p-Value
intercept	−2.3512	0.9231	−4.1604	−0.5420	<0.05
BU Grade	1.2794	0.4821	0.3345	2.2244	<0.01

Note: Akaike information Criterion 78.352
SE – standard error; CI – confidence interval; BU – buccal ulceration

Table 5. Parameters of the logistic regression fitted between the dichotomous variable ridden or not and the sharp enamel points grade.

Parameter	β	SE	95% Wald CI		p-Value
Intercept	−3.8117	1.3056	−6.3706	−1.2528	<0.01
SEP Grade	1.5957	0.5437	0.5301	2.6614	<0.01

Note: Akaike Information Criterion 76.264
SE – standard error; CI – confidence interval; SEP – sharp enamel points

Anthony et al. (2010) and Du Toit, Burden, and Dixon (2008) suggested that sharp enamel points are a normal feature of equine dentition. Dixon and Drake (2005) argued that SEP also develop in

wild horses, such as the Exmoor ponies. Penzhorn (1984) has found uneven wear of teeth in older wild zebra.

Therefore, we can find evidence of maladaptation to the process of domestication, but at the same time, we can find evidence of the same dental disorders in domestic and wild equids. However, the current study shows that ridden horses are more prone to SEP, and to BU as a consequence (positive correlation). Therefore, higher SEPs show higher BU grade. Whether this is due to a higher degree of stabling and poor access to roughage or higher degree of mouth tack contact, or both, remains to be researched. Other factors such as age, breed, rider ability and type of mouth tack may also deserve to be investigated.

It is important that further studies are carried out in this area to facilitate the evolution of the health and welfare of the horse.

Di Filippo et al. (2018) found that the dental correction including SEP improves grinding and chewing, and therefore, mastication efficiency of fibers leading to lower fecal particle sizes. This improves digestibility by the exposure of intracellular contents of feedstuff and prevents the development of colic (Cohen, Matejka, Honnas, & Hooper, 1995; Gunnarsdottir et al., 2014).

Equine dental care may partially solve some problems through dental floating, but without access to grazed land, the limitation of a natural behavior hindering the welfare of the horse seems evident. In the wild, the horse spends around 15 hours a day grazing, covering up to 7 miles (Kenny et al., 2018), while in stables, he is limited in his movements and is meal fed with a ration ingested quickly.

Conclusion

Through the process of domestication, a change in the management of horses has encouraged high concentrate ration feeding, reduced grazing time, and therefore reduced wear on the occlusal surface of their cheek teeth. This reduction in grazing time, reduced wear on the occlusal surface and the anisognathic nature of the horse's dentition leads to the development of sharp enamel points on the edges of the teeth. These sharp enamel points can cause ulcerations within the oral cavity, which can lead to oral discomfort. It is in the interests of the horse's continuing high welfare standards that these ulcerations and their relationship with the humans are investigated.

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