How to Assess the Equine Periodontium

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The periodontium is the attachment apparatus of the tooth. Evaluation of the periodontium requires specific knowledge of anatomy, processes of examination, instrumentation used, classification criteria and grading systems for findings to arrive at a correct diagnosis and to develop an appropriate treatment plan. Author’s address: Kettle Moraine Equine Hospital, Regional Equine Dental Center, N8818 Highway 67, Whitewater, Wisconsin 53190; e-mail: jmgkmeb@aol.com. © 2010 AAEP.

1. Introduction
The standard of care in equine dentistry continues to rise as scientific information becomes available and practitioners improve their knowledge base. A thorough understanding of the basics of all sub-disciplines of dentistry is important to appropriately diagnose and treat dental pathology. The seven primary subdisciplines, oral equilibration, periodontics, orthodontics, endodontics, restorative dentistry, exodontics, and oral surgery, each require specific knowledge of anatomy, processes of examination, instrumentation used, classification criteria, and grading systems for findings to arrive at a correct diagnosis and develop an appropriate treatment plan. The incidence of periodontal disease in horses has been documented for over 100 yr. In the past, the standard of care has been based primarily on gross intraoral examination findings. Recent introduction of high-quality radiographic techniques, intraoral cameras, and better instrumentation has enabled our profession to develop a periodontal examination standard similar to that used in human and small-animal dentistry. The periodontium has a complex anatomy that requires consideration during examination and either directly or indirectly must be considered when developing treatment plans for practically all dental pathology encountered.

2. Anatomy
The periodontium is the attachment apparatus of the tooth. It is defined as those tissues supporting and investing the tooth, and it consists of cementum, periodontal ligament, bone lining of the alveolus, and gingiva facing the tooth. Cementum is a creamy tan to yellowish bone-like mineralized component of the tooth (Fig. 1). It attaches to either dentin or enamel on one side and the periodontal ligament on the other side (in the normal horse). The periodontal ligament (PL) is a markedly complex structure consisting of collagen fibrils and fiber bundles with a network of blood vessels and nerves coursing throughout it. The PL attaches to the cementum of the tooth and the alveolar bone through Sharpey’s fibers and to the gingiva through the gingival ligament. The alveolar process is the bone of the maxilla, mandible, and incisive bone that contains the alveoli (sockets). The outer layer (vestibular, lingual, or
labial) is the cortical plate. The dense inner layer, the cribriform plate, can be seen radiographically as the lamina dura (Fig. 2). Cortical plate bone meets the inner alveolar bone at the alveolar crest. These can be differentiated radiographically in the normal patient. The alveolar bone at the coronal extent of the alveolus is referred to as crestal bone. Bone between two teeth is interproximal bone (mesial or distal to two adjacent teeth in a battery/arcade) (Fig. 3). Bone at the root tips is apical. The remaining alveolar bone is referred to as either labial, lingual, vestibular, or palatal, depending on the alveolar wall involved.

The gingiva surrounding and facing the tooth is also a component of the periodontium (Fig. 4). The coronal extent of the free/marginal gingiva is the gingival crest. The epithelium facing the tooth on this free gingiva is the gingival sulcular epithelium. It attaches to the tooth as the junctional epithelium coronal to the crestal bone in the fully erupted tooth. In the normal equine, the gingiva attaches to tooth cementum on one side and alveolar crestal bone or periosteum on the other side. Normal sulcular depth is up to 3 mm for incisors, canines, and second premolars and up to 5 mm for the remaining cheek teeth (Fig. 5).

3. Materials and Methods

When to Schedule the Periodontal Examination

In patients being evaluated for dental health for any reason, a periodontal examination should be a standard component of the complete oral examination. Periodontal disease may be a manifestation of a variety of infectious and metabolic disorders, and it is not limited to dental pathology. A thorough physical examination will help rule out concomitant systemic causes of periodontal disease.

Instrumentation

Specific instrumentation is necessary to properly evaluate for and grade the extent of periodontal
disease. A bright head light, full-mouth speculum with bite/gum plates, buccal/lingual retractors, dental explorers, periodontal probes, dental picks, long-handled alligator forceps, long-handled dental curettes, dental mirrors, molar forceps, and air-water irrigation are required (Fig. 6). Intra- and extraoral radiographic equipment are also necessary to fully evaluate and stage periodontal disease (Fig. 7). Digital and intraoral cameras are helpful for recording intraoral findings during the initial examination and documenting the treatment and results over time. Clinicians should be familiar with standing sedation/anesthetic techniques.

Execution of the Periodontal Examination

Significant time and effort must be devoted to the execution of the examination, because it is the basis of all further decisions regarding patient care. History, signalment, and physical examination findings are compiled. All patients are evaluated for risk factors that may preclude safe examination. Oral disorders may include diseased, absent, or structurally compromised tissues: equine odontoclastic tooth resorption and hypercementosis (EOTRH), missing incisors, temporal mandibular joint disease, and/or jaw trauma. These may cause pain or further injury with full-mouth speculum placement. Limb arthritis, hyperkalemic periodic paralysis (HYPP), cervical vertebral instability, equine protozoal myeloencephalitis (EPM), etc. may increase risks to the patient, handler, and clinician. Proper restraint is an important consideration during sedation. A fixed or portable stocks with a boom for suspending the dental halter significantly aids restraint (Fig. 8). Head stands may be used as an alternative to booms and dental halters. Conditions that increase risks should be addressed before proceeding to the periodontal examination.

The patient is sedated so that a full-mouth speculum may be placed, chewing and tongue motion is eliminated, and the oral cavity may be instrumented. Periodontal disease is painful. In some specific cases, patient anxiety levels may escalate dramatically on instrumentation of the oral cavity. Animals may exhibit head tossing or excessive chewing and tongue motion, resulting in an inadequate

Fig. 4. Gingival/mucosal anatomy. Red arrows, gingival crest of the free/marginal gingival; red bracket, marginal/free gingival; blue bracket, attached gingival; yellow bracket, mucosa; line where blue and yellow brackets meet, gingival mucosal junction. Note that the area forming a sulcus between the free gingiva and the tooth is the gingival sulcus, and the lining of this sulcus on the gingival side is the gingival sulcular epithelium.

Fig. 5. Periodontal probe entering the gingival sulcus on the labial side of 104. Note the bleeding from the gingival sulcus and gingival crest of 404 post-prophylactic therapy (black arrow).
periodontal examination. These horses are generally guarding against real or anticipated pain from instrumentation. Deeper sedation and local infiltration or regional anesthesia may be necessary under these circumstances. Staging of the examination and treatment may be necessary to ensure clinician, handler, and patient safety.

Decomposition of static food impactions in periodontal pockets, widened interproximal spaces, buccal vestibules, and lingual sulci leads to food and tissue degradation, often resulting in a fetid odor (Fig. 9).

The longer the food material is lodged/static in these areas, the greater the risk of advancing periodontal disease. The presence of fetid odor should be noted before flushing with an antibacterial mouthwash (chlorhexidine gluconate, 0.12–0.20%, or dilute povidone iodine flush solution) to remove food matter and debris. A bright head light, retractors (buccal/lingual), intraoral cameras, and a mirror aid complete/accurate visualization of the exposed oral aspect of the periodontium. All aspects of the incisor, canine, premolar, and molars are examined. Any abnormalities (such as gingivitis, gingival recession, periodontal pockets, trauma, widened interproximal spaces, etc.) (Fig. 10) are noted, measured, and recorded on the dental chart.

The gingival sulcus is checked for depth with a periodontal probe and examined for the tendency to bleed. If present, food material must be removed from periodontal pockets with dental picks, irrigation, and/or long-handled alligator forceps before pockets can be evaluated for pocket type (suprabony or infrabony) and pocket depth. Periodontal pockets are measured for depth, mesial to distal length, and width. Supra and subgingival surfaces of the teeth are evaluated for cemental abnormalities using dental explorers and mirrors: evidence of decay, calculus, fractures, and hypo or hyperplasia may be seen (Fig. 11).

Tooth mobility/compressibility is assessed and graded using molar forceps and digital manipulation, being careful not to damage the periodontium or the tooth on manipulation. Physiologic movement is considered normal and is limited to the width of the periodontal ligament and the elasticity of the alveolar support. Pathologic movement is a displacement of a tooth, either horizontally or vertically,
beyond its physiologic movement. Occasionally, because of advanced periodontal disease, mobility will be detected when tooth surfaces are examined with the dental explorer.

If evidence of periodontal disease is found during the oral examination, radiographic evaluation is indicated. Both intra- and extraoral radiographic techniques are used to evaluate attachment loss. Radiographs are paramount to the staging of periodontal disease (attachment loss), which is the basis for periodontal treatment. Radiographic findings primarily associated with periodontal disease include horizontal bone loss, vertical bone loss, and widened periodontal ligament spaces (Fig. 12). Other radiographic findings that may be associated with periodontal disease include bone lysis, bone sclerosis, blunting of root tips, fractures, etc. (Fig. 13). All findings of the periodontal examination are recorded in the permanent medical record/dental chart for future reference.

Grading the Severity of Periodontal Disease

The function of the periodontium is attachment of the tooth within the gomphosis joint. Disease of the periodontium (gingiva, cementum, periodontal ligament, and alveolar bone) results in attachment loss. Periodontal disease is the stage of progressive attachment loss, not the process itself. Periodontitis occurs in periods of quiescence and active inflammation, and the process is not linear. Periodontal disease is distinguished from periodontitis in that it is the state of the progressive attachment loss resulting from the periods of periodontitis. Although attachment loss (periodontal disease) may be present, the examiner may not see the active state of disease because of the phasic nature of periodontitis.

Accurate assessment and staging of the state of the periodontal attachment apparatus requires consideration of intraoral physical-examination findings, primary and supportive radiographic findings, and indices used to stage the disease. Staging indices are used when diseases are progressive in nature.

The gingivitis index (GI) is used to stage severity of gingivitis (Table 1). Careful attention should be given to the exposed gingiva as well as the sulcular gingiva when grading gingivitis. Cementum
on the clinical and gingival crown is evaluated for staining, decay, hypoplasia, and hyperplasia. Periodontal pockets are measured for depth and mesial to distal length, and when interproximal spaces are involved, a lingual to vestibular, palatal to vestibular, or labial to lingual measurement is recorded on the patients’ dental chart. Tooth mobility is measured with reference to the occlusal surface of the teeth. It should be noted that the tooth occupies a gomphosis joint, and in some cases, slight physiologic mobility may be evident, especially in geriatric patients with expiring teeth. All measurements are recorded in millimeters. The mobility index is used to grade tooth mobility (Table 2). A grade of M1 indicates slight movement beyond normal physiologic mobility and is pathologic mobility. When the components of the periodontium have been intraorally and radiographically evaluated, an estimate of attachment loss is made, and the stage of periodontal disease is assigned based on the periodontal disease index (PDI) (Table 3).

Treatment
The goal of treatment is to preserve the periodontium supporting the tooth, preventing tooth failure and eventual exfoliation. Addressing all factors that result in food stasis is important in achieving this goal. To a large extent, humans rely on mechanical cleansing of the teeth to remove food deposits, plaque, and disease-causing bacteria of the periodontium. Horses must rely primarily on the salivary bathing of the periodontium, continual movement of food matter through deglutition, and hypsodontic dental anatomical adaptations to reduce the likelihood of periodontal disease. Oral equilibration is an important component of treatment to reduce food stasis. Malocclusions causing dental interlocks reduce normal masticatory motion and food movement (Fig. 14). Vestibular (buccal) and/or lingual enamel points may lead to ulcerations causing oral pain and packing of food in the vestibules, increasing the risk of periodontal disease. Abnormal occlusal forces resulting in orthodontic movement of teeth may create areas where food becomes lodged (Fig. 15). Normalizing these forces and reducing sharp enamel points must be considered when treating periodontal disease. Dental fractures and areas of decay may not only increase the risk of food stases but may directly contribute to periodontal disease through trauma to the periodontium. These conditions should be treated accordingly with appropriate methods.
which may include endodontic, restorative, or surgical procedures.

Correction of all conditions predisposing to food stasis may not be possible. In aged horses with minimal tooth remaining in the alveolus, widened interproximal spaces may not be reducible. Although uncommon, the same is true for younger horses with cheek teeth that have parallel axes of eruption and widened interproximal spaces. In cases where the teeth are unable to drift together to close the widened interproximal spaces, the condition is managed, not cured. Eliminating grain from the diet and increasing grass or soft hay will increase masticatory motion and time. This results in more salivary bathing of the periodontium and reduced food stasis. Horses with interproximal spaces that trap even soft hay or grass may be fed a watered-down complete pelleted feed. Pelleted feeds break down quickly in a small amount of water and have a small particle size, helping them to move through the widened interproximal space. Time spent masticating this food can be increased by spreading the feed out in a pan or trough as opposed to feeding from a bucket.

Before debridement of the periodontium, rinsing the oral cavity with antiseptic mouthwash will reduce oral microflora loads. Careful attention must be paid to rinsing agents and their dilutions (chlorhexidine, 0.12% or less), because some have been shown to inhibit healing of the periodontium. In patients predisposed to high risk of infection, perioperative prophylactic antibiotics should be considered. It is imperative to remove as much infected and/or necrotic tissue from the periodontium as possible. This may require supra and subgingival scaling, curettage, or root planning of affected

<table>
<thead>
<tr>
<th>Stage</th>
<th>Degree of Attachment Loss</th>
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<tbody>
<tr>
<td>PD0</td>
<td>Normal: no attachment loss. Probing depth &lt;3 mm I, C, and PM1-PM2 and &lt;5 mm to PM2-M3.</td>
</tr>
<tr>
<td>PD1</td>
<td>Gingivitis: no attachment loss. Probing depth &lt;3 mm I, C, and PM1-PM2 and &lt;5 mm to PM2-M3.</td>
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<tr>
<td>PD2</td>
<td>Early periodontal disease: &lt;25% attachment loss and/or radiographic evidence of crestal/marginal bone loss around teeth.</td>
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<tr>
<td>PD3</td>
<td>Moderate periodontal disease: &lt;50% attachment loss or radiographic evidence of bone loss &lt;50% around tooth root(s).</td>
</tr>
<tr>
<td>PD4</td>
<td>Advanced periodontal disease: &gt;50% attachment loss or radiographic evidence of bone loss &gt;50% around tooth root(s).</td>
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PD, periodontal disease; I, incisor; C, canine; PM, premolar; M, molar.

![Fig. 13. Bone sclerosis related to dental disease. (Left) 100 arcade in an 18-yr-old horse. (Right) The same patient’s 200 arcade, with red arrows indicating an area of sclerotic bone related to chronic 127 fracture and accompanying periodontal disease.](image)
teeth. Currently, this is limited by the instrumentation available. Hand instruments, air abrasion units, magnetostrictive or piezoelectric ultrasonic scalers, high-speed hand pieces with diamond burs, and equine diastema burs are available. If human dental instruments are used, the dental bur and scaler tip lengths are limiting factors when debridging deep pockets in equidae.

Doxycycline and metronidazole have been used in periocetic products for the treatment of periodontal pockets with the goal of regeneration of the periodontal ligament. When regeneration efforts are unsuccessful, gingivectomy should be considered. Vinyl polysiloxane or polymethylmethacrylate patches placed in widened interproximal spaces may help retain the periocetic in place longer and act as a physical barrier to food impaction during the healing process (Fig. 16).

Systemic antibiotics may include potentiated trimethoprim sulfa, metronidazole, potentiated trimethoprim sulfa in conjunction with metronidazole, and doxycycline. In humans, antiseptic mouthwashes (chlorhexidine digluconate, 0.12–0.20%) q 12 h for 1–4 wk post-periodontal surgery aid in wound healing and reduction of gingivitis. In horses, caregivers can be taught to use 400-ml nylon dose syringes or garden sprayers to administer post-periodontal surgery antiseptic mouthwashes.

If a tooth has a mobility index of M3 or a periodontal disease index of PD4, the treatment of choice is extraction. If left in place, these teeth only predispose proximal teeth to the spread of periodontal disease. When the extent of treatment necessary is beyond the scope of the primary practitioners experience and/or instrumentation, referral to a practitioner with advanced training in equine dentistry is appropriate.

Prevention
Prevention is a key component in the control of periodontal disease. Regular veterinary oral-health examinations, oral-equilibrium maintenance, appropriate grazing periods, and early detection and treatment of periodontal disease all decrease the likelihood of advancing periodontal disease. By the time owners notice common signs of periodontal disease (halitosis, pain, attitudinal changes, behavioral changes, facial swellings, weight loss, etc.), the patient is already in advanced stages of periodontal disease. To meet the goal of treatment, which is preservation of the tooth, periodontal pathology must be diagnosed and treated before the advanced stages of PD3–PD4 (Table 3). After periodontal disease has exceeded stage 2, extraction becomes a likely course of treatment. Frequency of veterinary

Fig. 14. Arrows, malocclusions reducing normal masticatory motion. Note the disparity between the 100 and 200 arcades.

Fig. 15. Widened interproximal space after removing food matter. Note the gingival recession (arrow) and bleeding.

Fig. 16. Vinyl polysiloxane in a widened interproximal space.
examination and treatment is based on patient pathology. Combined efforts of the veterinarian and owner are necessary to improve prevention, early initial detection, detection of recurrence, and treatment of periodontal disease.

4. Results and Discussion

The periodontium is structurally and functionally complex. It requires regular evaluation to ensure appropriate treatment. Treatment should be directed at elimination of food stasis, direct treatment of periodontal tissues, management of ongoing disease, and prevention of recurrence of the disease state to eliminate exfoliation of the teeth. Owner compliance and regular veterinary monitoring are critical to success of treatment. Examination and treatment of periodontal disease are often an exercise in management of an ongoing condition and not a curative process. Owners must be informed of the definition of success for any given case.

Meticulous evaluation and record keeping are paramount, because they are the basis by which we are able to define outcome of past treatment, modify current treatment, and develop future treatment plans for our patients. In addition, they provide a body of knowledge whereby we as a profession may assess our efforts and over time, improve the quality of care.

References