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Periodontal Disease and Tooth Decay in the Horse

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1. Introduction

Chronic progressive periodontal disease and infundibular decay are the leading causes of tooth loss in the horse. These conditions are very common but often go undetected due to lack of recognition and incomplete examination of the oral cavity. These pathologies are often very preventable and treatable if diagnosed early. Modern instrumentation and medications allow for treatment and preventative maintenance. It is advantageous to the overall health of the horse, as well as to the oral cavity, to prevent tooth loss.

2. Periodontal Disease

The pathogenesis of periodontal disease is a complex multifactorial disease process affecting the oral cavity and extending systemically in more advanced stages [1]. A brief description of the disease process follows. The periodontium is a dynamic structure constantly undergoing normal change as the horse's teeth erupt. The periodontium consists of the gingiva, alveolar bone, periodontal ligament, and the cementum of the tooth. The periodontal ligament is made up of collagen bundles called Sharpey's Fibers that attach the tooth cementum to the alveolar bone. Electron microscopy has revealed the presence of blood vessels and nerves above the clinical crown, illustrating that the cementum above the gingival margin is living tissue [2]. The horse has normal host defenses that work to maintain the integrity of the tissues that support the tooth. Cervicular fluid in the gingival sulcus contains saliva, leukocytes, antibodies, and normal oral bacterial flora [3]. A disruption of the defense mechanisms results in an opportunistic infection. In the horse, salivary secretions are very important in cleansing the oral cavity. Domestic feeding practices and processed feeds often lead to abnormal mastication and decreased salivary fluid production. Decreased range of motion, malocclusions, and food stasis may lead to a deleterious environment in the oral cavity. Normally the lack of interproximal space between horses' teeth prevents feed from collecting. Malocclusions and uneven pressures on teeth can create increased interproximal spaces and misalignment of the teeth. Feed packing around or in between teeth undergoes decay and bacterial fermentation. This process and the resulting byproducts cause a breakdown of the periodontium, which gradually migrates apically along the tooth to form a periodontal pocket. Cemental decay is often present on the exposed crown. As the disease progresses, the alveolar bone and connective tissue attachments become further compromised and tooth loss is inevitable. Periodontal disease can lead to apical infection of the root, a necrotic pulp, and an apical abscess. Other systemic conditions, such as Cushing's syndrome, can exacerbate periodontal disease and alter the outcome of treatment.

3. Oral Examination

A thorough oral exam is required to diagnose periodontal disease. This exam must include the use of a bright headlight, a full mouth speculum, and a good dental mirror on a properly sedated horse. One should always observe the mouth before rinsing to determine where the horse prefers to masticate food, and then the oral cavity should be rinsed clean. Visual examination involves looking for food and debris collection between or around the dentition (Fig. 1).

Figure 1. Periodontal pocket between molars 210, 211. - To view this image in full size go to the IVIS website at www.ivis.org . -

One should observe the soft tissues around the teeth for signs of irritation or recession. Damage to soft tissues from course feed material or the presence of foreign bodies, tooth fragments, or retained roots can also initiate periodontal disease. Overgrowths, misalignments, or malocclusions often lead to abnormal feed accumulation between or around teeth. A dental

mirror should be used to observe the buccal and interproximal spaces of the maxillary cheek teeth. The mirror must be used to examine the buccal, lingual, and interproximal spaces of the mandibular cheek teeth. A retractor can be useful to hold the tongue and cheek aside when observing the mandibular cheek teeth and the buccal aspect of the maxillary cheek teeth. The incisors should be examined on the labial, palatal, and occlusal aspect without a speculum in place. Normal dentition in the horse should be tightly opposed. Increased or open interproximal spaces, or diastema, create a place for feed and debris to collect. Rotated or crowded teeth often also collect feed. These are the places to look for periodontal disease. The presence of a foul odor is often an indicator that feed is collecting in an area and should make one observe closely for its source. Accumulated feed should be removed and the condition of the periodontium should be visually observed to assess the extent of disease and the presence of cemental decay and calculus. A periodontal probe should also be used to check the depth of the periodontal disease. Calculus often forms on the canine teeth, incisors, and in diastema between cheek teeth.

4. Proper Dental Maintenance

A complete oral exam should also include the notation of dental malocclusions. Both malocclusions and the masticatory process of domesticated horses lead to dental overgrowths. These overgrowths alter the mastication of the horse and are progressive without good dental care. Often due to the altered mastication and the mechanical effects of the overgrowth, food will be forced between teeth or coarse feed will cause damage to the soft tissues and begin disease processes. Overgrowths can also cause improper forces on teeth, causing them to shift or loosen over time. For example, a ramped 306 or 406 can create too much rostral pressure on these teeth, and a diastema may form between it and the 307 or 407. A single enlarged transverse ridge can force its way between two opposing teeth and create a diastema in which feed can collect. Often times reducing the overgrowth or reducing the opposing tooth and taking the affected area out of occlusion will be all that is needed to allow a periodontitis to heal. Overly aggressive dental work can also create problems. Overworking the occlusal surfaces of the cheek teeth can lead to excessive rostral-to-caudal slide of the jaw as the horse masticates. This can lead to diastema forming between the last two teeth of the cheek teeth rows, most often between the 306 and 307, 406 and 407, 310 and 311, and the 410 and 411. Too much lateral excursion can cause cheek teeth to shift in a buccal or lingual direction. Too much occlusal pressure on one tooth can cause it to shift or even fracture. It is very important to evaluate cheek teeth occlusion by using a cheek retractor and observing how the teeth come into occlusion as the mandible is manipulated laterally, with the mouth closed and the teeth forced together. Too much occlusal pressure on the incisors will often lead to abnormal lateral forces as the incisors come together during mastication. Abnormal pressures force them apart and create diastema and a place for food to collect. Thorough examination and routine dental maintenance, providing a balanced occlusion, is of the utmost importance for the prevention of dental disease in the horse.

5. Treatment of Periodontal Disease

Once the periodontal disease has been located and any overgrowths corrected, the feed and debris should be cleaned out of the area (Fig. 2). The large particles of feed should be removed manually using a small dental pick, forceps, and lavage. Superficial periodontitis may readily respond to a simple cleaning.

Figure 2. Periodontal pocket interproximally between molars 210, 211. - To view this image in full size go to the IVIS website at www.ivis.org . -

Radiographs may be helpful in determining the extent of the disease and the integrity of the underlying bony structures. There are many different types of irrigation systems available. The Equine Dental System by Pacific Equine Dental Institute (P.E.D.I.) offers the advantage of having a prophylaxis/air abrasion unit, which utilizes high-pressure lavage (100 - 200 psi) with sodium bicarbonate/chlorhexidine solution to clean and disinfect [a]. The system also offers a high-speed drill, sonic scaler, venturi suction, and triplex syringe for air and water. The affected area should be examined with a dental mirror, and a periodontal probe should be used to check the extent of the disease. Calculus should be removed using a manual scaler, sonic scaler, or air abrasion at 100 - 125 psi with sodium bicarbonate or, in more severe cases, 25-micron aluminum oxide powder. The extent of cemental decay should be evaluated, and the cementum should be polished with either the air abrasion or a high-speed drill. The area should be rinsed and dried, which can best be accomplished using a triplex syringe. After debridement, a sustained release antibiotic can be used subgingivally to aid in healing. Doxicycline gel can be injected into the pocket [b]. The gel consists of two parts, a liquid and a powder, that are mixed. When the resulting gel polymer comes in contact with liquid, it solidifies. This product not only places a sustained release antibiotic subgingivally at the site of infection but also provides a substance that biodegrades over time and allows the soft tissues to migrate in and fill the void. It can be difficult to apply on upper teeth without the gel running out of the pocket. Once the doxicycline gel is applied, a small dental probe can be wetted, inserted between the teeth, moved up into the pocket, and then slipped out of the gel along the palate. One can also wet a gloved finger and press the gel into place. If the pocket is

large, impression material can be used to protect the area from the abrasive forces of food. Impression material can be obtained from 3-M in a gun with mixing tips [c]. There are many different set times available, and the ambient temperature and number of areas to be covered will determine which product is used. It is recommended that beginners use a longer set time while becoming accustomed to the procedure. Care must be taken not to fill the pocket with impression material because it will not allow proper healing. The impression material should just protect the doxicycline gel and be level with the surface of the gingiva and may extend between the teeth to aid in retention (Fig. 3).

Figure 3. Impression material in place to protect doxicycline gel in periodontal pocket. - To view this image in full size go to the IVIS website at www.ivis.org . -

Another product that can be very useful is Coe-Pak [d]. This can be used like a Band-Aid over the affected area. Two equal parts are mixed together on a used piece of x-ray film using a tongue depressor. Dry the gingiva with a stream of air where the Coe-Pak is to be applied. Wet a gloved hand, apply the Coe-Pak with the tongue depressor, and smooth with a wet finger. Again, care should be taken to cover only the surface. The area should be re-evaluated in about 2 wks, and any remaining impression material or Coe-Pak should be removed. The doxicycline gel biodegrades and does not need to be removed. Retreatment may be necessary depending on the extent of the disease. Systemic antibiotics should be considered when treating periodontal disease. Blood-borne microbes can affect vital organs, cause vegetative endocarditis, or cause disseminate abscesses elsewhere in the body.

Another viable treatment in the case of "valve"- type diastema is that of enlarging the diastema to allow food and debris to more easily clear the open interproximal space [4]. In a valve diastema, the distal portion of the interproximal space, next to the occlusal surface, is narrower than the space next to the gum. This results in feed getting trapped in this wedge-shaped space. A right angle, water-cooled carbide or diamond burr can be used to enlarge the interproximal space. There is one grave danger with this procedure. The sensitive pulp of the tooth is very close to the rostral and caudal interproximal edges of the teeth (Fig. 4). If the burr creates too much heat or inadvertently enters the sensitive pulp of the tooth, and the damage is not immediately repaired, the tooth will become infected and eventually abscess. This damaged tooth will likely need removal within months or, occasionally, years later. Extreme care must be taken to remove the least amount of tooth necessary to avoid permanently damaging the tooth. Depending upon the severity of the disease process, it may be advisable to first treat the periodontal disease as described above. After the soft tissues have healed, the diastema may be enlarged. If the diastema is enlarged first, it can be very difficult to get retention of the medication and impression material or Coe-Pak.

Figure 4. Pulp chambers 1, 2, 3, 4, 5 filled with secondary dentin. Infundibuli A and B filled with cementum with patent central canal. Peripheral cementum C. Enamel folds D and E. Primary dentin F. - To view this image in full size go to the IVIS website at www.ivis.org . -

6. Infundibular Decay

Infundibular decay or caries is the most common type of decay in horses' teeth. The infundibula are enamel invaginations found in the incisors and maxillary cheek teeth. Cemental hypoplasia or incomplete filling of the maxillary cheek teeth infundibula with cementum is the most common reason for infundibular decay. In a normal tooth, the infundibulum is filled with cementum. There is a normal pin-like hole in the cementum that generally travels the length of the infundibulum where the blood vessels withdrew as cementum was laid down. Cemental hypoplasia is believed to be a problem that occurs during tooth development. Early disruption of the blood supply to the infundibulum could result in a lack of cementum formation. Premature removal or loss of deciduous teeth (caps) would disrupt the blood supply to the occlusal surface of the permanent tooth. This lack of cementum within the infundibula allows food material and bacteria to accumulate in the center of the tooth (Fig. 5). Fermentation and acid production leads to decalcification of the surrounding cementum, enamel, and dentin. This may eventually lead to tooth loss due to decay or fracture. Coalescing of the infundibula weakens the center of the tooth and can lead to a saggital fracture and a split tooth (Fig. 6 & Fig. 7). Decay into the pulp chamber of the tooth will lead to infection and may often lead to an apical abscess, sinusitis, and/or a draining fistulous tract.

Figure 5. (1) Decayed infundibulum packed with feed material. (2) Infundibulum filled with composite filling. - To view this image in full size go to the IVIS website at www.ivis.org . -

Figure 6. Split upper molar 109 due to infundibular decay. - To view this image in full size go to the IVIS website at www.ivis.org . -

One should become familiar with the differences between the location and occlusal appearance of the pulp chambers and infundibuli of the maxillary cheek teeth (Fig. 4) [5]. The maxillary cheek teeth have between five and eight pulp chambers, recognized by the darkly stained secondary dentin. They also have two infundibuli with light cream-colored cementum. The mandibular cheek teeth only contain five to seven pulp chambers and no infundibuli. A thin probe should not be able to be inserted into a normal pulp chamber's secondary dentin but often can be inserted into a small hole in the center of the cementum of the normal infundibulum. The incisors on a young horse have a single infundibulum (cup) containing cementum. The incisors also have a pulp chamber that can divide into two or more canals and should be filled completely with dentin (dental star).

Again, a thorough oral examination is necessary to diagnose infundibular decay. Visual examination will often reveal abnormal food collection in the occlusal surface of the teeth. The occlusal surface of the teeth should be carefully examined visually and with a small probe to look for defects and discoloration or decay of the surface. Damaged or fractured areas on a tooth should be carefully examined to determine if there is communication with the pulp chamber of the tooth. Each pulp chamber should be examined on the incisors and upper and lower cheek teeth. One should not be able to insert a probe into the pulp chamber, since the stained secondary dentin should be intact in a normal tooth. The infundibula of the maxillary cheek teeth should be probed and checked for signs of decay. Observing feed packing in the infundibulum on the occlusal surface indicates possible infundibular decay of the maxillary cheek teeth. This food should be cleaned out of the infundibulum to observe the extent of the decay. A dental mirror and incremented periodontal probe are necessary to determine the depth of the decay.

Accidental pulp exposure should be repaired immediately. The upper 3 - 4 mm of the pulp canal should be cleaned out carefully with a high-speed drill or small curette. The canal can then be packed with calcium hydroxide powder or paste and a composite filling applied to ensure a proper seal. In the past, visualization of a "blush" or redness to the surface after reduction of a tooth indicated the close proximity of the sensitive pulp and was thought to be acceptable. In many cases, the heat created by aggressive reduction of the tooth will severely damage the sensitive pulp, likely leading to the death of the tooth. Once damaged, the sensitive pulp may not produce secondary dentin to seal the pulp canal. Over time, as the occlusal surface is worn away, the open pulp chamber will be exposed and cause contamination of the interior of the tooth and abcessation. Aggressive reduction of the premolars, or large "bit seats," can also cause this damage to the sensitive pulp (Fig. 8 & Fig. 9). To prevent this type of damage, water-cooled, sharp instruments should be used and a conservative approach taken. When tall teeth are reduced, the correction should be done in stages, over several treatments. Treatment intervals can vary from months to years depending on the severity of the condition and the age of the horse.

Figure 8. Four open pulp chambers in 206 due to overly aggressive "bit seat" 3 yrs prior. A 1.5 inch needle inserted into rostral pulp chamber. - To view this image in full size go to the IVIS website at www.ivis.org . -

Figure 9. Open pulp chambers on 406 due to overly aggressive "bit seat" 4 yrs prior. Occlusal surface viewed in dental mirror. - To view this image in full size go to the IVIS website at www.ivis.org . -

7. Treatment of Infundibular Decay

Most important is the recognition of cemental hypoplasia and infundibular decay. Young horses may appear to have an enlarged infundibulum but, as the tooth comes into wear, the initial surface is worn away and a normal infundibulum filled with cementum appears. In the case of a young horse, under 8 yr of age, that does not appear to have a problem, re-evaluate the horse in 6 - 12 mo. In the older horse with food packing in the infundibulum, clean the majority of the debris out of the infundibulum using a fine dental pick. Air abrasion and a high-speed drill are also very helpful in removing the packed feed and the decayed tooth material. The most important part of filling a tooth is making sure that all of the debris and decay is removed by repeated observation with a dental mirror. Air abrasion with 25-micron aluminum oxide set between 150 - 200 psi will aid in removing decayed tooth without harming the healthy tooth material. One must allow adequate time to do a complete prep, which involves multiple cleanings, rinses, and re-checks with the mirror. The utmost care must be taken not to drill through the enamel of the infundibulum and into the pulp canal or sensitive portion of the tooth. Repeated use of a dental mirror will allow removal of only the decayed portion of the tooth. If one does enter the pulp and bleeding occurs, a dental astringent can be used to stop the bleeding before filling the tooth. The etchant should be used before the astringent or the area will bleed again after etching. Once the decayed portion of the tooth is removed, the area should be rinsed and a phosphoric acid etchant applied for 20 seconds. This should be rinsed and dried with a triplex syringe. A bonding agent is applied and light-cured for 20 s. Next, the composite filling material is applied (Fig. 5). In the case of large defects, the filling material should be applied in layers and light-cured between layers. An anodized probe or plugger can be helpful in

applying the composite to ensure no voids are left in the defect. We prefer a dual-cure flowable composite (StarFill 2B) [e]. This ensures that the filling will cure, without light activation, no matter how deep the defect. When using a dual-cure composite, use a curing light as little as possible to help prevent shrinkage of the filling. Undercutting the rim of the defect slightly will give a mechanical advantage in retaining the filling. One must carefully inspect the margins of the filling to ensure a tight seal and prevent micro leakage. A shepherd's hook probe is very useful in finding small defects. Open pulp canals should be approached in a similar manner. One should drill out the open canal as deep as possible, rechecking frequently with the mirror to make sure the canal is being followed. If one pulp is affected, one should carefully check the remaining dark stained secondary dentin with a fine probe, filling if open. These teeth should be re-checked every 6 mo to evaluate the integrity of the filling and check the remaining pulp canals for patentcy. If the tooth is dead, secondary dentin will not fill the remaining pulp canals, and they will become exposed as the occlusal surface is worn away. Minimizing the occlusion of the tooth by reducing the opposing tooth can help increase the life of the fillings. Radiographs will not typically show details of the structure inside the tooth itself but are very helpful in determining the integrity of the supporting structures around the tooth.

As with all dental disease, early diagnosis and preventative dental care are the best treatments for periodontal disease and infundibular decay. These diseases can cause extreme discomfort and deterioration of the overall health of the horse. Thorough oral examination and treatment with modern instrumentation and methods can greatly improve oral health and extend the useful life of the horse's dentition.

Photos courtesy of Pacific Equine Dental Institute, Tony Basile.

This paper is to reinforce the ideas on corrective dental procedures presented by the panel members and to serve as a reference source for members wanting information on equine dentistry.

Footnotes

a. The Equine Dental System; Pacific Equine Dental Institute (P.E.D.I.), El Dorado Hills, CA 95762.
b. Doxirobe; Pharmacia & Upjohn Co., Kalamazoo, MI 49001.
c. 3M Dental Products; St. Paul, MN 55144.
d. Coe Comfort; GC America Inc., Chicago, IL 60658.
e. Danville Materials; San Ramon, CA 94583.

References

1. Loman SJ. Periodontal disease in the horse. Horse Dentistry Bitting J 2003;24-26.

2. Kempson S. Equine cementum: the Cinderella tissue. In: Proceedings of the 17th Annual Veterinary Dental Forum 2003; 205.

3. Klugh DO. Equine periodontal disease. In: Proceedings of the 17th Annual Veterinary Dental Forum 2003; 206-210.

4. Carmalt J, Wilson DG. Treatment of a valve diastema in two horses. Equine Vet Educ 2004; 16(4):242-248.

5. Dacre IT, Dixon PM. Clinical aspects of the dentino-pulpal complex in equine dental disease. In: Proceedings of the 17th Annual Veterinary Dental Forum 2003; 193-199.