How to Recognize and Clinically Manage Class 1 Malocclusions in the Horse

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Class 1 malocclusions are a frequent finding in the dentition of the horse. These malocclusions often result in tooth elongations that can be detrimental to normal mastication, cause pathologic orthodontic tooth movements, and predispose to painful periodontal disease. Odontoplasty, the removal of tooth material with manual or motorized instrumentation, is generally used in a conservative manner to correct the malocclusion or prevent it from becoming worse over time. Author's address: Salem Valley Veterinary Clinic, 12 Center Street, Salem, Connecticut 06420; e-mail: rbaratt1dvm@gmail.com. © 2010 AAEP.

1. Introduction
A malocclusion is defined as any deviation from normal occlusion. In the horse, the normal occlusion (orthooclusion) is a level incisor bite. In humans (and many breeds of dog and cat), the incisors have a normal overbite. The hypsodont dentition, angled conformation of the temporomandibular joints, and anisognathism (mandibular jaw width narrower than the maxillary counterpart) result in the normal 10–15° angle to the occlusal surface of the cheek teeth and enamel points on the lingual aspect of the mandibular cheek teeth and buccal aspect of the maxillary cheek teeth. The normal horse has a curvature of the occlusal surfaces of the cheek teeth in the longitudinal plane, called the curvature of Spee (Fig. 1). The rostral angulation of the distal cheek teeth and the caudal angulation of the mesial cheek teeth maintain tight interproximal contact until very late in life.

A class 1 malocclusion (neutoclusion) occurs in horses with normal jaw lengths and teeth in their normal mesiodistal location. Abnormalities of cheek tooth wear are frequently seen and often described as waves, steps, hooks, and ramps. Although these types of occlusal abnormalities have not been previously classified as a type of malocclusion, their description as a class 1 malocclusion is justified and lends credence to the idea that occlusal adjustment is an orthodontic procedure. Similarly, abnormal incisor wear, given the descriptive terms smile, diagonal, stepped or irregular, and frown, can be considered another type of class 1 malocclusion.

A malpositioned tooth, in the horse with normal jaw lengths, is another type of class 1 malocclusion. Rotations, embrications (crowding), displacements, and versions (tilting) are seen in both the incisor and cheek teeth, with the highest incidence in the Miniature Horse. An overjet is a facial projection of the maxillary incisors, whereas an overbite is the vertical overlap of the maxillary incisors over the mandibular incisors. The overbite (parrot mouth) is most commonly seen in the class 2 malocclusion, in which the mandible is short relative to the maxilla (Fig. 2). The maxillary incisor overbite or overjet may be accompanied by abnormalities in cheek tooth...
wear, such as hooks on the rostral maxillary and caudal mandibular cheek teeth. However, normal cheek tooth occlusion is often observed with these incisor malocclusions (Fig. 3). The class 3 malocclusion, in which the mandible is of greater length than the maxilla-incisive bones, is most commonly seen in the Miniature Horse. Mandibular incisor overjet or overbite may occur in the absence of cheek teeth abnormalities but is most commonly associated with ramped mandibular first cheek teeth (306, 406).

The etiology of class 1 malocclusions generally can be determined by physical examination and radiographic imaging. Because malocclusions can be responsible for poor mastication, periodontal disease, and poor athletic performance related to oral pain, proper diagnosis and management is important.

2. Materials and Methods

The equipment needed and method of performing a thorough physical examination of the horse’s head and mouth have been described. The clinician should perform a brief physical examination before sedation, noting the horse’s body score, rectal temperature, and in some cases, observation of the horse’s chewing behavior and whether quidding is present. An extraoral examination should include the observation of any facial swelling, nasal discharge, malodorous breath, ocular discharge, ptosis, painful response to palpation of the temporo-mandibular joint region, and lymphadenopathy. After sedation, and before placement of the full-mouth speculum, oral examination of the lips, oral mucosa and gingiva of the lips and incisors, incisor malocclusions, and periodontal disease and assessment of the lateral excursion to molar contact is performed. After placement of the full-mouth speculum, the diastema between the incisors and the cheek teeth is examined, and the presence of canine teeth and first premolars (wolf teeth) is noted. The examination of the cheek teeth requires both an overall evaluation of the occlusion for patterns of abnormal tooth wear and a detailed, tooth by tooth examination with a good headlight, dental mirror, dental explorer, and periodontal probe. Mobility of teeth can be assessed digitally and using

Fig. 1. Quarter Horse gelding, 7-yr-old. Normal development of sharp enamel points on the buccal side of the maxillary cheek teeth and the lingual aspect of the mandibular cheek teeth (left). Buccal mucosal lacerations (arrows). Normal curvature of Spee gives the false impression of a hook on the lower third molars (311, 411). Conservative management: floating of the enamel points; note that very little rasping of the occlusal surface has occurred.

Fig. 2. Quarter Horse mare, 11-yr-old. Class 2 malocclusion (short mandible). Incisor overbite in conjunction with a normal cheek tooth occlusion.

Fig. 3. Warmblood X gelding, 14-yr-old. Incisor overjet, with ramp overgrowth of 206 and 311.
a variety of forceps. It is important to carefully examine the tooth opposite from any overly long tooth. Although crown reduction of the overlong tooth may be indicated, the pathology is generally in the opposing tooth (Fig. 4).

The pulp horn numbering system devised by Da-cre has been generally adopted.9 Particular attention to the presence of pulpar exposure in all cheek teeth is important. Any “catch” of the dental explorer on the occlusal aspect of a pulp horn should be noted. The depth of pulp horn and infundibular cavities can sometimes be assessed using 25- to 27-gauge hypodermic needles, but computed tomogra-
phy studies have shown that these estimates generally underestimate the apical extent of the lesions.9 Recording of these findings on a dental chart is recommended and should be kept as part of the medicolegal records. Fewer errors and omissions will be made if an assistant records the find-
ings that are dictated by the clinician as he performs the oral examination. The use of standard abbre-
viation approved by the Academy of Veterinary Dentistry10 and the American Veterinary Dental College11 will facilitate communication with col-
leagues and specialists.

Meticulous evaluation of any sites of feed impac-
tion is important. A variety of instruments may be required to accomplish the removal of impacted feed material and cleansing and sounding of the diastem-
ata and periodontal pockets. Long-handled straight and right-angled alligator forceps, long-handled picks and scalers, marked (in millimeters) periodon-
tal probes, and irrigation devices are often needed. Accurate periodontal disease assessment requires the introduction of sharp instruments into the horse’s mouth and therefore adequate sedation needs to be used to prevent iatrogenic injury to the oral soft tissues. Radiographic evaluation is cer-
tainly indicated when probing depths exceed 10 mm or there is significant tooth mobility or clinical evi-
dence of apical infection.12 Techniques for obtaining diagnostic dental radiographs have been described.13 There have been several papers docu-
menting the efficacy of widening the diastema be-
tween cheek teeth in cases where feed impaction is the cause of painful periodontal disease.14,15 Burs of various sizes and shapes are available from the manufacturer of some models of motorized dental floats.

Instrumentation for the reduction of tooth over-
growths is largely a matter of personal preference. Although there is no substitute for direct visual oral examination, some practitioner’s prefer to use in-
struments (floats) to rasp tooth overgrowths with digital rather than visual guidance and assessment. In the author’s opinion, the use of motorized instru-
mentation allows easier direct visualization of the odontoplasty procedure and a more precise adjust-
ment of occlusal abnormalities. The procedure is generally faster with motorized equipment, and often the ergonomics are improved. A scanning electron microscopy study indicated that live odonto-
plastic processes were exposed by routine odonto-
plasty procedures and that motorized floats resulted in less trauma to the treated surface of the tooth.16 Of course, the two types of instrumentation can be used in conjunction with each other. Regardless of the instrumentation used, care must be taken not to cause iatrogenic trauma to soft tissues or teeth. Removal of excessive tooth material can cause irreversible pulptis either from direct pulp exposure or thermal damage.17,18 The clinician should always bear in mind that the equine hypsodont tooth is a vital structure, which continuously erupts. Although removal of sharp enamel points on a young (<15 yr old) horse may be necessary at 6- to 12-mo intervals, the older horse may require this only ev-
ery 2 yr or even less frequently. Tooth wear is also significantly affected by the horse’s access to pasture
and the proportion of concentrate to roughage in the diet. Because an unopposed cheek tooth will erupt more quickly and has less wear than a normal cheek tooth, occlusal adjustment, in the form of crown height reduction, may be required at frequent (6 mo) intervals in a young horse and yearly in an older horse.

Once a diastema has formed between adjacent cheek teeth, an excessive transverse ridge tends to form on the opposing cheek tooth (Fig. 5). This dental overgrowth acts as a wedge, perpetuating or even increasing the diastema width.19 In some early cases, the associated feed packing and periodontitis may be adequately addressed by removal of the excessive transverse ridge/tooth overgrowth. Removal of the tooth overgrowth will often allow closure of the diastema (by mesial drift) and resolution of the periodontal disease. Similarly, a hook on the mesial aspect of the maxillary second premolar will sometimes result in mesial orthodontic movement of this tooth that will correct when the hook is removed.

It is not possible to predict with any degree of certainty how much tooth overgrowth can be removed without the risk of pulp exposure. Conservative odontoplasty, the removal of <4 mm of clinical crown at any time, can be performed at 2-mo intervals when large tooth overgrowths must be corrected. The apical retraction of the vital pulp and coronal deposition of secondary dentine in the pulp horns will occur in response to this staged odontoplasty procedure. The coronal extent of the mesial pulp horn (#6) of the first maxillary and mandibular cheek teeth is not likely to extend beyond the occlusal surface of the body of the premolar. If the base of the hook is narrow, the entire hook can be removed at one visit, because the #6 pulp horn is not at risk (Fig. 6). However, if the base of the hook is broader, a more conservative crown reduction is justified (Fig. 7).

Once the cheek teeth overgrowths have been addressed, the full-mouth speculum should be removed, and the excursion to molar contact should be reassessed. If there is excessive excursion to molar contact, conservative incisor crown reduction can be performed.20 Some diagonal incisor malocclusions have recently been shown to have accompanying deformation of the incisive bone.9 In the author’s opinion, it is not necessary and potentially deleterious (inadvertent pulp exposure) to perform occlusal adjustments of these cases in an effort to recreate a level bite. Odontoplasty of incisors is generally not needed if there is normal excursion to molar contact (Fig. 8).

3. Results

Sharp enamel points are normal in the horse. Although there is no doubt they are occasionally the cause of painful buccal or lingual lacerations in the horse, removal of enamel points (floating) has not been shown to affect either feed digestibility or performance in a limited number of studies.21,22 However, it is generally accepted that, for many performance horses, the removal of sharp enamel points on the cheek teeth results in
improved “rideability.” The author believes that this procedure should be conservative and in general should not reduce the occlusal surface of the cheek tooth (Figs. 1 and 9).

Conservative management of class 1 malocclusions has, in the author’s experience, been successful in the vast majority of cases presented in general practice for a “routine float” (Fig. 10). With the exception of the geriatric patient, conservative management of diastema between cheek teeth is probably preferred over diastema widening, because the risk of iatrogenic pulp exposure is significant. Removal of the opposite tooth overgrowths and addressing any tooth overgrowths that are exerting orthodontic forces that tend to create the diastema should be attempted before diastema burring in most cases. In the author’s experience, mesial drift will often close the diastemata in horses <20 yr of age, if tooth overgrowths are corrected.

4. Discussion
The hypsodont dentition of the horse is always in a state of eruption and wear. Although class 1 malocclusions are commonly observed in the horse, the practitioner should bear in mind that the vast majority of these horses have an occlusion that is quite functional, with a normal excursion to molar contact. In these cases, the goal of intervention is as follows: reduce dental overgrowths that are causing orthodontic movement of teeth, diastemata, feed bolus, and improve “rideability.”
packing, and periodontal disease and reduce dental overgrowths that are the cause of traumatic soft tissue contacts or excessive wear of opposing diseased teeth.

With mesial drift and continued eruption of cheek teeth, conservative management of many class 1 malocclusions will be enough to eliminate the malocclusion in young horses with undamaged cheek teeth. The frequent occurrence of asynchronous eruption of the maxillary and mandibular fourth premolars is presumed to be a common etiology of the wave complex in which there is relative tooth overgrowth of the mandibular fourth premolars. In the horse <15 yr of age, correction of this malocclusion may be possible with several crown reductions of 3–4 mm over the course of 1–2 yr, because the short (infracluded) maxillary cheek tooth erupts without the occlusal contact of the opposite mandibular cheek tooth. On the other hand, in the older horse, there may not be significant reserve crown eruption of the infracluded maxillary cheek tooth to permit correction of the wave malocclusion. Again, very conservative odontoplasty is generally all that is needed.

Complex malocclusions, such as waves, should not be corrected to a theoretical normal anatomical condition by trying to reduce the height of all overgrown teeth in an effort to create a “textbook” occlusion. This results in unnecessary removal of crown, runs the risk of iatrogenic irreversible pulpitis, would often require excessive incisor crown reduction to allow normal excursion to molar contact, and may result in quidding or even anorexia (Fig. 11). In the case of a mild to moderate wave, when the most overgrown tooth is opposed by a diseased tooth, then annual reduction of 3–5 mm of this “peak” of the wave is enough to keep the weakened tooth out of occlusion and to protect it from traumatic contact. This degree of crown reduction is not associated with quidding or a measurable change in excursion to molar contact.

Another proposed etiology is the presence of infundibular cemental hypoplasia of the maxillary premolars or molars. This may predispose to infundibular caries and a crown that is relatively weaker than the mandibular counterpart. Excessive wear is recognized as a prematurely expired (cupped) crown opposite the overgrown mandibular tooth. In this case, regular reduction of the mandibular cheek tooth overgrowth will be needed for the life of the horse.

Step overgrowths, ramps, and large hooks on cheek teeth not only impede normal mastication, they exert orthodontic forces that move the overgrown teeth, with creation of diastemata. The resultant feed impaction in turn causes periodontal disease. Some hooks are so large that they cause significant trauma to the opposite soft tissues. In the author’s experience, removal of large hooks back to the level of the normal occlusal surface may need sequential reduction to avoid pulp exposure. Pulp exposure has been documented when removing the normal occlusal surface along the mesial aspect of the second premolars (the so-called “bit seat”). Basic dental principles dictate that the occlusal tables should be preserved. In regard to large tooth overgrowths, until more scientific evidence is available, a conservative reduction of 3–4 mm every 2–3 mo is recommended. The use of molar cutters is not recommended, because these instruments can cause vertical tooth fracture. In cases where the mandibular third molar has a very large distal hook, a motorized float can still be used by placing the instrument cutting disc on the lingual or buccal aspect of the tooth overgrowth and pressing it coronally until enough space is created so the float can be placed on top of the tooth overgrowth.

In the author’s opinion, if there is normal excursion to molar contact, diagonal incisor bite malocclusions need not be corrected. In these instances, there has likely been adaptive remodeling of the incisive bone and/or rostral mandible (axial rotation and/or lateral deviation). Shortening of overgrown teeth will not change this skeletal adaptation. On the other hand, if incisor overgrowth has precluded molar contact, crown reduction of the overlong inci-
sors can be done in a conservative manner (3–4 mm, every 2 mo).

References and Footnote
